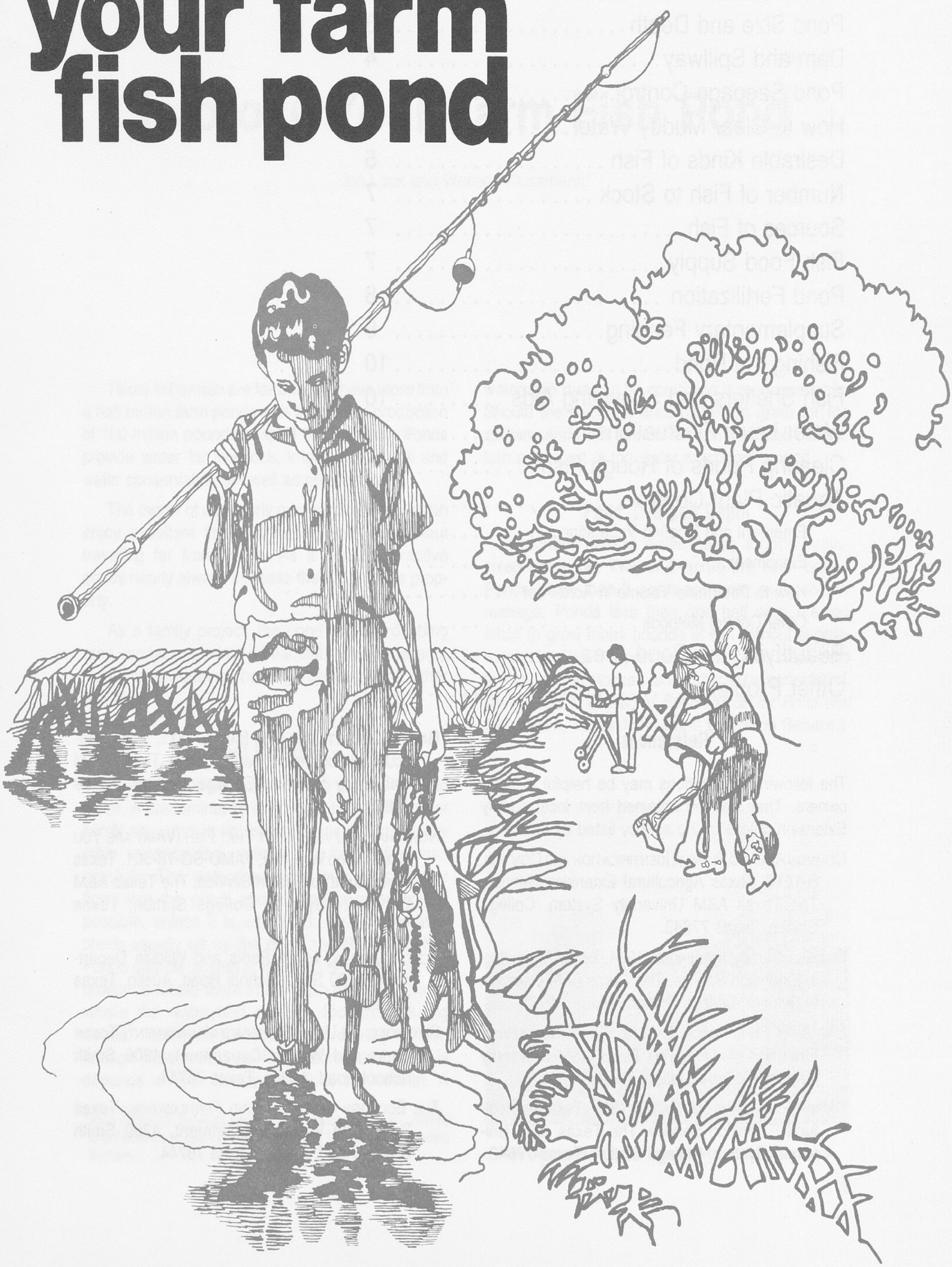
B-213

improve your farm fish pond



Texas Agricultural Extension Service • The Texas A&M University System • Daniel C. Pfannstiel, Director • College Station, Texas

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References

The following publications may be helpful to pond owners. They can be obtained from local county Extension offices or the agency listed by each.

COMMON AQUATIC PLANTS, IDENTIFICATION AND CONTROL, B-1018, Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas 77843.

CHANNEL CATFISH FARMING, B-1024, Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas 77843.

CATFISH IN FARM PONDS, B-1319, Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas 77843.

RAISING FISHWORMS FOR BAIT, L-1310, Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas 77843.

RAISING CRICKETS FOR FISH BAIT, L-1311, Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas 77843.

NOW THAT YOU'VE CAUGHT THAT FISH (WHAT ARE YOU GOING TO DO WITH IT?), TAMU-SG-76-501, Texas Agricultural Extension Service, The Texas A&M University System, College Station, Texas 77843.

POND PLANNING, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

ROTENONE: ITS USE IN FISHERIES MANAGEMENT, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

THE ECOLOGY OF FARM POND FERTILIZATION, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

Improve Your Farm Fish Pond

Joe Lock and Wallace Klussmann*

Texas fishermen are fortunate to have more than a half million farm ponds with a potential production of 100 million pounds of sport fish annually. Ponds provide water for livestock, irrigation and soil and water conservation, as well as recreation.

The owner of a properly managed farm pond can enjoy excellent fishing for food and fun without traveling far from home. As a bonus, attractive ponds nearly always increase the value of the property.

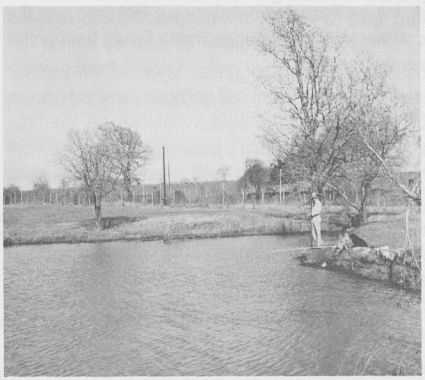
As a family project, the pond and surrounding area can be made into a beautiful recreational area providing swimming, boating, camping and other activities.

Pond Location

Ponds should be located where the soil will hold water. A predominantly clay soil is best. Gravelly or sandy sites should not be used unless bentonite or other water-sealing material can be applied successfully. The watershed (area over which water flows into the pond) should have a grass sod, if possible, unless it is woodland. Cultivated watersheds usually silt up the pond and shorten its life. Ponds may be located at the head of a draw, but it is unwise to locate them in the main bed of a stream where the watershed may be too great during floods. Twenty-five to 50 acres usually furnish enough watershed area for an acre pond, but this depends on the annual rainfall of the section. A watershed that can be controlled is more desirable. Should the drainage area prove too great for the spillway and dam, control terraces may be used to turn away part of the water entering the pond.

Pond Size and Depth

A surface acre of water makes a good family-sized fish pond. Two or 3 acres are even better. Ponds larger than 3 acres are more expensive to manage. Ponds less than one half acre are too small to grow many pounds of fish without supplemental feeding. If a pond is less than a surface acre in size, catfish stocked alone should be considered. (See B-1319, *Catfish in Farm Ponds for Food and Recreation,* Texas Agricultural Extension Service.)



