

Chautauqua Lake Symposium NCSU Update

North Carolina State University

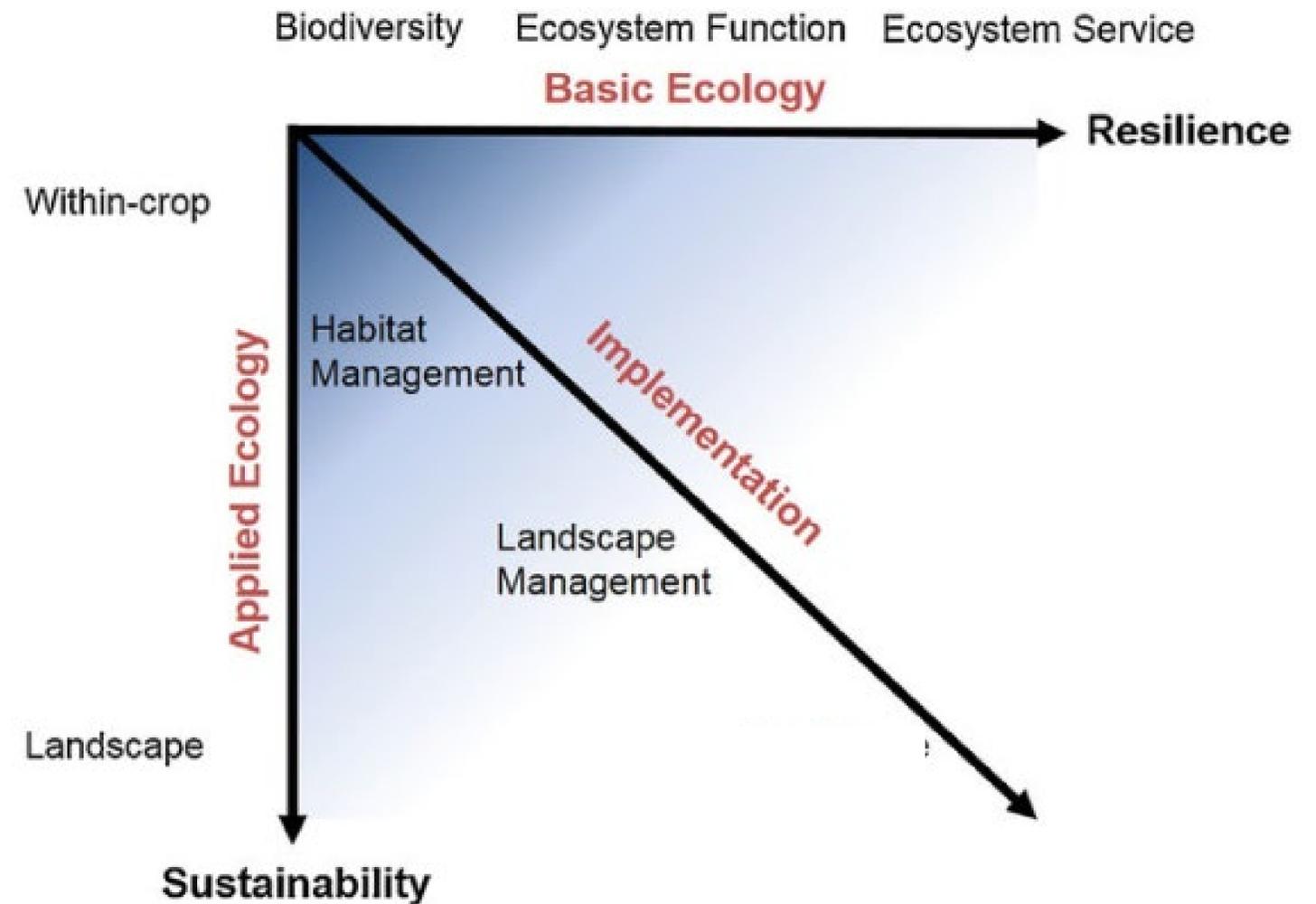
Raleigh, NC

Topics

- 1) Aquatic Vegetation and Applied Research**
- 2) Long Term Management Plan**

Applied Ecological Research for Aquatic Plant Management

- Address practical unknowns or problems with specific questions that can improve existing practices
- Can focus on solving operational challenges:
 - Water quality
 - Invasive species control
 - Ecosystem restoration
- Findings are used to develop practical solutions
- Provides opportunity to solve problems and improve existing management



Conceptual framework between the intersection of basic ecology, applied ecology, and implementation by Landis (2016)

Linking Plant Biology to Management

- Each weed species will have different biological characteristics regarding growth, reproduction, etc.
- Management techniques need to reduce growth and interfere with reproduction
- Poor timing can make management fail
- Tools that look good in the short term may not hold up on a year to year basis



Linking Plant Biology to Management

- Understanding species biology is important for targeting sensitive areas in the life cycle
- Species that produce propagules are more difficult to manage than those that don't
- Hydrilla may require 10 years of treatment to deplete the turion bank

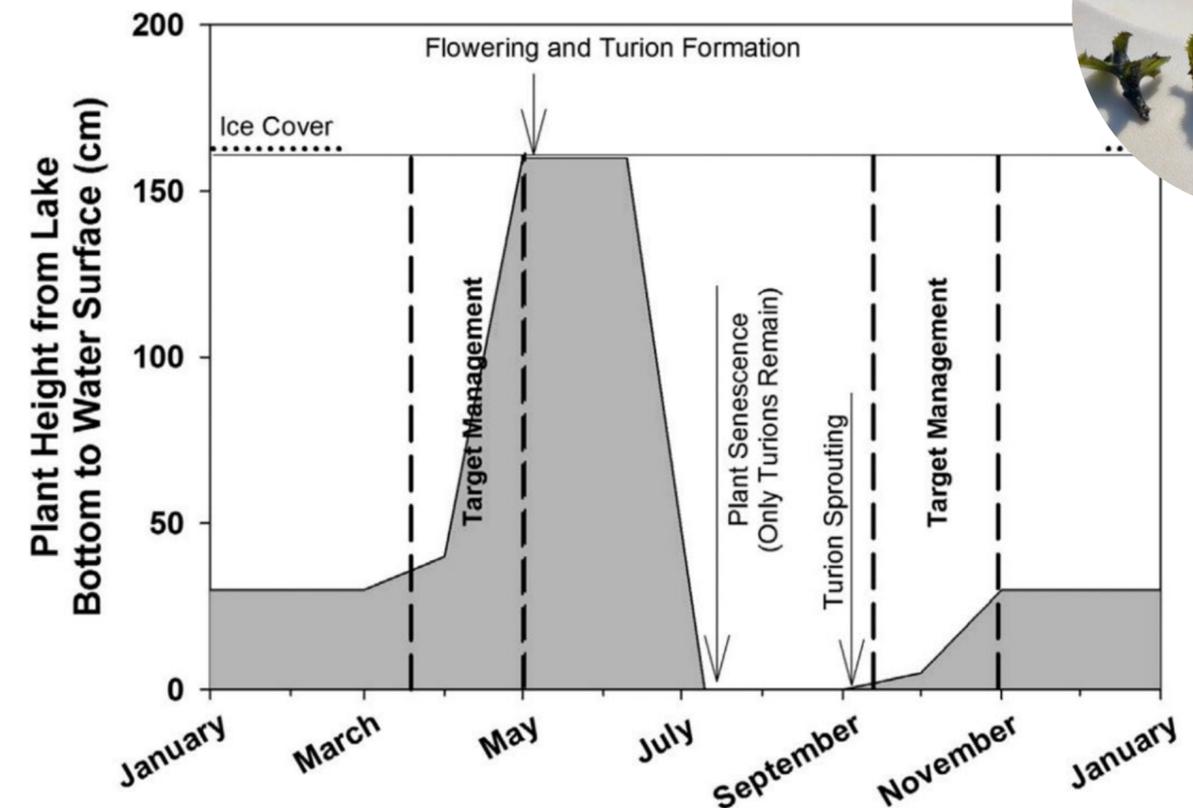


Figure 3. Conceptual diagram based on curlyleaf pondweed phenology for timing management based on seasonal phenology (adapted from Turnage et al. in press).

