Ohio EPA Studies in Natural and Mitigation Wetlands

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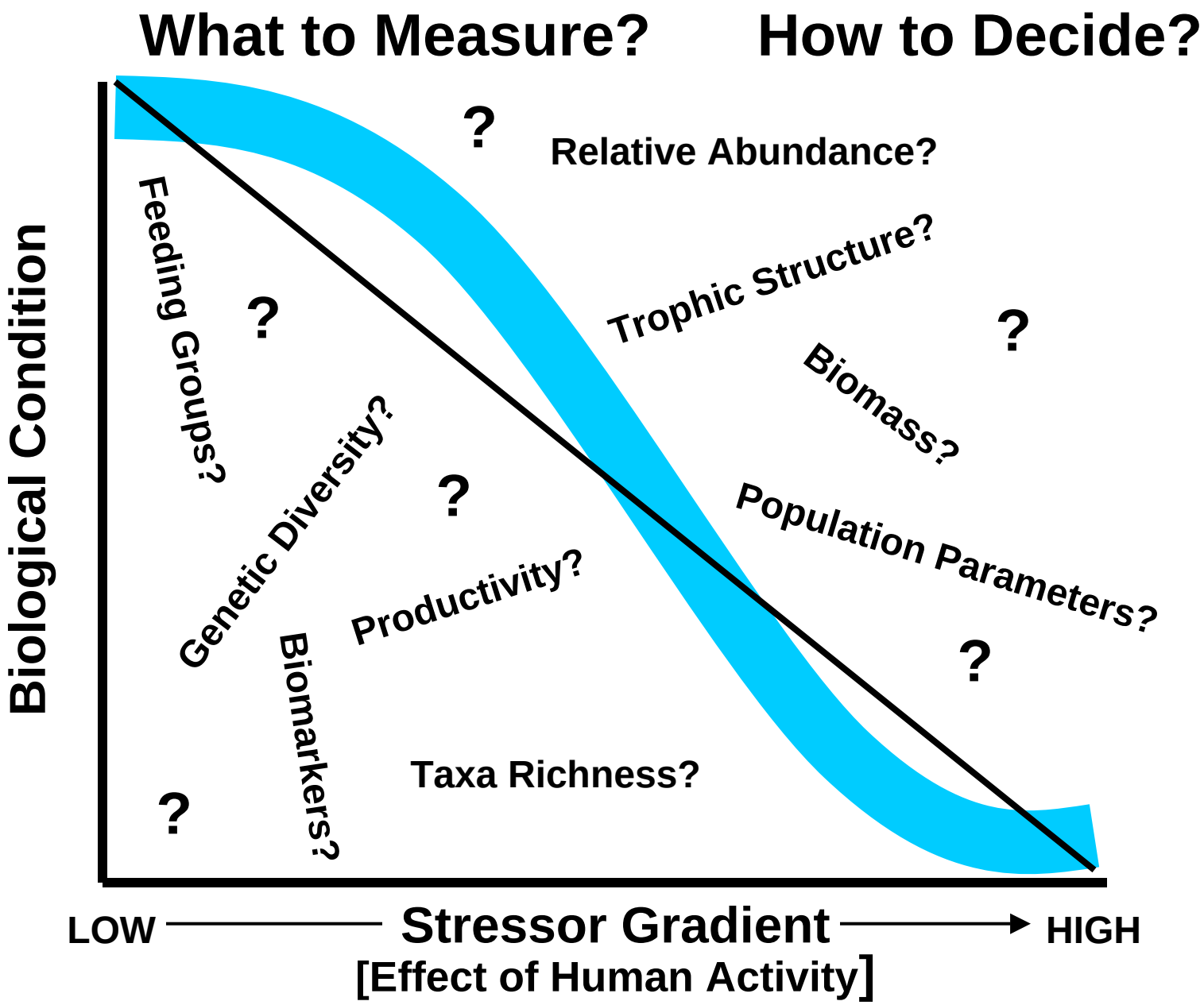
Wetland Assessment Methods

Developing Wetland Assessment Tools

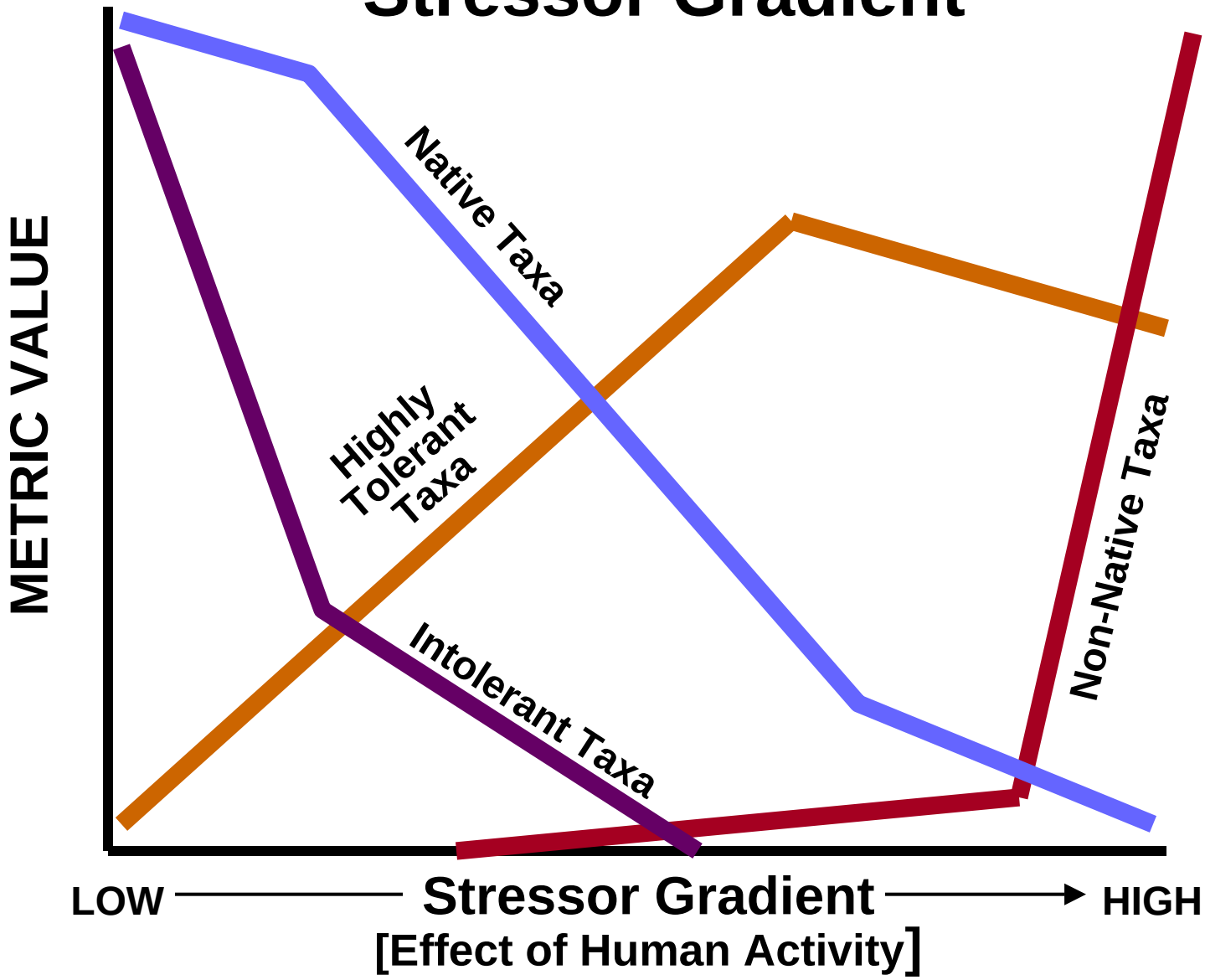
- Used an Index of Biotic Integrity Approach
  - Worked well in stream program
  - Does a good job of integrating physical, biological and chemical factors
  - Provides an overall measurement of condition which directly relates to the ecological services being provided
- Also worked on having a rapid assessment method -lead to development of ORAM 5.0

Monitoring Ohio's Wetlands

- Started monitoring Ohio's natural and mitigation wetlands in 1995
- Monitor the plant, amphibian and macroinvertebrate communities, chemical and physical attributes, and hydroperiods
- Have monitored over 300 natural wetlands and more than 75 mitigation wetlands including wetland mitigation banks
- Sites have been from all of Ohio's major ecoregions – have covered the entire state


What to Measure?
How to Decide?
Biological Condition
?
Relative Abundance?
Feeding Groups?
?
Trophic Structure?
?
Biomass?
Genetic Diversity?
?
Population Parameters?
Productivity?
?
Biomarkers?
Taxa Richness?
?
LOW
Stressor Gradient
HIGH
[Effect of Human Activity]

