MichiganTech Research Institute

Applied Ecological Services, Inc.™

A Baseline and Standardized Method for Monitoring the Treatment and Control of Invasive *Phragmites*

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UMWC Annual Meeting

Freshwater Research to Support Great Lakes Decision Making

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Background/Context

- The invasive wetland plant, *Phragmites australis* develops large monotypic stands in the coastal Great Lakes reducing habitat quality and ecosystem services
- Resource managers report spending over $80 million on *Phragmites* management
  - Treatment consists of herbicide application and/or burning/mowing
- Treatment and control has not been systematically assessed in terms of restoring ecosystem integrity and wildlife habitat
  - Few data have been published justifying effectiveness of the management
- A baseline method for assessment of the effectiveness of treatment in terms of biodiversity and landscape context is needed for effective management and control

Saginaw Bay – Walking through an Untreated Stand of *Phragmites*, Summer 2014

- This project is designed to develop standardized methods for assessment of the effectiveness of treatment through monitoring in a nested design *and* provide information for adaptive management

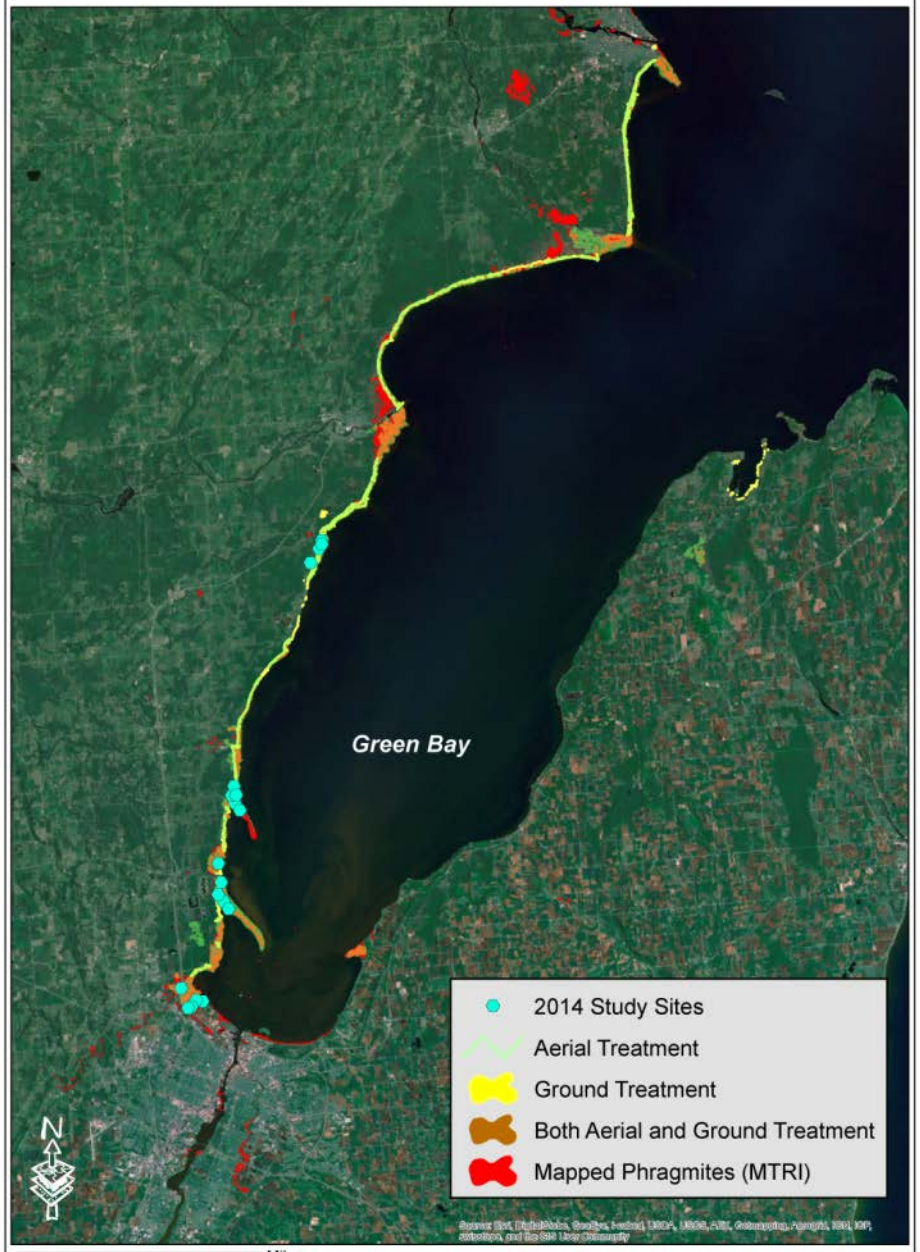
Research Questions

- How effective is herbicide treatment with and without burning/cutting in restoring coastal wetland habitats?
  - Scientific literature shows a lack of studies evaluating the effectiveness of treatment
    - most have observed only post-treatment presence/absence of the invader
    - Few evaluate beyond 1-2 years post-treatment
