

# Marching Orders for Lake/River Stewards: Memorize Invasive Water Chestnut

Katie DeGoosh-DiMarzio, Environmental Analyst, RIDEM/NEIWPC  
2022 Rhode Island Land and Water Summit (July 15)



Valley Falls Pond, Central Falls, RI



# RIDEM Surveys Lakes for Invasive Plants

Water Chestnut  
*Trapa natans*



Chapman Pond, Westerly

# RIDEM Surveys Lakes for Invasive Plants

Water Chestnut  
*Trapa natans*







Central Pond, East Providence  
2016

# 14 Invasive Plants in RI

**Aquatic Invasive Species Found in RI Lakes**  
 Find more information @ <http://www.dem.ri.gov/programs/water/quality/surface-water/acidrain.php>  
 Pictures taken at various scales to show basic shape and form of plant parts. See text or items for size reference (fingers, pen, ruler etc.)


**Floating-leaved Invasive Plants - Rooted in Sediment**

<p><b>Water Chestnut</b> (<i>Trapa natans</i>)</p>  <p><b>Floating Leaves</b></p> <ul style="list-style-type: none"> <li>Triangle-shaped</li> <li>Many arranged in circular rosette</li> <li>Toothed edges</li> <li>Shiny finish</li> <li>Feathery leaves are underwater on stem</li> </ul> <p><b>Flowers (July)</b></p> <ul style="list-style-type: none"> <li>Colored white</li> <li>Size of pencil eraser</li> <li>4 petals</li> <li>Center of rosette</li> </ul> <p>Seeds</p>	<p><b>Yellow Floating Heart</b> (<i>Nymphoides peltata</i>)</p>  <p><b>Floating Leaves</b></p> <ul style="list-style-type: none"> <li>Circular shape with cleft</li> <li>Multiple leaves per stem</li> <li>Scalloped edges</li> <li>Shiny finish</li> <li>2 to 6 inches across</li> </ul> <p><b>Flowers (July-August)</b></p> <ul style="list-style-type: none"> <li>Colored yellow</li> <li>1-1.5 inches</li> <li>5 petals</li> <li>Friilly edges</li> </ul> <p>(flower enlarged)</p>
<p><b>Sacred Lotus</b> (<i>Nelumbo nucifera</i>)</p>  <p><b>Floating Leaves</b></p> <ul style="list-style-type: none"> <li>Complete circle</li> <li>Smooth edges</li> <li>One per stem</li> <li>Stem is in center</li> <li>Velvet texture</li> <li>Up to 3 feet wide</li> </ul> <p><b>Flowers (August)</b></p> <ul style="list-style-type: none"> <li>Colored pink</li> <li>About 18 petals</li> <li>Yellow cone center</li> </ul>	<p><b>American Lotus</b> (<i>Nelumbo lutea</i>)</p>  <p><b>Floating Leaves</b></p> <ul style="list-style-type: none"> <li>Complete circle</li> <li>Smooth edges</li> <li>One per stem</li> <li>Repels water</li> <li>1-2 feet wide</li> </ul> <p><b>Flowers (August)</b></p> <ul style="list-style-type: none"> <li>Colored white</li> <li>At least 20 petals</li> <li>Yellow cone center</li> </ul> <p>seed pods</p>

**Free-Floating Invasive Plants (NOT Rooted in Sediment)**

<p><b>Water Hyacinth</b> (<i>Eichhornia crassipes</i>)</p>  <p><b>Floating Leaves</b></p> <ul style="list-style-type: none"> <li>Pringle (TM) Shaped</li> <li>Smooth edges</li> <li>Glossy finish</li> <li>Wide, buoyant float at base of stem</li> </ul> <p><b>Flowers (July)</b></p> <ul style="list-style-type: none"> <li>Colored purple</li> <li>5 petals</li> <li>Spike with many flowers</li> </ul>	<p><b>Inflated Bladderwort</b> (<i>Utricularia inflata</i>)</p>  <p><b>Underwater Leaves</b></p> <ul style="list-style-type: none"> <li>Thread-like, finely branched</li> <li>Look like free-floating roots</li> <li>Have carnivorous bladders</li> </ul> <p><b>Flowers (May-June)</b></p> <ul style="list-style-type: none"> <li>Snapdragon shape</li> <li>Colored yellow, dime-size</li> <li>5-7 per tall stem held above water</li> <li>Stem sits atop snowflake-like float</li> </ul>
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**Underwater Invasive Invertebrates**

<p><b>Asian Clam</b> (<i>Corbicula fluminea</i>)</p>  <ul style="list-style-type: none"> <li>Colored tan-brown</li> <li>Tiny: only up to 1.5 inches</li> <li>Self-fertilize, multiply exponentially</li> <li>Larvae are microscopic and free-swimming</li> </ul>	<p><b>Mystery Snail</b> (<i>Cipangopaludina chinensis</i>)</p>  <ul style="list-style-type: none"> <li>Colored brown - black</li> <li>Large: up to 2 inches</li> <li>Can spread parasites</li> <li>Can reproduce quickly</li> </ul>
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**Aquatic Invasive Species Found in RI Lakes**  
 January 2023

**Underwater, Rooted Plants with Thin, Feather-like Leaves**

<p><b>Variable Milfoil</b> (<i>Myriophyllum heterophyllum</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>Densely packed along stem</li> <li>4-6 leaves attach to stem at same spot ("whorl")</li> <li>Thick, red stem</li> </ul> <p><b>Emergent Flower Spike</b></p> <ul style="list-style-type: none"> <li>Bracts are blade shaped</li> <li>Leaf-bracts are jagged</li> <li>White, miniscule flowers</li> <li>Stick 2-4 inches above water</li> </ul>	<p><b>Eurasian Milfoil</b> (<i>Myriophyllum spicatum</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>Openly spaced along stem</li> <li>4 leaves attach to stem at same spot in "whorl"</li> <li>Filmy, spaghetti-like stem</li> </ul> <p><b>Emergent Flower Spike</b></p> <ul style="list-style-type: none"> <li>Spike is 1-2 inches long</li> <li>Many tiny flowers, 1-3 mm</li> <li>Flowers colored pink-purple</li> <li>Stick 1-2 inches above water</li> </ul>
<p><b>Parrot feather</b> (<i>Myriophyllum aquaticum</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>Muted pea green</li> <li>Rubbery texture</li> <li>Whorls of 4-6 leaves</li> <li>Leaf looks like a feather</li> <li>Maintains shape out of water</li> <li>Grows above the water surface</li> </ul>	<p><b>Fanwort</b> (<i>Cabomba caroliniana</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>Bright green</li> <li>Fan shape</li> <li>Pairs of 2 leaves</li> </ul> <p><b>Flowers (July-Sept)</b></p> <ul style="list-style-type: none"> <li>6 petals</li> <li>Colored white</li> <li>Size of pencil eraser</li> <li>Yellow center</li> <li>Stick out ~1 inch above water</li> </ul>

**Underwater, Rooted Plants with Whole, Blade-like Leaves**

<p><b>Brazilian Elodea</b> (<i>Egeria densa</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>Leaves 1-3 cm long</li> <li>Linear, blade shape</li> <li>Jagged edges</li> <li>Densely packed whorls along stem</li> <li>Whorls (4-6 leaves)</li> </ul> <p><b>Flowers</b></p> <ul style="list-style-type: none"> <li>Colored white</li> <li>5 petals</li> <li>Rare to find</li> <li>Submersed</li> </ul>	<p><b>Mudmat</b> (<i>Glossostigma cleistanthum</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>0.5-1.5 inches long</li> <li>2 leaves opposite on stem</li> <li>Look like rabbit ears</li> <li>Can be submersed or terrestrial</li> </ul> <p><b>Flowers</b></p> <ul style="list-style-type: none"> <li>Colored white</li> <li>5 petals</li> <li>Rare to find</li> <li>Submersed</li> </ul>
<p><b>Spiny Naiad</b> (<i>Najas minor</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>1-1.5 inches long</li> <li>Jagged edges, stiff</li> <li>Leaves opposite</li> <li>Maintains shape out of water</li> <li>Stems branch profusely at top</li> <li>Leaves arched back</li> </ul>	<p><b>Curly-leaf Pondweed</b> (<i>Potamogeton crispus</i>)</p>  <p><b>Leaves</b></p> <ul style="list-style-type: none"> <li>1.5 - 2 inches long</li> <li>Leaves have wavy edges like bacon</li> <li>Veins have stained glass-like appearance</li> <li>Alternate attachment of leaves along stem</li> <li>Reddish tinge</li> </ul>



# RIDEM Survey Results



<http://www.dem.ri.gov/programs/benviron/water/quality/surfwaq/aismaps/tranat.pdf>



<http://www.dem.ri.gov/programs/water/quality/surface-water/aisplant.php>

## Overview and Contents

Between 2007 and 2021 the Rhode Island Department of Environmental Management, Office of Water Resources (OWR) has been documenting the presence of aquatic invasive species (AIS) in lakes, ponds and rivers, statewide. RIDEM OWR monitors approximately 20 lakes or ponds during the summer by visually surveying for invasives, and as resources allow, may visit additional ponds in response to public concerns. To date, RIDEM has visited 167 lakes or ponds, and visited hundreds of sites on streams.

As of November 2021, at least one invasive species was documented by RIDEM staff at 109 lakes or ponds (65% of the visited locations) in addition to invasives found at sites along 27 distinct rivers. A map of this data and list of each location by town, with the invasives species that were identified can be downloaded here: <http://www.dem.ri.gov/programs/benviron/water/wetlands/pdfs/invasive.pdf>. Provided herein are maps showing the species-specific statewide distribution of 16 different invasive species (see page number below) accompanied by a list of locations where the species was documented (plants in order below from least to most common).

### Number of Documented Freshwaters with Invasive Species (as of October 22, 2021) (listed most common to least common)

Invasive Species	Scientific Name	Rivers	Lakes/Ponds	Total	Page Number
1. Variable milfoil	<i>Myriophyllum heterophyllum</i>	19	69	88	(1)
2. Fanwort	<i>Cabomba caroliniana</i>	16	61	77	(8)
3. Curly-leaf pondweed	<i>Potamogeton crispus</i>	7	14	21	(14)
4. Water chestnut	<i>Trapa natans</i>	3	16	19	(17)
5. Eurasian milfoil	<i>Myriophyllum spicatum</i>	2	12	14	(20)
6. Mudmat	<i>Glossostigma cleistanthum</i>	1	12	13	(23)
7. Spiny naiad	<i>Najas minor</i>	0	11	11	(25)
8. Inflated bladderwort	<i>Utricularia inflata</i>	0	9	9	(27)
9. Water hyacinth	<i>Eichhornia crassipes</i>	1	4	5	(29)
10. Brazilian elodea	<i>Egeria densa</i>	0	5	5	(31)
11. Yellow floating heart	<i>Nymphoides peltata</i>	0	3	3	(33)
12. American lotus	<i>Nelumbo lutea</i>	0	2	2	(35)
13. Parrot feather	<i>Myriophyllum aquaticum</i>	0	1	1	(37)
14. Sacred lotus	<i>Nelumbo nucifera</i>	0	1	1	(39)
15. Chinese mystery snail	<i>Ciparigopadula chinensis</i>	3	23	26	(41)
16. Asian clam	<i>Corbicula fluminea</i>	8	17	25	(44)
<b>Total waterbodies with at least one invasive*</b>		<b>27</b>	<b>108</b>		

\*some waterbodies have more than one invasive species; therefore, total reflects distinct waterbodies

<http://www.dem.ri.gov/programs/benviron/water/quality/surfwaq/pdfs/aisridist.pdf>

# RIDEM Survey Results – Water Chestnut



Town	Waterbody Name
<u>RIVERS</u>	
1	Blackstone River (Seg A)
2	Ten Mile River & Tribs (Seg A)
3	Ten Mile River & Tribs (Seg B)
<u>Central Falls</u>	
4	Valley Falls Pond
<u>Cumberland</u>	
5	Carls Pond
<u>East Providence</u>	
6	Central Pond
7	Lakeside Cemetery Pond
8	Omega Pond
9	Turner Reservoir
<u>Foster</u>	
10	Porters Pond
<u>Hopkinton</u>	
11	Solitude Springs Farm Ponds
<u>Lincoln</u>	
12	Barney Pond
13	Olney Pond
14	Spectacle Pond (Lincoln)

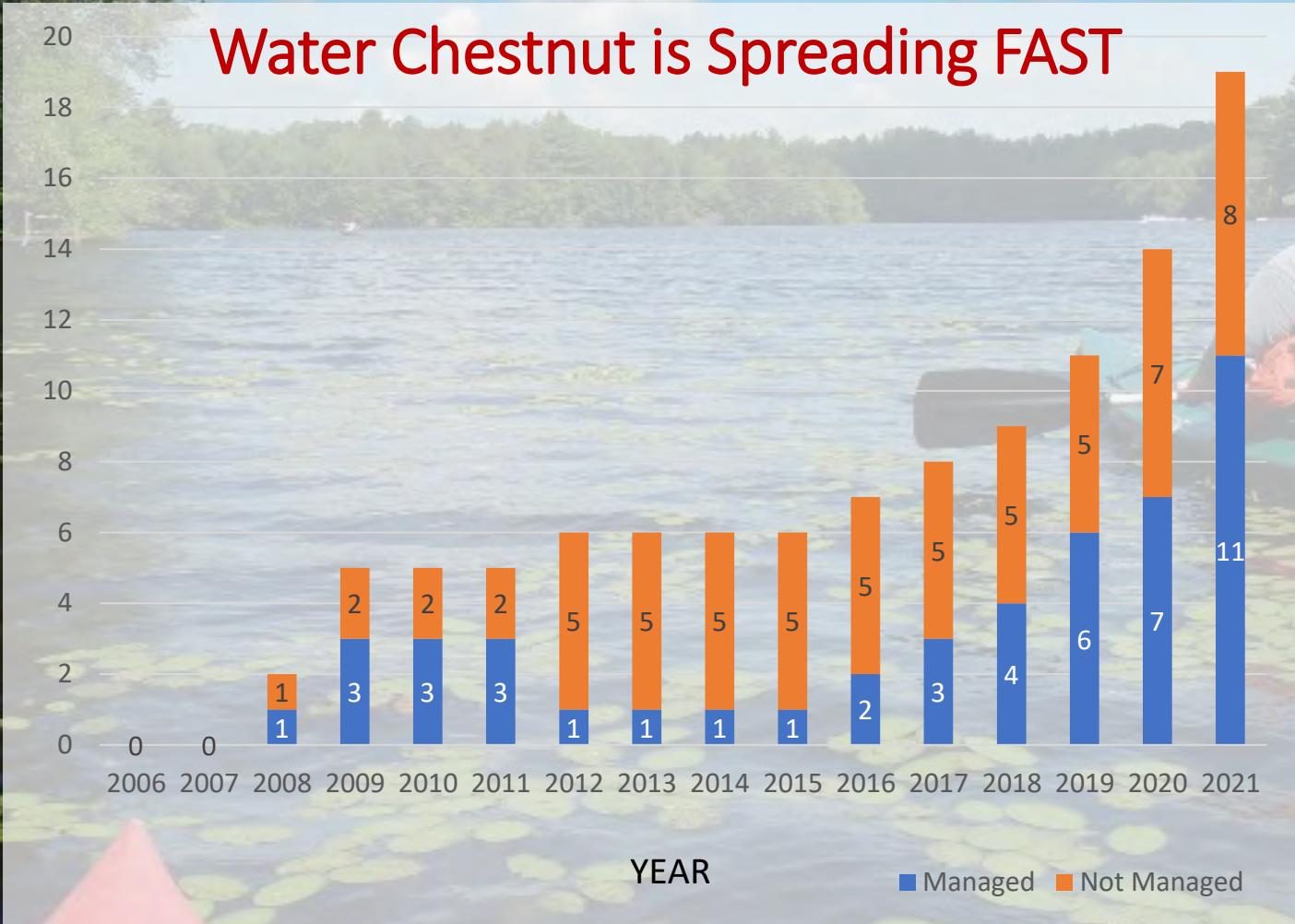
Town	Waterbody Name
<u>North Kingstown</u>	
15	Belleville Ponds
<u>Providence</u>	
16	Roger Williams Park Ponds
<u>West Greenwich</u>	
17	Reynolds Pond
<u>Westerly</u>	
18	Chapman Pond
<u>Woonsocket</u>	
19	Sylvestre Pond



# RIDEM Surveys Lakes for Invasive Plants

## Water Chestnut is Spreading FAST

# Sites  
In RI



# Agenda



1. The Warning: Why is water chestnut a problem?
2. What's the deal with Water Chestnut?
3. How to manage it? Monitoring, pulling, controlling
4. Community/Volunteer Pulling Events
5. Questions/Comments





# 3 Problems with Invasive Plants

1. Disrupt ecological balance in a lake or pond:



# 3 Problems with Invasive Plants

## 1. Disrupt ecological balance in a lake or pond:



Often have fewer predators in new environments



High reproduction and growth rates



Adapt well to new conditions



Exceptional competitors replace native plants



Change in habitat structure degrades conditions



Can impact fish spawning, foraging and nesting habitat



Mass plants decompose, reducing oxygen/water quality

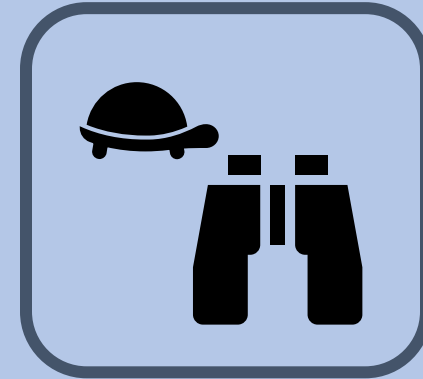
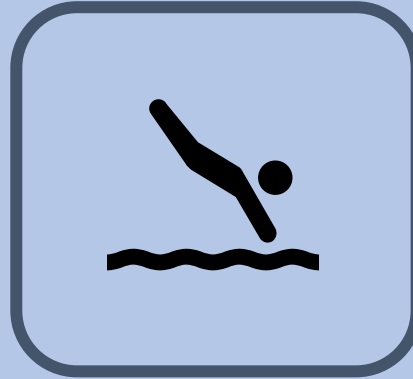
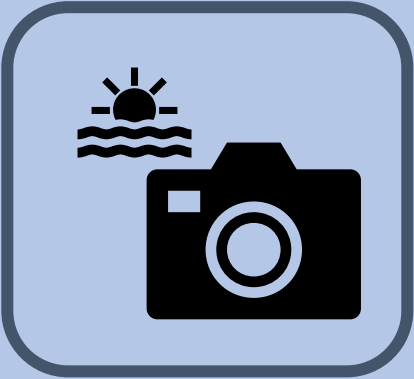
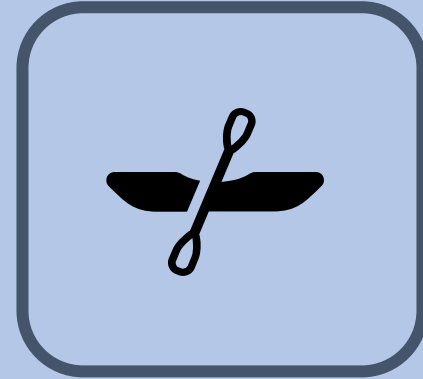
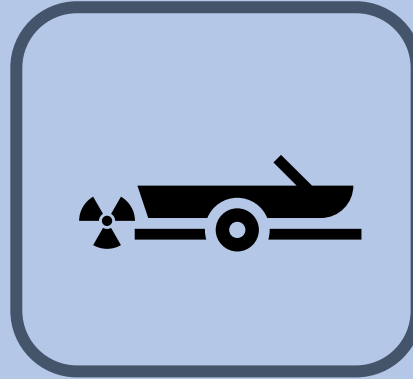
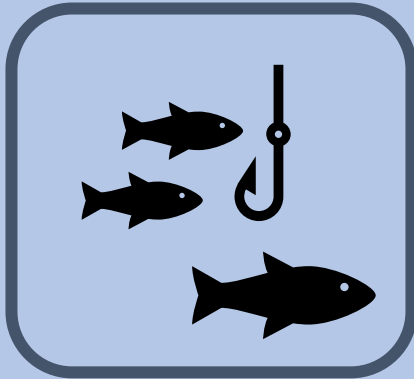


