

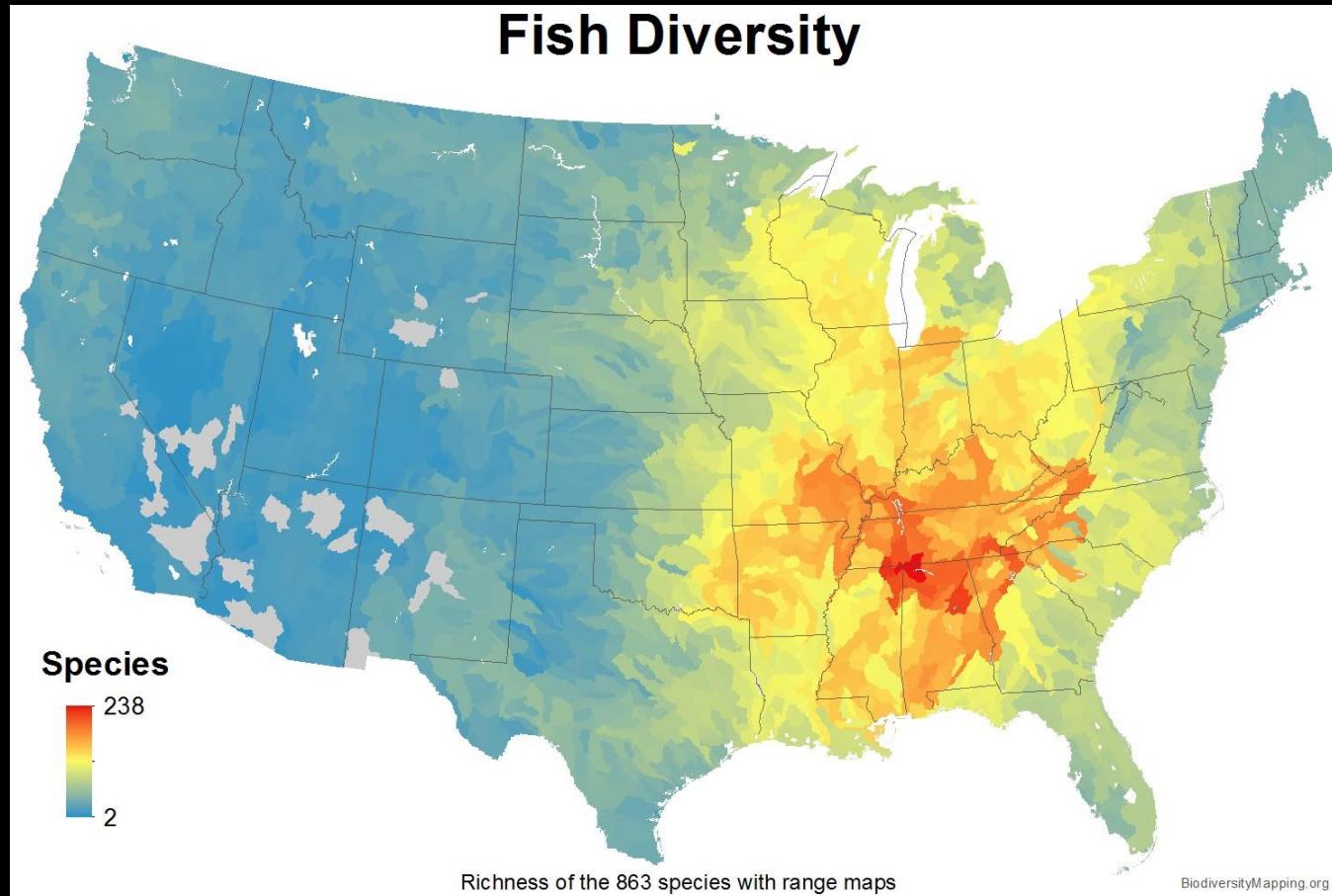
# The Southeast Aquatic Conservation Strategy

Duncan Elkins<sup>1</sup>, Sarah Sweat<sup>2</sup>, Katie Hill<sup>1</sup>, Bernie Kuhajda<sup>2</sup>, Anna George<sup>2</sup>, and Seth Wenger<sup>1</sup>

<sup>1</sup>River Basin Center, University of Georgia, Athens, GA

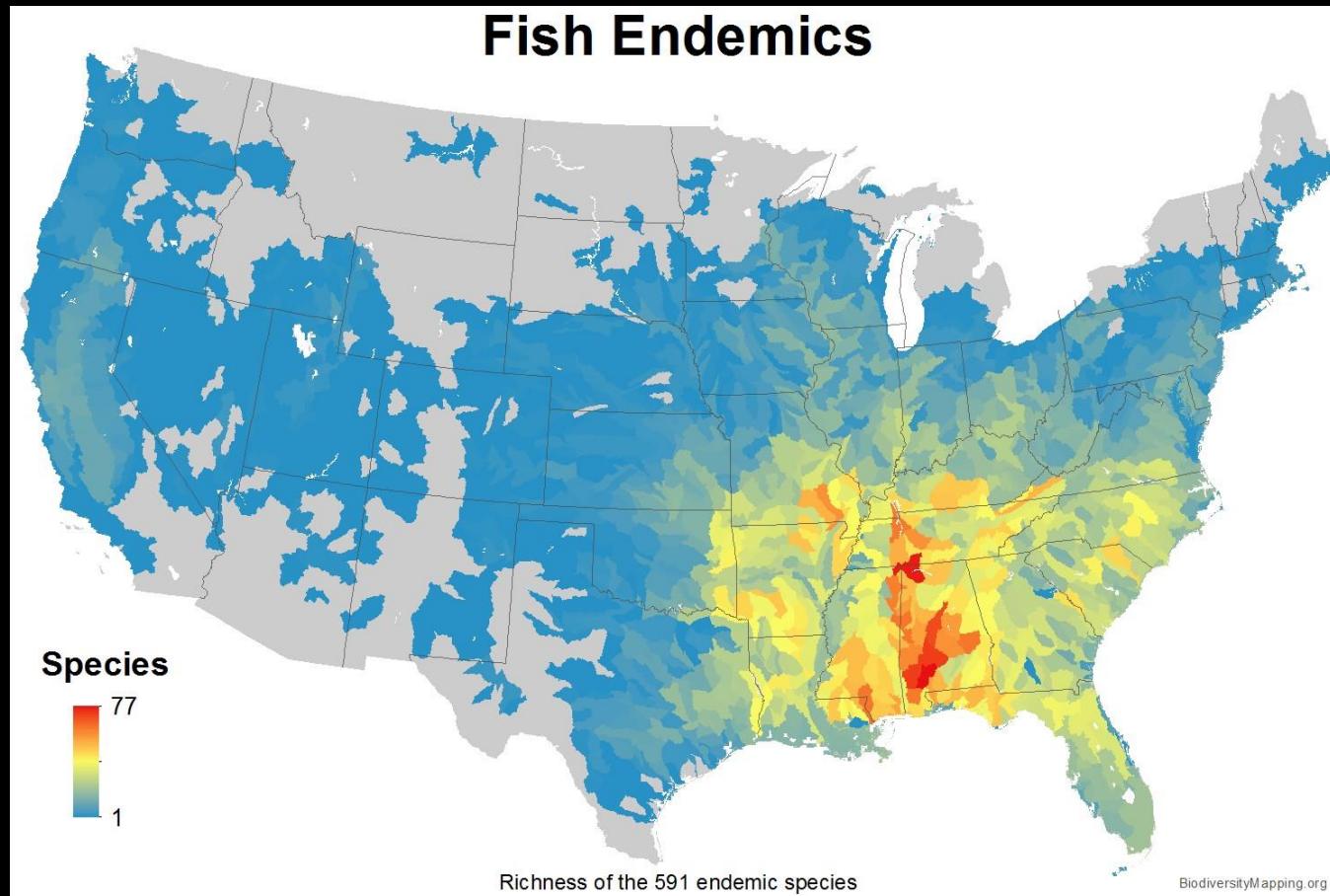
<sup>2</sup>Tennessee Aquarium Conservation Institute, Chattanooga, TN

