Mapping Monotypic Stands of Invasive *Phragmites* in the Coastal Great Lakes

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Project Objectives

Map current invasive *Phragmites* extent for Great Lakes coastal zone
- Remote Sensing
- Field Work
- Validation

Identify major environmental drivers of *Phragmites australis* distribution

Provide decision support tool

Assess vulnerable areas to new invasion
**Presentation Overview**

- **Project goal:** Develop methods for creating a distribution map of invasive *Phragmites* for management and control—decision support

- **Solution:** Use Satellite Remote Sensing-SAR
  - SAR technique developed from GLCWC pilot study for mapping landscape indicators (SOLEC), Preliminary analysis of 2008 PALSAR funded by USFWS over Lake St. Clair

- **Methods:** Field and Remote Sensing

- **Early Results:** Preliminary Maps Lakes Huron, Erie, Michigan & Ontario

- **Decision Support:** Development of publicly accessible tool to assess vulnerability and aid land managers in allocating resources
2010 Development of Mapping Methods for U.S. Coastal Great Lakes Basin

- Sensor: PALSAR (10-20 m resolution)
  - ~ 87 (70x70km swath) 3-date image stacks are required (spring, summer, fall triplicates)
- Ancillary Data:
  - Landsat
  - air photos (NAIP 2009, 2005, and DHS 2008 border flight)
- Area of Interest: 10 km inland from the coastal zone
- Target: Monotypic stands *Phragmites australis*, ½ acre
2004 Initial Research: *Multi-SAR Sensor Composite*

Multi-sensor L- and C-band radar composite depicts the biomass and flooding differences between the various emergent wetlands in this delta.
2008 PALSAR Three Date Color Composites and Maximum Likelihood Classification


Lake St. Clair

Harsens Island, USA

Wapole Island, CA

L-HH 3 Date Composite
28 July 2006
09 Oct. 2007
17 April 2008

L-HV 3 Date Composite
09 Oct. 2007
26 May 2008
17 April 2008

Phenological differences in vegetation and flood condition help discriminate different wetland ecosystem types.
PALSAR Phragmites Map
Preliminary Validation

<table>
<thead>
<tr>
<th>SAR Map</th>
<th>Phragmites</th>
<th>Shrub</th>
<th>Typha</th>
<th>Prairie</th>
<th>sum</th>
<th>user's accuracy</th>
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<tr>
<td>Phragmites</td>
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<td>2</td>
<td>0</td>
<td>17</td>
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<tr>
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<tr>
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<td>0</td>
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<tr>
<td>sum</td>
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<td>3</td>
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<td>0.67</td>
<td>0.8</td>
<td>1.00</td>
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<td>0.90</td>
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</table>

Note that the misclassified pixels for Phragmites were small areas of shrub or Typha within a larger Phragmites dominated area, thus the error is likely due to resolution (20 m in this case), 10 m resolution may resolve this error and is being investigated.
3 Season PALSAR Mosaics
Field Component

- Field data:
  - Needed 377 randomly selected validation locations (.5 acre) for 95% confidence level per basin
  - Summer 2010 target: total of 375 for entire GL basin
  - Opportunistic training data locations collected

- First Field Season: May-Oct 2010
Field Component

• Measurements taken:
  – GPS locations
    • Center
    • Perimeter edges
  – Photos with GPS tag
  – Vegetative composition/species
  – Wetland type
  – Average height (3)
  – Density (stems per area)
  – Current water level/date-time
  – Recent changes/treatments
Great Lakes Phragmites 2010 Field Data

- 775 unique field site visits.
  - 459 validation, 316 training
- Phragmites observed at 29% of sites. (228 of the 775).
  - 24% Validation sites
  - 38% training sites
- Only NWI "Palustrine Emergent" polygons used to generate random points for validation sites of these, only 47% were documented as emergent in the field observations.
from radar ...

... to Phragmites
Preliminary Potential Phragmites Maps
Western Basin of Lake Erie
Saginaw Bay
Decision Support Tools for Management

- Publically accessible
- Clickable and zoomable
- Showing locations of Phragmites and vulnerable areas given different water-level scenarios, nutrient loading, and land-use influences.
Lake Ontario coastal corridor exposed during a 1-meter drop in lake level

- Red areas most vulnerable to invasion
- Early attention key to control -- tool helps managers focus resources

Potential *Phragmites* monocultures

- Distance to existing *Phragmites*
  - Far
  - Near
Project Mapping Status

- Lake Huron
  - Preliminary products complete
- Lake Ontario
  - Preliminary complete
- Lake Michigan
  - Preliminary complete
- Lake Erie
  - Preliminary complete
- Lake Superior
  - Preliminary map on hold for reevaluation of mapping methods

Steps remaining
- Full accuracy assessment (validation points)
- Final product generation for Lakes Erie, Ontario, Huron, Michigan (May-July 2011)

Outreach/Sharing Products
MTRI project website (http://mtri.org/phragmites.html)
- Jpeg of 3 season radar image mosaics for 4 lakes
- 2010 Site Visit Field Data in Google Earth
- 2010 Site Visit Geotagged Field Photos in Google Earth
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Example Site Map

Site H-2-500  (-82.474403, 43.04690)
Example Field Data Sheet

Validation and Training Field Data

Wetland Complex Name:...
Site ID: H-2-500-T1
Water Level (cm): 0
GPS: Lat: 43.444100 Long: -89.474403
GPS Time: 07/11 AM
GPS MTR #: 0931
GPS Data Valid

ECOSYSTEM TYPE: Open / Flooding / Aquatic / Wetland / Forest / Shrub / Other
Other (please describe):
Choose one below and describe:
1. Pure stand (monotypic) species:
   Phragmites
2. Mixed with fewer than six vascular species
3. Mixed with six or more vascular species

Distribution:
Species Distribution (if more than one species present): Mixed Other
Phragmites present? Yes No
If yes, Phragmites Present: Burned / Newd / Chemically treated / Other
Comments/Notes:

Plant Size and Status (note if Phragmites is native or invasive)

| Species | Live | Dead | Live | Dead | Stage of Growth | % Cover
|---------|------|------|------|------|-----------------|-------
| Phrag   | 3.45 | 2.01 | 7    | 6    | Flowering      | 75    |
| Phrag   | 4.41 | 2.78 | 10   | 17   | Flowering      | 50    |
| Phrag   | 3.91 | 3.73 | 8    | 18   | Flowering      | 75    |

GPS for perimeters, when applicable (mark on All Photo)

<table>
<thead>
<tr>
<th>Lat:</th>
<th>Long:</th>
<th>Waypoint ID:</th>
<th>Comment:</th>
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</table>

All other comments:

Overview Map
Sample Area Map (1/2 acre)
Web-based Data Entry

Used to manage spatial, attribute, and image data collected by field teams

Web Browser

Web Server

Spatial Database

Output Products (shapefiles, KML, etc.)
Field Data Results

- Conducted 770 Site Visits between May – October 2010
- Validation Sites
  - 110 with Phragmites
  - 348 other land cover types
- Training Sites
  - 114 with Phragmites
  - 198 other land cover types
- Site Visits
  - Classified vegetation / ecosystem type
  - GPS Points
  - GPS encoded photos
- Over 3,000 GPS-encoded photos
  - Creating kml of these photos for distribution

From the Field Data GIS:
Validation point and Field of View (FOV) for Digital Photos for a Phrag site. Corresponding GPS-encoded photo shown above for highlighted FOV.