    - None evaluate the effectiveness in terms of the larger landscape context
- What are the costs/benefits of assessing treatment and control in the field, from high resolution aerial imagery and from moderate resolution satellite imagery?
  - Need to assess effectiveness of management controls through scientific evaluation of the changes to habitat biodiversity
    - Treatment effectiveness is being assessed in a nested design of scales, from field surveys to high resolution aerial imagery to moderate resolution satellite imagery.
    - Develop a standard methodology for assessment that can be replicated by resource managers for monitoring sites in other areas.
- What are adaptive management strategies that could be implemented to improve effectiveness of treatment?
  - Thorough assessment will assist land managers in developing appropriate management plans and putting into context of landscape will aid in planning to target the sources of the problem

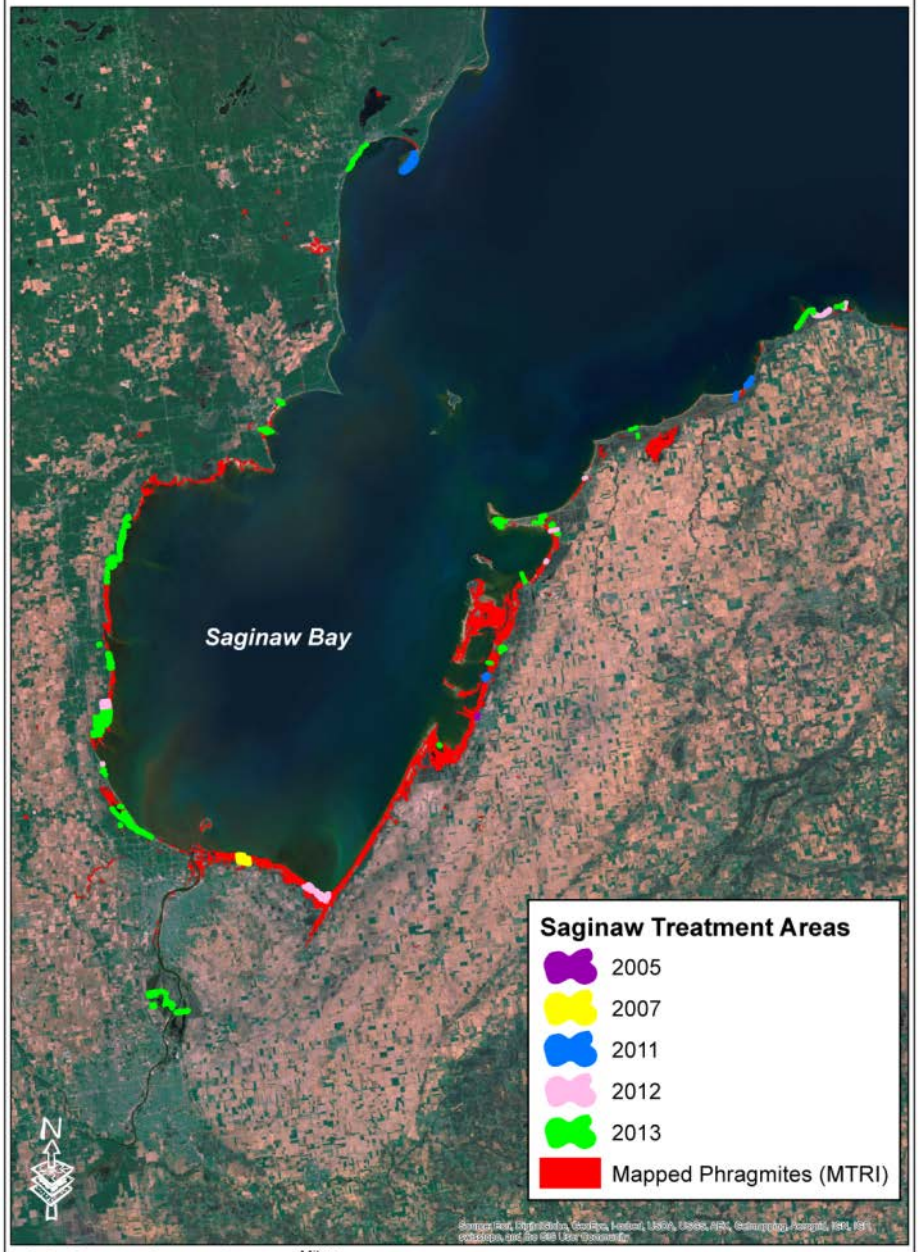
Project Overview

- Two Study areas:
  - (1) Green Bay, WI where 3,300 acres were treated with blanket herbicide treatment/follow up in 2011-12;
  - (2) Saginaw Bay, MI where treatment occurs by land ownership, most areas treated in Fall 2013
- Paired Treatment and Control Sites
  - Survey vegetation, birds and amphibians in paired treated/nontreated *Phragmites* wetlands in Saginaw and Green Bays
    - Paired sites needed to be similar in hydrogeomorphology, ecology, hydrology; need pre-treatment data collected
    - 9 site pairs (18 samples) in Saginaw Bay and 6 site pairs (15 samples) in Green Bay; 1 site in each sampled 3-5 years ago
- Use a before-after control impact (BACI) statistical framework for assessing field indicators of habitat restoration

