



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

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- **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**

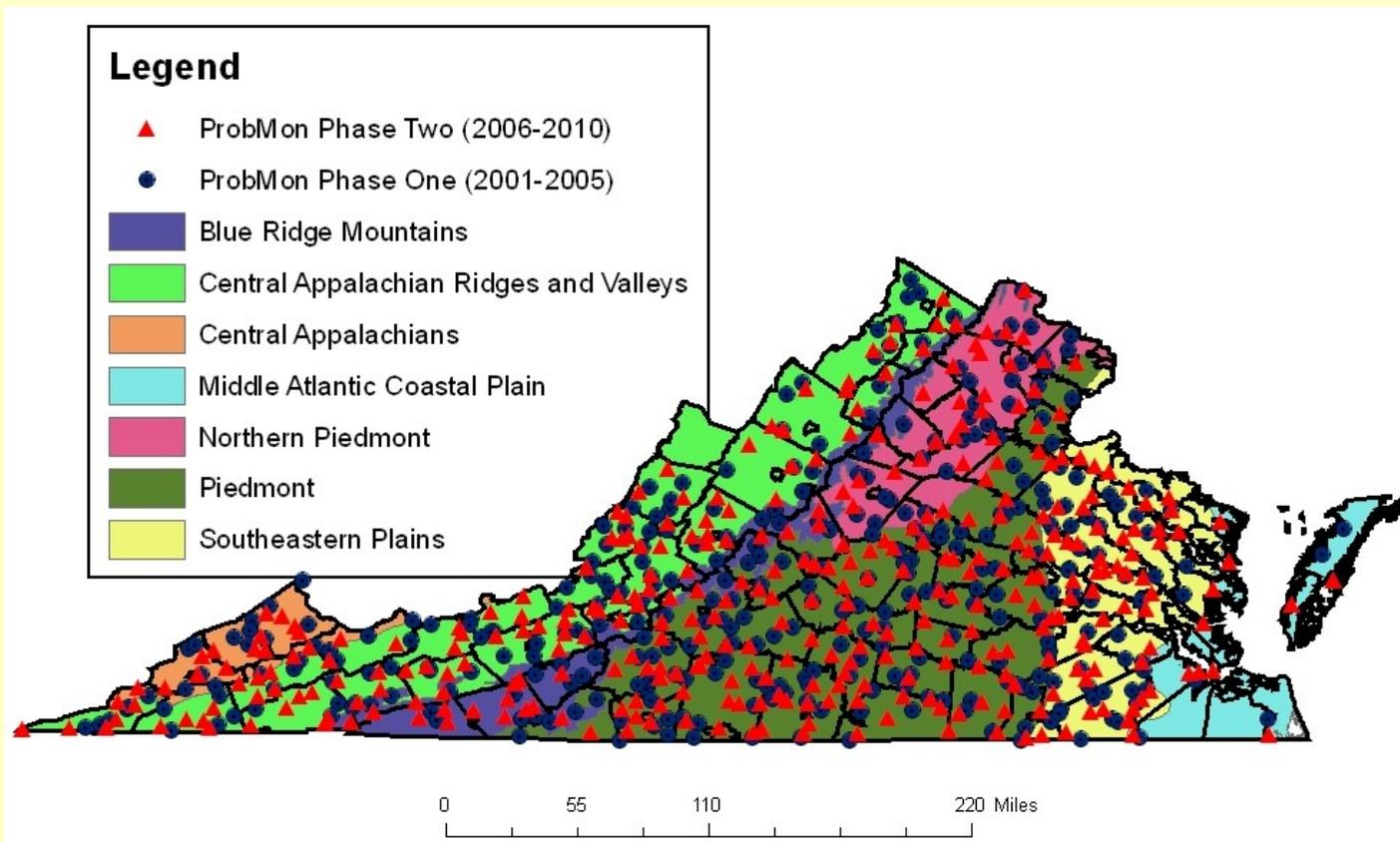
- **Greg Pond, Maggie Passmore, Karen Blocksom, Anthony Olsen**

- **Virginia Academic Advisory Committee**



Probabilistic Monitoring in Virginia

- 1997 - Water Quality Monitoring, Improvement, and Restoration Act (WQMIRA)
- 1999 - VDEQ monitoring taskforce revamps monitoring programs
- 2001- Probabilistic monitoring (ProbMon) begins
- Virginia uses design very similar to WSA study



Probabilistic Monitoring in Virginia

- Biologist contacts the landowner
- Sample spring and fall (different parameters)
- Four years of potential sampling (n=280)
 - 234 target and sampled
 - 13 permission denied
 - 9 other target
 - 24 non-target



Biomonitoring Validation Case Study

- Non-Coastal Virginia Stream Condition Index (VSCI)
- Categories: season, basin size, ecoregion, bioregion, basin size, VDEQ region, river basin
 - Test for patterns in reference taxa
 - Test for statistical significance
 - Test for environmental significance
 - Best standard value calibration

