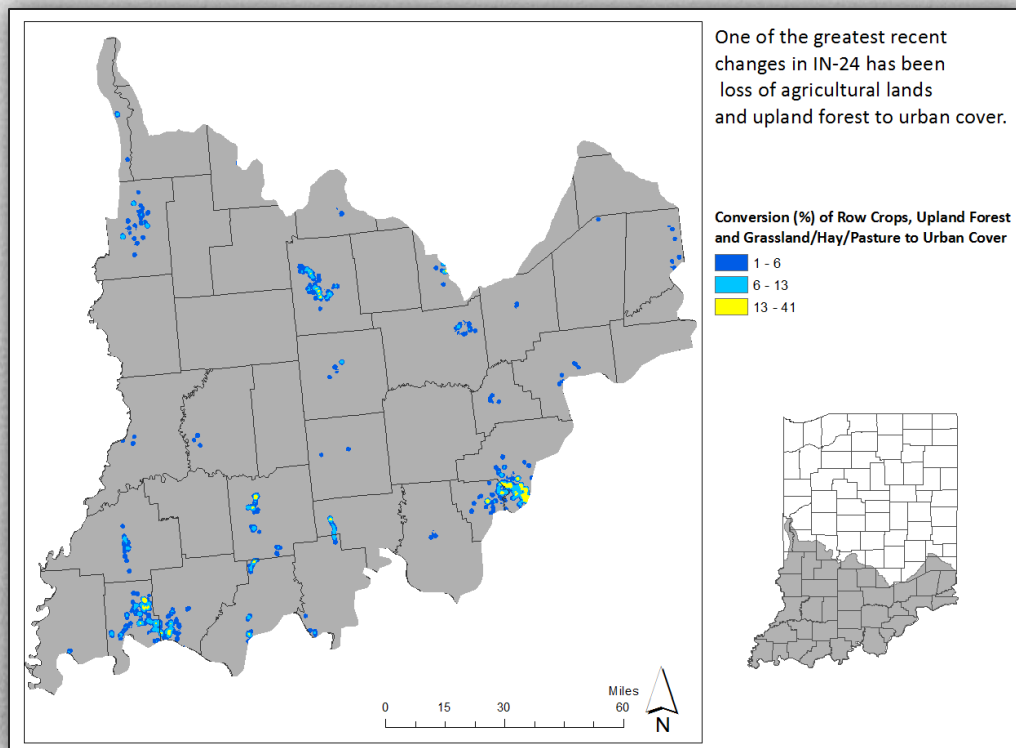




Indiana BCR 24 – Assessment Summary

Bird conservation Joint Ventures (JVs) were established to help achieve continental bird population goals by designing and managing landscapes with high value to birds at regional, state, and local scales. JVs develop Implementation Plans where “focal species” are used to represent guilds and biological models are employed to translate population objectives into habitat objectives. This summary includes highlights from a JV assessment of bird habitat objectives and landscape trends in the Indiana BCR 24 (IN-24) “State x Bird Conservation Region.” Objectives in the 2007 JV Implementation Plan were developed using spatial data from 2001, and JV partners have reported significant conservation accomplishments since objectives were established. However, trends in landscape cover types suggest mixed results in maintaining and increasing those land covers associated with key bird habitats. We provide general landscape trends based on the National Land Cover Database (2001 to 2006), comparisons between JV bird habitat objectives and cover type availability, and broad implications of those land-cover trends to bird habitat conservation. **Please see the complete IN-24 assessment for more details.**



Primary cover-types

IN-24 consists of extensive row crops (24%), grassland/hay/pasture (13%), and urban cover (7%) but its primary cover type is upland forest (44%). Urban land expanded (+12,200 ac) between 2001 and 2006, whereas area of upland forest (-12,000 ac) and row crops (-7,800 ac) declined. Gain in urban acreage was largely the result of conversion from upland forest and agricultural land.

Comparison (acres) of Joint Venture bird habitat objectives (maintenance and restoration combined, from 2007 JV Plan) and estimated cover type availability (NLCD 2006) and trend (NLCD 2001 to 2006) in Indiana Bird Conservation Region 24. Wetland and open water availability based on recent NWI, not NLCD. **Note:** Bird "conservation objectives" represent quality habitats (high recruitment/high survival) for JV focal species whereas "cover type availability" reflects landscape cover types but not necessarily quality habitats.

Habitat/cover types	Conservation objective	Cover type availability	Short-term land cover trend (%)
Woodland and openland			
Deciduous forest	396,929	3,711,440	-0.3
Evergreen forest	0	112,818	-0.3
Shrubland	854,620	22,667	2.3
Other forest	0	5,666	2.7
Grassland	432,250	173,174	0.8
Savanna	1,729,000	n/a	n/a
Marsh, mudflat, and open water			
Emergent wetland	38,487 ^a	34,486	14.1
Woody wetland	55,452 ^b	233,095	-0.6
Dry mudflat	2,223	2,945,882 ^c	-0.3
Open water	2,502	186,226	3.3

^a Includes habitat objectives for multiple focal species combined: shallow semi-permanent marsh, wet meadow with open water, wet mudflat/moist soil plants, shallow water depth (<2 in), and moderate water depth (2-8 in) subcategories.

^b Includes habitats for multiple focal species combined: marsh with associated shrub/forest and forested wetlands.

^c Area of row crop, which can provide some value to dry mudflat bird species.

Management Implications

Woodland:

- Despite slight declines in forest cover in recent years, upland forest is abundant relative to current JV forest habitat objectives; however, fragmentation should be addressed through conservation planning.
- Migration and wintering landbird objectives were not developed for the 2007 JV Plan, but the non-breeding period will be a focus of future JV planning. In the meantime, maintaining forest bird migration corridors, especially along river floodplains, should be considered a management priority.
- The area of available shrubland appears to be substantially lower than habitat objectives for shrubland birds and restoration of this cover type remains a priority (also see Central Hardwoods JV woodland planning information produced for the [Central Hardwoods Bird Conservation Region](#)).

