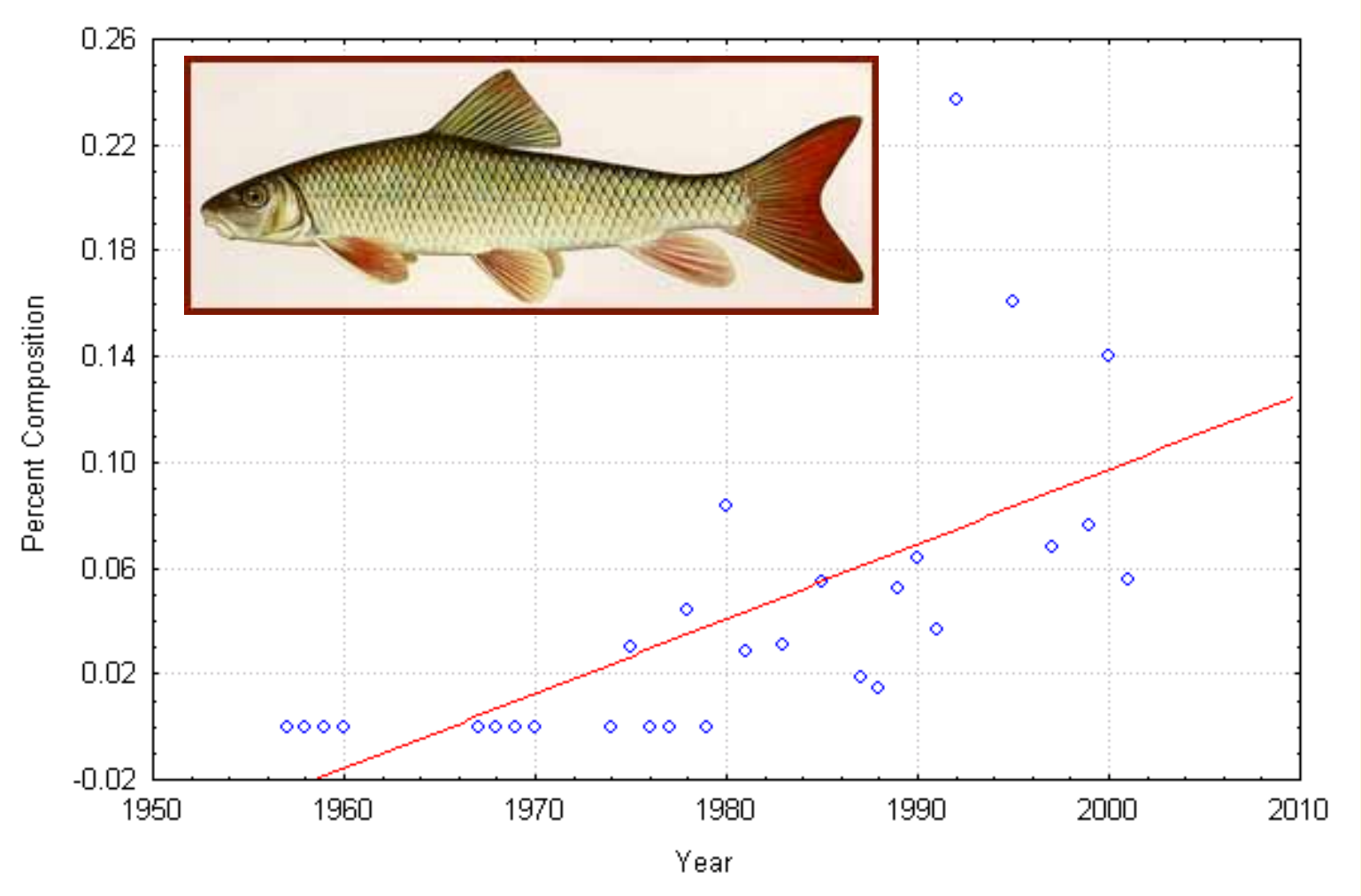
ORSANCO

Biological
Monitoring & Assessment
Programs

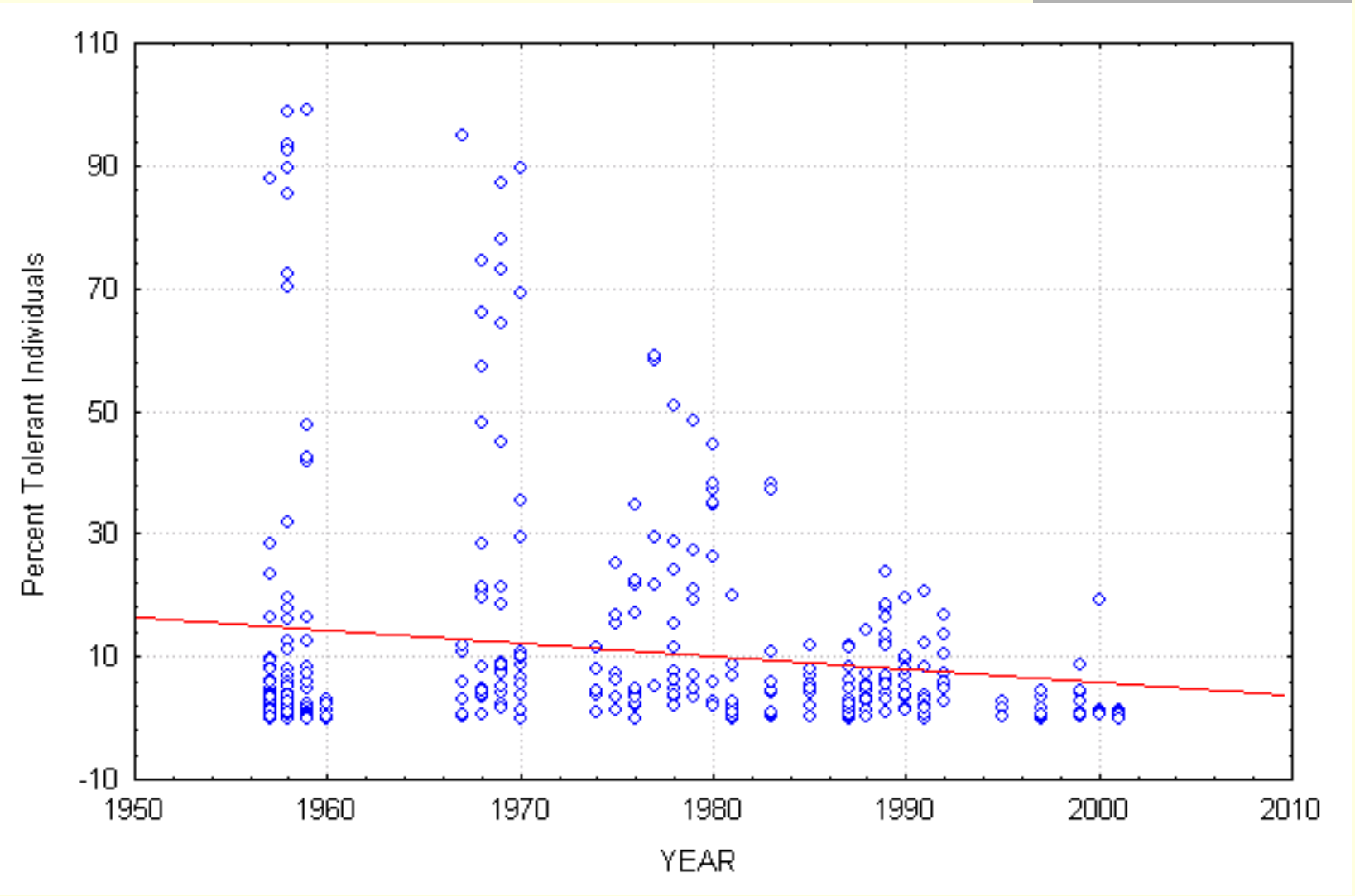
Biological Program History

- Lockchamber Surveys
  - 1957 – present
  - Rotenone (old school)
  - Track temporal and spatial trends
  - Measure effectiveness of pollution control efforts