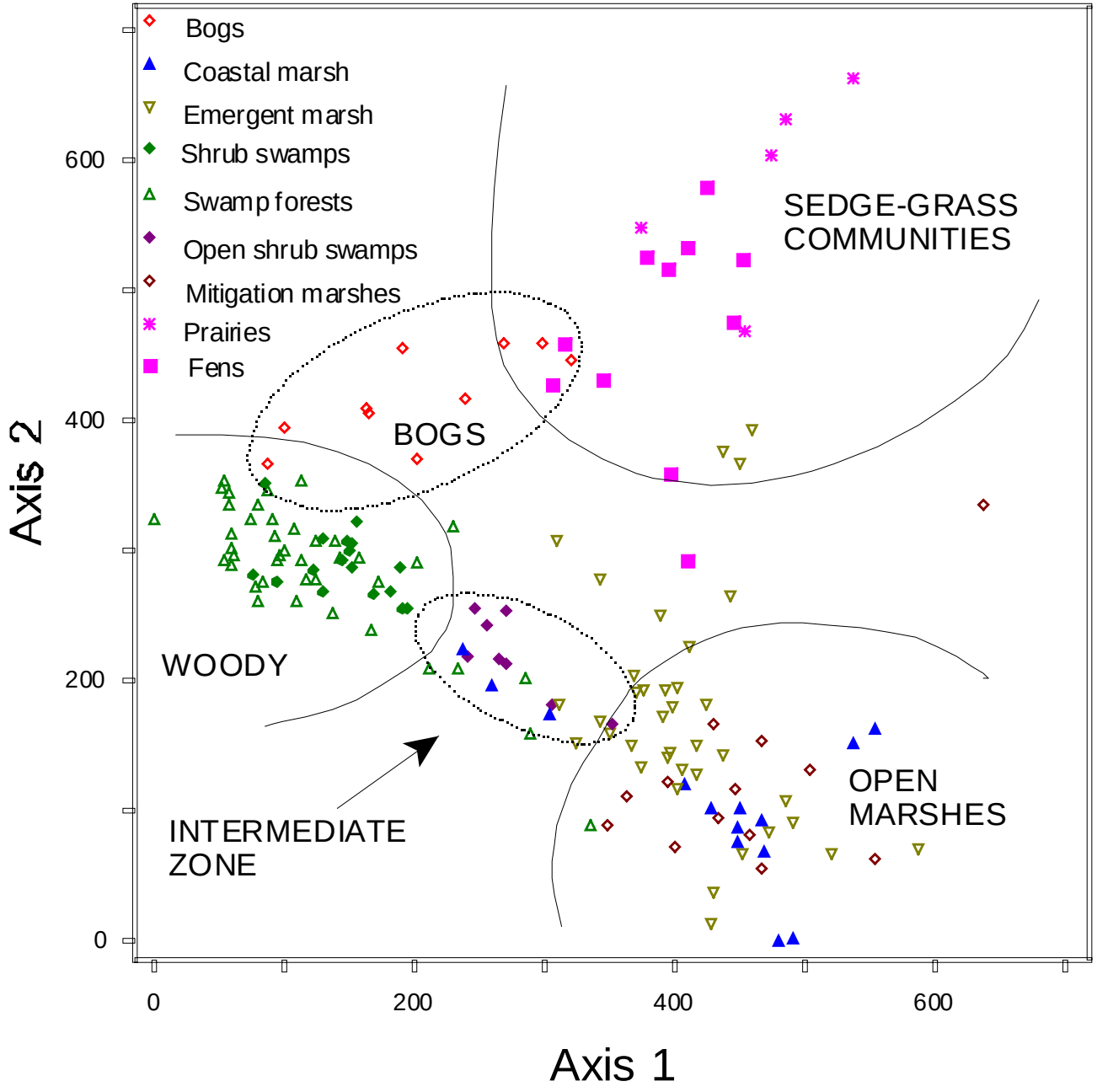
Metric Behavior Along the Stressor Gradient



Classification

- Two classification schemes used:
  - Dominant plant community
    - based on Anderson (1982), Cowardin et al. (1979), Ohio EPA data
  - Dominant landscape position
    - hydrogeomorphic (HGM) scheme (Brinson 1993)
- Also classified by ecoregion

Ordination of Wetland Data



Forested Depression, Pickaway County

Daughmer Savannah, Prairie Sedge Meadow, Crawford Co. Ohio

Slope (Hillside Fen), Miami Co. Ohio

Slope (Forest Seep), Mohican State Forest, Ashland, Ohi

Developing a Vegetation IBI

- Monitored over 250 natural wetlands using intensive vegetation survey methods
- Wetlands sampled
  - span the range of human disturbance
  - all over Ohio (all ecoregions)
  - all HGM and vegetation classes
  - includes a large mitigation wetland set
- Developed a Vegetation IBI that correlates strongly with human disturbance levels

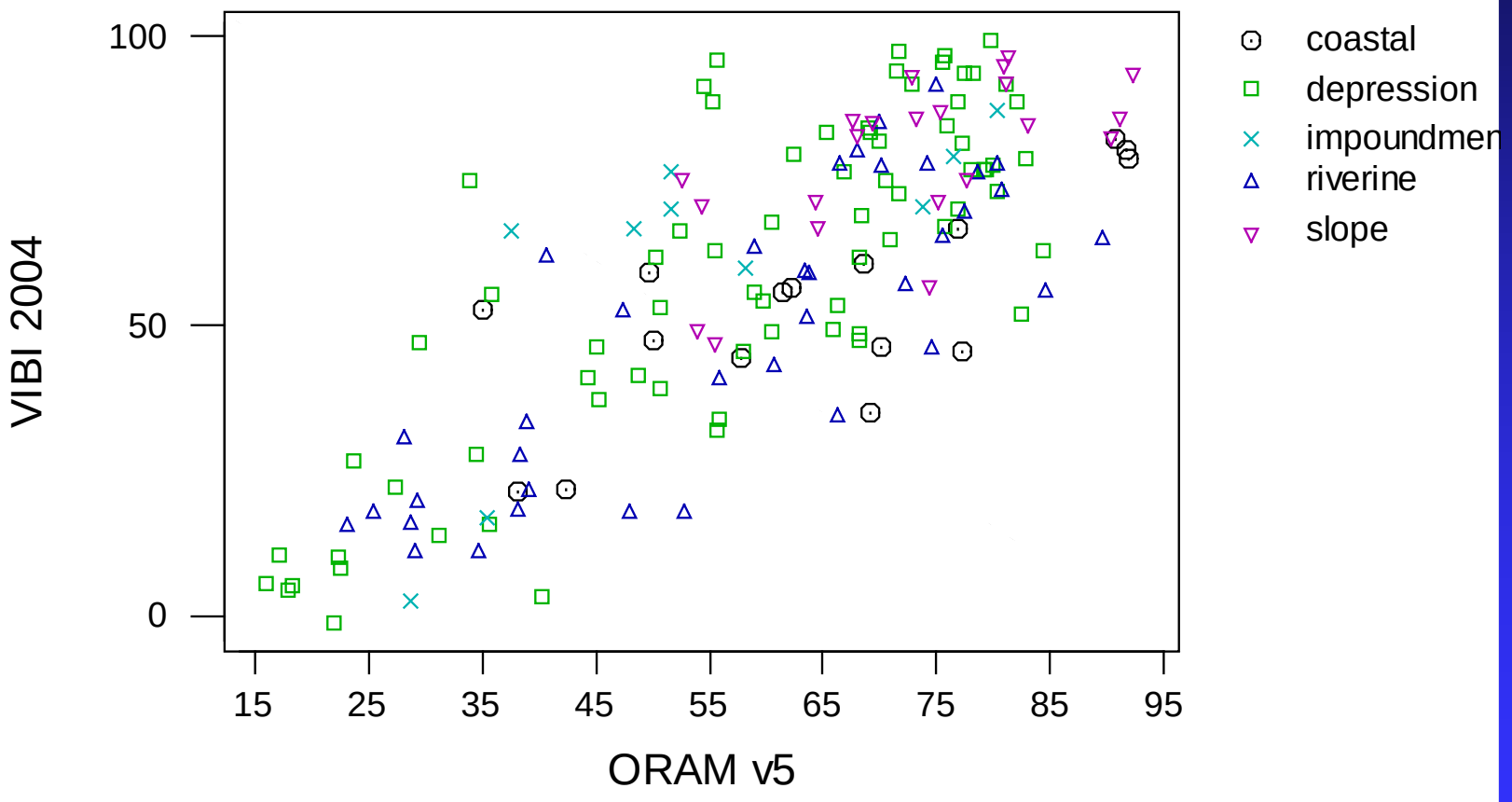
Parameters Monitored

- presence/absence (~2900 vouchers collected 1996-2004, 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
shrub	richness	X	X	X
hydrophyte	richness	X	X	X
shade species	richness		X	
seedless vascular plants	richness		X	X
FQAI	index	X	X	X
%tolerant	community	X	X	X
%intolerant	community	X	X	X
%invasive graminoids	community	X		
%bryophyte	community		X	X
subcanopy IV	community/productivity		X	X
canopy IV	index		X	
std biomass	productivity	X		

