

## **GIS Analysis**

The Upper Mississippi Forest Partnership has developed an Action Plan focusing on four key issues:

1. restoration of bottomland hardwoods;
2. establishment of riparian forest buffers;
3. providing critical migratory bird habitat; and
4. conservation of priority forest areas.

In an effort to guide the implementation of the UMFP Action Plan, the partnership contracted with the USGS, Upper Midwest Environmental Sciences Center to conduct a GIS analysis. The goal of this project was to generate products that will help the UMFP limited resources be utilized in a more focused manner. The main tasks of the GIS analysis were to:

- assemble GIS layers for conservation planning within the geographical boundary of the Upper Mississippi River system;
- organize the data layers;
- create and execute GIS models to identify geographical areas conducive to the four above management themes.

The maps produced and a summary document is included here. For the complete report and the ability to print larger size maps go the Upper Mississippi Forest Partnership website at:

[www.na.fs.fed.us](http://www.na.fs.fed.us/watersheds)  
watersheds

United States of  
Department of  
Agriculture

Forest Service

**Northeastern Area**  
State and Private Forestry  
Newtown Square, PA

NA-TP-04-07

July 2007

# Identification of Priority Forests in the Upper Mississippi River System:



## A Summary





# Identification of Priority Forests in the Upper Mississippi River System: A Summary

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**Prepared for:**

Upper Mississippi Forest Partnership, November 2006



*“It is strange how little has been written about the Upper Mississippi. The river below St. Louis has been described time and again, and it is the least interesting part. One can sit on the pilot-house for a few hours and watch the low shores, the ungainly trees and the democratic buzzards, and then one might as well go to bed.*”



*“One has seen everything there is to see. Along the Upper Mississippi every hour brings something new. There are crowds of odd islands, bluffs, prairies, hills, woods and villages—everything one could desire to amuse the children.”*

*Mark Twain*



# IDENTIFICATION OF PRIORITY FORESTS IN THE UPPER MISSISSIPPI RIVER SYSTEM: A SUMMARY

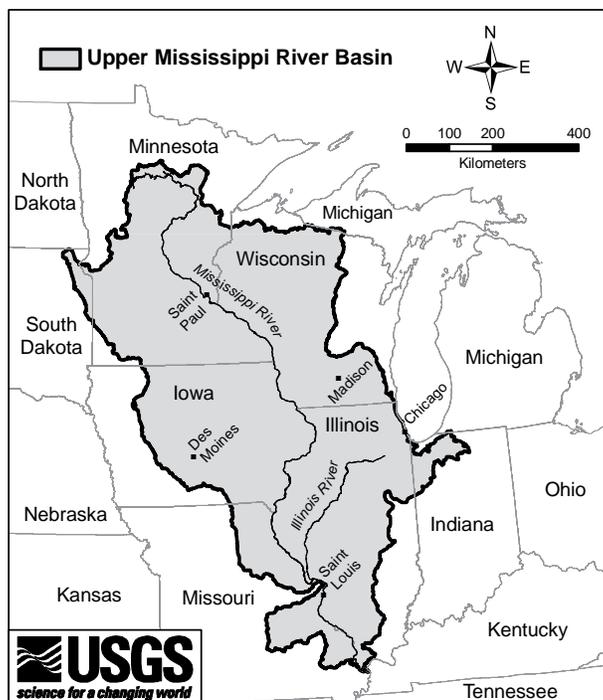
The goal of the Upper Mississippi Forest Partnership is to improve water quality and migratory bird habitat by restoring and enhancing forests in the six-state watershed. This document summarizes the results of a GIS analysis that identified forests where allocation of resources would make the most difference. Also included in this document are case studies that represent priority areas in the six states of interest and involve the issues analyzed. Other land management entities can also use the resulting maps to plan and prioritize their work.

## Upper Mississippi River Watershed

The Upper Mississippi River Basin, a major subwatershed of the Mississippi, drains approximately 189,000 square miles in six midwest states. Changing land use and expanding navigational use have transformed the river and its watershed. Conversion of prairies and forest to agriculture has altered the hydrology and increased the runoff of nutrients and sediment. This runoff degrades local rivers and contributes to hypoxia in the Gulf of Mexico.

## State and Federal Partnership

To improve water quality and migratory bird habitat in the Upper Mississippi River watershed, State and Federal agencies (the six midwest State Foresters, and the Northeastern Area State and Private Forestry, Forest Service, U.S. Department of Agriculture), formed the Upper Mississippi Forest Partnership. Its focus is restoring riparian forests and improving the condition of forests throughout the watershed.



## Key Issues:

The Upper Mississippi Forest Partnership is concerned with a number of issues that affect water quality and wildlife habitat:



- Each year, sediment and nutrients are washed off the landscape, into tributaries, and ultimately into the Mississippi River, reducing farm income, increasing channel maintenance costs, threatening drinking water, and filling side channels used by river wildlife.
- Dredging river sediment costs more than \$100 million annually.
- The Upper Mississippi River watershed comprises 15% of the entire Mississippi watershed but contributes more than 30% of the nitrogen that causes the hypoxic zone in the Gulf of Mexico.
- Aquatic organisms and fish are harmed by environmental contaminants attached to soil particles and deposited in river pools.
- Forests and wetlands, once important migratory bird habitat, continue to be lost or fragmented by urban population growth, and many remaining forests are unhealthy.

## GIS Analysis

To guide its actions the Upper Mississippi Forest Partnership conducted a Geographic Information System (GIS) study in cooperation with the U.S. Geological Survey's (USGS) Upper Midwest Environmental Sciences Center. The resulting report on priority forests, published in November 2006, indicates the forests where allocation of resources could yield the greatest benefit.

## Issues Studied:

The GIS analysis addressed the following questions related to four issues:

### 1. Bottomland forests and afforestation.

- Where do they exist today?
- Which sites are of highest priority for reestablishment?

### 2. Riparian forest buffers.

- Which watersheds have a high percentage of agricultural land within 300 feet of water?
- How much of that buffer zone is still in agriculture, and how much is forested?

### 3. Migratory bird habitat.

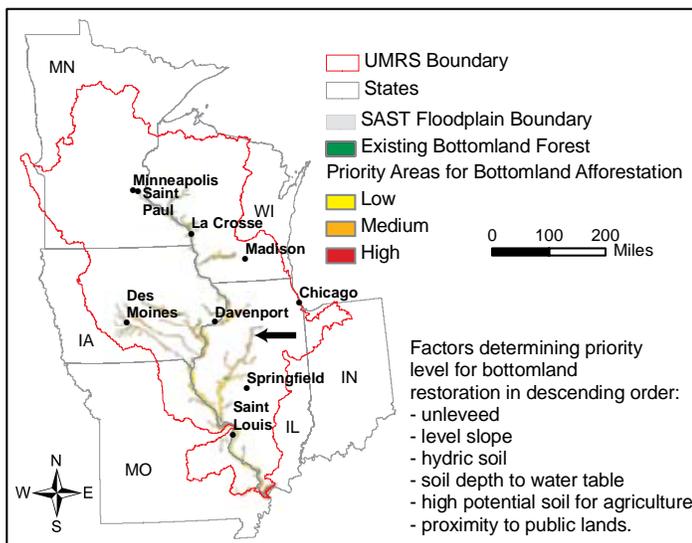
- Which forested areas are important for bottomland, upland, shrubland, and grassland birds?

### 4. Priority forests for conservation.

- Which forest areas threatened by development are important for several reasons, including slope or soil factors that could contribute to erosion, proximity to public water supply, proximity to existing large tracts of public forestland, or their location in areas where water quality issues are significant.

## Bottomland forests and afforestation

The analysis prioritized areas within the Upper Mississippi River floodplain based upon their location and capability to regenerate bottomland forest. The existing floodplain



is 21% forested. Any forested land cover type (deciduous, coniferous, mixed, woody wetland) within the floodplain was classified as bottomland forest. Six factors determined priority: unleveed, slope, hydric soil, depth to water table, agricultural soil, and proximity to public lands. Of the 2.3 million acres of flood plain identified as having reforestation potential, 24% was high priority, 35% medium priority, and 41% low priority.

## Issue: Bottomland hardwood restoration

### Case Study: Wightman Lake, Illinois

#### Key Partner: Ducks Unlimited

Ducks Unlimited is restoring 110 acres of wetlands and bottomland forests at Wightman Lake, a backwater lake of the Illinois River. A survey found that 81 bird species use the diverse habitat—some only during migration and some for breeding. An inventory of 71 acres of bottomland forest found that it lacked tree species diversity (85% silver maple) and age diversity, and was overstocked (145 ft<sup>2</sup>/acre basal area.) A total of 178 trees were harvested to open up the stand and encourage tree regeneration. An additional 12 acres were planted to bottomland hardwoods.

## Riparian forest buffers

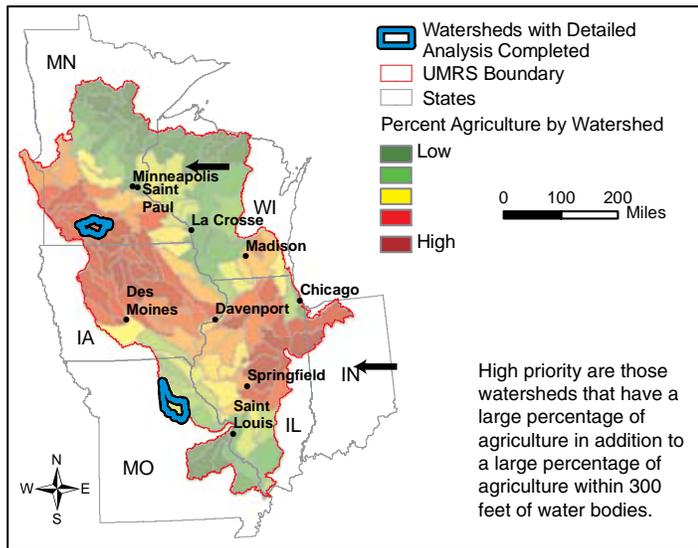
The GIS analysis of riparian corridors consisted of two steps. The first identified high-priority watersheds as those with a high percentage of agricultural land and with agriculture within 300 feet of water bodies.

In the second step, two of the high-priority watersheds were selected for more detailed analysis using SSURGO soils data on soil erosion. This data, combined with land cover

To address these questions the following land attributes were considered:

Land Attributes	Data Source
Forested wetlands	U.S. Fish and Wildlife Service, National Wetlands Inventory, 1980's (except Wisconsin State Data)
Land cover	U.S. Geological Survey (USGS), National Land Cover Database, 1992
Slope	USGS, Digital Elevation Model
Public lands	Conservation Biology Institute, Protected Areas Database, dates vary
Housing density	Colorado State University, Theobald, 2005
Public water supply	State GIS Offices, Universities, U.S. Environmental Protection Agency (EPA)
Soils	Natural Resource Conservation Service, Soils Inventory, STATSGO and SSURGO data
Nitrogen yield	USGS, SPARROW model, 1997
Flood plain boundary	Interagency Science Assessment and Strategy Team, 1994
Hydrography	EPA/USGS National Hydrography Dataset (NHD)
Natural heritage inventory	State GIS Offices

data, identified areas where buffers would stop soil and soil nutrients from reaching a water body. Conversely, the data also indicated areas such as forest, close to water, that should remain permanently vegetated.



### Issue: Riparian Buffers

**Case Study: Yellow River Workshops, Indiana**

**Key Partner: Arrow Head Country RC&D**

The Yellow River drains into the Kankakee River, making up the eastern-most drainages of the Upper Mississippi River system and contributing high amounts of nitrogen. Trees along water bodies create a buffer that filters out nutrients before they reach the water. The Arrow Head Country Resource Conservation and Development Area (RC&D) hosted field days and tree planting workshops for landowners along the Yellow River. The events emphasized the value of forest habitat, especially along water systems, both as a buffer and as migratory bird habitat.

