

National Biological Assessment
and Criteria Workshop

Advancing State and Tribal Programs



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

WET 101

Assemblage Selection and Index Development for Wetland IBIs

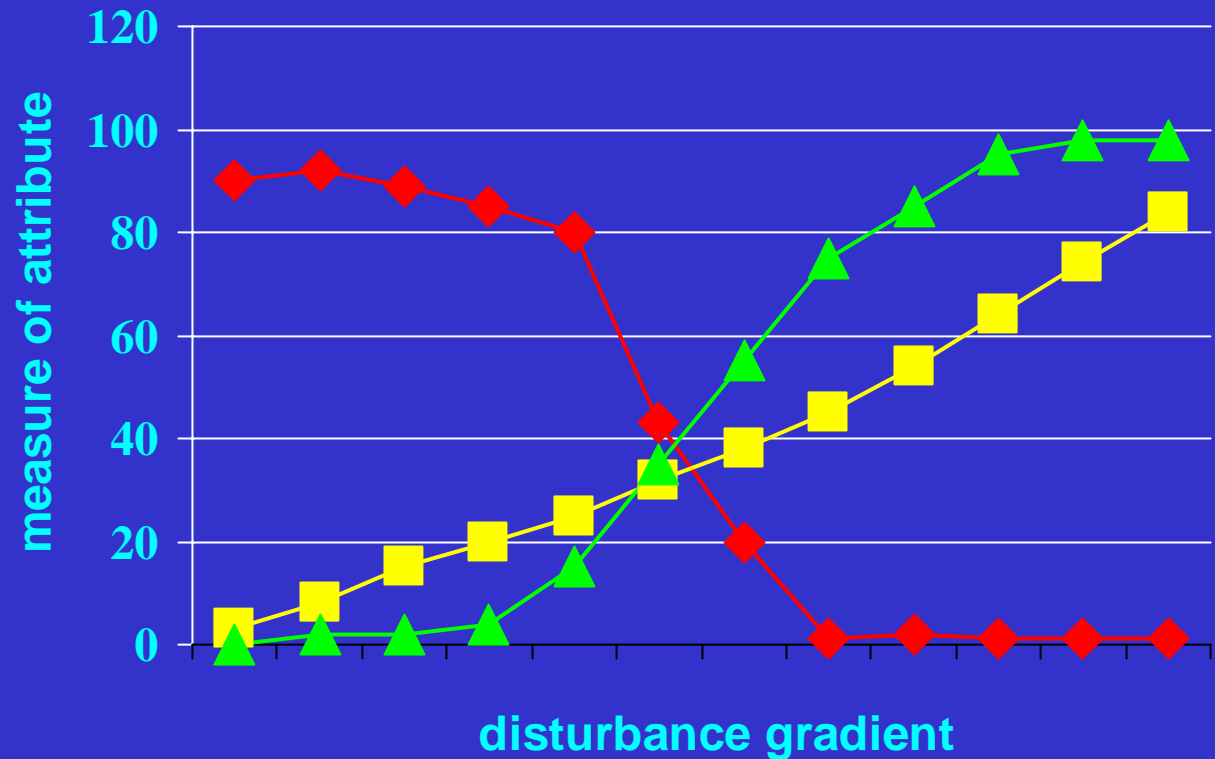
Presented by
Mick Micacchion
Ohio Environmental Protection Agency

Background

- “Attributes” versus “metrics”
 - attributes = measurable characteristics of natural community, taxa, etc.
 - metrics = attributes selected for inclusion in a multi-metric index
- ecological meaningful, predictable relationships to human disturbance
- “dose-response” relationships
- dose = human disturbance
- response = change in metric with increasing or decreasing disturbance

Types of relationships

- type of relationship to disturbance can vary within and between assemblages
 - threshold
 - linear
 - curvilinear



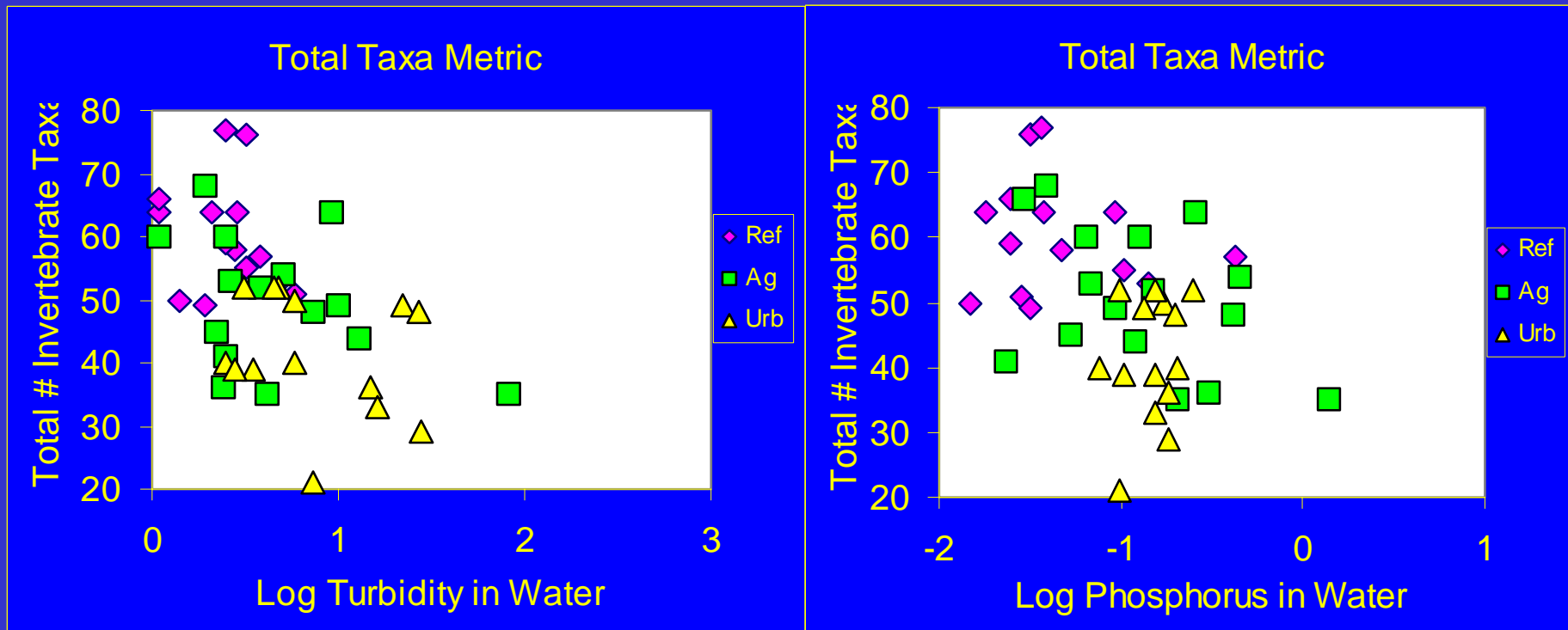
Human disturbance scales

- Most wetland IBIs have developed and used semiquantitative, quantitative, or qualitative human disturbance scales to select metrics and develop IBIs
- develop and refine at same time as IBI data collection and development
- Examples from MN, OH, PA, ME, FL

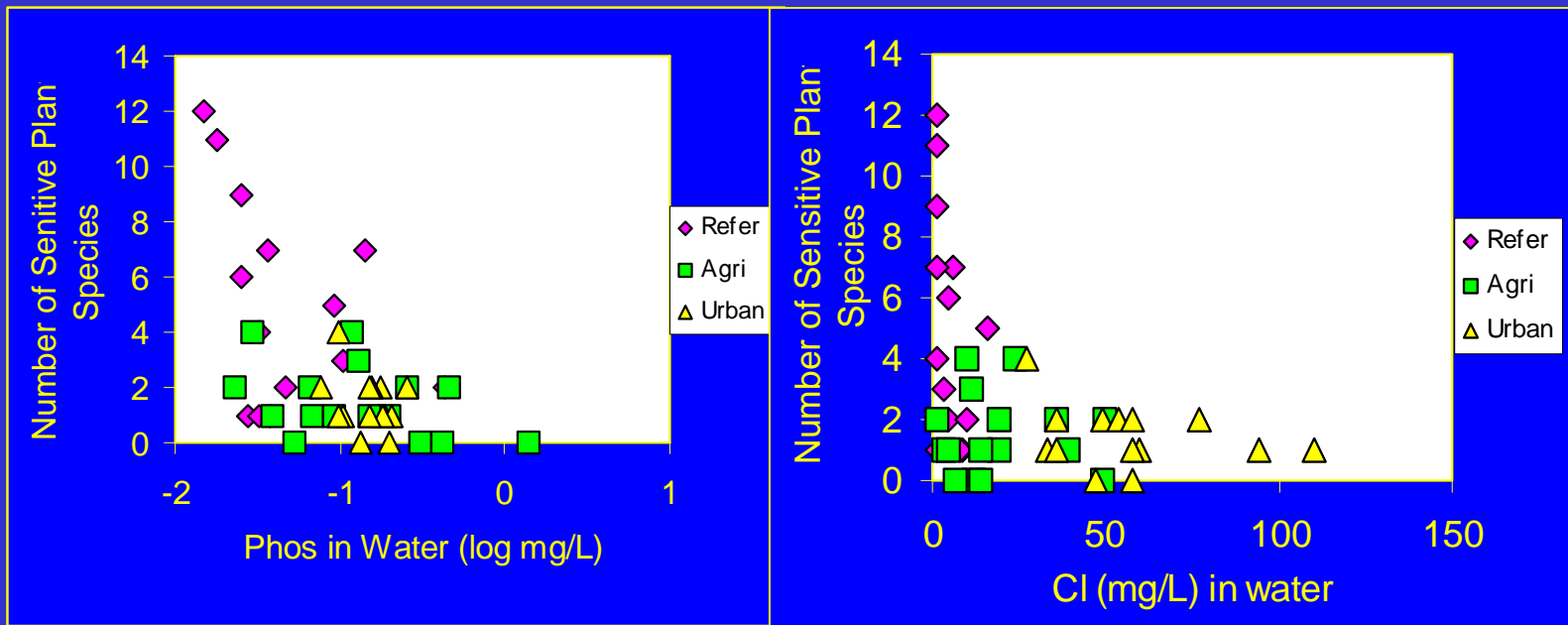
Quantitative scales

- Single parameter chemical scales
 - e.g. turbidity, P, Zn
- Quantified landscape variables
 - GIS based, %landuse covers within x distance from wetland

