National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
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LR 101

Section 2: Initial Decisions and Considerations

Presented by

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Essential Principles of Adequate Monitoring and Assessment Approaches

- **Methods Development: cost-effective approaches that meet the needs of a bioassessment program.**
- **Data Quality Objectives:** produce data and information at a sufficient level of resolution so as to assure accuracy and precision.
- **Scale of Assessment:** essential to encompass the full gradient of response and exposure to multiple stressors and influences; scale of assessment = scale of management.
- **Comprehensive Assessments:** integrated and careful analysis of multiple indicators adhering to a disciplined approach (Hierarchy of Indicators).
- **Learn by Doing:** gain new knowledge and insights by interactive assessment and observing responses to management actions (determine what works).

Large River Fish Assemblage Assessment Attributes

- Standardized & Representative Sampling – pulsed D.C. electrofishing methods, summer – fall seasonal index period.
- Relative Abundance – numbers and weight (biomass) per unit distance (effort).
- Data Quality Objectives – species level I.D. based on regional ichthyology keys and AFS nomenclature.
- Key Component of Biocriteria – IBI, MIwb, and component metrics; development of tiered uses and numerical biocriteria.
- Longitudinal Sampling Design – longitudinal reach-scale sampling and interpretation of results along entire mainstems.
- Sampling Site Considerations – include complete cycles of riverine habitat types; may vary between constrained and floodplain rivers.
- Experienced Biologists – knowledge of regional fauna, natural history, response signatures, impact types.

Large River Macroinvertebrate Assemblage Assessment Attributes

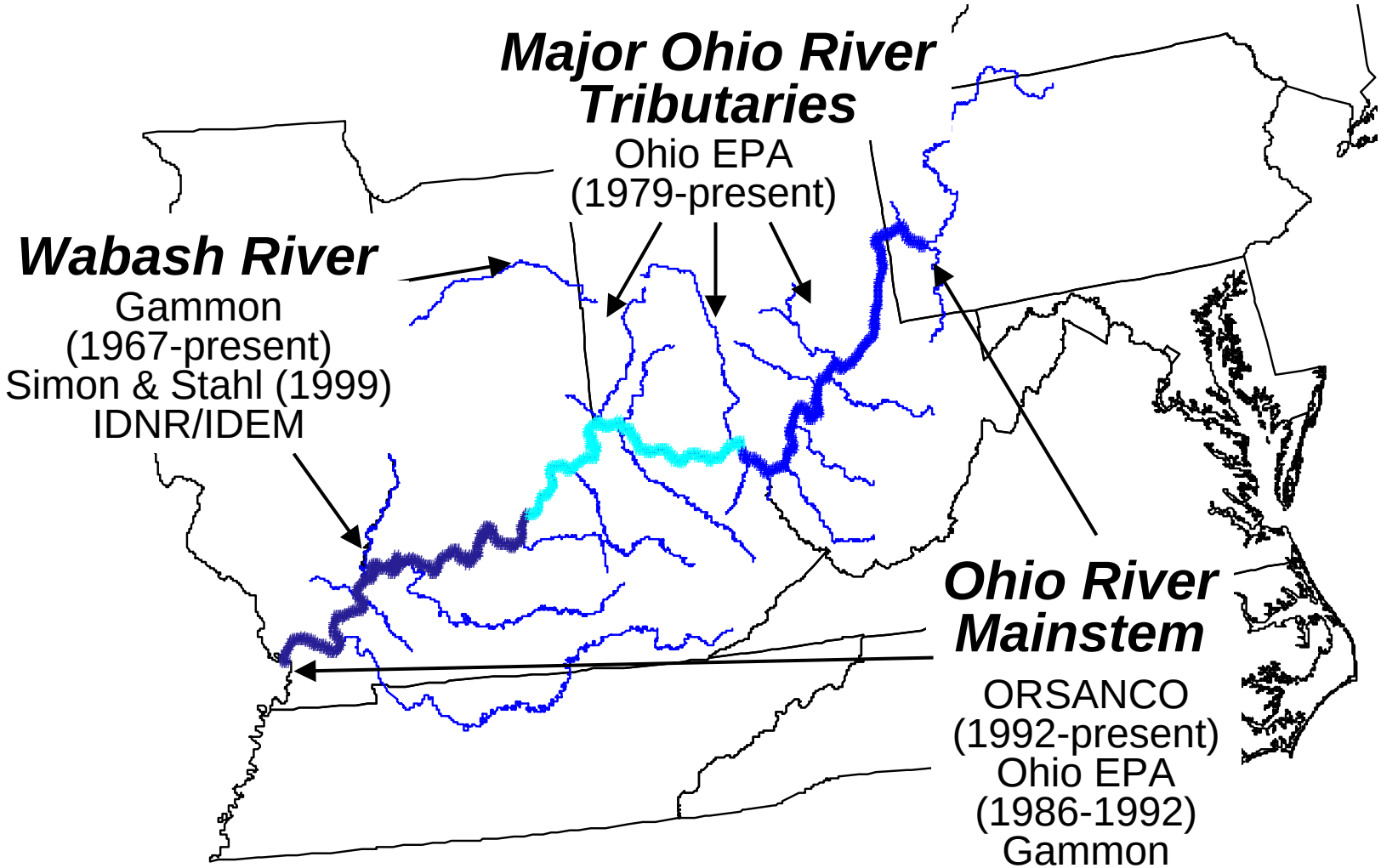
- Standardized & Representative Sampling – artificial substrates, summer – fall seasonal index period.
- Relative Abundance – organisms per unit surface area.
- Data Quality Objectives – lowest practicable level I.D. based on representative keys.
- Key Component of Biocriteria – ICI, BIBI, and component metrics, also RIVPACS, discriminant function model; development of tiered uses and numerical biocriteria.
- Longitudinal Sampling Design – longitudinal reach-scale sampling and interpretation of results along entire mainstems.
- Sampling Site Considerations – include complete cycles of riverine habitat types; may vary between constrained and floodplain rivers.
- Experienced Biologists – knowledge of regional fauna, natural history, response signatures, impact types.

Methods Development Issues: Fish Assemblage Example

History of Large River Fish Assemblage Assessment

- **Since Late 1960s** – improved electrofishing equipment & technology (pulsed DC, sophisticated electronics).
- **Early 1970s:** – Gammon's work on the Wabash River, Indiana; resulted in development of single-gear approach (shoreline electrofishing based on distance).
- **1980s/1990s** – Ohio EPA initiated statewide use of electrofishing to survey fish assemblages; followed by IBI development and biological criteria adoption.
- **Late 1980s** – Hughes & Gammon work on the Willamette River, Oregon; addressed challenges with depauperate fish faunas in bioassessment and IBI development.
- **1990s** – Western EMAP (Large Coldwater Rivers), ORSANCO (Ohio R. mainstem), and Wisconsin (Lyons, IBI), Idaho (IBI, Mebane et al.).

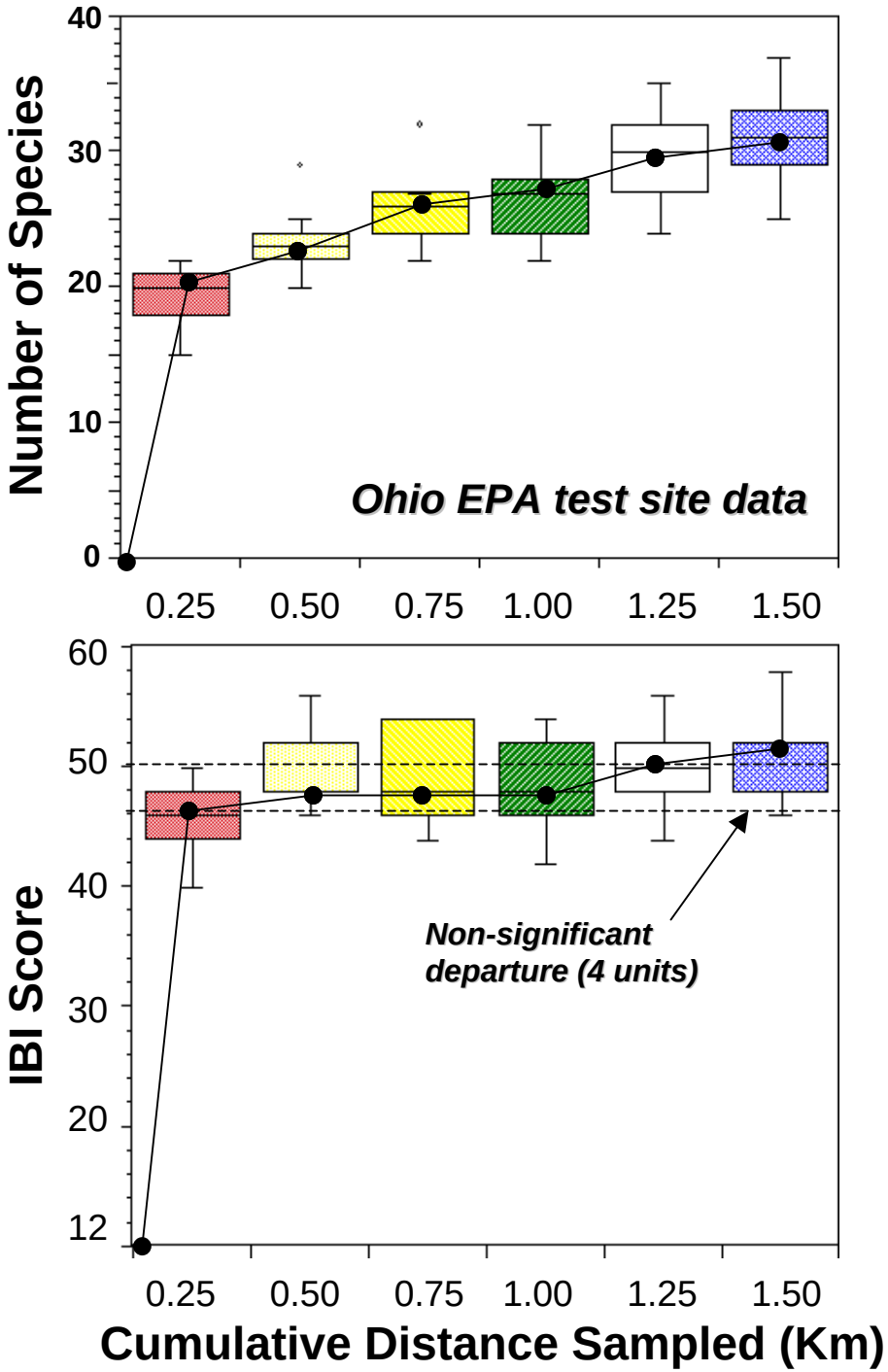
Fish Assemblage Assessments of Large and Great Rivers in the Upper Ohio Basin



