

Using Probabilistic Monitoring Data to Recommend Stressor Risk Levels in Aquatic Life Use Total Maximum Daily Load Studies

Jason Hill, Mary Dail, and Larry Willis | 29 April 2014

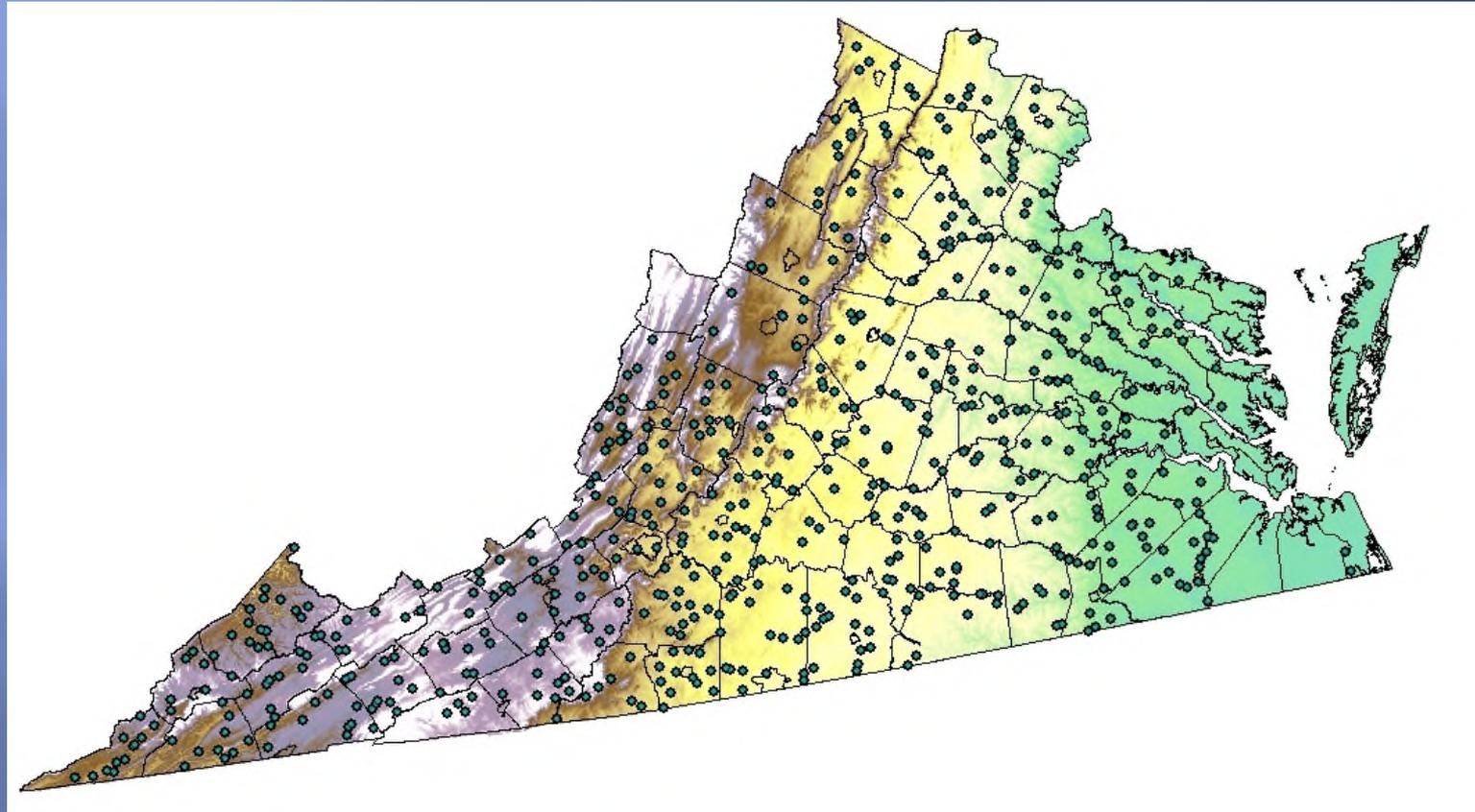


Need for Stressor Thresholds

- ▣ More defensible stressor analysis process
- ▣ 563 “Biologically Impaired Reaches” in Virginia
 - 134 Category 4A (Benthic TMDL done and approved)
 - 265 Category 5A (Benthic TMDL needed)
 - 162 Category 5D (Benthic TMDL may be needed)
 - 2 Category 5F (Benthic TMDL may be needed)



Wadeable Probabilistic Sites 2001-2010



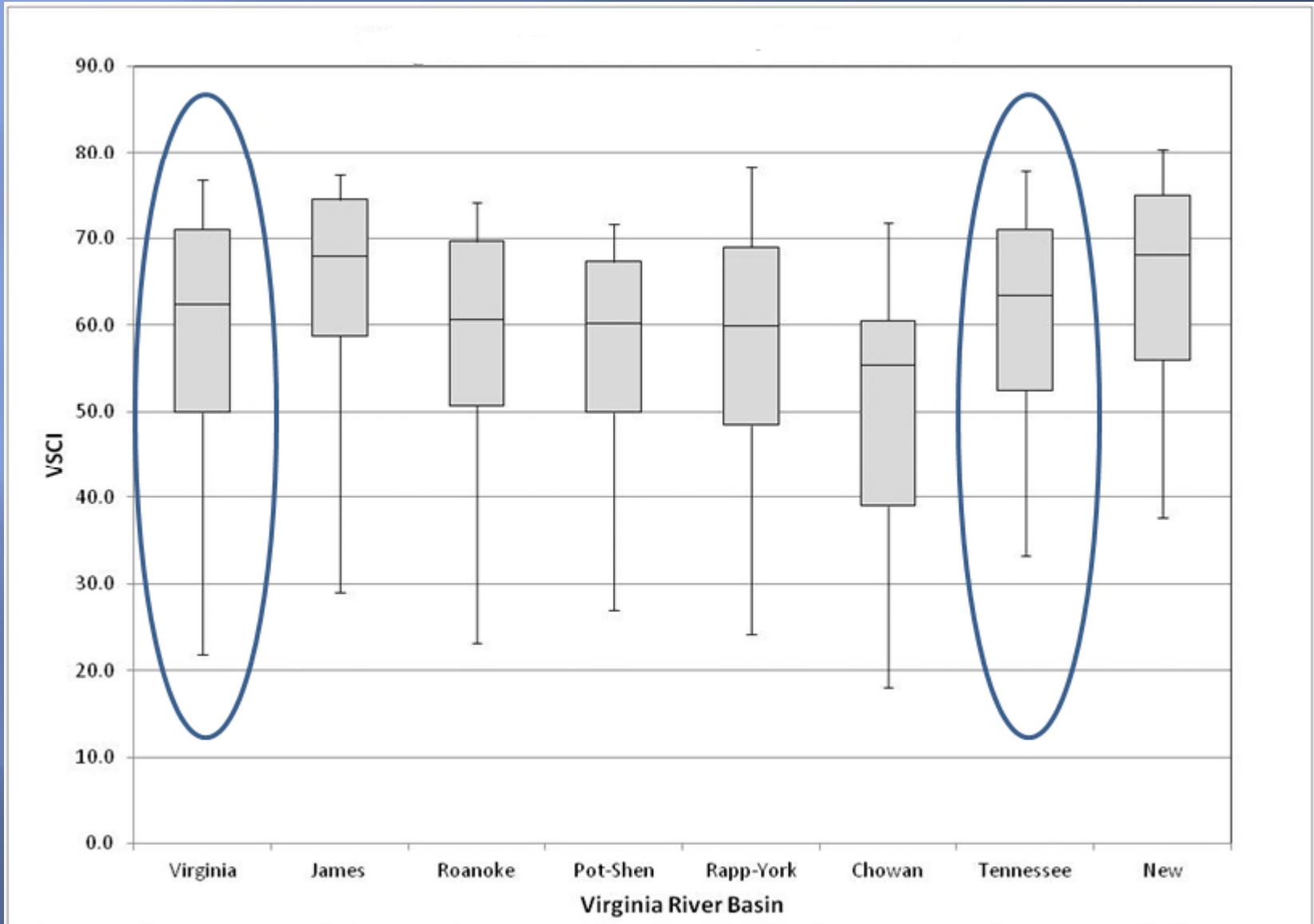
- ▣ Probabilistic data set: 474 sites with co-located benthic and water chemistry/habitat data

What makes a “healthy” benthic macroinvertebrate community?

