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MANAGING RECREATIONAL FISH PONDS

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Pond Management

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Kentucky has over 135,000 farm ponds. These ponds are used for irrigation, watering livestock, and recreation. However, most ponds are under-utilized for recreation. Existing ponds can provide excellent recreational opportunities if properly managed.

The first step in recreational pond management is to determine the pond's purpose. Ponds can be managed for swimming, fishing, aesthetics, and to attract wildlife. It may be difficult to manage for all of these things simultaneously. The pond owner must decide about goals or what is most important. If fishing is the desired objective, the following should help.

POND DYNAMICS

No two ponds are exactly alike. Ponds close to one another but on the same watershed (surrounding area from which the pond receives rainfall or water drainage) will have slight differences. These disparities are not well understood. Soil characteristics and localized variations in the watershed are unique for each pond. Attributes which affect pond management are associated with plankton, fish populations, and water quality.

Plankton is a term used to describe microscopic and near microscopic organisms that are suspended in the water column. Planktonic life includes plants (phytoplankton) and animals (zooplankton). All phytoplankton are algae; however, not all algae (size) are phytoplankton. Both forms of plankton are important in fish pond management.

Phytoplankton are at the bottom of the aquatic food chain or web. Zooplankton and insects, which are eaten by small fish, graze on phytoplankton. Small fish are food for larger fish. Except for the few terrestrial insects and worms which fall or are washed into ponds, aquatic animals are supported by phytoplankton. An adequate phytoplankton population is essential for producing a large and healthy fish community.

Pond clarity or color can be related to plankton populations, called "blooms," or to suspended sediments and organic matter. Productive water has a green tint. The green color is produced by chlorophyll pigments contained in the billions of phytoplankton cells suspended in the water column. These blooms can die-off or "crash" rapidly, which causes the water to appear dark or black. When that happens, the dead cell decay consumes oxygen; resultant low oxygen levels may stress or kill fish. Phytoplankton die-offs are common in deep hillside ponds or ponds receiving too much nutrient (manure or fertilizer in watershed runoff).

Sediments washed into ponds after heavy rains can change pond color. Normal color should return within a few days as particle settling occurs. Heavy sediment loads can shade plants and stress fish by reducing photosynthetic oxygen production or clogging gills. Either condition may cause fish deaths.

WATER QUALITY

Water quality is another concern. Factors such as pH, alkalinity, and dissolved oxygen affect fish health and pond productivity. Not all aspects of pond water quality are constant. Dissolved oxygen and pH fluctuate or cycle each day. Alkalinity can change over time, usually weeks to months, depending on the pH of watershed and bottom soils.

Oxygen is not freely available in pond water. It must dissolve into the water (dissolved oxygen) from air or from oxygen produced by photosynthesis. Diffusion of atmospheric oxygen at the water surface is enhanced by wind and wave action. Plants produce oxygen as a by-product of food manufacture during photosynthesis. Aquatic plants, primarily phytoplankton and other algae, release oxygen directly into the water. Photosynthesis is driven by the energy in sunlight. Therefore, oxygen production does not occur at night. Dissolved oxygen levels rise throughout the day. After sunset, oxygen slowly declines as all plants and animals consume oxygen to breathe (respiration). In a well managed pond, dissolved oxygen levels should not fall below 3 or 4 parts per million (ppm or mg/l) during darkness. Oxygen levels below 3 ppm stress fish, and many species may suffocate when oxygen is below 2 ppm.

Pond pH varies daily due to respiration and photosynthesis. The carbon dioxide released from respiration reacts with water, producing carbonic acid. Acidity (pH between 1–7) is a measure of the hydrogen ion level in water. Acidity increases (pH falls) as the hydrogen ion concentration increases. As carbonic acid is formed from heightened nighttime carbon dioxide levels (increased plant respiration), pH is lowered and the pond becomes more acidic. During daylight, phytoplankton use carbon dioxide in photosynthesis; reducing acidity and increasing pH. Pond pH may normally fluctuate between

6.5 and 9. If the pH drops below five (e.g., acid runoff in mining areas) or rises above ten (low alkalinity combined with enhanced carbon dioxide removal by dense phytoplankton or algal blooms), fish may become stressed and die.

