Wetlands Bioassessment: the 1 – 2 - 3 approach

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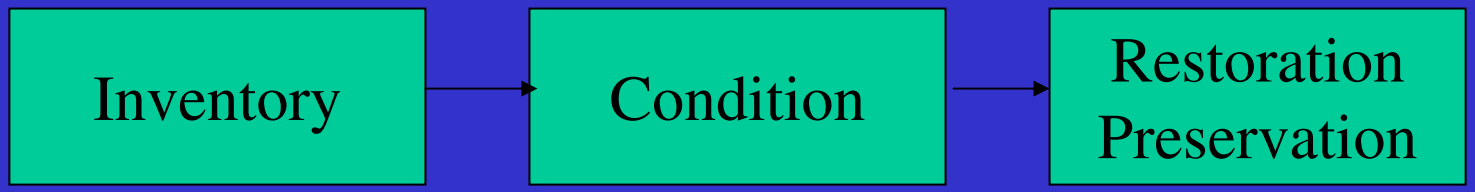
Wetland Assessment

- Current wetland bioassessment thought outlines 3 levels of assessment:
- Level 1: landscape level assessments using remote data and without site visit
- Level 2: "rapid" assessments with habitat, function, and stressor checklists with site visit
- Level 3: detailed biological and/or biogeochemical surveys with quantitative data collection of floral, faunal, physical, and/or chemical characteristics of wetland

Fundamental Questions

- Where are (or were) the wetlands on the landscape? (Inventory)
- How do we assess their ecological integrity? (Condition)
- How do we use this information to improve condition (Restoration) or protect and maintain the existing resource (Preservation)



INVENTORY

CONDITION

RESTORATION PRESERVATION

Level 1 Assessment

Use existing remote sensing map resources, e.g. NWI maps

Map land use in watershed; calculate preliminary landscape measures

Initial map of condition and location of existing and former wetlands; target assessment watersheds

Level 2 Assessment

Field verification and develop of maps of existing and former wetland location

Add site observational data; use in permit program; use in probability based sampling

Preliminary map of restoration and perservation locations; assess wetlands proposed for impact in permit applications

Level 3 Assessment

Develop landscape profiles of existing and former wetland resource And final verified maps based on GIS, field verification, and Predictive models

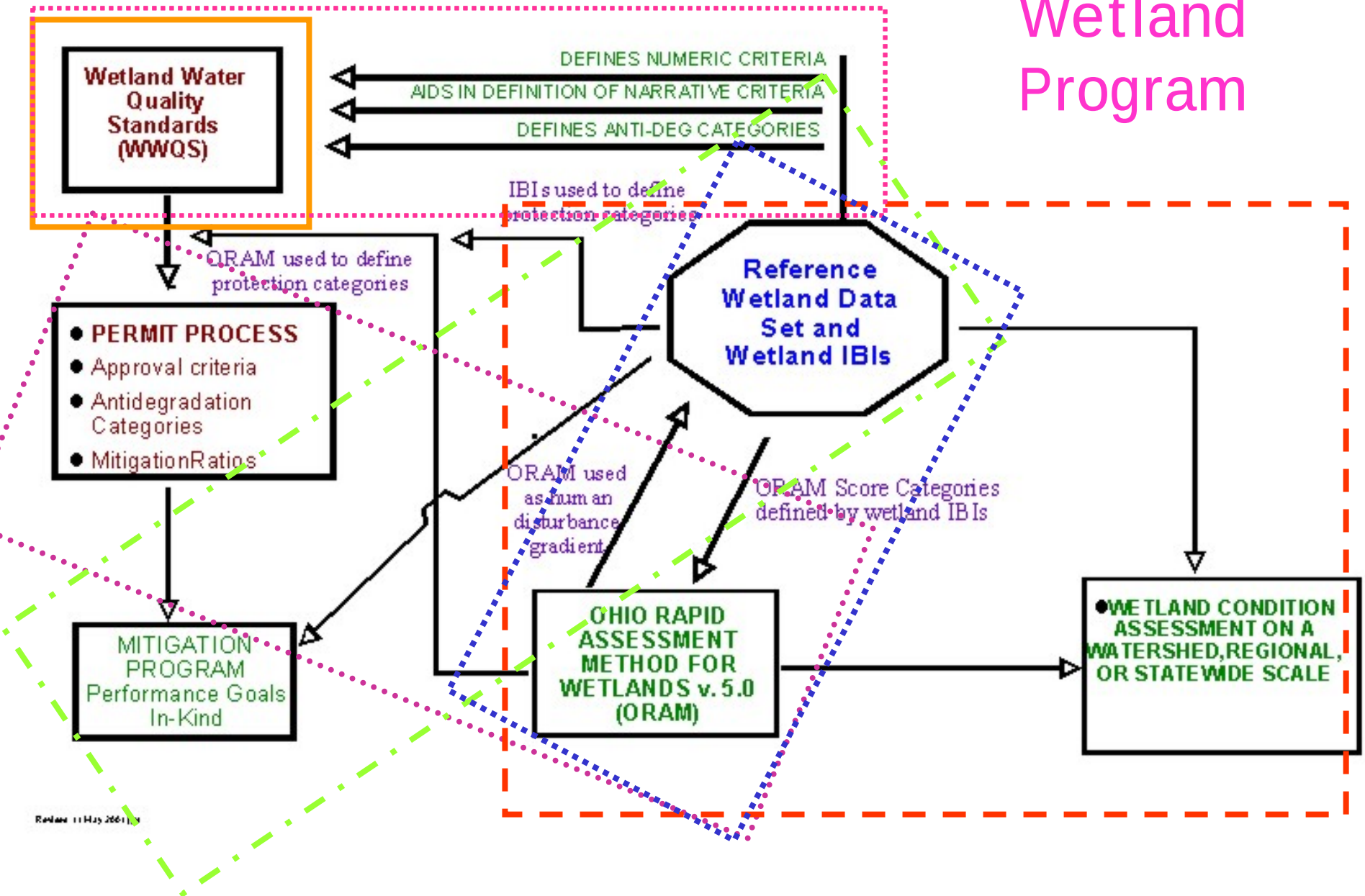
Apply IBIs w/ HGM classification to targeted or probability based sampling locations

