



# 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**

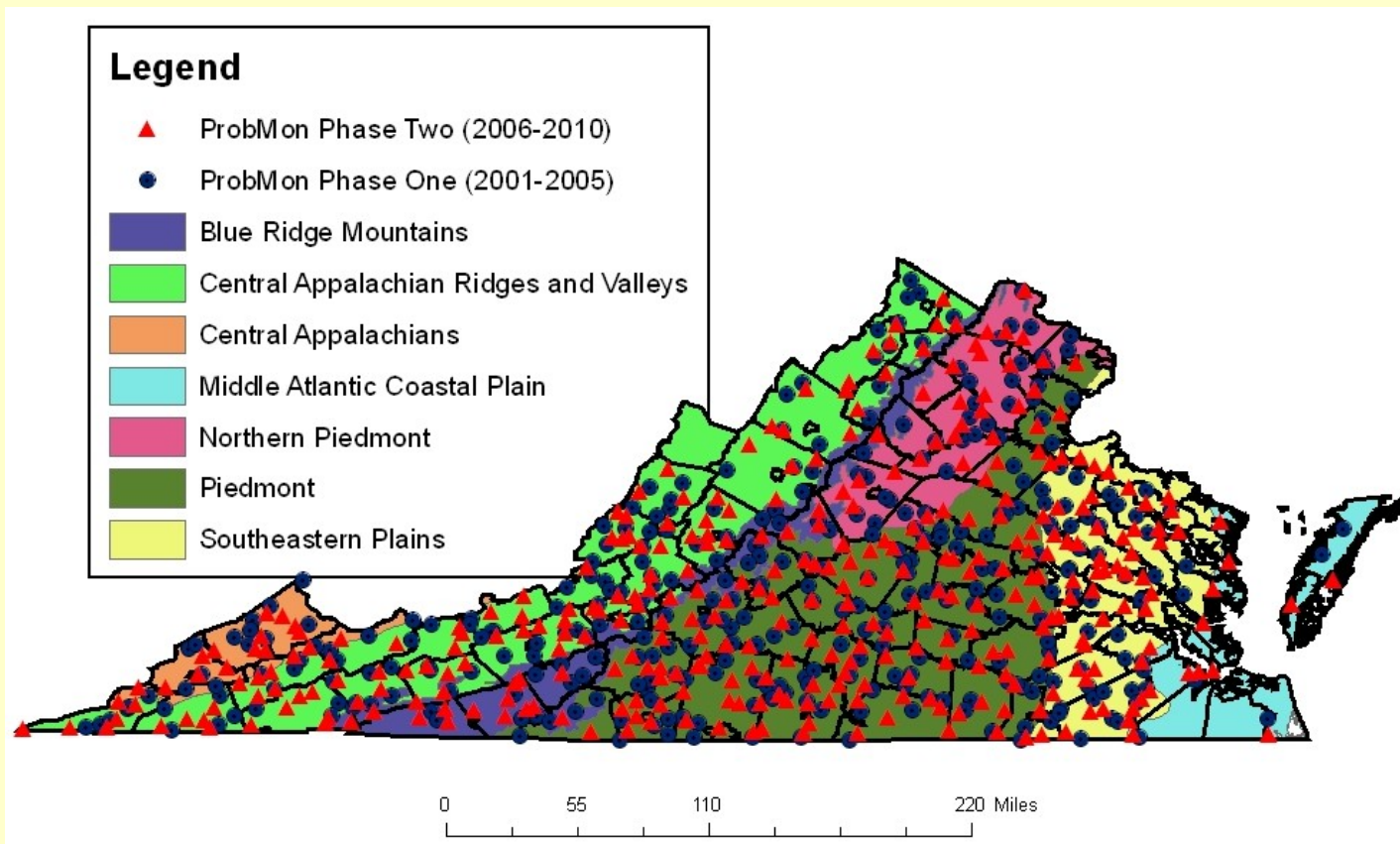
- **USEPA**

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

- **Virginia Academic Advisory Committee**

# 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



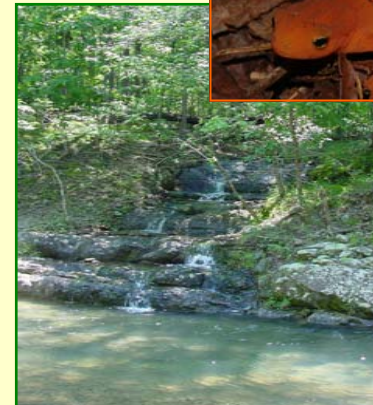
# Probabilistic Monitoring in Virginia

- 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



