

# Rooted in Water

## Understanding Aquatic Plants in Our Lakes

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# Overview

- **Background** – macrophyte ecology 101
  - What is a macrophyte?
  - What role do they play in aquatic ecosystems?
- **Native macrophytes** – the “good”
- **Invasive macrophytes** – the “bad”
- **Macrophyte management** – approaches and case study

# Background

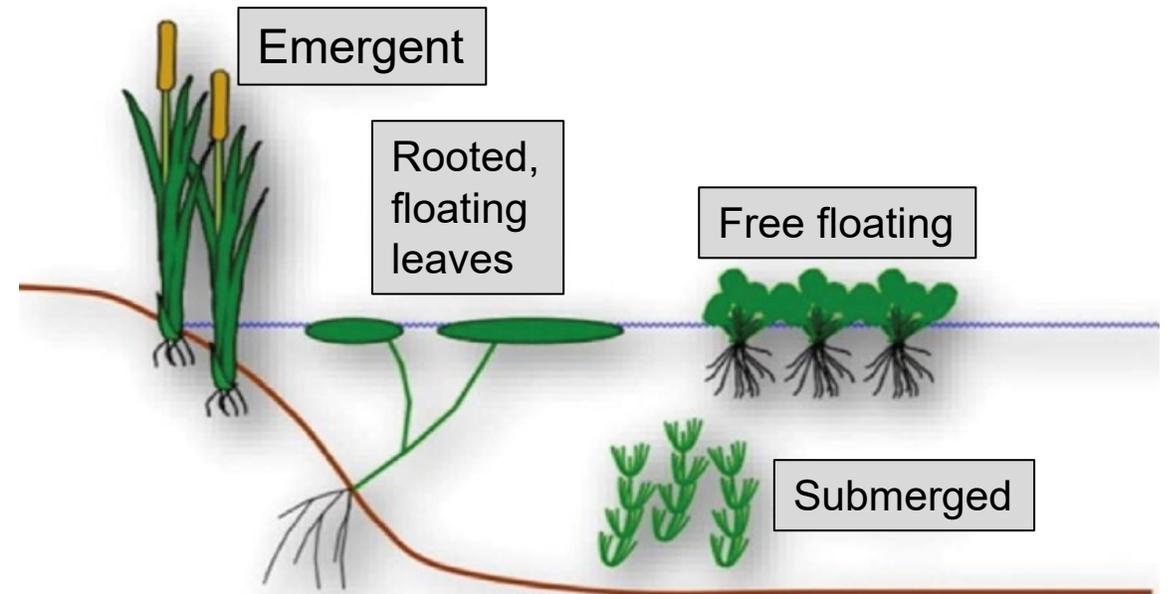
What is a macrophyte?

# Macrophyte

**Large**

Visible to the eye  
(contrast – micro)

**Plant**



Alarcón-Herrera *et al.* (2018)

*“A (usually aquatic) plant visible to the naked eye”*

*- Oxford English Dictionary*

# Background

## Where are macrophytes?

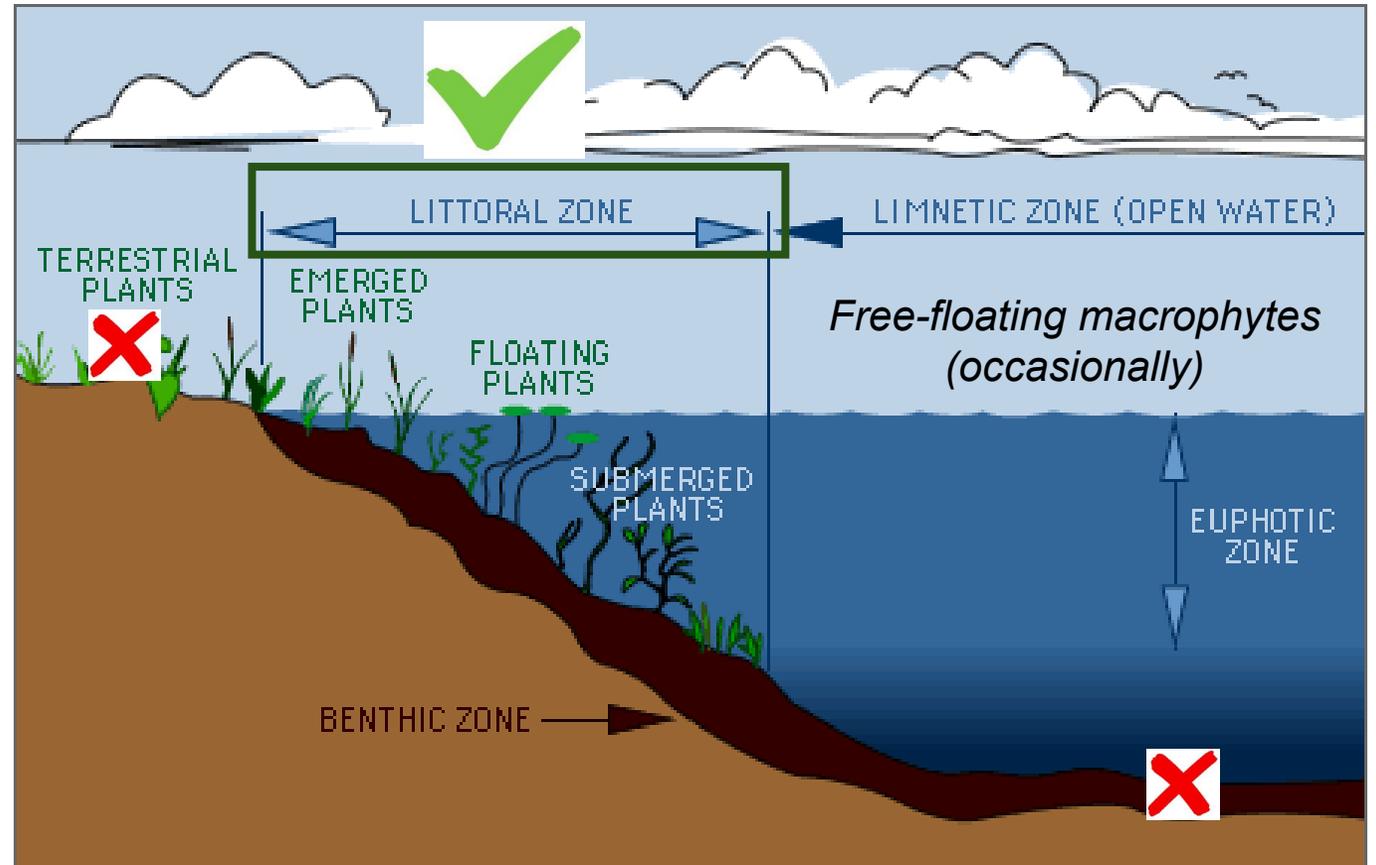
Typically\*, where there is:

- Substrate (sediment)
- Light
- Water (permanent/seasonal)

\* exception, free-floating macrophytes



e.g., Duckweed

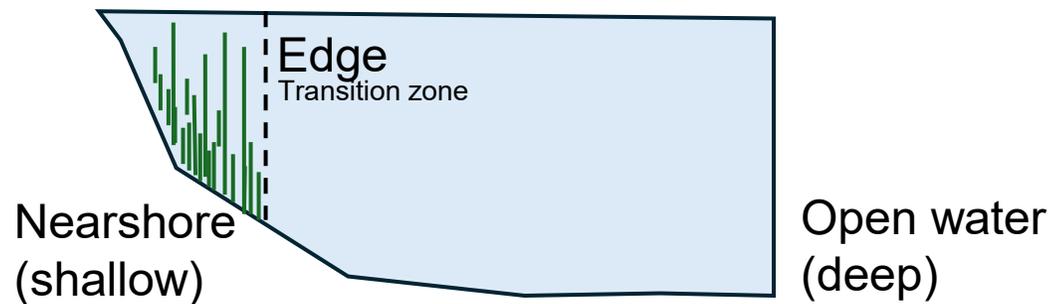


# Background

## Benefits of macrophytes

### (1) Habitat

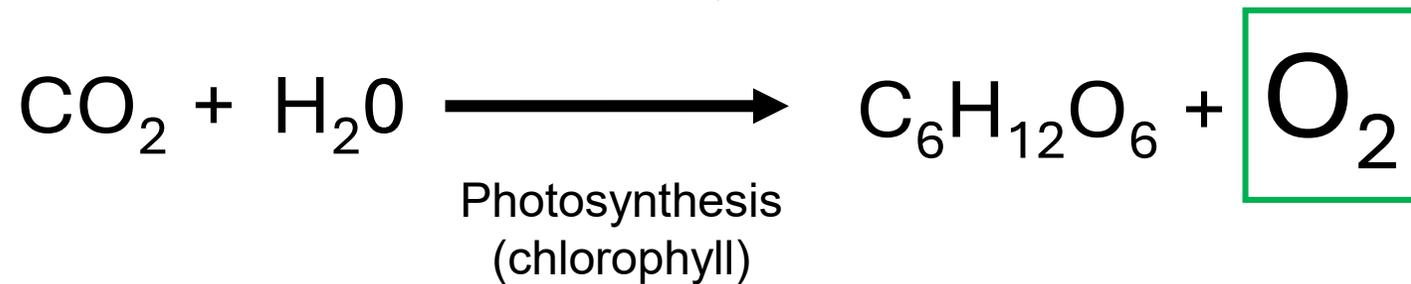
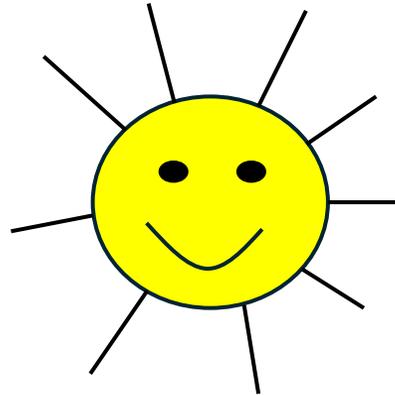
- Spawning and nursery areas
- Waterfowl feeding areas
- Amphibian breeding
- Edge habitat - complexity