Trends - species



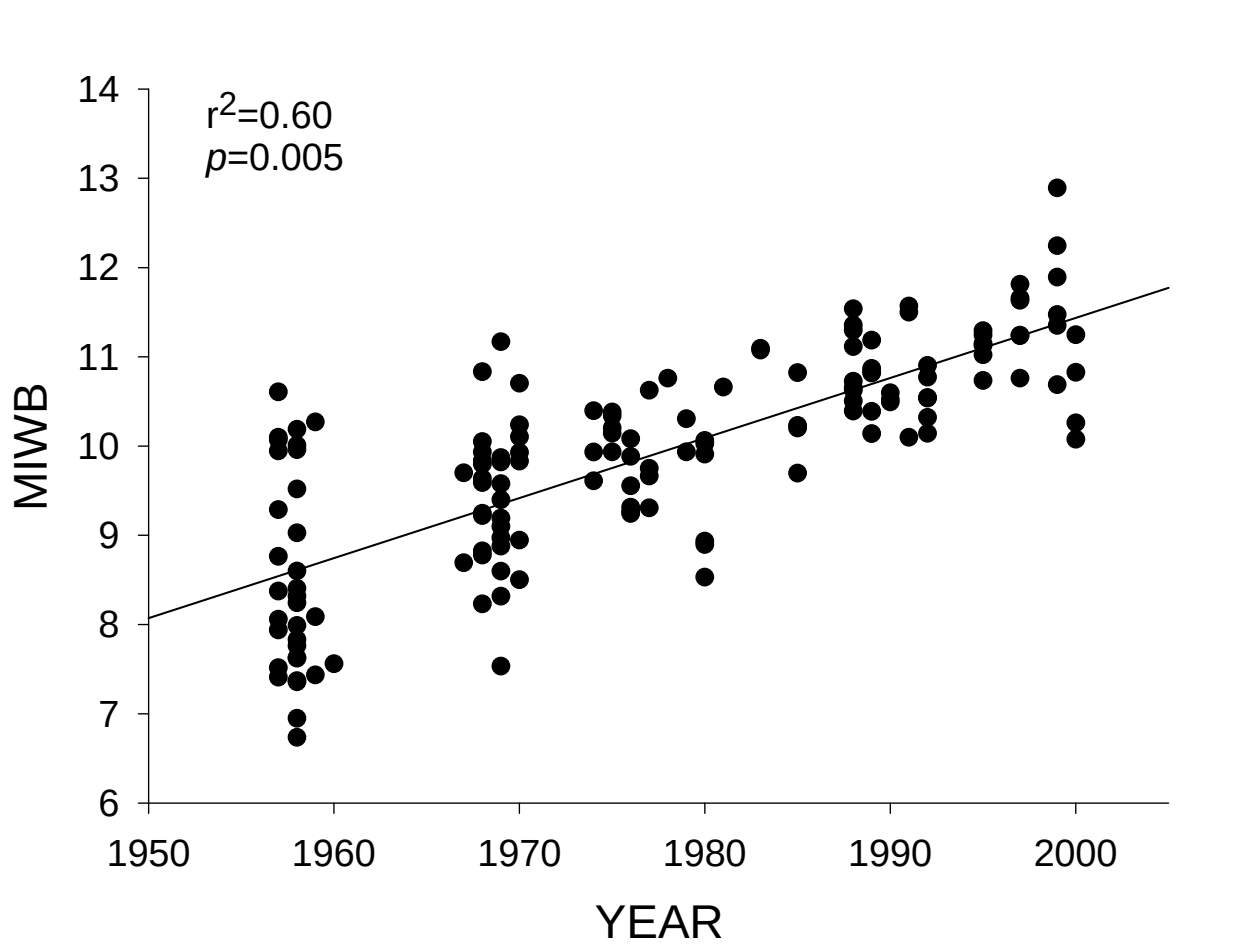
Trends – community (metric)



Trends – community (Index)

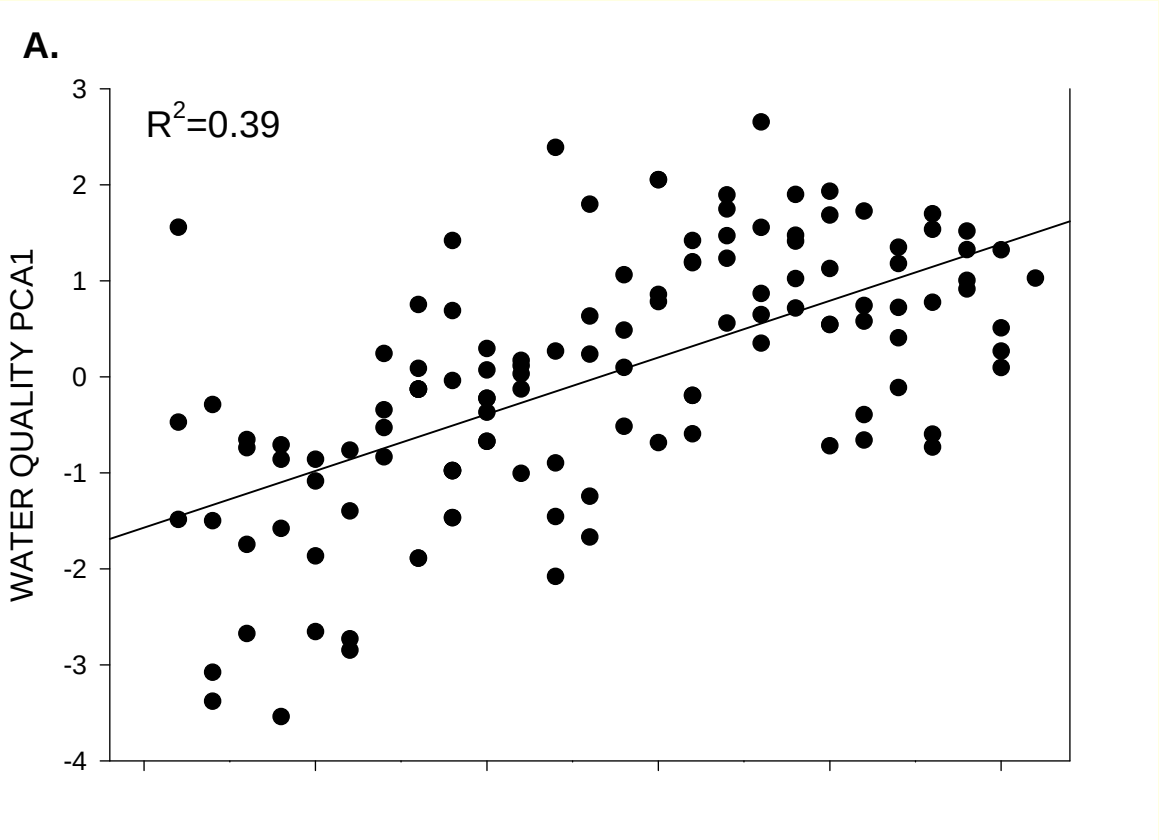
Modified Index of Well Being – MIWB: One tool in the toolbox

Improved species richness, biomass and diversity



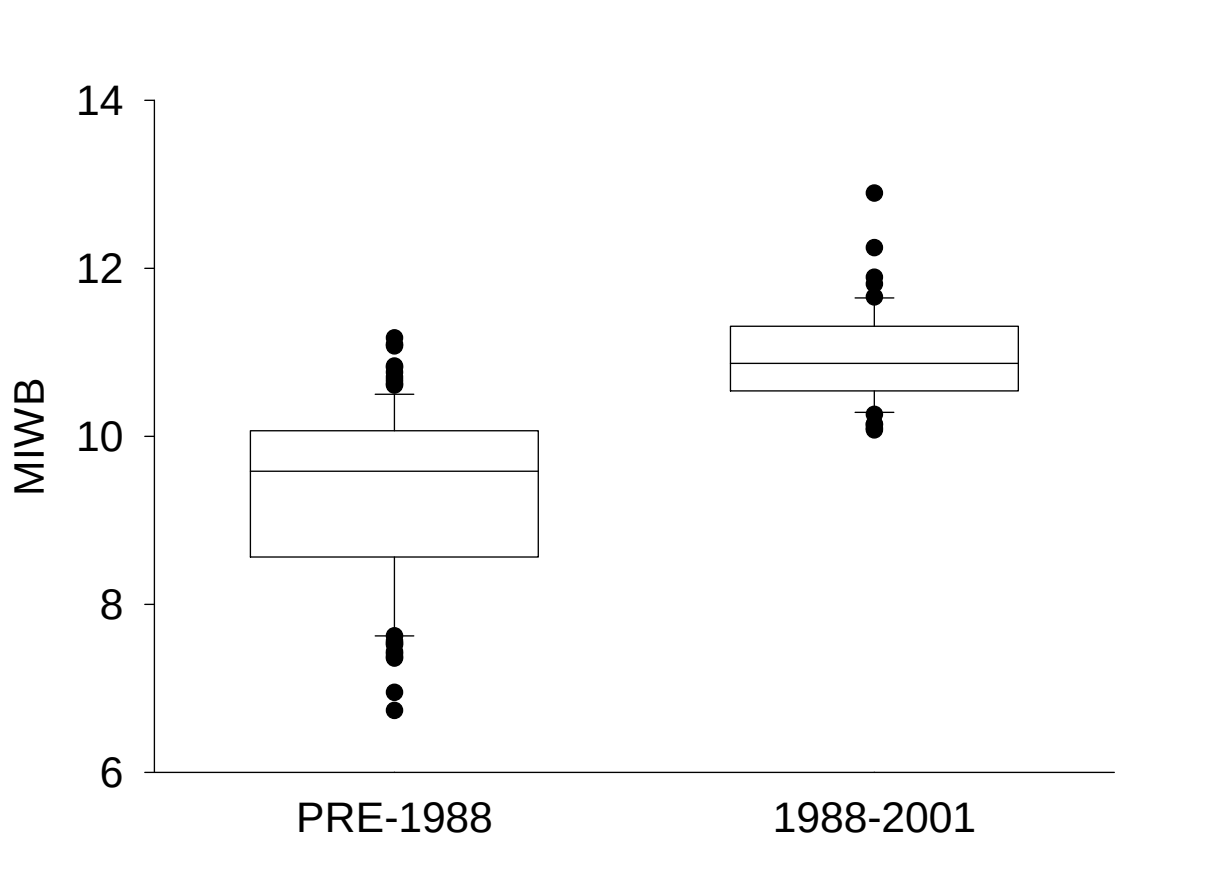
Trends – water quality improvement

Improved WQ Condition



Measuring Program Effectiveness

1988 – Secondary Treatment of Municipal Wastewater



Defining Biological Integrity

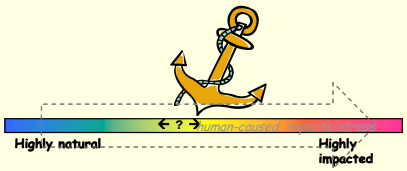
- Pollution Control Standards
  - Provides Authority
- Biological Water Quality Subcommittee
  - Develop and provide the method(s) used to define biological integrity
  - Initial focus on fish

