Managing Mississippi
Farm Ponds and Small Lakes

Mississippi has more than 130,000 farm ponds totaling 230,000 acres, ranging in size from 1/2 to 5 acres. There are an additional 150,000 acres of ponds ranging from 5 to 40 acres.

Because of poor planning, improper construction, or lack of proper management, many Mississippi lakes and ponds are relatively unproductive. A pond that consistently produces good catches of fish is a result of proper planning, construction, and management. The purpose of this publication is to encourage Mississippi landowners to plan, construct, and manage their ponds and lakes properly for recreational fishing.

A good pond depends on location, design, construction, stocking, and management. After the pond is completed, success or failure depends on the landowner's using necessary practices to establish and maintain good fish populations. Proper stocking of the right species and number, a balanced harvest of mature fish, proper fertilization, water quality management, and aquatic weed control are basics the pond owner should understand. Many unmanaged ponds could produce many more pounds of fish than they now produce if good management practices were followed. The annual harvest of fish can provide hours of recreation, pounds of nutritious food, and supplemental income.

If you need assistance in planning a new pond or in managing an old one, contact one of the following agencies or one of their field offices located throughout the state:

Department of Wildlife, Fisheries and Parks
P. O. Box 451
Jackson, MS 39025
601/364-2200
(Six district offices)

Department of Wildlife and Fisheries
Mississippi State University Extension Service
Box 9690
Mississippi State, MS 39762
662/325-3174
(Extension office in each county)

Natural Resources Conservation Service
100 West Capitol Street
Suite 1321, Federal Building
Jackson, MS 39269
601/965-4339
(District office in each county)

Planning

Site

Site selection is extremely important. Natural Resources Conservation Service personnel can assist in site selection, soil suitability, engineering survey, and design at no cost to the landowner. They can provide an estimate of the cost of the earth work, quality control checks during construction, and information on other aspects of planning, design, and construction.

Consider the following site characteristics before you design and construct your pond: (1) topography, (2) water supply, and (3) soil type. If possible, consider more than one location and study each one to select the most practical, aesthetic, and economical site. A typical layout of a properly constructed farm pond is shown in Figure 1.

Topography

Consider topography first because it directly affects construction costs and management. Locate the pond where an adequate volume of water can be impounded with the least amount of earthfill. A good site is usually one where a dam can be constructed across a narrow section of a steep valley, and where the slope of the valley floor permits a large area to be flooded. Such sites are ideal and minimize areas of shallow water. Avoid large areas of shallow water because they become too shallow for use during late summer and fall dry periods, and they encourage the growth of undesirable aquatic plants. If possible, avoid locations with constantly flowing creeks or streams.

Water Supply

Water should be adequate, but not excessive, and may be provided by springs, wells, or surface runoff. For ponds where surface runoff is the main source of water, the contributing drainage area should be large enough to maintain a suitable water level during dry periods. However, the drainage area should not be so large that expensive overflow structures are needed and water exchange occurs too frequently. As a rule, a pond should have 5 to 10 acres of drainage area for each acre of impounded water. The amount of runoff that can be expected from a watershed depends on several factors: topography, soil type, and plant cover.

Soil

Suitable soil is one of the primary factors in selecting a pond site. The soil should contain a layer of material that water will not seep through. Clays and silty clays are excellent for this purpose. Sandy clays are also usually satisfactory. To determine suitability, take soil borings at frequent intervals and have them analyzed. The local Natural Resources Conservation Service can assist in this evaluation. Failure to evaluate hidden soil strata properly could result in a pond that will not hold water.

Your Extension county agent can advise you how to collect soil samples for analysis to determine the lime requirements (of the pond bottom) for the site you have selected. A minimal fee is charged by the State Soil Testing Lab for this analysis.

Permit

Mississippi law now requires that all landowners constructing an impoundment capable of holding 25 acre feet of water file an application with the Mississippi Department of Environmental Quality before constructing a dam. There is no fee required, but there are penalties for failure to file.

Under the guidelines and recommendations in this publication, most properly constructed ponds greater than five surface acres will require this permit. Please consult your local Natural Resources Conservation Service office and request form BLWR-PDC81.

Fish Stocking

While you are in the planning stage, so also are the fish hatcheries! Gamefish are available from private hatcheries for stocking into new ponds. Consult Mississippi Department of Agriculture and Commerce (601-354-6720) (MDAC), district offices of the Mississippi Department of Wildlife, Fisheries and Parks, your local Natural Resources Conservation Service, or county Extension office for a list of licensed game fish hatcheries in Mississippi.

Construction

Size

Pond size should be determined by the needs and desires of the owner. Bigger is not always better. Small ponds can provide enjoyable fishing if good planning and proper management guidelines are followed. Larger ponds and lakes provide many other uses, such as water supply, limited irrigation, swimming, boating, and hunting, and they are less susceptible to water level fluctuations and overfishing.

Depth

Ponds in Mississippi should usually be at least 6 feet deep over 20 percent of the area to maintain maximum production of sport fishes. To prevent aquatic weed infestations and other management problems, avoid shallow water areas less than 3 feet. Depths greater than 12 feet seldom provide any productive fisheries benefits because of low summertime dissolved oxygen levels.

Dams

Dams should be at least 8 to 12 feet wide at the top, depending on the height of the dam. Dams less than 12 feet high require an 8-foot top width. Dams between 12 and 15 feet

high require a 10-foot top width, and those higher than 15 feet require a 12-foot top width. Dams with tops wider than the required minimum are much easier to maintain. In many areas of Mississippi, soil types are such that dams must be cored with clay to prevent seepage. The dam should have slopes no steeper than 3:1 on either side. On the backside, a 4:1 slope will allow the pond owner to maintain the vegetation on the dam. For example, a dam with a 3:1 slope will have a 1-foot rise for every 3 feet of horizontal measurement. Establish suitable vegetation, such as Bermudagrass, fescuegrass, Bahiagrass, or other perennial cover on the dam as soon as possible to prevent erosion, muddy water, and maintenance problems. Do not allow trees to grow on dam.

Drain and Overflow Pipe

A combination drain and overflow pipe, as well as an emergency spillway, are necessary for good management. The emergency spillway is designed to carry excessive runoff from heavy rainfall. The overflow pipe is the outlet for normal waterflow through the pond. The bottom drain allows the water level to be lowered, which is often necessary for weed control and fishery management. A drain gives the pond owner a necessary tool to manage his pond efficiently. Overflow and drain pipes may be corrugated metal, aluminum, steel, or polyvinyl chloride (PVC). Some materials are more durable than others, and thus may be preferred. For example, PVC pipe, although inexpensive, is prone to breakage and vandals. Be sure the pipe meets the standards for use in a pond dam. Drains can be added to existing ponds, but you will need professional assistance.

Banks

Banks should be sloped with a water depth of 3 feet near the shoreline to eliminate shallow water areas around the pond edge where aquatic weeds often start. Cattle may cause bank erosion and muddy water; fencing the pond may be necessary to limit or prevent damage.

Seepage

Seepage in new ponds sometimes develops. Seepage can often be corrected by draining the pond and compacting the bottom. If the bottom soils have marginal water-holding capacity, a blanket of clay or other soil sealant packed with a sheepsfoot roller may reduce the seepage. If the problem persists, contact any Natural Resources Conservation Service office or Mississippi Department of Wildlife, Fisheries and Parks district office.

Pond Basin

Many pond sites have trees in the basin, most of which should be cut and salvaged or piled and burned. However, it is acceptable to retain some trees, bushes, and brush piles. Underwater cover provides habitat for certain aquatic organisms on which fish feed, as well as cover for gamefish. Be sure you can find these areas after they are flooded.

Usually up to 10 percent and not more than 25 percent of the pond area should have some tree cover (fish attractors) where possible. It is important to leave tree cover in the right areas. Leave bushes and trees in deeper water areas, along creek runs, and in the middle of the pond or lake. Leave trees in small clumps. Cut standing trees about 2 feet above the normal water level, and anchor brushy tops to the base of the tall stumps. This will serve as a permanent marker to brushtop locations and avoid the dangers of falling limbs in later years. Do not leave trees or bushes in shallow areas, narrow coves, or along the bank, because these areas will become difficult to fish and may develop aquatic vegetation problems. Too much cover in shallow water will make it hard for bass to control the bream. You should be able to navigate the entire shoreline by boat.

If no trees or brush are present to leave for cover, fish shelters can be established during pond construction. See the section on fish attractors for more detailed information. Prepare the pond basin during construction because equipment and labor are available at that time. Most landowners are reluctant to drain the pond later for necessary improvements, so it is important to complete all work during construction.

Lime the pond bottom after all other excavation and dirt work are complete. Liming is extremely important and is discussed in greater detail later. During construction, decide which trees to leave, clear unwanted trees, and develop fish attractors. Before flooding, prepare gravel beds for bluegill spawning. Build wooden and earthen piers, and deepen the pond edges. Plant wheat, rye, millet, or other suitable grasses in the pond bottom to produce an abundance of aquatic life when the pond is filled and to reduce erosion and siltation.

The dam should be limed, fertilized, and seeded with an appropriate grass as soon as construction is complete. Mulching of the dam and other sloping areas is recommended. It is critically important to prevent erosion of the dam. The pond should be completed during summer before stocking fish in the fall. If practical, do not allow the pond to fill with water until just prior to stocking. This will prevent the pond from becoming contaminated with unwanted species.

Stocking

Stock ponds with fish from reliable fish hatcheries to eliminate the introduction of undesirable fish species, parasites, or diseases. Gamefish for stocking purposes are available from licensed commercial fish hatcheries. A list of the licensed commercial fish hatcheries is available upon request from the Mississippi Department of Agriculture and Commerce, Mississippi Department of Wildlife, Fisheries and Parks district offices, Cooperative Extension Service, and Natural Resources Conservation Service.

Bass and Bream Combinations

For the best recreational fishing in Mississippi, the recommended species for stocking all new impoundments are largemouth bass, bluegill, redear sunfish, channel catfish, and fathead minnows at rates and combinations listed in Table 1. Channel catfish may also be

stocked with bass and bream or stocked alone. **(Crappie are not recommended for impoundments less than 500 acres. Crappie should not be stocked into farm ponds because they tend to overpopulate, resulting in a pond full of stunted fish.)**

Table 1. Recommended stocking rates (number of fish fingerlings per acre) and species combinations for farm ponds larger than one acre.