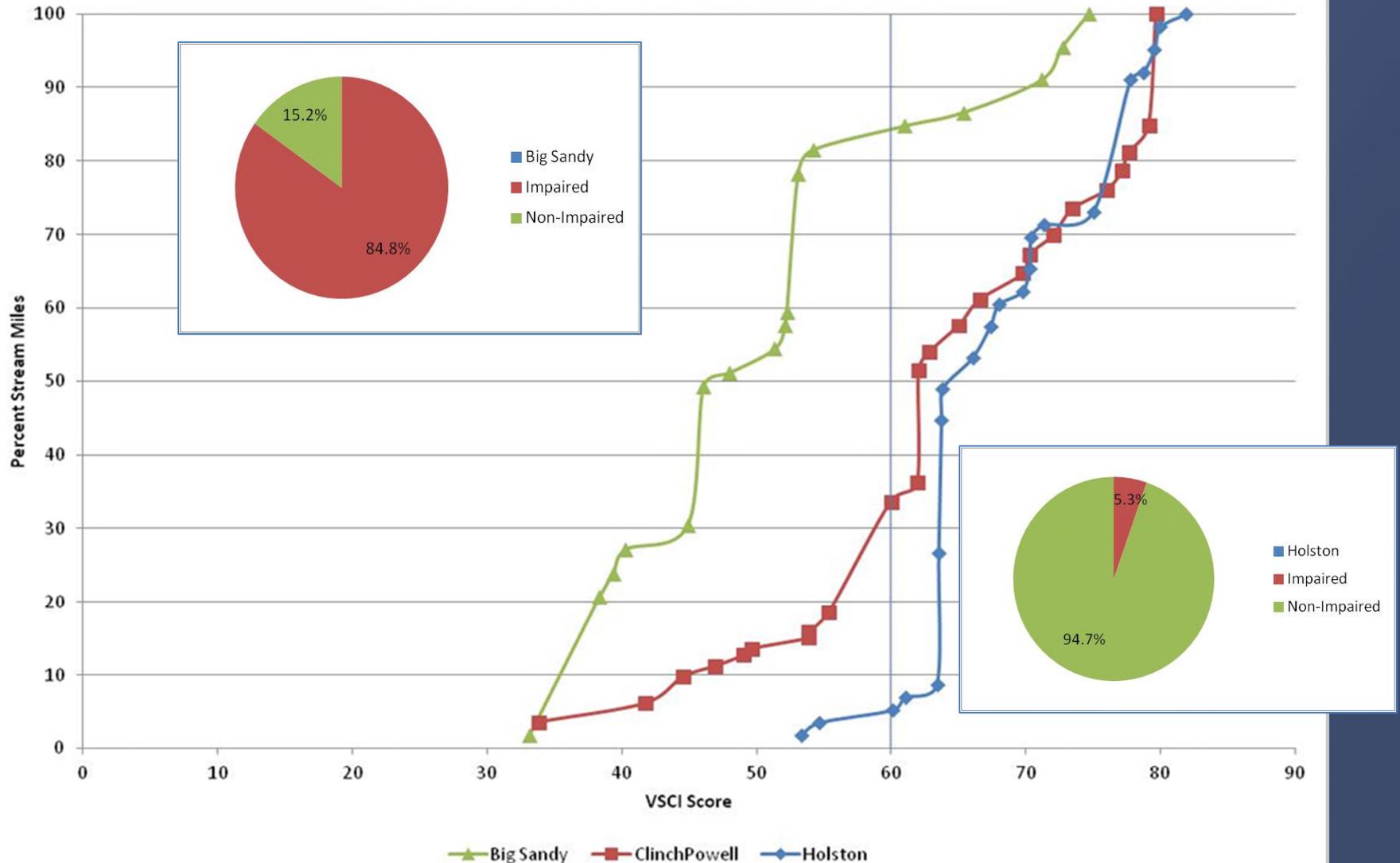
- ▣ Diversity
- ▣ Presence of pollution intolerant invertebrates
 - Stonefly, Mayfly & Caddisfly larvae
- ▣ Habitat
- ▣ **VSCI Score > 60**
 - ▣ Integrated to reflect biological community characteristics and measure the overall response of the community to pollution or environmental stress



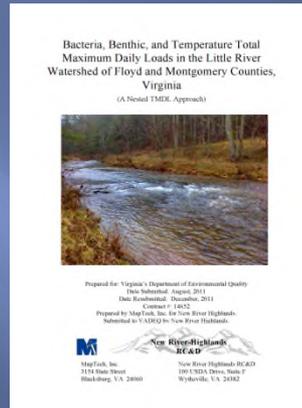
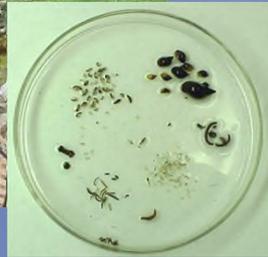
Statewide Virginia Stream Condition Index Scores by Basin



Statewide Virginia Stream Condition Index Scores by Tennessee River Sub-Basin



Benthic Macroinvertebrate TMDLs in Virginia



Impairment Listing

Biomonitoring shows shift in benthic macroinvert community

TMDL Study

- *Stressor Analysis*
- Pollutant reductions
- Public Participation
- TMDL Report

TMDL IP

- Address NPS & PS pollution
- Develop Cleanup Plan 
- Identify & obtain funding

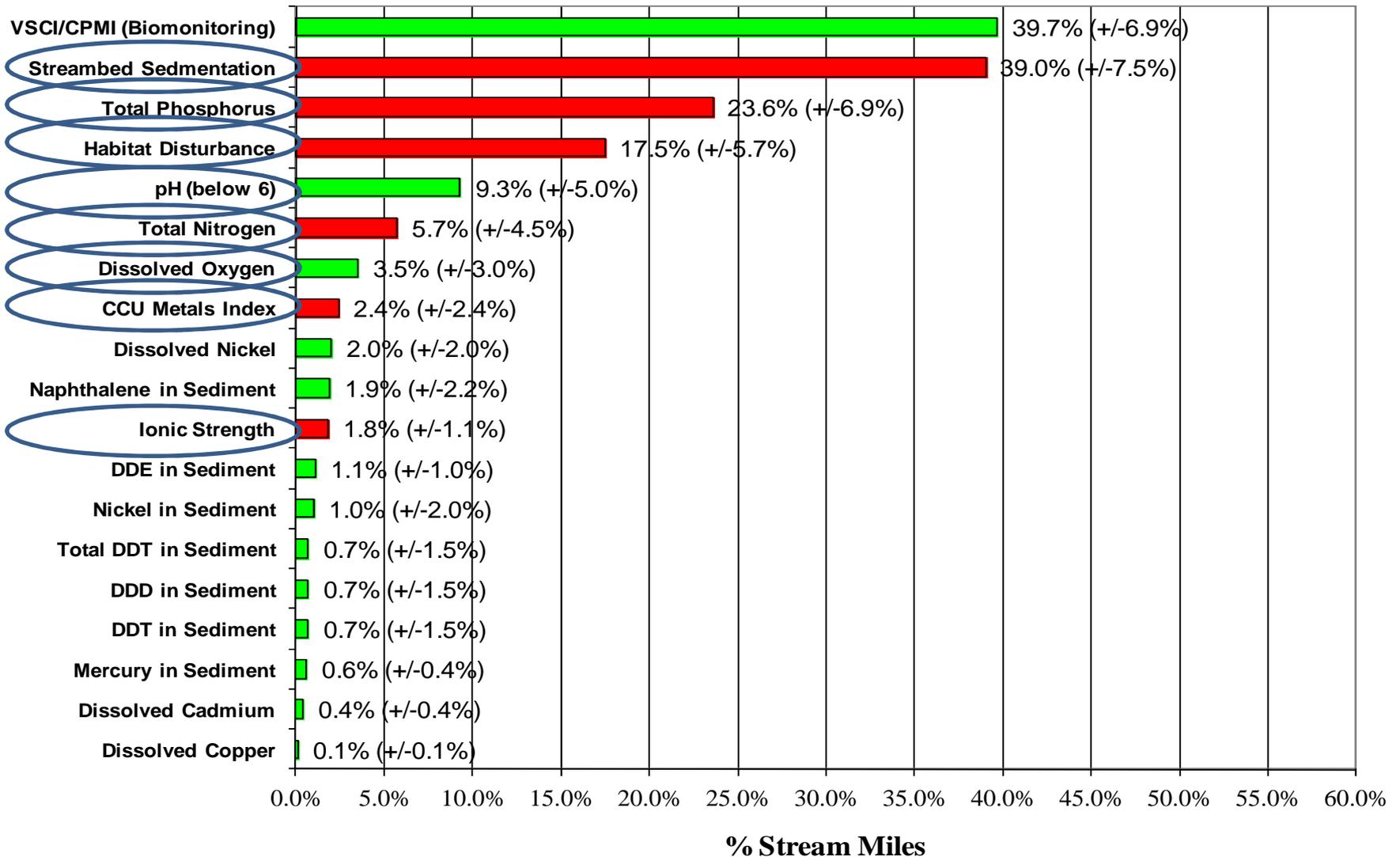
GOAL: Restore water quality and **DELIST** stream segment(s) based on follow-up Biomonitoring

Biologist/TMDL Staff Workgroup

- 2009 Biologist Self Assessment identified a need to improve **stressor analyses** for benthic TMDLs
- A workgroup was formed to develop *Benthic TMDLs: Data Collection and Stressor Thresholds* document:
 - Foster greater collaboration between Biologists & TMDL staff
 - **Provide data collection guidelines**
 - **Develop new tools for water quality data analyses**
 - Screening values & statewide percentiles
 - **Data interpretation “how to”**
 - Establish a standing workgroup of technical experts for benthic TMDL advice.



