Mid-Atlantic Freshwater Wetlands: Using Science to inform Policy and Practice

MAWWG – Mid-Atlantic Wetlands Work Group

Regina Poeske, EPA – Region 3, Co-Director

www.mawwg.psu.edu

Riparia - a Center where science informs policy and practice in wetlands ecology, landscape hydrology, and watershed management

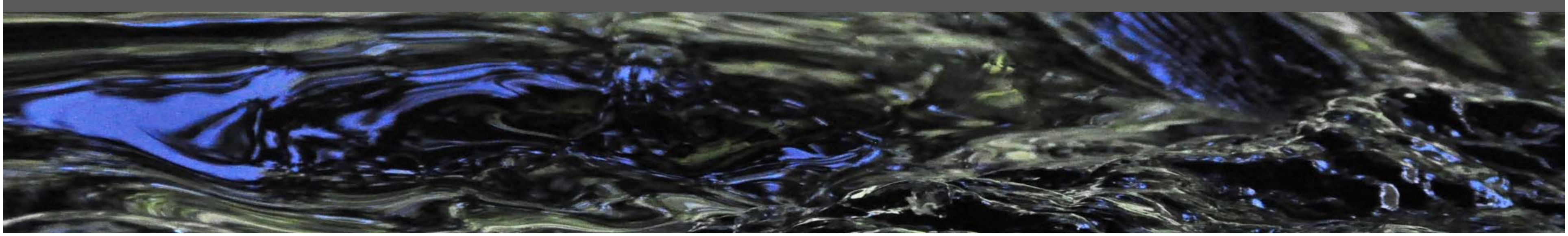
Robert P. Brooks, Ph.D., Director

www.riparia.psu.edu

Putting Tools into Practice

Presentation Outline

- MAWWG Background
- Scale of Assessment
- Level 1 – Landscape Assessment
- Level 2 – Rapid Assessments
- Level 3 – Intensive Assessments



Clean Water Act

- Under the Clean Water Act 305(b) States are required to monitor and report on the quality of waters within their states, which includes wetlands.
- Some data on quantity, but little on the quality or condition of wetlands.
- Wetland monitoring & assessment major priority for EPA's National Wetlands Program.
- Goal to increase quantity and improve the quality of the nation's wetlands.

Strategies for Capacity Building

- National Wetlands Monitoring Work Group
  - Build state/tribal capacity in wetland monitoring and assessment
  - Help guide a National Wetland Condition Assessment
  - Establish a baseline of ambient wetland condition across the nation
  - Build science behind wetland assessment in collaboration with ORD, academia and states
- EPA Office of Research and Development (ORD)
  - Advance the science of natural resource monitoring at regional and national scales
  - Provide EPA with national scientific leadership for wetland monitoring initiatives
  - Support method development, design and analysis for wetland monitoring programs
- Regional Wetland Monitoring Workgroups

Mid-Atlantic Wetland Work Group

– Purpose - Forum for states in the Mid-Atlantic to facilitate the development and implementation of wetland monitoring and assessment strategies and integration into wetland program management.

– Goals:

  - Development and implementation of state wetland monitoring strategies and methods for the Mid-Atlantic region
  - Integrate wetland monitoring activities into water assessment programs
  - More effectively manage waters on a watershed basis
  - Integrate best available science into wetland program decision-making

State and Federal Partners

Academic Partners

- Pennsylvania State University
- Virginia Institute of Marine Science
- West Virginia University
- Virginia Tech
- Kenyon College (Ohio)

2002 Mid-Atlantic Wetland WorkGroup formed

	Milestones	State Products	Collaborative Products
2003	Identification of Existing Wetland Assessment Tools, Training Needs	Assessment of Existing WQ Tools and Methods (New Jersey)	Launched MAWWG Web site
2004	Introduction to Probabilistic Sampling Methods	Unveiling of Wetland Data-Viewer (Virginia)	Developed Training Strategy for Member States
2005	Introduction to Tiered Aquatic Life Uses for Wetlands	Conducted Rapid Assessment for Riverine Wetlands (Maryland)	Report on Status of Wetland Monitoring by States and Academic Partners
2006	First Deployment of Monitoring and Assessment Programs	Conducted Non-tidal Wetlands Assessment (Virginia) ; IBI for Headwater Wetlands (Pennsylvania)	Initiated Atlantic Slope Consortium
2007	Discussion on Regulatory and Non-Regulatory Use of Wetland Assessment Data	Evaluated Mitigation Wetlands (West Virginia)	Committed to and Initiated Mid-Atlantic Regional Wetland Assessment
2008	Introduction to Wetland Ecosystem Services	Developed Rapid Assessment Procedure (DERAP) (Delaware)	
2009	Examination of Climate Change in the Mid-Atlantic and Impacts to Aquatic Resources	Developed Comprehensive Assessment Procedure (DECAP) (Delaware)	Introduction to EPA's Coastal Wetland Initiative
2010		Conducted Rapid Wetland Assessment (WVRAP) and Floristic Quality Assessment (West Virginia)	Completed Regional Floristic Quality Index
2011	Discussion of Mitigation Banking in the Mid-Atlantic	Conducted DECAP for Mitigation Wetlands (Delaware)	Conducted National Wetland Condition Assessment
2012	Introduction to Outreach Tools and Strategies	Reported on Economic Valuation of Wetland Ecosystem Services (Delaware)	Demonstrated Mitigation Design and Performance Database and Floristic Quality Assessment Calculator

home | overview | tools and products | training | resources | participants

Bioassessment Tools

Search for bioassessment tools by state or physiographic province

Floristic Quality Assessment Index (FQAI)

General information and developments for the Mid-Atlantic region

Mid-Atlantic Regional Wetland Condition Assessment

On-going project to develop a regional rapid assessment protocol for wetland condition

Wetlands Mitigation Design and Performance Database

On-going project compiling reference wetland data to be interpreted and used to inform the design and performance evaluation of restored and mitigated wetlands

Robert P. Brooks · Denice Heller Wardrop *Editors*

Mid-Atlantic Freshwater Wetlands: Advances in Wetlands Science, Management, Policy, and Practice

Mid-Atlantic Freshwater Wetlands: Advances in Wetlands Science, Management, Policy, and Practice summarizes over two decades of work by Riparia, a Center at The Pennsylvania State University. This comprehensive book delves into the ecology and conservation of these critically important and valued ecosystems. The 14 chapters written or edited by Riparia's leadership and colleagues, focus on understanding the ecology of freshwater wetlands and the stressors that affect them in a watershed context. Wetlands are viewed not as isolated patches, but as part of an integrated aquatic and terrestrial system. Early chapters address concepts of reference and hydrogeomorphic classification. The current state of our knowledge about hydrology, hydric soils, plants, and wildlife is covered in the middle chapters. Later chapters include policy issues and practice, with emphases on monitoring and assessment, restoration and mitigation, and conservation and regulatory programs. There are extensive reviews and listings of recent literature, and linkages to Riparia's website where supplemental information can be found.

Environment

ISBN 978-1-4614-5595-0

springer.com

Brooks · Wardrop *Eds.*

Mid-Atlantic Freshwater Wetlands: Advances in Wetlands Science, Management, Policy, and Practice

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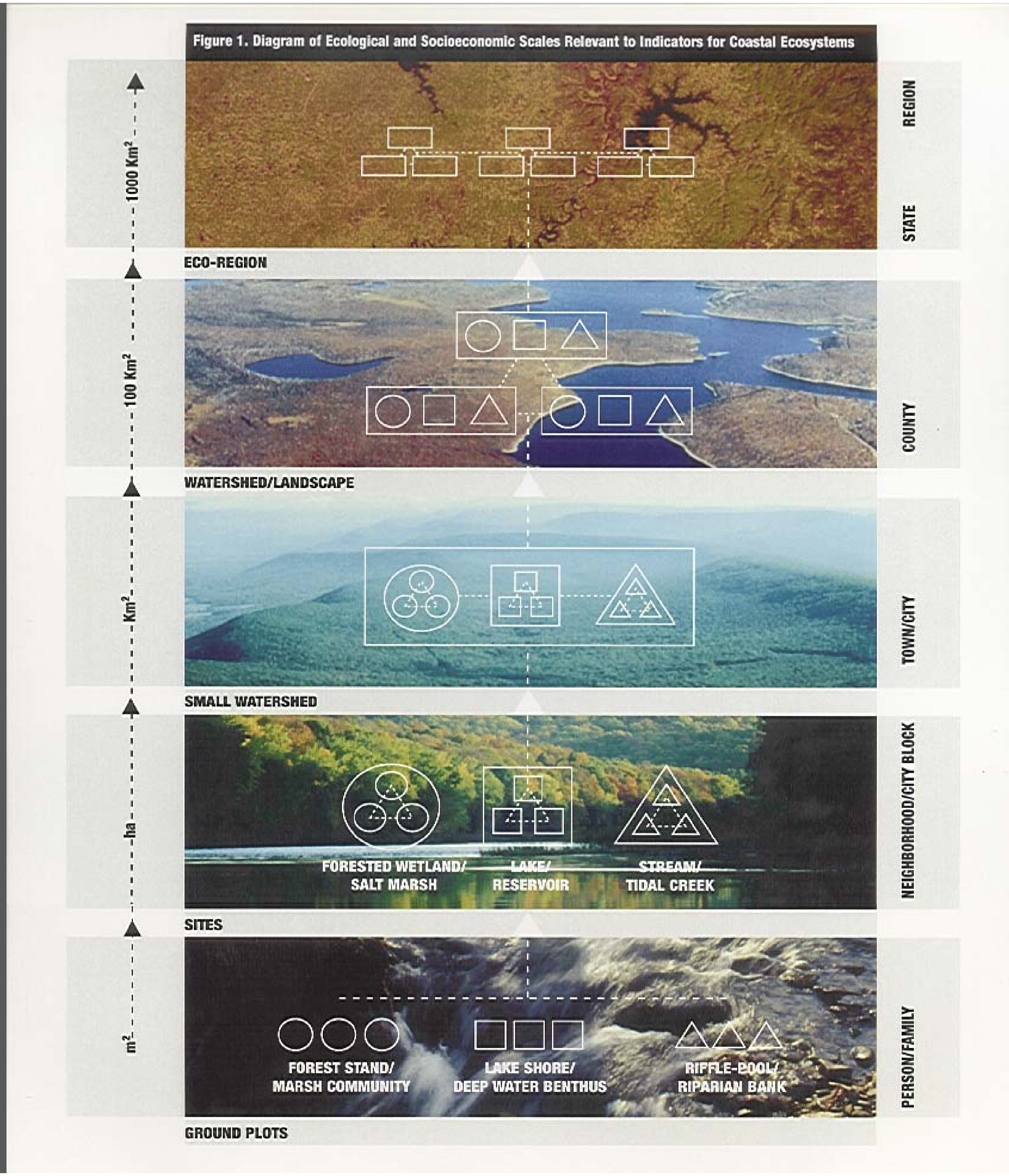
Denice Heller Wardrop *Editors*