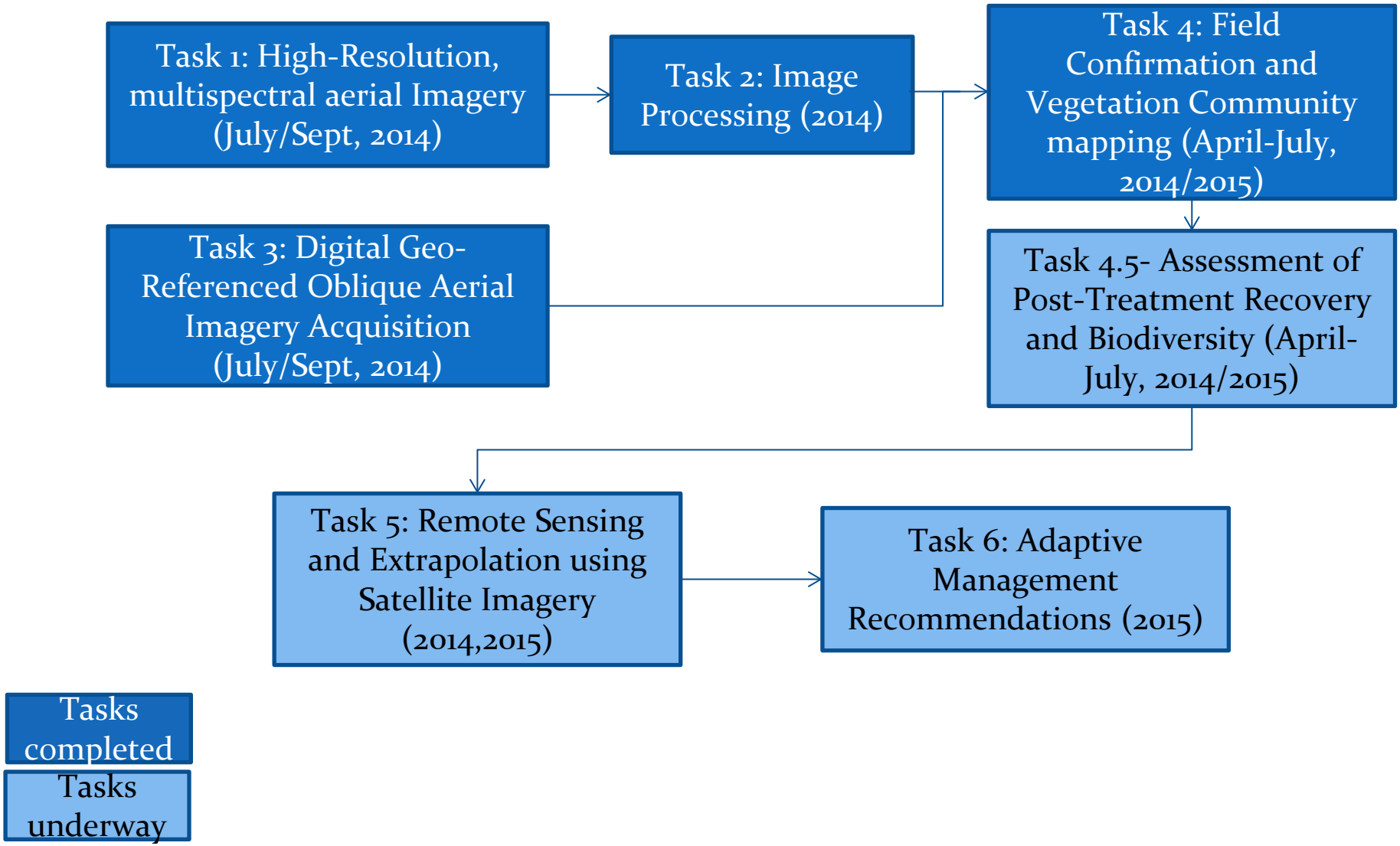
Green Bay Phragmites australis Treatment 2011 - 2012



