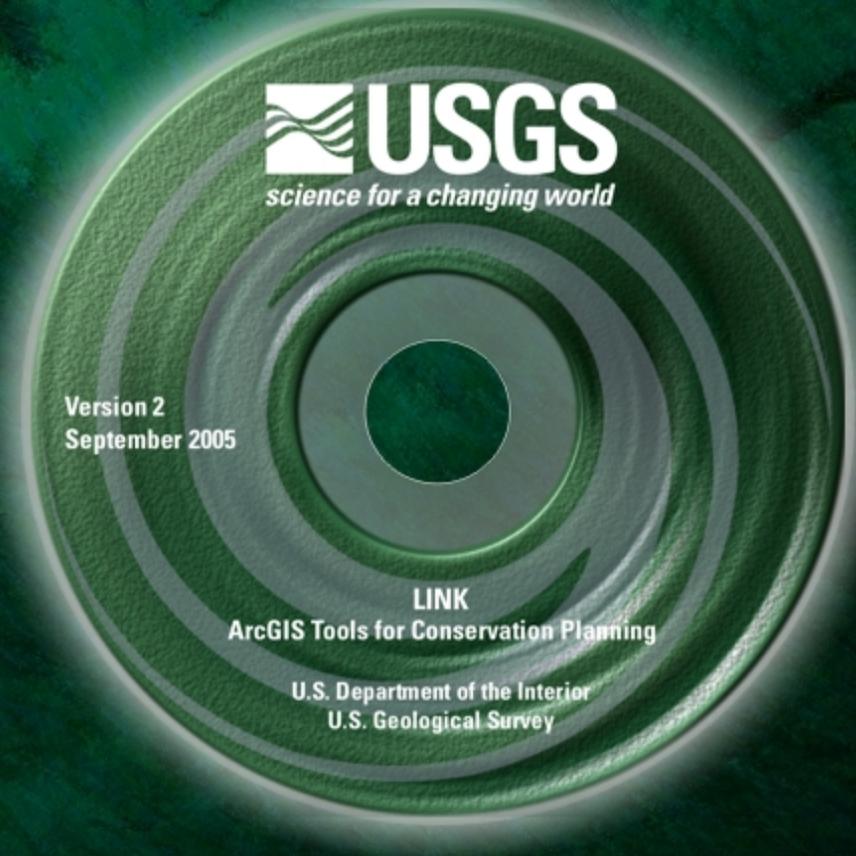




LINK

ArcGIS Tools for Conservation Planning



U.S. Department of the Interior
U.S. Geological Survey
Upper Midwest Environmental Sciences Center

What does LINK do?



LINK is a set of ArcGIS tools that create maps, tables, and graphs of

- Potential Species Occurrence (PSO)
- Potential Species Richness (PSR)
- Simpson's Diversity Index (SDI)
- Zonal composition

LINK's Background



- Part of the Bird Conservation Region 23 bird modeling project
- Developed in partnership with the USFWS
- Provides tools to evaluate potential habitat
- LINK was created for refuge and regional planners



LINK's Technical Background



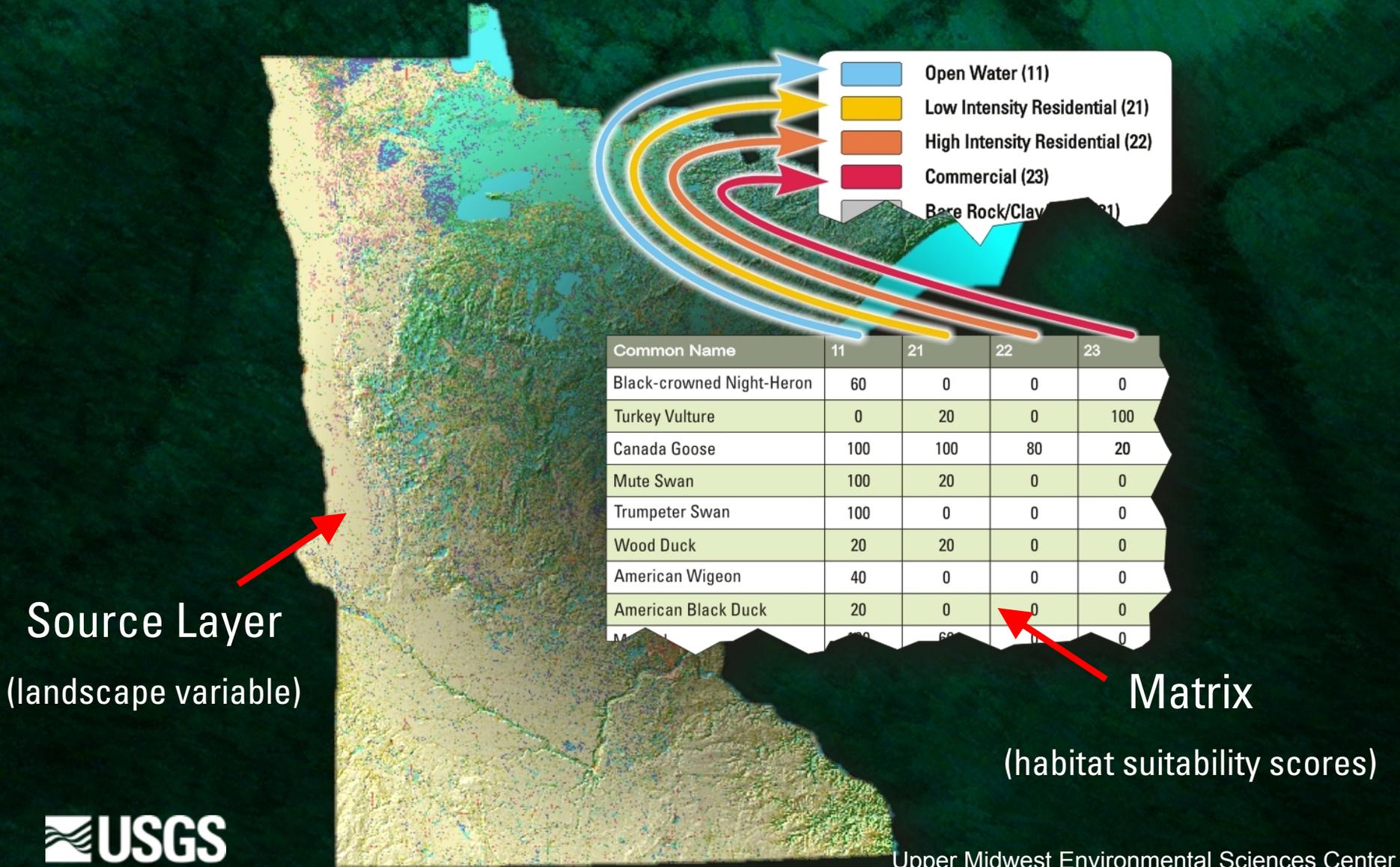
- LINK operates within ArcMap 9.1, requires Spatial Analyst
- Open-ended tool, allowing for user-supplied data
- Can perform analyses over broad areas

LINK Input Variables

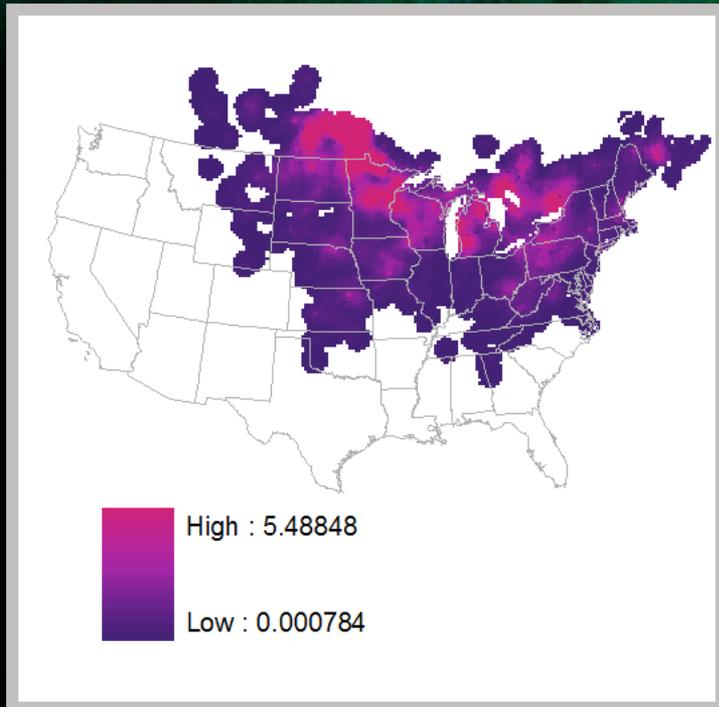


- **Matrices** contain species/landscape variable retaliations
- **Source layers** define landscape variables
- **Range maps** restrict and modify analysis
- **Zonal layers** provide spatial units for summarization and comparison

Matrix\Source Layer



Range Maps



Black-billed Cuckoo

Breeding Bird Survey,
relative abundance

- Range maps restrict and modify analyses
- Range can be treated as a
 - binary mask
 - continuous surface of abundance
- The use of range is optional

Zonal Layers



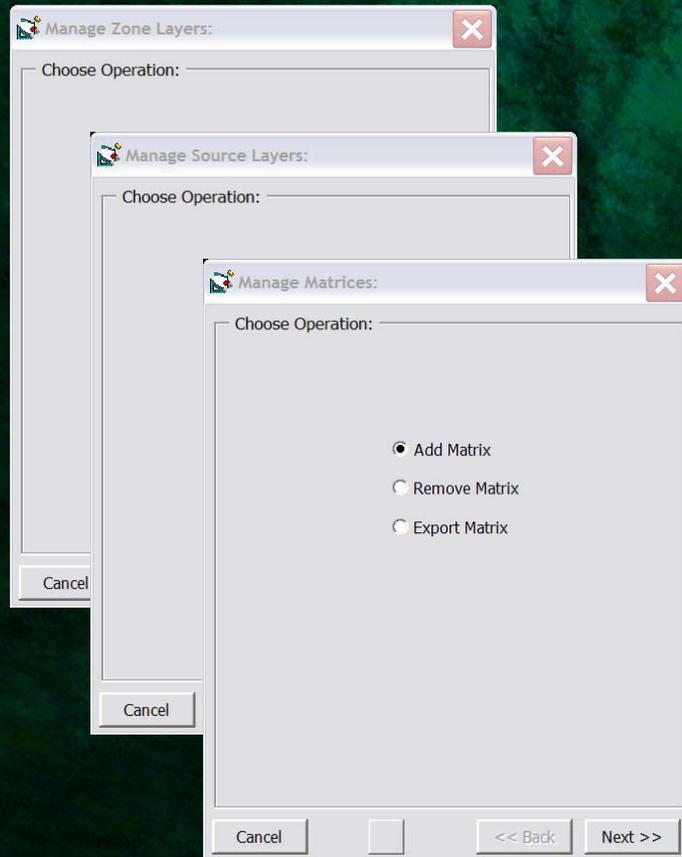
- Zonal layers provide units of comparison
- Examples
 - land ownership
 - refuge boundaries
 - political boundaries
 - ecological zones
- The use of a zonal layer is optional

LINK: Installed Data



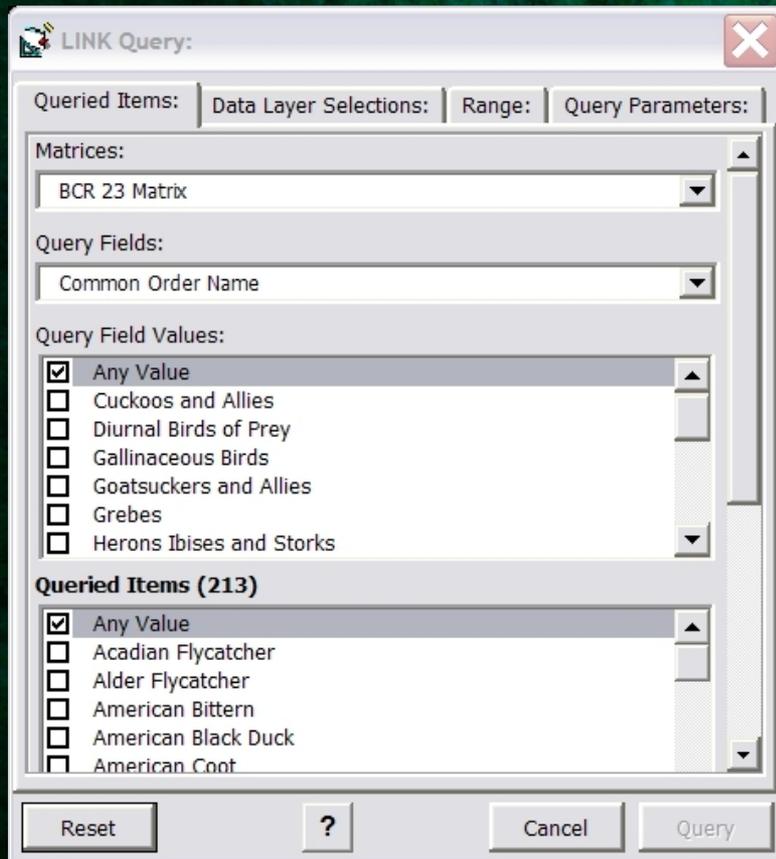
- 1 Matrix
 - birds of Bird Conservation Region 23 (BCR 23)
 - scored for the National Land Cover Dataset (NLCD)
- 609 MB of source layers, NLCD
- 12 MB of zonal layers
 - hexagons grids
 - counties
 - incremental buffers
 - ecoregions
- 156 MB of range maps
 - Breeding Bird Survey (BBS)
 - NatureServe (NS)

LINK: User Data



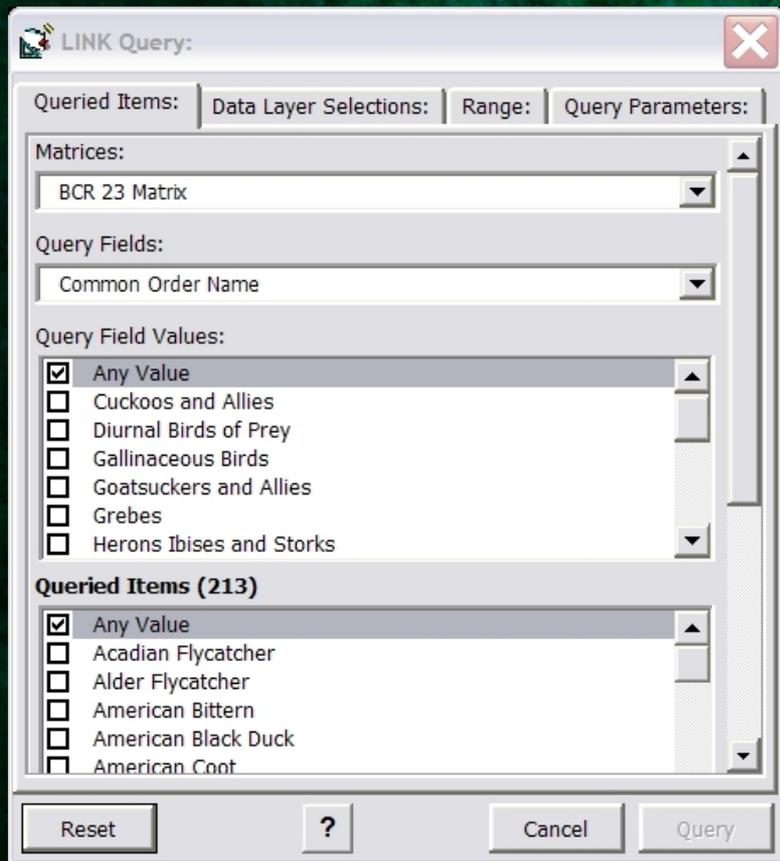
- Users can enter data specific to their needs
 - matrices
 - source layers
 - zonal layers
 - range maps
- Wizards mediate data entry

LINK Query Dialog



- A single run of the LINK tool is termed a *LINK query*
- LINK query parameters are set in the LINK Query dialog

LINK Query Dialog



The LINK Query dialog is launched within ArcGIS from a toolbar

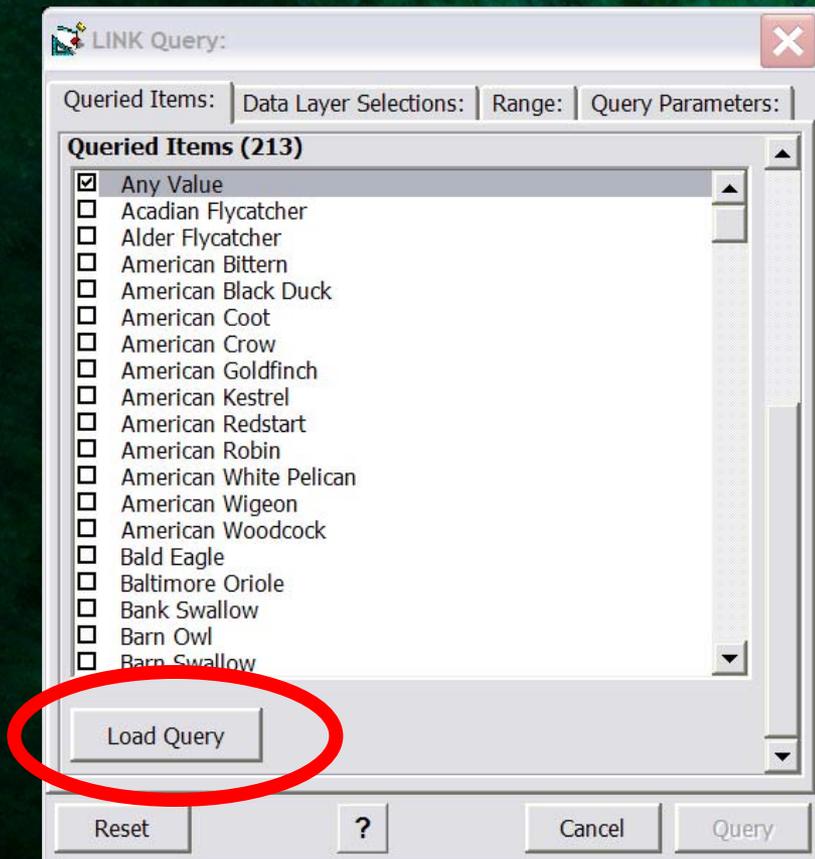


Wizards to enter matrices, source layers, and zonal layers

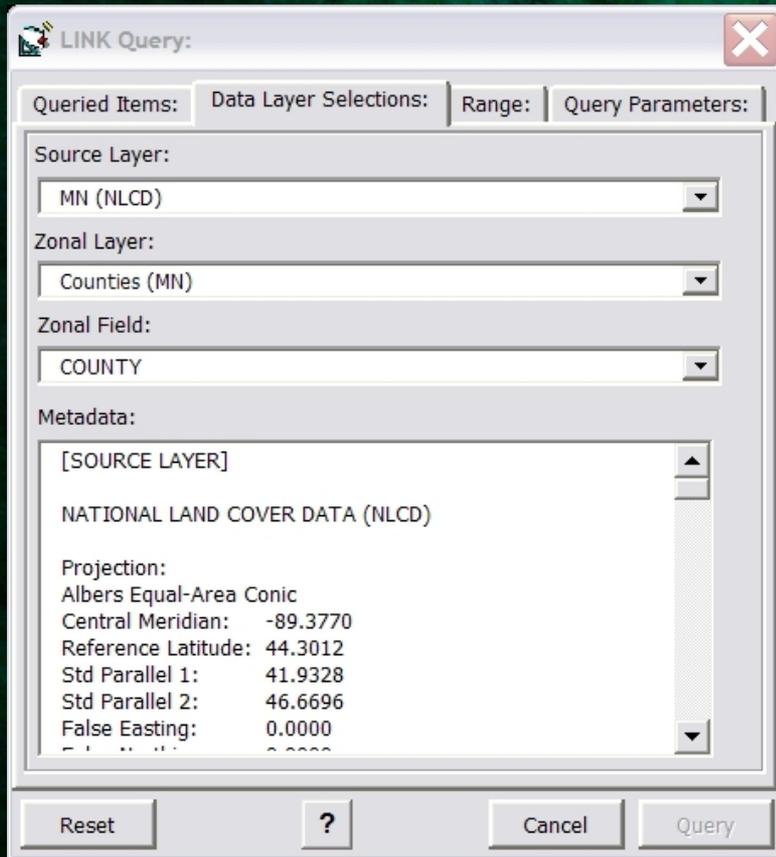
Help

LINK Query Dialog: Queried Items

- Select matrix
- Select
 - a single species
 - or
 - a collection of species
- You may also load a previous query



