National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

LR 201

ORSANCO: Biological Criteria Development for the Ohio River

Presented by

Erich Emery, ORSANCO

Introduction

- ORSANCO
  - Interstate water pollution control agency for the Ohio River Basin
  - Compact Signed in 1948
  - Eight States (NY-VA-PA-WV-OH-KY-IN-IL)
  - Committee Structure (All States represented; multiple levels).
  - Regulatory Authority
    - Wastewater Discharge Requirements
    - Pollution Control Standards
    - Ohio River 305(b)

Introduction (Cont'd…)

- ORSANCO
  - Unique Organization
    - Regulatory Authority
      - Standards Development
      - Expanding Role (TMDLs)
  - Expanding role from a 'Mainstem' Agency to a 'Basin' Agency
  - New concept of developing biological standards across multiple state boundaries.

Program Objectives

- Future pollution control standards for the Ohio River to include, or reference numeric biological criteria.
- Expand community condition indicators to the basin.
  - Next step; large Ohio River tributaries.

Sampling Design

- Fish
  - Lockchamber rotenone surveys (1957 – present)
  - Night Electrofishing (1991-2001)
    - Targeted sampling of individual pools (2 mile resolution).
    - Provided resolution to detect critical spatial and temporal aspects of background variability.
  - Night Electrofishing (2002 and beyond)
    - Employing a random probability design with a spatial systematic component developed by US EPA's EMAP program.
- Macroinvertebrates
  - Hester-Dendy artificial substrates
    - Gathering background information (1991-2000)
      - 2mi. Resolution; entire river (1997-1998)

Quality Assurance Measures

- In-Field
  - Gear efficiency
  - Seasoned biologists in place as crew leaders
  - Redundancy of expertise in the field
  - Vouchers
    - Site; Pool; Regional
    - Small specimens preserved for in-house ID
- In-house
  - Panel review of results

Data Applications

- Assessment and reporting of biological condition for 305(b) report.
  - 303(d) list; TMDL's
- Supplement to State Programs.
  - NPDES, 404, 319 etc..(at states request)
- Temporal and spatial trend assessments.
  - Public reports and documentation.

Scales Addressed

- Past
  - Mainstem Ohio River
- Present
  - Moving into major tributaries with the States
- Future
  - More comprehensive basinwide assessment

Design Features

- Site Selection
  - Past: Targeted Intensive Surveys (2mi. Res.)
  - Present: Probability-based site selection
- Sampling Period
  - Targeting low flow, stable period of July through October.
    - Reduces flow-induced variability; most YOY large enough to be identified; worst-case-scenario for WQ impacts such as thermal, DO etc.

Indicators

- Fish (500m night electrofishing)
  - Most information in place at program inception (1991).
    - Lockchamber rotenone sampling
      - 1957 to present!
- Macroinvertebrates (Hester-Dendy multiplates, composite of 5)
  - Began baseline collections in 1991; expanded program in 1997 (2 mile resolution –1997-1998)

Future Indicators

- Algae
  - Collections of phytoplankton ongoing
    - Initiated by drinking water utilities
      - 10 locations / semimonthly / species counts / Chl.a
    - Community indices under development
      - May influence nutrient standards
- Mussels
  - Workload carried by USFWS
  - Future work may be geared to developing community expectations
  - Excellent measure of historic perturbations (habitat loss)
  - Historic collection in existence
- Genetic Diversity (fish community)
- Impacts from endocrine disruptors
  - Feminization of males (fish)

Obstacles to Program

- Scale
  - Samples, Samples, Samples
- Lack of ‘True’ Reference Condition
  - Best attainable condition defined as ceiling for expectation.
  - Set as a ‘moving target’, designed to reflect condition as system continues to improve.
- Lack of Defined Methods
  - Methods modified from stream techniques (OH EPA)

Existing Biocriteria

- Panel of experts established to help develop an IBI for the Ohio River.
  - Reviewed, reconsidered and reclassified all Ohio River species.
  - Over 70 metrics developed for testing; 13 selected for index.
  - Metrics scored following traditional methods.
    - Over 800 ‘least impacted’ sites utilized to derive expectations for metrics.
      - Equally distributed over entire length of river
      - Captures full range of variation within all possible segments

