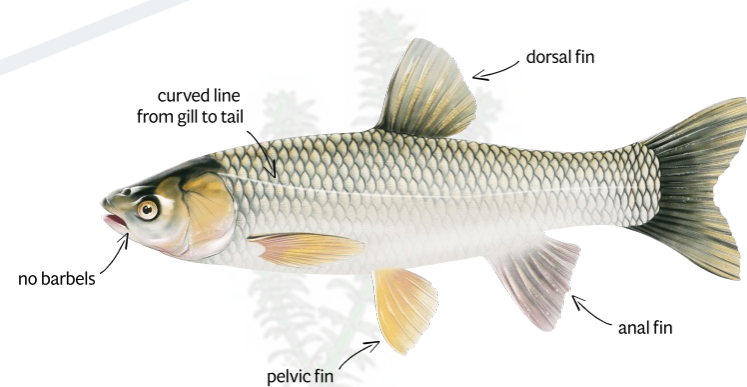


# Grass Carp

- **Native to China / Siberia**
  - Live in large river systems
  - Natural reproduction doesn't occur in lentic systems
  - 110 pounds / 20 years
- **Imported to US in 1963 from Malaysia**
  - USFWS for biological control
- **Grow rapidly with abundant food source**
  - Average 20 – 25 pounds
  - Can get over 40 pounds
- **Can live for 20+ years, but do have annual mortality**
- **One of the most widely used control measures for piedmont reservoirs in SE US**



# Integration of Grass Carp and Herbicides

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- **Limitation of Herbicide Treatments**
  - **High cost** for large treatment areas.
  - **Multiple applications** needed throughout season.
  - Areas of high water exchange **minimize herbicide** contact
- **Limitations of Grass Carp Stockings**
  - **No targeted approach.**
  - **Reduced efficacy** in expansive, shallow areas.
  - **Control may not be immediate**, stakeholder patience an issue.



# Monitoring Grass Carp Effect





# Mortality





# Aquatic Weeds & Triploid Grass Carp

- Most emergent and floating plants
- Filamentous algae
- Planktonic algae
- Eurasian watermilfoil

**NOT PREFERRED**



# Aquatic Weeds & Triploid Grass Carp

Duckweeds	Watermeal
Aquatic Grasses	Water Pennywort
Milfoils (not EWM)	Azolla
Mosquito Fern	Coontail

**INTERMEDIATE PREFERENCE**



# Aquatic Weeds & Triploid Grass Carp

- |                            |                 |
|----------------------------|-----------------|
| Naiads                     | Fanwort         |
| Coontail                   | Pondweeds       |
| Bladderwort                | Chara           |
| Widgeongrass               | Egeria          |
| Creeping Rush              | American Elodea |
| Proliferating<br>Spikerush |                 |

**HYDRILLA**



**PREFERRED**





# Management in Small Impoundments



# Management in Small Impoundments

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- Generally straight forward:
  - 15 triploid grass carp per acre of pond for control
    - Increase or decrease based on weed density and species
  - 5 triploid grass carp per acre of pond for prevention
  - Restock periodically as needed (assume 20-30% annual mortality)
  
- Reasons for lack of success:
  - Grass carp were stocked years ago and only 1-2 remain
  - Grass carp stocked months ago and have not had time
  - Weed species present are not preferred



# Management in Large Systems





# Regulated at State Level

- Triploid may\* be stocked with approved permit:
  - South Carolina
  - North Carolina
  - Virginia
  - West Virginia
  - Pennsylvania
  - Ohio
  - New York
- Not legal to stock:
  - Maryland
  - New Hampshire
  - Vermont
- Grass carp are considered invasive in many states

