Comparison of Three Tiered Wetland Assessment Methods for use on Wetlands in the Prairie Pothole Region

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Study Area

- Designated area of the Missouri Coteau Ecoregion
- Central North Dakota
Site Selection

- Used a probabilistic sampling design
  - Stevens and Olsen 2004
  - Stevens and Jensen 2007
- Randomly selected points
- 750m X 750m quadrats
Landowner Information

- Legal description and landowners were identified
  - Using plat maps
  - Looking through county courthouse tax/land information
- Verbal permission was received from all landowners and/or renters
- Written permission for all land managed by local, state, or federal agencies
Level 1 - Remote Assessment

- Uses GIS software and satellite/aerial imagery to assess wetland
- Done in the office
- Costs vary
- Use in this study:
  - Landscape Wetland Condition Assessment Model (LWCAM)
Landscape Wetland Condition Assessment Model (LWCAM)

- Uses remote sensing and habitat fragmentation to predict wetland condition
- Developed on seasonal wetlands in ND

(Mita et al. 2007)
LWCAM Model

- 300 m buffer created around wetlands
- Land use data is overlaid with wetland buffer
- Model assesses
  - Total area of grassland
  - Number of patches
  - Largest patch of grassland
- Categorizes wetlands as Good, Intermediate, or Poor condition
Level 2 - Rapid Assessment

- Rapidly assesses wetland condition/function
- On the ground assessment
- Minimal time spent at site
- Used in this study:
  - North Dakota Rapid Assessment Method (NDRAM)
North Dakota Rapid Assessment Method (NDRAM)

- Rapidly assesses wetlands based on plant and landscape characteristics
- Developed based on
  - Other rapid assessment methods
    - Ohio (Mack 2001)
    - California (Collins et al. 2007)
  - Wetland characteristics specific to Prairie Pothole Region wetlands
North Dakota Rapid Assessment Model (NDRAM)

- Approximately 20 minutes to conduct survey
- Final scores on a scale of 0-100
- Groups wetlands based on final score
- 3 metric system used
- Results intended to be similar to the IPCI
Level 3 - Intense Assessment

- On the ground survey
- More time intensive (exact time varies)
- Larger amount of information gained
- Used in this study:
  - Index of Plant Community Integrity (IPCI)
  - Hydrogeomorphic (HGM) model
Index of Plant Community Integrity (IPCI): a form of IBI

- Developed on temporary, seasonal and semi-permanent wetlands within ND, SD, and MT (DeKeyser et al. 2003, Hargiss et al. 2008)
- Evaluates health of Prairie Pothole Region wetlands based on plant community
- Final scores on a scale of 0-99
- Groups wetlands based on final score
Index of Plant Community Integrity (IPCI)

Example of quadrat layout for a seasonal wetland.

- Low Prairie
- Wet Meadow
- Shallow Marsh
# Seasonal Metric Value Ranges

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value Range for 0</th>
<th>Value Range for 4</th>
<th>Value Range for 7</th>
<th>Value Range for 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp. Rich.¹</td>
<td>0-19</td>
<td>20-31</td>
<td>32-41</td>
<td>42+</td>
</tr>
<tr>
<td># Genera²</td>
<td>0-14</td>
<td>15-24</td>
<td>25-32</td>
<td>33+</td>
</tr>
<tr>
<td>Grass-like³</td>
<td>0-6</td>
<td>7-10</td>
<td>11-17</td>
<td>18+</td>
</tr>
<tr>
<td>% of intro.⁴</td>
<td>41.1+</td>
<td>30.8-41.0</td>
<td>21.1-30.7</td>
<td>0-21.0</td>
</tr>
<tr>
<td># Nat. in WMZ⁵</td>
<td>0-8</td>
<td>9-16</td>
<td>17-24</td>
<td>25+</td>
</tr>
<tr>
<td># C ≥ 5⁶</td>
<td>0-7</td>
<td>8-17</td>
<td>18-26</td>
<td>27+</td>
</tr>
<tr>
<td># C ≥ 4 in WMZ ⁷</td>
<td>0-4</td>
<td>5-9</td>
<td>10-16</td>
<td>17+</td>
</tr>
<tr>
<td>Avg. C⁸</td>
<td>0.00-2.60</td>
<td>2.61-3.12</td>
<td>3.13-3.52</td>
<td>3.53+</td>
</tr>
<tr>
<td>FQI⁹</td>
<td>0.00-10.00</td>
<td>10.01-16.10</td>
<td>16.11-22.99</td>
<td>23.00+</td>
</tr>
</tbody>
</table>

¹ Species richness of native perennial plant species.
² Number of genera of native perennial plant species.
³ Number of grass and grasslike species (Poaceae, Juncaceae, Cyperaceae).
⁴ Percentage of the total species list that are annual, biennial, and introduced.
⁵ Number of native perennial plant species found in the wet meadow zone.
⁶ Number of plant species with a C-Value ≥ 5.
⁷ Number of plant species with a C-Value ≥ 4 found in the wet meadow zone.
⁸ Average C-Value of all species present.
⁹ Floristic Quality Index = Average C-Value multiplied by the square root of the total number of species.
IPCI

