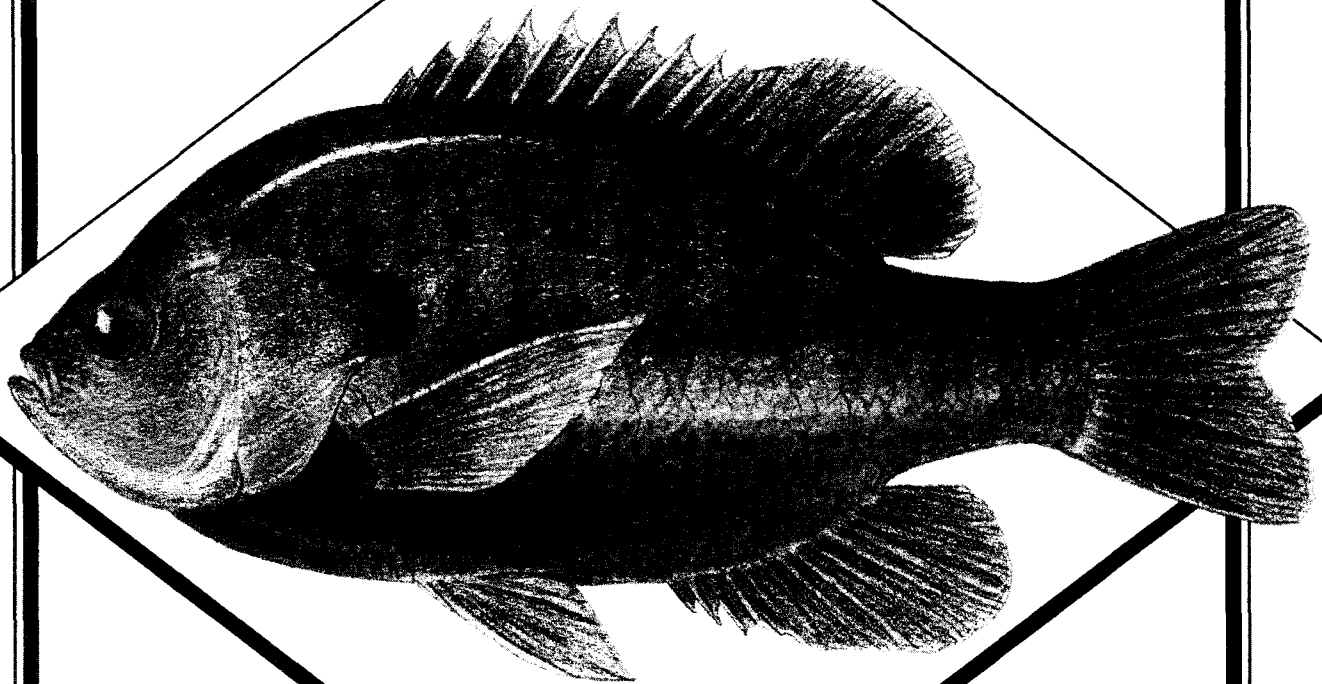


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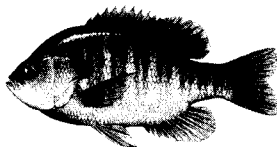


Management of Recreational Fish Ponds in Texas



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Texas has more than 800,000 private ponds. Ponds are usually built for several purposes: irrigation, livestock watering and recreation. Recreation is probably the most important reason for building a pond in Texas. Unfortunately, most ponds are poorly managed for recreation, even though as much as 25 percent of all fishing takes place in private ponds.

Properly managed ponds provide excellent recreational opportunities. A good fishing pond must be managed like a vegetable garden: It must be seeded (or stocked) properly, limed and fertilized correctly, weeded now and then, and harvested in the correct numbers and on an appropriate timetable.

The purpose of this publication is to provide the owner or manager with guidelines for correct pond management.

The first step in recreational pond management is to decide what kind of recreation is desired. Ponds can be managed for fishing, swimming, wildlife attraction and aesthetics. It is difficult to manage for all of these recreational activities equally well, but the most important can be emphasized. This publication will target fishing and attracting wildlife.

Pond Dynamics

No two ponds are ever exactly alike. Even ponds in the same watershed and built very close to each other can be very different in appearance, and differences in watershed and soil characteristics are particular to each pond. Differences affecting management are those associated with water quality, plankton and fish populations.

Water Quality

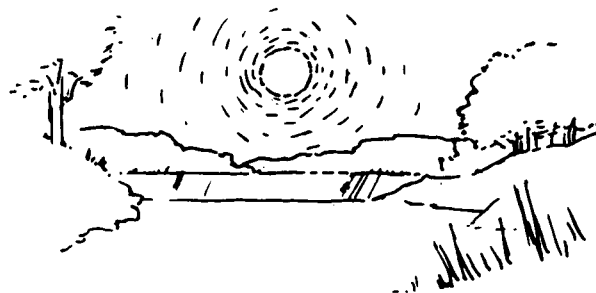
Water quality factors such as temperature, pH, alkalinity, hardness and dissolved oxygen affect fish health and production. These factors are rarely constant in a pond. Temperature, dissolved oxygen and pH will change or cycle each day and alkalinity can change over longer periods of time.

Oxygen Cycle

Oxygen is dissolved in water from two sources—air and photosynthesis. Oxygen dissolves into the pond water from the air as the two are mixed together through wind and wave action. Mechanical aeration using pumps,

sprayers and paddlewheels can be used to increase dissolved oxygen levels during periods of low oxygen.

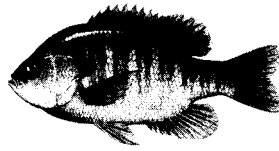
Photosynthesis is the other source of dissolved oxygen. In this process, plants produce oxygen while making food from carbon dioxide and water in the presence of sunlight. Algae release this oxygen directly into the water during photosynthesis. Since photosynthesis is driven by the energy of sunlight, oxygen production occurs during daylight. Therefore, dissolved oxygen concentrations in ponds tend to rise throughout the day. At night dissolved oxygen slowly declines as fish, insects, zooplankton, bacteria and algae consume oxygen through respiration. Under normal conditions dissolved oxygen concentrations should not fall below 3 or 4 parts per million (ppm). Oxygen concentrations below 3 ppm stress fish and many fish will suffocate at concentrations below 2 ppm.



Alkalinity, Hardness, and pH

Alkalinity and hardness are important in providing adequate natural food and in maintaining a healthy fish population. The pH of the pond cycles daily because of respiration and photosynthesis. Carbon dioxide released from respiration reacts with water, producing carbonic acid. The pH scale measures the acidity; therefore, as carbonic acid is formed the pH is lowered or the pond becomes temporarily more acidic. Algae use carbon dioxide for photosynthesis during daylight hours and the pond water becomes less acidic with the decline of carbonic acid. Because of this, a pond pH normally fluctuates between 6.5 and 9. If the pH drops below 5, as it does in ponds that receive acid runoff, or rises above 10, as in low alkalinity ponds with excessive algae blooms, fish will be stressed and can die. The only practical method to manage for abnormal pH changes is to increase the alkalinity of the pond.

Alkalinity is a measure of bases in the water. Bases react to neutralize acids and, therefore, directly influence pH. As bases react with the hydrogen ions present, they buffer or



suppress pH changes. Some alkalinity is necessary for good algae production. An alkalinity of 20 ppm or more is necessary for proper algae growth and, therefore, good fish production.

Hardness is a measure of calcium and magnesium ions. Hardness concentrations are usually similar to alkalinity (if derived from limestone) but can be different, especially in coastal areas. A lack of hardness can reduce plankton production and cause muddiness.

