

**Indiana's
Biological
Diversity:
Strategies
and Tools for
Conservation**

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Strategies and Tools for Conservation

ELI

*Indiana's Biological Diversity:
Strategies and Tools for Conservation*
An Environmental Law Institute Research Report

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* Introduction

WHY THIS PUBLICATION?

The diverse Hoosier landscape sustains thousands of species that give Indiana its distinctive character, including woodland and grassland birds, ducks, prairie grasses and wildflowers, bottomland and upland hardwood trees, freshwater fish and shellfish, mammals, and invertebrates. This natural heritage makes Indiana an ecologically rich state that sustains economic markets and provides recreational opportunities for all Indiana citizens.

Biological diversity is the assortment of habitats and natural regions, the diversity among species, and the genetic variation within each species. It is the foundation of the ecological processes that make life possible, and it makes natural communities resilient to disturbances such as floods, tornadoes, pest infestation and human alteration of habitat.

Public and private development and management decisions can — and have — resulted in losses and degradation of Indiana's biological diversity. Sometimes these losses occur because of a lack of knowledge about the many opportunities that exist in Indiana for conservation and restoration activities. Many individuals, companies, institutions, and government agencies could contribute to protecting biological diversity if they recognized its economic value and social benefits.

This publication identifies Indiana laws, policies, and institutions that affect the state's biological diversity. Understanding these mechanisms can give individuals the tools they need to conserve and restore the rich biological diversity that is part of Indiana's unique natural heritage.

PRINCIPLES

Three principles guide this publication's approach to biological diversity conservation and restoration in Indiana:

Although acquisition of key lands and waters is important, it cannot be the primary strategy to conserve and restore biological diversity.

While public acquisition is an important part of any strategy to protect biological diversity, direct acquisition of lands and waters is often prohibitively expensive, politically difficult, or economically undesirable. Only three percent of Indiana, or approximately 700,000 acres, is publicly-owned for the purposes of conserving and protecting natural areas and providing recreational opportunities. Because such a small portion of the state's biologically rich natural areas fall under the protection of state and federal agencies, the stewardship efforts of private landowners are of vital importance in the regional landscape.

Conservation and restoration efforts should maintain the productivity and usefulness of private lands.

Protecting and restoring ecosystems and species does not preclude the use of lands and waters for economic purposes. Indeed, conservation can often occur while simultaneously enhancing land values and the use of land and resources. Farmers can plant filter strips along waterways to protect water quality, provide habitat corridors, and produce hay. Corporations can participate in habitat enhancement programs on lands that are buffers around production facilities, or donate land or easements to contribute to natural areas abutting their privately held land. Utility companies, railroads, and other landholders can undertake measures to protect and restore habitat in their rights of way to connect otherwise fragmented, isolated habitat. Highway planners and city and county land managers can take habitat values into account while promoting economic growth. All of these activities that protect biological diversity can occur while land is used to produce goods and services.

Most Indiana citizens value the environment and will support actions that conserve it.

Nearly 70 percent of Indiana residents, 2.8 million Hoosiers, participate in wildlife-associated activities each year, including hunting, fishing, photographing, observing, and feeding wildlife. This active appreciation of Indiana's biological richness is reflected not only in the numbers of Hoosiers who choose to

take advantage of the state's heritage, but also by Indiana's corporations which have shown dedication to the preservation of biological diversity through innovative conservation and restoration projects. Indiana's Environmental Policy Act, enacted in 1972, recognizes the importance of this personal commitment. It provides that "each person has a responsibility to contribute to the preservation and enhancement of the environment."

Chapter I

*

Indiana's Biological Diversity — A Valuable Resource

At one time, many of us thought we knew what was meant by “nature.” Nature was something you could go to see in a park, or could encounter by looking at the plants and animals in a favorite patch of meadow or stream along a farm field. But nature includes much more than this. Indeed, it includes interactions of human beings with all of our surroundings — not just preserves, but working landscapes and privately owned lands and waters. The concept of biological diversity has been developed by scientists to give us a way of thinking about the richness and variety of the natural world.

Biological diversity is the “variety of life and its processes.” It includes “the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.”¹ A region that has only uniform landscapes with few species and little variation within species is biologically impoverished. Thus, concern for biological diversity implies conservation of many types of landscapes, sustaining many different native plant and animal species, and preserving healthy and diverse genetic stocks within species.

INDIANA'S HISTORIC BIOLOGICAL DIVERSITY

The historic biological diversity of Indiana drew settlers to Indiana and made the region economically productive. Ironically, these values were not well understood, and much human activity has led to the loss of the state's prairies, wetlands, forests, and dunescapes, as well as reductions in the diversity of plant, animal, fish and bird life found in the state.

Two hundred years ago, Indiana was a land of vast hardwood forests, wetlands, and limestone communities, blending westward into the prairies. Its lands and waters provided rich and productive habitat for myriad songbirds, waterfowl, mammals, fish, and other species. Diverse forest ecosystems provided ample cover and habitat for wildlife; while on the prairie, a rich diversity of native plant species were able to survive natural and Indian-set fires that excluded invading woody plants. These natural ecosystems and their processes built the soil that became the base of much of the state's prosperity.

The first European settlers were attracted to Indiana by the discovery that the swamps and sloughs of northwestern Indiana were teeming with fur-bearing animals, the pelts of which they obtained by trading with local tribes.² Indian tribes lived on the rich lands of Indiana, raising crops such as corn, tobacco, and squash, and hunting and fishing. Both Native Americans and settlers drew on the biologically diverse landscape for sustenance and trade goods.

Northwest Indiana remained relatively inaccessible to the east through the early 1800s. The “Black Swamp” in northwestern Ohio blocked any direct routes from the east, and Indiana's vast Kankakee Marsh was virtually impassable from the south. In 1849 Congress passed the Swamp Land Act, which granted to Louisiana the control of all swamplands and overflow lands in the state for the general purpose of controlling floods in the Mississippi Basin. In the following year the act was extended to twelve other states, including Indiana. The federal government passed the Swamp Land Act in an effort to relieve federal agents

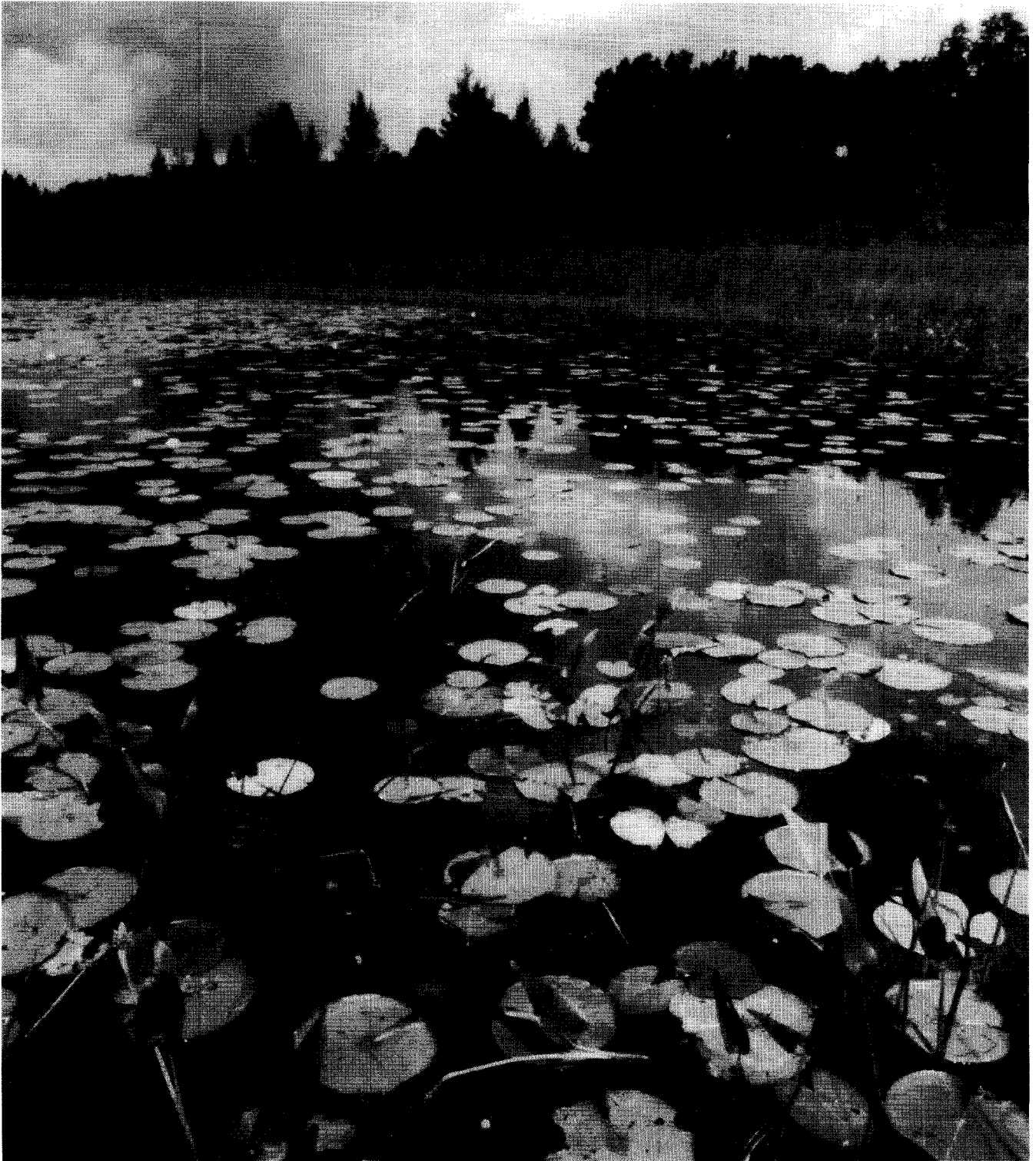


PHOTO: LEE CASEBERE

Needham Lake at Swamp Angel Nature Preserve, Noble County, Indiana. Eighty-five percent of Indiana's original 5.6 million acres of wetlands have been lost.

of flood-control and drainage activities. The act transferred federally owned wetlands to the states, leaving them the initiative of "reclaiming" wetlands through activities such as levee construction and drainage. The states sold the lands to individuals for pennies per acre and the money was used to drain and "reclaim" the lands.³ For example, swamp land in Lake County was sold for an average of \$1.25 per acre.⁴

In the 1850s the railroad arrived in Indiana. Four railroads intersected the Calumet Region, connecting the east to Chicago. These railroads greatly affected the region's future, increasing land values and speculation. The Hammond area suddenly became accessible from the east and Chicago and was developed by the meat-packing industry. Eventually, large parcels of land in the area were bought for industrial development.⁵ As the cities of the Great Lakes grew, manufacturing became an increasingly important economic force. As a legacy of this industrial boom, the Grand Calumet River, a tributary to Lake Michigan, remains one of the nation's most polluted rivers.⁶

When settlers arrived in south central Indiana after 1800, they encountered a forested region dominated by oak-hickory forests with some beech-maple forests in stream valleys. This terrain proved inhospitable to early settlers who cleared it with the speed and efficiency of an industrious people determined to make a living from the land. By the turn of the century, the region contained very little forest cover.

The animals present and hunted in south central Indiana in the early 1800s included deer, bear, passenger pigeon, raccoon, squirrel, and turkey. Although eastern bison had inhabited the region in the 1600s and 1700s, they were gone by 1810. By the late 1800s, passenger pigeons were so overhunted that they had disappeared from the wild. The passenger pigeon became extinct in 1914 when the last individual died in captivity. Bear disappeared before 1850 and wild turkey and deer were absent by the mid-to late 1890s due to overhunting and habitat loss. These two species were reintroduced in the mid-1900s. Elk became extinct in Indiana by approximately 1830, cougar by 1836, and wolf by 1907. Beaver probably vanished from the state in the early 1830s, but was reintroduced in the 1900s.⁷ The forests now found in southern Indiana are not the mature forests encountered by the early settlers, but rather are the result of natural regeneration and some replanting since the 1930s.⁸

Rich soils and abundant water made Indiana one of the most productive farm states in the country.

Today, there are 65,000 farms and 16 million acres of farmland in a state of 23 million acres.⁹

Settlement affected three factors that historically maintained Indiana's biological diversity: fire, water levels, and regeneration of forests. Without the fires, the prairies were invaded by woody plants and exotic species. The plow finished off much of the prairie, replacing its myriad wildflowers and grasses with profitable rows of cornstalks and soybeans. In addition, the displacement of Indians, and indirectly the fire they introduced, and elimination of indigenous animals from the prairies, removed the processes that maintained these diverse ecosystems. Government policies encouraged drainage of wetlands, and by the 1980s, nearly 30 percent of Indiana was drained; 85 percent of its wetlands were converted to other uses, predominantly agriculture. As drainage of Indiana continued, the formerly saturated soils could no longer support wetlands vegetation and the vast waterfowl populations of the past. The native forests were extensively logged to make way for agriculture and to meet the demand for timber used in building. In the process their diversity was decreased and the formerly contiguous stands were fragmented.¹⁰

Indiana's prosperity was built on its biological diversity. Yet, while Hoosiers took advantage of the state's natural riches to build an economic future, they were simultaneously compromising the base for that diversity. There are now compelling reasons to reestablish that base for the future. Indiana's economy is linked to many different resources. We "live in a landscape made up of natural systems which sustain us. If we degrade those systems, we degrade the quality of our own lives."¹¹

WHY CONSERVE BIOLOGICAL DIVERSITY?

Conservation and restoration of Indiana's biological diversity provides numerous benefits:

- 1) *Commercial consumption.* Biological diversity provides a multitude of natural resources used commercially for food, fuel, fiber, and other products.¹² Enormous direct economic benefits from biological diversity have already been achieved, and there is the potential for gaining many more. Almost a quarter of all medical prescriptions throughout the world are either chemical compounds from plants or microorganisms, or synthetic versions or derivatives of

them.¹³ Other commercial benefits are less apparent. For example, the forest products industry is a viable economic force in the state, generating over \$3.5 billion in annual revenues, but it too is dependent on biological diversity. For example, researchers have found that declines in songbird populations have negative effects on economically important tree species. Songbirds feed on insects that consume tree leaves and reduce the health of trees. As songbird populations decrease, so does the health of forest tree species, and the value of those trees.¹⁴ Similarly, as genetic diversity and diversity among species is lost, marketable timber crops become more vulnerable to disease, pest outbreak, and other factors that could greatly reduce the profits arising from maintenance of healthy forests.

- 2) *Noncommercial consumption.* Indiana plants, forests, and wildlife support fishing and hunting, use of native plants for dyes, and production of other natural products not sold in the marketplace. Hoosiers annually spend over \$400 million on fishing trips and on related fishing equipment and over \$240 million on hunting trips and related hunting equipment.¹⁵
- 3) *Nonconsumption uses.* Over 2 million Hoosiers participate annually in nonconsumptive wildlife activities, such as observation and photographing wildlife. They spend over \$250 million on related trips and equipment for nonconsumptive wildlife activities.¹⁶ Recreation in Indiana depends upon opportunities to view wildlife and to enjoy outdoor experiences.¹⁷
- 4) *Ecological services.* Biological diversity helps supply vital ecological services such as photosynthesis, moderating effects on climate, water purification, and flood control.¹⁸ For example, the generation and maintenance of soils is a crucial service supplied by biological organisms, and the soils themselves provide ecosystem services, including cycling of nutrients. Another critical service is the control of the vast number of pests that attack crops or domestic animals. Most of these pest species are herbivorous insects, and the diversity of predacious and parasitic insects and songbirds that naturally feed upon them are the primary natural control against pest outbreaks.¹⁹ The maintenance of diverse, sustainable ecosystems is essential for the future stability of human com-

munities. Healthy ecosystems tend to have many checks and balances and every species plays a role in maintaining this system. The loss of diversity generally weakens entire natural systems. When simplified by the loss of diversity, systems become more susceptible to natural and artificial perturbations and the chance of a system-wide collapse increases.²⁰

- 5) *Ethical values.* As residents of the natural world, many Hoosiers feel a strong sense of stewardship for that world — that regardless of their monetary value, all forms of life warrant respect and protection. Many also believe that humans have a social, spiritual, or moral responsibility, to ourselves and to future generations, to maintain the ecosystems and their associated species.²¹
- 6) *Option values.* Maintaining biological diversity preserves options for future generations to gain the benefits derived from biological resources. Our understanding of diversity's many values is incomplete. The reduced benefits from a degraded biological landscape may inadvertently eliminate options to use untapped resources for agricultural, industrial, recreational, and medicinal development in the future.²² Since the "future is uncertain and extinction is forever," the best way to protect ourselves from the uncertain and unknowable future consequences is to protect biological diversity today as a "safety net."²³

In considering Indiana's 5.6 million people and labor force of 2.9 million, biological diversity is an important part of the state's future. In a 1994 report, the Indiana Economic Development Council stated that "Indiana's prosperity lies in not only protecting natural resources and capitalizing on our central location, but also in developing our people, schools, communities, industry clusters, and a spirit of partnership — for these are the assets that will distinguish the leading states of the future."²⁴ Employment in areas relating to biological diversity is important. For example, while farm employment in Indiana declined over the last decade, employment in agricultural services, forestry and fishing together increased 71 percent.²⁵ In order for Indiana to continue supporting its natural resource-based industries and to serve as a model for the future, Hoosiers must act today to ensure a vibrant future for tomorrow.

SOURCES OF THE LOSS OF BIOLOGICAL DIVERSITY

The most serious threats to biological diversity in Indiana include:

- habitat loss and fragmentation;
- habitat degradation; and
- the proliferation of exotic species.

Several studies conducted in areas of Indiana with active restoration or preservation sites state that the most significant threat in the region is loss of wildlife habitat from habitat degradation and fragmentation.²⁶ Over 95 percent of the species listed under the Endangered Species Act in the United States are threatened, at least in part, by habitat loss or alteration. "Habitat degradation and [exotic] species introductions have been identified as the leading causes of species declines in rivers and streams and are the major factors in extinction and endangerment of freshwater fishes in North America."²⁷

Habitat Loss and Fragmentation

The direct loss of habitat for plants and animals has been caused by a variety of human activities. These include the conversion of lands and waters from prairie, forest, or wetland for agricultural use; the filling of wetlands, destruction of dunes and clearing of forests for industrial, residential, and commercial development; and extractive activities such as oil and gas, coal, and gravel mining. Much of this loss is historic and unavoidable. Some of it, especially future loss, is unnecessary.

Habitat fragmentation is a significant threat to biological diversity wherever human activities dominate the landscape. Habitat fragmentation is the process whereby large continuous areas of habitat are reduced in area and separated into discrete parcels. When habitat is destroyed, a patchwork of habitat fragments is left behind. The fragments are often isolated from one another by a highly modified landscape. Fragmentation often results from a dramatic reduction in the original habitat area, but it can also occur if the original habitat is divided by roads, railroads, canals, dams, power lines, fences, or other barriers to the free movement and migration of plant and animal species.²⁸

Habitat fragmentation can lead to the rapid loss of species since it creates barriers to the normal processes of dispersal and colonization. Many species of animals that dwell in a forest interior, for example, will not cross even very short distances of open area. When species

migration is limited, so is the dispersal of plant seeds that are carried by animals. Fragmentation of habitat also reduces the foraging ability of animals. Particular fragments may lack the range of food types and other resources necessary to support permanent populations of certain species.²⁹ Two effects of fragmentation are critical — the *edge effect* and the *island effect*:

THE EDGE EFFECT. Habitat fragments differ from the original habitat in that fragments have a greater amount of edge for the area of habitat, and the center of each habitat fragment is closer to an edge. The increased amount of edge and reduced area of interior cause what is referred to as the "edge effect". The fragment edge differs from the conditions in the interior, including differences in light, temperature, wind, and the incidence of fire. While some edge effects benefit species like white-tail deer, other effects are highly adverse. For example, increases in forest edge create a disturbed environment that offers suitable habitat for the establishment of pest species and predators, which can then disperse into the interior of the fragment.³⁰ Researchers have found that small mammalian predators, such as raccoons and feral house cats, and egg-eating birds like crows and blue jays, concentrate their hunting along the forest edge. Habitat fragmentation increases the vulnerability of the fragments to invasion by exotic species and native pest species.³¹ Each of these edge effects can have a significant impact on the vitality and composition of the species in the fragment.³²

THE FRAGMENT AS ISLAND. Fragmentation of habitat decreases the total habitat area and affects dispersal and immigration rates of species. Ecologists liken habitat fragmentation to the biogeographical model of islands which holds that "islands with large areas have more species than islands with small areas" and "the extinction rate will be lower on large islands than on small ones because large islands have more habitat diversity and a greater number of populations."³³ Smaller islands tend to have fewer species because they have less variety in their environments and community types. Smaller islands tend to support fewer populations per species than do comparable islands with larger areas.³⁴ The smaller the population, the more likely it is to go extinct because of inbreeding, disease, catastrophe, and other forces.³⁵

The smaller and more isolated a patch or island is, the less likely it is that new immigrants will be able to supplement diminishing populations. Therefore, small islands or patches of isolated habitat tend to be more

Declining Neotropical Migratory Birds

Neotropical migrants are birds that migrate long distances, breed in the forests of the north temperate zone, and spend the winter in the tropics¹. Researchers have found that the populations of many neotropical migrants have shown severe declines in recent years, and attribute this reduction in biological diversity to the negative impact of habitat fragmentation. In Indiana, over 40 neotropical migratory bird species are species of special management concern because of declines in their populations².

Habitat fragmentation reduces breeding success by creating conditions that are favorable to high rates of nest predation and parasitism. Forest edge increases when habitat is fragmented, and many species of nest predators — such as the blue jay, American crow, common grackle, and raccoon — and nest parasites — such as the cowbird — occur in higher densities around forest edges³. Brown-headed cowbirds, a common species in the areas where migrants breed, lay their eggs in the nests of "host" species such as thrushes and warblers, which then raise cowbirds at the expense of their own young⁴.

Populations of cowbirds and many nest predators are higher in fragmented landscapes^{1, 4}. In landscapes fragmented by agricultural fields, levels of nest predation and brood parasitism are so high that many populations of forest birds in the fragmented landscapes are likely to be population "sinks" in which local reproduction is insufficient to replenish the population⁴.

In the 1990s, several researchers measured nest predation and brood parasitism in nine different landscapes in Indiana, Illinois, Minnesota, Missouri, and Wisconsin in which forest cover varied from 6 to 95 percent. They found that for all migrant species, cowbird parasitism decreased as the percentage of forest cover increased, and that levels of nest predation also decreased with increasing forest cover. They concluded that fragmentation at the landscape scale affects the levels of parasitism and predation on most migrant forest species in the midwestern United States⁴.

The landscapes with little forest cover were found to be population "sinks" where reproduction is too low to sustain the population. These popula-

tions must depend on dispersal of birds from "source" populations that produce more young than they need to perpetuate themselves. Heavily forested landscapes have low enough rates of predation and parasitism to generate this surplus⁵. The study found that the extensive forests of south-central Indiana have low levels of nest predation and parasitism in comparison with other areas in the midwest and may provide the source of colonists necessary to maintain populations in fragmented forests elsewhere in the state and the midwest⁴.

Many studies of the effects of forest fragmentation on migratory birds conclude that in order to maintain populations it will be necessary to institute a regional conservation strategy that will identify, maintain, and restore large tracts of habitat that are most likely to be population sources. Large tracts of continuous forests should be preserved not only because they contain a high diversity of forest migrants, but also because they are the source of immigrants that sustain populations in other regions where the habitat has been fragmented⁴. Comparisons of forests also show that both the density and the number of species of neotropical migrants are substantially higher in large forests than in small forests⁵. These studies conclude that any further loss or fragmentation of habitat could lead to a collapse of regional populations of some forest birds^{1, 4, 5}. One study concludes that as long "as an adequate number of large, unfragmented regions remain in North America, it is unlikely that fragmentation alone will drive populations of migrant birds to extinction"⁴.

1. Askins, Robert, A. 1995. "Hostile Landscapes and the Decline of Migratory Songbirds." *Science*. 267: 1956-1957.

2. Office of Migratory Bird Management. 1995. "Migratory Nongame Birds of Management Concern in the United States." U.S. Fish & Wildlife Service.

3. Wilcove, David S., Charles H. McLellan and Andrew P. Dobson. 1986. "Habitat Fragmentation in the Temperate Zone." *Conservation Biology: The Science of Scarcity and Diversity*. Ed. Michael E. Soule. Sinauer Associates, Inc.: Sunderland, Mass.

4. Robinson, Scott K., Frank R. Thompson III, Therese M. Donovan, Donald R. Whitehead, and John Faaborg. 1995. "Regional Forest Fragmentation and the Nesting Success of Migratory Birds." *Science*. 267: 1987-1990.

5. Line, Les. 1995. "Songbird Population Losses Tied to Fragmentation of Forest Habitat." *The New York Times*. Tuesday, April 4, 1995: C4.

prone to extinctions.³⁶ In a fragmented landscape, when land surrounding the fragments is inhospitable to species of the original habitat, either because it is degraded, does not provide any suitable habitat, or is home to predators, species dispersal success is low. The remnant patches of habitats can become “habitat islands.”³⁷

However, if migration between habitat fragments is high, or if the landscape between fragments can support populations of many of the species from the original habitat, communities in the fragments may retain diverse populations of native plants and animals.³⁸ Thus, plant and animal populations from larger habitat areas or “sources,” can help to maintain healthy populations within a fragment, or “sink” area that depends upon immigration to ensure species survival. Researchers have found that the quality of the area between fragments can influence significantly the health of populations within fragments.³⁹ Thus, it matters greatly what land uses and activities surround and border wetlands, forests, refuges, and waterways. It also means that the existence of larger, undisturbed Indiana habitats can help maintain the biological health of more fragmented areas across the landscape — such as small woodlots or grasslands.

Habitat Degradation

Short of the direct loss of native habitat, the degradation of habitat can significantly diminish natural biological diversity. Excessive siltation has degraded water quality and impacted aquatic biological diversity in many of the rivers, streams, and caves of Indiana. Excessive siltation is caused by urban and agricultural activities, bank destabilization, and other types of erosion. Aquatic habitat has also been impaired by the introduction of chemical pollutants from highway runoff, discharges from disturbed areas of land, and industrial sites and agricultural lands.

Wildlife habitat has been degraded through manipulation of the hydrology by clearing vegetation in headwaters and adjacent uplands, as well as by ditching, draining and tiling for agriculture. In addition, some forestry activities, particularly those that do not include soil conservation or that fail to leave some standing live and dead trees, have impaired natural habitat.

Riparian areas, areas along stream and rivers that flood occasionally, have also been degraded through activities intended to make waterways more effective conduits of water. These areas are often cleared of vegetation and other debris to facilitate the flow of water.



PHOTO: CRAIG LARCOM

The Yellow-headed blackbird, a neotropical migrant, is an Indiana state listed threatened species. The species migrates to the tropics in the winter and returns to Indiana in the spring and summer to breed and nest.

Plant and animal communities rely on the annual flood cycle which deposits nutrients in floodplains, clears obstructions in streams, and creates diversity within stream habitats. When streams are channelized and cleared of adjacent vegetation, the result is loss of biological diversity, excessive siltation, and altered hydrologic conditions. The resulting aquatic communities and riparian areas are less diverse and more susceptible to disease, pollution, and genetic impoverishment. In addition, once simplified and denuded of vegetation, riparian zones have a decreased ability to filter water as it flows from uplands into the aquatic environment.