Alkalinity is related to pH; pH indicates whether water is acidic or basic. The quantity of base in water defines what is known as alkalinity. These bases, usually bicarbonates, react with hydrogen ions and buffer pH changes. Alkalinity can increase the availability of carbon dioxide and other nutrients to phytoplankton. A total alkalinity of 20 ppm or more is necessary for good pond productivity.

BASIC PRINCIPLES OF FISH POND MANAGEMENT

Good fishing in farm ponds depends on one's understanding of and ability to follow some fundamental rules. The essentials of fish pond management include:

(1) proper pond construction and watershed management;
(2) removal of unwanted and overpopulated species of fish;
(3) liming and/or fertilization;
(4) species selection and stocking;
(5) harvest and record keeping;
(6) evaluation of pond balance;
(7) weed control.

Pond Construction and Watershed Management

Poorly constructed ponds are hard to manage. Water levels may change dramatically due to seepage and inadequate watershed area. Shallow areas may cause aquatic weeds to proliferate rapidly. Erosion and contamination from the watershed may make pond management difficult or impossible.

Generally, Kentucky ponds need 3 to 5 acres of watershed per acre-foot of pond volume. Soil types and vegetative cover on the watershed will affect runoff. Usually, ponds with wooded watersheds require more area than impoundments supplied by field or pasture watersheds. If the pond is fed by springs, less watershed may be necessary. An encircling diversion ditch can be used to prevent or minimize rapid pond flushing, which can occur when watersheds are too large.

Shallow areas, less than 2-1/2 feet, can promote aquatic weed growth by allowing sunlight to reach the pond bottom. Pond banks should slope at a 2:1 or 3:1 ratio—horizontal distance to height—and should be high enough to allow a minimum depth of 2-1/2 feet.

Livestock should be fenced well away from the pond. Cattle can cause severe erosion damage on pond banks and levees. Eroded sediments slowly fill the pond and create shallow areas which enhance weed growth. Animal wastes may wash into the pond during heavy rainfalls and cause water pollution or nutrient overload problems. Watering areas should be located below the pond. Livestock should not be allowed to graze or roam on watershed land.

Ponds should be separated from row-crop land by a turf barrier. Pesticides, herbicides, and contaminated soils washed into a pond can kill fish. Turf or grass strips 50–100 feet wide, surrounding the pond, reduce soil erosion and chemical runoff from neighboring pastures and fields.

Pond leakage due to improper construction is common. Soils for pond construction must contain a minimum of 20% clay. Pond dams should be constructed with a compacted clay core. Trees or other woody vegetation should not be permitted to grow on embankments. Ponds need drains so water levels can be easily regulated. When building or renovating ponds, get help. Contact the local U.S.D.A. Natural Resources Conservation Service office and the Kentucky Cooperative Extension Service.

Fish Removal

Ponds that are poorly managed or ignored usually experience poor fish harvests. Fish populations become imbalanced or contaminated with unwanted species. Typically, unmanaged ponds become crowded with small, stunted green sunfish (*Lepomis cyanellus*) or bullhead catfish. The best remedy for these situations is to eliminate all fish and start over. Destroying unwanted fish is easier, less expensive, and requires less chemical if the pond is partially drained and the fish are concentrated. Fish can survive in small puddles. Treat all puddles regardless of size.

Rotenone is a registered aquatic chemical which can be used to kill fish. In Kentucky, rotenone for fish control must be purchased from the Kentucky Department of Fish and Wildlife Resources. Contact the conservation officer, district fisheries biologist, or extension aquaculture specialist for information about purchasing and applying rotenone.

Rotenone dissipates within 3–20 days depending on water temperature and weather conditions. Generally, it is safe to restock 2weeks after applying rotenone during the warm months of spring, summer, and autumn. To check for residual rotenone, place a few small fish in a minnow bucket and float them in the pond. If the fish are alive after 24 hours, it is safe to restock.

Pond Fertilization

Fertilization is usually necessary to provide phytoplankton with adequate nutrients for growth, much the same as fertilizing fields increases crop yields. Proper fertilization increases food availability throughout the food chain and indirectly increases the total amount of fish a pond can support. However, ponds should be limed first.