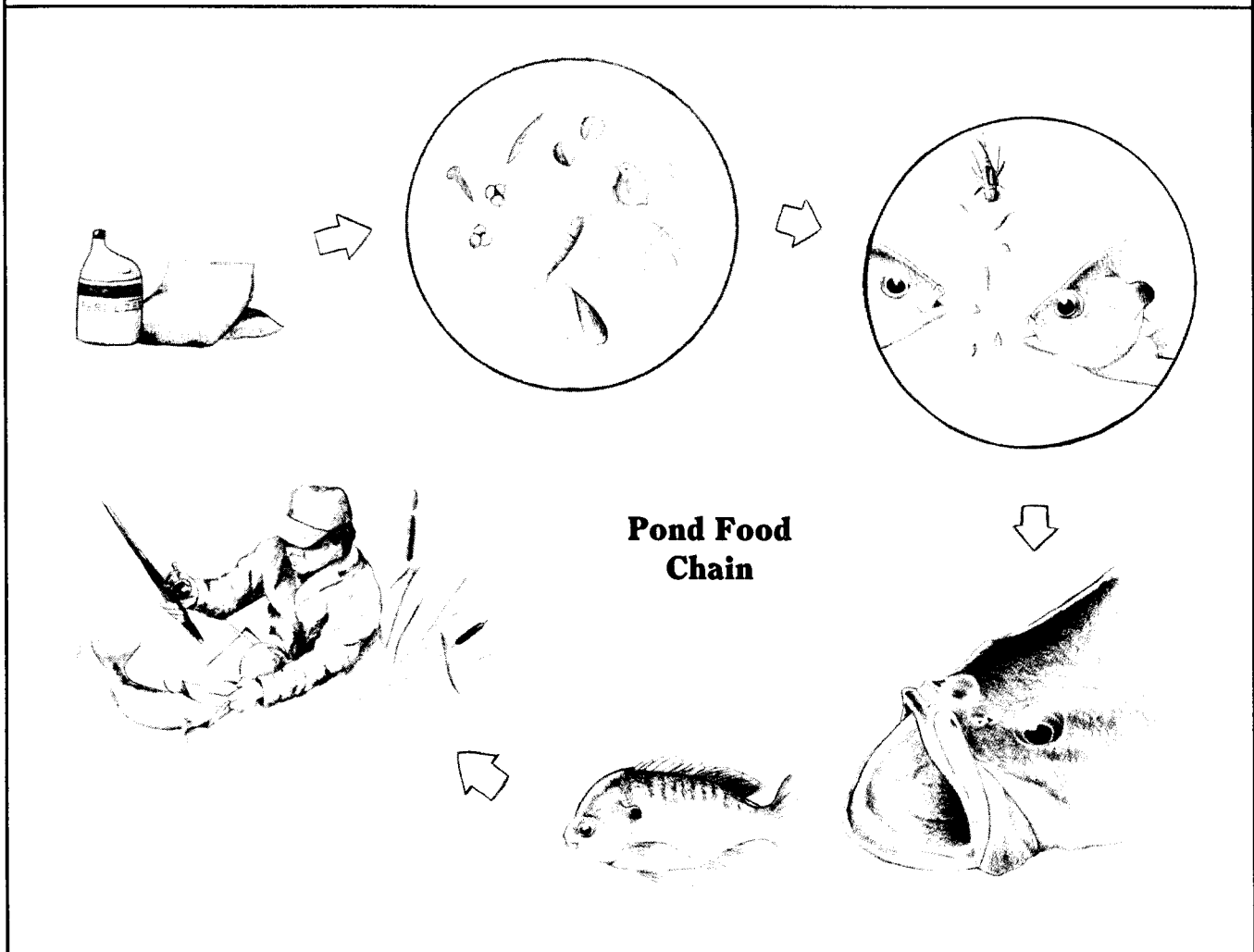
Blooms and Pond Color

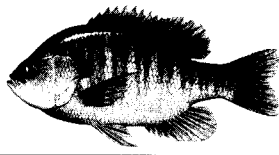
Plankton is a term used for all microscopic and near microscopic living things that float in the water. Plankton includes both tiny aquatic plants called phytoplankton or

algae, and animals called zooplankton. Planktonic algae serve as the base of the food chain. Zooplankton and aquatic insects feed on algae, and they in turn are eaten by small fish (fry). Small fish are then eaten by larger fish (Figure 1). Directly or indirectly, algae provide almost all the basic food for the pond except for a small quantity of insects and worms that fall or wash into the pond. Managing planktonic algae is essential in providing the food to produce an abundant and healthy fish population.

Changes in pond water color can be related to planktonic algae concentrations, called "blooms," or to suspended sediments and organic matter. Water which is good for fish production is green; the green color comes from billions of suspended microscopic algae. Water color changes if these algae blooms "die-off" rapidly, turning the water brown,

Figure 1. Pond food chain from fertilizer to fishing.





black, milky or clear. When this happens, decomposition of the dead algae consumes oxygen, leading to possible stress, suffocation or disease in fish. Algae die-offs are common in deep ponds or in fish ponds receiving too many nutrients. Mechanical aeration may be necessary after algae die-offs to keep fish alive.

Sediments washed into ponds after heavy rains will also change pond color. Color should return to normal within a few days as settling occurs. Heavy sediment loads can stress fish by irritating the gills and reducing oxygen production. Ponds that receive sediments from surrounding fields may need a wide sod strip around the pond to help trap the sediments before they enter the pond (see Pond Construction). Bare pond banks should be covered with hay to establish sod and reduce erosion. A pond that receives sediment only during heavy rains may need a diversion ditch built around it to channel excess water away from the pond. Many chronically muddy ponds need lime to reduce acidity and to settle suspended clay. If your pond is always muddy, contact your county Extension office for help. The office is listed under your county name in the telephone book.

Essential Ingredients of Pond Management

Even though ponds are never exactly alike, all can be managed for fishing. The basic guidelines for good pond management will increase pond productivity and decrease problems. The guidelines are discussed in the following sections:

1. Pond construction and watershed management.
2. Species selection and stocking.
3. Removal of unwanted and overpopulated species of fish.
4. Liming and fertilization.
5. Harvesting and record keeping.
6. Pond balance management.
7. Weed control.

Pond Construction and Watershed Management

Poorly constructed ponds are always difficult to manage. Water levels may fluctuate radically because of pond seepage or inadequate watershed (area that drains rainfall into the pond), or both of these conditions. Aquatic weeds

may grow rapidly in shallow areas. Erosion and contamination from the watershed may make good management impossible. For assistance in pond construction or renovation, contact your local USDA Soil Conservation Service (SCS) Office. The SCS can provide assistance in design, layout and monitoring construction of ponds.

All ponds should be designed and maintained with the following guidelines:

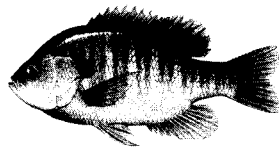
- The dam should have a compacted clay core.
- Soil lining the pond should be a minimum of 30 percent clay.
- Pond size should be matched to watershed area.
- Banks should slope rapidly to a depth of at least 2.5 feet.
- Drains and overflow pipes should be built through the dam.
- An emergency spillway should be constructed for periods of heavy run-off.

Pond leaks caused by poor construction are common. Pond dams must be constructed with a compacted clay core that is trenched into an impervious soil or rock layer below the pond bottom. Trees or other woody vegetation should never be allowed to grow on the dam, because roots will eventually penetrate the core and cause the pond to leak. Drains allow water levels to be regulated for better control of weeds and fish populations, and for easy access to repair or renovate the pond.

Texas ponds generally need 4 to 100 acres of watershed per acre-foot of pond storage. More watershed is required in West Texas and less in East Texas. Soil types, slope and vegetation covering the watershed will affect run-off. Generally, more area is needed if the watershed is wooded than if it is open. If the watershed is too large, a diversion ditch around the pond may be needed to keep the pond from flushing too rapidly.

Aquatic weed growth occurs most easily in shallow water. Pond banks should slope rapidly (2:1 or 3:1 ratio) to a depth of 2.5 feet or more. Aquatic plants do not easily establish themselves at this depth, especially if a good algae bloom is maintained (see Fertilization).

Fields next to ponds should have sod borders. Sod or grass strips 50 to 100 feet wide between the field and the pond reduce soil erosion and pesticide contamination that can kill fish.