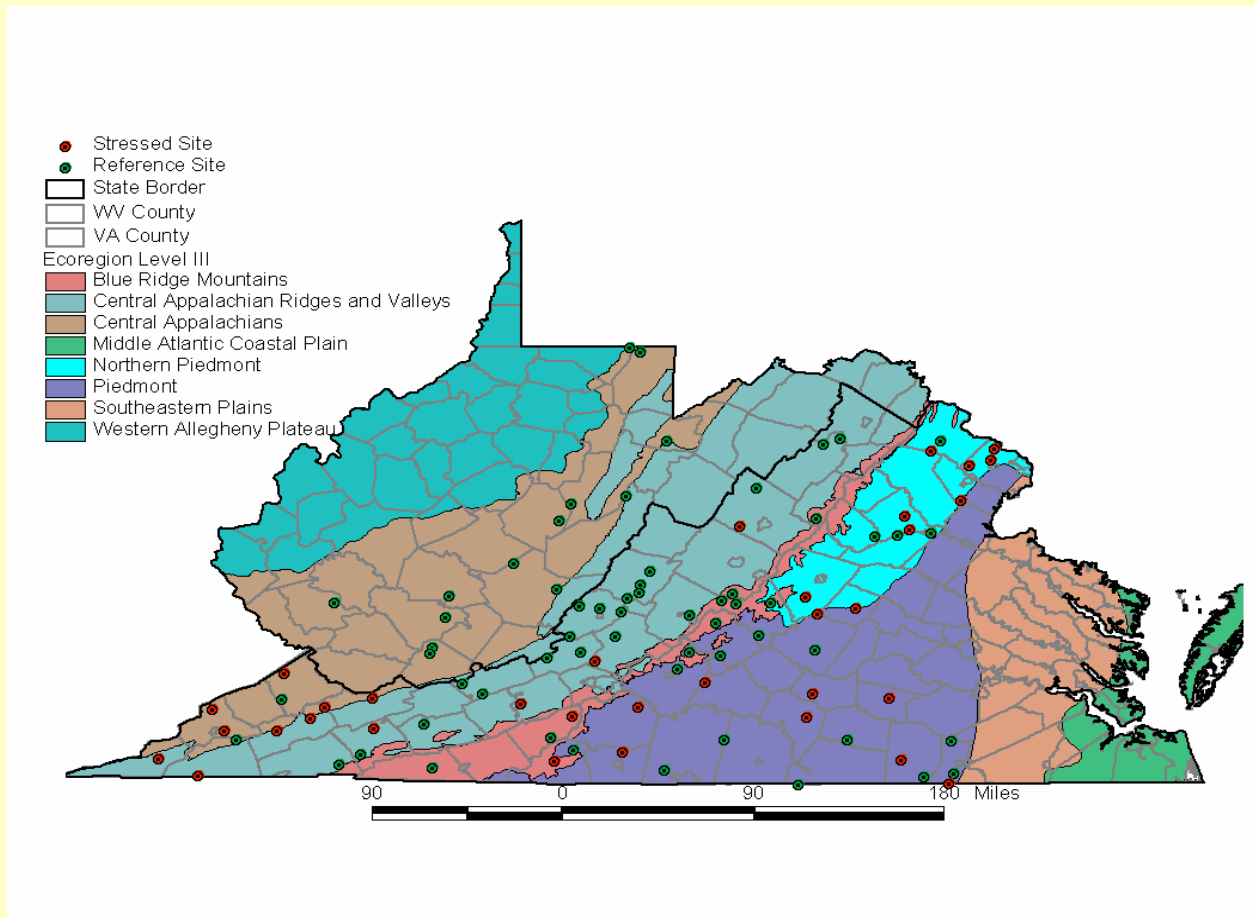


# Reference Data Used in this Analysis

**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)\***

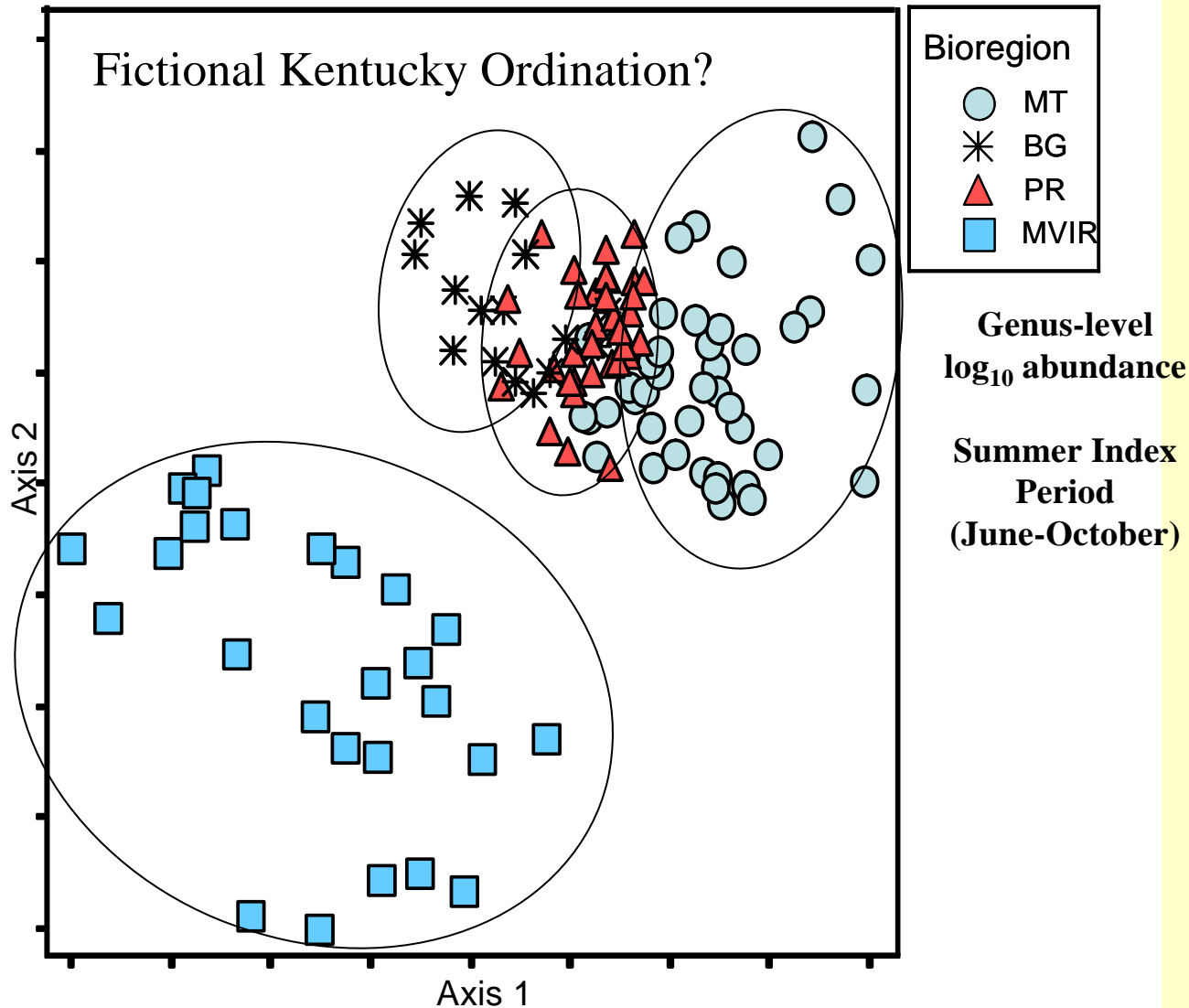
\*5<sup>th</sup> order and greater, total habitat does not appear to be a good filter!

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

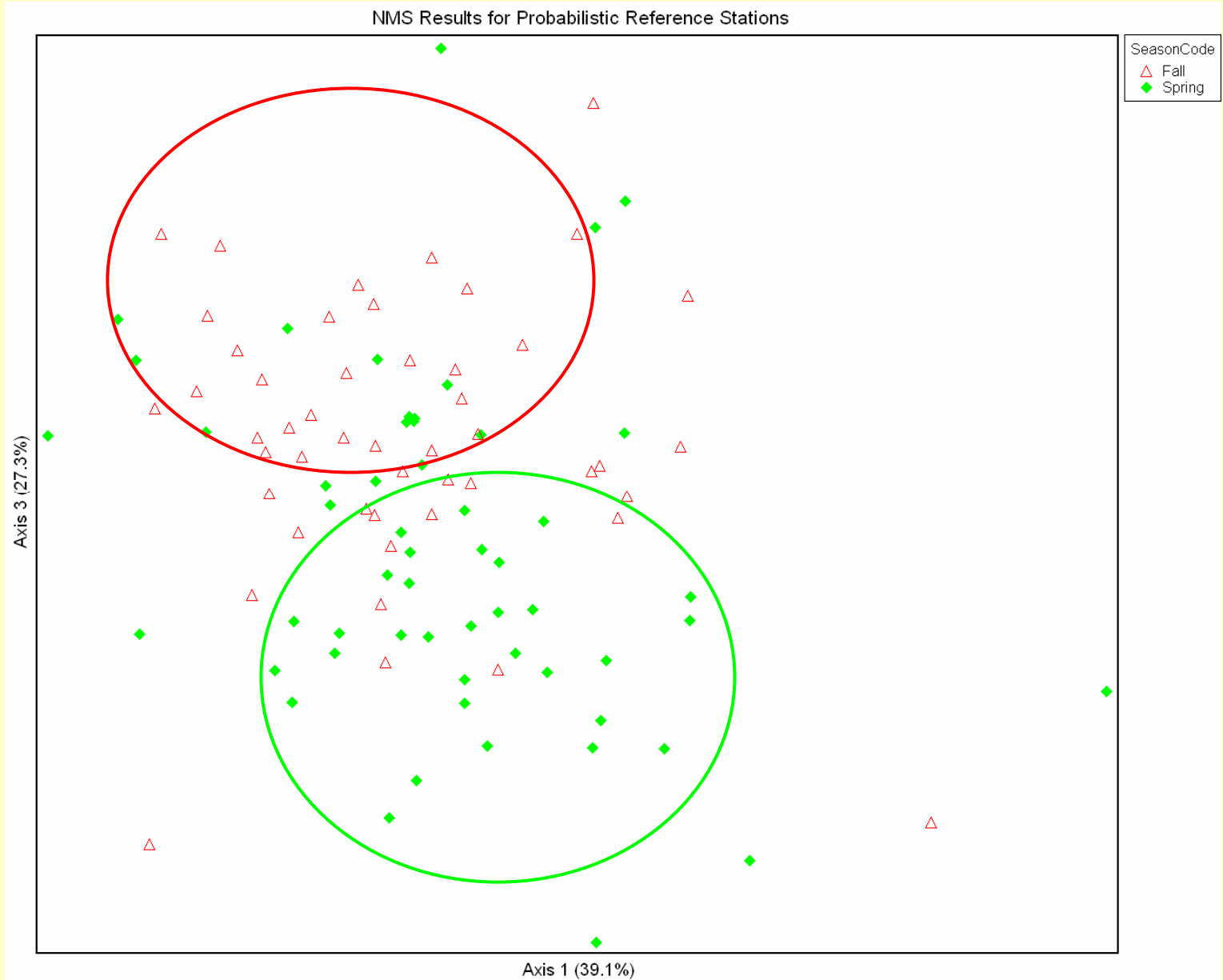
# NMS = Purpose of nonmetric multidimensional Scaling is to find patterns

