

this, draw the water down as far as possible, and when the drying and/or freezing has had its effect, raise water level as rapidly as possible. If plants have begun to grow in the shallow drawdown pool, it may be well to destroy them by raking or other means before refilling the pond.

To avoid fish kills caused by low dissolved oxygen levels, special caution is advised when using drawdown.

Selective Discharge*

In a pond formed by a dam, designing the outlet facilities so as to vary the depth from which water is released may help control water fertility. At certain times of the year when dissolved nutrients are concentrated at certain levels, discharge water can be drawn from those depths to reduce the pond's total nutrient load. Possible adverse effects of nutrient-rich discharge on downstream waters should be considered.

Pond Flushing and Dilution*

It is sometimes thought that removing nutrient-rich pond water and replacing it with "sterile" water—or simply diluting it—will alleviate algal blooms and other plant problems. If truly nutrient-poor water is available from a well or elsewhere, this might be possible. But the effects would likely be brief if nutrients occur in shallow muds where rooted plants can use them or if nutrients flow from land—which is what probably caused the problem in the first place. Also, it is often believed that diverting "clean" stream water through a pond will keep nutrient levels low. Although nutrient concentration in the stream may be relatively low (not always the case!), the net effect is to deposit nutrients in the pond. The water slows down and the pond acts as a physical and biological trap.

Phosphorus Inactivation/Precipitation*

Introducing certain chemicals can change dissolved phosphorus to forms less available to plants or can entrap it and carry it down to the pond bed. The effect may be brief,

as described in the section on pond flushing. Various compounds of aluminum, iron, calcium and other elements can be used. The chemicals are typically broadcast as a powder or injected as a slurry into outboard motor wash. Aluminate and alum, used in combination, may be available to the pond owner, as may zeolite, fly ash, powdered cement and clay. Before using these materials, consult with a limnologist who understands the effects and possible pitfalls of using these materials. Hire a licensed applicator.

Pond Aeration

Pumping air into the depths of a pond and creating a rising stream of bubbles, will help aerate a pond. This is done by an on-shore compressor which passes air through a hose to the deepest part of the pond where a special dispenser, such as an air stone, plastic foam block or metal baffle, breaks it into fine bubbles. The rising bubbles draw water upward, causing the pond water to circulate from bottom to top and take on oxygen from the atmosphere. More oxygen is gained through the pond surface than from the stream of bubbles. With the water of the pond bottom oxygenated, the surface of the pond mud is kept oxidized, holding phosphorus in an insoluble form and less available for growing plants.

In the case of deep trout ponds, there is special equipment (hypolimnetic aerators) for circulating cool water of the deep zone to the surface and back during summer without mixing it with the upper layers. This avoids detrimentally warming the depths.

It may be especially important to aerate the pond in winter. This keeps an area ice-free and allows continual movement of oxygen from the atmosphere into the depths of the pond. It also reduces transfer of phosphorus from mud to water which occurs during winter stagnation.

Pondbed Sealing and Blanketing*

The pond bed can be covered with black plastic sheeting weighted with a gravel layer. Use a rake or pitch-

fork to puncture the sheet first with many small holes to allow escape of gas formed under it, otherwise the plastic may balloon up through the sand and gravel. The sheet makes mud nutrients less available to plant roots. You can also use a 6- to 8-inch layer of sand or gravel alone to cover organic sediments. This has the disadvantage of decreasing valuable pond depth and appears to have less lasting effect than when used on a plastic sheet.

Shading or Coloring the Water

Sheets of black plastic supported by a floating wooden framework can be used to cover large sectors of pond surface. Such a covering is anchored in one spot for the 3-4 weeks needed to shade out plants beneath it, then moved to a new place. Shading with plastic is apparently effective on most submergent plants (except chara) but not on emergents. The device may be cumbersome and unsightly.

Special dyes are available (one with the trade name, Aquashade) which temporarily color the water so as to cut off light and control plants.

Poisoning the Plants

Killing pond plants with toxic chemicals is another form of temporary chemical treatment. Substances toxic to algae are called **algicides**. Those for poisoning rooted, leafy water plants are **aquatic herbicides**. There is no all-purpose aquatic weed-killer that is presently legal.

Chemical treatments have advantages of convenience, but the following drawbacks should be considered:

- Poisoning kills plants without removing them from the pond. After death, the material sinks, consuming oxygen, creating odors and releasing nutrients for new plant growth.
- The poisoned plants disappear only slowly from the treated area. One to several weeks may pass before the nuisance plant masses sink away.

*Contact nearest DNR office (Appendix) to secure permit for this procedure.