Mapping watershed degree of invasion across the continental U.S.

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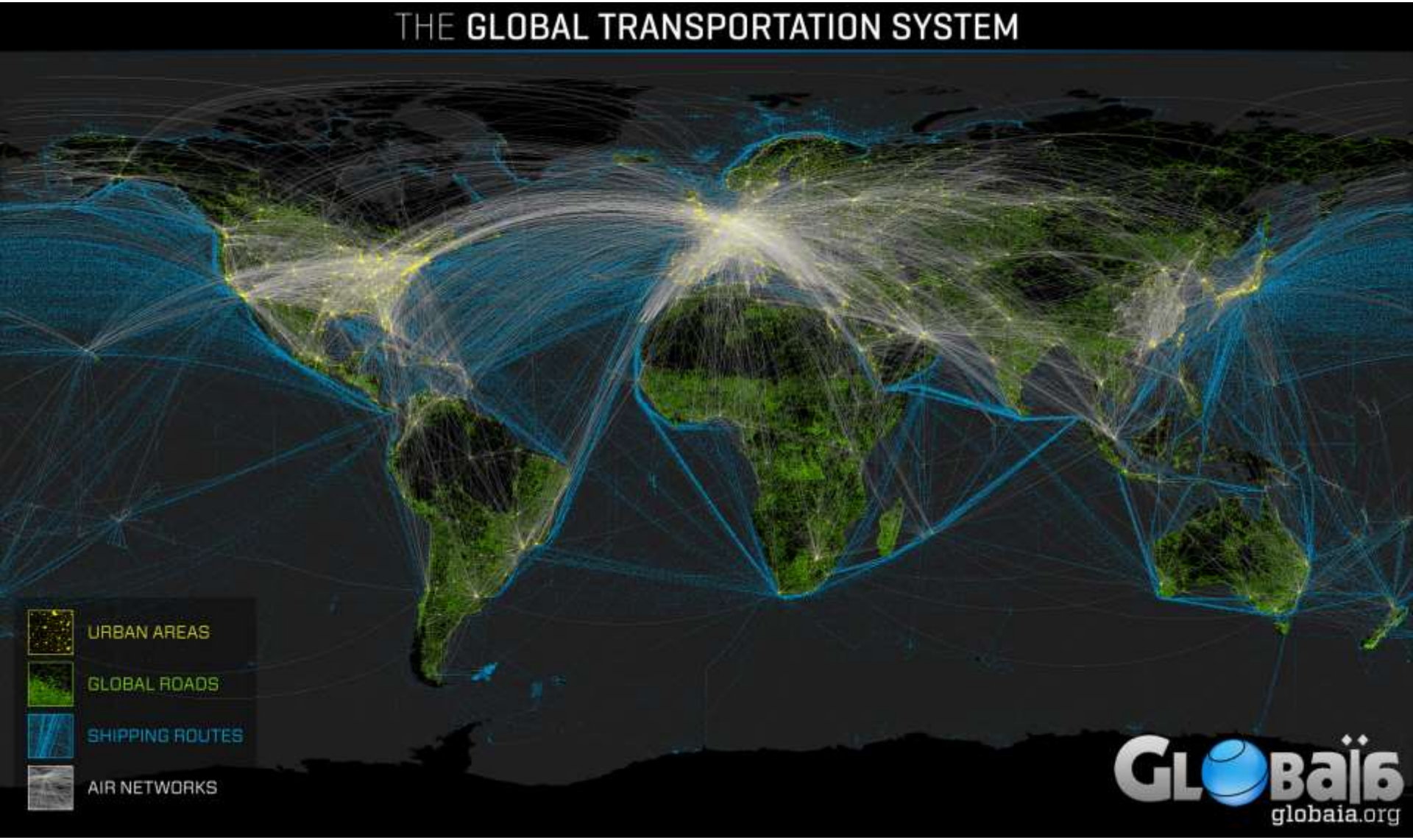
U.S. Environmental Protection Agency



http://matadornetwork.com/change/our-global-transportation-footprint-infographic/

Macroscale Approach

1. Invasions are the results of global processes, but studies often focus on one/few species or local scales

    - Limits our ability to make inferences due to differences in heterogeneity, climate, propagule pressure between study regions

2. Macroscale studies have the potential to identify robust drivers across taxa, geographies, and scales

http://matadornetwork.com/change/our-global-transportation-footprint-infographic/

Objective

Map freshwater aquatic exotic species richness of watersheds across the contiguous U.S.

Methods:

A. Database Development

1. Obtained freshwater aquatic exotic species occurrence data from the following sources :
    - USGS BISON
    - USGS NAS
    - EddMaps (Early Detection and Distribution Mapping System)

2. Cleaned data in R : removed centroids and duplicate occurrence records; extracted relevant attributes

3. Georeferenced point data by HUC unit in ArcGIS

4. Integrated data using MySQL

Can now quickly summarize exotic richness by HUC watershed boundary

Exotic Aquatic Plants Database

- All exotic plants listed in USDA Plants inhabiting aquatic freshwater habitats (n=67)
- total of 245,507 records