Chautauqua Lake

Management Challenges



- **Invasive Species**

- Curly Leaf Pondweed
- Eurasian Watermilfoil
- Water Chestnut
- Brittle Naiad
- Starry Stonewort
- Common Carp
- Goldfish
- Zebra Mussels
- Asian Clam

- **Water Quality**

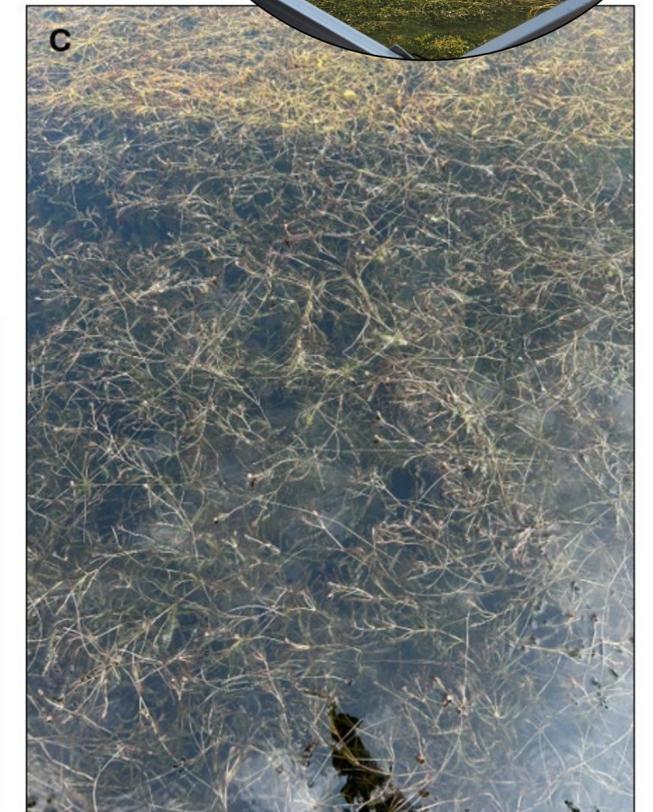
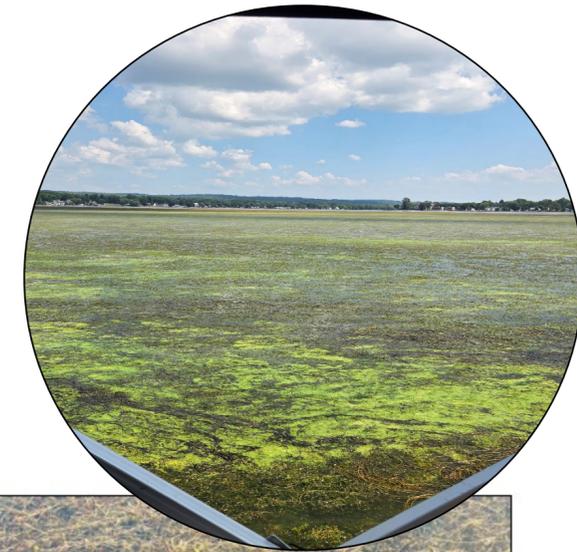
- HAB's

- **Nutrient Loading**

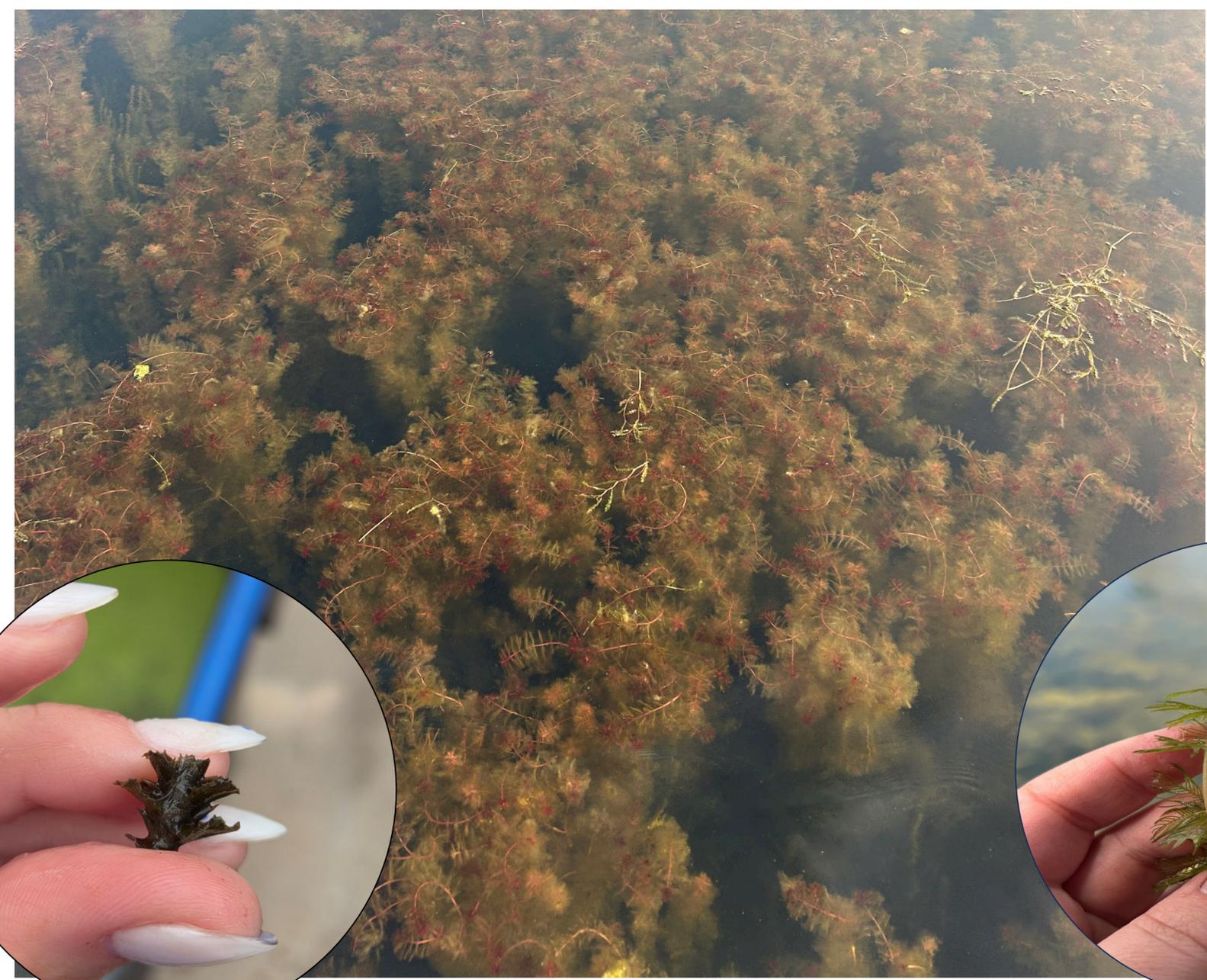
- Watershed Runoff
- Legacy nutrients
- Excessive Plant Growth