Exotic Species

Due to physical and environmental barriers, plants and animals are often restricted in their ability to migrate and colonize other areas. Yet, “exotic” species which have evolved in different areas have been transported by people for use deliberately as cultivated plants, game fish, and domestic animals, as well as introduced inadvertently on ships and vehicles. The extent of the movement of human-transported species is unprecedented on a geographical scale, and has been described as “one of the great historical convulsions of the world’s flora and fauna.”⁴⁰

The majority of introduced species do not become established in the environments in which they are introduced. Yet, because exotics are transplanted to areas where their natural predators do not exist, they may have a substantial advantage over native species. Those species that do establish themselves may greatly influence the composition of native species through competition for resources, direct predation to the point of extinction, or they may alter the native habitat such that indigenous species can no longer survive.⁴¹

Exotic species in Indiana — both plants and animals — have disrupted natural communities across the state. In many forested areas of Indiana, garlic mustard has become established. The plant has become so dense in some places that populations of spring wild flowers have dwindled.⁴² In northwest Indiana, purple loosestrife and the common reed (*Phragmites*) have invaded wetlands and drastically altered the natural plant communities. In the area’s uplands, glossy buckthorn, honeysuckle, and the tree-of-heaven have displaced many native species. In addition, even plants and animals native to Indiana can become overly aggressive when their ranges are expanded because of alterations to processes that normally control their establishment, such as fire. For example, cottonwood, aspen, and willows, although native to Indiana, can rapidly spread into prairies and wetlands, altering the species compositions of these scarce systems.⁴³

VISION OF INDIANA’S FUTURE

Indiana is blessed with a great variety of land types and natural communities. There are twelve recognized “natural regions of Indiana” based on considerations of climate, soils, topography, and species composition and distribution.⁴⁴ Two of these are aquatic environments — Lake Michigan and the Ohio River, including the mouths of the White and Wabash Rivers. The other

ten are land regions of the state, including their associated waters and wetlands.

Without care and the attention of Indiana’s citizens, businesses, organizations, and government, each of these regions may gradually be transformed into a pale, generic landscape indistinct from other parts of America — impoverished in species, lacking in economic and ecological value, and unappreciated by its children. With care and resolute action, the biological richness and distinctiveness of these regions can be conserved and restored for the future. A biologically diverse Indiana could look like this:

- Northwest Indiana’s lake region can be a rich and diverse landscape of dune and swale regions, and their associated plants and animals; dune forests with wildflowers, butterflies, oak and hickory forests and savannas; and marsh and fen communities. Although heavily populated by humans and industry, protection and linkage of remnant tracts of natural habitat can help to maintain and revive the diversity of plant and animal species that has earned it the reputation of the most biologically rich area in Indiana.
- The Grand Prairie region of Indiana was the major eastern lobe of the great prairies of the midwest. Remnant prairies can be restored with the reintroduction of fire, replanting of native species, and elimination of exotic invasive species. Natural prairie ecosystems can be maintained as an economically, ecologically, and historically valuable asset.
- The vast Grand Kankakee Marsh, also within the Grand Prairie Region, once meandered its way across the lower portion of northwestern Indiana, providing habitat to hundreds of thousands of waterfowl, and is still home to 220 state threatened or endangered animal and plant species, five federally endangered or threatened species, and 10 federal candidate species for threatened or endangered status. In addition, at least 100,000 waterfowl, including 20,000 greater sandhill cranes, migrate through the area during the spring and fall. If restored, the Grand Kankakee Marsh could once again be a safe haven for its endangered and threatened species and a protected stopover site for ducks and the tens of thousands of sandhill cranes that migrate through the area.⁴⁵
- Northeastern Indiana has historically supported a vast diversity of natural community types,

Invasive Exotic Plants and Animals in Indiana Natural Areas

The following list contains non-native plants and animals that have been observed occurring in natural communities. Some are more invasive than others, but all can spread or migrate into natural communities and compete with native plants and animals. Exotic plant species should be avoided in landscaping and revegetation projects.

Exotic Plants

garlic mustard (*Alliaria petiolata*)
 tree-of-heaven (*Ailanthus altissima*)
 smooth brome (*Bromus inermis*)
 musk thistle (*Carduus nutans*)
 round-leaved bittersweet (*Celastrus orbiculatus*)
 star-thistle; knapweed (*Centaurea* spp.)
 Canada thistle (*Cirsium arvense*)
 bull thistle (*Cirsium vulgare*)
 crownvetch (*Coronilla varia*)
 teasel (*Dipsacus sylvestris* and *D. laciniatus*)
 autumn olive (*Elaeagnus umbellata*)
 burning bush (*Euonymus alatus*)
 wintercreeper (*Euonymus fortunei*)
 leafy spurge (*Euphorbia esula*)
 tall fescue (*Festuca elatior*)
 meadow fescue (*Festuca pratensis*)
 ground ivy (*Glechoma hederacea*)
 common day-lily (*Hemerocallis fulva*)
 dame's rocket (*Hesperis matronalis*)
 silky bush clover (*Lespedeza cuneata*)
 Korean clover (*Lespedeza stipulacea*)
 Japanese clover (*Lespedeza striata*)
 common privet (*Ligustrum vulgare*)
 Japanese honeysuckle (*Lonicera japonica*)
 Amur bush honeysuckle (*Lonicera maackii*)
 Tartarian bush honeysuckle (*Lonicera tatarica*) and related species
 moneywort (*Lysimachia nummularia*)

ganded loosestrife (*Lysimachia vulgaris*)
 purple loosestrife (*Lythrum salicaria*)
 Osage orange (*Maclura pomifera*)
 eulalia grass (*Microstegium vimineus*)
 white sweet clover (*Melilotus alba*)
 yellow sweet clover (*Melilotus officinalis*)
 wild parsnip (*Pastinaca sativa*)
 reed canary grass (*Phalaris arundinacea*) non-native strain
 common reed (*Phragmites australis*) non-native strain
 Canada bluegrass (*Poa compressa*)
 Kentucky bluegrass (*Poa pratensis*)
 Kudzu vine (*Pueraria lobata*)
 common buckthorn (*Rhamnus cathartica*)
 glossy buckthorn (*Rhamnus frangula*)
 black locust (*Robinia pseudo-acacia*) in areas other than Ohio River counties
 multiflora rose (*Rosa multiflora*)
 Johnson grass (*Sorghum halapense*)
 white clover (*Trifolium repens*)
 highbush cranberry (*Viburnum opulus*)
 myrtle, periwinkle (*Vinca minor*)

Exotic Animals

zebra mussel
 carp
 starling
 house sparrow
 pheasant
 cowbird — a native species that has greatly expanded its range
 feral house cat

— Compiled by Michael A. Homoya, Indiana Department of Natural Resources, Division of Nature Preserves and Forest Clark, U.S. Fish & Wildlife Service, Bloomington Field Office.

including bogs, fens, marshes, prairies, meadows, lakes, and forests, all within the same region. In the Northern Lake Region, and east of Fort Wayne in the Black Swamp region, the ancient swamp forests that existed in floodplains along rivers and bogs, have been replaced

almost entirely by agriculture and thousands of miles of legal drainage ditches.⁴⁶ The natural aquatic communities are threatened by siltation and pesticide runoff from surrounding agriculture and erosion, but through the continued dedication of private landowners, erosion can be

reduced, protective riparian vegetation can be replanted, and the rivers, lakes, and wetlands of northeastern Indiana can once again be home to a diverse array of plants, animals, and the unique assemblage of fresh water mussels that once thrived in the region.

- Central Indiana is a relatively homogeneous natural region that spans the middle of the state dividing the ecologically distinct northern and southern natural communities. The region was once a great beech-maple-oak forest, the remnants of which are now confined to scattered woodlots. It also includes bogs, prairies, marshes, seep springs and ponds.⁴⁷ The Wabash River, which spans central Indiana, is for much of its length one of the longest free-flowing U.S. rivers east of the Rocky Mountains. Although this region of Indiana is dominated by the influence of agriculture, management of private lands with a consideration for wildlife and forest values can be achieved through protecting and restoring riparian areas, which provide corridors for wildlife and protect water quality. Farming practices can be consistent with enhancing the biological diversity of the entire region through riparian protection.
- Southwestern Indiana retains unique bald cypress swamps, oak-dominated forests, and southern bottomland swamps.⁴⁸ Oxbow lakes throughout the area are formed by the meandering Wabash and Ohio rivers, and many of the plant and animal species found in areas of standing water, such as the bald cypress, are more commonly characteristic of ecosystems in the deep South.⁴⁹ This bottomland hardwood region is on the Mississippi Flyway, providing critical and productive habitat for breeding and stopover for waterfowl, as well as feeding, spawning, and nursery areas for fish species.⁵⁰ The bottomland and upland forest communities of the southwest can be a profoundly important recreational and economic resource to Indiana, providing direct and indirect benefits from timber, fish and wildlife.
- The south-central portion of Indiana is characterized by limestone bedrock which dissolves easily, thus creating sink holes, underground rivers and an abundant number of water-filled caves and karst communities that provide habitat for endangered species of invertebrates, bats, and blind cave fish. This region and southeast-

ern Indiana have the state's largest contiguous areas of upland forest, in both public and private ownership. Portions of the unfragmented forests in the region, including areas within and around the Hoosier National Forest, can be a major breeding ground for neotropical migrant birds, providing a source population not only for the rest of the state but for other fragmented landscapes throughout the midwestern United States. They also have the best potential for the reintroduction of large area-dependent mammals such as the elk, red wolf, or black bear.

WHY INDIANA NEEDS TO ACT NOW

Impending Losses

Indiana's native plants, animals, and aquatic life are in decline in many parts of the state. In Indiana there are 29 species federally listed as endangered and one proposed for listing; 4 species are federally listed as threatened. In 1995, the state list included 84 species of endangered vertebrate and invertebrate species, 30 threatened species, 18 rare species, 39 species of special concern, and 46 extirpated from Indiana. Of the vascular plant species in Indiana, 197 are endangered, 99 are threatened, 95 are rare, and 72 are extirpated.⁵¹

Neotropical migratory birds, such as the wood thrush, the scarlet tanager, the Kentucky warbler, and others overwinter in the tropics and return to Indiana in the spring and summer to lay eggs and fledge new birds. In Indiana, 44 percent of all neotropical migratory bird species have declining populations, in substantial part because of human impacts on their Indiana breeding grounds.⁵²

In Indiana, as elsewhere, often those species that persist are losing genetic variation as the numbers of individuals in plant and animal populations are reduced and populations are increasingly isolated from one another. Genetic variation is being lost even in domesticated species as farmers rely upon fewer and fewer species. In the United States, about 97 percent of the vegetable varieties that once were cultivated are now extinct.⁵³

Direct habitat loss is critical as well. At one time, 4,720 square miles, or 13 percent of Indiana was prairie. Now less than one thousandth of one percent of these prairies remain. Fire suppression, invasion by exotic species, a lowered water table, and encroachment by agriculture, rights-of-way, and development, have led to the direct loss of prairies.⁵⁴

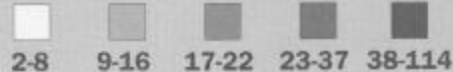
Endangered and Threatened Species by County



**NUMBER OF STATE LISTED
ENDANGERED AND THREATENED
ANIMAL SPECIES PER COUNTY**



**NUMBER OF STATE LISTED
ENDANGERED AND THREATENED
PLANT SPECIES PER COUNTY**



Indiana Natural Heritage Data Center, Indiana Department of Natural Resources

The remaining prairies are small and unconnected to other tracts of prairie due to lack of available lands and a shortage of native plants. These “cemetery prairies” — so called because they sometimes persist in small cemeteries — do not provide the same ecological functions as did the larger prairies that once existed. As a result, several species of grassland birds and other prairie species that require large tracts of prairie for survival are listed as threatened or endangered under

state and federal law.⁵⁵ In addition, an insufficient supply of prairie species indigenous to Indiana slows restoration efforts.

Indiana wetlands support a significant amount of biological diversity. When the first European settlers arrived, 5.6 million acres of wetlands existed across the Indiana landscape. Only 813,000 acres, or 15 percent of the state’s original wetlands still exist. The U.S. Fish & Wildlife Service estimates that 5 percent of Indiana’s

remaining wetlands are being lost annually.⁵⁶ Historically, about 85 percent of this wetland loss has been from agricultural conversions with the remainder attributable to urban and industrial development. Ditching, diking, and channelization for these alternate land uses have directly decreased wetland acreage, in addition to degrading water quality and lowering the level of subsurface water, all of which have profoundly negative impacts on biological diversity. Few of Indiana's remaining natural wetlands support their original complement of plants and animals due to the degradation of 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.⁵⁷

The aquatic environment in Indiana has been severely degraded, as is evidenced by the large number of threatened and endangered fresh water mussel species in the state. Indiana lakes, reservoirs, wetlands, rivers, and streams are under severe threat from pollution from diffuse sources. The most pervasive water pollution problem in Indiana is soil erosion. It is estimated that 40 percent of the state's cropland is "eroding at rates considered to be higher than tolerable levels".⁵⁸ Sediment from eroding cropland and development sites not only degrades the aquatic environment by creating cloudy conditions and limiting light penetration, but sediment also smothers bottom-dwelling organisms, and fills in lakes and reservoirs. Sediment also carries with it harmful agricultural chemicals, and other material picked up as the sediment is carried to waterbodies.⁵⁹

Untreated or incompletely treated sewage is another serious source of pollution in the state. Sewage originating from failed septic systems, inadequate sewage treatment facilities, and livestock confinement areas, contributes significant amounts of bacteria, nutrients, and organic matter to water bodies.⁶⁰

Although Indiana's 4.4 million acres of forest land are more than existed in the early part of the 20th century, these are only a fraction of the historic stock. Many forest areas are severely fragmented or under threat of further fragmentation. The U.S. Forest Service began purchasing the first parcels of the Hoosier National Forest in the mid-1930s, as farmers began abandoning the degraded and eroded landscape on which they had been struggling to maintain a marginal

existence for almost a century. Still, only 43 percent of the land within the boundaries of the Forest is under National Forest ownership.⁶¹ Moreover, Indiana forest land and rural woodlots are being converted to other uses, such as residential, commercial, and second-home development sprawl surrounding Indiana's metropolitan areas and the Indiana suburbs of Louisville and Cincinnati.

Hopeful Trends

Although Indiana's diversity of species, ecosystems, and diversity within species is under severe threat, there is also reason for optimism and hope. Substantial tracts of land have already been set aside and are being managed for the preservation and restoration of native biological diversity. For example, the Hoosier National Forest is home to 52 state listed endangered, threatened or special concern vertebrate animal species in addition to 147 species of state listed endangered, threatened, and rare plant species. The Forest represents approximately half of the public forest land in Indiana and is the largest single public land base in the state. As a result, the Hoosier National Forest plays a vital role in providing a relatively unfragmented, contiguous forest landscape which "enhance[s] biological diversity on a regional scale."⁶²

The Forest Service acknowledges that Hoosier National Forest represents a unique opportunity that does not exist elsewhere in Indiana, and exists rarely in the Midwest, "to begin restoration of a portion of the forest ecosystems that were once so extensive in the region."⁶³

Remnant prairies in northwestern Indiana have been located and are being protected. These tracts, found in railroad and powerline rights-of-way, cemeteries, and among factories, landfills, and urban areas, are able to provide seeds to build a stock of native prairie plant species and are giving natural resource managers a vision of what Indiana's once vast prairies were like.⁶⁴ These and some prairie remnants on state-owned lands maintain some of the functions of the original prairie ecosystems.

Large scale restoration projects, such as the Grand Kankakee Marsh Restoration Project, the Patoka River National Wetlands Project, The Nature Conservancy's Fish Creek bioserve, river and flood plain commissions, and watershed management projects are springing up all over the Hoosier state to protect Indiana's remaining wetlands and waterways and restore those that have been heavily manipulated and degraded.

In addition, corporations, private land owners, and government agencies are joining together around the state with local citizen groups, land trusts, and environmental groups to protect their shared and dwindling biological diversity. Private groups are embarking on ambitious voluntary projects to protect and enhance wildlife habitat, often with the help of state and federal natural resource management agencies. With every one of these efforts, individuals

participating in these projects are learning about Indiana's rich native biological diversity and history, the forces that threaten its continuance, tools to protect what remains, and methods to restore what has been degraded. This growing knowledge will be spread to other individuals and to the children of those citizens, who will then be empowered to carry on a Hoosier tradition of respecting and protecting biological diversity.

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Chapter II

✱

Conserving Biological Diversity

A practical definition of biological diversity conservation is “To maintain in a healthy state both the species and the ecological processes historically native to a natural landscape.”¹ A similar, alternative formulation is: “the maintenance of viable populations and natural distributions of native species and communities in the regional landscape.”²

Both of these definitions focus on the importance of functioning ecological *systems* that support native plants and trees, and animals such as mammals, birds, reptiles, amphibians, fish, and invertebrates. It is not enough simply to conserve particular species or particular parcels of land in isolation. In order to practice this kind of conservation, it is important to understand some basic tenets of conservation biology — principles that can be applied in the field when making decisions about the use and acquisition of land, siting of facilities, harvesting practices, and other economic activities.

GOALS

How do we know a good biological diversity conservation effort when we see it? Effective public and private efforts to conserve Indiana’s biological diversity should have three goals:

Comprehensive protection of the remaining healthy parts of Indiana’s biological communities

Conservation of these areas will provide the base upon which the entire state’s biological diversity can rest. The protection of core areas of unfragmented forest, fragile cave communities, prairie remnants, dunes, and other key areas can provide sources of populations and refuges for species that also must live in a fragmented and intensely utilized landscape. Such protection need not mean that all such lands must be in

public ownership. What it does mean is that such lands must be identified and managed in a way that recognizes their unique contribution to the state’s biological and economic health and connection to the larger landscape.

Active restoration of biological diversity

As the state is a heavily manipulated and fragmented landscape, Indiana’s biological diversity must be restored in an intentional way. Simply leaving land alone, or idling particular areas, can contribute to biological diversity, but may not restore historic drainage patterns, increase waterfowl populations, or regenerate prairie communities. It will be important to educate people who may equate “nature” with whatever happens naturally, that active restoration has a significant role to play. New market opportunities can be stimulated by restoration, as demand may expand for commercial growing of native species for restoration. Moreover, restoration projects may allow other landscapes to be managed more intensively.

Active participation of individuals and local communities

People work for what they care about, and they care about what they know. The effort to conserve and restore biological diversity will never amount to anything if it is perceived by Hoosiers as the responsibility of someone else — or as a function for the government alone. The best current examples of biological diversity conservation in Indiana are those that involve voluntary coalitions of committed volunteers, using their own lands and labors in service to their state and communities. As private citizens become involved in protection and restoration, they learn valuable information about the value of biological diversity, as well as tools to protect and restore it. This knowledge can then be

passed across communities and down generations. This is Indiana at its best.

FUNDAMENTALS OF BIOLOGICAL DIVERSITY CONSERVATION

How people use species, manage the land, and invest in development will determine the ultimate success of biological diversity conservation.³ Conservation must occur at two levels — on individual parcels of land, and on a regional basis. By focusing on an individual parcel of land or segment of a stream, decisions can be made that affect species success on that parcel or segment. On the other hand, a regional perspective is important because many species depend upon large areas, and because cumulative impacts of human activities across multiple ownerships and land uses can promote the success — or cause the failure — of conservation of biological diversity.

It is important to understand some basic ecological concepts that can be used in management for biological diversity.

1. MAINTAIN THE VIABILITY OF INDIVIDUAL SPECIES REPRESENTED IN AN ECOSYSTEM. Management for the conservation of biological diversity should focus on maintaining the viability of populations of species, while allowing natural ecosystem processes to continue. Aldo Leopold, the respected ecologist and wildlife manager, wrote in 1949, "To keep every cog and wheel is the first precaution of intelligent tinkering."⁴ The mix of species in an ecosystem changes continually because plants and animals respond to environmental changes in different ways.⁵ But the ability of species to deal successfully with changing ecosystem conditions requires attention to the needs of each particular species — for example, for cover, breeding area, and food supplies for animals, and for pollination, fire, and saturated or unsaturated soils for plants.⁶

2. FAVOR NATIVE PLANTS AND ANIMALS AND AVOID USE OF NON-NATIVE SPECIES. Native plants and animals have great intrinsic value, as they represent the natural conditions once found in a landscape. They are uniquely adapted to their surroundings and greatly affect ecosystem processes and the persistence and viability of other plants and animals native to the area. Non-native, or exotic species, on the other hand, can severely disrupt the natural conditions and species composition in an area. For example, Hoosier Prairie in Lake County is one of the largest remnant tracts of prairies in Indiana. Because fire has been suppressed for decades, the native prairie species are being threatened

by the invasion of exotic species such as purple loosestrife and the glossy buckthorn shrub. Woody species, such as the glossy buckthorn, would normally be suppressed by natural fires, but in the absence of fire, they shade out native prairie species and threaten to disrupt the composition and integrity of native plant communities.

3. ALLOW NATURAL PATTERNS OF DISTURBANCE TO CONTINUE, OR AT LEAST MANAGE THE LANDSCAPE TO EMULATE NATURAL PATTERNS. Periodic disturbances, such as storms, floods, and fires, play an important role in maintaining patches in various successional states, and the plants and animals that co-evolved with the influence of these natural processes.⁷ Allowing seasonal flooding where consistent with other land management objectives, for example, can be highly beneficial to local biological diversity. Land management techniques that mimic natural processes can also be important. These may include such techniques as leaving standing dead trees (snags) when conducting a selective timber harvest, or reserving seed trees for forest regeneration or mature oaks for production of acorns essential to wildlife when conducting more intensive harvests. For example, the nocturnal southern flying squirrel depends on snags for nesting cavities.⁸ Fires and floods raise safety and property considerations, but are not always detrimental and in fact, can be beneficial to the natural environment. Controlled burns are essential to prairie regeneration and many forest communities, for example.

4. CONSERVE AND PROTECT INTACT MATURE STAGES OF HABITAT. Late-successional or mature forests and prairie communities are essential for the conservation of native wildlife that does not survive well in disturbed landscapes.⁹ In Indiana, leadplant depends on mature prairie systems. The pileated woodpecker, broad-winged hawk, whip-poor-will, ovenbird, black-and-white warbler, and worm-eating warbler, some of which are Indiana species of special concern, depend on late-successional forest habitat.¹⁰

5. FOCUS CONSERVATION AND RESTORATION EFFORTS ON LARGER HABITAT AREAS. Larger habitats are better than smaller areas at ensuring the survival of species. Smaller populations are more vulnerable to extinction due to environmental fluctuations, demographic variation, inbreeding, and reduced gene pools.¹¹ Habitat fragmentation is a leading cause of the loss of biological diversity. Habitat fragmentation includes not only reductions in overall habitat area, but the introduction of avenues for predation and barriers to migration —



PHOTO CREDIT: RICH FIELDS

This unique square-toed amphibian, the green salamander, was rediscovered in Indiana in 1993. It is among the rarest vertebrates in the state, and the first to be added to the state's list of animals in 23 years. The amphibian is a state listed endangered species, and because it is particularly sensitive to environmental changes, the presence of the salamander is a good indicator of ecosystem health.

such as roads, railroads, power lines, and fences. Fragmentation of prairie habitat in Illinois due to agriculture has caused the decline of up to 85-90 percent of prairie bird populations.¹² Indiana forest habitats have undergone similar modifications and the state has little remaining unfragmented forest.

Because population size is the best predictor of extinction probability, reserves should be large enough to preserve large populations of important species, including rare, endangered, and economically important species. In Indiana, several grassland species require large areas for survival, including the upland sandpiper, northern harrier, and short-eared owl, all state endangered species, as well as the bobolink, and Henslow's sparrow, a state threatened species.¹³ Large

habitat areas are also important for interior forest species because of the reduced influence of edge effects.¹⁴ Where there is an opportunity to avoid breaking up or isolating pieces of habitat, land development should be clustered. Such a strategy might, for example, involve limiting the area to be disturbed for an industrial facility to that necessary for the building, roads, and associated facilities, while avoiding the creation of clearings, paved areas, or landscaping using exotic species.¹⁵

6. PROMOTE AND MAINTAIN HABITAT LINKAGES. Connected habitats are better than disjointed habitats. In practice, some areas act as population *sources* by contributing immigrants to less stable populations, thus

Strategies to Protect Biological Diversity in a Fragmented Landscape

Research has found that the harmful effects of fragmentation and isolation of populations can be mitigated if even a small number of individuals are successful at moving between populations. As a result, small plant and animal populations in scattered reserves can be managed as a number of smaller healthy sub-populations if natural migration can occur between reserves.¹ Ecologists, recognizing the threats to biological diversity from habitat fragmentation, offer several basic strategies to facilitate the survival of small populations of rare species that are isolated in fragmented habitats.

1. *Maintain areas of habitat large enough to protect species of concern.* When habitat is fragmented, fragments should be large enough to maintain the minimum necessary territories of the species. This is especially true of large species and species at the top of the food chain.²
2. *Minimize edge and fragmentation effects.* Design rounded conservation areas to minimize edge-to-area ratio; a square protected area is better than an elongated rectangular area of the same acreage for the same reason.² Avoid or minimize the internal fragmentation of habitats by roads, development, fences, drainage ditches, power lines, land clearing, logging, and other human activities.
3. *Coordinate new and existing natural areas.* Develop strategies for aggregating small

nature reserves into larger conservation blocks to facilitate gene flow and migration among populations and to ensure adequate representation of species and habitats.

4. *Link protected areas with habitat corridors.* Habitat corridors allow plants and animals to disperse from one protected area to another, facilitating gene flow and colonization of suitable sites. These can be strips of land running between the protected fragments, riparian zones linking them, or simply less hostile habitats between the fragments. The habitat that exists between fragments of natural area can determine the ability of species from large healthy fragments to migrate and maintain populations in "sink" areas³. Corridors may also help to preserve animals that migrate seasonally. However, it should be noted that corridors may also facilitate the movement of pest species and disease, so that an infestation may spread to connected areas¹.

1. Primack, Richard B. 1993. *Essentials of Conservation Biology*. Sinauer Associates, Inc. Publishers: Sunderland, Massachusetts.

2. Wilcove, David S., Charles H. McLellan and Andrew P. Dobson. 1986. "Habitat Fragmentation in the Temperate Zone." *Conservation Biology: The Science of Scarcity and Diversity*. Ed. Michael E. Soule. Sinauer Associates, Inc. Publishers: Sunderland, Massachusetts.

3. Askins, Robert. A. 1995. "Hostile Landscapes and the Decline of Migratory Songbirds." *Science*. 267: 1956-1957.

rescuing them from local extinction. Other areas act as *sinks* by attracting individuals to populations that would otherwise collapse. Wildlife corridors, such as riparian zones (the vegetated banks and floodplains of rivers and streams), provide habitat for plants and animals and can link populations. They may minimize local extinction and genetic isolation of wildlife populations, and may allow source areas to contribute to sink areas.¹⁶ In fact, researchers have noted that maintaining linkages between fragments may be at least as

important to maintaining biological diversity as the size of the fragments.¹⁷ For example, the Karner blue butterfly, a state and federal endangered insect, is restricted in its ability to disperse, and therefore needs linked habitat to ensure its survival. In an effort to protect the butterfly, the Indiana Department of Natural Resources (IDNR), federal agencies, and The Nature Conservancy have been coordinating their efforts in Northwest Indiana to maintain connected habitat for the Karner blue butterfly.¹⁸

7. **MINIMIZE THE DISTANCE BETWEEN PROTECTED HABITATS.** The distance between suitable habitats and the nature of the habitat between areas exchanging species will influence the persistence of species.¹⁹ Habitats in close proximity to one another are better than widely separated habitats. Minimizing the distance also means increasing the permeability of the barriers that separate or fragment habitats. For example, powerline rights-of-way can be designed with crossings or the creation of small peninsulas of forest or shrub habitat into the right-of-way to limit the effective width at various points. Another approach is to alternate spraying of sections of a corridor to create opportunities for crossing; in hilly terrain, forest connections can be left intact in some of the stream valleys or other depressions.²⁰ Similar techniques, such as use of wildlife culverts, can be used to minimize the barrier effect of highways and roads.

8. **MINIMIZE HUMAN INTRODUCTION OF NUTRIENTS, CHEMICALS, AND POLLUTANTS.** Introduced compounds can directly impair biological diversity by killing plants and animals. These human inputs from industrial activities, mining, and urban and agricultural runoff can have drastic indirect effects that can cause reduced reproductive rates and survival rates, disrupt the species composition of an area, or cause birth defects. For example, the input of large amounts of sediment and associated agricultural chemicals in the St. Joseph River basin in northeast Indiana, has caused a drastic decline in the aquatic diversity in the region. This decline has led to the state listing of 15 mussel species as endangered.²¹

9. **REMAIN CONSCIOUS OF THE FATE OF HUMAN INTRODUCED COMPOUNDS.** When working with fertilizers, agricultural chemicals, industrial chemicals, or road salt, or maintaining large numbers of farm animals, citizens should remain aware of potential contamination of groundwater, lakes, and streams. Natural areas, such as riparian strips along rivers, buffer zones, and infiltration basins, can be used to capture, filter, and treat potential pollutants.