Mid-Atlantic Freshwater Wetlands: Advances in Wetlands Science, Management, Policy, and Practice

Springer

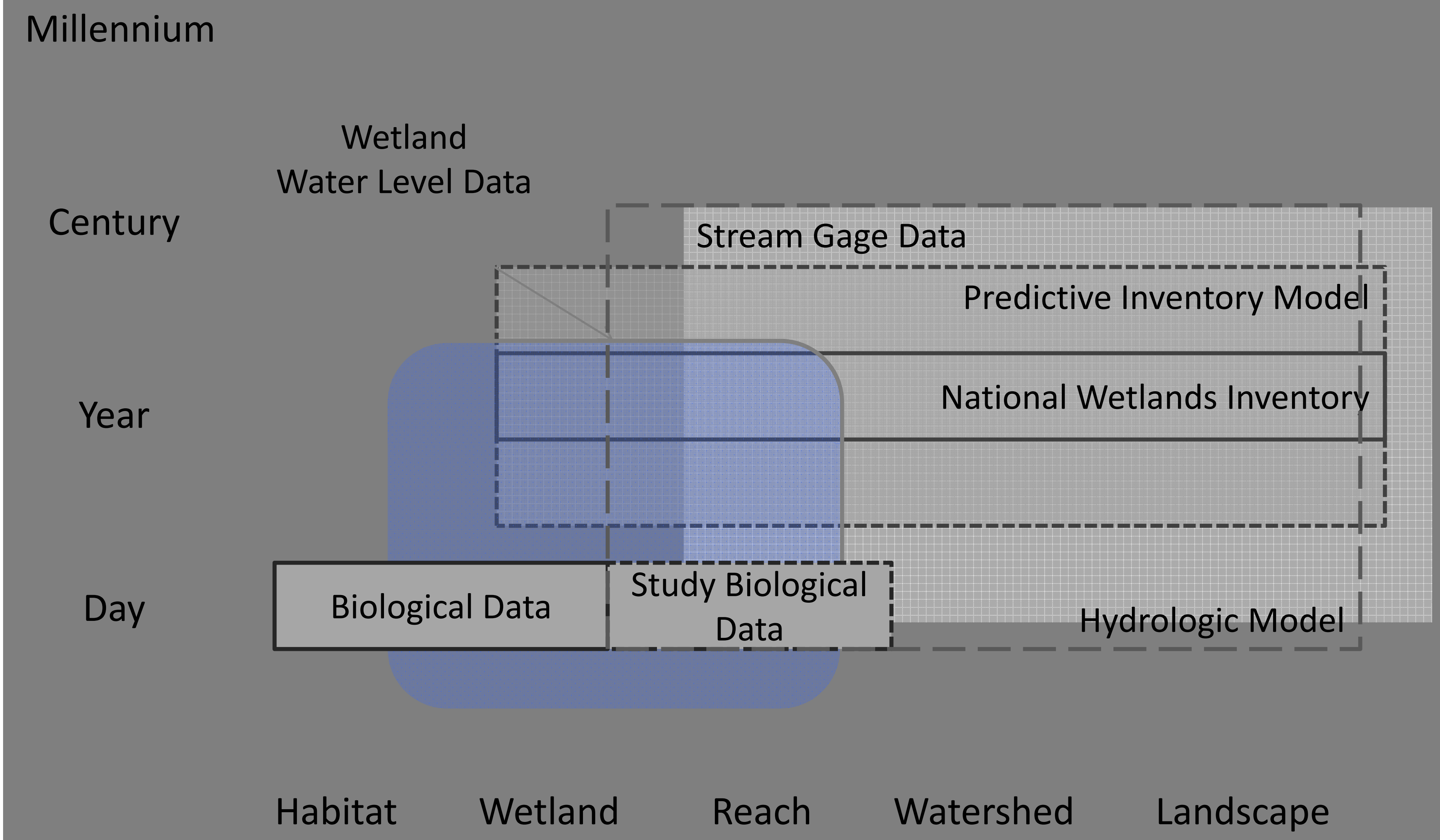
February 2013

Spatial/Temporal Scales



Human Scales

Scale of Riparia's Research Focus



Hychka & Yetter

How do we inventory, assess ecological integrity, and restore natural resources across geographic scales?

Case Study – Level 1

Wetland classification, inventory, & landscape assessment

Case Studies – Level 2

Mid-Atlantic Regional Wetlands Assessment

Case Studies – Level 3

Floristic Quality Assessment Index

Reference Wetlands for Mitigation

(Rapanos vs. U.S.)

LEVEL 1 LANDSCAPE FROM GIS

↕

LEVEL 2 RAPID FIELD ASSESSMENT

↕

LEVEL 3 INTENSIVE FIELD ASSESSMENT

- Condition assessment from office, reference

- Refined condition assessment
- Landscape profiles
- Stressor profiles

- High quality condition assessment
- FQAI, IBI, & HGM
- Mitigation design & performance

Wetland Monitoring Matrix

	INVENTORY	ASSESSMENT	RESTORATION
LEVEL 1	Use existing map resources (NWI) of wetlands	Map land uses in watershed; compute landscape metrics	Produce synoptic watershed map of restoration potential
LEVEL 2	Enhance inventory using landscape-based decision rules	Rapid site visit and stressor checklist; preliminary condition assessment	Select sites for restoration; examine levels of threat from surroundings
LEVEL 3	Map wetland zone abundance using verified inventory	Apply HGM and IBI models to selected sites for condition based on reference	Map specific sites for restoration; design projects with reference data sets

Typical Sample Sizes

- Level 1 - Landscape Assessment
  - Unlimited number of sites
- Level 2 - Rapid Assessment
  - Approximately 20-50 sites per watershed; more watersheds
- Level 3 - Intensive Assessment
  - 2 to 3 sites/week, 10 weeks per year, 20 - 30 sites per watershed

Level 1 – Landscape Assessment

- Issues:
  - Wetland classification and inventory
  - Reference wetlands
- How? - Assess condition, ecosystem services, or restoration potential, using:
  - Existing synoptic land use
  - Enhanced inventory
- Policy Implications
  - Decisions made based on wetland classification and inventory

Hydrogeomorphic Classification for Mid-Atlantic Wetlands
Brooks et al. 2011 Wetlands 31:207-219

R.P. Brooks[1], M.M. Brinson[2], K.J. Havens[3], C.S. Hershner[3], R.D. Rheinhardt[2], D.H. Wardrop[1], D.F. Whigham[4], A.D. Jacobs[5] & J.M. Rubbo[1](Penn State[1], ECU[2], VIMS[3], SERC[4], DNREC[5])

- Riverine
  - lower perennial (mainstem floodplain)
  - floodplain complex
  - upper perennial (headwater floodplain)
  - headwater complex
  - intermittent
    - beaver impounded
    - human impounded
- Lacustrine (fringe)
  - permanently inundated
  - semipermanently inundated
  - intermittently inundated
  - artificially inundated

Hydrogeomorphic Classification for Mid-Atlantic Wetlands

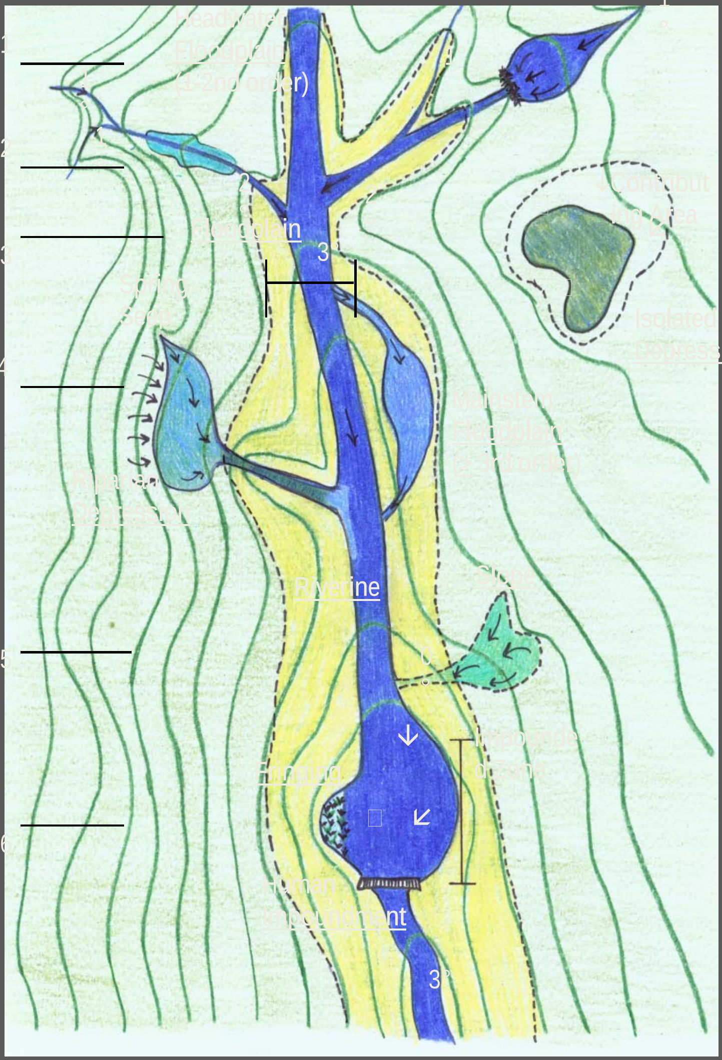
- Slope
  - Stratigraphic
  - Topographic
    - mineral soil
    - organic soil
- Depression
  - perennial (riparian depression, emergent marsh)
  - seasonal
  - temporary (isolated depression, vernal pool)
    - human impounded
    - human excavated

Hydrogeomorphic Classification (Riparia - PA)