Stocking Combination	Bass	Bluegill	Redear	Channel Catfish	Hybrid Sunfish	Fathead Minnows
Bass-Bluegill	**50**	**500**	**-**	**-**	**-**	**-**
Bass-Bluegill-Channel Catfish	**50**	**500**	**-**	**50**	**-**	**-**
Bass-Bluegill-Redear	**50**	**350**	**150**	**-**	**-**	**-**
Bass-Bluegill-Redear-Channel Catfish	**50**	**350**	**150**	**50**	**-**	**-**
Bass-Hybrid Sunfish	**50**	**-**	**-**	**-**	**750**	**-**
Channel Catfish-Hybrid Sunfish	**-**	**-**	**-**	**100**	**350-500**	**-**
Channel Catfish Only	**-**	**-**	**-**	**100-150**	**-**	**-**

Bass-Bluegill-Redear-Fathead Minnows	**50**	**350**	**150**	**-**	**-**	**500**

[*] **No other fish stocking is necessary after this initial stocking. It is usually a waste of money to stock additional fingerlings into a pond that contains adult fish. Supplemental stocking should be done only upon advice from a competent fisheries biologist.**

Largemouth bass are predatory and eat a variety of foods. Their diet includes small fish, frogs, crawfish, and insects. Largemouth bass are well adapted to ponds and reproduce successfully, usually spawning only once a year. They grow rapidly in a pond where food is plentiful, generally reaching sexual maturity and spawning at one year of age. In the spring, when water temperatures reach 60 °F, mature males fan out depressions or "nest" on the pond bottom. Females lay their eggs in the nest. The male fertilizes the eggs, and they usually hatch within four days.

The two strains of largemouth bass commonly stocked in ponds and lakes are the northern largemouth (native to all parts of Mississippi) and the Florida largemouth. Crosses between these two, called intergrades, are also available. Although some research has been conducted to determine which, if any, of these largemouth strains or intergrades is best for stocking farm ponds and small lakes, no conclusive answer has been found. A few observations, based partly upon science and partly upon field experience, may be helpful as you decide which largemouth strain to stock:

- Natives, Floridas, and intergrades have all been used with success in Mississippi.
- The Florida strain and the intergrade have the greatest potential to attain trophy size (greater than 10 pounds).
- Growing evidence exists that the Florida strain is, on the average, harder to catch than northerns or intergrades.
- Many hatcheries no longer maintain pure Florida strains, but rather intergrades with varying percentages of mixed nothern/Florida genes.
- It is not known at this time whether all intergrades are equivalent in growth, catchability, etc. For example, an intergrade that is 50 percent Florida and 50 percent northern MAY perform differently from an intergrade that is 25:75, etc.
- There is usually no difference in cost among the strains.

7. Your ultimate success in producing trophy sized fish with either nothern or Florida bass will depend more on the quality of your management program than on strain selection.

Bluegill and redear sunfish (bream) are also well adapted to ponds and eat a variety of foods. When small, they eat microscopic plants and animals. As they grow, their diet changes to include insects, snails, crawfish, and small fish. If sufficient food is available, these fish grow rapidly, reaching sexual maturity at one year. When water temperatures reach 70 to 75 °F in the spring, redear sunfish begin spawning, followed by bluegill when temperatures reach 80 °F. Bluegills may spawn as many as five times in one season, while redear sunfish normally spawn only twice. Bream spawn in groups, and their collections of nests are called spawning "beds."

The two strains of bluegills commonly stocked in Mississippi are native bluegills and a Florida strain called coppernose bluegill. Biologically, the two are very similar, as are general growth rates and other characteristics. Appearance differs slightly, with coppernose easily distinguished from natives by a broad copper band across the top of the head, white margins on the fins, and a pronounced pattern of vertical bars on the sides. Opinions vary regarding the pros and cons of stocking coppernose instead of native bluegills, and many questions have yet to be answered. A few general observations may be helpful:

- Both are readily available from hatcheries around the state.
- Either bluegill is an acceptable choice. Some biologists (and pond owners) prefer natives; others prefer coppernose. There is no advantage or disadvantage to either.
- Costs are currently the same.
- There is some opinion, though not conclusive, that coppernose may not be quite as prolific as native bluegills. Depending upon other factors in a management program, this can be either a positive or negative attribute.
- **Ultimate performance of the bluegills, regardless of strain, depends more on the qulity of your management program than on strain selection.**

Size of the pond has direct influence on future fishing potential, but there are very few limitations if the owner has reasonable expectations. **Ponds less than one acre are often best suited for channel catfish alone. A farm pond that is to be stocked with bream and bass should be at least one acre in size, preferably larger. Although small ponds can normally provide unlimited bream fishing, there is a potential for overharvesting the bass in ponds less than one acre.**

Stocking Rates and Sequence

Follow these fingerling stocking rates and sequences: channel catfish at 50 per acre stocked in the fall; bluegill and redear sunfish (commonly called bream) at 500 per acre (mixed) stocked in the fall or winter; fathead minnows at 500 per acre with bluegills in the fall or winter; largemouth bass at 50 per acre stocked the following spring. The ratio of bream to bass should be 10 to 1 (Table 1). Fingerling catfish should be 6-8 inches long, bluegills and redear sunfish 2-3 inches, and largemouth bass 2 inches at time of initial stocking.

Stock channel catfish first to ensure enough growth to prevent predation by bass. Until channel catfish reach a length of about 18 inches, they will be in direct competition with bream for food. Stocking more than 50 channel catfish per acre may suppress growth of bream. Bluegill and redear sunfish fingerlings stocked in the fall and winter will spawn the next spring. Largemouth bass fingerlings are stocked in the spring to coincide with the first bream spawn. They feed on the small bream, thus preventing an overpopulation of bream. Fathead minnows provide abundant forage for largemouth bass during the first year of growth but are of little benefit thereafter.

If timing is such that you cannot stock the pond in this sequence, consult a fisheries biologist to discuss an alternative stocking strategy that might work. Since all situations are different, there is no single recommendation that can easily be applied to all cases.

After you complete the initial stocking of fingerling fish, do not add any fish to the pond except on the recommendation of a fisheries biologist. The practice of adding additional fish, including catfish, to the pond year after year can lead to overcrowding and stunted fish. This practice has ruined the fishing in many ponds in Mississippi.

With proper management, a correctly stocked pond generally results in a balanced fish population and will ensure good fishing for years to come.

Catfish Ponds

Channel catfish grow well alone, with few disease problems, stocked at 100-150 per acre. When stocked alone, fish will grow faster with supplemental feeding. Natural foods include decaying organic matter, plant material, crawfish, small fish, and insects. The relatively low stocking rate (100-150 per acre) ensures good growth to a harvestable size in a reasonably short period of time. **It is not desirable to encourage catfish spawning because of potential crowding and disease problems.** To control the possibility of unwanted spawning, add a few bass to the ponds to eliminate any fingerlings less than 6 inches.

One of the most common mistakes pond owners make is stocking too many catfish. In general, the natural maximum carrying capacity in most farm ponds is about 500 pounds of fish per acre. This means that no more than 500 pounds of fish can be maintained without aeration and additional feeding. When catfish are stocked and grown to acceptable catachable sizes (1 to 3 pounds), this carrying capacity is exceeded when more that about 150 catfish are present. Attempts to exceed this natural limit in farm ponds without supplemental aeration, feeding, etc., will usually result in stress and ultimate disease in the catfish. In extreme cases, oxygen can be depleted and catastrophic losses may occur.

Recreational catfish ponds are intended to be much less intensively managed than their commercial counterparts in the Mississippi Delta.

Hybrid Bream

Stocking hybrid sunfish offers some attractive management possibilities in small ponds, provided certain conditions are met. These conditions are critical to success of ponds stocked with hybrid sunfish, and pond owners will be disappointed unless they take proper consideration before stocking. **Do not stock hybrids into ponds containing other fish, and never stock them in combination with other bream species.** Always stock hybrids in combination with a predator fish since, contrary to popular belief, they are not sterile. Most hybrid populations are 85-95 percent males, and this results in lower reproductive potential. They will, however, still tend to overpopulate, and the offspring are not desirable. **Therefore, stock hybrids in combination with either bass or catfish.** When stocked with bass, hybrid offspring do not survive, since the predacious bass quickly consume all of them. This prevents overpopulation and provides conditions for optimum growth of the originally stocked hybrids. Hybrids are best suited to ponds of 3 acres or less.

The most commonly used hybrids result from crossing male bluegills with female green sunfish. These hybrids are usually 95 percent males and are highly vulnerable to fishing. They readily accept artificial feed and grow faster than bluegills or redear sunfish under similar conditions. Maximum growth can be attained by stocking 750 hybrids and 50 bass per acre and then following a good fertilization program and feeding supplementally.

It is important to remember that hybrid sunfish management is for production of trophy bream, and bass growth will be less than desirable. Bass are stocked primarily as a management tool to keep hybrid reproduction down and to influence growth of hybrids favorably. Additionally, this is a "put and take" fishery, meaning that hybrids are grown, caught, and replaced by other hybrids stocked in subsequent years. In this sense, hybrid ponds can be likened more to cattle feed-lot operations than some other, more traditional pond management scenarios.

In many ways, management of hybrids is similar to management of most other species. They must be stocked into appropriate conditions, provided ample space, cover, and food, and protected until they reach desirable sizes. Hybrid management is specialized, however, in that protection of these fish is absolutely essential, since they can be easily fished out. Additionally, hybrid populations, unlike bluegill populations, are not self-perpetuating. The second generation is not desirable, and we manage the population to prevent that generation from occurring.

Periodic restocking is necessary to sustain a fishery for more than a few years. Pond owners should keep records of the number of hybrids removed and plan to restock when 50 to 70 percent of the originally stocked fish have been caught and removed. This is one more reason security from poachers is paramount. At restocking time, larger fingerlings (3 to 4 inches) are preferred, since they are less vulnerable to predation than smaller fish. They will, however, cost more, and pond owners may prefer to compensate by stocking higher rates of smaller (and cheaper) fingerlings. Restock at the same rates as the initial stocking.