The pond can be made into a family recreational area.

*Area Extension fisheries specialist (Overton) and Head, Wildlife and Fisheries Sciences Department, The Texas A&M University System.

The depth of the pond should range from shallow to deep. The pond should be about 3 to 5 feet deep around the margin or water's edge when full. This provides for evaporation during the summer. This depth also will permit fishing at the water's edge and assist in controlling weeds, mosquitoes and "mosses" around the margin of the pond. Water deeper than 5 feet does not increase fish production, but may be necessary to prevent the pond from going dry during drouths.

Dam and Spillway

The soil where the levee will be should be cleaned to clay first to obtain a seal between the levee and the clay soil. Remove roots and plants. Allow nothing in the dam that will decay and weaken it.

The core of the dam should be filled with clay soil removed from the excavation. The clay core should meet with clay at the base of the dam. The dam on the water side should have at least 3 feet of slope to every foot in the height of dam, and a two-to-one slope on the back side.

The crown or top of the dam should be 5 feet wide plus one-fifth the height of the dam. Thus, a dam 15 feet high should have a crown at least 8 feet wide.

The spillway should be wide enough to accommodate maximum flood waters. Few fish will escape over wide spillways with shallow overflows. Those that escape usually are small and the loss of a few small fish will help prevent overstocking. The screening of a properly constructed spillway is not necessary. In fact, it may prove dangerous to the dam during floods if screens become choked with brush or other trash. Dropped inlet structures or drains, as illustrated below, or a 4-foot drop over the spillway will prevent undesirable fishes from entering the pond.

Since all ponds eventually need draining, a drain pipe should be provided through the dam at construction time. Pour a concrete water seal or install a steel collar around this pipe in the center of the dam to prevent seepage. Close the end and drill or torch cut sufficient holes in the projecting portion of the pipe to allow intake of full water capacity.

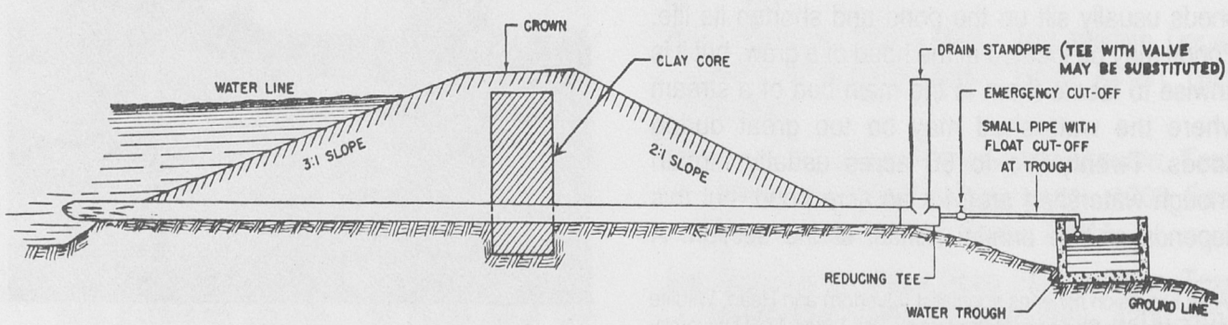
The bottom of the pond at the point where the drain pipe projects into the lake should be the lowest point. When the pond is drained, fish collect at this point. The water level can be lowered for weed control or the pond drained by tilting over the standpipe on the outside of the dam. Fence the pond and water livestock at a trough below the dam. Water may be piped through the dam and the supply controlled by a float in the trough.

Pond Seepage Control

Stopping water seepage is a problem in certain areas. If the pond is located over substrata of gravel and coarse sand, seepage is so great that the pond will not hold water. Gradual seepage from new ponds when first filled may cease after silt has had time to settle and blanket the bottom. Sometimes it is necessary to drain and rework the bottom of the pond.

Feeding fish daily may reduce seepage. The exact mechanism of this process is unknown. The increased accumulation of organic material on the pond bottom from solid fish wastes and phytoplankton probably aids sealing.

Bentonite, a soft, porous, moisture-absorbing mineral clay, is an excellent product to seal seepy ponds. (Bentonite products are sold under several trade names in coarsely crushed and powdered form in 100-pound bags, by the ton or car lot.) One hundred to 150 pounds of the bentonite powder will cover adequately 100 square feet of the bottom of the pond. When worked into the soil and upon



Cross section of dam showing water trough and drain lines. Turn drain pipe down to lower water level or drain the pond.

contact with water, it swells to many times its original size and stops seepage by filling in between the soil granules.

Before applying bentonite, drain the pond area to be sealed and let it dry. Fill holes and crevices and remove large stones, rocks and roots. Plow or disc to a depth of about 6 inches. Level the area and mark it off in squares of 100 square feet. Spread 100 pounds of bentonite product evenly over the surface of each square and rake or disc it to a depth of 3 to 4 inches. Roll the area several times to pack the surface. Then the area is ready again for flooding. Your county Extension agent may have additional information.

Certain salt compounds can be used to seal ponds in certain clay soils where seepage is a problem. The salt helps break down soil granules, thus forming a more impervious pond bottom. Contact your local Soil Conservation Service or county Extension office for further information on the value of this practice in your locality.

How to Clear Muddy Water

Muddy pond water is often a problem because it inhibits growth of natural fish foods and is not aesthetically pleasing. It is not a problem in ponds where fish are fed, since turbidity reduces oxygen-depleting aquatic vegetation.

The first step in clearing ponds is to inspect the watershed and shoreline for erosion. Grass sod should be established on bare areas. Rocks or other rip-rap material should be placed on shorelines of larger ponds if eroded by wave action.

In ponds that remain muddy without apparent cause, negatively charged clay particles continue to repel each other so they do not settle. Adding positively charged particles causes coagulation and precipitation of the clay particles.

Alum (aluminum sulfate) is effective in clearing ponds but must be used with caution in acid waters of east Texas. Hydrated lime (calcium hydroxide) can be used to clear acid ponds but can harm fish if too much is used. Agricultural limestone will clear most ponds in east Texas or ponds in lime deficient soils. Excessive amounts of agricultural lime are not harmful to fish or other aquatic life. Gypsum (calcium sulfate) is also relatively safe but requires larger applications.

To avoid danger to fish from large shifts in pH caused by excessive alum or hydrated lime, test the water for pH and total alkalinity before treatment. Submit a sample to an Extension fisheries specialist if testing is not locally available.

A treatment similar to one of the following will be recommended.

- If the alkalinity is below 30 parts per million (ppm) (many east Texas soft waters), broadcast 2 tons of agricultural lime per surface acre. If the pond has not cleared in 2 weeks, treat with 27 pounds of alum and 12 pounds of hydrated lime per acre-foot. Repeat the treatment in 2 days if the pond remains muddy.
- If the total alkalinity exceeds 30 ppm, treat with 27 pounds of alum per acre-foot of water. Repeat the treatment in 2 days if needed. Add 12 pounds of hydrated lime with the alum if a third treatment is necessary.

Increases in organic matter normally will decrease turbidity. Organic matter can be increased by using organic or inorganic fertilizers. Hay, about ½ to 1 ton per surface acre, can be effective. Turbidity in new ponds can be reduced by sodding the entire bottom and dam, before filling.

