Biology and Control of Nuisance Aquatic Plants

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AQUATIC BIOLOGIST – AQUATIC CONTROL
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Outline

- Introduction to Weed Science
  - What is a weed?
  - What is an invasive plant?
  - Invasion Ecology
- Biology and Control of Major Invasive Aquatic Plants
  - Regionally relevant species
    - Submersed
    - Floating
    - Emergent

Introduction to Weed Science

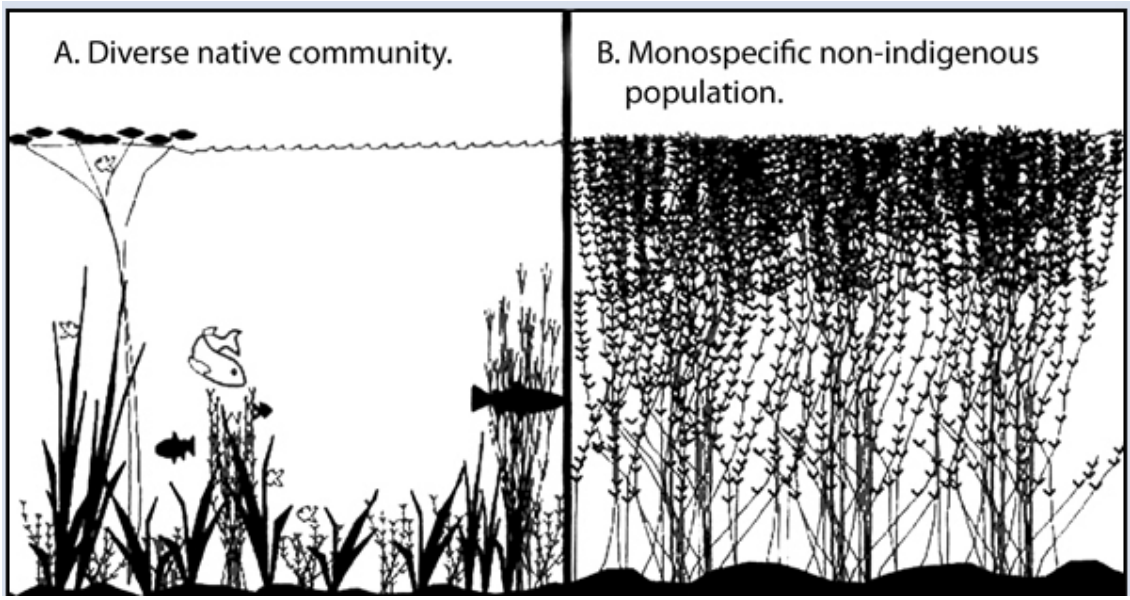
- What is a weed?
  - Any plant that originates under a natural environment that has been imposed or disturbed and interferes w/ human activity
- Human dimension of weed science
  - Human dependence on agriculture
    - w/o humans there are no weeds
  - Individual interpretation of interference
    - One person's trash is another's treasure
    - Especially true in aquatics

What is an invasive plant?

