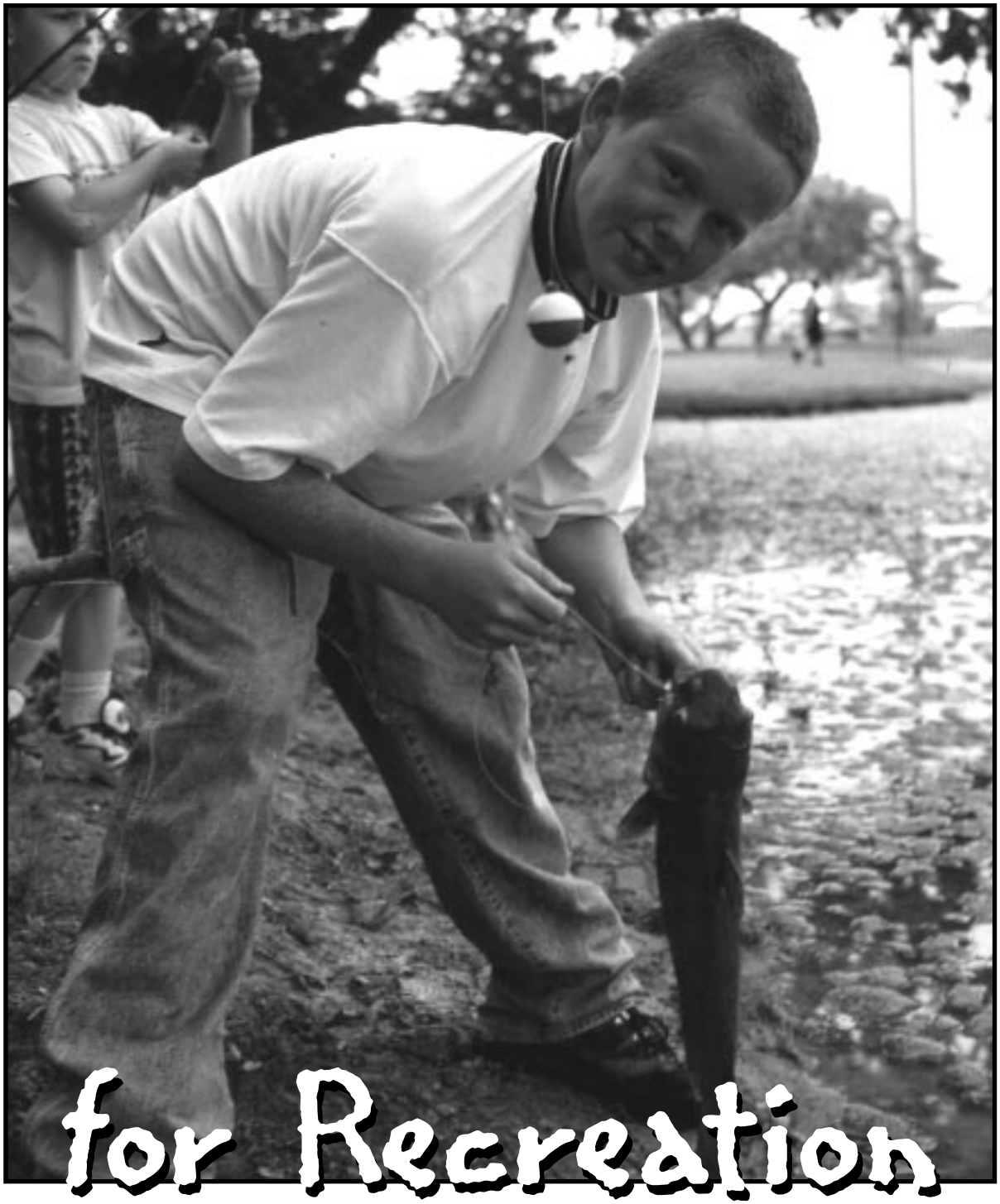
Texas Agricultural Extension Service
The Texas A&M University System

B-1319
6/99

Catfish Ponds



Catfish Ponds
FOR RECREATION

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Most of Texas' more than 800,000 private ponds are smaller than 1 acre, making them too small for recreational bass and bluegill management. However, small or large Texas ponds can support channel or blue catfish. Catfish ponds require minimum effort by the owner if they are managed at low to moderate stocking and feeding levels.