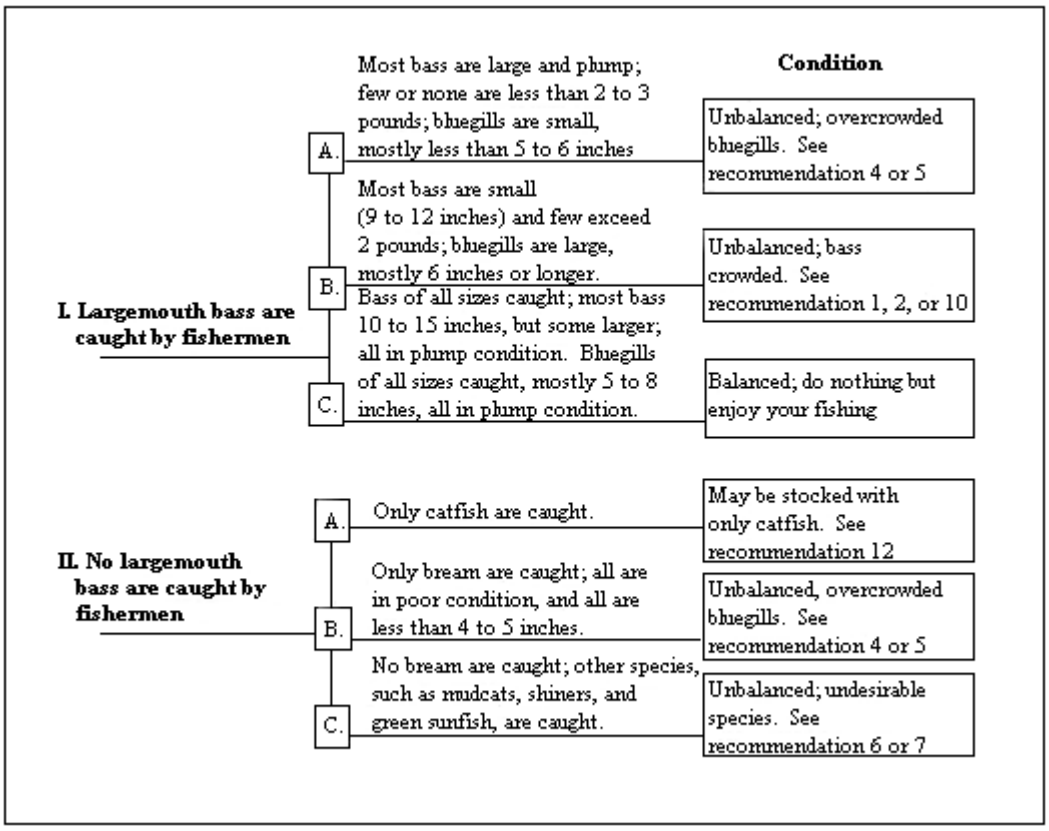
Growth of hybrids can be maximized by taking three steps:

1. Stock with largemouth bass.
2. Conduct a good fertilization program (request Extension Information Sheet 229, *Fertilizing Mississippi Farm Ponds*).
3. Feed supplementally.

A feeding program can be established using floating catfish pellets. A handy guide is to feed all the feed the fish will consume in 15 to 20 minutes and adjust the amount as fish grow. If fish do not eat all the feed offered in that time period, you are probably overfeeding and wasting feed and money. A demand-type or automatic fish feeder is a good investment. One problem with hand-feeding is that someone has to be there to do it! Research shows that most people tire of the novelty of feeding fish within the first season, and then the fish may become neglected. Installing a feeder ensures that the fish receive feed on a regular basis, regardless of the pond owner's schedule and availability.

Management

You can enjoy good fishing for years if you follow a sound pond-management program. Building the pond properly, stocking the correct species at recommended rates, having a good fertilization program, and controlling weeds are steps in the right direction. Continued good fishing depends on harvesting the correct number, sizes, and species of fish each year. See the Farm Pond Calendar.



Fishing

For bass and bream ponds, begin fishing your pond two years after the initial stocking of bream. This will be in the fall, after the original stock of bass has spawned for the first time. To ensure a balanced fish population, release some of the bass that are caught during the first, and possibly the second, year of fishing. In most cases, after the first year you can remove as many bream as you desire without harming the population.

Most of the fish harvested from the pond should be bluegill and redear sunfish. Bream reproduce throughout the summer and are the most numerous fish in the pond. **A general recommendation is to harvest a minimum of 10 pounds of bream for every pound of bass.** It is extremely important to keep the bream harvest in line with the bass harvest. Many Mississippi ponds are underfished for bream and can stand a much greater bream harvest. This should ensure an adequate number of bass for reproduction as well as control of the bream. When too many bass are removed, the remaining bass can no longer control the bream, and the bream become over crowded and stunted. Once bream become overcrowded, bass reproduction is reduced or stopped completely. To keep this from happening, keep a record of fish harvested and ask others who fish the pond to tell you the number and size (length and weight) of bass and bream they remove from the pond. A record sheet is included.

If the pond were also stocked with channel catfish, spread the fishing for them over a period of 3 to 4 years. Channel catfish may reproduce, but offspring usually do not survive because of bass predation. Restock with channel catfish when most of the originally stocked catfish have been removed. In a bass and bream pond, it is necessary to restock with 8- to 10-inch channel catfish fingerlings to ensure that these fingerlings are not quickly consumed by the bass. **Do not overstock catfish, since overstocking leads to poor growth and possible disease problems as well as excessive competition with bream for food.**

Achieving a Balance

After the second year, you must decide the kind of fishing experience you want the pond to provide. For example, if you want trophy bream, you must minimize the harvest of bass, to result in a bass-crowded condition. If you want "quality" fishing for both bass and bream, follow the "10:1" rule, harvesting some of all sizes present. This is the management situation that is most suitable for the majority of ponds. Trophy bass fishing will require careful protection of certain sizes of bass, usually through a specified protective slot limit, and also harvest of some of the smaller (10-12 inch) bass to prevent them from becoming crowded.

The balance between bass and bream can often be determined by using a short seine and/or by close examination of fishing results (Tables 2-3). When fishing produces large numbers of small bass and large bream, an overpopulation of bass is probable. When only a few large bass and many small bream are caught, the pond is probably overpopulated with bream. In some instances, heavy fishing pressure on the crowded species can bring the pond back into balance. However, in most cases you must practice other management procedures to regain a balanced fish population.

Corrective Measures

Corrective measures vary according to circumstances. Recommendations for common balance problems are listed below. Consult a fisheries biologist for specific recommendations if you think your pond has problems similar to these.

Management Recommendations for Tables 2 and 3

1. Remove 10 to 40 pounds (depending upon productivity of the pond and location within the state) of bass per acre by fishing (one time only).
2. Stock 200 to 300 3- to 5-inch bluegills per acre.
3. Do nothing; you will have a crowded bass pond with large bluegills; see Table 3 (Catch Record Data), and use the table for analysis.
4. Remove intermediate bluegills with shoreline poisoning in the early fall; see Extension Publication 1954 for procedures.
5. Stock 25 to 35 10- to 12-inch bass per acre.

6. Rotenone and restock.
7. Check catch data to see if any bass are caught; if bass have been caught, stock 200 to 300 intermediate-to-large bluegills per acre.
8. Check catch data to see if any bass are caught. If no bass are caught, rotenone and restock.
9. Do nothing; you have a balanced pond. Check catch data (Table 3) to be sure fishing is desirable.
10. If you like catching large bluegills and can live with poor bass growth, do nothing. You a have a trophy bream pond!
11. Check catch data; if shad have been observed, do a selective shad kill.
12. If catch rates are desirable, monitor catch and restock when catch rates decline.