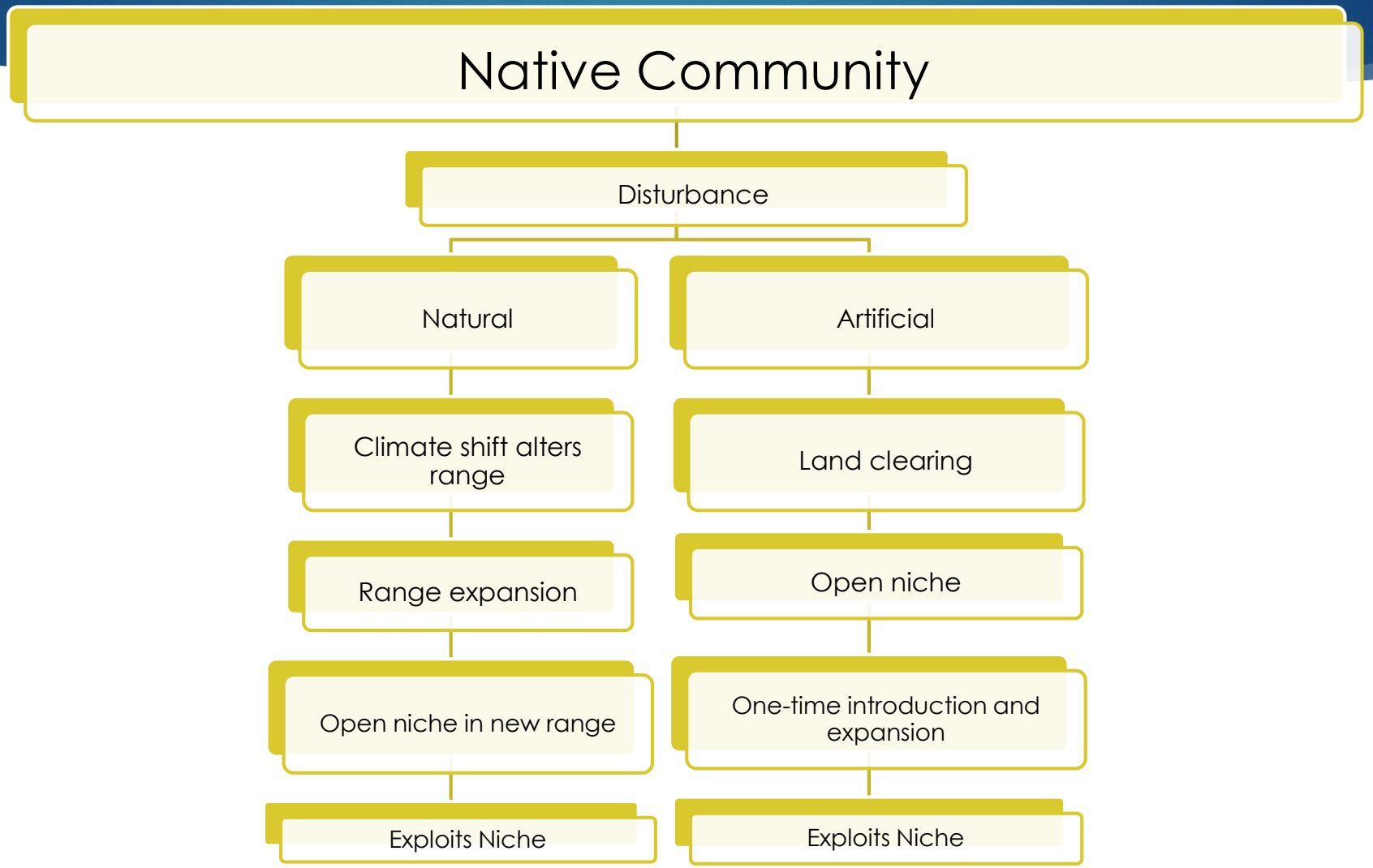
- A plant that is non-native to a specific ecosystem, whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
  - Can be exotic (sourced from another country) or 'native'
  - Problem since international travel and commerce
- Impacts
  - Direct competition for resources with other native plants
  - Decrease recreation opportunities
  - Degrade water quality
  - Degrade habitat

What makes a plant invasive?

- Why is the plant a problem here but not 'there'
  - Invasion Ecology
    - New field of study (~60 years)
- Numerous hypotheses
  - Escape from predation
  - Open niche
  - Evolutionary constraints (adaptive trough)
    - Natives often sub-optimally adapted for environment
    - Outcompeted by invasives in same environment.