Methods Development Issues:

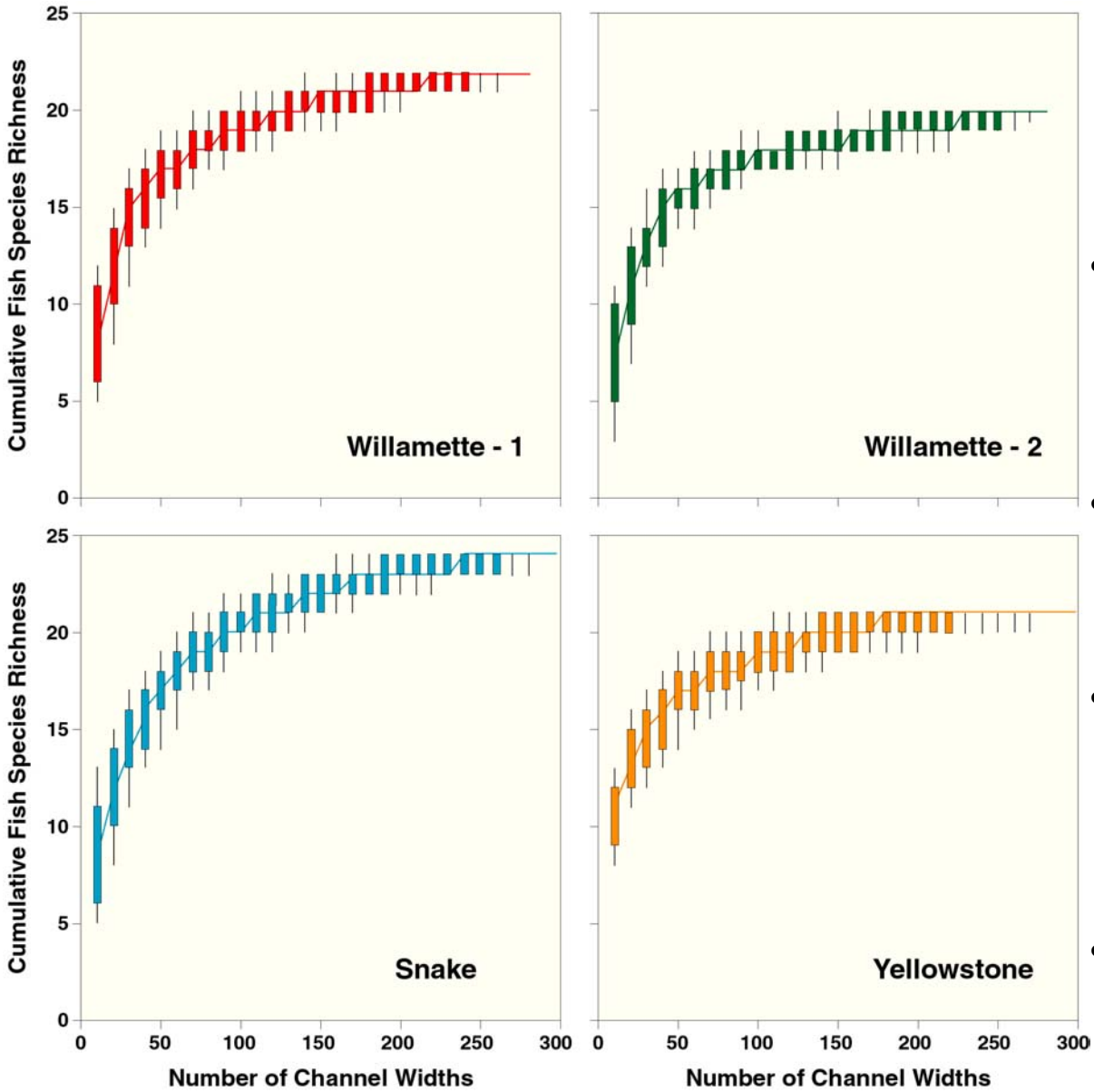
Sampling Effort:

- **How to measure sampling effort – time or distance or both?**
- **Pilot studies conducted in the Wabash R. (1973-76), Ohio rivers (1979-81), Wisconsin rivers (mid-1990s), Oregon rivers (late 1990s).**
- **Early studies derived fixed distance criteria (e.g., 500m); Ohio EPA added minimum time requirement.**
- **Later studies derived a river width formula (40-80x)**
- **Choice influenced by program objectives.**
- **Some protocols developed for source assessment – Ohio EPA mixing zone, ORSANCO T-zone.**



Methods Testing and Evaluation: Ohio

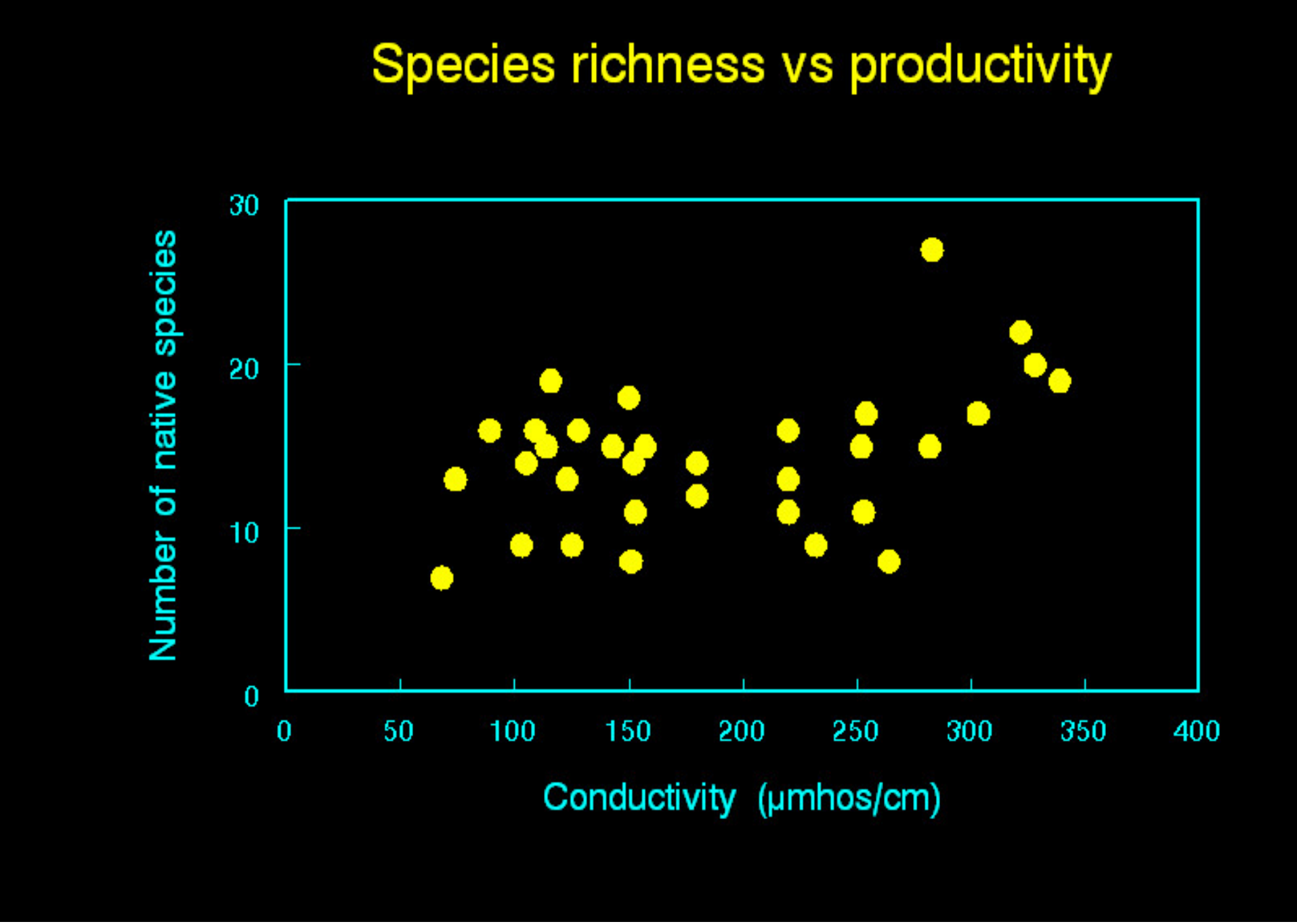
- **Methods testing to determine effect of effort, variability, and reproducibility.**
- **Conduct repeated samplings under controlled circum-stances.**
- **Species richness increases with distance; rate of increase stable >250 m.**
- **IBI increase diminishes at shorter distances; non-significant differences 500-1250 meters; >@ 1500 m.**