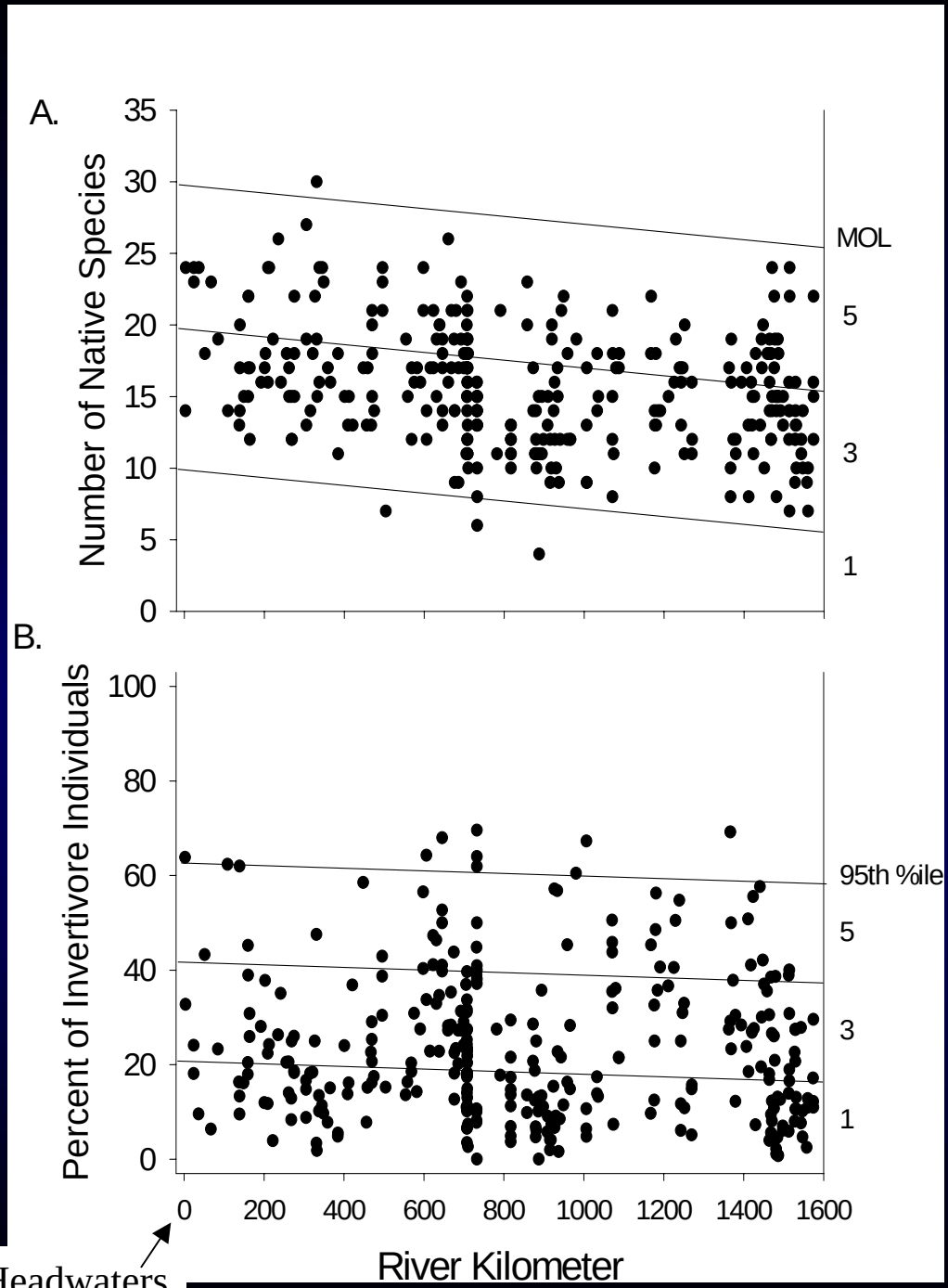
Ohio River Fish Index (ORFIn)

- Number of Native Species
- Number of Sucker Species
- Number of Centrarchid Species
- Number of Great River Species
- Number of Intolerant Species
- Percent Tolerant Individuals
- Percent Simple Lithophils
- Percent Non-Native Individuals
- Percent Detritivores
- Percent Invertivores
- Percent Top-Piscivores
- Relative Number of DELT Anomalies
- Catch Per Unit Effort