Cutting a trench for the clay core of the pond dam.



Species Selection and Stocking

The choice of fish to stock depends on the pond owner's goals and on the resources available. It is very difficult to manage a pond of less than 1 acre for bass and bluegill. If your pond is less than 1 acre, catfish is probably your best choice. See Extension publication B-1319, "Catfish in Farm Ponds," for more detailed information.

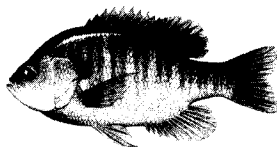
The most common stocking strategy is to combine largemouth bass and bluegill (or largemouth bass, bluegill and redear sunfish). The combination generally works well in ponds larger than 1 acre and provides excellent fishing for both species indefinitely.

The beauty of the bass and 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. The bluegill will reproduce and grow rapidly with the abundant food and provide excellent forage (food) for the bass. If bass are not over-harvested, they will keep the bluegill from overpopulating. Some large bluegill will survive bass predation to provide good bluegill angling.

Channel catfish may also be added to a bass and bluegill pond, but the catfish will consume a portion of the food supply, slightly reducing the total pounds of bass and bluegill the pond can maintain.

Recommended stocking rates in Texas vary with the size, location and condition of the pond and the desires of the pond owner. See "Stocking and Management Recommendations for Texas Farm Ponds," Special Publication No. 1 of the Texas Chapter of the American Fisheries Society, to determine the number and species to stock. The publication is available from the Texas Agricultural Extension Service, Texas Parks and Wildlife Department and USDA Soil Conservation Service. A typical pond larger than 1 acre that will be fertilized should be stocked with 1,000 bluegill fingerlings (or 60 adults), 100 largemouth bass and 100 channel catfish per acre.

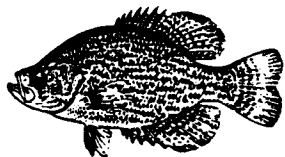
Bass, forage fishes and catfish for stocking new or renovated ponds can be obtained from private hatcheries. Private hatcheries will deliver directly to ponds and can provide fish at almost any time of the year. Many offer varieties or hybrids that have been selected for rapid



growth. Contact your county Extension office for lists of private hatcheries that sell fish in Texas.

Stocking of 3- to 5-inch bluegill is most often done in the fall or early winter. The bluegill will grow and spawn by the following spring. Bass are stocked in late May or June and grow rapidly, feeding on the new bluegill fry. Bluegill will spawn two or three more times before fall, providing adequate forage for the bass. Bass growth should average 1/4 to 1/2 pound in the first year and can approach 2 pounds if forage is plentiful. Catfish can be stocked in fall or spring. If stocked together always stock catfish as large or larger than the bass. Catfish usually cannot successfully reproduce in ponds with bass and bluegill populations and will have to be restocked as they are fished out.

Species that should not be stocked into farm ponds or should be stocked only under certain conditions include crappie, flathead catfish, common carp and green sunfish.



Black Crappie

Crappie (both black and white) may pose management problems in small ponds in that they overpopulate and become stunted at sizes too

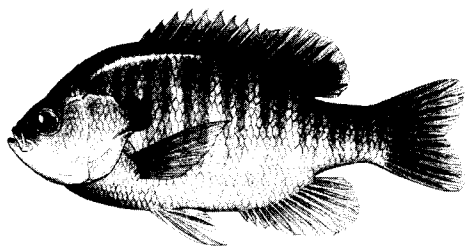
small to be harvested. Under these conditions they compete with both bass and bluegill for food. Crappie can be stocked in larger farm ponds (more than 25 acres), but only after the largemouth bass initially stocked have spawned several times. Also, largemouth bass harvest must be carefully controlled to ensure enough bass in the pond to control crappie numbers.

Flathead catfish are voracious eaters, cannibalistic, and grow large enough to prey on even large bass. Other species that should not be stocked into farm ponds are common carp and bullhead catfish. Common carp can overpopulate rapidly, eat eggs of other fish, compete for food and muddy the pond through their bottom feeding activity. These species also compete for the available food resources and that can affect the survival of desirable fish.

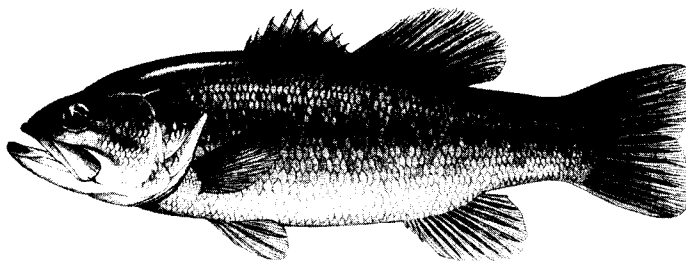
Removal of Unwanted and Overpopulated Species of Fish

Fish populations in poorly managed ponds usually become out of balance and may become contaminated with unwanted fish species. Texas ponds often become crowded with small or stunted bass or bluegill populations

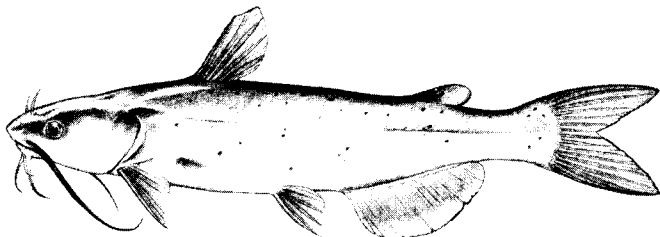
Fish species most commonly stocked in Texas ponds.



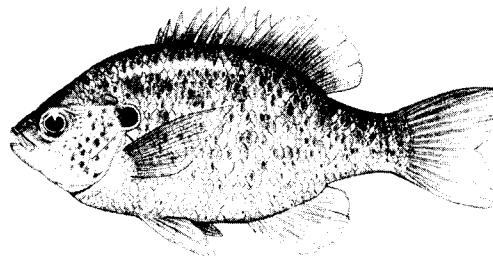
Bluegill



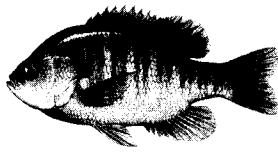
Largemouth Bass



Catfish



Redear Sunfish



or become populated with green sunfish, bullhead catfish, shiners or other unwanted species. The best management option in these situations may be to destroy all fish in the pond and start over. Removing or killing the fish population usually is much easier and less expensive if the pond can be drained dry or partially drained and the fish concentrated. Fish will survive in very small pools or puddles away from the main body of water. To get a complete kill you must treat all puddles, even those in the watershed, no matter how small!

Rotenone is a registered aquatic chemical that is used to kill fish. In Texas, rotenone for pond renovation can be purchased from most farm supply or feed-and-seed stores. You must have a private applicator license to purchase and use this chemical.

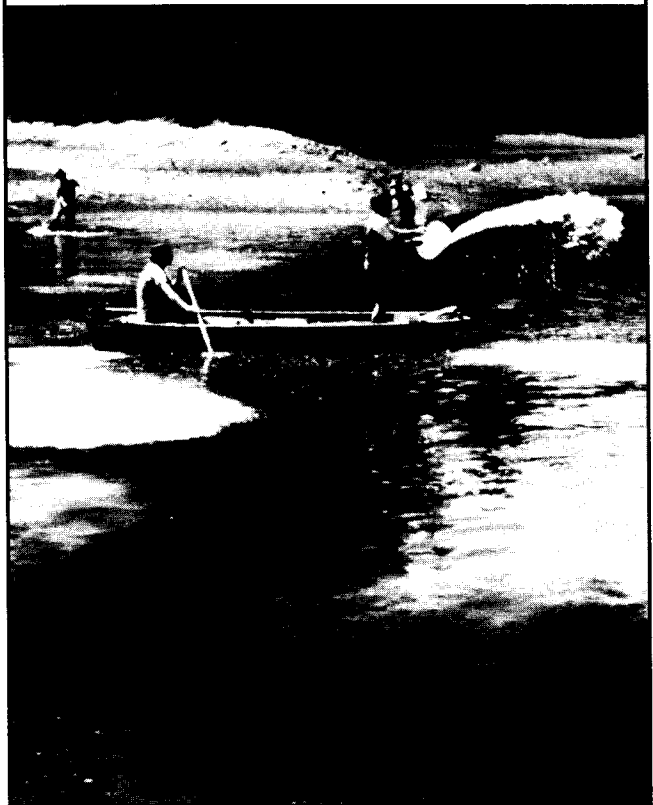
Rotenone comes in liquid or powder formulations, at a concentration of 5 percent active ingredient. Rotenone should be applied at a rate of 10 pounds per acre-foot. The volume of water in the pond (in acre-feet), or that remaining after draw-down, must be estimated so this concentration of rotenone can be calculated. One gallon of the liquid rotenone formulation (5 percent) is sufficient to treat approximately 1 acre-foot. The acre-feet in a particular pond can be calculated by multiplying the surface area in acres times the average depth in feet. For example, a 2-acre pond with an average depth of 6 feet would have 12 acre-feet, and would require 12 gallons of the liquid 5 percent formulation to treat.