## NMDS – Wadeable (~ 5 - 150 sq. mi.)

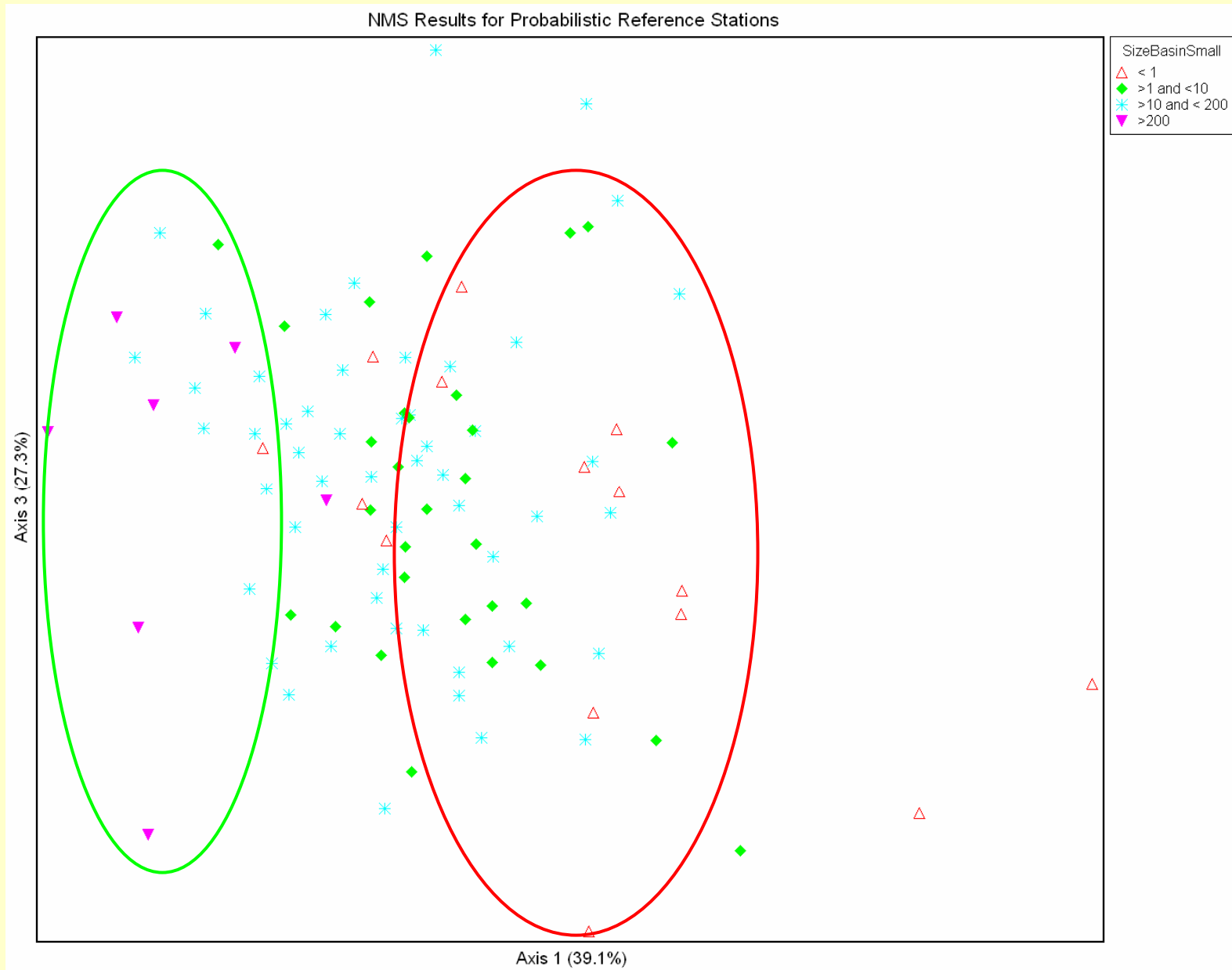
19.6% Stress for 2-dimensional solution



# NMS = Patterns for Ref Sites? Season?



# NMS = Patterns for Ref Sites? Basin Size?

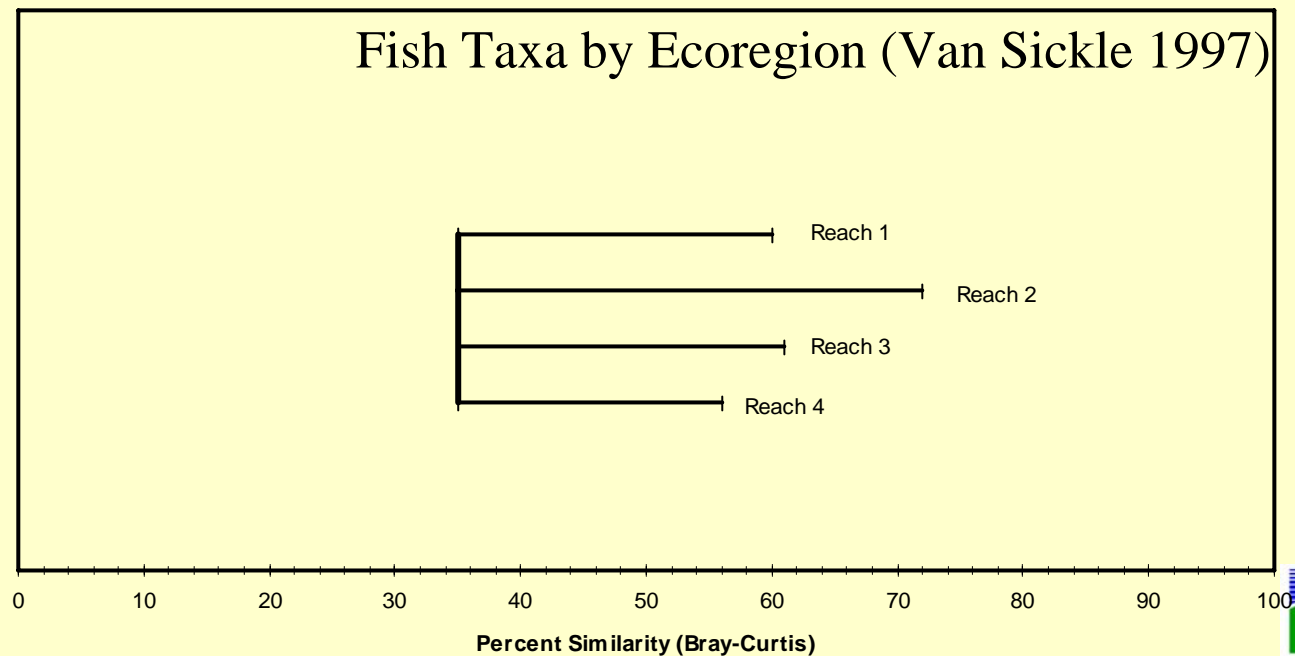
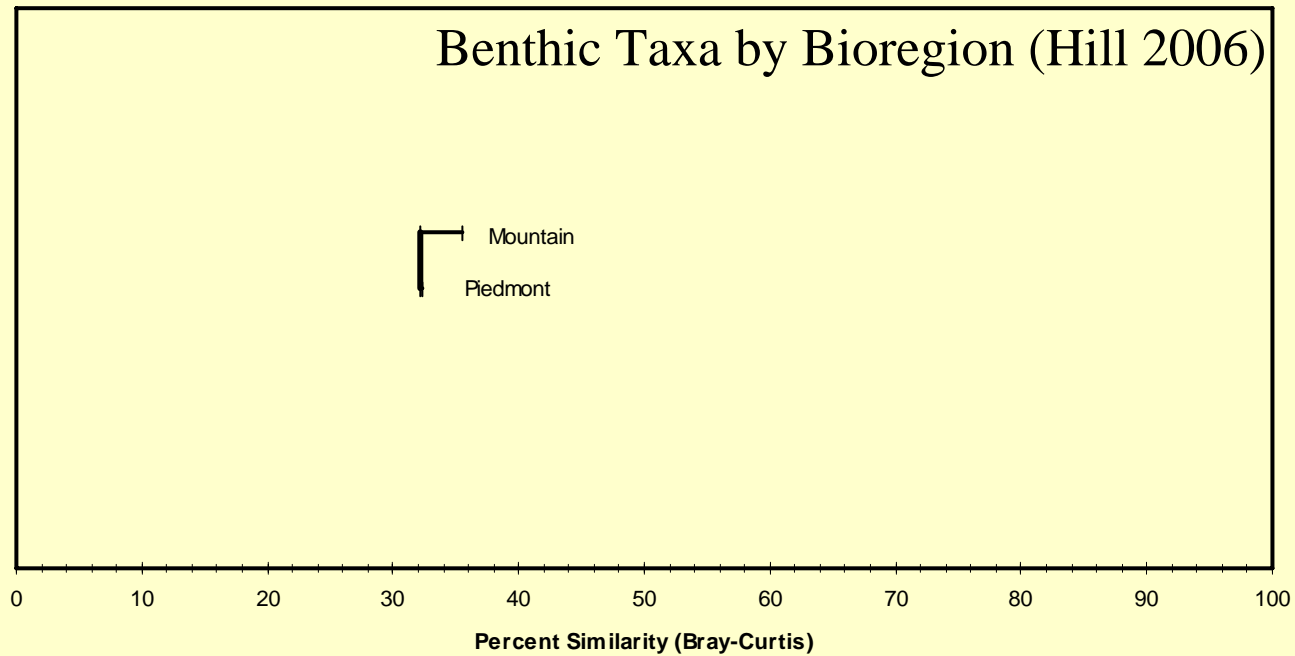


# Mean Similarity Test

- 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

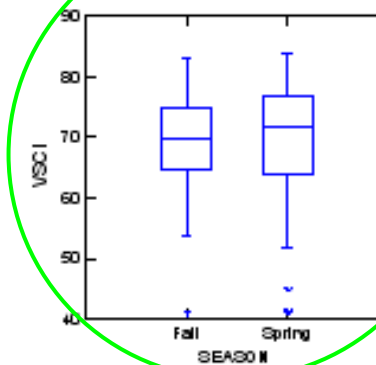
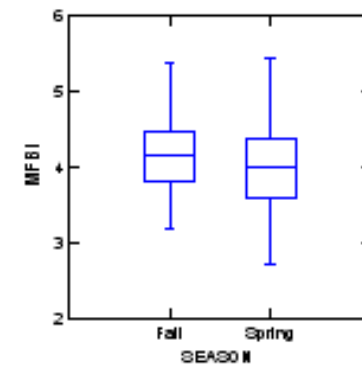
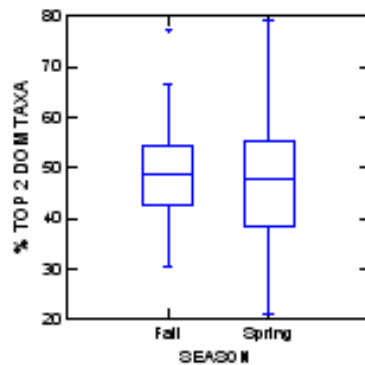
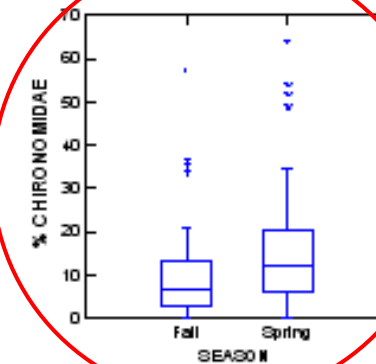