Water Quality Stressors in Virginia

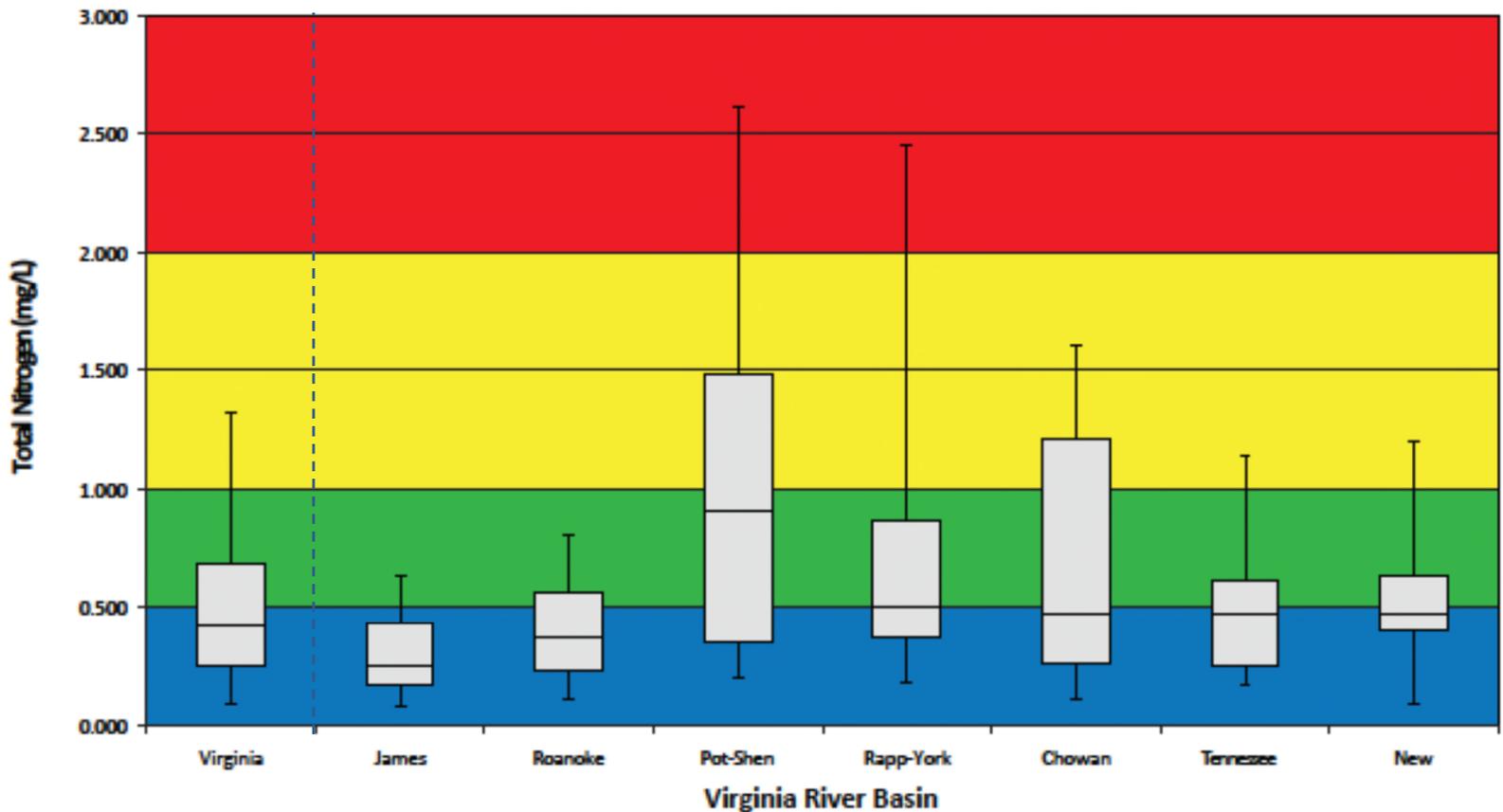


Sample Chapter: Total Nitrogen

- ▣ Chapter Content (Exit to Word)
 - Total Nitrogen
 - Total Nitrogen in VA
 - ▣ Box-and-whisker plots and percentiles by basin, ecoregion and stream order
 - Total Nitrogen (mg/L) Level Risk Recommendations for Aquatic Life
 - Relationship to other stressors
- ▣ Appendices contain in-depth statistical analyses

Provide Tools - Basin

Total Nitrogen (mg/L) By Basin

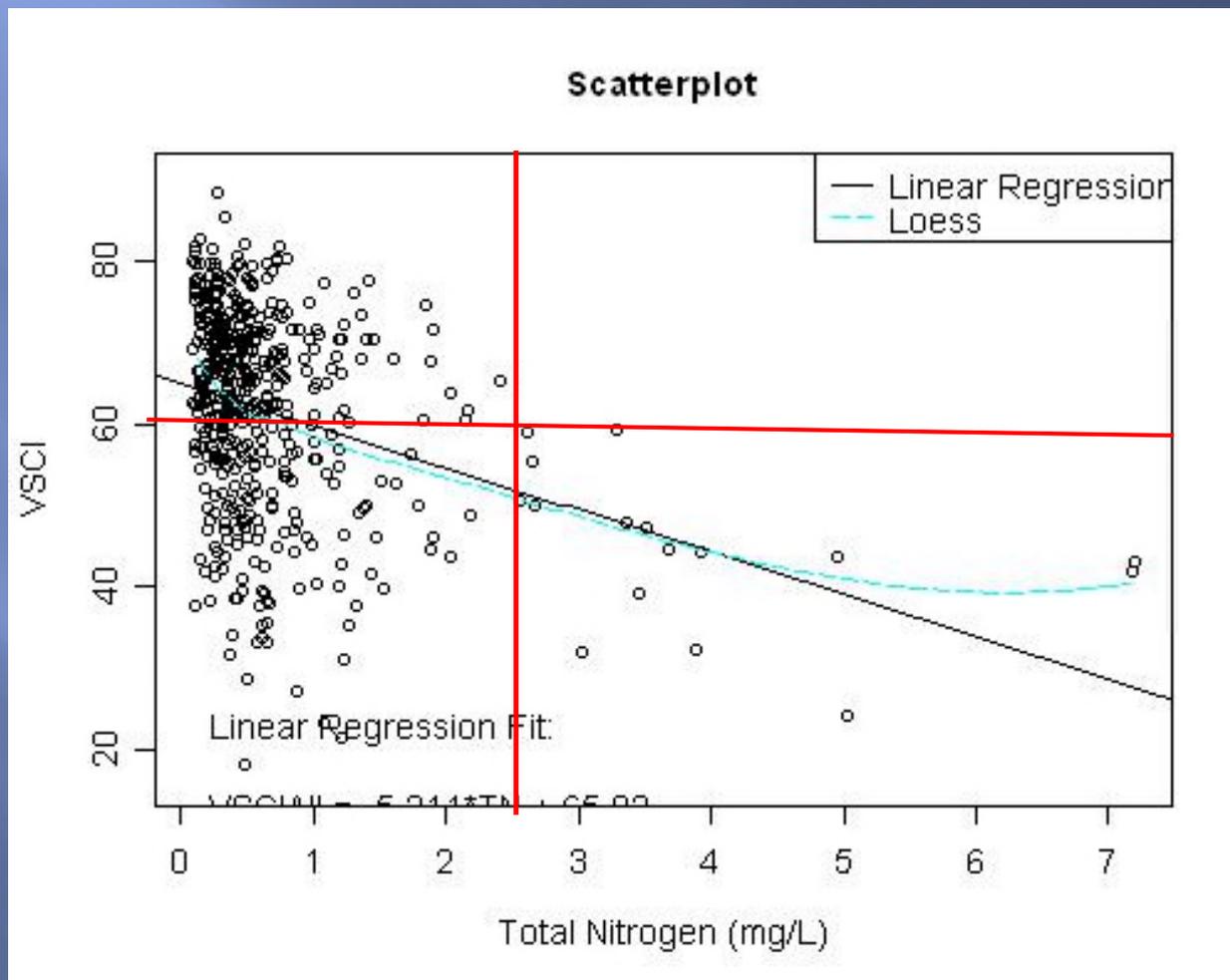


Provide Tools - Basin

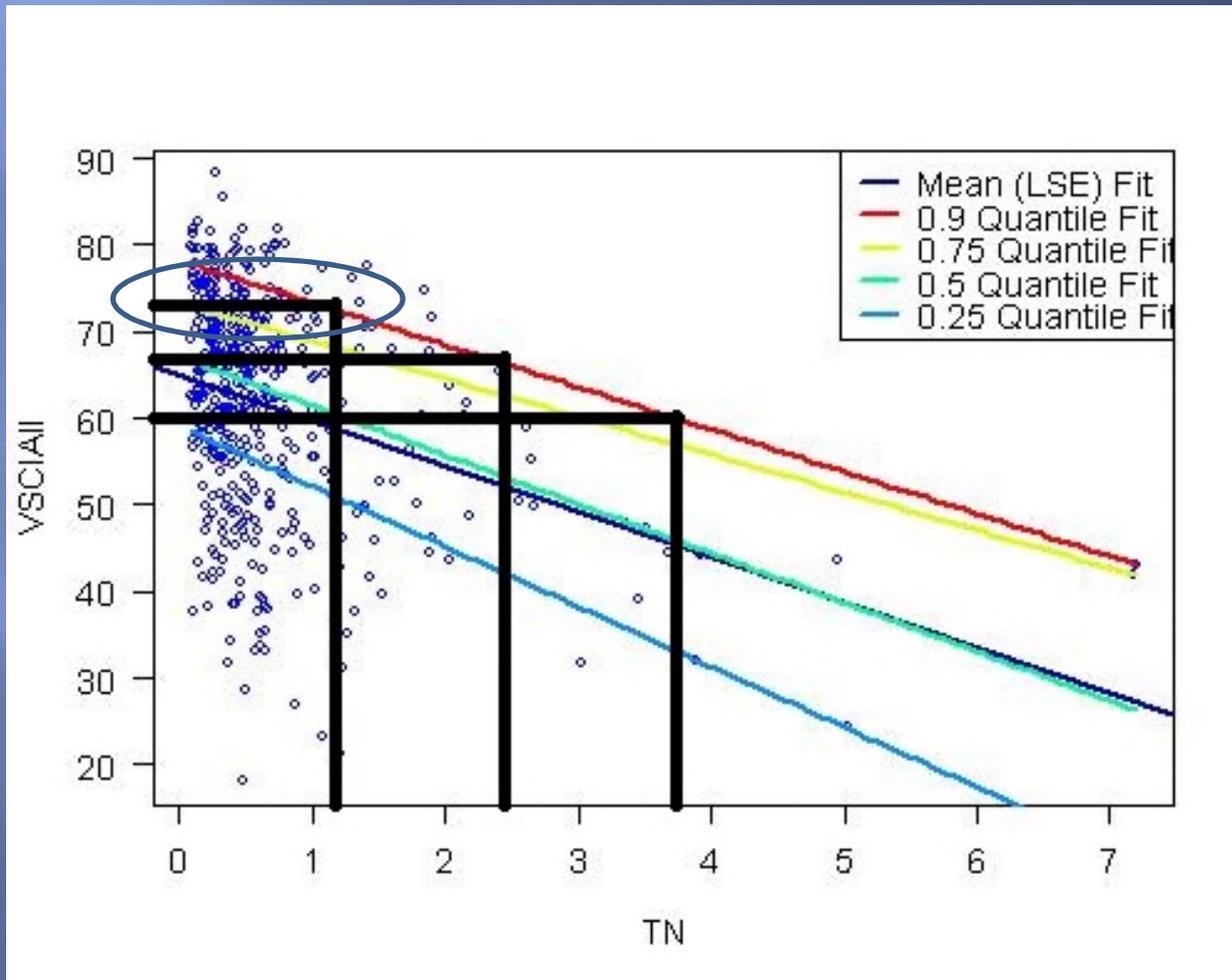
Statistic	Virginia	James	Roanoke	Pot-Shen	Rapp-York	Chowan	Tennessee	New
1Pct	0.093	0.084	0.106	0.200	0.180	0.105	0.170	0.085
5Pct	0.130	0.096	0.141	0.221	0.216	0.105	0.177	0.096
10Pct	0.160	0.109	0.172	0.247	0.262	0.130	0.180	0.099
25Pct	0.248	0.172	0.235	0.357	0.370	0.265	0.246	0.401
50Pct	0.428	0.252	0.376	0.905	0.503	0.470	0.476	0.469
75Pct	0.687	0.433	0.566	1.488	0.864	1.210	0.620	0.636
90Pct	1.317	0.637	0.806	2.612	2.453	1.604	1.139	1.197
95Pct	1.883	1.015	1.041	3.441	3.193	2.279	1.361	1.381
99Pct	3.497	1.975	1.174	7.189	4.007	2.872	1.929	1.630