Curlyleaf Pondweed and Eurasian Watermilfoil

- CLP and EWM both thrive in eutrophic waters
- Senescence of CLP may increase available nutrients
 - How does this relate to increase SAV growth or algal blooms?
- Strategic management can be beneficial to reduce nutrient release
 - Aim to reduce CLP biomass and turion production, different treatment strategies for CLP and EWM
- Danger of Harmful Algal Blooms
 - Potential to produce toxins harmful to humans and ecosystem function



Curlyleaf Pondweed and Eurasian Watermilfoil in Chautauqua Lake



Why Are Long Term Plans Needed?

- Inconsistent management generally fails to reduce invasive plant populations, increases expenses, and may not account for desirable species

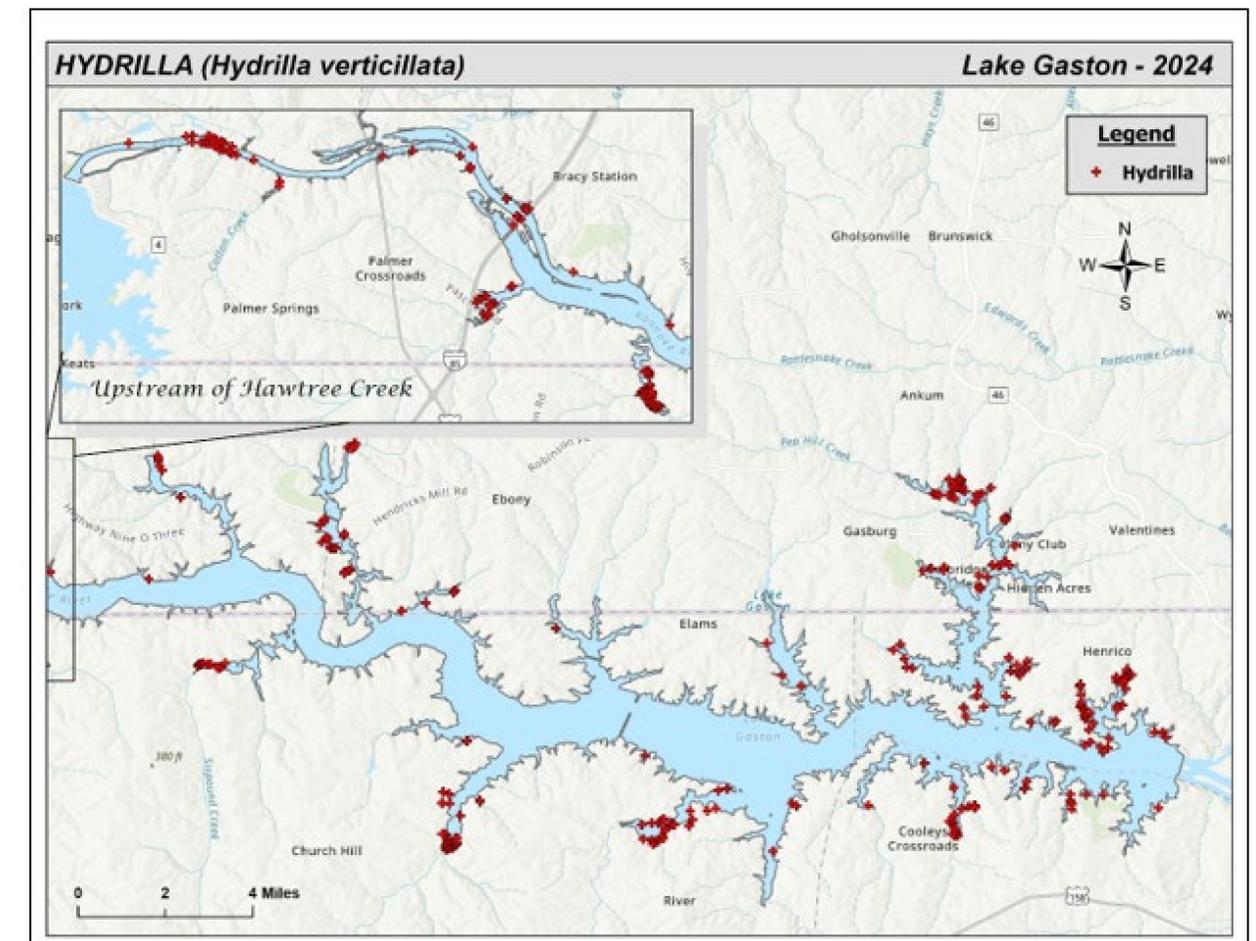
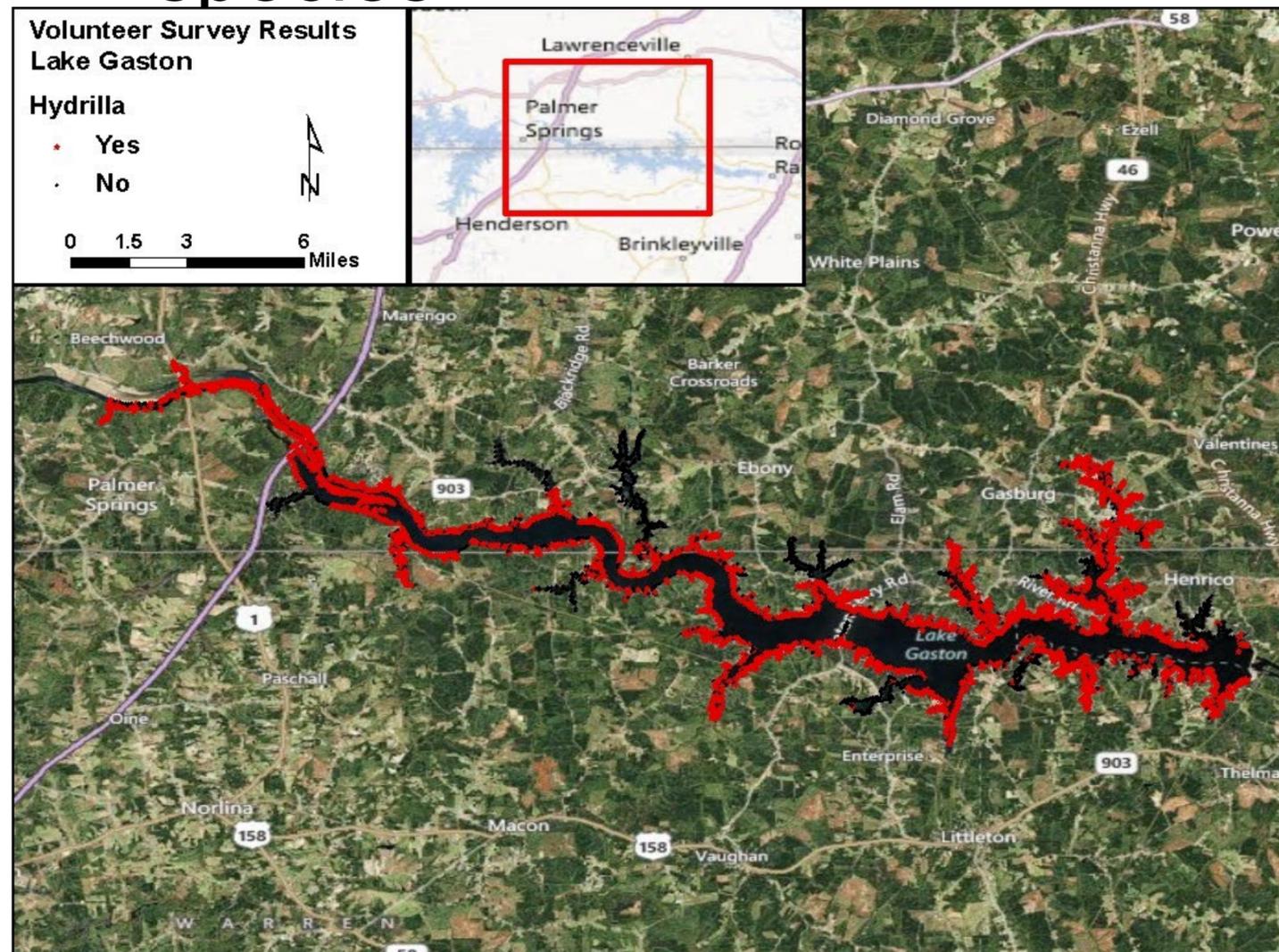