LINK Query Dialog: Data Layer Selections



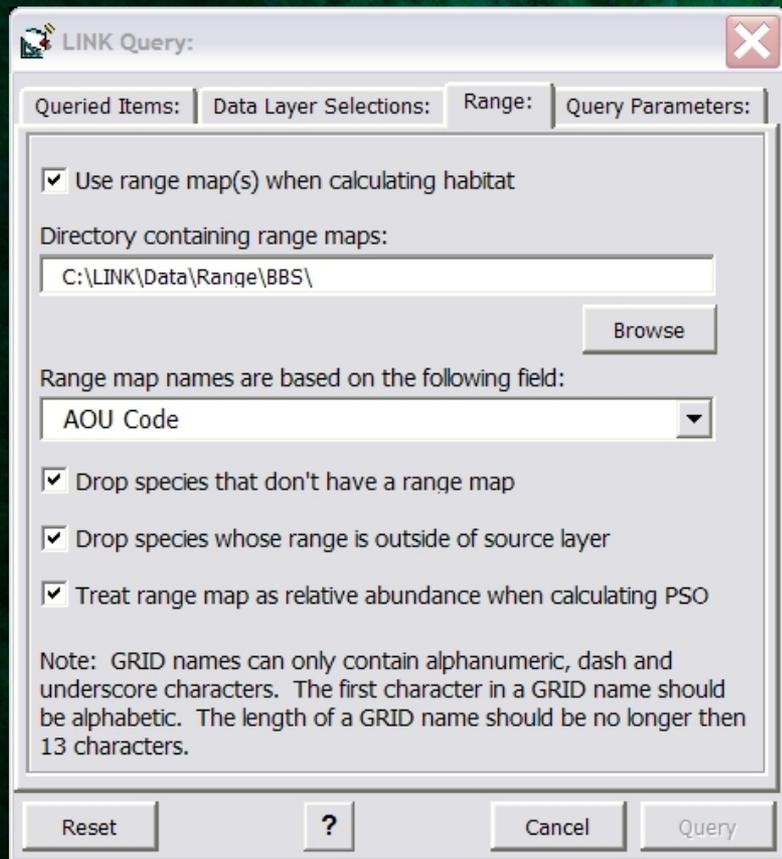
The screenshot shows the 'LINK Query' dialog box with the 'Data Layer Selections' tab selected. The 'Source Layer' is set to 'MN (NLCD)', the 'Zonal Layer' is 'Counties (MN)', and the 'Zonal Field' is 'COUNTY'. The 'Metadata' section displays the following information:

[SOURCE LAYER]
NATIONAL LAND COVER DATA (NLCD)
Projection:
Albers Equal-Area Conic
Central Meridian: -89.3770
Reference Latitude: 44.3012
Std Parallel 1: 41.9328
Std Parallel 2: 46.6696
False Easting: 0.0000

Buttons at the bottom include 'Reset', '?', 'Cancel', and 'Query'.

- Select source layer
- Select zonal layer
- Select zonal field
- Metadata for the selected zonal and source layers loads into the Metadata textbox

LINK Query Dialog: Range

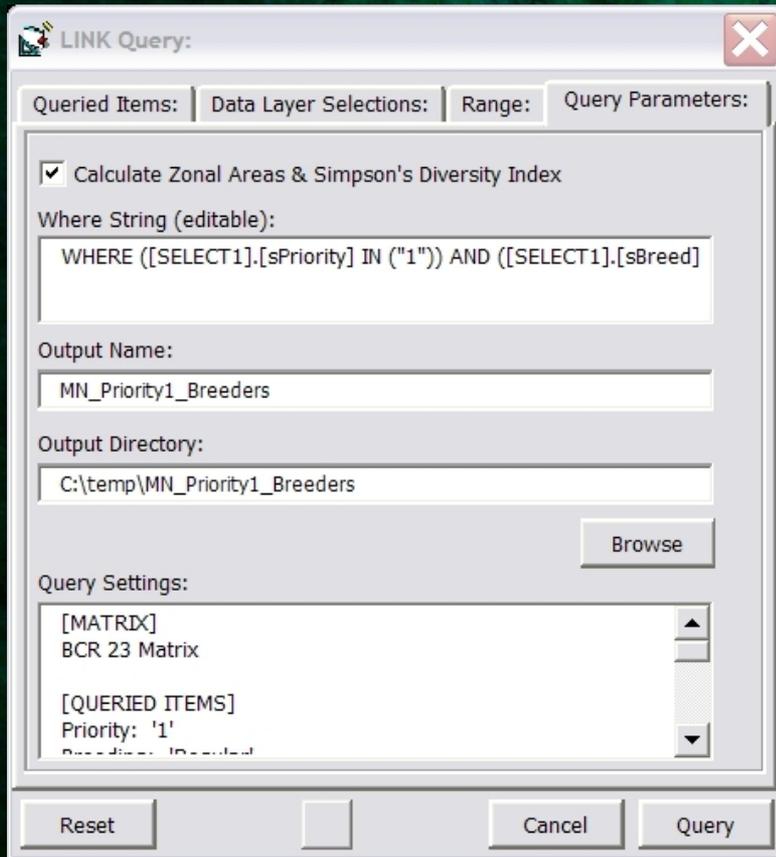


The screenshot shows the 'LINK Query' dialog box with the 'Range' tab selected. The dialog has a title bar with a close button (X) and a help icon. Below the title bar are four tabs: 'Queried Items:', 'Data Layer Selections:', 'Range:', and 'Query Parameters:'. The 'Range' tab contains the following elements:

- A checked checkbox labeled 'Use range map(s) when calculating habitat'.
- A text field labeled 'Directory containing range maps:' with the path 'C:\LINK\Data\Range\BBS\'. A 'Browse' button is to the right of the text field.
- A label 'Range map names are based on the following field:' above a dropdown menu showing 'AOU Code'.
- Three checked checkboxes:
 - 'Drop species that don't have a range map'
 - 'Drop species whose range is outside of source layer'
 - 'Treat range map as relative abundance when calculating PSO'
- A note: 'Note: GRID names can only contain alphanumeric, dash and underscore characters. The first character in a GRID name should be alphabetic. The length of a GRID name should be no longer than 13 characters.'
- At the bottom are four buttons: 'Reset', a help icon (?), 'Cancel', and 'Query'.

- Locate the directory containing range maps
- Identify which matrix field contains range map names
- Choose how to handle problematic conditions
- Choose how range maps are treated (PSO)

LINK Query Dialog: Query Parameters



The screenshot shows the 'LINK Query' dialog box with the 'Query Parameters' tab selected. The 'Calculate Zonal Areas & Simpson's Diversity Index' checkbox is checked. The 'Where String (editable):' field contains the SQL query: `WHERE ([SELECT1].[sPriority] IN ("1")) AND ([SELECT1].[sBreed]`. The 'Output Name:' field is 'MN_Priority1_Breeders' and the 'Output Directory:' field is 'C:\temp\MN_Priority1_Breeders'. The 'Query Settings' list shows '[MATRIX] BCR 23 Matrix' and '[QUERIED ITEMS] Priority: '1''. The 'Query' button is highlighted.

- Choose to calculate zonal areas and SDI
- Fine tune the query's "where string"
- Name data frame and output folder
- Specify the location for output folder
- Launch LINK query

Example Query

Example Query's Objective:

To evaluate Minnesota counties for high priority, regularly breeding, bird habitat as identified within the BCR 23 matrix.

Example Query: Queried Items

Example query:

- Matrix = **BCR 23 Matrix**
- Priority = **1**
- Breeding = **Regular**
- Number of queried items
 - 213 species
 - 22 species
 - 20 species

LINK Query:

Queried Items: | Data Layer Selections: | Range: | Query Parameters:

Matrices:
BCR 23 Matrix

Query Fields:
Breeding (1)

Query Field Values:
 Any Value
 Rare
 Regular

Queried Items (20)
 Any Value
 Acadian Flycatcher
 Black Tern
 Black-billed Cuckoo
 Blue-winged Warbler
 Boholink

Reset ? Cancel Query

Example Query: Queried Items

Acadian Flycatcher

Black Tern

Black-billed Cuckoo

Blue-winged Warbler

Bobolink

Cerulean Warbler

Common Tern

Dickcissel

Golden-winged Warbler

Henslow's Sparrow

Loggerhead Shrike

Long-eared Owl

Marbled Godwit

Peregrine Falcon

Red-headed Woodpecker

Sedge Wren

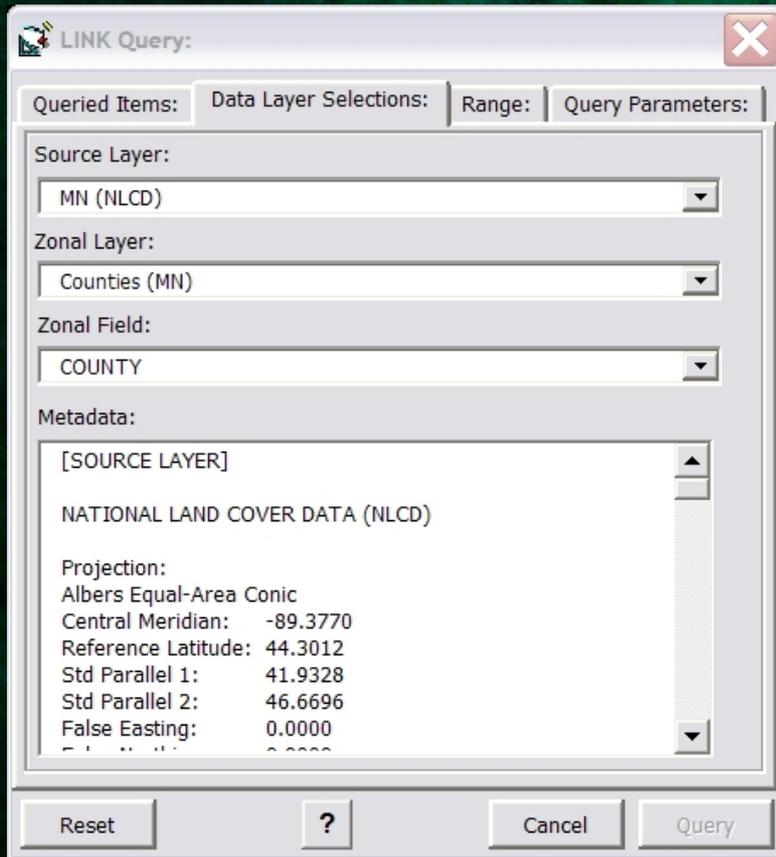
Short-eared Owl

Upland Sandpiper

Wilson's Phalarope

Wood Thrush

Example Query: Data Layer Selections



The screenshot shows a dialog box titled "LINK Query:" with a close button (X) in the top right corner. The dialog has four tabs: "Queried Items:", "Data Layer Selections:", "Range:", and "Query Parameters:". The "Data Layer Selections:" tab is active. It contains the following fields:

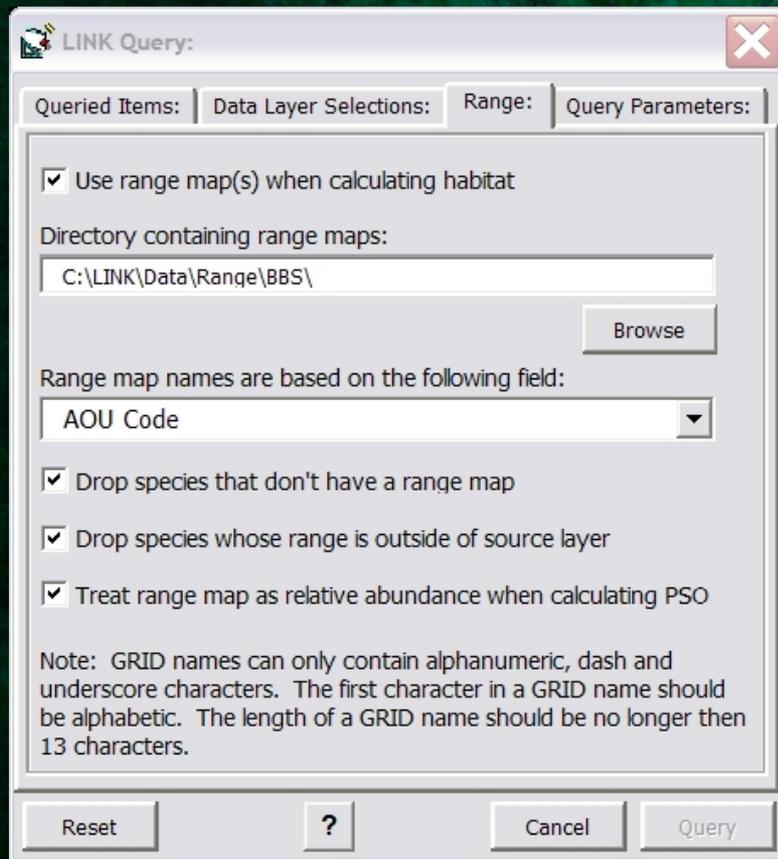
- Source Layer:** A dropdown menu with "MN (NLCD)" selected.
- Zonal Layer:** A dropdown menu with "Counties (MN)" selected.
- Zonal Field:** A dropdown menu with "COUNTY" selected.
- Metadata:** A text area containing the following information:
 - [SOURCE LAYER]
 - NATIONAL LAND COVER DATA (NLCD)
 - Projection:
 - Albers Equal-Area Conic
 - Central Meridian: -89.3770
 - Reference Latitude: 44.3012
 - Std Parallel 1: 41.9328
 - Std Parallel 2: 46.6696
 - False Easting: 0.0000
 - False Northing: 0.0000

At the bottom of the dialog, there are four buttons: "Reset", "?", "Cancel", and "Query".

Example query:

- Source layer = ***MN (NLCD)***
- Zonal layer = ***Counties (MN)***
- Zonal field = ***COUNTY***

Example Query: Range



The screenshot shows the 'LINK Query' dialog box with the 'Range' tab selected. The 'Use range map(s) when calculating habitat' checkbox is checked. The 'Directory containing range maps' field is set to 'C:\LINK\Data\Range\BBS\'. The 'Range map names are based on the following field:' dropdown is set to 'AOU Code'. Three checkboxes are checked: 'Drop species that don't have a range map', 'Drop species whose range is outside of source layer', and 'Treat range map as relative abundance when calculating PSO'. A note at the bottom states: 'Note: GRID names can only contain alphanumeric, dash and underscore characters. The first character in a GRID name should be alphabetic. The length of a GRID name should be no longer than 13 characters.' Buttons for 'Reset', '?', 'Cancel', and 'Query' are at the bottom.

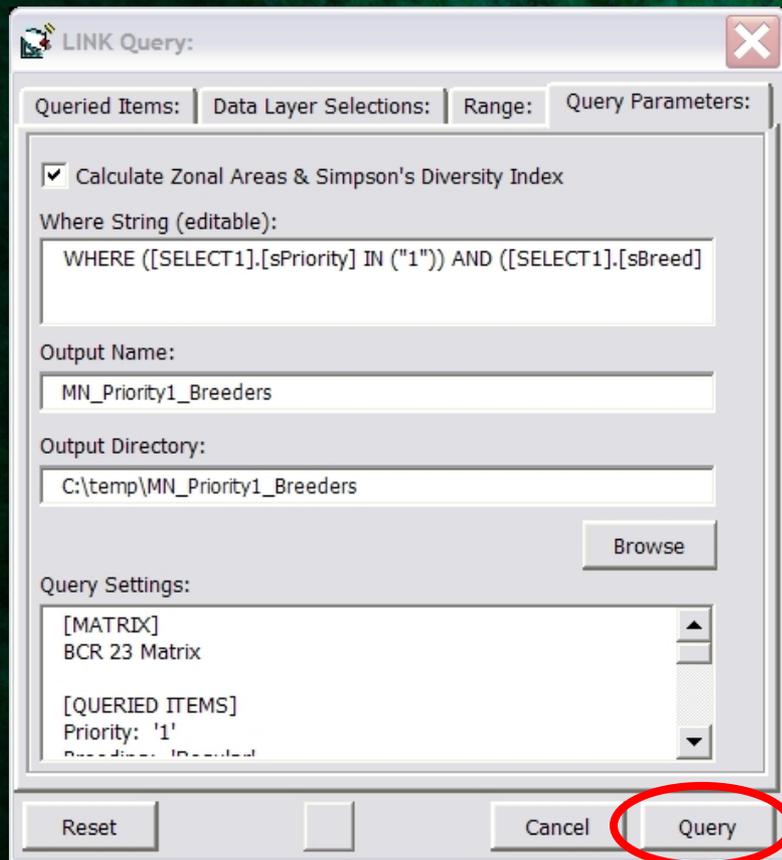
Example query:

- Range Maps = **BBS relative abundance**
- Range names field = **AOU Code**
- Drop species
 - that do not have a range maps = **true**
 - whose range is outside of source layer = **true**
- Treat range map as relative abundance when calculating PSO = **true**

Example Query: Query Parameters

Example query:

- Calculate zonal areas and SDI = **true**
- **No edits** to “where string”
- Data frame and output folder name
MN_Priority1_Breeders
- Output folder location
C:\temp

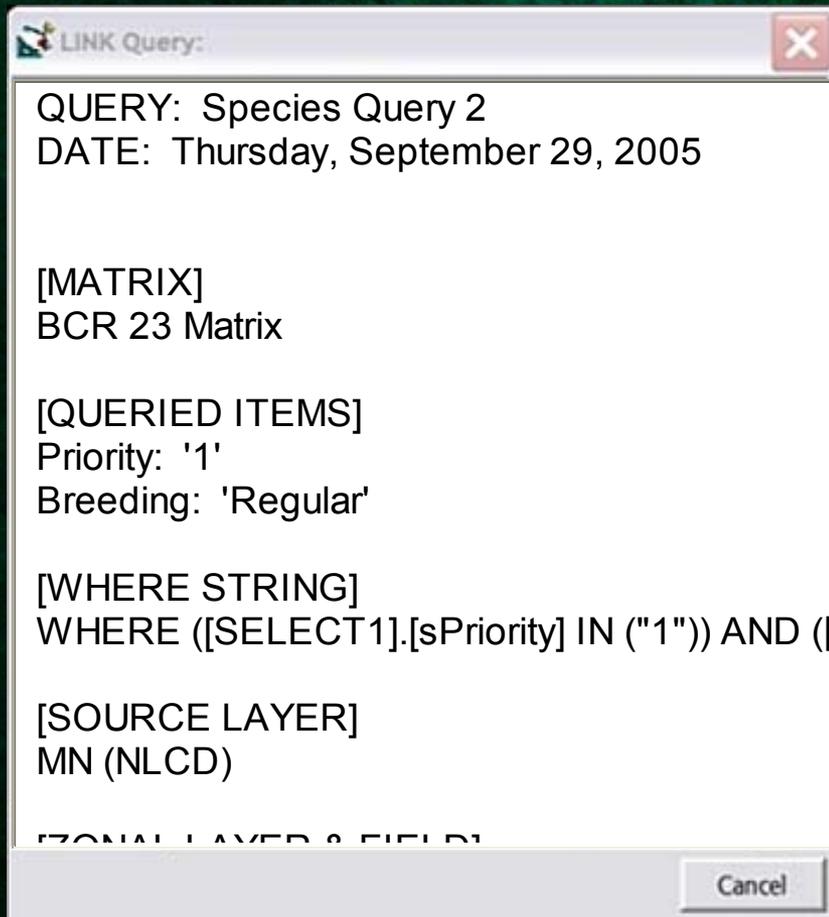


The screenshot shows the 'LINK Query' dialog box with the following settings:

- Calculate Zonal Areas & Simpson's Diversity Index
- Where String (editable):
WHERE ([SELECT1].[sPriority] IN ("1")) AND ([SELECT1].[sBreed]
- Output Name:
MN_Priority1_Breeders
- Output Directory:
C:\temp\MN_Priority1_Breeders
- Query Settings:
[MATRIX]
BCR 23 Matrix
[QUERIED ITEMS]
Priority: '1'

The 'Query' button at the bottom right is circled in red.

