

Solutions to Common Fish Pond Problems

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Introduction

At one time or another nearly every farm pond owner has been frustrated by at least one of the many problems that affect ponds and pond life. Among the 60,000 privately owned ponds scattered throughout Virginia, a large number fail to hold water, contain muddy waters, are choked with waterweeds, or do not produce good sportfish populations. This publication addresses these and other typical problems that plague pond owners. Since most pond problems can be avoided, we emphasize preventing problems through careful planning, proper construction, correct stocking, and sound management. Solutions to problems resulting from bad weather, unauthorized fish harvest, accidental introductions of nuisance fish, and chemical contamination are presented.

Selecting the Pond Site

Careful selection of the pond site is one of the most important steps in avoiding farm pond problems. A good pond site contains (1) a topography ("lay of the land") that provides for economical pond construction; (2) a water supply that provides adequate but not excessive amounts of water; and (3) a soil type with sufficient clay content to hold water. Failure to select a good site will result in serious pond problems (flooding, leakage, pollution) that are very expensive to correct. Before making the final site selection, a pond owner should consider all potential sites and consult with soil scientists and engineers. The Soil Conservation Service, with agents in almost all counties in Virginia, will provide (free of charge) soil testing and site selection advice to landowners.

Topography

The topography of the pond site should be carefully evaluated to minimize costly soil removal. Ideally, the topography of the land should be relatively flat, permitting construction of a pond of regular size, shape, and depth. Optimal pond sites are located in small, stable, well-vegetated drainage basins, preferably above the flood plain. Flooding causes serious problems in managing sportfish ponds. Incorporating the topography of the land with the design of the pond dam will permit natural drainage and avoid expensive drain systems or costly pumping equipment.

Water Supply

A continuous supply of high-quality water should be available throughout the year to replenish losses due to evaporation, seepage, or partial drainage of the pond for irrigation, weed control, or fish management purposes. The water supply should be sufficient to provide enough water to fill the pond within a reasonable period of time (less than 15 days) and maintain a relatively constant water level (fluctuations less than 2 feet year-

round). Excessive inflows flush essential nutrients downstream and may allow valuable sportfish to escape.

Small streams are a major source of water for most Virginia ponds. These streams are satisfactory if (1) the flow is adequate to maintain a relatively constant water level; (2) the stream is not subject to heavy flooding; (3) the watershed is forested; and (4) the stream carries a light silt load. When a stream is used as a water supply, it should be directed around the pond and have an inlet pipe which can be screened and closed as needed. An inlet pipe with an open-close valve provides control over water level, siltation, and nuisance fish entry.

Springs, wells, and underground seepage provide additional sources of water for farm ponds. Water from these sources normally assures a reliable flow of high-quality water free of fish diseases, fish parasites, silt, nuisance fish, predators, pesticides, and other contaminants. Some ground waters, however, contain high levels of carbon dioxide, nitrogen, or minerals, which can be harmful to fish and other aquatic life. All waters should be analyzed before pond construction to assure that they can sustain aquatic life.

Surface runoff (waters which flow on the land surface after rains) is another source of water for filling farm ponds. In Virginia, about 3 acres of watershed land is required to provide for each 1 acre foot of pond water (1 acre foot = 1 acre of water 1 foot deep). Thus, pond owners wishing to provide sufficient water flow for a pond one surface acre in size and 6 feet deep (6 acre-feet) should have a watershed area of approximately 18 acres. The exact watershed area required to fill a pond and maintain the water level year-round varies with land use and soil types. For example, a larger watershed area may be necessary to fill ponds located on forested watersheds or sandy soils than to fill those located on pasture lands or in clay soils. Since surface water runoff may transport high quantities of silt, nutrients, and pesticides, ponds fed only by surface waters are subject to more problems than those fed by streams, springs, and wells. A diversion ditch around a farm pond can be used to control runoff water levels and prevent contaminated waters from entering the pond.

Bottom Soils

Since the pond is simply a container for holding water, its dam and bottom must be composed of a soil that minimizes seepage. Soils with a high clay content are preferred because clay particles tend to swell when wet and, thereby, help to seal the pond bottom. It's impractical to build a pond on soils that will not hold water. Sites located in gravel or sandy soils are often too porous to seal effectively. Similarly, sites in limestone or shale regions are frequently unsuitable because of the high risks of fractures that create leaks. Sites in swampy areas may also be unsuitable because they are often difficult to drain and costly to maintain.

Pond Construction

Inflow-Outflow Control

Ideally, the pond owner should have complete control of the water entering and leaving the pond. Thus, two of the most important structural requirements of a good farm pond are (1) a permanent drain, and (2) an inlet control structure. Since it is often necessary to lower water levels to control flooding, erosion, waterweeds, and fish populations, an “easily operated” drain of “adequate size” (sufficient to drain the pond in 5 days or less) is essential. Water levels in old ponds lacking a drain can be controlled by pumping or siphoning, but these are time-consuming and expensive alternatives that cannot substitute for an adequate drain. Similarly, since it is often necessary to prevent waters containing chemical contaminants, heavy silt loads, or nuisance fish from entering the pond, an inflow control system is important. When streams are used as a water supply, the stream should be diverted around the pond and an inlet pipe, which can be screened or closed as needed, should be installed. When surface runoff waters are used as a water supply, an embankment or diversion ditch with an inlet pipe, which can be screened or closed, is recommended. Inflow-outflow control structures designed into new ponds or installed in old ponds will prevent and help control common farm pond problems.

