Results from the Southeast Wetland Monitoring and Assessment Intensification Study with North Carolina, South Carolina, Alabama, and Georgia to Assess Forested Wetland Condition

Presented by

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A Huge Collaborative Effort

Funding:

- *EPA Region IV and EPA Headquarters*

Field Work:

- ***North Carolina:***
  - ***James Graham, team lead***
  - *Anthony Scarbraugh*
  - *Michael Coleman*
  - *Kristie Gianopulos*
  - *Greg Rubino*
  - *Virginia Baker*
  - *Amanda Johnson*
  - *Joe Grybz*
  - *Rick Savage*
- ***South Carolina:***
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  - *Justin Lewandowski*
  - *Erin Owen*
  - *Jeff Schrag*
- ***Alabama:***
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  - *Ruth Perez*
  - *Ron Sparks*
  - *Brien Diggs*
  - *Aaron Goar*
  - *Dan Spaulding*
- ***Georgia:***
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  - *Danielle Floyd*
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- *Rick Savage*
- *Breda Munoz*

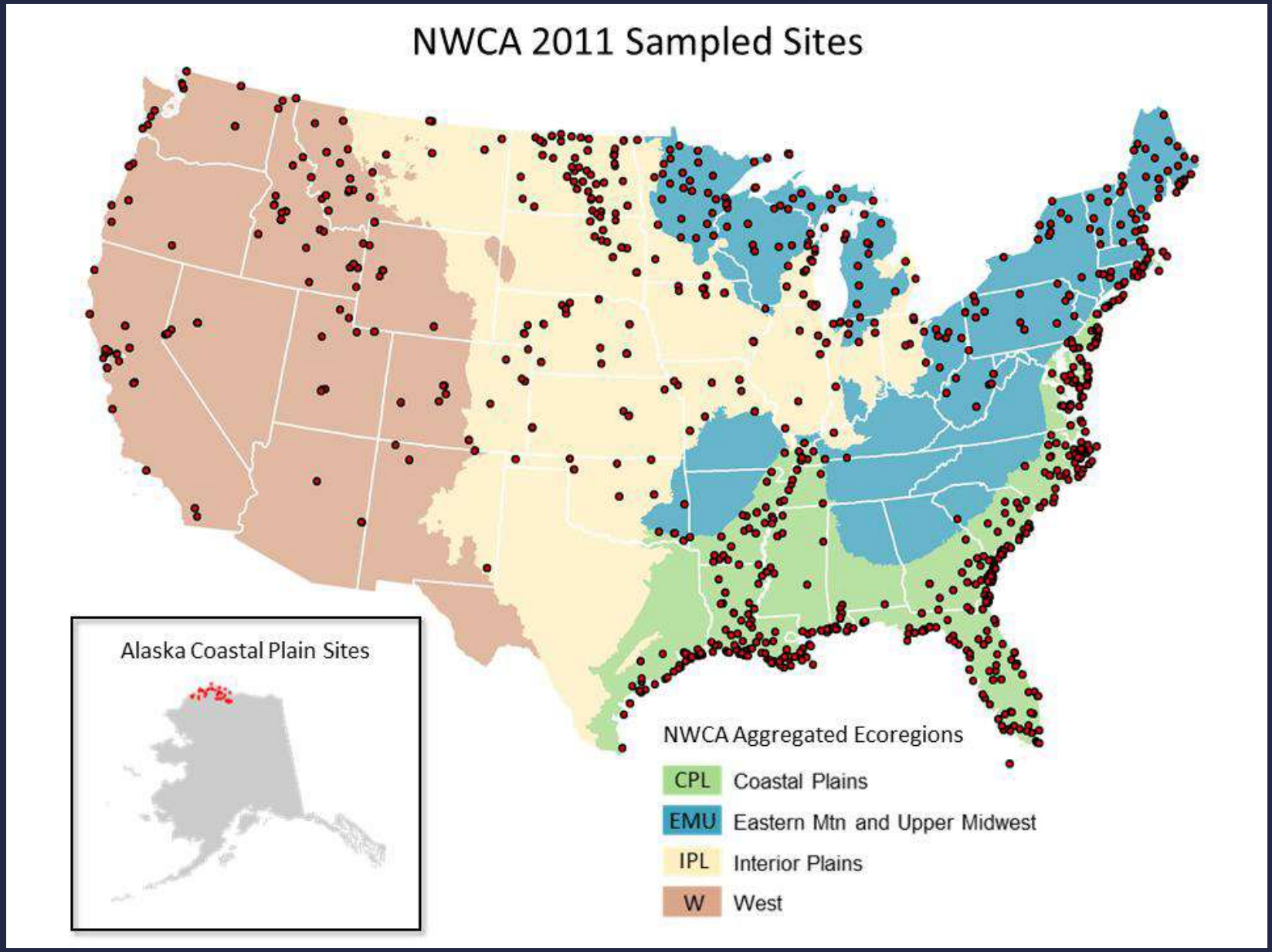
Document Review:

- *Rusty Wenerick*
- *Brandon Moody*
- *Gina Curvin*

Purpose

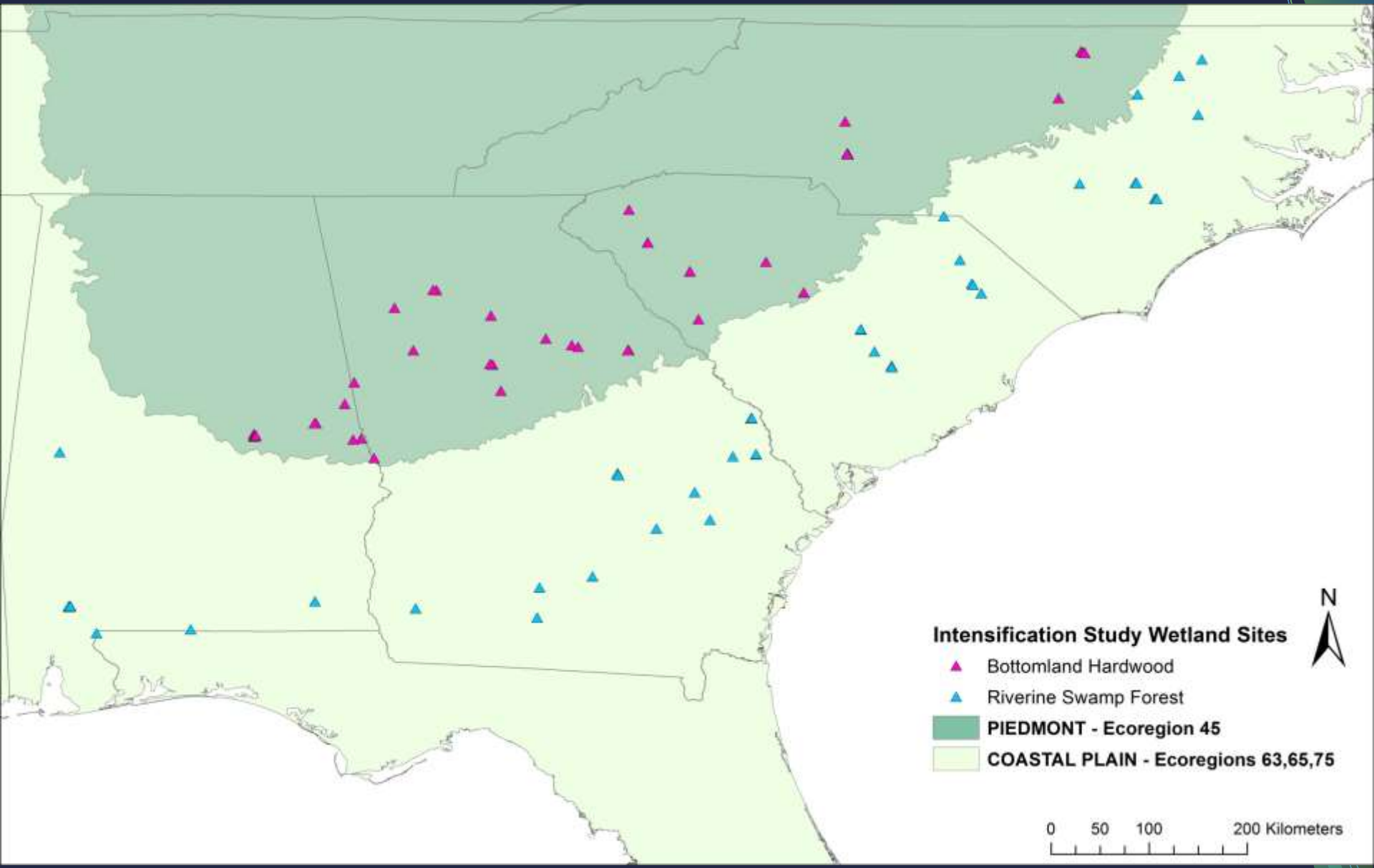
- Augment data collected in the EPA's first National Wetland Condition Assessment (NWCA) (2011)
- Focused on forested wetland condition in Southeast (bottomland hardwoods and riverine swamp forests)
- 90 wetland sites, intensively surveyed, chosen from same population of sites in NWCA

NWCA National Survey – 1138 sites

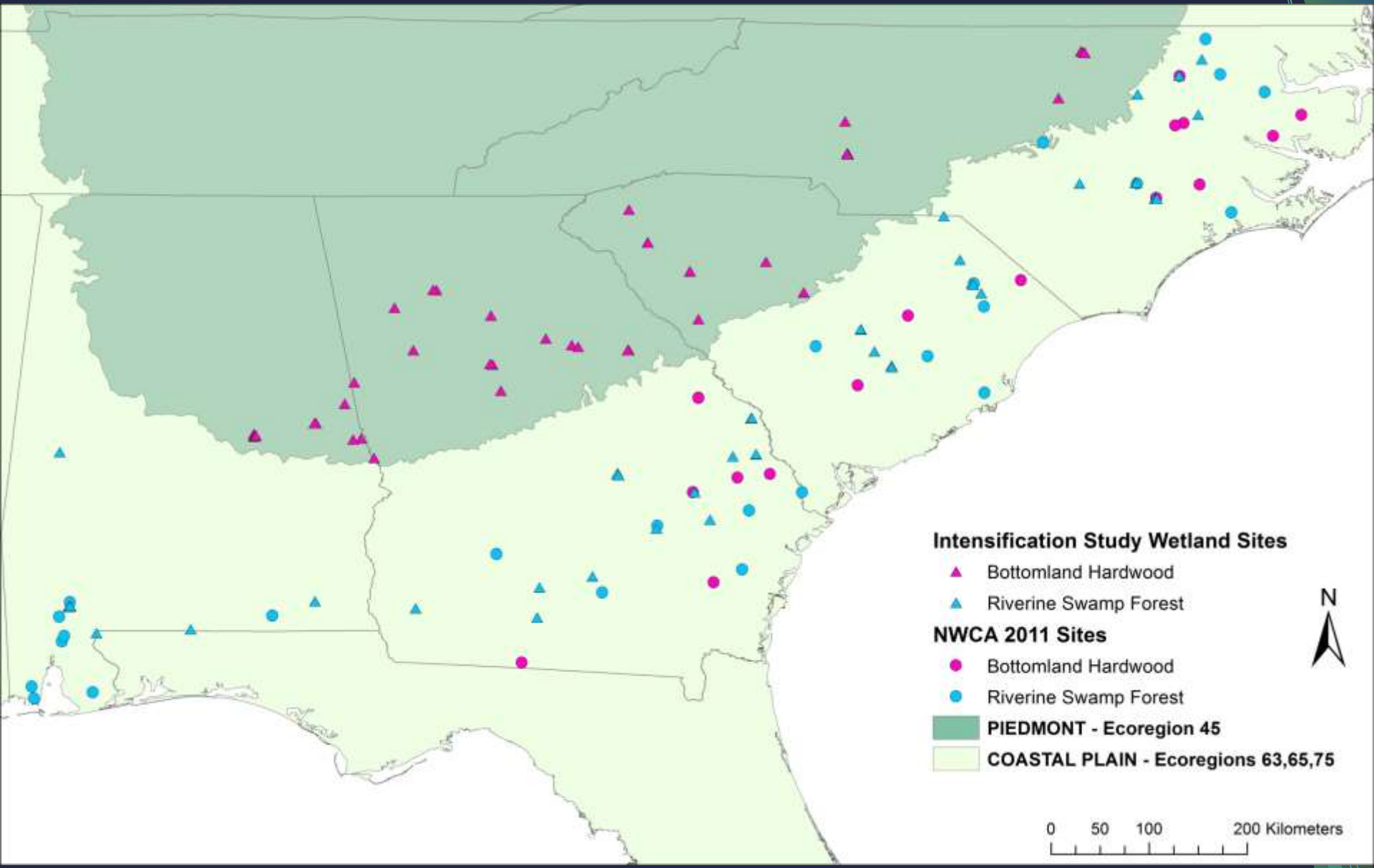


Map from EPA NCWCA 2011 Draft Public Report

Forested Wetland Sites – Intensification (90 sites)



Forested Wetland Sites – Intensification (90) + NWCA 2011 (43)



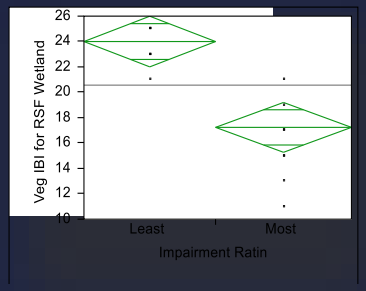
Site Assessment

- Level 1: GIS Assessment – Landscape Development Intensity index (LDI)(Brown and Vivas 2005)
- Level 2: Rapid Field Assessment
  - NCWAM (function), ORAM (habitat quality), USARAM (stressors)
- Level 3: Intensive Surveys (NWCA or NC DWR methodology)
  - Vegetation
  - Amphibians
  - Macroinvertebrates
  - Soils
  - Water Quality
  - Buffer Assessments
  - Hydrology Wells