Detailed map showing wetland abundance and condition

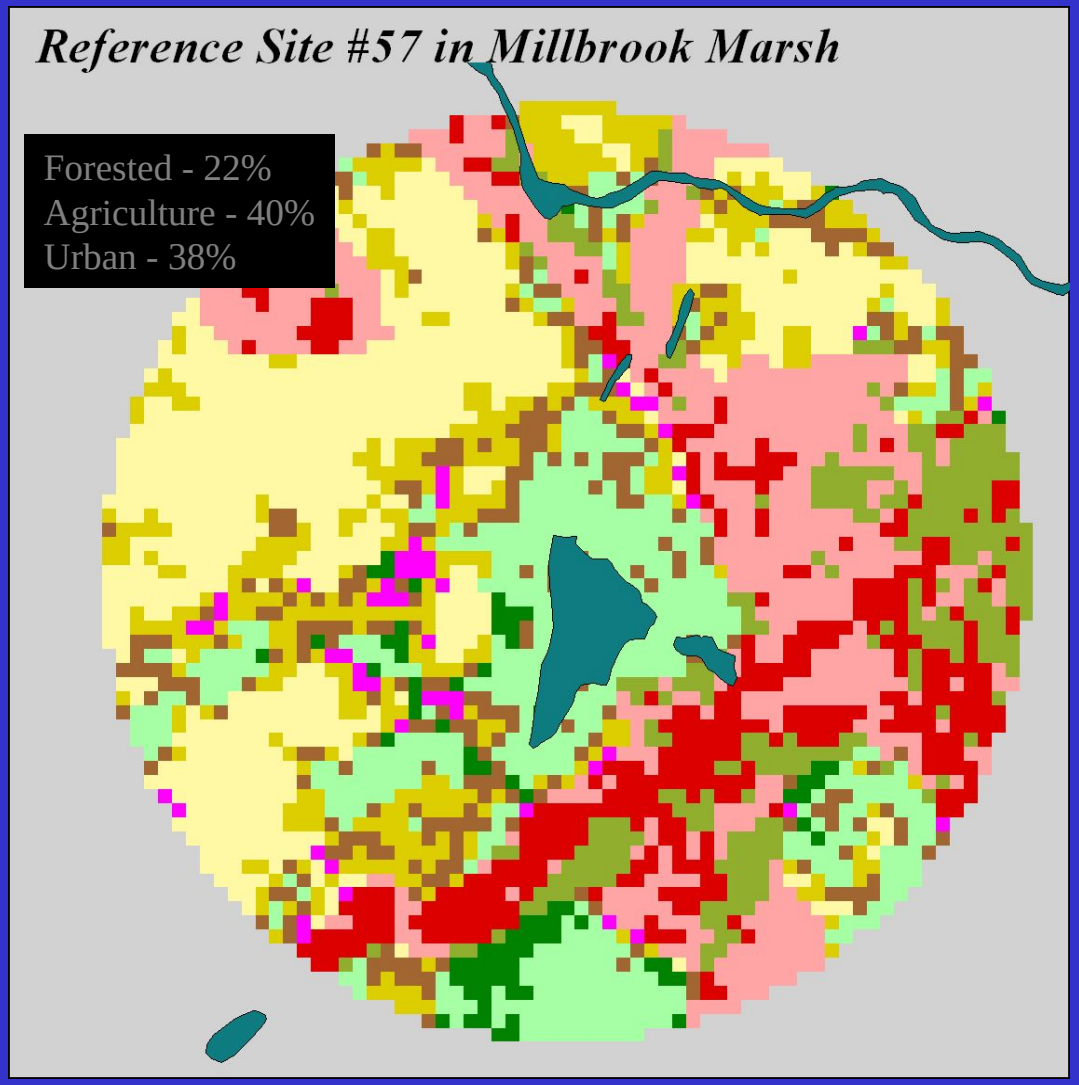
Performance standards for wetland mitigation

Slide Concept: Robert Brooks, Penn State Cooperative Wetlands Center

Ohio Integrated Wetland Program



Level 1:
Landscape Level Assessment



FL Landscape Development Intensity (LDI) Index

- Quantifies disturbance gradients
- Independent measure of disturbance using land use/land cover, aerial photographs, and ground observations
- LDI multiplies land use percents by weighting factors
- Weighting factors based on calculation of supplemental “emergy” needed to maintain non-natural landscapes

$$LDI = \Sigma (LDI_j * \%LU_j)$$

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"

Rangeland, 3.03
Upland Forest or Wetland, 1.0
Citrus, 5.73
Intense Row Crops, 6.84
Study Wetland
100 m buffer

Morgan Swamp, Northeast Ohio

Stages Pond, Central, Ohio

Calamus Swamp, Central, Ohio

Comparison of Level 1 Results

Land use data in 1km radius circle from center of wetland. Land use based on National Land Cover Dataset