Pond Size

Good sportfishing ponds should be 1 acre in size or larger. Small ponds less than 1/2 acre in size generally do not provide enough natural food or cover to support healthy sportfish populations and are easily overharvested. Except for this lower size limitation, selection of pond size is left to the discretion of the pond owner. Some advantages of small ponds (1/2 to 2 acres in size) are that they (1) can be drained and filled rapidly, (2) are easier to treat for waterweeds and fish disease problems, and (3) are less susceptible to bank erosion by strong winds and water currents. On the other hand, larger ponds (2-10 acres) (1) are less subject to drought, (2) cheaper to construct per unit of water, (3) provide more uses (irrigation, livestock, fish farming), and (4) can support greater sportfish populations than smaller ponds.

Pond Depth

Pond depth depends primarily on the prevailing weather conditions. In northern states, ponds must be deeper than those in the southern United States in order to avoid “winterkills” (fish kills caused by suffocation under snow-covered surface ice). Similarly, ponds located in the mountains of Virginia that develop ice cover during the winter months should be built deeper (10 to 12 feet) than those in eastern or central Virginia (8 to 10 feet deep). Shallow ponds (less than 8 feet in depth) are not recommended, since they may develop weed problems or get too warm during the summer months. Deep ponds (greater than 15 feet in depth) are not recommended because deeper waters are often devoid of oxygen and contribute little to fish production. However, ponds used for crop irrigation, livestock watering, and other high consumptive water uses should be deeper than 12 feet. Deep water along the shoreline discourages water weed growth. The pond edges should be at least 3 feet deep (a 3 to 1 shoreland slope).

Water Quality

Water Temperature

Water temperature plays an important role in determining what kinds of sportfish can survive in a particular farm pond. In general, freshwater sportfishes can be divided into three major groups based on their temperature preferences: coldwater fish, warmwater fish, and coolwater fish. All trout (brook, rainbow, and brown) are coldwater fish. Coldwater fish thrive in coldwater ponds (fed by springs or groundwater) where the average surface water temperature for trout is below 70°F (21°C) during the summer. Optimal water temperature for trout is about 60° to 68°F. Trout may survive at slightly higher water temperatures, but only for short periods of time. Water temperatures above 70°F cause stress in trout, and death occurs within minutes at temperatures above 80°F. Warmwater fish (largemouth bass, bluegill, sunfish and catfish), on the other hand, can survive at water temperatures of 90°F (32°C) or higher. Most farm ponds in Virginia, particularly those fed by surface waters, are warmwater ponds (surface water temperatures above 75°F or 21°C during the summer) and should be stocked with warmwater fish. Coolwater fish (smallmouth bass, rockbass, and pike) prefer an intermediate temperature range (70° to 80°F). Coldwater ponds should be stocked with trout and warmwater ponds should be stocked with bass, sunfish, or catfish. Stocking farm ponds with the wrong species of fish will result in fish kills or slow growth.

Acid or Alkaline Waters

The pH of pond water is a chemical measurement indicating how acidic or alkaline (basic) the water is on a standard scale ranging from 0 to 14. Pure (neutral) water is neither acidic nor basic and has a pH value of 7.0. Acid waters have pH values ranging from 0 (very acidic) to 6.9 (slightly acidic). Alkaline waters have pH values ranging from 7.1 (slightly alkaline) to 14.0 (very alkaline). Sportfish favor waters within a range of 6.5 to 9.0. Values above and below this range may kill fish or lower production. Extremely acid waters (below pH 4) or alkaline waters (above pH 11) are lethal to most sportfish. Moderately acidic or alkaline waters may result in slow growth or low survival.

If pond waters are consistently too acidic (below pH 6), liming materials can be broadcast over the bottoms of empty ponds or over the surface waters. Common liming materials are agricultural limestone [CaCO_3 or $\text{CaMg}(\text{CO}_3)_2$], hydrated or slaked lime [$\text{Ca}(\text{OH})_2$], and unslaked or quicklime [CaO]. Finely crushed agricultural limestone is the best liming material to use in ponds since the other liming materials may elevate the pH too high and cause fish kills. Acidic pond waters can be treated by applying 1000 pounds of finely ground agricultural limestone per surface acre of water each week until a pH level near 6.5 is reached. A number of materials, including filter alum (aluminum sulfate) and agricultural gypsum (calcium sulfate), have been used to treat highly alkaline waters (above pH 10), but the effectiveness of these chemicals in reducing high pH values remains questionable.

Dissolved Oxygen

Dissolved oxygen is one of the most important water quality factors to consider in managing sportfish ponds. Without an adequate supply of dissolved oxygen, fish cannot survive. Most of the dissolved oxygen (70 to 90%) in pond water is produced by green plants (algae and rooted water plants) through the process of photosynthesis. Photosynthesis and oxygen production by water plants is regulated by sunlight. On sunny days plants produce oxygen. At night no oxygen is produced. Maximum oxygen production generally occurs in late afternoon (2-4 p.m.) each day and during the summer months when more sunlight is available. Minimum oxygen production generally occurs just before dawn (sunrise) and during the winter months when less sunlight is available. At night or on cloudy days, respiration (oxygen consumption) by plants and fish may exceed photosynthesis (oxygen production) during the day, resulting in critically low oxygen levels and fish kills. Since water plants produce oxygen, a limited number growing in the pond are beneficial. However, large growths of rooted water weeds or floating mats of algae are harmful because they can use all the dissolved oxygen in the pond during the night.

Pond waters should contain at least 5 mg/L (parts per million) of dissolved oxygen to sustain a healthy population of warmwater sportfish and a minimum of 6 mg/L for coldwater sportfish (trout). Dissolved oxygen levels below 5 mg/L stress fish resulting in low production and slow growth. Oxygen levels below 3 mg/L for long periods of time may kill fish directly or lower their resistance to diseases and parasites.