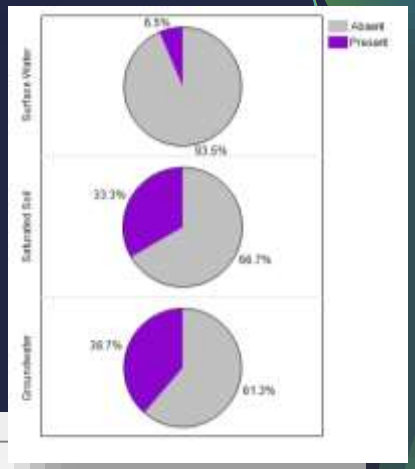
(not all data types were collected by all states)

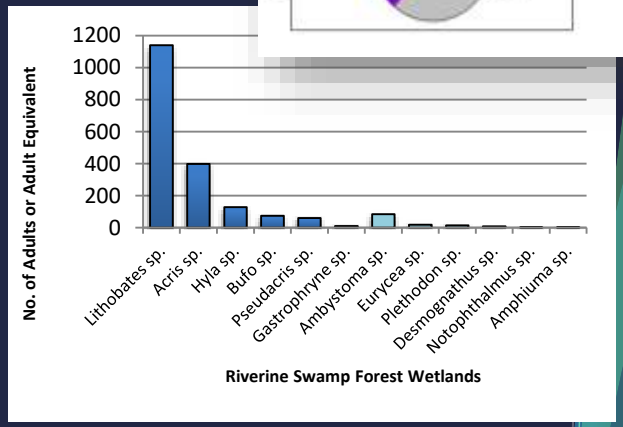
Descriptive Metrics Calculated

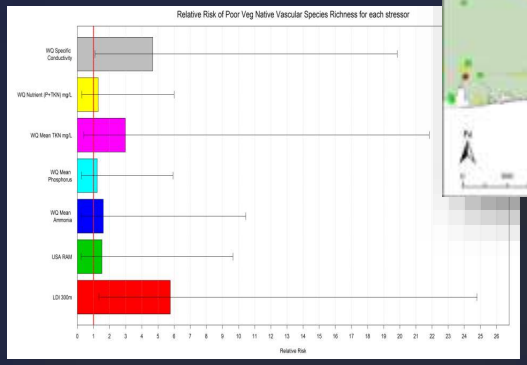
- LDI, USARAM (NCWAM, ORAM)
- Buffers - number of stressors, veg. structure profiles
- Soils – metals, nutrients, depth to groundwater/saturated soils,
- Water Quality – metals, nutrients, fecal, upstream/downstream
- Hydrology Wells - hydrographs
- Vegetation –variety of metrics (community balance, floristic quality, wetness, functional guild, community structure)
- Amphibians – Amphibian Quality Assessment Index (AQAI), tolerant/sensitive, richness, abundance
- Macroinvertebrates –richness/diversity, taxonomic composition, trophic structure, Macroinvertebrate Biotic Index (MBI), tolerant/sensitive

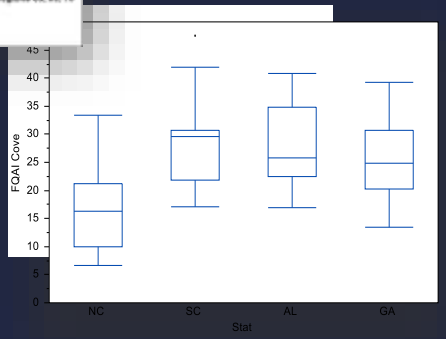


Results Highlights….



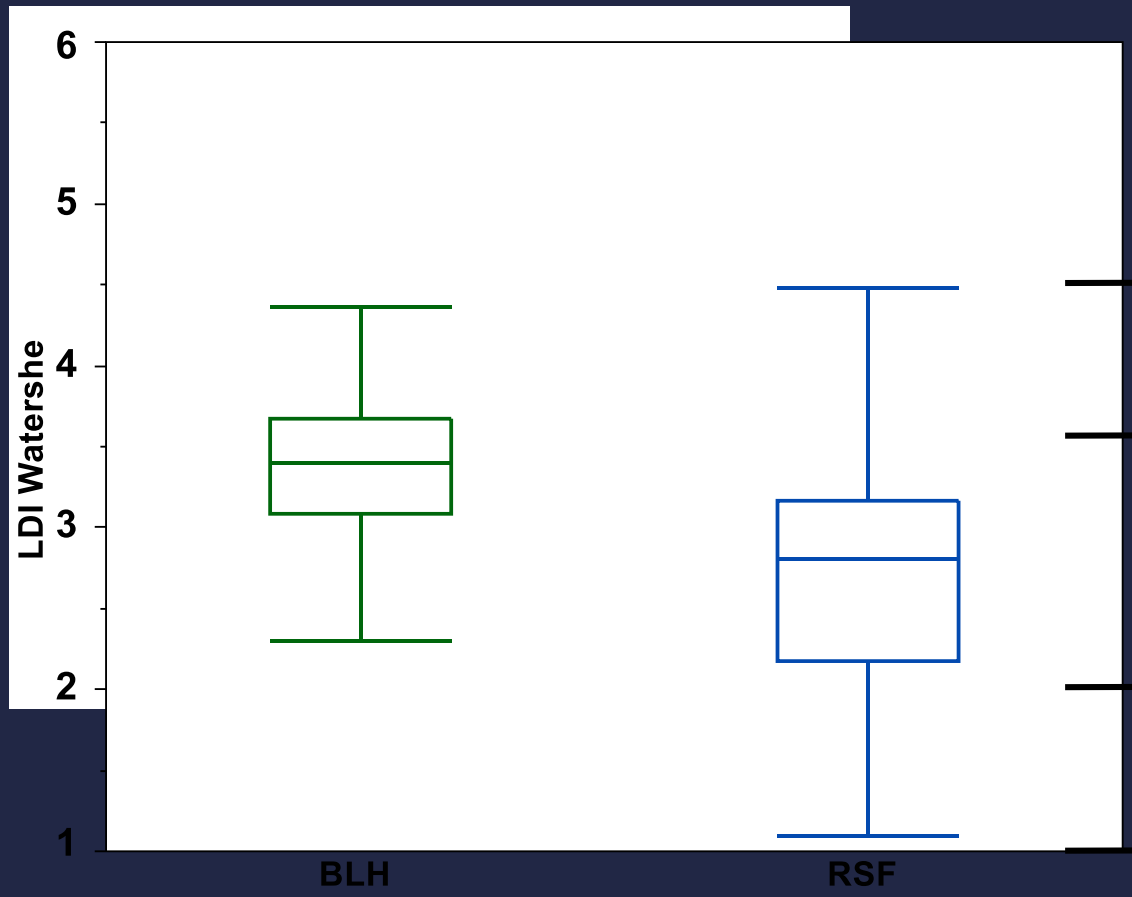






Landscape Development Intensity Index (LDI)

Watershed LDI



Single fam. residential – 6.9

Row crops – 4.5

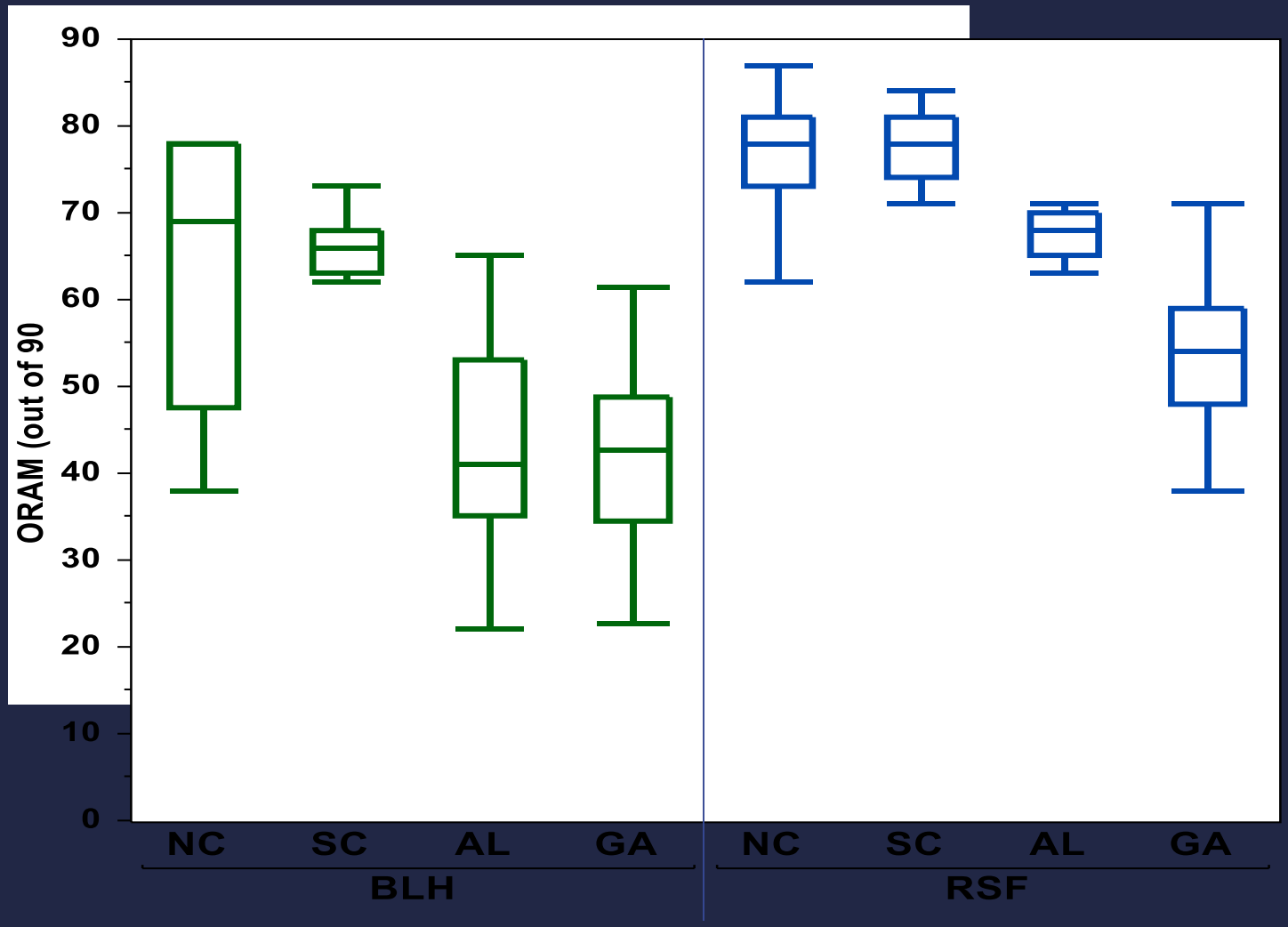
Grazed pasture – 3.4

Grazed woodland – 2.0

Natural system – 1.0

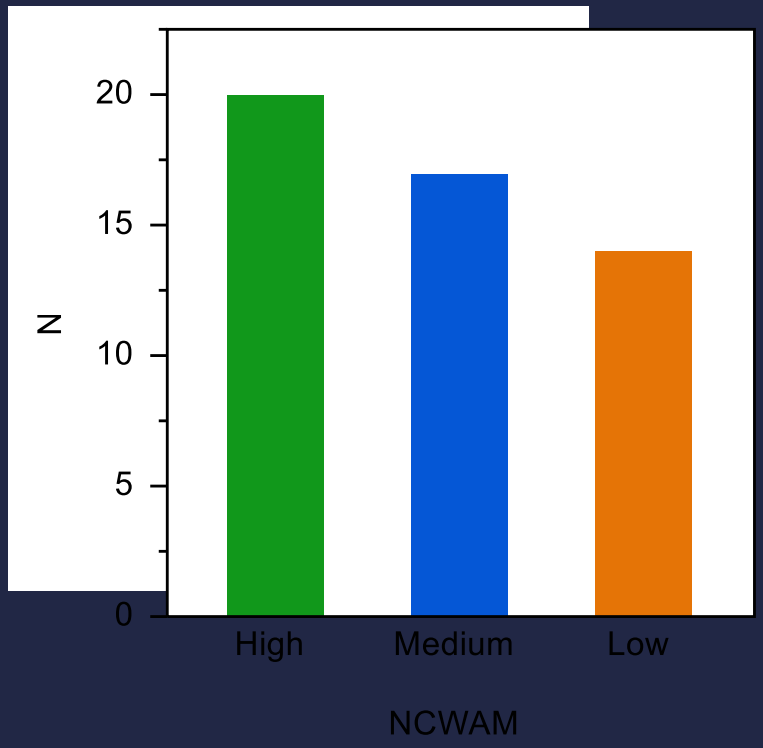
Mean development intensity is higher in BLH wetlands than RSF wetlands

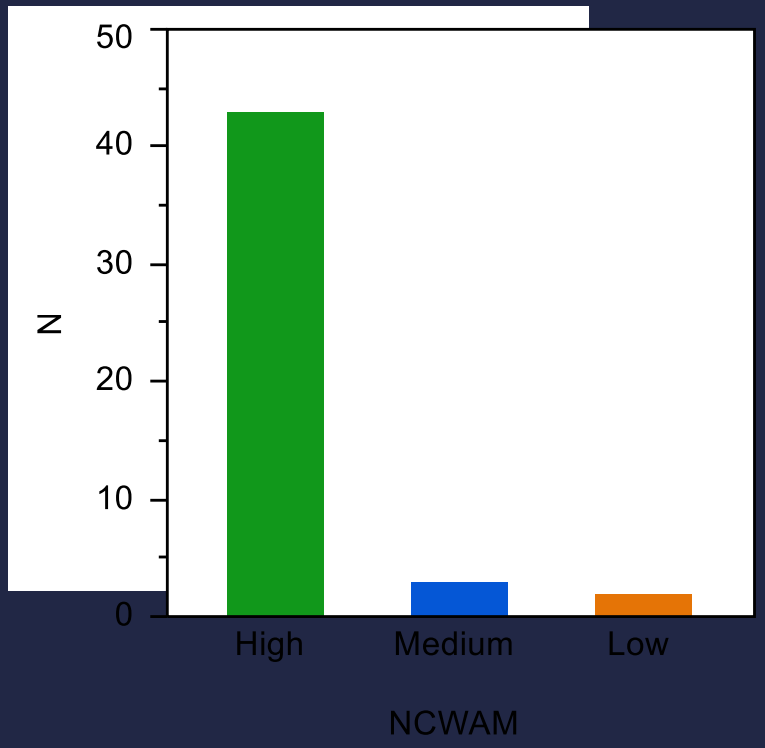
Rapid Assessments - ORAM



Bottomland Hardwood wetlands (Piedmont) had lower ORAM scores than Riverine Swamp Forests (Coastal Plain)