	Morgan Swamp LU%	Stages Pond LU%	Calamus Swamp LU%
Natural water	2.6	3.2	1.1
Forest	**47.3**	8.6	5.2
Wetland Forest	**26.6**	0.1	1.2
Wetland Emergent	**14.8**	0.2	0.3
Pasture	5.8	9.5	12.0
Row crop	2.9	**78.4**	**80.2**
Suburban	0	0	0
Rock-Transitional	0	0	0
Urban	0	0	0
LDI Score	**1.31**	**5.90**	**6.10**

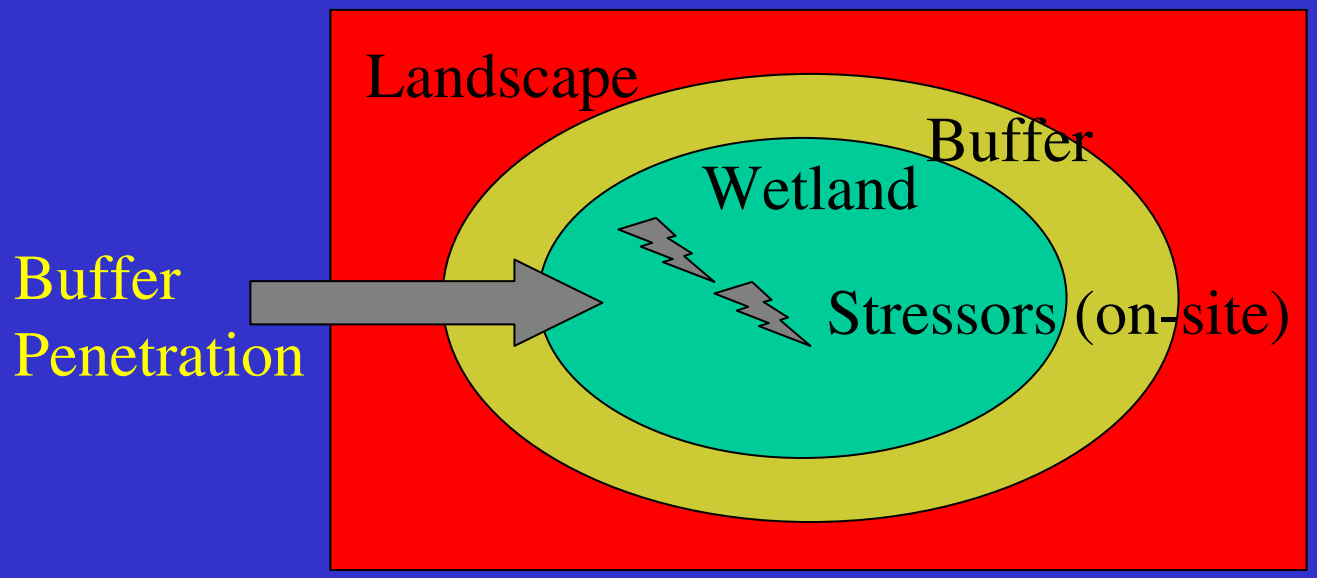
Level 2:
Rapid Assessment

Semi-quantitative scales

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

Rapid Assessment Score

- Combination of landscape, buffer, and site-specific stressors
- Score=Buffer+(%For*WF)-Buffer Hits



A brief history of the ORAM

- 1996-97. Field testing of methods from Washington, Minnesota, Oregon, Wisconsin
- 1997. Development of ORAM v. 1.0, 2.0 and field testing by ORAM technical workgroup
- May 1998. ORAM v. 3.0 began to be used in permit decisions with adoption of new wetland rules
- February 2001. ORAM v. 5.0 major revision from earlier versions method resulted from:
  - experience implementing earlier versions, and
  - Comparison to level 3 reference wetland data sets
  - Need to develop effective disturbance gradient for level 3 wetland IBI development

Assessing “Condition” versus “Function”

- ORAM is not a “functional assessment” method
- Focus is on overall wetland condition and ecological integrity as integrating “super” function (see Smith et al. 1995)
- However, component questions of ORAM can be “deconstructed” and related back to function by function assessment
- If condition “good” or “excellent”, then “functions” unique to that type of wetland also occurring at moderate to high levels

Parts of the ORAM

- Five main parts to the ORAM:
  - BACKGROUND INFORMATION SECTION
  - SCORING BOUNDARY SECTION
  - NARRATIVE RATING QUESTIONS
  - QUANTITATIVE RATING QUESTIONS
  - CATEGORIZATION WORKSHEET
- Dual purpose of ORAM
  - 1) a tool for performing regulatory categorization of wetlands
  - 2) a wetland disturbance/ecological integrity scale

Key features of ORAM

- highly transparent scoring scheme
- explicitly incorporated evaluation of “condition” while retaining more “traditional” habitat, function, value type evaluations
- used narrative “on-ramps” to higher protectioin categories to deal with “residual” functions or special wetland types
- was not biased for or against any particular type of wetland or function
- extremely “rapid” to use and able to be used by wide range of people of varying training
- intuitive 100 point scale

Internalized Classification Scheme

- Classification of Wetlands by Landscape Position (HGM class) and Plant Community is critical to using and developing wetland assessment tools like ORAM v. 5
- Classification avoids having to develop a comprehensive list of those functions and values for every wetland assessed
- Iterative *a priori* classification: refine over time as reference data set develops
- *Absolutely essential to rate wetland against other wetlands of that same type*

