



Using Probabilistic Monitoring Data to Validate Virginia's Non-Coastal Stream Condition Index

Jason R. Hill



Acknowledgements

- **Virginia Biomonitoring Program**

- **Warren Smigo, George Devlin, Tony Silva, Bill Shanabruch, Billy Van Wart, Mike Shaver, Eddy Cumbow, Greg Brown, Larry Willis, Drew Miller, Mary Dail, Mike Scanlan, Chip Sparks, Ted Turner**

- **USEPA**

- **Greg Pond, Maggie Passmore, Karen Blocksom, Anthony Olsen**

- **Virginia Academic Advisory Committee**



Evolution of the VSCI...

- **2000 USEPA contracted Tt to develop bio-index for Virginia (8 core metrics identified–EPT, MFBI, % Scapers, etc)**
- **Final Report submitted in September 2003**

- **VDEQ had concerns with the data set used to develop the VSCI**
 - **Lack of stream size diversity**
 - **Bias toward mountain ecoregions**
 - **Multiple samples at the same location**

- **Use probabilistic data set to validate VSCI**
- **Provide data for policy decisions**

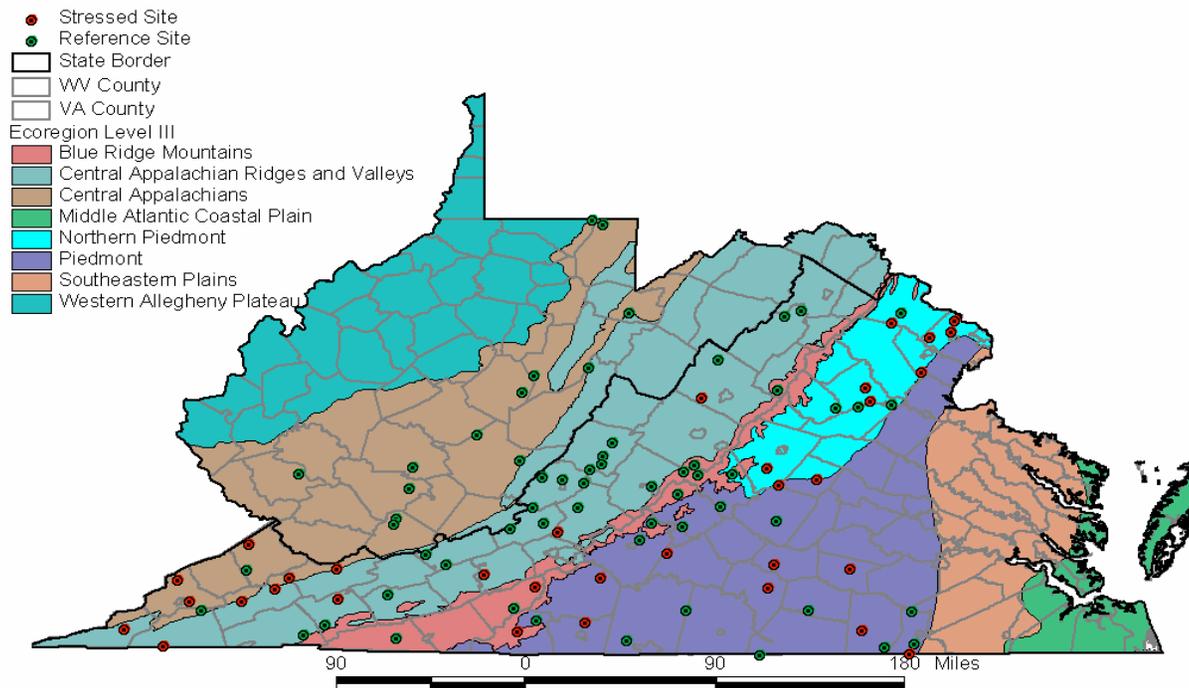


Reference Data Used in this Analysis

n=104, n=47 spring, n=43 fall, n=14 WV

Mountain (spring=38), (fall=33), Piedmont (spring=18), (fall=15)

Bonus Data = 13 sites, 14 samples from Central Apps in WV



Piedmont Bioregion Reference Filter

1	% Urban	< 5%
2	Total Nitrogen	< 1.5 mg/L
3	Total Phosphorus	< 0.05 mg/L
4	Conductivity	< 250
5	DO	> 6 mg/L
6	pH	> 6 or < 9
7	Channel Alteration	> 11
8	Available Cover	> 11
9	Riparian Vegetation	> 11
10	Total Habitat	> 140

Mountain Bioregion Reference Filter

1	% Urban	< 5%
2	Total Nitrogen	< 1.5 mg/L
3	Total Phosphorus	< 0.05 mg/L
4	Conductivity	< 250
5	DO	> 6 mg/L
6	pH	> 6 or < 9
7	Channel Alteration	> 11
8	Available Cover	> 11
9	Embeddedness	> 11
10	Riparian Vegetation	> 11
11	Total Habitat	> 140

Stress Filter Used the Study

n=64, n=33 spring, n=31 fall

Mountain (n=15 spring, 15 fall)

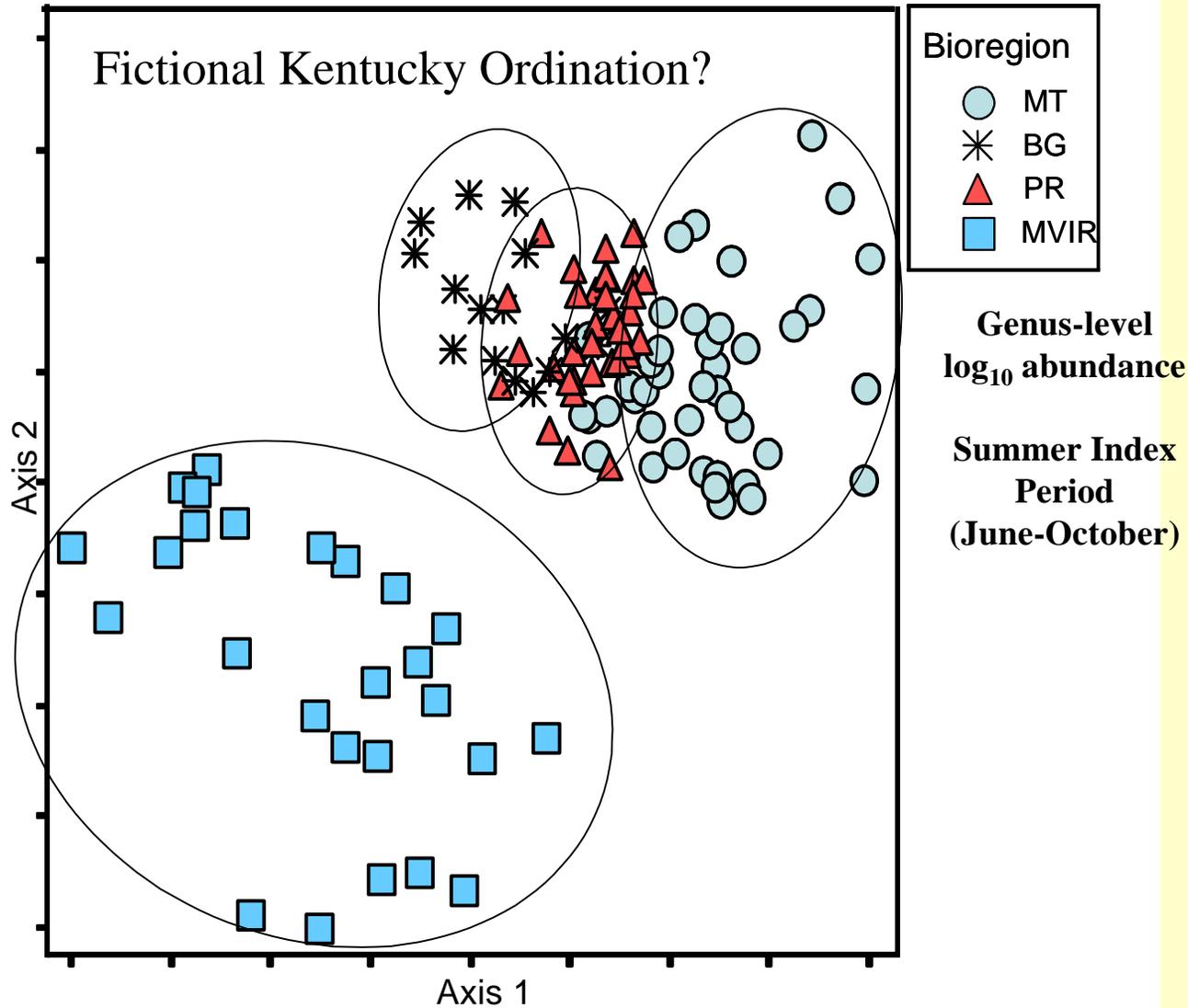
Piedmont (n=18 spring, 16 fall)*

*5th order and greater, total habitat does not appear to be a good filter!