Rapid Assessments - NCWAM



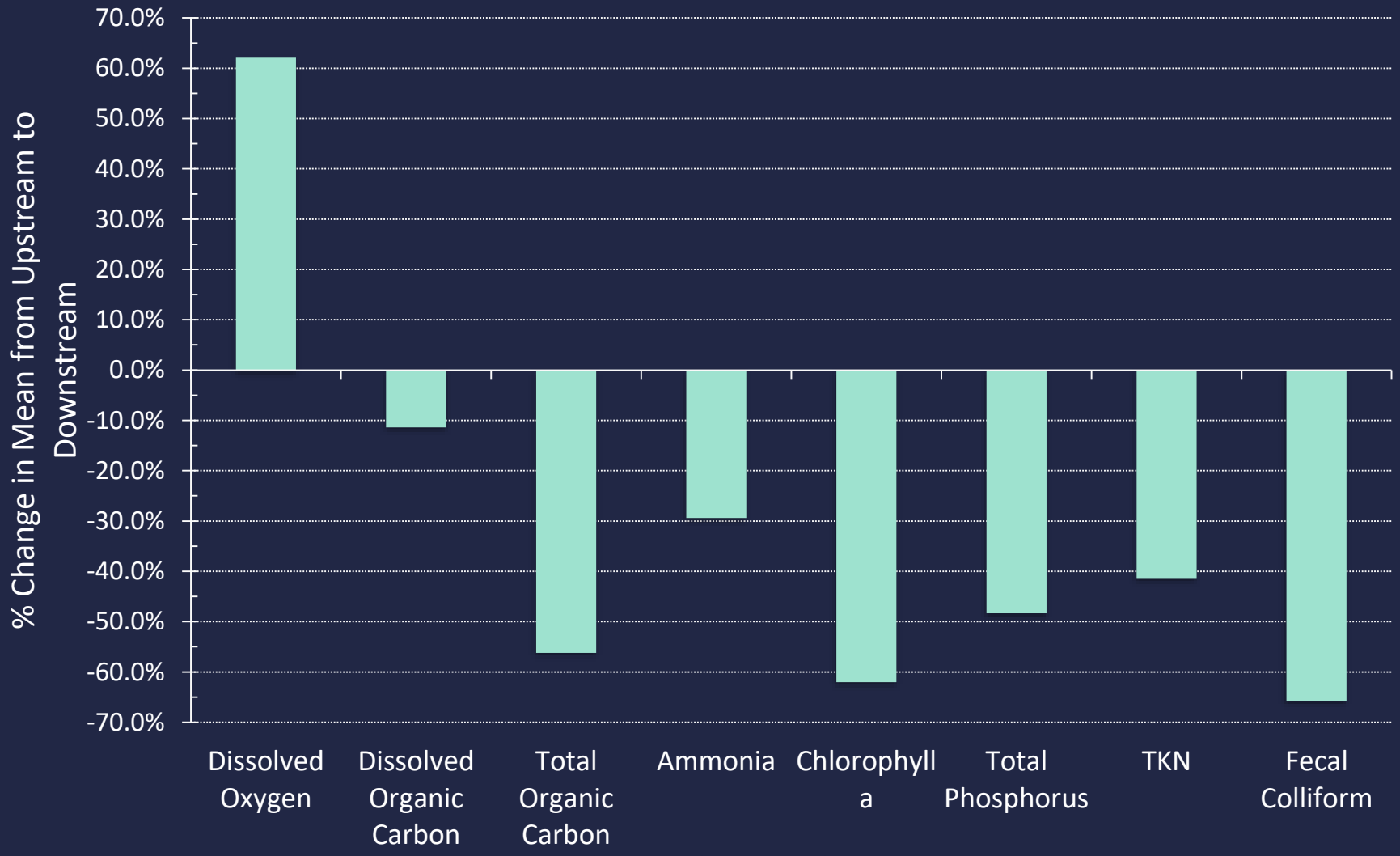


Bottomland Hardwood Wetlands

Riverine Swamp Forests

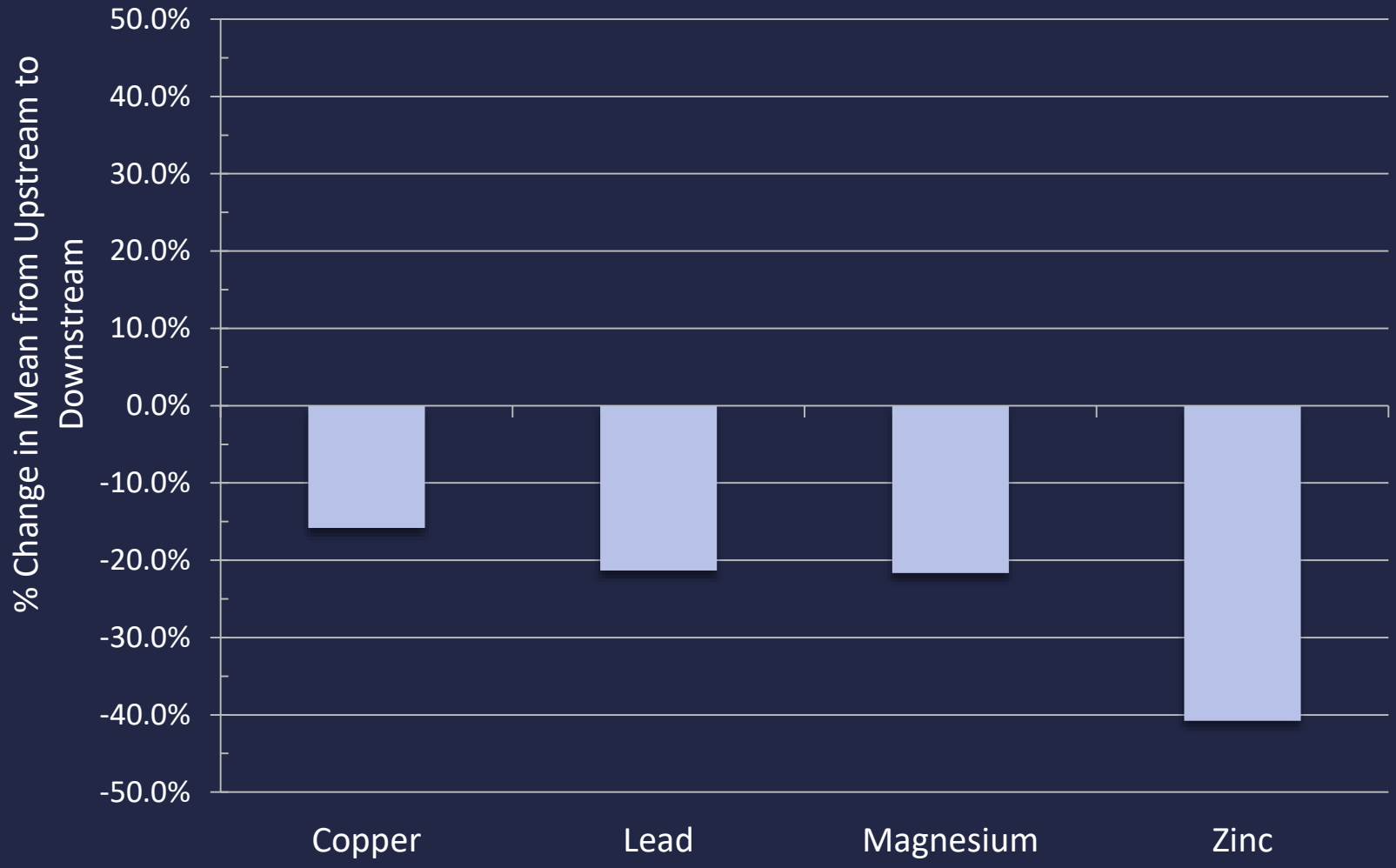
Bottomland Hardwood wetlands (Piedmont) had more sites with medium and low function than Riverine Swamp Forests (Coastal Plain)

Changes in Nutrients Upstream/Downstream in Southeastern Riverine Swamp Forests



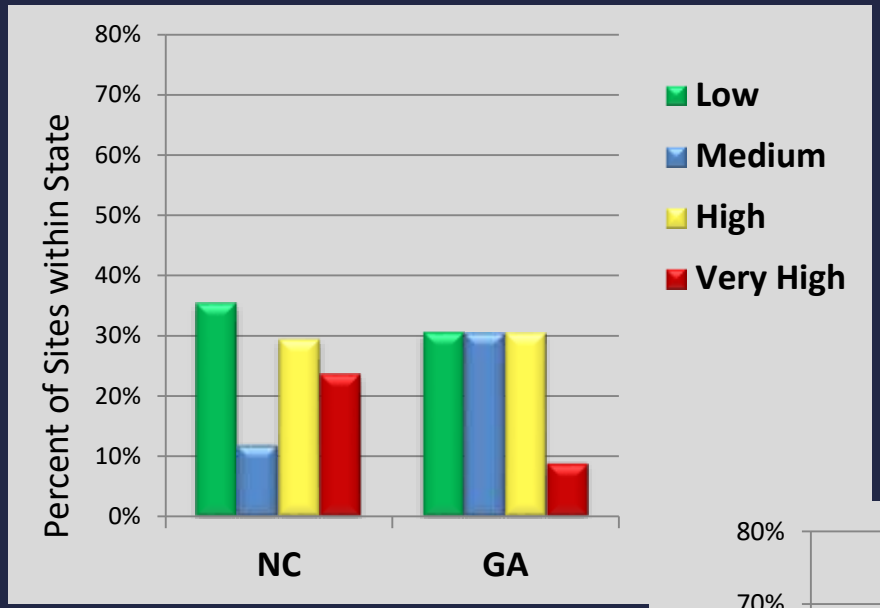
Riverine Swamp Forests showed significant changes in WQ from upstream to downstream in these parameters

Change in Metals from Upstream to Downstream in Southeastern Riverine Swamp Forest Wetlands



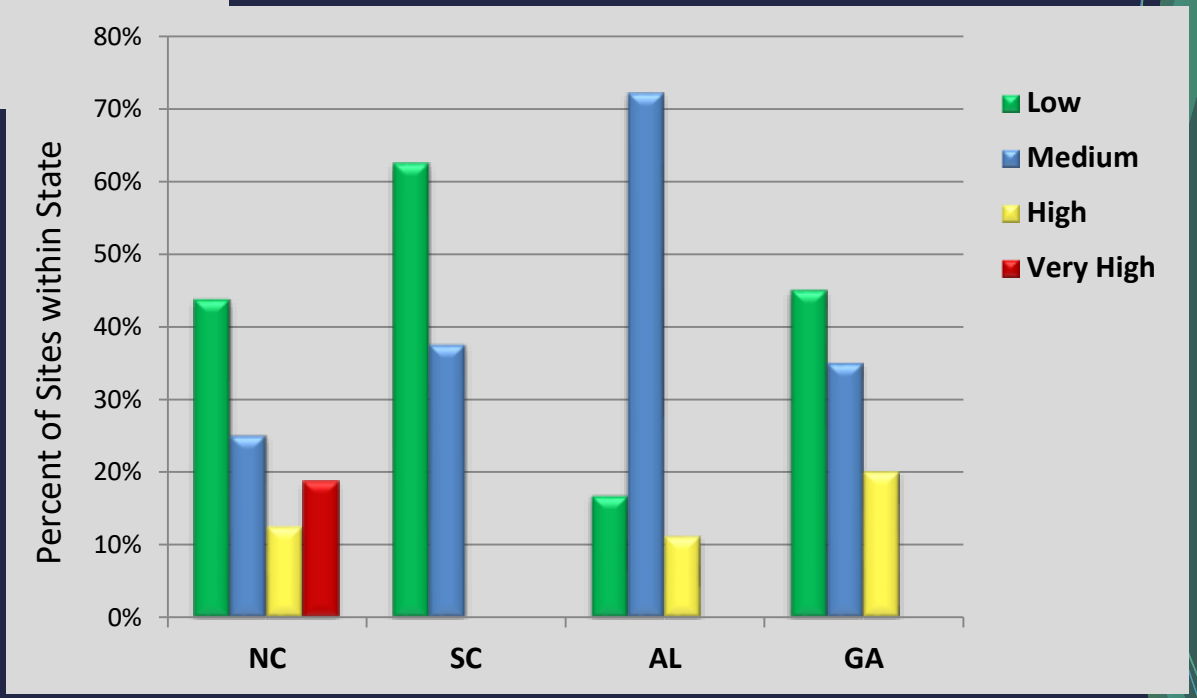
Riverine Swamp Forests showed significant changes in WQ from upstream to downstream in these parameters

