

# Indiana Gap Analysis Project

Compiled from Final Project Report

## Introduction

The Indiana Gap Analysis Project (IN-GAP) was born out of the concern that agencies charged with the protection and restoration of biological resources in the state functioned without the benefit of information at the landscape scale.

IN-GAP established goals to:

- (1) provide data to the national gap analysis center for the national scale biotic assessment,
- (2) support conservation projects underway at the U.S. Fish and Wildlife Service (USFWS) and various partner agencies and organizations,
- (3) support the expansion of habitat restoration efforts from the existing scale to a landscape scale,
- (4) provide part of the scientific basis for the development of a biodiversity protection and restoration plan for Indiana,
- (5) provide useful data to non-partner organizations whose actions and decisions affect biological diversity

We determined, based on national project specifications developed in the early 1990s, that Indiana partners would require products at levels of detail beyond the ability of the National Gap Analysis Project to support. Moreover, it seemed important that IN-GAP pay dividends as soon as possible in the project timeline. The solution we implemented used gap analysis generated products and outside funding to address specific conservation issues of concern. We termed these *metaprojects*. Metaprojects were developed to foster cooperation and acceptance of IN-GAP among the conservation community, generate monetary support to develop detailed data useful for state and regional analyses, demonstrate applications for gap analysis, produce information useful in protecting Indiana's natural resources, and test IN-GAP products.

IN-GAP metaprojects included: a white-tailed deer modeling project with the Indiana Department of Natural Resources, Division of Fish and Wildlife, which used a preliminary statewide landcover map; The Nature Conservancy (TNC) Bioreserve Planning which employed Gap Analysis products and developed additional data as one component in the Blue River Watershed plan; a pilot project to evaluate the utility of gap analysis products for landscape scale wetland restoration with the USFWS Partners for Fish and Wildlife Program; a cooperative project with the USFWS to facilitate listing and recovery of the copperbelly water snake (*Nerodia erythrogaster neglecta*); contaminants investigations involving nesting bald eagles; and the evaluation of Big Oaks (Jefferson Proving Grounds) and Grand Kankakee Marsh National Wildlife Refuges.

## Land Cover

The land cover map for Indiana was developed at the Center for Remote Sensing and Geographic Information Systems in conjunction with the Department of Geography, Geology, and Anthropology at Indiana State University (ISU 2006). IN-GAP began in October 1994, before the NVCS was available. Land cover in Indiana was mapped using the spectral characteristics of Landsat 5 Thematic Mapper (TM) imagery to identify 16 distinct classes ([Table 1](#)). The majority of these classes are Level 3 types consistent with the sub-class level of the UNESCO (1973) hierarchy.

The majority of Indiana is used for agricultural purposes with 59.5 percent of the landscape classified as row crop agriculture and another 12.5 percent of the state classified as agricultural pasture/grassland cover (Table 1). Agricultural lands are primarily in the northern two-thirds of the state. Forests, more specifically upland deciduous forest (18.7 percent) and wetland deciduous forests (2.2 percent) dominate the landscape in the south-central area of the state (Berta et al. 1998).

**Table 1.** The land cover types mapped, their area mapped in the state and percentage of Indiana's total area represented by the mapped type.

[Abbreviations: km<sup>2</sup>, square kilometer; <, less than; >, greater than]

Land cover class	Area covered (km <sup>2</sup> )	Area covered (percent)
Developed–non-vegetated	564.3	0.60
Developed–urban, high density	651.3	0.70
Developed–urban, low density	1,697.2	1.81
Agriculture–row crops	55,784.1	59.54
Agriculture–pasture and grasslands	11,693.2	12.48
Terrestrial–shrubland (canopy closure < 50 percent)	356.8	0.38
Terrestrial–woodland (canopy closure 50–75 percent)	613.4	0.65
Terrestrial–deciduous forest (canopy closure > 50 percent)	17,542.9	18.72
Terrestrial–evergreen forest (canopy closure > 50 percent)	511.4	0.55
Terrestrial–mixed evergreen/deciduous forest	313.0	0.33
Palustrine–deciduous forest (canopy closure > 50 percent)	2,076.7	2.22
Palustrine–deciduous woodland (canopy closure 50–75 percent)	30.6	0.03
Palustrine–shrubland (canopy closure < 50 percent)	322.9	0.34
Palustrine–herbaceous	479.0	0.51
Palustrine sparsely vegetated	86.7	0.09
Water	939.6	1.00
Unclassified–cloud/shadow	34.7	0.04

## Accuracy Assessment

The Indiana land cover classification was determined to have an overall classification accuracy of 70.98 percent. The largest class, row crop agriculture, has a user accuracy of 91.89 percent, while upland deciduous forest (75.41 percent), wetland deciduous forests (83.33 percent), and pasture/grassland (12.41 percent) have lower class accuracy statistics.