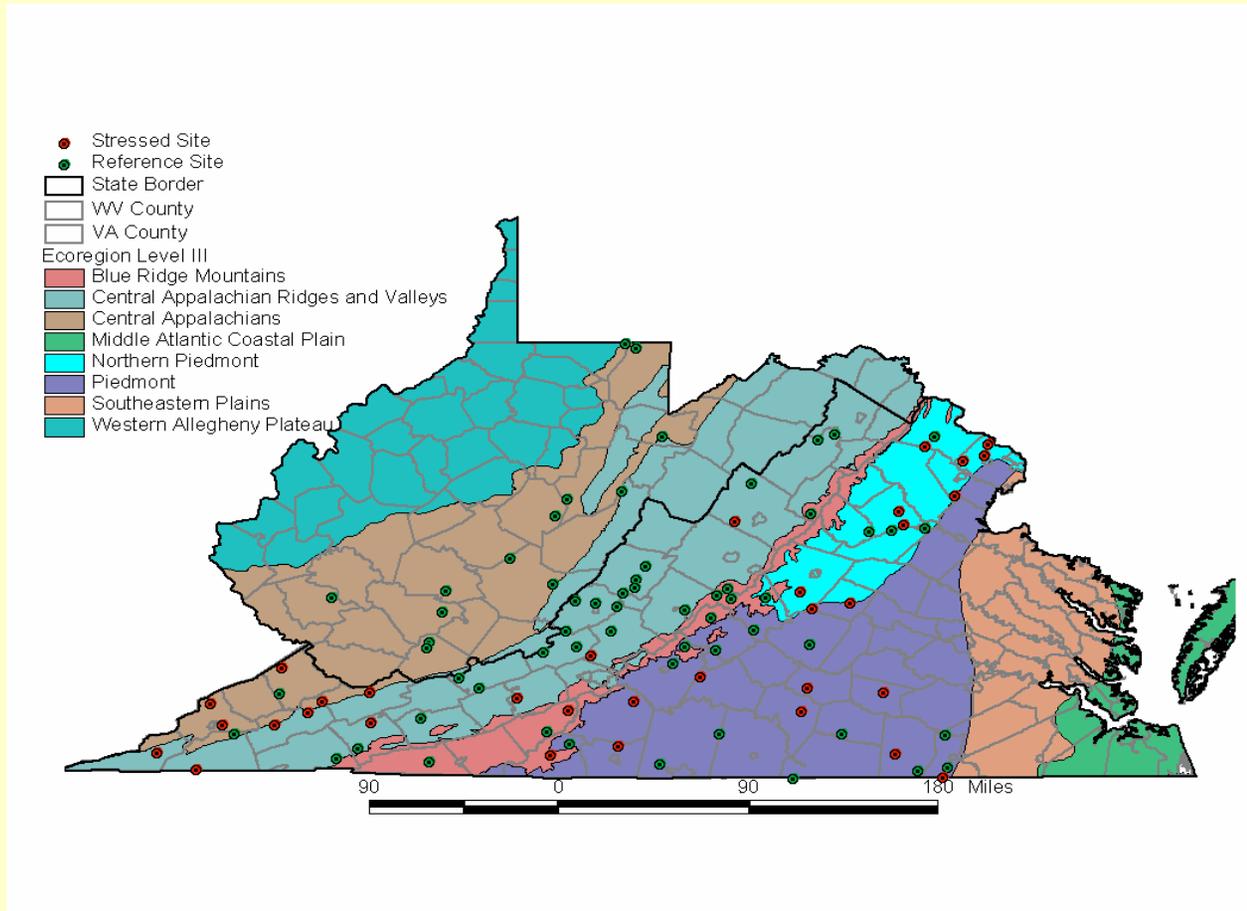


Reference Data Used in this Analysis

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)