Powdered rotenone should be mixed to a "soupy" consistency with water (about 2 gallons per pound of powder). Liquid rotenone also should be diluted with water at a rate of about 10 gallons of water to 1 gallon of rotenone. Apply rotenone evenly over the pond using buckets, sprayers or pumps. If the pond is more than 4 feet deep, use a hose to pump rotenone into deep sections of the pond. Rotenone applied properly and at recommended rates will not harm most livestock, even if they drink the water. Pigs, however, might be affected by the rotenone formulation, and ducks and geese may suffer if they gorge themselves on dead or dying fish. Caution: Make sure no water containing rotenone runs off your property to kill fish elsewhere!

Rotenone is usually applied in the summer or fall when water temperature is above 70 degrees F. Contact a fisheries biologist or county Extension agent for additional information on purchasing and applying rotenone.

Rotenone will dissipate within 3 to 10 days, depending on weather conditions. Generally it is safe to restock 2 to 3 weeks after applying rotenone. To check for the presence of rotenone, place a few small bluegill in a minnow bucket and float it in the pond. If the fish are still alive after 24 hours it is safe to restock.

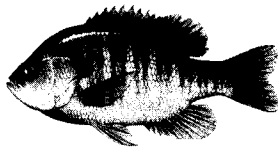
Application of rotenone to kill unwanted fish populations. Pond was partially drained to concentrate fish and reduce risk of run-off.



Fertilization and Liming

Fertilization provides planktonic algae with nutrients for growth, much the same as fertilizing pasture increases grass yields. Proper fertilization increases available food throughout the food chain, thus increasing the amount of fish the pond supports.

Fertilization, however, will not stimulate a good algae bloom if the total alkalinity of the water is below 20 ppm. In East Texas, check the alkalinity of the pond first. If alkalinity is below 20 ppm, add agricultural limestone to neutralize acidity in the soils. Do not use quick or slaked



lime; these will cause a rapid pH change that may kill fish. The amount of lime necessary depends on the characteristics of mud in the pond bottom. A mud sample should be analyzed to determine the amount of lime to add.

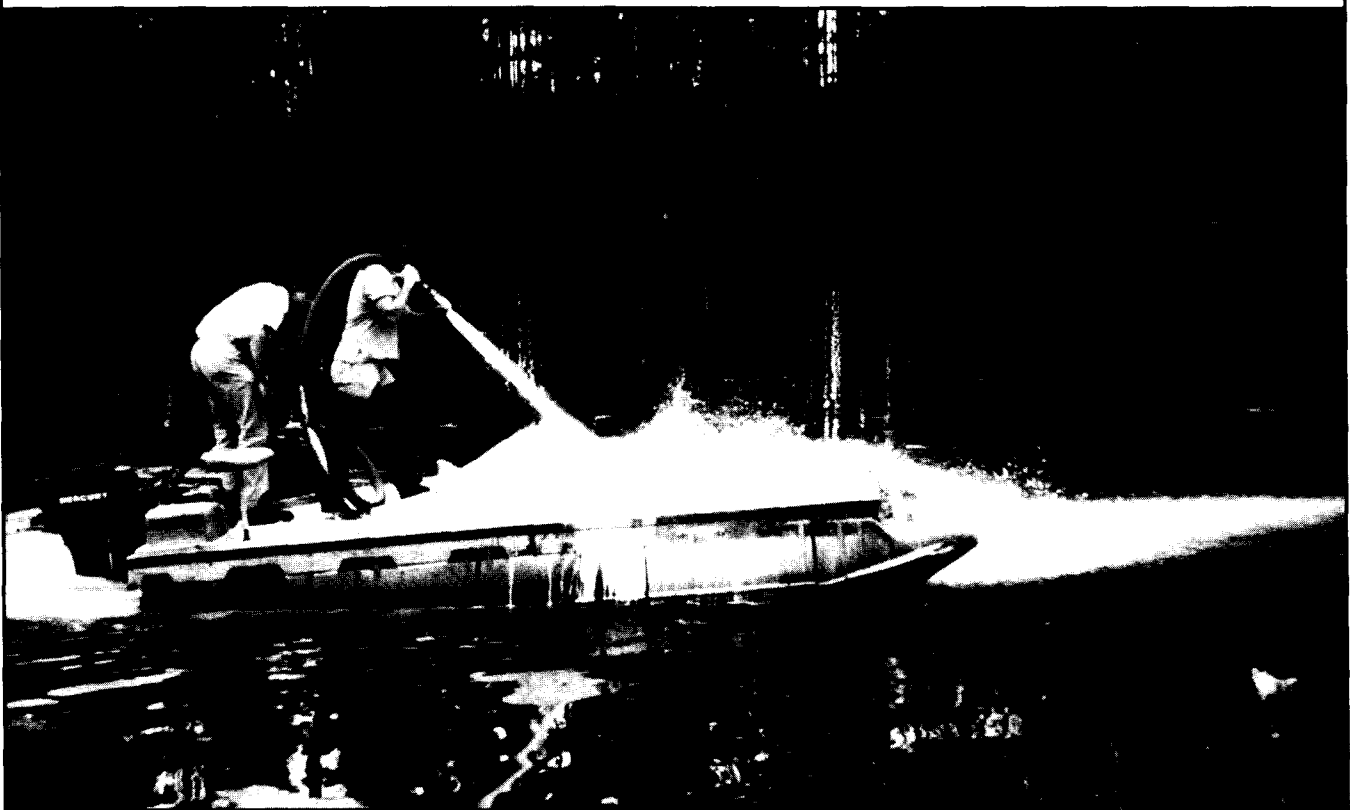
Take mud samples from many places in the pond. Combine these samples and spread them out to dry. After samples are dry, mix them together thoroughly and take one sample for analysis. Send this sample to the Texas A&M University Soil Testing Lab in a soil-test box (available from your county Extension office). Mark the sample "fish pond" so that the proper tests can be run. The analysis will recommend the proper liming rate.

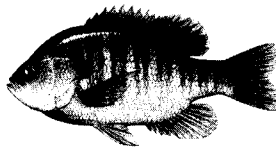
Lime must be applied evenly over the entire pond so that it can react with the bottom mud. If the pond is thoroughly dry, a spreader truck could distribute the lime. If the pond is full, however, the lime will have to be shoveled or washed into the pond from a boat. Several pond management consultants in Texas will lime ponds at a modest cost. Ask your county Extension office for a list of Texas Fisheries Consultants.

Lime slowly dissolves into the pond water and is washed out with overflow water. This means that ponds usually need to be relimed every 2 to 4 years. Many pond managers find it practical to increase the liming rate by one and a half or two times the amount recommended. This increases the length of time between lime applications. Some managers reapply half the recommended lime every 2 years to maintain alkalinity. Adding more than the recommended lime (agricultural lime only) will not harm the pond. A typical liming rate in East Texas is 2 tons per surface acre of pond. Remember, if a pond needs lime it will not respond well to fertilizer.