### Issue: Riparian Buffers

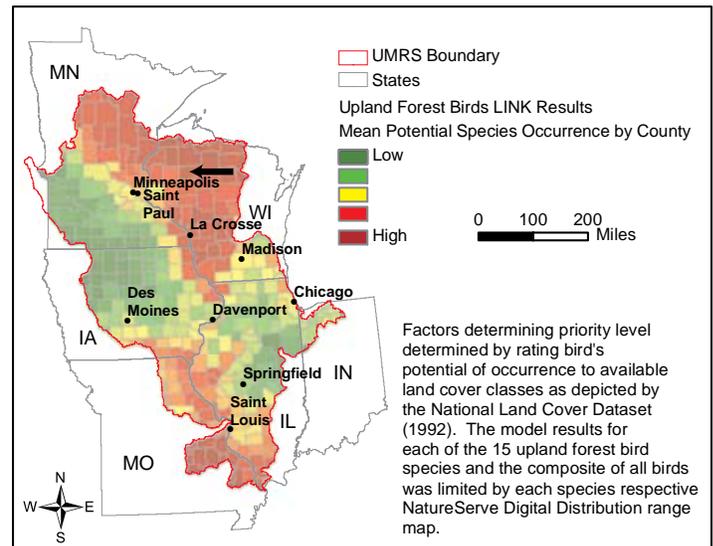
**Case Study: Targeted CRP bottomland plantings, Iowa**

**Key Partner: Iowa Department of Natural Resources**

Trees never dominated Iowa's landscape, but they were common along streams and rivers. Most of these riparian forests have been eliminated. Landowners with cropland adjacent to streams in northeastern Iowa will be offered incentives to enroll their riparian land in the Conservation Reserve Program (CRP), which reduces soil erosion, and to reestablish bottomland forests.

### Migratory Bird Habitat

LINK is an ArcGIS tool designed to map species-habitat patterns across a landscape. LINK uses species-habitat matrices to model potential species habitat and habitat diversity. Because the Upper Mississippi watershed is diverse, the LINK GIS tool was used to analyze four different groups of birds: bottomland, upland, grassland, and shrubland species.



The LINK information will be important to forest managers and private forest landowners in assessing the potential of forested and transitional areas to provide migratory bird habitat. The large-scale analysis points out areas important for habitat connectivity. The potential species richness data points out areas where restoration has a better chance of providing habitat for a variety of species.

### Issue: Bird Habitat

**Case Study: Tanglewood Nature Preserve, Minnesota**

**Key Partner: Minnesota Department of Natural Resources**

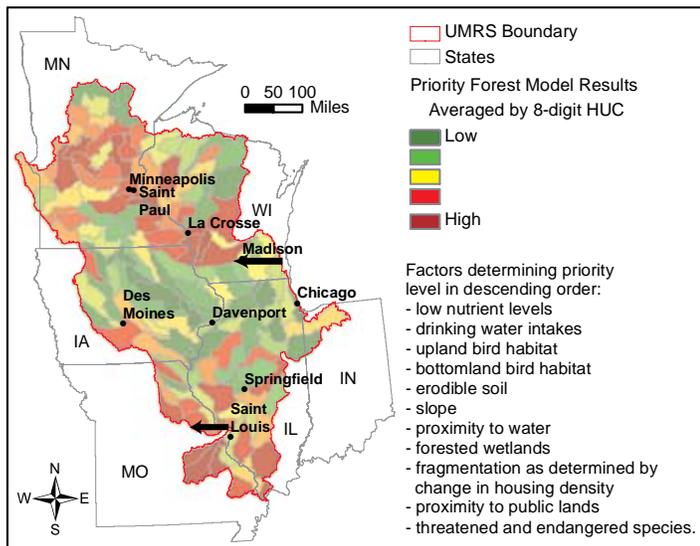
Tanglewood is a 10-acre nature preserve adjacent to the St. Croix River. A total of 400 locally grown tree seedlings were planted in a 3-acre former hay field. The intent of this project is to “close the gap” in the tree canopy, making Tanglewood more appealing to bird species that prefer larger blocks of unbroken forest. The National Park Service conducted a bird survey on the site and found 29 species, including 4 species of interest. (Species of interest are those species for which management actions may be necessary to achieve ecological or other multiple-use objectives. They may be species for which there are local concerns resulting from declines in habitat, population, and/or distribution, species that are of high public interest, or species such as invasives for which control measures may be desirable.)

### Priority forests for conservation

Forest conservation consists of long-term sustainable forest stewardship resulting in clean water and migratory bird habitat. The analysis examined bird habitat and runoff nutrient data along with information about drinking water intakes and trends in forest fragmentation.

The results identify forests where action should be given priority. This information will be valuable to forest planners and policy makers, as they make decisions about the future of the Upper Mississippi watershed's forests.

The Northeastern Area can use this data in focusing program activities including Forest Stewardship, Forest Legacy, and Urban Watershed Forestry. Other land management entities can also use the analysis results to plan and prioritize their work.



## Applying the GIS Analysis

Four working groups that the Upper Mississippi Forest Partnership assigned to the issues (bottomland forests, riparian buffers, migratory bird habitat, and priority forest conservation) will continue to use the analysis results. For example, along with results of the 2006 stakeholders meeting discussions, they will use the analysis results to prioritize ongoing efforts of the partnership.

The data will be used by the National Fish and Wildlife Foundation to prioritize projects funded through the Upper Mississippi Watershed Fund.

Discussion with partners continues as to where the Upper Mississippi Forest Partnership can add value to local projects. The GIS data will enhance these discussions.

Other land management entities can use the resulting maps to plan and prioritize their work.

### Issue: Priority Forests for Conservation

#### Case Study: Driftless Area, Wisconsin

#### Key Partner: Stewardship Forester, Southwest Badger RC&D

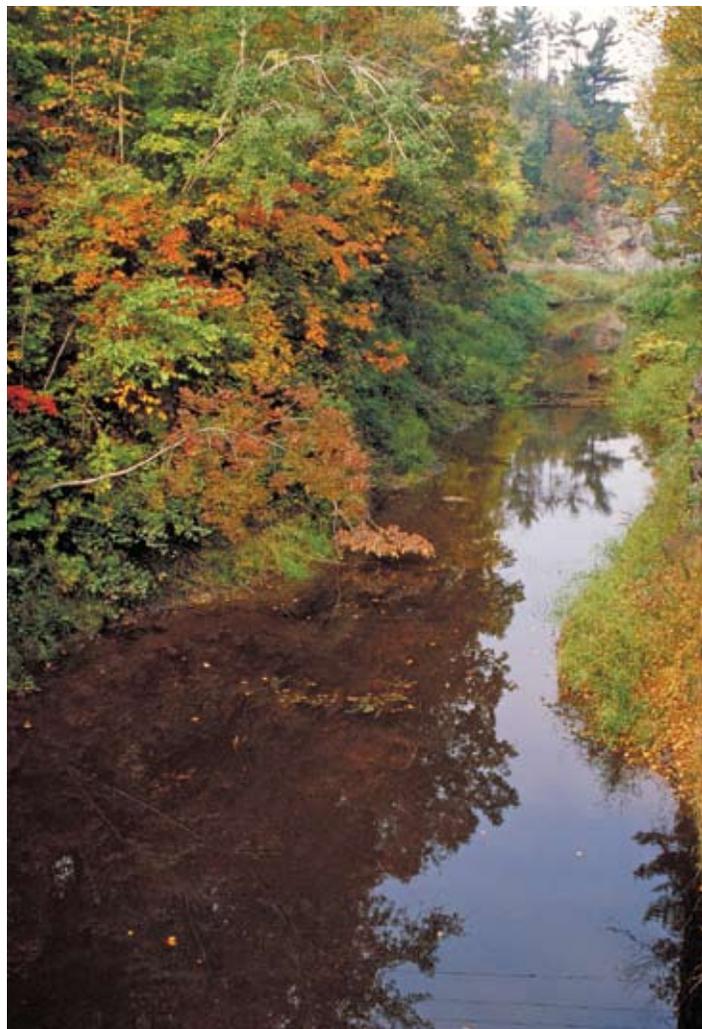
Landowners with forest management plans are more likely to keep their forest and not convert it to other land uses. The forested Driftless Area of southwestern Wisconsin is unique—a landscape of sink holes, bluffs, steep hills, and spring-fed streams. Over 2 years the RC&D stewardship forester worked with more than 30 landowners to develop management plans for 2,233 acres of forest. Of this forestland, 85% was actively worked on in some way (trees thinned, harvested, or planted; or invasive species controlled).

### Issue: Conservation of Priority Forests

#### Case Study: River Hills Restoration Project, Missouri

#### Key Partner: Missouri Heritage Conservation Foundation

The River Hills area is known for its diverse habitats important to sensitive wildlife species. Historically fire periodically moved through this landscape. With fire suppression the forests have become overcrowded, and the trees have shifted from types that do well in full sun to types that fair better in shade. Glades have changed from grass to cedar thickets. About 800 acres of privately owned forests will be thinned, and trees will be removed. Land adjacent to public land or already treated private land will be given priority.



# The Mississippi River Basin



Map not to scale.

[http://www.na.fs.fed.us/watershed/upper\\_mississippi\\_partnership/](http://www.na.fs.fed.us/watershed/upper_mississippi_partnership/)

## Published by:

Northeastern Area State and Private Forestry, Forest Service,  
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NA-TP-04-07  
July 2007

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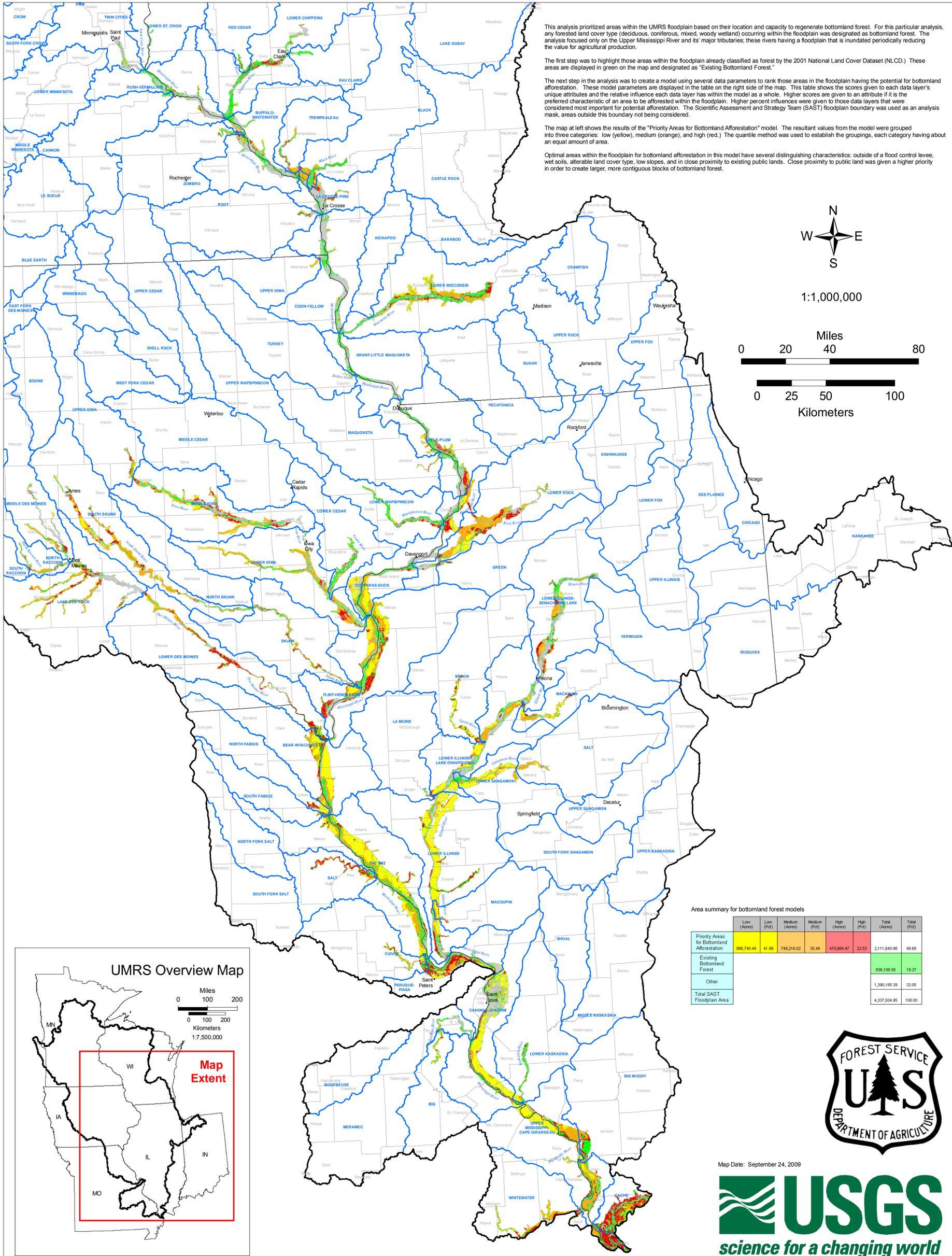
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# Upper Mississippi Forest Partnership

## Existing Bottomland Forests and Priority Areas for Bottomland Afforestation (2001 Land Cover Update)



This analysis prioritized areas within the UMRS floodplain based on their location and capacity to regenerate bottomland forest. For this particular analysis, any forested land cover type (deciduous, coniferous, mixed, woody wetland) occurring within the floodplain was designated as bottomland forest. The analysis focused only on the Upper Mississippi River and its major tributaries; these rivers having a floodplain that is inundated periodically reducing the value for agricultural production.

