Aquatic Weed Identification & Management

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Aquatic Plants

• Adapted to grow in standing water or saturated soils

• **Good because they:**
  – Stabilize shorelines
  – Absorb nutrients – improve water quality
  – Food source and habitat for pollinators & wildlife, especially ducks, fish
  – Plantings on banks deter Canadian geese
  – Can be attractive
Can Be Bad When Out of Balance

- Reduce habitat value, fish kills when out of balance
- Impede water flow
- Impede recreational activities
- Aesthetics, appearance
This started with one plant!!!
When Does a Plant Become a Weed?

Weed Definitions

• Weed Science Society:
  – “Any plant that is objectionable or interferes with the activities or welfare of people”

• A plant out of place
Why do some aquatic plants become weeds?

- Introduced from other regions or countries
  - No natural enemies to limit spread
  - Have a competitive advantage
- Aquatic habitats are vulnerable to disruption

Both native and non-native species of water primrose (*Ludwigia*) occur in NC.
Most Aquatic Weeds That Cause Serious Problems Are Non-Native

- Non-native plants that invade natural areas and displace native species are termed invasive.
- Many of our most threatening invasive species are aquatic.  

Giant Salvinia

In summer, can double its coverage every day!
What about native plants?

Native Plants
• Occur naturally in a region without human interference

Can they be weeds?
• Yes, particularly in non-native conditions
  – Man-made ponds, drainage canals

Variable Leaf Watermilfoil, *Myriophyllum heterophyllum*
Why do some aquatic plants become weeds?

Reproduce and spread rapidly
- Seed, fragments, roots

Large bodies of clear, shallow water
- High nutrient levels, esp. nitrogen and phosphorus
How do aquatic plants spread?

- **Human activities**
  - Wildlife plantings, boating, fishing enhancement, *aquarium dumping*, water gardens, dredging
- **Animals**
  - Wading birds, aquatic mammals
- **Water movement**
- **Transport by wind and rain**

Hydrilla
Why Do We Have to Manage Aquatic Weeds?

- Irrigation
- Drainage
- Flood control
- Water supplies
- Power generation
- Aesthetics
- Aquaculture
- Transportation
- Mosquito control
- Fishing/Recreation

NC 4th in nation for inland water area, 2690 sq. miles!
Types of Aquatic Plants

Functional Groups
- Emergent/Shoreline
- Rooted Floating (Emersed)
- Submersed
- Free Floating
- Filamentous Algae
- Planktonic Algae

Taxonomic Groups
- Blue-green algae (Cyanobacteria)
- Green algae
- Ferns (Azolla)
- Angiosperms
  - Broadleaf Dicots
  - Grasses, sedges, rushes
Algae

- Very simple structure - no stems, flowers, or roots
- Problematic in **clear, shallow water**
- Prolific in water with excess nutrients, especially nitrogen and phosphorous
  - Common sources: fertilizers, geese
Algae

Planktonic Algae
• ‘Pea Soup’
• Excess nutrients

Filamentous Algae
• Grow up from the bottom, “Moss”
Filamentous Algae

**Spirogyra**
- Bright green in spring, darker later in year
- Spiral chloroplasts
- Feels slimy

**Pithophora**
- Cottony masses – not slimy

**Lyngbya**
- Cyanobacteria
- Releases toxins, dermatitis
- Musky smell
- Invasive
Free Floating True Plants

- Float on water surface with roots dangling below
- Move freely on water surface
- Often very prolific
- Many aggressive weed species

Duckweed
Free Floating

Duckweed *Lemna spp.*
- Up to ¼”, small root

Watermeal *Wolffia spp.*
- Smaller, gritty
- No roots

- Wind will blow colony to one end of pond
- Often occur together
Floating Rooted (Emersed) Plants

Rooted in pond soil
- Leaves attached to long, tough stems, float on surface or emerge
- Flowers float on surface or emerge

