UPPER MISSISSIPPI RIVER & GREAT LAKES REGION
JOINT VENTURE
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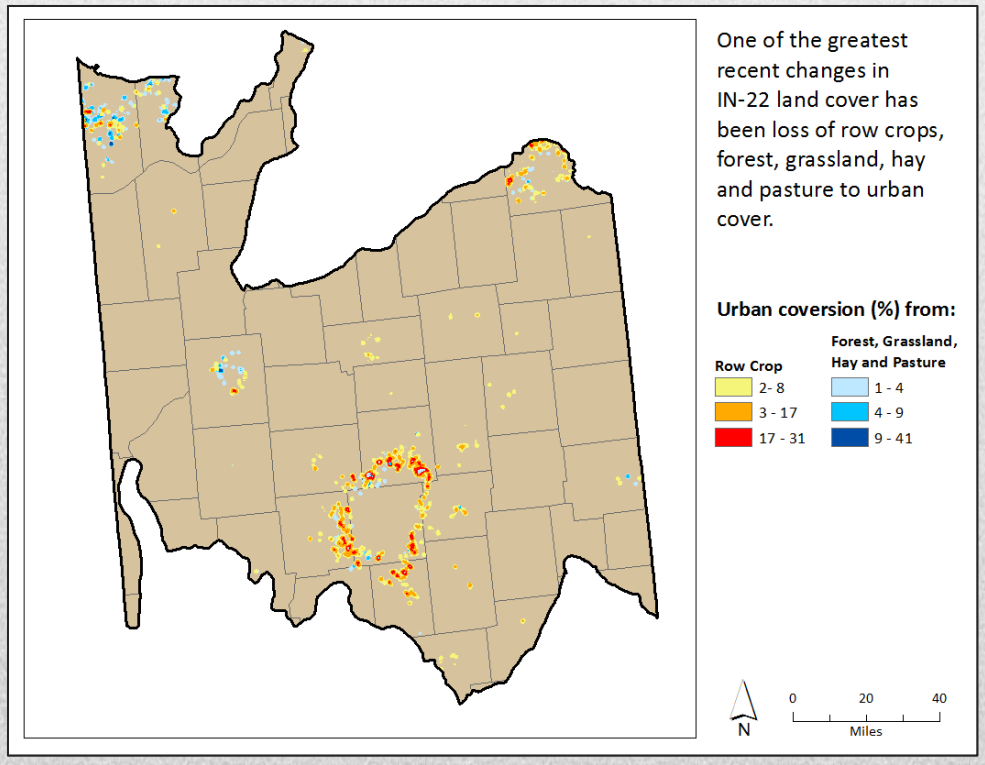
Indiana BCR 22 – Assessment Summary

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 22 (IN-22) "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-22 assessment for more details.**



Primary cover-types

IN-22 consists of extensive urban cover (13%), upland forest (10%), and grassland/hay/pasture (5%), but its primary cover type is row crop (70%). Urban land expanded (+42,000 ac) between 2001 and 2006, whereas total acreage of row crop (-35,000 ac), upland forest (-4,800 ac), and grassland/hay/pasture (-4,300) declined. Gain in urban acreage was largely the result of conversion from 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 22. 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	0	1,024,772	-0.5
Evergreen forest	0	7,300	0.9
Shrubland	454,480	32,148	-1.8
Other forest	0	1,673	-2.8
Grassland	463,372	138,866	-1.4
Savanna	1,440,998	n/a	n/a
Marsh, mudflat, and open water			
Emergent wetland	72,555[a]	49,467	2.9
Woody wetland	15,781[b]	63,006	-1.4
Dry mudflat	37,771	7,560,357[c]	-0.5
Open water	7,376	116,490	2.3

[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:

- Forest cover is greater than needed to meet current JV breeding bird objectives, yet fragmentation should be reduced through conservation planning.
- Migration and wintering landbird objectives were not developed for the 2007 JV Plan, but the non-breeding period will be addressed in the future. 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.