Fertilizing ponds will increase fish production two- to threefold. Infertile ponds will seldom produce more than 50 to 100 pounds of fish per acre. Well-managed, fertile ponds can maintain 300 to 400 pounds of fish per acre. If, however, the pond is naturally fertile and is not going to receive much fishing pressure, it may not require fertilizer. If the pond receives only minor fishing (or harvest) pressure, do not fertilize or fertilize at only half the recommended rate.

Lime application using a pontoon barge and water pump to evenly distribute the lime.





Once fertilization is started it should be continued. If fertilization is stopped the fish will be stunted because of the reduced food supply. This makes them more susceptible to disease.

Not all fertilizers work well in ponds. Phosphorus is the nutrient most needed in ponds. Given time, the phosphorus will be absorbed and trapped in the mud of the pond through chemical processes. Once trapped, it is not available to planktonic algae but can promote the growth of weeds and filamentous algae. Nitrogen is seldom needed in older ponds. Occasionally, new ponds need nitrogen, but once a pond is established nitrogen usually is abundant.

Fertilizers are labeled with N-P-K ratios or percents of nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O). The equivalent of 8 pounds of granular—4 pounds of liquid—phosphorous per acre per application is commonly recommended. Liquid fertilizers can be easier to apply and may produce blooms quicker than granular fertilizers. Table 1 lists recommended rates for commonly available fertilizers.

Table 1. Recommended Fertilization Rates for Ponds.

| Fertilizer formulation | Amount/acre/application |
|------------------------|-------------------------|
| Granular | |
| 20-20-5 | 40 lbs. |
| 16-20-5 | 40 lbs. |
| 18-46-0 | 18 lbs. |
| 0-46-0 | 18 lbs. |
| Liquid | |
| 13-38-0 | 1 gal. |
| 10-34-0 | 1 gal. |

A simple method of knowing when to fertilize is based on water clarity. The depth that light can penetrate into the pond is a measure of the algal density or bloom. Light penetration can be measured using a Secchi disk. A Secchi disk can be made from an 8-inch diameter disk of plywood, metal or plastic. Mark the disk into quarters and paint the two opposite quarters white and black, respectively. Attach the disk to a yardstick or to a pole marked at 12, 18 and 24 inches from the disk.

The optimum algae bloom is one that allows light to penetrate to a depth of 18 to 24 inches. Submerge the Secchi disk into the pond until it just disappears and note that depth. Follow Table 2 as a guide to fertilization.

Table 2. Recommendations for Fertilization and Management Based on Secchi Disk Readings.

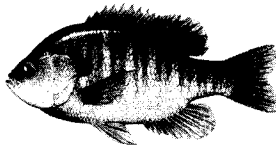
| Secchi Disk Reading | Recommended Management |
|------------------------|-----------------------------------------------------------------------|
| Greater than 24 inches | fertilize |
| 18 to 24 inches | good bloom - do nothing |
| 12 to 18 inches | dense bloom - watch closely |
| 12 inches or less | bloom too dense - determine source and be prepared to aerate at night |
| 6 inches or less | oxygen depletion imminent |

If the Secchi disk disappears between 18 and 24 inches there is no need to fertilize. It is time to fertilize again if the disk visibility is increasing rapidly toward 24 inches or if the disk is visible past 24 inches. If the disk disappears between 12 and 18 inches, the bloom is too dense; do not fertilize and watch the pond closely. If the disk disappears in less than 12 inches, the bloom is very dense and a severe oxygen depletion could occur. Remember, do not consider low Secchi readings that are the result of muddiness rather than algae.

A Secchi disk reading of 12 inches or less means the pond is too rich in nutrients. At that point you need to determine where excess nutrients are coming from. Have you over-fertilized? Are livestock manures or crop fertilizers entering the pond? If you are feeding the fish, are you overfeeding? Try to discover the source of the problem. Dense blooms can consume most of the pond's oxygen at night. Be prepared to aerate at night if the visibility is low and there are consecutive days of cloudy weather.

Granular fertilizers should not be broadcast into the pond. Granules will sink to the bottom and the phosphate will be absorbed directly into the mud and lost. Granules should be placed on a platform or in a permeable sack that is submerged about 12 inches underwater. Usually one platform is needed for every 10 surface acres of pond. Place the platform in an area of the pond that has wave action. Granules placed on the platform dissolve slowly, spread throughout the pond by water currents and stimulate a bloom.

Liquid fertilizers are dense and must be diluted with water before applying them or they will sink to the bottom and be absorbed into the mud. Dilute liquid fertilizers about 10 to 1 (water to fertilizer) and spray, splash or mix them into the pond. Apply fertilizer mixture as evenly as possible over the pond surface.



A Secchi disk can be used to determine when to fertilize.



Fertilization should begin in early spring. This first fertilizer application does not always stimulate a bloom. Continue to fertilize at 2- to 3-week intervals until the pond blooms green. Once a bloom is established, fertilize as necessary to maintain it. Use the Secchi disk guide in Table 3 to help make fertilization decisions. Continue fertilizing until late October.

One important word of caution: Do not fertilize ponds that are infested with aquatic weeds. The fertilizer will only stimulate growth of the weeds. Control weeds before fertilizing. Establishing a good fertilization program before weeds appear is one of the best methods of weed prevention.

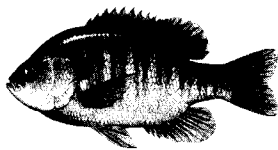
Ponds that are flushed by large volumes of water will lose fertilizer more rapidly and may not sustain a bloom. In this case fertilization is usually ineffective and should be discontinued unless the excess water can be diverted (see Pond Construction). Many ponds will flush repeatedly in winter and early spring but respond well to fertilization in late spring, summer and fall.

Muddy ponds (12 inches or less visibility) usually will not respond to fertilization. Several methods have been used to clear muddy ponds; however, in most cases, the addition of lime to reduce acidity will settle a muddy pond.

Harvesting and Record Keeping

Improper harvest of largemouth bass ruins future fishing in more Texas ponds than any other cause. Pond owners and other anglers frequently overharvest the bass population in the first season of fishing. This allows bluegills to overpopulate in the pond. In some established bass populations, bass harvest is too low to remove a surplus of bass less than 12 inches long.

A pond owner can reduce the likelihood of bass overharvest by making his pond off limits to everyone. This practice is, however, not encouraged because underfishing can lead to almost as many problems as overfishing. Although the pond owner controls access to his pond, he should not deny entrance to a responsible sportsman asking permission to fish if he follows a few simple regulations regarding catch and release of certain sizes of fish. The pond owner should encourage all anglers to record their catches by species and size. This recordkeeping system provides an estimate of the size composition and relative abundance of game species over time.



Largemouth bass growth rates are influenced by a number of factors including genetics, water quality, habitat and forage availability. Statewide average growth rates for bass have been calculated: Age I - 8 inches; Age II - 12 inches; Age III - 15 inches; Age IV - 17 inches; and Age V - 18 inches. The most sensible way to prevent bass overharvest is to establish a 15-inch minimum length limit for a period of 3 years after stocking. If those who fish the pond abide by the restriction and release all bass less than 15 inches, the pond should begin producing good fish of all species. The bass that were originally stocked will have to support the majority of the catch for 3 years, so they have to be used wisely.

After 3 years a decision must be made. The decision will depend upon what kind of fishing is desired. Bass will have reproduced two or three times during this 3-year period and there may be a surplus of young bass. If unharvested, poor growth rates occur because of excessive competition. The result will be a bass population comprised primarily of individuals less than 12 inches long. All these small bass will effectively control bluegill numbers and the pond will have plenty of 7- to 8-inch bluegills.

If the pond owner is interested in catching bass more than 12 inches long, 8- to 12-inch bass must be harvested. About 25 8- to 12-inch bass (weighing 10 to 15 pounds) should be harvested per acre each year after the third year from stocking. The removal of these small bass reduces competition and allows some fish to attain lengths of 12 inches.