How do plant invasions happen



Invasive Aquatic Plants of Iowa

- Brittle Naiad
- Eurasian watermilfoil
- Curly leaf pondweed
- Flowering Rush
- Purple Loosestrife
- Salt Cedar
- Yellow Floating Heart
- Hydrilla
- Water Soldier
- Water chestnut
- Starry Stonewort*

Brittle Naiad

NAJAS MINOR

Brittle Naiad *(Najas minor)*

- Identification
  - Rooted submersed plant
    - Bushy appearance, up to 4 feet long
  - Long, slender leaves at end of stems
    - Green to olive in color
    - recurved
  - Leaves are thin and stiff with toothed edges
    - 1-2 inches long
  - Very fragile, fragments easily
- Habitat
  - Shallow, slow or non-moving water <10' deep
  - May grow deeper if water is clear
    - Murky water will slow growth
    - Strong currents will slow growth

Brittle Naiad

- Biology
  - Annual plant
  - Native to Europe, west Asia, North Africa
    - Suspected ship ballast water discharge or contaminated cultivated species
- Spread
  - Primary-Seeds
    - Flowers pollinated by water movement
    - Seed set in late Summer (August)
    - Seeds do not move in the water
      - Will regrow year after year in same place
  - Secondary- fragments
    - Float around and can result in new patch infestations
    - Can occur at any time of growth stage
    - Caused by physical contact or disturbance
      - fish nesting (lots of carp and catfish), strong current, waterfowl feeding, boat motor contact, etc.

Brittle Naiad- Management

- Cultural
  - Preventive measure in place
- Mechanical/Manual harvesting
  - Spread fragments, disturb sediment
  - Difficult to collect all plant material
    - May cause seeds to germinate from disturbance
    - Will cause fragment spread
- Biological control
  - No 'classical' bio control agents
  - Grass carp 'general' bio control
    - May cause spread/fragmentation from feeding
    - Eventually metabolism slows and control is reduced

Brittle Naiad- Management

- Grows very aggressively
- Not difficult to kill, long term control is challenge
- Contact Herbicides
  - Work very well in small isolated systems, or large patches
  - Reward, Clipper, Komeen/Nautique, Aquathol K
    - Fast acting
  - Need to be applied at first sign of growth and often
    - Plan on at minimum of monthly treatments from late June- August
- Systemic herbicides
  - Sonar (prevents protective pigments from forming, Chlorophyll degrades)
    - Slower acting
    - Translocated
    - May prevent seed development
  - Can be applied prior to mature growth
    - Preemergent
      - Early June, monitor and 'bump' as needed
    - Need to maintain concentration longer to control initial growth and any seed sprouting

Eurasian watermilfoil

MYRIOPHYLLUM SPICATUM

Eurasian watermilfoil *(Myriophyllum spicatum)*

- Submersed aquatic plant
- Long green to reddish stems, branching
  - Feather-like leaves, whorled at nodes
    - 9-21 pairs of leaflets
- Flower spikes
  - Small, white,purple, pink or reddish flowers

The Solutions for Lake Problems

AQUATIC CONTROL Est. 1966

Eurasian watermilfoil *(Myriophyllum spicatum)*

- Introduced from Europe in the 1940's
  - Suspected aquarium trade release
- Reported in 48 states
  - Estimated 126,000 acres in IA
- Quickly spreads through fragments
  - Canopy former with peak growth of 12.5 inches/day
  - Out competes native plants
- Hybridizes with natives
  - Often more tolerant to herbicides

Eurasian watermilfoil

- Control methods
  - Cultural
    - Clean, Drain, Dry. Boat wash stations
  - Biological
    - No consistently effective biocontrol
    - Weevils have been occasionally effective in small areas
      - Small fish love to eat them!
  - Physical
    - Drawdowns can reduce or prevent growth.
    - Benthic barriers will work in small areas

Eurasian watermilfoil

- Control methods
  - Mechanical
    - Effective for small areas
      - contribute to spread of fragments
  - Chemical
    - Many options
      - Selective: 2,4-D, Renovate, ProcellaCOR EC*, Sonar
      - Non-selective: Reward, Aquathol K, Clipper, Stingray