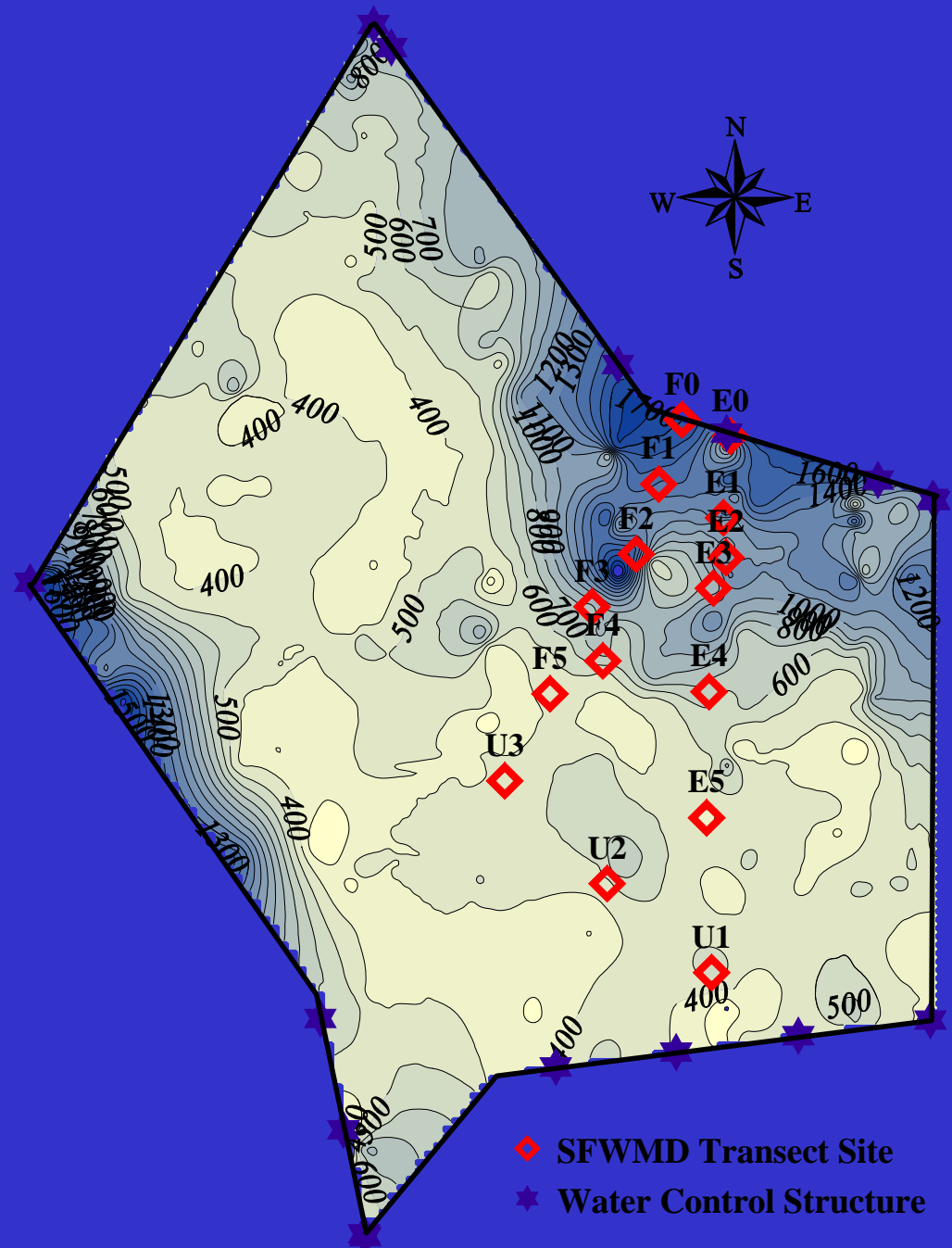
Total Taxa Invertebrate Metric vs turbidity and phosphorus



Number of Sensitive Plant Species vs Phos and Cl in Water



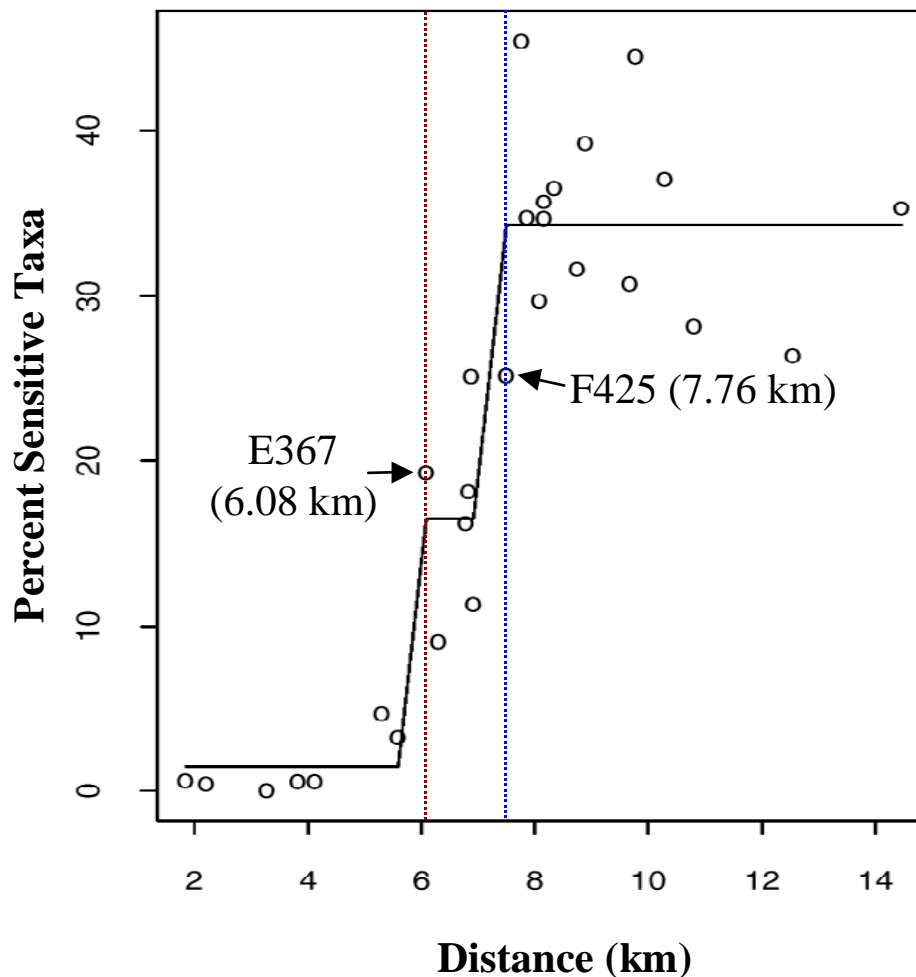
Total Sediment Phosphorus (mg/kg) Contour Map for WCA-2A



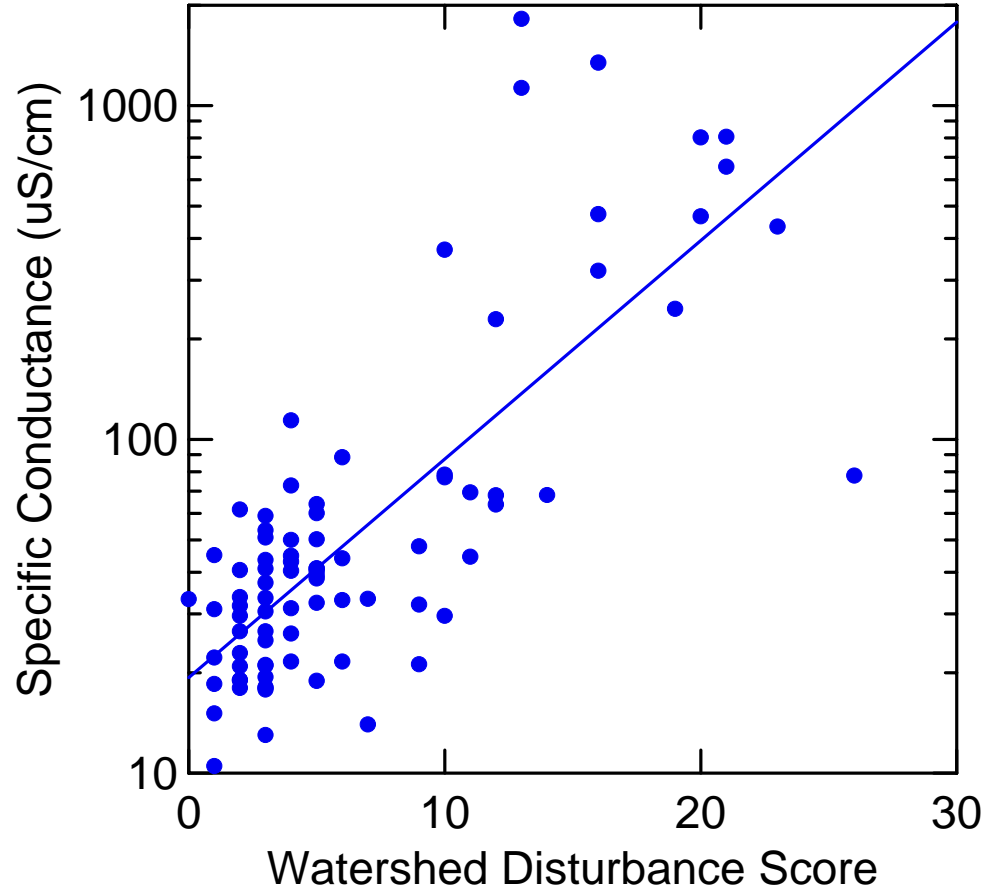
Results of Change Point Analyses Performed on Everglades Pollution-Sensitive (Literature Determined) Periphyton Taxa.