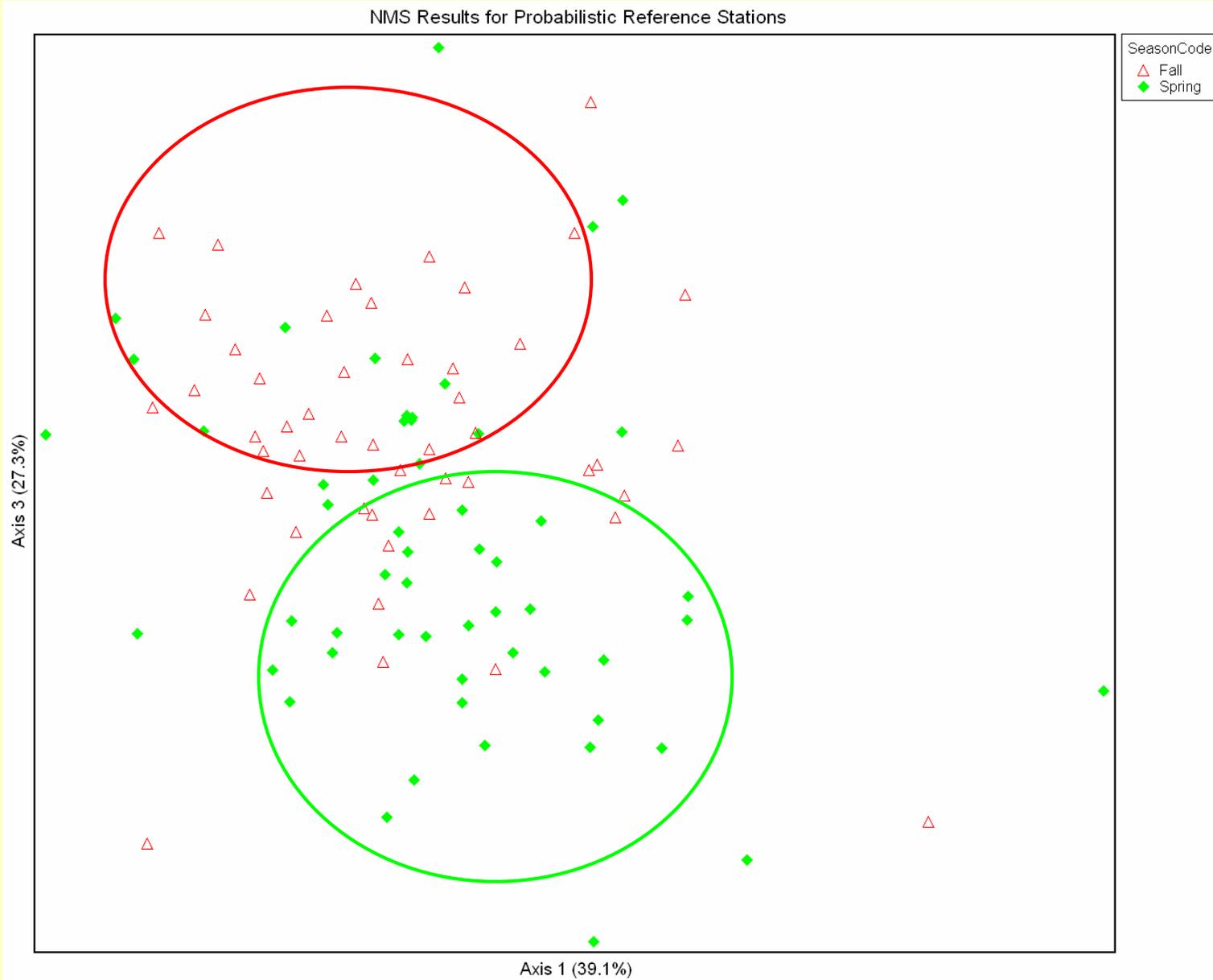
1	% Urban	> 10%
2	Total Nitrogen	> 3 mg/L
3	Total Phosphorus	> 0.1 mg/L
4	Conductivity	> 500
5	Riparian Vegetation	< 6
6	Total Habitat	< 120

NMS = Purpose of nonmetric multidimensional Scaling is to find patterns

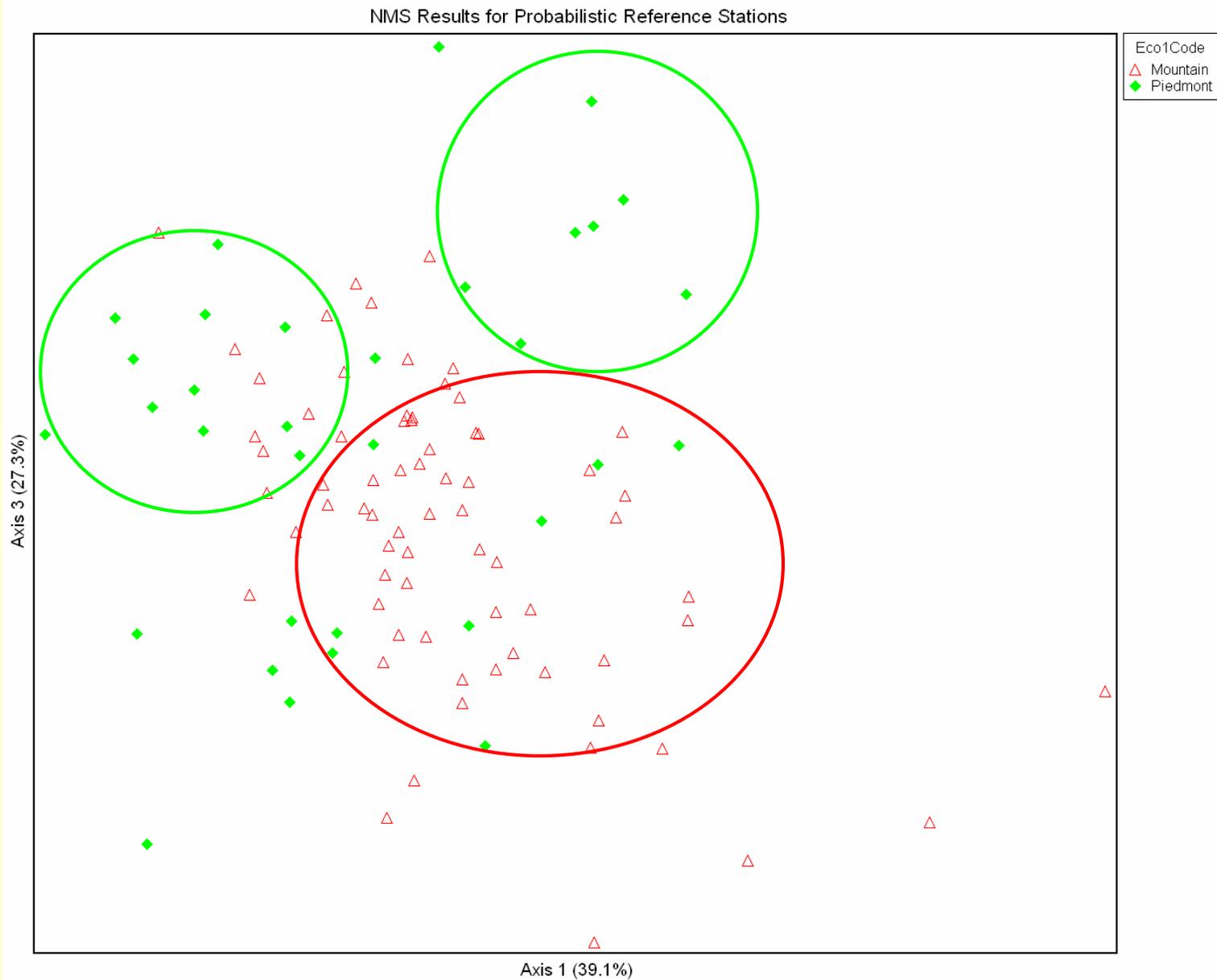
NMDS – Wadeable (~ 5 - 150 sq. mi.)
19.6% Stress for 2-dimensional solution