Openland:

- Area of grassland appears inadequate to meet current breeding grassland bird objectives, and the area of savanna (mixed wooded openland) could not be determined with NLCD spatial data.
- Managers should seek opportunity to convert row crop back to native cover, particularly grassland, savanna, and shrubland. However, current JV population and habitat objectives for grassland / openland birds are likely not achievable based on recent economic and land use trends.

Marsh, mudflat, and open water:

- Wetland cover types were relatively stable between 2001 and 2006, but restoring and protecting high quality emergent marsh and wet meadow remains a priority as these cover types are still below goal.
- Expanding protection and restoration of marshes and riparian wetlands can help reduce river nutrient loading and potentially expand available mudflat areas associated with rivers.
- Areas of open water and dry mudflat appear adequate to meet habitat objectives for JV focal species, although the quality of these potential wetland-bird habitats could not be assessed using available data.
- Managers should seek opportunity to convert lowland/floodplain croplands to native wetland cover types as a means to improve water quality for open-water bird species plus downstream stakeholders.



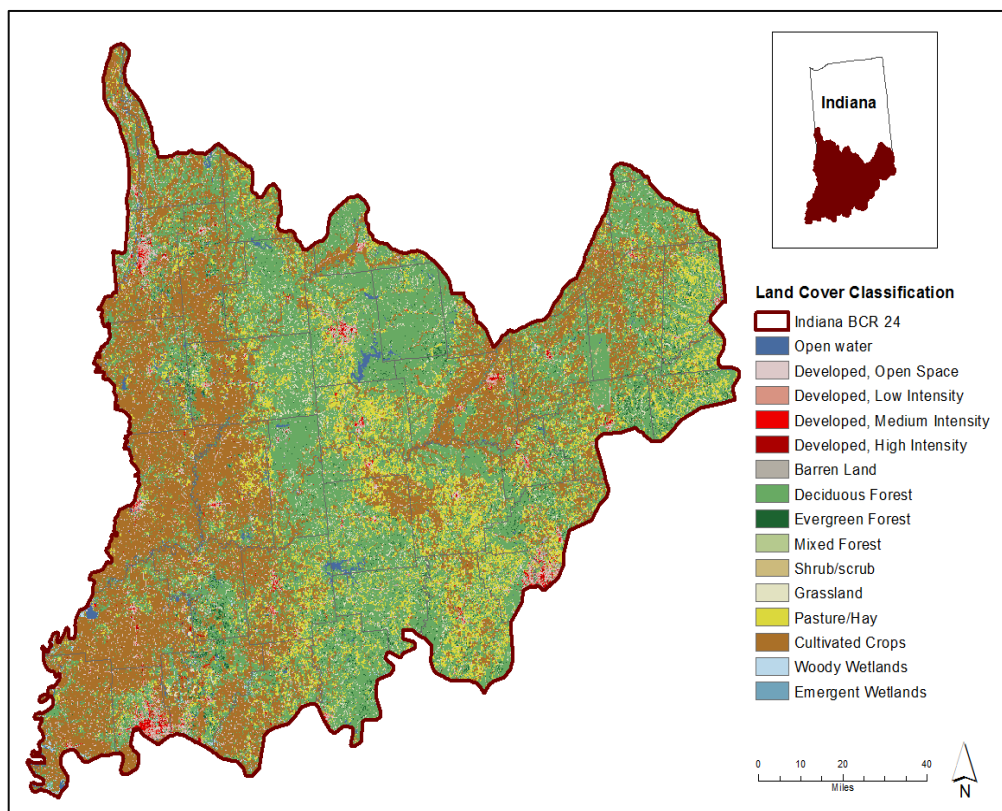
State by BCR Assessment

Indiana 24 – Central Hardwoods

This document was developed to serve as a stepped-down version of the 2007 [Joint Venture \(JV\) Implementation Plan](#) with focus on Indiana BCR 24, the Central Hardwoods portion of Indiana. It includes lists of bird species used for JV regional planning (i.e., focal species) that occur in manageable numbers in IN-24 and the land cover types, or bird habitat associations, they require. Bird habitat (cover type) objectives are presented for maintenance/protection and restoration/enhancement based on the 2007 JV Plan.

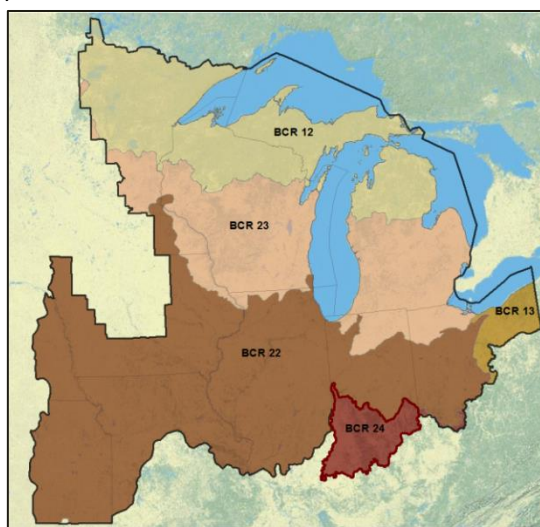
Spatial data were not available to assess each bird habitat type identified in the JV Plan, but recent trends in broad land cover categories believed to be important to JV focal species are provided. Land cover trend analyses are based on quantities (acres) calculated from the 2001 and 2006 [National Land Cover Database \(NLCD\)](#). Although area estimates do not translate into high quality bird habitats, significant increases or decreases in specific cover types likely result in similar population trends for species

associated with those cover types. Also included in this assessment are the amount and location of land currently protected, primary modes of recent cover type conversion, and general management implications for IN-24 bird conservation partners.