By increasing pH and alkalinity alone, nutrient availability may be improved enough to sustain an adequate phytoplankton bloom

Fertilizing ponds will increase fish production by a factor of two or three. Infertile ponds will seldom produce more than 200 pounds of fish per acre. Well managed, fertile ponds will support 300–600 pounds of fish per acre. If the pond is fished infrequently or receives some natural fertilization, only half the recommended rates (Table 1) may be needed, or fertilizer may not be required at all. Once started, a fertilization program should be continued or fish growth may become stunted due to reduced food supply.

Not all fertilizers work well in ponds. Phosphorus is usually the limiting nutrient in most ponds and is tied up by bottom sediments as a result of chemical precipitation and decomposition. Once trapped, phosphorus is no longer available to phytoplankton and promotes rooted weed or filamentous algae growth. Nitrogen is rarely limiting in older ponds. New ponds may need nitrogen; however, once established, ponds infrequently require nitrogen.

Fertilizers are labeled with N:P:K ratios or percent composition of nitrogen (N), phosphorus (P), and potassium (K). The equivalent of 8 pounds of phosphate per acre is a commonly recommended treatment rate. Table 1 lists application rates for commercially available fertilizers.

Table 1. Recommended pond fertilization rates (lbs/acre) on a per treatment basis.

Fertilizer formulation	Application (pounds/acre)
20–20–5	40
16–20–4	40
18–46–0	18
13–38–0 (liquid)	20
10–34–0 (liquid)	20
0–46–0	18

Liming Before Fertilization

Fertilization will not stimulate a good phytoplankton bloom if alkalinity is below 20 ppm. Check alkalinity first. If alkalinity and pH are low, the addition of powdered, agricultural limestone should help. It is not advisable to use quick or slaked lime; these compounds can cause a rapid pH change which may kill fish. The amount of lime necessary depends on the chemical characteristics of bottom sediments or mud. A soil sample from the pond bottom must be analyzed to determine how much lime is required.

Take mud samples from several locations in the pond; combine, mix evenly and spread the sample out to dry. After drying, send the combined sample off for analysis at the University of Kentucky Soil Testing Lab. Mark the sample "pond mud" so the appropriate tests can be conducted. The analysis report will indicate proper liming rates.

Ponds should be limed similarly to land used for alfalfa production. Another way to estimate liming requirements is to apply 1¼ to 1½ times the amount of agricultural lime used for row-crops in nearby areas. It is not possible to over-treat a pond with agricultural limestone. Limestone does not dissolve once the pH reaches 8.3.

Lime must be applied as evenly as possible over the entire pond so it can react with the bottom mud. Contact your county extension office to determine the best method of applying lime. Limestone dissolves slowly over time and is washed out of the pond with overflow water. Ponds which require lime usually need repeat treatments every 3 to 5 years. Alternatively, annual lime applications at one-fourth the original amount can be used to maintain alkalinity and pH at acceptable levels. If a pond needs lime, it will not respond well to fertilizer.

When to Fertilize

A simple method of determining when to fertilize measures the clarity of pond water. The depth of light penetration in water correlates with the phytoplankton density or bloom. Light penetration can be measured using a Secchi disk. A Secchi disk is made from an 8-inch diameter disk of plywood, metal, or plastic. Mark the disk into quarters and paint each set of opposing quadrants white and black, respectively. Attach the disk to the bottom of a broomstick or pole. Indicate with tape or paint the distances 12, 18, and 24 inches from the disk.

The desired bloom density allows light to penetrate to a depth of 18 inches. Lower the Secchi disk into the water until it just disappears from sight and record that depth. Use Table 2 as a guide for fertilization based on Secchi disk measurements.

Table 2. Recommendations for pond fertilization and management based on Secchi disk measurements.

Secchi disk measurement	Recommended management
≥ 24 inches	fertilize
18–24 inches	good bloom—do nothing
12–18 inches	dense bloom—watch closely
6–12 inches	bloom too dense —find cause; prepare to aerate
≤ 6 inches	oxygen depletion likely; nighttime aeration is indicated

There is no need to fertilize if the Secchi disk disappears close to 18 but shallower than 24 inches depth. Fertilizer is needed when the disk is visible at 24 inches or deeper. Measurements above 18 inches depth (e.g., 12 inches) indicate the bloom is too dense. Do not fertilize and continue to monitor closely. Readings less than 12 inches deep mean the bloom is excessive and oxygen depletion could occur. Low Secchi disk readings in muddy water (suspended sediments) are not reliable estimates of phytoplankton blooms.