Muddy Waters

Muddy water is not only unattractive, but harmful to aquatic life. High levels of suspended sediments (1) limit light penetration and oxygen production by aquatic plants; (2) increase water temperatures; (3) smother fish eggs; (4) suffocate bottom-dwelling fish food animals; (5) retard the growth of sportfish; and (6) reduce the holding capacity of ponds. Although high sediment loads seldom kill sportfish directly, muddy waters can seriously reduce fish production. All other things being equal, clear water ponds can produce several times more fish than muddy ponds. Turbid water not only reduces the amount of fish food available, but seriously interferes with the ability of sportfish to see and catch prey (most sportfish are visual feeders). It is a sad irony that the same soil that is vital for food production and life on land becomes a major pollutant when suspended in waters.

Muddy pond waters are normally the result of soil erosion. Heavy rains and strong winds transport eroded soil particles into ponds from overgrazed pastures, unprotected croplands, and unvegetated shorelines. Any area where cover plants have been stripped and the bare soil is exposed provides a source of polluting sediments. Livestock trampling shorelines and wading in ponds or upstream waters add large quantities of soil sediments. Bottom feeding fish, particularly carp and bullheads, contribute to the problem by rooting and stirring up silt in their search for food.

The best way to keep pond water clear is to keep the soil on the land. Water clarity can be conserved by (1) strip cropping and contour plowing, (2) land grading and terracing, (3) installing sediment basins and soil traps at the pond inlet, (4) routing muddy water around the pond through diversion ditches, (5) planting cover crops and protecting existing shelter belts along shorelines, and (6) fencing livestock from ponds and inflowing streams. It is much easier to limit soil erosion and prevent surface runoff than it is to remove sediments once they have entered the pond.

Surface application of certain chemicals that bind and precipitate clay particles can be used to clear muddy ponds. Chemical treatments effective in treating muddy ponds include: (1) filter alum (hydrated aluminum sulfate, $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$) applied at a rate of 5 lbs./surface acre; (2) finely ground agricultural limestone (CaCO_3) applied at a rate of 500 lbs./surface acre, and (3) agricultural gypsum (hydrated calcium sulfate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) applied at a rate of 500 lbs./surface acre. Since the exact application rate varies, concentrations for individual ponds should be determined by treating pond water samples in jars and selecting the minimum level that will cause the clay particles to precipitate within an hour. Cautious application is advised because these chemicals can be harmful to fish life. Alum, for example, reduces the pH and should not be used in soft water ponds with low pH values. Chemical clearing agents provide only temporary relief; the source of the eroded sediments and clay particles should be eliminated by proper land management practices.

Leaking Ponds

One of the most common farm pond problems is heavy water loss through leakage. The ability of the pond to retain water depends largely on the characteristics of the soil at the pond site. Most leaky pond problems can and should be prevented by cautious site selection. Before building a pond, be sure to test the capacity of the soil to hold water. Soils with a high clay content will minimize seepage since clay particles tend to swell when wet and, thereby, provide a good bottom seal.

Bottom Seals

Although it is usually expensive, leaky ponds can be sealed using one or more of a variety of compounds. The most commonly used pond sealant is bentonite clay. Bentonite is most effective on sandy soils that contain insufficient amounts of clay. This clay has the capacity to expand up to 20 times its original size when moistened. For best results, bentonite should be spread evenly over the dry pond bottom at a rate of 50 lbs/100 ft (20,000 lbs/acre) mixed with the existing soil, moistened, and then compacted with a roller. Other sealants, including soluble salts and polyphosphate chemicals, are effective on certain soils. Laboratory analysis of the soil is essential to determine the appropriate type of sealant and its rate of application. Another increasingly popular method of pond sealing involves lining the bottom with a flexible plastic or rubber sheeting of polyethylene, vinyl, or butyl at least 2 mm thick. To protect against punctures and tears, the pond liners should be covered by at least 6 inches of sand or fine soil.

Plastic or rubber sheeting can be purchased from local hardware stores.

Burrowing Animals

Leaking ponds may be caused by burrowing animals such as crayfish, muskrats, and beaver, who construct their homes or “burrows” by digging into soil banks along the shorelines of waterbodies. Tunnels dug above the water level can decrease structural support of the embankment and increase the risk of washout during flood conditions. These hazards are multiplied in waters where burrowing animals are abundant and where water levels fluctuate. Rising and falling water levels often stimulate these animals to dig new burrows, increasing the potential for structural damage and water leaks.

If large numbers of burrowing animals and extensive tunneling activity are undermining the structural integrity of the dam, several control measures can be effectively employed. Efforts at total eradication are usually futile since burrowers from upstream waters or nearby ponds can migrate considerable distances and will continually reinvade the pond. Therefore, the control measures suggested below should be viewed simply as actions the pond owner can incorporate to reduce excessive numbers of crayfish or muskrats to a level at which structural damage and water leaks will be minimized.

Crayfish

Trapping crayfish is an effective method for control. Several types of trap are available from sporting goods outlets or can be made at home using 1/2-inch mesh chicken wire. Modified funnel-end commercial minnow traps are often used. The funnel openings should be enlarged to about 2 inches in diameter to allow for easy entry by large crayfish if this type of trap is used. Lift traps, similar to the ones used to catch saltwater crabs, are commonly used to catch crayfish. Simply lower the baited trap to the bottom, then quickly pull it up at frequent intervals. Meat scraps, fish heads, soybean cake, perforated cans of dog food, or almost any high-protein substance can be used as crayfish bait. For overnight or long trap setting times, you can enclose the bait in hardware cloth to prevent the trapped crayfish from eating all the bait.