JV focal species were selected to facilitate planning and monitoring when developing the 2007 Implementation Plan. Population and habitat objectives for landbirds and waterbirds included the breeding period only, whereas objectives generated for waterfowl and shorebirds also included the non-breeding period (migration/winter). The following JV focal species represent bird guilds requiring specific cover types found in IN-24 (species within guild may be more common than focal species, see 2007 JV Plan).

Landbird	Shorebird
Whip-poor-will	American Golden-Plover
Chimney Swift	Killdeer
Red-headed Woodpecker	Upland Sandpiper
Willow Flycatcher	Dunlin
Wood Thrush	Short-billed Dowitcher
Blue-winged Warbler	American Woodcock
Cerulean Warbler	Wilson's Phalarope
Prothonotary Warbler	
Louisiana Waterthrush	Waterfowl
Kentucky Warbler	Tundra Swan
Yellow-breasted Chat	Wood Duck
Henslow's Sparrow	American Black Duck
Eastern Meadowlark	Mallard
Waterbird	Blue-winged Teal
Black-crowned Night-Heron	Canvasback
King Rail	Lesser Scaup



Bird Conservation Regions (BCR's) in the Upper Mississippi River and Great Lakes JV region.

Introduction

A primary goal of bird habitat Joint Ventures is to achieve continental bird population targets by designing landscapes with greater value to birds and employing conservation actions at regional, state, and smaller scales. To contribute to this goal, the UMRGLR JV developed an all-bird Implementation Plan in 2007, which included explicit regional bird population and habitat conservation objectives. These objectives were created by sequentially stepping-down continental population goals to the JV region, Bird Conservation Regions (BCRs), and the intersections of states and BCRs (e.g., IN-24). This “top-down” planning process relied on accurate population estimates and biological models to determine the amount of high quality habitat area needed to achieve bird population goals. A key assumption of the planning process was that population goals could be achieved with current and potential bird habitat cover types available on the landscape. JV planners also assumed existing bird habitats would remain available through time, but given the dynamic nature of some landscapes, this is not always the case.

Compared to the 2007 JV Implementation Plan, this complementary document includes updated and refined information to help guide IN-24 managers in decision making for bird habitat conservation. Its primary purpose was to use existing spatial data to evaluate the suitability of established focal species habitat objectives by comparing them with the area of cover type associated with that species (i.e., capacity of the landscape to support the objectives). Spatial data used in this analysis were the [National Land Cover Database \(NLCD\)](#) and [National Wetland Inventory \(NWI\)](#); however, these data are imperfect. Classification accuracy is 80-85% but lower for some cover types such as grassland, shrubland, and pasture/hay. In addition, these spatial data do not necessarily identify “high quality” bird habitats, where focal species abundance, survival, and reproduction are relatively high. Despite these inadequacies, NLCD and NWI are useful for indicating current land use and patterns of change, and are sufficient for identifying gross disparities between the JV's bird habitat objectives and available land covers. Updated cover type information, coupled with new bird research and monitoring data and JV partner priorities, will be used to improve future versions of the JV Implementation Plan.

Land Cover Change

Bird habitat objectives and decision-support maps in the 2007 JV Plan were developed using population information and 2001 NLCD. Although NLCD categories were often more general than JV habitat categories, NLCD (supplemented with NWI) provided a source of spatial data for the whole JV region. However, smaller-scale landscape conditions, trends in land cover, or how these conditions might correspond with JV objectives were not considered. Landscapes are not static, which inevitably has a strong bearing on the attainability of bird habitat objectives. As such, this assessment aims to provide a better understanding of land cover conditions in IN-24 and to illustrate how the landscape has changed since development of the 2007 JV Plan. Periodic assessment of landscape conditions allows us to identify land cover trajectories and provides a means to continually reevaluate the feasibility of achieving bird population and habitat objectives. Furthermore, knowledge of whether we are gaining or losing priority bird habitats and where on the landscape this change is occurring provides managers an additional tool to assist in focusing on-the-ground conservation efforts.

Table 1. General land cover types (acres) and percent change between 2001 and 2006 in Indiana BCR 24 based on NLCD. **Note: The correct classification rate of NLCD is 80 to 85%; misclassification often occurs between pasture and grassland categories and forested**

Cover Type	Year		% change from 2001	Acres gained/lost
	2001	2006		
Open Water	128,752	133,023	3.3	4,271
Urban	595,434	607,604	2.0	12,171
Barren	8,288	10,674	28.8	2,386
Upland Forest	3,841,951	3,829,926	-0.3	-12,026
Shrub/Scrub	22,162	22,666	2.3	504
Grassland/Hay/Pasture	1,162,174	1,160,980	-0.1	-1,194
Grassland	171,715	173,175	0.8	1,460
Row Crops	2,953,642	2,945,882	-0.3	-7,760
Wetlands	52,901	54,549	3.1	1,649
Emergent Wetlands	13,278	15,151	14.1	1,873
Woody Wetlands	39,622	39,398	-0.6	-224
Total	8,765,303	8,765,303		

IN-24 is a mosaic of upland forest, row crops, and grassland/hay/pasture (Table 1).¹ Upland forest, the dominant cover type, declined slightly between 2001 and 2006, accounting for a 12,000 acre loss, and area of row crops declined by nearly 7,800 acres. Conversely, urban cover increased by nearly 12,200 acres, an area 10% larger than Lake Monroe located south of Bloomington. Gains in urban cover came primarily from land previously in row crop and upland forest (Figure 1, Table 2), representing permanent habitat loss for some bird species. This conversion to urban cover occurred primarily adjacent to metropolitan areas (Figure 2). Moreover, there was substantial gain in barren cover, which likely represents a transitional stage between upland forest and urban development (Figure 1, Table 2). Land cover types that were largely stable in area between 2001 and 2006 were shrub/scrub, grassland, hay/pasture, and forested wetlands.