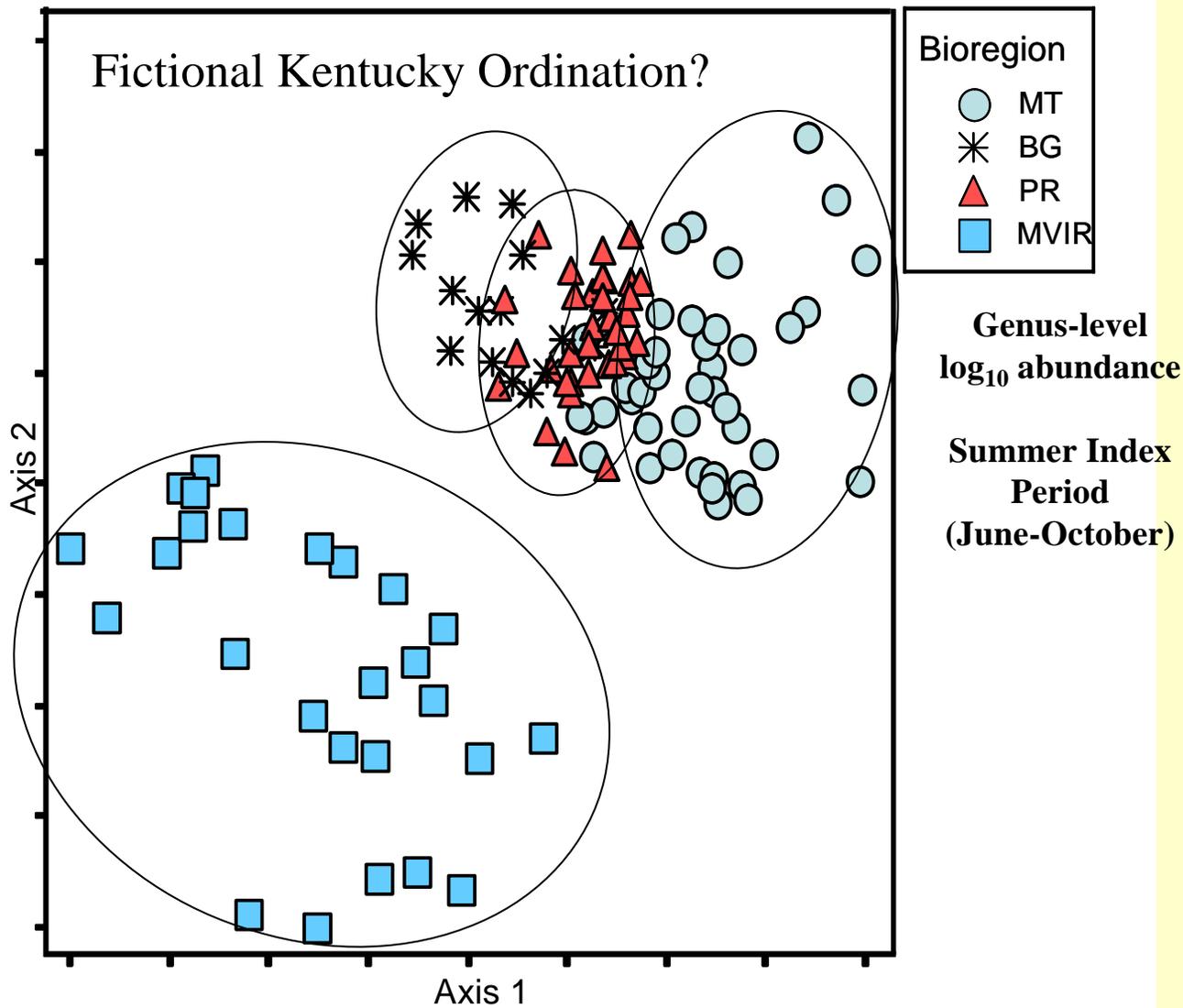
Piedmont (n=18 spring, 16 fall)*

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

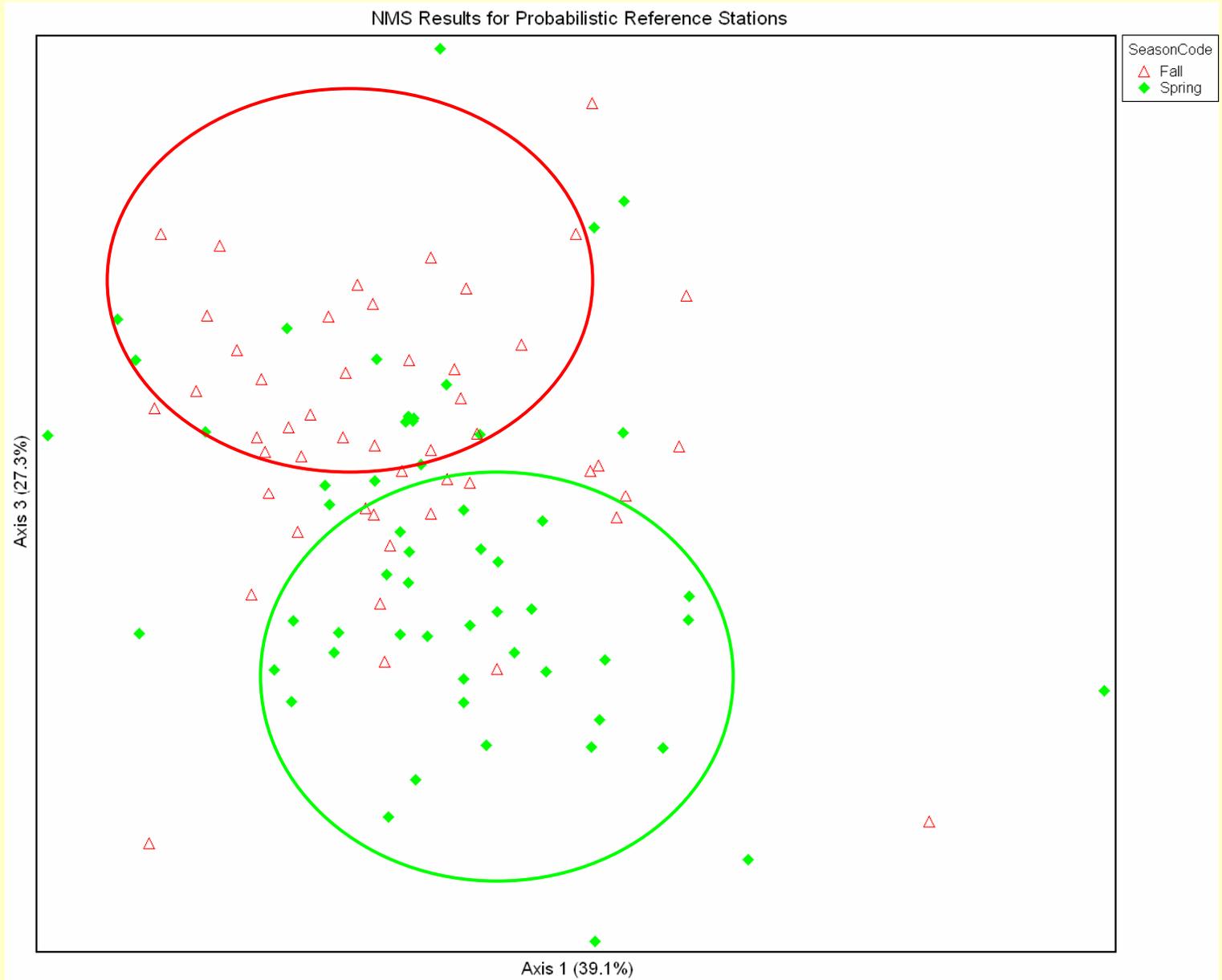
1	% Urban	> 10%
2	Total Nitrogen	> 3 mg/L
3	Total Phosphorus	> 0.1 mg/L
4	Conductivity	> 500
5	Riparian Vegetation	< 6
6	Total Habitat	< 120

NMS = Purpose of nonmetric multidimensional Scaling is to find patterns

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

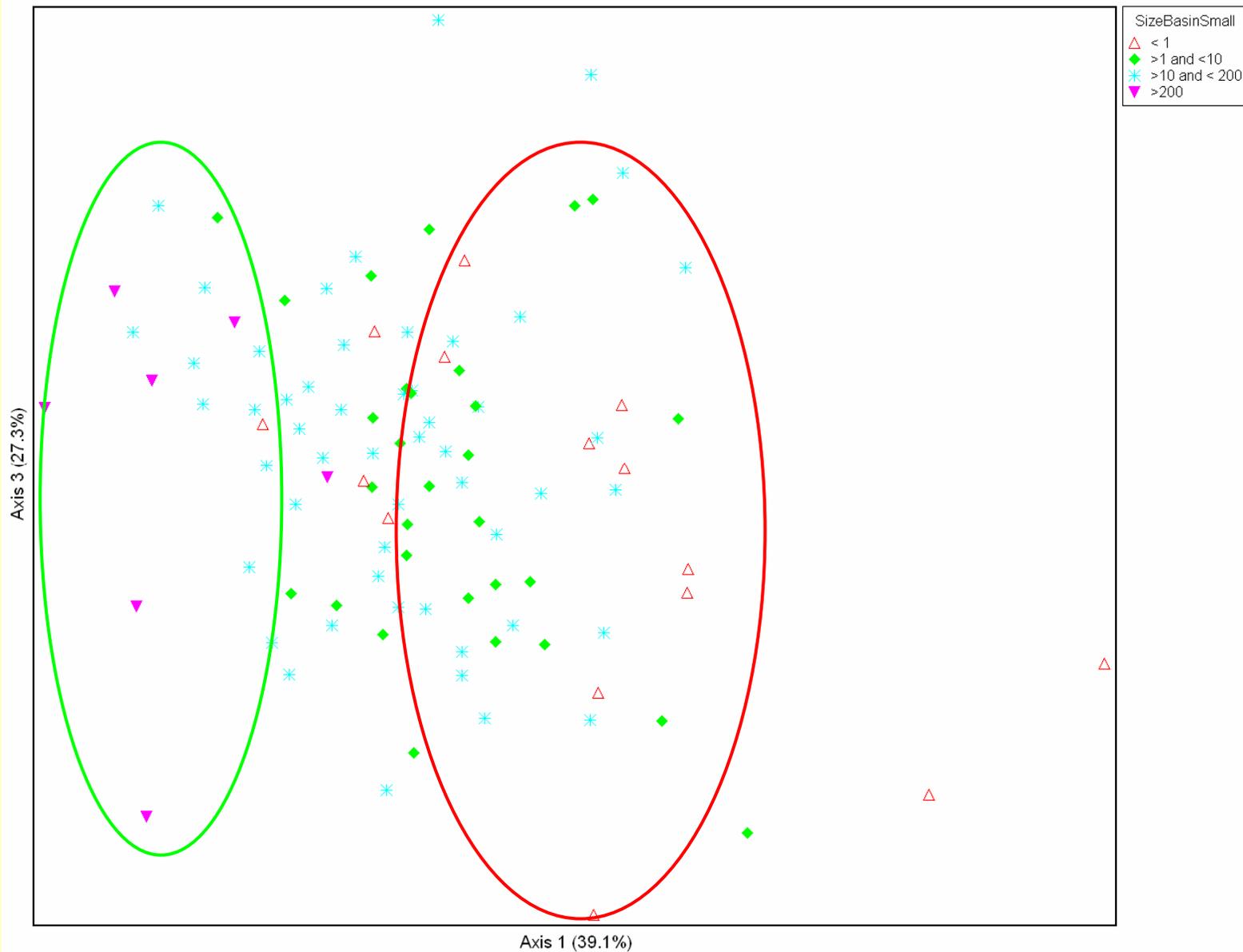


NMS = Patterns for Ref Sites? Season?



NMS = Patterns for Ref Sites? Basin Size?