Structure of ORAM

- Setting “scoring boundaries” with well defined rules using hydrologic breaks (i.e. defining the “assessment unit”)
- “Narrative” Rating for predefined “special” wetland types
- “Quantitative” Rating
  - size, buffer width, surrounding land use
  - hydrologic characteristics
    - source, depth, length of inundation/saturation, hydrologic connectivity to other waters
  - habitat characteristics
    - plants communities, horizontal/vertical heterogeneity, micro- and macrohabitat features, amphibian habitat, invasive plant abundance, overall habitat development
  - condition of natural hydrology, habitat, substrates

Fundamental Approach of ORAM

- For any given type of wetland, lack of evidence of human disturbance means you score well
- As evidence of disturbance increases you lose more and more points
- Point allocations weighted to ensure all wetland types able to score well, or poorly
- Error is conservative since sites will be overcategorized if disturbance is old or subtle
- Specific pre-determined habitat, T & E spp., flood storage, etc. services or values are dealt with by narrative on-ramps to higher protection categories

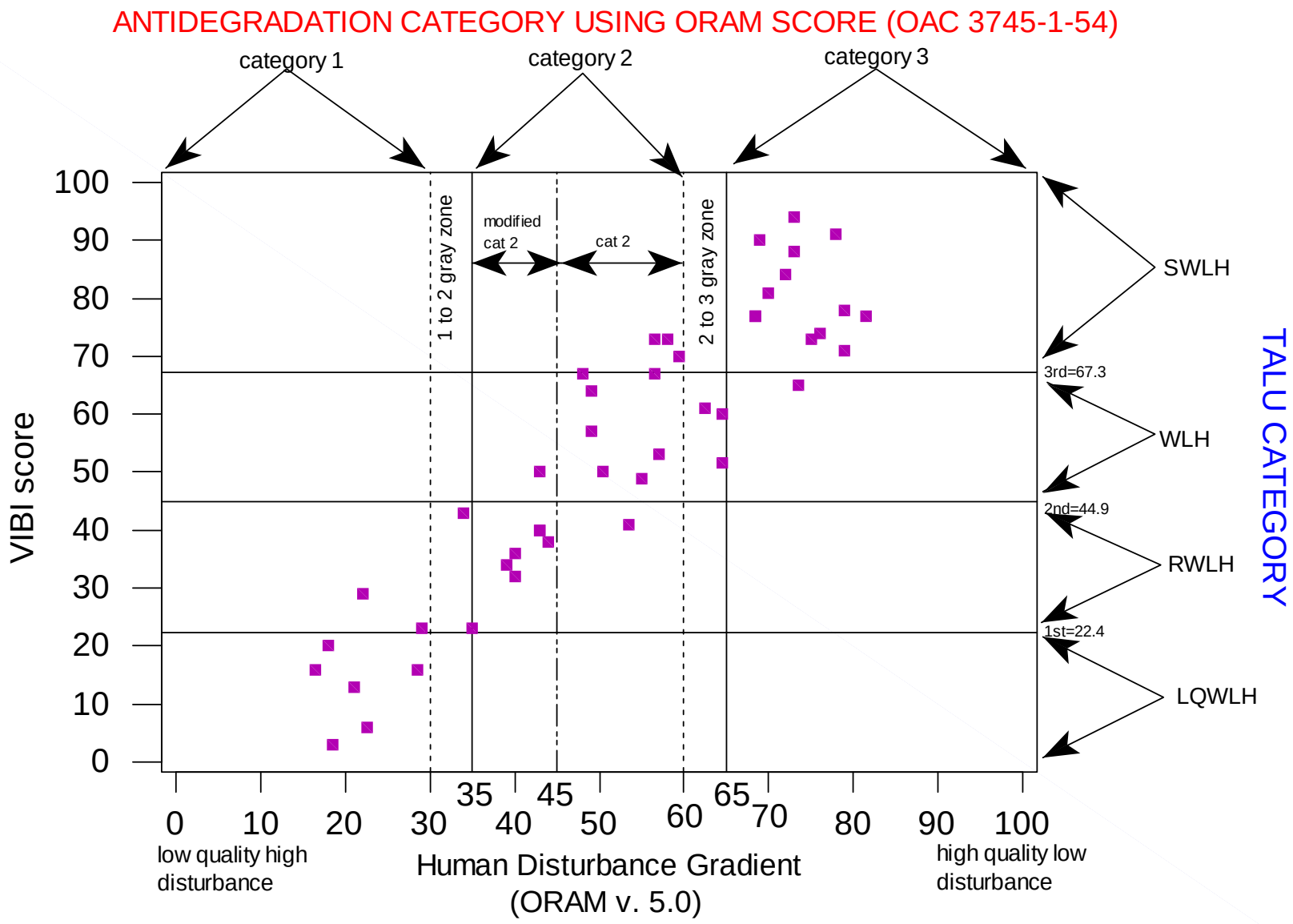
Point Allocations in ORAM

	Metric 3a, b, c, d	calcareous fen	vernal pool	riparian forest	coastal marsh
3a	High pH groundwater	5			
	Other ground water				
	Precipitation	1	1	1	1
	Seasonal/Intermittent Surface Water			3	
	Perennial surface water				5
3b	100 year floodplain			1	
	Between stream/lake and other human use				
	Part of wetland/upland (e.g. forest) complex		1		1
	Part of riparian or upland corridor	1		1	
3c	>70cm water depth		3	3	3
	40-70cm water depth				
	<40 cm water depth	1			
3d	Semipermanently to permanently inundated or saturated	4			
	Regularly inundated or saturated				3
	Seasonally inundated		2	2	
	Seasonally saturated in upper 30cm (12in)				
	SUBTOTAL FROM 3	**12**	**7**	**11**	**13**
6d	Vegetated hummocks/tussocks	3	3	1	
	Coarse woody debris		3	2	1
	Standing dead >25 cm dbh			1	
	Amphibian breeding pools		3	2	2
		15	**16**	**17**	**16**