Biological Monitoring & Assessment

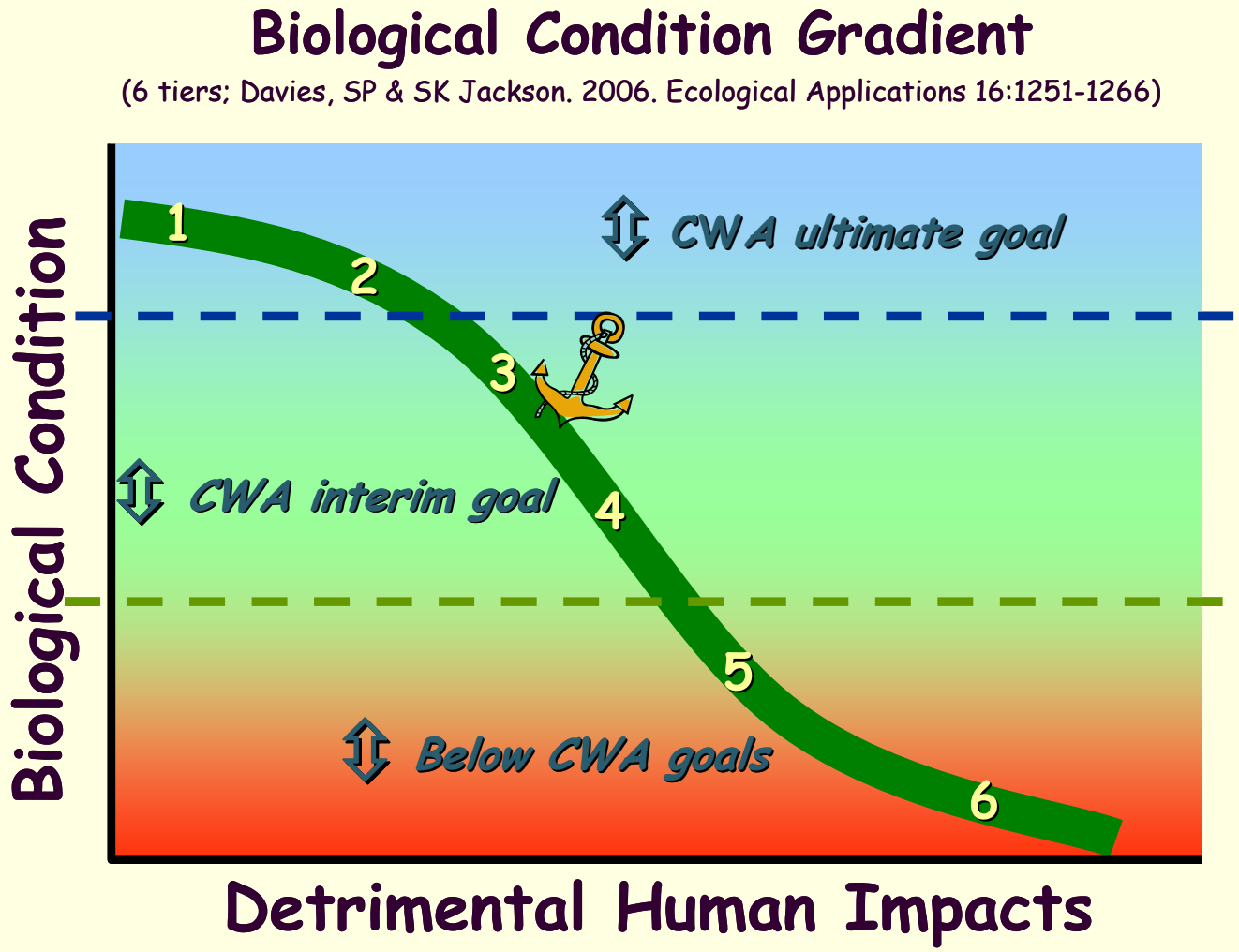
- 1991- 1998
  - Pool Surveys
    - Build database
    - Goal: Index development (IBI)
    - Targeted and stratified random sampling
- 1999-2001
  - Index Testing
    - Targeted sampling
- 2003
  - Index Published
- 2003 – Present
  - Index used to assess condition: determine if uses are being met
  - 305(b) – report to Congress
- 2008
  - Index refined (updated)

Biological Monitoring & Assessment

- Critical Steps
  - Selecting Method
  - Building Database
  - Defining Reference (least impacted) Condition

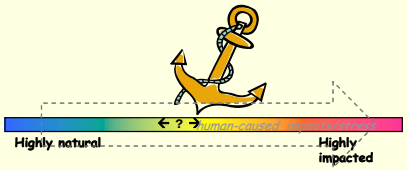


Where are we now?



Biological Monitoring & Assessment

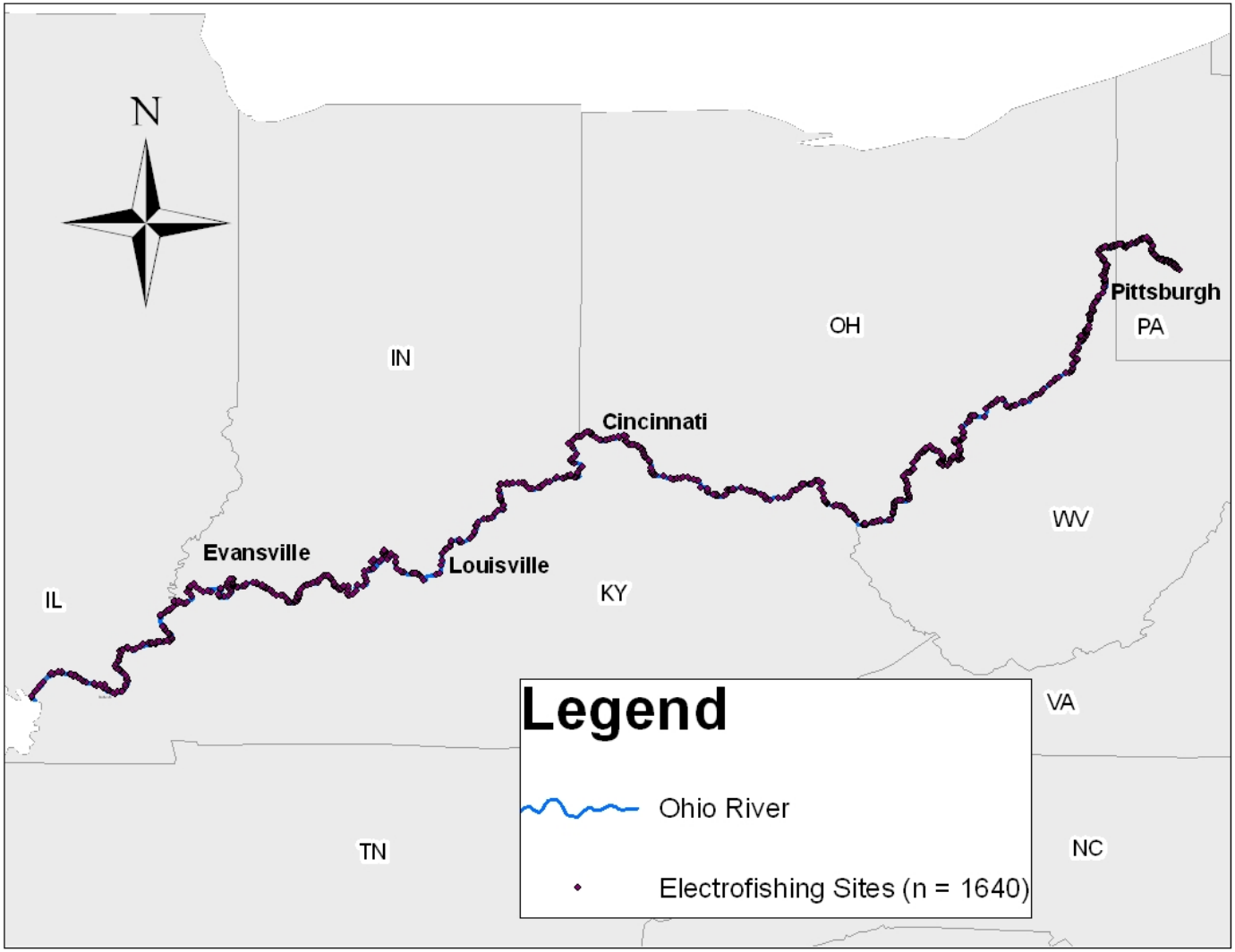
- Critical Steps
  - Selecting Method
  - Building Database
  - Defining Reference (least impacted) Condition
  - Developing Index
    - Testing & Calibration
    - Setting Expectations (predictive model)
      - Removing natural variability – (*signal –vs- noise*)
  - Defining Assessment Units
    - River reach; pool; segment; local; area targeted for specific restoration activity
  - Determining number of sites needed to make assessment
  - Developing strategy for determining when/where impairment exists (or how to mark significant improvements following restoration)
  - Define corrective actions necessary to improve condition
    - CWA Process
    - Restoration Process