For example, the Blue River watershed in south-central Indiana is characterized by limestone bedrock which dissolves easily — creating sink holes, underground rivers, and an abundant number of water-filled caves which are the homes of endangered invertebrates, bats, and blind cave fish. The high quality water in the area supports these unique cave ecosystems, yet it is being degraded. Unaware of the fate of the material disposed, individuals deposit contaminants in sinkholes

that can then enter groundwater directly without the filtration benefits of infiltration through soil. The addition of the pollutants associated with the unfiltered water threatens the biotic communities that live within the caves and aquatic environment of this karst region.

10. **WHENEVER POSSIBLE, IMPROVE EXISTING HABITAT OR RESTORE DEGRADED AREAS TO OFFSET IMPACTS OF DEVELOPMENT ON EXISTING HABITAT.** If uses of lands and waters are likely to lead to losses of biological diversity, compensation through restoration measures within the same landscape can be an appropriate measure to conserve biological diversity and the functioning of natural systems. Wetland mitigation can serve the objective of “no net loss” in the case of wetlands. So too can compensation for other habitat losses or impairments.²² Moreover, voluntary restoration efforts can provide important habitat linkages that may strengthen biological diversity sufficiently to allow more intensive development to occur elsewhere. Nevertheless, mitigation may not adequately replace or restore all functional values of natural systems.

11. **MANAGE ON THE REGIONAL LEVEL WHEREVER POSSIBLE.** Planning on the regional scale can provide habitat for species that require large areas of relatively undisturbed land, for highly specialized species, and for species that may be rare regionally, but common locally. The landscape matrix matters quite a bit. Research has shown that no matter how carefully they are protected, small nature preserves (or private conservation areas) may progressively lose their most distinctive species if they are surrounded by a hostile, incompatible landscape.²³ Maintenance of diversity from a regional perspective permits more flexibility in land-use options than a strategy that considers a site in isolation.²⁴ Cooperation on a regional level may also reduce costs to particular land owners.²⁵

Government, private, and corporate landowners must take into account the regional threats to biological diversity and the sources of those threats. Landowners have different roles to play. Owners of small parcels of land may have fewer management options than owners of larger parcels. The way a corporate land manager views its options may depend in part upon whether the company's land holdings are a major part of the company's primary business, or are simply lands surrounding or adjacent to its production or office facilities.²⁶ Farmers' views of their options may depend upon whether productivity of the land can be maintained and a sufficient return on investment can be achieved. Residential developers may need to under-

Meeting the Habitat Needs of Species

Conservation biologists have pointed out that some management activities that strive to maximize local diversity may backfire by unintentionally creating conditions that are unfavorable to species most in need of protection.^{1,2} For example, management *within* an individual land unit often focuses on creating or maintaining a variety of habitats. This technique increases species diversity (measured in number of species) by increasing the edge effect. But if every land manager creates "edge," the favoring of edge-adapted species will occur at the expense of forest interior species.² In Indiana, this phenomenon has led to proliferation of deer and predatory bird species at the expense of migratory songbirds. Maintaining a diversity of habitats on a regional level rather than on each parcel can enhance diversity without disproportionately favoring edge species.

Moreover, even apparently "uniform" habitats on a particular parcel may have diverse functions. Although habitats such as forest or grassland may seem uniform, they are really a mosaic of different microhabitats.³ Protecting such areas is important for maintaining species that require two or more microhabitat types in their life cycles. For example,

a number of amphibians require an aquatic habitat to breed, but spend the majority of their lives in terrestrial habitats; both may be found in a wet forest.⁴ Copperbelly water snakes move from dry forest habitat to wetlands each spring where their main food supply exists, and return to their forest dens in the fall. The snake, a state threatened species, has disappeared from much of its original Indiana range.⁵ Thus, microhabitats within a seemingly uniform system may be vital for biological diversity.

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stand the ways in which clustering development can make biological diversity an amenity that offers an incentive to home buyers. Regardless of the ownership pattern, those managing biological diversity can have a greater impact with larger, far reaching effects if management decisions are made in the context of the larger landscape.

The relationship between land management objectives and ecological principles is frequently shaped by laws and policies. The next chapter addresses Indiana laws and policies that affect biological diversity, and ways in which they can support the realization of an ecologically productive, biologically diverse future for the state and its citizens.

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Chapter III

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Indiana Law and Policy Opportunities for Biological Diversity

Laws and policies have profound influences on public and private choices. This chapter identifies Indiana laws and policies that can provide opportunities for biological diversity conservation.

While many of these laws and policies have little to do - on the surface - with biological diversity, they often affect it to a far greater extent than do overtly “environmental” laws administered by the Indiana Department of Environmental Management (IDEM). For example, because habitat fragmentation is such an important contributor to the loss of biological diversity, the laws of planning and zoning, highway siting, and taxation of forest land can provide incentives that contribute to more conservation (or more loss) than laws dealing directly with endangered species or pollution control.

This chapter identifies the tools in Indiana’s current laws and policies that can conserve biological diversity, limits in these tools that work against biological diversity, and changes that could make them more useful. Relevant laws and policies fall generally into six categories:

- Planning
- Regulation
- Taxation
- Direct government action
- Incentives
- Voluntary programs

This review makes it clear that Indiana does not lack for legal authority. The real issue is whether this authority will be used by Hoosiers to conserve plants, animals, habitats and other components of biological diversity for the state’s future.

PLANNING MECHANISMS

Many of the best opportunities to conserve and restore biological diversity involve planning. Indiana has an array of planning tools in its existing laws and policies that offer opportunities for promoting biological diversity in the future. These tools have been underutilized in many of the situations where they could offer the greatest benefit.

Land Use Planning and Zoning

Comprehensive land use planning and zoning can be effective tools for the conservation and restoration of Indiana’s biological diversity. Land use planning establishes the kinds of land uses that are important in an area and provides a basis for guiding public and private development to benefit communities, the economy, and surrounding lands. Zoning then sets out the rules and procedures that implement the land use plan. Planning and zoning are valuable not only for urban and suburban areas where population pressures have already affected the use of open space and the viability of natural communities, but also for rural and newly developing areas where losses are less pronounced. These areas can employ land use planning to preserve local control and avoid haphazard losses of valuable regional resources as their desired development occurs.¹

Indiana has a straightforward approach to land use planning.² *City and town plan commissions* plan for the areas within the city or town boundaries and may exercise jurisdiction up to two miles outside their boundaries if there is no county plan commission, or with the approval of the county plan commission.

County plan commissions have jurisdiction within the county over unincorporated areas. *Area plan commissions* are cooperative ventures of jurisdictions within a county; they cover their participating areas - cities, towns, and the county. *Metropolitan plan commissions* cover the Indianapolis and Muncie metropolitan areas. *Regional plan commissions*, which have advisory powers only, may also be established by cooperating counties.³

The relevant plan commission prepares a comprehensive plan, holding at least one public hearing on the plan. The commission then recommends the plan to the legislative body of the city, town, or county — which may adopt, reject, or amend the plan. The same process is used for zoning, which provides the enforceable provisions that control actual land uses. Indiana zoning legislation allows classification of land for agricultural, commercial, industrial, residential, special, or unrestricted uses, and any subcategories or combination of these uses.⁴ Zoning may not be implemented by a jurisdiction unless it has adopted a comprehensive plan.⁵ This prevents Indiana land use regulation from occurring haphazardly without planning. Subdivision controls establish the standards for laying out subdivisions, the manner in which subdivision of land may be approved, and standards for infrastructure, parks, schools, and the like. Despite the value of planning and zoning, substantial portions of Indiana lack plans, and even more areas lack zoning, which is common in the state's cities and metropolitan areas. Fifteen counties, mostly in southwestern Indiana, do not even have plan commissions.

Under Indiana law, the comprehensive plan is prepared for the “promotion of public health, safety, morals, convenience, order, or the general welfare and for the sake of efficiency and economy in the process of development.”⁶ Every plan must contain at least: “(1) a statement of objectives for the future development of the jurisdiction, (2) a statement of policy for the land use development of the jurisdiction, and (3) a statement of policy for the development of public ways, public places, public lands, public structures, and public utilities.”⁷ While none of the mandatory elements speaks directly to the issue of biological diversity, permissible elements of a plan provide opportunities to protect, promote, or restore biological diversity. Indiana law provides that comprehensive plans *may* include elements dealing with:

- Air, land, and water pollution.
- Parks and recreation, including parks, play-

- grounds, reservations, forests, wildlife refuges, and other public places of a recreational nature.
- Land utilization, including agriculture, forests, and other uses.
- Conservation of energy, water, soil, and agricultural and mineral resources.
- Any other factors that are part of the physical, economic, or social situation within the jurisdiction.⁸

The Indiana Natural Heritage Data Center, operated by the Indiana Department of Natural Resources (IDNR), can be a valuable resource for local planning. It can provide information on locations and biological needs of the state's endangered, threatened, and special concern species, as well as information on high quality natural areas and conservation lands. This information, along with locally available information on such things as demographics and existing land uses, can help target planning to serve multiple objectives — including biological diversity conservation.

Local community control is important. Planning and zoning do not prevent development. Rather they provide a basis to assure that undesirable effects are mitigated and that reasonable conditions can be imposed on large-scale actions. They also channel development away from critical areas and toward areas where roads, sewers, and infrastructure can better support development. Moreover, zoning decisions are not irreversible. If a person is experiencing a hardship under a zoning ordinance, the local jurisdiction has authority to grant a variance. Similarly, a landowner may petition for rezoning of a parcel of land. The existence of a land use plan and zoning serve to identify the trade-offs that are being made, and to identify possible ways to mitigate a decision to allow activities. Land use planning and zoning are consistent with property rights. Indeed, they serve to maintain the values of property in a community by spreading the benefits and burdens of development.

Planning is not solely a tool for Indiana's urban and suburban environments. The development of substantial infrastructure — such as highways or water and sewer projects — or of new destination resorts may put previously rural areas under substantial development pressure. While these developments often are welcome, their growth-stimulating effects can be hard on local jurisdictions and their natural resources if there is no land use plan and zoning ordinance in place. The development of a major project or infrastructure may be the alarm bell that should activate planning and

zoning activity to manage growth into the future in a way that serves a county's tax base and preserves its existing land uses.

For example, the Patoka Lake Regional Sewer and Water District has proposed an 85 mile water line project into rural Dubois, Pike, Gibson, Spencer, and Warrick Counties. This area represents the potential sprawl area between Evansville and Patoka Lake. The project, while locally supported, would occur in an area with no land use controls in place to deal with follow-on development. While planning, zoning, and land use controls are unpopular in many rural jurisdictions, it is far easier to plan preemptively than to deal with misplaced infrastructure or losses of community assets after the fact.

Town of Beverly Shores v. Bagnall,⁹ illustrates the possibilities of zoning for biological diversity conservation. In this 1992 decision, the Indiana Supreme Court upheld the town's enforcement of its zoning ordinance, which required the consideration of the effect of any application for a building permit on local dunes. Specifically, the ordinance provided that applicants must employ "planning and design to fit the topography, soils, geology, hydrology and other conditions existing on the proposed site" and orient the planning and design to the site "so that grading and other site preparation is kept to an absolute minimum." It also required that development of the site be timed so that "construction can be completed within one construction season in order that areas are not left bare and exposed during the winter-spring period." The ordinance required "[l]andscaping of areas around the proposed structure in a manner which blends into the natural topography...[and] minimum disruption of existing plant or ground cover..." The court held that the decision of the town to deny a building permit was reasonably based on the town's power to plan and zone for protection of the "general welfare."

The City of Bloomington has protected wetlands through planning and zoning. Under its zoning ordinance, if a site has wetlands, the developer must submit an environmental review plan designed to protect the wetlands; zoning compliance approval is only granted if the proposed use can protect wetland resources. The City has similar requirements for development in karst (limestone) areas. Indeed, construction of buildings over specific karst features is prohibited in residentially zoned areas and restricted in nonresidential areas — for safety as well as environmental reasons. Runoff from paved areas or from built structures is not allowed to drain into karst

features without passing through a vegetated filter strip or other filter.

Zoning ordinances could also be used to protect areas of particular concern such as river banks and floodplains. For example, Porter County could zone to protect Salt Creek and the Little Calumet River, which were excluded from the expansion of the Indiana Dunes National Lakeshore authorized by Congress in 1992.¹⁰ Such local planning and regulation is within the powers of local Indiana jurisdictions. Comprehensive land use planning can support conservation of biological diversity by protecting riparian corridors, minimizing habitat fragmentation, limiting incompatible uses near key public preserves, siting utility and other right-of-way corridors appropriately, and assuring retention of key features such as wetlands, dunes, limestone caves, cliffs, and other areas. It can also promote development that takes advantage of the economic benefits of biological diversity. Areas that protect water quality, wildlife, waterfowl and natural communities can often command higher prices and sustain property values.

Floodplain Planning

Local land use authority in a floodplain may also be important for biological diversity. A local government may establish a floodplain commission to regulate land uses within identified flood hazard areas to assure the promotion of public health, safety, convenience, and the general welfare within its jurisdiction.¹¹ The commission's floodplain zoning ordinance must be approved by the Indiana Department of Natural Resources (IDNR).¹² The "general welfare" clause of the floodplain law may provide local commissions with authority to protect biological diversity within the floodplain. Although such ordinances typically provide that structures may not be located or uses of structures changed except in conformance with certain rules, they may also limit development in the floodplain in ways that can foster biological diversity through protecting the natural flood storage capacity of wetlands and riparian zones.

River Protection

Indiana has a natural, scenic, and recreational rivers system which may provide significant opportunities to conserve and restore biological diversity. Under the establishing legislation, enacted in 1973,¹³ IDNR is required to prepare and maintain a plan for the establishment, development, management, use, and adminis-

River Corridor Planning Along the Blue River

Experience on Indiana's Blue River shows how planning and use of IDNR and river commission authority can accommodate local landowner interests and the protection of biological diversity. The 1992 Memorandum of Understanding (MOU) between the Blue River Commission and the IDNR specifically recognizes the role of an association of riparian landowners, the Big Blue River of the Ohio Association. The association contributed to the shaping of the final regulations for permitted activity along the river. For example, the regulations prohibit clear cutting of timber within the river corridor dis-

trict but allow selective harvesting following consultation by a qualified forester agreed on by the landowner and the Commission. Other provisions prohibit herbicide spraying in the district, except direct stump spraying within rights-of-way; allow normal agricultural cutting of vegetation in the river channel to prevent damage to agricultural fields; and permit cutting (but not removal of) fallen trees from the channel to prevent localized flooding. In general, planning along the Blue River allows economic and biological diversity objectives to be identified and harmonized.

tration of rivers in the system.¹⁴ Because of the importance of riparian corridors to terrestrial biological diversity, as well as the populations of plants, animals, fish, mollusks, and invertebrates that live in the rivers themselves, the river preservation system is a potentially important tool for the protection of high quality biological resources. The system is useful in identifying and planning for the protection of resources.

The system is primarily used to manage activities along designated rivers. IDNR may also acquire land, water use easements, scenic easements, or land use easements, but may use eminent domain (involuntary acquisition) only to acquire conservation easements and water use easements.¹⁵ Since 1978, IDNR has been authorized to establish river commissions for any river in the system.¹⁶ Any county containing a designated river segment may participate in the commission.¹⁷ A memorandum of understanding (MOU) between IDNR and the commission provides for management of the river.¹⁸ Establishment of a river commission provides an excellent opportunity for local land owners and other residents to take an active role in managing the river and its biological diversity. Where a river commission exists, no person may substantially affect the natural or scenic qualities of the river without a permit.

Permits are prohibited for any project that "substantially affects" the natural or scenic qualities of the river in a manner visible from five feet above the water surface of the river at normal water level between May 1 and October 15.¹⁹ Essentially this prohibition preserves the scenery for recreational boaters, rather than the biological health of the river system. Nevertheless,

the power of a commission or local zoning authority to protect a designated river through planning and permitting is potentially significant. Local or county zoning authority may also protect the river and other areas in the watershed, including rivers not part of the system.

Three rivers are currently part of the Indiana system:

- *Blue River* — 45.4 miles, designated 1978. The Blue River Commission includes three counties (Crawford, Harrison, and Washington), none of which has zoning. The Commission's MOU gives it authority over land use activities within 50 feet from the top of the riverbank. This is fairly limited authority, and does not protect tributaries to the river.
- *Cedar Creek* — 13.7 miles, designated 1976. Allen County can use its zoning authority to protect the river corridor. However, other planning tools may be needed to protect the watershed.
- *Wildcat Creek* — 48.5 miles, designated 1980. Although there is no river commission, an advisory group meets 3-4 times per year to make recommendations to IDNR. The Carroll County segment has no zoning; the downstream Tippecanoe County segment has county zoning which may be used to protect the river.

Several other Indiana rivers have been evaluated for possible inclusion in the system, including Sugar Creek, Big Pine Creek, South Branch of the Elkhart River, and Whitewater River; there has also been some

consideration of Sand Creek, Big Walnut Creek, and the Tippecanoe River.

River designation means, at a minimum, that development projects along the river segment must be reviewed and evaluated by IDNR or the appropriate river commission.²⁰ Outright disapproval of a project is *required* only if the project would result in a substantial loss of the natural or scenic qualities that made the river segment eligible for the state system.²¹ However, other uses may be limited or disapproved within the discretion of the IDNR and local land use authority or river commission. Biological diversity considerations clearly have a role to play in the management of these rivers.

Transportation Planning

TRANSPORTATION PLANNING OPPORTUNITIES. The location and management of highways in Indiana can either harm or provide opportunities for conservation and restoration of biological diversity. Transportation planning critically affects land use. Indeed, the primary determinant of growth in Indiana, as in the rest of the United States, has been its transportation networks — initially the rivers and canals, later the railroads, then state and federal highways. Indiana has over 10,000 miles of state highway and over 1,100 miles of interstate highway.

Highway construction can promote suburban sprawl and dictate patterns of growth. Unless concern for biological diversity is built into transportation planning, transportation improvements may unintentionally harm Indiana's rich biological heritage. Fortunately, there are ways to integrate these concerns into the state's transportation plans.

Transportation planning has been significantly affected by the 1991 federal Intermodal Surface Transportation Efficiency Act (ISTEA, usually pronounced "ice tea").²² ISTEA imposes detailed planning requirements on local and state governments, working primarily through regional planning organizations composed of local officials. The ISTEA planning requirements are highly important, because most state highway construction and reconstruction in Indiana involves the expenditure of federal funds.

The regional planning organizations are required to engage in two types of planning, both of which call for heavy public involvement: 1) the preparation of 20-year Long Range Plans (LRPs), and 2) the preparation of 3-year Transportation Improvement Programs (TIPs). The LRP must outline a set of goals in a specific

region of Indiana over a 20-year period, and define a transportation system that will meet these goals. The LRP must be prepared with public participation, including public hearings. Its content must conform to the federal Clean Air Act. The plan must reflect only state, local, and federal financing which is realistically expected to be available — not hypothetical funding. The LRP must be revised every three to five years. In contrast, the TIP contains a prioritized list of the projects that the planning organization actually expects to be implemented in the next three to five years. It is updated every other year. At the state level, the Indiana Department of Transportation (INDOT) prepares a state-wide long-range plan, a state TIP, and a long-range plan for pedestrians and bicycles.

The ISTEA regulations, issued in October 1993, added significantly to existing requirements for public participation. HB 1043 (passed by the 1995 Indiana legislature) ensures the right of the public to testify at public hearings on transportation plans. In addition to local government, important private participants in the planning process include advocacy groups like the Hoosier Environmental Council, as well as civic associations, conservancy districts, sportsmens' organizations and others interested in biological diversity.

From the perspective of biological diversity, ISTEA planning is an important addition to planning. Previously, transportation planning's only concession to biological diversity was the longstanding requirement of §4(f) of the federal Transportation Act.²³ That section denies federal approval for any federally supported transportation project that requires the use of any publicly owned land from a park, recreation area, or wildlife and waterfowl refuge — unless there is no prudent and feasible alternative and the project includes "all possible planning to minimize harm" to the unit. While this provision has helped to prevent highway siting through parks and refuges, ISTEA planning greatly extends the potential focus of planning concern to a broad array of issues — not simply impacts on publicly owned lands. It requires consideration of state and local land use plans, impacts on air quality and other resources, and understanding of efficiencies and trade-offs in siting highways or funding other modes of transportation. The ISTEA planning process provides an opportunity to consider impacts on biological diversity and opportunities for restoration and mitigation.

The LRP is one of the few opportunities in Indiana where issues of multi-county regional concern can be addressed and weighed against one another in a publicly open forum. Although ISTEA planning is some-

what constrained by its primary focus on allocating transportation funds, it provides a rare opportunity for Indiana citizens to adopt regional approaches that could focus more directly on environmental concerns — including conservation of biological diversity, prevention of habitat fragmentation, and improvement of water quality for the benefit of water-dependent species.

TRANSPORTATION ENHANCEMENTS. Although ISTEA authorizes federal funding assistance for traditional highway projects, bridges, maintenance, and research, it includes other programs as well. The Surface Transportation Program (STP) is the most relevant for conserving biological diversity. STP funds may be expended by the state of Indiana for a variety of activities, including mitigation of environmental impacts resulting from highway construction, carpool projects, fringe and corridor parking programs, bicycle transportation, and pedestrian walkways.

At least 10 percent of STP funding *must* be allocated for “transportation enhancements.” These locally developed projects are 1) bike and pedestrian facilities, 2) acquisition of scenic easements or scenic sites, 3) scenic or historic highway programs, 4) landscaping, 5) historic preservation, 6) rehabilitation and operation of historic transportation facilities, 7) rails-to-trails projects, 8) control of outdoor advertising, 9) archaeological research, and 10) mitigation of water pollution due to highway runoff. Enhancement projects may be proposed by Indiana local governments or private organizations (including civic groups and conservation groups), and the projects compete for funding at the state level. In order to be classified as an enhancement, an activity must either 1) have a functional relationship to the transportation system (e.g., a bike lane on a bridge), 2) be in direct proximity to that system (e.g., the purchase of an easement beside a scenic highway), or 3) have a direct impact on the system (e.g., reduce traffic congestion). Enhancements have been used for conservation purposes in Indiana, and can be used for biological diversity projects.

PREVENTION AND MITIGATION MEASURES. Transportation planning can help determine not only where projects or enhancements are sited or constructed, but also how to mitigate the adverse impacts of transportation infrastructure. Well-planned mitigation can be targeted for maximum benefit to biological diversity. The following examples demonstrate that state, local, and federal coordination has resulted in the development of

a number of important mitigation programs in Indiana. There are many more possibilities available.

One example of mitigation relevant to biological diversity is the 1991 agreement among INDOT, IDNR and the US Fish & Wildlife Service (USFWS) concerning wetland mitigation for highway projects.²⁴ The parties agreed that a mitigation agreement based on field review would accompany permit applications. INDOT agreed to replace wetlands destroyed by highway projects at a 1:1 or greater ratio, thus providing more restoration for each acre lost. INDOT agreed to provide at least one acre of restored or created wetland for each acre of farmed wetland lost. Scrub-shrub and emergent freshwater shoreline wetlands will be replaced at 2:1 or 3:1; bottomland hardwood wetlands at 3:1 or 4:1; and exceptional, unique, or critical wetlands at 4 (or more):1. Absent complete mitigation at a designated site, INDOT agreed to pay IDNR \$1500/acre to be used for future restoration or creation at the same ratios. Wetland restoration is a key opportunity for biological diversity conservation because it helps mitigate historic losses, and because appropriately sited restoration can provide large tracts of wetland habitat for wildlife.

In 1992, INDOT and IDNR reached an agreement concerning the use of highway rights-of-way for the establishment and management of trees.²⁵ This agreement implemented a new law that required the Division of Forestry to supply trees, supervise planting, and manage “with the same responsibility and authority as trees in a state forest.”²⁶ INDOT is to plant trees along the rights-of-way “when consistent with public safety.” Under the MOU, receipts from timber sales go to INDOT for reuse “exclusively for tree planting and forest improvement.” While the new law and the MOU provide an opportunity to re-forest Indiana as well as to mitigate for tree-clearing associated with highway construction, the biological diversity advantages of the law may only be realized if IDNR can assure a management focus on biological diversity for right-of-way lands where it is appropriate to do so. A more limited effort started in 1978 involved IDNR planting of shrubs and tree seedlings in rights-of-way as wildlife cover.

In 1993, INDOT entered into an agreement with IDEM, IDNR, and USFWS with respect to road construction and maintenance activities in fragile karst regions — limestone areas characterized by caves and springs and the many unique species dependent on those systems and their clear, mineralized waters. INDOT agreed to identify karst features and

Managing Powerline Corridors

Voluntary efforts can be undertaken by powerline right-of-way managers to reduce adverse effects, such as predation or barriers to migration. For example, rights-of-way can be feathered to avoid some edge effects "with the objective of creating a series of successional bands of vegetation parallel to the corridor opening." These bands "minimize the barrier effect found at abrupt edges" and disperse prey and predator species.

The width of rights-of-way is also an important factor: "The wider the corridor and the greater the contrast between corridor and the adjacent habitat, the more effective a barrier it becomes." Therefore, management techniques should seek to reduce the effective width of the corridor. One beneficial procedure might be "the creation of small lobes or penin-

sulas of shrubby vegetation extending from the forest edge into the corridor."

Animals can cross barriers through breaks incorporated in the corridor. For example, land managers can maintain different stages of vegetative growth at different points of the corridor to facilitate crossings. One approach is to alternate spraying of different sections of the corridor so that some sections would have recently been sprayed, while others act as migration pathways. Forests in hilly areas could also "be left intact where the powerline corridor crosses stream valleys or depressions."

— from J. Edward Gates, "Powerline Corridors, Edge Effects, and Wildlife in Forested Landscapes of the Central Appalachians," in J.E. Rodiek and E.G. Bolen (eds.) *Wildlife and Habitat in Managed Landscapes* (Island Press 1991).

subsurface and surface water flow, and to calculate pollution loads prior to, during, and after highway construction. The agreement provides for hazardous materials traps at stormwater outfalls and other locations, and a monitoring and maintenance plan for karst features. A low road salt and no herbicide spray strategy will be developed for each future project, and INDOT will develop an erosion control plan for the construction phase. These activities are critical if irreplaceable elements of Indiana's biological diversity are to be maintained for the future.

INDOT has initiated a modest program to plant native prairie species at six or seven sample plots in rest areas in Newton and White counties. Native grasses and forbs are planted and maintained with controlled burns.²⁷ In addition, in cooperation with the Division of Nature Preserves, prairie remnants are located and managed along railroad rights-of-way, or rights-of-way between railroads and highways. Management consists of cutting brush and burning; there are no replanting efforts at these sites. INDOT cooperates with the Division of Nature Preserves to ensure that these areas are not sprayed with herbicides or mowed. The longest tract, along US Route 52 between Lafayette and Fowler, is about 30 miles in length.²⁸

Erosion control on highway projects is extremely

important to INDOT, both during construction and during standard maintenance activities. INDOT's objectives for its rights-of-way include maintaining the stability of the right-of-way and assuring traveler safety. Like most transportation departments in the Midwest, "objectives for highway corridor landscapes include the development of a stable, low-growing, erosion-controlling, and low-maintenance vegetative cover that enhances safety and fits in aesthetically and biologically with surrounding lands."²⁹

Until the 1920s and 30s, Indiana roadsides were often kept natural due to limited resources and technology, but as gas mowers replaced horsedrawn mowers in the 1920s and herbicides supplemented mowing and brush cutting by the late 1940s, "rights-of-way began taking on the appearance of mown lawns."³⁰ Today, highway districts in several states, including Minnesota, Iowa, Ohio, Wisconsin, Illinois, and Michigan are planting native prairie forbs and grasses in place of agronomic species. On I-70 and I-71 near Ashland, Ohio, for example, the state of Ohio is using native grasses for highway vegetation and educating the public on the importance and value of native species. Along some medians and interchanges, INDOT has planted wildflower species, but has concentrated on those which provide a colorful view

for motorists. While some of these are native prairie species, there is no agency policy to use native plants or to restore functioning prairie systems.

Unfortunately, INDOT relies primarily upon agronomic species for stabilization — fescues, bluegrass, ryes, and legumes. These are currently more readily available and inexpensive initially than native grasses, shrubs and prairie plants. The result is a missed opportunity for the restoration of biological diversity to Indiana, and the possible introduction of non-native species that can out-compete remnant native plants and their associated wildlife communities.

