

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 mmu



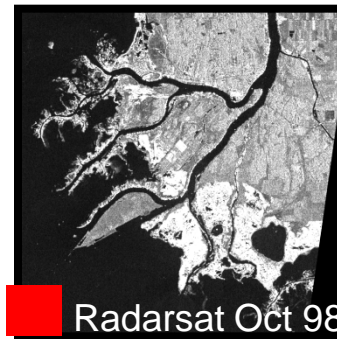
Why use Synthetic Aperture

A satellite map of the Great Lakes region. The lakes are shown in dark blue, and the surrounding land is in shades of green and brown. A red rectangular box is drawn around Lake St. Clair, which is located between Lake Michigan and Lake Huron. The text "Initial GLCWC Study Area" is overlaid in large, bold, black letters at the top. The text "Lake St. Clair" is overlaid in white letters at the bottom, centered under the red box.

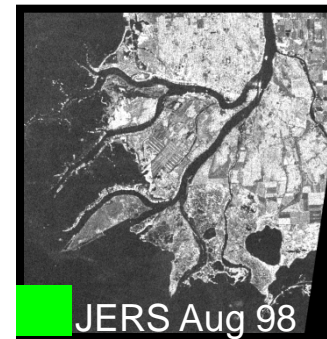
Initial GLCWC Study Area

Lake St. Clair

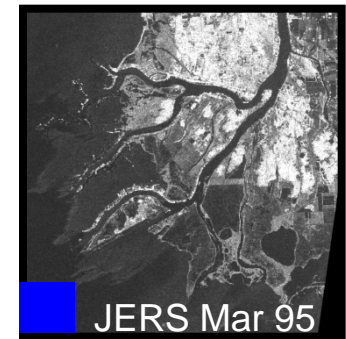
2004 Initial Research: *Multi-SAR Sensor Composite*



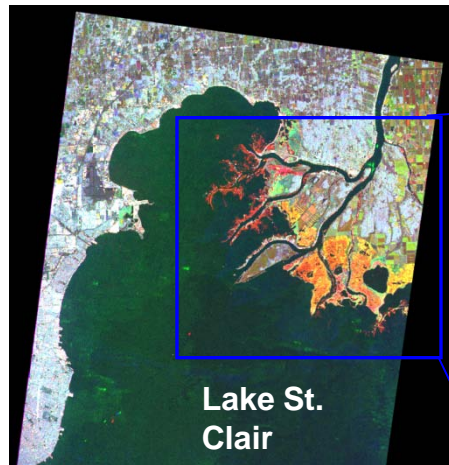
Radarsat Oct 98



JERS Aug 98



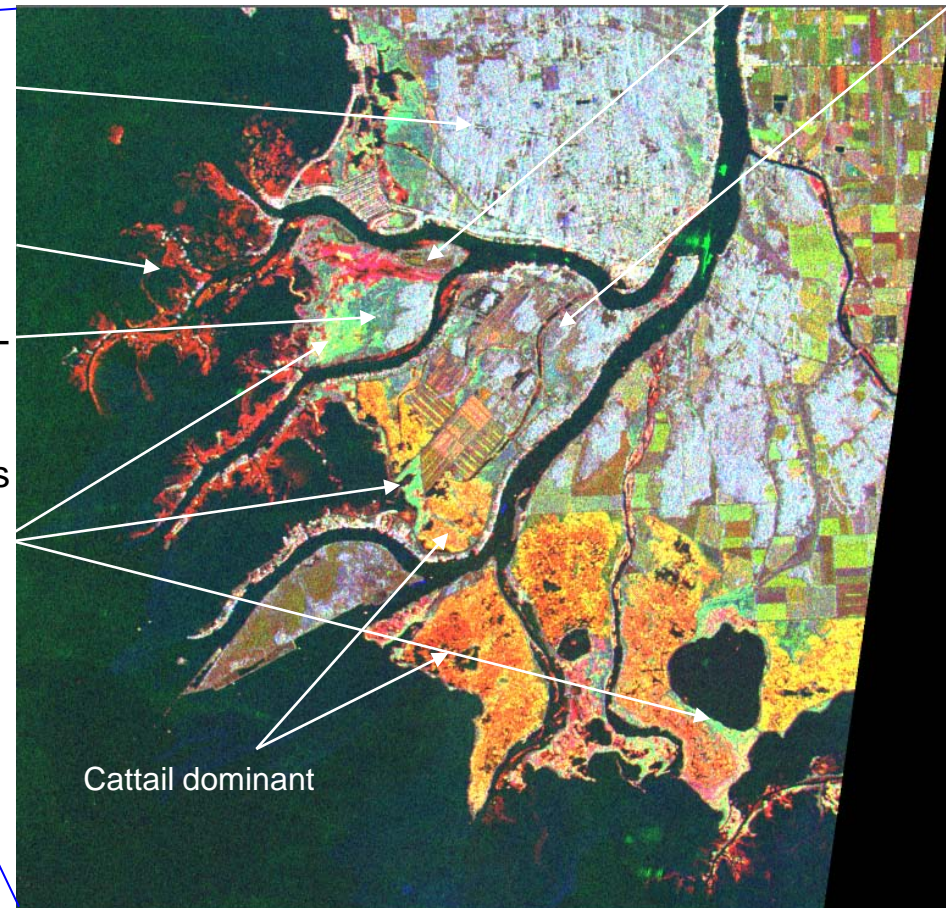
JERS Mar 95



Lake St. Clair

Multi-sensor L- and C-band radar composite depicts the biomass and flooding differences between the various emergent wetlands in this delta

