A Pilot Study: Using Mallard Habitat Preference to Target Wetland Restoration in Northwest Iowa

By Claudette Sandoval-Green 2013

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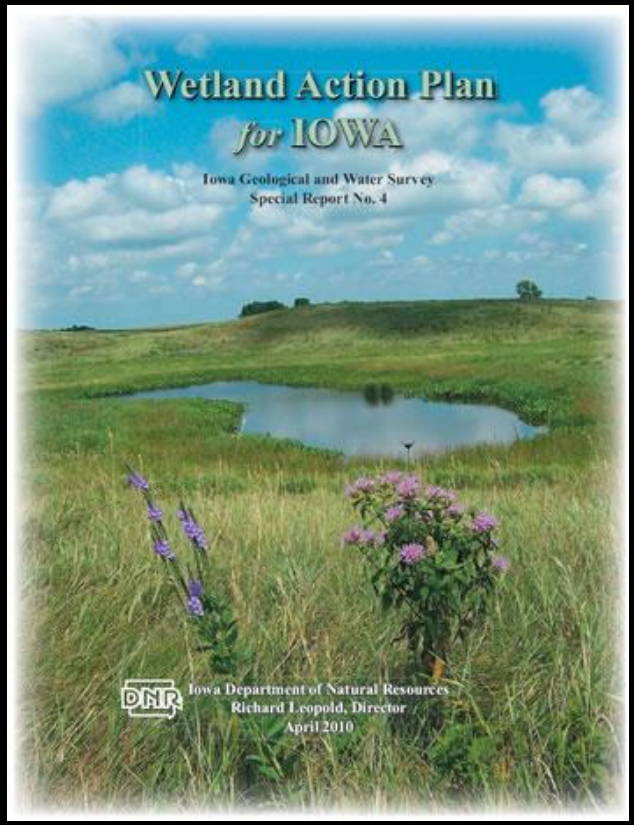
Motivation

- Wetland restoration in Iowa is a BIG DEAL!

- Creating wetlands
- Restoring wetlands
- Protecting wetlands

- Why are we going through all this trouble?



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Motivation

Locally

- Iowa's Natural Landscape
- Flood abatement
- Water quality
- Wildlife habitat
- Filtration of agricultural runoff
- If we had more, we could assist nationally -

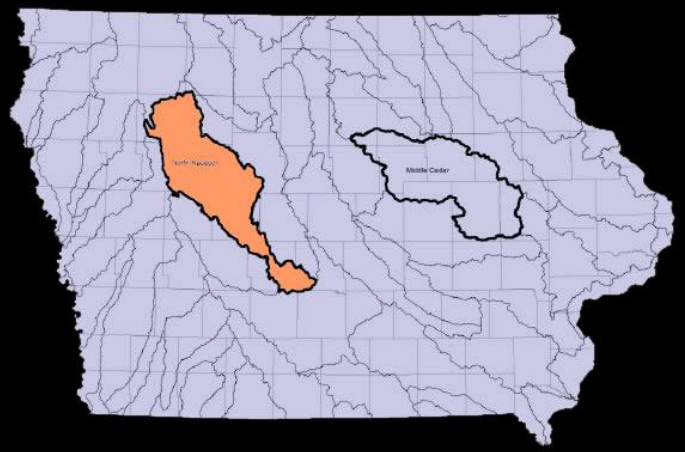
Nationally

- Reduce nutrient load in the hypoxic zone in the Gulf of Mexico
- Improve the health of the Upper Mississippi
- Improve the health of the Missouri River
- Improve surface and ground water
- Help declining populations of migratory waterfowl, shorebirds, and songbirds

Motivation

Currently

- The U.S. is going to spend $6 million dollars on Iowa's wetland restoration.
- It will restore 1,020 acres in the North Raccoon River.
- So it is important that resource mangers choose these areas for restored or created wetlands wisely.



- The North Raccoon watershed (in orange) is a priority watershed for Iowa due to water quality and frequent flooding in this area.

Spatial Problem

Selecting sites for wetland restoration or creation, that will maximize wildlife habitat, increase wildlife diversity, and abundance.

Literature Review

One Technique

- Might be to consider the spatial habitat preference of breeding Mallards.

- One study looked at this, and discovered that when Mallard spatial habitat preference is used to target wetland restoration, Mallard abundance increased by nearly 80% and conversely sites that did not account for spatial habitat preference, only increased by13-33%.

Literature Review

- I followed a paper by Newbold, S. & Eadie, J.M. 2004. Using Species-Habitat Models to Target Conservation: A Case Study with Breeding Mallards. *Ecological Applications* 14:1384-1393.

- They used 3 datasets that I knew I could get for Iowa (land cover, wetlands, and mallard distribution).
- I wanted to try and replicate their idea as much as possible by using ArcMap and GeoDa.
- Essentially, testing what I have learned so far.

Project Framework

Their Study

- Transects
- 400 meter buffer
- Breeding Bird Survey Data
- 10 land cover types
- Northern California
- Mallards as focal species

My Study

- Polygons (wetlands)
- 400 meter buffer
- Gap Predicted Species Distribution
- 20 land cover types
- Northwest Iowa
- Mallards as focal species

Project Framework

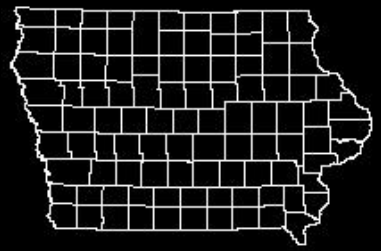
Data

- Land Cover Data 2012 from CropScap (raster)