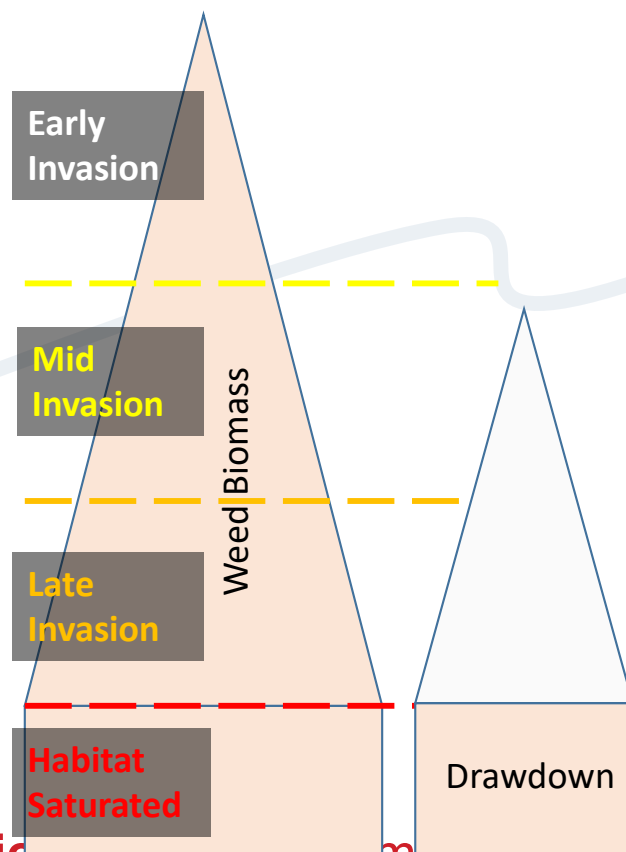
\*Stocking requests may also be declined



# Selecting Control Options

Weed Growth

Control Options for Stage of Weed Growth



## Drawdown

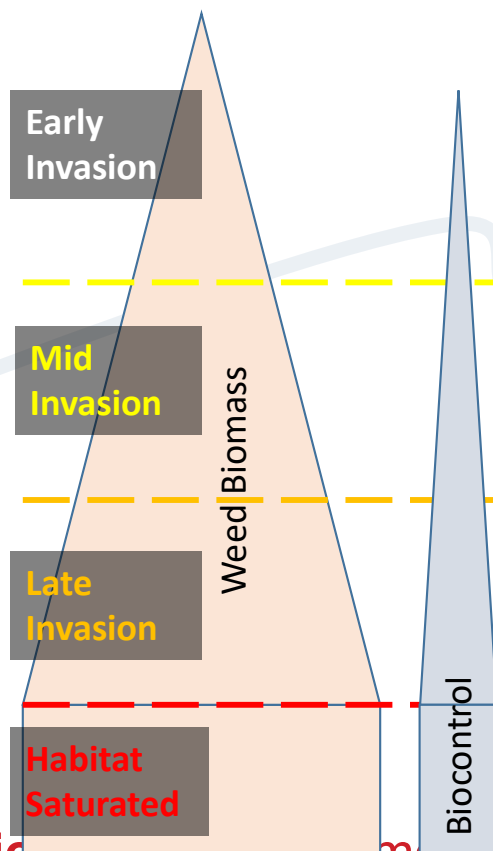
- Inexpensive; may supplement other strategies
- Impacts to non-target species?
- Effect based on plant biology/reproduction



# Selecting Control Options

Weed Growth

Control Options for Stage of Weed Growth



## Host specific biocontrol

- Several agents released in Florida
- Most require the host in order to overwinter
- Minimal options for NC climate
- Alligatorweed flea beetle may overwinter near Wilmington

