Wadeable Streams Assessment: Analysis of Results from Region V

2008 NEAEB Conference
March 27, 2008

Chris O. Yoder and Robert J. Miltner
Center for Applied Bioassessment & Biocriteria
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, OH 43221-0561

Edward T. Rankin
Ohio University
Voinovich Center
Athens, OH 45701

United States Environmental Protection Agency
Office of Water
Office of Environmental Information
Washington, DC

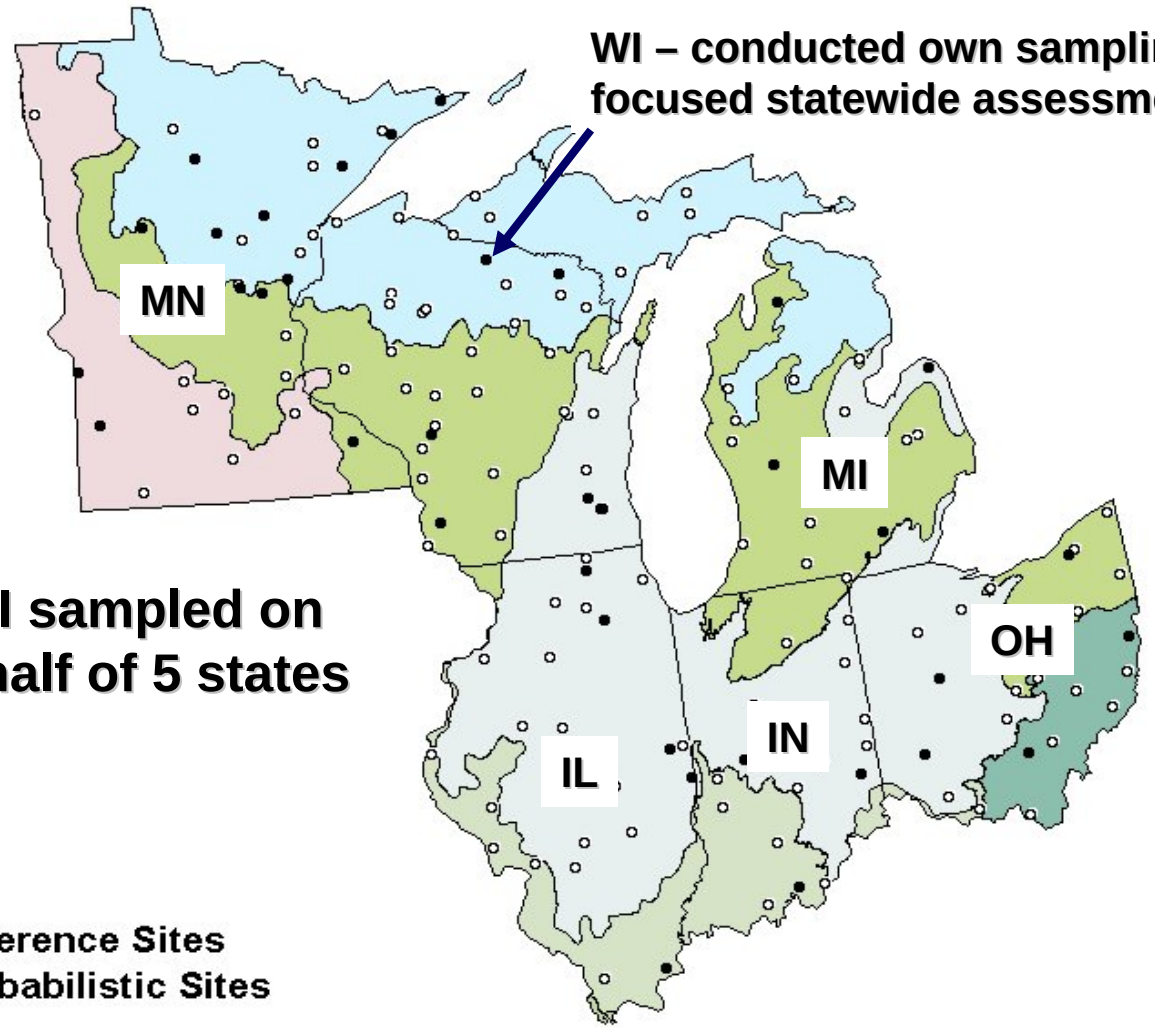
Wadeable Streams Assessment

Site Evaluation Guidelines

National Wadeable Streams Survey

- Accomplish a national assessment of wadeable streams (orders 1-4/5)
- Random site selection approach – follows EPA's EMAP protocol
- Estimate the condition of the "assessed population" with few sites.
- Primary sites (15-25 per state) sampled for inverts., fish, habitat, water quality
- Reference sites (10-12 per L2 ecoregion)
- EMAP sampling protocols

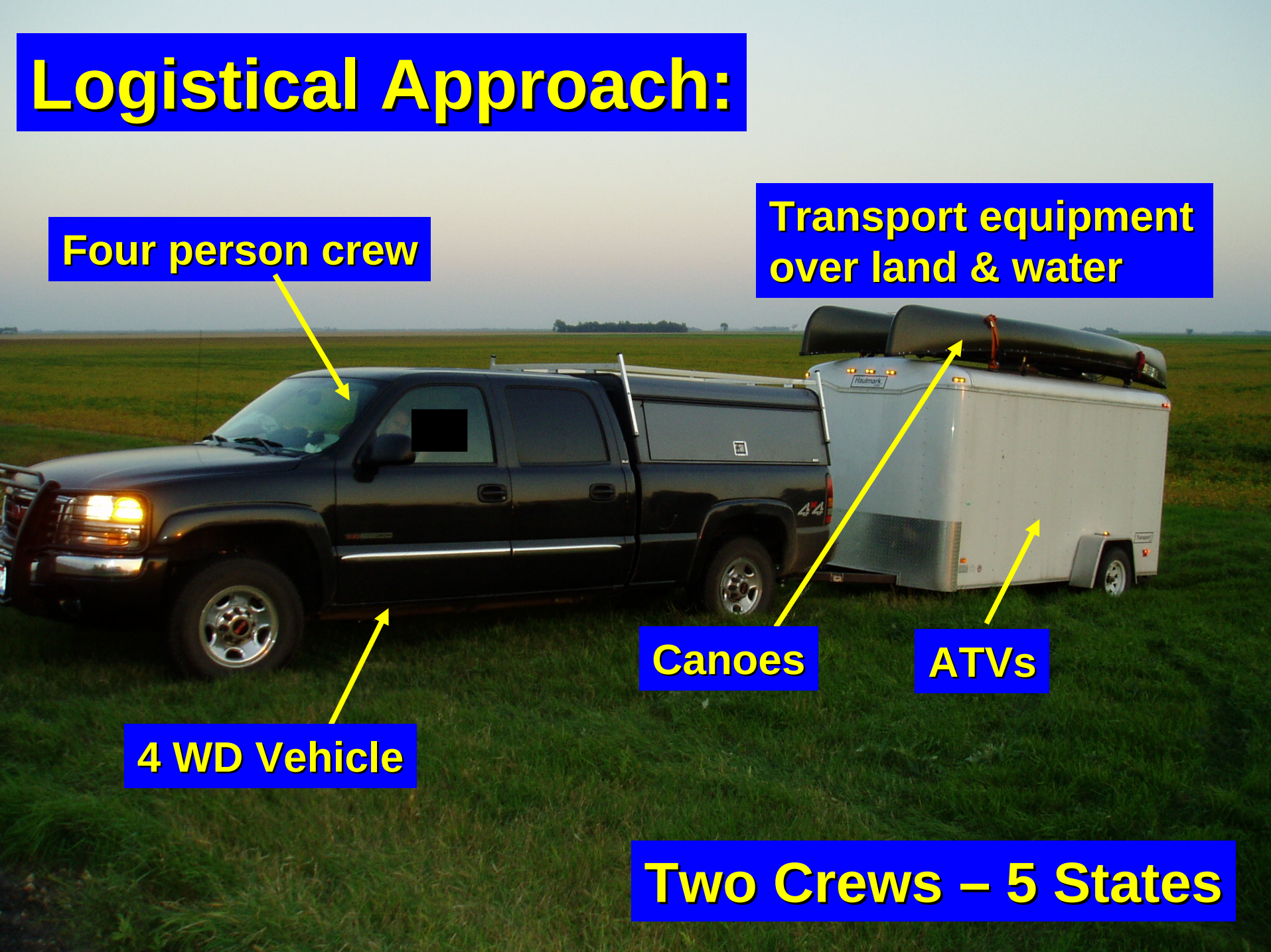
Region 5


WI – conducted own sampling; more focused statewide assessment.
MN
MI
OH
IN
IL
MBI sampled on behalf of 5 states
Reg 5 Reference Sites
Reg 5 Probabilistic Sites
N
W
E
S

