Early Detection and Rapid Response:

Is it possible in the Midwestern US?

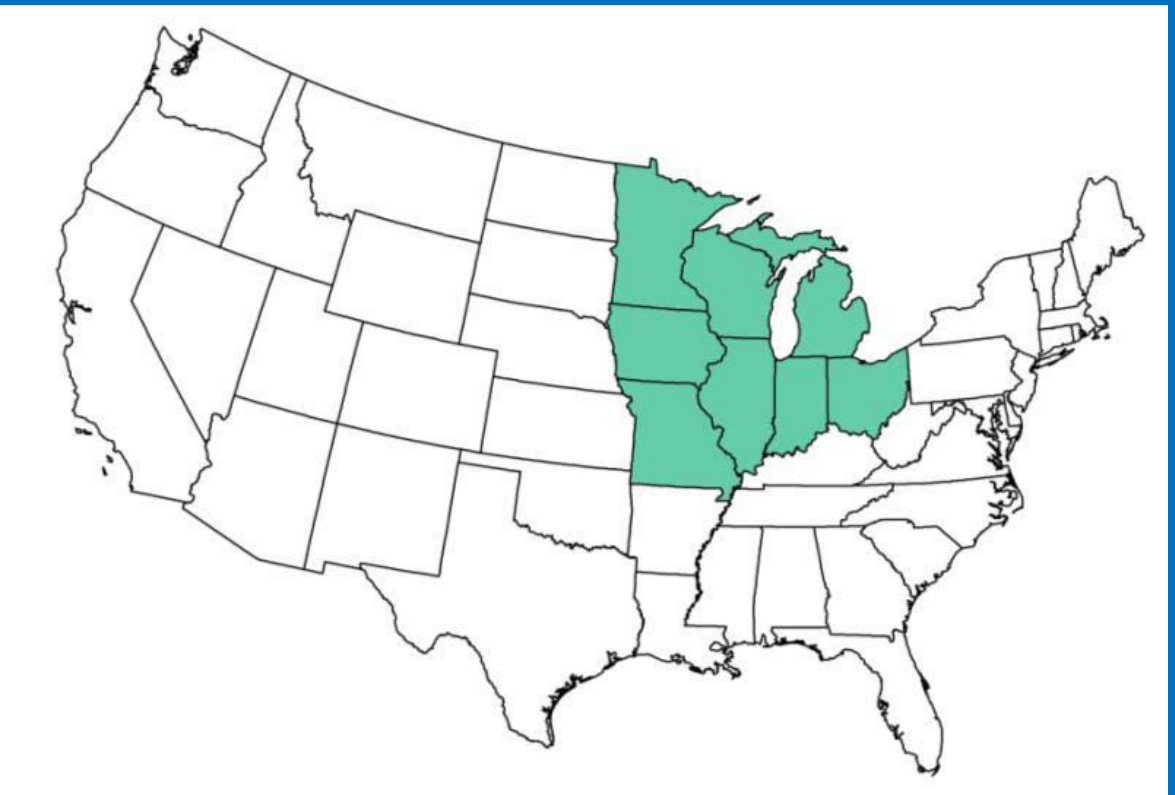
Mark Renz mrenz@wisc.edu
Univ. of Wisconsin-Madison
MIPN

MIPN.org
Midwest Invasive Plant Network

THE UNIVERSITY of WISCONSIN MADISON

Midwest Invasive Plant Network

Our mission is to reduce the impacts of invasive plants in the Midwest.



MIPN.org
Midwest Invasive Plant Network

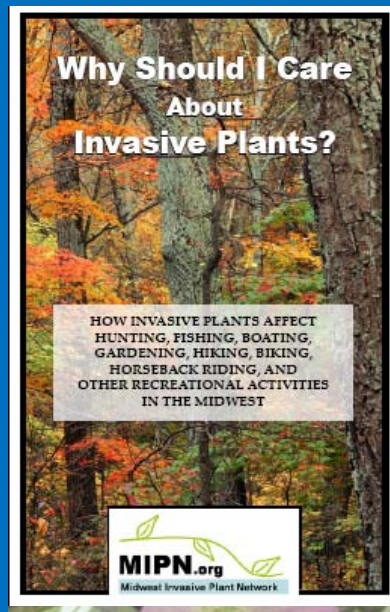
What is the best way to reduce the impacts of invasives?

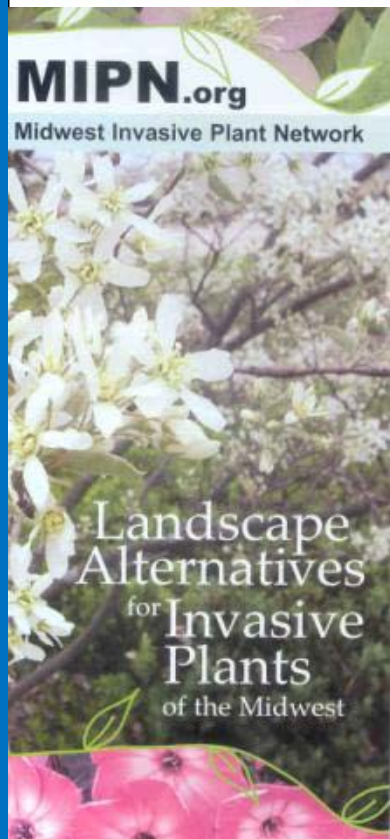
1. Prevention
2. Early Detection
3. Rapid Response

Prevention

- Support national efforts to prevent introductions

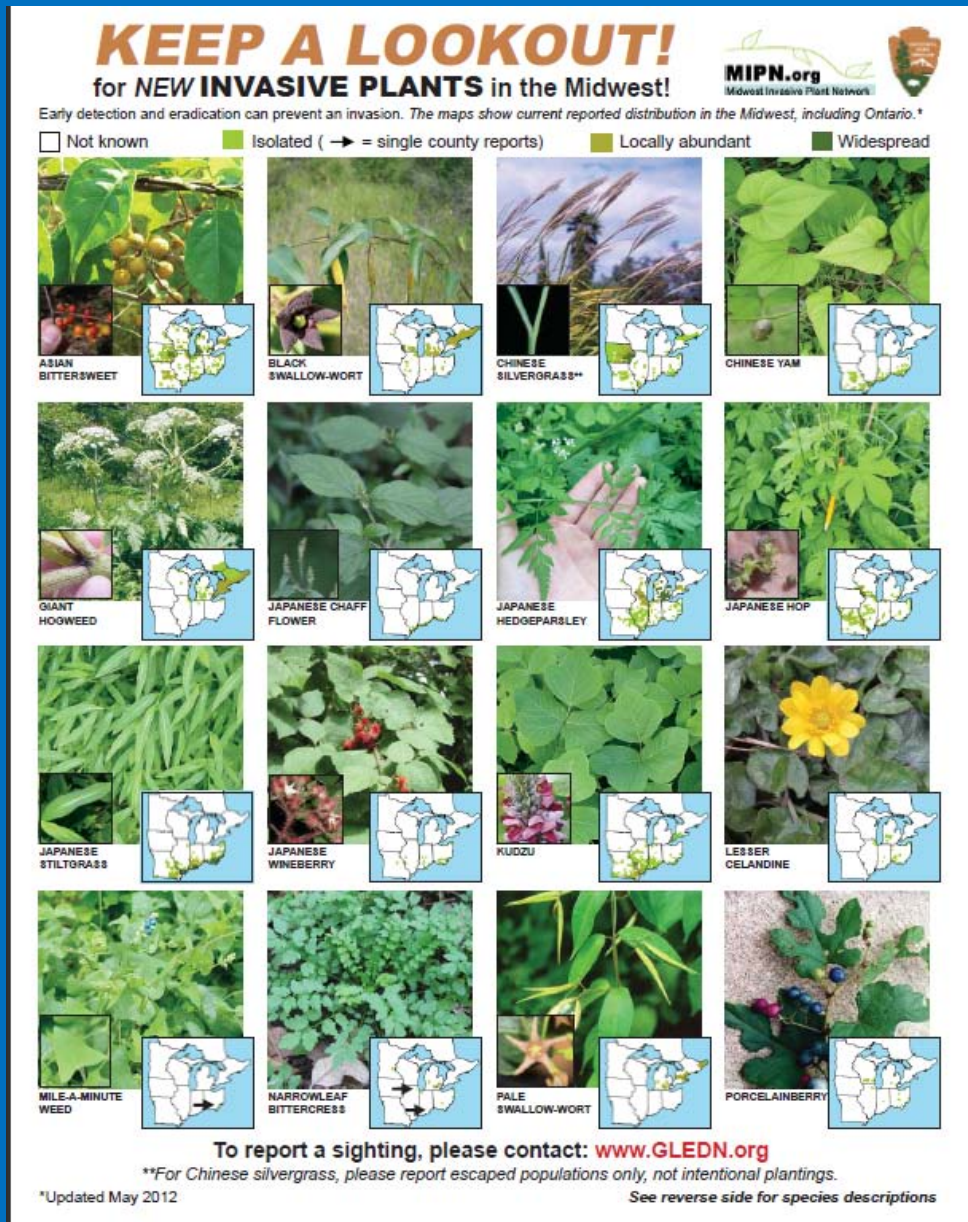
- Education to prevent introduction into the midwest
  - Ornamental invasives
    - Now available as an “app” for free





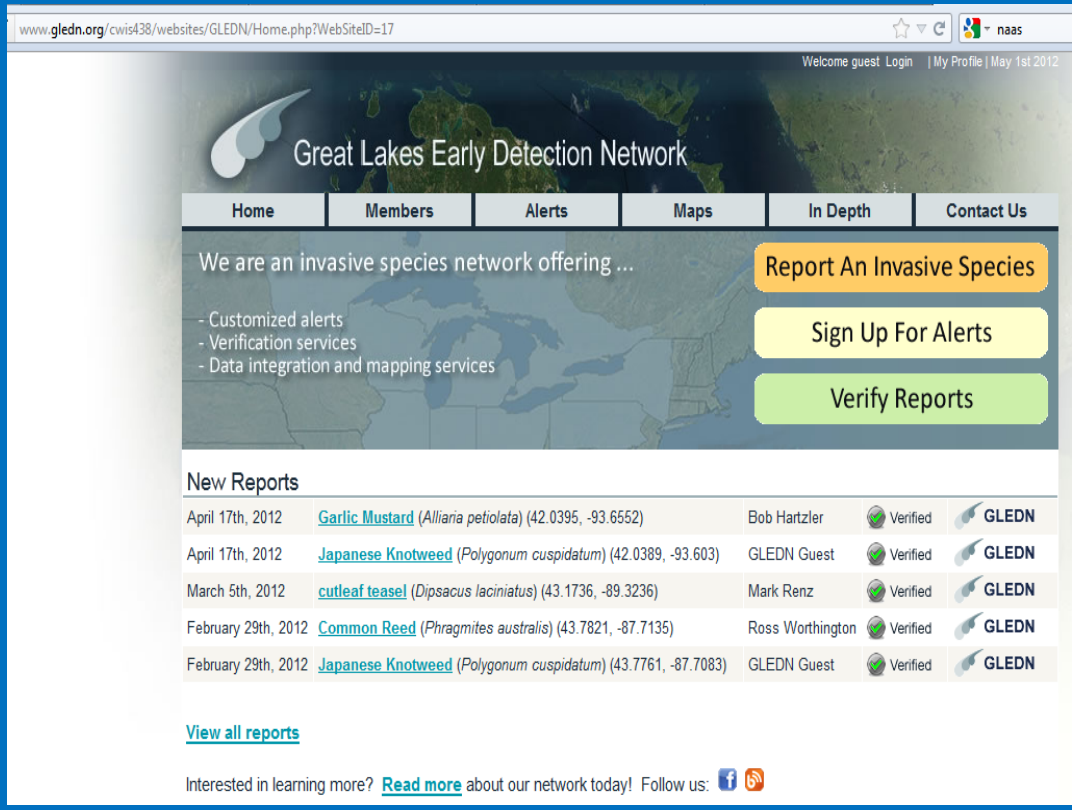
Early Detection

- Keep a lookout flier
- Field Guide



Great Lakes Early Detection Network (www.GLEDN.org)

- Report a sighting
- View data from all major invasive plant databases for the region
  - MISIN, EDDmaps, GLIFWC, NAISN
- Customize e-mail alerts for new reports



Coming this spring, use a smartphone to report an invasive…..