Openland:

- Grassland is only 30% of the area needed to meet 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, when conditions are suitable. However, current JV population and habitat objectives for grassland / openland birds are likely not be achievable with current economic and land use trends.

Marsh, mudflat, and open water:

- Wetland cover types were relatively stable between 2001 and 2006, but restoring and protecting quality marsh-bird habitat is a priority as emergent wetland area is still below goal.
- Partners should focus on expanding protection and restoration of emergent marsh and wet meadow and provide energy resources (e.g., shallows/moist-soil foods) where this practice is suitable.
- 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.
- Low water quality and associated lack of waterfowl forage (e.g., aquatic plants, invertebrates) is a concern in many open water areas, especially large rivers.

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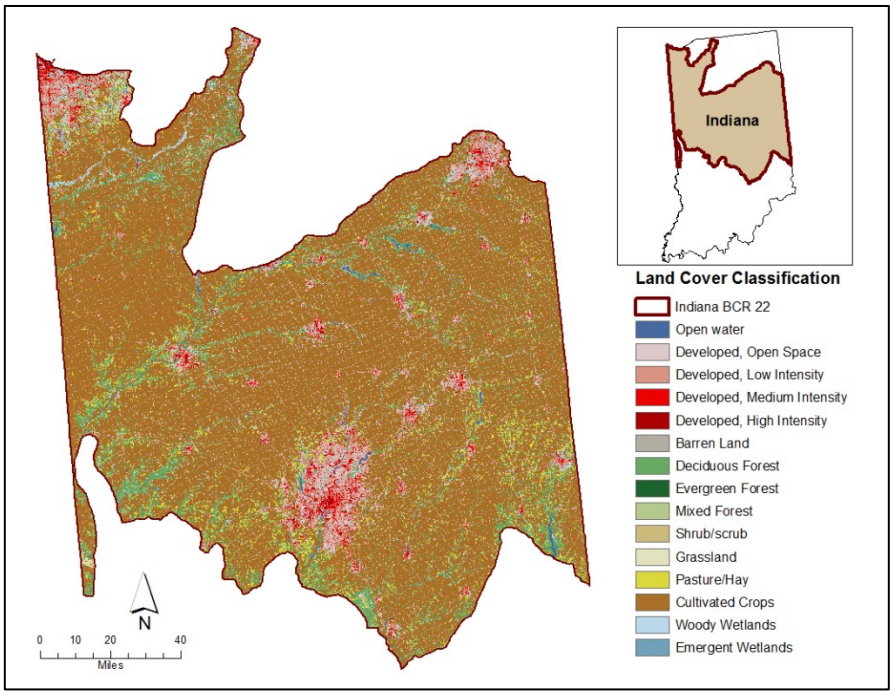
State by BCR Assessment

Indiana 22 – Eastern Tallgrass Prairie

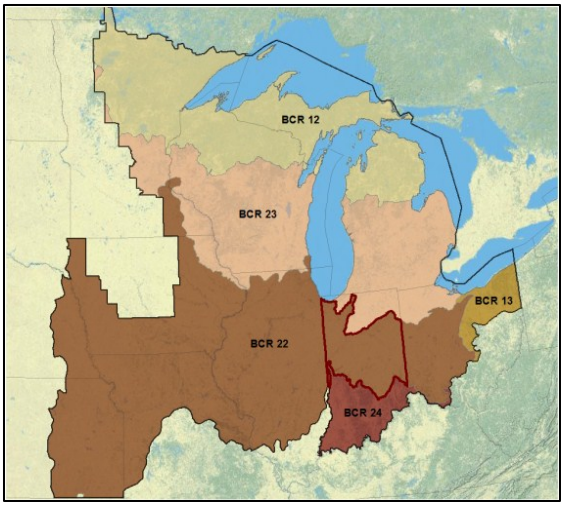
This document was developed to serve as a stepped-down version of the 2007 Joint Venture (JV) Implementation Plan with focus on Indiana BCR 22, the Eastern Tallgrass Prairie portion of Indiana. It includes lists of bird species used for JV regional planning (i.e., focal species) that represent land cover types, or bird habitat associations, important to bird guilds occurring in IN-22. 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 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 under protection, primary modes of recent cover type conversion, and general management implications for IN-22 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-22 (species within guild may be more common than focal species, see 2007 JV Plan).