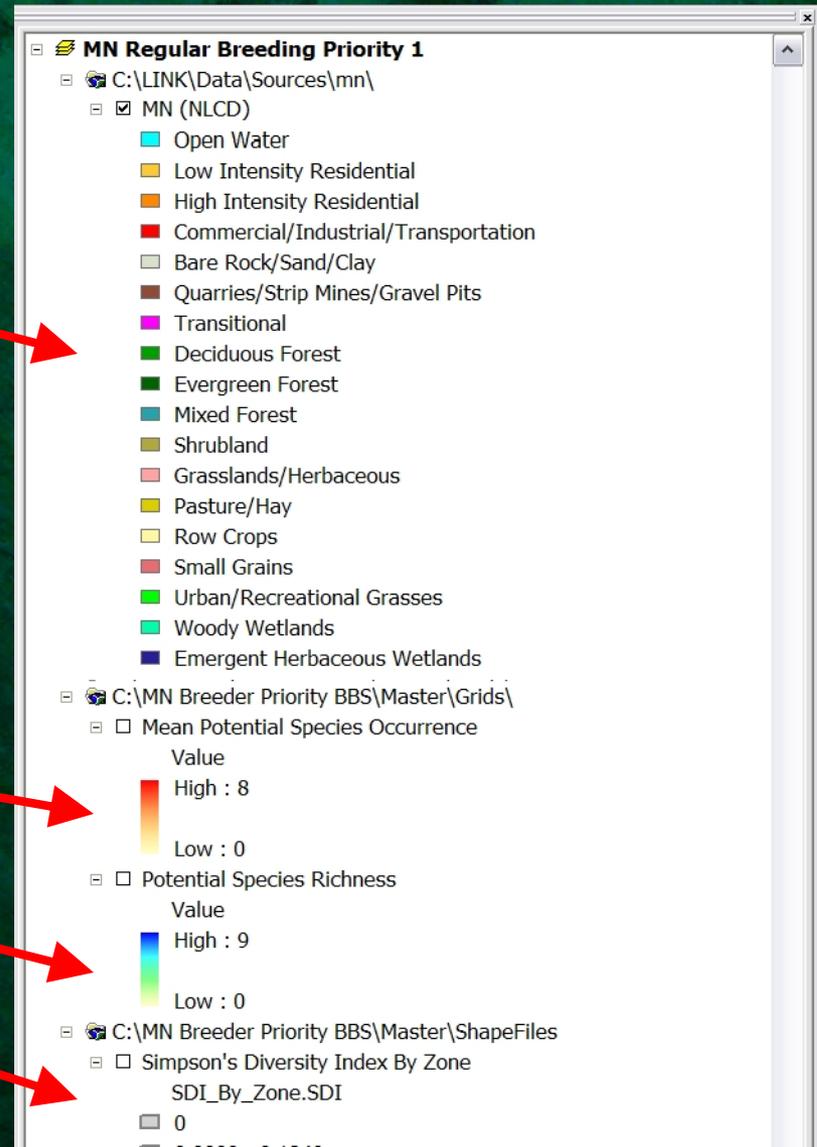
Example Query: Output Report



- Processing time \approx 10 hours
- When the query has finished, a text report window opens \approx 20 minutes
- Why so long?
 - species that were dropped due to range conditions
 - # of times source layer is reclassified = # of species * 2
 - summary statistics for PSO, PSR, and SDI
 - # zonal analyses = # of species * 3

Example Query: Output Products

- Source layer
- Output products for the queried species as a group
 - Mean PSO
 - PSR
 - SDI

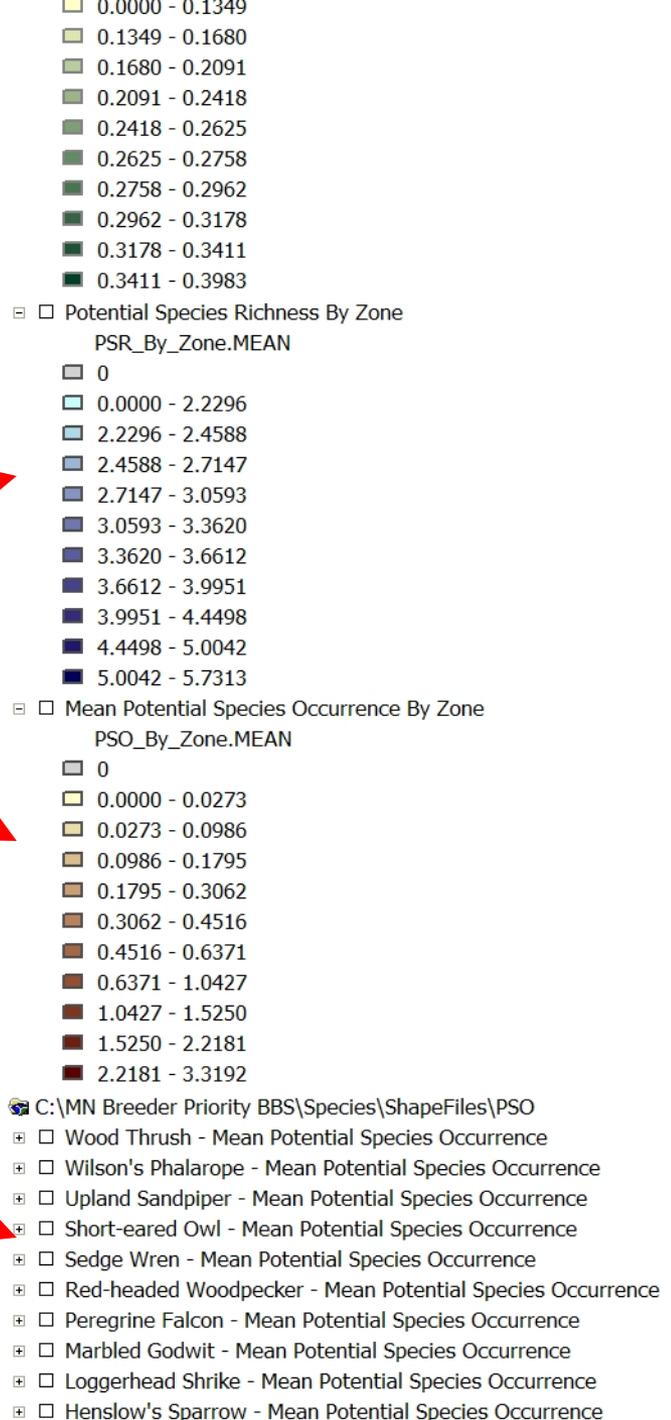


- Output products for the queried species as a group (continued)

- PSR by zone
- Mean PSO by zone

- Individual species output

- PSO



- Individual species output (continued)

- PSR

- SDI

- Golden-winged Warbler - Mean Potential Species Occurrence
- Dickcissel - Mean Potential Species Occurrence
- Common Tern - Mean Potential Species Occurrence
- Cerulean Warbler - Mean Potential Species Occurrence
- Bobolink - Mean Potential Species Occurrence
- Blue-winged Warbler - Mean Potential Species Occurrence
- Black-billed Cuckoo - Mean Potential Species Occurrence
- Black Tern - Mean Potential Species Occurrence
- Acadian Flycatcher - Mean Potential Species Occurrence
- C:\MN Breeder Priority BBS\Species\ShapeFiles\PSR
 - Wood Thrush - Percent Potential Habitat (PSR * 100)
 - Wilson's Phalarope - Percent Potential Habitat (PSR * 100)
 - Upland Sandpiper - Percent Potential Habitat (PSR * 100)
 - Short-eared Owl - Percent Potential Habitat (PSR * 100)
 - Sedge Wren - Percent Potential Habitat (PSR * 100)
 - Red-headed Woodpecker - Percent Potential Habitat (PSR * 100)
 - Peregrine Falcon - Percent Potential Habitat (PSR * 100)
 - Marbled Godwit - Percent Potential Habitat (PSR * 100)
 - Loggerhead Shrike - Percent Potential Habitat (PSR * 100)
 - Henslow's Sparrow - Percent Potential Habitat (PSR * 100)
 - Golden-winged Warbler - Percent Potential Habitat (PSR * 100)
 - Dickcissel - Percent Potential Habitat (PSR * 100)
 - Common Tern - Percent Potential Habitat (PSR * 100)
 - Cerulean Warbler - Percent Potential Habitat (PSR * 100)
 - Bobolink - Percent Potential Habitat (PSR * 100)
 - Blue-winged Warbler - Percent Potential Habitat (PSR * 100)
 - Black-billed Cuckoo - Percent Potential Habitat (PSR * 100)
 - Black Tern - Percent Potential Habitat (PSR * 100)
 - Acadian Flycatcher - Percent Potential Habitat (PSR * 100)
- C:\MN Breeder Priority BBS\Species\ShapeFiles\SDI
 - Wood Thrush - Simpson's Diversity Index By Zone
 - Wilson's Phalarope - Simpson's Diversity Index By Zone
 - Upland Sandpiper - Simpson's Diversity Index By Zone
 - Short-eared Owl - Simpson's Diversity Index By Zone
 - Sedge Wren - Simpson's Diversity Index By Zone
 - Red-headed Woodpecker - Simpson's Diversity Index By Zone
 - Peregrine Falcon - Simpson's Diversity Index By Zone
 - Marbled Godwit - Simpson's Diversity Index By Zone
 - Loggerhead Shrike - Simpson's Diversity Index By Zone
 - Henslow's Sparrow - Simpson's Diversity Index By Zone
 - Golden-winged Warbler - Simpson's Diversity Index By Zone
 - Dickcissel - Simpson's Diversity Index By Zone
 - Common Tern - Simpson's Diversity Index By Zone
 - Cerulean Warbler - Simpson's Diversity Index By Zone
 - Bobolink - Simpson's Diversity Index By Zone
 - Blue-winged Warbler - Simpson's Diversity Index By Zone
 - Black-billed Cuckoo - Simpson's Diversity Index By Zone

- Individual species output (continued)

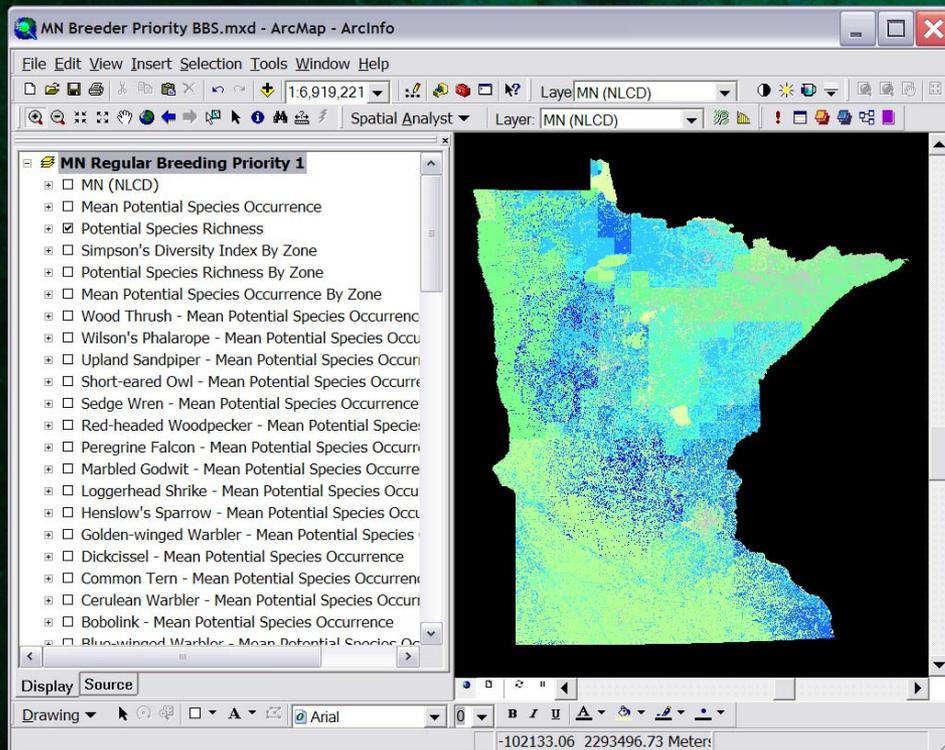
- range
- tables

- Other tabular output

- PSR
- PSO
- SDI
- grid classes by zone
- individual PSO
- individual area-weighted mean PSO
- matrix

- Black Tern - Simpson's Diversity Index By Zone
- Acadian Flycatcher - Simpson's Diversity Index By Zone
- C:\LINK\Data\Range\BBS\
 - Wood Thrush Range
 - Wilson's Phalarope Range
 - Upland Sandpiper Range
 - Short-eared Owl Range
 - Sedge Wren Range
 - Red-headed Woodpecker Range
 - Peregrine Falcon Range
 - Marbled Godwit Range
 - Loggerhead Shrike Range
 - Henslow's Sparrow Range
 - Golden-winged Warbler Range
 - Dickcissel Range
 - Common Tern Range
 - Cerulean Warbler Range
 - Bobolink Range
 - Blue-winged Warbler Range
 - Black-billed Cuckoo Range
 - Black Tern Range
 - Acadian Flycatcher Range
- C:\MN Breeder Priority BBS\Acadian Flycatcher\Tables
- C:\MN Breeder Priority BBS\Black Tern\Tables
- C:\MN Breeder Priority BBS\Black-billed Cuckoo\Tables
- C:\MN Breeder Priority BBS\Blue-winged Warbler\Tables
- C:\MN Breeder Priority BBS\Bobolink\Tables
- C:\MN Breeder Priority BBS\Cerulean Warbler\Tables
- C:\MN Breeder Priority BBS\Common Tern\Tables
- C:\MN Breeder Priority BBS\Dickcissel\Tables
- C:\MN Breeder Priority BBS\Golden-winged Warbler\Tables
- C:\MN Breeder Priority BBS\Henslow's Sparrow\Tables
- C:\MN Breeder Priority BBS\Loggerhead Shrike\Tables
- C:\MN Breeder Priority BBS\Marbled Godwit\Tables
- C:\MN Breeder Priority BBS\Peregrine Falcon\Tables
- C:\MN Breeder Priority BBS\Red-headed Woodpecker\Tables
- C:\MN Breeder Priority BBS\Sedge Wren\Tables
- C:\MN Breeder Priority BBS\Short-eared Owl\Tables
- C:\MN Breeder Priority BBS\Upland Sandpiper\Tables
- C:\MN Breeder Priority BBS\Wilson's Phalarope\Tables
- C:\MN Breeder Priority BBS\Wood Thrush\Tables
- C:\MN Breeder Priority BBS\Master\Tables
 - PSR_By_Zone
 - PSO_By_Zone
 - SDI_By_Zone
 - Grid_Classes_By_Zone
 - Individual_PSO

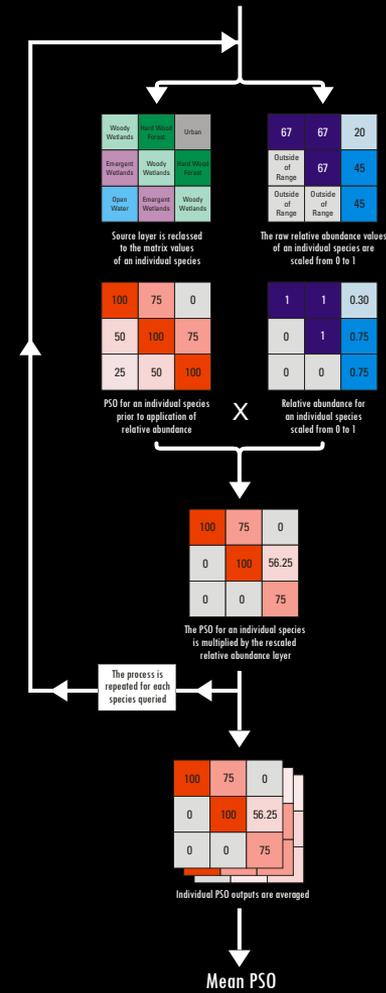
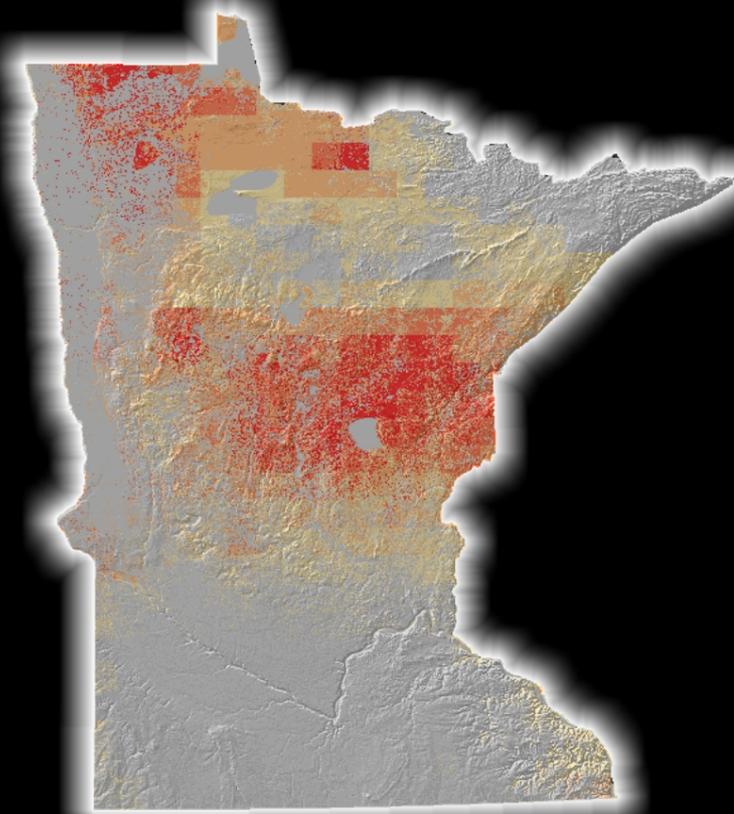
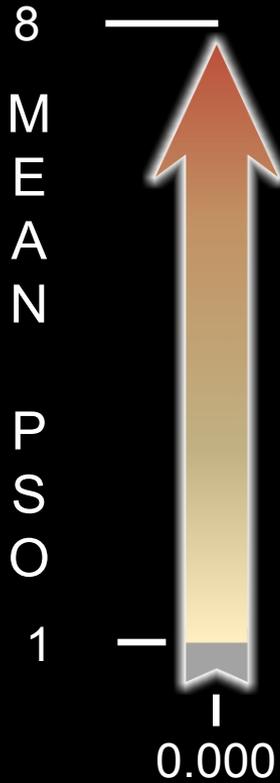
Example Query: Output Products