Fitting rapid method breakpoints

- Goal: to be able to use and rely on level 2 rapid method results in lieu of level 3 data in permit decisions, condition assessments, etc
- Not possible to perform level 3 assessments in every situation because of cost, staff resources, applicant resources, etc.

How were current ORAM scoring breakpoints developed?



Level 2 Assessment – Site visit Morgan Swamp

Level 2 Assessment – Site visit Stages Pond

Level 2 Assessment – Site visit Calamus Swamp

Level 3: Quantitative Assessments

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

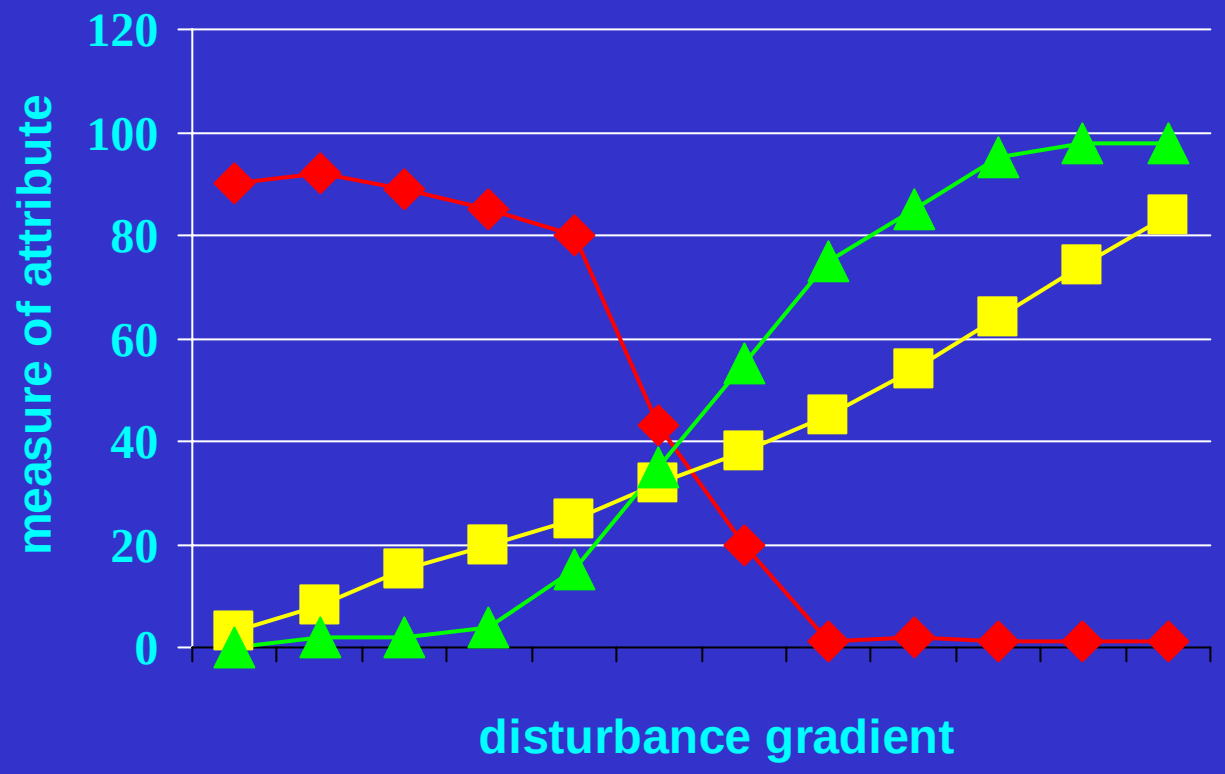
* = most commonly selected

Types of metrics

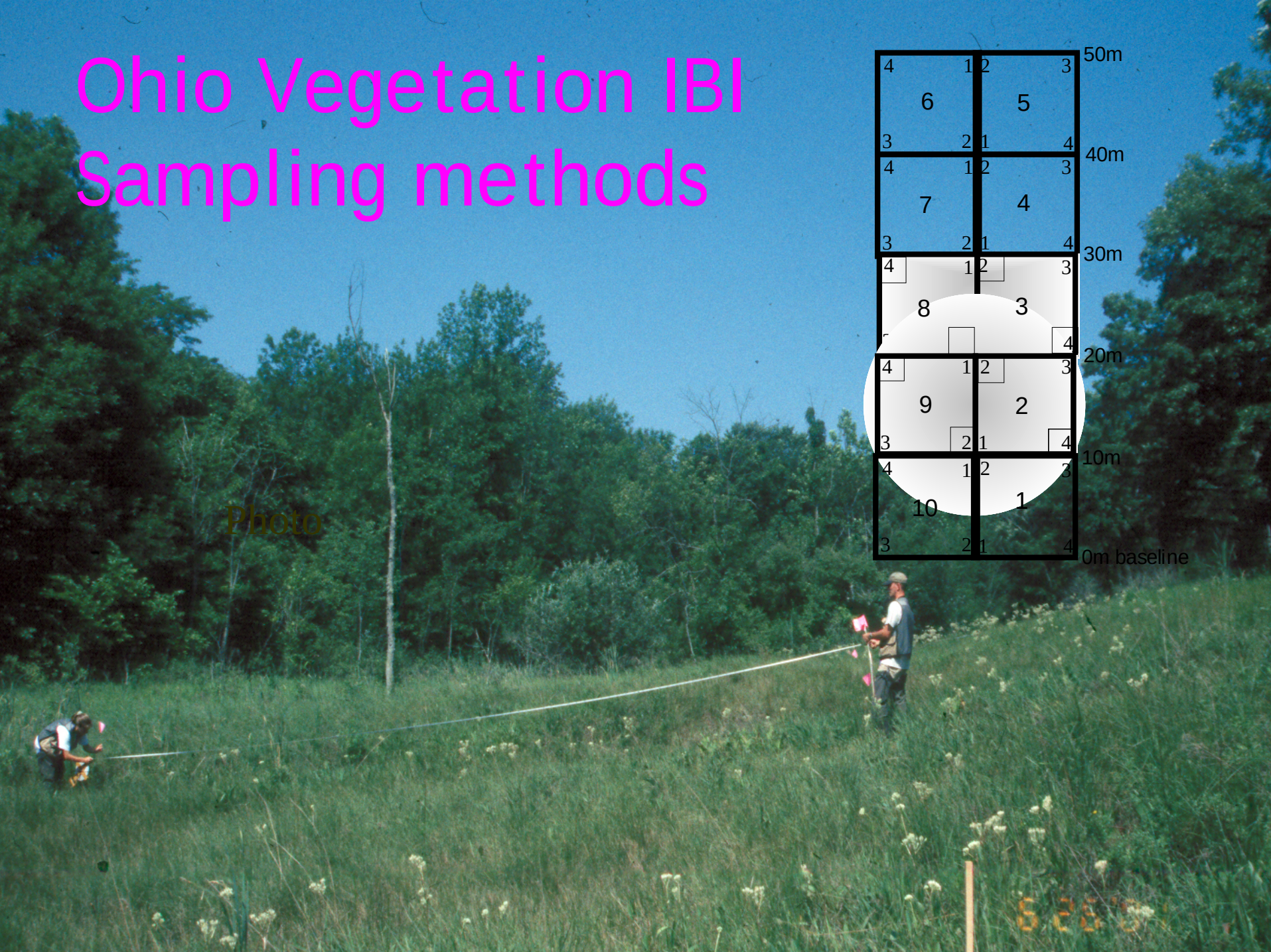
- richness
  - no. of species
- richness ratios (proportions)
  - no. of species divided by all species
- abundance, relative abundance
  - no. of ind., % cover, stem density
- productivity
  - grams/unit area or volume biomass
- diversity indices
  - Shannon-Wiener, Simpsons D, Floristic Quality Index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

Types of relationships

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



Ohio Vegetation IBI Sampling methods



Metrics for VIBI-E, -F, -Sh

metric	type	E	F	Sh
Carex spp.	richness	X		X
dicot spp.	richness	X		X
shade spp.	richness		X	
shrub spp., native wetland	richness	X		X
hydrophyte spp.	richness	X		X
fern and fern ally spp.	richness		X	X
Annual spp./Perennial spp.	richness ratio	X		
FQAI	index	X	X	X
%hydrophyte cover	community		X	
%bryophyte cover	community		X	X
%tolerant spp. cover	community	X	X	X
%sensitive spp. cover	community	X	X	X
%invasive graminoid spp. cover	community	X		
pole timber density	community/productivity		X	
subcanopy importance value	index of comm./productivity		X	X
canopy importance value	index of comm./productivity		X	
std biomass	productivity	X		