¹ To evaluate landscape change, we compared satellite imagery (NLCD) of IN-24 between 2001 and 2006. We used ArcGIS to determine whether a given pixel (30 x 30 m resolution) changed from one cover type to another. We collapsed cover types into eight distinct categories; open water, urban, barren, upland forest, shrub/scrub, grassland/hay/pasture, row crops, and wetlands. Although coarse, these broad cover types provide a good indication of landscape composition and a means for prioritizing finer scale analyses.

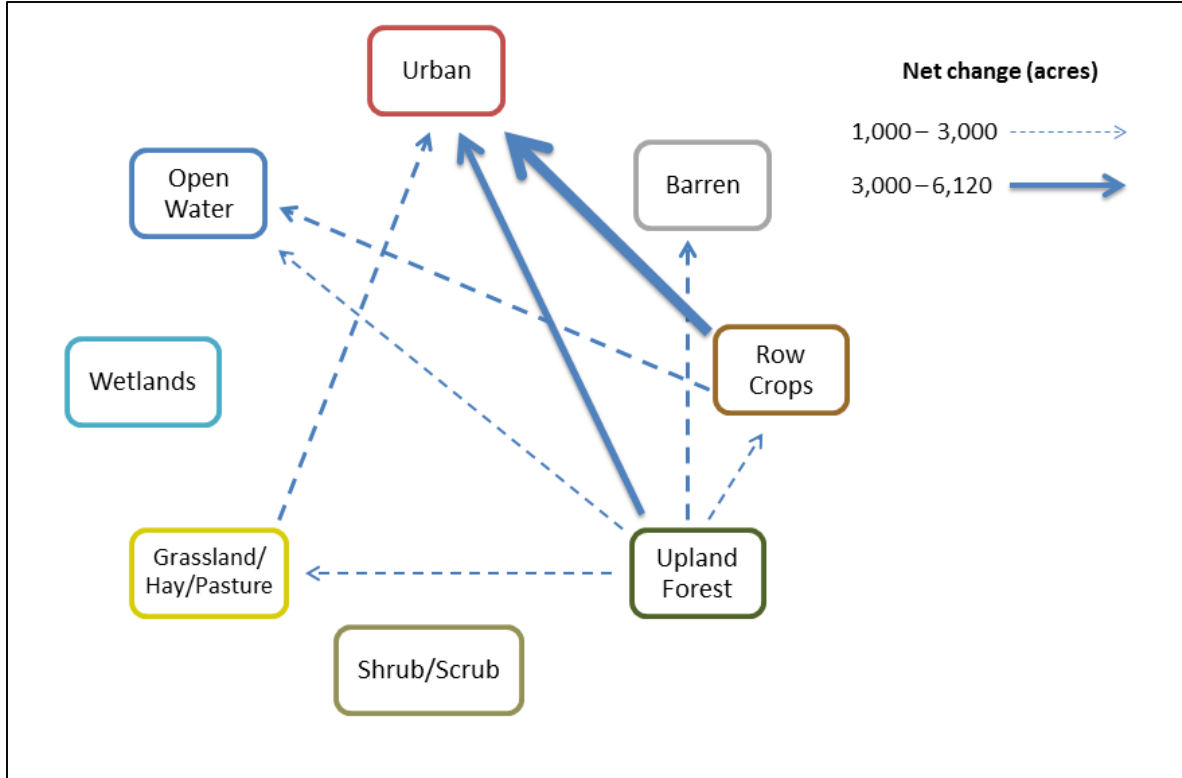


Figure 1. Net change of general land cover types (>1,000 acres converted) in Indiana BCR 24 between 2001 and 2006 (NLCD). Arrows point in the direction of change between two cover types and line thickness increases in proportion to amount of net change. “Wetlands” include woody and emergent herbaceous wetland, whereas “upland forest” represents upland (non-wetland) forest cover.

Table 2. Conversion (acres) of primary land cover types in Indiana BCR 24 between 2001 and 2006. Grey cells represent the acreage in which no change occurred, whereas remaining cells represent the area of 2001 cover types (vertical axis) converted to other cover types by 2006 (horizontal axis). For example, between 2001 and 2006, 163 acres of open water converted to wetland and 88 acres of wetland converted to open water, for a net change among these two cover types of +75 wetland acres (also see Figure 1). **Note: The correct classification rate of NLCD is 80 to 85%; misclassification often occurs between pasture and grassland categories and forested wetlands and upland forest categories.**

Land Cover Type		2006							
		Open Water	Urban	Barren	Upland Forest	Shrub/Scrub	Grassland/Hay/Pasture	Row Crops	Wetlands
2001	Open Water	128,058	64	99	7	0	129	232	163
	Urban	2	595,430	1	0	0	0	0	0
	Barren	375	30	7,329	0	0	458	62	34
	Upland Forest	1,617	3,254	2,619	3,829,347	524	1,268	2,415	908
	Shrub/Scrub	21	21	12	1	22,067	13	21	6
	Grassland/Hay/Pasture	339	2,585	144	144	7	1,158,723	150	81
	Row Crops	2,523	6,106	434	426	64	349	2,942,957	783
	Wetlands	88	115	37	1	4	39	44	52,573

