Remote Sensing Series Part II:
Implementing practical field and remote sensing methods to inform adaptive management of non-native Phragmites australis in the Midwest

Colin Brooks, Michigan Technological Research Institute
December 10, 2015

The webinar is listen only. You can listen by phone or through your computer’s speakers. The webinar will be recorded and posted at greatlakesphragmites.net

We will begin shortly
Implementing practical field and remote sensing methods to inform adaptive management of non-native *Phragmites australis* in the Midwest

http://www.mtri.org/treatment_effects_phragmites.html

**MTRI:** Laura Bourgeau-Chavez, Colin Brooks, Amanda Grimm, Sarah Endres, Elizabeth Banda, Eleanor Serocki, Liz Schold, Michael Battaglia

**AES:** Jason Carlson, Steve Apfelbaum, Michael McGraw, Ry Thompson, Fugui Wang

**CMU:** Donald Uzarski

Great Lakes Phragmites Collaborative Webinar
Remote Sensing Series Part II
10th December, 2015
Millions of dollars have been spent on treatment of *Phragmites* infested wetlands with herbicide and other control methods.

But, few studies or management efforts have included standardized monitoring or an assessment of the effectiveness of treatment in terms of habitat restoration.

Therefore, a standardized method for assessment of the effectiveness of treatment is needed for adaptive management and control.

Field and remote sensing data were analyzed in a nested design to help develop standardized methods for monitoring treatment success and provide recommendations.

*Latest literature reviewed, adaptive management principles described: what do our field & remote sensing results mean for practical Phragmites management?*
Uncertainty – inherent in all natural systems

- A single “historical precedent” has likely not existed
  - Ecosystems are flexible, esp. with species composition

- Not trying to manage to a historical, closed ecosystem

- Cannot completely know how an ecosystem will respond to intervention

- Need a process that enables new information to inform management

- Work towards specific goals rather than focus on specific treatments

- Be willing to change management practices as project progresses
Adaptive management background cont’d

- Adaptive management encourages reinvention of processes, flexibility in methods
  - Use best current knowledge
  - Change when new knowledge becomes available
  - “Active” AM – testing hypothesis, treatments to gain new info
  - “Passive” AM – info on “best” treatment is a side-effect, not main goal, but cheaper

- Well suited to addressing areas dominated by invasive Phragmites

- No “one best method” for treating Phragmites

- US Department of Interior actively integrating adaptive management into its invasive species control efforts (USGS example)

- Scientific literature is revealing new information, updated existing knowledge; our report reviews this for:
  - Nutrients, Climate Change
  - Management lessons, Agency Guides
  - Biological control
  - Monitoring methods, novel ecosystems
US DOI dealing with practical issues of effective *Phragmites* management


Ex: *Phragmites* control as part of integrated waterbird management & monitoring program (Moore et al. 2014)

Important principles:
- Dealing with uncertainty for transition states
- Understanding constraints to management can exist in certain areas
- Collect observations of results to inform decision making
- Provide a decision support tool to help refuge managers in *Phragmites* control efforts
- Enables gain in knowledge to improve performance of decision making over time

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Step 1</th>
<th>Year 2</th>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat</td>
<td>Area</td>
<td>Treat</td>
<td>Area</td>
</tr>
<tr>
<td>G</td>
<td>Glyphosate broadcast</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>I</td>
<td>Inert</td>
<td>Glyphosate broadcast</td>
<td>N/A</td>
</tr>
<tr>
<td>1G</td>
<td>Glyphosate broadcast</td>
<td>Inert</td>
<td>Glyphosate broadcast</td>
</tr>
<tr>
<td>1I</td>
<td>Inert</td>
<td>Glyphosate broadcast</td>
<td>Inert</td>
</tr>
<tr>
<td>2G</td>
<td>Glyphosate broadcast</td>
<td>Glyphosate broadcast</td>
<td>Glyphosate broadcast</td>
</tr>
<tr>
<td>2I</td>
<td>Inert</td>
<td>Glyphosate broadcast</td>
<td>Inert</td>
</tr>
<tr>
<td>3G</td>
<td>Glyphosate broadcast</td>
<td>Glyphosate broadcast</td>
<td>Glyphosate broadcast</td>
</tr>
<tr>
<td>3I</td>
<td>Inert</td>
<td>Glyphosate broadcast</td>
<td>Inert</td>
</tr>
</tbody>
</table>

