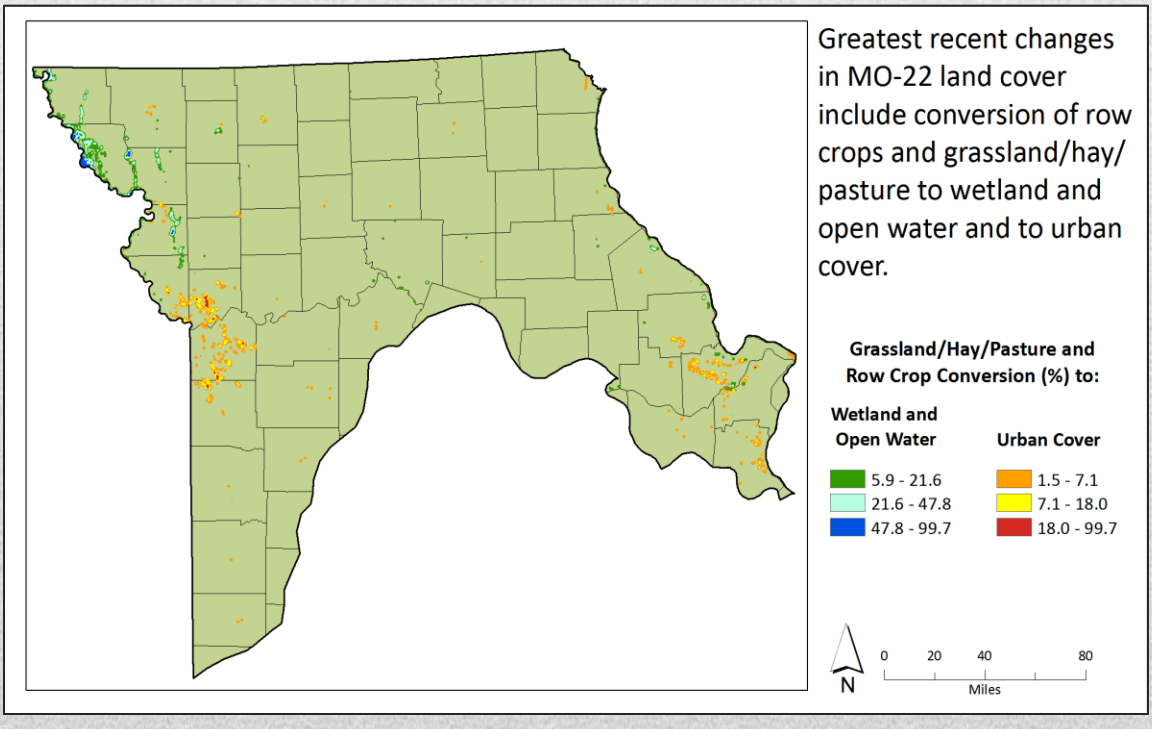
UPPER MISSISSIPPI RIVER & GREAT LAKES REGION
JOINT VENTURE
Delivering bird conservation through partnerships

Missouri 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 Missouri BCR 22 (MO-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 MO-22 assessment for more details.**



Primary cover-types

MO-22 consists of extensive row crops (32%), upland forest (20%), and urban cover (8%), but its greatest land coverage is grassland/hay/pasture (35%). Emergent wetland (+48,000 ac) and urban land (+27,900 ac) expanded between 2001 and 2006, whereas total acreage of row crop (-53,400 ac), upland forest (-21,800 ac), and grassland/hay/pasture (-17,300) declined. Gains in wetland acreage were largely the result of conversion from row crop, and some were likely a temporary result of higher water levels in 2006.

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 Missouri Bird Conservation Region 22. Wetland and open water availability based on 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 (%)
Openland and woodland			
Grassland	2,840,500	341,465	-2.1
Savanna	8,233,498	n/a	n/a
Deciduous forest	132,392	3,928,673	-0.5
Evergreen forest	0	38,111	-1.1
Shrubland	117,572	109,156	-1.4
Other forest	0	64,603	-0.8
Marsh, mudflat, and open water			
Emergent wetland	209,913[a]	148,471	78.6
Woody wetland	112,828[b]	505,448	0.1
Dry mudflat	69,916	6,558,266[c]	-0.8
Open water	18,468	320,893	6.4

[a] Includes habitat objectives for multiple focal species combined: deep water marsh, 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 habitat objectives for multiple focal species combined: marsh with associated shrub/forest and forested wetlands.