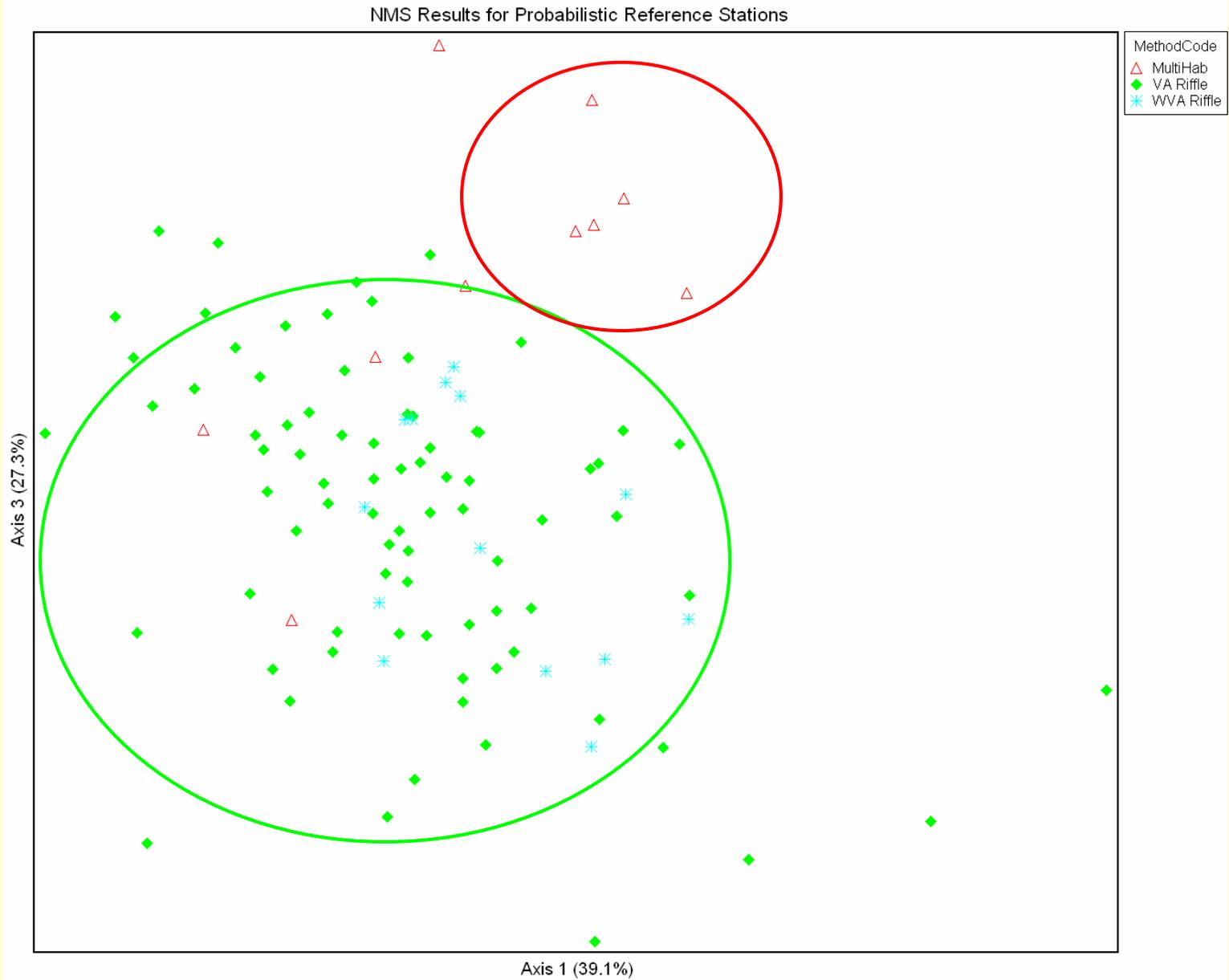
NMS = Patterns for Ref Sites? Season?



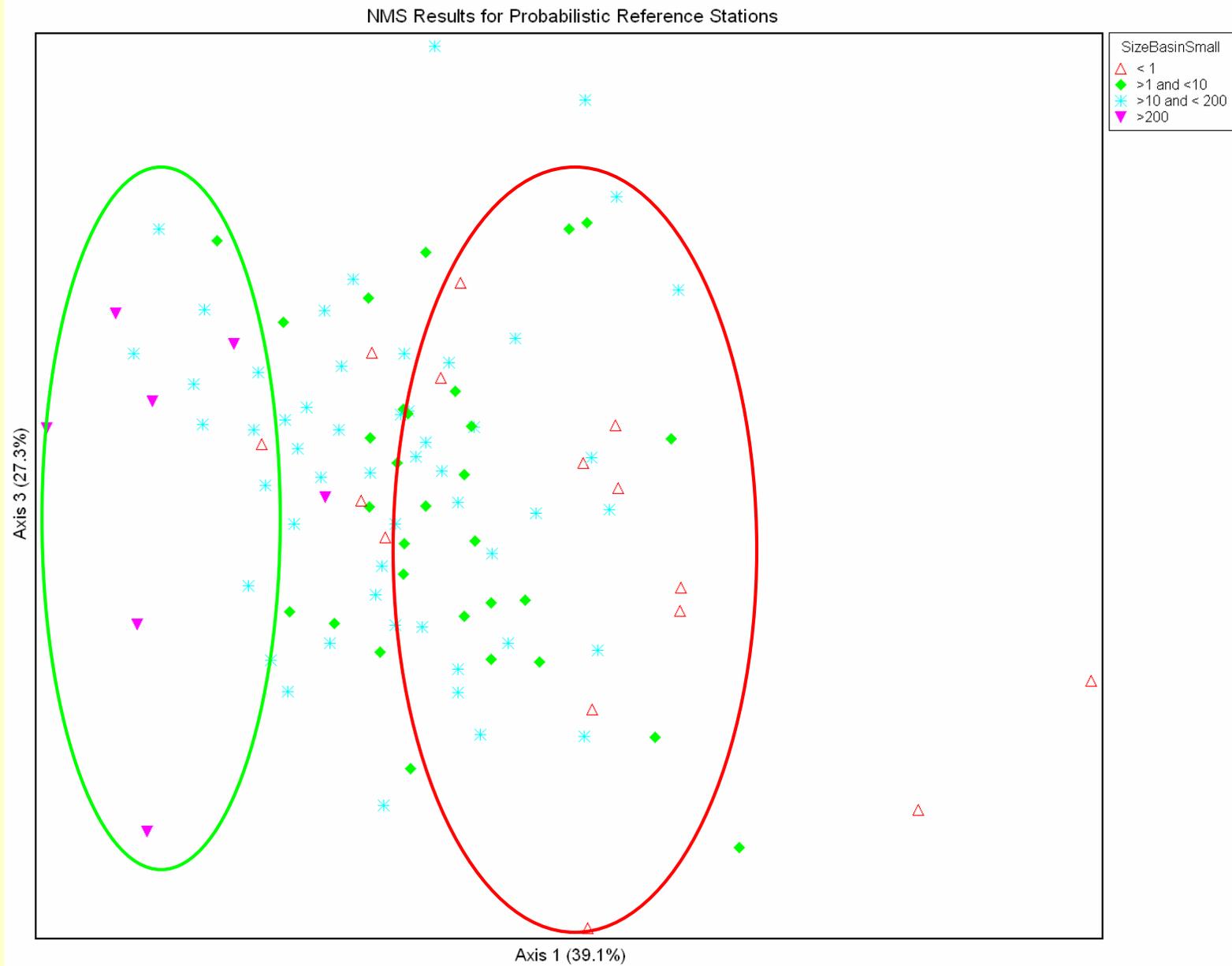
NMS = Patterns for Ref Sites? Bioregion?



NMS = Patterns for Ref Sites? Collection Method?



NMS = Patterns for Ref Sites? Basin Size?