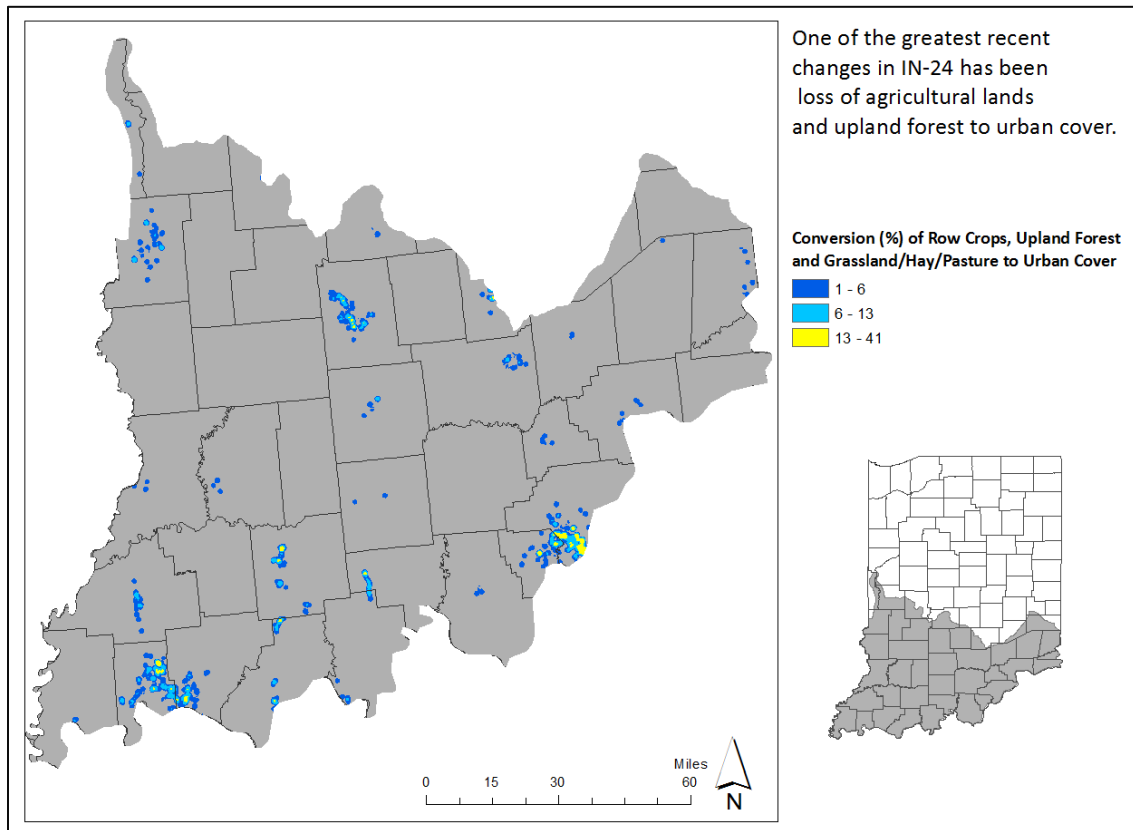


Figure 2. Conversion (percent total area converted within 1 km circular radius) from row crops, upland forest, and grassland/hay/pasture to urban cover in Indiana BCR 24, 2001 to 2006 (NLCD).

Bird Habitat Objectives and Cover Type Availability

JV bird habitat conservation objectives fall under two categories: “maintain and protect” (hereafter maintenance) and “restore and enhance” (hereafter restoration). Maintenance objectives reflect estimated area of habitat needed to maintain current bird populations, whereas restoration objectives were generated based on population deficits (deficit = population goal - current population) and represent the amount of new habitat needed to achieve JV population goals. For each category, there are breeding and non-breeding bird habitat objectives. Breeding objectives were established for all four bird groups – waterfowl, waterbirds, shorebirds, and landbirds – whereas non-breeding (migration and wintering) objectives were developed only for only shorebirds and waterfowl. Breeding habitat was calculated based on cover-type area needed for successful reproduction and non-breeding habitat was based on food-energy needs critical to survival.

Objectives presented here represent the total of IN-24 objectives in the 2007 JV Plan. The area of cover types potentially providing bird habitat was estimated using the National Wetland Inventory for wetlands and National Land Cover Database (NLCD 2006) for upland / openland. Location and ownership of public lands was also assessed. Spatial data from the [Protected Areas Database \(PAD\)](#), the [Conservation and Recreation Lands Database \(CARL\)](#), and the [National Conservation Easement Database](#) were pooled to display IN-24 protected land configuration and ownership composition (Figure 3). [December 2013](#), 240,800 acres were enrolled in the Conservation Reserve Program (CRP) in Indiana with roughly 95,500 acres scheduled to expire by 2018. We were unable to partition total Indiana CRP enrollment to the IN-24 portion of the state or assess land cover composition of CRP lands due to privacy protections in the U.S. Farm Bill.