- You will be able to automatically take a picture and upload it into GLEDN
- Smartphone will know location from internal GPS

Rapid Response

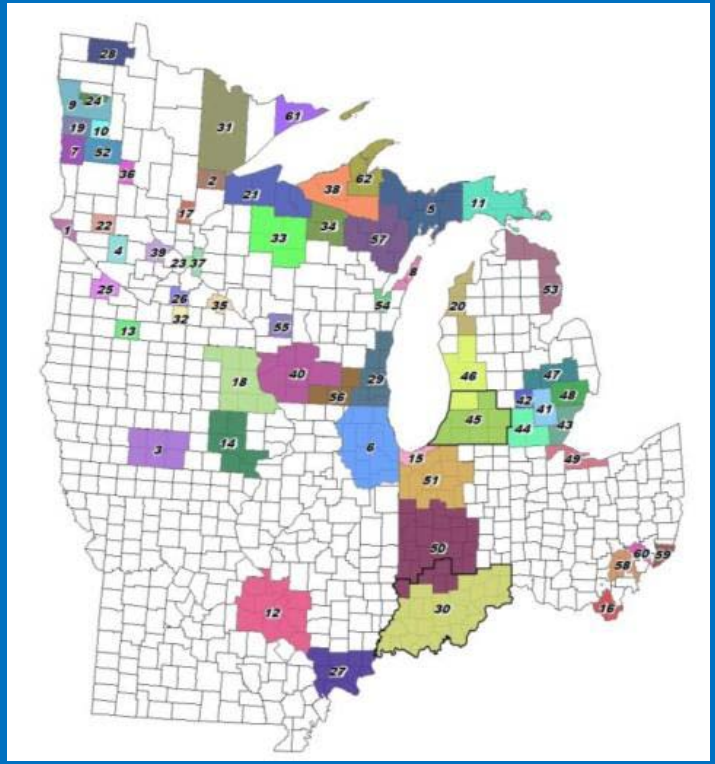
- Respond and manage infestation to prevent:
  - Spread
  - Impact
    - Environmental
    - Economic
    - Health/Safety

Response has been the problem in the Midwest

- Why?
  - Fragmented landscape (many owners)
  - Few laws/regulations across region that require management
  - Limited groups that have the resources and skill-set to manage

Potential groups that can be <u>"first responders"</u>

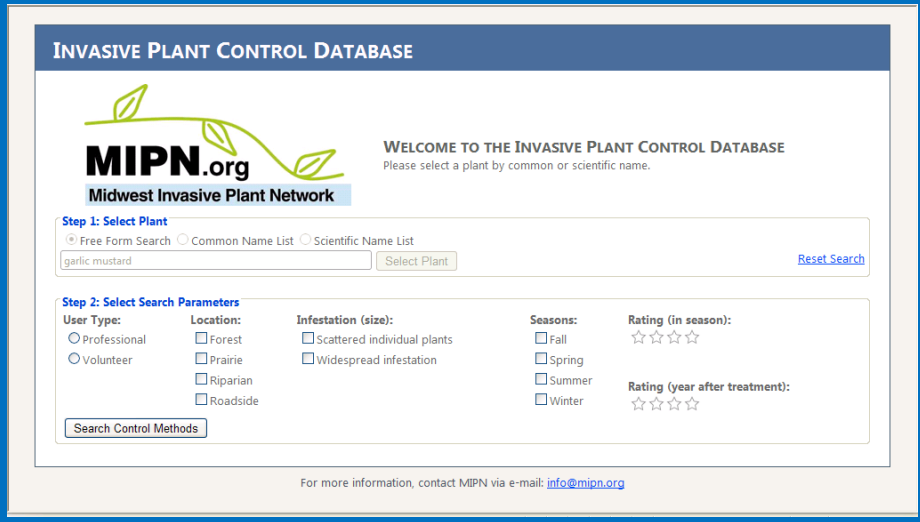
- Local organizations
- NGO staff
- Local, state and federal agency staff
- Concerned citizens



COORDINATED EFFORTS ACROSS GROUPS HAVE BEEN THE MOST SUCCESSFUL = CWMAs (Cooperative Weed Management Areas)

Support for CWMAs

- Assistance in formation and development of CWMAs
- Detailed control information to maximize effectiveness in response
  - MIPN control database



https://mipncontroldatabase.wisc.edu

Early Detection and Rapid Response:

Example

- Perennial pepperweed in WI
  - Found 7/1/12
    - Small patches
  - Local CWMA Brown county treated 3 weeks later
  - Continue eradication procedure
    - funding from WI DNR)

Early Detection and Rapid Response:

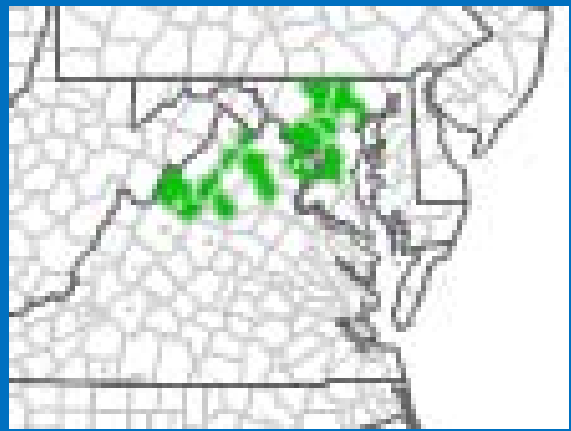
Example

- Kudzu in Ontario
  - Found in July 2009
  - No law to require removal
  - Groups willing to eradicate
  - Infestations are being managed to prevent spread

Early Detection and Rapid Response:

Example

- Wavyleaf basket Maryland
  - Initial population found in 1996
  - Invasiveness unknown
  - Decided to not manage
  - Now currently a widespread in MD



Wavyleaf basketgrass
(*Oplismenus hirtellus* ssp. *undulatifolius*)

When the grass was first found and identified, it appeared in patches (outlined here in yellow) scattered through the woods in Patapsco Valley State Park and on Baltimore City's Liberty Reservoir property.

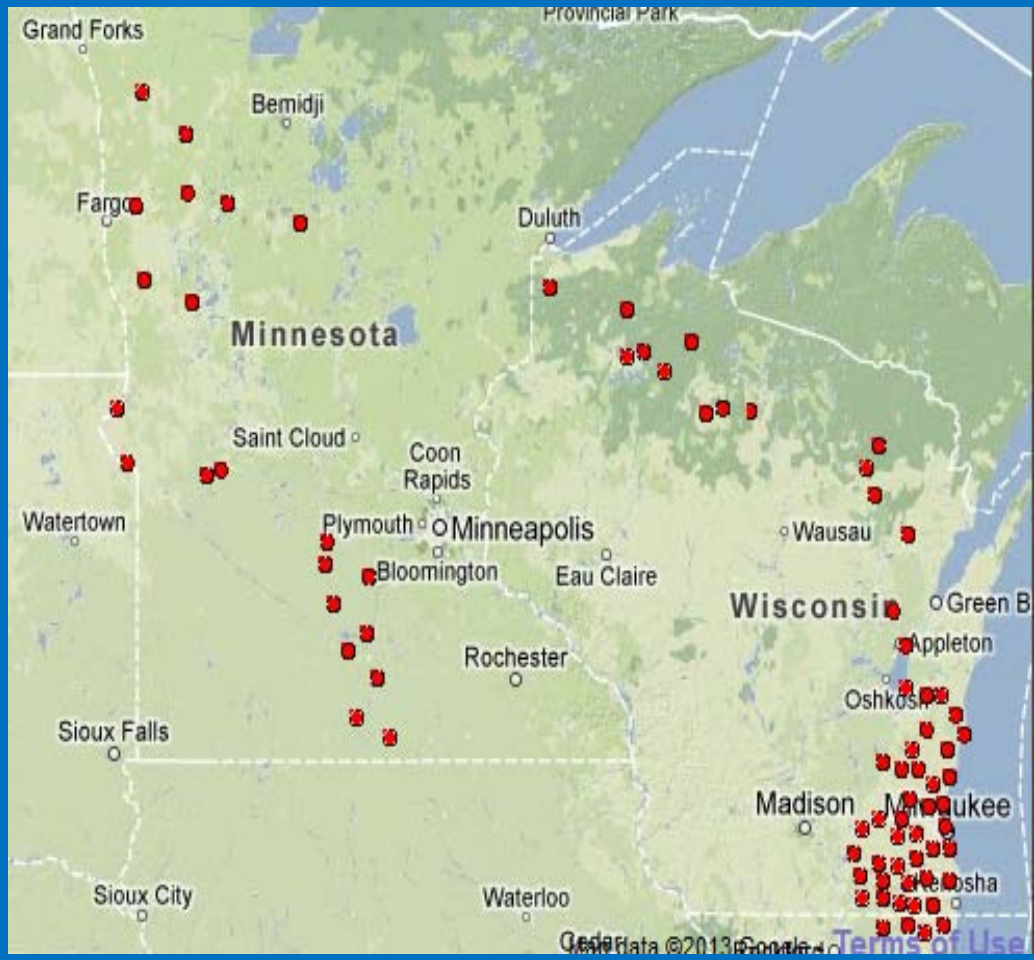
1996

By 2007, it had spread to cover many acres. Everything you see on the ground here in this picture is wavyleaf basketgrass.

Early Detection and Rapid Response:

What should we expect with Phrag?

- Eradication impossible in region
- Prevention of spread
- localized eradication
  - Minimize environmental and economic impact



Work together to conduct EDRR

- Each organization can bring talent and resources to the table that enable EDRR
  - Equipment
  - People
  - Expertise (plant ID)
  - Mapping (IT)

- A coordinated approach tends to be more sustainable over many years

MIPN.org
Midwest Invasive Plant Network

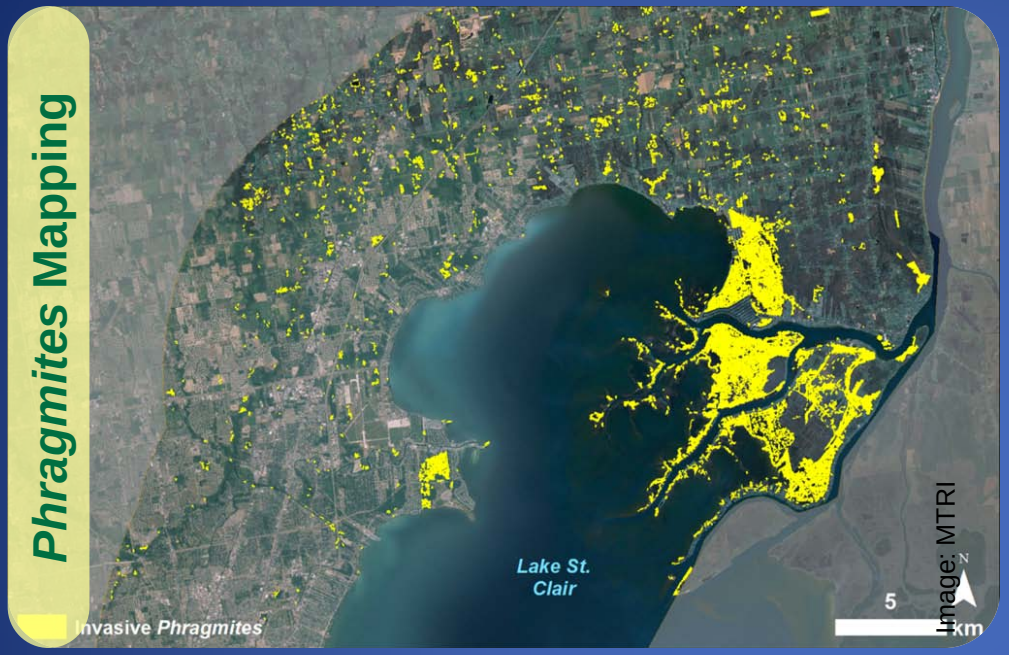
Phragmites Invasion: Habitat Suitability and Decision Support in the Great Lakes Coastal Zone

Kurt P. Kowalski[1], Martha. L. Carlson Mazur[2], and David M. Galbraith[3]

[1]U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, MI, USA
[2]Boston College, Chestnut Hill, MA, USA
[3]U.S. Fish and Wildlife Service, Albuquerque, NM, USA

U.S. Department of the Interior
U.S. Geological Survey

Mapping



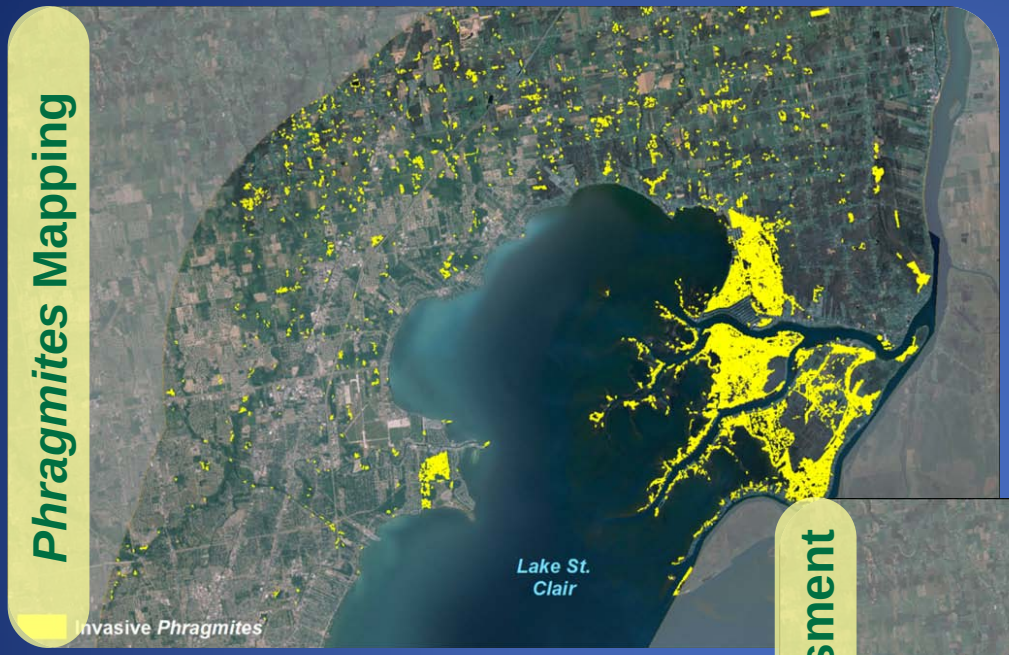
<u>Component 1</u>: Map of the current *Phragmites* distribution along the U.S. Great Lakes coastal zone (10-km inland buffer)