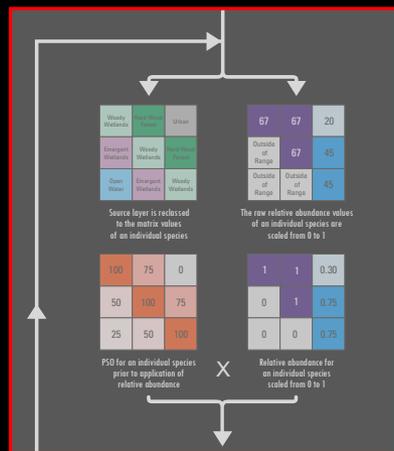


Example query:

- 62 spatial layers
- 64 tables
- 58 graphs
- Text files
 - report file
 - log file
 - metadata file
 - query file

Example Query: PSO





Woody Wetland	Hard Wood Forest	Urban
Emergent Wetland	Woody Wetland	Hard Wood Forest
Open Water	Emergent Wetland	Woody Wetland

Source layer is reclassified to the matrix values of an individual species

100	75	0
50	100	75
25	50	100

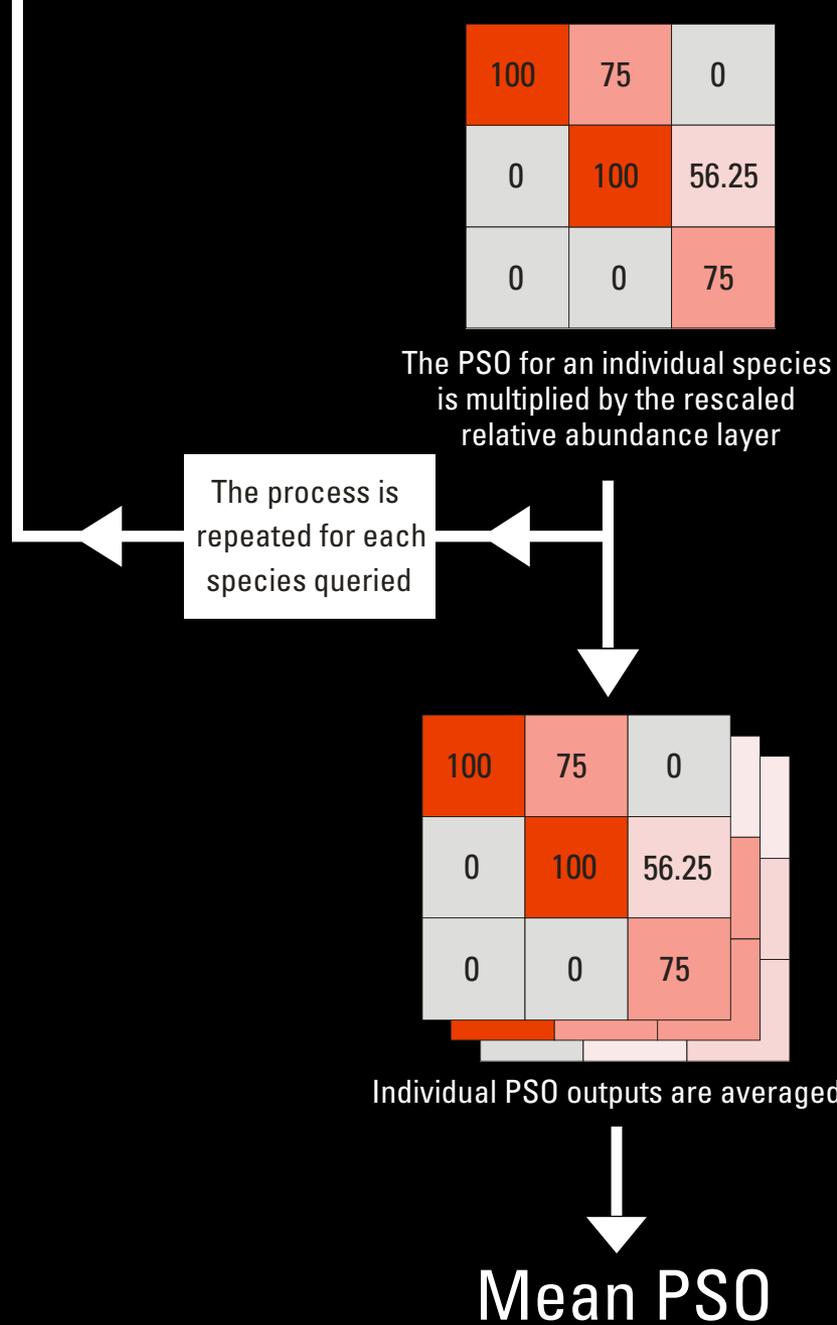
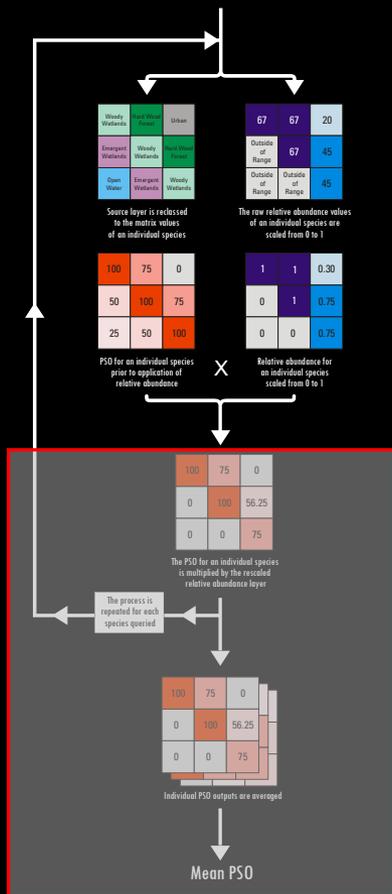
PSO for an individual species prior to application of relative abundance

67	67	20
Outside of Range	67	45
Outside of Range	Outside of Range	45

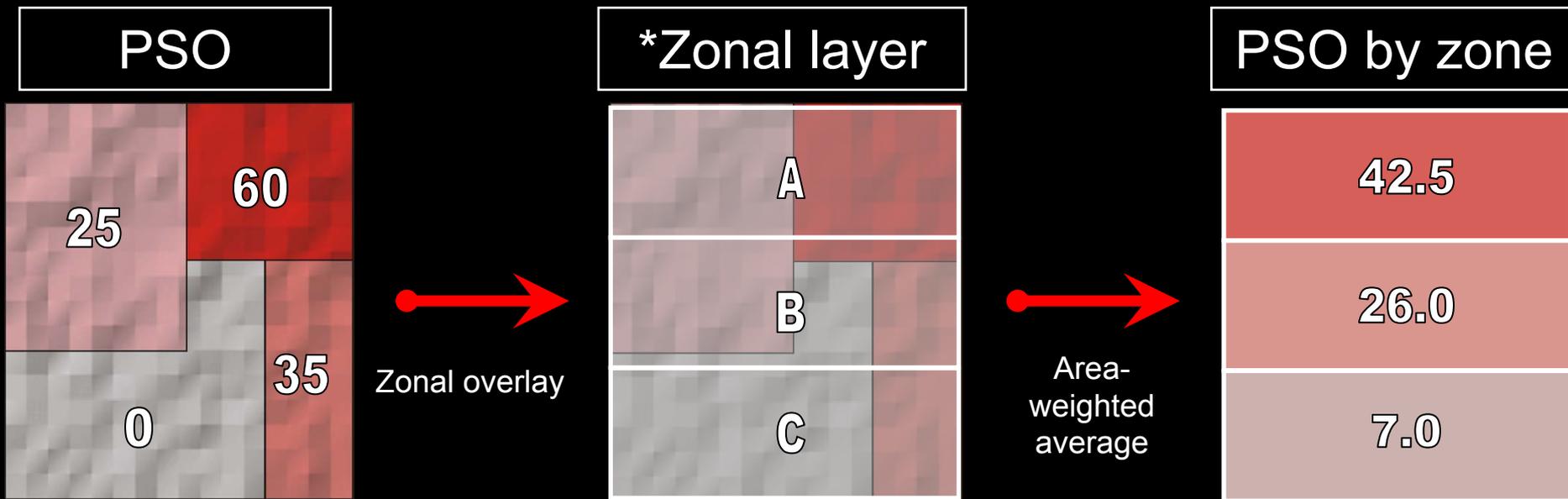
The raw relative abundance values of an individual species are scaled from 0 to 1

1	1	0.30
0	1	0.75
0	0	0.75

Relative abundance for an individual species scaled from 0 to 1



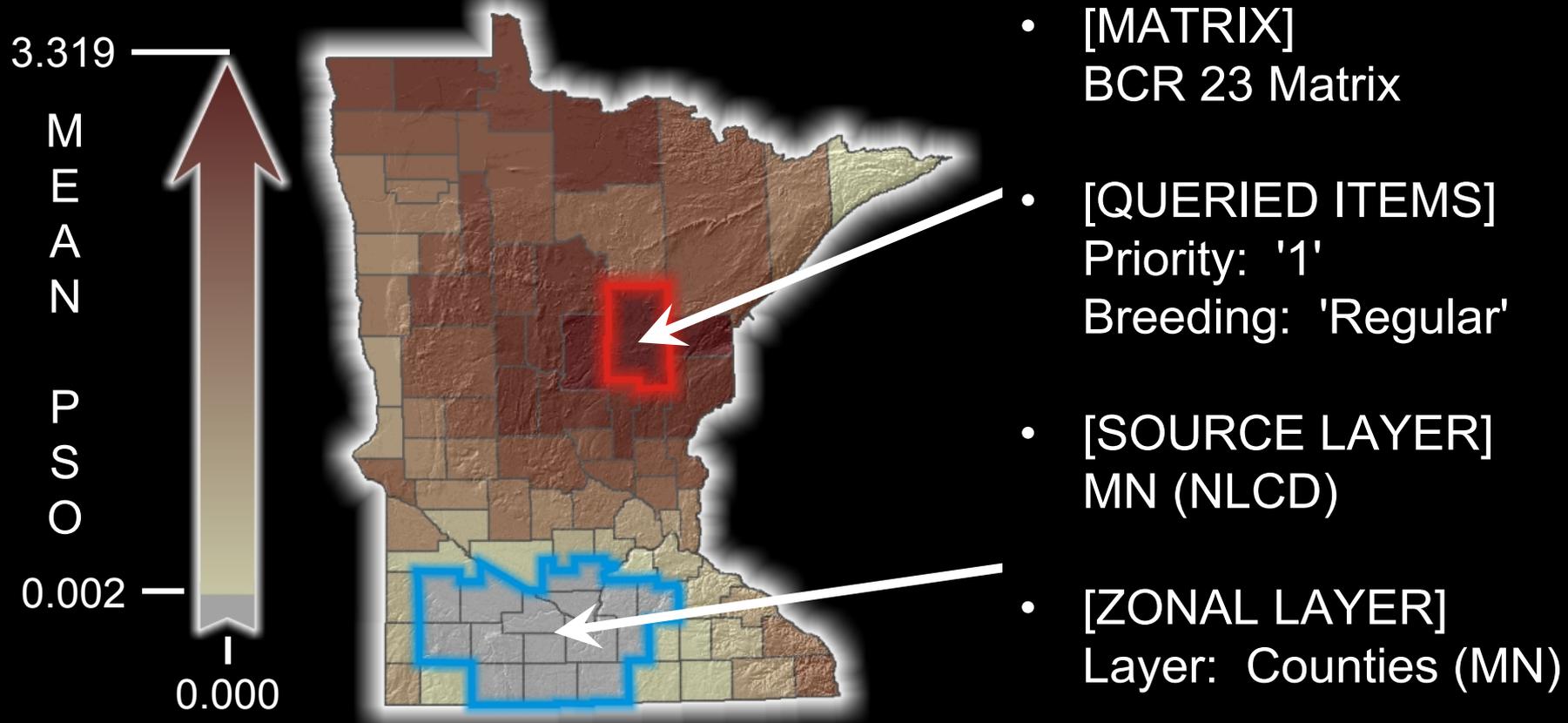
Potential Species Occurrence By Zone



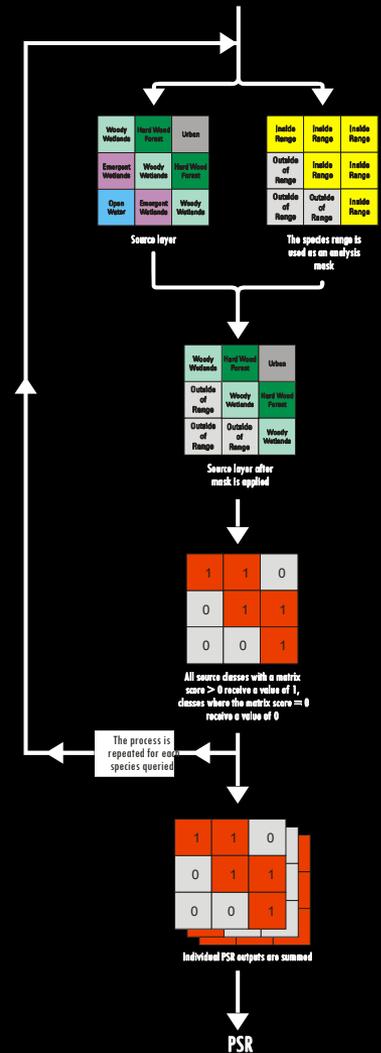
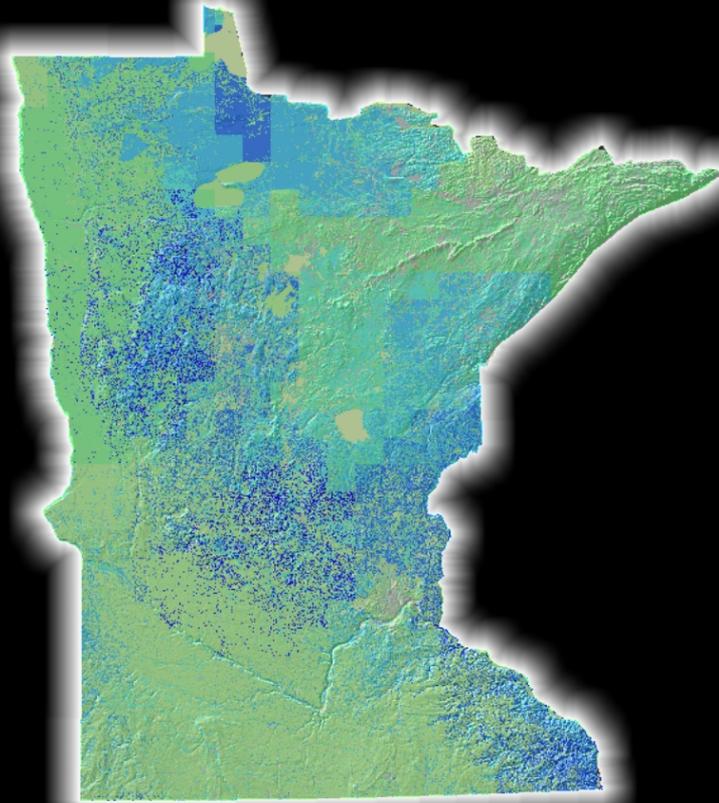
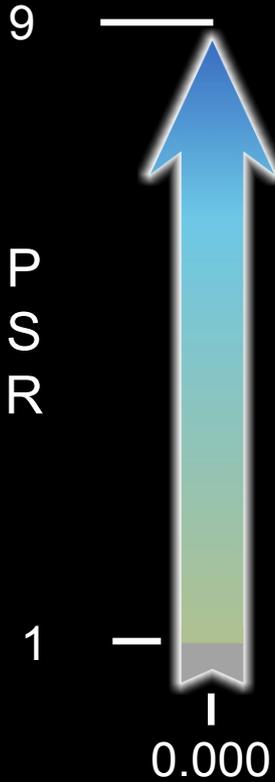
*Examples of possible zonal layers: counties, ecoregions, management units, etc.

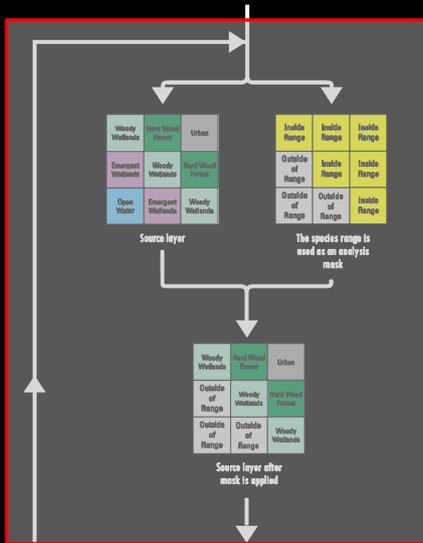
Example Query: PSO by Zone

Objective: To evaluate Minnesota counties for high priority, regularly breeding, bird habitat as identified within the BCR 23 matrix.