Desirable Kinds of Fish

The choice of fish to be stocked depends on the goals of the pond owner and the method of management. The fish stocked most commonly in farm ponds are channel catfish, blue catfish, largemouth bass, bluegill, redear and forage fish.

The channel catfish is rapidly becoming the number one pond fish in Texas. It does well if stocked alone or in combination with bass and sunfish, and will not reproduce if bass or sunfish are present. Do not stock forage species other than fathead minnows if maximum growth is desired, because sunfish compete with catfish for food. Catfish should be stocked in the fall if bass are to be stocked the following spring, or anytime if stocked alone. However, handling fish in hot weather should normally be avoided. Large fingerlings (7 to 10 inches long) must be used if catfish are stocked in a pond containing bass. Blue catfish also do well and attain a larger maximum size than channel catfish, but the fingerlings are not as readily available. (See B-1319 *Catfish in Farm Ponds for Food and Recreation,* Texas Agricultural Extension Service for more detailed information on stocking and rearing catfish in small ponds.)

Largemouth (black) bass, a satisfactory predator fish and an excellent sport fish, should be stocked during the first spring after construction or renova-

tion of the pond. The Florida strain of largemouth bass looks like native bass, but differs slightly in anatomy and habits. Florida bass can grow larger than bass native to Texas. Bass may be stocked alone, but grow bigger if forage species are present. Preliminary research results indicate native bass may be desirable for stocking in small farm ponds.

Forage fish should be prolific, phytoplankton and detritus feeders, grow fast, and reach a maximum size that can be eaten by most bass. They should be able to withstand heavy bass predation. They should not interfere excessively with bass reproduction. Unfortunately, an ideal forage fish has not been found.

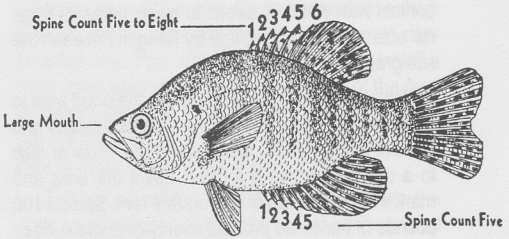
The threadfin shad is an excellent forage species in larger ponds but may be eliminated by severely cold winters. Bass normally grow much faster if shad are present.

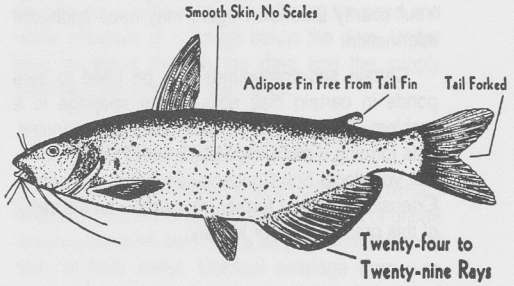
Fathead minnows provide good forage for young-of-the-year bass and larger catfish, but are usually eliminated if bass predation is heavy. Stocking fathead minnows prior to or at the same time as stocking bass usually will assure good growth of the young bass.

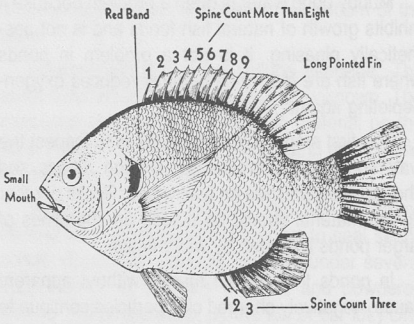
Golden shiners are used as forage fish but sometimes become too large for most bass to eat unless bass predation is heavy. Golden shiners are excellent forage fish in south Texas where low water levels often concentrate forage fish.

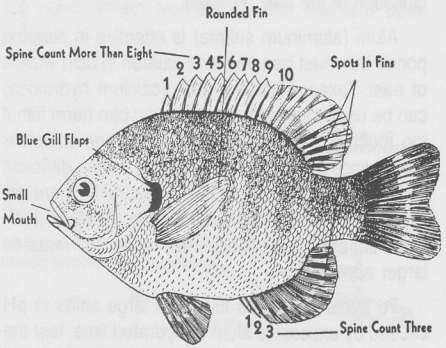
Bluegill provide forage and good bream fishing if the pond is not turbid. Bluegill sometimes overpopulate, become stunted and interfere with bass reproduction. Overpopulation usually is the result of low stocking rates, which results in an unusually large first spawn. If bream fishing is the desired goal, do not overharvest bass from the pond. A large bass population and clear water prevent bluegill overpopulation and stunting.

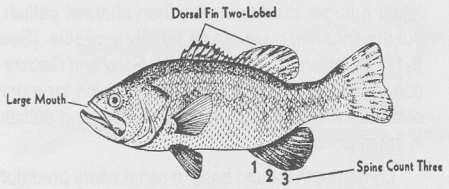
Redear provide good bream fishing, but bass are needed to prevent overpopulation. Redear do not











overpopulate as much as bluegill, but do not produce adequate forage for bass.

Redear and bluegill combined usually work well in east Texas ponds. The redear provide excellent angling and control bluegill overpopulation through competition.

Hybrid sunfish grow faster and larger than other sunfish if adequate food is available, and they do not overpopulate as readily as most sunfish. The bluegill crossed with green sunfish is the best choice for Texas ponds. However, hybrid sunfish will not provide sufficient forage for good growth of largemouth bass. The offspring will not be as desirable as their parents. For this reason, hybrid sunfish provide good fishing for only 2 to 3 years.

Crappie are preferred by many fishermen, but usually overpopulate and become stunted in small lakes or ponds if the water is turbid. For that reason, they usually are not recommended for farm ponds.

Freshwater trout can be stocked in Texas ponds but usually will not survive the summer if the water temperature exceeds 75 degrees F. These fish are limited to waters supplied from cold springs. Trout can be stocked as fingerlings in late fall in most ponds and will reach edible size by spring if artificially fed.

Number of Fish to Stock

Stocking recommendations vary according to several factors, so get specific recommendations from a fisheries biologist for each pond. The surface acreage of water is the most important criteria for determining the number of fish, but the fishing goals of the pond owner, the location within the state, the acidity, turbidity and the level of management after stocking are also important.

Stocking the proper number and combination of fish helps maintain proper balance in the fish population. Overpopulated fish ponds result in a food shortage and stunted fish. When the pond is badly out of balance, drain it or remove all fish and start over with the right kinds in balanced proportions. A new pond, properly stocked and managed, should not need restocking.

The enclosed key was developed by the Farm Pond Management Committee of the Texas Chapter, American Fisheries Society. The key allows for differences among ponds and goals of the pond owner.

The following examples, applicable to many Texas farm ponds, were developed from the more detailed key.

Example 1:

A fairly clear pond in central Texas, one acre or larger, which the owner plans to fertilize would be stocked as follows.

Kind of Fish	Number to Stock per Acre
Largemouth bass	40 6-8 in. or 100 1-3 in.
Channel catfish	200
Forage Fish:	
Bluegill	60 adults or 1000 fingerlings
Golden shiners or Threadfin shad	1000

Example 2:

Catfish alone in any size pond.

a. Catfish fed daily	up to 1,000 catfish per acre
b. Catfish not fed	200 catfish per acre in fertilized pond 100 catfish per acre in unfertilized pond 500 fathead minnows per acre

Sources of Fish

Fish for stocking private waters are available from private hatcheries. Many private fish producers specialize in producing fingerlings for this purpose.

