Landscape Assessment of Wetlands for Conservation Priorities in Delaware

January 30, 2014
• 100,000 ha of wetlands
• About a third is tidal marsh
• Forested wetlands especially vulnerable to conversion
• Many wetlands degraded by ditching, road building, and other hydrologic alterations.
Conservation Opportunity Areas

• Holistic approach to identifying and setting priorities for preservation and restoration within DNREC.

• Centralized tool for planning, allocating resources and making daily decisions.

• Scientifically based

• Proactive and strategic
Core Areas:
- Contain fully functional natural ecosystems
- Provide high-quality habitat for native plants and animals

Corridors:
- Link core areas together
- Allow animal movement and seed and pollen transfer between core areas
Blocks of relatively undisturbed forest

(1) at least 40 ha (100 ac)

(2) contain forest Habitats of Conservation Concern from the DE Wildlife Action Plan

(3) contain documented occurrences of forest-dependent state rare species.
Table 4. Index of wetland condition (IWC) formulas for flats and riverine wetlands in the Inland Bays watershed. Variable names and definitions are listed in Table 3.

<table>
<thead>
<tr>
<th>Wetland Type</th>
<th>IWC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flats</td>
<td>$50/7 \times (V_{\text{disturb}} + V_{\text{herb}} + V_{\text{rubus}} + V_{\text{ta}} + V_{\text{reed}} + V_{\text{treespp}} + V_{\text{shrubden}}) + 40/3 \times (V_{\text{micro}} + V_{\text{fill}} + V_{\text{drain}}) + 10/1 \times (V_{\text{landuse200}})$</td>
</tr>
<tr>
<td>Riverine</td>
<td>$50/4 \times (V_{\text{rubus}} + V_{\text{invasive}} + V_{\text{tree}} + V_{\text{ta}}) + 40/2 \times (V_{\text{floodplain}} + V_{\text{channelout}}) + 10/1 \times V_{\text{buffuse200}}$</td>
</tr>
</tbody>
</table>
### Landscape variables

<table>
<thead>
<tr>
<th>Scale</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance to channelized streams or ditches</td>
</tr>
<tr>
<td></td>
<td>Distance to nearest disturbed land</td>
</tr>
<tr>
<td></td>
<td>% assessment area with natural cover</td>
</tr>
<tr>
<td>Assessment point (n = 511)</td>
<td>% assessment area within 30 m of cleared or developed land, roads, railroads, ditches or channelized streams; or within 120 m of tax ditches</td>
</tr>
<tr>
<td></td>
<td>% assessment area disturbed (&lt;30 m from cleared or developed land, roads, or railroads; converted to pine plantation; other non-natural vegetation or land cover; &lt;120 m from tax ditches; &lt;30 m from other ditches or channelized streams)</td>
</tr>
<tr>
<td></td>
<td>% assessment area with natural cover since at least 1937</td>
</tr>
<tr>
<td></td>
<td>% of 0-20 m buffer with natural cover</td>
</tr>
<tr>
<td></td>
<td>% of 0-20 m buffer with mature natural cover</td>
</tr>
<tr>
<td></td>
<td>% of 20-100 m buffer with natural cover</td>
</tr>
<tr>
<td></td>
<td>% of 20-100 m buffer with natural cover since at least 1937</td>
</tr>
<tr>
<td>Entire wetland containing assessment point (n = 442)</td>
<td>Total area of wetland</td>
</tr>
<tr>
<td></td>
<td>Identified as drained, ditched, farmed, impounded, filled, or excavated</td>
</tr>
<tr>
<td></td>
<td>% of stream channels identified as channelized or ditched</td>
</tr>
<tr>
<td></td>
<td>Density of channelized streams or ditches</td>
</tr>
<tr>
<td></td>
<td>% disturbed (&lt;30 m from cleared or developed land, roads, or railroads; converted to pine plantation; other non-natural vegetation or land cover; &lt;120 m from tax ditches; &lt;30 m from other ditches or channelized streams)</td>
</tr>
<tr>
<td></td>
<td>% of wetland with natural cover since at least 1937</td>
</tr>
<tr>
<td>Wetland drainage catchment (n = 197)</td>
<td>Ratio of natural cover to non-natural cover</td>
</tr>
<tr>
<td></td>
<td>Ratio of natural cover since at least 1937 to cover modified since then</td>
</tr>
<tr>
<td></td>
<td>Ratio of impervious surface to non-impervious surface</td>
</tr>
<tr>
<td></td>
<td>Road density (ratio of 10 m cells with roads to cells without roads)</td>
</tr>
<tr>
<td></td>
<td>Ratio of ditches and channelized streams to non-channelized streams</td>
</tr>
<tr>
<td></td>
<td>Density of channelized streams or ditches</td>
</tr>
<tr>
<td></td>
<td>Ratio of wetlands lost to currently mapped wetlands</td>
</tr>
</tbody>
</table>
Data Analyses

- Spearman correlations
- Scatter plots
- Variable selection regressions
- Classification and regression trees (R v2.14.0; package rpart)
Core Wetlands

- Natural condition (relatively undisturbed since at least 1930’s)
- Upland buffers at least 30 meters wide
- Be away from water table drawdown from ditches or channelized streams.
- Fall within contiguous natural areas containing at least 7 acres of wetlands.