Curly-leaf pondweed

POTAMOGETON CRISPUS

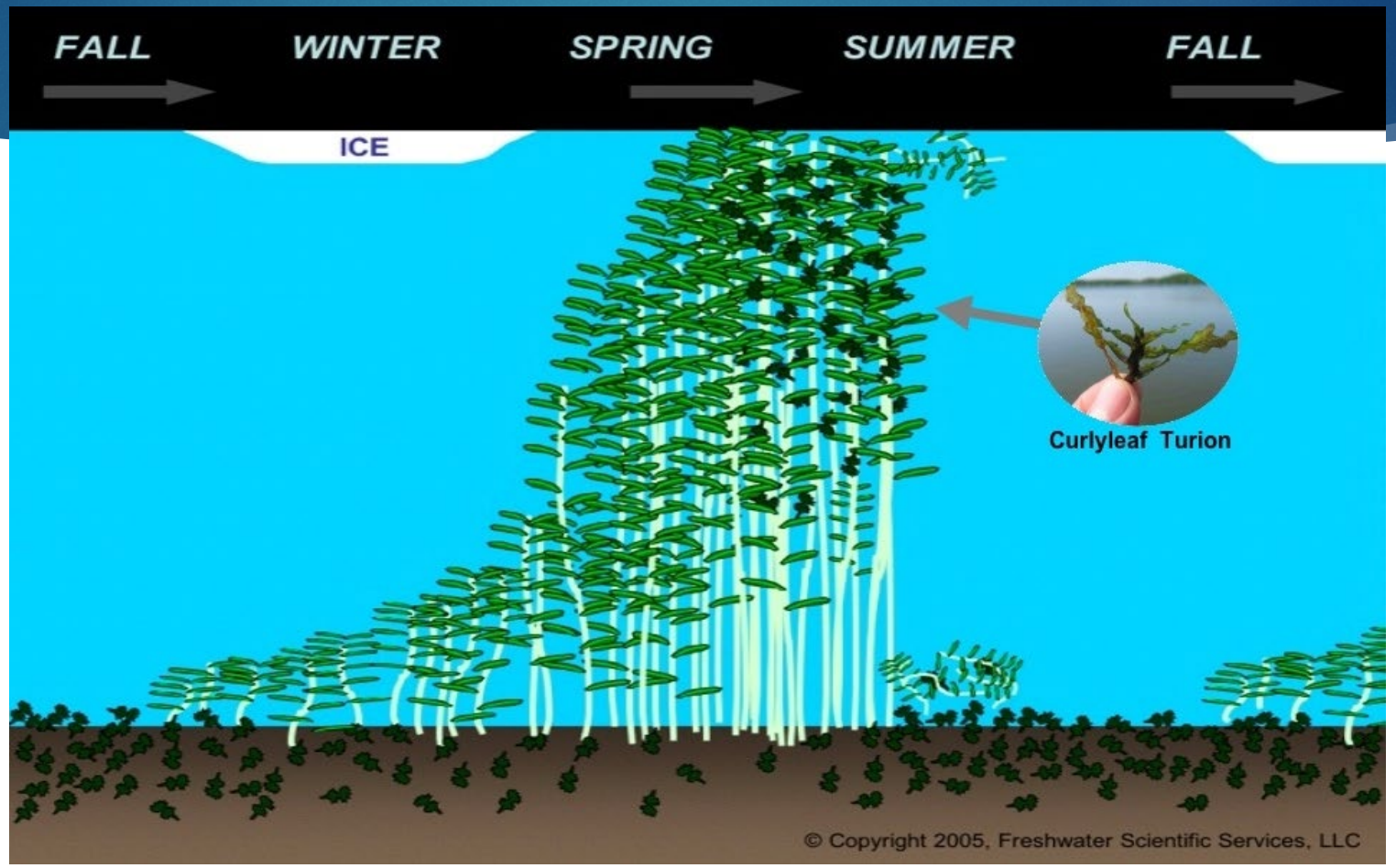
Curly leaf pondweed *(Potamogeton crispu*

- Wavy leaves
- Serrated edges
  - Blunt tip
- Prominent midvein
  - Reddish in color
  - 3-5 veins

Curly leaf pondweed *(Potamogeton crispus)*

- Introduced from Europe in 1800's
- Found in 47 states
- Forms dense monocultures
  - Crowd out native species
- Reproduction by turion formation, fragmentation
  - Turions sprout in fall and winter, grow rapidly in spring, senesce in summer
  - Turions dormant for up to 5 years