Region V WSA Sampling by MBI/CABB

- Assignment: 92 primary, 37 reference sites (WI assigned 14 primary, 7 reference sites
- 124 sites sampled: 88 sites by MBI crews (6 sites resampled); 36 by contractor crews (4 re-sampled) – fish by MBI crews
- 61 primary sites (34% of total site visits) were rejected (most were non-wadeable)

Logistical Approach:



Two Crews – 5 States

Wadeable Sites

EMAP Site Protocol – 40 x mean width

Finding the “X” Point


Most sites are “off road”

Biological Assessment: Macroinvertebrates (primary indicator)

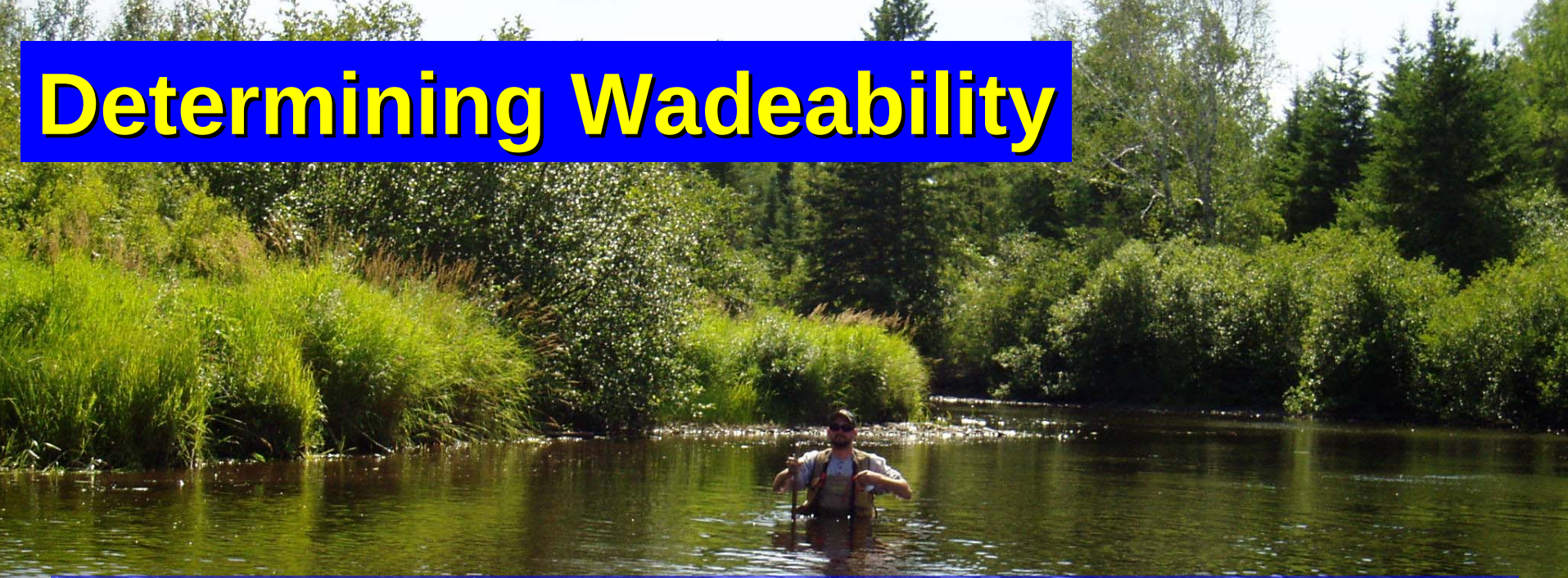
- EMAP Protocol – Semi-quantitative kicks at multiple points along transect (zig-zag) – samples are composited
- Samples are grid sorted – 500 count subsample
- Identification to genus level for most groups
- Data analysis by U.S. EPA

Biological Assessment: Fish (supplemental indicator)

- Pulsed D.C. electrofishing – T&J 1736 DCV unit on roller barge or bank set long line
- Wisconsin battery backpack unit used as secondary method (access or size limited)
- Sampled 40 x mean width up to 500 meters; kept data from first 200 meters separate
- Data analysis by MBI/CABB in 2005-6

Getting the “right” sampling equipment to a site

Determining Wadeability



25+% of primary sites rejected due to non-wadeable conditions (34% rejected – all reasons)

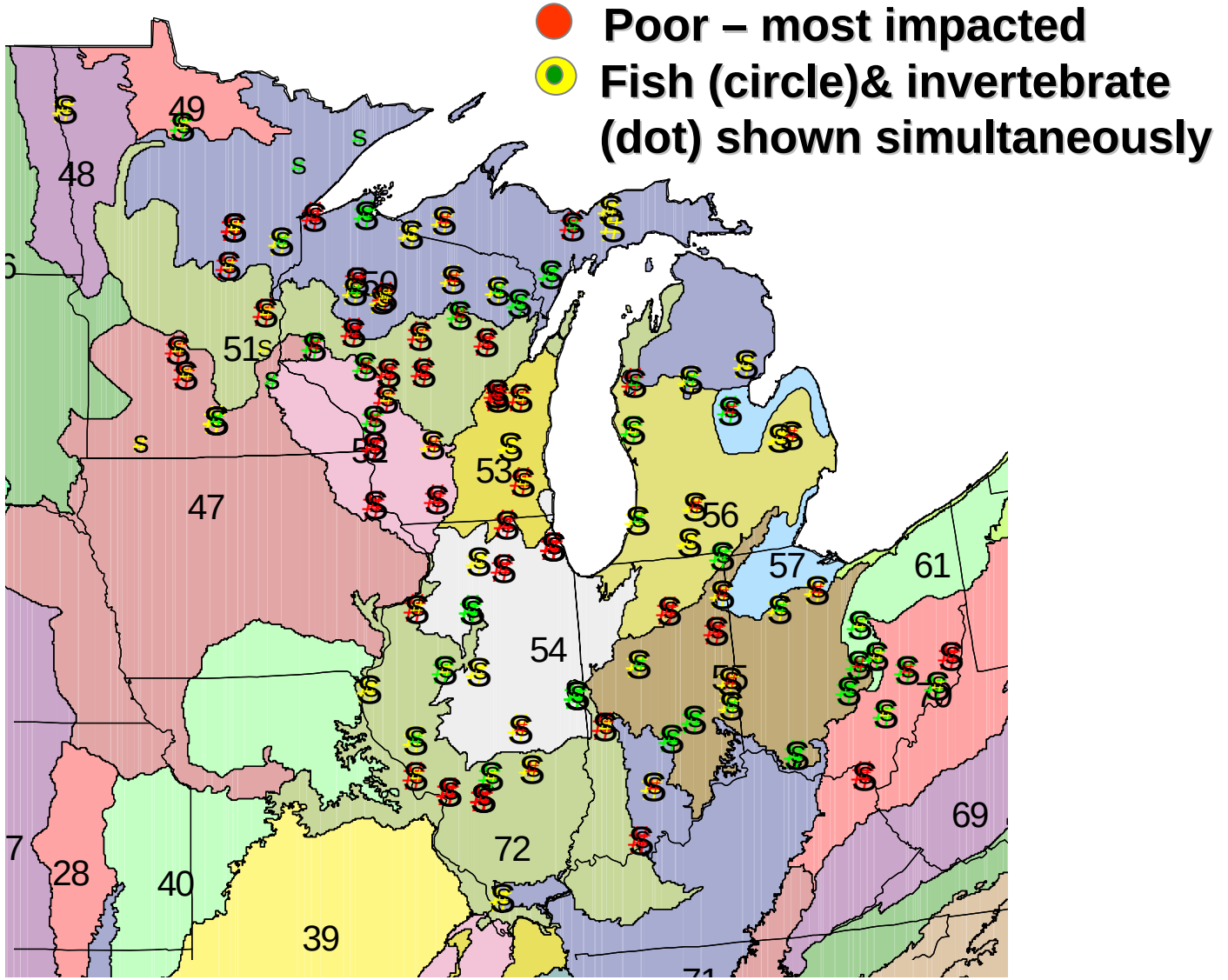
A major consideration for the next round of national stream and river surveys

Table 1. Summary of wadeable and non-wadeable fish sampling sites in the Illinois and Rock River Basins, Illinois based on site reconnaissance and sampling of 198 probability sites in 2007. A site was rejected if it was not sampleable with boatable electrofishing methods used by MBI. Some of the sampleable sites were not sampled because of inaccessibility.