Landbird	Shorebird	Waterbird
Whip-poor-will	American Golden-Plover	Black-crowned Night-Heron
Chimney Swift	Killdeer	King Rail
Red-headed Woodpecker	Upland Sandpiper	Black Tern
Willow Flycatcher	Sanderling	Common Tern
Wood Thrush	Dunlin	**Waterfowl**
Cerulean Warbler	Short-billed Dowitcher	Tundra Swan
Prothonotary Warbler	American Woodcock	Wood Duck
Louisiana Waterthrush	Wilson's Phalarope	American Black Duck
Kentucky Warbler		Mallard
Yellow-breasted Chat		Blue-winged Teal
Henslow's Sparrow		Canvasback
Eastern Meadowlark		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-22). 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 quality 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-22 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 NCLD 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-22 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 22 based on NLCD. 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.

	Year			Acres
Cover Type	2001	2006	% change	gained/lost
Open Water	71,676	73,333	2.3	1,657
Urban	1,361,890	1,403,928	3.1	42,038
Barren	3,477	4,919	41.5	1,443
Upland Forest	1,040,197	1,035,444	-0.5	-4,754
Shrub/Scrub	32,734	32,148	-1.8	-586
Grassland/Hay/Pasture	571,833	567,539	-0.8	-4,294
Grassland	140,792	138,866	-1.4	-1,925
Row Crops	7,595,496	7,560,357	-0.5	-35,139
Wetlands	81,300	80,935	-0.4	-365
Emergent Wetlands	17,423	17,929	2.9	506
Woody Wetlands	63,877	63,006	-1.4	-872
Total	10,758,603	10,758,603		

IN-22 is dominated by row crop agriculture, with large amounts of urban cover and upland forest (Table 1).[1] Row crop area declined slightly between 2001 and 2006, accounting for a 35,000 acre loss, and upland forest declined by nearly 4,800 acres. Conversely, urban cover increased by 42,000 acres, roughly the area equivalent to the cities of Muncie and Anderson combined. Gains in urban cover came primarily from land previously in row crop, grassland/hay, and upland forest (Figure 1, Table 2), representing permanent habitat loss for some bird species. Gain in barren cover likely represents a transitional stage between agriculture and urban development. Most row crop and upland forest conversion to urban cover occurred adjacent to metropolitan areas (Figure 2). In addition to upland forest, land cover types that were largely stable in area between 2001 and 2006 were open water, shrub/scrub, grassland, hay/pasture, and wetlands.

[1] To evaluate landscape change, we compared satellite imagery (NLCD) of IN-22 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 general landscape composition and a means for prioritizing finer scale analyses.