To keep bluegills in good condition, incorporate a "slot limit" where 12- to 15-inch bass are released from the third

year on. Releasing bass of this size will also ensure that some bass will grow to more than 15 inches.

If bass have not been harvested properly, the fish community may have to be adjusted. It is likely that bass overharvest has occurred if primarily 3- to 5-inch bluegills and few or no bass are caught. This problem can be rectified by stocking 40 8- to 12-inch bass per acre. Bass less than 15 inches long should be released until small bass become abundant. Then, bass less than 12 inches and more than 15 inches long can be harvested.

If only small bass and few bluegills are caught, harvest of bass has not been adequate. In this case, 30 3- to 5-inch bluegills should be stocked per acre. Approximately 25 8- to 12-inch bass should be harvested per acre each year thereafter. Again, 12- to 15-inch bass should be released. Bass larger than 15 inches should be released if "trophy" bass are the goal.

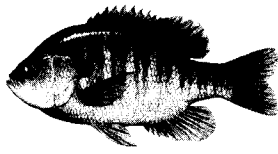
When a decision is made to stock a pond with limited numbers of larger bass and bluegills rather than fingerling fish, the few bass must be returned to the pond and carefully protected. One cannot afford to lose the few original fish.

Begin catfish harvest whenever the fish reach an edible size. Catchable size catfish should be checked for body condition. If it seems that many catfish caught are "skinny" it could be an indication of poor body condition caused by overcrowding (corrected by increased harvest) and/or inadequate food supply (corrected by increased feeding frequency).

Catch records are important for determining when supplemental stocking of catfish is needed. In catfish-only ponds, at least one-half of the original fish should be caught before restocking. Total weight of catfish in these ponds should not exceed 1,000 pounds per surface acre during the warm months to decrease the risk of fish losses from oxygen depletions. In ponds where catfish were stocked in combination with largemouth bass and forage species, occasional restocking may be necessary to maintain catfish populations over time. In these ponds, restock catfish at least 8 inches in length at the rate of 50 to 100 per surface acre at 2- to 4-year intervals. However, the total weight of catfish in "combination" ponds should not exceed 250 pounds per surface acre in order to decrease potential competition for food between species.

Plump bass (top) is in good condition, while skinny bass (bottom) is in poor condition and suggests "bass-crowded" pond.





Evaluation of Pond Balance

Managers should assess fish populations in ponds every 1 to 2 years. More detailed information is given in "Assessment and Corrective Management for Fish Populations in Small Impoundments," Special Publication No. 2 of the Texas Chapter of the American Fisheries Society. Private fisheries consultants also can evaluate fish populations.

Pond balance can be checked by using a 15-foot minnow seine (1/4-inch mesh). The best time to check is early June. Seine several (at least three) shallow areas of the pond that are clear of brush and weeds. Allow the seine to arch or cup slightly as it is pulled, so that fish cannot easily swim around it. Samples from seining provide information on reproductive success and the presence of unwanted species.

Sampling with a 30-foot or larger (1/2- to 1-inch mesh) seine will provide further data for evaluating pond balance. Seine one or two 50-foot areas in the pond. Record the number of bluegill captured in groups: less than 3 inches; 3 to 5 inches; and longer than 5 inches. Also look at bass condition (that is, plumpness) and for unwanted species.

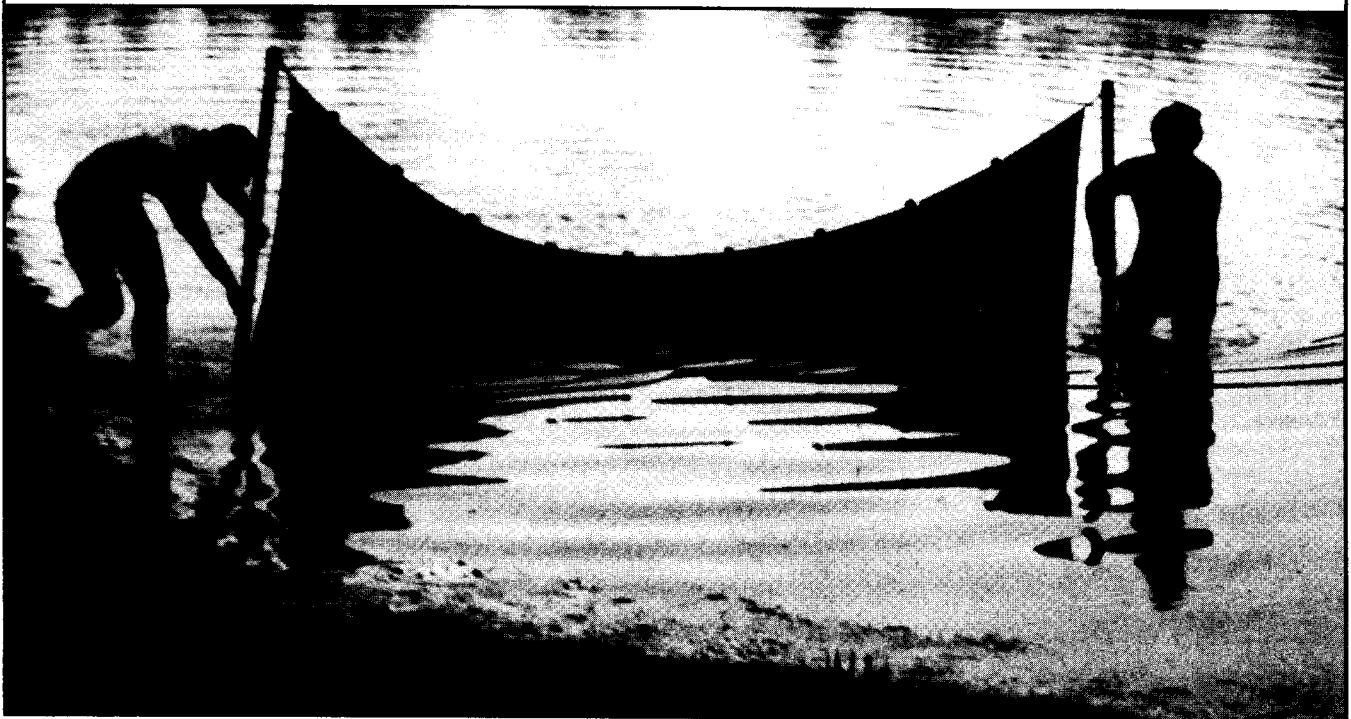
Refer to Table 3 to analyze pond balance from seine and catch data.

If fishing is adequate and seine data show both young bass and recently hatched bluegill fry, the pond is probably in balance. If no young bass and bluegill fry are found but many 3- to 5-inch bluegill are caught, your pond is probably out of balance. If you find undesirable species, it is time to poison and restock.

A balanced pond means that bream are available and abundant in sizes that allow for bass predation. As a bass grows it preys on larger bream.



Seining a pond in early June to check pond balance.



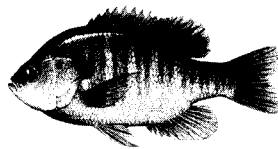


Table 3. Evaluation of Pond Balance Using 15-foot Seine and Catch Data.

| Type of Fish Caught | Conclusion | Recommendation |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Seine Data— small and intermediate bluegill and young of the year (YOY) largemouth bass Angler Catch Data— bass and bluegill of various sizes | fish populations in balance | no additional management necessary |
| Seine Data— many intermediate bluegill and few or no young of the year bass Angler Catch Data— few harvestable size bluegill; large bass | bluegill-crowded | remove intermediate bluegill by shore line rotenone in fall or stock 20-30 adult ($\geq 12"$) bass per acre |
| Seine Data— few intermediate bluegill; many recently hatched bluegill Angler Catch Data— bass, numerous but small and thin; bluegill, few but large and robust | bass-crowded | remove 50-75 (35 lbs.) bass per acre stock 200, 3-5" bluegill per acre |
| Seine Data— unwanted species, no recent bluegill hatch, few intermediate bluegill Angler Catch Data— few harvestable size bluegill and unwanted species (crappie, bullhead, green sunfish, shiners, etc.) | fish populations dominated by unwanted species | rotenone and start over |

Weed Control

Aquatic weeds are a common problem in farm ponds, although some aquatic vegetation might be good for the pond. Rooted aquatic vegetation does provide habitat for small aquatic animals, which adds to the food chain. Vegetation also provides small fish with places to hide from larger predators. The problem with weeds is uncontrolled growth. If too many weeds become established in the pond, too many small fish survive (overpopulate) and predators become thin because they are not able to prey on the forage species. Large growths of weeds also remove nutrients, which reduces algae production (food).