Example Query: PSR





1	1	0
0	1	1
0	0	1

All source classes with a matrix score > 0 receive a value of 1, classes where the matrix score = 0 receive a value of 0

The process is repeated for other species queried

1	1	0
0	1	1
0	0	1

Individual PSR outputs are summed

PSR



Woody Wetland	Hard Wood Forest	Urban
Emergent Wetland	Woody Wetland	Hard Wood Forest
Open Water	Emergent Wetland	Woody Wetland

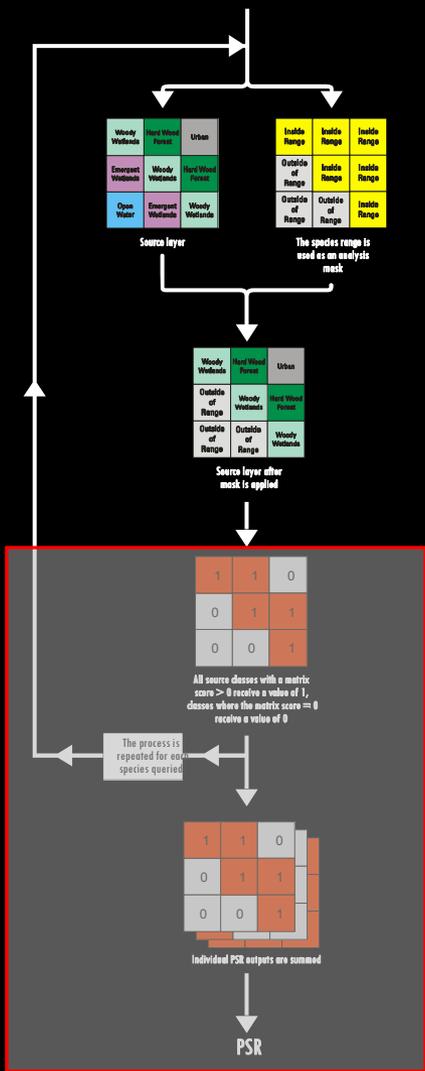
Source Layer

Inside Range	Inside Range	Inside Range
Outside of Range	Inside Range	Inside Range
Outside of Range	Outside of Range	Inside Range

The species range is used as an analysis mask

Woody Wetland	Hard Wood Forest	Urban
Outside of Range	Woody Wetland	Hard Wood Forest
Outside of Range	Outside of Range	Woody Wetland

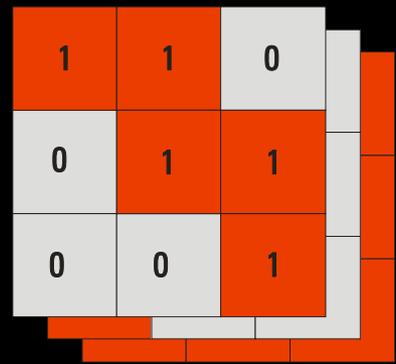
Source layer after mask is applied



1	1	0
0	1	1
0	0	1

All source classes with a matrix score > 0 receive a value of 1, classes where the matrix scores = 0 receive a value of 0

The process is repeated for each species queried

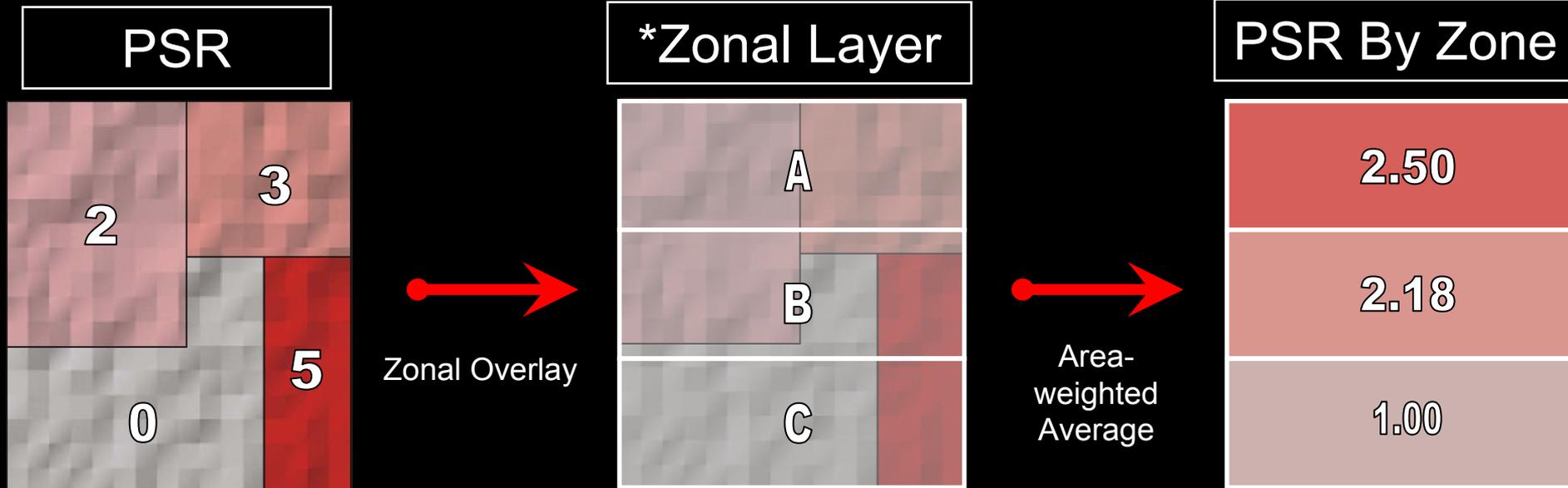


Individual PSR outputs are summed

PSR



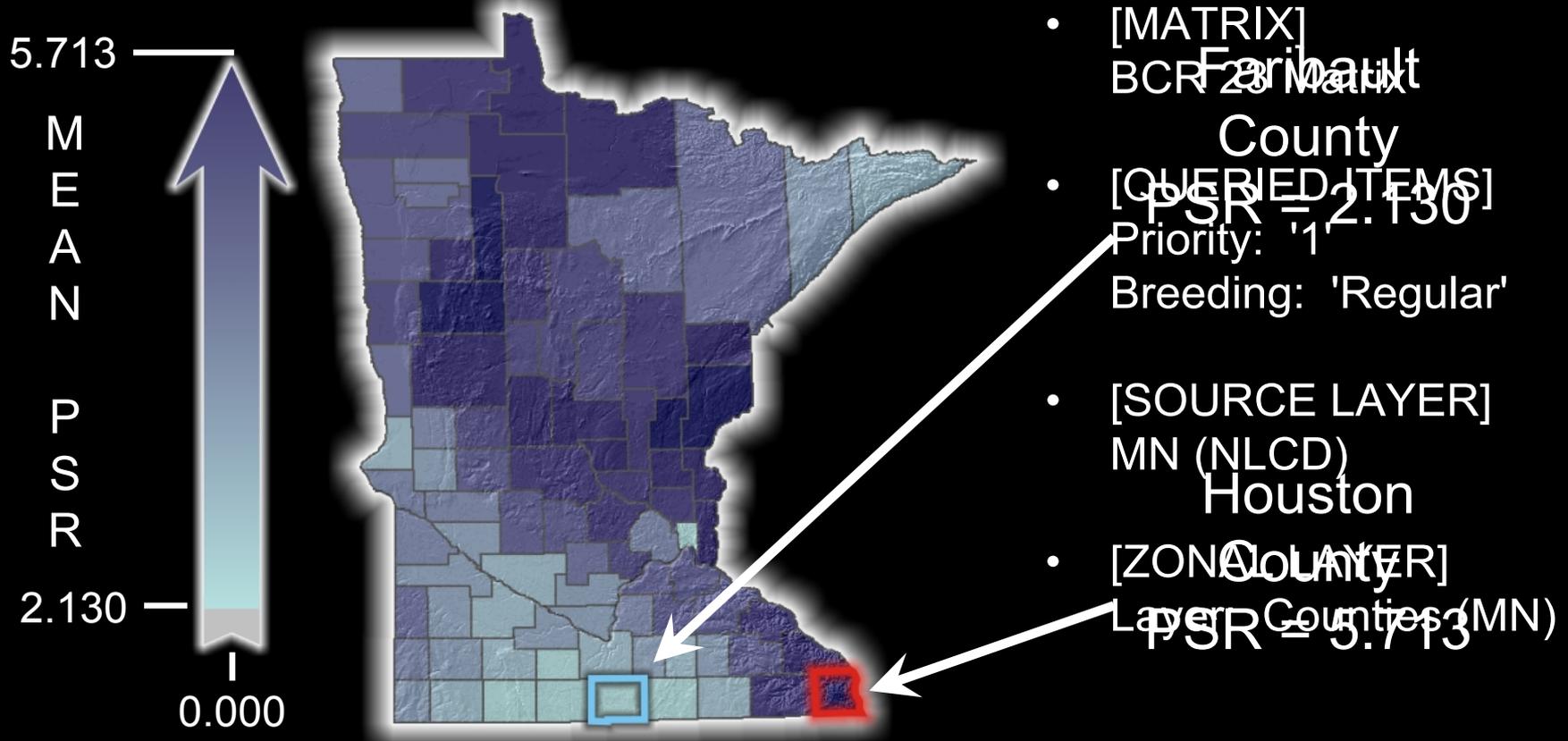
Potential Species Richness By Zone



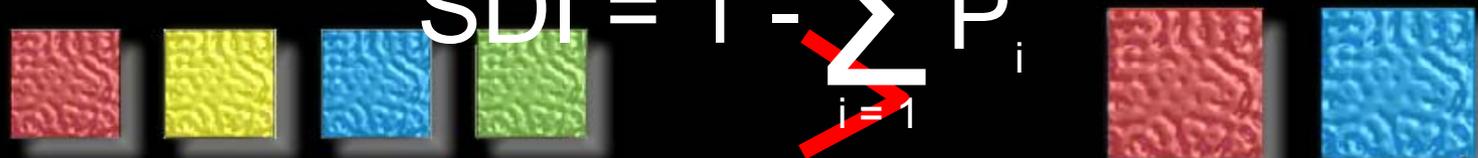
*Examples of possible zonal layers: counties, ecoregions, management units ...

Example Query: PSR by Zone

Objective: To evaluate Minnesota counties for high priority, regularly breeding, bird habitat as identified within the BCR 23 matrix.



Simpson's Diversity Index

$$SDI = 1 - \sum_{i=1}^n P_i^2$$


The greater the number of class types the

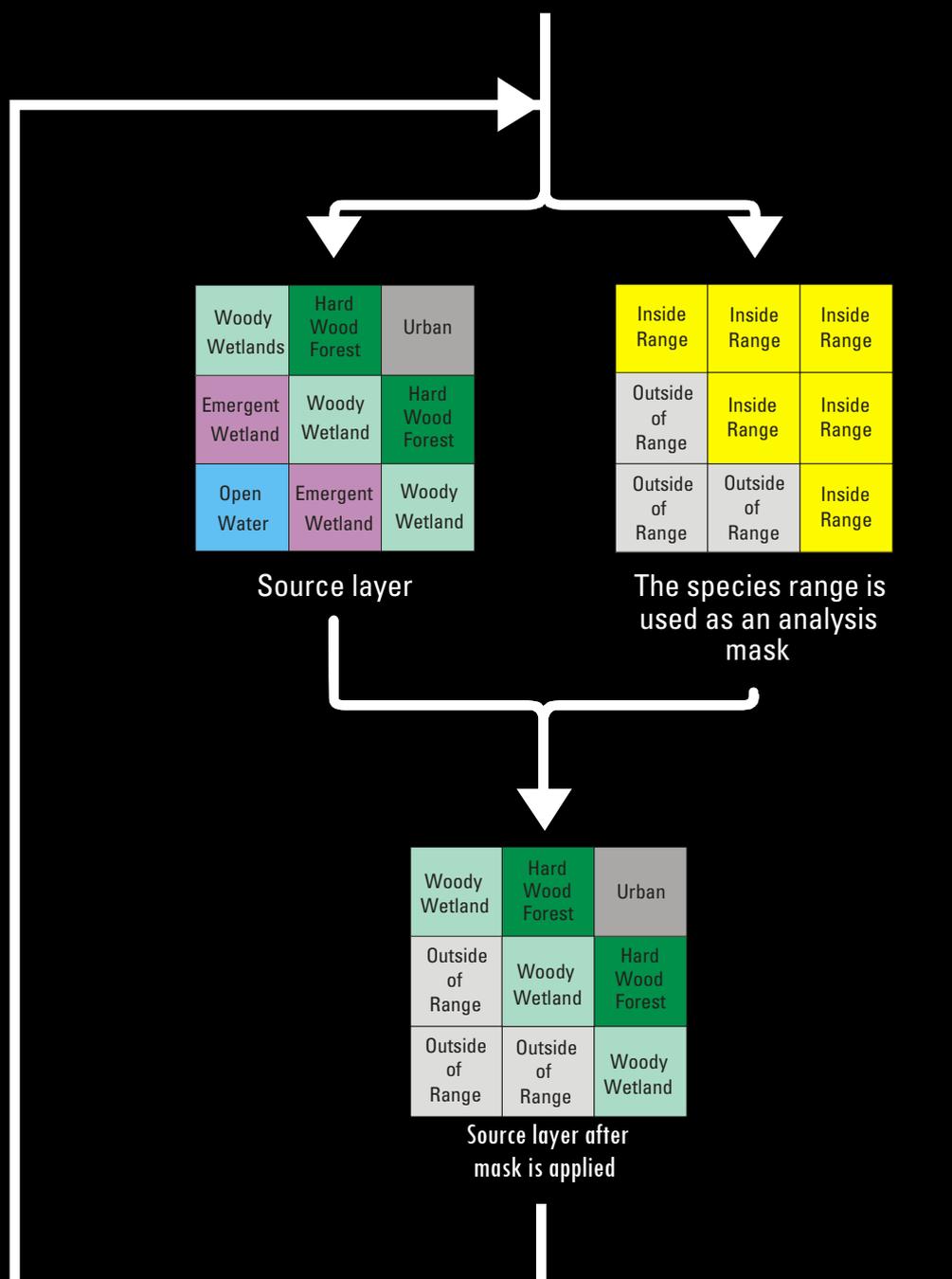
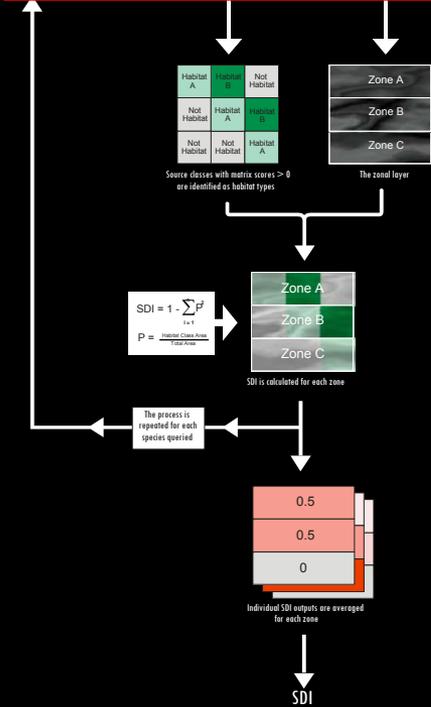
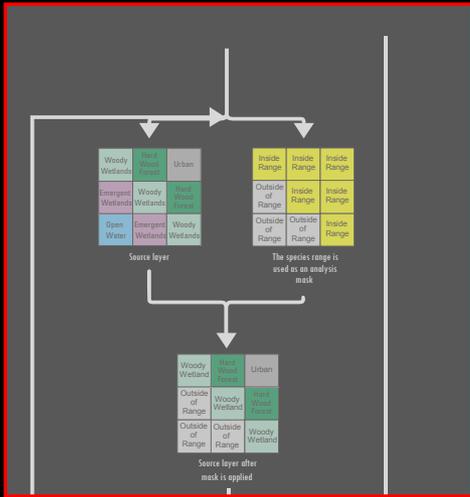
greater the SDI value.
 P = Class Area / Total Area

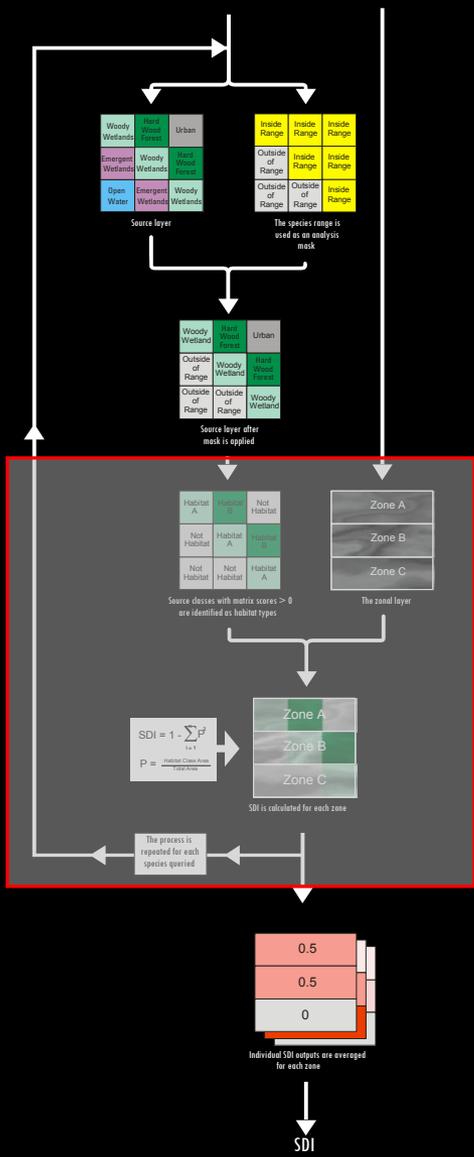
Value Range: 0 to < 1



A value of 0 = no diversity, as SDI

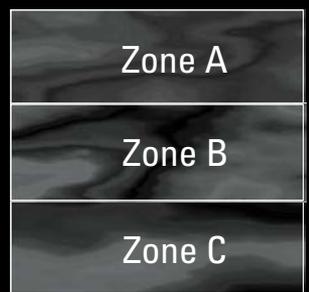
The more proportionate diversity in the class types are the greater the SDI value.





Habitat A	Habitat B	Not Habitat
Not Habitat	Habitat A	Habitat B
Not Habitat	Not Habitat	Habitat A

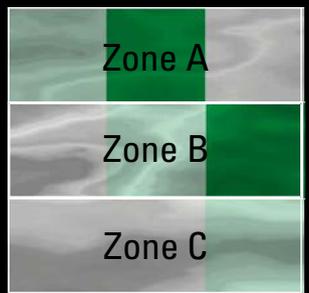
Source classes with matrix scores > 0 are identified as habitat types



The zonal layer

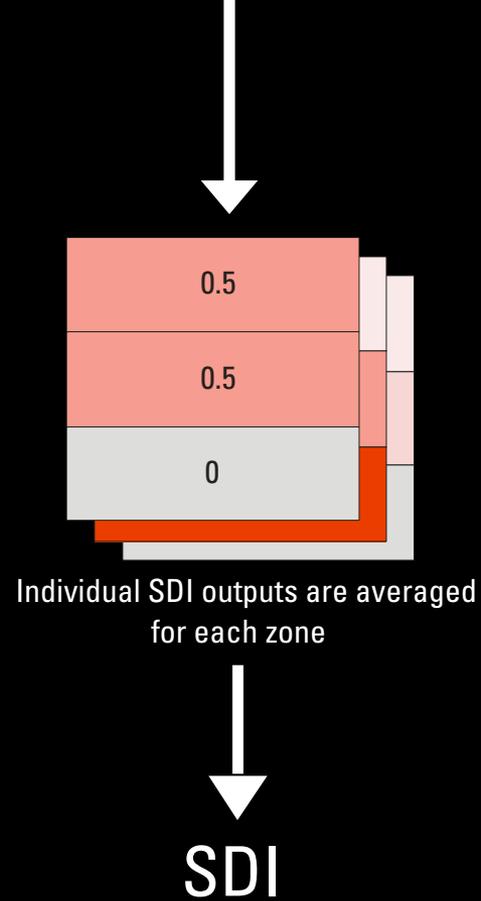
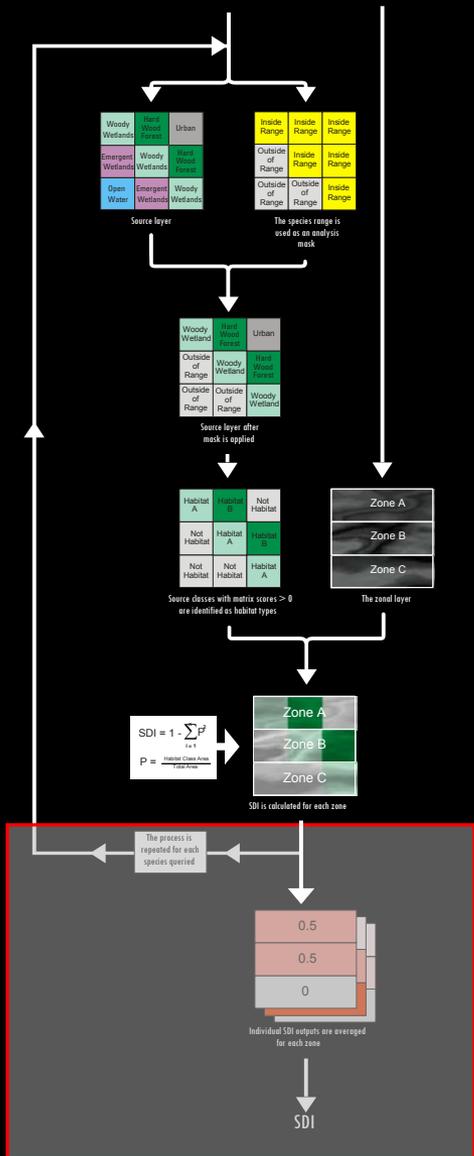
$$SDI = 1 - \sum_{i=1}^n P_i^2$$