# Context



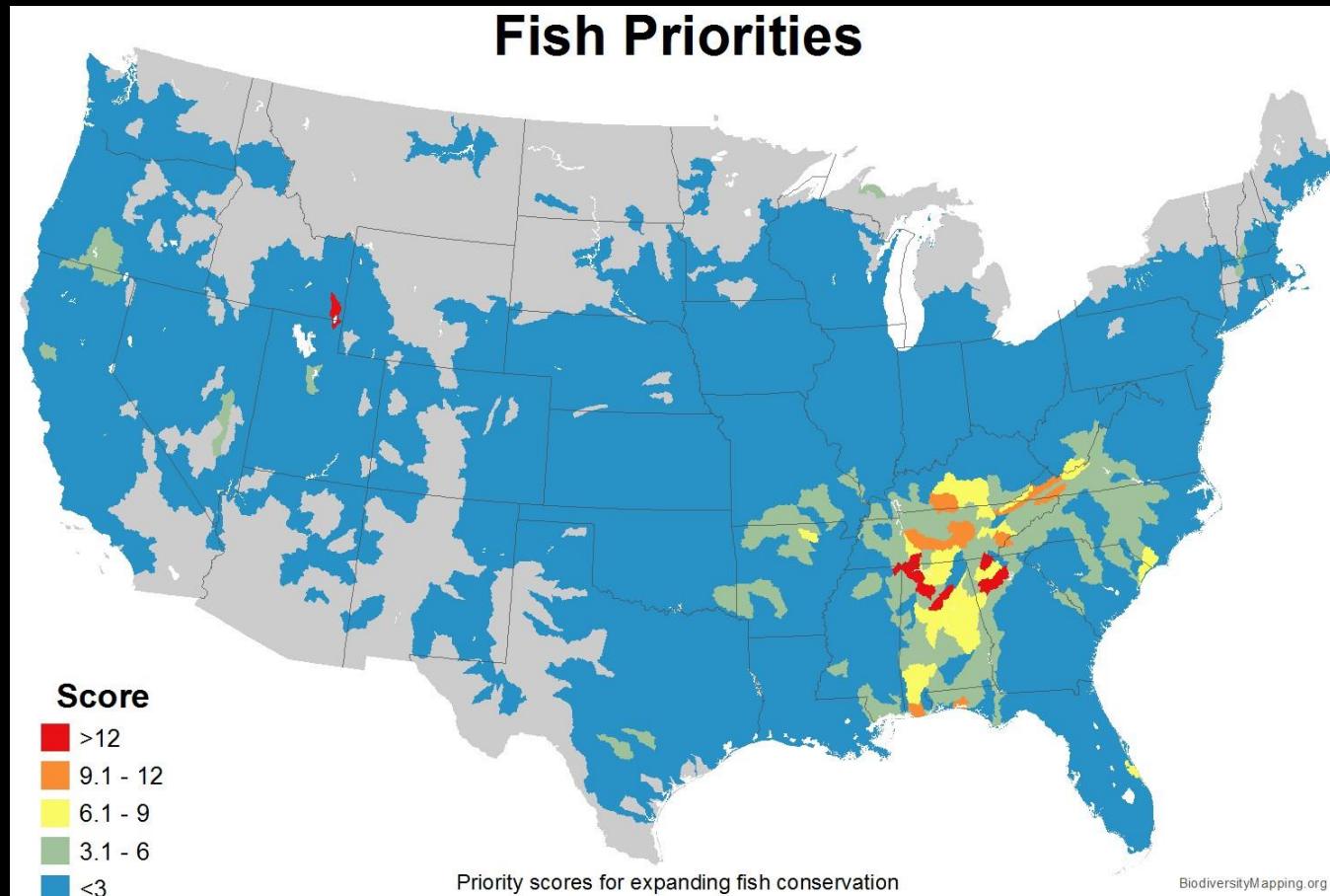
Jenkins, et al., 2015 PNAS

# Context



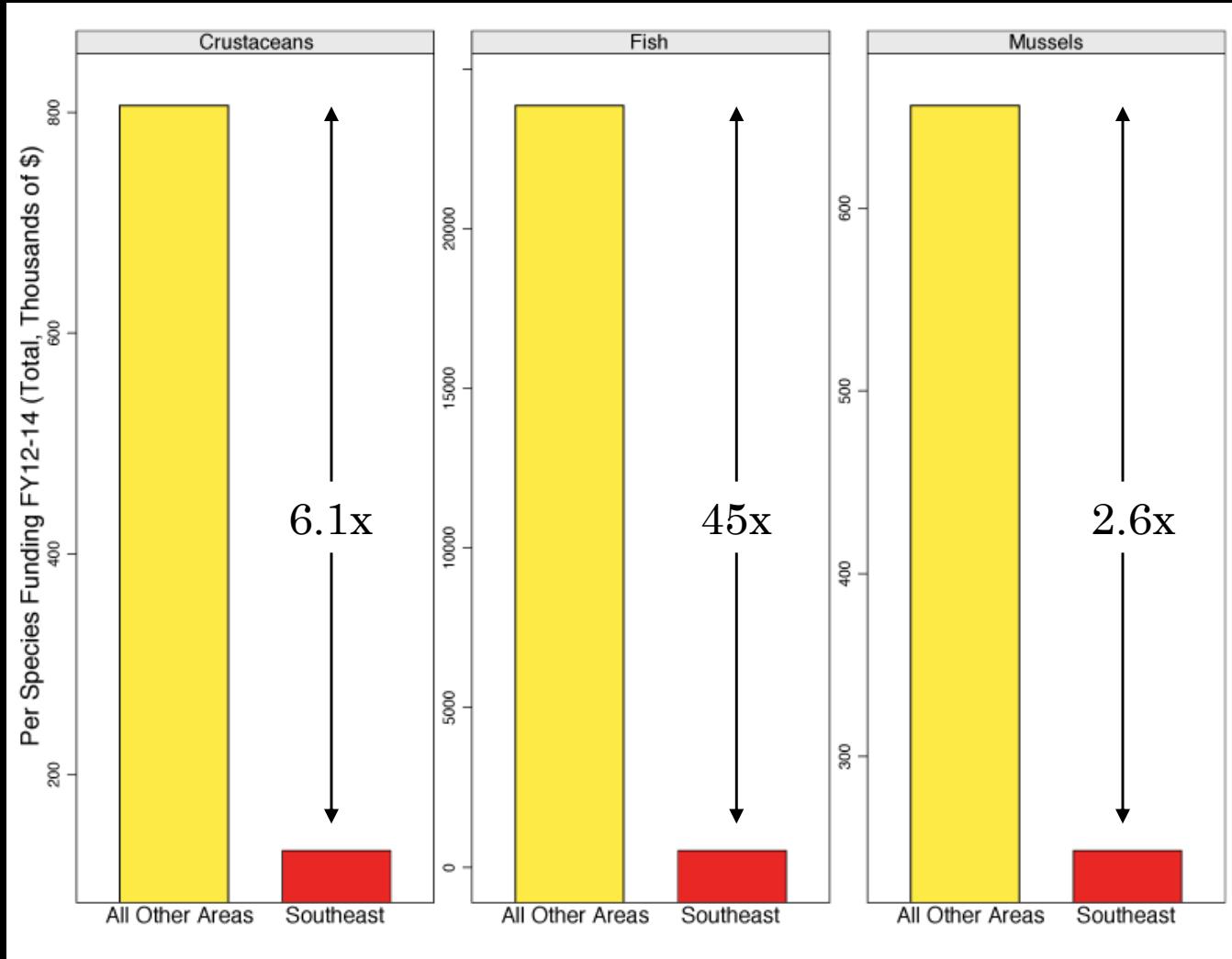
Jenkins, et al., 2015 PNAS

# Context



Jenkins, et al., 2015 PNAS

# Context (Sobering)



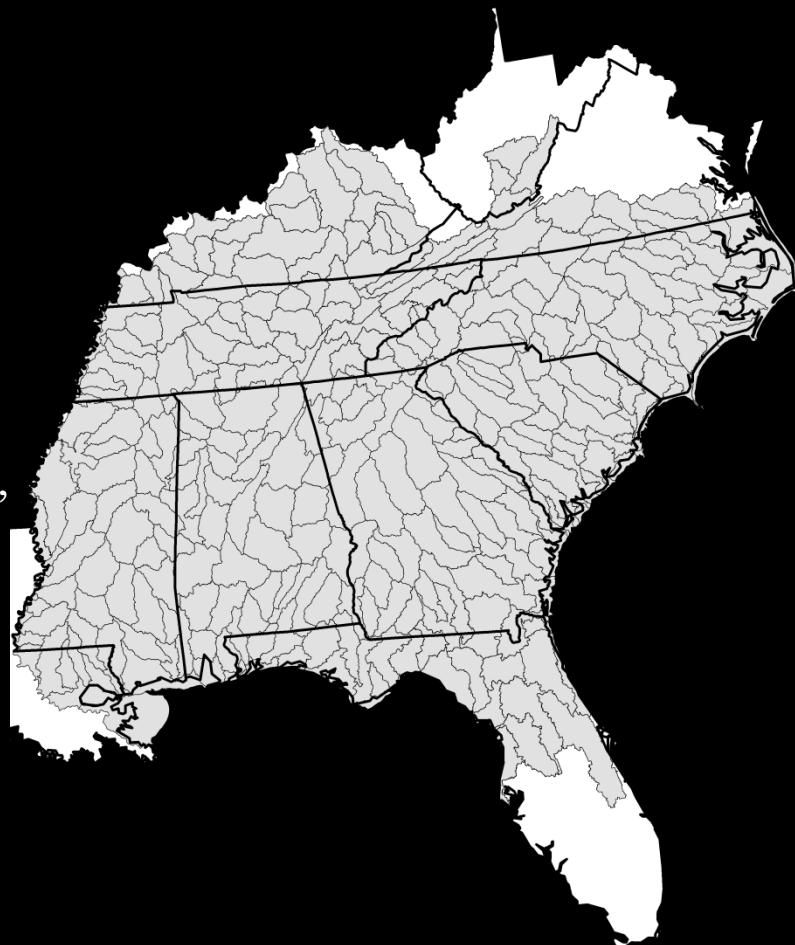
# Goals

- Identify areas high biodiversity and unique fauna within the Southeast
- Use this data for prioritization of conservation and future funding opportunities



# Study Area: “The Southeast”

- HUC8s as analysis unit
- Boundaries based on fish biogeography
- 290 HUC 8 Study area to encompass the southeastern biodiversity of fishes, crayfishes, and mussels



# Why not just use the SWAPs?

Must reconcile states' decisions about appropriate scale of conservation planning

For example:

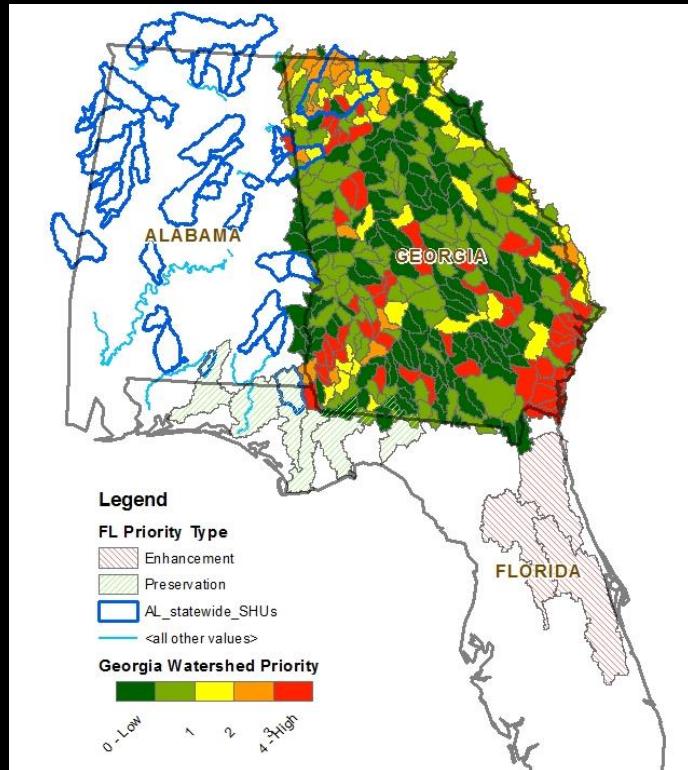
Alabama: SHUs & SRUs

(HUC8s and smaller, River segments)

Florida: Priority Basins (Preservation vs Enhancement)

Georgia: HUC10, priority scores

Also S1/G5 inflation



# Plan for the Plan

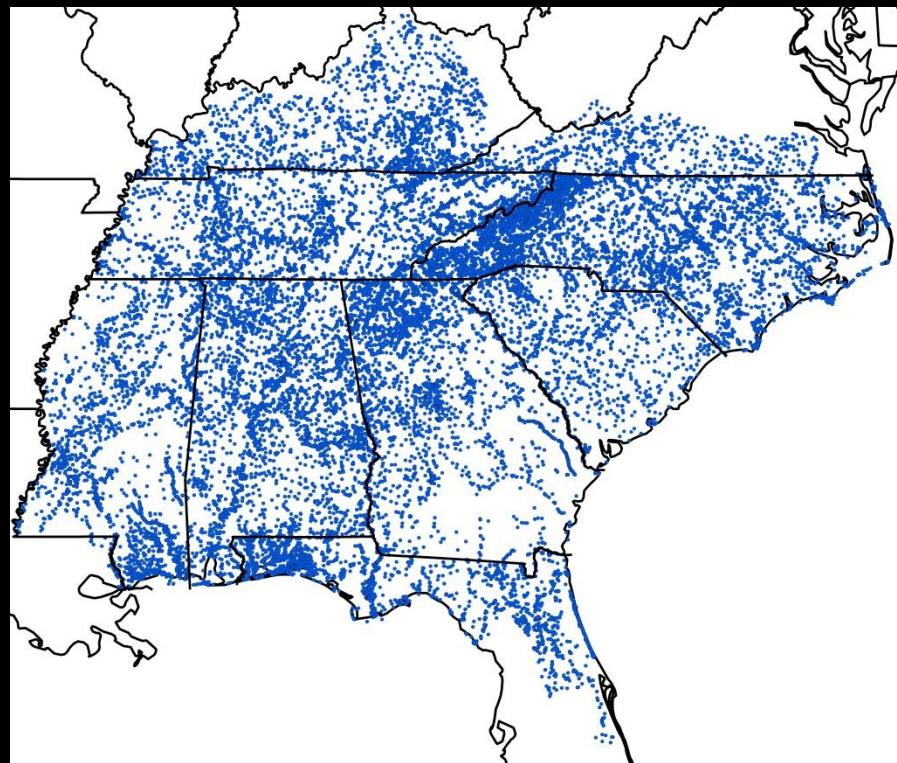
- Backstop the selection of priority areas with whatever layers of aquatic biodiversity we could assemble with sufficient uniformity at regional scale.

# General Procedure

- Obtain point/polygon data of species occurrence
- Aggregate to HUC-8 level
- Generate range maps for each species
- Check range maps
- Calculate richness, endemism, imperilment

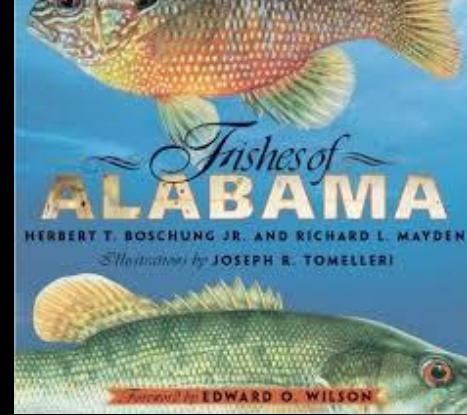
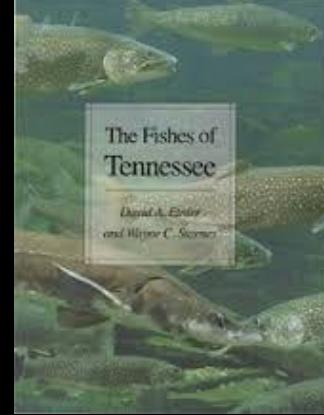
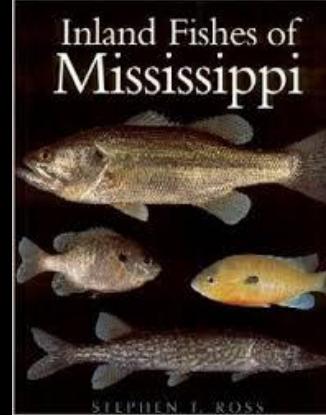
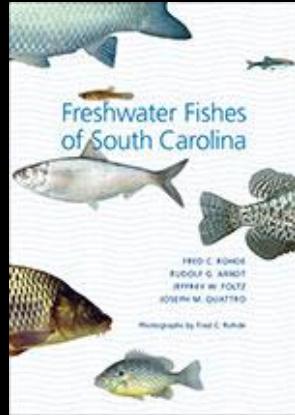
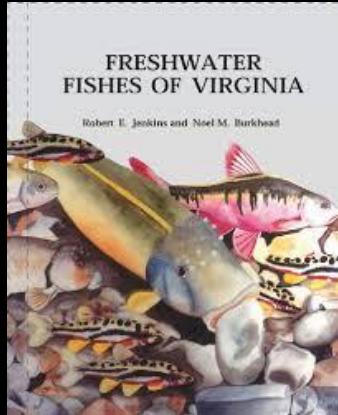
# A (half-) million points of fish