Metric Scoring

- Least – Impacted sites used as reference for developing scoring expectations.
- Data plotted longitudinally along river-mile, acting as a surrogate for drainage area.
- Data was trisected following conventional methods.
  - 95th Percentile (Proportional Metrics) –OR- Maximum Observed Line – MOL (Species Richness Metrics)
    - Drawn parallel to regression line
    - Trisected beneath

Metric Scoring



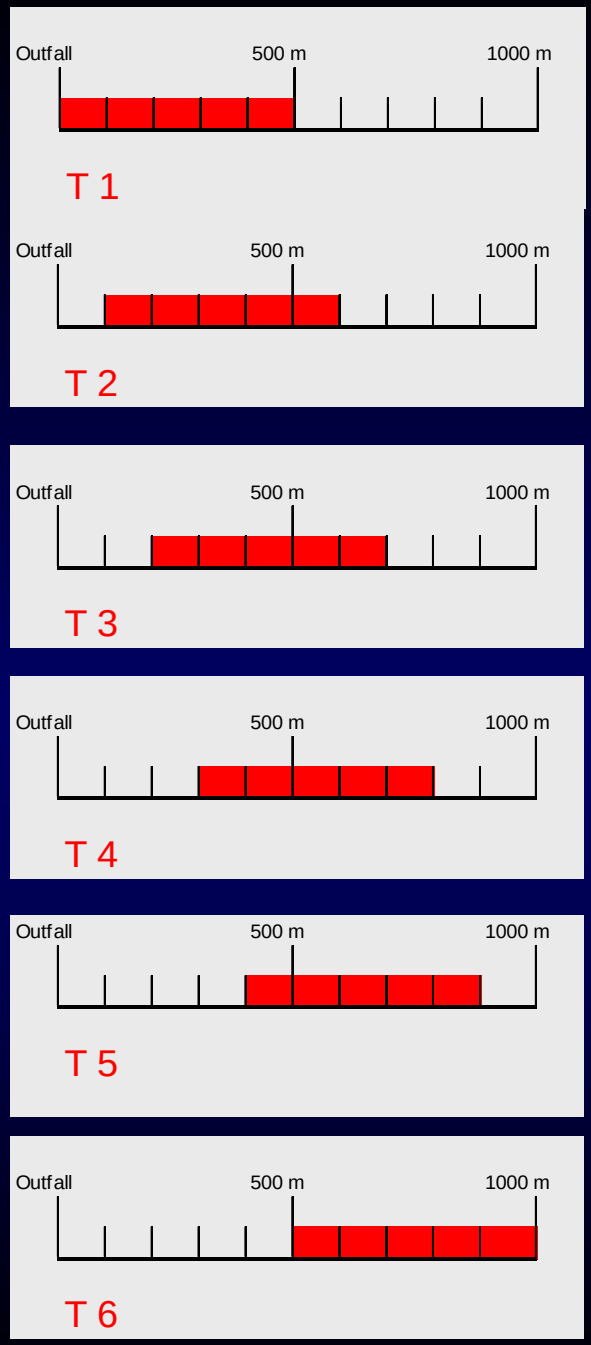
Metric Testing

- Are metrics responsive?
  - Do they respond as expected?
- Do they reveal disturbance?
  - Do they reveal the magnitude of the disturbance?

