



RESERVOIR DRAWDOWNS AND AIS MANAGEMENT

Two Case Studies: Lac Sault Dore and Musser Flowages
Price County

Lakes Convention – April 24, 2015

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Aquatic Invasive Plant Management Methods

Chemical

Selective
Contact

Biological

Weevils
Beetles

Mechanical

Manual
Harvesting
Dredging

Physical

Drawdown
Bottom Barriers


Generally Used in WI

Drawdown



- Limited applicability
- Requires 2-3 months of freezing conditions
- Low cost if available
- Near shore areas only

Expected Benefits

- Winter drawdowns have been shown to be effective in controlling Eurasian water milfoil (EWM)
 - Need to study what it can do to other invasives like curly-leaf pondweed (CLP)
 - Mixed results on controlling CLP (not many studies out there)
- 

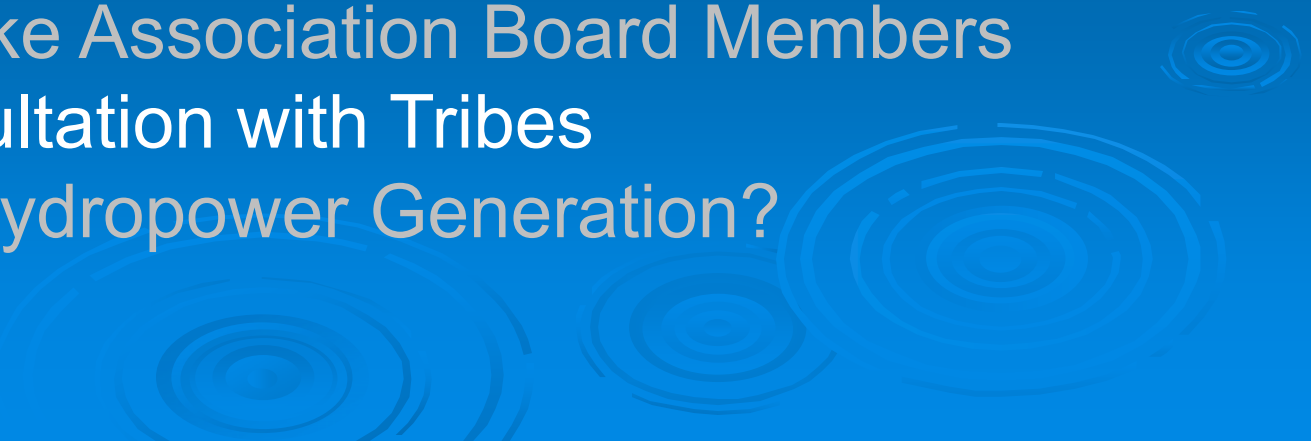
Background

- Winter drawdowns proposed for dam repair (both cases).
- Both flowages have AIS/opportunity to evaluate as a management tool.

Lac Sault Dore (Soo) in 2010, **EWM**

Musser in 2013, **CLP**

Drawdown pre-planning considerations

- Who has Legal Authority?
 - Who owns the dam?
 - Review existing Chapter 31 operating order
 - May have to request a temporary exemption to the existing operating order if drawdown is more than what is allowed in current order (obtain permit)
 - Is an Environmental Assessment (EA) required?
 - Meet with County Dam Tender
 - Meet with Lake Association Board Members
 - Initiate Consultation with Tribes
 - Any loss of Hydropower Generation?
- 

Public Participation/Communication (once drawdown plans are set)

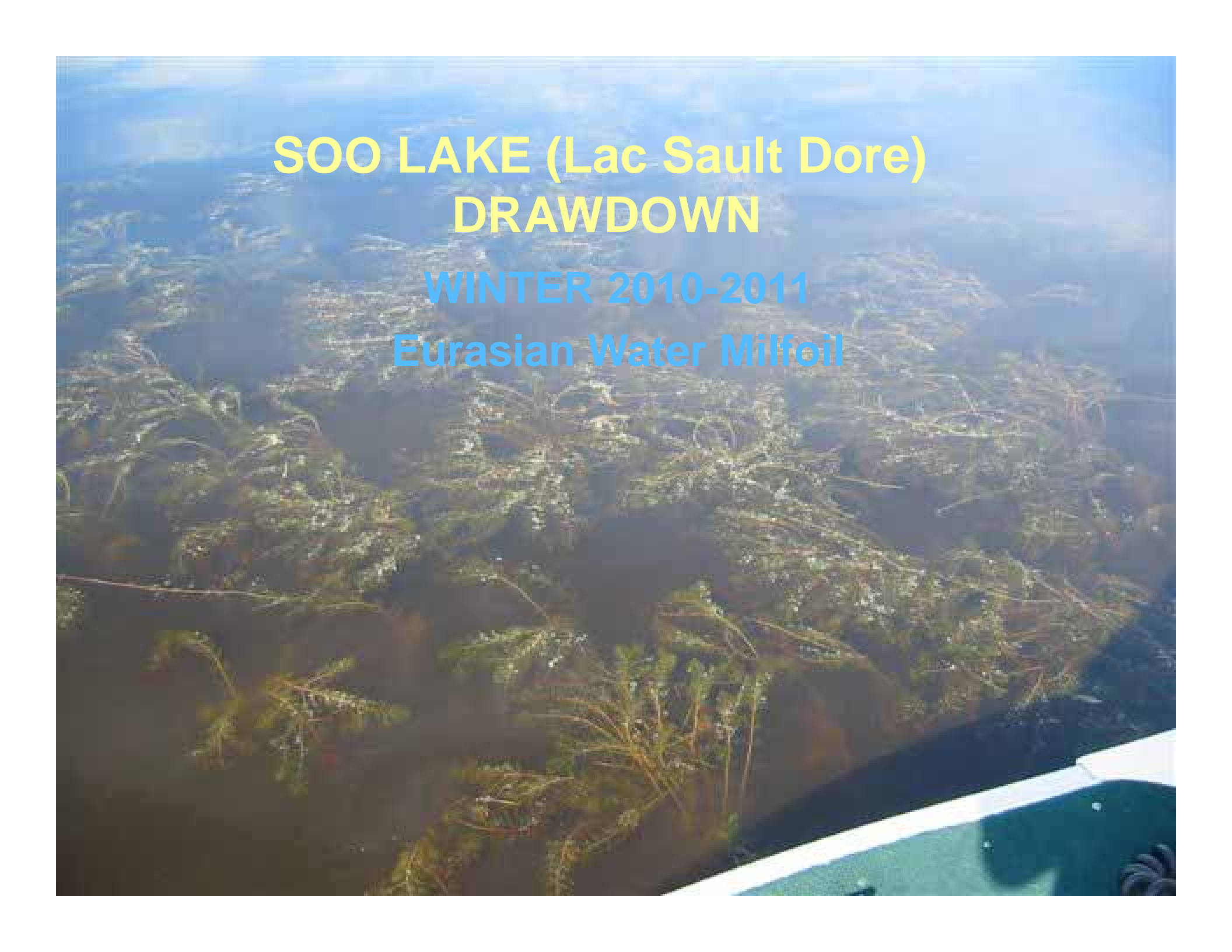
- Develop frequently asked questions document
- Meet with County Board
- Attend Lake Association Annual meeting
- Complete Environmental Assessment
- Address Tribal Concerns
- Receive one year exemption to operate outside of existing Chapter 31 permit
- Public Information Meeting



Resource Issues that need evaluation (EA)

- Timing and extent of drawdown
- Why is dam repair necessary?
- Will the reservoir refill?
- Amount of flowage bed exposed?
- Any impact on private water supplies?
- Fishery impacts
- Wildlife impacts
- Dissolved Oxygen problems?
- Will the ice be safe?
- Impact on native and Invasive plants.
- Will the flowage get deeper?
- Can shoreline work (chapter 30) be done?
- Pre/post monitoring plan





**SOO LAKE (Lac Sault Dore)
DRAWDOWN**

WINTER 2010-2011

Eurasian Water Milfoil

Introduction

- Lac Sault Dore (Soo Lake) on Elk River - Price County, WI
- 561-acre shallow reservoir
- Max depth: 21ft, Mean depth: 6ft
- 165,981-acre watershed
- Eutrophic system, highly stained water
- EWM discovered in 2004
- 254 acres of EWM in 2010 (pre-drawdown)
- No previous management actions to control EWM



Introduction

- Winter drawdown required for maintenance on Weimer Dam
 - Limited to **6 feet**, per specs of the dam
 - Start water drawdown after Labor Day 2010
 - Refill by May 1, 2011
 - Secondary benefit to possible control EWM population





Legend

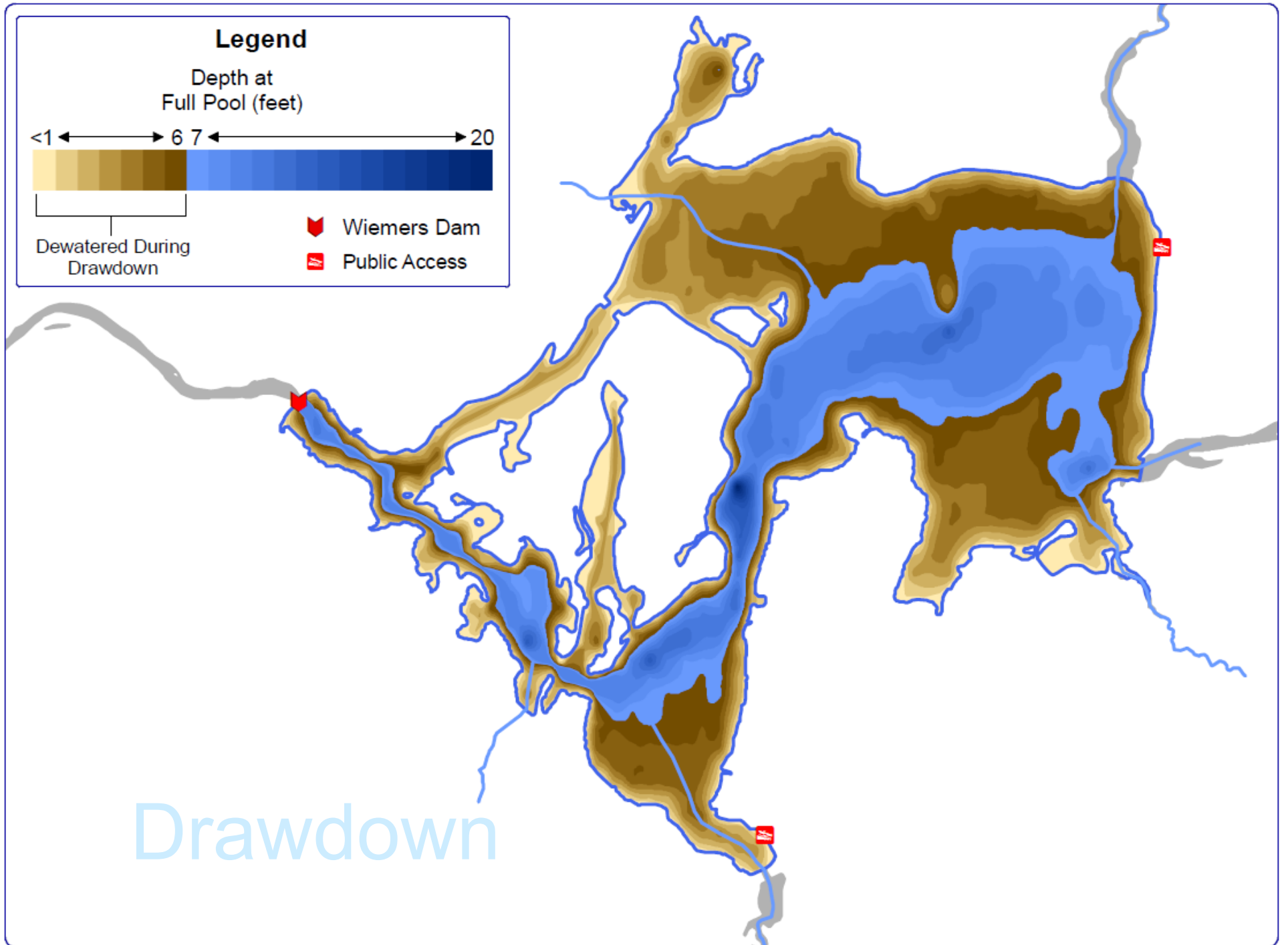
Depth at Full Pool (feet)

<1 ← 6 7 ← 20



Dewatered During Drawdown

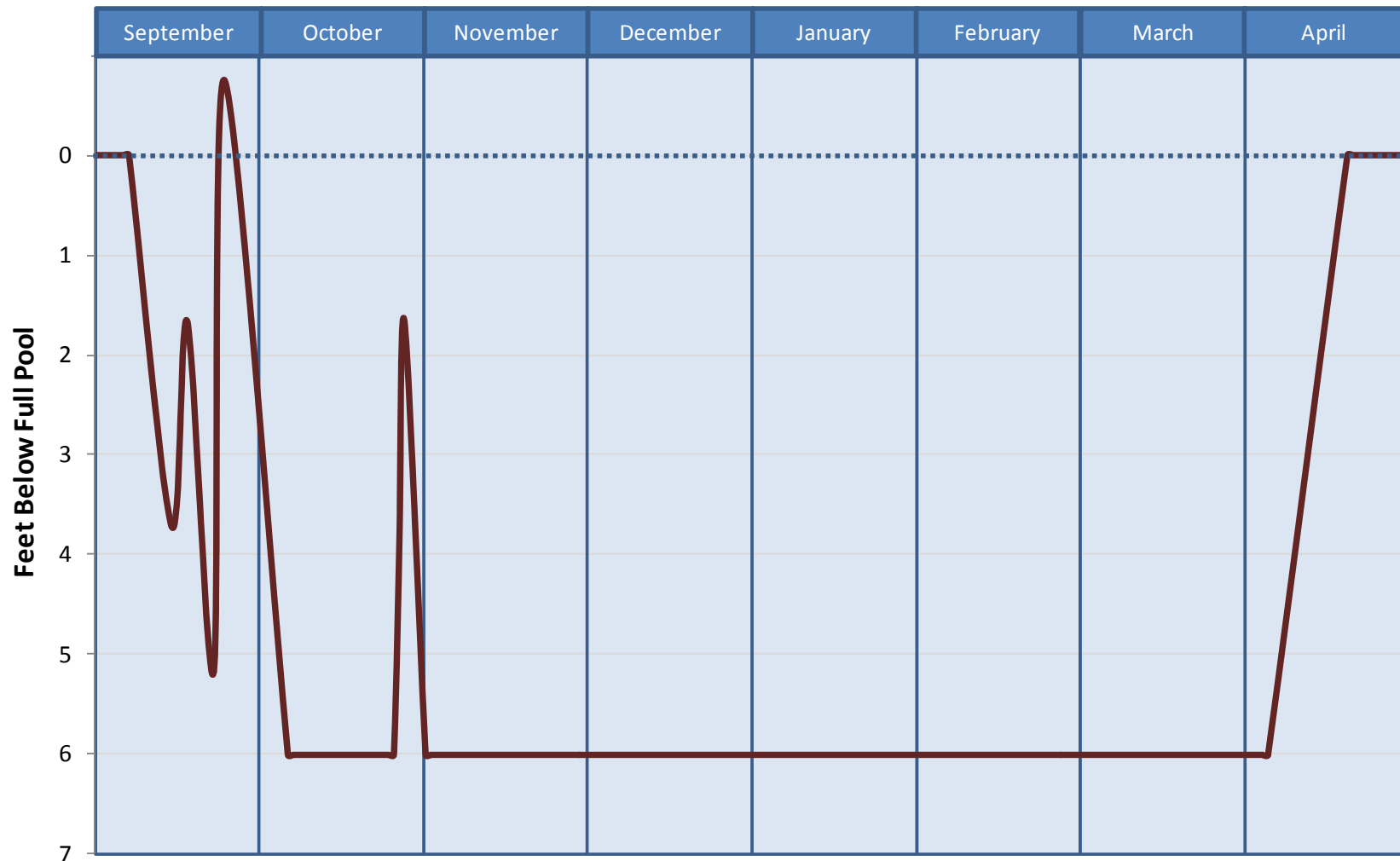
-  Wiemers Dam
-  Public Access



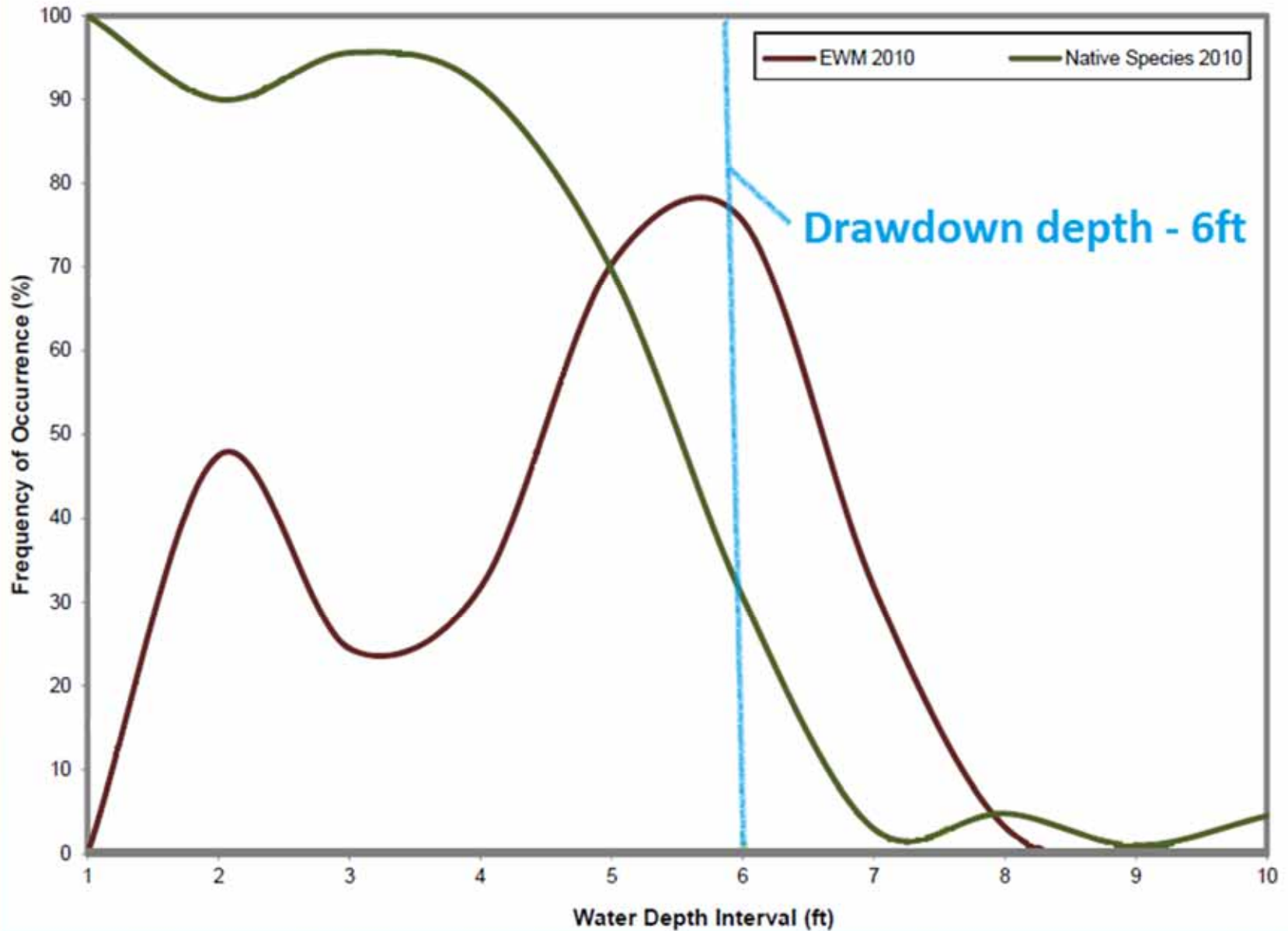
Drawdown Water Levels

Lac Sault Dore Water Levels

September 2010 - May 2011



Plant Depths- pre drawdown



Monitoring Methods

- Objective: Evaluate response of EWM and native plants to drawdown
 - Whole-lake point-intercept survey (2010, 2011, 2012)
 - EWM colony/density mapping
 - Emergent/floating-leaf community mapping