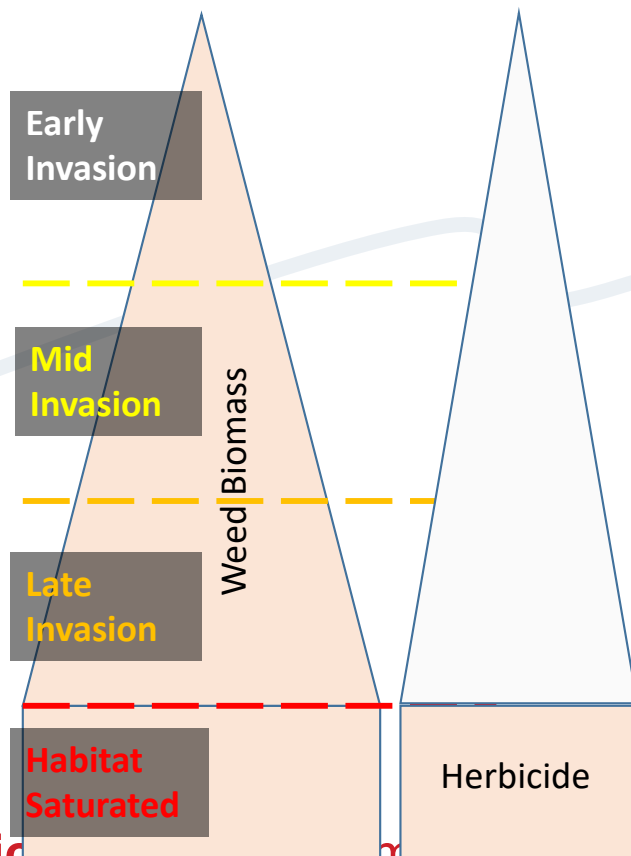




# Selecting Control Options

Weed Growth

Control Options for Stage of Weed Growth



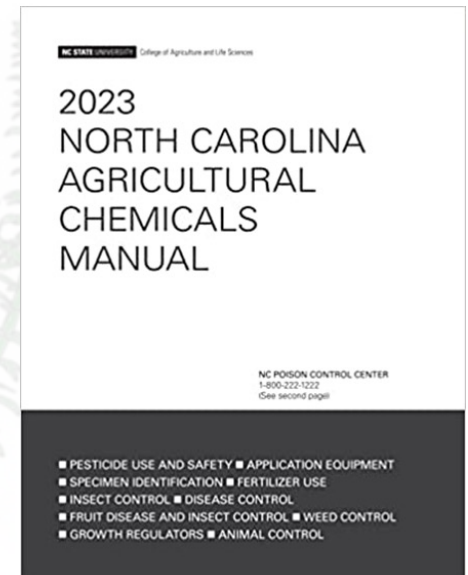
## Herbicides

- About 15 active ingredients
- Usually plant-specific modes of action
- Can be used on small to large scale depending on system
- Aquatic herbicides do not bioaccumulate
- Registered by EPA and NCDA
- Extensive use history in NC:
  - Lake Gaston
  - Lake Waccamaw
  - Lake Tillery



# Chemical Options

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



# Herbicides - Overview

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- 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





# Herbicides - Label

- The label is the law – always check
- Be extra cautious with:
  - 2,4-D
  - Glyphosate
  - Diquat
  - Copper products



**Many different brands  
with different use  
patterns and restrictions**

- Some formulations not labeled for sites used for irrigation, watering, etc.



# Herbicides – Water Use Restrictions

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- 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

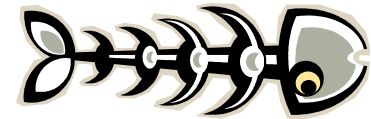


# Herbicides – Irrigation Restrictions

- 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 (0 to 25)
  - Fluridone (to 30 days)
  - Imazapyr (120)
  - Triclopyr (120\*)  
\*0 for established grass
- Clearcast <50 ppb: no restrictions
- Galleon >1ppb: no irrigation
- Testing can be done to determine levels



# Herbicides – 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





# Advantages of Herbicide Use

- Can treat small as well as large areas
  - Target site is reasonably defined
- Proper choice & rate = selectivity
- Newer Products – excellent toxicology profiles
- Compatible with other management options
- Best tool for initially removing large amounts of invasive vegetation



# Advantages of Herbicide Use

- Cost effective
- Predictable, consistent efficacy
- Relative ease of application
- Minimal ecosystems impacts



# Disadvantages of Herbicide Use

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- Commitment to long-term management
- Use restrictions
  - When/where you can apply
  - Drinking, swimming, fishing, irrigation
- Can sometimes select for a worse problem
- Target plants will ultimately recover
- Public perception of chemical use
  - Human/eco-toxicology issues
  - Fear of pesticides