Can have impacts up the food chain










# 3 Problems with Invasive Plants

## 2. Impede Recreational Opportunities



# 3 Problems with Invasive Plants

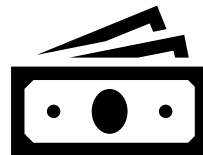
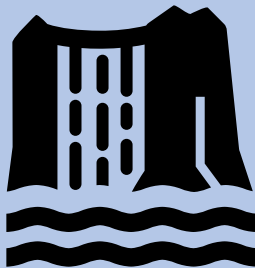
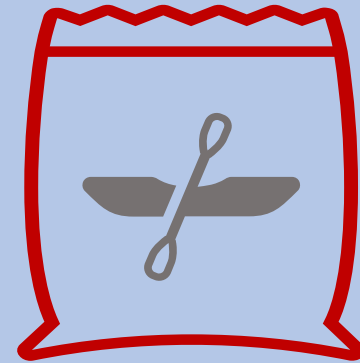
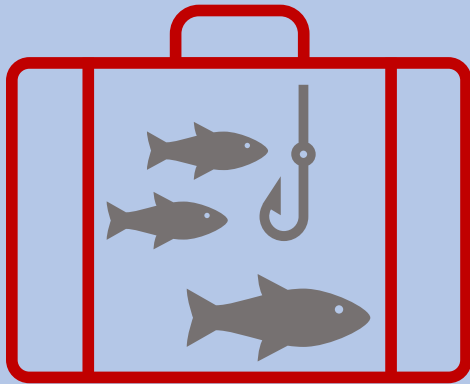
## 2. Impede Recreational Opportunities

-   Reduce serene, picturesque views and enjoyment
-   Become entangled around boat motor propellers
-   Difficult to paddle through and navigate / obstruct access
-   Unpleasant to swim in
-   Snag fishing lines
-   Ecological changes may impact angling success
-   Wildlife viewing may be reduced with changes in habitat



# 3 Problems with Invasive Plants

## 3. Cause economic losses



# 3 Problems with Invasives

## 3. Cause economic losses



Reduced angling and paddling trips (spending)



Threaten tourism/recreational business income



May devalue waterfront property



Potential to reduce tax revenues



Outlet flow / hydro clogged; Shellfish can damage infrastructure



Reduce flood storage and resilience



Require substantial funds to manage



# Agenda



1. The Warning: Why is water chestnut a problem?
2. What's the deal with Water Chestnut?
3. How to manage it? Monitoring, pulling, controlling
4. Community/Volunteer Pulling Events
5. Questions/Comments



# Water Chestnuts Multiply Annually via Heavy Seed Production

1 germinated seed (Spring) → can produce 10 to 15 rosettes



1 Seed





## Water Chestnuts Multiply Annually via Heavy Seed Production

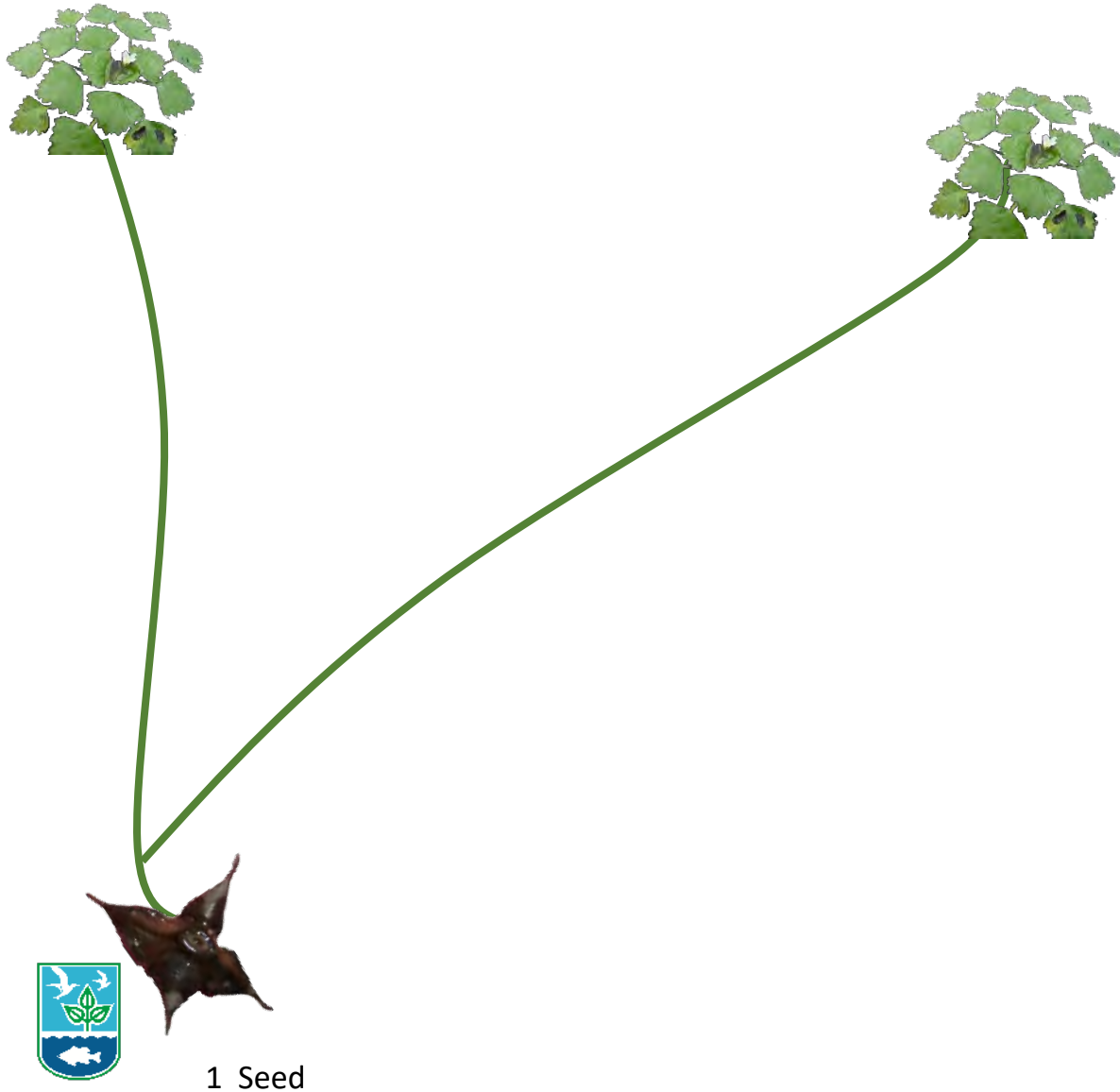
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1 Seed

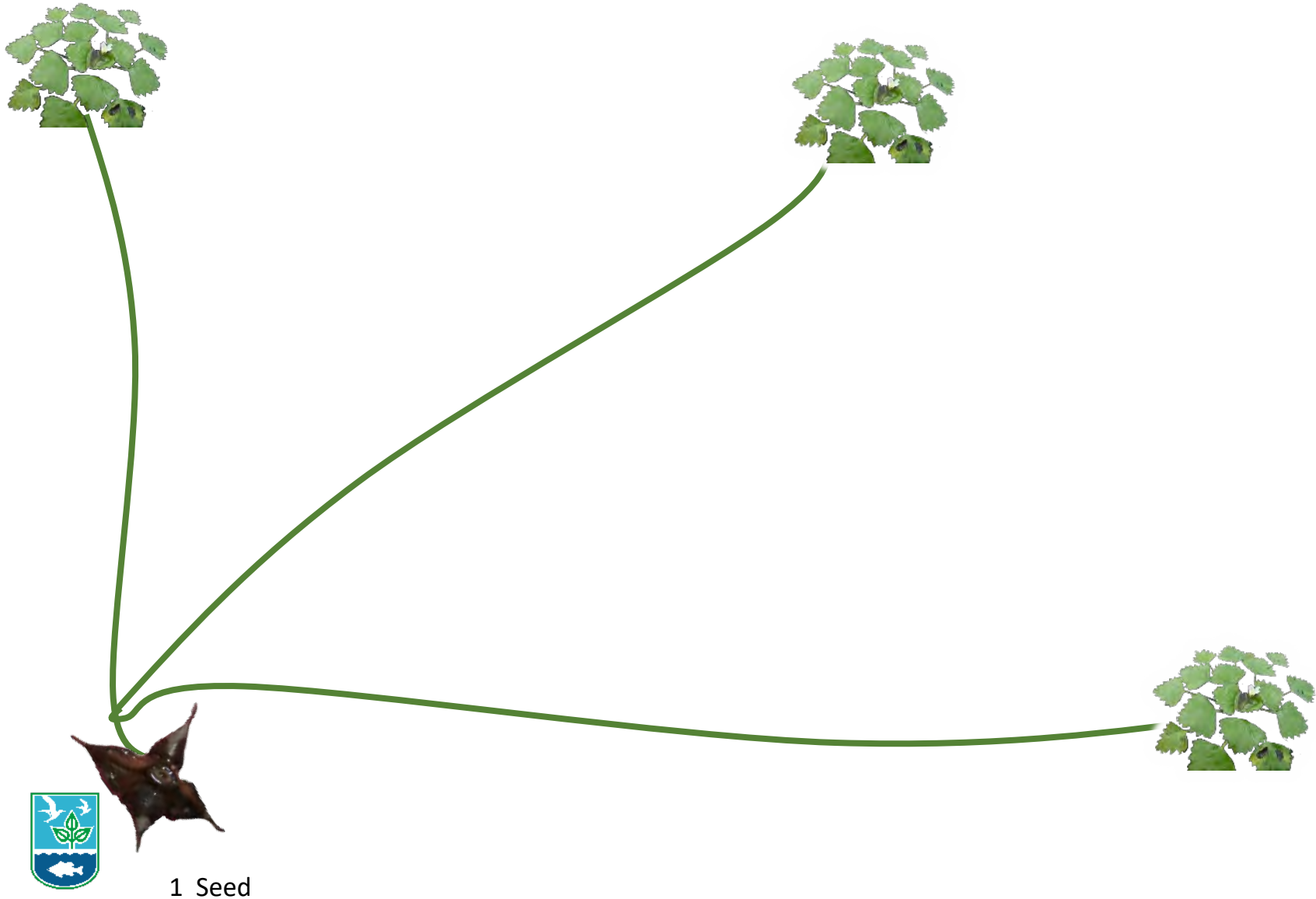
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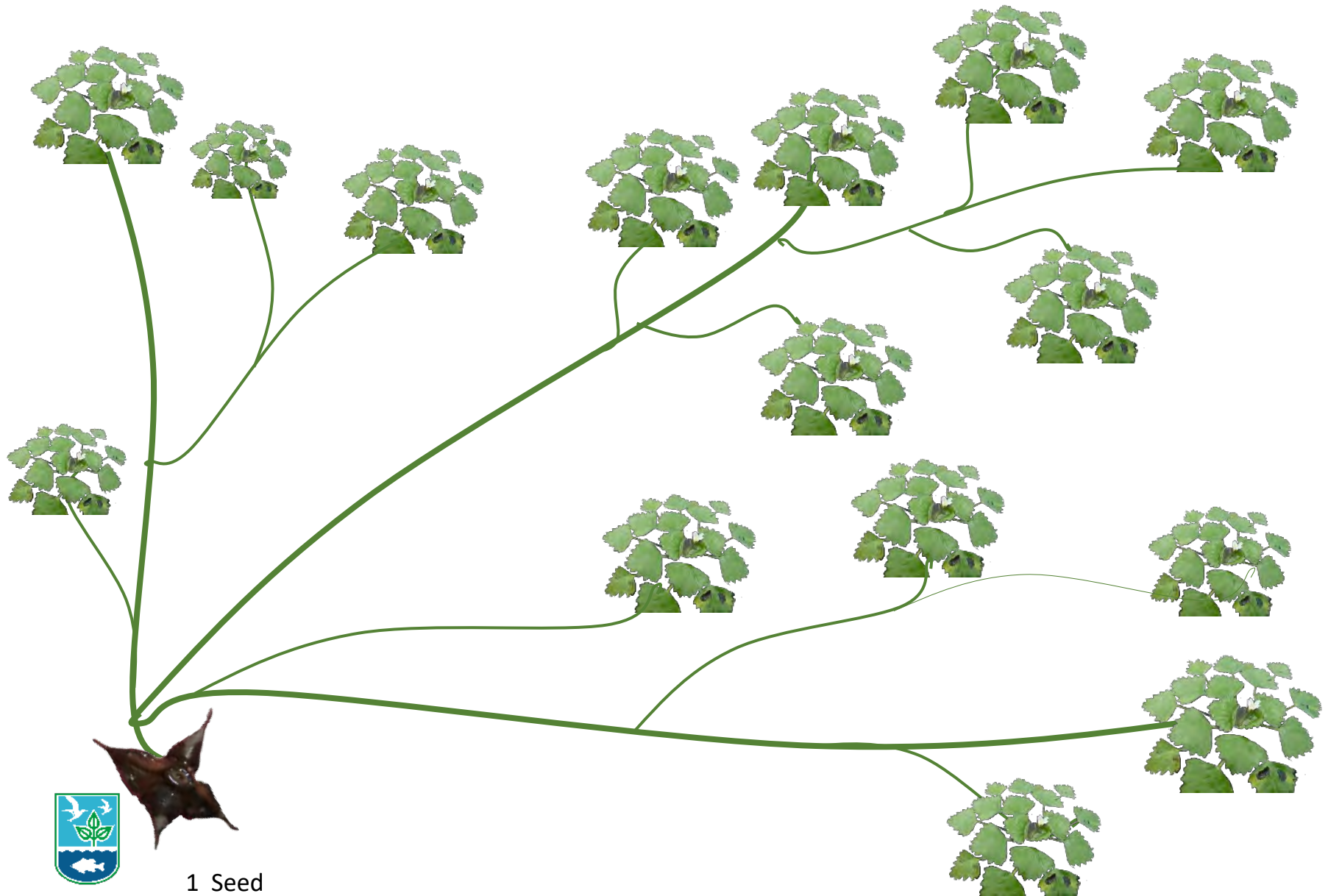
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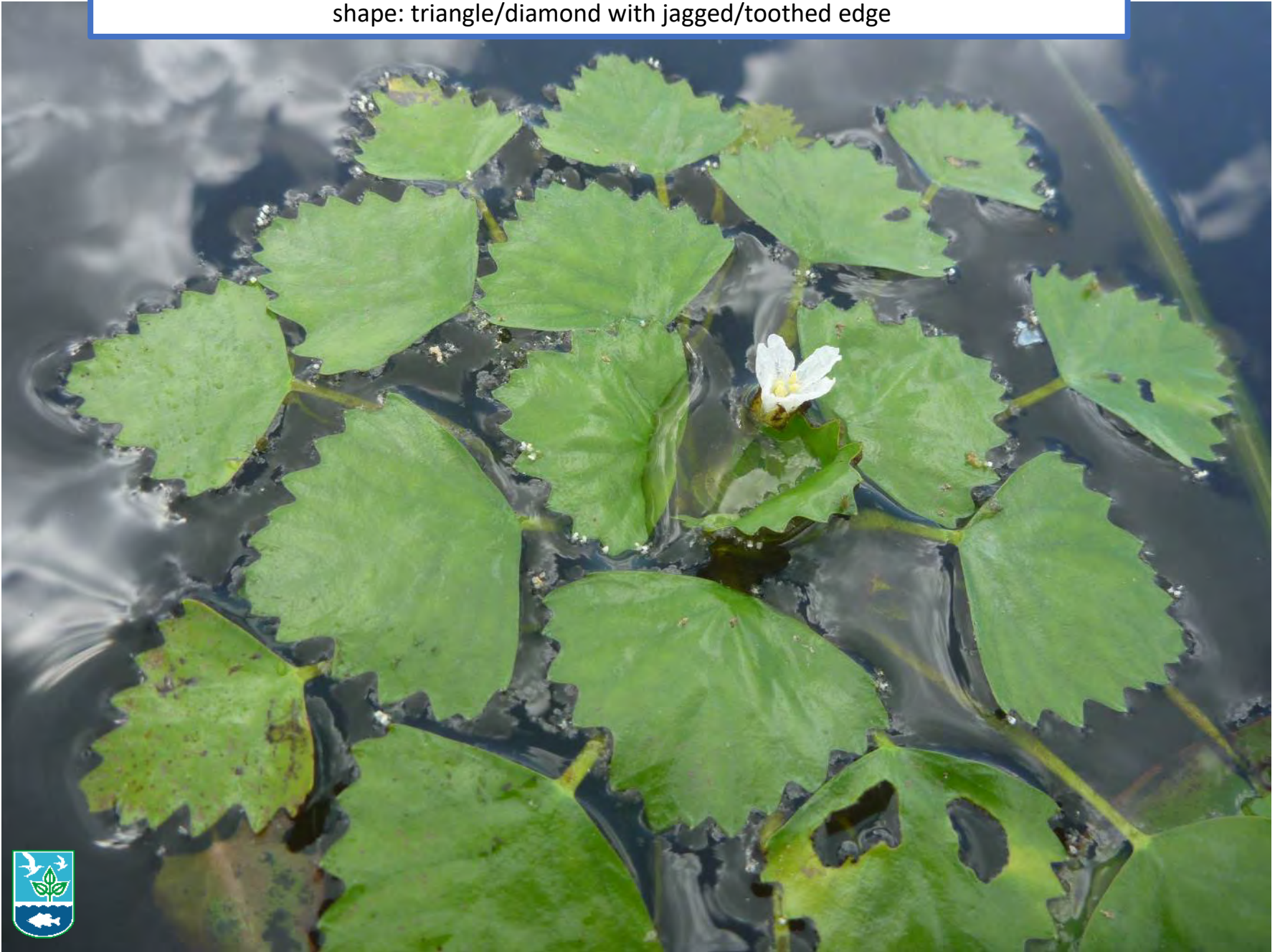