Saginaw Bay Phragmites australis Treatment 2011 - 2013



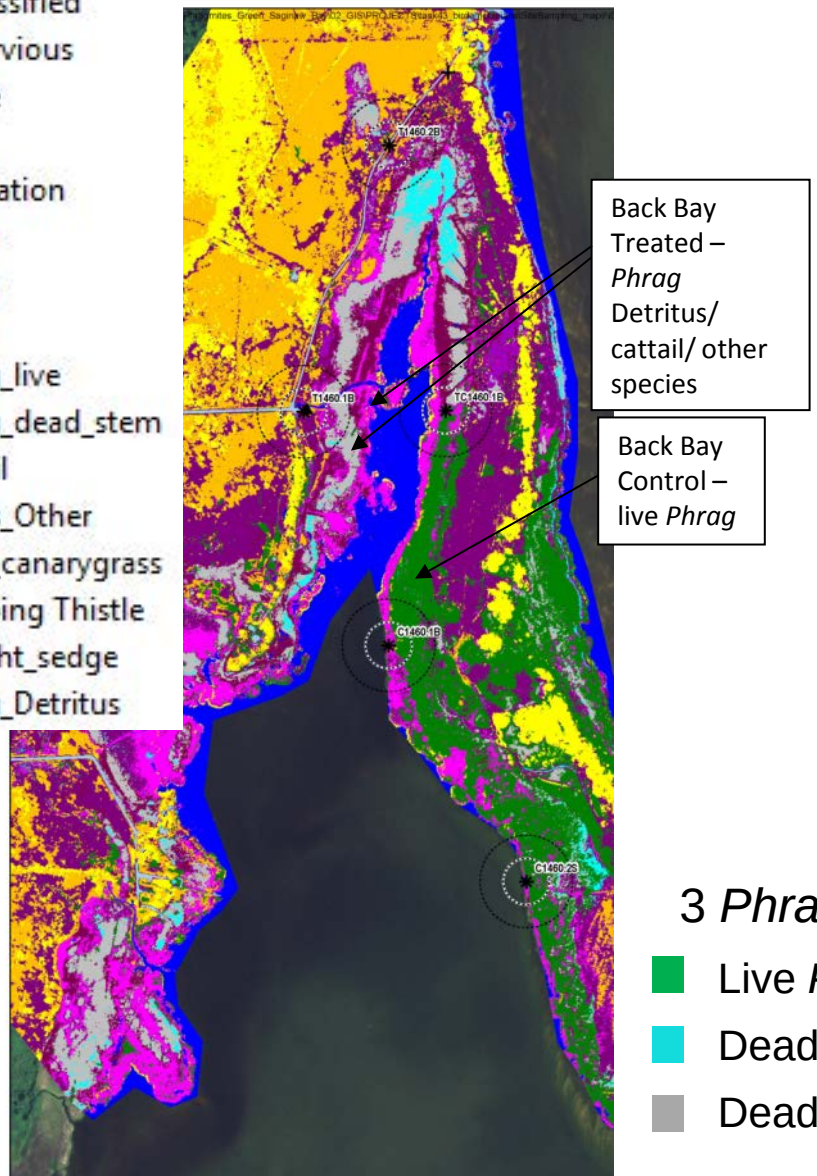
Project Overview Approach



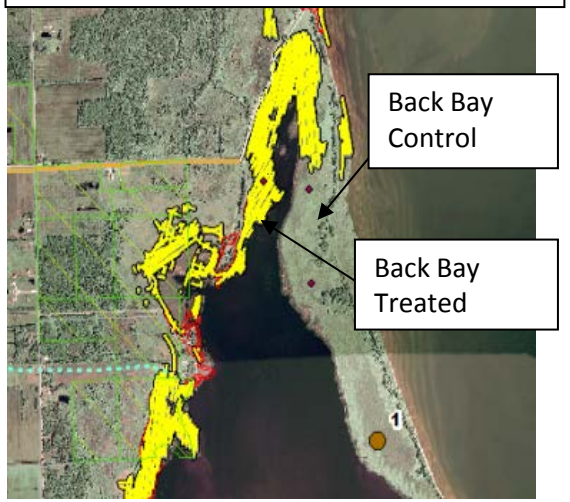
Project Outputs : Post-treatment Maps

(2014 imagery with 15 cm resolution)

- unclassified
- impervious
- shade
- tree
- vegetation
- water
- shrub
- temp
- Phrag_live
- Phrag_dead_stem
- Cattail
- Herbs_Other
- Reed_canarygrass
- Creeping Thistle
- Upright_sedge
- Phrag_Detritus



Blanket Herbicide Treatment Area- yellow



Fall 2013 Oblique

3 *Phragmites* Classes

- Live *Phragmites*
- Dead Standing *Phragmites*
- Dead "matted" *Phragmites*

Project Outputs: Coastal Wetland Biodiversity Assessment – IBI Calculations

- Standard sampling protocol requires field observation of frog calls from edges of wetlands
- 2015 Saginaw Bay – Frog call recorders were placed inside the treated and non-treated sites
  - Recordings made on same nights that in-person surveys were performed for comparison
  - Recordings occasionally picked up species that were missed during surveys, but more often, species observed during surveys were not audible in recordings
  - Calls of certain species (Wood Frog, Chorus Frog) may be hard to distinguish from background noise in recordings when faint
- Index of Biologic Integrity (IBI) score ranges from 0-100
- Amphibian IBI scores for the Saginaw Bay sites range from ~70 to 100
- Amphibian IBI scores remained similar or increased from 2014 to 2015, except for one site where ice scour removed large amounts of vegetation
- In 2014 treated and untreated sites had similar amphibian IBI scores; in 2015, treated sites had a slightly higher average score
- Average bird IBI scores were somewhat higher at untreated sites in 2014; 2015 surveys have just been completed and are being QA/QC'd.