MichiganTech Research Institute

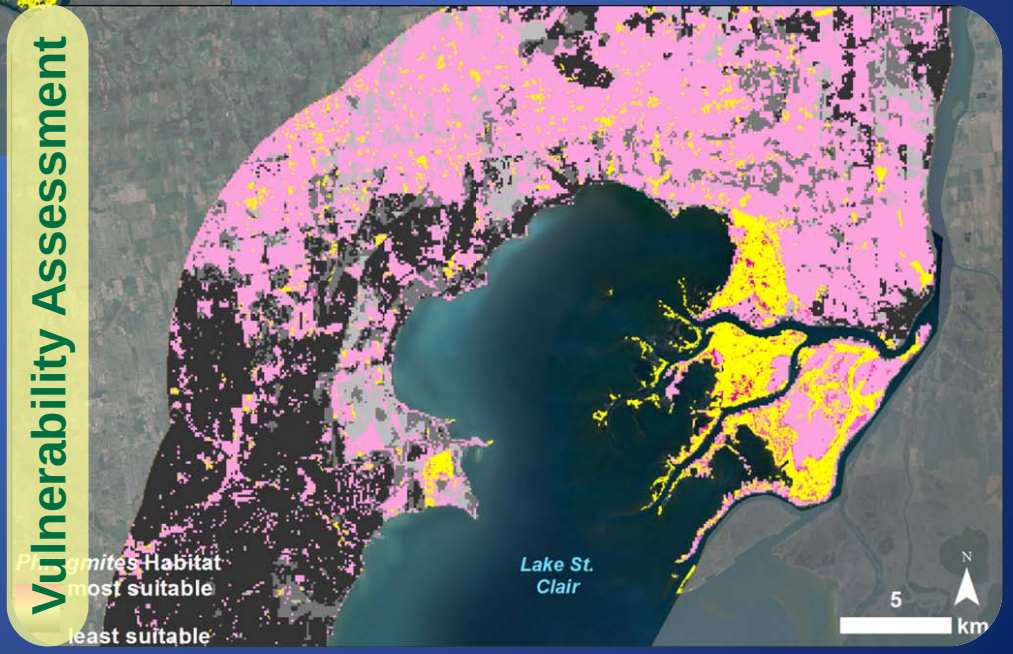
U.S. FISH & WILDLIFE SERVICE

USGS

Modeling



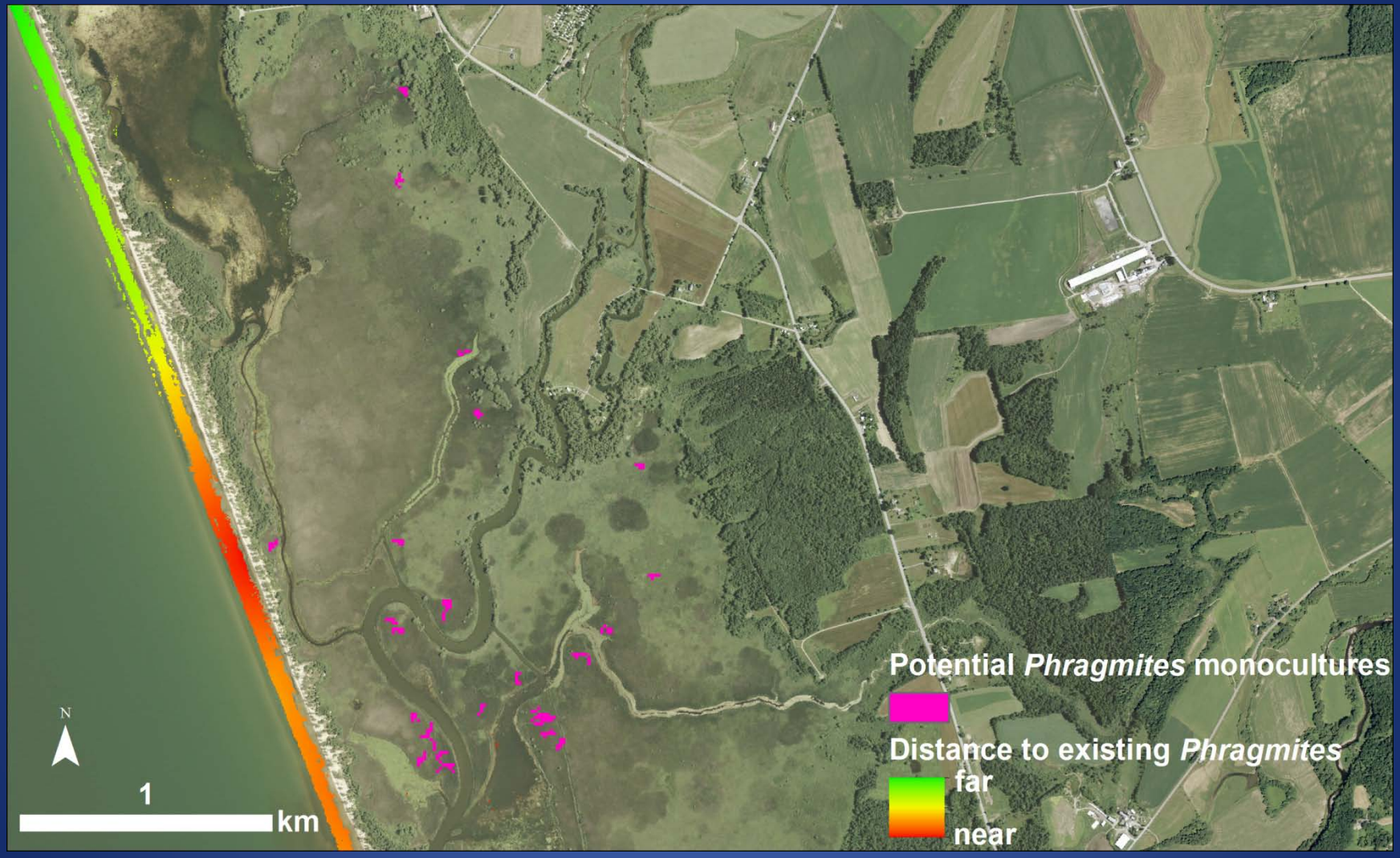
Component 1: Map of the current *Phragmites* distribution along the U.S. Great Lakes coastal zone (10-km inland buffer)



Component 2: Assessment of areas vulnerable to *Phragmites* expansion (habitat suitability)

USGS

Reduced Lake Level Corridors



USGS

Data source: NOAA/USACE lidar

Research Questions

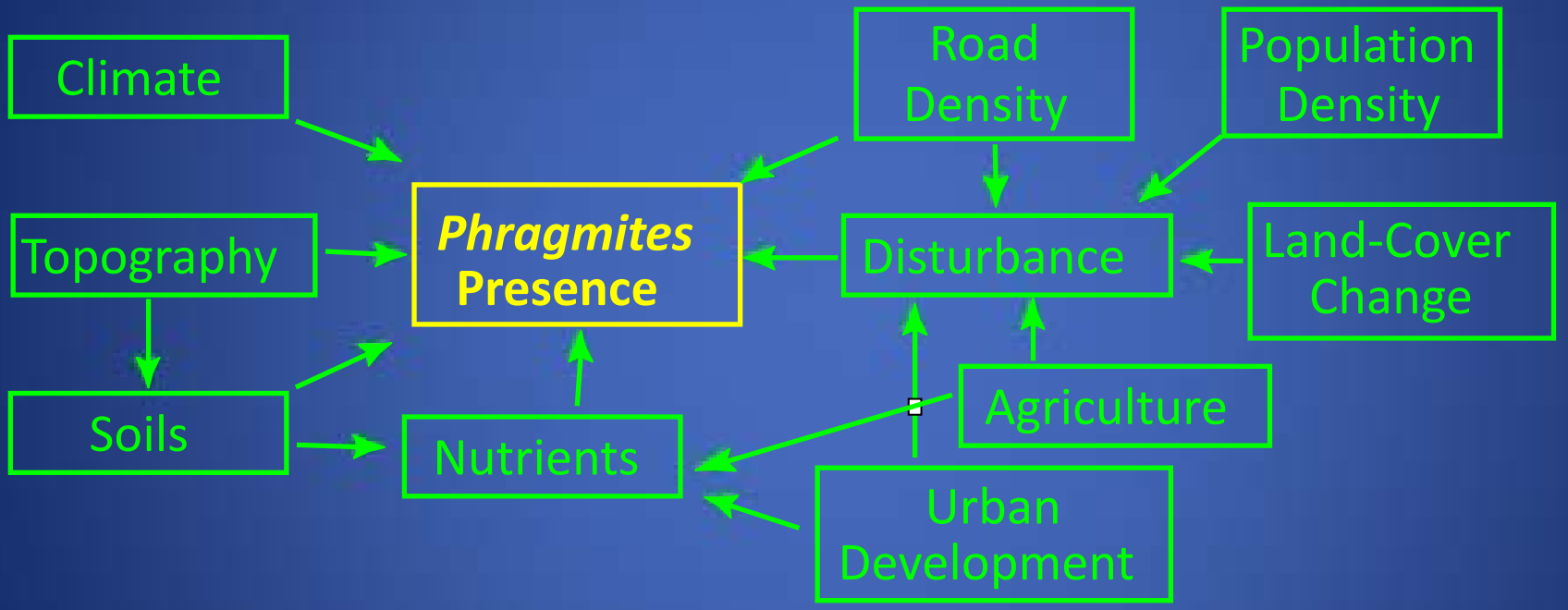
1. What are the major large-scale drivers influencing *Phragmites* distribution in the Great Lakes coastal zone?

2. What are the areas most vulnerable to future *Phragmites* invasion and expansion?

USGS

Photo: M. Carlson Mazur

Conceptual Model



USGS

Boosted Regression Trees

Methods

Topography

Soils

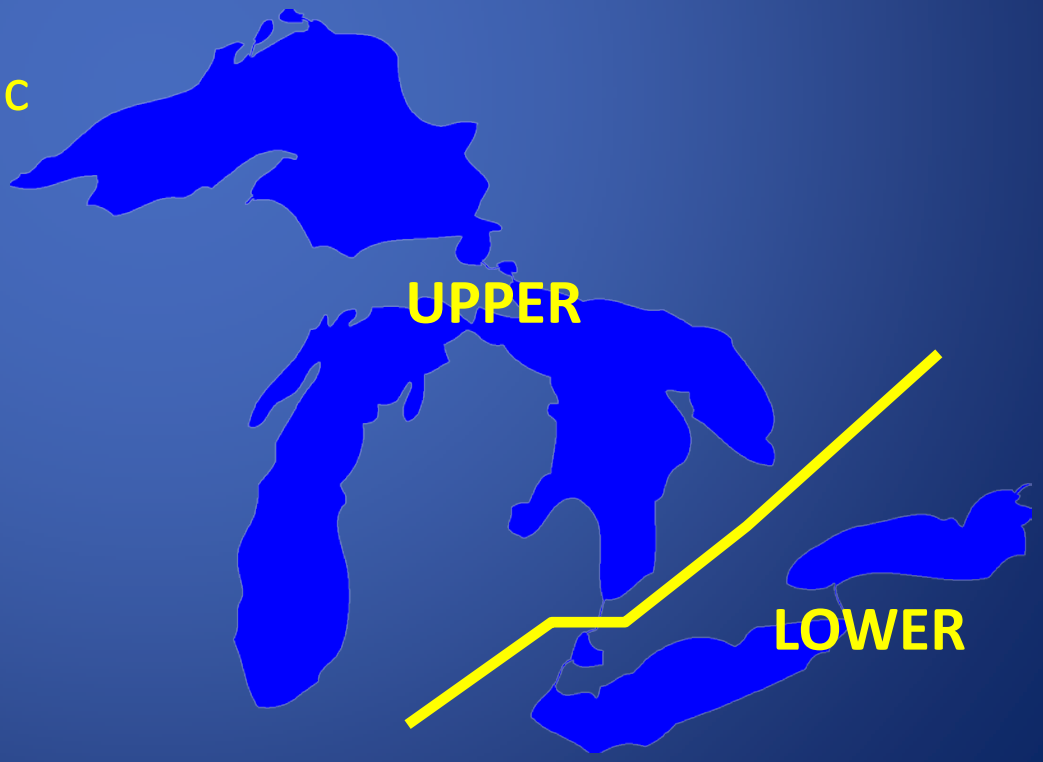
Climate

Variables

Proximity

Nutrients

Anthropogenic Change



USGS

Research Questions

1. What are the major large-scale drivers influencing *Phragmites* distribution in the Great Lakes coastal zone?

2. What are the areas most vulnerable to future *Phragmites* invasion and expansion?

USGS

Photo: M. Carlson Mazur

Top Predictors (Rel. Influence)

Results

Topography (16.9)

Proximity to Development (11.2)

Soil Hydrologic Group (8.2)

Road Density (8.1)

Proximity to Agriculture (7.5)