- Scores for each metric are added together
- Total score between 0-99
- Condition categories based on final score
  - Very Good (80-99)
  - Good (60-79)
  - Fair (40-59)
  - Poor (20-39)
  - Very Poor (0-19)
Hydrogeomorphic (HGM) Model

- Assesses the physical attributes and functional characteristics of each wetland
  - Synthesized physical characteristics, land-use information, biological data, soil data, and GPS and GIS information
  - Calculated six Functional Capacity Indices (FCI) for each wetland
    (Gilbert et al. 2006)
HGM FCI’s

- FCI’s scaled from 0 to 1.0
  - 1 = reference sites for the area

- FCI 1 = Water Storage
- FCI 2 = Groundwater Recharge
- FCI 3 = Retention of Particulates
- FCI 4 = Removal, Conversion, and Sequestration of Dissolved Substances
- FCI 5 = Plant Community Resilience and Carbon Cycling
- FCI 6 = Ability to Provide Faunal Habitat
Results: Contacting Landowners

- 390 landowners were contacted
- Approximately 8-9 months to get all permission needed (Whigham et al. 2003)
- In person responses were between 95-97% yes!
- Phone calls estimated at 50% or less yes rate
- Letters estimated at 50% or less response rate
  - Rate of yes in those that responded was very low
Wetlands tested

- Total of 106 quadrats tested (750m X 750m)
- 25% of total wetlands were seasonal wetlands tested using three tiered design
  - 255 wetlands
Condition Conclusions

- Wetland condition is based on land use
  - Topography/geology is the main factor affecting land use
- Smaller wetlands were more disturbed than larger wetlands
- More wetlands in Poor condition than in Good condition
Statistical Analysis

- **Nonmetric Multidimensional Scaling**
  - Reduced multi-metric systems to significant axes to rank against IPCI final score

- **Kendall Coefficient of Concordance Test**
  - Determined if methods ranked wetlands similarly
Similarity of Models

<table>
<thead>
<tr>
<th>Model</th>
<th>IPCI</th>
<th>HGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWCAM</td>
<td>75%*</td>
<td>77%*</td>
</tr>
<tr>
<td>NDRAM</td>
<td>87%*</td>
<td>89%*</td>
</tr>
<tr>
<td>HGM</td>
<td>92%*</td>
<td></td>
</tr>
</tbody>
</table>

*p-value = .0001

*Significant p-value indicates that methods were similar

- Techniques rank sites similarly but measure different attributes
Comparison of Models

- Differences between the IPCI and LWCAM is due to:
  - Specificity in the data
    - LWCAM broad categorization
    - IPCI on the ground specific data

- Differences between the IPCI and NDRAM is due to:
  - Timing of sampling
    - Sample only after mid June
  - Differences in metrics
  - Area sampled

- Differences between the IPCI and HGM overall
  - HGM relies heavily on physical criteria and landscape characteristics
    - Scores for HGM are much higher than IPCI
    - Biological differences may exist that could be overlooked by the HGM model
Sample Size Adequacy

- **Determined two different ways**
  - New areas that have not been sampled before
    - Modified species area curve (species accumulation curve)
      - McCune and Grace (2002)
  - Returning to an area to determine change over time
    - 10% and 20% change tested
    - At .8 and .9 power
Sample Size Adequacy

- Sampling a new area

<table>
<thead>
<tr>
<th></th>
<th>Number of Wetlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWCAM</td>
<td>25-75</td>
</tr>
<tr>
<td>IPCI</td>
<td>25-75</td>
</tr>
<tr>
<td>NDRAM</td>
<td>35-90</td>
</tr>
<tr>
<td>HGM</td>
<td>35-90</td>
</tr>
</tbody>
</table>

- Return sampling to assess change

<table>
<thead>
<tr>
<th></th>
<th>10% Change</th>
<th>20% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.8 Power</td>
<td>.9 Power</td>
</tr>
<tr>
<td>LWCAM</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>IPCI</td>
<td>79</td>
<td>105</td>
</tr>
<tr>
<td>NDRAM</td>
<td>50</td>
<td>66</td>
</tr>
<tr>
<td>HGM</td>
<td>38</td>
<td>50</td>
</tr>
</tbody>
</table>
Conclusions

- All models studied are valuable in indicating wetland condition in different capacities
  - LWCAM as first indication of land use in an area
  - NDRAM as overall condition assessment
  - IPCI used for in-depth assessment and for indicating condition trends
  - HGM indicates general function and physical condition

- A combination of all models is best to indicate overall condition at a site
Management Implications

- Repeat assessment can indicate the trend in relation to the present and future predominant land practices.
- Information from this study can be used as a model for determining appropriate wetland sampling methods based on:
  - Project needs
  - Time
  - Finances
Acknowledgements

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  - Mike Ell

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Questions?


Gilbert, M.C., P.M. Whited, E.J. Clairain, Jr., and R.D. Smith. 2006. A regional guidebook for applying the hydrogeomorphic approach to