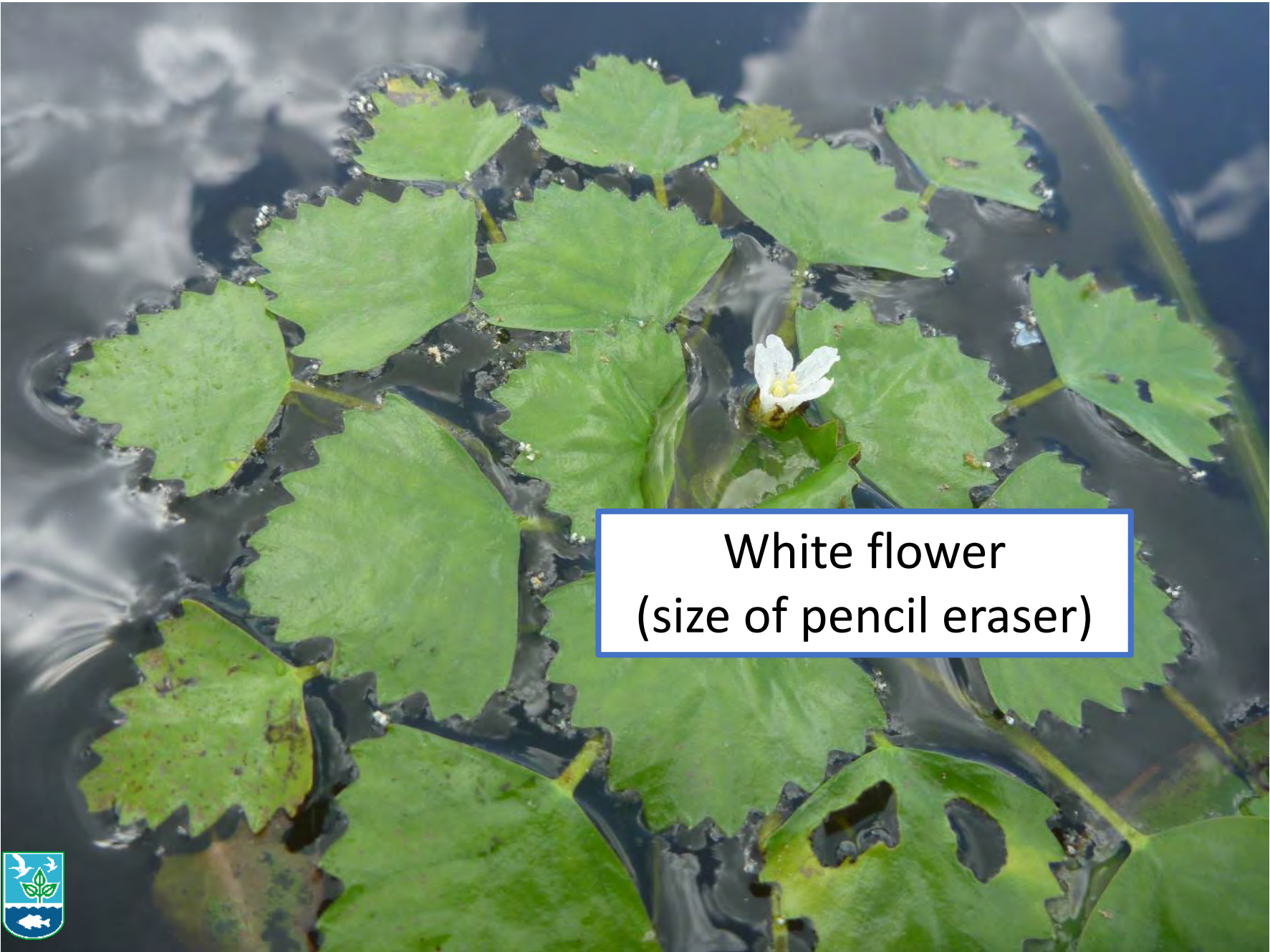
## Early June: Water Chestnut Begins Emerging



Leaves radiate from central point creating a rosette (one plant)

Glossy leaves  
shape: triangle/diamond with jagged/toothed edge





White flower  
(size of pencil eraser)



Leaf stems have air filled bladders to keep afloat





Flower buds  
(underneath rosette)



Mid-July: Seeds Begin Forming

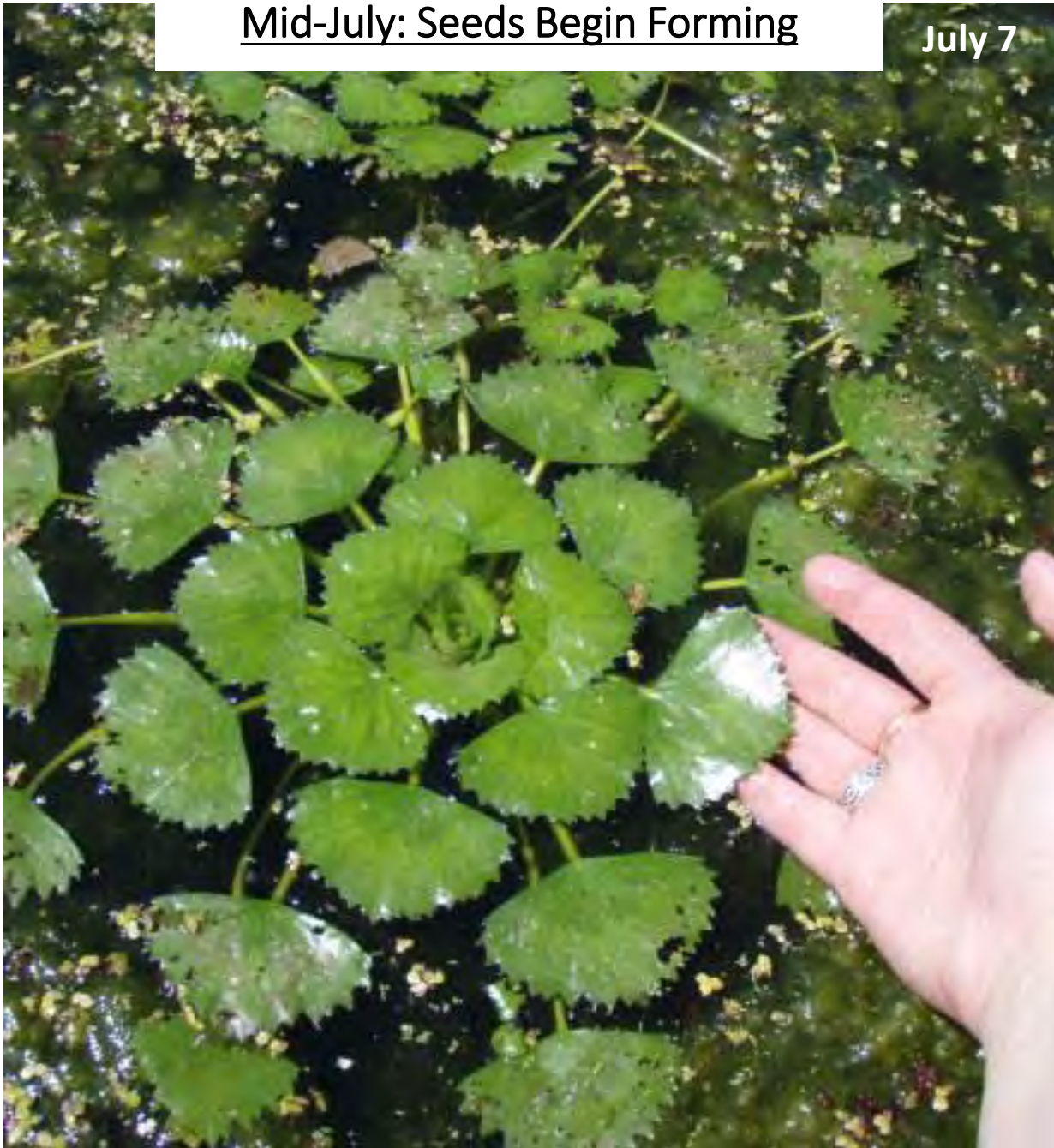


July 14

Chapman Pond, Westerly

Mid-July: Seeds Begin Forming

July 7



Rosette maintains shape out of water



Rosette can be 1-2 feet across



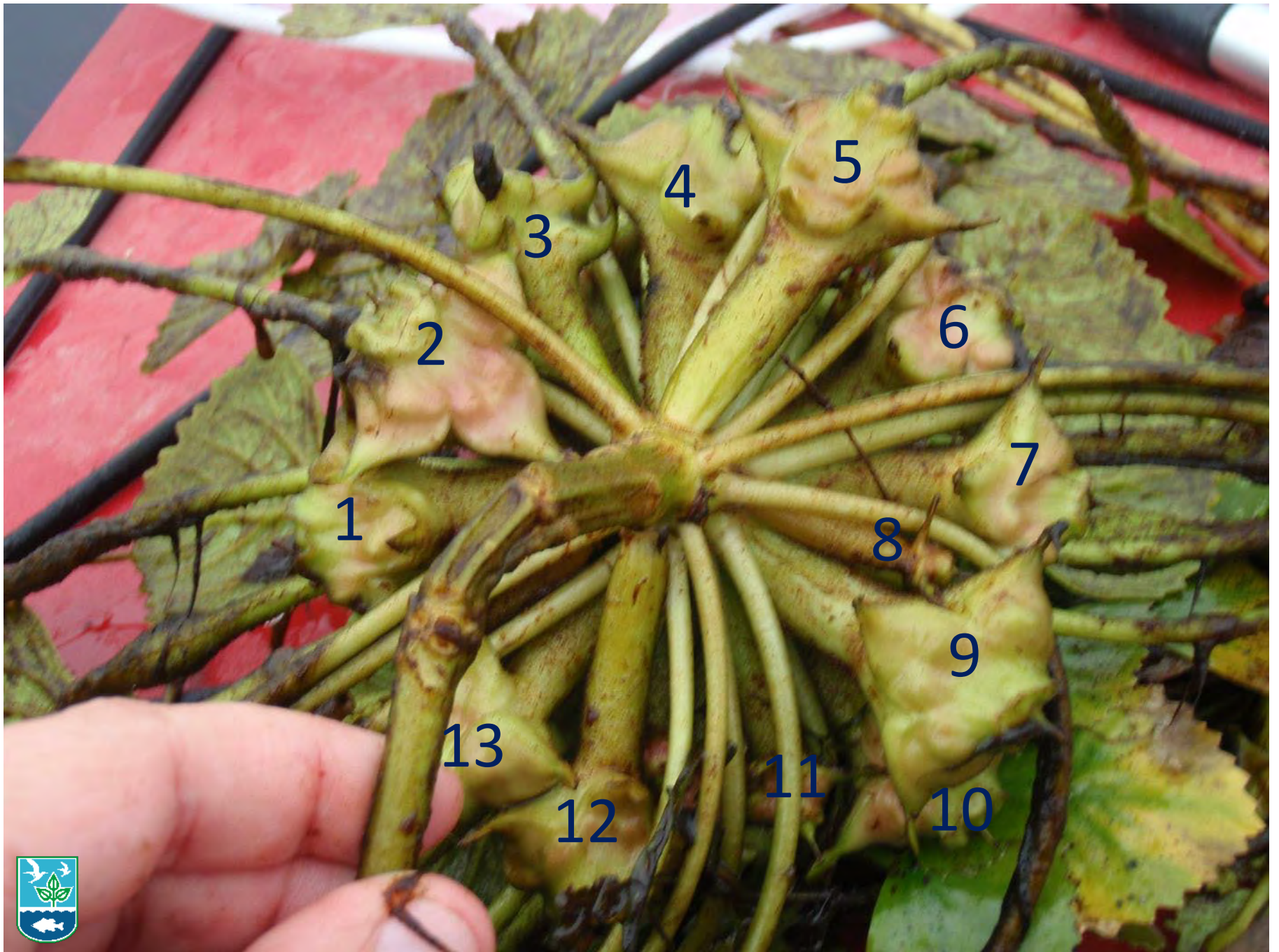
Chapman Pond, Westerly

August 10

End July - August: Seeds Develop









October



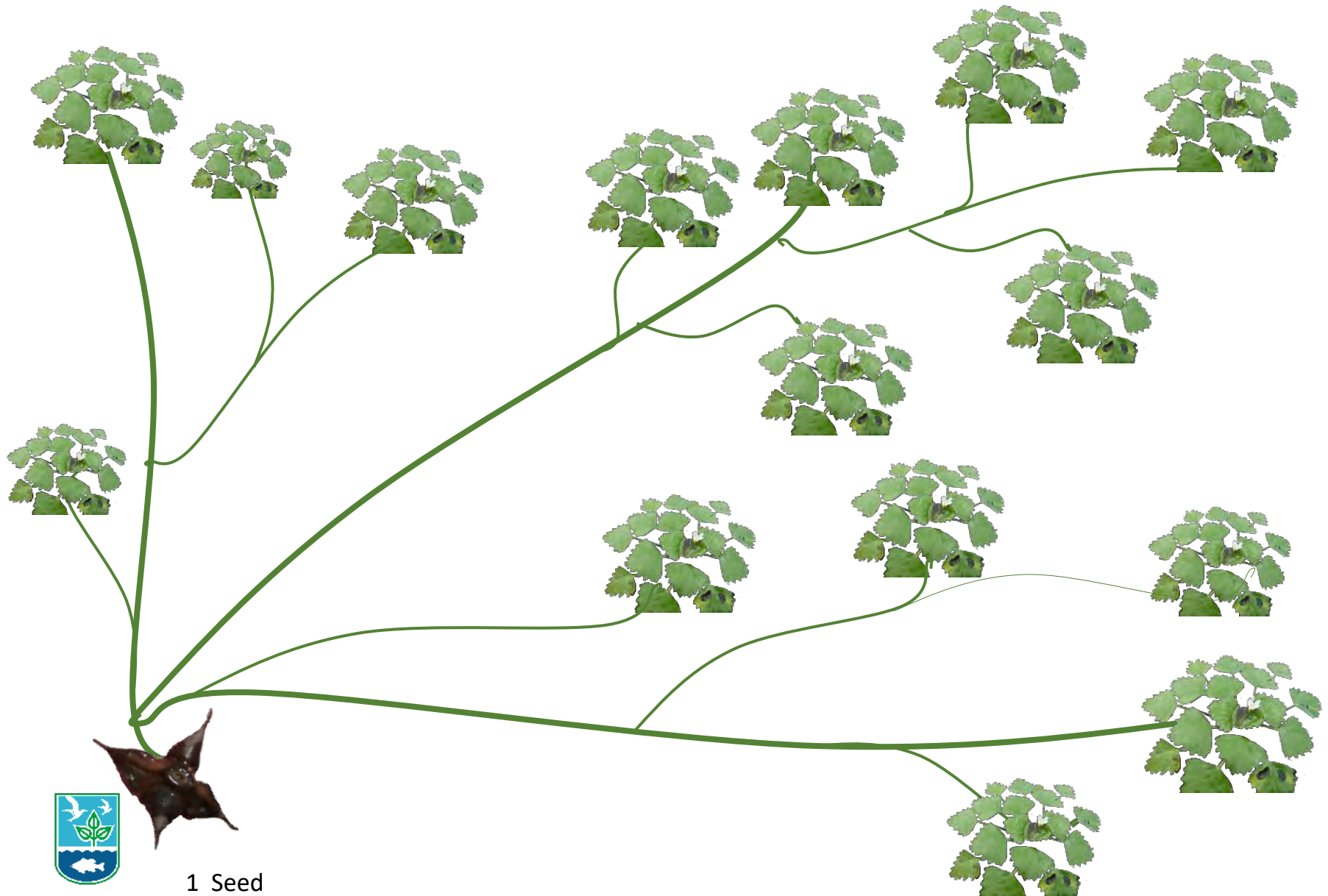
rosettes → can produce 10-20 seeds (Fall)

Scars where nuts have  
fallen off (10)



# Water Chestnuts Multiply Annually via Heavy Seed Production

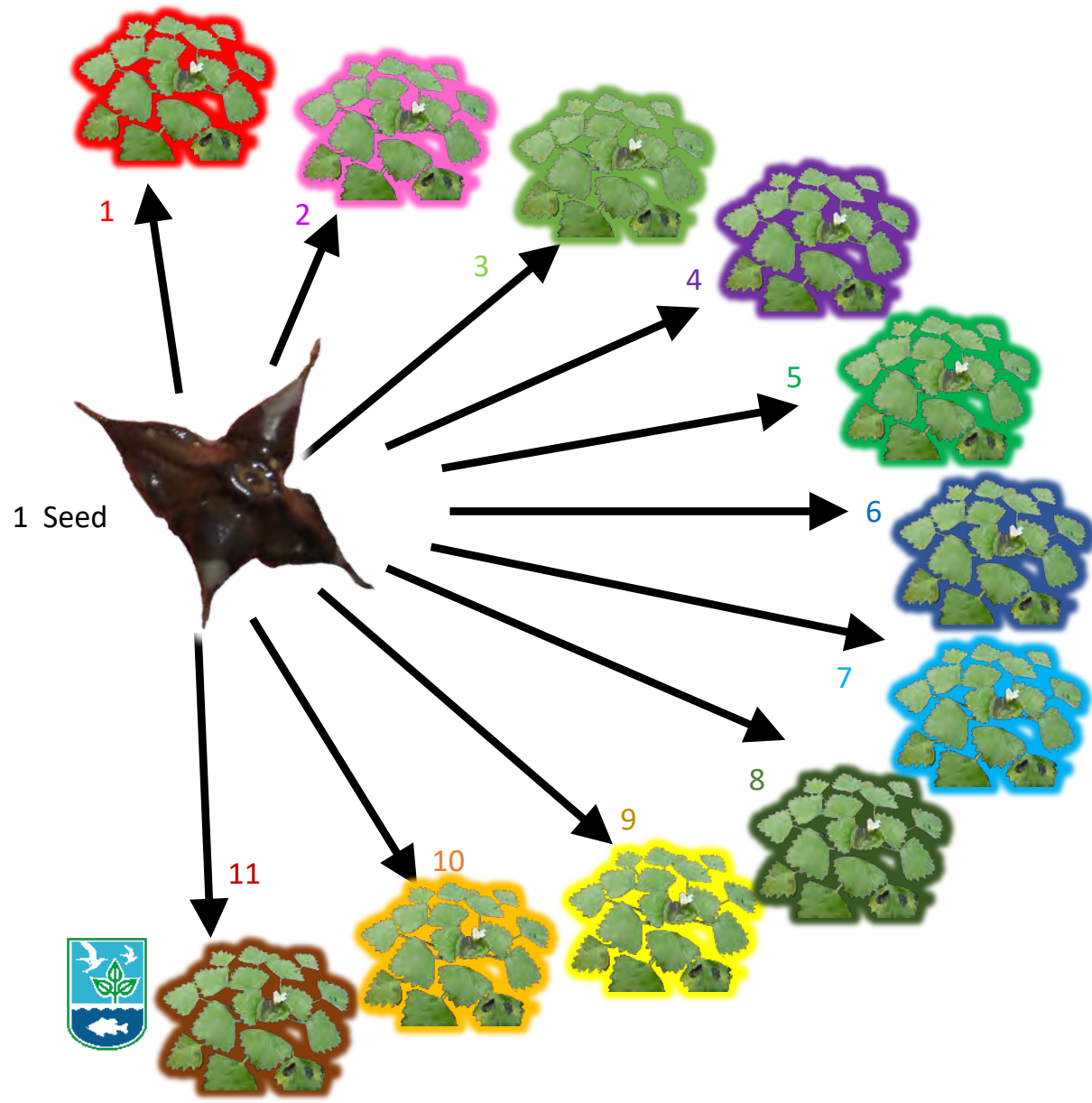
1 germinated seed (Spring) → can produce 10 to 15 rosettes