Curly leaf pondweed life cycle



Source: http://www.freshwatersci.com/Blog/2014/04/30/what-happens-to-lake-plants-in-the-winter/

Curly leaf pondweed

- Control methods
  - Cultural
    - Clean, drain, dry. Wash boats, clean trailers
  - Biological
    - No classical biocontrol
    - Grass carp
  - Physical
    - dredging may help remove turions,
    - benthic barriers prevent sprouting in small areas
    - drawdowns

Curly leaf pondweed

- Control methods
  - Mechanical
    - will not remove turions.
    - Spread fragments
  - Chemical
    - Systemic: Sonar, Galleon
      - Most effective early in growth cycle
      - Can be done through the ice
    - Contact: Aquathol K, Reward, Coppers, Clipper
      - Spot treatment or large area
      - Aquathol K very effective at low doses
      - Apply early to prevent turion formation

Flowering Rush

BUTOMUS UMBELLATUS

Flowering rush *(Butomus umbellatus)*

- Native to Eurasia
  - 1918 first confirmed in US
- Easiest to ID when in bloom
  - Triangular, green stems
  - Leaves, erect, spiraled at tips
    - 5' above water level
  - Stems end in umbrella shaped flower cluster
  - Each flower with 3 pink/white petals 1" across

Flowering rush

- Reproduction
  - Some viable seed production
  - Creeping rhizomes
    - Bulblets develop and break away to form new plant
    - Spread by current, wildlife, humans
- Impacts
  - Competes with natives
  - Obstacle for boaters
  - Slows water movement
  - Hardiness capable of being highly invasive

Flowering rush control

- Cultural
  - Do not buy/plant
  - Clean boats/equipment after use
- Physical
  - Draw downs will be ineffective
  - Planting open areas with native vegetation
- Biological
  - None currently
    - Research underway with weevils

Flowering rush control

- Chemical
  - Systemic: AquaPRO, Habitat, Clearcast, Renovate 3
    - Clearcast, Renovate 3 if selectivity is needed
  - Contact: Reward & Stingray
- Mechanical
  - Harvesting
    - Must harvest below surface
    - slows spread
  - Hand digging
    - Isolated patches

Purple loosestrife

LYTHRUM SALICARIA

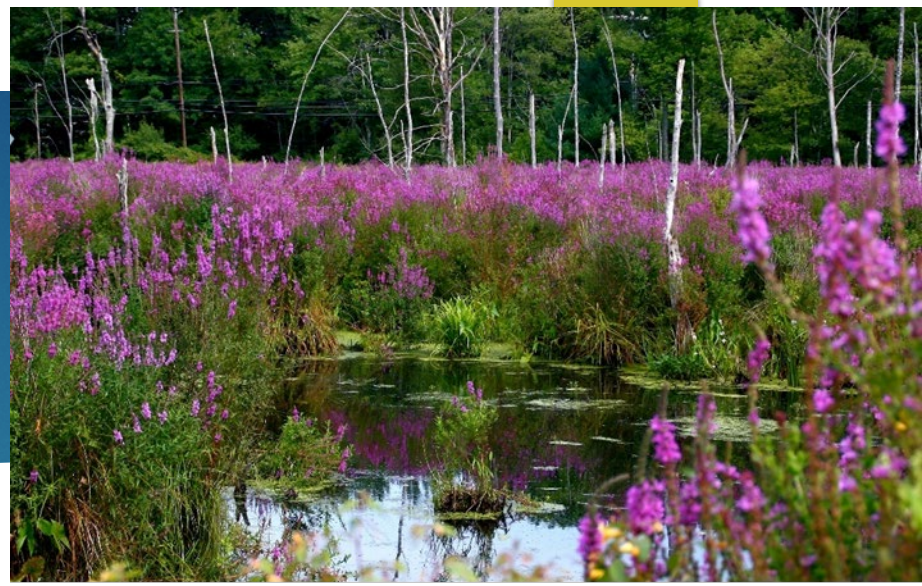
Purple Loosestrife *(Lythrum salicaria)*