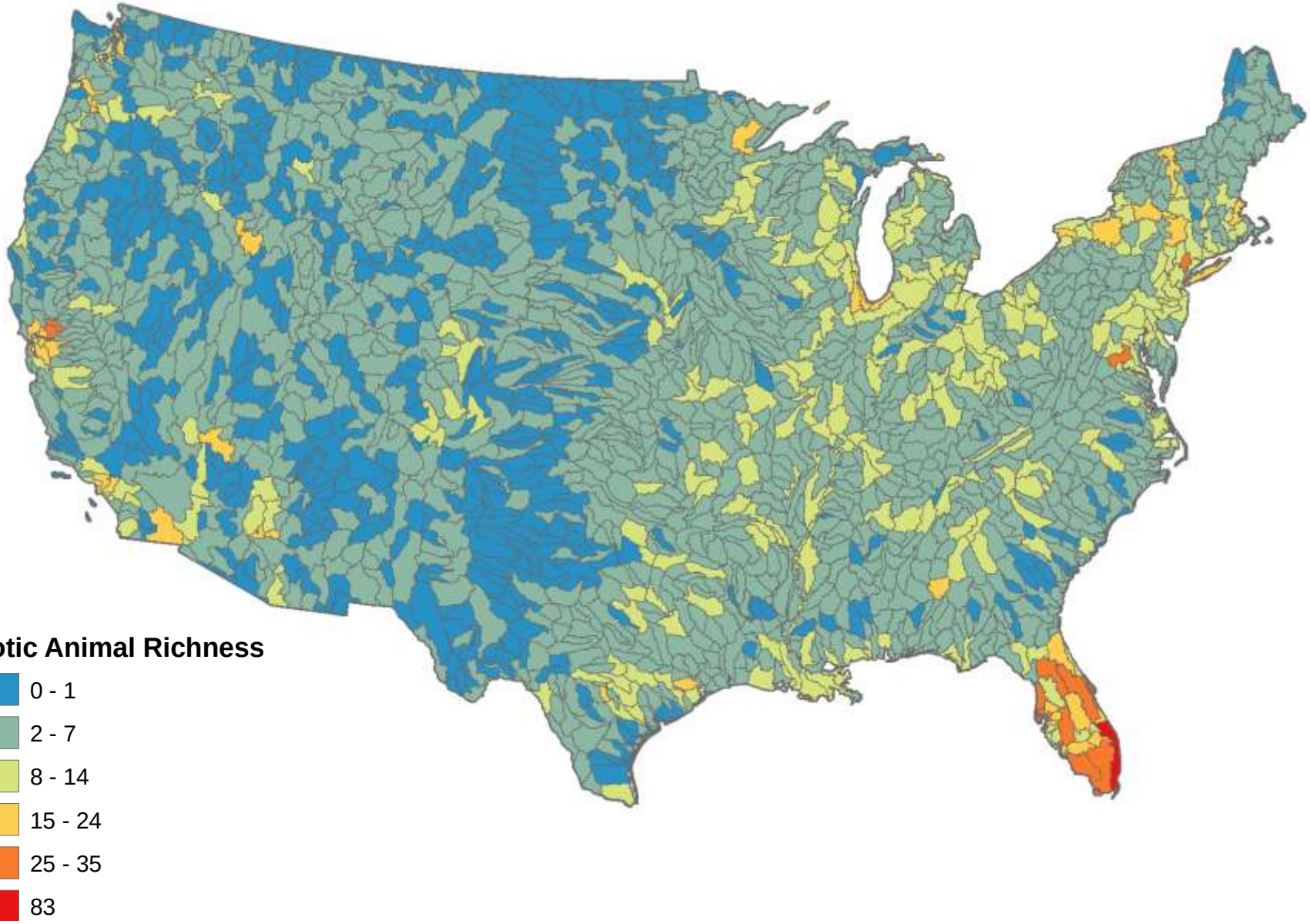
Exotic Aquatic Animals Database

- All exotic freshwater aquatic animal species listed by USGS NAS (n=287)
- total of 156,269 records

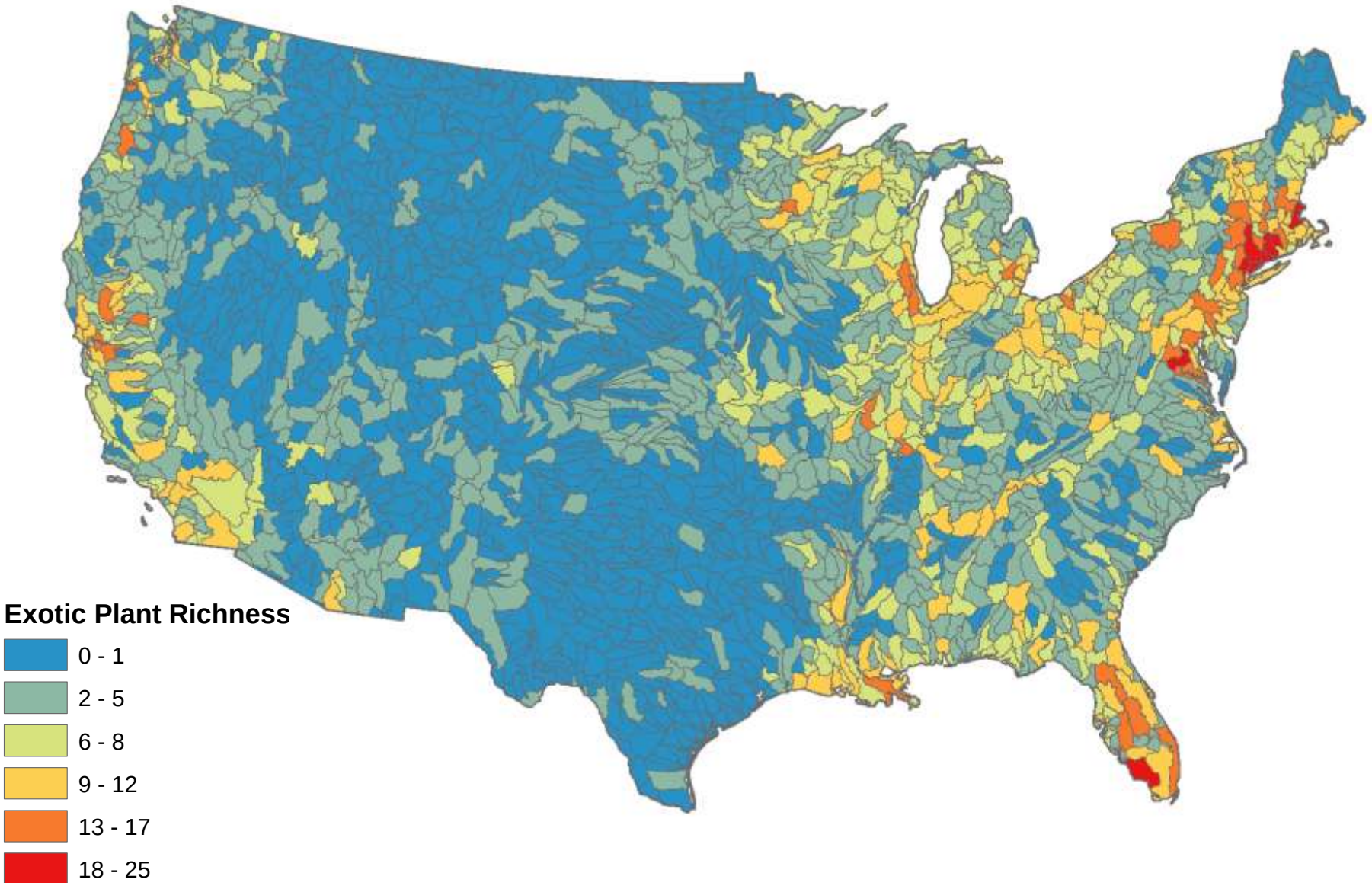
Connecticut River Watershed

Image adapted from: http://nh.water.usgs.gov/project/ct_atlas/water_wsheds_huc.htm