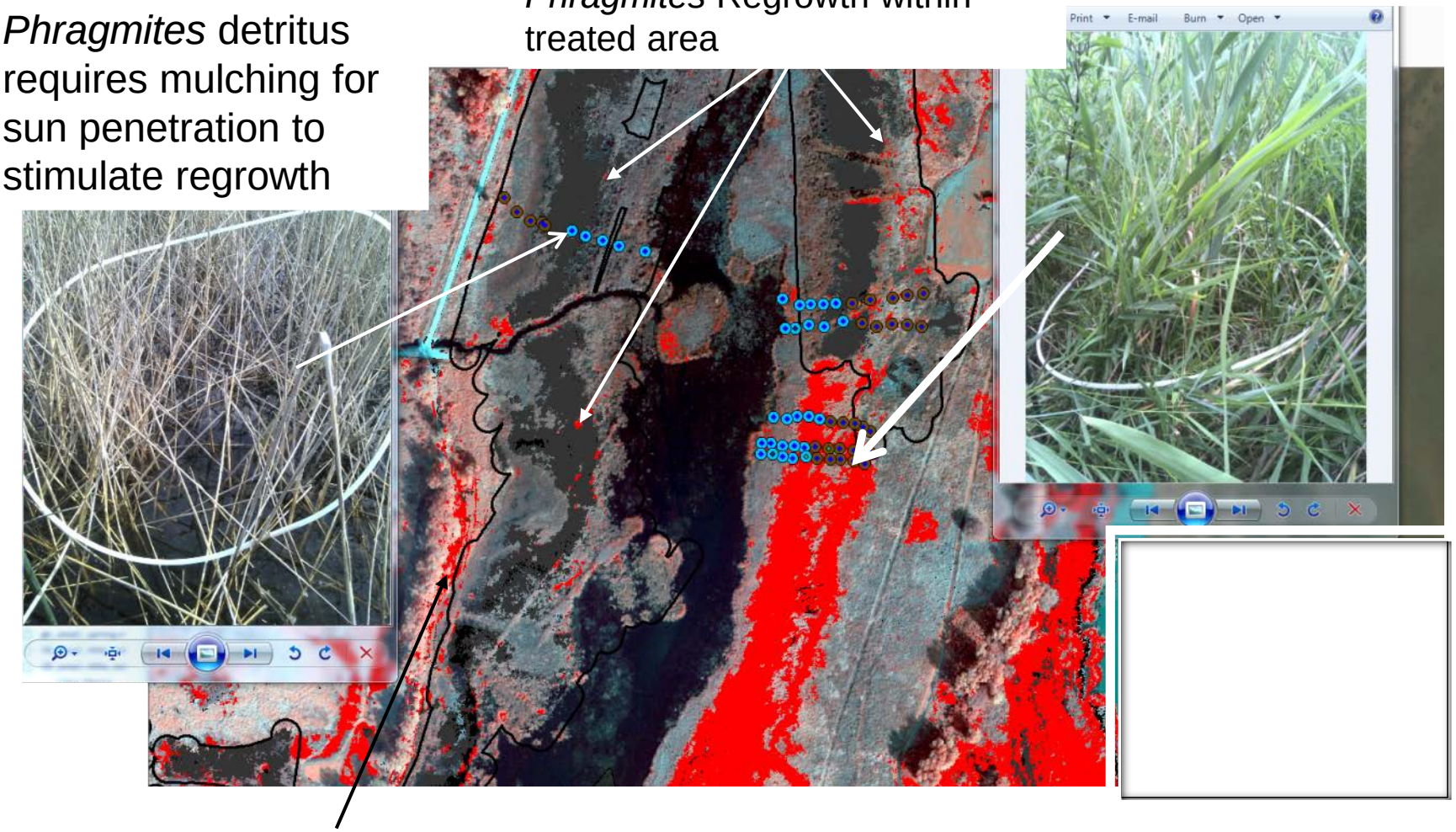
End User Engagement

- WDNR & MDEQ as well as Landowners/land managers have shown a vested interest in our study and the results
- End user input drove our site selection and sampling strategy
- Additional outreach through project webpages on Great Lakes *Phragmites* Collaborative website and MTRI website
- MDEQ and WDNR engagement is influencing the adaptive management strategies.
  - MDEQ was interested in the spatial dataset produced for Saginaw Bay on location of *Phragmites* (map from USGS-USFWS 2010 GLRI project) as well as location of treatment areas (from DEQ permits and land owner information) and is awaiting project maps and results to aid in updates to the "*Phragmites* Treatment/Management Prioritization Tool"
  - WDNR land managers/ Ducks Unlimited are currently using the 15 cm resolution output maps for determining adaptive management strategies and directing follow up treatment (see next slide). Bay-Lake Regional Planning Commission and Ducks Unlimited not only using data but investing in continuing the process.
  - MDNR St. Clair Flats are using a 5-8 m resolution 2013 map produced by MTRI for other research that coincidentally captured treatment areas and non-treated *Phragmites* on Harsen's and Dickenson Islands which the MDNR are actively working to control *Phragmites* infestations. They have suggested that updates to the maps are needed annually to bi-annually to aid in effective treatment and control.