Whole-lake Point-intercept Survey

55-meter resolution- 799 total points

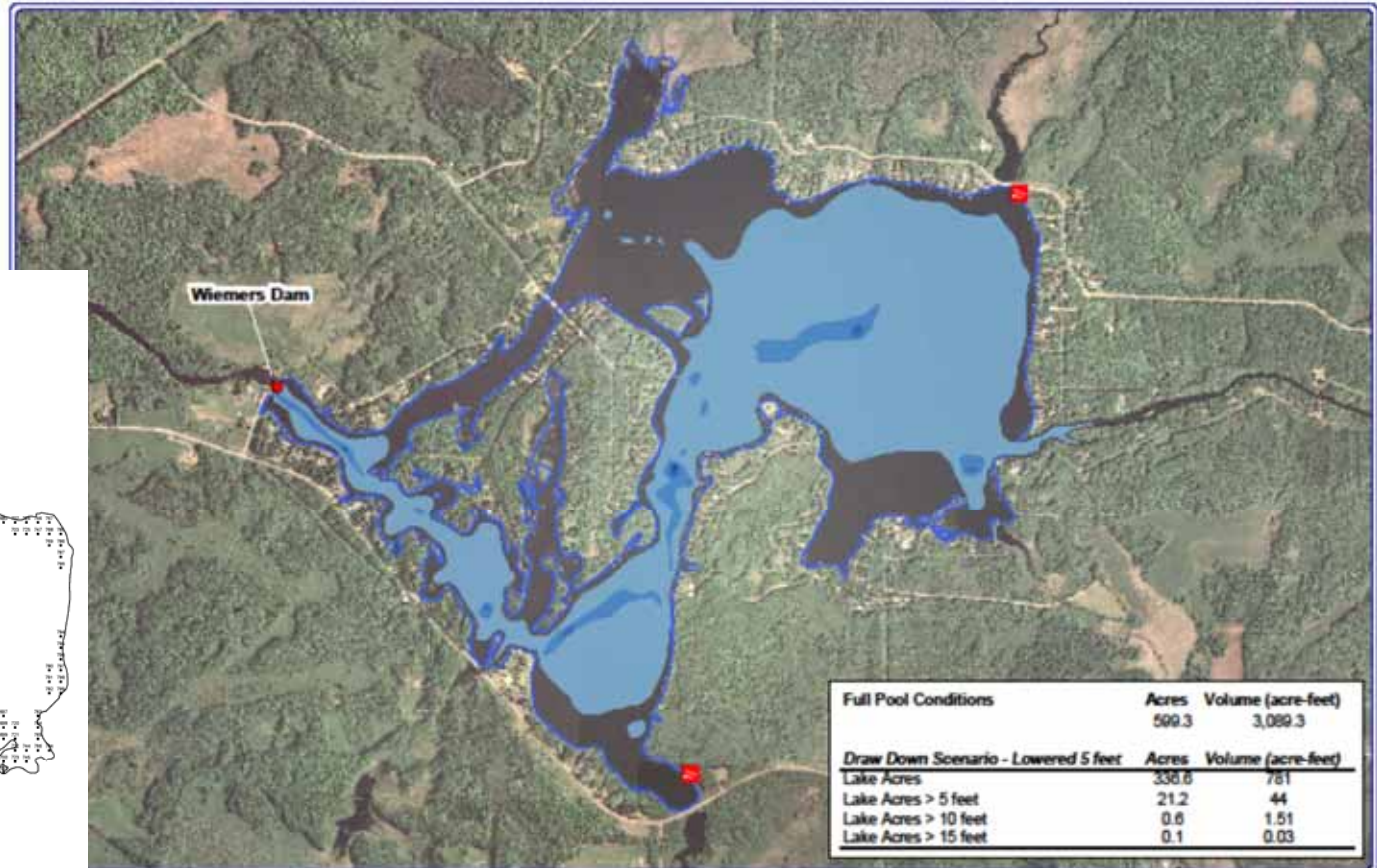
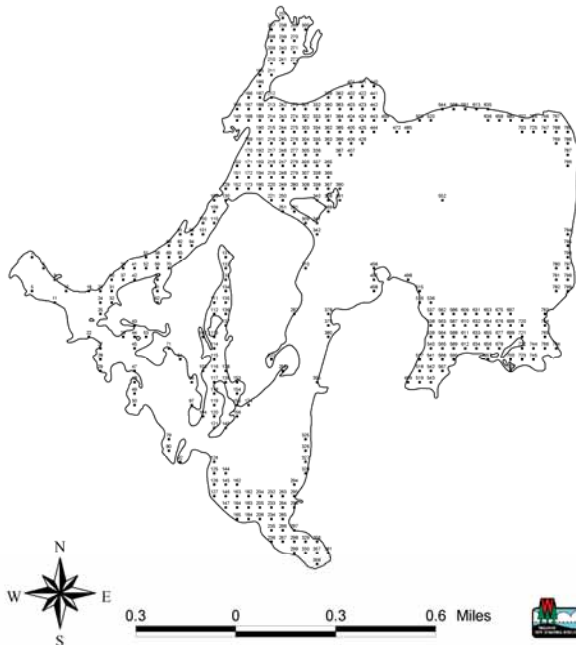
Surveys Completed:

August 17-18, 2010

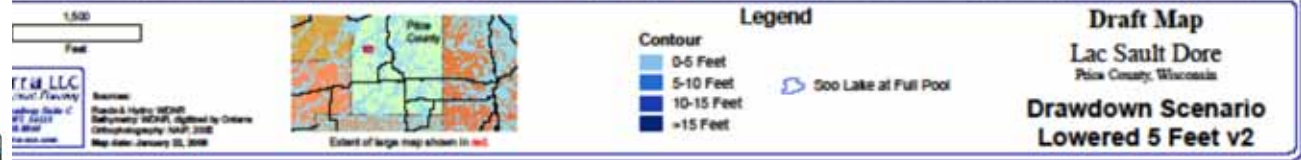
August 18-19, 2011

August 14-15, 2012

Figure 3
Soo Lake
Littoral Zone Sampling Sites



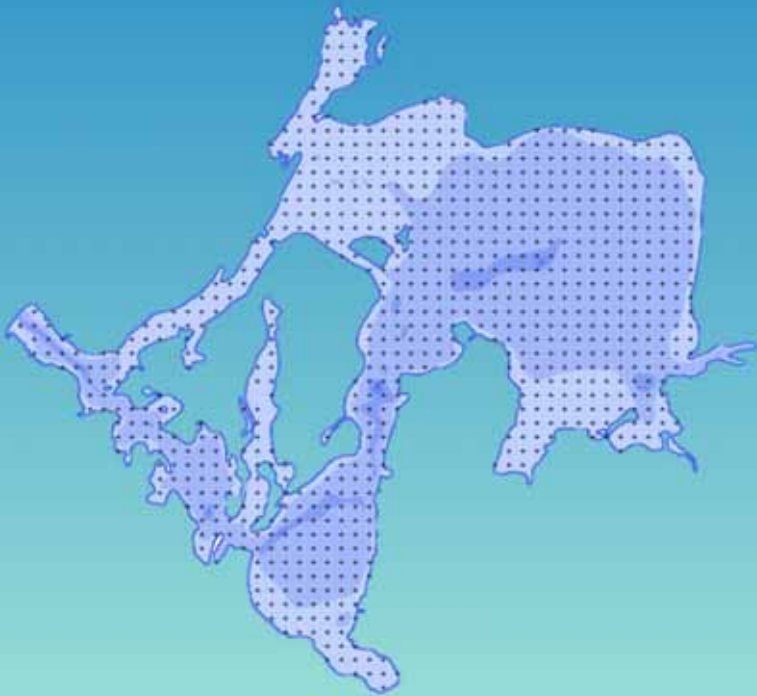
Full Pool Conditions	Acres	Volume (acre-feet)
	599.3	3,089.3
Draw Down Scenario - Lowered 5 feet		
Lake Acres	338.8	781
Lake Acres > 5 feet	21.2	44
Lake Acres > 10 feet	0.6	1.51
Lake Acres > 15 feet	0.1	0.03



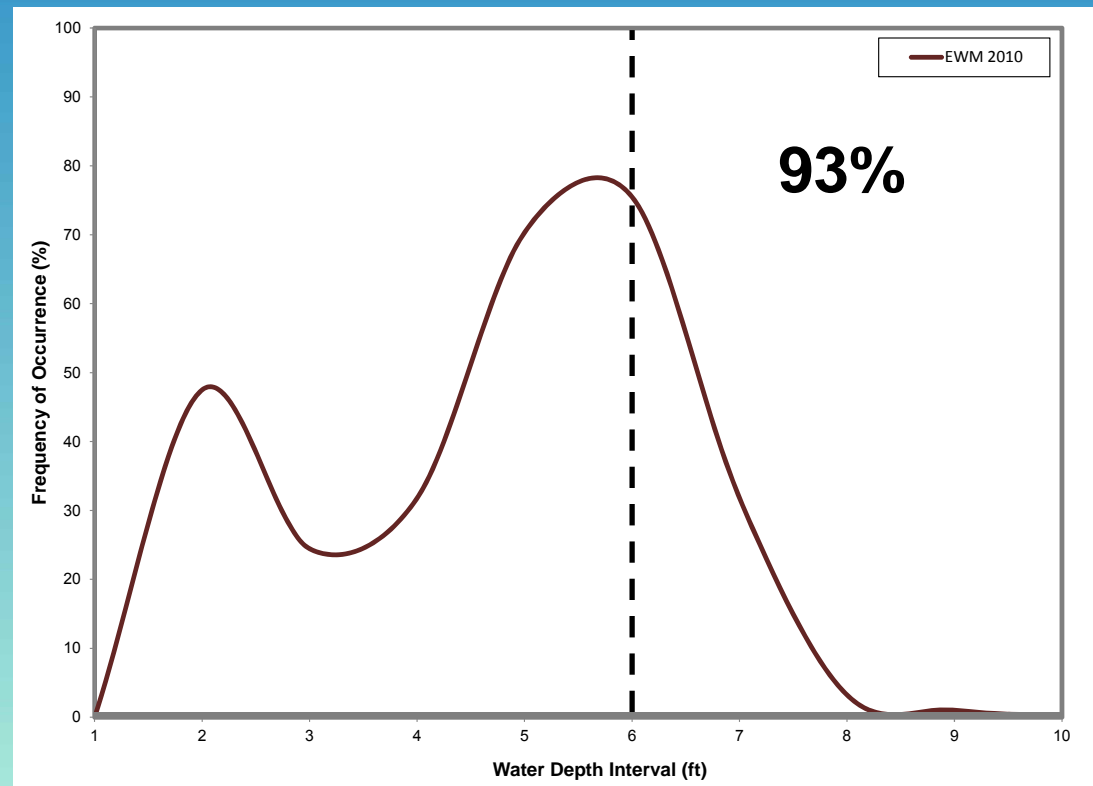
Results:
EWM – Point-intercept
Survey



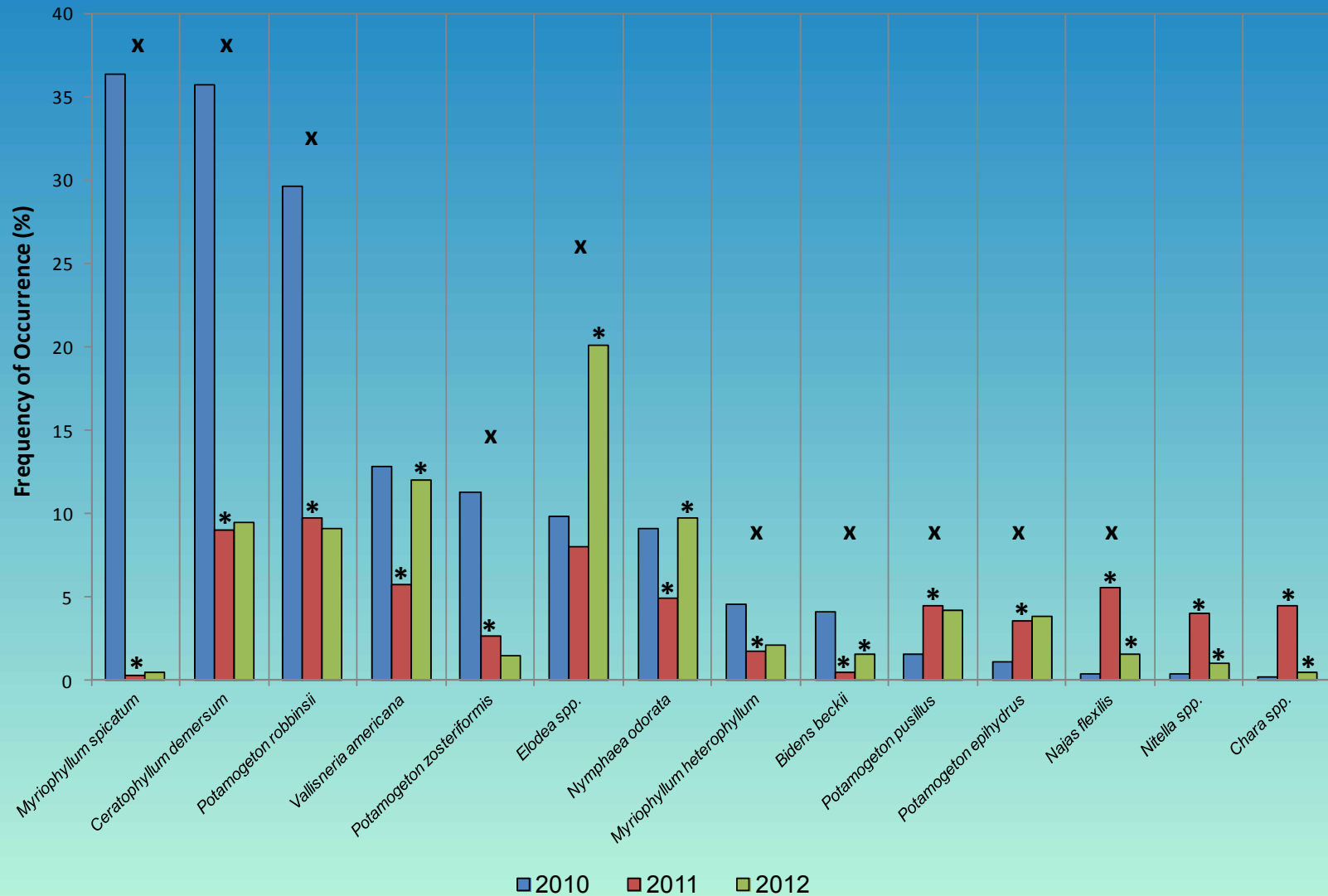
Frequency of Occurrence for EWM in 2010 (pre-drawdown)



Whole-lake PI Survey



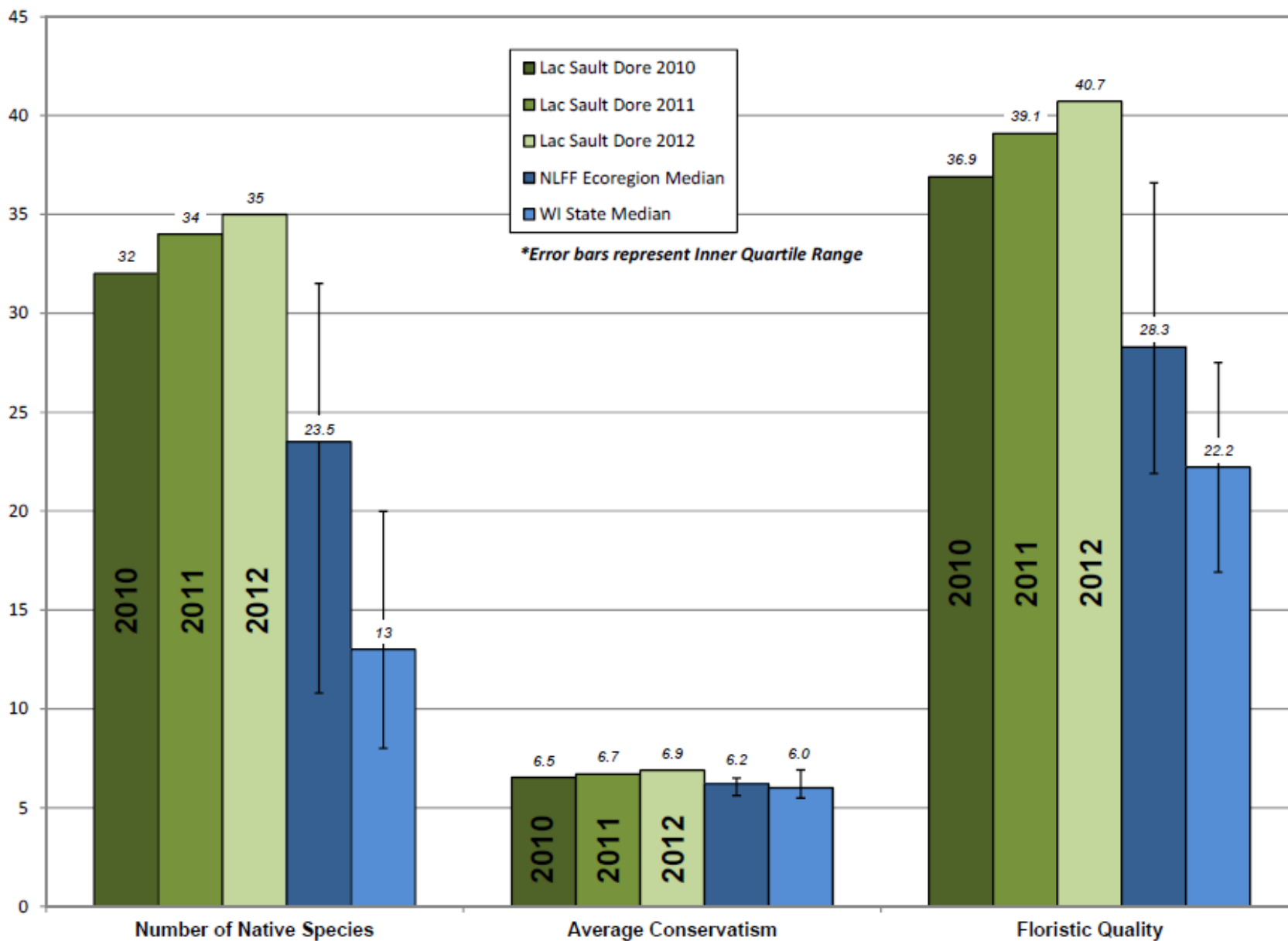
PI Survey Results – changes in frequency of occurrence