Vegetation – Nonnative Plant Stressor Indicator



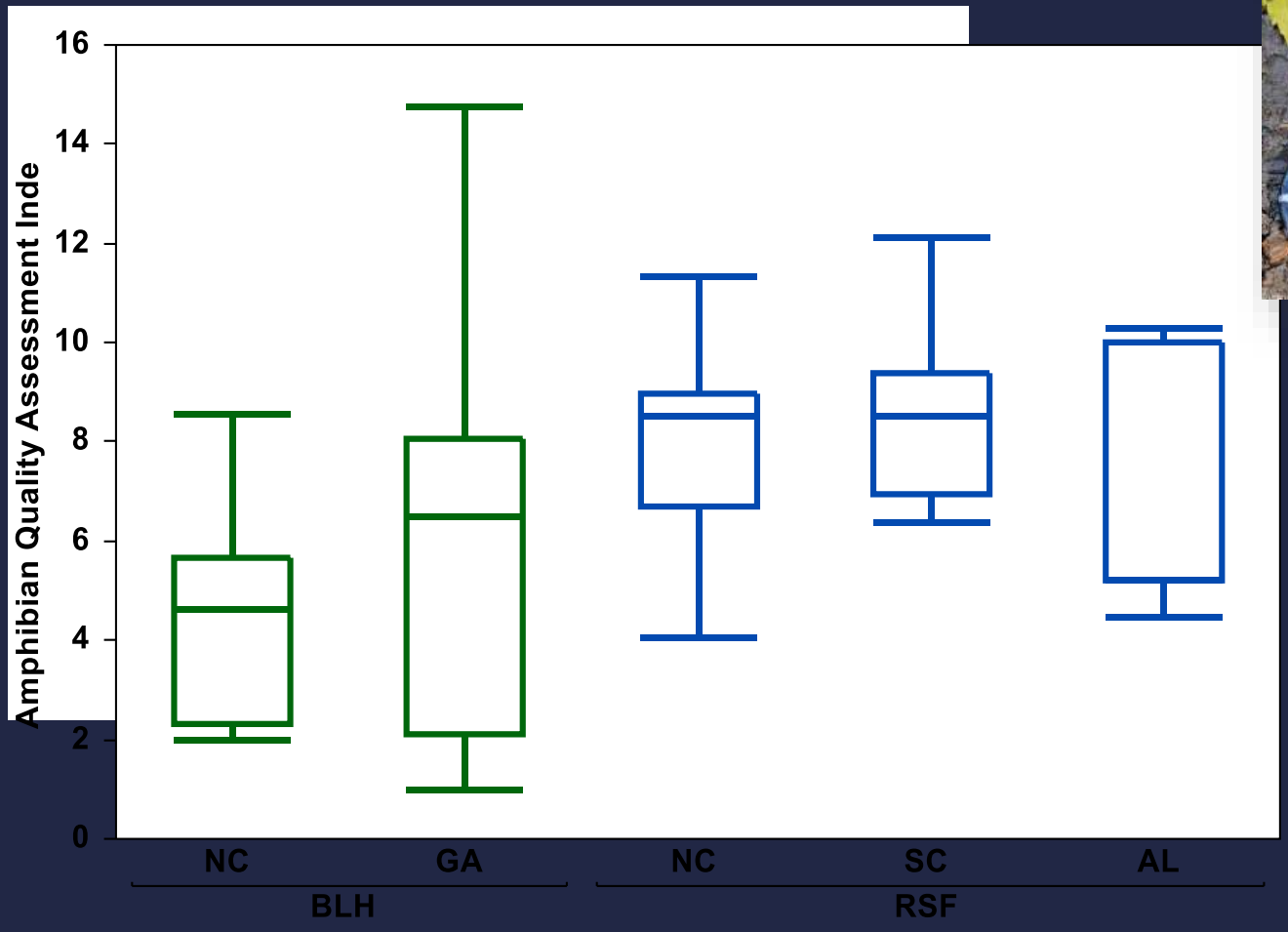
Bottomland Hardwood Wetlands

- Developed by EPA Corvallis
- Incorporates:
  - nonnative relative cover
  - nonnative richness
  - relative frequency of nonnatives



Riverine Swamp Forests

Amphibians – Amphibian Quality Assessment Index (AQAI)



Mean Species Richness -

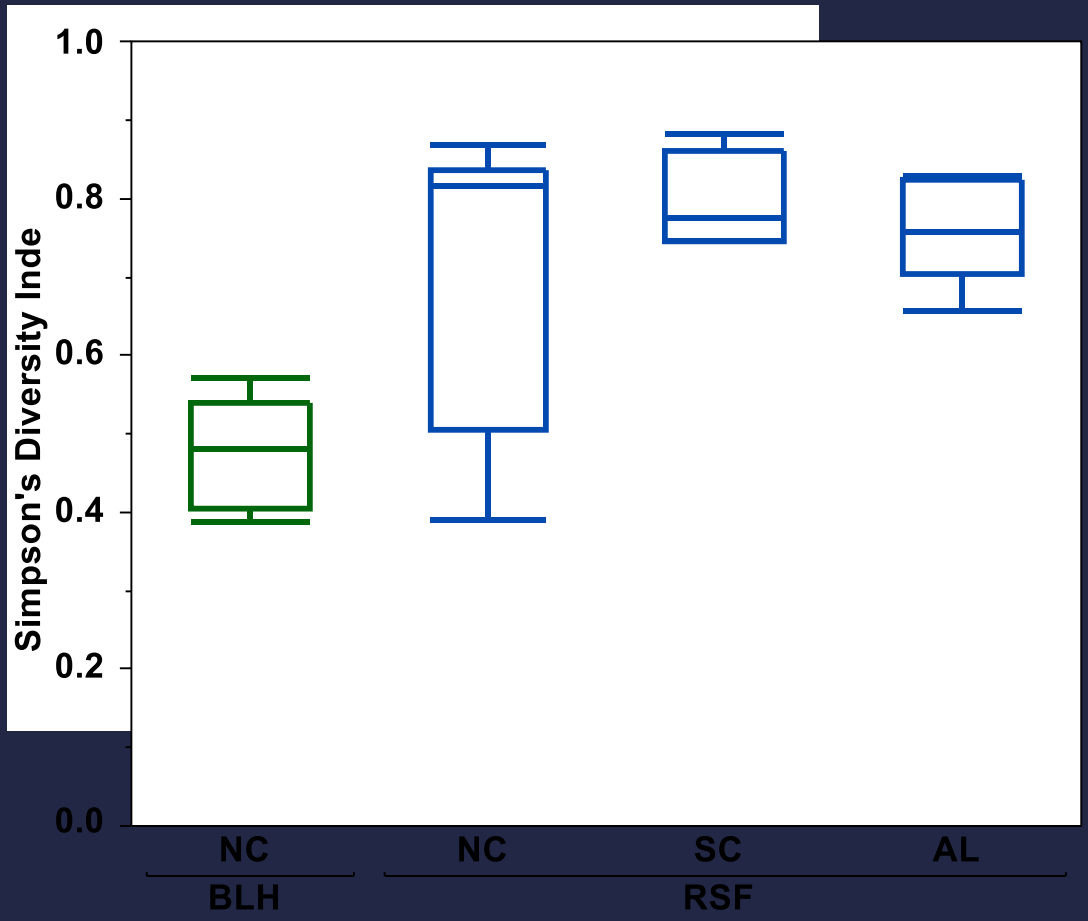
BLH: 3.6

RSF: 4.8

RSF and BLH significantly different (p=0.017); Wilcoxon test

Macroinvertebrates

Simpson's Diversity Index



Overall most common taxa:
Freshwater isopods - Caecidotea spp. and Asellus spp.

**BLHs were drier than RSFs in sampling year

BLH:
18 orders
32 families

RSF:
25 orders
81 families

RSF and BLH significantly different (p=0.002); Wilcoxon test

Overall Wetland Condition – Multi-metric Ranking

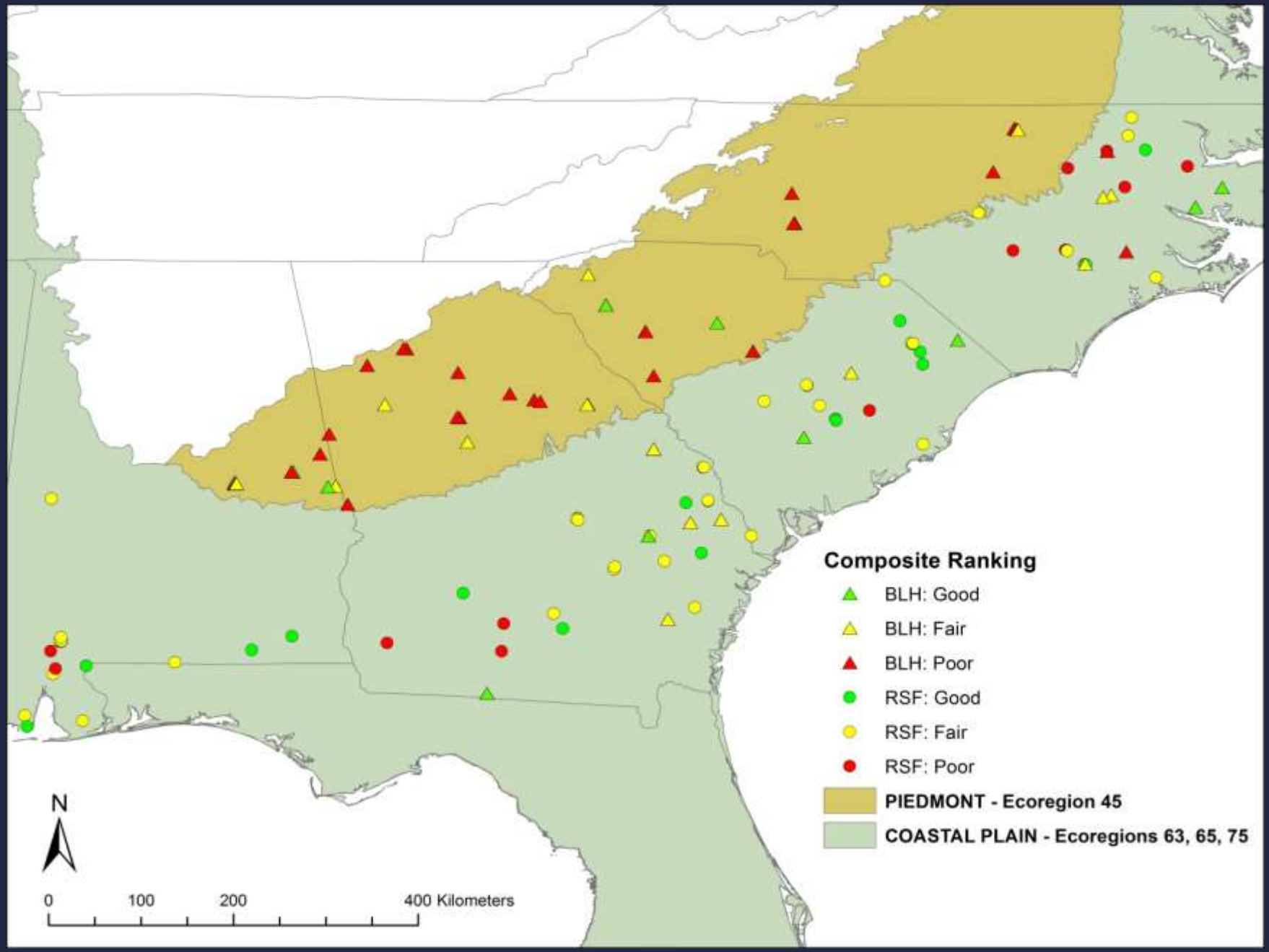
Composite score for each site based on:

- LDI 300m
- Ohio Rapid Assessment Method (ORAM)
- NC Wetland Assessment Method (NCWAM)
- USARAM
- Amphibian Quality Assessment Index
- Macroinvertebrate Biotic Index
- Veg Index of Biotic Integrity (IBI)
- Soil Combined Metals (Cu, Mg, Zn)
- Water Quality Nutrients (P+TKN)

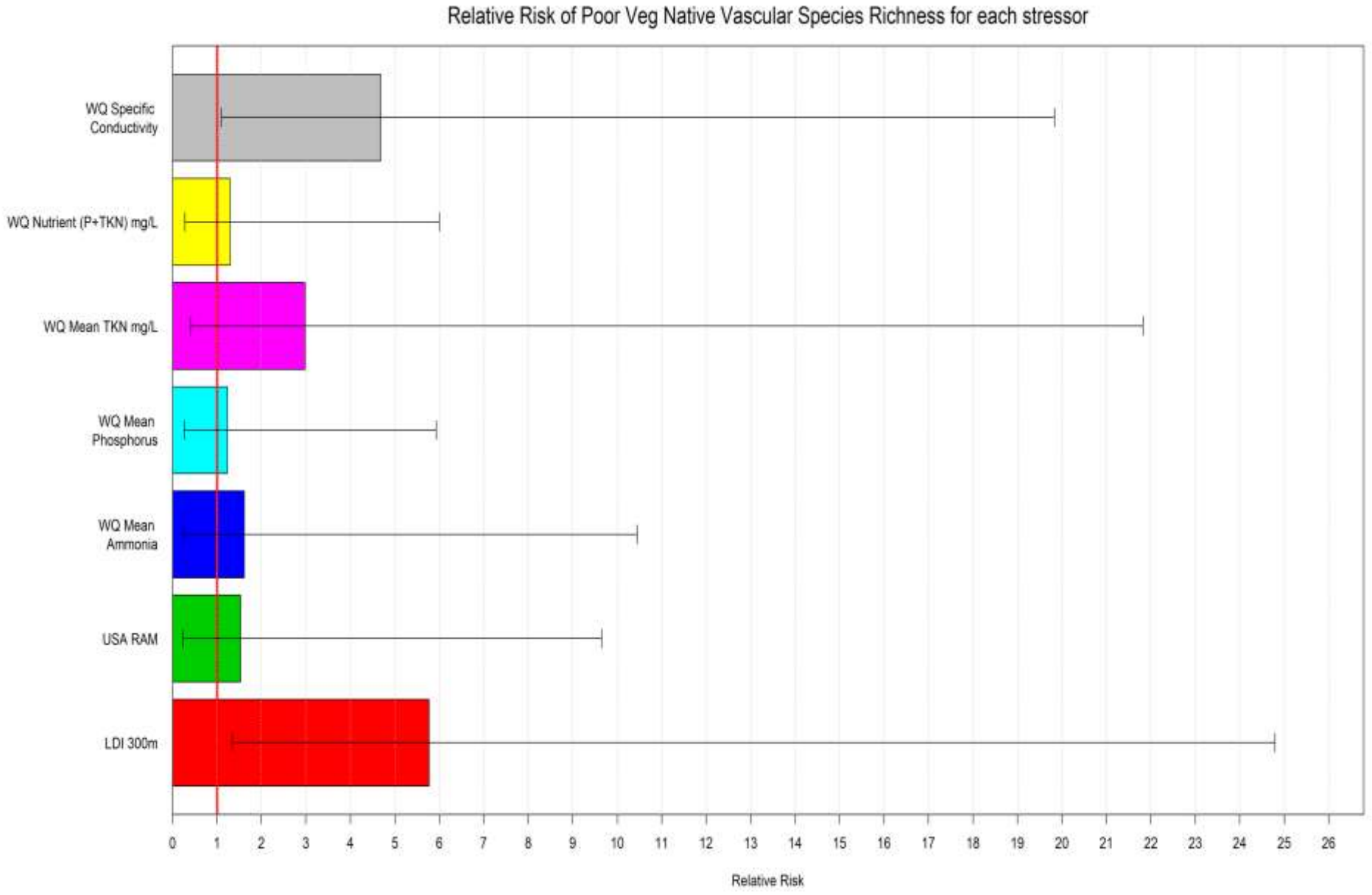
Rank sites from best to worst for each metric
Ranks averaged for each site