$P_i = \frac{\text{Habitat Class Area}}{\text{Total Area}}$



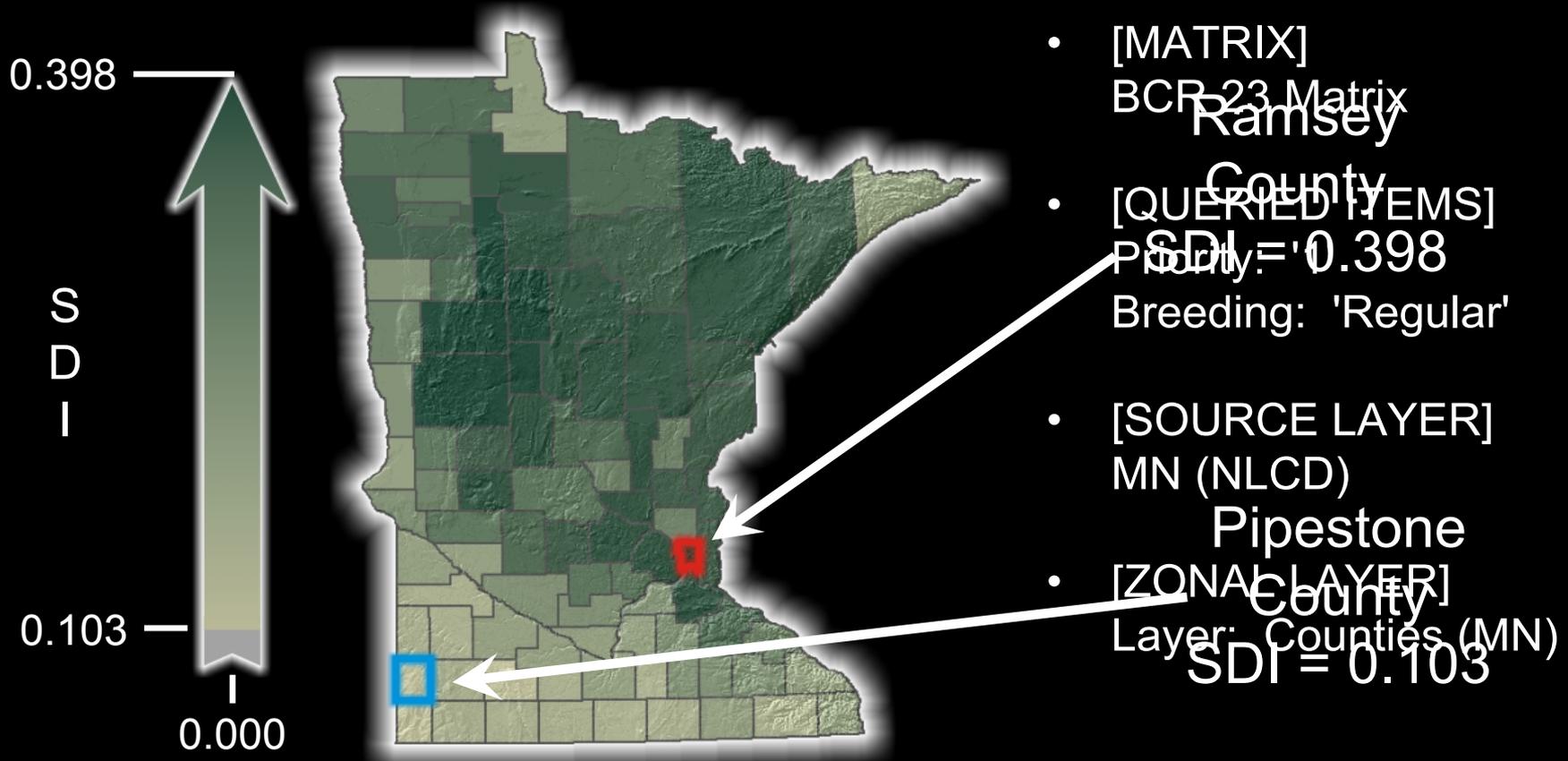
SDI is calculated for each zone

The process is repeated for each species queried



Example Query: SDI by Zone

Objective: To evaluate Minnesota counties for high priority, regularly breeding, bird habitat as identified within the BCR 23 matrix.



Tabular Products

COUNTY	Open Water	Low Intensity Residential	High Intensity Residential	Commercial	Bare Rock Sand Clay	Quarries Pits Mines Gravel Pits
Anoka County	499,810,000	3,390,300	1,282,500	15,863,600	0	920,700
Atkin County	56,529,900	107,320,000	42,824,700	28,790,100	0	621,000
Becker County	344,460,000	8,702,100	1,837,800	10,079,100	8,100	2,252,700
Beltrami County	1,425,300,000	13,457,700	3,869,900	26,281,800	736,200	970,200
Benton County	11,329,200	11,883,600	4,365,900	5,623,200	0	607,500
Big Stone County	60,822,900	2,636,100	1,352,700	6,131,700	0	793,800
Blue Earth County	42,556,500	19,442,700	5,110,200	18,146,400	0	2,206,000
Brown County	23,842,800	11,664,300	1,519,200	6,454,800	0	549,900
Carlton County	45,252,000	9,068,400	4,094,100	13,958,600	0	2,418,300
Carver County	50,849,100	23,168,500	4,315,500	7,744,500	0	603,900
Cass County	1,023,690,000	8,144,100	1,928,700	18,170,100	9,900	2,022,300
Chippewa County	19,952,100	8,402,600	581,400	4,958,100	0	281,700
Chicago County	67,692,700	8,427,600	1,759,500	4,204,800	0	660,600
Clay County	30,212,100	13,091,400	6,246,000	16,866,000	0	4,687,100
Clearwater County	116,300,000	2,912,400	512,100	9,214,200	0	423,900
Cook County	415,960,000	421,200	456,300	4,724,100	0	927,900
Cottonwood County	23,983,200	5,883,300	790,200	9,945,300	0	366,100
Crow Wing County	429,340,000	17,986,500	6,992,800	17,433,900	131,400	6,089,400
Dakota County	42,278,400	107,600,000	29,943,300	44,481,600	0	3,935,700
Dodge County	603,000	3,163,500	1,583,100	12,393,900	0	356,400
Dodge County	603,000	3,163,500	1,583,100	12,393,900	0	356,400
Dakota County	42,278,400	107,600,000	29,943,300	44,481,600	0	3,935,700
Dodge County	603,000	3,163,500	1,583,100	12,393,900	0	356,400
Dodge County	603,000	3,163,500	1,583,100	12,393,900	0	356,400

- PSO, PSR, and SDI by zone
 - queried species summarized as a single unit
 - each individual species
- Source classes by zone
- Individual PSO
- Area-weighted mean PSO
- Matrix

Example Query: Source Classes by Zone

COUNTY	Open Water	Low Intensity Residential	High Intensity Residential	Commercial Industrial	Bare Rock Sand Clay	Quarries Strip Mines Gravel Pits
Anoka County	499,810,000	3,300,300	1,282,500	15,663,600	0	920,700
Aitkin County	56,529,900	107,320,000	42,824,700	28,790,100	0	621,000
Becker County	344,460,000	8,702,100	1,837,800	10,079,100	8,100	2,252,700
Beltrami County	1,425,300,000	13,457,700	3,069,900	26,281,800	736,200	970,200
Benton County	11,329,200	11,883,600	4,365,900	5,623,200	0	607,500
Big Stone County	60,822,900	2,636,100	1,352,700	6,131,700	0	793,800
Blue Earth County	42,556,500	19,442,700	5,110,200	18,140,400	0	2,205,000
Brown County	23,842,800	11,664,900	1,519,200	6,454,800	0	549,900
Carlton County	45,252,000	9,068,400	4,094,100	13,950,000	0	2,418,300
Carver County	50,849,100	23,188,500	4,315,500	7,744,500	0	603,900
Cass County	1,023,600,000	8,144,100	1,928,700	18,170,100	9,900	2,022,300
Chippewa County	19,952,100	6,402,600	581,400	4,958,100	0	281,700
Chisago County	67,592,700	8,427,600	1,759,500	4,204,800	0	660,600
Clay County	30,212,100	13,091,400	6,246,000	16,866,000	0	4,607,100
Clearwater County	116,300,000	2,912,400	512,100	9,214,200	0	423,900
Cook County	415,960,000	421,200	456,300	4,724,100	0	927,900
Cottonwood County	23,983,200	5,883,300	799,200	9,945,900	0	368,100
Crow Wing County	429,340,000	17,986,500	8,992,800	17,433,900	131,400	6,089,400
Dakota County	42,278,400	107,880,000	29,943,900	44,481,600	0	3,935,700
Dodge County	603,000	3,163,500	1,583,100	12,393,900	0	356,400

Example Query: Individual PSO

Common Name	PSO	ACRES
Acadian Flycatcher	0	55,814,948
Black Tern	0	51,305,140
Black Tern	1	879,410
Black Tern	2	1,036,617
Black Tern	3	635,097
Black Tern	4	465,965
Black Tern	5	457,685
Black Tern	6	225,821
Black Tern	7	274,151
Wood Thrush	0	45,618,432
Wood Thrush	1	5,773,468
Wood Thrush	2	2,543,036
Wood Thrush	3	1,014,846
Wood Thrush	4	488,454
Wood Thrush	5	234,850
Wood Thrush	6	85,14
Wood Thrush	7	56,715

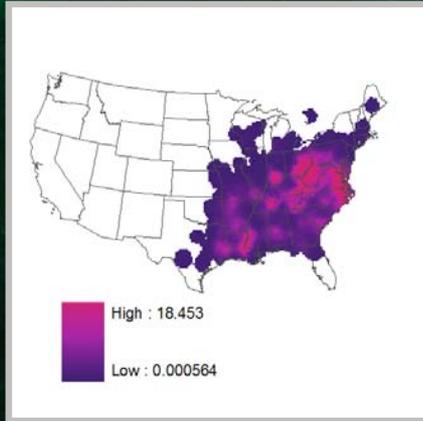
Breakdown of the number of acres at each PSO level for each species

Example Query: Individual Area-weighted Mean PSO Score

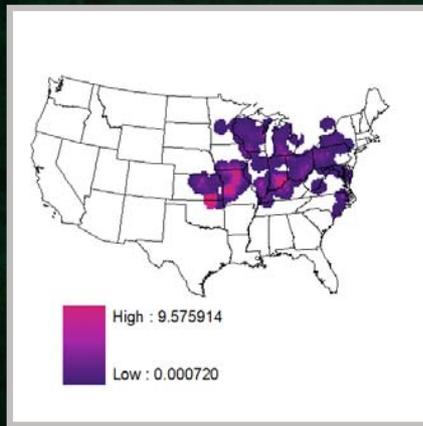
Common Name	Area-weighted Mean PSO
Black-billed Cuckoo	6.02663
Sedge Wren	5.37883
Golden-winged Warbler	4.98775
Bobolink	1.29980
Short-eared Owl	0.56838
Upland Sandpiper	0.38364
Red-headed Woodpecker	0.37285
Wood Thrush	0.32141
Black Tern	0.30952
Dickcissel	0.15924
Blue-winged Warbler	0.14698
Marbled Godwit	0.12647
Peregrine Falcon	0.00950
Cerulean Warbler	0.00215
Loggerhead Shrike	0.00080
Wilson's Phalarope	0.00042
Acadian Flycatcher	0.00000
Common Tern	0.00000
Henslow's Sparrow	0.00000

- Average PSO for each species over the entire source layer (Minnesota)
- Species with area-weighted mean PSO = 0

Example Query: Individual Area-weighted Mean PSO Score

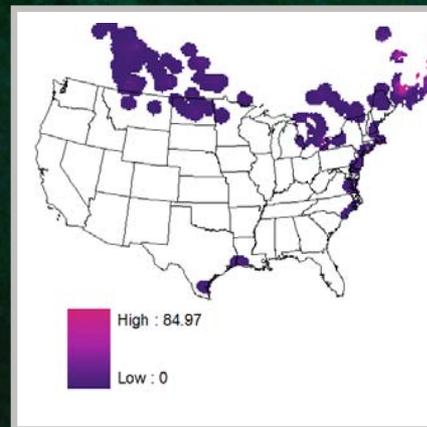


Acadian Flycatcher



Henslow's Sparrow

Species with area-weighted mean PSO = 0



Common Tern

- Low abundance
- Minnesota is mostly out of the species range
- Low quality habitat

Example Query: Individual Area-weighted Mean PSO Score

Common Name	Area-weighted Mean PSO
Black-billed Cuckoo	6.02663
Sedge Wren	5.37883
Golden-winged Warbler	4.98775
Bobolink	1.29980
Short-eared Owl	0.56838
Upland Sandpiper	0.38364
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Black Tern	0.30952
Dickcissel	0.15924
Blue-winged Warbler	0.14698
Marbled Godwit	0.12647
Peregrine Falcon	0.00950
Cerulean Warbler	0.00215
Loggerhead Shrike	0.00080
Wilson's Phalarope	0.00042
Acadian Flycatcher	0.00000
Common Tern	0.00000
Henslow's Sparrow	0.00000

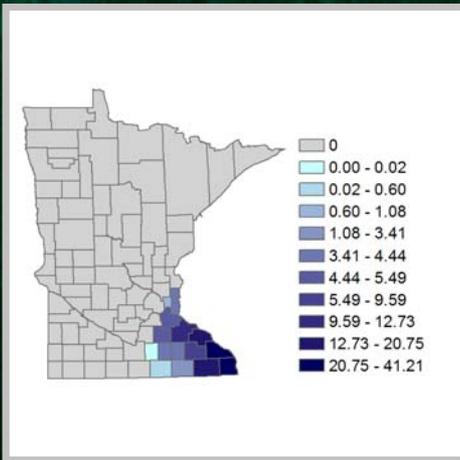
Alternative query parameters

- Clip range maps to Minnesota boundary (this ignores the fact that species may be uncommon in Minnesota)
- Do not treat range maps as relative abundance

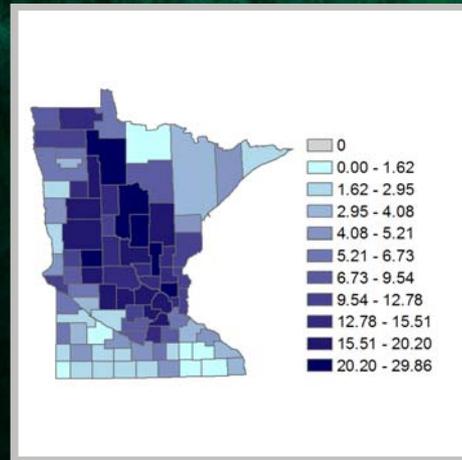
Example Query: Matrix

Common Name	Open Water	Low Intensity Residential	High Intensity Residential	Small Grains	Urban Recreation Grasses	Woody Wetlands	Emergent Herbaceous Wetlands
Acadian Flycatcher	0	0	0	0	0	100	0
Black Tern	100	0	0	0	0	0	100
Black-billed Cuckoo	0	20	0	0	0	60	0
Blue-winged Warbler	0	0	0	0	0	60	0
Bobolink	0	0	0	0	20	0	20
Cerulean Warbler	0	0	0	0	0	100	0
Common Tern	100	0	0	0	0	0	0
Dickcissel	0	0	0	0	0	0	0
Golden-winged Warbler	0	0	0	0	0	100	0
Henslow's Sparrow	0	0	0	0	0	0	40
Loggerhead Shrike	0	0	0	0	0	0	0
Marbled Godwit	40	0	0	20	0	0	80
Peregrine Falcon	60	0	0	0	0	40	80
Red-headed	0	40	0	0	20	40	0
Sedge Wren	0	0	0	0	0	40	100
Short-eared Owl	0	0	0	20	0	20	60
Upland Sandpiper	0	0	0	0	40	0	0
Wilson's Phalarope	20	0	0	0	0	0	100
Wood Thrush	0	0	0	0	0	40	0

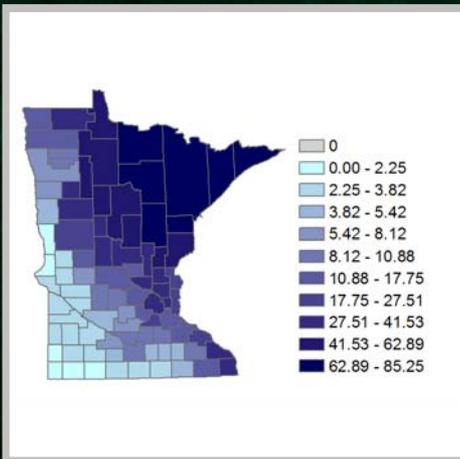
Example Query: Individual, PSR by Zone



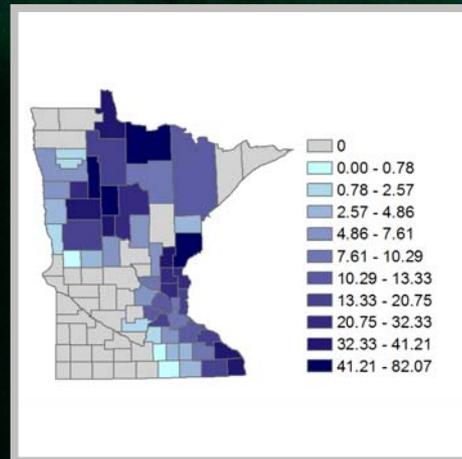
Acadian Flycatcher



Black Tern



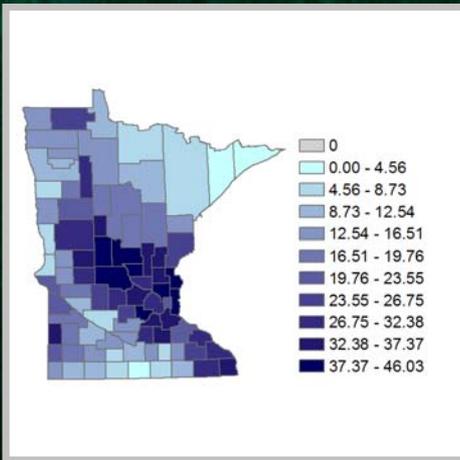
Black-billed Cuckoo



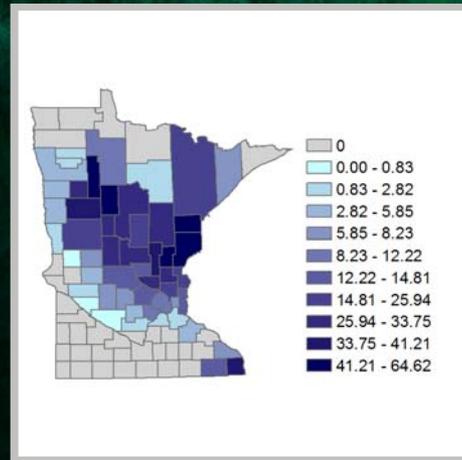
Blue-winged Warbler

- Restricted by range
- PSR = percent habitat when evaluated for a single species
- Habitat = source layer class with a matrix score >0