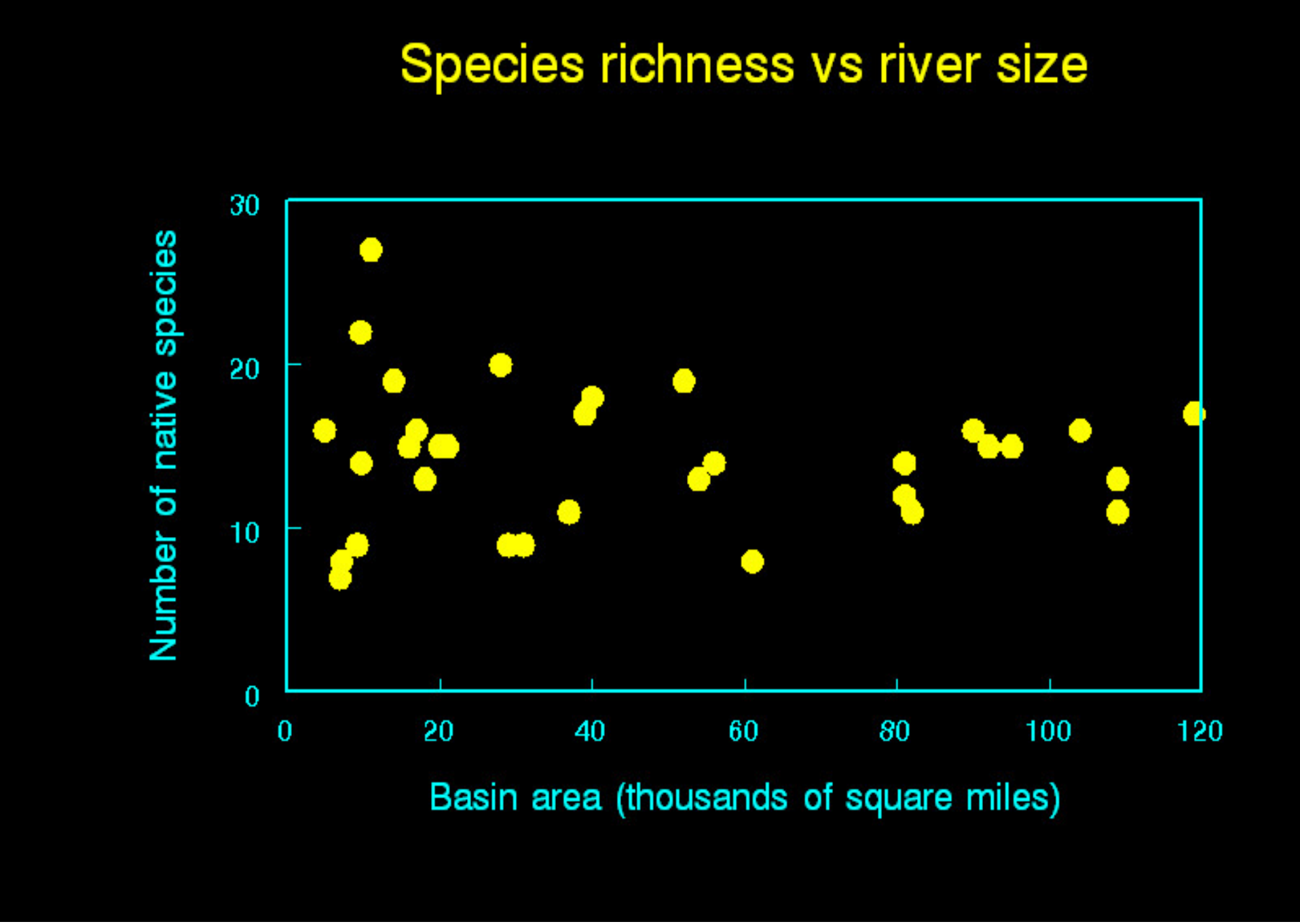
Methods Testing and Evaluation: Western EMAP

- Methods testing to determine effect of effort, variability, and reproducibility.
- Test sites to determine effect of sampling distance on species richness.
- Cumulative species richness increases sharply with increasing distance sampled.
- 186-240 widths required to accumulate 95% of true species richness.