USGS

Research Questions

1. What are the major large-scale drivers influencing *Phragmites* distribution in the Great Lakes coastal zone?

2. What are the areas most vulnerable to future *Phragmites* invasion and expansion?

USGS

Photo: M. Carlson Mazur

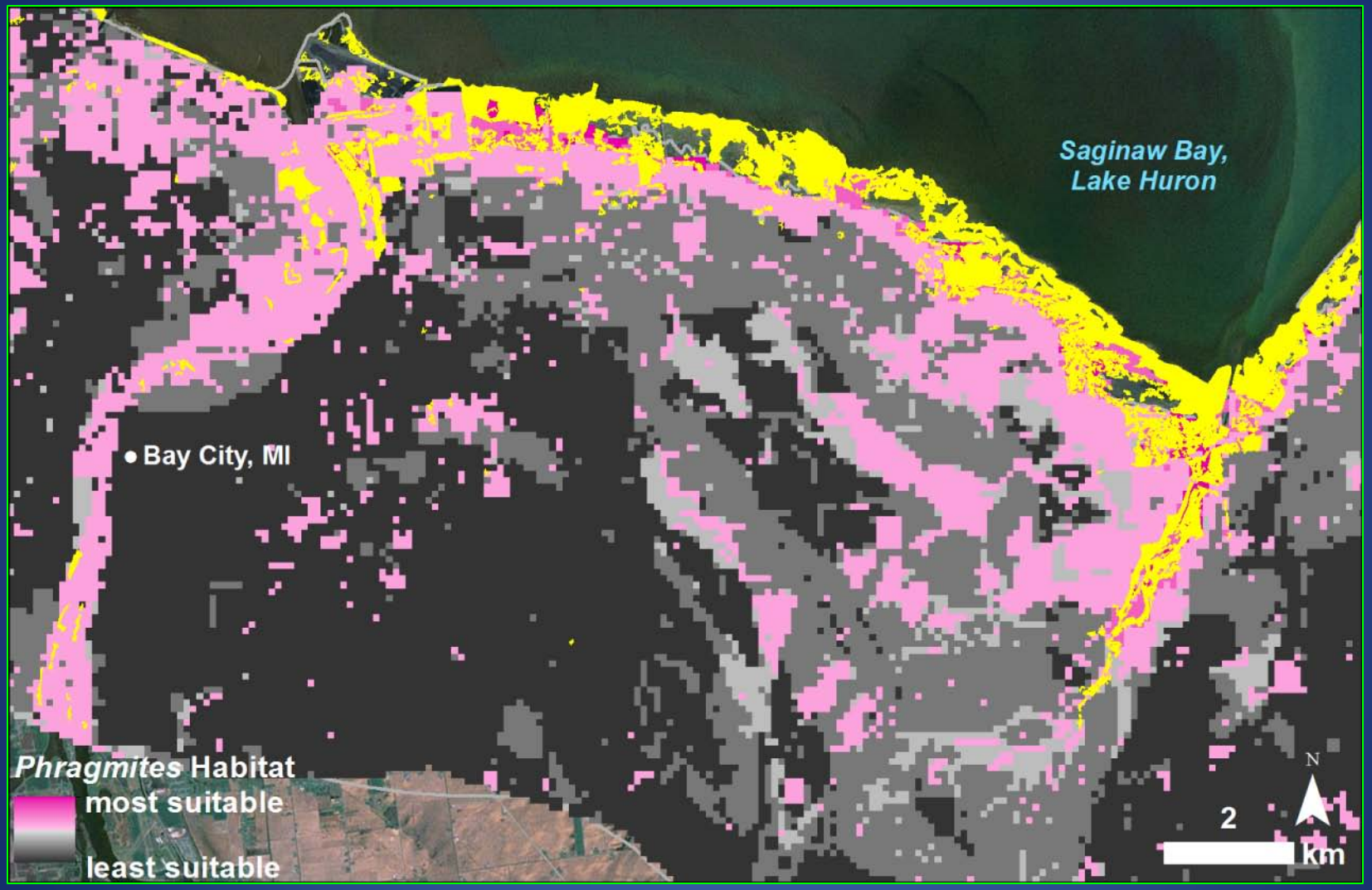
Results

Existing *Phragmites* stands…

USGS

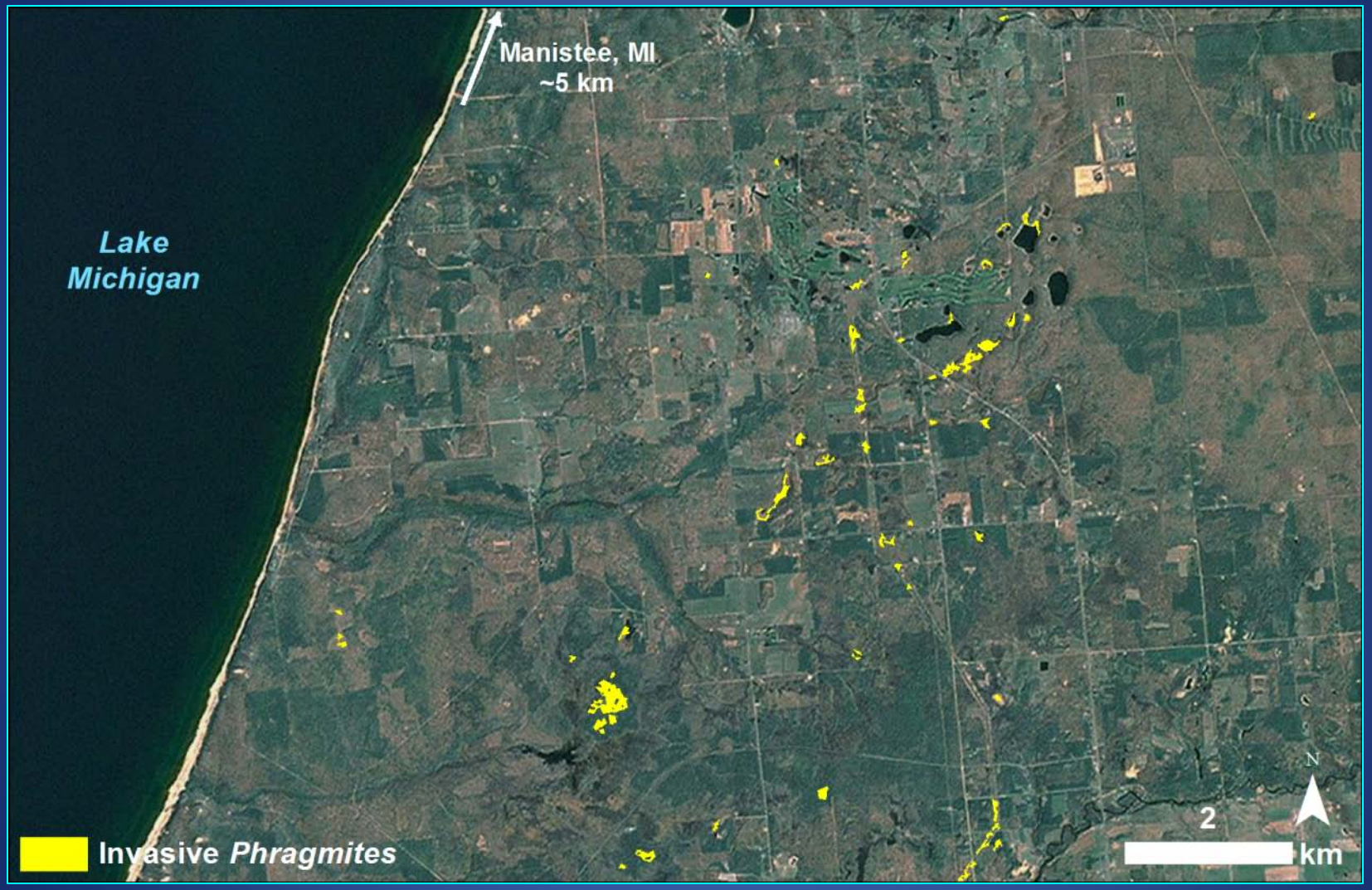
Results

…and habitat suitability index



USGS

Existing *Phragmites* stands…

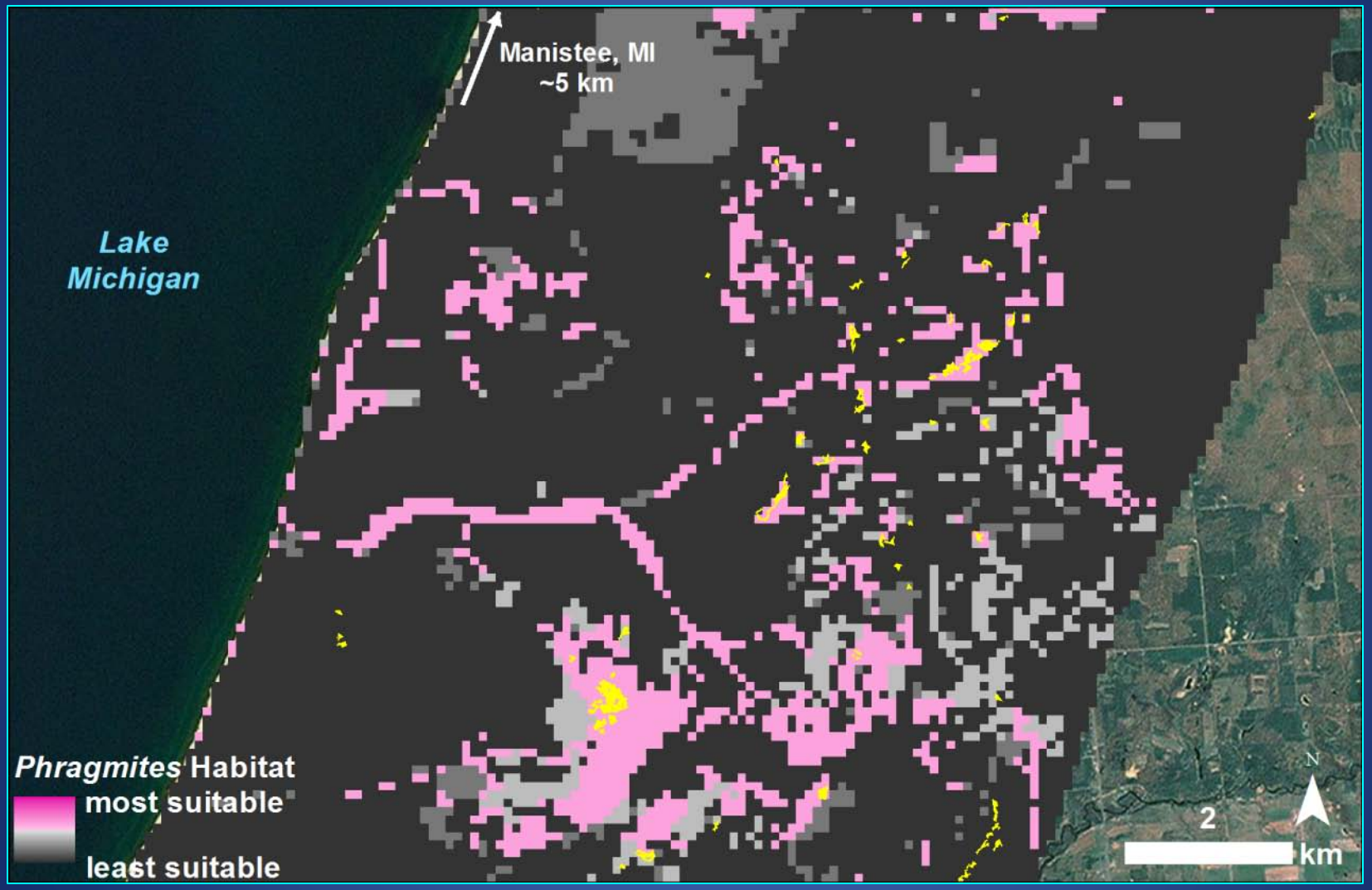


Results

USGS

Results

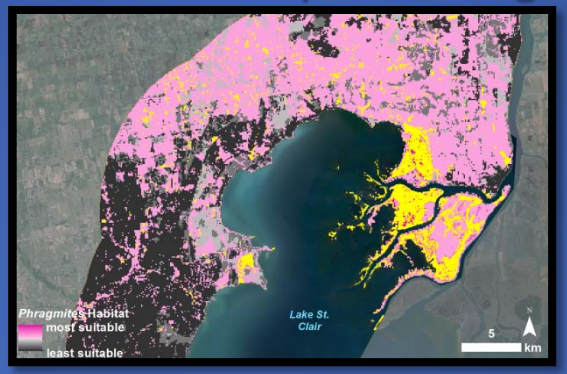
…and habitat suitability index



USGS

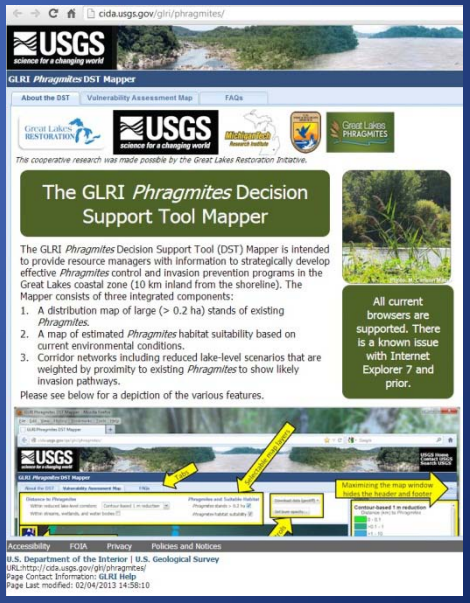
Decision Support for *Phragmites* control

Vulnerability Modeling



Phragmites Distribution

Decision Support Tool



USGS

URL: http://cida.usgs.gov/glri/phragmites/

Acknowledgments

Funding provided by:

Many thanks to:

Richard Powell, Kirk Scarborough, David Bennion, Jean Adams, Dale Robertson, David Saad, Brian Huberty, Christine Geddes Joseph, Lacey Mason, Nicholas Danz, Tom Hollenhorst, Jana Stewart, David Blodgett, Howard Reeves, Lori Fuller, Rebecca Mataosky, Charlene Sylvester, Calvin Lawrence

USGS

Things to cover in DST demo

- Layout
  - Header and footer don’t change
  - Tabs across top
  - Main viewing window to left
  - Context sensitive legend and information window to right
- About the DST
  - Short abstract
  - Highlight of features
- FAQs
  - Series of links to text further down page
  - Text contains links to word definitions or other projects
  - Contains extensive background information to help the user understand how the data were derived, known limitations, and context of the work.
- Vulnerability Assessment Map
  - Map in middle with features along sides (zoom, background, context map)
  - Selectable layers across top
    - Mapped Phragmites stands >0.2 ha
      - Note Legend reflects recent data selection
      - Info panel provides summary and links to supporting info

- Selectable layers across top
  - Mapped Phragmites stands >0.2 ha
    - Note Legend reflects recent data selection
    - Info panel provides summary and links to supporting info
  - Phragmites habitat suitability layer
    - Provisional because data not available for full release yet
    - Shows results of HSI modeling
  - Distance to Phragmites (move map to St. Clair delta)
    - Not covered earlier in presentation, but this tool allowed us to present results from an analysis of the areas that may become vulnerable to Phragmites expansion under two low water-level scenarios possible given climate change model results (50cm below 2009 mean annual average and 1m below 2009 average).
    - Drop down box gives ability to show
      - No reduction (default)
      - Lidar-based 50 cm reduction
        - Shows areas that may be exposed
        - Precise, but limited to areas with lidar data
      - Lidar-based 1 m reduction
        - Limited coverage of lidar data
      - Contour-based 1 m reduction
        - Based on historic soundings
        - Less precise but give representation of possibilities

- Contour-based 1 m reduction
  - Based on historic soundings
  - Less precise but give representation of possibilities
- Within streams, wetlands, and water bodies
  - Recognizes pathways for invasion
  - Distance to existing Phragmites
- Download data drop down box
  - Can see layers available for download
  - Whole data sets are downloaded
- Set layer opacity

Michigan Tech Research Institute

Detecting and Mapping Invasive *Phragmites australis* in the coastal Great Lakes with ALOS PALSAR imagery

Laura L. Bourgeau-Chavez, Kirk Scarbrough, Liza Jenkins, Kevin Riordan, Richard Powell, Colin Brooks, Zach Laubach, Elizabeth Banda
Michigan Technological University
Michigan Tech Research Institute (MTRI)
Ann Arbor, MI

Martha Carlson Mazur, Kurt Kowalski, and David M. Galbraith
USGS Great Lakes Science Center
Ann Arbor, MI

Brian Huberty
U.S Fish & Wildlife Service Region 3 Ecological Services
Bloomington, MN

