

# Welcome

## Aquatic Invasive Species Workshop & OAIS Update

February 28, 2026



***Thank you to our event  
sponsor...***



APPLIED WATERSHED SCIENCES



# Invasive Aquatic Plants

State of the State

**Gregory J. Bugbee**  
**Department of  
Environmental  
Science and  
Forestry**



# OFFICE OF AQUATIC INVASIVE SPECIES



**Summer Weidman**



**Maddie Watts**



**Jeremiah Foley, Ph.D**



**Olajumoke Omosowone**



**Riley Doherty**



**Madison Manke**

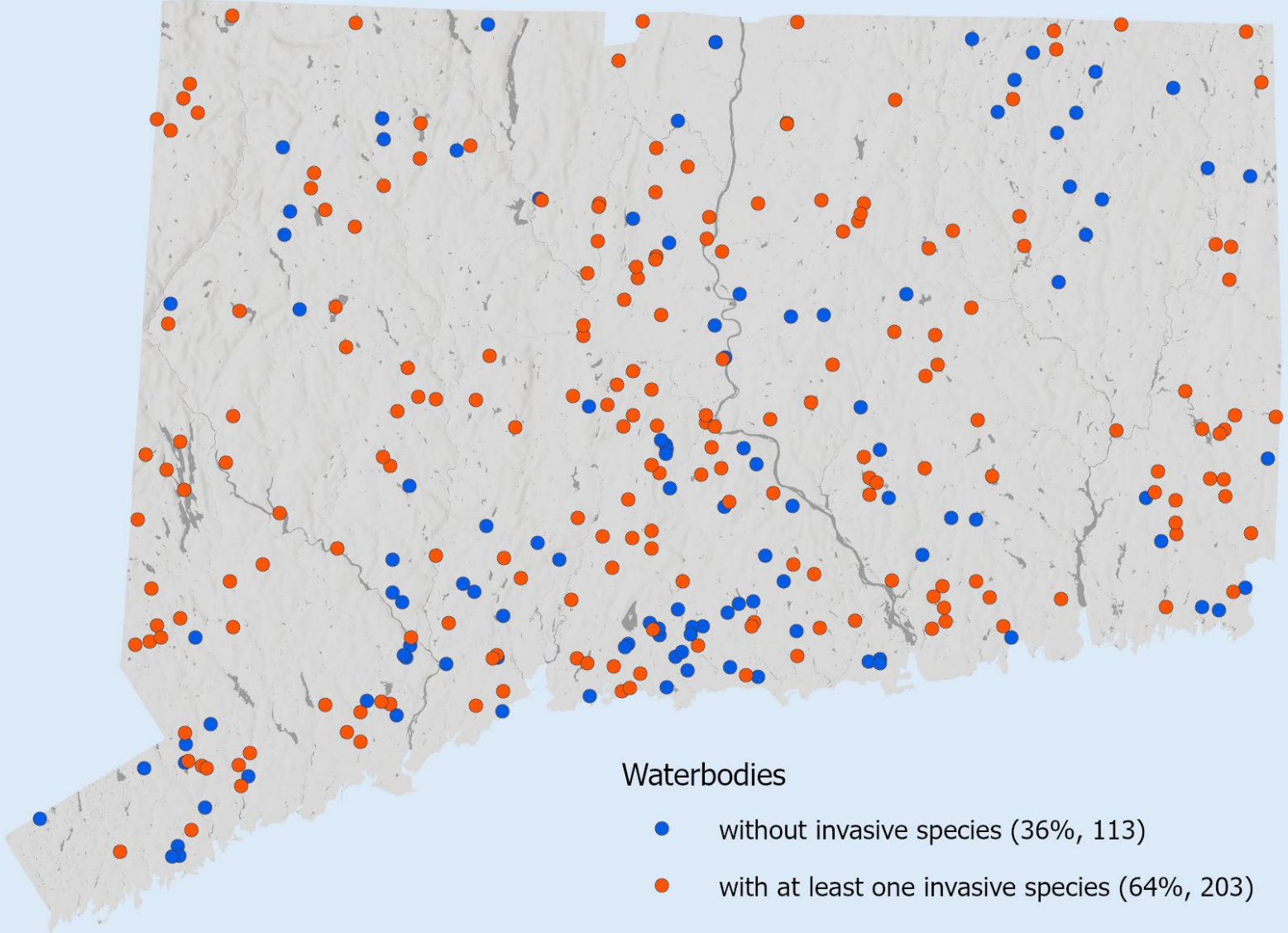
# Connecticut's Invasive or Potentially Invasive Aquatic Plants

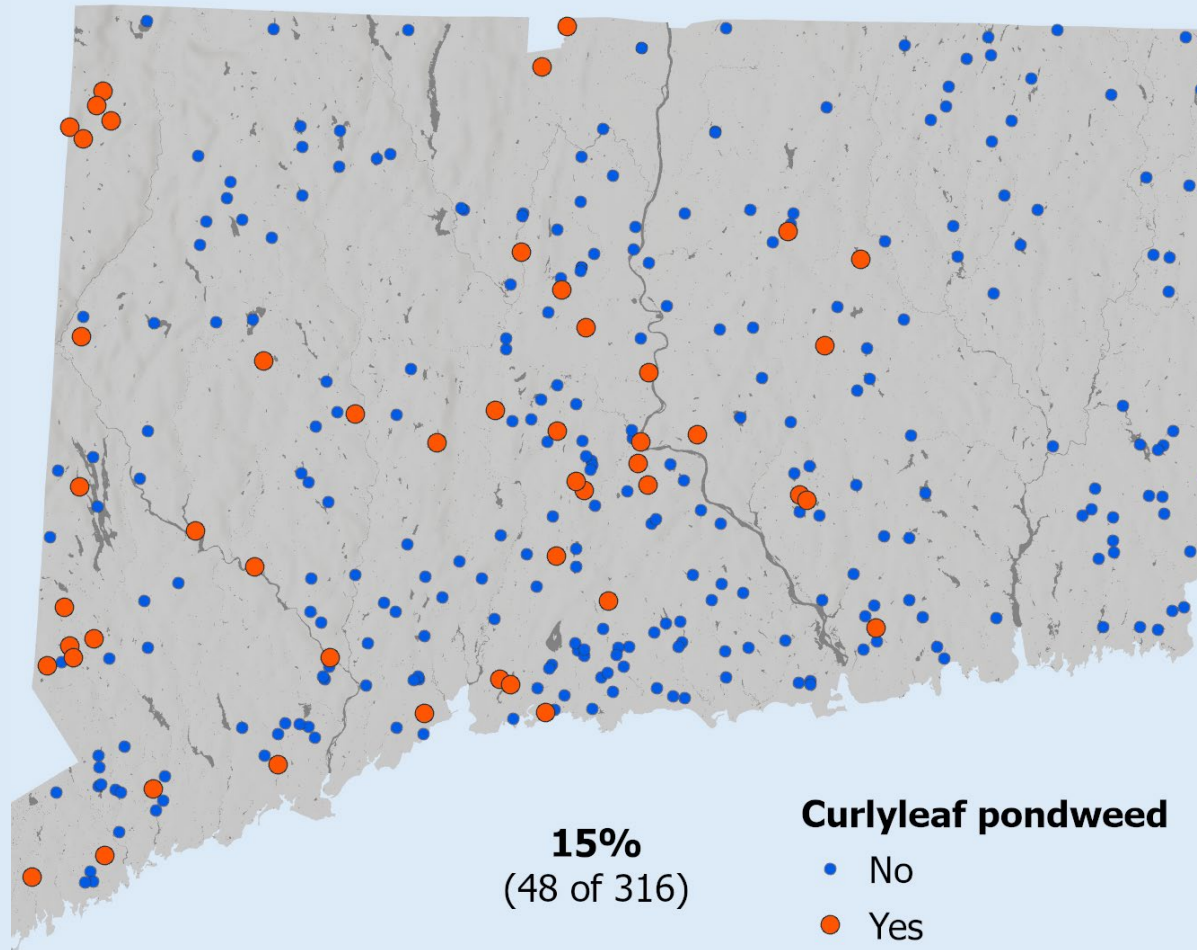
CT State Statutes (Sec. 22a-381d)

#	COMMON NAME	SCIENTIFIC NAME	DISPERSAL
1	American water lotus	<i>Nelumbo lutea</i>	Water Gardening
2	Brazilian water-weed, Anacharis, Egeria	<i>Egeria densa</i>	Aquariums, Boats/Trailers, Bait
3	Brittle water-nymph, Minor naiad	<i>Najas minor</i>	Boats/Trailers
4	Common water-hyacinth*	<i>Eichhornia crassipes</i>	Water Gardening
5	Curly leaf pondweed, Crispy-leaved pondweed	<i>Potamogeton crispus</i>	Boats/Trailers
6	Eurasian watermilfoil	<i>Myriophyllum spicatum</i>	Aquariums, Boats/Trailers, Bait
7	European waterclover, Water shamrock	<i>Marsilea quadrifolia</i>	Water Gardening, Boats/Trailers
8	Fanwort	<i>Cabomba caroliniana</i>	Aquariums, Boats/Trailers
9	Flowering rush	<i>Butomus umbellatus</i>	Water Gardening
10	Forget-me-not, Water scorpion-grass	<i>Myosotis scorpioides</i>	Water Gardening
11	Giant salvinia	<i>Salvinia molesta</i>	Water Gardening
12	Hydrilla	<i>Hydrilla verticillata</i>	Aquariums, Boats/Trailers, Bait
13	Onerow yellowcress	<i>Rorippa microphylla</i>	Water Gardening
14	Parrotfeather	<i>Myriophyllum aquaticum</i>	Water Gardening, Boats/Trailers
15	Pond water-starwort	<i>Callitriche stagnalis</i>	Water Gardening
16	Purple loosestrife	<i>Lythrum salicaria</i>	Nursery Stock, Water Gardening
17	Variable-leaf watermilfoil	<i>Myriophyllum heterophyllum</i>	Aquariums, Boats/Trailers
18	Water chestnut	<i>Trapa natans</i>	Water Gardening, Boats/Trailers
19	Water lettuce, American water lotus	<i>Pistia stratiotes</i>	Water Gardening
20	Watercress	<i>Rorippa nasturtium-aquaticum</i>	Water Gardening
21	Yellow floating heart	<i>Nymphoides peltata</i>	Water Gardening
22	Yellow iris, Yellow flag iris	<i>Iris pseudacorus</i>	Nursery Stock, Water Gardening

\*only plant on list that is not banned

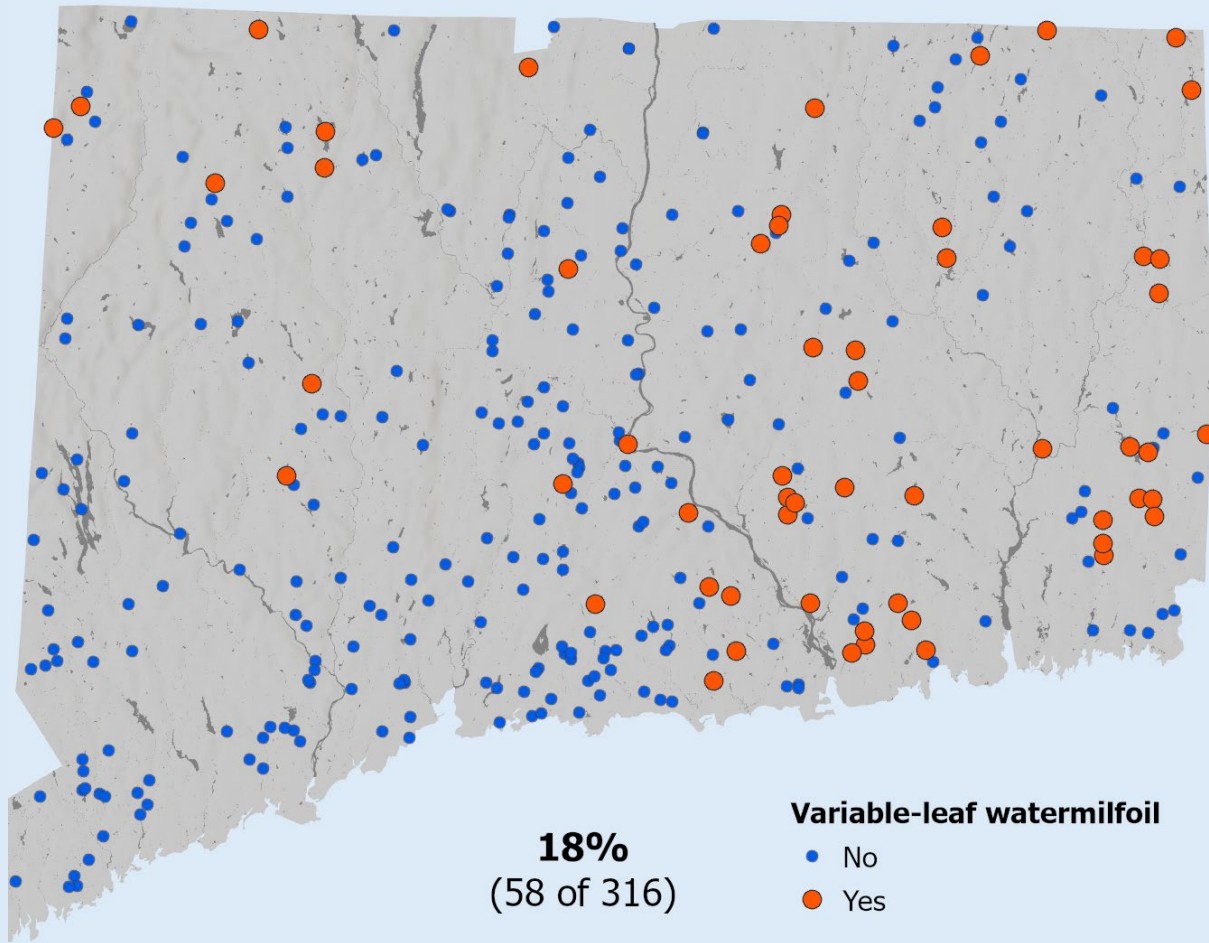
# Connecticut Lakes With and Without Invasive Plants



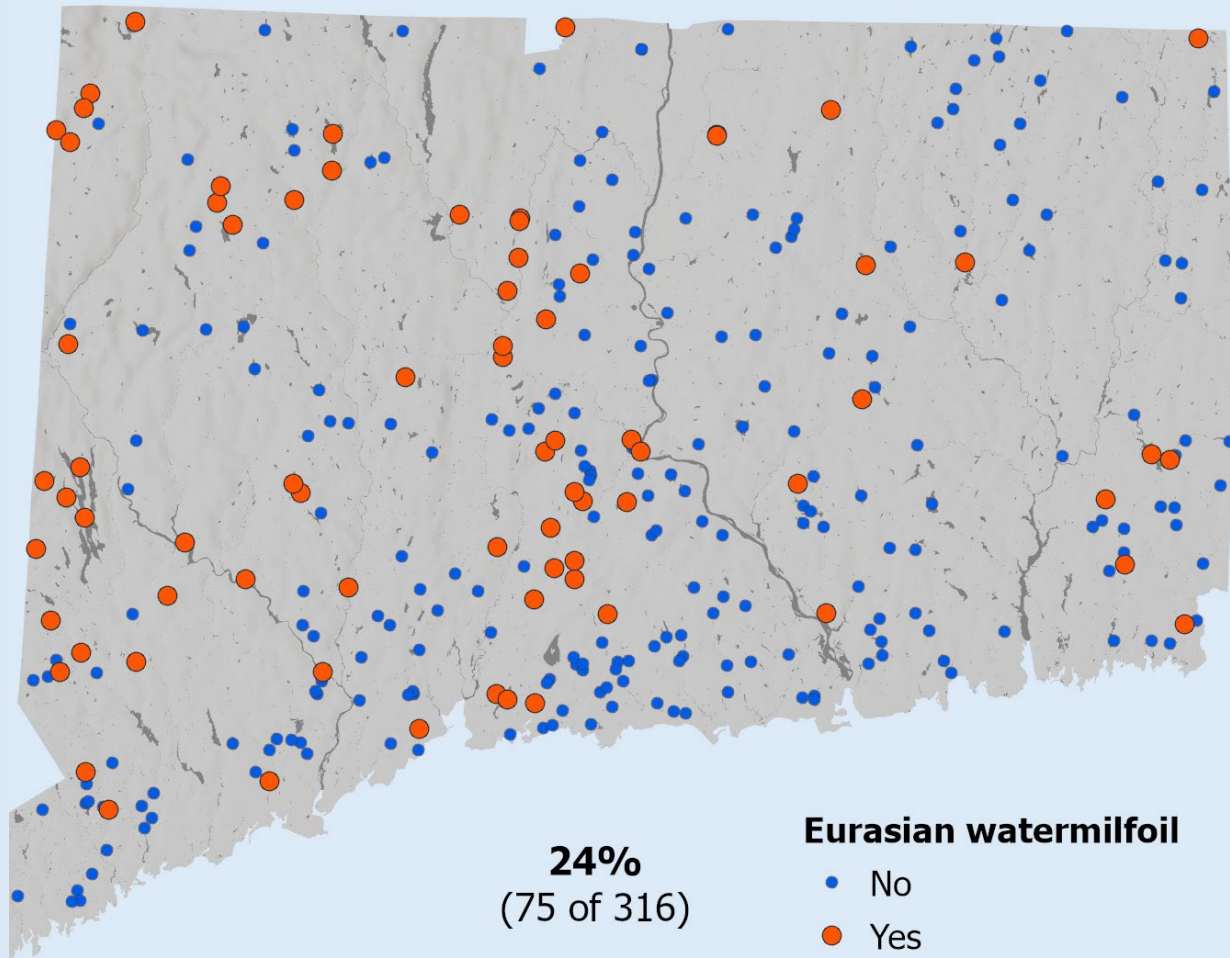


# Connecticut Lakes With Curlyleaf Pondweed\*

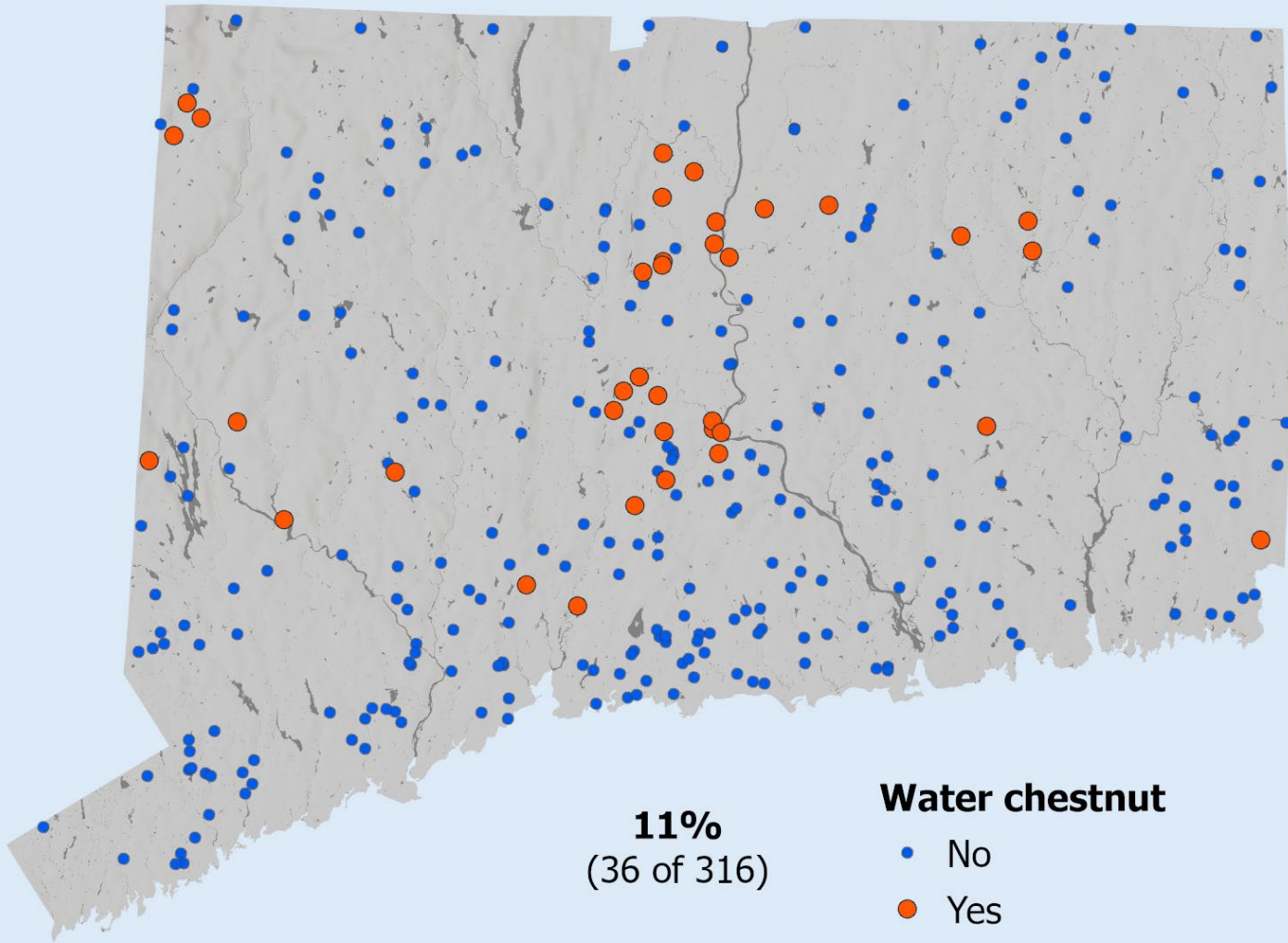
\*Likely and underestimate because many surveys were performed after early summer senescence



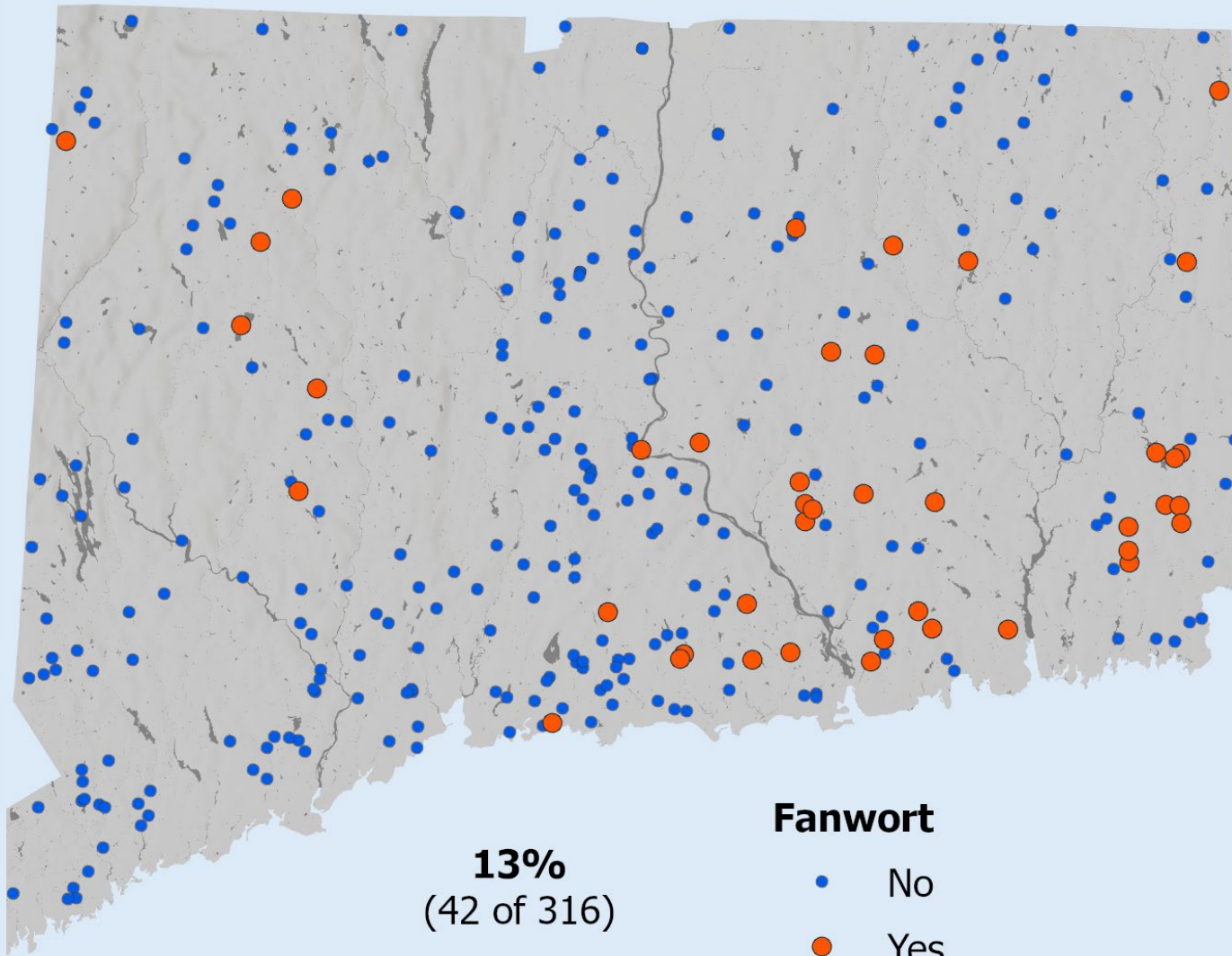
# Connecticut Lakes With Variable Watermilfoil



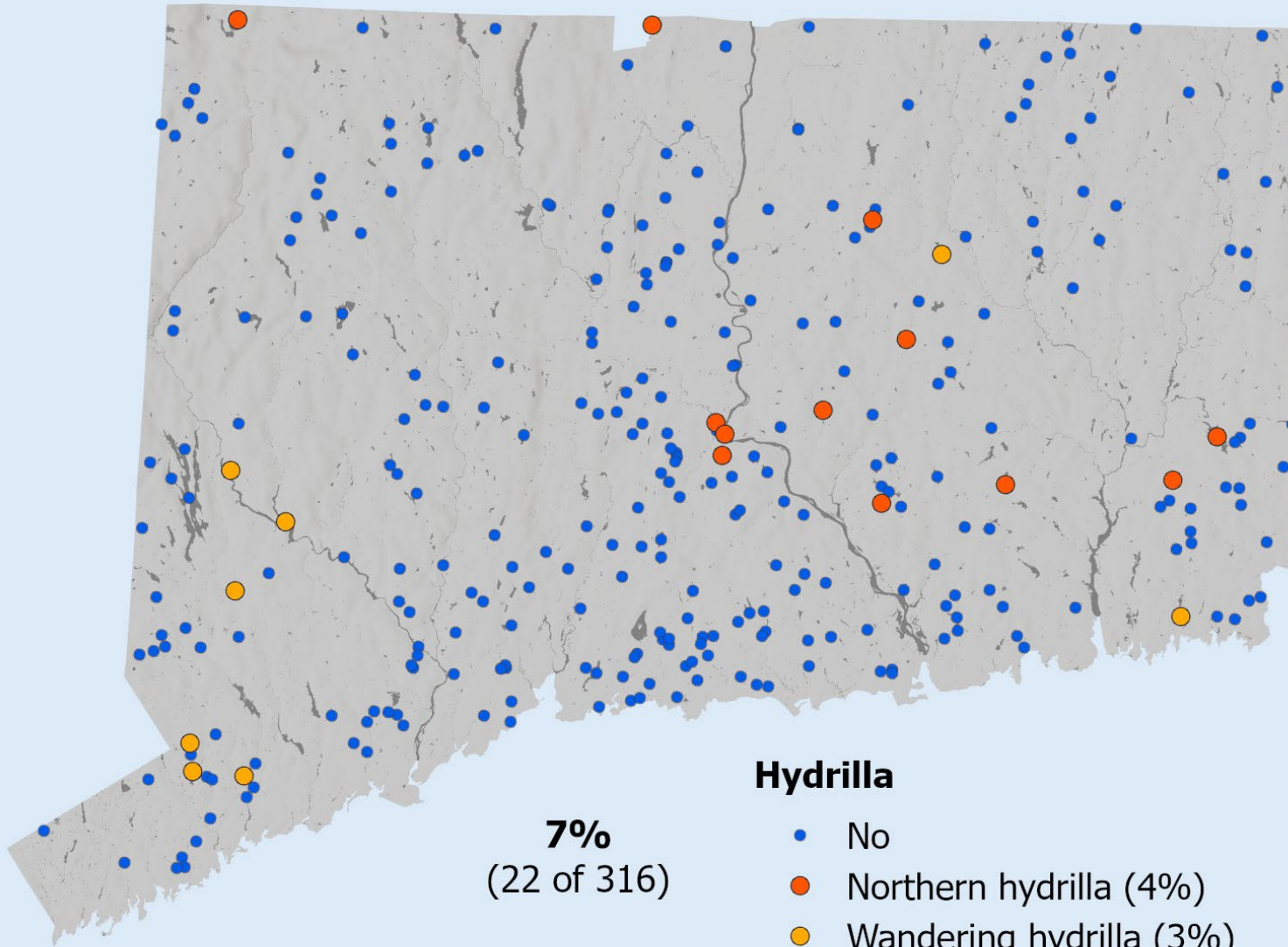
# Connecticut Lakes With Eurasian Watermilfoil



# Connecticut Lakes With Water Chestnut



# Connecticut Lakes With Fanwort



# Connecticut Lakes With Hydrilla

# Topics of the Year

## Wake Boat Ordinances (No wake enhancement)

- Lake Waramaug
- Bashan Lake, Moodus Reservoir

*Raised Bill No. 313: AN ACT CONCERNING WAKESURFING ON CERTAIN LAKES IN THE STATE.*

## Boat Launch Inspectors

- Funding, Staffing, Insurance

## Boat Wash Stations

- Technology, Siting, Funding

## CT AIS Grants

- Reduction

CAES Workshop February 28, 2026



# CAES OAIS Webpage

portal.ct.gov/caes-oais



CAES Connecticut State  
The Connecticut Agricultural Experiment Station

CT.gov Home / The Connecticut Agricultural Experiment Station / Office of Aquatic Invasive Species

- Office of Aquatic Invasive Species >
- Explore CT AIS Data >
- Aquatic Plant Survey Results >
- Management and Prevention >
- Connecticut River Project >
- Herbarium >
- Publications >
- Resources >
- Contact Us >

Search The Connecticut Agricultural Experiment Station

by Keyword

Office of Aquatic Invasive Species  
Connecticut Agricultural Experiment Station

## Office of Aquatic Invasive Species

Formerly the Invasive Aquatic Plant Program

[About](#) | [Employment](#) | [In the News](#) | [Legislation](#) | [Program History](#) | [Advisories](#)

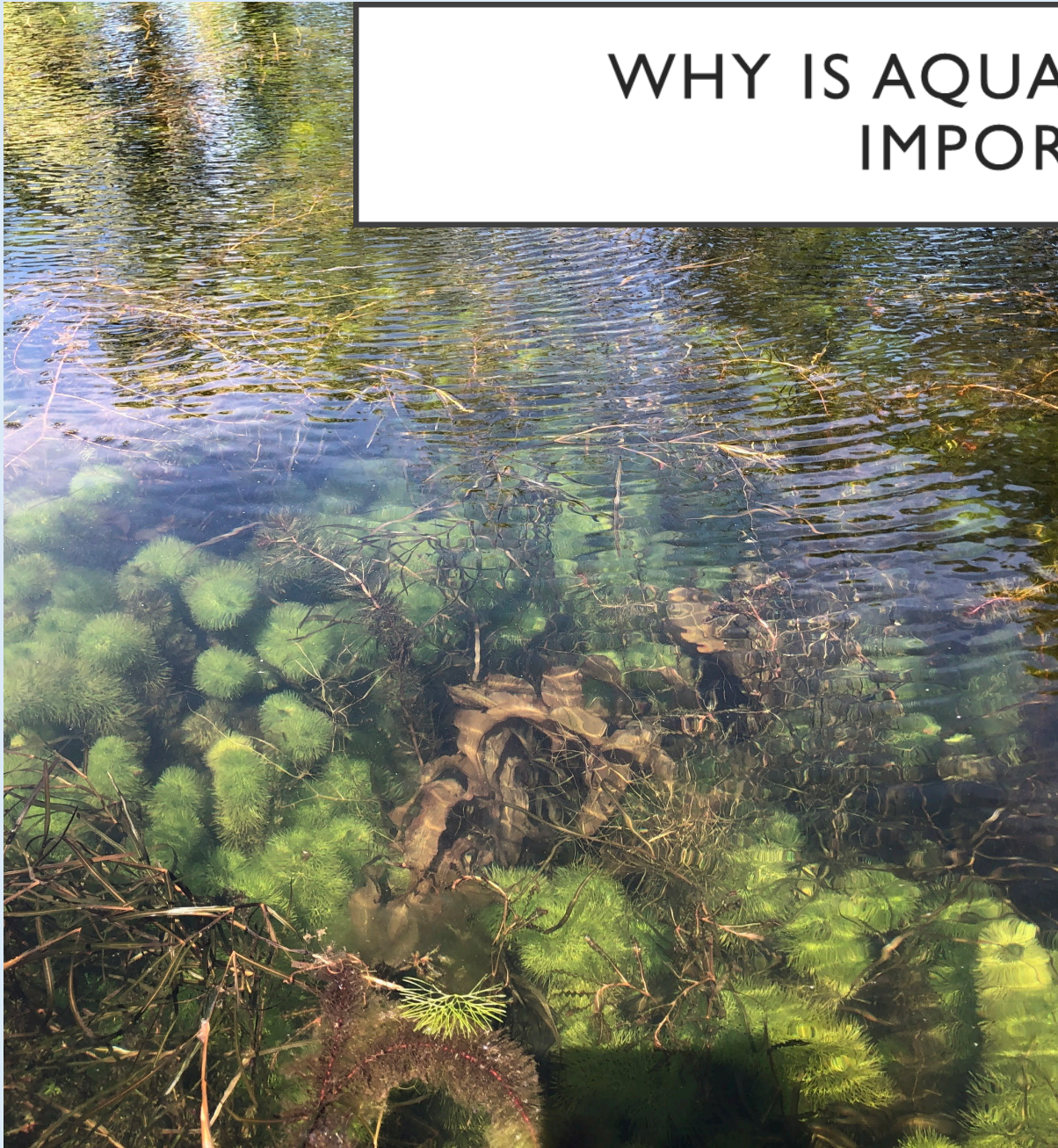
[\\*New\\* CT AIS Web App](#)

In 2002, scientists at the Connecticut Agricultural Experiment Station (CAES) began surveying Connecticut lakes and ponds for invasive aquatic plants and investigating novel management options. Surveillance focuses on both invasive and native vegetation to quantify the effects of invasive species on aquatic ecosystems. This research allows us to track the spread and record the arrival of invasive aquatic plants. Surveys also provide baseline information to determine if the frequency and magnitude of invasions may be related to water chemistry, sediment type, boat launches, watershed development and climate change. Management studies include tests on the effectiveness of herbicides, mechanical removal, water level manipulation, biological control, and integrated pest management. In 2022, the Office of Aquatic Invasive Species (OAIS) was established and was provided additional State funding. CAES OAIS research is conducted through the support of the United States Department of Agriculture (USDA) HATCH funds, CT DEEP, and private supporters.

For assistance with accessibility for the OAIS website and documents, please contact Summer Weidman, [summer.weidman@ct.gov](mailto:summer.weidman@ct.gov).

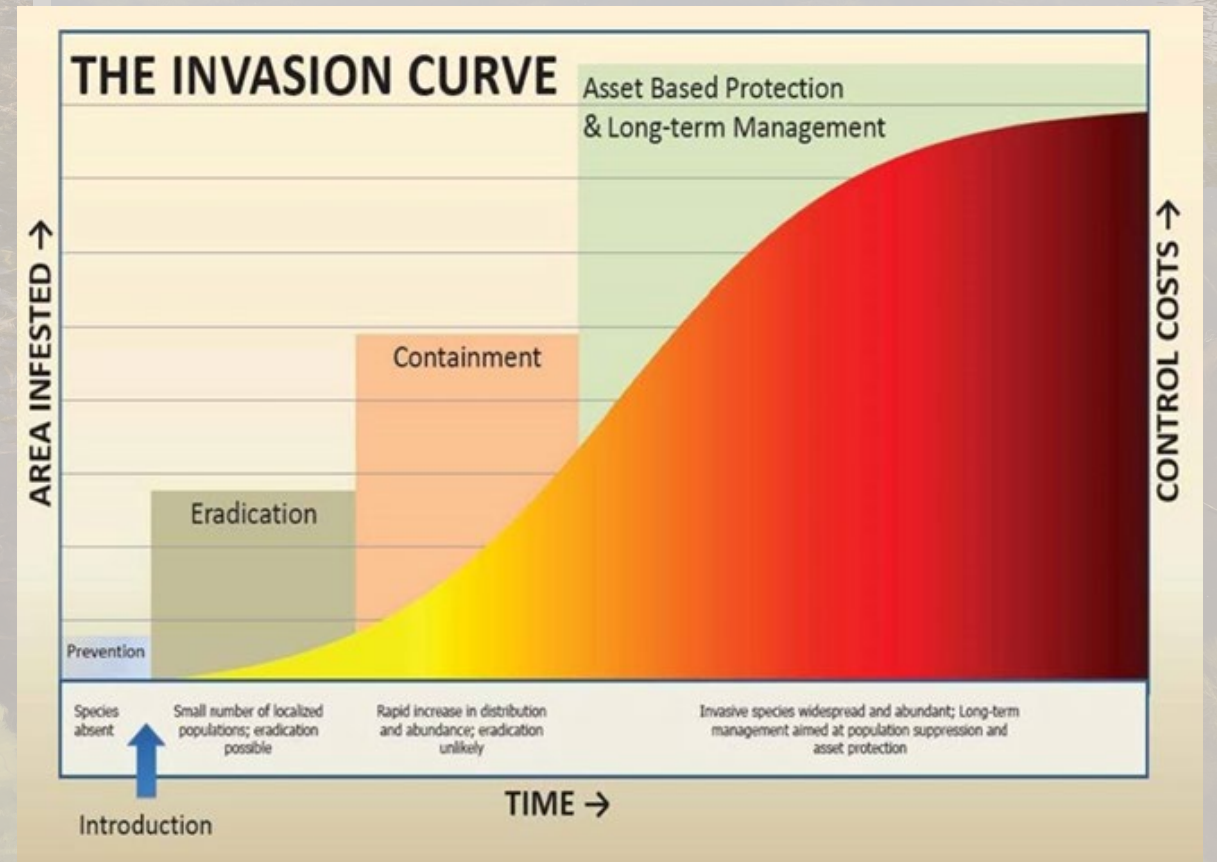
[Request an Invasive Aquatic Plant Workshop](#) [Request an Aquatic Plant Survey](#)

# WHY IS AQUATIC PLANT ID IMPORTANT?



# WHY IS AQUATIC PLANT ID IMPORTANT?

*The quicker we identify an invasion, the easier and cheaper it is to manage.*



**Curlyleaf pondweed**  
*Potamogeton crispus*

48  
Waterbodies

**Fanwort**  
*Cabomba caroliniana*

42  
Waterbodies

**Eurasian watermilfoil**  
*Myriophyllum spicatum*

75  
Waterbodies

**Variable-leaf watermilfoil**  
*Myriophyllum heterophyllum*

58  
Waterbodies

**Water chestnut**  
*Trapa natans*

36  
Waterbodies

**Northern Hydrilla (CT River)**  
*Hydrilla verticillata ssp. lithuanica*

12

**Wandering Hydrilla (Monoecious)**  
*Hydrilla verticillata ssp. peregrina*

9

**Whorled Hydrilla (Dioecious)**  
*Hydrilla verticillata ssp. verticillata*

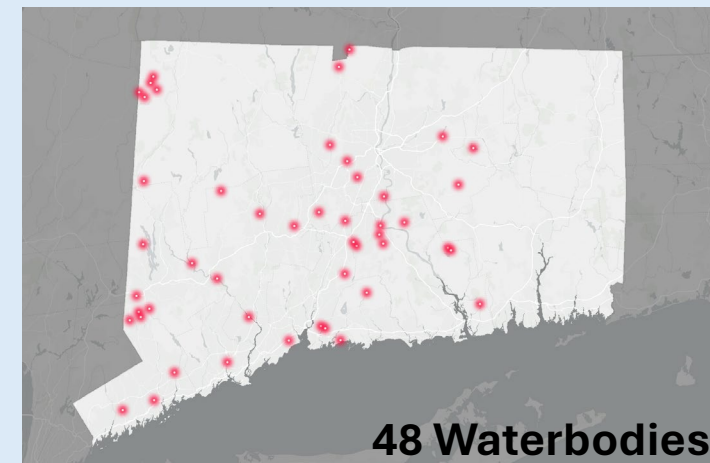
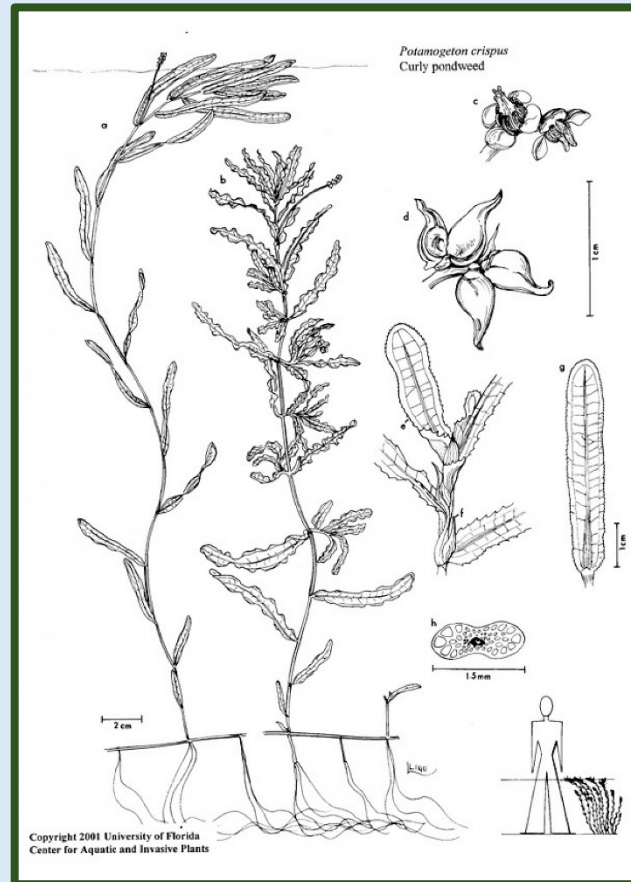
0