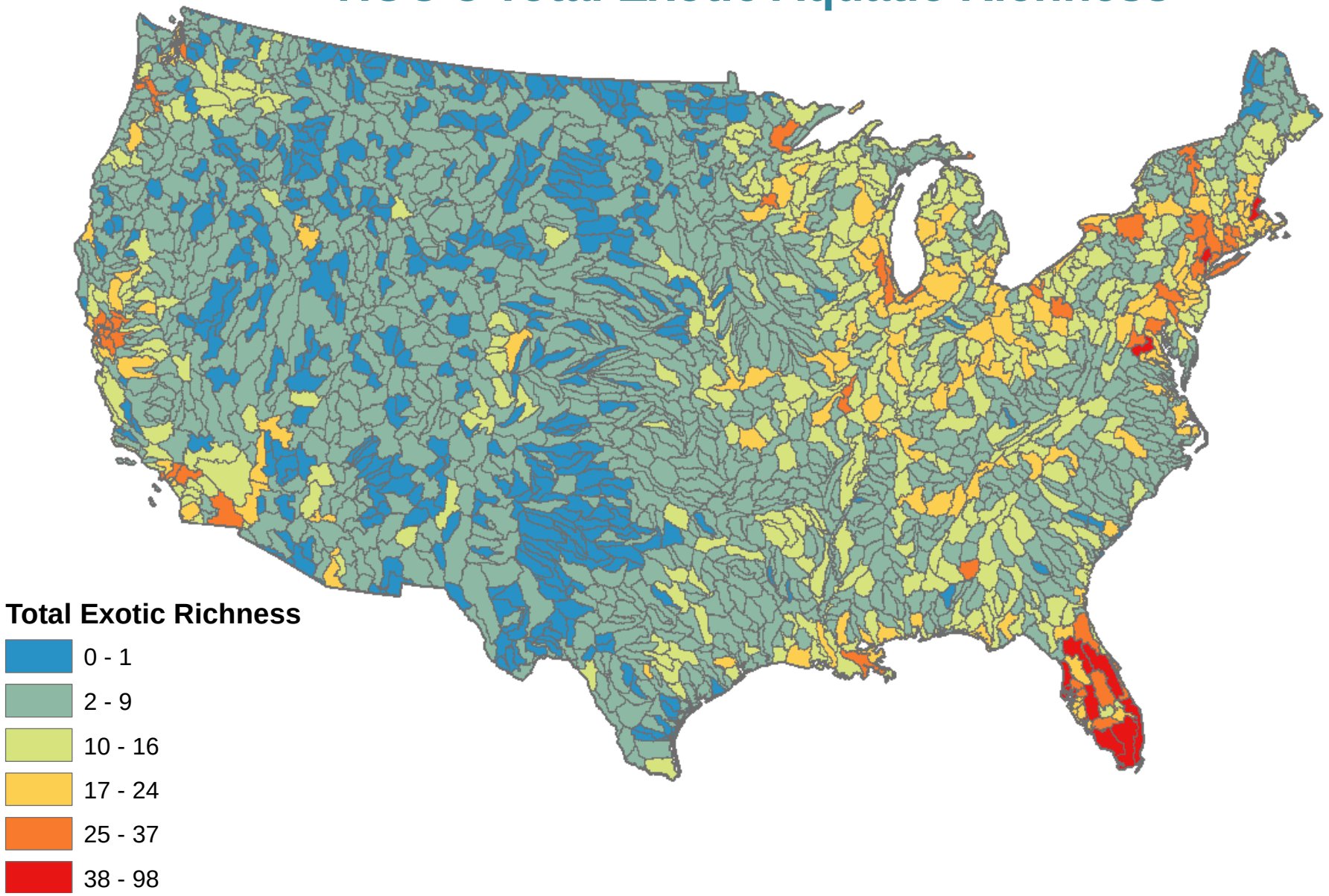
HUC 8 Exotic Animal Richness



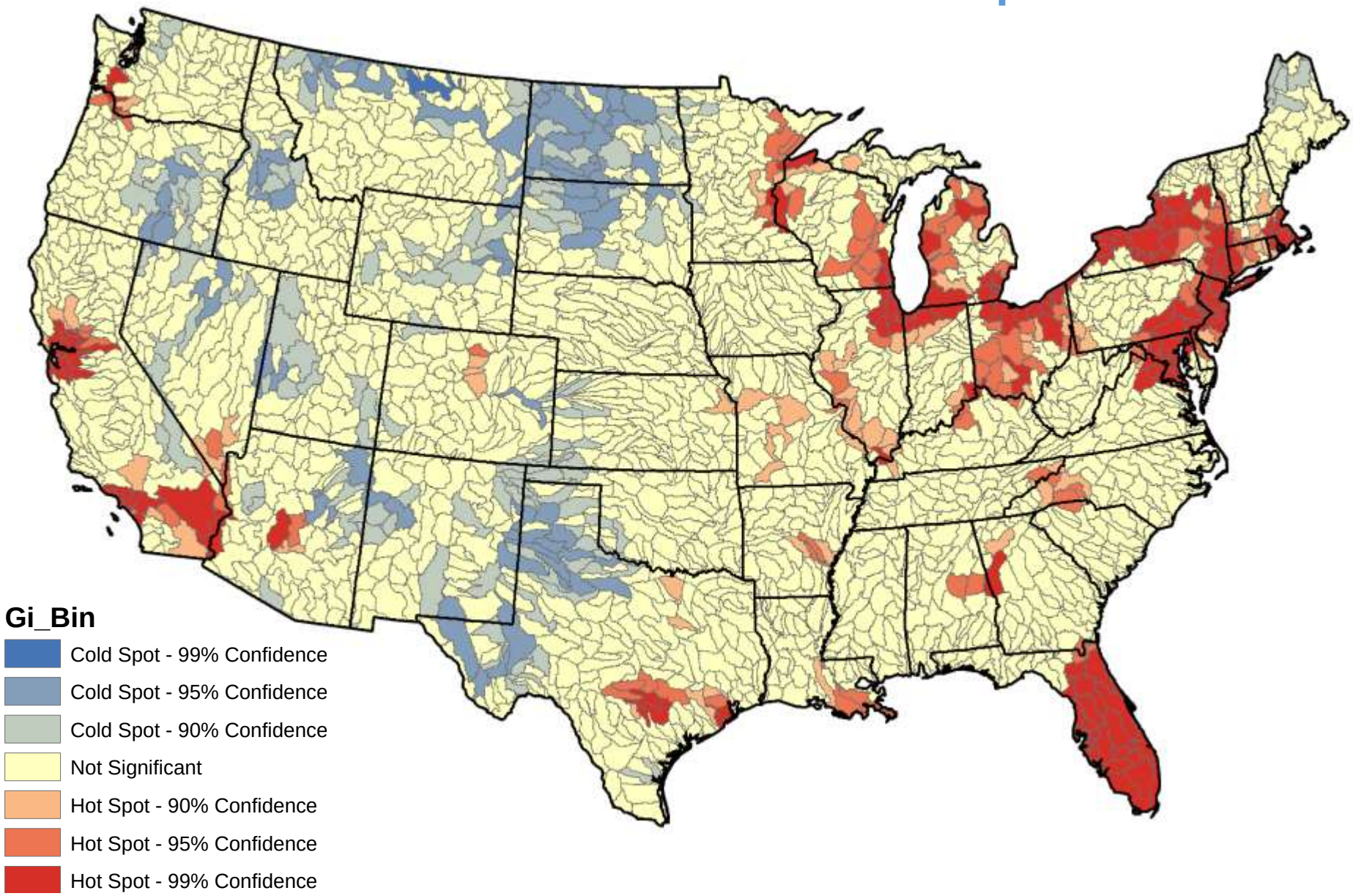
HUC 8 Exotic Aquatic Plant Richness



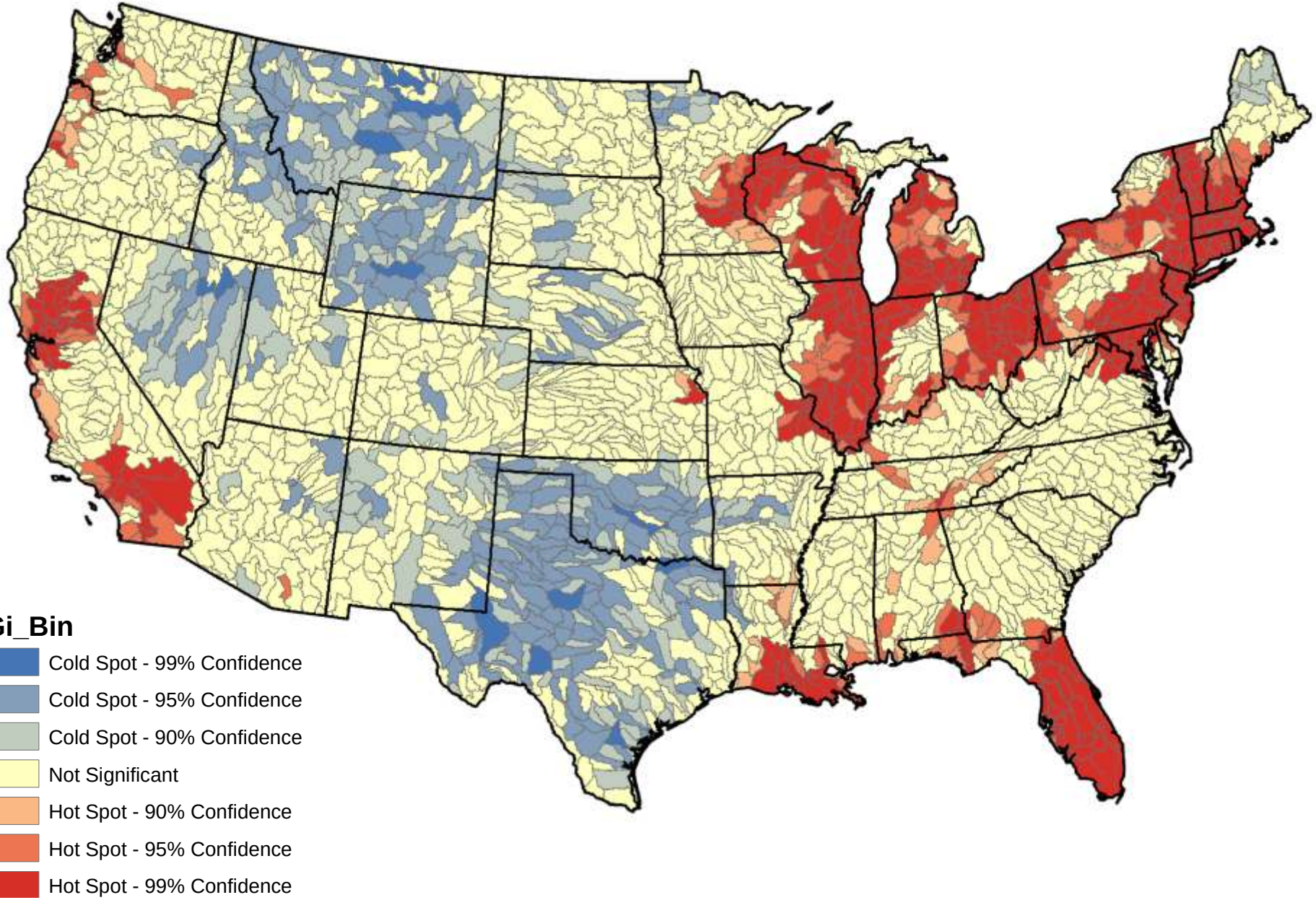