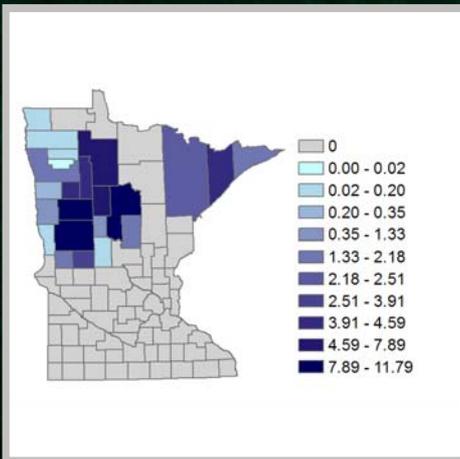
Example Query: Individual, PSR by Zone



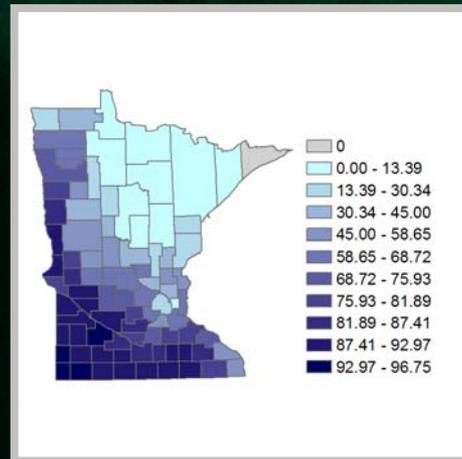
Bobolink



Cerulean Warbler



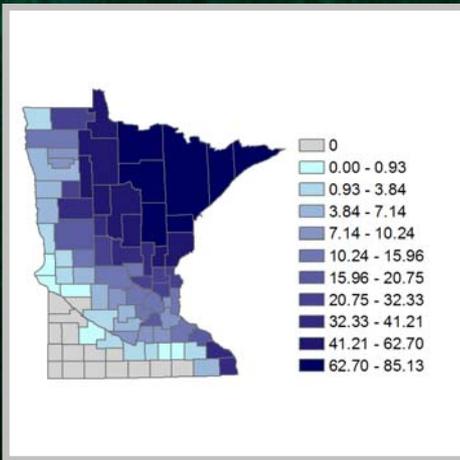
Common Tern



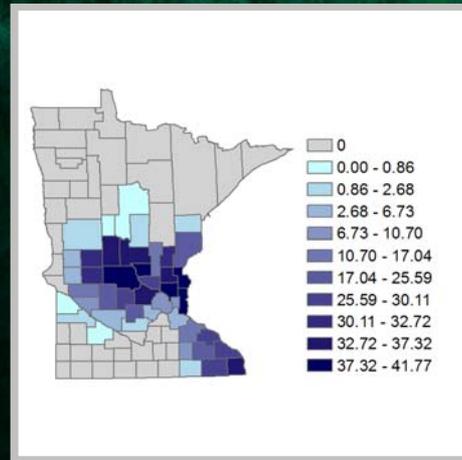
Dickcissel

- Restricted by range
- PSR = percent habitat when evaluated for a single species
- Habitat = source layer class with a matrix score >0

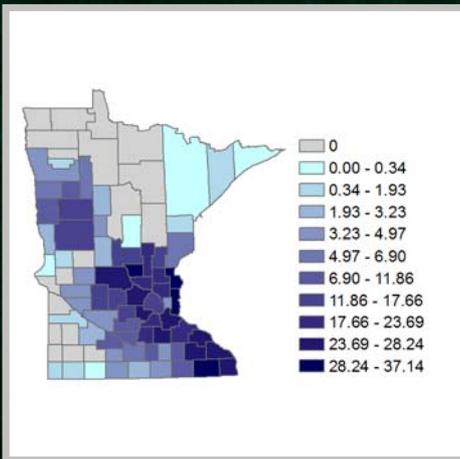
Example Query: Individual, PSR by Zone



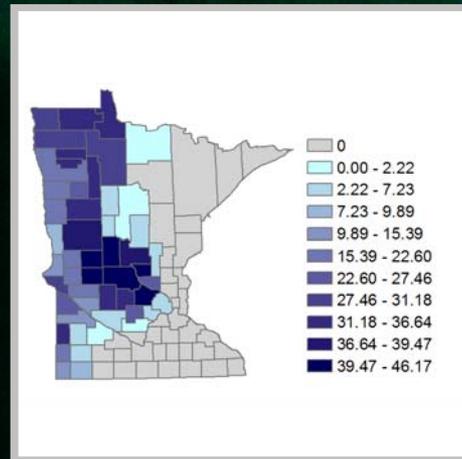
Golden-winged Warbler



Henslow's Sparrow



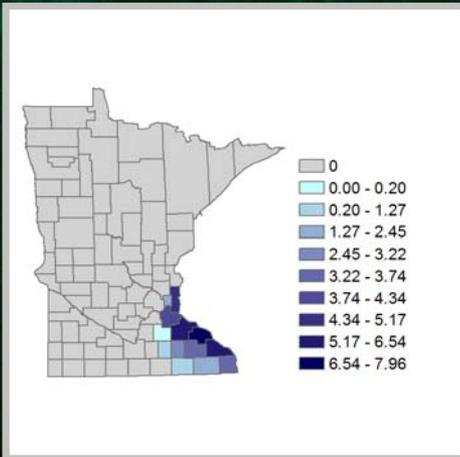
Loggerhead Shrike



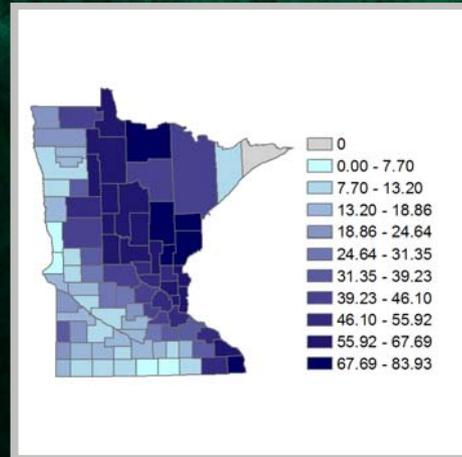
Marbled Godwit

- Restricted by range
- PSR = percent habitat when evaluated for a single species
- Habitat = source layer class with a matrix score >0

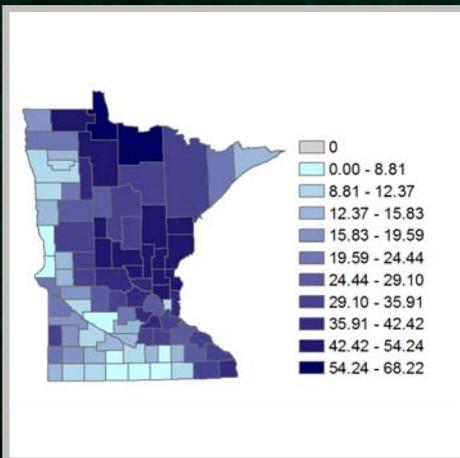
Example Query: Individual, PSR by Zone



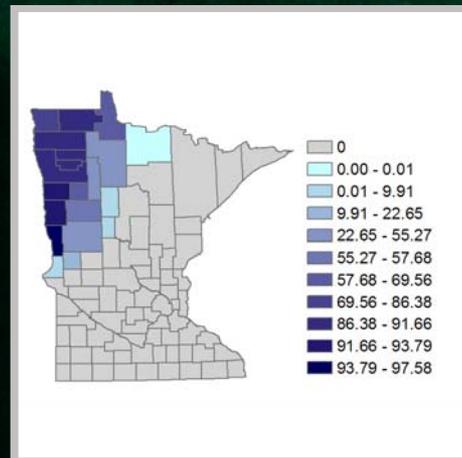
Peregrine Falcon



Red-headed Woodpecker



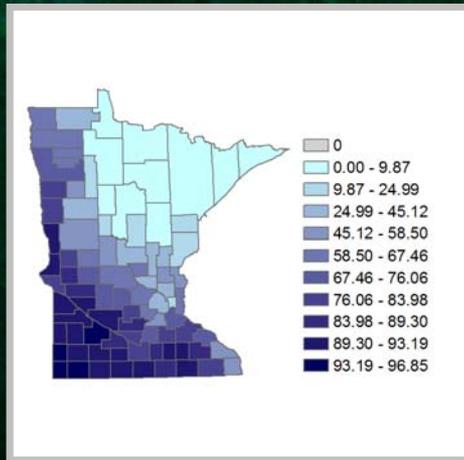
Sedge Wren



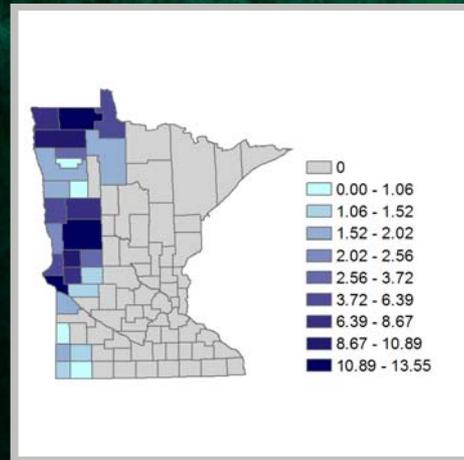
Short-eared Owl

- Restricted by range
- PSR = percent habitat when evaluated for a single species
- Habitat = source layer class with a matrix score >0

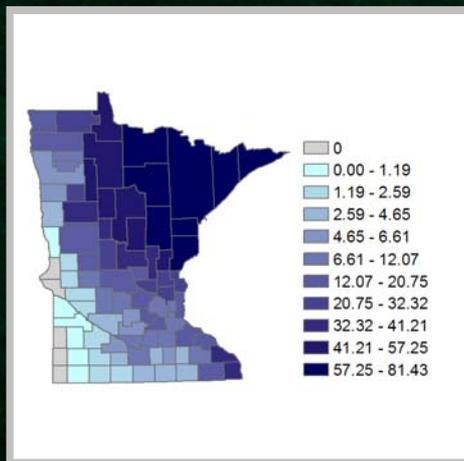
Example Query: Individual, PSR by Zone



Upland Sandpiper



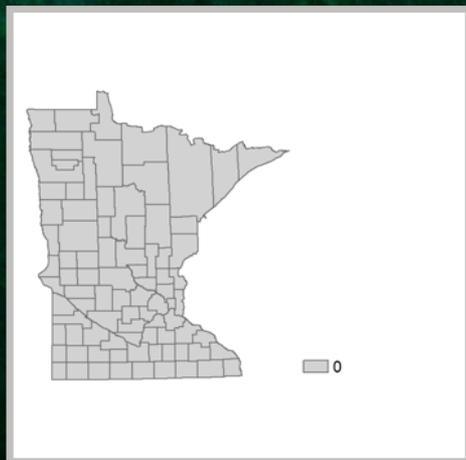
Wilson's Phalarope



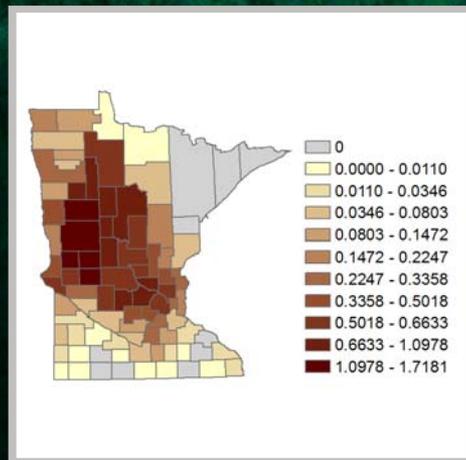
Wood Thrush

- Restricted by range
- PSR = percent habitat when evaluated for a single species
- Habitat = source layer class with a matrix score >0

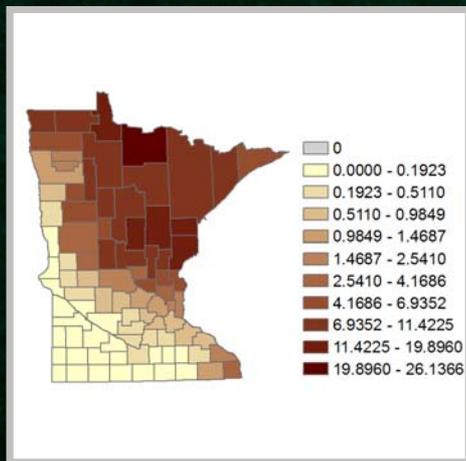
Example Query: Individual, PSO by Zone



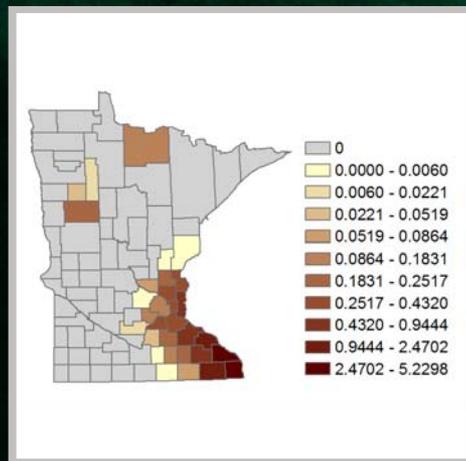
Acadian Flycatcher



Black Tern



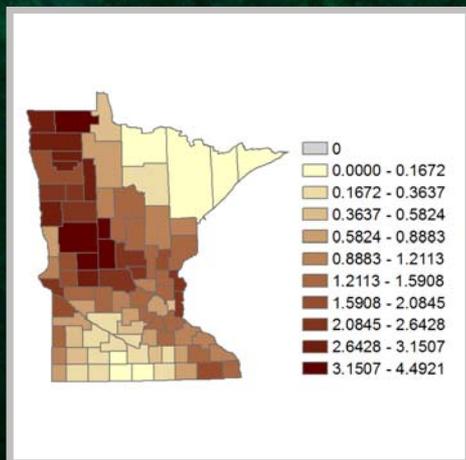
Black-billed Cuckoo



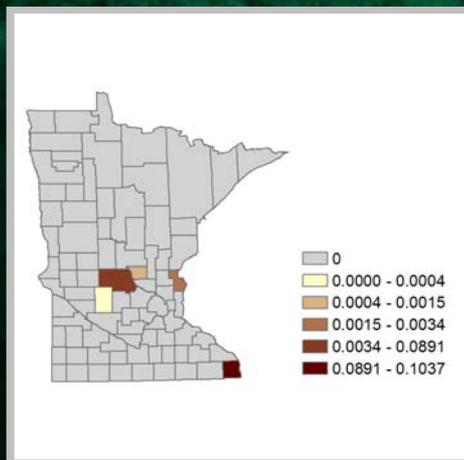
Blue-winged Warbler

- Restricted by range
- Option, range is treated as relative abundance when calculating PSO
- $PSO = MS * RA$
 - MS = Matrix score (0-100)
 - RA = Relative abundance (0-1)
- Summary statistics by county

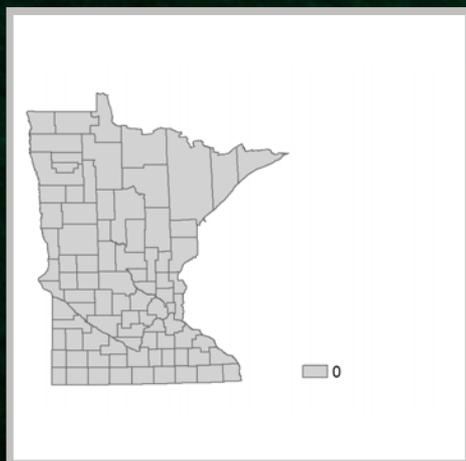
Example Query: Individual, PSO by Zone



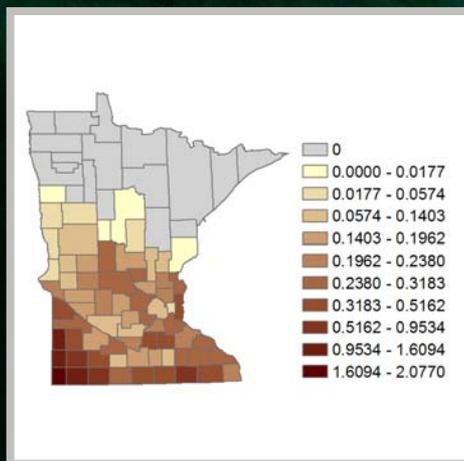
Bobolink



Cerulean Warbler



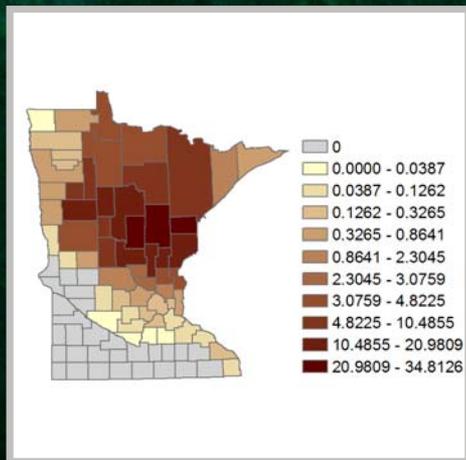
Common Tern



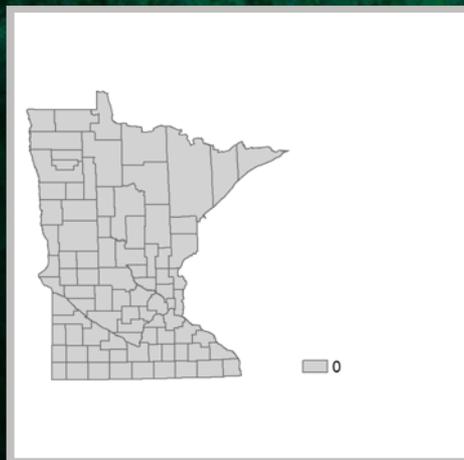
Dickcissel

- Restricted by range
- Option, range is treated as relative abundance when calculating PSO
- $PSO = MS * RA$
 - MS = Matrix score (0-100)
 - RA = Relative abundance (0-1)
- Summary statistics by county

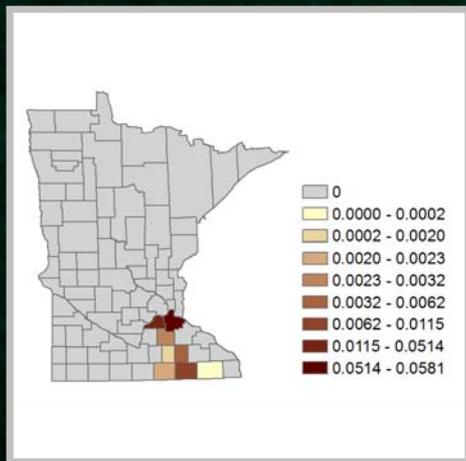
Example Query: Individual, PSO by Zone



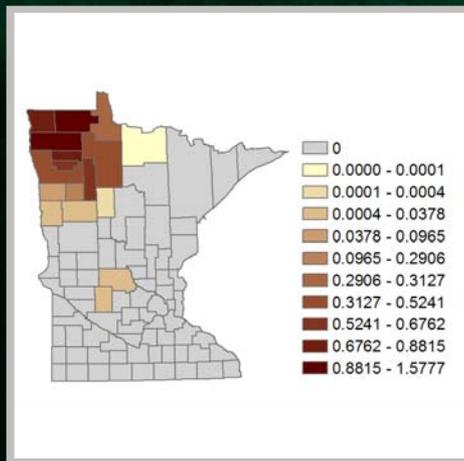
Golden-winged Warbler



Henslow's Sparrow



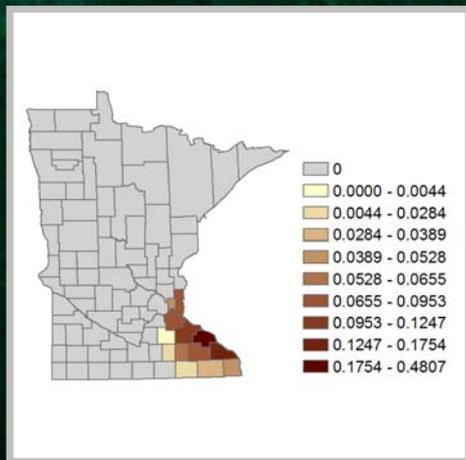
Loggerhead Shrike



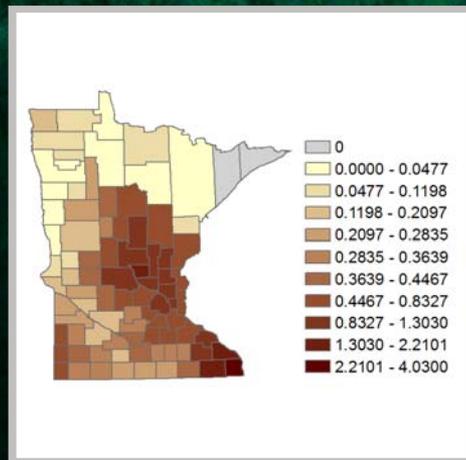
Marbled Godwit

- Restricted by range
- Option, range is treated as relative abundance when calculating PSO
- $PSO = MS * RA$
 - MS = Matrix score (0-100)
 - RA = Relative abundance (0-1)
- Summary statistics by county