1 Seed

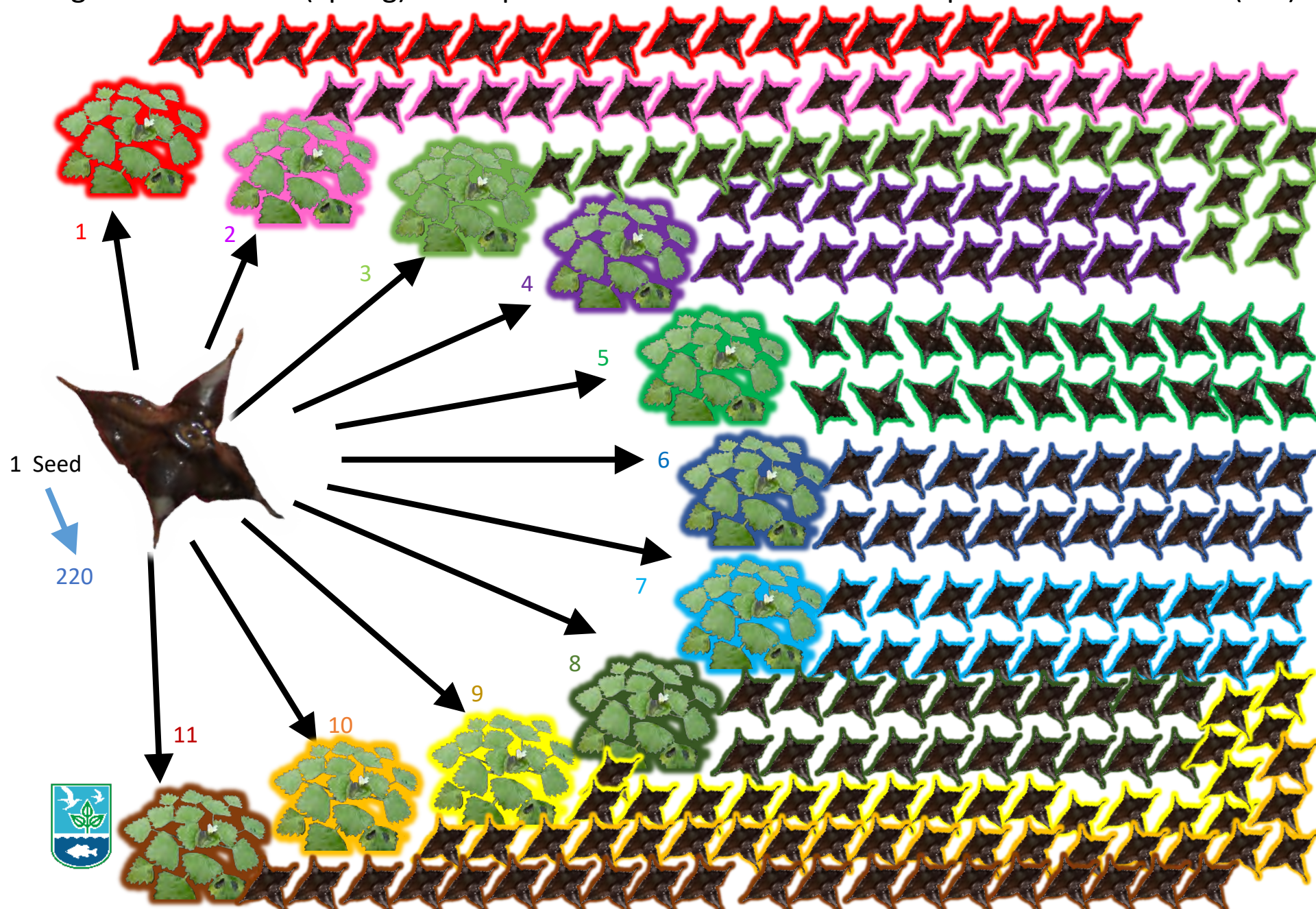
# Water Chestnuts Multiply Annually via Heavy Seed Production

1 germinated seed (Spring) → can produce 10 to 15 rosettes → can produce 10-20 seeds (Fall)



# Water Chestnuts Multiply Annually via Heavy Seed Production

1 germinated seed (Spring) → can produce 10 to 15 rosettes → can produce 10-20 seeds (Fall)



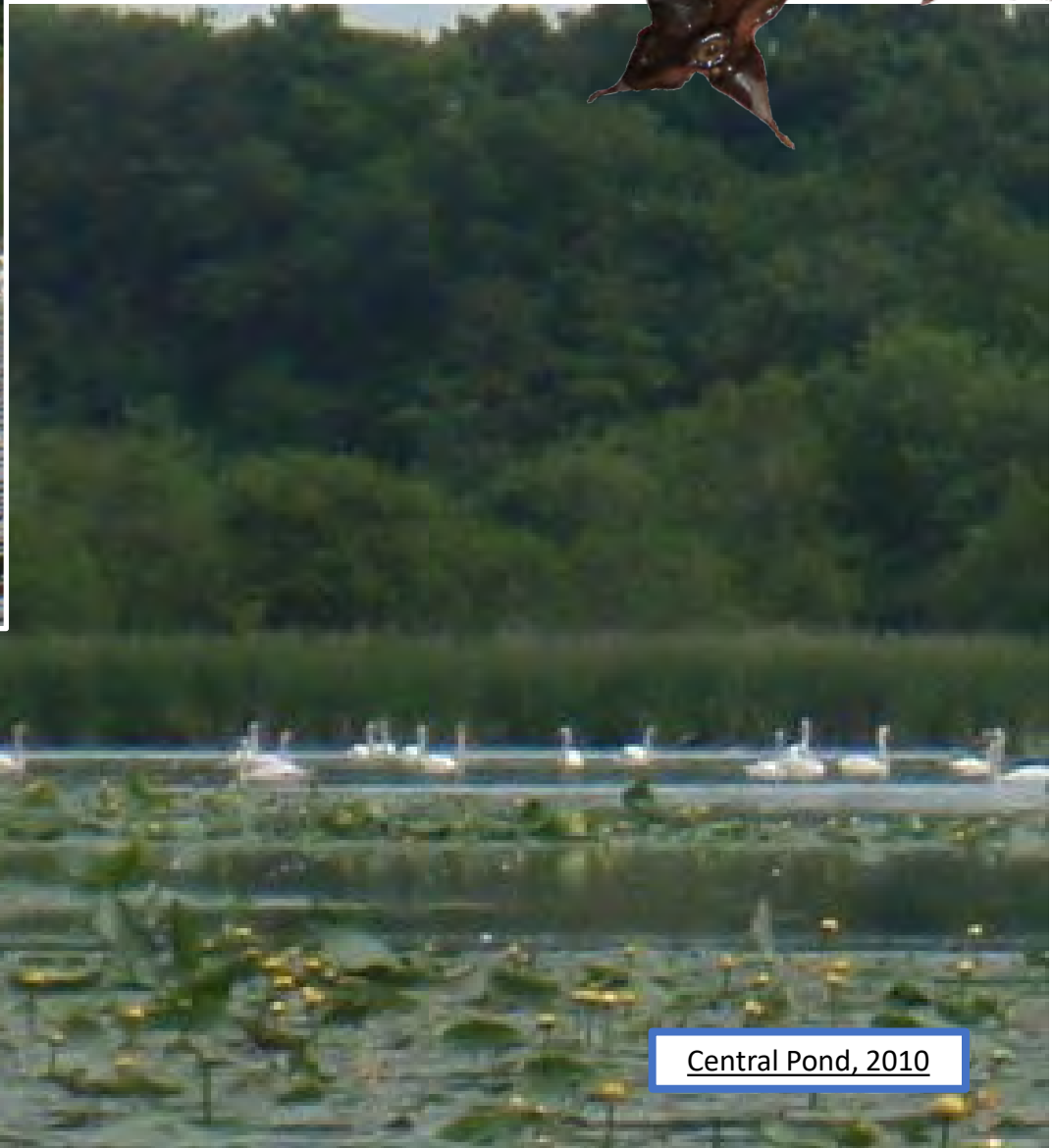


Dodgeville Pond, Attleboro, MA  
Zoomed (156 seeds)

**Shoreline of seeds: dormant up to 12 Years**

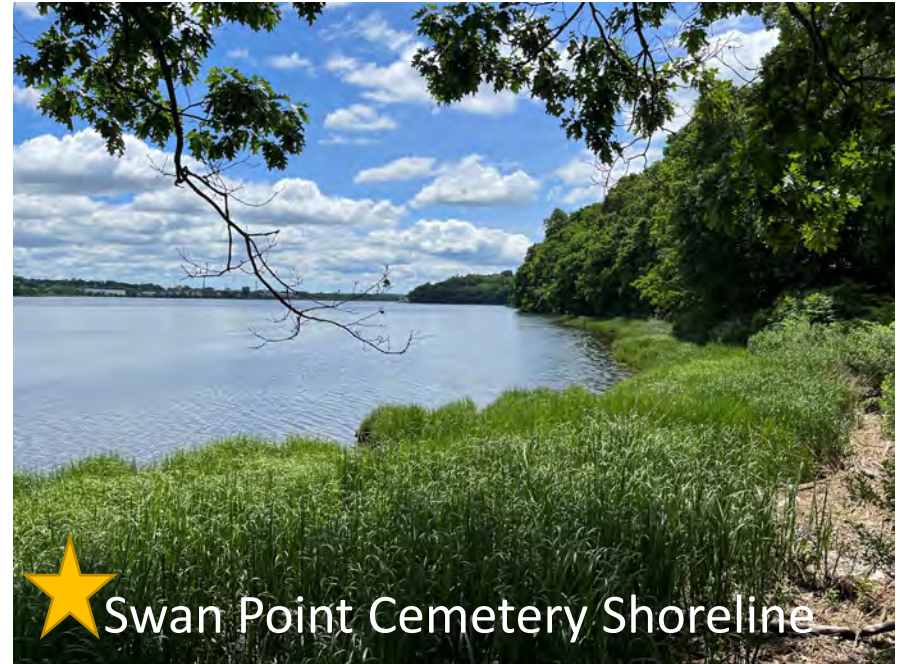


Water fowl and wildlife move seeds around the region...