Good = best 25%
Fair = middle 50%
Poor = worst 25%

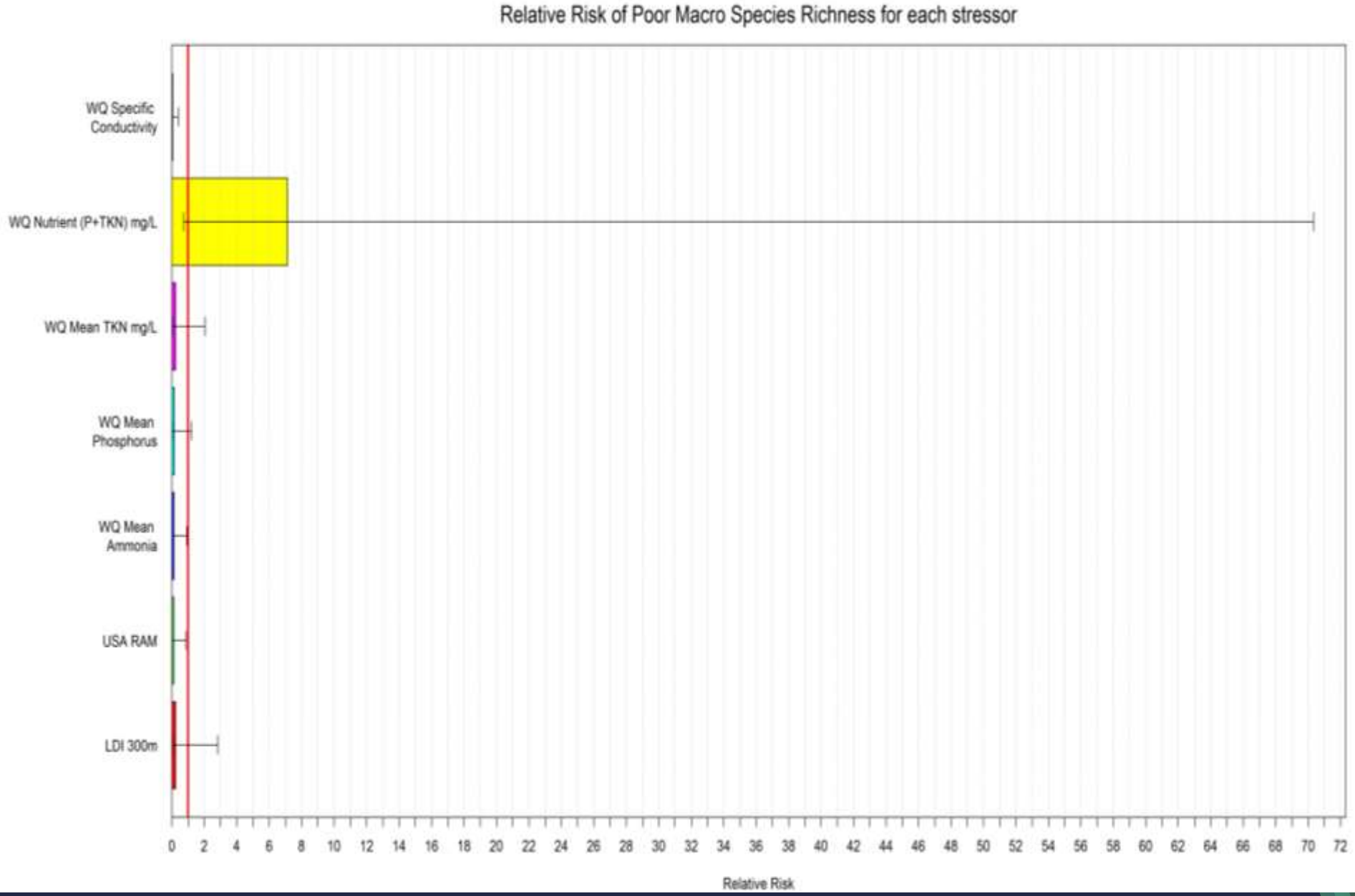
Wetland Condition Analysis – Multi-metric Ranking



Relative Risk Analyses

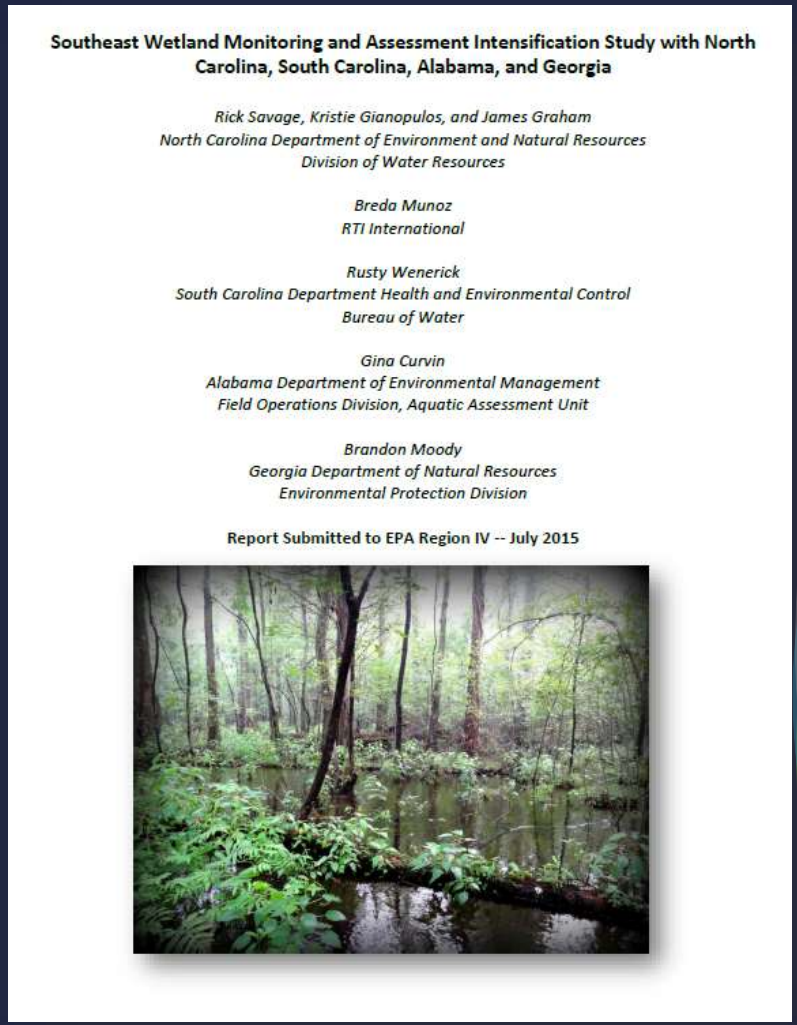


Relative Risk Analyses



Final report available on Southeast Wetland Workgroup website

https://sewwg.rti.org --> Information and Resources



Southeast Wetland Monitoring and Assessment Intensification Study with North Carolina, South Carolina, Alabama, and Georgia

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Report Submitted to EPA Region IV -- July 2015

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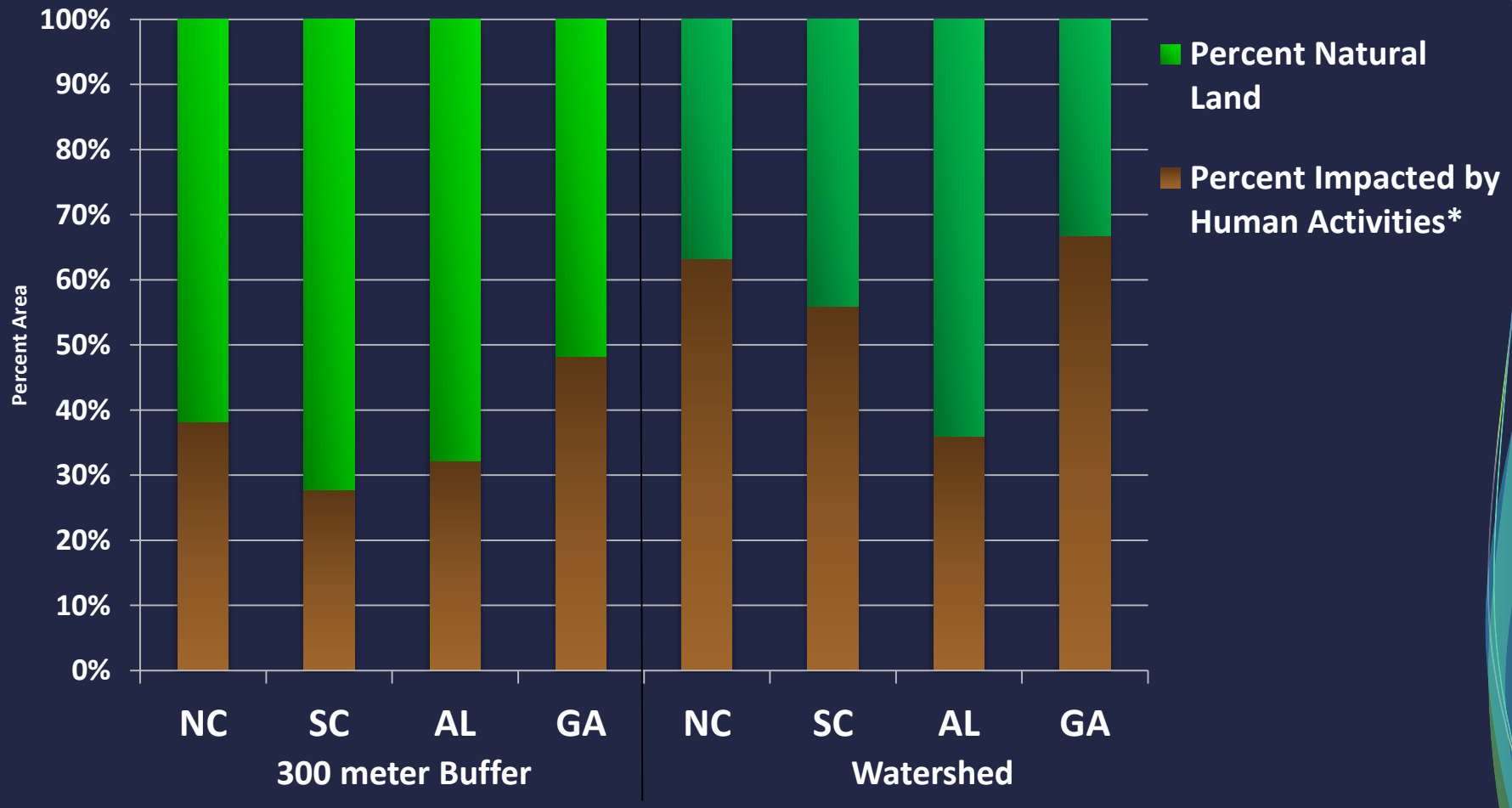
Marbled Salamander photo by John White
All other photos by Kristie Gianopulos