- Also would provide tables, graphics by stream order (size) and ecoregion to help determine stressor significance

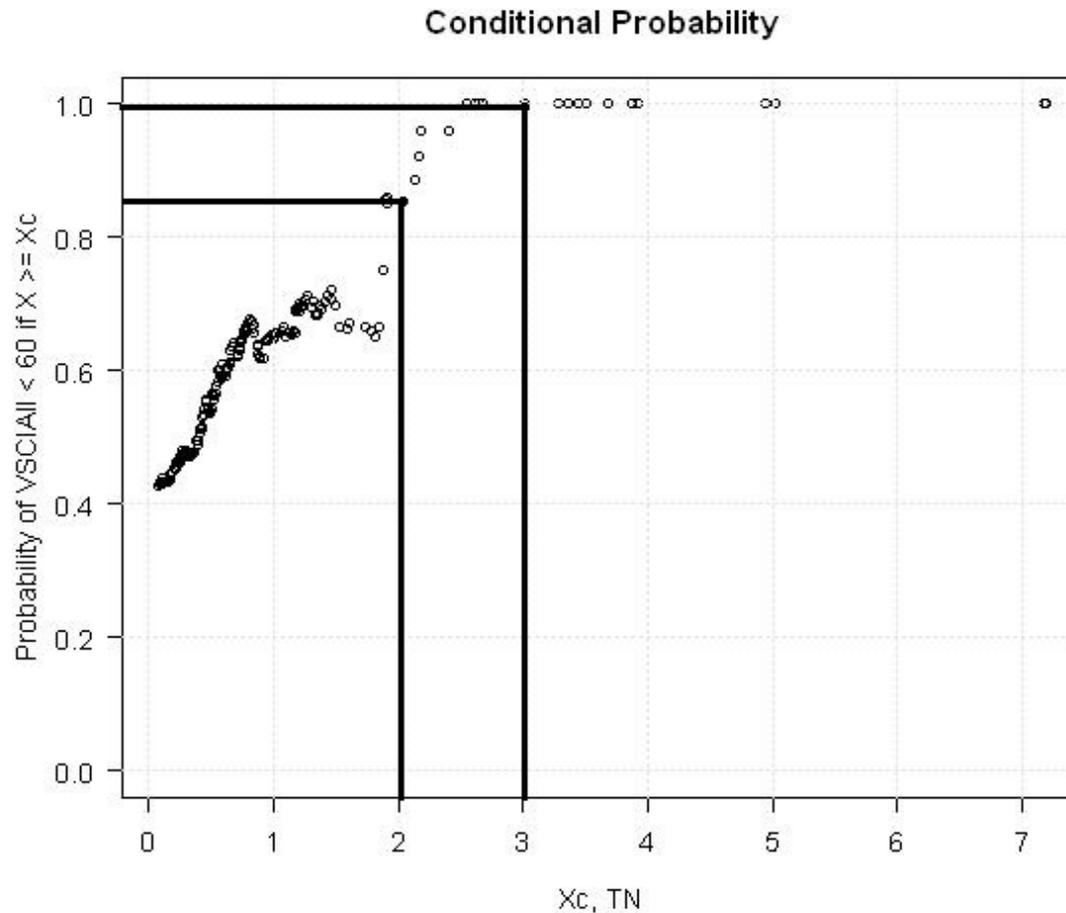
Stressor Response



Quantile Regression



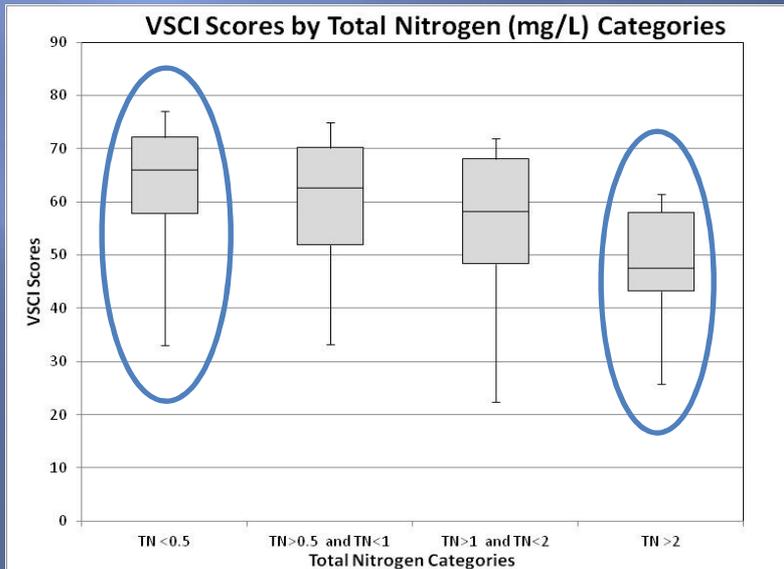
Conditional Probability



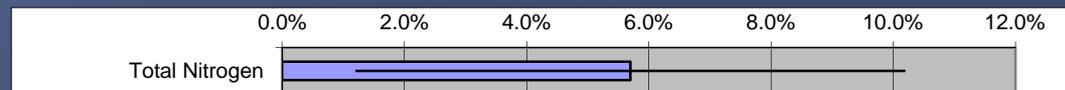
Interpretation

Risk Category	Total Nitrogen (mg/L)
High Risk to Aquatic Life	>2 (high stress)
Medium Risk to Aquatic Life	>1 , <2 (medium stress)
Low Risk to Aquatic Life	>0.5, <1 (low stress)
No Risk to Aquatic Life	<0.5 (non-stressor/background)

Test Interpretation



Stressor Parameter	Optimal	Suboptimal
Total Nitrogen (mg/L)	<1	>2



Questions?



