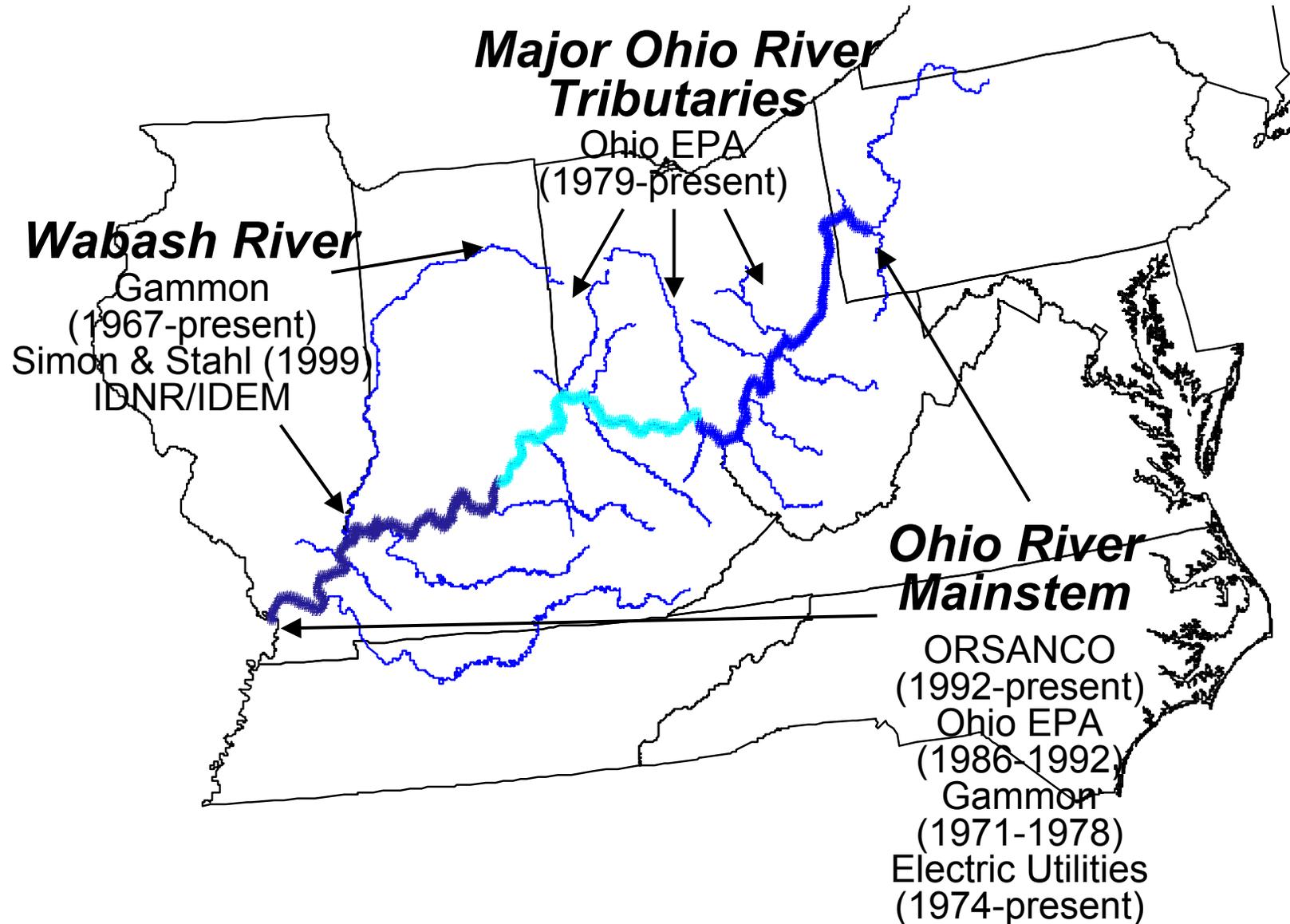


An Overview of Fish Assemblage Assessments in Great and Large Rivers of the Upper Mississippi and Ohio River Basins

**2002 EMAP Symposium
May 9, 2002**

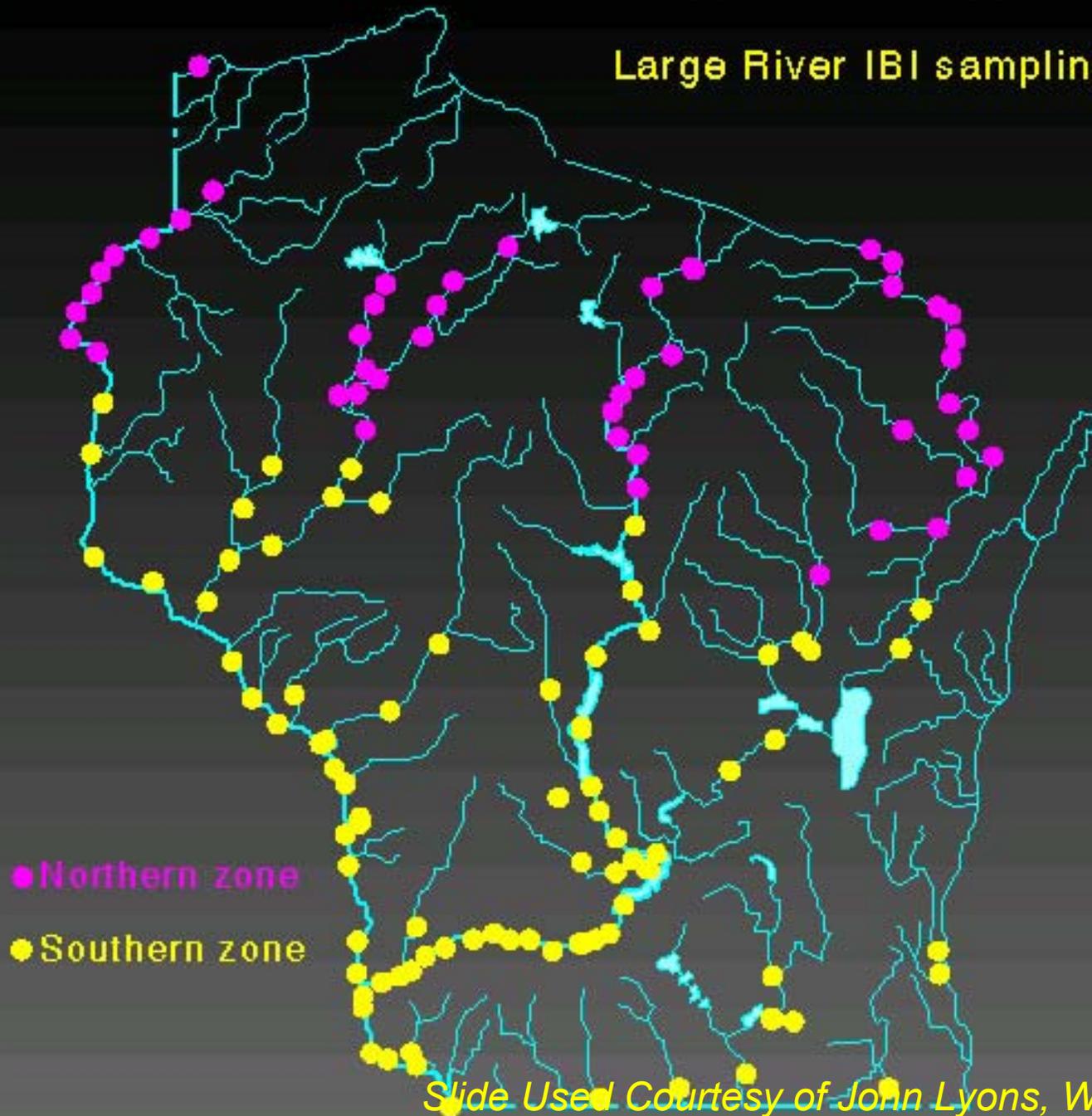
**Chris O. Yoder
Midwest Biodiversity Institute &
Center for Applied Bioassessment & Biocriteria
P.O. Box 21561
Columbus, Ohio 43221-0561**

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



Wisconsin – Upper Mississippi Basin

Large River IBI sampling



Slide Used Courtesy of John Lyons, Wisconsin DNR

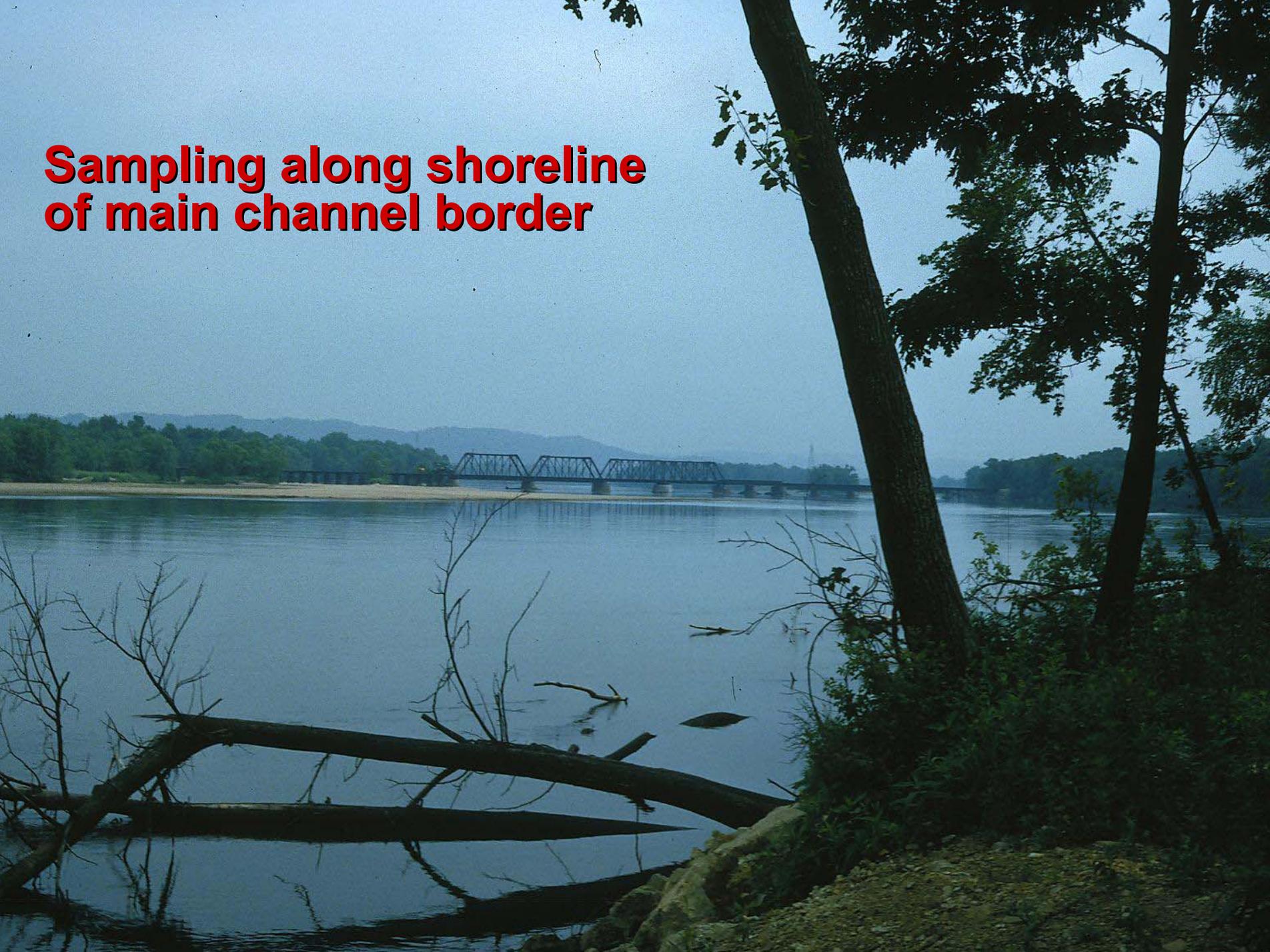
History of Large River Fish Assemblage Assessment

- **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 Statewide Large Rivers (Lyons, IBI), several others in midwest U.S.



