WEED MANAGEMENT IN SMALL PONDS

The presence of some vegetation in small ponds is desirable for appearance and to enhance the habitat for fish. It is important, however, to maintain a good balance between vegetation and other aquatic life. Selecting a good pond site, designing the pond properly, and keeping nutrients in runoff water from reaching the pond are the most important ways to prevent excessive growth of aquatic weeds.

Pond Design

Construct pond banks with a minimum slope of 1:4 (ratio of the depth to the distance from the bank) and a minimum depth of 2 to 3 feet. Maintain a healthy sod cover around the pond. If the pond adjoins heavily fertilized areas (such as pastures, golf courses, and residential lawns), maintain an unfertilized buffer zone at least 50 feet wide (wider if the slope is steep) around the pond to minimize nutrient runoff. For stream-fed ponds, constructing a small sedimentation pond immediately upstream from the main pond will also reduce sediment and nutrient deposition in the main pond. Constructing the pond properly and taking care to prevent accidental or intentional introduction of undesirable species (especially exotic weeds such as hydrilla) are critical to maintaining healthy pond systems.

Figure 1. Weed problem in a golf course pond.

Weed Identification

When excessive aquatic vegetation grows in a pond (Figure 1), the first step is to identify the weeds correctly. It is necessary to know the weed species so that you can select the proper management procedures. Wrap samples of the weeds in a damp (not wet), absorbent paper towel, place it into a sealed plastic bag, and take it to your county Extension office. The agent will identify the weed and recommend an appropriate management strategy.

Control Methods

Cultural, mechanical, biological, and chemical techniques can be used to manage weeds in ponds.

Cultural Control

Cultural techniques modify the environment to make conditions less suitable for weed growth. They include drawdowns and the use of physical barriers (such as fibrous screens), pond dyes, and fertilizers. Drawdowns are effective mainly on submersed vegetation (for example, Brazilian elodea) and are not generally recommended unless the pond is larger than 1 acre and has a control structure that allows you to adjust

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the water level easily. A drawdown should be done during the winter when the combination of drying and exposure to cold temperatures will kill many aquatic weeds. Drawdowns during warmer months are not recommended because they stress fish populations and may enhance the spread of marginal species (such as cattails, rushes, and willows).

Fibrous screens, such as Texel and Aquascreen, can be spread over the pond bottom to block out sunlight, preventing photosynthesis and eliminating weed growth. These materials are very expensive, but they may be useful in controlling submersed weeds around access areas and water intakes where other management procedures often cannot be used. Physical barriers are largely ineffective on floating species (for example, duckweeds) and emergent species (such as, cattails). Pond dyes (Aquashade and others) and pond fertilizers may be effective if there is little water exchange in the pond and if the pond has been constructed properly.

Fertilization is a fisheries management technique that enhances the bloom of microscopic planktonic algae, increasing fish production and reducing the amount of light available to weeds. Fertilization should be done only if you plan to harvest fish regularly, or stunting of your fish may occur. Fertilize in the spring before the appearance of weed growth when the water temperature reaches 60 to 65ºF. Apply fertilizer at 2-week intervals until an algal bloom develops, and then repeat as necessary to maintain the bloom through the summer and early fall until water temperatures drop below 65ºF. Do *not* fertilize when emergent weeds (cattails and rushes) and floating weeds (such as duckweed and water-meal) are present or when dense growths of algae or other aquatic weeds are already present in the pond, as these species will absorb the fertilizer and spread prolifically.

Nontoxic pond dyes provide similar weed control without the addition of fertilizer. Pond dyes may be effective for 6 months to a year and are safe for fisheries, irrigation, livestock, and recreational uses of the pond. Both techniques reduce the amount of light reaching the pond bottom and are effective mainly on submersed vegetation.