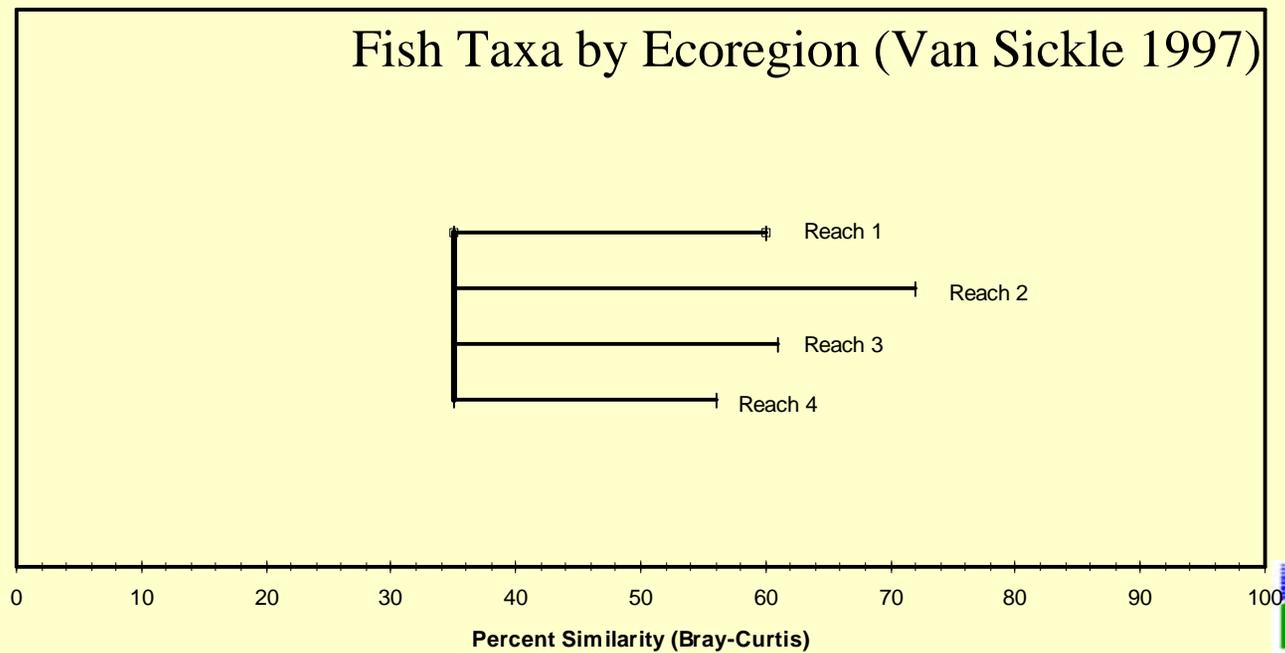
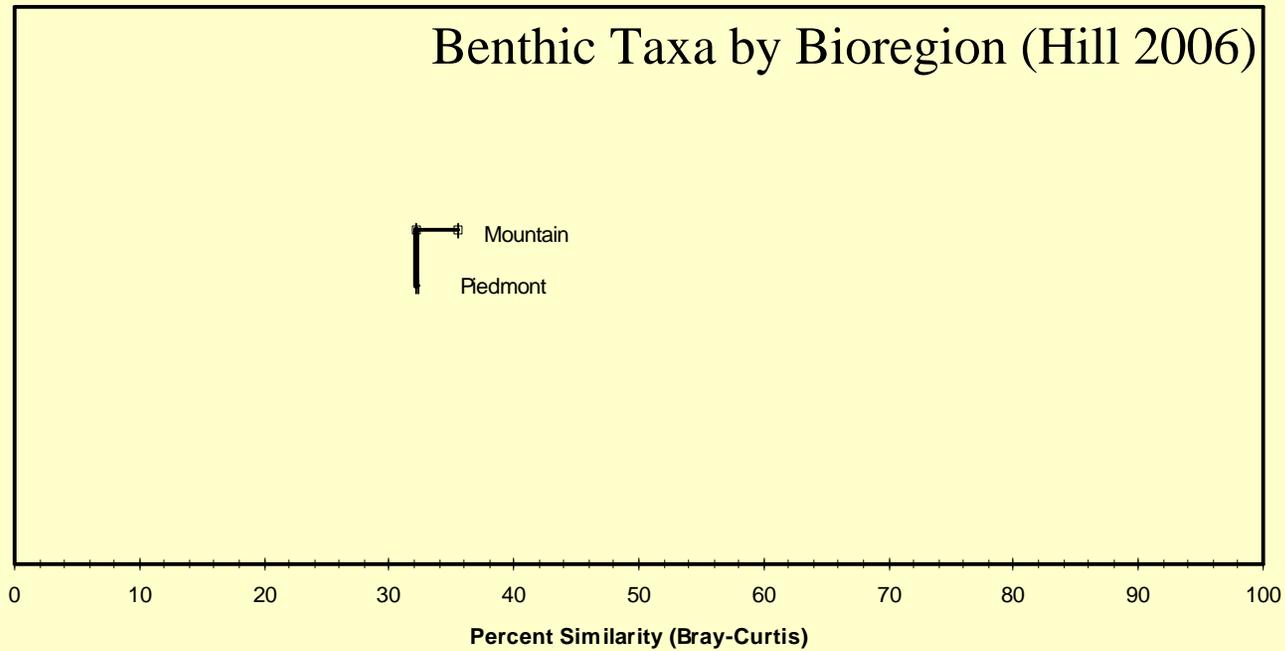


Mean Similarity Test

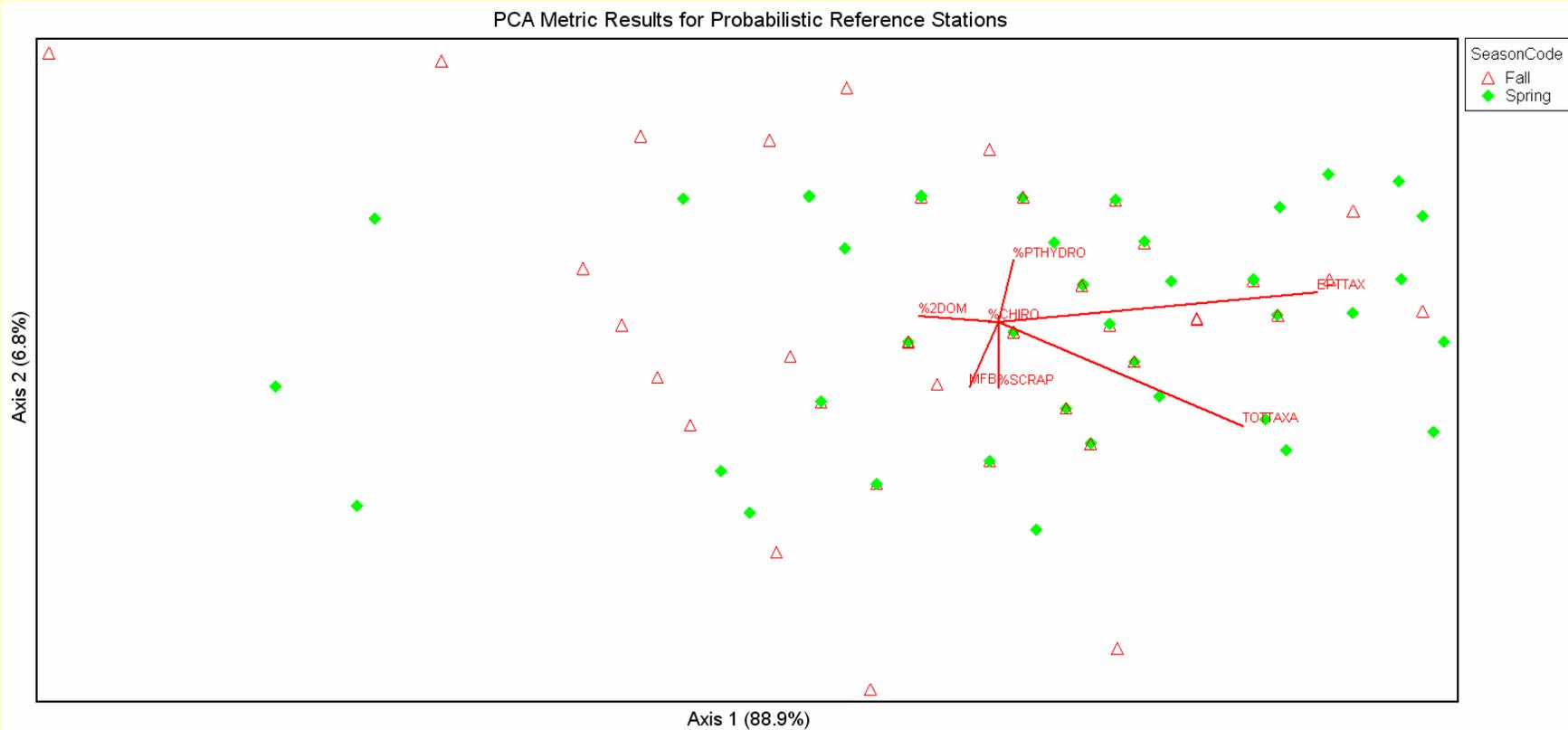
- Moving beyond graphical analysis
- Input taxa similarity matrix to the EPA MeanSim program
- Provides within group similarity and between group similarity
- Calculate a ‘classification strength’ for different categories