Large Rivers: Single-Gear Electrofishing Approach

**Sampling along shoreline
of main channel border**





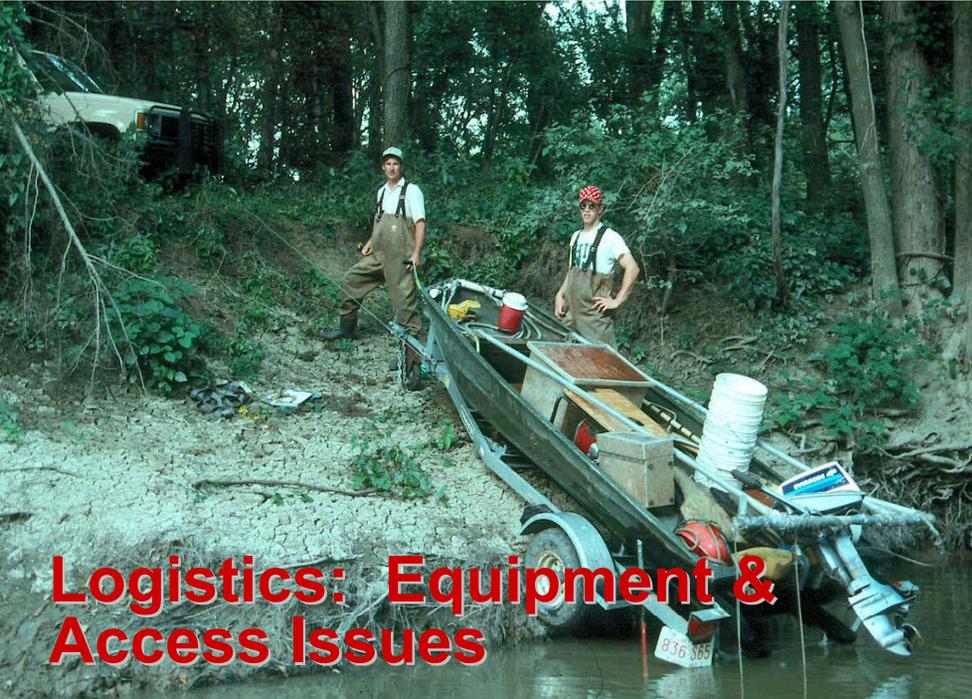
Ohio EPA Non-Wadeable Methods



**Electrofishing Gear Array:
Wadeable to Non-Wadeable**



Effort: Distance Sampled



**Logistics: Equipment &
Access Issues**



Multiple Habitats Sampled

ELECTROFISHING METHODS



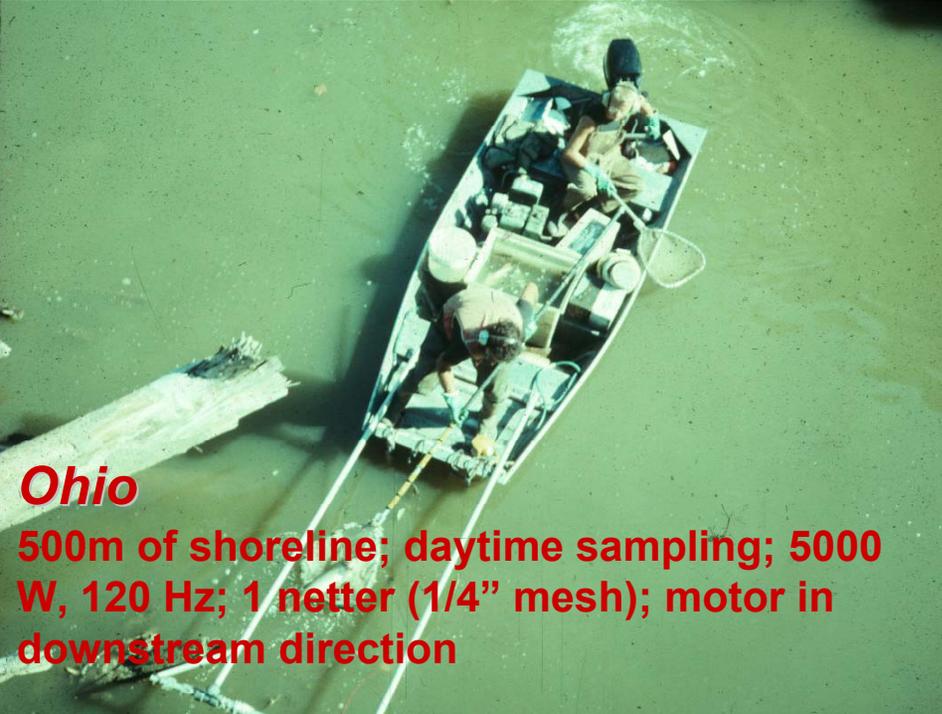
Wisconsin

One mile of shoreline; daytime sampling; 3000 W, 60 Hz; 1 netter (17 mm mesh); motor in downstream direction



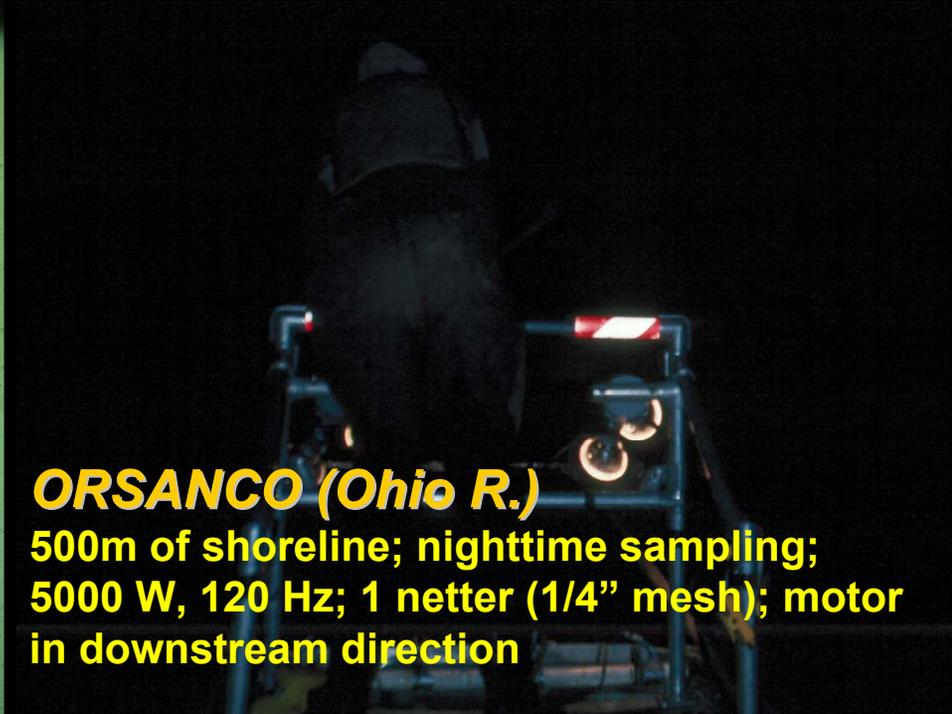
EPA – EMAP

80X width along shoreline; daytime sampling; 2500 W, 120 Hz; 1 netter (1/4" mesh); row in downstream direction



Ohio

500m of shoreline; daytime sampling; 5000 W, 120 Hz; 1 netter (1/4" mesh); motor in downstream direction



ORSANCO (Ohio R.)

500m of shoreline; nighttime sampling; 5000 W, 120 Hz; 1 netter (1/4" mesh); motor in downstream direction

Sample Processing & Data Management



Fish Are Placed On-Board



Individual or Batch Measurements (Weights, Anomalies, etc.)

Field Crew: Kenny Sanders, Chris Williams Location: Shawnee Golf Course
 River/Stream: Ottawa River Secchi Disk: _____ Time Fished: _____
 Date: 8/15/96 Sampler Type: A Color: Biological Total Seconds: 2684
 River Code: 04200 Depth: 80 Observed Flow: _____
 RM: 34.7 Data Source: 07 Temp (°C): 24.5 Number of Entries: 18
 Distance: 500

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; L-lesions; M-multiple DELT anomalies; N-blind; P-parasites; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes)

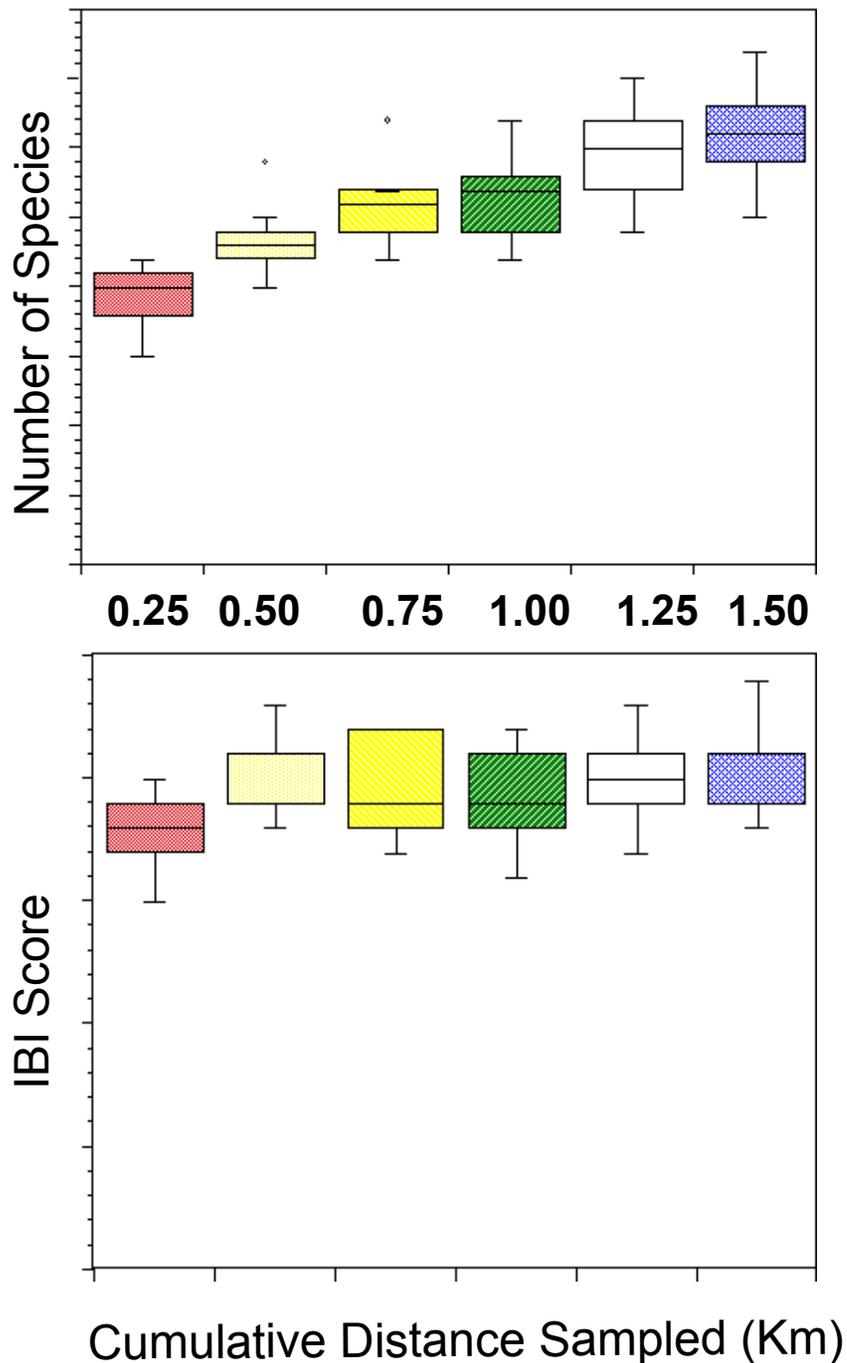
SPECIES	# WEIGHED	TOTAL COUNTED	WEIGHT (GRAMS)					ANOMALIES						
			5200	1550	1700	2860	1560	D	L	E	M	F	L	H
47001 Carp	7	7	5200	1550	1700	2860	1560							
V: 10X			1510	1800										
40018 Spotted Sucker	5	5	251	161	132	93	370							
V: 10X														
40016 White Sucker	19	30	120	110	109	132	98							
V: 10X			42,5	117	92	61	171							
47006 Black Bullhead	3	3	173	143	175									
V: 10X														
47004 Yellow Perch	3	3	72	229	243									
V: 10X														
77008 Green Sunfish	45	45	120	61	69	8	174	13	118	18				
V: 10X														