Recreational catfish ponds provide enjoyable outdoor recreation as well as excellent food fish. Anglers of all ages can catch catfish relatively easily, and the fish are good fighters. Catfish ponds also offer a steady supply of fresh, farm-raised, contaminant-free fish for the table.

Catfish are omnivorous (meaning they eat both plants and animals) and feed on a wide variety of natural organisms. They also can be fed commercially formulated pelleted feeds, which allows a pond to support more catfish than it could game fish. For the most successful catfish pond, managers must prepare the pond properly, maintain water quality, stock the appropriate number of fish, feed them the right feed in the correct amounts, and harvest the catfish.

Pond preparation

Catfish pond management starts with preparing the pond. The manager can use or convert an existing pond into a catfish pond, or build a new one. In both cases:

- The pond must be built properly;
- The pond must have an adequate water source, a standpipe drain and/or an emergency spillway;
- Unwanted fish species must be controlled;
- The pond may need to be limed and fertilized; and
- Aquatic weeds must be controlled.

Extremely deep (more than 15 feet), small ponds (less than 2 acres) can be a problem (see Turnovers). For technical assistance in pond construction, contact the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) office servicing your county.

Water source

One of the first considerations for any fish pond is the quality and quantity of available water to fill it. Most recreational ponds are filled from rainfall. The land area that channels rain runoff into the pond is called the **watershed**. A healthy watershed is critical to a healthy pond. Catfish may grow poorly in ponds surrounded by cultivated fields, too many livestock (particularly feedlots), or industrial or mining activities that release contaminants into their watersheds.

Other sources of water that can be used are wells and surface water from creeks or other ponds. Pond and creek water must be filtered or screened to remove wild fish and fish eggs and to keep the catfish pond from becoming overpopulated with undesirable fish species. Pumping water from a creek requires permits from the Texas Natural Resource Conservation Commission (TNRCC).

Removing unwanted fish

A common problem in managing catfish ponds is the invasion and overpopulation of unwanted fish species. Sunfish (bream or perch), shiners, shad, suckers, carp and bullheads often invade catfish ponds and compete with the catfish for food and oxygen. They also increase the likelihood of disease. Because catfish eat mostly aquatic insects and

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worms and actually catch few fish as food, these fish species are relatively unimportant in the catfish diet. Therefore, before stocking, check the pond thoroughly for other fish.

Use rotenone to eliminate any fish you find. Rotenone is the only fish pesticide registered in the United States. It is a **"restricted use"** pesticide, which means that it must be bought and applied by a certified pesticide applicator.

Rotenone is applied at concentrations of 2 to 5 parts per million (ppm), depending on the water temperature and the species to be eliminated. Rotentone is best applied when the water is 70 °F or higher. Drain the pond as low as possible before treatment to reduce the amount of rotenone required. This lowers the cost and the possibility that an immediate rain will wash the pesticide downstream.

Rotenone decomposes naturally within 3 to 14 days, depending on water temperature and sunlight.

Liming

Most East Texas soils and some in other isolated areas of the state are acidic. Acidic soils make the pond water acidic, which lowers pond productivity and can stress the fish.

Pond productivity, or **carrying capacity**, refers to the number of fish a pond can support or feed through the natural food chain. The natural food chain starts with pond plants, particularly microscopic algae or **phytoplankton**. Phytoplankton are the start of the pond's food chain, much as grasses are the start of many food chains on land. These algae and their detritus (dead bodies) are eaten by microscopic animals (zooplankton) and by aquatic insects and worms, which are in turn eaten by fish such as catfish.

Microscopic algae color the pond's water some shade of green. This green water is often referred to as an **algal bloom** or **bloom**. A bloom indicates good pond productivity. Clear water means little natural food and low pond productivity.

The productivity of ponds with acid soils can be improved by adding agricultural limestone. The amount of limestone (or lime) needed to neutralize acidic soils depends on the soil's characteristics. Have a soil or mud sample analyzed to determine the amount of lime you need. The county Extension office can give you information on proper soil sampling and testing procedures.

