

# Invasive Aquatic Plants in New Jersey

By Chris Doyle, CLM  
*Senior Aquatic Biologist*  
*Director of Biology*

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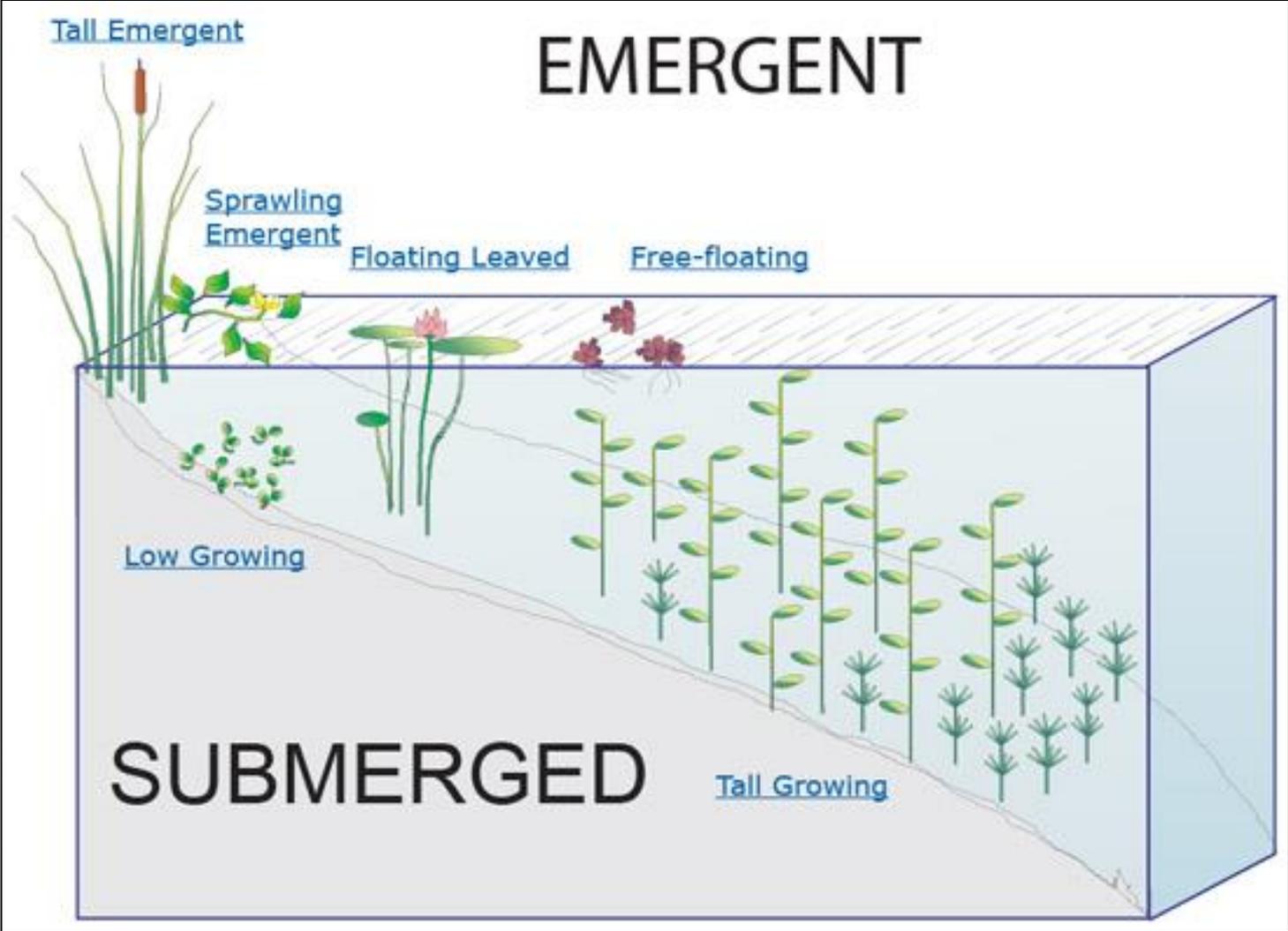
SÖLITUDE  
LAKE MANAGEMENT

Restoring Balance. Enhancing Beauty.

May 24, 2017

Presented at NJWMC Meeting

# Aquatic Plant Communities



# Benefits of Aquatic Plants

## Aquatic Biota Habitat

- Fish
- Aquatic Invertebrates
- Zooplankton (Refuge)