# Background

## Benefits of macrophytes

### (2) Oxygen

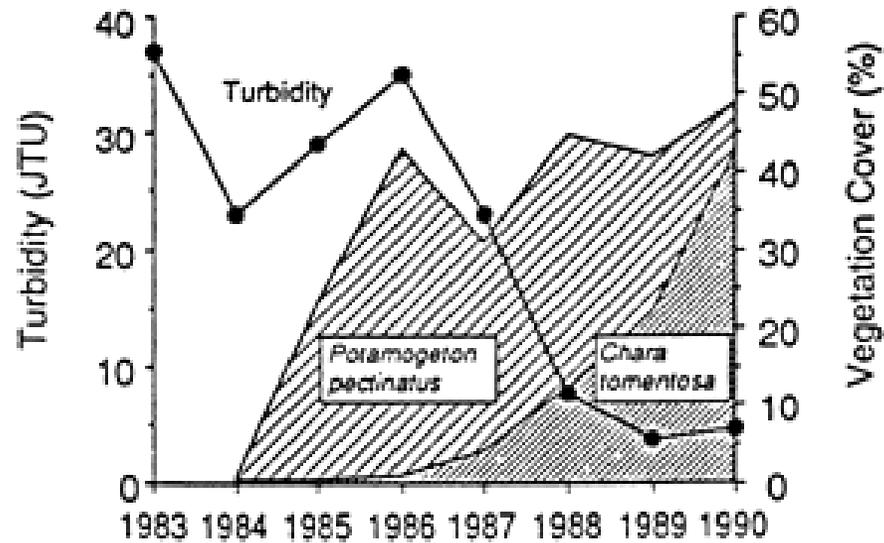


# Background

## Benefits of macrophytes

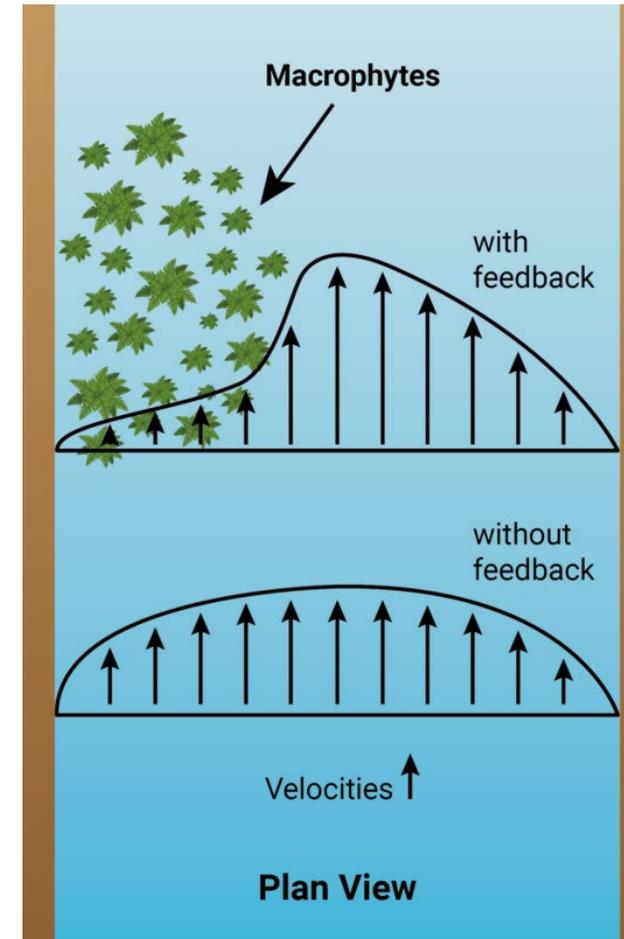
### (3) Water movement and water quality

*Water quality*



Hargeby *et al.* (1994)

*Nearshore water movement*



Credit: DSI

# Background

## Challenges with macrophytes (when overabundant)

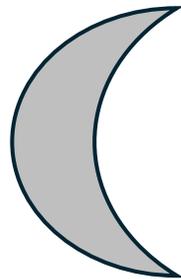
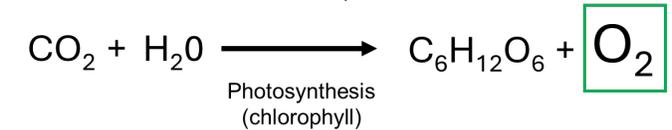
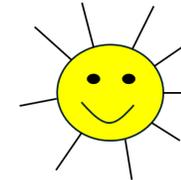
### (1) Recreation



# Background

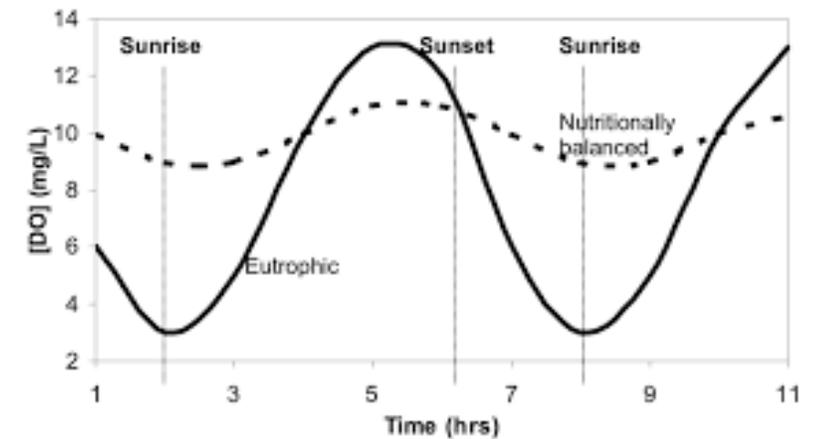
## Challenges with macrophytes

### (2) Oxygen



Seasonal influence on oxygen availability

### Nearshore diurnal cycle



Bass (2008)

# Background

## Challenges with macrophytes (when overabundant)

### (3) Economics

- Clogging of intake pipes/pumps – water intakes, irrigation systems
  - operations and maintenance
- Property values<sup>1,2</sup>
- Management alternatives – various costs for control
  - approach, size, frequency, duration

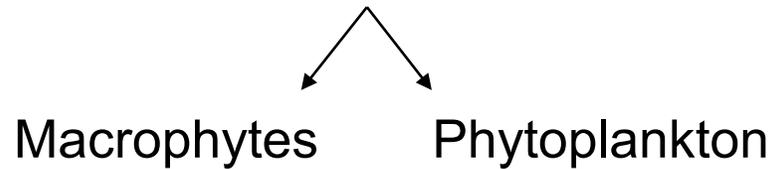


<sup>1</sup>Olden and Tamayo (2014); <sup>2</sup>Zhang and Boyle (2010)