- Primarily from fish databases (MARIS, GBIF, FishNet2)
- ~500,000 records

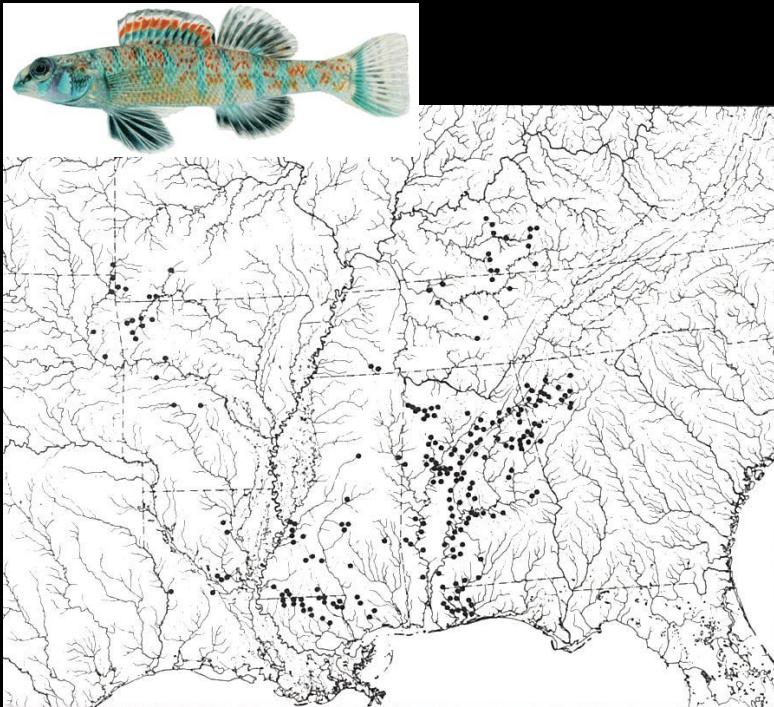


# Vetting Fish Data

- Fish ranges checked against published “Fishes of . . .” books or online atlases for each state (AL, FL, GA, KY, MS, NC, SC, TN, VA, WV)
- Only native ranges of fishes were delineated
- Deleted non-native distributions



# New Taxonomy



Five New Fish Species from Rivers of the United States of America  
Named in Honor of US Presidents and Vice President



*Etheostoma teddyroosevelt*  
Highland Darter



*Etheostoma jimmycarter*  
Bluegrass Darter



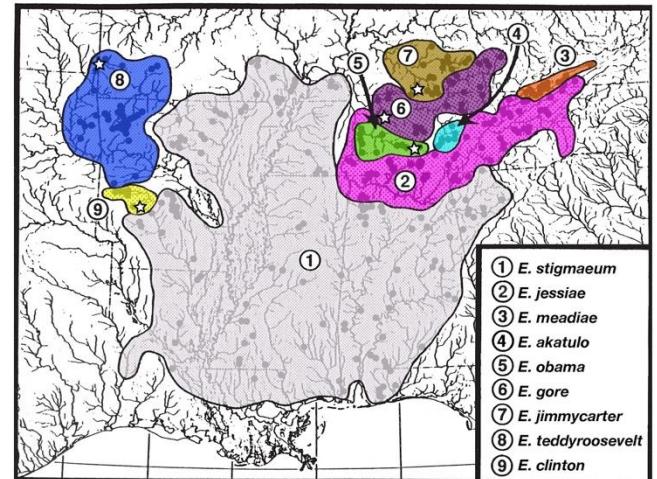
*Etheostoma clinton*  
Beaded Darter



*Etheostoma gore*  
Cumberland Darter



*Etheostoma obama*  
Spangled Darter



# Crayfish Data Sources

- Records from regional astacologists & museums, some state polygons

Susie Adams, USFS

Tyler Black, NCWRC

Chris Skelton, HNTB Corp

Arnie Eversole, Clemson

David Withers, TDEC

Guenter Schuster, GSA

Chris Taylor, INHS

Carl Williams, TWRA

Roger Thoma, Midwest Biodiversity Institute

Bronwyn Williams, NCMNS

Geological Survey of Alabama

Zach Loughman, West Liberty

Jeff Simmons, TVA

Illinois NHS

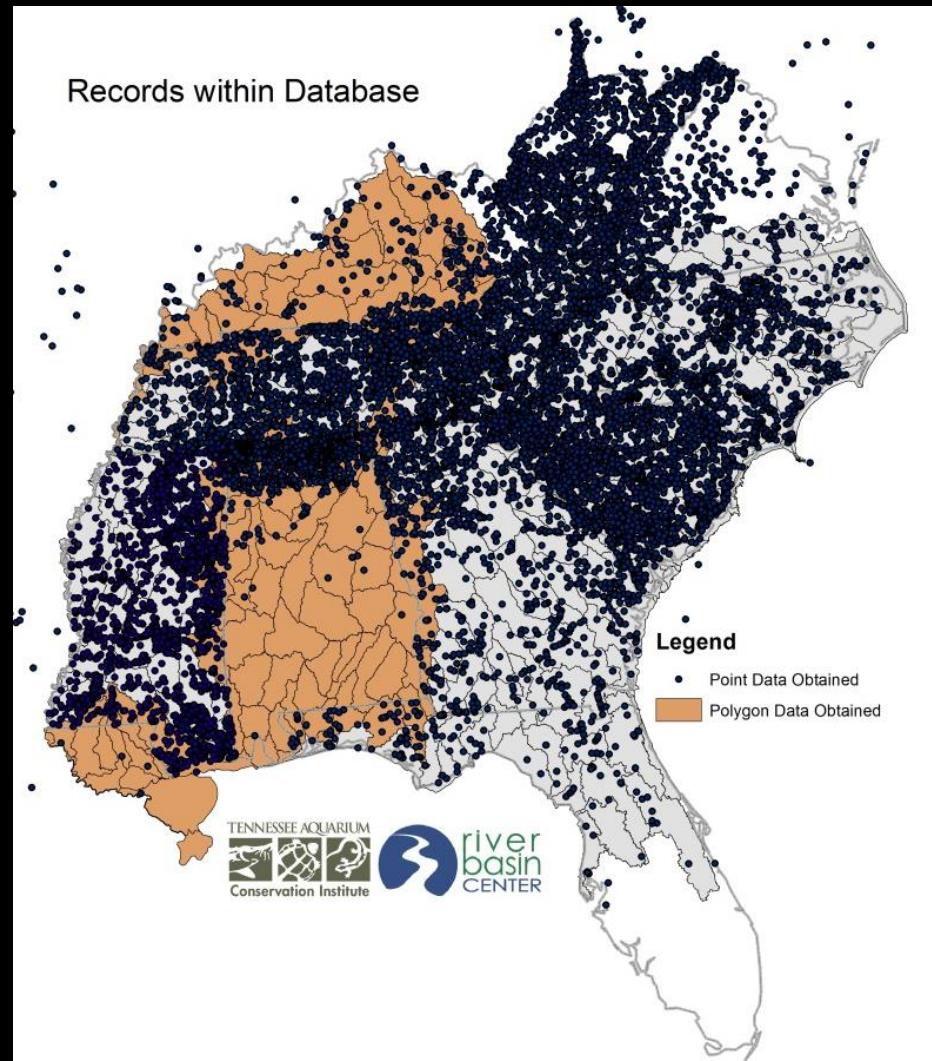
Kentucky DFWR

Smithsonian NMNH

GBIF

# Crayfish sampling: surprisingly good!

- ~41,000 points
- High confidence



# Crayfish data vetting

- Crayfish summit meeting
- Edit data
- Assign endemism
- Focus on stream species
- Secondary and Tertiary burrowers
- Records from 221 species

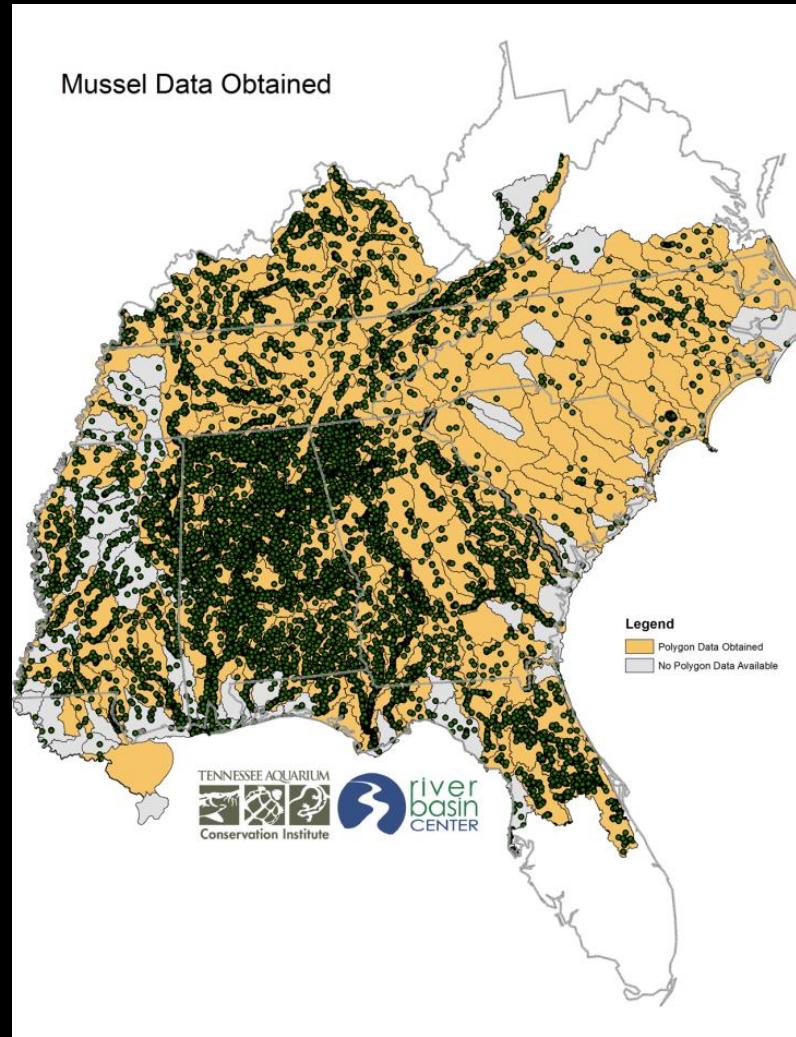


# Mussel Data Sources

- Queried museums, state collections, authors
- Jeff Garner, AL DCNR
- Stuart McGregor, GSA
- Jason Wisniewski, GA DNR
- Bob Jones, MS Museum of Natural Sciences
- Art Bogan, NC Museum of Natural Sciences
- Ohio State University Museum of Biological Diversity
- Jim Williams, Florida Museum of Natural History
- Kentucky DFWR

# Mussel sample distribution

- ~185,000 records



# Mussel Data Vetting

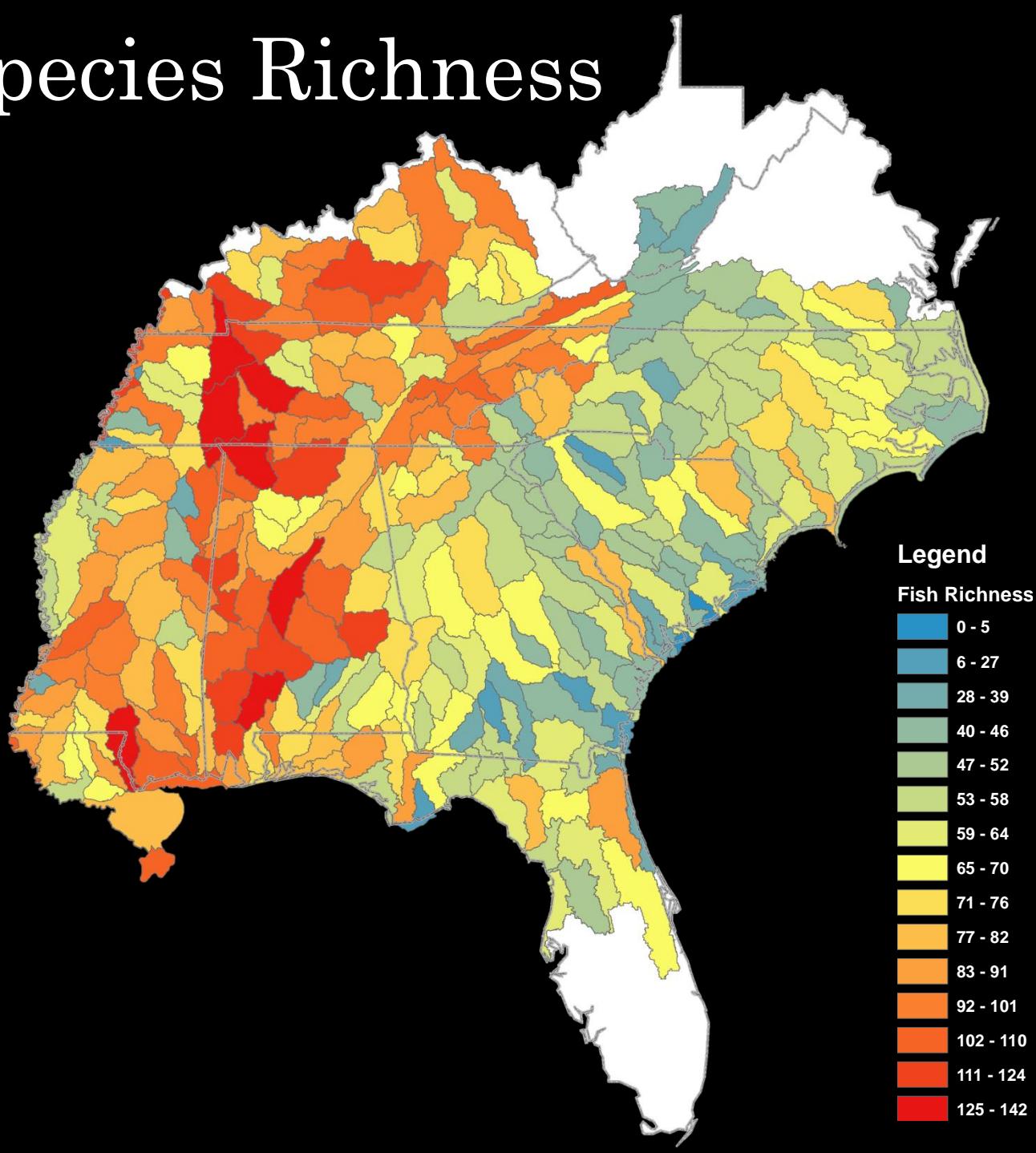
238 maps subset by state (roughly), vetted via email