The habits of crayfish strongly influence how easily they are caught. Crayfish overwinter in their burrows in the bottom muds or shoreline banks, emerging as the water warms. The opening of trout season roughly corresponds with the time when crayfish first become active in Virginia. The optimal water temperature range for crayfish is between 40°F (4°C) and 75°F (24°C). If temperatures are below or above this range, crayfish become inactive and quit feeding. Crayfish are nocturnal (active at night). Traps should therefore be set in late afternoon and left overnight.

An excellent method for preventing high numbers of crayfish is to stock and maintain a balanced population of fish. Trout, bass, catfish, and large bluegills (bream) are all predators of crayfish and reduce excess numbers. Other natural predators that feed heavily on both young and adult crayfish are: amphibians (bullfrogs, salamanders), reptiles (turtles, water snakes), waterbirds (herons, kingfishers, ducks, geese), and

mammals (raccoons, otters, mink). These beneficial creatures should be protected and encouraged to live in or near your ponds. Natural predators, which act as biological controls, have the advantage of providing year-round protection from burrowing crayfish problems without the need for trapping.

Muskrats and Beaver

Muskrats and beaver can be discouraged from living in a pond by eliminating water plants and shoreline vegetation that provide food and cover for these burrowers. Muskrats prefer to feed on starchy aquatic plants, particularly cattails, bulrushes, reeds, arrowhead, and aquatic grasses. Controlling the growth of these water plants and keeping the pond banks well mowed will limit muskrat populations. Physical barriers to prevent muskrats from tunneling into shorelines and earthen dams can be used to reduce tunneling. Lining the inner face of the dam with pea gravel, sand, rock rip-rap, concrete, cement board, or wire screening (1-inch mesh) will effectively discourage digging. These physical barriers should extend from 1 foot above the high water mark to at least 4 feet below the normal water level.

Trapping is the most practical method for controlling muskrats and beaver. They can be “live-trapped” with wire cage or box traps, or humanely killed using the steel traps set underwater. Traps should be set in runways, or den openings. If possible, trapping should be conducted during the winter when the fur is prime. Muskrats and beaver are valuable furbearers that represent a potential cash crop to the pond owner.

Nuisance Fish

Although many different types of freshwater fish will live in Virginia ponds, only a few fish species will produce good sportfishing over many years. The fish species recommended for stocking warmwater ponds in Virginia are largemouth bass, bluegill sunfish (bream), redear sunfish (shell crackers), and channel catfish. A single pond can be stocked with all of these species or desired combinations, but should contain no other types of fish. Coldwater ponds should contain only trout. All other types of fish, particularly crappie, bullheads, carp, goldfish, perch, suckers, and other types of sunfish will compete with desirable fish for food, cover, and spawning sites. Nuisance fish tend to overpopulate ponds and ruin sportfishing. Moreover, nuisance species and wild fish obtained from nearby streams or ponds often carry diseases or parasites that infect sportfish and reduce fishing quality.

Three major causes for nuisance fish problems are (1) failure to kill all fish life in a pond and its inflowing waters before hatchery fish are stocked, (2) failure to prevent the entry of wild fish into a stocked pond, and (3) failure to stock only the recommended fish species. Before stocking, fish life can be eliminated by completely draining and drying the pond bottom or by partially draining and applying fish poison to the remaining waters. Inflowing waters should also be screened or filtered to keep out unwanted fish. A saran screen filter (100 meshes per inch) can be used to filter out nuisance fish and their eggs. The best way to stock only the recommended types of fish is to obtain all stocks

from a commercial hatchery. Reliable commercial hatcheries will not only provide the proper kinds of sportfish in the correct numbers and sizes, but will also guarantee live delivery of disease-free fish. This is a particularly valuable service since small fish are very difficult to identify. Unless one is an expert at fish identification and diseases, never stock fish from nearby streams, ponds, or lakes. The pond owner must also ask neighbors and friends not to introduce any fish into the pond.

Desirable Sportfish Nuisance Fish

Largemouth Bass Black Crappie (Speckled Perch)
Bluegill Sunfish (Bream) White Crappie (Silver Perch)
Redear Sunfish (Shell Crackers) Yellow Perch
Channel Catfish Carp
Brook Trout Goldfish
brown Trout Suckers
Rainbow Trout Bullheads (Mudcats)
Pumpkinseed Sunfish
Green Sunfish
Golden Shiners
Minnows

Fish Diseases and Parasites

Fish are continuously exposed to a wide variety of diseases and parasites. Fish are subject to infection by disease-causing viruses, bacteria, and fungi. Fish are also parasitized by tapeworms, leeches, grubs, and lice. All of these organisms normally occur at low levels in most farm ponds and in limited numbers on many fish. Fish disease-causing organisms and parasites seldom cause problems in farm ponds. A few parasitized fish in a farm pond are not unusual. However, large numbers of infected fish are cause for concern since slow growth, sterility, and fish kills may result from extensive diseases and parasite infestations.

Fish diseases and parasites seldom reach epidemic levels. Sudden, large fish kills in farm ponds are rarely caused by diseases or parasites. Fish suffering from diseases or parasites usually die slowly—a few fish each day. Only in severe cases when fish are in poor condition, starving, crowded, injured, mixed with wild fish, or stressed by rough handling, low oxygen levels, high temperatures or chemical toxins, do diseases and parasites become a serious problem. Fish suffering from disease or parasite infections are easily recognized. Some of the early warning symptoms are: (1) a general loss of appetite or refusal to feed; (2) abnormal coloration and the erosion of the scales or skin; (3) abnormal distribution such as crowding at the surface, near inflowing waters, or in the shallow water at the sides of the pond; (4) abnormal activity such as flashing, twisting, whirling, or lack of activity. Fish exhibiting any unusual form of behavior should be closely examined for external symptoms of disease or parasites. Infected fish usually show visible sores, discoloration, bleeding, swollen areas, tumors, popeyes, small black or white spots, or other abnormal growths on the head, body, and fins.