Upland Forest
Cattail/*Scirpus* beds
Wet meadow-sedges
Phragmites dominant



Cattail dominant

Dickinson Island

Harsen's Island

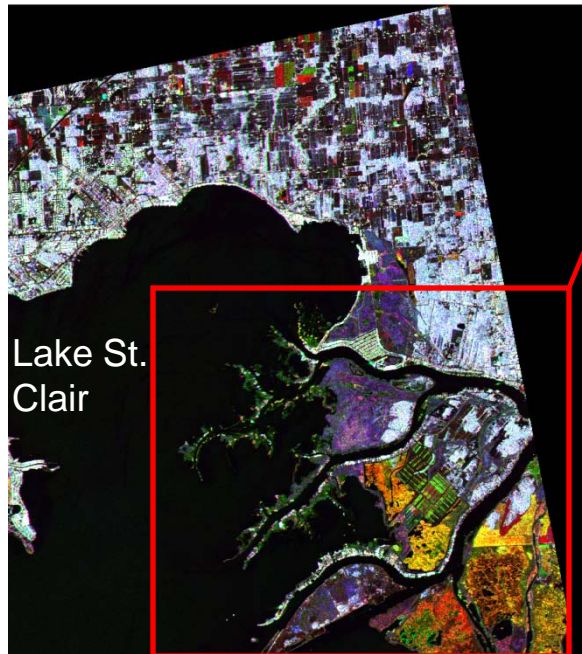
22.7 km

23.6 km

©CSA 1998 ©NASDA 1995-8 ©GD-AIS 2003

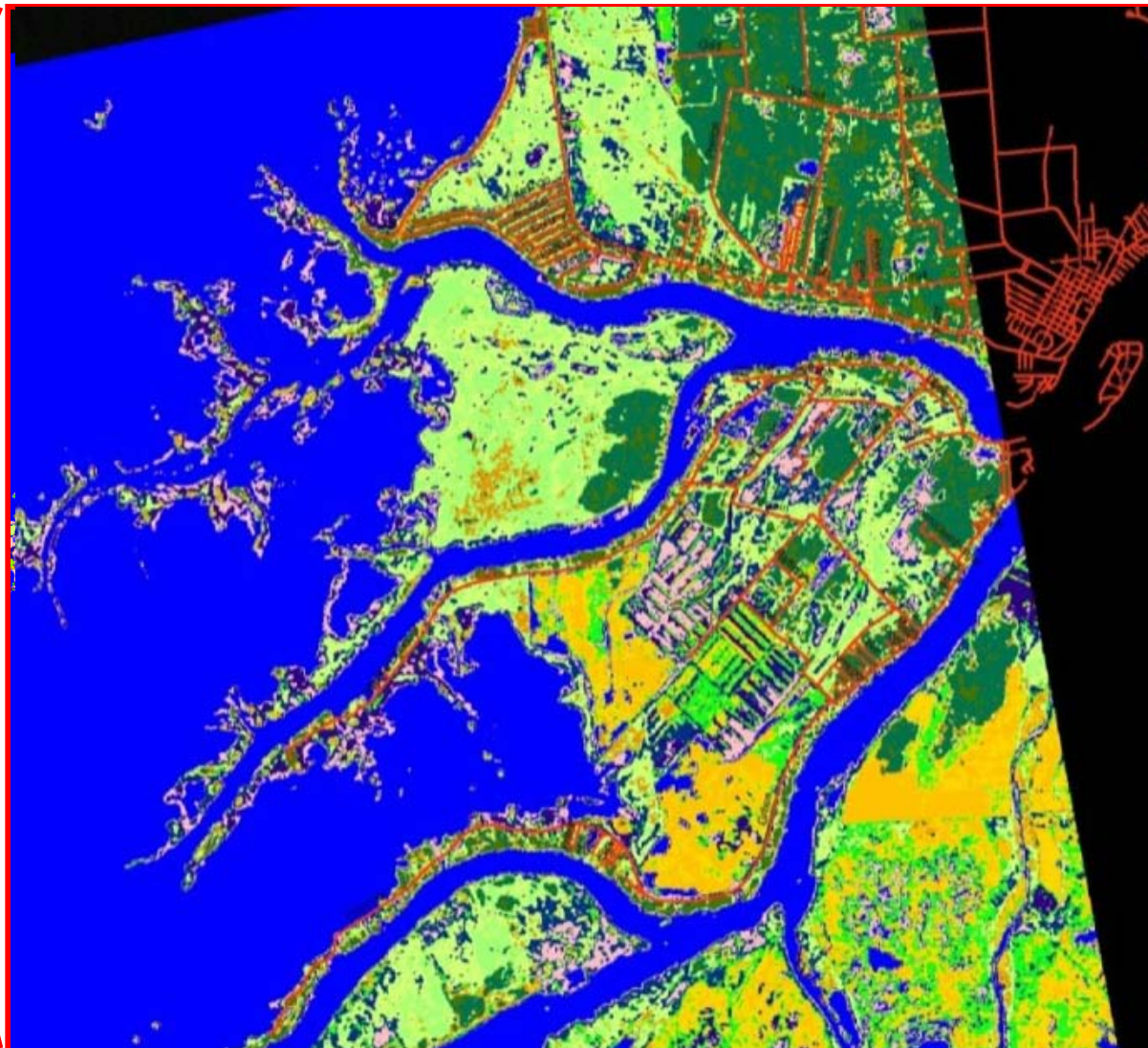
2008 PALSAR Three Date Color Composites and Maximum Likelihood Classification