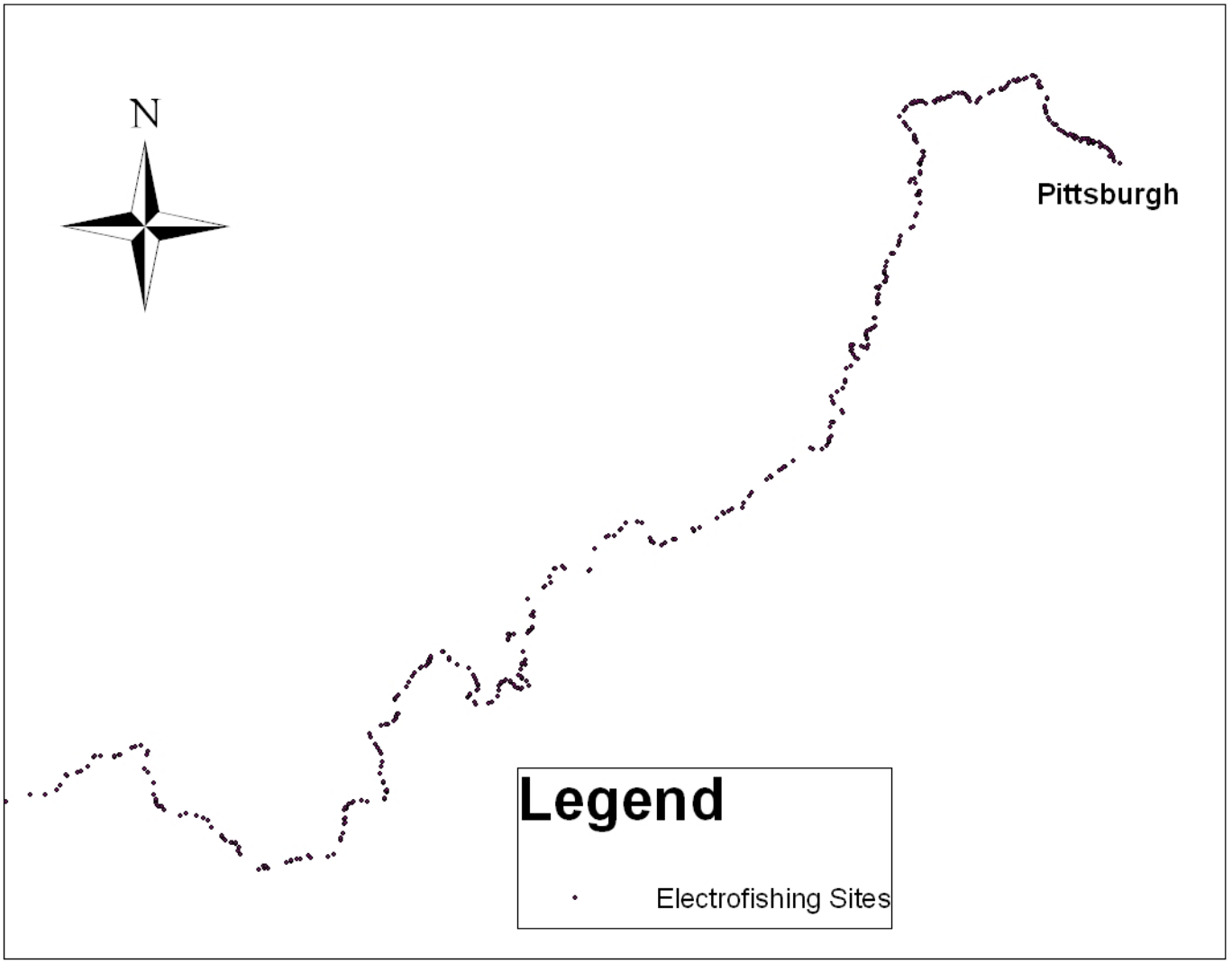
Method

- Electrofishing
  - Nighttime
  - 500m
  - 2 netters (1/4” mesh)
- Assessment Units
  - 18 navigational pools
- Mix of prob-mon, targeted and fixed stations

All EF sites - 1640



Upper River EF sites



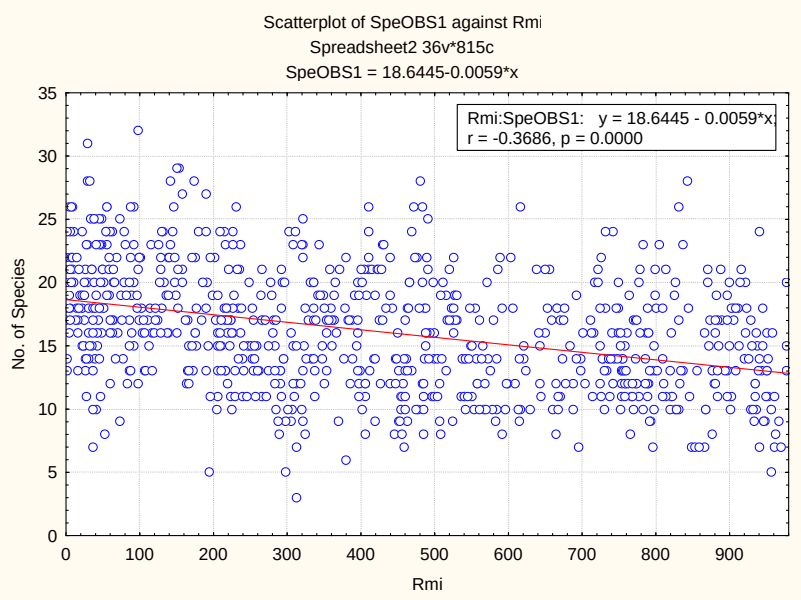
Index Development

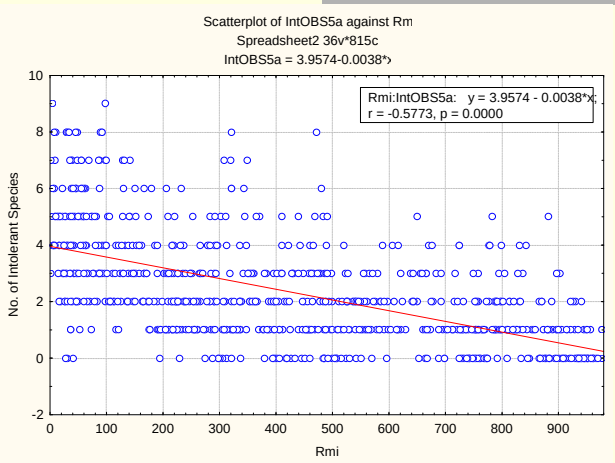
- Ohio River Fish Index (*ORFIn*)
- 709 sites – 318 Least Impacted
- 'T-zone' tested effectiveness – *'signal'*
- Pubs
  - Emery, E. B., T. P. Simon, F. H. McCormick, P. L. Angermeier, J. E. DeShon, C. O. Yoder, R. E. Sanders, W. D. Pearson, G. D. Hickman, R.J. Reash, and J. A. Thomas. 2003. Development of a Multimetric Index for Assessing the Biological Condition of the Ohio River. Transactions of the American Fisheries Society 132:791-808.
  - Emery, E.B., and J.A. Thomas. 2002. A method for assessing outfall effects on Great River fish populations: the traveling zone approach. In T.P. Simon (Ed.). *Biological Response Signatures: Patterns in Biological Indicators for assessing Freshwater Aquatic Assemblages*. CRC Press, Boca Raton, FL.
  - Emery, E.B., F.H. McCormick and T.P. Simon. 2002. Response Patterns of Great River Fish Assemblage Metrics to Outfall Effects from Point Source Discharges. In T.P. Simon (Ed.). *Biological Response Signatures: Patterns in Biological Indicators for assessing Freshwater Aquatic Assemblages*. CRC Press, Boca Raton, FL.

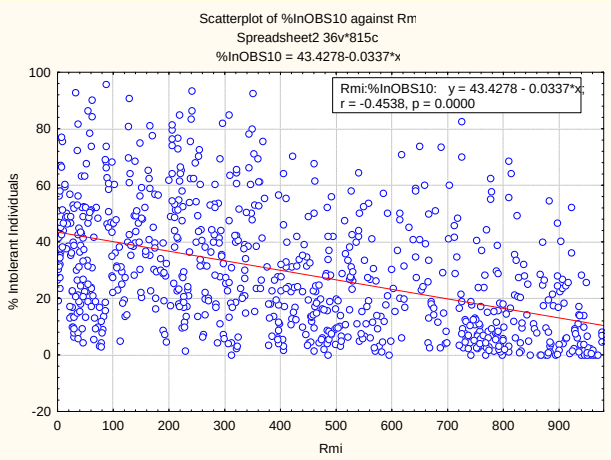
Index Revised – 2008

- ***M***odified ORFIn (***M***ORFIn)
  - Same metrics
  - 1640 sites
  - Continuous Scoring (0-100) instead of discrete (1-3-5)
- Noise reduced
  - Metric scaling: drainage area (rivermile)
  - Index scaling: 5 Habitat types identified
    - Index expectations set based on the particular habitat type at the site in question
- Signal strength tested
  - Index tested against water quality gradient

Noise reduction: Removing variability due associated with drainage area (river mile)