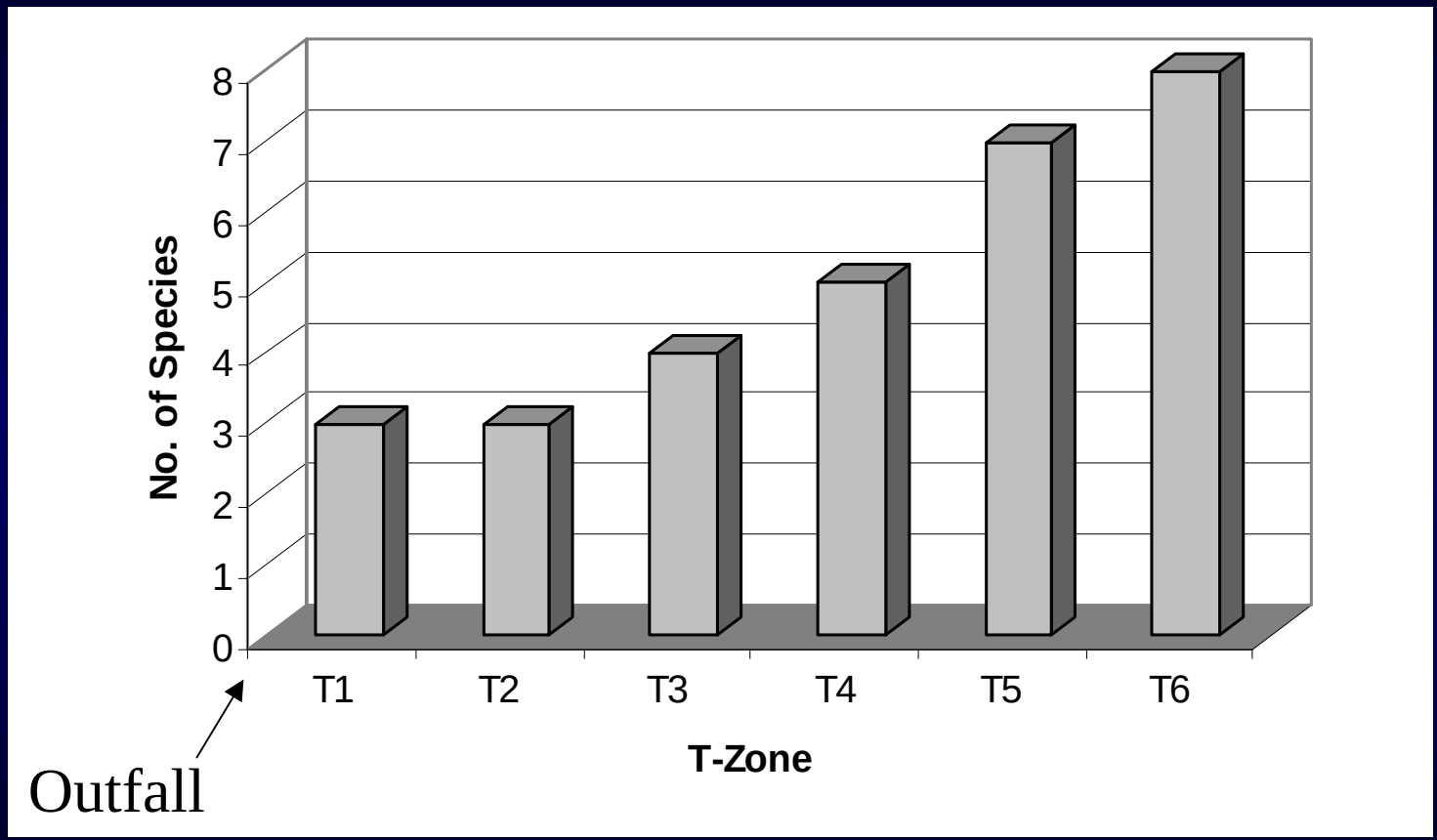
Metric Testing

- Two 500-m electrofishing zones (data collected in 100m increments) were conducted simultaneously, back-to-back, in an area where a known water quality gradient existed.
- Design allowed data reconfiguration /compilation for 6 500m traveling or T-zones, each beginning progressively further downstream from the area of impact.

Metric Testing (T-Zones)