Table 2

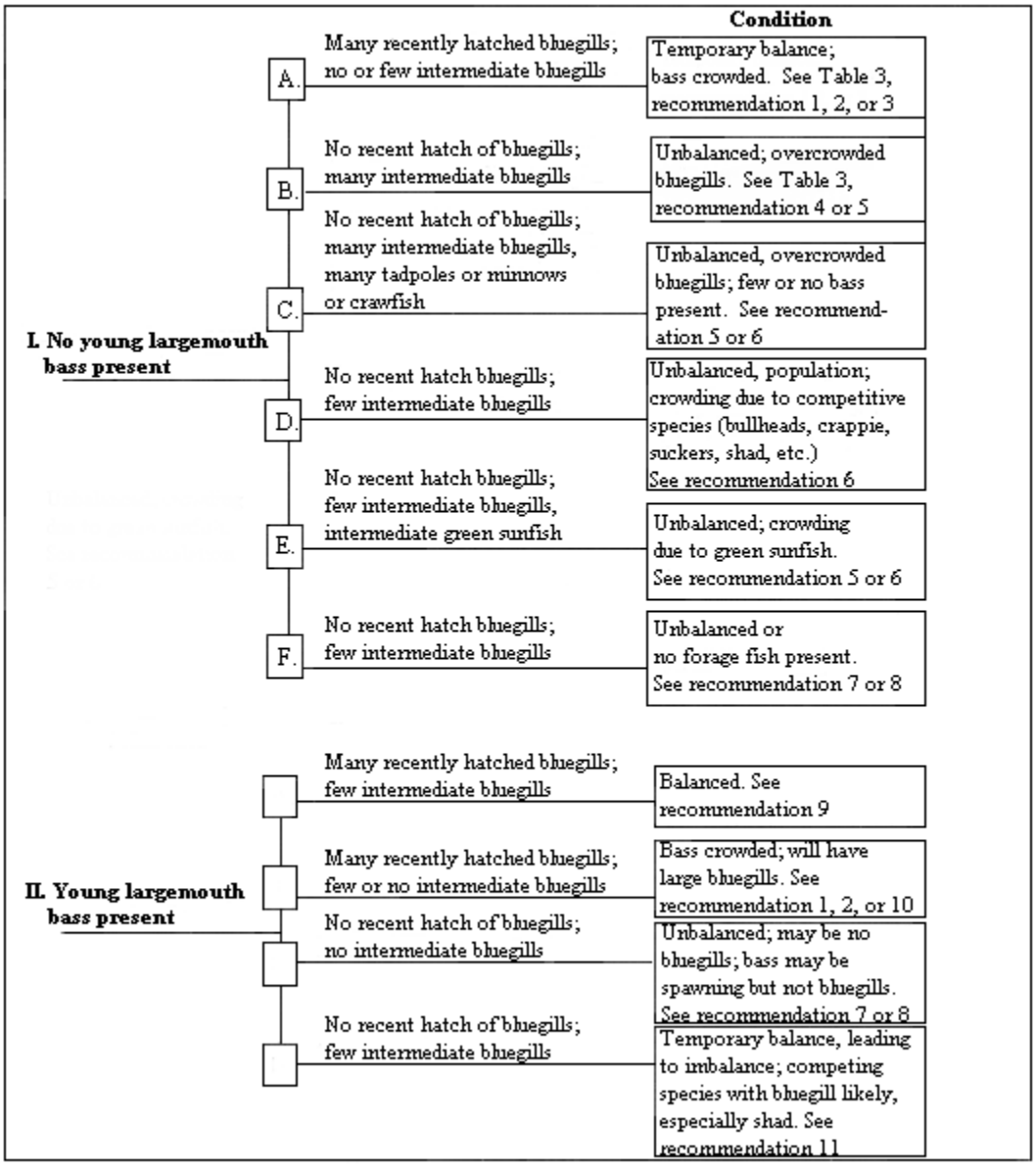
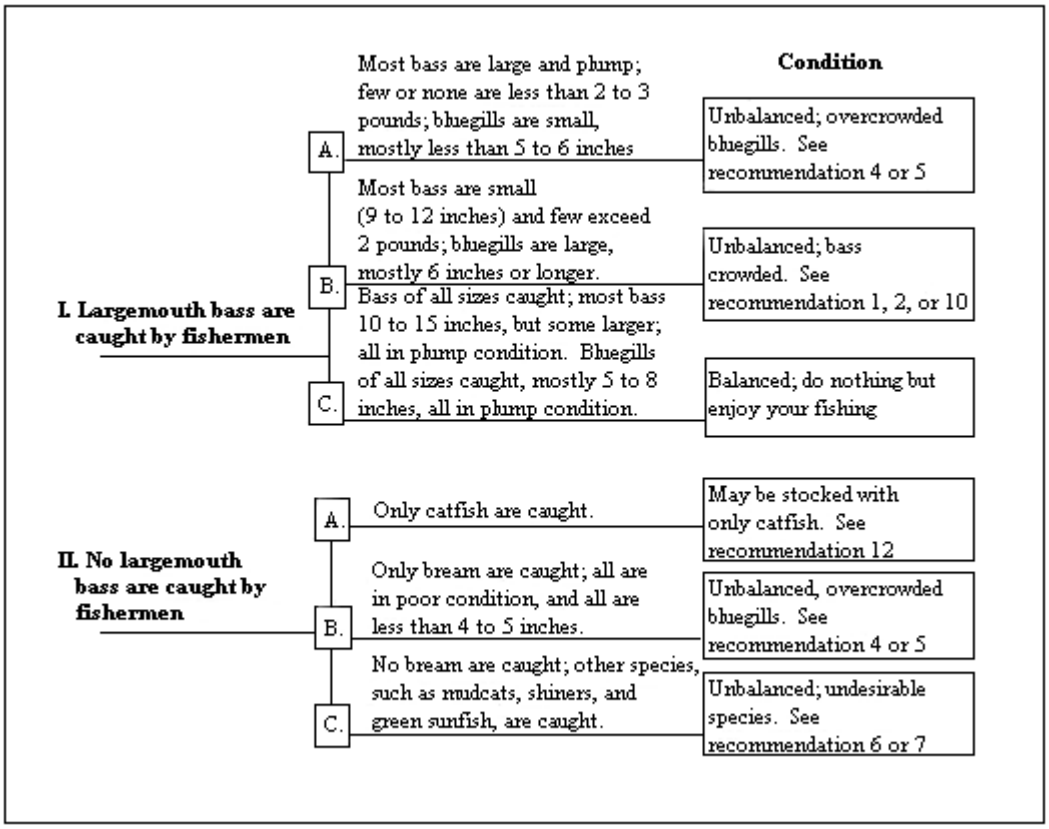

Condition
I. No young largemouth bass present
A.
Many recently hatched bluegills; no or few intermediate bluegills
Temporary balance; bass crowded. See Table 3, recommendation 1, 2, or 3
B.
No recent hatch of bluegills; many intermediate bluegills
Unbalanced; overcrowded bluegills. See Table 3, recommendation 4 or 5
C.
No recent hatch of bluegills; many intermediate bluegills, many tadpoles or minnows or crawfish
Unbalanced, overcrowded bluegills; few or no bass present. See recommend-ation 5 or 6
D.
No recent hatch bluegills; few intermediate bluegills
Unbalanced, population; crowding due to competitive species (bullheads, crappie, suckers, shad, etc.) See recommendation 6
E.
No recent hatch bluegills; few intermediate bluegills, intermediate green sunfish
Unbalanced; crowding due to green sunfish. See recommendation 5 or 6
F.
No recent hatch bluegills; few intermediate bluegills
Unbalanced or no forage fish present. See recommendation 7 or 8
II. Young largemouth bass present
Many recently hatched bluegills; few intermediate bluegills
Balanced. See recommendation 9
Many recently hatched bluegills; few or no intermediate bluegills
Bass crowded; will have large bluegills. See recommendation 1, 2, or 10
No recent hatch of bluegills; no intermediate bluegills
Unbalanced; may be no bluegills; bass may be spawning but not bluegills. See recommendation 7 or 8
No recent hatch of bluegills; few intermediate bluegills
Temporary balance, leading to imbalance; competing species with bluegill likely, especially shad. See recommendation 11

Table 3



Aquatic Vegetation Control

Aquatic plants fulfill many natural functions and are vital in aquatic and wetland environments. However, they may interfere with fishing, swimming, and boating in private ponds and lakes. Since some aquatic plants are desirable and serve as food sources for waterfowl and other wildlife, they should be controlled only when they become pests by interfering with the owner's preferred use of a particular pond or lake.

Prevention should always be the first choice, if practical, since it is usually easier and cheaper to prevent an aquatic weed problem than it is to cure one. Preventive methods include proper pond location, construction, fertilization, and drawdown. Refer to the sections on site selection, pond construction, and fertilization for specific details on these aquatic weed prevention measures. If you use proper preventive methods, aquatic weeds are seldom a problem.

Should aquatic weeds become a problem, you can control them through mechanical, biological, and chemical methods. Each method has advantages and disadvantages.

Mechanical Control

This may be as simple as cutting a willow tree or removing a few objectionable plants (such as cattails) that have just gotten started along the water margin. While cutting and removing a few plants by hand can be effective in small and limited areas, mechanical aquatic weed control on a large scale is generally difficult and expensive. **A properly maintained dam can be mowed, front and back. Don't allow trees to become established on new dams.**

One mechanical technique, called a drawdown (removal of part of the water), can be effective and economical in controlling many kinds of aquatic weeds. See drawdowns for a discussion of drawdowns. For detailed information on winter drawdowns, request Extension Publication 1501, *Winter Drawdown: A Useful Management Tool for Mississippi Farm Ponds* from your county Extension agent.

Biological Control

Biological control involves use of an animal or other living organism to control the weeds. Many rural residents are familiar with the biological control of weeds and other plants provided by farm animals such as sheep and goats. Biological control has many advantages over other weed control means. It takes much less human effort than most mechanical control means and does not require use of expensive and sometimes hazardous aquatic herbicides. Additionally, use of animals provides longer term control than other means, since the animals usually have a life span of several years.

The most common and effective biological control for aquatic weeds is the grass carp. The grass carp, also known as the white amur, is a Chinese carp imported into this country as a means of achieving biological aquatic weed control. It is native to southeast Asia and was brought into the United States in the early 1960's as an experimental aquatic weed control method. Since that time, use of grass carp has become commonplace. Because of concerns about the potential impacts on the environment and native fish populations, several states restrict or prohibit their uses. While some states prohibit the stocking of grass carp altogether, others will allow the use of a sterile carp known as a "triploid." Triploid grass carp have an extra set of chromosomes and, thus, are sterile, eliminating any possibility they may reproduce if they escape into the wild. Stocking of grass carp in Mississippi is currently not restricted by law. Either normal (diploid) or triploid carp may be used, **but it is recommended that pond owners stock only triploid carp.**

The amount of vegetation they will consume depends upon several environmental conditions, such as water temperature, water chemistry, and the kinds of plants available. Consumption rates also vary with fish size. For example, until they reach weights of about 6 pounds, grass carp may eat 100 percent of their body weight in vegetation per day. (This is equivalent to a 150-pound human's eating 150 pounds of food per day.) As they grow larger, consumption decreases; up to about 13 pounds, they will eat 75 percent of their body weight per day, and above 13 pounds, they slow down to about 25 percent of body weight per day.

Grass carp prefer soft, low fiber aquatic weeds such as duckweed and various underwater plants. Table 4 provides a list of plants that are typically controlled by grass carp. If the more desired species of plants are not available, they will feed on plants above the water surface; and in cases where no aquatic food is available, they will feed on overhanging brush and tree branches. It is this voracious appetite for plants that makes grass carp useful in controlling aquatic weeds.

The number of grass carp required to control weed problems varies, depending on the degree of weed infestation, kind of weed, size of pond or lake, and size of fish stocked.

The general rule of thumb in farm ponds is to stock enough grass carp to control the weeds in one to two seasons, but not so many that they completely eradicate all vegetation in a short period of time. The best approach is to consider the carp as a weed "maintenance" tool, rather than an eradication tool. This usually results in less environmental disturbance of the pond, and the carp are not subject to starvation due to complete loss of vegetation. Additionally, recent research indicates that eradication of weeds from a pond may not be desirable, since vegetation harbors many tiny organisms that contribute to productivity in the pond. Fishing around weed beds and other vegetative "structures" can be highly desirable, since they provide shade and cover for sport fish. The problem occurs when weed growth passes the "fine line" between desirable and undesirable amounts. For most farm pond situations where weeds have already become a problem, 5 to 10 grass carp per surface acre will achieve desired weed control without resulting in crowded conditions of the fish. In severely weed-choked cases, higher rates of 15 to 20 grass carp per acre may be necessary to attain control. In such cases, it is sometimes more effective to treat the pond with a herbicide first, and then stock moderate numbers of grass carp. You can get assistance in diagnosing the situation by contacting your county Extension agent or a fisheries biologist from other state or federal agencies.

In new ponds where grass carp are stocked as a weed preventive measure, three to five fish per acre usually do the job. In new ponds, fingerling grass carp may be successfully stocked anytime before the bass are stocked. Once bass are established, however, a minimum carp size of 8 inches will be required to ensure that the bass do not eat them. Although this size fish costs more, it is a cost-effective stocking technique, since predation losses are minimized. Because grass carp tend to follow flowing water, you should consider constructing a barrier fence across your spillway to prevent their escape.