- Wetland Data 2012 from National Wetland Inventory

- Mallard Data 2002 from the Iowa Natural Resource GIS Library

- Iowa County Map from the Iowa Natural Resource GIS Library



Project Framework

Workflow

Prepared Mallard Data

2

Defined Northwest Iowa

3

Clipped Mallard Presence Raster Data to NW Iowa

4

Created a Fishnet for Cluster Analysis

5

Spatial Joined Mallard to NW Iowa Fishnet

Prepared Iowa Land Cover Raster

6

Performed GeoDa Cluster Analysis

7

Prepared Wetland Raster Data

8

Intersect Buffer with Land Cover Data

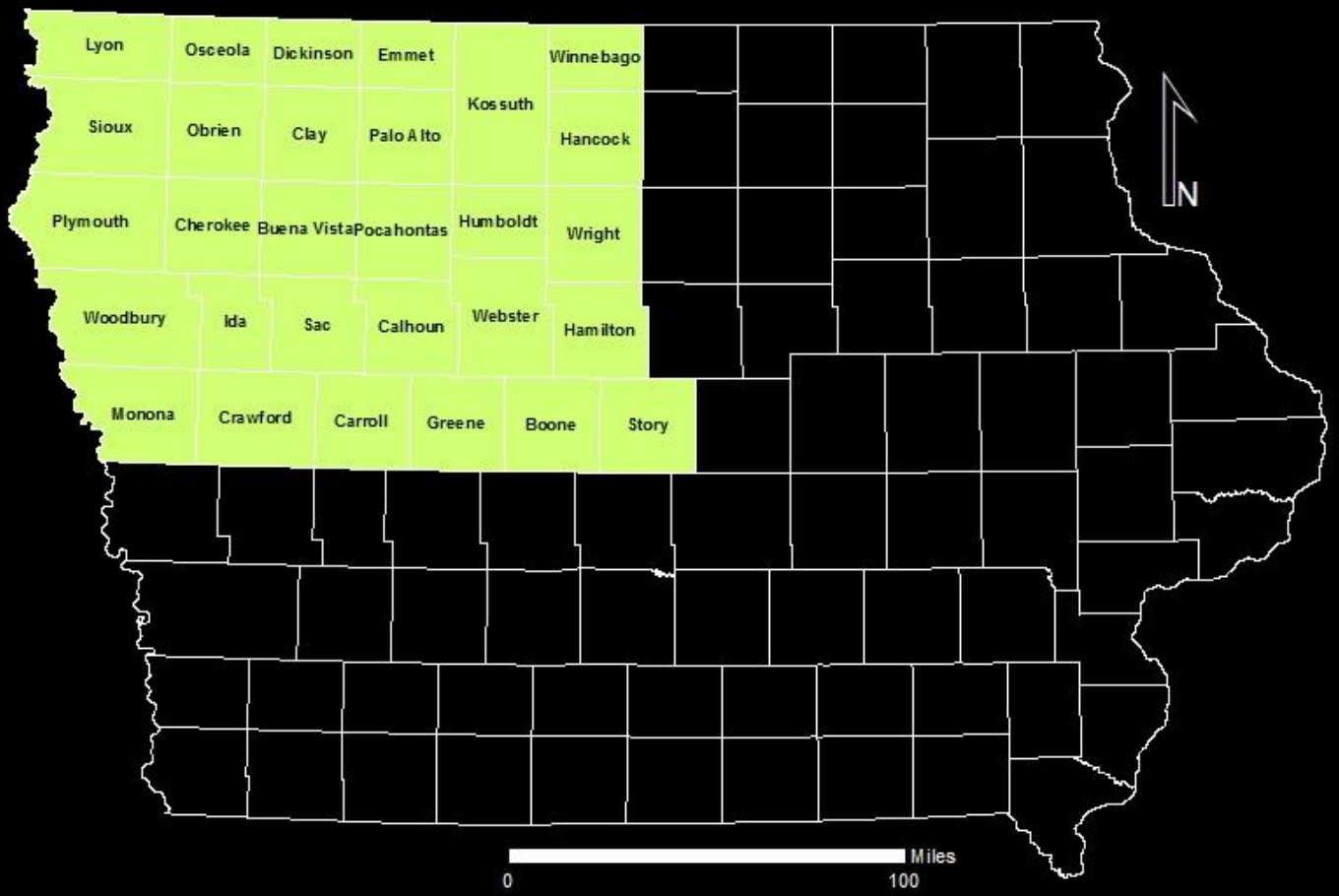
9

Compare Land Cover in High/High and Low/Low

Hypothesis is that there will be a significant difference.

Methodology

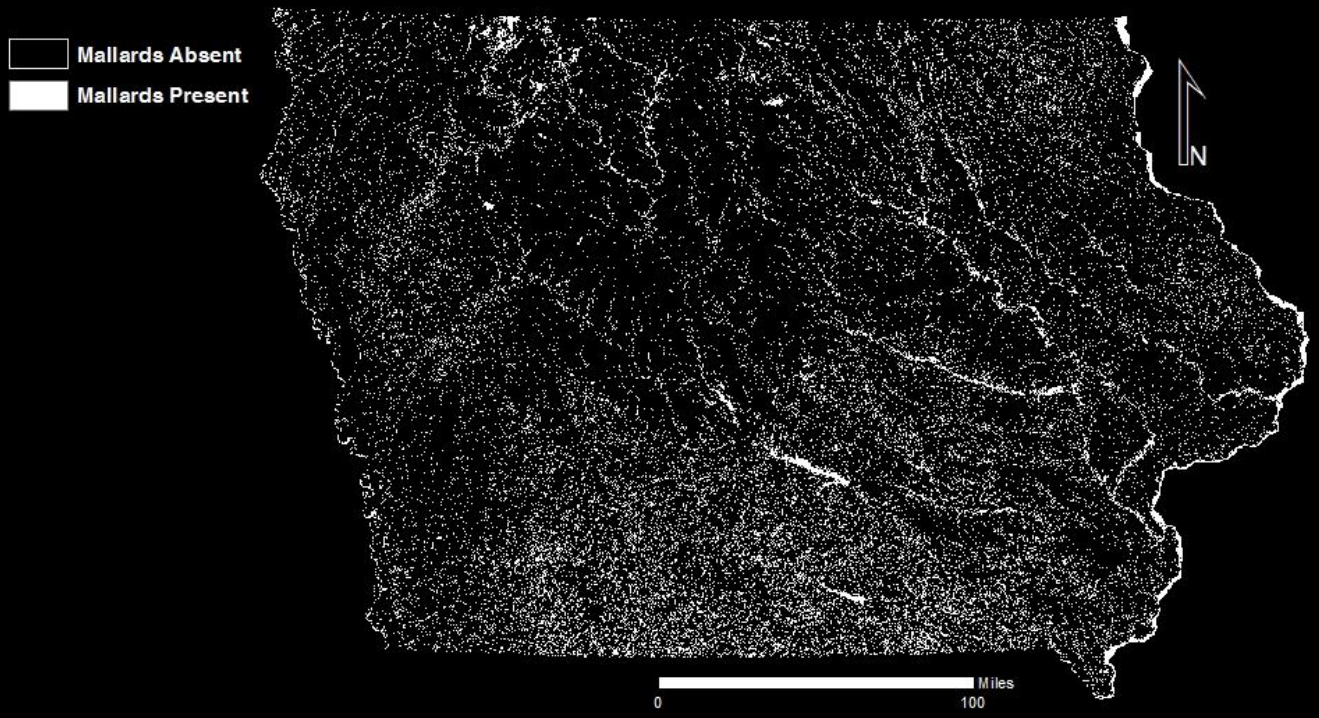
Define Northwest Iowa (study area)