## Wildlife Habitat and Food

- Waterfowl, muskrats, otters, mink, beavers, deer

## Nutrient Sink

- Competes with Algae

## Shoreline and Benthic Stabilization

- Reduction of Nutrients

## Aesthetics



## But at Nuisance Densities...

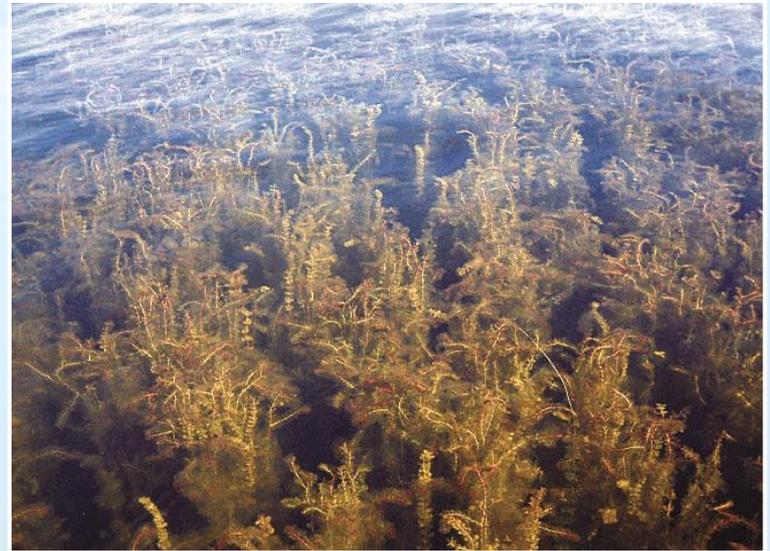
### Restrict Recreation

- Boat Movement
- Fishing Frustration
- Aesthetics

### Ecological Imbalances

- Fish Community Shifts
- Negative WQ Impacts

### Invasive Species



## Submersed Plant: **Curly-leaf Pondweed**

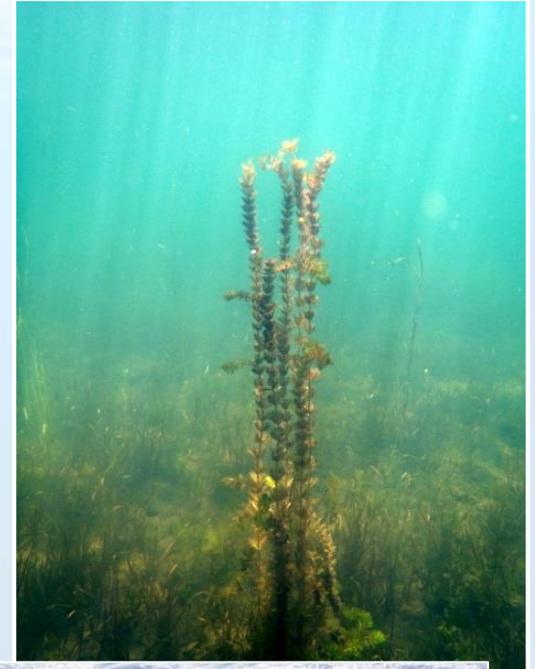
- The Only Invasive Pondweed
- Native to Europe and Asia
- Established in most US States
- Thrives in disturbed water
- Stems can reach 3 to 4 meters long!
- Serrated, wavy leaves (stiff)
- Early Grower (winter)
- Natural die-off in June/July
  - Decaying plant biomass can trigger algae blooms
- Pine cone-like turions
- **Control Options:** Herbicides



*Potamogeton crispus*

## Submersed Plant: **Eurasian Water Milfoil**

- Native in Europe and Asia
- Most common exotic invasive aquatic plant in the USA
- Millions of dollars spent annually to control
- Fast grower, and can grow in cool water
  - Thrives in a variety of habitats
  - Competitive advantage vs. native species
- Produces seeds, but usually only reproduces via fragmentation
- Low light and higher temperatures promote canopy formation
  - Shades out desirable submersed plants



*Myriophyllum spicatum*

# Submersed Plant: **Eurasian Water Milfoil**

## Eurasian Water Milfoil Control Options:

- Herbicides (many)
- Hand Pulling
- Benthic Barriers
- Herbivorous Insects



**Mechanical Harvesting  
Not Recommended**



*3-6 leaves per whorl (4 typical)*

## Submersed Plant: Variable-leaf Water Milfoil

- Native to North America, but not the Northeast
- Highly invasive in New England, but...
  - Protected in New Jersey!
- Whorls closely spaced ( $>10$  mm)
  - “Bottle brush” appearance
- Distinct toothed bracts out of water
- Can reproduce via fragmentation
- Thrives in a variety of habitats
- **Control Options:**
  - Herbicides (typically higher dose)
  - Hand Pulling
  - Benthic Barriers



*Myriophyllum heterophyllum*

## Submersed/Emergent Plant: **Parrot Feather**

- Native to South America
- Has both submersed and emergent leaves
  - Up to 30 cm above surface
  - Emergent leaves are vibrant and waxy
  - Submersed leaves are degraded/limp
- Reproduces via roots and fragmentation
- Can survive stranded on the shore
- Can survive in salt-intruded waters
- **Control Options:**
  - Herbicides
  - Hand Pulling



*Myriophyllum aquaticum*

## Submersed Plant: **Fanwort**

- Native to Europe (South USA?)
  - Not native in the Northeast
- Very popular in aquarium trade
- Reproduces by fragmentation
- Forms extensive surface mats
- Prefers low pH water
- Northern vs. Southern strains?
- Difficult to Control
- **Control Options:**
  - Herbicides
  - Grass Carp
  - Benthic Barriers
  - Hand Pulling



*Cabomba caroliniana*



Aggressive Fanwort infestation in NJ



## Submersed Plant: **Hydrilla**

- Native to Asia/India
  - Two Biotypes
- Introduced to USA in 1960's
- Whorls of 4 to 8 (sometimes 3)
  - Leaves have serrated edges
- Can reach 25 feet long
  - Can grow 1" to 2" per day
- Produces Tubers
- Widespread in the South (FL)
- Tolerates a Wide Variety of Habitats
  - Flowing and non-flowing, bottom substrates, salinity, water chemistries
- **Control Options:**
  - Herbicides (Can become resistant)
  - Grass Carp
  - Other Biological Options?
    - Need to Manage the Tuber Bank



*Hydrilla verticillata*

# Submersed Plant: **Hydrilla**

Often Called the “Perfect Weed”



**Tubers**  
Viable in Sediment  
for at least 6 years

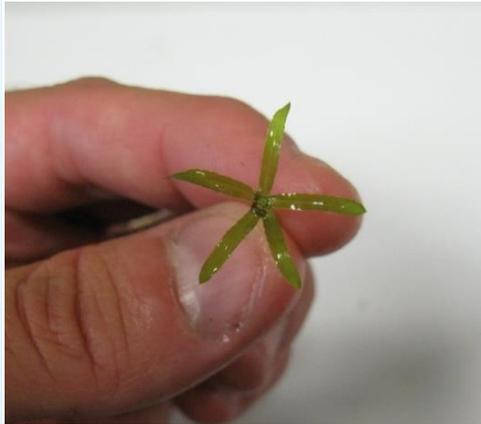
## Submersed Plant: **Brazilian Elodea**

- Native to South America
- Leaves in whorls of 4 to 8
- Robust Stems
- Introduced to USA in late 1800's
- Popular aquarium plant ("*Anacharis*")
  - "Oxygenator"
- Reproduces via Fragmentation
- Growth actually slows in mid-summer
- Fall growth flush
- **Control Options:**
  - Grass Carp
  - Hand Pulling
  - Herbicides