Most are rhizomatous
- Spread rapidly

Can grow in 6’ of water or more
Floating Rooted (Emersed) Plants

Leaves growing underwater may differ from leaves growing above water

Variable Leaf Watermilfoil
*Myriophyllum heterophyllum*
Floating Rooted (Emersed) Plants

Spatterdock

Larger leaves; still water

Nuphar luteum ssp. luteum

Narrow leaves; flowing water

Nuphar luteum ssp. sagittifolium
Floating Rooted (Emersed) Plants

Water lily
*Nymphaea odorata*

American Lotus
*Nelumbo lutea*

Native, but both can quickly colonize shallow ponds
Watershield *Brasenia schreberi*

- Underwater parts covered in mucus or jelly like substance
- A.k.a. snotweed!
- Leaves float at water surface, backside red and slimy
- Non-showy flowers emerge out of water in summer
Submersed Plants

• Rooted in the bottom, can grow to depths of 10’+
• Leaves grow up through water
• Flowers may emerge above
• Native species provide habitat for fish
• Non-native species are some of our worst aquatic weeds
Coontail *Ceratophyllum demersum*

- Rootless – attaches to sediment by rhizoids
- One main, highly branched stem
- Feels rough and stiff
  - Denser towards tips
- Non-showy flowers stay submersed
- Duck food
- Habitat
Native Submersed Plants

- **Bladderworts** *Utricularia spp.*
- Carnivorous
  - Catch insects in underwater bladders
  - Stems photosynthesize
- Favors acidic water
- No true roots
- Yellow flowers in spring, above water
- Invertebrate habitat
Submersed Plants

Pondweeds *Potamogeton* spp.

- Several species
- Leaves float at water surface
- Non showy flowers emerge out of water
- Feed on by ducks
- Habitat for macro and micro invertebrates (fish food)
**Hydrilla Hydrilla verticillata**

- Rough to the touch
- Toothed leaf margins and midrib
- Leaves in whorls of 3-8
- Propagates by tubers & turions
- Adapted to low light conditions
- **NC’s most costly aquatic weed** > $1 million spent annually in control
Invasive Submersed Plants

**Brazilian Elodea Egeria densa**

- Smooth to touch
- Showy flowers
- Leaves in whorls of 3-6
- Less common than hydrilla
- Used in aquariums
- Not to be confused with native *Elodea canadensis*
Shoreline (Emergent) Plants

- Grow in shallow water (6” to 1’) with leaves and flowers held well above water surface
- Often grow up onto banks in moist soils
- Can tolerate periods of dryness
- **Native shoreline plants are rarely problematic**
Native Shoreline Plants

Many are attractive

• Natives may be planted

• **Blue Flag Iris**
  – *Iris virginica*
  – Shallow water

• **Swamp Mallow**
  – *Hibiscus moscheutos*
Native Shoreline Plants

Arrowhead/Duck Potato
*Sagittaria latifolia*

- Flowers in summer
- Rhizomatous and forms tubers
Shoreline Plants

Smartweeds *Polygonum spp.*
- Native perennial species

Nodding Smartweed
- *Polygonum lapathifolium*
- Non-native, annual

Ocrea
Shoreline Plants

Primrose *Ludwigia* spp.
- Many species, some native, some *non-native*
- Most perennial
- Summer flowers
- Alternate, variable-shaped leaves
- Flowers critical for ID

Creeping Water Primrose, *L. hexapetala* - non native
Invasive Shoreline Plants

Alligatorweed *Alternanthera philoxeroides*

- Spreads rapidly by seed or fragmentation
- Can be aquatic or terrestrial
- Aquatic forms have hollow stems
- Opposite leaves
- Flowers summer
Other Shoreline Monocots

Rushes *Juncus* spp.
20+ spp.
“Rushes are round”

Sedges *Carex* spp.
60+ spp.
“Sedges have edges”

Cattails *Typha latifolia*.
Form large monocultures
Aquatic Weed Identification

NC STATE UNIVERSITY
Aquatic Plants App

Download on the
App Store

GET IT ON
Google Play
Aquatic Weed Identification

Contact your local Extension Agent!