SFWMD Transects

7 Sampling Periods (9/7/94, 4/5/95, 11/20/95, 6/6-12/96, 8/22-23/96, 11/18/96, and 3/11-12/98).



Relationship of Conductivity and Watershed Disturbance Score 1998-2001 Maine DEP Wetland Data



FL Landscape Development Intensity (LDI) Index

- Quantifies disturbance gradients
- Independent measure of disturbance using land use/land cover, aerial photographs, and ground observations
- Primary factors considered in LDI:
 - sediment and nutrient loading
 - hydrologic alterations
 - physical impacts

$$\text{LDI} = \sum (\text{LDI}_j * \% \text{LU}_j)$$

Where,

LDI = Landscape Development Intensity Index

LDI_j = LDI coefficient for land use “j”

%LU_j = Percent area of the wetland drainage basin occupied by land use “j”

LDI based on surrounding land uses

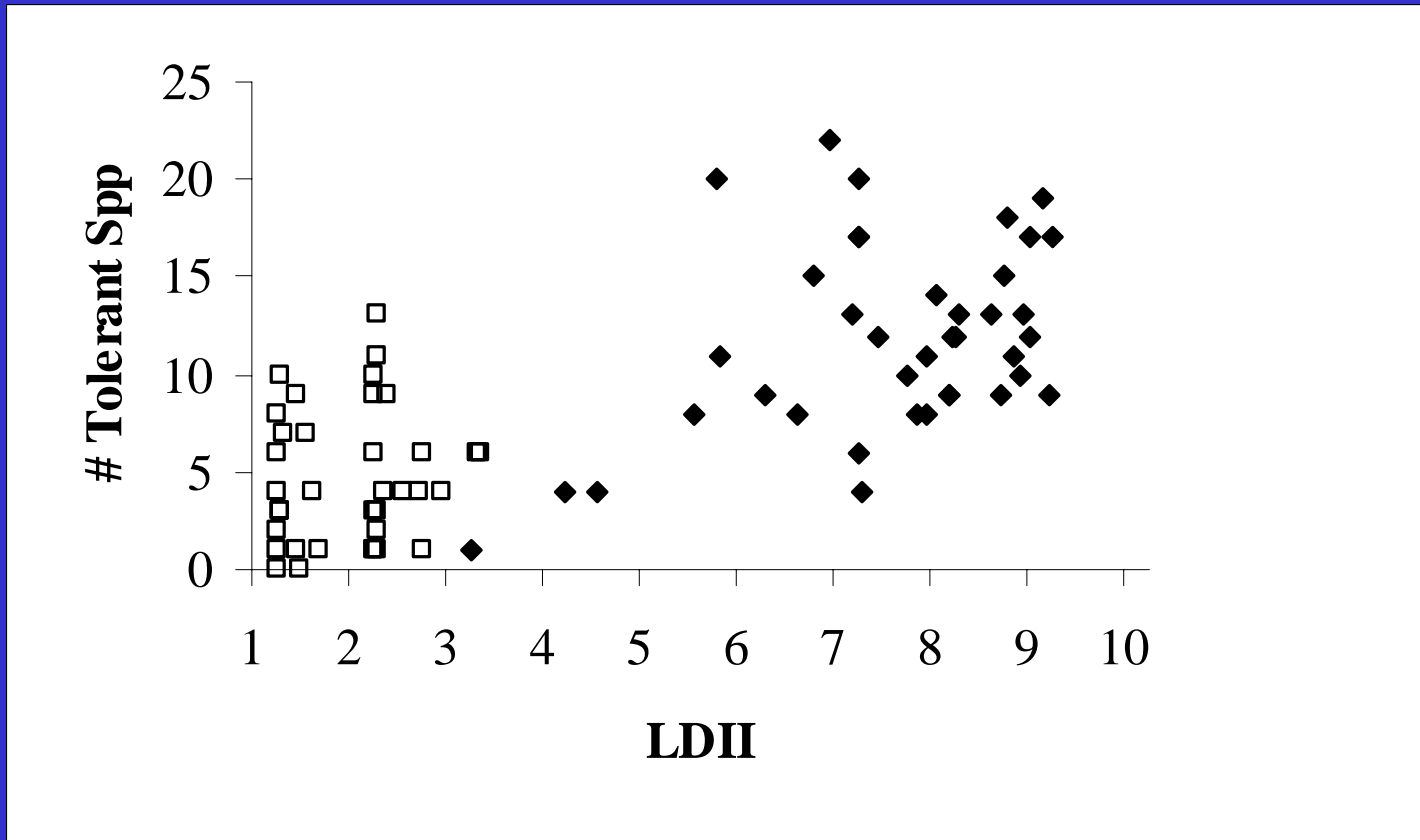


Four different buffers tested...

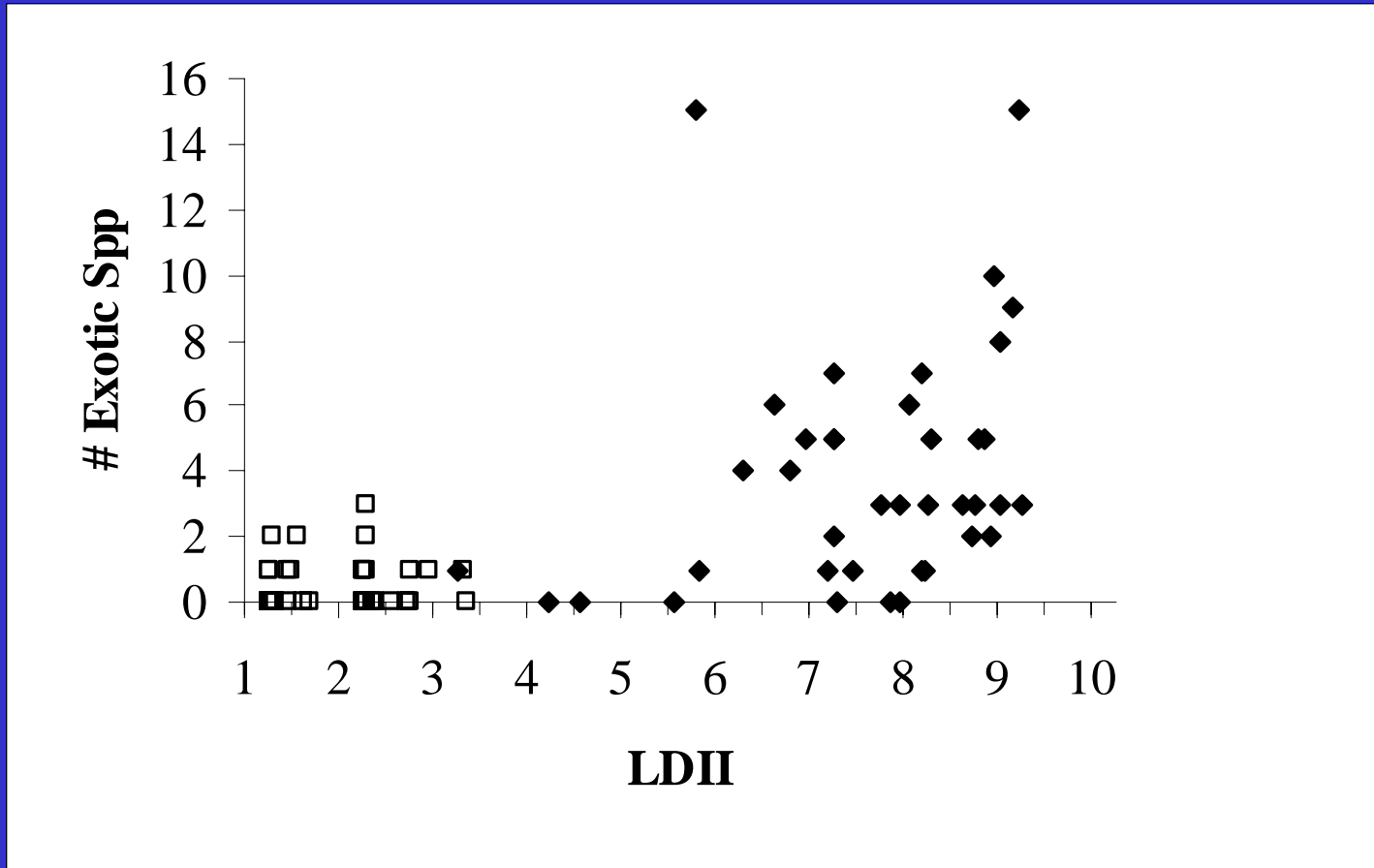
- 18 meters
- 100 meters
- 150 meters
- 500 meters



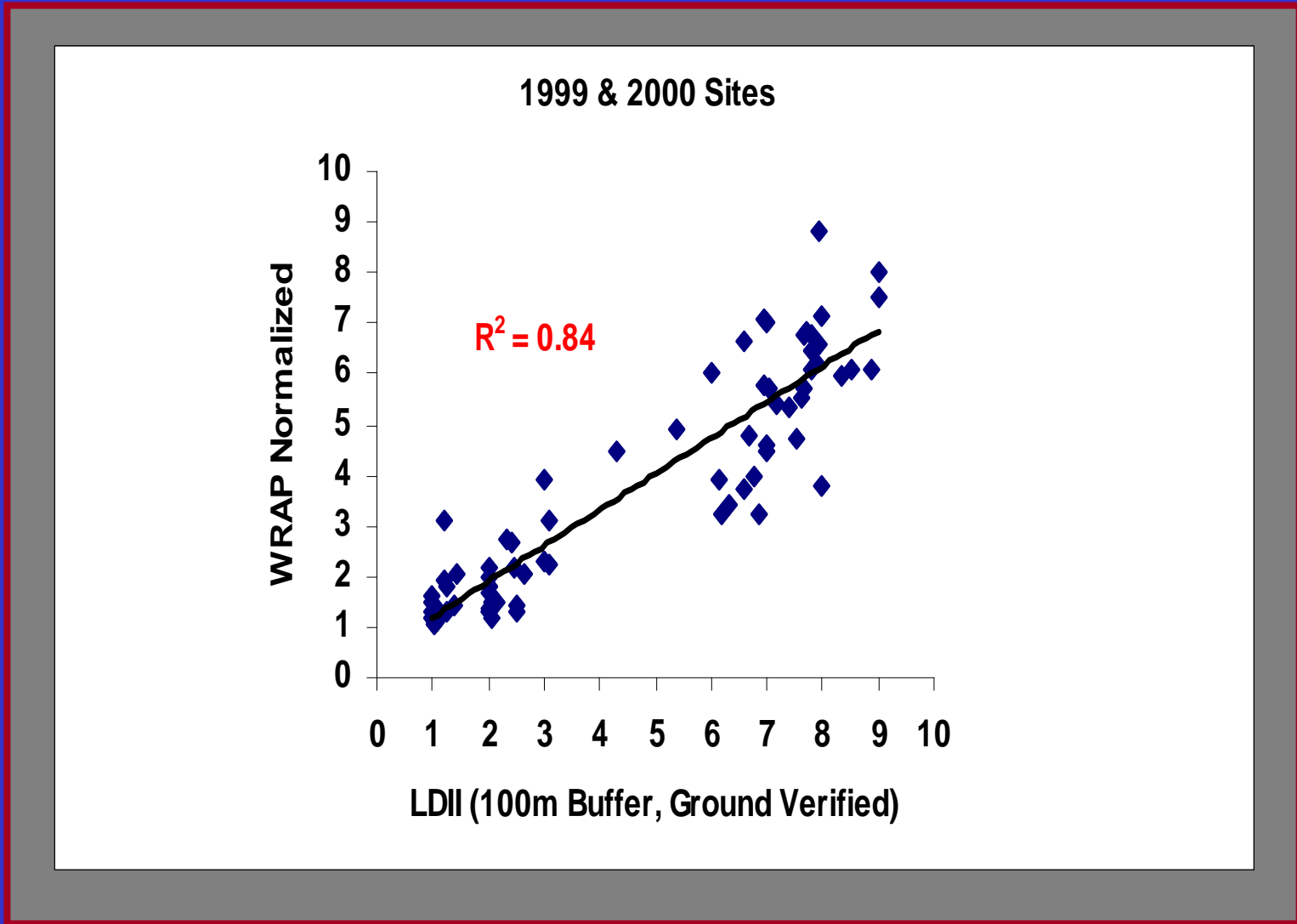
Tolerant Plant Species vs. LDII



of Exotic Species vs. LDI



Correlation of LDI with FL Wetland Rapid Assessment Procedure



Semi-quantitative scales

- OH and MN disturbance scales
- some type of stressor checklist
- on site stressors (hydrology or habitat alterations)
- landscape stressors (buffers, intensity of surrounding landuse)