HUC 8 Total Exotic Aquatic Richness



Animal Exotic Richness Hot Spots



Plant Exotic Richness Hot Spots



Objective

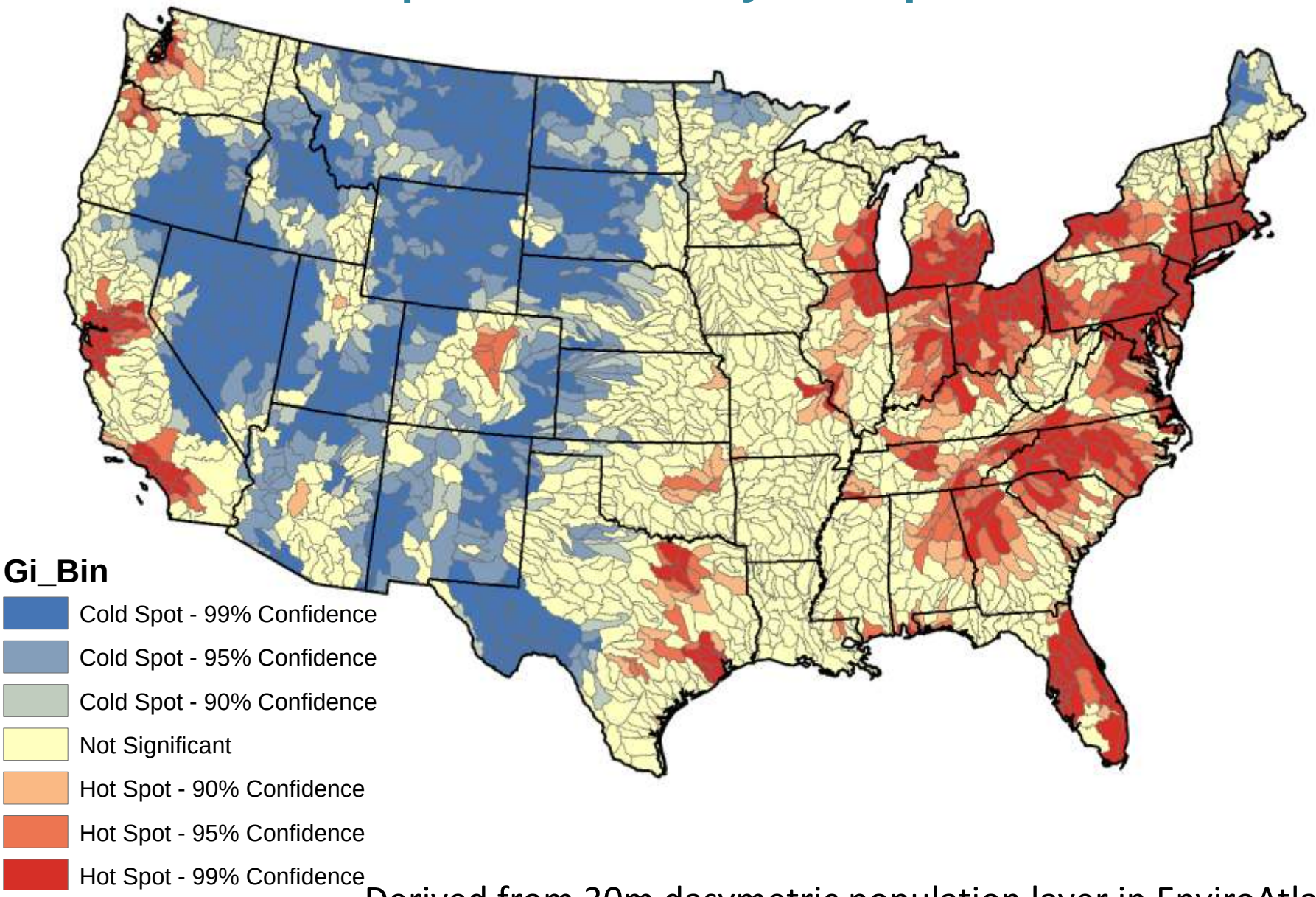
Determine if freshwater fishing demand is a better predictor than population density of aquatic exotic species richness

- Population density: difficult to separate human dispersal effect from observer effect in ad-hoc data