- Fresh sample
- In jar with water
- Wrapped in moist paper towels in a plastic bag
- Whole plant or sections with stems + several leaves
- Flowers and/or seed pods, if present

List of NCCE County Centers:
https://www.ces.ncsu.edu/local-county-center/

Chatham’s finest agent!
Integrated Weed Management

Choose combination of methods best suited to:

- Weed species
- Water use
- Budget
- Environmental issues & wildlife
- Aesthetics
Prevention

• Don’t plant weeds!
  – Avoid rhizomatous species

• **Inspect new plant material** for hitchhikers

• Don’t bring weeds in on equipment
  – Seeds, roots, fragments

Scouring Rush/Horsetail – spreads rapidly in shallow water and dry land
Disposing of Excess Plants

• Dispose of properly – allow them completely dessicate before disposal

• **DO NOT** “Give them a good home” in a nearby water body
Prevention
Cultural Control
Pond Dyes

- Not herbicides
  - Admiral Liquid®
  - Aquashade®
- Reduce sunlight
  - Filamentous algae
  - Submersed weeds
  - Not effective w/in 18 in. of surface
- No aquaculture
- No outflow
- Not for drinking water

Apply in early spring
Cultural Control
Pond Drawdown

- Requires water control infrastructure
- Done in winter
- Not selective, impacts other organisms
Cultural Control
Benthic Barriers

- Special fabrics block sunlight and inhibit germination of seed bank
- Broad spectrum
- Immediate effect
- Ideal near water intakes
- $3,000 per acre

This ain’t cheap…
Physical Control
Hand Removal

• Cheap, but labor intensive
  – Got friends?
• Plant ID critical
• Some my spread when fragmented
• Dry on-shore to reduce weight
Mechanical Harvesting
• Direct and immediate
• $400/acre
• Slow, temporary, ongoing
• Fragmentation and disposal

Hydro-raking
• Good control of rooted species
• Up to 12’ depths
• Fragmentation and disposal
Biological Control: Triploid Grass Carp

- Native to rivers of eastern Eurasia
- Herbivorous
- Sterilized
- Excellent control of many submersed weeds
Weeds Controlled by Triploid Grass Carp

1) Submersed plants
2) Tender shoots of some emergent or floating plants
Weeds Sometimes Controlled by Triploid Grass Carp

Duckweeds

Salvinia

Adults cannot feed on small plants

Watermeal

Azolla

High stocking rates (50-75 per acre) of juveniles required
Weeds NOT Controlled by Triploid Grass Carp

Alligatorweed

Lotus

Waterlillies

Filamentous Algae

Cattail
Using Triploid Grass Carp

Stocking Rates
• 10-15 per acre
• 10-20 per vegetated acre (large ponds)
• 8-10 in. long to avoid predation
• Live 5-10 years

Regulations
• Permit from WRC if >150 fish
• Notify WRC

Purchasing Grass Carp
• $7-10 per fish
• Licensed Suppliers:
  http://www.ncagr.gov/markets/aquaculture/grasscarp.htm
Aquatic Herbicides

- Must use herbicides labeled for use on aquatic plants
- “The Label is the Law”
- Refer to the label for specific instructions on application methods, applications amounts, target weeds, environmental hazards, and personal safety
Aquatic Herbicides

Application Methods

• Spray Shoreline
  – Small Ponds
  – Shoreline weeds
  – Emergent weeds

• Spray from boat
  – Larger ponds

• Weighted trailing hoses
  – Submersed weeds

• Granular spreaders
  – Copper sulfate crystals (algae)
Aquatic Herbicides
Applying the Right Amount

Surface Area Treatments
– Emergent and floating weeds

Acre-Foot Treatments
= Area x Depth x Rate
• Take average depth of pond

PPMW Treatments
= Area x Depth x 2.72 x PPM %
Active Ingredient

Estimate number of overlaid squares on large, irregular bodies
Avoiding Fish Kills