Data Recorded in Field



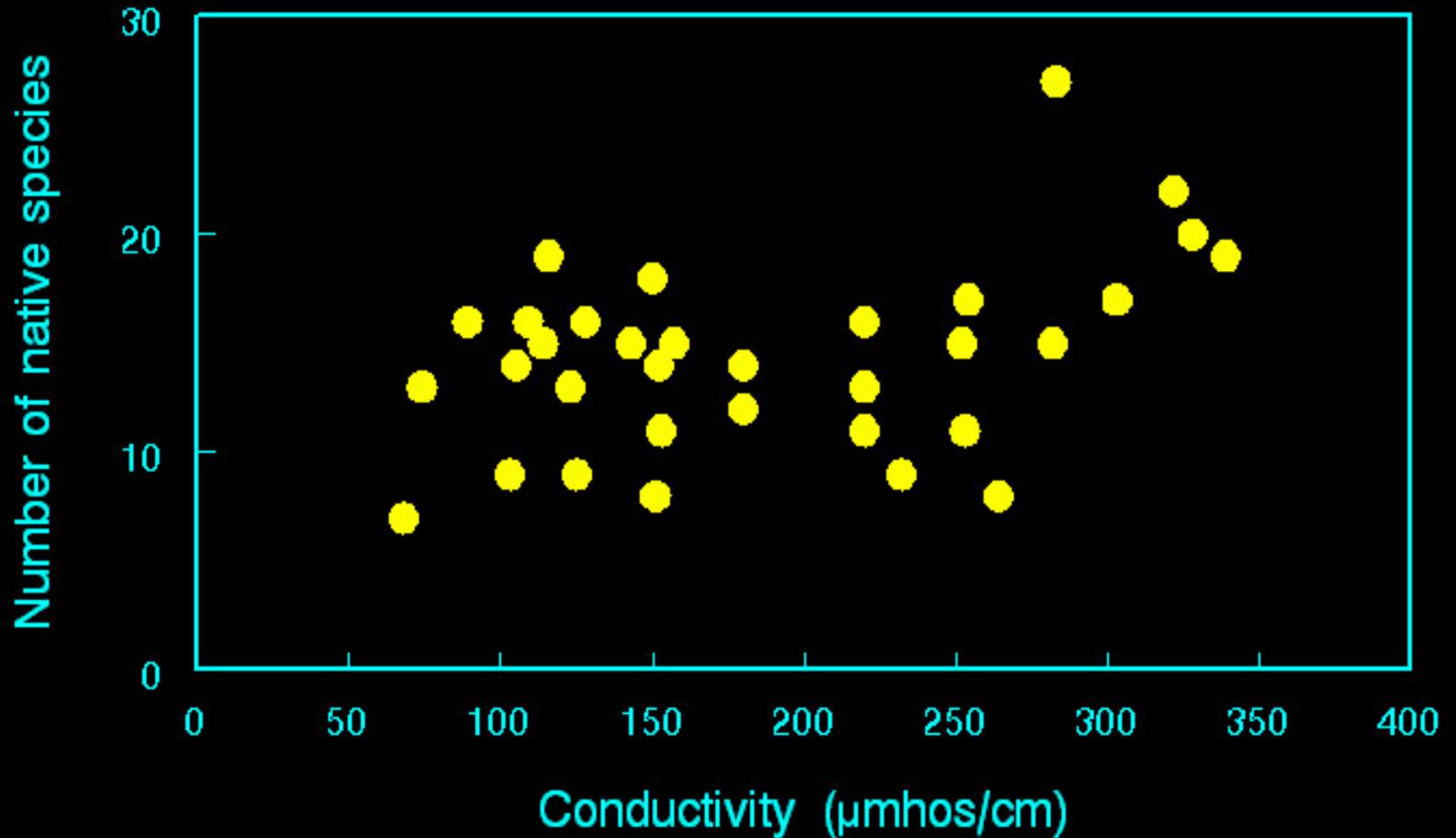
Data Stored Electronically

Methods Testing and Evaluation

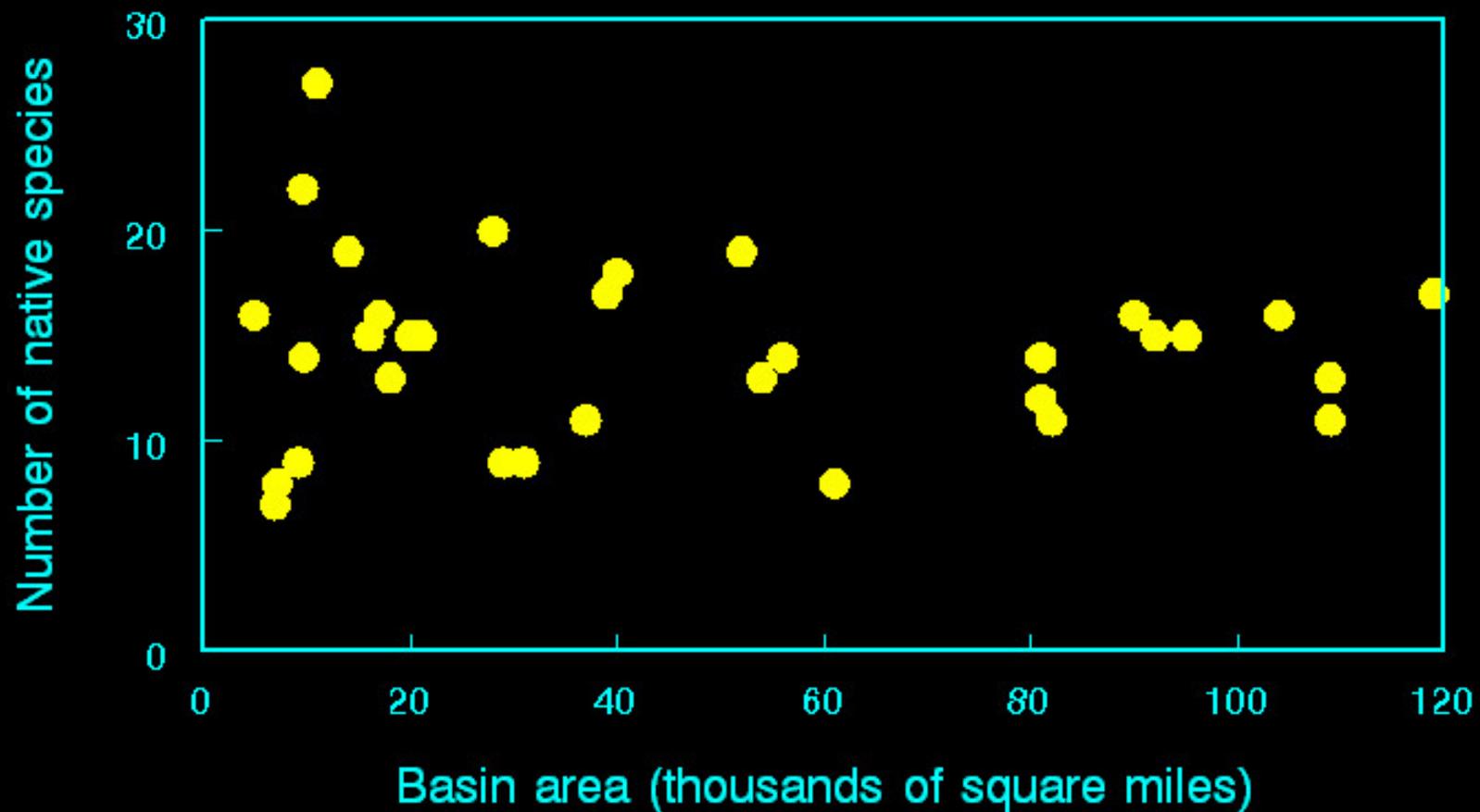


- **Methods testing to determine effect of effort and effectiveness.**
- **Conduct repeated samplings under controlled circumstances.**
- **Species richness increases with distance; rate of increase diminishes.**
- **IBI reaches asymptote at shorter distance.**