Central Pond, 2010

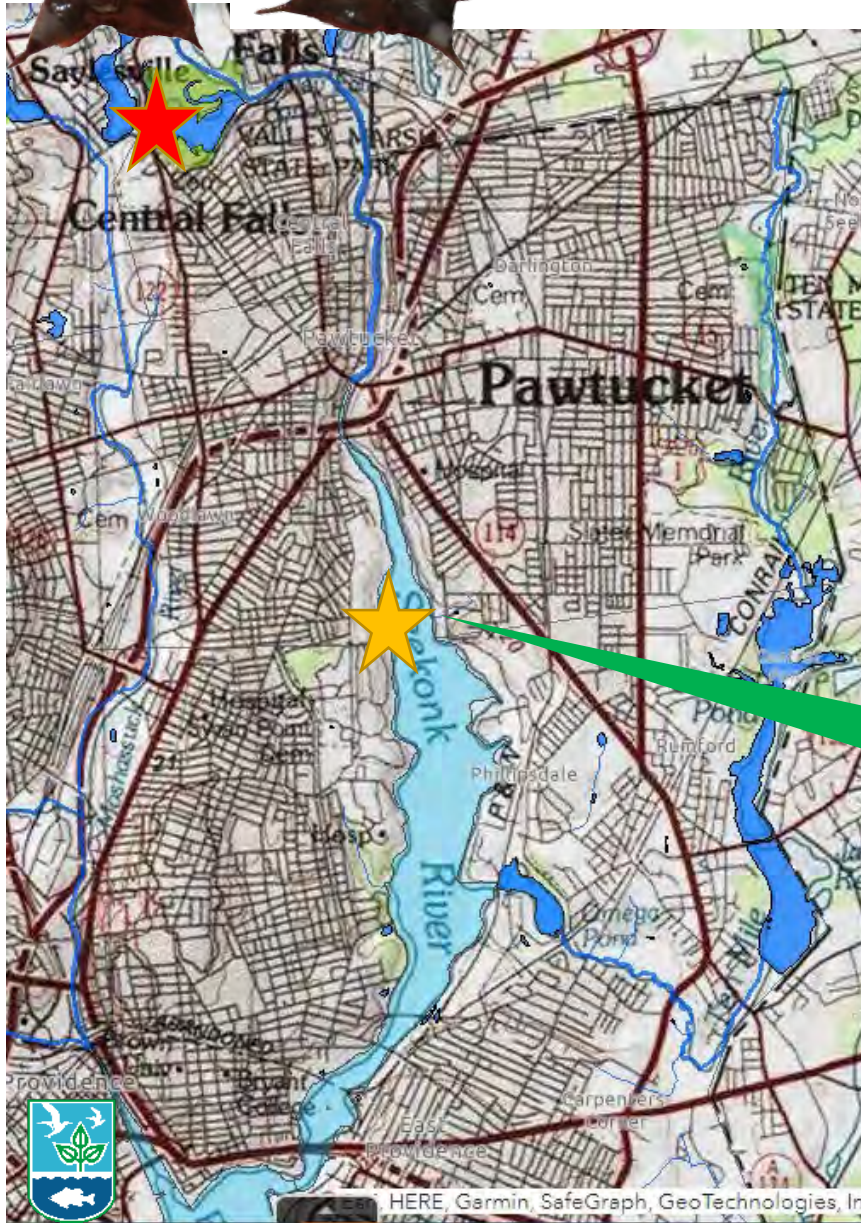
Seeds also float downstream



★ Swan Point Cemetery Shoreline



## Seeds also float downstream



WPRI.COM/2

NEWS ▾

WEATHER ▾

POLITICS ▾

WATCH ▾

TARGET 12 ▾

ENVIRONMENT

## Many more than '7 swans a swimming' seen in the Seekonk River this spring

by: T.J. Del Santo

Posted: Apr 12, 2021 / 03:29 PM EDT

Updated: Apr 13, 2021 / 10:44 AM EDT

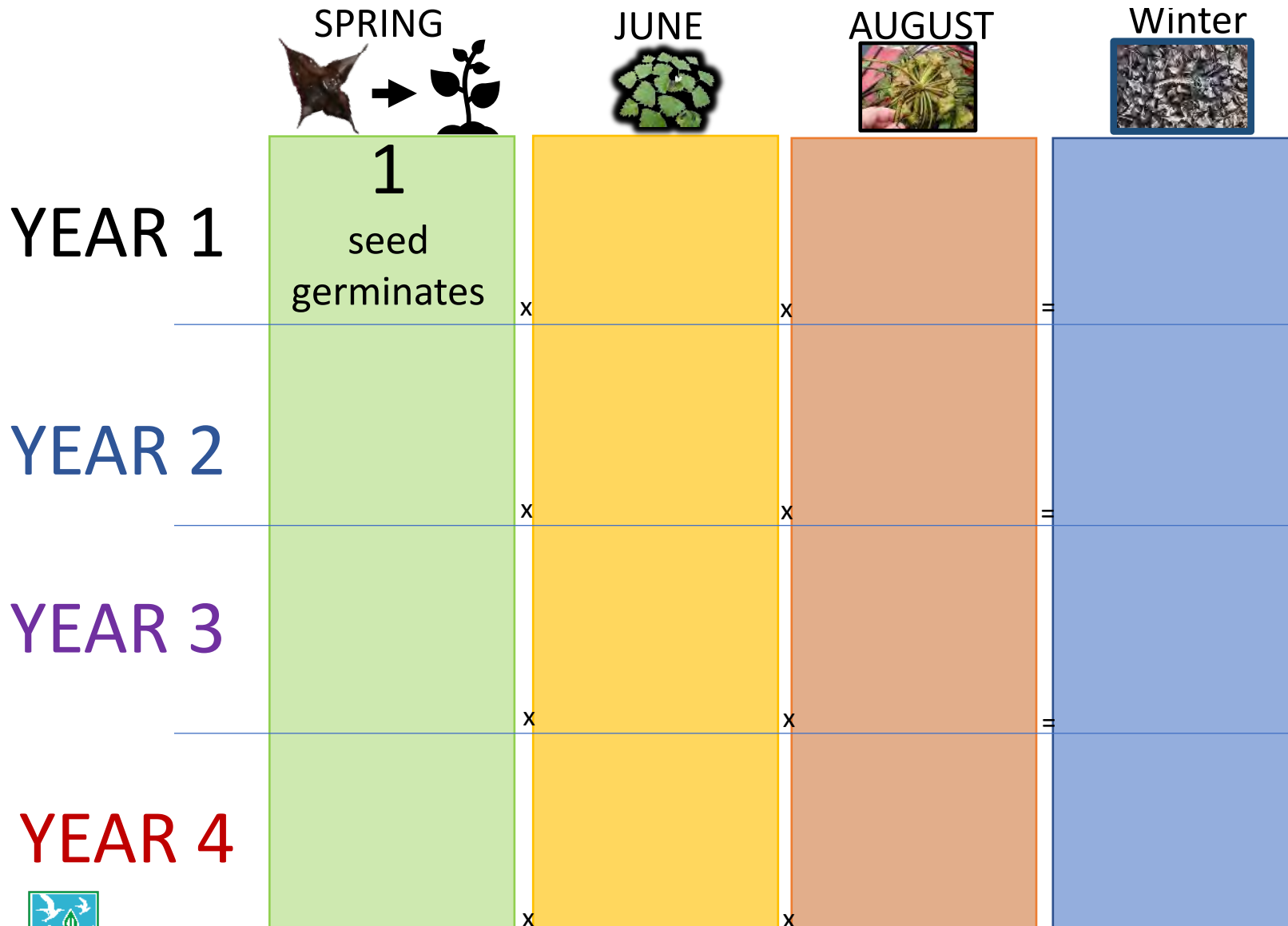
SHARE



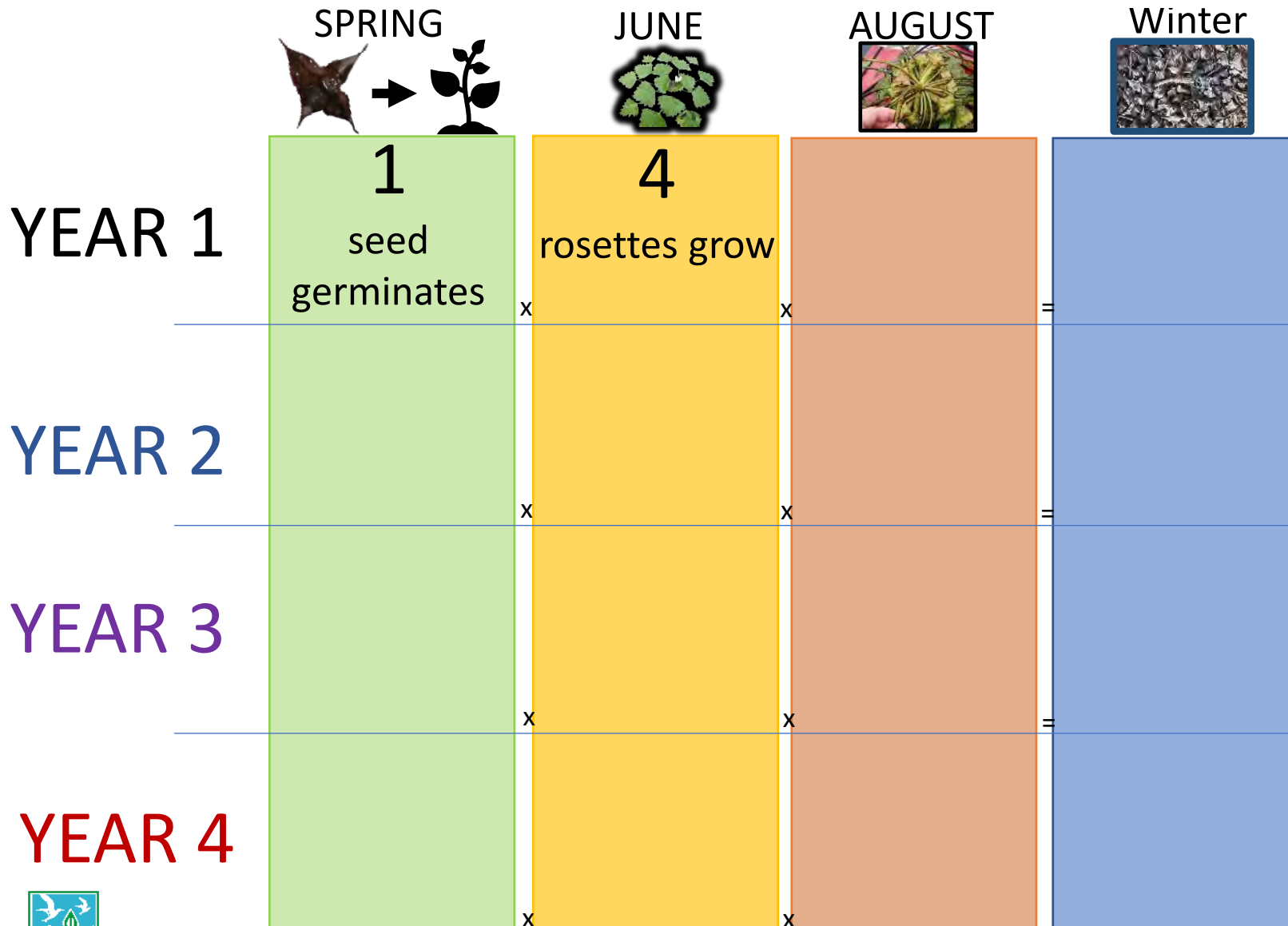
PROVIDENCE, R.I. (WPRI) — A large collection of swans in a river along the Provi caught the attention of passersby.

Dozens upon dozens of swans have been seen swimming in the waters off River weeks.

# Water Chestnuts Multiply Exponentially in Just a Few Years



# Water Chestnuts Multiply Exponentially in Just a Few Years



# Water Chestnuts Multiply Exponentially in Just a Few Years

SPRING



JUNE



AUGUST



Winter



YEAR 1

1  
seed  
germinates

x

4  
rosettes grow

x

15  
seeds develop  
per rosette

=

YEAR 2

x

x

=

YEAR 3

x

x

=

YEAR 4

x

x



# Water Chestnuts Multiply Exponentially in Just a Few Years

SPRING



JUNE



AUGUST



Winter



YEAR 1

1  
seed  
germinates

x

4  
rosettes grow

x

15  
seeds develop  
per rosette

=

60  
Seeds  
overwinter

YEAR 2

x

x

=

YEAR 3

x

x

=

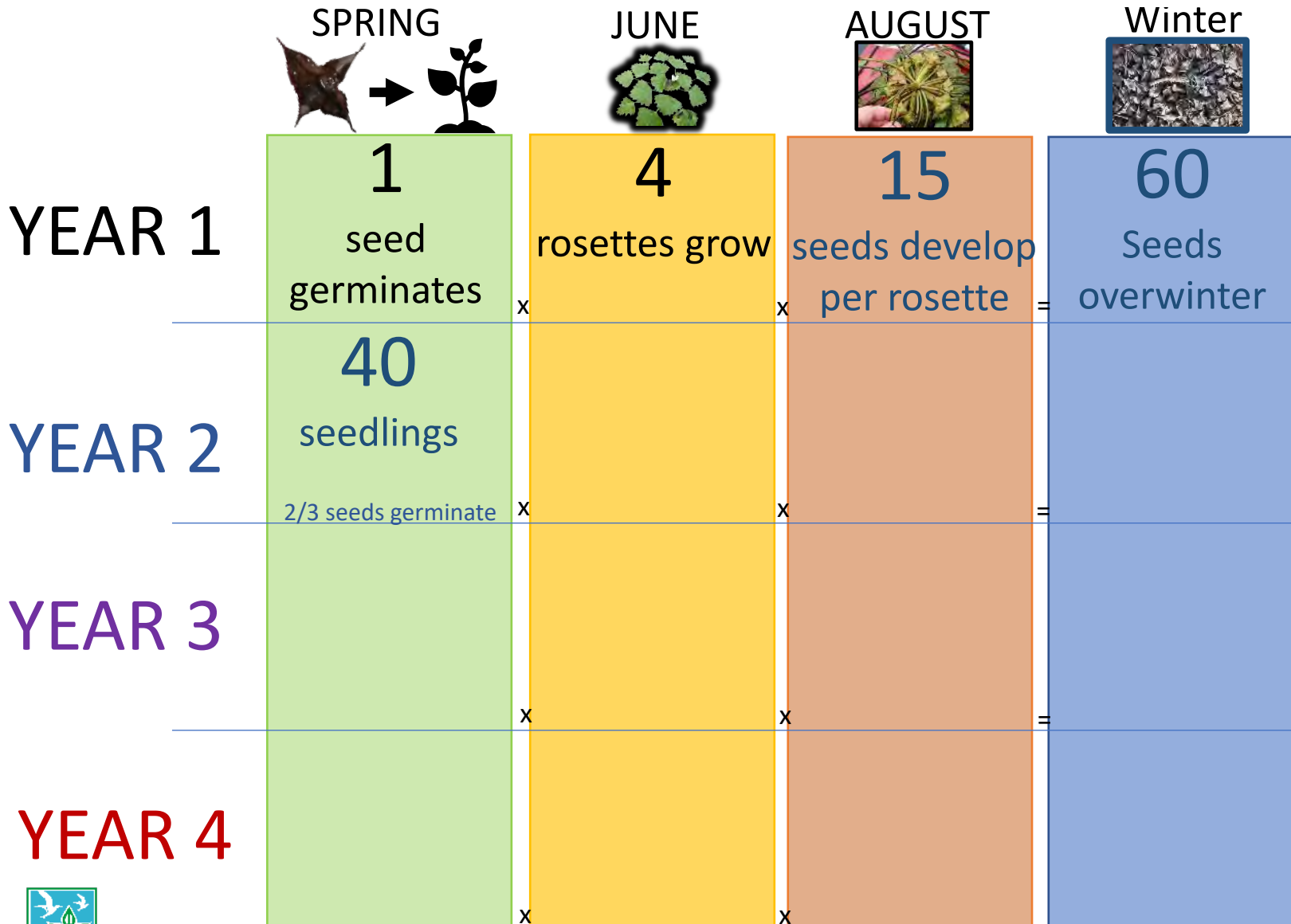
YEAR 4

x

x



# Water Chestnuts Multiply Exponentially in Just a Few Years



# Water Chestnuts Multiply Exponentially in Just a Few Years

SPRING



JUNE



AUGUST



Winter



YEAR 1

1  
seed  
germinates

x

4  
rosettes grow

x

15  
seeds develop  
per rosette

=

60  
Seeds  
overwinter

YEAR 2

40  
seedlings  
  
2/3 seeds germinate

x

160  
rosettes  
  
4 rosettes grow / seed

x

2400  
new seeds  
  
15 seeds grow on each

=

2420  
Seeds  
overwinter  
2400 + 20

YEAR 3

x

x

=




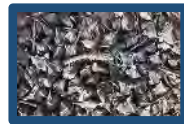
YEAR 4

x

x







# Water Chestnuts Multiply Exponentially in Just a Few Years

	 SPRING	 JUNE	 AUGUST	 Winter
<b>YEAR 1</b>	1 seed germinates	4 rosettes grow	15 seeds develop per rosette	60 Seeds overwinter
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<b>YEAR 3</b>	1598 seedlings <small>2/3 seeds germinate</small>	6392 Rosettes (~0.15 acres) <small>4 rosettes grow / seed</small>		
<b>YEAR 4</b>				









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<b>YEAR 4</b>				



# Water Chestnuts Multiply Exponentially in Just a Few Years

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<b>YEAR 4</b>	63,824 Seedlings ~1.5 acres <small>2/3 seeds germinate</small>	255,296 Rosettes ~5 acres <small>4 rosettes grow / seed</small>	3,829,440 new seeds <small>15 seeds grow on each</small>	3,861,351 Seeds overwinter <small>3.8M + 31.6k + 269 + 2</small>



# Agenda



1. The Warning: Why is water chestnut a problem?
2. What's the deal with Water Chestnut?
3. How to manage it? Monitoring, pulling, controlling
4. Community/Volunteer Pulling Events
5. Questions/Comments



# Management Depends on Stage of Invasion



**ARRIVE**

Plant is introduced



**ESTABLISH**



**GROW & SPREAD**



**DISPLACE NATIVES**



**DOMINATE ECOSYSTEM**

# Management Depends on Stage of Invasion

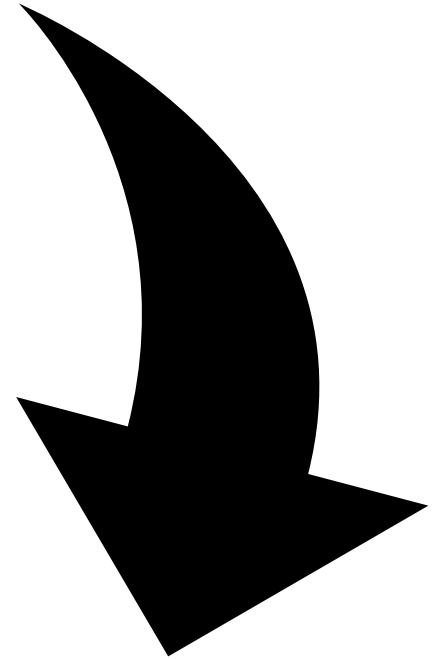


ARRIVE

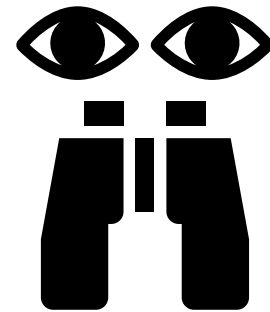
Plant is introduced



ESTABLISH



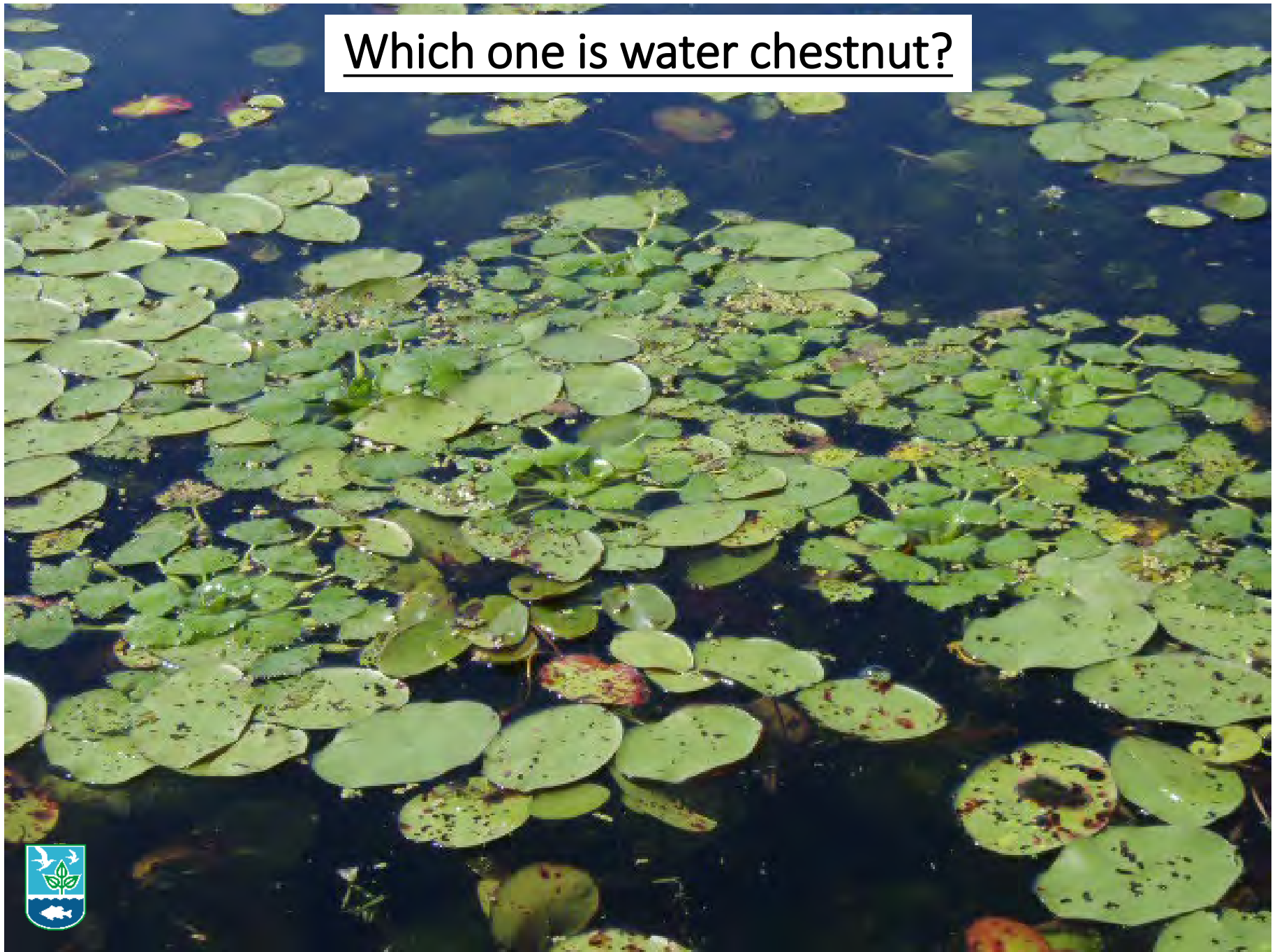
**Requires  
MONITORING**



Learn to recognize water chestnut  
Report to RIDEM immediately – with picture  
[DEM.WaterResources@dem.ri.gov](mailto:DEM.WaterResources@dem.ri.gov)



Which one is water chestnut?



# Watermeal, duckweed and water chestnut



# Management Depends on Stage of Invasion



**ARRIVE**

Plant is introduced



**ESTABLISH**



**GROW & SPREAD**



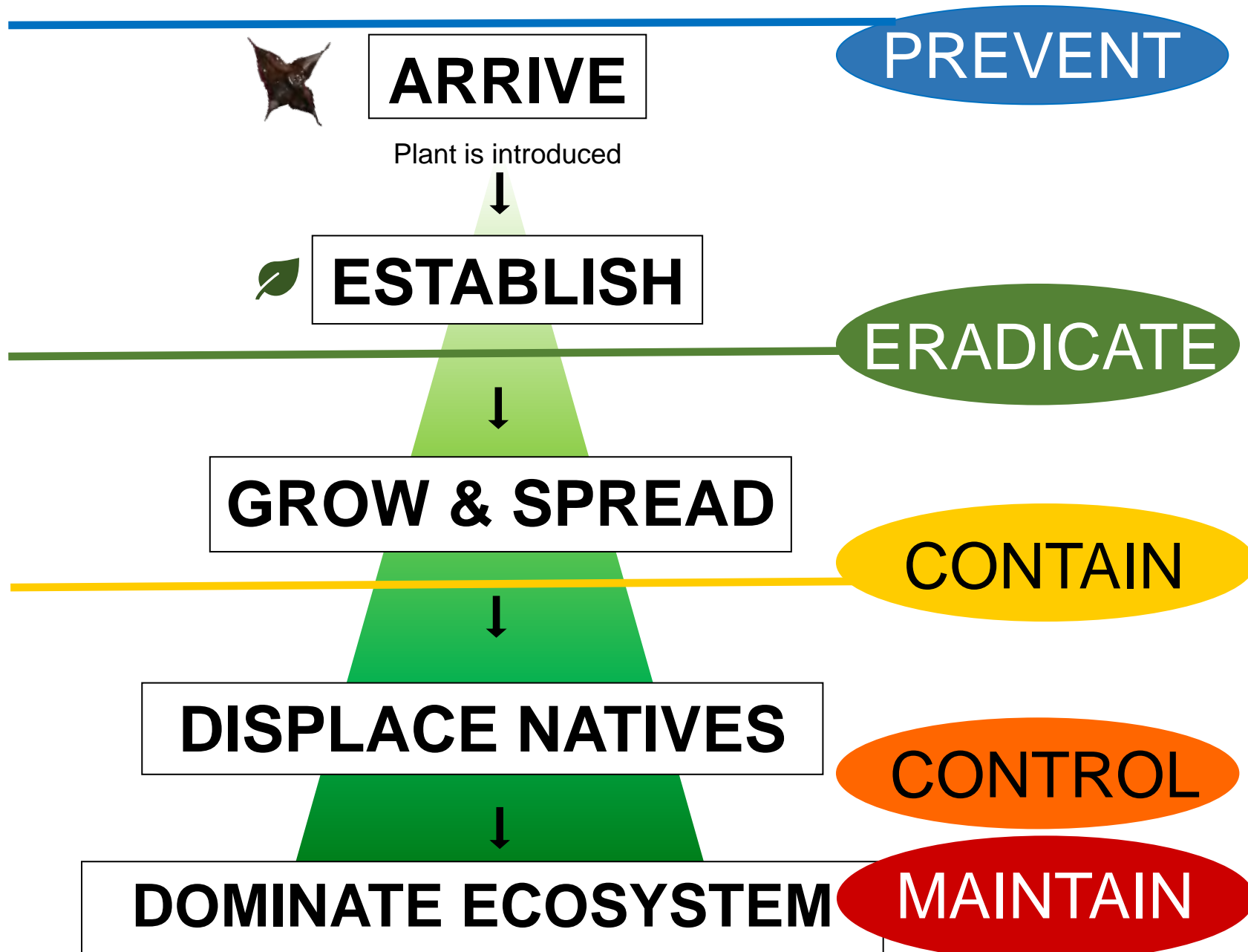
**DISPLACE NATIVES**



**DOMINATE ECOSYSTEM**



# Water Chestnut Management Objectives



# Water Chestnut Management Objectives



**ARRIVE**

Plant is introduced



**ESTABLISH**



**GROW & SPREAD**



**DISPLACE NATIVES**



**DOMINATE ECOSYSTEM**

**PREVENT**

# Protect lakes/ponds without water chestnut



**ARRIVE**

Plant is introduced

**PREVENT**

STOP the movement of seeds to new lakes



Focus on controllable human behaviors

# Protect lakes/ponds without water chestnut



## ARRIVE

Plant is introduced

## PREVENT

### STOP the movement of seeds to new lakes



## Decontaminate Your Gear:

### CLEAN

Remove mud & debris on:

- Boats, Trailers, Fishing rods
- Anchors, Paddles, Gear
- Hose off, use hot water if available (best at 140° F)

### DRAIN

- Motor Boats
- Canoes and Kayaks
- Motors
- Live Wells
- Bait Buckets

### DRY

All wet gear & equipment:

- Hang or leave out in sun
- Dry completely before going to another lake, pond or river



RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

To report invasive animals, contact: Division of Fish and Wildlife (401) 789-0281

To report invasive plants, contact: Office of Water Resources (401) 222-4700



# Water Chestnut Management Objectives



**ARRIVE**

Plant is introduced



**ESTABLISH**

**PREVENT**

# Water Chestnut Management Objectives



**ARRIVE**

Plant is introduced

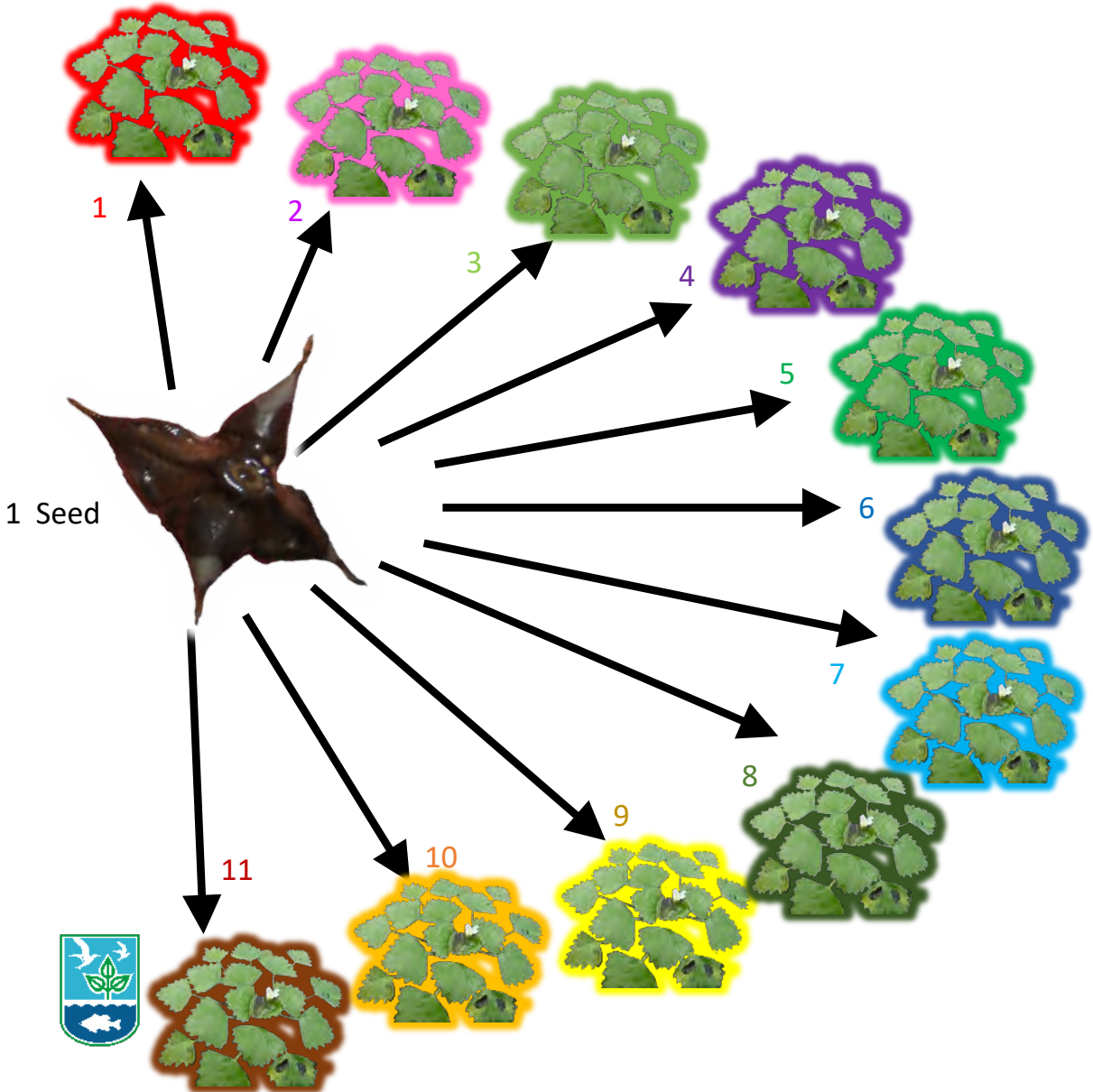


**ESTABLISH**

**PREVENT**

**ERADICATE**

# Eradication Options: Hand-pulling



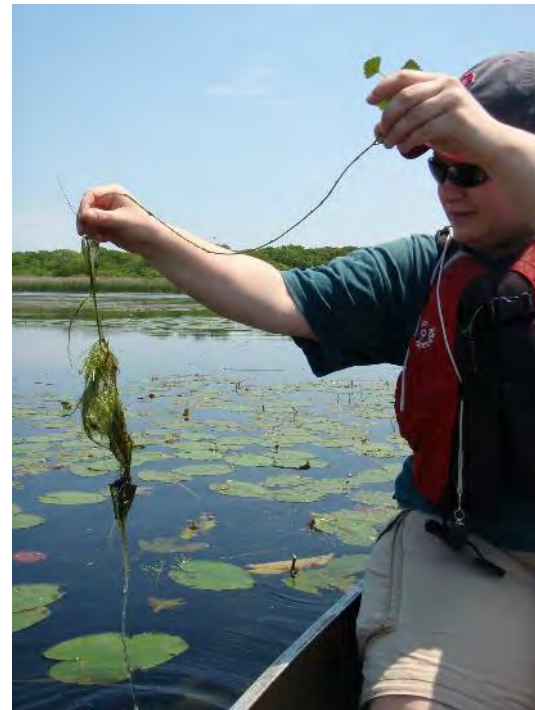
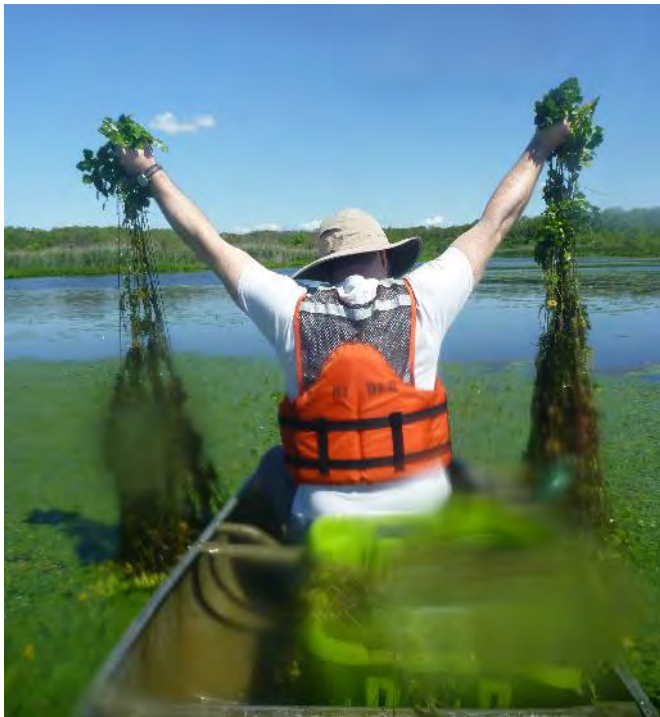
ANNUAL PLANT

Remove it, no seeds form (if early in season)

# Eradication Options: Hand-pulling

## Hand Pulling (video)

- do every year till seed bank is depleted (can be 12+ yrs)
- Ideal for small populations 1 acre or less (ideally)
- Funded full-time groups may be able to handle 10 ac



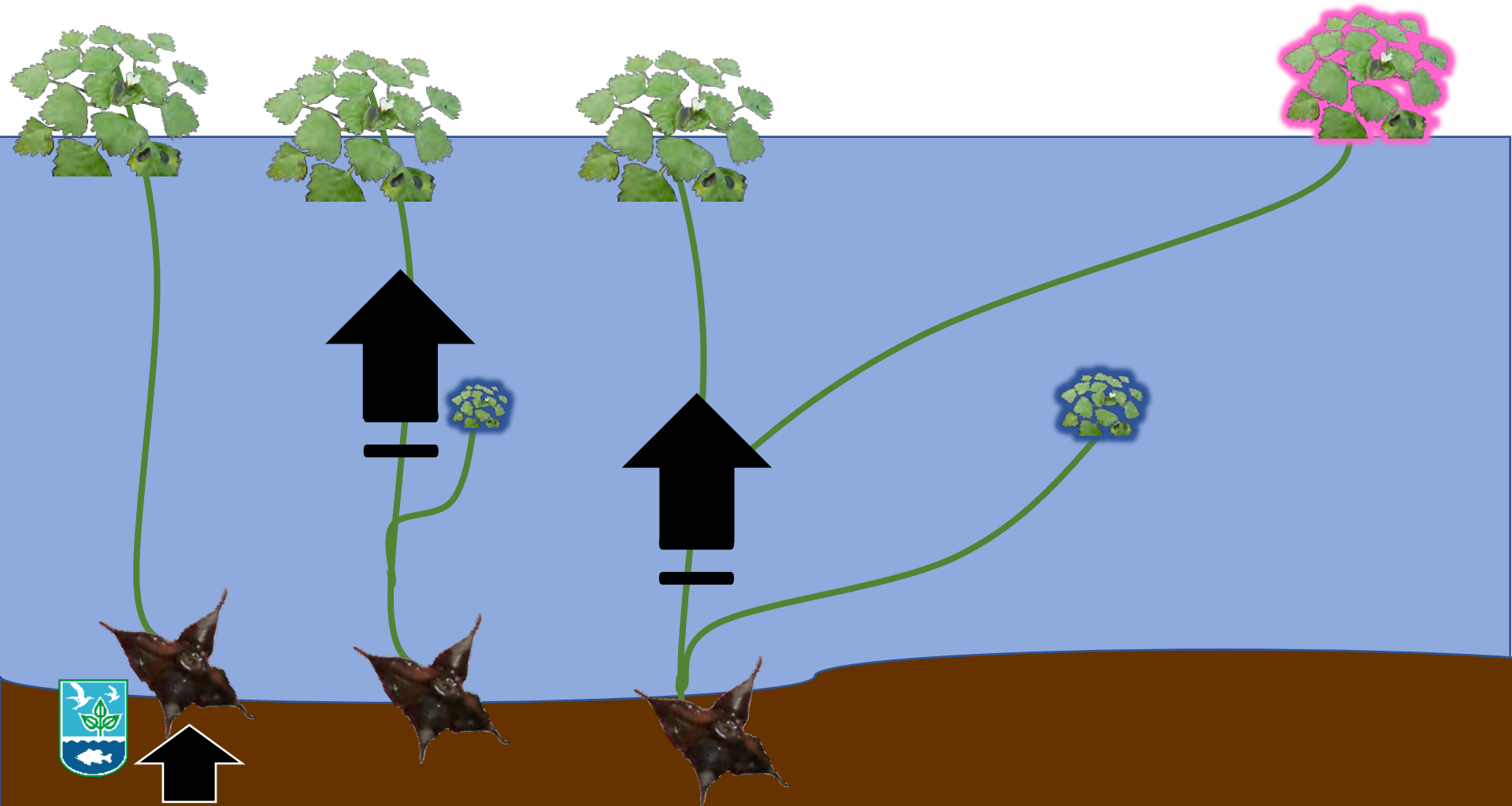


# Eradication Options: Hand-pulling

Pro tips:

Pull gently; multiple tugs often brings it

Try to get the seed, revisit in 2 weeks



# Eradication Options: Hand-pulling

In watershed – community outreach

## Invasive Water Chestnut

**Spot**      **Pull**      **Prevent**

## Pull This Invasive Plant Out!

**Spot**

- Learn to recognize its triangular leaves that grow radiating from the center
- All the jagged leaves on one plant form a rosette that floats
- In August, up to 15-20 large, pointy seeds can develop under the leaves
- The following year, the seeds produced can mature into 10-15 new plants
- This aggressive plant grows large and reproduces exponentially to form a dense mat of plants that will cover several acres (see [http://www.dem.ri.gov/benviron/water/quality/surfwq/pdfs/invasive-spot-water-chestnut-4s.pdf](#))

**Pull**

- Paddlers can easily pull water chestnuts from their boats
- In early June, new rosettes can be seen in shallow water. As they get larger over the summer, they can be pulled by hand
- It is easier to pull the smaller plants
- After removing the plants, dispose of them properly. As an annual, the plant will regrow from the roots.

**Prevent**

- Pulling plants before they produce seeds
- The large, pointy seeds are eaten by waterfowl, and can be spread to new locations
- Mature seeds that have been pulled will sink to the bottom and will not germinate the following year, so pulling is a long term effort

**Rhode Island Department of Environmental Management**  
 To report water chestnut at a new location, call 800-877-7273 or visit <http://www.dem.ri.gov/benviron/water/quality/surfwq/pdfs/invasive-spot-water-chestnut-4s.pdf>  
 For more info, go to: <http://www.dem.ri.gov/benviron/water/quality/surfwq/pdfs/invasive-spot-water-chestnut-4s.pdf>

Please post on social media

## Spot It!

Learn to Recognize Invasive Water Chestnut

It's small in June...      1 - 2 feet by August!

Plants start off small (fit in the palm of your hand) but can grow up to 2 feet across by the Fall.

Tiny white flowers bloom (only in the mornings) in early July. Leaves of the rosette float on the water, and one main stem anchors the plant in shallow mud.

Spikey seeds start off green and turn brown

By the end of July, each rosette can produce up to 20 large, pointy, green or brown seeds that grow on the underside of the rosette. Seeds will drop off and sink to the bottom, where they may be viable to sprout up to twelve years later.

<http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/invasive-spot-water-chestnut.pdf>





## Water Chestnut Management is a LONG TERM endeavor



\*\*\*Un-germinated seeds may lay dormant for up to 12 years in lake sediment



...so even if you remove every plant, you have to monitor for the next 12 years!



# Water Chestnuts Multiply Exponentially in Just a Few Years

**NO removal**

SPRING



JUNE



AUGUST



Winter



**YEAR 1**

**1**  
seed  
germinates

**4**  
rosettes grow

**15**  
seeds develop  
per rosette

**60**  
Seeds  
overwinter

**YEAR 2**

**40**  
seedlings  
2/3 seeds germinate

**160**  
rosettes  
4 rosettes grow / seed

**2400**  
new seeds  
15 seeds grow on each

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2400 + 20

**YEAR 3**

**1598**  
seedlings  
2/3 seeds germinate

**6392**  
Rosettes  
~0.15 acres  
4 rosettes grow / seed

**95,880**  
new seeds  
15 seeds grow on each

**96,703**  
Seeds  
overwinter  
95,880 + 816 + 7

**YEAR 4**

**63,824**  
Seedlings  
~1.5 acres  
2/3 seeds germinate




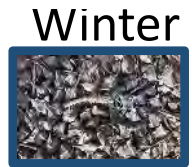
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~5 acres  
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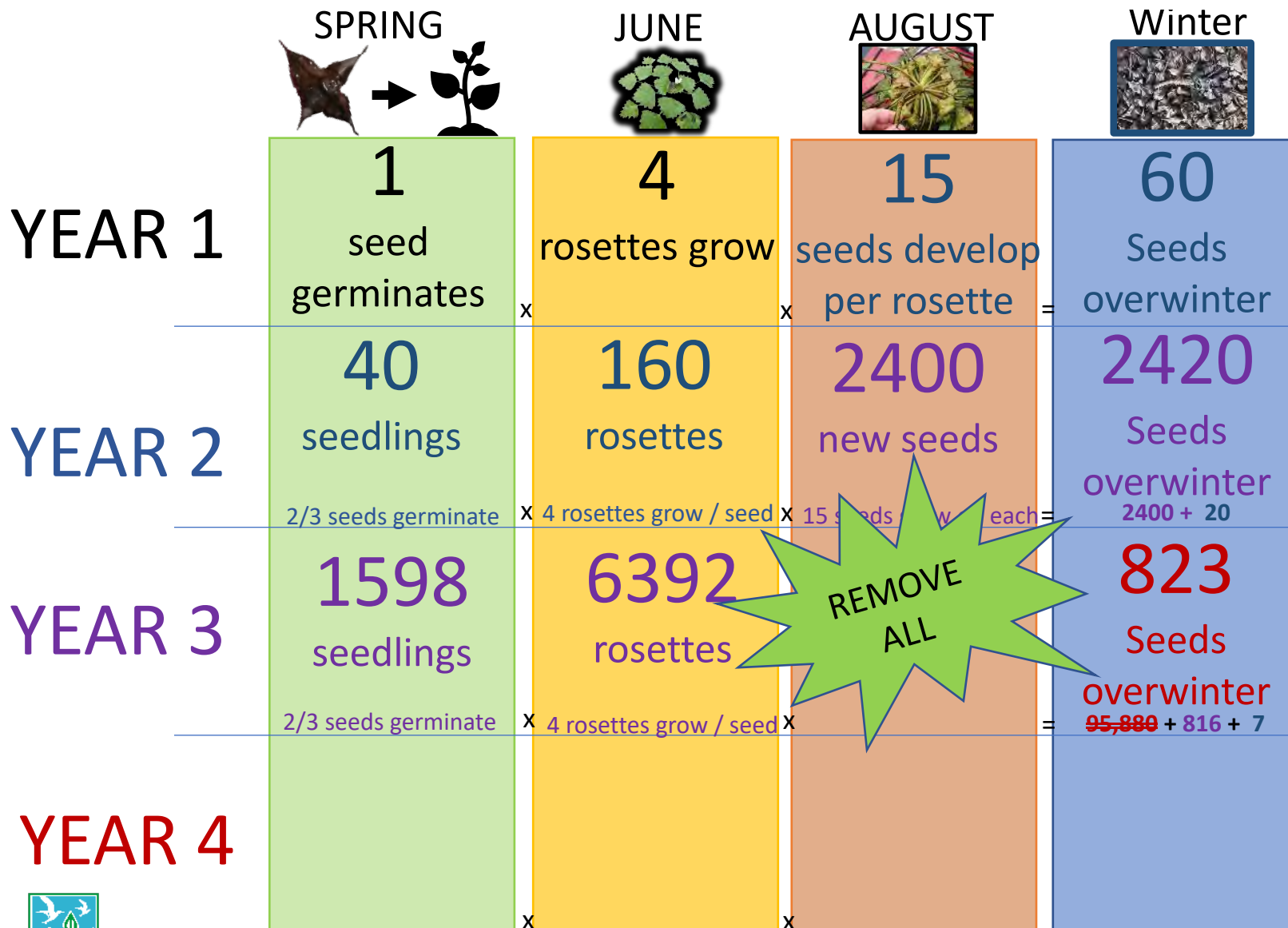
## Hand-pulling Example:

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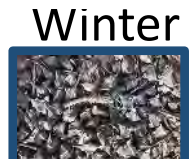
**REMOVE ALL**



## Hand-pulling Example: Small effort, BIG impact



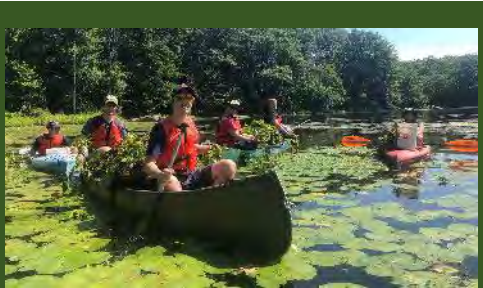
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<b>YEAR 2</b>	40 seedlings	160 rosettes	2400 new seeds	2420 Seeds overwinter
<b>YEAR 3</b>	1598 seedlings	6392 rosettes	<b>REMOVE ALL</b>	823 Seeds overwinter
<b>YEAR 4</b>	543 seedlings	2172 rosettes	<b>REMOVE ALL</b>	280 Seeds overwinter





# Case Study: Small populations can be hand pulled: Olney Pond, Lincoln, RI (Lincoln Woods State Park)



June 27, 2019



July 15, 2019



2019

2020: pulled 4 laundry baskets full of invasive plants

July 10, 2020



July 16, 2020



2020

2021: pulled 1.5 laundry baskets full of invasive plants

June 23, 2021



2021

2022: pulled only 12 + 8 plants!

