Aquatic Weed Management

Charlotte Glen
Horticulture Agent,
NC Cooperative Extension,
Chatham County Center

Sam Groce
County Extension Director,
NC Cooperative Extension,
Chatham County Center
Tonight’s Class:

• What makes a plant a weed
• Identifying aquatic weeds
• Aquatic weed control techniques
• Using aquatic herbicides
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

Pickerelweed, *Pontederia cordata*
Can Be Bad When Out of Balance

• Reduce habitat value, fish kills when out of balance
• Increase rate of sedimentation
• Impede water flow
• Impede recreational activities
• Aesthetics, appearance
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**

Water Hyacinth, *Eichhornia crassipes*
Water Hyacinth, Cape Carteret
This Started With 1 Plant!!!
Why Do Some Aquatic Plants Become Aquatic Weeds?

• Reproduce and spread rapidly
  – Seed, fragments, roots

• Large bodies of clear, shallow water
  – High nutrient levels, esp. nitrogen and phosphorus

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*
Most Aquatic Weeds That Cause Serious Problems Are Non-Native

- Introduced from other regions or countries
  - No natural enemies to limit spread
  - Have a competitive advantage
- Non-native plants that invade natural areas and displace native species are termed invasive

Both native and non-native species of water primrose, *Ludwigia*, occur in NC.
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
Why Do We Have to Manage Aquatic Weeds?

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

NC 4\textsuperscript{th} in nation for inland water area, 2690 sq. miles!
Why Control?

Hydrilla at Wakulla Springs, Florida
*Hydrilla verticillata*
Photo by Vic Ramey
Copyright 1998 Univ. Florida
Variety of Control Methods

- **Cultural** – preventing weeds, altering habitat
- **Mechanical** – hand/machine removal
- **Biological** – natural predators
- **Chemical** – aquatic herbicides

Which is right for your situation depends on **the weed to be controlled**, how body of water used, budget, and environmental and aesthetic considerations.
Weed Identification

• 1st step to controlling any pest = **proper identification**
  Determines:
  – Management strategy
  – Potential Pesticide use

• Control may not be necessary
ID Guides

• NCCE Aquatic Weeds: Pocket Guide, $16
  – Order from NCSU

• NCSU Aquatic Plant Mgmt Website:
  http://www.weedscience.ncsu.edu/aquaticweeds/
Bring Sample To Your Local Extension Center

• Fresh!
• Wrapped in moist paper towels, inside plastic bag
• Stem section with several leaves or whole plant
• Flowers and/or seed pods if present
• Keep refrigerated if cannot bring immediately
Types of Aquatic Plants

• Algae
• Floating
  – Free
  – Rooted
• Submersed
• Emergent
Type of Plant: 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
  - Under microscope spiral chlororplasts
  - Feels slimy

- **Pithophora**
  - Cottony masses – not slimy
Aquatic Plants

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

Duckweed
Free Floating

- **Duckweed**
  - Up to ¼”, small root

- **Watermeal**
  - Smaller, gritty

- Wind will blow colony to one end of pond
Free Floating

• Carolina Water Fern, *Azolla*
  – Green to reddish color, velvety texture
  – Individual plants smaller than a dime
Floating Rooted Plants

- Rooted in soil
- Leaves attached to long, tough stems, float on surface or emerge above
- Flowers float on surface or emerge
- Most are rhizomatous – spread rapidly
- Can grow in 6’ of water or more

Fragrant Waterlily
Appearance:

- Leaves growing underwater often look very different to leaves growing above water

Variable Leaf Milfoil
Spatterdock

- **Nuphar luteum**
  - Larger leaves, still water

- **Nuphar luteum**
  - ssp. *sagittifolium*
  - Narrow leaves, flowing water
• Water Lily
  – *Nymphaea odorata*

• American Lotus
  – *Nelumbo lutea*

• Both can quickly colonize shallow ponds
Watershed, Dollar Bonnet

- *Brasenia schreberi*
  - Underwater parts covered in mucus or jelly-like substance
  - Leaves float at water surface, backside red and slimy
  - Non showy flowers emerge out of water, summer
Pondweeds

- *Potamogeton* species
  - Several species
  - Leaves float at water surface
  - Non showy flowers emerge out of water
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 some of our worst aquatic weeds**

Hydrilla – Lake Gaston
Native Submersed Aquatic Plants

- Coontail
  - *Ceratophyllum demersum*
  - Feel rough
  - Non showy flowers stay submersed
**Bladderworts**

- *Utricularia* species
- Carnivorous! Catch insects in underwater bladders
- Acidic water
- No true roots, underwater portions finely divided leaves
- Yellow flowers spring, above water
Non-Native Submersed Aquatics