Nurseries for prairie species are a potential private business opportunity for Indiana, especially if there is a core market such as that provided by demand for highway corridor vegetation.³¹ The assurance of this level of demand can then lead to the broader availability of such species for use in other Indiana settings. Prairie restoration is providing work for about 100 small, specialized firms in the midwest, although not in Indiana. Maintenance costs for some of these native grass communities can be lower than for turf.³² There is a need in Indiana for seed and plant stock for such restorations. Until recently, however, there was no local source for native prairie plants; the Indiana Division of Fish & Wildlife established a nursery in the Jasper-Pulaski Fish and Wildlife Area in 1993. If INDOT made a commitment to prefer native species in revegetation efforts, a substantial contribution to biological diversity throughout the state could occur.

REGULATION

Regulatory mechanisms are among the most familiar governmental approaches to public issues. Apart from its pollution control laws and regulations, Indiana has a number of authorities that can have a profound effect on the conservation and restoration of biological diversity.

Drainage Regulation

Indiana's lands and waters have been extensively manipulated to control water flows and to drain lands that are naturally wet or subject to flooding. Over 6.5 million acres of Indiana have been drained, primarily for agriculture.³³ The effect of this drainage has been a drastic change in the biological communities present on Indiana lands. For example, a century of ditching of the Grand Kankakee Marsh has "all but eliminated" the natural wetlands that support waterfowl, rare plants

and animals, and aquatic life.³⁴ While drainage has had some beneficial effects for agriculture, its effect on biological diversity has eliminated much of the value of Indiana's waterways, wetlands, and surrounding upland habitats.

Indiana regulates drainage under several state laws. Drainage activities are primarily conducted by county drainage boards under the Drainage Board Act,³⁵ which authorizes each Indiana county to establish a drainage board.³⁶ Over 3/4 of the 92 counties have county drains overseen by these drainage boards.³⁷ There are more than 34,000 miles of regulated drains in Indiana,³⁸ three times the mileage of state and federal highways in the state. In addition to county drainage boards, drainage activities may also be conducted under other authority, such as maintenance and repair districts or conservancy districts.³⁹

The Drainage Board Act has no provisions for the protection of biological diversity or the environment. Indeed, when constructing and reconstructing drains, the county surveyor must determine the "best and cheapest method" to adequately drain all affected land.⁴⁰ This economic standard leaves no room for environmental concerns. In fact, the "best and cheapest method" may include removing obstructions from a natural watercourse, diverting a watercourse, or deepening, widening or changing the channel.⁴¹ These alterations may disrupt plant and animal communities, increase turbidity, eliminate slack water pools and sub-surface cover essential to aquatic species, and raise water temperatures. Many of these effects are avoidable if identified during the planning process for project work.

Although the Drainage Board Act does not include environmental review of drainage impacts, Indiana's Ditch Act⁴² and Flood Control Act⁴³ do provide for the environmental review of some drainage projects. If the project requires a permit from the Indiana Department of Natural Resources (IDNR) under either the Ditch Act or Flood Control Act, or if a federal permit is required (which triggers review by IDEM to certify that the project will not impair state water quality),⁴⁴ an environmental review must occur.

Under the Ditch Act, no person may locate, make, dig, dredge, construct, reconstruct, repair, or reclean any ditch or drain within 1/2 mile of a fresh water lake of more than 10 acres without a permit.⁴⁵ IDNR may issue a permit only if it finds that the proposed action "will not result in unreasonably detrimental effects upon fish, wildlife, or botanical resources."⁴⁶ There is an opportunity for public comment on the permit



PHOTO: LEE CASEBERE

Nearly 30 percent of Indiana has been ditched using practices such as this example on agricultural land in Steuben County, Indiana.

application. In 1995, the law was amended to provide that if a request for a permit is submitted for the reconstruction or maintenance of a regulated drain, IDNR must approve or refuse the request within 150 days after the request is deemed complete.⁴⁷ A request held more than 150 days by IDNR without action is approved.

Indiana's Flood Control Act makes it unlawful to build any structure, place any obstruction, or make any deposit or excavation in any floodway without a permit from IDNR.⁴⁸ This applies to activities in the floodways of regulated drainage ditches, as well as unaltered streams and rivers. However, drain reconstruction or maintenance projects are exempt from permitting if they are located on a stream or open drain 10 miles or less in length.⁴⁹ During review of a request for a floodway permit, notice is provided to adjacent landowners,

who are given the opportunity to comment. Any affected property owner may request a hearing prior to permit issuance if the owner procures 25 signatures in support of a hearing request.⁵⁰ IDNR will issue a permit only if the project applicant has "clearly proven" that the structure, obstruction, deposit or excavation will not adversely affect the efficiency of the floodway or unduly restrict its capacity; that the project will not constitute an unreasonable hazard to the safety of life or property; *and* that it will not result in unreasonable detrimental effects upon fish, wildlife, or botanical resources.⁵¹

Under both the Ditch Act and the Flood Control Act, "unreasonable detrimental effects on fish, wildlife, or botanical resources" means damage which, based on the opinion of a qualified professional, is likely to occur and which creates a condition where *recovery* of the

affected resources is not likely to occur within an acceptable period, and which *cannot be mitigated* through the implementation of a mitigation plan.⁵² This often means that "unreasonable detrimental effects" are rarely found, even though the resource is impaired. Information from the Indiana Natural Heritage Data Center is important in this process of identifying species and communities that are at particular risk. In evaluating a permit application, IDNR must also consider the project's cumulative effects.⁵³ Cumulative effects means the impact which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what person undertakes those actions. The cumulative effects analysis is intended to consider effects upon fish, wildlife, or botanical resources.⁵⁴

Despite the limited reach of the state legislation, there is an important opportunity to assure that biological diversity is protected. Under 1995 legislation, a county surveyor or board planning to perform a project for the reconstruction or maintenance of a regulated drain that is subject to regulation under the Ditch Act, the Flood Control Act, or that requires an individual wetlands permit under the federal Clean Water Act, *must* request an on-site field review of the project. The review must be conducted by a team consisting of county representatives, IDNR representatives, IDEM representatives, and, if applicable, representatives of the local soil and water conservation district.⁵⁵ Within 30 days after the field review, IDNR must provide the county surveyor with a written summary of the review, including a list of all mitigation conditions that IDNR would place on a permit and that IDEM would place on a certification to comply with the Clean Water Act. Although the time-frames are short, Indiana citizens should be aware of the on-site review and be sure to identify relevant biological diversity issues.

Not only the drains themselves, but also the areas adjacent to regulated drains can be very important to biological diversity. Under the Drainage Board Act, the board or county surveyor has a right of entry upon land within 75 feet of any regulated drain.⁵⁶ Anyone exercising this right must use "due care" to avoid damage to crops, fences, buildings and other structures outside the right-of-way, and to crops and approved structures inside the right-of-way.⁵⁷ Reflecting its historic origins, the law does not require due care to avoid damage to biological diversity in these areas. Thus, unless required by IDNR permit or IDEM water quality certification, drainage maintenance activities can seriously impair habitat in the riparian zone. The owners

of the land adjacent to a drain may use their land in any manner consistent with the proper operation of the drain. However, trees, shrubs and woody vegetation may not be planted in the right-of-way without the written consent of the board; and trees and shrubs may be removed by the surveyor if necessary to the proper operation or maintenance of the drain.⁵⁸

Because trees may make it difficult to get equipment to the drain or to conduct other maintenance while remaining within the right-of-way, and because trees may partly obstruct a drainage channel if they fall, some Indiana drainage boards and surveyors are hostile to the use of trees in the riparian zone.

This can have an unfortunate effect on biological diversity. In Indiana, "many species of birds such as red-shouldered hawks, yellow-crowned night herons and neotropical migrants (e.g., yellowthroats and cerulean and parula warblers) are attracted to trees overhanging river channels for nesting and feeding....Without such habitat conditions the result is reduced nesting success and eventual failure to maintain a viable population."⁵⁹ Wood ducks have similar cover needs for brood rearing in riparian areas, as do Indiana bats. In addition, without shade, water temperatures can become too high for some species of fish.⁶⁰ Unfortunately, the 1995 legislation prohibits IDNR from requiring or even *recommending* tree planting or tree retention within the right-of-way if (1) the project involves construction on only one side of the drain, (2) vegetation on the opposite bank will not be disturbed, and (3) the drainage board agrees to establish a filter strip of grasses and legumes along the disturbed side. This limitation may make it more difficult to prevent unreasonable effects on fish, wildlife, or botanical resources. However, there is nothing in Indiana law that prevents drainage boards and surveyors from recommending or requiring the planting or retention of trees on their own.

The Indiana legislature did authorize the establishment of a legislative study committee and a work group to develop a technical and administrative handbook for drainage projects. Beginning work in late 1995, the work group is to develop a handbook that describes techniques and develops best management practices that are protective of the environment and take into account on-site and off-site effects, cumulative effects, and downstream impacts.⁶¹ The work of this group can be critically important to the future health or future loss of Indiana's biological diversity.

There is a profound need to encourage support for biological diversity among the boards, surveyors, and

landowners involved in drainage construction, reconstruction, and maintenance. Harmonizing economic interests with biological diversity is a key challenge if Indiana's extensively drained landscape is to be restored to ecological health. This will require creativity and innovation by drainage boards and county surveyors; it may also involve voluntary efforts by landowners and interested residents coordinating with drainage district activities. Law may have a role to play as well. Indiana's drainage boards do not look at environmental impacts or cumulative impacts affecting biological diversity, in part because of the limited focus of the Drainage Board Act. Environmental review, when it is performed at all, is left to state agencies and applies only to a limited array of circumstances. In contrast, the drainage laws in some other states, including Ohio and Minnesota, require mitigation for impacts on water quality and natural resources and apply environmental conditions. Indiana's drainage maintenance and other laws may need to support similar considerations.

Other Regulatory Laws Related to Waters

Indiana law also has several broad water-related provisions that could be used creatively to curb damage to biological diversity. For example, Indiana's water quality law prohibits drainage or placement of material into state waters that causes or contributes to a polluted condition such that "any fish life or any beneficial animal or vegetable life in any waters may be destroyed or the growth or propagation thereof prevented or injuriously affected."⁶² This provision offers the water pollution control board the authority to protect biological diversity through adopting appropriate regulations.⁶³

Another provision of the Flood Control Act prohibits any person from putting contaminants or solid waste in, upon, or within 15 feet of a lake or within a floodway.⁶⁴ If aggressively implemented by IDNR, this provision could prevent the degradation of riparian areas by ending unlawful trash disposal, as well as by limiting the discharge of road salt or other substances potentially harmful to biological diversity by INDOT, local governments, and individuals. It has received little use in the context of biological diversity protection, but offers a useful opportunity.

Indiana's Lakes Preservation Act provides that a permit from IDNR is required to alter the water level or shoreline of a public freshwater lake through excavation, filling, erecting a permanent structure, or otherwise causing a change.⁶⁵ A permit "shall not" be issued until the IDNR makes a written determination that the

issuance of the permit would not result in significant environmental harm.⁶⁶ Such harm includes damage to water, fish, plant life and minerals in the lake.⁶⁷ Many of these permits are issued each year for vacation home developments, docks, and other alterations, allowing impairment of important shoreline habitat, and increasing the potential for polluted runoff.

Indiana law also controls erosion from certain sources. Anyone engaged in construction activities that affect 5 or more acres must take measures to control erosion.⁶⁸ Erosion control requirements can be significant to biological diversity in local streams; excessive turbidity from sediment discharges can be fatal to aquatic life and to important parts of the food chain that support fish, birds and other animals. The regulations require a notice of intent, proof of publication, and certification that erosion control measures are in place. An erosion control plan must include detention of sediment-containing water, minimization of wastes from leaving the site via runoff, minimization of sediment distributed off-site by vehicles, and protection of on-site storm drains through filtration. Storm drainage from adjacent areas must be routed around the site during construction, and on-site runoff must be controlled. Local regulation under zoning codes also can require controls including buffer zones for streams. Local erosion control regulation can also deal with sites smaller than 5 acres.

Each of these regulatory authorities dealing with pollution and manipulation of habitats can protect biological diversity. Erosion control and general laws against discharges of contaminants apply to government projects, such as highway maintenance and construction, as well as to the acts of individuals. Creative enforcement of the prohibitions can eliminate detrimental actions by both governmental and private parties or provide a basis for negotiating the reduction of adverse impacts. If an activity may cause harm to aquatic biological diversity and related systems, Indiana law does provide a potential remedy.

Wetland Restoration

Indiana has encouraged wetland restoration efforts by reducing regulatory requirements. An IDNR permit under the Flood Control Act is not required for wetland restoration conducted under the direction of IDNR, the federal Natural Resource Conservation Service (formerly Soil Conservation Service), or the U.S. Fish & Wildlife Service, if the measure will not adversely affect the floodway, constitute an unreason-

Habitat Protection and Mining Along the Patoka River

The Patoka River National Wetlands Project is in Gibson and Pike Counties in southwestern Indiana. The project includes about 30 miles of the Patoka River channel, 16 miles of natural meanders, and 19 miles of cut-off oxbows. The area contains some of the best wood duck habitat in the state and supports a number of endangered species and bald eagles. Implementation of the plan will restore approximately 5,108 acres of bottomland farm ground to 4,108 acres of bottomland hardwood forest and 1,000 acres of managed wetlands.

The U.S. Fish & Wildlife Service's (FWS) plan will establish the Patoka River National Wildlife Refuge through the acquisition of 6,800 acres. A

Wildlife Management Area will be established through the selected acquisition of land within an adjacent 15,283-acre area. The plan will allow surface coal mining to continue within the Management Area. Yet, if active coal-mine sites and oil and gas sites are reclaimed with biological diversity in mind, the disruption occasioned by mineral extraction activities may be offset by long-term contributions to the restoration project.

References:

"Record of Decision for the Establishment of the Patoka River National Wetlands Project: Gibson and Pike Counties, Indiana." September 1994. U.S. Fish & Wildlife Service, Great Lakes-Big Rivers Region, Fort Snelling, Minnesota.

Final Environmental Impact Statement. July 1994. "Patoka River National Wetlands Project." U.S. Fish & Wildlife Service.

able hazard, or result in unreasonable detrimental effects upon fish, wildlife, or botanical resources. The exemption applies if the restoration measure does not obstruct more than 5 percent of the cross section of the 100-year flood plain, does not remove more than a half acre of forest, provides for reclamation and revegetation of disturbed areas and, to the extent practicable, restores plant species native to the site.⁶⁹

Regulation of Mineral Extraction

Various beneficial economic activities involve the disturbance of lands. Mineral industries are not the only regulated entities with biological diversity impacts and opportunities, but they illustrate some of the possibilities that are available in Indiana. They show how regulatory approaches can provide opportunities for the conservation and restoration of biological diversity in the context of Indiana law.

COAL MINING. Coal mining is a significant land use activity in southern Indiana. Under both state and federal law, areas disturbed by coal mining must be reclaimed to an approved post-mining land use.⁷⁰ Prime farmlands must be restored to their pre-mining productivity, but other lands and farmlands can be converted to other uses. Federal and state regulations require reclamation to include provision for fish and wildlife, as well as reclamation for agriculture, residential,

public, or industrial uses.⁷¹ Reclamation presents both difficult challenges and opportunities.

A substantial amount of hardwood forest clearance occurs in connection with surface mining, and some occurs in connection with underground mining. At least two mechanisms can lead to decreased habitat quality for species associated with mature forests as a result of surface mining — reduction of mature forest acreage and fragmentation of mature forest stands.⁷² Coal mining reclamation seeks to establish vegetative cover on the site within 2 years, chiefly in order to minimize erosion and to comply with regulatory standards. In Indiana, as elsewhere, "a common practice is to reclaim to grasses and legumes and then graze the lands."⁷³ This produces areas dominated by herbaceous plants and exotic species, often less supportive of biological diversity than pre-mining conditions. On the other hand, some of these large blocks can be important to area-sensitive grassland species if they are appropriately managed. Fortunately, since a 1985 IDNR policy statement, most of the larger Indiana coal mines operating in forested areas have begun replanting hardwoods. This kind of activity can contribute to long term recovery of biological diversity on these lands. It will be important to assure that reclamation continues to support biological diversity, especially since Indiana's coal mining regulatory program has recently experienced a cut-back in funding that may threaten state oversight.

Several attempts have been made across the state to construct wetlands to treat polluted water discharged from abandoned mine lands. The 1994 Innovation Award by the Indiana Society of Mining and Reclamation recognized a new method of alkaline treatment of mine drainage and flooding of slurry areas that created suitable wetland habitat while solving pollution problems. Such innovation will continue to be important, and IDNR should continue to support such approaches as a way of restoring biological diversity while solving chronic pollution problems.

OIL AND GAS. There are over 7,500 active oil wells and 750 gas wells in Indiana, plus over 3,000 disposal wells associated with such operations. Over 50,000 abandoned oil and gas wells dot the state.⁷⁴ Oil and gas operations are regulated under state law. Until recently, such regulation was primarily for safety rather than for impacts on environmental resources or biological diversity.⁷⁵ Site reclamation requirements are limited to the plugging and closure of wells.⁷⁶ Well areas must be restored as nearly as possible to pre-development conditions.⁷⁷ This usually means regrading the site. There are no revegetation requirements. Although a site is often seeded by the operator with grass following regrading, re-planting with native plants or with trees would do more to promote biological diversity.

Such a change in practice could be required under a recently enacted law. In 1993, the legislature amended the law to allow IDNR's Division of Oil & Gas to regulate not just to prevent waste, fresh water pollution, blowouts, cavings, seepage and fires, as in the past, but also "to prevent...unreasonably detrimental effects upon fish, wildlife and botanical resources."⁷⁸ This phrase, borrowed from other Indiana legislation, provides a substantial opportunity to make oil and gas operations and storage operations more protective of biological diversity. IDNR is working on a rule to require netting of ponds and pits to prevent the accidental poisoning of migratory birds. Other issues are under consideration, but the Division is moving carefully given the lack of a history of regulation in this area.⁷⁹

With care, future regulations could ensure that restoration of oil and gas sites occurs in a manner suitable to conserve biological diversity. For example, using its new authority, IDNR could promote or require revegetation with compatible native species and reforestation of forest openings. Even a very modest set of requirements could be profoundly important to the ecological well-being of Indiana's oil and gas producing regions. Indeed, the state itself could lead the way

toward demonstrating proper site restoration by using its oil and gas environmental fund for abandoned wells to cover biological restoration costs.⁸⁰ While such expenditures have, thus far, been primarily limited to removing health and safety hazards, a broader approach is authorized by the law, which allows expenditures from the fund "to cover the cost to...mitigate environmental damage."⁸¹ The industry itself might demonstrate the feasibility of such approaches on a voluntary basis.

TAXATION

Taxes on real estate can influence land use and the conversion of property from one use to another. Indiana has long recognized the importance of taxing lands in different ways to prevent taxation itself from causing changes in use. In 1963, the legislature directed tax assessors to assess land devoted to agricultural use as agricultural land, rather than at a "highest and best use" value which might force development. A decade later, the legislature provided for the use of soil survey data in valuing such land.

Indiana also has special "classified lands" programs to encourage rural landowners to engage in conservation uses of their lands. In order to understand the incentives provided by these programs, it is necessary to understand the background of basic taxation of agricultural lands. Today, Indiana agricultural land is assessed by multiplying the acreage times a base rate of \$495 per acre, times a productivity factor based on soils, to obtain the "true tax value."⁸² The assessed value is then calculated at 1/3 of the true tax value. The relevant local tax rate is then multiplied by the assessed value to calculate the amount of tax due.

Certain lands, because they are not routinely tilled for agricultural use or are less productive, have a discounted true tax value determined by subtracting an "influence factor." Woodland is discounted 80 percent, non-tillable shrubland is discounted 60 percent, farmed wetlands are discounted 50 percent, and flood prone land is discounted 30 percent or 50 percent. Wetlands are valued by using a productivity factor of 0.5 and then discounting the product by 40 percent.

To illustrate, forty acres of agricultural land on good soils in a jurisdiction with a tax rate of 8 percent would incur an annual tax bill of \$530.⁸³ Forty acres of woodland on the same soils would incur a tax bill of only \$105.⁸⁴ Forty acres of wetland would also incur a tax bill of \$105.⁸⁵ Some of this tax discounting may

produce incentives to leave wetland or woodland in an unaltered condition, and thus incidentally to benefit biological diversity. More importantly, however, the state also has a number of programs to encourage management of lands in forest, wildlife habitat, or conservation uses that provide a much greater tax abatement.

Indiana's "classified lands" programs allow participating Indiana landowners to have their lands assessed at only \$1 per acre. The same forty acre woodland that would incur a \$105 tax bill as noted above, would, if enrolled in a classified forest category, incur a tax bill of only \$3.20. So would the same forty acre wetland if enrolled in a classified wildlife habitat category. Participation in these programs can provide a benefit to landowners and promote the protection and restoration of biological diversity at the same time. In general, the tax breaks afforded by these programs are not sufficient by themselves to prompt changes in behavior, but provide some benefit to owners who want to manage their lands for conservation purposes. With some adjustments, these programs could provide even stronger incentives for conservation of biological diversity.

Classified Forest Lands

Indiana has about 4.4 million acres in forest, of which 3.7 million are privately owned. These forests, themselves part of Indiana's biologically diverse heritage, also support many species of birds, reptiles, mammals and other creatures that are important parts of the state's wildlife.

The Indiana tax code provides that parcels of contiguous forest land 10 acres or larger may be classified as "forest plantations" or "native forest lands" for real estate tax purposes.⁸⁶ The assessed value is set by law as \$1 per acre. Forest plantations are defined as previously cleared lands which have a "good stand of timber producing trees." Native forests are lands that have never been plowed or cultivated and that contain at least 40 square feet of base cover by trees per acre or 1,000 timber producing trees of any size per acre. Certain trees — including dogwood, apple, sassafras, willow, ironwood, persimmon, and commercially grown Christmas trees — are excluded from either definition.

A parcel of land may not be enrolled as classified forest land if there is a dwelling or other building on it (except a sugar camp or sawmill), if it is grazed by a domestic animal, or if it contains an open area. However, open areas can be allowed if they are less than one acre, and are authorized by special permit issued for small lake areas, wildlife food plots, or similar uses that

have the primary purpose of wildlife production or fire protection, or other uses consistent with the law. Lands on which surface mining was conducted prior to modern surface mining regulation are also ineligible for classified forest status.⁸⁷ The limitation on buildings applies only to the parcel of land enrolled in the program. For example, a homeowner can enroll a 10 acre portion of land while living on the remaining portion which is not enrolled.

A landowner applies to the state forester to enroll the forest land. Before approval, the land must be surveyed by a registered surveyor and assessed at fair market value by the county tax assessor. A forest management plan must be prepared by the district forester in consultation with the landowner. The owner must agree to follow IDNR's "minimum standards of good timber management" and carry out the management plan.⁸⁸

The standards require only that the owner: "(1) maintain the land according to its management plan, (2) prevent excessive erosion and control the deposition of sediment off-site, and (3) maintain a healthy forest environment." The owner must also improve the timber stand if required in a management plan, or if directed by a district forester following a commercial harvest of timber.⁸⁹ The landowner submits an annual report on the condition of the land and on any commercial harvest. The state forester is to inspect the land every five years. An owner may withdraw land from classification at any time but must pay back taxes (at the higher rate) for the ten preceding years plus a 10 percent interest charge; the state forester may also involuntarily terminate an owner's participation for failure to follow the plan.

In 1975, Indiana landowners had enrolled 265,000 acres as classified forest — about 7 percent of the private forest land in Indiana. By 1994, enrollment had risen to 360,000 acres (about 10 percent) encompassing 6,500 enrolled parcels of land. While the program offers opportunities to manage land for biological diversity, the program does not require management for this purpose. Because the program recognizes landowner objectives of managing for wildlife, watershed protection, and aesthetics, as well as timber, it could encourage greater biological diversity on privately owned Indiana forest lands. Management plans could promote biological diversity through management techniques that recognize the utility of controlled fires, standing dead trees as habitat, and diverse tree species representation in the enrolled parcels.

Participation rates in this program are surprisingly low, and are primarily due to a lack of landowner awareness of the program or a reluctance to deal with state government. Some southern Indiana counties are also concerned with the potential diminution of the tax base that the program could represent if more parcels were enrolled. Nevertheless, the classified forest program offers a modest financial incentive and technical assistance for those Indiana woodlot owners who desire to manage their lands for biological diversity as well as for timber values.⁹⁰

Classified Wildlife Habitat

In 1979, the legislature extended a similar tax break to non-forest landowners for wildlife habitat and riparian land. The law also assessed these classified lands at \$1 per acre. The law can cover a broader range of land types, such as prairies, wetlands, grasslands, shrublands, and others.⁹¹

A wildlife parcel must be 15 acres or larger and be capable of supporting wildlife species. It must contain less than 10 acres of woodland. It may not contain a dwelling or other building. Alternatively, land located within 100 feet of a stream may be classified as riparian land. There is no minimum size limitation for riparian habitat, but again no building may be within the zone. The land must be conducive to fish and wildlife restoration or enhancement, erosion control, increased bank stability, improved water quality, or increased stream storage capacity.

The procedures for wildlife habitat or riparian lands are similar to the classified forest program, including the survey and fair market value assessment. Landowners must enter into a land management plan and follow minimum standards of good wildlife management practice as prescribed by IDNR (which has not prescribed any). Grazing is prohibited except by temporary permit issued by IDNR. Burning, mowing, or otherwise altering land or vegetation is prohibited except by temporary permit from IDNR. District wildlife biologists inspect the parcel at least once every two years. Landowners file annual reports certifying that the land has not been converted to a different use. Penalties for withdrawing from the program, or failing to comply with the management plan, require payment of 10 years of back taxes and 10 percent interest. Land participating in the program may be reclassified as forest land and vice versa without penalty.

Currently 40,375 acres of land are classified under this act in northern Indiana, and 26,348 acres in south-

ern Indiana. Only 4.5 acres in northern Indiana are classified as purely riparian. Given the 100-foot restriction on riparian classified lands, it is rarely worthwhile to enroll in the program unless a larger contiguous parcel can also be included — in which case the whole parcel is generally enrolled as classified wildlife habitat. Typical management practices include growing native grasses, planting trees and shrubs for food and cover and planting food plots for wildlife.

The program's central weakness is that it does not adequately protect riparian zones. Riparian habitats are among the most important remaining habitats in the state for conservation and restoration — including those in such areas as the Grand Kankakee, Cedar Creek, Fish Creek, Blue River, and other watersheds. A more substantial incentive will be needed if riparian lands are to be managed by landowners in a way that protects biological diversity, because the tax break on a 100-foot zone even over a long linear distance is relatively small. Either a more substantial tax forgiveness or a much wider zone may be needed. At the same time, the 15-acre requirement for wildlife classification may unduly limit participation in this program by smaller landowners; the forest classification program allows enrollment of 10-acre parcels.

The exclusion of wooded land from enrollment as classified wildlife habitat also works against the protection of biological diversity. Rural lots with mixed forest and open land may fall between the programs, being ineligible for either, or larger lots with mixed forest and open space may need to participate in both programs in order to get the full tax benefits. It may be appropriate for the legislature to consider amending the wildlife and forest classification programs to allow enrollment of mixed lands, and to change acreage requirements.

Filter Strips and Windbreaks

Filter strips are also eligible for a \$1 per acre assessment under 1991 legislation.⁹² Lands may qualify as filter strips if they are adjacent to open water, including ditches, creeks, lakes, and wetlands. The parcel must be 20–75 feet wide, but no wider. The strip cannot contain a building or be used for grazing. It must be placed under agreement with the appropriate drainage board along regulated drains, and the county surveyor on unregulated drains, with concurrence of the local soil and water conservation district. The strip must contain vegetation suitable for removing sediment, organic matter and other pollutants from runoff and wastewater. The owner cannot mow a filter strip

before July or engage in any practice that permanently alters land or vegetation. A person may not grow crops on the strip, but may cut grass-legumes for hay up to three times per year. There is no preference for native vegetation or for vegetation that is particularly suitable for maintaining biological diversity of associated bird, amphibian, reptile, fish or other wildlife communities.