June 14, 2022 and 6/30



2022



# Agenda



1. The Warning: Why is water chestnut a problem?
2. What's the deal with water chestnut?
3. How to manage it? Monitoring, pulling, controlling
4. Community/Volunteer Pulling Events
5. Questions/Comments



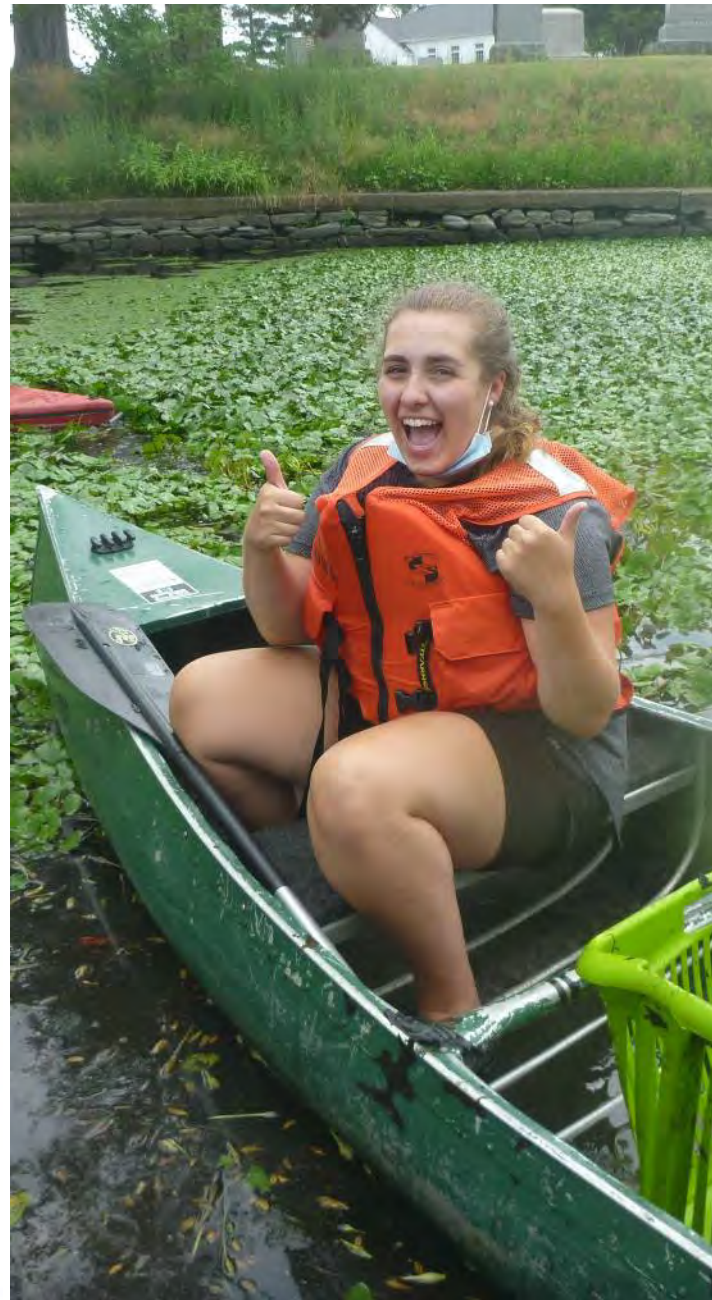


# VOLUNTEER!

Help Harvest Invasive Water Chestnut



**Paddlers and Land Crew Needed**



# Volunteer Hand Pulling – What YOU can do!

Paddlers Pull Water Chestnut (use laundry baskets)



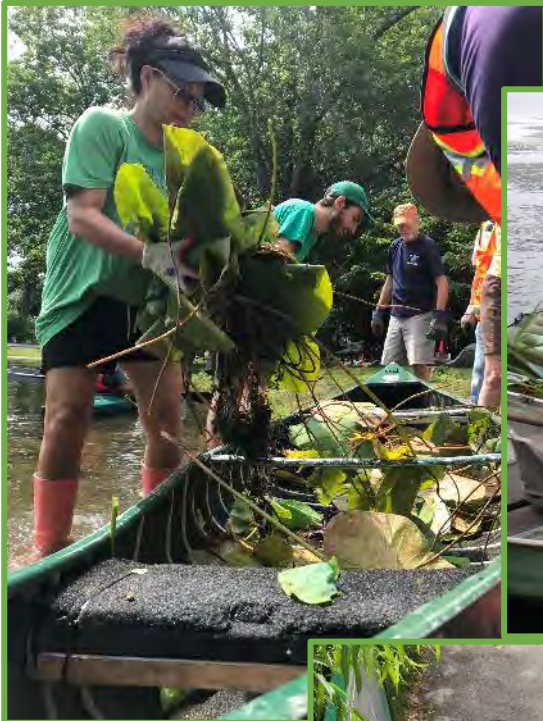
# Volunteer Hand Pulling – What YOU can do!

Boats to ferry/shuttle water chestnuts back to shore



# Volunteer Hand Pulling – What YOU can do!

People on Shore Unload Boats



# Volunteer Hand Pulling – What YOU can do!

Haul Water Chestnut to Compost or Trash/Dumpsters



# VOLUNTEER!



Help Harvest Invasive Water Chestnut



**Paddlers and Land Crew Needed**

**Next Week!**

**Sign-up:**

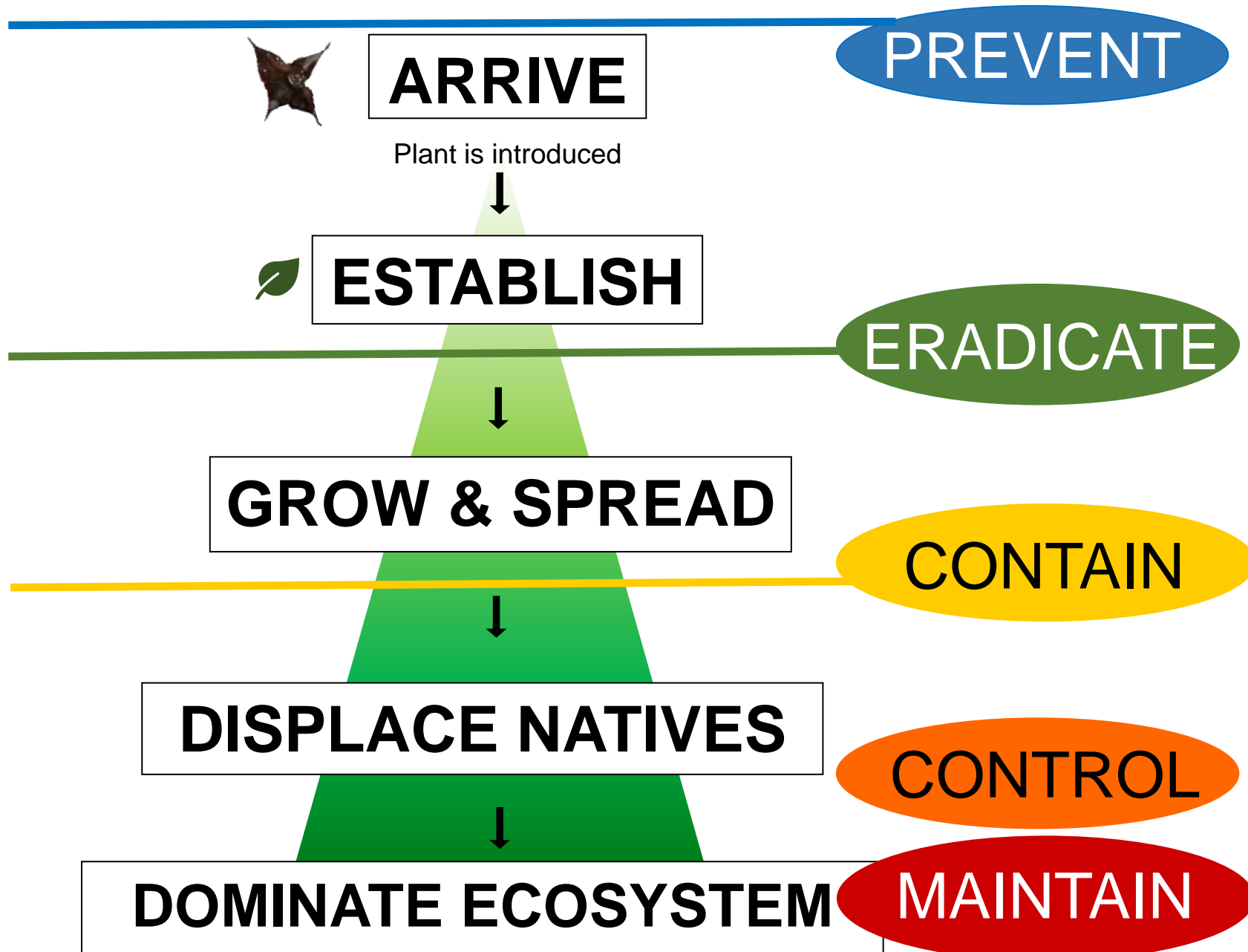


**Turner Reservoir**

**366 Newman Ave, East Providence, RI**



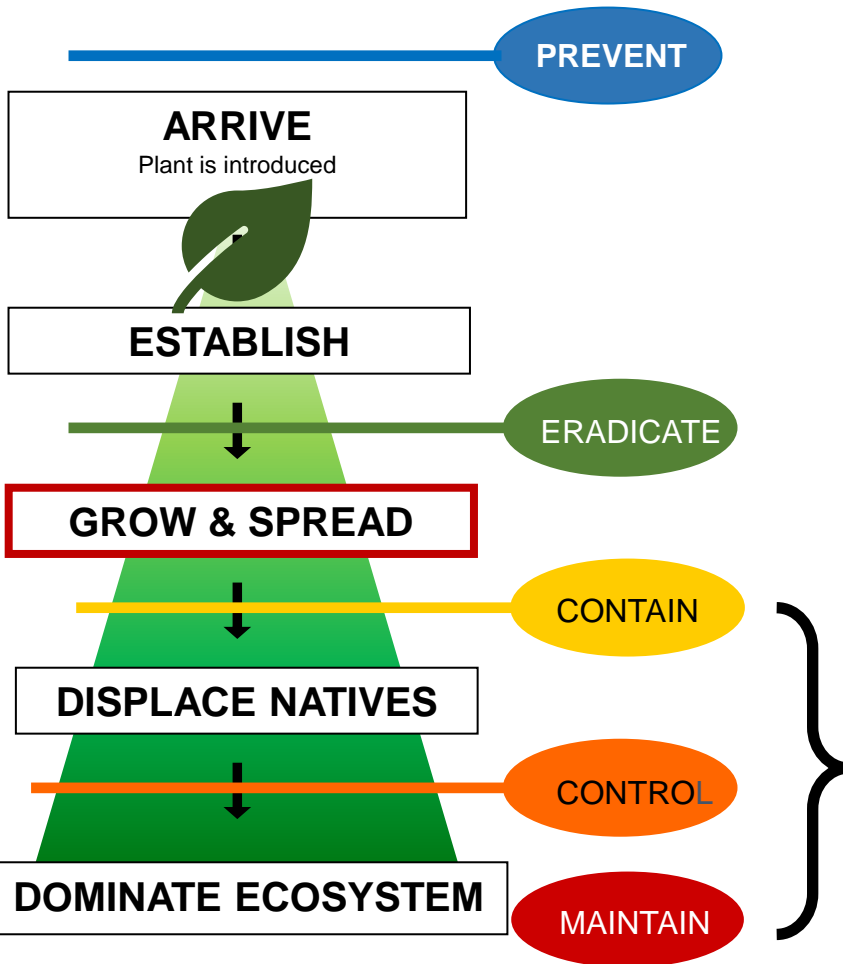
# Water Chestnut Management Objectives





# Water Chestnut Management Options

## Common Control Types:



**ANNUAL  
REMOVAL STRATEGIES  
REQUIRE PERMIT**



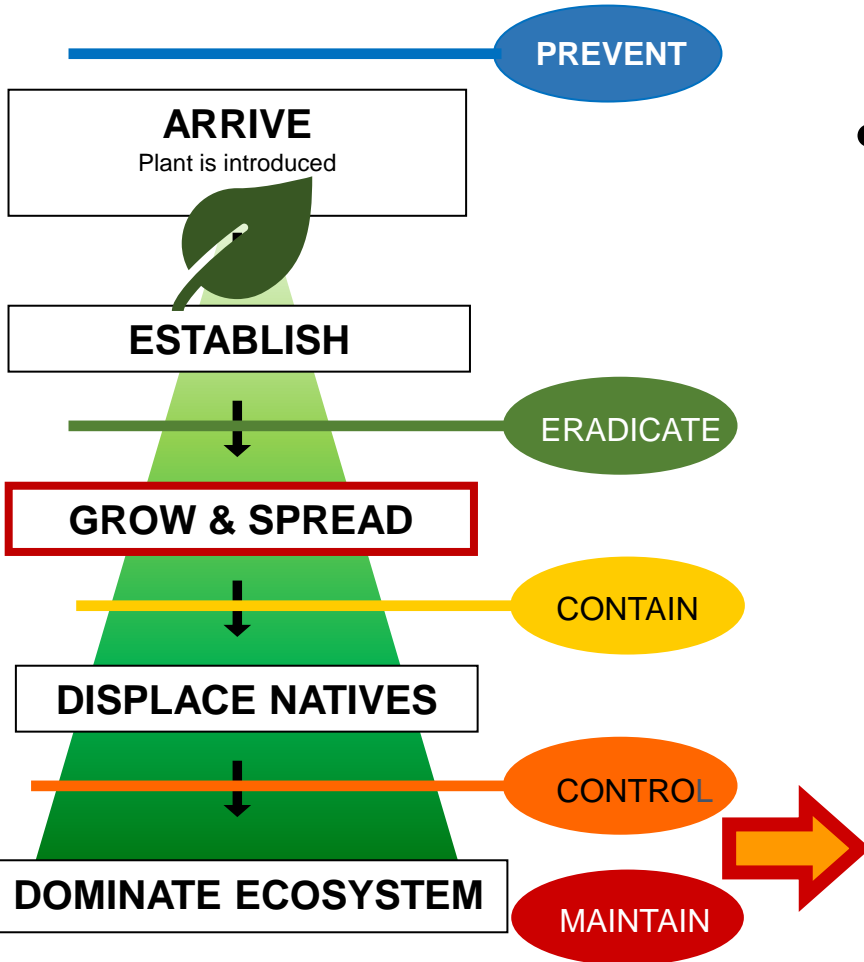
# Water Chestnut Management Options

## Common Control Types:

- Physical Methods
  - Mechanical



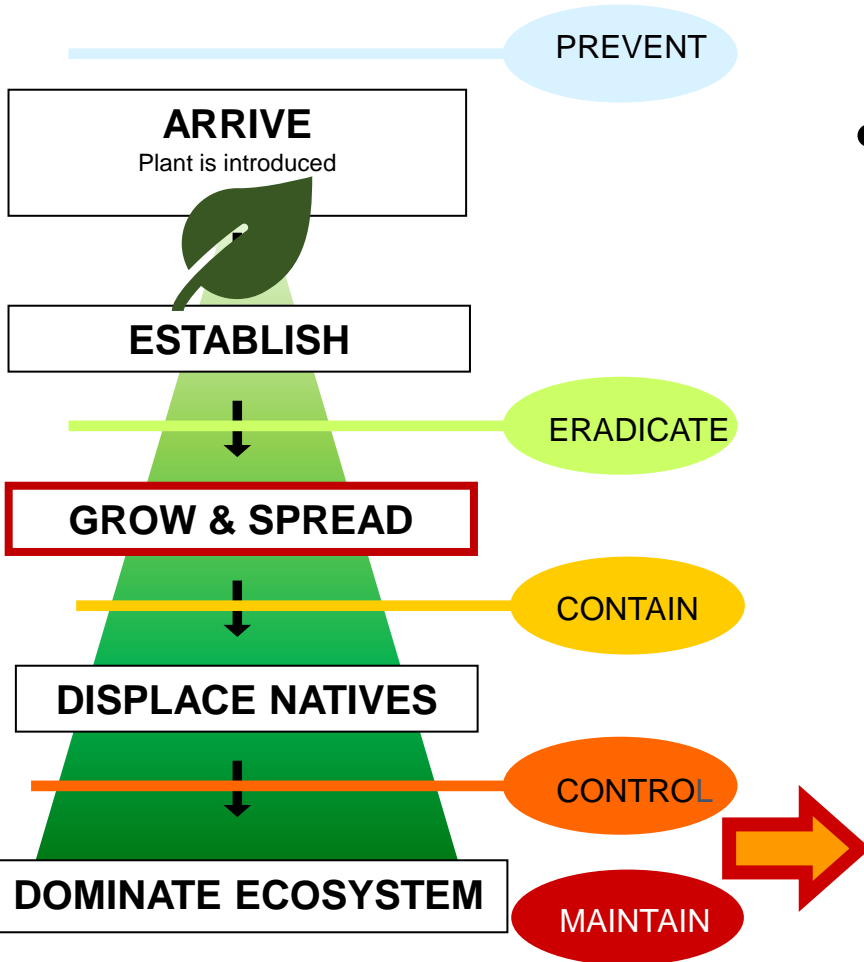
- MUST HAVE 3 feet depth
- Averages 1 acre per day removed
  - Removes ALL plants
  - Requires wetland permit