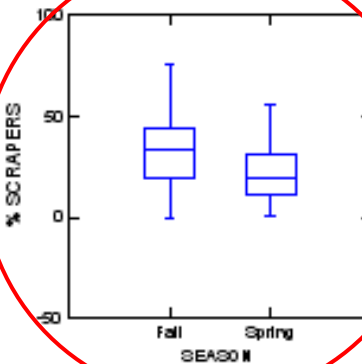
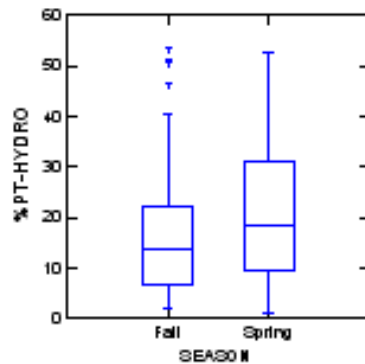
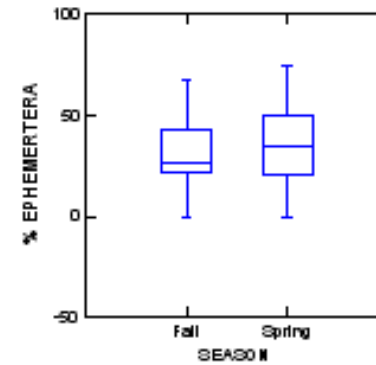
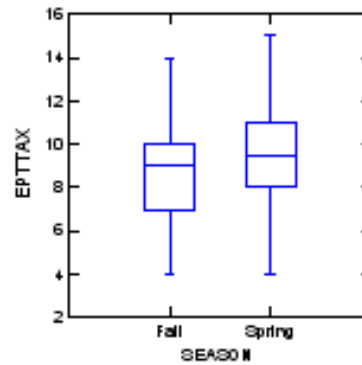
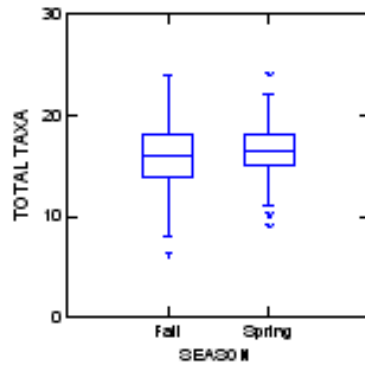
Bray Curtis Similarity Matrix							
	N (ref sites)	N (Groups)	Within Group (W)	Between Group (B)	CS (W-B)	M (B/W)	p-value
Season	104	2	35.9%	31.7%	4.3%	0.88	0.0001
Basin Size	104	4	35.1%	32.7%	2.3%	0.93	0.0002
Ecoregion (III)	104	5	36.4%	32.9%	3.5%	0.91	0.0001
Bioregion	104	2	34.5%	32.2%	2.3%	0.93	0.0001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