OH Disturbance Scale

- Ohio Rapid Assessment Method for Wetlands v. 5.0.
- Semi-quantitative or semi-qualitative
 - Some questions (wetland size, buffer width, depth of water, % invasive plant cover) clearly quantifiable
 - Other questions qualitative with ordinal ranking
- Developed to be used as wetland disturbance/ecological integrity scale
- ORAM also a tool for performing regulatory categorization of wetlands

Overview of ORAM questions

- Metric 1 (6) - Wetland Size
- Metric 2 (14) - Buffer and Surrounding Land Use
- Metric 3 (30) - Hydrologic characteristics and intactness
- Metric 4 (20) - Habitat characteristics and intactness
- Metric 5 (10) - Special Wetland Communities
- Metric 6 (20) - Plant community types and quality, Interspersion, Microtopography, amphibian habitat quality

ORAM v. 5.0

- Disturbance metrics
 - buffer width, intensity of surrounding land use, hydrologic, substrate, and habitat intactness
- Other metrics
 - size, water source, hydroperiod, connectivity, habitat development, special wetland communities (fen, bogs, T&E spp., old growth), plant community quality, microtopography, habitat heterogeneity, amphibian habitat

Wetland assemblages

- *vascular plants (MN, OH, PA, MA, FL, MN, ND, MI, plus others)
- algae (FL, ME)
- *macroinvertebrates (MN, ME, OH, MI, plus others)
- amphibians (OH)
- birds (PA)
- mammals

* = most commonly selected

Types of metrics

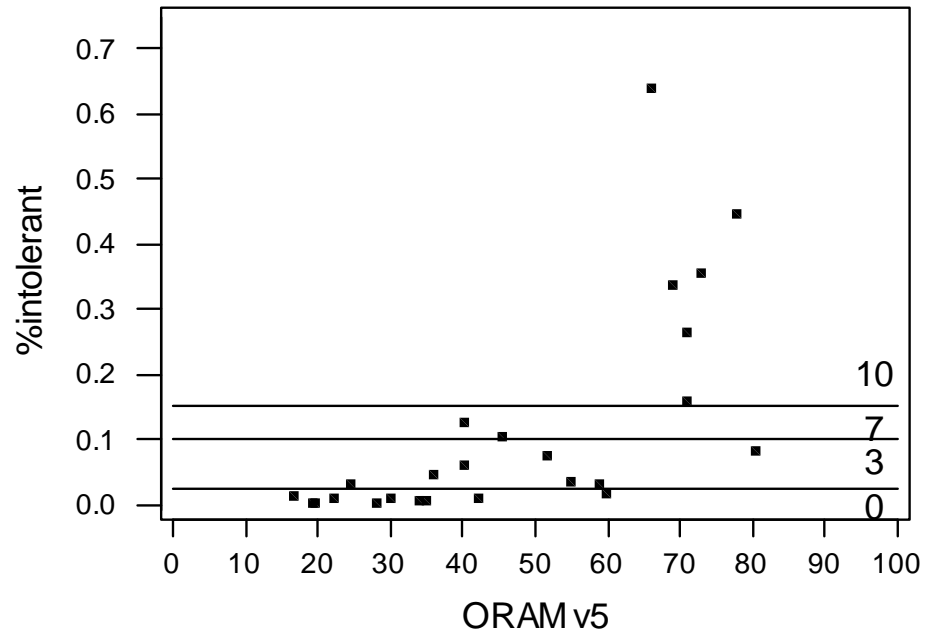
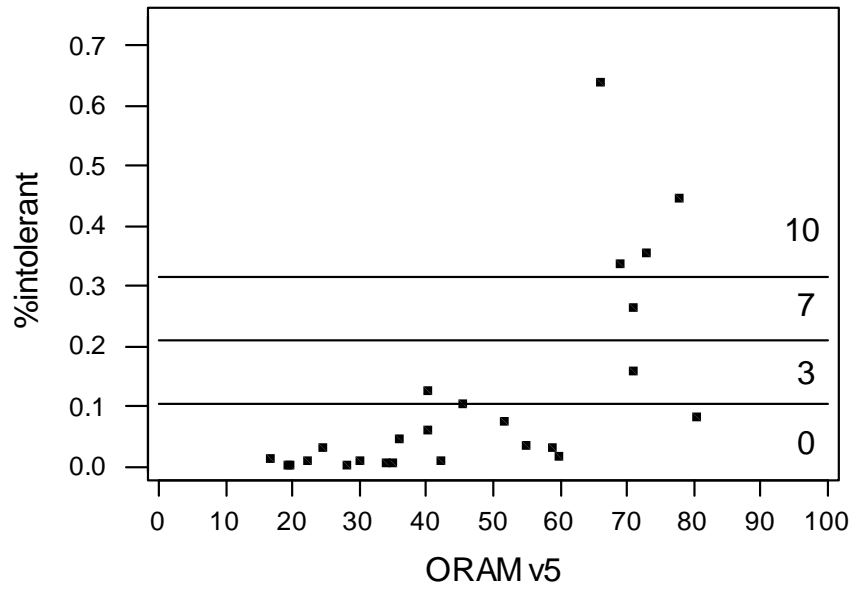
- richness
 - no. of species
- richness ratios (proportions)
 - no. of species divided by all species
- abundance, relative abundance
 - no. of ind., % cover, stem density
- productivity
 - grams/unit area or volume biomass
- diversity indices
 - Shannon-Wiener, Simpsons D, Floristic Quality Index
- tolerant or sensitive taxa
 - abundance, richness, proportions
- anomalies

Index development

- attribute selection
 - what attributes to select as metrics
 - e.g. OH plant table of different scales and features of assemblage community
- Metric scoring
 - trisection 1, 3, 5
 - quadrisection 0, 3, 7, 10
 - graphical fitting
 - sliding scale

Types and characteristics of attributes which can be included in biological assessments using vascular

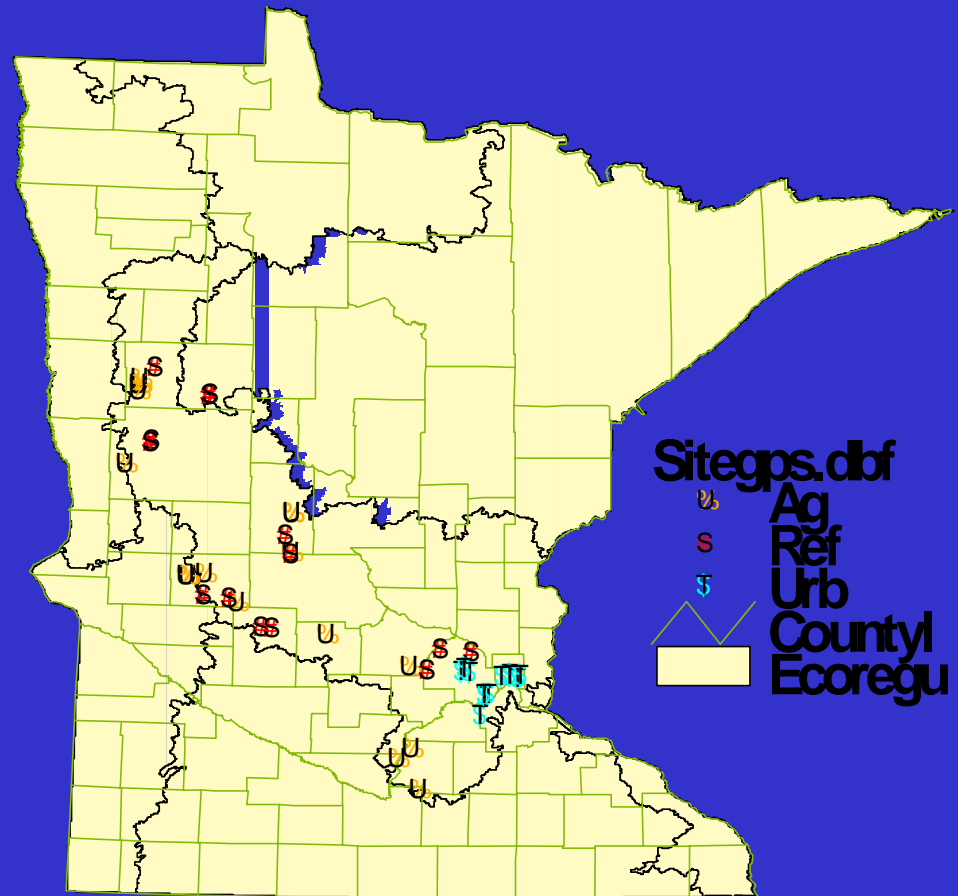
type	possible attributes
community structure	taxa richness, relative cover, density, dominance
taxonomic composition	identity, floristic quality (FQAI), tolerance or intolerance of key taxa
individual condition	disease, anomalies, contaminant levels
biological processes	productivity, trophic dynamics, nutrient cycling



Examples of Wetland IBIs and Index Development

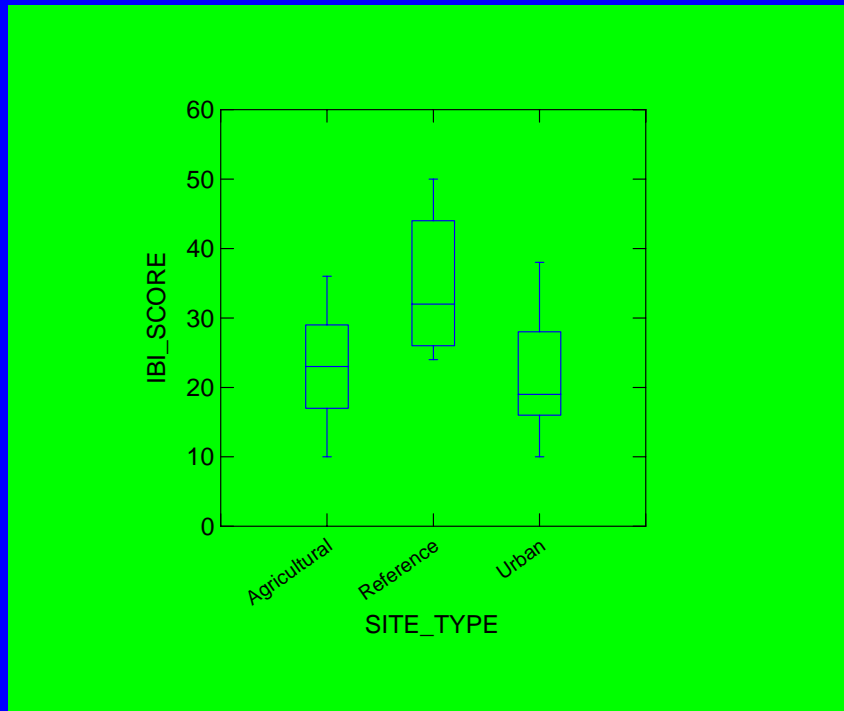
- Maine – macroinvertebrates
- Minnesota – plants, macroinvertebrates
- Ohio – amphibians, plants