NMS Results for Probabilistic Reference Stations

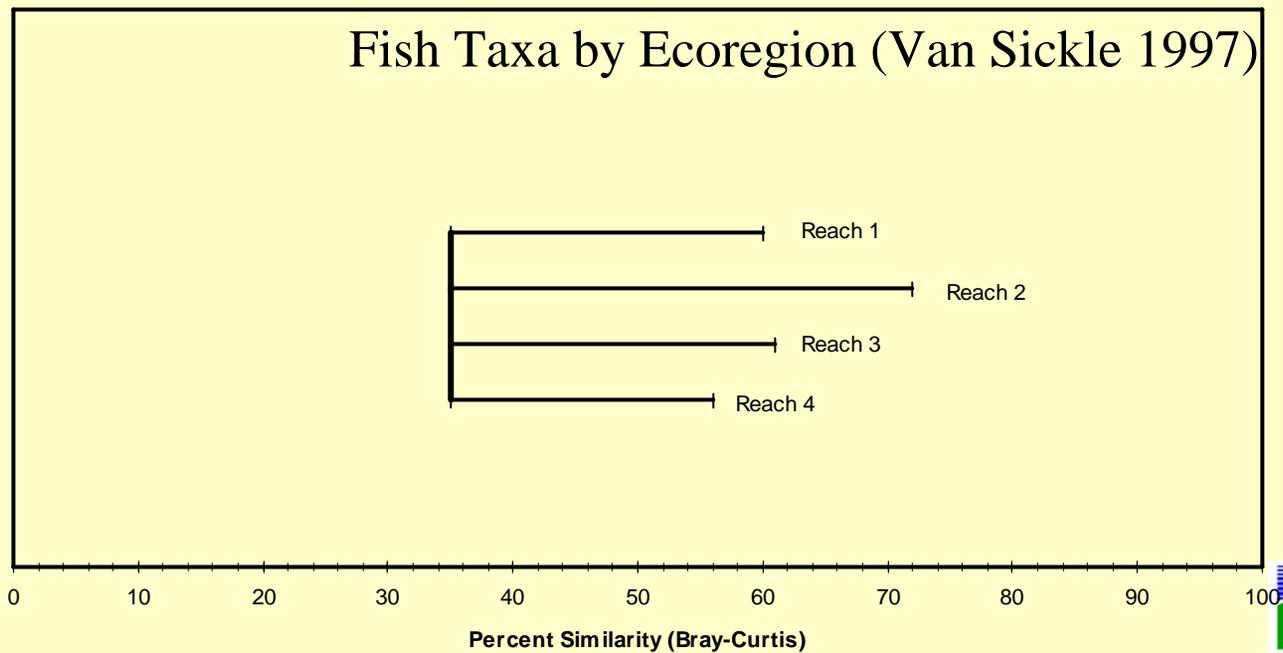
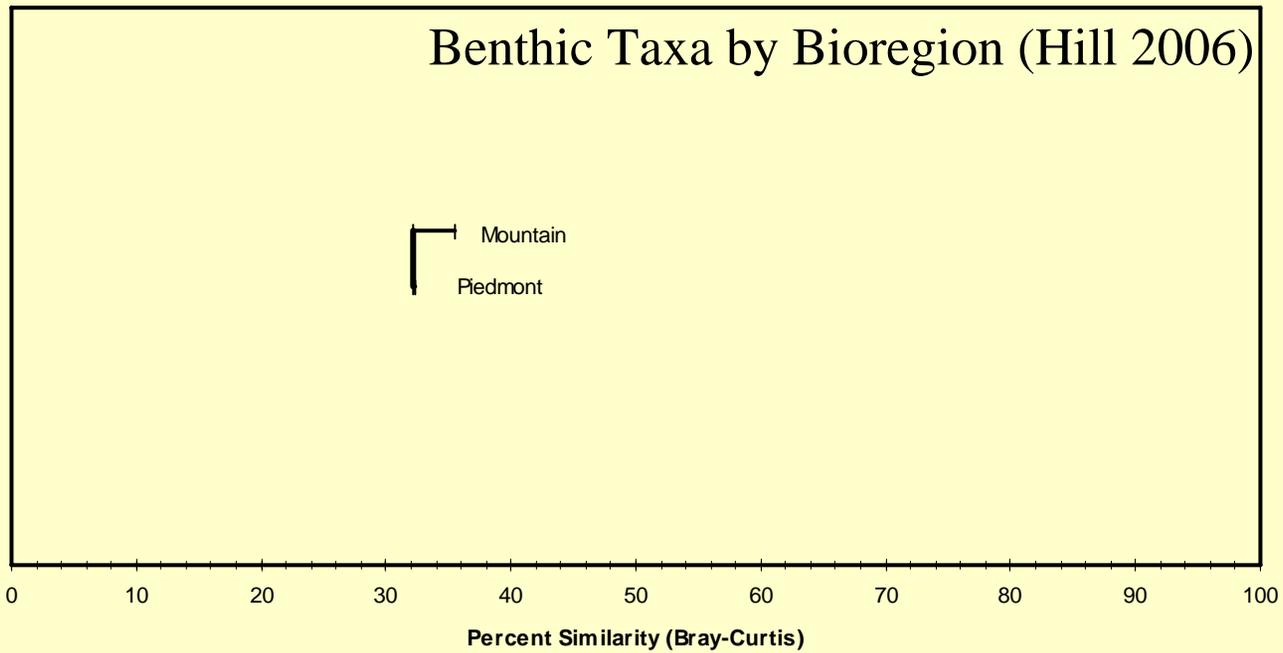


Mean Similarity Test

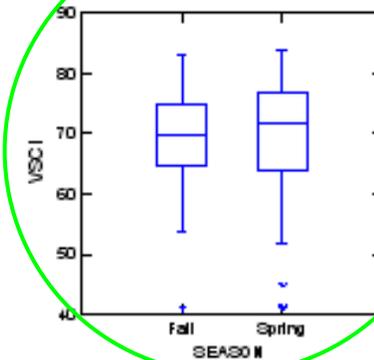
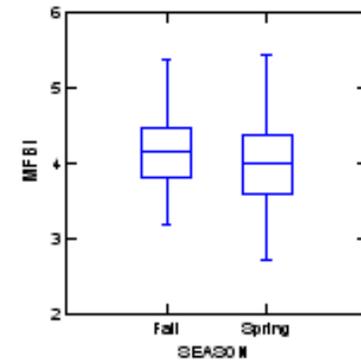
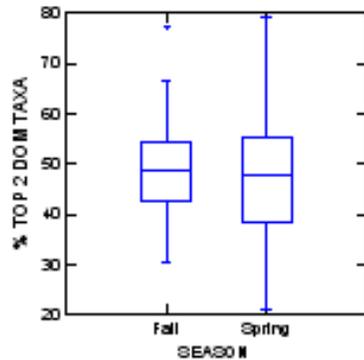
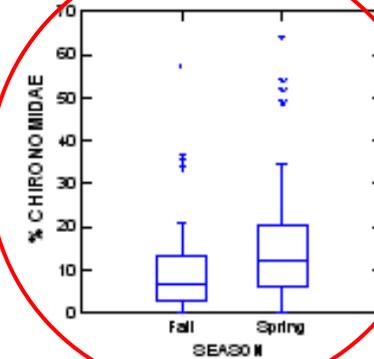
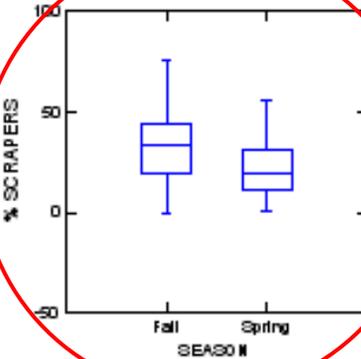
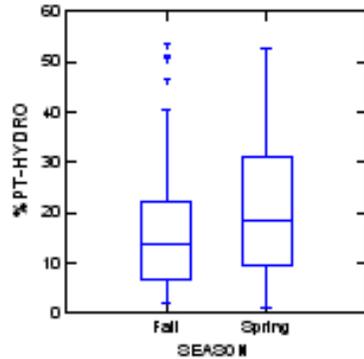
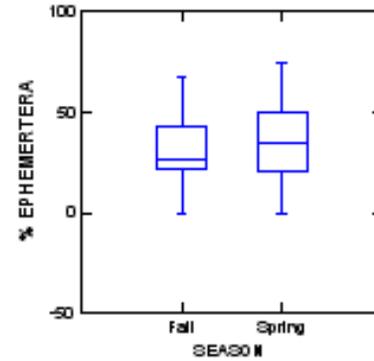
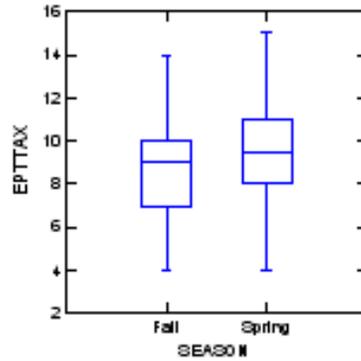
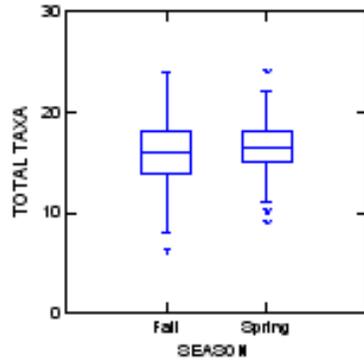
- Moving beyond graphical analysis
- Input taxa similarity matrix to the EPA MeanSim program
- Provides within group similarity and between group similarity
- Calculate a ‘classification strength’ for different categories