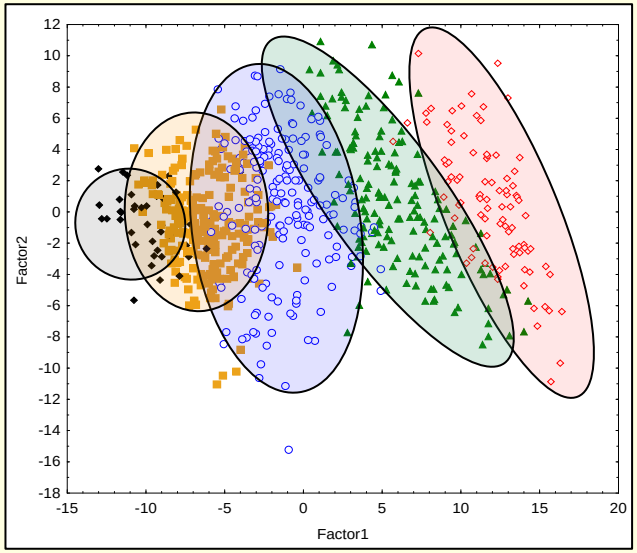




Noise Reduction: Removing variability due to habitat

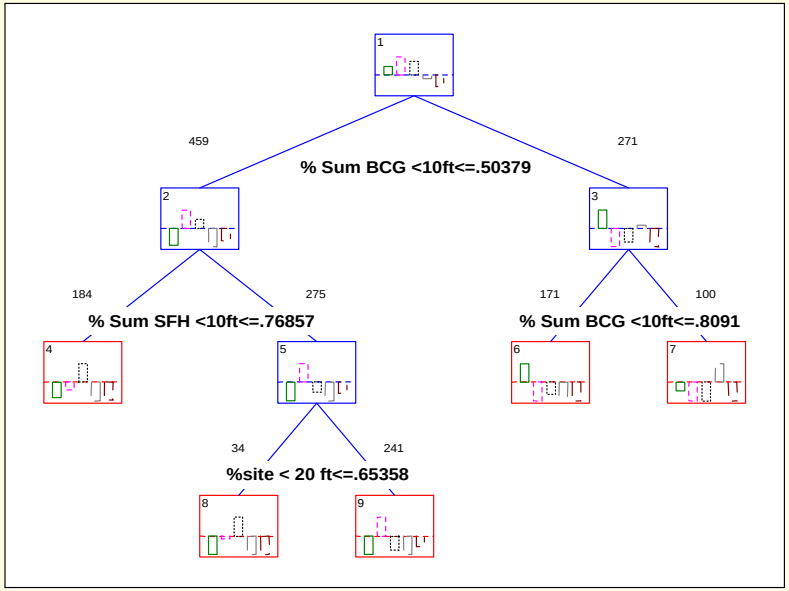
%Site <20’

Avg Depth



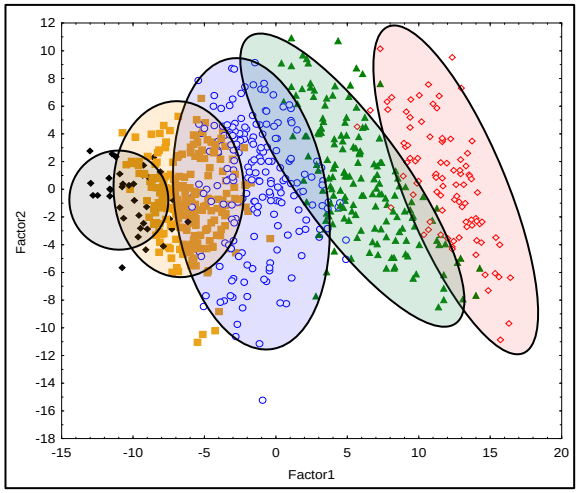
%Fine <10’

%Coarse <10’



- K-means Cluster Analysis
  - Expanded the habitat variable list
    - 7 Original Candidates – 120 Candidate for recalibration
  - Included Historic – 2008 (904 Sites)
- Principal Components Analysis
  - Confirmation that clusters existed
- Classification Tree
  - Determine which variables responsible for clustering

%Site <20’

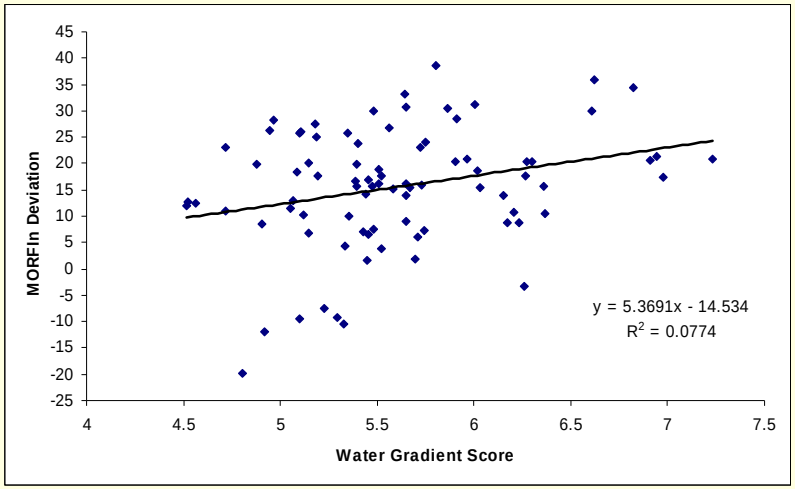


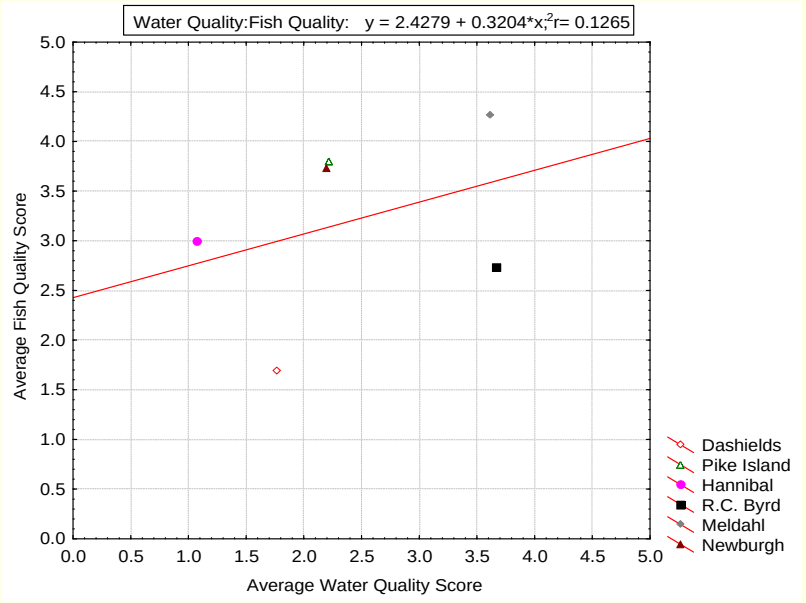
Avg Depth

%Fine <10’

%Coarse <10’