after Hughes et al. 2002

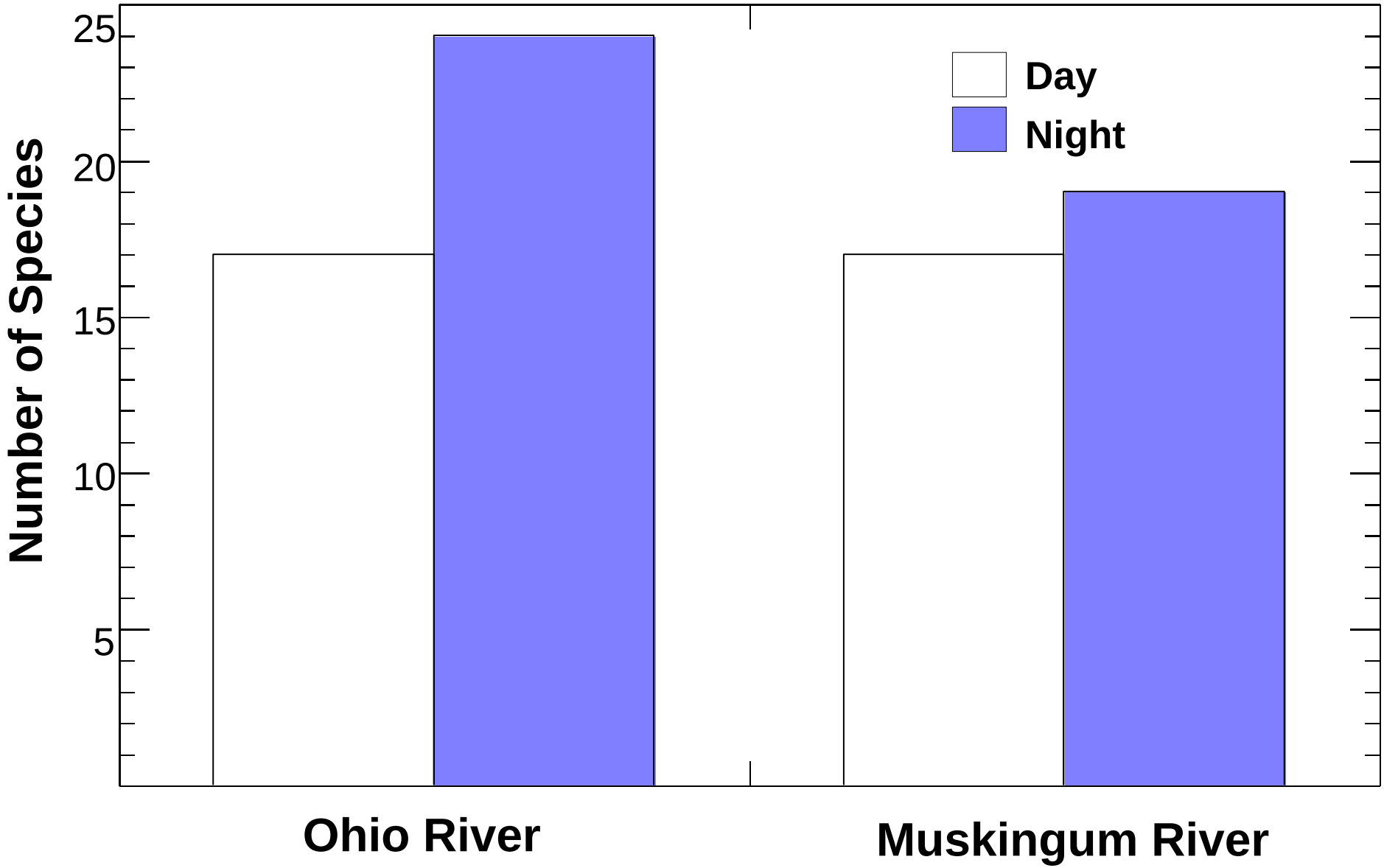


Slide Used Courtesy of John Lyons, Wisconsin DNR

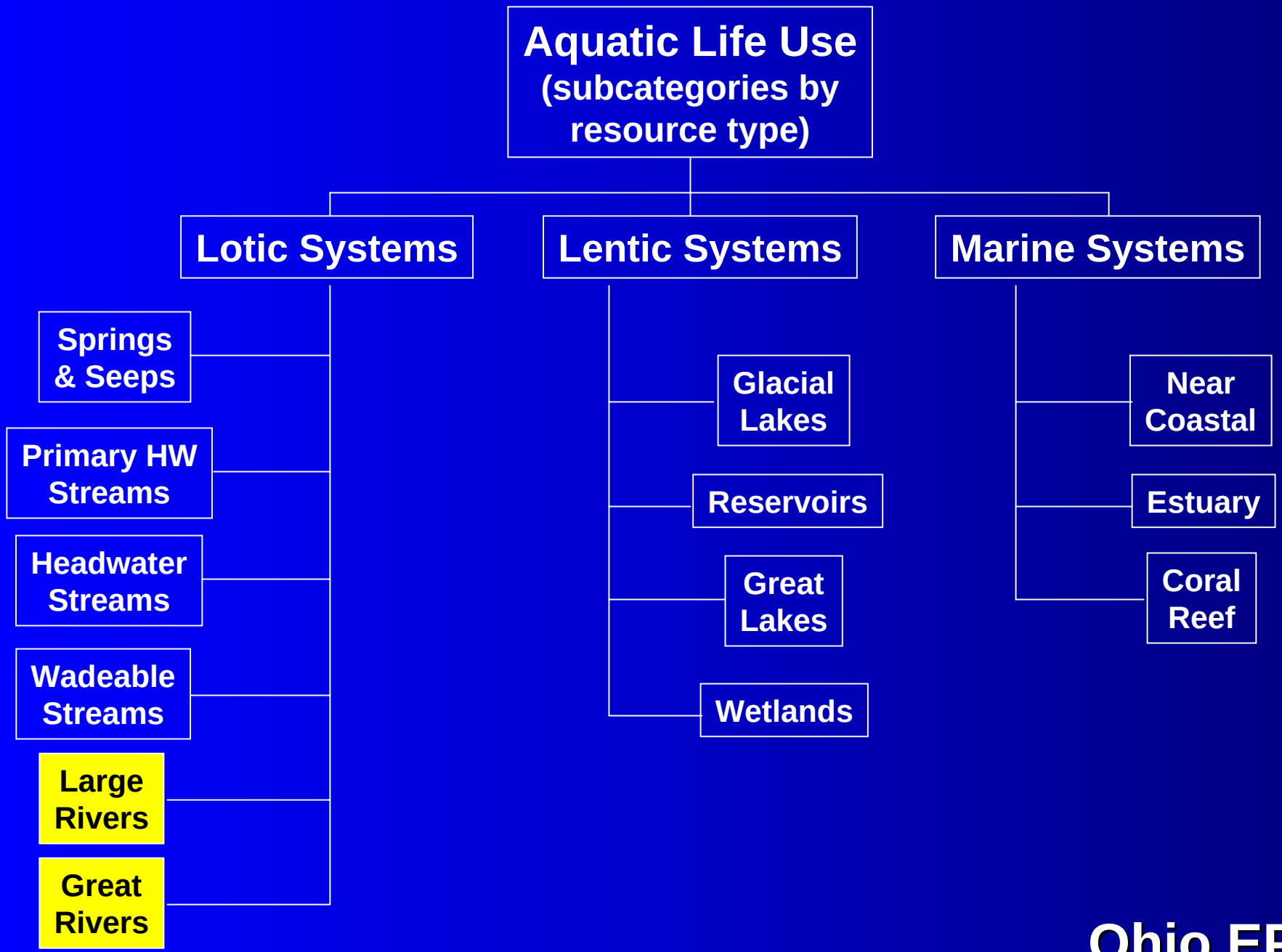


Slide Used Courtesy of John Lyons, Wisconsin DNR

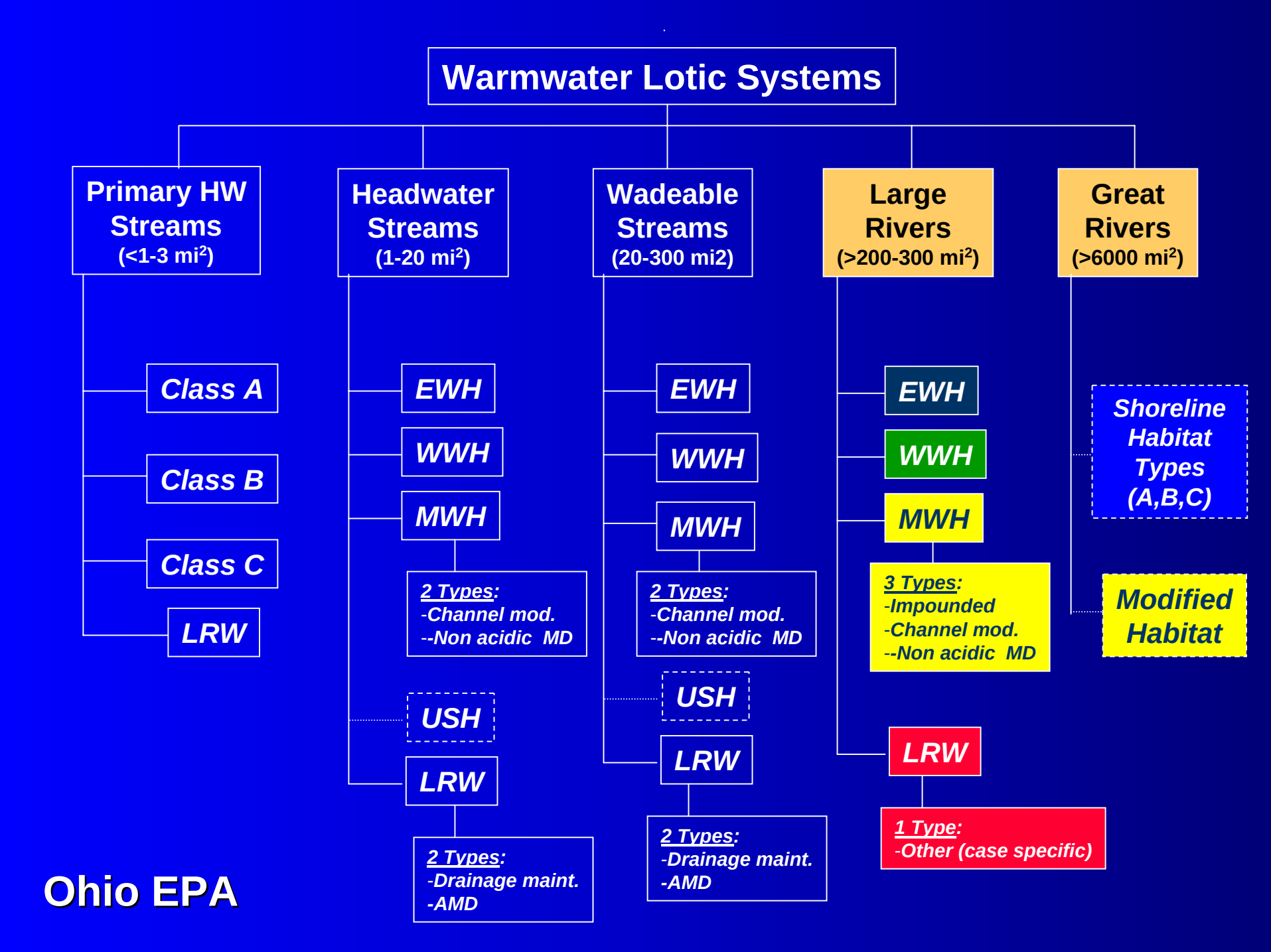
Effect of Time of Day on Electrofishing Efficiency: Impounded Rivers