Contact Information

Jason Hill

3019 Peters Creek Rd

Roanoke, VA 24019

540.562.6724

Jason.Hill@deq.virginia.gov

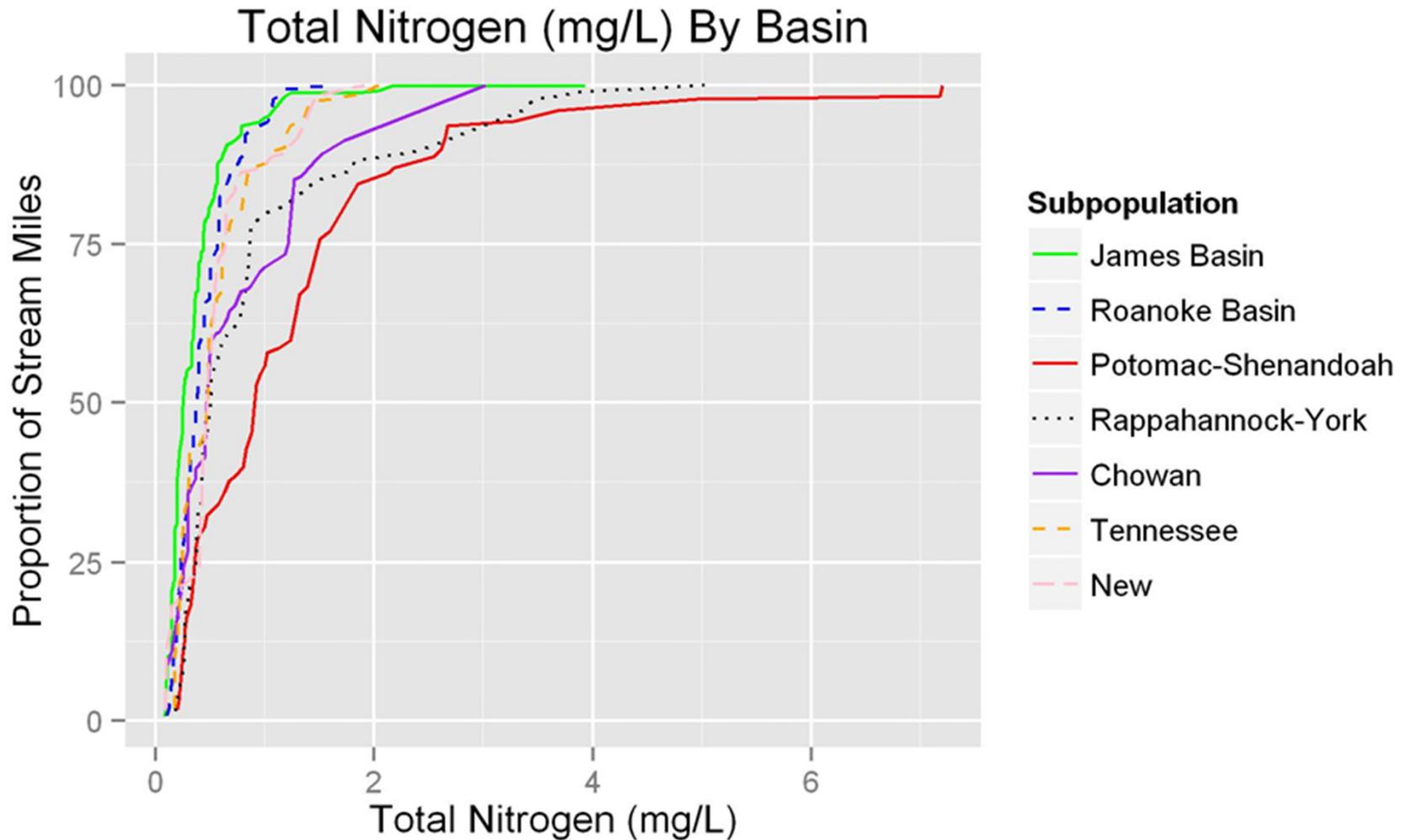
<http://www.deq.virginia.gov/probmon/>

Stressor Document Link:

<http://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterQualityMonitoring/ProbabilisticMonitoring/stressor.pdf>