Signal Strength



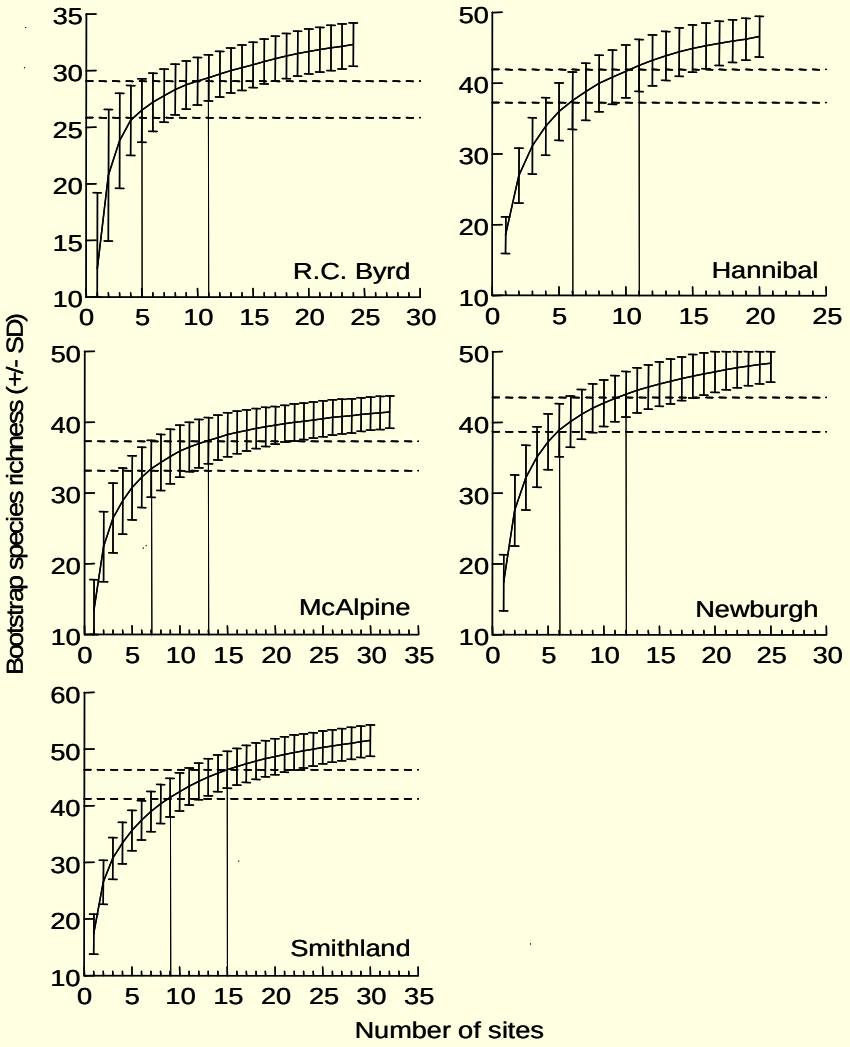


Defining Assessment Units

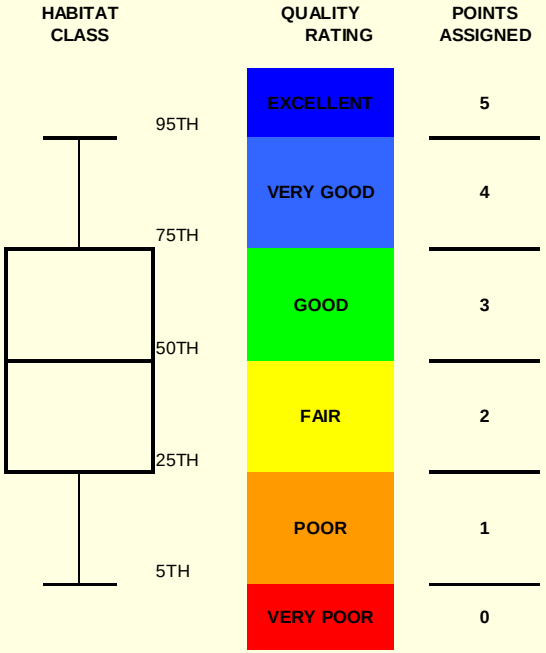
- Sampling Design
  - Assessment Units
    - Pools? Reaches? Sites?
  - Studies revealed pools most appropriate
    - Population synchrony
    - Fatty acid study / fish health / genetics
- Site Layout
  - Targeted?
  - Fixed Stations?
  - Probability-Monitoring (prob-mon)?
    - Comparison of prob-mon to targeted / strat. random
    - Comparison of prob-mon at 3 scales
      - Riverwide
      - River 1/3
      - Pools

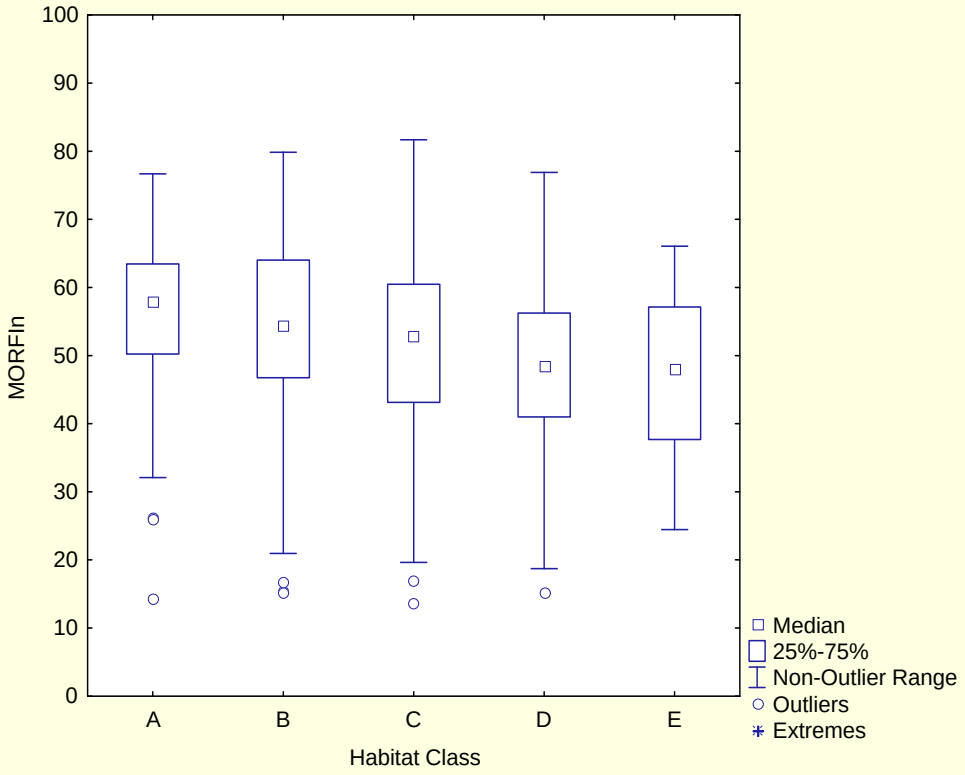
Assessments – How many sites needed?

- Total species richness and assessment variability used to set goal for assessment effort
- Oversampled to determine how many samples needed to achieve capture of 90% of species in a pool and reduce variability.
  - 15 sites
    - Regardless of pool length
- Blocksom, K.A., E. Emery, and J. Thomas. 2008. Sampling effort needed to estimate condition and species richness in the Ohio River, USA. Environmental Monitoring and Assessment (In Press)

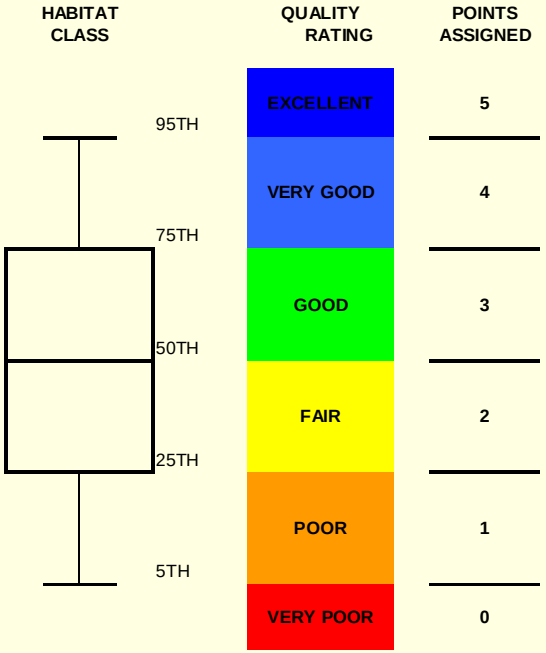


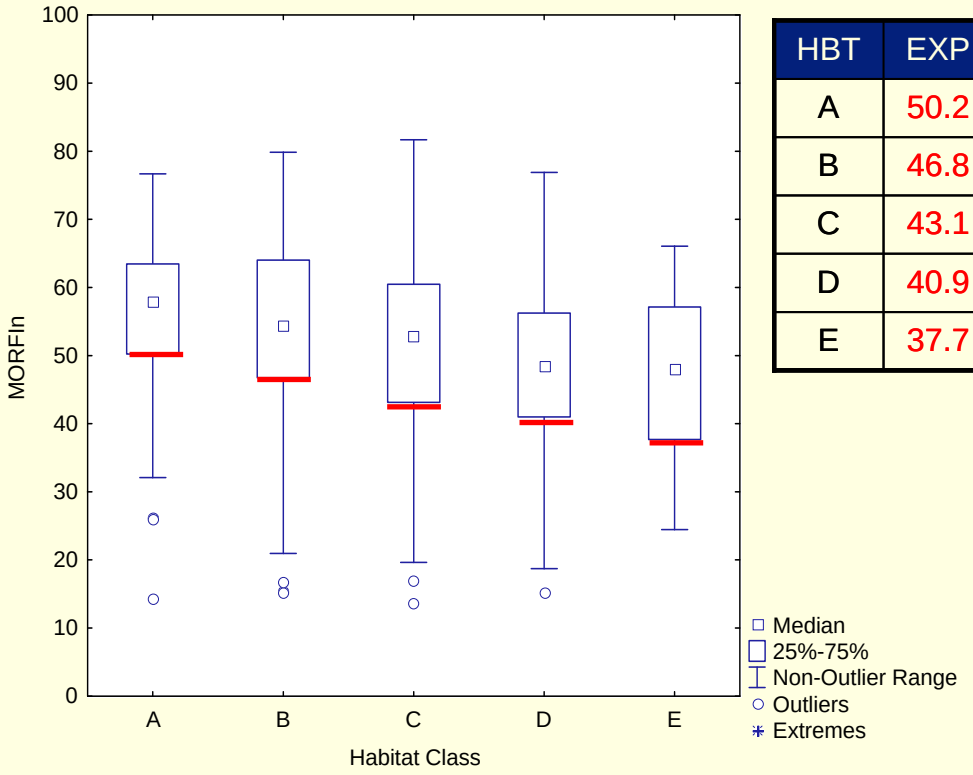
Quality Rating is applied to all 5 habitat classes