Vegetation IBI



Developing an Amphibian IBI

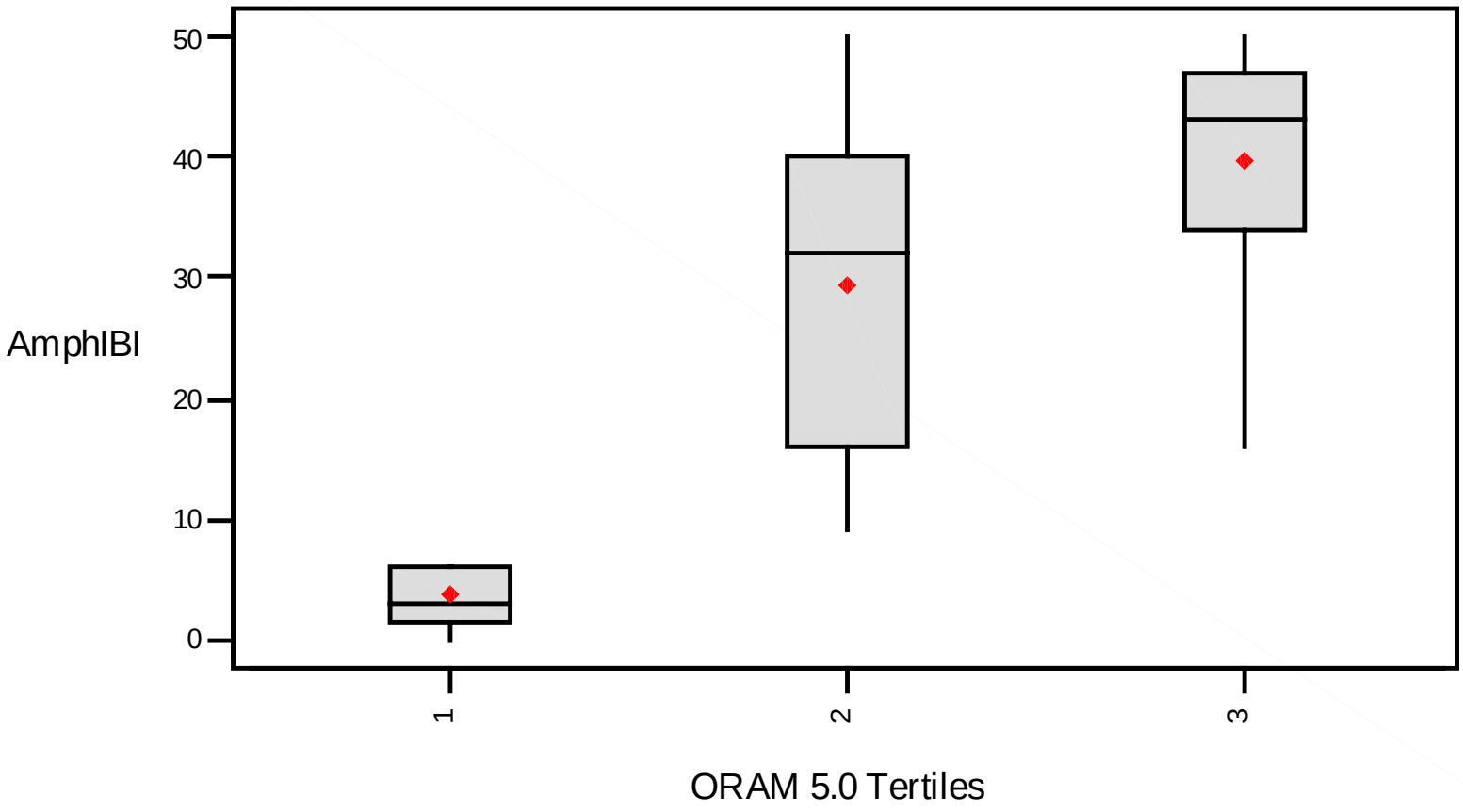
- Ohio EPA has been monitoring wetland amphibians since 1996
  - 1996-2005 monitored 172 natural wetlands
  - 2001 - monitored 4 wetland mitigation banks and 10 individual wetland mitigation projects
  - 2004 – monitored 8 wetland mitigation banks – 35 individual wetland subareas
- Amphibian Index of Biotic Integrity (AmphIBI)
  - 2002 – developed index
  - 2004 – tested with additional sites

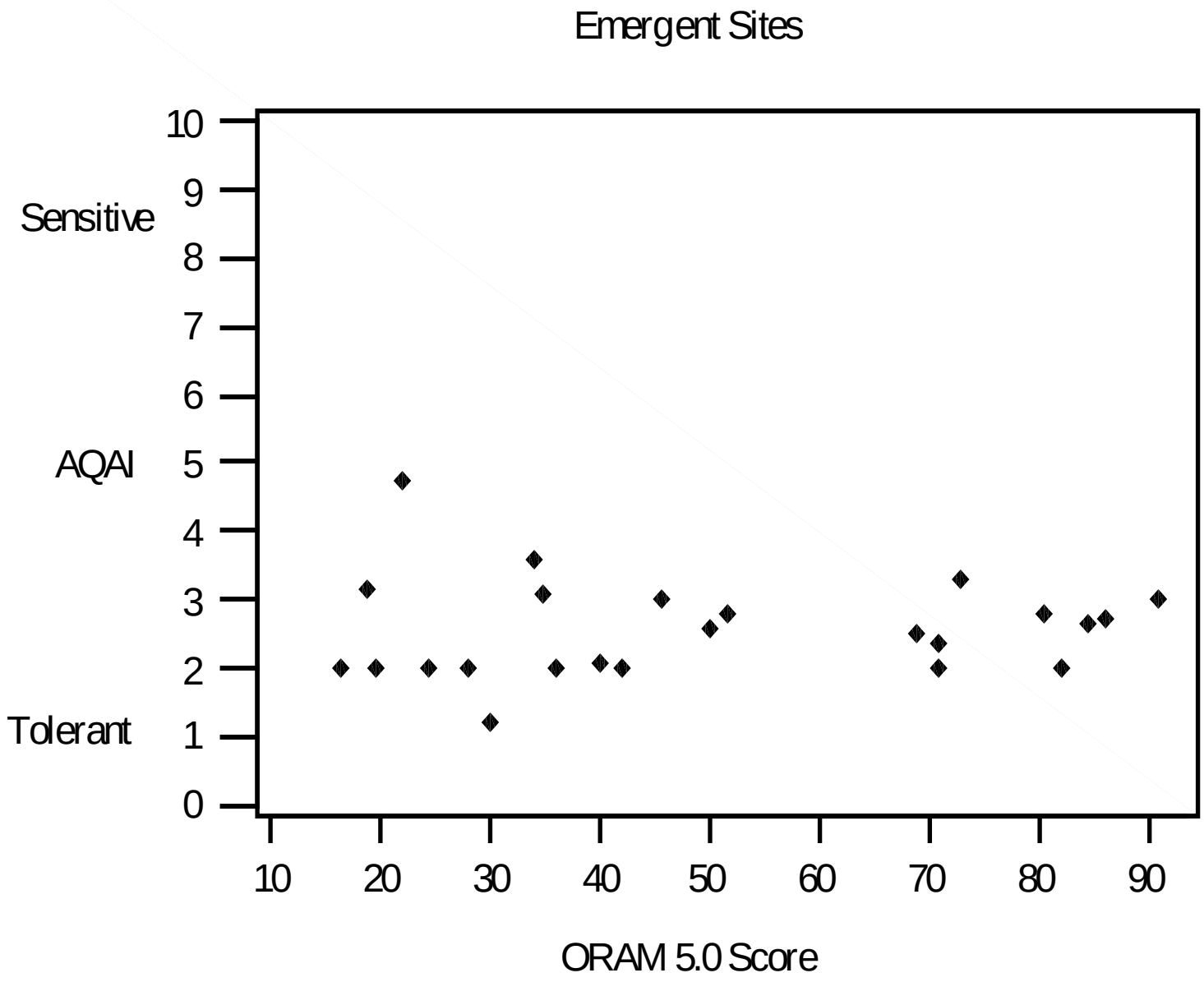
Amphibian Monitoring

AmphIBI Metrics

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

Amphibian IBI

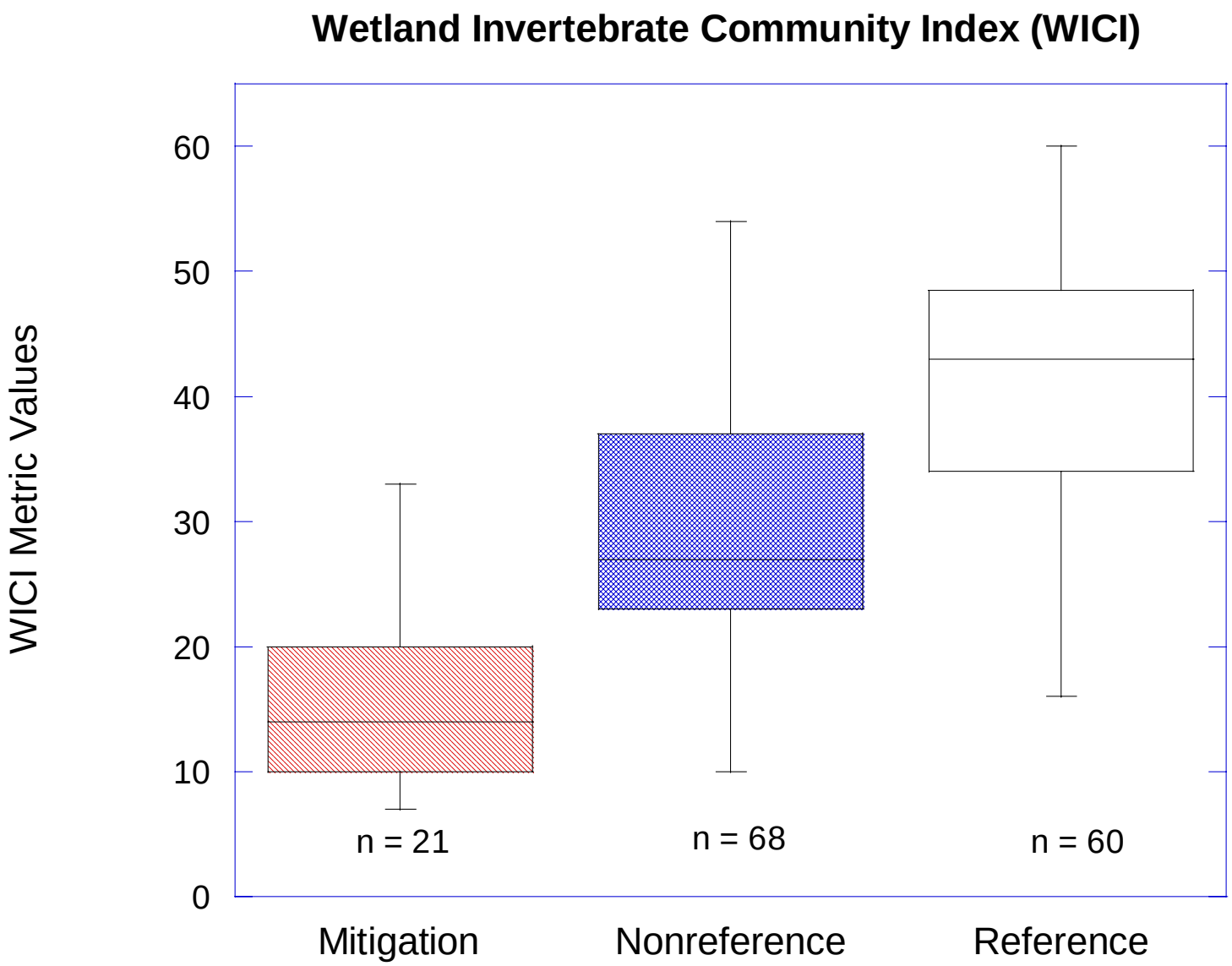



Emergent Sites
Sensitive
AQAI
Tolerant
10
9
8
7
6
5
4
3
2
1
0
10
20
30
40
50
60
70
80
90
ORAM 5.0 Score