- Jason Wisniewski, GADNR
- Bob Jones, MS Museum of Natural Sciences
- Art Bogan, NC Museum of Natural Sciences
- Jim Williams, FL Museum of Natural History
- Bob Butler, USFWS
- Wendell Haag, USFS
- Jess Jones, VADFWC
- Don Hubbs, TWRA

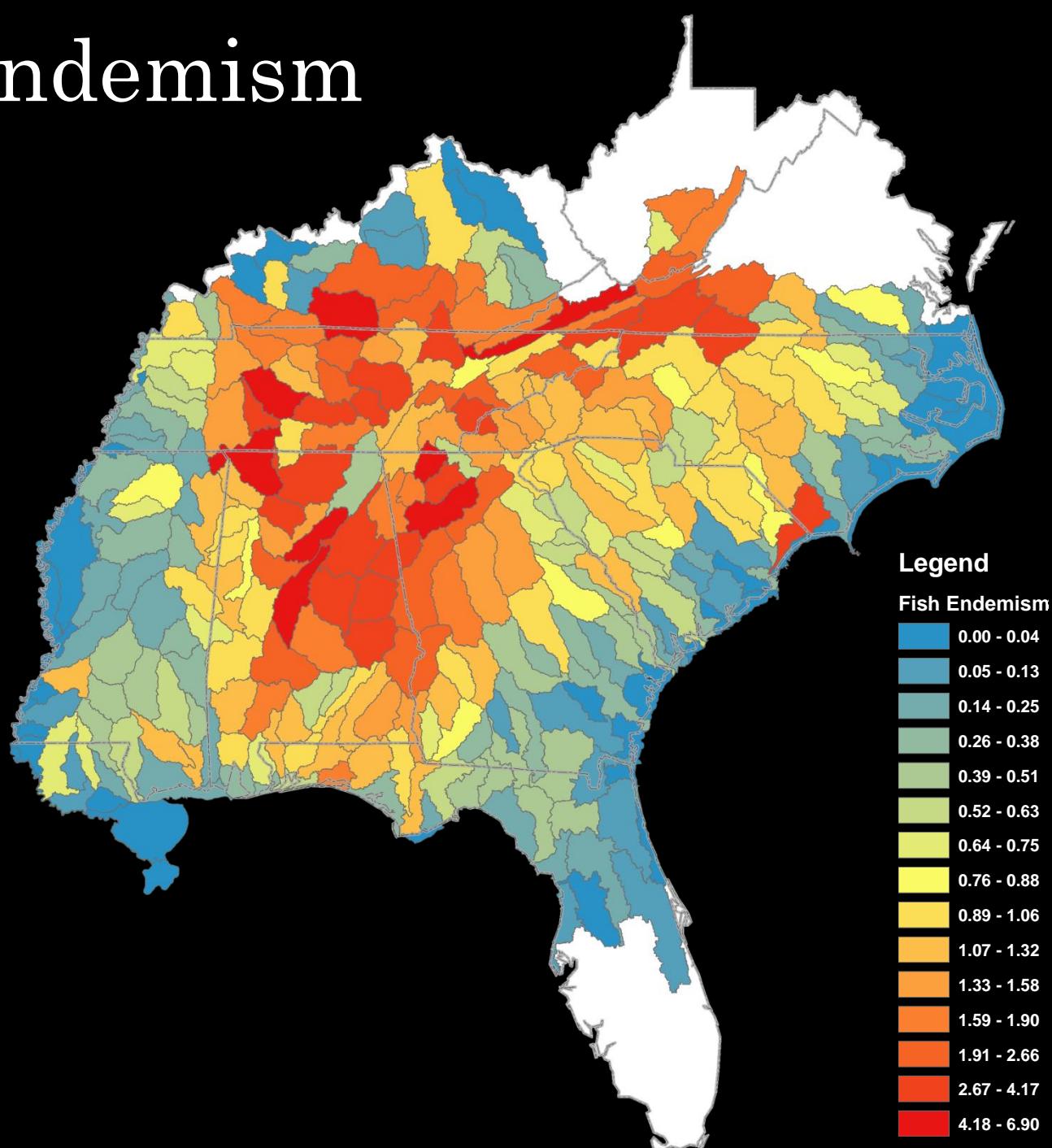
# Scoring the Hucs

- Richness: Sum of species with records in HUC
- Endemism:
  - Only species with range entirely within project area
  - Sum the number of HUCs in which each species appears
  - Divide the 1s in the presence/absence matrix by HUCs in range
  - Sum within HUCs, as with richness
- Imperilment:
  - Using most recent literature and professional societies' imperilment lists
  - Weights: 3 points for each endangered, 2 points for threatened, 1 for vulnerable
  - Sum within HUCs, as with richness