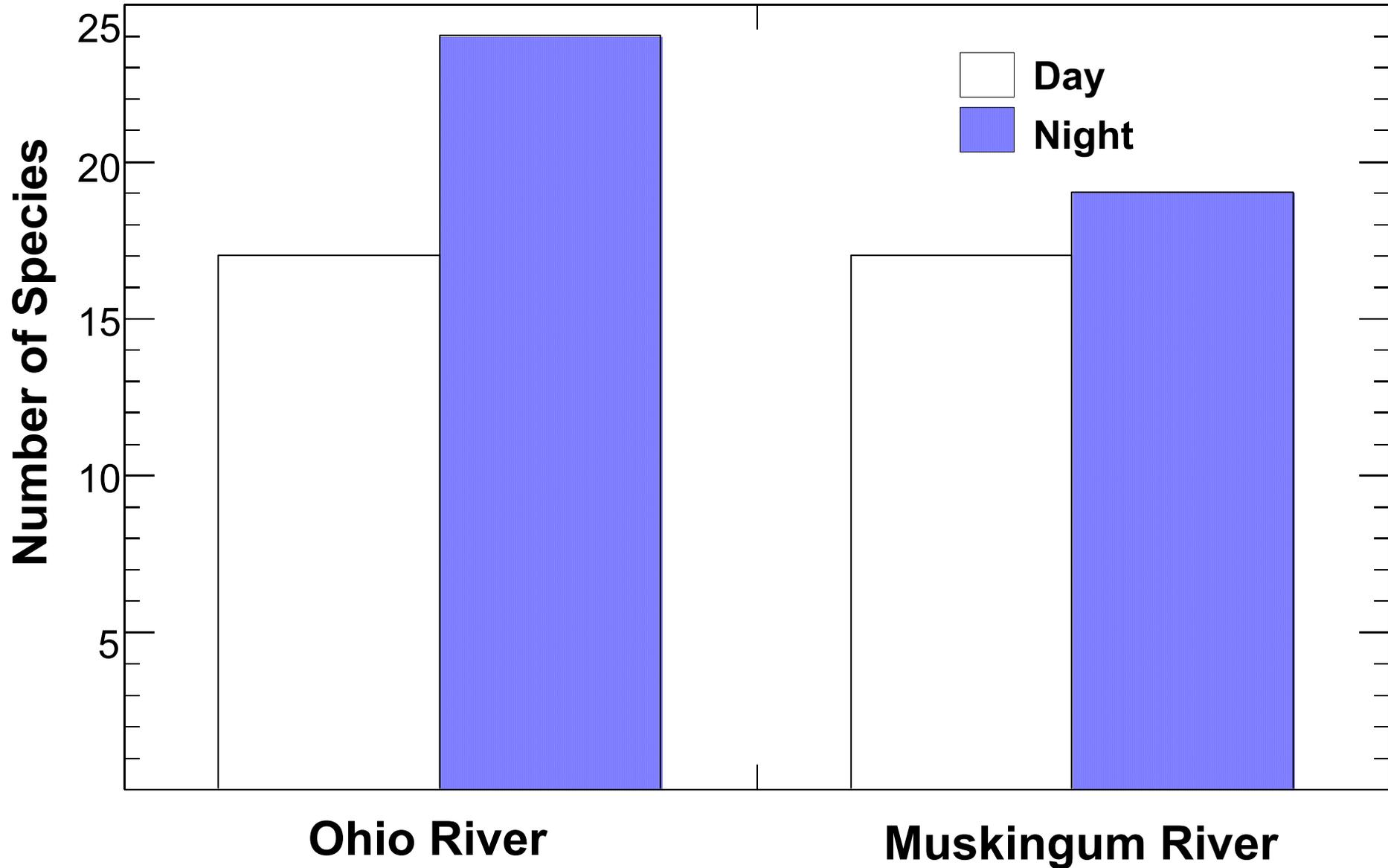
Species richness vs productivity



Species richness vs river size

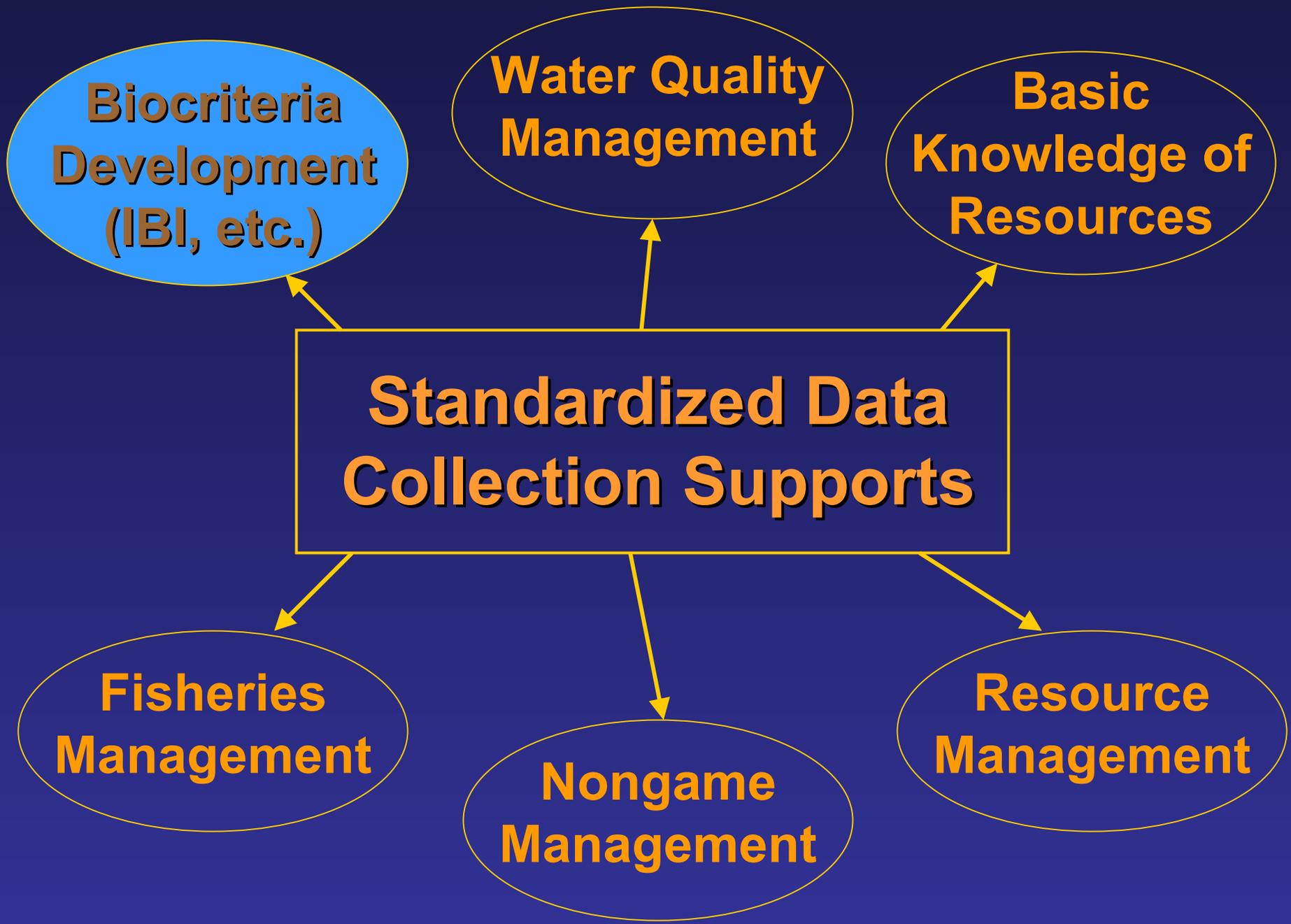


Effect of Time of Day on Electrofishing Efficiency: Impounded Rivers

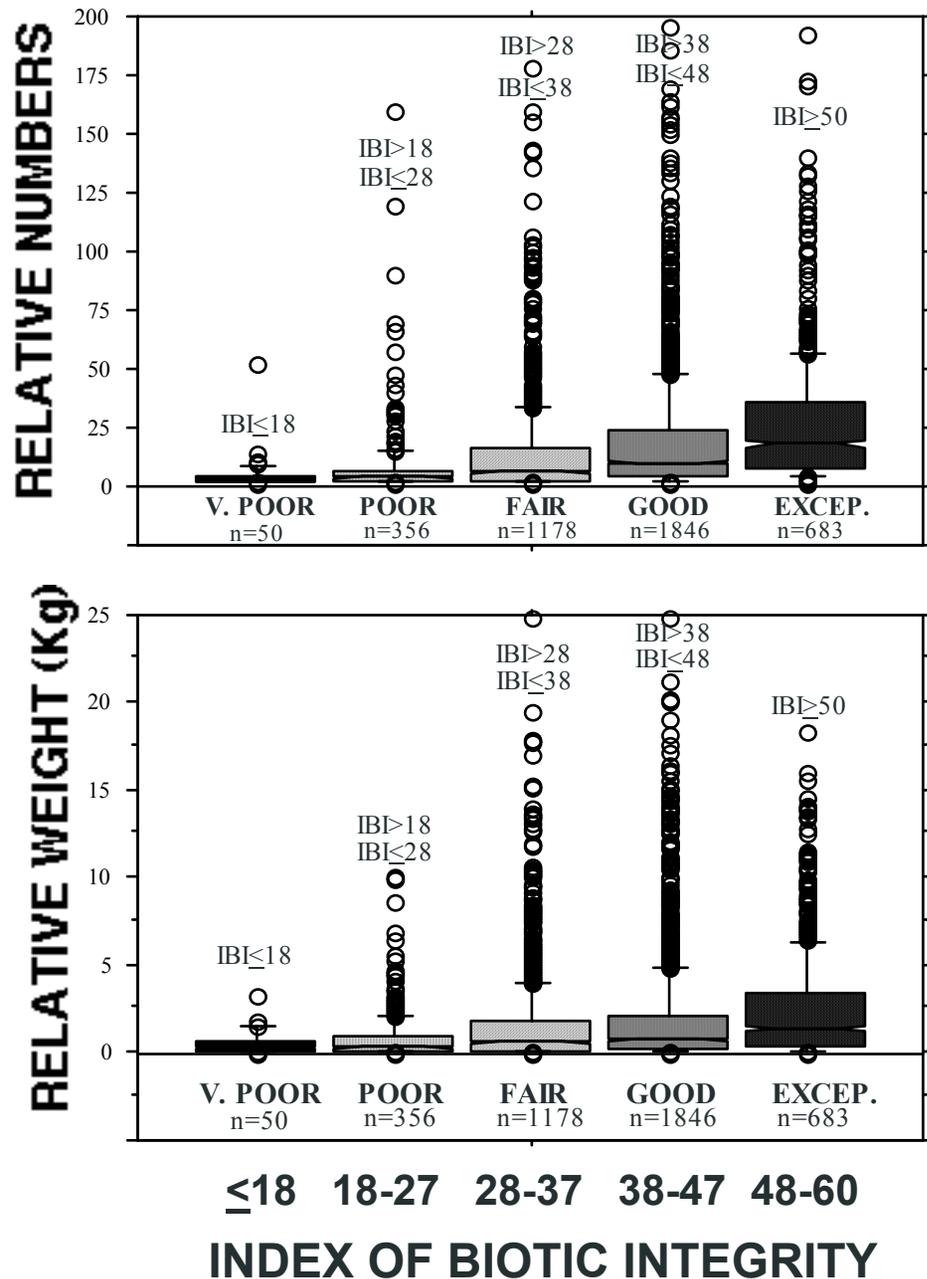


Large Rivers Fish Assemblage Assessments

- **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; support development of tiered use classes.
- **Longitudinal Sampling Design** - longitudinal reach-scale Sampling and interpretation of results.
- **Reach Scale Considerations** - include entirety of mainstem and all habitat types; metric development considers each.
- **Experienced Biologists** - regional fauna, natural history, response signatures, impact types.

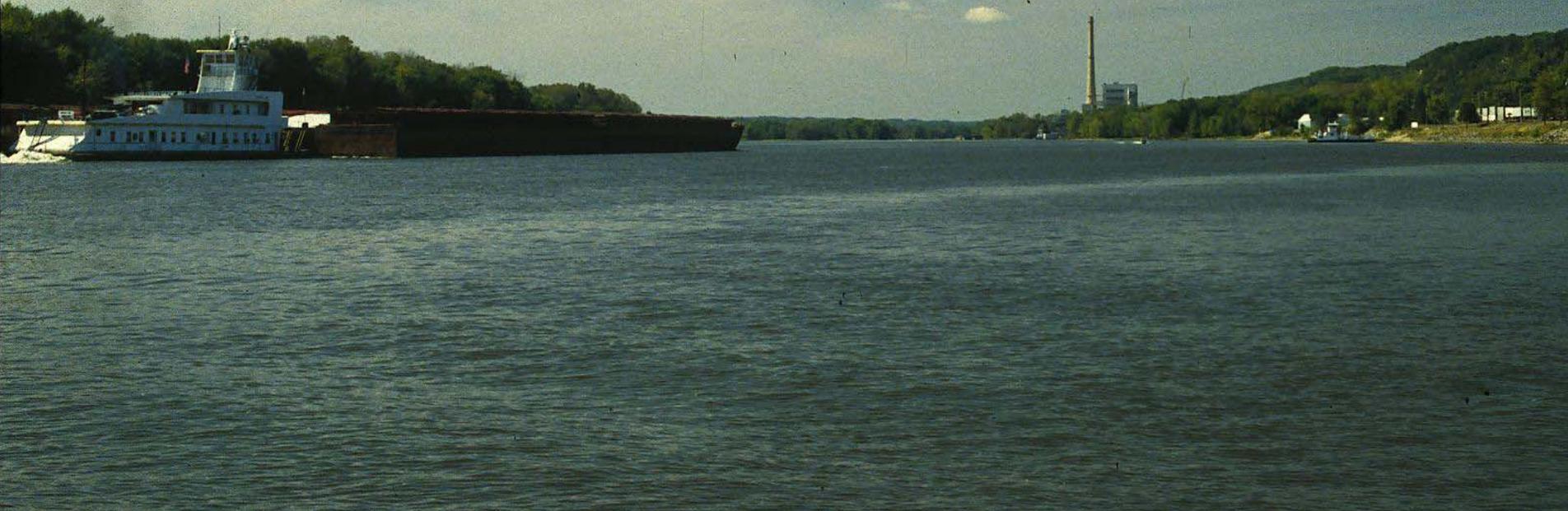


The Abundance and Size of Smallmouth Bass Corresponds to the IBI in Ohio Streams & Rivers



- Smallmouth bass are one of the most popular and widespread game fish in Ohio and achieve their highest numbers and size in streams and rivers which attain WWH and EWH.
- As a top carnivore, smallmouth bass abundance and size decrease as overall aquatic community condition and health declines.