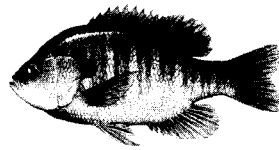
Aquatic weeds can be controlled by manual, chemical and biological means. Manual control of species such as cattails is practical when they first start to colonize a pond. Woody vegetation along the dam also can be controlled manually.

Chemical control with herbicides is possible but few herbicides are approved for aquatic use and the type of aquatic vegetation must be accurately identified before it is treated. Herbicides can kill planktonic algae, which

leads to oxygen depletion. Oxygen depletion after herbicide treatment is particularly common in hot weather, if the pond is heavily infested with weeds, or in both conditions. Check with a fisheries biologist or your county Extension agent for plant identification information and current herbicide recommendations. When using chemical pesticides, protect yourself and others by strictly following all label directions.

The simplest and most economical long-term aquatic weed control method for aquatic weeds such as duckweed, hydrilla, pondweed and milfoil is to stock sterile triploid grass carp. The grass carp, or white amur, is an Asian carp brought to this county, for aquatic weed control. Grass carp consume vegetation almost exclusively after they reach 10 inches in length. They will not reproduce in the pond, will not muddy the pond like common carp, will not disturb the nests of other fish, and they consume 30 to 40 percent of their body weight in weeds every day during warm weather.

The use of grass carp is regulated by the Texas Parks and Wildlife Department. Contact the Department or your



county Extension office for information on required permits, stocking rates and lists of available sources.

Grass carp grow rapidly and will control most underwater weeds if stocked at recommended rates.



Turn-Overs

Many of the basic problems of farm pond management have already been discussed. These include how to maintain a good food supply for the fish, how to harvest to maintain a balanced population, how to check balance, how to control weeds and how to avoid fish kills from algae bloom die-offs. These are not simple problems. Ponds are complex systems that take understanding and commitment to manage properly.

One common problem in Texas is pond "turn-over." Turn-overs occur when ponds are stratified; that is, surface water is warmer than the water below and the two layers no longer mix. This causes the cooler water near the bottom to stagnate and become depleted in oxygen. Fish avoid this layer of water. A turn-over occurs when the warm upper layer suddenly cools and mixes with the stagnant layer. The two layers mixed together may not have enough oxygen to support fish and they die. This usually occurs after a cold, hard rain. If a turn-over occurs, quick aeration may save the fish. Similar fish kills also can be caused by oxygen depletions from a bloom die-off or rotting vegetation from herbicide treatment.

Enhancement Strategies

Many techniques can be used to enhance fishing in ponds. Some of these include stocking fathead minnows for forage, constructing fish shelters, providing supplemental feed for fish, manipulating water level, aerating and destratifying.

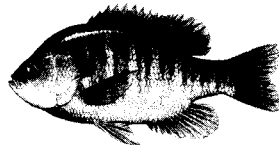
Fathead minnows stocked at about 1,000 per acre the first year of a new or renovated pond will improve bass survival and growth. Fatheads should be stocked in February or March before the bass are stocked in June. Fatheads will spawn and produce abundant forage for the young bass. Bass will eliminate the fatheads within a few months and then turn to bluegill for forage.

Fish shelters or "attractors" can be made from many different materials (Figure 2). The purpose of a fish shelter is to provide a place for some small fish to escape predation and attract fish for anglers. These structures should be at a depth of 2 to 6 feet. Discarded Christmas trees and cedar trees make excellent shelters if anchored to the bottom. Stake beds (stakes driven into the bottom), rock piles and tire reefs are also good shelters. Usually only one reef is placed for every 1 to 3 acres, and no more than three per acre.

Supplemental feeding of commercial fish feeds increases bluegill and catfish growth. Bass do not readily consume artificial feeds but benefit from the increase in bluegill reproduction. Feeding can double the average size of harvestable fish and total pond production (up to about 600 pounds per acre). Fish can be fed throughout the warm months of the year, but best results are obtained by feeding from March through May and October through November when most bluegill growth occurs. Feed three or four times per day if possible. Feed in the same area and at about the same time of day. Feeding can be done by hand or with demand or automatic feeders. Floating feeding rings to contain the feed can be made from PVC tubing anchored in place. Provide one feeding station for every 3 acres of pond.

The protein level of the feed is not very important. Studies have shown that low protein feed (25 percent) will produce excellent growth. Therefore, it is not necessary to purchase high protein feed.

It is very important not to overfeed. A good rule of thumb is to feed all the fish will eat in 10 to 15 minutes, but not more than 10 pounds per acre per day. Winter feeding is not necessary but may increase bluegill growth. Feeding is expensive and can be justified only when there is an obvious need to increase production above that which can be supplied by fertilization and controlled harvest. Feeding stimulates plankton blooms in the same way as fertilization; thus, fertilization is usually unnecessary if feeding is done regularly. If feeding is not done on a regular basis it may be necessary to fertilize. Use the Secchi disk to determine if fertilization is needed (see Fertilization).



Ponds with drains have distinctive management advantages. Water level can be drawn down several feet (2 to 3) in late fall through mid-winter. This helps control aquatic weeds by exposing them to drying and freezing. Draw-downs also concentrate the fish, making forage fish more available to the bass. This increases bass growth and reduces bluegill overpopulation. The pond should be allowed to refill in February and March.