# Background

## Alternative stable states

*Balance among primary producers and lake condition(s)*

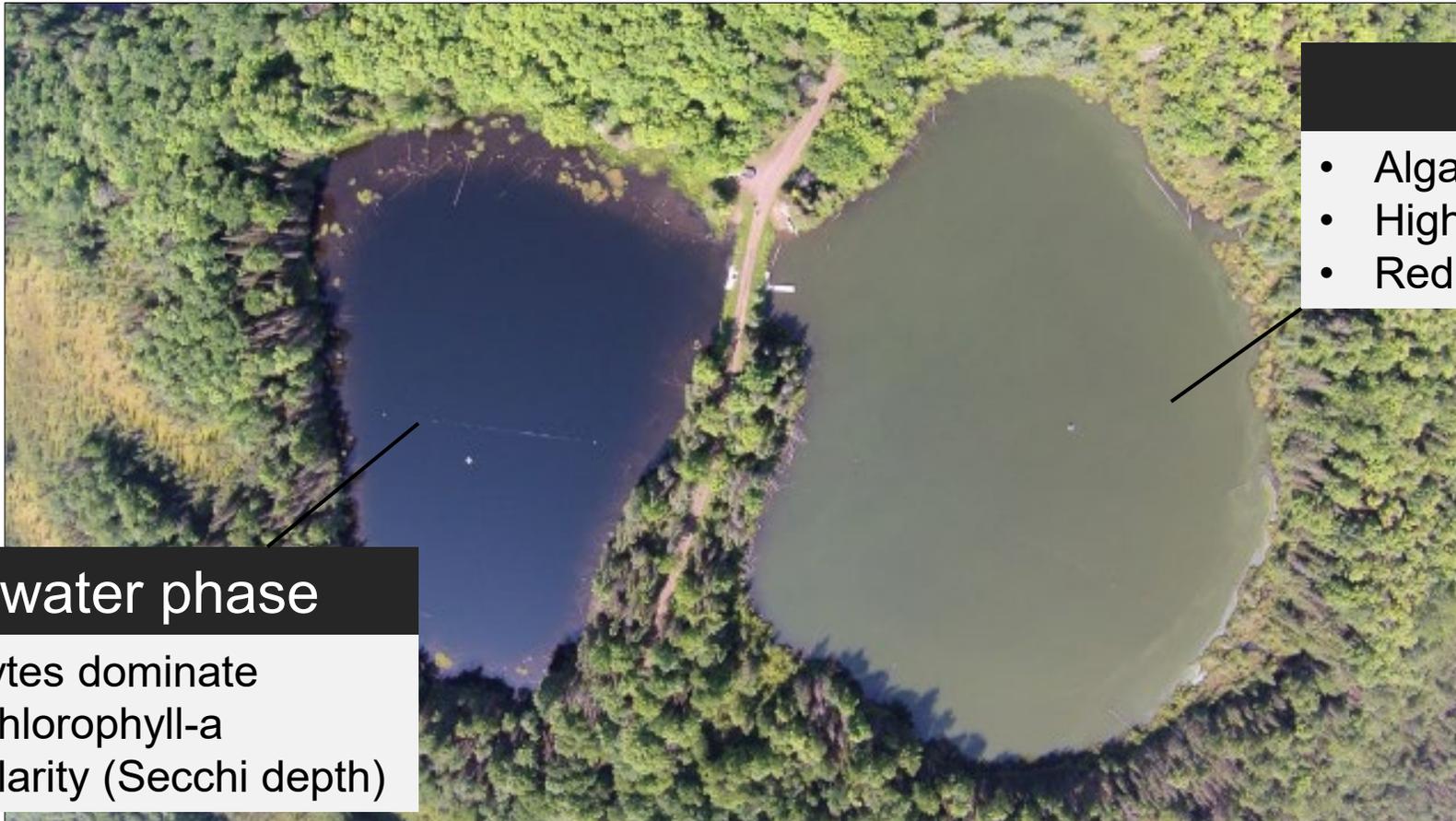


→  
TIPPING POINTS  
←



# Background

## Alternative stable states – trade-offs



### Clear water phase

- Macrophytes dominate
- Low(er) chlorophyll-a
- Greater clarity (Secchi depth)

### Turbid phase

- Algae dominate
- High(er) chlorophyll-a
- Reduced clarity (Secchi depth)

Photo credit: Stephen R. Carpenter, Univ. Wisconsin

# Warning!

Abrupt  
Transition  
Ahead

- **Background** – macrophyte ecology 101

- **Native macrophytes** – the “good”

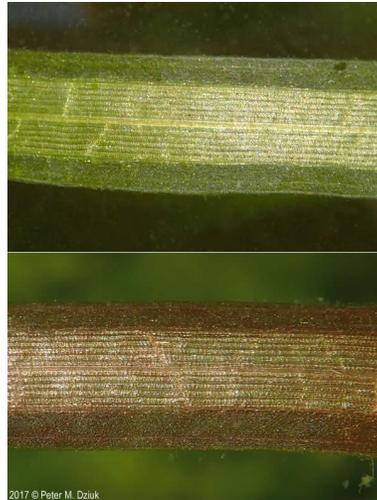
- **Invasive macrophytes** – the “bad”

- **Macrophyte management** – approaches and case study

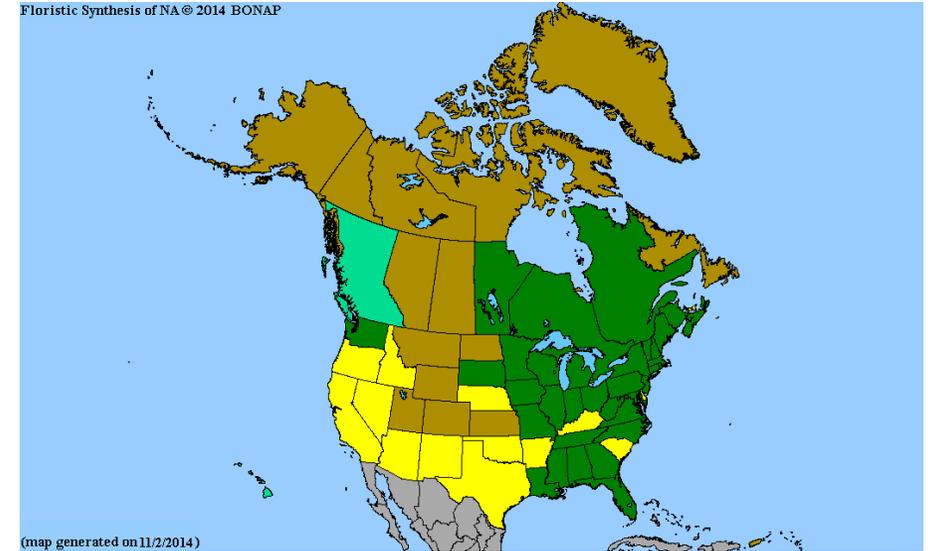
# Native macrophytes

The “good”

## Eelgrass (*Vallisneria americana*)



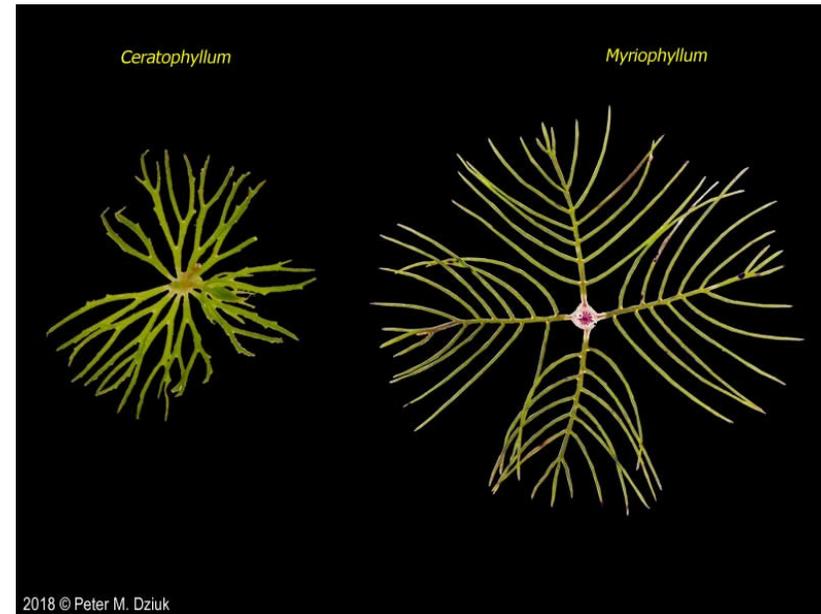
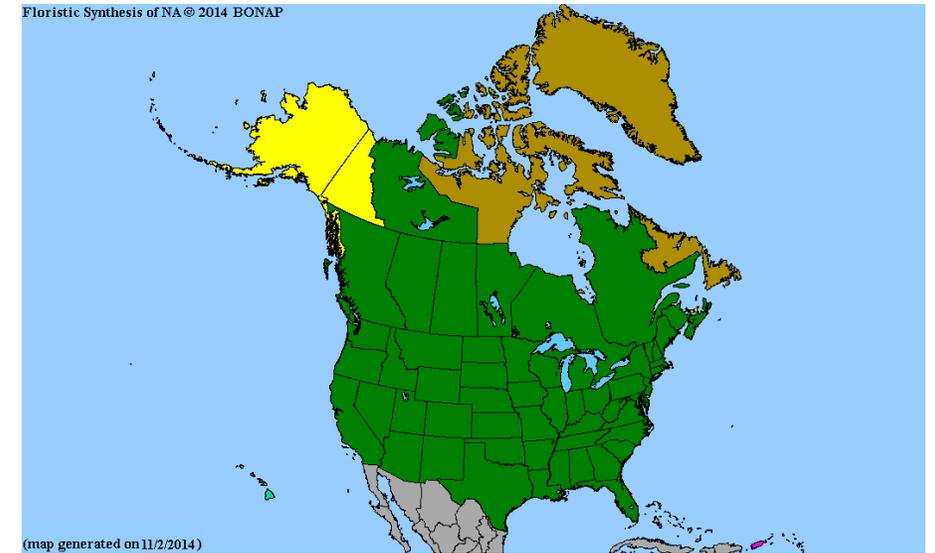
Floristic Synthesis of NA © 2014 BONAP