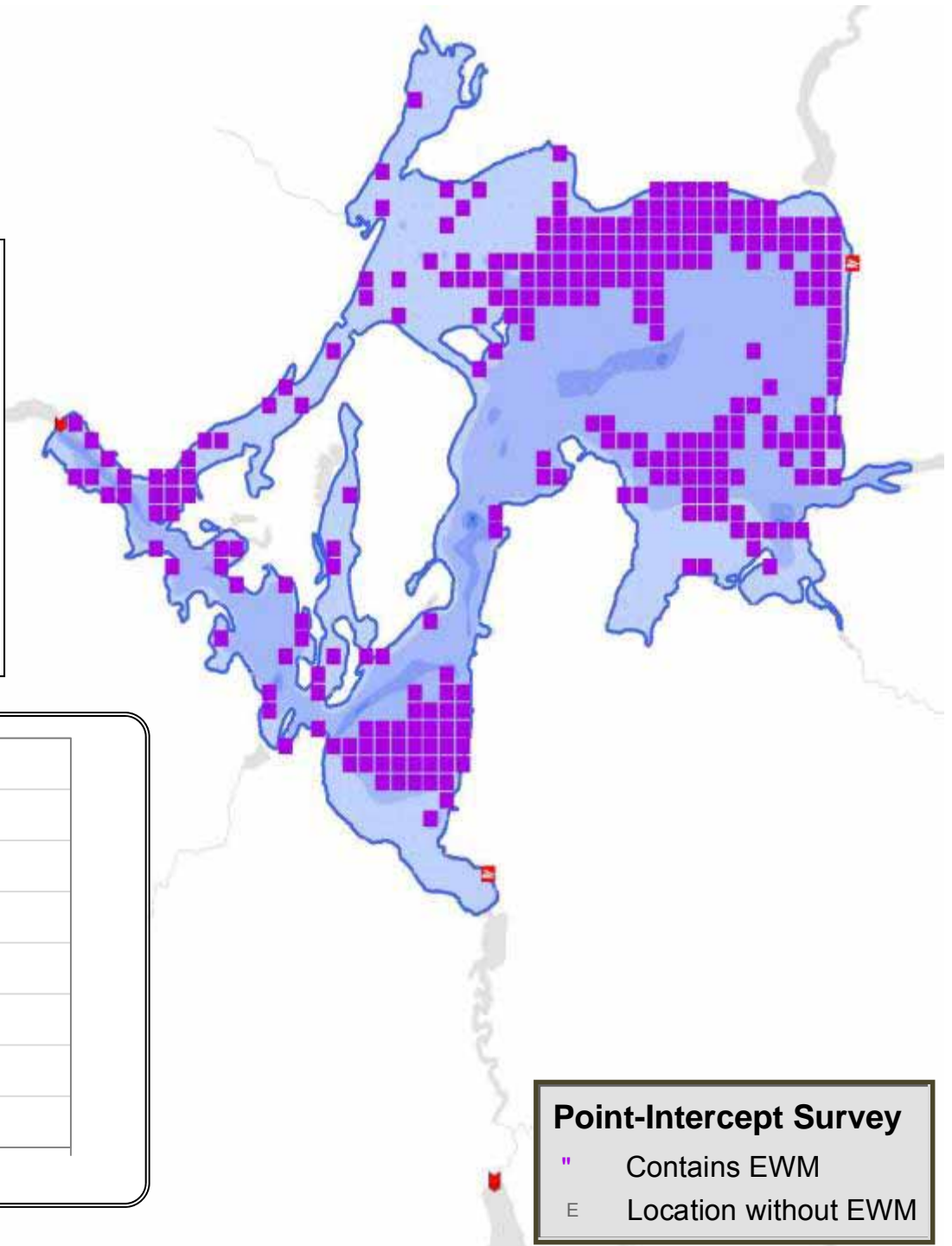
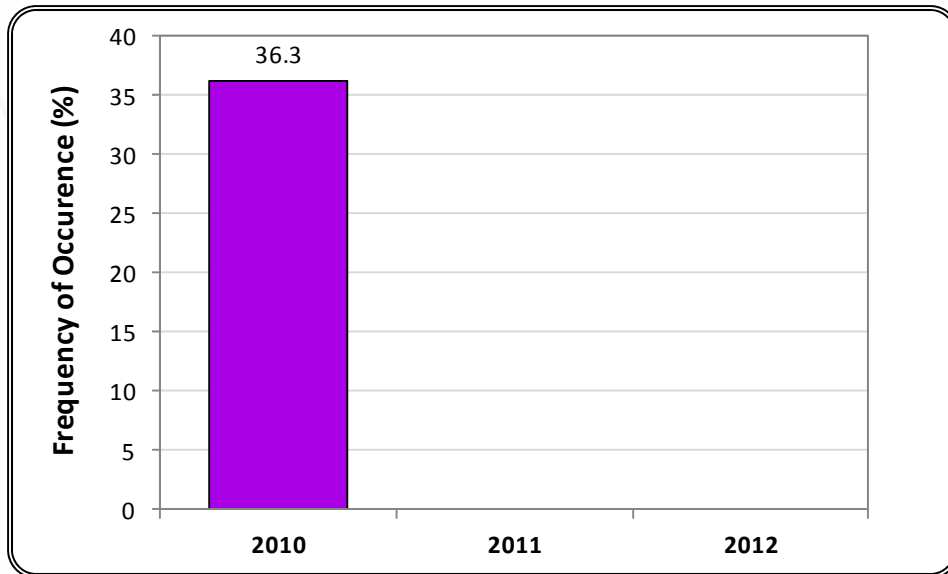
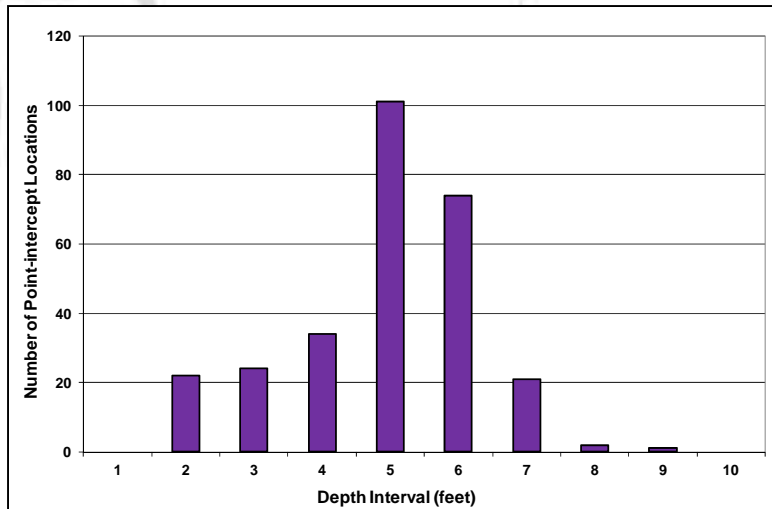
* Statistically valid change in occurrence from previous year (Chi-square $\alpha = 0.05$)

X Statistically valid change in occurrence from 2010 to 2012 (Chi-square $\alpha = 0.05$)

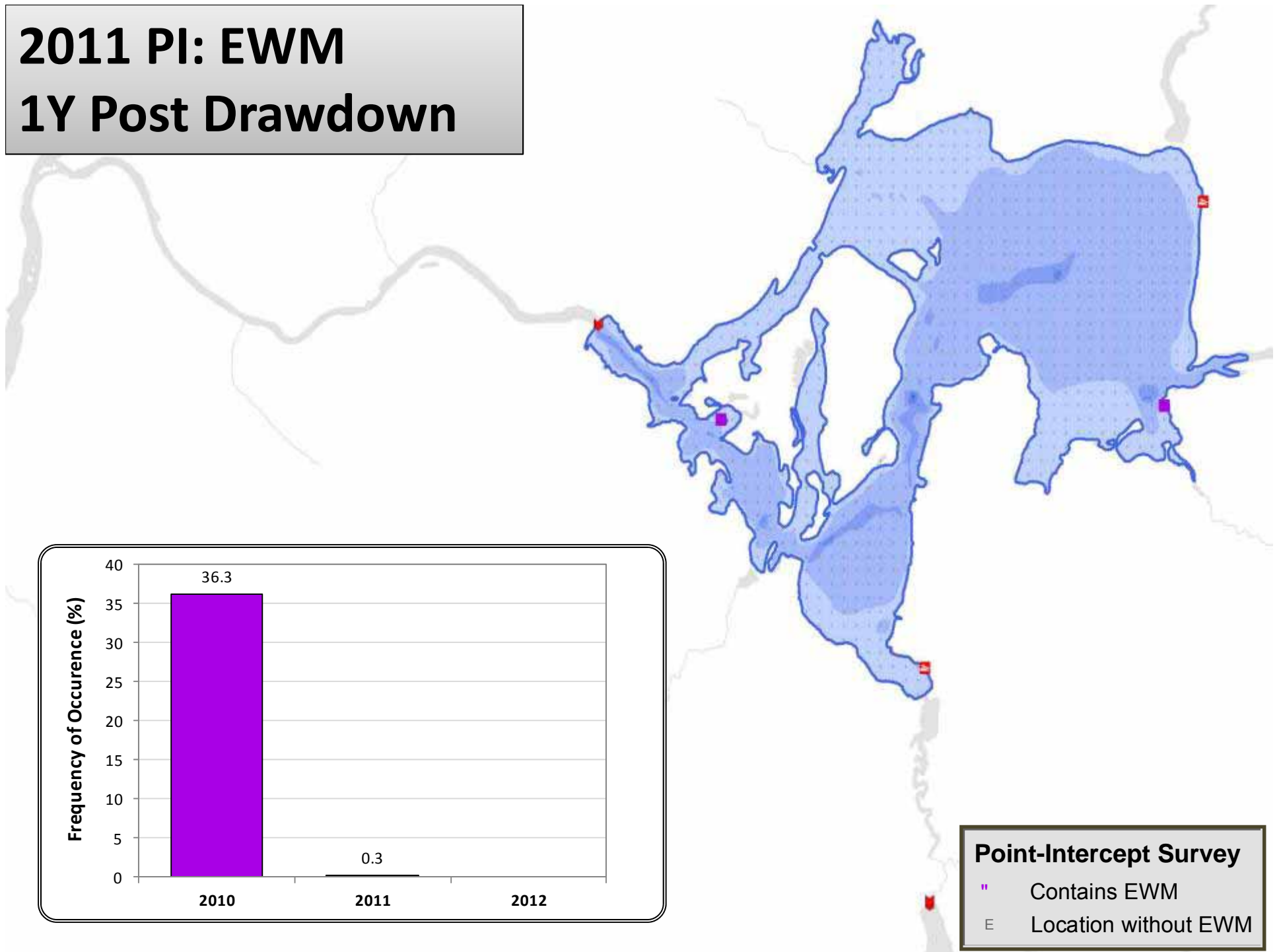
PI Survey- Summary Stats



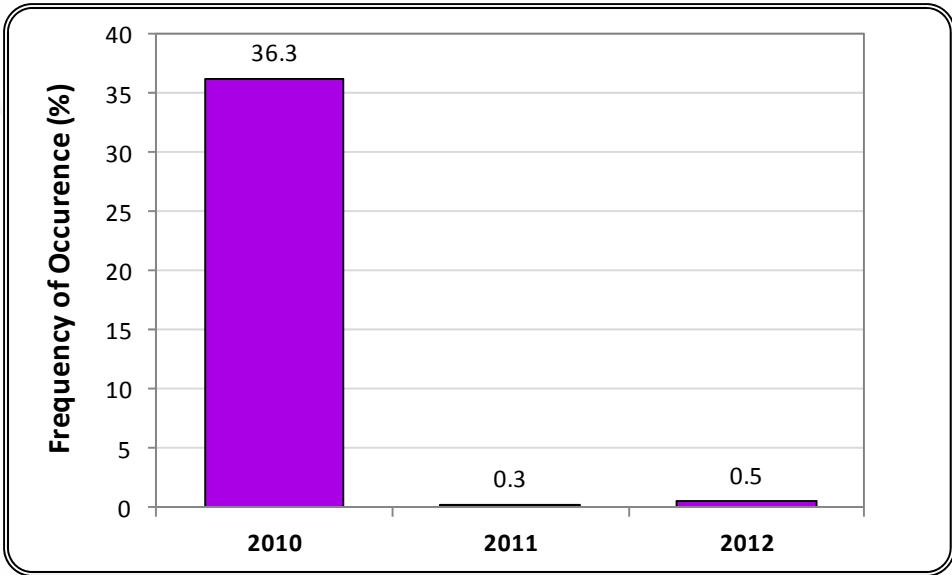
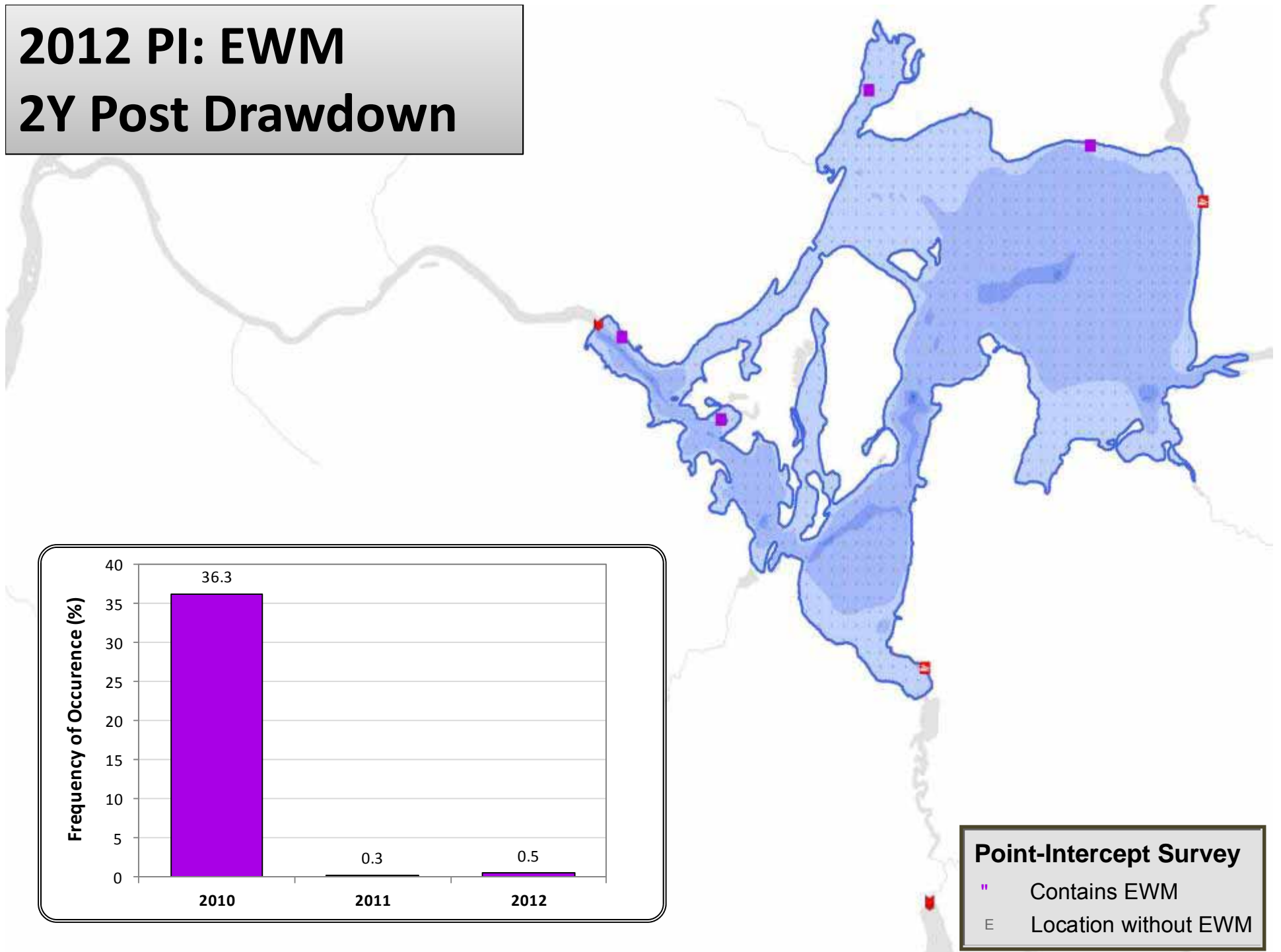
2010 PI: EWM 1Y Pre-Drawdown



2011 PI: EWM 1Y Post Drawdown




2012 PI: EWM 2Y Post Drawdown



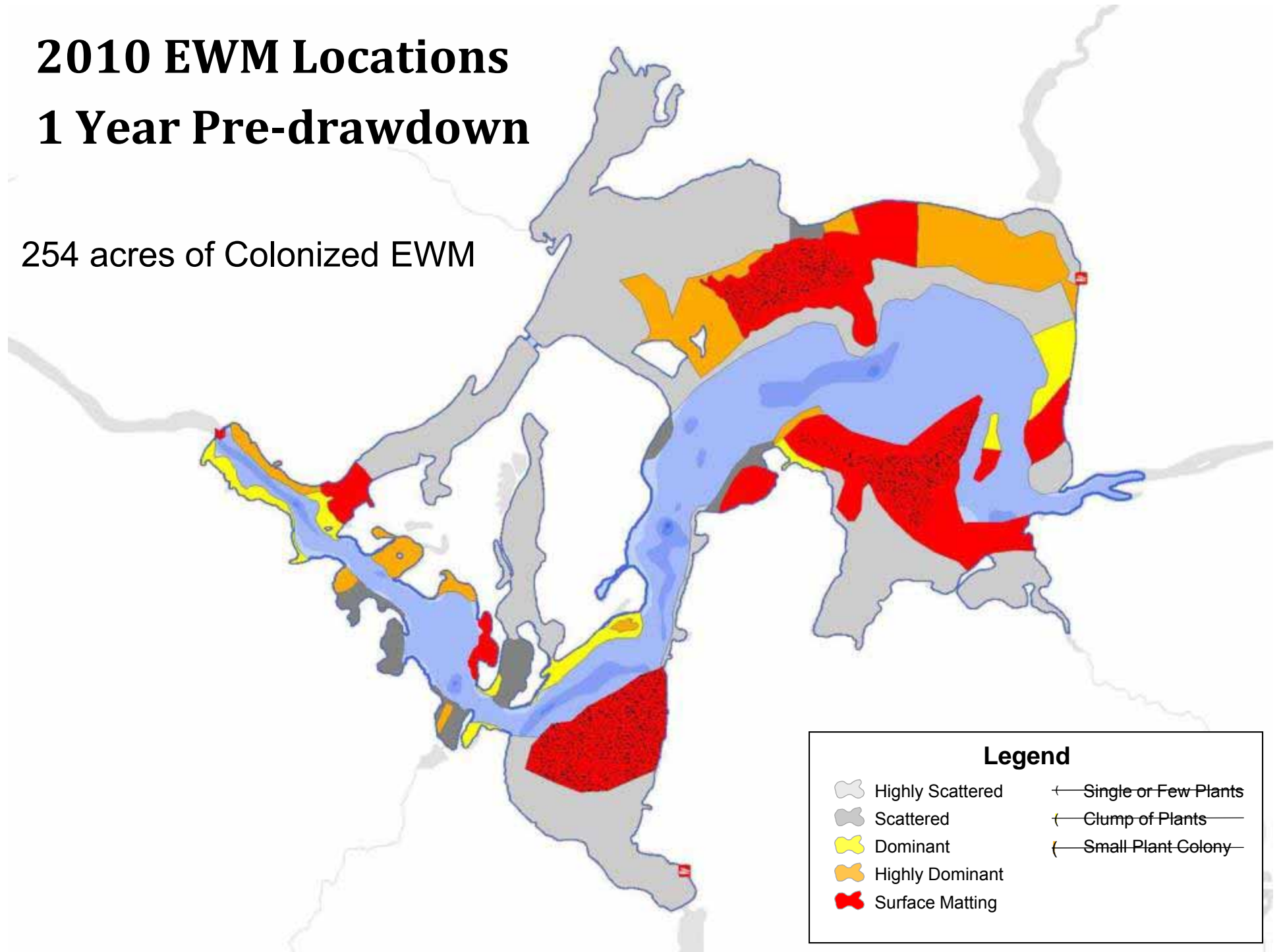
Point-Intercept Survey
" Contains EWM
E Location without EWM