Chemical Control

Chemical control requires the use of aquatic herbicides that have met strict EPA standards for use in an aquatic environment. As a result, the herbicides are of low toxicity to fish and wildlife (and subsequently man) when used according to guidelines, rates, and restrictions specified on the label for each herbicide. Some herbicides have limited livestock (cattle) restrictions before reentry into treated areas.

Chemical control has its limitations. Application of herbicides may require specialized equipment and expertise. Some herbicides can be very expensive, and some may not provide prolonged weed control. Rooted aquatics usually develop in water that is too shallow or too clear. Even after treatment of the vegetation, the conditions conducive to aquatic weed growth may still exist. Reoccurrence of the same or another weed problem is often likely, requiring additional applications of herbicides. **It is important to eliminate the conditions that encourage the growth and spreading of aquatic plants.**

Before using any chemical control, correctly identify the aquatic weed to be treated so you can select the most effective and economical herbicide. Publications on the identification and control of aquatic weeds are available from the Mississippi State University Extension Service (your county agent), the Natural Resources Conservation Service, and the Department of Wildlife, Fisheries and Parks. Assistance in aquatic weed identification is available from any of these agencies. In most cases, you can ship or mail a sample of your weed in a ziploc bag with no water to any one of these offices, and a biologist can make an accurate identification. Table 4 lists many of the common aquatic weeds that occur in Mississippi and the herbicides that are usually effective in their control.

You must know the surface area and/or volume of water in the pond, since the amount of herbicide to use is determined by either the surface area or water volume to be treated, depending on the type of vegetation problem.

The herbicide label will tell how much should be used per surface area of vegetation or per volume of water to be treated.

For effective aquatic weed control, you must select the proper herbicide and apply it properly. Some herbicides may be used directly from the container; others must be mixed with water or water plus a surfactant before being used. **Always follow label instructions and precautions when applying herbicides.** Some may be applied by hand (low volume, spot spray), while others require the use of power sprayers (high volume, tank mix).

Table 4:Control of some common aquatic weeds with herbicides and grass carp.

		Komeen, Algae Pro, Cutrine-Plus[1], K-TEA, Other Complexed Coppers	Hydrothol 191	Reward[2] (diquat)	(2,4-D)	Aquathol (granular)[3] Aquathol (liquid)	Rodeo	Sonar (liquid & pellets)	Grass Carp
Algae	plankton (single cell)	X							

	filamentous & water net	**X**	**X**	**X**					
	Chara & Nitella	**X**	**X**						X
Floating Weeds (not attached to bottom)	duckweed			**X**				X	
	watermeal			**X**				**X**	**X**
	water hyacinth			**X**	**X**		**X**		X
Emersed Weeds (attached to bottom)	american lotus				**X**			**X**	
	watershield				**X**			**X**	
	white waterlily				**X**			**X**	
	frogbit				**X**				
	water pennywort			**X**					
Submersed Weeds (not attached to bottom)	bladderwort			**X**		**X**		**X**	**X**
Submersed Weeds (attached to bottom)	coontail			**X**		**X**		**X**	**X**
	bushy pondweeds (Najas)			**X**		**X**		**X**	**X**
	parrottfeather			**X**	**X**	**X**		**X**	**X**
	eurasian watermilfoil			**X**	**X**	**X**		**X**	**X**
	fanwort							**X**	**X**
	pondweeds (Potamogeton)			**X**		**X**		**X**	**X**
	hydrilla & elodea			**X**		**X**		**X**	**X**
	spikerush				**X**			**X**	
	hairgrass			**X**		**X**		**X**	**X**
Marginal Weeds	alligator weeds						**X**	**X**	
	water primrose				**X**			**X**	
	smartweed				**X**		**X**	**X**	
	arrowhead				**X**			**X**	
	willows				**X**		**X**		
	cattail & cutgrass			**X**			**X**	**X**	
	bulrush				**X**				
	burreed				**X**				
	water leaf (Hydrolea)				**X**		**X**		

NOTE: It is not intended that any suggested usage in this table be in violation with existing regulations or manufacturer's label.
[1]Use products containing copper with caution because its toxicity to fish and its effectiveness in controlling aquatic weeds depend on total alkalinity of the water.
[2]Diquat has a 14-day livestock restriction. Use only in bright sunny weather. Do not use in muddy water or cloudy weather.
[3]Aquathol and Hydrothol have a 7-day livestock restriction. Do not consume fish from treated water for a period of three (3) days.

Time of Application

The time of application of herbicides is very important. **Usually, treatments that are applied in the spring or early summer when the weeds are actively growing achieve the best results.** Herbicide applications in the late summer and fall are generally less effective. Failure to control some problem aquatic plants can result in an increase in the affected area requiring treatment. Many of these plants make mature seeds by midsummer that will sprout the following year.

In hot weather, be careful not to cause an oxygen depletion by killing too many weeds at one time. Low "dissolved oxygen" levels result from the natural decomposition of treated (killed) aquatic plants. Fish kills may result if the dissolved oxygen level becomes too low in your pond. This biological problem is not caused by a reaction of the fish to an aquatic herbicide but by their reaction to low oxygen levels resulting from killing too much vegetation too quickly. It is seldom safe to treat more than one-half of the pond at one time in the summer unless you are treating marginal aquatic weeds. **A good rule-of-thumb to prevent an oxygen depletion is to treat one-third of the pond; wait one week, and treat another one-third of the pond; wait a week, and treat the remaining one-third.**

For many types of marginal (shoreline) vegetation problems, a pond owner may simply "spot treat" on an "as needed" basis to maintain good control. On older ponds and lakes where aquatic vegetation is well established, it is advisable to seek professional assistance to gain the level of control needed.

It is a violation of Federal Law to use any chemical other than aquatic herbicides that have been approved and registered by the Environmental Protection Agency. Improper use of chemicals may result in serious environmental damage, fish kills, contaminated water supplies, and, ultimately, danger to human health. The legal aquatic herbicides listed in Table 4 are provided for educational purposes only and generally represent various products on the market at the time of publication. References to commercial products or trade names is not an endorsement and is made with the understanding that no discrimination is intended of other labeled products that may also be suitable or become available in the future.

Read and observe label precautions before using any chemical in an aquatic environment. Follow these steps in aquatic weed control:

1. Identify the problem weed.

2. Choose the most economical and efficient control method.
3. If you select a chemical method of control, be sure it is both economical and safe as well as effective.
4. Calculate pond area or volume affected (to be treated).
5. Follow label instructions.

Lime and Fertilization

Fertilizer stimulates growth of microscopic plants, called phytoplankton. Phytoplankton form the base of the food chain and are eaten by small animal organisms, which serve as food for bream, which in turn are eaten by bass. Phytoplankton make the water turn green, or "bloom," which also shades the bottom and discourages growth of troublesome aquatic weeds. (See Figures 2 and 3.)

Proper fertilization will significantly increase the total weight of fish produced in a pond. If only a few people will fish a larger pond, it does not necessarily need fertilization to have good fishing. A heavily fished pond, on the other hand, should be properly fertilized to produce the best fishing.

Many Mississippi fish ponds do not develop a satisfactory phytoplankton "bloom" when fertilized at recommended rates because of low soil pH and water alkalinity. Lime can increase fish production in ponds with acid bottom mud and soft water by altering the soil pH and alkalinity of the water.

Soil Testing

If you are building a new pond, have Extension's Soil Testing Laboratory test the soil to determine how much lime is needed before the pond is filled. Soil sample boxes, instructions, and information sheets are available at your county Extension office.

Use the following procedures in sampling pond soils:

1. If pond is larger than 3 acres, partition the pond into 3 acre blocks and sample each block separately. (If pond is less than 3 acres, collect 3 samples per acre and treat each acre as a block.)
2. Collect about a pint of soil from each of 10 locations per block.
3. Thoroughly mix the 10 samples together in a bucket.
4. Take one sample from the mixture and air-dry; then place this sample in a soil sample box and submit to the Soil Testing Lab at Mississippi State University. Be sure to indicate in the "crop grown?" window on the submission form that this sample is for a farm pond.
5. Repeat this procedure for each 3-acre block in the pond. The sample will be analyzed, and you will receive a report indicating if your pond needs lime and how much to apply.

Lime

Ponds in the Delta generally do not need additional lime, and ponds in the Black Belt and thick and thin loess soils need only small amounts. Ponds in the red clay hills of North and Central Mississippi usually need 2 tons of lime per acre, and the sandy soils of South Mississippi usually need from 2 to 3 tons of lime per acre (see Figure 4). Time is needed for the lime to react with the bottom muds and provide the beneficial results; therefore, **add lime in the fall and winter, before spring fertilization.**

The best liming material in Mississippi is agricultural or dolomitic limestone. This is the same form of lime that farmers use on their crop and pasture land and can be purchased in bulk or bag form. **Do not use quicklime, hydrated lime, or other more potent liming agents!** Lime spreader trucks can be used in new pond sites (and those that have been drained) prior to flooding. On older established ponds, it may be necessary to back the spreader truck to the edge of the water and turn on the spreader. This method works well if there is good vehicular access to the edges of the pond. In some cases, it may be necessary to spread lime evenly along the upper shoreline and allow it to wash by runoff into the pond, or you can spread the lime from boats. Even distribution is preferable since the lime needs to be applied to the bottom muds. In very limited access areas, sometimes a small in-flowing creek is the only way to introduce lime into the pond, but this would be the least beneficial of the methods mentioned. A lime treatment will usually last from 2 to 5 years, depending on the amount of water flowing through the pond and the acidity of the bottom muds. A method that usually works well on ponds with high acid soils is to apply the lime the soil testing report calls for; then apply one-fourth of that amount during each following year to be sure the lime requirement is satisfied.

Type and Rate of Fertilizer To Use

Several methods and types of fertilization programs can be used, and all can be effective if the pond soil pH and water chemistry are in appropriate ranges. Pond fertilizers are available in liquid, granular, or powdered forms. Liquid fertilizers dissolve most readily, followed by powders, and then granular types.

Typical formulations for liquid fertilizers include 10-34-0 and 13-37-0; the key ingredient is phosphorous (middle number), and any similar formulation will be adequate. Apply these fertilizers at the rate of ½ to 1 gallon per surface acre, depending upon pond location and soil fertility (Table 5). Powdered, highly water-soluble fertilizers, such as 12-49-6 or 10-52-0, have recently become available and have proven to be effective and convenient to use. These formulations are typically applied at the rate of 2 to 8 pounds per surface acre, again depending upon pond location and soil fertility (Table 5).