Bray Curtis Similarity Matrix							
	N (ref sites)	N (Groups)	Within Group (W)	Between Group (B)	CS (W-B)	M (B/W)	p-value
Season	104	2	35.9%	31.7%	4.3%	0.88	0.0001
Basin Size	104	4	35.1%	32.7%	2.3%	0.93	0.0002
Ecoregion (III)	104	5	36.4%	32.9%	3.5%	0.91	0.0001
Bioregion	104	2	34.5%	32.2%	2.3%	0.93	0.0001
Bioregion and Season	104	4	36.8%	32.4%	4.4%	0.88	0.0001
Collection Method	104	3	35.1%	32.6%	2.5%	0.93	0.0033

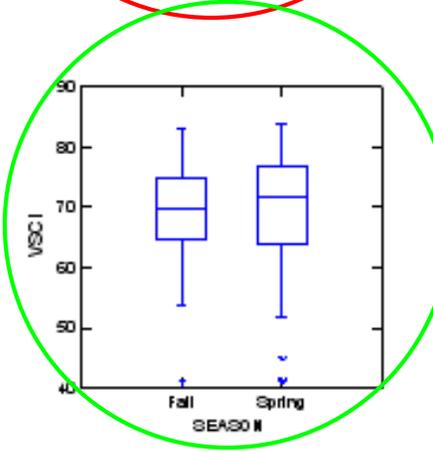
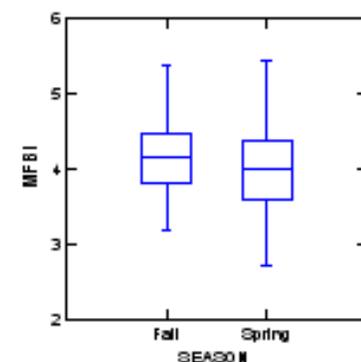
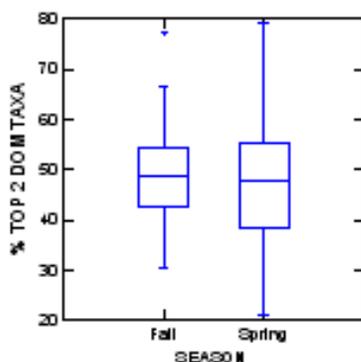
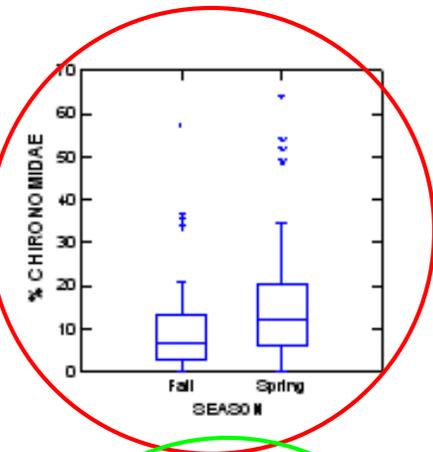
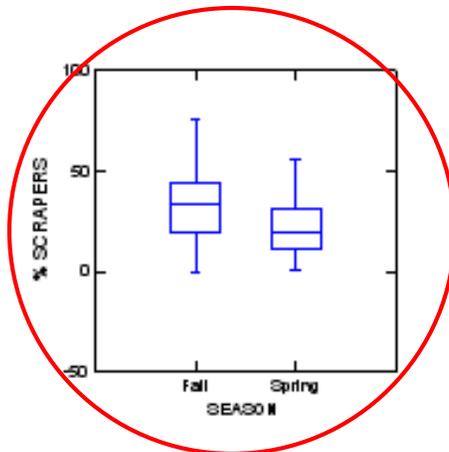
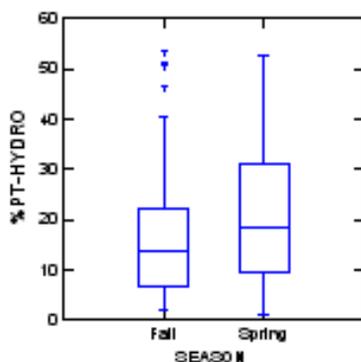
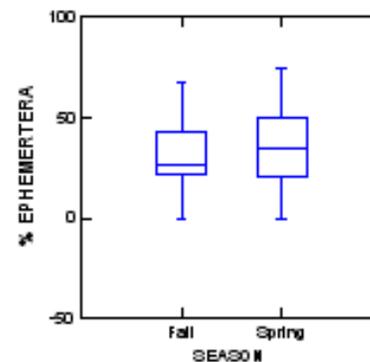
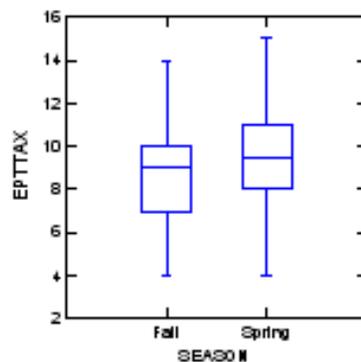
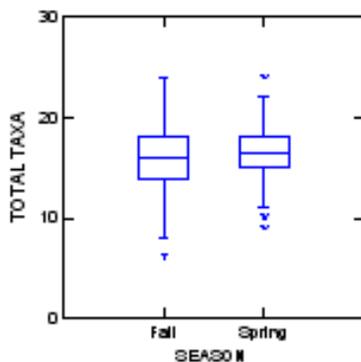
MeanSim Dendograms Outputs