17 April 2008, 9 Oct 2007, 28 July 2006, 26 May 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

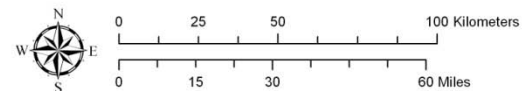
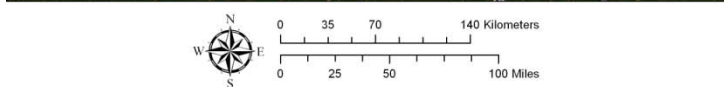
Preliminary Validation

SAR Map	Field Observation						
		Phragmites	Shrub	Typha	Prairie	sum	user's accuracy
	Phragmites	14	1	2	0	17	0.82
	Shrub	0	2	0	0	2	1.00
	Typha	0	0	8	0	8	1.00
	Prairie	0	0	0	2	2	1.00
	sum	14	3	10	2	29	
	producer's accuracy	1.00	0.67	0.8	1.00		0.90

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

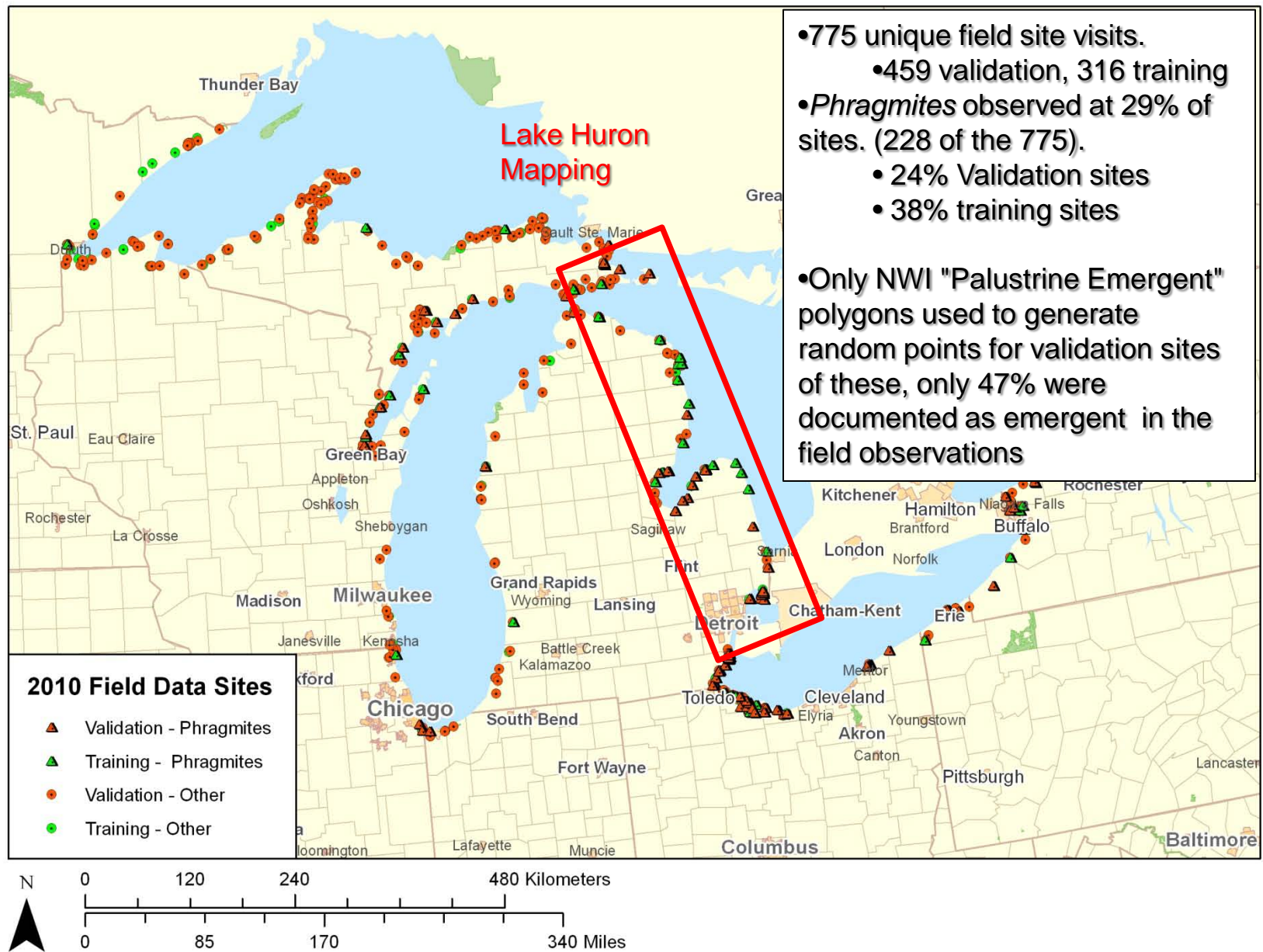


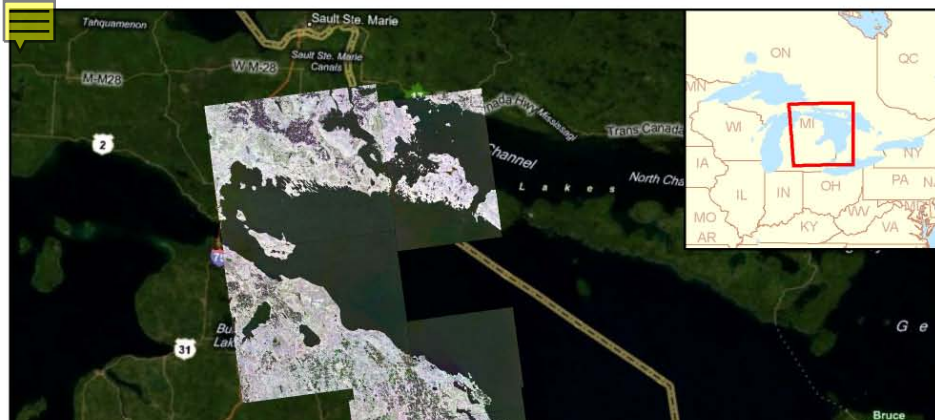
Field Component



- 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

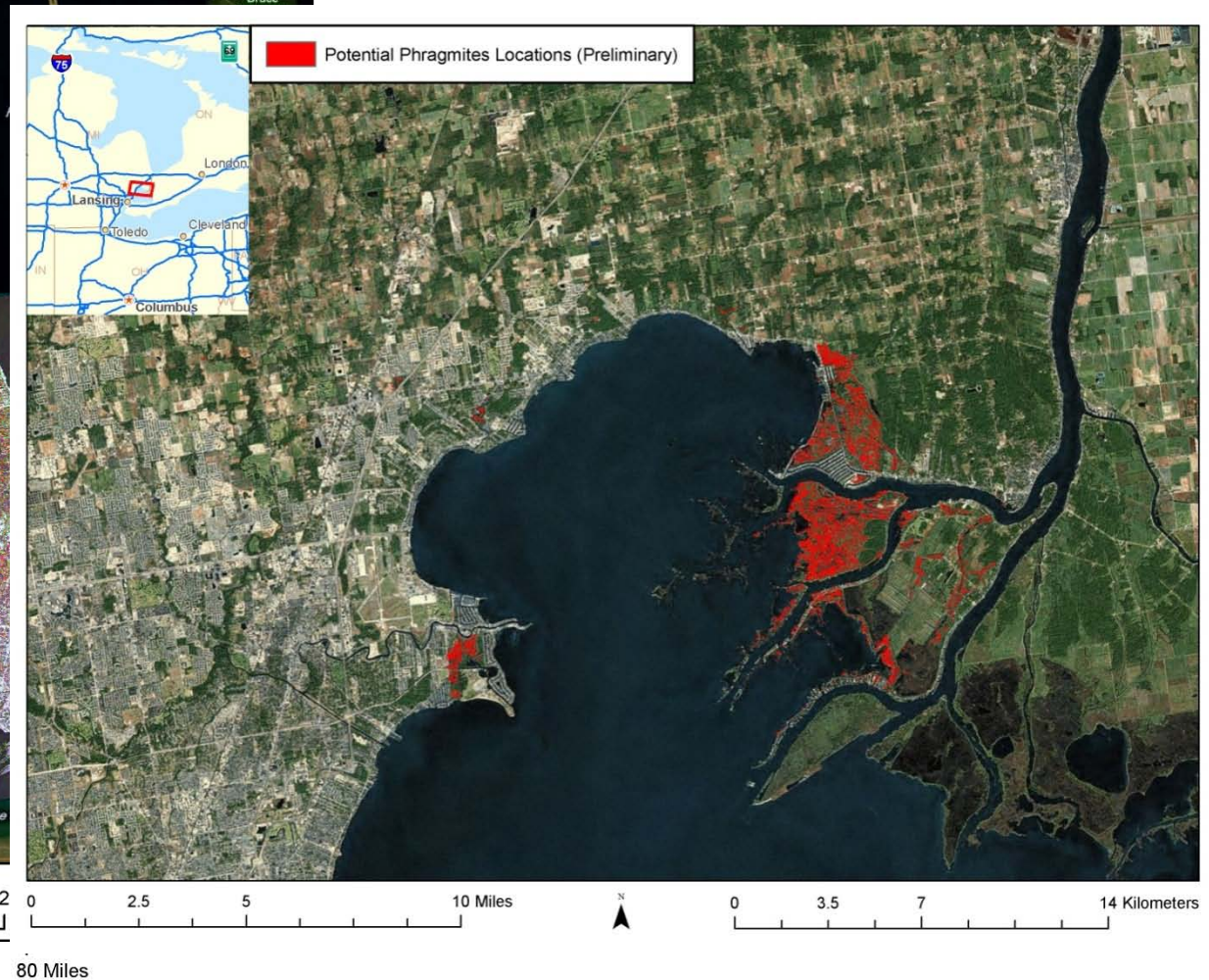
Great Lakes Phragmites 2010 Field Data





from radar ...