*Egeria densa*

# Waterweed Look-Alikes



**Hydrilla**

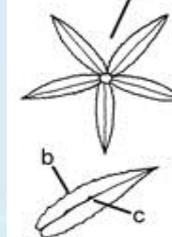


**Common Waterweed**

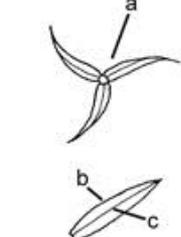


**Egeria**

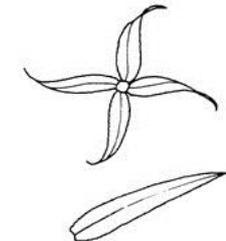
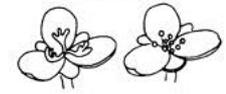
## HYDRILLA



## ELODEA



## EGERIA



**4-8 whorls**  
**heavy serration**  
**(can be 3)**

**3 whorls (rarely 4)**  
**fine serration**

**4-6 whorls**  
**very fine**  
**serration**

## Submersed Plant: **Brittle Naiad**

- Native to Europe
- Occurs in most US states
- Sometimes called European naiad
- Leaf serrations visible to naked eye
- Prolific seed producer
  - Primary means of reproduction
  - One acre plot can produce 10,000,000 viable seeds in one season
- Stems generally do not reach surface
  - Typically doesn't require control
- **Control Options:**
  - Benthic barriers
  - Herbicides
  - Hand Pull?



*Najas minor*

## Submersed Plant: **Mud Mat**

- Native to Australia and New Zealand
- First identified in CT in 1992
- Since confirmed in CT, NJ, RI, and PA
- Prefers shallow sandy lake areas
- Diminutive stems
  - 1 to 4 cm leaves, in pairs
  - Often overlooked
- Can form dense mats
  - 10,000 to 25,000 plants/m<sup>2</sup>
- Exotic, but low potential to become a nuisance to recreational lake uses
- **Control Methods:**
  - Unknown (hand pulling?)
  - Likely Not Needed



*Glossostigma cleistanthum*

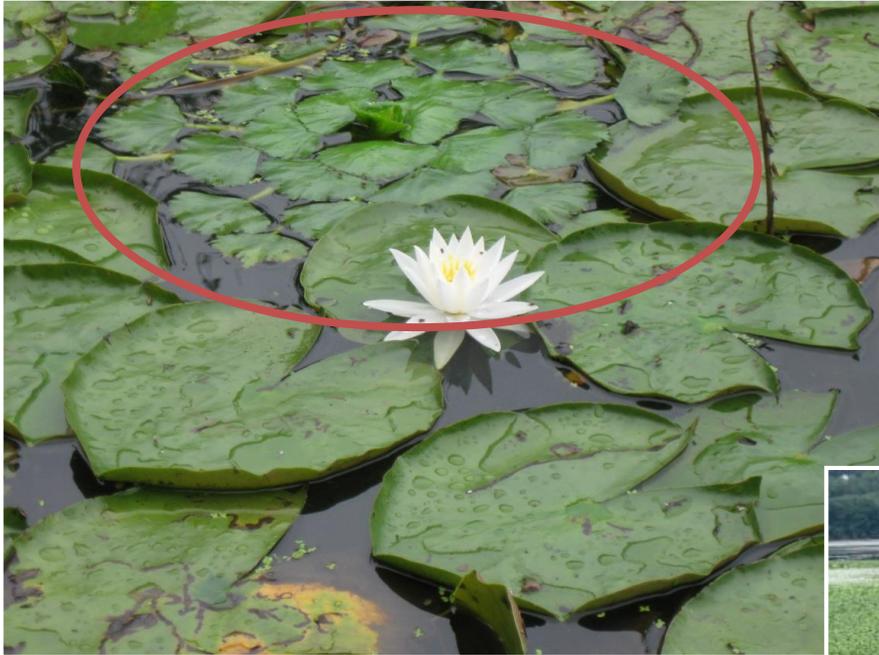
## Floating-leaf Plant: **Water Chestnut**

- Native to Europe, Asia and Africa
- Hardy, robust stems, with floating leaves
- Can reproduce via fragmentation
- Air-filled petioles (buoyancy)
- Produces hard spiked fruit
  - Can lie dormant for 15 years
- **Control Options:**
  - Hand Pulling
    - Very effective at low density
  - Herbicide Use
  - Mechanical Removal



*Trapa natans*

# Floating-leaf Plant: **Water Chestnut**



40 acre Water Chestnut Infestation →



## Floating Plant: **Creeping Water Willow**

- Native to South and Central America
- Also called Creeping Water Primrose
- Peconic River, 2003 (Long Island, NY)
- Primary Reproduction via fragmentation
- Ditches, riverbanks, slow streams
  - Pond/lake margins too
- Stems can sprawl for 3 meters
  - Very aggressive
- **Control Options:**
  - Hand pulling
  - Topical herbicide spraying



*Ludwigia peploides*

## Floating Plant: **Yellow Floating Heart**

- Native to Europe and Asia
- Introduced to the USA as an ornamental
- Occurs throughout Northeast (not ME)
- Round to heart-shaped leaves
  - Shallow scalloped edges (wavy)
  - Stem supports several leaves
- Bright yellow, showy flowers
  - Five petals
- Native Floating Heart
  - Little Floating Heart (*N. cordata*)
- **Control Options:**
  - Hand pulling
  - Topical herbicides

*Nymphoides peltata*



## Floating Plants: **Invasive**

- All three are free-floating
- Popular Ornamental
- Create nuisance stands in quiet waters
- Similar to “giant duckweeds”
- Not Common in NJ
- **Control Options:**
  - Hand Pulling
  - Topical Herbicides
  - Not typically hardy