Mechanical Removal

Seining, raking, dredging, or using a backhoe are the most common yet most expensive methods for weed management in ponds. Mechanical harvesters are available but are expensive and are usually impractical in ponds because of shallow waters, the presence of obstructions, and limited access. Mechanical removal has several advantages. This method removes the vegetation completely rather than leaving it in the pond to decay. Mechanical removal prevents fish kills resulting from oxygen depletion and algal blooms that can occur when decaying weeds release nutrients. Mechanical removal also eliminates the need for herbicides that may kill irrigated crops and other desirable vegetation or may necessitate other water-use restrictions.

The method also has several disadvantages. It may be necessary to have access to a disposal facility (landfill); the movement of machinery may physically disrupt the shoreline; and portions of the vegetation may remain. Also vegetative fragments may disperse, taking root elsewhere in the pond. If you have a serious weed problem requiring mechanical removal, it may be better to drain the pond entirely and redesign it by excavating the shallow areas.

Biological Control

The triploid sterile grass carp is the most effective and least costly long-term management practice for many weed problems in ponds. Grass carp feed primarily on submersed plant species (such as, pondweeds, naiads, and hydrilla). They may reach weights exceeding 50 pounds and live as long as 10 years. Although grass carp may also feed on floating and emergent weeds and algae, they usually are not effective on those species and are not stocked for that purpose. They can be used in ponds and lakes that are closed systems (having no major outflow through which the fish may readily escape). Table 1 lists the weeds they do and do not control effectively.

Grass carp usually are stocked in North Carolina ponds at 10 to 15 fish per acre, depending upon the nature and extent of the weed problem. The carp should be 10 inches or more in length to prevent predation by larger fishes, such as bass. You may purchase up to 150 fish without a permit. To purchase more than 150 fish, you must obtain a permit from the North Carolina Wildlife Resources Commission. A regional fisheries biologist will visit the site before issuing the permit. For additional information, see AG-456, *Using Grass Carp for Aquatic Weed Management*. For a permit application, call (919) 733-3633.

Chemical Control

Several herbicides are available for use in ponds. However, **do not select herbicides as your first choice if other more environmentally acceptable and equally effective management options can be used.**

Herbicide application rates for ponds and lakes are expressed in three ways:

- in pounds or gallons per surface acre;
- in terms of the herbicide concentration in the water in parts per million (ppm);
- in pounds or gallons per acre-foot (the equivalent of 1 surface acre of water 1 foot deep).

When the rate is given by the second or third method, it is necessary to calculate the *volume of water to be treated*. (This may be part of a pond or, in some cases, the whole pond). You can determine the volume by lowering a long, calibrated pole (such as a cane fishing pole marked at 1-foot intervals) to the bottom at least four times at equally spaced intervals while moving across the pond or treatment area. Record the depth each time. Divide the sum of these measurements by the number of measurements plus 1. Repeat this process at least three times in different directions across the area to be treated. The average of your measurements multiplied by the surface acreage of the area to be treated is the number of acre-feet in the treatment area. One acre-foot weighs 2.7 million pounds; applying 2.7 pounds of active ingredient (a.i.) per acre-foot will give a concentration of 1 ppm.

The required amount of herbicide may be calculated as follows:

Pounds of a.i. required =
desired ppm X 2.7 X no. of acre-feet

To calculate the amount of a granular herbicide formulation that does not consist of 100 percent active ingredient or to calculate the number of gallons of a liquid formulation, use the following formulas:

Granular formulation:

$$\frac{\text{pounds of a.i required x 100}}{\text{percentage of a.i.}}$$

Liquid formulation:

$$\frac{\text{pounds of a.i. required}}{\text{pounds of a.i. per gallon}}$$

It is important to apply herbicides at the correct time to ensure effectiveness and prevent fish kills. In most cases, it is best to apply herbicides early in the growing season after the water temperature is at least 65ºF. At this time the plants are growing actively and will absorb the herbicide more readily. Fewer weeds are present and therefore less herbicide is required. In addition, fish kills resulting from oxygen depletion are less likely because there is less plant material to decay. The water can also hold more oxygen because it is cooler. About 99 percent of all fish kills that occur after herbicide applications are caused by oxygen depletion resulting from the decomposition of dead vegetation. Direct toxicity of aquatic herbicides is rare; when it occurs, it is usually the result of errors, such as overapplication or improper herbicide selection. The proper selection, timing, and application of herbicides rarely results in fish kills or other undesirable consequences.