Results:
EWM – Colony/Density
Mapping Survey



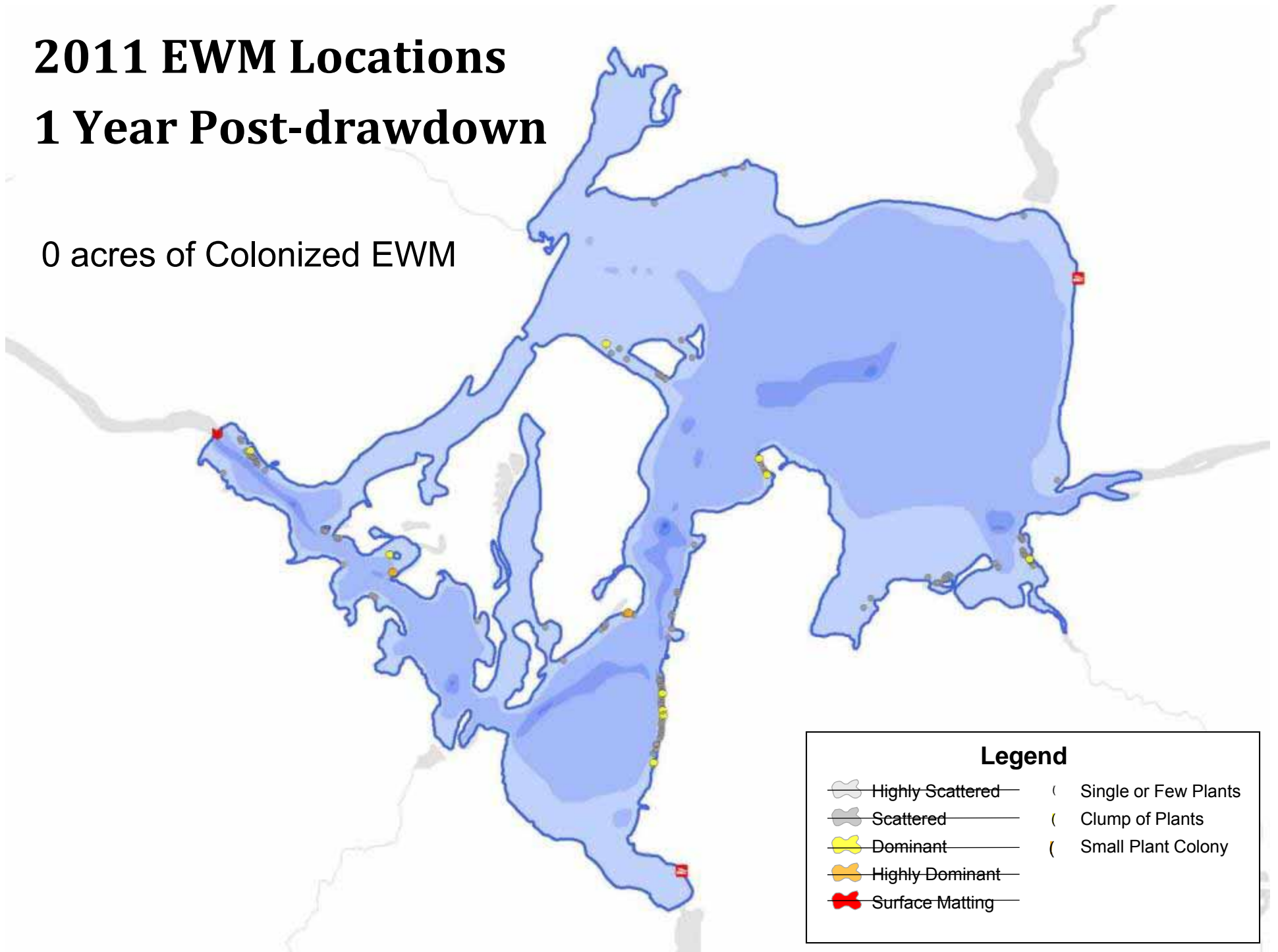
2010 EWM Locations 1 Year Pre-drawdown

254 acres of Colonized EWM

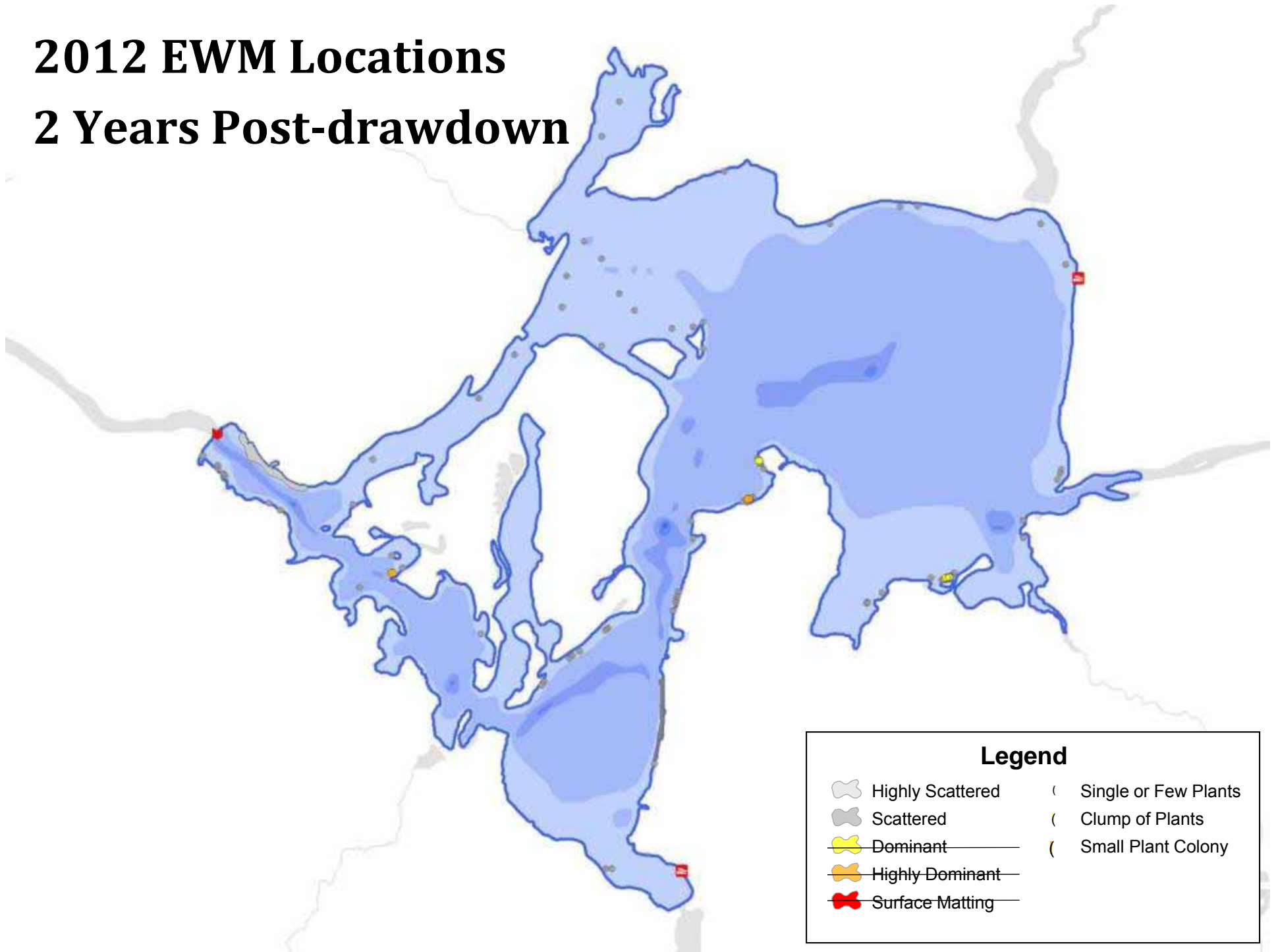


2011 EWM Locations 1 Year Post-drawdown

0 acres of Colonized EWM



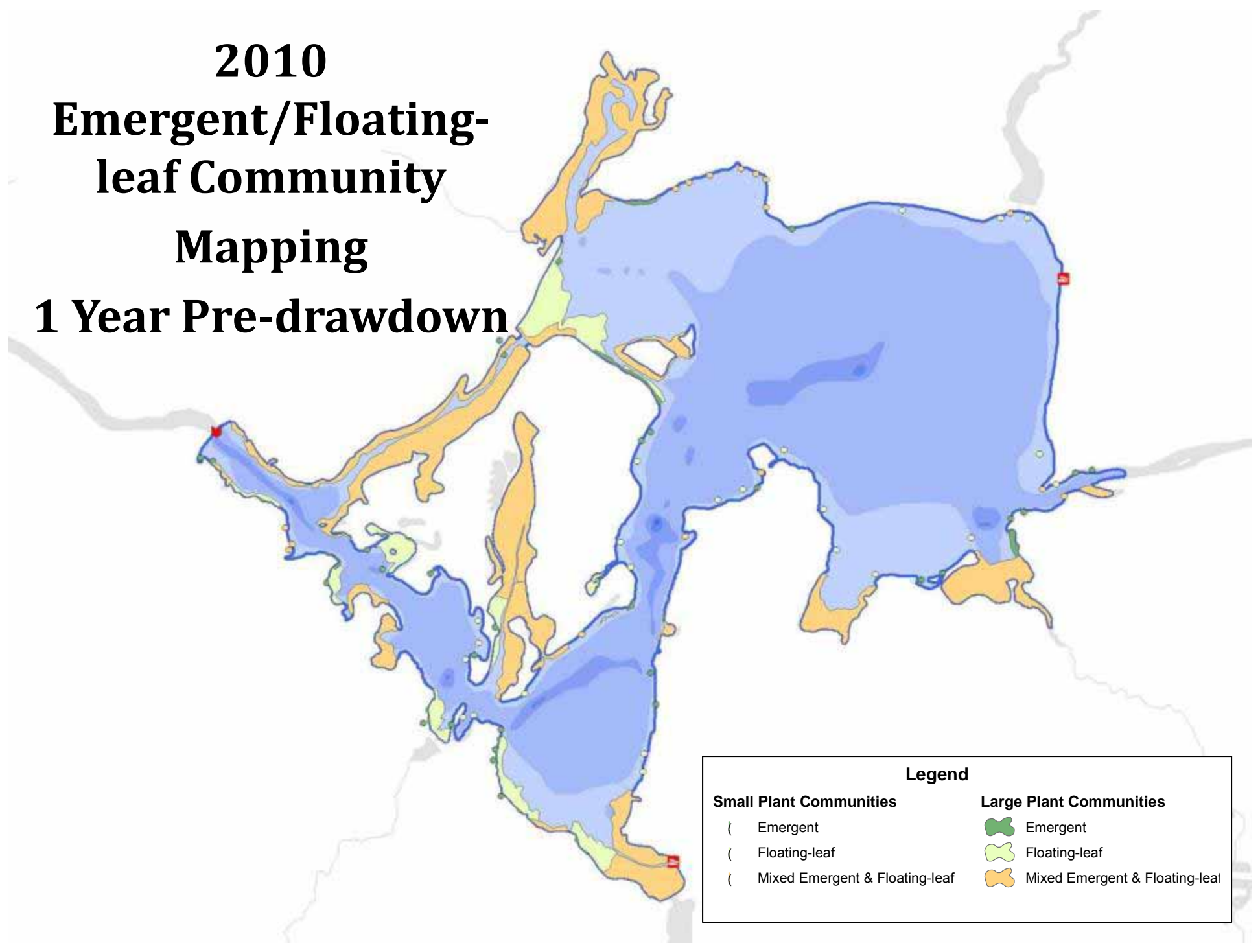
2012 EWM Locations 2 Years Post-drawdown



Results:
Floating-leaf & Emergent
Community Mapping

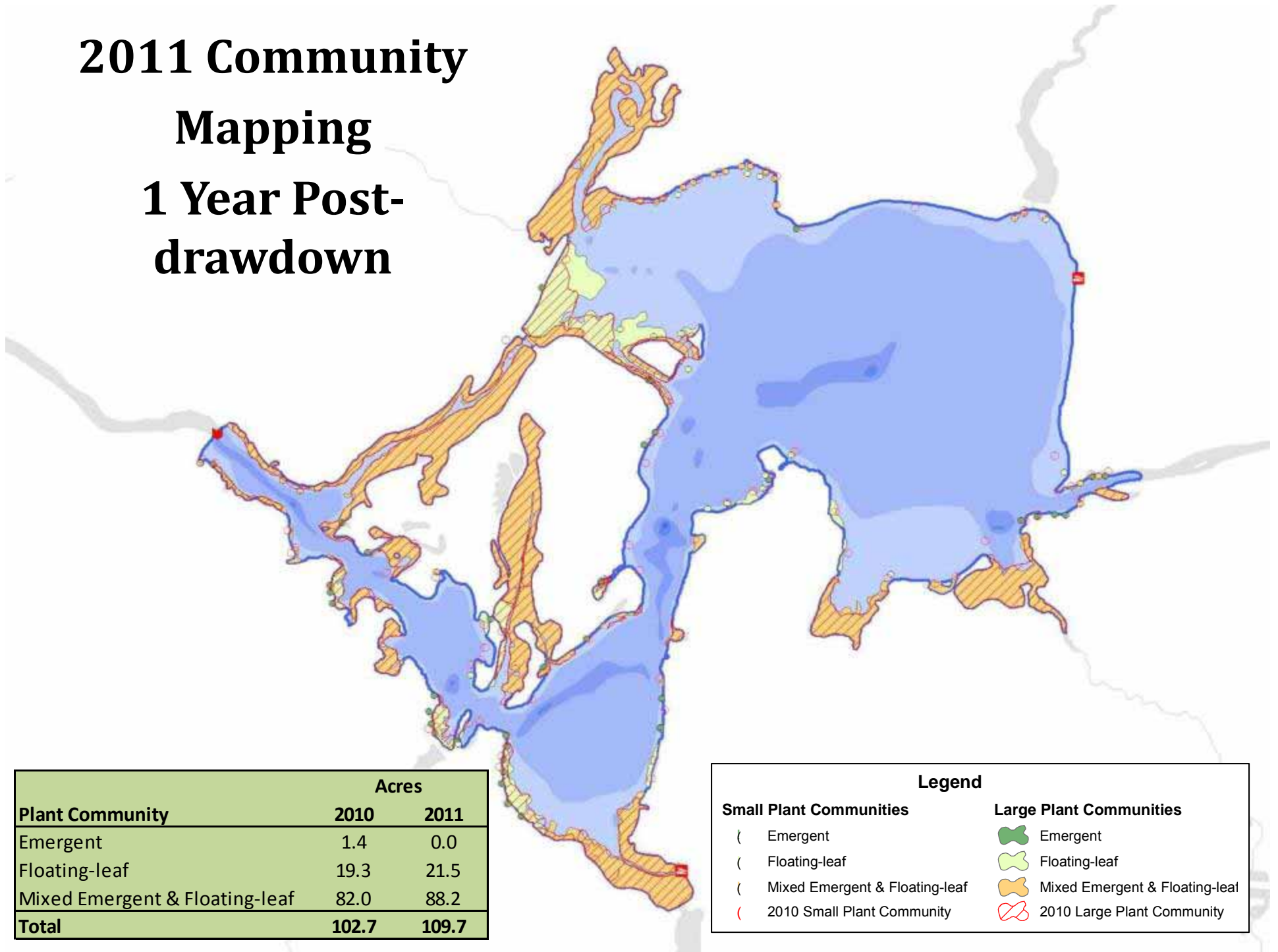


**2010
Emergent/Floating-
leaf Community
Mapping
1 Year Pre-drawdown**







2011 Community Mapping

1 Year Post-drawdown



Plant Community	Acres	
	2010	2011
Emergent	1.4	0.0
Floating-leaf	19.3	21.5
Mixed Emergent & Floating-leaf	82.0	88.2
Total	102.7	109.7

Legend	
Small Plant Communities	Large Plant Communities
(Emergent	 Emergent
(Floating-leaf	 Floating-leaf
(Mixed Emergent & Floating-leaf	 Mixed Emergent & Floating-leaf
(2010 Small Plant Community	 2010 Large Plant Community

Conclusions:

- Overall success reducing EWM plants (~98% reduction in littoral FOC)
- Colonized acreage of EWM reduced to 0
- Drawdown had impacts on native plant community
- Minor changes to Emergent/Floating-leaf community
- The Soo Lake chapter 31 order was amended to include periodic drawdowns to target EWM (Trigger 30 % or greater littoral frequency, or greater than 175 point intercept locations that contain EWM)

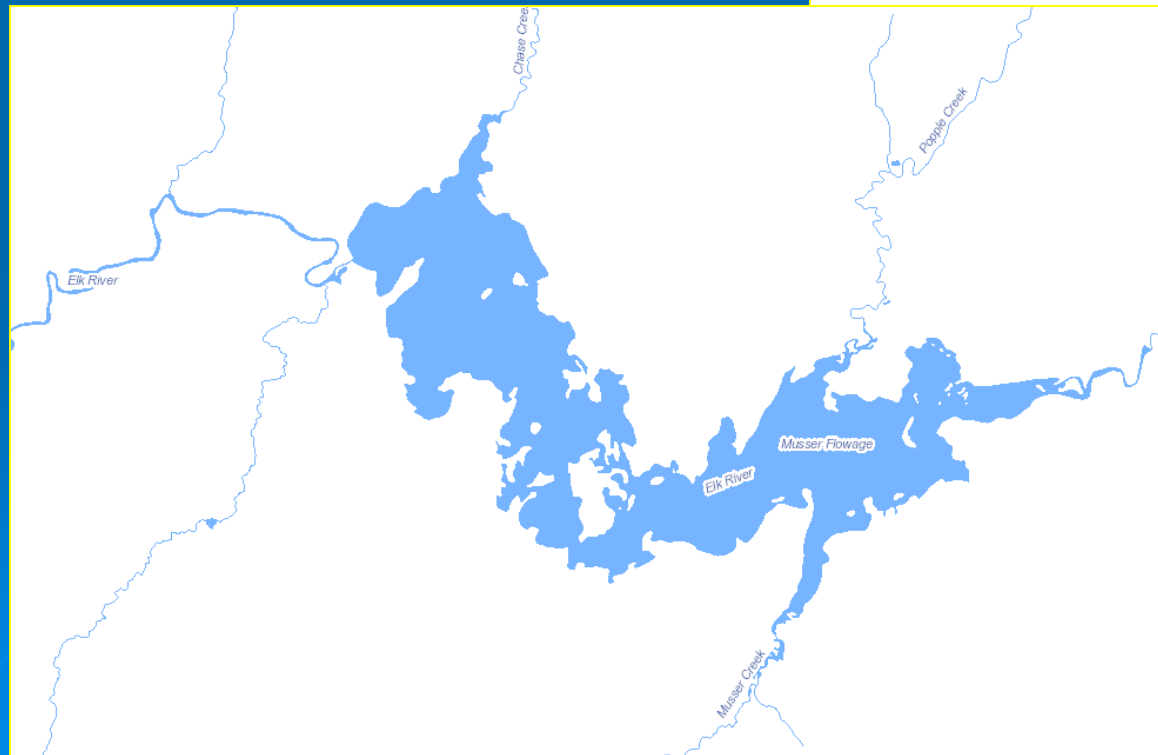
An aerial photograph of a lake heavily infested with curly leaf pondweed. The water is dark, and the plants are a dense, tangled mass of green and brown stems and leaves, covering most of the visible surface. The text is overlaid on the center of the image.