# Curlyleaf pondweed

## *Potamogeton crispus*

### Key Info:

- Introduced to CT in 1943
- Annual, sprouts from turions
- Fully grown in May/June, dies back midsummer



# Curlyleaf pondweed

*Potamogeton crispus*

## Key Features:

- Wavy, lasagna-like leaves
- Leaves alternate, no petioles
- Brown turions, like small pinecones



CAES OAIS

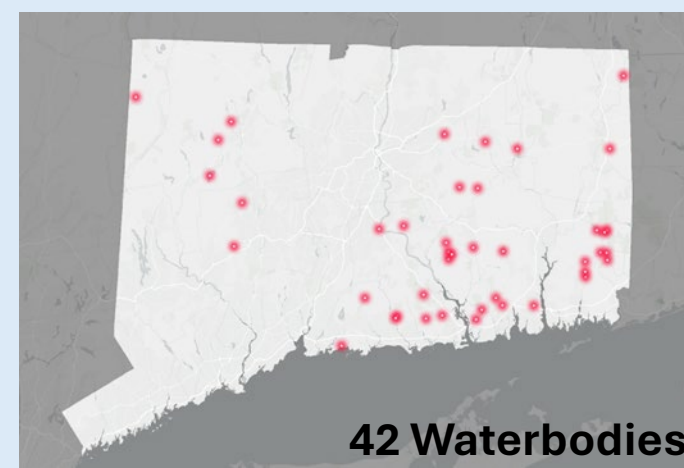


Curly pondweed  
*Potamogeton crispus*  
Photo by Vic Ramey  
© 2001 University of Florida



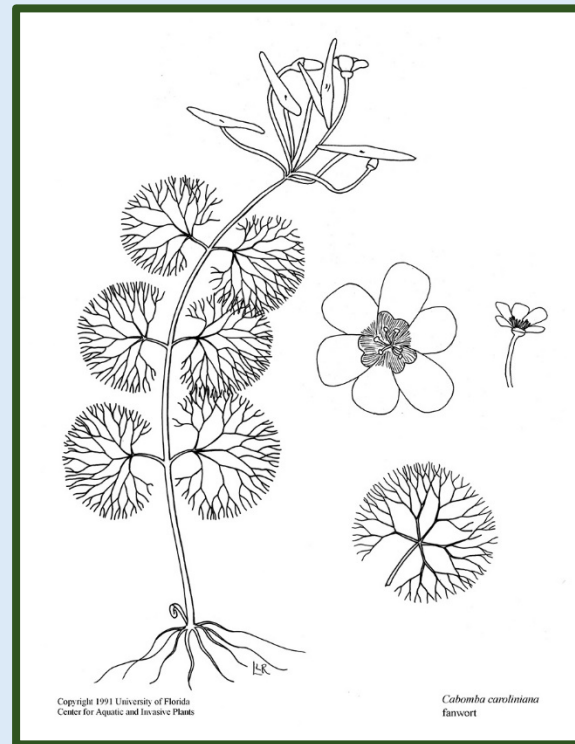
# Fanwort

## *Cabomba caroliniana*



### Key Info:

- Introduced to CT in 1937
- Submersed plant
- Grows in 3-10 feet of water
- Spreads through fragmentation



# Fanwort

*Cabomba caroliniana*

## Key Features:

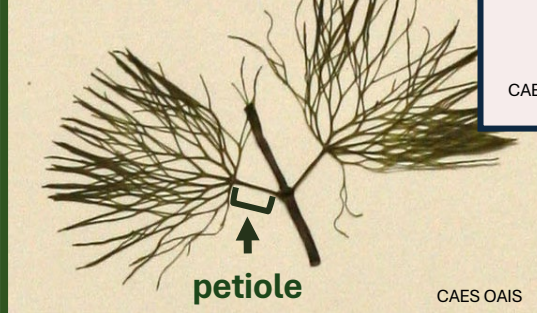
- Bright green, looks like a pipe cleaner
- Flowers: white, solitary
- Leaves: opposite, long petioles, fan-like



A. Smagula



Opposite leaves



CAES OAIS

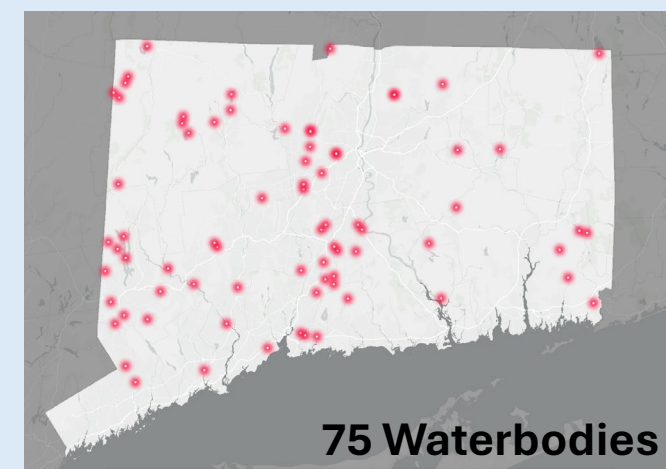
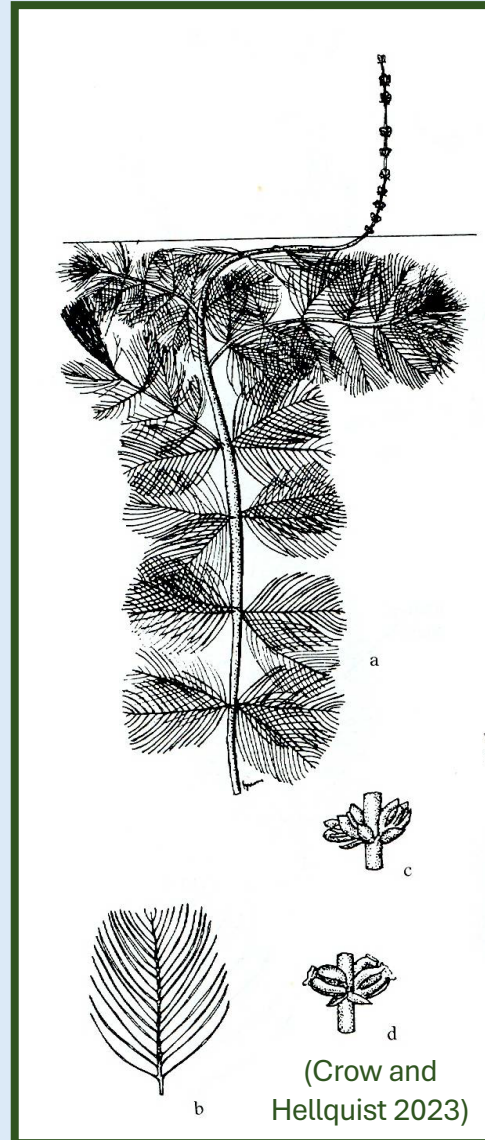
CAES OAIS

# Eurasian watermilfoil

*Myriophyllum spicatum*

## Key Info:

- Introduced to CT in 1979
- Most common invasive aquatic plant in CT and northern U.S.
- Spreads through fragmentation



# Eurasian watermilfoil

*Myriophyllum spicatum*

## Key Features:

- Thin flower spike
- Rectangular leaf
- Leaves > 1 inch apart
- $\geq 12$  leaflet pairs

CAES OAIS

Whorl

1"

CAES OAIS

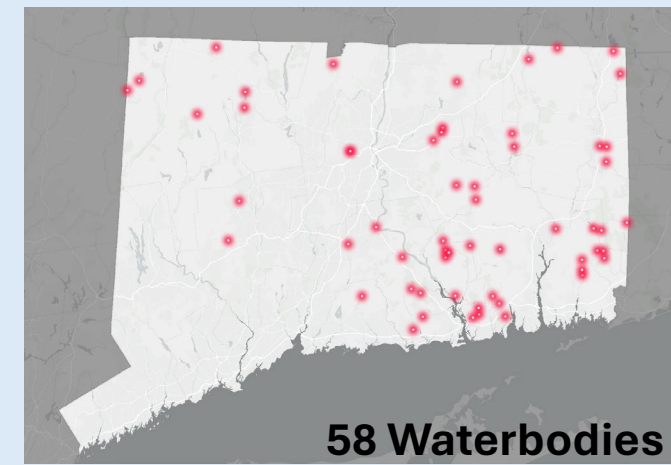
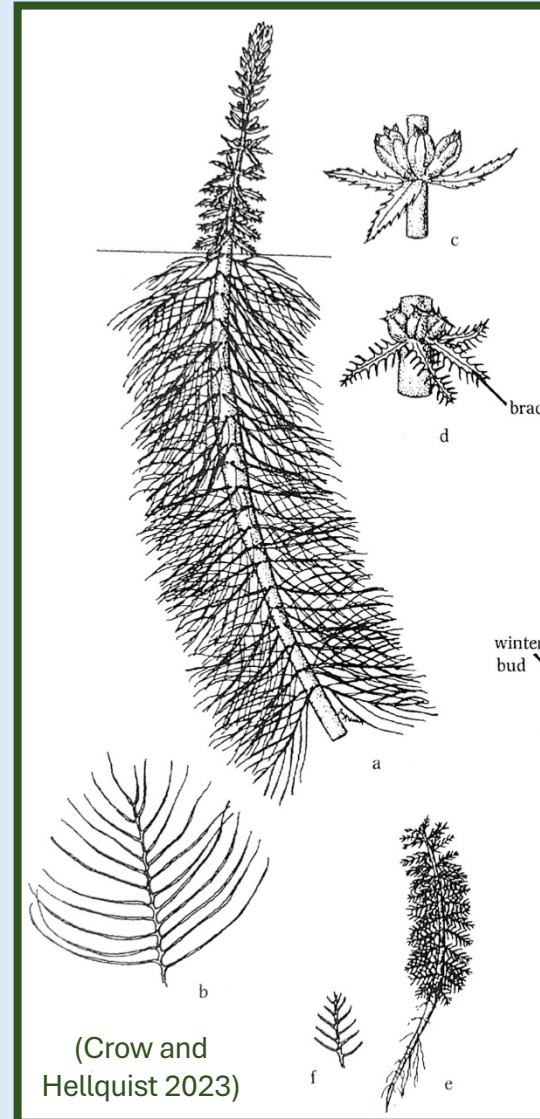
CAES OAIS

# Variable-leaf watermilfoil

*Myriophyllum heterophyllum*

## Key Info:

- Introduced to CT in 1932
- Variable appearance, sometimes reddish, sometimes green
- Spreads through fragmentation

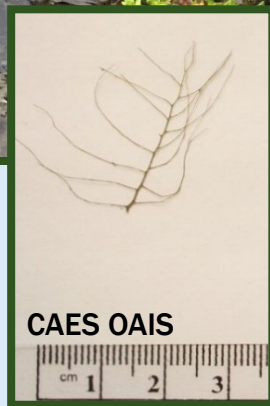


# Variable-leaf watermilfoil

*Myriophyllum heterophyllum*

## Key Features:

- Thick flower spike
- Red or green Stem
- Triangular leaf
- Leaves < 1 inch apart
- ≤ 11 leaflet pairs



# Eurasian watermilfoil

*Myriophyllum spicatum*

- Thin flower spike
- Rectangular leaf
- Leaves > 1 inch apart
- $\geq 12$  leaflet pairs

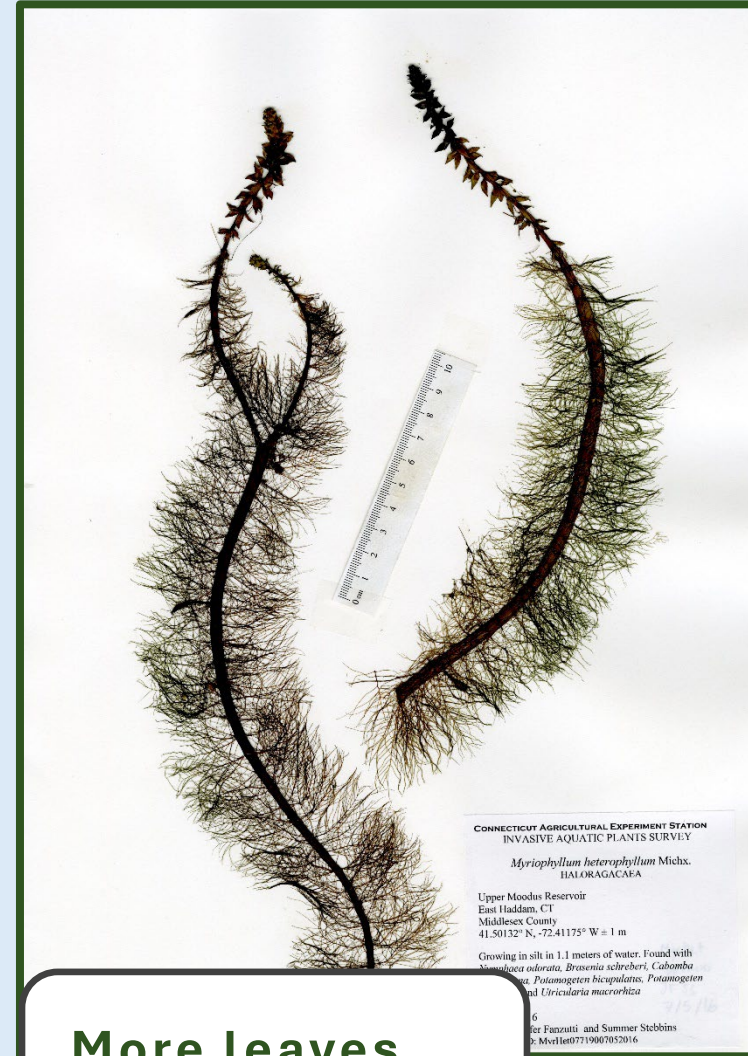


Fewer leaves,  
more leaflets

# Variable-leaf watermilfoil

*Myriophyllum heterophyllum*

- Thick flower spike
- Triangular leaf
- Leaves < 1 inch apart
- $\leq 11$  leaflet pairs



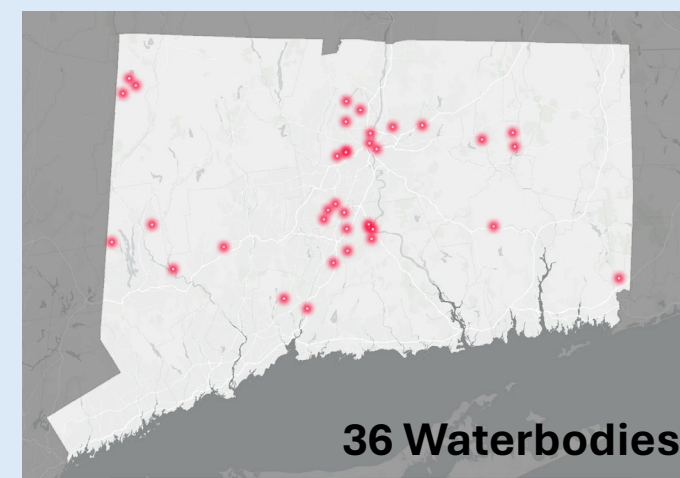
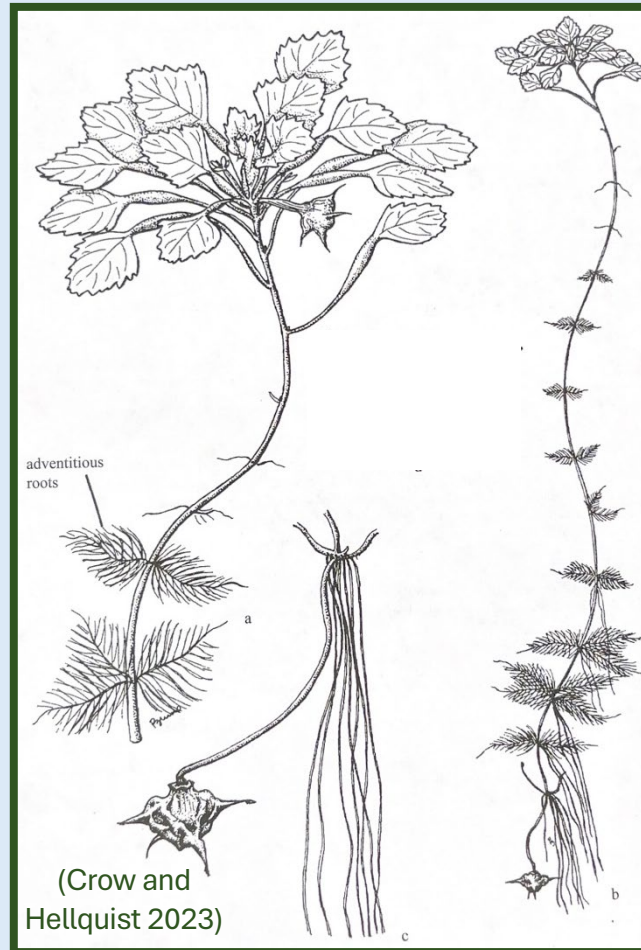
More leaves,  
fewer leaflets

# Water chestnut

## *Trapa natans*

### Key Info:

- Introduced to CT in 1998
- Annual, sprouts from nutlets
- One nutlet = 10-15 rosettes
- One rosette = 15-20 nutlets
- One nutlet = 150-300 new nutlets



# Water chestnut

*Trapa natans*

## Key Features:

- Floating rosette
- Waxy, triangular leaves
- Feathery submerged leaves
- Small, white flower



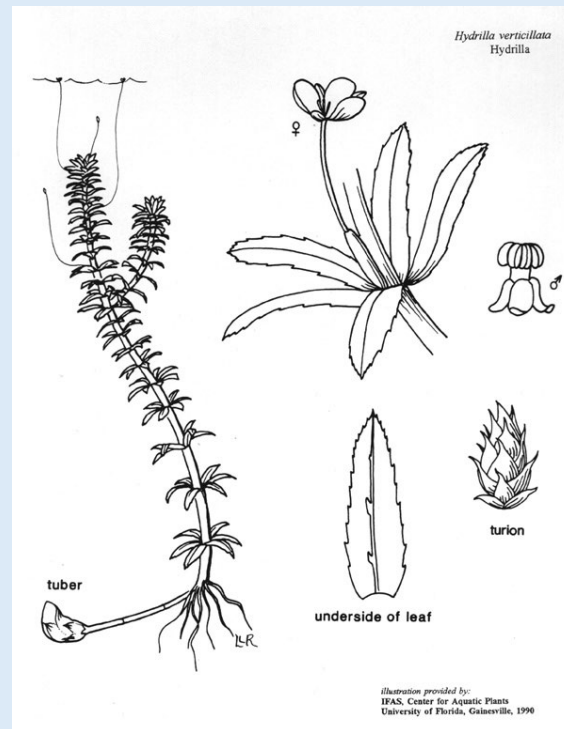
# Hydrilla\*

*Hydrilla verticillata*

\*Three different subspecies

## Key Info:

- Introduced to CT in 1989
- Spreads through turions, tubers, fragmentation
- Commonly confused with native waterweed



# Hydrilla

*Hydrilla verticillata*

## Key Features:

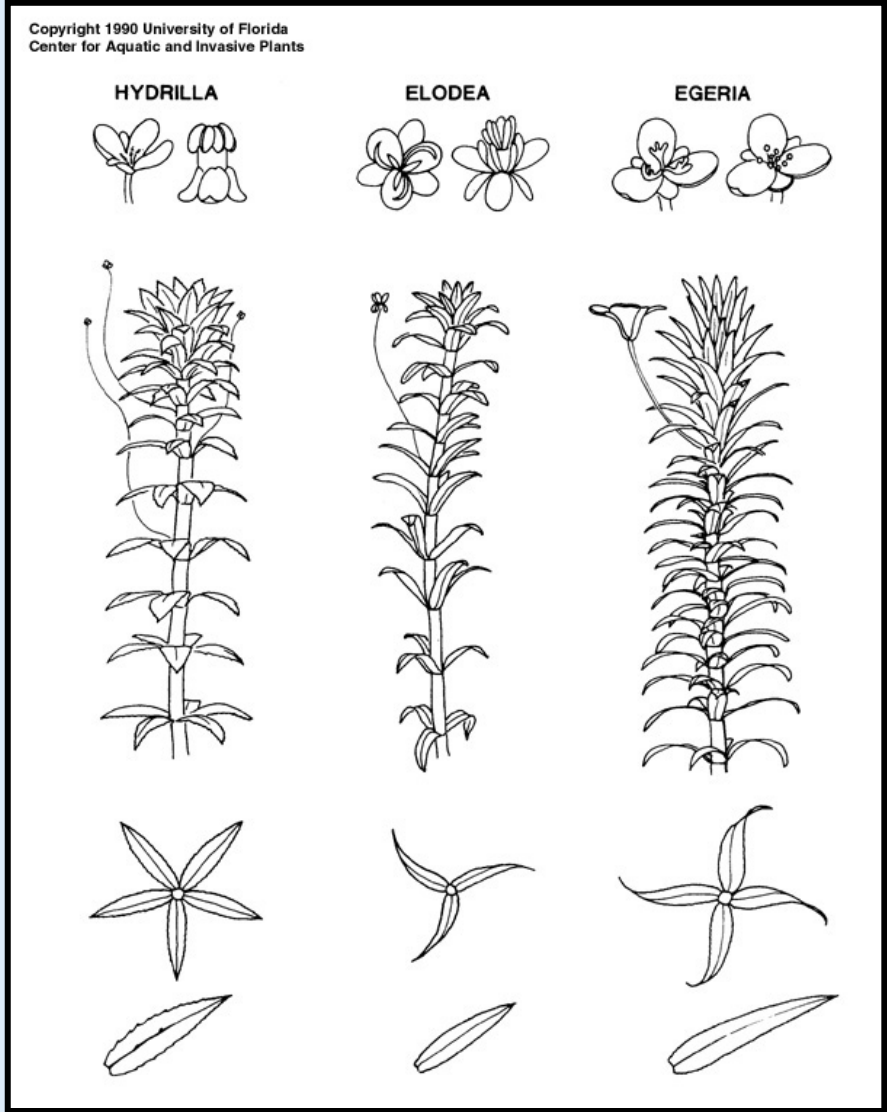
- Whorls of  $\geq 5$  leaves
- Submersed plant
- May have turions or tubers



### Turions



# Native vs Invasive



# The Three Subspecies

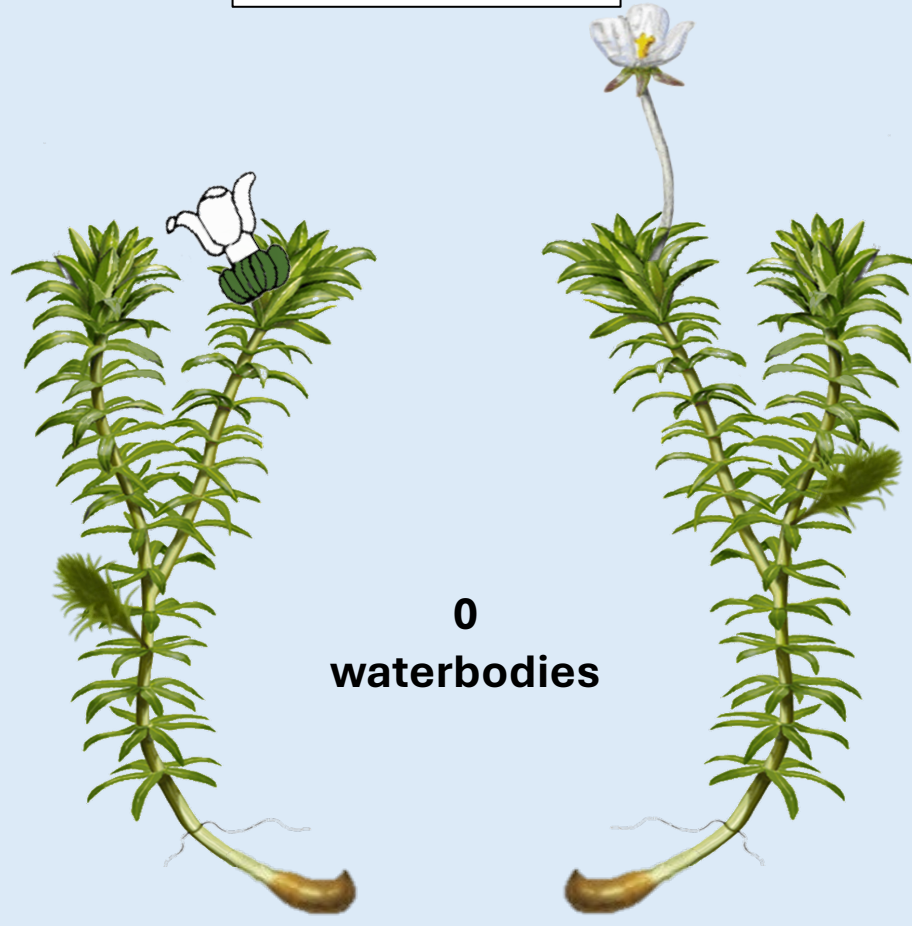
**Monoecious  
(Wandering)**



9  
waterbodies

*H. v. ssp. peregrina*

**Dioecious  
(Whorled)**



0  
waterbodies

*H. v. ssp. verticillata*

**Connecticut River  
(Northern)**



12  
waterbodies

*H. v. ssp. lithuanica*

**Flowers**

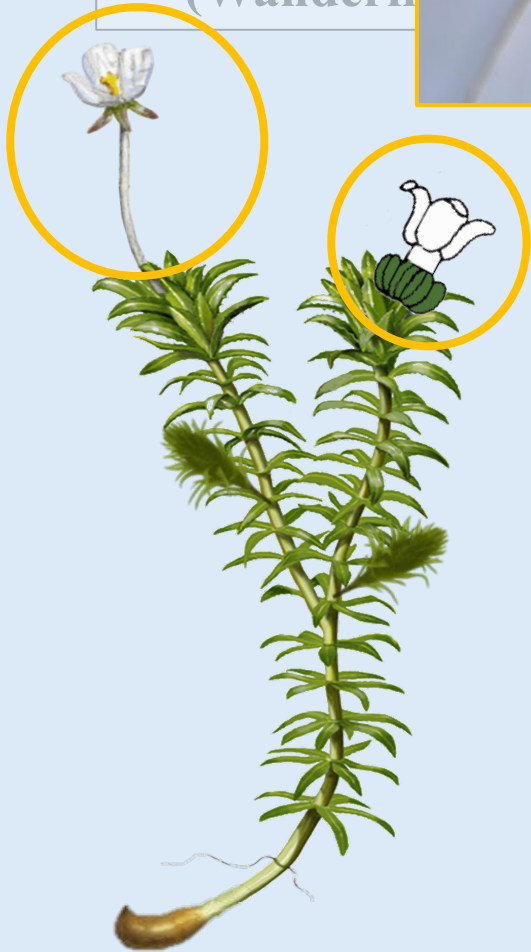


**Subspecies**

**Monoecious**  
(Wandering)

**Dioecious**  
(Whorled)

**Connecticut River**  
(Northern)



*H. v. ssp. peregrina*

*H. v. ssp. verticillata*

*H. v. ssp. lithuanica*



# Subspecies

Monoecious  
(Wandering)

Dioecious  
(Whorled)

Connecticut River  
(Northern)



*H. v. ssp. peregrina*



*H. v. ssp. verticillata*



*H. v. ssp. lithuanica*





# Three Subspecies

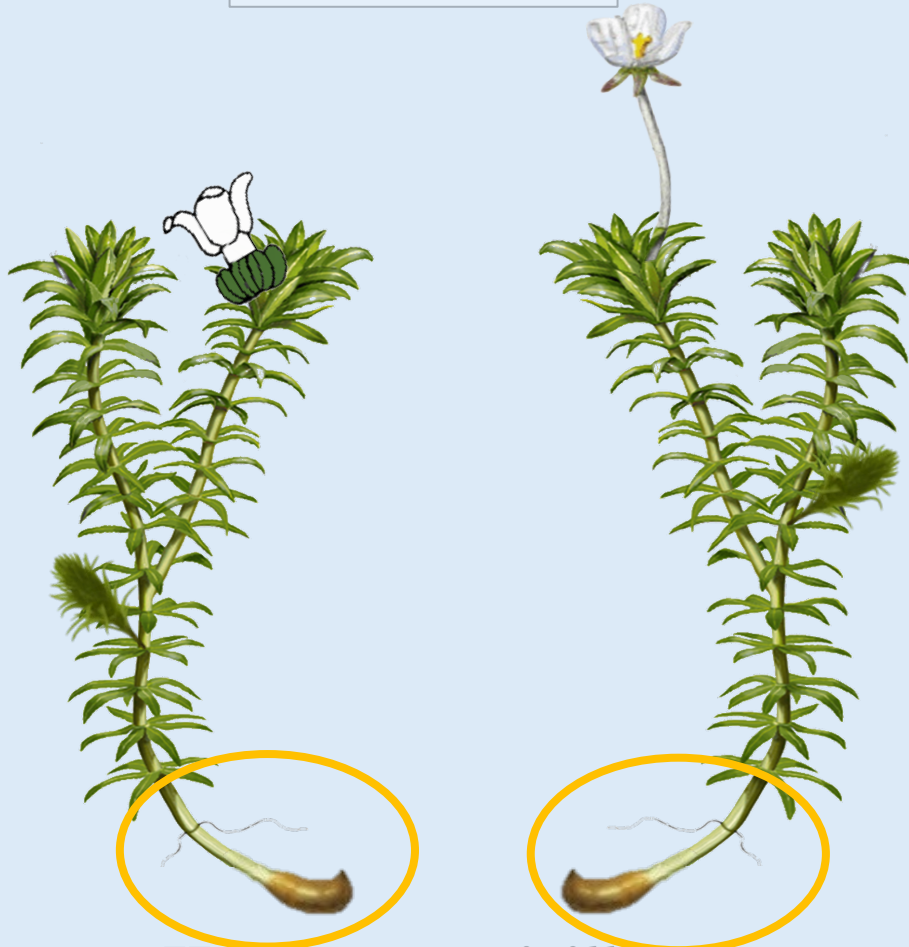
**Monoecious**  
(Wandering)

**Dioecious**  
(Whorled)

**Connecticut River**  
(Northern)



*H. v. ssp. peregrina*



*H. v. ssp. verticillata*



*H. v. ssp. lithuanica*

The

Subterranean turion

Connecticut River  
(Northern)



*H. v. ssp. peregrina*



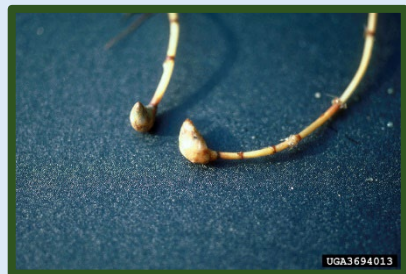
*H. v. ssp. verticillata*



*H. v. ssp. lithuanica*

# Wandering Hydrilla “Monoecious Hydrilla”

- Whorls of 5
- Less robust
- Tubers
- Less turions
- Coventry Lake
- Silvermine River



UGA3694013



CONNECTICUT AGRICULTURAL EXPERIMENT STATION  
INVASIVE AQUATIC PLANTS SURVEY

*Hydrilla verticillata* L. F. Royle  
HYDROCHARITACEAE

Coventry Lake  
Coventry, CT  
Tolland County  
41.76552° N, -72.31004° W ± 1 m  
Growing in sand in 3.4 meters of water

October 08, 2015  
Coll.: Greg Bugbee and Jennifer Fanzutti  
Herbarium ID: HydVer00015110082015

*Hydrilla verticillata* ssp. *peregrina*

# Northern Hydrilla “CT River Hydrilla”

- Whorls  $\geq 5$
- Very robust
- No tubers
- Abundant turions
- CT River, 12 other waterbodies\*



CONNECTICUT AGRICULTURAL EXPERIMENT STATION  
INVASIVE AQUATIC PLANTS SURVEY

*Hydrilla verticillata* L. F. Royle  
HYDROCHARITACEAE

Connecticut River  
Lyme, CT  
New London County  
41.38794° N, 72.35224° W ± 1 m

Growing in muck in 1.5 meters of water. Found with *Nymphaea odorata*.

September 25, 2019  
Coll.: Greg Bugbee  
Herbarium ID: HydVer02200009252019



CAES OAIS

*Hydrilla verticillata* ssp. *lithuanica*

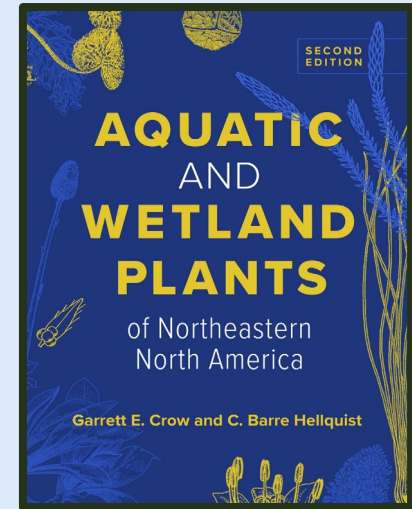
# Identification Resources

**iNaturalist**

- [inaturalist.org](https://www.inaturalist.org)
- Post Photos of Plants
- AI & Community ID



- [portal.ct.gov/CAES-OAIS](https://portal.ct.gov/CAES-OAIS)
- Bring us a sample!
- [Web App](#)
- [ID Guide](#)
- [Herbarium](#)

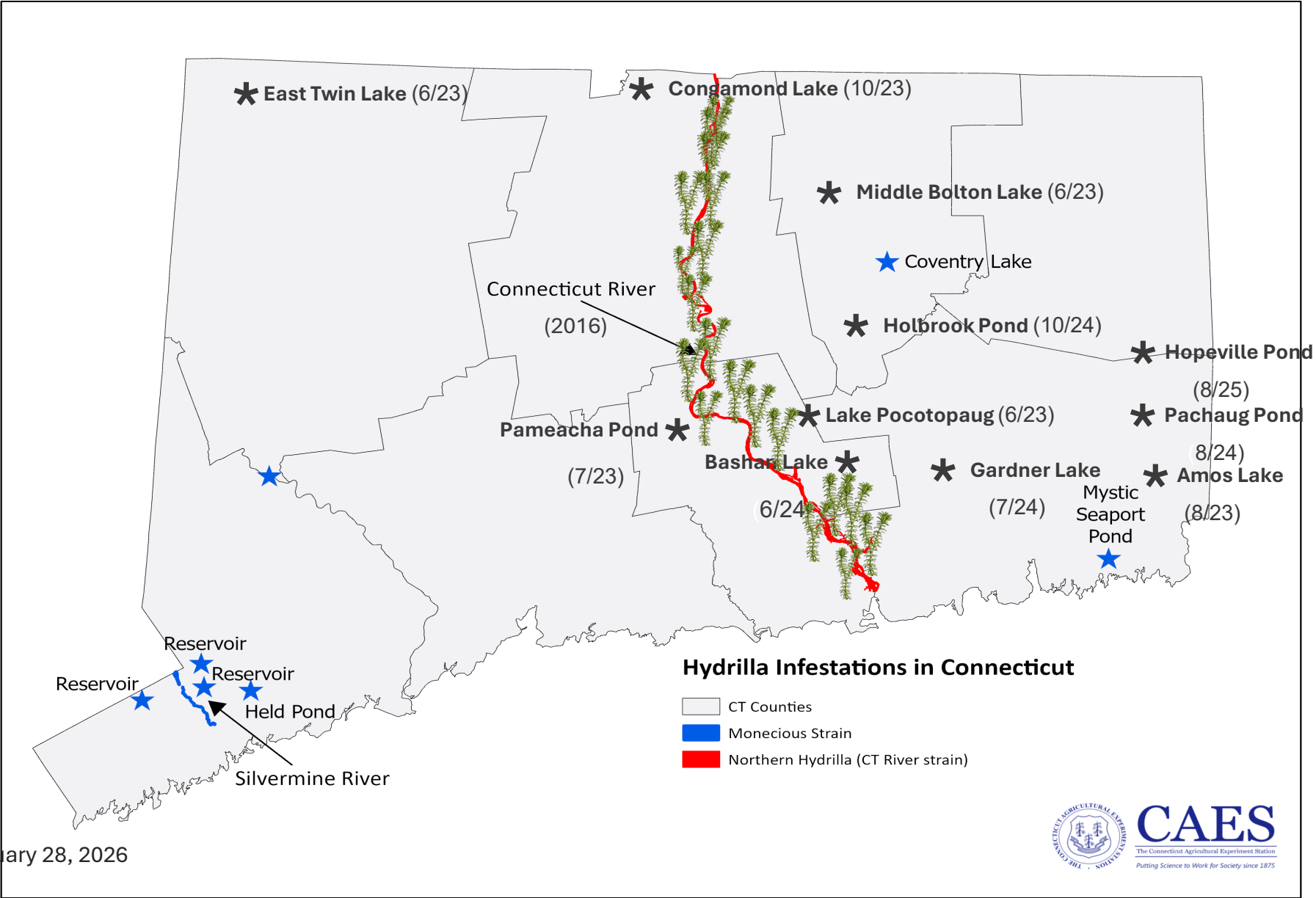


<https://uwpress.wisc.edu/books/5921.htm>

The Big Book of Plants

# The Spread of Connecticut River Hydrilla

# CT Hydrilla Detection Timeline



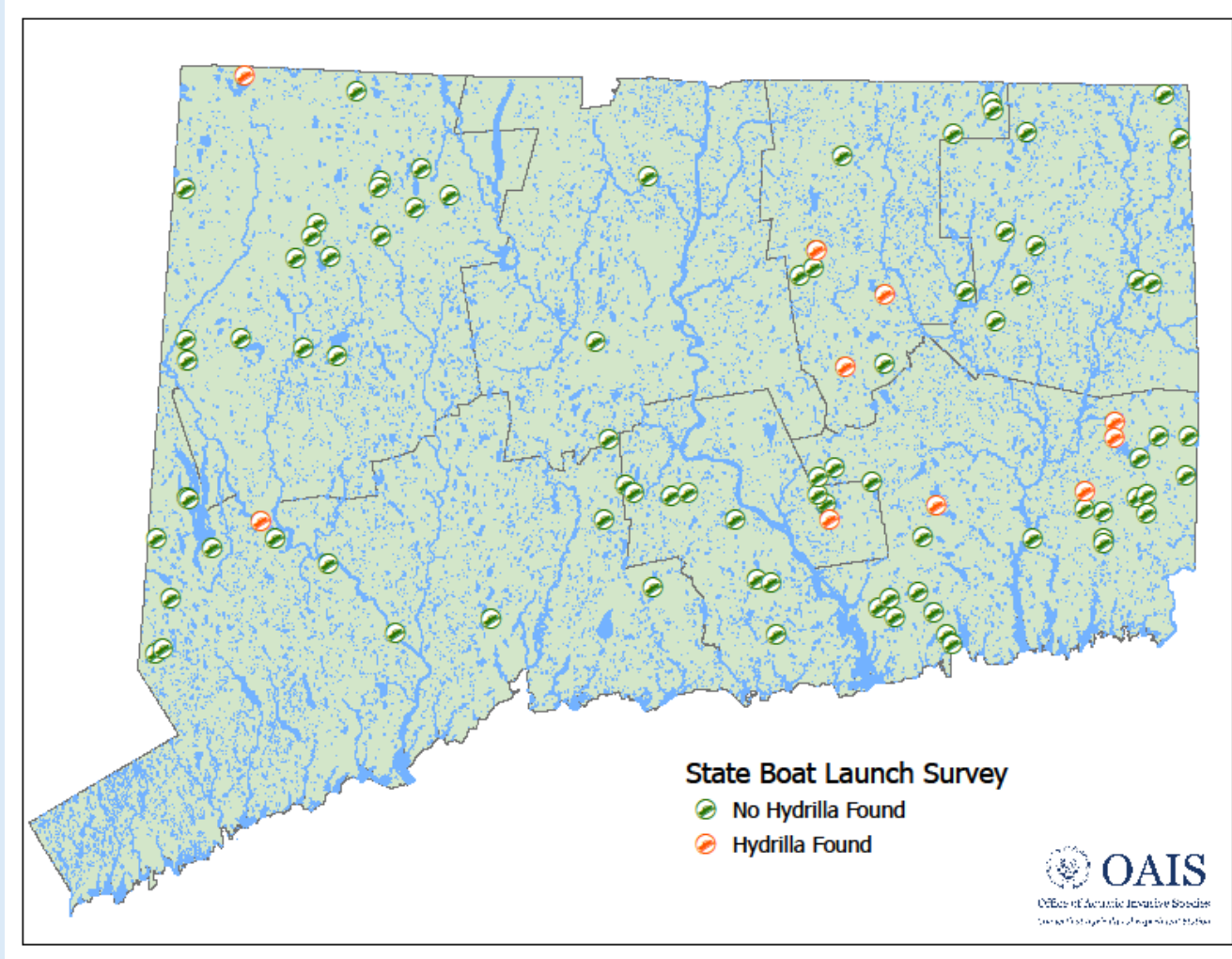
# East Twin Lake



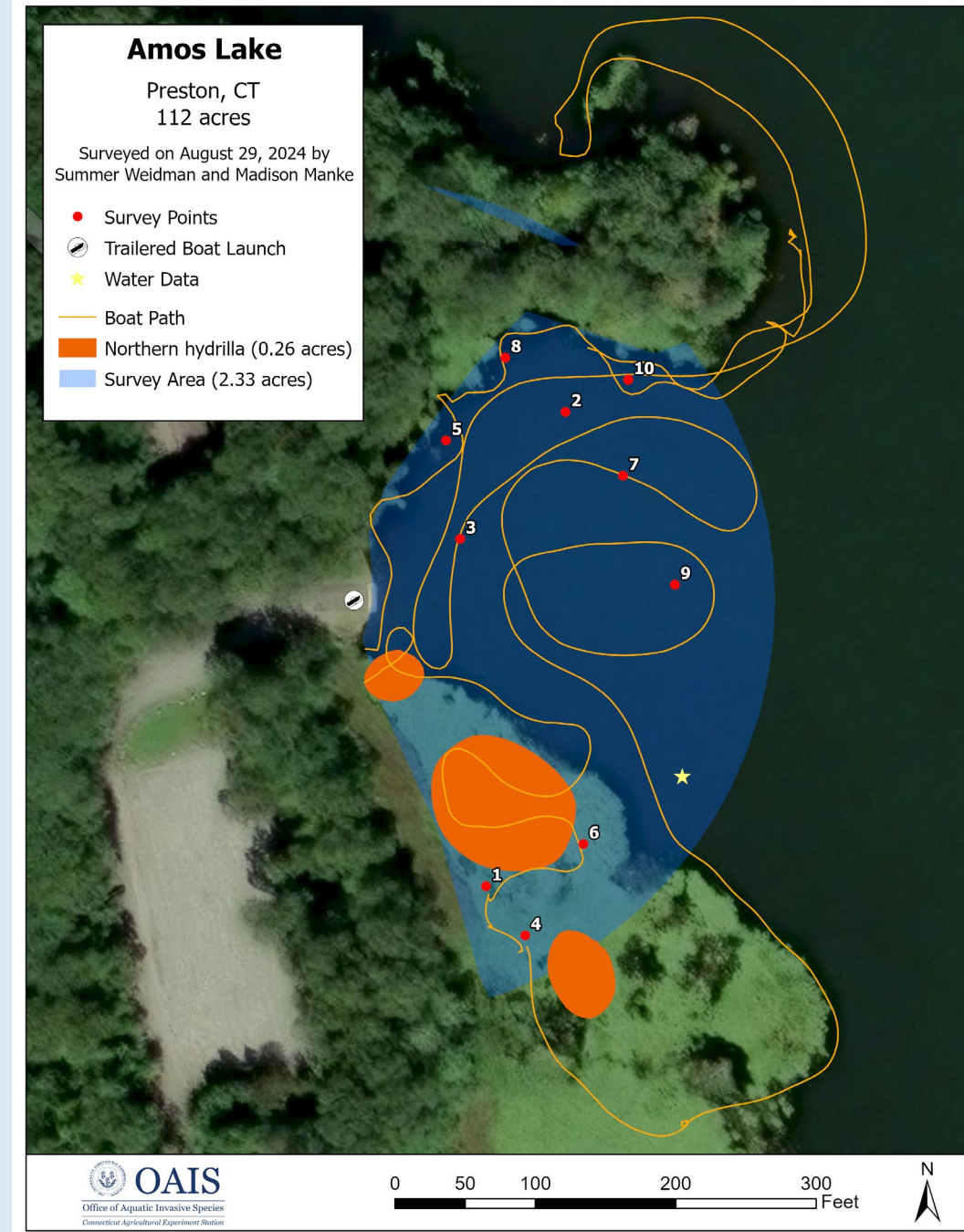
# Movement By Watercraft



# Survey of State Boat Launches



CAES Workshop February 28, 2026



# Survey of all 93 Inland State Boat Launches (74 allow trailers, 19 carry-in only)

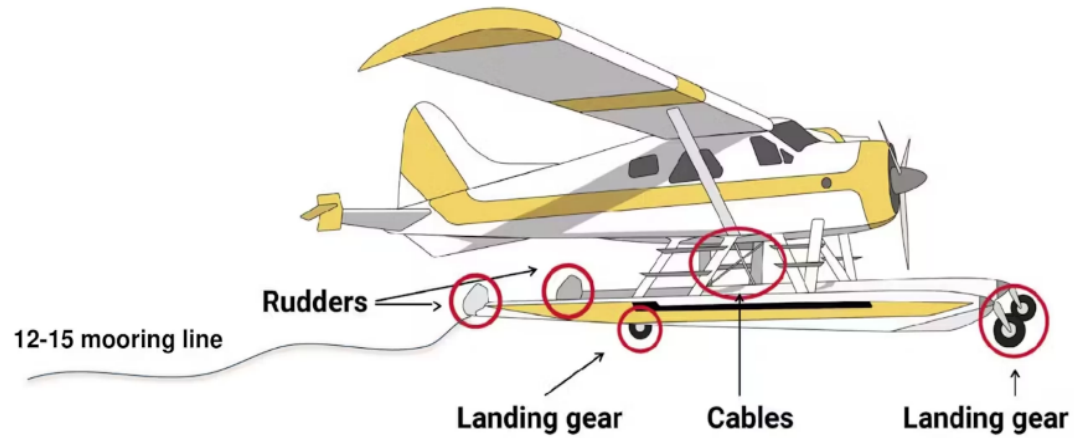
*Nine with CT River Hydrilla – All allow trailers*