Headwater Floodplain

Riparian Depression

Stream Order



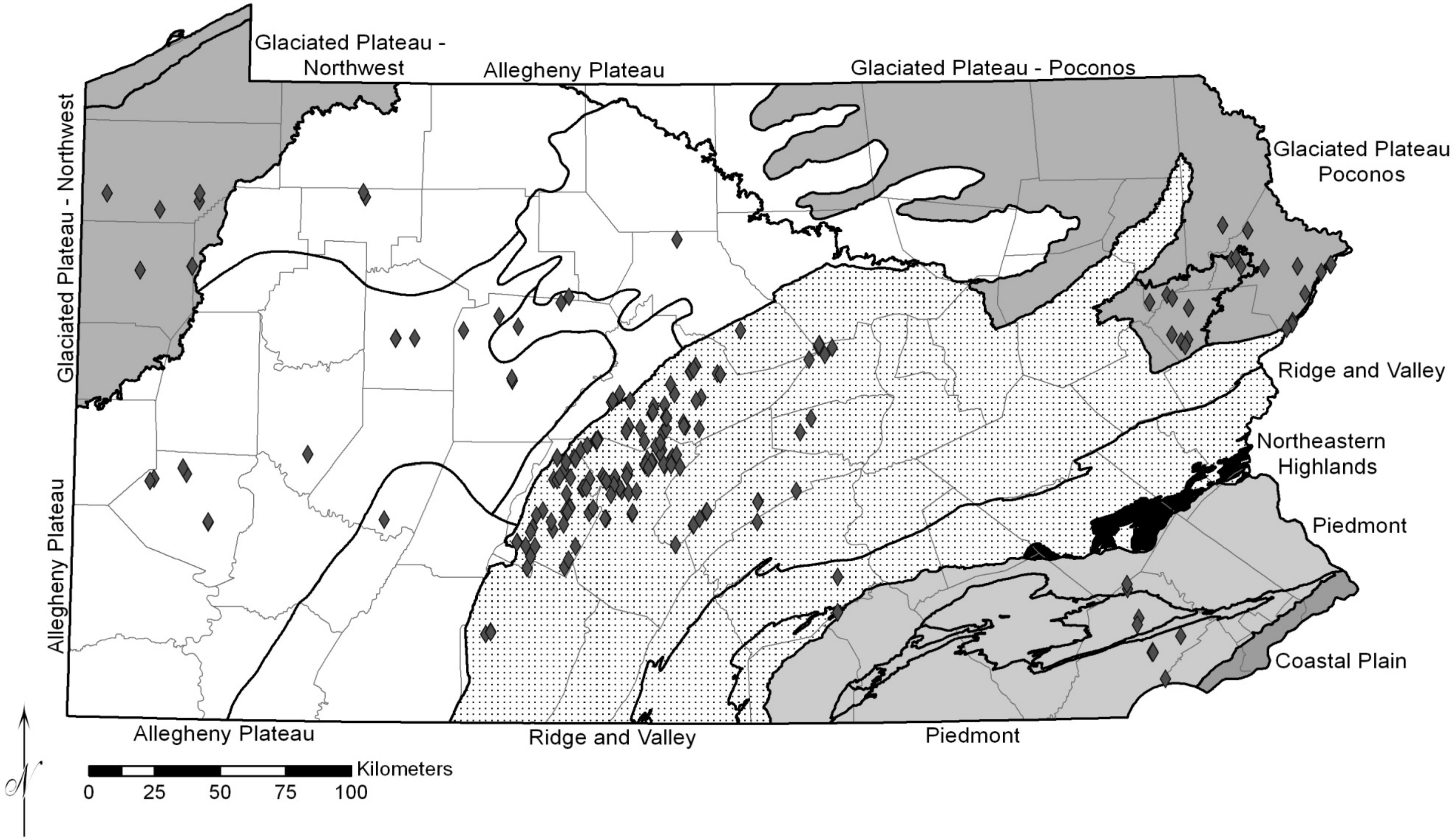
Mainstem Floodplain

Slope

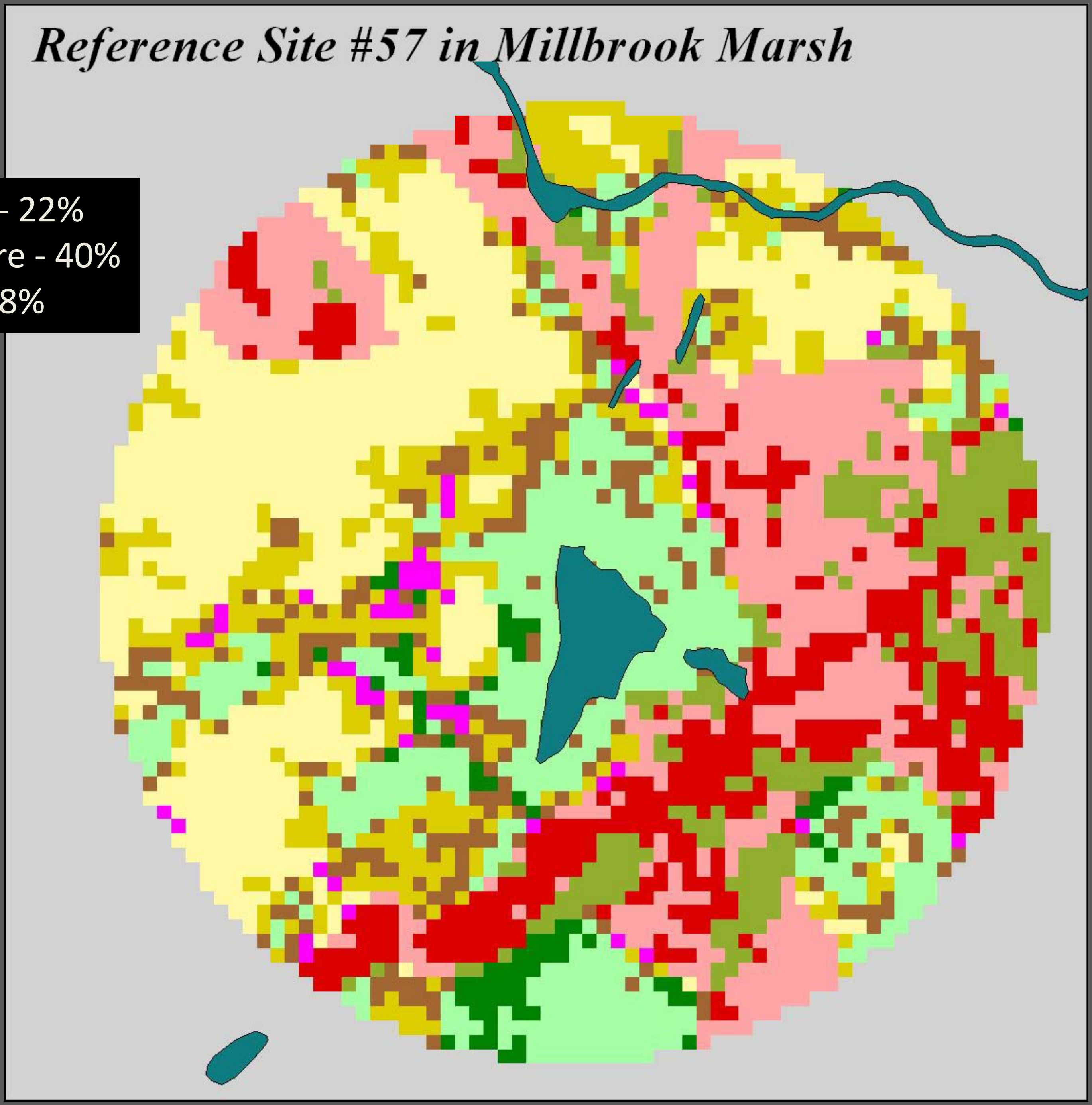
Riverine Lower Perennial - Mainstem Floodplain (Forested) - *Swamp*

Depression temporary - *Vernal pool*

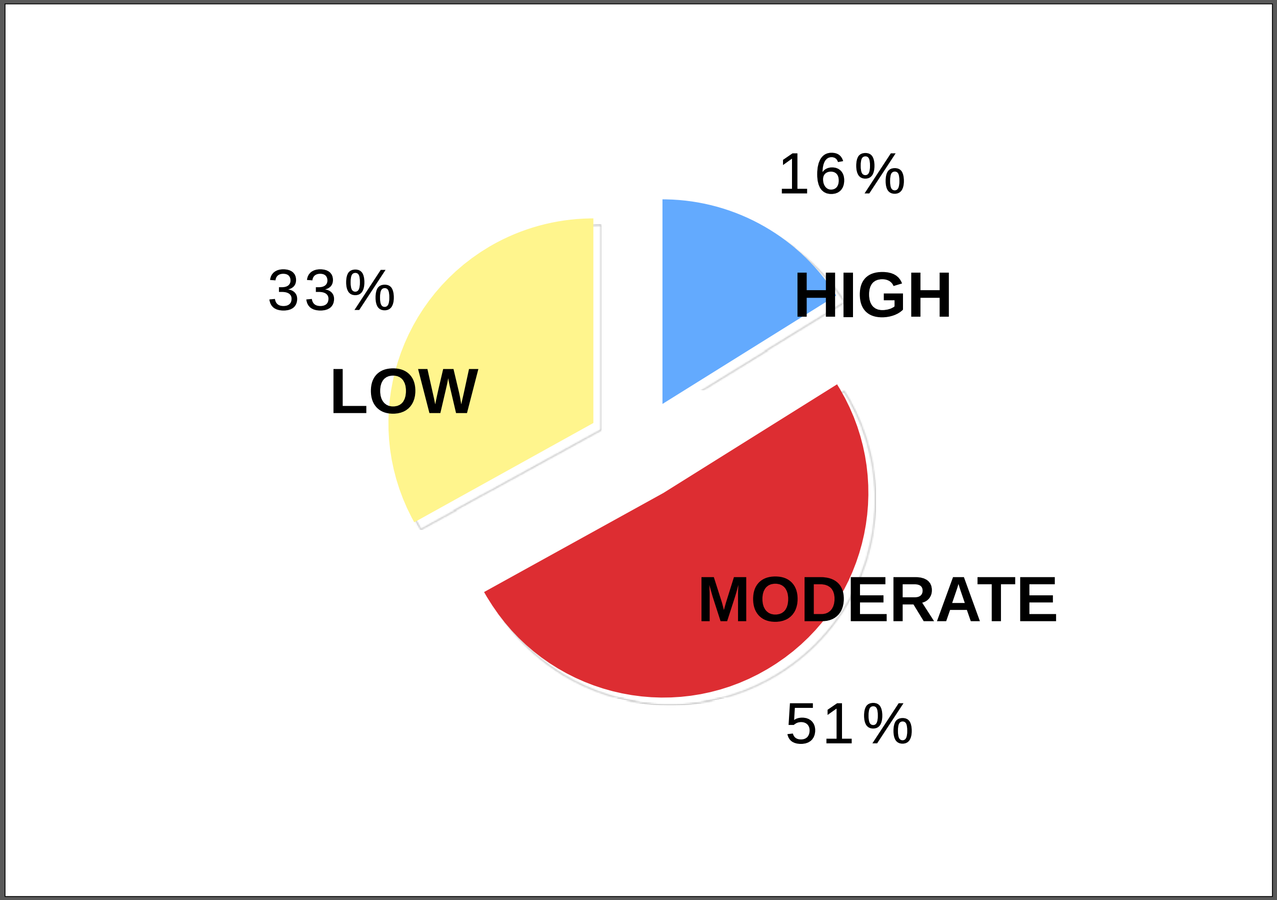
Riparia's Reference Wetlands Collection (n = 222)