Supplemental Slides

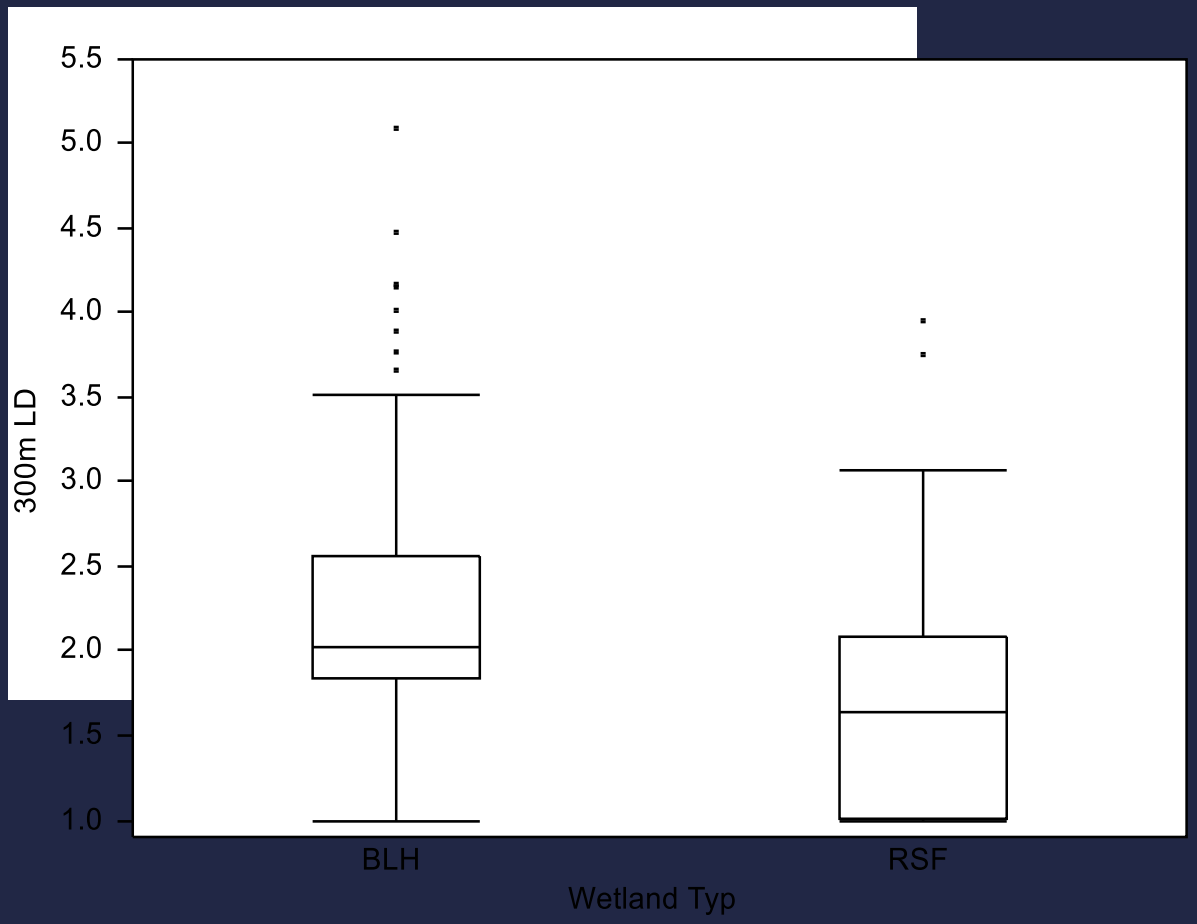
Landscape Development Extent



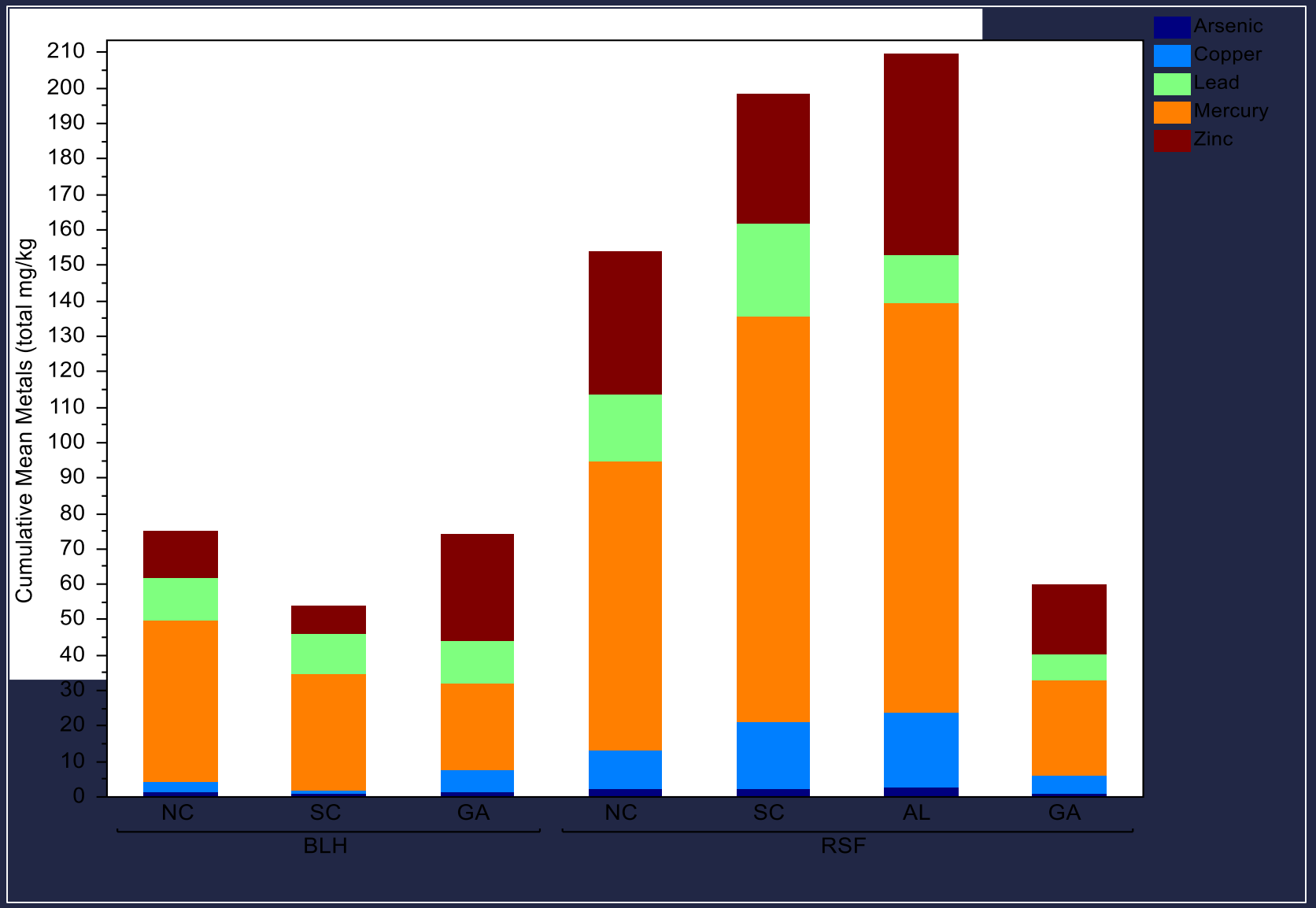
*Relatively recent human activities (distinguishable from aerial photointerpretation)

Landscape Development Intensity Index (LDI)

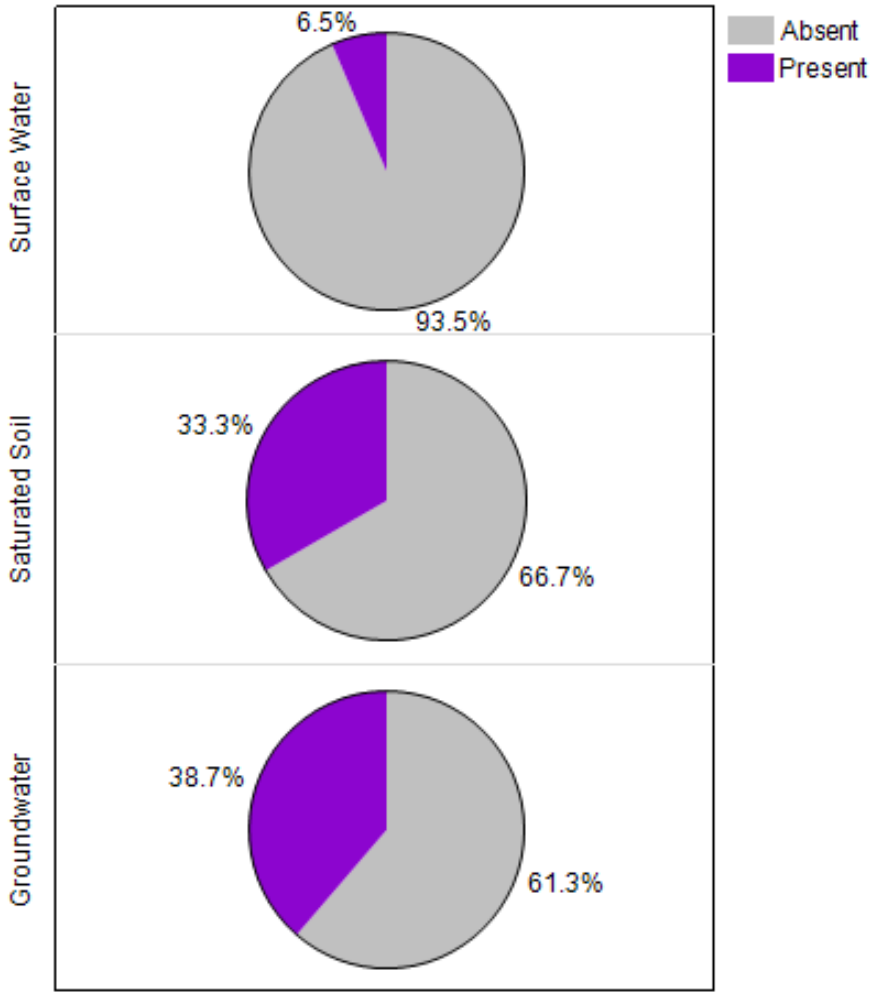
300m LDI



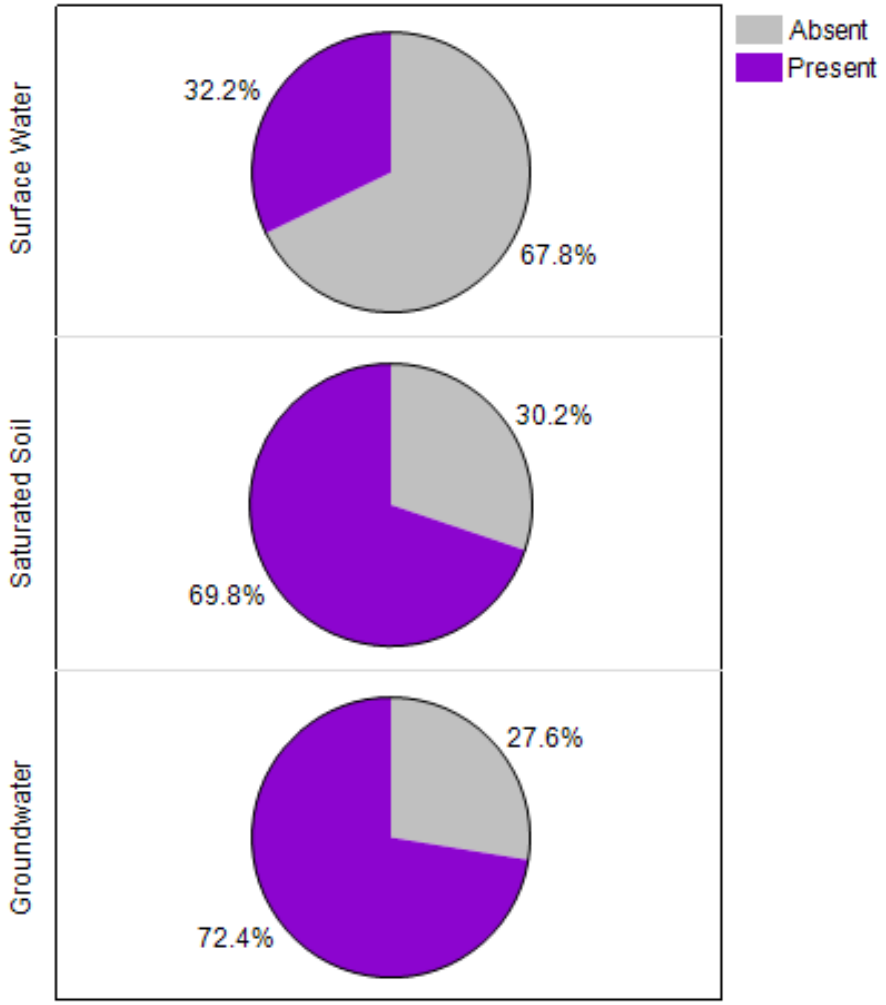
Soils


Arsenic
Copper
Lead
Mercury
Zinc
Cumulative Mean Metals (total mg/kg
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
NC
SC
GA
NC
SC
AL
GA
BLH
RSF