From Moore et al. 2014

Eight *Phrag* treatment alternatives
US DOI perspectives on adaptive management

- Describes framework for managing responsive natural resources where uncertainty is present for impacts of management actions
  - Monitoring data can help reduce uncertainty
- Learning-based management
  - Provides flexible decision making environment
  - Can make changes to management methods based on careful monitoring data
- Adaptive management involves:
  - Clear statement of objectives
  - Identification of management alternatives
  - Precisions of management consequences
  - Recognition of uncertainties
  - Monitoring of resources responses
  - Learning
- Not an expensive “extra”, but critical to understanding success of control efforts
Where nitrogen (N) is high, Phragmites has far higher biomass accumulation (Rickey & Anderson, 2004)

High N – make it easier for Phrag to invade native wetlands, explain higher Phrag cover (Silliman & Bertness, 2004)

- Reducing N could help reduce the spread of Phrag, increase effectiveness of management
  - Ex: New / enhanced stream buffers
- N-focused management efforts likely to be more beneficial (Romero et al., 1999)

Phragmites also impacts the N cycle

- Lower processing of N-rich fertilizers through denitrification (Arce, 2009)
Invasives often most suited to take advantage of a changing climate

Changing water levels, removal of climatic barriers, increased nutrient deposition, stress on native veg – CC factors favoring Phrag (Dukes & Mooney, 1999; Hellmann et al. 2008)

Invasive *Phragmites* less common in northern MI, historically rare in U.P.; may be changing (anecdotal info)

Warmer temperatures, favors long distance reproduction (seeds) (Brisson et al. 2008)

May need to monitor larger areas, not just neighboring wetlands

USGS Great Lakes Science Center “GLRI Phragmites Decision Support Tool Mapper” – invasion risk related to existing large stands, changing water levels (Mazur et al. 2014)

Management lessons

- Treatments should be specified based on stand being treated (Currie et al. 2014)

- Multi-year treatment & monitoring needed
  - Hazelton et al. 2014 – “Phragmites australis management in the United States: 40 years of methods and outcomes”
  - Large scale treatments need to be followed up by yearly spot treating

- Beaver Island – address Phrag problem as a whole community (McDonough 2007, Grassmick 2011)
  - Local ordinance requiring “opt out”
  - Yearly contact with landowners
  - “Early detection, rapid response” (EDRR)
  - Volunteers critical to effort
  - Reduced extent from 27 to 3 acres, improved beach visibility

Hazelton et al. 2014

http://greatlakesphragmites.net/beaver-island-invasive-species-initiative/
“Volunteers disembarking on High Island, September 2013”
UM Water Center project conducted ecosystem modeling of the effects of various treatment scenarios in MONDRIAN modeling (PI Elgersma)

- Dr. Kenneth Elgersma’s new work focused on understanding optimal # of years of treatment to control invasives (non-native *Typha, Phragmites*) informed by local N levels

- MONDRIAN modeling with varying N levels and treatments showed optimal treatment scenarios are dependent on N-loading, propagule pressure, hydrology and level of invasion

Elgersma et al. 2015 in prep
Mondrian Model Runs

B - Burned
H - Herbicide
M - Mowed

Treatment should be appropriate for level of N in ecosystem

HM, BHM most effective in higher N areas

Model can be run for specific site conditions to aid in management strategies

Too many years of treatment with lower N areas - negative effect

Elgersma et al. 2015 in prep
Integration of Wetland Ecosystem Modelling (MONDRIAN) of 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.
- N retention, C storage, and invader biomass recover relatively quickly after management ends.