Minnesota Plant IBI from 1999 large depressional wetland study sites



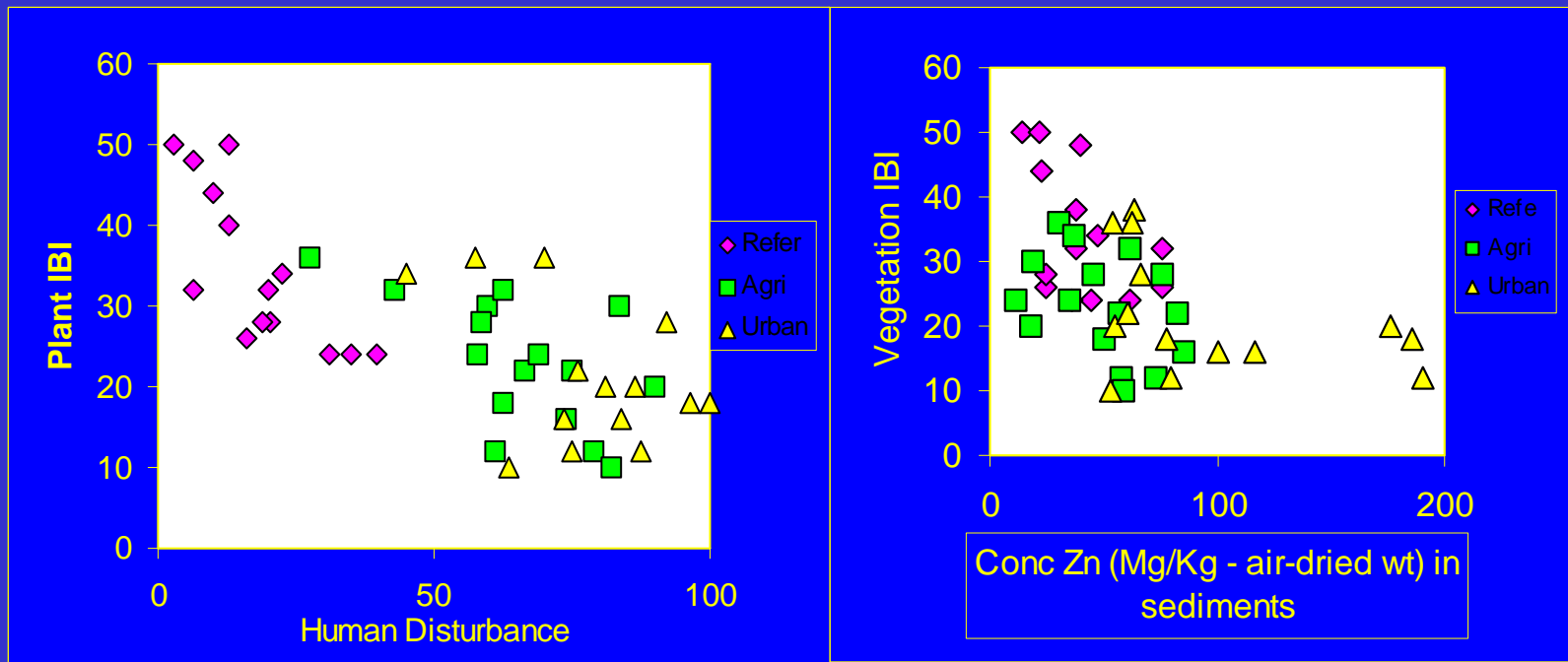
Large Depressional Wetland Assessments

<i>Site Type/Score Range</i>	<i>High Quality 50 - 36</i>	<i>Moderate Quality 35 - 23</i>	<i>Poor Quality 22 -10</i>
Reference	5	9	0
Agricultural Landscape	1	7	8
Urban Landscape	3	1	10



Boxplot of
plant IBI
scores by a
priori site
type

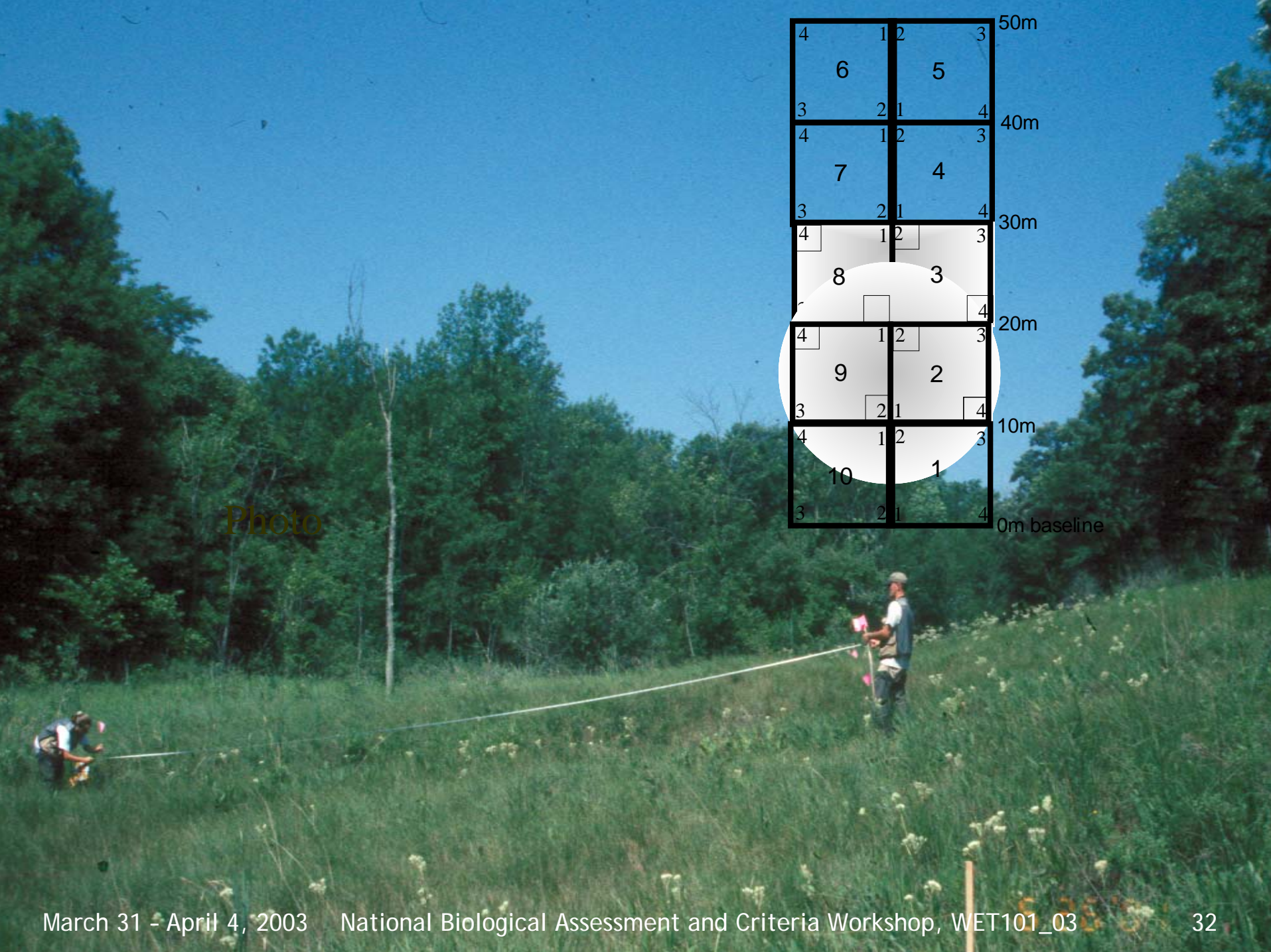
Wetland Plant IBI vs HDR and Zn in Sediments



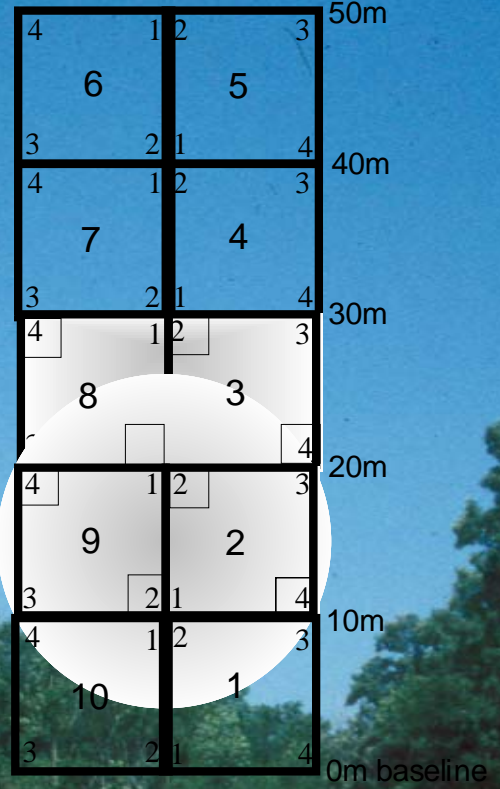
Ohio Vegetation IBI

Sampling methods

- plot based sampling method
- combines aspects of releves and transects and quadrats
- flexible multipurpose method for diverse plant communities
- locate plots in areas most representative of plant community of interest
- minimize environmental heterogeneity