# Native macrophytes

The “good”

## Coontail (*Ceratophyllum demersum*)



# Native macrophytes

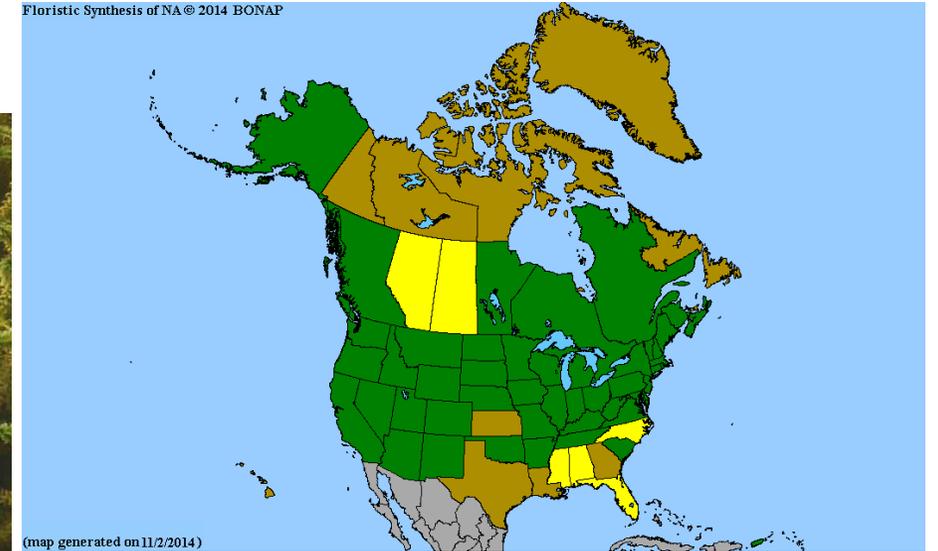
The “good”

## Canadian waterweed (*Elodea canadensis*)



elodea  
*Elodea canadensis*  
Photo by William Haller  
© 2008 University of Florida

Floristic Synthesis of NA © 2014 BONAP



Invasive in Europe, Asia, Africa

# Native macrophytes

The “good”

## Pondweeds (*Potamogeton* spp.)

Illinois pondweed  
(*Potamogeton illinoensis*)



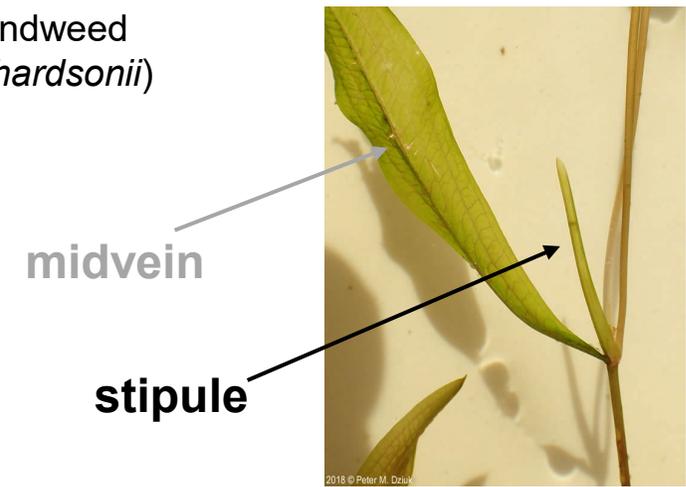
Flatstem pondweed  
(*Potamogeton zosteriformis*)



White-stem pondweed  
(*Potamogeton praelongus*)



Richardson's pondweed  
(*Potamogeton richardsonii*)



# Native macrophytes

The “good”

## Bladderworts (*Utricularia* spp.)



Purple-flowered bladderwort  
(*Utricularia purpurea*)

Carnivorous!



Common bladderwort  
(*Utricularia vulgaris*)

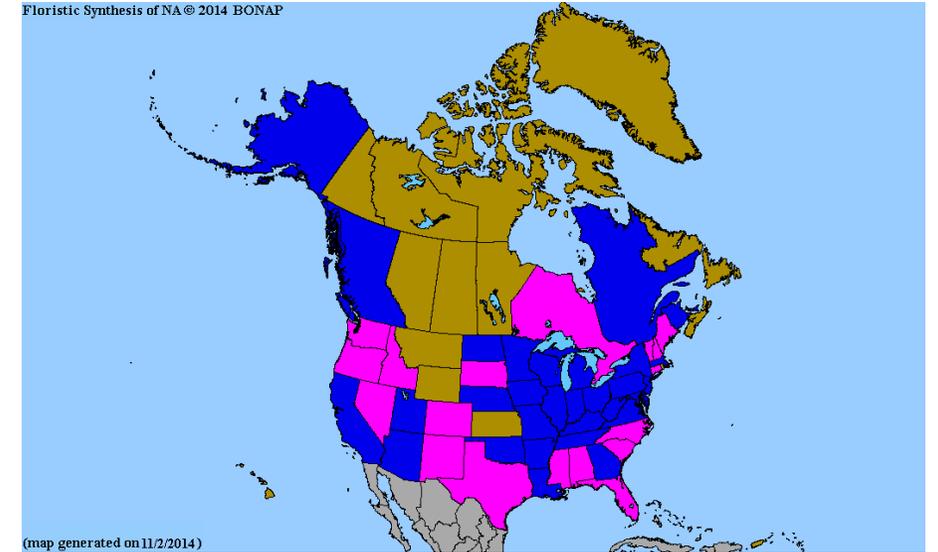
# Invasive macrophytes

The “bad”

## Eurasian watermilfoil (*Myriophyllum spicatum*)



Floristic Synthesis of NA © 2014 BONAP



*Myriophyllum spicatum*

*Myriophyllum sibiricum*



# Invasive macrophytes

The “bad”