Apply the agricultural lime over the entire pond surface or, if the pond is drained, across the entire pond bottom. Lime reacts slowly with the soil to neutralize its acidity and dissolves into the pond water, making it more alkaline. For good natural productivity, a pond needs an alkalinity of 20 ppm or more. Although lime can be added anytime, it is probably best to lime ponds during cool weather if they contain desirable fish. Over time, the dissolved lime is washed out of the pond in overflowing water.

Ponds with acid soil usually need to be limed every 2 to 5 years, depending on the amount of lime added and the amount of water overflow. If you double or triple the liming rate recommended by the soil test, you won't need to lime as often. Adding extra agricultural lime does not harm the pond.

Fertilization

First, not all ponds need to be fertilized. Ponds in alkaline soils with runoff from livestock pastures or fertilized fields may maintain algal blooms without extra fertilizer. However, most ponds need the application of fertilizers or feeding of pelleted feeds to develop a good algal bloom. Algal blooms increase the number of catfish a pond can support. Pelleted feeds reduce or eliminate the need for fertilization, except possibly in the early spring.

Catfish do not feed well at water temperatures below 70 °F. Therefore, fertilizing in the early spring to establish an algal bloom and enhance the natural food chain can be beneficial. Stop fertilizing when the catfish start feeding actively. **Do not fertilize if the pond has an aquatic weed problem** (see Controlling Aquatic Weeds). Table 1 gives general guidelines for fertilizing ponds.

Table 1. Common fertilization rates used to establish a phytoplankton bloom in fish ponds.

Fertilizer formulation[a]	Amount/acre/application[b]		
	Low hardness	Moderate hardness	High hardness
Granular			
20-20-5	8-16 pounds/acre	16-32 pounds/acre	32-64 pounds/acre
18-46-0	4-8 pounds/acre	8-16 pounds/acre	16-32 pounds/acre
Power			
10-52-0	4-8 pounds/acre	8-16 pounds/acre	16-32 pounds/acre
Timed release[c]			
10-52-0	25 pounds/acre	30-40 pounds/acre	50 pounds/acre
14-14-14	75 pounds/acre	100-125 pounds/acre	150 pounds/acre
Liquid			
10-34-0	1/2-1 gallon/acre	1-2 gallons/acre	2-4 gallons/acre

[a]For other formulations, use similar phosphorus (middle number) as a guide.

[b]Pond waters with calcium hardness 1) below 50 milligrams/liter are considered **low**, 2) between 50 and 100 milligrams/liter are **moderate**, and 3) above 100 mg/L are **high**.

[c]Single application per year—**do not use timed release if catfish are fed.**

For more information on pond fertilization, contact your local county Extension office or an Extension fisheries specialist.

Fertilizer should be applied based on the water's clarity, or clearness. The depth that light penetrates into the water is a measure of algal bloom density (except for muddiness). You can measure bloom density using a Secchi disk (Figure 1). A Secchi disk can be made from any 6- to 8-inch-diameter disk, painted black and white in quarters, and attached to a yard stick or a pole (marked at 12, 18, and 24 inches from the disk). Submerge the disk into the pond until it just disappears and then read the depth to get a measure of the bloom density.

The best algal blooms allow light to penetrate 18 to 24 inches deep. Table 2 gives recommendations for using a Secchi disk to guide fertilization. If the Secchi disk disappears between 18 and 24 inches, no fertilization is needed. Fertilize if the Secchi disk can still be seen at 24 or more inches. If the disk disappears between 12 and 18 inches, the bloom is too dense; watch the pond closely for oxygen problems (see Water quality). If the disk disappears in less than 12 inches, oxygen depletion could occur soon. **Prepare to aerate.**

Catfish grow more slowly in ponds that are only fertilized than those given a manufactured catfish feed. In ponds that are fertilized only, a 6-inch fingerling usually reaches 1 pound in about two growing seasons; catfish fed at least 3 days a week should reach that size at the end of the first growing season.

Table 2. When to fertilize a pond, based on Secchi disk readings.