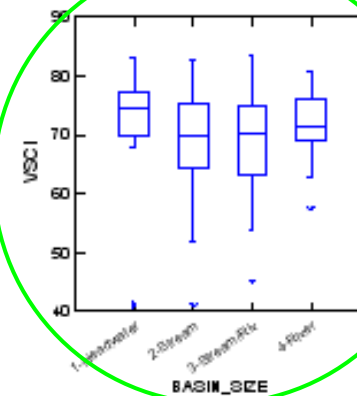
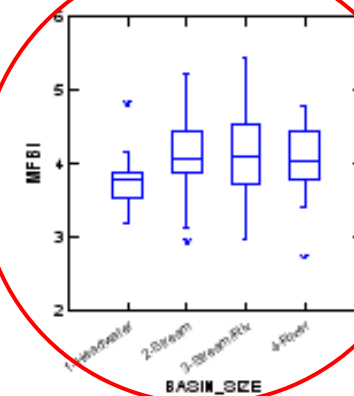
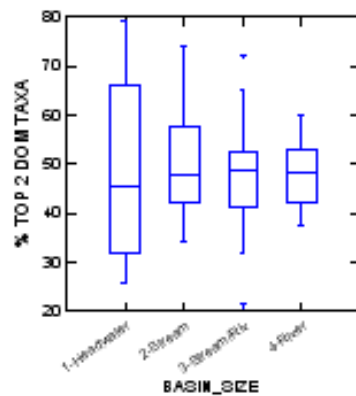
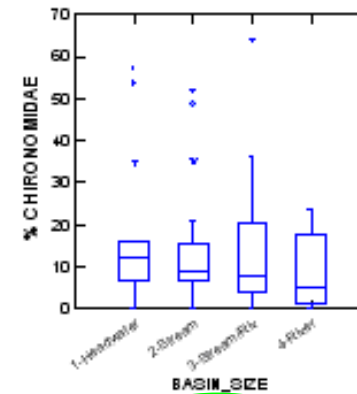
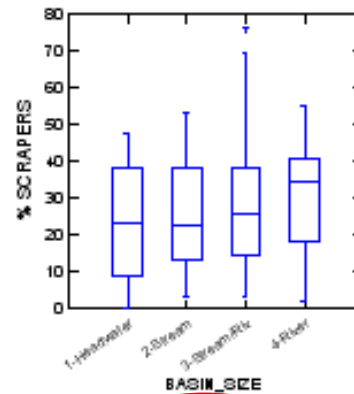
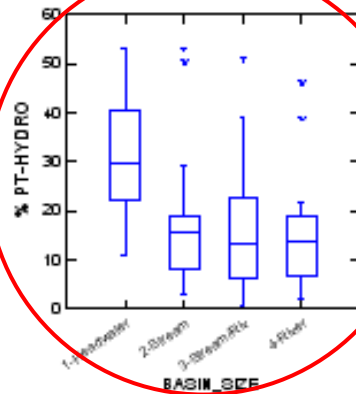
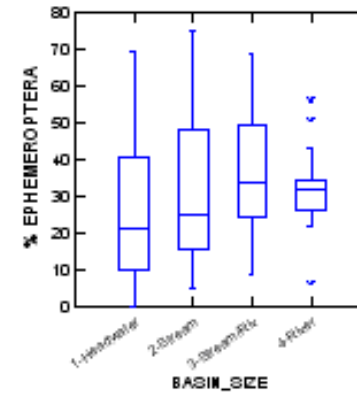
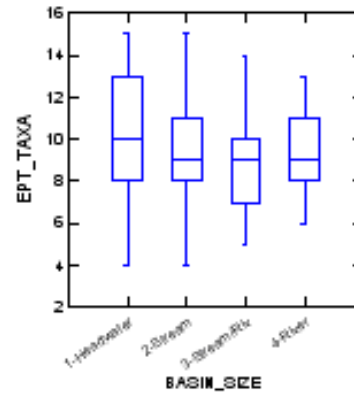
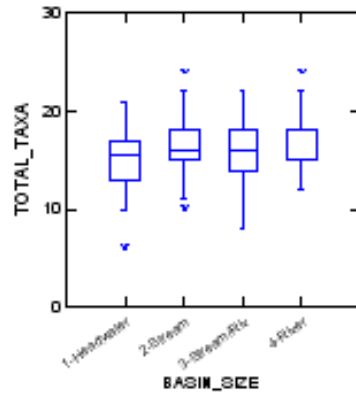