Windbreaks may receive the same \$1 per acre tax assessment, subject to similar conditions.⁹³ These are vegetated areas at least 50 feet wide along the fence lines or property lines adjacent to arable land. Windbreaks provide sites for reproduction, food, escape cover, and shelter from severe weather for birds and mammals. In addition, if properly coordinated in a region, windbreaks "can serve as stepping stones for migrating birds or those dispersing between riparian habitats and other wooded tracts." Migratory birds use windbreaks for feeding and resting.⁹⁴

The number of wildlife species in windbreaks is strongly correlated with windbreak area. In sum, "diversity increases as the number of rows increases." Research has also shown that increases in "woody-plant diversity increase the structural complexity of windbreaks," which is good for wildlife.⁹⁵ The most desirable windbreak configuration for wildlife is at least one row of shrubs on each side of internal rows of trees. The second most desirable is a shrub row on the windward side of the rows of trees.⁹⁶ Under Indiana's classified lands program, nothing may be harvested from the windbreak. Participation in this program could be improved if harvesting of Christmas trees or native plants were allowed; these could be harvested for sale under appropriate conditions and replanted without impairing the function of the windbreak.

Tax Programs Generally

Indiana's classified lands programs provide support for companies and individuals that desire to manage their lands for conservation purposes. A more explicit focus on biological diversity, or the restructuring of some of the programs to allow enrollment of wider strips, or mixed forest and open wildlife areas, could benefit the state even more.

Other approaches are worth considering as well. For example, Massachusetts has an agricultural tax relief program; it provides that if an owner enrolled in the program desires to take the land out of agricultural use, the state — or a designated, qualified nonprofit organization — has 120 days to match the sale price. Such an approach, if applied to taxation of particularly

important biologically diverse lands in Indiana might be of great benefit while preserving landowner autonomy. Minnesota exempts undisturbed wetlands and ungrazed native prairie from property taxes if certified by the state. The Indiana Natural Heritage Data Center could provide useful information on habitats and species that could help guide such programs in Indiana.

DIRECT STATE GOVERNMENT ACTIVITIES

The state government itself is a major actor, managing lands and operating programs — such as the Dedicated Nature Preserves and Nongame Wildlife programs — that could conserve or restore biological diversity on public and private lands. The state also undertakes projects that can adversely affect biological diversity. Indiana's Environmental Policy Act, which applies to a broad range of state activities, could be used more effectively to protect biological diversity.

Dedicated Nature Preserves

Under the 1967 Indiana Nature Preserves Act,⁹⁷ the IDNR's Division of Nature Preserves may accept and designate lands as nature preserves. Lands may be acquired by the state or be privately held with a conservation easement conveyed to the state. The private landowner retains the ownership and use of the land, while the holder of the easement has a legal basis to ensure that incompatible uses are not allowed. Master plans are developed for each preserve to maintain and restore the ecological integrity of the site.

Currently, Indiana has 19,000 acres of dedicated nature preserves at 145 sites. Lands dedicated to nature preserves are protected permanently. Land may be removed from protected status only if there is an "unavoidable necessity" and only if approved by the Governor and IDNR after a public hearing. No Indiana lands have been removed from nature preserve status.

The nature preserve program creates a wonderful opportunity for protection of core areas of unusual significance. It will be used, for example, to protect some of the biological resources of Fort Benjamin Harrison, in northeastern Marion County, which is scheduled to close in 1997. Much of the 2,500 acre site is undeveloped and contains high quality floodplain forestland along Fall Creek, and upland forest communities. The 1,100 acre woodland within the fort is the largest remaining contiguous forest in central Indiana with a substantial diversity of birds, including the rare black-throated green warbler.⁹⁸ The re-use plan for the facility

calls for a 1,700 acre state park at the site with three nature preserves protecting the majority of the undisturbed land. The legislature appropriated three million dollars in the 1995 budget to implement the plan.⁹⁹

The Division of Nature Preserves also takes into account the need for plant and insect species protection, which are not specifically protected under Indiana law. There is a gap in Indiana law on this issue.

Nongame Wildlife Program

In 1973, Indiana enacted a law to protect nongame and endangered species (not including plants and insects).¹⁰⁰ "Nongame species" means "any wild mammal, bird, amphibian, reptile, fish, mollusk, crustacean or other wild animal not otherwise legally classified by statute or regulation of the state."¹⁰¹ The nongame law provides ample authority for Indiana to conserve and restore these species through three key provisions:

- (a) The director [of IDNR] shall establish such programs, including acquisition of land or aquatic habitat, as are deemed necessary for the management of nongame species. The director shall utilize all authority vested in the department to carry out the purposes of this section.
- (b) In carrying out programs authorized by this section, the director may enter into agreements with federal agencies, political subdivisions of the state, or with private persons for administration and management of any area established under this section or utilized for management of nongame species.
- (c) The governor shall review other programs administered by him and, to the extent practicable, utilize such programs in furtherance of the purposes of this chapter. The governor shall also encourage other state and federal agencies to utilize their authorities in furtherance of the purposes of this chapter.¹⁰²

These authorities allow biological diversity conservation and restoration to involve many departments of government, local government, and public-private cooperation.

The provision directing the governor to review other programs and, to the extent practicable, utilize such programs in furtherance of the purposes of nongame species presents the broadest possible mandate for biological diversity conservation. This

authority could be used to require virtually every state-supported activity to take biological resources into account. The governor's "review" of state programs has never taken place, but could serve as the basis for a comprehensive effort to protect biological diversity.

A modest example of the usefulness of this provision is INDOT's recent experience in building a road through a karst region of Indiana, an activity potentially detrimental to the species that inhabit the caves. A group of citizens threatened to bring suit charging a violation of the state nongame act.¹⁰³ INDOT then established best management practices to control erosion and to avoid sinkholes (and if avoidance were not possible, to install filter systems around them). INDOT was thus encouraged by this little-used authority in Indiana law to protect key species in this region. As noted above, INDOT entered into an MOU with other agencies regarding future activities in karst areas.¹⁰⁴

Management of species under the nongame law means the collection and use of biological information to increase and maintain species populations at the optimum carrying capacity of their habitats.

Management activities include research, law enforcement, habitat acquisition and improvement, education, and the periodic or total protection of species or populations, as well as the regulated taking of species.¹⁰⁵ Surveys of nongame species also provide information for the Division of Nature Preserves' Natural Heritage Data Center.

Funding for nongame management activities comes from voluntary state income tax check-offs, private donations, and corporate donations. The nongame fund is used to purchase habitat, for cost-share projects with private landowners, and to support field studies and restoration activities. To date, about 500 acres of private land have been purchased for habitat preservation.

The tax check-off started in 1982, and has generated between \$360,000 and \$400,000 each year. For the 1993 tax year, fewer than 3 percent of Indiana taxpayers supported the program, with a check-off totalling \$374,000. Direct donations are minimal; for a recent falcon restoration project, private donations totaled between \$10,000 and \$15,000. Indiana has recently launched a river otter reintroduction project that will need additional donations. River otters were extirpated from the state by 1942. Twenty-five otters were released at Muscatatuck National Wildlife Refuge in Jackson County in January 1995.¹⁰⁶

Funding for nongame species is limited in part by a statutory provision that states that the costs of the program, including the habitat purchases, surveys,



PHOTO: INDIANA DEPARTMENT OF NATURAL RESOURCES

Twenty-five northern river otters were reintroduced at the Muscatatuck National Wildlife Refuge in Seymour, Indiana in January, 1995. An additional 325 otters are scheduled to be released between 1995 and 1999. The river otter is on the state list of endangered species.

studies, and restoration, shall not be borne by funds dedicated to fish and game purposes.¹⁰⁷ By segregating hunting and fishing funds, this law unnecessarily distinguishes parts of the biological community which are interdependent in the field. Game species may feed on nongame species, or vice versa, and both may contribute to ecological resilience of an area or stream segment. Although funding is not shared between nongame and game management programs, there are some opportunities where the two can work together. For example, land purchased for nongame species conservation may require management of game species, allowing some use of game management funds. More opportunities for this kind of cooperation must be found, or the walls between game and nongame funding should be eliminated by the legislature.

Land Acquisition and Information

Hoosiers have actively supported the Indiana Heritage Trust Program, which provides funding for a wide range of conservation activities important to the state's biological diversity, including nature preserves.¹⁰⁸ Approved in 1992, the program has raised \$3 million for conservation by selling automobile license plates.¹⁰⁹ Over 90,000 plates were sold through the end of 1994.¹¹⁰ Half of the funds go to IDNR for land acquisition, while the other half goes to a discretionary fund for acquisition that must be matched on a 3-1 ratio by non-state money. In addition, the legislature appropriated \$5 million to the program in the 1995 budget. The program is intended to "acquire real property for new and existing state parks, state forests, nature preserves, fish and wildlife areas, wetlands, trails, and river corridors. The program will insure that Indiana's rich natural heritage is preserved or enhanced for succeeding generations."¹¹¹ It is intended to acquire at least 150,000 acres of land in Indiana.¹¹² Biological diversity would benefit from a science-based plan to guide the program's acquisition priorities.

The Natural Heritage Protection Campaign is a \$10 million public/private program used for acquisition (80 percent) and stewardship (20 percent) of Indiana natural areas since 1984.¹¹³ Lands acquired must be dedicated as State Nature Preserves. More than half of the current Nature Preserves owned by IDNR are a result of this program.

IDNR's Division of Fish & Wildlife operates a Wildlife Habitat Trust Areas program, which allows landowners, conservation organizations, and local governmental units to donate habitat lands to IDNR for habitat conservation. Several hundred acres have been acquired in this manner. Donations to the program may also be made by will.

State activities provide essential biological information to assist in conservation and restoration activities by both private and public organizations. The Indiana Natural Heritage Data Center was established cooperatively by the Indiana Chapter of The Nature Conservancy and IDNR in 1978 and is now administered by the Division of Nature Preserves. It collects and provides valuable information on the distribution and location of outstanding natural communities, endangered and threatened plants and animals, and other features important to Indiana's biological diversity. The Indiana Natural Heritage Data Center provides the scientific and geographical

understanding that enables conservation efforts to go forward in a logical, cost-effective manner.

Natural Resource Damage Projects

Indiana law provides for the payment of damages by any person who “discharges, sprays or releases any waste materials, chemicals or other substances, either accidentally, negligently or willfully...so that wild animals are killed as a result thereof...” whether or not there is a permit or license for the discharge. The proceeds must be used by the IDNR to “replace the population or habitat in the water or lands in question.”¹¹⁴ Several other laws, including federal law, make the state the trustee of natural resources so that damage payments can be used for ecological restoration.¹¹⁵ These laws provide a potential source of conservation lands and management funds.

For example, Indiana recently obtained 258 acres along the Calumet River as a nature preserve as part of the settlement of a federal natural resource damages claim for two Superfund sites. The area obtained by the state, along with an adjacent nature preserve, contains “the greatest number of rare plants per acre in Indiana.”¹¹⁶ After cleanup activities and some wetland restoration, the site will be preserved as a key biological resource in a region which has been heavily stressed by human activities.

Indiana Environmental Policy Act

In 1972, Indiana enacted its Environmental Policy Act (IEPA),¹¹⁷ modeled after the federal National Environmental Policy Act (NEPA). IEPA provides that “...it is the continuing policy of the state of Indiana, in cooperation with the federal and local governments, and other concerned public and private organizations, to use all practicable means and measures...to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Indiana’s citizens.”¹¹⁸ There are six goals that all state government actions must take care to assure:¹¹⁹

- 1) *responsibility for the future*: “fulfill the responsibilities of each generation as trustee of the environment for succeeding generations”
- 2) *environmental equity*: “assure for all citizens of Indiana safe, healthful, productive and aesthetically and culturally pleasing surroundings”
- 3) *beneficial use*: “attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences”
- 4) *historical, cultural, and biological diversity and individual liberty*: “preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice”
- 5) *widespread prosperity*: “achieve a balance between population and resource use which will permit high standards of living and a wise sharing of life’s amenities”
- 6) *managing for quality and conservation*: “enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.”

These six objectives can be used as a checklist to measure the policy decisions or actions of the state. Indeed, state courts are to “interpret” the laws of Indiana in light of these objectives:

The general assembly authorizes and directs that, to the fullest extent possible the policies, rules, and laws of the state of Indiana shall be interpreted and administered in accordance with the policies set forth in this chapter.¹²⁰

These objectives apply to all state plans, functions, programs and resources. The law gives more specific directions to state agencies.¹²¹ In addition to the policy requirements, the law requires an environmental impact statement to accompany “every recommendation or report on proposals for legislation and other major state actions significantly affecting the quality of the human environment,”¹²² except for issuance of a license or permit.¹²³ The impact statement requirement applies to “any department, board, commission, bureau, or council created by the legislature having state-wide jurisdiction, the operation of which is financed from appropriations of the general assembly. Local government units at the town, city, township, or county level are not included.”¹²⁴

The regulations specify the procedures for impact statements.¹²⁵ A draft impact statement must be circulated for a 30 day comment period and public comments must be summarized and responded to.¹²⁶ After completion, IDEM must review the impact statement and within 60 days either accept it, accept it with recommendations, or reject it.¹²⁷ Perhaps most impor-

tantly, alternatives to any proposed project must be evaluated, and the best alternative must be selected "in accordance with the provisions of [the section which sets out the six substantive goals]." ¹²⁸ IEPA provides a clear guide to state decision-making and an opportunity for public involvement. ¹²⁹

IEPA provides authority for those state agencies without obvious environmental responsibilities to conserve and restore the state's biological diversity. The requirement to select environmentally preferable alternatives, as well as the requirement to maintain an environment that supports diversity, both suggest that all state agencies should integrate biological diversity into their programs, actions, and projects.

INCENTIVE PROGRAMS

Forest Stewardship and Wildlife Cost Share Opportunities

According to IDNR's Division of Forestry, less than 20 percent of Indiana's 3.7 million acres of private forestland is being managed by its owners under forestry management plans. Such plans are important to maintain the health and productivity of forests and to assure that landowner objectives are realized. The Forest Stewardship Program provides a way for landowners to get technical assistance to develop a management plan. State district foresters assist landowners in preparing plans for the management of their woods. This includes assessment of current conditions and recommended improvements. The Stewardship Incentive Program includes cost-shares of up to 60 percent for plan development, tree planting, windbreak establishment, forest improvement, soil and water protection, riparian and wetland restoration and planting, and wildlife habitat enhancements associated with private forest management. Some of the funding supports conversion of agricultural lands to mixed hardwood forests. ¹³⁰

A 1994 survey of Indiana woodland landowners revealed that there is far less participation in state cost-share and related technical assistance programs by individuals not primarily motivated by commercial timbering than by those who are. ¹³¹ Non-participants also tended to own smaller acreages and to have held the land for a longer period of time than participants. They also tended to have fewer years of education and lower income levels than participants. These findings suggest that landowner participation could be increased by targeting the program toward managing lands for wildlife,

recreation, and other purposes conducive to biological diversity, and not just enhancing timber values.

Possible strategies that are more conducive to biological diversity conservation and restoration may include the following approaches: (1) encouraging reforestation with native tree species; regenerating forests may "act as buffers between existing grasslands and mature forests;" (2) planning the location and size of timber harvests so as "to minimize reduction in core area of adjacent mature stands;" (3) maintaining mature forest stands by extending harvesting rotations; and (4) basing land-use decisions on a "regional plan that adequately considers optimal amounts and distributions of [successional] stages from a wildlife-habitat perspective." It may be possible to overcome difficulties in mixed ownership landscapes "by implementing a coordinating council and a program of landowner incentives." ¹³²

Partners for Wildlife, a project of the USFWS, has included bottomland hardwood reforestation since 1992 in cooperation with the IDNR Division of Forestry. The Service provides 100 percent of the cost of establishing the trees, which includes site preparation, nursery stock, planting, and initial weed control. Planting efforts have focused on oaks — which are not self-regenerating well in southern Indiana — and on lightseeded bottomland species such as ash, sycamore, and red maple. The landowner signs a 15-year agreement to maintain the forest. Most sites are on former agricultural land, with areas retired from crop production the year of the tree planting. The program also provides opportunities for private landowners to restore wetlands and prairies. For example, Partners for Wildlife is currently involved in restoring approximately 100 acres of prairie within the Grand Kankakee Marsh Restoration Project.

The IDNR Division of Forestry, Nurseries Section, operates to serve all Indiana landowners who wish to plant trees for conservation purposes. IDNR provides low-cost seedlings for wildlife, timber, erosion and sediment control, wetland enhancement, conservation and education purposes — but not for landscaping or Christmas tree farming. A wide selection of species and sizes of seedlings is available through the state nurseries in Pulaski and Jackson Counties, which will ship anywhere in the state. Costs are quite reasonable. Hardwood seedlings, for example, are approximately \$7.50 per 50; shrubs at \$6.50 per 50; and conifers at \$5.50 per 50.

IDNR's Division of Fish and Wildlife provides cost-share incentives for habitat improvements on pri-

Planning for Bottomland Hardwood Protection

The Wabash Lowlands in southwest Indiana are a rich area of bottomland hardwood forests of great ecological value. This region is a critical part of the great Mississippi Flyway of migratory waterfowl, providing essential breeding and resting grounds. The U.S. Fish & Wildlife Service estimates that at least 70 percent of birds regularly breed in bottomland hardwood forests.

The Nature Conservancy recently purchased 1,400 acres in the Wabash Lowlands, its largest land acquisition in the state to date. The parcel is half agricultural lands and half bottomland hardwood forest. The project plans to connect 12,000 acres of key land already owned by the IDNR, the U.S. Army Corps of Engineers, Ducks Unlimited, and Waterfowl USA.

In 1992, the Fish & Wildlife Service developed a partnership with the Indiana Department of Natural Resources (IDNR), to restore bottomland

hardwood forests by providing financial assistance to Indiana landowners in the Wabash Lowlands to reforest cleared areas and to manage their forest land for both habitat and future timber values. The program has received a grant from the U.S. Environmental Protection Agency to restore bottomland hardwood forests along the lower Wabash River corridor. This project is an excellent example of how coordination of protected areas can successfully protect large tracts of critical habitat, and how protection can occur simultaneously with forest management for habitat and timber.

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U.S. Fish & Wildlife Service (FWS). Restoration of Bottomland Hardwood Forests in Indiana through the Partners for Wildlife Program of the U.S. Fish & Wildlife Service.

vate lands. Under this program, established in 1980, applicants with 10 or more acres of land may receive up to 90 percent of the cost of habitat improvements, with a maximum payment of \$1,000.¹³³ Technical assistance from the district wildlife biologist is also provided. This program provides an excellent opportunity for private landowners to conserve biological diversity on their own lands.

Agriculture and Wetland Cost Share Opportunities

While agriculture and biological diversity can be mutually beneficial, large agricultural fields often provide poor habitat for many wildlife species, which need cover and protection from predators. Misuse or overuse of pesticides and herbicides can also be harmful to wildlife populations, and native plants can be squeezed out by agricultural cultivation from fence-row to fence-row. Soil loss can also be a problem not only for farmers but also for biological communities — by adding sediment to streams, erosion impairs water-dependent species such as fish, mussels, and invertebrates, as well as the birds and other wildlife that feed upon them.

There are a number of incentive and cost-share programs that can support private efforts to conserve biological diversity. State efforts to promote these programs could produce significant economic as well as ecological benefits to landowners. IDNR's Division of Soil Conservation enters into cost share agreements — 70-80 percent of costs of conservation tillage, conservation farming practices, filter strips, and buffer strips. The Division also administers the T-by-2000 program that provides technical, educational and financial help to solve erosion-related problems that occur on the land and in public waters. Local soil and water conservation districts work individually with landowners with the aim of achieving tolerable ("T") erosion rates by the year 2000.¹³⁴ Other authorities also provide cost shares. The Maumee River Basin Commission has made funding available for filter strips along Fish Creek and tributary ditches, for example, paying 1 cent per square foot. Maintenance is required for a minimum of 5 years.

State efforts are complemented by federal incentives. The federal Conservation Reserve Program (CRP) retires highly erodible lands, paying farmers under contracts to implement conservation practices on their fields. In Indiana over 490,000 acres are enrolled in

CRP, under more than 12,000 contracts. A variety of conservation uses are recognized, including many beneficial to wildlife such as grasslands and forestry. About 17,000 of the Indiana CRP acres have been planted with trees.¹³⁵ Preliminary results from a multi-year study in this region of the country show that grassland birds have had more nests and greater nesting success in fields enrolled in CRP than in comparable row-crop fields. In Indiana, the CRP fields had 20 times more nests than the row-crop fields, and 29 percent of the CRP nests fledged successfully, compared with 0 percent for the row-crop fields.¹³⁶ This suggests a substantial benefit from this program.

The federal Wetland Reserve Program (WRP) was first opened to Indiana farmers in 1994 (one of 20 states eligible), and from this initial round, approximately 2,000 wetland acres are being enrolled in nine northern and eight southern Indiana counties. Partners for Wildlife, administered by USFWS, has also helped Indiana landowners. This program has helped restore over 700 wetland areas in Indiana, totalling more than 3,500 acres, by providing financial and technical assistance. The North American Waterfowl Management Plan has also provided matching funds for important regional conservation efforts, such as the restoration of the Grand Kankakee Marsh.

Incentive programs of various kinds can provide an important push toward biological diversity conservation and restoration. Hoosiers' natural affinity for — and support of — the environment can be encouraged by the provision of timely and supplementary financial assistance and technical advice.

VOLUNTARY EFFORTS

Voluntary conservation is the hallmark of a society that cares about biological diversity. Indiana includes many examples of voluntary efforts, including efforts by corporations, non-profit organizations, and individuals.

In the corporate sector, the Wildlife Habitat Council, a national non-profit organization, has established a Wildlife Habitat Certification Program designed to recognize corporations that voluntarily engage in active management for wildlife or offer environmental education programs. Facilities must go through a certification process that includes completion of a wildlife management plan. Eligible corporate programs include enhancement, creation, restoration and protection of habitat, and individual species management. The application must include a species inventory, monitoring and

maintenance documentation, and a program description, among other requirements. Two facilities in Indiana have received Wildlife Habitat Certification — U.S. Steel's Gary Works and the Vulcan Materials Company. The Gary Works, a 4,000-acre industrial complex that has been producing steel since 1909, borders the southern shore of Lake Michigan and is adjacent to the Indiana Dunes National Park. In cooperation with the National Park Service, Indiana Department of Natural Resources, University of Minnesota Raptor Center, Save the Dunes Council, and The Nature Conservancy, U.S. Steel has provided three nesting boxes for a pair of peregrine falcons who fledged three young in 1994, totalling nine fledglings since 1989. In addition, the sand dunes, oak savanna, ponds, and wildlife cover on the property provide habitat to Blanding's turtle, which is in danger of eradication from its Indiana range, as well as support wild blue lupine, a plant species critical for the support of the endangered Karner's blue butterfly.¹³⁷

The Vulcan Materials Company's South Bend Sand and Gravel Quarry has dedicated approximately 185 acres of its 345 acre site for wildlife enhancement. A nest box program for bluebirds and wrens was initiated in 1993 along with other enhancement programs. The facility has a tree planting effort in conjunction with local boy scout troops to increase food production for wildlife and songbirds. In addition, quarry areas are being reclaimed with a mixture of prairie species to reestablish native vegetation.

Other companies are engaged in conservation efforts. For example, the Northern Indiana Public Service Company (NIPSCO) is involved in several natural resource projects throughout the state. NIPSCO owns and manages a large amount of property along its transmission lines. In areas where NIPSCO's rights-of-way abut nature preserves, NIPSCO has allowed the IDNR and The Nature Conservancy to manage the rights-of-way. Management practices in the areas include controlled burning adjacent to the Indiana Dunes National Lakeshore. In 1994, NIPSCO enrolled 5 of its properties in the Indiana Classified Wildlife Habitat Area Program. These properties total 304 acres. NIPSCO is one of the 14 founding partners of the Indiana Grand Kankakee Marsh Restoration Project. The company contributed approximately 850 acres in Jasper County in support of the Project's goal of restoring and enhancing 4,400 acres of wetlands in the Kankakee River Basin. In addition, NIPSCO donated 1.5 acres of shoreline along Wolf Lake to the Hammond Parks Department where the Natural

Resources Conservation Service constructed an artificial wetland. The wetlands will serve as a stormwater demonstration project to treat highway runoff that would otherwise enter Wolf Lake directly.

Associations also contribute to the effort. The Woodland Steward Institute, for example, is a group comprised of 11 organizations including woodland owners, forest products organizations, state agencies and others. The participants are working to develop voluntary best management practices to afford broad, watershed-type protection for forest land or land that could be forest land (i.e. reforestation of riparian land). The practices are intended to protect the health of the forest and adjacent waters by focusing on aesthetics, management, wildlife, and biological diversity.

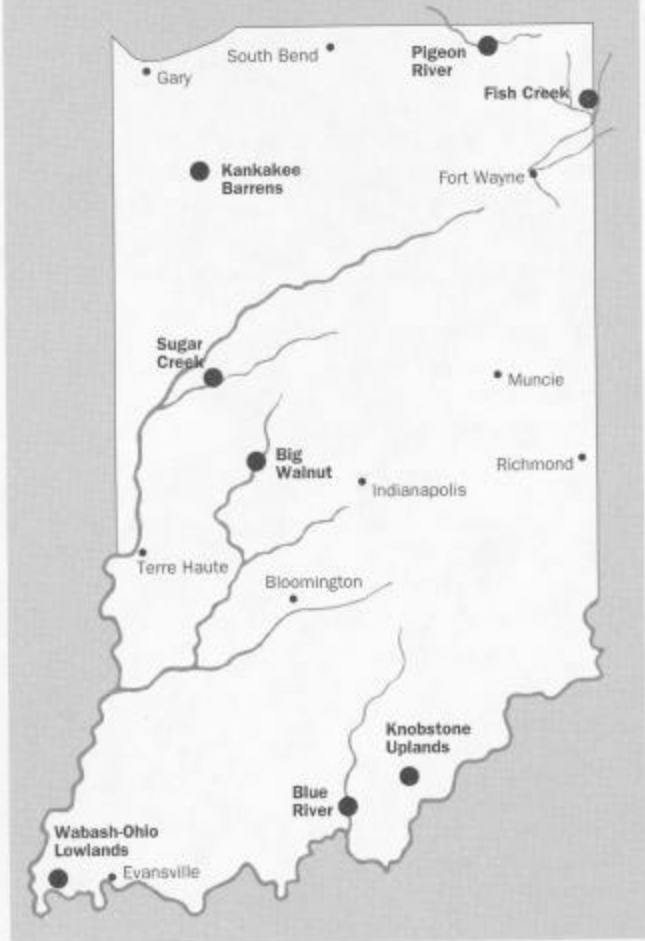
Organizations such as Waterfowl USA's Northwest Indiana Chapter have raised funds and engaged in active restoration efforts to benefit waterfowl. This organization, for example, has raised thousands of dollars for wetland restoration in the Grand Kankakee Marsh. In 1992, it bought a 78 acre drained farm and restored its wetlands, operating it as the Jerry Allen Waterfowl Management Unit. Efforts of this kind have been greatly encouraged by the North American Waterfowl Management Plan.

The Nature Conservancy's (TNC's) program, *Hoosier Landscapes — Saving Our Last Great Places*, is raising \$7 million in private funds to protect eight natural ecological systems in Indiana. The program will leverage additional public resources, generate new conservation partnerships and build upon the existing resources of TNC's Indiana Chapter. The eight natural systems were targeted for protection using information from the Indiana Natural Heritage Data Center. They include Fish Creek, Sugar Creek, the Blue River, the Pigeon River, the Big Walnut, the Wabash-Ohio Lowlands, the Kankakee Barrens, and the Knobstone Uplands. TNC intends these reserves to be an integrated system of larger reserves, necessary to protect plants and animals at genetic, species, and ecosystem levels. The reserves are also places where economic and human activities co-exist with natural systems. TNC reserves offer another excellent example of a consortium of concerned citizens, agencies, and private interests coordinating conservation efforts to protect biological diversity.

In Indiana, TNC also operates a Natural Areas Registry to recognize private owners of outstanding natural areas for their commitment to the survival of the land's natural heritage. The voluntary program is designed to make public and private land owners

The Nature Conservancy's Hoosier Landscapes

The eight natural systems targeted for protection under TNC's *Saving Our Last Great Places* project.