T-Zone Example



Flow

Reducing Variance

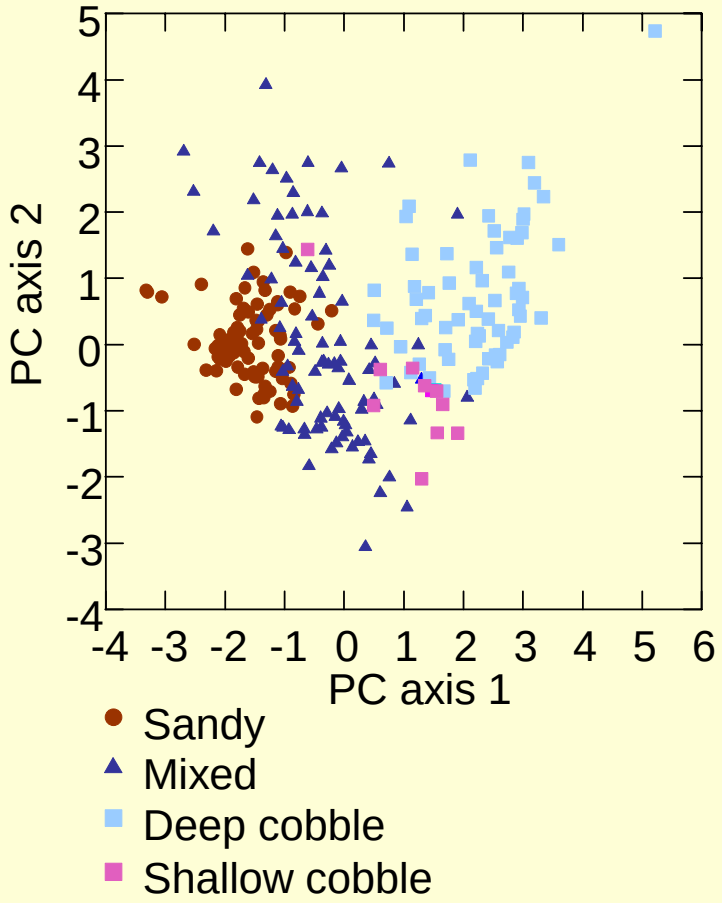
- Spatial
  - Ecoregions?
    - Data suggests 3 river reach segments may exist
  - 3 Distinct habitat types defined.
- Temporal
  - Seasonal shifts in water quality (temperature and DO) result in shifts in aquatic community over certain habitat types.
  - Seasonal expectations may be set for these habitats.

Defining Habitat Types

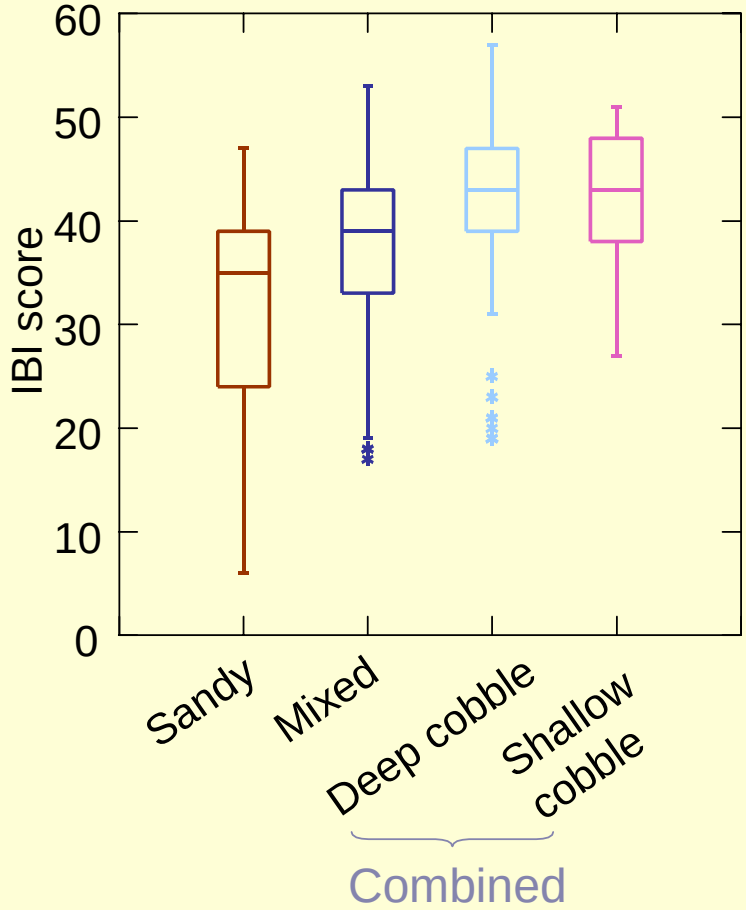
- Use first visits to least impacted sites only.
- Principal Components Analysis (PCA) on habitat variables: measures of depth, woody cover and substrate composition.
- K-means clustering based on PCA axis.
- Use CART with cluster as dependant and habitat variables predictor variables.