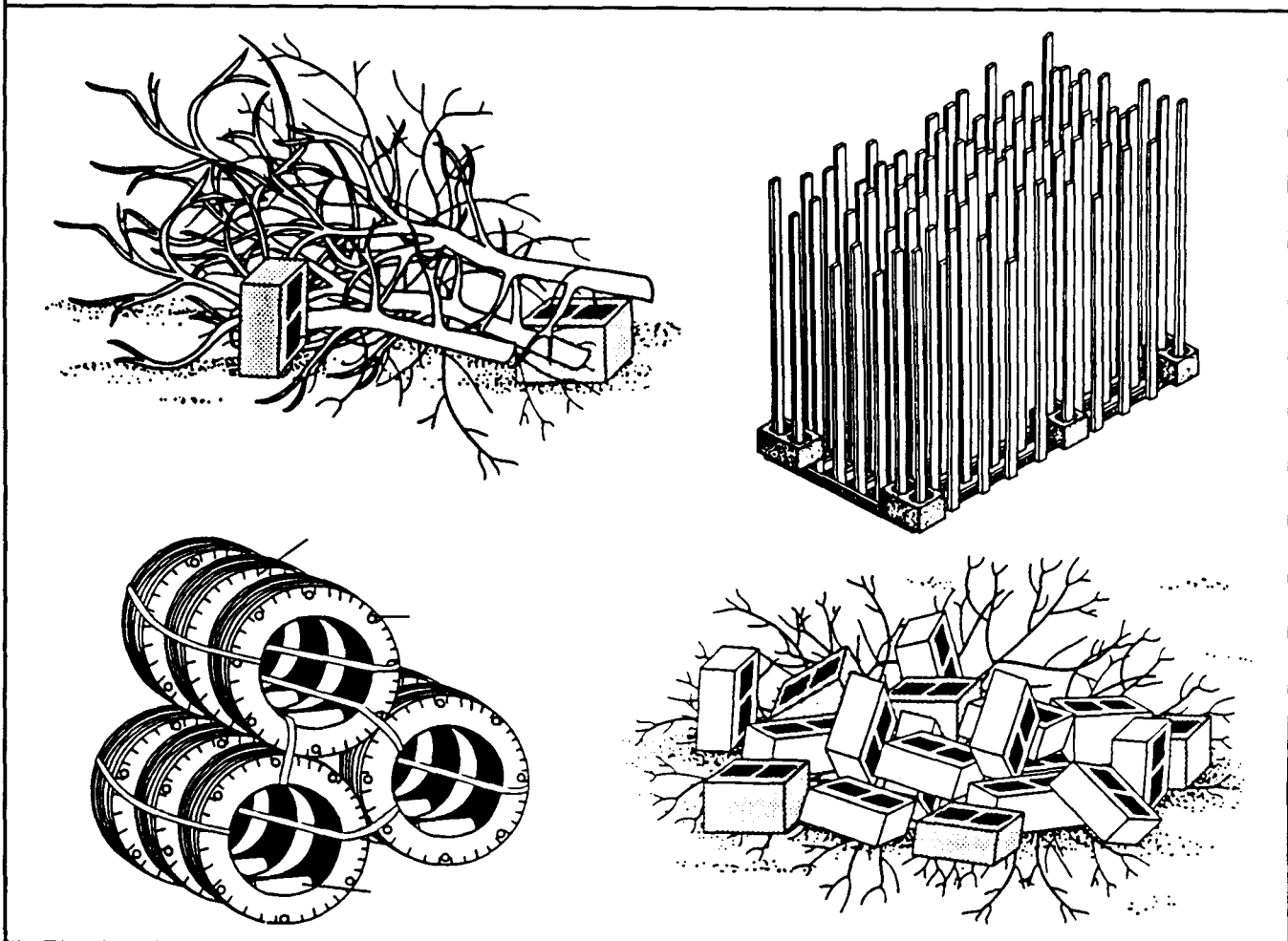
Ponds that have a history of fish kills will benefit from aeration or destratification (if deeper than 8 feet), or both. Many types of electric aerators are available. Supplemental aeration requires approximately 1/2 to 1 horsepower of aeration per surface acre of pond. If a turn-over or bloom die-off occurs additional aeration may be necessary.

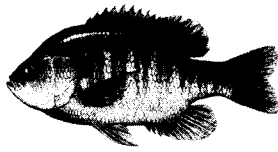
Destratification, or the mixing of the pond to stop thermal layering, can be done using blowers, underwater fans and

propeller aspirator type aerators. Each of these devices has advantages and disadvantages. Destratification will eliminate the chance of a fish kill caused by a turn-over and increase the area of the pond inhabited by the fish during the summer months. Destratification does alter algae blooms and may aggravate low oxygen problems during periods of overcast weather. For additional information on aeration and destratification devices, contact your county Extension agent or fisheries specialist.

Fish also can be encouraged to spawn where you want them to by providing them with a good spawning substrate. Place sand and gravel beds in several locations around the shoreline in 2 to 5 feet of water. The sand and gravel should be 4 to 6 inches deep and can be contained in a frame or box if the bottom is particularly silty. These beds allow the pond owner to concentrate seining efforts in areas where spawning should have occurred.

Figure 2. Reefs used as fish attractors.





Wildlife Enhancement

Wildlife, both game and nongame, require food, water and shelter to survive. If managed properly, ponds can provide fishing while at the same time providing food and shelter for a variety of wildlife species. Figure 3 depicts how the upper reaches of a pond can be managed for wildlife, while the lower areas adjacent to the dam have the characteristics of a typical fish pond. No more than half of the pond area should have water less than 2 feet deep. Ideally, the pond should be constructed so that the shallow areas can be dried by draining during May through October. Draining exposes an area of mudflats. In the mudflats natural vegetation may grow or specific plants can be planted. These mudflats are then flooded in the fall and provide habitat and a food source for ducks and other waterfowl. Draining and flooding can be accomplished by fitting the standpipe with two valves, one to drain the pond completely and the other positioned to drain only the upper reaches of the pond. Nesting boxes placed in the pond can provide artificial nesting cavities for wood ducks.

Ponds are watering sites for a variety of wildlife species. Cleared and sodded shorelines (15- to 20-foot wide) provide an unobstructed view of the pond and attract mourning doves and other bird species. Or, the shoreline can be planted with native trees and shrubs that provide seeds and fruits for wildlife to eat.

Wading birds, aquatic reptiles and amphibians are a natural part of any pond. These animals can provide many hours of enjoyment to those who have the opportunity to watch them.

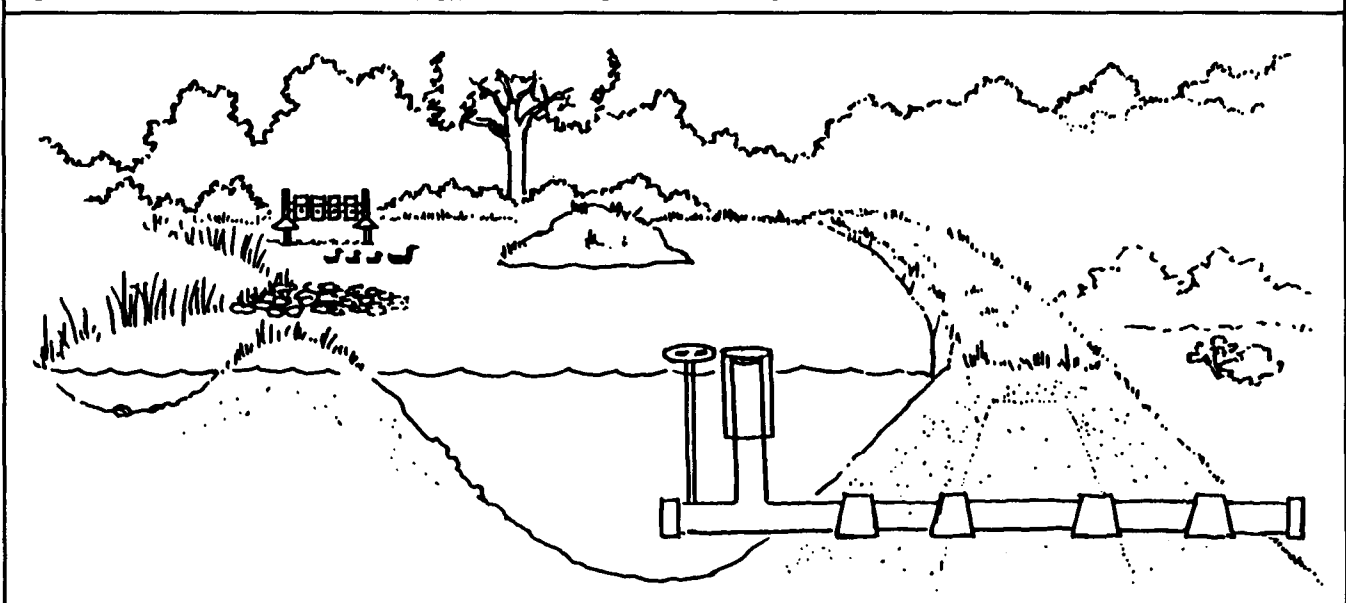
Whether it is waterfowl to be hunted or nongame species to be watched, wildlife can enhance the recreational benefits of ponds. Contact your county Extension office for more information on maximizing wildlife around a pond.

Summary

Small farm ponds are not mother nature's creations; they are the work of human beings. They must be managed to be productive and provide good fishing. Think of a pond as you would a garden or orchard. It must be properly laid out, fertilized, planted (stocked), weeded, pruned (in this case selectively harvested) and protected from climate-related catastrophe (for example, turn-overs) in order to be bountiful. All of this takes time and effort, but the rewards are outdoor recreation and good food.

All fishing should be recorded (see Table 4). Write in the number of fish caught under the various species fished for, or zero if none were caught. One person should initial each entry in case further information is needed.

Figure 3. Shallow areas attract wildlife (top), while deeper pond areas are typical fishing pond.



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