... to *Phragmites*



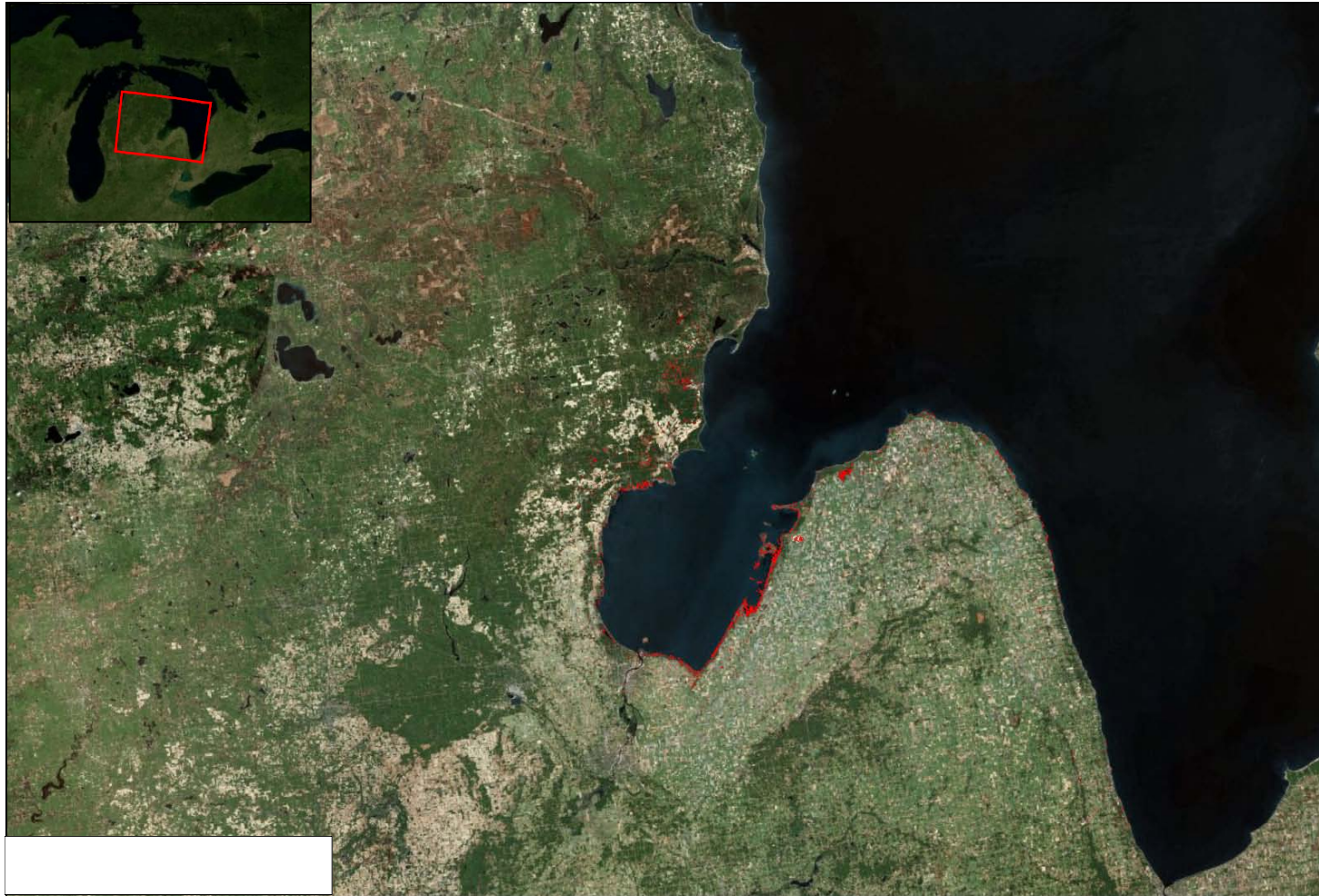
Preliminary Potential Phragmites Maps



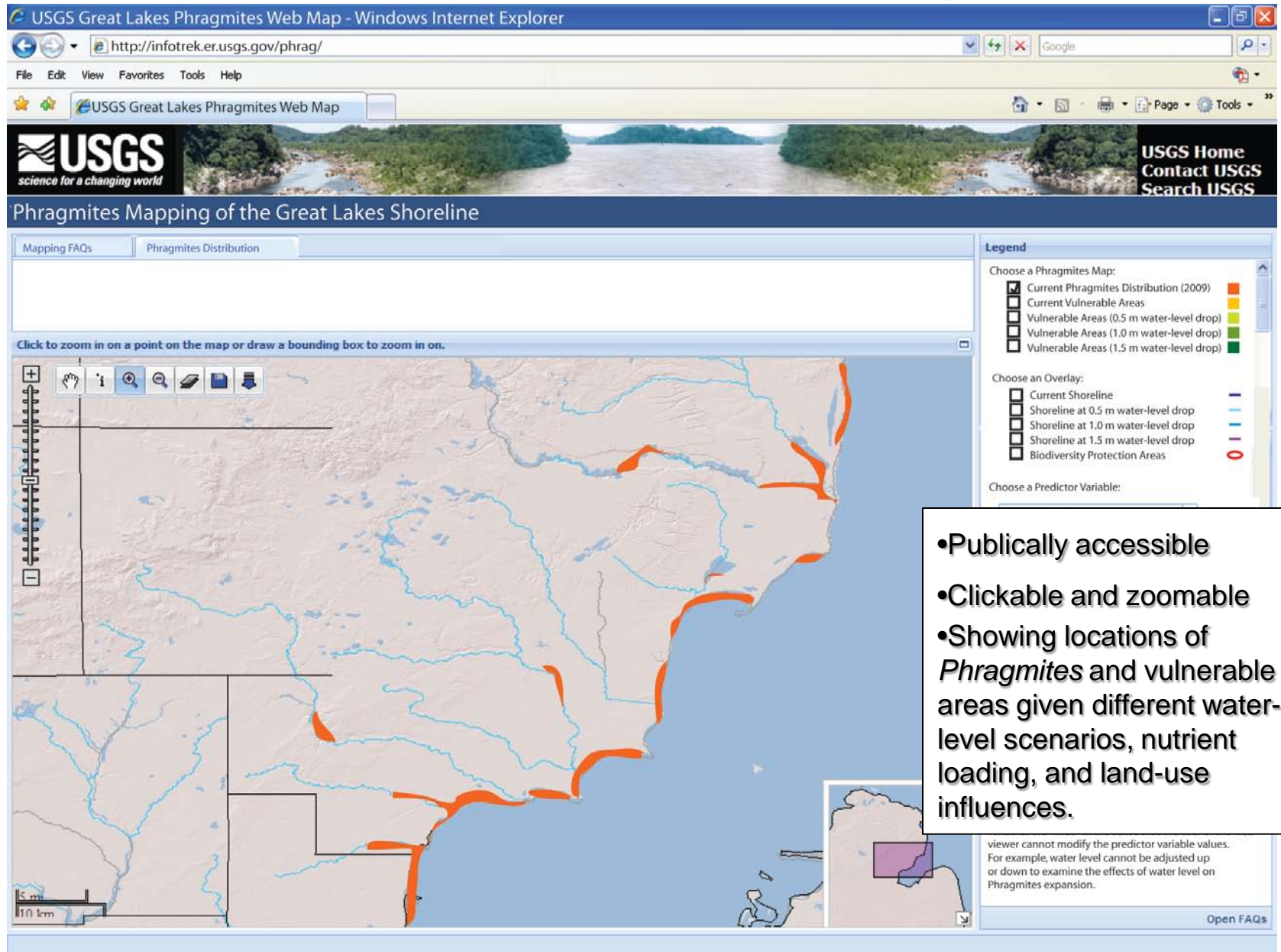
Western Basin of Lake Erie



Saginaw Bay

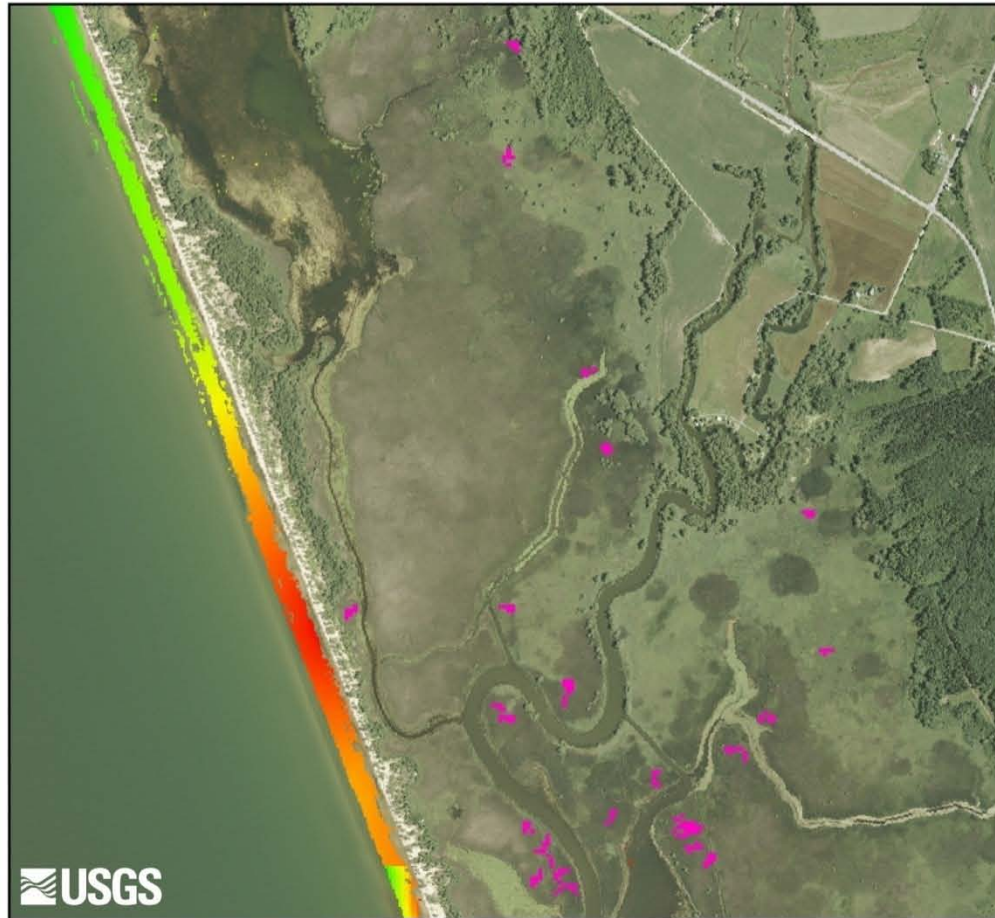


Decision Support Tools for Management



- 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



0 250 500 1,000 1,500 2,000
Meters

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) 0 0.125 0.25 0.5 0.75 1 Miles