Most caused by oxygen depletion
• Hot weather cold water (O$_2$-depleted) turnover
• Algal or weed die-off
• Do not treat more than $\frac{1}{4}$-$\frac{1}{3}$ at a time!
  – If more than $\frac{1}{4}$ of pond is covered
  – If weedy area > 2 acres

Direct herbicide die-off rare
• Exception: copper algacides at high pH or in wrong amount
Selecting Herbicides

1) Know the right species
2) Understand use restrictions
3) Read the label
4) Read the label
5) Read the label again
Selecting Aquatic Herbicides: Correct Species Identification

• Herbicides vary in efficacy among species
• More closely related species respond similarly
Using the NC Ag. Chem. Manual

Selecting a Herbicide

Herbicides rated on efficacy of common species
- Excellent
- Good
- Fair
- Poor
- Insufficient Data
- Not Recommended
Herbicides may have waiting periods for use of pond water:

- Irrigation of crops or turf
- Fish Consumption
- Watering Livestock
- Swimming

### Table 7-22: Waiting Period (in Days) Before Using Water After Application of Herbicides for Aquatic Weed Control

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Irrigation</th>
<th>Fish Consumption</th>
<th>Watering Livestock</th>
<th>Swimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-D (various formulations and manufacturers)</td>
<td>Do not irrigate until concentrations are ≤ 1.0 ppm</td>
<td>No restrictions</td>
<td>Do not water livestock until concentrations are ≤ 1.0 ppm</td>
<td>No restrictions</td>
</tr>
<tr>
<td>Diquat (Rival)</td>
<td>1 to 14</td>
<td>No restrictions</td>
<td>0 to 1</td>
<td>No restrictions</td>
</tr>
<tr>
<td>Endosulfan (Lodan)</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>Flumioxazin (Glink)</td>
<td>0 to 5</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>Fluometuron (Maxima, Ultra)</td>
<td>1 to 30</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>glyphosate (AquaLiner, Aqua Neat, Rodeo, Touchdown Pro)</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>imazamox (Ceara)</td>
<td>0 to 3</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>imazethapyr (Heptila)</td>
<td>130</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>mesotrione (Glean)</td>
<td>Do not irrigate food crops until residues are ≤ 1 ppm</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>Sodium carbonate peroxide (GreenCear Pro, Pact 27)</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
<tr>
<td>Trifluralin (Reneva, Renova OFT)</td>
<td>3 to 7 days</td>
<td>No restrictions</td>
<td>No restrictions</td>
<td>No restrictions</td>
</tr>
</tbody>
</table>

Notes:

1. Irrigation restrictions may be removed for specific products if a laboratory assay of treated water meets a standard as stated on the product label.
2. Do not use treated water for irrigation in commercial nurseries or greenhouses.

Table 7-22 NC Agricultural Chemicals Manual
What herbicides can be used to treat PARROTFEATHER in a pond used for watering dairy cows?

POP QUIZ!
Some Herbicides Require Adjuvants

- Read the label!
- Improve herbicide efficacy
- Most require non-ionic surfactant
  - Many, many brands
  - 80% active ingredient
  - 0.25% v/v to herbicide solution
Aquatic Herbicides
Sodium Carbonate Peroxyhydrate

Weed Controlled
• Cyanobacteria (blue-green algae)

Labeled Sites
• Ponds, lakes, lagoons, canals, ditches

Trade Names
• Pak 27®
• GreenClean Pro®

Restrictions
• Do not apply to treated, finished drinking water

Other Notes
• Fast-acting
• Degrades into $\text{H}_2\text{O}_2$
• Non-toxic to fish
Aquatic Herbicides

Copper Compounds

Weed Controlled
• Green algae

Labeled Sites
• Potable water reservoirs, farm and fish ponds, lakes, golf course water hazards, fish hatcheries