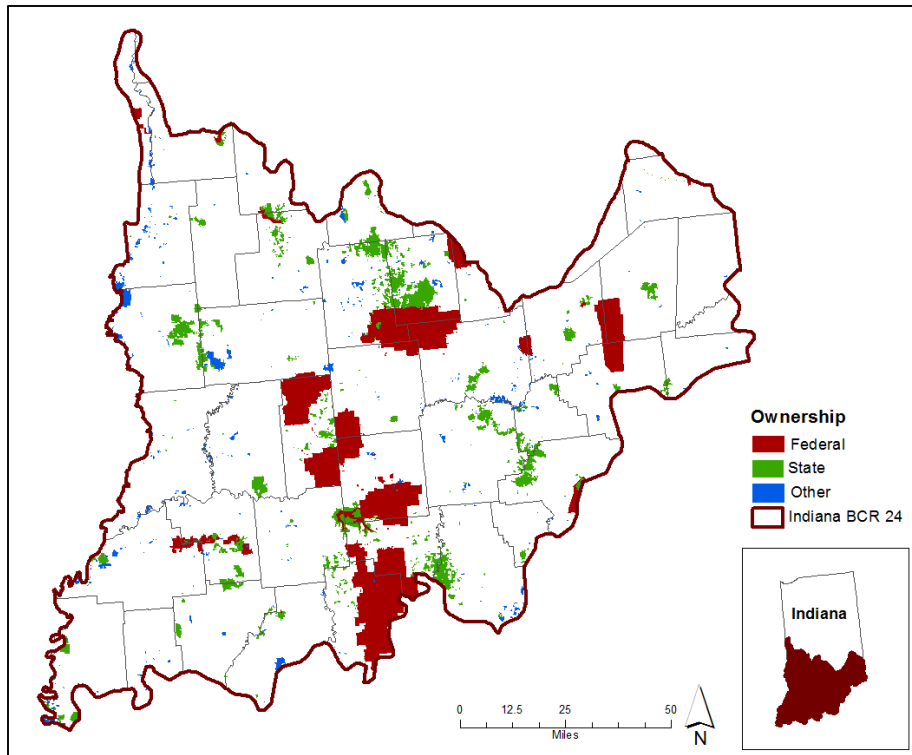


Figure 3. Location of federal, state, or other conservation lands in Indiana Bird Conservation Region 24. “Other” ownership category includes private land with temporary and permanent easements, conservancy land, and county, township, and city owned land. Conservation lands spatial data suggest total area conserved (excluding CRP lands) is about 1,048,000 acres, including up to 916,366 woodland/grassland acres and up to 131,848 acres of marsh wetland, row crops, and open water. However, these estimates include numerous private holdings within mapped federal-land administrative boundaries.

Woodland and Openland

The estimated area of high quality habitat needed in IN-24 to maintain current populations of birds dependent on woodland and openland is 1.72 million acres (Table 3). This area, plus an additional 1.74 million acres of restored high quality habitat is predicted to achieve a landscape design adequate (i.e., provide carrying capacity) to meet JV population goals for breeding woodland and openland birds. The overall 3.5-million acre objective represents 20% of the total area of IN-24 and considerably more than what is currently under federal, state, or other protection (Table 3). Savanna (mixed wooded openland) accounts for half of IN-24 upland bird habitat objectives in the 2007 JV Plan.

Landbird cover types and focal species

Deciduous forest	Whip-poor-will, Wood Thrush, Cerulean Warbler, Louisiana Waterthrush, Kentucky Warbler
Forest generalist	Chimney Swift
Forested wetland	Prothonotary Warbler
Shrubland	American Woodcock, Blue-winged Warbler, Willow Flycatcher, Yellow-breasted Chat
Grassland	Upland Sandpiper, Henslow's Sparrow, Eastern Meadowlark
Savanna	Red-headed Woodpecker

Woodland.—Objectives developed for deciduous forest, forested wetland, and shrubland were all driven by the needs of breeding landbirds. IN-24 encompasses about 4,072,000 acres of woodland, of which an estimated 852,300 acres are located within a protected area boundary based on available spatial data (Table 3). Forest cover is well above objective levels (except for shrubland); however, forest fragmentation is a concern because it can limit habitat quality for breeding forest birds. IN-24 forests are moderately fragmented, having size and configuration that may limit daily survival and productivity of area- and edge-sensitive forest birds. Habitat objectives for shrubland birds (854,600 acres) were substantially higher than the estimated area of shrubland available (Table 3). However, the shrubland cover type is poorly mapped and estimates based on remote sensing (i.e., NLCD) are not sufficient for assessment. Local managers should consult the [USDA Forest Service](#)

[Forest Inventory and Analysis](#) (FIA) program for county-level measures of this rather dynamic cover type. Also, see forest and shrubland bird conservation strategies developed by the Central Hardwoods Joint Venture ([Central Hardwoods Bird Conservation Region](#)).

Table 3. Upland bird habitat maintenance and restoration objectives (acres) by primary woodland and openland cover types and the estimated amount of each currently on the landscape in Indiana BCR 24. Objectives are from the 2007 JV Implementation Plan and represent area of high quality habitat required to meet the needs of JV focal species during the breeding period. Cover types were measured using the National Land Cover Database (2006), except forested wetland which was determined using National Wetland Inventory. Conservation status (protected land) and ownership was determined using the Protected Areas Database, Conservation and Recreation Lands Database, and National Conservation Easement Database.

Bird habitat categories	Habitat objective ^a		Cover type area on landscape	Land cover			
	Maintenance	Restoration		Conservation status (protected) ^b			
				Federal	State	Other	Total
Woodland							
Deciduous forest	264,537	132,392	3,711,440	482,327	249,203	38,459	769,989
Evergreen forest	0	0	112,818	16,143	11,577	704	28,424
Forested wetland	29,640	14,820	219,274	19,210	13,611	12,118	44,939
Shrub/scrub	345,800	508,820	22,667	6,667	912	64	7,643
Other forest	0	0	5,666	828	487	27	1,342
Openland							
Grassland	216,125	216,125	173,174	18,278	3,136	714	22,128
Pasture/Hay ^c	--	--	987,805	32,017	6,118	3,766	41,901
Savanna	864,500	864,500	na ^d	na	na	na	na
Total	1,720,602	1,736,657	5,232,844	575,470	285,044	55,852	916,366

^aUpland bird habitat objectives are for the breeding period only; non-breeding habitat objectives were not calculated for landbirds (see 2007 JV Implementation Plan for more detail).

^bEstimated area of government-owned land, especially federal land, is inflated as spatial data included all lands within large administrative boundaries.