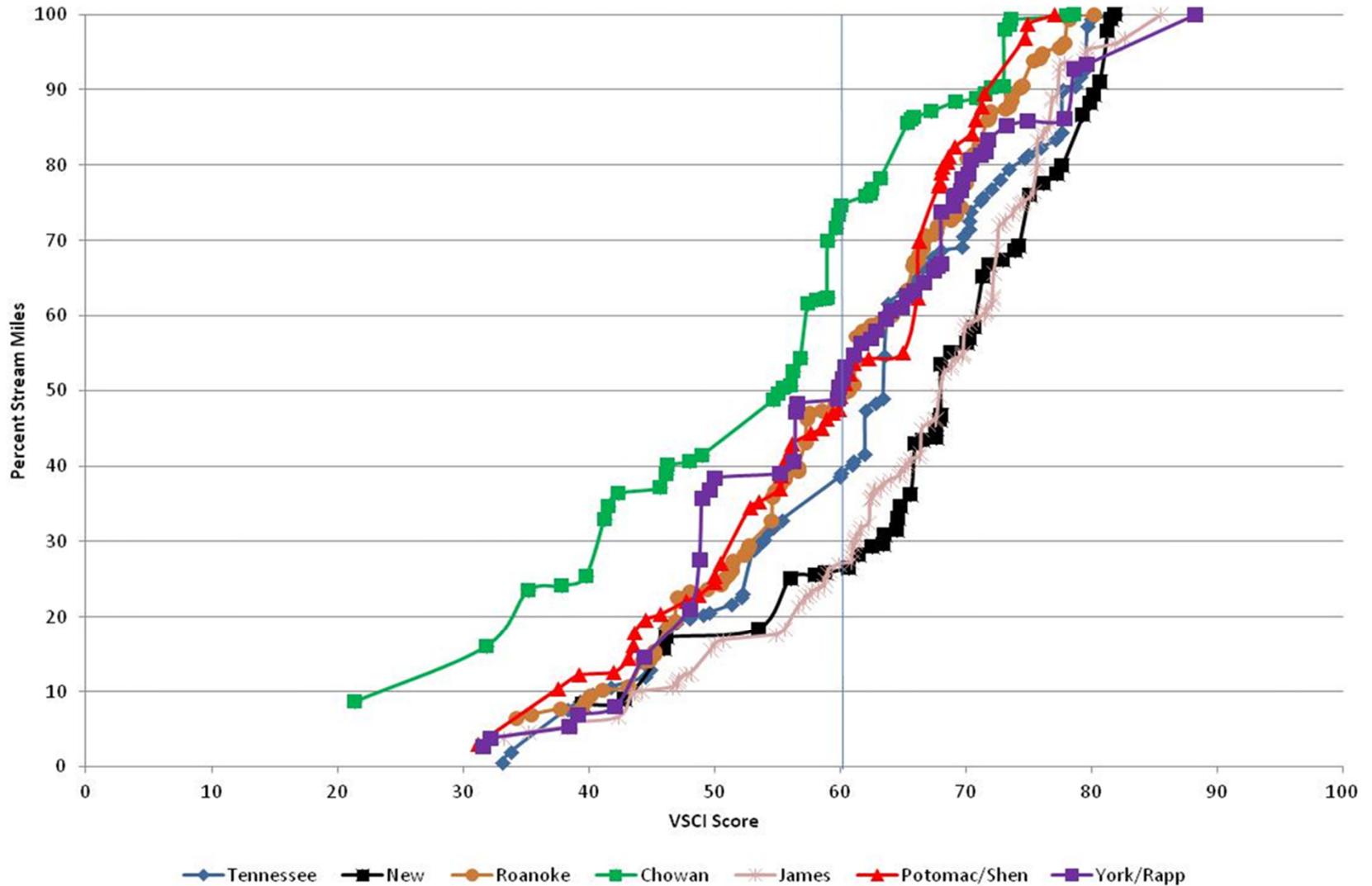


Stressor Distribution

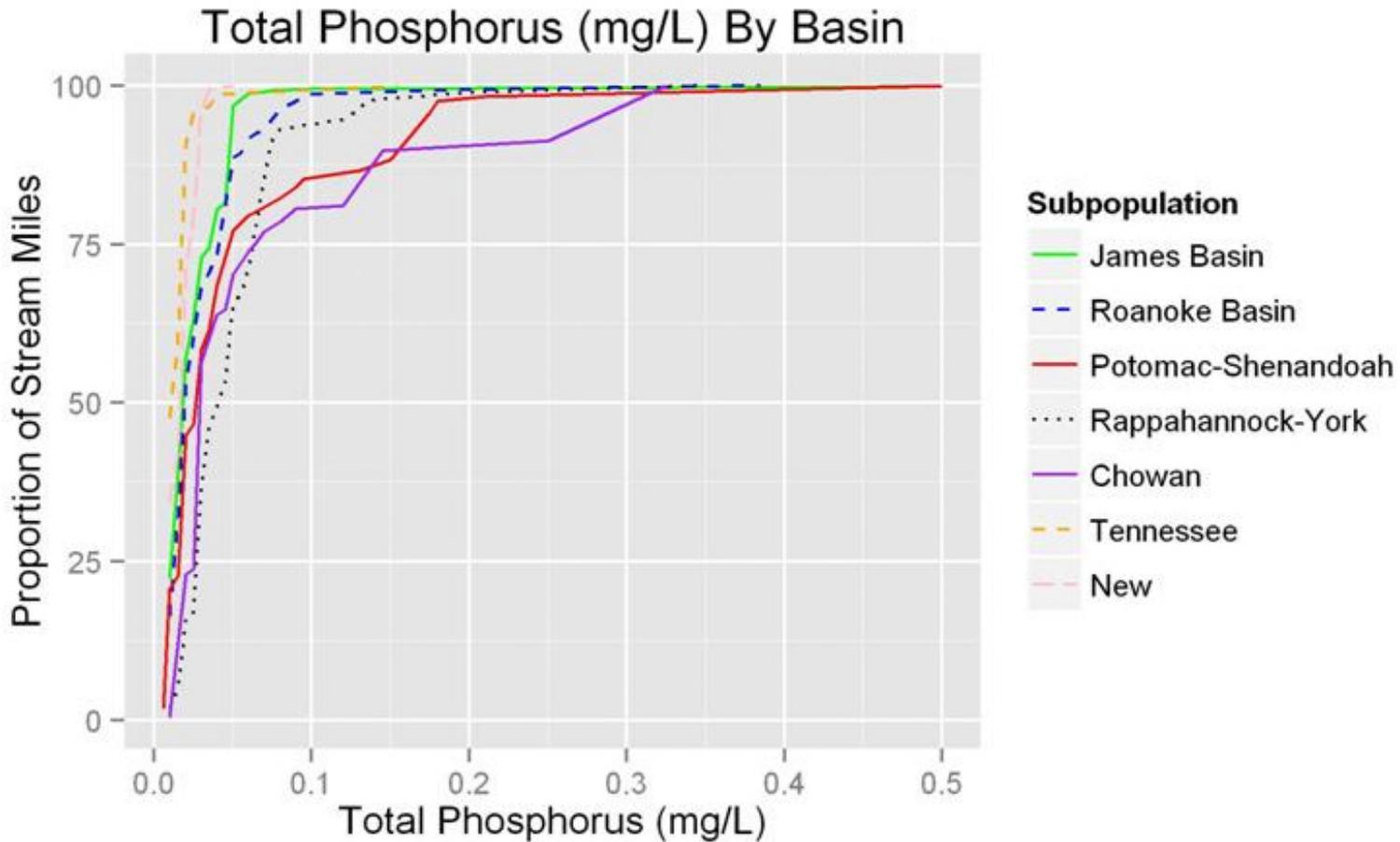


Statistics/Data Chapter Workgroup

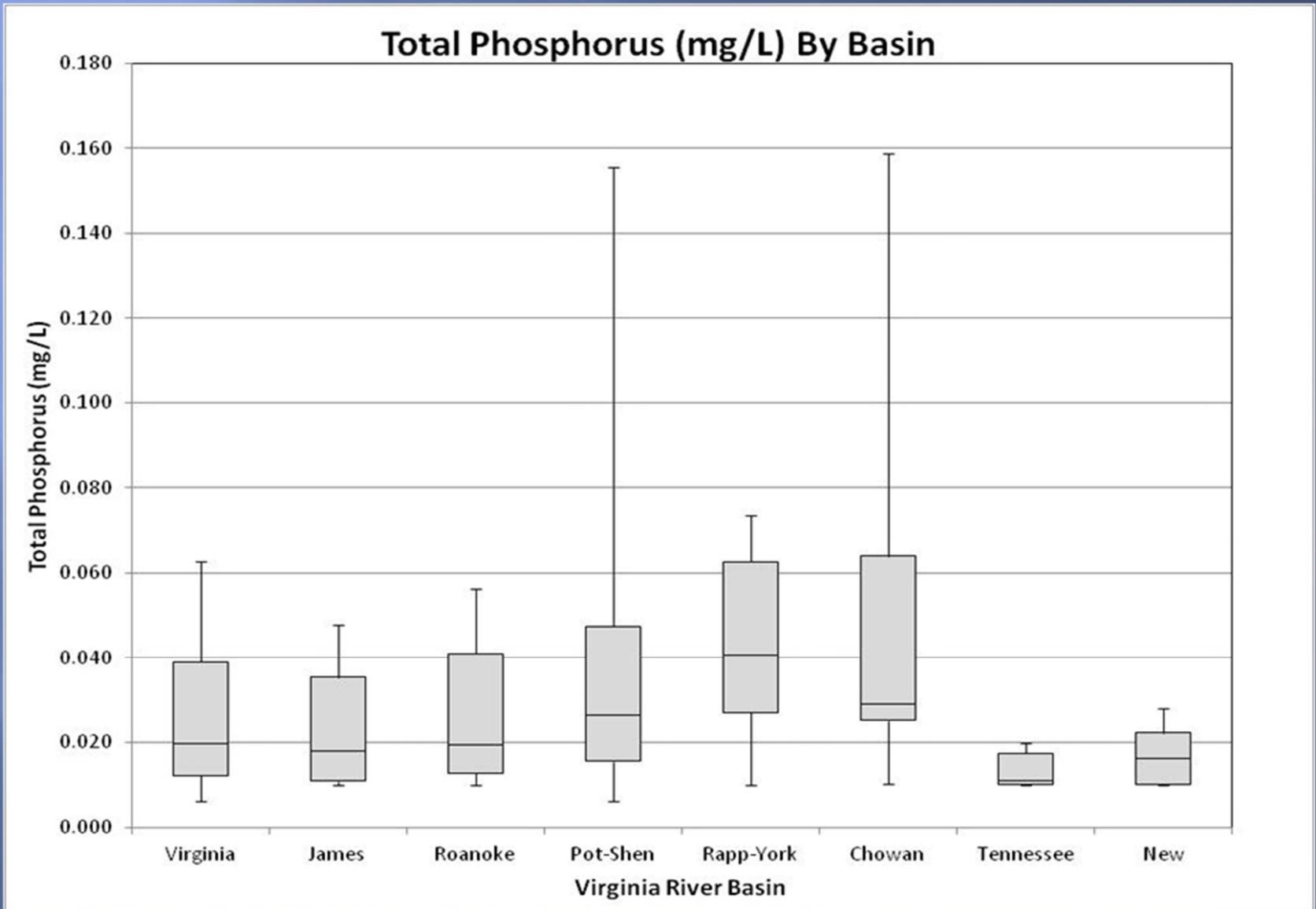
VSCI Scores By River Basins



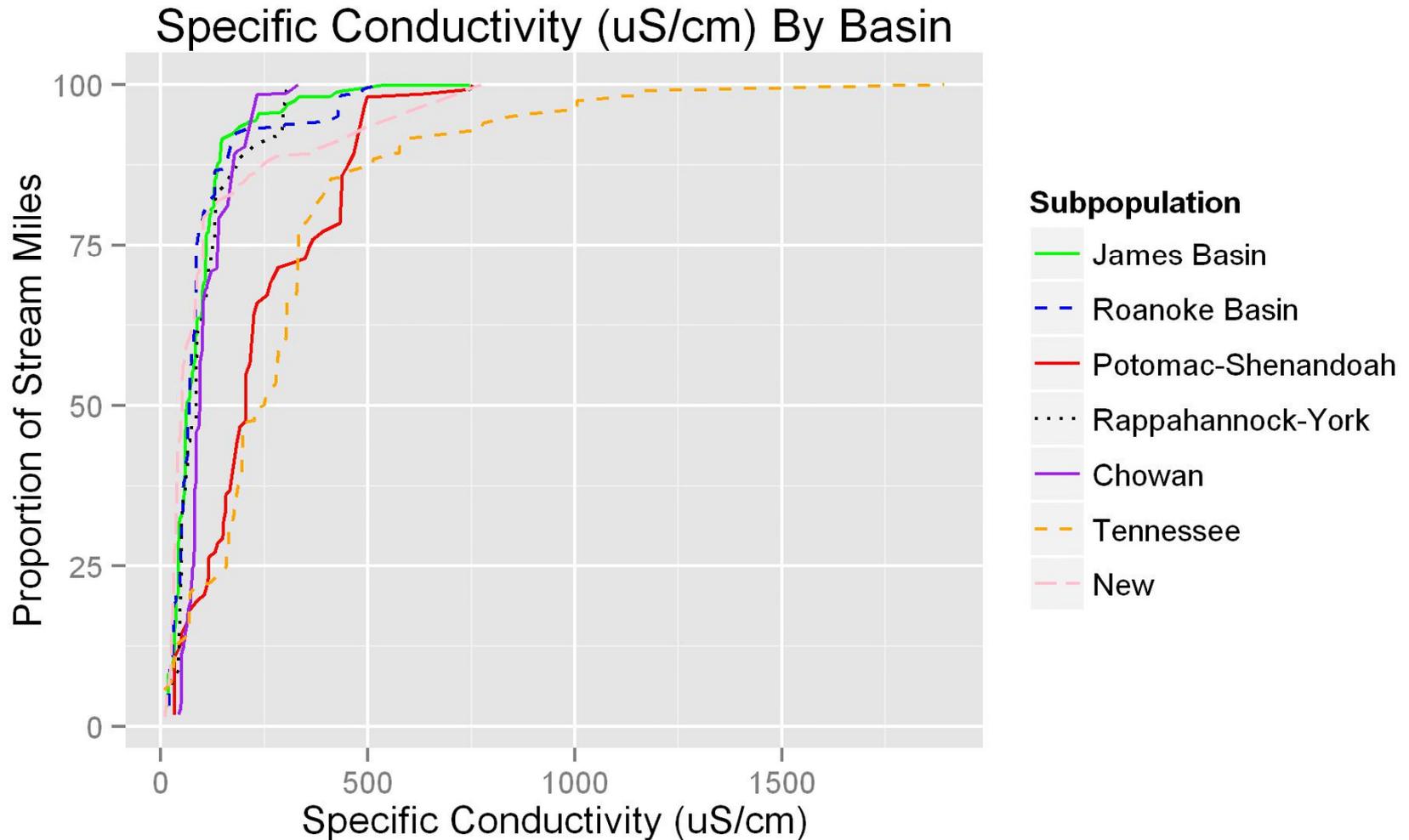
Statistics/Data Chapter Workgroup



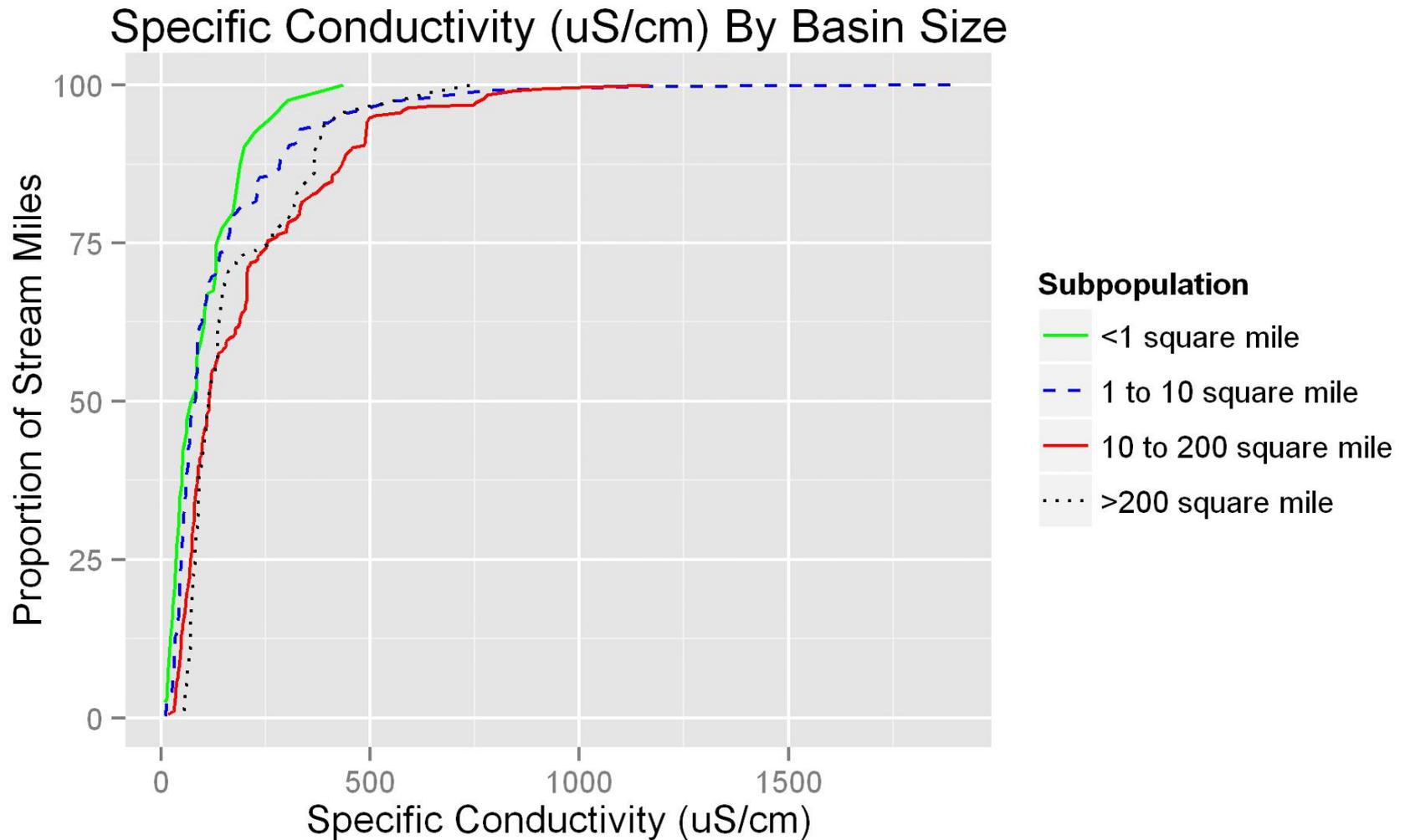