Elgersma et al. 2015 in prep
Land use/cover on adjacent watersheds influences
- the structure and function of wetlands,

Plant invasions are triggered by interacting factors including
- disturbance, nutrients and propagule pressure (Colautti *et al.* 2006).
- Propagule pressure includes the quality, quantity and frequency of the arrival of invading organisms at a site (e.g. via seeds or rhizomes).
Agency Guides

- Critical resource to many managers, from smallest local nature center to state & federal decision-makers

- Examples described:
  - Virginia
  - Ohio
  - Michigan

  - Prioritization Tool – based on patch size, treatment history, location:
    http://www.michigan.gov/deq/0,4561,7-135-3313_71151_71481_8314-178183--,00.html


    – Anne Arundel Community College
    – USDA
    – Great Lakes Phragmites Collaborative
    – Ontario
<table>
<thead>
<tr>
<th>Guide</th>
<th>Publisher</th>
<th>Year</th>
<th>Link</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary of Common Questions</td>
<td>Anne Arundel Community College</td>
<td>2006</td>
<td><a href="http://home.comcast.net/~herringbay/pdfs/PhragQandA.pdf">http://home.comcast.net/~herringbay/pdfs/PhragQandA.pdf</a></td>
<td>8 pg FAQ for land owners</td>
</tr>
<tr>
<td>Invasive Phragmites BMPs</td>
<td>Ontario MNR</td>
<td>2011</td>
<td><a href="http://www.nvca.on.ca/Shared%20Documents/Phragmites%20control%20best%20practices.pdf">http://www.nvca.on.ca/Shared%20Documents/Phragmites%20control%20best%20practices.pdf</a></td>
<td>17 pg guide for land owners, note Canadian Herbicide legislation</td>
</tr>
</tbody>
</table>
Biological Control

- Biological control agents not yet released for Phrag control

- Parasitic European moth (*A. geminipuncta*) – appears promising
  - infects 2/3 of stands in native range, parasitizes up to 90% of stems (Blossey 2014)
  - Specific to invasive Phragmites (Hinz et al. 2014)

- 3 other moths tested – some potential effectiveness; 2 fly species – but impacted native Phrag as well (Lambert et al. 2007)

- Field testing must be completed, ensure that bio agents are safe, be cautious of unanticipated problems

- Should be assessed periodically for progress

---

*Archanara geminipuncta*, a European moth currently being considered for Phragmites bio-control. (photo credit: Kevin Leighton, 2013)
Novel ecosystems implications

- Not all Phragmites stands can be controlled everywhere
  - Remote non-natives that have integrated into local ecosystems challenging & not always desirable because they can provide some ecosystem services (Lugo 2013 – novel ecosystems theory example)

- In some situations, Phragmites can contribute to total function of an ecosystem & complete removal can negatively impact wetland function (Hershner & Havens 2008, Kiviat 2013)

- Can contribute to nutrient update, sediment retention (filter between upland areas & water)

- Stands can provide habitat / cover for some birds

- Select populations that pose greatest threat (ex: valuable wetlands, popular parks)

---

Hobbs et al. 2009
highly altered ecosystems are difficult to restore

Kiviat 2013 – birds nesting Phrag
Monitoring methodologies

- This project’s methods derived from Great Lakes Commission’s Great Lakes Coastal Wetlands Monitoring Plan
  - Burton et al. 2008:
  - D.Uzarski (CMU) GLRI coastal wetlands monitoring project
  - See also Wilcox et al. 2002 & Uzarski et al. 2004 for Index of Biological Integrity (IBI) background
  - See Bourgeau-Chavez et al. 2004, 2008 for remote sensing methods – combining optical & radar satellite imagery data provided mapping of Typha vs. Phragmites
Other example monitoring protocols

- **PhragNet – Chicago Botanical Garden (CBG)**
  - Series of transects per Phragmites patch, 3 points (edge, outside, 15m inside)
  - Leaf & soil samples
  - Simple to implement
  - Provides baseline information on a stand, but not focused on effectiveness of management
  - [http://greatlakesphragmites.net/files/2.-PhragNet_6_5_2013FINAL.pdf](http://greatlakesphragmites.net/files/2.-PhragNet_6_5_2013FINAL.pdf)

- **USGS / CBG protocol for US Fish & Wildlife Service (Moore et al. 2014)**
  - Uses transects
  - Landcover by category
  - Some training, wide application
  - Explicitly part of US DOI adaptive management efforts
Our UM Water Center project...
Monitoring: A Tiered Approach

Remote Sensing Monitoring

- High-Resolution, multispectral aerial Imagery (July/Sept, 2014)
- WorldView-2 acquisition (July 2015)

Field Monitoring

- Vegetation Mapping at 15 cm resolution
- Vegetation Mapping at sub-meter resolution
Remote sensing overview

- Described in detail in Part I: “Monitoring and Assessment of the Treatment and Control of non-native Phragmites australis in terms of Habitat Restoration” by Dr. Laura Bourgeau-Chavez (MTRI) and team.