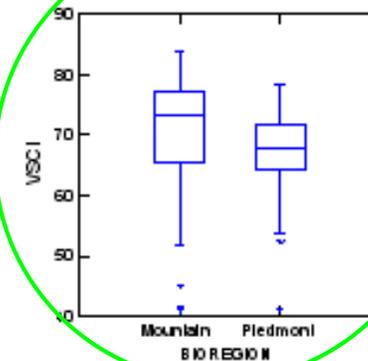
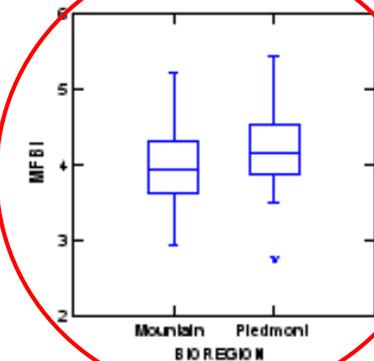
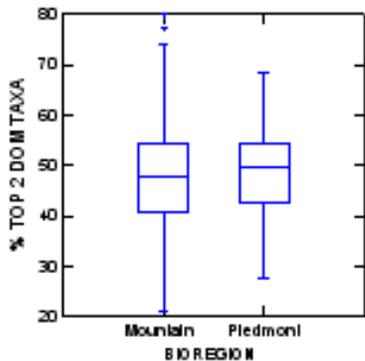
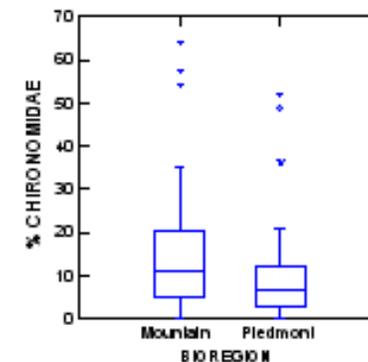
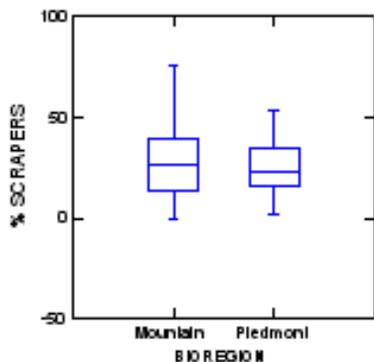
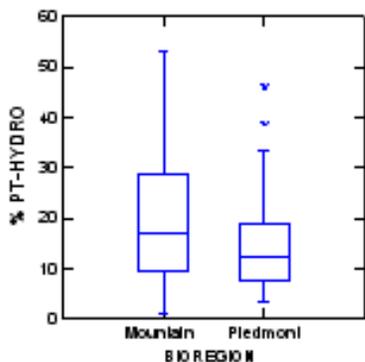
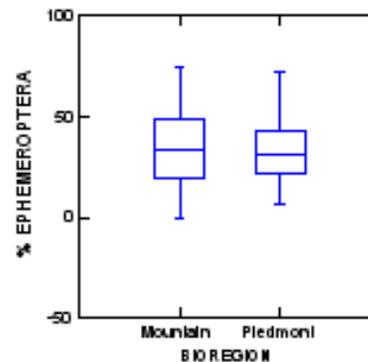
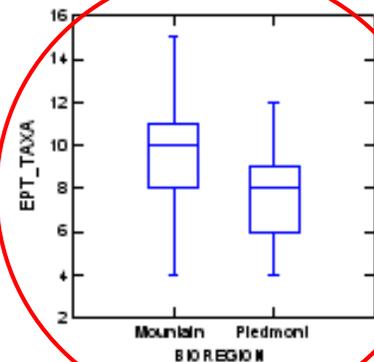
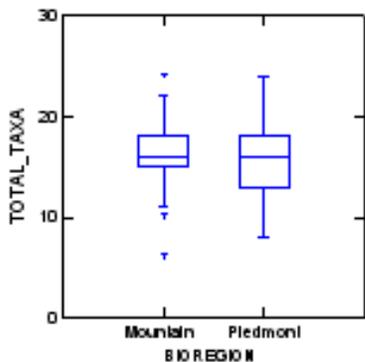
Environmental Significance?



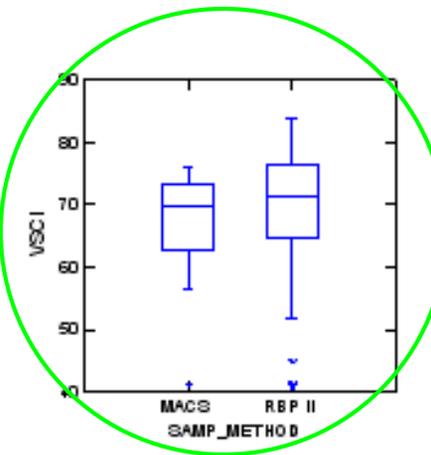
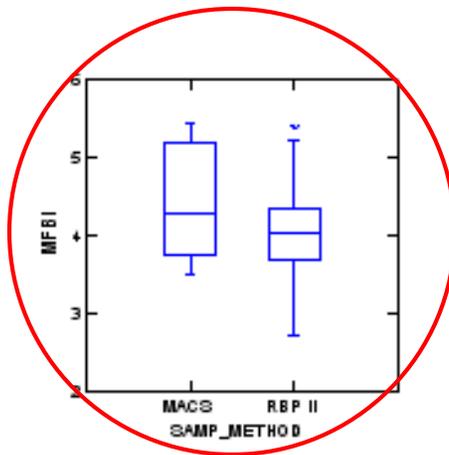
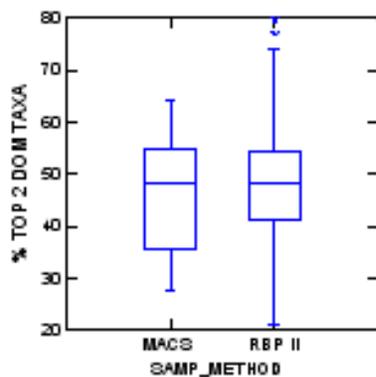
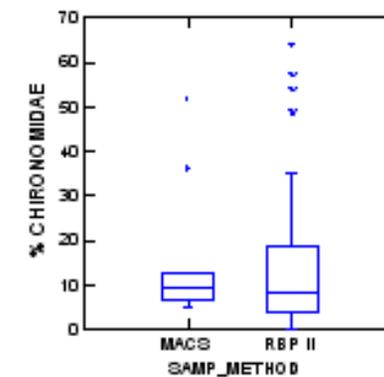
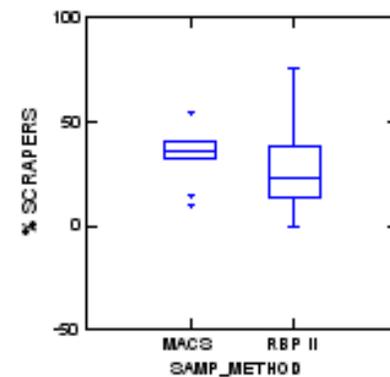
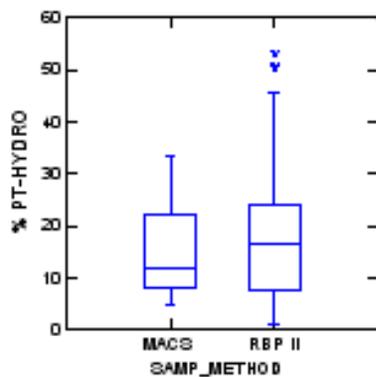
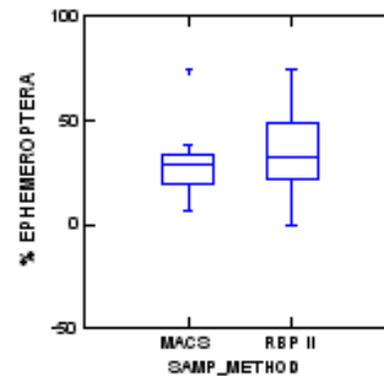
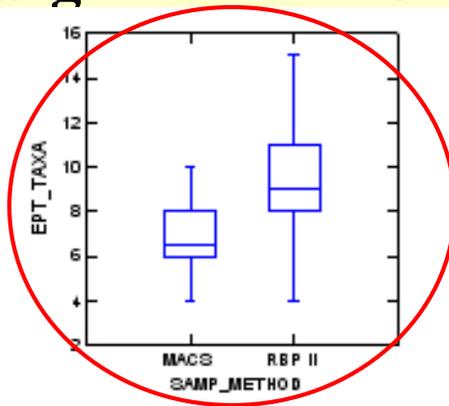
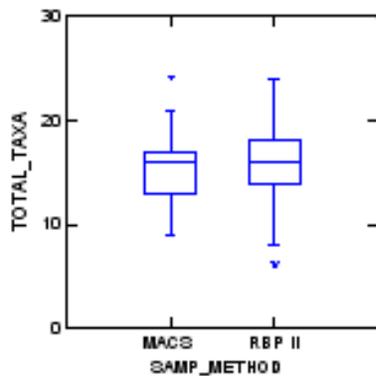
Environmental Significance? Season?