[c] Area of row crops, which can provide some value to dry mudflat bird species.

Management Implications

Openland:

- Grassland availability is only 12% 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.
- Public-land managers should seek opportunity to convert row crops to native cover, particularly grassland, and promote private-land management practices that can benefit birds.

Woodland:

- Despite slight declines, forest cover is greater than needed to meet current JV breeding bird objectives.
- Migrating and wintering landbird objectives were not developed for the 2007 JV Plan, but the non-breeding period will be addressed in 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 near the habitat objective for species dependent on shrub and young-growth forest, but restoration of this cover type remains a priority.

Marsh, mudflat, and open water:

- Wetland cover types expanded between 2001 and 2006. However, restoring and protecting quality semi-permanent marsh and wet meadow remains a priority as these bird habitats are still below objective levels.
- Providing wetlands with energy resources (e.g., moist-soil foods) is also important where this practice is suitable and can be conducted efficiently.
- Areas of open water and dry mudflat (represented by agricultural fields in spring) 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 areas, especially large rivers.

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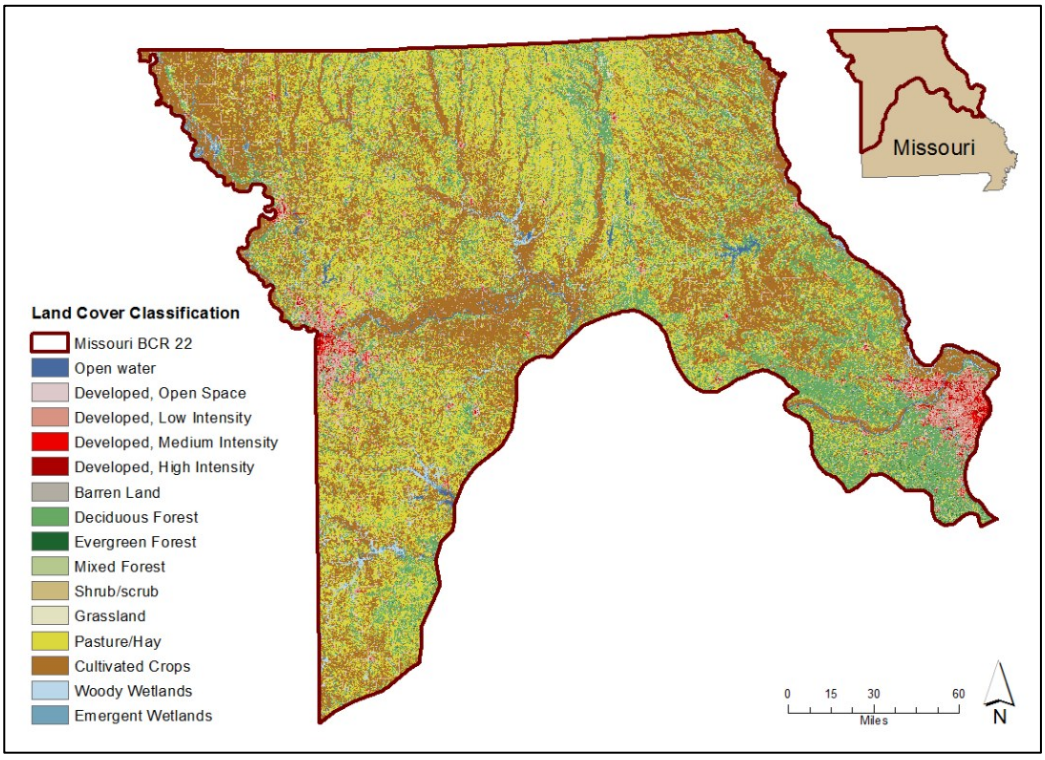
State by BCR Assessment