Photo



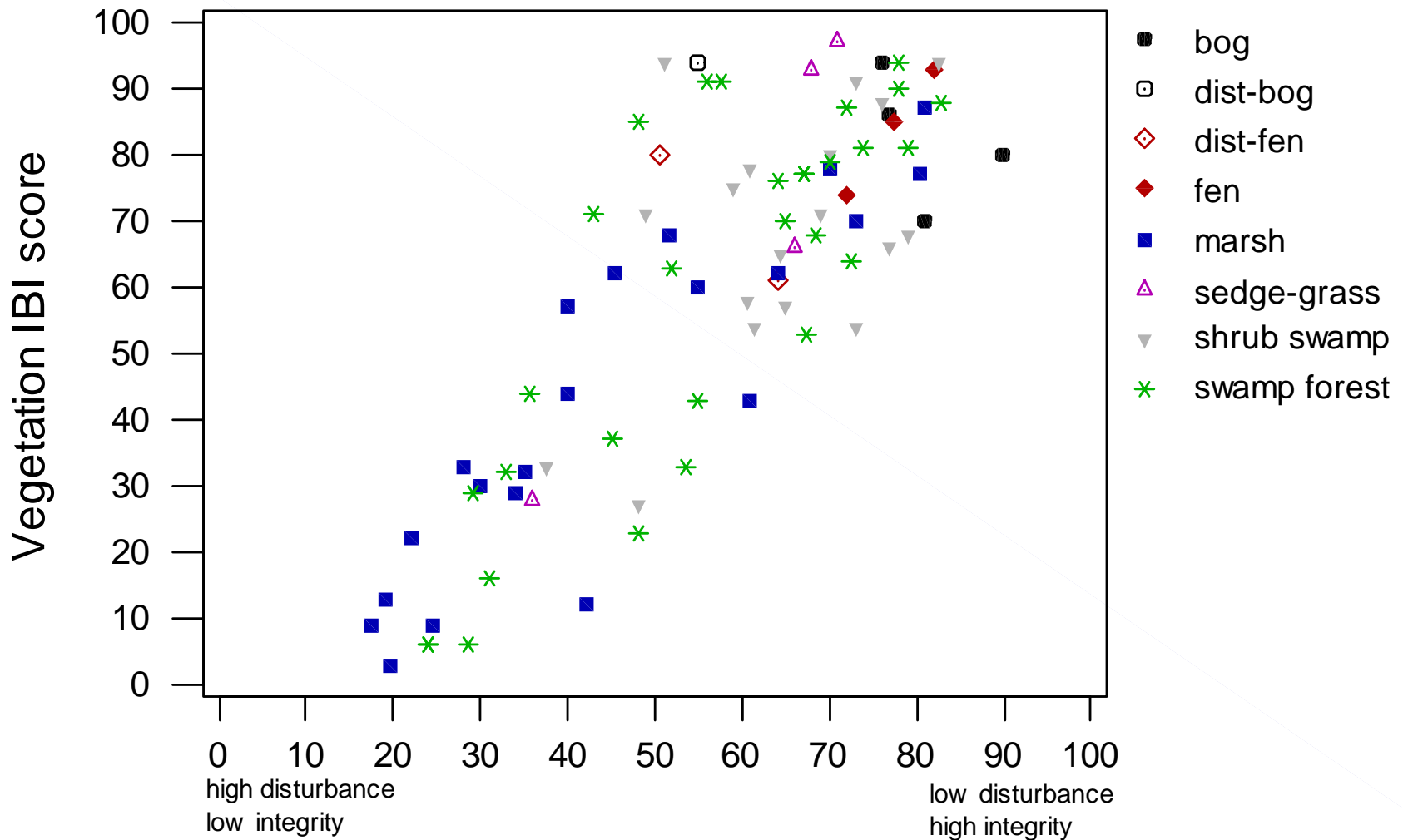
Parameters measured

- presence/absence (~2500 vouchers collected 1996-2002, avg ~16 per plot)
- % cover herb and shrub stratum
- stem density and basal area shrub and tree stratum (shrub and forest only)
- standing biomass (emergent only)
- soil nutrients
- water chemistry
- physical parameters: water depth, depth to saturated soils, coarse woody debris, hummocks and tussocks, standing dead, etc.

Metrics for VIBI-E, -F, -Sh

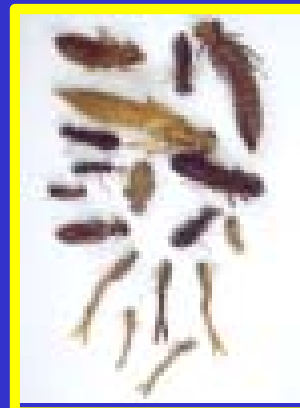
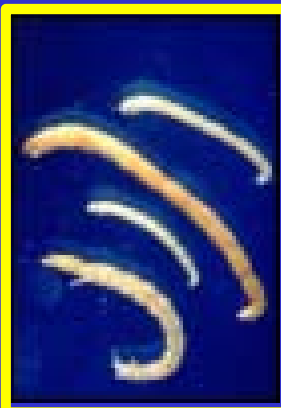
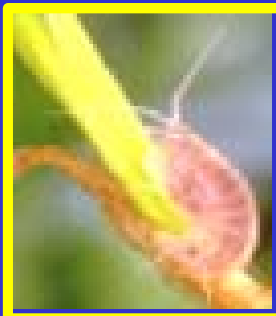
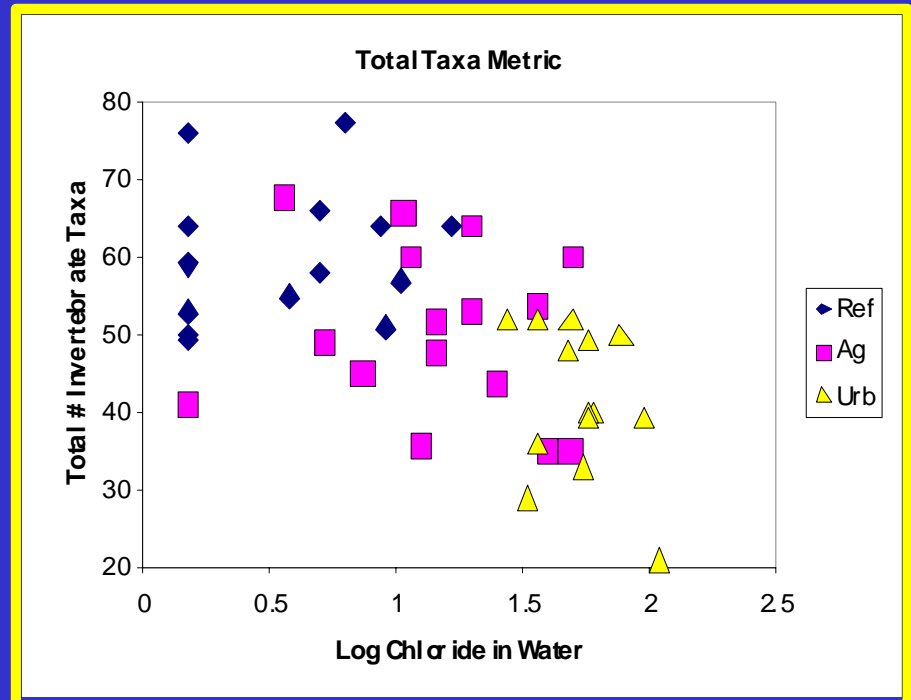
metric	type	E	F	Sh
carex	richness	X		X
dicot	richness	X	X	X
shrub	richness	X	X	X
hydrophyte	richness	X	X	X
Rosaceae	richness	X	X	X
FQAI	index	X	X	X
%tolerant	community	X	X	X
%intolerant	community	X	X	X
%invasive graminoids	community	X		
small tree density	community/productivity		X	X
shrub density	community/productivity		X	X
max IV	index		X	
std biomass	productivity	X		

Vegetation IBI (1996-2000)

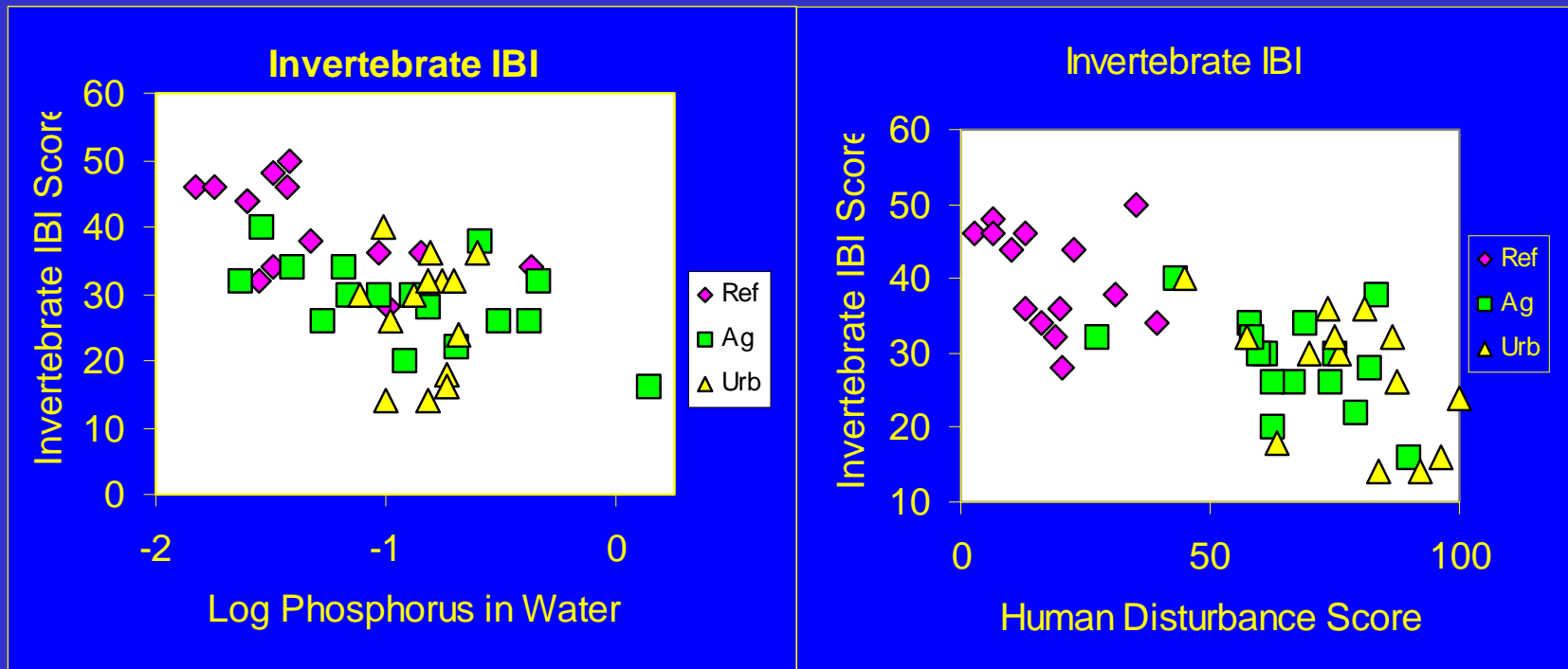


Minnesota macroinvertebrate IBI

The invertebrate Index of Biological Integrity (IBI) has 10 metrics. The total number of taxa is one of the metrics. Each metric is scored a 5, 3 or 1.