2014 Aerial Maps intersected with Treatment Data Informs Adaptive Management

Areas of matted *Phragmites* detritus requires mulching for sun penetration to stimulate regrowth

Many small isolated patches of *Phragmites* Regrowth within treated area



•Edges missed by herbicide treatment

Next Steps

- Complete 2015 Vegetation Field Surveys
- Refine Saginaw Bay high resolution map
- Create moderate resolution map from satellite imagery (Landsat and PALSAR-2)
- Evaluate bird, amphibian and vegetation IBIs with BACI design
- Complete adaptive management recommendations report
- Integrate project results with modeling from Tier I sister project (next slide)
- End User Engagement –
  - Work with MDEQ in integrating results with updating the *Phragmites* Treatment/Management Prioritization Tool
  - Continue working with WDNR, Ducks Unlimited and Bay-Lake Regional Planning Commission on adaptive management strategies
  - *Phragmites* Collaborative Webinar on Project results and adaptive management
  - Reports/manuscripts

Integration of MONDRIAN Wetland Ecosystem Modelling of Treatment Scenarios

- Integrate adaptive management with output from Tier I project conducting ecosystem modeling (PI Elgersma)
  - MONDRIAN wetland ecosystem model with varying N levels and treatments showed optimal treatment scenarios- Results show that the effectiveness of treatments depends on how eutrophic the wetland is:

- Combined treatments, especially herbicide + mowing, are generally more effective than single treatments

- 3 years of combined management is often— but not always— better than 1 year, depending on the specific treatments used and how eutrophic the wetland is

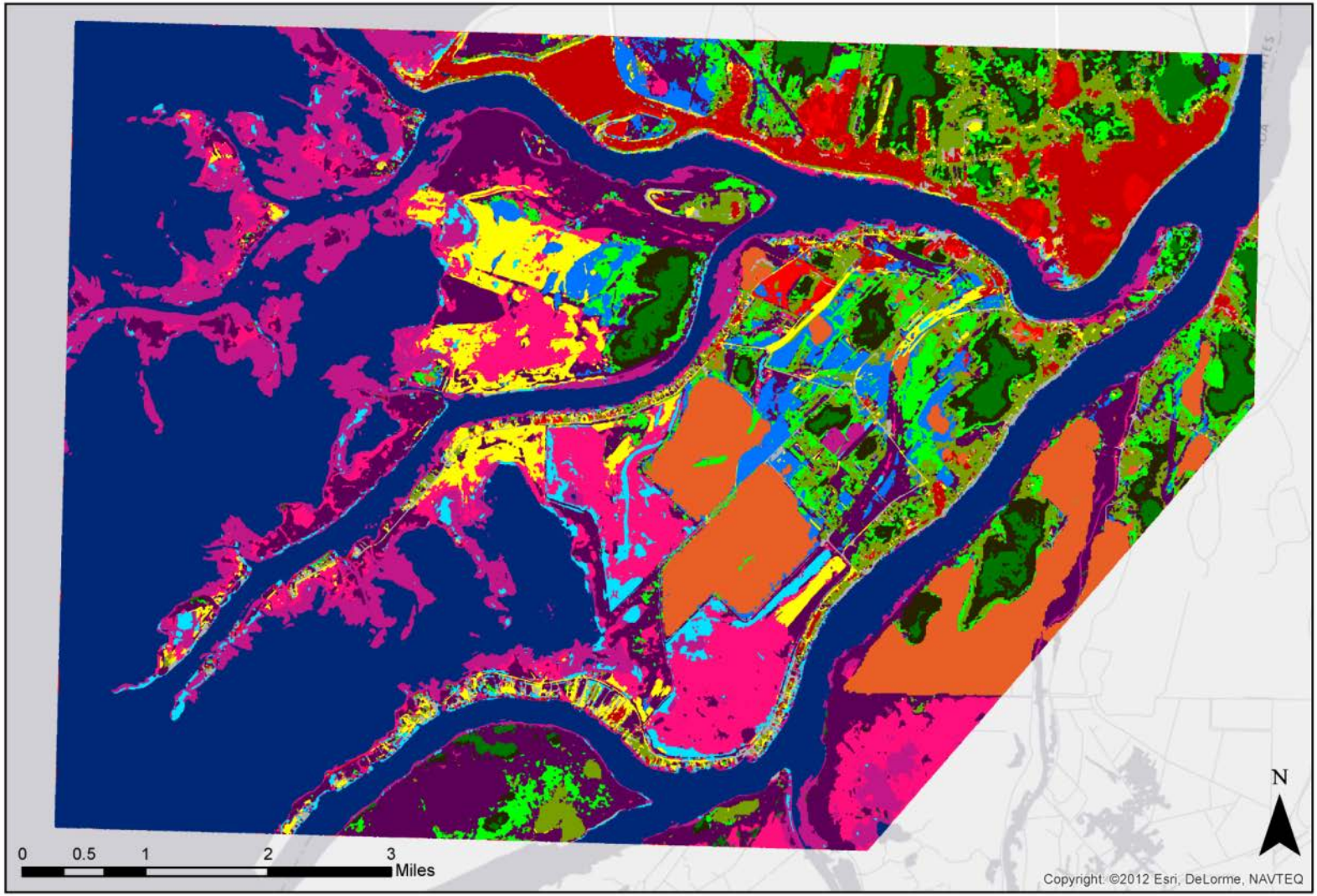
- 6 years of management is seldom better than 3 years. In oligotrophic wetlands, 6 years of management actually *benefits* invasives due to stress on native plants