State-wide lists of fish producers usually are available from local and state offices of the Texas Agricultural Extension Service, the Texas Parks and Wildlife Department and the Soil Conservation Service.

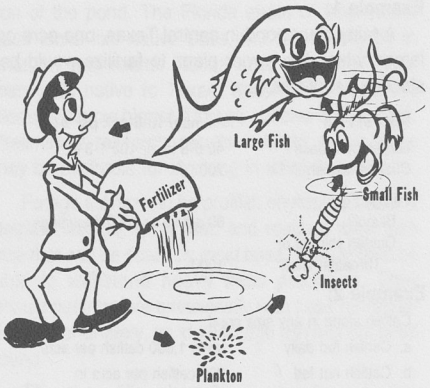
Delivery is available from many sport fish hatcheries. In some counties, delivery is arranged through the county Extension office, Soil and Water Conservation District, or local feed and farm supply dealers.

Stocking unknown fish from local waters or releasing bait fish from minnow cans into your pond is not recommended.

Fish Food Supply

To produce a maximum number of large, healthy fish in the shortest time, a pond must have an adequate fish food supply throughout the year. Nature's answer to this problem is a food chain which begins with microscopic plant and animal life called plankton or "bloom". Plankton is the food supply for small fish. The next link in the food chain is water insects and other organisms upon which small fish feed. With sufficient food, the small fish develop into large fish or provide an abundant supply of food for larger fish already present.

Plankton must have fertile water to be abundant.



Water draining into ponds from fertile watersheds sometimes supplies sufficient nutrients for plankton growth. However, ponds usually must be fertilized for maximum fish production just as cropland must be fertilized for maximum crop production.

If the pond is new, it often is wise to begin fertilization before fish are stocked. Thus, an abundant food supply will be available upon delivery of the young fish.

Pond Fertilization

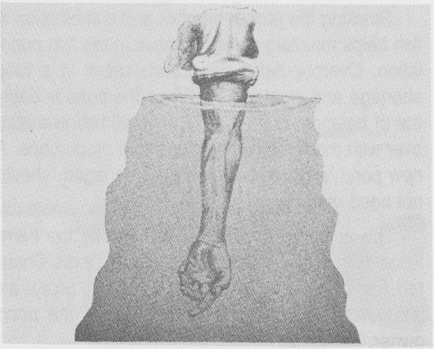
Commercial inorganic fertilizers are used commonly to more than double fish production. Large numbers of small farm ponds used for sport fishing have received the major impact of this practice. In recent years, larger impoundments used for bait and food-fish production also have benefited from fertilization programs.

Occasionally, fertilization programs fail to produce the benefits expected for various reasons. Growth of rooted plants and filamentous algae can decrease the effectiveness of fertilizer and in many cases reduce yields below those expected with no fertilizer. Chemically treat undesirable aquatic plants before beginning a fertilization program. Once they are brought under control, proper fertilization will help keep them controlled. The control is the result of turbidity created by the dense population of plankton organisms. This turbidity inhibits penetration of sunlight, thus, shading out many undesirable aquatic plants. This and increased fish production are the prime benefits of a proper pond fertilization program.

Many fertilization programs are ineffective because of failure to follow through with applications of fertilizer at the proper time. Once a good plankton bloom has been established, the nutrient level for maintaining the bloom must be regulated. This can be accomplished only by regular additions of needed nutrients to the water.

Phytoplankton (floating microscopic plants) is the starting point in the natural food cycle for fish. The nutrients required by these water plants are the same as those required by plants which grow in soil, namely, nitrogen, phosphorous and potassium. To assure a continuous supply of a minimum amount of these nutrients, applications of fertilizer must be repeated.

The complete solution of the problem of pond fertilization is unknown. The most economical method of producing the most pounds of fish per acre also is debatable. Limited research and the experience of pond owners in Texas indicate that nitrogen and phosphorus are the two most essential elements. Most Texas soils contain adequate potassium to supply the small amount needed by phytoplankton. If in doubt about the potassium content of the soil or water, include a small amount in the fertilizer. The amount of fertilizer needed will vary from pond to pond and from one area of the state to another. Most Texas waters respond to an initial treatment of 100 pounds of 20-20-5 fertilizer per surface acre. Fertilizer, such as 16-20-4, can be substituted if the recommended analysis is not readily available. If the soil contains abundant potassium, use 20-20-0 or 16-20-0. Less concentrated fertilizers, such as 8-8-8 or 12-12-12, can be used at double the recommended amount if these are more readily available.



The plankton bloom is sufficient if a person's cupped hand disappears when the arm is immersed to elbow depth (about 18 inches).

A Fish Stocking Key for Texas Farm Ponds

Don W. Steinbach*

Characteristics	Recommendations	Now see
I. **pond size**		
A. less than 1 surface-acre	channel catfish	V-stocking recommendations I-B, 1 or 2 or 3
B. greater than 1 surface-acre	largemouth bass and/or channel catfish	V-stocking recommendations
1. only channel catfish desired	Stock 50-100, 6-8 inch channel catfish per acre. (These do not need to be fed.)	II-forage fish stocking in relation to water characteristics
2. only bass desired	Stock 50, 1-3 inch bass per acre or 20, 6-8 inch bass per acre. Must also have forage species.	II-forage fish stocking in relation to water characteristics
3. bass and channel catfish desired	Follow recommendations for I-B, 1 *and* 2.	
II. **water characteristics**		
A. pond muddy (These ponds are less productive and forage species over-populate.)	Stock 250 bluegill and 250 redear per acre or 500 golden shiners per acre.	IV-time of stocking
B. pond clear	Modify stocking rate based on acidity/alkalinity.	II-C&D-water pH
C. acid waters (pH less than 7, typical in east Texas)	Stock 250 bluegills and 250 redear per acre. 400 threadfin shad may be added to increase yields.	IV-time of stocking
D. alkaline waters (pH greater than 7)	Base stocking rates on rainfall/water levels.	III-A or B
III. **location**		
A. low rainfall areas (less than 20 inches per year)	Stock 500 bluegills per acre. Bluegills *must* be supplemented with: 500 threadfin shad per acre *or* 500 golden shiners per acre.	IV-time of stocking
B. high rainfall areas (more than 20 inches per year)	Stock 500 bluegills per acre. Bluegills *may* be supplemented with: 500 threadfin shad per acre *or* 500 golden shiners per acre.	IV-time of stocking
IV. **time of stocking**	Forage should be stocked in the fall prior to stocking bass. Advanced sunfish (greater than 3 inches) must be stocked at the same time as advanced (6-8 inch) bass. If advanced sunfish are used, reduce stocking rate to 30 per acre.	VI-fertilized ponds
V. **only channel catfish desired**		
A. fish to be unfed or occasionally fed	Stock 100 channel catfish and 500 fathead minnows per acre.	VI-fertilized ponds
B. fish to be fed daily	Stock 1,000 channel catfish per acre.	stop
VI. **fertilized ponds**	If an annual fertilization program will be conducted, double all stocking rates.	

