Establishing a national Reference Wetlands Registry for the USA

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WHM Group, State College, PA
Bald Eagle Mitigation Site information

Thank you!
“...So, when we experiment in planting forests, we find ourselves at last doing as Nature does. Would it not be well to consult with Nature in the outset? for she is the most extensive and experienced planter of us all...”

Henry David Thoreau, On the succession of trees, c1850s

“The time has come for science to busy itself with the earth itself. The first step is to reconstruct a sample of what we had to begin with.”

Aldo Leopold, 1934, discussing a prairie restoration project on the UW-Madison Arboretum.

“The characterization of wetland reference condition is an important step in the design of a wetland monitoring and assessment program.”

EPA 2006 Elements of State Wetlands Program
Calls for improving restoration, creation, and mitigation performance

- Kusler and Kentula 1990 – Restoration of wetlands...
- Kentula et al. 1992 – Decision making in wetland restoration...
- NRC 1992 - Restoration of Aquatic Ecosystems...
- NRC 2001 - Compensating for wetland losses...
- GAO 2001 - Fish & wildlife mitigation guidance...
- Corps 2002 - National wetlands mitigation action plan...
- EPA & Corps 2008 - National Wetlands Compensatory Mitigation Rule
Ecological restoration to recover critical ecosystem services has been widely attempted, but the degree of actual recovery of ecosystem functioning and structure from these efforts remains uncertain.
There is no cookbook at the end of the rainbow for wetlands mitigation and restoration!
We must embrace *reference* concepts for wetlands mitigation and restoration, if we want to be successful, and use these data to inform disturbance and climate change trends.
Smith et al. (1995) definitions for reference concepts:

Reference Domain - geographic area from where reference wetlands are selected

Reference Standards - conditions exhibited by a group of reference wetlands that correspond to the highest level of functioning (least disturbed, best attainable, ...)

Reference Wetlands - wetland sites that encompass the variability of a regional wetland subclass in a reference domain

See Brooks et al. 2013, 2016
Riparia’s Reference Wetlands Collection (n = 222)

Established 1993-2003, resampling, 10 sites/yr at 10-year intervals

How do we use reference data?
Recommendations for establishing reference wetlands

Establish multiple objectives that consider all needs, makes efficient use of limited human & resources:
  • assessing condition
  • designing better wetlands by region and type
  • evaluating performance for mitigated & restored sites
  • baseline for long-term trend analyses
  • serve as experimental controls for managed sites
  • enhance our understanding of wetland ecosystems

Sites should have long-term accessibility, if possible

*See Brooks et al. 2002, 2013 for detailed steps for establishing and selecting reference wetlands.*
Disturbance-Response Curve (dose-response)

Wardrop et al. 2013
Disturbance-Response Curve (dose-response)

Deviation from reference condition

Impaired condition

Wardrop et al. 2013
Level 3 Intensive Assessment

Floristic Quality Assessment Index (FQAI) & Plant Index of Biological Integrity

Sarah Chamberlain - Riparia
Declining condition or health, as indicated by plant community AND shows same pattern for mitigation.

Graphic by Sarah Chamberlain.
FQAI Calculator
Example

mawwg.psu.edu
or
www.riparia.psu.edu (under products)
Wetland Homogeneity Model

Reference Population

Disturbed Population

Equivalence

Goal for Restored and Created Populations

Created Population

Degradation

Restoration

Brooks et al. 2005 Eco Engin.
Natural reference wetlands vs. mitigation projects

Gebo & Brooks 2012
Brooks & Gebo 2013
Overall, mitigation sites displayed lower potential to perform a characteristic wetland function than reference wetlands.

Gebo and Brooks 2012
Sampled Mitigation Wetlands in Pennsylvania (n=72)
HGM Distribution of Natural Wetlands to Mitigation Projects in Pennsylvania

**Type Shift** from riverine to depression
Landscape Disturbance

![Box plot showing landscape disturbance index comparison between Mitigation and Reference areas. The Mitigation area shows a lower median and less variability, indicated by the lower box position and shorter interquartile range compared to the Reference area. The p-value of 0.000 suggests a statistically significant difference between the two groups.]
Floristic Quality Assessment Index (FQAI): Depression, Fringing, Slope Wetlands

Reference wetlands had significantly higher scores than mitigation sites for these 3 types of wetlands.
Soil Organic Matter: Depression & Fringing Wetlands

Depression - Percent Organic Matter (5 cm)

Fringing - Percent Organic Matter (5 cm)
Wetland Mitigation and Restoration Workshops 2014

Sponsored by USEPA HQ, Region 3, USGS, & Riparia

- #1 Gainesville, VA
- #2 State College, PA (SWS Chapter mtg)
- #3 New Orleans, LA (SER National mtg)

- Participants examined pre- and post-construction sites and data for the interactive database for sites located in central Pennsylvania – requested more hydrologic data and plant species lists
Wetlands Mitigation Workshop Participants
Conclusions … thus far

• Mitigation wetlands are not providing high functioning replacements for natural wetland encroachments
  – HGM class distribution is skewed toward wrong types
  – Mitigation wetlands have lower average function scores

• Use reference data for design, construction, and performance evaluations.