Reasons for Absence of Sensitive Species at Emergent Sites

- Originally 95% of Ohio was forested – sensitive species are adapted to this environment
- Many emergent wetlands have stream hydrology inputs and therefore predatory fish populations
- Often wetlands are predominately emergent due to past disturbances

Wetland Invertebrate Community Index

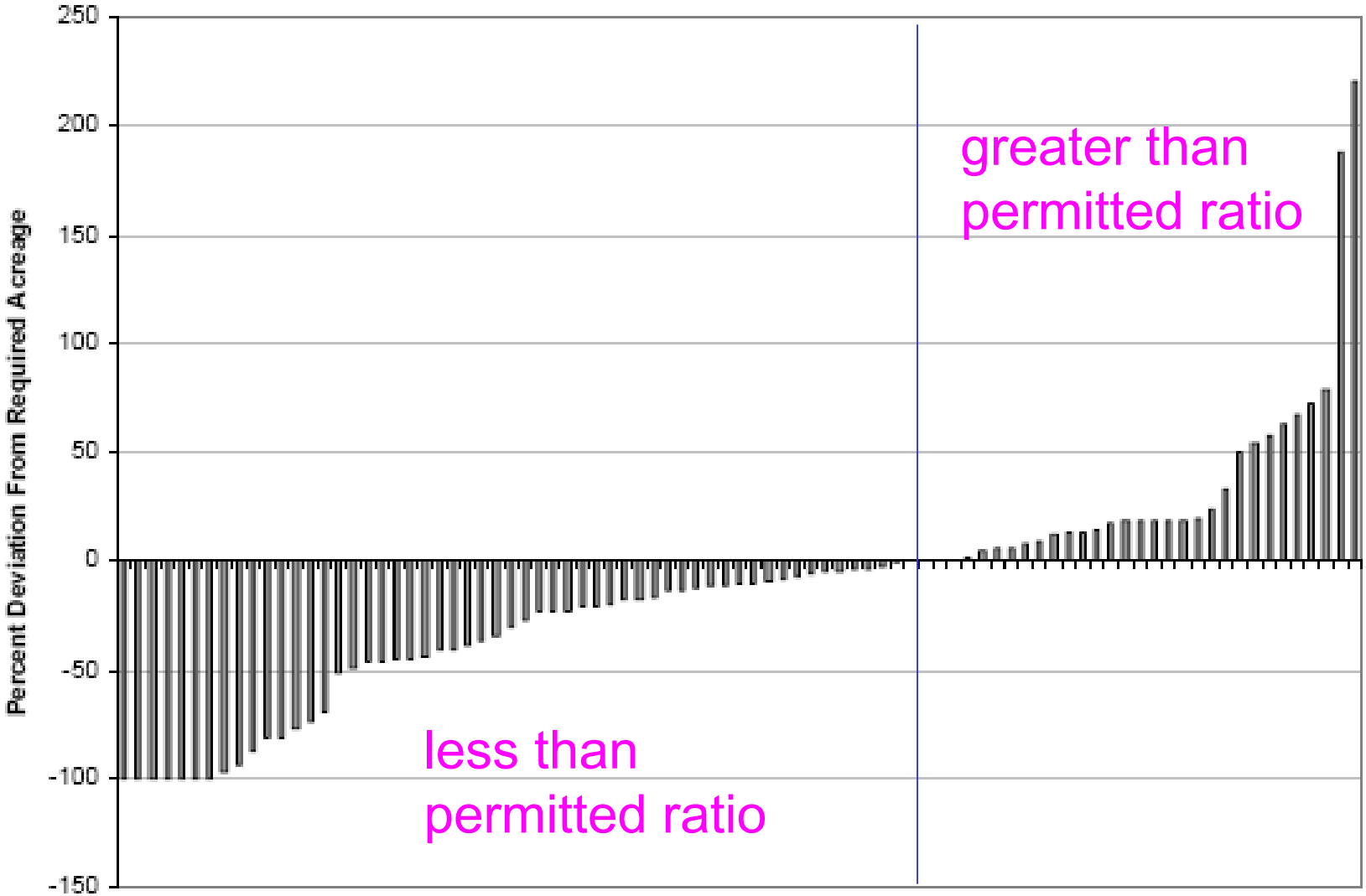


Wetland Mitigation Studies

2002-2004 Mitigation Inventory Surveys – Deni Porej & Chad Kettlewell

- 101 projects (178 wetlands)
- 71.2% of required acreage constructed
- 425.3 ac wetland impacts, 697.8 ac required, 496.8 ac constructed (71.2%)
- Replacement ratio 1:1.17
- Approx. 95% emergent marshes
- 5% no mitigation constructed

“No net loss” in Ohio



Types of Wetland Impacts and Replacement Occurring in Ohio

- Most impacts are to hydrologically isolated depressions
  - A large percentage of these are forested wetlands or shrub wetlands in a forested setting
  - Somewhere between 40-50% of impacts occur to forested and shrub depressions
- Replacement through mitigation projects has not resulted in replacing these systems