- **Hydrilla**
  - *Hydrilla verticillata*
  - Rough to the touch
  - Toothed leaf margins
  - Leaves in whorls of 3-8
  - Tubers
  - NC’s most costly aquatic weed, > $1 million spent annually in control
• Brazilian Elodea
  – *Egeria densa*
  – Smooth to touch
  – Showy flowers
  – Leaves in whorls of 3-6
  – Less common than hydrilla
Emergent Aquatics

• 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
• Sometimes referred to as shoreline or marginal plants

Pickerelweed
Many Are Attractive

- Natives may be planted
- **Blue Flag Iris**
  - *Iris virginica*
  - Shallow water
- **Swamp Mallow**
  - *Hibiscus moscheutos*
• Pickerelweed
  – *Pontederia cordata*
  – 3’ tall
  – Flowers summer
  – Common
  – Often planted
  – Not an aggressive spreader
• Duck Potato, Arrowhead
  – *Sagittaria* species
  – Flowers summer
  – Rhizomatous and forms tubers

• Arrow Arum
  – *Peltandra virginica*
  – Not rhizomatous
Rushes
*Juncus species*

- Rushes are round
- Over 20 species native
- Clumping

Common Rush, *Juncus effusus*
Sedges
Carex species

- Sedges have edges
- 60+ native species
- Many bloom early summer
- 1’-3’

- Beak-rushes, *Rhynchospora*
- Spikerushes, *Eleocharis*
Cattails
*Typha latifolia*

- Native
- Often form large monocultures
- Most prolific in shallow water > 2’
Smartweed, Knotweed

- Several native perennial species

- Nodding Smartweed
  - *Polygonum lapathifolium*
  - Non native, annual
Water Hemlock
*Cicuta maculata*

- Hollow stems
- All parts of plant very poisonous
- Resembles Elderberry – a large shrub with purple berries
Elderberry
*Sambucus canadensis*
Water Primrose

- *Ludwigia* species
- Many species, some native, some non native
- Most perennial
- Summer flowers
• Parrotfeather
  – *Myriophyllum aquaticum*
  – **Not Native – Invasive!**
  – Feathery whorls of leaves
  – Stems sometimes red
  – Emerges out of water
  – Grows in shallow (3’) water
Alligator Weed

- *Alternanthera philoxeroides*
- Spreads rapidly by seed or fragmentation
- Non native
- Can be aquatic or terrestrial
- Aquatic forms have hollow stems
- Flowers summer
- Alligator flea beetle excellent control, but does not overwinter
Controlling Aquatic Weeds – An Integrated Approach

- Choose combination of methods best suited to:
  - Weed species
  - Water use
  - Budget
  - Environmental issues and 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
Floating Plants Increase Rapidly
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

• Habitat Modification
  – Most practical: Reduce light
  – **Pond Dyes**, eg. Aquashade

• Can control **algae** and **submersed weeds**
  – Not a herbicide, blocks light – best applied **early in growing season**

• **Closed systems**
  – Should not be applied to drinking water, streams, or fish ponds

Too late to apply dye!
Biological Control

- **Triploid Grass Carp** (sterile)
  - Only effective on *submersed species*, (coontail, elodea, hydrilla), **NOT algae**
  - Use in closed systems – no outflow
  - 10-15 fish per acre, at least 10” long
  - Can live 10 years, weigh up to 50 lbs.
    - Feeding reduced after 5 years, restock
Grass Carp

• Main hydrilla control method in NC ponds
  – Cost-effective over lifetime (to 10 years)
  – Other vegetation not an issue
• Cannot be used in all lakes due to feeding on native vegetation and resulting environmental impacts
Physical Control

- Physical or mechanical removal
- Expensive
- Somewhat effective for free floating plantings, only temporary for rooted plants
- May propagate some plants!
Hand Removal

• Highly labor intensive/inefficient
• Plants may reproduce as fast as removed!
• Generally for special situations:
  – Active water intakes
  – Active irrigation intakes
Aquatic Decision Making

• Treatment
  – Know your weed
  – Use the appropriate treatment
  – Treat at the appropriate time of the year
    • Weeds should be actively growing
    • For most species water temperature should at least 60°F preferably 70°F.

• Type of Treatments
  – Chemical - Mechanical
  – Cultural - Biological
Spraying Aquatic Weeds

• Must have aquatic subclass if “purposefully applying to water”
  – Includes retention ponds, ditches AND ditchbanks, lakes, wetlands, etc.

• Not necessary if ONLY applying to banks, up to water’s edge
Spraying Aquatic Weeds

• Must use **aquatic herbicides**, registered for use in aquatic habitats

• **Improper use** – up to $2000 fine + potential for additional fines from DENR Division Water Quality

• **Stay out of trouble** - Have the right license, use appropriate products, and READ and FOLLOW label directions!
Adjuvants

- Materials that when added to spray solution, facilitate or modify the action of the herbicide.