**European Frogbit** (*Hydrocharis morus-ranae*)



**Water Lettuce** (*Pistia stratiotes*)



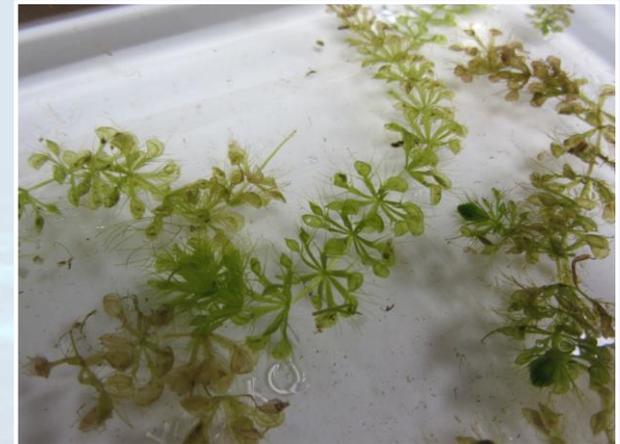
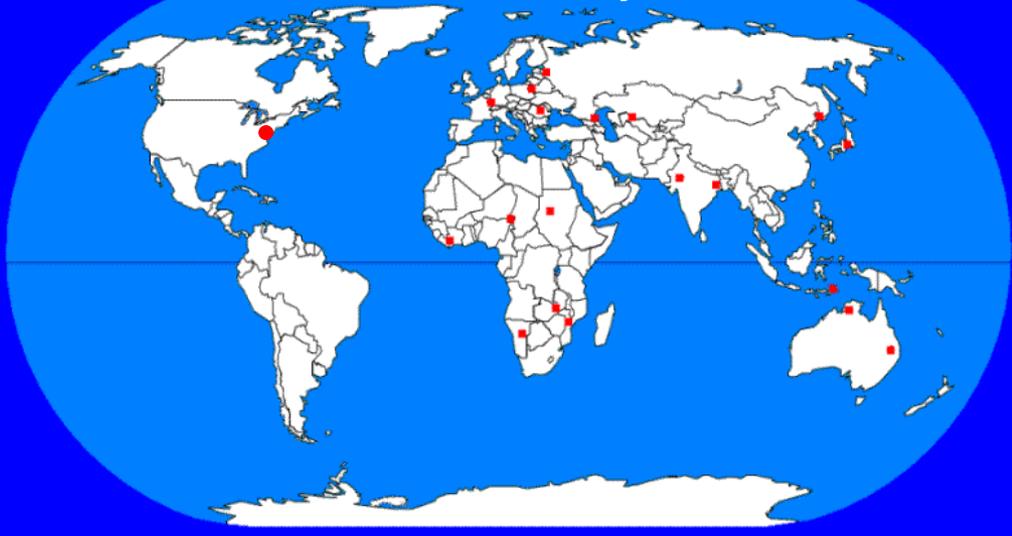
**Water Hyacinth** (*Eichhornia crassipes*)

# Floating Plant: **Waterwheel**

- Family: Droseraceae (sundews)
  - Most common: Venus Flytrap (*Dionaea muscipula*)
  - Carnivorous plant
- Native to Europe, Africa, Asia and Australia
  - Scattered distribution and dwindling
  - Less than 50 sites left throughout its range
- Never Officially Documented in North America!
  - Hellquist and Les (personal communication, 2012)



*World-wide Distribution of Aldrovanda*

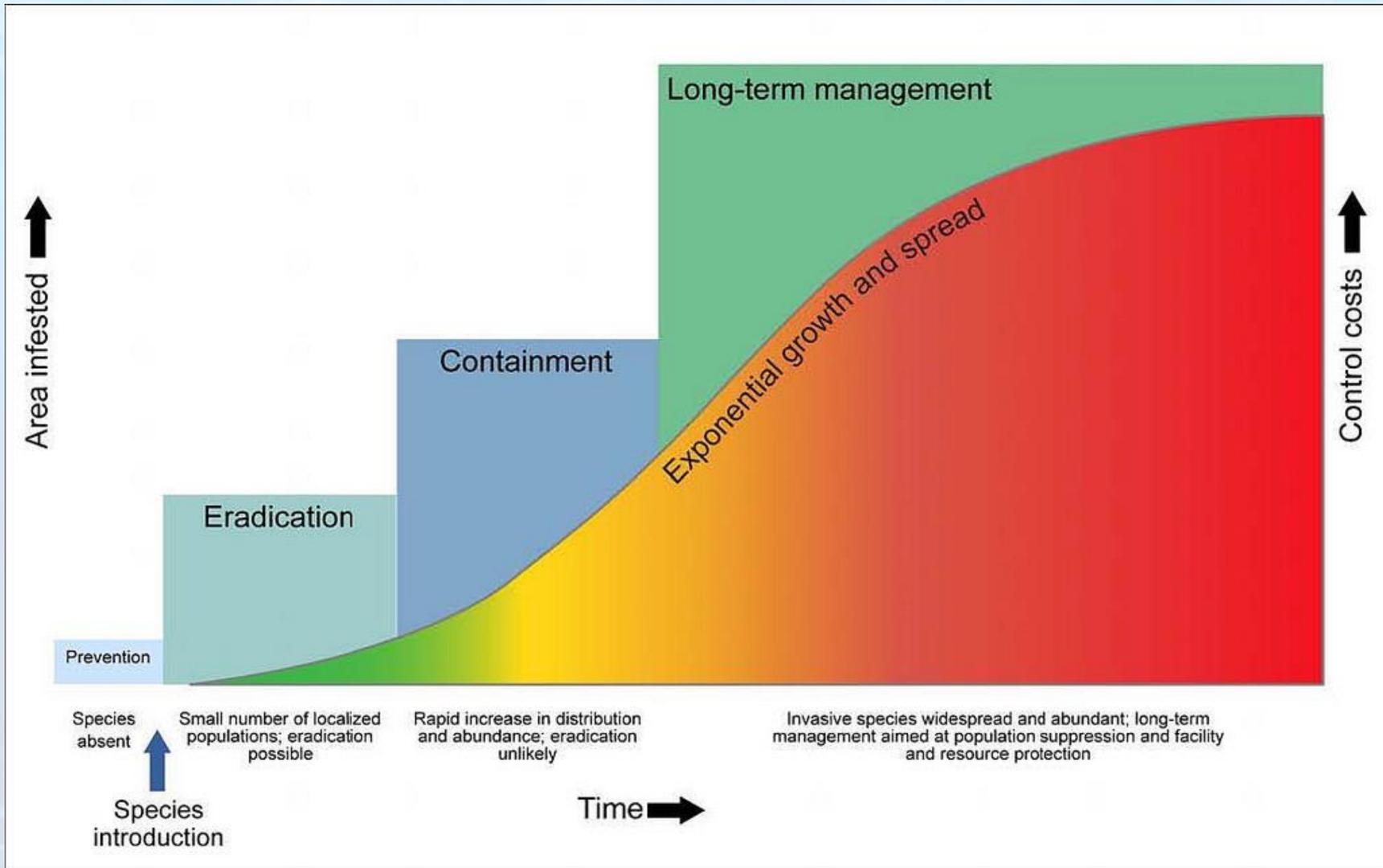


*Aldrovanda vesiculosa*

## Floating Plant: **Waterwheel**

- 2012: Discovered in NJ
- 2013: Confirmed in NY
  - Documented in Peer-reviewed Journal
- 2016: Documented as a Nuisance in VA
  - Fort AP Hill, VA
  - North Carolina State University
- 2017 Task Force Created
  - White Paper Draft: Control Options?