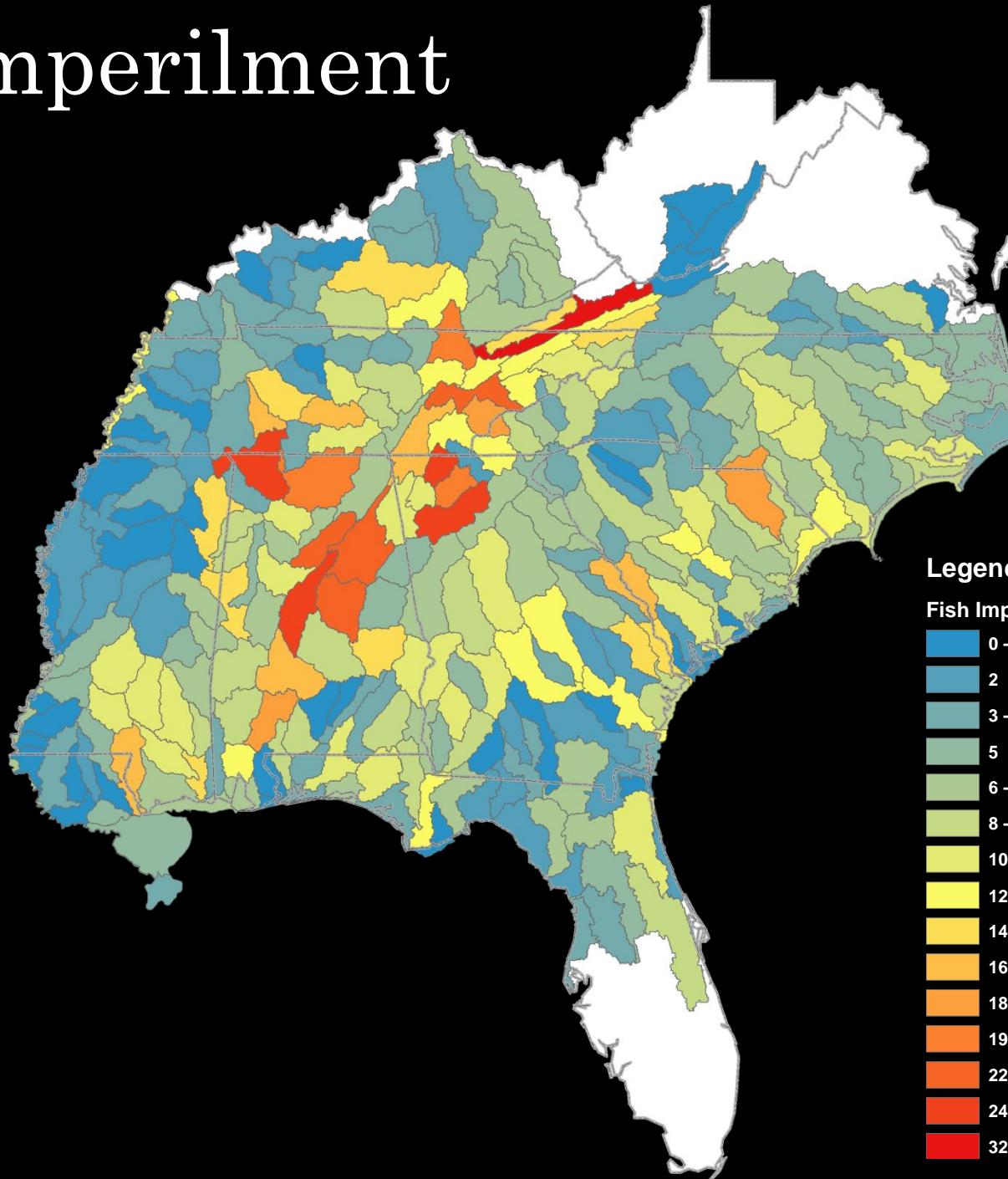
# Fish Species Richness



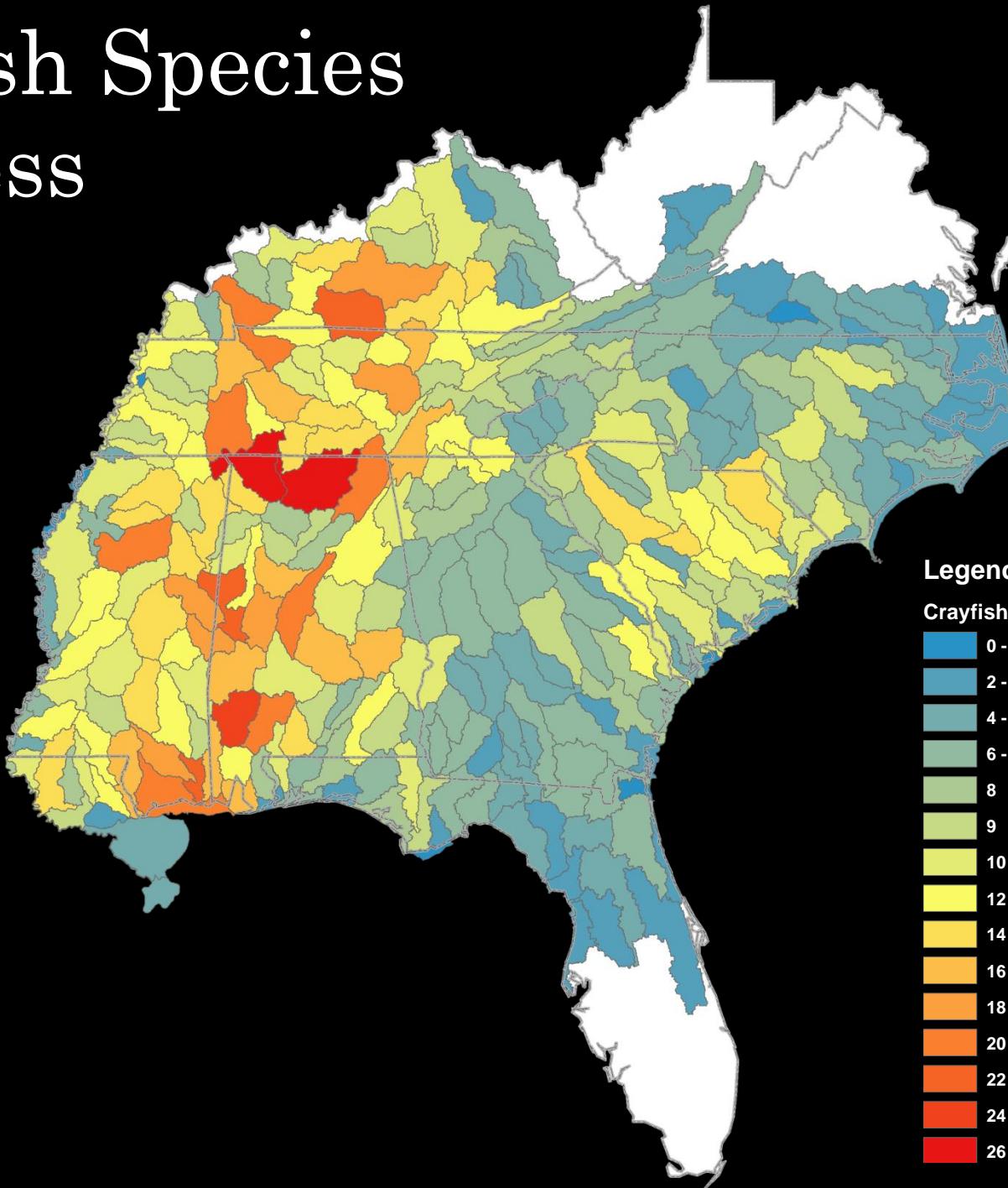
# Fish Endemism



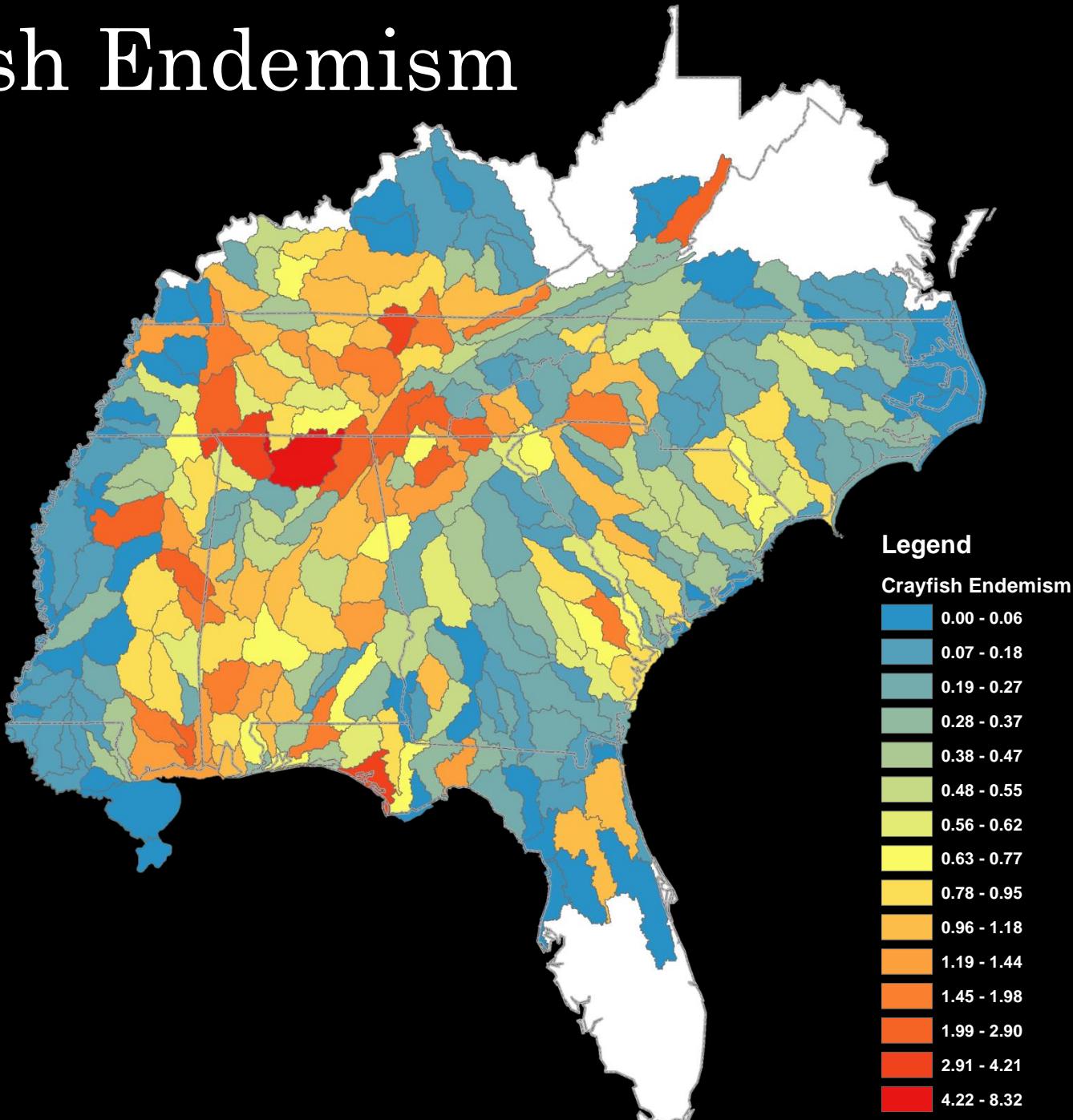
# Fish Imperilment

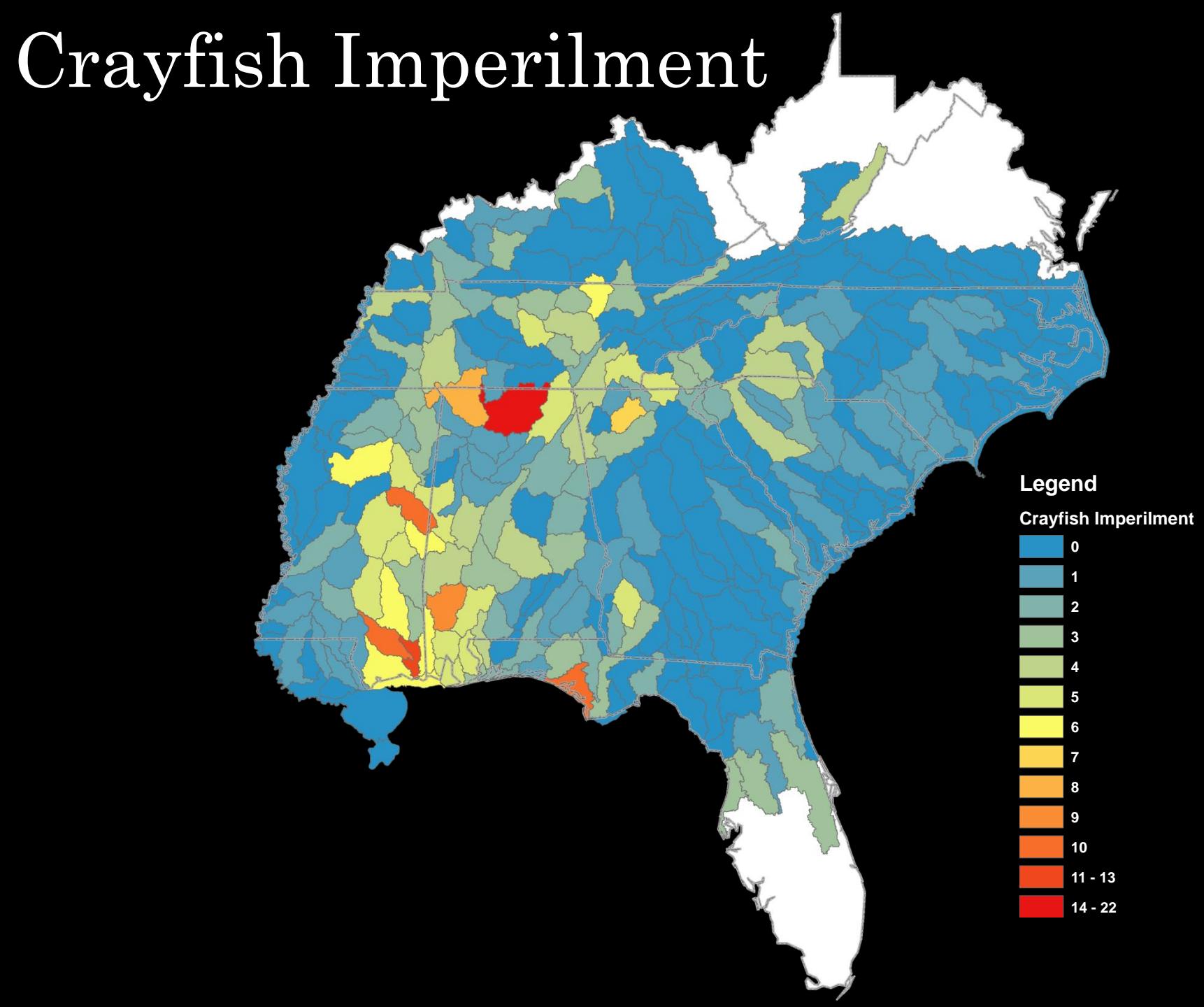


# Crayfish Species Richness

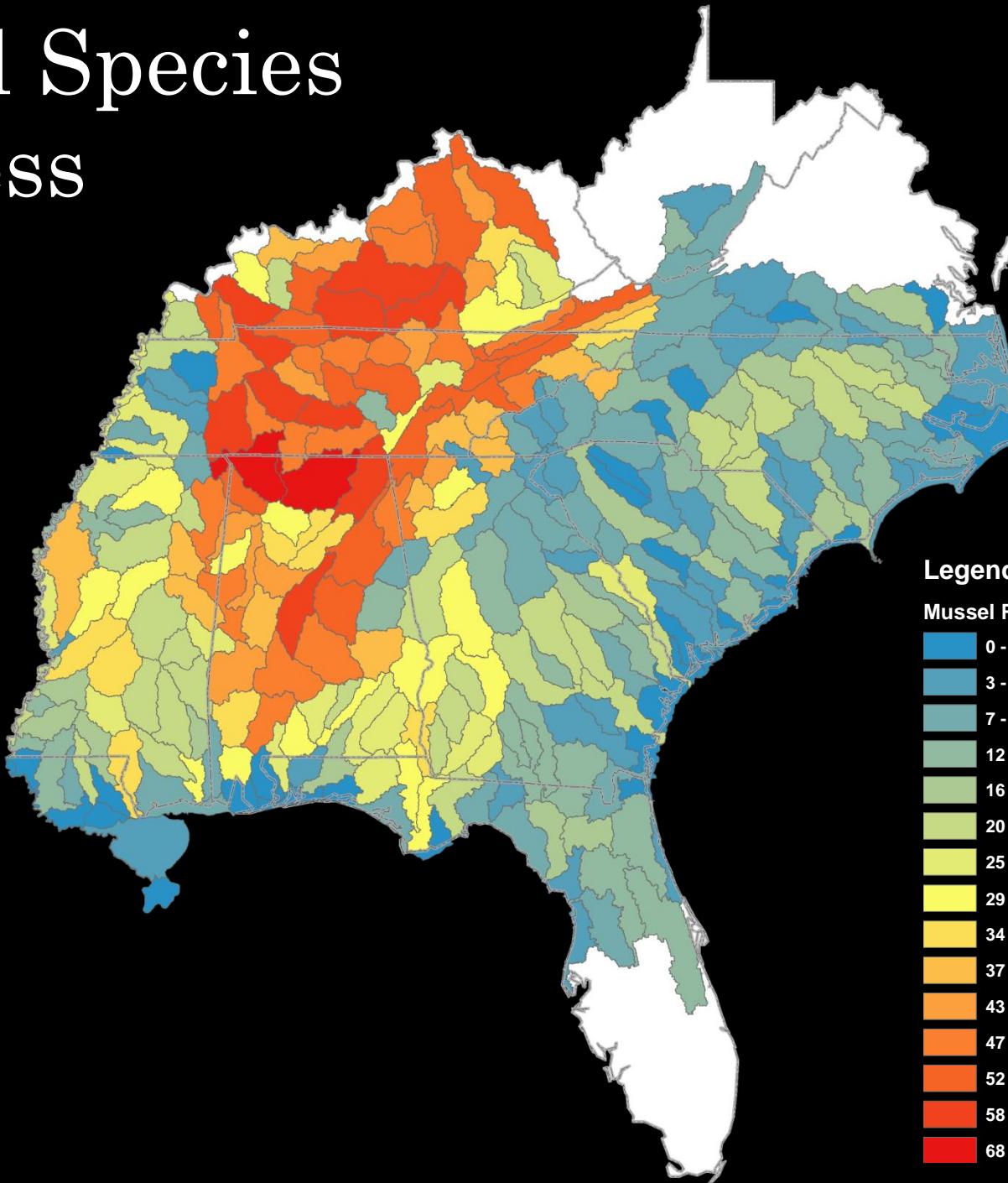