February 6, 2013

USGS science for a changing world

Great Lakes RESTORATION

U.S. FISH & WILDLIFE SERVICE

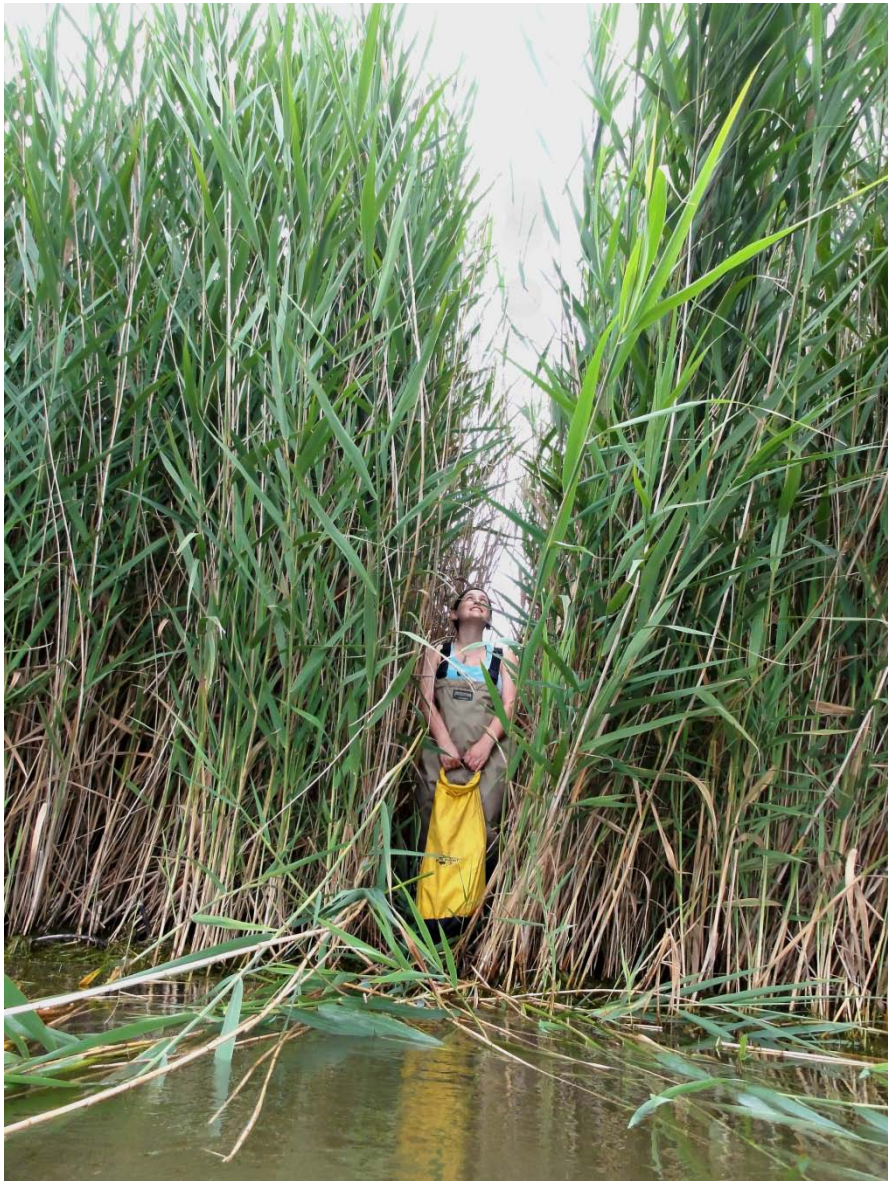
www.mtri.org

Invasive *Phragmites australis*

PROBLEM: Aggressive invader that Impacts ecosystem services:

- Displaces native vegetation in wetlands
- Reduces biological diversity
- Dries wetland soils and traps sediment
- Restricts shoreline views
- Forms monospecific stands
- Changes structural complexity

– Difficult to control



Project Objectives

Great Lakes RESTORATION

Michigan Tech Research Institute

USGS science for a changing world

U.S. Fish & Wildlife Service

Map current invasive *Phragmites* extent for Great Lakes coastal zone

- **Remote Sensing**
- **Field Work**
- **Validation**

Identify major environmental drivers of *Phragmites australis* distribution

Assess vulnerable areas to new invasion

Provide decision support tool

Project Overview

- **Project goal:** Develop methods for creating a distribution map of invasive *Phragmites* for management and control – decision support
- **Approach:** Use satellite remote sensing, synthetic aperture RADAR (SAR) L-band data at 20 m resolution to obtain mmu of ½ acre
- **Methods:** Extensive field surveys and Classification of Satellite SAR imagery, Unsupervised-Supervised Classification
  - Pilot Study - Lake St. Clair
- **Results**: Maps of distribution of invasive *Phragmites* (field data and PALSAR maps) and accuracy assessments

Mapping Approach for U.S. Coastal Great Lakes Basin

Target: Monotypic stands *Phragmites australis*, ½ acre minimum mapping unit

- Area of interest: 10 km inland from the coastal zone

Approach

Sensor: Japanese satellite ALOS PALSAR

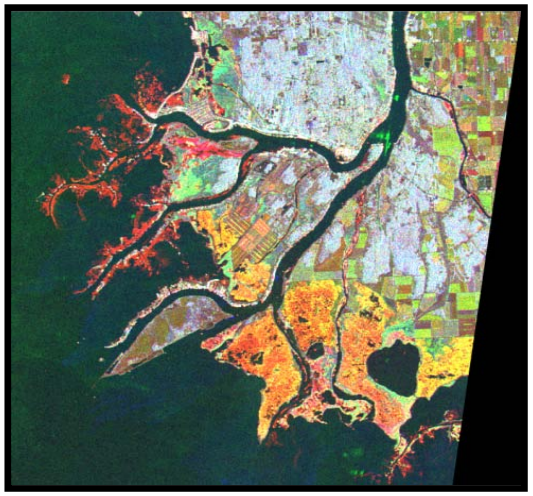
- ~23 cm wavelength, 10-20 m resolution
- 2 bands L-HH and L-HV
- Multi-season (spring summer and fall) datasets
  - Requires ~ 87 (70x70km swath) 3-date image stacks

Why use Synthetic Aperture RADAR (SAR)?

Landsat ETM (Aug ’01) 5,4,3 False Color Composite

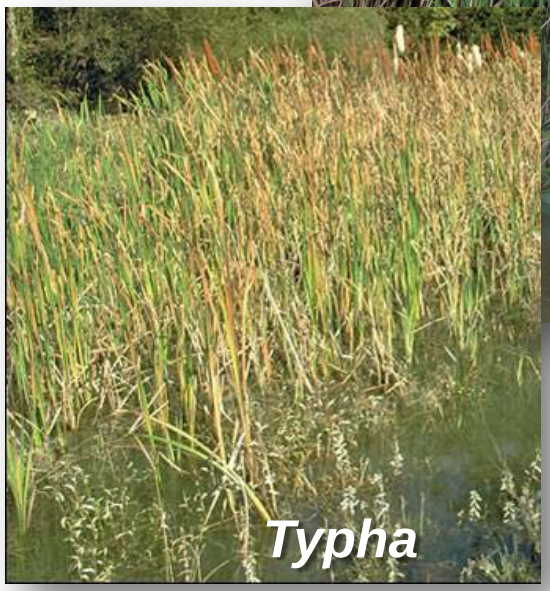
- **LANDSAT can be used to identify a broad spectrum of land cover types**
  - Radiant energy reflectance from vegetation varies depending on features at the cellular level (e.g. chlorophyll, leaf moisture), as well as variations in surface or background reflectance (e.g., soil type, water).

Radarsat (Oct‘98), JERS (Aug ’98), JERS (March ‘95) False Color Composite



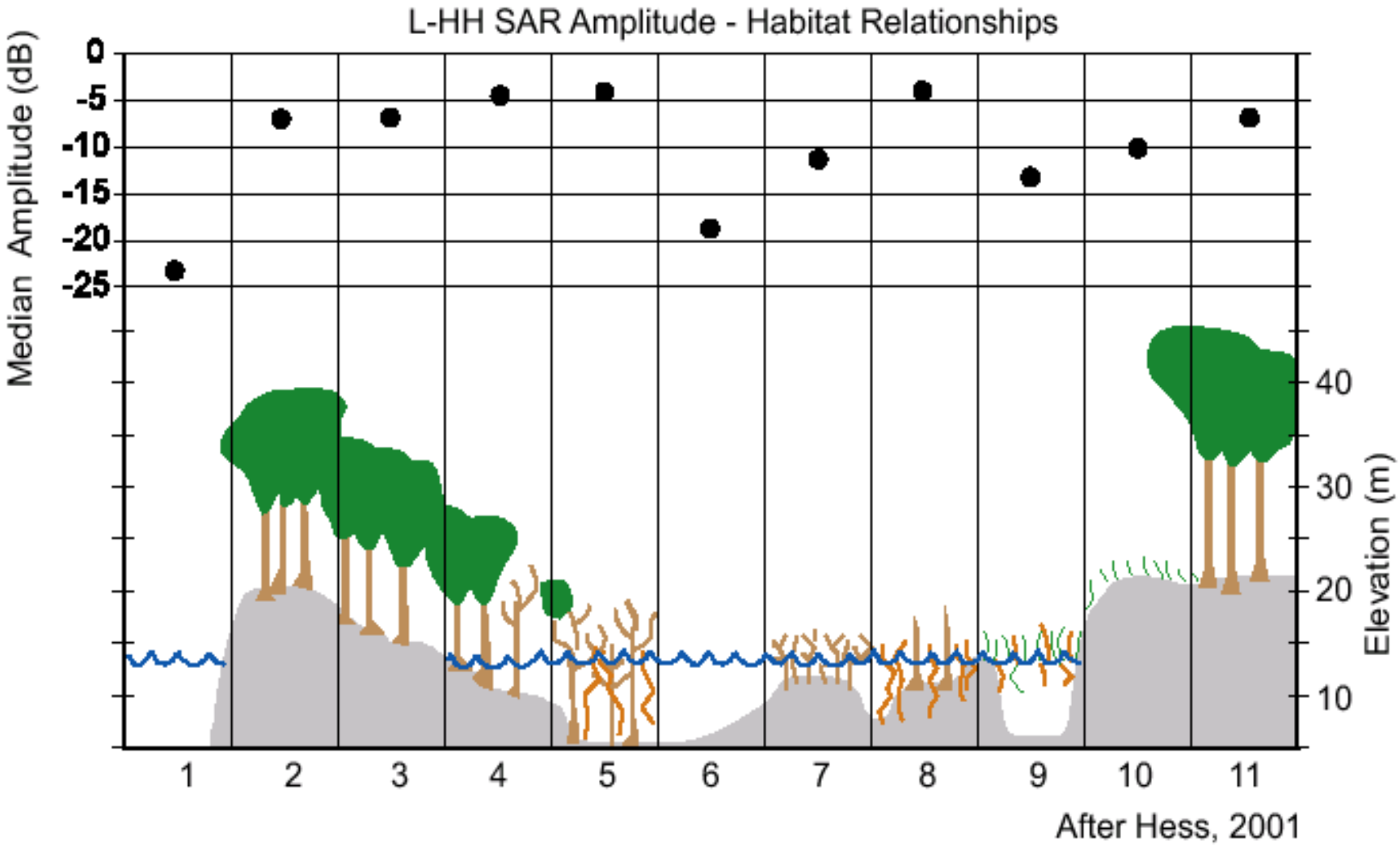
- **SAR can differentiate wetland types based on:**
  - Inundation/water level patterns
  - Vertical structure
  - Soil moisture
  - Biomass

Why use Synthetic Aperture RADAR (SAR)?

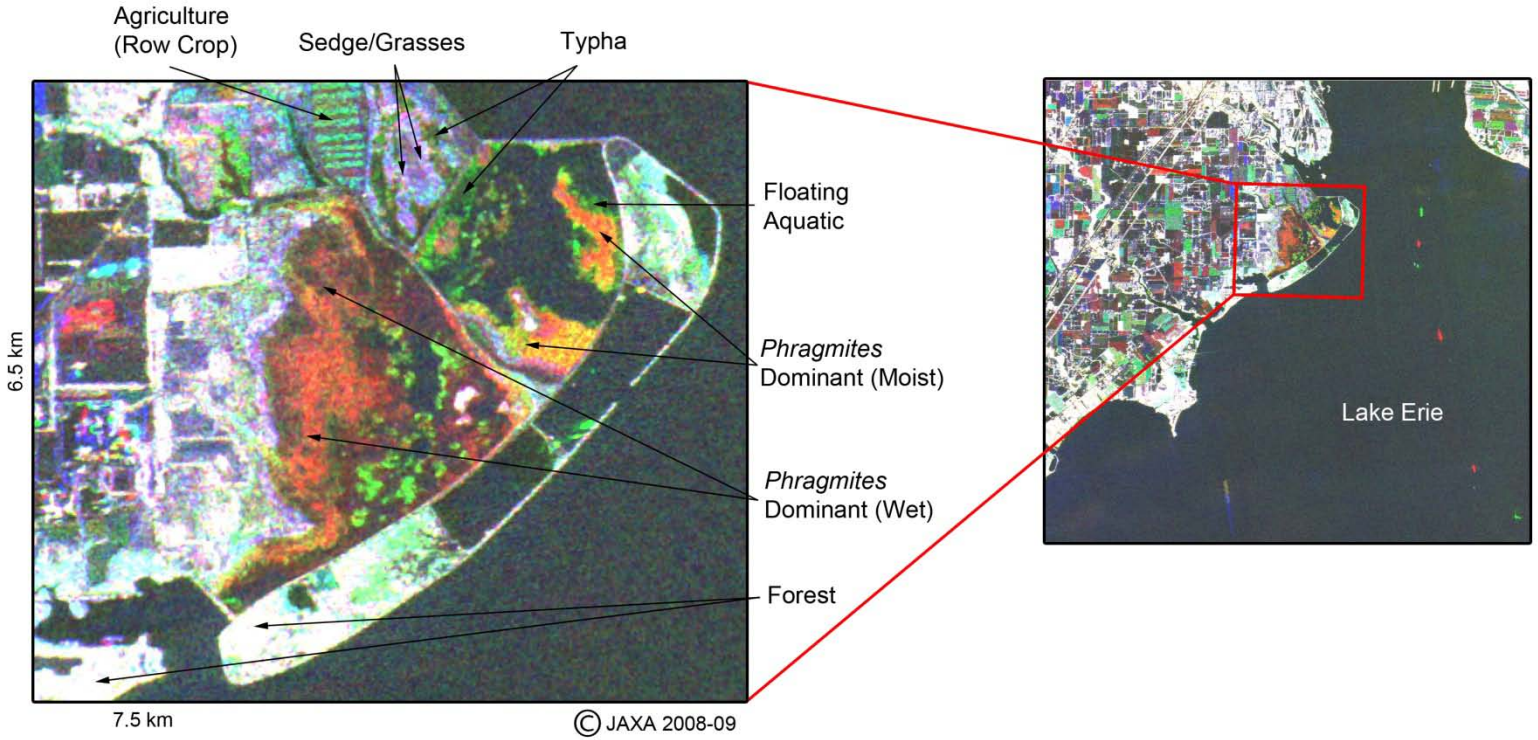


- SAR can be used to differentiate wetland species based on:
  - Inundation/water level patterns (HH)
  - Vertical Structure (HH)
  - Soil moisture (HH)
  - Biomass (HV)
- Seasonal (spring, summer, fall data)
  - Phenological variation
  - Water level cycles