Sources: National Invasive Species Council; U.S. Department of Agriculture; National Park Service; U.S. Fish and Wildlife Service; Rodgers, L, South Florida Water Management District; Department of Primary Industries, State of Victoria, Australia; and GAO. | GAO-16-49

# Thank you! Questions?

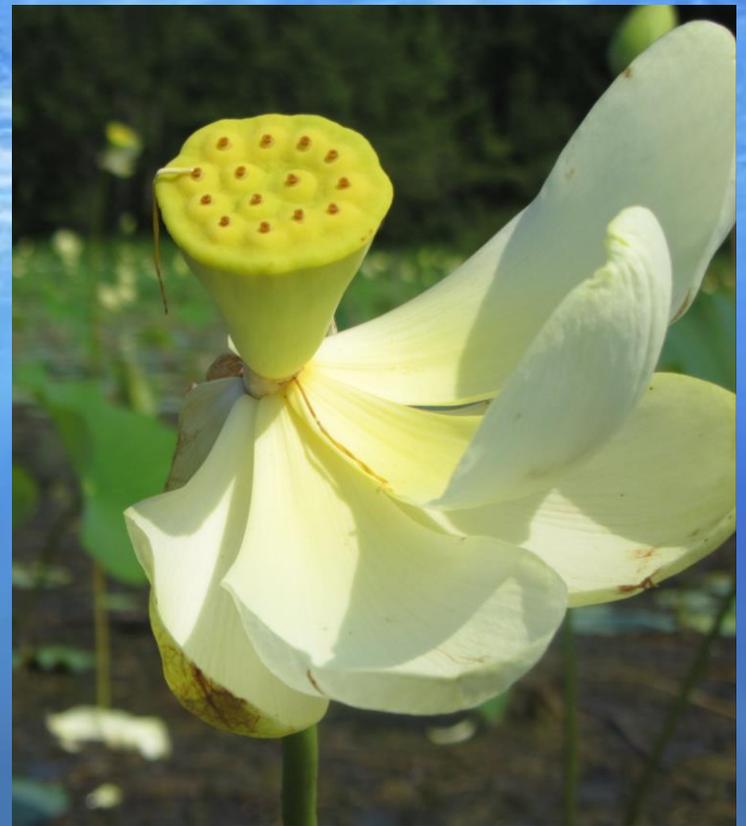
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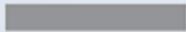
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October 19, 2017

# AQUATIC PLANT MAPPING USING POINT INTERCEPT METHODS (PIM)

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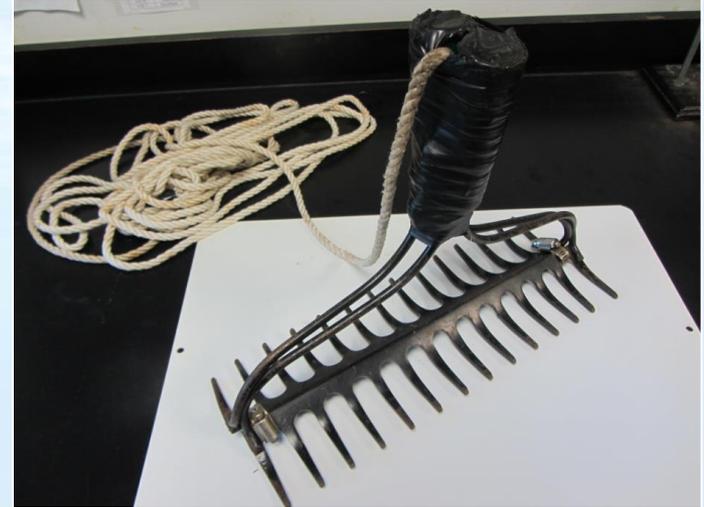
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# Types of Aquatic Plant Surveys Used by Lake Managers

- **Visual Surveys**
  - Commonly Used, Easy to Perform
  - Difficult to Quantify Results/Repeat
- **Biomass Sampling**
  - 1 meter quadrant
- **Transect Sampling**
- **Remote Sensing**
- **Point Intercept Method**
  - Developed by ACOE (Technical Note MI-02: 1999)