- Available at GLPC webpage at http://greatlakesphragmites.net/resources/webinars-presentations/

- Full recording of Part I webinar available

- https://www.youtube.com/watch?v=rfrakf2Ysqo&feature=youtu.be

- Reviewed here:
  - Monitoring approach
  - Locations
  - Amphibians, bird results
  - Vegetation results (NEW since Part I webinar)
  - Remote sensing results
Study site locations

[Map showing study site locations in Green Bay and Saginaw Bay with labeled points including Pensaukee 01, Pensaukee 02, Littletail Point 01, Littletail Point 02, Longtail Point 01, Longtail Point 02, Dexter Hastings Restoration, Ken Euers 01, Ken Euers 02, 499A, 499B, 522A, 522B, 518Caest, 518Cwest, 518B, 515A, 515B, 517Aeast, 517Awest, 517B, 761A, 761B, 761C, 510A, 461A, 461B, and 499A.]
Biodiversity Data Collection and Processing

- Amphibian and bird diversity
  - Surveyed using point count protocols
  - Calculated Indices of Biotic Integrity (IBIs) developed and recommended by the GLCWC for assessing community condition
  - Also analyzed simple species diversity for anurans

- Vegetation diversity
  - Calculated the GLCWC vegetation IBI (standardized measure of community condition), native species diversity, site-wide *Phragmites* cover, *Phragmites* cover in the emergent plant zone, mean conservatism index (measure of community intactness) and mean conservatism ratio (measures degradation of the site by invasions)
# Field Monitoring in Green and Saginaw Bays

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Amphibians</th>
<th>Birds</th>
<th>Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-</td>
<td>Post-</td>
<td>Pre-</td>
</tr>
<tr>
<td></td>
<td>treatment</td>
<td>Treatment</td>
<td>treatment</td>
</tr>
<tr>
<td>Saginaw Bay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>515A</td>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Bay</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*data only available for treated site, not control*
Amphibian Diversity: Before After Control Impact (BACI) Design

- Mean BACI effect (estimated by two-factor mixed-effect ANOVA) was not significant for IBI or species diversity

Amphibian Monitoring Takeaways

- Species diversity, but not IBI, shows significant decrease over time
  - choice of indicator metric is important!
- *Phragmites* treatment appears to have no significant effect on amphibian diversity for the two years of study
- **Highlights value of control sites**: looking at change over time in treated sites alone, we might assume a negative effect of treatment, but control sites show this is not the case
Bird Monitoring Takeaways

- Large year-to-year variations require either more surveys per year (pseudo-replicates) or more years of surveys to increase statistical power.

- Indicator taxa respond differently and on different timescales.

- The GLCWC bird IBI emphasizes cryptic marsh nesting obligate species (rails, bitterns), which may benefit from *Phragmites* treatment over the long term but not the short term if mowing removes the thick emergent vegetation they prefer.

- More suitable sampling approach may be applied when monitoring begins prior to treatment.
Measuring success: Is *Phragmites* cover lower in treated sites compared to similar, nearby untreated sites?

In Green Bay, Yes

In Saginaw Bay, No
Measuring success: Is *Phragmites* cover lower in treated sites compared to similar, nearby untreated sites?

- In Green Bay, where *Phragmites* was treated with aerial spraying followed by ground-based touch-up treatment the next year, live *Phragmites* cover decreased following treatment at all sites with both pre- and post-treatment survey data.

- In Saginaw Bay, live *Phragmites* cover actually increased following treatment at three of the four sites for which pre-treatment data were available.