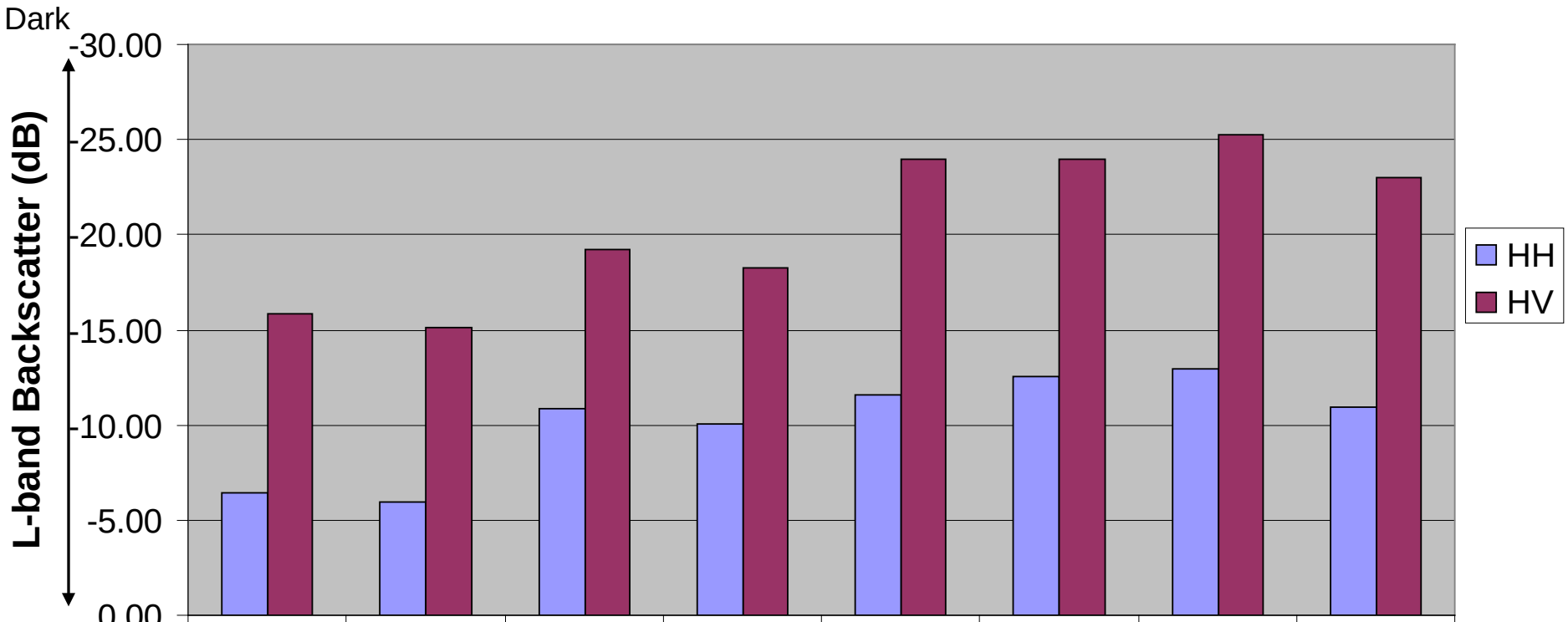
Theoretical L-band Scattering in Forest, Herbaceous and Open Areas



Pointe Mouillee Lake Erie

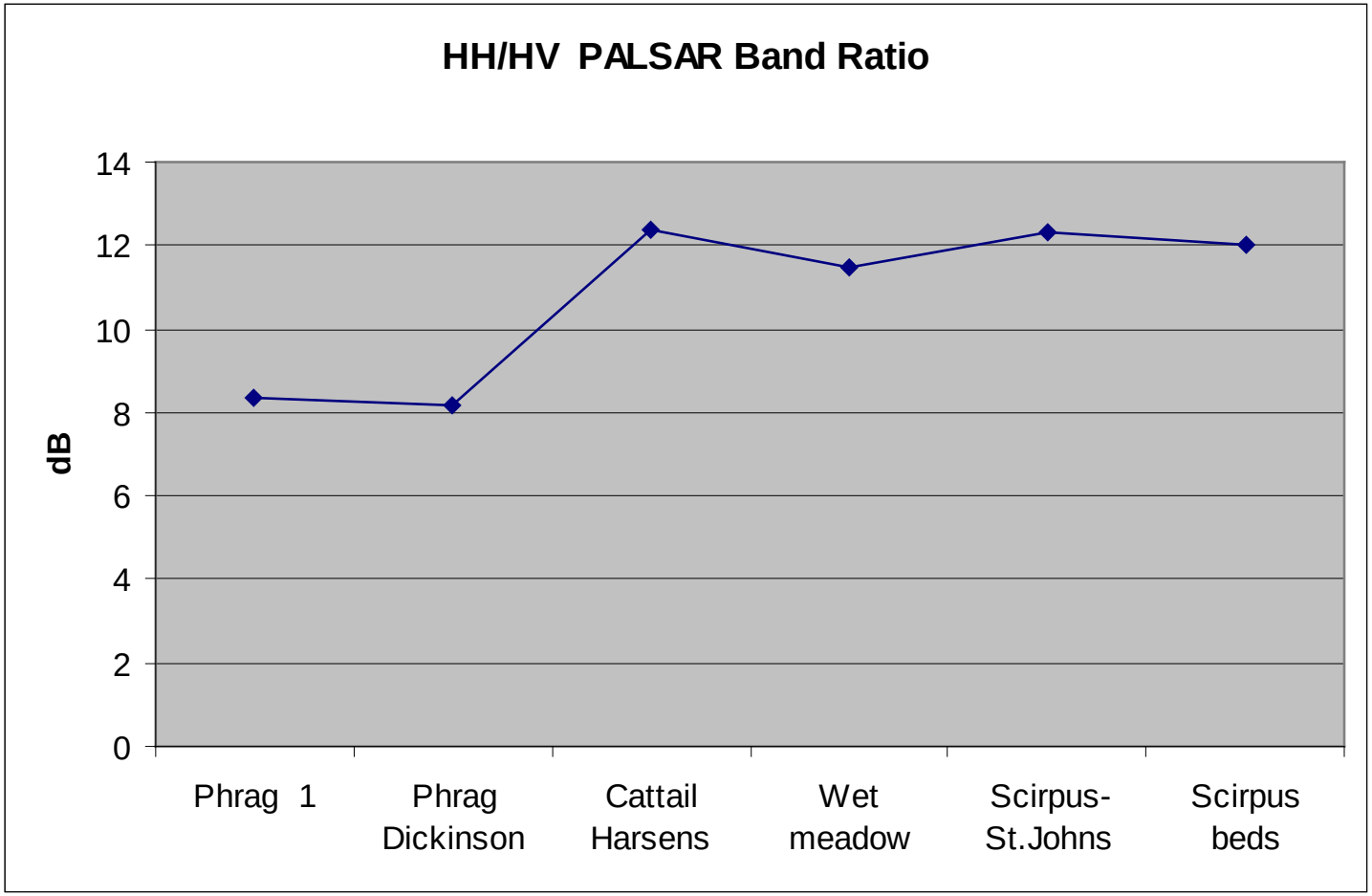


PALSAR Backscatter from Various Wetland Types



	Forest	Forest wetland	Phrag 1	Phrag Dickinson	Cattail Harsens	Wet meadow	Scirpus-St.Johns	Scirpus beds
HH	-6.46	-5.93	-10.86	-10.09	-11.61	-12.52	-12.92	-10.97
HV	-15.85	-15.09	-19.21	-18.24	-23.98	-23.98	-25.23	-23.01

Ratio of HH/HV PALSAR Backscatter

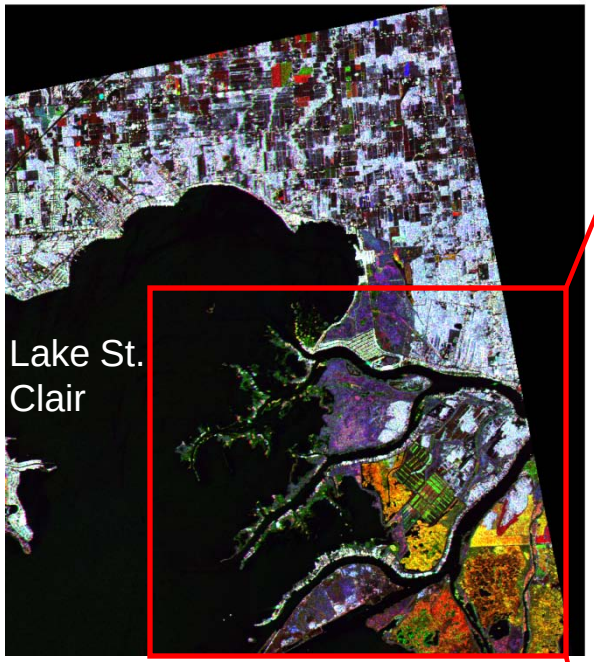


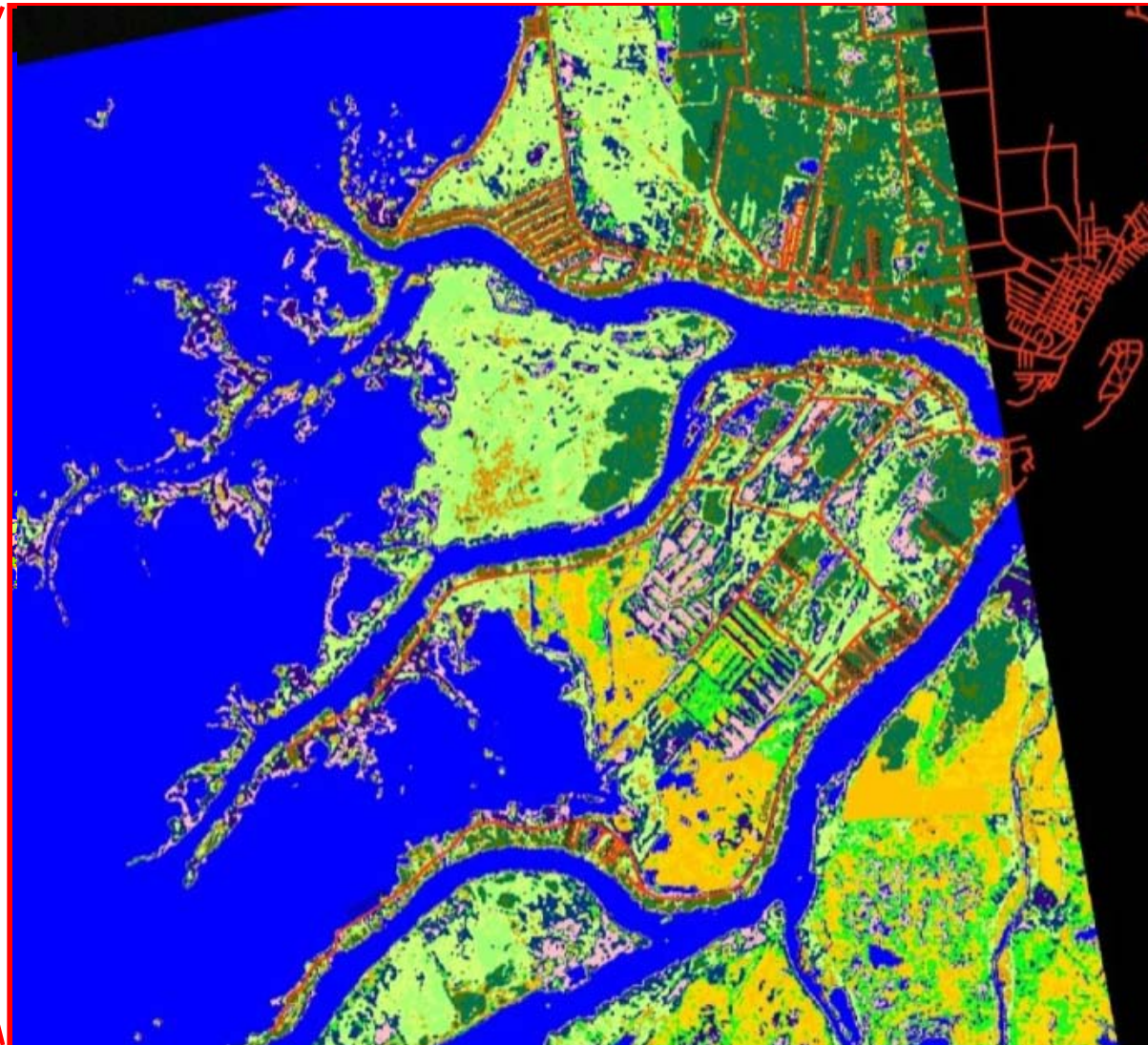
Phragmites has a significantly different L- HH/HV band ratio (4-5 dB) than the other herbaceous wetland ecosystems