Statistics/Data Chapter Workgroup



Statistics/Data Chapter Workgroup

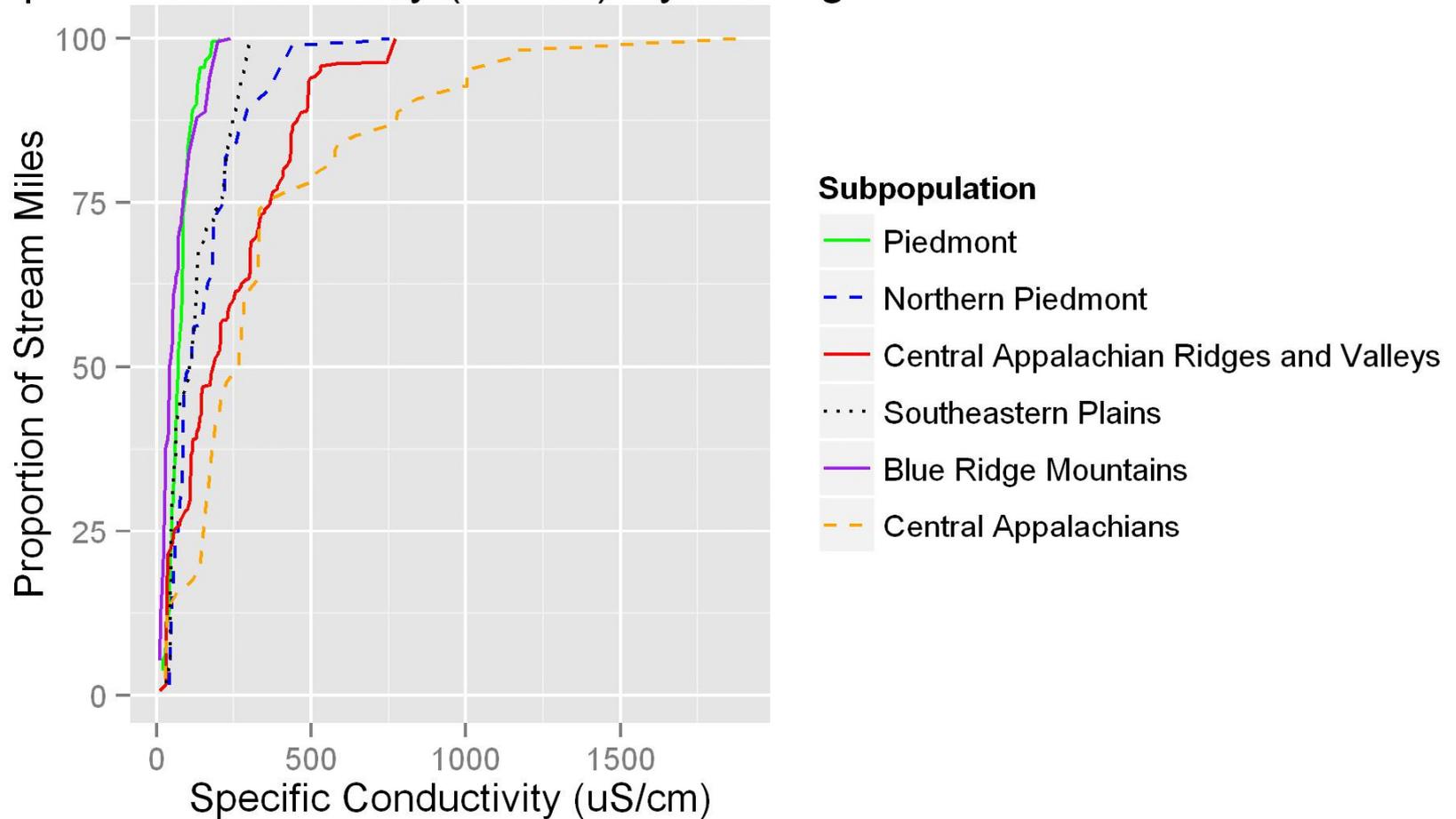


Statistics/Data Chapter Workgroup



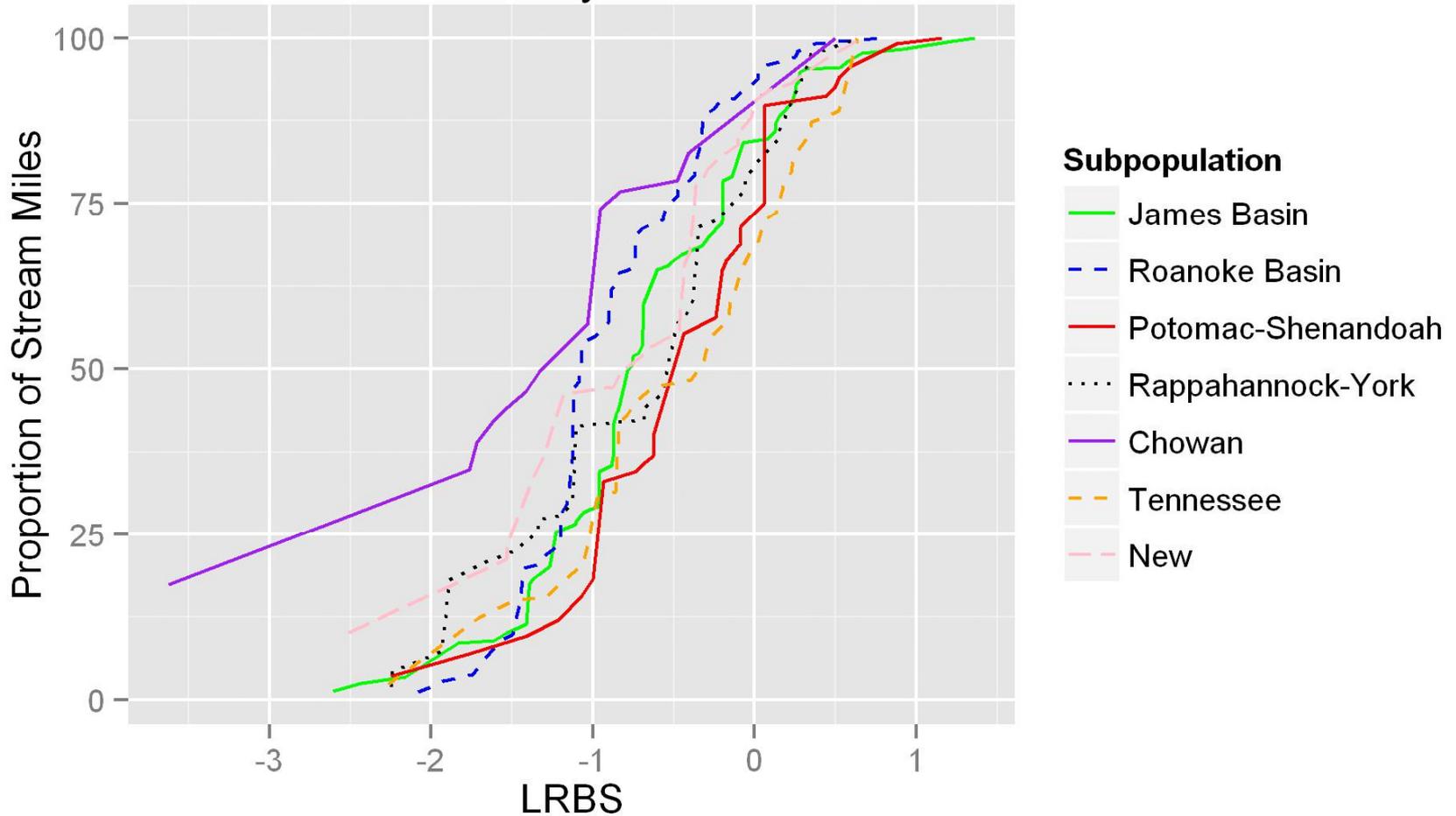
Statistics/Data Chapter Workgroup

Specific Conductivity (uS/cm) By Ecoregion



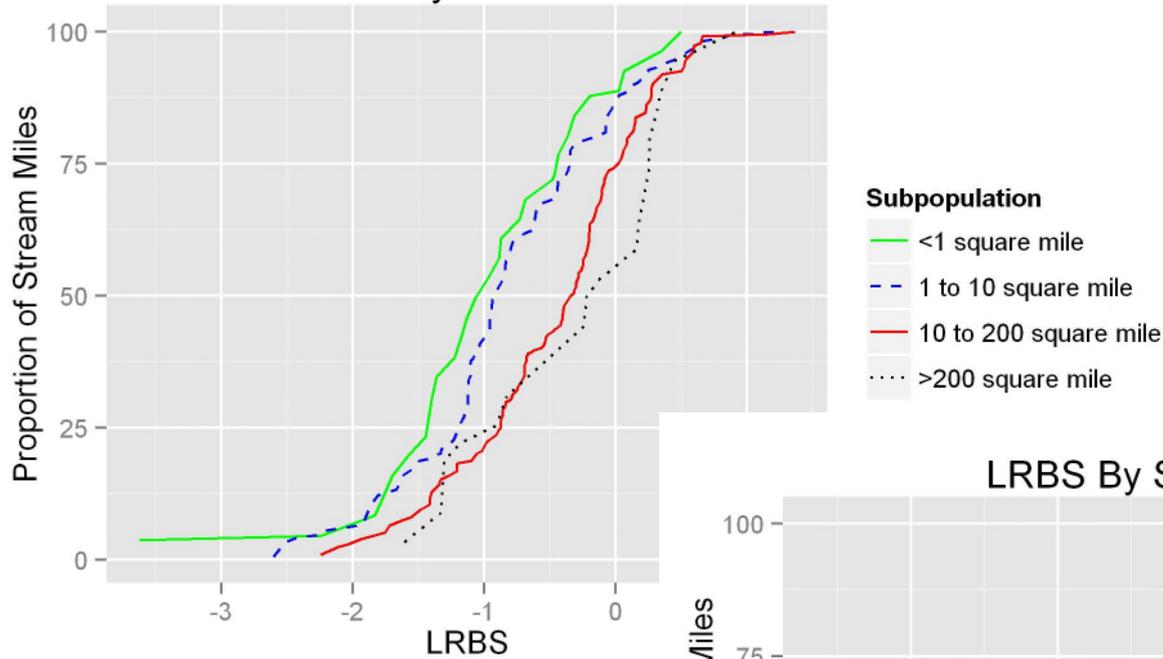