- Hardy Perennial
  - Stiff stems
  - 4-6 sided
  - Up to 7' tall
- Purple flowers
  - Long spikes
  - June-September
  - >2,000,000 seeds
- Leaves
  - Smooth margins
  - Opposite arrangement
  - Alternate down stalk at 90* angles

Purple Loosestrife *(Lythrum salicaria)*

- Native to Europe
  - Introduced in 1800's ornamental planting
- Spread by seed and rhizome
  - Produces monoculture stands
  - Eliminates food and cover for many species of wildlife
  - Commonly observed in roadside ditches

Purple Loosestrife control



- Cultural
  - Do not buy or plant
    - Illegal in many states
- Physical
  - Fire, not effective (seed bank)
  - Dig small isolated patches
- Biological
  - *Galerucella calmariensis, G. pusila*
    - *Leaf eating beetles*
    - *>$ spent in testing and releases than in chemical control*

Purple Loosestrife control

- Mechanical
  - Mowing, not effective
- Chemical
  - AquaPRO, Habitat, Renovate 3, Clearcast

Salt Cedar

TAMARIX SPP.

Saltcedar *(Tamarix spp.)*

- Shrub
  - 5-20’ tall
- Flowers
  - Petals in groups of 4-5
  - White-pink color
- Leaves
  - Small
  - Alternate
  - Scale-like

Saltcedar *(Tamarix spp.)*

- Temperate and tropical regions of Asia
  - 8 species listed as introduced in US
- Spread
  - Vegetative propagules
    - Adventitious roots
    - Submerged stems
  - Seed
    - Wind and water dispersal

Saltcedar control

- Cultural
  - Do not buy or plant
    - Illegal in many states
- Physical
  - Only effective if root crown is removed
  - Fire is ineffective
- Biological
  - Leaf eating beetle (*Diorhabda elongatata*)

Saltcedar control

- Mechanical
  - Must remove root crown
- Chemical
  - Habitat, Renovate3, in aquatic sites
    - Possible use for ProcellaCOR
    - Milestone (aminopyralid) in terrestrial