Pilot Study Area
Lake St. Clair

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

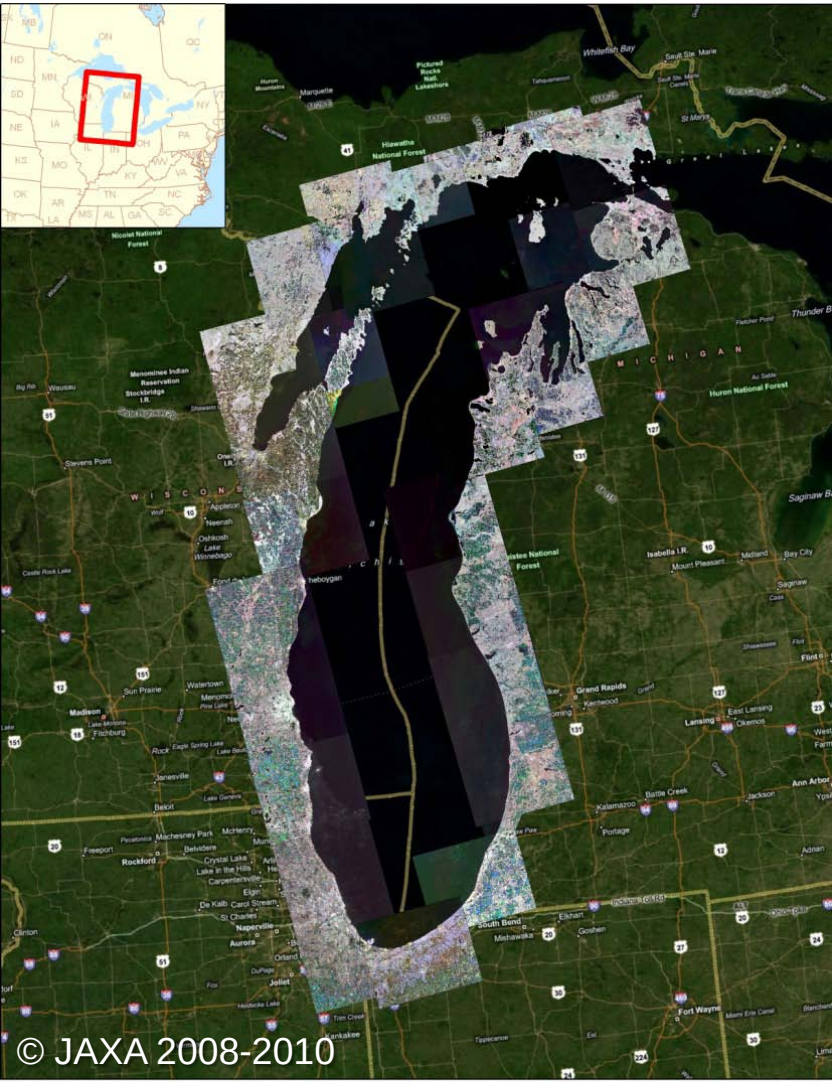
09 Oct. 2007

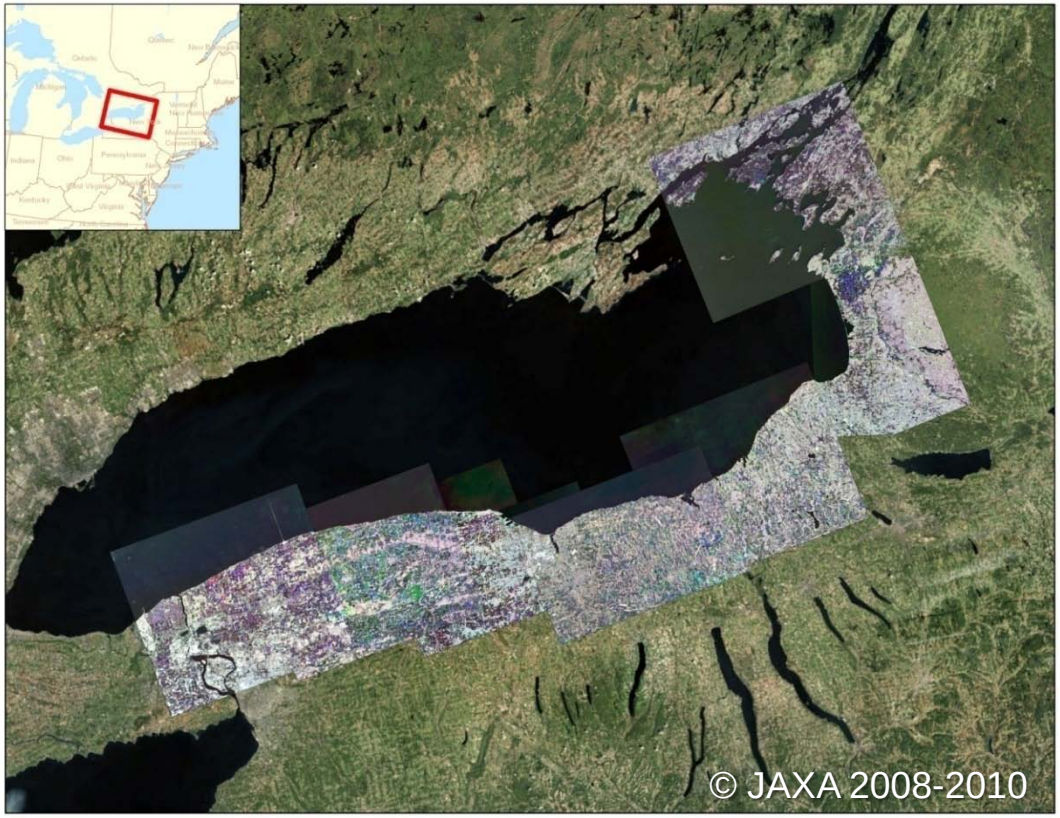
26 May 2008

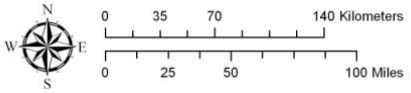
17 April 2008

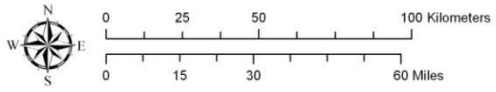
Phenological differences in vegetation and flood condition help discriminate different wetland ecosystem types

DATA:Three-season PALSAR Mosaics





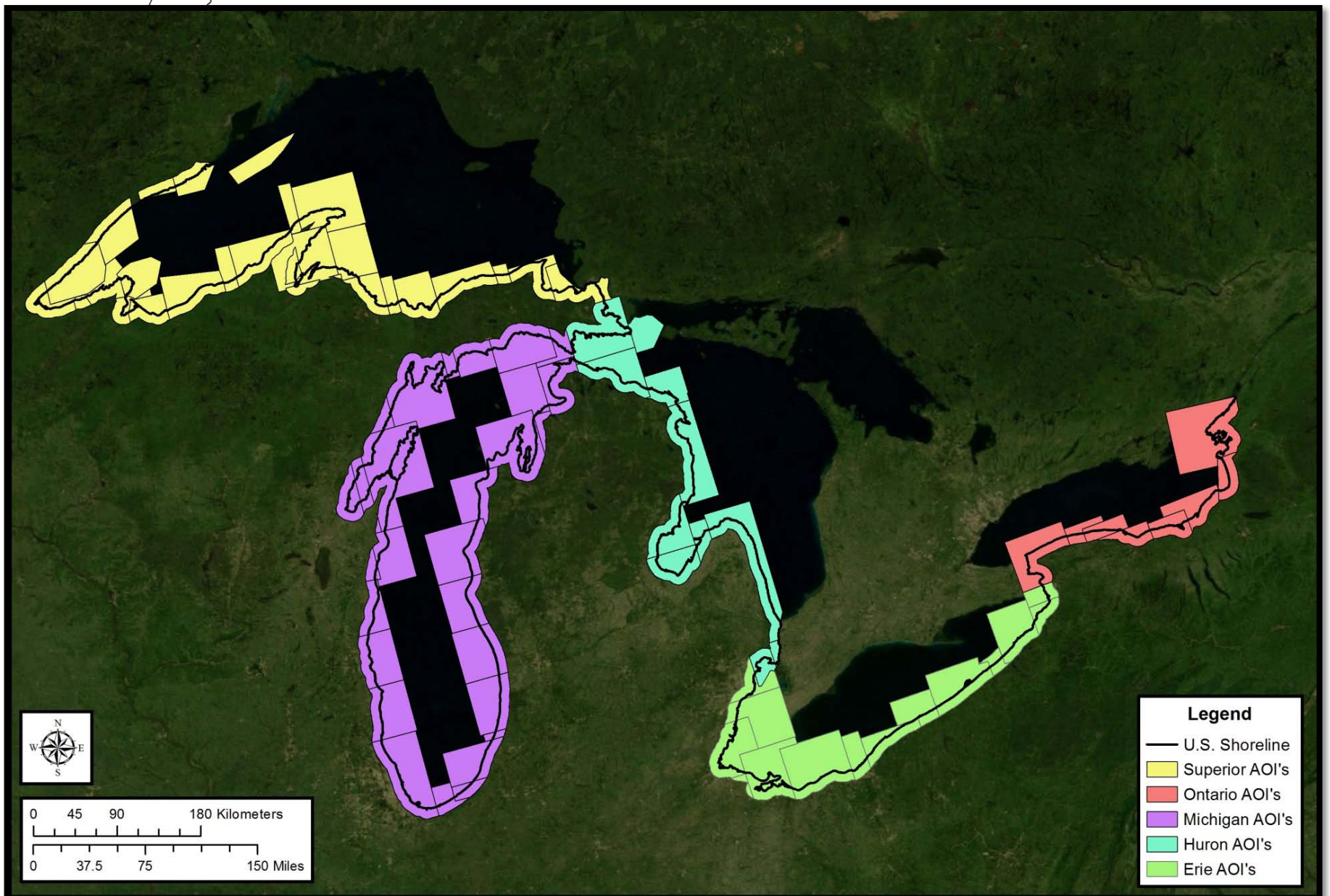




All PALSAR data were processed, terrain corrected and georectified by Don Atwood and staff of Alaska Satellite Facility

Alaska Satellite Facility

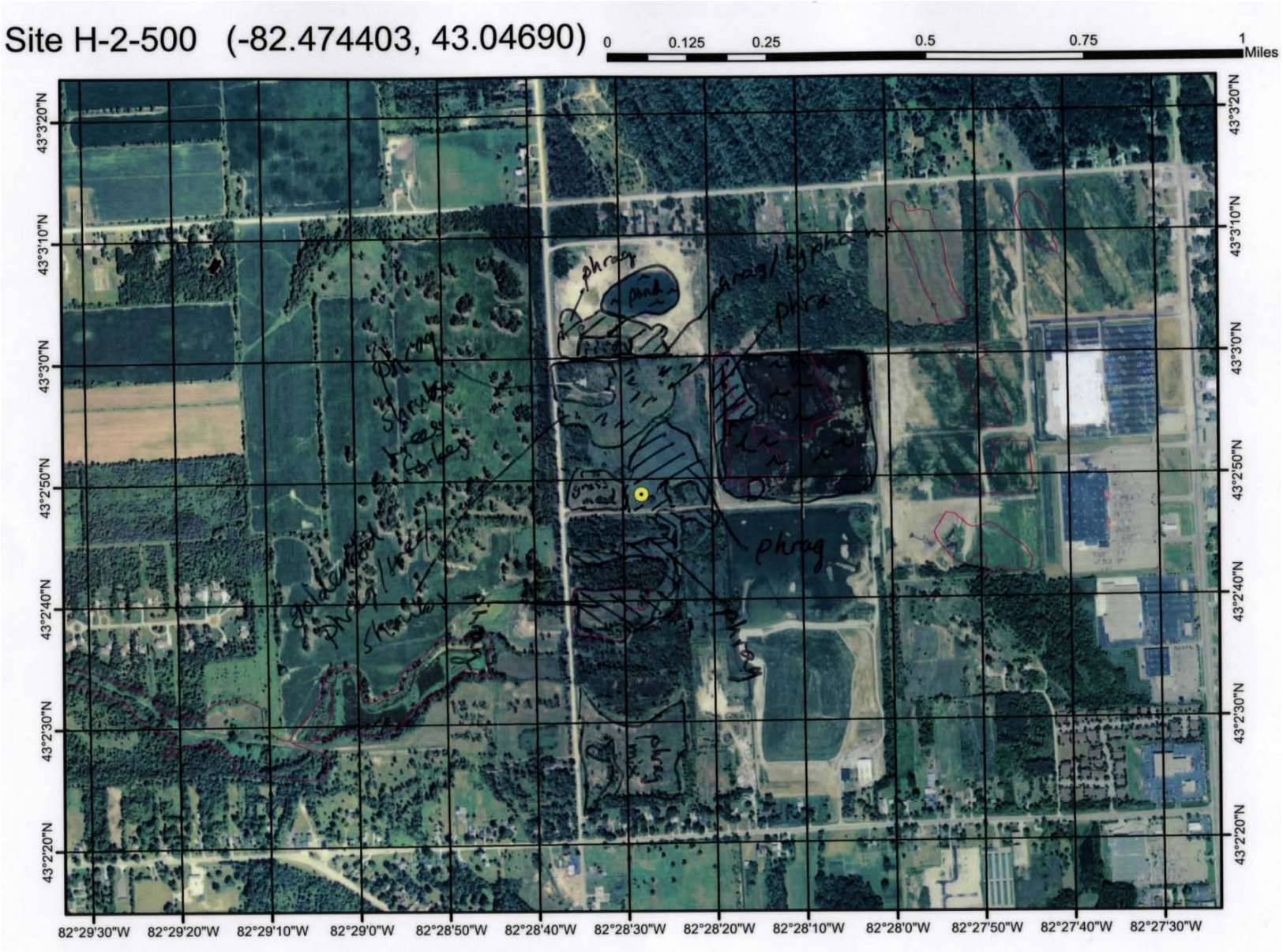
PALSAR Areas of Interest



Field Measurements Collected in ½ acre plots

- GPS locations
  - Center of ½ acre plots
- Photos with GPS tag – 4 cardinal directions (over 3000 photos in archive)
- Dominant covertype-Vegetative composition
- Wetland Ecosystem type
- Average Veg. height (3)
- Density of Phrag and Typha only
- *Phragmites* presence
- Recent changes/ herbicide/burn treatments

Example Site Map



Example Field Data Sheet

Validation and Training Field Data

Wetland Complex Name: Fort Gratiot Township Nature Preserve + Walking Trail Date: 10-12-10

Site ID: H-2-500T1 (V-validation / T-training site; circle one) Team/Observer: Zach, (Christina)

Water Level (cm): 0 GPS Time: 10:11 am

GPS: Lat: 43.041690 Long: -82.474403 (datum WGS84, decimal degrees)

GPS MTRI #: 0727

Center of 1/2 acre area sampled GPS: Lat: 43.041678 Long: -82.47427 (datum WGS84, decimal degrees)