- Add wetlands if in Habitats of Conservation Concern
- Add wetlands with wetland-dependent rare species

- Added adjacent natural land and open water (wetland supporting landscapes)
About half of total wetland area

Plots in core wetlands had significantly better scores than plots in other wetlands

86% of wetland-dependent rare species fell within core wetlands.
Criteria for core rivers and streams:
• Natural morphology (e.g., not ditched, channelized, impounded, or entrenched)
• Perennial flow
• <10% impervious surface in catchment
• ≥30 m forest or wetland on both sides of the bank
• No dams, road crossings (except for bridges), or other stream blockages
• At least 1 km with the above conditions

Criteria for core lakes and ponds:
• Add lakes and ponds with state rare fish or mussels

Added natural land adjacent to core streams and water bodies (aquatic supporting landscapes)
Combine Core Areas

Combine the following:

• Core forest

• Core wetlands

• Core aquatic areas

• Habitats of Conservation Concern that don’t fit the above types (e.g., beaches)
Corridors/Connectivity

• Corridors link core habitat areas.
• Both context and species dependent.
• Link similar types.
• Identified paths of least resistance by simulating movement of organisms through the landscape.
• Common dispersal conduits include forest, riparian areas, wetlands, and streams.
• Common dispersal barriers include busy roads, urban areas, or dams and other stream blockages.
• Relatively undisturbed, established wetlands
• Other wetlands
• “Potential wetlands” (signature unclear)
• Degraded wetlands
• Former wetlands (e.g., farmed or filled)
• Upland forest or old fields
• Upland agriculture
• Minor roads and railroads (except for bridges)
• Developed land
• Major roads
Terrestrial Movement Analysis tool models landscape connectivity.

- Identifies and prioritizes areas most important for wildlife movement.
- Randomly places simulated organisms throughout suitable habitat in landscape.
- Optimal pathways identified between organism locations and other suitable habitat.
- Runs multiple iterations
  - Random placement varies for each iteration, thus pathway locations vary as well

- Outputs from iterations averaged to create final pathways
Connections should be more than one “cell” wide

Corridors include suitable areas surrounding optimal pathways
Corridors/Connectivity

- TMA outputs
  - Pathways (weighted by importance)
  - Corridors (weighted by ease of movement)
  - Overall landscape movement potential

- Network Prioritization outputs
  - Corridor importance to overall connectivity
  - Core importance to overall connectivity
  - Corridors tenuous or not
  - Existing connection vs. restoration needed
Delaware Ecological Network – Core Areas and Corridors

Legend:
- Core areas
- Intact corridors
- Potential corridors

Source: Data: DigitalGlobe; datasets: Esri, USGS, I-896, I-95, I-96, Delaware, Marlit, SECT, Naturalis, Juris, and the GIS User Community
Core Rankings

- Weighted sum of rare species and community occurrence scores
- Area of Habitats of Conservation Concern
- Area of mature interior natural forest
- Area of potentially mature, undisturbed wetlands
- Length of core streams
- Connectivity (maximum value of any given pathway)
- Measurement of proximity to other core areas (the closer to 1, the less isolated)
## Protected areas inside and outside the Delaware Ecological Network

<table>
<thead>
<tr>
<th></th>
<th>All land and water (ac)</th>
<th>DEN core areas (ac)</th>
<th>Existing corridors (ac)</th>
<th>Potential corridors (ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protected</td>
<td>319,069</td>
<td>153,983</td>
<td>6,155</td>
<td>16,443</td>
</tr>
<tr>
<td>Unprotected</td>
<td>966,731</td>
<td>192,204</td>
<td>22,446</td>
<td>27,541</td>
</tr>
<tr>
<td>Total land</td>
<td>1,285,800</td>
<td>346,187</td>
<td>28,601</td>
<td>43,984</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>All land and water (%)</th>
<th>DEN core areas (%)</th>
<th>Existing corridors (%)</th>
<th>Potential corridors (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protected</td>
<td>25%</td>
<td>44%</td>
<td>22%</td>
<td>37%</td>
</tr>
<tr>
<td>Unprotected</td>
<td>75%</td>
<td>56%</td>
<td>78%</td>
<td>63%</td>
</tr>
</tbody>
</table>
1. Identify stakeholder/partner uses
2. Identify Conservation Opportunity Areas
3. Incorporate finer levels of prioritization
4. Refine forest and aquatic prioritization methodologies
5. Identify key restoration opportunities
6. Identify core grassland/early successional areas?
7. Incorporate benefit/cost optimization?
8. Incorporate sea level rise?
9. Work with interested individual landowners to implement protection of high-priority areas