Statistics/Data Chapter Workgroup

LRBS By Basin

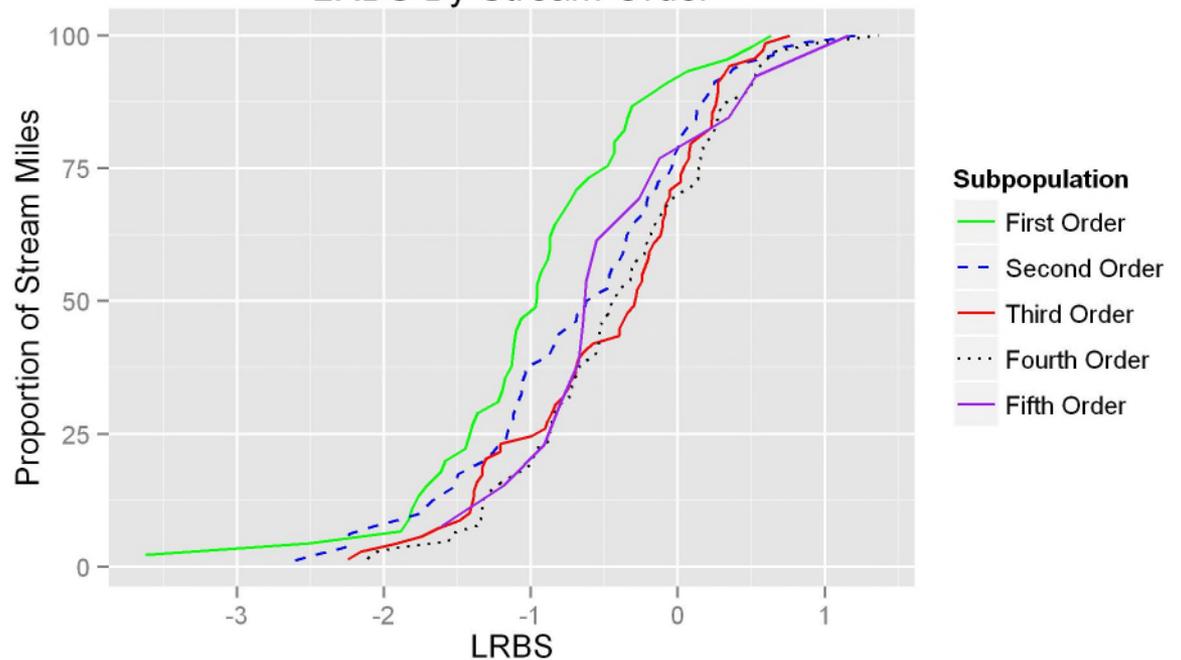


Statistics/Data Chapter Workgroup

LRBS By Basin Size

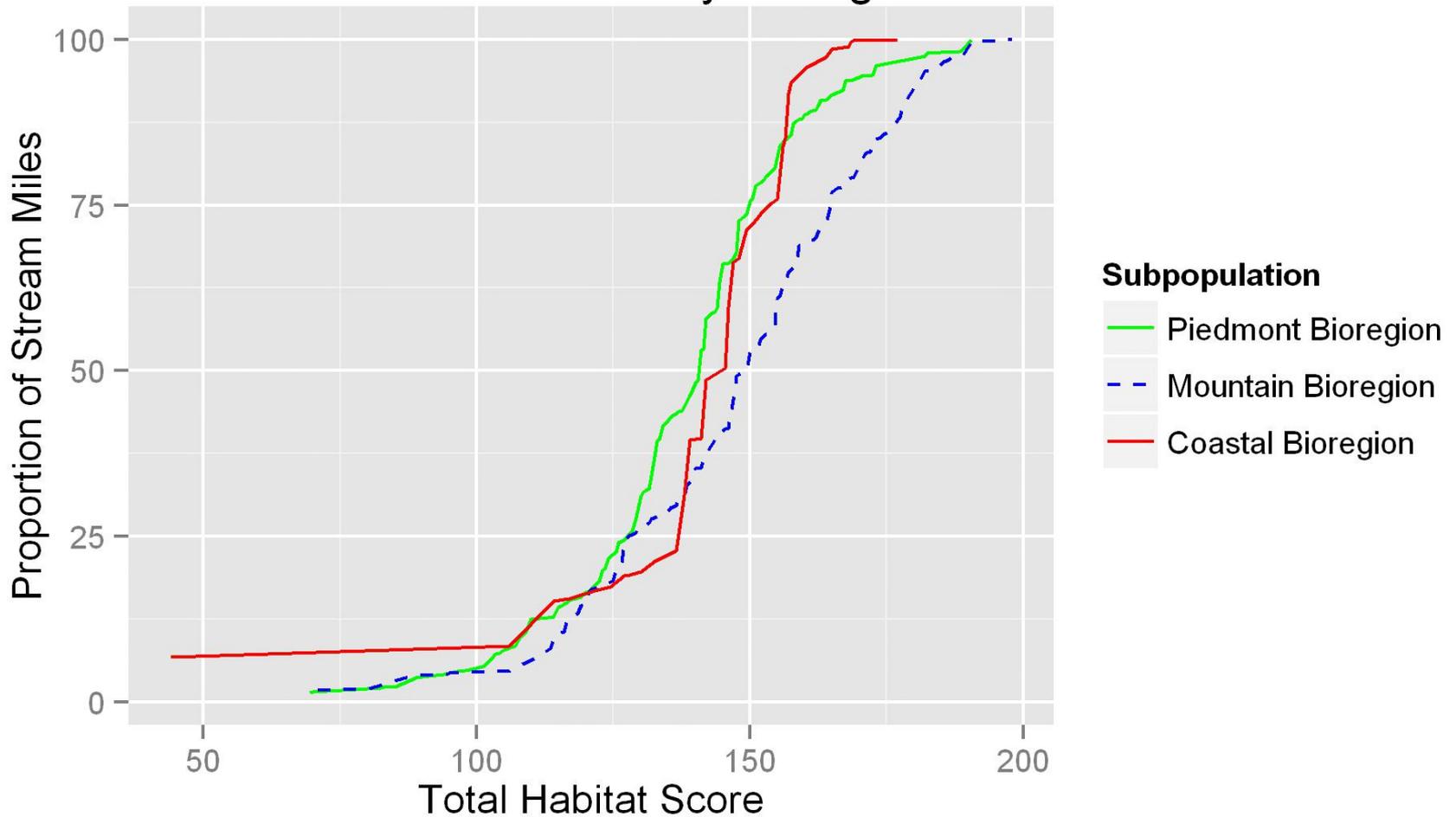


LRBS By Stream Order



Statistics/Data Chapter Workgroup

Total Habitat Score By Bioregion



Statistics/Data Chapter Workgroup

Dissolved Metal CCU By Basin