Where along the continuum do mitigation wetlands fall

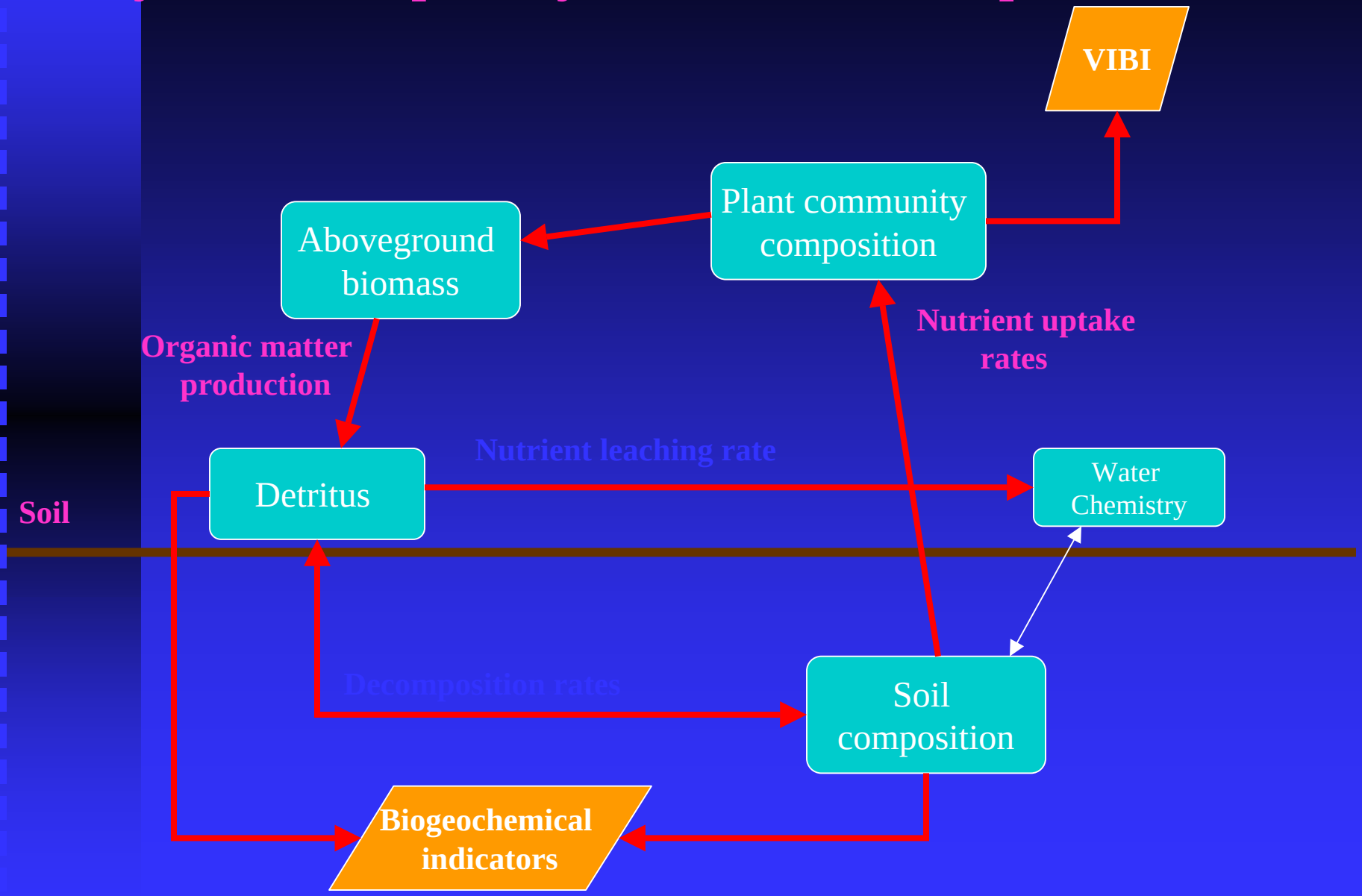
Least impacted

Most disturbed

Range of Natural Wetland Condition

slide from Fennessy and Roksosh 2002

Ecosystem complexity: Measured components

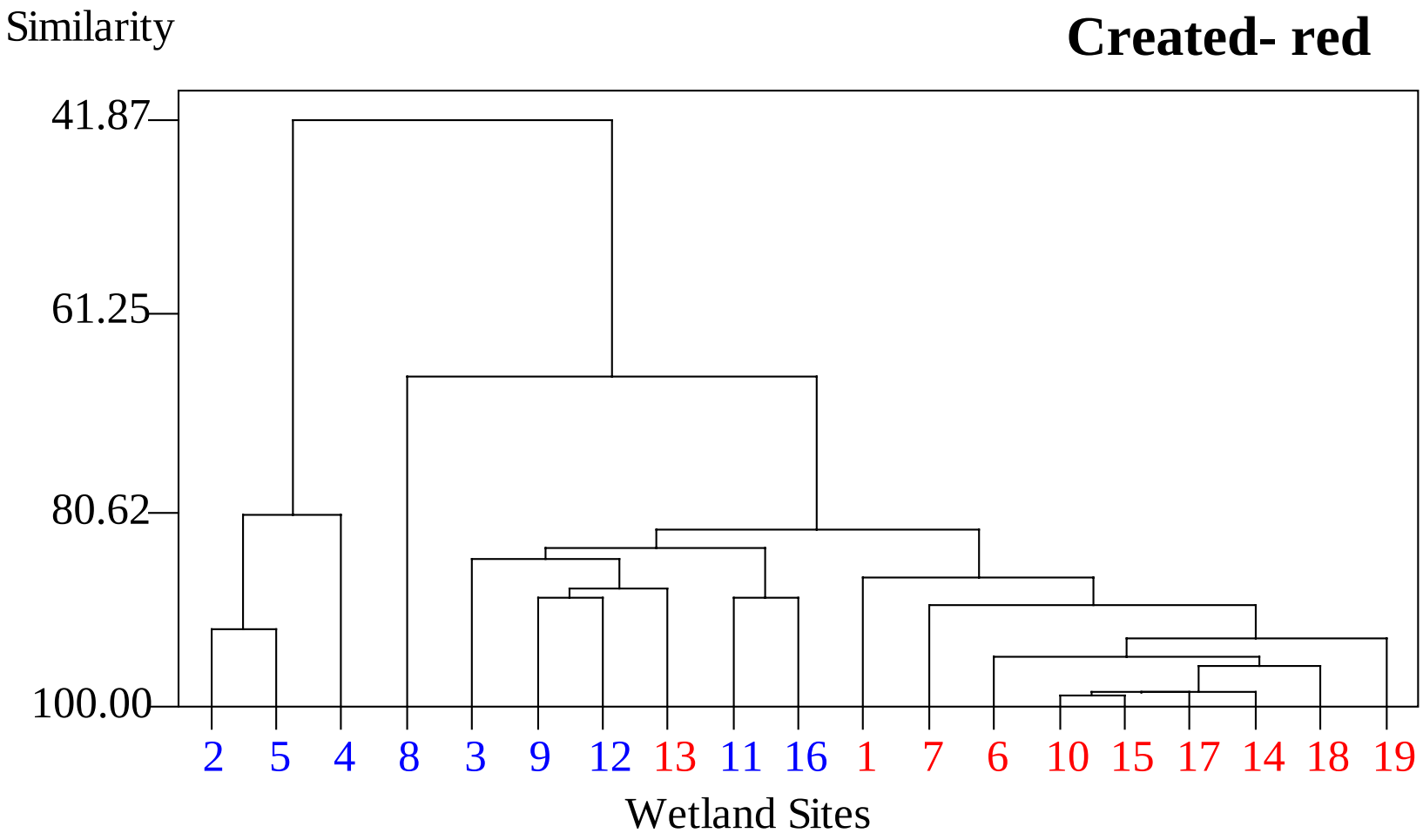


slide from Fennessy and Rokosch 2002

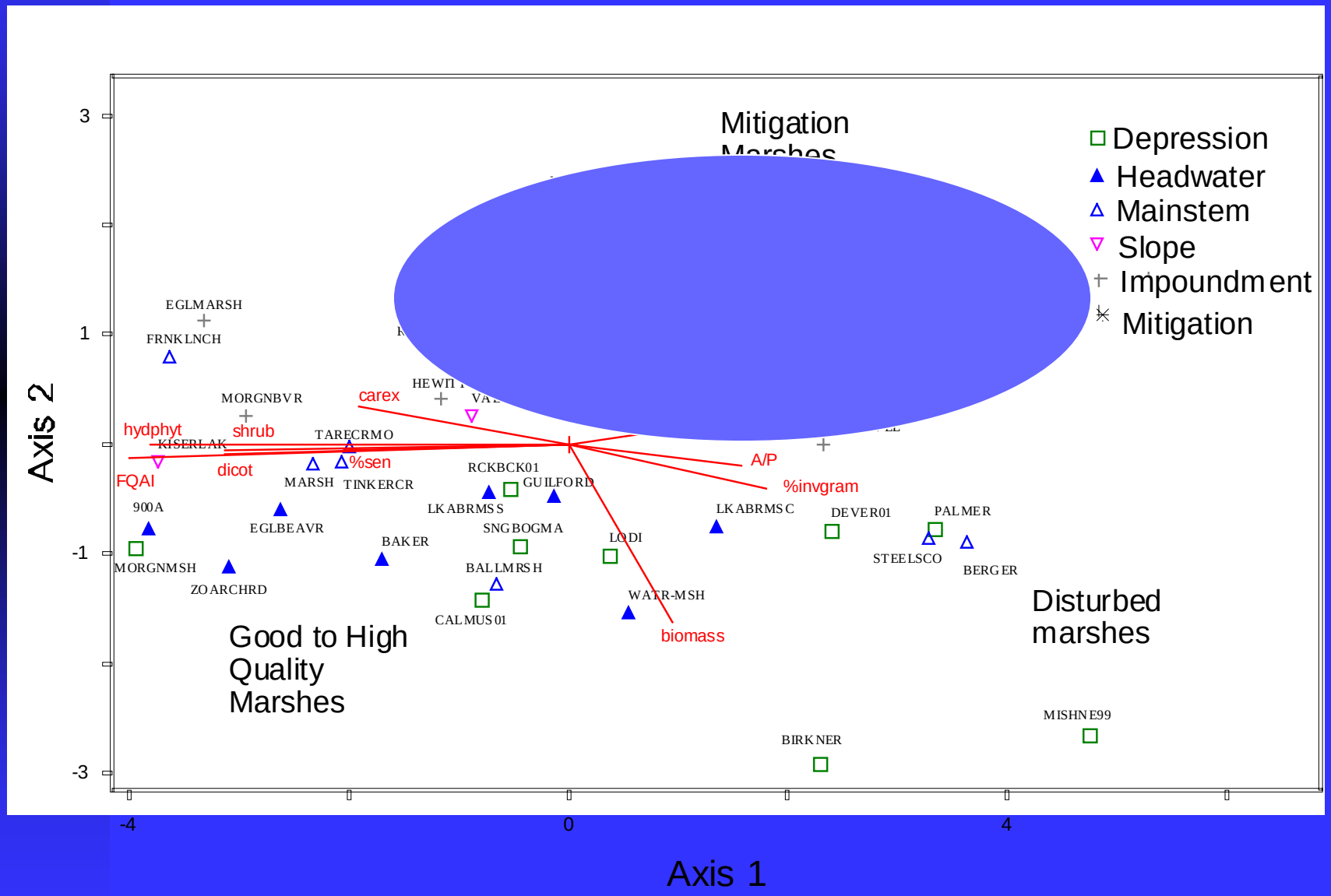
Using wetland flora, decomposition rates, and soil chemistry to evaluate mitigation wetland success

A Comparison of the *Similarity* between Natural and Created Wetlands, Fennessy and Rokosch 2002