Figure 6. Map indicating sites where hydrilla was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2024. Hydrilla is a federally noxious weed species and was the most prevalent submersed species found in 2024.

Management Plan Considerations

- Management plans cannot be written in stone, they must be adaptive
- Annual reviews of management effectiveness and species abundance and distribution should be conducted
- Specific applied research should be recommended to address unknown factors that impact invasive plant growth and management
- Management priorities and techniques may change over time

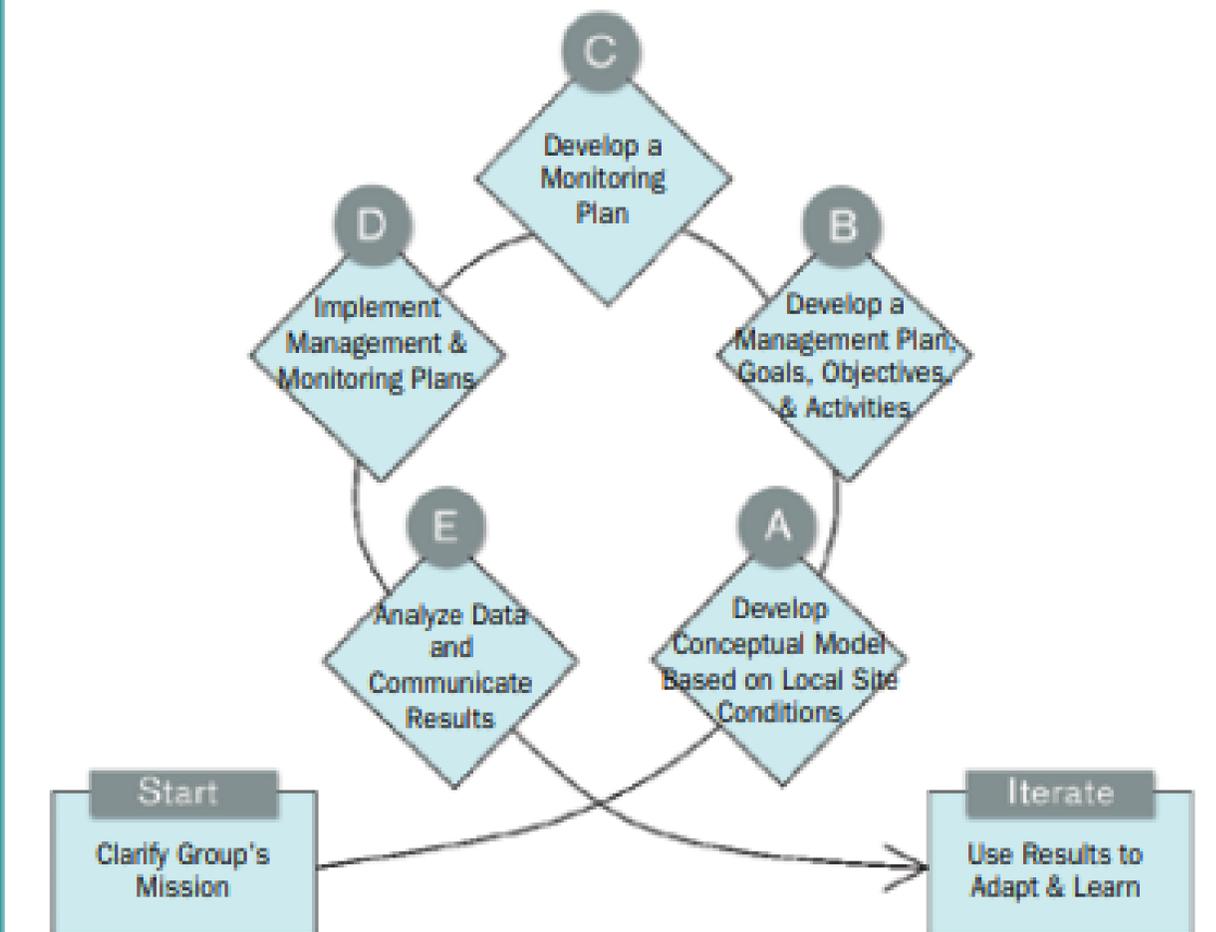


Management Plan Considerations

Applied Research Implications

- **Assessing Site-Specific Data**
 - Reevaluate previous activities to establish feedback loop on effectiveness of management
 - Can be used to perform outreach to engage public and stakeholders in project goals
- **Decision-making**
 - How much and how often should treatment be applied to minimize the proliferation of invasive plants
 - Consideration of non-target and fiscal constraints
- **Adaptive Management**
 - Evolve management strategy to reach shifting goals
 - Identify ways to meet environmental, social, and economic goals while reducing tension among stakeholders

Figure 1. The Adaptive Management Cycle



Source: Adapted from Margoluis & Salafsky 1998.