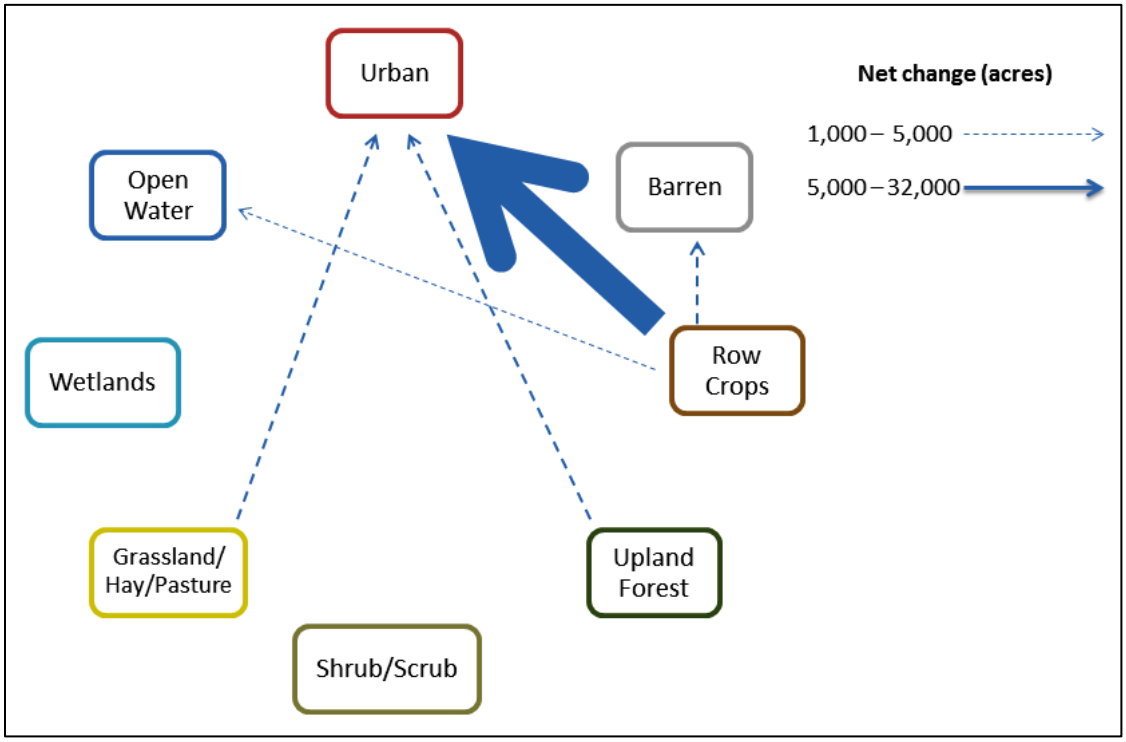


Figure 1. Net change of general land cover types (>1,000 acres converted) in Indiana BCR 22 between 2001 and 2006 (NLCD). Arrows point in the direction of change between two cover types and line thickness increases in proportion to amount of net change. "Wetlands" include woody and emergent herbaceous wetland, whereas "upland forest" represents upland (non-wetland) forest cover.

Table 2. Conversion (acres) of primary land cover types in Indiana BCR 22 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) coverted to other cover types by 2006 (horizontal axis). For example, between 2001 and 2006, 110 acres of open water converted to wetland and 83 acres of wetland converted to open water, for a net change among these two cover types of +27 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	70,924	269	56	15	12	39	134	110
	Urban	0	1,359,664	0	0	0	0	0	0
	Barren	486	90	2,895	0	0	0	0	0
	Upland Forest	285	3,111	137	1,033,374	242	97	924	326
	Shrub/Scrub	140	687	36	4	31,618	39	119	36
	Grassland/Hay/Pasture	102	4,518	169	28	20	565,940	48	73
	Row Crops	1,193	32,282	1,604	259	156	472	7,546,587	528
	Wetlands	83	1,013	15	71	48	23	185	79,729