THE NATURE CONSERVANCY, INDIANA FIELD OFFICE

throughout the state aware of the natural features on their land, and to recognize those owners for their voluntary protection efforts. In order to qualify for the registry, the property must contain one or more of these natural values:

- habitat for plants or animals with declining populations;
- plant communities characteristic of the native vegetation;

- outstanding natural features such as virgin forests or bogs.

In joining the registry, owners voluntarily commit to preserving and protecting the area to the best of their abilities, to notify TNC of any threats to the area, such as pollution, rights-of-way, or drainage, and to notify TNC of any intent to sell or transfer ownership of the property. TNC will ask permission to visit the registered area yearly to determine whether the condition over the last year has changed and to help determine whether any new threats have arisen. This voluntary program combines landowner stewardship with expert free advice. Approximately 400 sites of exceptional biological diversity significance are enrolled in the registry program.

Institutional landowners can undertake biological diversity efforts as well. For example, Koinonia Environmental Center is a 100 acre center operated by Manchester College in Kosciusko County with a wetland restoration project, hardwood and pine forest areas, and an arboretum and prairie area under development.

There are many individual biological diversity conservation efforts in Indiana. Some have achieved national recognition. For example, family farmer Ray McCormick won the 1992 National Wetlands Award for wetland restoration efforts on his Knox County farm. He restored over 130 acres of wetlands and

floods hundreds of acres of cropland each fall for migratory birds. He constructed goose nesting structures, and maintains nesting cover around water edges, delays mowing on upland areas to reduce nest destruction, plants upland food plots, and utilizes minimum tillage practices. This farm was also selected "Special Honor" winner over 174 other national nominees in the Farming in the Flyway contest sponsored by *Successful Farming* magazine.

Some voluntary efforts had governmental assistance in getting started. For example, IDNR organized the Rivers Advisory Group in 1992, which in turn created Hoosier Riverkeepers and Riverwatch programs — voluntary efforts to focus on river conservation. IDNR provides technical assistance to these groups. Hoosier Riverkeepers encourages local community groups to "adopt" stream segments and maintain their ecological integrity. In 1995, it published *Organizing a Cleanup: A River Stewardship Manual*, to guide Indiana communities in grassroots activities to restore Indiana rivers and streams. Riverwatch is a water quality monitoring initiative. It involves local organizations in monitoring water quality and provides training and assistance.

Voluntarily taking responsibility for our environment and the variety of life within it is the best gift we can give our children. Many Hoosiers are actively involved in these efforts. The next chapter highlights a number of major efforts in greater depth.

NOTES

¹ Cooperative Extension Service. *Answers to Your Questions About Planning and Zoning in Indiana*. EC-208. West Lafayette, IN: Purdue University.

² Indiana Code (IC) 36-7-1 et seq.

³ IC 36-7-7-2.

⁴ IC 36-7-4-601(d).

⁵ IC 36-7-4-601(a). *Pro-Eco v. Board of Commissioners of Jay County*, 956 F. 2d 635 (7th Cir. 1992).

⁶ IC 36-7-4-501. The term "general welfare" includes protection of the environment.

⁷ IC 36-7-4-502.

⁸ IC 36-7-4-503(2) (H), (M), (P), (Q), (R).

⁹ 590 N.E. 2d 1059 (Ind. 1992).

¹⁰ In 1992, Congress enacted the Indiana Dunes National Lakeshore Expansion Act, adding 1,154 acres to the lakeshore, bringing the total to 14,960 acres. Areas added included the Hobart Prairie Grove, Calumet Prairie, Woodlake Dune, Fadell Dune, and land in the SR 49 entrance corridor.

¹¹ IC 14-28-3 and 14-28-4 are supplemental to IC 14-28-1, Indiana's Flood Control Act, discussed below. Promotion of general welfare and other purposes are in IC 14-28-4-3.

¹² IC 14-28-4-15(a). IDNR approval for flood plain commission ordinances is required by IC 14-28-4-20.

¹³ IC 14-29-6.

¹⁴ IC 14-29-6-12.

¹⁵ IC 14-29-6-12.

¹⁶ IC 14-29-7-3. In Indiana there are also river commissions for some rivers not in the system. For example, the Wabash River Parkway Commission is examining recreational and other uses of the Wabash River corridor.

¹⁷ IC 14-29-7-4.

¹⁸ IC-14-29-7-16.

¹⁹ IC 14-29-7-18.

²⁰ IC 14-29-6-10.

²¹ IC 14-29-6-11.

²² Pub. L. 102-240, 105 Stat. 1914 (1991).

²³ 49 U.S.C. §303(c).

²⁴ *Memorandum of Understanding...to facilitate state and federal permitting requirements in the determination of the*

type and level of wetlands mitigation required. January 28, 1991. Indiana Department of Transportation, the Indiana Department of Natural Resources, and the U.S. Fish & Wildlife Service.

²⁵ *Memorandum of Understanding...regarding forest tree planting and management on highways*. August 5, 1992. Indiana Department of Transportation and Indiana Department of Natural Resources.

²⁶ IC 8-23-24-1 to -3 (enacted 1991, effective July 1, 1992).

²⁷ Zay, Dan. 1995. Personal communication. J.F. New & Associates.

Bickle, Don. 1995. Personal communication. INDOT, Crawfordsville District.

²⁸ Bickle, Don. 1995. Personal communication. INDOT, Crawfordsville District.

²⁹ Harrington, John A. Summer 1994. "Roadside Landscapes: Prairie Species Take Hold in Midwest Rights-of-Way." *Restoration and Management Notes*. 12(1): 9.

³⁰ Harrington, John A. Summer 1994. "Roadside Landscapes: Prairie Species Take Hold in Midwest Rights-of-Way." *Restoration and Management Notes*. 12(1): 8.

³¹ Egan, Dave. Summer 1995. "Growing Green." *Restoration and Management Notes*. 12(1): 26.

³² "Prairie Aesthetics at Home on the Range." September 1994. *Environmental Business Journal*: 2.

³³ 1978 Census of Agriculture. Drainage Tables.

³⁴ Homoya, Michael A., D. Brian Abrell, James R. Aldrich, and Thomas W. Post. 1985. "The Natural Regions of Indiana." *Indiana Academy of Sciences*. 94: 252.

³⁵ IC 36-9-27, which pertains to regulated drains.

³⁶ IC 36-9-27-4.

³⁷ IC 36-9-27-2. Private and mutual drains are exempt (IC 36-9-27-16).

³⁸ Indiana Association of County Surveyors data.

³⁹ *Drainage Maintenance & Repair District*: Where a public ditch or drain has been or shall be constructed, 20% of the owners of the real estate assessed, who would benefit by the construction of the ditch or drain may petition for the establishment of a drainage maintenance and repair district (IC 14-27-8-1). The board of commissioners of the county where the ditch or drain is located shall appoint 3 landowners as drainage commissioners to take charge of the maintenance and repair of the ditch or drain (IC 14-27-8-10). If the district is composed of lands from more than one county, the board of commissioners of each of the counties may participate in the selection of the drainage commissioners (IC 14-27-8-11). *Conservancy Districts*. Special districts may be created for flood control and other projects that involve drainage. IC-14-33-1-1.

⁴⁰ IC 36-9-27-49(a) & 36-9-27-61(5).

⁴¹ IC 36-9-27-61(5).

⁴² IC 14-26-5.

⁴³ IC 14-28-1.

⁴⁴ Clean Water Act § 401, 33 U.S.C. § 1341.

⁴⁵ IC 14-26-5.

⁴⁶ IC 14-26-5.

⁴⁷ IC 14-26-5-7.4 (SB 368, enacted in 1995).

⁴⁸ The "floodway" includes the channel and the portions of the flood plain that are reasonably required to carry the peak

flow of the 100-year-frequency flood. 310 Indiana Administrative Code (IAC) 6-1-3(15).

⁴⁹ IC 14-28-1-22(b)(1). However, Natural Resources Commn v. Porter County Drainage Board, 576 N.E. 2d 587 (Ind. 1991) held that a permit was required where the 8.5-mile regulated drain was an integral part of a 24.5 mile creek.

A permit is not required for the production of crops, or for pasture, forests and park and recreational uses provided they do not involve any structure, obstruction, deposit or excavations. 310 IAC 6-1-9. There are other exceptions relating to the construction or reconstruction of bridges, surface coal mining operations, certain utility crossings, and activities determined by IDNR to pose minimal threat to the floodway. IC 14-28-1-22.

⁵⁰ If a permit is denied, formal review is under the Orders and Procedures Act. IC 4-21.5.

⁵¹ IC 14-28-1-22; see Indiana Department of Natural Resources v. United Refuse Co., Inc., 598 N.E. 2d 603 (Ind. Ct. App. 1992).

⁵² 310 IAC 6-1-3(24).

⁵³ IC 14-28-1-20, 14-28-1-22.

⁵⁴ 310 IAC 6-1-3(7).

⁵⁵ IC 36-9-27-53.5, effective July 1, 1995.

⁵⁶ IC 36-9-27-33(a).

⁵⁷ IC 36-9-27-33(b).

⁵⁸ IC 39-9-27-33(d).

⁵⁹ U.S. Fish & Wildlife Service. 1994. *Final Environmental Impact Statement: Patoka River National Wetlands Project*: 554.

⁶⁰ "Forestry Practices and Water Quality." June 1977. *Purdue University Cooperative Extension Bulletin*: 148.

⁶¹ A Drainage Board Task Force was previously appointed per Senate Concurrent Resolution 38 (1994). Its *Final Report* (Oct. 3, 1994) made 8 recommendations: 1. MOA between county drainage boards/surveyors, IDEM, IDNR, USFWS, and COE to clarify permit decision-making. 2. Permitting agencies to consider projects on their own merits and compare impacts of project vs. impacts of no project; and evaluate both positive and negative cumulative impacts within a watershed. 3. Develop a technical and administrative manual specifying BMPs that are protective of the environment and clarifying process ("The selection of BMPs should consider not only their short term on-site effects, but their off-site, cumulative, and downstream impacts as well.") 4. Allow 2-phase permitting of projects — formal permitting of construction through completion of construction and establishment of permanent vegetative cover; and simple maintenance under control of the permittee, not subject to further permitting and review. 5. Regulatory agencies to work with county drainage boards/surveyors to devise a regulated drain classification system (pre-identify environmental impacts, and ways to reduce regulatory oversight on less significant classes of drains). 6. If drainage work includes environmental remediation that is an "enhancement" from original conditions, then provide for costs to be borne for environmentally-benefited public at large and not just assessed landowners. 7. Provide training on wetland delineation. 8. Federal and state agencies should develop a

consistent policy for wetland mitigation with respect to drainage maintenance and reconstruction activities.

The 1995 legislature passed SB 303, which established a legislative study committee and a work group to produce a technical and administrative handbook for drainage projects, primarily responding to the prior task force's third recommendation.

⁶² IC 13-1-3-8; regulatory authority is provided in IC 13-1-3-7.

⁶³ Federal water pollution law also contains similar authority. Fischman, Robert. 1992. "Biological Diversity and Environmental Protection: Authorities to Reduce Risk." *Environmental Law*. 22: 435.

⁶⁴ The prohibition does not apply to persons using chemicals in a normal manner in the production of agricultural products, or to persons acting in accordance with discharge permits issued by IDEM or IDNR (but not including floodway and lake preservation permits). IC 14-28-1-27.

⁶⁵ IC 14-26-2-6. The construction, reconstruction, or repair of ditches and dams which will affect or likely result in a lowering of the water level 10 acres or more is flatly prohibited. IC 14-26-2-7. Permanent structures are covered by 310 IAC 6-2-15(a). Examples of permanent structures include any structure in or over a public freshwater lake which uses poured concrete, steel sheet piling, timber piling, or a similar material for support (310 IAC 6-2-15(b)).

⁶⁶ 310 IAC 6-2-15(g).

⁶⁷ 310 IAC 6-2-7.

⁶⁸ 327 IAC 15-5.

⁶⁹ 310 IAC 6-1-15(c).

⁷⁰ See IC 14-34; 30 U.S.C. § 1201 et seq.

⁷¹ See 30 CFR 816.97.

⁷² McComb, William C., Kevin McGarigal, James D. Fraser, and Wayne H. Davis. 1991. "Planning for Basin-level Cumulative Effects in the Appalachian Coal Field." *Wildlife and Habitats in Managed Landscapes*. Eds. Jon E. Rodiek and Eric G. Bolen. Washington, D.C.: Island Press.

⁷³ McComb, William C., Kevin McGarigal, James D. Fraser, and Wayne H. Davis. 1991. "Planning for Basin-level Cumulative Effects in the Appalachian Coal Field." *Wildlife and Habitats in Managed Landscapes*. Eds. Jon E. Rodiek and Eric G. Bolen. Washington, D.C.: Island Press.

⁷⁴ State Nonpoint Source Task Force. 1989. *Indiana Non-point Source Water Pollution Management Program*: 34.

⁷⁵ Evaporation pits for produced waters are prohibited. 310 IAC 7-1-38.

⁷⁶ IC 13-8-10.

⁷⁷ 310 IAC 7-1-40.

⁷⁸ PL. 120-1993, §8, amending IC 13-8-4-6 "Preventative Regulations" (now IC 14-37-3-5).

⁷⁹ Historically, however, permit requirements allow the IDNR to modify a permit for a well where "The department has received information that the cumulative effects on the environment resulting from the permitted well are unacceptable." 310 IAC 7-1-44(3).

⁸⁰ IC 14-37-10.

⁸¹ IC 14-37-10-5.

⁸² 50 IAC 2.2-5.

⁸³ 40 acres x \$495 x 1.0 x 1/3 x .08 = \$530.

⁸⁴ 40 acres x \$495 x 1.0 - 80% x 1/3 x .08 = \$105.

⁸⁵ 40 acres x \$495 x 0.5 - 40% x 1/3 x .08 = \$105.

⁸⁶ IC 6-1.1-6-1 to -27.

⁸⁷ IC 14-36-1-36.

⁸⁸ IC 6-1.1-6-16.

⁸⁹ 310 IAC 22-3.

⁹⁰ Hoover, William L. and W. L. Mills, Jr. 1995. *Indiana's Non-Industrial Private Forest Landowners*. West Lafayette, IN: Purdue University.

⁹¹ IC 6-1.1-6.7-1 to -25.

⁹² IC 6-1.1-6.7-1 to -25.

⁹³ IC 6-1.1-6.2-1 to -27.

⁹⁴ Cable, Ted T. 1991. "Windbreaks, Wildlife, and Hunters." *Wildlife and Habitats in Managed Landscapes*. Eds. Jon E. Rodiek and Eric G. Bolen. Washington, D.C.: Island Press.

⁹⁵ Cable, Ted T. 1991. "Windbreaks, Wildlife, and Hunters." *Wildlife and Habitats in Managed Landscapes*. Eds. Jon E. Rodiek and Eric G. Bolen. Washington, D.C.: Island Press. 44.

⁹⁶ Schroeder, R.L. 1986. "Habitat Suitability Index models: wildlife species richness in shelterbelts." *U.S. Fish & Wildlife Service Biological Reports*. Washington, D.C.: U.S. Fish & Wildlife Service. 82(1).

⁹⁷ IC 14-31-1-1 to -18.

⁹⁸ Hedge, Cloyce, et al. 1992. "A Survey of Fort Benjamin Harrison, Indianapolis, IN for Special Plant Species and Natural Areas." Indiana Department of Natural Resources, Division of Nature Preserves.

⁹⁹ Maloney, Tim. August 23, 1995. Correspondence. Hoosier Environmental Council.

¹⁰⁰ IC 14-22-34.

¹⁰¹ IC 14-22-34-4.

¹⁰² IC 14-22-34-14.

¹⁰³ The suit was threatened under the Indiana Environmental Protection Act, IC 13-6, which provides for citizen challenges to certain actions that impair the environment. See generally, Rhoades, Mary Jane. 1987. "The Indiana Environmental Protection Act: An Environmentalist's Weapon in Need of Repair." *Valparaiso University Law Review*. 22: 149-189.

¹⁰⁴ *Memorandum of Understanding...for the purpose of delineating guidelines for construction of transportation projects in karst regions of the state*. October 13, 1993. Indiana Department of Transportation, Indiana Department of Natural Resources, Indiana Department of Environmental Management, and the U.S. Fish & Wildlife Service.

¹⁰⁵ IC 14-22-34-3.

¹⁰⁶ Johnson, Scott. May-June 1995. "Otterly fantastic." *Outdoor Indiana*: 24-31.

¹⁰⁷ IC 14-22-34-19.

¹⁰⁸ IC 14-12-2.

¹⁰⁹ IC 9-18-29-1 to -5.

¹¹⁰ Morgan, Ginger. January-February 1995. "Dennis McGrath: A Matter of Trust." *Outdoor Indiana*: 11.

¹¹¹ IC 14-12-2-1.

¹¹² U.S. Fish & Wildlife Service. 1994. *Final Environmen-*

tal Impact Statement: Patoka River National Wetlands Project: 48.

¹¹³ IC 14-31-2-1 to -17.

¹¹⁴ IC 14-22-10-8.

¹¹⁵ 42 U.S.C. § 9607(f) (natural resource damages under the Comprehensive Environmental Response, Compensation, and Liability Act); 33 U.S.C. § 2706 (natural resource damages under the Oil Pollution Act).

¹¹⁶ Indiana Department of Natural Resources. *Clarke & Pine East Nature Preserve Management Plan, Gary, IN*.

¹¹⁷ IC 13-1-10-1 to -8.

¹¹⁸ IC 13-1-10-2(a).

¹¹⁹ IC 13-1-10-2(b).

¹²⁰ IC 13-1-10-3(1).

¹²¹ IC 13-1-10-3(2).

¹²² IC 13-1-10-3(2)(C).

¹²³ IC-13-1-10-6.

¹²⁴ Ind. Admin. Code tit. 326, r. 16-2-2; tit. 327, r. 11-2-2, tit. 329, r. 5-2-2.

¹²⁵ The regulations are at 326, r. 16-1-1 to -2-3; 327, r. 11-1-1 to -2-3; and 329, r. 5-1-1 to -2-3.

¹²⁶ "The draft statement shall be circulated to local, state, and federal agencies and to the general public deemed by the agency to have an interest in the proposed action for comment in accordance with agency procedures. At least thirty (30) days shall be allowed for submission of comments." -2-3(b)(3). Comments must be responded to. -2-3(b)(5).

¹²⁷ -2-3(b)(8).

¹²⁸ -3(b)(6), (7).

¹²⁹ Carmichael, Jeffrey L. 1995. "The Indiana Environmental Policy Act: Casting a New Role for a Forgotten Statute." *Indiana Law Journal*. 70: 613.

¹³⁰ Ernst, Dan. 1995. Personal communication. Indiana Department of Natural Resources, Division of Forestry.

¹³¹ Hoover, William L. and W. L. Mills, Jr. 1995. *Indiana's Non-Industrial Private Forest Landowners*. West Lafayette, IN: Purdue University.

¹³² McComb, William C., Kevin McGarigal, James D. Fraser, and Wayne H. Davis. 1991. "Planning for Basin-level Cumulative Effects in the Appalachian Coal Field." *Wildlife and Habitats in Managed Landscapes*. Eds. Jon E. Rodiek and Eric G. Bolen. Washington, D.C.: Island Press.

¹³³ Indiana Department of Natural Resources. Brochure. *Wildlife Habitat Cost-Share Project*

Indiana Department of Natural Resources. Brochure. *Save Our Small Game*.

¹³⁴ Division of Soil Conservation. Brochure. *DNR Division of Soil Conservation: Who We Are and What We Do*. Indianapolis, IN: Indiana Department of Natural Resources.

¹³⁵ Data provided by the U.S. Department of Agriculture, Consolidated Farm Service Agency. Indianapolis, IN.

¹³⁶ Robel, R.J. April 15, 1994. *Preliminary Report: Grassland Bird Production in Conservation Reserve Program Fields*. NC-203. Manhattan, KS: Kansas State University.

¹³⁷ Gary Works - USX Corporation. August 16, 1994. *Application for Habitat Certification to Wildlife Habitat Enhancement Council*.

Chapter IV



Good News for Conservation in Indiana

Conservation and restoration of Indiana's biological diversity is not just a good idea. It is becoming a reality, thanks to the hard work of many individuals, organizations, government agencies, educational institutions, and private companies. This chapter highlights just a few efforts that offer hope for the Hoosier environment. There are many others.

HOPE FOR WETLANDS: GRAND KANKAKEE MARSH RESTORATION PROJECT

The Grand Kankakee Marsh once covered over 500,000 acres and the Kankakee River extended 75 direct miles, meandering through 2,000 bends on its 240 mile voyage across northwest Indiana. Beginning in the 1850s the Grand Marsh was extensively drained to provide land for agriculture and development. Numerous drainage and channelization projects have reduced the river to one-third of its original length. Drainage of the Grand Kankakee Marsh accounts for over 10 percent of the 4.85 million acres of wetlands lost in the state of Indiana.¹

Drainage and channelization of the Grand Kankakee Marsh have significantly reduced waterfowl habitat and degraded many of the remaining wetlands. These activities have created a system that no longer provides the same functions for migrating birds as the historic Grand Marsh once did. The agricultural lands that replaced the natural wetlands have had adverse impacts on the river and wildlife habitat. Erosion and runoff of associated agricultural contaminants degrade wildlife habitat and water quality.

The Grand Kankakee Marsh Restoration Project is a partnership of private organizations and public agencies that have joined together to protect and restore wetlands in the Kankakee River Watershed and to

increase the "production" of waterfowl. Project partners include the IDNR, The Nature Conservancy, Ducks Unlimited, Waterfowl USA, Cedar Lake Fish & Game, Lake County Parks, Lowell Parks Department, the Kankakee River Basin Commission, J.F. New & Associates, Prime Time Cable Ads, Wille & Steiner Real Estate, Snell Environmental, NIPSCO (the state's largest gas and electric utility), and the U.S. Fish & Wildlife Service. In total, the partners have contributed \$2.36 million, in addition to approximately a thousand acres of land, and substantial voluntary services and in-kind contributions. The participants applied for matching funds from the North American Waterfowl Management Plan (NAWMP), which is a joint effort among Canada, Mexico, and the United States designed to "protect, enhance and restore" at least six million acres of critical wetlands habitat in the three nations.

On September 13, 1994, the North American Wetland Conservation Council, the funding body of NAWMP, approved the Project and awarded a grant of \$1.5 million in matching funds to "restore wetlands, purchase easements on restored acreage, purchase key wetland parcels, and manage wetlands." It is estimated that, at a minimum, 60 state endangered, threatened and rare animal and plant species, two federally endangered and threatened species, and four federal candidate species for threatened or endangered status are found within the boundaries of the project.² In addition, at least 100,000 waterfowl, and up to 20,000 greater sandhill cranes, migrate through the region during the spring and fall.³

The NAWMP grant covers the first two years of the project which aims to "protect, restore and enhance 4,400 acres of wetlands in the Kankakee River Basin." The project landowners will retain management of their own lands. The project is part of a 10-year plan to



PHOTO: RICH FIELDS

Approximately 20,000 greater sandhill cranes migrate through Indiana during the spring and fall, stopping over at the Grand Kankakee Marsh and Jasper-Pulaski Fish and Wildlife Area. The birds are listed as a state threatened species.

restore, protect and enhance an additional 26,500 acres of wetlands and uplands in the Kankakee River Basin.

The Grand Kankakee Marsh Restoration Project is an excellent example of private corporations, state and federal agencies, and non-profit conservation organizations voluntarily working in cooperation to protect and restore the valuable biological diversity resources of Indiana's wetlands.

HOPE FOR UNFRAGMENTED HABITAT: JEFFERSON PROVING GROUNDS

Jefferson Proving Grounds (JPG) is a 55,254 acre tract in Jefferson, Ripley, and Jennings Counties in southeast Indiana. JPG was acquired by the Department of the Army in 1940 and has been under the

single ownership of the Department since its establishment.⁴ JPG has been used by the Army since World War II to test military weapons and munitions, such as bombs, artillery, tank weapons, mines, and small arms. The forest terrain characteristic of JPG, once common in southeast Indiana and southwest Ohio, has been largely cleared for agricultural production on other lands. Jefferson Proving Grounds is the largest intact parcel of upland forests remaining in Indiana.⁵

The proving grounds include 12,000 acres of unfragmented forest in the northern end and 6,000 acres of forested and shrub wetlands.⁶ It is estimated that the largest remaining wetland areas in Ripley and Jefferson counties are found in Jefferson Proving Grounds.⁷ There are six major streams of the White River Basin that cross through tract. Because the stream

channels and watersheds have been relatively undisturbed, there are high quality aquatic habitats and fish communities.⁸ The limestone bluffs along two of the major streams support a unique assortment of cliff plant communities.⁹ Seven hundred acres of flat meadows found in the southwest corner of the property support a diverse array of upland and wetland plant species, including a wide variety of orchids.¹⁰

One hundred and three species of birds are known to nest within the Jefferson Proving Grounds.¹¹ Nearly 50 percent of these are neotropical migrant species. The Jefferson Proving Grounds contains "among the highest densities of breeding birds found anywhere in Indiana" because of its large contiguous areas of undisturbed forestland, wetlands, and grasslands.¹² Seven of the 12 bat species that occur in Indiana have been identified on the property, in addition to an "unusually rich diversity of reptiles and amphibians." Three candidate species for federal endangered listing have been identified, along with 41 state listed plant and animal species.¹³ Jefferson Proving Grounds is also home to one of the largest nesting colonies of great blue heron in Indiana. The continued growth of the colony is thought to be due to the "low levels of human activities in the area."¹⁴

In 1989, the Secretary of Defense approved the recommendation of the Base Realignment and Closure Commission to close and dispose of the JPG. Operations on the site are to continue no later than September 30, 1995. The Army is required to screen the property to determine potential demand by subsequent users, including other federal and state agencies or the public. In February 1995, the Army published a Draft Environmental Impact Statement, analyzing the potential impacts to the natural and human environment resulting from 3 alternative disposal plans.¹⁵

The U.S. Fish & Wildlife Service (FWS) has submitted a request to the Army that 53,000 acres of the Proving Grounds be designated as a wildlife refuge.¹⁶ The Hoosier Environmental Council (HEC) submitted a separate proposed reuse management plan to the Army that also suggested that 53,000 acres be designated as National Wildlife Refuge to be managed the U.S. Fish & Wildlife Service.¹⁷ The Draft Environmental Impact Statement acknowledges the FWS's interest in transferring 53,000 acres for a wildlife refuge, and states that discussions between the Army, FWS officials, and local community leaders and representatives are "expected to result in a reduction of the amount of acreage requested by the Fish & Wildlife Service."

The U.S. Fish & Wildlife Service, Bloomington Field Office, received funding to conduct a pilot gap analysis at Jefferson Proving Grounds.¹⁸ Gap analysis is a geographic information system (GIS) based methodology developed to assess biological diversity and identify gaps in representation of biological diversity in areas managed for the long term maintenance of native species and natural ecosystems.¹⁹ The gap analysis project is now a state-wide effort, with projects including work on endangered species, contaminants, landscape-scale restoration, and The Nature Conservancy's bioreserves. The gap analysis now underway at JPG may be critical in identifying the most biologically valuable habitats on the property, and aiding managers in targeting their conservation efforts on these areas.

Loss of habitat function and fragmentation have contributed to a steep decline in migratory bird species in Indiana. Jefferson Proving Ground provides habitat for many of these species and preservation of its large tracts of unfragmented forest could buffer these species against the threat of extinction. Protection of habitat at the ecosystem or landscape level is the most efficient way to guarantee that plants and animals do not reach the brink of extinction. Transferal of a large portion of JPG, especially the contiguous forested land and wetlands, to the U.S. Fish & Wildlife Service as a wildlife refuge would create an excellent source of species to maintain the fragmented landscape in Indiana and surrounding states. A unique opportunity exists at JPG to ensure the survival of the largest unprotected unfragmented forest in the state.