Granular fertilizers are more traditional and are available in numerous formulations. Most older ponds respond well to a phosphorous-only fertilizer such as Triple Super Phosphate (0-46-0), which is the most economical formulation. Rates range from 4-12 lb per acre per application (Table 5).

In some areas, it may be difficult to buy 0-46-0, but 0-20-0 is usually available. If this is the case, use twice the amount recommended for 0-46-0. A relatively new granular

technology provides a timed release of the fertilizer. This formulation is a 10-50-0 granular pellet that can be applied one time in the early spring and slowly releases fertilizer throughout the season.

When To Apply Fertilizer

Begin fertilization in the spring when water temperatures have stabilized at 60°F or higher. As a rule of thumb, this means about March 15 in south Mississippi and April 1 in central and north Mississippi.

If you use liquid, powder, or traditional granular formulations, make the first three applications of fertilizer two weeks apart; then make additional applications whenever you can see your hand clearly with your arm under water at elbow depth. By fertilizing only when water clarity increases to 18-24 inches, you will fertilize the pond at approximate 3-to 5-week intervals from spring through September.

If you use the timed-released fertilizer, apply 25 to 40 pounds of pellets per acre. This is a one-time application and will provide gradual release of nutrients until fall. This one-time application eliminates the 6 to 12 periodic applications necessary with traditional fertilizers.

Table 5. General fertilizer recommendations for the various soil regions in Mississippi.

Region	Lime	Liquid (0-46-0)	Water Soluble Powder	Time-Release
1. Delta	not needed	usually not needed	usually not needed	usually not needed	usually not needed
2. Thick & Thin Loess Bluff	usually not needed	½ gal/acre each application	4 lb 0-46-0/acre each application	2-4 lb/acre each application	25 lb/acre
3. Blacklands	usually not needed	½ gal/acre each application	4 lb 0-46-0/acre each application	2-4 lb/acre each application	25 lb/acre

4. Upper Coastal Plain & Interior Flatwoods	2 tons/acre	¾-1 gal/acre each application	8 lb 0-46-0/acre each application	4-6 lb/acre each application	40 lb/acre
5. Lower Coastal Plain	2-3 tons/acre	1 gal/acre each application	12 lb 0-46-0/acre each application	6-8 lb/acre each application	40 lb/acre

How To Apply Fertilizer

Never broadcast granular fertilizer, and never apply undiluted liquid fertilizer. In either case, the fertilizer will rapidly sink to the bottom and be tied up in soils rather than becoming available in the water. **Powdered formulations can be broadcast,** since they are highly water soluble and do not sink to become tied up in bottom muds.

If you use granular forms, or the timed-release pellet, apply them in a way that minimizes fertilizer-soil contact. This can be accomplished by constructing fertilizer platforms -- one for each 5 to 6 acres of water. Build the platform so it can be raised or lowered. Lay the required amount of fertilizer on the platforms so 4 inches of water will cover them. Tear off the top layer of each sack. Wave action will distribute the fertilizer throughout each pond.

Platform construction can be difficult in existing ponds. An alternative method is simply to place bags containing the needed amount of fertilizer in shallow water with the tops cut out. The bags serve to separate soil and fertilizer, and wave action will dissolve and distribute the fertilizer.

Dilute liquid fertilizer with at least two parts water to one part fertilizer before application. In small ponds, liquids can be sprayed effectively from the bank with hand-held sprayers. Boats make application easy in larger ponds. You can spray the diluted fertilizer over the water surface or allow it to flow into the prop-wash of an outboard motor. Powdered formulations can be poured directly on the water surface.

New ponds, or those that have never been fertilized, sometimes fail to respond to fertilizer, and it can be difficult to start up a plankton bloom. Should your first efforts to produce a bloom with 0-46-0 or other low nitrogen fertilizer be unsuccessful, even after

liming the winter before, use a more complete (high nitrogen) fertilizer, such as 20-20-5, at a rate of 40 pounds per acre on the specified schedule until the pond gets a green bloom. Continue with your normal application of pond fertilizers thereafter.

When Not To Fertilize

Some ponds should not be fertilized. Here are some cases where this is true:

- **Muddy ponds.** Mud prevents sunlight from passing through the water. Plankton must have sunlight to grow. If a pond stays muddy most of the time, do not fertilize the pond until the mud problem is corrected.
- **Ponds infested with trash fish.** If undesirable fish dominate the pond, poison the pond, restock, and then begin fertilizing.
- **Ponds infested with weeds.** During warm months, pond weeds use up the fertilizer that the microscopic plants should get. Therefore, the pond stays clear even after repeated fertilizer applications.
- **Ponds not fished heavily.** Fertilizing a large pond is a waste of time and money if you fish it only occasionally. You just produce more fish that aren't caught.
- **Unbalanced fish population.** If the bream population is overcrowded, it means there are not enough bass to keep the bream down. It would be foolish to fertilize if this condition exists.
- **Catfish ponds.** It is not necessary to fertilize catfish ponds if you follow a feeding program. If you don't follow a commercial feeding program, fertilize in the same manner as for bream-bass ponds.
- **Excessive water flow.** In some spring-fed ponds, the volume of water flowing through the pond is too high to maintain adequate plankton blooms. In this case, fertilizer is constantly being diluted and will have little positive effect.

Important Points

- **Continue fertilization program from year to year. Discontinuing a fertilization program will leave you worse off than if you had never started one.**
- Improper fertilization, once or twice a year, is worse than no fertilization.
- If a bloom does not develop after four applications of fertilizer, check for lime requirements, excess water outflow, excessive weeds, or muddy water.
- Do not attempt to kill weeds by applying fertilizer.

Muddy or Turbid Water

Muddy or turbid water limits fish production because basic fish food organisms must have sunlight to grow. Silt and mud deposits also cover fish eggs and fill the pond. Controlling the erosion in a pond's watershed is essential for permanent control of most muddy water problems. In ponds that stay muddy because of suspended clay particles, use any of the following methods:

- Apply 20 pounds of triple superphosphate (0-46-0) per acre at 2- to 3-week intervals. This should be well dissolved in solution.
- Use 10 square bales of hay per acre. Break up the bales and shake out into the water. When water clears, return to your regular fertilization program. Use caution during summer months since decomposition of the hay may also lead to oxygen depletions.
- Apply 5-15 pounds of alum per surface acre of water.
- Use gypsum at the rate of 15 to 35 pounds per 1,000 cubic feet of pond water. Spread the gypsum from a boat over the pond surface and stir with an outboard motor. The gypsum will keep the water clear as long as the gypsum is not washed from the pond. When used according to recommendations, it will not kill fish, change the pH of the water, or harm livestock.

If livestock are muddying your pond, fence off the pond and install drinking troughs below the pond.

If the water in your pond stays milky, apply 75 pounds of cottonseed meal and 25 pounds of superphosphate per acre each time you apply the other fertilizer until the water clears. When the water clears, return to your regular fish pond fertilization program.

Consult your local Natural Resources Conservation Service office for erosion control techniques and suggestions.

Feeding

It is not necessary to feed fish in a fertilized bream and bass pond to produce good crops of fish. Natural food organisms will also be abundant enough to feed fish in fertilized bass/bream ponds. However, you can significantly enhance growth of bluegills by a supplemental feeding program. Bluegills readily accept feed and can be attracted quickly to feeding areas.

Small ponds stocked only with channel catfish or hybrid sunfish should always be fed to maximize fish growth. Not feeding will give poor results. Here are some points to consider about feeding:

- Feed at the same time and location each day.
- Use floating feed, with a pellet size small enough to be easily eaten.
- Never feed more than the fish will eat in 5 to 10 minutes. Keep in mind that uneaten feed may pollute the water.
- If fish quit eating, stop feeding for a few days. Watch for signs of disease.
- Do not feed in very cold or very hot water.
- Taper the feeding rate as winter approaches to about one fourth of the feed rate of the previous summer.
- Automatic feeders will give good growth results where small ponds are unattended for long periods.

- Do not try to feed fish up to large sizes without some harvest to reduce the number of fish. Otherwise, crowded large fish may become diseased and die.

Fish Kills

Occasionally, a fish kill occurs in farm ponds because of water quality problems, infectious disease, swarming fire ants (in the spring), or misused agricultural chemicals (pesticides). In some cases, the losses may be enough to affect the balance of the fish population. Therefore, **get professional help to evaluate the fish population balance following a fish kill. In many cases, a phone call will provide enough information.**

Fire Ants

During warm spring rains, fire ants are often washed into ponds, and small and intermediate sized bream may die from eating these insects. Bass are rarely affected. This condition generally does not have a detrimental effect on the population balance.

Oxygen Depletions

This is probably the biggest cause of fish kills in farm ponds. Oxygen depletions usually occur July through September during the period of highest water temperature. Die-offs caused by low dissolved oxygen levels result from natural biological processes, and there are rarely any effective preventive measures. One common cause of oxygen depletion is die-off of microscopic algae during several days of cloudy weather. Decay of these microscopic algae uses up the dissolved oxygen the fish require for respiration.

Another phenomenon, often called "pond turnover," can occur after heavy cold rains in late summer or in early fall when temperatures drop suddenly. This is actually a mixing of warm surface waters with cooler bottom waters (Figure 5), more properly termed "destratification," and often results in an oxygen depletion. An early symptom of a low dissolved oxygen level is when fish are at the surface of the pond at sunrise. Fish appear to be "gasping for air." Adult fish die first, and intermediate fish follow if the low oxygen level continues for many days. Usually, some fingerling fish will survive, but there is a tendency toward overcrowding bream afterward. Stocking yearling size bass in the fall may be advisable if there are no undesirable species (such as crappie) in the pond.

Infectious Diseases and Parasites

Bream and bass generally do not have significant problems with infectious diseases in well-balanced ponds, although an occasional sore may be evident on individual fish during spawning season or following an injury. These external sores do not pose any health hazard to humans. As previously suggested, never throw bream back, and remove bass with sores from the population. Occasionally, bass and bream are caught that contain small white or yellowish grubs imbedded in the flesh. These grubs, although not pleasant to look at, pose no threat to humans. The affected area can be trimmed away, and the remainder of the fish is safe to eat.

Infectious diseases and parasites of channel catfish are common problems in catfish ponds. Factors contributing to this in recreational ponds include overstocking, inconsistent feeding, and poor water quality. Disease and parasite problems of catfish rarely occur when low stocking densities (100-150 per acre) are used. Stress from handling may cause die-offs of fish within 2 weeks of stocking new or established ponds.