## Hydrilla (*Hydrilla verticillata*)

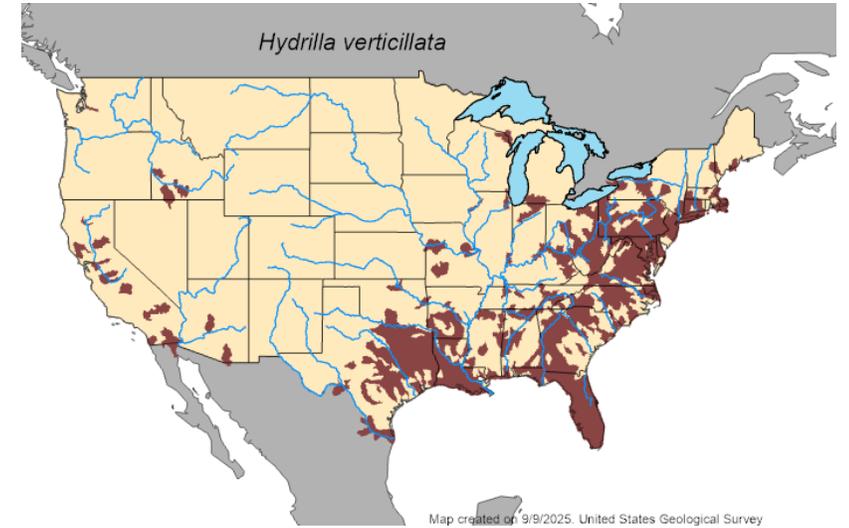


Illustration by Bruce Kerr

Hydrilla

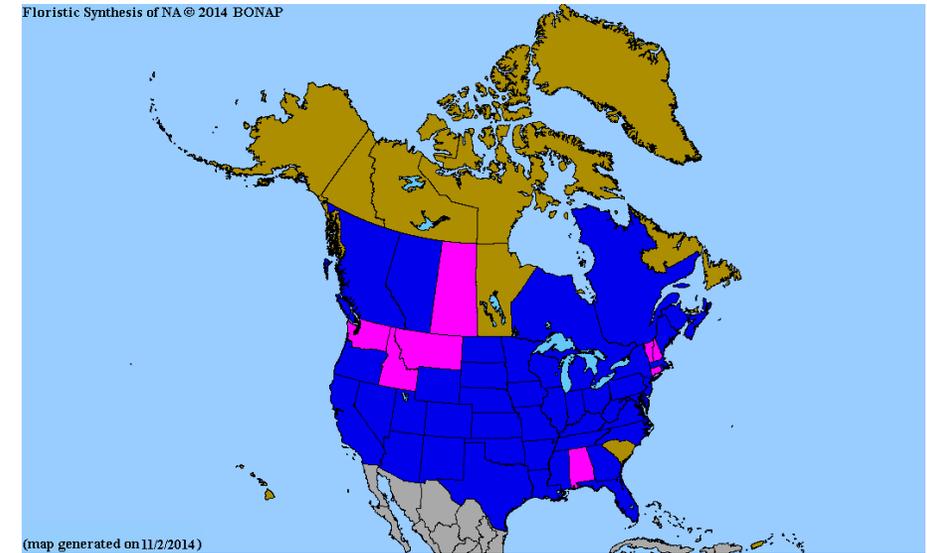
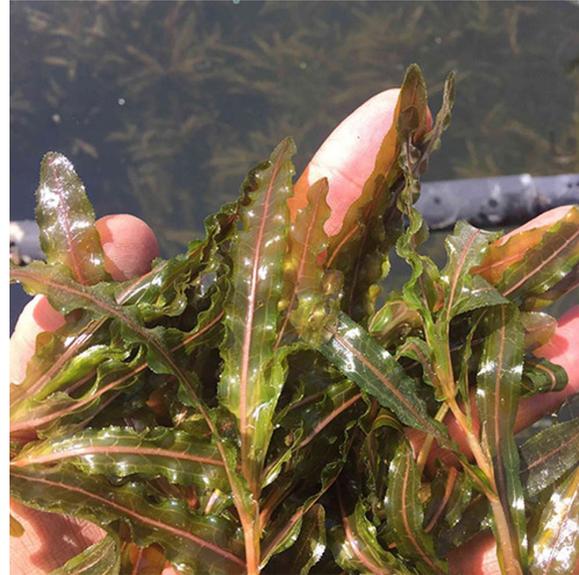


Elodea

# Invasive macrophytes

The “bad”

## Curly-leaf pondweed (*Potamogeton crispus*)

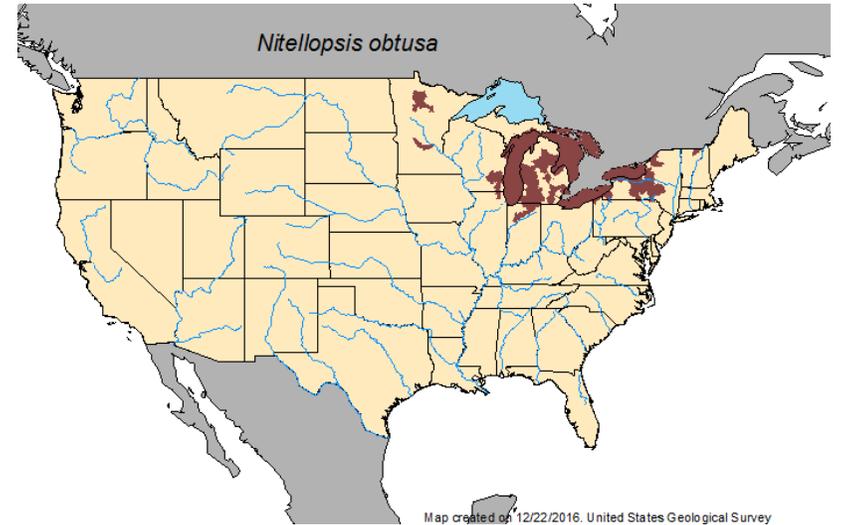


Early season  
(May-July)

# Invasive macrophytes

The “bad”

## Starry stonewort (*Nitellopsis obtusa*)



Star-shaped  
bulbil

# Invasive macrophytes

The “bad”

## Starry stonewort (*Nitellopsis obtusa*)

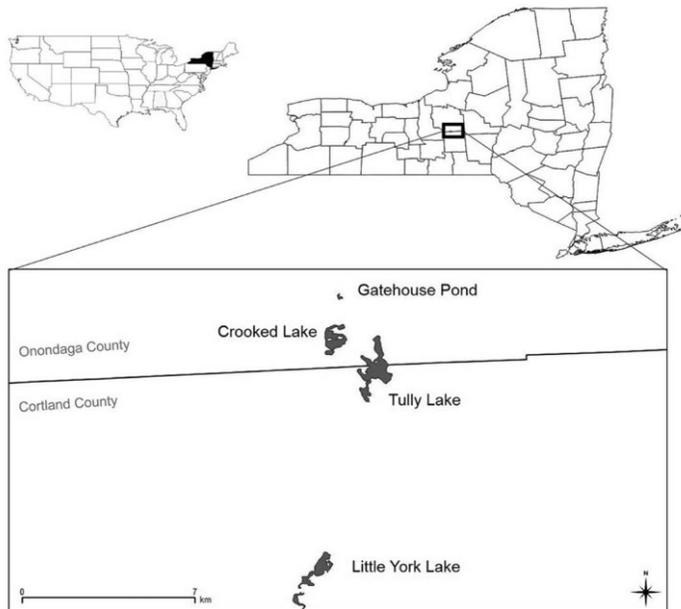
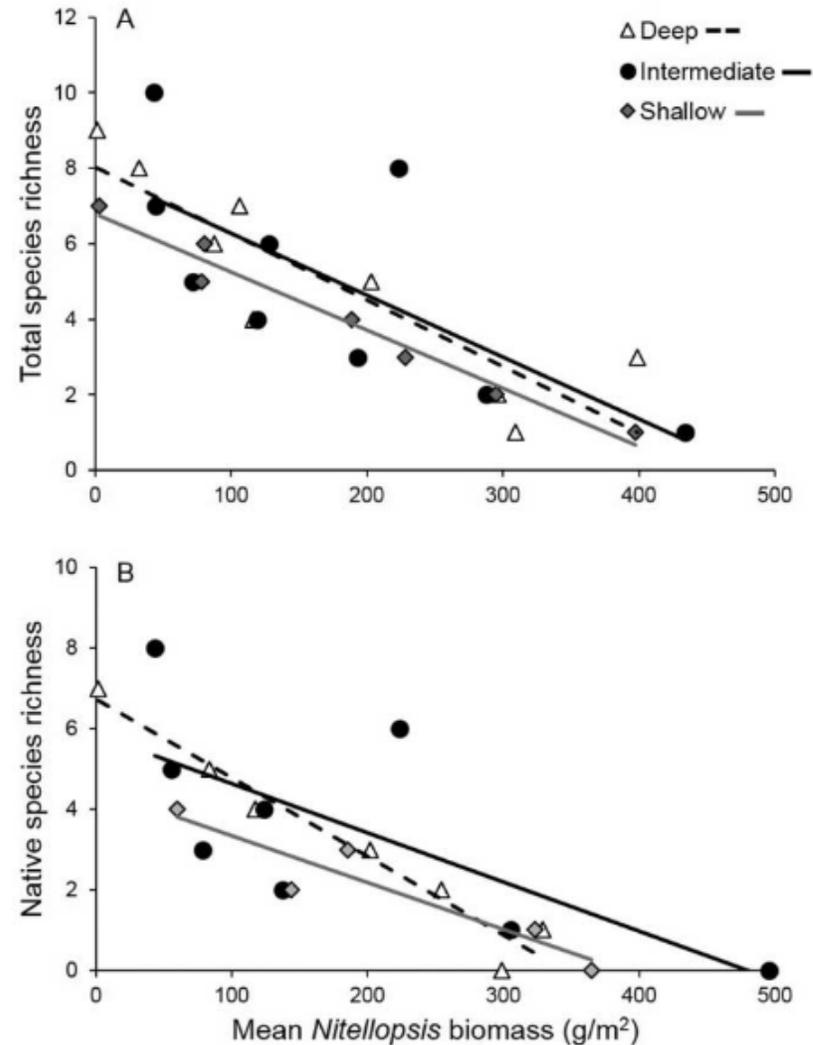


Figure 2. Location of study lakes in New York, USA.