- Freshwater fishing demand is a mechanistic link

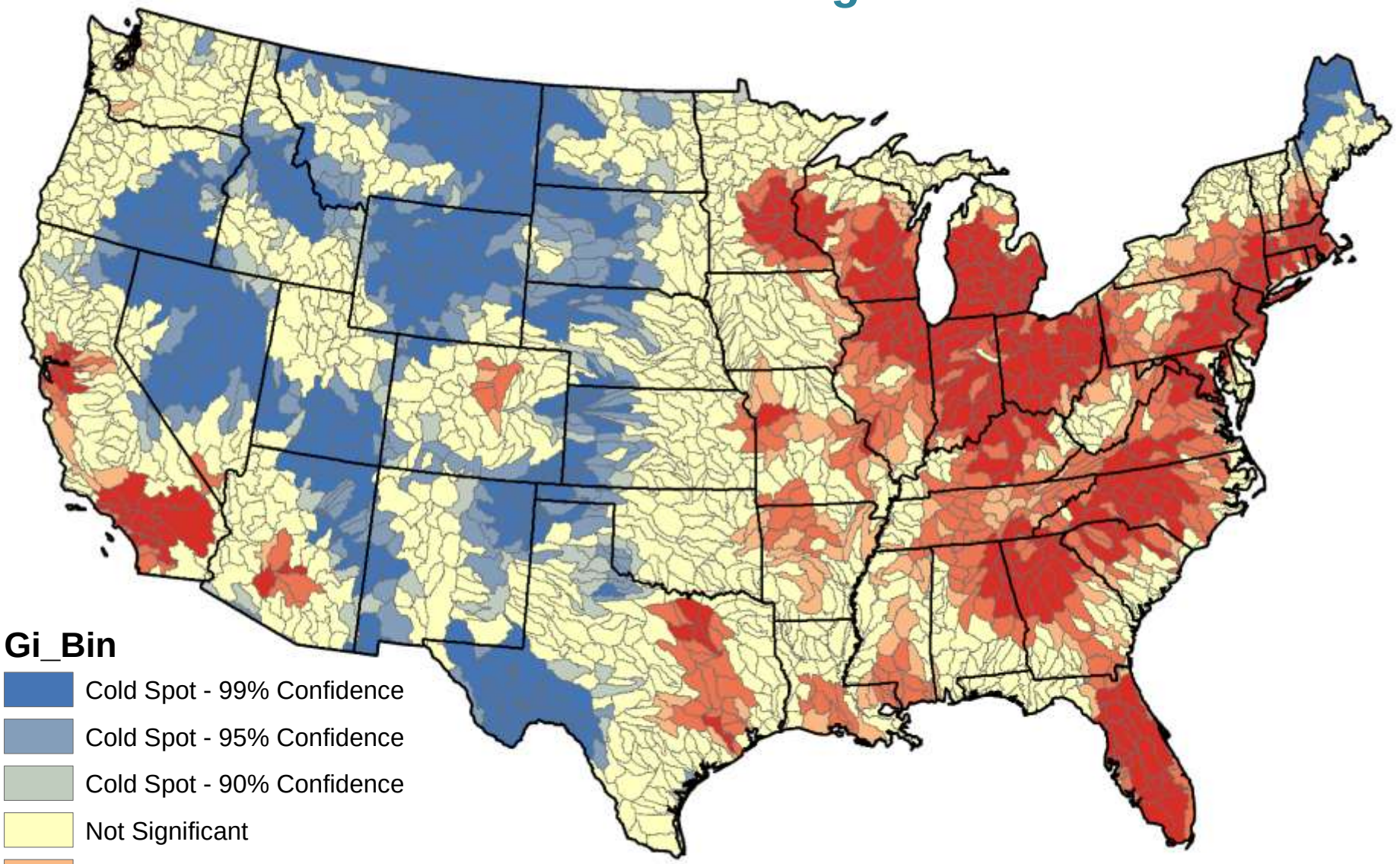
http://www.swl.usace.army.mil/

Population Density Hot Spots



Derived from 30m dasymetric population layer in EnviroAtlas

Freshwater Fishing Demand



Mazzotta et al., 2015 Ecological Economics

Population Bias

- Survey effort and propagule pressure both linked to human population density

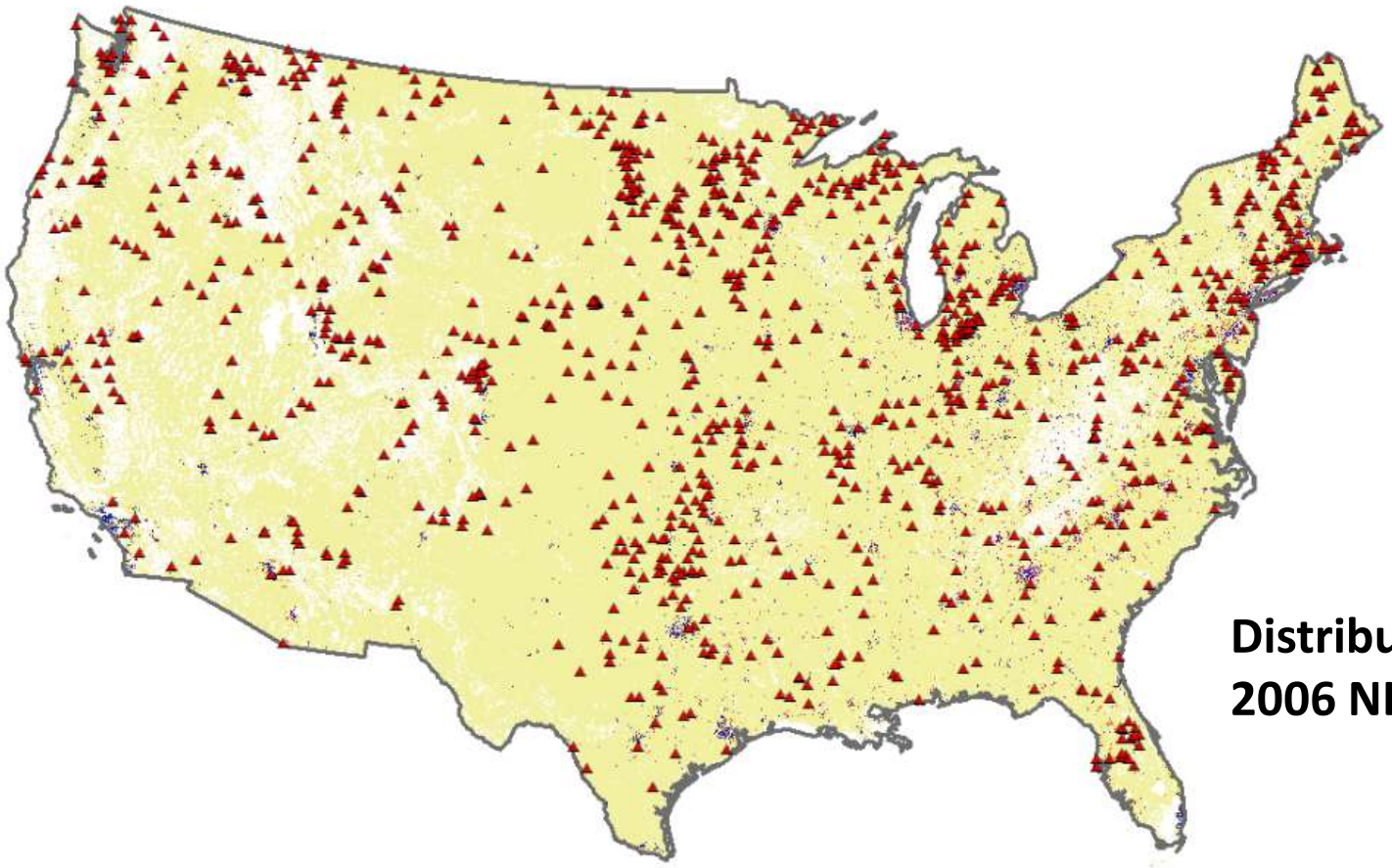
- Our first task is to test for it by comparing BISON observations to data collected from a stratified random survey
    - ➢ Does it vary geographically?
    - ➢ Can we develop a correction ?