Identifying Impairment

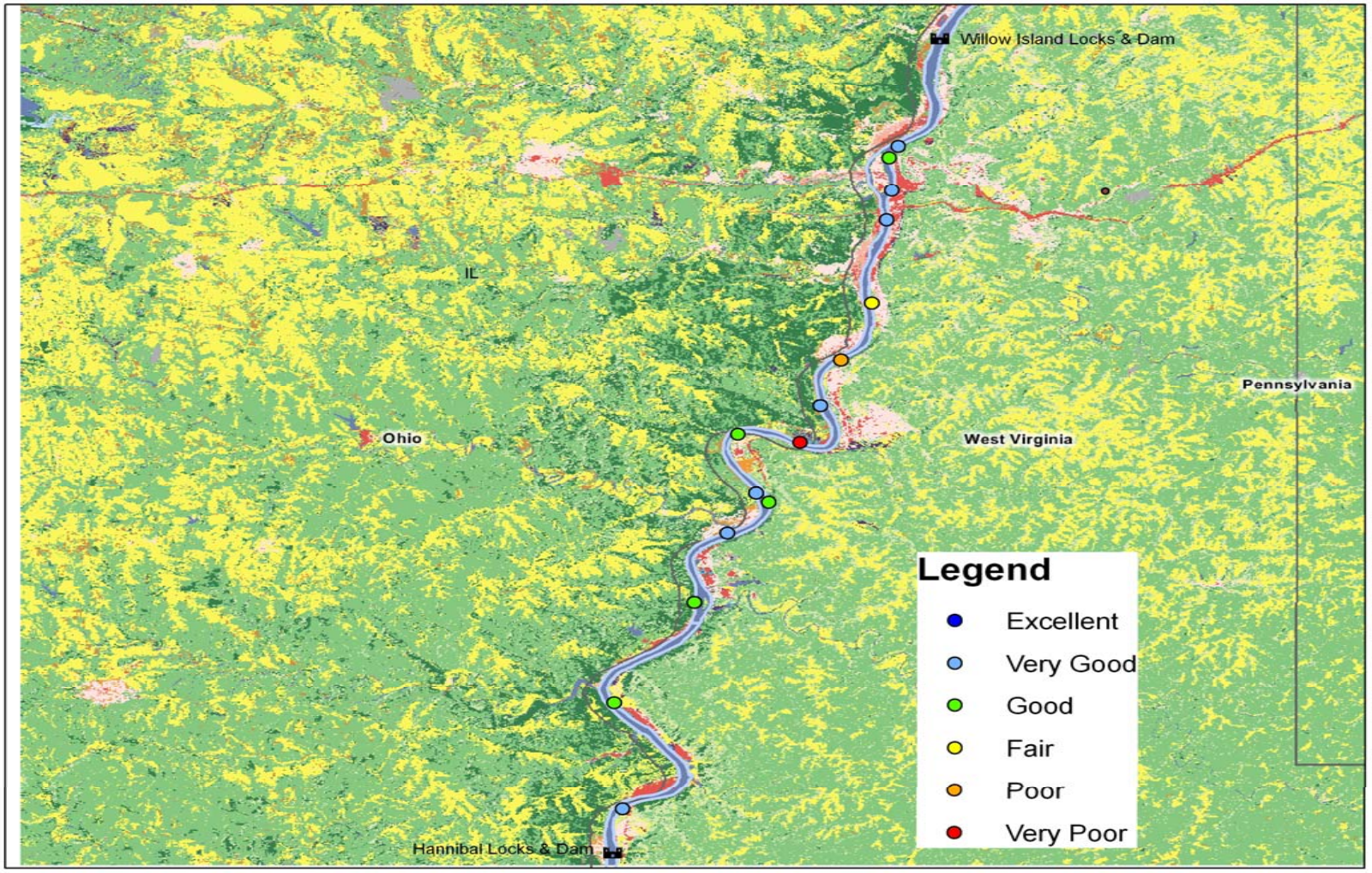




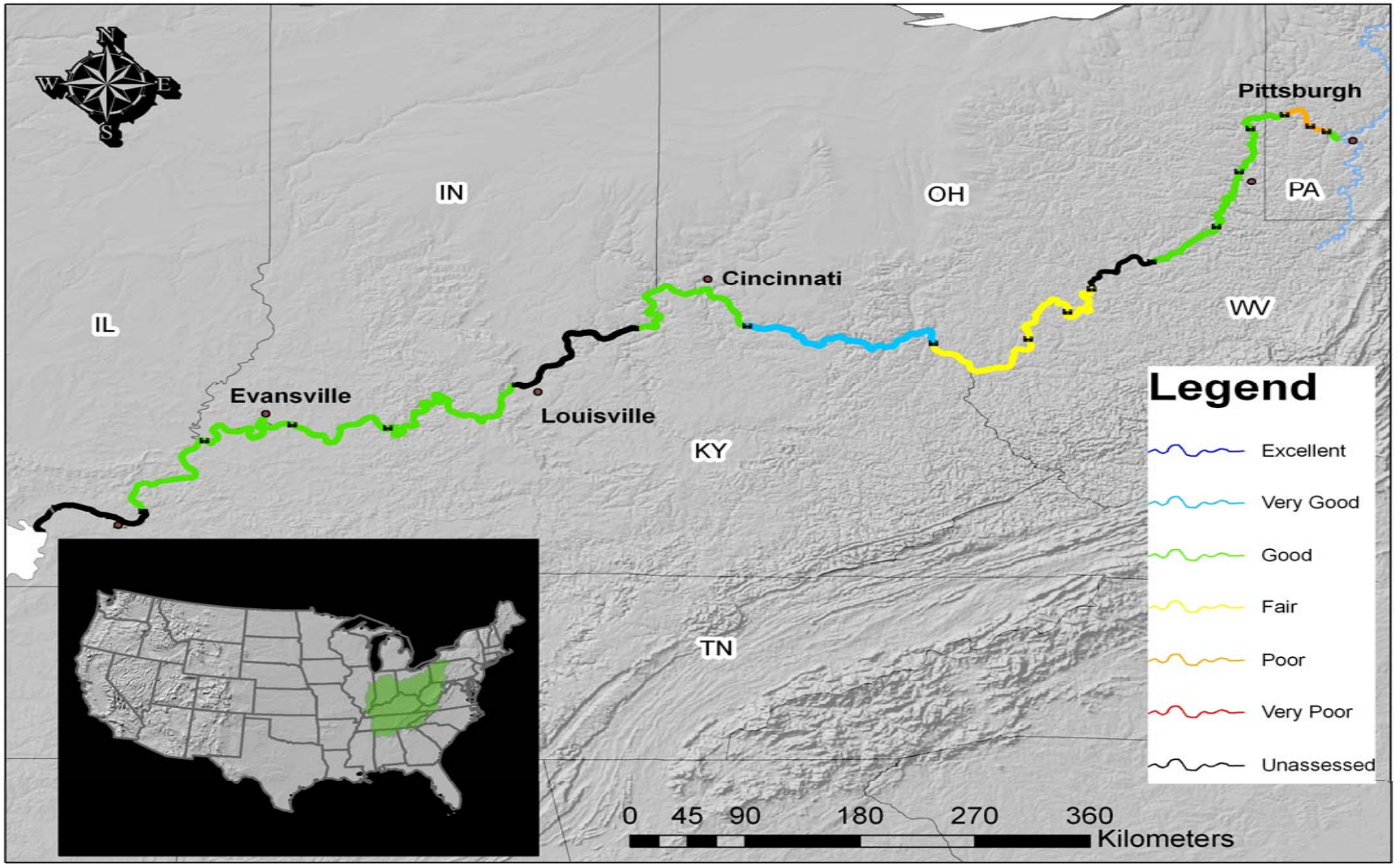
HBT	EXP
A	50.2
B	46.8
C	43.1
D	40.9
E	37.7

- Goal: QR > 2.0 (*FAIR* or better)