*Extension fisheries specialist. Key developed by the Farm Pond Management Committee of the Texas Chapter, American Fisheries Society.

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Applications of the same fertilizer recommended for surrounding soil may not give optimum plankton production. Experience and research indicate that large amounts of nitrogen and phosphorous are necessary regardless of soil analysis.

Make the initial application in March or April or when the water temperature reaches 65 degrees F. Follow initial application with small applications at 2-week intervals until a desirable bloom is attained. A desirable bloom is one that shades out a bright object at approximately 18 inches below the surface. (A shiny tin can lid attached to the end of a stick can be used to make this determination.) The desired bloom usually appears in 1 to 5 weeks after the initiation of the program. Subsequent applications should be made only as needed to maintain the bloom.

Commercial inorganic fertilizer may be applied by broadcasting over the water surface in shallow water or by placing whole bags around the edge of the pond. Split the bags to allow wave action to distribute the dissolved nutrients. This method is effective but may detract from the appearance of the pond. Probably the best method of application is to support the fertilizer near the surface of the water to prevent the rapid tie-up of nutrients in the bottom soil. This can be done by using stationary platforms or floating devices. This method of application allows the nutrients to dissolve slowly into the water and to maintain a more even bloom, often with less fertilizer.

It is important to continue fertilization annually. If a pond is fertilized one year and not the next, a severe food shortage will result for the increased weight of fish produced the previous year.

Placing fertilizer in a floating device allows the nutrients to dissolve directly into the water.

Fertilizer can be poured into shallow water.

Organic fertilizers, such as barnyard manure, will increase small animal life (zooplankton), but usually will not increase phytoplankton to the desired level unless very large amounts are used.

The fertilization program should cease in most areas of Texas about June 1. It may be continued a few weeks longer in cooler areas of the state. As hot weather approaches, a fish kill can result from oxygen shortages. Warm water holds less dissolved oxygen than cold water and a heavy plankton bloom can result in reduced oxygen supply. Such fish kills usually result after two or three overcast, windless days. Often the fish are found dead or dying in the early morning hours (about daybreak) when the oxygen supply is usually at its lowest level.

In certain acidic waters of east Texas, it is beneficial to add lime, alone or in combination with fertilizer. Rate of application usually varies from 500 pounds to 2 tons per surface acre. Check the pH (acidity or alkalinity) after each application. A pH of 6.5 or above is desirable for optimum benefits from fertilization.

Supplementary Feeding

Feeding commercial fish feeds increases growth of sunfish and catfish and congregates fish for good fishing. Bass do not readily take artificial feeds, but may benefit from increased forage production caused by the feeding.

Both floating and sinking food pellets are available. The primary disadvantage of using the floating type is that it is more expensive. The advantages of using floating feed are: (1) The correct amount of feed per day is easily determined by the amount the

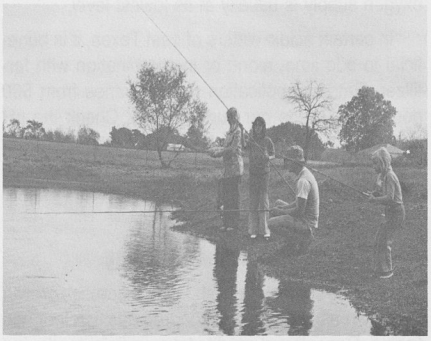
fish will eat in about 15 minutes. Feeding more than the fish will eat is wasteful and adds to pond pollution problems. (2) Fish can be observed while feeding. If fish health is threatened (by disease or water-quality problems), food consumption will decrease.

Use of floating feed may be a problem if wind and wave action wash it against the bank before all of it is eaten. This can be prevented by the construction of a 10-foot-square feeding area made from 2-inch by 12-inch redwood boards. This floating device encloses the feed until it is eaten by the fish.

Use only the amount of floating feed that the fish will eat in about 15 minutes, never more than 15 pounds per surface acre per day. Warm water fish usually will not take the feed during the winter.

Demand feeders are recommended for pond owners who cannot visit their ponds daily. Several types of demand fish feeders are available. These devices are activated when a fish pushes a lever extending into the water, causing a small portion of feed to be dropped into the water. In theory, fish will only eat the amount required and will not waste feed. However, other animals, such as rats and waterfowl, also feed from the feeder and a considerable portion is wasted. To prevent such loss, a wire-mesh screen about 2 feet in diameter and extending 1 foot into the water should enclose the trigger.

Fertilizer should not be used if fish are fed because increased waste products generated by an increased fish growth will serve the same purpose as the inorganic fertilizer.



Ponds stocked with sunfish may be fished heavily.

Fishing the Pond

After a pond has been stocked, begin fishing when each species has reached edible size or sexual maturity. In Texas, this normally takes about 1 year, often 2 years for bass. After the fish have spawned, fish the pond heavily. Make a few drags with a seine in shallow water in June or July. If the fish have spawned successfully, you should catch young fish of each species stocked.

Since sunfish, including redear, tend to overpopulate farm ponds, catch as many as possible. For every bass or catfish removed from the pond, at least 10 to 12 sunfish should be removed. Do not return small sunfish that are caught to the water. Fish for sunfish in their nesting beds throughout the warm weather.

Bass harvest should not exceed 20 pounds per acre annually. Overfishing for bass results in stunted sunfish and may hinder bass reproduction.

Water temperature, availability of natural food, seasonal activities of fish and skill of the fisherman are a few factors which influence fishing success. Alternating periods of good and poor fishing are to be expected. Even the best fisherman will not always catch fish. Submerged piles of brush or automobile tires concentrate the fish. Fish frequently gather in such areas.

Fish Shelters and Spawning Aids

Fish shelters can be made by anchoring brush and logs or automobile tires with piles of rocks and boulders. Green brush, such as black willow, will last for a long time under water. Stake beds may be constructed before the pond is filled, or during a drawdown. Stake beds provide shelter and attract fish with a minimum of hook hanging. The locations of all shelters should be remembered or marked since they provide excellent fishing spots. Shelters should be scattered over the pond at various depths with some placed in deep water.

Sand and gravel beds 2 to 3 feet in diameter located around the shore in shallow water make ideal nesting sites for some fish. Gravel nests also may be made with shallow boxes about 3 feet square and 4 to 6 inches deep. The boxes should be filled with sand and gravel and placed in shallow water up to 5 feet deep.

Channel catfish spawn more readily if provided with nests. Channel catfish nests may be made by submerging old milk cans, small barrels or wooden boxes made for this purpose. The spawning containers should be staked around the south and west margin of the pond at depths of 2 to 6 feet, with the slightly-raised open end toward deep water.

Water Level Fluctuations

Lowering the water level 1 to 2 feet in the fall and winter concentrates forage species and makes them more available to bass, thus producing larger bass and bream. This practice also aids in control of marginal aquatic weeds. The pond should be filled again by March to provide shelter areas for bass fry. Do not lower the water in the summer unless water can be drained from the bottom of the pond using a system similar to that illustrated on page four.