When starry stonewort was very abundant (g/m<sup>2</sup>) –

***displacement of other macrophyte species***

# Management

- ✓ • Background – macrophyte ecology 101
- ✓ • Native macrophytes – the “good”
- ✓ • Invasive macrophytes – the “bad”
- **Macrophyte management** – approaches and case study

# Management

## Macrophyte management approaches:

(1) **Aquatic herbicides** – “spraying the weeds”

Photo credit: Wisconsin Lake & Pond Rescue



(2) **Mechanical harvesting** – “mowing the lawn”



Photo credit: Aquatic Ecosystem Restoration Foundation

### Others (not all inclusive)

- Hand pulling
- Benthic mats
- Light limitation – shading (e.g., dyes)
- Drawdown of water levels
- Dredging
- Biological controls (e.g., grass carp, insects)

# Management – Case Study

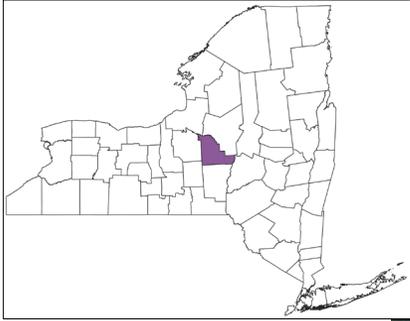


Photo credit: Invasive Species Centre

## Cazenovia Lake

**Eurasian watermilfoil (*Myriophyllum spicatum*)**

First introduced in early 1990s

Large expansion and growth in early 2000s

# Management – Case Study

## Historic use of herbicides (2009 – 2024):



### 16-year period of herbicide use

- 8 years treated
- 8 years w/ no treatment

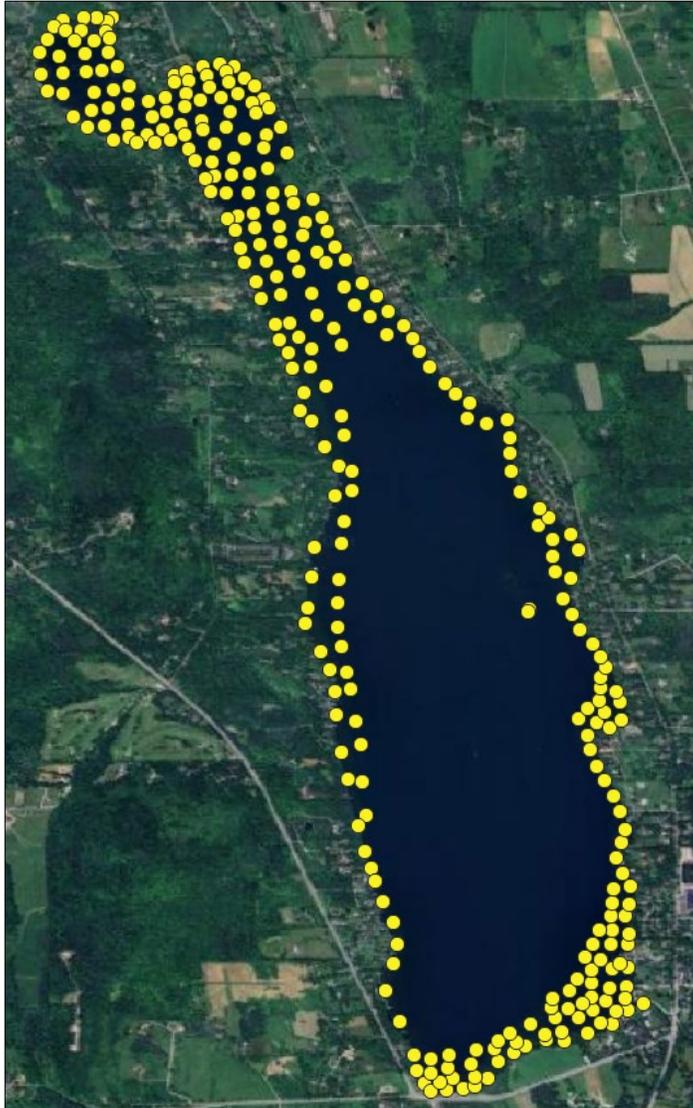


- **Active ingredient** – triclopyr
- **Target** - broadleaf plants



- **Active ingredient** – florpyrauxifen-benzyl
- **Target** – invasive aquatic plants

# Management – Case Study



## Annual survey – 2009 to 2024

300+ sampling sites each year

Rake-toss sampling

Two rake toss samples / site



~ early August

# Management – Case Study

(1) Has treatment with herbicides reduced the presence of Eurasian watermilfoil?

Are there measurable declines in the presence of native macrophytes?

(2) Has treatment with herbicides reduced the abundance of Eurasian watermilfoil?

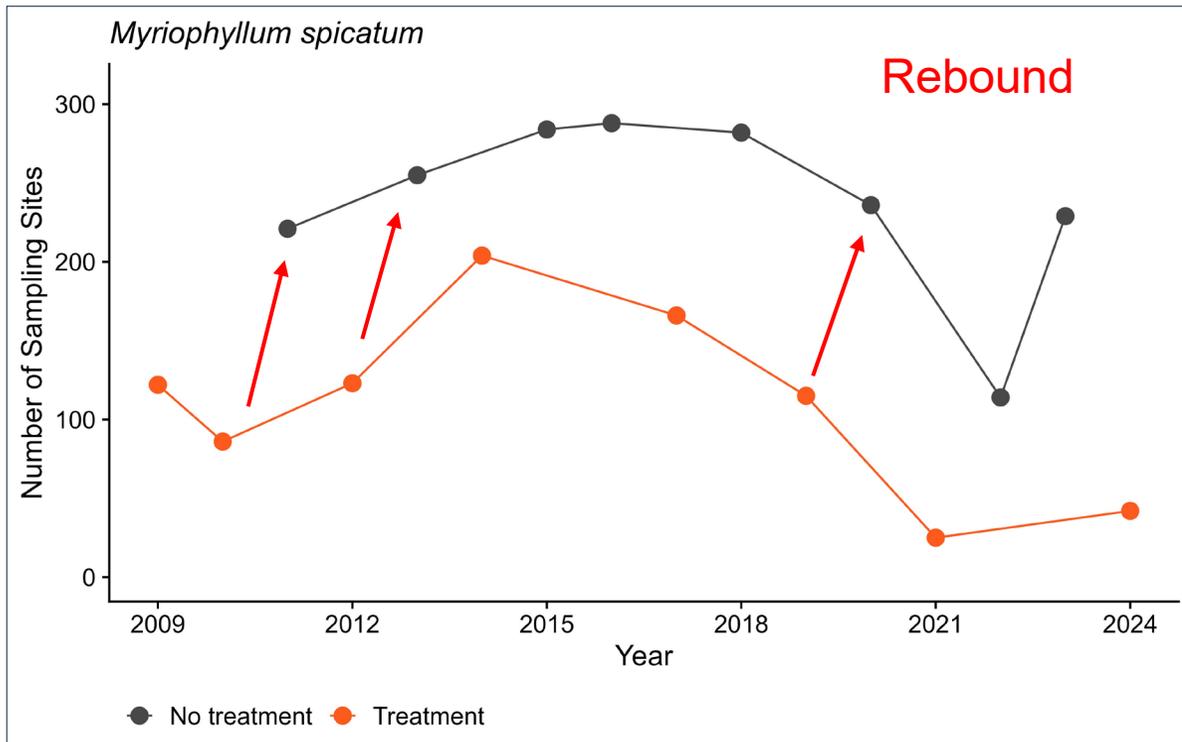
Are there measurable declines in the abundance of native macrophytes?

(3) Is there evidence indicating a shift to a more turbid state – *increased chlorophyll-a and decreased water clarity* – over time?

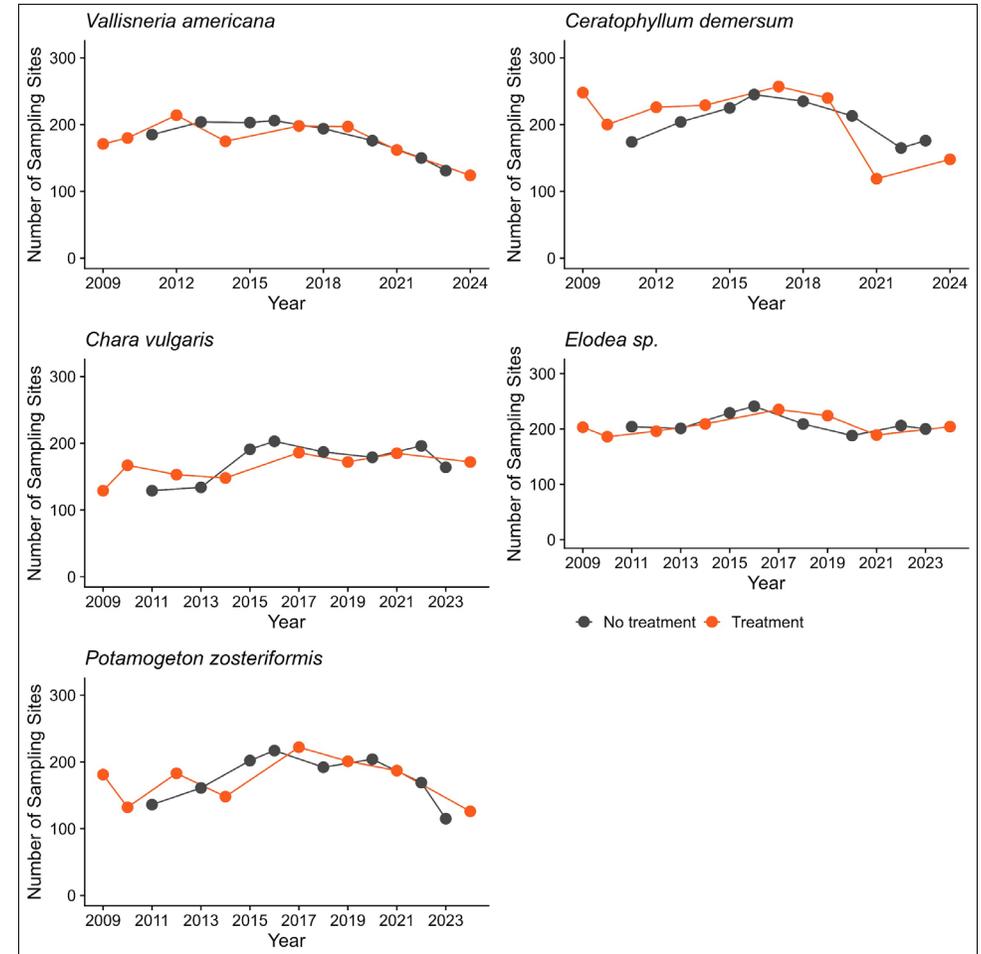
CSLAP data from 1988 to 2023, evaluating pre-2009 and post-2009 periods