Methodology

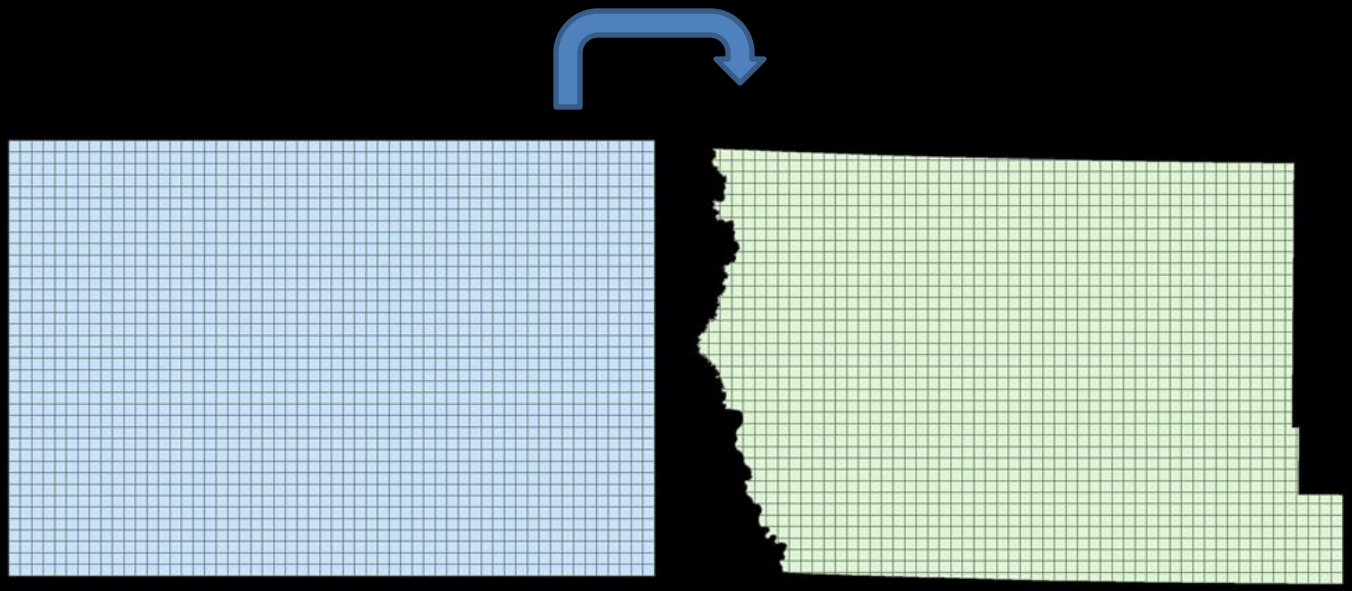
Mallard GAP Data

(Extracted by Attributes for Mallard presence only.)