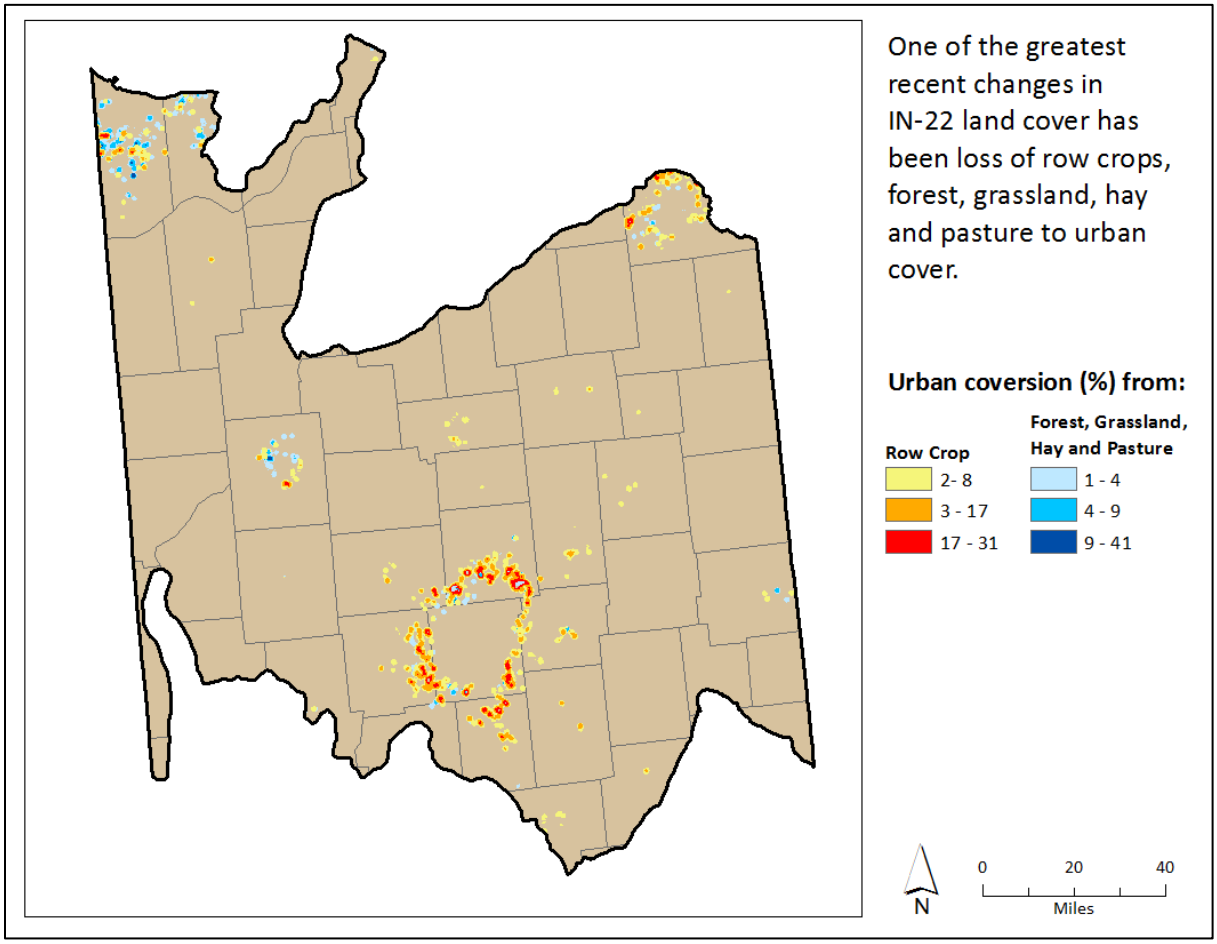


Figure 2. Conversion (percent total area converted within 1 km circular radius) from row crop cover to urban (yellow to red) and from forest, grassland, hay and pasture to urban (light to dark blue) in Indiana BCR 22, 2001 to 2006 (NLCD).

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 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-22 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-22 protected

land configuration and ownership composition (Figure 3). In December 2013, 241,000 acres were enrolled in the Conservation Reserve Program (CRP) in Indiana with roughly 95,000 acres scheduled to expire by 2018. We were unable to partition total Indiana CRP enrollment to the IN-22 portion of the state or assess land cover composition of CRP lands due to privacy protections in the U.S. Farm Bill.