Missouri 22 – Eastern Tallgrass Prairie

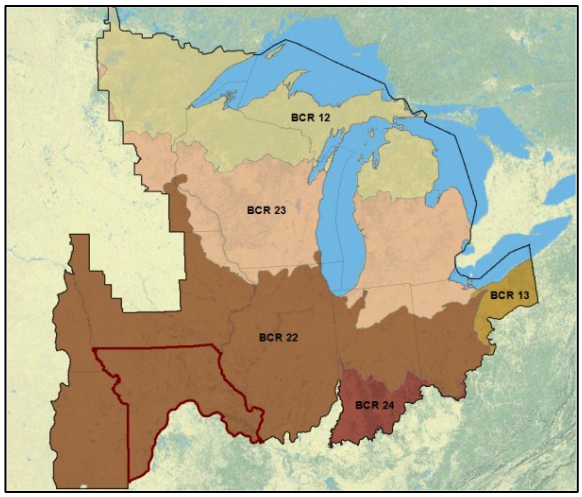
This document was developed to serve as a "stepped-down" version of the 2007 Joint Venture (JV) Implementation Plan with focus on Missouri BCR 22, the Eastern Tallgrass Prairie portion of Missouri. It includes lists of bird species used for JV regional planning (i.e., focal species) that represent land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

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



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

Introduction

A primary goal of bird conservation 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., MO-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 goal populations 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 MO-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 they are sufficient to identify 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 MO-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 Missouri 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	296,652	315,543	6.4	18,891
Urban	1,663,758	1,691,676	1.7	27,918
Barren	24,901	24,214	-2.8	-687
Upland Forest	4,059,755	4,037,985	-0.5	-21,770
Shrub/Scrub	110,752	109,156	-1.4	-1,595
Grassland/Hay/Pasture	7,139,888	7,122,557	-0.2	-17,331
Grassland	348,926	341,465	-2.1	-7,461
Row Crops	6,622,413	6,569,005	-0.8	-53,408
Wetlands	573,749	621,730	8.4	47,981
Emergent Wetlands	60,612	108,227	78.6	47,615
Woody Wetlands	513,137	513,503	0.1	366
Total	20,491,867	20,491,867		

MO-22 is dominated by grassland/hay/pasture and row crop agriculture, with large amounts of upland forest and urban cover (Table 1).[1] Row crop area declined between 2001 and 2006, accounting for a 53,000 acre loss, and upland forest declined by nearly 22,000 acres. Conversely, urban cover increased by 28,000 acres, an expanse roughly equivalent to the city of St. Joseph. Gains in urban cover came primarily from land previously in row crop, grassland/hay/pasture, and upland forest (Figure 1, Table 2), representing permanent habitat loss for some bird species. Most row crop and upland forest conversion to urban cover occurred adjacent to metropolitan areas (Figure 2). Considerable gains in emergent wetland (48,000 ac) and open water (18,900 ac) occurred between 2001 and 2006, primarily along the Missouri River corridor in northwestern Missouri. However, some of these gains in aquatic area may have been temporary, resulting from greater precipitation

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

and higher water levels when 2006 spatial data were collected. Relative change in area (%) between 2001 and 2006 was low for woody wetland, grassland/hay/pasture, upland forest, and shrub/scrub.