Methodology

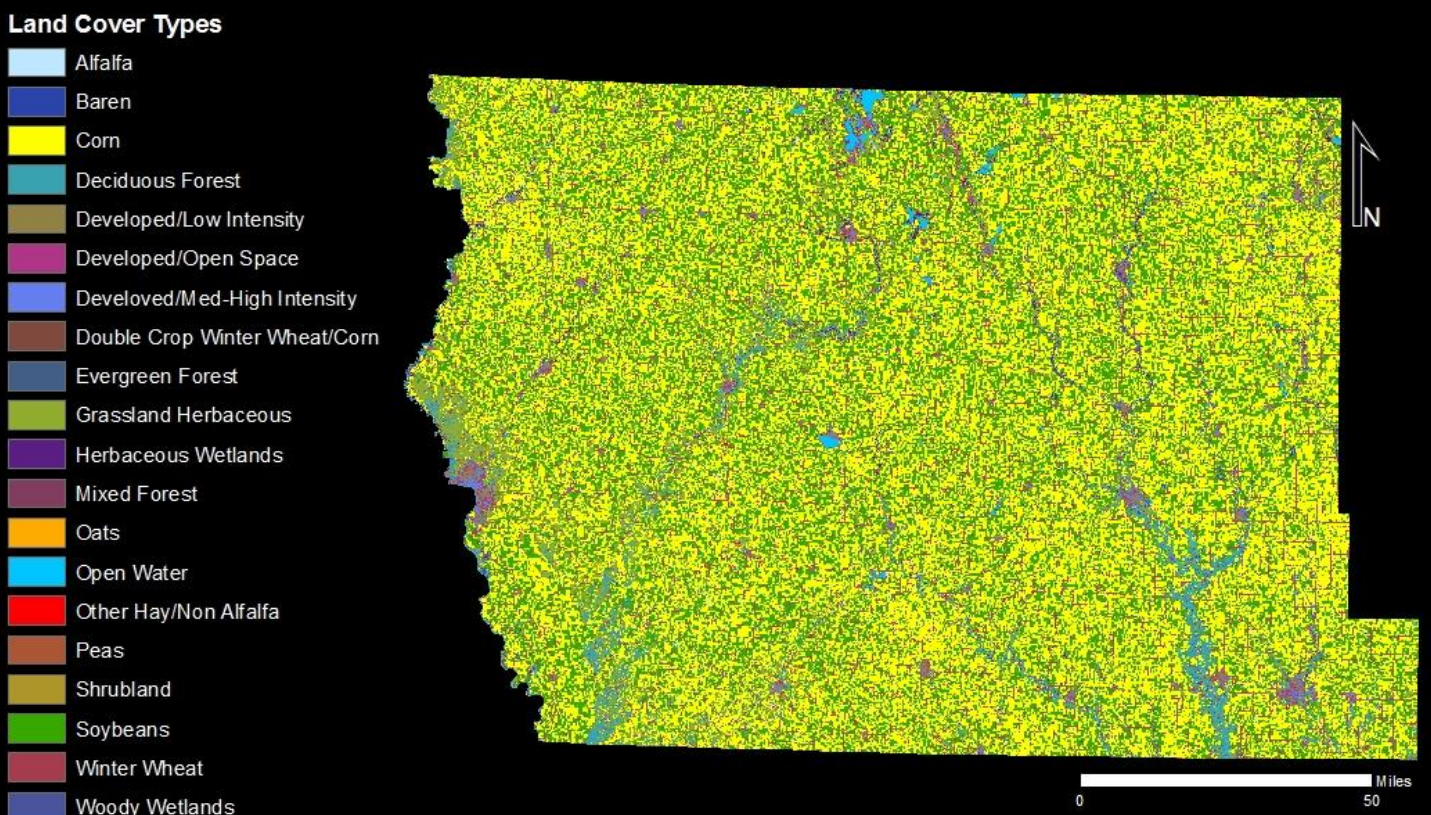
Create Fishnet (or Grid) for Cluster Analysis



Each box is approximately 3 sq miles or less.

Methodology

Iowa Land Cover Raster Data



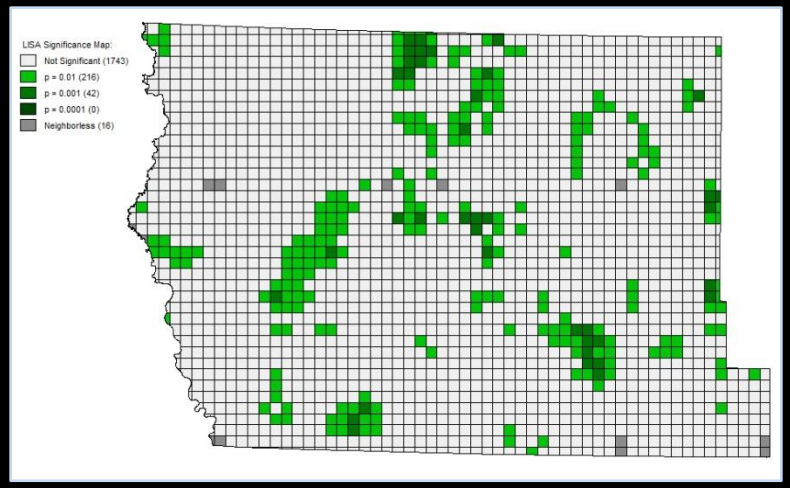
Out of 40 Land Cover Types,
I Reclassified the data to 20.

Methodology

GeoDa Spatial Autocorrelation (Univariate Moran's I and Univariate Local Moran's I .)

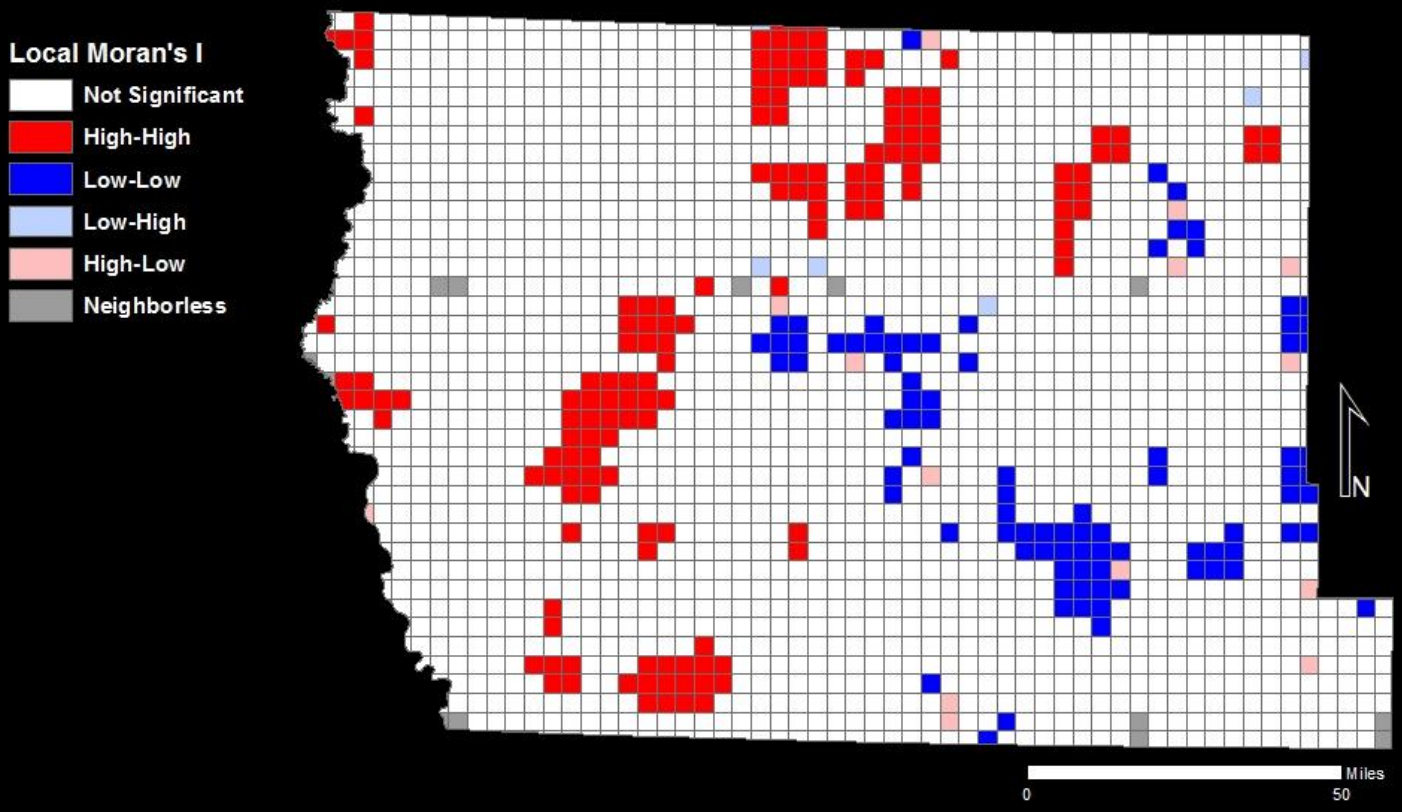
- You can run a Global and Local analysis in ArcMap; however, it is very dissatisfying.