# Point Intercept Aquatic Plant Survey (PIM)



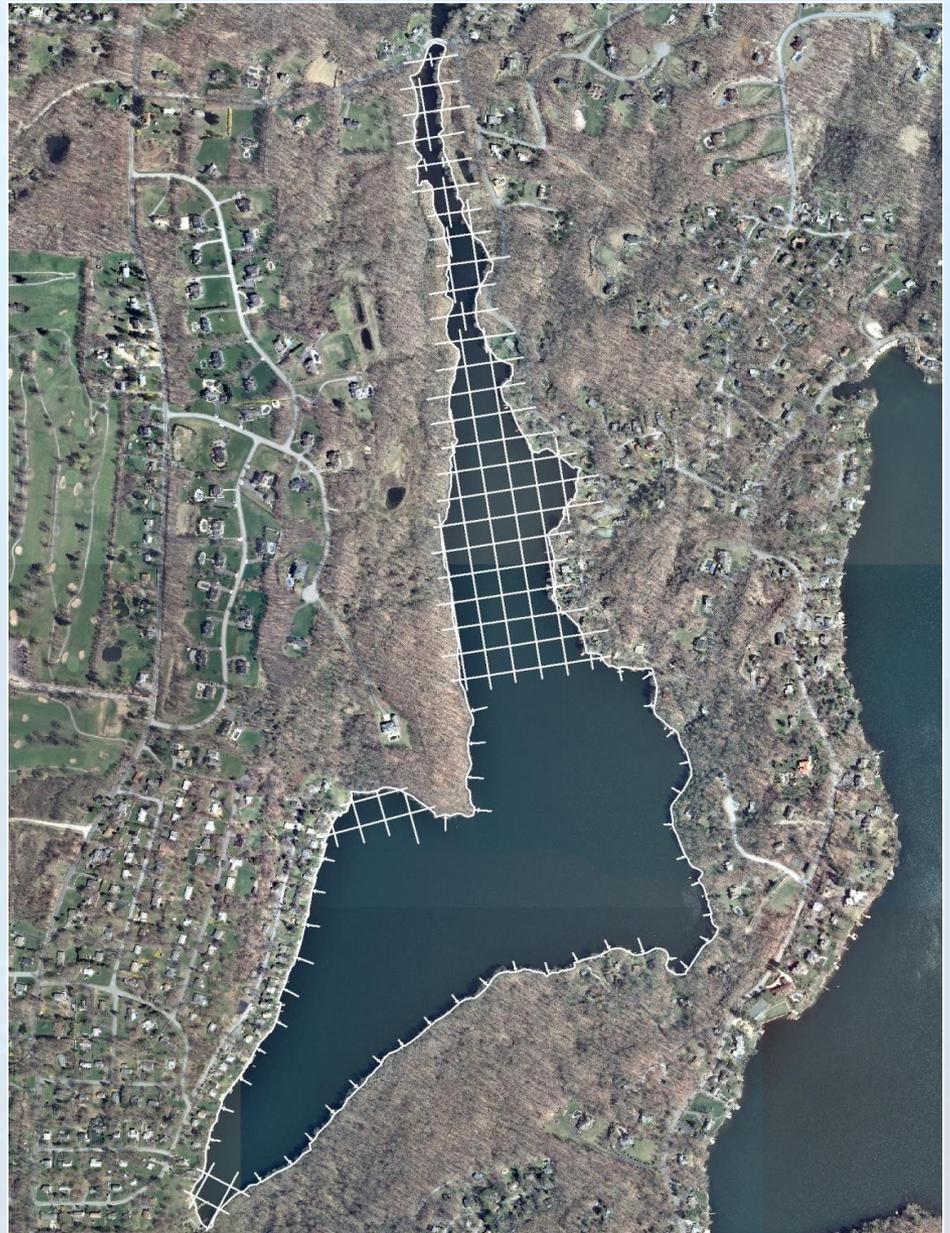
- **Developed by ACOE**
  - Modified by Cornell University
  - Tweaked by SLM
- **Accepted Methodology by Regulators**
  - Recommend one survey location/hectare
  - We target 1+ per littoral zone acre (100/day)
- **Assign Plant Mass Densities**
  - No plants, trace, sparse, medium, dense
  - Assigned to overall plants (Submersed and Floating)
    - Then assigned to each different plant species
    - Data presented as a compendium of maps

Abundance	Abundance #	Dry Weight (g/m <sup>2</sup> )	Mean Weight (g/m <sup>2</sup> )	Description
No Plants (“0”)	0	0.0	0.0	Bare Rake
Trace (“T”)	1	~0.0001-0.9999	0.5	Finger-full
Sparse (“S”)	2	~1.0000-24.9999	13.0	Hand-full
Medium (“M”)	3	~25.0000-99.9999	62.5	Covers Rake
Dense (“D”)	4	~100.0000-400.0000+	250.0	Difficult to get plant mass into the boat