Soils



Bottomland Hardwood Wetlands

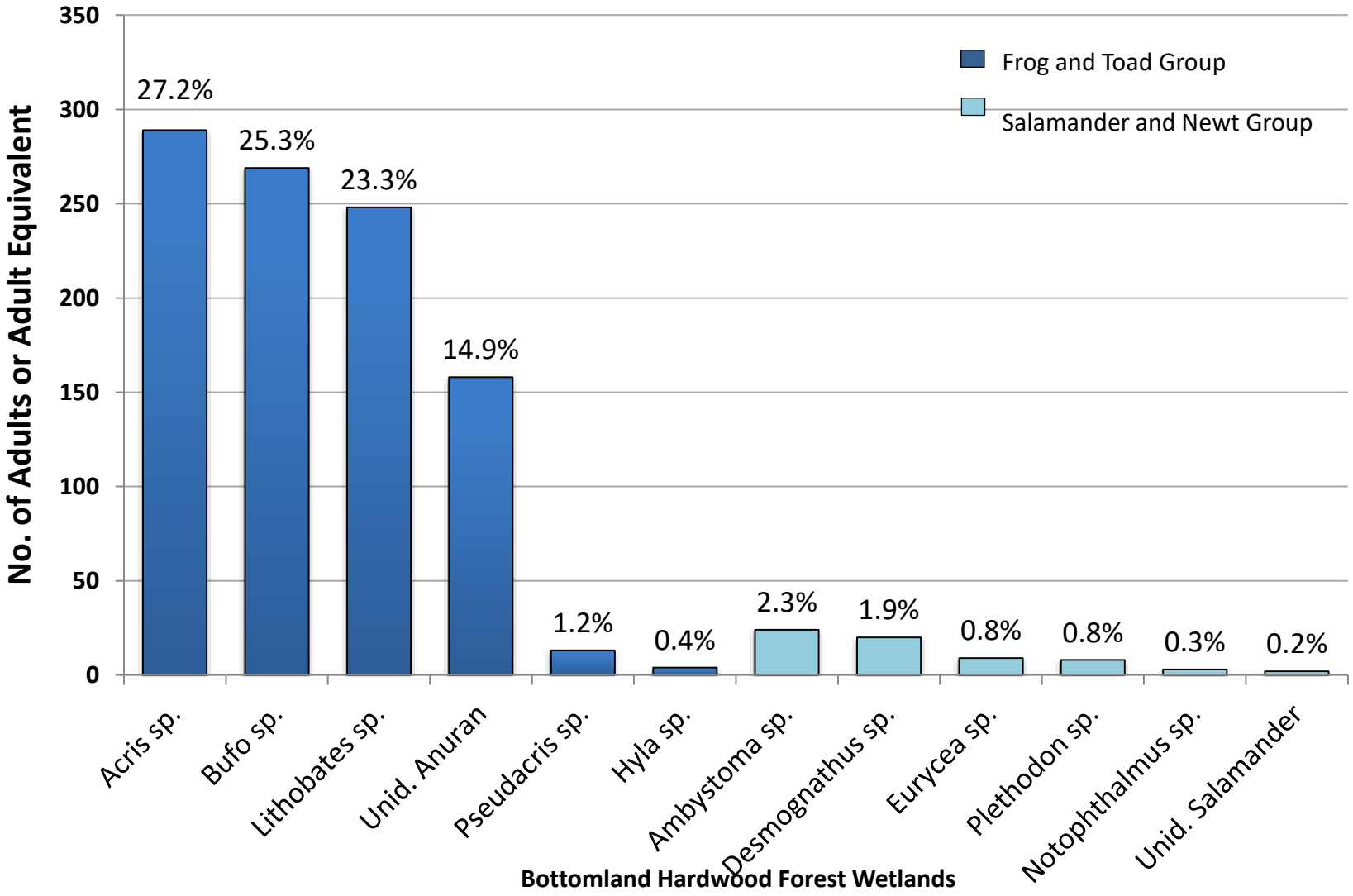


Riverine Swamp Forests

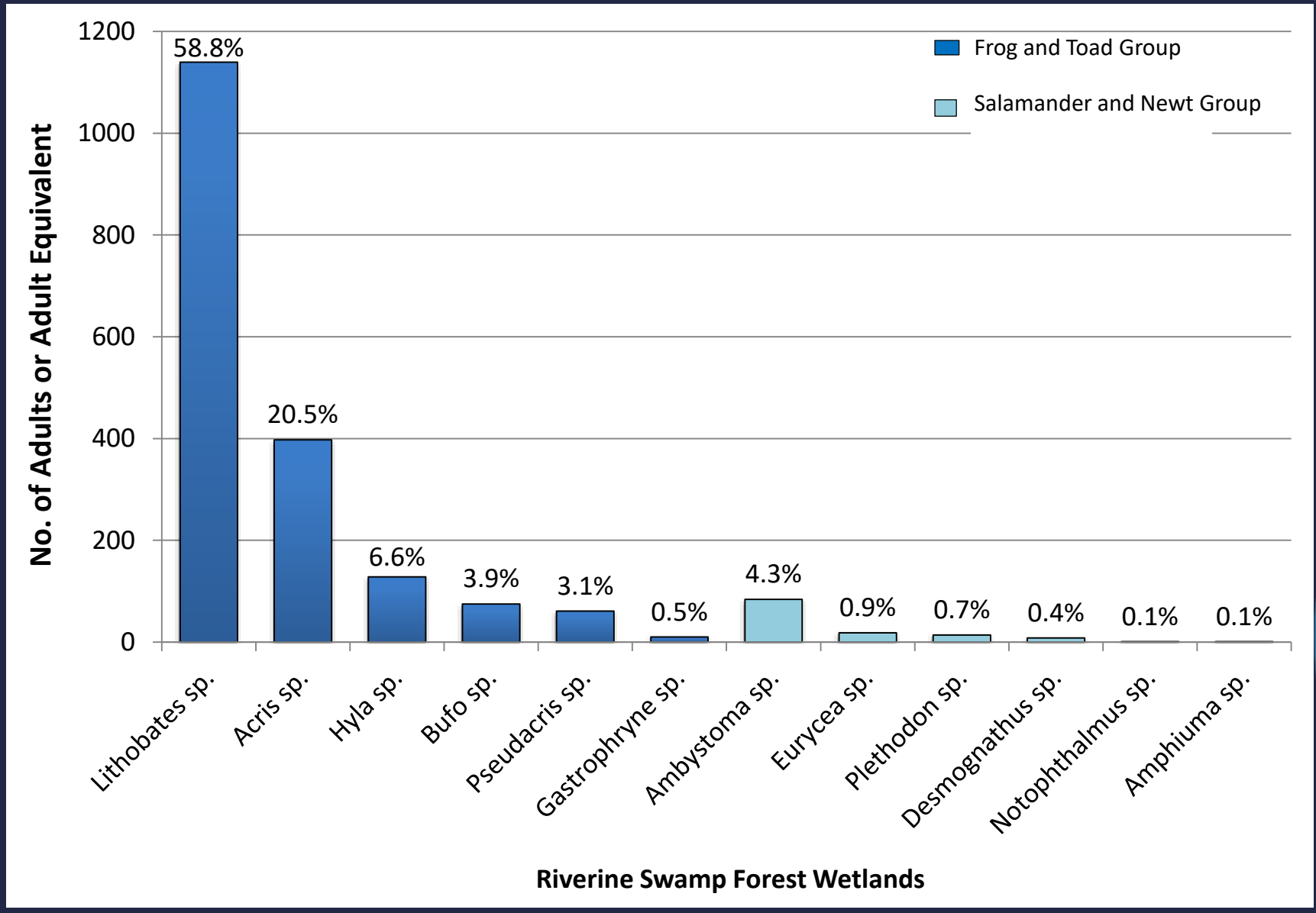
Amphibians –

- BLH:
  - 15 frog species (+ 2 unid.)
  - 9 (+ 2 unid.) salamander species
- RSF:
  - 19 frog species (+ 3 unid.)
  - 12 (+ 2 unid.) salamander species
- BLH: Mean 42 indiv. (range 1-264)
- RSF: Mean 67 indiv. (range 3-885)
- Most common frog/toad sp.: Northern Cricket Frog
- Most common salamander spp.: Marbled and Spotted salamanders

Amphibians – BLH wetlands



Amphibians – RSF wetlands

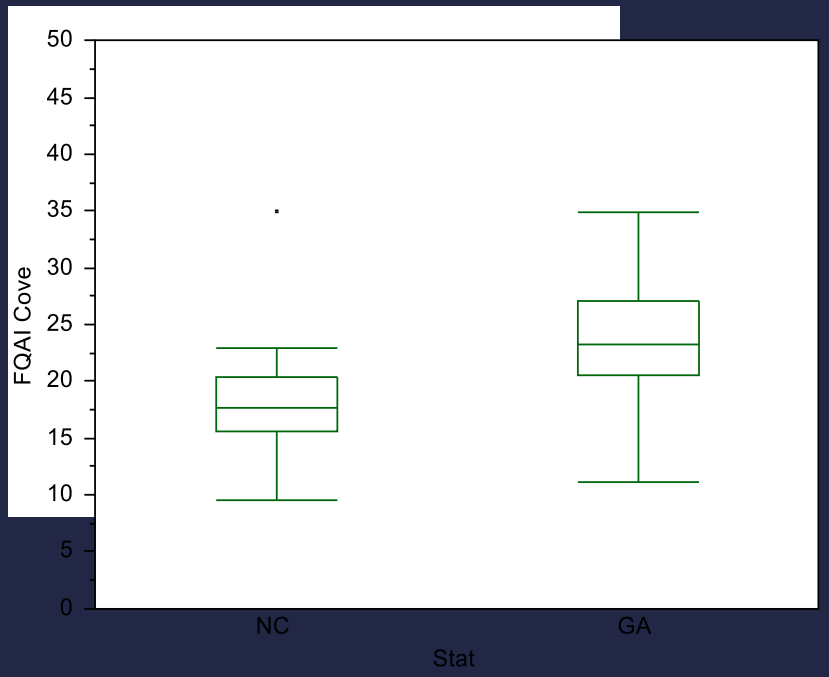


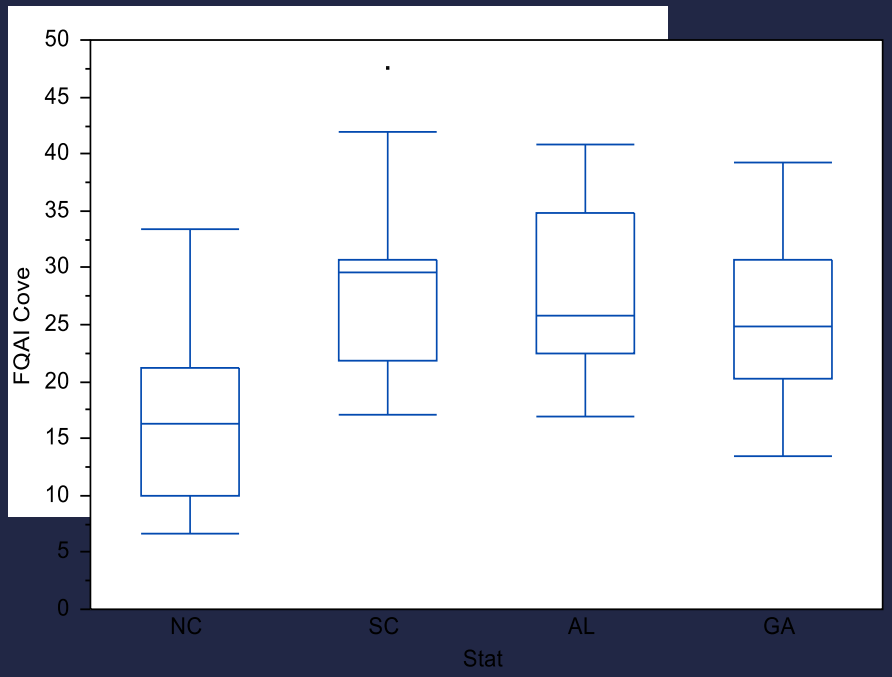
Macroinvertebrate Species Composition

- BLH: 56 taxa
- RSF: 232 taxa
- BLH: Mean 291 individuals (range 110-635)
- RSF: Mean 424 individuals (range 37-895)
- Overall most common taxa:
  Freshwater isopods - Caecidotea spp. and Asellus spp.
- Rare (1 indiv. observed across all sites):
  73 different taxa

Vegetation – FQAI (Cover weighted)

$$FQAI_{cov} = \frac{\sum(C*cover)}{\sqrt{(N*total\ cover)}}$$





Bottomland Hardwood Wetlands

Riverine Swamp Forests

Regression Analysis – what are the rapid assessments able to predict?

LDI (300m)

Soil
- Combined Metals
- Total % Carbon and % Nitrogen

Water
- Magnesium
- Depth to Groundwater
- Depth of Surface Water

Veg
- Dominance (cover)
- Mean C and % Tolerant Cover

Macroinvertebrates
- % Crustaceae, % Decapoda, and % Diptera
- Richness and Diversity

LDI
- Watershed LDI

NCWAM

Soil
- Mean Humic Matter

Water
- Nutrients (TKN+P), Nitrates
- Fecal Colliform
- Depth to Groundwater
- Depth of Surface Water

Veg
- FQAI, Mean C, and % Tolerant Cover
- Native Richness
- Relative Cover of Trees
- Herb Cover in the Buffer

Amphibians
- AQAI and Mean C

Macroinvertebrates
- % Crustaceae and % Decapoda
- Diversity

LDI
- Watershed LDI

Regression Analysis – what are the rapid assessments able to predict?

ORAM

Soil
- Combined Metals
- Total % Carbon and % Nitrogen

Water
- Nutrients (TKN+P), Magnesium
- Fecal Colliform
- Depth to Groundwater
- Depth of Surface Water

Veg
- FQAI, Mean C, and % Tolerant
- Native Richness, Tolerant Richness
- Small Woody Shrubs in the Buffer

Amphibians
- AQAI and Mean C
- Species Richness and Abundance of Adults

Macroinvertebrates
- % Chironomidae, % Crustaceae, and % Decapoda
- Richness and Diversity

LDI
- Watershed LDI

USARAM (NC DWR scoring method)

Soil
- Mean Humic Matter
- pH and Base Saturation

Water
- Copper
- Fecal Colliform
- Depth to Groundwater

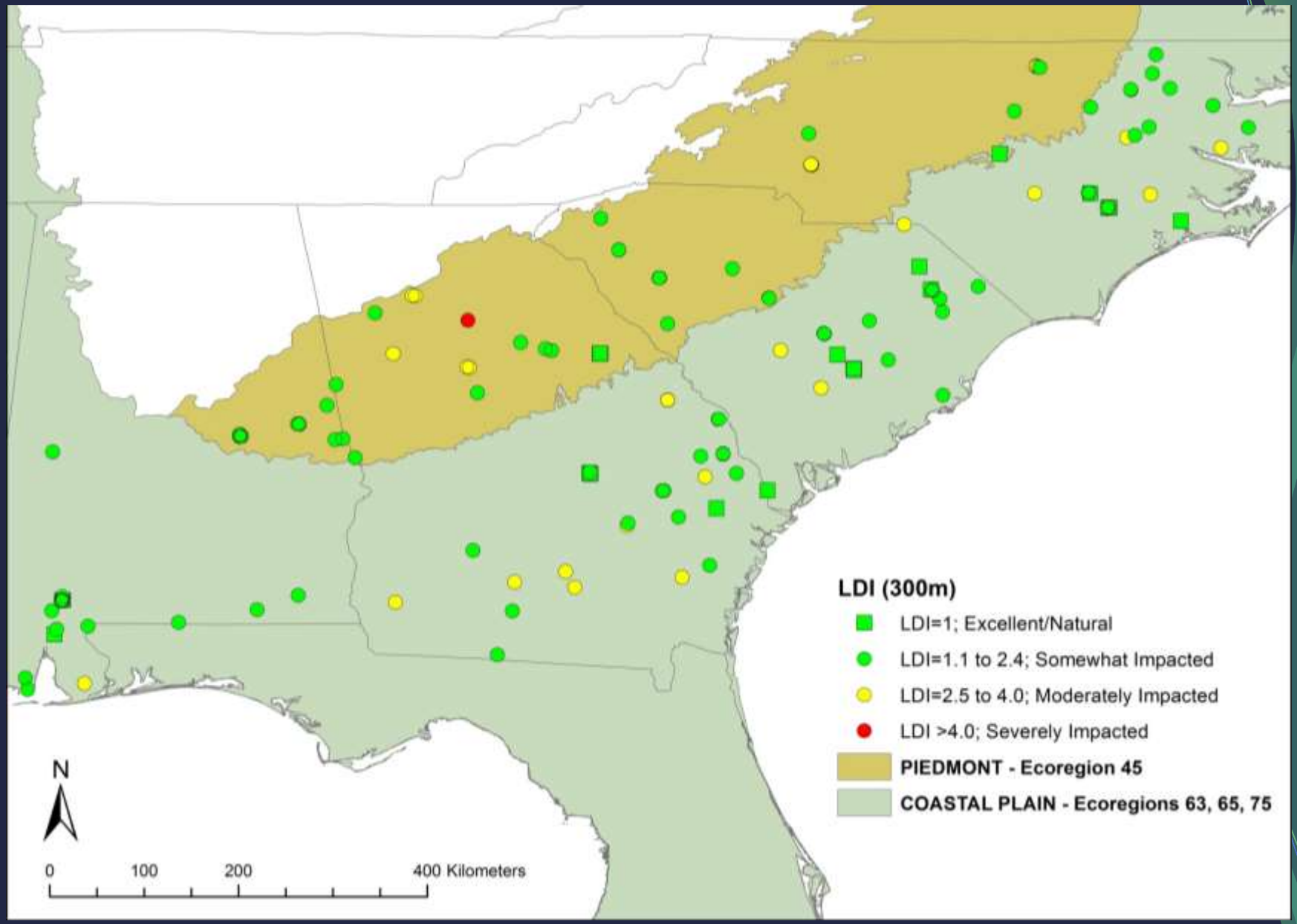
Veg
- FQAI, Mean C, and % Tolerant Cover
- Relative Cover of Trees
- Herb Cover in the Buffer