Example Field Data Sheet

Validation and Training Field Data

Wetland Complex Name Fort Gratiot Wildlife Preserve Date 10-12-10

Site ID H-2-500T1 Team/Observer Zach (Christina)

Water Level (cm) 0 GPS: Lat: 43.04690 Long: -82.474403

GPS Time: 10:11a datum WGS84, decimal degrees

GPS MTRI #: 0727

Center of 1/2 acre area sampled GPS: Lat: 43.04678 Long: -82.47427

Waypoint ID: H-2-500T1C datum WGS84, decimal degrees

ECOSYSTEM TYPE Open H₂O / Floating Aquatic / Mudflat / Emergent Wet meadow / Shrubby / Forest / Other

other (please describe):

Choose One Below and Describe

Pure stand (monotypic)-species Phragmites

Mixed with fewer than six vascular species

Mixed with six or more vascular species

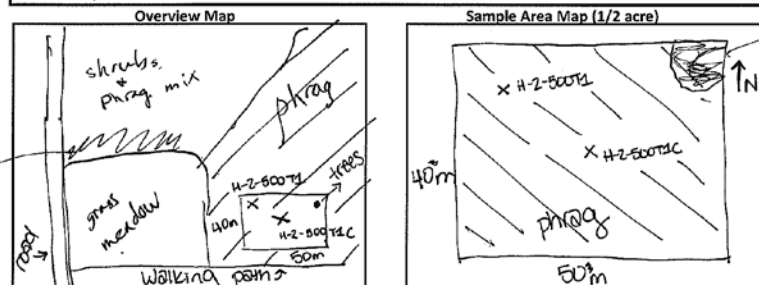
Distribution

Species Distribution (if more than one species present): Patchy Evenly mixed Other