**Developing an IBI that accurately
depicts human impacts
on large rivers...**



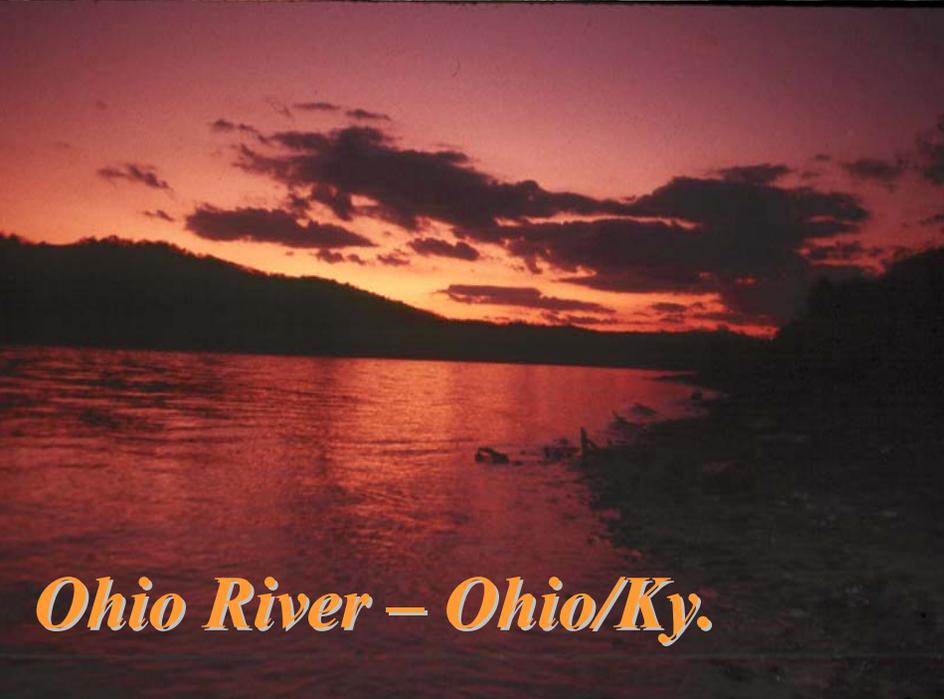
REFERENCE CONDITION



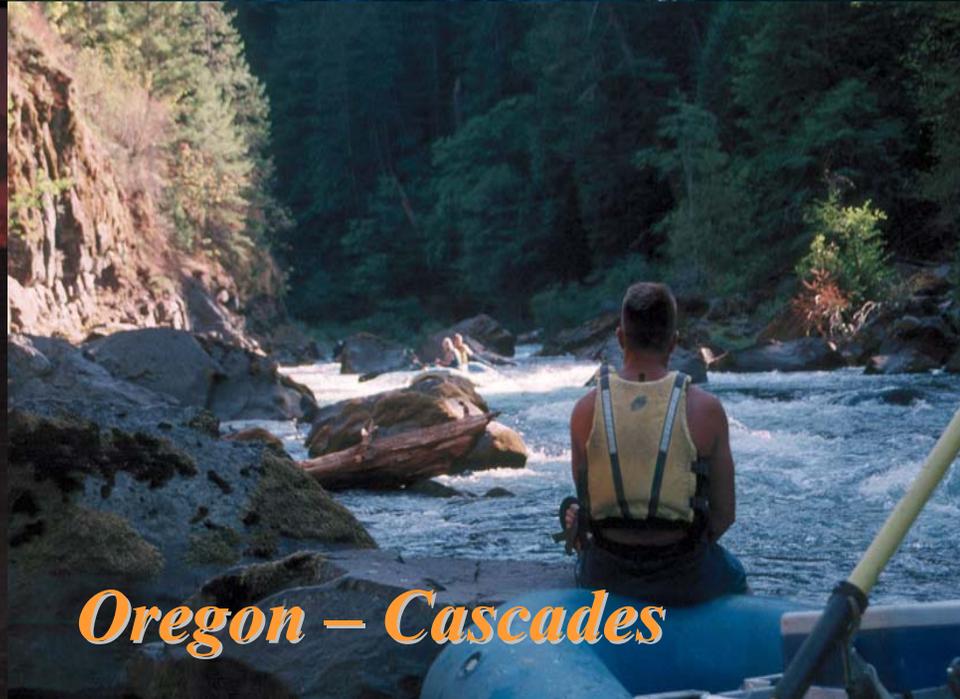
*Wisconsin –
N. Lakes/Forests*



Ohio – Allegheny Plateau

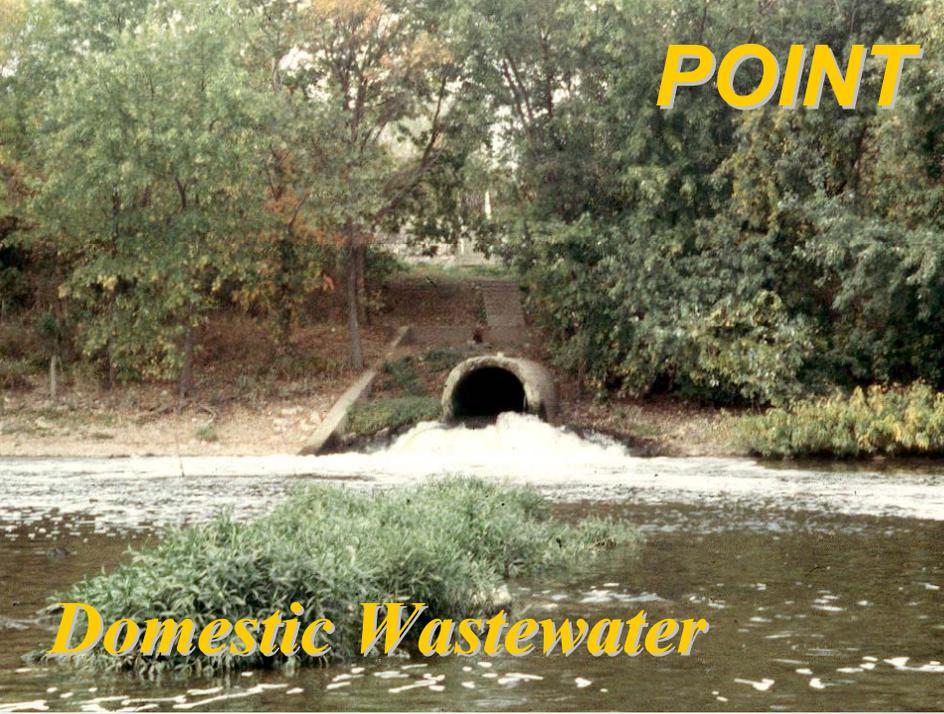


Ohio River – Ohio/Ky.