• Link condition assessment, mitigation, and restoration with consistent monitoring protocols.
• Riparia’s **Database of Reference Wetlands**
  – **Assessing** condition (due to stressors)
  – **Designing** mitigation and restoration projects
  – **Evaluating** performance of projects

  – **Interactive website** to provide data to practitioners
Estimates above-ground vegetative biomass using percent cover of tree, shrub and herbaceous layers. This variable is used as a relative estimate of the ability of the site to temporarily sequester nitrogen in above-ground biomass. It is comprised of three sub-variables: VTREE, VSHRUB and VHERB; no dimensions.

Variable Tile

Variable Tile (Stacked)

Reference sites
Reference standard sites
PA Reference Wetlands – Soil Organic Matter – 3 HGM Types

- Riverine upper perennial (headwater)
- Slope
- Depression perennial
Wetland Hydrograph Analysis (over a decade!)

Reference Standard Sites

Disturbed (Stressed) Sites

Hychka et al. 2013
Sample Mitigation Site:

Bald Eagle Site A  (highway mitigation)  2002

• Located in central Pennsylvania between the Ridge & Valley and Allegheny Plateau ecoregions along Rt. 220/I-99 corridor (most similar to R&V)
Landscape Context

Bald Eagle Mitigation
Site A

Located between Ridge & Valley (S) and Allegheny Plateau (N)

Hydrologic flows

Associated with I-99 Highway mitigation

Designed & built by WHM, State College Pennsylvania
Bald Eagle Mitigation Site A
Basin Design
Evaluated with sampling from planting plan (2002), sampling (2003 & 2008), and reference wetlands.
### Bald Eagle A – Planting plan vs Performance
(after 1 yr, after 5yr)

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<th>Planted</th>
<th>Performance</th>
<th>Ref Slope</th>
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Trending drier...
Reference Wetlands

2016 National Wetlands Awards
National Wetlands Condition Assessment 2011-2016
Adding Blue Carbon Value to Coastal Restoration
<table>
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<tr>
<th>Name</th>
<th>Primary Manager</th>
<th>Years/Number of Sites</th>
<th>Data Available</th>
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| National Wetland Condition Assessment (NWCA)                        | EPA and partners of NWCA                             | 2011: 1,179  
2016: 1,000+                                          | Yes; 2016 data available after collection |
|                                                                    |                                                      |                                                             |                                                                              |
| **State-Based Programs**                                           |                                                      |                                                             |                                                                              |
| California Wetlands and Watersheds                                  | California Water Resources Control Board             | 2003-2013: 650 streams and  
100+ wetlands                                                | Yes |
|                                                                    |                                                      |                                                             |                                                                              |
| Washington State Dept. of Natural Resources, Natural Heritage Program | State agency                                        | ~1,000                                                      | Yes |
|                                                                    |                                                      |                                                             |                                                                              |
| Washington State Dept. of Ecology                                  | State agency                                         | ~200                                                        | Yes |
|                                                                    |                                                      |                                                             |                                                                              |
| West Virginia Dept. of Natural Resources                            | State agency                                         | ~1,700                                                      | Yes, with permission |
|                                                                    |                                                      |                                                             |                                                                              |
| **Regional Workgroups**                                            |                                                      |                                                             |                                                                              |
| Mid-Atlantic Region                                                 | Riparia Reference Wetlands Database                  | 1993-2003: 222 now, 1,000+ anticipated                   | Yes, summary data available                                                      |
|                                                                    |                                                      | (after data from other states added)                     |                                                                              |
|                                                                    |                                                      |                                                             |                                                                              |
| **Nongovernmental Organizations**                                   |                                                      |                                                             |                                                                              |
| NatureServe                                                         | 32 Natural Heritage Programs                         | 2010: >17,000 (wetland communities)                        | Yes, with permission |
|                                                                    |                                                      |                                                             |                                                                              |
Intent of a national Reference Wetlands Registry

• *How can we find where these data are collected and stored?*

• *How do we access those data to serve our specific needs?*

• *How do we select the reference sites most appropriate for our desired situation or location?*

Brooks et al. 2016 NWN
Intent of a national Reference Wetlands Registry

• Spatially attributed clearinghouse for metadata on available reference wetlands
• Portal to assist users in accessing these resources
• Reference data will reside on local servers and databases
• Standardized submissions, but voluntary participation
• Users = federal and state agencies, consultants, environmental and natural resource organizations, research institutions
• Our vision = federal agency, or other designated institution with capability, to house the RWR as digital repository/clearinghouse

Brooks et al. 2016 NWN
Thank you for listening!