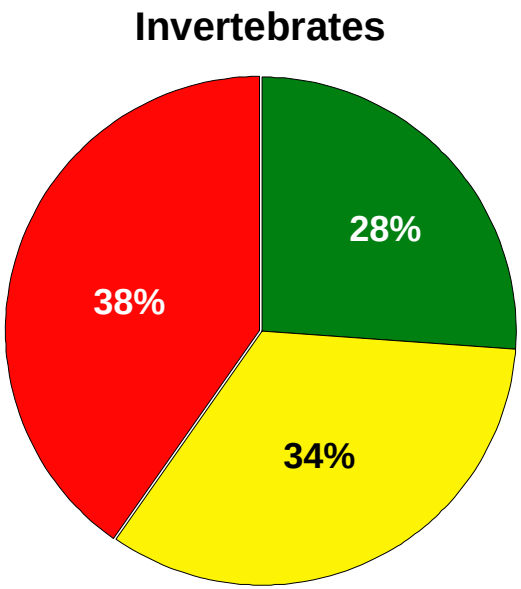
Drainage Area (mi^2)	Wadeable	Boatable
0-150 (n=113)	Rejected=113 100%	None=0 0%
150-500 (n = 42)	Rejected=6 14%	Completed=18 Inaccessible=18 86%
500-1000 (n = 26)	Rejected=3 12%	Completed=16 Inaccessible=7 88%
>1000 (n = 17)	Rejected=1 6%	Completed=13 Inaccessible=3 94%

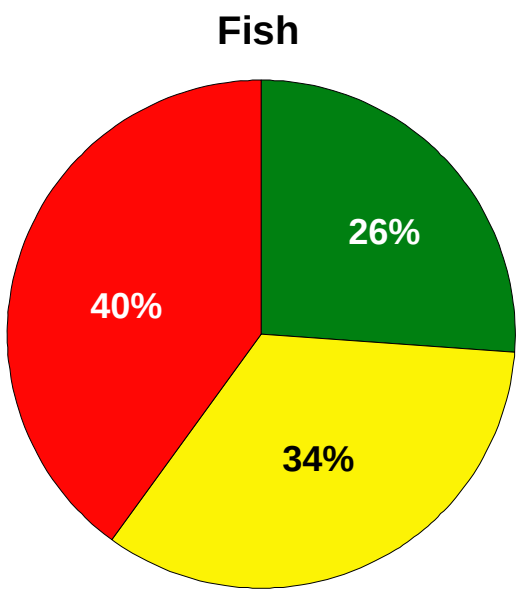
WSA Biological Data Analyses

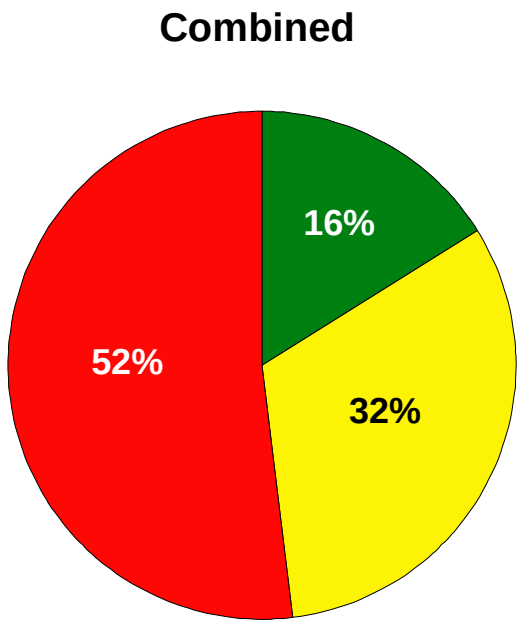
- Macroinvertebrates – used condition classes from EPA WSA report & database
- Fish – used each state's IBI; no attempt to develop a regional index
- Condition assessment was truncated into 3 condition classes – good, fair, & poor
- Used state 305b reports for attainment/non-attainment comparisons to WSA results


Good – least impacted
Fair – intermediate impacted
Poor – most impacted
Fish (circle)& invertebrate (dot) shown simultaneously
49
48
51
47
53
56
57
61
54
69
72
28
40
39

Region V WSA Condition Classes







Adding fish increased Poor category by 12-14%; reduced Good by 10-12%

The Qualitative Habitat Evaluation Index (QHEI)

QHEI Includes Six Major Categories of Macrohabitat

- **Substrate - types, origin, quality, embeddedness**
- **Instream Cover – types and quantity**
- **Channel Quality – sinuosity, development, stability**
- **Riparian – width, quality, bank stability & quality**
- **Pool/Run/Riffle – depth, current types, embeddedness, morphology**
- **Gradient – local gradient (fall per unit distance)**

Source: The Qualitative Habitat Evaluation Index (Rankin 1989)

Quantitative Habitat Index (T-HAB)

Extracted components from WSAHAB that approximate the intent of QHEI metrics

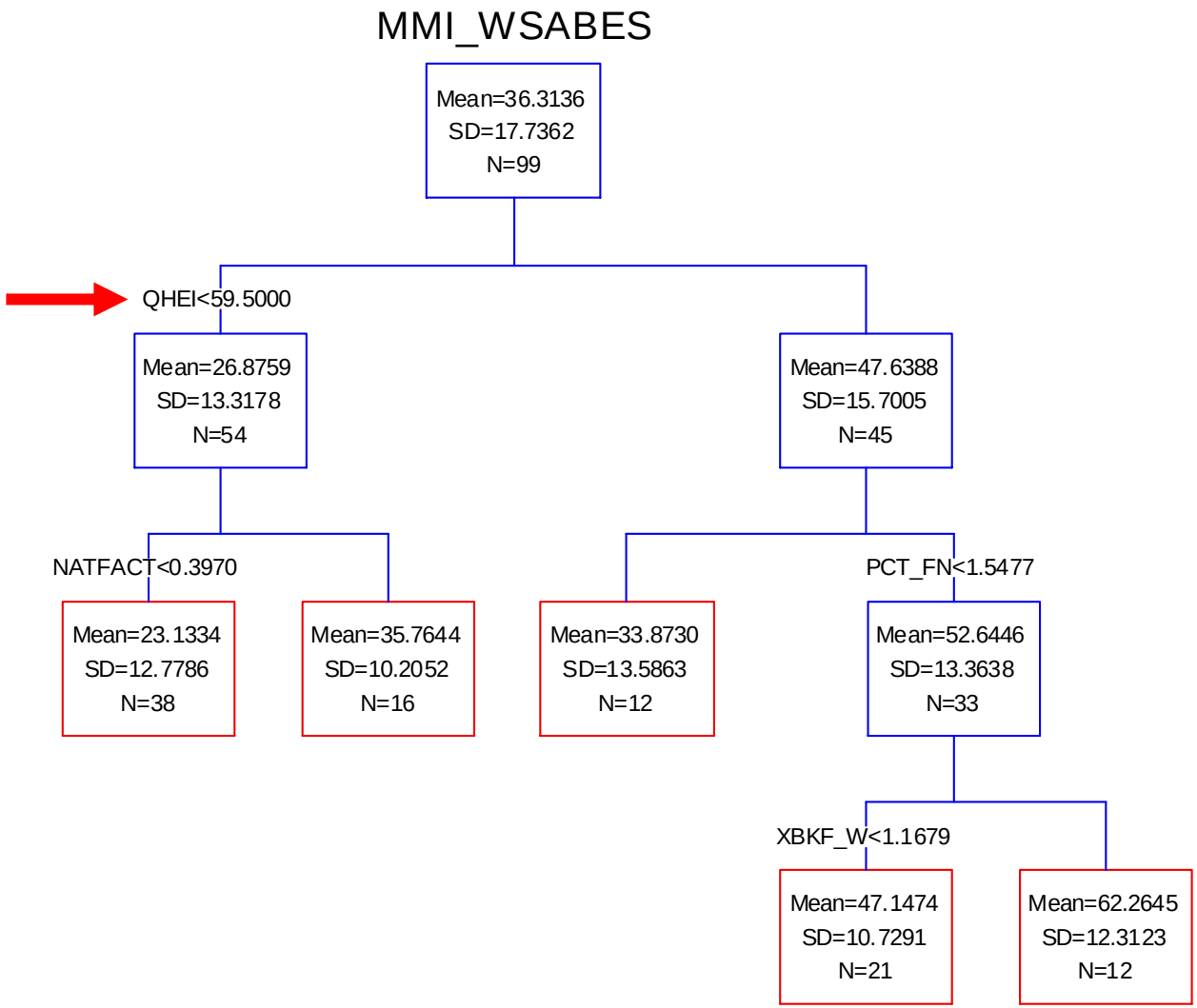
- **Comprised of more precise field measurements vs. visual observation & estimation**
- **Will it provide a better explanation of variability on biological results related to habitat?**
- **Correlation matrices of QHEI and T-HAB vs. WSA biological indices and metrics (MMI, O/E, HBI, fish IBI).**