Oregon – Cascades

POINT SOURCES



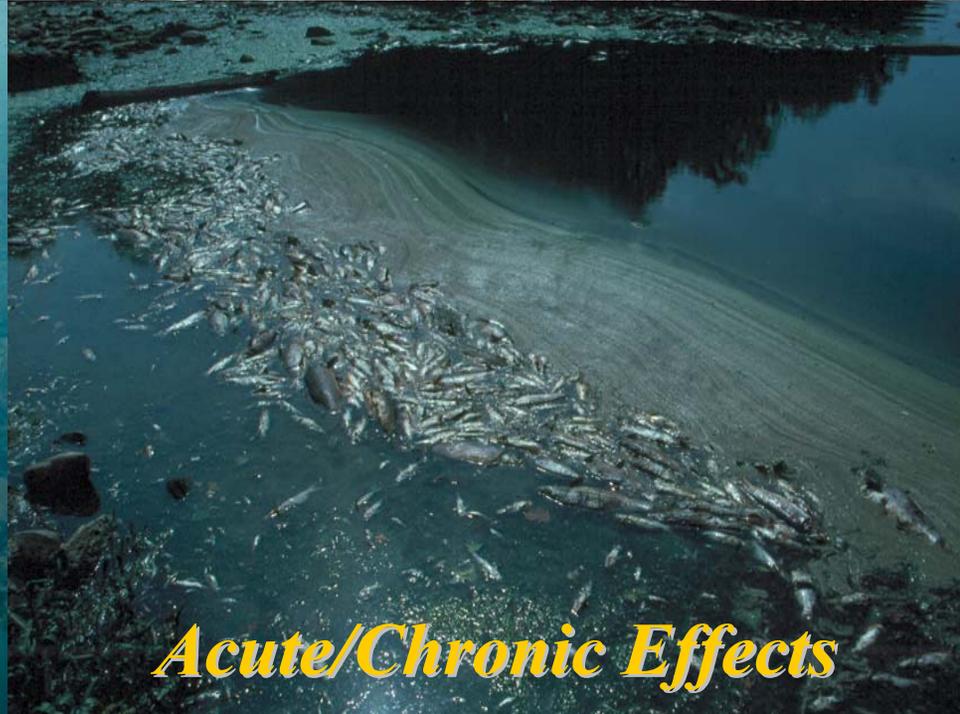
Domestic Wastewater



Industrial Wastewater

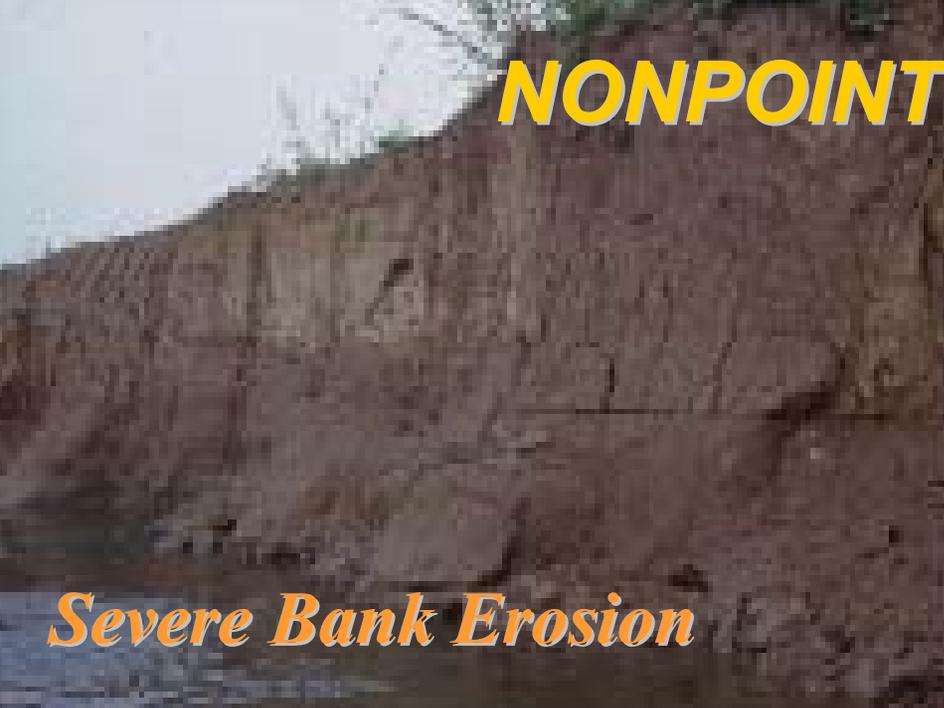


Multiple, Interactive Sources



Acute/Chronic Effects

NONPOINT SOURCES



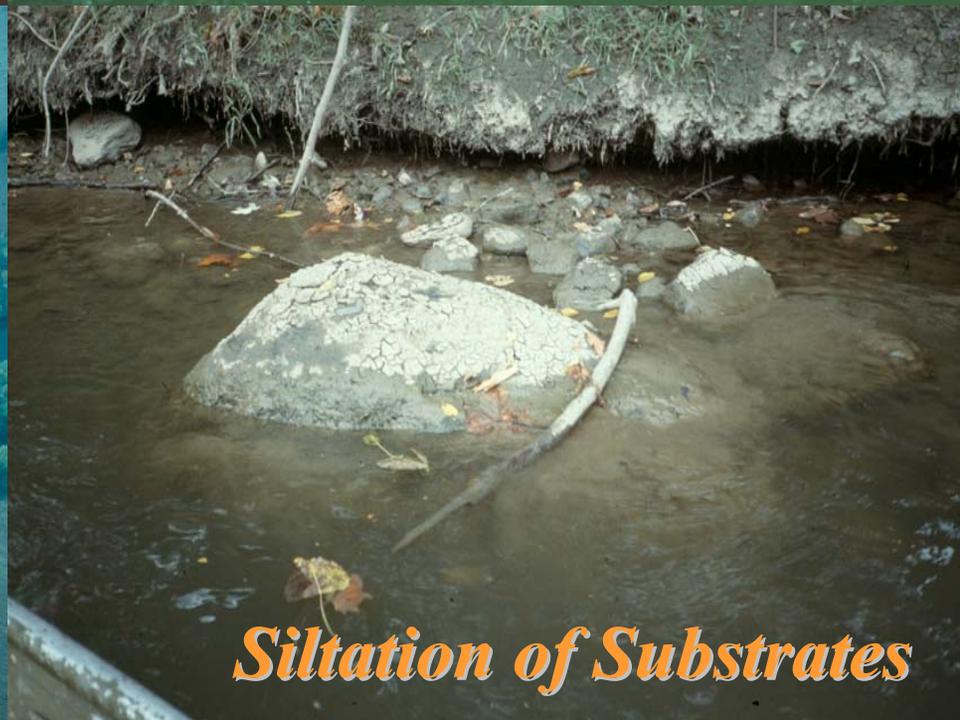
Severe Bank Erosion



Urban Stormwater

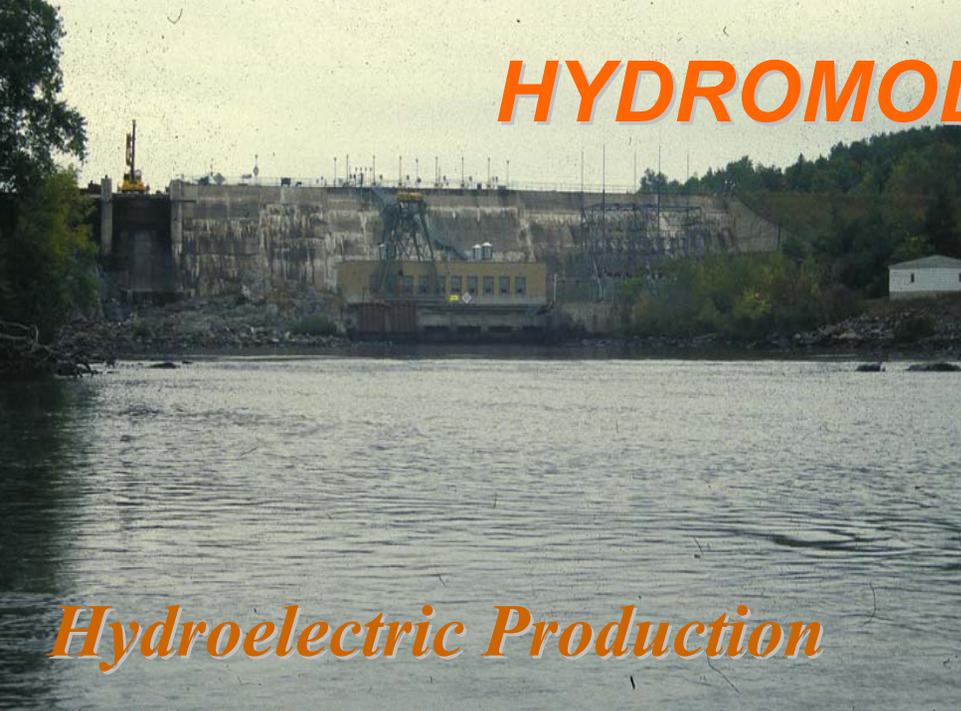


Riparian Encroachment

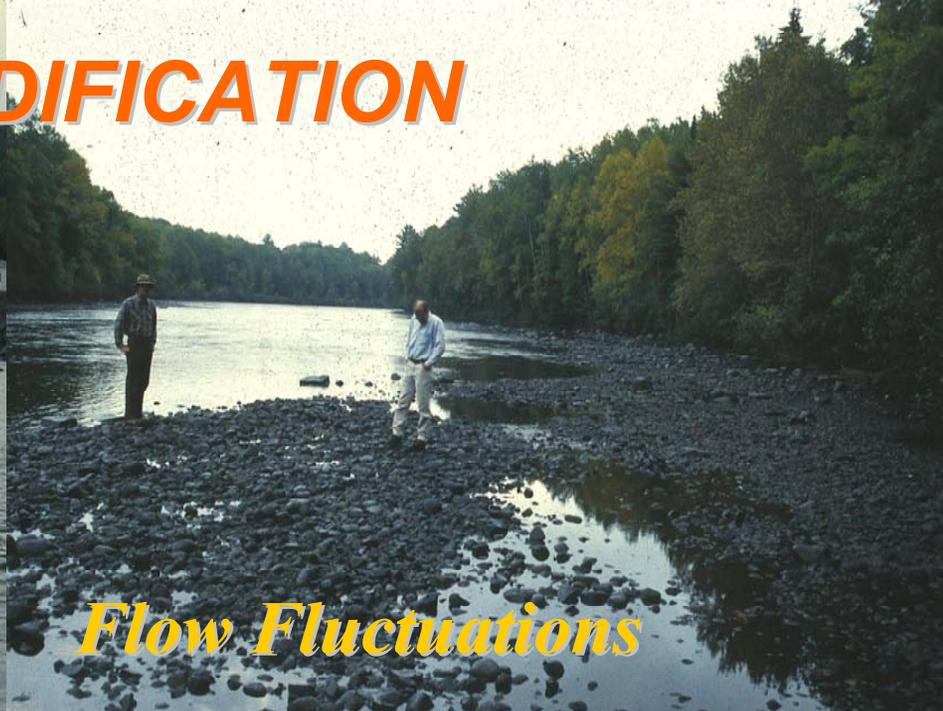


Siltation of Substrates

HYDROMODIFICATION



Hydroelectric Production



Flow Fluctuations



Habitat Modification



Low-head Dams

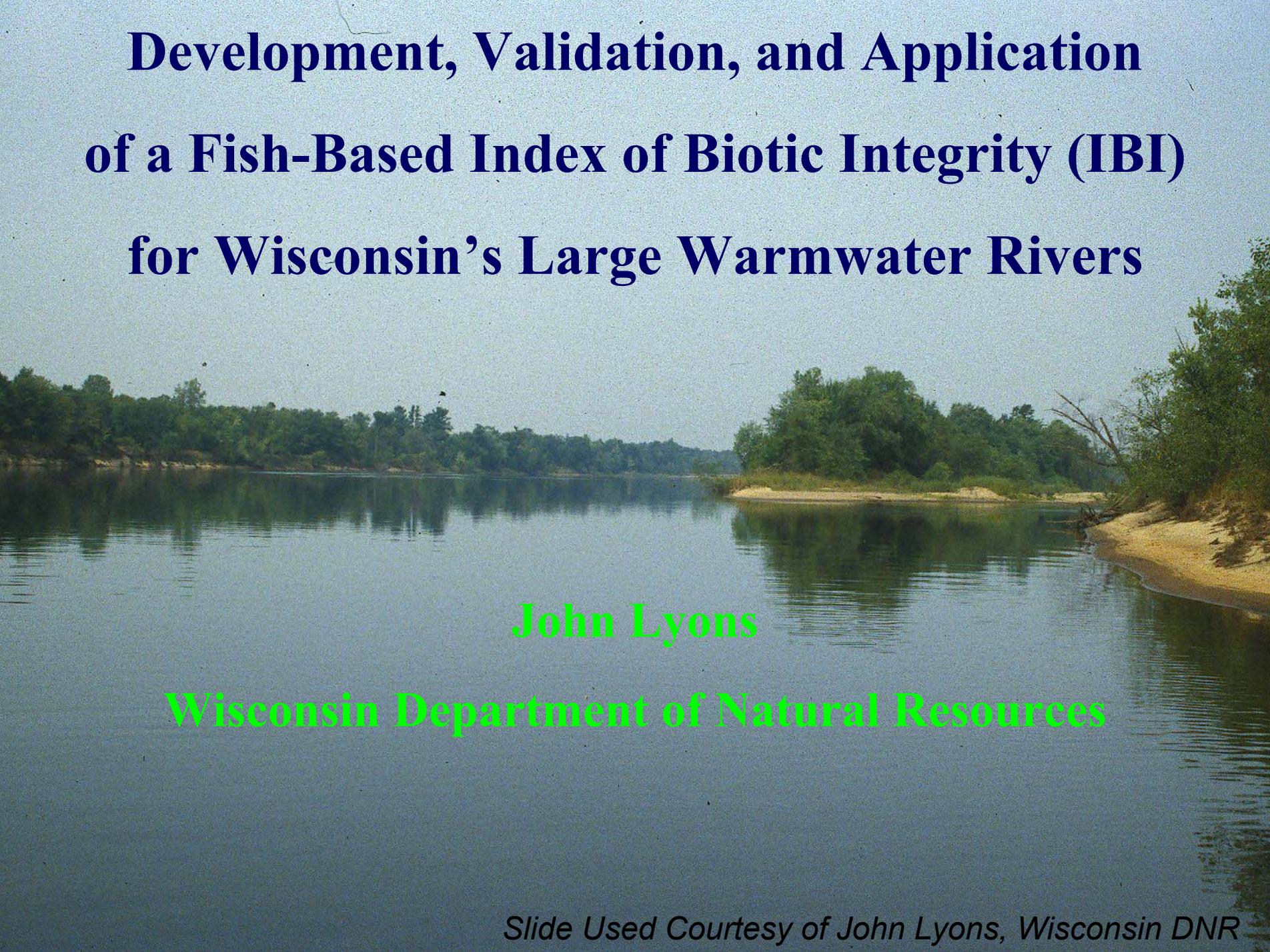
Characteristics of a good IBI:

- Relatively fast, straightforward sampling and analysis
- Accurate depiction of human impacts on ecosystem
- Low variation when no change in human impacts
- Ability to disaggregate individual metrics and data attributes for other uses

Ohio EPA Modified IBIs for Streams and Rivers

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)



**Development, Validation, and Application
of a Fish-Based Index of Biotic Integrity (IBI)
for Wisconsin's Large Warmwater Rivers**

John Lyons

Wisconsin Department of Natural Resources

Large River IBI Metrics (Part 1)

Species richness and composition metrics:

- Number of native species ($N < S$)
- Number of sucker species

Indicator species metrics:

- Number of intolerant species
- Number of riverine species ($N < S$)
- Percent of individuals as riverine spp ($N > S$)
- Percent of biomass as "round" suckers ($N > S$)

Large River IBI Metrics (Part 2)

Trophic function metrics:

- Percent of biomass as insectivores ($N > S$)