Forested - 22%
Agriculture - 40%
Urban - 38%



First approximation - Pennsylvania's wetland condition (Level 1) based on landscape analyses for 424,000 NWI wetlands

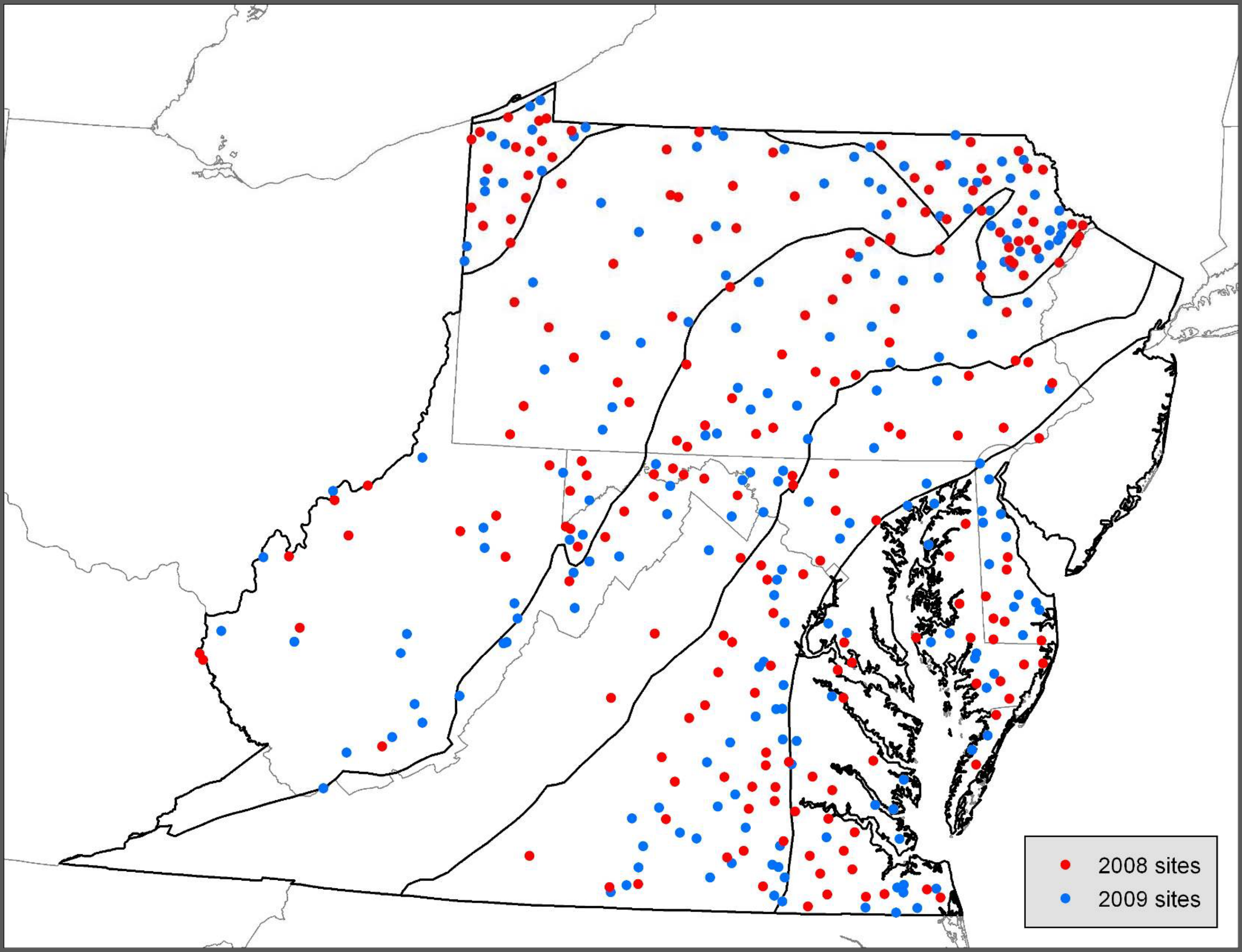


Brooks et al. 2004

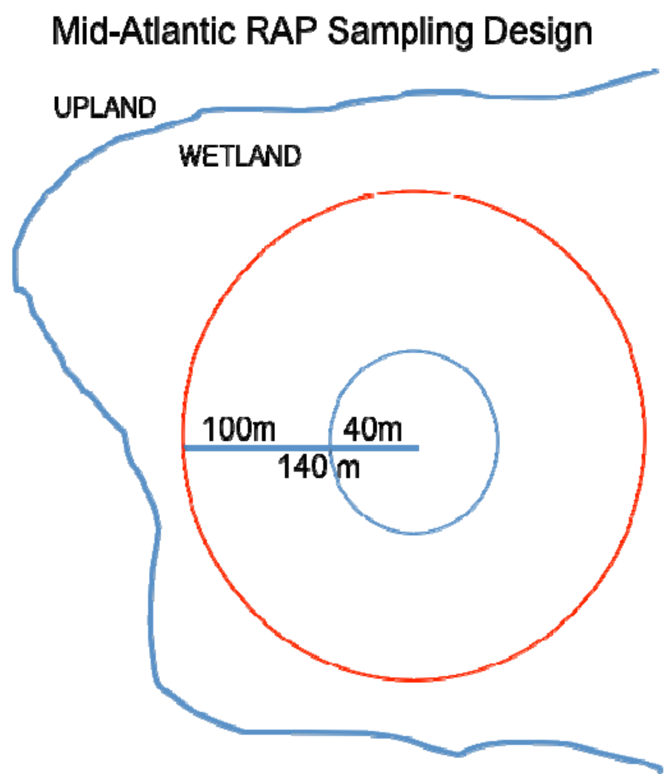
Level 2 – Rapid Assessment Protocols (RAPs)

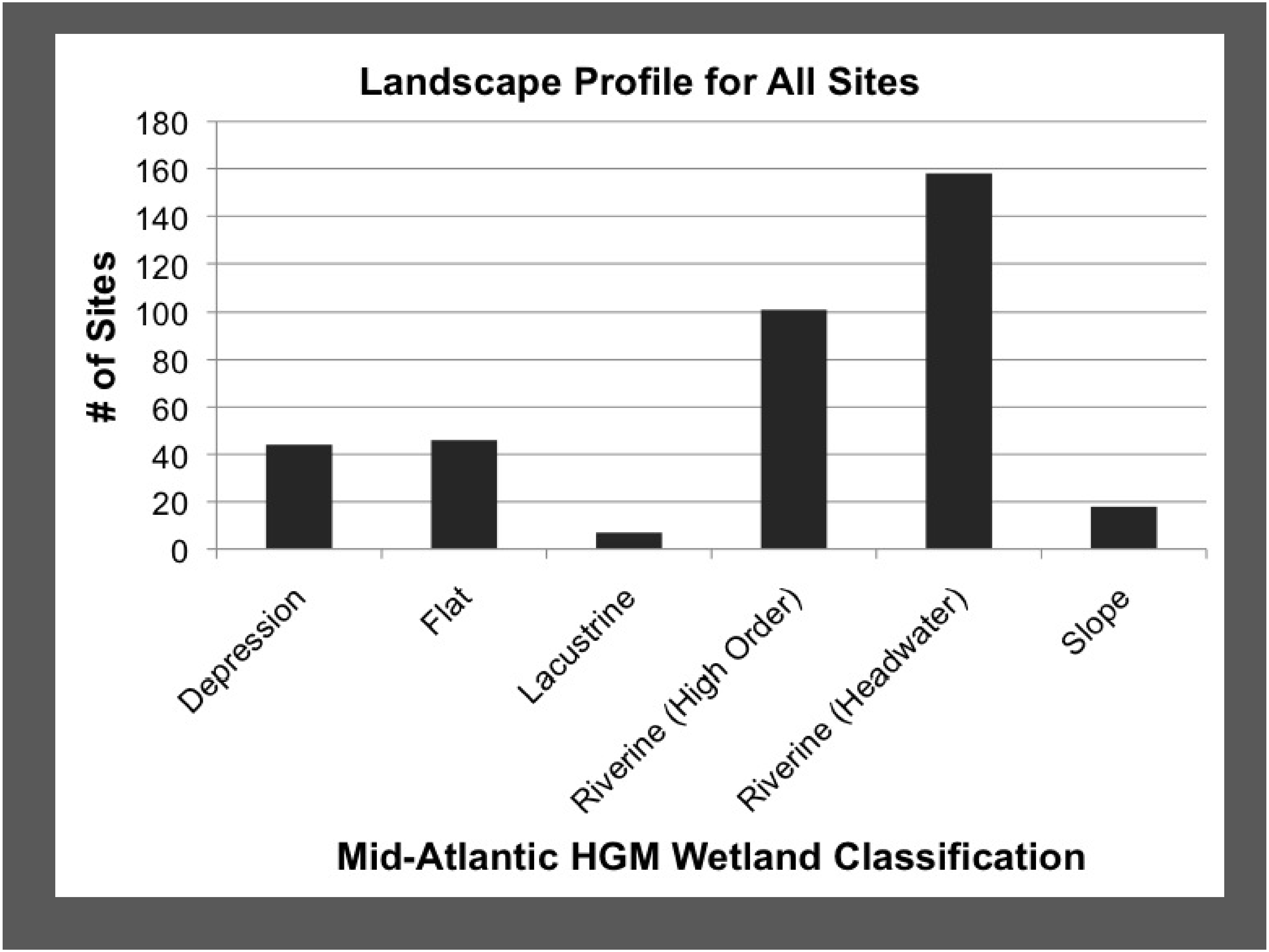
- Issue:
  - Implementing field-based, inexpensive assessments of wetlands
- How? Existing <u>rapid assessment protocols </u>(RAPs)
  - PA, DE, VA RAPs = Unified Mid-Atlantic RAP for Wetlands (MAWWG)
  - (also available) - Stream-Wetland-Riparian Index (SWR Index); Brooks et al. 2009 Env Monit Assmt
- Policy Implications
  - Determining condition of wetlands for states