Phragmites present? Yes No

If yes Phragmites: Untreated Burned / Mowed / Chemically treated / Other

Comments/Notes:



HOMOGENEITY of minimum 1/2 acre area—all covertypes

---MARK ON AIRPHOTO---

Category % Cover (should sum to 100%)

Dense Vegetation 100

Sparse Vegetation

Exposed Mud

Open Water

Other (please describe):

PICTURES

Camera MTRI #: 0731

Photo ID

North 1533

East 1534

South 1535

West 1536

Others (please describe):

Plant Size and Status (note if Phrag/Typha is native or invasive)

	Dominant Species/Phrag	Height (m)		Density (stem ct)		Stage of Growth	% Cover
		Live	Dead	Live	Dead		
1	phrag	3.45	2.01	7	6	Flowering	75
2	phrag	4.41	2.78	10	17	Flowering	50
3	phrag	3.91	3.73	8	18	Flowering	75

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

GPS: Lat: _____ Long: _____ waypoint ID _____ Comment: _____

datum WGS84, decimal degrees

Lat: _____ Long: _____ waypoint ID _____ Comment: _____

Lat: _____ Long: _____ waypoint ID _____ Comment: _____

Lat: _____ Long: _____ waypoint ID _____ Comment: _____

Lat: _____ Long: _____ waypoint ID _____ Comment: _____

All other comments:

Web-based Data Entry

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

Select site visit to change | Django site admin - Google Chrome

geodjango.mtri.org/phragmites/admin/survey/sitevisit/

Wetlands Field Sampling

Welcome, Tyler. Change password / Log out

Home > Survey > Site visits

Select site visit to change

2010

Action: [dropdown] Go 0 of 100 selected

Site ID	Site Visit Date	Wetlands Complex Name	Ecosystem Type	Phragmites present?	Phragmites Condition	Has water?
H-225T1	Oct. 6, 2010	Fish Point	Emergent	✓	Untreated	False
H-225V	Oct. 6, 2010	Fish Point	Emergent	✓	Untreated	False
H-83V	Oct. 6, 2010	Vanderbilt Park	Wet Meadow	✓	Untreated	False
H-83T1	Oct. 6, 2010	Vanderbilt Park	Emergent	✓	Untreated	False
E-37T1	Oct. 7, 2010	Point Mouillee State Game Area	Emergent	✓	Untreated	False
E-37V	Oct. 7, 2010	Point Mouillee State Game Area	Emergent	✓	Untreated	False
E-192T1	Sept. 7, 2010	Lake Erie Metro Park	Emergent	✓	Untreated	False
E-2-192V	Sept. 7, 2010	Lake Erie Metro Park	Emergent	✓	Untreated	False
H-221T1	Oct. 4, 2010	Metro Beach Metro Park	Emergent	✓	Not Present	False
H-221V	Oct. 4, 2010	Metro Beach Metro Park	Emergent	✓	Chemically Treated	False
H-111V	Oct. 4, 2010	Metro Beach Metro Park	Emergent	✓	Burned	False
H-111T1	Oct. 4, 2010	Metro Beach Metro Park	Wet Meadow	✓	Untreated	False

Filter

By Site Visit Date

Any date

Today

Past 7 days

This month

This year

By Phragmites present?

All

Yes

No

By Ecosystem Type

All

Open Water

Floating Aquatic

Mudflat

Emergent

Wet Meadow

Shrubby

Forest

Other

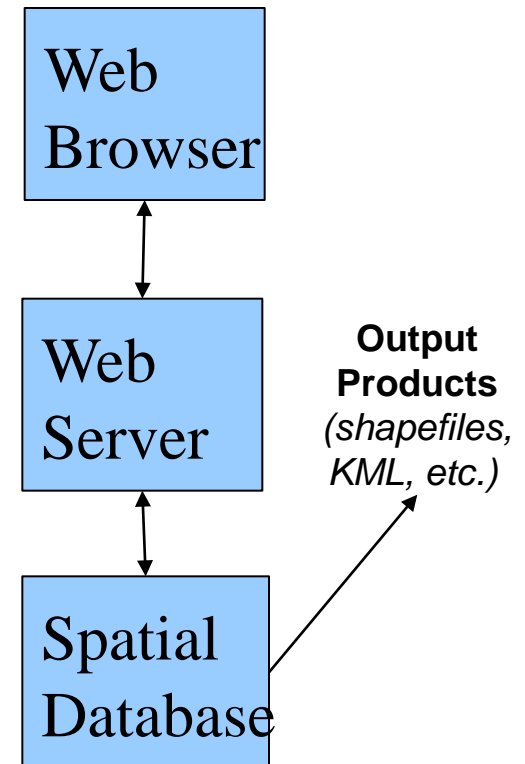
By Wetlands Complex Name

All

3Grand River Sailing Club

69th St. Woods

Adam Grimm Habitat Restoration



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 .