- Surfactant
  - Any material that facilitates and accentuates the emulsifying, dispersing, spreading, wetting or other surface modifying properties of liquids.
Applying the Right Amount

- Surface acres

\[
\text{Length (ft)} \times \text{Width (ft)}
\]

43,560 sq ft/acre
Applying the Right Amount

• Area of a triangle (acres)
  \( \frac{1}{2} \text{ Base (ft)} \times \text{Height (ft)} \)
  43,560 sq ft/acre
Applying the Right Amount

- Area of circle (acres) $3.14 \times \text{radius}^2 \text{ ft}$
  $43,560 \text{ sq ft/acre}$

NOTE: Radius is ½ of the diameter
Applying the Right Amount

• Acre Feet
  • Take several depth measurements making a star pattern across the pond.
  • Average these measures together
  • Determine surface acreage of the pond

– Use formula of Surface Acreage times Average Depth = Acre Feet of Water
In-water treatment

Must calculate water volume before calculating product to apply
In-water treatment

Must calculate water volume before calculating product to apply

at least 10 depth measurements
Chemical Options

- 2,4-D products
- Carfentrazone
- Copper products
- Diquat
- Endothall
- Fluridone
- Glyphosate
- Imazamox
- Imazapyr
- Penoxsulam
- Peroxide products
- Triclopyr
Overview

- Aquatic herbicides are applied to water
- EPA considers this to be a “food use”

Major considerations:
- Off-target movement (water flow-through)
- Irrigation
- Drinking
- Fishing
- Swimming/recreation
- Livestock use
- Fish kills
The label is the law – always check

Be extra cautious with:

- 2,4-D
- Glyphosate
- Diquat
- Copper products

Some formulations not labeled for sites used for irrigation, watering, etc.
Water Use Restrictions

- Fishing: consumption of fish or use for fish meal
- Swimming: any activity which immerses the body
- Irrigation: including use for preparation of agricultural pesticide sprays
- Livestock watering: may include humidification of poultry houses
- Domestic drinking water supplies: a setback distance also may apply
Irrigation

➢ Includes water use for preparation of agricultural pesticide sprays

➢ Restrictions on:
  • 2,4-D (21 & check label)
  • Carfentrazone (to 14)
  • Diquat (3 to 5)
  • Endothall (to 25)

➢ Clearcast <50 ppb: no restrictions

➢ Galleon>1 ppb: no irrigation

➢ Testing can be done to determine levels
Watering Livestock

- Includes humidification of poultry houses
- Triclopyr has next growing season restriction on lactating dairy animals

Restrictions:
- Carfentrazone (to 1)
- Diquat (1)
- Endothall (to 25 days)
Fish Kills

- Most fish kills (> 99%) due to oxygen depletion
- Application of copper products at incorrect rate or to too large of an area
- Fish kills by oxygen depletion when:
  - Herbicide treatments are too late in the season
  - Too much weed growth treated/killed at once
Aquatic Herbicide Application Techniques

- Direct pouring of undiluted or (preferably) diluted product into the water
- Surface application (spraying over surface)
- Foliar application (for emergent vegetation)
- Dilute injection beneath water’s surface
- Direct metering into water column
- Granular spreader (centrifugal or blower)
Copper Products

- Primarily an algaecide / fast acting
- Toxic to fish if not used properly
- Copper sulfate is worst environmentally
- Often used in tank mixes with either diquat dibromide or endothall
- Formulations included copper sulfate pentahydrate and several chelated (complexed copper) formulations
Peroxide Products

- AI: sodium carbonate peroxyhydrate
- PAK27 and GreenClean registered
- Fast acting / contact algaecide
- Non-toxic to fish (as labeled)
- Primarily for blue-green algae control
- May control other algae as well
Endothall Products

• Fast acting / contact algaecide

• Important differences in products
  – Ex. Hydrothol controls algae, Aquathol does not

• Only effective on submersed plants
  – Coontail, Eurasian watermilfoil*, hydrilla, parrots feather, pondweeds, brittle naiad, variable leaf milfoil
Diquat Dibromide (Reward)

- Fast acting \ contact \ non-selective
- Excellent algaecide, particularly for difficult species of algae (*Spirogyra, Pithophora*, etc.)
- Used extensively for control of submersed weeds and duckweed (not good on watermeal)
- Often used in tank mixes with copper
- Should not be applied to muddy water or mixed in a tank with muddy water due to irreversible binding onto soil particles
2,4-D Products

- Primarily a broadleaf herbicide used for many submersed dicot weeds and a few selected broadleaf monocots
- Both liquid and granular formulations
- Best available product for waterhyacinths
- Excellent for all of the watermilfoil group (parrotfeather, variable-leaf milfoil, etc.) and for fragrant waterlily
Triclopyr (Renovate)