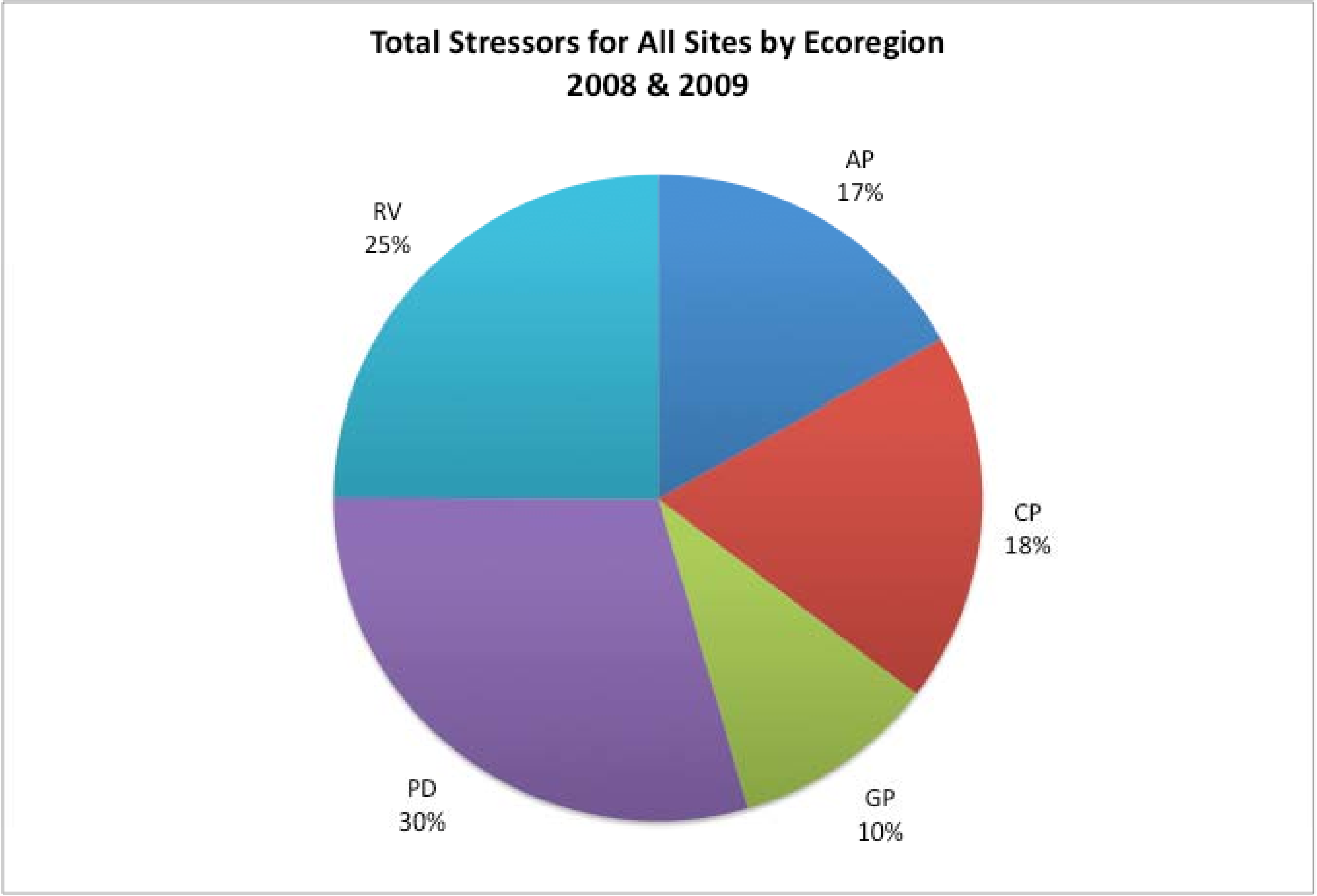
Regional Wetland Assessment Sampling Locations



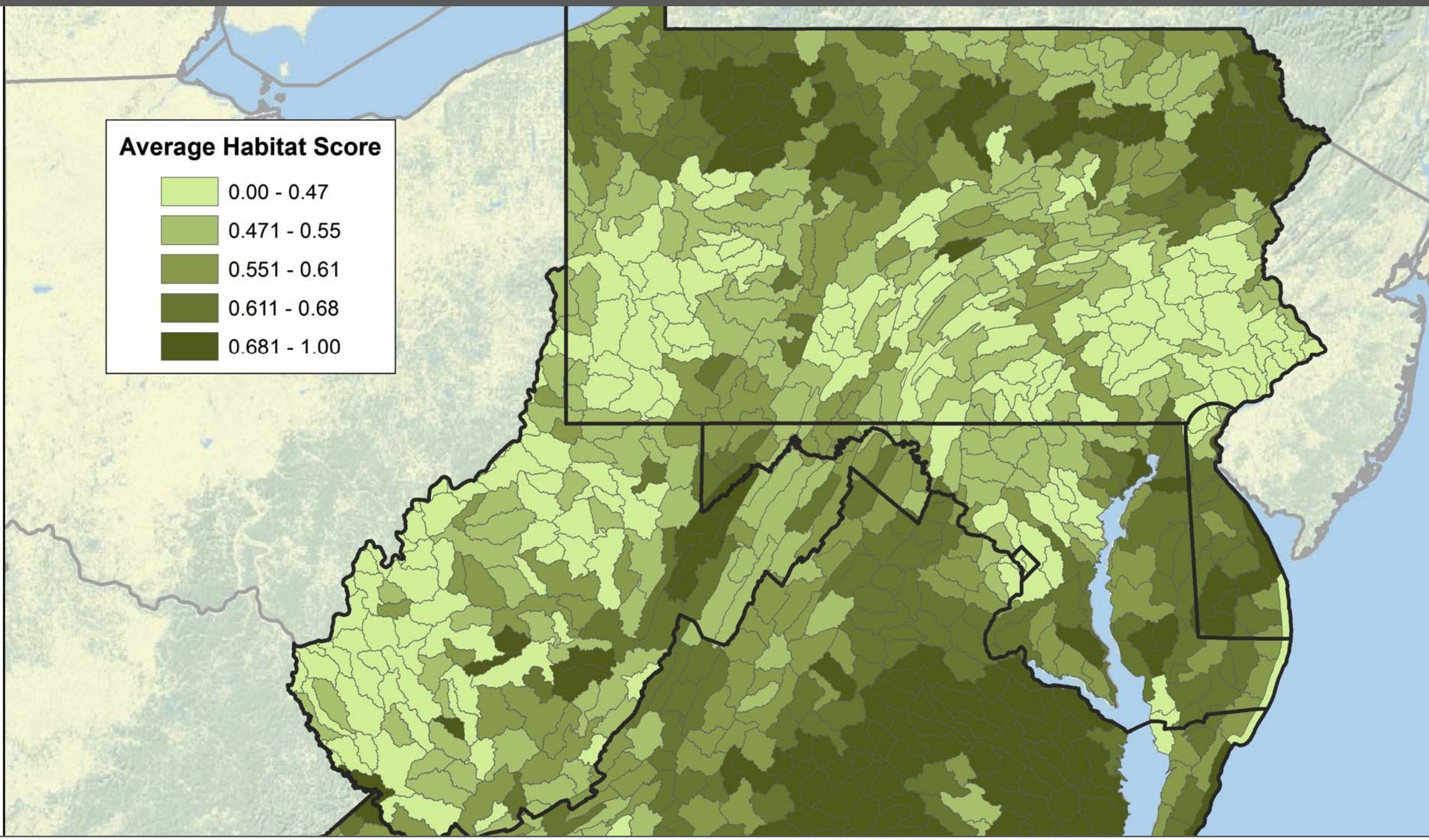
- Assessment Area (AA): 0.5 ha (40m-radius circle) can be altered in shape to fit site)
- Buffer – 100 m concentric “ring” around AA




Landscape Profile for All Sites
180
160
140
120
100
80
60
40
20
0
# of Sites
Depression
Flat
Lacustrine
Riverine (High Order)
Riverine (Headwater)
Slope
Mid-Atlantic HGM Wetland Classification


Total Stressors for All Sites by Ecoregion
2008 & 2009
AP
17%
CP
18%
GP
10%
PD
30%
RV
25%

Mid-Atlantic ecosystem service score by watershed: Habitat (all NWI polygons)



1 # Level 3 – Intensive Assessment Methods

- Issue: Using plant community to assess disturbance and/or mitigation performance
  - Mid-Atlantic Region plant list is finalized for use in FQAI

- How? - Floristic Quality Assessment Index
  - Enter plant species list into Calculator (MAWWG/Riparia), and compare scores
  - Testing efficacy with rapid (delineation) and intensive (reference and mitigation) data