Level 3 Results for Morgan Swamp, Stages Pond, and Calamus Swamp

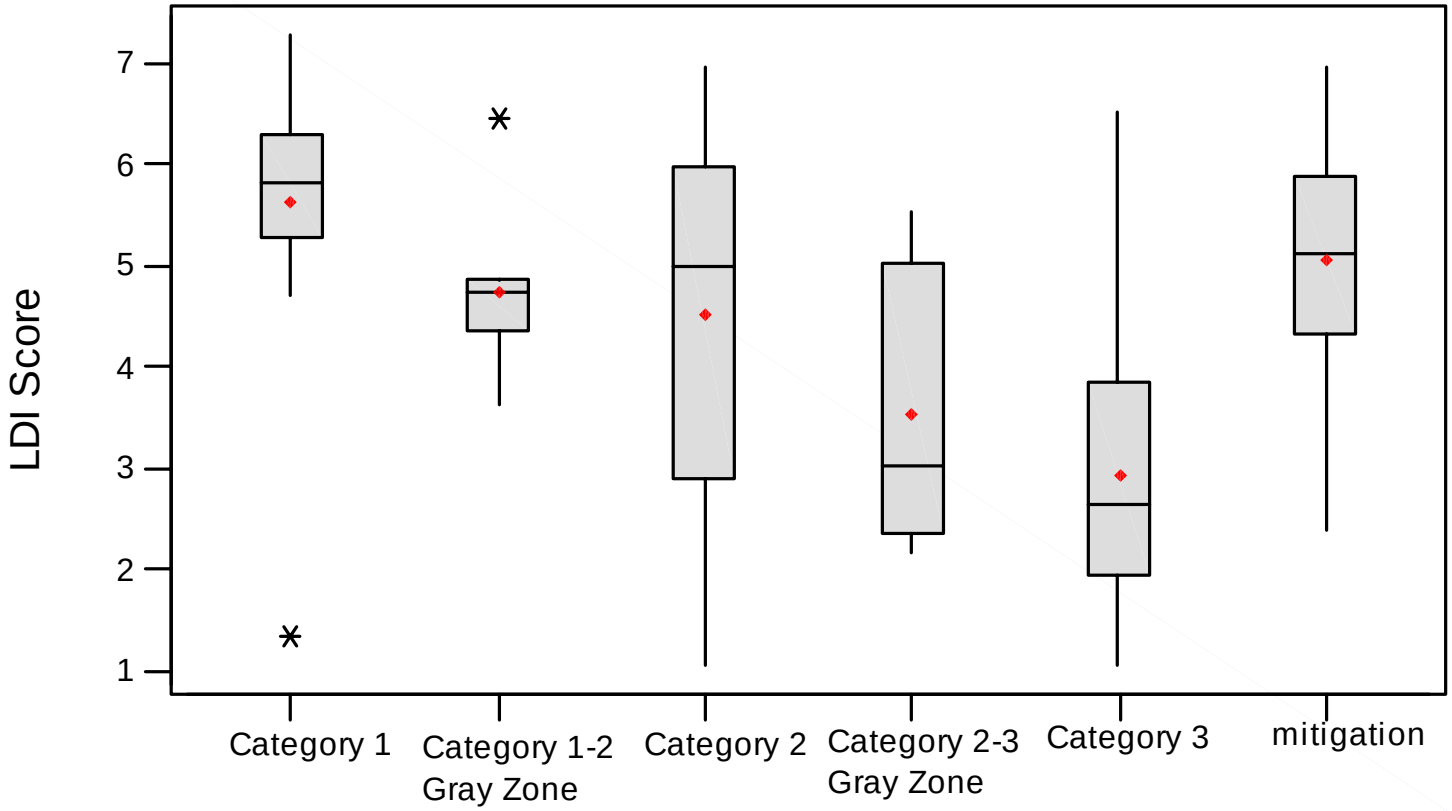
Metric	Morgan Swamp	Stages Pond	Calamus Swamp
Carex spp.	4	0	1
Dicot spp.	30	9	17
Shrub spp.	8	0	1
Hydrophyte spp.	38	12	26
Annual/Perennial	0.17	1.14	0.40
FQAI score	25.1	7.5	20.2
%tolerant spp.	0.31	0.74	0.028
%sensitive spp.	0.31	0.0	0.19
%invasive	0.006	0.70	0.006
standing biomass	133	671	394
VIBI score	84	6	57

Comparison of Level 1,2,3

ACTUAL RESULTS

SITE	LEVEL 1 (LDI)	LEVEL 2 (ORAM)	LEVEL 3 (VIBI)
MORGAN SWAMP	1.31	77	94
STAGES POND	5.93	38	6
CALAMUS SWAMP	6.10	68	57

How do the results compare?



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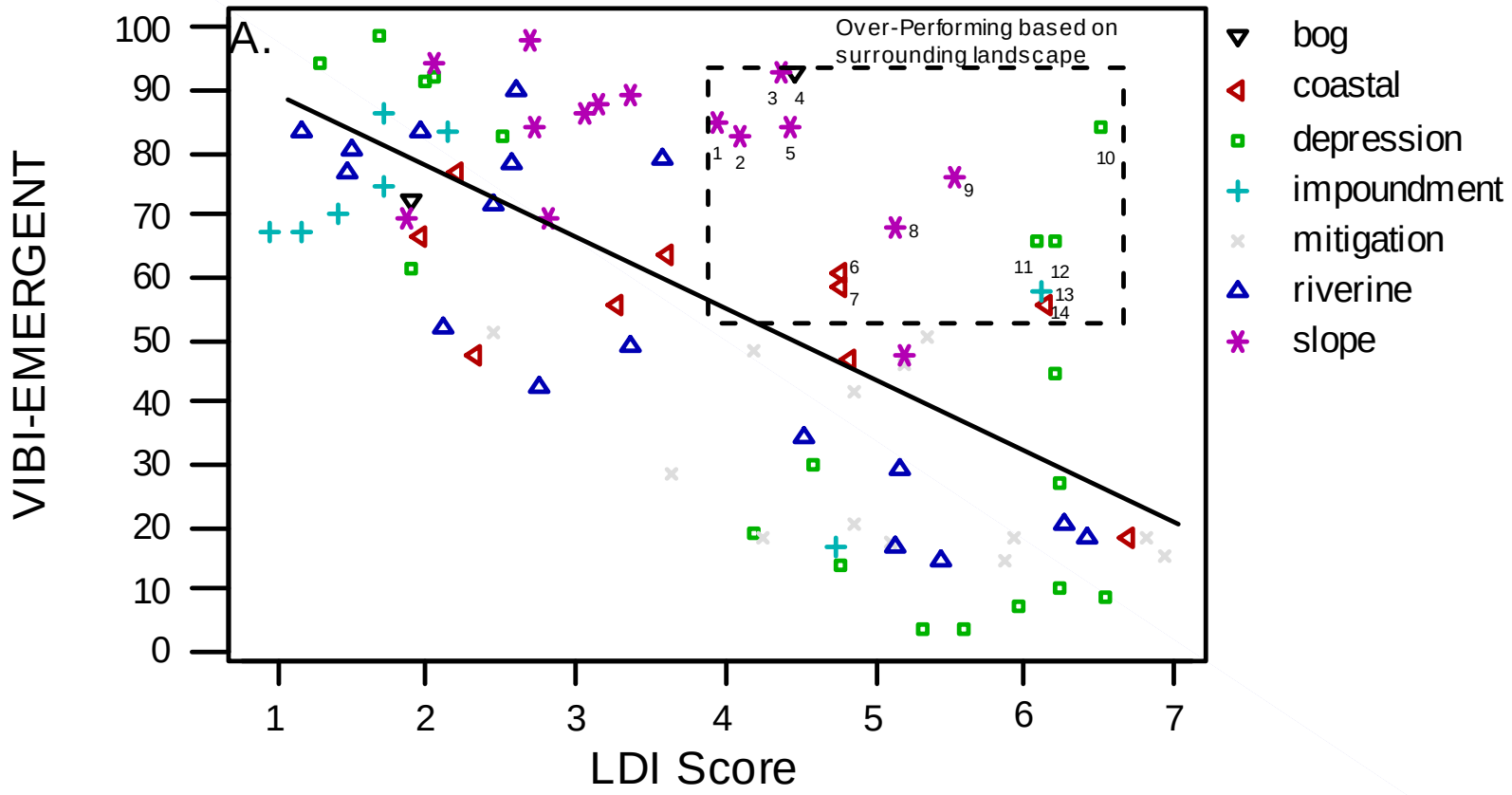