HOPE FOR PRAIRIES: PRAIRIE RESTORATION EFFORTS

Prior to European settlement, about 13 percent (4,720 square miles) of Indiana was native prairie habitat. Less than 0.001 percent of these original prairies remain.²⁰ The vegetation in prairie ecosystems is determined by, and the ecological balance is dominated by, the influence of fire. When fire is suppressed in prairie and dry oak savannas, tree and shrub species colonize open areas and the enclosed canopy threatens the prairie species that rely on the availability of sunlight. Invasion by exotic species is another serious threat common to these areas. Alterations of the water table due predominantly to agricultural development, grazing, and encroachment by agriculture and development, including right-of-way construction and grazing also severely degraded the biological diversity of Indiana's native prairies. In addition, an insufficient supply of



PHOTO: LEE CASEBERE

Prairie gentian is a state listed threatened species. Less than .001 percent of Indiana's prairies remain. As the prairies were converted to other uses, many of the plants and animals native to the prairie became threatened, endangered, extinct, or rare.

seeds from prairie species indigenous to Indiana hinders restoration efforts.²¹

In an effort to restore remnant tracts of Indiana's prairie region, several initiatives are underway in the state. Prescribed burning is one mechanism used to remove exotic species and promote the reestablishment of native prairie.

Hoosier Prairie is a state nature preserve, owned and managed by IDNR. It is located in Lake County and is considered "a natural asset with profound mid-western significance, and a natural amenity for which

the people of Indiana will one day be very grateful."²² A survey of Hoosier Prairie conducted in 1980 revealed the presence of 323 native species. Management activities including brush cutting, clearing, and prescribed burning allowed dormant seeds to germinate and thrive, and underrepresented species to expand their populations to an extent to which they could be inventoried. As a result, a 1990 study identified 503 native prairie species.²³

The Tefft Savanna Nature Preserve is a 480 acre parcel of the 8,000 acre Jasper-Pulaski Fish and Wildlife Area (JPFWA). Over 260 species of plants have been identified in the preserve, 30 of which are listed as rare, threatened, or endangered in Indiana. In the nature preserve, over 100 species of birds have been identified, while JPFWA as a whole has reported the presence of over 250 species.²⁴

Although more than 500 acres of warm-season grasses are planted annually in Indiana for restoration purposes, the majority of seeds planted were developed to improve western rangelands for grazing. The ratio of the western variety to seeds that are native to Indiana is over 100:1 and, as a result, the biological diversity of the local ecotypes is under threat from "genetic swamping" from foreign genotypes.²⁵ Until recently, no in-state vendors of prairie seeds existed, but the U.S. Fish & Wildlife Service and IDNR have established a nursery to produce a supply of native prairie species seeds at the Jasper-Pulaski Fish and Wildlife Area. IDNR has been planting warm season native grasses at JPFWA for the last two years to produce prairie seeds for restoration uses throughout northwestern Indiana. To date, IDNR has planted about 11 acres of native prairie species. The seed was collected in nearby counties in the Kankakee Sand Section of Indiana's Grand Prairie Natural Region.²⁶ Prairie restoration efforts by IDNR have provided a basis for restoration to occur elsewhere in Indiana through private efforts.

HOPE FOR AGRICULTURAL LANDSCAPES: THE ST. JOSEPH RIVER BASIN

Fish Creek and Cedar Creek are both tributaries to the St. Joseph River, which is in turn a tributary to the Maumee River, a major river feeding into Lake Erie. The St. Joseph provides drinking water to the city of Fort Wayne and several other surrounding communities with total populations exceeding 200,000. Fort Wayne is Indiana's second largest city, and is located in Allen County, the third most densely populated county in the state.

The Cedar Creek watershed is a 174,500 acre area located in Noble, DeKalb, and Allen Counties. The watershed includes the Cedarville reservoir and Cedar Creek, which is a state designated scenic and recreational river.²⁷ Cedar Creek is not only a designated river, but also represents natural communities that are scarce in this part of Indiana. The primary natural communities are forested, although there are minor areas of bog, prairie, fen, marsh and lake communities.²⁸

The Fish Creek watershed, located in Steuben and DeKalb Counties (and Williams County in Ohio) drains approximately 110 square miles, and includes about 30 miles of primary stream channel, and 90 miles of tributaries and legalized drainage ditches. The creek's riparian areas flood seasonally, and deciduous hardwoods are the dominant species.²⁹ Although forested and open wetlands were once prevalent, less than 20 percent of the watershed retains forest cover.

Fish Creek, Cedar Creek, and other tributaries of the St. Joseph River have experienced serious degradation from land use activities in the watershed, channelization, and both point source (end-of-pipe) and diffuse (nonpoint source) pollution. These factors have led to a trend of increasing biological impoverishment in the Maumee River and its tributaries. A survey of benthic macroinvertebrates of the St. Joseph River conducted by IDNR found a low diversity of benthic organisms in the river. The Indiana State Nonpoint Task Force determined that the river is a "priority area for nonpoint source pollution control." The report identifies sediment as the primary nonpoint source pollutant that has caused a decline in fish and mollusk species diversity, and diminished recreational uses and the quality of drinking water supplies.

Cropland erosion, streambank erosion, chemical runoff, animal waste, and the discharge of industrial metals are the five major contributory causes of the water quality problems in the St. Joseph River and its tributaries. Soil loss from erosion on cropland is estimated at 7 tons of soil per acre per year. Approximately 20 percent of the streambank is severely eroding and 30 percent shows moderate erosion, with direct soil deposition each year.

Pesticides, nitrogen, and phosphorous from agriculture and poultry and confined livestock operations significantly affect the aquatic environment. Runoff contributes large quantities of nutrients to the tributaries of the St. Joseph, which in turn feeds into the Maumee River Basin and Lake Erie. The Maumee River Basin is considered the single largest contributor of phosphorus and sediment to Lake Erie. Although the

basin only provides 3 percent of the water flowing into Lake Erie, it contributes 46 percent of the phosphorus and 37 percent of the sediment.³⁰

The headwater portions of Fish Creek and Cedar Creek have been ditched to increase the agricultural land area. The ditches must be maintained by dredging, which creates straight, narrow channels that are characterized by unstable banks. The riparian zones, denuded of vegetation and made unstable by dredging, are particularly susceptible to erosion.³¹ Riparian vegetation provides shade, food, and shelter for the biota, stabilizes stream banks, and traps sediments, nutrients, and toxics. In addition, the riparian corridor provides area for flooding during seasonal events. Riparian areas are also vital for reducing the input of nutrients, chemicals, and silt as water runs off of the surrounding agricultural lands. As riparian zones are lost or degraded, so is their value as natural filters.

Stream bed siltation from erosion kills stream biota directly by smothering organisms, and indirectly by degrading and decreasing habitat. The Nature Conservancy believes that siltation from surrounding agriculture is the greatest stress to the Fish Creek system, and that "if unalleviated, siltation alone may degrade the system beyond the point of natural ecosystem recovery".³²

Recreational use of the waterbodies has declined due to the excessive input of sediment which increases the cloudiness of the stream, making it less aesthetically pleasing. Sedimentation has reduced fish stocks popular among recreational anglers and caused a change in the species of fish found in the waters, from game fish to sediment-tolerant suckers and carp. Sediment deposition in the riparian zone has adversely affected the productivity of stream-side wetlands and woodlands and caused an overall decline in the productivity of the fisheries in the Scenic Cedar River and other tributaries to the St. Joseph.

Excessive sedimentation carries with it increased public costs, as the suspended material must be removed before the water is consumed by humans. The Cedarville Reservoir, which is located on the St. Joseph, supplies Fort Wayne with an emergency drinking water supply. In addition to causing a decline in aquatic and terrestrial biological diversity, it is estimated that Fort Wayne must spend over \$1.2 million dollars annually to remove over 30,000 tons of suspended sediment from its drinking water supply.³³ Cedar Creek water quality also suffers from *E. coli* bacteria pollution. This pollution may come from a variety of sources, including inadequately performing septic systems affected by

heavy clay soil types in the region; agricultural drains located in close proximity to a septic field may also act as conduits for bacteria to enter streams.³⁴

Despite the nonpoint pollution problems in the tributaries to the St. Joseph, Fish Creek is considered one of the "most biologically diverse aquatic ecosystems in the Great Lake drainage basin".³⁵ It supports a diverse array of aquatic species, including 31 species of mussels and 42 fish species, and over a dozen rare or endangered species.³⁶ Fish Creek is the only habitat for the White Cat's Paw Pearly Mussel and two other federally-endangered mussels.³⁷ Fish Creek is believed to be one of the most diverse sites left in the Great Lakes Drainage Basin for populations of fresh water mussels, yet the runoff from agricultural activities causes siltation which can bury mussels and deprive them of oxygen and flowing water.³⁸ The Nature Conservancy states that it represents "the last stronghold for the unique faunal assemblage that once characterized the Maumee River/western Lake Erie drainage," and reflects the unique natural heritage of the Great Lakes Basin.³⁹

A number of important cooperative efforts are underway to protect and restore these biologically important areas. For example, the U.S. Fish & Wildlife Service (FWS) has been working in both the Fish Creek and Cedar Creek watersheds to restore ditched and tile-drained kettle wetlands and forested riparian wetlands through the Partners for Wildlife Program.⁴⁰ The Partners for Wildlife Program provides financial and technical assistance to restore drained wetland habitat on private property. Restoration projects in Fish Creek's Steuben and DeKalb counties account for approximately 30 percent of the 3,500 acres of Indiana wetlands restored under the Program.⁴¹

IDNR has designated approximately 350 acres of riparian corridor in Cedar Creek as a Scenic River. The designated area receives protection and some maintenance from the Division of Nature Preserves and private organizations. Designation helps to control the character of development along the river, and preserve the natural habitat. Local land use controls also help protect the river.

The Cedar Creek Watershed Alliance was recently established and held its first meeting in September 1994. The Alliance is working to improve water quality and land management practice in the Cedar Creek watershed. Members plan to work with land owners to encourage incentives and education on Conservation Reserve Program participation, promote conservation tillage, and advocate the use of best management prac-

tices to control soil erosion.⁴² Nearly one-third of the cropland (approximately 18,000 acres) within the Fish Creek watershed has been enrolled in the Conservation Reserve Program, which offers private landowners payments and cost-share assistance to establish permanent vegetative cover on cropland that is highly erodible.⁴³

Several efforts are underway throughout the two watersheds to encourage planting and restoration of riparian habitat to filter sediments and nutrients that run off agricultural lands into wetlands, rivers, and streams. The Allen & DeKalb County Soil and Water Conservation Districts have also been working with the U.S. Fish & Wildlife Service to re-establish prairie in the Cedar Creek watershed. They have planted prairie grasses and forbs in an effort to establish buffer areas around restored wetlands to provide additional habitat and erosion control. The prairie replanting project has scheduled over 100 acres of prairie restoration for 20 different landowners to be planted in 1995. The Allen County Soil & Water Conservation District has also received an EPA grant for the restoration of wetlands, prairies, and bottomland hardwoods in the Scenic Cedar Creek and surrounding watersheds. The project was established to reduce the input of nonpoint source pollution to the St. Joseph River and to increase wildlife habitat.

In the Fish Creek watershed, The Nature Conservancy, through its Fish Creek Project Office, has been cooperating with local farmers to encourage them to adopt conservation tillage methods in an effort to mitigate the impacts of siltation from surrounding land uses and alteration of the riparian zone.⁴⁴ The conservation tillage program has helped to purchase necessary equipment and provide farmers with funds to purchase such equipment.⁴⁵ The Fish Creek Project estimated that by 1995, almost 50 percent of the crops in the watershed were planted using no-till and 75 percent of the cropland is "at a tolerable soil loss".⁴⁶ From 1992 to 1994, the percent of no-tilled agriculture rose from 23 percent to 44 percent for corn and 46 to 53 percent for soybeans. Although it is commonly believed that the shift to no-till practices has been fueled by conservation compliance, the economic savings may also be promoting the change. Farmers can save an estimated \$15 per acre on average for no-till corn over conventional plow practices. There is a minimal reduction in the average corn yield, and equal to better yields for soybeans.⁴⁷

The Fish Creek Project, in conjunction with the Maumee River Basin Commission, and Steuben County Soil and Water Conservation District and County Drainage Board, has initiated a filter strip incentive

program. The group encourages landowners to plant and vegetate strips along drainage ditches and creeks.⁴⁸ The filter strips must be a minimum width of 20 feet and a maximum width of 66 feet, and landowners are reimbursed for up to \$435.60 per acre, under the condition that the participant maintain the filter strip for five years.⁴⁹ The Fish Creek Project also has a tree planting initiative in which all costs associated with the establishment of trees, including the purchase of seedlings, planting and weed control, are covered for three years. As of January 1995, the project had planted 124 acres of trees along the riparian corridor, with an additional 36 acres planned.⁵⁰

The majority of the conservation activities in the watersheds of the St. Joseph River focus on restoring or protecting natural resources and improving water quality while simultaneously continuing agriculture and livestock production. Residents of the watersheds recognize that their livelihood is directly linked to the conservation of soil and water quality and that it is in their best interest to contribute to efforts that maintain those resources. As has been shown through continuing projects, such activities as conservation tillage can serve to

protect biological diversity while simultaneously increasing economic return.

GOOD NEWS FOR INDIANA

These ambitious and varied activities are only a tiny fraction of the many innovative, collaborative efforts underway throughout Indiana to conserve and restore biological diversity. Through many such activities, Hoosiers across the state have demonstrated a commitment to biological diversity and a recognition of its value. These and other projects also demonstrate that residents of Indiana recognize and appreciate the connection between a healthy environment and a vibrant economy and sustainable agriculture.

Through individual initiative and cooperation with not-for-profit organizations, federal and state agencies, and corporations, biological diversity restoration and conservation efforts can have regional and state-wide benefits. These benefits can have an even greater impact if efforts are coordinated through a state-wide strategy. Some ideas for a state-wide strategy, and some examples from other states, are explored in the next chapter.

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Chapter V

* Toward a Comprehensive Strategy

WHY A COMPREHENSIVE STATE-WIDE STRATEGY?

This report has described existing opportunities in state laws and programs that can be used as tools to conserve and restore the state's diminished biological diversity. Like many of the efforts occurring around Indiana, though, these tools are currently being used to make progress only in a piecemeal fashion. To meet the goals of comprehensive protection, restoration, and active local participation, Indiana needs a strategy that will integrate the disparate ongoing projects, future public and private initiatives, and the available tools.

A comprehensive strategy would be a plan around which public agencies and private interests could rally to guide efforts toward conservation of Indiana's biological diversity. Such a strategy would identify urgent needs and build on current successes. More important, it would weave a web to connect legal tools, projects and programs, geographic hot spots, and people. A comprehensive strategy is the best vehicle for local groups and individuals to join their efforts around the state. It would help place seemingly small, incremental improvements in biological diversity conservation within a larger vision for Indiana.

Despite the need to understand and focus upon ecological systems, the most practical scale for a comprehensive strategy is at the state level. Although this scale conforms to state boundaries, which are drawn without regard to ecological boundaries, three advantages for protecting biological diversity using programs with state-wide scales have been identified:¹ First, most biological data have been collected by state institutions such as universities, museums, and state agencies, and are organized on a state level. Second, applicable laws tend to be uniform on a state-wide

scale. Local planning and zoning laws are also structured to meet state enabling acts, while many national laws, such as the Clean Water Act, are implemented through state programs. Third, people identify themselves primarily in terms of state loyalty. This is particularly true in Indiana where citizens tend to think of themselves first as Hoosiers before they identify as Midwesterners or residents of the Ohio Valley. A state-wide approach would be large enough in scale to take into account available tools and sizeable land and water areas. It would, however, require careful coordination with neighboring states to avoid spill-over effects or duplicative initiatives, and to conserve shared resources — such as Lake Michigan or the Ohio Valley.

Indiana is ready to take on a challenge of this type. Hoosiers have demonstrated enthusiasm for biological diversity and the unique character of Indiana's resources. This enthusiasm is reflected in a number of settings where Hoosiers have gathered to support a state-wide approach. For example, in 1992, agencies, individuals, and organizations interested in biological diversity conservation began organizing a continuing series of meetings where they could begin to plan together. This group, called the "80 percenters" because they felt they agreed on about 80 percent of what was important and could afford to set the other 20 percent aside for the time being, is an example of the kind of constituency needed for a state-wide biological diversity strategy. Other ongoing efforts include the Indiana Environmental Institute, backed by Indiana corporations, which is compiling a source book on Indiana's environment. There are many other state task forces and committees involving citizens in watershed management, groundwater protection, drainage and other issues on a state-wide basis.

Legislative Recognition of the Importance of Biological Diversity

Indiana's Nature Preserves Act, enacted nearly 30 years ago, explicitly emphasizes biological diversity:

"As part of the continuing growth of the population and the development of the economy of the state of Indiana it is necessary and desirable that areas of unusual natural significance be set aside and preserved for the benefit of present and future generations....Such areas are irreplaceable as laboratories for scientific research, as reservoirs of natural materials not all of the uses of which are

now known, as habitats for plant and animal species and biotic communities whose diversity enriches the meaning and enjoyment of human life, as living museums where people may observe natural biotic and environmental systems of the earth and the interdependence of all forms of life, and as reminders of the vital dependence of the health of the human community upon the health of the natural communities of which it is an inseparable part."

— IC 14-31-1-1.

Indiana also has the capacity to prepare a strategy. Its state agencies and its universities have a wealth of technical expertise, dedication to protecting the state's environment, and the desire to see Indiana's biological diversity conserved and restored in a comprehensive manner. Federal agencies also have substantial information and expertise that they are ready to contribute.

STRATEGIC EFFORTS IN OTHER STATES

Indiana is facing the challenge of conserving biological diversity at a time when many other states are undertaking initiatives to achieve similar goals. Some states, including Washington and Florida, have begun watershed-level planning that encourages coordination between the public and private sectors.²

Some state agencies such as the Wisconsin Department of Natural Resources, have begun the process of incorporating biological diversity conservation goals into their existing programs.³ In other states, including Georgia and Tennessee, multi-agency coalitions that also include nongovernmental organizations, have collaborated on projects designed to achieve specific goals for biological diversity conservation such as protection of neotropical migratory birds.⁴ A few state legislatures, including California, New York, and Michigan, have mandated planning for biological diversity.⁵

Comprehensive state-wide strategies are beginning to appear around the country. As early as 1992, a task force composed of personnel from Missouri's universities, the U.S. Forest Service, and the state's Department of Conservation prepared a report describing Missouri's biological diversity and making recommenda-

tions to improve its conservation.⁶ Florida, as a result of 1993 legislation,⁷ embarked on a series of initiatives to improve protection of ecosystems.⁸ Florida is developing a comprehensive ecosystem management strategy that will likely contain many elements essential for conserving biological diversity anywhere, including Indiana. The Florida strategy will address land acquisition, greenways, education, incentive-based regulatory alternatives, pollution prevention, science and technology, public lands management, role of private land owners, intergovernmental coordination, training, and audit and evaluation.⁹

Pennsylvania has also begun work on a comprehensive state-wide biological diversity strategy. In 1995, a technical committee composed of experts from academia, state government, and private conservation organizations issued a detailed report entitled *A Heritage for the 21st Century: Conserving Pennsylvania's Native Biological Diversity*.¹⁰ The 5-member steering committee for the effort consisted of the directors of the three state agencies with jurisdiction over Pennsylvania's lands and waters, and the two nature conservancies (TNC and the Western Pennsylvania Conservancy) that operate in the Commonwealth. The report points state and private decision-makers in the right direction by identifying the specific problems that are causing declines in the state's biological diversity and making brief recommendations for action. The Pennsylvania report found, for example, that the primary threats to Pennsylvania's biological diversity are pollution, shifting land uses and demographics, and the proliferation of aggressive exotic species. It noted that Pennsylvania has difficulty responding to the threats because of frag-

mented agency authority, combined with the lack of a comprehensive policy to conserve biological diversity. Other factors included poor understanding of the principles of biological diversity by the state's citizens and political subdivisions; inadequate resources for research and inventory efforts; absence of a comprehensive system for long-term monitoring; and lack of a dedicated system of biological reserves.¹¹ Pennsylvania's next step will be to design and identify programs to address these problems.

Some strategic work to conserve biological diversity has also coalesced around multi-state resources, particularly where threats do not conform to state boundaries. Multi-state strategies offer useful lessons in the application of science to management of biological diversity, and in coordination of public and private resources.¹² The Nature Conservancy's 1994 strategy to conserve biological diversity in the Great Lakes is a particularly helpful model, and one in which Indiana can play an important role.¹³

Indiana should not lag behind these other states in its commitment to biological diversity, and indeed can readily become a regional or national leader if action is taken soon.

DEFINING THE FOCUS FOR AN INDIANA STRATEGY

There are complex tradeoffs involved in most conservation and development activities. Coordinated efforts can help citizens identify appropriate responses on particular landscapes by defining units within which tradeoffs should be evaluated. There are several approaches available to Indiana to focus its protection of biological diversity:

Indiana could begin with an emphasis on watersheds. To some extent, watersheds provide reasonably distinct systems that can be mapped and monitored with relative ease. There is already interest in watershed management in Indiana. The Indiana legislature created a 12-member Watershed Task Force to establish a pilot watershed management program and to develop methodologies and criteria for assessing, managing, and monitoring water quality at a watershed scale. The pilot efforts are designed to improve water quality, guide future economic development with watersheds, and maintain and improve biological diversity.¹⁴ An interagency committee chaired by NRCS also meets monthly to address watershed issues and technical matters. A watershed approach also fairly characterizes The Nature Conservancy's approach to many of its



PHOTO: RICH FIELDS

The peregrine falcon is a federally listed endangered species. Indiana's reintroduction program successfully released 30 falcons in urban areas of Indiana between 1991 and 1994.

Indiana bioreserves — Fish Creek, the Blue River, Sugar Creek, and others in which biological diversity is to be conserved and restored.

An alternative approach could build on the "Natural Regions of Indiana," which identifies twelve distinct ecological regions of Indiana based on such characteristics as soil and vegetation type.¹⁵ This approach, which recognizes watersheds, also takes into account common features that cross watershed boundaries and provides ready reference to various ecosystem community types. By focusing on the distinct natural regions,

this approach provides a way to target public and private efforts on conserving and restoring the full complement of Indiana's biological diversity across its entire geographic range. This classification has been used extensively by the Division of Nature Preserves, as well as by federal agencies, to target their protection efforts.

Still a third approach could focus on particular ecosystem types (such as wetlands, prairies, dune systems, hardwood forests) or on particular species of concern (such as threatened, endangered, rare, and special concern species). This approach would seek to conserve and restore threatened and underrepresented landscapes, and to prevent the losses of those species and natural communities that are the most threatened in the near term. A number of existing programs, including Indiana's non-game and endangered species program, and IDNR's prairie restoration efforts, utilize this approach. This approach is also represented by the efforts now underway to develop a state-wide Indiana Wetlands Conservation Plan which allows for a balance between resource development and protection. Since 1994, IDNR has been bringing together interested parties — industries, county surveyors, environmental organizations, farmers, educators, and others — from across the state to plot a course for state-wide wetlands conservation. The effort is intended to produce a broadly accepted comprehensive plan in 1996. This project, which is limited to a particular land type, may provide lessons usable in crafting a broader effort aimed at developing a strategy for Indiana biological diversity. Other focused efforts include Partners for Wildlife's new emphasis on restoring and replanting bottomland hardwood forests in Indiana, and the stated commitments of the City of Bloomington and INDOT to protect fragile karst systems.

A fourth landscape-scale approach could take advantage of Indiana's existing network of planning and zoning, including regional planning. While regional planning is fairly weak outside of the context of transportation planning required under ISTEA, the mechanisms are in place for using existing planning and zoning commissions to implement biological diversity conservation. For example, bodies such as the Northwest Indiana Regional Planning Commission have substantial information available on issues that affect land and water use, protection of dunes and dune systems, and other ecological features. If aided by solid scientific information from Indiana's Natural Heritage Data Center, the U.S. Fish and Wildlife Service's gap analysis project, and other locally generated data, regional and local planning bodies could form the basis for an active

and effective effort at least in those parts of the state where planning is well-rooted.

Combinations of these four approaches are also possible. Indiana will need to identify what is most likely to gain public acceptance and produce real results. While there is sufficient authority under Indiana law to use any of these approaches, a legislative mandate to conduct strategic planning and to pursue these approaches would be quite helpful. Creation of an advisory council would help elevate biological diversity conservation and restoration in Indiana to the level that it is already beginning to command in other states. Yet legislation, while desirable, is not a prerequisite to action. Indiana's governor and state agencies, its conservation organizations and businesses, and its local governments and private individuals have the capacity to act if a state-wide commitment to biological diversity is made.

EXISTING TOOLS TO SUPPORT AN INDIANA STRATEGY

This report identifies many tools that can support a state-wide strategy. Among these are creative and intelligent uses of planning, regulation, taxation, direct government action, incentives, and voluntary action. For example:

- Indiana's Environmental Policy Act is a grant of authority for all state agencies to incorporate biological diversity conservation and restoration into their program activities.
- Local governments can incorporate biological diversity considerations into their comprehensive plans and zoning ordinances using existing authority.
- Local floodplain commissions can consider multiple objectives, including biological diversity, in floodplain planning and ordinances.
- River commissions can incorporate biological diversity conservation into their review of proposed activities.
- ISTEA plans can assess environmental impacts, including losses of, and opportunities for restoration or preservation of, biological diversity.
- INDOT can incorporate habitat considerations into its tree-planting programs in rights-of-way. It can initiate a policy of using native species in its plantings in medians and other rights-of-way and avoiding exotic species. Such a policy could

- stimulate new economic opportunities for Indiana native plant nurseries.
- Multiple objectives, including biological diversity conservation, can be served in the plans and specifications of drainage proposals under the Drainage Board Act. Drainage boards can consider projects' environmental and cumulative impacts, not leaving these issues solely to IDNR or IDEM review.
 - Restrictions on planting or maintaining trees within the drainage easement area can be eliminated, particularly where biological diversity can be enhanced or maintained consistent with the operation of the project. Moreover, drainage assessments could be reduced or eliminated for wetlands, which provide flood storage, and forested areas, which absorb and hold more precipitation, thereby incidentally benefiting biological diversity through encouragement of these habitat types.
 - IDNR can aggressively implement the prohibitions on discharge of contaminants within a floodway to reduce impacts to biological diversity. This authority could be used to discourage impacts like overapplication of road salt or unlawful disposal of other substances.
 - Mining reclamation can be made more supportive of biological diversity by expanding the practice of restoring mined land with native species. Acid mine drainage problems from previous mining can be remedied by using techniques such as constructed wetlands that may also benefit biological diversity.
 - IDNR's new authority with respect to environmental effects of oil and gas operations can be used to develop regulations that promote biological diversity by encouraging site restorations that reestablish native species.
 - The tax programs for classified lands can be modified to assure that biological diversity protection is available on enrolled mixed forest and open lands, and to increase the size of riparian, filter strip, and windbreak widths so that the tax benefit, as well as the biological diversity benefit, is made more meaningful.
 - Indiana's non-game law can be used by the governor to review Indiana state programs and increase their supportiveness of biological diversity conservation and restoration.
 - IDNR can manage all of its holdings with a goal of conserving biological diversity.

- Cost share incentive programs, such as the Stewardship Incentive Program and agricultural cost shares, can be targeted even more closely to managing lands and waters for biological diversity.
- Voluntary efforts can be celebrated, recognized, and rewarded.

A comprehensive state-wide strategy should set priorities so that interested agencies, organizations, communities, or individuals can channel their time and resources into activities that will make the greatest contribution to biological diversity conservation. This report takes some initial steps in the direction of setting priorities by identifying sources and stressors that impair biological diversity as well as describing conditions favorable to conservation; it also identifies many of the available tools for conservation. These initial steps are useful in themselves; they provide a person seeking to protect or restore biological diversity in a particular place with information to accomplish the task. However, a comprehensive strategy should build on this information to provide more pro-active direction for the state.

NECESSARY COMPONENTS OF AN INDIANA STRATEGY

A state-wide plan that achieves comprehensive conservation of biological diversity should incorporate the following elements:

- Public involvement
- Ecological research
- Gap analysis
- Coordination of efforts
- Advisory council
- Monitoring
- Implementation of environmental laws

Public Involvement

The key to any successful strategy is to encourage the citizens of Indiana, those with the most intimate knowledge of, and the greatest stake in, the state's biological diversity, to contribute to conservation efforts. Scientists are not the only ones who have important information about the state's biological diversity. Farmers and other people who are in contact with natural systems on a regular basis have a great deal to contribute to understanding the proper direction for a strategy. A comprehensive strategy must provide chan-

nels for local knowledge, local preferences, and local uses to be incorporated in state-wide goals and priority projects.