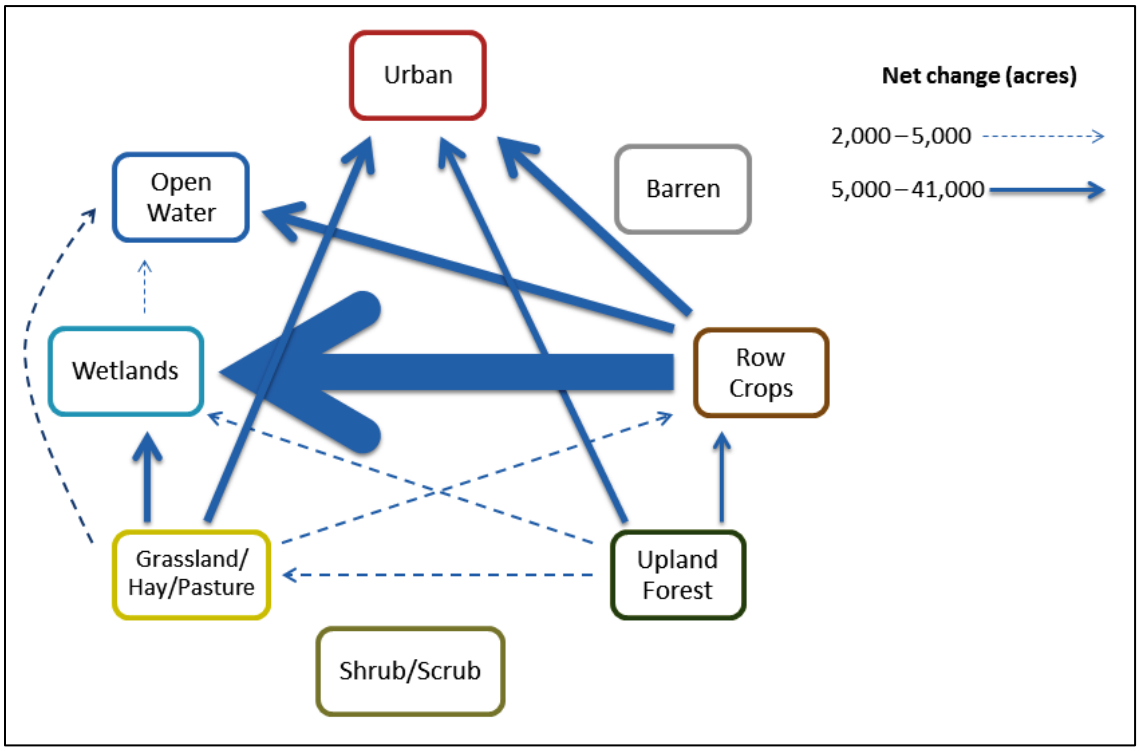


Figure 1. Net change of general land cover types (>1,000 acres converted) in Missouri BCR 22 between 2001 and 2006 (NLCD). Arrows point in the direction of change between two cover types and line thickness increases in proportion to amount of net change. "Wetlands" include woody and emergent herbaceous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

Table 2. Conversion (acres) of primary land cover types in Missouri 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, 1,012 acres of open water converted to wetland and 3,456 acres of wetland converted to open water, for a net change among these two cover types of -2,444 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 wetland 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	293,458	114	127	63	20	417	955	1,012
	Urban	0	1,661,029	0	0	0	0	0	10
	Barren	252	829	22,690	83	0	196	631	180
	Upland Forest	1,593	8,042	1,129	4,030,570	30	3,843	5,251	2,660
	Shrub/Scrub	107	216	25	226	108,821	552	568	55
	Grassland/Hay/Pasture	3,952	8,608	77	167	69	7,104,169	2,582	8,591
	Row Crops	12,209	9,778	73	240	38	273	6,548,221	40,756
	Wetlands	3,456	295	55	36	0	1,462	58	567,449