The water is too nutrient rich in the last situation (Table 2). Try to determine the source of the nutrient entering the pond. The pond may have been over fertilized. Livestock manures or field fertilizers may have washed into the pond. Overfeeding fish can result in excess nitrogen and phosphorus loads; if so, reduce or stop feeding. Be prepared to aerate at night.

How to Fertilize

Granular or liquid fertilizers may be used. Phytoplankton have no roots and absorb nitrogen, phosphorus and other required elements directly from the water. Granular fertilizers should not be broadcast directly into the pond. Fertilizer particles sink to the bottom. The nutrients then become tied up in bottom sediments and are unavailable for phytoplankton uptake.

Solid fertilizers should be placed on a platform (e.g., a sheet of plywood) that is 12 inches underwater. One platform is needed for every 5 acres of pond surface. Situate the platform in an area of the pond which receives good wind and wave action—water circulation. Granules placed on the platform will slowly dissolve and promote a bloom.

Liquid fertilizers must be diluted with water before application; undiluted, they too will sink to the bottom and be trapped by sediments. Once diluted, liquid fertilizer can be sprayed or splashed into the pond. Apply evenly over as much of the pond surface as possible.

Ponds should be fertilized no sooner than 21 March and when water temperatures have reached a minimum of 60°F. Fertilization should stimulate a phytoplankton bloom within 2 weeks. If a bloom does not appear, fertilize again and continue at 2-week intervals, no more than three times. After a bloom has developed, fertilize as necessary (Secchi disk guide, Table 2) to maintain it. Continue phytoplankton management until 21 September or until water temperatures have dropped to 60°F.

Ponds which routinely experience large volumes of water flow-through (runoffs or flooding) lose fertilizer rapidly and do not sustain good blooms. Therefore, fertilization is ineffective and should not be attempted. Many ponds will flush repeatedly in winter and early spring but respond well to fertilization during the dry periods of late spring, summer, and fall.

Constantly muddy ponds (visibility of ≤ 12 inches) do not usually respond to fertilization. Because of the shading effect, it is difficult to establish phytoplankton blooms in turbid water. Therefore, the pond is unproductive and receives little photosynthetically produced oxygen, which can account for as much as 95% of aquatic oxygen content. Contact your county extension office for information about clearing muddy water.

Fertilizing ponds with an aquatic weed problem stimulates weed growth only. Nutrients are absorbed by the unwanted vegetation, not by phytoplankton. Weeds must be controlled first. Establishing a fertilization program before weeds appear is one of the best methods of weed prevention. A good phytoplankton bloom can shade out weeds and compete for essential nutrients.

Species Selection and Stocking

The choice of fish to be stocked depends on the pond owner's goals and the resources available. It is difficult to manage bass and bluegill populations in ponds one-half acre or less. Stocking combinations that work better in small ponds (<½ acre) are catfish; hybrid bluegill and bass; or hybrid bluegill, bass, and catfish.

The largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*) combination is the most common strategy for stocking ponds in the Southeast and Midwest. It works well in ponds larger than one-half acre and can provide excellent fishing for both species. The beauty of the bass-bluegill system is its simplicity. In a well fertilized pond, zooplankton and insect larvae will be plentiful enough to supply food for bass fry and all sizes of bluegill. Bluegill grow rapidly and reproduce repeatedly throughout the spring and summer; providing bass with an abundant food supply (forage). With proper harvest techniques, bass will grow rapidly and prevent bluegill from overcrowding the pond. Several large bluegill will survive and sustain good bluegill populations and fishing.

Channel catfish (*Ictalurus punctatus*) can be added to a bass-bluegill pond. However, catfish will compete with bass and bluegill for natural foods and lower overall bass-bluegill harvests. Table 3 gives recommended stocking rates for bass, bluegill, and catfish in new or renovated ponds. Blue catfish (*Ictalurus furcatus*) may be stocked instead of channel catfish. Blue catfish are better predators than channel catfish and will also compete with bass for bluegill.

One can obtain fish for new or renovated ponds from the Kentucky Department of Fish and Wildlife Resources. Contact your county conservation officer for more information. Private hatcheries also sell fish and may offer varieties or hybrids that have been selected for rapid growth. Contact your county extension office for a list of live fish suppliers.