There are few practical methods for treating diseased or parasitized fish in natural pond, lake, or stream waters. Sick fish can be effectively treated in hatcheries and aquariums under controlled conditions. However, in natural waters it is almost impossible to eradicate a disease or parasite without draining, drying, and disinfecting the pond bottom soil and destroying all the fish. Some chemicals can be used for partial treatment (see Virginia Cooperative Extension publication 420-899), but even limited treatments are expensive, time-consuming and seldom successful. Therefore, pond owners should make every attempt to prevent fish diseases and parasites from becoming a problem. Pond owners who: (1) stock only healthy fish from disease-free commercial hatchery stocks, (2) exclude all wild fish from the pond, (3) do not transfer fish from other ponds, lakes, or streams into the pond, (4) follow the recommended stocking rates to avoid overcrowding and starvation, and (5) prevent fertilizer or pesticide runoff from entering the pond, seldom experience fish disease or parasite problems.

Aquatic Animals

Water Snakes

Although water snakes do eat some fish, they pose no serious threat to pond fish populations or man. Water snakes are not poisonous! Of the 36 different types of snake found in Virginia, only two species, the northern water snake (*Natrix sipedon*) and the brown water snake (*Natrix taxispilota*), are true water snakes. Many people confuse these water snakes with the eastern cottonmouth or water moccasin (*Agkistrodon piscivorus*) which is a poisonous, water-dwelling snake. However, the cottonmouth is found only in the extreme corner of southeastern Virginia, near the Dismal Swamp. Since these snakes have never been found further west than Petersburg, about 90% of the state has no cottonmouths. Water snakes will bite if handled, but are relatively harmless and should not be indiscriminately destroyed. Clearing debris and mowing vegetation at the pond edges reduces hiding places for snakes and will effectively reduce their numbers.

Turtles

Turtles are beneficial scavengers that feed primarily on aquatic plants and dying fish. Turtles are not harmful to fish populations and can actually improve fishing by removing unhealthy fish. Of the 18 species of turtle found in Virginia, only the snapping turtle can become a nuisance by occasionally stealing fish bait or eating ducklings. Turtles seldom cause problems and should not be indiscriminately killed. Snapping turtles can be caught with trot lines, large minnow-type traps, rat traps, or box traps baited with fish heads, fresh meat, or watermelon rind. Snapping turtle meat is considered a delicacy if properly prepared.

Water Birds

A wide variety of wading birds (sandpipers, terns, herons), waterfowl (grebes, mergansers, ducks, geese), and other birds (kingfishers, gulls, and ospreys) feed on water animals and are attracted to ponds. These birds do eat some fish, but rarely can catch

enough fish to seriously affect sportfish populations. These birds, like turtles and water snakes, are beneficial predators that cull weak and diseased fish from ponds. Wading birds like the greater yellowleg sandpiper provide a very useful service to the pond owner by consuming thousands of insect pests. They are very effective in controlling mosquitoes, biting flies, leeches, snails, and other nuisance animals that dwell along the shorelands of ponds. Moreover, these birds contribute to the beauty and scenic enjoyment of pond owners. Many of these birds are becoming rare and nearly all are protected by state or federal laws. They should not be killed or discouraged from feeding or nesting on ponds. Pond owners who are fortunate enough to have these species on their property should enjoy and protect them so that their children may have similar pleasures.

Waterfowl

Wild ducks and geese cause few farm pond problems. In fact, many pond owners wish to attract nesting and migrating waterfowl. The most critical decisions for a pond owner desiring waterfowl concern siting and design of the pond. Guidelines for creating ponds attractive to waterfowl differ from those for ponds used for most other common purposes. The ideal sportfish pond, with its regular shape, steep banks, limited weed growths, and deep water, is not best for attracting ducks. Waterfowl prefer to feed and raise their young in weedy, shallow ponds located away from human activity. It is usually not worthwhile to artificially seed a shallow pond in Virginia, since naturally occurring aquatic plants produce good food and cover. However, it is wise to construct nesting islands located at least 10 yards from the banks, to provide nesting habitat for mallard and black ducks and Canada geese. Wood ducks can be attracted to ponds by placing nest boxes on poles or in nearby trees.

Livestock

Domestic livestock (cattle, horses, hogs) should be completely fenced out of ponds used for sportfish production. Water pollution from livestock wastes and soil erosion caused by the trampling/grazing activities of livestock at pond edges or in upstream waters can seriously reduce the growth and production of sportfish. Livestock wastes and eroded soil particles entering pond waters create a number of problems including (1) infilling of the pond basin; (2) reduction of storage capacity and depth; (3) reduction of water clarity and light penetration; (4) increasing water temperatures; (5) low dissolved oxygen levels; (6) smothering of fish eggs and fish food animals; (7) stimulating algae and weed growths; and (8) fish kills. To protect pond water quality, water for livestock should be piped by gravity-flow into watering troughs located below the dam, downstream from the pond. Drainage from barnyards, feeding lots, bedding areas, or other sources of contamination should be diverted around the pond. If fencing the entire pond is not practical, pave livestock trails to the pond with gravel and confine livestock to a small area of the pond by partial fencing.

Aquatic Weed Control

Although limited numbers of aquatic plants growing in ponds are beneficial, dense

growths of algae and other waterweeds can seriously interfere with man's uses of ponds and create undesirable changes that threaten pond life. Nuisance growths of waterweeds may restrict swimming, boating, fishing, and other water sports in recreational ponds. Certain types of waterweeds impart unpleasant taste, emit offensive odors, and discolor pond waters. In valuable sportfish ponds, dense growths of aquatic vegetation provide cover for small fish, permitting overpopulation and stunted fish populations. Decomposition of waterweeds depletes dissolved oxygen, often resulting in the suffocation of sportfish (winter kills and summer kills).