Clearing Ponds of Rough Fish

When the fish population becomes badly out of balance with small, stunted fish, and undesirable fish such as gar, carp, suckers and bullhead catfish, it is often best to remove all fish and start over with a balanced stock. The use of rotenone (Derris®) powder is an easy and practical method of removing fish from privately owned ponds. Emulsifiable rotenone also can be used. The use of rotenone or other materials toxic to fish is permitted in privately owned ponds where the pollution of public waters will not result, and when it is done as a management practice.

Use 10 pounds of 5 percent rotenone powder or 1 gallon of liquid to each acre-foot of water (1 surface acre, 1 foot deep). A surface acre of water averaging 3 feet deep equals 3 acre-feet and requires 30 pounds of the rotenone powder. Mix the rotenone powder with enough water to make a thick paste or dough. Add water until the mixture is about the density of milk and place the solution in tubs. Using a boat, pour the solution into water as the boat is rowed or motored. Begin on the windward side of the pond so that wave action will assist in covering the pond. The entire surface area and the deep water of the pond must be treated with the solution for effective results. For large areas, 50-gallon drums with a spigot on the end may be placed on the side at the front of the boat. Outboard motors will assist in distribution when the spigot is opened. Poor results usually occur when ponds are treated with rotenone in cold weather. Treat ponds during late spring or summer when the temperature is 70 degrees F or higher, and when the water is at its lowest yearly level.

Since rotenone affects only the gills, fish killed by this method may be eaten if cleaned while fresh. This treatment is harmless to livestock or humans using the water. The rotenone will have lost its strength within 7 to 14 days and the pond can be restocked. Rotenone usually does not give complete kills of bullhead catfish.

Rotenone should be mixed into the pond with an outboard motor.

Aquatic Plant Control

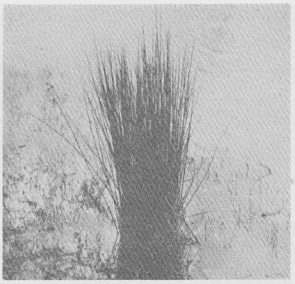
Aquatic plants in a pond produce oxygen for fish. They provide areas for the production of small aquatic organisms which are important links in the fish-food chain. Plants offer small fish protection from large predatory fish. Certain fish spawn in the roots and leaves of aquatic plants. Decaying plant matter also adds to the fertility of a pond. Certain plants offer food and cover for desirable wildlife, especially waterfowl.

When aquatic plants become too abundant, partial control is necessary. Dense growths of aquatic plants interfere with boating, fishing and swimming. Small fish then have so much protection that large fish are unable to feed upon them, which upsets the population balance. Under certain conditions, dense growths of aquatic plants and decaying vegetation deplete oxygen in the water. When this occurs, many fish die.

If a pond is constructed without extensive shallow water areas and the pond is fertilized properly, aquatic vegetation probably will not be a serious problem.

Emergent and Floating Vegetation

Emergent vegetation includes cattails, bulrushes and water lilies that normally grow along the margins of a pond in shallow water. Water hyacinths are floating plants. Often manual control, either by hand or with pitchfork or rake, can be used to control certain obnoxious plants if removed as soon as they appear.

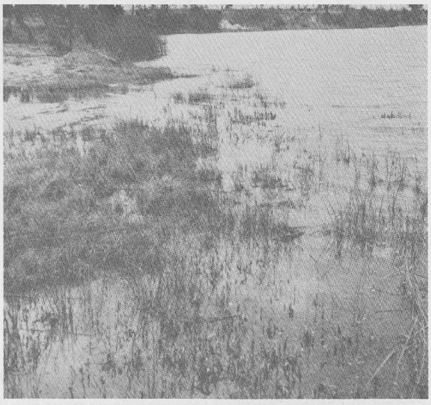


Emergent vegetation should be controlled when it first appears.

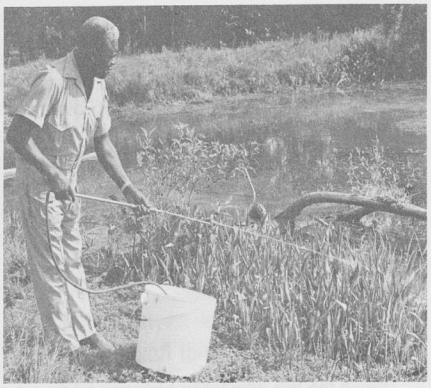
Cattails and bulrushes occasionally can be controlled if they are cut at maximum growth before the seed matures. Cut near the rootstock with a briar hook scythe. Several cuttings over one or two growing seasons may be necessary for complete control.

The use of systemic herbicides such as 2,4-D is restricted by law in certain counties. Obtain complete information on permits and clearance from the State Commissioner of Agriculture, Texas State Department of Agriculture, P.O. Box Drawer BB, Austin, Texas 78711.

Chemical control of emergent and floating plants may be necessary when large areas become infested. Certain species of plants must be controlled by specific chemicals. Thus, the pond owner first should identify the plants and then use the proper chemical formulations. (See B-1018, *Common*



Excessive shallow water areas create weed problems.



Marginal and submerged aquatic weeds can be treated with either hand-pump or pressure sprayers.

Aquatic Plants, Identification and Control, Texas Agricultural Extension Service.)

Before using chemicals remember to:

- Apply during the plant growing season before the seeds or fruits are formed (spring and early summer).
- Choose a warm, calm day for spraying.
- Check local and state regulations regarding use of the chemical.
- Be sure you have the proper chemical.
- Avoid inhaling or skin contact with chemicals.
- Avoid treating water to be used for irrigation.
- Follow directions on the label.

Equipment

For large and medium-sized areas, a power sprayer is recommended. Equipment consists of a drum to hold the chemical, a pump to draw dilution water from the pond and the chemical solution from the drum, and a spray boom through which the diluted chemical is distributed evenly over the water surface. The boom can be made of a ¾-inch pipe with ⅛-inch holes spaced 12 inches apart.

For small areas and areas where a boat cannot be used, a 5-gallon pressure-type sprayer is recommended.

Good results depend on using a sufficient quantity of the proper chemical and distributing it evenly in the water. Once treatment begins on a given area, complete it quickly. Any delay causes some decrease in the chemical concentration already applied, which may prevent good results.

Treat only a section of the heavily weed-choked waters at a time, allowing about a week between treatments. Too rapid decay of vegetation reduces the oxygen supply in the water. When this occurs in the entire pond, fish die of suffocation. Suffocation is more hazardous to fish than the herbicides. An early sign of oxygen depletion is congregation of fish along the shore or at the surface. If this occurs, run fresh water into the pond or pump the old water out and spray it back into the pond.

A few days after spraying, treated plants turn brown, become limp and sink to the bottom where they begin to decay. Water may turn brown and turbid during this period. The plants remain on the bottom where they gradually disintegrate without objectionable odor.

About 7 to 10 days following decay, bloom of algae is likely to appear in the treated area. This lasts a short time and usually requires no treatment.

How to Determine Volume in Acre-Feet

An acre-foot is equivalent to 1 surface acre of water 1 foot deep.

1. Determine the surface area of the pond in acres. This measurement must be fairly accurate. Your local Soil Conservation Service office has aerial maps from which the surface area of any pond shown often can be determined with a planimeter.