Applying Management Plans

- Tar River Reservoir goals:
 - Deplete hydrilla propagules
 - Transition to low intensity management
- Assess outcomes and modify as needed

Tar River Reservoir Tuber Bank Attrition

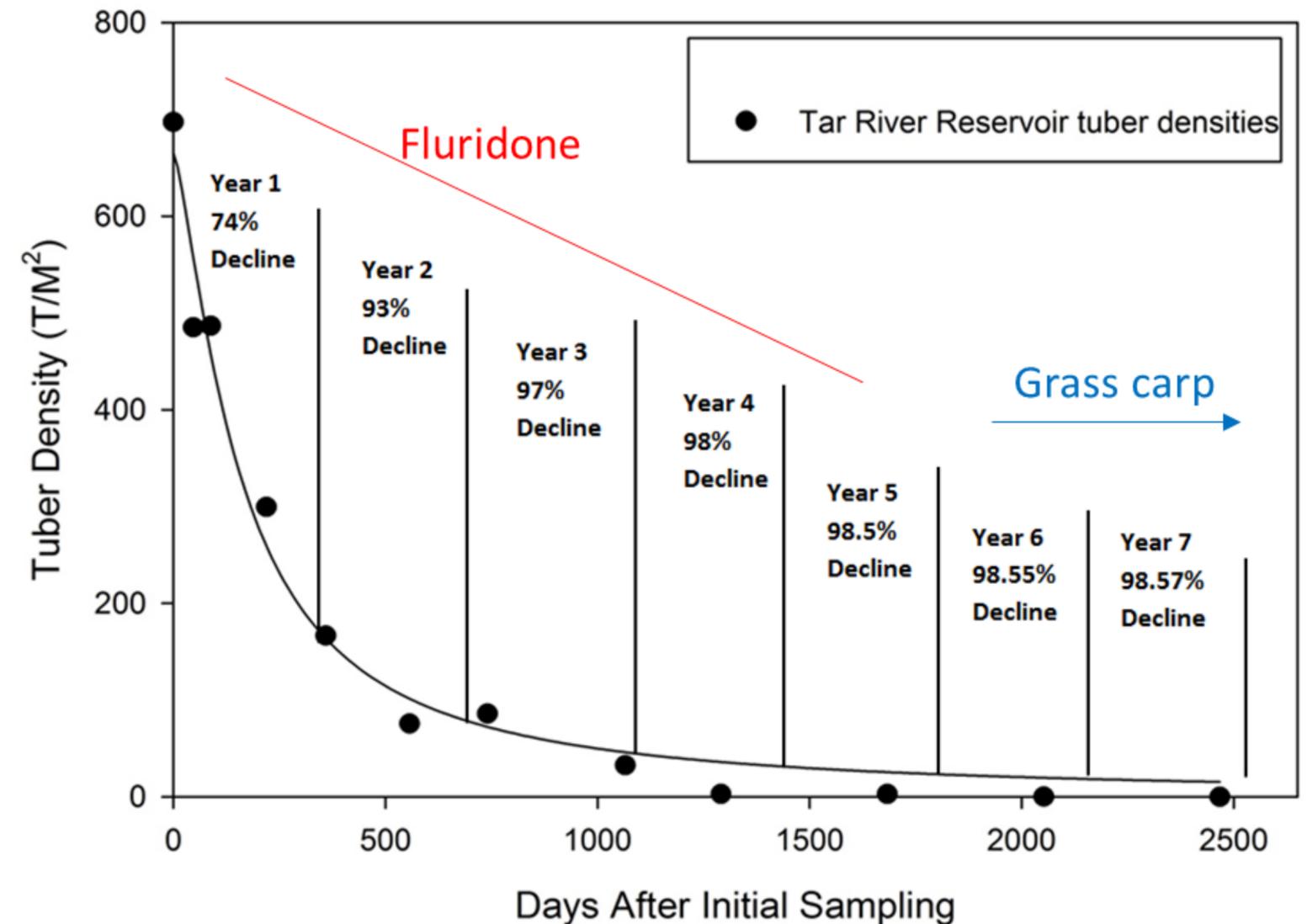
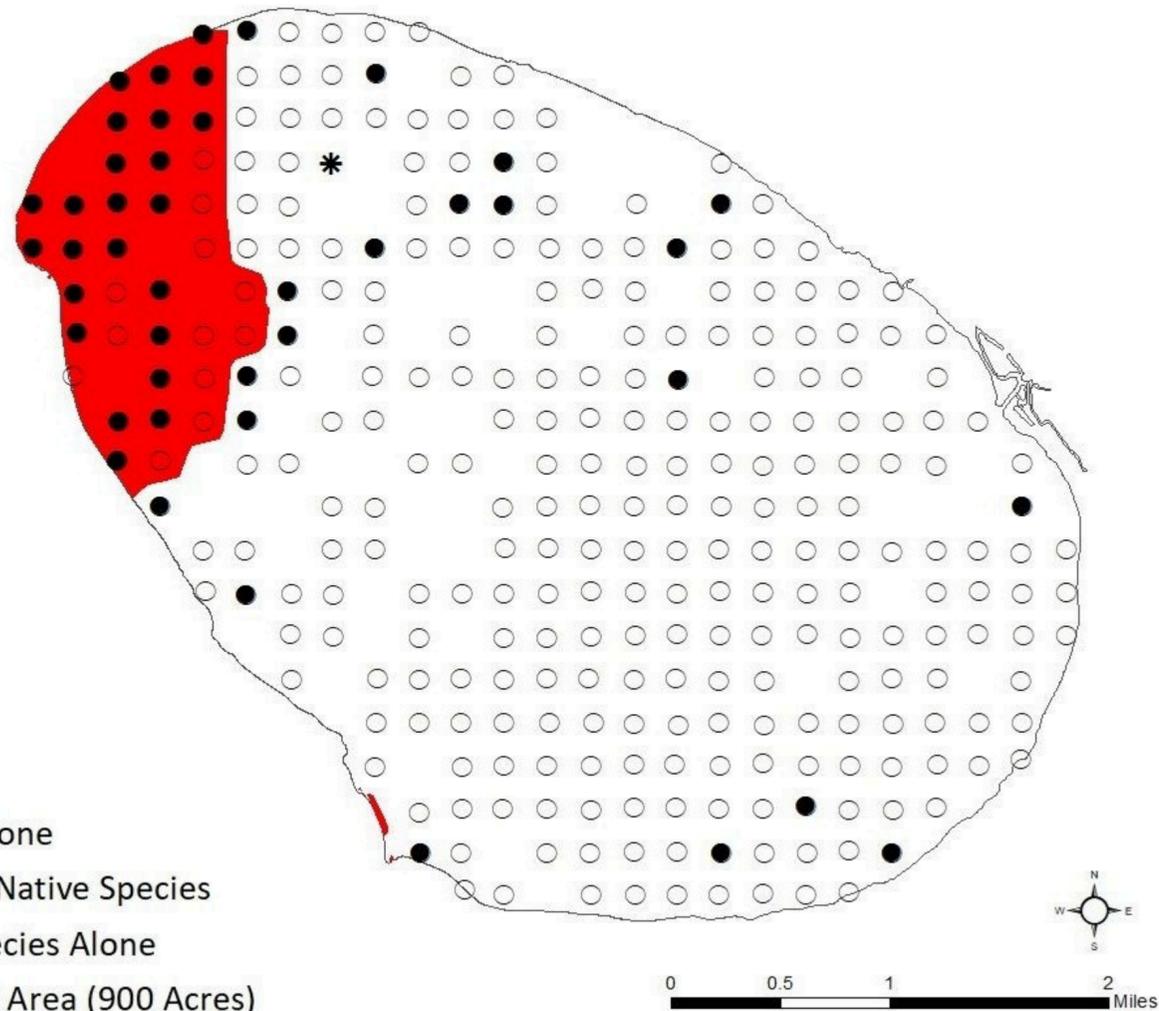


Figure 4. Observed and predicted decline of the averaged tuber bank density in the Tar River reservoir.