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

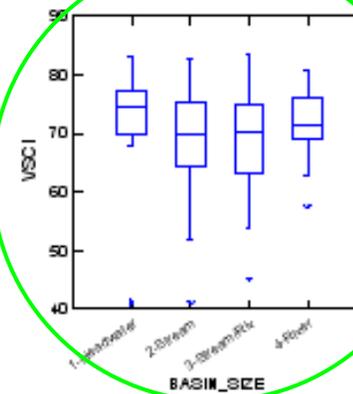
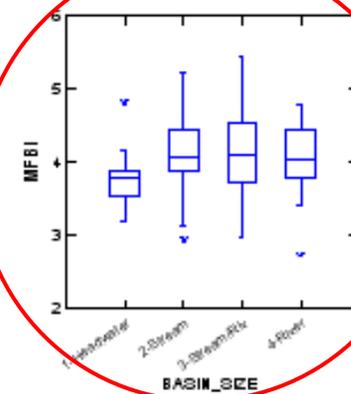
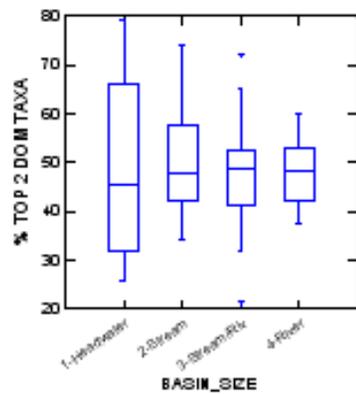
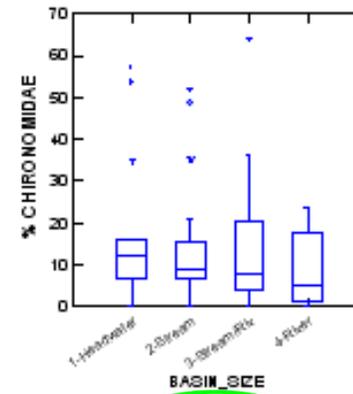
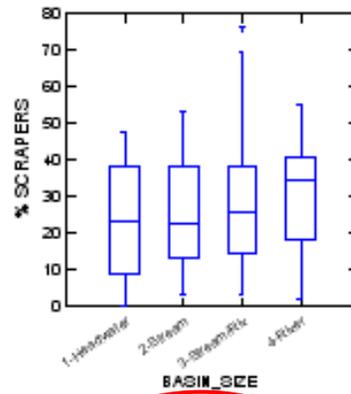
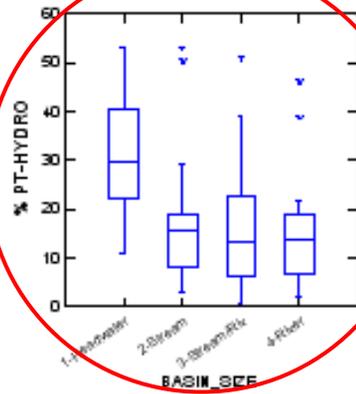
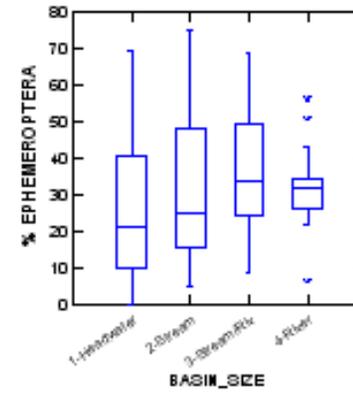
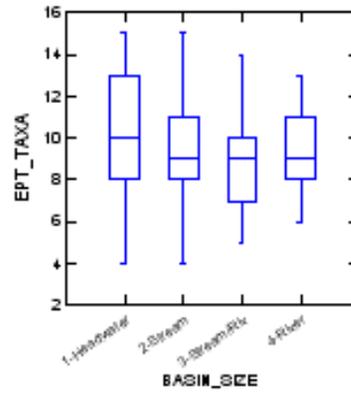
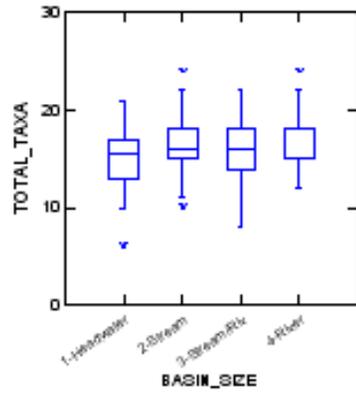
MeanSim Dendograms Outputs



Environmental Significance? Season?



Environmental Significance? Basin Size?