2. Determine the average pond depth in feet. Do this by making a series of systematic depth soundings over the pond area. Make the soundings approximately 30 to 50 feet apart in straight lines across similar areas of the pond. Add the depth measurements together and divide by the number of soundings to obtain average depth. Always begin and end each row of soundings with the zero measurements at the water's edge and add these in the number of soundings made.

3. Multiply the average depth in feet by the number of surface acres to obtain the total acre-feet of water.

Conversion Factors:

1 gallon = 8.3453 pounds
1 cubic foot = 7.4805 gallons
1 acre = 43,560 square feet
1 acre-foot = 43,560 cubic feet
1 acre-foot = 2,718,144 pounds of water
1 ppm = 2.7 pounds per acre-foot
1 ppm = 0.028 grams per cubic foot
1 ppm = 1 pound in 1,000,000 pounds

Other Control Methods

Fertilizer added to a pond infested with a large amount of weeds only increases the growth of the obnoxious weeds. Once the weeds are killed, a good fertilization program will help keep them controlled.

In a new pond, the best method of controlling submerged aquatic plants is by maintaining a good fertilization program where the pond fills with water. Since fertilization increases microscopic organisms, the resulting "soupy" or "darkened" color filters the sunlight. If this plankton "bloom" is maintained throughout spring and early summer, submerged aquatic plants will be unable to develop into thick, troublesome masses.

When new ponds are built or when old ones are improved, elimination of large shallow-water areas will help prevent the growth of troublesome plants. However, some shallow water (3 to 5 feet in depth) should be maintained for fish spawning areas.

In past years the nutria, a large aquatic mammal, has been introduced in ponds and lakes to control aquatic plants, with only limited success. These animals are reported to have damaged agricultural crops, native wildlife habitat and other properties to such an extent that state and federal agencies now discourage further release of them.

Beautifying the Pond Area

The pleasure of having a good pond can be increased by beautifying the area.

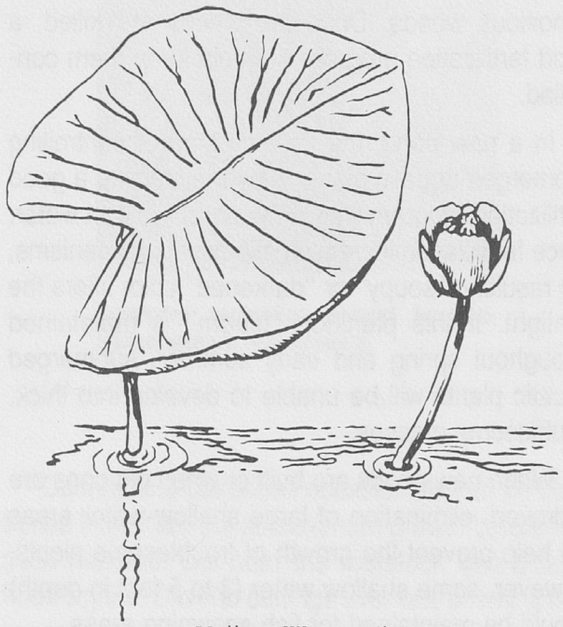
Fencing the pond and immediate area will prevent livestock from keeping the water muddy by breaking down the banks of the pond. Also, attractive plant life will be able to develop.

Trees and shrubs planted around the pond add to eye appeal and are attractive to birds and other forms of wildlife. Trees should be far enough away from the banks so that they will not interfere with casting. They should not be planted on the dam.

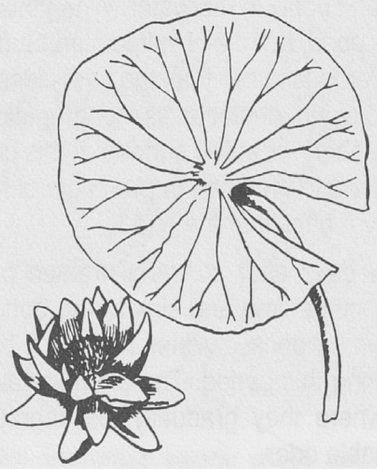
The establishment of grass, such as Bermuda, adds to the beauty of the area and prevents erosion and rank growth of weeds. Grass should be mowed periodically.

A barbecue pit and picnic table add to the usefulness of the area.

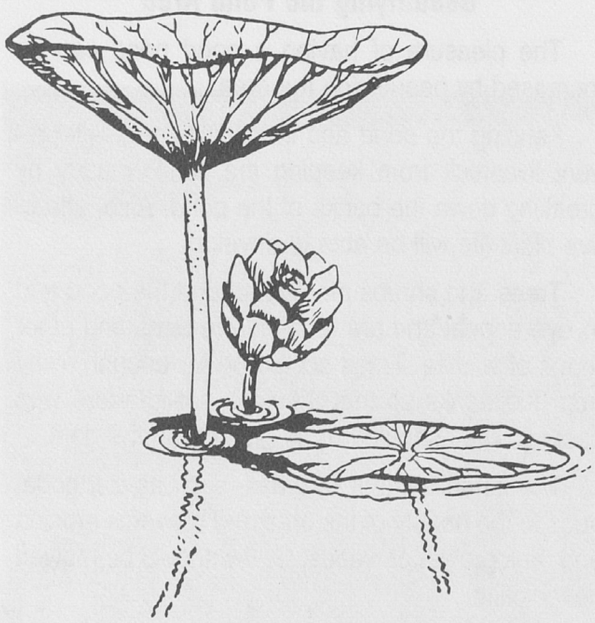
Emergent and Floating Vegetation



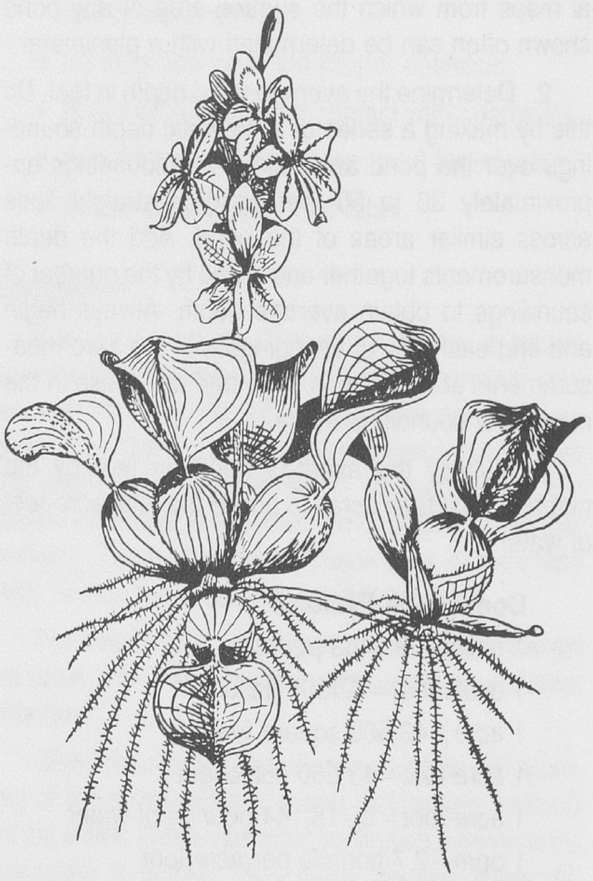
Yellow Water Lily



White Water Lily



Lotus



Water Hyacinth

Other Problems

The pond owner may encounter problems other than those discussed. Some of these problems and possible solutions are discussed below.