There are a number of recommended methods for controlling waterweeds in ponds. Selecting the best technique or combination of techniques depends on the kind of nuisance weed present, the extent of the problem, the nature of the problem, economic considerations, and local environmental conditions. To obtain successful results, control measures should be carefully selected. For additional help in controlling waterweeds, consult your county Extension or Soil Conservation agent (see Virginia Cooperative Extension Publication 390-809).

Watershed Management

A major objective in waterweed control is to keep the soil and its nutrients on the land and out of pond waters. Land use practices that prevent soil erosion and limit the movement of soil particles into ponds are essential in controlling waterweed growth. Eroded soil sediments not only fill in ponds, but also transport nutrients which stimulate weed growth. Wise land use practices are fundamental in controlling waterweeds. These include: (1) no-till farming, (2) strip cropping, (3) contour plowing, (4) installing sediment basins, (5) preventing livestock overgrazing, (6) fencing livestock out of ponds and inflowing streams, and (7) creating shelterbelts along shorelines. All of these practices can significantly reduce waterweed problems. Careful consideration should be given to preventing animal wastes and fertilizers from entering pond water. Feed lot and barnyard runoff should be channeled around a pond by using a grass-lined diversion ditch.

Dredging and Deepening

The removal of pond bottom sediments is a very effective way to control rooted waterweeds in shallow ponds. Dredging reduces waterweed problems directly by removing the weeds, bottom sediments, and their associated nutrients. Dredging and deepening shallow shoreline areas limits weed growth indirectly by exposing a soil layer that may be nutrient-poor or impervious to plant roots and by decreasing the amount of sunlight available to plant life. Dredging can be conducted on dry land, after the pond has been drained, or underwater. Underwater or hydraulic dredging is normally too expensive for use in small ponds. On drained pond bottoms, dry-land excavation machinery such as bulldozers or draglines can be used. Although digging and removing bottom sediments by hand is hard work, it represents a simple, economical, and efficient alternative to mechanical dredging. The dredge spoils must be trucked away from the pond basin to

prevent subsequent contamination.

Harvesting

The physical removal of waterweeds from ponds is an ideal control technique. Waterweed harvesting consists of three essential steps. These are (1) cutting or uprooting the weeds, (2) collecting the cut weeds, and (3) removing the weeds from the pond. Harvesting can be accomplished by simple hand tools and physical labor or with the help of cutting machines. In shallow shoreline areas, weeds can be pulled by hand, cut by sickle, dug out with a hoe, and removed from the water with rakes or forks. In large ponds, a variety of commercial powered cutting machines are available. Some cutting blades can be mounted on the bow of a motor boat. The success of any harvesting operation depends on the prompt and complete removal of all cut weeds. Haphazard or partial removal of the cut weeds can increase the problem, since each unremoved weed fragment has the potential to form a new weed. Also, cut weeds left in the water will decay and release nutrients that stimulate future weed growths. Decomposing weeds left in the pond use oxygen and can cause fish kills. Harvesting provides immediate relief from nuisance weed growths and does not endanger fish life.

Water Level Management

Lowering the water level of a pond can be an easy way to control nuisance waterweeds. Pond drawdown, particularly during the winter months, exposes weeds to harsh conditions including freezing, desiccation (drying out), strong wind action, and bottom sediment compaction. In addition, frost heaving of the bottom sediments uproots the weeds and aids in their destruction. To insure effective over-winter control, the bottom muds should freeze to a depth of 4 inches for several weeks or longer. Freezing weather conditions, however, are not necessary for successful weed control. Pond drawdown at any time of the year will reduce waterweed growth. Waterweeds exposed by lowering the water level must be collected and removed from the pond basin, or the rotting weeds will contribute nutrients that promote new weed growths when the water level is once again raised. In ponds without drains, water pumps can be used to manage the water levels.

Shading

Limiting the amount of sunlight available to aquatic plants by floating black plastic sheeting on the water surface or by using dark-colored dyes has been effective in controlling waterweeds. Black plastic sheeting attached to styrofoam floats serves as a floating shade which can be moved easily from one place to another for spot treatment of nuisance water plants in small areas. This technique is ideal for weed control around boat docks, fishing piers, and swimming beaches. Several commercially available water dyes, including nigrosine, analine, and aqua-shade, can be used to color the water in order to reduce light penetration and shade out nuisance plants. To be effective, the dyes must persist or the floating black plastic raft should remain in one place for four weeks or longer. For the best results, this technique should be used in early spring at the start of the

growing season before the waterweeds have had a chance to establish themselves.

Pond Bottom Linings

Covering the bottom sediments of small ponds with either plastic sheeting, a layer of mineral soils (sand, gravel, clay) or both of these materials is an effective waterweed control technique. Perforated black plastic sheeting covered with a blanket of sand or gravel provides a relatively cheap alternative to dredging. These coverings limit the exchange of nutrients from the bottom muds to aquatic plants and inhibit the establishment of rooted waterweeds. In addition, sediment covers provide a firm stable bottom which can minimize water loss. Plastic sheeting (4 mil or thicker) should be evenly weighted and perforated with small holes to permit the escape of gases produced by decomposition and prevent ballooning. If only a mineral soil blanket is used to cover the bottom sediments, a 6- to 8-inch layer often is necessary. Covering the pond or lake bottom sediments with a layer of sand, gravel, or another mineral soil has proved less effective than using plastic sheeting in combination with mineral soil. Black plastic sheeting overlaid with several inches of mineral soil is recommended. Important wetland habitats, such as fish spawning or waterfowl nesting areas, should not be covered.