Resource Classification and Stratification Issues: Tiered Uses and Biocriteria

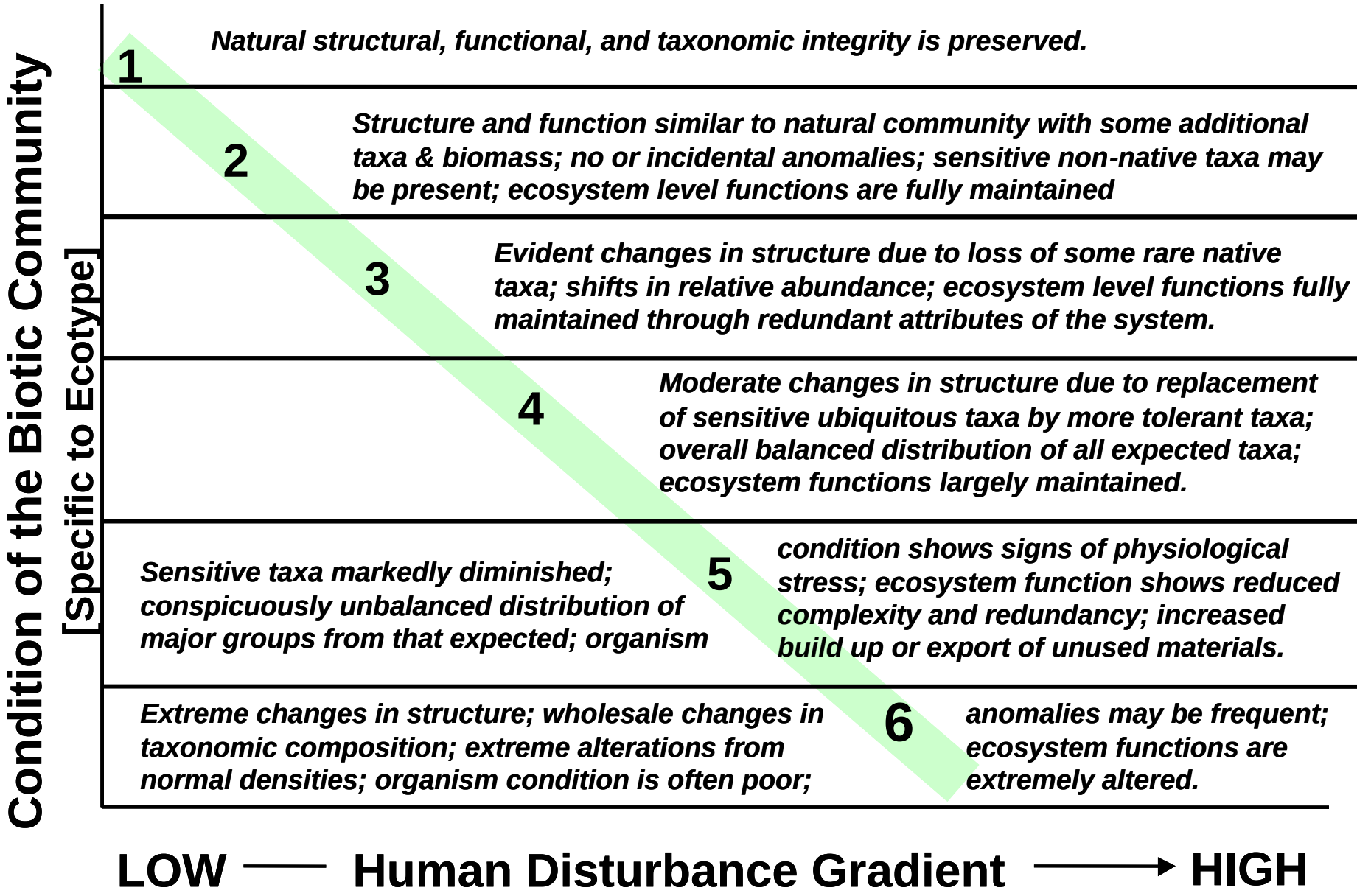

Aquatic Life Use
(subcategories by resource type)
Lotic Systems
Lentic Systems
Marine Systems
Springs & Seeps
Primary HW Streams
Headwater Streams
Wadeable Streams
Large Rivers
Great Rivers
Glacial Lakes
Reservoirs
Great Lakes
Wetlands
Near Coastal
Estuary
Coral Reef

Ohio EPA

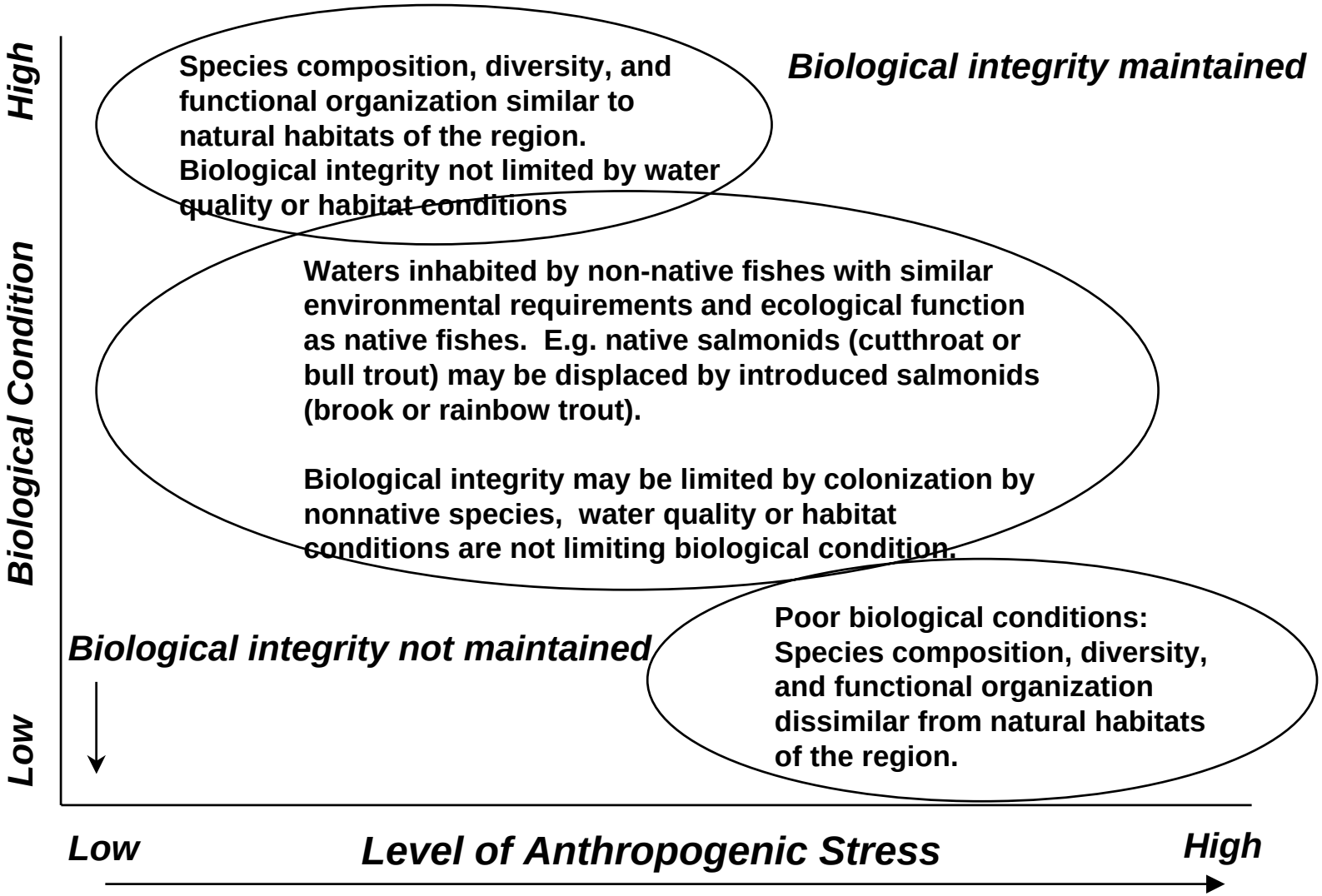

Warmwater Lotic Systems
Primary HW Streams (<1-3 mi²)
Headwater Streams (1-20 mi²)
Wadeable Streams (20-300 mi2)
Large Rivers (>200-300 mi²)
Great Rivers (>6000 mi²)
Class A
Class B
Class C
LRW
EWH
WWH
MWH
2 Types: -Channel mod. --Non acidic MD
USH
LRW
2 Types: -Drainage maint. -AMD
EWH
WWH
MWH
2 Types: -Channel mod. --Non acidic MD
USH
LRW
2 Types: -Drainage maint. -AMD
EWH
WWH
MWH
3 Types: -Impounded -Channel mod. --Non acidic MD
LRW
1 Type: -Other (case specific)
Shoreline Habitat Types (A,B,C)
Modified Habitat
Ohio EPA

Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers

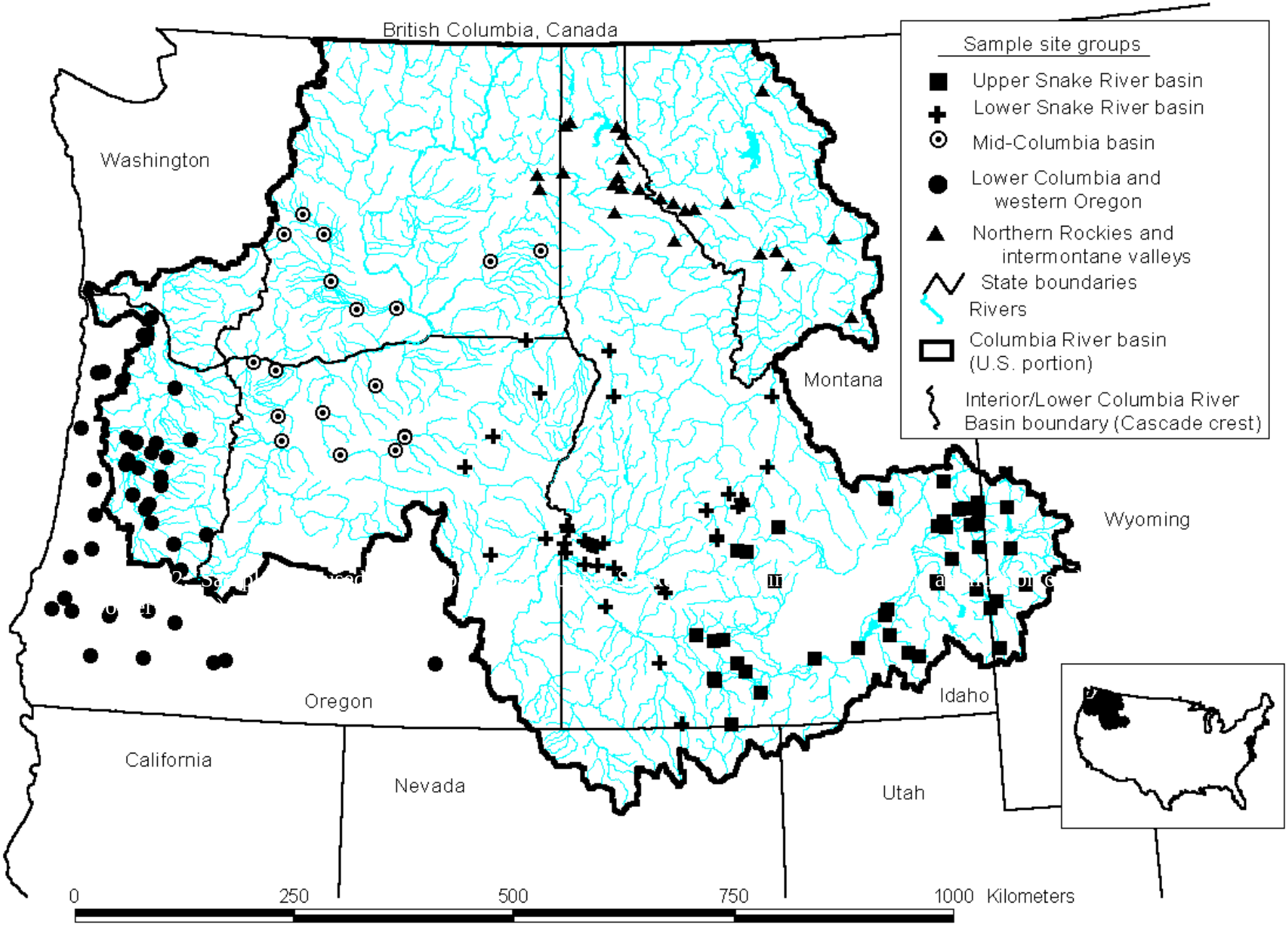
(10/22 draft)



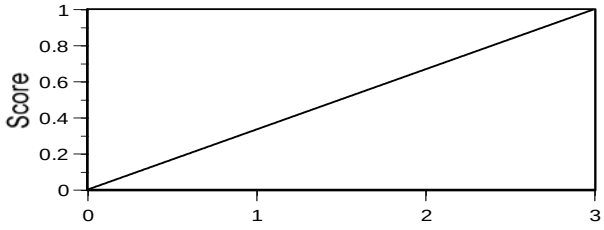
Conceptual Response of a Large Cold Water Fish Assemblage to the Increased Effect of Stress

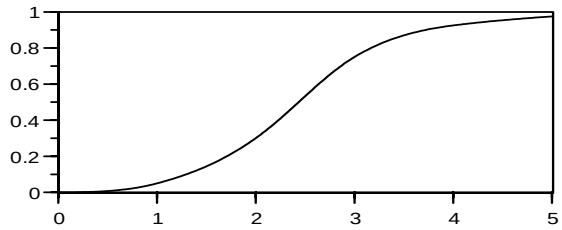


after Mebane et al. 2003

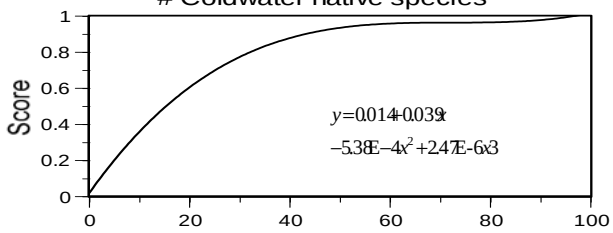


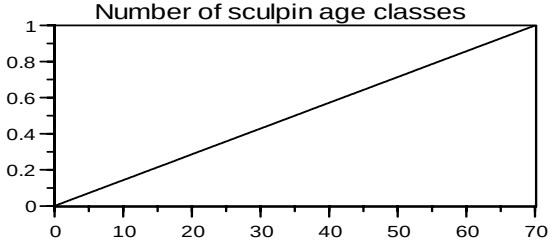
after Mebane et al. 2003

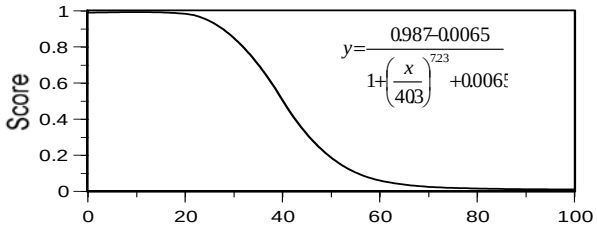


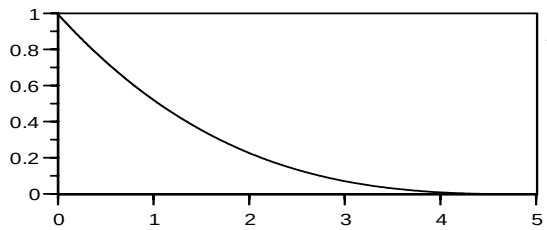


Ages	Score
0	0
1	0.05
2	0.3
3	0.75
4	0.93
>4	1



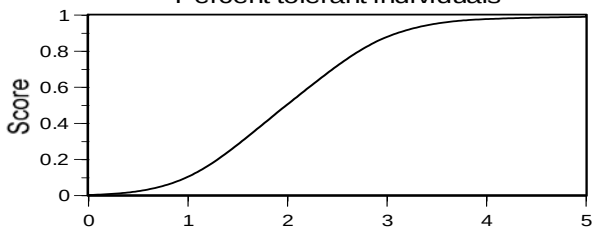


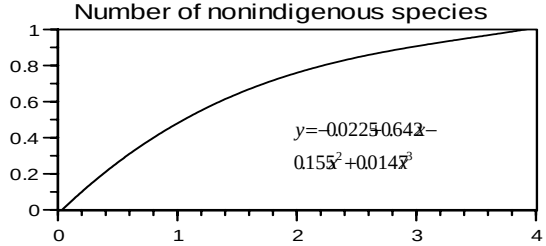


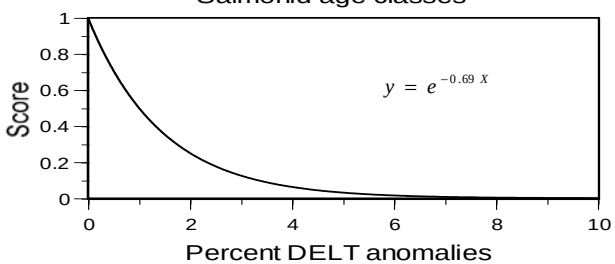


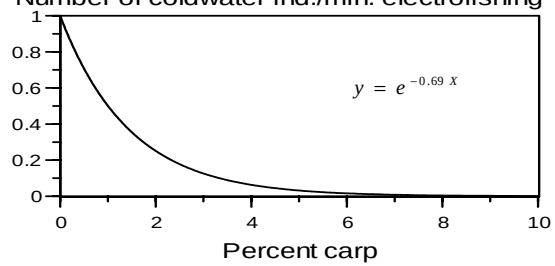
Ages	Score
0	1
1	0.5
2	0.25
3	0.0625
>3	0