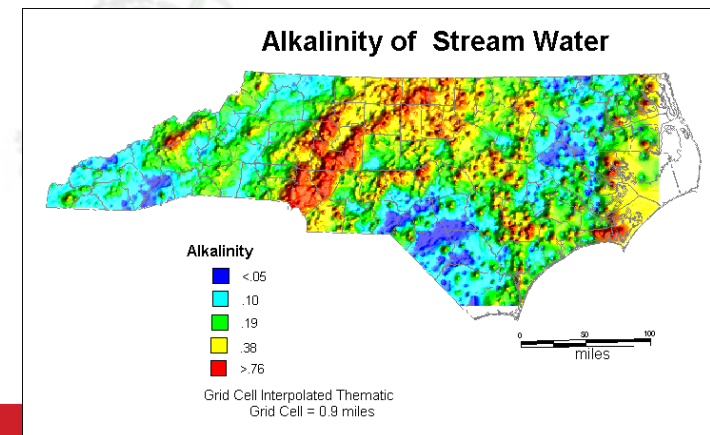
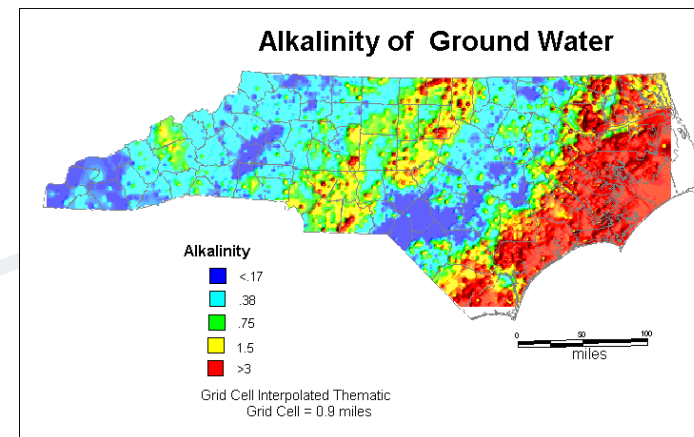
# Water Quality Can Influence Weed Control

- pH (carfentrazone, flumioxazin)
  - Acid < 7=neutral > basic
- Hardness/alkalinity (copper)
  - Soft < 50 ppm  $\text{CaCO}_3$  >Hard
- Turbidity (diquat)
  - Organic
  - Inorganic



# Alkalinity

- The buffering capacity of water
- Needs to be  $> 20$  ppm
- Copper is much more toxic to fish at low alkalinities
- Use lower rates