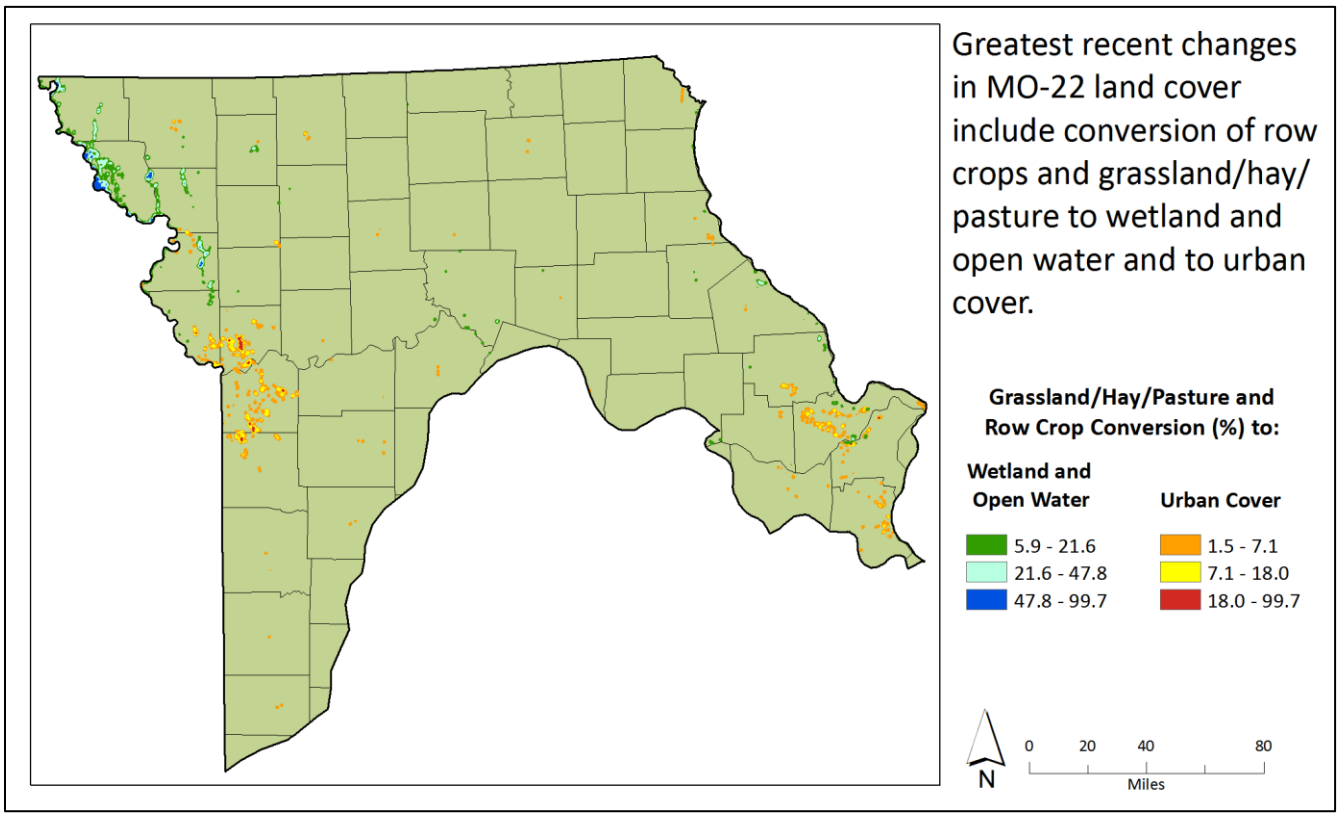


Figure 2. Conversion (percent total area converted within 1 km circular radius) from grassland/hay/pasture and row crops to wetland and open water or urban cover in Missouri BCR 22, 2001 to 2006 (NLCD).

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 needed to maintain current bird populations, whereas restoration objectives were generated based on population deficits (deficit = population goal - current population) and reflect 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 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.

The area of cover types potentially providing bird habitat was estimated using the National Wetland Inventory for wetlands and 2006 National Land Cover Database 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 MO-22 protected land configuration and ownership composition (Figure 3). In December 2013, there were 1,045,000 acres enrolled in the Conservation Reserve Program (CRP) in Missouri with roughly 333,000 acres scheduled to expire by 2018. We were unable to partition total Missouri CRP acreage to the MO-22 portion of the state or assess the land cover composition of CRP lands due to privacy protections in the U.S. Farm Bill.