Pearson correlations between WSA biological indicators and the QHEI and T-HAB habitat quality indices

Biota	QHEI	T-HAB
IBI	0.5425*	0.5431*
MMI	0.6297*	0.6493*
OE-0	0.2861	0.3217
OE-5	0.5703*	0.5203*
OE-R5	0.4316*	0.3038
HBI	-0.5876*	-0.6060*

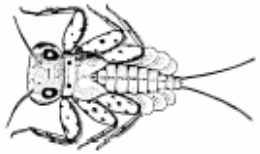
* - P <0.05

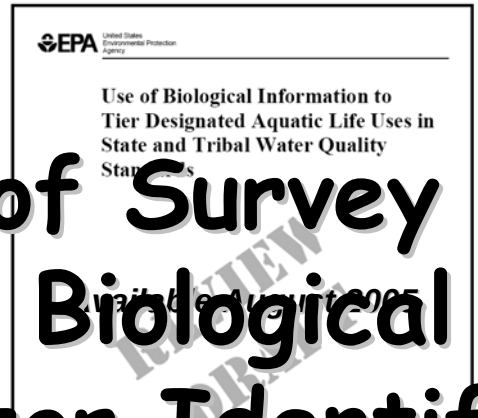
Region V WSA CART ANALYSIS:
Dependent variable: MMI
Independent Variables: WQ, land use, drainage area, QHEI, relative bed stability (RBS)

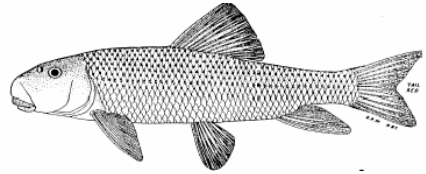


CART analysis – explanatory variables forming the first three splits and the associated error reduction.

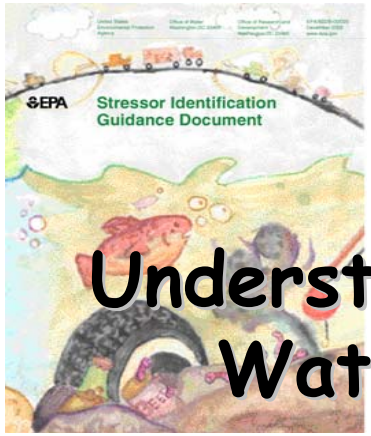
Biological Indicator	First Split Independent	Error Red.	Second Split Independent	Error Red.	Third Split Independent	Error Red.
IBI	QHEI	0.296	DOC	0.088	Width	0.084
MMI	QHEI	0.343	Percent Fines	0.101	Width	0.057
O/E-0	Natural	0.192	QHEI	0.080	Riparian	0.111
O/E-5	QHEI	0.228	Bankfull	0.059	%Fines	0.104
O/E-R5	QHEI	0.230	Conductivity	0.077	Depth	0.070
HBI	QHEI	0.310	%Fines	0.072	Tot N	0.130

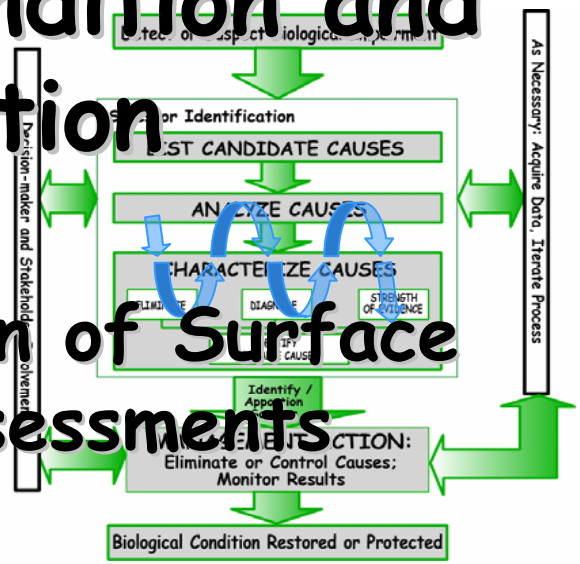






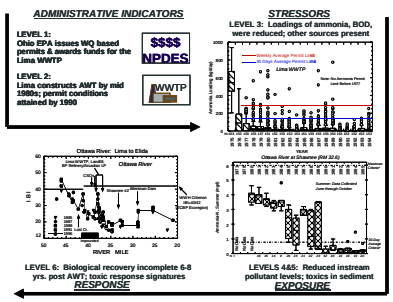
Effects of Survey Design on Estimates of Biological Condition and Stressor Identification

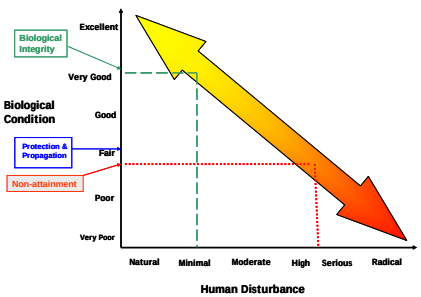


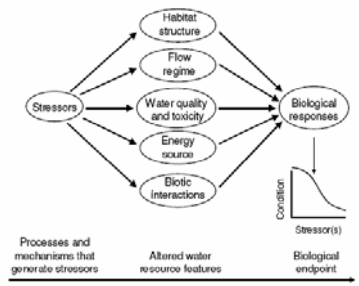


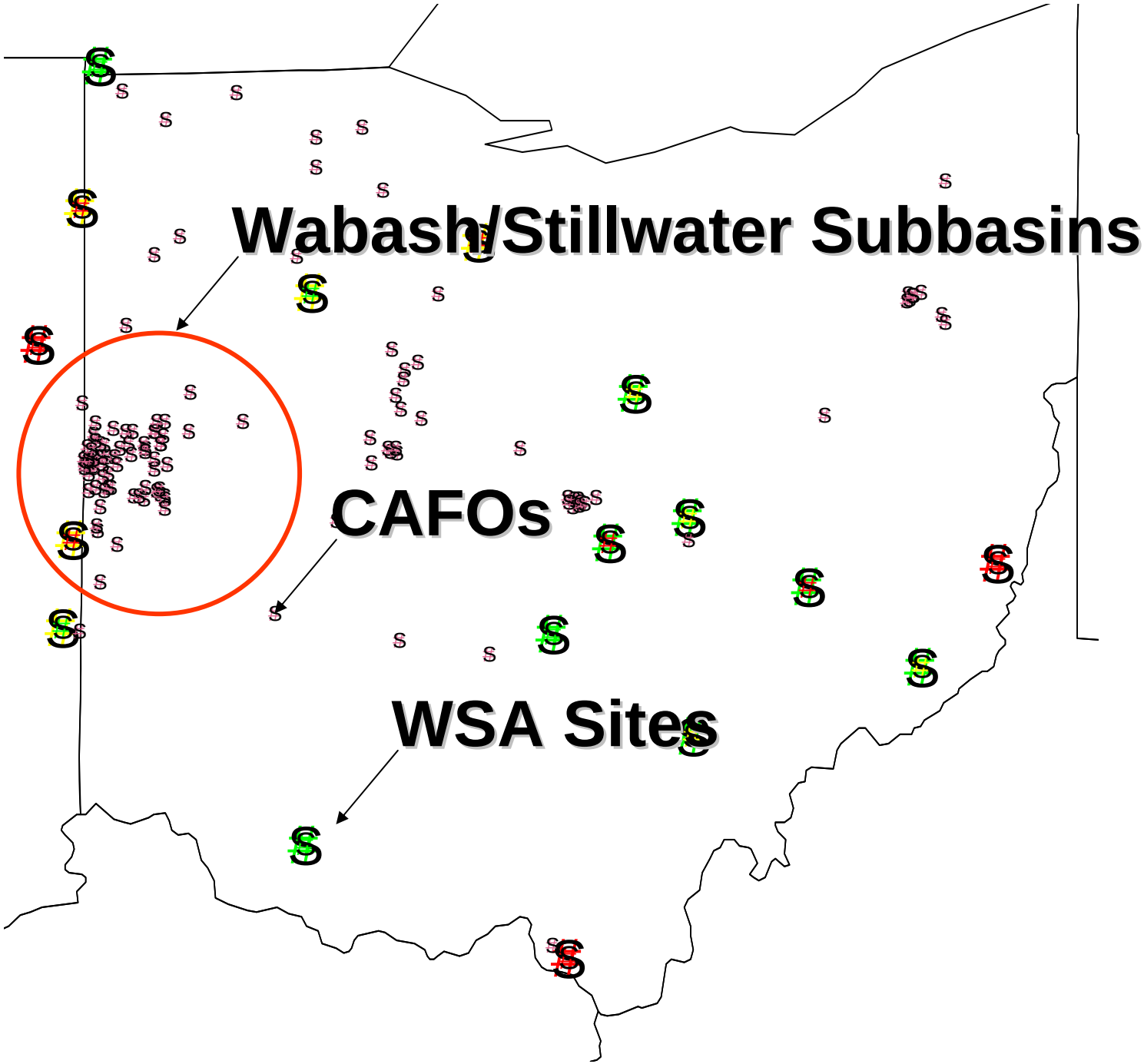
Understanding Ecological Condition of Surface Waters: Approaches and Assessments
2007 AFS Meeting