Results from Poisson regression comparing effects of std. population and recreational demand on richness

	Freshwater fishing demand		Population density	
Richness	exp(B)	95% CI	exp(B)	95% CI
animal	2.35	[1.95, 2.82]	1.94	[1.81, 2.07]
plant	2.86	[2.34, 3.51]	1.96	[1.81, 2.11]
total	2.55	[2.15, 3.03]	1.95	[1.83, 2.07]

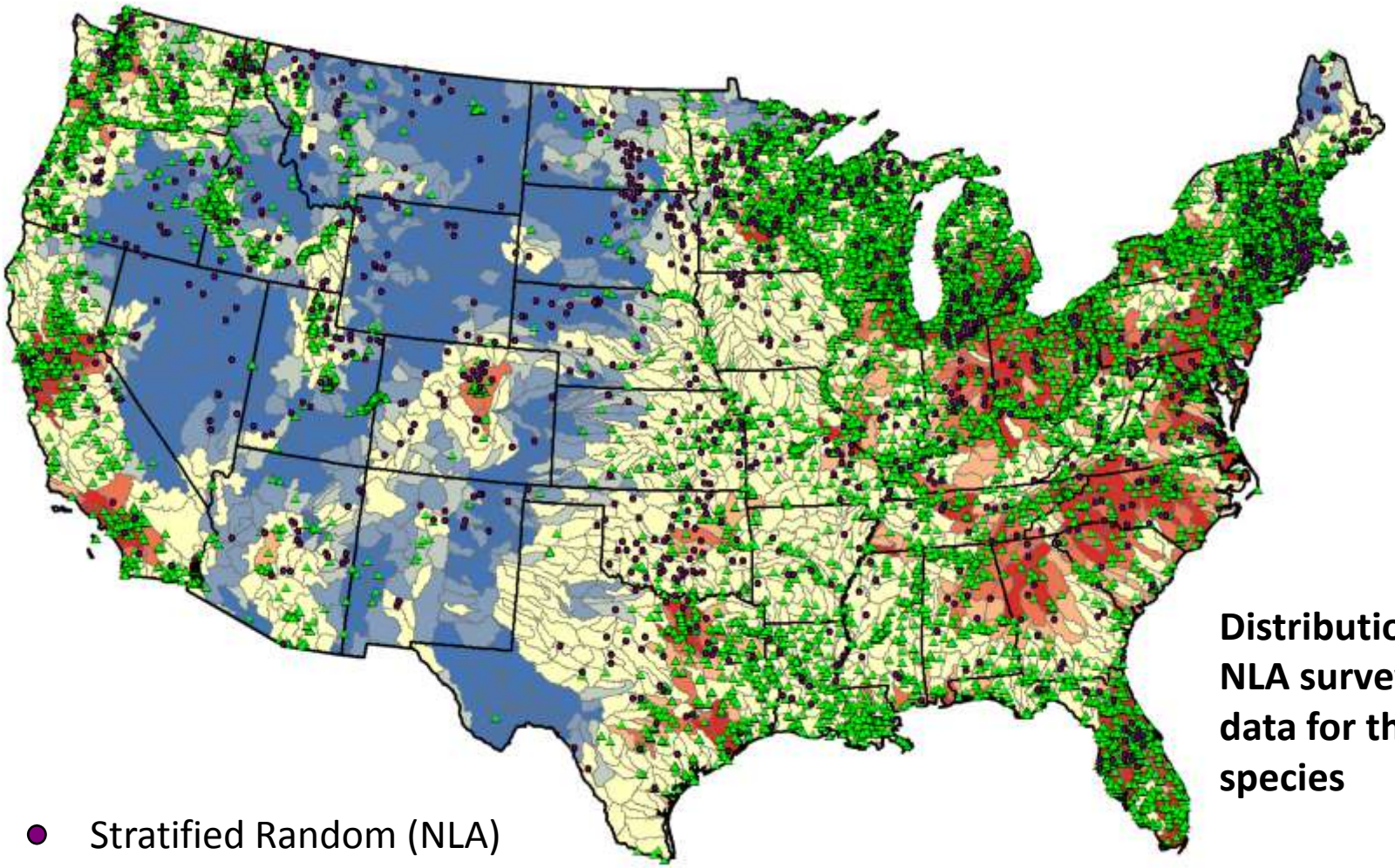
Use spatial mismatches between NLA and BISON data to test for population bias

- If present in NLA and not reported in BISON = mismatch
- If present both NLA and BISON= match



Distribution of 2006 NLA survey

Are the spatial matches/mismatches influenced by population?



Distribution of 2006 NLA survey and BISON data for the same species

- Stratified Random (NLA)
- # Ad-hoc (BISON)

Points overlaid on map of population density by HUC 8

Summary

- Freshwater fishing demand has a larger effect on exotic aquatic species richness