Outcomes

- This project will fill in critical gaps in knowledge
  - Providing peer reviewed scientific manuscript on effectiveness of herbicide treatments on spread of *Phragmites*, and recovery of wetland ecosystems in context of biodiversity
    - Provides analysis in context of landscape scale
    - Provides comparison of treated sites to invaded sites
  - Provides resource managers and other end users with confirmation of current methods, or recommendations for further, more effective adaptive management strategies

Extra Slides

RapidEye-Radarsat 5 m Resolution Map of St. Clair Flats



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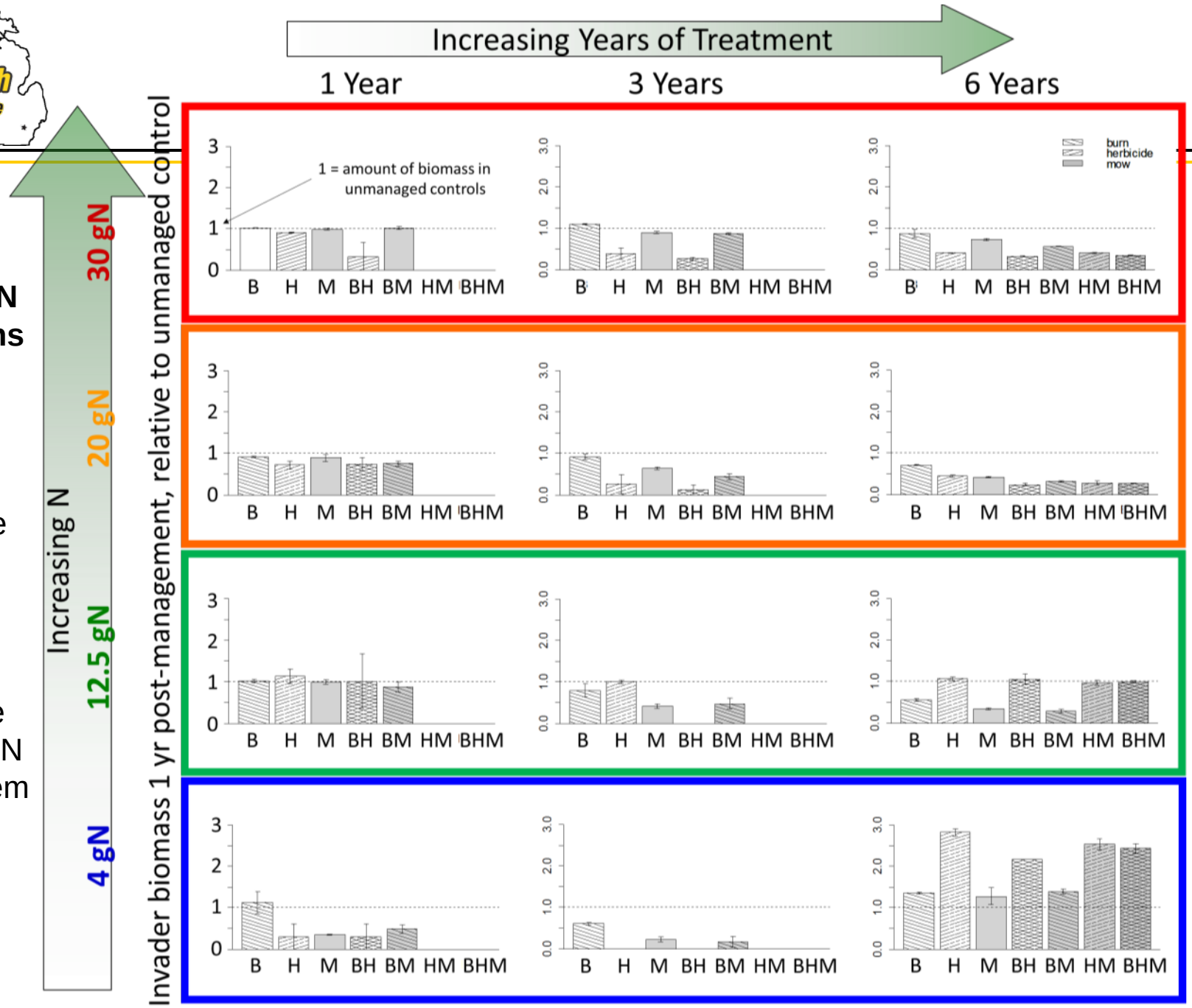
MONDRIAN Model Runs from Elgersma