  - Treatment at all of these sites consisted of a single year of ground-based herbicide application (one site mowed) with no followup treatment in subsequent years.
Field Monitoring in Green and Saginaw Bays

- Vegetation Community Condition
- Three indicator metrics:
  - Vegetation IBI was developed by the GLCWC and reflects the conservatism of the native species present and the number and cover of invasive species present in 3 vegetation zones.
Vegetation Community Condition

Three indicator metrics:
- Native diversity is the number of native macrophyte species recorded in the 45 quadrats measured per site
Field Monitoring in Green and Saginaw Bays

- Vegetation Community Condition

- Three indicator metrics:
  - Mean Native C is the “mean coefficient of conservatism” of the native species recorded at the site; species with greater habitat specificity and lower tolerance to disturbance have higher C
Vegetation Diversity: Spatial Matched-Pairs Design

- No significant differences in vegetation diversity or mean native C between control and treated sites post-treatment
- Vegetation IBI varied significantly between bays with a significant interaction between bay and site class (treated/untreated)
- Pairwise comparisons: treated and untreated sites were significantly different in Green Bay but not Saginaw Bay
Vegetation Diversity: Temporal Baseline Design

- Compared values before and after treatment at the same sites
- No significant differences for vegetation IBI or mean native C
- Native species diversity significantly higher after treatment in both bays
Vegetation Diversity: BACI Design

- Two pairs of sites with complete data, not enough pairs for significant results
- Treatment appeared to have no effect on vegetation IBI for pair 522, but may have caused a short-term boost for pair 461
Vegetation Monitoring Takeaways

- Spatial-matched pairs results suggest that aerial herbicide spraying in Green Bay, which had a stronger effect on reducing *Phragmites* cover, also had a stronger effect on increasing vegetation diversity than the piecemeal ground-based treatment in Saginaw Bay.

- On average, native species diversity increased at treated sites in both bays.

- Large variations in vegetation metrics from year to year and between sites:
  - Annual weather conditions, ice/wave scour, slope, bathymetry, and surrounding land use are all likely to have strong influences on both invasive species cover and the native species assemblage present at a site.
  - Before/after data and inclusion of control sites provides the best opportunity to distinguish treatment effects from other sources of variation.
40 acre Treated site
- mowed since late 1990s and
- herbicide treated for 4 years (2010-2014)
Remote Sensing

- **Satellite Sensors**
  - Radar
    - ~24 cm wavelength L-band PALSAR-2 (10 m resolution)
    - ~5.6 cm wavelength C-band Radarsat-2 (5 m resolution)
  - Optical multi-wavelength
    - Landsat 8 (30 m resolution)
    - Worldview-2 (1 to 2 meter resolution)
    - RapidEye (5 m resolution)

- **Aerial Imaging**
  - AES multi-wavelength system
    - 15 cm resolution
    - Includes near-infrared bands (visible + NIR = 4 total)
    - Timely collections
  - AES oblique images for field site assessment, paired site imagery, monitoring tool
  - Tested small UAVs for field site imaging
Importance of Mapping in Management

- Identify where *Phragmites* stands are including leading edges and the surrounding landscape
- Determine outliers, pathways, and possible sources
- Allows for strategic planning of locations to treat and the best type of treatment
- Annual (frequent) map updates can monitor treatment success and identify areas needing additional treatment
- Maps provide information on the level of invasion (density) and degree of regrowth post treatment
High resolution aerial imagery classification used to identify areas of *Phragmites* regrowth post treatment.
UAV-enabled field site imaging

- **UAV-enabled sensing** provides a quick overview of field sites & useful images for monitoring sites.

- Can be done with systems in the **$600 - $1000 range** for rapid aerial images (not mapping grade)
  - Systems can fly from 300’ to 2500’ feet away, with first-person viewer (FPV) capabilities
  - DJI Phantom 2 Vision shown

- **Hobbyists can fly now** (within certain limits – below 400’, not near airports, within line of sight, during daytime)

- **Can be done commercially with FAA Section 333 exemption** under similar rules
  - Public agencies: Certificates of Authorization (COA), or partner with existing operator

- **New rules coming from FAA in 2016/2017** making this more practical (no pilot’s license, just a $300 UAV operator’s permit)
AES Oblique 2014 Aerial Images (from airplane)

