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

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Biological</th>
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<tbody>
<tr>
<td>Selective</td>
<td>Weevils</td>
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<td>Contact</td>
<td>Beetles</td>
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<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Physical</th>
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<tbody>
<tr>
<td>Manual</td>
<td>Drawdown</td>
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<tr>
<td>Harvesting</td>
<td>Bottom Barriers</td>
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<td>Dredging</td>
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*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
Lac Sault Dore Water Levels

Drawdown Water Levels

September 2010 - May 2011

Feet Below Full Pool

<table>
<thead>
<tr>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
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- Initial water level
- Seasonal variations
- Peak and low points
- Recovery trend
Plant Depths - pre drawdown

Drawdown depth - 6ft
Monitoring Methods

- Objective: Evaluate response of EWM and native plants to drawdown
  - 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
Results:
EWM – Point-intercept Survey
Frequency of Occurrence for EWM in 2010 (pre-drawdown)

Whole-lake PI Survey

93%
PI Survey Results – changes in frequency of occurrence

- Statistically valid change in occurrence from previous year (Chi-square α = 0.05)
- Statistically valid change in occurrence from 2010 to 2012 (Chi-square α = 0.05)
PI Survey - Summary Stats

*Error bars represent Inner Quartile Range*
2010 PI: EWM
1Y Pre-Drawdown

Point-Intercept Survey
- Contains EWM
- Location without EWM
2011 PI: EWM
1Y Post Drawdown

Point-Intercept Survey
- Contains EWM
- Location without EWM
2012 PI: EWM
2Y Post Drawdown
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

Legend
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- Surface Matting
Results:
Floating-leaf & Emergent Community Mapping
2010
Emergent/Floating-leaf Community
Mapping
1 Year Pre-drawdown
Plant Community 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
- Emergent
- Floating-leaf
- Mixed Emergent & Floating-leaf

Large Plant Communities
- 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)
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 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

- Drawdown depth

<table>
<thead>
<tr>
<th>Depth Bin (feet)</th>
<th># Sites</th>
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<tbody>
<tr>
<td>1</td>
<td>9</td>
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<tr>
<td>3</td>
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<td>5</td>
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<td>39</td>
<td>1</td>
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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
Survey methods follow: Aquatic Plant Management in WI Appendix D - Aquatic Plant Treatment Evaluation

Sub-sample PI Survey

233 sampling points
20 meter spacing

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

100 points
20 meter spacing

Completed by WI-DNR:
Sept. 4 2013
Sept. 9 2014

Methodology based upon:
Madsen 1999; Woolf and Madsen 2003
Turion Field Collection Method
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

Results:
Point-intercept Survey
## Plant Lists

<table>
<thead>
<tr>
<th>2013</th>
<th>2014</th>
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</thead>
<tbody>
<tr>
<td>Brasenia schreberi</td>
<td>Acorus americanus</td>
</tr>
<tr>
<td>Ceratophyllum demersum</td>
<td>Brasenia schreberi</td>
</tr>
<tr>
<td>Ceratophyllum echinatum</td>
<td>Ceratophyllum demersum</td>
</tr>
<tr>
<td>Elodea canadensis</td>
<td>Ceratophyllum echinatum</td>
</tr>
<tr>
<td>Elodea nuttallii</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Equisetum fluviatile</td>
<td>Elodea canadensis</td>
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<tr>
<td>Lemna minor</td>
<td>Elodea nuttallii</td>
</tr>
<tr>
<td>Lemna turionifera</td>
<td>Equisetum fluviatile</td>
</tr>
<tr>
<td>Myriophyllum verticillatum</td>
<td>Lemna minor</td>
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<tr>
<td>Nitella sp.</td>
<td>Nitella sp.</td>
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<tr>
<td>Nuphar vareigata</td>
<td>Nuphar vareigata</td>
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<td>Potamogeton amplifolius</td>
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<tr>
<td>Potamogeton crispus</td>
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<td>Potamogeton natans</td>
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<td>Potamogeton natans</td>
<td>Potamogeton pusillus</td>
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<tr>
<td>Potamogeton pusillus</td>
<td>Potamogeton robbinsii</td>
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<tr>
<td>Potamogeton spirillus</td>
<td>Potamogeton zosteriformis</td>
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<tr>
<td>Potamogeton zosteriformis</td>
<td>Ranunculus aquatilis</td>
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<tr>
<td>Schoenoplectus tabernaemontani</td>
<td>Sparganium angustifolium</td>
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<tr>
<td>Sparganium fluctuans</td>
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<td>Spirodel a polyrhiza</td>
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<tr>
<td>Utricularia vulgaris</td>
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<tr>
<td>Wolffia sp.</td>
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<tr>
<td>Zizia na palustris</td>
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<tr>
<td>Aquatic Moss</td>
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<tr>
<td>Filmentous algae</td>
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<tr>
<td>Ricca sp.</td>
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<tr>
<td>Carex sp.</td>
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*Indicates found in 2013 but not 2014

*Indicates found in 2014 but not 2013
PI Survey Stats

- Points w/ vegetation: 181 (2013 pre-drawdown) vs. 127 (2014 post-drawdown)
- Species Richness: 25 (2013 pre-drawdown) vs. 23 (2014 post-drawdown)
- FQI: 32.456 (2013 pre-drawdown) vs. 30.7 (2014 post-drawdown)

CLP Stats from PI Survey

- Frequency of Occurrence (%): 14.2 in 2013 vs. 9.3 in 2014
- Relative Frequency (%): 8.1 in 2013 vs. 3.6 in 2014

63% decrease
June 2013 (Pre-Drawdown)

Legend
- No Vegetation
- Total Rake Fullness = 1
- Total Rake Fullness = 2
- Total Rake Fullness = 3
- Below Max Depth of Plant Growth
- Non-navigable/Temporary Obstacle
June 2014 (Post-Drawdown)

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

No Vegetation  Rake-fullness = 1  Rake-fullness = 2  Rake-fullness = 3
Results:
CLP Sub Point-intercept Survey
Sub PI Survey

Legend
Curly-Leaf Pondweed
- Not present
- Rake Fullness = 1
- Rake Fullness = 2
- Rake Fullness = 3

Extent of above images shown in red

Curly-Leaf

75%
Results:
CLP Colony/Density Mapping
June 2013 (Pre-Drawdown)

Legend
- Curly-leaf Pondweed
- Highly Scattered: Single or Few Plants
- Scattered: Clumps of Plants
- Dominant: Small Plant Colony
- Highly Dominant
- Surface Matting

52 acres of colonized CLP
June 2014 (Post-Drawdown)

Legend

- Curly-leaf Pondweed
- Highly Scattered (Single or Few Plants)
- Scattered (Clumps of Plants)
- Dominant (Small Plant Colony)
- Highly Dominant
- Surface Matting

0 acres of colonized CLP
Results:
CLP turions
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?