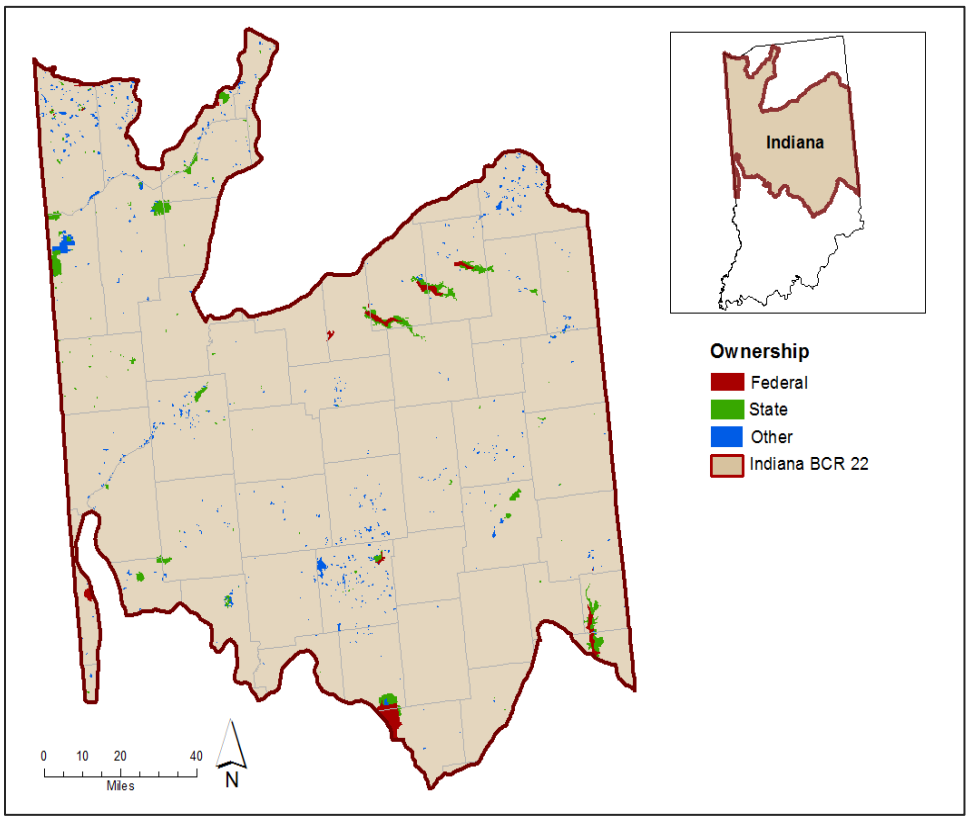


Figure 3. Location of federal, state or other conservation lands in Indiana Bird Conservation Region 22. "Other" ownership category includes private land with temporary and permanent easements, conservancy land, and county, township and city owned land. Total land area conserved (excluding CRP lands) is 233,300 acres, including 125,400 woodland/grassland acres and 83,900 acres of row crops, open water, and marsh wetland.

Woodland and Openland

The estimated amount of woodland and openland/grassland needed in a high quality habitat condition to maintain current landbird populations is 1.14 million acres (Table 3). This represents 11% of the total area of IN-22 and considerably more than what is currently under federal, state or other protection (Table 3). Savanna (mixed wooded openland) accounts for a majority (63%) of IN-22 upland bird habitat objectives in the 2007 JV Plan.

Landbird cover types and focal species	
Deciduous forest	Cerulean Warbler, Louisiana Waterthrush, Kentucky Warbler
Forested wetland	Prothonotary Warbler
Forest generalist	Chimney Swift
Shrubland	American Woodcock, 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, shrubland, and other mixed forest were all driven by the needs of breeding landbirds. IN-22 encompasses about 1,233,000 acres of woodland, of which 111,500 acres are protected (Table 3). Forest cover is well above objective levels and especially abundant along river floodplains, but forest fragmentation is a concern because it can limit habitat quality for breeding forest birds. IN-22 forests are largely fragmented having size and configuration that may limit daily survival and productivity of species sensitive to forest fragmentation.

Habitat objectives for shrubland birds (455,000 acres) were substantially higher than the estimated area of shrubland available in IN-22 (Table 3). However, shrubland cover types are 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.

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 22. Objectives are from the 2007 JV Implementation Plan and represent estimated area of 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.