Applying Management Plans

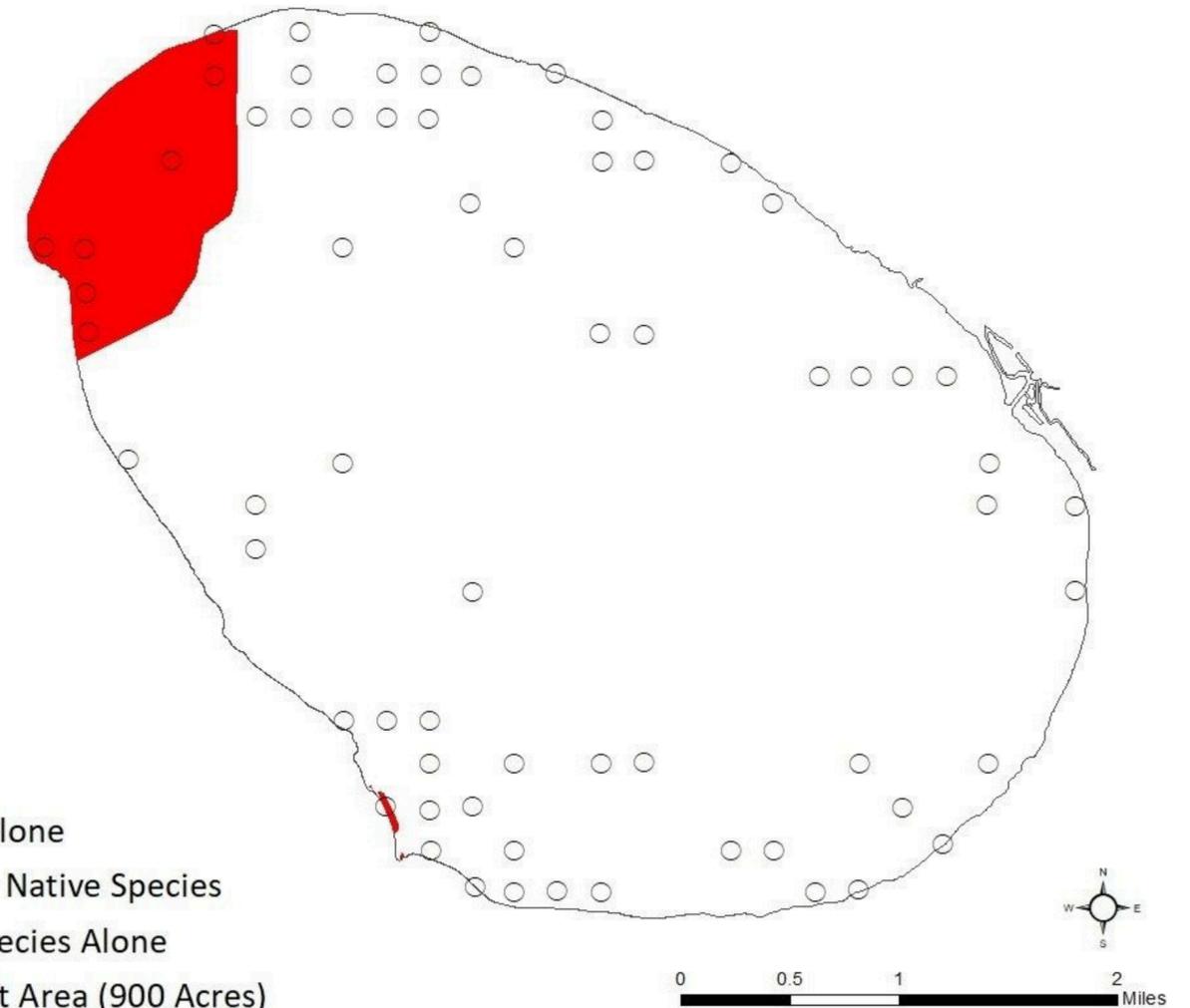
Lake Waccamaw 2012



Legend

- * Hydrilla Alone
- Hydrilla + Native Species
- Native Species Alone
- Treatment Area (900 Acres)

Lake Waccamaw 2018



Legend

- * Hydrilla Alone
- Hydrilla + Native Species
- Native Species Alone
- Treatment Area (900 Acres)

Eno River: Monoecious Hydrilla Management

- 44 Miles Long
- Drains into Falls Lake (reservoir)
- Has exceptional water quality
- Home to numerous rare species including the endangered Panhandle Pebble Snail
- Main attraction of 3,900 acre Eno River State Park
- Hydrilla spread raised concern about impact to native species



Applied Research Projects – Eno River

- Pre-Management Research:
 - Herbicide impacts to riffleweed (primary native plant)
 - Herbicide impacts to non-plant species
 - Grass carp tagging and monitoring
 - River surveys

Environmental Assessment for Controlling the Growth and Spread of a Noxious Aquatic Weed, *Hydrilla verticillata*, in the Eno River Watershed.

February 2015



Above photo: Hydrilla infesting the Eno River at the Pleasant Green access, Eno River State Park, Orange County, NC. Photo taken by Erik Nygard, 2011.

Authored by: Eno River Hydrilla Management Task Force

Edited by:

Jimmy Dodson, NCDENR- Division of Parks and Recreation, 919-707-9330

Rob Emens, NCDENR- Division of Water Resources, 919-707-9012

Drew Gay, NCDENR- Division of Water Resources, 919-707-9020

Management Outcomes

August conditions at Pleasant Green: 2011 before management (top) and 2016 post two years of treatment (bottom)



Management Success



Native, desirable Riffleweed

Management Plan for Chautauqua Lake

LONG-TERM MANAGEMENT PLAN
FOR SUBMERSED AQUATIC VEGETATION
AT CHAUTAUQUA LAKE, NY



2024 - 2028

NC STATE UNIVERSITY
 Aquatic Plant Management Program

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Vision

The goal of this project is to achieve a balanced and sustainable aquatic ecosystem at Chautauqua Lake. Objectives include reducing the nuisance level of invasive species and maintaining or increasing the relative distribution of native species. Integrated management of invasive species is encouraged as well as monitoring of both invasive and non-native species. Implementation of this plan will be based on set priorities and will occur in defined stages to ensure that progress is completed according to a systematic design. Annual reviews should be conducted of the plan, management effectiveness, and lake surveys.

Specific Goals

The goals of this long-term plan include:

- Reduce the nuisance level of Eurasian Watermilfoil and Curly-Leaf Pondweed in the Chautauqua Lake system.
- Identify control measures for Starry Stonewort in Chautauqua Lake.
- Encourage native submersed aquatic vegetation species diversity throughout the system, with particular focus on South Basin assembly
- Limit continued spread of non-native species in the Chautauqua Lake watershed
- Shift algal community away from cyanobacterial dominance
- Support the local fishery, especially the established game fish population

Plan Components

- Plan Manager
 - Ideally, oversight is organized through a central entity
 - Lake Manager or equivalent
 - Works directly with local and state agencies
 - Collaborate with executive board



Plan Components

- Integrated Management
 - Defined lake areas
 - Long Term Management
 - Short Term Management
 - Maintenance Management
 - Habitat Protection
 - Biological, Chemical, and Mechanical Control Techniques
- Long Term Management
 - Target vegetation well established
 - High Use Areas
- Habitat Protection
 - Limited to low-impact management only
 - Contain rare species, sensitive habitat, high biodiversity, etc.