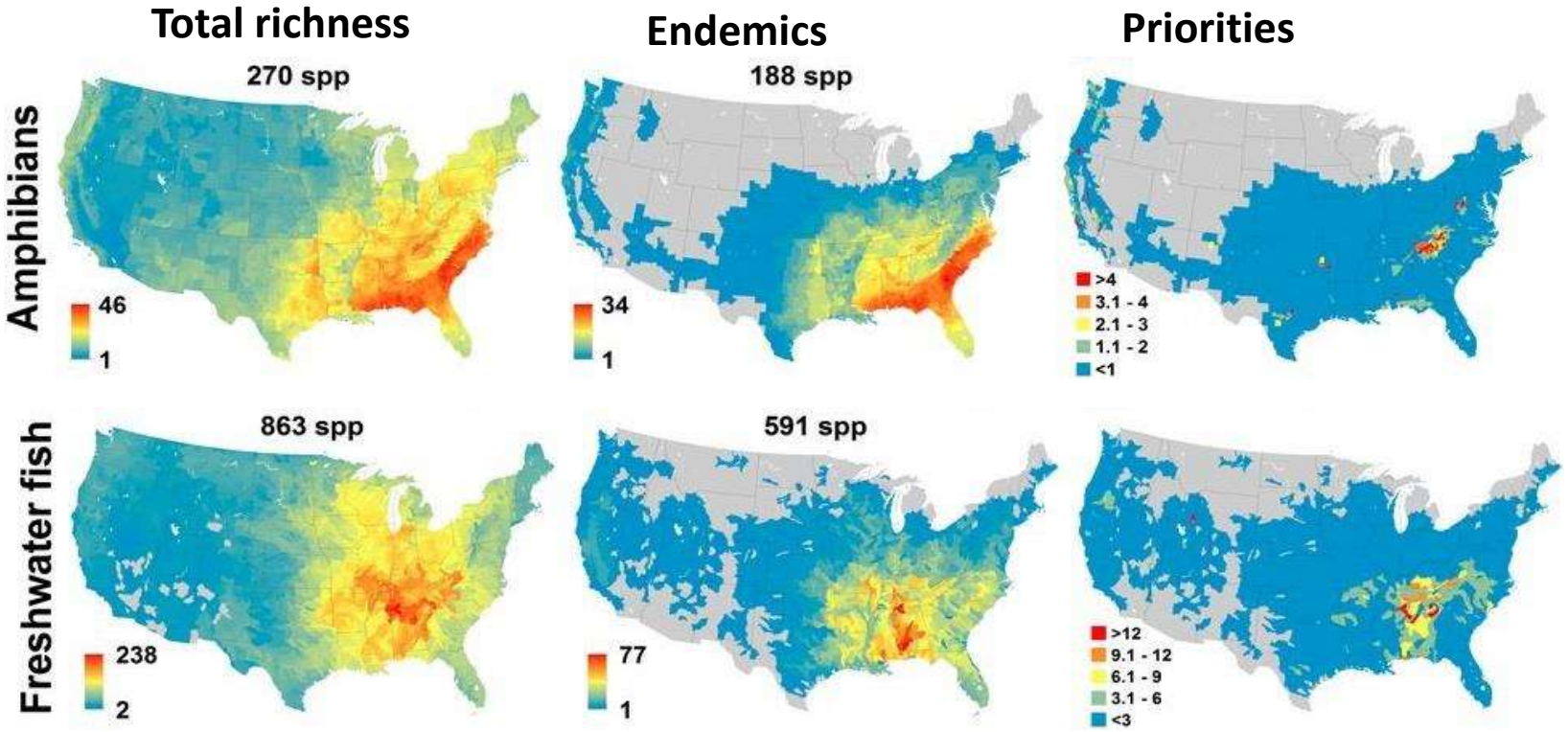
- Assessment of population bias is possible
  - we'll gain understanding of how much of a problem it is with ad-hoc and/or citizen science data sets

Thank You!

Please send questions/comments to:

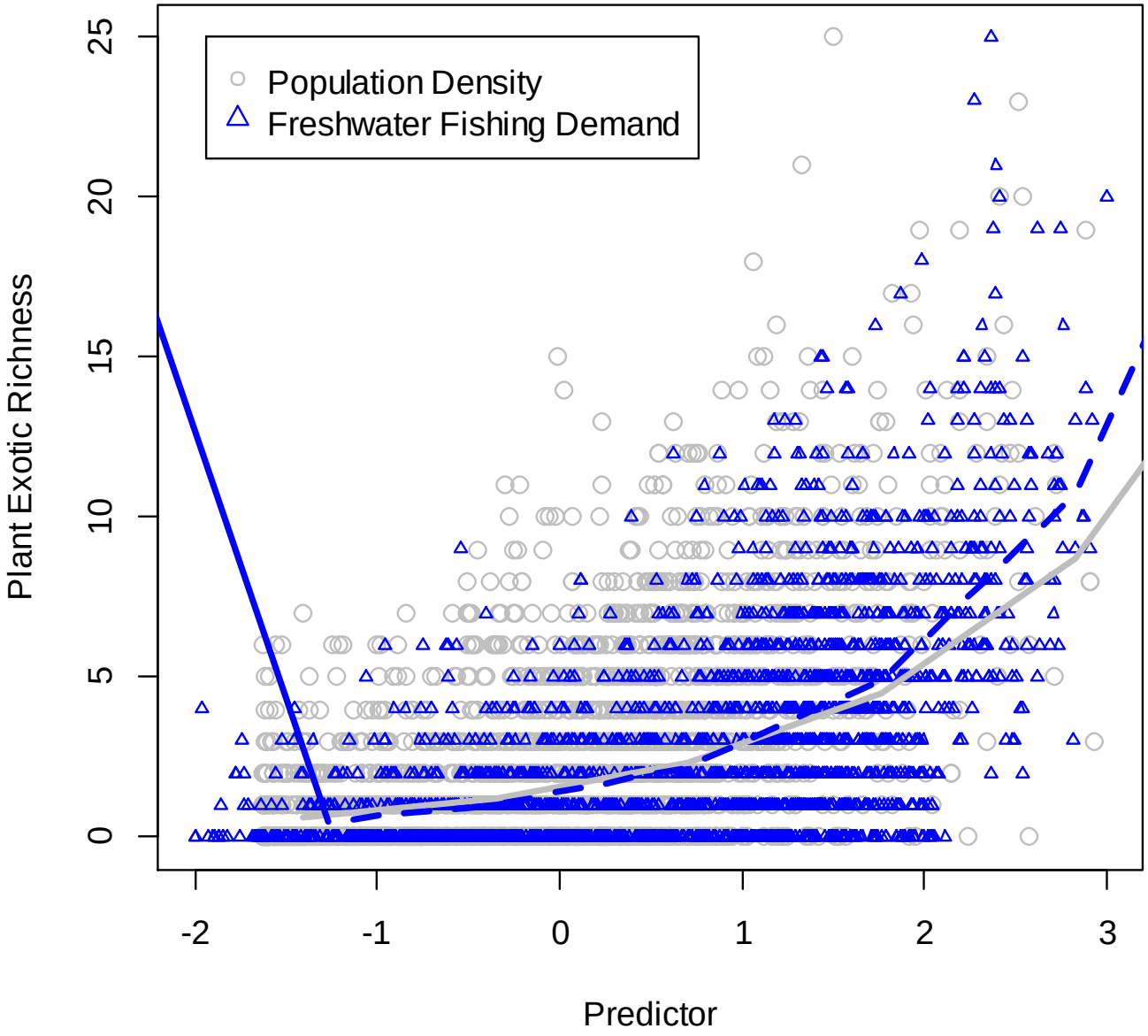
Davis.Amy@epa.gov

- Now we can investigate the drivers of aquatic species invasions and their impacts and how they vary geographically across the U.S.
- Assess threats to endemic species, protected areas, threatened & endangered species



Biodiversity of the lower continental United States and priority areas for individual taxa.

Clinton N. Jenkins et al. PNAS 2015;112:5081-5086


Population Density
Freshwater Fishing Demand
Plant Exotic Richness
0
5
10
15
20
25
-2
-1
0
1
2
3
Predictor