# SEAPLANES



## SEAPLANES AS A PATHWAY FOR AIS SPREAD



- Construction factors: floats
- Operation factors: taxi, moorage, landing, takeoff
- Survivability of AIS under various conditions

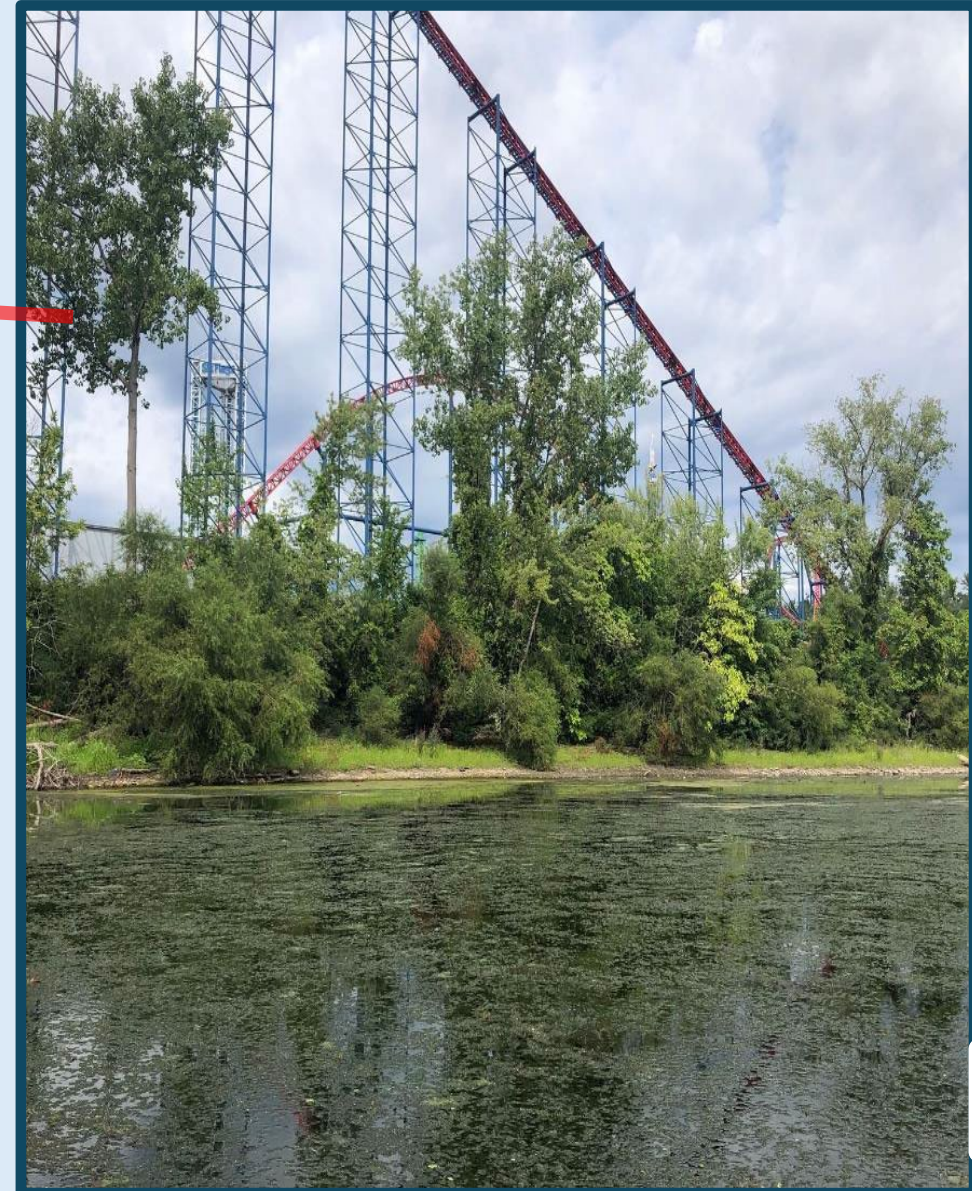
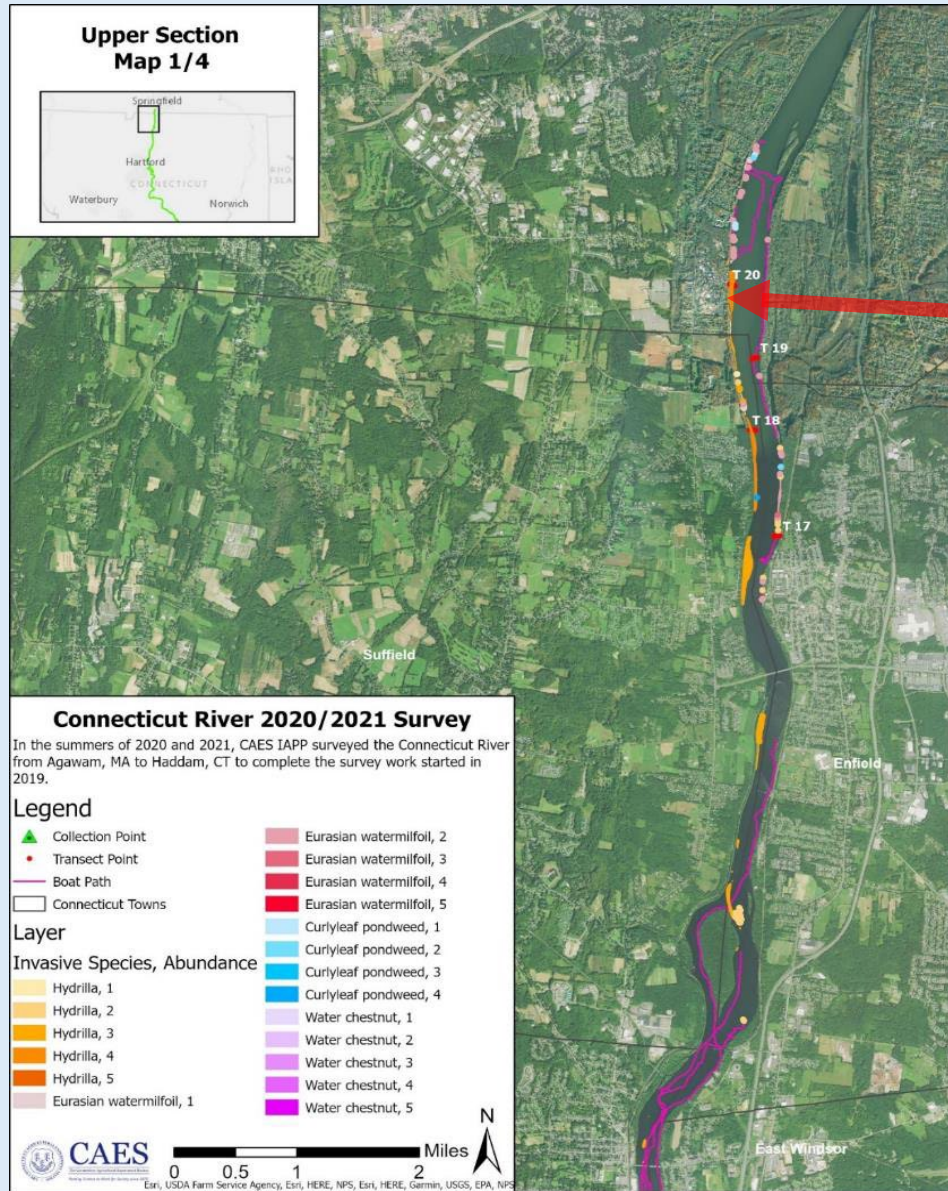
Next slide



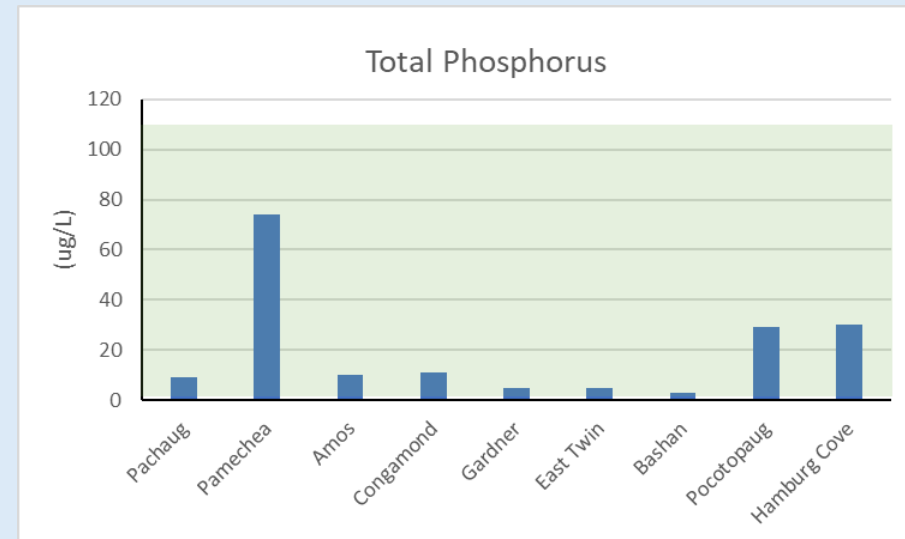
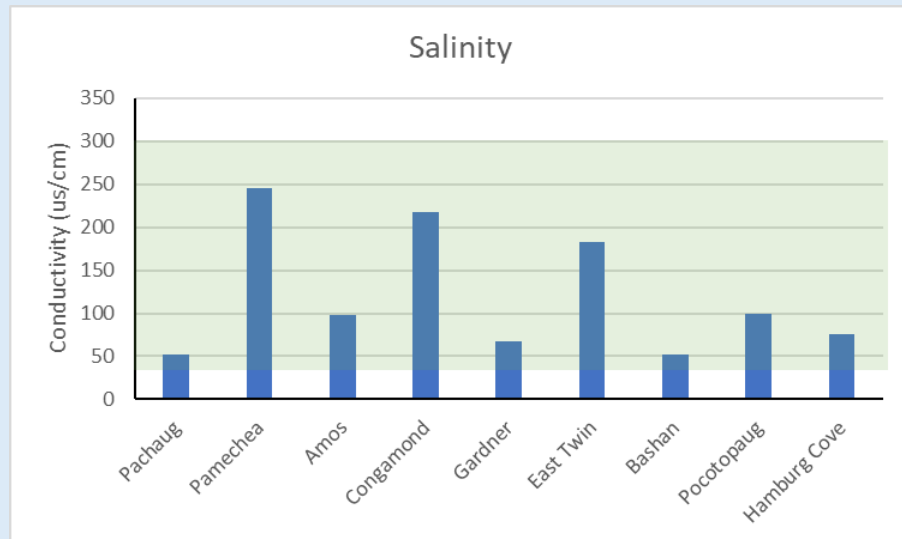
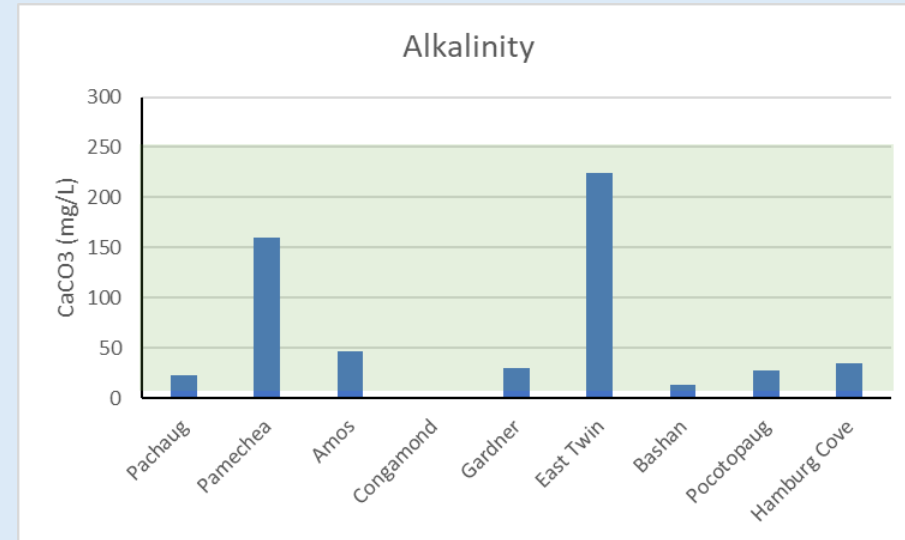
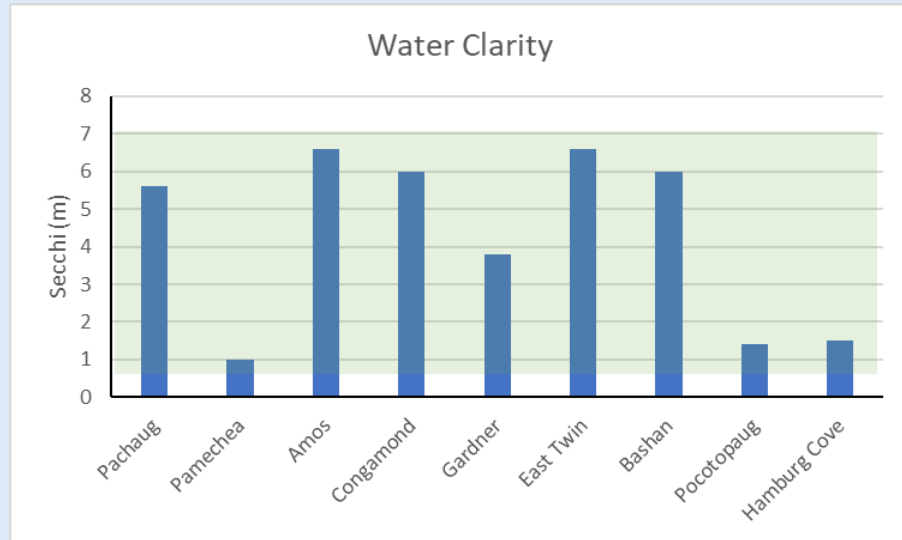
6



# Ct River Hydrilla has Not Moved North



# Hydrilla Infestations are Not Affected by Water Chemistry (Green shading = CT Range)



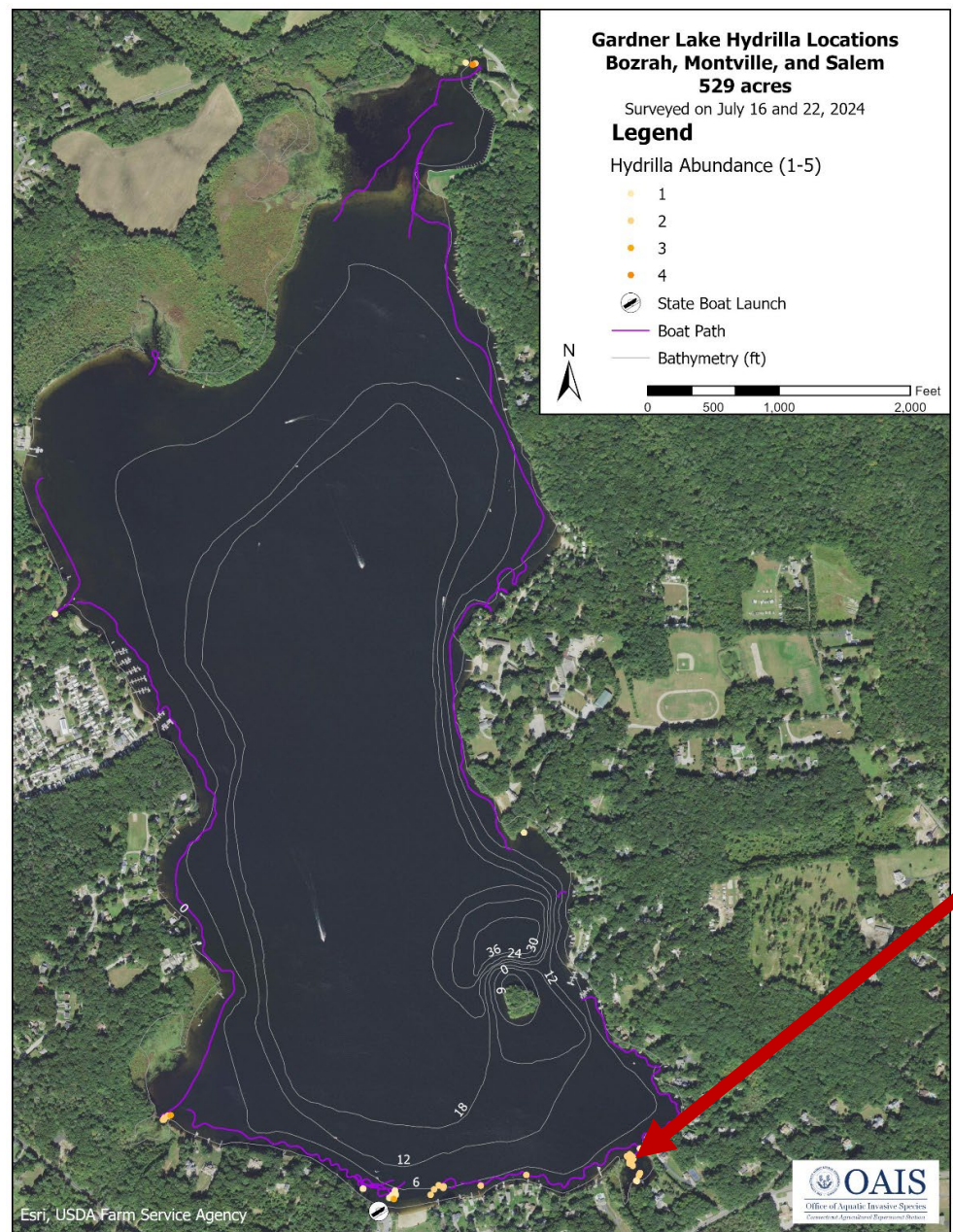
# YEAR TO YEAR VARIABILITY

**2020**



**2025**





# “First, Do No Harm”

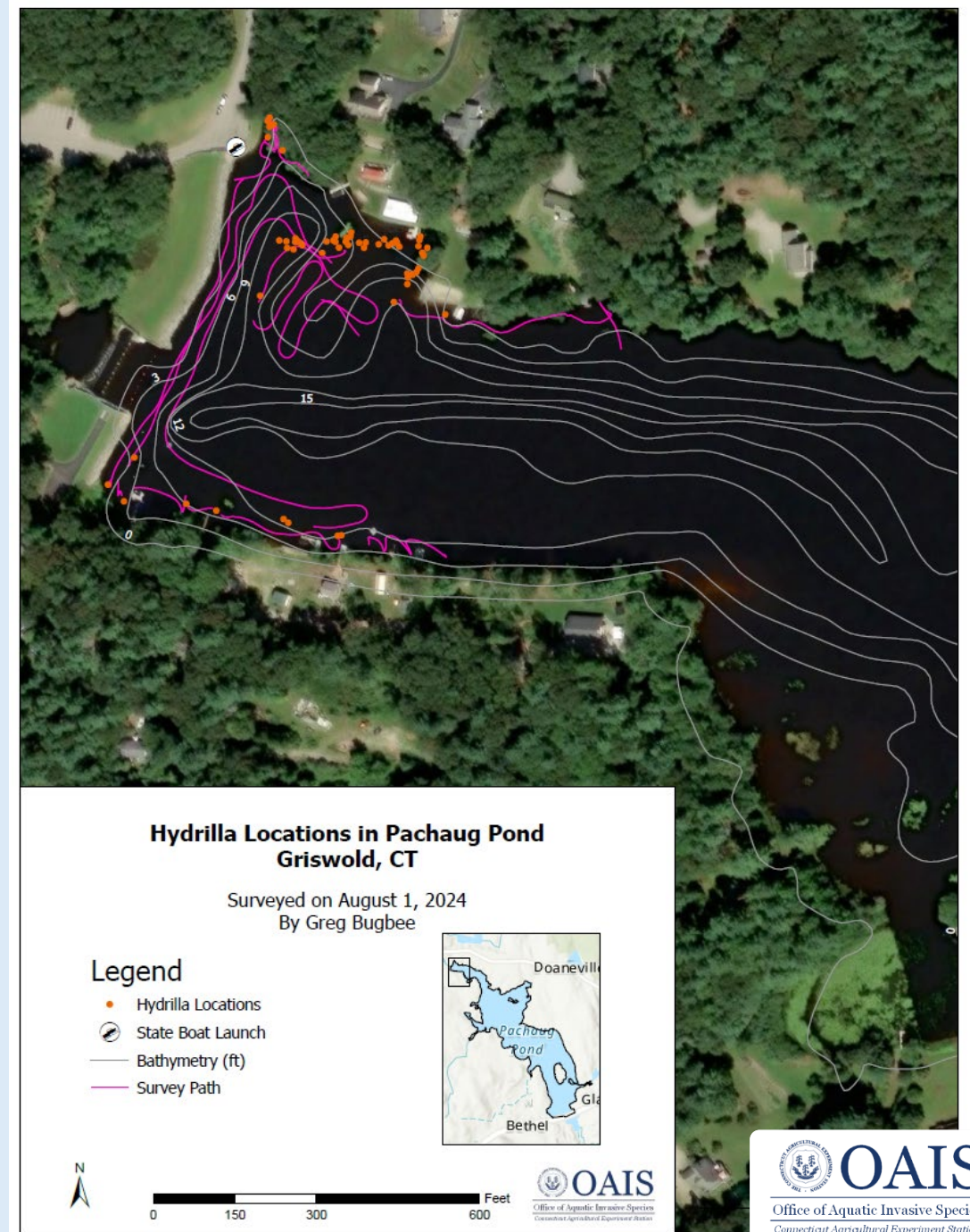


# Ultralow Grass Carp Stocking

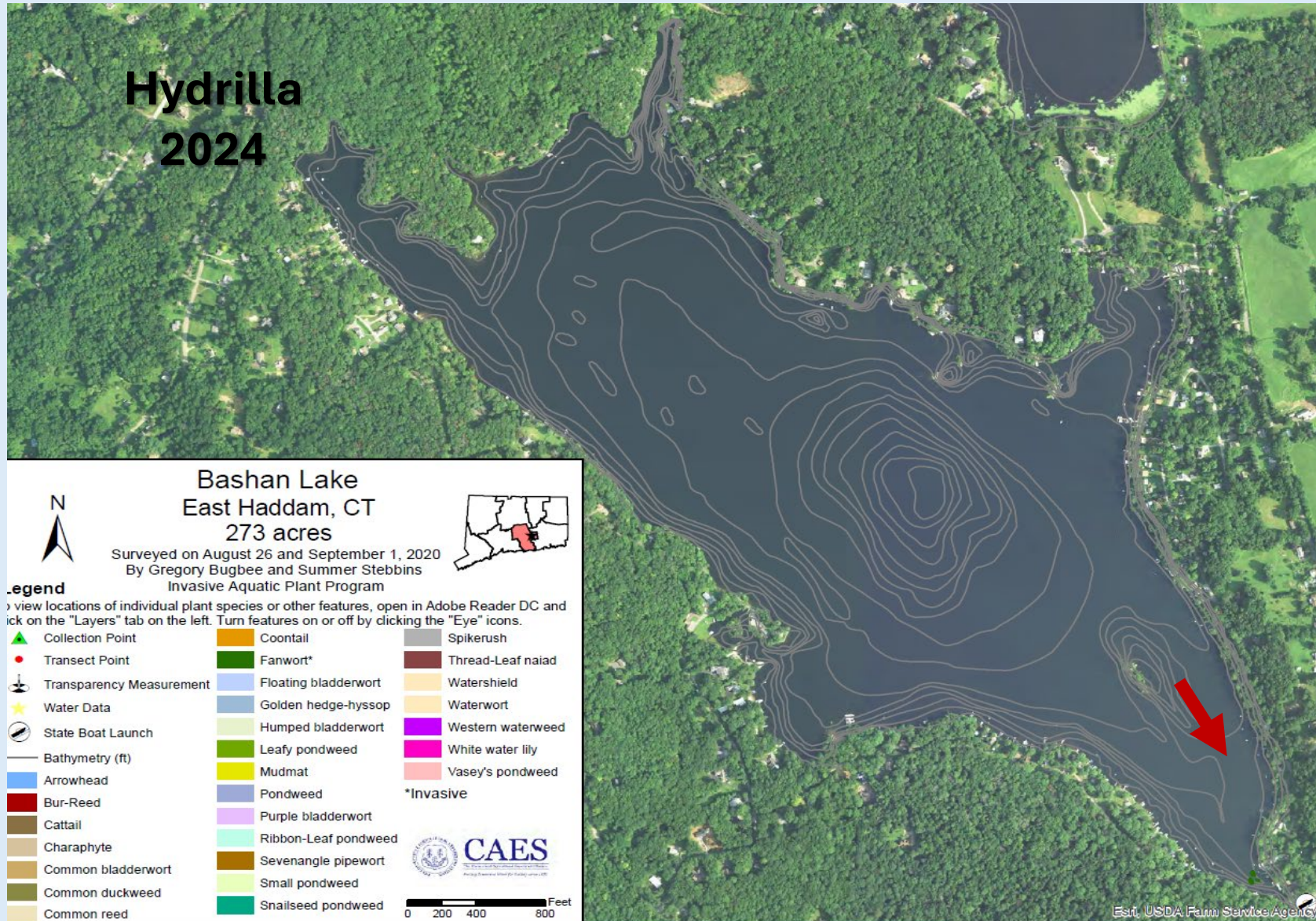
## Leveraging Feeding Preference

Table 1. Grass Carp Feeding Preferences\*

Order of Preference	Common Name	Scientific Name
1	Hydrilla	<i>Hydrilla verticillata</i> (L.f.) Royle
2	Muskgrass	<i>Chara</i> spp.
3	Southern Waternymph; Southern Naiad	<i>Najas guadalupensis</i> (Spreng.) Magnus
4	Brazilian Waterweed; Brazilian Egeria; Brazilian Elodea	<i>Egeria densa</i> Planch.
5	Watermeal	<i>Wolffia</i> spp.
6	Duckweed	<i>Lemna</i> spp.; <i>Spirodela</i> spp.; <i>Landoltia</i> spp.
7	Azolla; Waterfern; Mosquitofern	<i>Azolla</i> spp.
8	Pondweeds	<i>Potamogeton</i> spp.; <i>Stuckenia pectinata</i> (L.) Börner; <i>Zannichellia palustris</i> L.
9	Coontail	<i>Ceratophyllum demersum</i> L.
10	Torpedoglass	<i>Panicum repens</i> L.
11	Cattail	<i>Typha</i> spp.
12	Crab's-claw; Wateraloe	<i>Stratiotes aloides</i> L.
13	Watercress	<i>Nasturtium</i> spp.
14	Eurasian Watermilfoil	<i>Myriophyllum spicatum</i> L.
15	Tapegrass; American Eelgrass	<i>Vallisneria americana</i> Michx.
16	Parrotfeather	<i>Myriophyllum aquaticum</i> (Vell.) Verdc.
17	Waterhyacinth	<i>Eichhornia crassipes</i> (Mart.) Solms
18	Waterlettuce	<i>Pistia stratiotes</i> L.
19	Waterlily	<i>Nymphaea</i> spp.
20	Spatterdock	<i>Nuphar lutea</i> ssp. <i>advena</i> (Ait.) Kartesz & Gandhi



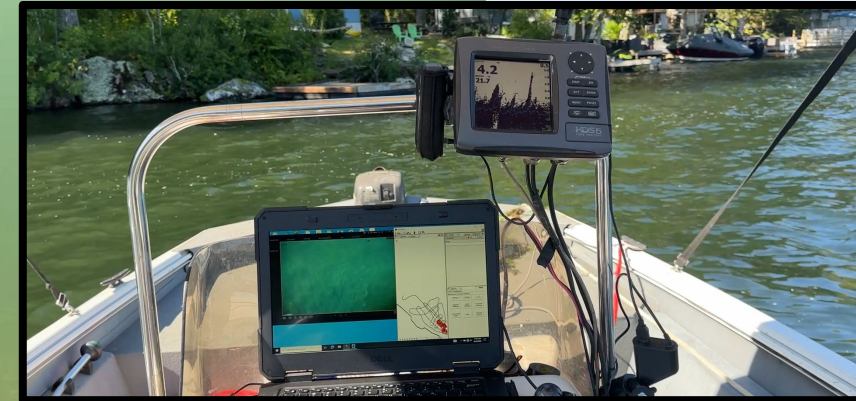
# Hand Pulling Pioneer infestation



# Bashan Lake, East Haddam



IAPP/OAIS



# Bashan Lake, East Haddam



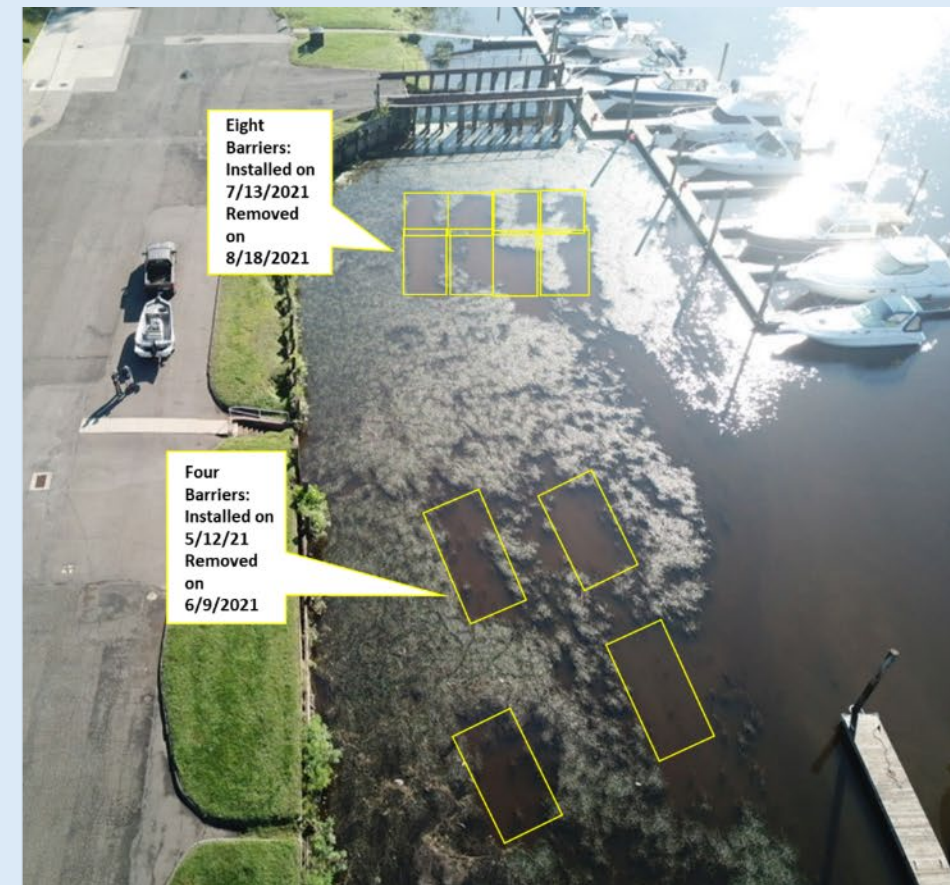
# Bashan Lake, East Haddam

08/29/2024

IAPP/OAIS

Bashan Lake

# Benthic Barriers



# Wethersfield Cove

## Treated with Diquat - 2022, 2023, 2024\*



**\*Innovative Mosquito Management**

# What Brought Me to CAES



# USACE Hydrilla Cooperative Agreement



**ERDC**  
ENGINEER RESEARCH & DEVELOPMENT CENTER



**US Army Corps  
of Engineers**®  
New England District



**Agricultural  
Research  
Service**

**UF | IFAS**  
UNIVERSITY of FLORIDA



**CENTER FOR AQUATIC  
AND INVASIVE PLANTS**



**OAIS**

Office of Aquatic Invasive Species

*Connecticut Agricultural Experiment Station*

**NC STATE  
UNIVERSITY**

# USACE Hydrilla Cooperative Agreement



# What We Study

Turion Cold Stratification

Turion Field Densities

Turion and Fragment  
Salinity Tolerance

Plant Growth and Turion  
Production Timing

Herbicide Application Timing

Native Plant Herbicide Injury

Threatened and Endangered  
Plant Herbicide Injury



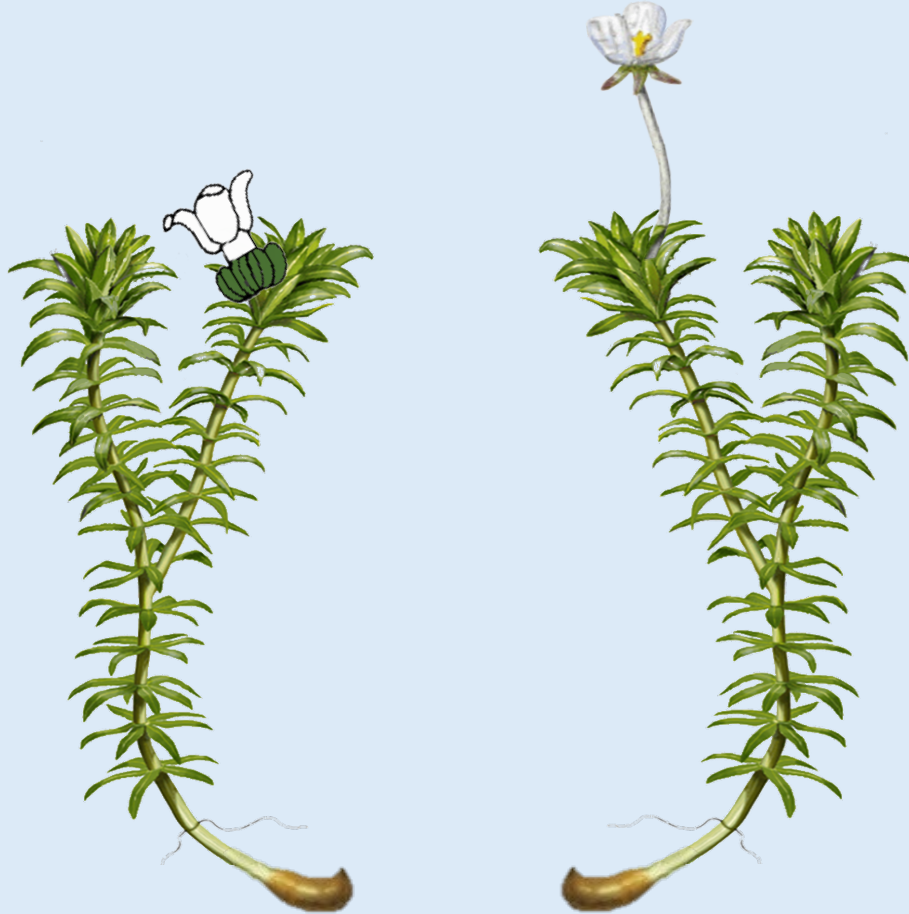
Integrated Management – Biological Control

# *Hydrilla verticillata*

**Monoecious**



**Dioecious**



**Connecticut River**

~6× fewer subterranean  
turions



# *Hydrilla verticillata*

**Monoecious**



**Dioecious**



**Connecticut River**

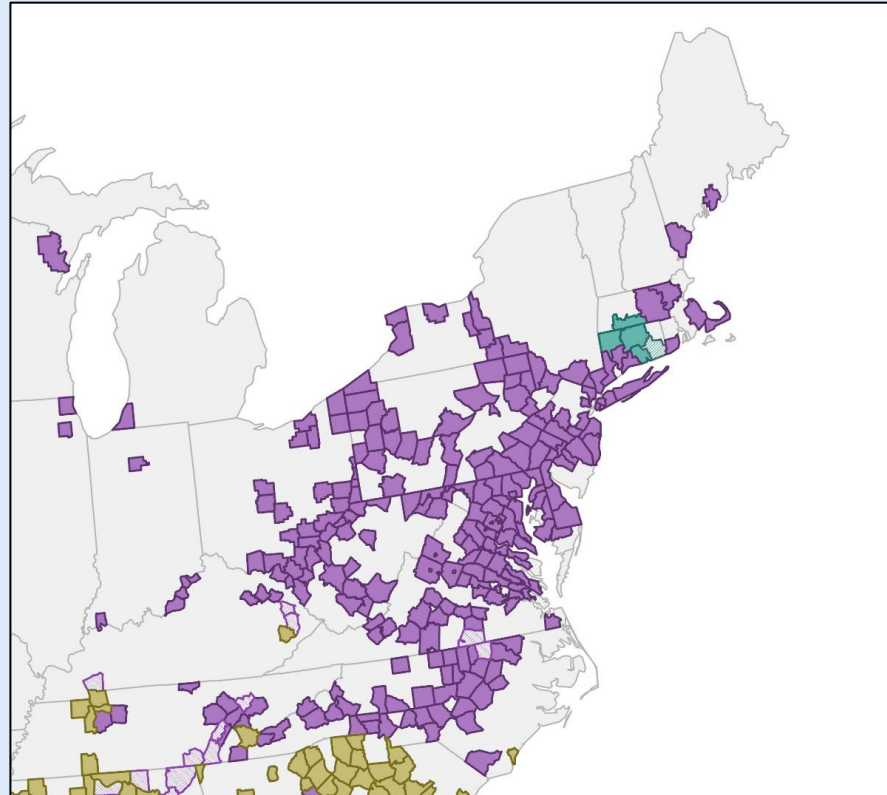
~3-60× more axillary  
turions



# *Hydrilla verticillata*

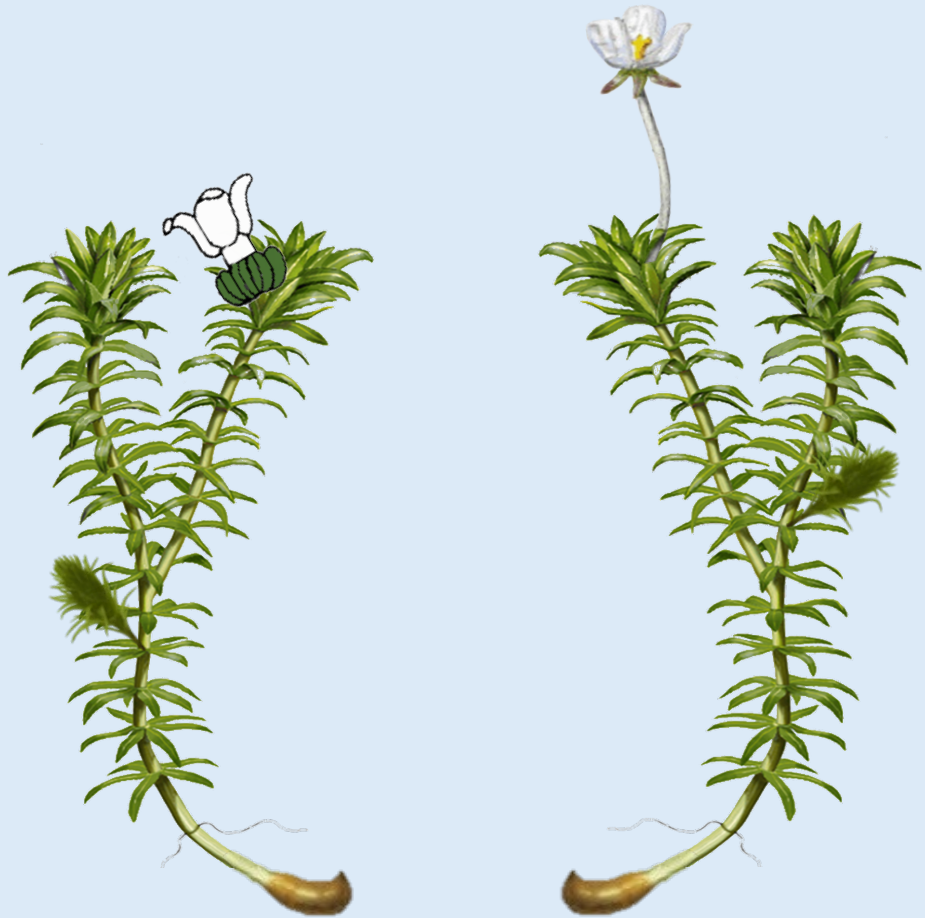
**Monoecious**

- Non-chilled axillary turions fail to sprout
- 92% germination after 42 days at 2°C