September 6, 2007





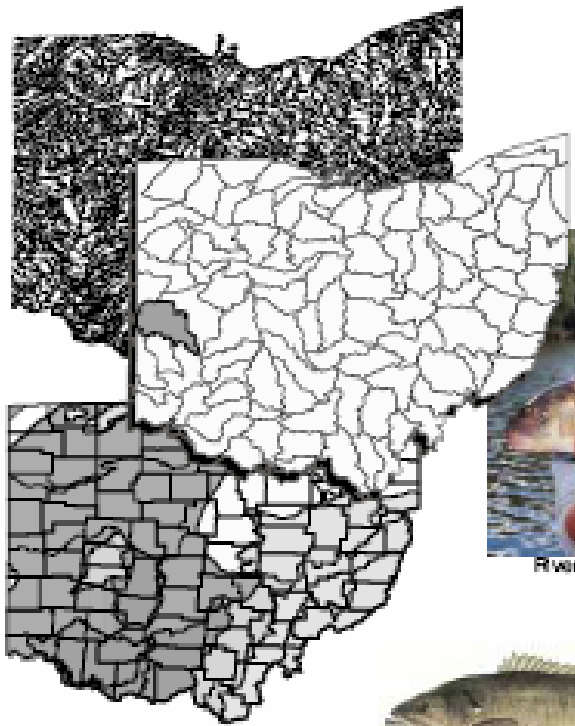



Wabash/Stillwater Subbasins
CAFOs
WSA Sites

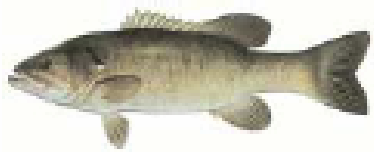
Biological and Water Quality Study of the Stillwater River Watershed

Darke, Miami and Montgomery Counties

Mayfly (*Eurylophella* sp.)



River Redhorse (*Moxostoma carinatum*)

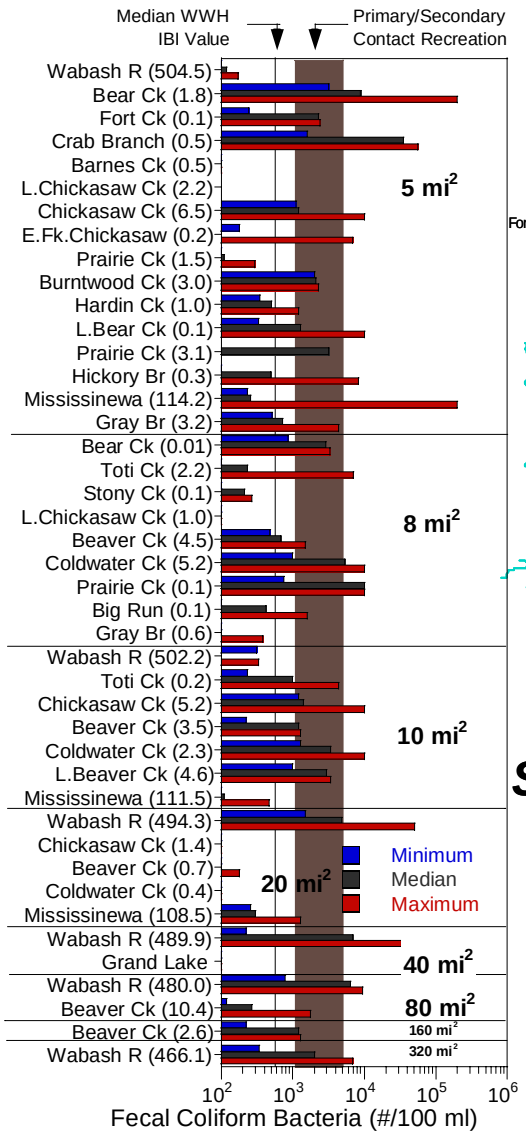


Smallmouth Bass (*Micropterus dolomieui*)