# Management – Case Study

Has treatment with herbicides reduced the presence of Eurasian watermilfoil?

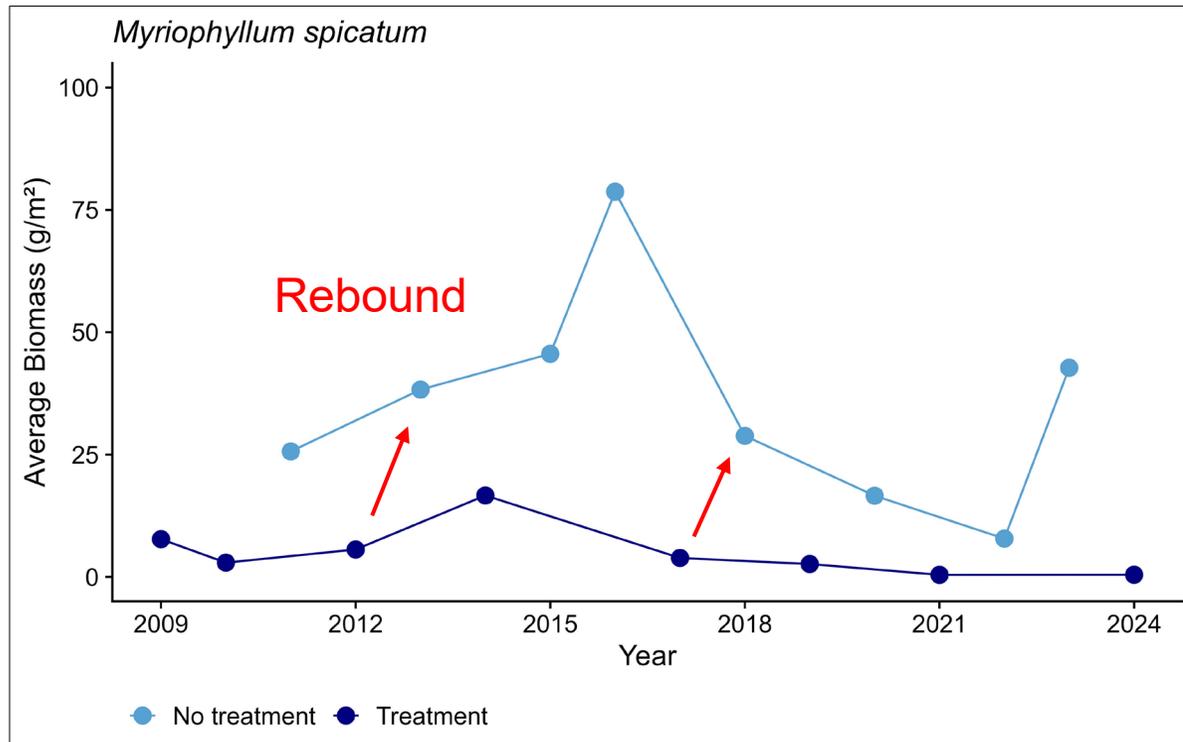


**Significant decrease in number of sites with EWM in treatment years**

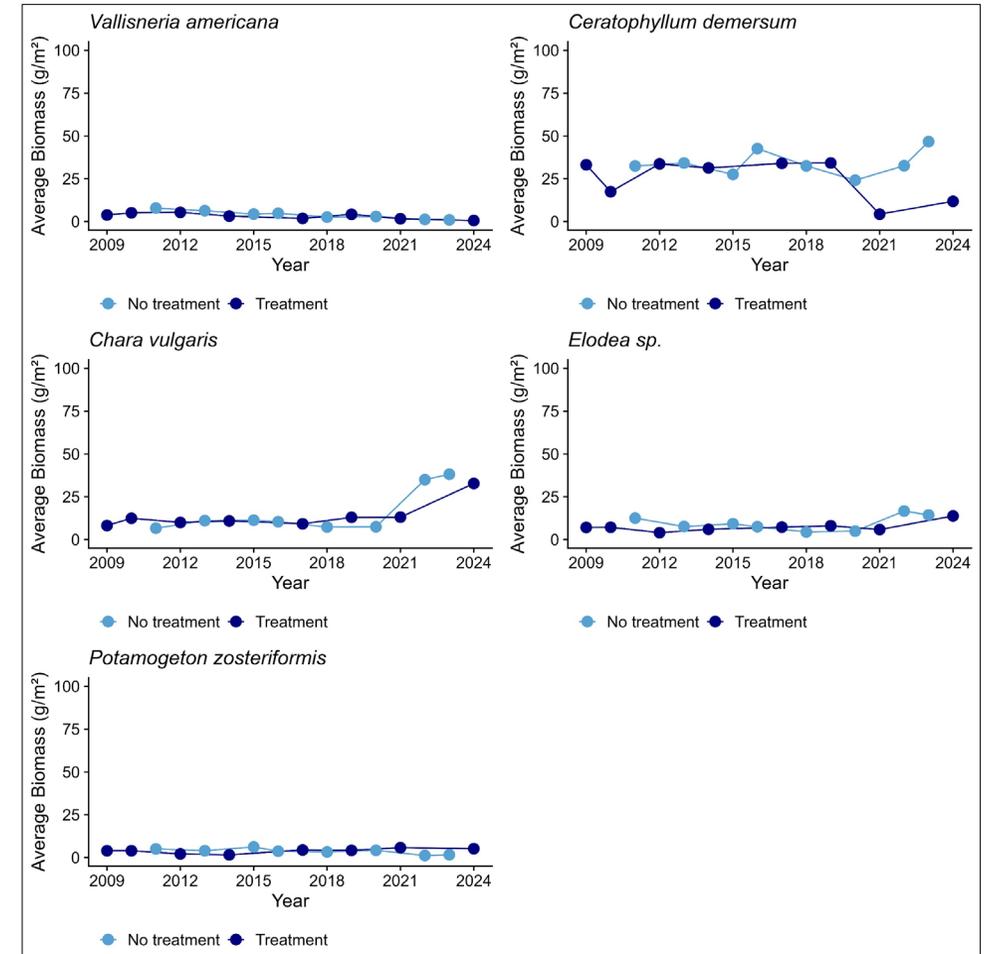


# Management – Case Study

Has treatment with herbicides reduced the abundance of Eurasian watermilfoil?