# Environmental Significance? Season?



# Environmental Significance? Basin Size?

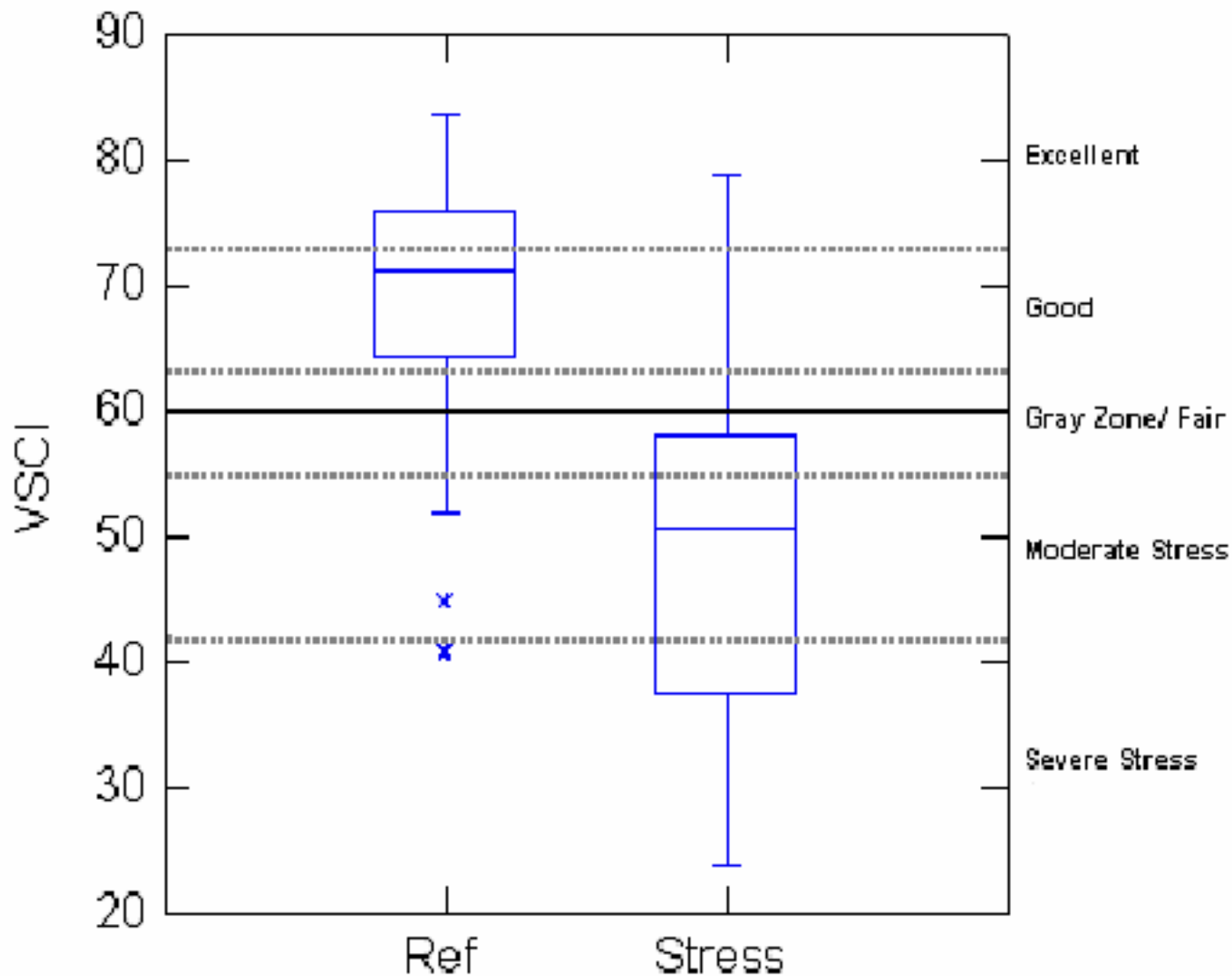


# Best Standard Value Comparison

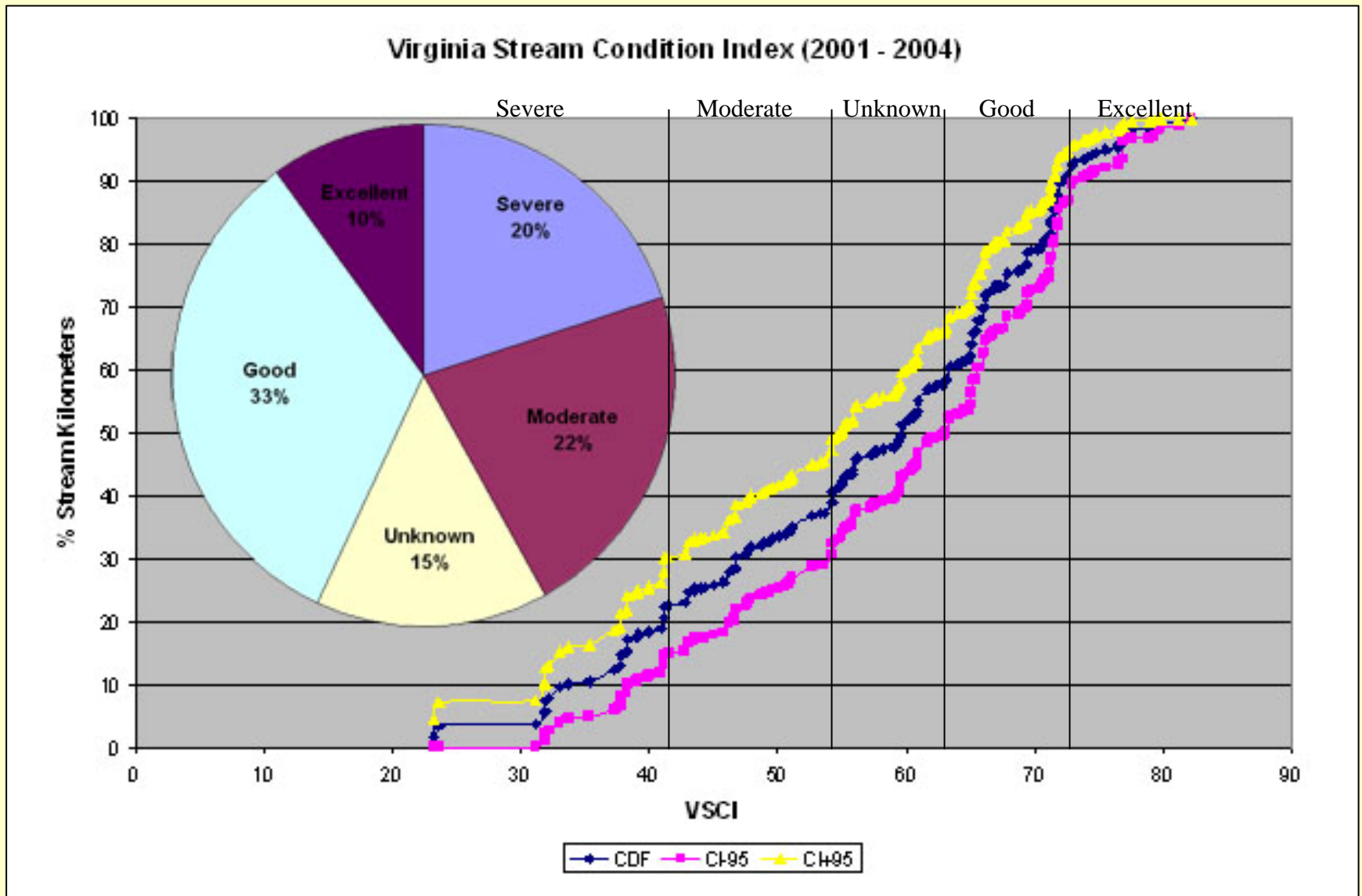
Tetratech 95<sup>th</sup> percentile versus ProbMon 95<sup>th</sup> percentile