# Water Chestnut Management Options

## Common Control Types:

### •Chemical Methods

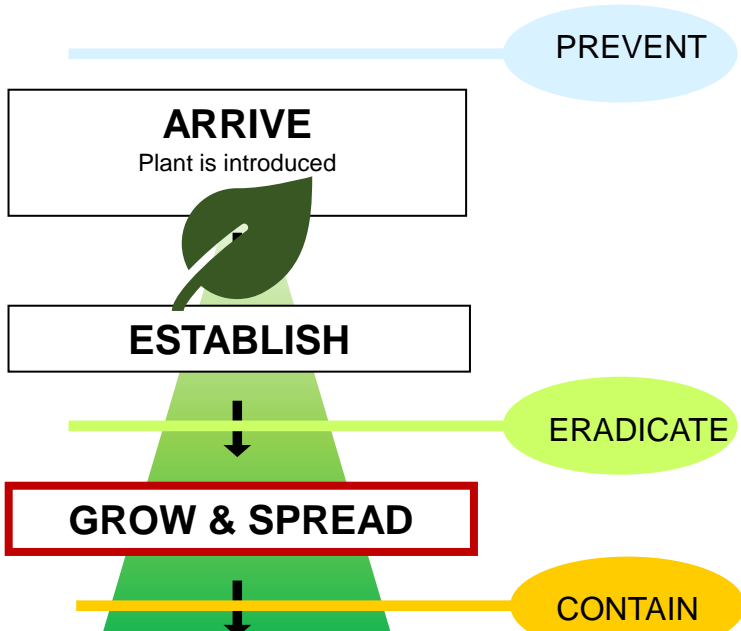


- Requires Agriculture Permit
- Chemicals specific to type of plant
- May require 1-2 applications/year
- May need annual treatment

# Water Chestnut Management Options

## Common Control Types:

### •Chemical Methods



**Recommended 5-Year Herbicide Program and Estimated Herbicide Program Costs by Year**

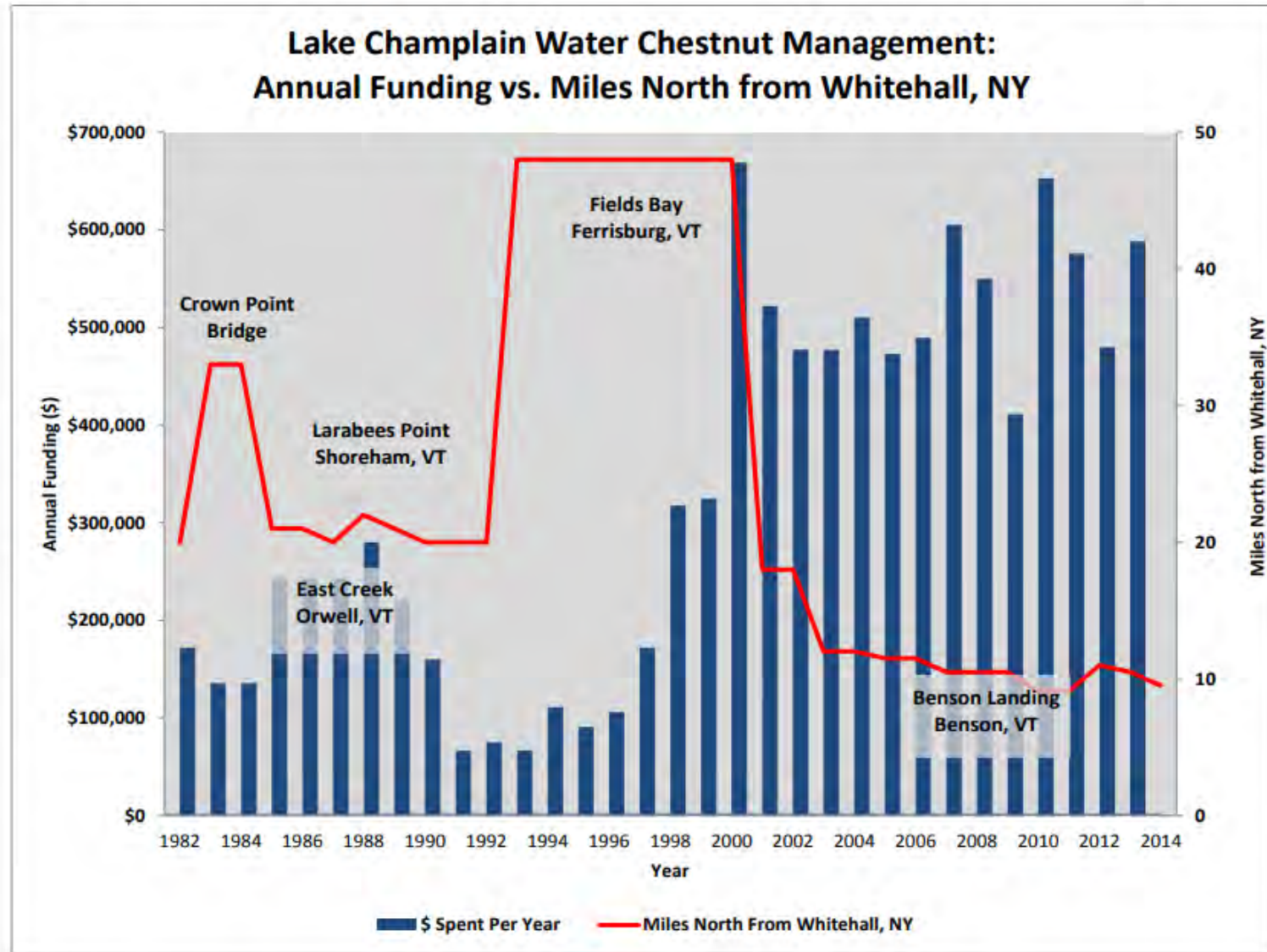
Year	DEM Permit	Chestnut w/ Clearcast	Fanwort	Milfoil	Total
1	\$350	\$33,000 (2 Treatments)	\$5,000 (2 Sonar ONE Treatments)	\$1,500 (Procellacor)	\$39,850
2	\$350	\$29,700 (2 Treatments)	\$1,500 (Flumioxazin)		\$31,550
3	\$350	\$26,400 (2 Treatments)	\$1,500 (Flumioxazin)		\$28,250
4	\$350	\$24,000 (2 Treatments)	\$1,500 (Flumioxazin)		\$25,850
5	\$350	\$24,000 (2 Treatments)	\$1,500 (Flumioxazin)		\$25,850

Total to treat 40 acres water chestnut in Valley Falls Pond (over 5 years): \$151,350



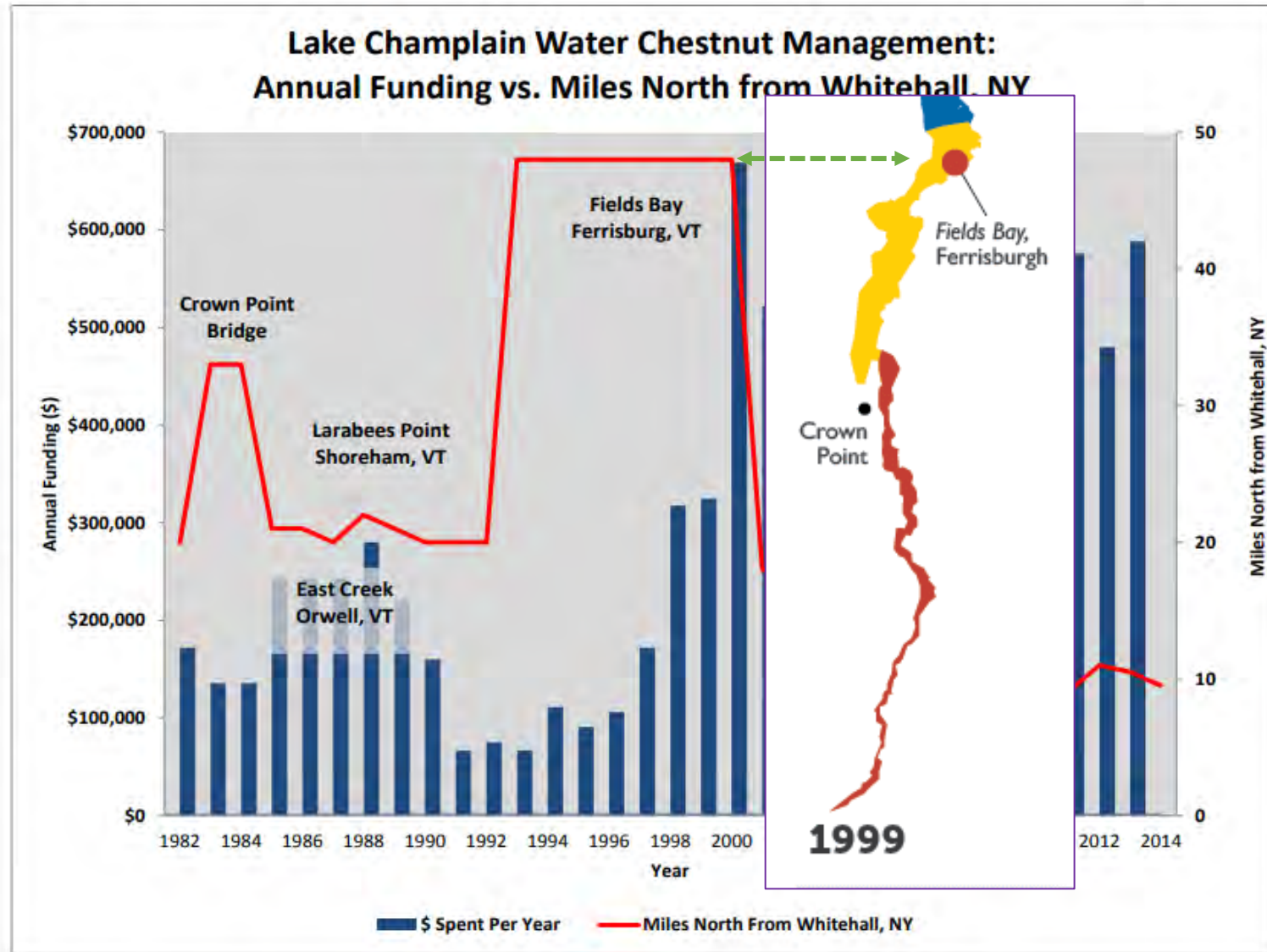
# Lessons from Lake Champlain

Figure 2-5: Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2014



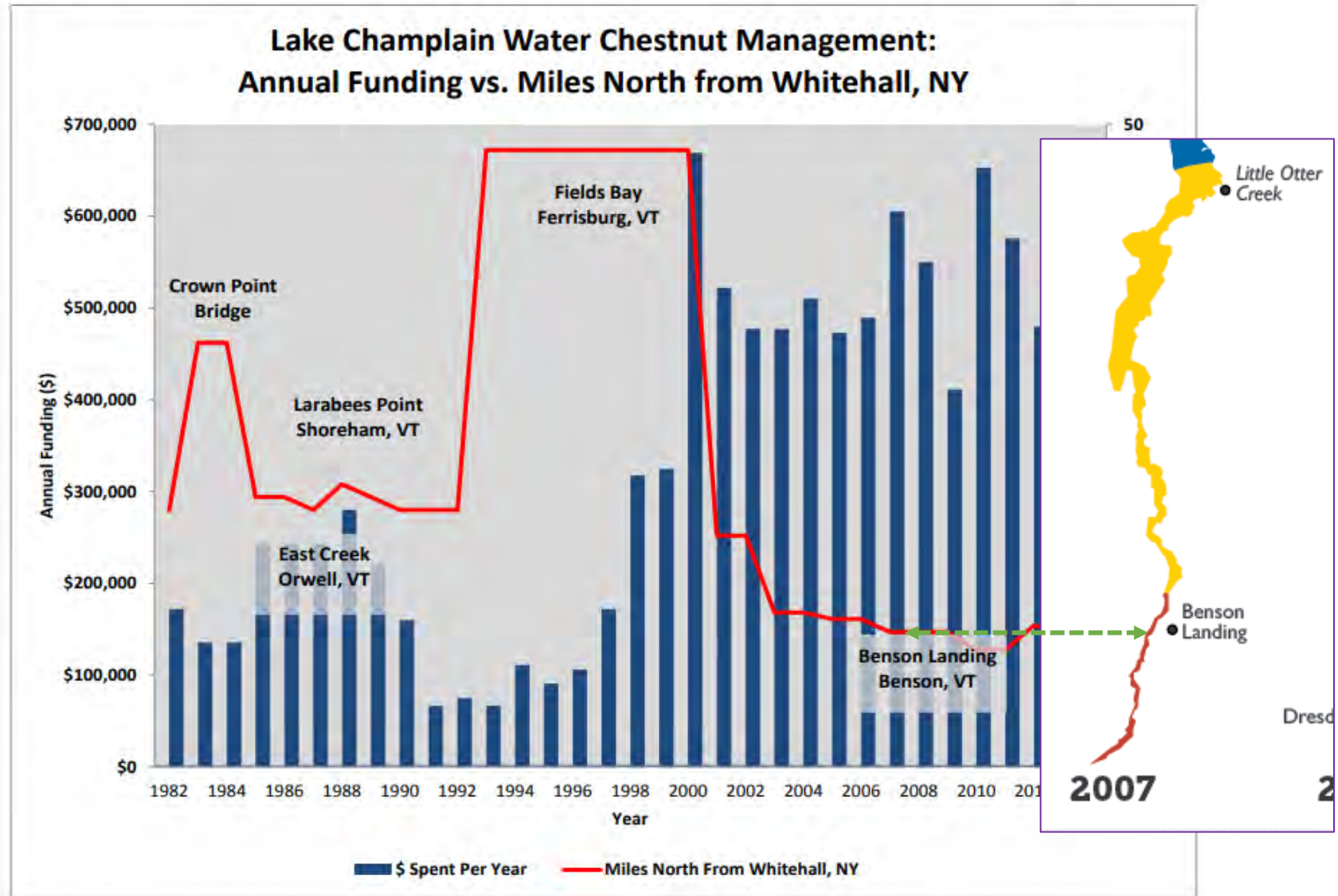
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Figure 2-5: Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2014



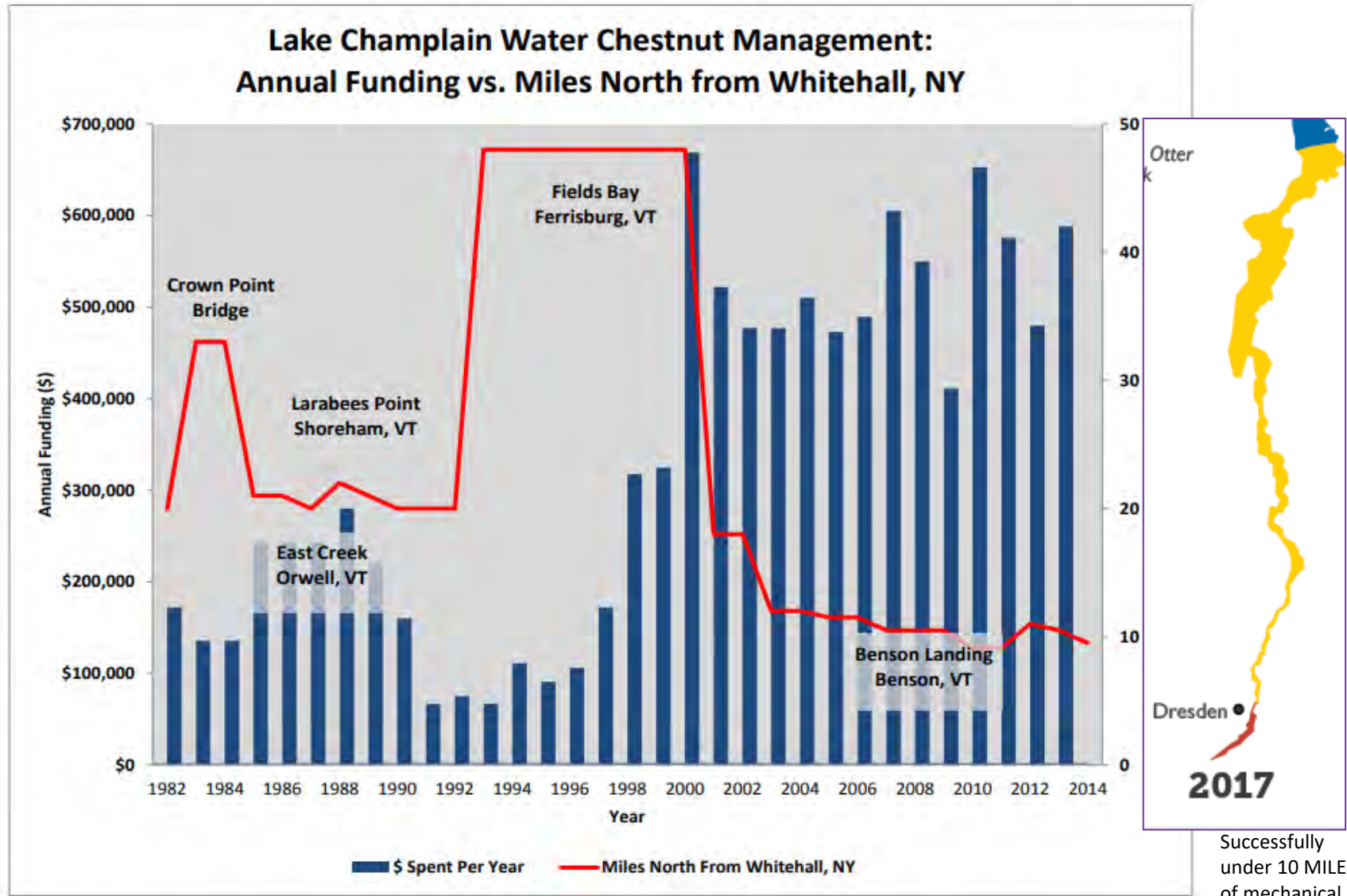
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Figure 2-5: Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2014



# Lessons from Lake Champlain

Figure 2-5: Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2014



Successfully  
under 10 MILES  
of mechanical  
harvesting!



# Agenda



1. The Warning: Why is water chestnut a problem?
2. Identifying Water Chestnut and other invasives
3. How to manage it? Monitoring, pulling, controlling
4. Community/Volunteer Pulling Events
5. Questions/Comments



Katie DeGoosh-DiMarzio, Environmental Analyst  
RIDEM Office of Water Resources  
katie.degoosh@dem.ri.gov

