Aquatic Weed Management

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

Sam Groce
County Extension Director,
NC Cooperative Extension,
Chatham County Center
There is a Cooperative Extension Center in every NC County!

**Chatham County Agriculture and Conference Center**

- Hwy 64 west, Pittsboro
- Will house:
  - Cooperative Extension
  - Soil and Water Conservation
  - USDA Farm Service Agency
  - NC Forestry Service
  - 800 seat auditorium!

November 2016
Review These Slides

http://chatham.ces.ncsu.edu/aquatic-weeds

Links to additional resources are also posted
Tonight’s Class:

Charlotte:
• What makes a plant a weed
• Identifying aquatic weeds
• Aquatic weed control techniques

Sam:
• 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
Water Hyacinth, Cape Carteret
This Started With 1 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

Water Hyacinth, *Eichhornia crassipes*
Why Do Some Aquatic Plants Become Aquatic 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 Aquatic Weeds?

- Reproduce and spread rapidly
  - Seed, fragments, roots
- Large bodies of clear, shallow water
  - High nutrient levels, esp. nitrogen and phosphorus

Brittle Naiad
*Najas minor*
Disturbance propagates it!
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!
Why Control?
Alligatorweed in drainage ditch

S. H. Kay, NCSU, 1989
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 and optimal timing
  - Whether or not control is necessary

Pickerelweed – Not a problem!
ID Guides: Free App!
NCSU Aquatic Plants

[Images of the app interface showing types of aquatic plants]

[Buttons for Google Play and App Store]
Aquatic plants are defined as any member of the kingdom Plantae, comprising multicellular organisms living or growing in water that typically produce their own food from inorganic matter by the process of photosynthesis and that have more or less rigid cell walls containing cellulose.
Profiles are available for common aquatic weeds.

- Includes id tips and control options.
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

Giant Salvinia
Types of Aquatic Plants

- Algae
- Free Floating
- Floating Rooted
- Submersed
- Shoreline
- Grasses, Sedges and Rushes
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 chloroplasts
  - 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
Watershield, 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, under water 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
Shoreline (aka Emergent)

- 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**

Pickerelweed
Many Are Attractive!

- Natives may be planted
- **Blue Flag Iris**
  - *Iris virginica*
  - Shallow water
- **Swamp Mallow**
  - *Hibiscus moscheutos*

Desirable!
• Pickerelweed
  - *Pontederia cordata*
  - 3’ tall
  - Flowers summer
  - Common
  - Often planted
  - Not an aggressive spreader

Desirable!
• Duck Potato, Arrowhead
  – *Sagittaria* species
  – Flowers summer
  – Rhizomatous and forms tubers

Desirable!
Smartweed, Knotweed

• Several native perennial species

• Nodding Smartweed
  – *Polygonum lapathifolium*
  – Non native, annual
**Water Primrose**

- *Ludwiga* species
- Many species, some native, some **non native**
- Most perennial
- Summer flowers

**Creeping Water Primrose,**

*L. hexapetala* - non native
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
Cattails
Typha latifolia

- Native
- Often form large monocultures
- Most prolific in shallow water > 2’
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*
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
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 because feed 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(s)!
  – 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
  – Cultural
  - Mechanical
  - 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)
  \[ \frac{1}{2} \text{Base (ft)} \times \text{Height (ft)} \]
  \[ 43,560 \text{ sq ft/acre} \]
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 \( \frac{1}{2} \) 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

Surface area

Avg. depth
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
- Imazapryr
- 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
Label

- 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.

Many different brands with different use patterns and restrictions
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

• Fluridone (to 30 days)
• Imazapyr (120)
• Triclopyr (120*)
  • *0 for established grass
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
Peroxdide 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
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

Figure 5. A duck with watermeal (arrow) clinging to its breast feathers.
Watermeal Infested Pond at Treatment
1 Month after Treatment
45 ppb fluridone
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
Before and After

4 MAT of 200ppb Flumioxazin
+ 100 ppb Diquat

Pretreatment
Web Sites of Interest

• NC State Aquatic Weed Site: http://www.weedscience.ncsu.edu/aquaticweeds
• NC Extension Pond Management Guide and other pond management resources: https://appliedecology.cals.ncsu.edu/extension/fisheries
• North Carolina Department of Agriculture – Grass Carp sources: http://www.ncagr.gov/markets/aquaculture/hatcheries.htm
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

Jessica Baumann

- Telephone: 919.304.2720
- Cell: 919-218-1434
- e-mail: jessica.baumann@ncwildlife.org
Review These Slides

http://chatham.ces.ncsu.edu/aquatic-weeds

Links to additional resources are also posted
Questions?

Aquatic Weed Management