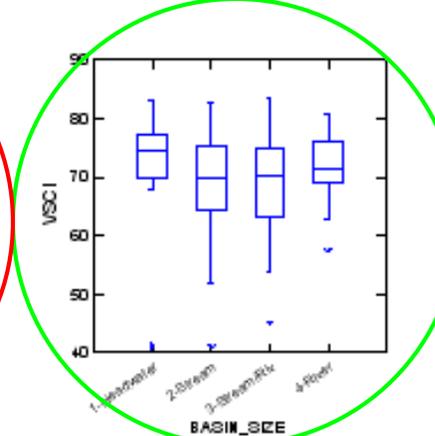
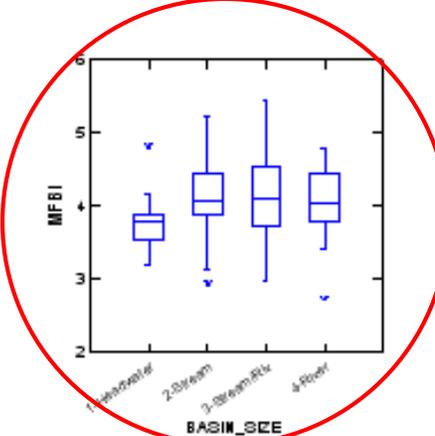
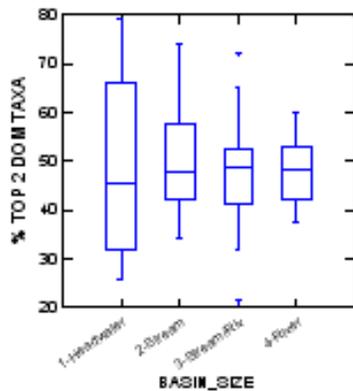
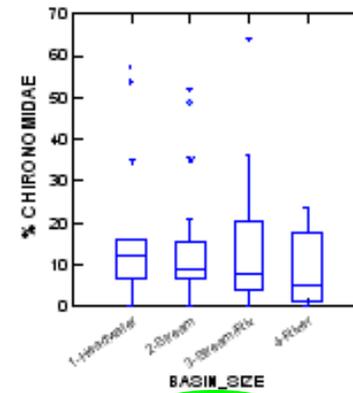
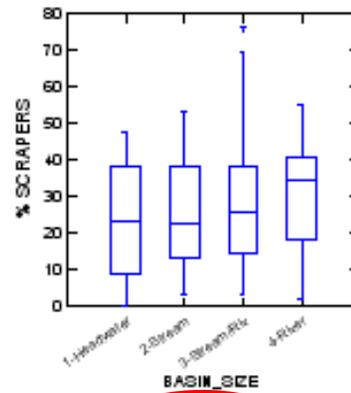
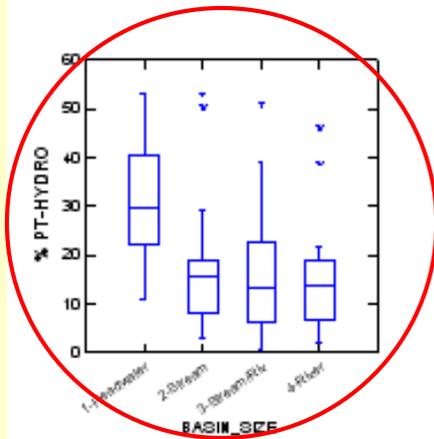
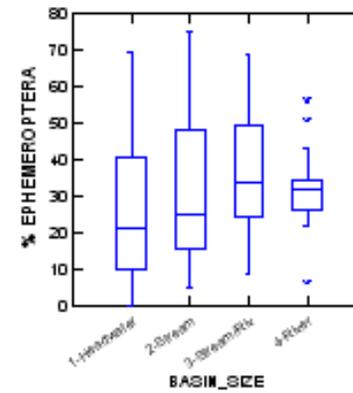
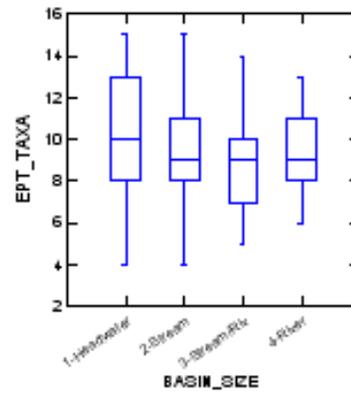
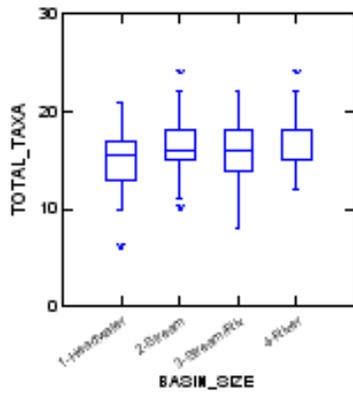
Environmental Significance? Bioregion?



Environmental Significance? Collection Method?



Environmental Significance? Basin Size?



Best Standard Value Comparison

Tetrattech 95th percentile versus ProbMon 95th percentile

Metric	TetraTech BSV	ProbMon BSV
Total Taxa (95Pct)	22.0	18.9
EPT Taxa (95Pct)	11.0	11.7
% Ephem (95Pct)	61.3	47.7
% PT- Hydro (95Pct)	35.6	56.2
% Scrapers (95Pct)	51.6	46.7
% Chiro (5 Pct)	0.0	1.6
% 2 Dom (5 Pct)	30.8	32.8
HBI (5 Pct)	3.2	2.9

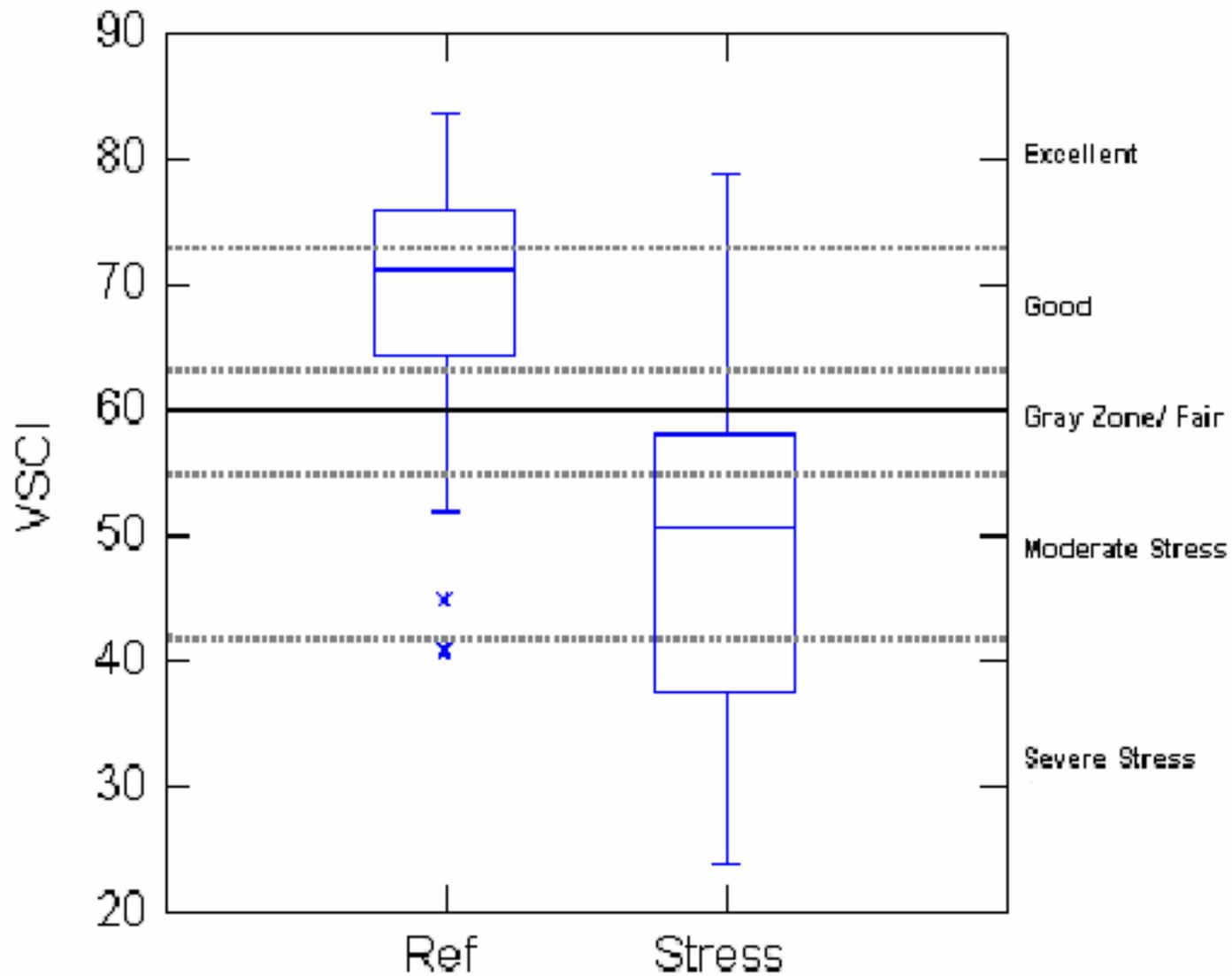
VSCI Variability Calculations*

Category	Mean (Field Samples)	Mean (Duplicate Samples)	Precision	Signal-to-Noise
All Seasons	62.7	63.4	7.9	1.9
All Fall	70.7	71.9	4.7	24.6
All Spring	54.6	55.0	10.1	4.2