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

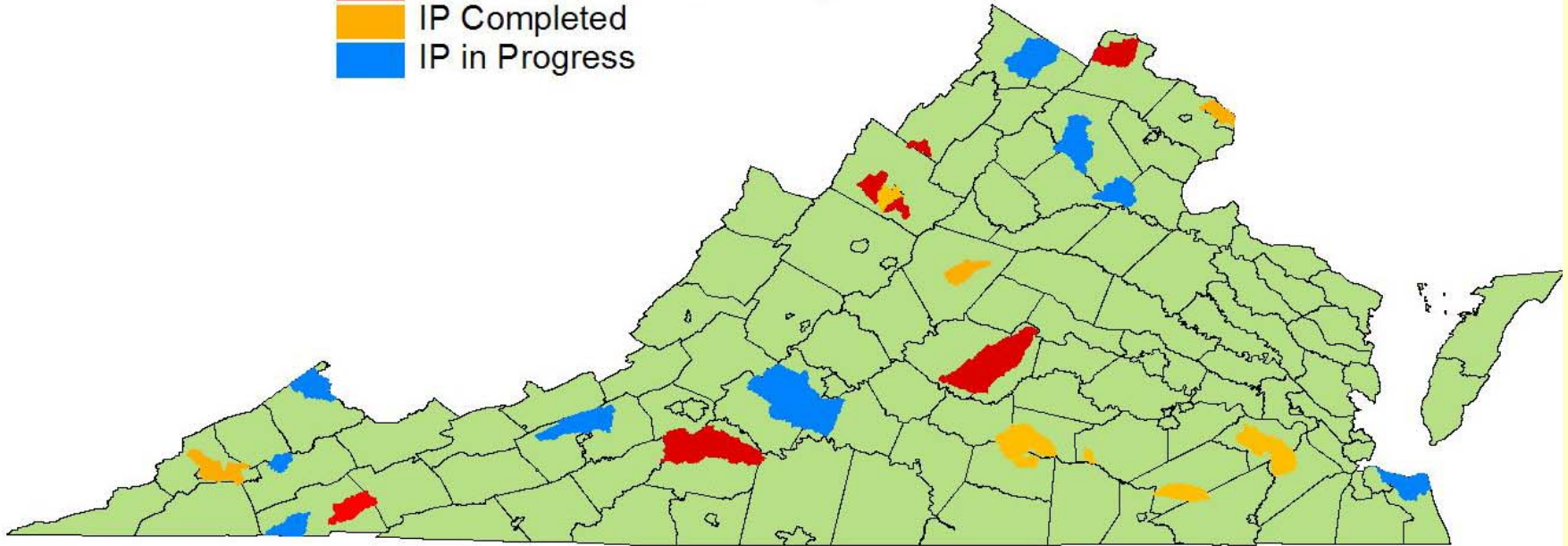
# VSCI Reference versus Stressed



# Biological Condition Estimate



# Capturing Watershed Improvement



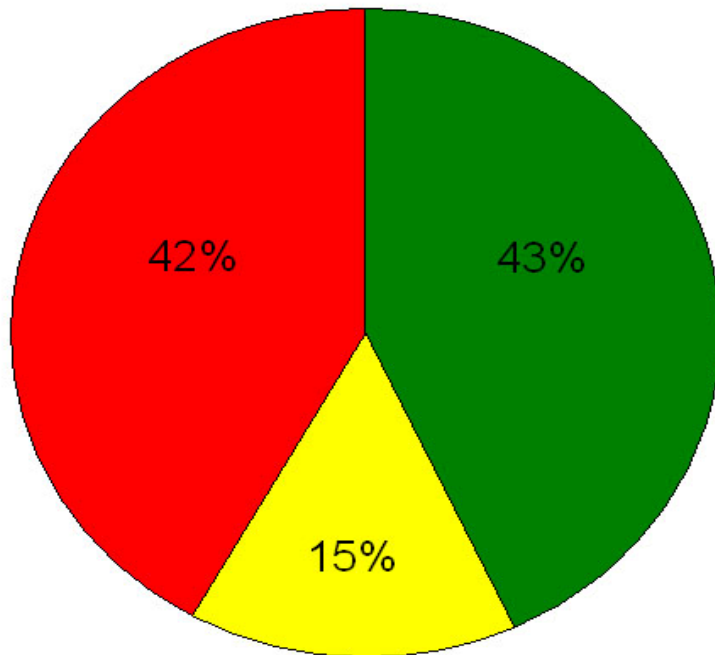
**Virginia has completed 14 IPs with an 8 IPs currently under development**  
**Current Implementation Projects administered by DCR:**