	Habitat objective[a]		Land cover				
				Conservation status (protected)			
Bird habitat categories	Maintenance	Restoration	Cover type area on landscape	Federal	State	Other	Total
Woodland							
Deciduous forest	3,211	3,211	1,024,772	24,476	51,450	15,244	91,170
Evergreen forest	0	0	7,302	82	867	198	1,147
Forested wetland	741	247	167,102	1,366	11,607	1,016	13,989
Shrub/scrub	187,720	266,760	32,096	1,161	3,114	853	5,128
Other forest	0	0	1,673	7	79	22	108
Openland							
Grassland	231,686	231,686	138,886	1,147	2,009	1,263	4,419
Pasture/hay[b]	--	--	428,653	2,377	3,114	3,969	9,460
Savanna	720,499	720,499	na[c]	na	na	na	na
Total	1,143,857	1,222,403	1,800,484	30,616	72,240	22,565	125,421

[a]Upland 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).

[b]Bird habitat objectives were not established for this primary NLCD cover type providing openland value.

[c]na 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 463,000 acres of high quality habitat in IN-22, and the region contains an estimated 138,900 acres of grassland plus 428,700 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. Changes in agricultural practices (i.e., early hay mowing) and fragmentation of large grasslands have generally been detrimental to breeding grassland birds.

Savanna objectives (1.4 million acres; Table 3) are based on the 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

Wetland and open water cover types and focal species	
Deep water marsh	Tundra Swan, American Black Duck, Black Tern
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 mudlfat	American Golden-Plover, Killdeer
Open water	Canvasback, Lesser Scaup
Beach	Sanderling
Islands with limited vegetation	Common Tern

The estimated area of high quality habitat needed in IN-22 to maintain current populations of birds dependent on marsh, mudflat/shallows, and open water is about 94,000 acres (Table 4)[2]. This area, plus an additional 39,000 acres of restored, high quality wetland is predicted to achieve a landscape design adequate (i.e., provide carrying capacity) to meet JV population goals for breeding and non-breeding wetland birds in IN-22. The overall 133,000-acre wetland bird habitat objective represents about 1.2% of the area in IN-22.

Marsh.—Habitat objectives were developed in the JV Plan for breeding wetland bird groups dependent on four marsh categories and totaling about 84,000 acres: wet meadow with open water and shallow semi-permanent marsh / hemi-marsh (68,600 ac), marsh with associated shrub or forest (15,800 ac), and deep-water marsh (20 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 61,900 acres of marsh wetlands currently available in IN-22 of which 12% are protected (Table 4). Thus, JV conservation objectives for marsh cover types, driven largely by the habitat needs of breeding waterfowl, are somewhat greater than the area of marsh wetland currently 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 (1,340 ac) for IN-22 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 (<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 2,650 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 very 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 44,400 acres of IN-22 row crops are on protected land; 23,000 acres of state and federal lands are in agriculture (Table 4).

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 6,700 acres of high quality foraging and resting habitat when populations are at goal levels. Whereas the region has abundant open water locations

[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-22 to maintain current populations of birds dependent on dry mudflat is 15,494 acres, as the breeding objective (15,494 ac) is greater than the non-breeding objective (116 ac) (See Table 4).

(Table 4), low food availability and human disturbance may negatively influence use of some open-water areas. Some species of shorebirds and terns depend on beach. Beach objectives total about 60 acres. Beach cover appears adequate to meet objectives.

Table 4. Wetland bird habitat maintenance and restoration objectives (acres) for marsh, mudflat, and open water and estimated amount of each cover type currently on the landscape in Indiana BCR 22. Objectives are from the 2007 JV Implementation Plan and represent 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				Land cover				
	Maintenance		Restoration		Cover type area on landscape	Conservation status (protected)			
	B	N	B	N		Federal	State	Other	Total
Marsh									
Deep-water marsh	12	1,339	5	0	1,539	32	353	15	400
Shallow semi-permanent marsh[a]	56,417	39,048	12,145	924	47,928[b]	469	3,877	309	4,655
Marsh with shrub/forest	13,150	0	2,631	0	12,397	640	1,700	133	2,473
Mudflat and shallows									
Wet mudflat/shallows[c]	0	2,074	0	575	na[d]	na	na	na	na
Dry mudflat[e]	15,494	116	22,277	69	7,547,995	7,317	15,671	21,407	44,395
Open water and beach									
Extensive open water	0	5,461	0	1,195	116,490[f]	10,420	19,309	1,777	31,506
Beach	0	17	0	47	4,912[f]	267	222	12	501
Total	85,073	48,055	37,058	2,810	7,731,261	19,145	41,132	23,653	83,930

[a]Bird habitat objectives for "shallow semi-permanent marsh" also include objectives for "wet meadow with areas of open water" in the 2007 JV Plan.