Biological Controls

Introducing animals and plants that eat or compete with waterweeds represents another control method. Herbivorous animals (those that eat plants) include a wide variety of insects, snails, crayfish, tadpoles, turtles, fish, ducks, geese, and swans which can be stocked in ponds to consume waterweeds. The major problem with introducing herbivorous animals into ponds for waterweed control is that their body wastes act as fertilizers and stimulate weed growth. Herbivorous animals, by recycling nutrients, may do more harm than good. Many different types of aquatic plant compete with waterweeds for space, light, nutrients, and other critical factors. Therefore, it is sometimes possible to discourage the growth of nuisance waterweeds by planting beneficial aquatic plants. Some biological control agents are more harmful than beneficial. Check with county agents before introducing animals or plants into your pond. Please note that the release of exotic (nonnative) animals or plants into Virginia without specific authorization is strictly forbidden by state laws.

Chemical Controls

The treatment of weed-infested waters with herbicides (chemicals that kill plants) is a method that must be used with caution and only after careful consideration of alternative control methods and the potential uses of the treated water for drinking, livestock watering, swimming, fish production, irrigation, or other uses. In no instance should a herbicide treatment be considered as a total cure for a pond weed problem. Rather, the weed problem should be approached using a combination of the methods listed above and, if absolutely necessary, supplemented with chemical control agents. Caution must be taken to apply herbicides at the correct time, at the correct rate, and in accordance with

label instructions. Chemicals that kill nuisance waterweeds may also kill beneficial water weeds and fish, disrupt aquatic food chains, or have other undesirable side effects.

Chemical treatments are costly, generally provide only short-term relief from the symptoms of the problem, and should not be viewed as a solution. Realize that the basic cause of excessive water weed growth—overfertilized water—is not affected by herbicides. It is important to understand that when waterweeds are killed by chemicals, they rot and release their contained nutrients (fertilizers) into the pond water. These nutrients are then available to stimulate future weed growth, often requiring more treatments. For successful, long-term control of water weeds, a continuous program using several of the weed control measures listed above, particularly preventing fertilizer from entering the pond and physically removing the weeds, is recommended. (For additional information on chemical control alternatives, consult Virginia Cooperative Extension Publication 456-017.)

Balanced or Unbalanced Populations

The term “balance” refers to the relative numbers and sizes of predatory fish (bass) and prey fish (bluegill) in a pond. A balanced sportfish population is one with a satisfactory number of catchable-sized bass and bluegill. Ponds with balanced sportfish populations provide desirable numbers of harvestable- sized fish of both species. For example, if both fish species are abundant and the average size of bluegills harvested is 6 inches or larger and bass average 12 inches (1 pound) or more, then the population is considered balanced.

In contrast, an unbalanced population is characterized by too many small fish and too few large fish of either species. In most cases, unbalanced populations are indicated by an overabundance of small bluegill (averaging 3 to 5 inches in length), and very few but some large bass (averaging 15 inches or larger). This condition usually occurs when bass are overharvested and bluegill are underharvested. However, unbalanced populations can also be indicated by an overabundance of small bass (averaging 9 to 10 inches) and an abundance of large bluegill (averaging 6 inches or larger). In either case, excessive numbers of one species or the other will rapidly exploit the available food supply, resulting in slow growth and stunted populations.

Table 1. Probable condition (balanced or unbalanced) of pond sportfish populations based on angler catch records and minnow seine hauls

Average Length Catch (Inches)	Probable Abundance	Condition
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I. Angler Catch

1. Situation One: Balanced
Bluegill 6" Abundant
Bass 12" Abundant
2. Situation Two: Unbalanced

Bluegill 3-5" Abundant
Bass 15" Rare
3. Situation Three: Unbalanced
Bluegill 6" Few
Bass 7-10" Abundant

II. Minnow Seine

1. Situation One: Balanced
Bluegill 0.5-2" Abundant
Bass 1-4" Few
2. Situation Two: Unbalanced
Bluegill 0.5-2" Few
Bass 1-4" Abundant
3. Situation Three: Unbalanced
Bluegill 0.5-2" Abundant
Bass 1-4" None

Pond owners can monitor the condition of their sportfish populations by (1) keeping an accurate record of numbers, sizes (length or weight), and species of all fish caught by fishing, and (2) assessing reproductive success each summer by making several hauls along the shoreline with a large minnow seine (1/2-inch mesh, 15-20 feet long) and recording the numbers, sizes, and species of young fish present. Table 1 can be used as a general guide to the probable condition of the population. For a more accurate analysis of balance, angler catch and seining catch information can be sent by your local Extension Agent to the Extension Fisheries Specialist at Virginia Tech.

A number of corrective methods can be used to control excessive numbers of small fish and restore population balance in ponds. These include: (1) harvesting large numbers of small fish by angling and seining with a minnow net (20 feet or longer with a 1/2-inch mesh size); (2) destroying spawning beds by raking over or trampling active nests; (3) stocking largemouth bass (12 inches or larger) to supplement the predator population; (4) lowering the water level to force small fish from shoreline cover into open water where they are more susceptible to predation; (5) partial poisoning by applying a fish toxicant in shallow shoreline areas; and (6) removing dense growths of water weed which provide shelter for small fish and trap nutrients that would otherwise be used to produce fish food organisms. All of these methods can be used singly or in combination to reduce overcrowding without killing the larger, more desirable sportfish. However, in ponds that are severely overcrowded with stunted fish, the only realistic solution is to kill all the fish by draining and poisoning and then restock the pond.