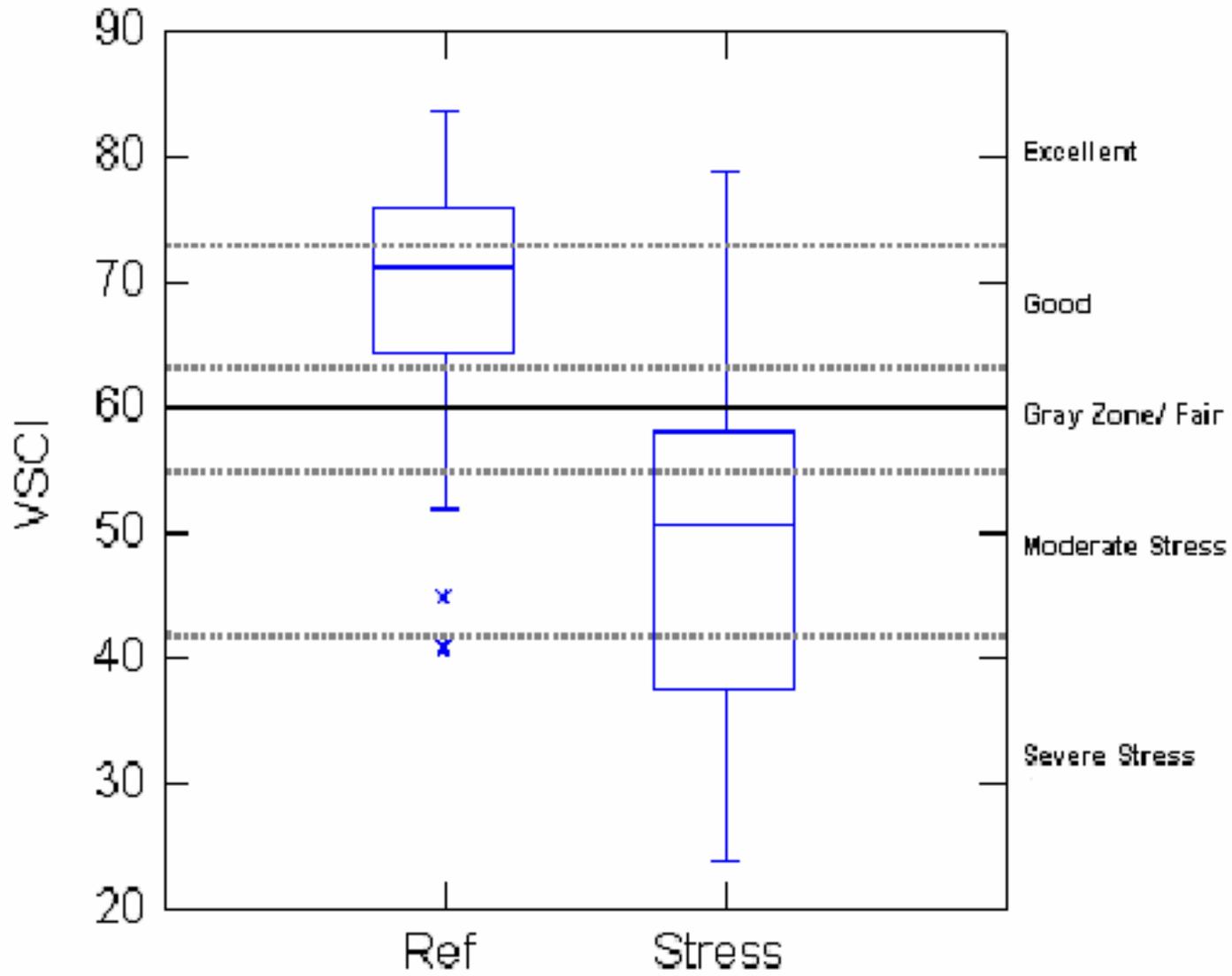


Best Standard Value Comparison

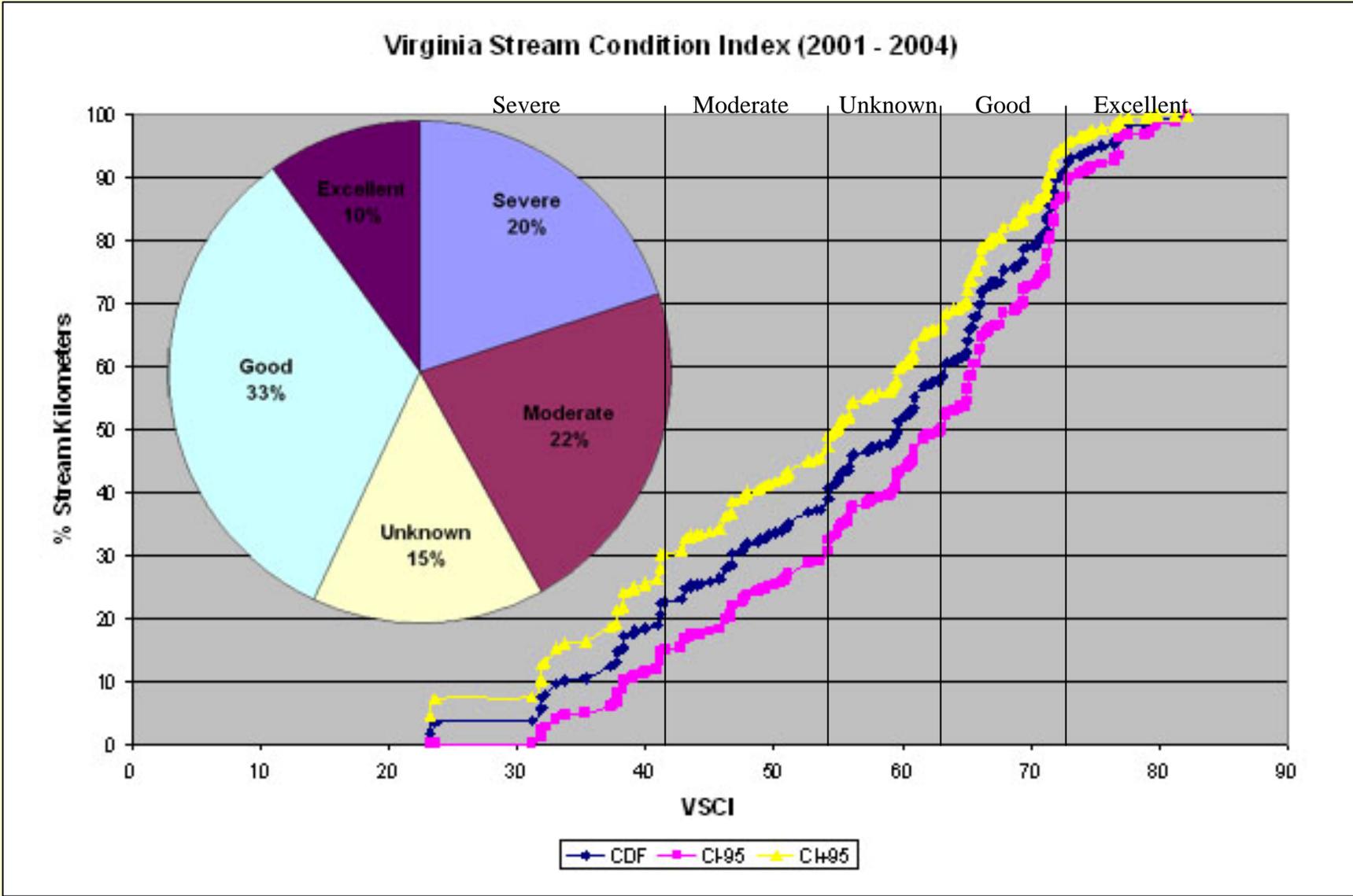
Tetrattech 95th percentile versus ProbMon 95th percentile