**MUSSER LAKE
DRAWDOWN**

**WINTER 2013-2014
Curly Leaf Pondweed**

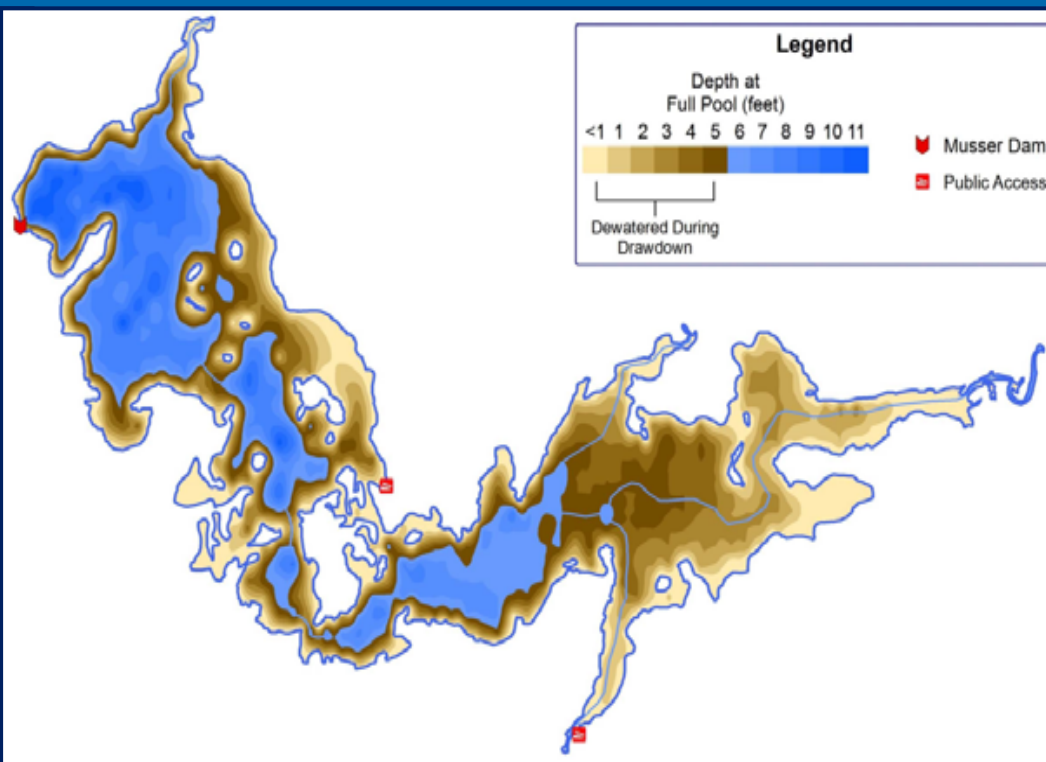
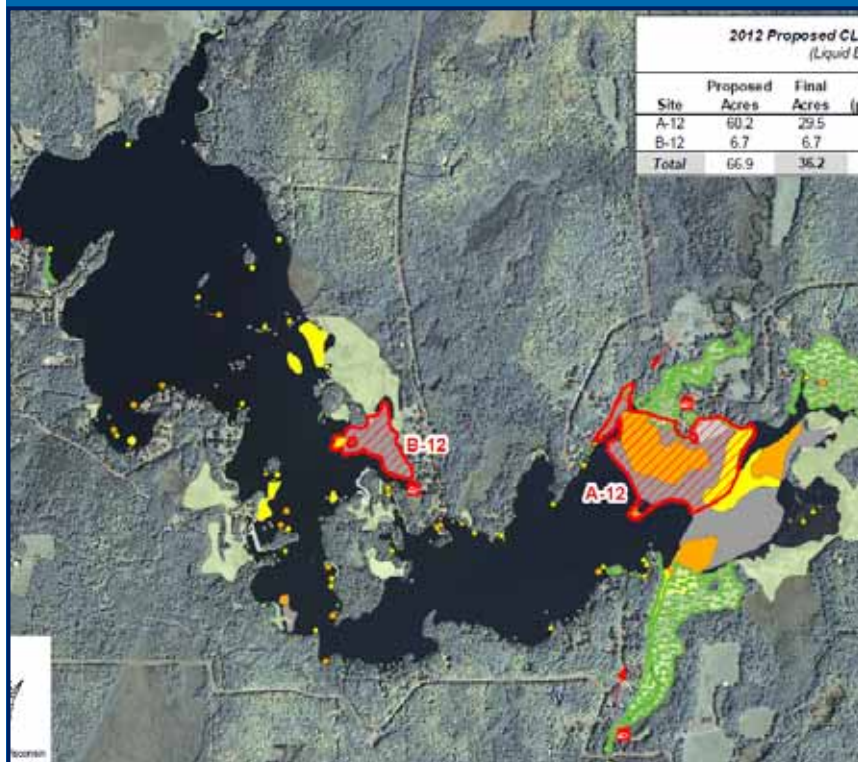
Introduction

- 563 acre impoundment on the Elk River
- Maximum depth is 15 feet
- Average depth is 5 feet
- The flowage is fertile and considered eutrophic.
- Dam repair needed



CLP in Musser

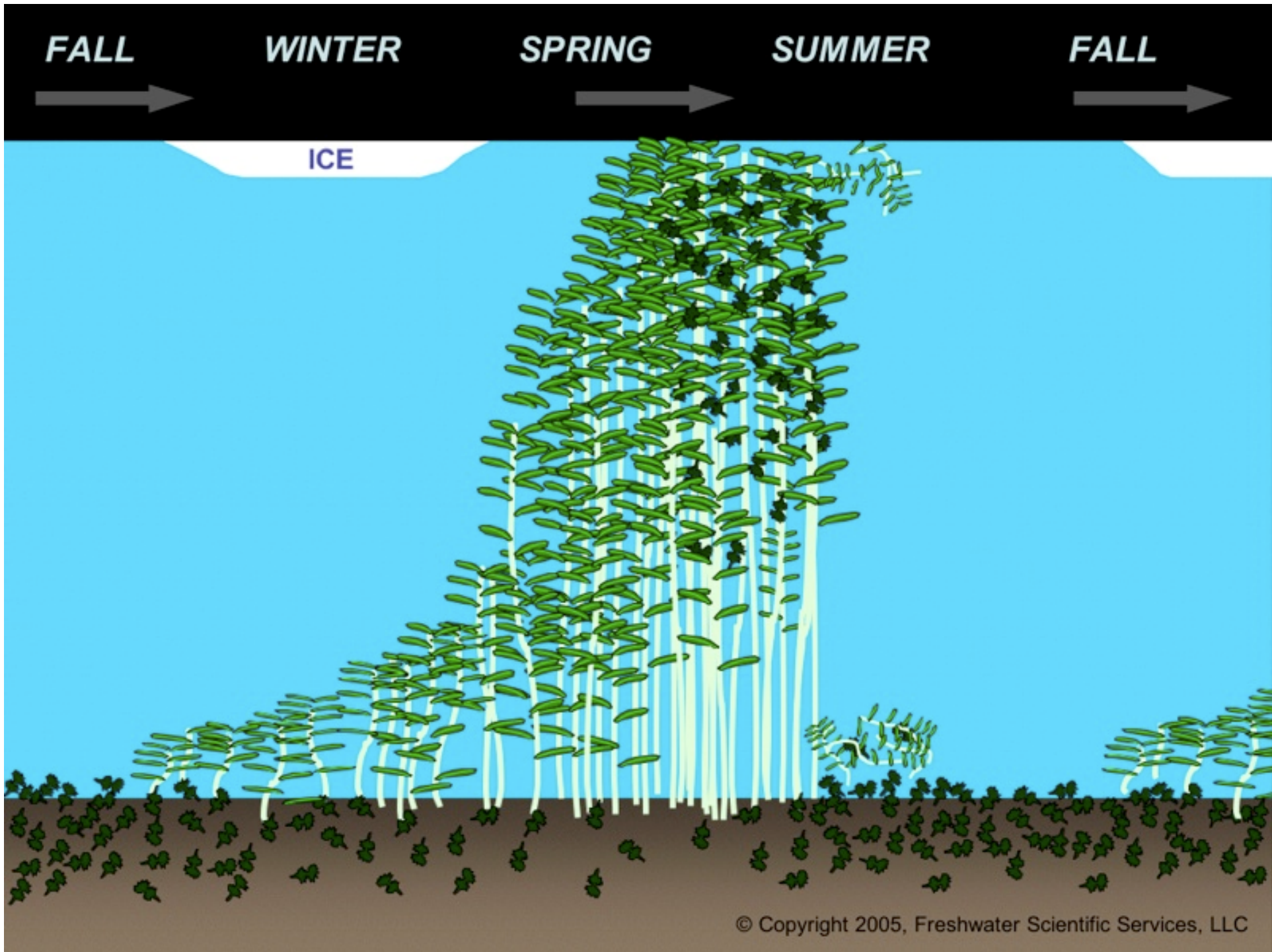
- First discovered in Musser Lake in 2002
- Chemically treated from 2005-2010
- In 2013 there was approximately 70 acres of CLP (52 acres colonized)



Curly Leaf Pondweed Biology

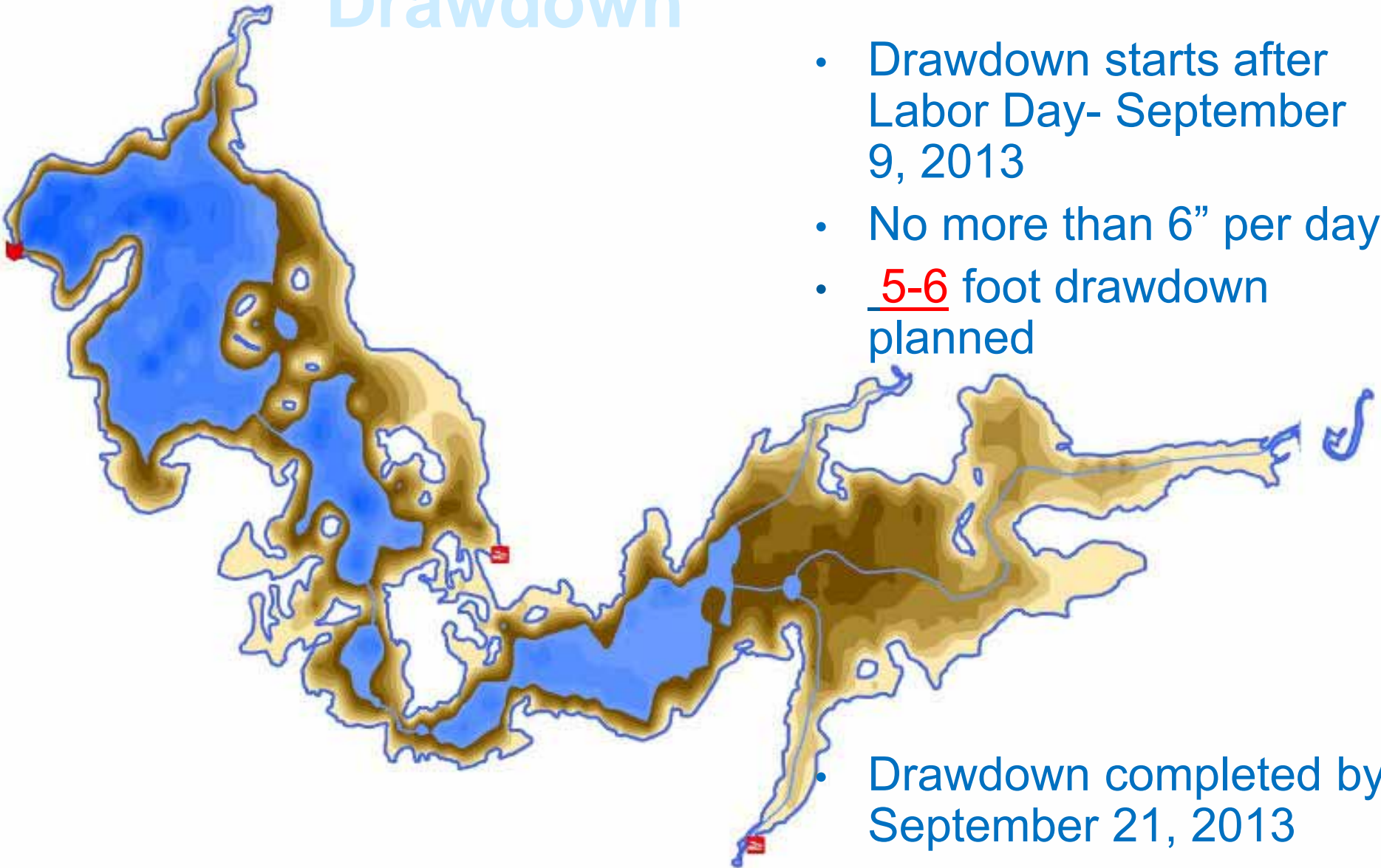
- Life cycle begins in autumn, with turion germination
- Plant may grow through the winter under the ice
- Maximum growth occurs in May and June
- Turions produced late July before plant dies back
- Turions fall into sediment and are viable 5-7 years





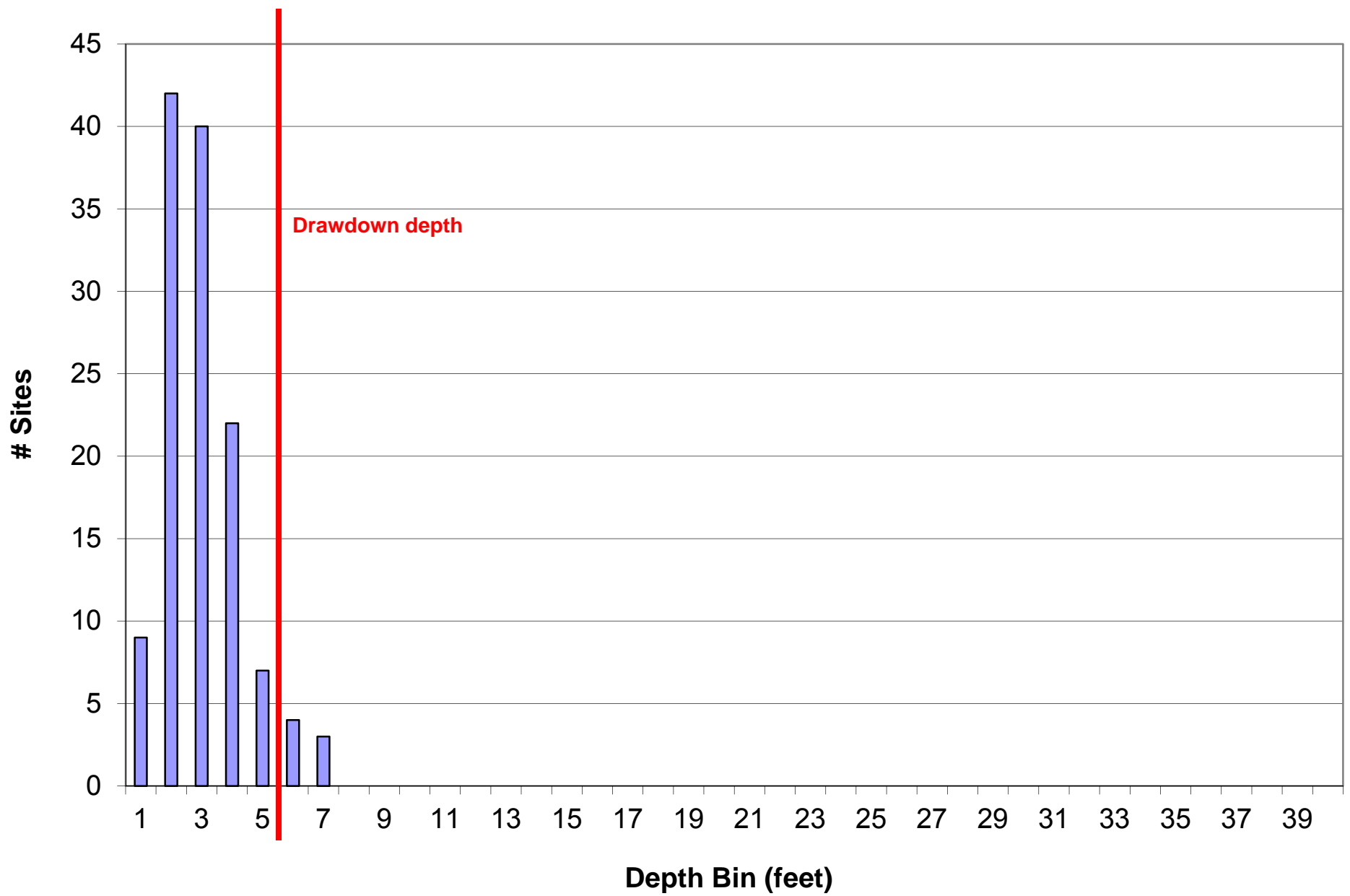
Drawdown

- Drawdown starts after Labor Day- September 9, 2013
- No more than 6" per day
- 5-6 foot drawdown planned