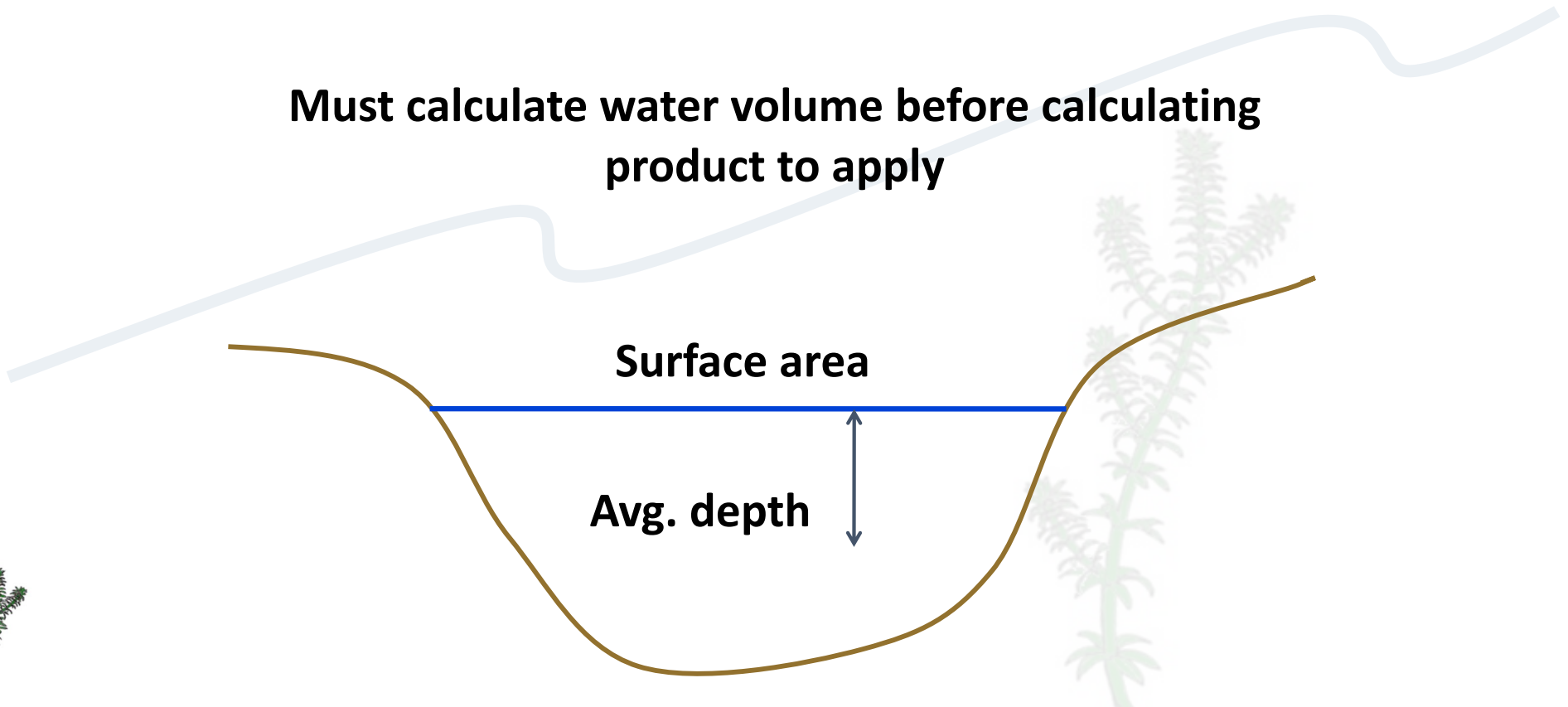
## Other Factors That Can Influence Weed Control

- Thermal Stratification
  - Drop hoses
  - Handgun
  - Pellet formulations
- Water movement
  - Slow release formulations
  - Metered/sequential applications
- Growth stage/time of year/plant maturity
- Adequate herbicide coverage/distribution