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

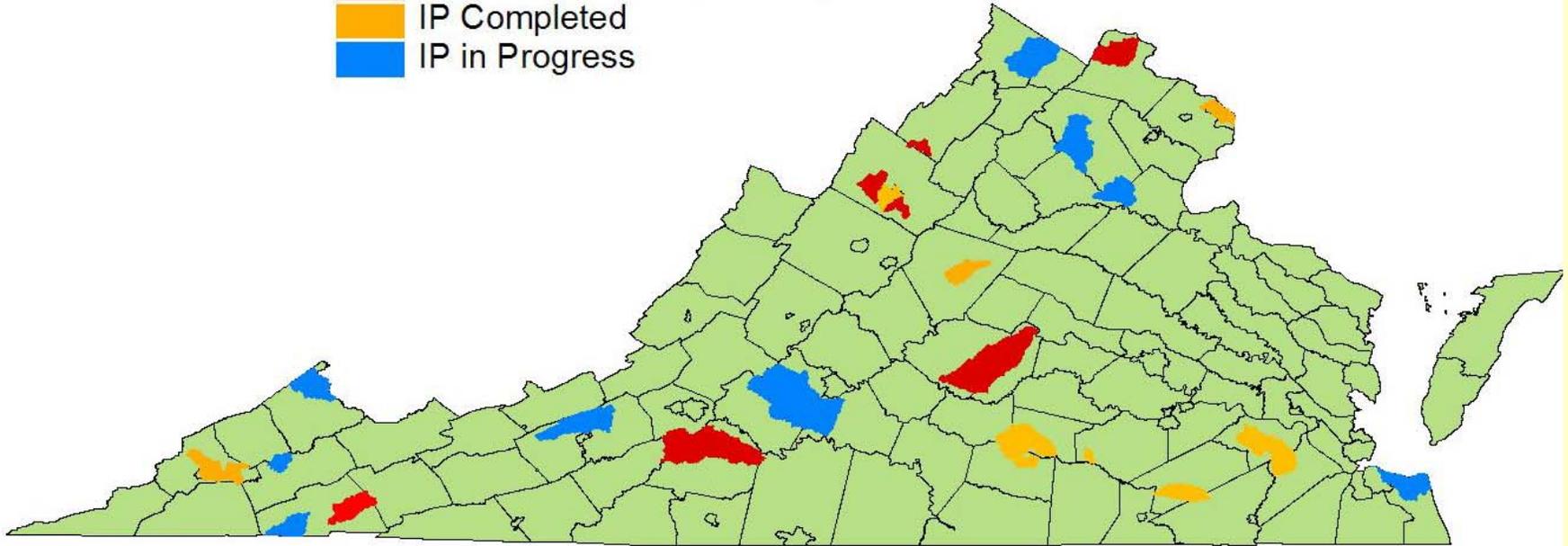
VSCI Reference versus Stressed



Biological Condition Estimate



Capturing Watershed Improvement

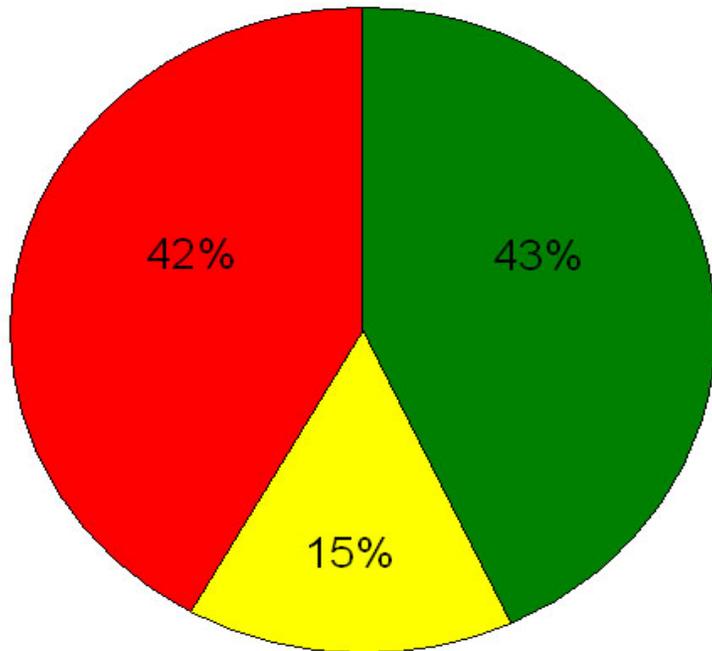


Virginia has completed 14 IPs with an 8 IPs currently under development
Current Implementation Projects administered by DCR:

- **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, Maggodee Creek and Gills Creek, Franklin County, 2006**
- **Willis River: Cumberland and Buckingham Counties, 2005**