The choice of a herbicide depends upon the weed species present and the uses of the pond. (See Table 1 for information on recommended herbicides for specific weeds.) In most cases, ponds have more than one intended use. The water-use restrictions (Table 2) for herbicides determine which chemicals, if any, may be used in a particular situation.

Water-use restrictions depend upon the persistence of the compound, public health considerations, and the toxicity to nontarget plants (crops) and to aquatic species (fish and aquatic vertebrates).

When you decide to use a herbicide, first identify the weed species to be managed, because herbicides that are effective on one species may not be effective on others. In many cases, more than one herbicide may be required for weed control in the same pond, particularly when several different species are present (for example, cattails and filamentous algae).

Diquat, endothall, glyphosate, fluridone, 2,4-D, and various copper compounds are approved by the EPA for use in ponds. Water-use restrictions vary greatly for these compounds. Copper (copper sulfate and organic copper complexes) may be applied without restriction to almost all inland waters. Use

Table 1. Relative Effectiveness of Grass Carp and Herbicides for Control of Common Aquatic Weeds in North Carolina

Species	Grass Carp	Endothall		Diquat	2,4-D	Copper Compounds	Fluridone	Glyphosate
		Aquathol	Hydrothol*					
Algae								
Planktonic algae	NR	NR	E	E	NR	E	NR	NR
Filamentous algae	NR	NR	E	E	NR	G	NR	NR
Macroalgae (*Chara, Nitella*)	E	NR	E	E	NR	G	NR	NR
Free-Floating Plants								
Duckweed	NR	NR	NR	G	P	P	E	NR
Watermeal	NR	NR	NR	NR	NR	NR	G	NR
Mosquito fern (*Azolla*)	NR	NR	NR	G	F	NR	E	NR
Waterhyacinth	NR	NR	NR	G	E	NR	NR	G
Submersed Plants								
American elodea	E	E	E	E	NR	F	E	NR
Bladderwort	G	P	P	G	G	NR	E	NR
Brazilian elodea	G	P	P	E	NR	G	E	NR
Brittle (*spiny*) naiad	E	E	E	E	NR	NR	E	NR
Coontail	G	E	E	E	G	NR	E	NR
Creeping rush	G	NR	NR	F	NR	NR	E	NR
Eurasian watermilfoil	P	E	E	E	E	NR	E	NR
Hydrilla	E	E	E	E	NR	F	E	NR
Parrotfeather	P	E	E	G	E	NR	E	NR
Pondweeds (*Potamogeton*)	E	E	E	E	NR	NR	E	NR
Southern Naiad	E	P	P	F	NR	NR	G	NR
Proliferating spikerush	E	NR	NR	NR	NR	NR	E	NR
Variable-leaf milfoil	P	E	E	E	E	NR	E	NR
Widgeongrass	E	F	F	G	NR	NR	E	NR
Emergent/Floating-Leaf Plants								
Alligatorweed	NR	NR	NR	NR	P	NR	P	G
American lotus	NR	NR	NR	NR	G	NR	P	E
Bulrushes (*Scirpus*)	NR	NR	NR	F	G	NR	NR	E
Cattail	NR	NR	NR	F	F	NR	F	E
Common reed (*Phragmites*)	NR	NR	NR	NR	NR	NR	NR	E
Creeping waterprimrose	NR	NR	NR	NR	E	NR	P	E
Fragrant waterlilly	NR	NR	NR	NR	G	NR	G	E
Grasses	NR	NR	NR	F	NR	NR	NR	E
Pickerelweed	NR	NR	NR	P	G	NR	F	G
Rushes (*Juncus*)	NR	NR	NR	NR	P	NR	NR	G
Smartweeds	NR	NR	NR	F	G	NR	F	G
Spatterdock	NR	NR	NR	F	G	NR	G	E
Water pennywort	NR	NR	NR	G	G	NR	F	G
Watershield	NR	F	F	F	E	NR	G	F
Waterwillow (*Justicia*)	NR	NR	NR	F	E	NR	P	F

*Hydrothol formulations may be toxic to fish at application rates used for weed control.