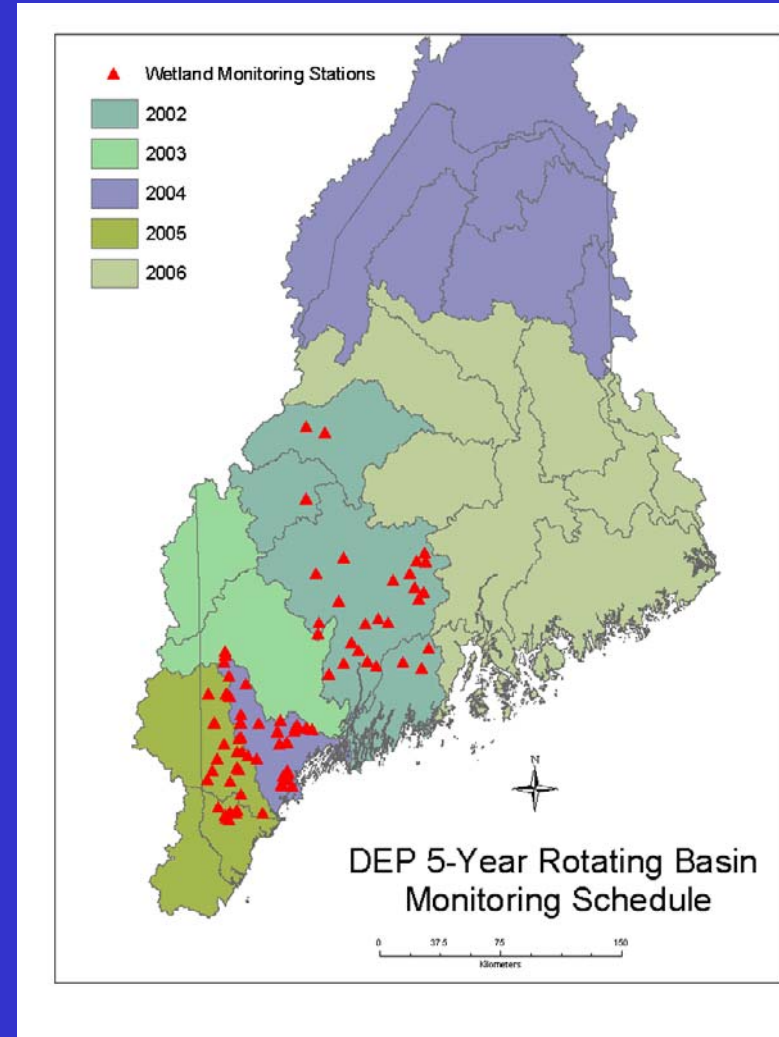


Invertebrate IBI vs P in water and Human disturbance rating

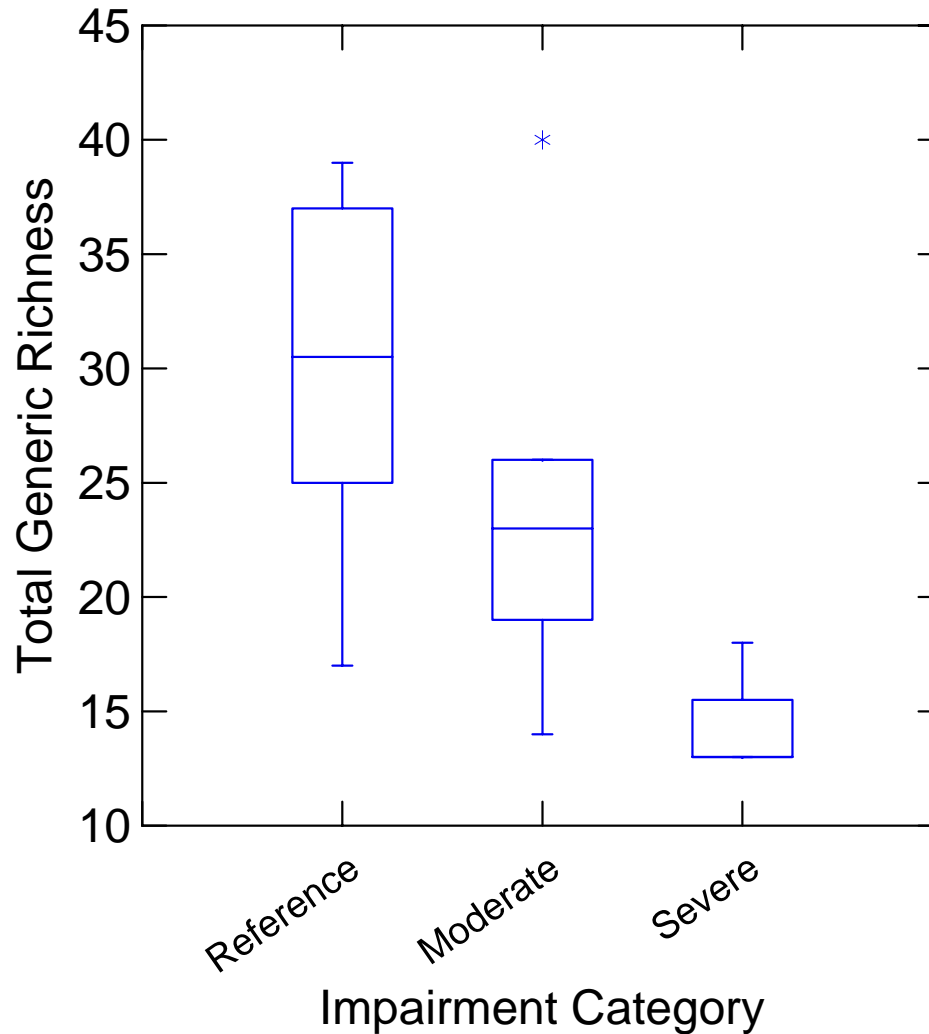


Maine Macroinvertebrate Index Development

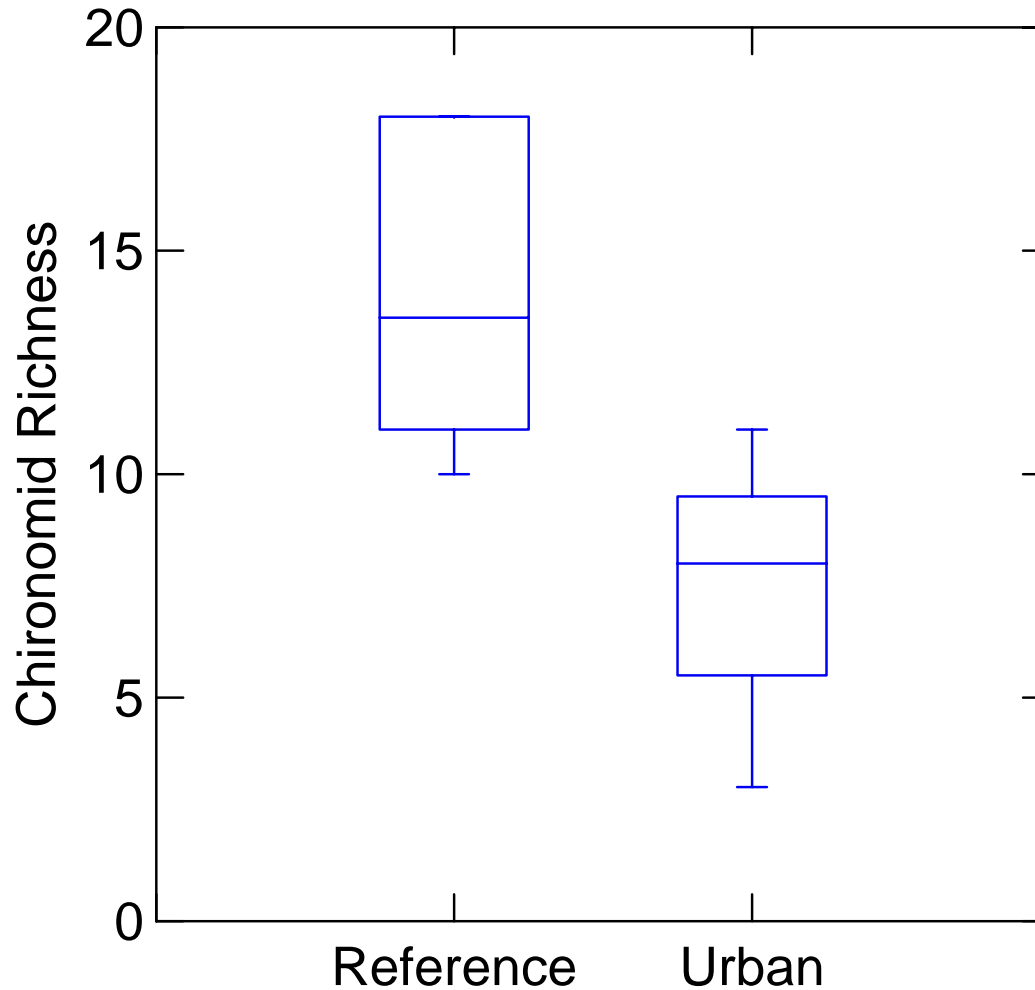
- Pilot study initiated in 1998 to develop monitoring protocols and candidate metrics
- Focus on aquatic macroinvertebrates and algae as biological indicators
- Collect supporting physical, chemical, habitat and land use data
- Characterize potential reference sites (minimally-impaired)



Total Invertebrate Richness (Number of Genera) by Predicted Impairment Category Maine DEP 1998 data

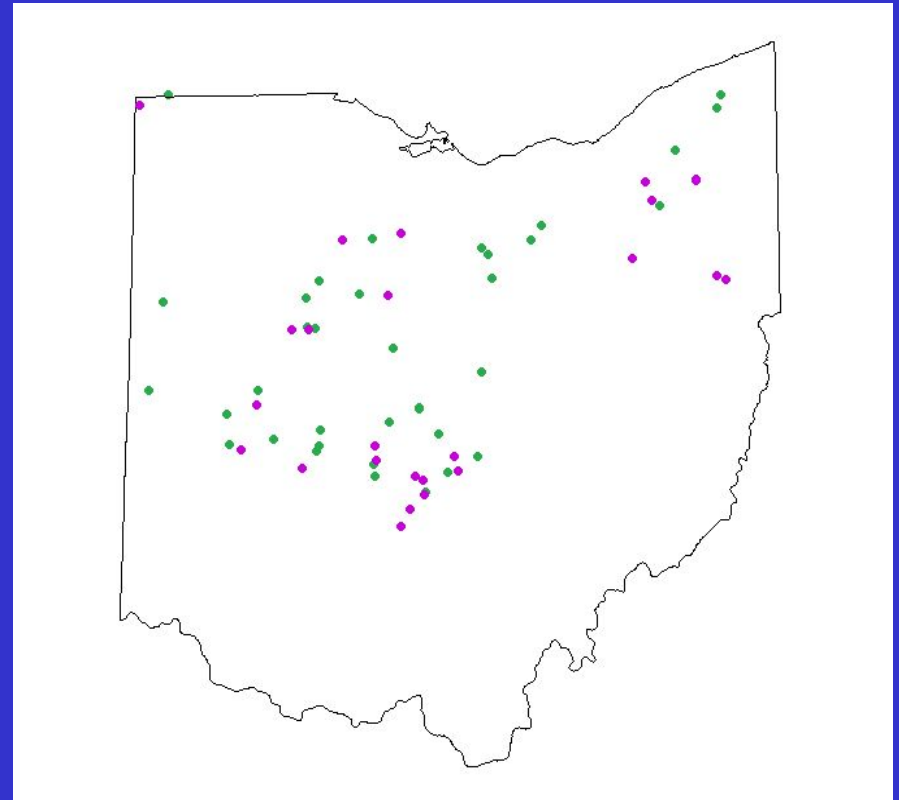


Comparison of Chironomid (Midge Larvae) Richness:
Reference and Urban Wetland Sites
(Number of Genera)
Maine DEP 1998 data