Statewide Biological Condition Estimate

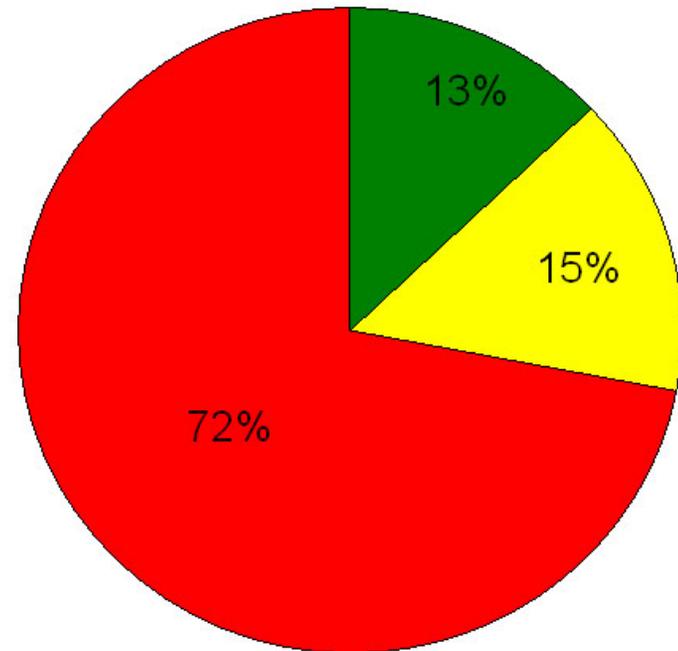
Virginia Stream Condition Index



Virginia Non-Coast +/- 4%



Mid-Atlantic Coastal Plain (MACP) Streams

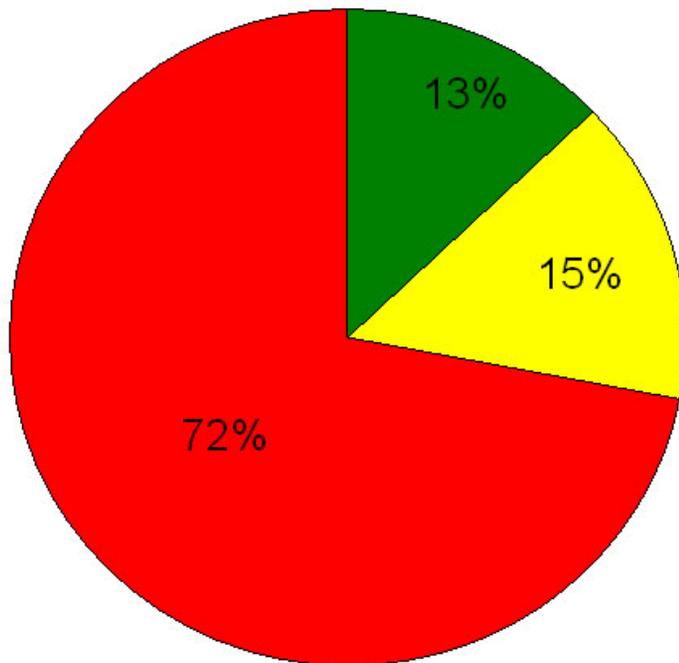


Virginia Coast +/- 17%



VDEQ vs EPA Biological Condition Estimate

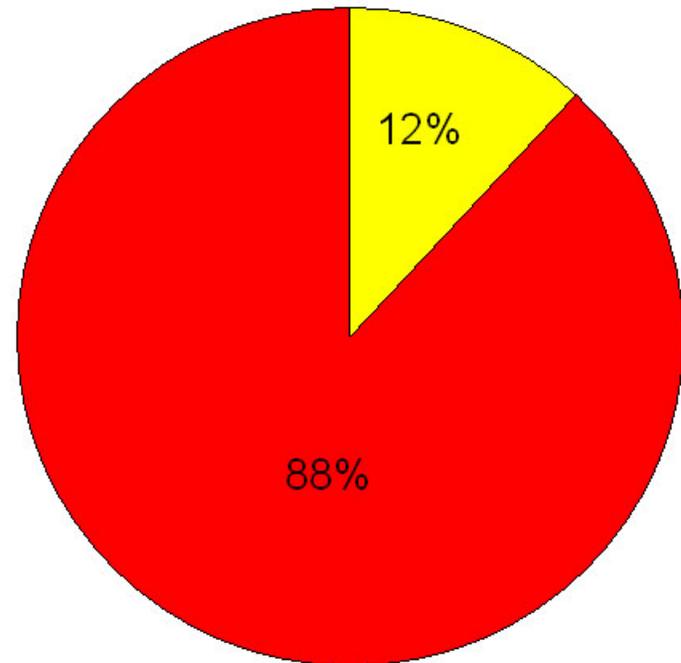
Mid-Atlantic Coastal Plain (MACP) Streams



Virginia ProbMon +/- 17%



Mid-Atlantic Integrated Assessment (MAIA)

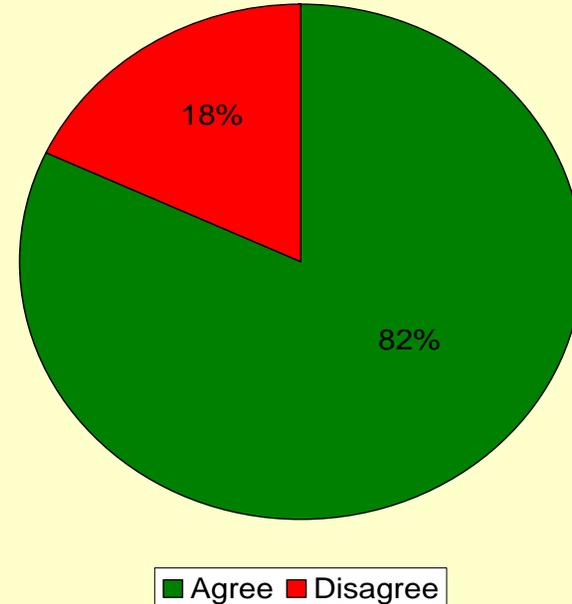


Regional EPA Survey +/- 23%



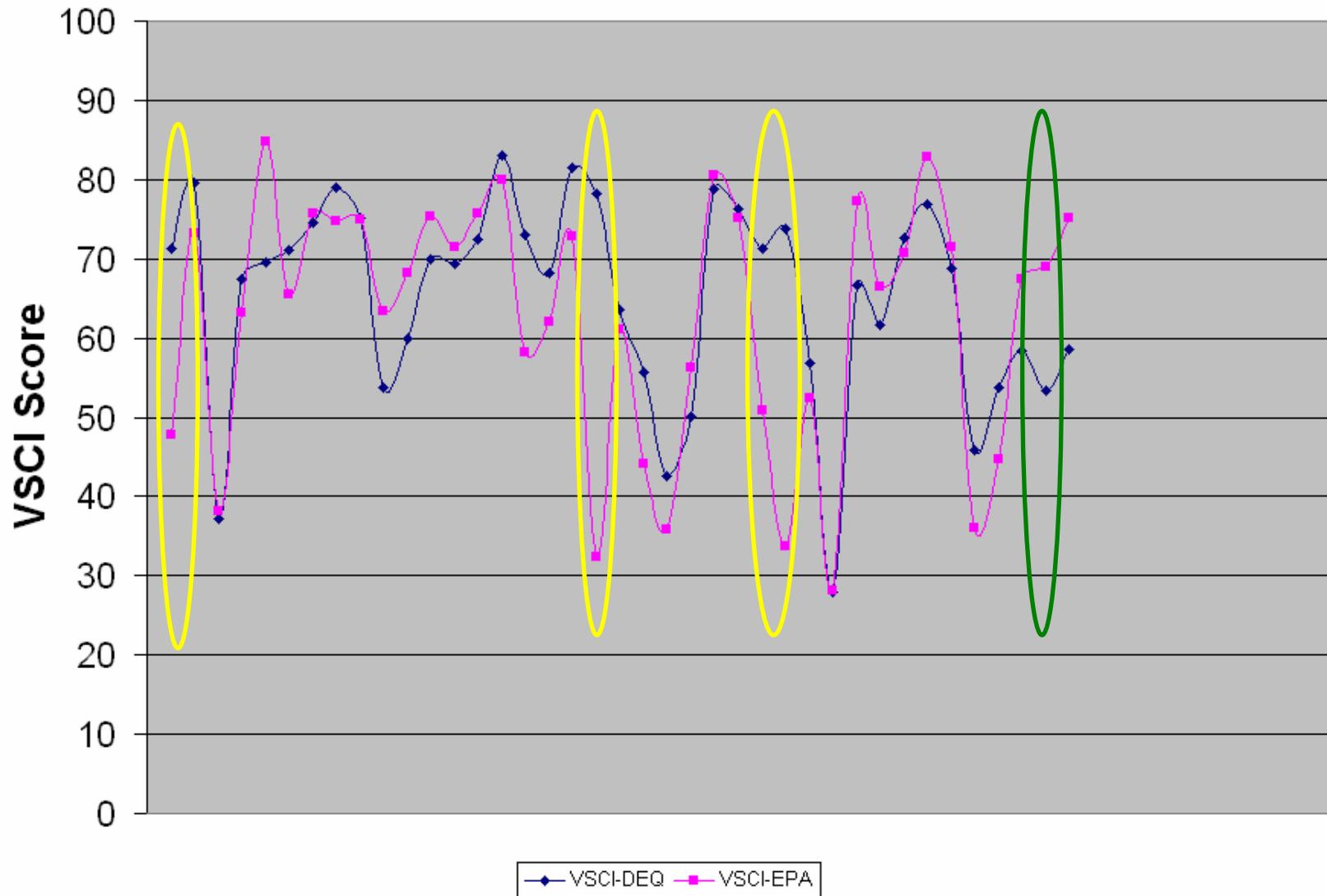
VDEQ vs USEPA WSA Methods

	Pass (Not 303d Listed)	Fail (303d Listed)
VDEQ Method	31	8
EPA Method	28	11



- WSA randomly samples transects (left, middle, right)
- WSA labs identified at least 500 organisms to genus
- VDEQ samples ‘most productive habitat’
- VDEQ identifies 100-200 organisms to family

VDEQ vs USEPA WSA Methods



Next Steps for VSCI

- 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 biological resources
- Monitor the baseline condition over time
- Describe background conditions at reference sites
- Determine most common ecological stressors

Questions?

VADEQ

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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/>