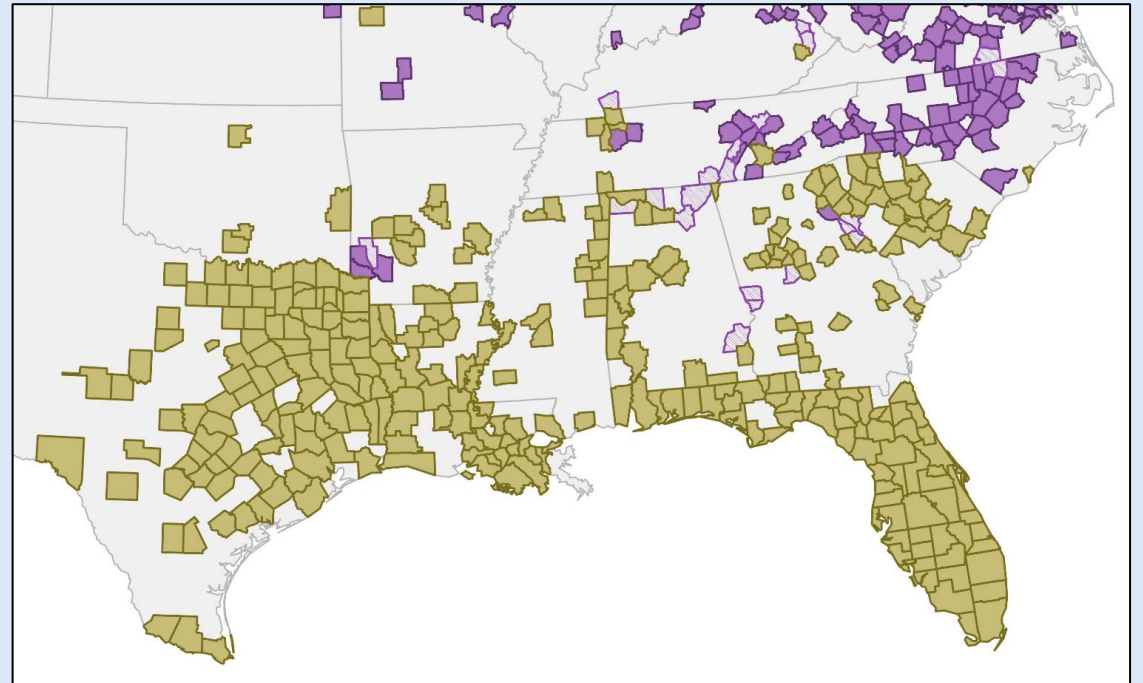


# *Hydrilla verticillata*

**Dioecious**



- No chilling necessary for sprouting
- Turion mortality in prolonged cold exposure



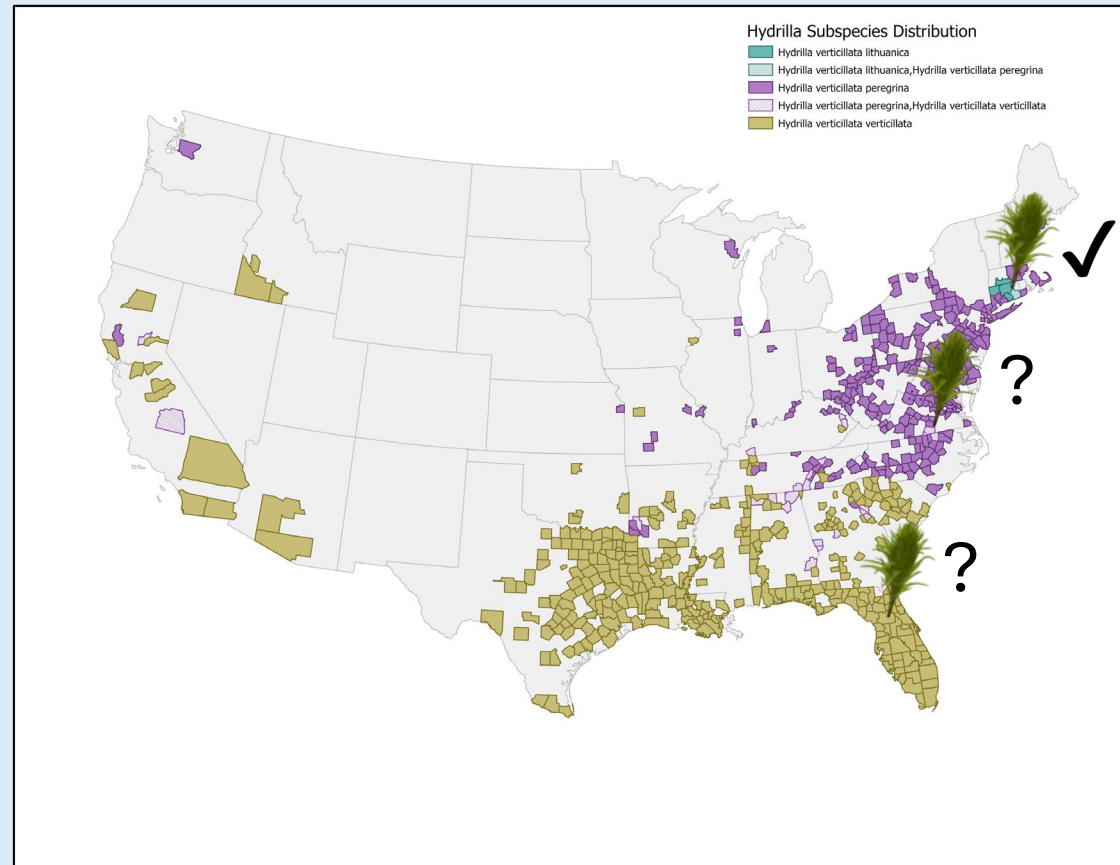
# *Hydrilla verticillata*

## Connecticut River



What are the cold stratification requirements, if any?

What climates will this subspecies be able to inhabit?



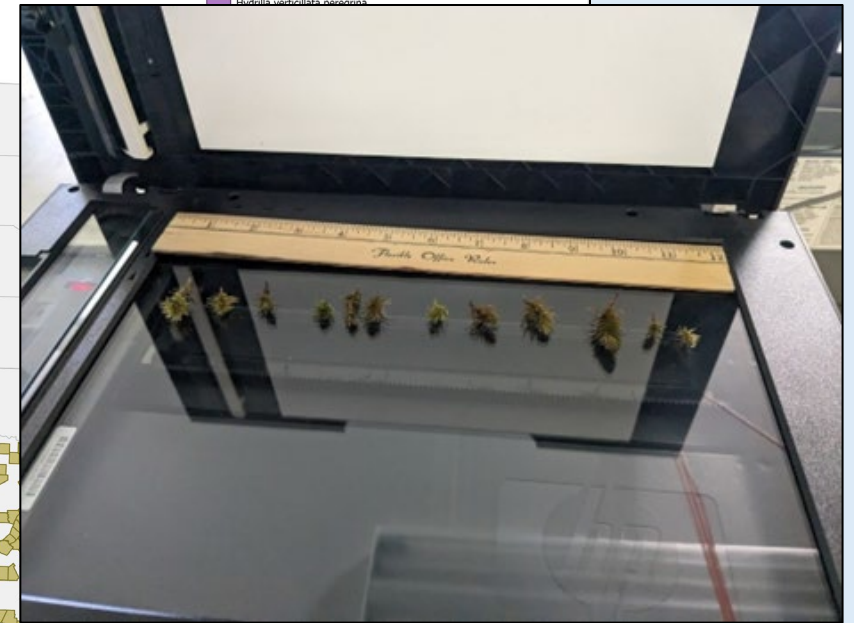
# Studies – Chilling Duration



## Connecticut River

What are the cold stratification requirements, if any?

What climates will this subspecies be able to inhabit?



# Studies – Chilling Duration



Non-chilled turions: **73% sprouted**

8 and 16-day chilled turions: **>97% sprouted**

## 0 Days of Cold Exposure (16 DAT)



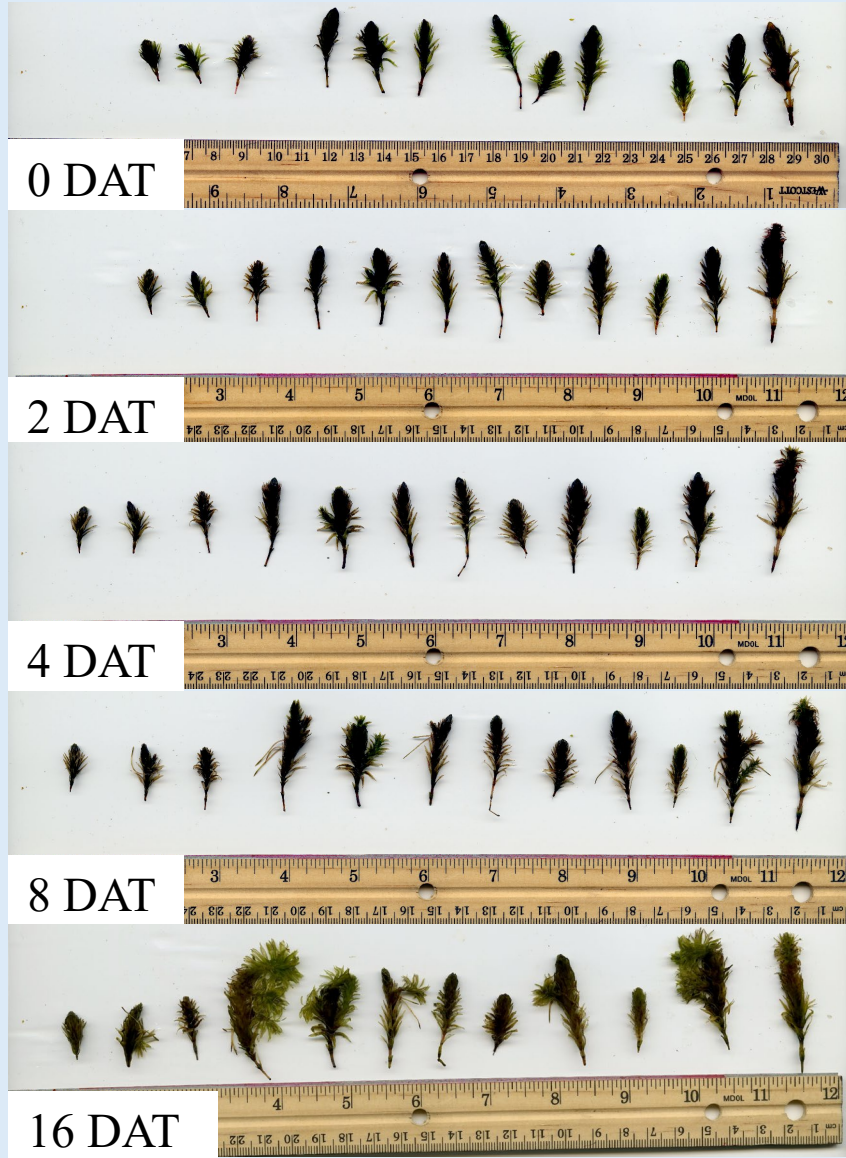
## 16 Days of Cold Exposure (16 DAT)



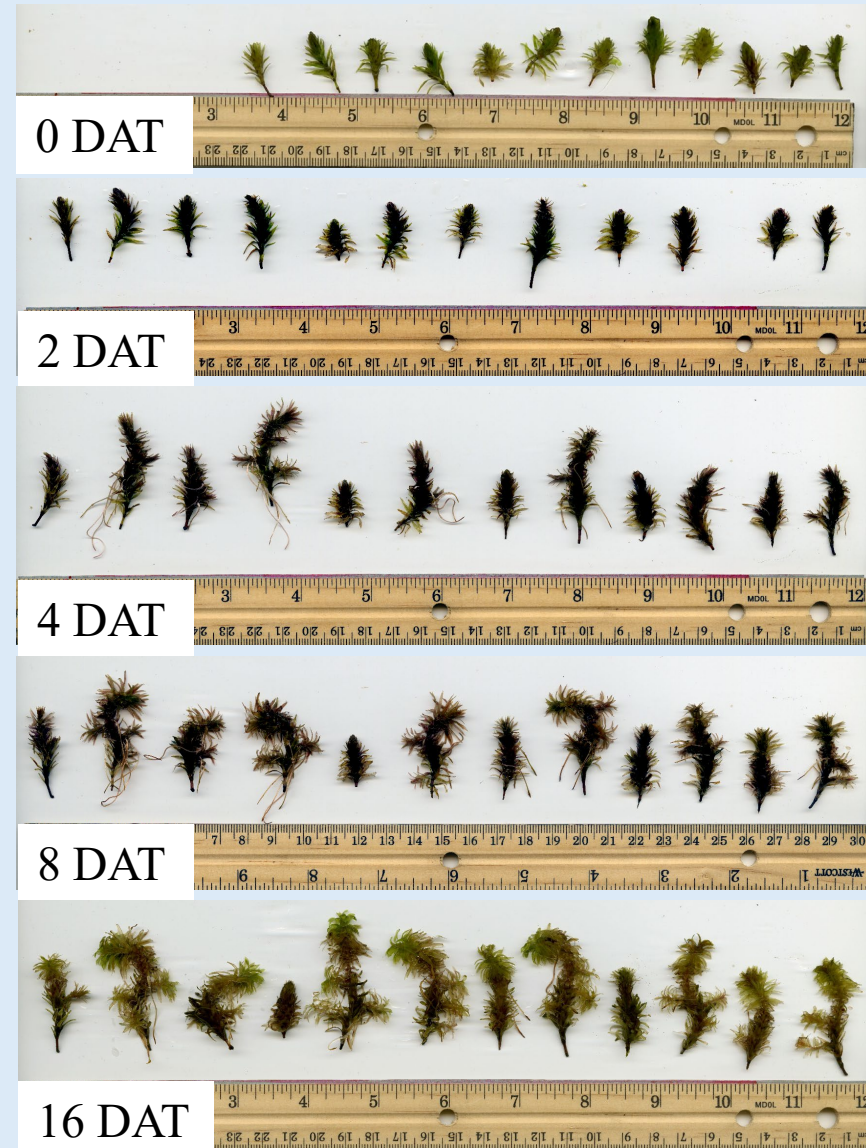
# Studies – Chilling Duration



Non-chilled  
turions



16-day  
chilled  
turions



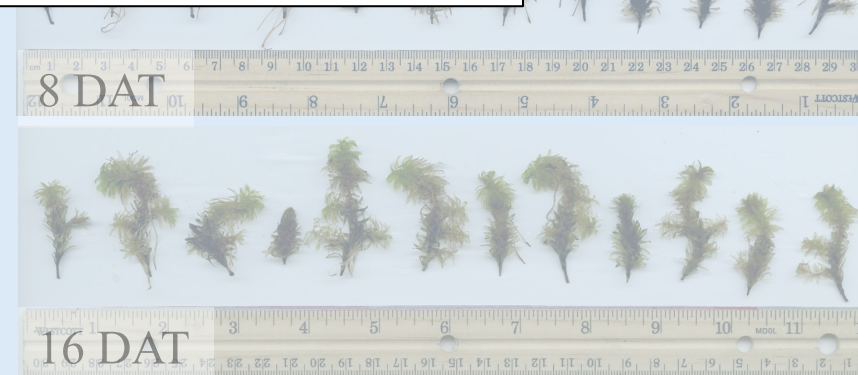
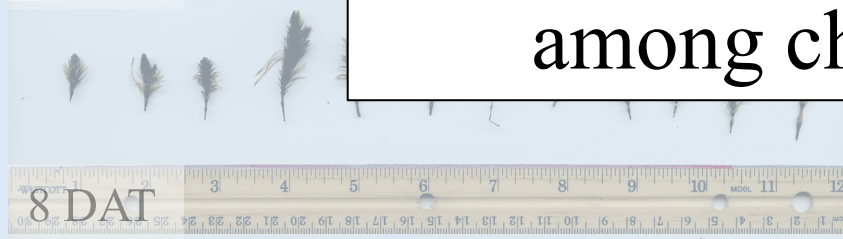
# Studies – Chilling Duration



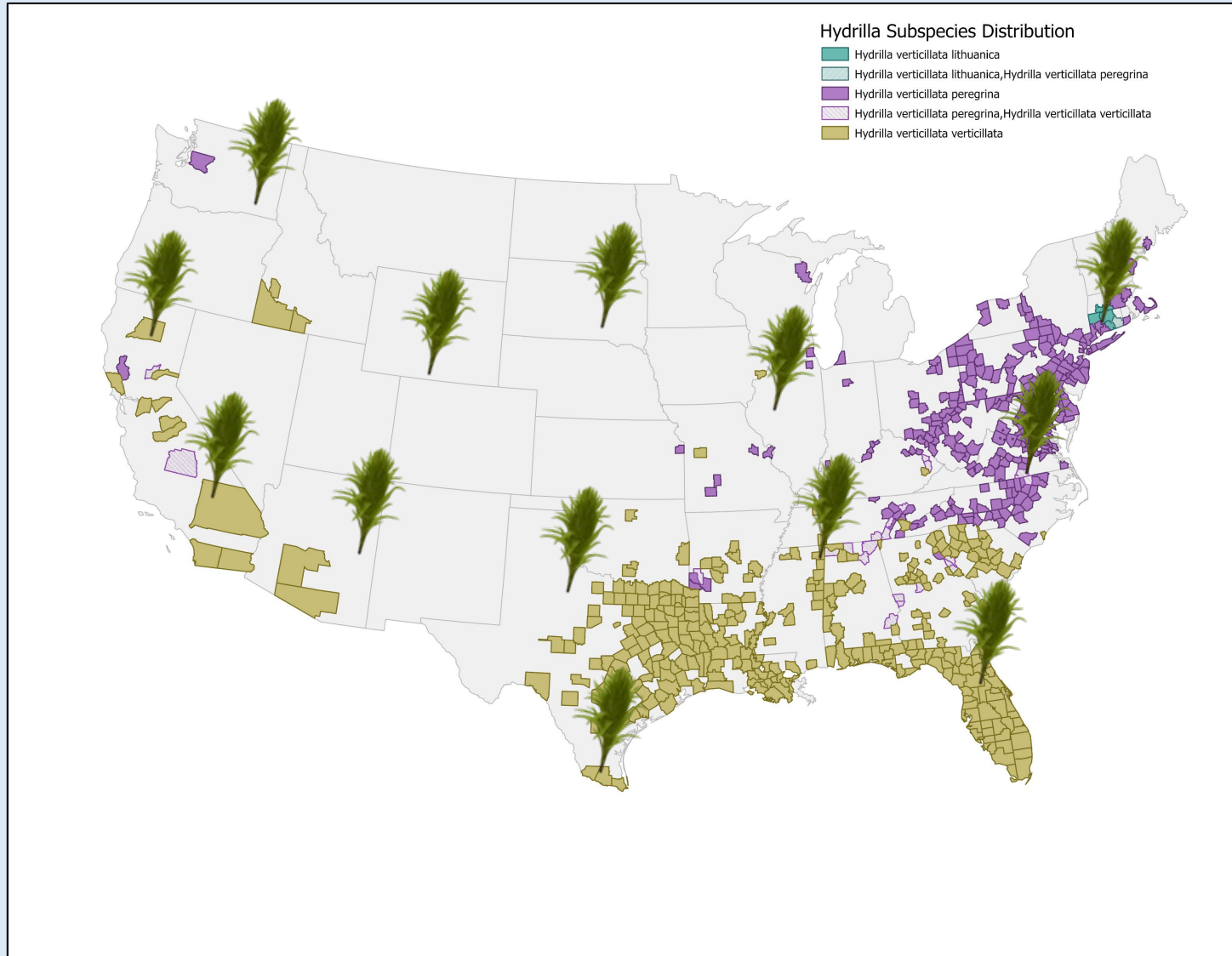
Time to 90% sprouting reduced from 33 days to just 5 days.



Rooting and branching faster among chilled turions.

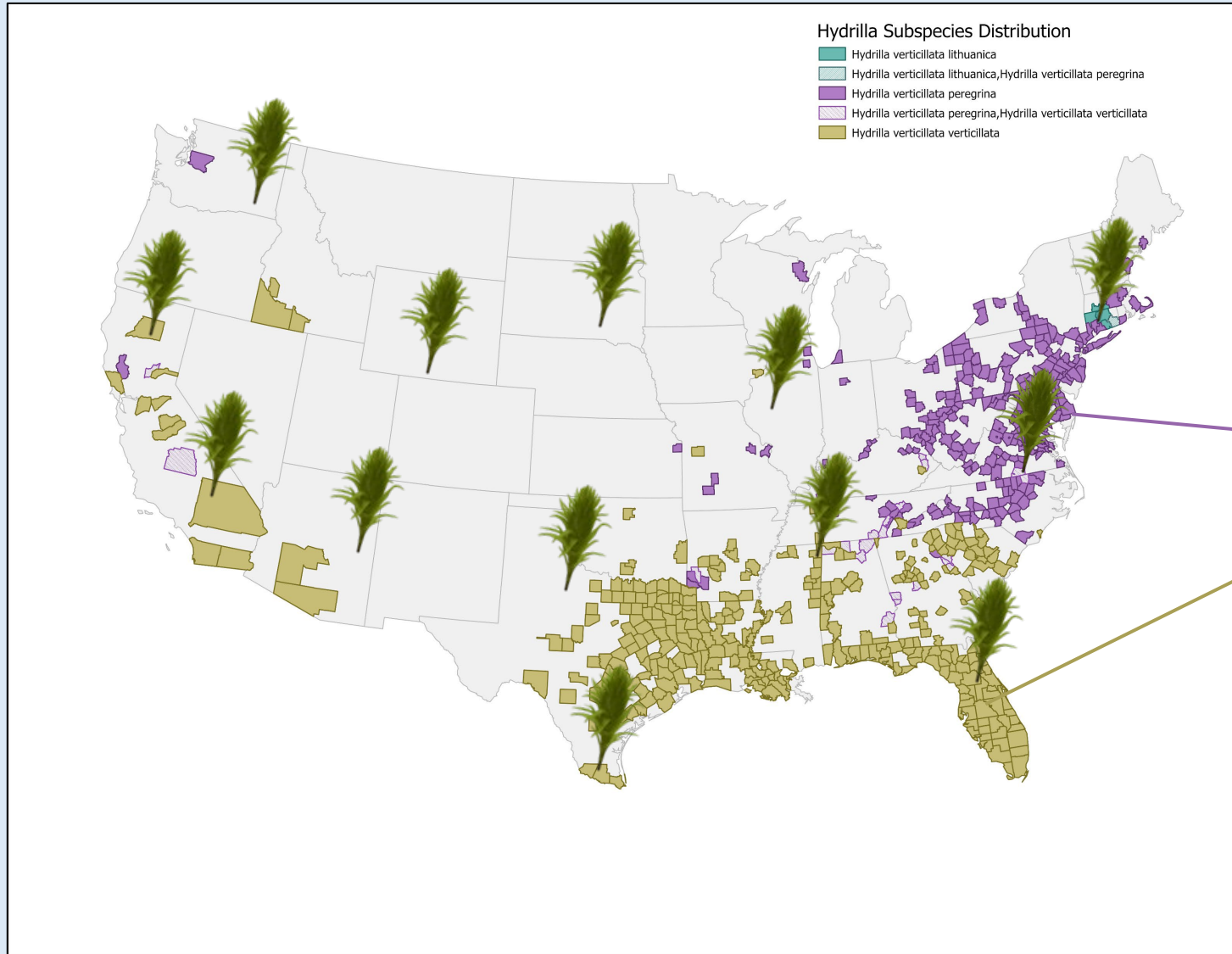


# Studies – Chilling Duration



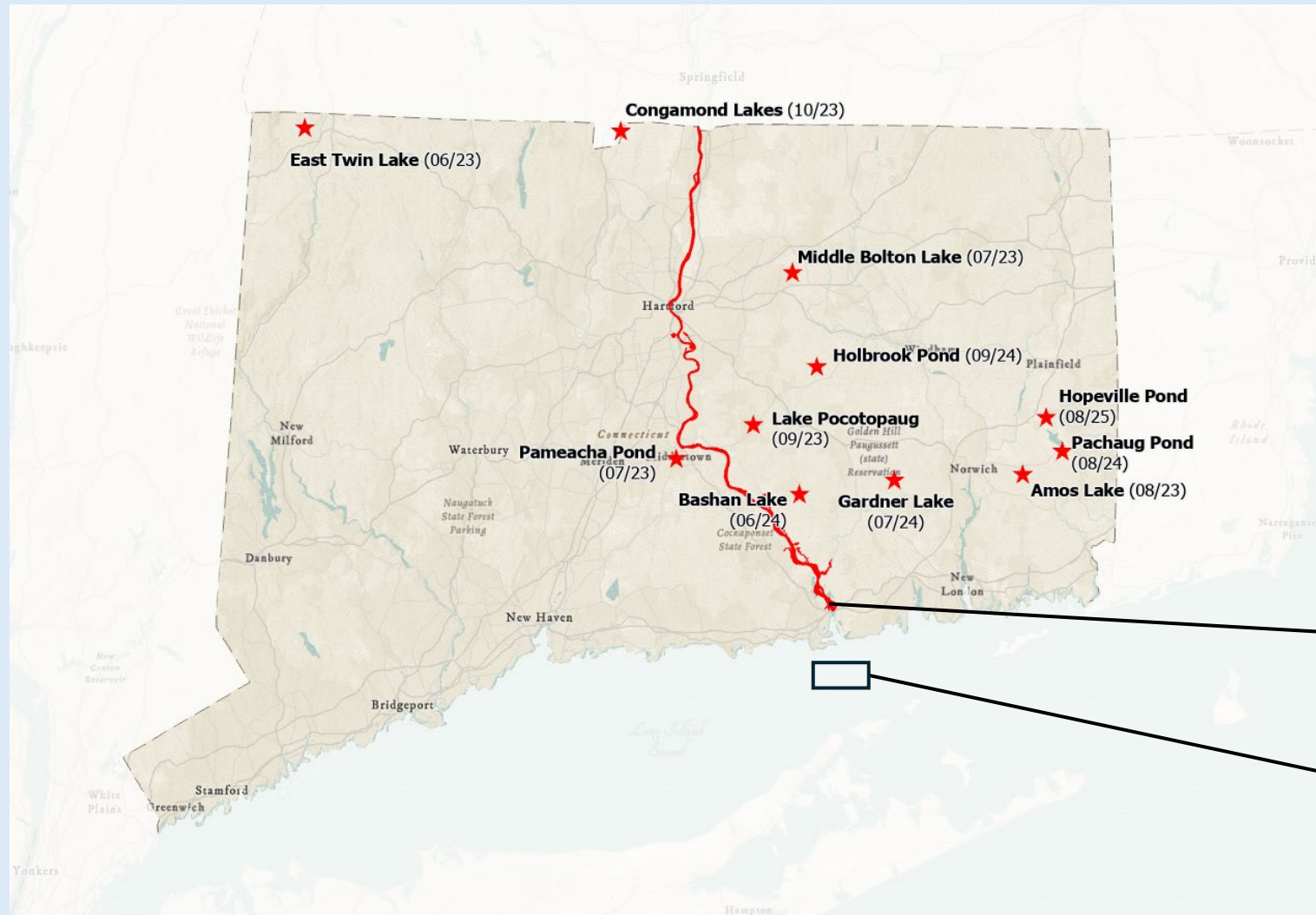
- This subspecies may spread to warmer or colder climates.
- Early and more synchronized sprouting after brief chilling → better performance in temperate climates.
- High production of turions greatly amplifies its invasion risk.

# Studies – Salinity Tolerance



Monoecious + Dieocious  
injury threshold at 13 ppt

# Studies – Salinity Tolerance



Late season  
~12-14 ppt

~35 ppt

# Studies – Salinity Tolerance



What is the salinity threshold for turion sprouting?



Can fragments survive salinity exposure and re-root and establish?

# Studies – Salinity Tolerance



What is the salinity threshold for turion sprouting?



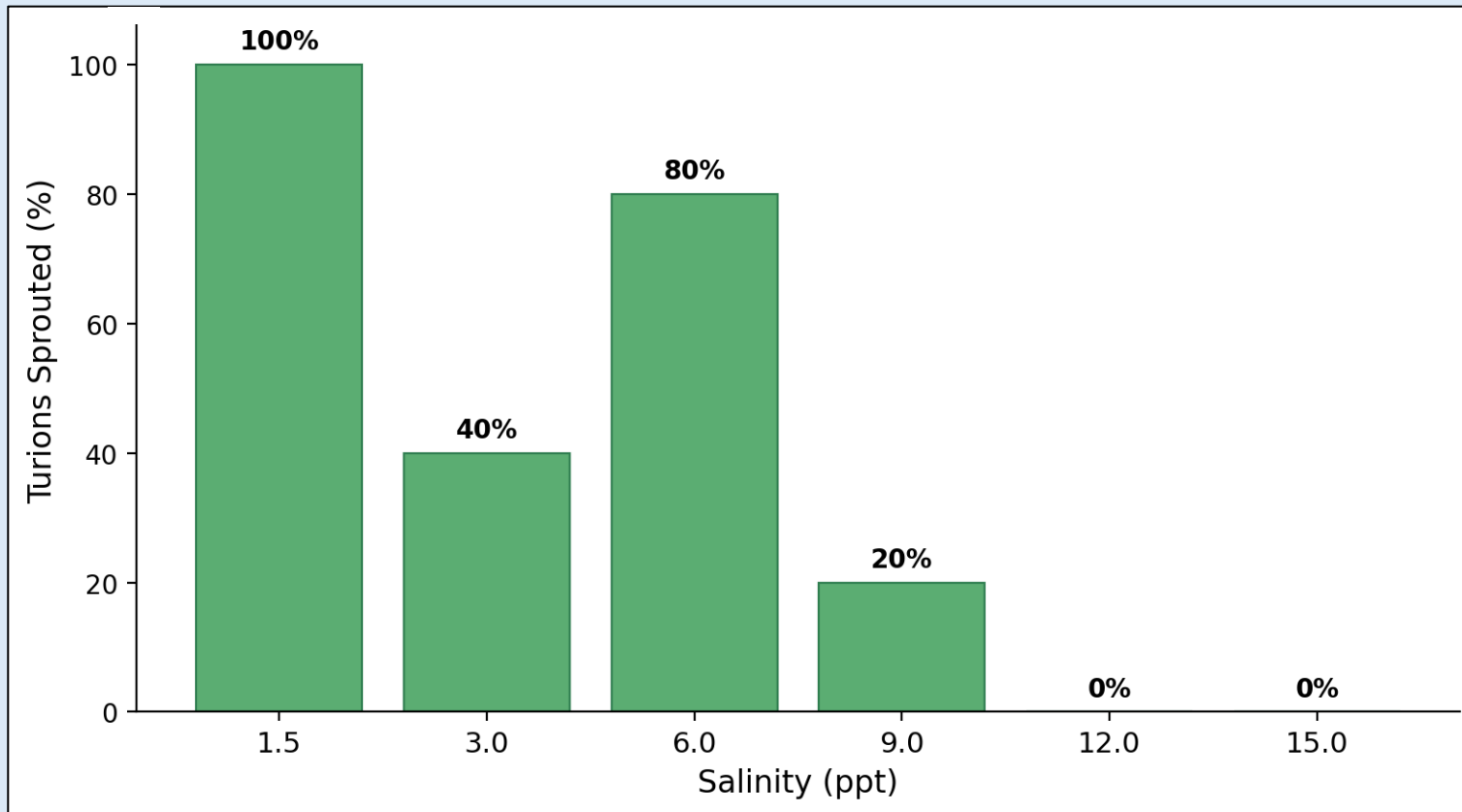
survive  
establish?



# Studies – Salinity Tolerance



Turion Sprouting Success by Salinity

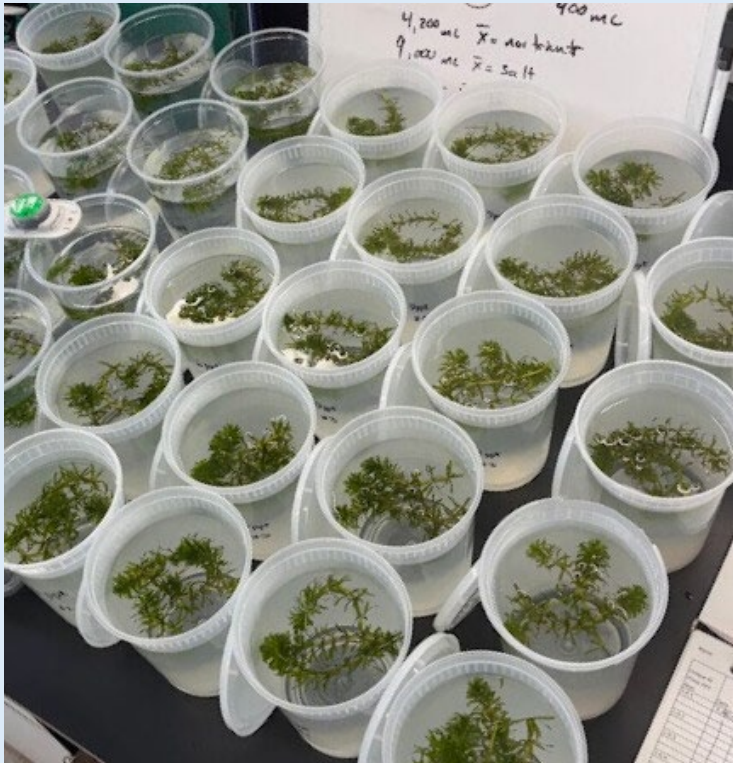


- Turions cannot sprout at 12.0 ppt or above

# Studies – Salinity Tolerance



Can fragments survive salinity exposure and re-root and establish?