- Site 515B treated

- Site 515A untreated

N 43° 39' 37.04"
W 83° 35' 50.47"
1056 ft
15 cm Aerial Imagery compared to Worldview and Landsat/PALSAR-2 Mapping

Classes
- Phragmites
- Wet Meadow/Emergent
- Barren
- Developed
- Typha
- Water
- Tree/Shrub
Field Work: Biodiversity-> Amphibian, Bird, Vegetation
Using Maps to Inform Adaptive Management

Legend

- Aerial Spraying

Class Names

- Phragmites Live
- Phragmites Detritus
- Phragmites Dead Stems

- Areas of standing dead Phrag - cutting, mulching or prescribed burn
- Areas of dense thatch require mulching, raking or prescribed burn
- Medium sized areas Phrag Re-sprout - ATV herbicide
- Edges missed by herbicide treatment - ATV/backpack herbicide
- Large Areas of dense Live Phrag - Helicopter or ATV Herbicide
- Small areas of Phrag Re sprout - Backpack herbicide
Using Maps to Inform Adaptive Management

- Planning with WI DNR (AES)
- Map describes what needs to be done
- Based on remote sensing results
- Turns mapping results into treatment plan
# Comparison of Benefits/Limitations of Remote Sensing/Mapping at various scales

<table>
<thead>
<tr>
<th>Source</th>
<th>Resolution</th>
<th>MMU</th>
<th>Capture Leading edges?</th>
<th>Cost of Imagery (High-Low)</th>
<th>Timeliness/limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial Imaging</td>
<td>15 cm</td>
<td>15 cm</td>
<td>All</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>World-view 2</td>
<td>1.85 m</td>
<td>2 m</td>
<td>many</td>
<td>Free for Federal Agencies</td>
<td>Cloud cover and satellite orbits</td>
</tr>
<tr>
<td>Rapid Eye/Radarsat-2</td>
<td>5-8 m</td>
<td>0.05 ha</td>
<td>many</td>
<td>High</td>
<td>Cloud cover and satellite orbits</td>
</tr>
<tr>
<td>Landsat/PALSAR-2</td>
<td>10-30 m</td>
<td>0.12 Ha</td>
<td>some</td>
<td>Landsat-free; PALSAR-2 (high)</td>
<td>Cloud cover for Landsat and satellite orbits/collection plans</td>
</tr>
<tr>
<td>UAV</td>
<td>1 cm+</td>
<td>3 cm+</td>
<td>All</td>
<td>Low</td>
<td>High for viewing/mapping more difficult</td>
</tr>
</tbody>
</table>
Implications of results for adaptive management

- Set of indicators needed to measure & understand success of management efforts
  - Vegetation IBI most clearly showed impacts of treatment, can become part of adaptive management efforts

- Longer-term monitoring, with pre-treatment measurements – really needed to...
  - Understand relative effect of treatment (BACI analysis)
  - Provide quantitative measures of effectiveness of treatments
  - Understand “half life” of treatments – how long are they effective? (rapid re-invasion risk)
    - Reduce risk of public perception of “wasted dollars”
  - Also confirm that rare species are not adversely affected

Surveying treatment site, Saginaw Bay
Project protocol points in light of adaptive management principles

- Spatial-matched pairs, temporal baseline results showed reduction in Green Bay Phrag cover (regional scale spraying), lack of strong effect at Saginaw Bay (patchwork of properties issue; need for follow-up spot treatments)

- Large variations in year-to-year Phrag cover; remote sensing can help with this

- Faster protocol by not sampling submergent zone (no Phrag)

- Survey just wet meadow, emergent plant zones

- Anuran data – unclear results in short time period after control (1-2 years not long enough to show effect); better for rare species evaluation than strong IBI indicator

- Bird data – mowing in short-to-medium term could negatively affect marsh nesting obligates; can confirm no rare species impacted; not characterizing breeding success but presence from a wider contributing region; mow in sections!