Artificial Feeding

Artificial feeding is usually unnecessary and generally not recommended in sportfishing ponds. Most ponds in Virginia, if correctly stocked, will provide enough natural food to support healthy sportfish populations without supplemental feeding. Artificial feeding is a

time-consuming, costly, and potentially harmful process that often is not worth the effort, expense, or risk. Overfeeding can create serious water quality problems. Decomposition of uneaten food and waste products can reduce dissolved oxygen levels and cause fish kills. Moreover, since sportfish prefer to eat live aquatic animals (insects, crayfish, frogs, and small fish) rather than dry, pelleted feeds, commercial feeds may not be readily consumed. Largemouth bass usually will not accept artificial feeds.

Artificial feeding is necessary in hatcheries and commercial fish farms where fish are grown at high densities and food is limited. Since channel catfish and trout accept dry, pelleted feeds, some pond owners who raise those species as food fish prefer to use commercially prepared feeds. Pelleted catfish and trout feed is available from farm supply dealers.

If artificial feeding is attempted, pond owners should carefully follow some important guidelines. These include: (1) do not provide more feed than can be completely eaten in 10 minutes (food remaining after this time is seldom eaten and pollutes the water); (2) if fish suddenly cease feeding, stop feeding and check for low oxygen, diseases, or other problems; (3) reduce feeding rates at high and low water temperatures (above 90°F and below 60°F for catfish, above 67°F and below 50°F for trout); (4) do not feed after sundown or at night when dissolved oxygen levels normally decrease; (5) feed on a regular schedule at the same time each day; (6) use floating pellets to allow for observation of feeding activity and general fish health; (7) use the pellet sizes recommended for the size of the fish grown; (8) distribute the feed evenly throughout the pond; and (9) do not substitute other animal feeds for fish feed. Pond owners should realistically evaluate the efforts and costs of a feeding program. Discontinuing an established feeding program or haphazard feeding can create overcrowded conditions and fish kills.

Fertilization

In Virginia, fertilizing pond waters to increase sportfish production is not recommended for a number of reasons. Some major objections to applying agricultural fertilizers directly into fish ponds include: (1) most ponds in Virginia are naturally fertile and will usually produce good crops of sportfish without artificial fertilization; (2) fertilization is expensive and most pond owners do not harvest enough fish to justify the added costs or efforts required to fertilize correctly; (3) haphazard or discontinuous fertilization programs can create serious water quality problems and fish kills; (4) added fertilizers may stimulate growths of nuisance algae and water weeds rather than desirable plant life (phytoplankton); and (5) the results of fertilizing ponds are generally unpredictable, often undesirable, and can be harmful to aquatic life.

Probably the greatest single misconception about fish ponds is that small, stunted fish are the result of “infertile or unproductive” pond waters. This popular myth suggests that simply sprinkling fertilizer into ponds will prevent overcrowding and stunted sportfish populations. This is, of course, not true. In fact, the sizes of sportfish in a pond are largely determined by the ratio of predatory fish to prey fish—what is called “balance.” Good

growth of sportfish depends on the presence of large predatory fish which reduce the abundance of small fish, leaving more food for the survivors. Without an abundance of predatory fish, fertilization will only increase the problem by sustaining more small fish to compete with one another. To make matters worse, the dense weedbeds often produced by fertilization provide cover for small fish so that large predatory fish cannot prey on them effectively. Contrary to popular belief, fertilization will not prevent or cure overcrowding.

After considering the potential problem, a pond owner may wish to initiate a pond fertilization program, particularly if natural fertility is low and large numbers of fish are to be harvested. Applications of a complete fertilizer (8-8-2 ratio) at a rate of 100 pounds per surface acre should begin in early March and be followed by a second application in two or three weeks. The fertilizer should promote a phytoplankton "bloom," characterized by green water. For the remainder of the year, applications should be made at monthly intervals or whenever a hand submerged underwater to a depth of about 18 inches becomes visible. Fertilization should be discontinued at the end of the growing season (October) and resume each March. If a fertilizer program cannot be maintained, do not fertilize. Discontinuous or haphazard applications of fertilizer will cause more harm than good.

Suggested Readings

Virginia Cooperative Extension Publications:

"Stocking Sportfish in Virginia Ponds: Methods and Commercial Supply Sources." Publication 420-009.

"Pond Construction: Some Practical Considerations." Publication 420-011.

"Treating Fish Disease and Parasite Problems." Publication 420-899.

"Planning for Commercial Aquaculture." Publication 420-012.

"Catfish Farming in Cages in Virginia Ponds and Lakes." Publication 420-918.

Books:

Management of Lakes and Ponds. G. W. Bennett: Van Nostrand Reinhold Co., 450 W. 33rd St., New York, NY 10001. \$15.95.

Sources of Assistance for Farm Pond Problems
Virginia Cooperative Extension
Contact your Extension agent

Virginia Tech
Fisheries Extension Specialist
Department of Fisheries and Wildlife
152 Cheatham Hall
Blacksburg, VA 24061
(540) 231-5059

Virginia Commission of Game and Inland Fisheries
Contact your District Fish Biologist.
Fish Division
PO Box 11104
Richmond, VA 23230
(804) 257-1000

Characteristics of a Good Sportfish Pond

1. Topography Above the flood plain
2. Water supply Groundwater or surface water
3. Water quantity Adequate to keep the pond filled
4. Water level Stable, relatively constant
5. Bottom soil type High clay content
6. Inflow waters Screened or filtered
7. Drain type Sufficient size
8. Shoreland slope Steep, 3 to 1 slope
9. Pond depth 8 feet or more
10. Pond size 1/2-acre or more
11. Pond edges grass, well vegetated
12. Temperature warmwater (> 70°F); coldwater (<70°F)
13. pH 6.5 to 9.0 range
14. Dissolved oxygen 5 mg/L or more
15. Turbidity low color and silt load
16. Fertility natural
17. Wild fish eliminated
18. Stocking hatchery fish