The first step was to highlight those areas within the floodplain already classified as forest by the 2001 National Land Cover Dataset (NLCD). These areas are displayed in green on the map and designated as "Existing Bottomland Forest."

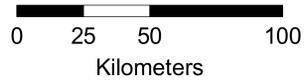
The next step in the analysis was to create a model using several data parameters to rank those areas in the floodplain having the potential for bottomland afforestation. These model parameters are displayed in the table on the right side of the map. This table shows the scores given to each data layer's unique attributes and the relative influence each data layer has within the model as a whole. Higher scores are given to an attribute if it is the preferred characteristic of an area to be afforested within the floodplain. Higher percent influences were given to those data layers that were considered most important for potential afforestation. The Scientific Assessment and Strategy Team (SAST) floodplain boundary was used as an analysis mask, areas outside this boundary not being considered.

The map at left shows the results of the "Priority Areas for Bottomland Afforestation" model. The resultant values from the model were grouped into three categories: low (yellow), medium (orange), and high (red.) The quantile method was used to establish the groupings, each category having about an equal amount of area.

Optimal areas within the floodplain for bottomland afforestation in this model have several distinguishing characteristics: outside of a flood control levee, wet soils, alterable land cover type, low slopes, and in close proximity to existing public lands. Close proximity to public land was given a higher priority in order to create larger, more contiguous blocks of bottomland forest.



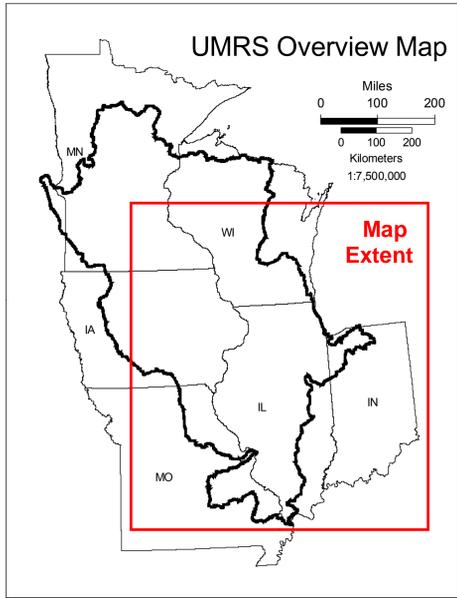
1:1,000,000



Area summary for bottomland forest models

	Low (Acres)	Low (Pct)	Medium (Acres)	Medium (Pct)	High (Acres)	High (Pct)	Total (Acres)	Total (Pct)
Priority Areas for Bottomland Afforestation	898,740.49	41.99	749,216.02	35.49	415,684.47	22.53	2,111,640.98	48.88
Existing Bottomland Forest							836,108.58	19.27
Other							1,380,185.39	32.05
Total SAST Floodplain Area							4,337,934.95	100.00

National Land Cover Dataset (2001)	
Score	Description
NoData	11 - Open Water
NoData	21 - Developed, Open Space
NoData	22 - Developed, Low Intensity
NoData	23 - Developed, Medium Intensity
NoData	24 - Developed, High Intensity
NoData	31 - Barren Land (Rock/Sand/Clay)
NoData	41 - Deciduous Forest
NoData	42 - Evergreen Forest
NoData	43 - Mixed Forest
10	52 - Shrub/Scrub
NoData	71 - Grassland/Herbaceous
10	81 - Pasture/Hay
10	82 - Cultivated Crops
NoData	90 - Woody Wetlands
NoData	95 - Emergent Herbaceous Wetlands
25%	Model Influence
COE Leveled Areas	
Score	Description
2	Leveled within Floodplain
10	Unleveled within Floodplain
20%	Model Influence
Slope (Percent Rise)	
Score	Description
10	0 - 2
0	3 - 5
0	6 - 9
0	10 - 14
0	15 - 18
0	19 - 25
0	26 - 163
13%	Model Influence
STATSGO (Percent Hydric)	
Score	Description
10	Water
0	0
1	1 - 10
2	11 - 20
3	21 - 30
4	31 - 40
5	41 - 50
6	51 - 60
7	61 - 70
8	71 - 80
9	81 - 90
10	91 - 100
12%	Model Influence
STATSGO (Ave. Depth to Water Table)	
Score	Description
10	Water
10	0
10	0.1 - 0.5 (feet)
9	0.6 - 1.0
8	1.1 - 1.5
7	1.6 - 2.0
6	2.1 - 2.5
5	2.6 - 3.0
4	3.1 - 3.5
3	3.6 - 4.0
2	4.1 - 4.5
1	4.6 - 5.0
0	5.1 - 5.5
0	> 5.5
10%	Model Influence
STATSGO (Ave. Capability Class)	
Score	Description
10	Not Classified/Water
1	0 - 1.0
3	1.1 - 2.0
5	2.1 - 3.0
6	3.1 - 4.0
7	4.1 - 5.0
8	5.1 - 6.0
9	6.1 - 7.0
10	> 7.0
10%	Model Influence
Proximity to Public (Including Tribal)	
Score	Description
10	0 - 0.5
5	0.5 - 1.0
0	1.0 - 1.5
0	1.5 - 2.0
0	2.0 - 2.5
0	2.5 - 3.0
0	3.0 - 3.5
0	3.5 - 4.0
0	4.0 - 4.5
0	4.5 - 5.0
0	> 5.0
5	Public Lands
10%	Model Influence



Map Date: September 24, 2009



### Legend

- Major Cities
- UMRS Boundary
- 8-Digit HUC
- State Boundaries
- County Boundaries
- Existing Bottomland Forest
- Priority Areas for Bottomland Afforestation
  - Low (Scores 3 - 6)
  - Medium (Score 7)
  - High (Scores 8 - 10)
- SAST Floodplain Boundary

# Upper Mississippi Forest Partnership

## Important Migratory Bird Habitat Bottomland Forest Birds LINK Model Results (2001 Land Cover Update)



### BOTTOMLAND FOREST BIRDS USED IN LINK QUERY:

- American Woodcock
- Canada Warbler
- Connecticut Warbler
- Louisiana Waterthrush
- Prothonotary Warbler
- Red-shouldered Hawk

### SOURCE LAYER:

National Land Cover Dataset (2001) within UMRS boundary intersecting the states of MN, WI, IA, IL, IN, and MO

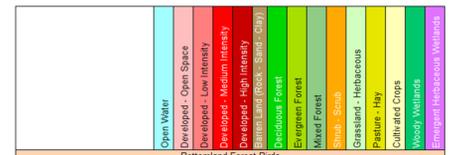
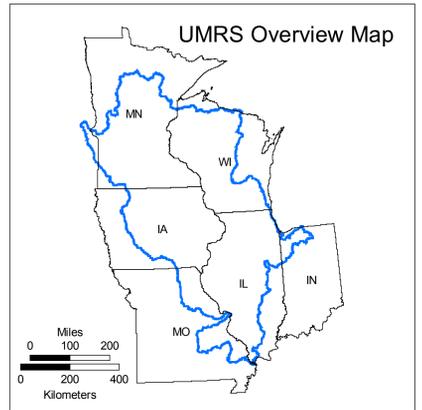
### ZONAL LAYER:

Counties

### RANGE USED:

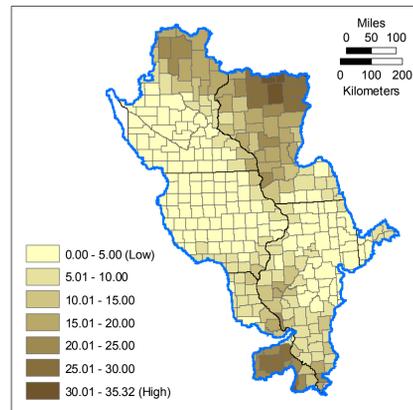
NatureServe: Digital Distribution Maps of the Birds of the Western Hemisphere

### Mean Potential Species Occurrence (PSO)

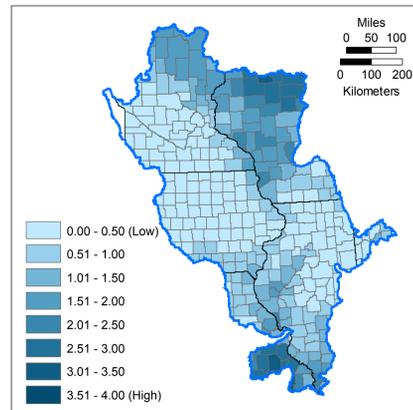


Bottomland Forest Birds	Open Water	Developed - Open Space	Developed - Low Intensity	Developed - Medium Intensity	Developed - High Intensity	Barren Land/Grass - Sparse Cover	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub - Scrub	Grassland - Herbaceous	Pasture - Hay	Cultivated Crops	Wetland/Barren
American Woodcock	0	0	0	0	0	0	80	80	0	0	0	0	0	80
Canada Warbler	0	0	0	0	0	0	40	20	100	0	0	0	0	80
Connecticut Warbler	0	0	0	0	0	0	100	20	0	0	0	0	0	20
Louisiana Waterthrush	0	0	0	0	0	0	20	0	0	0	0	0	0	100
Prothonotary Warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Red-shouldered Hawk	0	0	0	0	0	0	60	0	40	20	0	0	0	100

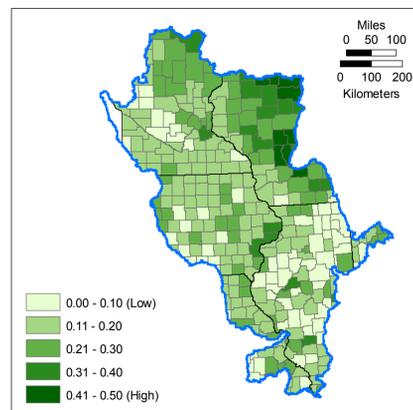
Bottomland forest birds matrix scores



Potential Species Occurrence By County (Mean)



Potential Species Richness By County (Mean)



Simpson's Diversity Index By County (Mean)

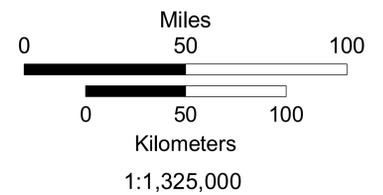
LINK is a set of Environmental Systems Research Institute (ESRI, Redlands, California) ArcGIS tools designed to map species-habitat patterns across a landscape. LINK uses species-habitat matrices to model potential species habitat and landscape diversity. Three main data sources are needed to run LINK: a species-habitat matrix, source maps such as land cover, and a zonal layer used to average model output scores such as counties, watersheds, or other management units.

LINK relates the values contained in the species-habitat matrix to the source maps generating several indices of potential habitat including: potential species richness (PSR), mean potential species occurrence (PSO) and habitat diversity as measured by the Simpson's Diversity Index (SDI). PSR is described as the potential total number of the queried species that may be found in a given area. Mean PSO is described as the average matrix score for all the queried species. The SDI measures the diversity of habitats and is influenced by the number of habitat types and how they relate to each other.

An extension was developed to the LINK tool that incorporates bird species ranges into models of habitat suitability; in this way, species are modeled only for those areas within their range. This range limitation emphasizes that the LINK tool models potential rather than occupied habitat. As part of this extension, we incorporated ranges of all birds in the Western Hemisphere as provided in the collection of digital distribution maps by NatureServe.