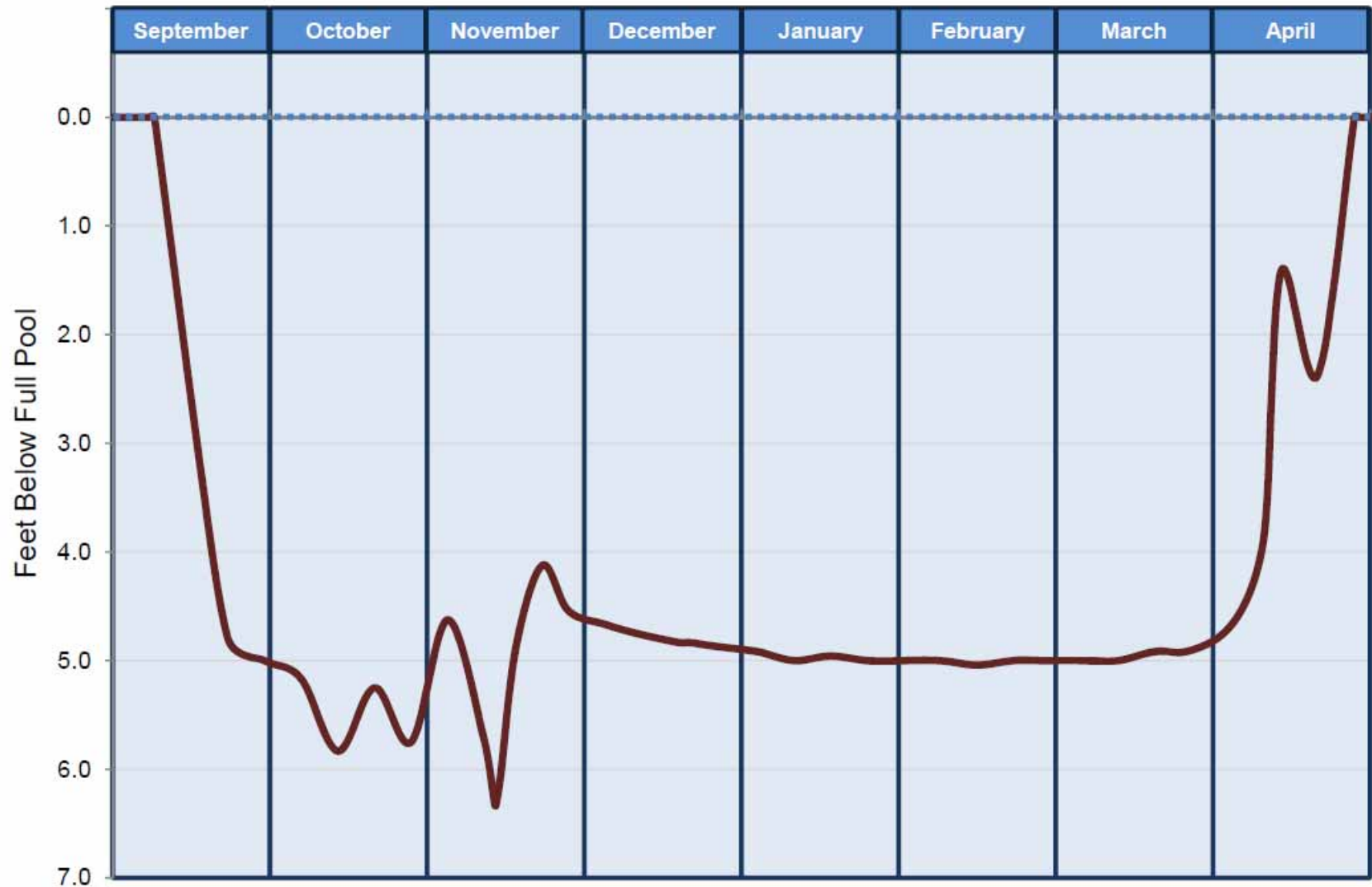


- Drawdown completed by September 21, 2013
- Refill by May 1, 2014

Maximum Depth of Plant Colonization



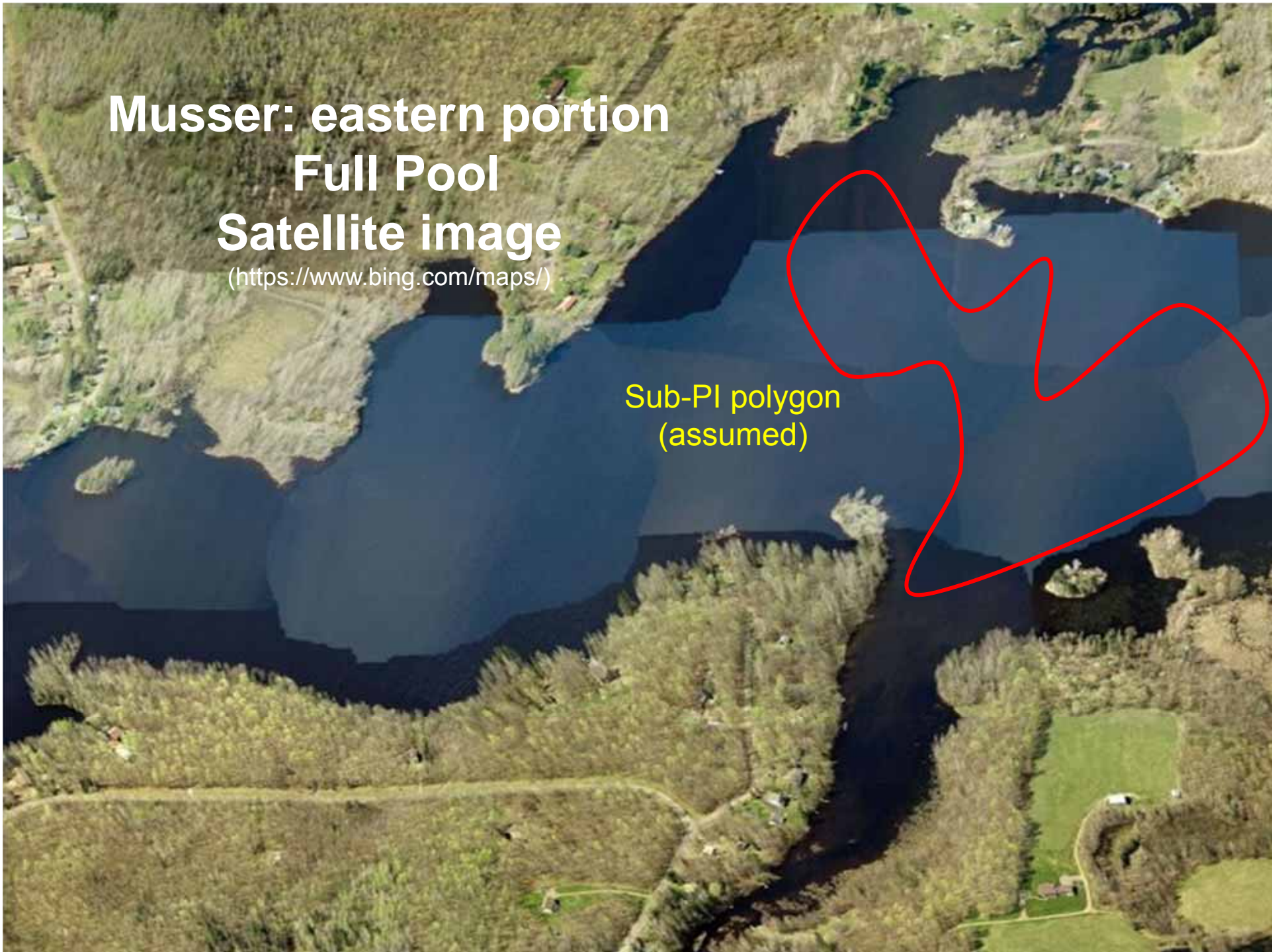
Winter Water Levels



**Musser: eastern portion
Full Pool
Satellite image**

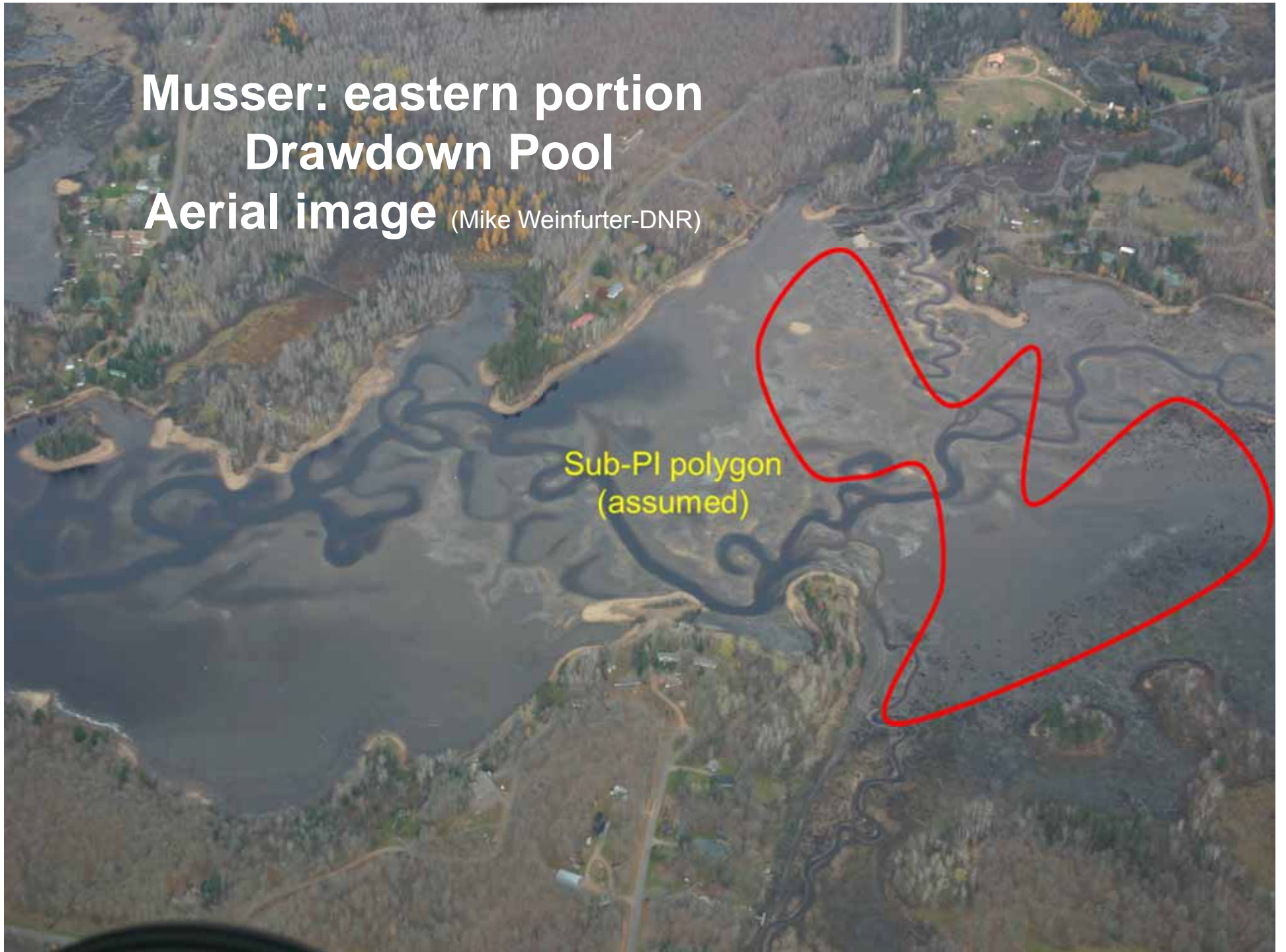
(<https://www.bing.com/maps/>)

Sub-PI polygon
(assumed)



**Musser: eastern portion
Drawdown Pool
Aerial image** (Mike Weinfurter-DNR)

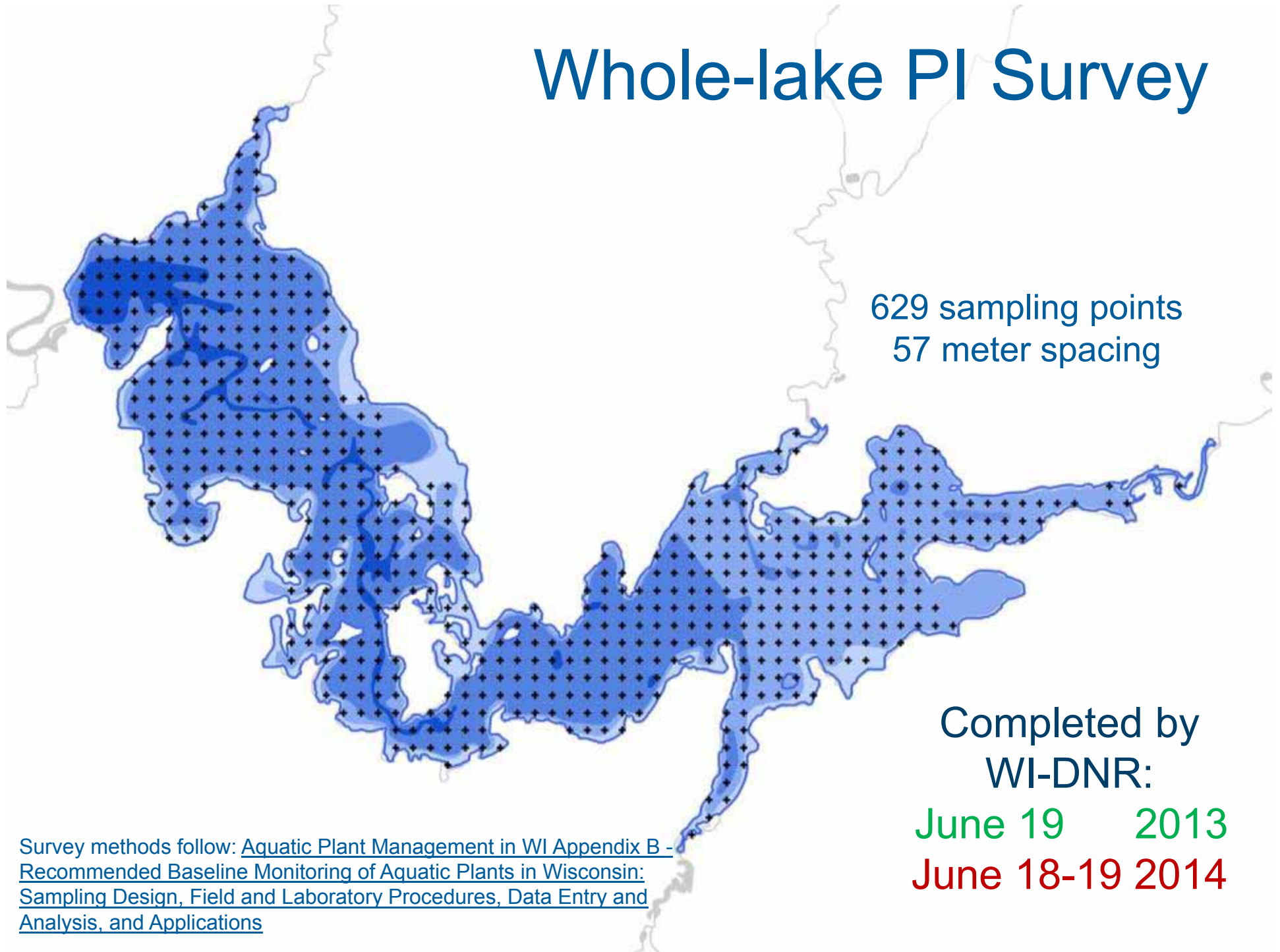
Sub-PI polygon
(assumed)



Monitoring Methodology

- Objective: Evaluate the response of all aquatic vegetation to drawdown
 - Whole-lake point-intercept survey - baseline survey for native plant and CLP response (mid-June both 2013, 2014)
 - Sub-sample PI survey within dense CLP beds - gain a finer detailed account of the CLP response
 - CLP colony/density mapping - track area occupied and density changes qualitatively
 - CLP turion sampling - determine turion response to drawdown

Whole-lake PI Survey



629 sampling points
57 meter spacing

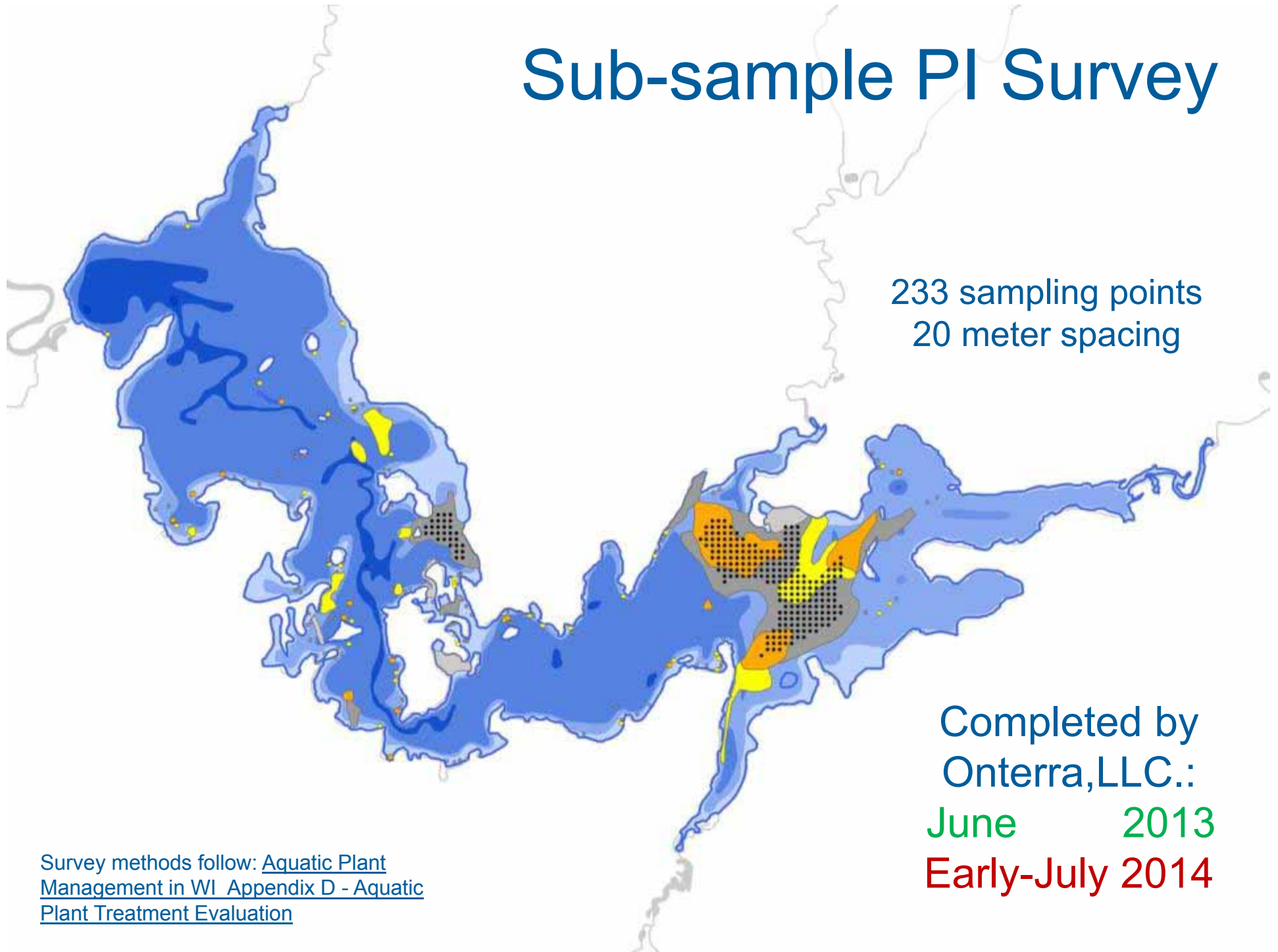
Completed by
WI-DNR:

June 19 2013

June 18-19 2014

Survey methods follow: [Aquatic Plant Management in WI Appendix B - Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications](#)

Sub-sample PI Survey

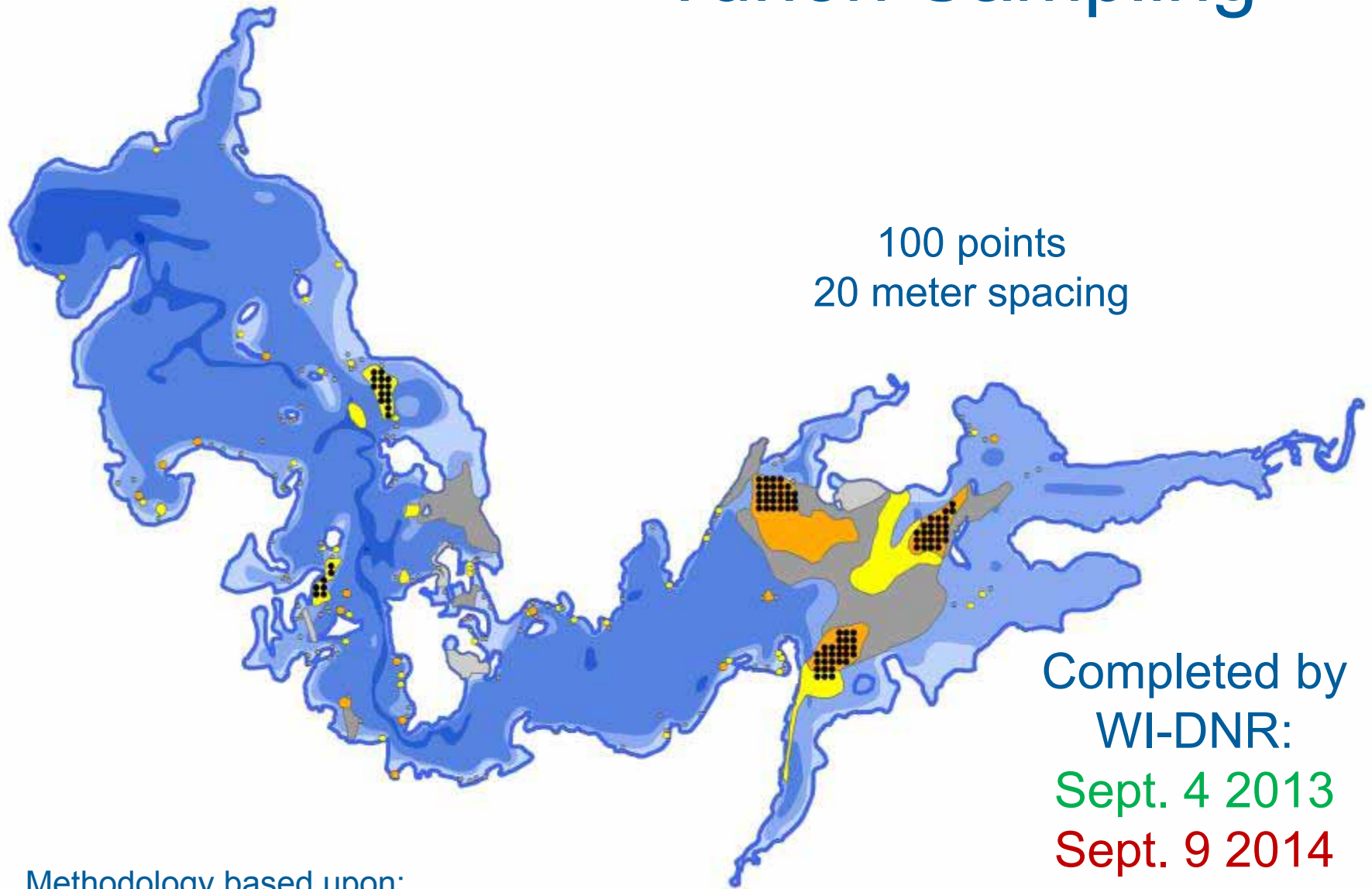


233 sampling points
20 meter spacing

Completed by
Onterra, LLC.:
June 2013
Early-July 2014

Survey methods follow: [Aquatic Plant Management in WI Appendix D - Aquatic Plant Treatment Evaluation](#)

Turion Sampling



Methodology based upon:
Madsen 1999; Woolf and
Madsen 2003

Turion Field Collection Method



Turion Germination Method - Lab

1. Chill turions in a refrigerator for 1 week

2. Place turions in aquarium

*some turions floated and after a day I placed plastic paper clips on the floaters to sink them

3. incubate at daily average temp of 81-85°F for 2 weeks

*10 light hours/ 14 dark hours

*nightly average temperature water=65-70°F
air=70-72°F

4. note any sprouting and remove sprouted individuals



Soetikno S. Sastroutomo, 1981, *Turion formation, dormancy and germination of curly pondweed, Potamogeton crispus L.*, Aquatic Botany, Volume 10, Pages 161-173