# In-water treatment

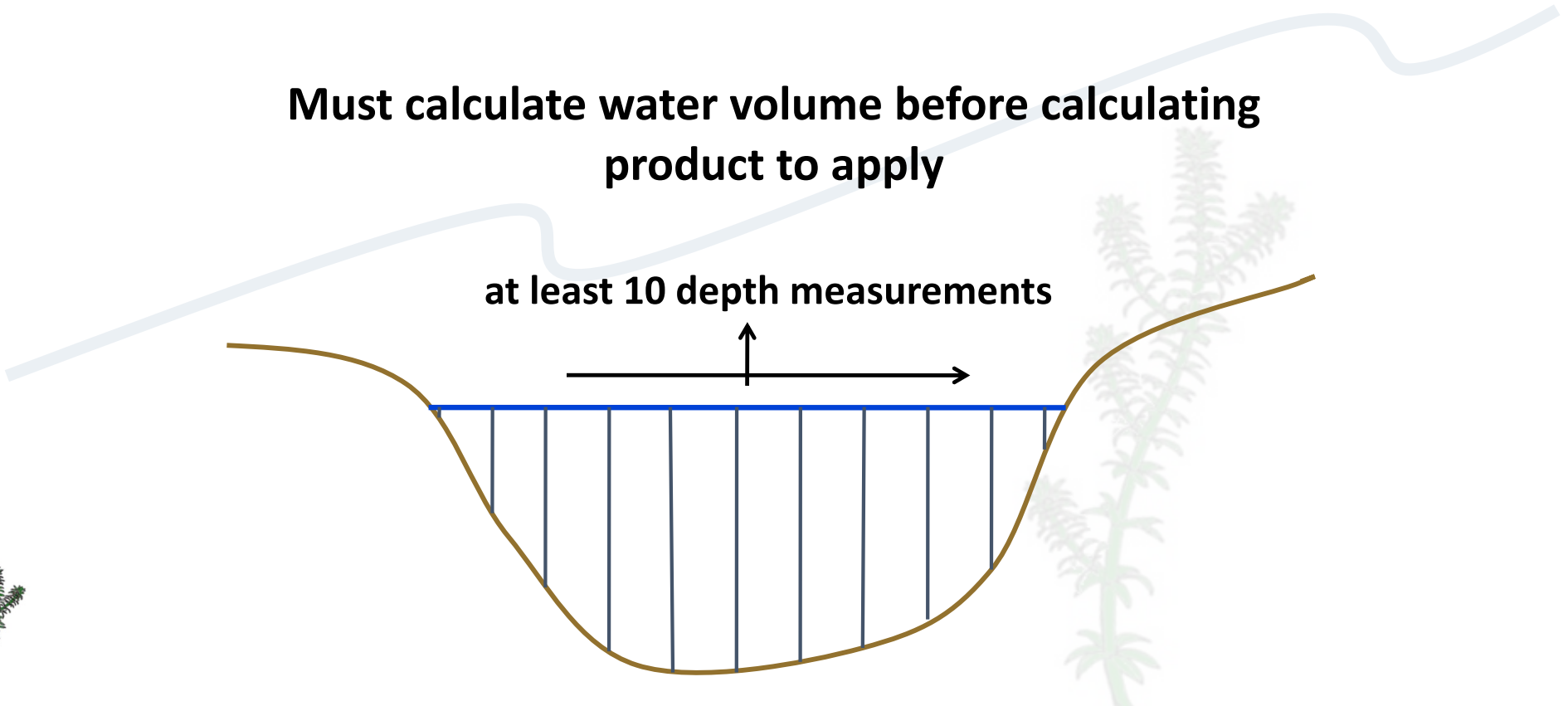
Must calculate water volume before calculating product to apply



# In-water treatment

Must calculate water volume before calculating product to apply

at least 10 depth measurements

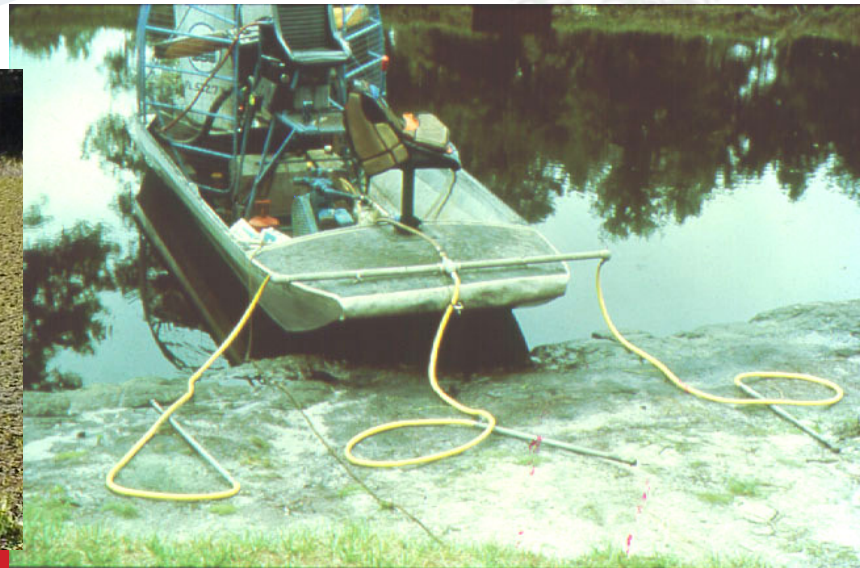


# Aquatic Herbicide Application Techniques

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- 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)





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# Eno River Treatment