New Habitat Clusters

First visits – least impacted

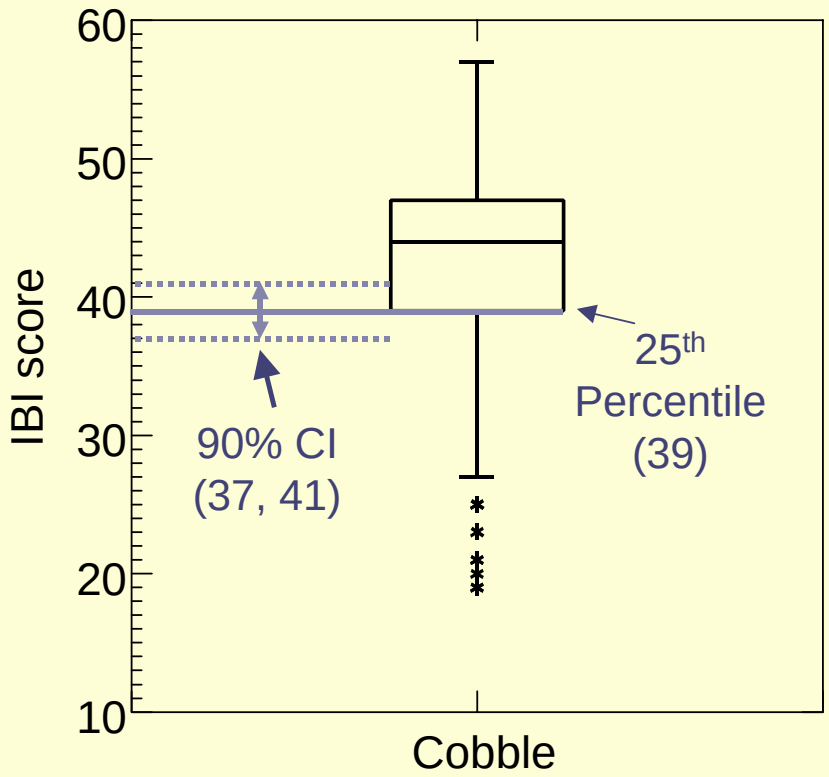


All visits – least impacted



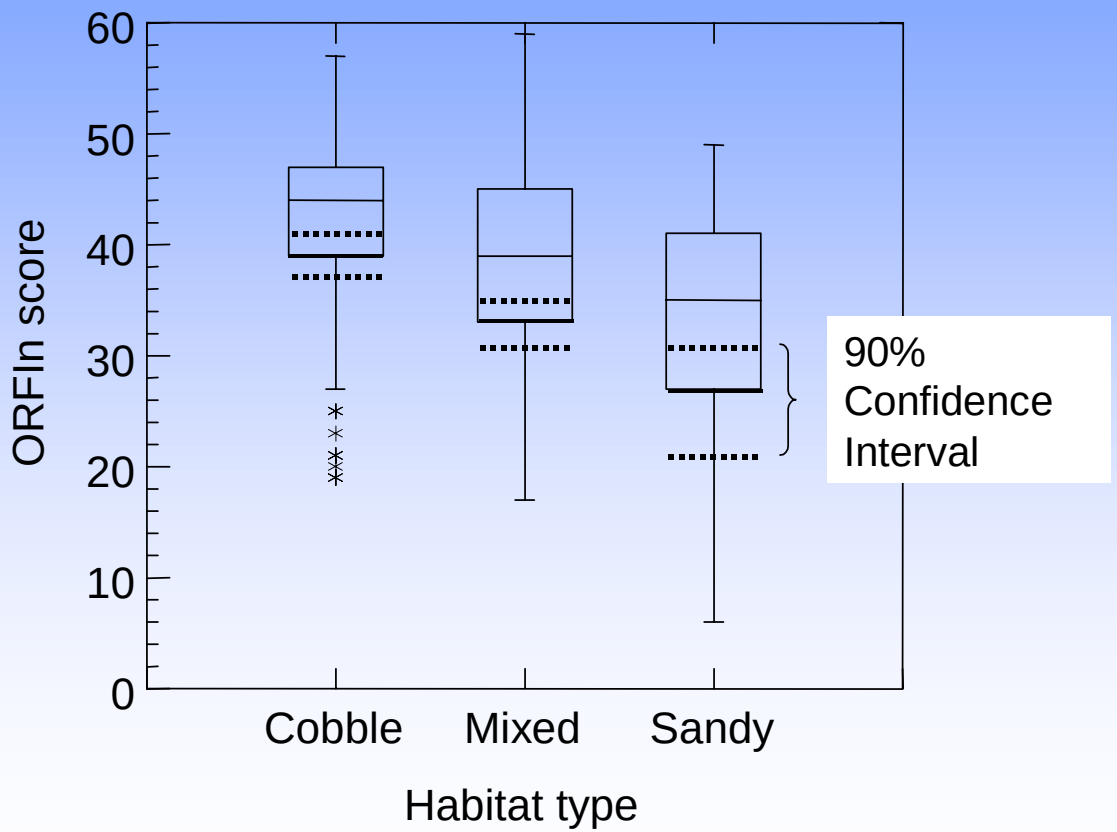
Calculation of Biocriteria

- Calculate 25th percentile value for least impacted sites (all visits)
- Calculate the nonparametric 90% confidence interval around percentile using binomial distribution
- Use lower confidence bound as biocriterion for that habitat class



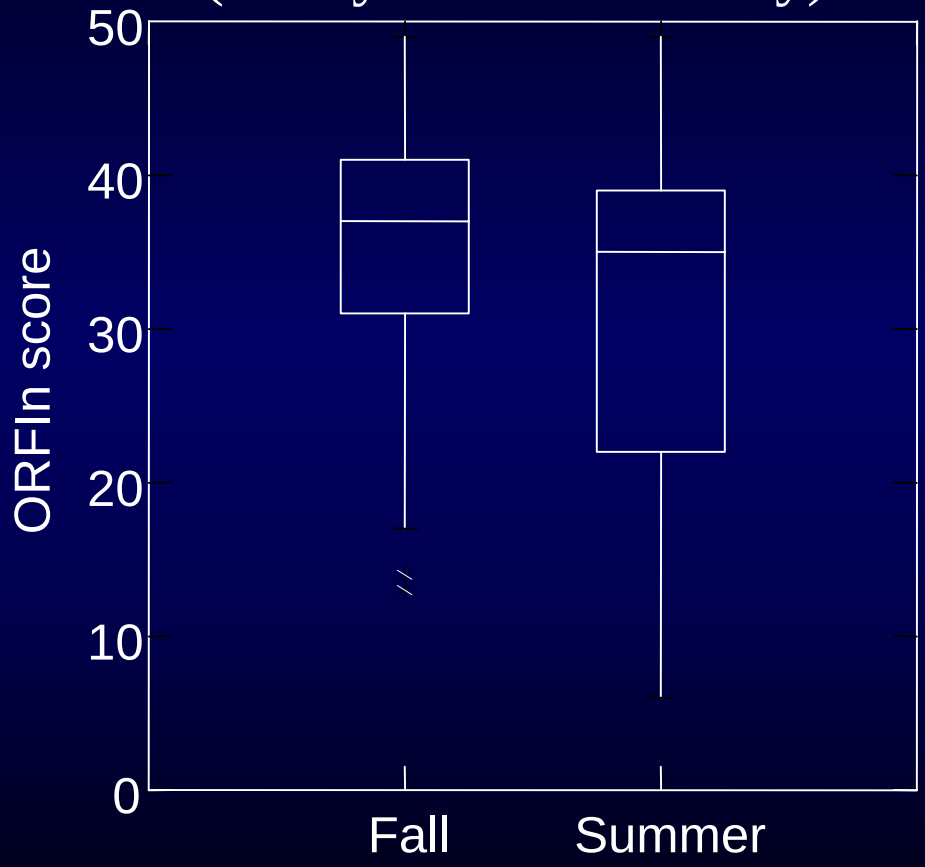
3 Habitat types defined based on substrate composition

Least impacted sites



Indications of Seasonal Differences Within Annual Timeframe

(Sandy Substrates Only)



Deriving Biocriteria

- Current
  - Using 3 habitat types
    - 25th percentile for each type
      - Lower 90th confidence interval around the 25th will serve as criteria.
      - Revisits required to sites falling within 90th bands.
      - Multiple passes used for assessment
- Future
  - Additional data collection needed
  - May incorporate seasonal and reach-specific expectations.

Regulatory Changes

- A more thorough and accurate 305(b) assessment.
- Demonstrated use of biological indices to detect and delineate areas of degraded condition.
- Action against dischargers.

Is it worth it?

- Yes!
- Very labor intensive.
- Many samples required.
- Results allow us to tap into the ability of large rivers to ‘tell their side of the story’.
  - The integrity, stability and beauty of the biotic community of large rivers can be measured, understood, and revealed to those who care to look.

Questions ?