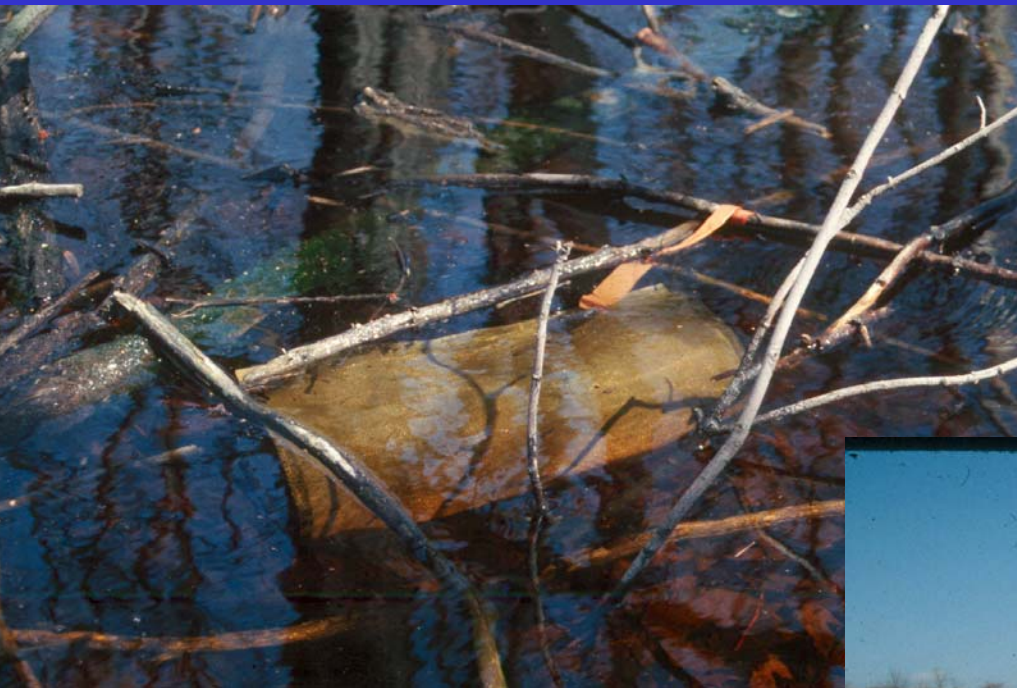


Ohio Amphibian IBI

- Forest and shrub wetlands
- Isolated depressions
- Sampling methods
 - activity traps
 - placed around perimeter

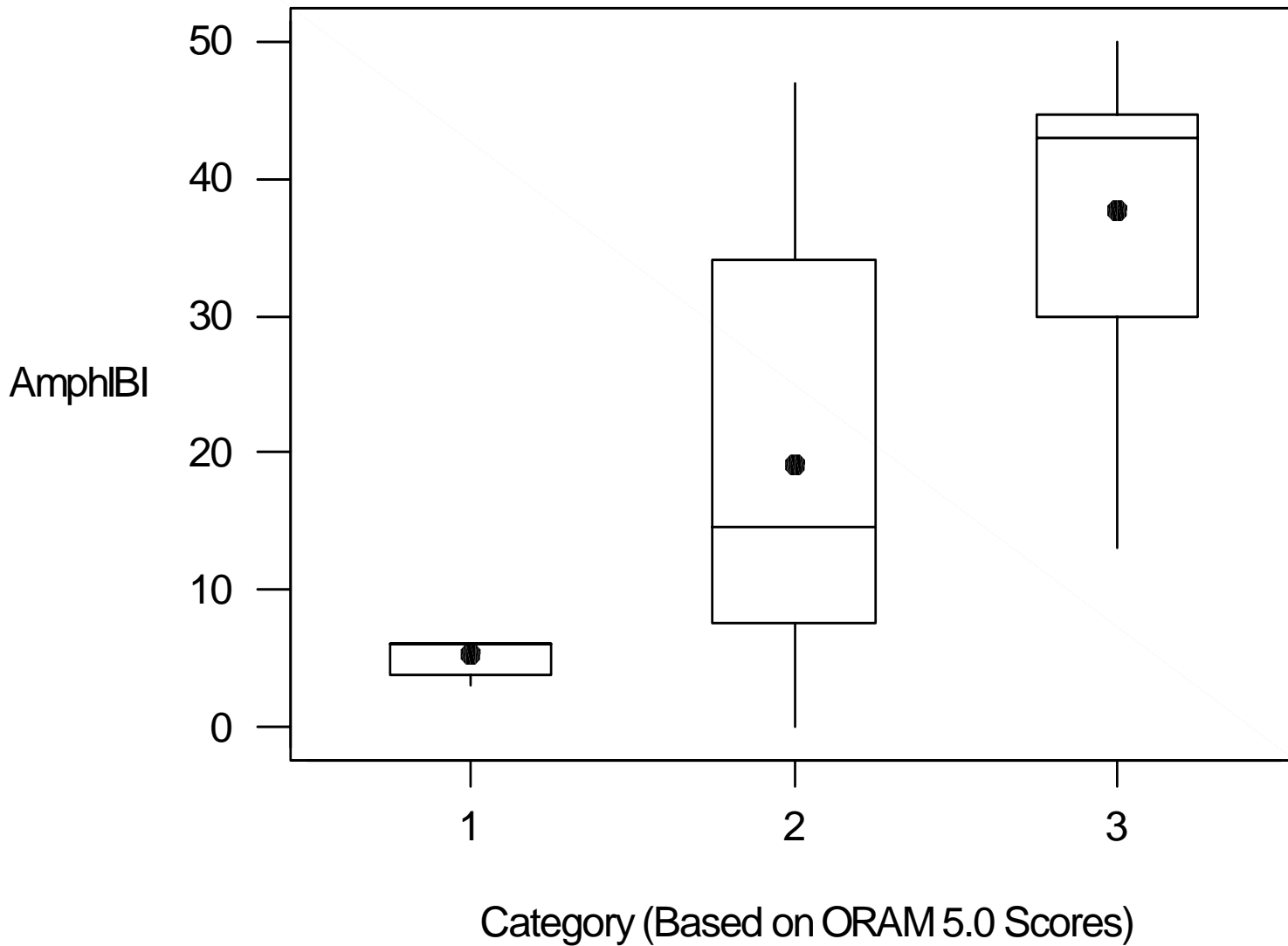


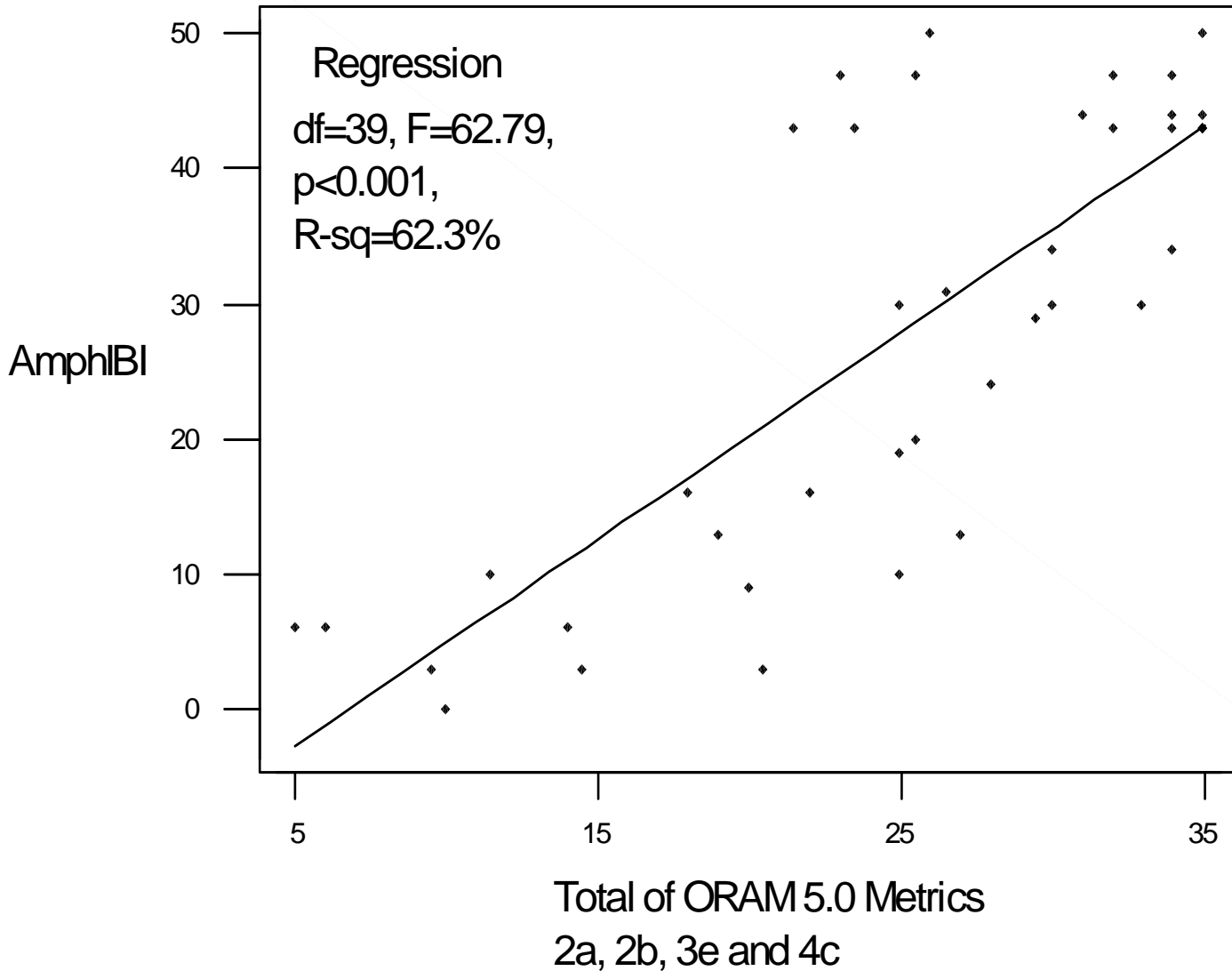
Using Funnel Traps



AmphIBI Metrics

- Amphibian Quality Assessment Index (AQAI)
- Number of species of pond-breeding salamanders
- Relative abundance of sensitive taxa
- Relative abundance of tolerant taxa
- Presence of spotted salamanders or wood frogs





Acknowledgments

- Mark Brown, Chuck Lane, and Susan Carstenn University of Florida
- Jeanne DiFranco, Maine DEP
- Mark Gernes, Minnesota PCA
- Judy Helgen, formerly MN PCA
- Mick Micacchion, Ohio EPA

Thank You...



Any Questions?