[http://www.umesc.er.usgs.gov/management/dss/bird\\_conservation\\_tools\\_link.html](http://www.umesc.er.usgs.gov/management/dss/bird_conservation_tools_link.html)

- Major Cities
- UMRS Boundary
- States
- Counties
- Mean Potential Species Occurrence
- 0
- 1 - 10 (Low)
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80 (High)



Map Date: September 24, 2009



# Upper Mississippi Forest Partnership

## Important Migratory Bird Habitat Grassland Birds LINK Model Results (2001 Land Cover Update)



### GRASSLAND BIRDS USED IN LINK QUERY:

- Bobolink
- Dickcissel
- Eastern Meadowlark
- Grasshopper Sparrow
- Greater Prairie-Chicken
- Henslow's Sparrow
- Le Contes Sparrow
- Loggerhead Shrike
- Northern Bobwhite
- Northern Harrier
- Sedge Wren
- Sharp-tailed Grouse
- Upland Sandpiper

### SOURCE LAYER:

National Land Cover Dataset (2001) within UMRS boundary intersecting the states of MN, WI, IA, IL, IN, and MO

### ZONAL LAYER:

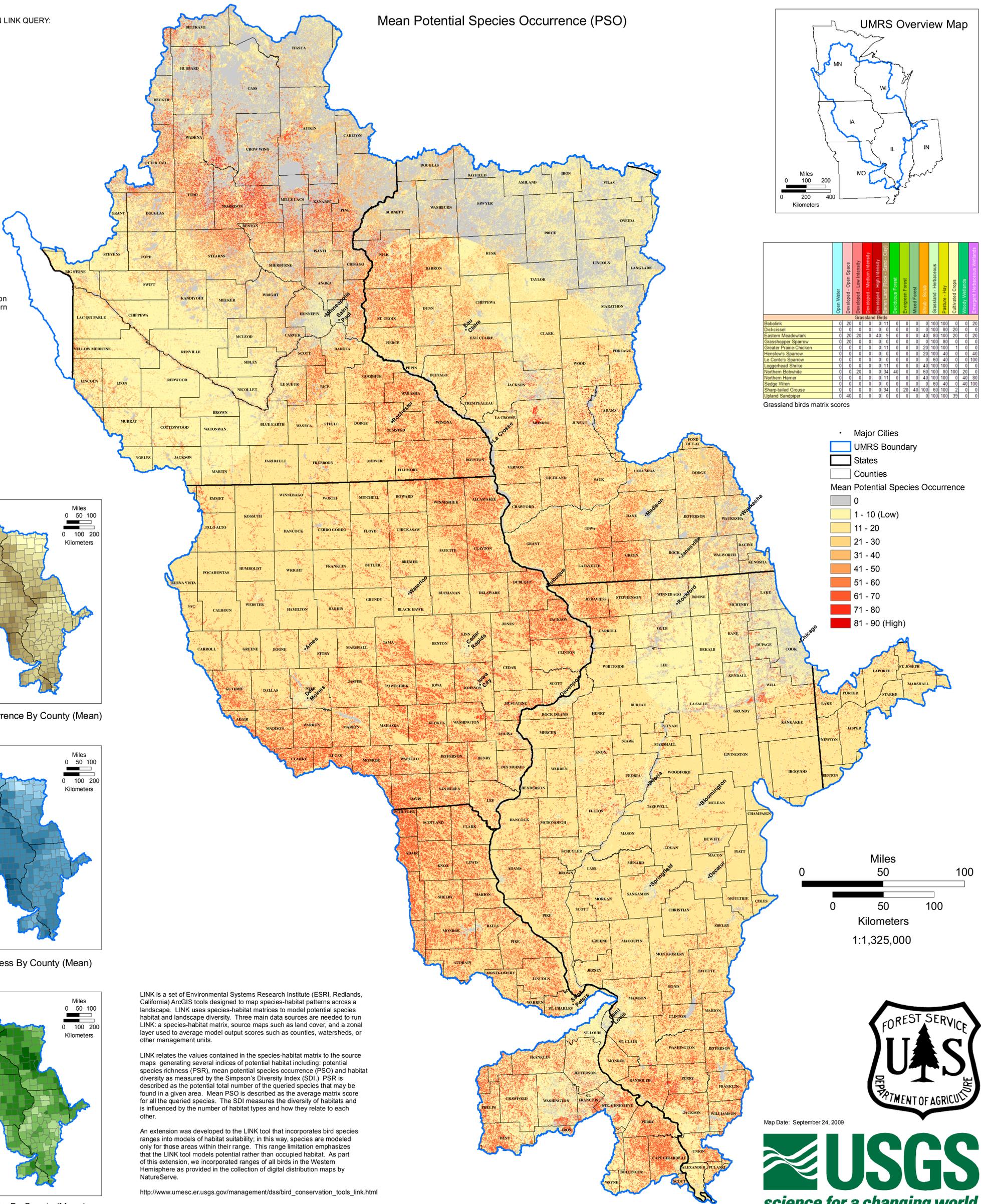
Counties

### RANGE USED:

NatureServe: Digital Distribution Maps of the Birds of the Western Hemisphere

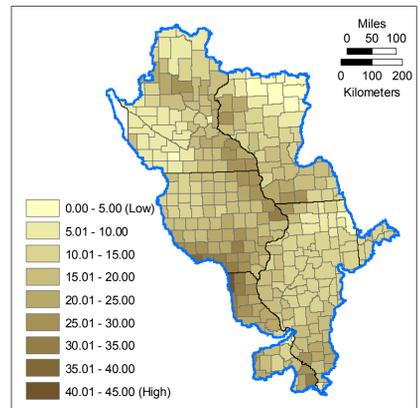
### Mean Potential Species Occurrence (PSO)

### UMRS Overview Map

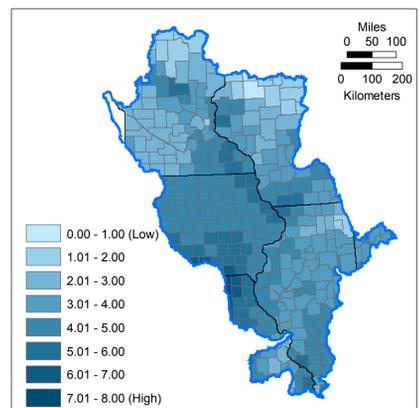


Grassland Birds	Open Water	Developed - Low Intensity	Developed - Medium Intensity	Developed - High Intensity	Urban Land (Urban - Suburb)	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland - Herbaceous	Pasture - Hay	Cultivated Crops	Woody Wetlands	Wetlands
Bobolink	0	20	0	0	11	0	0	0	100	100	0	0	0	0
Dickcissel	0	0	0	0	0	0	0	0	100	80	20	0	0	0
Eastern Meadowlark	0	20	0	40	0	0	0	40	80	100	20	0	0	0
Grasshopper Sparrow	0	20	0	0	0	0	0	100	80	0	0	0	0	0
Greater Prairie-Chicken	0	0	0	11	0	0	0	20	100	100	1	0	0	0
Henslow's Sparrow	0	0	0	0	0	0	0	20	100	40	0	0	0	0
Le Contes Sparrow	0	0	0	0	0	0	0	50	40	0	0	0	0	0
Loggerhead Shrike	0	0	0	0	11	0	0	40	100	100	0	0	0	0
Northern Bobwhite	0	20	0	34	40	0	0	60	100	80	100	20	0	0
Northern Harrier	0	0	0	11	0	0	0	40	100	100	0	40	80	0
Sedge Wren	0	0	0	0	0	0	0	50	40	0	0	40	100	0
Sharp-tailed Grouse	0	0	0	0	34	0	20	40	100	60	100	2	0	0
Upland Sandpiper	0	40	0	0	0	0	0	0	100	100	39	0	0	0

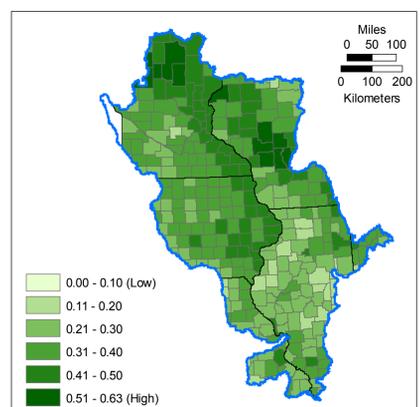
Grassland birds matrix scores



Potential Species Occurrence By County (Mean)



Potential Species Richness By County (Mean)



Simpson's Diversity Index By County (Mean)

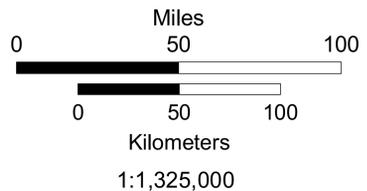
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[http://www.umesc.er.usgs.gov/management/dss/bird\\_conservation\\_tools\\_link.html](http://www.umesc.er.usgs.gov/management/dss/bird_conservation_tools_link.html)

- Major Cities
  - UMRS Boundary
  - States
  - Counties
- Mean Potential Species Occurrence
- 0
  - 1 - 10 (Low)
  - 11 - 20
  - 21 - 30
  - 31 - 40
  - 41 - 50
  - 51 - 60
  - 61 - 70
  - 71 - 80
  - 81 - 90 (High)



Map Date: September 24, 2009



# Upper Mississippi Forest Partnership

## Important Migratory Bird Habitat Shrubland Birds LINK Model Results (2001 Land Cover Update)



### SHRUBLAND BIRDS USED IN LINK QUERY:

Bell's Vireo  
Blue-winged Warbler  
Least Flycatcher  
Willow Flycatcher  
Yellow-breasted Chat

### SOURCE LAYER:

National Land Cover Dataset (2001) within UMRS boundary intersecting the states of MN, WI, IA, IL, IN, and MO

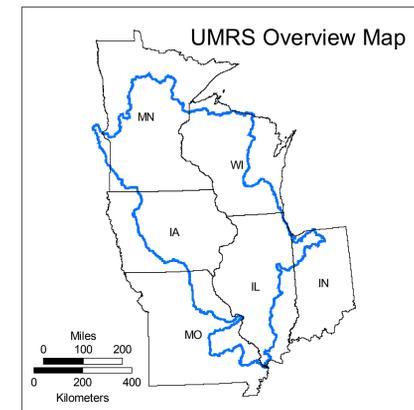
### ZONAL LAYER:

Counties

### RANGE USED:

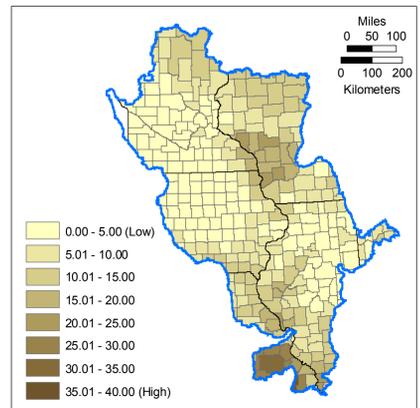
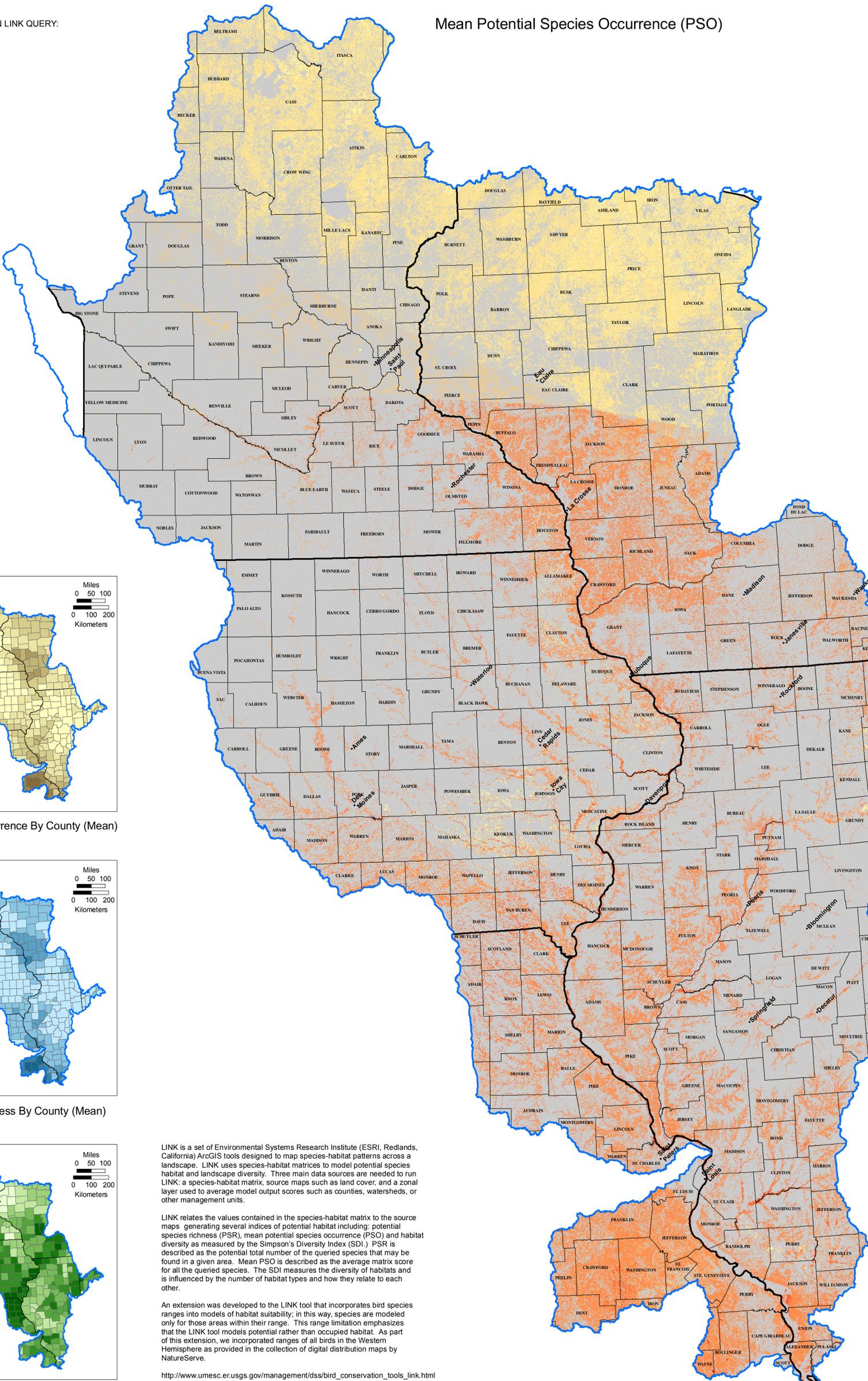
NatureServe: Digital Distribution Maps of the Birds of the Western Hemisphere

### Mean Potential Species Occurrence (PSO)

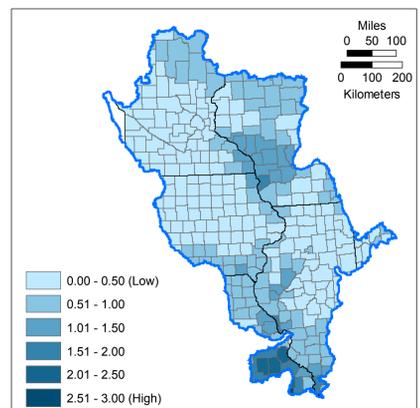


	Open Water	Developed - Open Space	Developed - Low Intensity	Developed - Medium Intensity	Developed - High Intensity	Barren Land (Rock, Sand, Clay)	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub - Scrub	Grassland - Herbaceous	Pasture - Hay	Woody Wetlands	Water Bodies - Wetlands
Bell's Vireo	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blue-winged Warbler	0	0	0	0	34	100	0	0	100	40	0	0	40	0
Least Flycatcher	0	0	0	0	11	100	0	100	20	0	0	0	40	0
Willow Flycatcher	0	0	0	0	0	20	0	100	0	0	100	0	100	0
Yellow-breasted Chat	0	0	0	0	11	0	0	100	0	0	0	0	40	0

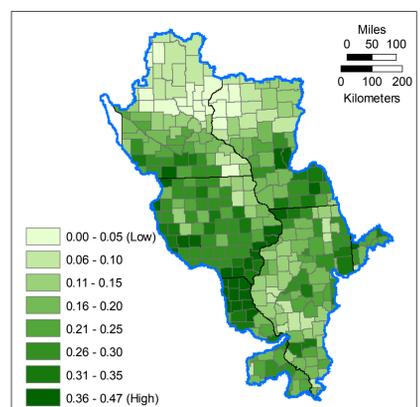
Shrubland birds matrix scores



Potential Species Occurrence By County (Mean)



Potential Species Richness By County (Mean)



Simpson's Diversity Index By County (Mean)

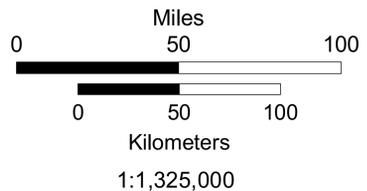
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# Upper Mississippi Forest Partnership

## Important Migratory Bird Habitat

### Upland Forest Birds LINK Model Results (2001 Land Cover Update)



#### UPLAND FOREST BIRDS USED IN LINK QUERY:

- Black-billed Cuckoo
- Brown Thrasher
- Cerulean Warbler
- Golden-winged Warbler
- Kentucky Warbler
- Yellow-shafted Flicker
- Ovenbird
- Red-headed Woodpecker
- Rose-breasted Grosbeak
- Ruffed Grouse
- Veery
- Whip-poor-will
- Wood Thrush
- Yellow throated vireo
- Yellow-billed Cuckoo

#### SOURCE LAYER:

National Land Cover Dataset (2001) within UMRS boundary intersecting the states of MN, WI, IA, IL, IN, and MO

#### ZONAL LAYER:

Counties

#### RANGE USED:

NatureServe: Digital Distribution Maps of the Birds of the Western Hemisphere

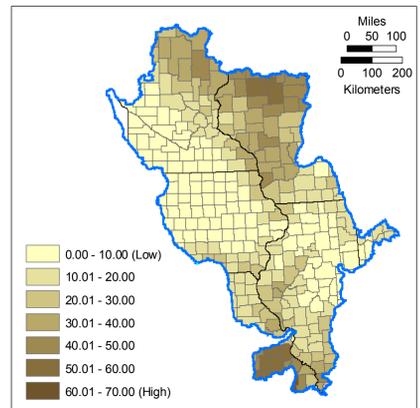
#### Mean Potential Species Occurrence (PSO)

#### UMRS Overview Map

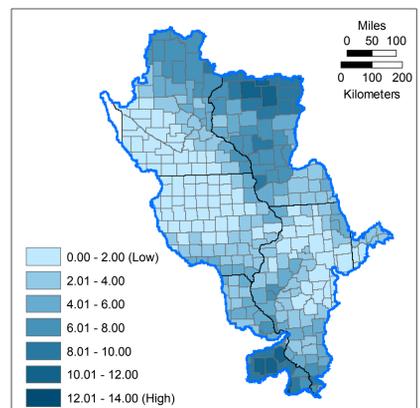


	Open Water	Developed - Open Space	Developed - Low Intensity	Developed - Medium Intensity	Developed - High Intensity	Barren Land/Rock/Soil/Crystalline	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub - Scrub	Grassland - Herbaceous	Pasture - Hay	Cultivated Crops	Wetlands
Black-billed Cuckoo	0	0	20	0	23	100	0	60	100	0	0	0	0	60
Brown Thrasher	0	20	60	0	23	40	0	60	100	20	0	0	0	60
Cerulean Warbler	0	0	0	0	100	0	0	0	0	0	0	0	0	100
Golden-winged Warbler	0	0	0	0	34	60	0	80	100	0	0	0	0	100
Kentucky Warbler	0	0	0	0	100	0	0	0	0	0	0	0	0	100
Ovenbird	0	0	0	0	0	100	20	80	0	0	0	0	0	40
Red-headed Woodpecker	0	20	40	0	0	60	0	40	20	20	20	0	0	40
Rose-breasted Grosbeak	0	40	0	0	11	100	0	80	60	20	0	0	0	60
Ruffed Grouse	0	0	0	0	11	100	40	100	0	0	0	0	0	0
Veery	0	0	0	0	0	100	20	80	0	0	0	0	0	100
Whip-poor-will	0	0	0	0	23	60	20	60	60	20	20	0	0	20
Wood Thrush	0	0	0	0	0	100	0	80	0	0	0	0	0	40
Yellow-billed Cuckoo	0	40	0	0	11	100	0	20	80	0	0	0	0	80
Yellow-shafted Flicker	0	40	60	0	43	100	20	60	80	80	80	0	0	80
Yellow-throated Vireo	0	0	20	0	0	80	0	60	0	0	0	0	0	100

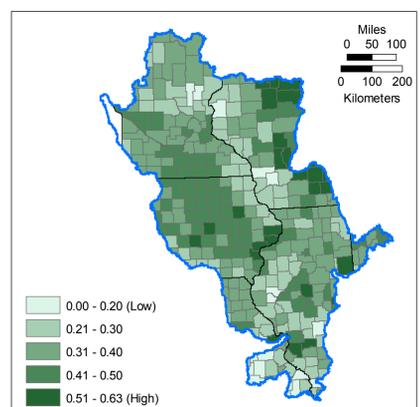
Upland forest birds matrix scores



Potential Species Occurrence By County (Mean)



Potential Species Richness By County (Mean)



Simpson's Diversity Index By County (Mean)

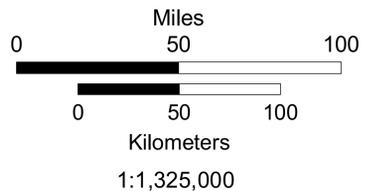
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Map Date: September 24, 2009