If you choose to stock catfish at rates higher than recommended here (100-150 per acre), then you should plan ahead to cope with problems that may occur. You must make arrangements for someone to receive your catfish before you ship them. Do not send fish samples to the Mississippi Department of Wildlife, Fisheries and Parks, or to any agency other than the Mississippi State University College of Veterinary Medicine.

Determining Factors in Fish Kills

If possible, send this information (along with the fish sample) to the disease specialist:

- Number of fish lost since the die-off started.
- Approximate number of fish lost each day.
- Date and time of day the losses started.
- Number of surface acres per pond (or exact dimensions of the vat or holding tank).
- Average pond depth.
- Number of fish stocked in the pond.
-

  Condition of the bloom:
  Light -- The pond has visibility of 18 inches or more and has no accumulation of algae in the corners or on the downwind side.

  Moderate -- The pond has a visibility of 12 to 15 inches and may have a moderate amount of algae accumulated in the corners or on the downwind side.

  Heavy -- The pond has a visibility of 12 inches or less.

Transporting and Shipping Samples

1. Place live fish in a plastic bag with no water and seal. If sending catfish, clip the spines to prevent them from puncturing the bag in transit. Then place the bag in an ice chest containing crushed ice.
2. If the fish are to be hauled for a short distance, you may place them in a container or ice chest containing well-oxygenated water. Add a few chunks of ice to keep the water cool.

3. Fish can be frozen for transport to the lab when there is no other way to keep them from spoiling. Frozen samples are hard to work with and you should avoid them whenever possible. Frozen samples are acceptable if they are for pesticide analysis.
4. Ice down immediately all dead fish collected but which are still acceptable for examination (red gills, etc.) to retard further tissue breakdown.
5. Make arrangements for shipping and delivery. Samples should arrive at the lab within 12 to 18 hours.
6. **Call the lab and provide details on case and anticipated arrival time.** Mississippi State University operates two labs, one on campus (325-3432) and one at the Delta Research and Extension Center (686-9311).

Drawdowns

One of the most useful and inexpensive pond management practices is called a "winter drawdown." This practice is the reduction of water levels in a pond to some predetermined level and generally is designed to expose 35 to 50 percent of the pond-bottom area. Winter drawdowns can be useful in controlling aquatic weeds and can be invaluable in manipulating fish populations and facilitating pond repairs, redesign, and liming. The primary disadvantage is the pond must have a drain pipe that will allow the water levels to be lowered and kept down throughout the winter. Ponds without a drain pipe can be retrofitted; detailed information on how to do this is available through your county Natural Resources Conservation Service office.

Drawdown for Aquatic Weed Control

Aquatic weed problems are common in farm ponds and usually represent a challenge. Of the three basic weed control methods (mechanical, biological, and chemical), mechanical control can be the least expensive and most convenient if it consists of a winter drawdown. Winter drawdown exposes weeds to air-drying and freezing temperatures. This can be an effective weed control technique, especially if done in successive years. It also has other advantages related to fish population management.

For effective weed control, drop the water level of the pond to expose aquatic weeds in the more shallow portions of the pond. Usually, water levels are reduced enough to expose 35 to 50 percent of the pond bottom, but this percentage may vary greatly, depending upon topography and design of the pond. Maximum drawdown should be accomplished by mid- to late November, and the water level should remain low through February. Spring rains will fill the pond.

After reflooding, if weeds persist and begin to sprout, apply an appropriate herbicide. The combination of a winter drawdown and effective early spring herbicide application usually does a good job of eliminating or greatly reducing aquatic weed infestations.

Drawdown for Fisheries Management

Winter drawdown is also a good fish population management technique in bass/bluegill ponds. By reducing the water level and pond area, forage fish, such as bluegills, are driven out of shallow water refuges and concentrated in open water, making them more vulnerable to bass predation. This is a good technique to use in ponds having "crowded bluegill" but still containing viable bass populations. The increased predation by bass reduces bluegill numbers and provides additional food for the struggling bass population. In some cases, routine annual drawdowns have helped the pond manager maintain a balanced bass/bluegill fishery.

Winter drawdown also provides a good opportunity to do repairs on piers, docks, and boat ramps, as well as minor dam repairs and shoreline renovation. Fish attractors, such as brush tops and gravel beds, can be easily put in place while the water is down, and this is a good time to deepen edges to the recommended minimum depth of 18 to 24 inches. Dirt from the shoreline-deepening operation can be used to construct earthen piers at various locations around the pond. These piers increase the shoreline area of the pond and also provide increased access for fishermen.

In most farm ponds, lowering the water level 2 to 4 feet exposes the proper percentage of the pond bottom; however, this is only a rule of thumb. You must consider the topography of the pond, amount of shallow water, and pond shape and design. Reach the maximum depth of drawdown by late November, and allow the water to remain down through February. In south Mississippi, the stand pipe can be raised a little earlier, perhaps mid-February, to allow the pond to refill and not hamper bass spawning activities that begin earlier in that part of the state.

Winter drawdown can be a useful tool for the farm pond manager if done properly. It poses no threat to the fish population and costs nothing if the pond is equipped with a water control structure. **Drawdowns should be done only in the winter, however, never in summer!** The extreme temperatures during Mississippi summers, coupled with the increased metabolism of fish and reduced oxygen levels in warm water, would prove disastrous in most farm pond situations.

Fish Attractors

The primary purpose for most farm ponds in Mississippi is recreational fishing. With proper management, even small ponds can provide excellent fishing and recreational experiences. One of the best ways to enhance the fishing experience is to create fish attractors at strategic locations in a pond or lake with a well-managed fish population.

Gamefish such as bass and bream are attracted to cover or shelter of all types. Shelters provide areas where prey fish can hide from predators and where predators can find prey species. They also provide spawning areas and harbor large numbers of invertebrates and insects that small fish feed upon. Natural cover that provides shelter for fish includes ditches, creeks, trees, stumps, vegetation, and irregular features of the bottom. In ponds where natural shelter for fish is missing or is inadequate, artificial structures can be established to act as fish shelters that will attract and hold fish.

Trees as Fish Attractors

Suitable fish shelters to increase fish harvest and angling success in existing ponds can be developed from small trees such as blackjack oak, post oak, or cedar. For small ponds, bushy-crowned trees 10 to 15 feet tall are sufficient. In larger lakes, larger trees can be used. In ponds of less than one acre, one brush shelter is enough. Larger ponds need one or two shelters per acre.

Select attractor sites that are accessible to anglers. Good locations are found in water 5 to 10 feet deep near creek channels, off points, or at dropoffs. Drive a stake or use a floating buoy to mark the shelter site permanently. Place three to five trees at each location. Green trees will usually sink without weights. Some trees, such as cedar, will float, and weights should be added to these varieties to keep the shelters in place.

Many new pond sites have trees in the basin, and most of these should be cut and salvaged or piled and burned. Some trees, bushes, and brush piles can be retained, however, to use in establishing fish shelters. Where possible, up to 10 percent of the pond area should have some tree shelter.

Leave bushes and trees in deeper water areas, along creek runs, and in the middle of ponds and lakes. Leave the trees in small clumps, then cut the standing trees about 2 feet above the normal water level and anchor the brushy tops to the bases of the stumps. The tall stumps will serve as permanent markers for the shelter locations. Do not leave trees or bushes in shallow areas, in narrow coves, or along pond banks, because these areas will become difficult to fish and may develop aquatic vegetation problems. Also, too much cover in shallow water will make it hard for bass to control bream successfully and will prevent navigation of the entire shoreline by boat.

Fish will immediately inhabit the brush-top shelters. Go fishing!

Gravel Beds as Fish Attractors

Gravel beds are extremely attractive to bream for spawning. Select an area in water 2 to 4 feet deep that is convenient for fishing. Drive a stake to mark the spot, and place washed gravel (1/2- to 1-inch-diameter) around the stake, creating a bed of gravel 4 to 6 inches deep. A 3- to 5-cubic-yard load will make a gravel bed 12 to 15 feet in diameter. Gravel beds can be added to flooded sites or strategically placed during drawdowns. Avoid sites that have a high silt erosion problem.

Bream will be using gravel beds frequently throughout the spring and summer. Remember to keep all the bream you catch; never throw them back into the pond no matter how small they may be unless advised by a fisheries biologist.

Other Fish Attractors

If trees or brush piles are not available, you can place other types of structures in the pond to attract fish.

One effective fish attractor is called a stake bed. A group of 2- by 2-inch stakes are driven into the bottom in a random or geometric arrangement in strategic locations. Old culverts and concrete blocks can be arranged to provide good cover and are usually available for little or no cost. Development of irregular bottom features during construction such as ditches and underwater dirt mounds also provides fish-attracting cover and creates excellent places to fish.

Pond Renovation

The ultimate fate of many farm ponds in Mississippi is an unbalanced fish population that is undesirable to anglers, and, therefore, has little recreational fishing value. Once a fish population reaches such a condition, the best alternative is usually to eliminate the resident fish and restock with a desirable combination of fish at recommended rates. Consult a fisheries biologist by calling any MDWFP district office to determine the condition of your pond and the possible need for a complete fish population renovation. This is a free service.

Antimycin-A and rotenone are two pesticides registered by the Environmental Protection Agency for eradication of fish. Only rotenone is economically feasible for eradicating fish populations and is the more commonly used compound. Antimycin can be used to selectively kill scaled fish from catfish ponds, but treatment is usually expensive.

What Is Rotenone?

Rotenone is a naturally occurring substance found in the roots and stems of several tropical plants. Jewel vine (Derris spp.), Lacepod (Lonchocarpus spp.) ,and hoary pea (Tephrosia spp.) are the more common plants from which rotenone is derived. Rotenone has many common and brand names, including Cube, Derris, Fish-Tox, Nox-Fish, Prentox, Nusyn Nox-Fish, rotenone dust, and Chem-Fish.

Rotenone works by inhibiting a biochemical process in the fish cells, resulting in an inability of fish to use oxygen in the release of energy during normal body processes. But, contrary to popular belief, rotenone does not remove oxygen from the water. Fish treated with rotenone move to the shallow water or to the surface of deeper water within a few minutes of exposure to the chemical. Different species of fish respond variously to rotenone, and it is a good idea to know what species are in the pond before treatment.