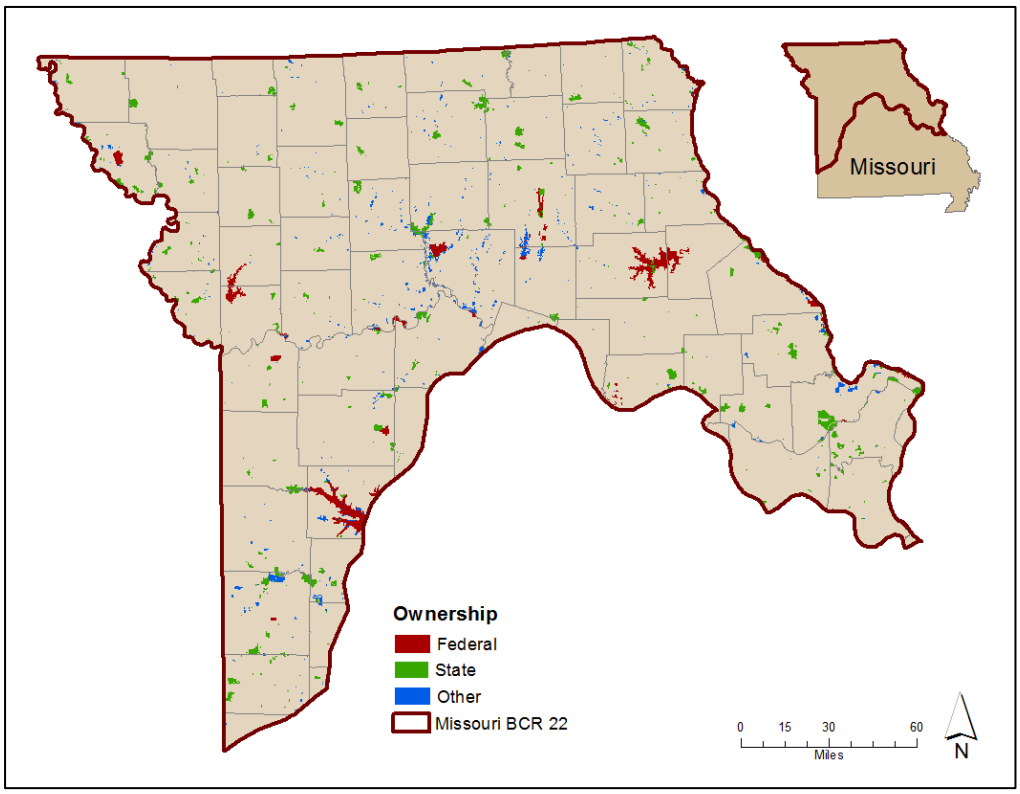


Figure 3. Location of federal, state or other conservation lands in Missouri Bird Conservation Region 22. "Other" ownership category includes private land with temporary and permanent easements, conservancy land, and county, township and city owned land. Total land area conserved (excluding CRP) is about 607,000 acres, including 337,400 woodland/grassland acres and 196,300 acres of row crop, open water, and marsh wetland.

Woodland and Openland

The estimated amount of woodland and openland/grassland needed in high quality habitat to maintain current landbird populations is about 5.8 million acres (Table 3); another 5.6 million acres is required to reach goal populations based on the 2007 JV Plan. The overall 11.4 million-acre upland bird habitat objective represents 56% of the land in MO-22 and far more conservation effort than could ever be achieved. Savanna (mixed wooded openland) accounted for a majority (72%) of MO-22 upland bird habitat objectives in the 2007 JV Plan.

Landbird cover types and focal species	
Deciduous forest	Whip-poor-will, Wood Thrush, Louisiana Waterthrush, Kentucky Warbler
Forest generalist	Chimney Swift
Forested wetland	Prothonotary Warbler
Shrubland	Willow Flycatcher, Blue-winged Warbler, Yellow-breasted Chat
Grassland	Upland Sandpiper, Greater Prairie-Chicken, 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. MO-22 encompasses about 4,624,400 acres of woodland, and 257,500 acres are protected (Table 3). Forest cover is well above JV objective levels and especially abundant along river floodplains, but forest fragmentation is a concern because it can limit habitat quality for breeding forest birds. A majority of MO-22 forests have size and configuration that may limit daily survival and productivity of edge-sensitive forest birds.

Habitat objectives for shrubland birds (117,600 acres) were slightly higher than the area of shrubland available in MO-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 somewhat dynamic cover type.

Openland.—The grassland-bird guild used for JV planning requires an estimated 2,841,000 acres of high quality breeding habitat in MO-22, and the region contains an estimated 341,500 acres of grassland plus 6,782,000 acres of pasture/hay based on the 2006 NLCD (Table 3). The amount of grassland appears inadequate to meet objectives. Although hay and pasture areas can provide value to openland birds, they rarely consist of high quality breeding 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 are based on the estimated breeding habitat requirements of birds occupying mixed open woodlands (e.g., Red-headed Woodpecker). This cover type is not mapped by NLCD and assessing the landscape's capacity for supporting populations of savanna birds is not possible with these spatial data. However, we can safely predict this level of habitat conservation for a single cover type (8.2 million acres for maintenance and restoration combined; Table 3) is unachievable even with large-scale conservation programs. New research and monitoring information will be used to develop more realistic openland objectives for savanna birds in future JV planning.

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 Missouri 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 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]		Land cover				
	Maintenance	Restoration	Cover type area on landscape	Conservation status (protected)			
				Federal	State	Other	Total
Woodland							
Deciduous forest	88,179	44,213	3,928,673	19,514	146,279	19,052	184,845
Evergreen forest	0	0	38,111	306	793	77	1,176
Forested wetland	61,750	30,875	483,844	37,174	29,267	0	66,441
Shrub/scrub	113,620	3,952	109,156	348	2,516	472	3,336
Other forest	0	0	64,603	198	1,213	321	1,732
Openland							
Grassland	1,420,250	1,420,250	341,465	2,231	11,661	2,118	16,010
Pasture/hay[b]	--	--	6,782,092	11,720	34,533	17,599	63,852
Savanna	4,116,749	4,116,749	na[c]	na	na	na	na
Total	5,800,548	5,616,039	11,747,944	71,491	226,262	39,639	337,392

[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 some openland value.