Results:
Point-intercept Survey



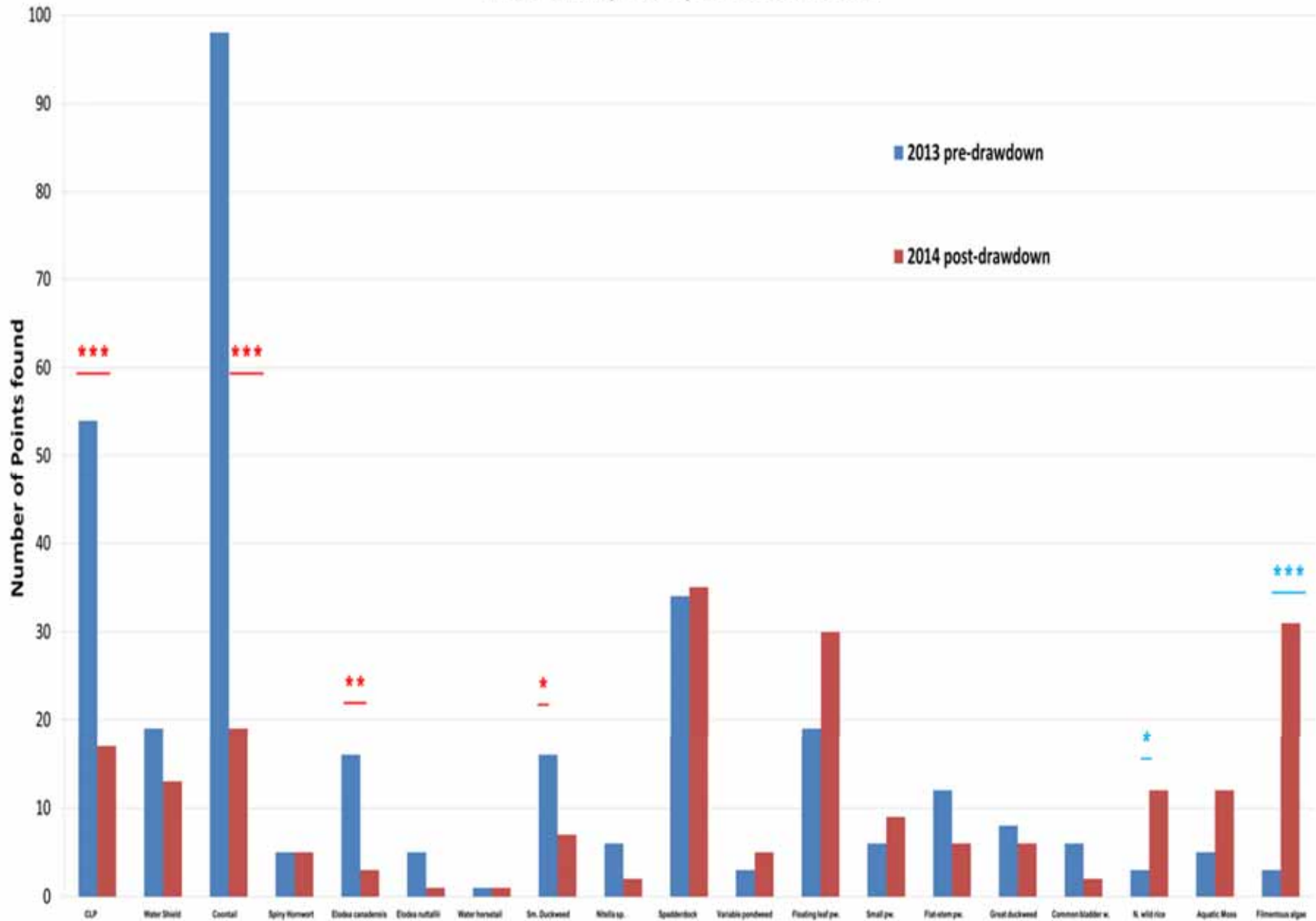
Plant Lists

2013	2014
Brasenia schreberi	Acorus americanus
Ceratophyllum demersum	Brasenia schreberi
Ceratophyllum echinatum	Ceratophyllum demersum
Elodea canadensis	Ceratophyllum echinatum
Elodea nuttallii	Chara sp.
Equisetum fluviatile	Elodea canadensis
Lemna minor	Elodea nuttallii
Lemna turionifera	Equisetum fluviatile
Myriophyllum verticillatum	Lemna minor
Nitella sp.	Nitella sp.
Nuphar vareigata	Nuphar vareigata
Potamogeton amplifolius	Potamogeton crispus
Potamogeton crispus	Potamogeton epihydrus
Potamogeton epihydrus	Potamogeton natans
Potamogeton natans	Potamogeton pusillus
Potamogeton pusillus	Potamogeton robbinsii
Potamogeton spirillus	Potamogeton zosteriformis
Potamogeton zosteriformis	Ranunculus aquatilis
Schoenoplectus tabernaemontanii	Sparganium angustifolium
Sparganium fluctuans	Spirodela polyrhiza
Spirodela polyrhiza	Utricularia vulgaris
Utricularia vulgaris	Vallisneria americana
Wolffia sp.	Zizania palustris
Zizania palustris	Aquatic Moss
Aquatic Moss	Filmentous algae
Filmentous algae	
Ricca sp.	
Carex sp.	

indicates found in 2013 but not 2014

indicates found in 2014 but not 2013

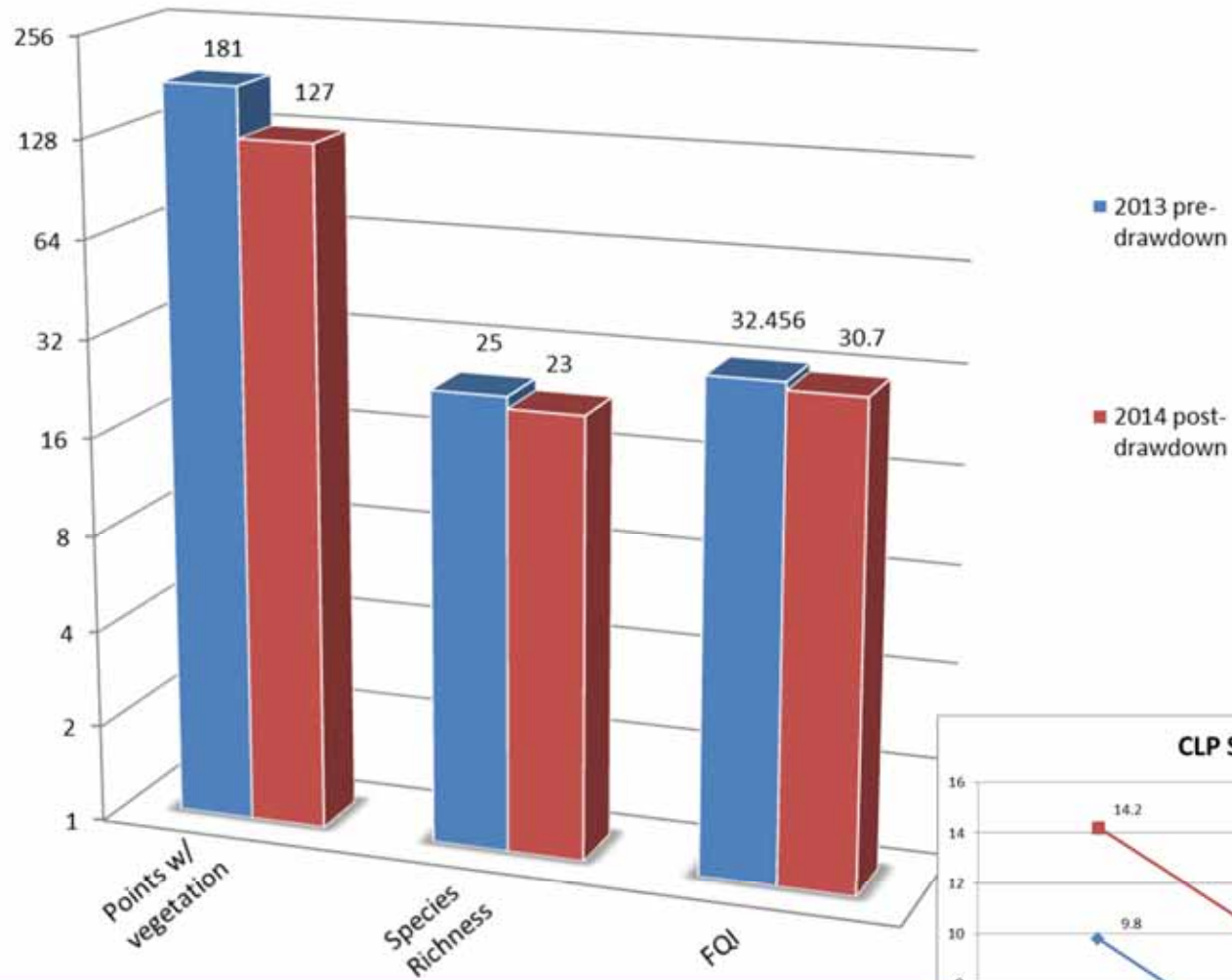
Point-intercept survey results 2013 & 2014



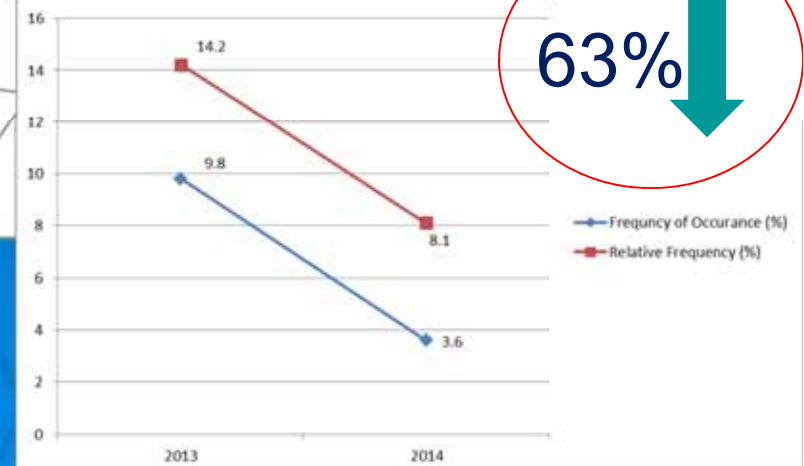
CLP Coontail Elodea Sm. Duckweed

Wild rice Fil. Algae

PI Survey Stats



CLP Stats from PI Survey



June 2013 (Pre-Drawdown)

Legend

- + No Vegetation
- + Below Max Depth of Plant Growth
- + Non-navigable/Temporary Obstacle

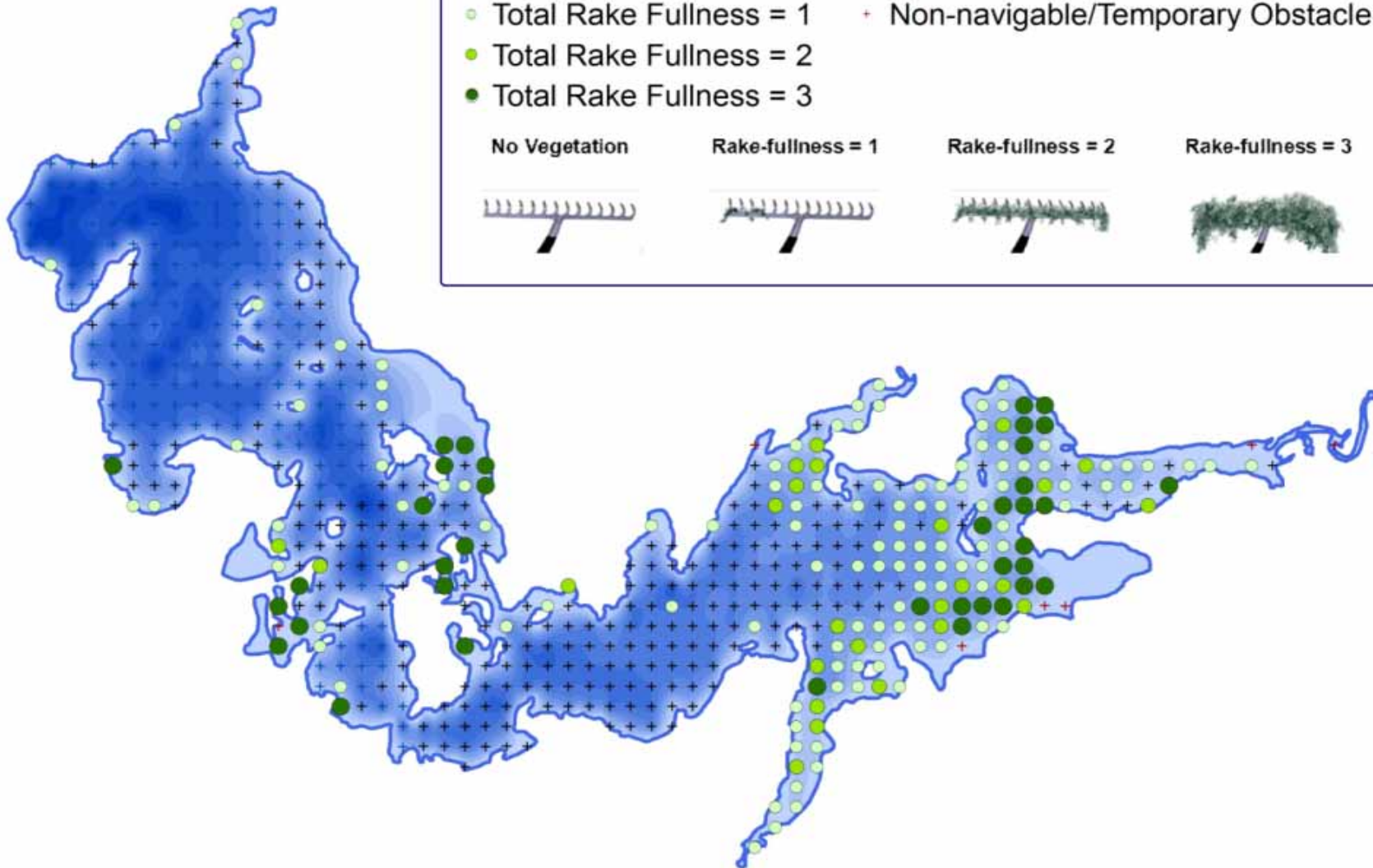
- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3

No Vegetation

Rake-fullness = 1

Rake-fullness = 2

Rake-fullness = 3



June 2014 (Post-Drawdown)

Legend

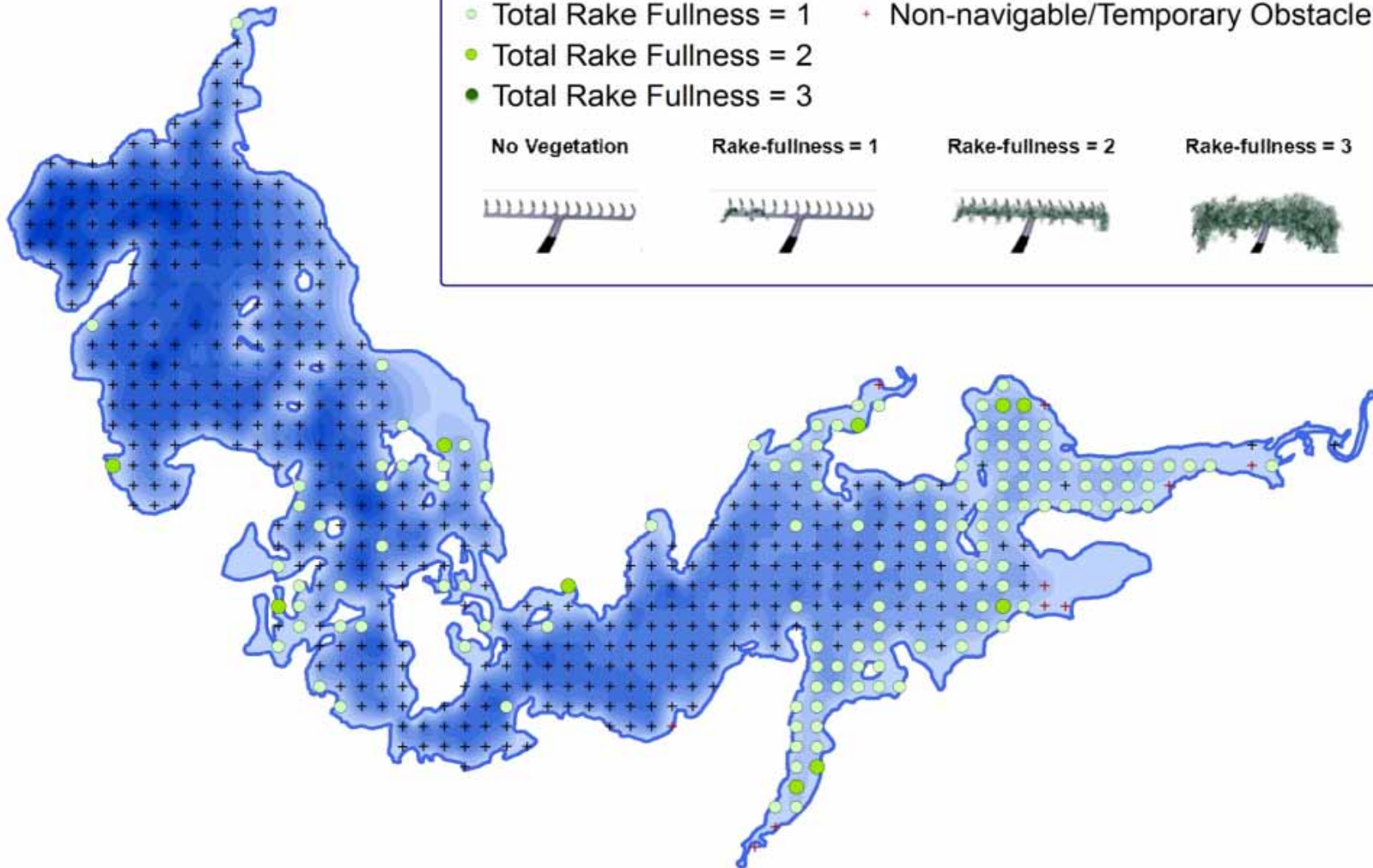
- + No Vegetation
- + Below Max Depth of Plant Growth
- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3
- + Non-navigable/Temporary Obstacle

No Vegetation

Rake-fullness = 1

Rake-fullness = 2

Rake-fullness = 3



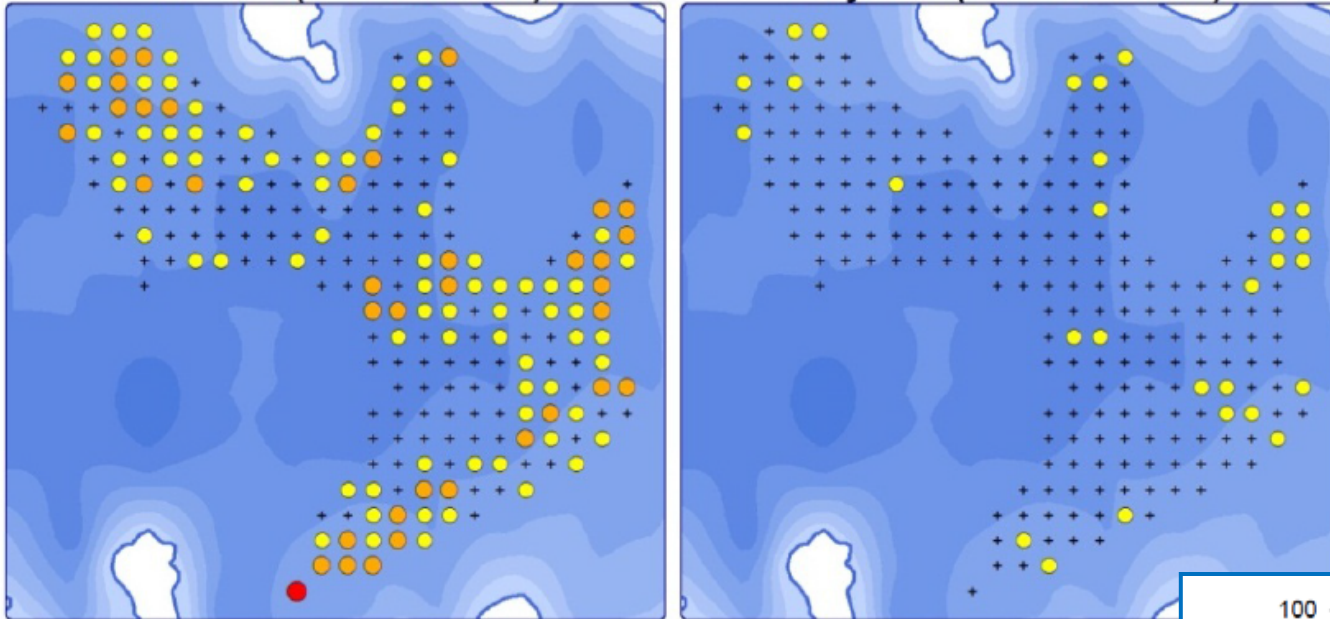
Results:
CLP Sub Point-intercept
Survey



Sub PI Survey

June 2013 (Pre-Drawdown)

July 2014 (Post-Drawdown)