# Crayfish Endemism

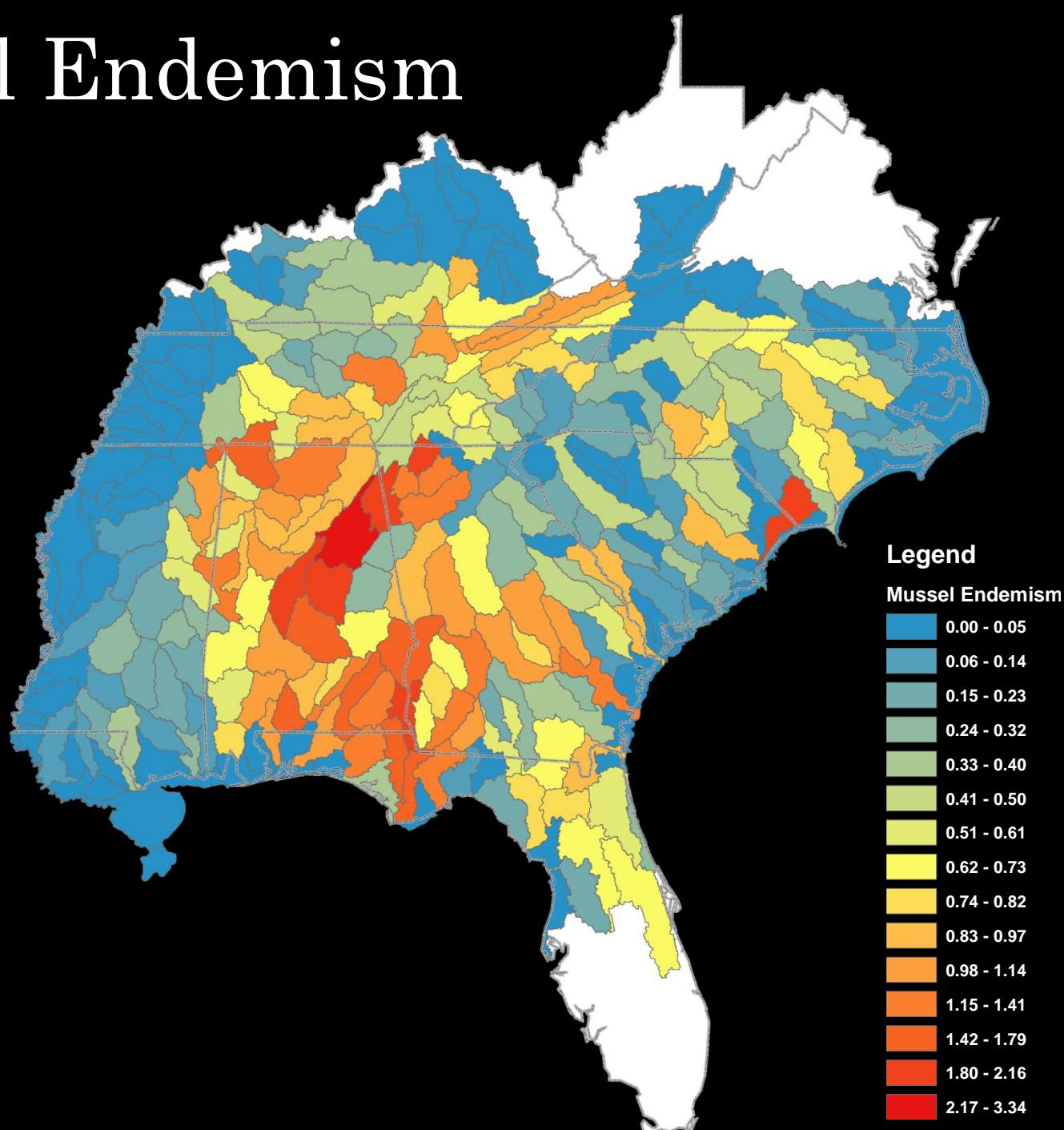




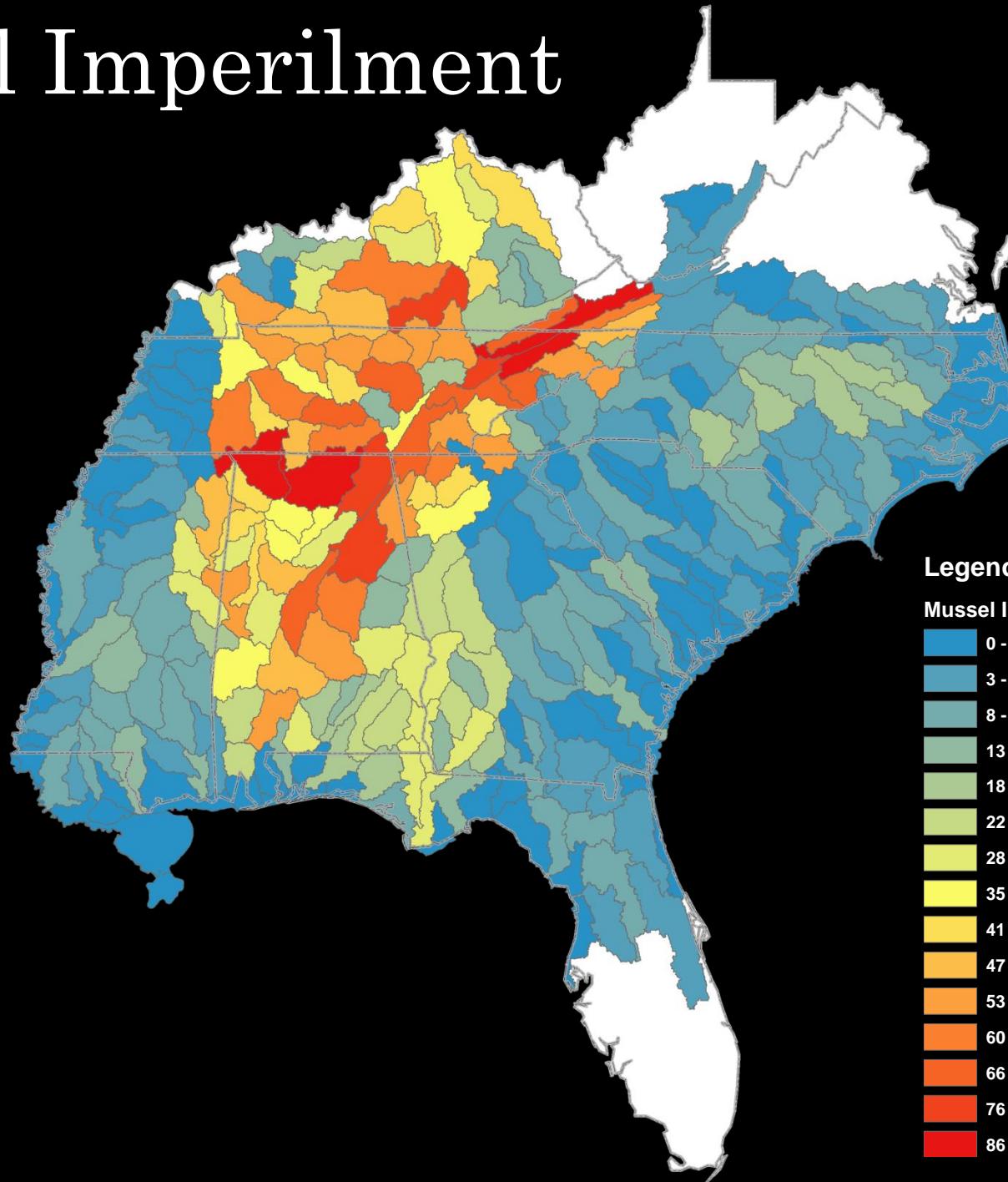
# Mussel Species Richness



# Mussel Endemism

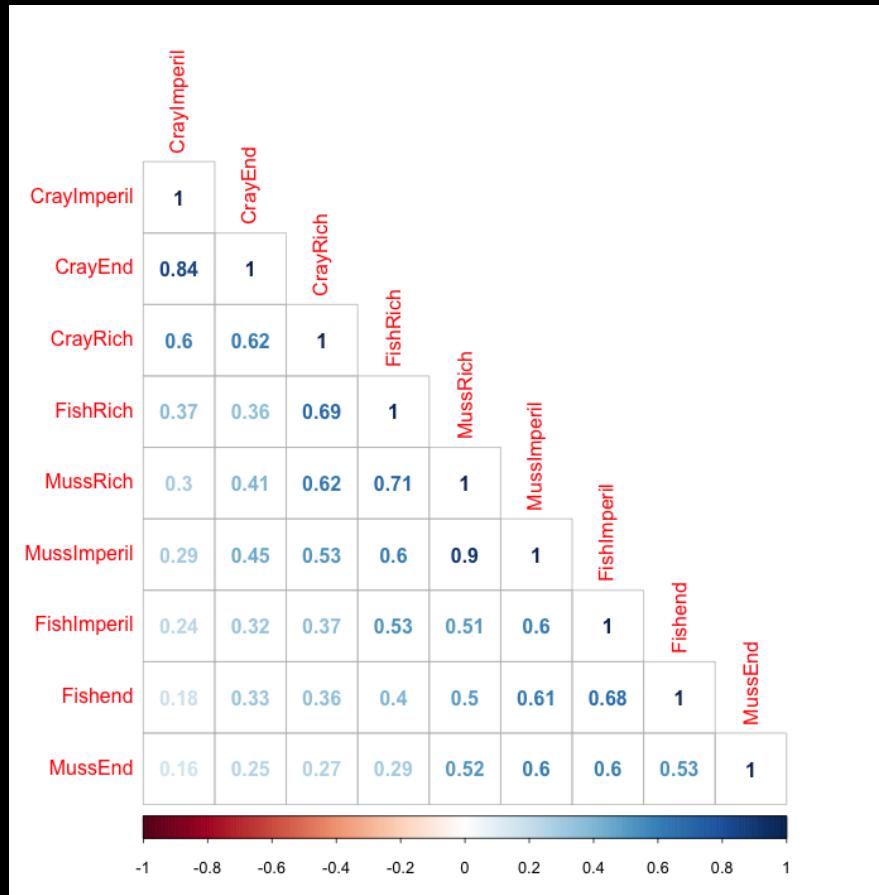


# Mussel Imperilment



# What to make of this?

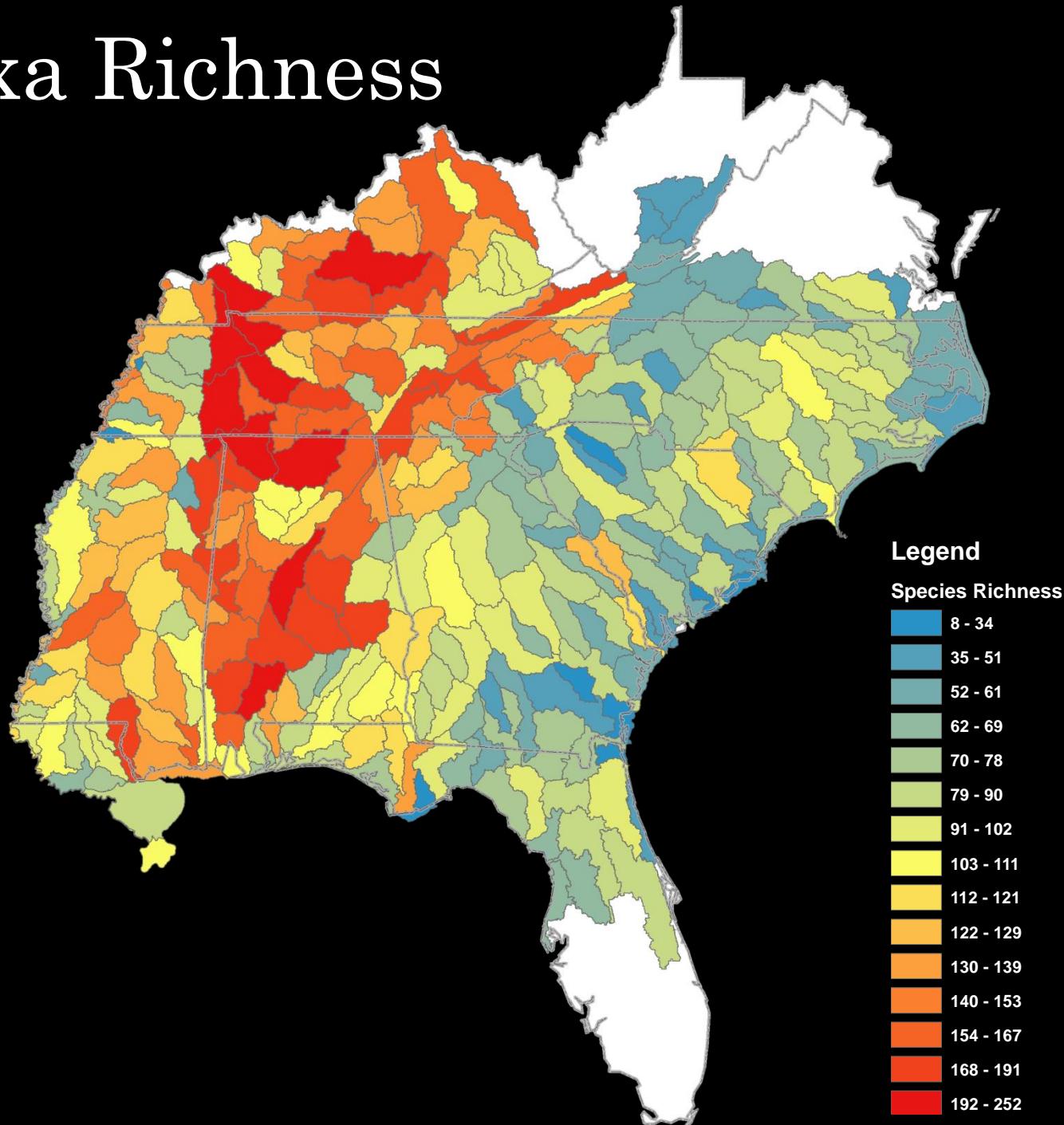
- Richness, Endemism, Imperilment correlated, but imperfectly