- B-Burned
- H-herbicide
- M-mowed
- Treatment should be appropriate for level of N in ecosystem



Power Analysis

Comparison of Planned vs. Feasible Site Design

- Power: the probability that a statistically significant difference will be found when such a difference actually exists
- Power of 0.80 is typically considered sufficient and frequently used in monitoring approaches
- The Great Lakes Coastal Wetlands Consortium has set a target α of 0.10
- Plan vs. Actual
  - Original plan: 2 regions (Green Bay, Saginaw Bay), 10-15 pairs of sites per region
  - Collected data: 8 pairs in Saginaw Bay (18 samples), 6 pairs in Green Bay (15 samples)
  - Control site data (untreated, natural vegetation) from GLIC will be included in analysis

- Because habitat type has 3 levels (control, untreated Phragmites, treated Phragmites), it requires 2 dummy variables to code
- Thus, IBI = b0 + b1(habitat type 1) + b2 (habitat type 2) + b3(survey) + b4(region) + b5(water level)
- Using this basis for the regression model and α = 0.1, the estimated power for the planned number of sites is 0.91.
- Estimated power for our actual site design = 0.85.

Saginaw Bay Sites

Type	SIZE (ha)	Hydrogeomorphic Poly	GEOMORPH TYPE	SiteName	CMU Pre-treatment data	Treatment Year	TREATMENT TYPE
Treated	5.7	499	RD	499A	No, 499 - 2014	2013	Refuge, Cygnet Plus, selective spray
Control	9.6	499	RD	499B			Control Site - No Treatment
Treated	5.0	761	LOE	761C	761 - 2011	2013	permit issued no report
Control	7.6	761	LOE	761B			Control Site - No Treatment
Treated	123.3	517/518	LOS/RD	517A-3	517 - 2012	2012	under investigation
Control	9.7	517	RD	517B			Control Site - No Treatment
Treated	9.8	522	LOS	522A	494 - 2012	2013	Spot Treatment-Rpdea
Control	2.8	522	LOS	522B			Control Site - No Treatment
Treatment	2.3	761	LOE	761A	761 - 2011	2013	under investigation
Control	2.9	510	LOE	510A			Control Site - No Treatment
Treatment	102.8	518	LOS	518C-1,3	No, 494 - 2012	2007	imazapyr-only, mowed
Control	45.3	518	LOS	518C-4			Control Site - No Treatment
Treated	3.2	461	LOE	461A	461 benchmark site 2011-15	2012	mowed -chemical treatment type under investigation
Control	4.2	461	LOE	461B			Control Site - No Treatment
Treatment	64.7	518	LOS/RD	517A-1	No, 494 - 2012	2007	imazapyr/glyphosate combo treatment
Control	4.0	518	LOS	518B			Control Site - No Treatment
Treated	New site	515	New Site	515B	No	1998	Mowing since 1998, herbicide 2010-2014
Control		515		515A			

Project Results
Amphibian-based coastal wetland IBI

- Mean values are calculated for total species richness (rTOT), richness of woodland-associated species (rWOOD), and probability of detection of woodland-associated species (pWOOD).
- Maximum possible values for rTOT and rWOOD are determined from species ranges.
- rTOT and rWOOD are corrected by dividing station richness by maximum possible richness

Project Overview - Engaging End Users (Resource Managers, concerned citizens, coastal land owners)

- Working with Green Bay – WDNR– blanket herbicide treatment was GLRI funded – strong interest in outcome from the project
- Creating project page on Great Lakes *Phragmites* Collaborative Website, end of project webinar with results, working with Michelle Selzer to engage end users
- Engaging resource managers working on control of *Phragmites*: Brian Huberty USFWS, Kurt Kowalski USGS, Lee Osterland MDNR, John Darling MDNR; Michelle VanderHaar - USFWS GLRI Cooperative Weed Management Area for Saginaw Bay; and concerned citizens
- Working with Don Uzarski and connecting our work to the GLIC project – we are using their pre-treatment sampled sites, and following the GLCWC protocol for field sampling. Our work will augment theirs but also provides a focused analysis of paired treated and non-treated sites for analysis of effectiveness of herbicide treatment