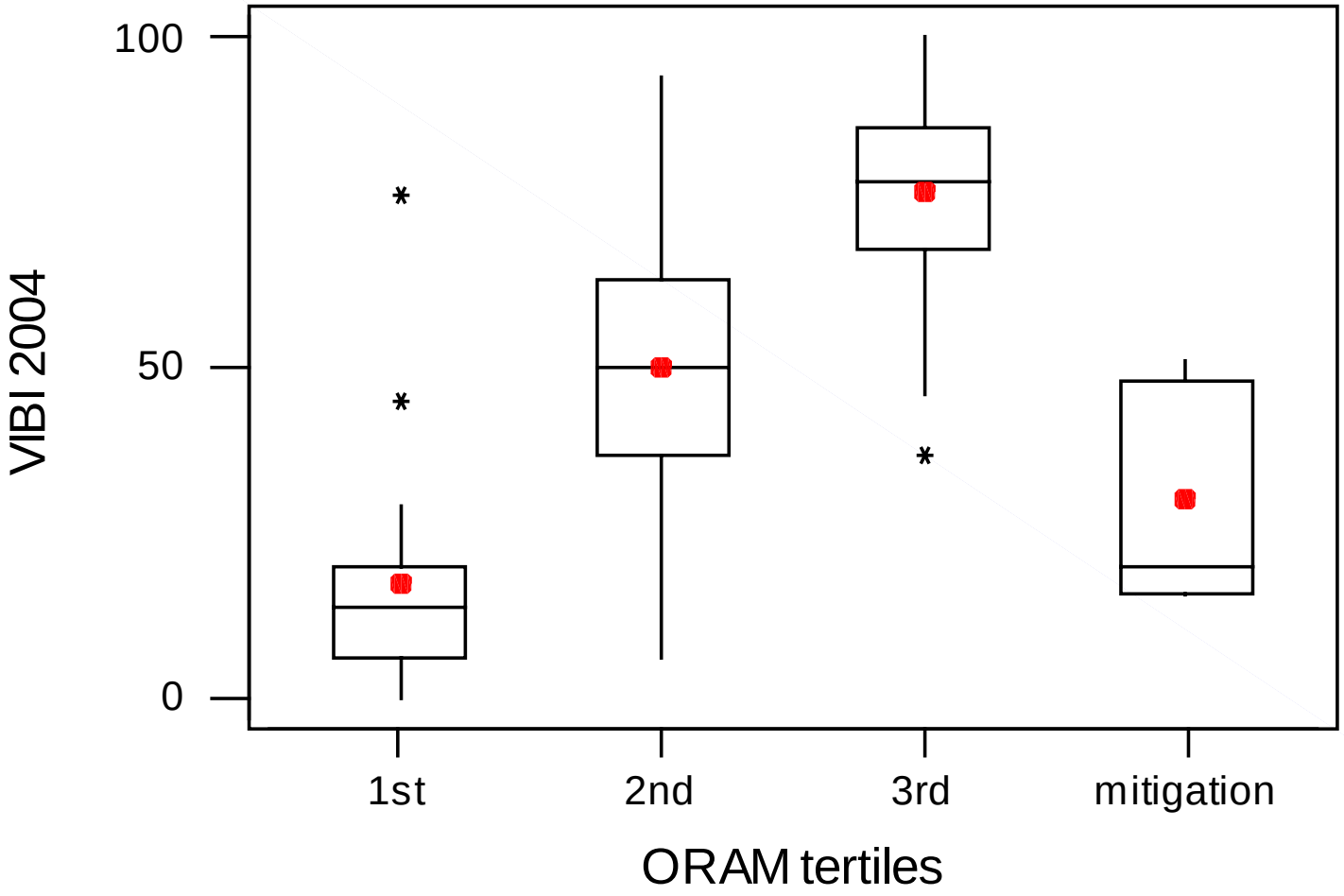
Natural- blue
Created- red



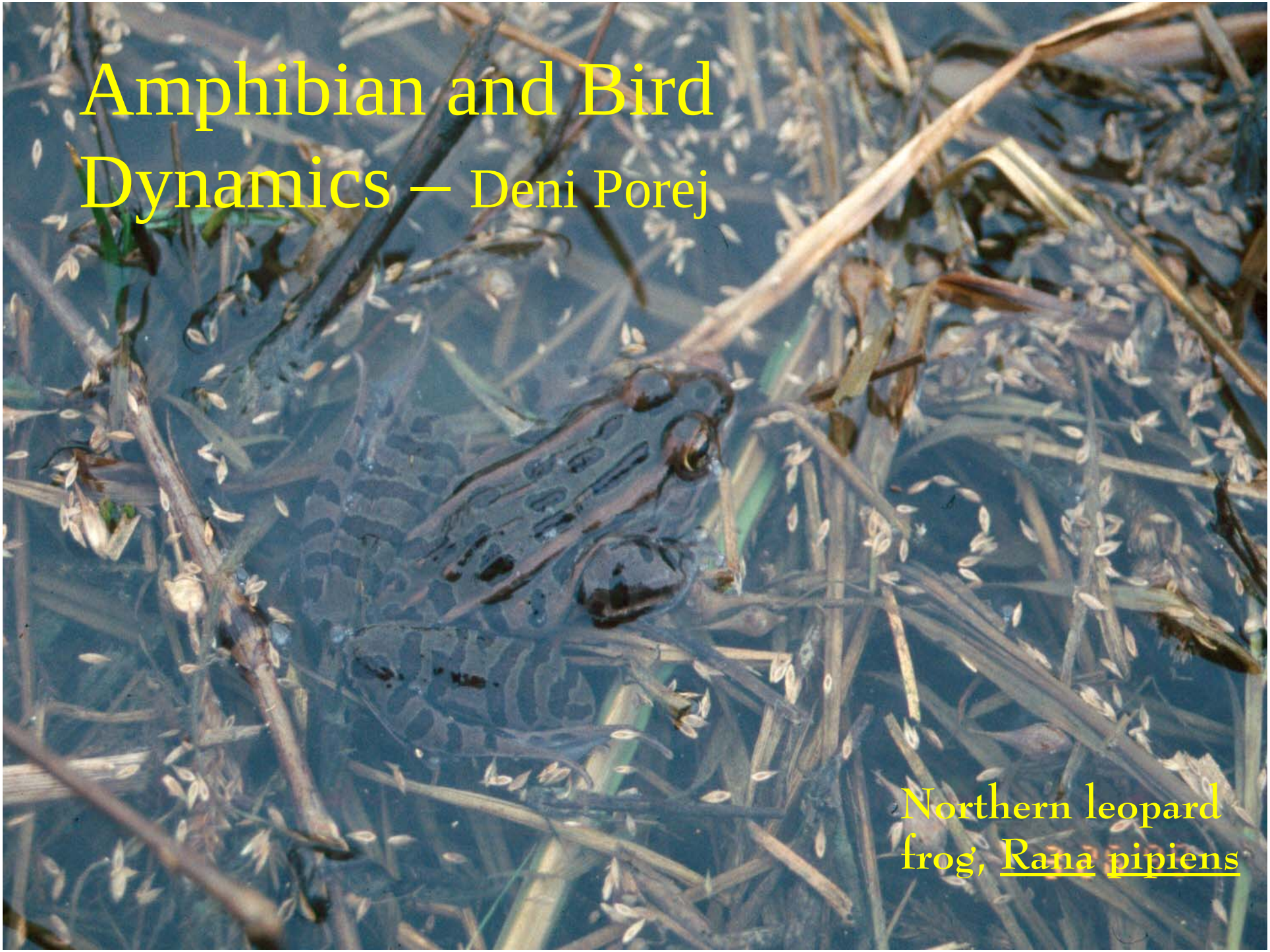
Using IBIs to evaluate mitigation wetland success



Vegetation IBI (1996-2002)



Amphibian and Bird Dynamics – Deni Porej



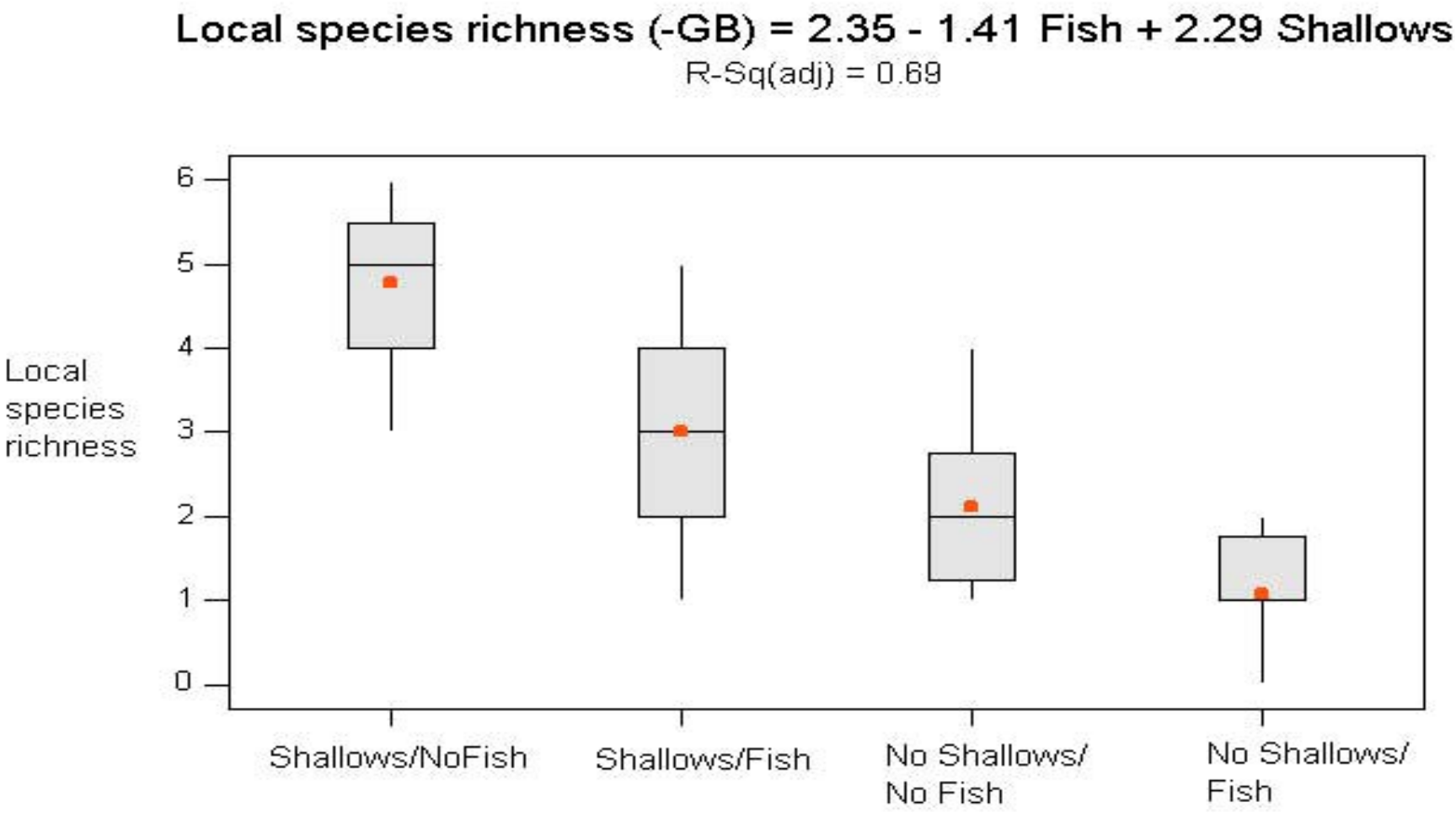
Northern leopard frog, Rana pipiens

Wetlands with “Shallows”