Trade Names
• Cutrine-Plus® (chelated)
• Copper Sulfate (various)

Restrictions
• No restrictions on use in treated water.
• Check tolerances for crop sensitivity
• Toxic to fish in hard water
  – Especially trout
  – Have water tested (NCDA $3)

Other Notes
• Chelated compounds less corrosive
Aquatic Herbicides

2,4-D

**Weed Controlled**
- Many emersed & some submersed and floating plants
- Waterhyacinth, Eurasian Watermilfoil

**Labeled Sites**
- Potable water reservoirs, farm and fish ponds, lakes, golf course water hazards, fish hatcheries (2,4-D amine); ponds and lakes (2,4-D granular)

**Trade Names**
- Weedar 64® (amine)
- Navigate ® (granular)

**Restrictions**
- Many restrictions for irrigating crops, dairy livestock, domestic use
- Varies by manufacturer

**Other Notes**
- Know for drift tendencies and non-target effects
- Systemic auxin mimic
Aquatic Herbicides

Diquat

Weed Controlled
• Filamentous algae, floating plants except watermeal; many submersed, few emersed plants

Labeled Sites
• Lakes, still ponds, ditches, laterals, waterways

Trade Names
• Reward®

Restrictions
• 1-5 day restrictions for irrigation and watering livestock

Other Notes
• Also mixed with copper for enhanced algal control
• Contact herbicide
Aquatic Herbicides
Endothall

Weed Controlled
• Submersed plants

Labeled Sites
• Drainage canals, lakes, ponds

Trade Names
• Aquathol®
• Hydrothol®

Restrictions
• 7-25 days watering livestock, some crop irrigation

Other Notes
• Fast-acting contact herbicide
Aquatic Herbicides
Triclopyr

Weed Controlled
• Invasive exotic emersed & submersed plants & water hyacinth (floating)

Labeled Sites
• Quiescent and slow-moving waters, non-irrigation canals

Trade Names
• Renovate®

Restrictions
• Next growing season for lactating animals
• 120 days for crops except established grass

Other Notes
• Systemic auxin mimic
Aquatic Herbicides
Fluridone

Weed Controlled
• Good-excellent control of most floating and submersed weeds, including duckweed and watermeal

Labeled Sites
• Lakes, ponds, canals

Trade Names
• Sonar®

Restrictions
• 7-30 days for crop irrigation

Other Notes
• Slow-acting, long contact time
  – Especially submersed plants
• Targets chlorophyll-related enzyme
• Selectivity decreases with concentration
Aquatic Herbicides

Imazapyr

**Weed Controlled**
- Emersed weeds and some larger floating weeds
- Not watermeal or duckweed

**Labeled Sites**
- In and around standing & floating waters, including estuarine and marine sites

**Trade Names**
- Habitat®

**Restrictions**
- 120 days for crop irrigation

**Other Notes**
- Slow-acting
- ALS-inhibitor
Aquatic Herbicides

Glyphosate

Weed Controlled
• Emersed & some floating weeds

Labeled Sites
• Varies by label
• MUST use aquatic-approved glyphosate, not RoundUp®!

Trade Names
• AquaMaster®
• AquaNeat®
• Rodeo®
• Touchdown Pro®

Restrictions
• None

Other Notes
• Rapidly deactivated in water
• Systemic: most effective in fall when plants translocating sugars to roots and tubers
• Need aquatic-approved non-ionic surfactant
Barley straw for weed control?

- Some efficacy on algae
  - Not effective on other pond weeds
- Poorly understood mechanism inhibits algal growth
- Does not kill existing algae
- Winter or early spring
  - 4-6 month effect

Apply 2-3 bales per surface acre
Pond Management Professionals

- Don’t want to do this yourself?
- See provided list
- Based on NCDA aquatic weed licensees
Questions?

Resources and slides will be available online next week:

https://golinks.ncsu.edu/link/details/linkId/171248