KEY: NR = Not Recommended P = Poor F = Fair G = Good E = Excellent

caution when applying copper (especially copper sulfate), as it may be toxic to fish under certain circumstances. Glyphosate may be used without restriction except in potable water supplies. There are restrictions on other compounds for varying periods of time and for various water uses, including fishing, swimming, irrigation, livestock watering, and human consumption. The water-use restrictions also vary with the specific formulation of a particular herbicide.

Application rates of herbicides vary greatly depending upon the specific herbicide and formulation and the specific weed to be treated. **Water-use restrictions and efficacy for specific weeds must be considered before purchasing and using a herbicide**. More information on application rates, the weeds controlled, water-use restrictions, and efficacy of specific herbicides and formulations may be found on the herbicide label. Also see the Aquatic Weed Management web site under the NCSU Crop Science Department Home Page (http://www2.ncsu/cals/crop_sci/home/crop0000.html) or in the aquatic weed section of the current edition of the *North Carolina Agricultural Chemicals Manual*. (Single copies may be purchased from the Agricultural Publications Office, Campus Box 7603, North Carolina State University, Raleigh, NC 27695-7603.) This also is available on line at http://ipmwww.ncsu.edu.edu/agchem/agchem.html. For additional information and assistance, call your county Extension office.

Table 2. Waiting Periods (Days) and Setback Distances to Observe After Application of Aquatic Herbicides[1]

Herbicide	Irrigation	Fish Consumption	Livestock	Swimming	Drinking Water
Copper (copper sulfate and various organic copper complexes)[2]	NR[3]	NR	NR	NR	NR
2,4-D (various formulations)[4]	see label	see label	see label	see label	see label
Diquat					
Reward[5]	1-5	NR	1	NR	1-3
Weedtrine D	14	NR	14	1	14
Endothall[5]					
Aquathol K	7-25	3	7-25	NR	7-25
Aquathol (granular)	7	3	NR	NR	7
Hydrothol 191[6]	7-25	3	7-25	NR	7-25
Hydrothol 191[6] (granular)	7-25	3	7-25	NR	7-25
Fluridone				NR	
Sonar 4AS	7-30[7]	NR	NR	NR	¼ mile
Sonar SRP	7-30[7]	NR	NR	NR	¼ mile
Glyphosate					
Rodeo	NR	NR	NR	NR	½ mile

[1]Labels of specific products may change without notice. Check the most current label for changes in water use restrictions.

[2] Copper may be toxic to sheep and goats. Use of copper in ponds used for watering these animals should be avoided unless the animals can be provided with another source of drinking water for at least 3-5 days to allow dissipation. Copper (especially copper sulfate) also may be toxic to fish near the application rate required for control of certain weeds. Care should be taken to calculate the treatment rate carefully to avoid over-application and a possible fish kill.

[3]NR = No restrictions.

[4]Water-use restrictions vary by formulation and manufacturer. Most labels do not permit the use of 2,4-D in irrigation waters. Regardless, if the water is used for irrigating sensitive crops, 2,4-D should not be used. Most turfgrasses are tolerant of low concentrations of 2,4-D.

[5]Water-use restrictions vary depending on formulation, treatment rate, and site of application.

[6]Hydrothol formulations may be toxic to fish at levels used for weed control.

[7]Water use restrictions vary with formulation, site of application, and type and maturity of crop that is irrigated. In some cases, a 30-day restriction may be insufficient for irrigation of seedlings or new transplants of sensitive crops, such as tobacco.

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