# Studies – Salinity Tolerance



3 hour exposure – 1 week post exposure

15 ppt

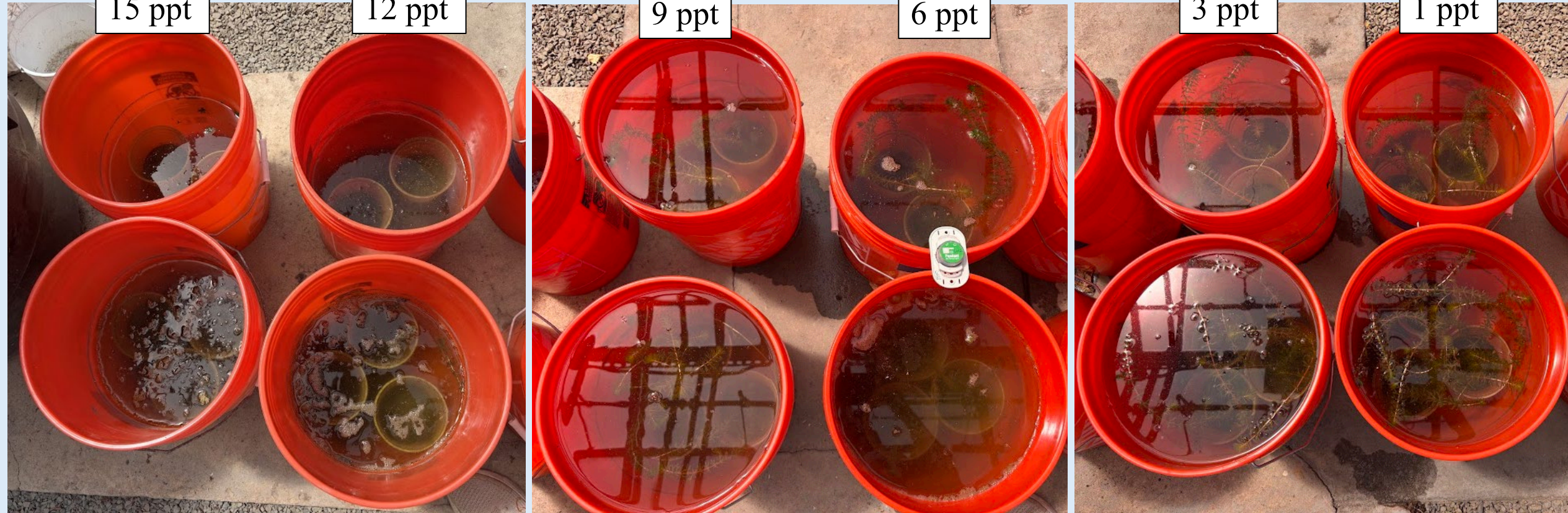
12 ppt

9 ppt

6 ppt

3 ppt

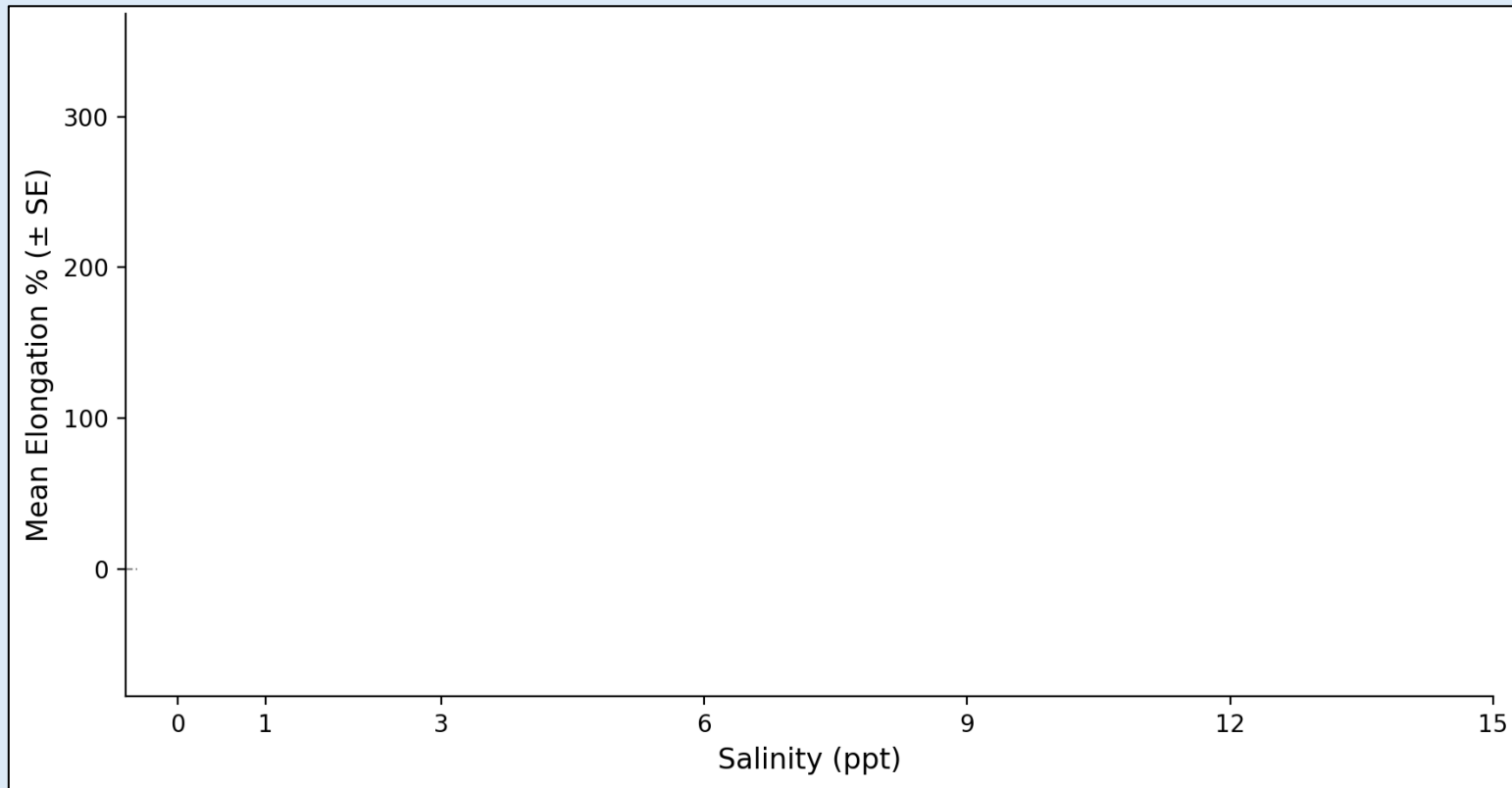
1 ppt



# Studies – Salinity Tolerance



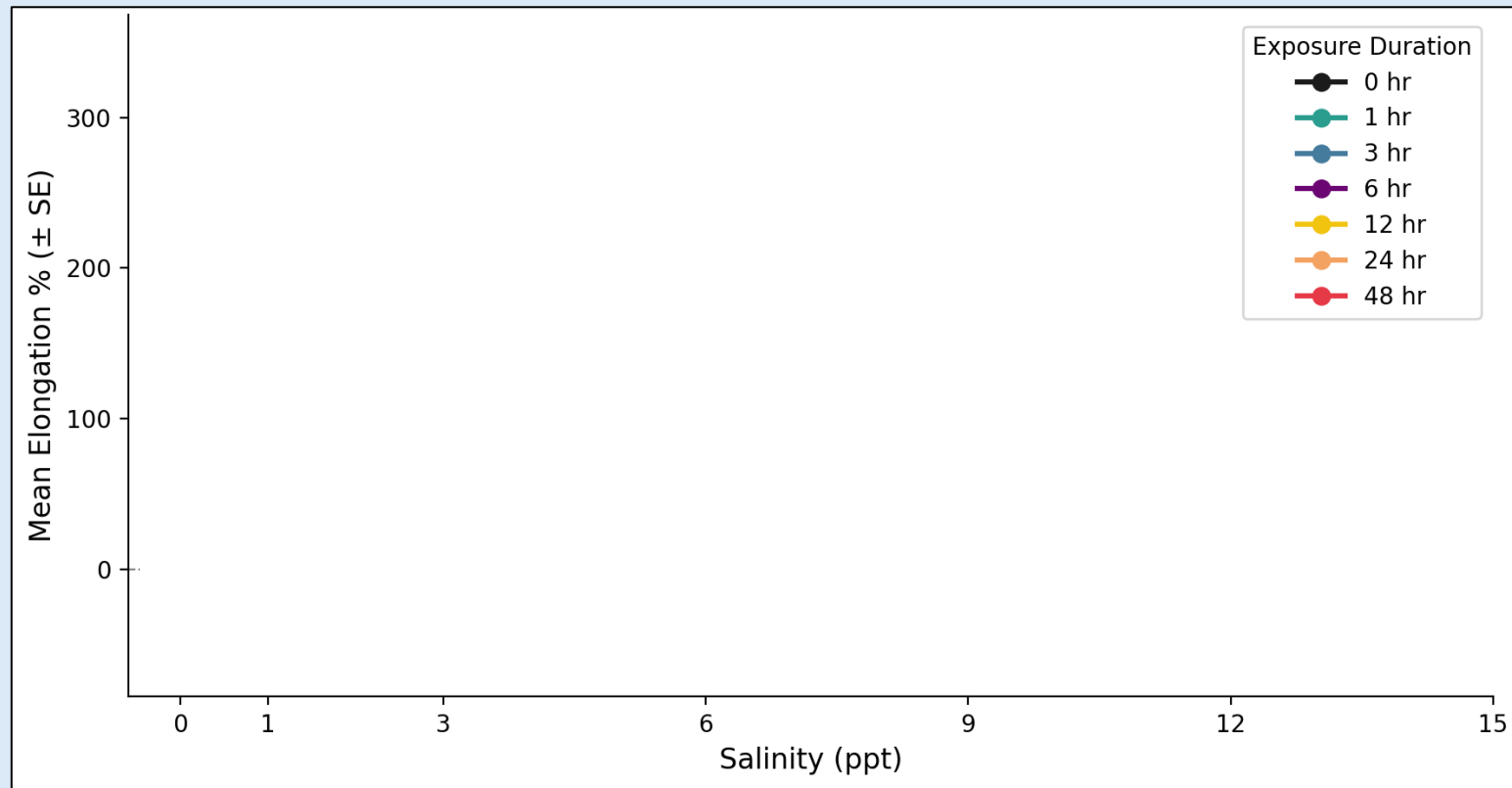
Fragment Growth Recovery by Salinity and Exposure Time



# Studies – Salinity Tolerance



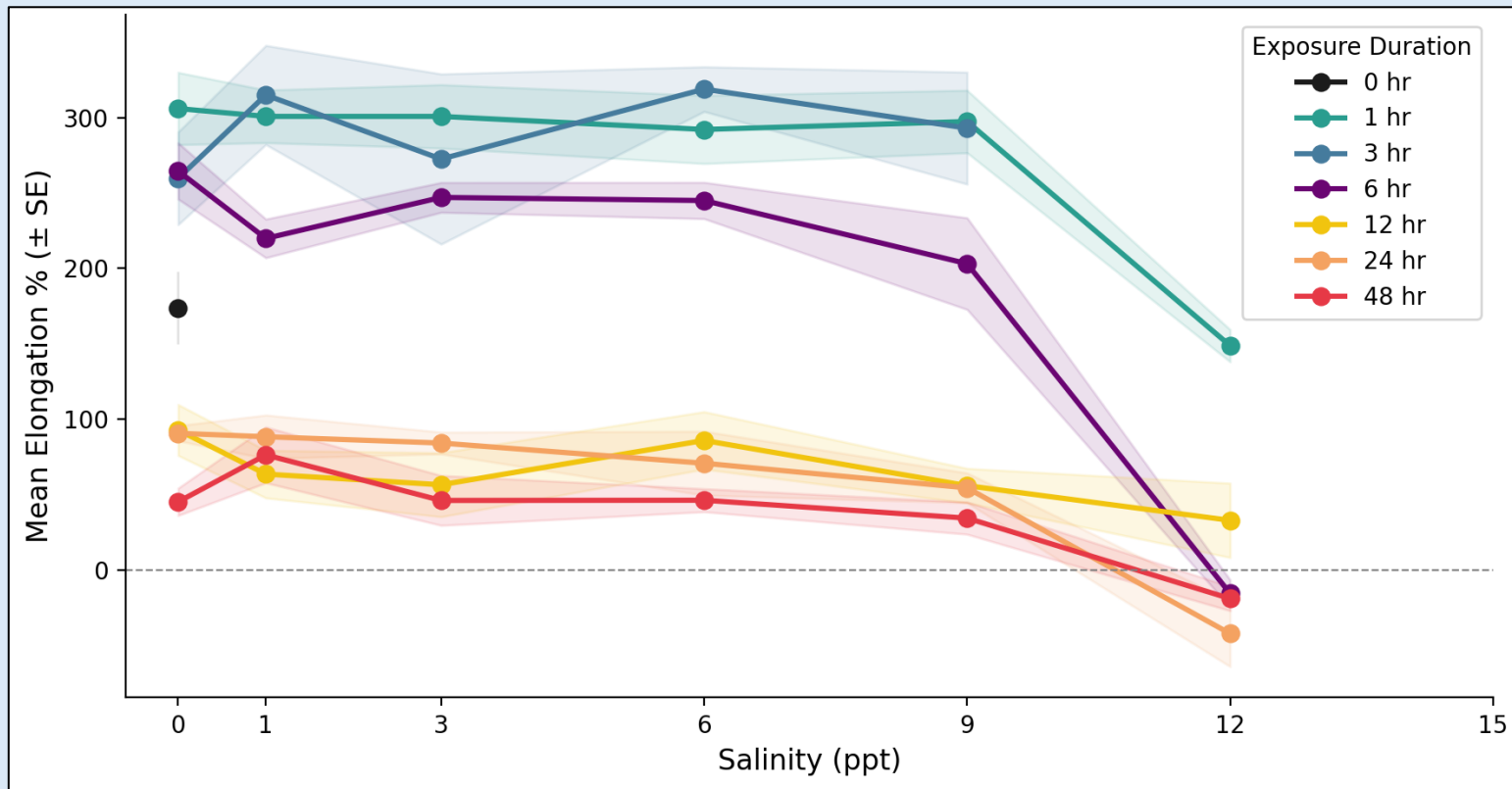
## Fragment Growth Recovery by Salinity and Exposure Time



# Studies – Salinity Tolerance



## Fragment Growth Recovery by Salinity and Exposure Time



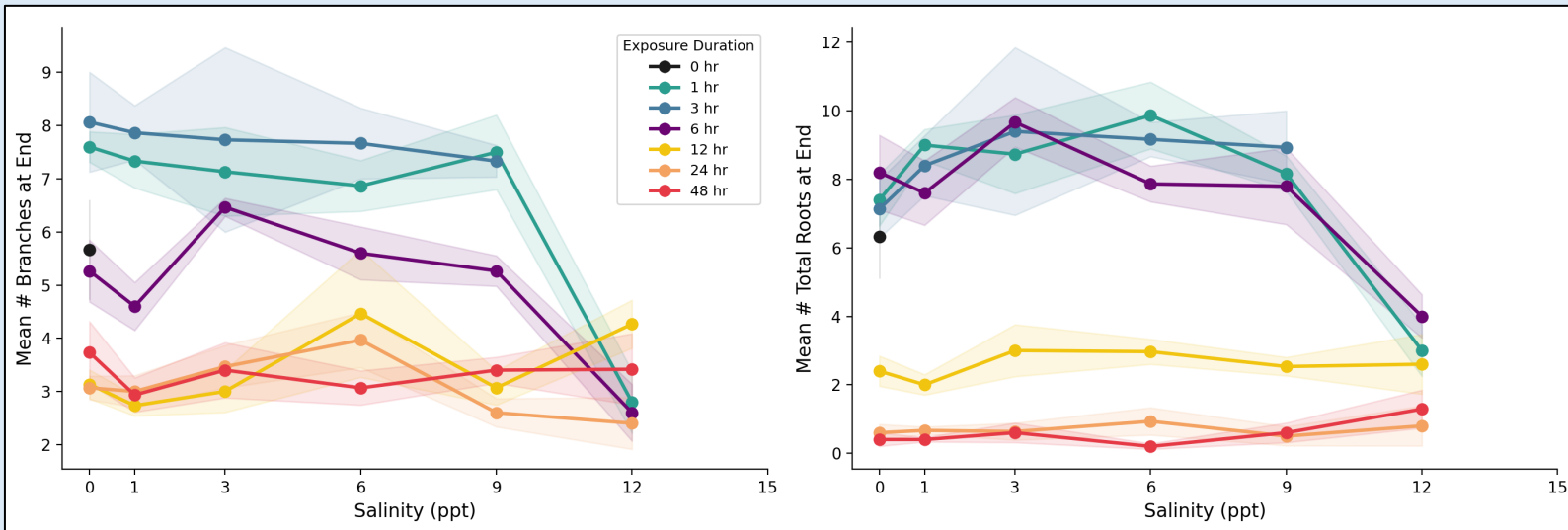
- Recovery after floating for greater than 6 hours is slower despite salinity.

- Salinities above 9 ppt have slower growth after planting.

# Studies – Salinity Tolerance



## Fragment Branching and Rooting by Salinity and Exposure Time



- Similar pattern for rooting and branching

# Studies – Salinity Tolerance



This subspecies cannot establish via turions, south of Essex, CT or in other waterbodies with salinities above 12 ppt.



This subspecies is not likely to survive travel, either on boats or currents, through salty water.

# Studies – Turion Field Density



## Sediment cores:

- Salmon River, East Haddam
- Selden Cove treated, Hadlyme
- Selden Cove untreated, Hadlyme
- Deep River
- Pecausset Pond, Portland

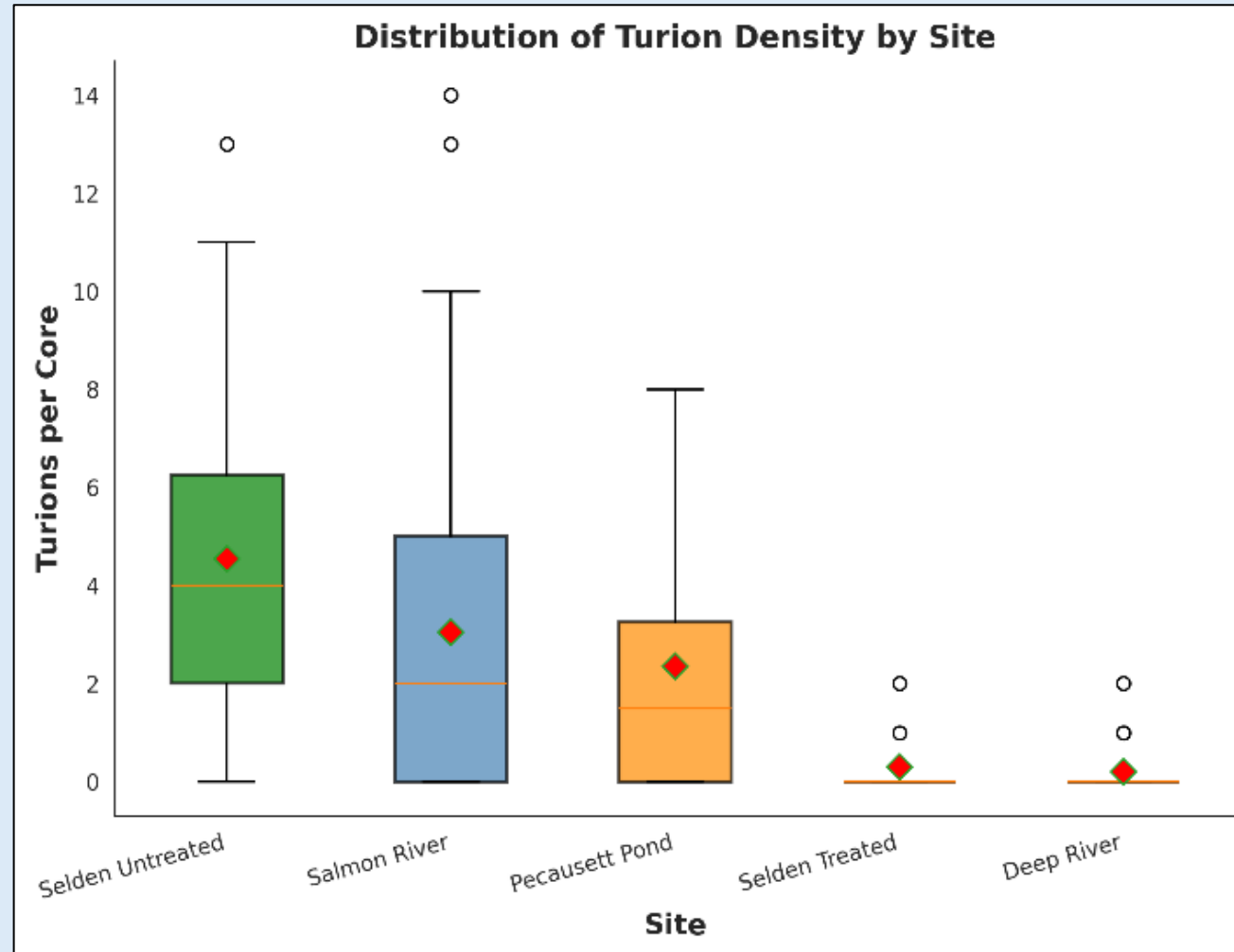
# Studies – Turion Field Density



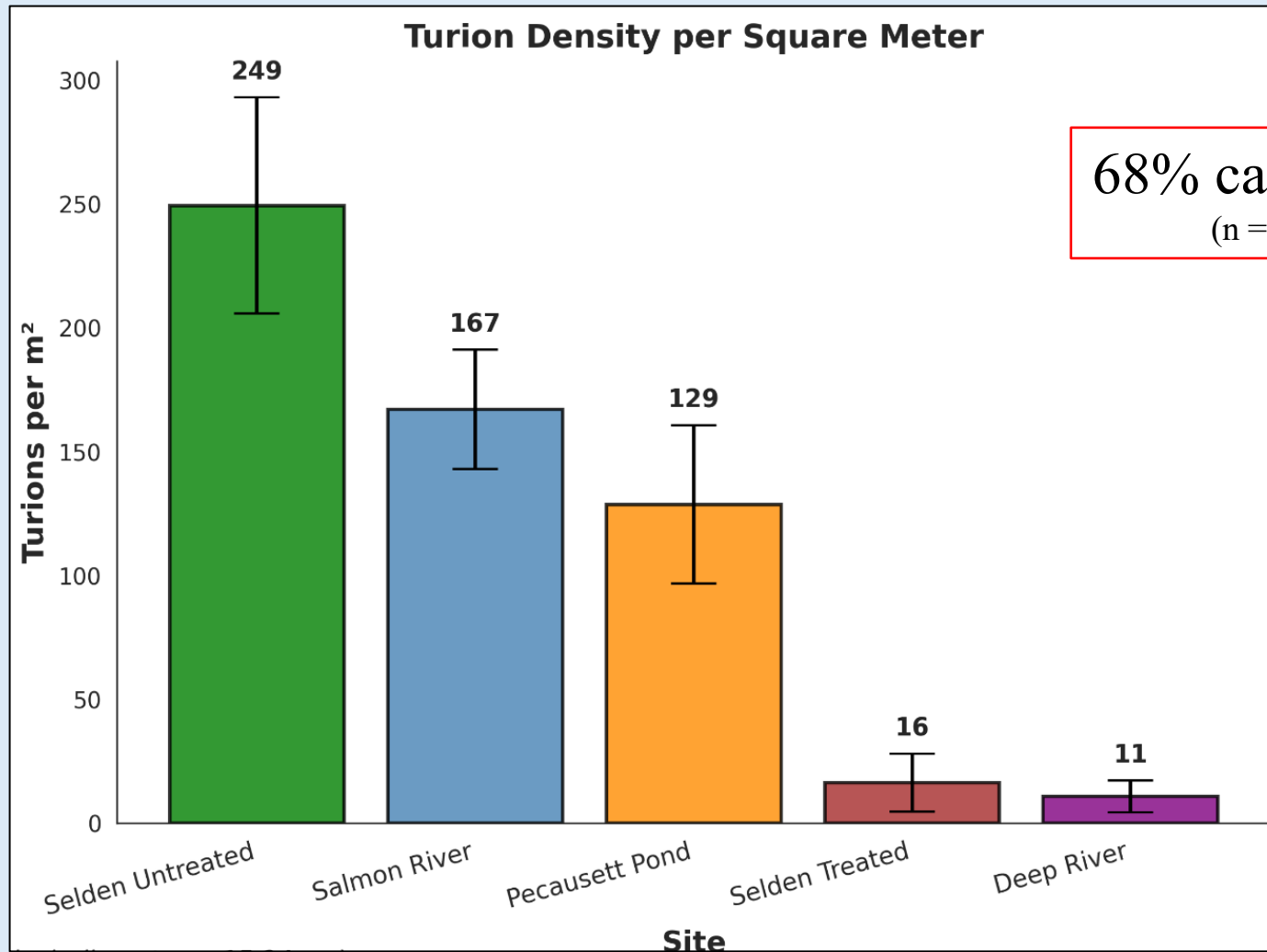
## Sediment cores:

- Salmon River, East Haddam
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# Studies – Turion Field Density

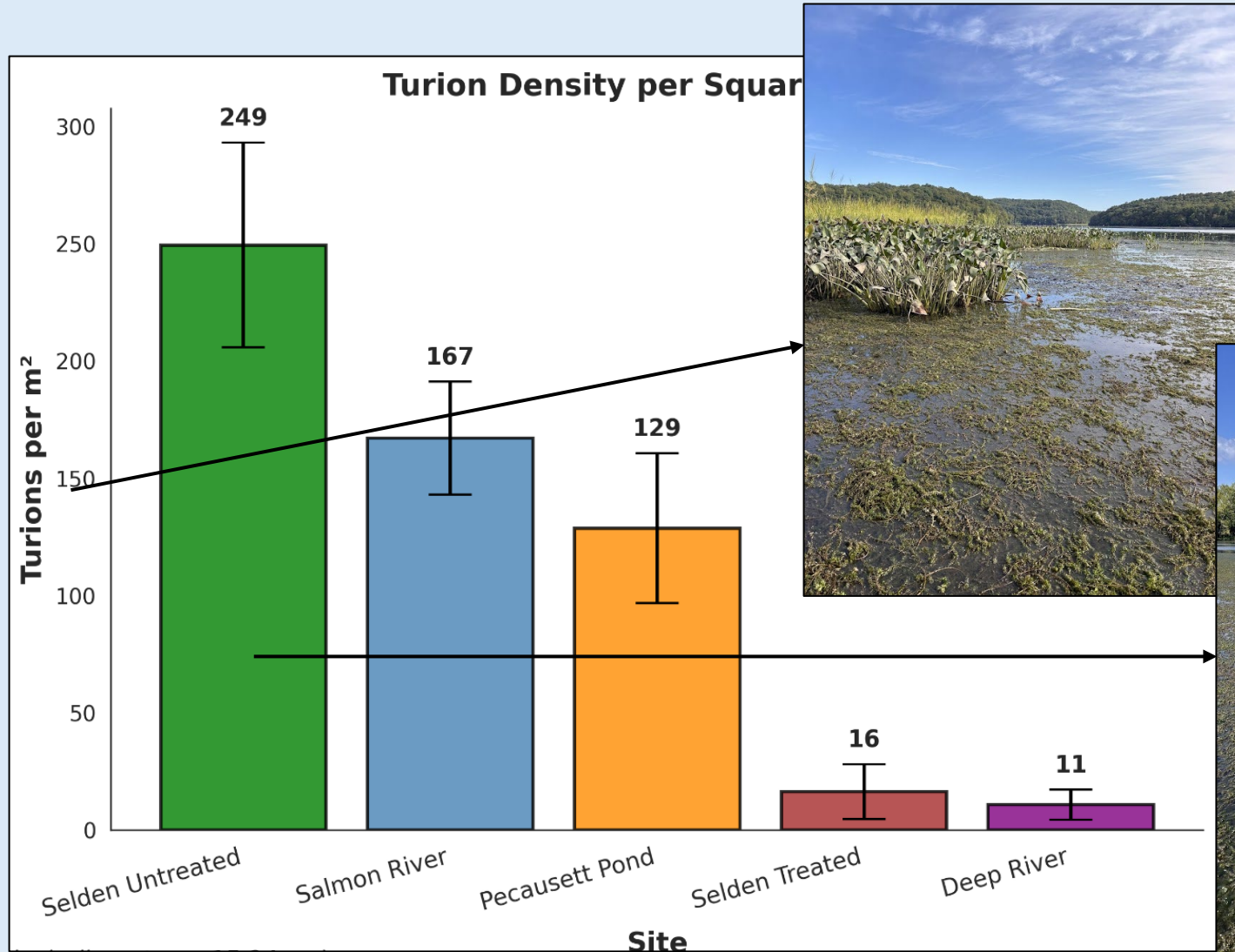


# Studies – Turion Field Density



68% can sprout  
(n = 328)

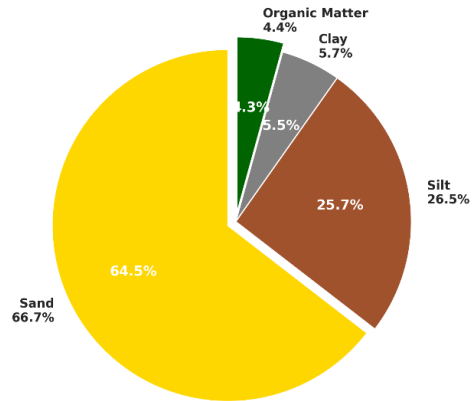
# Studies – Turion Field Density



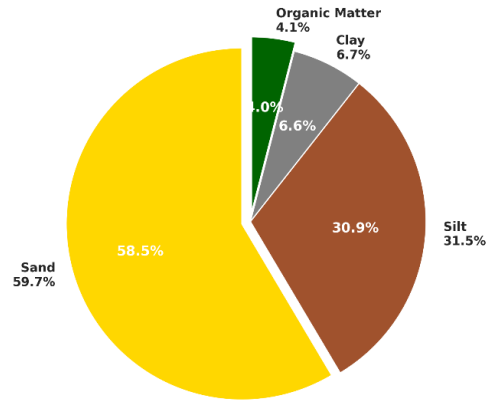
# Studies – Turion Field Density



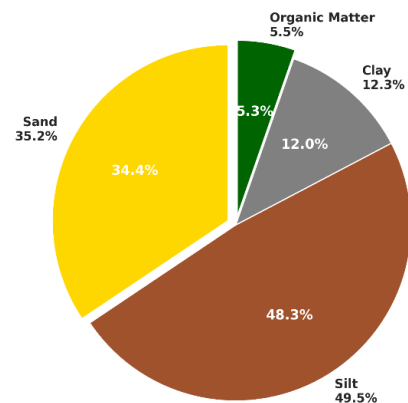
**Salmon River Sediment Composition**  
Mean: 14.2 turions/row (P1) | Total: 85 turions (6 rows)  
Mean: 17.7 turions/row (P2) | Total: 106 turions (6 rows)



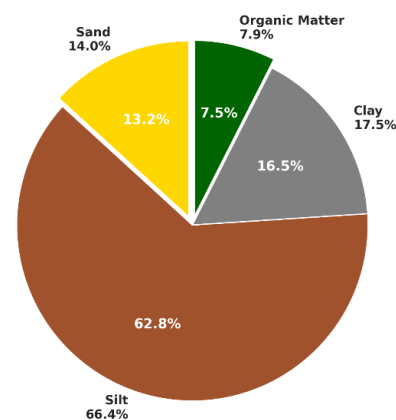
**Selden Untreated Sediment Composition**  
Mean: 23.0 turions/row | Total: 92 turions (4 rows)



**Pecausett Pond Sediment Composition**  
Mean: 11.8 turions/row | Total: 47 turions (4 rows)



**Deep River Sediment Composition**  
Mean: 1.0 turions/row | Total: 4 turions (4 rows)



- Sites with the highest turion density have a higher sand to silt ratio.

- Low turion density sites have a higher proportion of organic matter and clay.

## Studies – Turion Field Density



Even one year of treatment can reduce turion densities significantly.

Turion densities are higher in sandier/silty soil composition.

# Upcoming Studies – Turion Production

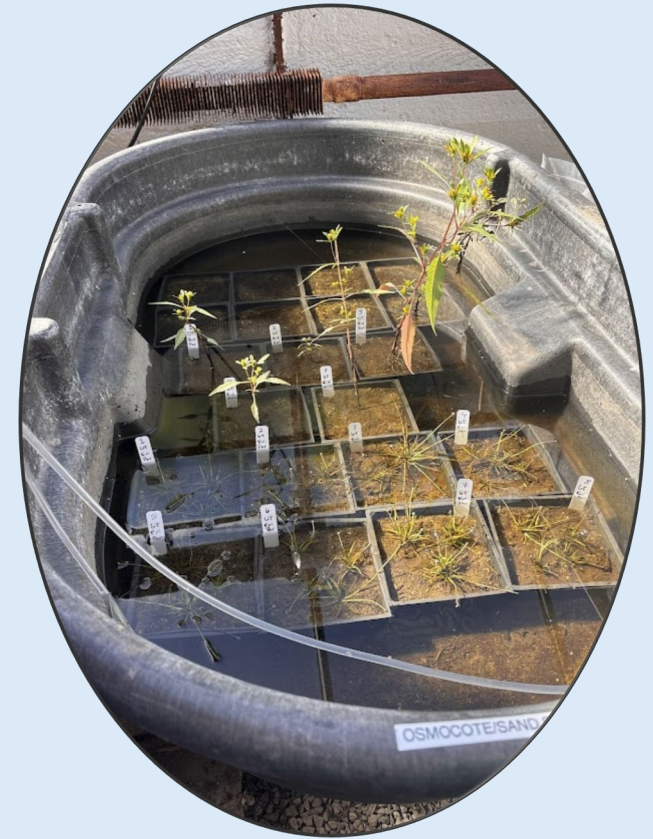


What are the precise environmental conditions that cue turion production?

- Light duration (day length)
- Temperature



# Upcoming Studies – Herbicide Sensitivity



# Upcoming Studies – Herbicide Sensitivity



What are the herbicide injury thresholds for native species Elodea and Valisneria?



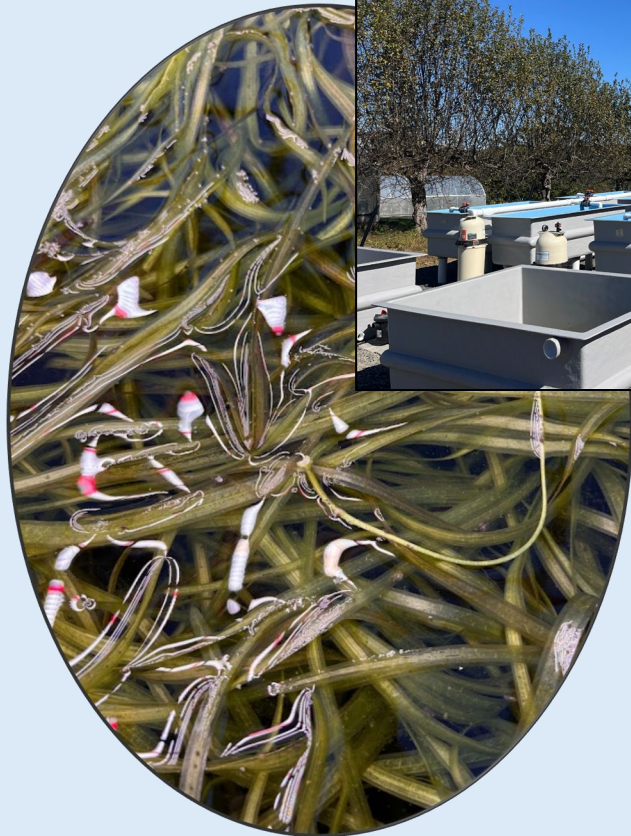
What are the herbicide thresholds for threatened and endangered (T&E) wetland plants, Parker's pipewort, Eaton's Beggarticks, and Water pygmyweed?



Oregon State  
University



# Upcoming Studies – Herbicide Sensitivity



What is the herbicide injury  
for native species  
Valisneria?

What is the optimal timing for herbicide  
application to reduce regrowth and turion  
production?

What are the herbicide sensitivities  
for threatened and endangered  
(T&E) wetland plants, Parker's  
pipewort, Eaton's Beggarticks, and  
Water pygmyweed?



# What We Study

Turion Cold Stratification

Turion Field Densities

Turion and Fragment  
Salinity Tolerance

Plant Growth and Turion  
Production Timing

Herbicide Application Timing

Native Plant Herbicide Injury

Threatened and Endangered  
Plant Herbicide Injury



Integrated Management – Biological Control

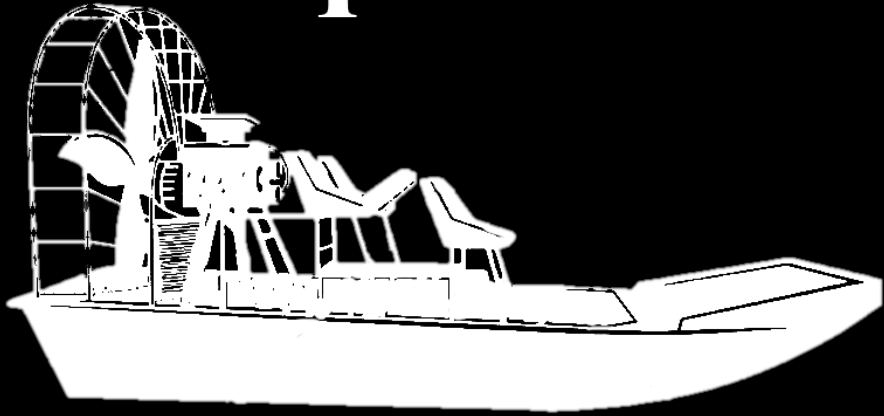


# **Integrated Aquatic Plant Management**

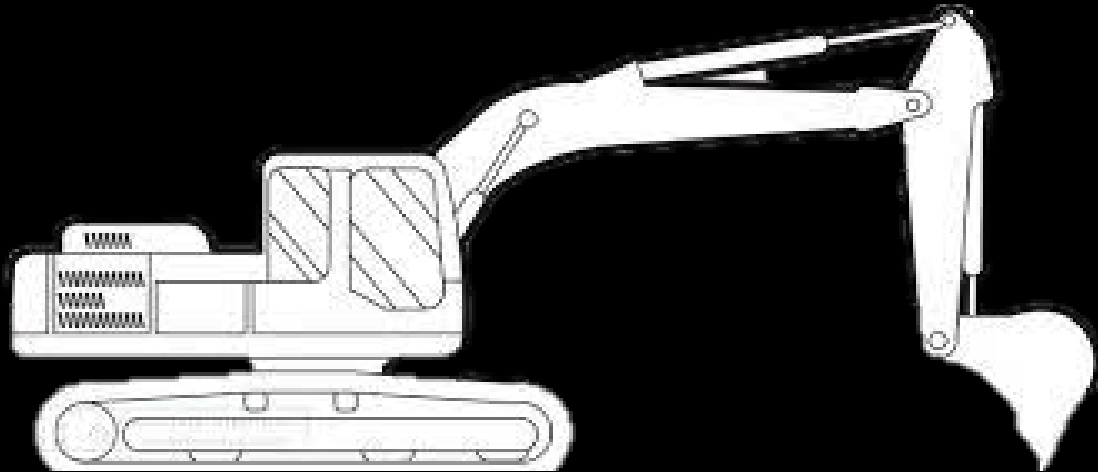
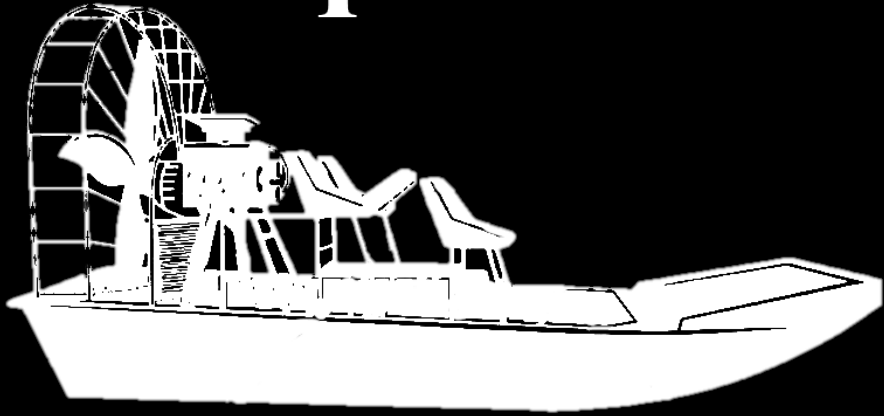
**By: Dr. Jeremiah R. Foley IV  
CAES – Dept. of Environmental Science and Forestry  
Office of Aquatic Invasive Species (OAIS)**

# Aquatic Plant Management

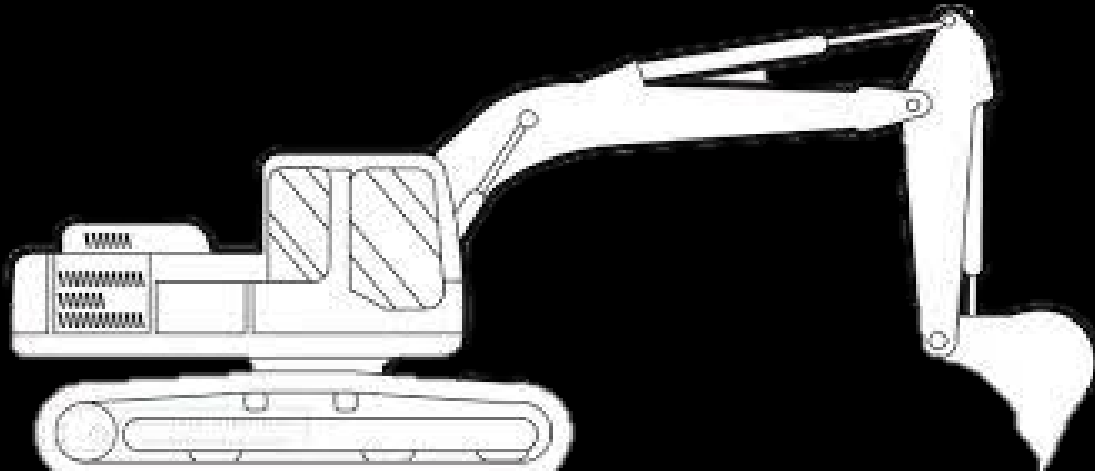
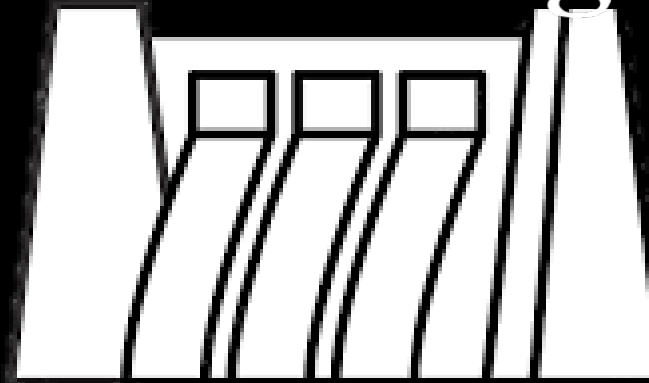
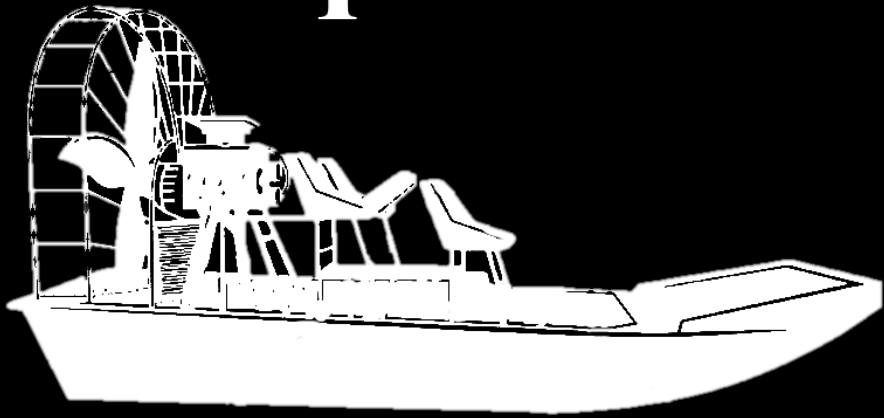
# Aquatic Plant Management



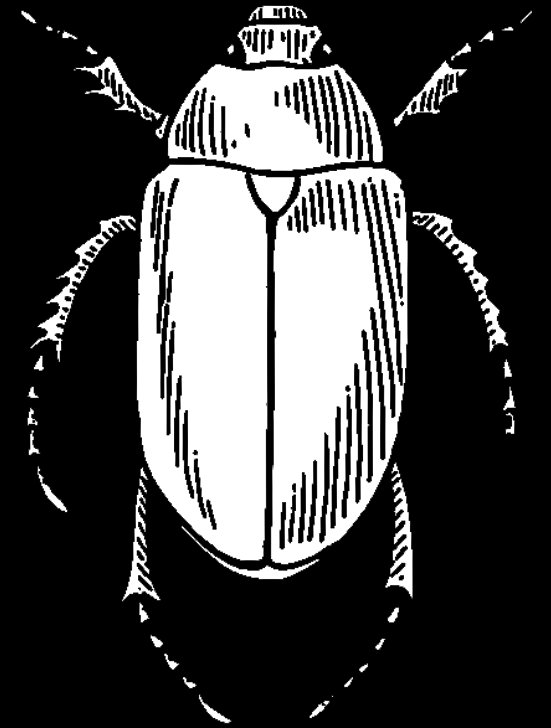
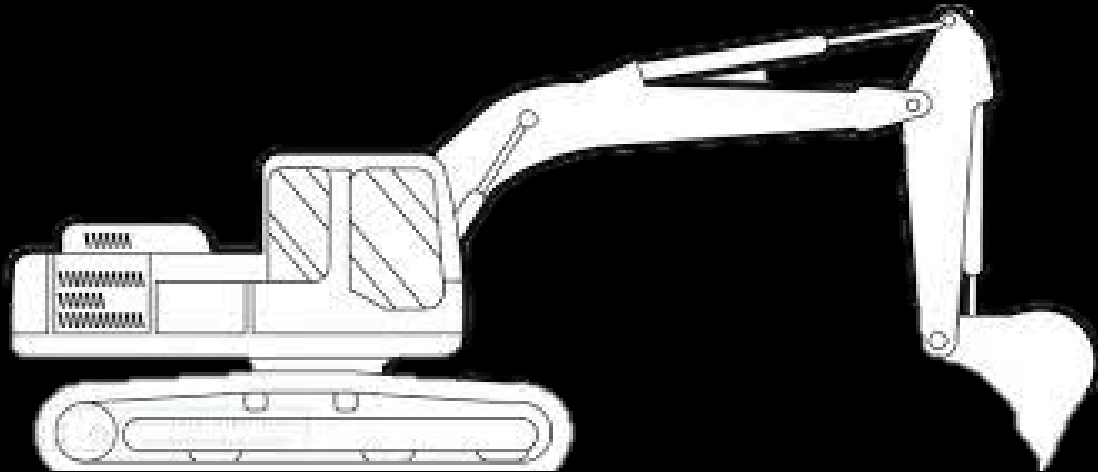
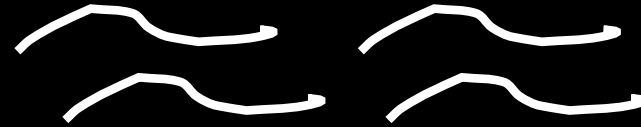
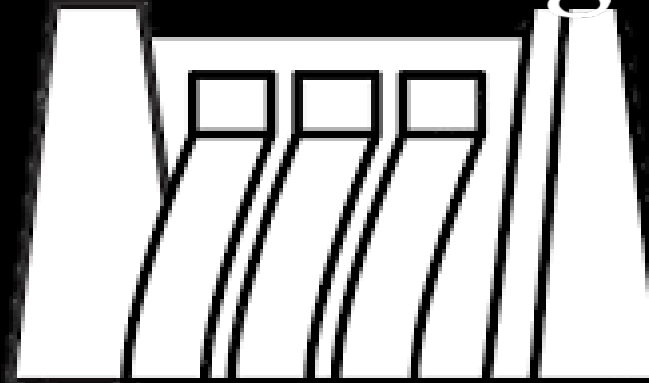
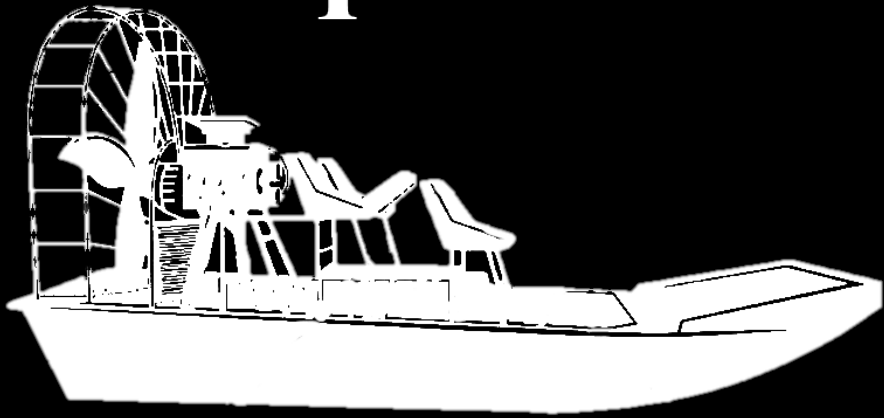
# Aquatic Plant Management