- A randomizations of 999 permutations for Queen and k-Nearest Neighbors.
- All pseudo p-value = 0.001
- Pattern is not random



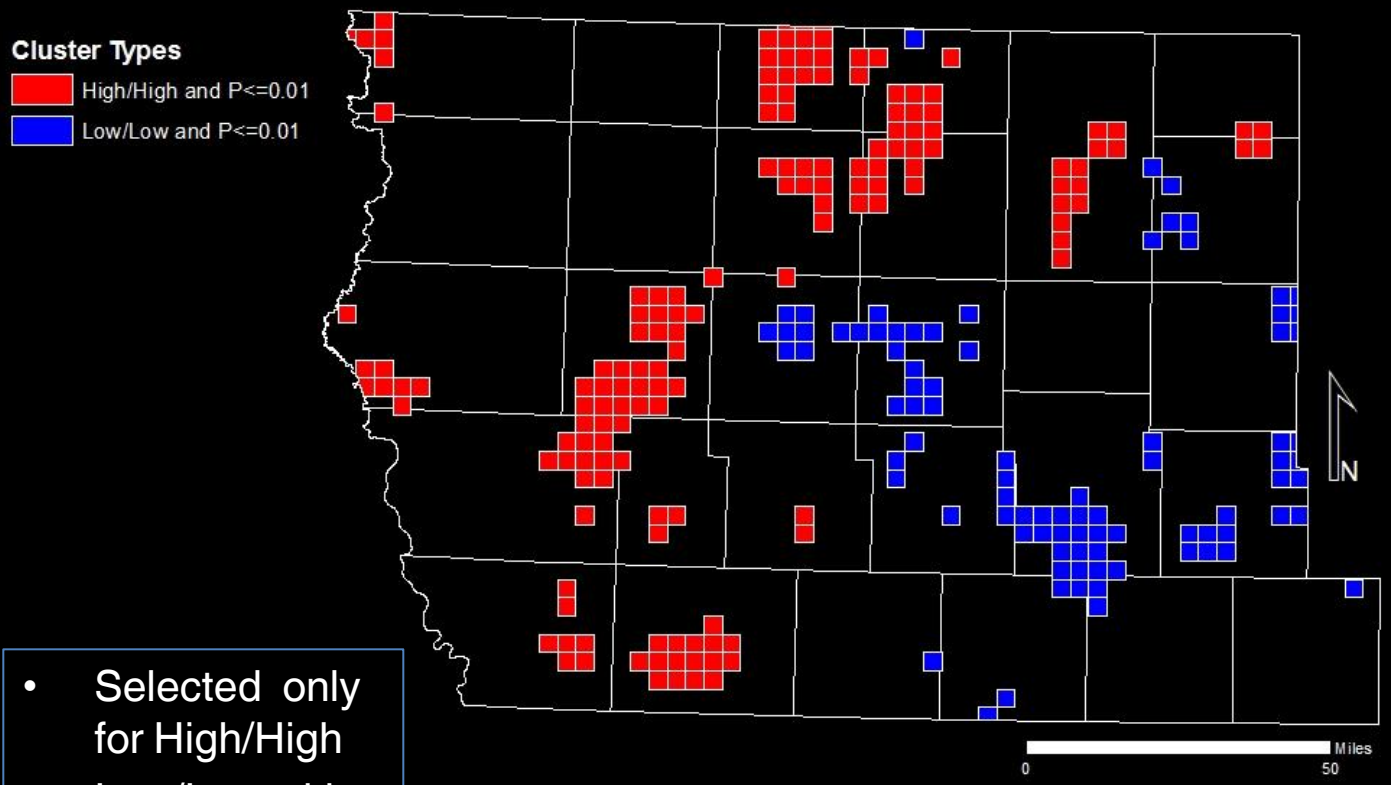
Methodology

GeoDa Spatial Autocorrelation (LISA Local Indicators Spatial Association or Univariate Local Moran's I for clusters.)