Plan Components

Table 5. Tiered management area focus over a 5 year timeframe

Year 1	<p>Tier 1: <i>Long-term management zones</i></p> <ul style="list-style-type: none"> - Consistent documented EWM growth (delineated from Fall survey) and CLP growth (delineated from Spring survey) - Any growth within 100 feet of High Use Areas 	<p>Habitat Protection Zones <i>Limited, low impact management</i></p> <ul style="list-style-type: none"> - Presence of rare, threatened or endangered aquatic plant species (delineated from Fall survey) - High aquatic plant diversity areas (delineated from Fall survey) - Sensitive fish spawning sites 		<p>Tier 3: <i>Maintenance Management</i></p> <ul style="list-style-type: none"> - Spot treatments as needed outside of Tier 1 and Tier 2 areas - Previously managed areas prior to development of long-term plan
Year 2				
Year 3				
Year 4				
Year 5				

Vegetation Surveys

- Monitoring is critical for integrated management programs
 - Is the pest present? (required for herbicide permitting)
 - How much target vegetation is present?
 - Where are the weeds?
 - Are rare species present?
 - How effective was previous management?
 - Is the plan working?
 - Has anything new moved into the lake?
- Surveys tell what is present at a specific time point. Different life cycles may require different survey timings for adequate mapping.

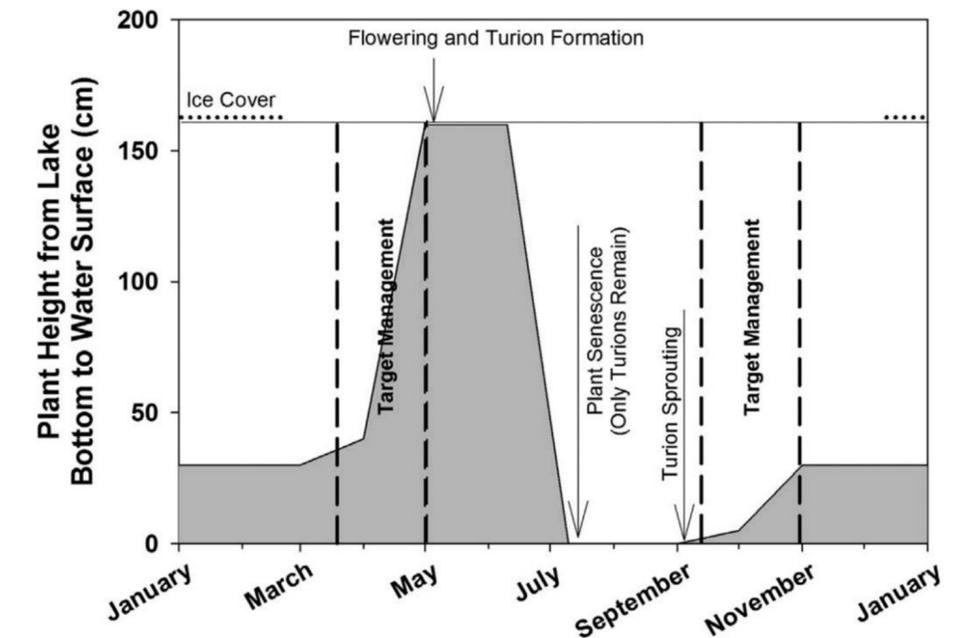


Figure 3. Conceptual diagram based on curlyleaf pondweed phenology for timing management based on seasonal phenology (adapted from Turnage et al. in press).