Ages	Score
0	0
1	0.1
2	0.5
3	0.875
>3	1



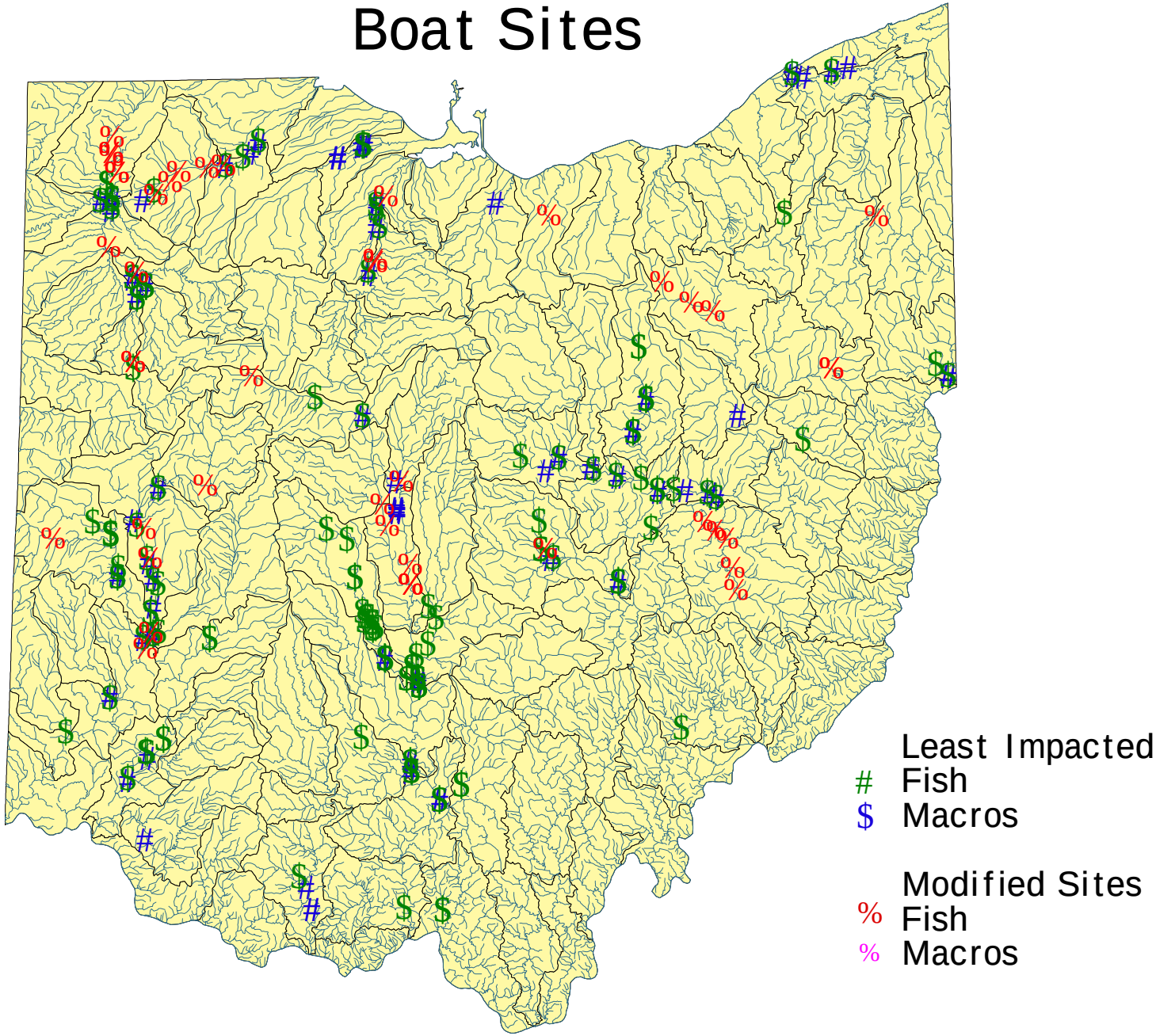






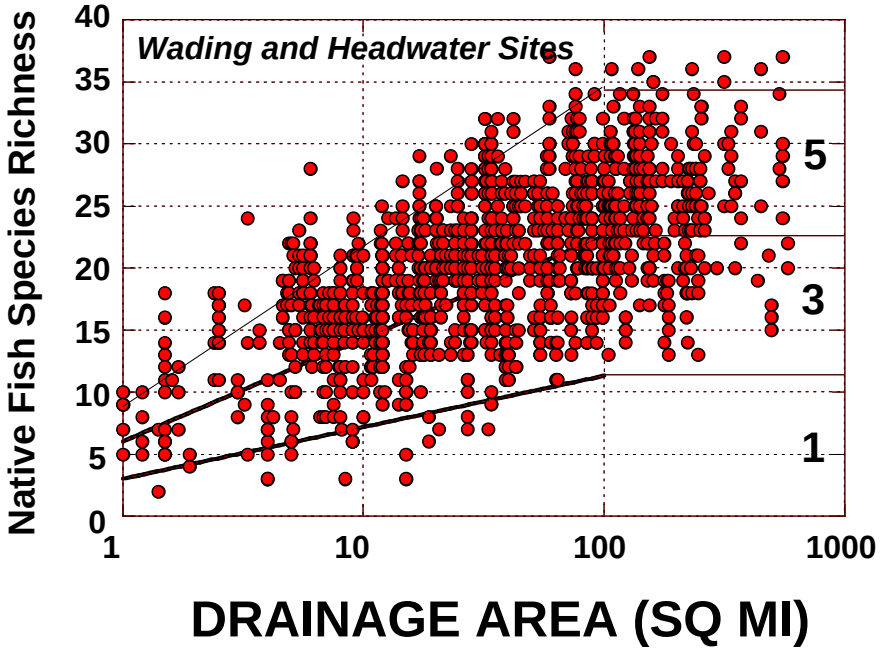
after Mebane et al. 2003

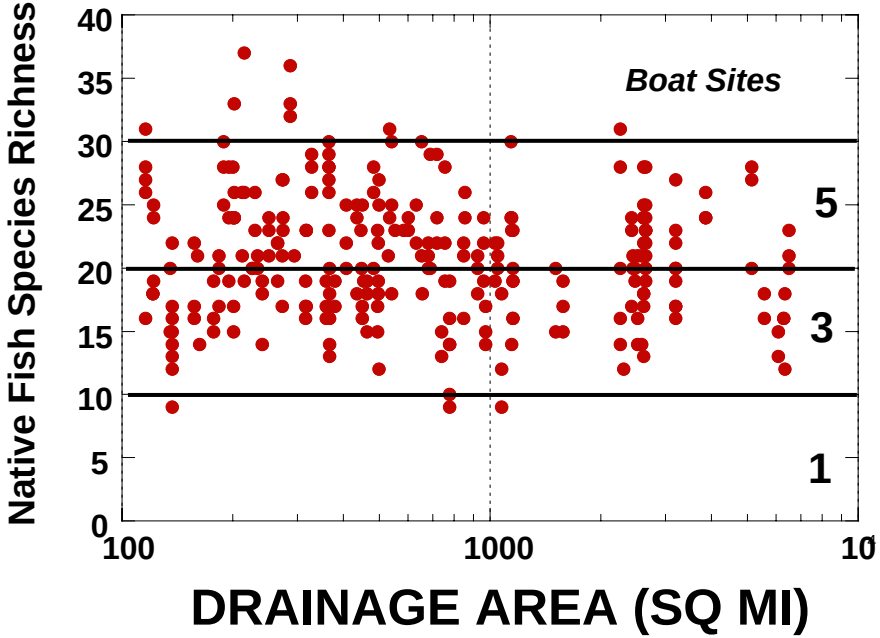
Ohio Biocriteria Reference Sites
Boat Sites



OHIO EPA MODIFIED IBI METRICs	HEADWATER SITE TYPE (<20 SQ. MI.)	WADEABLE SITE TYPE (20-300 MI.^{2})	BOATABLE SITE TYPE (200-6000 MI.^{2})
1. Total Native Species	X	X	X
2. #Darter Species		X	
#Darters + Sculpins	X*		
%Round-bodied Suckers			X*
3. #Sunfish Species		X	X
#Headwater Species	X*		
%Pioneering Species	X*		
4. #Sucker Species		X	X
#Minnow Species	X*		
5. #Intolerant Species		X	X
#Sensitive Species	X*		
6. %Tolerant Species	X	X	X
7. %Omnivores	X	X	X
8. %Insectivores	X	X	X
9. %Top Carnivores		X	X
10. %Simple Lithophils	X*	X*	X*
11. %DELT Anomalies	X	X	X
12. Number of Individuals	X	X	X

* - Substitute for original IBI metric described by Karr (1981) and Fausch et al. (1984)