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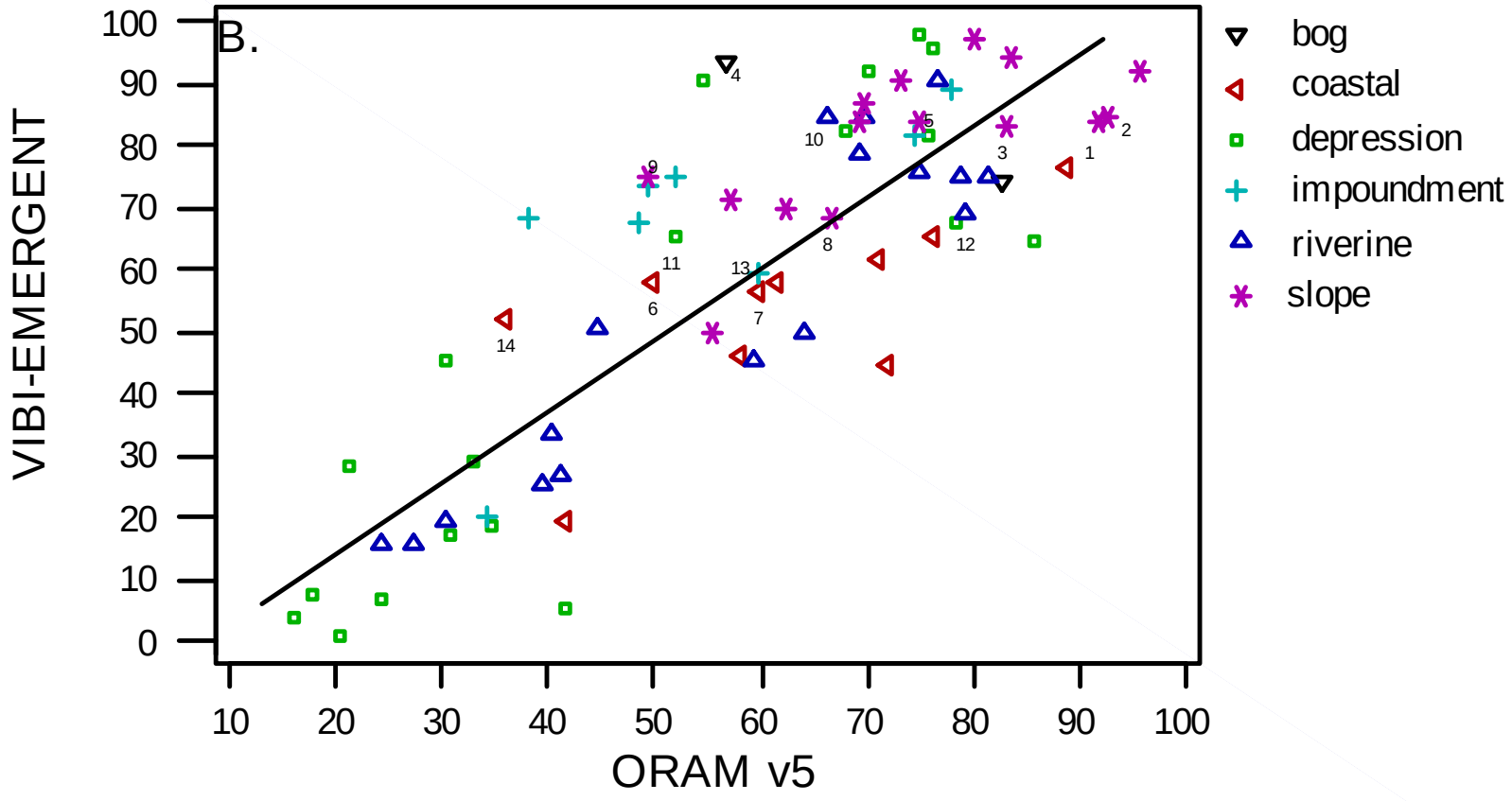

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Thank You…

Any Questions?