2

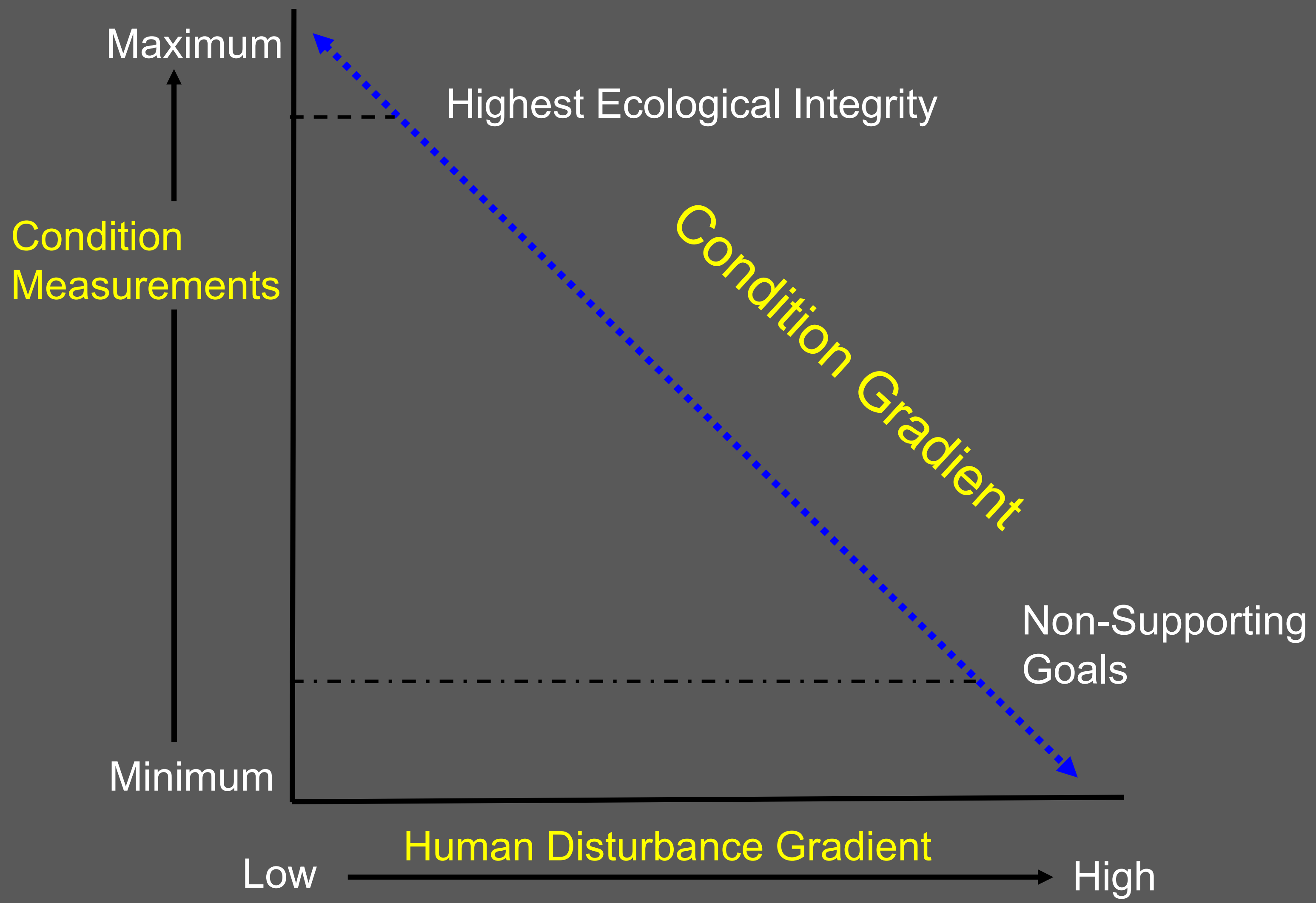
Level 3 – Intensive Assessment Methods

- Riparia/MAWWG Database of Reference Wetlands
  - Assessing degradation
  - Designing mitigation and restoration projects
  - Evaluating performance of projects

- How? – Choose from relevant variables, and use summary data sorted by ecoregion, state, and HGM wetland type

- (also available: Macroinvertebrate & Amphibian IBIs)

Condition Gradient – Clean Water Act



HGM Functional Assessment Models for Wetlands

- Energy dissipation/Short term SW detention
- Long term SW storage
- Interception of groundwater

- Cycling of redox-sensitive compounds
- Solute adsorption capacity
- Retention of inorganic particulates
- Export of organic particulates
- Export of dissolved organic matter

- Plant community structure and composition
- Detritus
- Vertebrate community structure and composition
- Invertebrate community structure and composition
- Maintenance of landscape-scale biodiversity

Wetlands Plants:

Floristic Quality Assessment Index (FQAI)

Plant Index of Biological Integrity

Sarah Chamberlain

FQAI Calculator Example

Region Ridge and Valley

List | Search

Enter up to 500 scientific names in the box at left--one name per line. You may type the names or copy and paste from a text editor or spreadsheet column.

Submit List

My Plant List

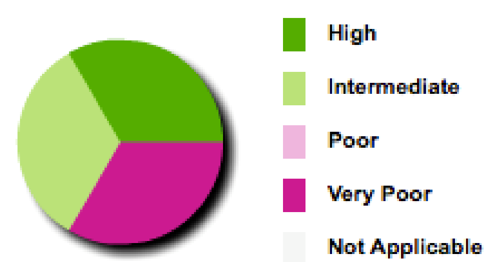
Clear All

	Symbol	Scientific Name	Family	C	Native
	CAST8	Carex stricta	Cyperaceae	6	Y
	DRRO	Drosera rotundifolia	Droseraceae	10	Y
	TYLA	Typha latifolia	Typhaceae	2	Y

Results

FQI	10.4
Adjusted FQI	60.0
Total mean C	6.0
Total N	3
Native mean C	6.0
Native N	3

Tolerance | Natives



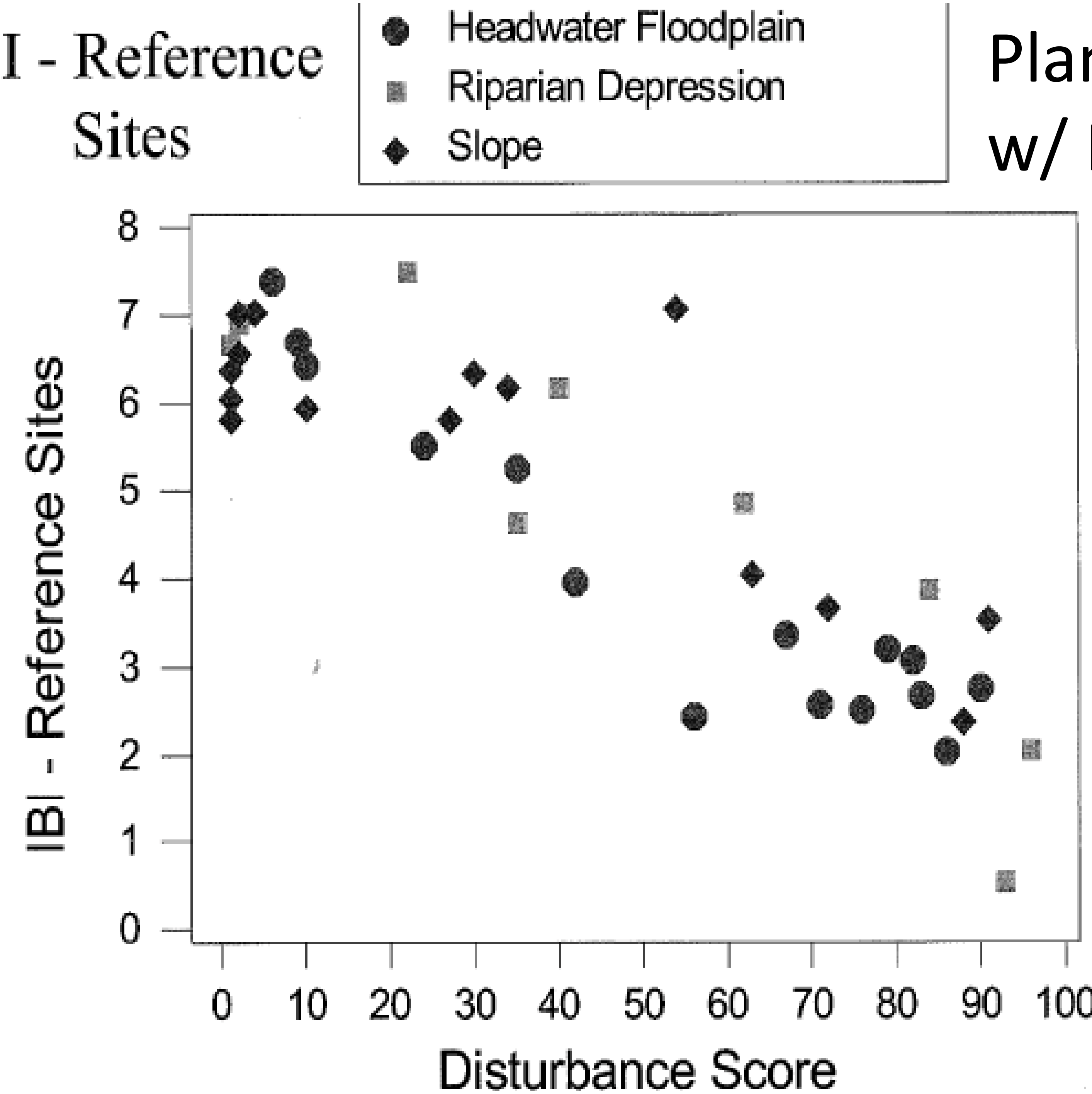
Print

FQAI Calculator Metrics:

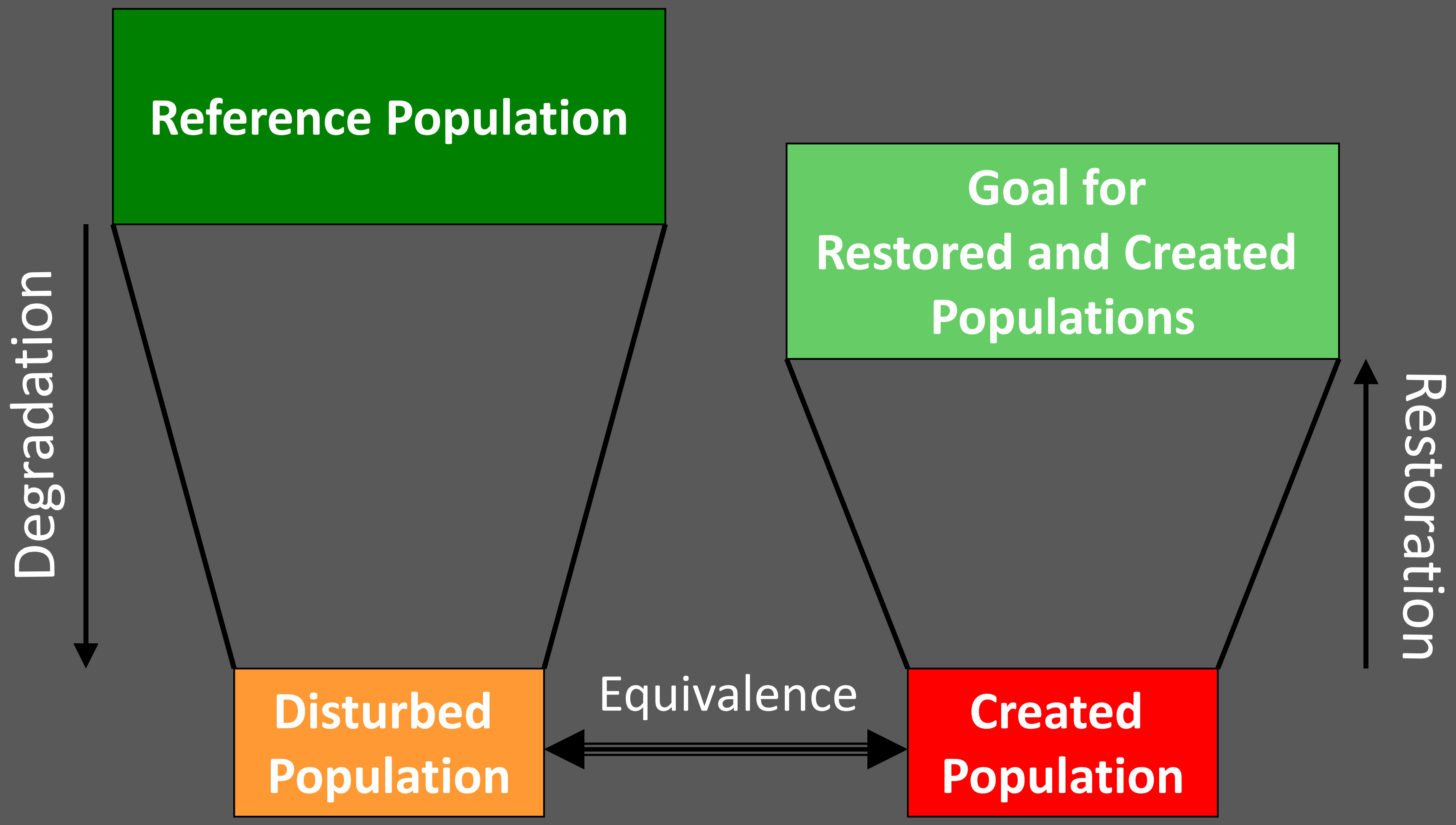
Metric	Description	Notes
FQI	$I = \overline{C} \times \sqrt{N}$	Uses only native species
Adjusted FQI	$I' = \left(\frac{\overline{C} \times}{10 \times} \frac{\sqrt{N}}{\sqrt{N+A}} \right) \times 100$	Includes non-native species (A)
Total Mean C	Average (C_{Native} and $C_{Non\text{-}Native}$)	Mean coefficient value for native and non-native species
Total N	No. of Native species + No. of Non-native species	Total number of species present
Native Mean C	Average (C_{Native})	Mean coefficient value for native species
Native N	No. of Native species	Total number of native species present

IBI - Reference Sites

Plant IBI w/ FQAI



Wetland "Homogeneity" Model



Brooks et al. 2005

Reference Standard Complexes

a.

Stressed Complexes

e.

Sample of landscape analysis for pair of headwater wetland complex sites in central Pennsylvania (Moon 2012, Moon & Wardrop 2013)

Using Reference Wetlands Data to Improve Design and Performance of Mitigation Projects

Gebo and Brooks 2012: Wetlands

Wetlands (2012) 32:321–331
DOI 10.1007/s13157-011-0267-3

ARTICLE

SWS

Hydrogeomorphic (HGM) Assessments of Mitigation Sites Compared to Natural Reference Wetlands in Pennsylvania

Naomi A. Gebo · Robert P. Brooks

Received: 17 September 2010 / Accepted: 27 December 2011 / Published online: 28 January 2012

Abstract The U.S. Environmental Protection Agency and U.S. Army Corps of Engineers completed revisions to the Mitigation Rule of the Clean Water Act in 2008. These revisions encourage states to carry out mitigation in a watershed context, prioritizing mitigation site design and placement by overall watershed need, to the extent appropriate and practicable (33 C.F.R. 332.3(c)). States are expected to establish monitoring programs and measureable performance standards for mitigation wetlands. In Pennsylvania, hydrogeomorphic (HGM)-based assessments involving 222 reference wetlands were used to compare mitigation wetland performance. For this study, 72 mitigation wetlands were sampled in 2007 and 2008 from three categories – Pennsylvania Wetland Replacement Program sites, Pennsylvania Department of Transportation mitigation banks, and permit required compensatory mitigation sites. Mitigation wetlands were intensively sampled using a Level 3 - Intensive methodology developed by Riparia. Field and GIS computed variables were used to derive the s of 10 HGM functional capacities. Overall, mitigation displayed lower potential to perform a characteristic w function than reference sho greatest discrepancy, whi the amount of difference from reference scores. Mitigatio size, age, and type were not significant factors in func capacity index scores.

Keywords Hydrogeomorphic functional assessment · Mitigation rule · Compensatory mitigation · Mitigation

Introduction

Compensatory mitigation is intended to replace the areal extent and, ideally, the functions of the impacted wetlands. The latter has proven elusive to assess and difficult to achieve. According to recent reports, wetland mitigation has resulted in a net increase in wetland area nationwide (Dahl 2006). However, functional replacement is not necessarily associated with these gains in wetland area. The need to establish a high degree of function across a variety of forms has long been neglected in the mitigation process. There is wide consensus among researchers that mitigation is not adequately compensating for natural wetland losses structurally, functionally (Race and Fonseca 1996; Mitsch and Wilson 1996; Zedler and Callaway 1999; Kentula et al. 2004), or with regard to temporal lags in functional performance (Gutrich and Hitzhusen 2004; Bendor 2009). Created

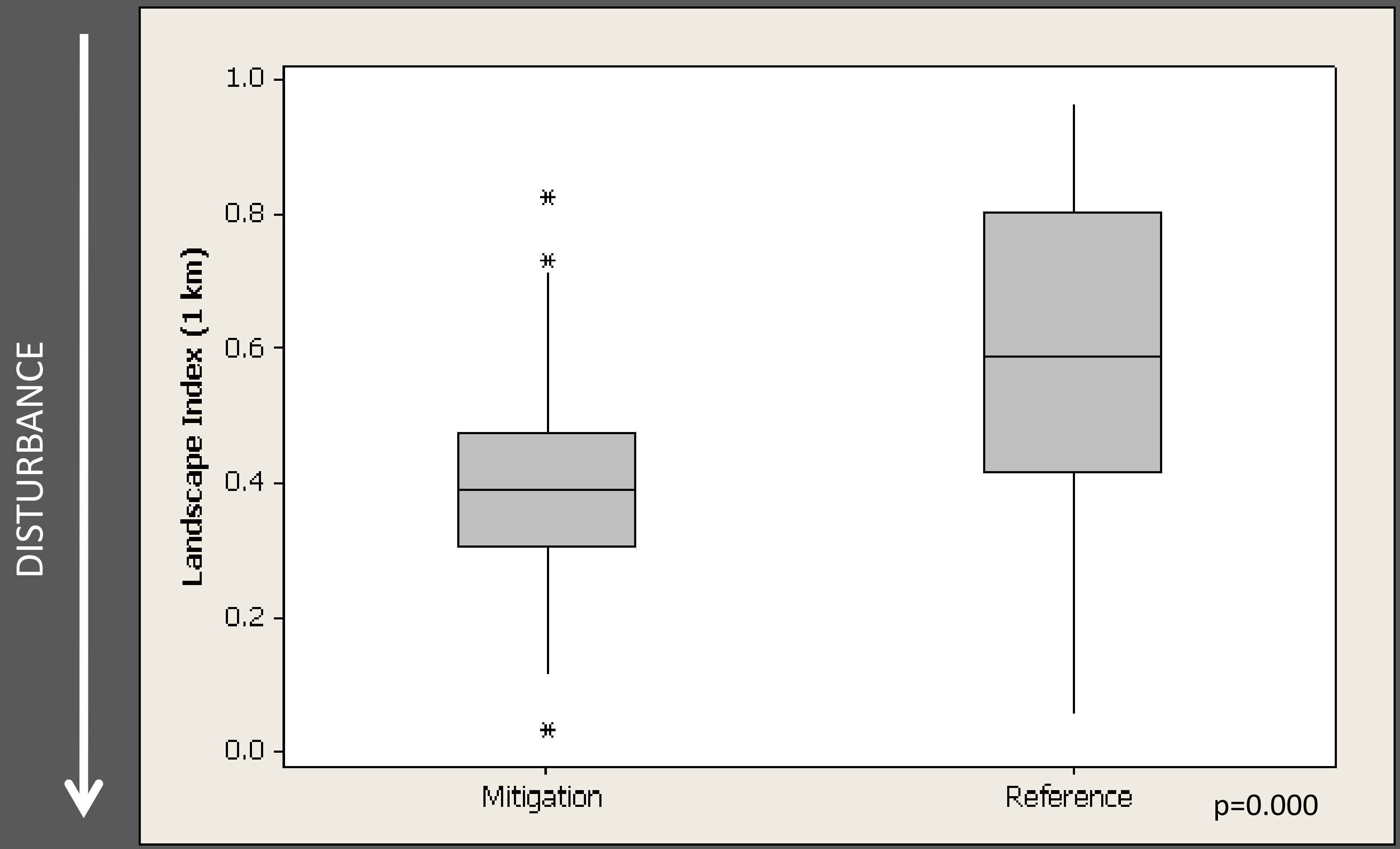
Overall, mitigation sites displayed lower potential to perform a characteristic wetland function than reference wetlands.