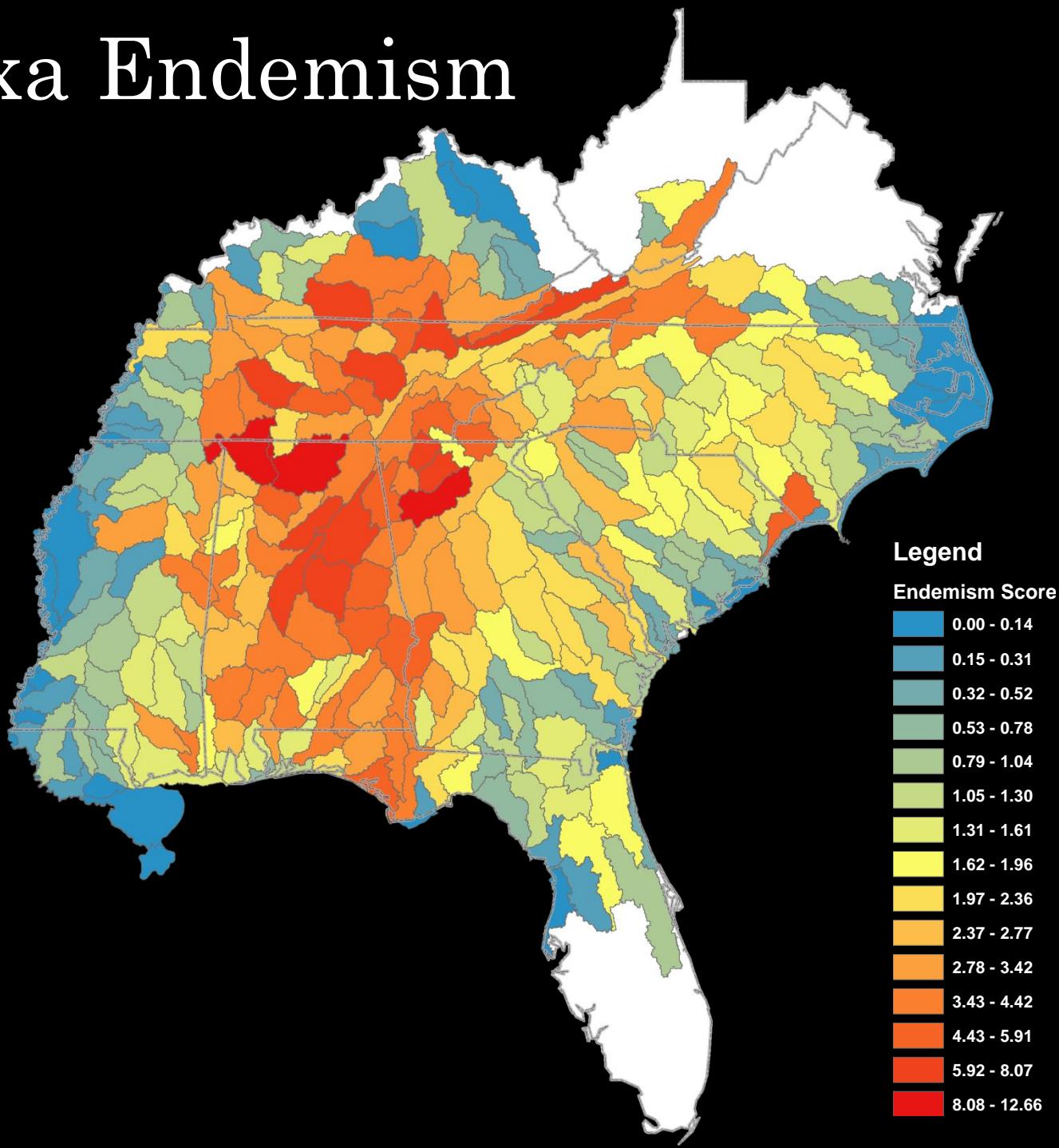
All species are created equal.  
All taxa? Maybe not.

- Debate: weight taxa equally or pool species?