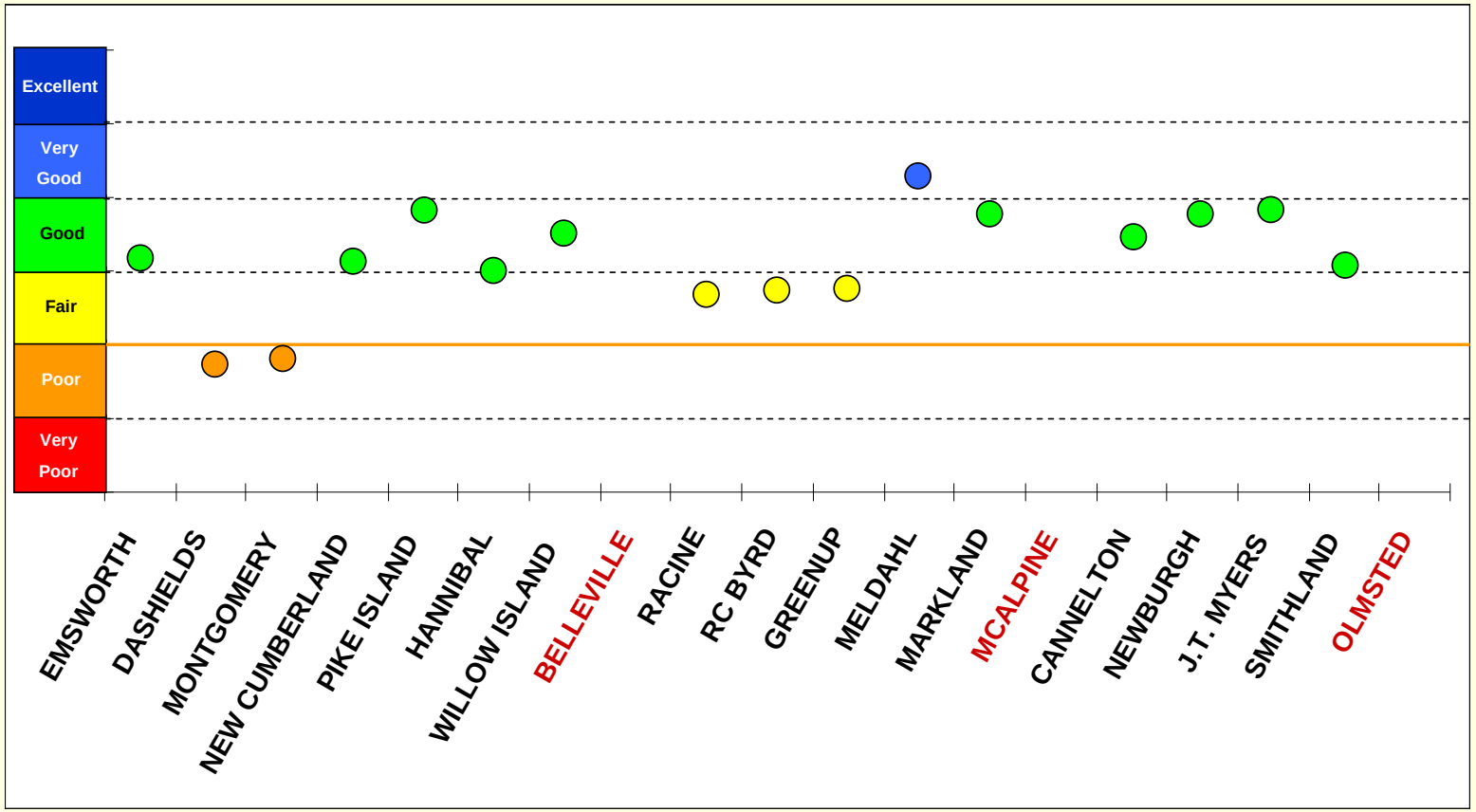
Pool Assessment



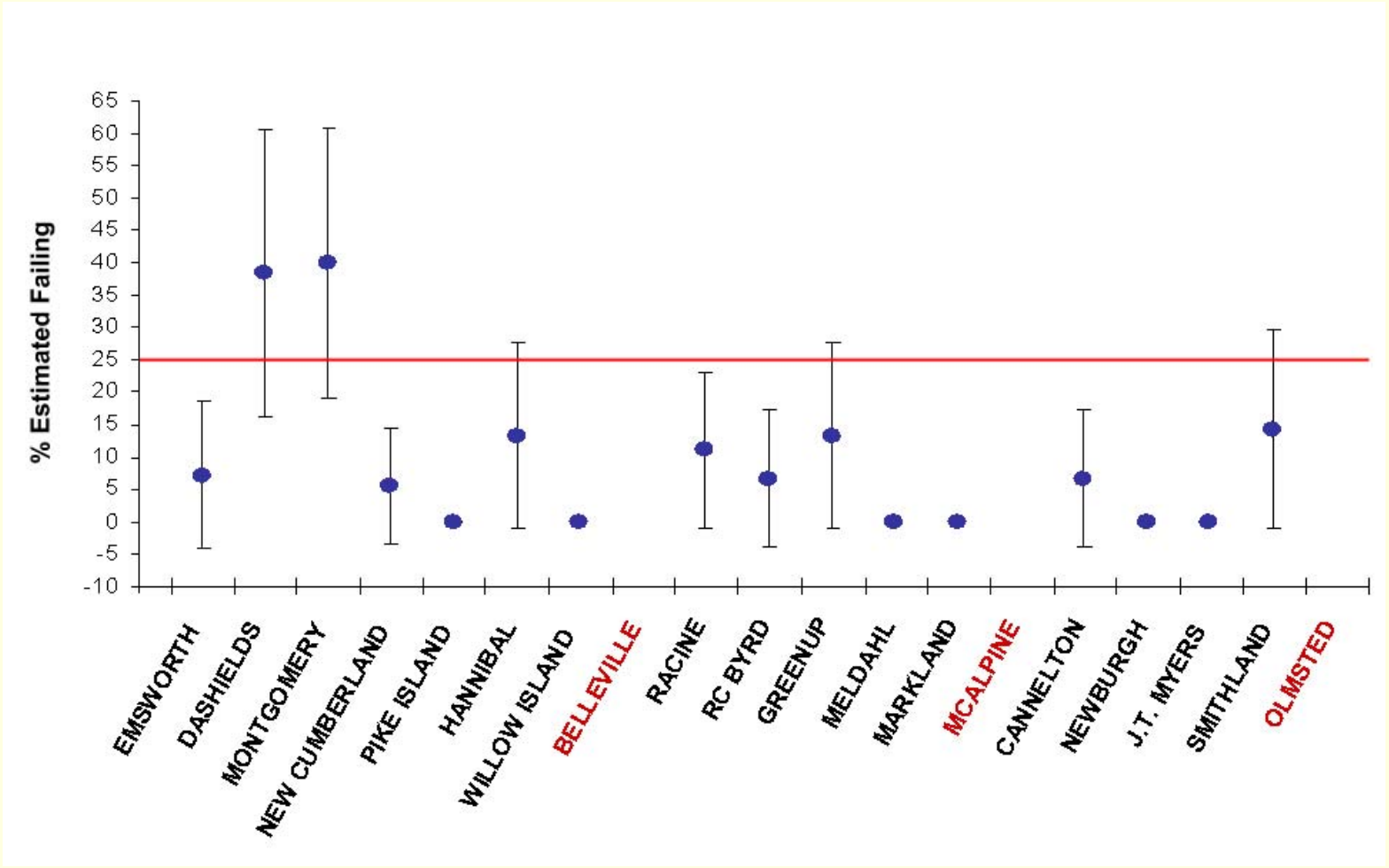
Riverwide Evaluation – 1st rotation completed - 2009



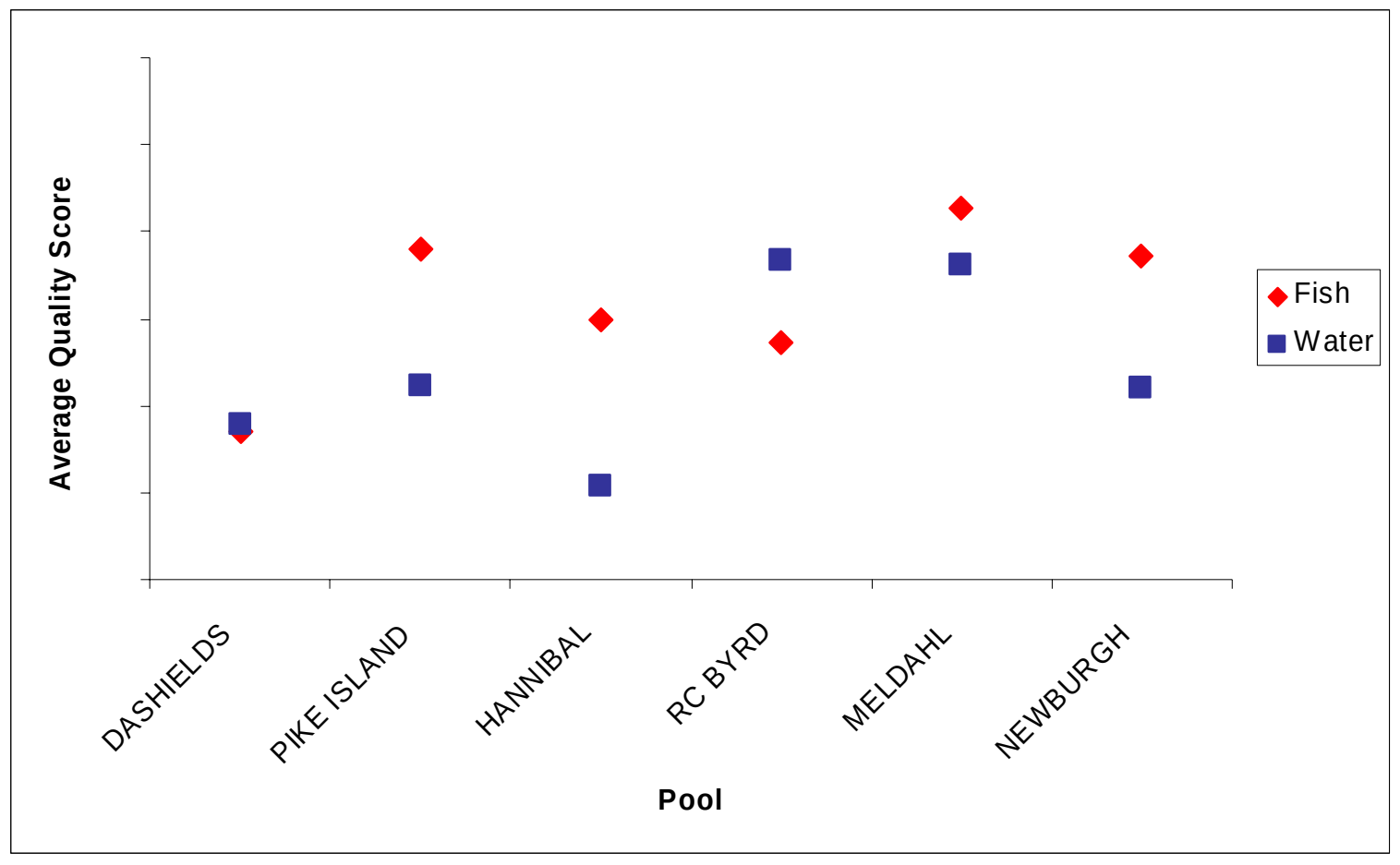
Assessment Results



Assessment Results



Relating Fish Community Condition to Water Quality Condition



What are we in to now?

- EPA Co-op Project
  - Fish
    - 

IBI
  - Bugs
    - Comparing 3 different collecting techniques
    - New IBI
  - Developing other indicators
    - Algae (diatoms)
  - Defining abiotic gradient
    - WQ/Sediment/Habitat
- Genetics
- Fish Health – EDCs etc
- Emerging contaminants

Questions ?