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

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 with open water	Blue-winged Teal
Wet mudflat/moist soil plants	Blue-winged Teal, Dunlin
Semi-permanent/hemi-marsh	American Black Duck, Mallard, King Rail
Marsh with shrub/forest	Wood Duck, Black-crowned Night-Heron
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

The estimated area of high quality bird habitat needed in marsh wetland, mudflat, and open water to maintain current bird populations is about 269,000 acres (Table 4)[2]. This area, plus an additional 50,000 acres of restored high quality wetland cover, is predicted to achieve a landscape design adequate (i.e., provide carrying capacity) to meet JV goal populations for breeding and non-breeding wetland birds. JV wetland bird habitat objectives represent about 1.6 % of the total area in MO-22.

Marsh.—Habitat objectives were developed for wetland bird groups dependent on four general marsh categories: wet meadow, shallow semi-permanent marsh / hemi-marsh, deep-water marsh, and marsh with associated shrub or forest. Based on NWI and the most recent conservation lands database, there was an estimated 170,100 acres of available marsh and marsh/shrub wetlands on the landscape, of which 18% are protected (Table 4). However, the most recent NLCD suggests an even greater amount of marsh in MO-22 as well as a positive trend in emergent marsh area (Table 1). Conservation objectives for marsh cover types were driven largely by the needs of migrating and wintering waterfowl and breeding waterbirds.

The JV Plan calls for high quality wetland-bird habitat totaling about 199,300 acres of shallow semi-permanent marsh / hemi marsh (includes 600 acres for wet meadow with open water) and 20,200 acres of marsh with associated shrub/forest (Table 4). Objectives for deep water marsh totaled 5,650 acres. These values are substantially higher than the marsh wetland currently available on the landscape (Table 4). In addition, we were unable to determine the quality of these areas for breeding and non-breeding marsh birds based on spatial data. The quality of marsh wetlands may be low in some areas due to nutrification from agriculture or proximity to developed lands and human activity.

Mudflat and Shallows.—Objectives for wet mudflat, shallow-depth (<2 in), and moderate-depth (2-8 in) open wetland communities were based primarily on the energetic needs of migrating shorebirds. These objectives total about 4,900 acres of wet mudflat and shallow-water providing high quality shorebird habitat (Table 4). However, assessments of these cover types are difficult using remotely sensed data and are not adequately identified by NWI. These cover types are also dynamic and can change daily and seasonally making one-time static assessments (i.e., NWI) poor estimators of cover type availability. The area of dry mudflat (i.e., row crop) protected totals 125,800 acres, including 70,400 acres of state and federal lands apparently in agriculture.

Open Water and Beach.—Open-water bird habitat objectives are based on the needs of migrating and wintering diving ducks and sea ducks. This group requires an estimated 18,500 acres of high quality foraging and resting habitat. Whereas the region has abundant open water locations (Table 4), low food availability and human disturbance can negatively influence use of open-water areas. Some species of shorebirds and terns depend on

[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 MO-22 to maintain current populations of birds dependent on semi-permanent marsh is 197,551 acres, as the non-breeding objective (197,551 ac) is greater than the breeding objective (8,766 ac) (See Table 4).

beach. Beach objectives total about 120 acres. Available beach appears adequate to meet objectives, especially along river corridors, and even during temporarily high water levels.

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 Missouri 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	20	5,651	10	0	603	2	5	0	7
Shallow semi-permanent marsh[a]	8,766	197,551	1,790	840	147,868[b]	16,534	11,016	0	27,550
Marsh with shrub/ forest	16,836	0	3,367	0	21,604	2,019	1,495	0	3,514
Mudflat and shallows									
Wet mudflat/ shallows[c]	0	3,841	0	1,070	na[d]	na	na	na	na
Dry mudflat[e]	28,682	215	41,234	126	6,569,005	23,282	47,093	55,440	125,815
Open water and beach									
Extensive open water	0	16,114	0	2,354	320,893[f]	27,458	10,238	0	37,696
Beach	0	32	0	86	24174[f]	662	746	346	1,754
Total	54,304	223,404	46,401	4,476	7,084,147	69,957	70,593	55,786	196,336

[a]Bird habitat objective for "shallow semi-permanent marsh" also includes objective 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 (<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 in the 2007 JV Plan and row crop (NLCD) was the cover type measured on the landscape.