Target Areas and Species Timing

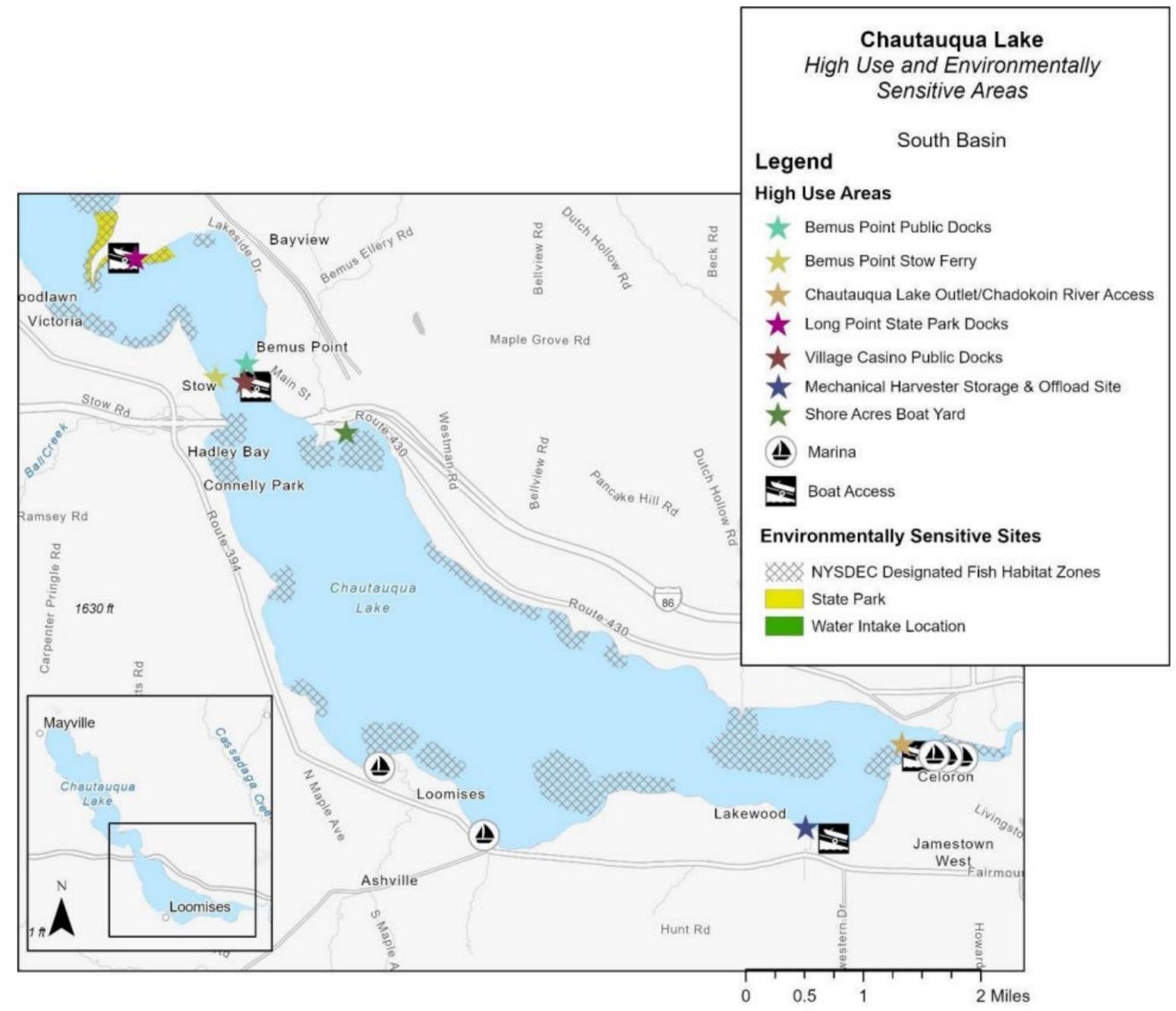
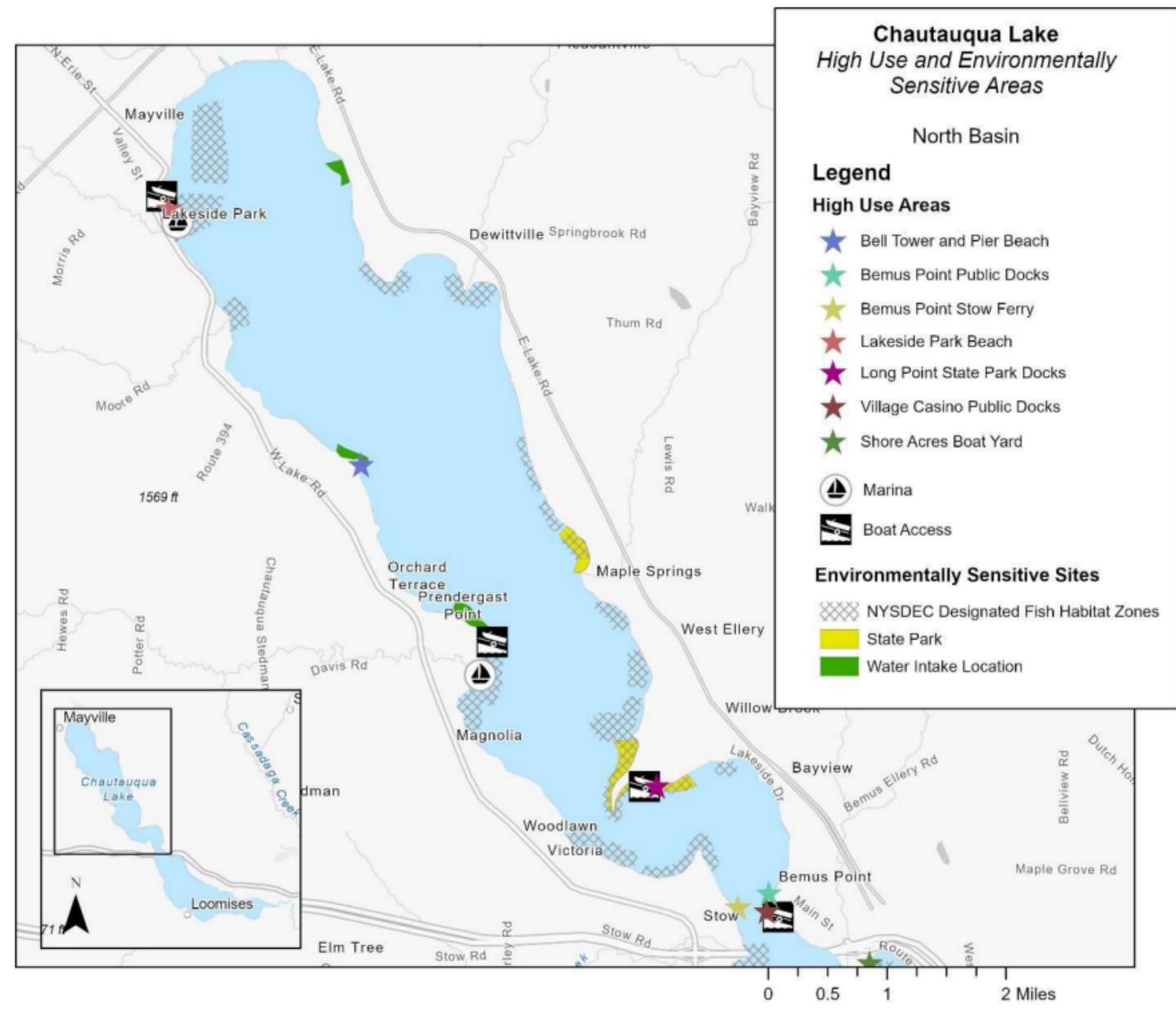


Figure 16. Major use and environmentally sensitive areas at Chautauqua Lake – North Basin

Figure 17. Major use and environmentally sensitive areas at Chautauqua Lake – South Basin

2026 Management Plan Update

2026 Update Focus:

- Incorporation of 2025 survey results; updated priority management area maps
- Expansion on management strategy recommendations and refine guidelines
- Incorporation of review comments from original document

Chautauqua Lake Management Plan

Adaptive Updates Over Time

- An adaptive management plan should consider:
 - Follow-up monitoring to track management
 - Changes in SAV abundance and distribution over time
 - Management assessment
 - Incorporation of actual vs. expected management outcomes
 - Outcomes and incorporation of applied research studies
 - Stakeholder input and shifting goals

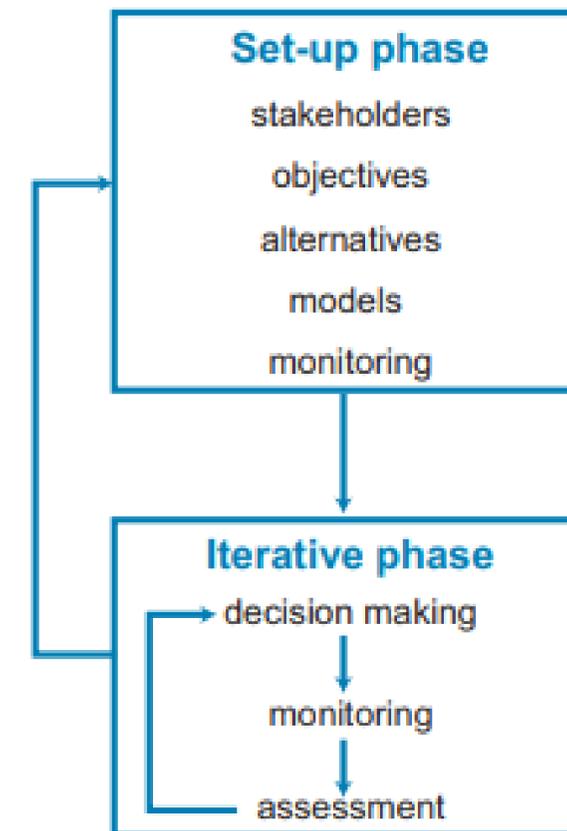


Figure 3.4. Two-phase learning in adaptive management. Technical learning involves an iterative sequence of decision making, monitoring, and assessment. Process and institutional learning involves periodic reconsideration of the adaptive management set-up elements.

Pending NCSU Research

- NYDEC Invasive Species Grant 2026 – In Review
 - Comprehensive Survey Analysis (2020 – 2025)
 - Optimizing management strategies for CLP and EWM
 - Investigating CLP seasonal growth influence on SAV species diversity
- Evaluating longevity of CLP turion bank



Presentation Summary

- A formal, adaptive management plan is beneficial, especially in complicated systems
- Vegetation surveys are essential for understanding system dynamics and for monitoring management efforts
- Multiple management techniques are available; the “best” tool will depend on site parameters, human dimensions, and plant biology
- Management techniques should be designed to not only remove weeds, but interfere with reproduction and long-term population sustainability

Questions?

