Effectiveness of Braided-Island Rehabilitation in Cherokee Marsh, Wisconsin

Peter Torma, John R. Reimer, Chin H. Wu
University of Wisconsin–Madison
Budapest University of Technology and Economics, Hungary
Motivations

640 acres lost ~ 1 square mile
Cherokee Marsh is disappearing!
Rehabilitation Alternatives

- **Floating Bog Interceptors (FBIs)**
  - Stabilize shoreline
  - Improve biodiversity
  - Local Solution

- **Water Level Regulation**
  - Restore globally
  - Cherokee
  - Public Interest

- **Braided Islands Rehabilitation**
  - Rehabilitate regionally
  - Provide diversities
  - Effectiveness
Research Objective
Assess effectiveness of braided islands rehabilitation in Cherokee Marsh, Wisconsin

- Reduce *sediment/nutrient* loading
- Promote *diversified habitat* and improve *biodiversity*

Vegetation  Fish  Wildlife
Assessment Framework

Statistics

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Wind Speed (m/s)</th>
<th>Flow (cfs)</th>
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<tr>
<td>1</td>
<td>21</td>
<td>102</td>
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<td>10</td>
<td>31</td>
<td>207</td>
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\[ \tau_{\text{wave}} \quad \text{wind shear} \]

\[ \tau_{\text{current}} \quad \text{Flood} \]

\[ Q(t) \]
**S-S Assessment Framework**

**Sensitivity**

<table>
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<tr>
<th>Water Level</th>
<th>Temperature</th>
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<tbody>
<tr>
<td>High (Flood Level)</td>
<td>Hot (Summer)</td>
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<td>Low (Winter)</td>
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**Velocity** ↔ **Vegetation**

**Shear stress** ↔ **Sedimentation**

**Temperature** ↔ **Habitat**
Modeling Approach

1D

- Longitudinal profiles
  - Water level
  - Flow

2D

- Wind induced
  - Horizontal variations
  - Wave motion

3D

- Vertical variations
  - Thermal structure
  - Wave-Current inter.

Waves - Hydrodynamics
Computational Mesh

Present State (2017)

$\Delta x: \quad 50 \text{ m} \quad – \quad 100 \text{ m}$
Computational Mesh

Rehabilitated Braided Islands

Δx: 8 m – 40 m
**S-S Assessment Framework**

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**Shear stress ↔ Sedimentation**

**Velocity ↔ Vegetation**

**Temperature ↔ Habitat**
Present State

Wave Height

21 m/s

Reduce sediment loading

Provide diversified habitat
Rehabilitated Braided Islands

21 m/s

Wave Height

Reduce sediment loading

Provide diversified habitat
Ratio = $\frac{\tau_b \text{ Rehabilitated Braided Islands}}{\tau_b \text{ Present State}}$

Average: 67%
Present State

Flow Velocity

\[ Q(t) \]

Reduce sediment loading

Provide diversified habitat
Rehabilitated Braided Islands

Flow Velocity

Reduce sediment loading

Provide diversified habitat
Ratio = $\frac{\tau_b \text{ Rehabilitated Braided Islands}}{\tau_b \text{ Present State}}$

Average: 103%
Present State

Flow Velocity

Reduce sediment loading

Provide diversified habitat

Pondweed

Riis & Biggs 2003, Kemp et al 2004
Rehabilitated Braided Islands

Flow Velocity

Reduce sediment loading

Provide diversified habitat

Pondweed

Riis & Biggs 2003, Kemp et al 2004
Present State

3D Thermal Structure

Reduce sediment loading

Provide diversified habitat
Present State

Temperature

Reduce sediment loading

Provide diversified habitat
Rehabilitated Braided Islands

Temperature

Reduce sediment loading

Provide diversified habitat
Summary

Assess effectiveness of braided islands rehabilitation in Cherokee Marsh.

**Assessment Framework**

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3D Waves - Hydrodynamics

Shear stress ↔ Sedimentation

Velocity ↔ Vegetation

Temperature ↔ Habitat
Summary

(i) Reduce sediment/nutrient loading

- Reduce wave impacts
- Reduce bottom shear stress

(ii) Provide diversified habitat

- Shelter for vegetation
- Fish spawning areas
Goals

- Decrease phosphorus loading
- Increase sediment trapping
- Rehabilitate marshland/wetland
- Restore fishery & wildlife habitat
- Promote public access & recreation

Vision for REHAB Cherokee Marsh:
Restore Ecological Health of Aquatic Bio-diversity