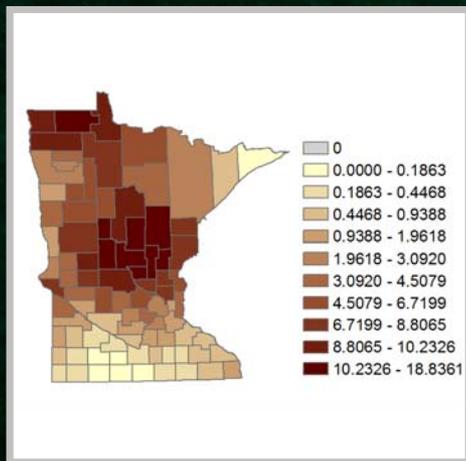
Example Query: Individual, PSO by Zone



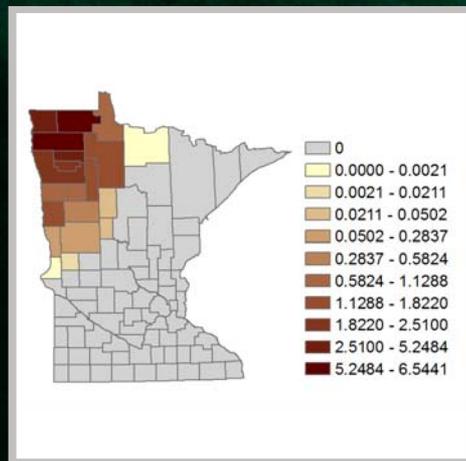
Peregrine Falcon



Red-headed Woodpecker



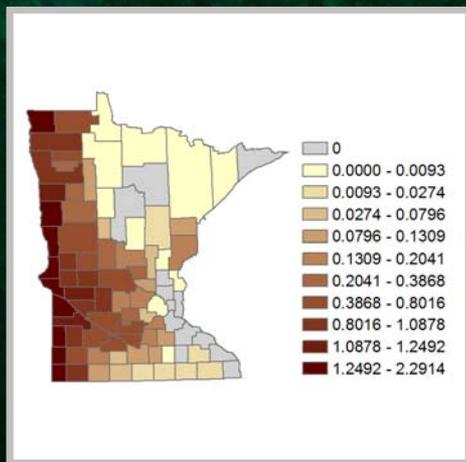
Sedge Wren



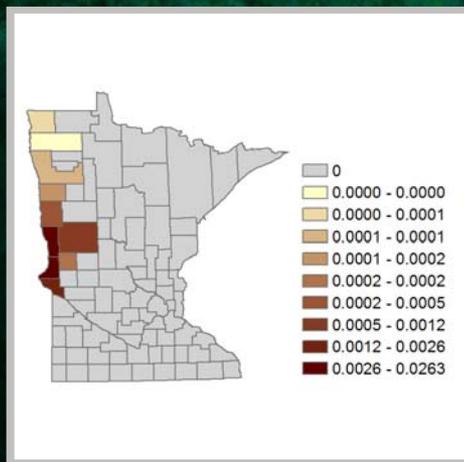
Short-eared Owl

- Restricted by range
- Option, range is treated as relative abundance when calculating PSO
- $PSO = MS * RA$
 - MS = Matrix score (0-100)
 - RA = Relative abundance (0-1)
- Summary statistics by county

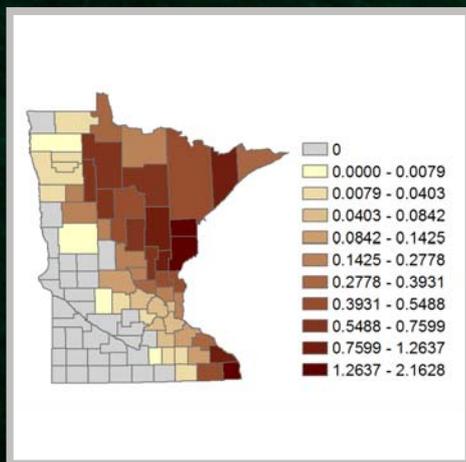
Example Query: Individual, PSO by Zone



Upland Sandpiper



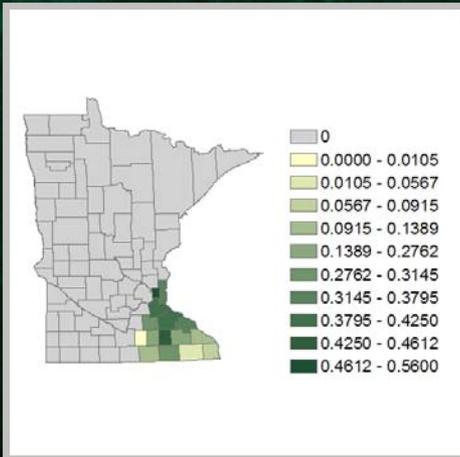
Wilson's Phalarope



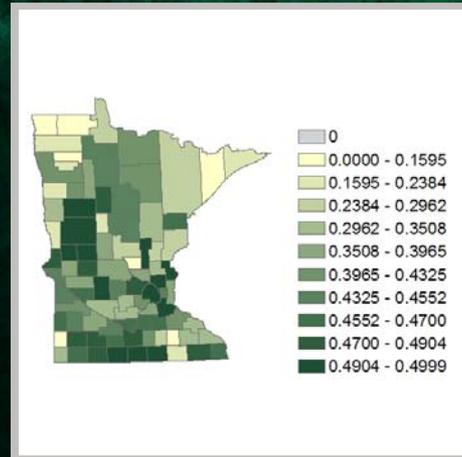
Wood Thrush

- Restricted by range
- Option, range is treated as relative abundance when calculating PSO
- $PSO = MS * RA$
 - MS = Matrix score (0-100)
 - RA = Relative abundance (0-1)
- Summary statistics by county

Example Query: Individual, SDI by Zone

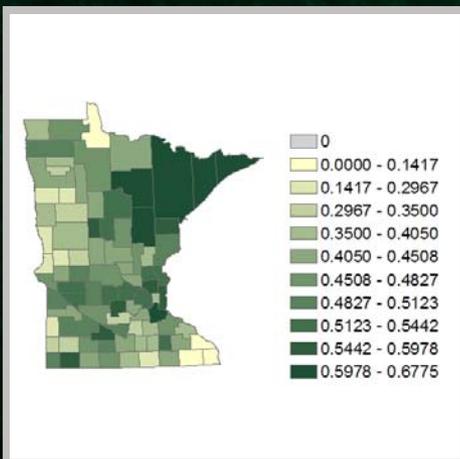


Acadian Flycatcher

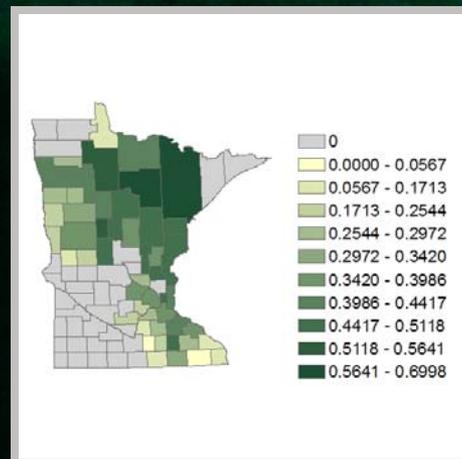


Black Tern

- Restricted by range



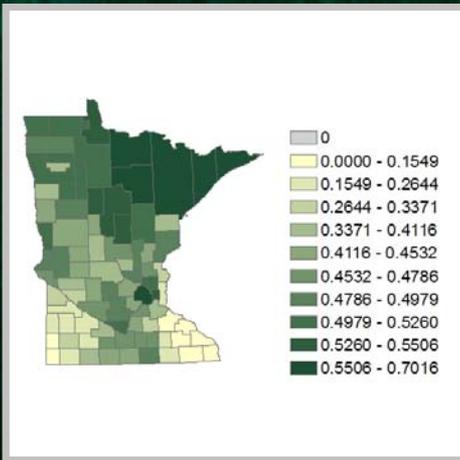
Black-billed Cuckoo



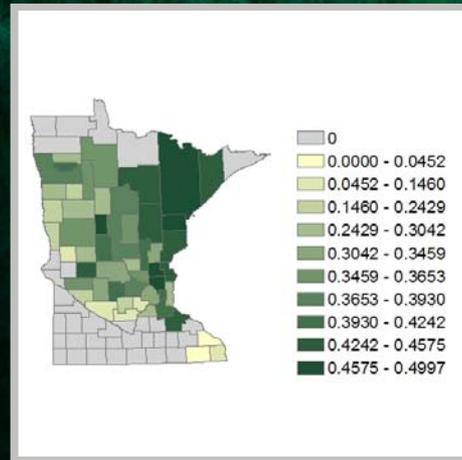
Blue-winged Warbler

- Habitat = source layer class with a matrix score >0

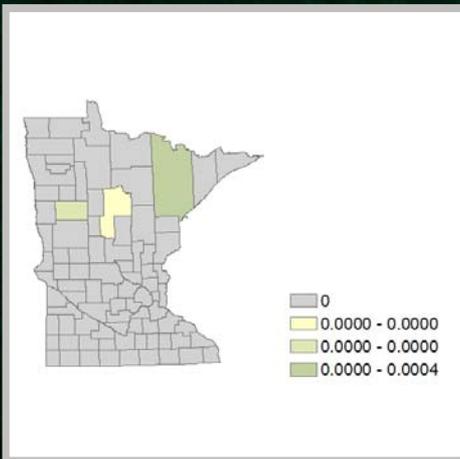
Example Query: Individual, SDI by Zone



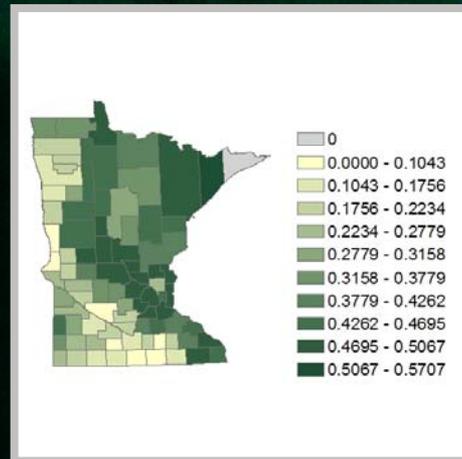
Bobolink



Cerulean Warbler



Common Tern

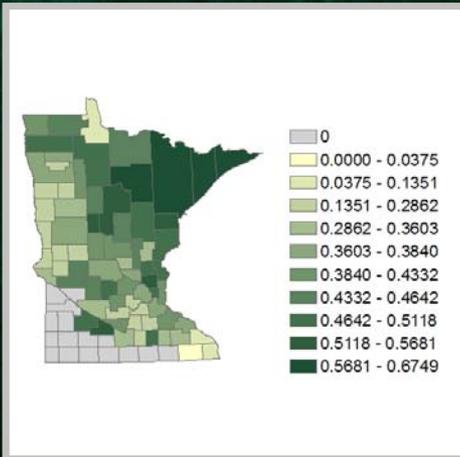


Dickcissel

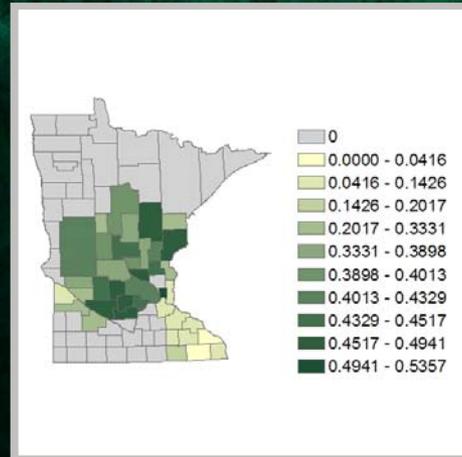
- Restricted by range

- Habitat = source layer class with a matrix score >0

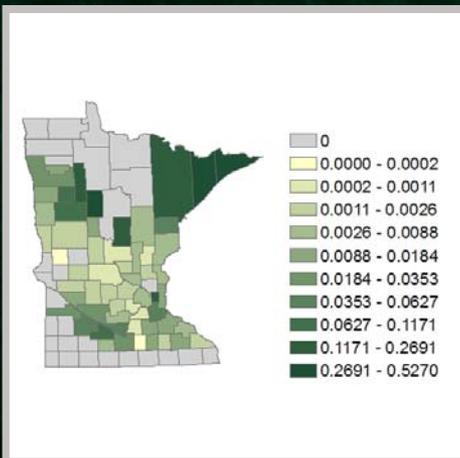
Example Query: Individual, SDI by Zone



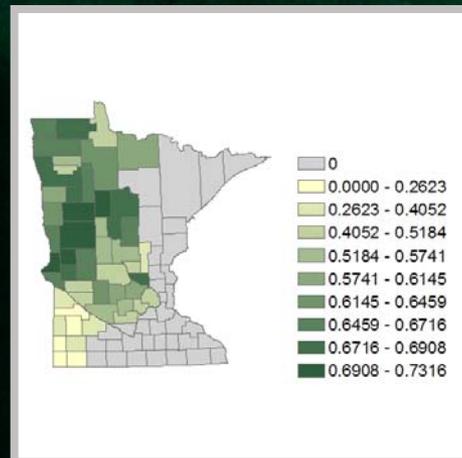
Golden-winged Warbler



Henslow's Sparrow



Loggerhead Shrike

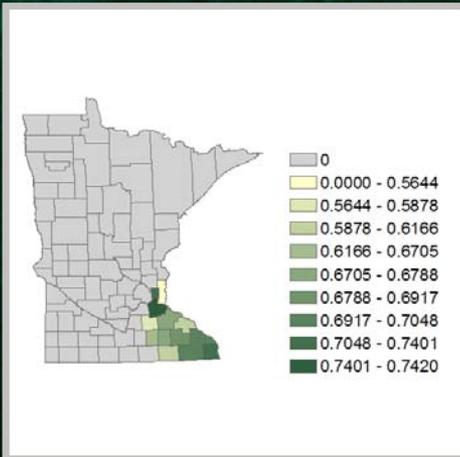


Marbled Godwit

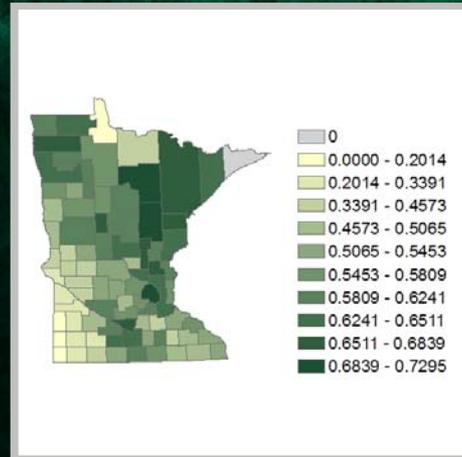
- Restricted by range

- Habitat = source layer class with a matrix score >0

Example Query: Individual, SDI by Zone

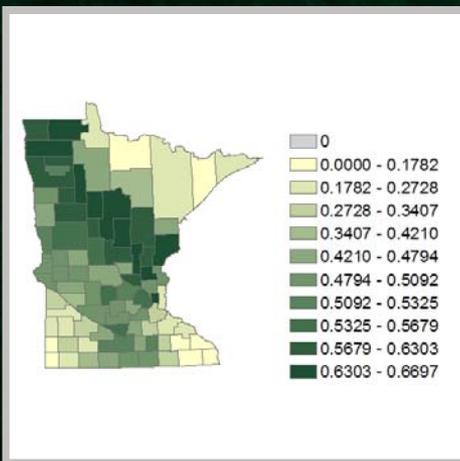


Peregrine Falcon

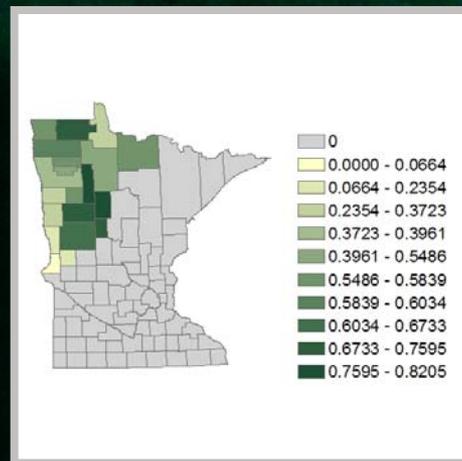


Red-headed Woodpecker

- Restricted by range



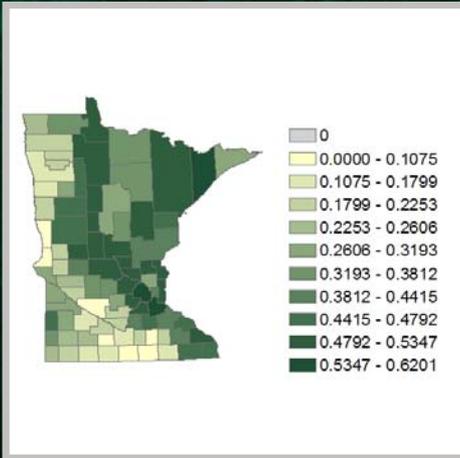
Sedge Wren



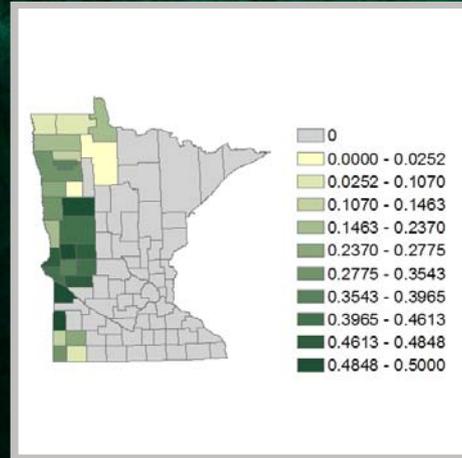
Short-eared Owl

- Habitat = source layer class with a matrix score >0

Example Query: Individual, SDI by Zone

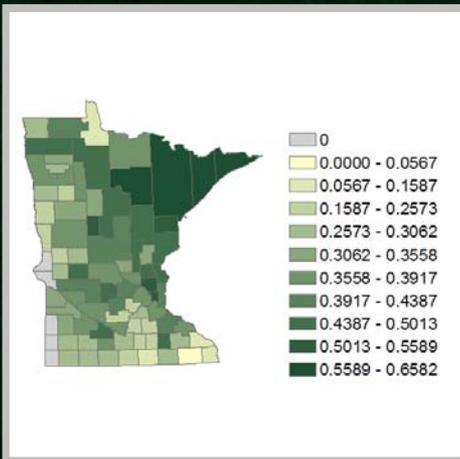


Upland Sandpiper



Wilson's Phalarope

- Restricted by range



Wood Thrush

- Habitat = source layer class with a matrix score >0

LINK: Flexibility

Range Mapper

- The example query focused on BCR 23 birds
- LINK is an open ended GIS tool
 - matrices
 - source layers
 - zonal layers
 - range maps

LINK: Availability

http://www.umesc.usgs.gov/management/dss/bird_conservation_tools_link.html



- Visit the web page above or email: tfox@usgs.gov
- Can be downloaded (350 MB)