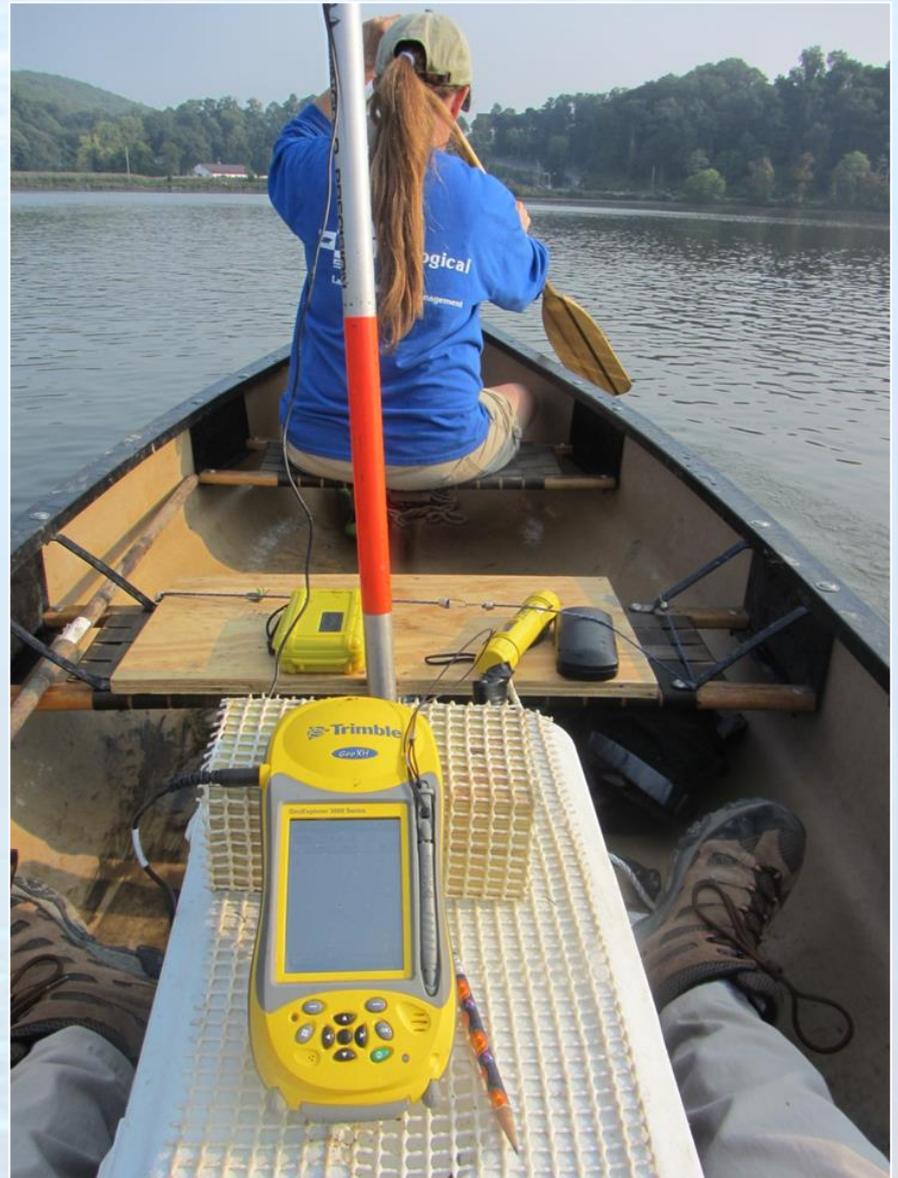
# Overlay Grid on the Littoral Zone

- **50 meter Grid**
  - Vary based on project site
  - Smaller = more sampling
  - Larger = less sampling
- **# of Weed Rake Tosses**
  - One, Two or Three
  - More Tosses = increased chance of finding Target or RTE species
  - But means more effort and reduced overall abundance



# Field Equipment

- **GPS Unit**
  - GeoXH Handheld
  - Sub-foot accuracy
  - External Antenna
  - ~ 20 cm post processing
- **Canoe Use**
  - Difficult Access
  - Tidal Sites
  - Shallow Water
  - Heavy Floating or submersed plant growth



# Percent Distribution Table

## Aquatic Macrophyte Abundance Distribution September 22, 2015

Aquatic Macrophytes	Total		Trace		Sparse		Medium		Dense	
	Sites	%	Sites	%	Sites	%	Sites	%	Sites	%
Total Sites	50	100%								
Overall Plant Abundance	40	80%	8	20%	5	13%	13	33%	14	35%
Small Duckweed	33	66%	19	58%	10	30%	2	6%	2	6%
Brittle Naiad	31	62%	5	16%	9	29%	9	29%	8	26%
Eurasian Water Milfoil	29	58%	13	45%	10	34%	5	17%	1	3%
Coontail	18	36%	16	89%	1	6%	1	6%	0	0%
Great Duckweed	16	32%	14	88%	2	13%	0	0%	0	0%
Northern Naiad	16	32%	8	50%	6	38%	2	13%	0	0%
Water Chestnut	15	30%	8	53%	5	33%	1	7%	1	7%
Spatterdock	6	12%	4	67%	2	33%	0	0%	0	0%
Wild Celery	4	8%	3	75%	1	25%	0	0%	0	0%
Water Stargrass	4	8%	4	100%	0	0%	0	0%	0	0%
Benthic Filamentous Algae	3	6%	2	67%	1	33%	0	0%	0	0%
Common Waterweed	2	4%	1	50%	0	0%	1	50%	0	0%

# Sample Abundance and Distribution Map

- Project Maps
  - Sample Station
  - Water Depth
  - Total SAV
  - Each Individual Plant

## For Example:

If a site has 17 different aquatic plants; 20 total maps will be produced



ALCYON LAKE  
Aquatic Vegetation Survey  
August 28, 2014

87 sampling points

Plant Density

- = No Plants
- ⊙ = Trace Plants
- ⊖ = Sparse Plants
- ⊕ = Medium Plants
- ⊗ = Dense Plants