Rotenone is an unstable compound that breaks down when exposed to the environment. It is ultimately converted to carbon dioxide and water. The breakdown process is rapid and is affected by temperature, light, oxygen, and alkalinity. At 80 °F, treated water will detoxify in about 4 days. In cooler water, the breakdown process is slower; at 45 °F, it can take 30 to 35 days for rotenone to detoxify. Most waters are safe for restocking within 5 to 6 weeks. In general, the cooler the water, the longer rotenone persists.

Rotenone is available at most farm and chemical supply stores. It is classified as a "restricted use pesticide" and cannot be purchased without a private pesticide applicator's certificate. You can get this certificate through your county Extension agent.

Preparing the Pond

Ponds of any size can be treated with rotenone, but it can be difficult to achieve an even distribution of rotenone for an effective fish kill in larger ponds or lakes. It is also expensive to treat large volumes of water. For these two reasons, it is advisable to reduce the water area and volume as much as possible before treating. This can be accomplished by draining the pond as low as possible with a built-in standpipe, by a pump, or by a siphon device. The less water you treat, the more cost effective the treatment.

How To Apply Rotenone

Rotenone is available in a wettable powder or a liquid formulation. Liquids are easier to get into solution and are more reliable for total fish kills. The liquid formulations typically contain 5 percent rotenone, although some contain 2.5 percent in a synergized form.

All formulations must be diluted with water and evenly distributed throughout the water column. The chemical can be sprayed over the pond surface or dripped into the prop wash of an outboard motor. The key consideration is to attain an even distribution; otherwise, fish may find "safe" areas and escape being killed. Application in a random "S" pattern throughout the pond will maximize even coverage.

The best time to eradicate fish from a pond for restocking is late summer or early fall. Water temperatures are at their highest at this time, and the weather is usually dry, allowing easy draining. Killing the fish at this time reduces the time between the kill and the restocking, which minimizes the chance the pond will be contaminated by unwanted fish before restocking. This is an important consideration, since the entry of unwanted species can defeat the purpose for the renovation.

If there are any puddles or pools in the upper portion of the pond after draining, it is critical that these also be treated to kill any fish therein. Many small fish can survive in these pools, puddles, or stump holes for long periods. These must be killed to accomplish a successful renovation. Otherwise, these surviving fish can represent contamination of the new fish population, and the renovation will have been for nothing.

When To Restock

It is important to wait until the rotenone dissipates before restocking. If the kill is conducted in early fall, the rotenone should be detoxified by the time winter rains have occurred to partially refill the pond. A good general rule of thumb is to wait one month. A simple test can help determine when it is safe to restock. Place a few fish (bream,

goldfish, minnows) in a small cage in the pond or in a container with water from the pond. If the fish survive 24 to 36 hours, it is safe to restock the pond.

Turtles

Turtles are seldom a biological problem in farm ponds, but they might sometimes compete with fish for food items such as crawfish, insects, or other small food items. They can, however, create a nuisance to anglers when they are caught on hooks and must be removed, when they take baits intended for fish on trot lines, or when they eat fish on stringers left in the water. Turtles also become a problem in ponds where fish are being fed, because turtles quickly learn that fish food tastes good and represents an easy and free meal. Nonetheless, turtles can be beneficial in several ways. Their greatest service is as scavengers that eat dead fish and other animals, or help to eliminate diseased or weakened fish. Except for snapping varieties, turtles do not capture many live fish at all and should not be considered a problem in this regard.

Before pursuing any type of control method, consider whether or not turtles are a genuine problem in your pond. Unless numbers are high and the interference with other pond uses is severe, it is probably best to leave the turtles alone. However, if you have significant problems, you may need to consider removing a portion of the turtle population.

Shooting turtles as they bask in the sun or as they swim in the water is an old practice you should never use. Shooting into or across water is dangerous! Shooting also creates the possibility of killing a protected species, since identification from a distance is impossible. Repellents or toxicants cannot be used, so trapping is the only alternative.

Trapping can effectively reduce local populations. The best seasons for trapping are spring, summer, and early fall. Most turtles are inactive through the winter and feed very little, which makes use of baited traps ineffective during that time.

Although you can trap snappers and soft-shelled turtles using underwater, baited traps, it is seldom necessary to remove these species from a farm pond. The more aggravating species are the "baskers," which often crowd together in large numbers on stumps, logs, or other structures above the water surface. By taking advantage of this trait, these you can take these species by trapping with a trap-box in the area turtles normally use. This trap has inclined boards leading up from the water, with pivoting "balance boards." When the turtles crawl onto these platforms, the boards overbalance, dropping the turtles into the collection box (Figure 6).

Check traps daily and remove all turtles, then transport the turtles to another location and release them into their natural habitat. If you do not plan to use the trap for an extended period, flip it over on its side so turtles are not captured and left in the trap for long periods.

Refer to Figure 6 and also modify, using your own ideas and available materials. Your county agent or Natural Resources Conservation Service office can provide you with other design illustrations.

Waterfowl Habitat

Many people enjoy having ducks around their ponds. It is fine to keep and feed domestic ducks, but it is not a good idea to keep excessive numbers of them. Their feeding habits can quickly muddy up a small pond, and they leave a lot of "litter."

Wood duck boxes can be installed to attract wild ducks. They should be properly maintained on an annual basis. Predator guards are required. It is necessary to clean out the boxes every winter and replace the nesting material (sawdust). It is better to have one box properly maintained than ten boxes neglected. Because of potential disease problems, do not encourage wild ducks to nest where there are populations of domestic ducks.

Guidelines for building duck, bluebird, and other types of nesting boxes are available upon request from many sources. Check with your Extension county agent, Natural Resources Conservation Service, or Mississippi Department of Wildlife, Fisheries and Parks.

Beaver and Muskrat Damage

The natural behavior of beaver and muskrats can severely damage farm ponds and lakes. Their burrowing activity can cause failure of the dam and result in expensive repairs. Tree cutting can cause an uncontrolled loss of valuable timber resources. Beaver dens or huts may be great places to catch fish, but it is at the landowner's expense. Fish attractors installed by man will give the same success with no sacrifices.

The best control is immediate action at the first sign of either of these animals taking up residence in your pond or lake. **Trapping is the most effective means of control. For detailed assistance, contact USDA Animal Damage Control (325-3014), or your Extension county agent.** Do not make repairs until the problem animals are brought under control.

Farm Pond and Lake Harvest Record

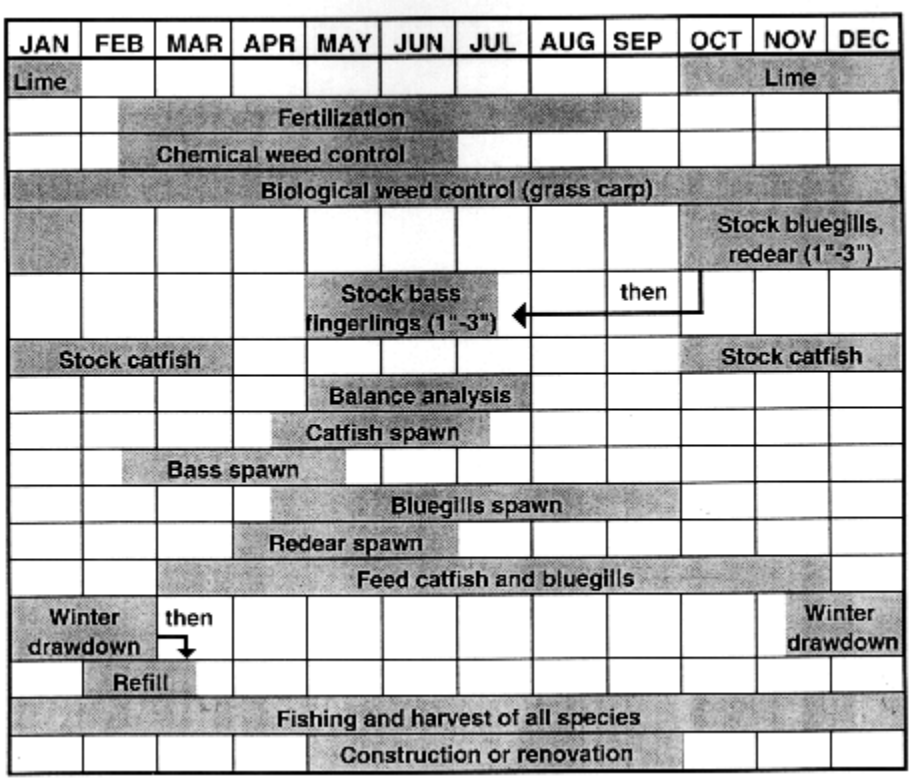
Instructions: Accurate and complete data are important to fisheries management. All anglers should complete a record after each trip. For convenience, you can group fish in size-length categories as follows:

Bass categories:	8 to 12 inches, 12 to 15 inches, > 15 inches
Bluegill categories:	3 to 6 inches, > 6 inches

Under each column, in each size group, enter the number of fish harvested (H) or released back into the lake (R).

		BASS			BLUEGILL		CATFISH	OTHER
Date	**Fisherman**	**8 - 12 inches**	**12 - 15 inches**	**> 15 inches**	**3 - 6 inches**	**> 6 inches**		
		H	H	H	H	H	H	H
			R	R	R	R	R	R

Farm Pond Calendar



For More Information

This publication contains a wealth of information that should be helpful as you develop, improve, or maintain your Mississippi farm pond. Remember, however, that trained professionals - county agents, district conservationists, and district fisheries biologists - are available to help you manage your pond to achieve your goals and objectives. And, this service is free of charge!

Many other sources of information are also available, such as publications, a video on farm pond management, local workshops, and seminars. Contact any of the three agencies that have provided this publication for details. The Mississippi State University Extension Service and the Natural Resources Conservation Service maintain offices in every county of the state. Also, you can contact the Mississippi Department of Wildlife, Fisheries and Parks district offices at any of the following locations:

Batesville	563-6330
Brookhaven	835-3050
Hattiesburg	545-5632
Merigold	748-2990
Newton	683-7471

Tupelo 840-5172

If you have questions about information in this publication, or if you encounter other situations or problems not mentioned here, we ENCOURAGE you to seek professional help. Proceeding with management techniques when you are uncertain about the correct thing to do can be frustrating and sometimes expensive! It can also delay the progress and development of your pond. It is wise to remember and heed the old adage, "A wiser person asks many questions!"

This publication and many others on the management of farm ponds and small lakes are available on the world wide web at the following URL:
"http://www.ext.msstate.edu/anr/aquaculture/aquapapers/farmpond.html"

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