## Terrestrial Vertebrate Distributions

This overall list of Indiana vertebrates includes 300 species, with 38 amphibians, 53 reptiles, 55 mammals, and 154 birds. Gap Analysis Projects model primarily native species. However, IN-GAP chose to model several introduced species including, ring-necked pheasants, rock dove, European starling house finch, Norway rat, and house mouse. It was decided that these species should be included in the analysis because they have become naturalized to Indiana and play an important role in the biodiversity of the state, albeit in many cases a negative role. For example, starlings compete with bluebirds and other native cavity nesters for nest sites, and ring-necked pheasants may negatively affect potential prairie chicken reintroduction efforts.

## Land Stewardship

### Results

Table 2 presents summary statistics of area representation of stewardship and management categories in Indiana. Less than 1 percent of the state is held in GAP Status 1 or 2 lands.

**Table 2.** GAP percentage of Indiana in various levels of protection.

GAP status code	Acres	Square miles	Hectares	Percentage of state
Status 1	77,234	121	31,256	0.33
Status 2	131,671	206	53,287	0.57
Status 3	457,586	715	185,183	1.98
Status 4	22,489,022	35,140	9,101,183	97.12

**Table 3.** Land cover types by percentage in GAP Status 1 and Status 2 categories in Indiana.

[Abbreviations: <, less than; >, greater than; NWI, National Wetlands Inventory]

Description	0 – less than 1 percent	1 – less than 2.5 percent	2.5 – less than 5 percent	5 – less than 10 percent	Greater than 10 percent
Class 1: Unclassified (clouds and shadows)		2.13			
Class 2: Developed: other (non-vegetated)	0.26				
Class 3: Urban: high density	0.23				
Class 4: Urban: low density	0.13				
Class 6: Agriculture: row crop	0.14				
Class 7: Agriculture: pasture and grasslands	0.22				
Class 8: Deciduous shrubland (canopy closure <50 percent)		1.52			
Class 9: Deciduous woodland (canopy closure 50–75 percent)		1.38			
Class 10: Deciduous forest			3.32		
Class 11: Evergreen forest					5.12
Class 12: Mixed evergreen/deciduous forest			3.63		
Class 13: Palustrine forest			2.85		
Class 14: Palustrine woodland		2.06			
Class 15: Palustrine shrubland			3.08		
Class 16: Palustrine herbaceous		2.39			
Class 17: Sparsely vegetated/unvegetated			2.54		
Class 18: Water bodies (derived partially from NWI)		1.78			

## Gap Analysis—Land Cover

Only agricultural row crop and agricultural grasslands had 0–less than 1 percent representation in GAP Status 1 and 2 (not including land cover types with virtually no conservation value like developed non-vegetated, urban low density, and urban high density). Agricultural row crop land has limited biodiversity conservation value, but because of the high percentage of this land cover type in Indiana, some clarification of the role of corn and soy beans in conservation is required. Row crops in Indiana are structurally similar to grasslands; however, because they have essentially no native plant species, they contribute nothing to floristic biodiversity conservation.

In addition to the unclassified class, five land cover classes have between 1 and 2.5 percent of their area in status 1 and 2 lands. These include: deciduous shrubland, deciduous woodland, palustrine woodland, palustrine herbaceous, and open water. Indiana has over 500 natural lakes in the glaciated northern part of the state larger than 2 ha. The largest, Lake Wawasee, covers 1,380 ha. In addition more than 60,000 ha of Lake Michigan covers the extreme northwestern section of Indiana. The open water in Status 1 and 2 categories, however, would mostly comprise Indiana’s flood control reservoirs;

principal among these are Lake Monroe, Patoka Lake, Brookeville, Mississinewa, and Salamonie reservoirs which total well over 12,000 ha. They are primarily managed by the U.S. Army Corps of Engineers.

Five land cover classes have 2.5 percent to 5 percent of their area in Status 1 and 2 lands. It is likely that upland deciduous forest and mixed evergreen/deciduous have similar profiles. We categorized 3.32 percent of upland deciduous forest and 3.63 percent of mixed forest as Status 1 and 2. The bulk of this would be national and state forest owned and managed land. A significant addition not reflected in the table is the establishment of Big Oaks National Wildlife Refuge in southeastern Indiana that protects over 12,000 ha of upland forest primarily for migratory bird and biodiversity conservation. Although upland deciduous forest emerges as one of the better protected habitat types in the state, fragmentation may affect Status 1 and 2 upland forests, and over 90 percent remains privately held.