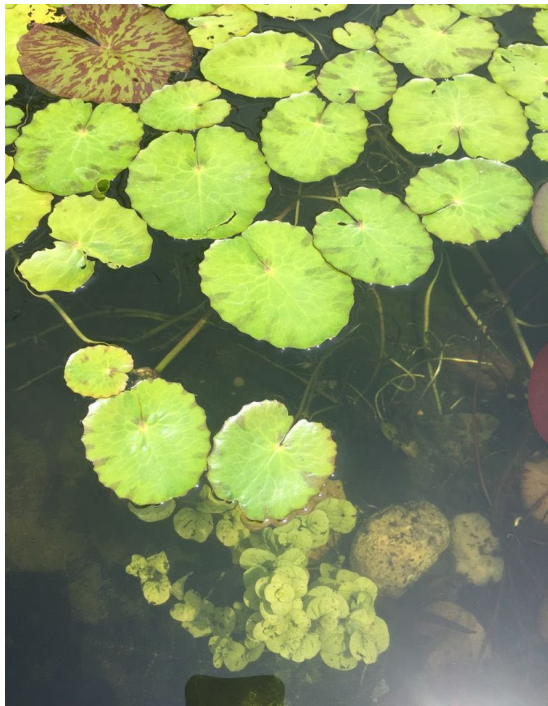
Photo courtesy of Ralph Whitesides

Yellow Floating Heart

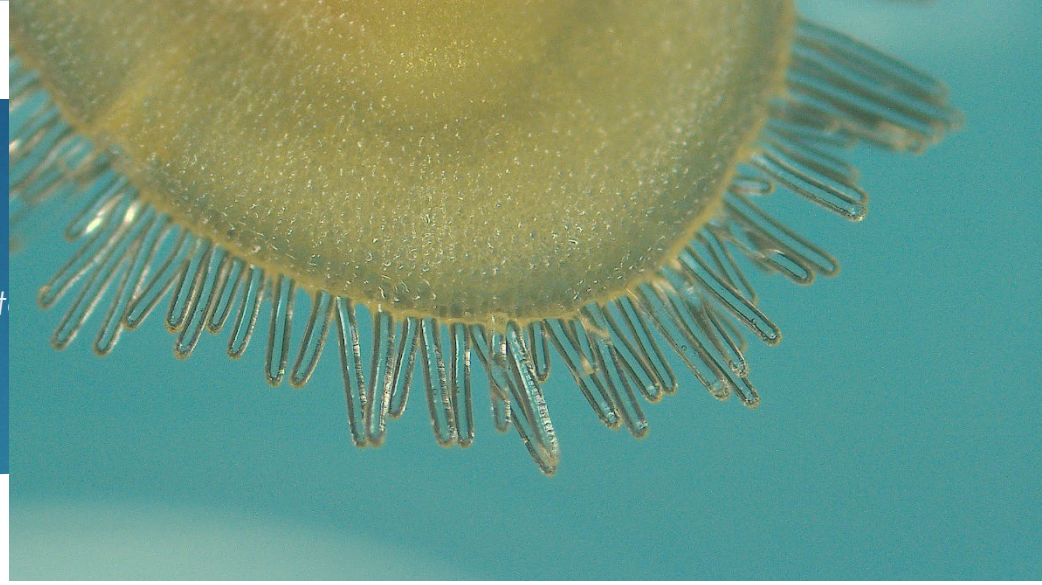
NYMPHOIDES PELTATA

Yellow floating heart *(Nymphoides peltata)*

- Identification
  - Rooted in sediments
    - Long stolons
  - Heart-shaped leaves with scalloped margins
    - Purple underside
    - Limp (challenge when using foliar applied herbicides)
  - Yellow flowers
    - Fringed

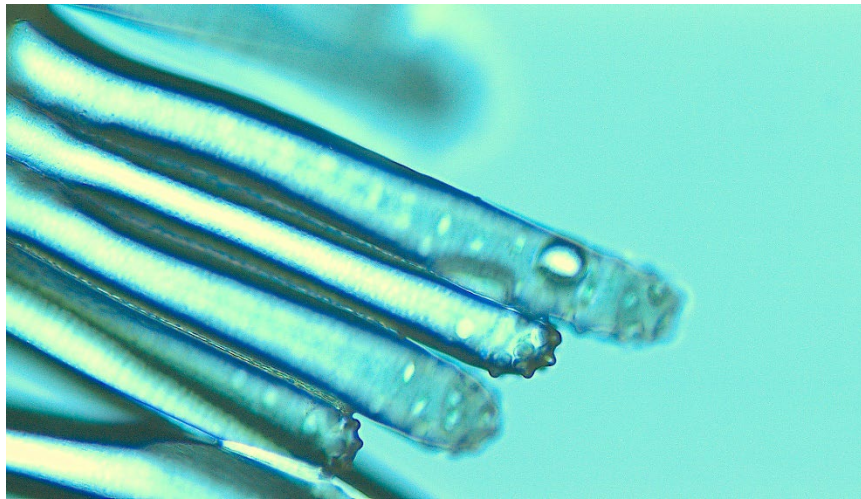


Yellow floating heart *(Nymphoides peltat*



- Native to Asia and Southern Europe
  - Early 1900's in US
    - Water garden industry ornamental
  - Extremely hardy

- Spread
  - Fragmentation and Seeds
    - Self compatible
    - Hollow trichomes allow seeds to float, stick to fur/feathers



Yellow floating heart control

- Cultural
  - Buy/Plant native lilies instead
- Physical
  - Winter draw downs
- Biological
  - None known

Yellow floating heart control

- Chemical
  - AquaPRO, Habitat, Clearcast, Renovate 3, 2,4-D, Galleon, ProcellaCOR
  - Reward, Aquathol K or Hydrothol 191, Clipper
  - Long term control is the largest challenge
- Mechanical
  - Harvesting/digging to remove
  - Will not remove all seeds