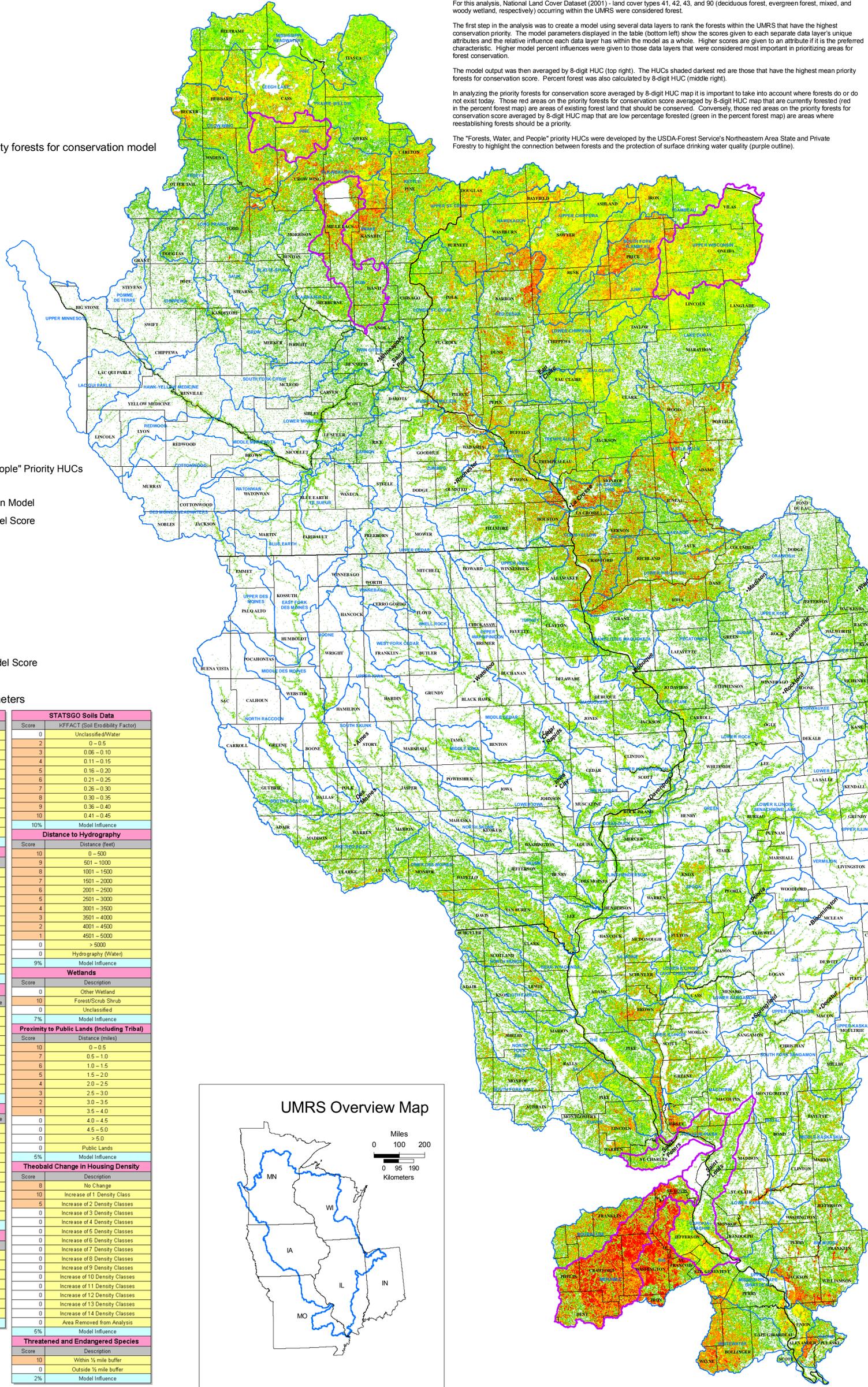


# Upper Mississippi Forest Partnership

## Priority Forests for Conservation (2001 Land Cover Update)



Priority forests for conservation model



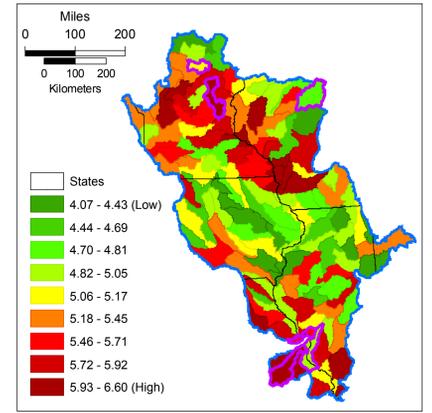
For this analysis, National Land Cover Dataset (2001) - land cover types 41, 42, 43, and 90 (deciduous forest, evergreen forest, mixed, and woody wetland, respectively) occurring within the UMRS were considered forest.

The first step in the analysis was to create a model using several data layers to rank the forests within the UMRS that have the highest conservation priority. The model parameters displayed in the table (bottom left) show the scores given to each separate data layer's unique attributes and the relative influence each data layer has within the model as a whole. Higher scores are given to an attribute if it is the preferred characteristic. Higher model percent influences were given to those data layers that were considered most important in prioritizing areas for forest conservation.

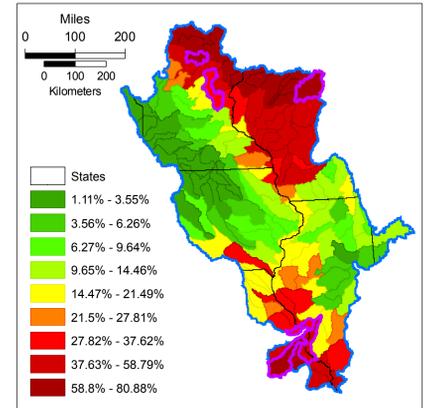
The model output was then averaged by 8-digit HUC (top right). The HUCs shaded darkest red are those that have the highest mean priority forests for conservation score. Percent forest was also calculated by 8-digit HUC (middle right).

In analyzing the priority forests for conservation score averaged by 8-digit HUC map it is important to take into account where forests do or do not exist today. Those red areas on the priority forests for conservation score averaged by 8-digit HUC map that are currently forested (red in the percent forest map) are areas of existing forest land that should be conserved. Conversely, those red areas on the priority forests for conservation score averaged by 8-digit HUC map that are low percentage forested (green in the percent forest map) are areas where reestablishing forests should be a priority.

The "Forests, Water, and People" priority HUCs were developed by the USDA-Forest Service's Northeastern Area State and Private Forestry to highlight the connection between forests and the protection of surface drinking water quality (purple outline).



Priority forests for conservation score averaged by 8-digit HUC



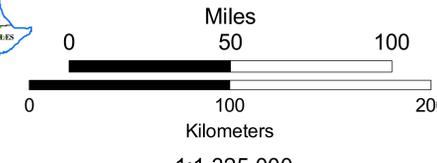
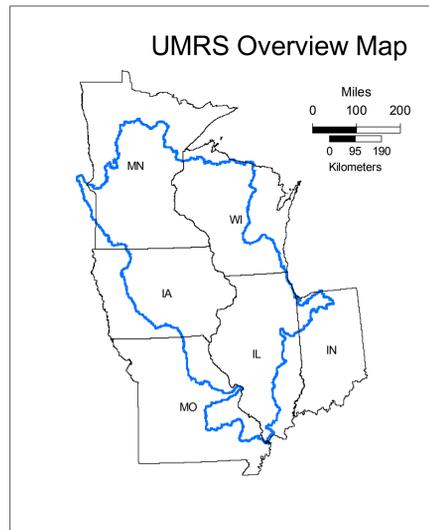
Percent forest (NLCD 2001) averaged by 8-digit HUC

### Legend

- Major Cities
  - ▭ States
  - ▭ Counties
  - ▭ "Forests, Water, and People" Priority HUCs
  - ▭ 8-Digit HUC
- Priority Forests for Conservation Model
- Low Priority Forest Model Score
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - High Priority Forest Model Score

### Priority Forest Model Parameters

SPARROW Nitrogen Yield		STATSGO Soils Data	
Score	Kg/ha km <sup>2</sup> /year	Score	KFFACT (Soil Erodibility Factor)
10	120 - 250	0	Unclassified/Water
9	251 - 500	2	0 - 0.5
8	501 - 750	3	0.06 - 0.10
7	751 - 1000	4	0.11 - 0.15
6	1001 - 1250	5	0.16 - 0.20
5	1251 - 1500	6	0.21 - 0.25
4	1501 - 1750	7	0.26 - 0.30
3	1751 - 2000	8	0.30 - 0.35
2	2001 - 2250	9	0.36 - 0.40
1	2251 - 2500	10	0.41 - 0.45
0	> 2500	10%	Model Influence
15%	Model Influence	Distance to Hydrography	
Score	Adjusted population of water consumers	Score	Distance (feet)
0	0 - 25	10	0 - 500
1	26 - 58	9	501 - 1000
2	59 - 83	8	1001 - 1500
3	84 - 170	7	1501 - 2000
4	171 - 207	6	2001 - 2500
5	208 - 281	5	2501 - 3000
6	282 - 470	4	3001 - 3500
7	471 - 694	3	3501 - 4000
8	695 - 1017	2	4001 - 4500
9	1018 - 1541	1	4501 - 5000
10	> 1541	0	> 5000
13%	Model Influence	9%	Hydrography (Water)
Score	Mean Potential Species Occurrence Score	9%	Model Influence
0	0	Wetlands	
1	1 - 10	Score	Description
2	10 - 20	0	Other Wetland
3	20 - 30	10	Forest/Scrub Shrub
4	30 - 40	0	Unclassified
5	40 - 50	7%	Model Influence
6	50 - 60	Proximity to Public Lands (Including Tribal)	
7	60 - 70	Score	Distance (miles)
8	70 - 80	10	0 - 0.5
9	80 - 90	7	0.5 - 1.0
12%	Model Influence	6	1.0 - 1.5
Score	Mean Potential Species Occurrence Score	5	1.5 - 2.0
0	0	4	2.0 - 2.5
1	1 - 10	3	2.5 - 3.0
2	10 - 20	2	3.0 - 3.5
3	20 - 30	1	3.5 - 4.0
4	30 - 40	0	4.0 - 4.5
5	40 - 50	0	4.5 - 5.0
6	50 - 60	0	> 5.0
7	60 - 70	0	Public Lands
8	70 - 80	5%	Model Influence
9	80 - 90	Theobald Change in Housing Density	
10	26 - 163	Score	Description
10%	Model Influence	8	No Change
Score	Description	10	Increase of 1 Density Class
0	0 - 2	5	Increase of 2 Density Classes
2	3 - 5	0	Increase of 3 Density Classes
6	6 - 10	0	Increase of 4 Density Classes
7	11 - 14	0	Increase of 5 Density Classes
8	15 - 18	0	Increase of 6 Density Classes
9	19 - 25	0	Increase of 7 Density Classes
10	26 - 163	0	Increase of 8 Density Classes
10%	Model Influence	0	Increase of 9 Density Classes
Score	Description	0	Increase of 10 Density Classes
0	0 - 2	0	Increase of 11 Density Classes
2	3 - 5	0	Increase of 12 Density Classes
6	6 - 10	0	Increase of 13 Density Classes
7	11 - 14	0	Increase of 14 Density Classes
8	15 - 18	0	Area Removed from Analysis
9	19 - 25	0	Area Removed from Analysis
10	26 - 163	0	Area Removed from Analysis
10%	Model Influence	Threatened and Endangered Species	
Score	Description	Score	Description
0	0 - 2	10	Within 1/2 mile buffer
2	3 - 5	0	Outside 1/2 mile buffer
6	6 - 10	0	Outside 1/2 mile buffer
7	11 - 14	2%	Model Influence
8	15 - 18		
9	19 - 25		
10	26 - 163		
10%	Model Influence		