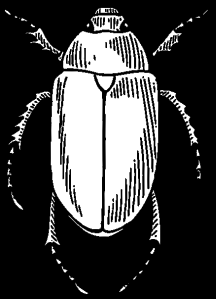
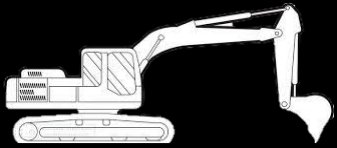
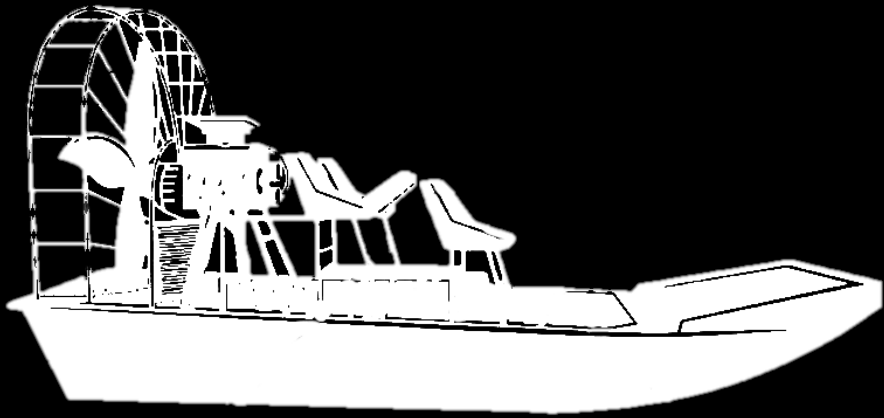
# Aquatic Plant Management



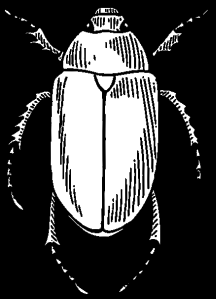
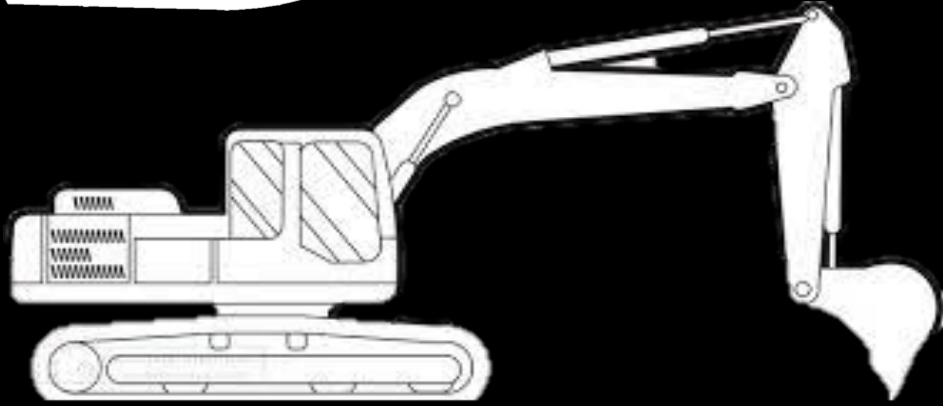
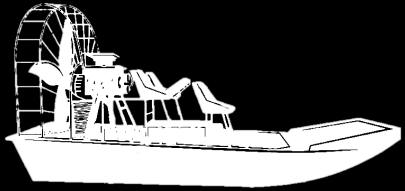
# Aquatic Plant Management



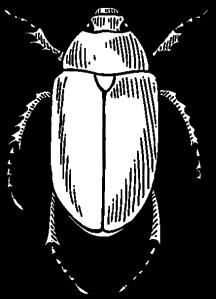
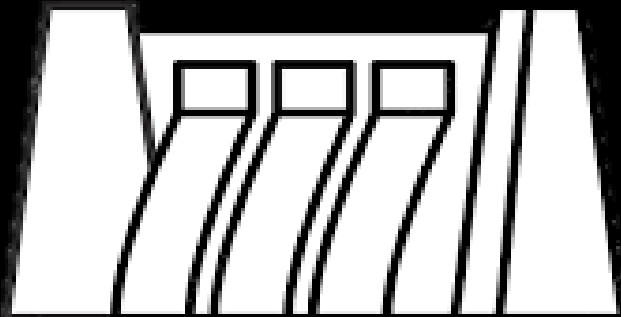
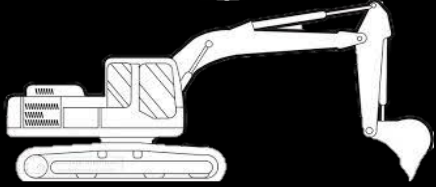
# Chemical Control



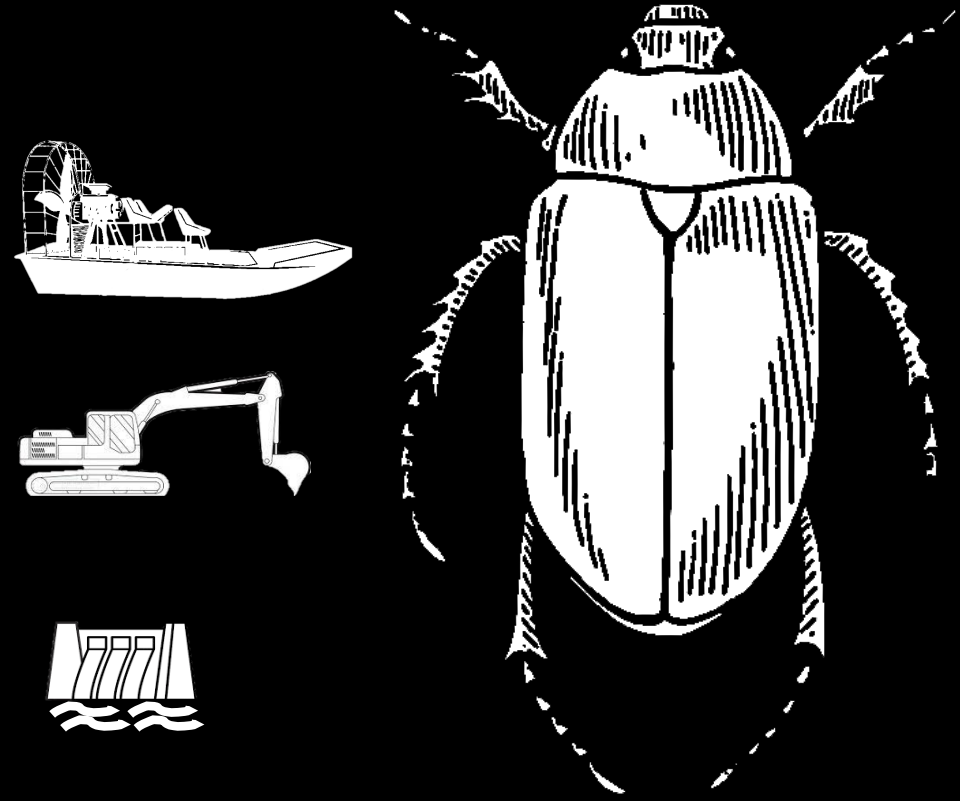
# Mechanical Control



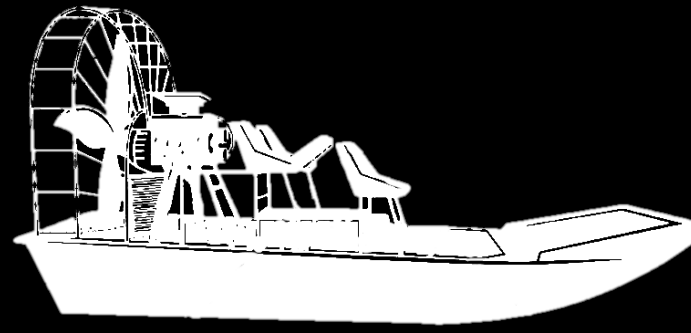
# Physical Control



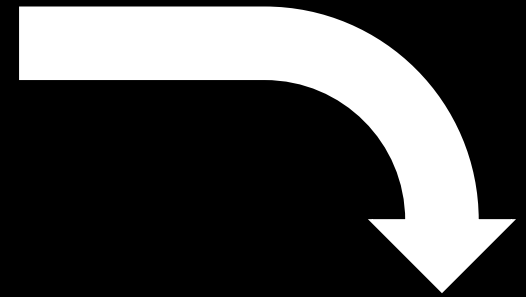
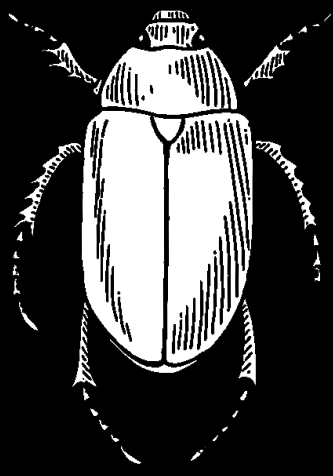
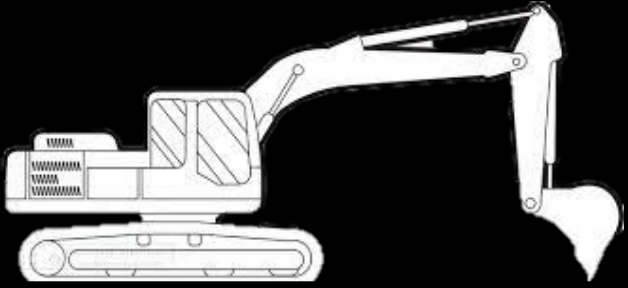
# Biological Control



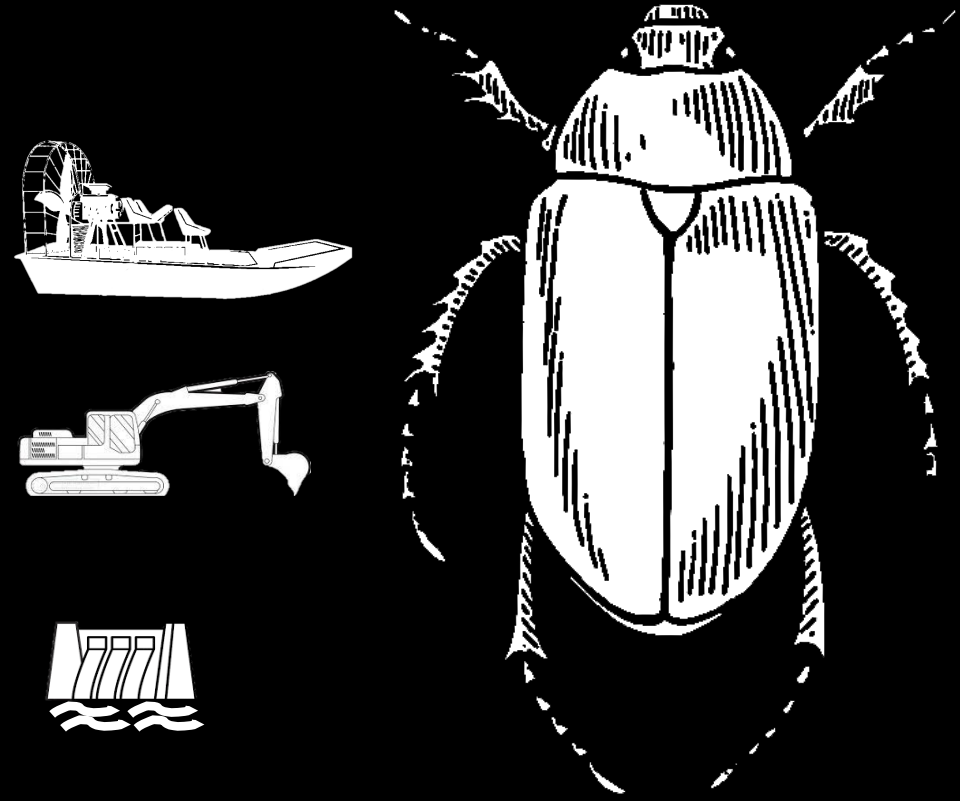
is the use of **living organisms**—such as predators, parasites, pathogens, or **herbivores**—to **manage** or suppress populations of unwanted species, like **invasive plants** and insects, to reduce their impact on **ecosystems**, agriculture, or **human activities**.



# Integrated Aquatic Plant Management



# Biological Control



Biological control is the action of parasites, predators, **herbivores** or **pathogens** in maintaining another organism's population density at a **lower average** than would occur in their absence - DeBach, 1964

# Biological Control



# Biological Control

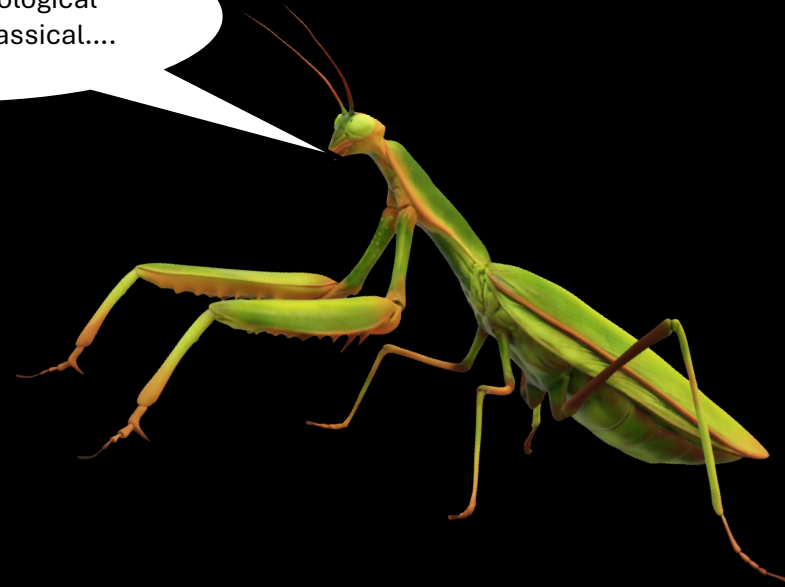


# Biological Control

You're just a biological harvester. I'm classical....



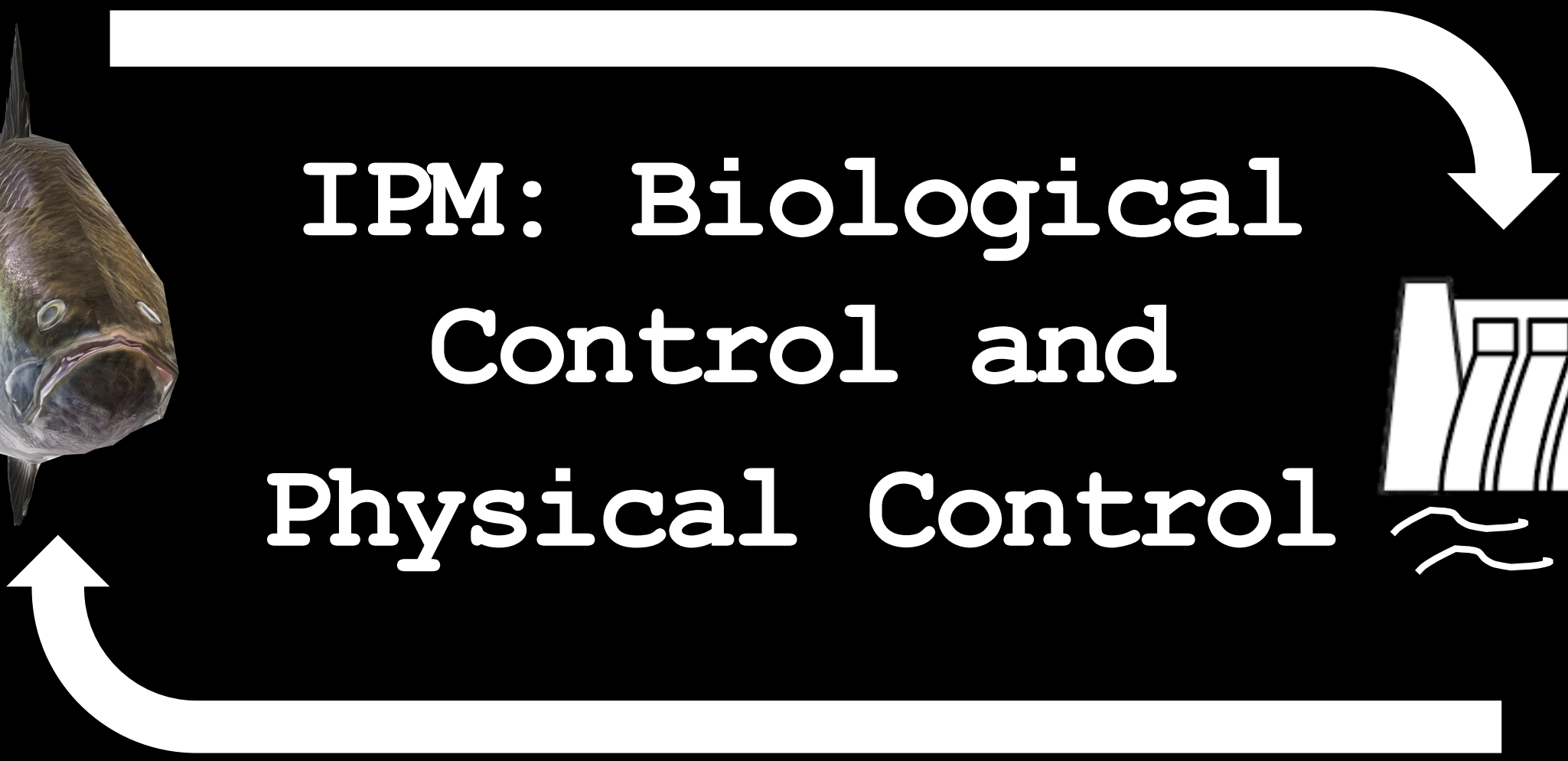
- Non-selective
- Long generation time
- Can not reproduce



- Highly selective
- Short generation time
- High reproductive output
- Redistribute



**IPM: Biological  
Control and  
Physical Control**

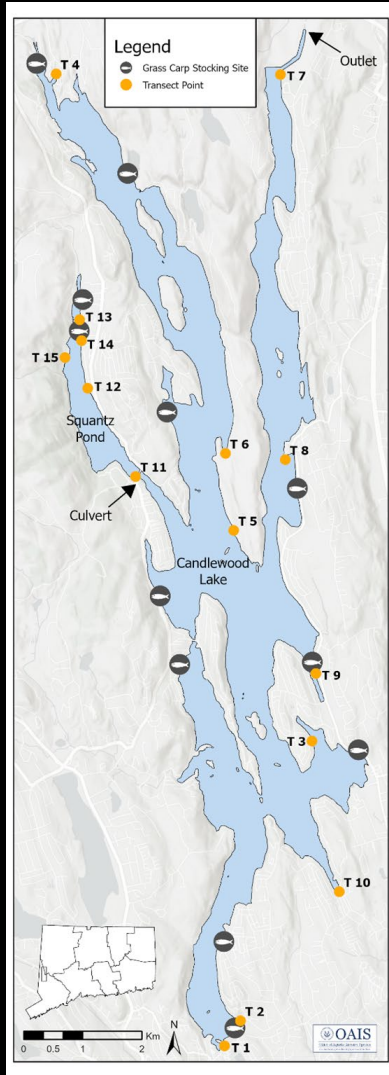




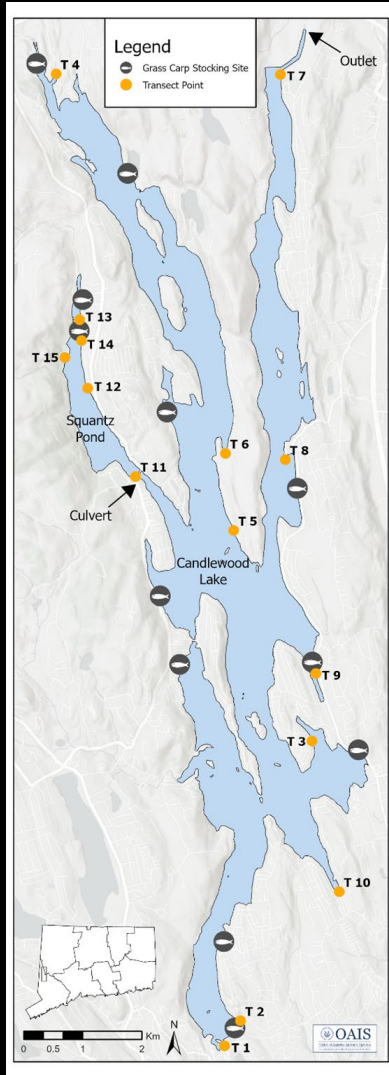
# Candlewood Lake



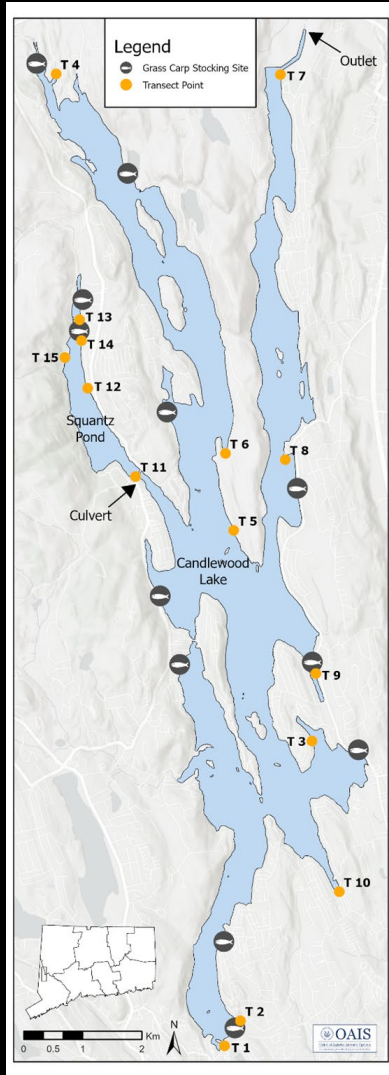
# Candlewood Lake



# Candlewood Lake

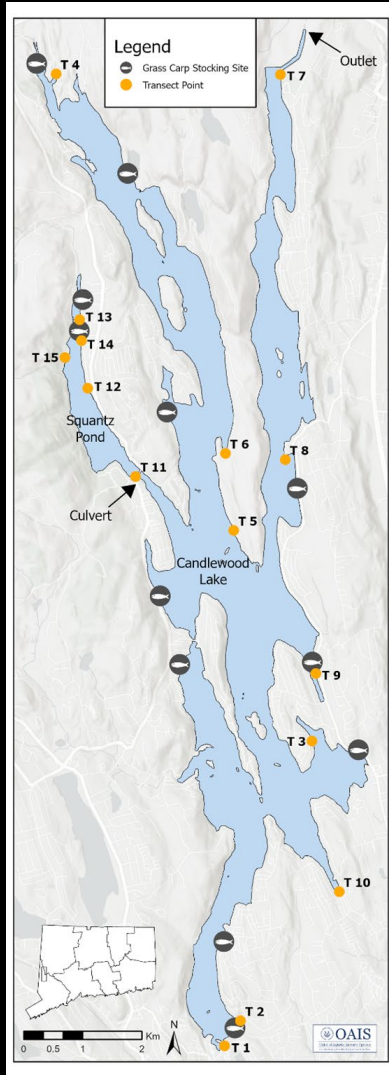


# Candlewood Lake



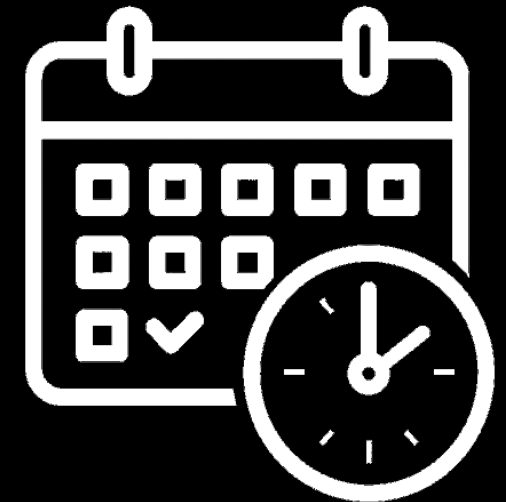
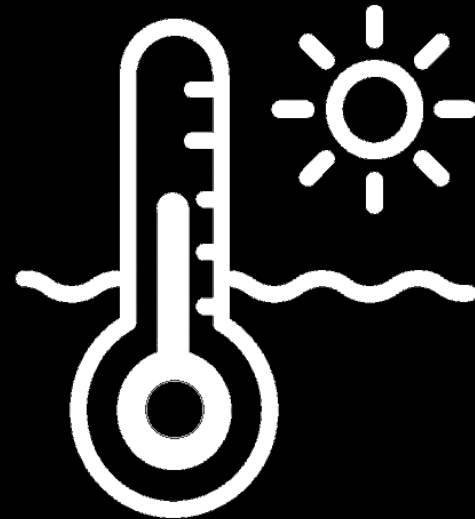
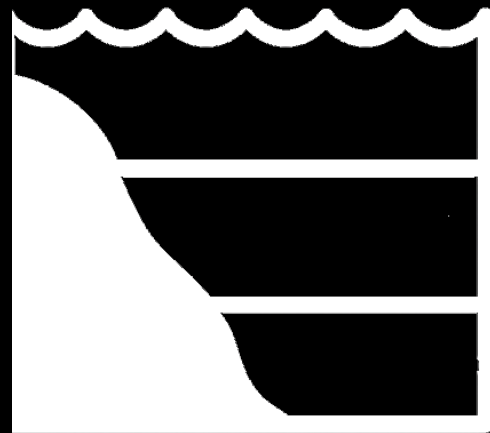
## Winter Drawdowns

# Candlewood Lake

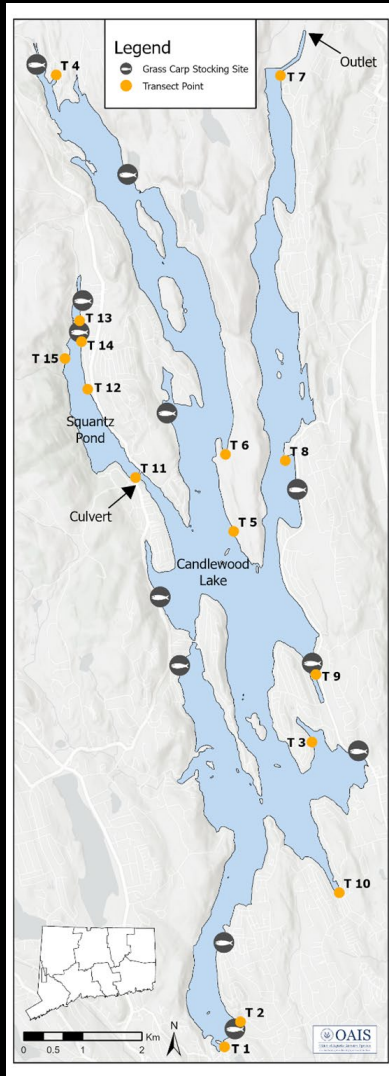


## Winter Drawdowns

In use since the 1980s to manage vegetation & protect shorelines

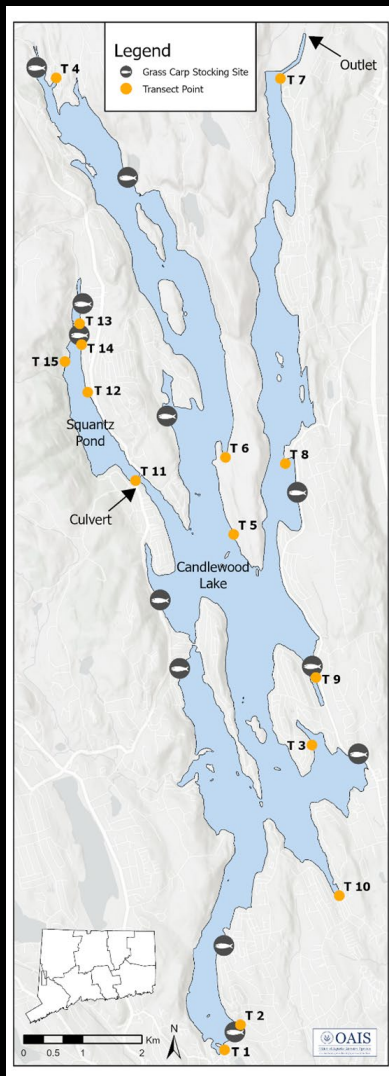


# Candlewood Lake



# Grass Carp

# Candlewood Lake

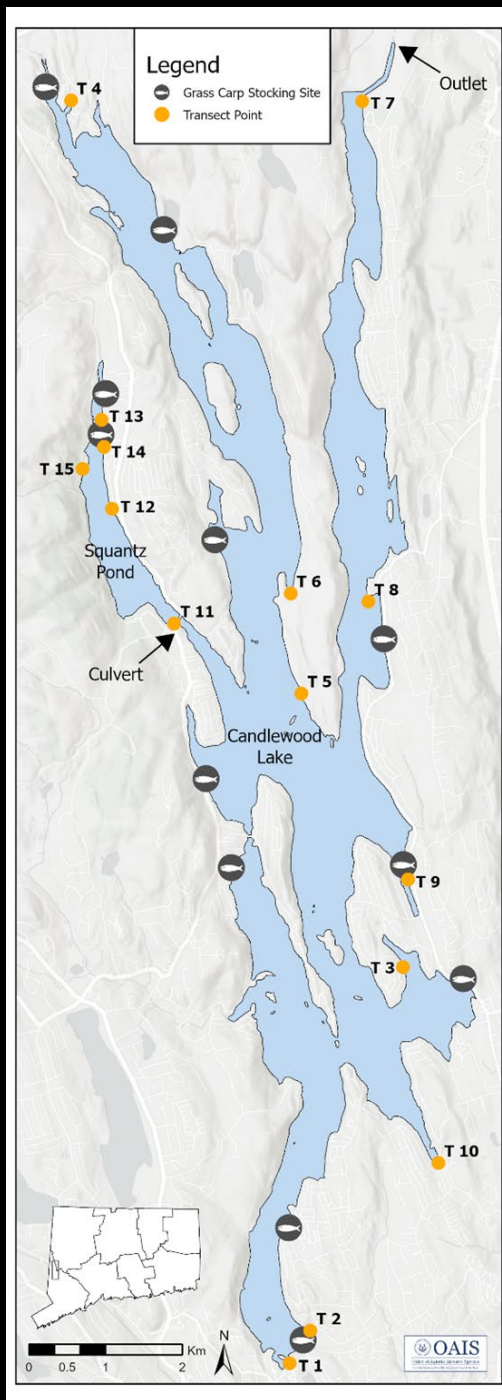


## Grass Carp

- **8,903 grass carp** were stocked:
  - 3,868 in **2015**
  - 5,035 in **2017**
- **CT DEEP** recommended:
  - 36 fish per vegetated hectare (~14.6 fish/acre)
- In **2014**, ~475 acres (192 ha) of **Eurasian watermilfoil** were present:
  - ~ 6,912 fish were needed for adequate control

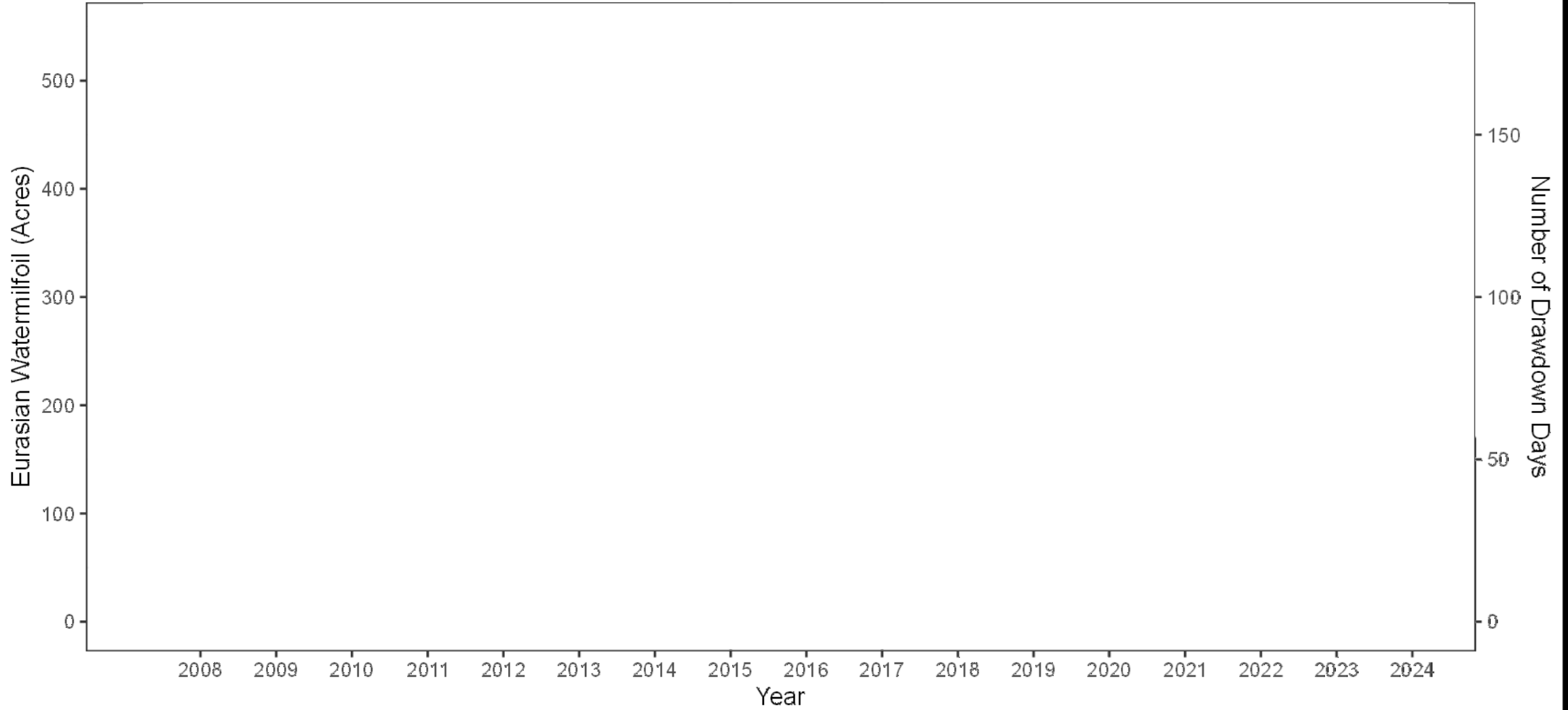
# Candlewood Lake

## Sampling

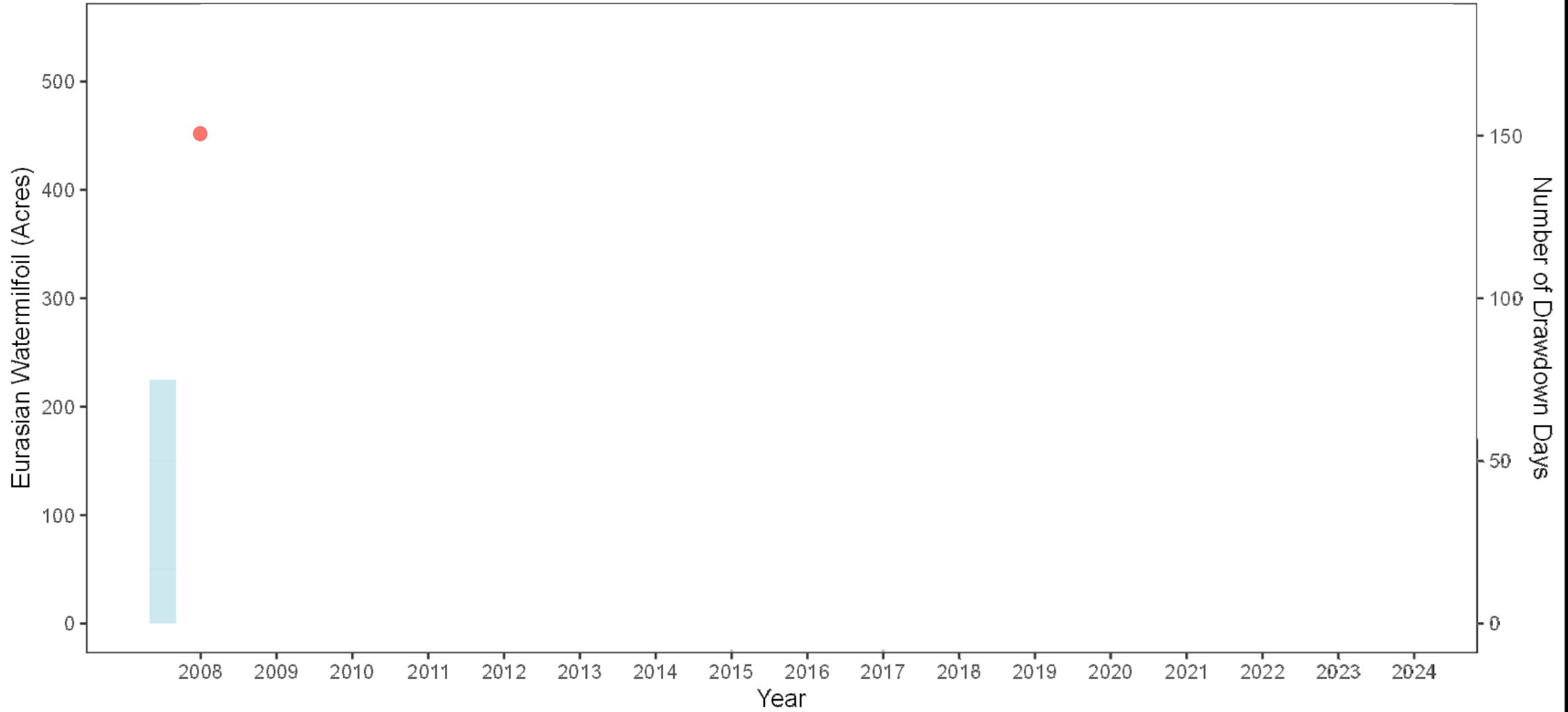


- **15 transects** surveyed (10 in Candlewood Lake, 5 in Squantz Pond)
- **Sampled annually from 2008–2024**
- **Vegetation recorded at fixed distances** from shore (0.5–80 m)
- **Plant abundance** rated on a **0–5 scale**
- **Used rake tosses** (shallow) and **grapples** (deep)
- **GPS mapping with sub-meter accuracy**
- **Focused analysis only on points** where plants were ever observed
- **Depth** calculated using lake elevation minus estimated bottom
- **Data analyzed using logistic and Poisson regression** to assess:
  - **Percent occurrence**
  - **Species richness**
  - **Effects of drawdown, temperature, depth, and grass carp biomass**

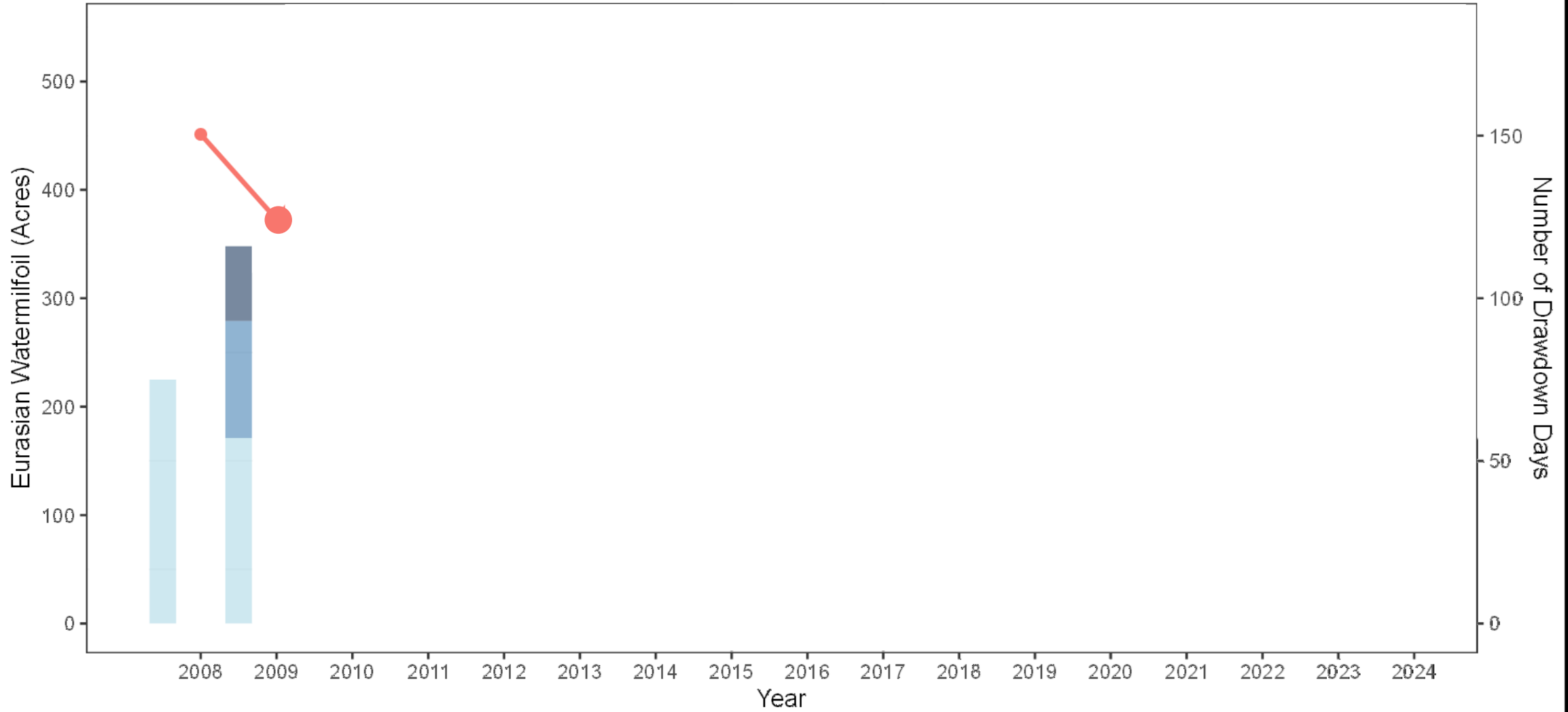
Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow

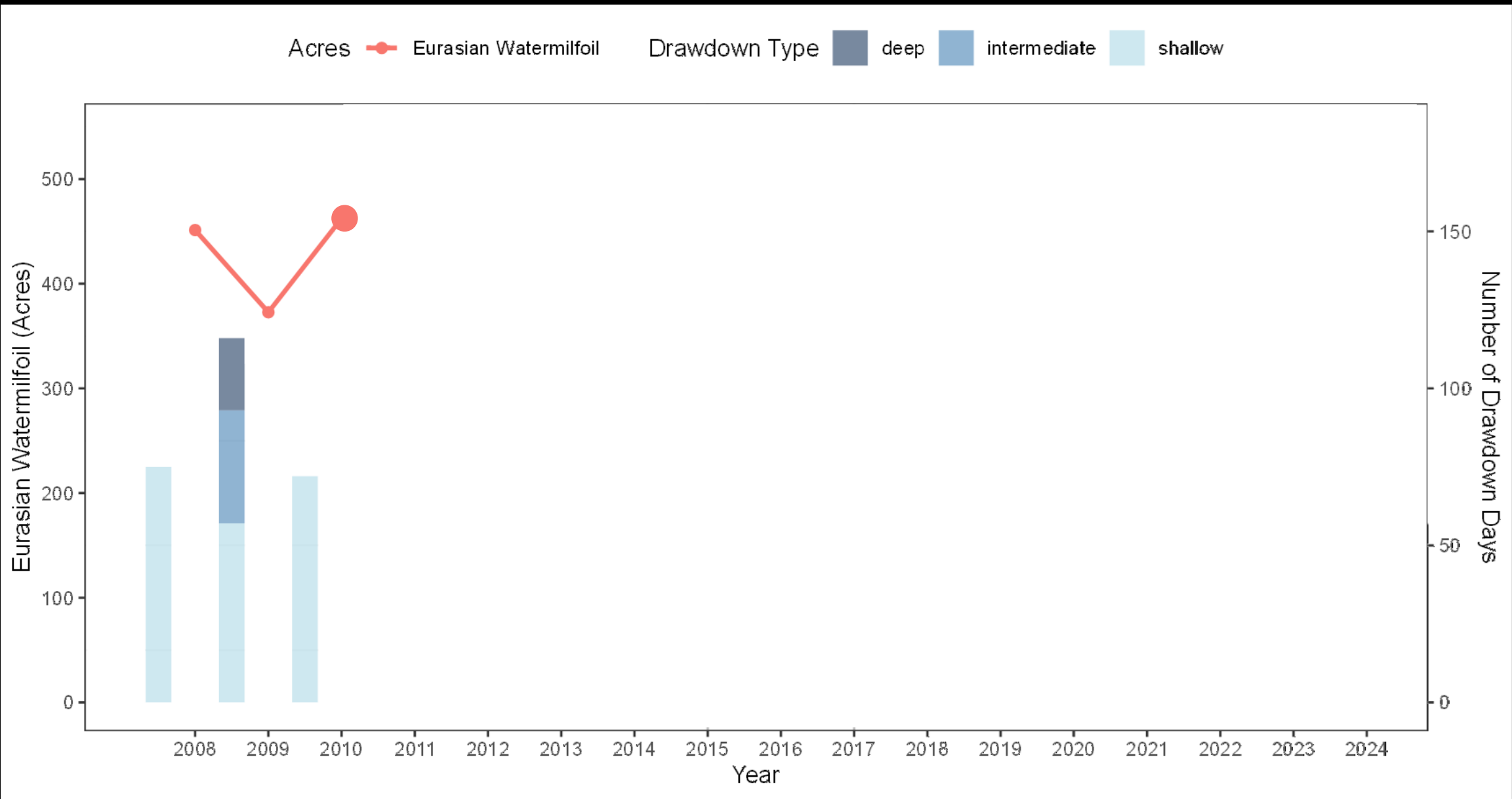


Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow

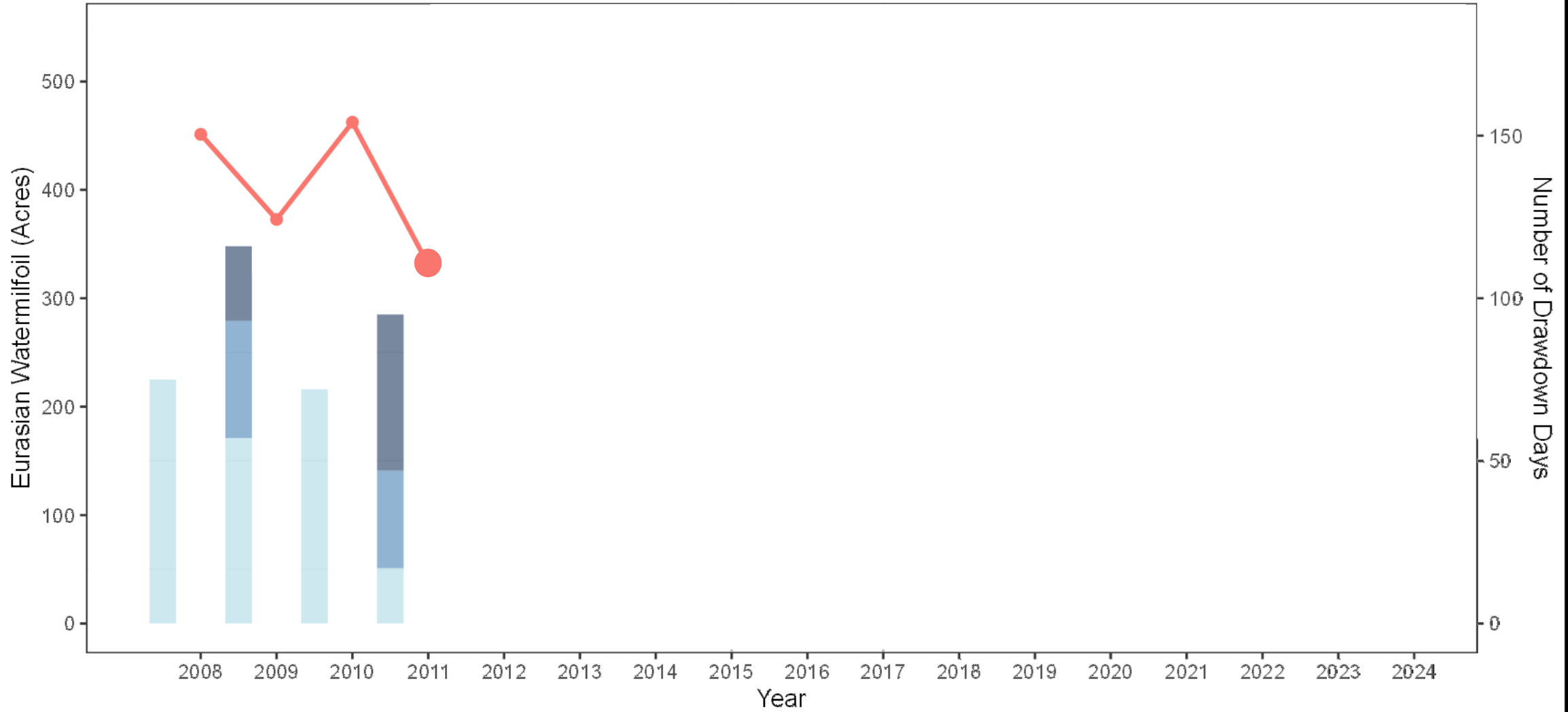


Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow

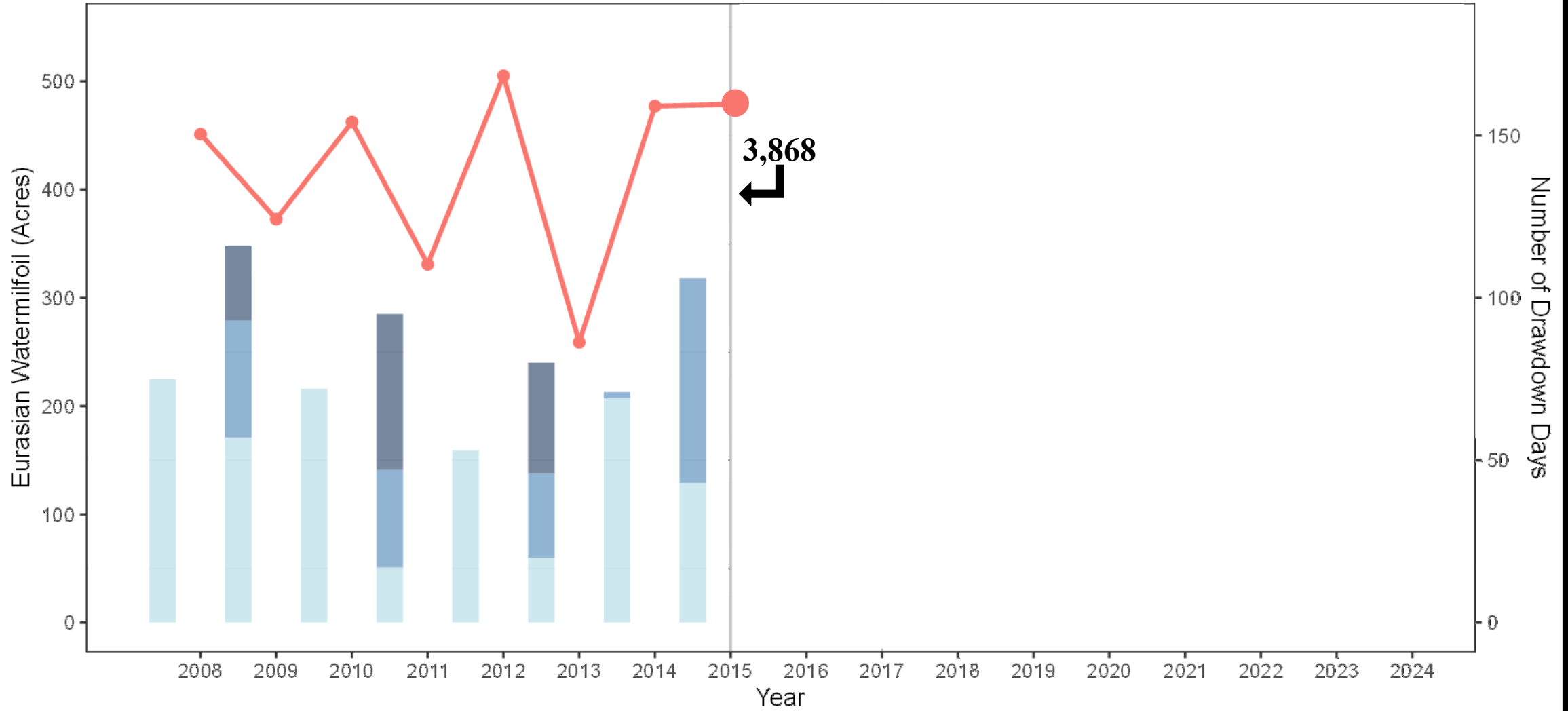




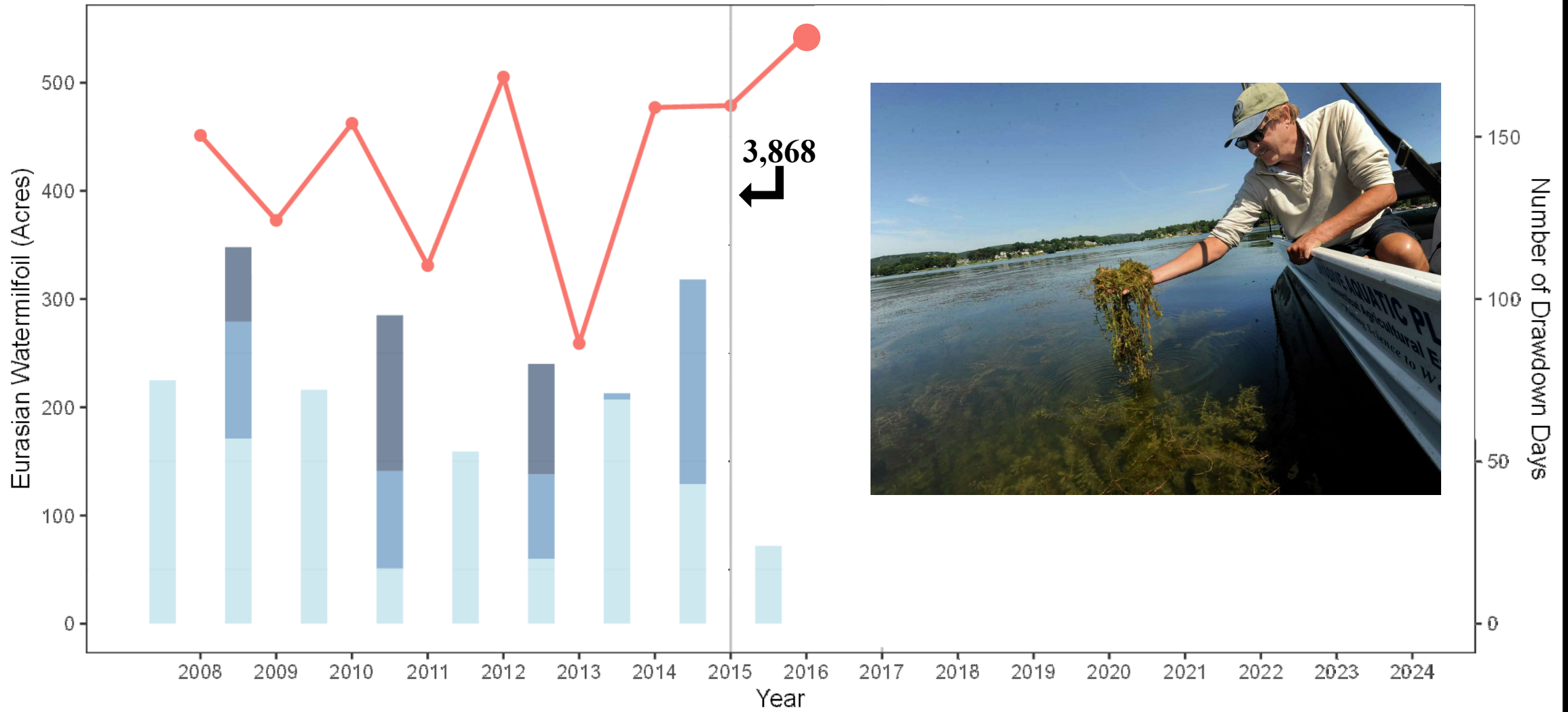
Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow



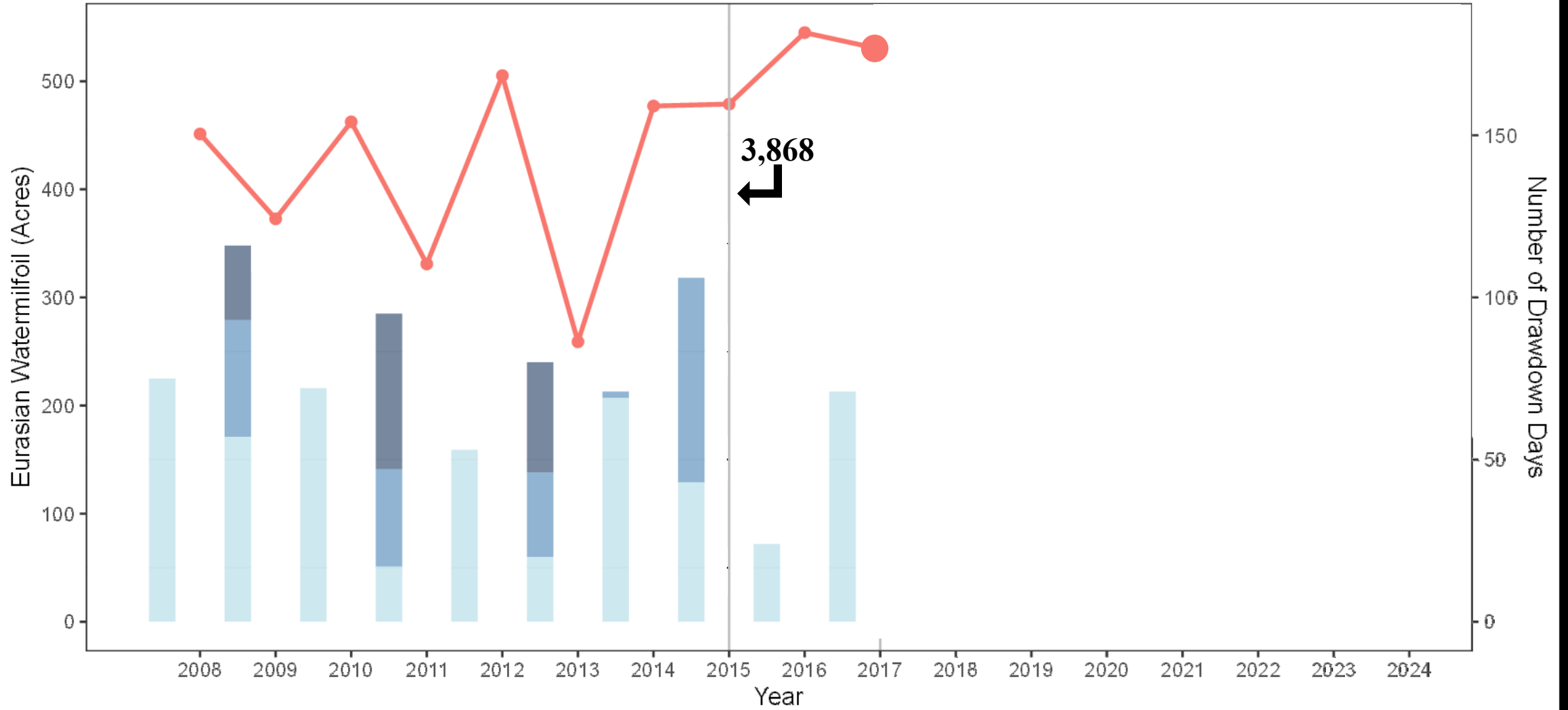
Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow



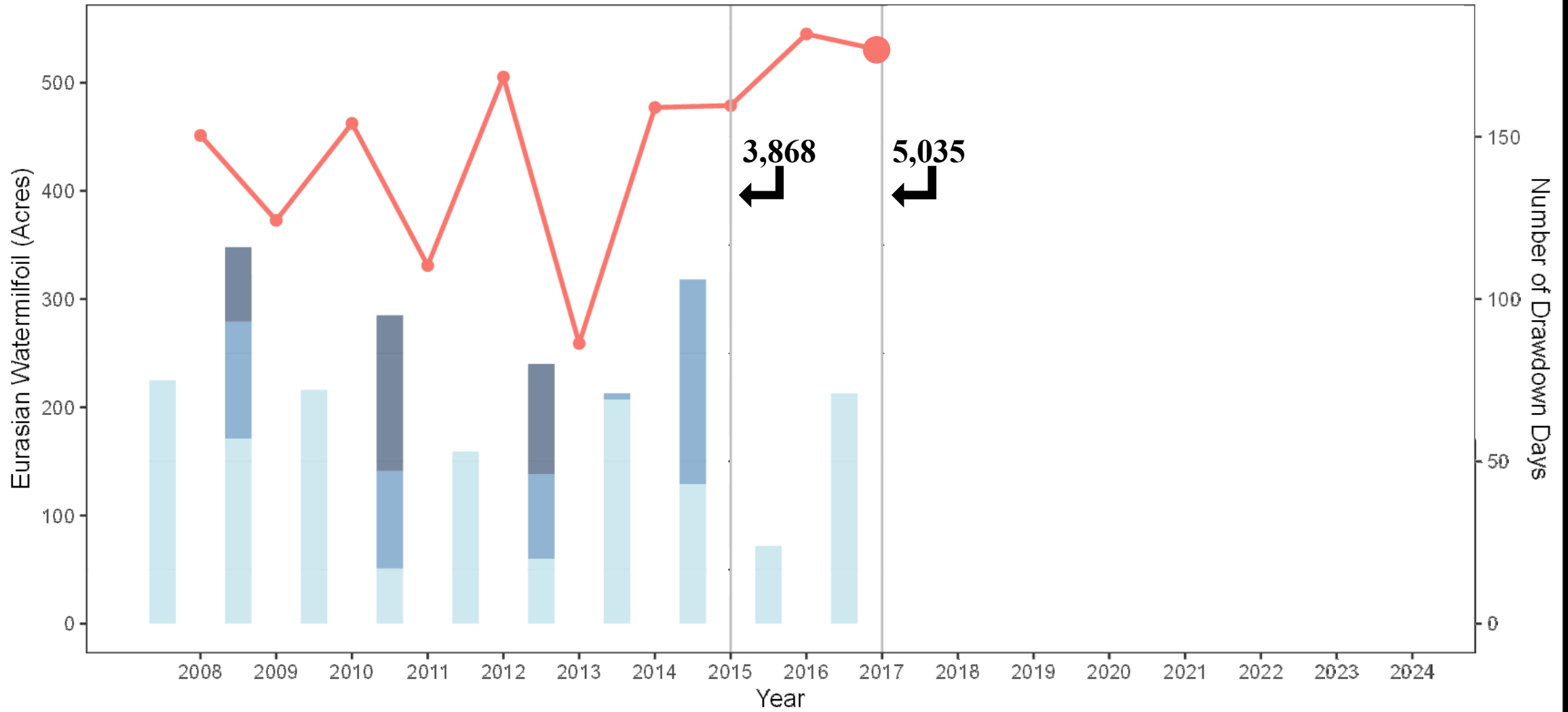
Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow



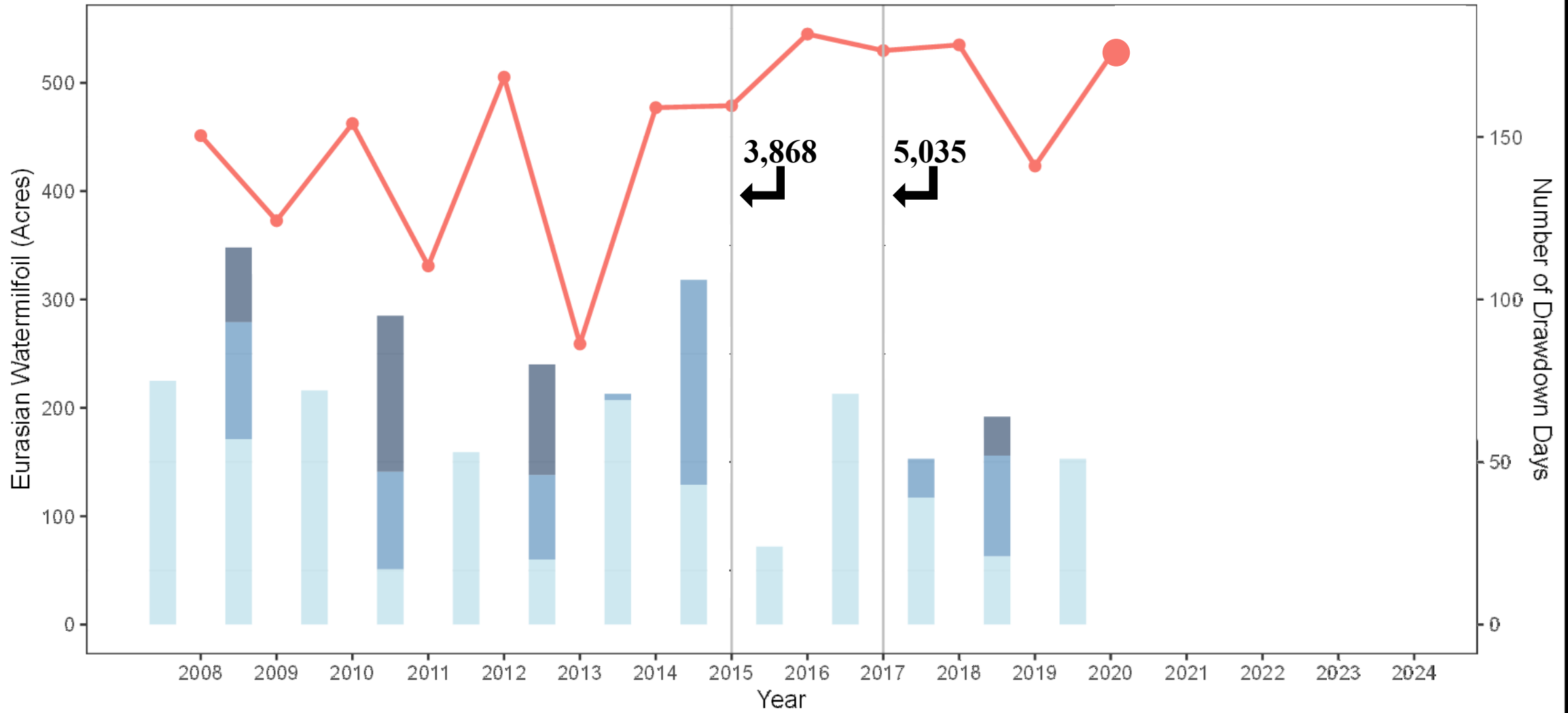
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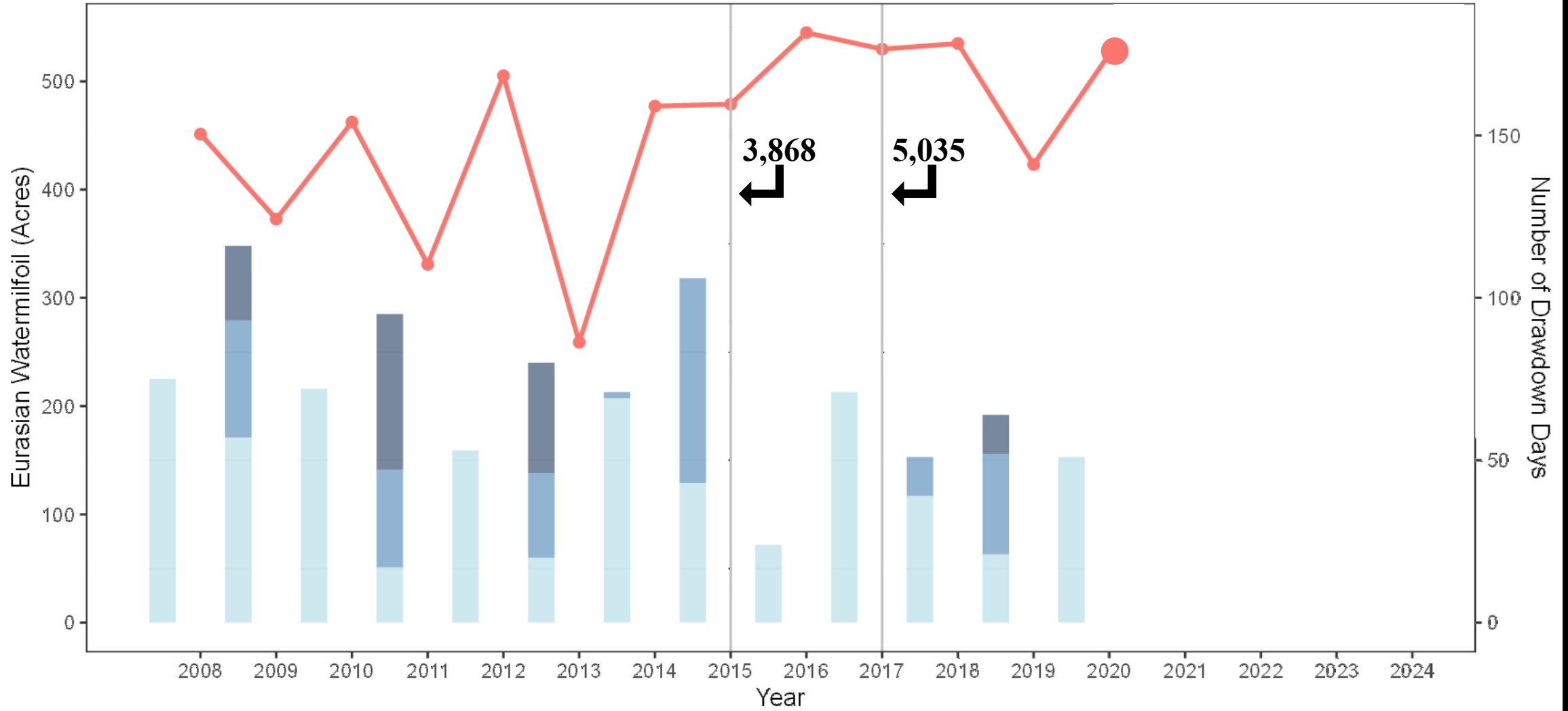
Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow



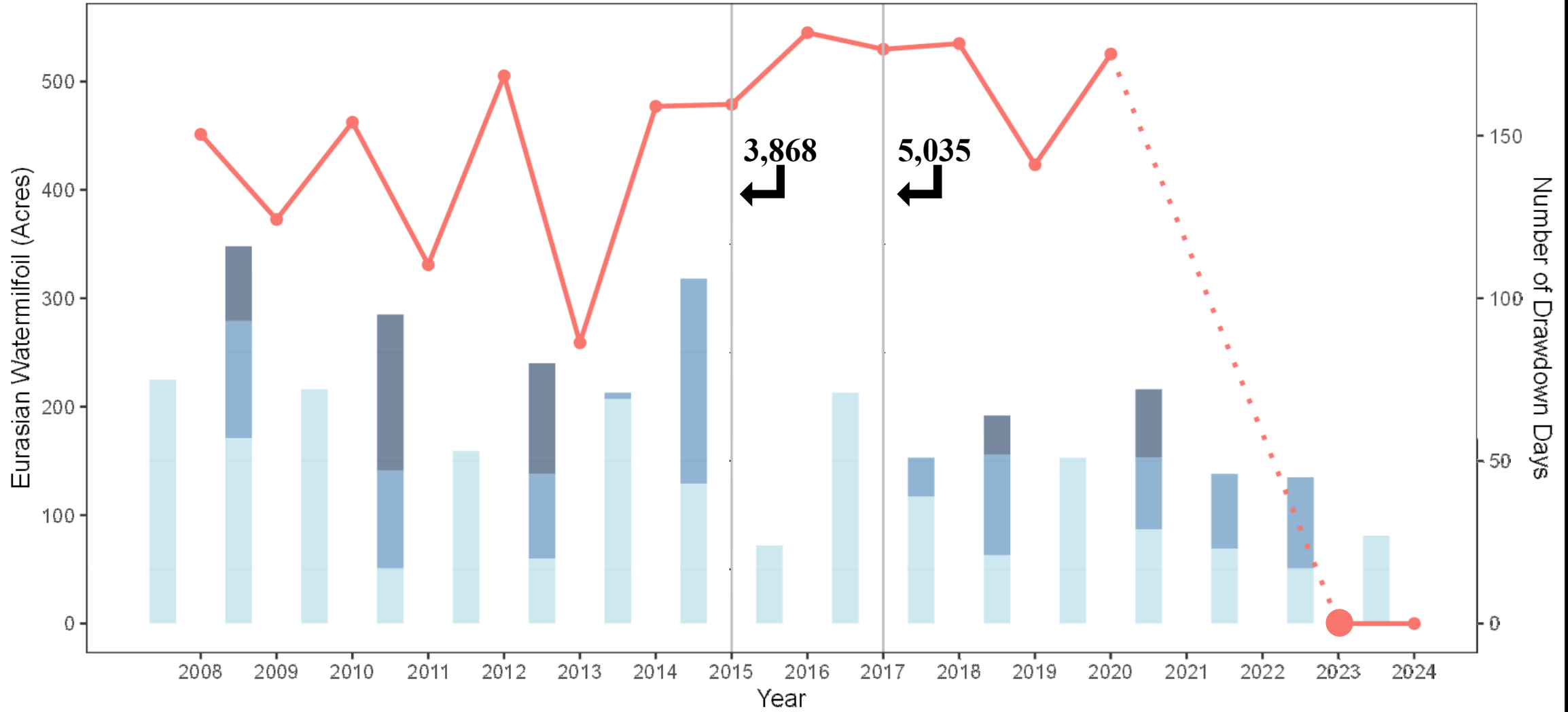
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Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow



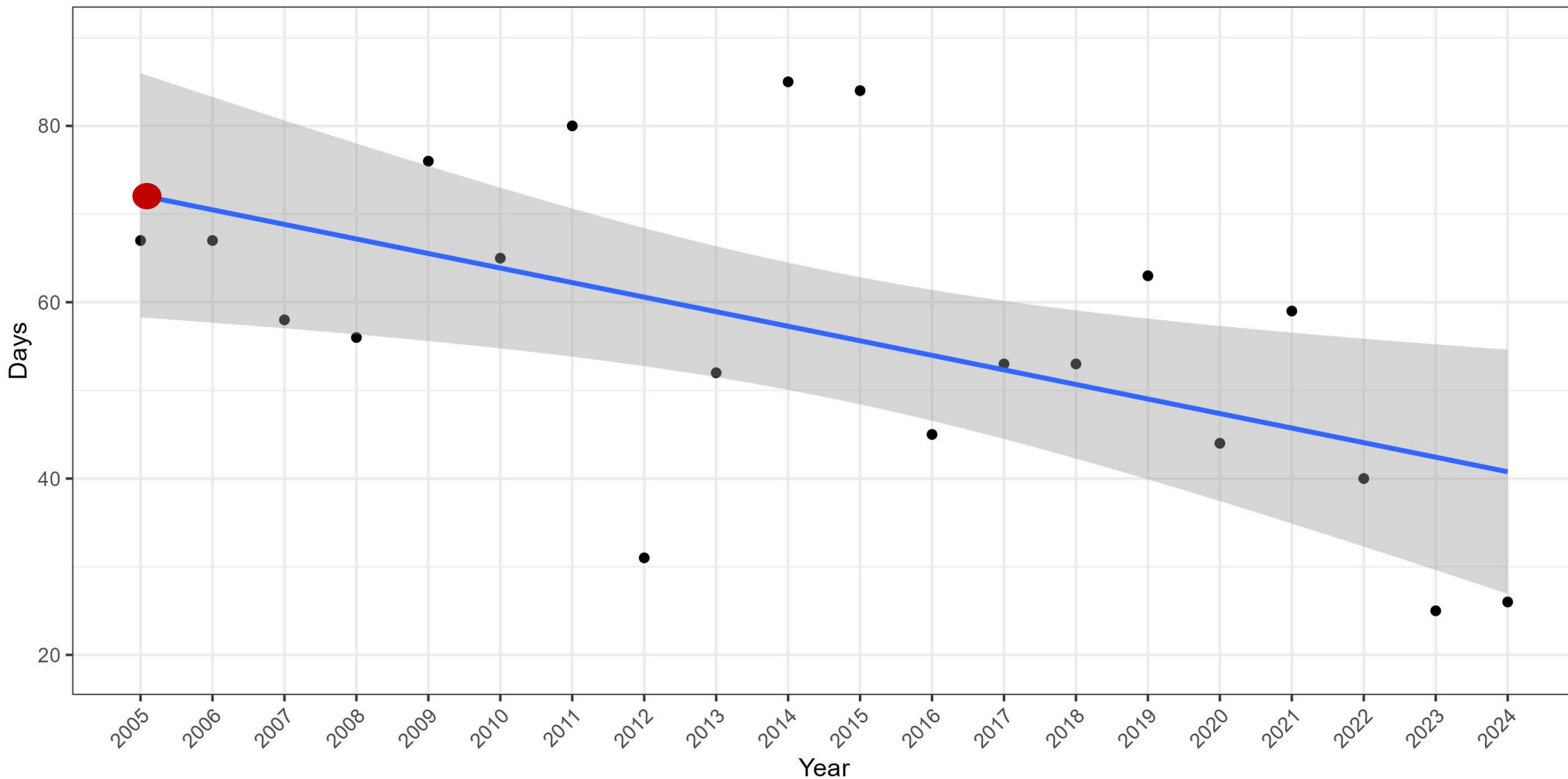
Acres Eurasian Watermilfoil Drawdown Type deep intermediate shallow





# Temperature

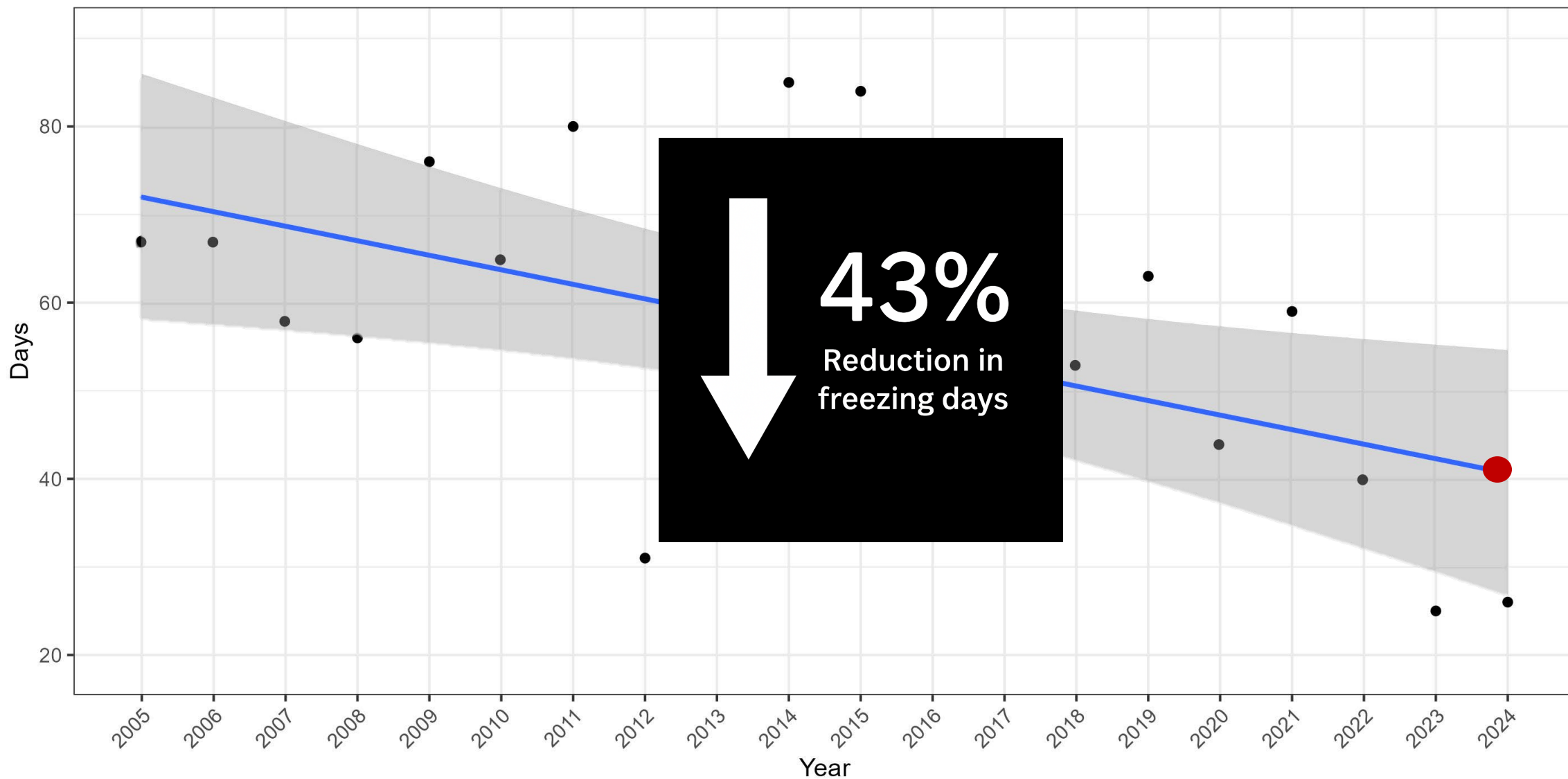
Number of days with freezing (32F) average temperature



( $\beta = -1.6504$ ,  $SE = 0.5932$ ,  $t = -2.782$ ,  $p = 0.0123$ )

# Temperature

Number of days with freezing (32F) average temperature



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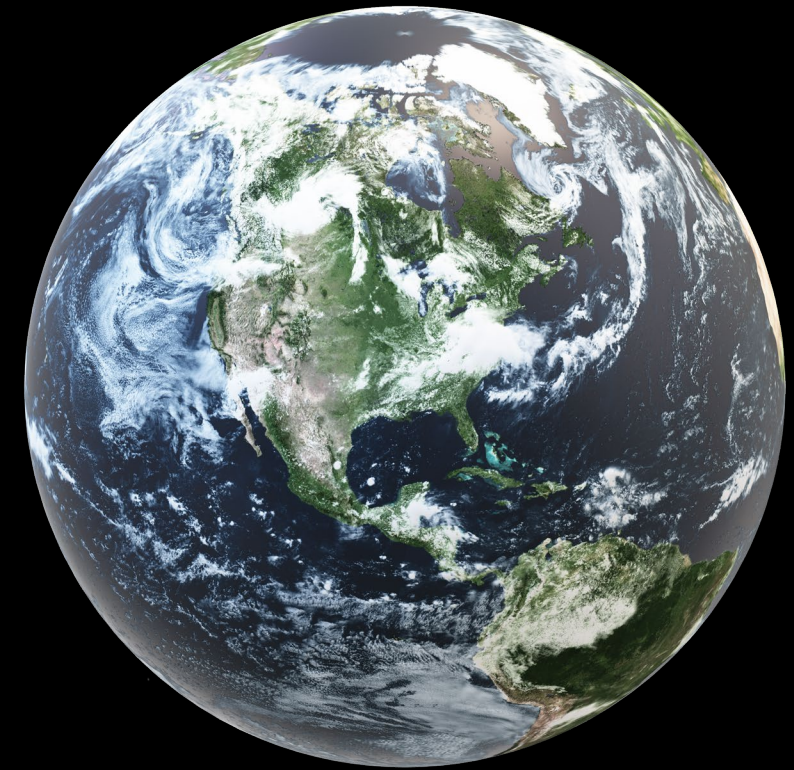
# Biological Control