Waypoint ID: H-2-500 T1C

ECOSYSTEM TYPE Open H_2O / 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

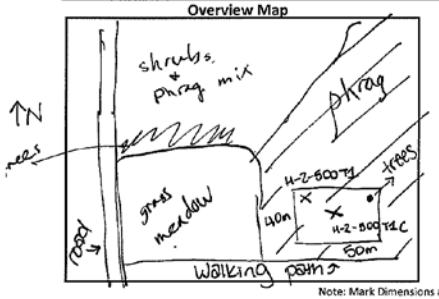
Species Distribution (if more than one species present): Patchy / (Evenly mixed) / Other

Phragmites present? (Yes) No

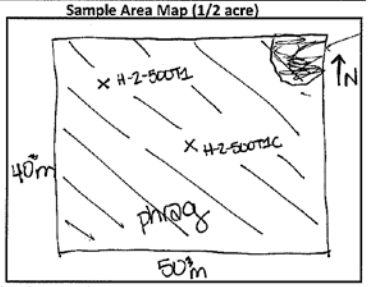
If yes Phragmites: (Untreated) / Burned / Mowed / Chemically treated / Other

Comments/Notes:

Overview Map



Sample Area Map (1/2 acre)



Note: Mark Dimensions and North on maps above

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) *Typha and Phrag stem count in 30x30 cm area*		Stage of Growth *dormant, emerging, immature, mature, flowering*	% Cover *of all green veg <25, 50, 75, 100%*
	Species	Live	Dead *for phrag and typha only*	Live	Dead		Live
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:

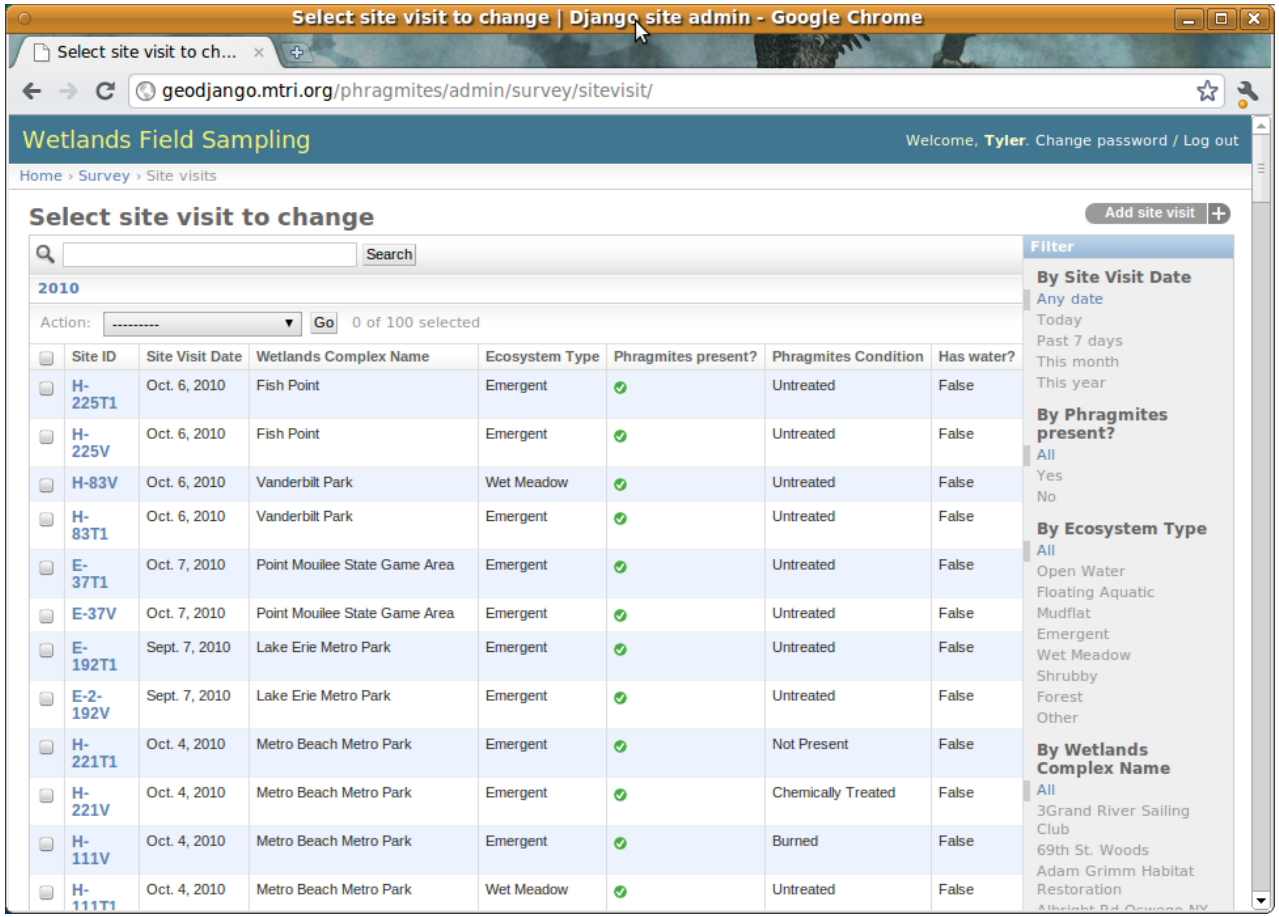
Field Photos with Geotags

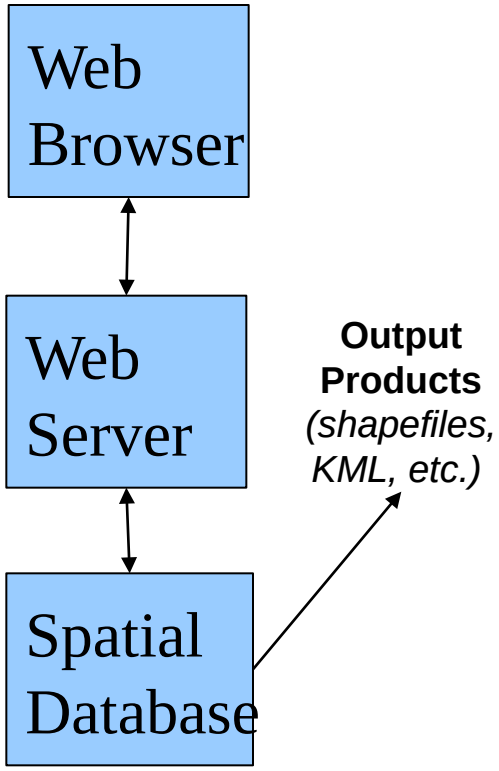
- Over 3,000 GPS-encoded photos
  - Created kml (for use in GoogleEarth) of photos for distribution

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 .

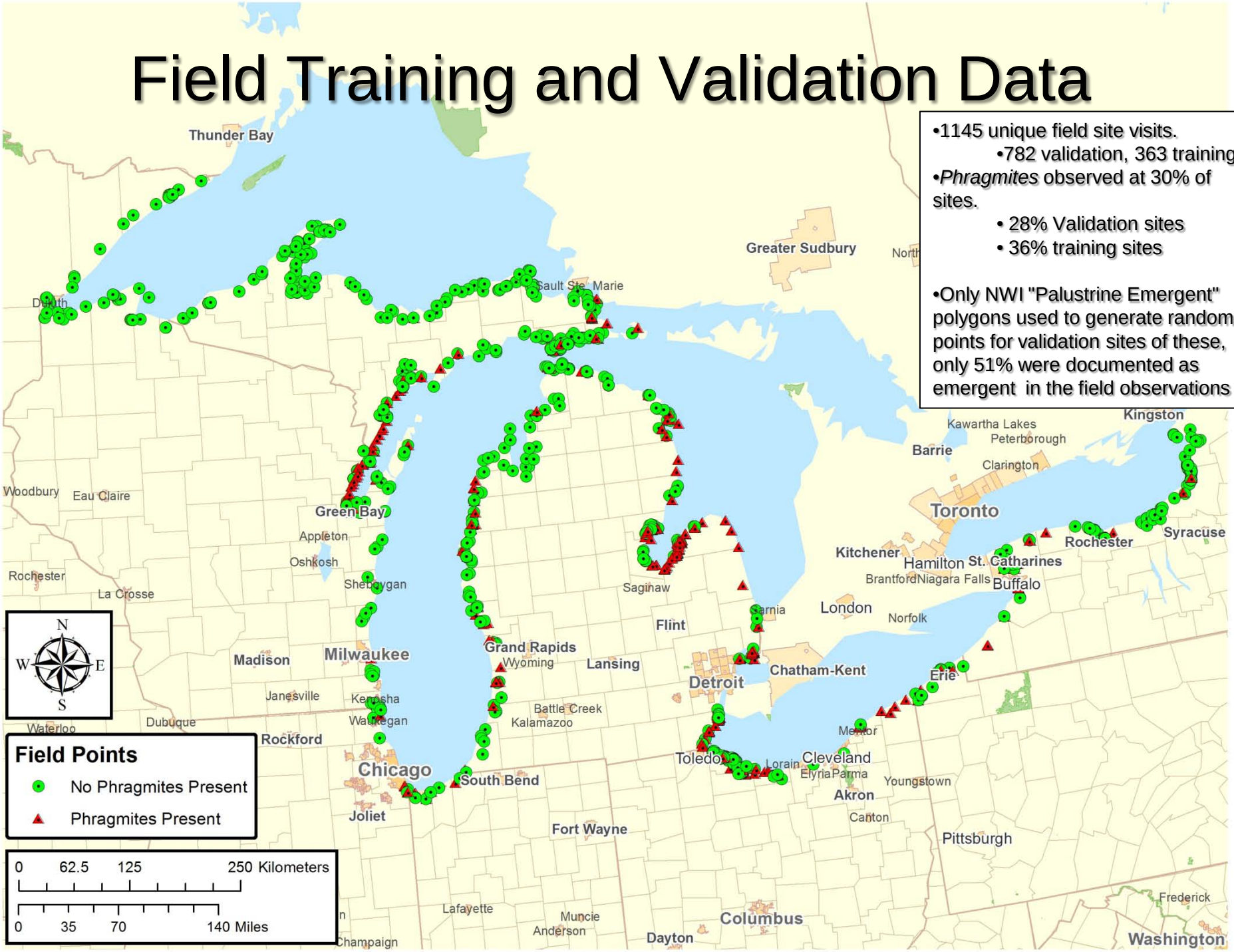
Web-based Data Entry

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





Field Training and Validation Data



- 1145 unique field site visits.
  - 782 validation, 363 training
- *Phragmites* observed at 30% of sites.
  - 28% Validation sites
  - 36% training sites

- Only NWI "Palustrine Emergent" polygons used to generate random points for validation sites of these, only 51% were documented as emergent in the field observations

Field Data Results

Coastal Lake Basin	Validation 0.2 ha Sites	Validation Sites with *Phragmites* present	Training 0.2 ha sites	Training sites with *Phragmites* present
Erie	120	55 (46%)	84	51 (61%)
Ontario	109	11 (10%)	31	6 (19%)
Huron	184	77 (42%)	90	48 (53%)
Michigan	255	74 (29%)	78	23 (29%)
Superior	114	0 (0%)	80	3 (4%)
Total	*782*	*217 (28%)*	*363*	*131 (36%)*

- Validation locations were randomly selected within NWI classed “Emergent” wetlands
- Need 377 validation locations per Lake basin for 95% confidence level (we have 109 to 255 per basin)
- *Phragmites* was often targeted in the Training data collection


Great Lakes Potential Invasive Phragmites
N
W
E
S
Potential Invasive Phragmites
0
50
100
200 Kilometers
0
35
70
140 Miles

Area Mapped as Invasive *Phragmites* Dominant

Coastal Lake Basin	Coastal area in 10 km buffer (ha)	Area of wetland and select ecosystem types in the filter (ha)	Hectares of Phragmites mapped in the filtered areas
Erie	778,447	96,862	8,233
Michigan	1,724,800	578,320	6,002
Ontario	442,113	102,056	13
Superior	1,270,484	N/A	N/A
Huron	650,715	75,402	10,395
Total	4,866,559	852,640	24,643

Western Lake Erie Potential Invasive Phragmites

Coastal Lake Erie Accuracy Assessment

Invasive Phragmites over 90% (and 50%) Lake Erie Basin					
		PALSAR Class			
Field Observations		Phragmites	other	Total	Producer's Accuracy (Omission Error)
	Phragmites	22 (29)	0 (4)	22 (33)	100 (88)
	other	21 (14)	77 (73)	98 (87)	82 (84)
	Total	43 (43)	77 (77)	120 (120)	
	User's Accuracy (Commission Error)	51 (67)	100 (95)		83 (85)

Great Lakes Basin Accuracy Assessment

Invasive Phragmites over 90% (and 50%) Entire Lake Basin					
		PALSAR Class			
Field Observation		Phragmites	other	Total	Producer's Accuracy (Omission Error)
	Phragmites	57 (73)	9 (33)	66 (109)	86 (70)
	other	75 (56)	527 (503)	602 (559)	88 (90)
	Total	132 (132)	536 (536)	668 (668)	
	User's Accuracy (commission error)	43 (58)	98 (94)		87 (87)

Summary

- PALSAR (L-band, 23 cm) provides a useful tool for mapping the high biomass invasive plant *Phragmites* on a regional scale
- Map accuracy was higher on the lakes with large expanses of invasion and lower on lakes where invasive *Phragmites* occurs in patches
- *Phragmites* is more prevalent in the more southern coastal areas where human development and populations are greater.
- Commission error evaluation showed that most of the areas misclassified as “invasive *Phragmites*” were a mix of *Typha* and *Phrag*, other *Phragmites* mix, tall dense *Typha* stands, or other grasses.

Outreach/ Product Sharing

MTRI project website http://mtri.org/phragmites.html

- Jpegs of 3-season radar image mosaics for Lakes Huron, Ontario, Michigan, and Erie
- 2010 field data in GoogleEarth as KMLs and geotagged field photos
- Join the Website list for updates and distribution of final map products
- Journal of Great Lakes Research Article in Press http://dx.doi.org/10.1016/j.jglr.2012.11.001

Decision support tool from USGS

http://cida.usgs.gov/glri/phragmites/

Contact Information

- Laura Bourgeau-Chavez
  MTRI Research Scientist
  laura.chavez@mtu.edu
  734-913-6873

- MTRI www.mtri.org
  Michigan Tech Research Institute
  3600 Green Court, Suite 100
  Ann Arbor, MI 48105

Great Lakes RESTORATION

Alaska Satellite Facility