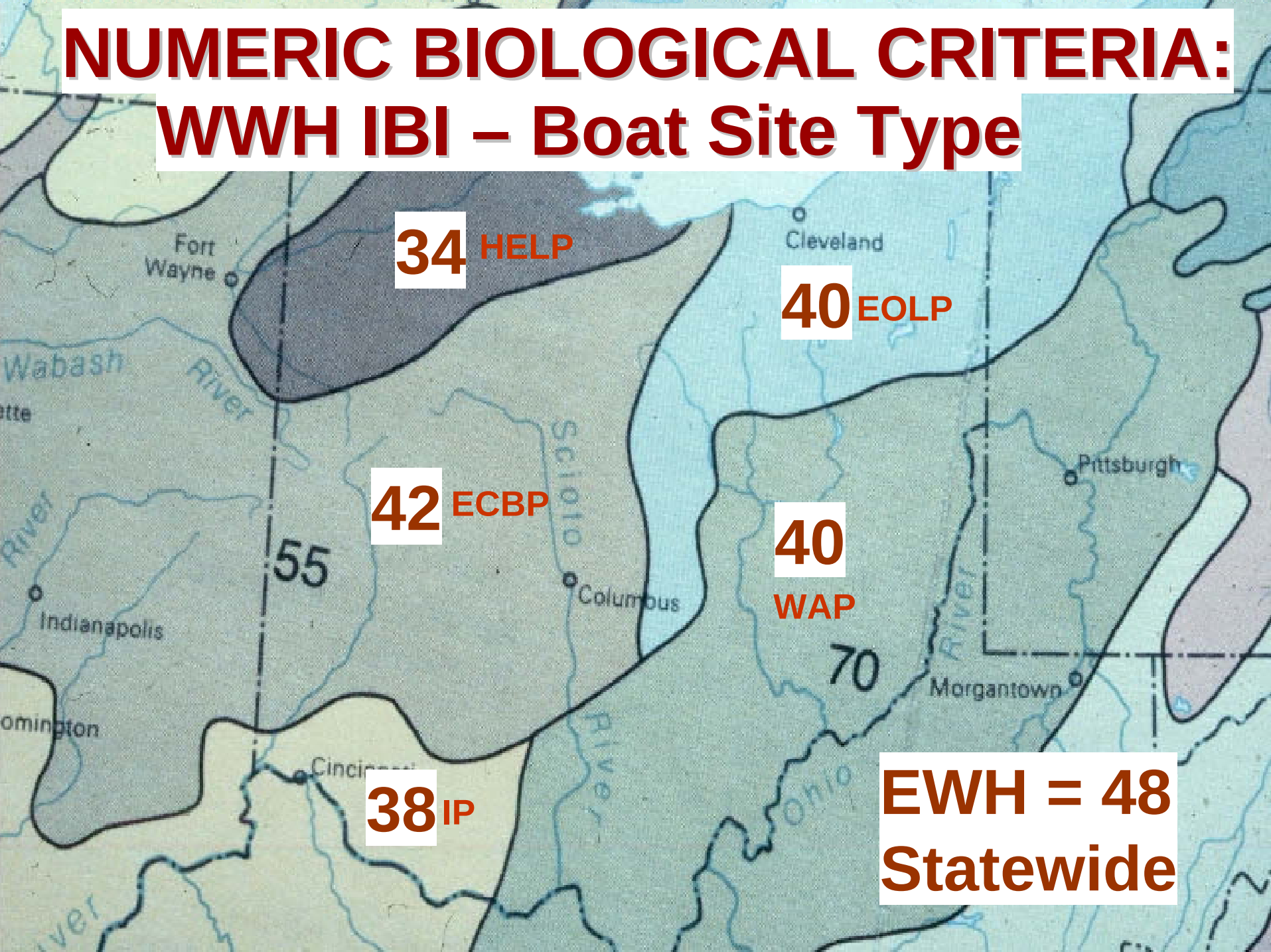




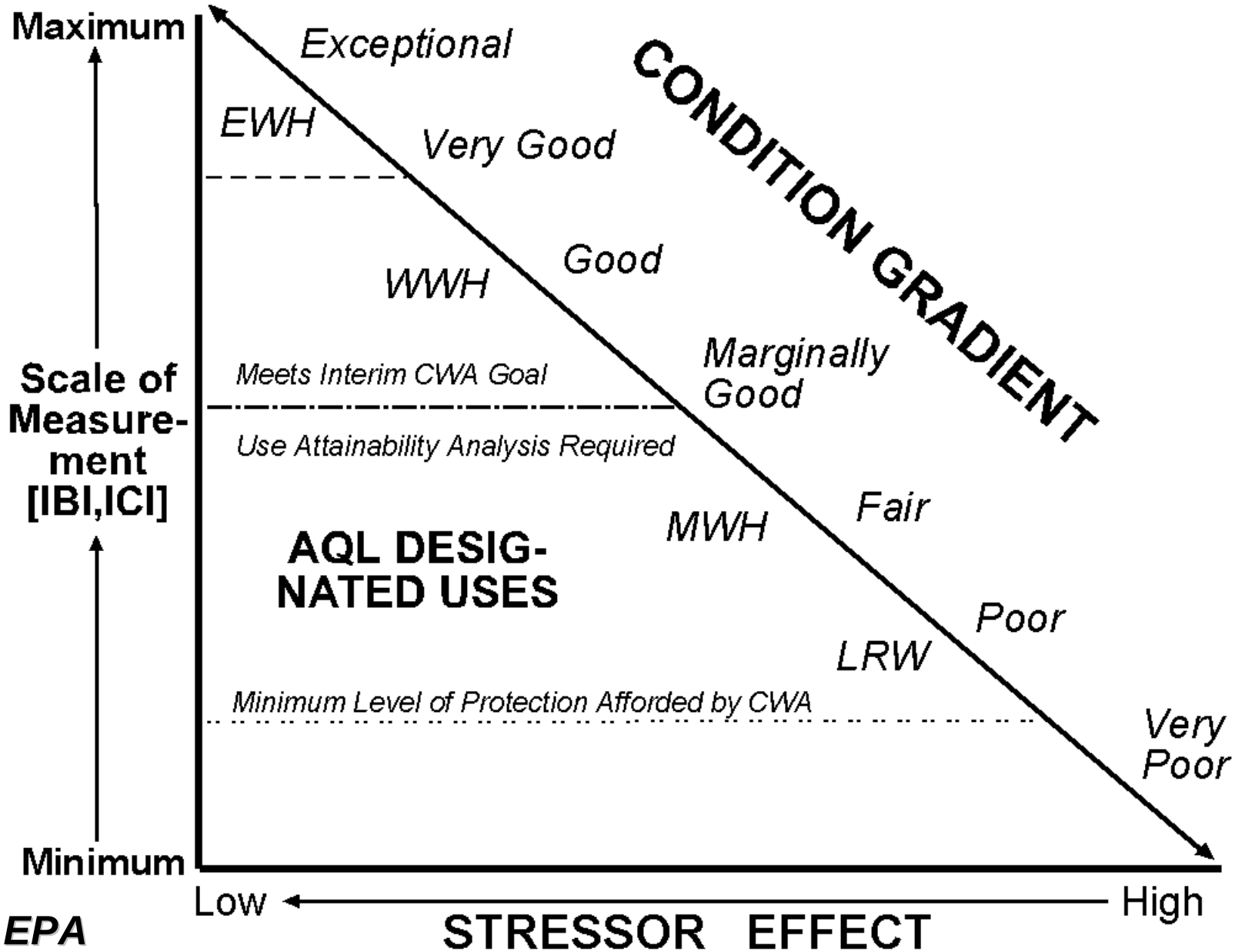
Calibration of Metrics Using Regional Reference Sites

- Scatter plot of metric value by appropriate calibration vector (e.g., watershed area).
- Determine 95% maximum line of best fit across surface of scatterplot; *driven by best reference sites.*
- Area beneath 95% line is subdivided (e.g., trisection) to determine metric scores - most data points should occur in upper ranges.
- This method reduces the influence of slightly degraded sites that may not biologically reflect the intent of reference condition.
- Slope of 95% line conservatively assumed to be zero for boat sites.

NUMERIC BIOLOGICAL CRITERIA: WWH IBI – Boat Site Type



DESIGNATED USE OPTIONS ALONG THE BIOAXIS AND BIOLOGICAL CONDITION GRADIENT



Ohio EPA

Reference condition and how biological condition are measured form the basis for determining what is acceptable vs. unacceptable, both of which require some management action.

- ***Designated Use –*** *sets management goals and criteria for protection and restoration (Water Quality Standards).*
- ***Management Action –*** *protection or restoration activity or reconciling standards to attainable conditions (NPDES Permits, TMDLs, BMPs).*

Coping With Biological Data Variability

- **Compress Variability**: use multi-metric measures (e.g. IBI, ICI, etc.).
- **Stratify Variability**: use ecoregions (or subsets) and tiered aquatic life use classification system.
- **Control Variability**: select efficient sampling methods that yield informative and consistent results.