[b]Cover type area for "shallow semi-permanent marsh" includes emergent marsh within palustrian, lacustrine, and riverine categories in NWI.

[c]Bird 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.

[d]na indicates cover type area could not be estimated due to resolution limitations of spatial data.

[e]Dry 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.

[f]Cover 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

IN-22 is dominated by agriculture, but portions of the region remain valuable to breeding and non-breeding birds, especially those dependent on grassland, savanna, marsh and forested wetland. Although not addressed in the 2007 JV Plan, habitat for migrating landbirds is important, especially forest and grassland birds traversing IN-22 during spring and fall. Maintaining quality landbird migration pathways, especially along rivers and north-south corridors, should be considered a priority in management planning. Both the breeding and non-breeding period of the life cycle for landbirds occupying IN-22 will be addressed when the JV Plan is next updated.

Slight declines in forest cover occurred in recent years, but IN-22 forest is abundant relative to JV objectives and considerable amounts of forest area are currently in public ownership. The existing area of shrub/scrub appears to be 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.

The amount of grassland is well below the established habitat objective for JV focal species. Grassland, hay, and pasture declined modestly between 2001 and 2006, and only a small portion of these openland cover types are protected under conservation ownership. Grassland quality for birds has been declining across BCR 22 due to change in plant species composition (e.g., tall fescue), fragmentation, agricultural use trends (e.g., un-prescribed cattle stocking rates), and a lack of prescribed burning regimes that emulate natural cycles. Because permanent protection (public ownership) of vast grassland and savanna tracts is often unfeasible, IN-22 partners must continue seeking opportunities to promote grassland bird conservation on private lands. Natural resource managers may have a greater impact by working with the agricultural community, especially where a focused effort may connect open landscapes valuable to birds. New initiatives on private lands in parts of BCR 22 have found success promoting and supporting a balance between short-term and long-term economic viability through maintaining healthy native-grass prairies.

Because a significant area of state and federally owned lands are mapped as cultivated cropland (23,000 acres), managers should seek opportunity to convert areas back to native cover, particularly grassland, 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. The 2007 JV Implementation Plan includes significant habitat objectives for savanna birds dependent on mixed-wooded openland in IN-22. We could not assess the abundance or quality of this cover type given the spatial data available, but savannah area is expected to be far below objective levels. However, the JV objective for this cover type will likely be reduced in the future due to new information regarding Red-headed Woodpecker, the JV focal species driving objectives for savanna. IN-22 partners should still continue to investigate ways to target conservation for savanna birds.

Wetland cover types mapped by NWI and NLCD were relatively stable between 2001 and 2006. The current area of dry mudflat appears adequate to meet habitat objectives for JV focal species. Conversely, the area of marsh cover types is only about half the objectives in the JV Plan. The area of wet mudflat and shallows providing forage to migrating wetland birds could not be determined using existing spatial data. Spatial data were also inadequate to thoroughly assess emergent wetland types (hemi-marsh vs. wet meadow), quality (high vs. low reproduction / survival), and timing of availability (recently wet vs. wet when image was taken). Due to altered hydrology in much of the region, management may still be necessary to assure mudflat and shallows are available during shorebird migration periods. IN-22 partners should also continue expanding protection of marsh and wet meadow providing quality wetland-bird habitat, while seeking and implementing effective management of invasive plants. Open water area seems adequate for foraging waterfowl during the non-breeding period, but some locations may require management to address water quality and disturbance.

Finally, conversion of row crop agriculture to native cover types can serve purposes beyond bird habitat restoration. For example, IN-22 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 where possible.

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