My Documents

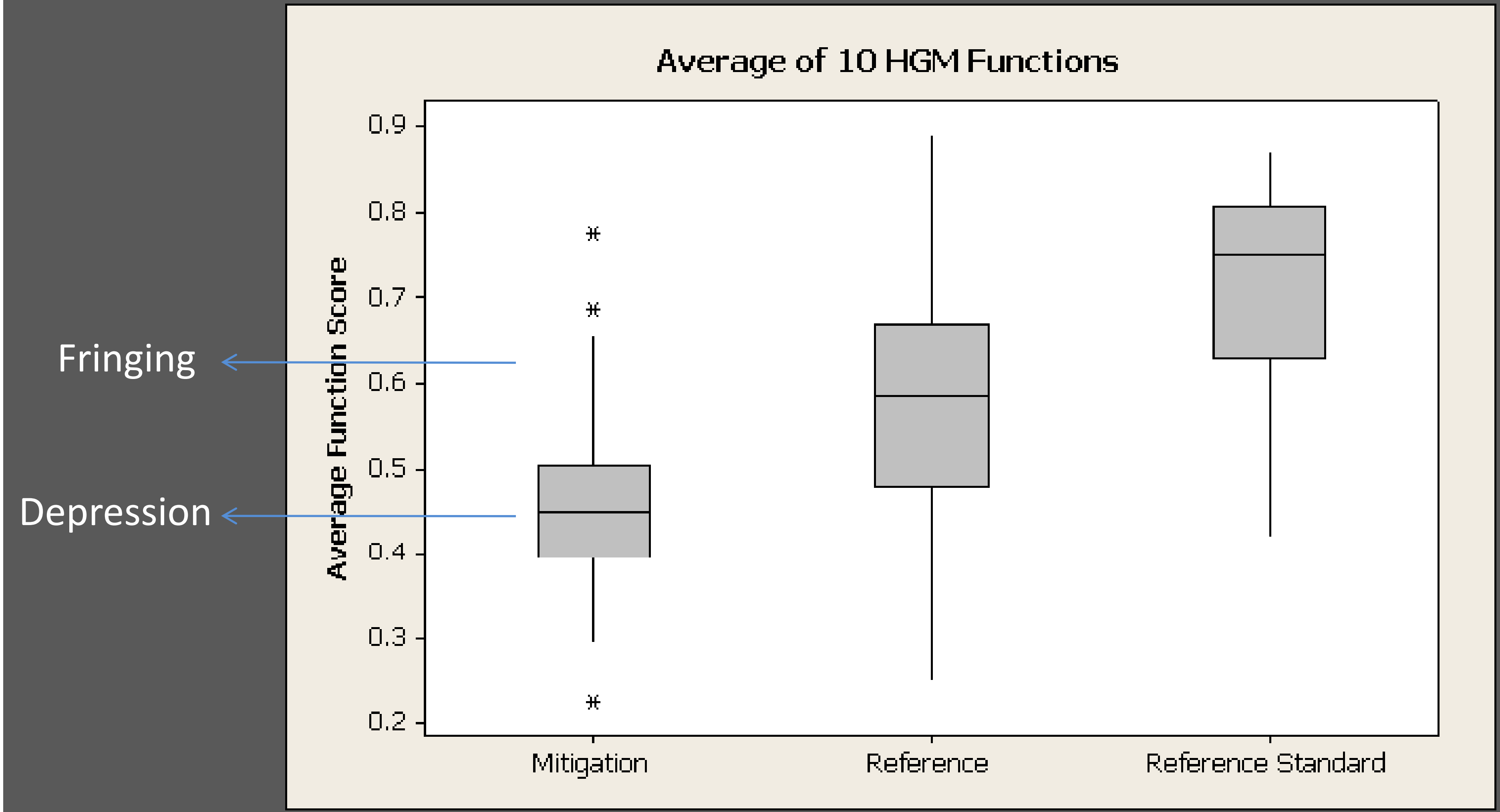
We are learning to build better wetlands

…

Landscape Disturbance

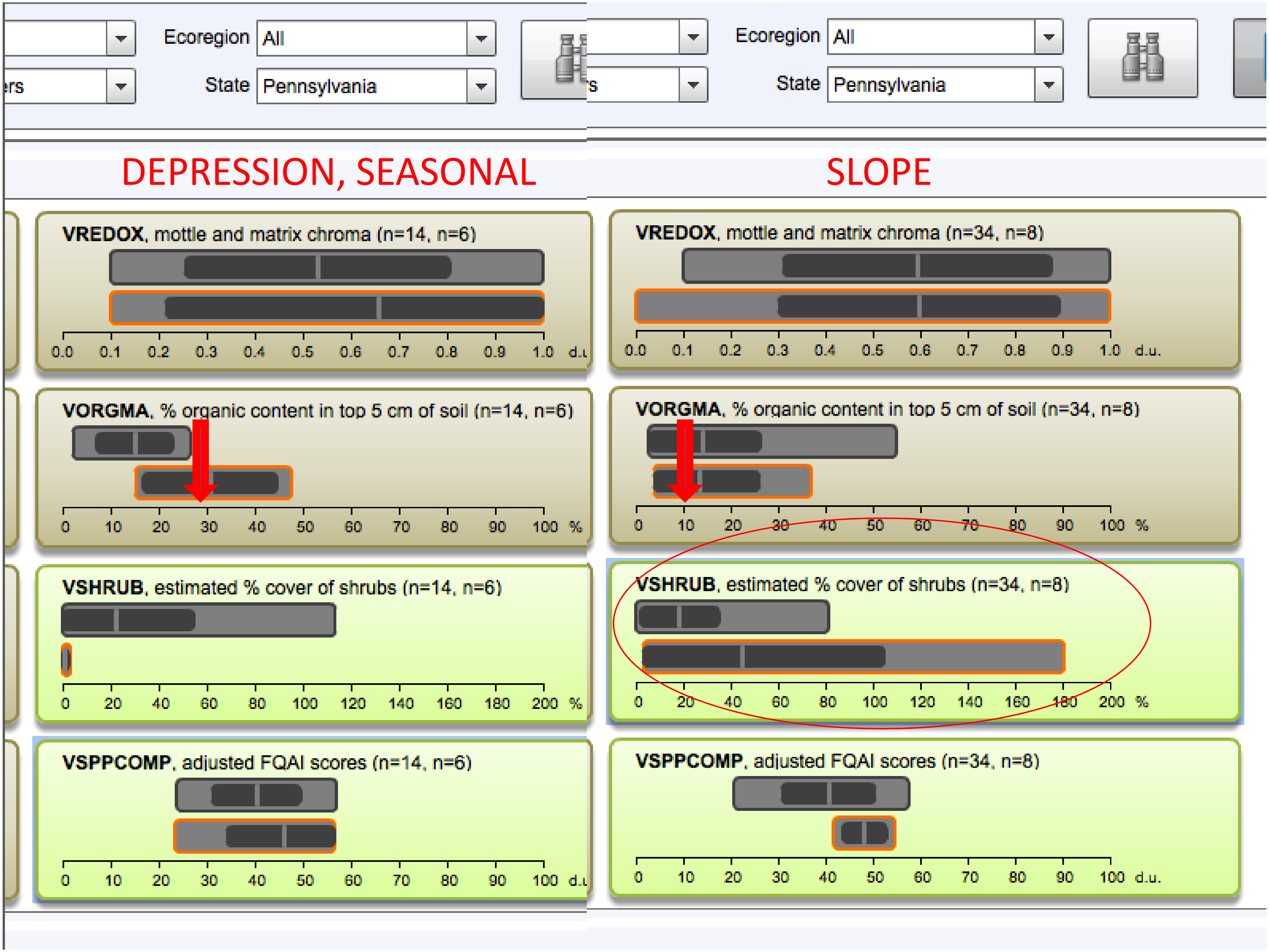


Comparison of Function in Reference and Mitigation Wetlands in Pennsylvania



Variables for mitigation design and performance

- Selected ground-based variables are used in design
- All ground-based variables are used to assess performance
- Landscape variables are relevant to site selection


Ecoregion All
State Pennsylvania
DEPRESSION, SEASONAL
VREDOX, mottle and matrix chroma (n=14, n=6)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
VORGMA, % organic content in top 5 cm of soil (n=14, n=6)
0 10 20 30 40 50 60 70 80 90 100 %
VSHRUB, estimated % cover of shrubs (n=14, n=6)
0 20 40 60 80 100 120 140 160 180 200 %
VSPPCOMP, adjusted FQAI scores (n=14, n=6)
0 10 20 30 40 50 60 70 80 90 100
Ecoregion All
State Pennsylvania
SLOPE
VREDOX, mottle and matrix chroma (n=34, n=8)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 d.u.
VORGMA, % organic content in top 5 cm of soil (n=34, n=8)
0 10 20 30 40 50 60 70 80 90 100 %
VSHRUB, estimated % cover of shrubs (n=34, n=8)
0 20 40 60 80 100 120 140 160 180 200 %
VSPPCOMP, adjusted FQAI scores (n=34, n=8)
0 10 20 30 40 50 60 70 80 90 100 d.u.

RIA
Explorer

Wetland type: Depression seasonal
Site type: All
Ecoregion: All
State: Pennsylvania

Category	Variable	Description	N	Min	Avg	Max
Landscape	VURB	% urban development in 1 km radius	20	0	2.69	42.2
Landscape	VUNOBSTRUC	floodplain obstruction index	20	0.08	0.79	1
SoilTopo	VGRAD	elevation gradient based on topo maps	20	0	0	2
SoilTopo	VMACRO	% macrodepressions along transect	20	0	44.68	80
SoilTopo	VMICRO	microtopography	20	0.06	0.35	0.99
SoilTopo	VORGMA	% organic content in top 5 cm of soil	20	2.2	19.34	47.7
SoilTopo	VREDOX	mottle and matrix chroma	20	0.1	0.57	1
SoilTopo	VTEX	soil texture determined in field	20	0.03	0.58	0.99
Stressors	VHYDROSTRESS	# of hydrologic modifications	20	0	0	3
Vegetation	VBIOMASS	estimated total biomass	20	74.92	245.72	1330.78
Vegetation	VTREE	estimated % cover of trees	20	0	0.17	1.16
Vegetation	VSHRUB	estimated % cover of shrubs	20	0	16.12	113.57
Vegetation	VHERB	estimated % cover of herbs	20	6.33	63.47	108.75
Vegetation	VCWD-BA	coarse woody debris est. basal area	20	17.7	218.63	996.16
Vegetation	VCWD-BA	CWD est. basal area, branches/saplings	20	0	78.12	360.59
Vegetation	VCWD-BA	CWD est. basal area, trees	20	0	79.71	227.54
Vegetation	VCWD-BA	CWD est. basal area, large trees	20	0	47.63	681.96
Vegetation	VCWD-SZ	coarse woody debris size class tally	20	1	2	3
Vegetation	VEXOTIC	% of species that are non-native	20	0	12.71	46.4

How we inventory, assess the ecological integrity, and restore natural resources across geographic scales.

LEVEL 1 LANDSCAPE FROM GIS

LEVEL 2 RAPID FIELD ASSESSMENT

LEVEL 3 INTENSIVE FIELD ASSESSMENT


Thank you!
Q & A