- “The responses of wildlife species to Phragmites invasion and control are individualistic & complex.” – Brooks et al. 2015 (forthcoming report to go with this briefing)

- Vegetation IBI data showed strongest effect of treatment – both Bays showed statistically significant increase in mean species diversity of native plants; focus on increasing diversity if complete control is unlikely (Carlson et al. 2009)

- Need longer-term monitoring, beyond 1-2 years after treatment to really understand response, information Adaptive Management (three to five years, depending on site); not “AM-Lite” (Fischman & Ruhl 2015)
Implications of results to management guidelines / tools

Potential update to Michigan DEQ Phragmites Treatment/Management Prioritization Tool

– Add a new Criteria category called “Planning and Monitoring” with these example questions:

1. Pre-control monitoring: Has monitoring taken place before control efforts, to establish a baseline for understanding control impacts:
   a. Yes, there was a pre-control monitoring program using an established protocol: +2 points
   b. Yes, there was pre-control monitoring, but using informal methods: +1 point
   c. No, pre-control monitoring did not take place: +0 points

2. Plans for monitoring: Do monitoring plans exist to evaluate impacts and success of control efforts:
   a. Yes, using identified methods for at least 5 years: +3 points
   b. Yes, using identified methods for at least 3 years: +1 point
   c. No, monitoring plans do not exist: -1 point

3. Management plan: Has a formal management plan been created for the site undergoing Phragmites control:
   a. Yes, and it uses the principles of adaptive management: +3 points
   b. Yes, but it does not explicitly include adaptive management: +1 point
   c. No, a management plan does not exist: 0 points
Implications & suggestions for state monitoring recommendations

- Treatment: Likely need for 3 years, but not more than six (Elgersma analysis)

- Include “key activities” of adaptive management (based on Williams & Brown 2012 – US DOI guide)
  - Stakeholder engagement
  - Resource monitoring
  - Modeling

- Monitoring:
  - At least three years, five recommended after control (site dependent)
  - Monitor for at least a year before control, providing information on evaluating impacts & success of treatment efforts
  - Include remote sensing imagery to understand effects of treatment, locate/monitor remaining areas needing further control

- Michigan example:
  - 3rd edition of Michigan Phragmites control & management guide explicitly references need for monitoring to inform management; detailed monitoring plan; provides the data needed to determining success & types of control methods needed.
Where do we go from here?

- Complete & publish adaptive management report that includes recommendations for monitoring and adaptive management based on literature/research (*due Dec. 2015*)

- Working with land managers to develop a strategic approach to adaptive management for *Phragmites* control and restoration that includes mapping, monitoring and modeling (*continuing applied research projects*)

- Seeking project partners, field sites, collaborations (future projects)
We recognize the limitations on invasive species control funding, but success should be measured by more than the amount of a controlled area (such as ‘87 acres of Phragmites were controlled in 2013’).

Being able to measure if vegetation diversity is definitely improving, and continuing to improve more than a year or two after control, is important.

Monitoring efforts provide the key data to adaptively manage a resource based on informed decision making.

Limited funding has the opportunity to be spent more wisely, and with greater effect, by following the principles of adaptive management.

(from forthcoming accompanying Brooks et al. report)
Thank you

Questions?

Colin Brooks, MEM; Senior Research Scientist
Environmental Sciences Lab Manager, MTRI

cnbrooks@mtu.edu  734-913-6858

www.mtri.org

http://www.mtri.org/treatment_effects_phragmites.html
References (1)

References (2)


- Hiland, N. (2013). Invasive Plants of Ohio: Common Reed Grass. O. I. P. Council, Columbus, Ohio, Ohio Department of Natural Resources.


• Wilson, J. (2012). DNREC’s Phragmites Control Program Treats more than 6,700 acres, including 5,720 acres in Bayshore region. D. o. N. Resources. dnrec.delaware.gov.


Searchable version will be including in related report
Q & A

Colin Brooks

Manager of Environmental Science Laboratory
Senior Research Scientist
Adjunct Lecturer in the Department of Biological Sciences
Michigan Technological University
Michigan Tech Research Institute

3600 Green Ct. Suite 100
Ann Arbor, MI 48105
(734) 913-6858
cnbrooks@mtu.edu
THANK YOU!

www.greatlakesphragmites.net
phragmites@glc.org
@GLPhrag
Great Lakes Phragmites Collaborative