Vegetation Succession of Riverine Planted and Unplanted Wetlands 15-17 Years After Creation in Ohio

Kay C. Stefanik and William J. Mitsch
Wilma H. Schiermeier Olentangy River Wetland Research Park and the Environmental Science Graduate Program, The Ohio State University
Wetland Creation and Restoration

- Wetlands provide a variety of ecosystem services such as flood water retention, water purification/nutrient removal, food, fiber, and wildlife habitat.

- Pre-European settlement, approximately 89.5 million ha of wetlands in lower 48 states.

- Approximate wetland loss of 50% in US and 90% in Ohio (Dahl 1990).

- Section 404 Clean Water Act: Permit is required to dredge or fill a jurisdictional wetland.

- Permit holders are required to mitigate wetland loss usually by creating or restoring wetlands.
Wetland Success

• Created wetlands usually monitored for only 5 years

• Mitigation wetlands have been shown to be reaching a state of equilibrium with vegetation resembling that of a natural wetland after 20 years (Atkinson et al. 2005; Balcombe et al. 2005; Spieles 2005; Mitsch et al. 2012)

• Hydrology, vegetation, and soil commonly examined; Standard vegetation parameters are % vegetation cover, species richness, and indicator status

• Tilman et al. (1997) suggest that functional diversity and composition were better determinates of ecosystem processes than structural characteristics in grassland systems
Objective

To compare development of vegetative structure and function in planted and unplanted wetlands maintained with identical hydrology for 15 to 17 years after wetland creation
Initial Experiment

- “The planted and unplanted wetlands will be similar in function in the beginning, diverge in function in the middle years, and ultimately converge in structure and function”
  - Mitsch et al. 1998
The wetlands were constructed 1993-1994 and are both 1 ha in size.

Wetland 1 was planted with 13 species (2500 propagules), while wetland 2 was left to rely on natural colonization.

The two wetlands receive identical water input from the Olentangy River.
Sampling Sites

- 12 sampling sites per wetland, located in dominant plant communities
  - Wetland 1: *Scirpus fluviatilis*, *Sparganium eurycarpum*, *Typha* spp.
  - Wetland 2: *Leersia oryzoides*, *Schoenoplectus tabernaemontani*, *Typha* spp., *Phragmites australis*

- 6 transects along each interior wetland edge
Methods

- Monthly macrophyte vegetation sampling from April through September 2008-2010
- Structural characteristics
  - Species richness
  - Floristic quality assessment index
  - Community diversity index
- Functional characteristics
  - Above and belowground net primary productivity
  - Functional group classification
Methods

- Vegetation surveys of the wetlands and edge areas were used to determine species richness, floristic quality, and functional groups of dominant macrophytes.
- GPS and aerial photographs were used to define the area of dominant macrophyte communities for community diversity index and for weighting biomass measurements.
- Aboveground Biomass (0.5 m² plots) using Sequential Harvest Method
  - Dried at 105°C for 48 hours.
- Belowground Biomass (cores 10-cm diameter, 30-cm depth)
  - Dried at 105°C for 48 hours.
## Results

<table>
<thead>
<tr>
<th>Species richness</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W1</td>
<td>W2</td>
<td>W1</td>
<td>W2</td>
</tr>
<tr>
<td>Species richness</td>
<td>97</td>
<td>92</td>
<td>98</td>
<td>92</td>
</tr>
<tr>
<td>FQAI</td>
<td>23.8</td>
<td>19.9</td>
<td>23.2</td>
<td>20</td>
</tr>
<tr>
<td>CDI</td>
<td>1.71</td>
<td>1.26</td>
<td>1.16</td>
<td>1.45</td>
</tr>
<tr>
<td># of wetland species</td>
<td>55</td>
<td>52</td>
<td>52</td>
<td>46</td>
</tr>
</tbody>
</table>
Monthly Aboveground Biomass of the Planted and Unplanted Wetlands
Monthly Accumulation of Aboveground Net Primary Productivity
Monthly Belowground Biomass of the Planted and Unplanted Wetlands
Tree Aboveground Net Primary Productivity of Wetland Edges
Conclusions

- Structural characteristics are influenced more by planting than functional characteristics.
- Planting of the wetland had no impact on the structure and function of the wetland edge vegetation.
- Since both structure and function of vegetation are important, it may be beneficial to plant a wide variety of species and allow the system to self-design.
Acknowledgements

- **Support**
  - Ohio Wetlands Foundation Fellowship
  - Fay Fellowship - Environmental Science Graduate Program at The Ohio State University
  - Rhonda and Paul Sipp Wetland Research Award, Olentangy River Wetland Research Park
  - US Environmental Protection Agency grant EM83329801-0 and MX95413108-0
  - National Science Foundation Grant CBET-1033451 and CBET-0829026

- Field and lab assistance – Brent Macolley, Matthew Thibault, Rachelle Howe, Felice Forby, Kyle Kingma, and Maoqi Sun
Thank you