There is a substantial need for more public education and outreach, so that people understand what biological diversity is, why conserving it is beneficial, and what is known and still needs to be known. Indiana is blessed with numerous sources for this information, ranging from its state agencies and universities to such sources as the Indianapolis Zoo, which has a fine outreach program. Education is an essential part of public involvement; people work for what they care about, and they care about what they know.

Washington state has included public involvement in its program of integrated landscape management. Its approach seeks to incorporate local knowledge and opinions at multiple steps in planning and during adaptive management.¹⁶ This approach includes surveys, open houses, task forces, and private meetings. The Florida ecosystem management program also seeks to incorporate local knowledge in these ways and through reference to locally produced land and resource use plans.¹⁷

Ecological Research

Academic institutions, government agencies, and nongovernmental organizations such as The Nature Conservancy, sponsor ongoing ecological research and are repositories of knowledge about Indiana ecosystems. The Indiana Natural Heritage Data Center is a valuable resource; it is the most comprehensive collection of data on biological diversity in the state. A comprehensive state-wide strategy must be rooted in science. It must recognize the sustainable levels of use that ecosystems can provide while maintaining biological integrity. Further ecological research will also help identify the indicators of ecosystem health that can be used to monitor the success of projects throughout the state. Biological diversity data must be made readily accessible to Indiana landowners, local government, agencies, corporations and others.

A state-wide strategy will use existing scientific expertise within the state and may also help set priorities for future ecological research and dissemination of results. New York has recognized the importance of such research by legislatively establishing a biological diversity stewardship and research fund, and also a research institute. The Illinois Natural History Survey includes a center for biological diversity research.¹⁸

Gap Analysis

The U.S. Fish & Wildlife Service, Indiana University, Indiana State University, and IDNR researchers are currently conducting a state-wide "gap analysis" of Indiana biological diversity. This analytical technique creates maps showing different characteristics of biological diversity, and digitally overlays them upon maps showing the degree of legal protection afforded those areas. When completed, gap analysis provides a geographic guide to locate and prioritize protection, restoration, or acquisition initiatives. Many states, including Florida, have produced useful maps through gap analysis.¹⁹

Indiana's gap analysis includes cooperation with The Nature Conservancy, the Natural Resources Conservation Service, the U.S. Forest Service, the Hoosier Environmental Council, and the Indiana Department of Environmental Management. In addition to its comprehensive state-wide goals, the gap analysis assists specific projects including IDNR white-tail deer management, TNC management of the Blue River biosphere reserve, and landscape-scale wetland restoration.

Coordination of Efforts

A key to conserving biological diversity is coordination across both geographic and administrative jurisdictions. Coordination embraces a spectrum of activities from simple information exchange, to consideration of concerns of other interested parties, to joint action. Coordination may be as little as agencies — such as the IDNR and INDOT — exchanging information about a particular biological area. Or, it may be as elaborate as a joint project sponsored by a local conservation group, a corporate landowner, and a state regulatory agency.

A comprehensive strategy can promote better coordination by providing a framework for considering the conservation of biological diversity in routine decision-making or special projects. The framework could regularize consideration of ecological concerns and help identify partners to support activities. Although coordination is easier said than done, the multi-agency approach used by Pennsylvania and specific initiatives in Tennessee and Georgia may serve as prototypes.²⁰ An intergovernmental coordination committee in Florida has identified a number of opportunities for better ecosystem management that may be applicable to Indiana.²¹

Coordination of efforts should also include a component for coordination where ecosystems or manage-

ment areas cross state boundaries. For example, conservation of the Black Swamp natural region would require coordination with Ohio, and the Ohio River Valley would require coordination with Kentucky.

Advisory Council

The state should convene an advisory council to help identify potential partners and joint goals for conservation efforts. A permanent council would help routinize considerations of biological diversity in state, local, and corporate policy. It also would serve as a focal point in the state for new information and concerns relating to biological diversity. The establishment of a permanent advisory council is a key recommendation of the Pennsylvania strategy.²² The establishment of advisory councils is a time-honored tradition in Indiana. This council, however, should plainly represent a knowledgeable range of interests and have a clearly defined role.

Monitoring

Any successful comprehensive strategy must be flexible enough to adapt to new information. Monitoring projects, revisiting goals and tactics, and learning new science will provide feedback for adaptive decision-making. A useful strategy will be dynamic, evolving as Hoosiers gain more experience with conserving biological diversity. An advisory council that helps develop a comprehensive strategy should plan on convening periodically to evaluate progress. Adaptive management, such as is incorporated in the Washington state landscape initiative, does not view the issuance of a plan as the end of the analytical or public participation process.²³ Monitoring and continual consultation are expected to modify implementation.

Implementation of Environmental Laws

Although this report focuses on programs other than the mainstream environmental laws administered

by IDEM, further work must grapple with the role that environmental laws, especially pollution control and environmental assessment rules, play in conserving the state's biological diversity. For instance, compliance with state water quality standards and water discharge permits can have enormous beneficial impacts on the health of aquatic ecosystems. Florida's approach of adopting a biologically-based ecosystem plan for implementation of environmental laws may prove to be an excellent model.²⁴

A state-wide strategy that encompasses these elements will help make biological diversity conservation and restoration activities in Indiana more effective.

CONCLUSION

There is ample authority — and public commitment — to prepare and implement a state-wide strategy to conserve and restore biological diversity in Indiana. Indiana's nongame law provides that "the governor shall review other programs administered by him and, to the extent practicable, utilize such programs in furtherance of the purposes of this chapter. The governor shall also encourage other state and federal agencies to utilize their authorities in furtherance of the[se] purposes."²⁵ And Indiana's Environmental Policy Act declares that:

it is the continuing policy of the state of Indiana, in co-operation with the federal and local governments, and other concerned public and private organizations, to use all practicable means and measures...to create and maintain conditions under which man and nature can exist in productive harmony...and maintain, wherever possible, an environment which supports diversity.²⁶

A strategy for conserving and restoring biological diversity will provide a valuable asset to the state as its citizens plan for an economically and ecologically sustainable future.

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Appendix A

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Conservation and Restoration Programs Available in Indiana

CONSERVATION RESERVE PROGRAM

The Conservation Reserve Program (CRP) was designed to encourage farmers to place their highly erodible lands and other sensitive lands in conservation status in return for annual payments. The CRP, administered by the Consolidated Farm Service Agency of the U.S. Department of Agriculture, offers landowners annual payments for 10–15 years in return for taking environmentally sensitive cropland out of production and implementing a conservation plan. Program goals include reducing soil erosion, reducing sedimentation, improving water quality, providing fish and wildlife habitat, limiting surplus commodities, and providing income for farmers. Operators must implement a conservation plan approved by the local conservation district that converts sensitive lands to a less intensive use.

WETLANDS RESERVE PROGRAM

The Wetlands Reserve Program (WRP) is administered by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and is a voluntary program offering agricultural landowners a chance to restore and protect wetlands on their property through easements. In return for federal payments, farm operators who enroll their lands must agree to a restoration plan for croplands and place the restored wetlands in the easement reserve where they cannot drain or plow them. Easements are authorized for 30 years, permanently, or the maximum allowed by state law. The WRP also provides 50 to 100-percent federal cost-sharing for reestablishment of wetlands vegetation and hydrology and subsequent maintenance. The pro-

gram gives priority to wetlands that enhance habitat for migratory birds and other wildlife.

Lands eligible for the WRP include prior converted croplands, farmed wetlands, substantially altered land, wetlands farmed under natural conditions, contiguous uplands, riparian areas, and natural wetlands.

AGRICULTURAL CONSERVATION PROGRAM

The Agricultural Conservation Program (ACP) was established in 1936 to protect natural resources damaged through farming practices and to improve conservation practices on agricultural lands. Today the ACP is available to private farmland owners and ranchers to improve water quality, habitat, and wetlands protection and restoration through cost-sharing agreements. Farmers must pay the total cost of establishing the approved conservation practices and then are reimbursed for the government's share of the cost, which may range up to 75 percent of total costs. Private agricultural landowners can receive up to \$3,500 annually in cost-sharing, but must meet a number of program conditions.

The ACP is administered by the U.S. Department of Agriculture's Consolidated Farm Service Agency (CFSA) local offices. CFSA provides technical assistance to ACP participants for planning, design, layout, supervision, and maintenance of practices, and certifies that the practices meet CFSA standards and specifications. Conservation practices eligible for cost-sharing funds under the ACP include establishment or improvement of permanent vegetative cover; contour or strip-cropping systems, and terrace systems; planting trees and shrubs and improving timber stands; develop-

ment of new or rehabilitation of existing shallow water areas to support food, habitat and cover for wildlife; and construction of structures needed to restore wetlands.

PARTNERS FOR WILDLIFE

Partners for Wildlife is a voluntary partnership program run by the U.S. Department of Interior's Fish & Wildlife Service (FWS) to provide financial and technical assistance to private landowners interested in wetlands, bottomland hardwood, and prairie restoration. The stated objectives of the program are to : (1) protect and restore, through cooperative efforts with other governmental agencies and private partnerships, habitat on private lands; and (2) contribute to the conservation of biological diversity through the careful selection, design and implementation of restoration projects. Partners for Wildlife gives priority to projects that will restore degraded habitats. The program works through voluntary partnerships to directly involve private landowners in proactive stewardship of habitat.

Participants receive direct assistance in planning their restoration projects from FWS, the Natural Resources Conservation Service, and their state wildlife agency. The FWS then contracts or otherwise arranges for the actual construction work or pays the landowners for the services. To receive the financial assistance, the landowner must sign a cooperative agreement to maintain the restored land for at least ten years. Through 1994, the FWS has worked with landowners nation-wide to restore over 256,000 acres of wetlands, 25,000 acres of prairie grassland, 300 miles of riparian habitat, and 33 miles of in-stream aquatic habitat.

NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

The North American Waterfowl Management Plan (NAWMP) is an international agreement between the United States, Canada, and Mexico created in response to drastic declines in waterfowl and other wetlands-dependent species. The plan creates a framework for protecting, restoring, creating, and enhancing critical wetland areas that function as waterfowl habitat. NAWMP is designed to initiate a long-term solution to land use problems by involving the coordinated action of federal, state, provincial, and local governments, businesses, conservation organizations, and individual citizens. NAWMP was updated in 1994 and expanded its goals to protect 11.1 million acres of wetlands and

associated uplands and restore or enhance 14.6 million acres. The Plan's goal is to restore waterfowl populations to levels seen in the 1970s through providing funds to collaborative public/private restoration projects. The office that oversees this program is the North American Waterfowl and Wetlands Office, located in Arlington, Virginia.

DUCKS UNLIMITED

Ducks Unlimited (DU) is an international wetlands conservation group founded in 1937 to restore, enhance, and protect wetlands and their associated uplands. With a membership of more than half a million people, it is now the largest private sector wetlands and waterfowl conservation organization in the world. DU is active around the world, but focuses primarily on the U.S., Canada, and Mexico. DU conducts a variety of different programs, including restoration of drained wetlands, water control enhancements, acquisitions, conservation land transfers, purchase of water rights, and a public education project. DU also pursues partnerships with public and private organizations.

DU's Private Lands Program began as an effort to protect wetlands on private lands. This program is designed to develop innovative, low cost mechanisms to protect private wetlands. Private lands program staff then introduce these ideas to private landowners in the form of demonstration projects, workshops and seminars. The program has five major components:

- Technical Assistance Programs
- Demonstrations
- Information and education programs
- Landowner workshops
- Habitat development projects

FORESTRY INCENTIVES PROGRAM

The Forestry Incentives Program (FIP) provides financial assistance to private landowners for tree planting and timber stand improvement. The purpose of the program is to increase the nation's supply of timber production from private non-industrial forest lands. Because many landowners do not have the funds to make long-term investments in developing forest areas, FIP offers to share the expense with eligible landowners.

FIP is administered by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). Landowners apply to participate in the program at the county NRCS office. The NRCS office then

asks the state forestry agency to examine the property, help develop a forest management plan for the property, and certify the need for the proposed activity. Consideration is given to enhancing other related forest resources as well as cost effective timber production. The state forestry service provides technical advice throughout the process and will help to locate experts to perform the work. The state forestry agency must then certify that the project has been completed successfully before the payment is made.

Cost-sharing payments are limited to a maximum of \$10,000 per landowner. Cost-share payments are used to develop forestry practices such as seedbed preparation; planting; weed control; and plant establishment.

FOREST STEWARDSHIP PROGRAMS

The Forest Stewardship Programs are administered by the Indiana State Division of Forestry within the Indiana Department of Natural Resources. There are two related programs:

Forest Stewardship Program

The Forest Stewardship Program (FSP) is aimed at encouraging long-term stewardship of non-industrial private forest land by assisting owners to actively manage their forest for multiple resource benefits. The program provides technical, planning, and management assistance to landowners to help them enhance and protect the timber, fish and wildlife habitat, water quality, wetlands, and recreational and aesthetic values on their property. The State Division of Forestry works with landowners in the program to develop a multiple resource management plan, called a Landowner Forest Stewardship Plan, for the property and to help the landowner identify cost-share opportunities. The plans are geared towards multiple resource management and are tailored to the economic needs of the landowner.

Stewardship Incentive Program

The Stewardship Incentive Program (SIP) is designed to give landowners the money they need to implement the Landowner Forest Stewardship Plans developed under the Forest Stewardship Program. SIP is administered by the State Forestry Department and the Consolidated Farm Service Agency. The overall goal of SIP is to enhance forest management on private lands through a long term commitment to stewardship,

and one of the objectives is to protect, restore, and use forest wetlands.

The Stewardship Incentive Program is available to landowners participating in the FSP who have developed their Landowner Forest Stewardship Plans. An eligible landowner may be a private individual, group, association, corporation, Indian tribe, or other legal private entity, who owns 1,000 acres or less of qualified land. A cost-share allowance of up to 60 percent may be obtained for approved activities. A 10-year commitment to maintain and protect SIP funded practices is also required. The guidelines for the SIP in Indiana define seven major categories for funding:

- Management Plan Development
- Reforestation and Afforestation
- Forest and Agroforest Improvement
- Windbreak and Hedgerow Establishment
- Soil and Water Protection and Improvement
- Riparian and Wetland Protection and Improvement
- Wildlife Habitat Enhancement

THE NATURE CONSERVANCY

The Nature Conservancy's (TNC) Indiana Chapter began in 1959. Nationally, TNC owns and manages more than 1,600 preserves throughout the U.S. and works to preserve plants, animals, and natural communities by protecting the lands and waters that they need to survive. TNC protects habitats and natural systems through acquiring the land either through a gift or by buying it. TNC also helps other conservation organizations and government agencies in their land preservation efforts.

TNC works extensively with private landowners to protect natural areas using acquisitions, conservation easements, and voluntary agreements. All TNC land is managed under a stewardship program designed to maintain the preserves for biological diversity. Land donated to TNC is maintained according to a long term management plan including prescribed burnings, reforestation, fencing and other planned activities.

Natural Area Registries

In Indiana, TNC runs a Natural Areas Registry to honor private owners of outstanding natural areas for their commitment to the survival of the land's natural heritage. The voluntary program is designed to make public and private land owners throughout the state aware of the natural features on their land, and to rec-

ognize those owners for their voluntary protection efforts. In order to qualify for the registry, the property must contain significant plant communities, rare plants and animals, or other special features such as virgin forests or bogs. Participation in the registry is non-binding, but owners commit to preserving and protecting the area to the best of their abilities, notifying TNC of any threats to the area, such as pollution, rights-of-way, or drainage, and notifying TNC of any intent to sell or transfer ownership of the property. TNC asks permission to visit the registered area yearly to determine whether the condition over the last year has changed and to determine whether any new threats have arisen.

Saving Our Last Great Places

The Indiana TNC has established this new program, which plans to raise \$7 million in private funds, to begin to protect eight special ecological systems in the state. The program will leverage additional public resources, generate new conservation partnerships, and build upon existing public/private conservation partnerships. The eight natural systems targeted for protection include Fish Creek, Sugar Creek, Blue River, Pigeon River, Big Walnut, Wabash-Ohio Lowlands, Kankakee Barrens, and Knobstone Uplands. Currently, two of these "bioreserves", Fish Creek and Blue River, have been officially established and have full time managers on staff.

Southern Lake Michigan Conservation Initiative

The Nature Conservancy established the Southern Lake Michigan Conservation Initiative (SLMCI) in an effort to protect the remarkable biological diversity that exists in the fragmented, urban, and industrial region of sand prairie, dunes, savannas, and wetlands in southern Lake Michigan. SLMCI is a network of trained volunteers working on public, corporate, and other private lands to perform integrated management, protection, and restoration of biological diversity around the southern end of Lake Michigan. The Nature Conservancy coordinates and supports the volunteer network, organizes training for network members, helps develop communication, and provides technical support as needed by agencies, corporations, institutions, and individuals. Activities include expeditions to remove exotic species in Indiana Dunes National Lakeshore, mapping of alien weeds and rare plants,

hikes, and educational and outreach activities.

INDIANA DEPARTMENT OF NATURAL RESOURCES DIVISION OF NATURE PRESERVES

Indiana Heritage Trust Fund

The Indiana Heritage Trust is a trust fund for the purchase of natural lands from willing sellers in Indiana for the purpose of conservation and preservation. It is funded by the sale of environmental license plates, and recently received a \$5 million appropriation from the state. The trust fund buys land for new and existing state parks, state forests, nature preserves, fish and wildlife areas, trails, and other areas for the Indiana Department of Natural Resources divisions, and cooperating organizations.

Indiana Natural Heritage Data Center

The Natural Heritage Data Center was established in 1978 as a cooperative effort between the Department of Natural Resources and The Nature Conservancy. The Data Center collects and stores information on the status and distribution of outstanding natural communities, rare and endangered plants and animals and other natural features in a comprehensive information management system that includes both manual and computer files as well as topographic map files. The inventory provides a process for identifying significant areas and setting preservation and acquisition priorities for the entire state. It is an important tool in providing the latest information for land use planning and environmental reviews.

EPA WETLANDS INFORMATION HOTLINE

The U.S. Environmental Protection Agency runs a toll free hotline, the EPA Wetlands Information Hotline, to provide private land owners, educators, state agencies, attorneys and consultants with up-to-date information on wetlands laws, regulations, internal agency documents affecting the administration of wetlands protection, and educational material. The Hotline is an excellent source of information and will provide contacts and references for further information. It will also provide educational literature and agency publications free of charge. The Hotline can be reached by dialing 1-800-832-7828.

Appendix B

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Further Contacts

STATE AGENCIES

Department of Natural Resources
Division of Fish and Wildlife
402 West Washington Street
Room 273W
Indianapolis, IN 46204
(317) 232-4080

Department of Natural Resources
Division of Fish and Wildlife
Jasper-Pulaski Fish and Wildlife Area
RR #1, Box 166
Medaryville, IN 47957
(219) 843-4841

Department of Natural Resources
Division of Forestry
Indiana Forest Stewardship Program
402 West Washington Street
Room 296W
Indianapolis, IN 46204
(317) 232-4105

Department of Natural Resources
Division of Nature Preserves
402 West Washington Street
Room 267W
Indianapolis, IN 46204
(317) 232-4052

Department of Natural Resources
Division of Nature Preserves
Indiana Heritage Trust
402 West Washington Street
Room 267W
Indianapolis, IN 46204
(317) 232-4052

Department of Natural Resources
Division of Outdoor Recreation
Hoosier Riverkeepers
402 West Washington Street
Room W271
Indianapolis, IN 46204
(317) 232-4070

Indiana Department of Environmental
Management
Office of Air Management
100 North Senate Avenue
Room N1001
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 232-5586

Indiana Department of Environmental
Management
Coordinator of Remedial Action Plan
Northwest Regional Office
504 Broadway, Suite 418
Gary, Indiana 46402
(219) 881-6714

Indiana Department of Environmental
Management
Office of Environmental Response
100 North Senate Avenue
Room N1255
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 233-6371

Indiana Department of Environmental
Management
Office of Pollution Prevention &
Technical Assistance
100 North Senate Avenue
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 232-8172

Indiana Department of Environmental
Management
Office of Solid & Hazardous Waste
Management
100 North Senate Avenue
Room N1154
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 232-3210

Indiana Department of Environmental
Management
Office of Water Management
100 North Senate Avenue
Room N1101
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 232-8670

Indiana Department of Transportation
Environment Assessment
100 North Senate Avenue
Room N808
Indianapolis, IN 46204-2249
(317) 232-5114

FEDERAL AGENCIES

U.S. Department of Agriculture
Consolidated Farm Service Agency
5981 Lakeside Boulevard
Indianapolis, IN 46278-1996
(317) 290-3030

U.S. Department of Agriculture
Cooperative Research, Education,
Extension Service
Purdue University
Department of Forestry and Natural
Resources
West Lafayette, IN 47907
(317) 494-3586

U.S. Department of Agriculture
Natural Resources Conservation Service
6013 Lakeside Boulevard
Indianapolis, IN 46278
(317) 290-3200

U.S. Department of Agriculture
Natural Resources Conservation Service
Farm Services Program
Indiana State Office
5975 Lakeside Boulevard
Indianapolis, IN 46278

U.S. Department of Agriculture
U.S. Forest Service (Headquarters)
Hoosier National Forest
811 Constitution Avenue
Bedford, IN 47421-9599
(812) 275-5987

U.S. Department of Agriculture
U.S. Forest Service
Hoosier National Forest
608 West Commerce Street
Brownstown, IN 47220
(812) 358-2675

U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, IL 60604
(312) 353-2147

U.S. Department of Interior
U.S. Fish and Wildlife Service
(Partners for Wildlife)
Bloomington Field Office
620 South Walker Street
Bloomington, IN 47403
(812) 334-4261

U.S. Department of Interior
U.S. Fish and Wildlife Service
Region III
1 Federal Drive, Federal Building
Fort Snelling, MN 55111-4056
(612) 725-3570

U.S. Department of Interior
U.S. Fish and Wildlife Service
North American Waterfowl and
Wetlands Office
4401 North Fairfax Drive
Room 110
Arlington, VA 22203
(703) 338-1784

U.S. Department of the Interior
National Biological Service
Lake Michigan Ecological Station
1100 North Mineral Springs Road
Porter, IN 46304
(219) 926-7561

U.S. Department of Interior
National Park Service
Indiana Dunes National Lakeshore
1100 N. Mineral Springs Road
Porter, IN 46304-1299

NON-GOVERNMENTAL ORGANIZATIONS

American Fisheries Society, Indiana
Chapter
P.O. Box 16
Avoca, IN 47420

Bass Federation
2865 North Hillcrest Drive
Seymour, IN 47274

Cedar Creek Wildlife Project, Inc.
P.O. Box 140
Huntertown, IN 46748

Citizens Action Coalition
3951 N. Meridian, 3rd Floor
Indianapolis, IN 46208
(317) 921-1120

Ducks Unlimited
P.O. Box 26060
Indianapolis, IN 46226

Forest Watch
R.R. 5 Box 91
Nashville, IN 47448

Friends of Sugar Creek, Inc.
P.O. Box 171
Darlington, IN 47940

Friends of the Wabash
P.O. Box 777
Lafayette, IN 46240

Friends of White Lick Creek
251 E. Ohio Street, Suite 950
Indianapolis, IN 46204

Friends of the White River
1635 E. 77th Street
Indianapolis, IN 46240

Friends of Whitewater River
P.O. Box 694
Connersville, IN 47331

Groups Advocating Urban Greenspace
Environments
6616 E. 34th Street
Indianapolis, IN 46226

Hoosier Environmental Council
1002 East Washington Street
Suite 300
Indianapolis, IN 46202
(317) 685-8800

Hoosier Rails to Trails Council
6140 N. College Avenue
Indianapolis, IN 46220

Indiana Association of Soil and
Water Conservation Districts
5525 East, 1000 South
Lafayette, IN 47905

- Indiana Environmental Institute
150 West Market Street, Suite 816
Indianapolis, IN 46204
(317) 635-6018
- Indiana Grand Kankakee Marsh
Restoration Project
c/o Dick Blythe
Blythe's Sports Shop
138 N. Broad
Griffith, IN 46319
(219) 924-4403
or
c/o Greg Costakis
406 Audubon
Valparaiso, IN 46383
(219) 464-4172
- Indiana Karst Conservancy
P.O. Box 2401
Indianapolis, IN 46206
- Indiana Lakes Management Society
909 W. Maumee
Angola, IN 46703
- Indiana Natural Areas Registry
Route 1, Box 115
Nashville, IN 47448
(812) 988-7547
- Indiana Rural Water Association
P.O. Box 679
Nashville, IN 47448
- Indiana University
Department of Biology
Bloomington, IN 47403
(812) 855-3091
- Indiana Wildlife Federation
301 E. Carmel Drive
Suite G200
Carmel, IN 46032
(317) 571-1220
- Izaak Walton League of America, Inc.
Indiana Division
1963 Salamonie Avenue
Huntington, IN 46750
- Little River Wetlands Project
7112 Sweet Brier Drive
Fort Wayne, IN 48804
- National Association of State Foresters
Department of Natural Resources
402 West Washington Street
Room 269
Indianapolis, IN 46204
(317) 232-4105
- National Audubon Society
Great Lakes Regional Office
692 North High Street, Suite 208
Columbus, OH 43215
(614) 224-3303
(Please call for the 12 Indiana
Audubon Society chapter contacts)
- Nature Conservancy
see The Nature Conservancy
- NW Indiana Steelheaders, Inc.
1507 Ohio Street
Michigan, IN 46360
- Patoka River Swamp Watchers
RR1 Box 455
Winslow, IN 47598
- Patoka Refuge Individuals in Defense of
the Environment (PRIDE)
540 Oriole Drive
Evansville, IN 47715
(812) 476-3248
- Patoka River National Wetlands Project
Office
510 1/2 West Morton Street
Oakland City, IN 47660
(812) 749-3199
- Protect Our Woods
P.O. Box 352
Paoli, IN 47454-0352
(812) 472-3907
- Purdue University
Department of Forestry and Natural
Resources
West Lafayette, IN 47907
(317) 494-3586
- Save the Dunes Council, Inc.
444 Barker Road
Michigan City, IN 46360
(219) 879-3937
- Sierra Club Hoosier Chapter
6147 North College Avenue
Indianapolis, IN 46220
(317) 253-2687
- Sierra Club Wetland Project
960 E. Washington Street, Suite 200B
Indianapolis, IN 46202
(317) 231-1908
- Soil and Water Conservation Society
Hoosier Chapter
Purdue Agronomy Department
Lily Hall of Life Sciences
West Lafayette, IN 47907
- Southern Lake Michigan Conservation
Initiative (SLMCI)
Indiana Nature Conservancy
444 Barker Road
Michigan City, IN 46360
(219) 879-4894
- Stream Watch
2507 Brewster Road
Indianapolis, IN 46268
- The Nature Conservancy
Indiana Field Office
1330 West 38th Street
Indianapolis, IN 46208
(317) 923-7547
- The Nature Conservancy
Blue River Project Office
P.O. Box 5
Corydon, IN 47112
(812) 738-2087
- The Nature Conservancy
Fish Creek Project Office
Peachtree Plaza, Suite B
1220 North 200 West
Angola, IN 46703
(219) 665-9141
- Trout Unlimited
P.O. Box 80123
Indianapolis, IN 46280

Wabash River Heritage Corridor
Commission
c/o Indiana Department of Natural
Resources
402 W. Washington Street, Room W271
Indianapolis, IN 46204

Waterfowl U.S.A. Limited
Northwest Indiana Chapter
1707 South Cline Avenue
Griffith, IN 46319
(219) 322-1545

Wildlife Habitat Council
1010 Wayne Avenue, Suite 920
Silver Spring, MD 20910
(301) 588-8994

The Wildlife Society, Indiana Chapter
R.R. 1 Box 72A
Muren, IN 47861
Woodland Steward Institute
P.O. Box Trees
Butlerville, IN 47223

THE ENVIRONMENTAL LAW INSTITUTE

For a quarter century, the Environmental Law Institute has played a pivotal role in shaping the fields of environmental law, management, and policy, domestically and abroad. Today, ELI is an internationally recognized, independent research and education center.

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