Slope of 1:15 or less over a 15m transect, >50% emergent vegetation

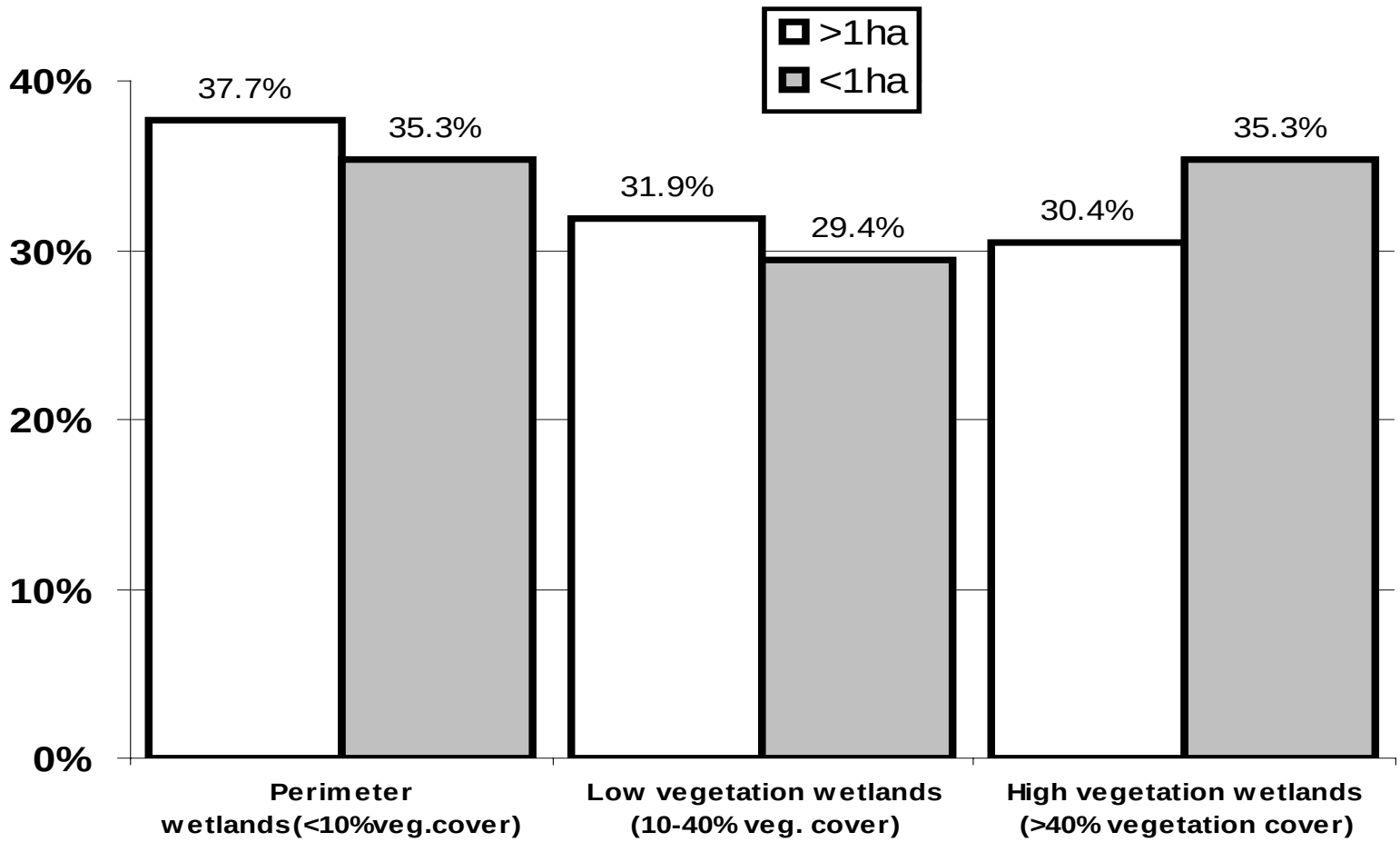
Wetlands without “shallows”

Association of “shallows” & fish predation with amphibian α - diversity



All coefficients significant at $p < 0.05$ level

Vegetation pattern in replacement wetlands



VEGETATION COVER

Slides from Deni Porej, TNC

Changes in amphibian communities

	Forested	Emergent	Mitigation
Red spotted newt	27	0	5
Spotted salam.	55	0	2
Jefferson salam.	45	12	0
Smallmouth salam.	86	31	20
Tiger salam.	64	38	5
Salamanders (sp/site)	3.00	0.92	0.26
Gray treefrog	27	33	31
N. spring peeper	64	92	53
Western chorus frog	42	41	22
Bullfrog	18	38	55
Green frog	64	54	68
N. leopard frog	45	85	65
Wood frog	27	0	0
American toad	0	8	48
Frogs & toads (sp/site	2.77	3.31	3.96
Total (sp./site)	5.77	4.23	4.32

Wetland bird responses to wetland vegetation pattern

	Perimeter wetlands	Low vegetation cover	High vegetation cover
Breeders	Pie-billed grebe 4.58 ± 0.60	Mallard Canada goose 7.26 ± 0.57	Virginia rail Sora Swamp sparrow Marsh wren Willow flycatcher Wood duck 9.74 ± 0.62
All birds	11.02 ± 1.37	17.39 ± 1.31	21.83 ± 1.42
Migrating waterfowl	29.34 ± 3.44	34.75 ± 3.28	17.57 ± 3.57
Migrating shorebirds	6.66 ± 1.97	15.66 ± 1.87	5.72 ± 2.04

Recommendations- Deni Porej's thesis

- Follow-up is necessary
- Hydrological equivalence
- Bank slopes 1:15 or less
- Restore forested and shrub wetlands with seasonal hydrology
- Avoid consolidation – several diverse pools rather than one big pool (maximize ß diversity)
- Require similarity in the landscape context, find creative ways to preserve terrestrial buffers

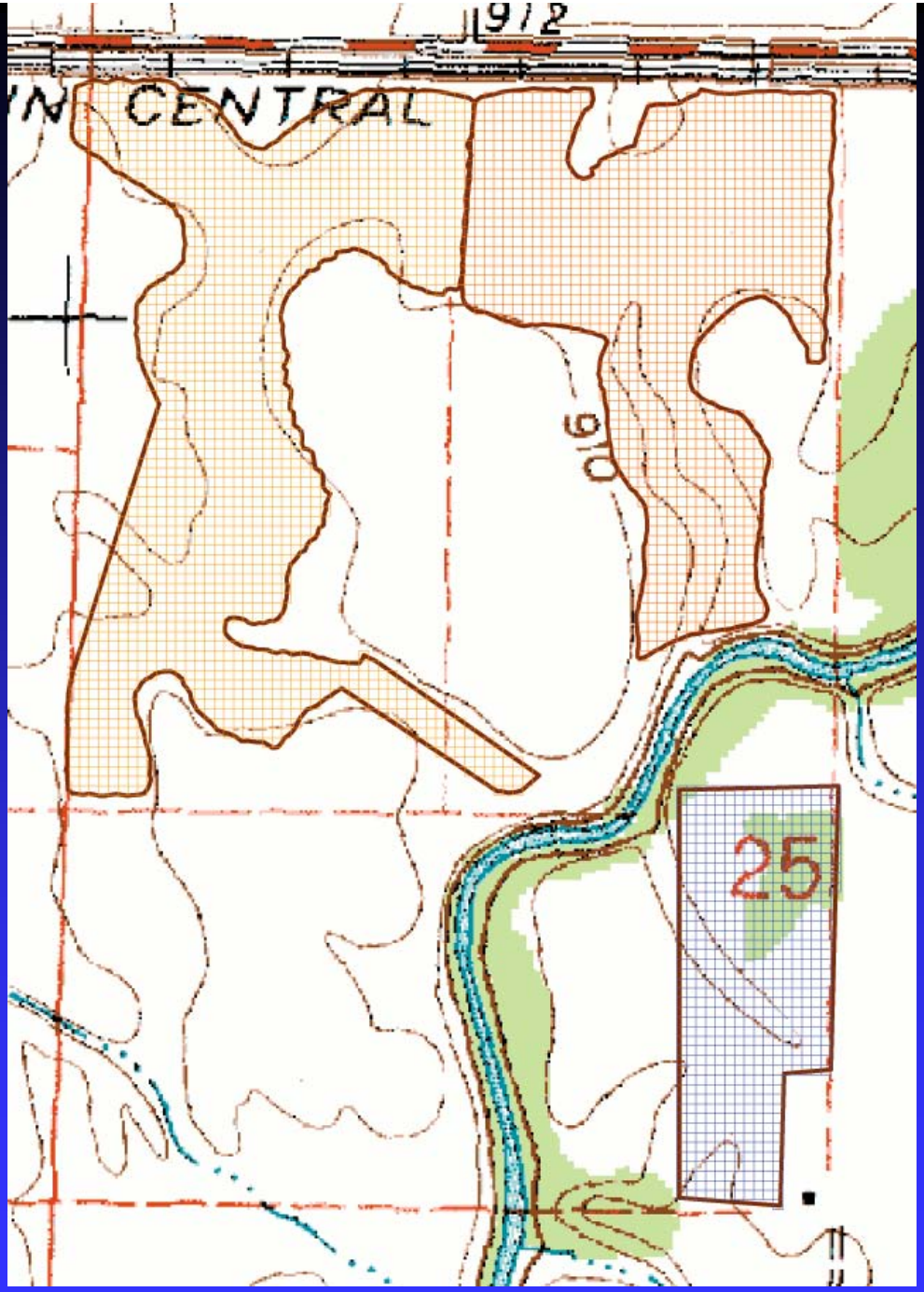
Mitigation Bank Study

- Monitored 33 subareas at 12 wetland mitigation banks
- Total = 999.2 acres (404.4 hectares)
- Data collected in 2003 and 2004