Amphibians
- AQAI
- Species Richness

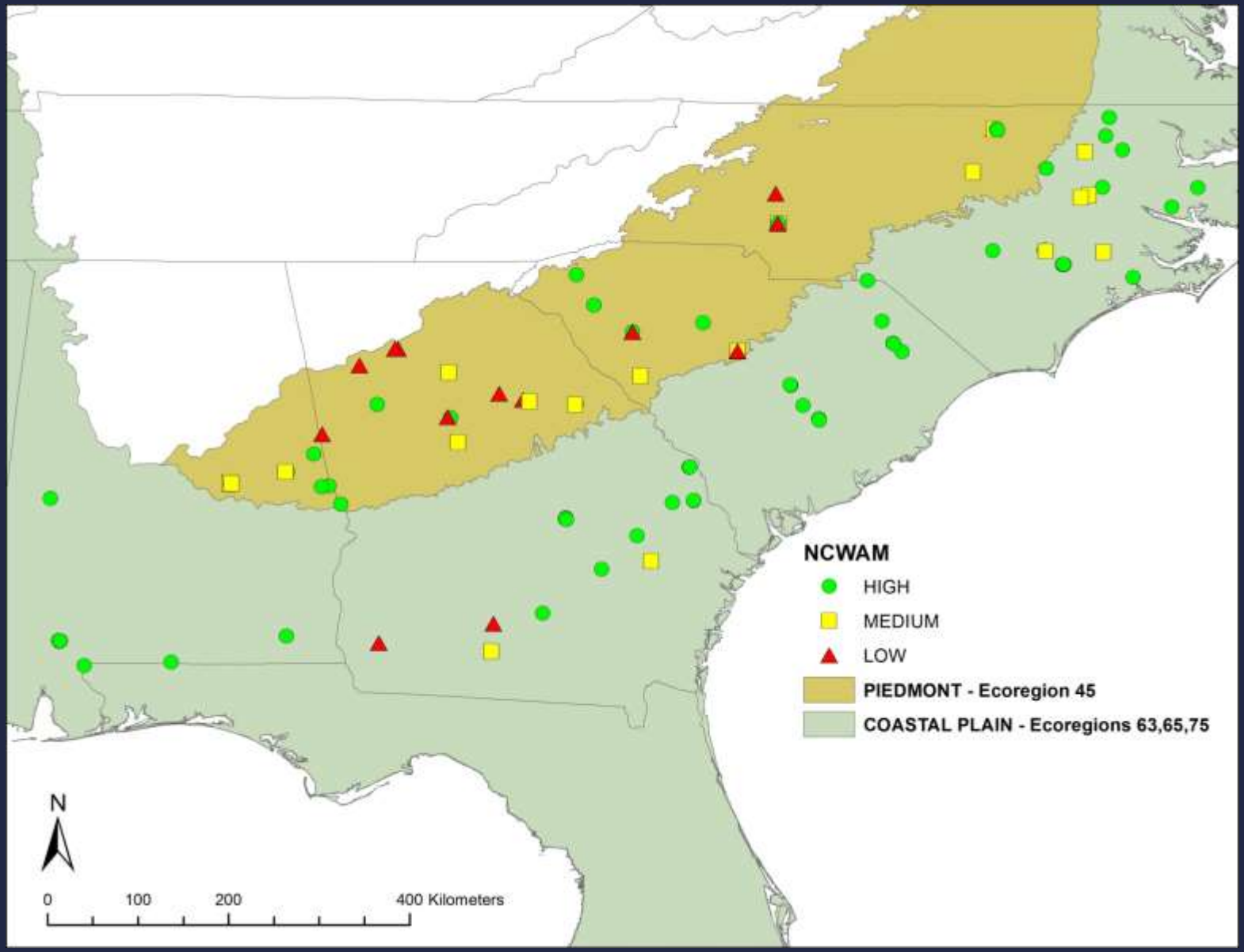
Macroinvertebrates
- % Crustaceae and % Decapoda
- Richness and Diversity
- Macroinvert. Biotic Index (MBI)

LDI
- Watershed LDI

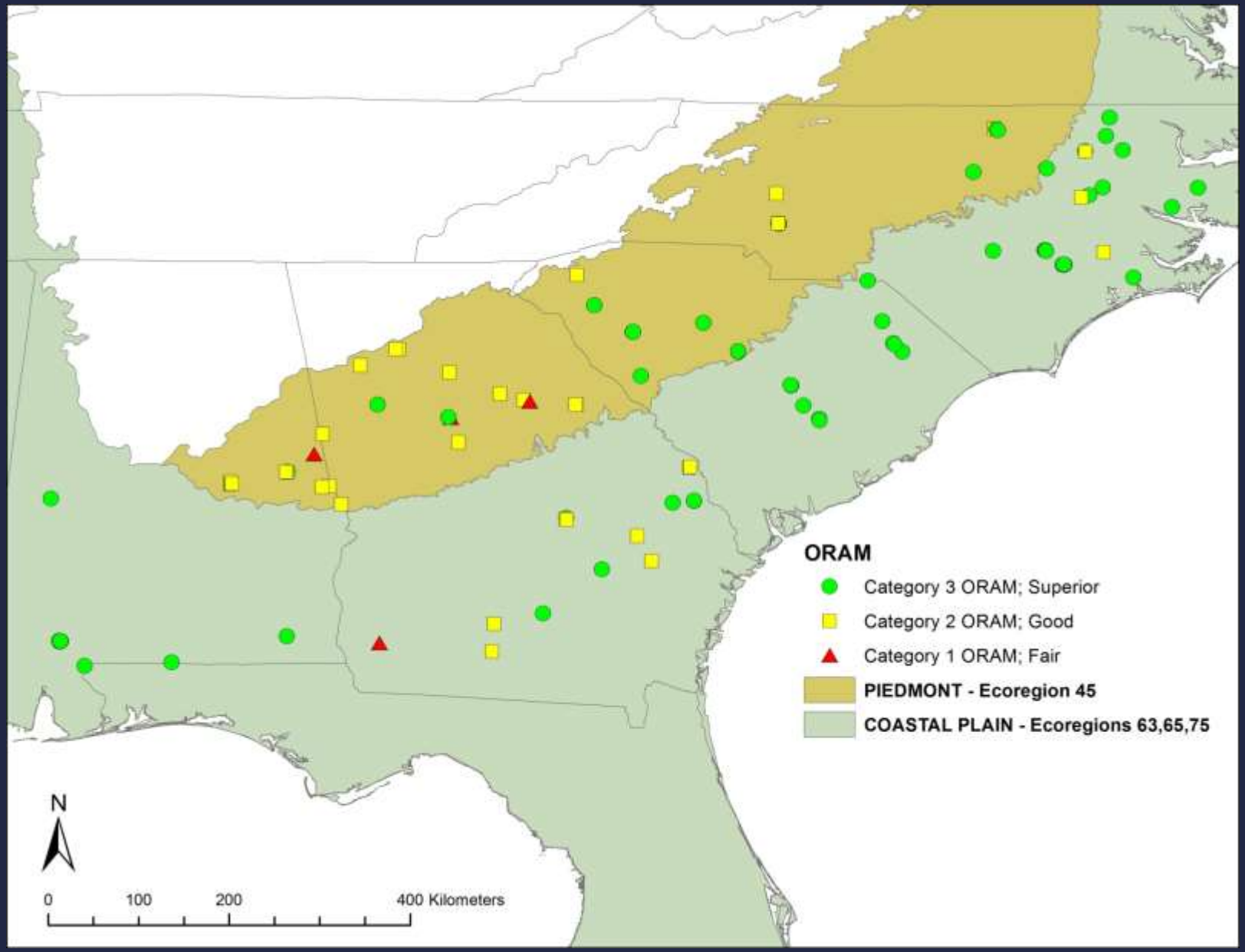
LDI 300m


LDI (300m)
LDI=1; Excellent/Natural
LDI=1.1 to 2.4; Somewhat Impacted
LDI=2.5 to 4.0; Moderately Impacted
LDI >4.0; Severely Impacted
PIEDMONT - Ecoregion 45
COASTAL PLAIN - Ecoregions 63, 65, 75
N
0
100
200
400 Kilometers

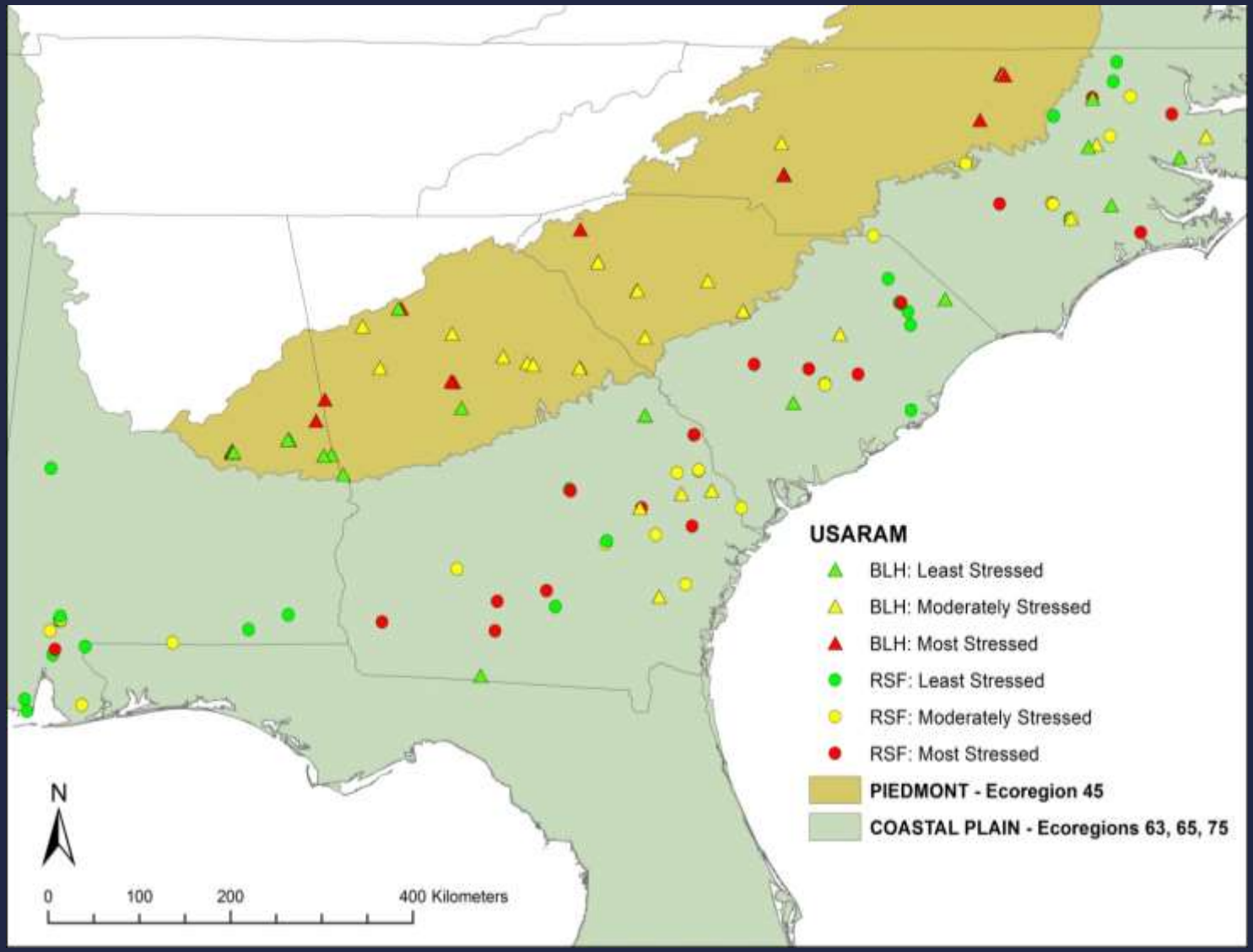
NCWAM


NCWAM
HIGH
MEDIUM
LOW
PIEDMONT - Ecoregion 45
COASTAL PLAIN - Ecoregions 63,65,75
N
0
100
200
400 Kilometers

ORAM


ORAM
Category 3 ORAM; Superior
Category 2 ORAM; Good
Category 1 ORAM; Fair
PIEDMONT - Ecoregion 45
COASTAL PLAIN - Ecoregions 63,65,75
N
0
100
200
400 Kilometers

USARAM



USARAM stress level classification was based on weighted lower (least stressed) and upper (most stressed) 25th percentiles, with the middle 50% percentile considered moderately. Percentiles were calculated separately for BLH and RSF. BLH Least Stressed = 0 – 16.8, BLH Moderately Stressed = 16.9 – 26.7, BLH Most Stressed = above 26.7; RSF Least Stressed = 0 – 15.0, RSF Moderately Stressed = 15.1 – 20.7, and RSF Most Stressed = above 20.7.