Table 3. Suggested bass-bluegill-catfish stocking rates for new or renovated ponds larger than ½ acre.

Species	Fertilized	Number stocked/acre
bass	yes	100–125
	no	75
bluegill	yes	400–500
	no	300
catfish	yes	50
	no	25

Bluegill should be stocked in early autumn (September) to ensure sufficient growth and maturation for spring spawning to occur. Bass should be stocked in May or June so they can grow rapidly, feeding on bluegill fry. Bluegill spawn three or four times between spring and fall. Bass should average ¼ to ½ pound after the first season and can approach 2 pounds if forage is plentiful. Catfish may be stocked in fall or spring. When stocking catfish with bass, be careful that the catfish are at least as large as the bass being stocked.

Alternative Stocking Strategies

It is difficult to manage bass-bluegill fishing in ponds less than one-half acre. These ponds are better for catfish or other species. Catfish are good fighters when hooked and are excellent table fare. Stock 200–500 catfish per acre and offer feed. If stocked alone, catfish may reproduce and the pond can become overpopulated. Catfish are cavity spawners. Reproduction can be prevented by: 1) removing all stumps, rock piles, etc. from the pond; 2) not allowing muskrats or beavers to colonize the pond (catfish will spawn in the burrows); and 3) not placing containers (e.g., tires or milk cans) in the pond that might be used for breeding. Bass stocked at about 20–30/ acre should help control catfish spawns.

Other fish with potential for use in small ponds include: blue catfish, rainbow trout (*Oncorhynchus mykiss*) (mid-autumn and winter months), redear sunfish (*Lepomis microlophis*), hybrid bluegill, threadfin shad (*Dorosoma petenense*), golden shiners (*Notemigonus crysoleucas*), and fathead minnows (*Pimephales promelas*). Species which should not be stocked into farm ponds include: crappie, gizzard shad (*Dorosoma cepedianum*), bullhead catfish, and flathead catfish (*Pylodictis olivarus*). These species rapidly overcrowd ponds and may reduce populations of desirable fish species.

Crappie are highly popular sport fish but are not desirable for small ponds (in this instance, less than 50 acres). Crappie reach sexual maturity when 2 to 3 years old and are approximately 7 to 8 inches long. If stunted, they may be only 4 inches long. A young, half-pound female crappie can produce 50,000 eggs. Just a few successful spawns during one season will overcrowd a pond. When this year class of juveniles grows, they consume all available food. Growth stops, and these young fish become stunted. Young crappie compete directly with juvenile bass and bluegills for prey. Large crappie will feed on small bass and bluegill. It is virtually impossible to manage bass and crappie populations together. The end result is poor fishing for all species.

Redear sunfish—also known as "shellcrackers" because they eat snails—can be stocked with bass and bluegill. Redear sunfish grow larger than bluegill and are excellent sport fish. Shellcrackers are not as prolific as bluegill and do not provide sufficient spawns for bass forage. If you want redear sunfish, stock 20–25% redear in place of bluegill (e.g., 300 bluegill and 100 redear/acre).

Hybrid bluegill have large mouths and can be easily trained to accept commercial fish feed. Many pond owners like to stock hybrid bluegill and feed them. If fed, they grow rapidly and are excellent for angling. Hybrid bluegill are not sterile. Most are males; but if females are present, they do breed. Reproduction is undesirable and leads to overpopulated ponds. Therefore, predatory fish should be stocked to feed on young hybrid bluegill. Bass, stocked at 20–30/acre, control spawns effectively. This combination works best for ponds one-half acre or less.

Fathead minnows are slow swimmers, have a small adult size, and can be stocked (1,000/acre) as forage in channel catfish ponds. These minnows are quickly eliminated if stocked with bass.

Rainbow trout can survive in Kentucky ponds during late autumn and winter. They should be stocked when water temperatures are at or below 65°F, usually mid- to late October. Fingerlings (7–9 inches long) feed on insect larvae, small sunfish, or minnows and grow rapidly. Trout readily accept commercial feeds and may reach 1 pound by April if offered a trout chow. Rainbow trout die when water temperatures reach 70–72°F in April or May.

Harvest and Record Keeping

Ponds should not be fished for 1 year following stocking. After the first season, bass are often easy to catch. The most common problem in small ponds is removing too many bass. Harvest must be carefully controlled to maintain good fishing.