Bank Study Design

- Collected data on banks flora, fauna, soil and water chemistry and hydrology
- Monitored plants using 42 fixed and 331 random plots
- Monitored amphibians and invertebrates 1040 funnel traps & 104 qual. samples
- Took grab water samples and used auger for soil samples
- Hydrology - used automated water recorders deployed for a year

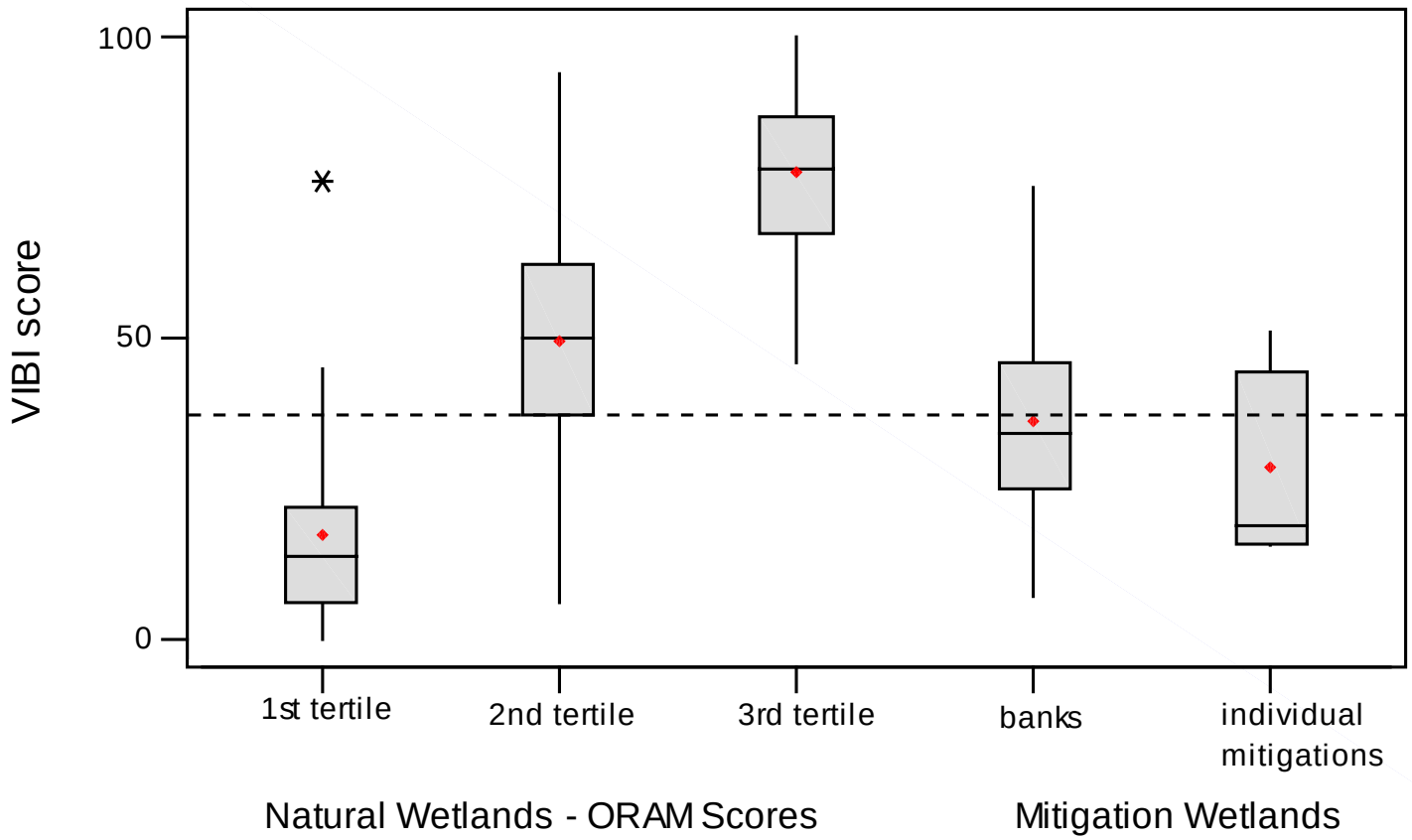
Random plot sampling variation



Results of Bank Vegetation Surveys

- Open water – 0 to 82% - avg = 29%
- Unvegetated open water – 0 to 75.8% - avg = 19%
- Net loss of wetland acreage = 157.1 acres
- Net loss at sold out banks = 105.3 acres
- Plant communities present:
  - 46% emergent marsh
  - 17% wet meadow
  - 11% forest, 4% dead forest
  - no natural shrub communities

Ecological Quality of Ohio Banks

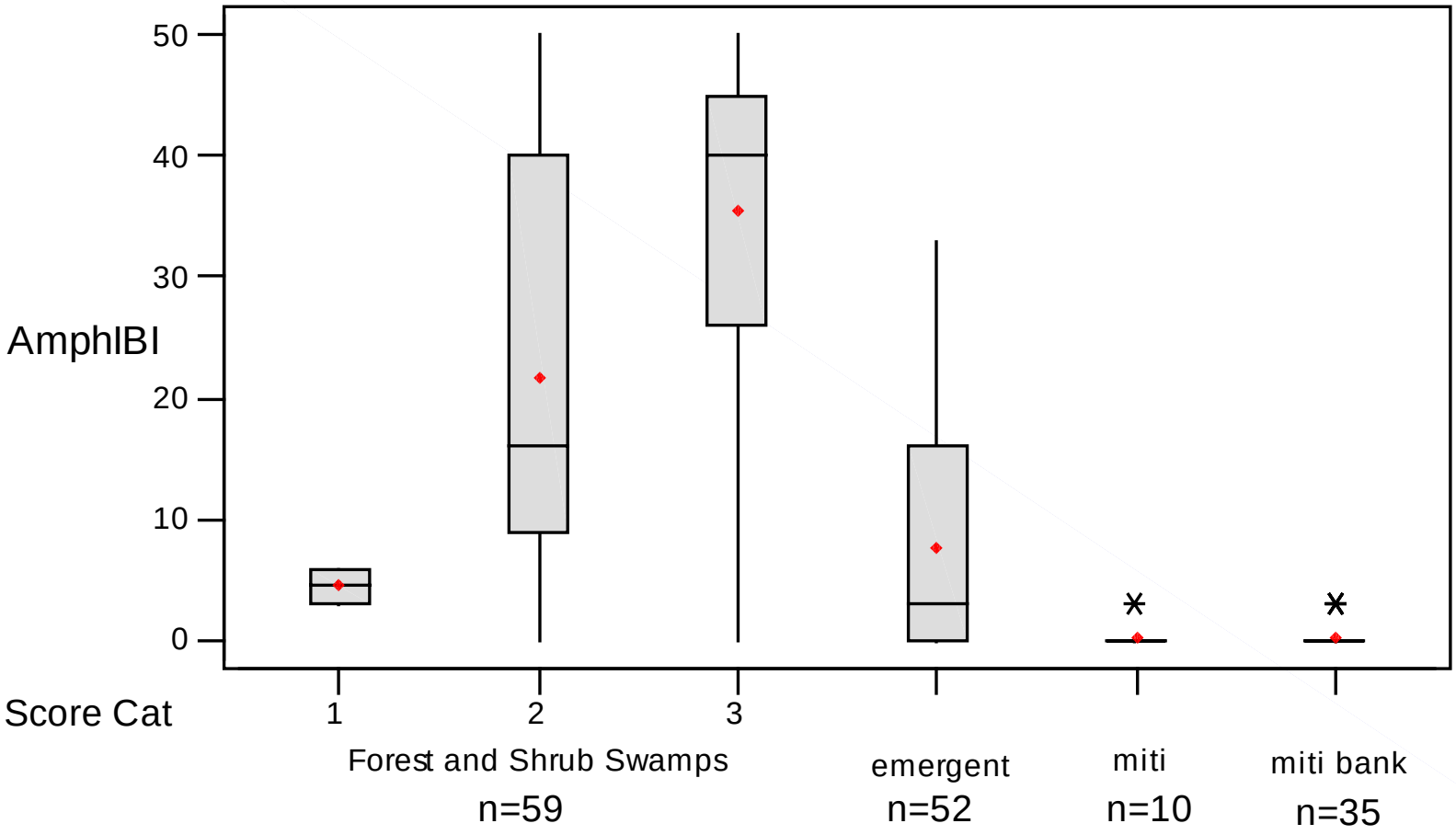


Species Composition of Wetland Mitigation Banks

- Abundant
  - Green frog, Rana clamitans 38%
  - Toads, Bufo sp. 21%
  - Leopard frog, R. pipiens 19%
  - Bullfrog, R. catesbeiana 12%
  - Spring peeper, Pseudacris crucifer 5%
- Absent or extremely rare
  - All ambystomatid salamander species
  - Red spotted newt, Notophthalmus viridescens
  - Wood frog, R. sylvatica
  - Spotted salamander, Ambystoma maculatum

Boxplots of AmphIBI by Wetland Type

(means are indicated by solid circles)



Bank Limitations to Amphibian Usage

- Presence of predatory fish – stream hydrology
- Permanent vs. seasonal hydrology
- Steep slopes and lack of vegetation – vegetation present is emergent class
- Narrow or no buffers and intensive surrounding land uses
- Large sizes minimizing edge habitats

Conclusions

- We have monitored wetlands
  - all ecoregions of Ohio
  - spanning the range of disturbance
  - all plant & HGM classes
  - including mitigation
- We have developed assessment tools (IBIs) that accurately measure wetland condition (quality)
- Wetland mitigation projects are not performing like the natural wetlands they are replacing

Thank You!