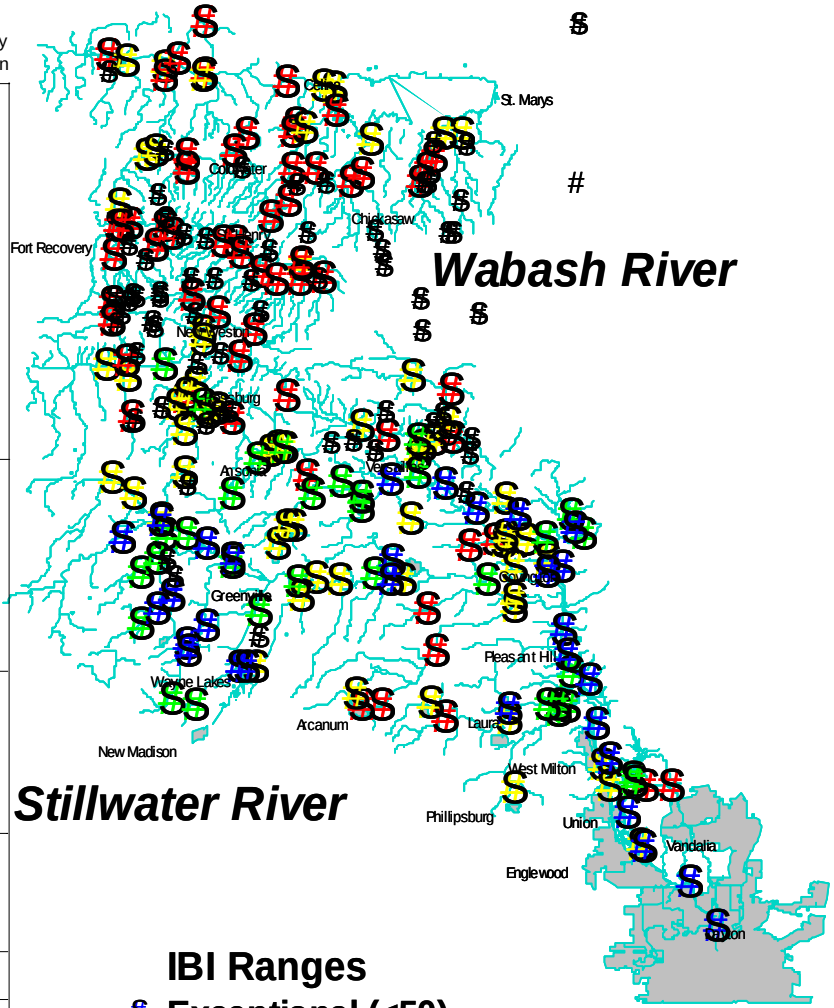
November 6, 2001

P.O. Box 1049, 122 South Front Street, Columbus, Ohio 43216-1049

CAFOs and Habitat: Cumulative Impacts

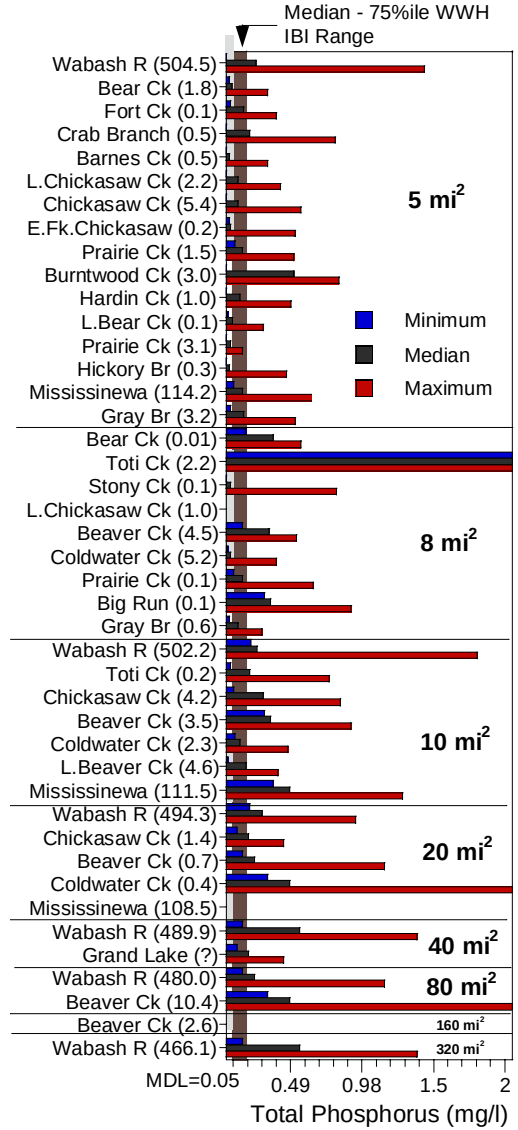


Fecal Bacteria



IBI Ranges

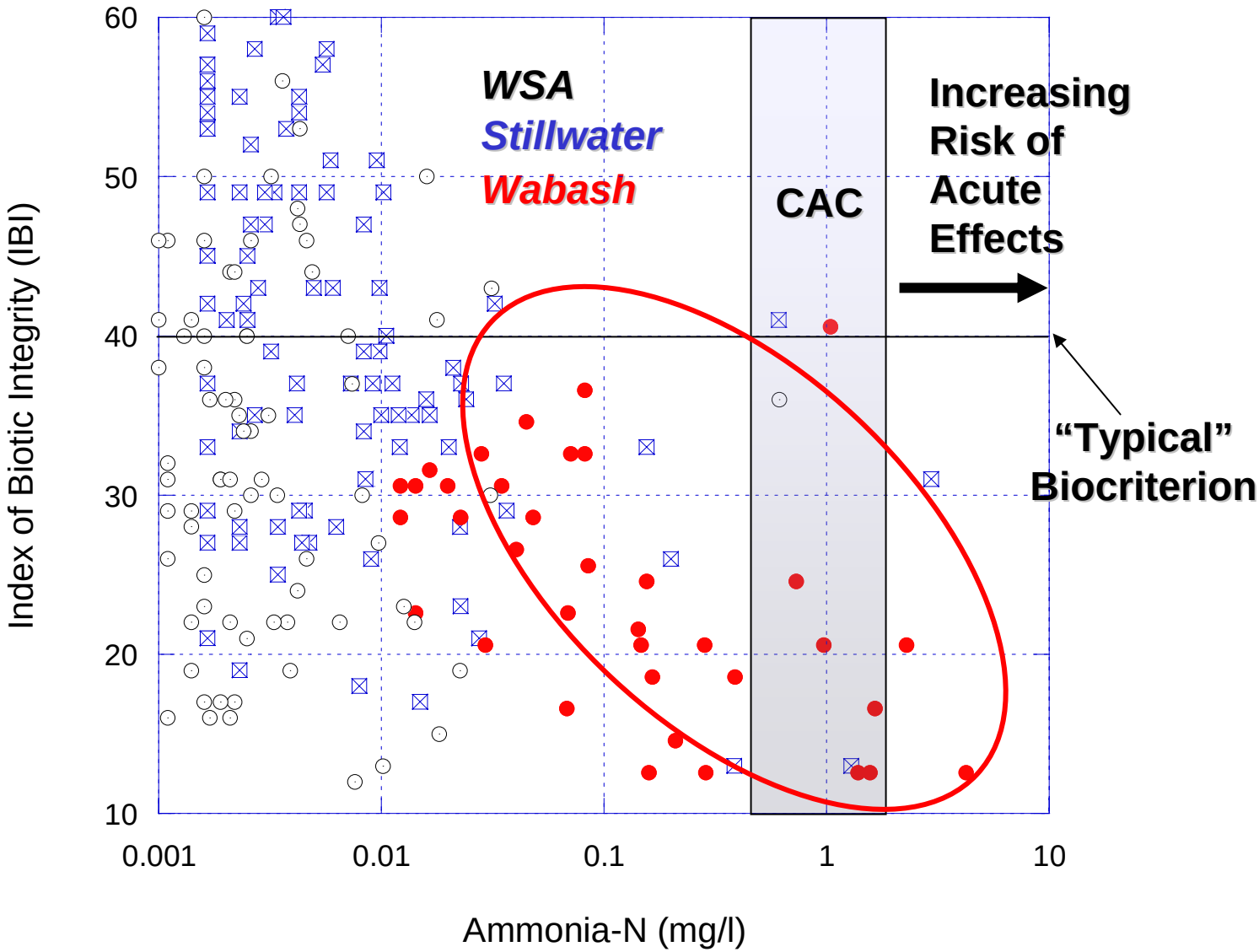
- Exceptional (<50)
- Good (40-49)
- Fair (29-39)
- Poor/V. Poor (12-28)
- Permitted CAFOs