Methodology

Import Cluster Shapefile into ArcMap



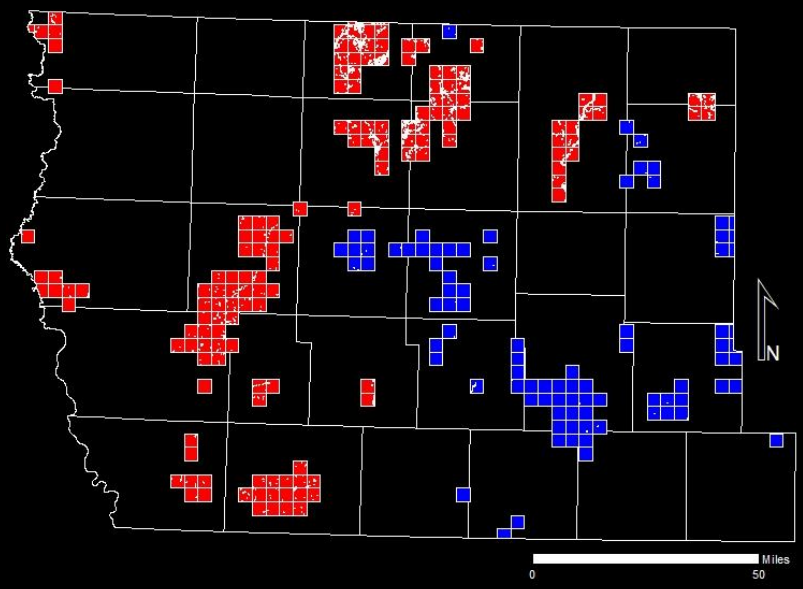
- Selected only for High/High Low/Low with P <=0.01.

Methodology

Prepare Wetland Raster Data

- Combined wetlands with High/High and Low/Low clusters
- Cleaned up wetland data: Only Freshwater Emergent Wetlands greater than 1 acre.
- Randomly selected 30 wetlands with no overlap.