1:1,325,000



Map Date: September 24, 2009

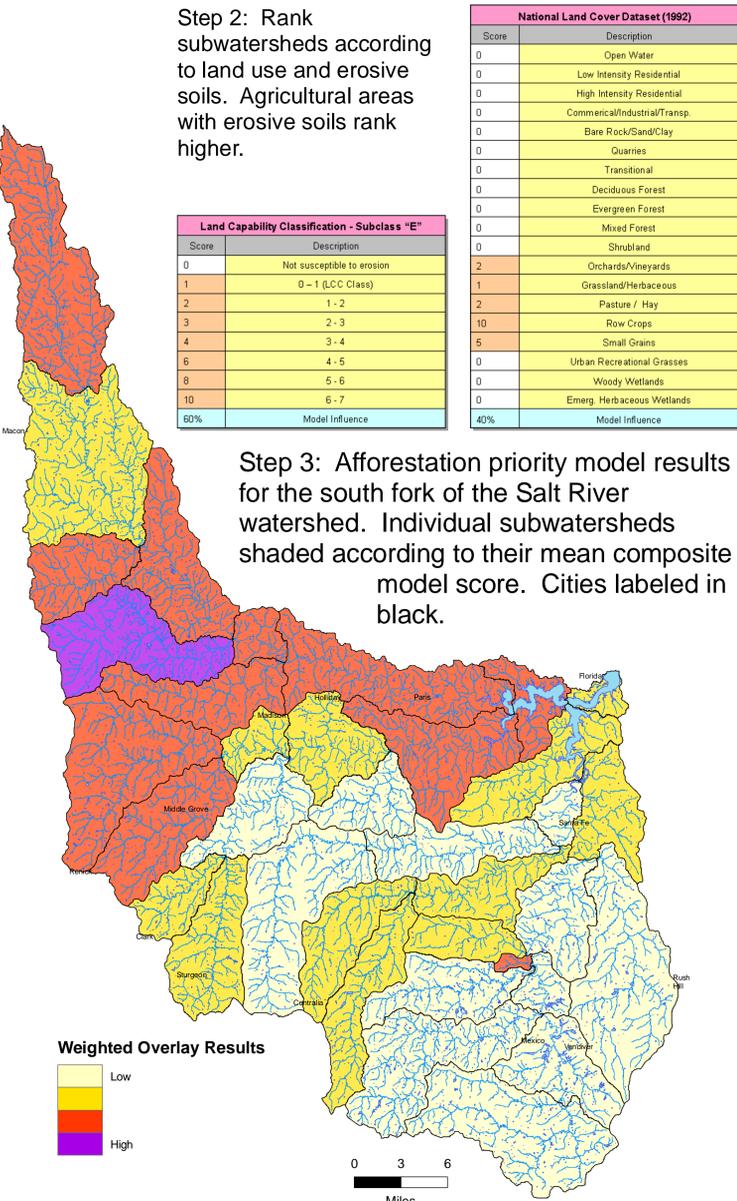


# Upper Mississippi Forest Partnership

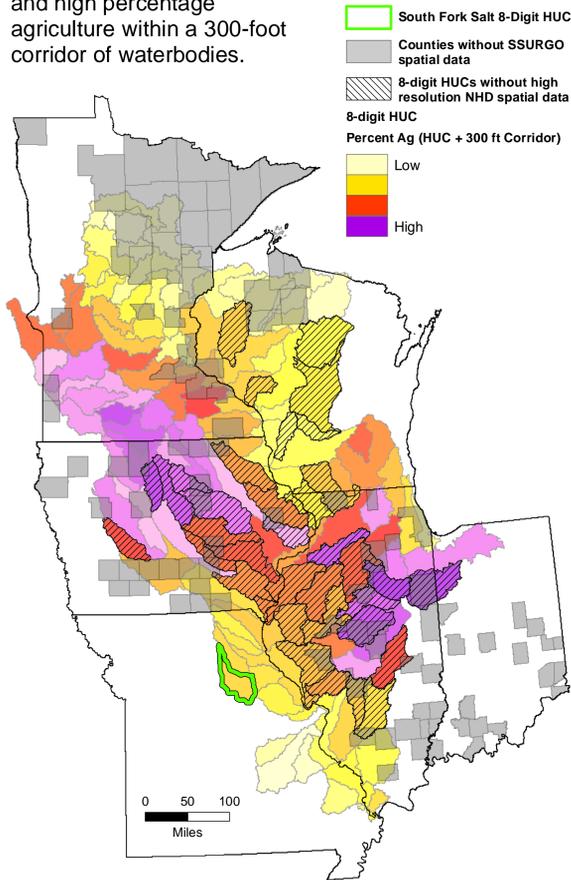
## Preservation of Riparian Corridor Water Quality and Aquatic Habitat South Fork Salt River Watershed Analysis



### Riparian corridor afforestation priority model



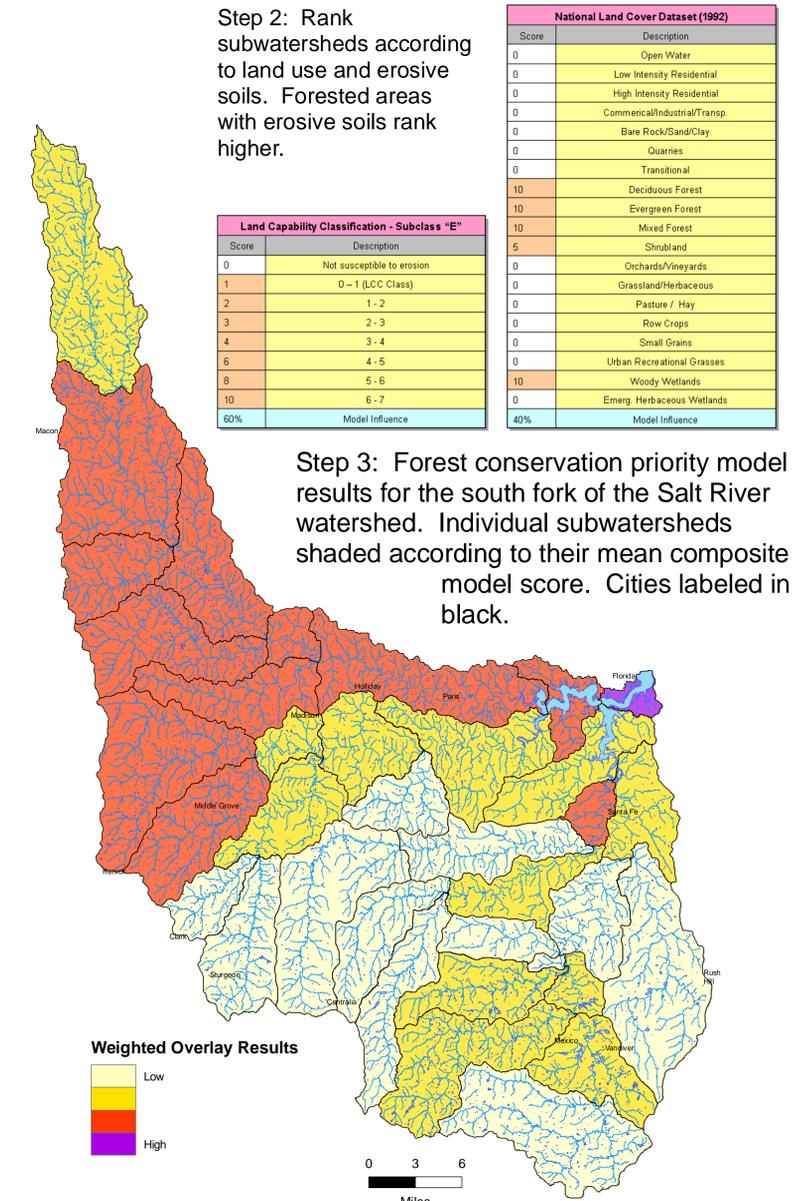
Step 1: Location of watersheds with high percentage agriculture and high percentage agriculture within a 300-foot corridor of waterbodies.



South fork Salt River watershed chosen based upon having a contrasting landscape to the Watonwan River watershed. The Watonwan River watershed is dominated by agriculture and gentle slopes, whereas the south fork Salt River watershed has steeper slopes and is less dominated by agriculture. Additionally, this watershed has surface run-off and other erosion problems and water quality concerns in Mark Twain Lake. This watershed also met the minimum data requirements with the availability of high resolution hydrography (NHD) and high resolution soils (SSURGO) data.

Afforestation and forest conservation models were individually run on land area within a 300 foot corridor surrounding perennial and intermittent water bodies within the south fork Salt River watershed as delineated by the National Hydrography Dataset (NHD). These results were then averaged by subwatershed boundary (MO NRCS) and are displayed in the map layers to the left and right.

### Riparian corridor forest conservation priority model

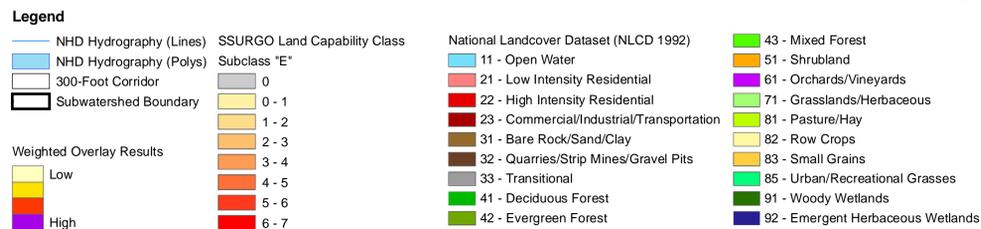
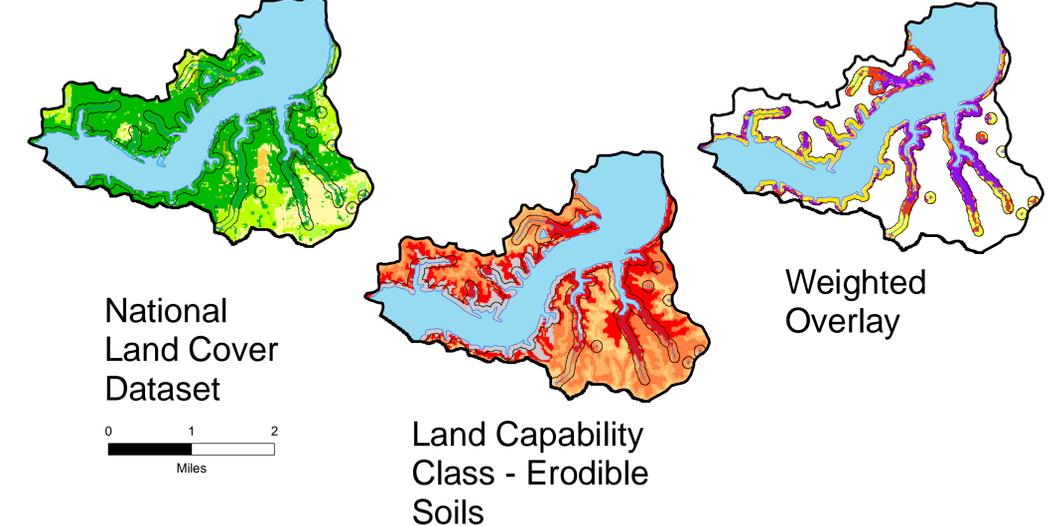
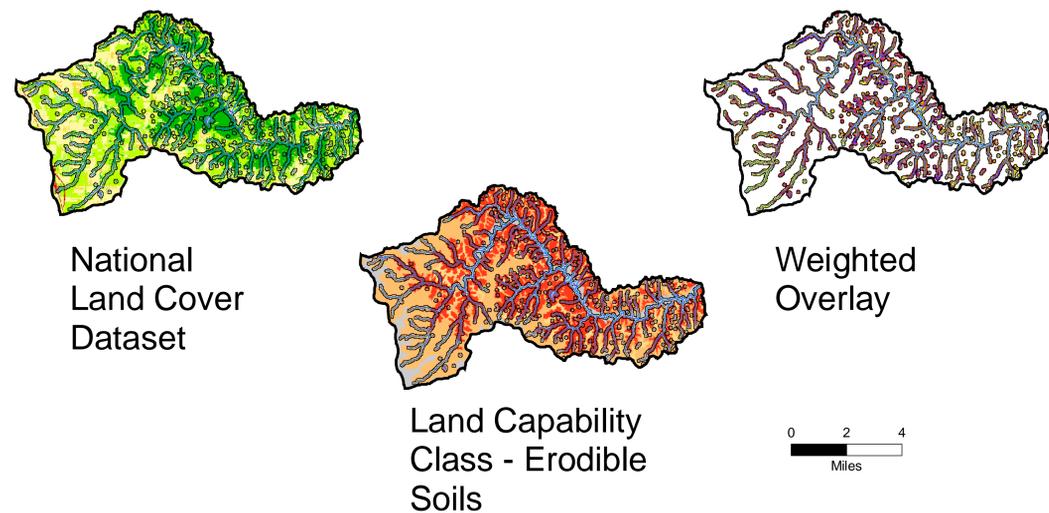


Step 4: Delineating agricultural areas with potentially erosive soils within 300 feet of a water body.

Step 4: Delineating forested areas with potentially erosive soils within 300 feet of a water body.

Example subwatershed (shaded in purple in map above) depicting NLCD, Land Capability Class, and weighted overlay results. Example subwatershed chosen based on highest mean afforestation priority model score.

Example subwatershed (shaded in purple in map above) depicting NLCD, Land Capability Class, and weighted overlay results. Example subwatershed chosen based on highest mean forest conservation priority model score.



Map Date: November 2, 2006



# Upper Mississippi Forest Partnership

## Preservation of Riparian Corridor Water Quality and Aquatic Habitat Watowan River Watershed Analysis

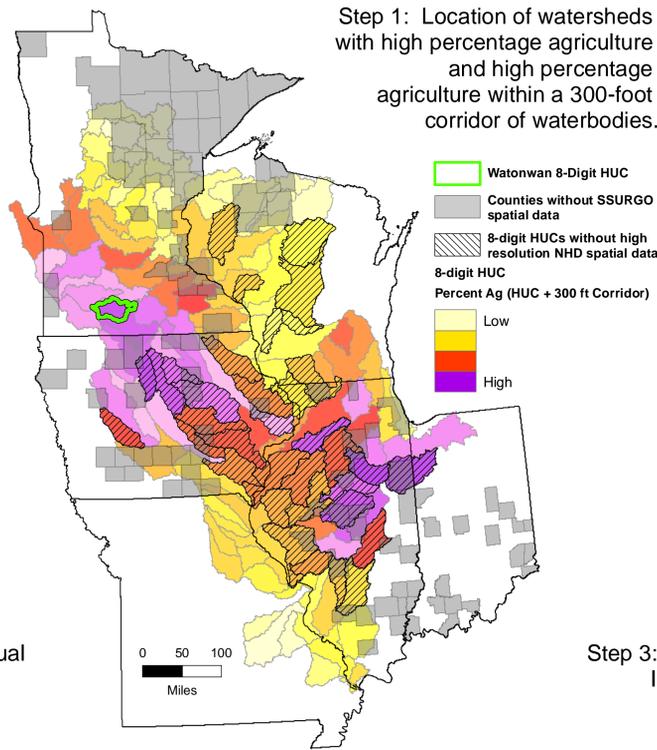


### Riparian corridor afforestation priority model

National Land Cover Dataset (1992)	
Score	Description
0	Open Water
0	Low Intensity Residential
0	High Intensity Residential
0	Commercial/Industrial/Transp.
0	Bare Rock/Sand/Clay
0	Quarries
0	Transitional
0	Deciduous Forest
0	Evergreen Forest
0	Mixed Forest
0	Shrubland
2	Orchards/Vineyards
1	Grassland/Herbaceous
2	Pasture / Hay
10	Row Crops
5	Small Grains
0	Urban Recreational Grasses
0	Woody Wetlands
0	Emerg. Herbaceous Wetlands
40%	Model Influence

Step 2: Rank subwatersheds according to land use and erosive soils. Agricultural areas with erosive soils rank higher.