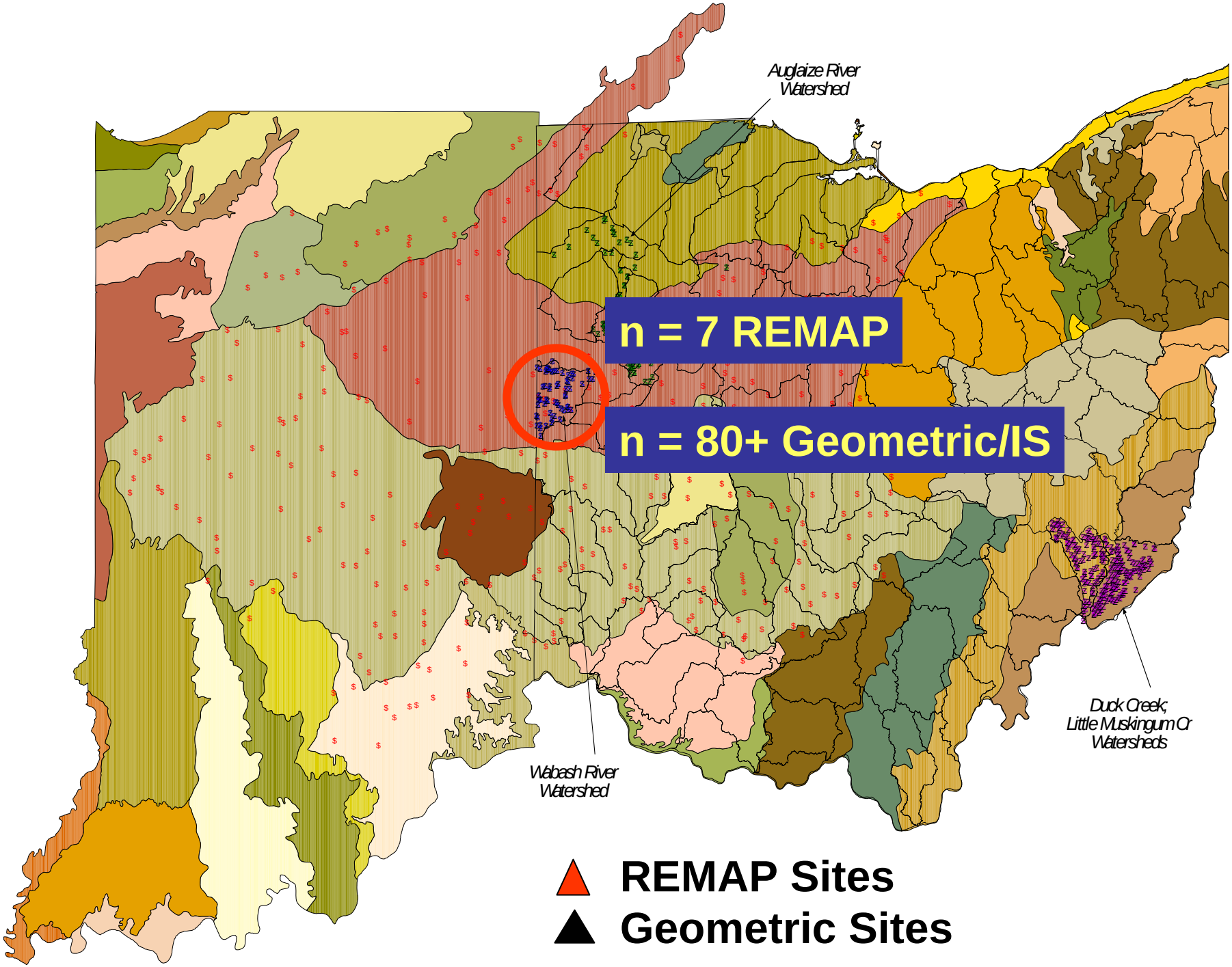


Total Phosphorus

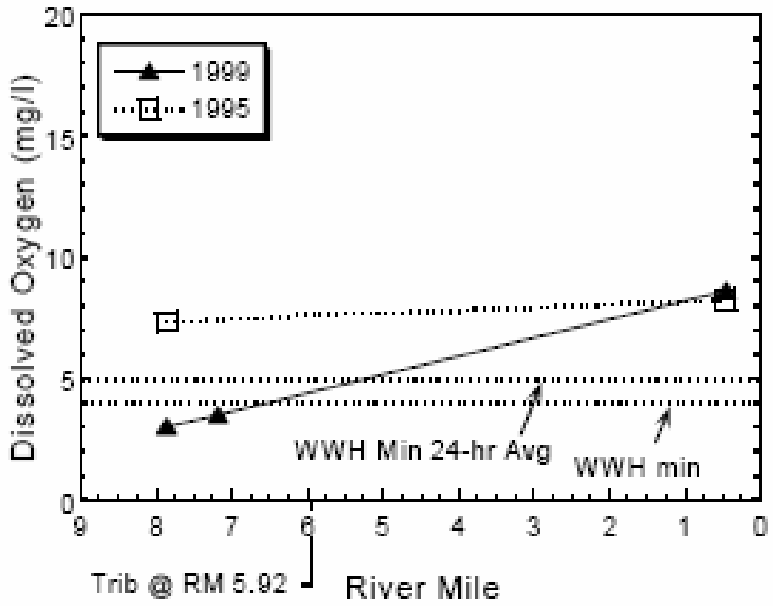
Ohio EPA Watershed Survey 1999

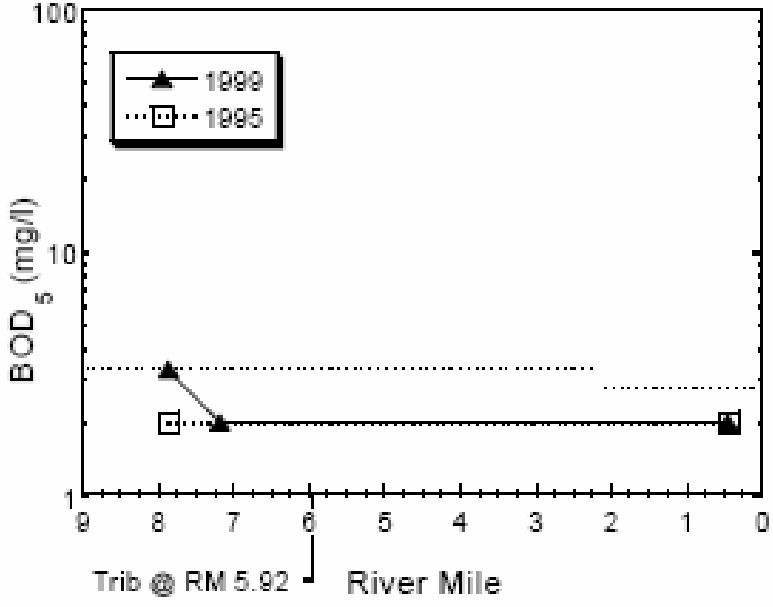
IBI Response to Ammonia-N: WSA Probabilistic and Wabash/Stillwater Geometric Design

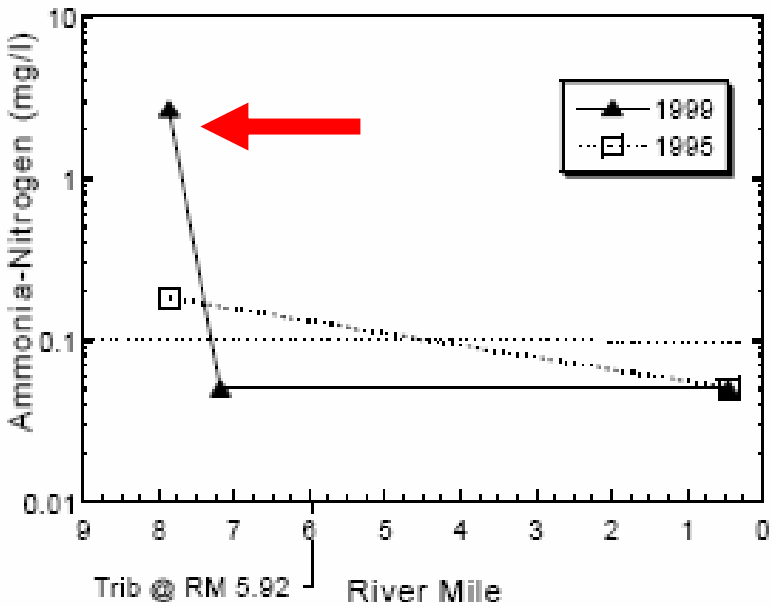


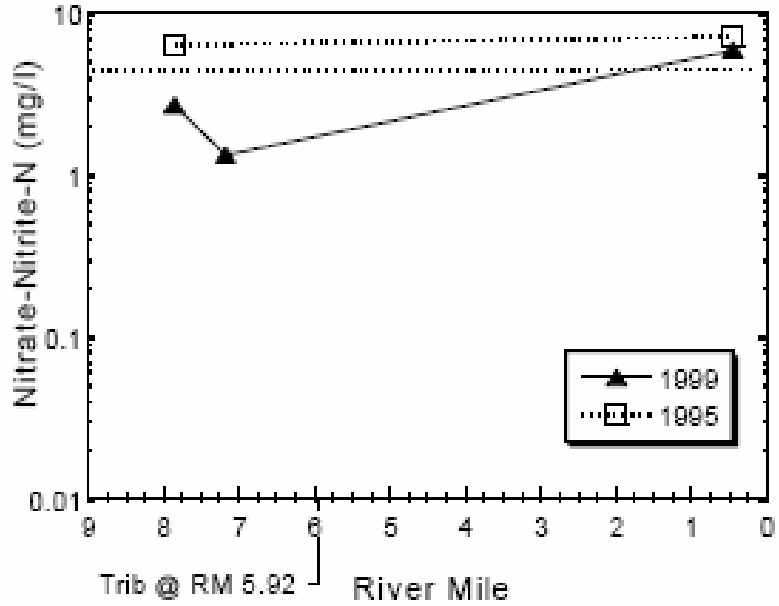

Auglaize River Watershed
n = 7 REMAP
n = 80+ Geometric/IS
Wabash River Watershed
Duck Creek; Little Muskingum Cr Watersheds
REMAP Sites
Geometric Sites