Evergreen forest is Indiana’s only land cover class with more than 5 percent of its area in status 1 and 2. Evergreen forest occurs as a native community in Indiana as comparatively small patches. Most of the evergreen forest consists of pine plantations grown for forest products or as shelterbelts.

## Gap Analysis—Vertebrates

Analysis of IN-GAP data indicates that no amphibian has more than 10 percent of its habitat in Status 1 and Status 2 managed lands. In fact, of the 38 amphibian species modeled, only 3 species have more than 5 percent of their predicted distributions in Status 1 and Status 2 managed lands, and for 8 species, habitat in the top 2 protection categories is less than one percent.

Reptiles in Indiana appear even less secure than amphibians. No reptiles have greater than 5 percent of their predicted distribution in Status 1 and Status 2 managed lands. A disheartening 21 of 55 reptiles have less than 1 percent of their predicted distributions in Status 1 and Status 2 managed lands.

We modeled 154 bird species that breed in Indiana. Of those, only three have greater than 10 percent of their predicted distributions in Status 1 and Status 2 managed lands and 56, more than one-third, have less than 1 percent.

Only 2 of the 55 mammals modeled have greater than 5 percent of their predicted distributions in Status 1 and Status 2 managed lands; no species has 10 percent. Nearly one-half of the species (27) has less than 1 percent of their predicted distributions in Status 1 and Status 2 managed lands.

## Limitations Specific to IN-GAP

The results derived from IN-GAP provide insight into the state of biodiversity conservation in Indiana. We envision the various component products of the project (landcover map, vertebrate models, and stewardship coverage) as points of departure for further investigation. It has become apparent, based on early interest in IN-GAP data, that various organizations, government agencies, and private firms recognize utility in these products.

Nevertheless, the conclusions and the component products developed for IN-GAP have some limitations.

Specifically, the Landsat Thematic Mapper satellite images used to develop the land cover map were approximately 10 years old at the release of this report. Because land cover is influenced by natural dynamics, (e.g., succession, beaver dams, storms) and by human alterations, the land cover map becomes less accurate with time. The data available in the mid-1990s were a limited number of 30 m pixel satellite imagery scenes. Moreover, little ancillary data existed in Indiana with which to augment the satellite

imagery, which combined with the complexity of Indiana's land cover, resulted in a limited number of land cover classes. The minimum mapping unit (MMU) of the land cover map is one hectare, (i.e., land cover classes in patches smaller than one hectare typically would merge with surrounding larger classes). When IN-GAP began, the goal involved producing products at a scale suitable for analyses at a national or regional scale. Although we modified this approach to the extent possible to address questions at the state scale, many uses (e.g., exclusive reliance on IN-GAP data for municipal environmental planning) were outside the scope of the project.

Vertebrate models reflect not only the limitations of the land cover map on which they are based, but also the incomplete understanding of the life histories of the species they model. In cases for which we have good information on habitat use, our understanding frequently exceeds the data available with which to model (e.g., the presence of snags or specific tree species, or forest maturity). IN-GAP constructed relatively simple habitat relationship models. Users should consider that predicted distribution refers in most cases to habitat where the species would normally reproduce. With respect to a vagile group like birds, for example, some species use backyard feeders, but we did not model suburban habitat unless the species also typically breeds there. Last, habitat may not always be occupied; depending on time of year, population density, habitat quality and numerous other factors, a particular species may or may not be present in any suitable habitat patch.

The stewardship coverage, in large part provided to IN-GAP by the IDNR, Division of Fish and Wildlife reflects the public ownership of land in Indiana circa 1995. We know that the state, counties, non-government organizations and others have continued to acquire land in Indiana for the purpose of natural resource management. Some military reservations also have changed ownership in the ensuing years. These changes by and large are not reflected in the Stewardship coverage. Small, less than one acre sites do not appear in the coverage. In addition, significant efforts like permanent easements through the U.S. Department of Agriculture's Wetland Reserve Program (WRP) do not occur in the Stewardship coverage. Although locally significant, we do not believe that additions to the public land base in Indiana since 1995 have been sufficient to fundamentally alter the results of this report.

The results and conclusions derived from the analysis of the component products of the Indiana Project necessarily carry the burden of the aforementioned limitations of data and analyses.

## References Cited

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