Land Capability Classification - Subclass "E"	
Score	Description
0	Not susceptible to erosion
1	0 - 1 (LCC Class)
2	1 - 2
3	2 - 3
4	3 - 4
6	4 - 5
8	5 - 6
10	6 - 7
60%	Model Influence



Step 1: Location of watersheds with high percentage agriculture and high percentage agriculture within a 300-foot corridor of waterbodies.

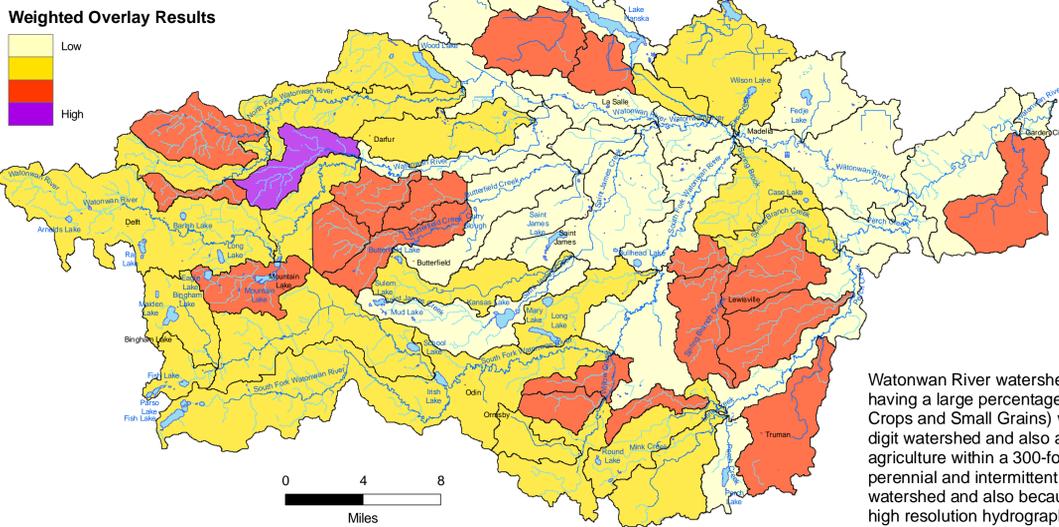
### Riparian corridor forest conservation priority model

National Land Cover Dataset (1992)	
Score	Description
0	Open Water
0	Low Intensity Residential
0	High Intensity Residential
0	Commercial/Industrial/Transp.
0	Bare Rock/Sand/Clay
0	Quarries
0	Transitional
10	Deciduous Forest
10	Evergreen Forest
10	Mixed Forest
5	Shrubland
0	Orchards/Vineyards
0	Grassland/Herbaceous
0	Pasture / Hay
0	Row Crops
0	Small Grains
0	Urban Recreational Grasses
10	Woody Wetlands
0	Emerg. Herbaceous Wetlands
40%	Model Influence

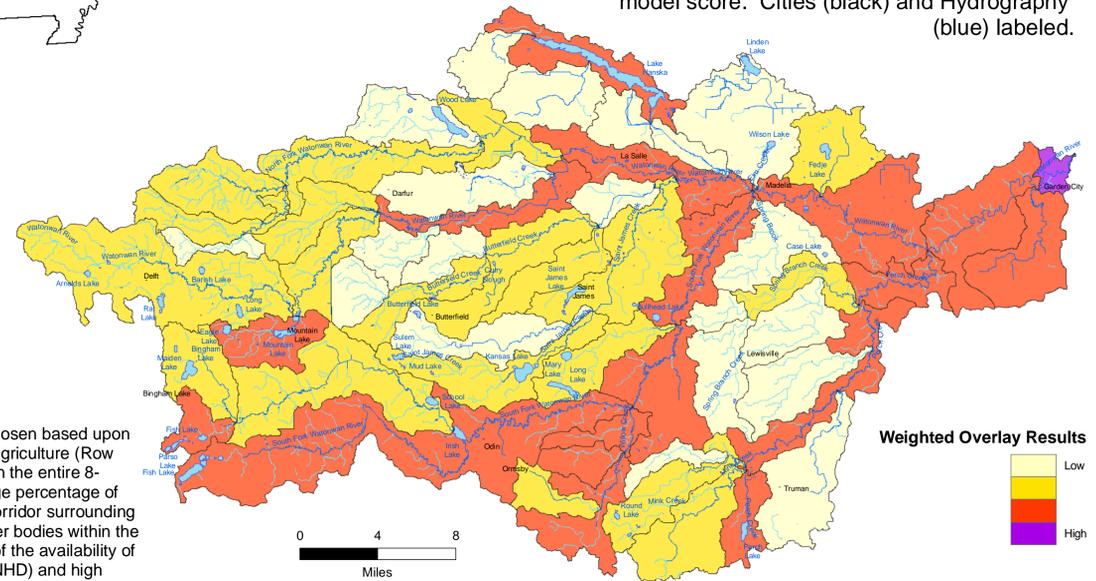
Step 2: Rank subwatersheds according to land use and erosive soils. Forested areas with erosive soils rank higher.

Land Capability Classification - Subclass "E"	
Score	Description
0	Not susceptible to erosion
1	0 - 1 (LCC Class)
2	1 - 2
3	2 - 3
4	3 - 4
6	4 - 5
8	5 - 6
10	6 - 7
60%	Model Influence

Step 3: Afforestation priority model results for Watowan River watershed. Individual subwatersheds shaded according to their mean composite model score. Cities (black) and Hydrography (blue) labeled.

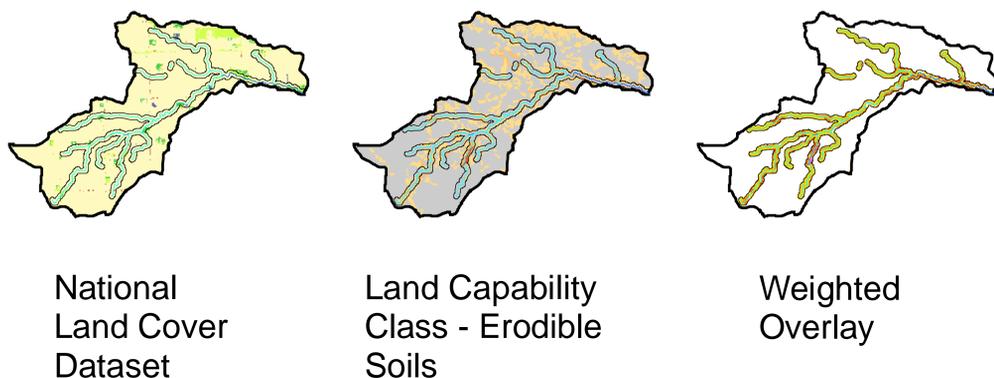


Step 3: Forest conservation model results for Watowan River watershed. Individual subwatersheds shaded according to their mean composite model score. Cities (black) and Hydrography (blue) labeled.



Step 4: Delineating areas in agriculture with potentially erosive soils within 300 feet of a water body.

Example subwatershed (shaded in purple in map above) depicting NLCD, Land Capability Class, and weighted overlay results. Example subwatershed chosen based on highest mean afforestation priority model score.



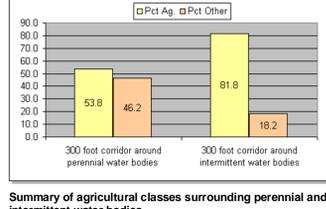
National Land Cover Dataset

Land Capability Class - Erodible Soils

Weighted Overlay



	300 foot corridor around perennial water bodies	300 foot corridor around intermittent water bodies
Acres of Ag.	20936.8	36866.7
Acres of Other	17875.1	8187.7
Total Acres	38711.9	45054.3
Pct Ag.	53.8	81.8
Pct Other	46.2	18.2



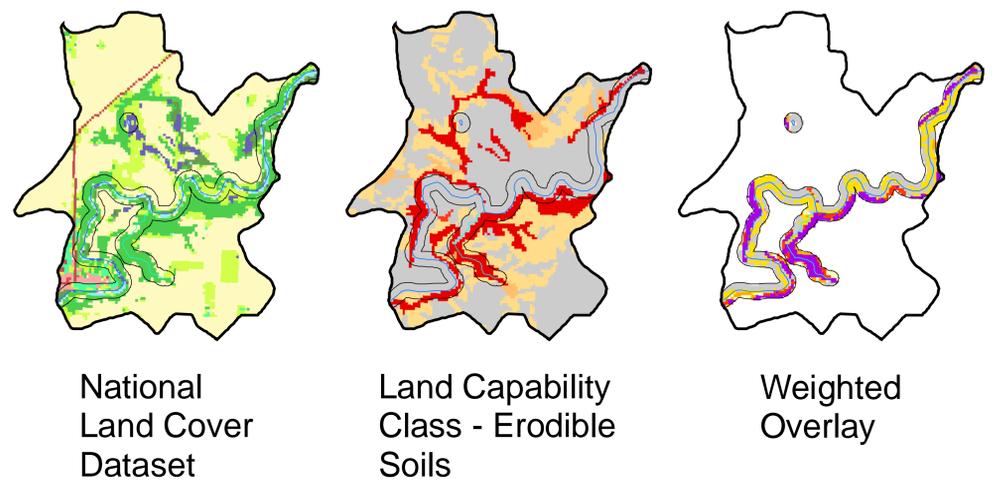
Summary of agricultural classes surrounding perennial and intermittent water bodies

- Subwatershed Boundary
- 300-Foot Corridor
- NHD Hydrography
- Intermittent (Lines)
- Perennial (Lines)
- Perennial (Polys)
- Weighted Overlay Results
- Low
- High

- SSURGO Land Capability Class
- Subclass "E"
- Not susceptible to erosion
- Low Erodibility
- High Erodibility

- National Land Cover Dataset (NLCD 1992)
- 11 - Open Water
- 21 - Low Intensity Residential
- 22 - High Intensity Residential
- 23 - Commercial/Industrial/Transportation
- 31 - Bare Rock/Sand/Clay
- 32 - Quarries/Strip Mines/Gravel Pits
- 33 - Transitional
- 41 - Deciduous Forest
- 42 - Evergreen Forest

- 43 - Mixed Forest
- 51 - Shrubland
- 61 - Orchards/Vineyards
- 71 - Grasslands/Herbaceous
- 81 - Pasture/Hay
- 82 - Row Crops
- 83 - Small Grains
- 85 - Urban/Recreational Grasses
- 91 - Woody Wetlands
- 92 - Emergent Herbaceous Wetlands



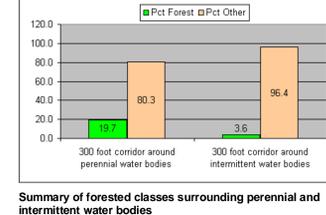
National Land Cover Dataset

Land Capability Class - Erodible Soils

Weighted Overlay



	300 foot corridor around perennial water bodies	300 foot corridor around intermittent water bodies
Acres of Forest	7626.1	1629.7
Acres of Other	31095.8	43424.6
Total Acres	38711.9	45054.3
Pct Forest	19.7	3.6
Pct Other	80.3	96.4



Summary of forested classes surrounding perennial and intermittent water bodies

Map Date: November 2, 2006