Brush Creek

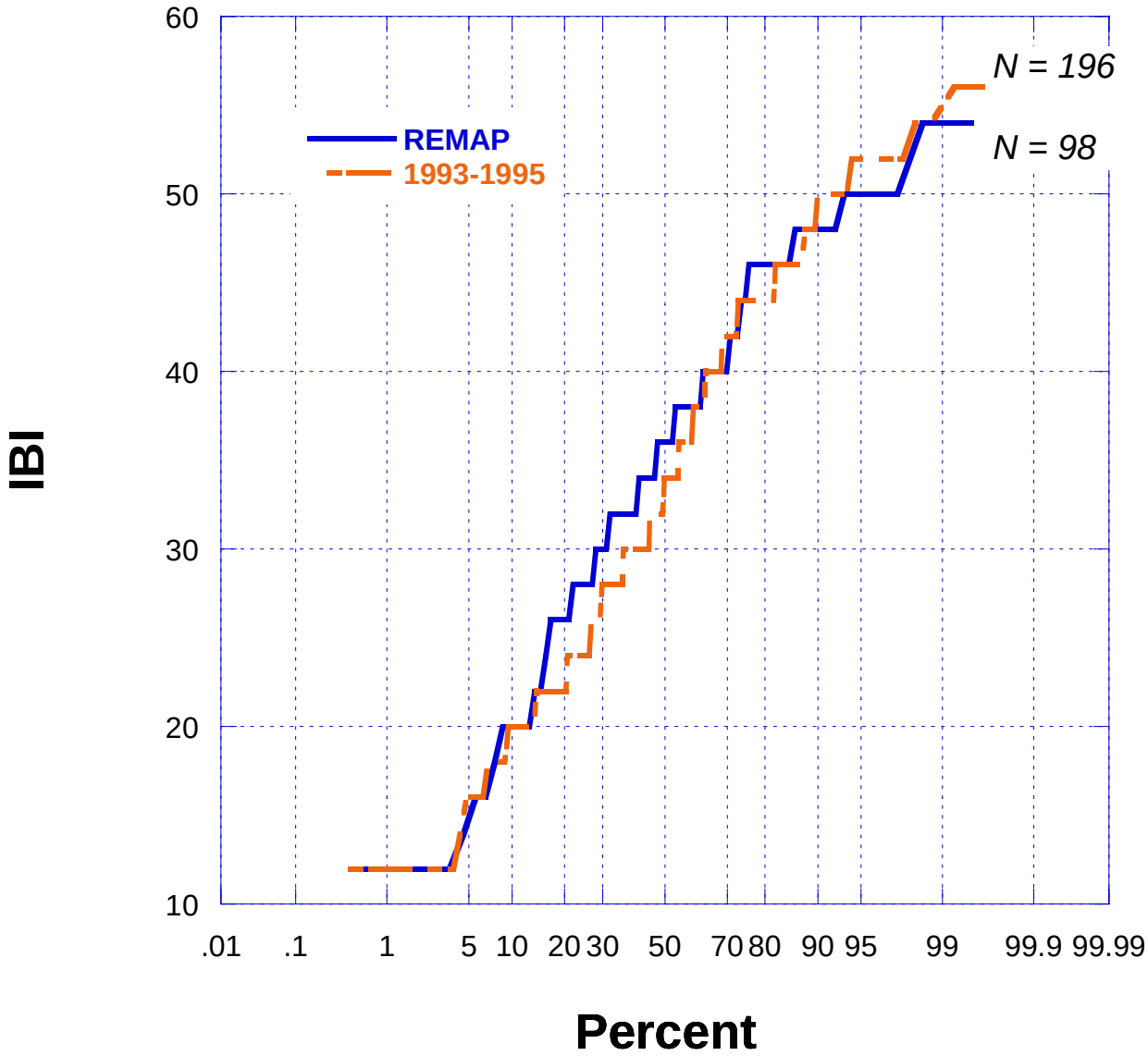

Dissolved Oxygen (mg/l)
20
15
10
5
0
1999
1995
WWH Min 24-hr Avg
WWH min
9 8 7 6 5 4 3 2 1 0
Trib @ RM 5.92
River Mile

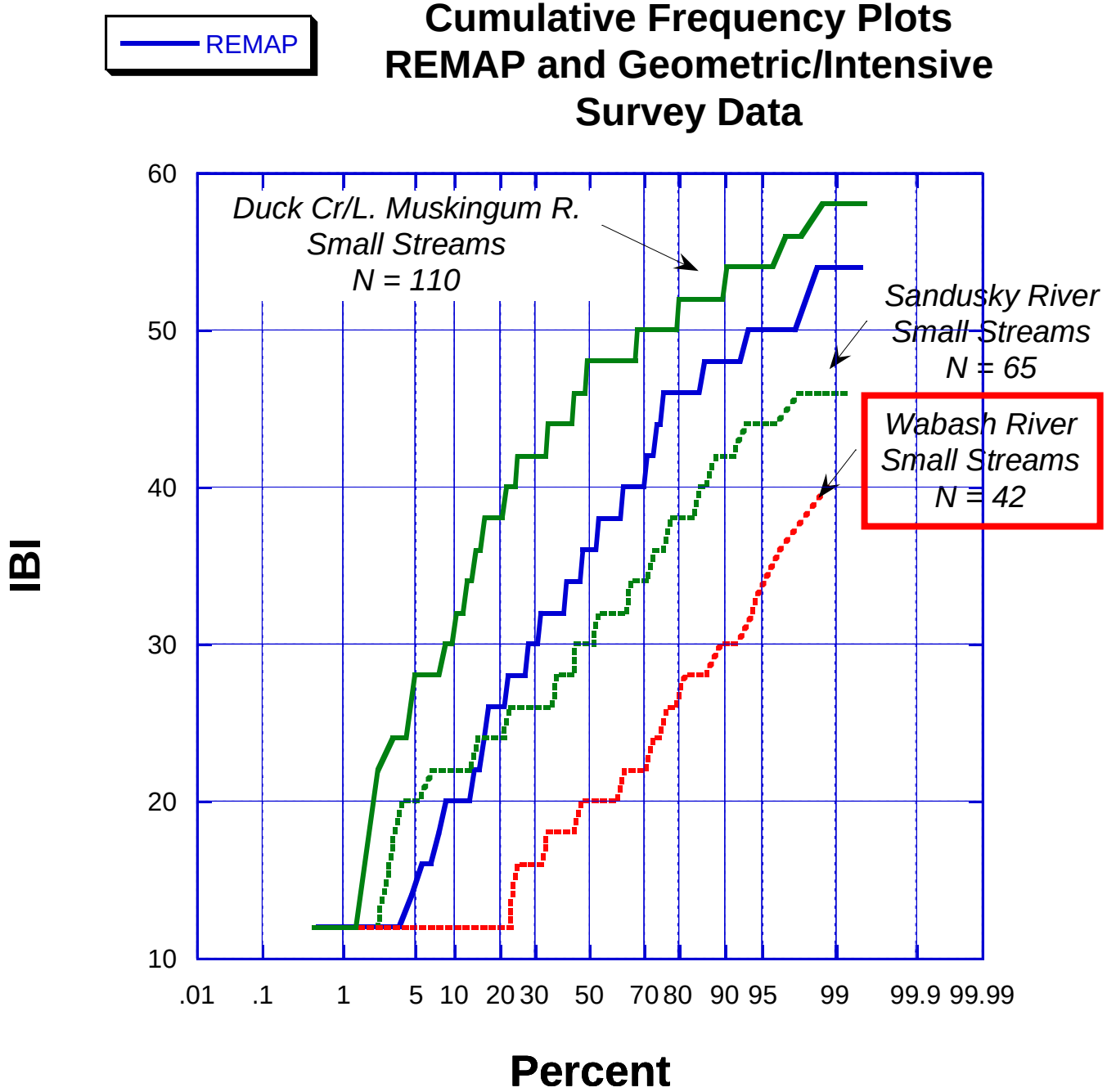

BOD5 (mg/l)
100
10
1
1999
1995
9 8 7 6 5 4 3 2 1 0
Trib @ RM 5.92
River Mile


Ammonia-Nitrogen (mg/l)
10
1
0.1
0.01
1999
1995
9 8 7 6 5 4 3 2 1 0
Trib @ RM 5.92
River Mile


Nitrate-Nitrite-N (mg/l)
10
1
0.1
0.01
1999
1995
9 8 7 6 5 4 3 2 1 0
Trib @ RM 5.92
River Mile

Cumulative Frequency Plots
REMAP and Intensive Survey Data
Less Than 100 sq mi




REMAP
Cumulative Frequency Plots
REMAP and Geometric/Intensive
Survey Data
Duck Cr/L. Muskingum R.
Small Streams
N = 110
Sandusky River
Small Streams
N = 65
Wabash River
Small Streams
N = 42
IBI
60
50
40
30
20
10
.01
.1
1
5
10
20
30
50
70
80
90
95
99
99.9
99.99
Percent

Benefits of Geometric & Intensive Survey Design

- Resolve use designation and impairment assignments prior to uses of data and making assessments – *baseline TALU program*
- Organizes watershed issues in proportion to the occurrence of resource types
- Corresponds to scales of management and implementation
- Prioritization can account for severity and extent of impairments and threats

What Did WSA Tell Us?

- General findings are in line with what most states already know about ***general*** status.
- Spatial detail is adequate for general status, but lacking for addressing watershed scale issues – ***some stressors were missed***
- Spatially intense M&A needed to extract more "value" from stressor:response relationships
- Selection of sampling methods is a critical decision – mostly made in the field.