Legend

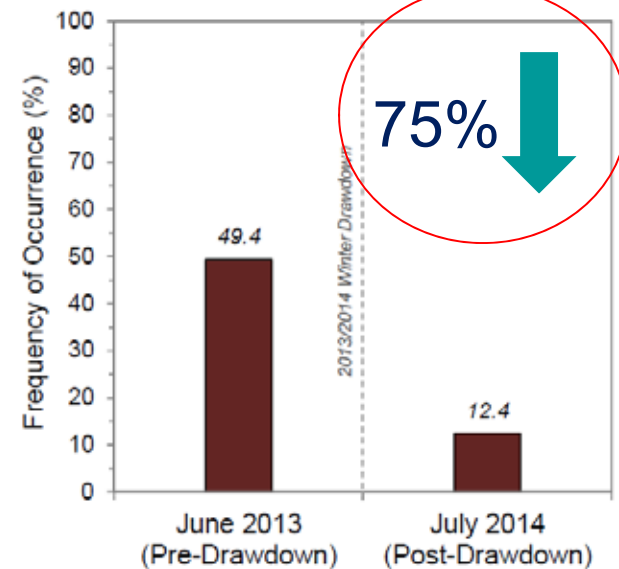
Curly-Leaf Pondweed

- + Not present
- Rake Fullness = 1
- Rake Fullness = 2
- Rake Fullness = 3



Extent of above images shown in red

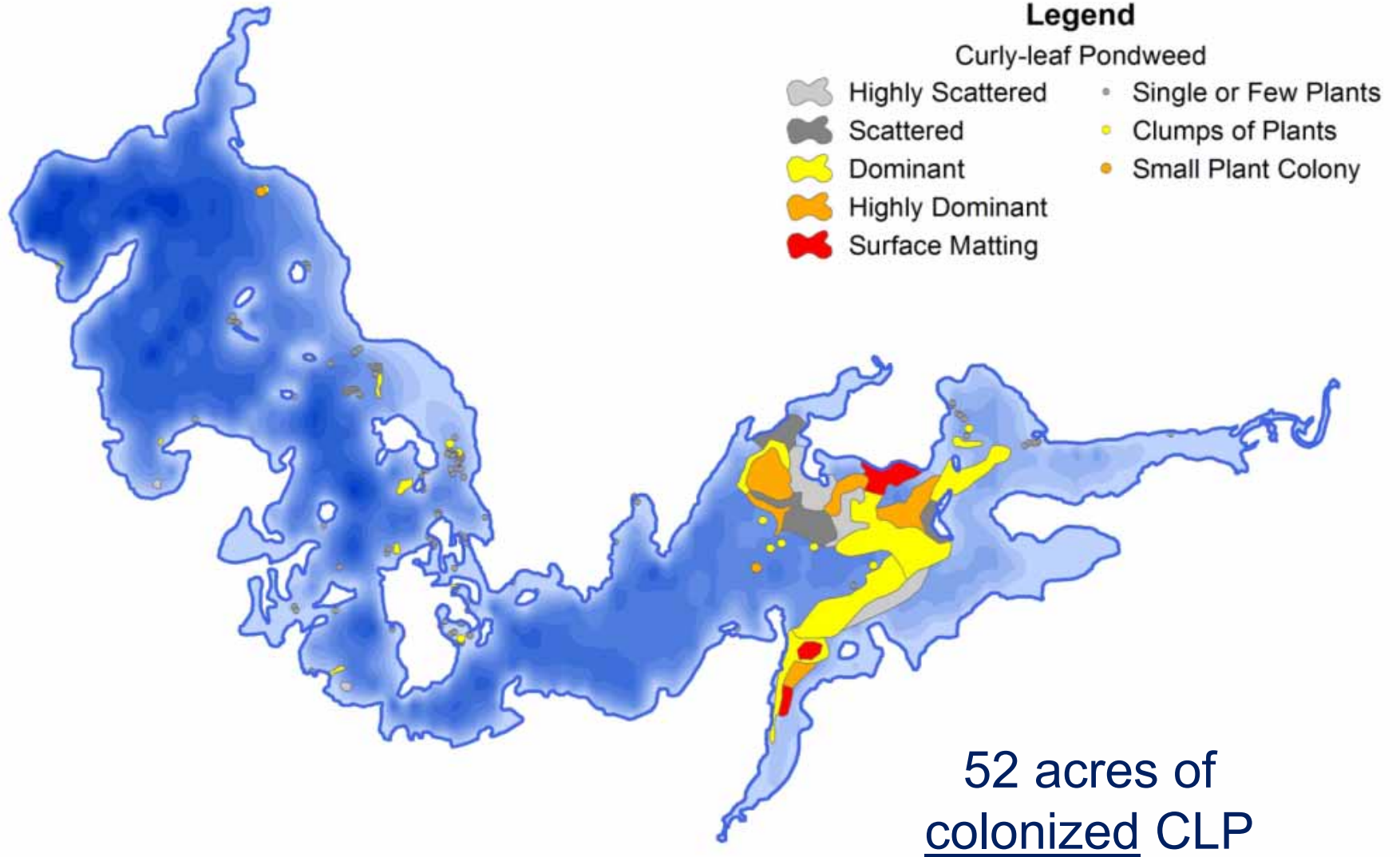
Curly-Leaf



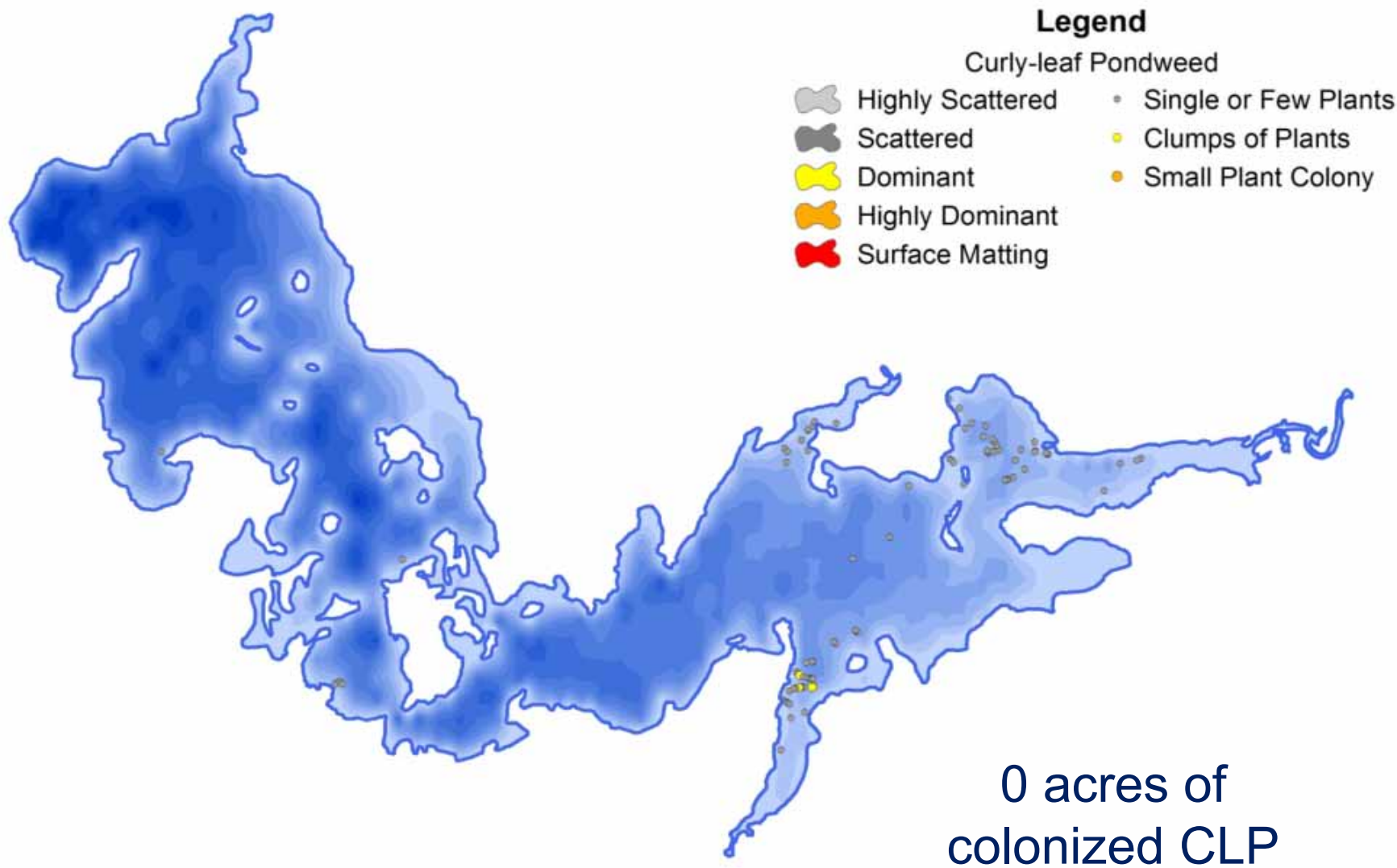
Results:
CLP Colony/Density
Mapping



June 2013 (Pre-Drawdown)



June 2014 (Post-Drawdown)



Results:
CLP turions



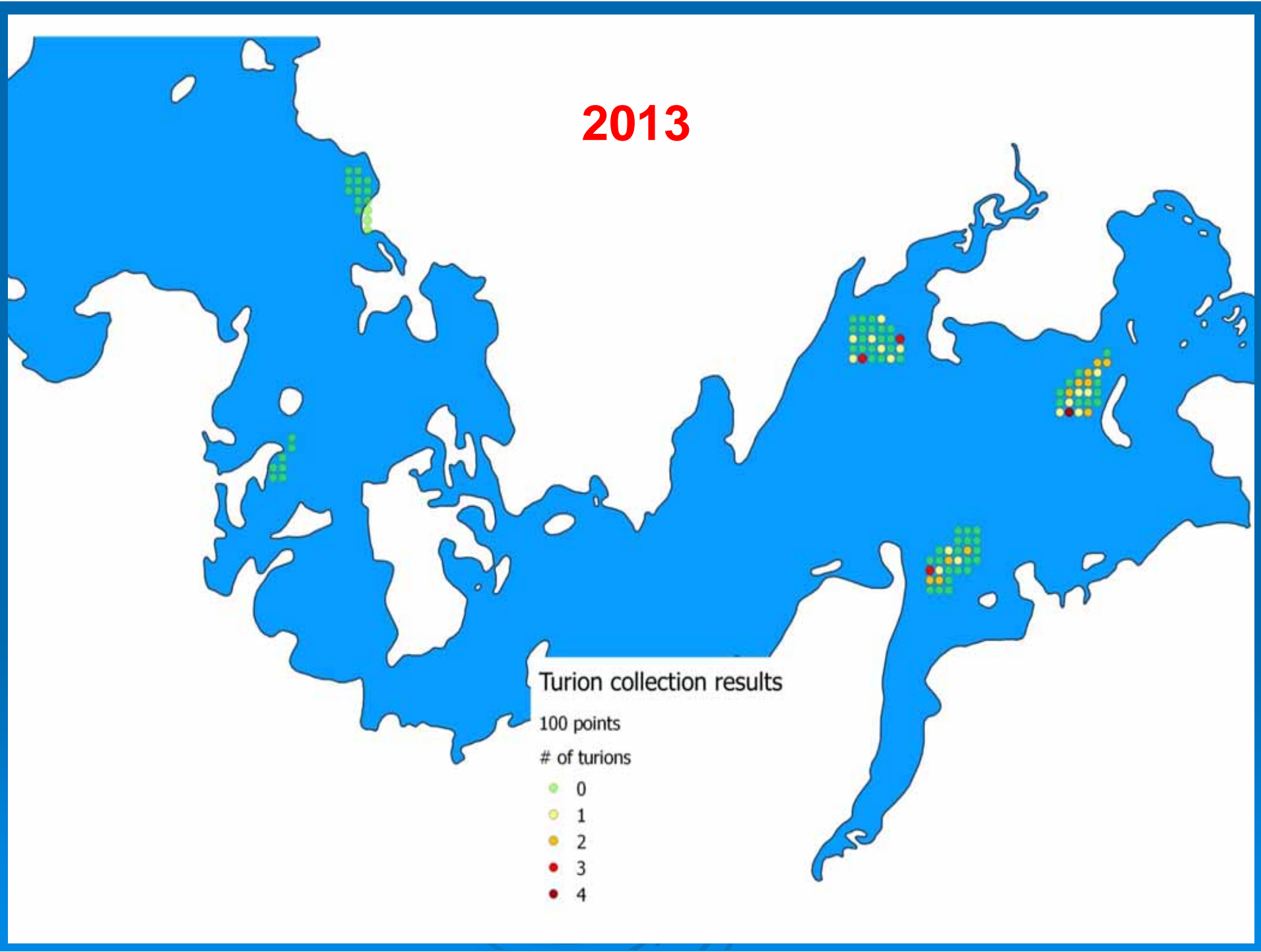
2013

Turion collection results

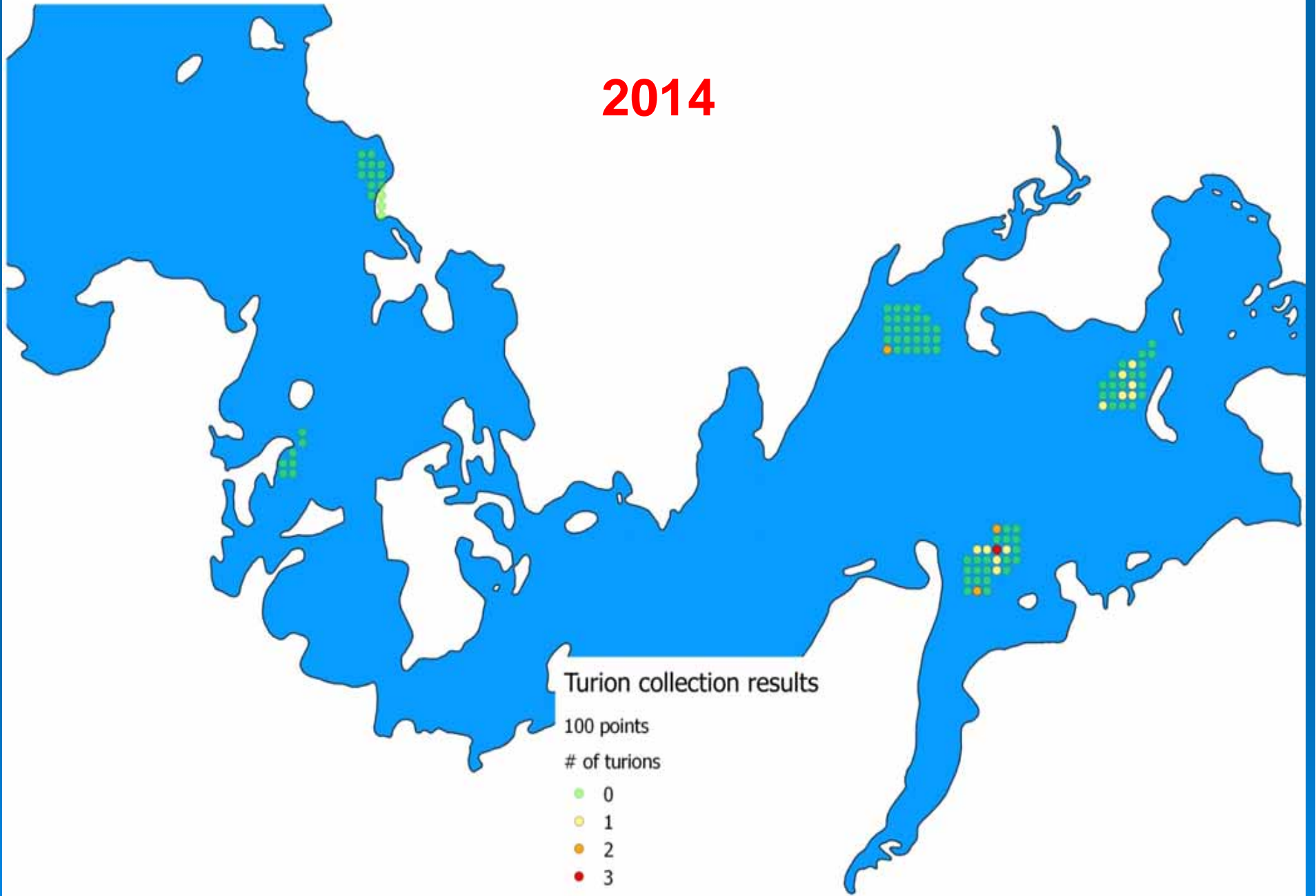
100 points

of turions

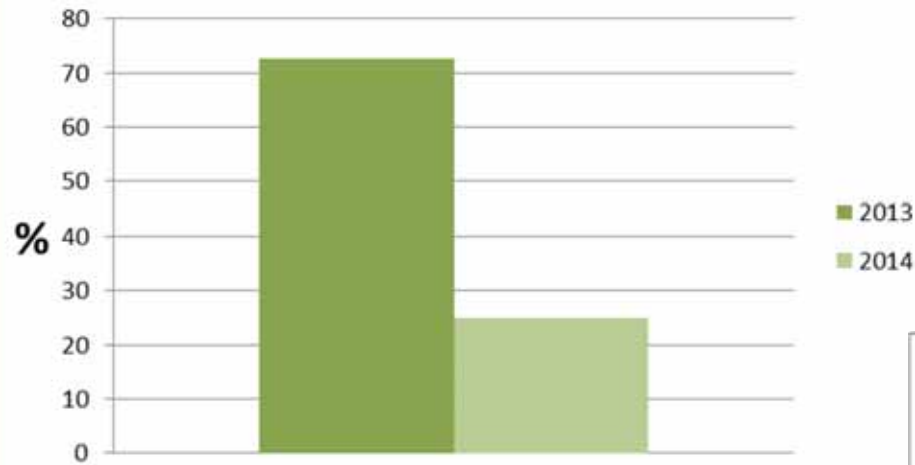
- 0
- 1
- 2
- 3
- 4



2014



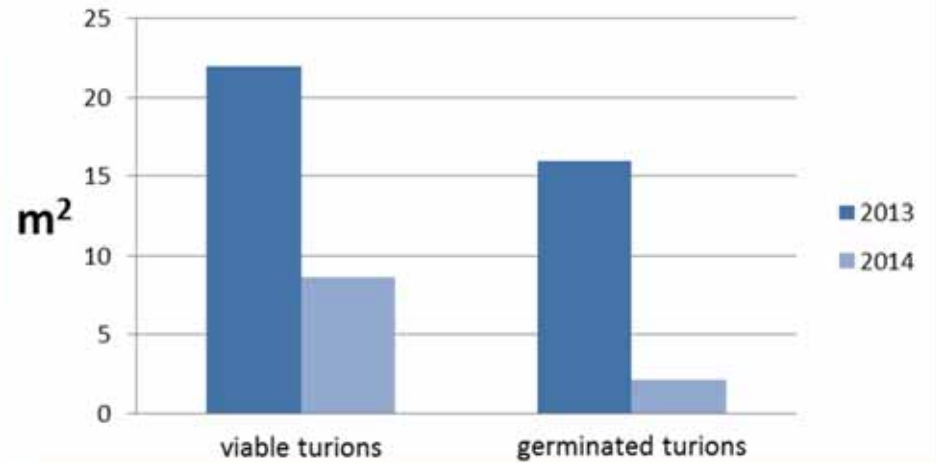
CLP Turion Germination Success



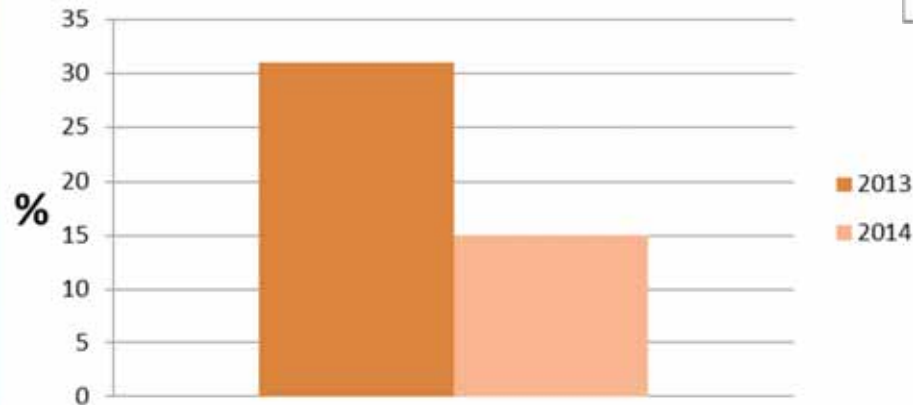
→ 65.5% ↓

60.1% ↓
viable difference

CLP viable turions/m²



Frequency of Occurance of viable turions within sample points



→ 51.6% ↓

Conclusions

- Overall success reducing CLP plants/turions (60-70%)
- Colonized acreage of CLP reduced to 0
- Overall plant biomass reduced (rake fullness)
- Drawdown has impacts on native plant community
- Monitoring to continue in 2015- PI
Survey scheduled for mid-to-late June

Acknowledgments

Special Thanks to Onterra, LLC for providing many graphics for this presentation and being great partners during both of the projects

- Bob Lepke, Price County Dam-tender
- Evan Lund, Price County Conservationist
- Soo Lake United
- Musser Flowage Lake Association
- WDNR Staff

Questions?