[f]Cover type area for "extensive open water" represents lacustrine, riverine, and unconsolidated bottom and shore (NWI), whereas "beach" is sand/gravel/bedrock with little vegetation (NLCD).

Management Implications

MO-22 may be dominated by agriculture and upland forest, but it is ecologically diverse, and unique for its mixed open landscape. This sub-region has a greater proportion of hay/pasture cover than anywhere else in the JV region. Many areas are important to breeding grassland and savanna birds, and additional areas have potential to be important; often the mixed open landscape simply lacks adequate blocks of grassland (e.g., >5,000 ac), key to higher rates of grassland bird reproduction and survival.

The amount of available grassland in MO-22 is far below what is needed to meet habitat objectives for JV focal species. Grassland area declined slightly between 2001 and 2006, and only a small portion of existing grassland is protected under conservation ownership. Grassland quality for bird habitat could not be assessed with remotely sensed data. Grassland quality for birds has been declining across BCR 22 due to 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 unfeasible, MO-22 partners must continue seeking opportunities to promote 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 by 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 row crops (70,000 acres), managers should seek opportunity to convert areas back to native cover, particularly grassland/savanna and other native cover types, when conditions are suitable. In addition, connecting "permanent" openings such as grasslands associated with right-of-ways (e.g., highways, utility corridors), perpetual grassland/pasture easements, and large marsh complexes can result in greater management efficiency by providing larger openland areas/unit cost. The 2007 JV Implementation Plan includes significant habitat objectives for savanna bird species dependent on mixed-wooded openland in MO-22. We could not assess the abundance or quality of this cover type given the spatial data available, but savanna area is likely far below objective levels. However, the JV objective for this cover type will likely be reduced substantially in the future due to new information. In the meantime, MO-22 partners should continue to investigate ways to evaluate habitat objectives and conservation targeting for savanna birds.

Slight declines in forest cover occurred in recent years in MO-22. However, the region still contains significant areas of upland forest, and amounts adequate to meet current JV goals for breeding forest birds. In addition, large amounts of forest cover are protected in public ownership. Although non-breeding landbird habitat objectives were not developed for the 2007 JV Implementation Plan, MO-22 contains important migration corridors for non-breeding grassland and forest birds. The non-breeding period of the life cycle for landbirds will be addressed when the JV Plan is next updated. Maintaining quality grassland and forest bird migration pathways, especially along rivers and north-south corridors, should be considered a priority in management planning.

In general, the current areas of open water and dry mudflat in MO-22 appear adequate to meet habitat objectives for JV focal species. Shallow semi-permanent marsh, deep water marsh, and marsh with shrub forest are below objective levels, but these cover types have been expanding in recent years. Gains in emergent wetland and open water were concentrated primarily in northwestern MO-22, an area with significant potential for habitat restoration targeted at non-breeding wetland birds (see 2007 JV Plan). Remotely sensed spatial data were inadequate to assess wetland type (hemi-marsh vs. wet meadow), quality (high vs. low reproduction / survival), and timing of availability (recently wet vs. wet when image was taken) for wetland birds. Moreover, some data categories have limited planning value; the most extreme example was the use of "row crops" to represent area of "dry mudflat" for shorebirds. New efforts are underway to evaluate alternate data sources to assess wetland-bird habitat abundance and quality in time and space.

The area of wet mudflat and shallows providing forage to migrating wetland birds could not be determined. However, due to altered hydrology in much of the region, management may be necessary to assure mudflat is

available during shorebird migration periods. MO-22 partners should continue expanding restoration and protection of marsh and wet meadow areas providing quality wetland bird habitat, while implementing effective inventory and control of non-desirable plants (e.g., invasive species) that can reduce habitat quality. The abundance and distribution of temporary wetlands providing moist soil food resources to dabbling ducks in MO-22 may be adequate. Likewise, open water area seems to be adequate for foraging waterfowl, but some locations may have limited value due to water quality and human disturbance.

Finally, conversion of row crop agriculture to grassland, savanna, marsh, and other native cover types can serve purposes beyond bird habitat restoration. For example, MO-22 is a primary 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 and Missouri rivers should be a priority where possible.

Recommended citation: Kahler, B.M., R.L. Pierce, and G.J. Soulliere. 2014. State X BCR Assessment: Missouri 22 – Eastern Tallgrass Prairie. Upper Mississippi River and Great Lakes Region Joint Venture, U.S. Fish and Wildlife Service, Bloomington, MN, USA.

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