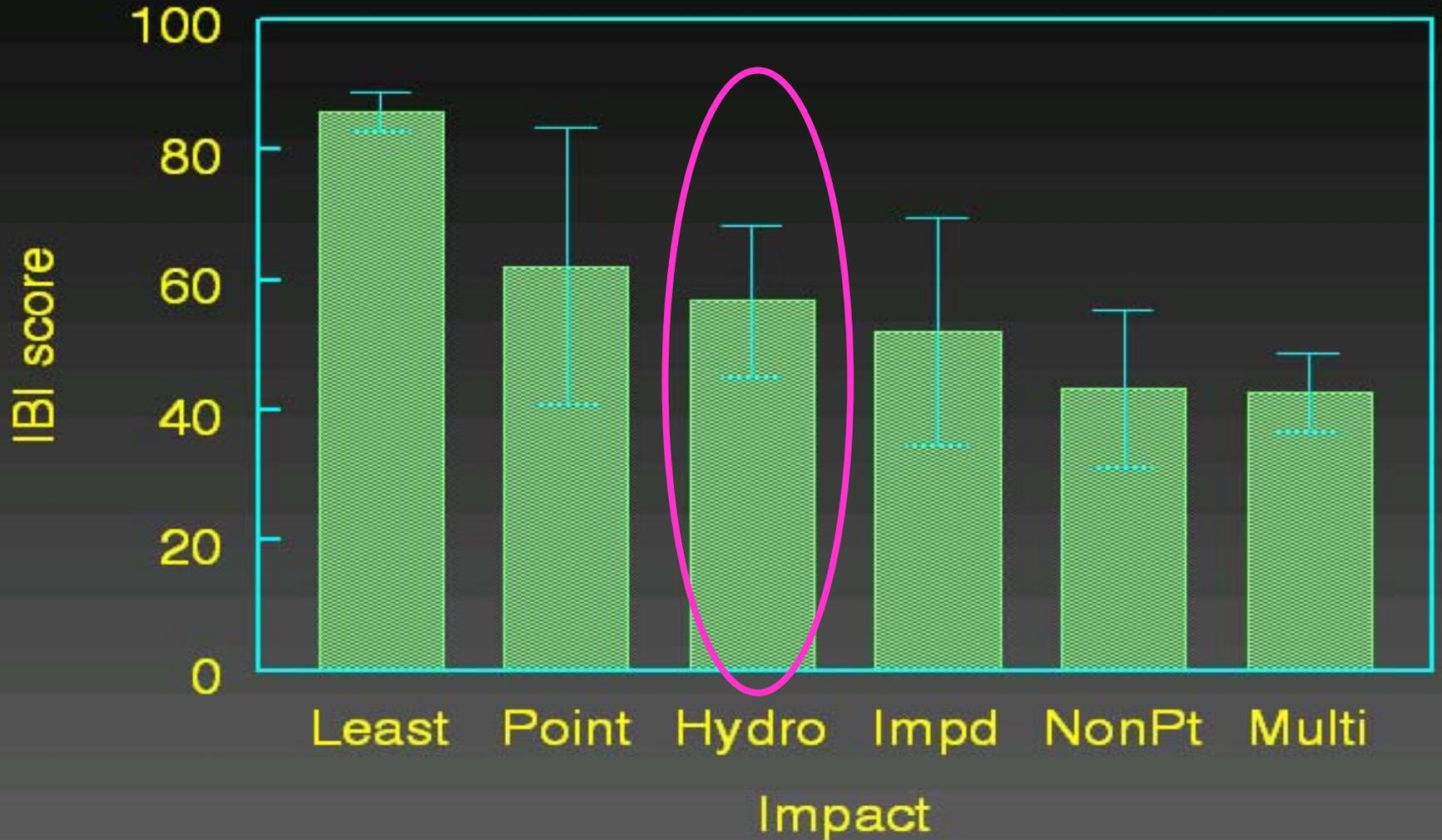
Reproductive function metrics:

- Percent of individuals as lithophils ($N > S$)

Abundance and condition metrics:

- Total biomass (excluding tolerant species)
- Percent of individuals w/ deformities or disease

Mean IBI score vs. impact type



Distribution of IBI ratings for hydropower peaking sites (N = 21)



Hydropower Peaking

Major effects on short (< 5 km)
riverine tailwaters; reduced
effects on long (> 35 km)
riverine tailwaters

Biological Criteria: I

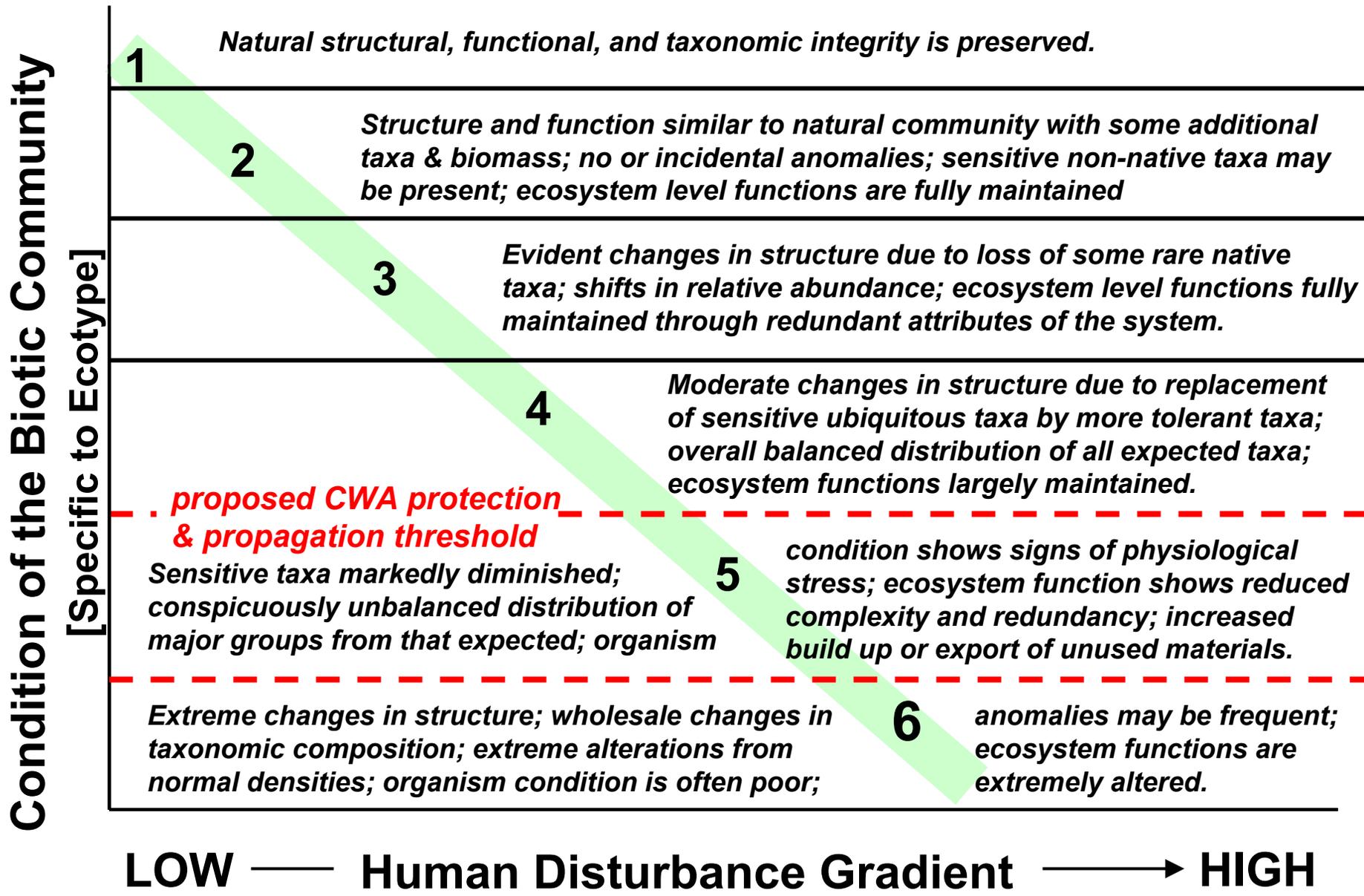
- Narrative ratings or numerical values which are based on the numbers and kinds of aquatic organisms (i.e., assemblage) which are found to inhabit a particular stream or river sampling location.

Biological Criteria: II

- Biological criteria are indexed to the reference assemblage of aquatic organisms within a particular geographical region (i.e., ecoregion) and with respect to stream and river size.

Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers

(10/22 draft)



Ohio Biological Criteria: Adopted May 1990 (OAC 3745-1-07; Table 7-14)

Huron Erie Lake Plain (HELP)

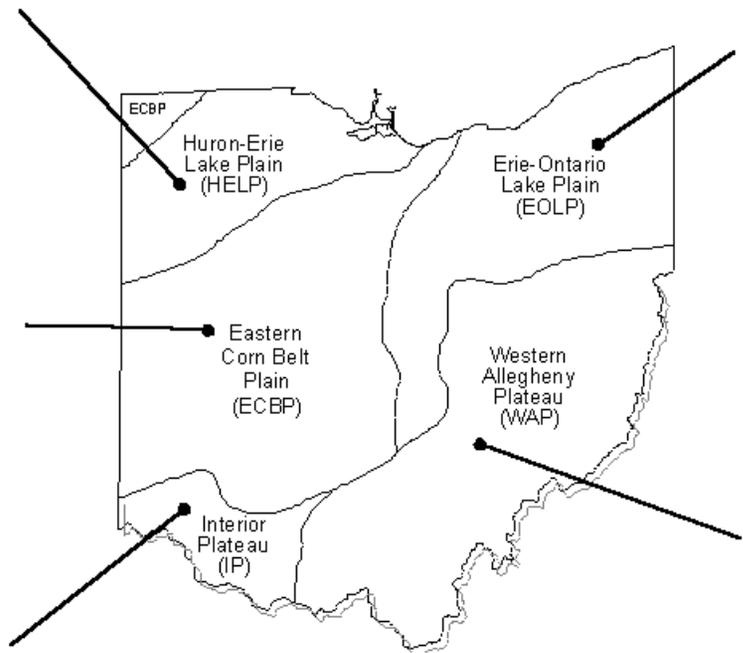
Use	Size	IBI	Mlwb	ICI
WWH	H	28	NA	34
	W	32	7.3	34
	B	34	8.6	34
MWH-C	H	20	NA	22
	W	22	5.6	22
	B	20	5.7	22
MWH-I	B	30	5.7	NA

Eastern Corn Belt Plains (ECBP)

Use	Size	IBI	Mlwb	ICI
WWH	H	40	NA	36
	W	40	8.3	36
	B	42	8.5	36
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Interior Plateau (IP)

Use	Size	IBI	Mlwb	ICI
WWH	H	40	NA	30
	W	40	8.1	30
	B	38	8.7	30
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA



Erie Ontario Lake Plain (EOLP)

Use	Size	IBI	Mlwb	ICI
WWH	H	40	NA	34
	W	38	7.9	34
	B	40	8.7	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