Hydrilla

HYDRILLA VERTICILLATA

Hydrilla *(Hydrilla verticillata)*

- Introduced from Asia to Florida in the 1950's
  - Aquarium plant trade
- The "perfect" aquatic weed
  - Multiple methods of spread
  - Fast growth
    - Peak rate of 191" total growth per day- Netherland and Glomski, 2012
  - Low light requirement
- Documented in 29 states
- Monoecious and Dioecious
  - Dioecious in the south US
    - Heavier stems, more robust appearance
    - 80% of biomass in top 2' of water column
  - Monoecious in the North US
    - Fragile appearance, thin stems
    - Biomass allocated throughout the entire water column

Hydrilla *(Hydrilla verticillata)*

- Leaves whorled around stem at nodes
- 5 leaves per whorl
  - Serrated margin and midvein
- Flowers form late summer from leaf axils
  - Very small

Hydrilla

- Control methods
  - Physical
    - Drawdowns provide temporary relief in the north
      - Tubers persist
  - Biological
    - Insect options have not been successful
    - grass carp will consume, widely used in the south
  - Cultural
    - Clean, Drain, Dry

Hydrilla

- Control methods
  - Mechanical
    - harvesters used to keep boating lanes open
      - Spread of fragments, biomass disposal
  - Chemical
    - Sonar, Galleon, Tradewind, ProcellaCOR,
    - Aquathol K, Copper, Reward, Clipper
    - Long term control/erradication takes time

Water Chestnut

TRAPA NATANS

Water chestnut *(Trapa natans)*

- Native to Eurasia
  - 1874 in US, Harvard garden
  - 'naturalized' to areas of NE U.S.

- ID
  - rosette of floating leaves
    - ½ to 1 inch long, at the tip of a long submersed stem
  - The flowers have four white petals
    - 1/3 inch long.
  - fruit is a black, four horned, nut

Water chestnut *(Trapa natans)*

- Spread
  - Vegetative and seed production
  - Fruits fall to the sediment overwinter
  - One acre of water chestnut can produce enough seeds to cover 100 acres the following year.
  - Each seed can give rise to 10-15 rosettes and each rosette can produce as many as 20 seeds.
  - Seeds can remain viable for up to 12 years.

Water Chestnut Control

- Cultural
  - Do not buy (banned)
  - Do not move seeds
- Physical
  - Draw downs to expose seeds/biomass
  - Hand removal
- Biological
  - Some tried but unsuccessful

Water Chestnut Control

- Mechanical
  - Harvesting removes biomass, misses seeds
  - Hand pulling, injury risk
- Chemical
  - 2,4-D, Renovate 3, Reward, Clearcast, AquaPRO

Starry stonewort

NITELLOPSIS OBTUSA

Starry Stonewort *(Nitellopsis obtusa)*

- First documented in 1978.
  - Likely introduced from ballast water discharge
- Macrophytic alga
  - Long variable length branches, internodal cells
  - Forms dense beds ‘pillows’ up to 6’ tall
  - White, star-shaped bulbils (reproductive structure)
  - Outcompetes native plants
  - Possibly creates phytotoxic conditions
  - Destroys spawning areas

Starry stonewort

- Control methods
  - Cultral
    - Clean drain dry, boat ramp stewards
  - Physical
    - benthic barriers will work in small areas, drawdowns expected to work
  - Biological
    - None

Starry stonewort

- Control methods
  - Mechanical harvesters can quickly reduce biomass in shallow water
    - Misses bulbils
    - Fragments
  - Chemical
    - Copper chelates (Cutrine, Captain), Clipper, Hydrothol 191
    - All are effective, no long term solution yet
    - Apply early and often
    - Small infestations easier than large

Summary

- Invasive species pose a serious threat to aquatic ecosystems
  - Many species of interest
  - Many important uses of water
- Effective educational efforts
  - Public awareness and support
  - Increased reporting
- Responsible, Integrated management programs
  - Reduce environmental impact
  - Maximize efficacy

Questions?

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