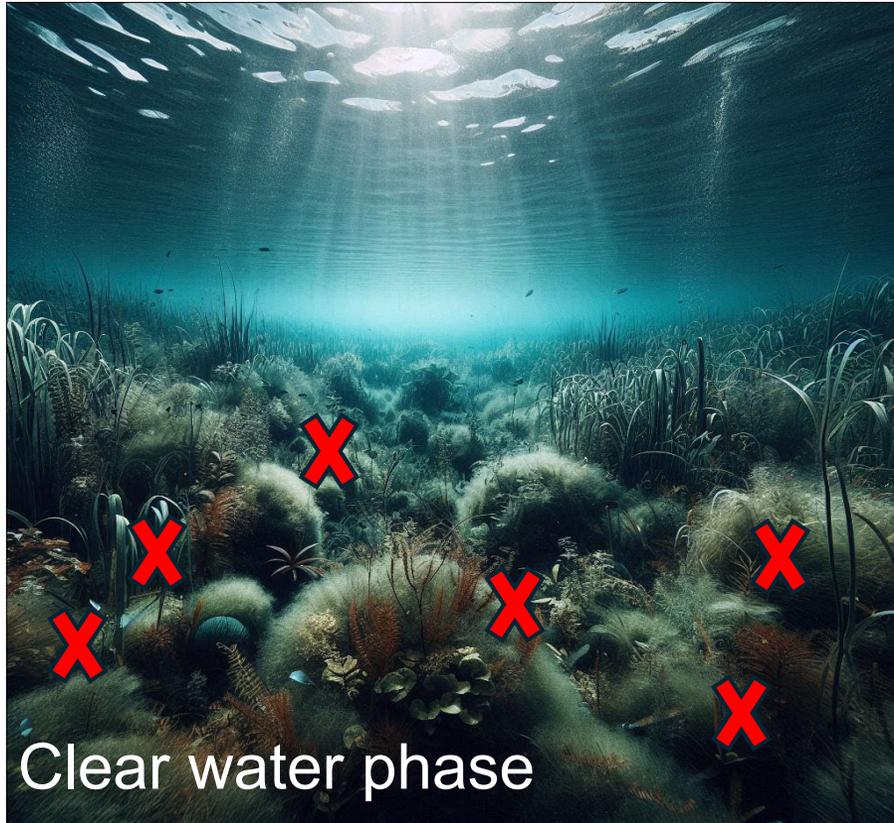


**Significant decrease in estimated biomass of EWM in treatment years**



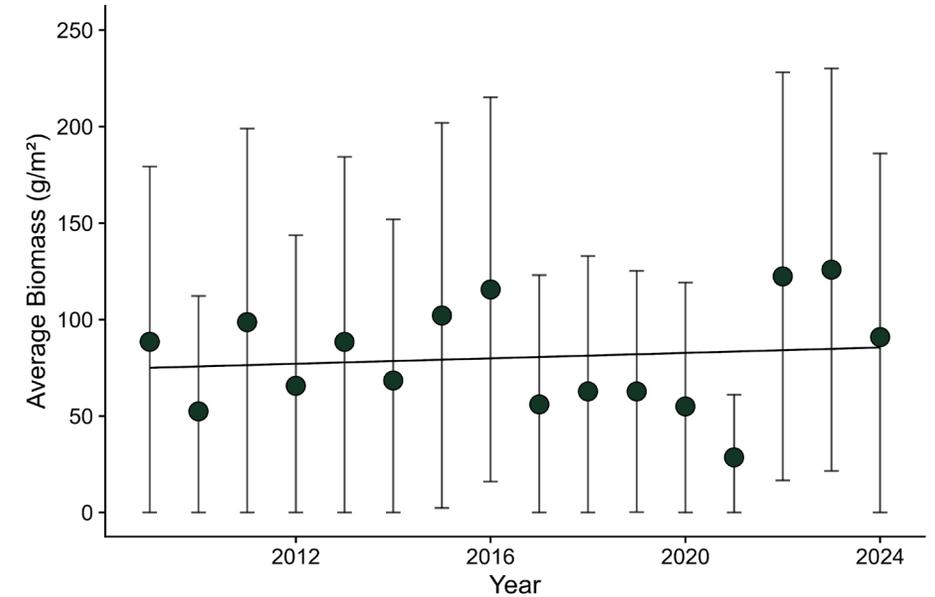
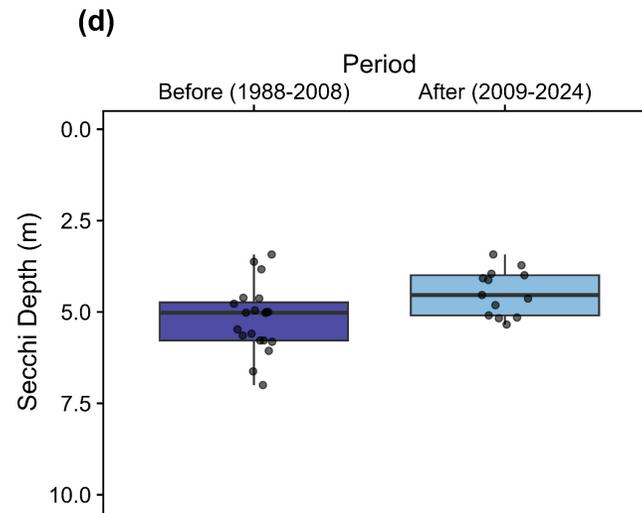
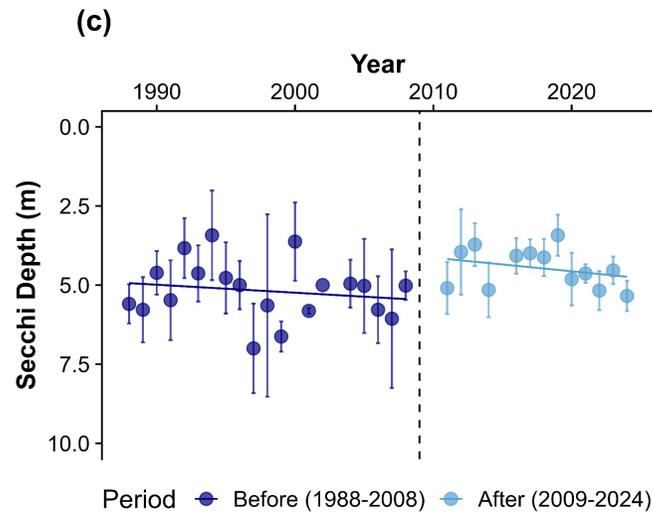
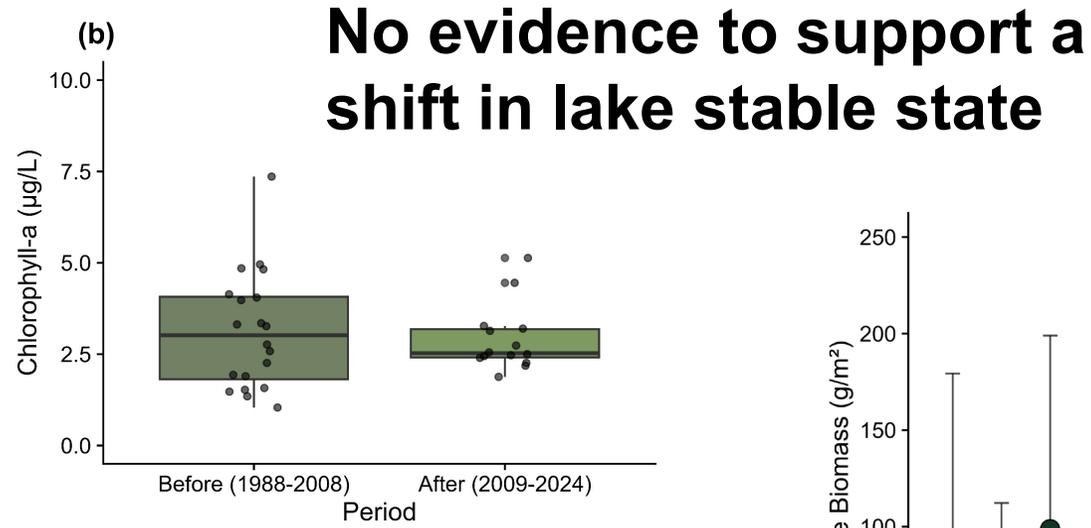
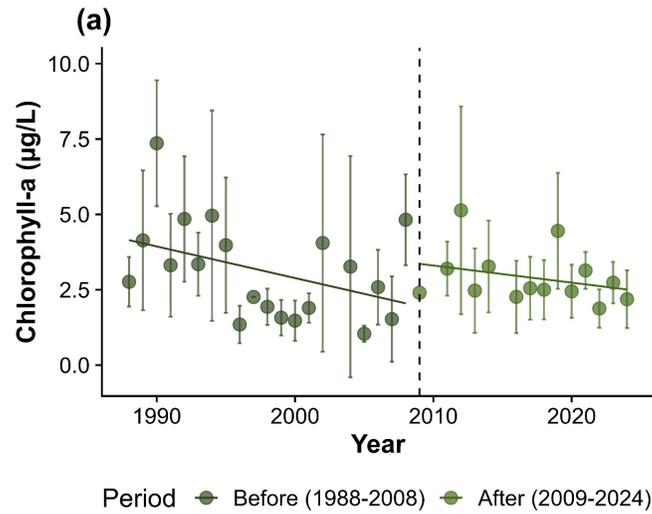
# Management – Case Study

Has long-term use of herbicides resulted in a stable state shift?



*Increased chlorophyll-a (phytoplankton)  
Decreased Secchi depth*

# Management – Case Study



**Overall total biomass of macrophytes has not declined**

# Thank you!

Macrophytes from Little York Lake  
on display table

-- Funding support --  
Cazenovia Lake case study

Town of Cazenovia  
NYSDEC ISGP Round 3

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