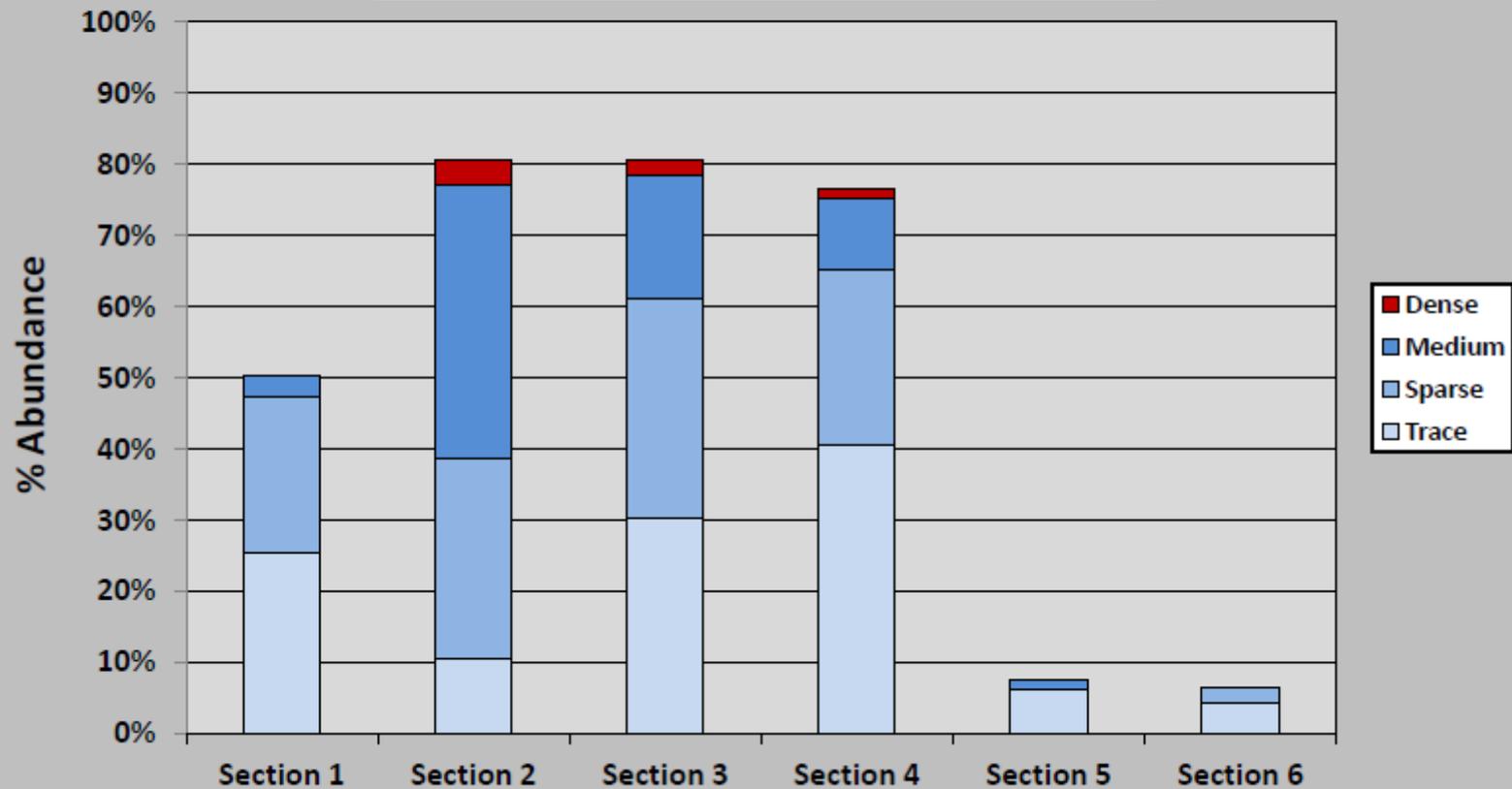
Percent Distribution

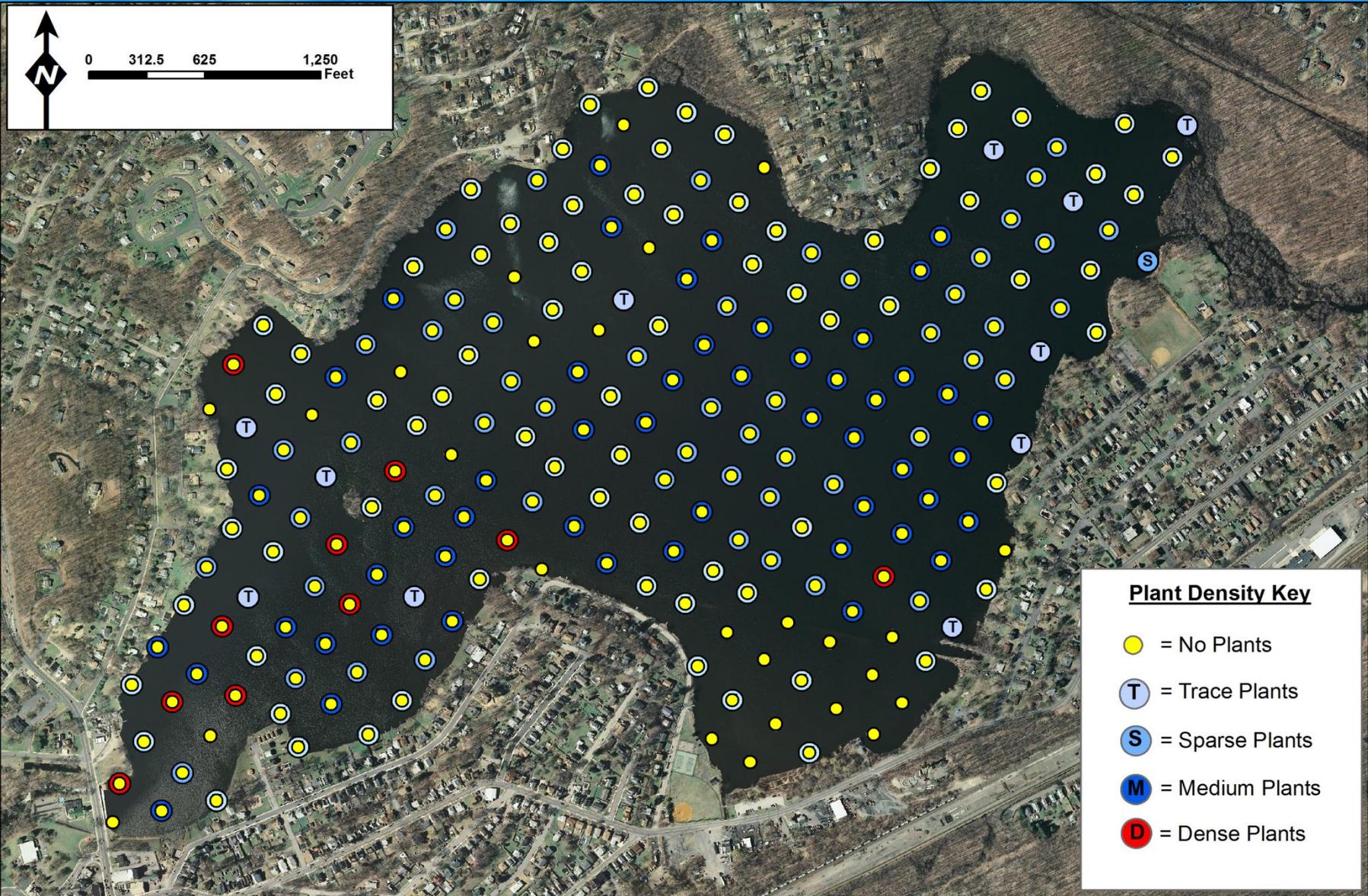
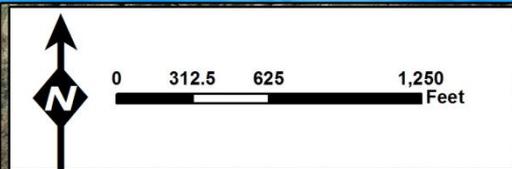
Abundance	Sites	Percent
Total	79	91%
Trace	20	25%
Sparse	30	38%
Medium	12	15%
Dense	17	22%

# Advantages of PIM Plant Mapping

- **Standard Method**
  - Important Part of Large Control Projects
- **Repeatable**
  - Suitable to track abundance and distribution of specific plants over time
  - Pre and Post SAV Control Efficacy
  - Site Comparisons
- **Can be Conducted by Volunteer Groups**
  - **Limitations:** GPS capabilities and Plant ID Skill

**Wild Celery (*Vallisneria americana*)  
Percent Abundance by Section  
D&R Canal**





**Plant Density Key**

-  = No Plants
-  = Trace Plants
-  = Sparse Plants
-  = Medium Plants
-  = Dense Plants

**Eurasian Water Milfoil (*Myriophyllum spicatum*) Distribution  
Lake Musconetcong Aquatic Vegetation Survey**

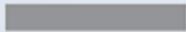
**September 20, 2010**

# Thank you! Questions?

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