**The CLASSICAL Biological Control Pipeline**



**Overseas  
Research**

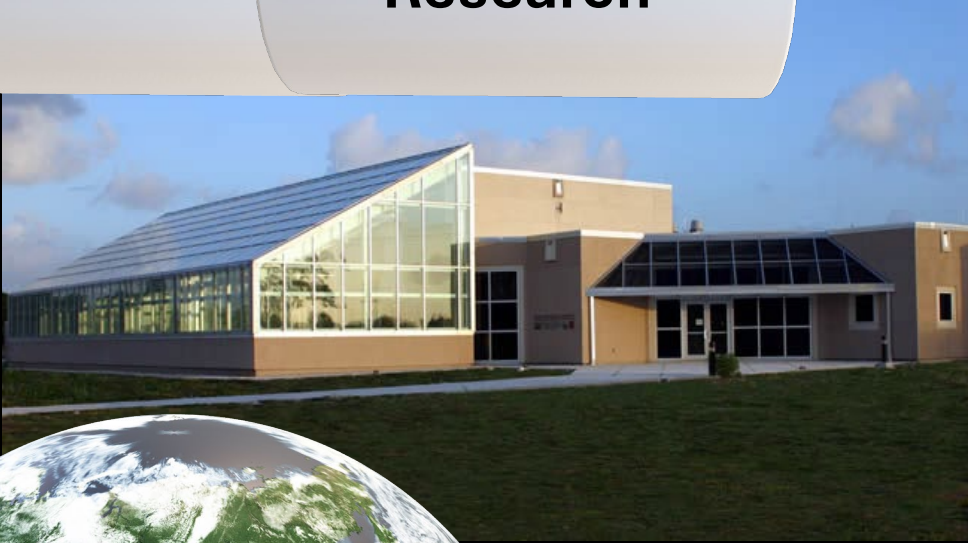


# Overseas Research



**Overseas  
Research**

**Quarantine  
Research**



**Overseas  
Research**

**Quarantine  
Research**

**Release**



**Overseas  
Research**

**Quarantine  
Research**

**Release**

**Establishment**



**Overseas  
Research**

**Quarantine  
Research**

**Release**

**Establishment**

**Technology  
Transfer**



# The Biological Control Pipeline

**Overseas  
Research**

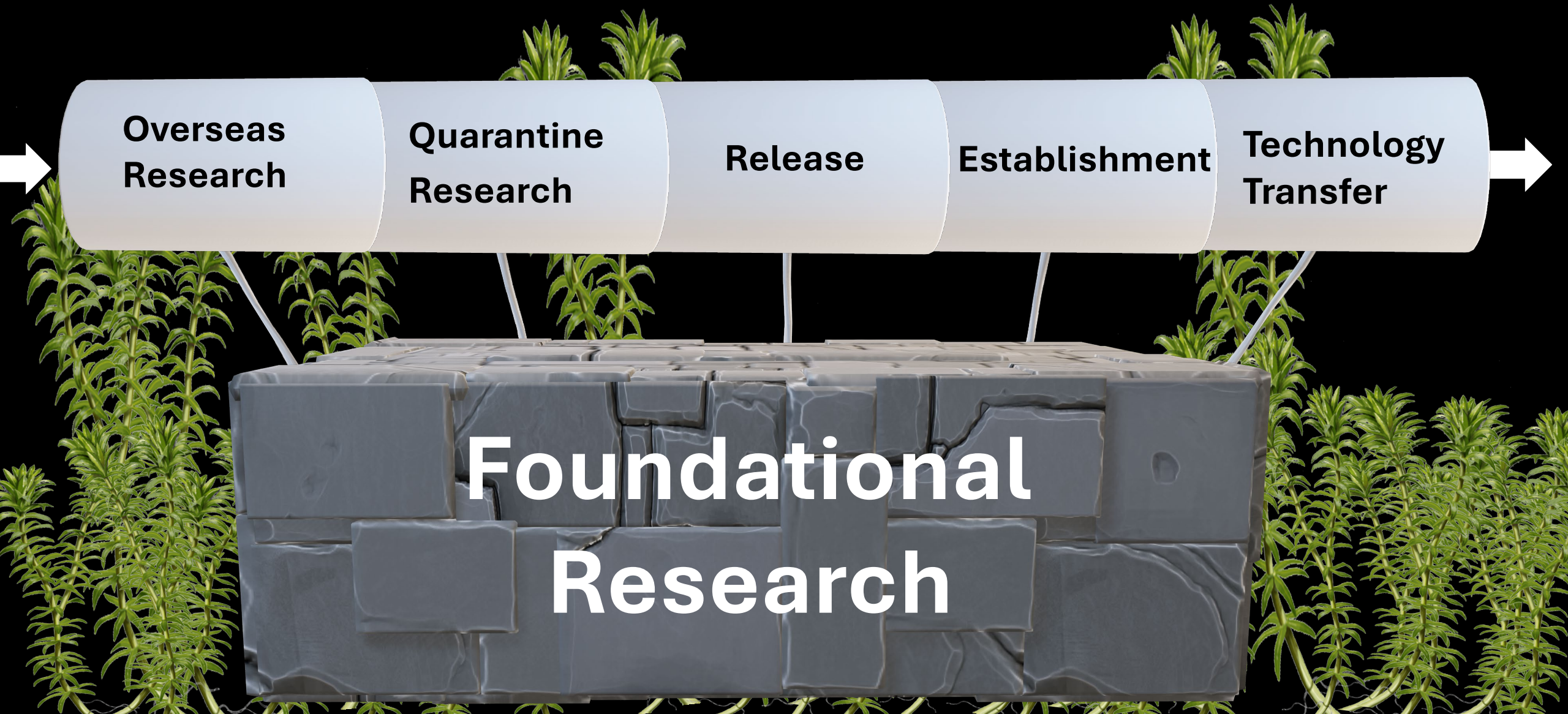
**Quarantine  
Research**

**Release**

**Establishment**

**Technology  
Transfer**

# The Biological Control Pipeline





## About

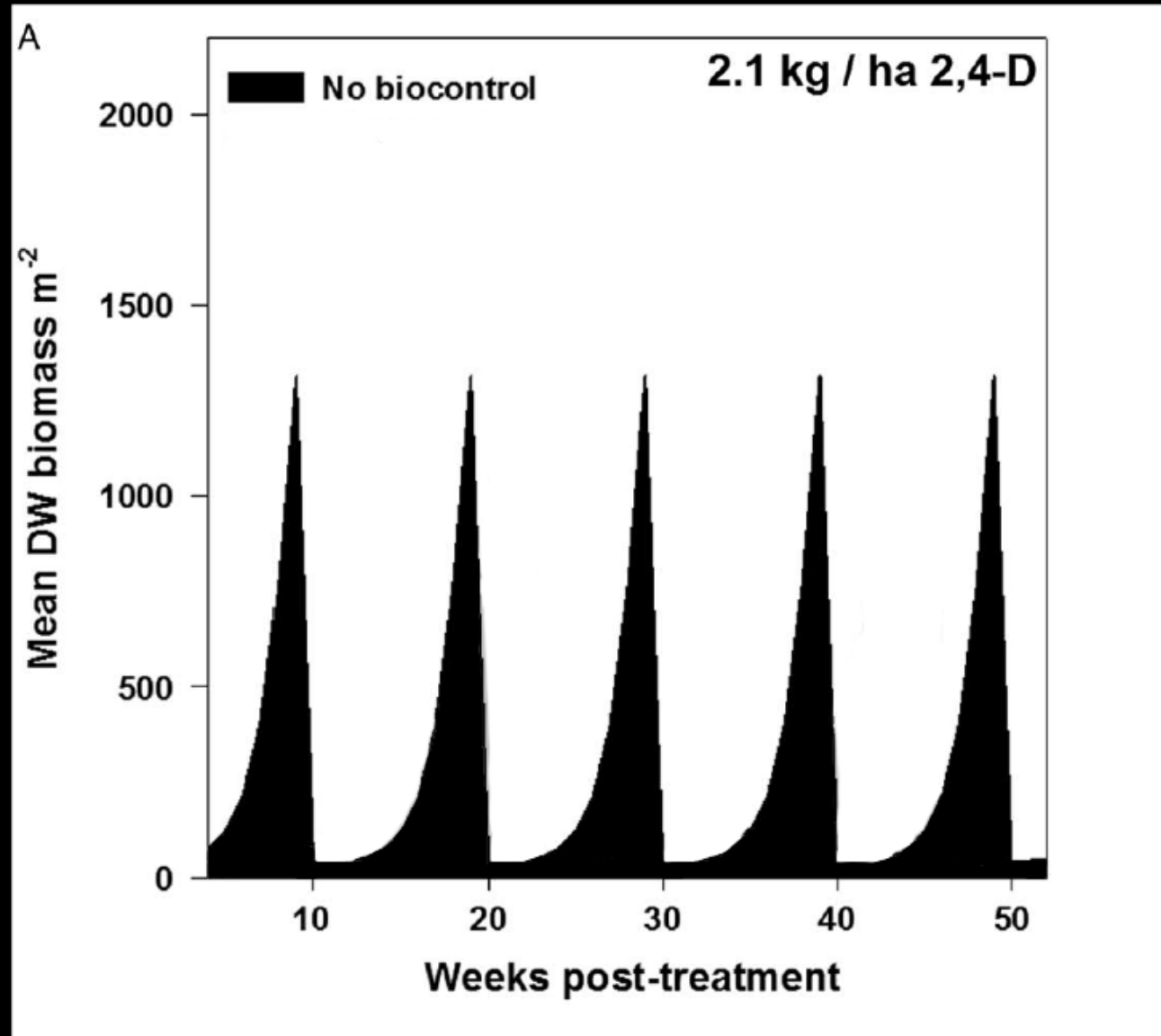
WATER HYACINTH WEEVILS *are* native to South America, were introduced to the U.S. in the 1970s to control invasive water. By feeding on the plant's leaves and stems, they reduce its growth, support native vegetation recovery, and lessen the need for chemical or mechanical controls



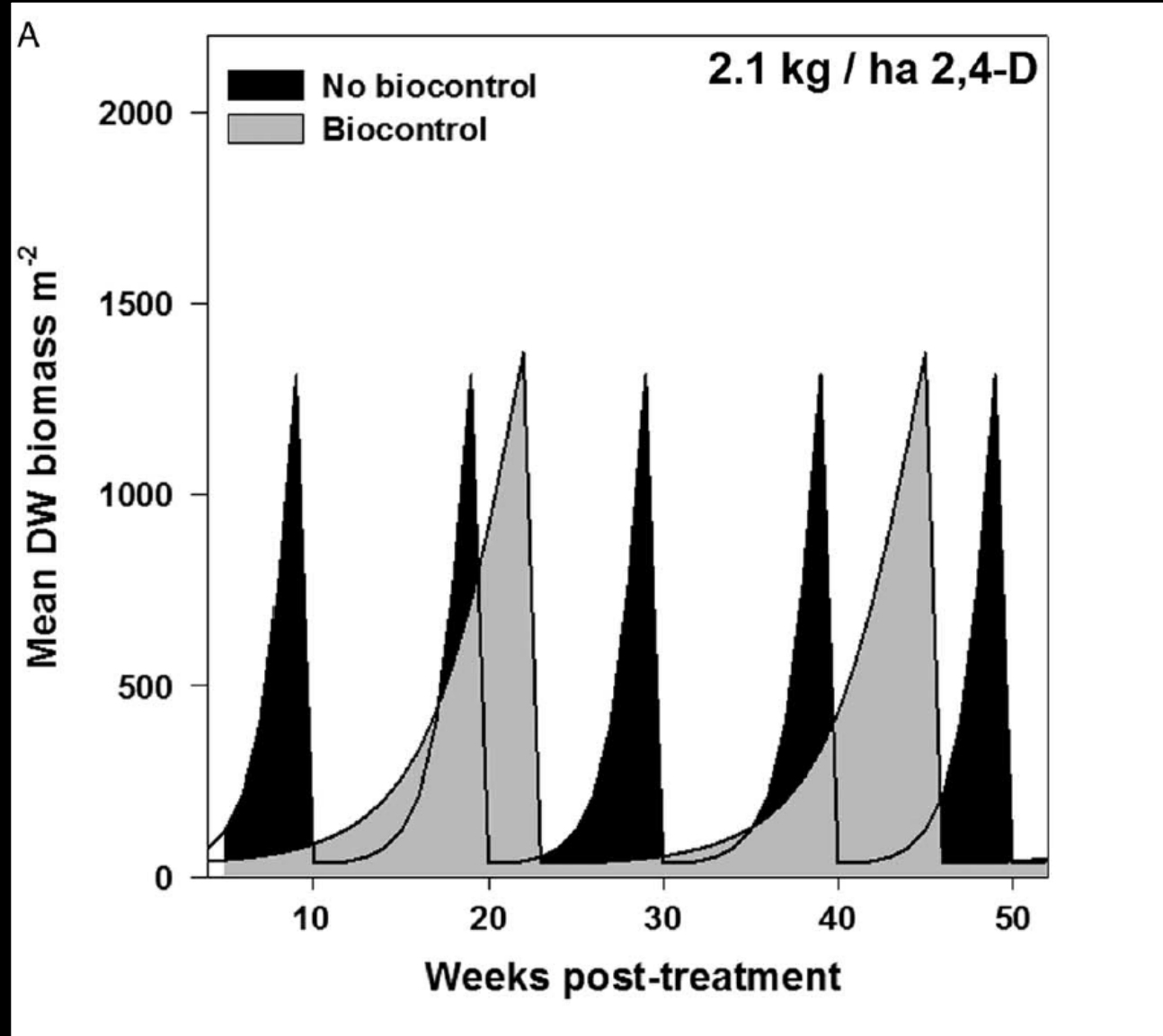
- 58.2% less biomass
- 97.3% fewer inflorescences
- 16.8% decrease in coverage



# Waterhyacinth IPM: Biomass Reduction



# Waterhyacinth IPM: Biomass Reduction







# Approved and Released Agents for Hydrilla



*Bagous affinis*



*Bagous hydrillae*



*Hydrellia balciunasi*



*Hydrellia pakistanae*

# Asian leaf-mining fly

*(Hydrellia pakistanae)*



# Asian leaf-mining fly

- Original host range testing on hydrilla

- Release

“...field densities of flies and the associated damage to hydrilla populations never reached more than 15 adults/m<sup>2</sup> and 15% of the whorls damaged, respectively, **about one-fifth the level estimated from cage studies that severely impact plant biomass**” - Wheeler and Center 2001

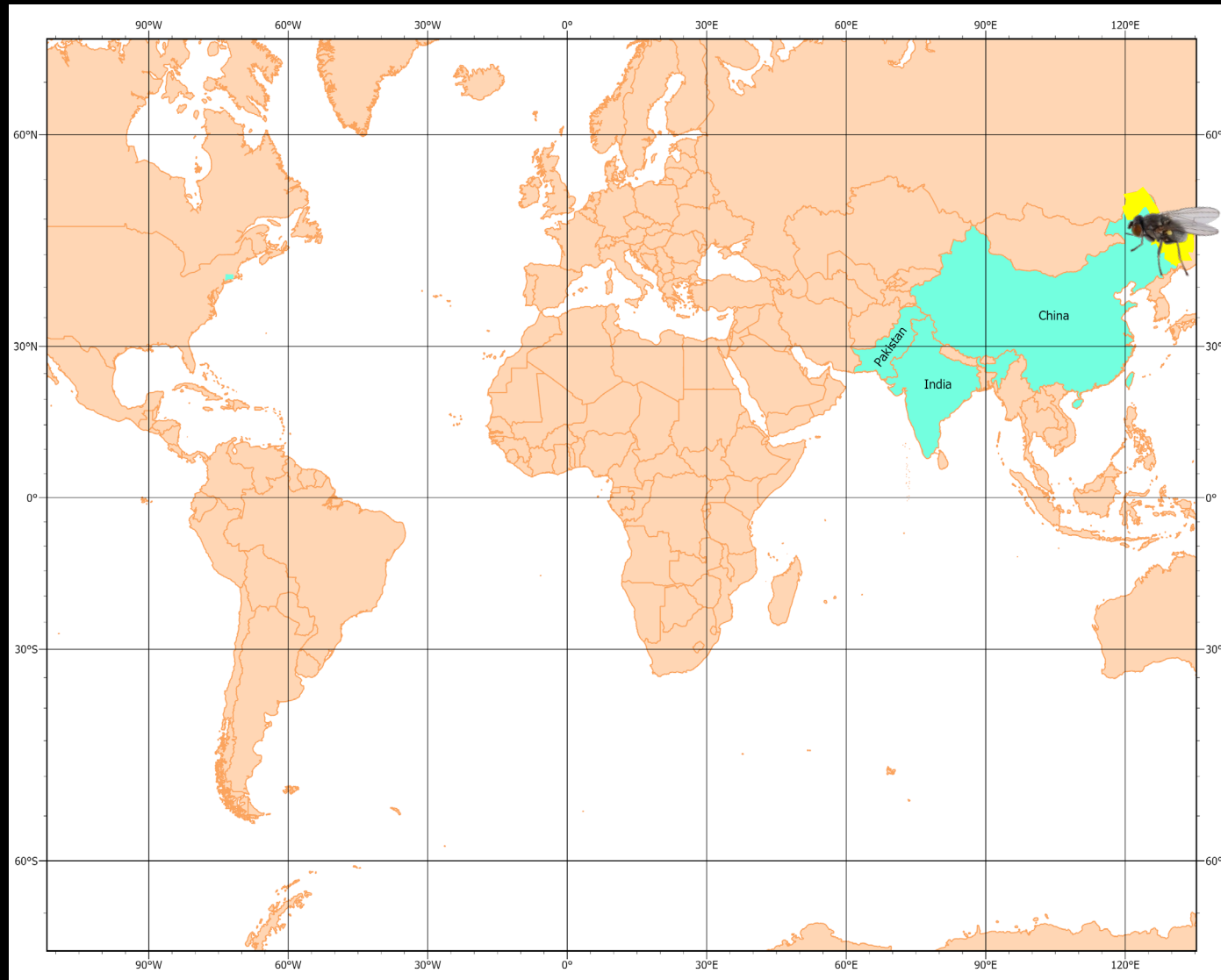
USDA - Aquatic and Wetlands Development Support Facility, Oxford, MS (>3 million released from 1987-1997)

# Asian leaf-mining fly

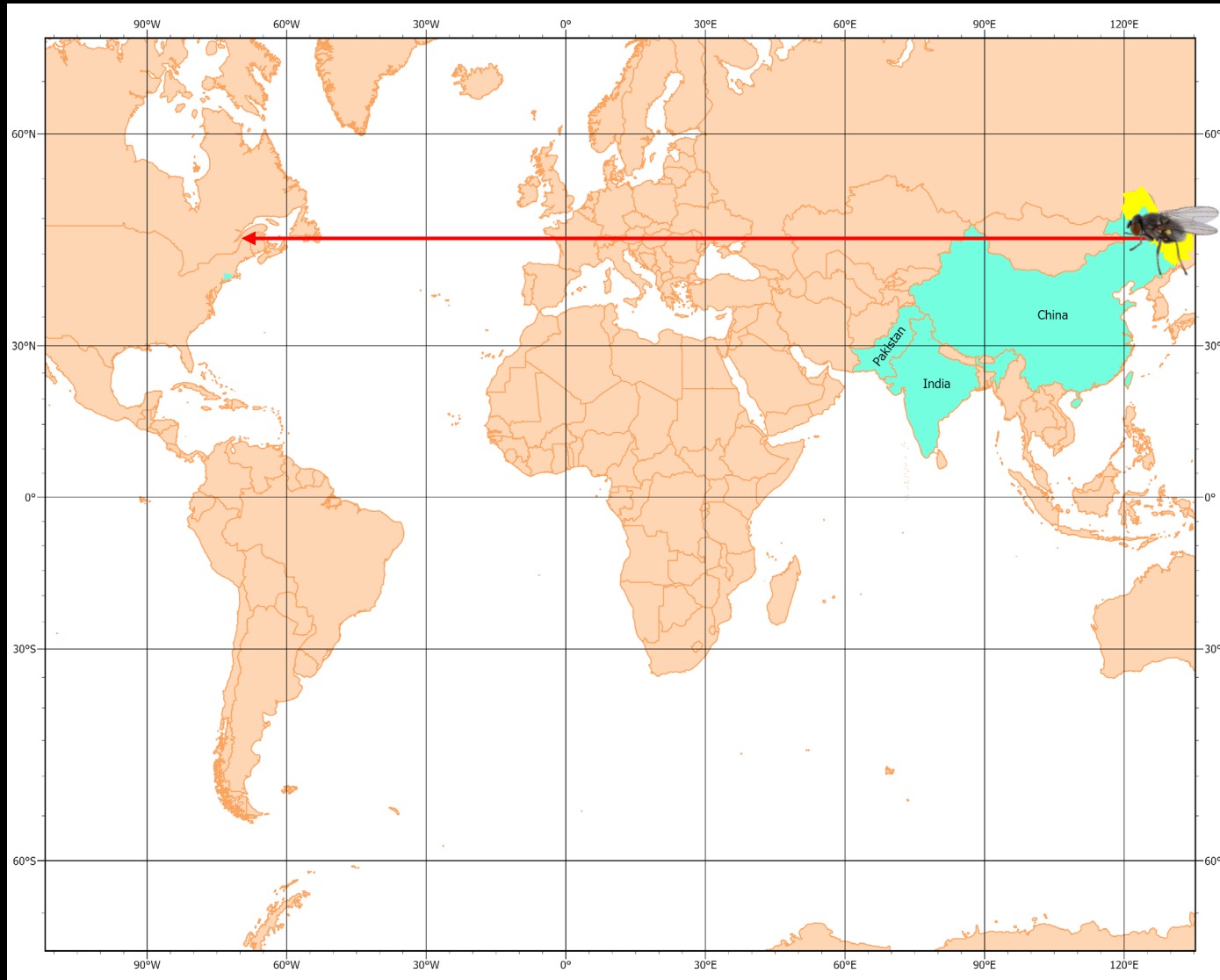




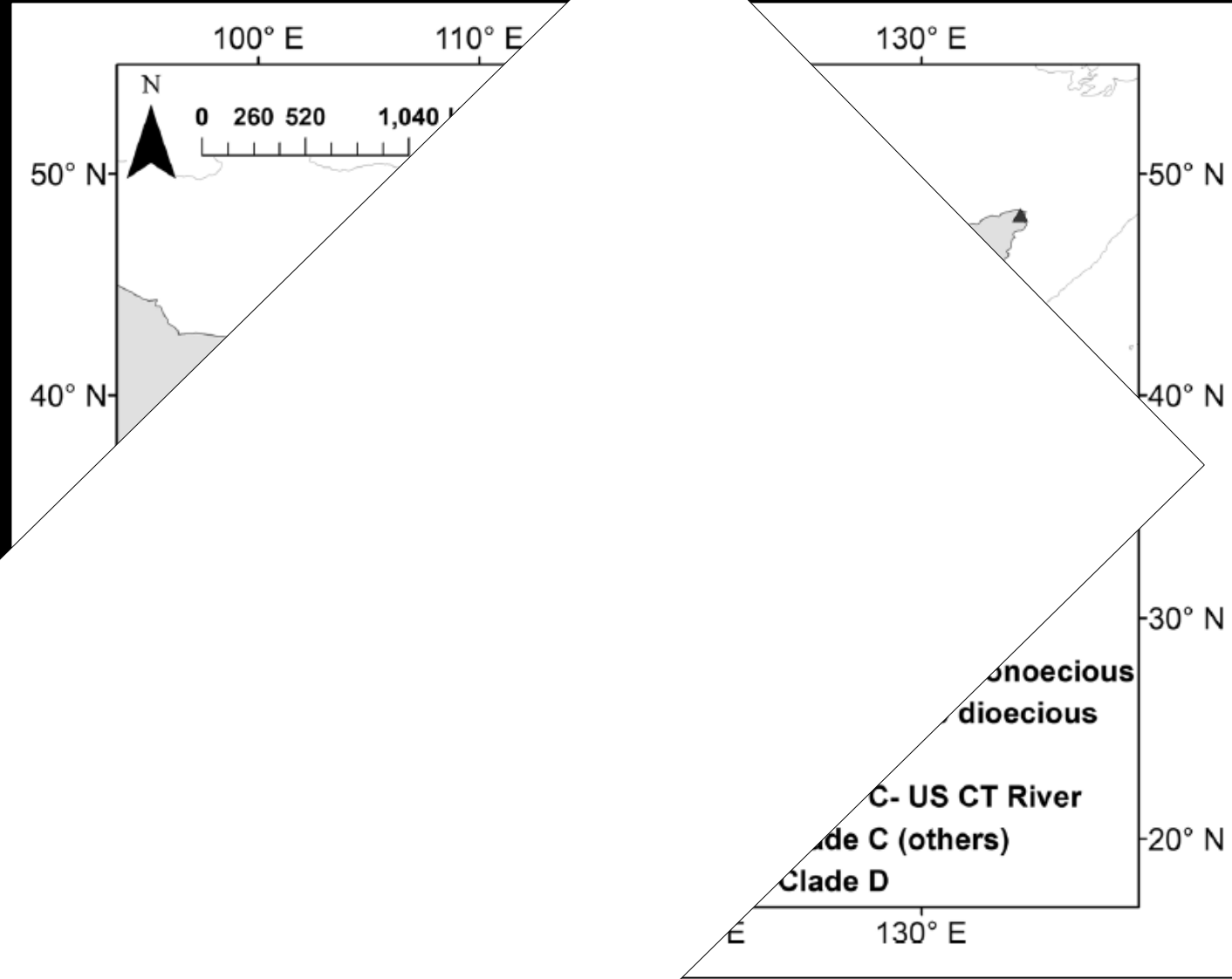
# Asian leaf-mining fly

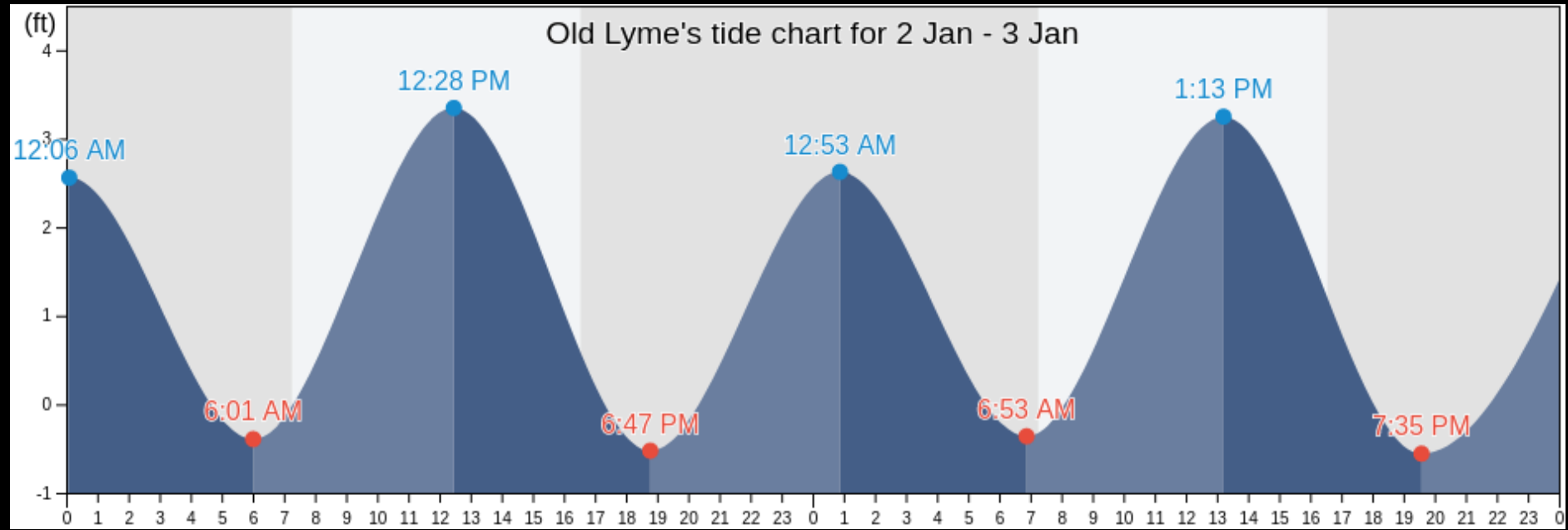


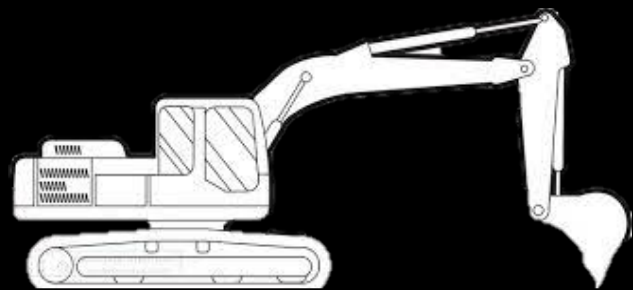
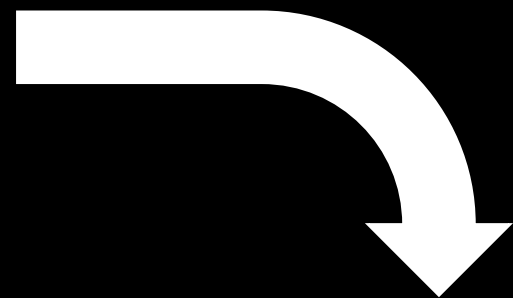
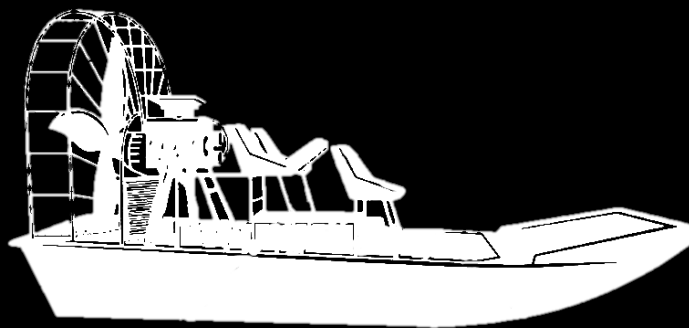
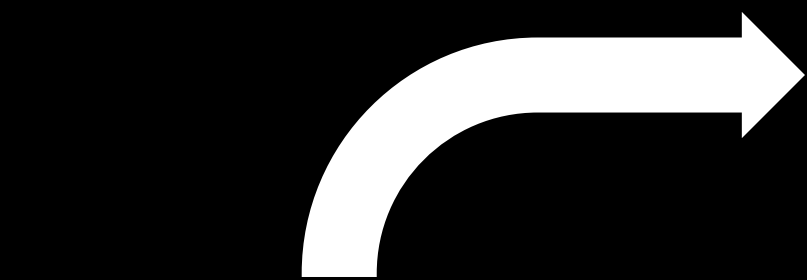
# Asian leaf-mining fly



# Asian leaf-mining fly









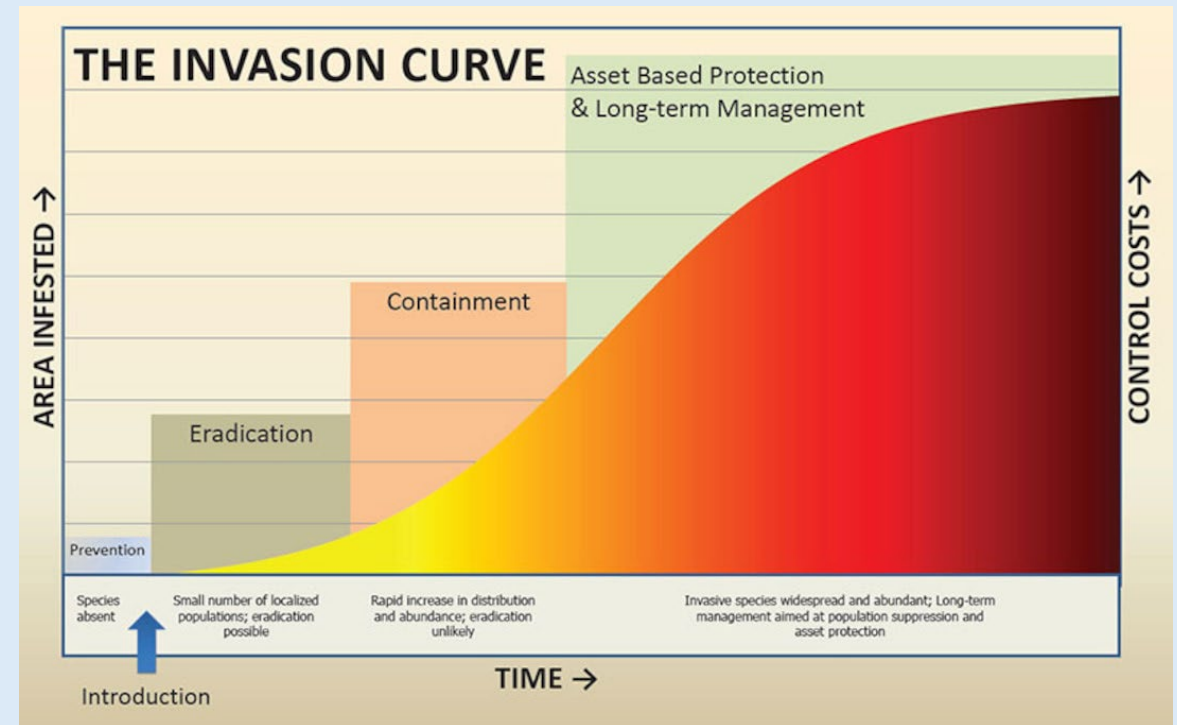
# OAIS

Office of Aquatic Invasive Species

*Connecticut Agricultural Experiment Station*

# Early Detection, Rapid Response


- Rapid Response is defined as... a systematic effort to **eradicate, contain, or control** an invasive species introduced into an ecosystem while the infestation is **still localized**
- Definition of 'rapid' can vary depending on species



# 2026 Hydrilla Rapid Response Protocol

1. Detect hydrilla early
2. Report it to OAIS
3. OAIS will confirm ID, map hydrilla, and map the NDDDB species in the vicinity of the hydrilla for DEEP permitting
4. Prepare to submit aquatic herbicide permitting

# CT AIS Web App




Aquatic Invasive Species

Home

Survey Data: 2011-2023

Connecticut River

Report AIS & Update Database



Waterbodies with invasives

Waterbodies without invasives

American water lotus

Basket (Asiatic) clam

Brazilian waterweed

Common water hyacinth

Curly-leaf pondweed

Eurasian watermilfoil

European

4-H Camp Pond, Marlborough

Ajello's Pond

Alexander Lake

Amos Lake

Amston Lake

Anderson Pond

Andover Lake

Angus Park Pond

Ashford Lake

Avery Pond

Babcock Pond

Ball Pond

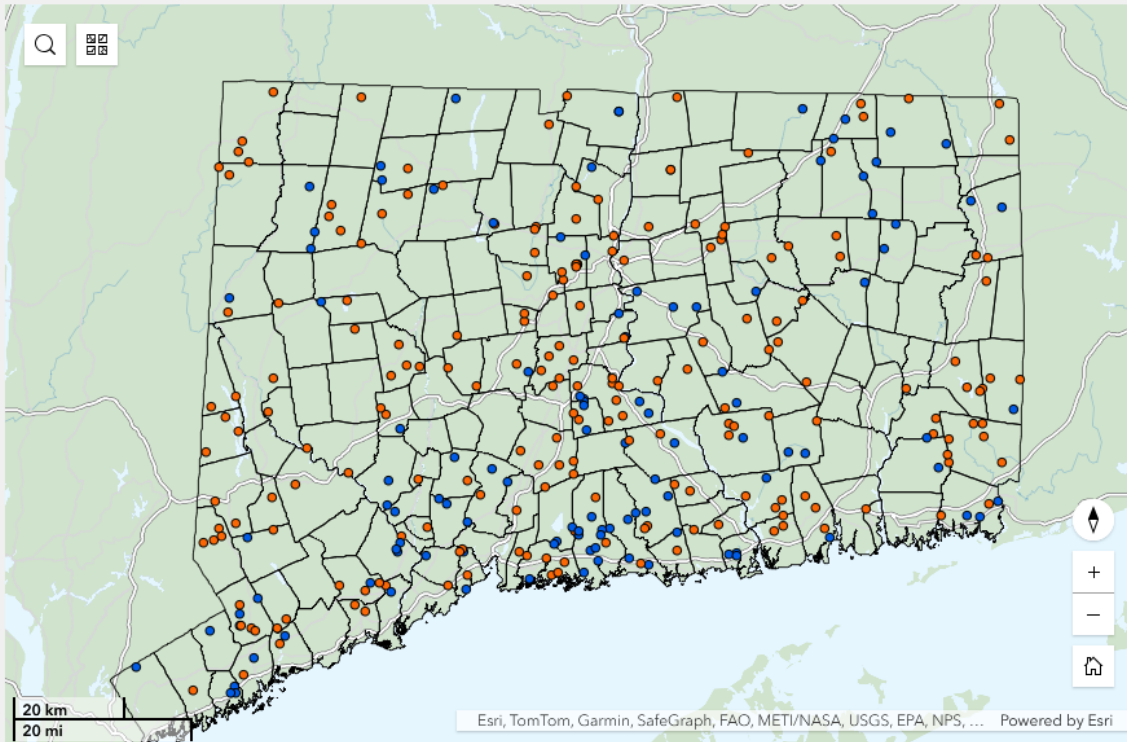
Bantam Lake

Bantam Pond

Barber Pond

Bashan Lake

Basserman Pond



20 km  
20 mi

Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, ... Powered by Esri

1 of 316

### 4-H Camp Pond, Marlborough

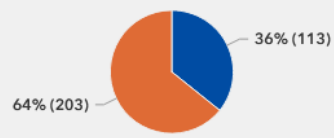
**4-H Camp Pond, Marlborough**

**Acres:** 1  
**Access:** Private  
**Town(s):** Marlborough  
**Invasive species:** None  
**Management history:** Unknown

[OAIS Surveys](#) | [Boat Launch](#) | [Organization](#)

**Waterbodies**

- without invasive species
- with at least one invasive species



36% (113)


64% (203)

**316**  
waterbodies

Connecticut Agricultural Experiment Station

Office of Aquatic Invasive Species

Stop Aquatic Hitchhikers!



# Tablet & Mobile Designs

The tablet design features a blue header with the OAIS logo, a menu icon, an information icon, and a "STOP AQUATIC HITCHHIKERS!" logo. The main content area is titled "Report Aquatic Invasive Species or Update Database" and includes a descriptive paragraph. Below this, there are three expandable sections: "Basic Information", "Report invasive species sighting", and "Update our database". The "Basic Information" section contains three required fields: "Your name\*" (with a "(First Last)" hint), "Email address\*" (with an envelope icon), and "Phone number" (with a "(000) 000-0000" hint). A "General comments or suggestions" text area is located at the bottom of the form. The footer contains the text "Connecticut Agricultural Experiment Station" and "Office of Aquatic Invasive Species".

The mobile design features a blue header with the OAIS logo, a menu icon, an information icon, and a "STOP AQUATIC HITCHHIKERS!" logo. The main content area is titled "Report Aquatic Invasive Species o..." and includes a descriptive paragraph. Below this, there are two expandable sections: "Basic Information" and "Update our database". The "Basic Information" section contains three required fields: "Your name\*" (with a "(First Last)" hint), "Email address\*" (with an envelope icon), and "Phone number" (with a "(000) 000-0000" hint). The "Update our database" section contains a "General comments or suggestions" text area. The footer contains the text "Office of Aquatic Invasive Species" and a share icon.



# USACE Cost Share Funding

## **33 U.S. Code § 610**

Control of aquatic plant growths  
and invasive species

## **50/50 Cost Share**

50% of cost is reimbursed  
when project is complete

## **AIS Prevention & Control**

Hydrilla is a USACE priority

## **USACE – CAES**

project partnership agreement  
is currently in the works

**Cost share funding should be available in 2027**

*Federally funded projects cannot be reimbursed*



# USACE Cost Share Funding

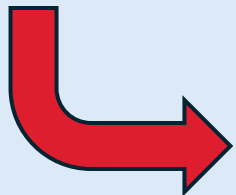
## Project Reimbursement Process

### 1. Partners submit project proposals

- *Future* webpage on CAES OAIS website will include information and instructions

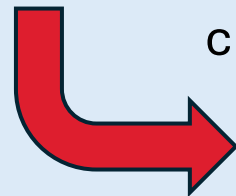


### 2. CAES OAIS submits list of projects to USACE every Jan/Feb



### 3. USACE approves projects for funding

- CAES OAIS sends confirmations to partner groups and creates contracts with partners



### 4. When project is complete, partners receive 50% reimbursement from CAES



# Questions?



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OAIS Lead

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**Jeremiah Foley IV, Ph.D.**

Biological Control Specialist

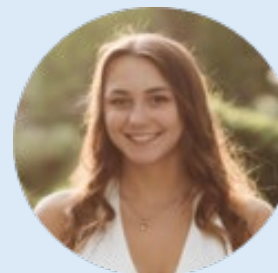
[Jeremiah.Foley@ct.gov](mailto:Jeremiah.Foley@ct.gov)



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## **Office of Aquatic Invasive Species**

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Connecticut Agricultural Experiment Station

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New Haven, CT 06511

[portal.ct.gov/caes-oais](http://portal.ct.gov/caes-oais)