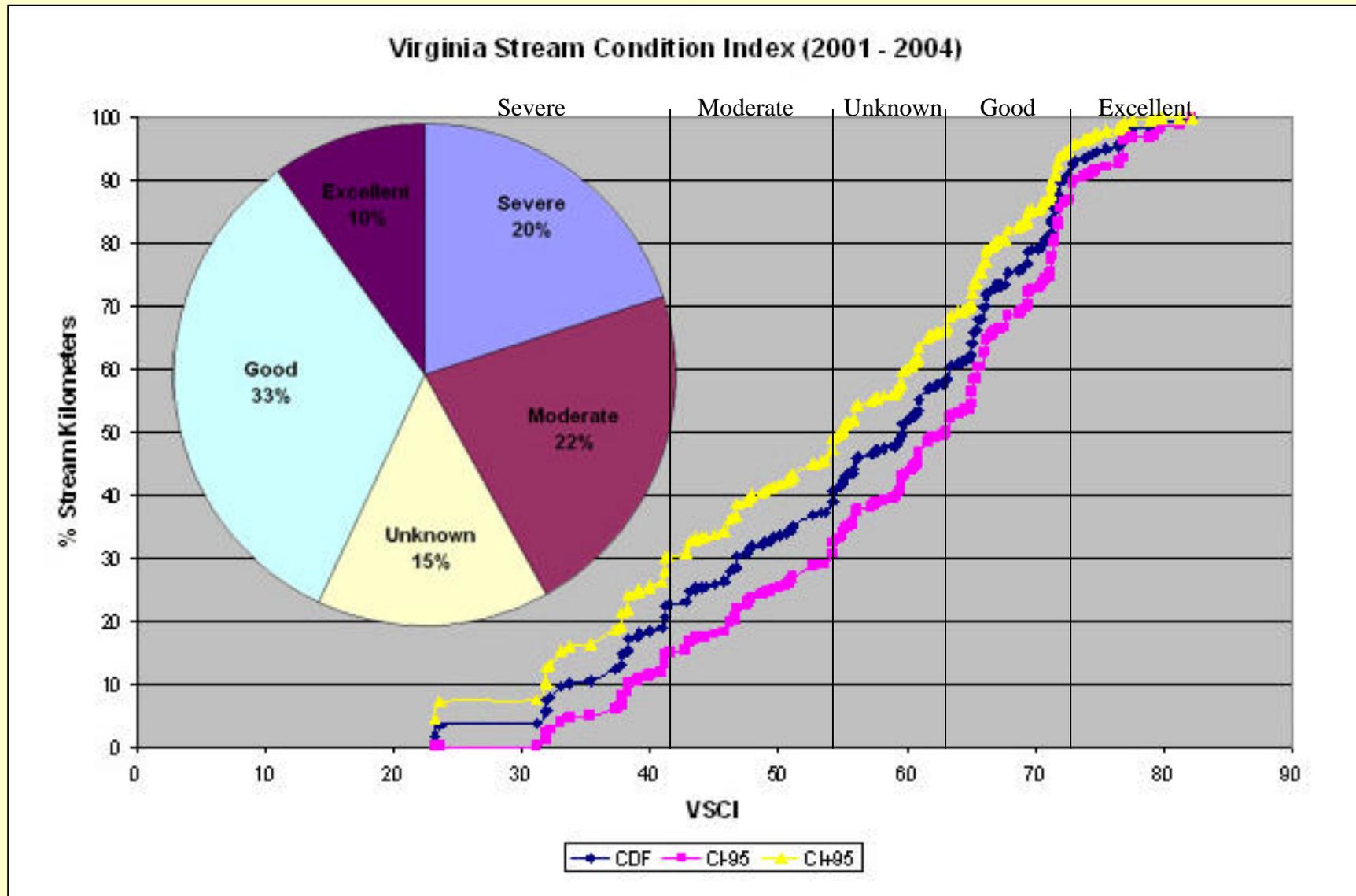
*Calculated for same day replicates (5% of probabilistic non-coastal sampling effort)



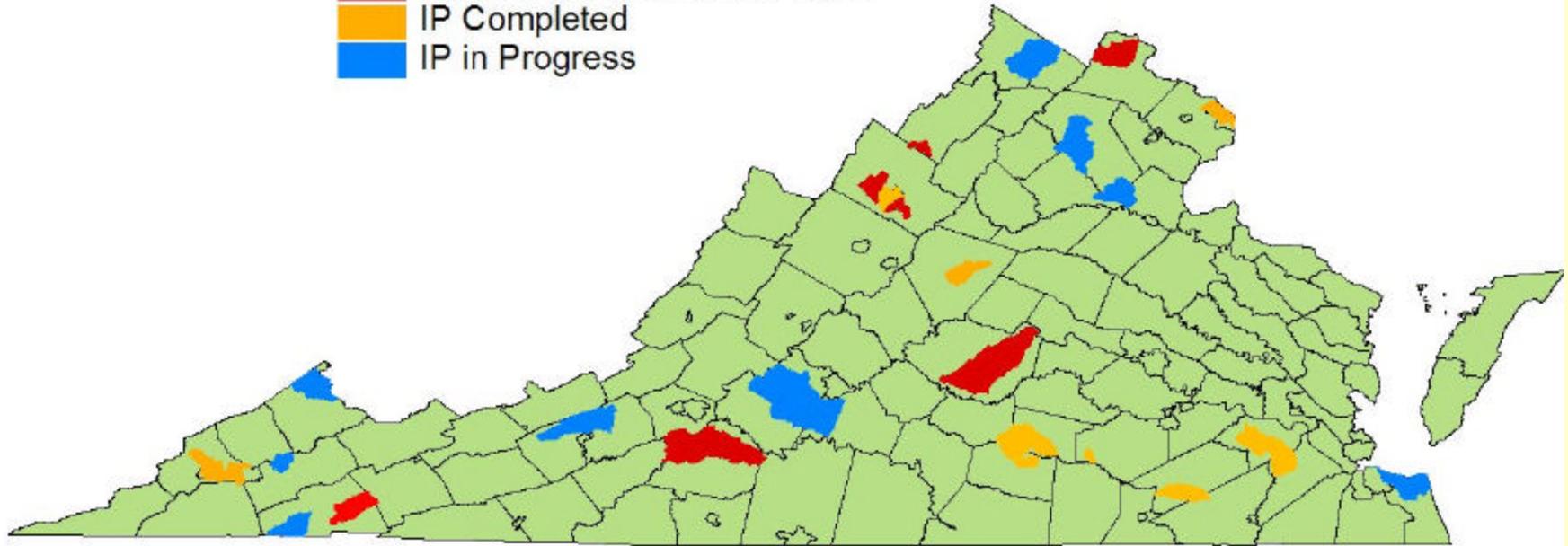
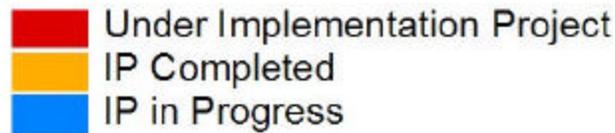
VSCI Reference versus Stressed



Biological Condition Estimate



Capturing Watershed Improvement



Virginia has completed 14 IPs with an 8 IPs currently under development
Current Implementation Projects administered by DCR:

- **Blackwater River: Franklin County, 2001**
- **Middle Fork Holston River: Washington County, 2001**
- **North River: Rockingham County, 2001**
- **Holman's Creek: Shenandoah County, 2004**
- **Catoctin Creek: Loudoun County, 2004**
- **Lower Blackwater River, Maggoodee Creek and Gills Creek, Franklin County, 2006**
- **Willis River: Cumberland and Buckingham Counties, 2005**



Next Steps

- **Good News = VSCI Works**
- **Incorporate USEPA and AAC guidance/feedback**
- **Propose assessment guidance for 2008 305(b)/303(d)**

Future Work With Probabilistic Data

- **Better reference and stress filters**
- **Create RIVPACS model**
- **Establish baseline condition of non-tidal resources**
- **Describe background conditions at reference sites**
- **Determine most common ecological stressors**
- **Monitor regional trends over time**



Questions?

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<http://www.deq.virginia.gov/watermonitoring/pdf/scival.pdf>

<http://www.deq.virginia.gov/watermonitoring/bio.html>

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