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



# Statewide Biological Condition Estimate

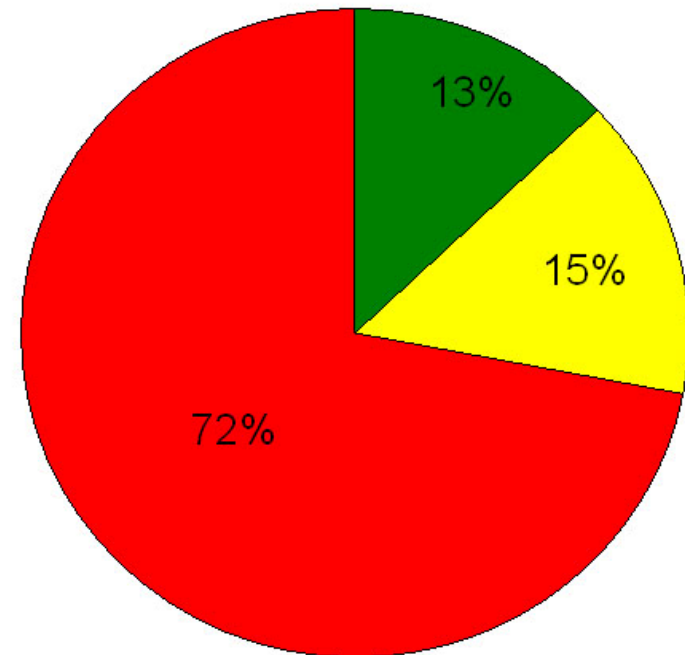
Virginia Stream Condition Index



Virginia Non-Coast +/- 4%



Mid-Atlantic Coastal Plain (MACP) Streams

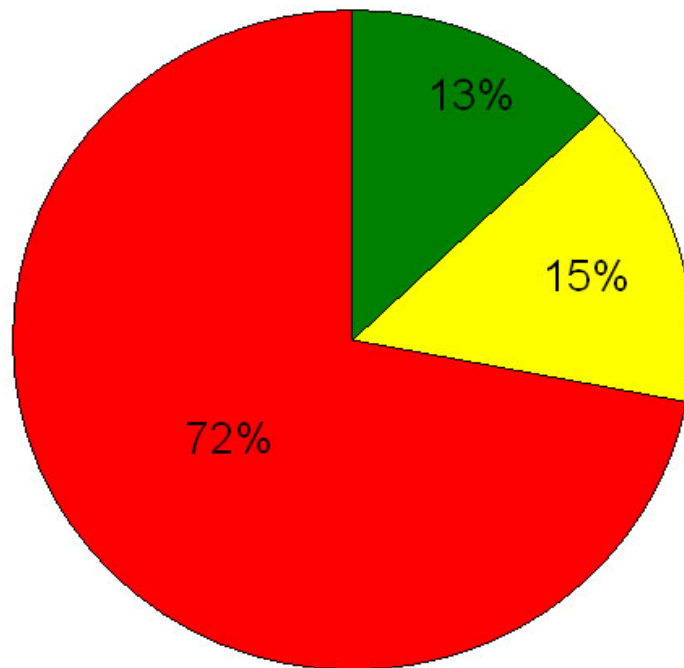


Virginia Coast +/- 17%



# VDEQ vs EPA Biological Condition Estimate

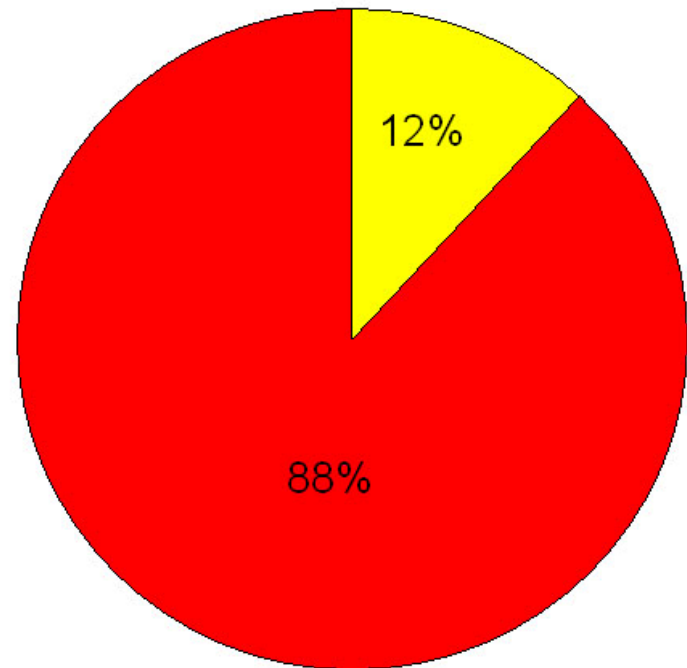
Mid-Atlantic Coastal Plain (MACP) Streams



Virginia ProbMon +/- 17%



Mid-Atlantic Integrated Assessment (MAIA)

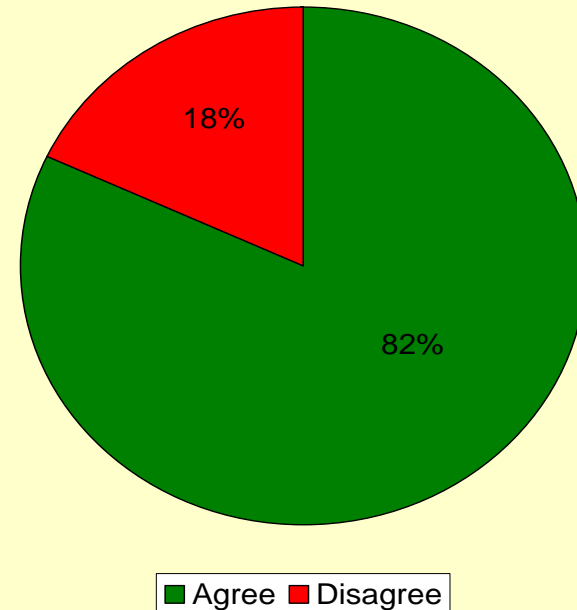


Regional EPA Survey +/- 23%



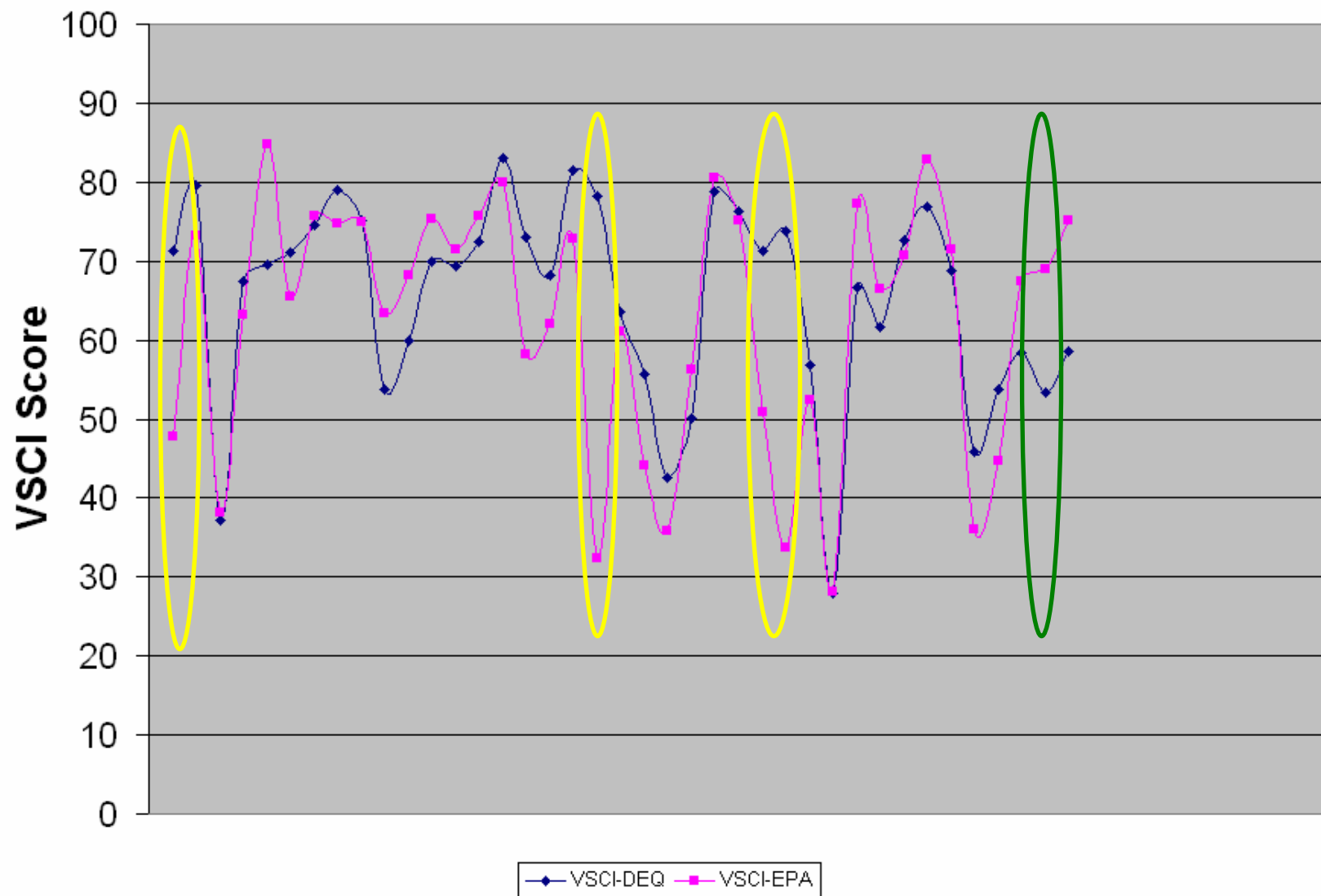
# VDEQ vs USEPA WSA Methods

	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

Jason Hill

3019 Peters Creek Rd

Roanoke, VA 24019

phone: 540.562.6724

email: [jrhill@deq.state.va.us](mailto:jrhill@deq.state.va.us)

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

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

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