^cBird habitat objectives were not established for this primary NLCD cover type providing openland value.

^dna indicates cover type area could not be estimated due to resolution limitations of spatial data.

Openland.—The grassland-bird guild used for JV planning requires an estimated 432,300 acres of high quality habitat in IN-24, and the region contains an estimated 173,200 acres of grassland plus 987,800 acres of pasture/hay based on the 2006 NLCD (Table 3). The amount of grassland appears inadequate to meet objectives as hay and pasture rarely provide quality grassland bird habitat. Some agricultural practices (i.e., early hay mowing, pasture over stocking) and fragmentation of large grasslands have generally been detrimental to breeding grassland birds.

Savanna objectives (1,729,000 acres; Table 3) are based on the estimated breeding habitat requirements of birds occupying savanna (e.g., Red-headed Woodpecker). This cover type is not mapped by NLCD and assessing the landscape's capacity for supporting current and future populations of savanna birds is not possible with these spatial data. In addition, the savanna area objective will likely be reduced substantially in future JV planning based on new information.

Marsh, Mudflat, and Open Water

The estimated area of high quality habitat needed in IN-24 to maintain current populations of birds dependent on marsh, mudflat/shallows, and open water is about 44,900 acres (Table 4)². This area, plus an additional 9,300 acres of restored high quality wetland is predicted to be adequate to meet JV population goals for breeding and non-breeding wetland birds. This 54,200-acre habitat objective represents about 1.2% of the area in IN-24.

Wetland and open water cover types and focal species	
Deep water marsh	Tundra Swan, American Black
Wet meadow w/ open water	Blue-winged Teal
Semi-permanent/hemi-marsh	American Black Duck, Mallard, King Rail
Marsh with shrub/forest	Wood Duck, Black-crowned Night-Heron
Wet mudflat/moist soil plants	Blue-winged Teal, Dunlin
Shallow water (<5 cm)	Short-billed Dowitcher
Moderate water (5-20 cm)	Wilson's Phalarope
Dry mudflat	American Golden-Plover, Killdeer
Open water	Canvasback, Lesser Scaup

Marsh.—Habitat objectives were developed in the JV Plan for breeding wetland bird groups dependent on four marsh categories totaling about 42,200 acres: wet meadow with open water and shallow semi-permanent marsh / hemi-marsh (30,500 ac), marsh with associated shrub or forest (11,000 ac), and deep-water marsh (650 ac). Some wetland categories were combined for this analysis (Table 4) due to resolution limitations of NWI and NLCD spatial data. Results suggest a total of 48,300 acres of marsh wetlands currently available in IN-24 of which an estimated 32% are protected based on available spatial data (Table 4). Thus, JV conservation objectives for marsh cover types, driven largely by the habitat needs of breeding waterfowl, are similar to the estimated area of marsh wetland available.

Habitat objectives for the non-breeding period were most substantial for shallow semi-permanent marsh and deep water marsh, reflecting the habitat needs of migrating and wintering waterfowl. Although semi-permanent marsh available during the breeding season will also accommodate birds during the non-breeding period, the deep water marsh objective (652 ac) for IN-24 is primarily important for non-breeding birds (Table 4). We were unable to determine the quality of existing marsh for breeding or non-breeding wetland birds based on NWI spatial data.

Mudflat and Shallows.—Objectives for wet mudflat, shallow-depth (<2 in), and moderate-depth (2-8 in) open wetland communities were based on the energetic needs of migrating shorebirds and waterfowl. These objectives total 7,400 acres of high quality wet mudflat and shallow-water habitat for wetland birds (Table 4). However, assessing the area of these bird habitats is difficult using remotely sensed data as they are not adequately identified by NWI. These cover types are also dynamic and conditions can change daily and seasonally, making one-time static assessments (i.e., NWI) poor estimators of cover type availability. The area of dry mudflat, which is represented by row crop fields in NLCD (i.e., agricultural fields provide value to some shorebirds), is far greater than objectives in the JV Plan. About 69,000 acres of IN-24 row crops are protected based on conservation lands spatial data. These data also suggest 34,900 acres of government lands are row crop (Table 4); estimates likely include private lands within mapped federal/state administrative boundaries.

Open Water and Beach.—Objectives for extensive open-water areas are based on the habitat needs of migrating and wintering diving ducks. This group requires an estimated 2,500 acres of high quality foraging and resting habitat when populations are at goal levels. Whereas the region has abundant open water locations (Table 4), low food availability and human disturbance may negatively influence use of some open-water areas.

² Acreage totals for habitat objectives in this section represent cumulative total of highest values between breeding and non-breeding habitat objectives for each cover type. For example, the estimated area of quality habitat needed in IN-24 to maintain current populations of birds dependent on dry mudflat is 911 acres, as the breeding objective (911 ac) is greater than the non-breeding objective (598 ac) (See Table 4).

Table 4. Wetland bird habitat maintenance and restoration objectives (acres) for marsh, mudflat, and open water and the estimated amount of each cover type currently on the landscape in Indiana BCR 24. Objectives are from the 2007 JV Implementation Plan and represent the estimated area of high quality habitat required to meet the needs of JV focal species and planning guilds during both breeding (B) and non-breeding (N) periods. Cover types were measured using National Wetland Inventory; National Landcover Database (2006) was used for dry mudflat and beach. Conservation status (protected land) and ownership was determined using the Protected Areas Database, Conservation and Recreation Lands Database, and National Conservation Easement Database.