- Primarily a broadleaf herbicide used for many submersed dicot weeds and a few selected broadleaf monocots
- Liquid - 3 lb/gal formulation
- Excellent for all of the watermilfoil group (parrotfeather, variable-leaf milfoil, etc.) and for waterlily, alligatorweed, spatterdock.
- May be used to control brush in and around water
Fluridone (Sonar/Avast)

- Slow acting herbicide for submersed weed control in slow moving waters
- Only product effective on watermeal
- Requires a long contact time
- No fish kills from oxygen depletion, as plants die slowly (several weeks to several months)
- Essentially non-toxic to fish, wildlife, humans
- No algaecidal properties
Imazapyr (Habitat)

- Slow acting / systemic herbicide
- Only for floating and emergent plants; no activity on submersed plants
- Best product for phragmites control
- Lengthy residual period
Glyphosate Products

- Broad-spectrum herbicide applied for control of most emergent weeds
- Certain species such as waterlily and watershield may be controlled effectively, provided that there is minimal wave action to wash the herbicide off the floating leaves
- Not applied into the water column
- Not effective on small, floating plants such as duckweed, watermeal, or mosquito fern
Emergent Weeds

• Herbicides
  – 2,4-D and triclopyr (broadleaves only)
  – Diquat bromide
    • Contact \ surfactant required
  – Glyphosate – check label
    • Systemic \ surfactant may be required
• Habitat
  • Systemic \ surfactant required
Submersed Weeds

• Grass Carp
  – Effective on chara and all vascular plants except watermilfoil

• Herbicides
  – 2,4-D and triclopyr (watermilfoils)
  – Diquat bromide
  – Endothall
  – Fluridone
Filamentous Algae

• Herbicides
  – Copper products (most algae)
  – Diquat bromide (difficult algae)
  – Hydrothall 191 (may kill fish)
  – Peroxide products

• Biological control??
  – High stocking rates (50-60/A) of small grass carp (4-8”), maybe
Watermeal (Wolffia spp.)

- Tiny, floating, rootless
- Member of the duckweed family (*Lemnaceae*)
- Asymmetric, elliptical shape
- Fronds 1 to 1.5mm long
- Most commonly found in still waters with little disturbance
- Commonly found along with duckweed
- Very problematic in Piedmont
Watermeal (Wolffia spp.)

• Smallest seed bearing plant in the world
  
  • Flowers rarely through upper surface with only a single stamen and single pistil and produces only a single seed
  
  • Primarily reproduces vegetatively from a pouch at one end of the long axis, daughter plants break away from parent plants upon maturity
  
  • Reproduction is often rapid completely covering small ponds in short periods of time

• Overwinters by sinking to the bottom and floating to the surface in the spring
Watermeal (Wolffia spp.)

• Dense colonies can completely cover water surface causing:
  
  • Decreased gas exchange between atmosphere and water = decreased levels of dissolved oxygen  
  
  • Blocks sunlight critical for beneficial submersed plants  
  
  • Aesthetics  
  
  • Clogged irrigation intakes  

• Easily transported

• Few control measures
Watermeal Infested Pond at Treatment

08/28/2006 12:11
1 Month after Treatment
45 ppb fluridone
At Treatment

12 Month after Treatment
45 ppb fluridone
Before and After

Pretreatment

2 WAT
400ppb flumioxazin
Before and After

Pretreatment

4 MAT
30ppb fluridone
fb 100 ppb flumioxazin
Web Sites of Interest

- [http://aquat1.ifas.ufl.edu/photocom.html](http://aquat1.ifas.ufl.edu/photocom.html)
  - Great pictures of aquatic weeds

- [http://www.weedscience.ncsu.edu/aquaticweeds](http://www.weedscience.ncsu.edu/aquaticweeds)
  - NC State Aquatic Weed Site

- [http://www.ces.ncsu.edu/nreos/wild/fisheries/index.html](http://www.ces.ncsu.edu/nreos/wild/fisheries/index.html)
  - Another NC State University Site

- [http://www.ncagr.gov/markets/aquaculture/product.htm](http://www.ncagr.gov/markets/aquaculture/product.htm)
  - North Carolina Department of Agriculture
People to Contact

• Aquatic Weeds
  – Sam Groce, County Extension Director
  – Charlotte Glen, Extension Agent, Agriculture
    • Telephone: 919.542.8202
    • e-mail: sam_groce@ncsu.edu or charlotte_glen@ncsu.edu

• Pond Design and Construction
  – Mike Sturdivant, DC, NRCS
    • Telephone: 919.542.8240
    • e-mail: brenda.williams@chathamnc.org
N. C. Wildlife Resources Commission – Fisheries Biologist

- Biologist
  - Jessica Baumann
    - Telephone: 919.304.2720
    - Cell: 919-218-1434
    - e-mail: jessica.baumann@ncwildlife.org