When bass are over-harvested, ponds become overpopulated with stunted bluegill. If that happens, it is difficult to restore balance to the pond. It may be necessary to poison the fish and start again. As a general rule, fertile ponds can sustain an annual harvest of 25–35 pounds of bass per acre. If the pond is infertile, annual harvest should not exceed 10–15 pounds/acre. Do not begin bass harvest in a new pond before spring spawning,

water at or above 60°F. Year-old bass (8–12 inches long) are sexually mature. Catch and release bass; and enjoy successful angling more often.

Although research has not shown bluegill removal to be an effective means of reducing their numbers in overpopulated ponds, bluegill should be harvested also. A good general rule is to remove 10–15 bluegill for each bass taken or 4 pounds of bluegill to each pound of bass.

Catfish may be harvested when they reach a size that satisfies the pond owner. In ponds stocked with bass and bluegill, catfish spawns do not usually survive. Catfish must be stocked periodically to replace individuals that have been removed. Large catfish fingerlings (≥ 8 inches) should be stocked into ponds with established bass-bluegill populations to minimize predation by bass.

Do not rely on memory. Keep records about numbers, sizes and species of fish caught. Pond balance can be evaluated from catch records and seine data. Table 6 is an example of a record keeping sheet for pond management.

Evaluation of Pond Balance

Pond balance should be checked at 1- or 2-year intervals. The local district fisheries biologist with the Kentucky Department of Fish and Wildlife Resources may be able to provide assistance.

Balance can be checked with a 10- or 15-foot minnow seine. The best time to check is early summer. Seine several shallow areas of the pond. Refer to Table 4 to evaluate findings.

If seine catches contain both young bass and recently hatched bluegill fry, the pond is most likely balanced. The pond is imbalanced when no young bass or bluegill fry are seined but many intermediate size bluegill (4–5 inches long) are caught. Samples containing large numbers of undesirable species mean it is time to poison and restock.

Weed Control

Aquatic weeds are a common problem in farm ponds. Rooted aquatic vegetation furnishes habitat for some small aquatic animals, increasing available food. Vegetation also provides small fish with cover to hide from predators. However, if left unchecked, weeds can take over the entire pond and remove the nutrients required for phytoplankton production.

Aquatic weeds can be controlled manually or by chemical and biological means. Manual control of plants such as cattails is only practical when they first appear. Woody vegetation along dams can be successfully controlled by hand.

Chemical control is possible with herbicides. However, many herbicides are not approved for aquatic use; and the weeds in question must be accurately identified. Herbicide applications may cause oxygen depletions. Oxygen depletions often occur following herbicide application during hot weather in ponds with heavy weed overgrowth. Check with your county extension office, a fisheries biologist, or an aquaculture specialist for plant identification and herbicide recommendations. Whenever applying chemicals, protect yourself and others. Carefully follow label instructions, always.

One of the simplest and most economical long-term methods of controlling rooted aquatic vegetation in new or recently treated ponds is to stock grass carp (*Ctenopharyngodon idella*). The grass carp or "white amur" is an Asian carp brought into the U.S. for aquatic weed control. Once they reach a length of 10 inches, these fish are primarily herbivorous. They do not stir up bottom mud like common carp or disturb the nests of other fish. During warm weather, grass carp can consume quantities of weeds equaling 30–40% of their body weight daily. Grass carp are considered good eating by many people.

Table 4. Evaluation of pond balance using seine and catch data.

Types of fish caught	Recommendation
seine data: small to intermediate size bass and bluegill	no additional management necessary
catch data: bass and bluegill of various sizes	no additional management necessary
seine data: small and intermediate bluegill; no bass	harvest bluegill and stock 25, 6–8 inch bass/acre
catch data: few intermediate bass; large bluegill	harvest bluegill and stock 25, 6–8 inch bass/acre
seine data: no bass or bluegill	remove 50-75 bass/acre; stock 30, 3–5 inch bluegill/acre
catch data: intermediate bass only; large bluegill	remove 50-75 bass/acre; stock 30, 3–5 inch bluegill/acre
seine data: unwanted species	rotenone and start over
catch data: unwanted species or no fish	rotenone and start over

Grass carp prefer flowing water and will swim over a pond spillway if given the opportunity. An escapement barrier can be placed across the spillway to prevent that from happening. Only sterile, triploid grass carp may be stocked in Kentucky. A list of certified, triploid grass carp suppliers and information about building an escapement barrier can be obtained from the Kentucky Department of Fish and Wildlife Resources or the Kentucky Cooperative Extension Service.