Turtles: Turtles do little harm to a fish population, yet their control sometimes is desirable because they steal fish baits and annoy fishermen. Ask your local county Extension agent for plans on building turtle traps.

Fish die-off: (a) Fish die-off may be due to depleted oxygen supply resulting from hot, cloudy weather with little wave action, large amounts of decaying vegetation, excessive algae bloom from improper fertilization, or from heavy silt run-off following rain. This can be prevented by proper fertilization, killing aquatic plants in small areas over a long period of time, or proper grass sodding of watershed. For immediate action when die-off begins, bring in a flow of fresh water or use a pump to aerate the top layer of water. If large numbers of fish are killed, remove those remaining and restock the pond.

(b) Fish die-off also may be a result of pollution by agricultural chemicals. To prevent this, spray crops in the area only when there is no possibility of chemical drift by the wind. Also, water run-off from treated areas should be diverted away from the pond. If many fish are killed, remove the remainder and restock the pond after chemicals in the water have dissipated.

(c) If the pond is not fenced, fish die-off may be caused by cattle wading in the pond after being dipped or sprayed with compounds containing chemicals such as toxaphene and rotenone.

Fish parasites: Yellow grubs, threadworms, spinyheaded worms, tapeworms, flukes and several other parasites are fairly common to fish. These parasites are not harmful to man and usually are removed from the fish during cleaning. At present, the only practical method of controlling many of these parasites is by controlling the snails which are their intermediate hosts, or by draining the pond and letting it dry for several months. Many times fish die-off is caused by parasitism, which often occurs in a crowded fish population. Contact the Extension fish disease specialist, Texas A&M University, College Station, Texas, if a large outbreak occurs.

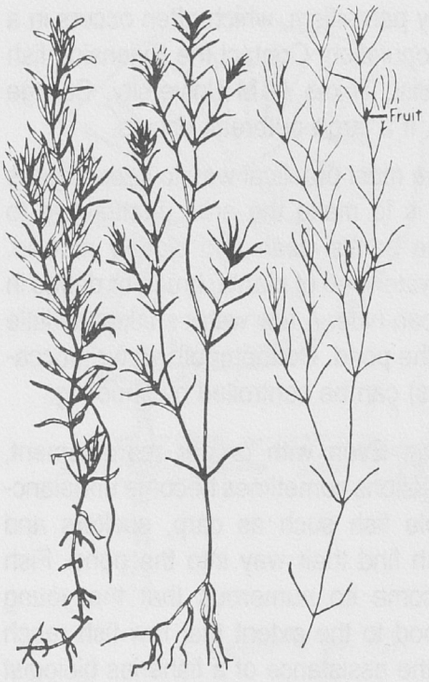
Snakes: The most practical way to keep snakes out of a pond is to make the area unattractive to them. Keep the banks clean and closely mowed. Keep shallow water free of plants, brush or debris in which snakes can hide. A few water snakes do little or no harm to the pond. Cottonmouth water moccasins (poisonous) can be controlled by shooting.

Poor fishing: Even with proper management, pond fish populations sometimes become unbalanced. Undesirable fish such as carp, suckers and bullhead catfish find their way into the pond. Fish frequently become so numerous that the young compete for food to the extent that few fish reach edible size. If the assistance of a fisheries biologist is obtained, the situation often can be remedied without removing all of the fish. If assistance is unavailable, the best solution is to remove all fish by using rotenone and restocking the pond. The problem of an unbalanced fish population, particularly with an overabundant supply of sunfish, is less likely if the pond is fertilized properly and sunfish are removed continuously by fishing or seining.

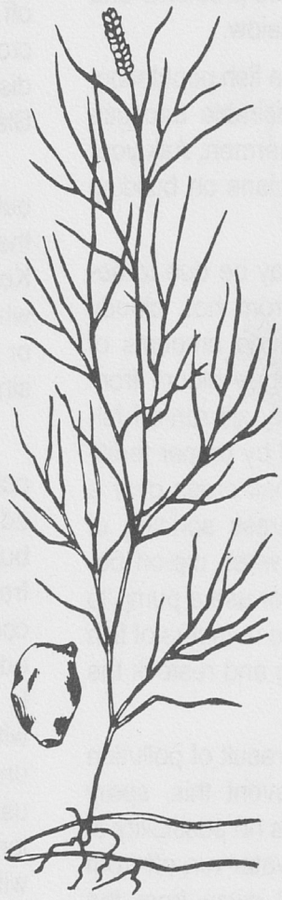
If pond management problems arise which the pond owner cannot solve, the following persons and agencies can offer assistance:

- County Extension agents
- Soil Conservation Service
- Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744
- Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas.

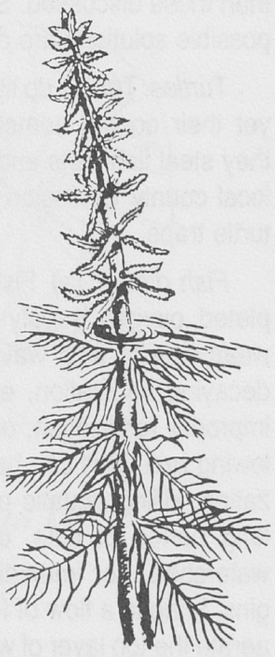
Submerged Vegetation



Bushy Pondweed

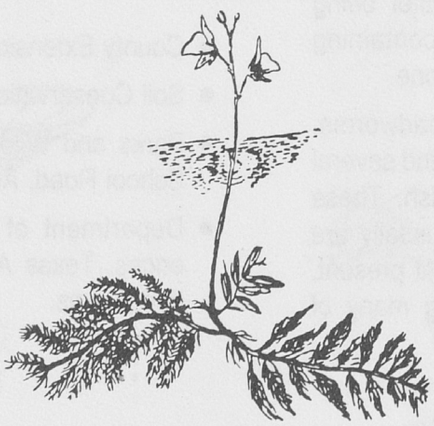


Sago Pondweed

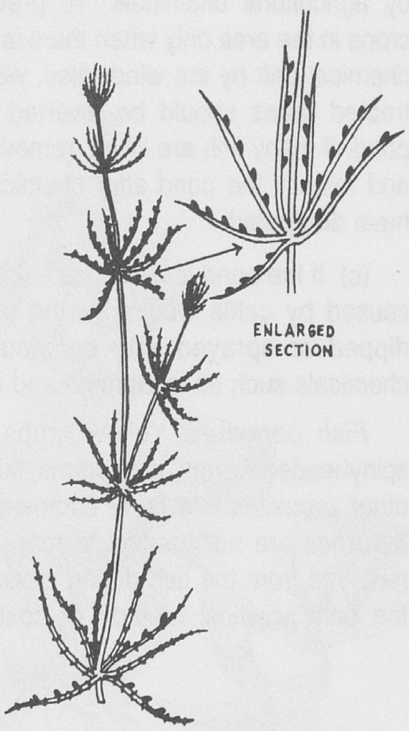


Watermilfoil

Waterweed



Bladderwort



Muskgrass

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