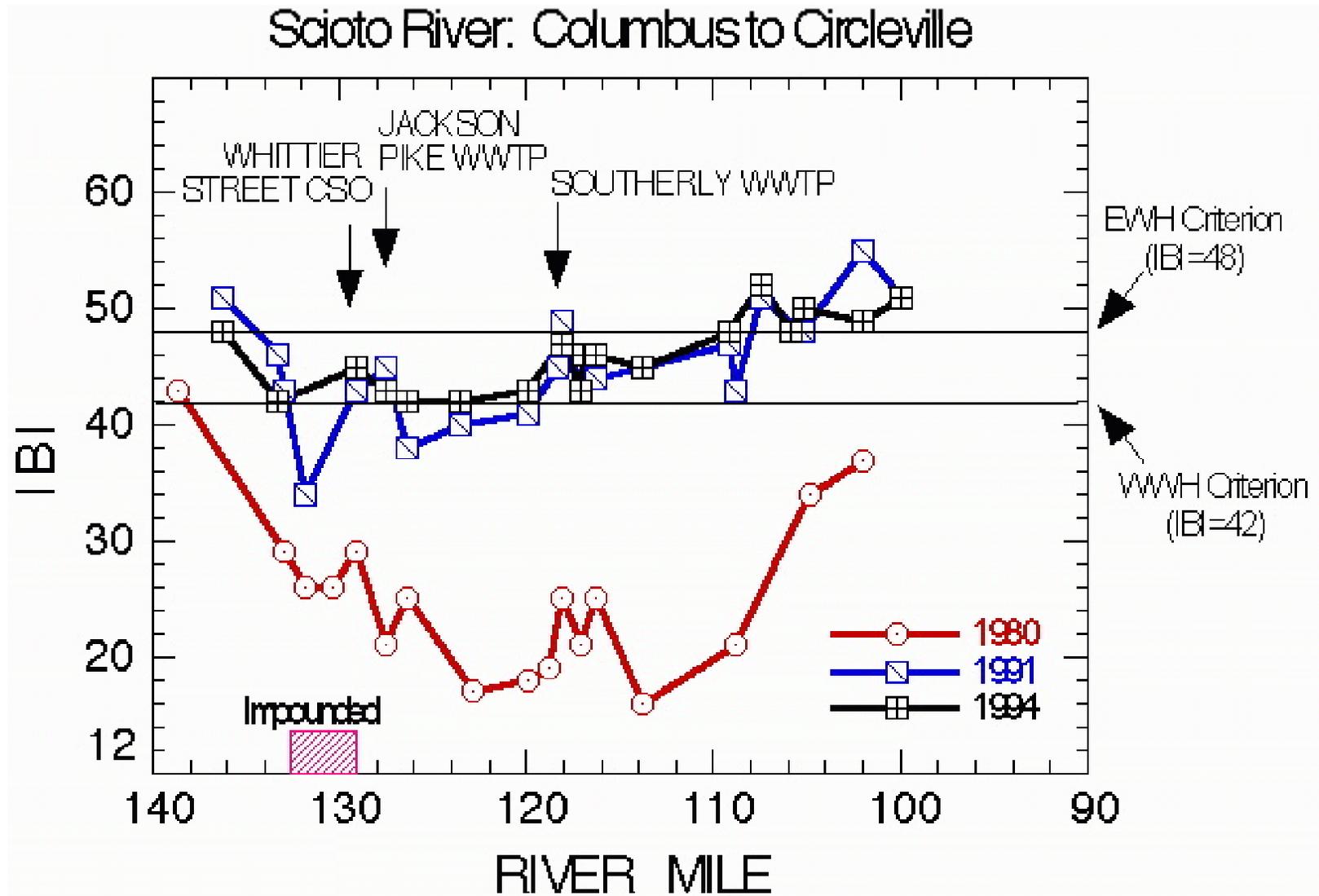
Western Allegheny Plateau (WAP)

Use	Size	IBI	Mlwb	ICI
WWH	H	44	NA	34
	W	44	8.4	34
	B	40	8.6	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-A	H	24	NA	30
	W	24	5.5	30
	B	24	5.5	30
MWH-I	B	30	6.6	NA

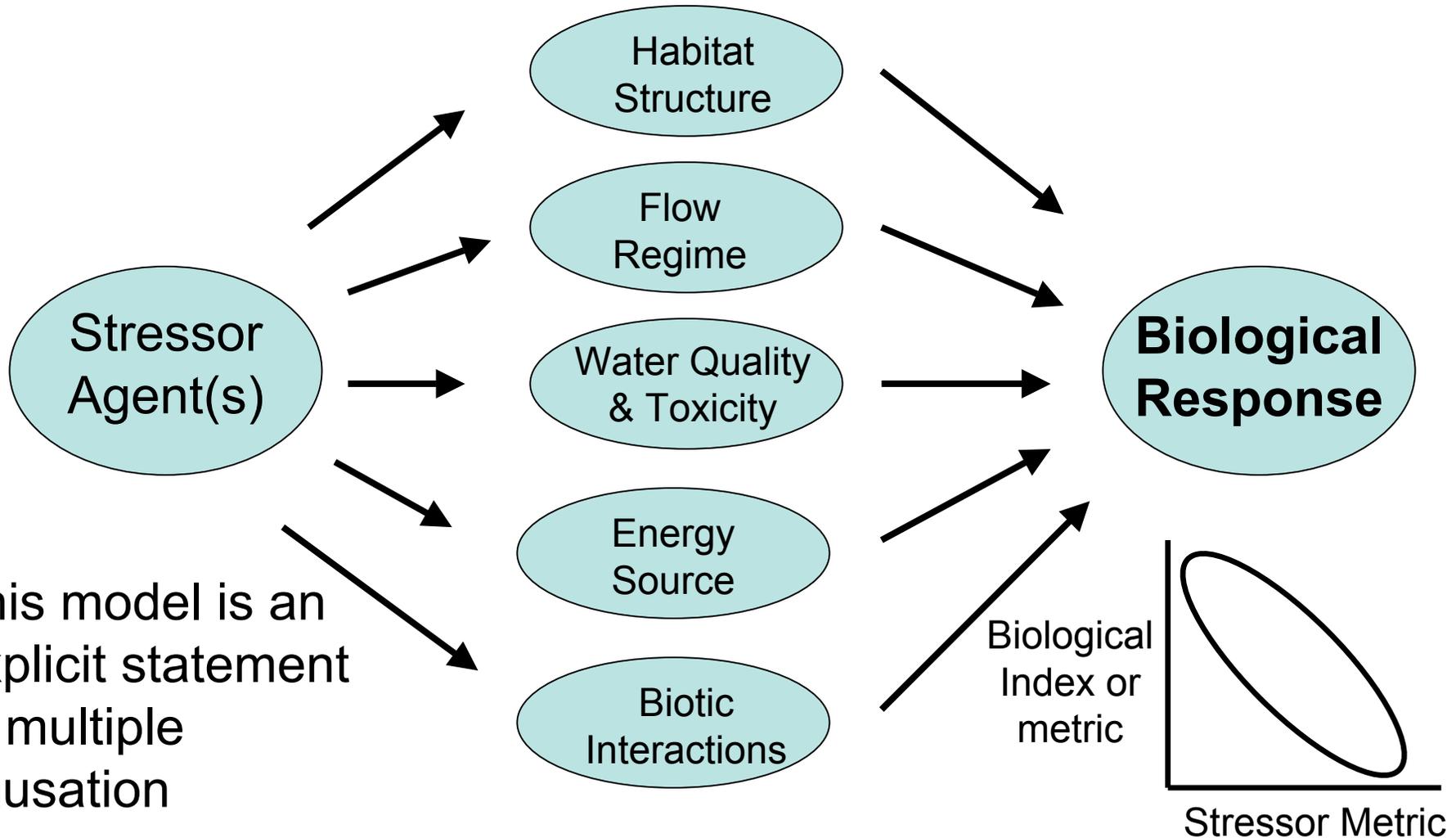
Statewide Exceptional Criteria

Use	Size	IBI	Mlwb	ICI
EWH	H	50	NA	46
	W	50	9.4	46
	B	48	9.6	46

Demonstrating Changes Through Time: Scioto River 1980 - 1994



The Linkage From Stressor Effects to Ecosystem Response



ADMINISTRATIVE INDICATORS

LEVEL 1:
Ohio EPA issues WQ based permits & awards funds for Columbus WWTPs

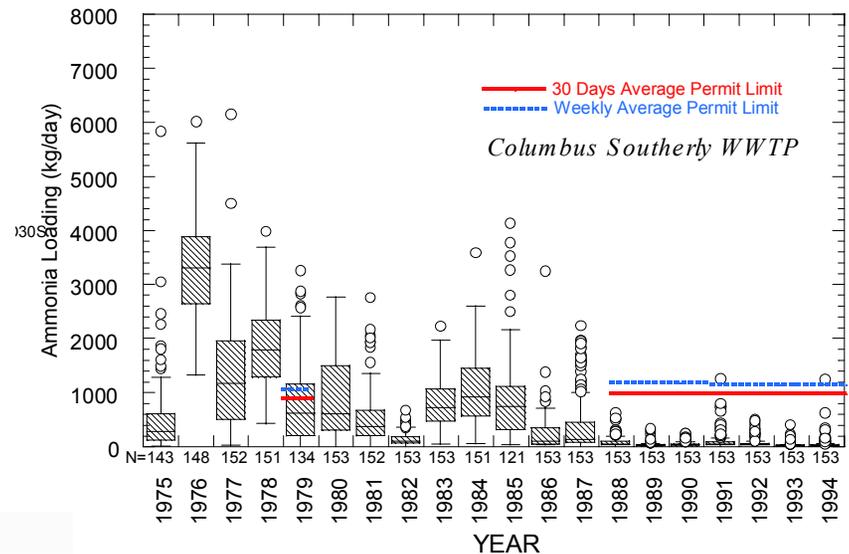
\$\$\$\$
NPDES

LEVEL 2:
Columbus constructs AWT by July 1, 1988; permit conditions attained

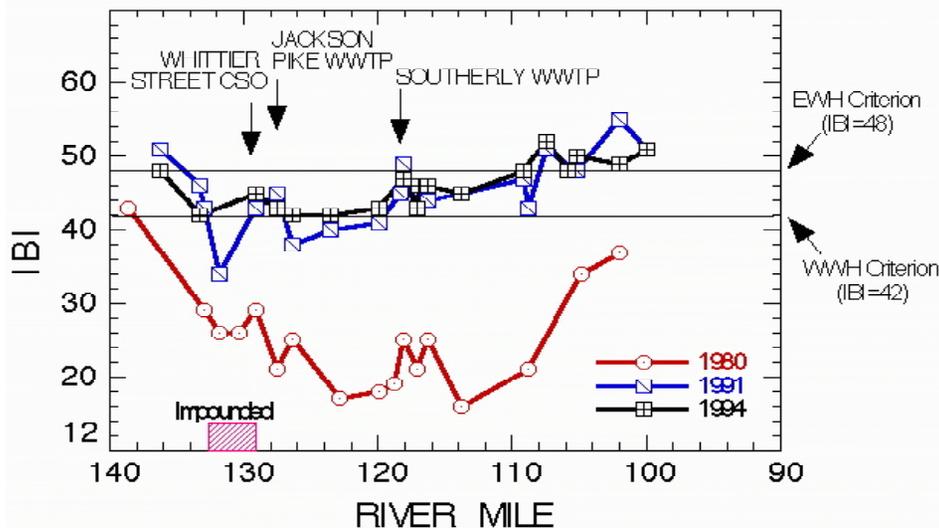


STRESSORS

LEVEL 3: Loadings of ammonia, BOD, etc. are reduced



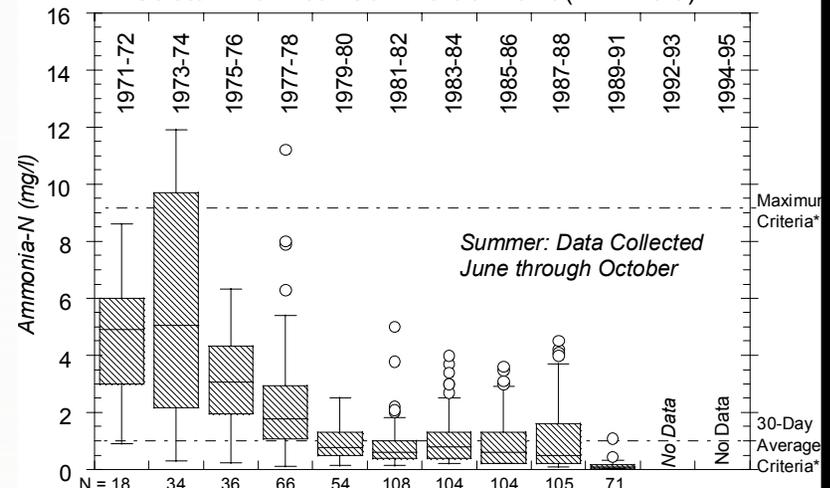
Scioto River: Columbus to Circleville



LEVEL 6: Biological recovery evidenced in biocriteria; 3 yrs. post AWT

RESPONSE

Scioto River Near Commercial Point (RM 115.3)



LEVELS 4&5: Reduced instream pollutant levels; enhanced assimilation

EXPOSURE

Implications - Wisconsin large river IBI

- Rapid bioassessment practical in large rivers
- Best uses:
 - Compare environmental quality among different reaches
 - Track EQ trends over time
 - Communicate EQ conditions with the public
- Not a substitute for:
 - Detailed fishery survey
 - Comprehensive faunal or T/E survey