The number of triploid grass carp that should be stocked depends on weed species and the magnitude of the problem. Table 5 presents recommended stocking rates. Ponds supplied by large springs remain cool and require additional grass carp for effective weed control. If the pond contains large bass, grass carp fingerlings must be longer than 8 inches. Bass eat small grass carp.

Table 5. Stocking rates for triploid grass carp.

Weed evaluation	Grass carp stocked/acre
new pond or minor weed problem	5
or moderate weed problem (10–20 % coverage)	12–15
severe weed problem or spring fed pond	≥ 20

POTENTIAL PROBLEMS

A common cause of fish kills is pond "turnover." Turnovers are related to pond stratification. Stratification occurs when surface water warms faster than water at greater depths. The warm layer is lighter and does not mix with cool, deep water. The cool water near the bottom becomes stagnant; oxygen is depleted and toxic compounds may be produced by bacteria and decaying organic matter. A turnover occurs when the upper layer cools quickly and mixes with the stagnant layer. The resultant mixture may not contain enough oxygen to support fish. Turnovers usually take place after a cold, heavy rain or a sudden cold front passage. Immediate or preventive aeration may save the fish. Fish kills can also be caused by oxygen depletions resulting from bloom die-offs or decomposing vegetation killed by herbicide applications.

As already discussed, most problems are related to improper pond management. Good management includes enhancing food availability for fish; controlled harvest to balance fish populations; weed control; and preventing situations that may cause fish kills. These are not simple tasks. Ponds are complex ecological systems and require personal commitment and insight for productive management.

ENHANCEMENT TECHNIQUES

Many methods are used to improve farm pond fishing. Some of these include adding fish shelters/habitat, supplemental feeding, checking and adjusting water levels, aeration, and destratification.

Artificial reefs or fish shelters allow young fish to escape predation. Felled cedars or discarded Christmas trees, anchored to the bottom, offer excellent refuge. Stake beds (stakes driven into the bottom), rock piles, and tire reefs make good fish sanctuaries. These structures should be placed at a depth of 2 to 6 feet; no more than 3 should be supplied per acre.

Fish spawns can be encouraged by furnishing breeding areas. Place sand and gravel beds at several locations around the shoreline and at a depth of 2 to 5 feet. The sand and gravel should be 4 to 6 inches thick and contained within a frame or box. Spawning beds permit observation of reproductive success and are necessary in ponds with silty bottoms.

Providing supplemental, commercial fish feed increases the growth of sunfish and catfish. Bass do not readily accept artificial feeds but do benefit from the increase in forage. Offer feed in the same area and at the same time each day. It is important not to over feed. Supply what the fish will consume in 10–15 minutes but no more than 15 pounds/acre each day. Fish can be fed from April through October. Winter feeding is not required but will improve bluegill growth and spawns. During winter months, use a sinking feed; do not offer more than 3 pounds/acre daily.

Ponds with drains have distinct management advantages. In relatively deep ponds, the water can be drawn down 2 to 3 feet in late fall and maintained at that level throughout the winter. Fall draw-down helps control aquatic weeds as a result of freezing and drying on areas of exposed pond bottom. Lowering water levels also concentrates fish, increasing forage availability to bass—bass growth is improved and sunfish populations are reduced. Ponds should be allowed to refill during March and April.

Ponds which experience annual, low oxygen fish kills may benefit from aeration (or destratification if > 6 feet). Many types of electric aerators are commercially available. Supplemental aeration is effective, using one horsepower of electric aeration per surface acre of water. If a turnover or sudden bloom die-off occurs, additional aeration capacity may be necessary.

Finally, small farm ponds are man-made and not natural environments. They must be carefully managed to provide productive, recreational fishing. Think of a pond as a garden or an orchard. It must be properly laid out, fertilized, seeded (stocked), weeded, pruned (selectively harvested), and protected from acts of God (e.g., oxygen depletions) to be bountiful. Good management takes time and effort. However, the rewards are good food and outdoor recreation.