THE HYDROGEOGOMORPHIC APPROACH TO FUNCTIONAL ASSESSMENT FOR PIEDMONT SLOPE WETLANDS

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Cooperators

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• USEPA Region 3
• US Army Corps of Engineers
  – Baltimore District, Norfolk District
• US Fish and Wildlife Service
• US Federal Highways
• Maryland Department of the Environment
• Pennsylvania Department of Environmental Protection
Wetland Functions

• Definition: biological, chemical, and physical processes that occur in wetlands

• Examples
  – N removal through denitrification
  – Surface water storage
  – Soil organic matter accretion
HGM Functional Categories

- Hydrology
- Biogeochemical cycling
- Plant community
- Wildlife habitat
Functional Assessment

• Quantify the functional capacity of individual wetlands.
• Functional capacity: the degree to which a function is performed.
• Functional capacity is judged relative to a reference standard.
Functional Assessment-Why?

- Evaluation of wetland quality for Federal mandates
- Evaluation of anthropogenic impacts
- Evaluation for mitigation purposes (compensation “in kind”)
- Site selection for wetland enhancement
- Identification of environmentally-sensitive areas
HGM Approach

- Wetland classification
- Site selection
- Model development
  - Identification/selection of functions
  - Data collection
  - Generate variables
  - Calibrate
Hydrogeomorphic Classification

- Geomorphic setting-topographic position in landscape
- Primary hydrologic input-precipitation, groundwater discharge, surface flow
- Hydrodynamics-direction, energy
Wetland Site Selection

• Reference domain
  – Wetlands under consideration
  – One subclass
  – Geographic limitations

• Reference wetlands
  – Subset of reference domain
  – Data collection sites for model development

• Reference standard wetlands
  – Subset of reference wetlands
  – Minimal anthropogenic disturbance
  – Highest functional capacity
Anthropogenic Disturbance

- Ditches
- Fill
- Roads
- Plow layers
HGM Models

- Target a regional subclass of wetlands (e.g., Piedmont slope wetlands)
- Generate a functional capacity profile
HGM Models

- Consist of a series of sub-models (Fc. assessment models) that address individual functions.

- Each sub-model shows the relationship between one function and a measurable wetland attribute (model variable).
Fc: Groundwater Discharge

Fc Index=$V_{GDWR}$

where $V_{GDWR}$=evidence of discharge
Fc: Surface Water Storage

Fc Index = \(\frac{V_{SRWR} + V_{MACTOPO} + V_{MICTOPO}}{3}\)

where:

\(V_{SRWR}\) = presence of surface water
\(V_{MACTOPO}\) = macrotopographic relief
\(V_{MICTOPO}\) = microtopographic complexity
Model Development Variables

- Simple variables-presence of a surface flow outlet
- Complex variables-water chemistry
- Temporal variables-soil Eh
“User Friendly” Attributes

• Visual or easily measured
• No temporal restrictions
• Correlated to a quantitative measure of a variable
Hydroperiod

Seasonal pattern of water table depth in a wetland.

- Direct measurement - monitoring well
- Indirect measurement - soil morphology
Indicators of Inundation

- $F_c =$ Surface Water Storage
  - Thick dark O and/or A horizon
  - Emergent vegetation
Indicators of Seasonal Saturation

• Fc=Denitrification
  – Redox features within 30 cm of surface
  – Tree stratum
Indicators of Resonance Time

- $F_c =$ Carbon export
  - Slope
  - Microtopography
Hydroperiod

1. permanently inundated
2. permanently saturated
3. seasonal
Surrounding Land Use

- Connectivity to other wetlands-wildlife
- Agricultural-sediment and nutrient loading
- Development-hydrologic inputs
Fc. Capacity Scale

- Range: 0.0-1.0
- 1.0=reference standard
- 0.0=unrecoverable loss of function
Scale ex: % herb. groundcover

- Ref. std. wetlands: 50-90%
- Ref. std.: 50%

- 50%+ 1.0
- 30-49% 0.7
- 10-29% 0.4
- <10% 0.1
Piedmont Slope Functions

- Surface & subsurface water storage
- Particulate retention
- Organic C export
- Nutrient cycling
- Removal of elements
- Maint. characteristic plant communities
- Maint. characteristic wildlife habitat
Strengths

• Regionalized
• Specific to a subclass
• Attributes easily and quickly measured
• Surrounding land use considered
Limitations

• Model development is labor intensive.
• Maximum index value limited by “pristine sites”.