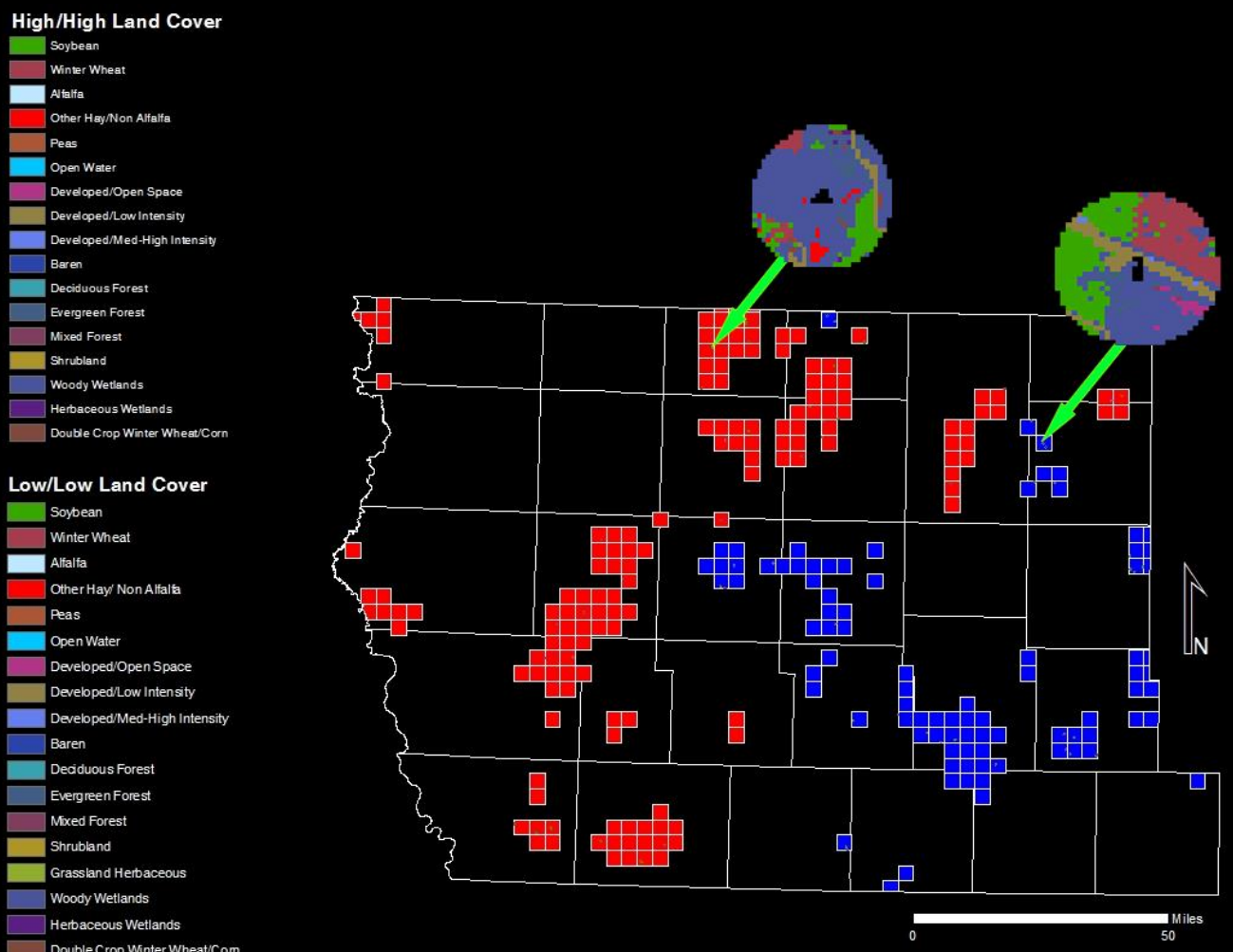
2203 High/High wetlands



64 Low/Low wetlands

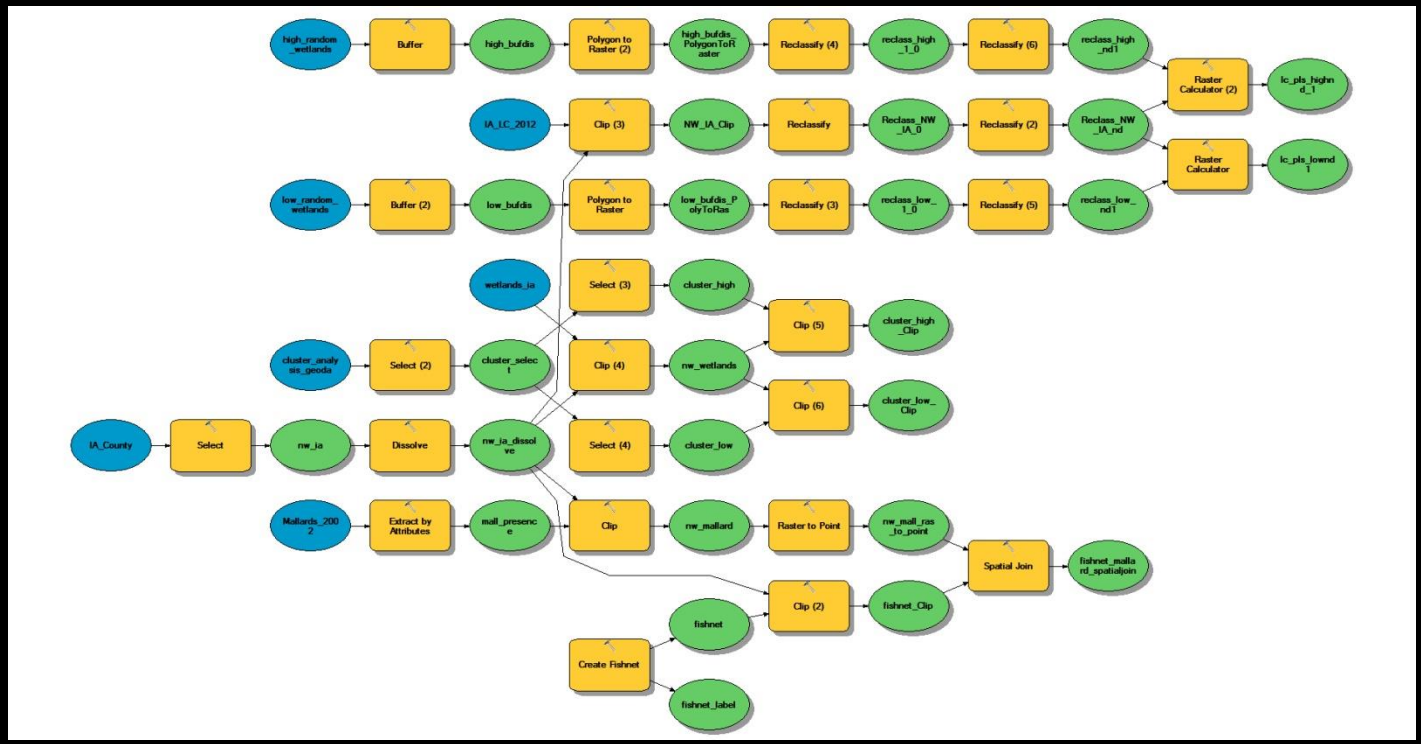
Methodology

Intersect Buffer with Land Cover Data



Methodology

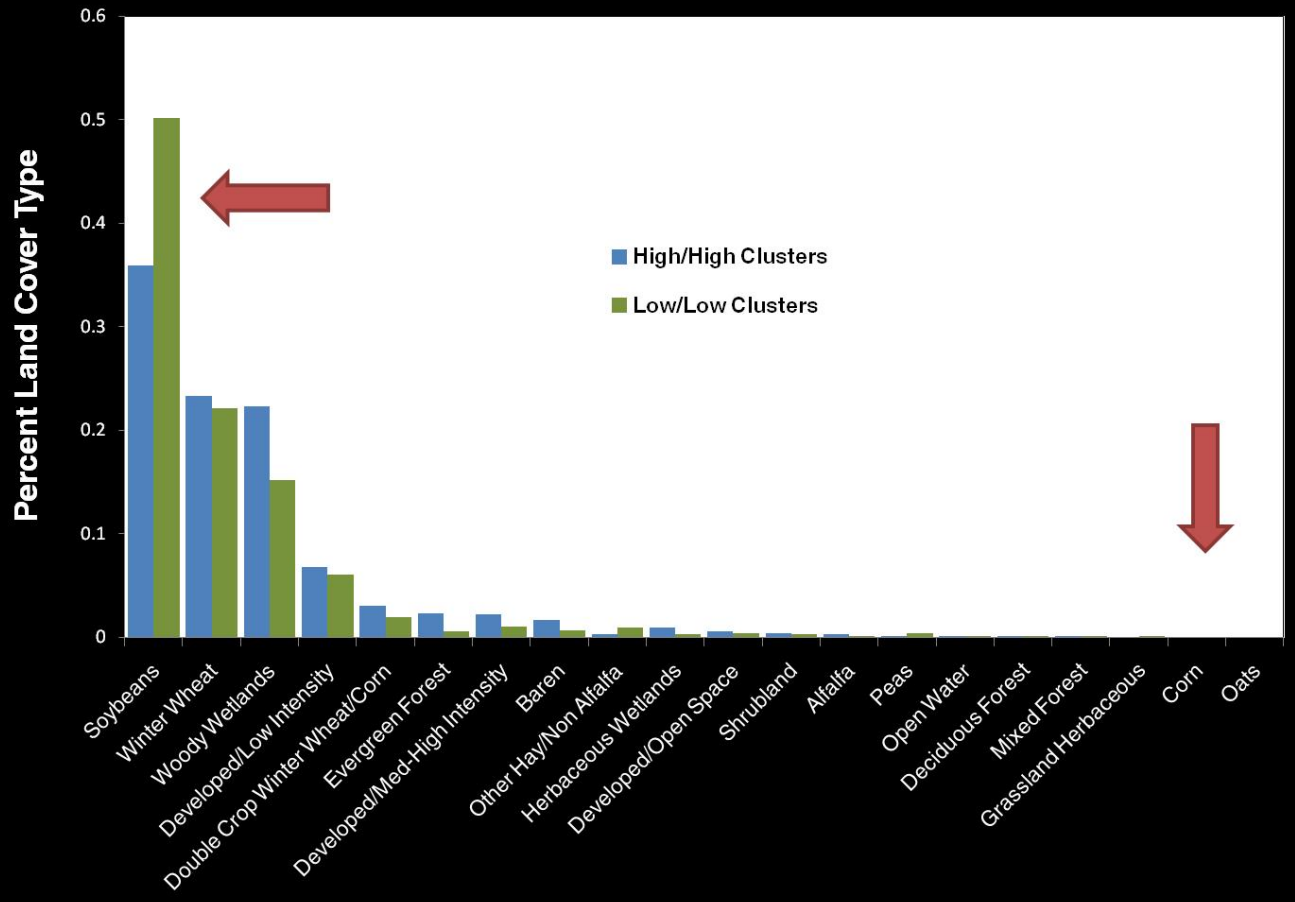
ArcMap Model



{feel my pain}

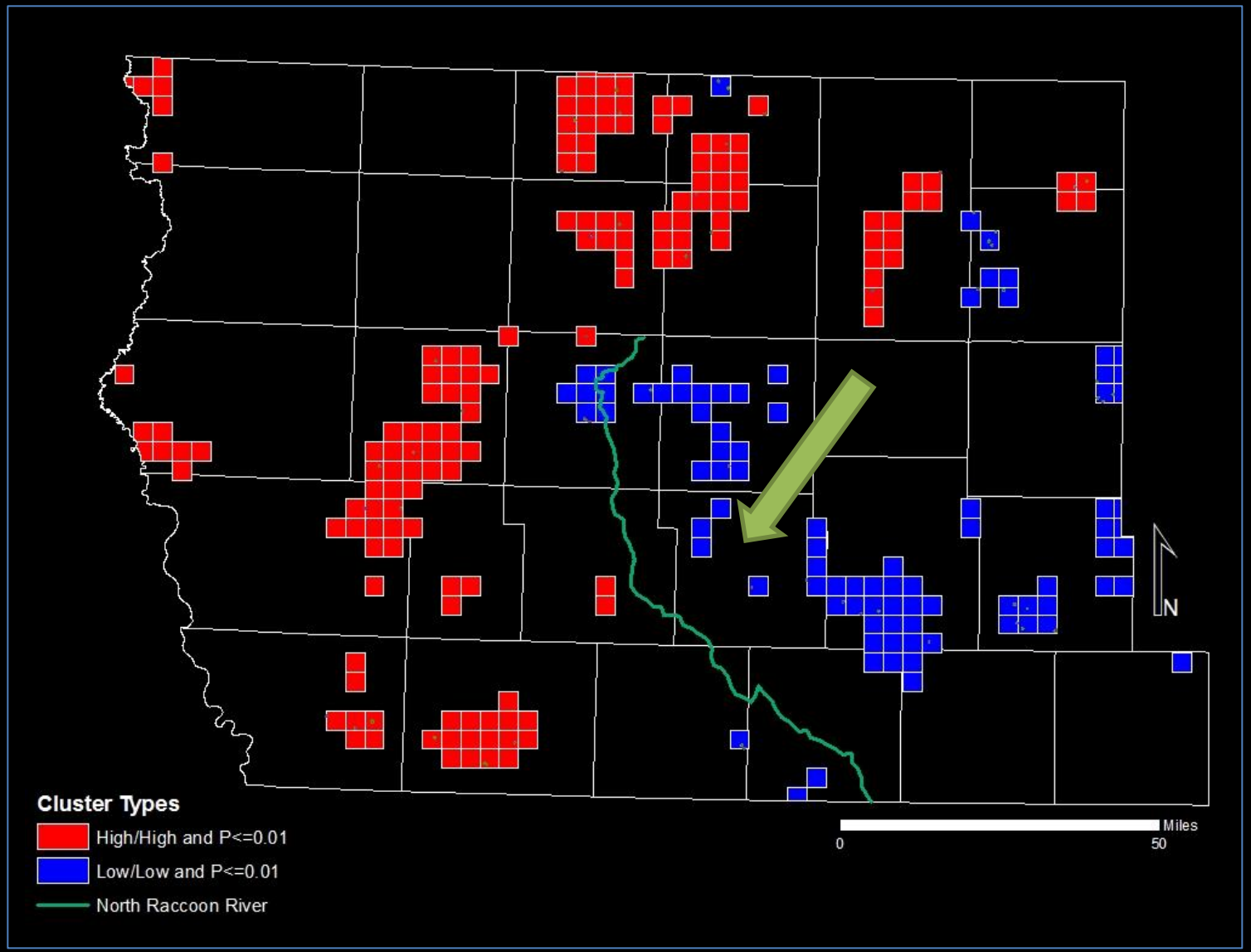
Results

Land Cover Type Percent



Cannot reject the null hypothesis.

Results


Cluster Types
High/High and P<=0.01
Low/Low and P<=0.01
North Raccoon River
N
0
50
Miles

Limitations

- The GAP predicted species distribution data is old (2002).
- Not certain if GAP data is appropriate for spatial autocorrelation. Also, GAP is known to over predict.
- I only looked at one type of wetland – Freshwater Emergent Wetlands … there are many different kinds of wetlands.
- Looking at more than 30 wetlands in each area may be more robust.
- Learning how to tabulate overlapping land cover types in ArcGIS … would be helpful.

Conclusion

- Maybe it's not just the water that attracts waterfowl!
- Perhaps accounting for the spatial arrangement of preferred habitats is another way to select sites for wetland restoration.
- However, Iowa might be a bad place to do this. It's hard to tell what land cover types mallards prefer when there is no choice.
- The California study concluded that Mallards preferred wetlands close to rice fields and other wetlands and did not prefer wetlands close to orchards and urban areas.

Future comparisons:

1. Look closer at only the High/High cluster area and run a spatial autocorrelation test there …
2. Compare land cover types for restored or created wetlands vs. natural wetlands, and do Mallards have a habitat preference for restored or natural?

References

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Williams, S. G., Rubino, M. J., Silvano, A. L., Cook, K., & Smith, S. (at least 2007) Appendix B. Predicted distribution model development for 602 terrestrial vertebrate species of the Southeast Gap Analysis Project.

Questions?