Bird habitat categories	Habitat objective				Cover type area on landscape	Land cover			
	Maintenance		Restoration			Conservation status (protected) ^a			
	B	N	B	N		Federal	State	Other	Total
Marsh									
Deep-water marsh	0	652	0	0	1,883	507	104	57	668
Shallow semi-permanent marsh ^b	14,596	27,960	2,504	1,378	32,603 ^c	2,167	1,908	4,809	8,884
Marsh with shrub/ forest	9,159	0	1,833	0	13,821	3,578	1,327	768	5,673
Mudflat and shallows									
Wet mudflat/ shallows ^d	0	4,071	0	3,300	na ^e	na	na	na	na
Dry mudflat ^f	911	598	1,312	373	2,945,882	22,304	12,558	34,113	68,975
Open water and beach									
Extensive open water	0	2,114	0	388	186,226 ^g	22,642	20,495	3,647	46,784
Beach	0	0	0	0	10,675 ^g	642	190	32	864
Total	24,666	35,395	5,649	5,439	3,191,090	51,840	36,582	43,426	131,848

^aEstimated area of government-owned land, especially federal land, is inflated as spatial data included all lands within large administrative boundaries.

^bBird habitat objectives for "shallow semi-permanent marsh" also include objectives set for "wet meadow with areas of open water" in the 2007 JV Plan.

^cCover type area for "shallow semi-permanent marsh" includes emergent marsh within palustrine, lacustrine, and riverine categories in NWI.

^dBird habitat objectives for "wet mudflat/shallows" category incorporates objectives for "wet mudflat," "shallow water depth (<2 in)" and "moderate water depth (2-8 in)" open flats in the 2007 JV Plan.

^ena indicates that bird habitat objectives were not set for a cover type or that a cover type could not be estimated due to resolution limitations of spatial data.

^fDry mudflat/agriculture was a bird habitat category used in the 2007 JV Plan and "row crop" (NLCD) is the cover type measured on the landscape.

^gCover type area for "extensive open water" represents lacustrine, riverine, and unconsolidated bottom and shore categories (NWI) whereas "beach" is the area of sand/gravel/bedrock with little vegetation (NLCD).

Management Implications

Within the JV region, IN-24 is unique for its expansive upland forests, juxtaposed within a highly agricultural landscape. This area is extremely valuable to forest breeding and non-breeding birds and remains a stronghold for many area-sensitive JV focal species. Objectives for migrating and wintering forest birds were not developed for the 2007 Implementation Plan, but this emphasis will be addressed in future JV landbird planning efforts.

Slight declines in forest cover occurred in recent years, but IN-24 forest is abundant relative to JV objectives and considerable amounts of forest area are currently in public ownership. However, fragmentation and reduced habitat quality of remaining forest tracts are of high conservation concern. JV partner collaboration with foresters and the timber industry will be key to improvements: silvicultural practices to mitigate fragmentation, connecting forest patches to increase tract size, increasing habitat quality of existing oak-hickory stands via controlled burns and mechanical thinning, and increasing forest diversity by reducing "high grading." The existing area of shrub/scrub is substantially lower than habitat objectives for shrubland birds. Although this

cover type is poorly mapped with available spatial data, populations of species dependent on shrub and young-growth forest are generally declining in the JV region and should be considered in forest management planning, especially where “short rotation” management is appropriate. Additional concerns in IN-24 include the effects of fire suppression, deer herbivory, cattle grazing within woodlots, and lack of management on forest composition and structure. Practices that restore and maintain diverse native tree composition help assure higher quality habitat for forest-breeding birds and must be considered in future management scenarios.

Areas once covered by grassland and savanna have largely been converted to pasture or row crops in IN-24, or they have succeeded to forest through succession processes and lack of fire. Despite slight increases in grassland, the area of this cover type is well below habitat objective for JV focal species and only a small portion of grassland is protected under conservation ownership. Because permanent protection (public ownership) of vast grassland is unfeasible in this region, partners must continue seeking opportunities to promote grassland bird conservation on private lands. The 2007 JV Implementation Plan includes significant habitat objectives for savanna birds dependent on mixed-wooded openland. We could not assess the abundance or quality of this cover type given the spatial data available, but the area of this cover type is expected to be far below objective levels. Fire suppression and lack of disturbances that historically favored oak savanna, raises questions about whether large oak openings can ever return to their former dominance within the region. However, IN-24 partners should investigate ways to target conservation and restoration of savanna through active forest management. Moreover, natural resource managers may have a greater impact maintaining grassland and savanna by working with the agricultural community, especially where a focused effort may connect open landscapes valuable to birds.

Wetland cover types mapped by NWI and NLCD were relatively stable between 2001 and 2006. The current area of dry mudflat appears more than adequate to meet habitat objectives for JV focal species. Likewise, habitat objectives established for marsh cover types nearly match the area of these cover types on the landscape, but the quality (high vs. low bird reproduction / survival) of these emergent wetlands could not be determined. In addition, spatial data were inadequate to thoroughly assess emergent wetland types (hemi-marsh vs. wet meadow) and their timing of availability (recently wet vs. wet when image was taken). IN-24 partners should continue expanding protection of marsh and wet meadow providing quality wetland-bird habitat, while working toward simultaneously improving quality of adjacent open water bird habitats.

A significant area of state and federally owned lands were mapped as cultivated cropland, and managers may have opportunity to convert some areas back to native cover, particularly grassland and savanna, when conditions are suitable. In addition, connecting “permanent” openings associated with right-of-ways (e.g., highways, utility corridors), perpetual grassland/pasture easements, mine-land reclamations, and marsh complexes can result in management efficiencies by providing larger openland areas/unit cost. Finally, conversion of row crops to native cover types can serve purposes beyond bird habitat restoration. For example, IN-24 is a contributor to hypoxia in the Gulf of Mexico due to nutrient loading of river systems in this agriculturally dominated landscape. Targeting both bird habitat conservation and reduced nutrient loading of tributaries of the Mississippi River should be a priority.

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