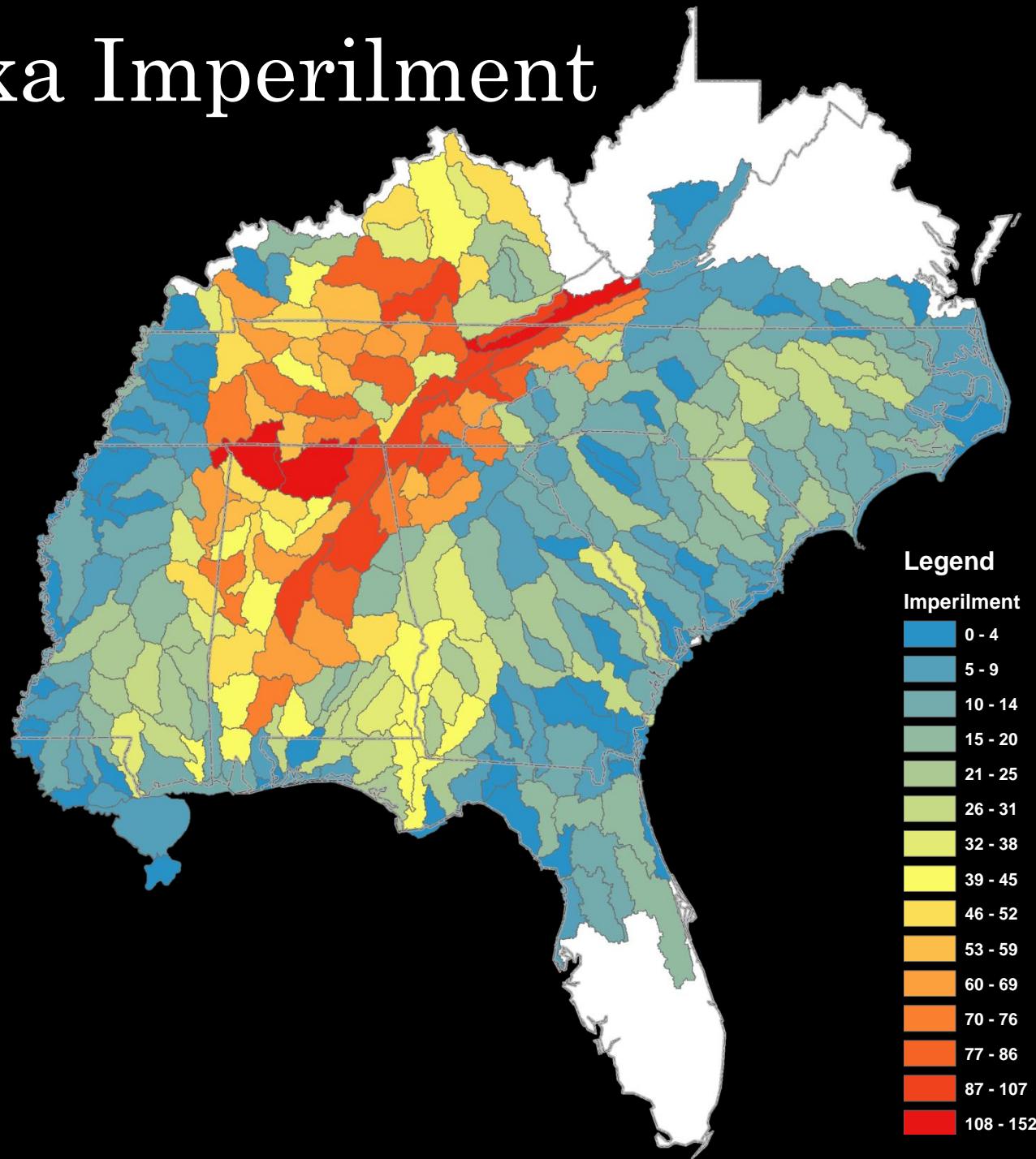
# All Taxa Richness



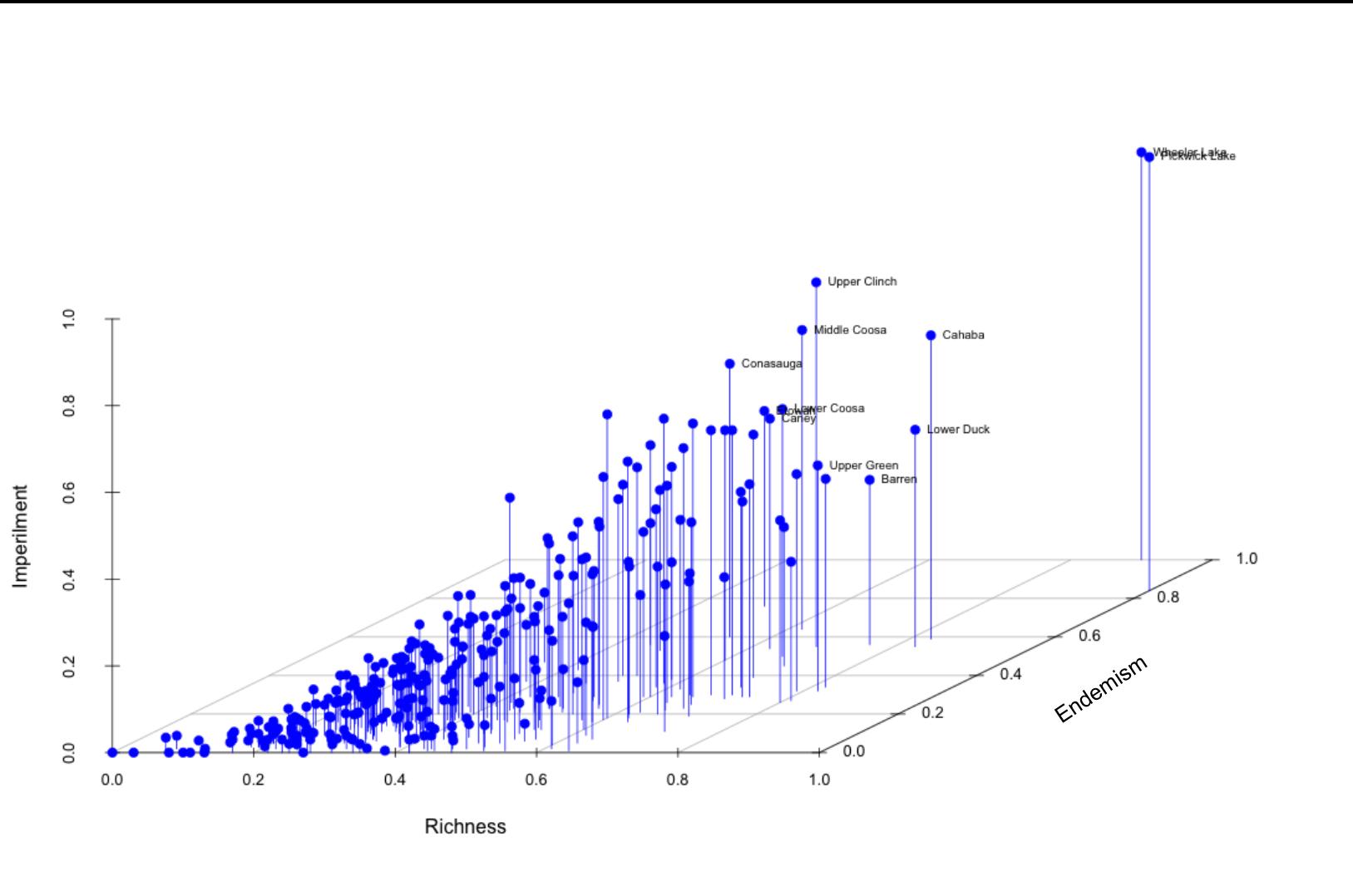
# All Taxa Endemism



# All Taxa Imperilment



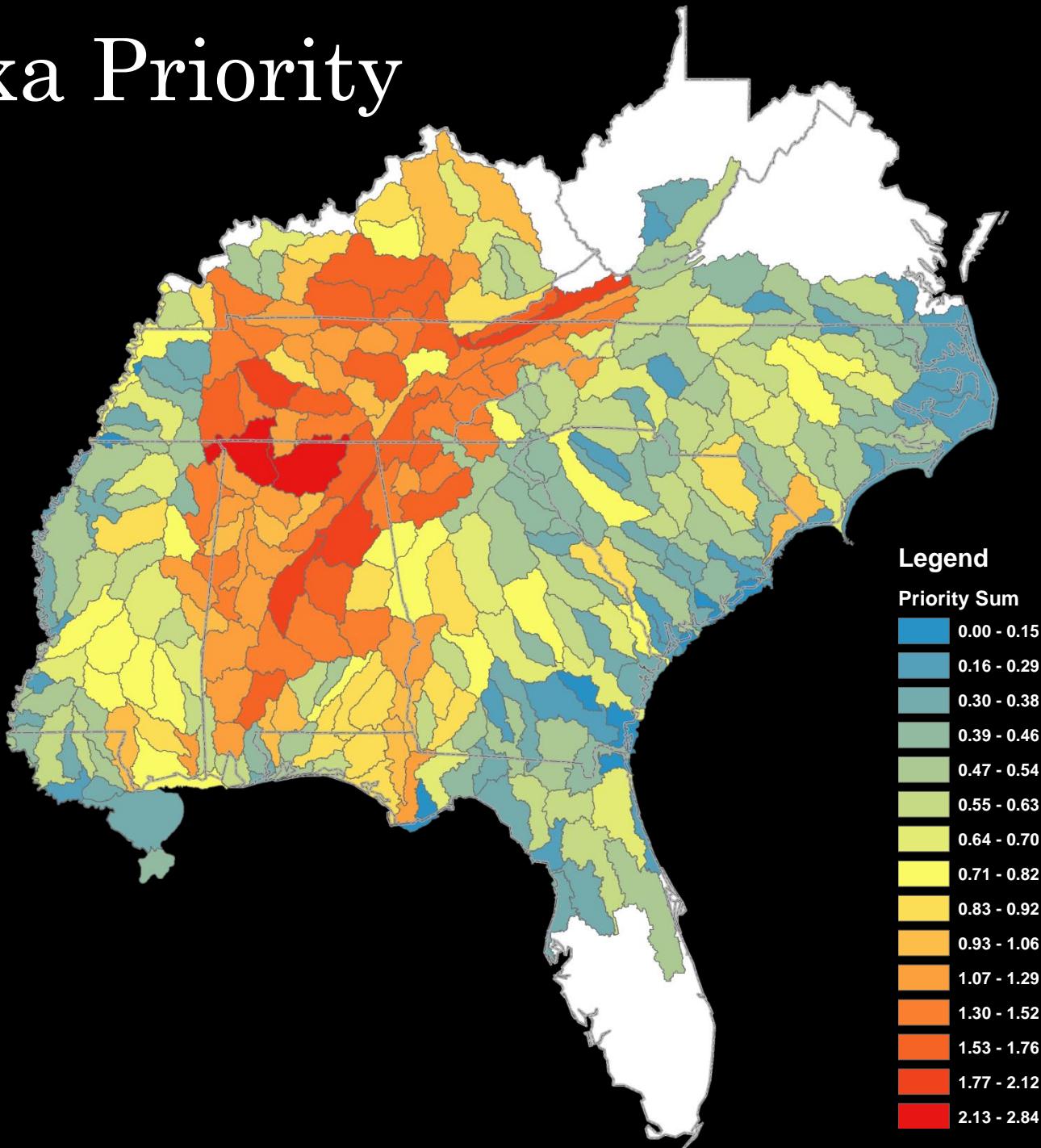
# Same data, as points



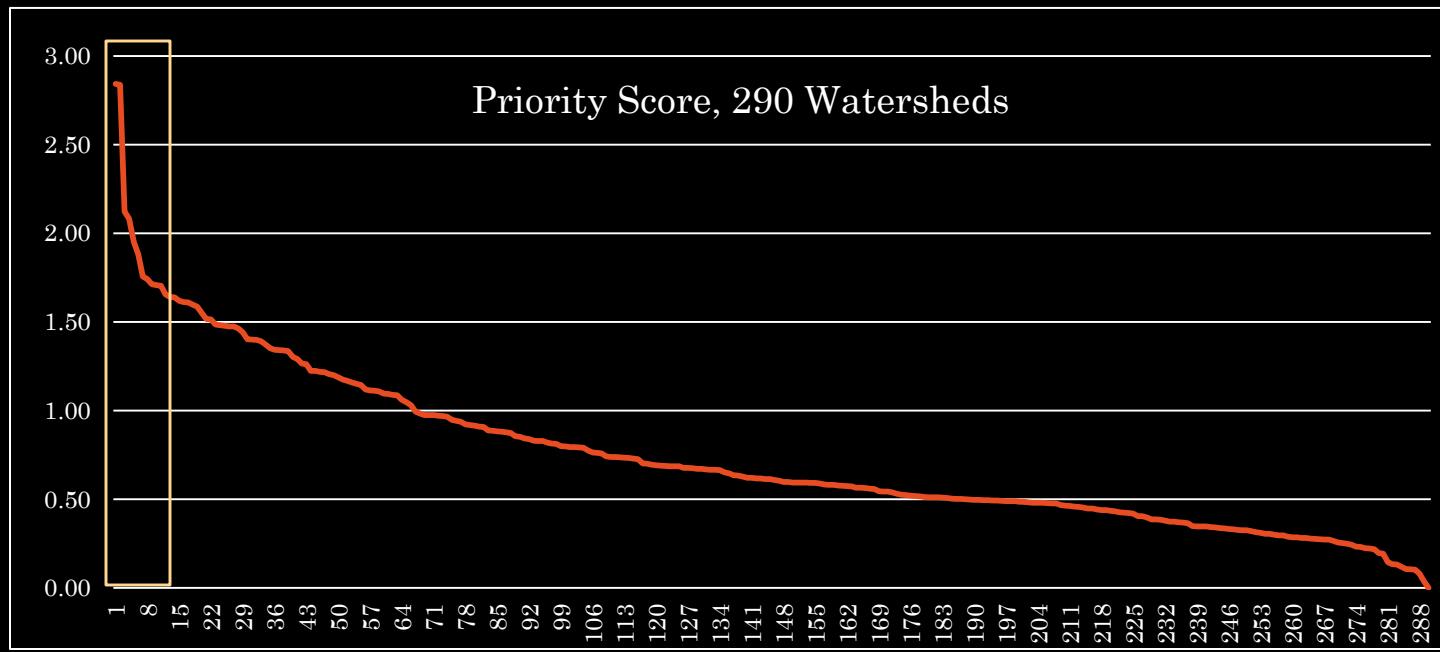
# Priority Scores

- Richness, endemism, imperilment each worth keeping
  - How best to combine?
- Advisory committee decided simple sum was best, in absence of compelling argument for a weighing scheme.
  - But acknowledge that there's a weighting scheme in imperilment, already...

# All Taxa Priority



# Are there tiers?



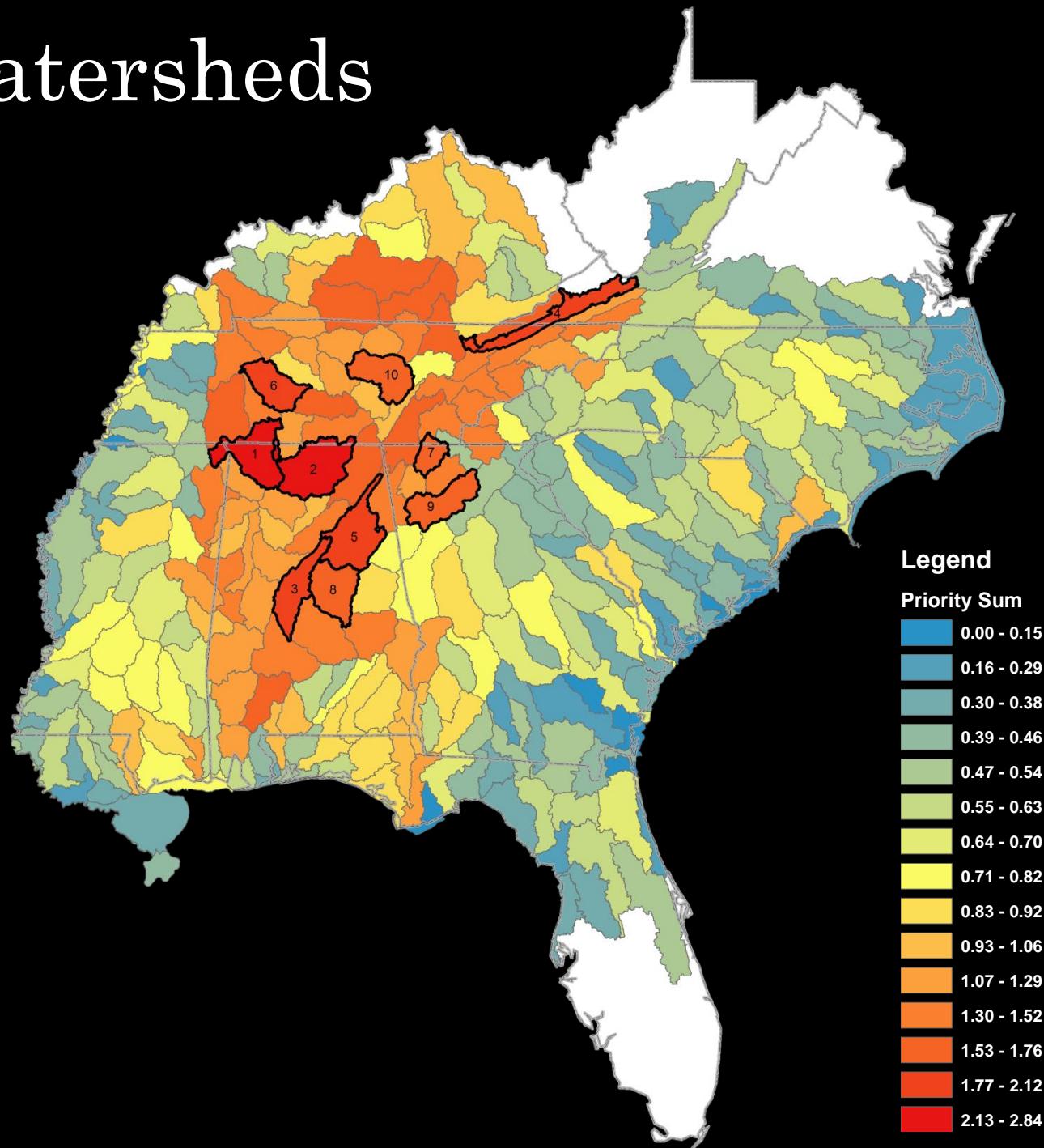
# Nod to complementarity

Priority Rank	Priority Score	Sub-basin	Major Drainage	Additional Unique Species
1	2.84	Pickwick Lake	Tennessee	252
2	2.84	Wheeler	Tennessee	22
3	2.12	Cahaba	Alabama	110
4	2.08	Upper Clinch	Tennessee	29
5	1.95	Middle Coosa	Alabama	15
6	1.88	Lower Duck	Tennessee	19
7	1.76	Conasauga	Alabama	9
8	1.74	Lower Coosa	Alabama	2
9	1.71	Etowah	Alabama	16
10	1.71	Caney	Cumberland	21
11	1.70	Barren	Green	26
12	1.66	Upper Green	Green	9
13	1.64	Upper Duck	Tennessee	1

# Nod to complementarity

Priority Rank	Priority Score	Sub-basin	Major Drainage	Additional Unique Species
1	2.84	Pickwick Lake	Tennessee	252
2	2.84	Wheeler	Tennessee	22
3	2.12	Cahaba	Alabama	110
4	2.08	Upper Clinch	Tennessee	29
5	1.95	Middle Coosa	Alabama	15
6	1.88	Lower Duck	Tennessee	19
7	1.76	Conasauga	Alabama	9
8	1.74	Lower Coosa	Alabama	2
8	1.71	Etowah	Alabama	16
9	1.71	Caney	Cumberland	21
10	1.70	Barren	Green	26
12	1.66	Upper Green	Green	9
13	1.64	Upper Duck	Tennessee	1

# Top Watersheds



# Threat Assessment

Threat	Barren	Cahaba	Caney	Conasauga	Etowah	Lower Duck	Mid. Coosa	Pickwick L.	Up. Clinch	Wheeler L
Ag - Livestock	2	1	1		2	1	1	1	1	1
Ag - Row Crops	1	1	2	1		1	1	1	1	1
Forestry		1				2	2	2		
Groundwater Withdrawal						2	1			1
Impoundments/Barriers	2	2	2	2	2	2	2	2	2	2
Industry				2			1			2
Invasive Species								2		2
Land Use Legacies					2					
Mines		1	2				1		1	
Power - Coal Ash					2		2	2		
Power - Other							2			
Reservoir Development					2					
Septic		2								
Sinkhole Dumping									2	
Stormwater Inject. - Karst	1									
Urbanization	1	1	1	2	1	1	1	1	2	1
Wastewater Systems		2	2				1	2		

# What Next?

- Report at [www.freshwater.org](http://www.freshwater.org)
- Ongoing outreach, Story Map in development
- Refinement of mussel data
- Finer scale analysis of crayfish data
- Would like to extend capacity analysis (not shown here)



# Thanks to

- Susie Adams, USFS
- Jason Wisniewski, GA DNR
- Georgia DNR
- Tyler Black, NCWRC
- Jeff Garner, AL DCNR
- Illinois Natural History Survey
- Art Bogan, NCMNS
- Carl Williams, TWRA
- Smithsonian Natural History Museum
- Bob Butler, USFWS
- David Withers, TDEC
- GBIF
- Arnie Eversole, Clemson
- Paul Angermeier VTU
- FishNet2
- Wendell Haag, USFS
- Matt Thomas, KYDFWR
- Kentucky DFWR
- Don Hubbs, TWRA
- Stuart McGregor, GSA
- MARIS
- Bob Jones, MMNS
- Rebecca Bearden, GSA
- Mississippi Museum of Natural Science
- Jess Jones, USFWS/VA Tech
- Katherine Baer, River Network
- North Carolina Museum of Natural Sciences
- Zach Loughman, West Liberty
- Stephanie Chance, USFWS
- Ohio State Univ Museum of Biological Diversity
- Guenter Schuster, GSA
- Tanya Darden, SC DNR
- TVA
- Chris Skelton, HNTB Corporation
- Jessica Graham, SARP
- Bronwyn Williams, NC Museum of Natural Sciences
- Todd Slack, ERDEC
- Mike Harris, USFWS
- Michael LaVoie, Eastern Band Cherokee Indians
- Chris Taylor, INHS
- Pat O'Neil, GSA
- Roger Thoma, Cleveland MNH
- Peggy Shute, USFWS
- Jim Williams, Florida FWCC

# Questions?

For further info:

Duncan Elkins (delkins@uga.edu)

[www.southeastfreshwater.org](http://www.southeastfreshwater.org)