Secchi disk reading	Recommended management
24 inches or more	Fertilize
18 to 24 inches	Good bloom–do not fertilize
12 to 18 inches	Dense bloom–watch closely
12 inches or more	Bloom too dense–be prepared to aerate

Controlling aquatic weeds

Aquatic weeds are difficult to control once they have become established in a pond. Therefore, the best way to control them is prevention. Preventive measures include:

- Building the pond so that banks slope steeply to a depth of at least 2 1/2 feet;
- Fertilizing to establish an algal bloom before weeds appear; and
- Stocking triploid grass carp.

Fertilizing to establish a bloom and steep bank slopes both help keep the pond bottom shaded. Rooted plants cannot get started if the bottom is shaded.

Stocking triploid grass carp is the best overall way to prevent and control aquatic weed growth. Grass carp readily eat almost all types of submerged aquatic plants. Compared to herbicide treatments, they are relatively inexpensive because they control submerged weeds effectively for many years (usually 5 to 7). Grass carp do not eat other fish or their eggs, do not muddy the water and cannot reproduce in ponds. Because they cannot reproduce, they must be restocked as they age and can no longer control weeds effectively.

To keep grass carp in a pond during heavy rains, build a barrier across the pond's emergency spillway. Permits for stocking triploid grass carp must be obtained from the Texas Parks and Wildlife Department (TPWD). Information on building spillway barriers can be obtained from TPWD or from an Extension fisheries specialist.

Stocking

Channel and blue catfish (Figure 2) are both suitable for stocking in ponds. However, channel catfish are more readily available from private hatcheries and tolerate low dissolved

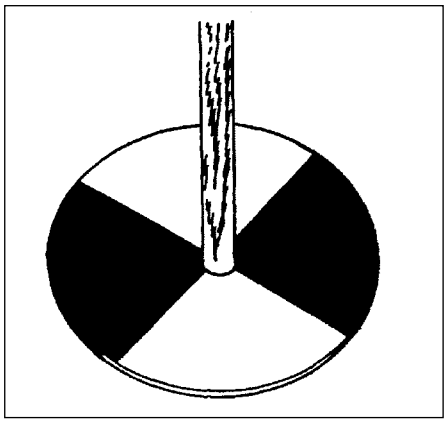

Figure 1. Secchi disk.

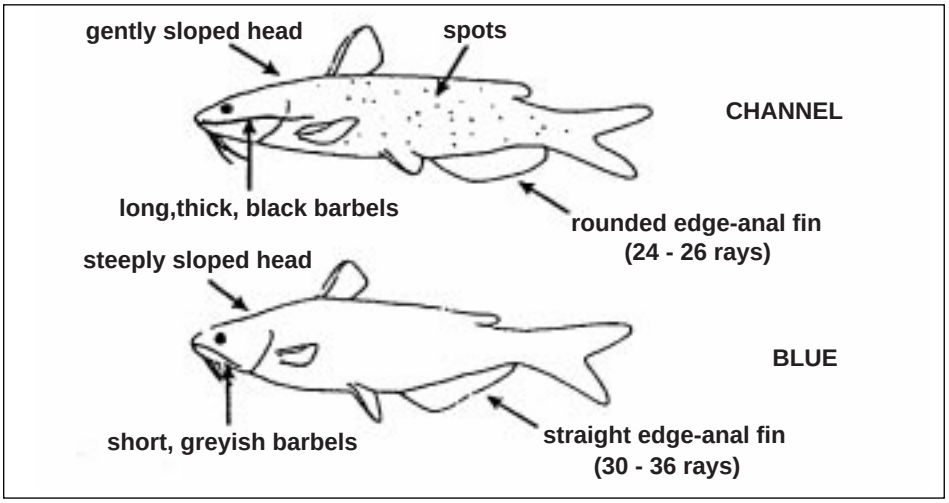

Figure 2. Comparison of channel and blue catfish characteristics.

oxygen better than blue catfish. Blue catfish grow larger than channel catfish after the second year post-stocking. There is no difference in taste or flesh texture between the two species.

Although available year-round, catfish are best stocked during cool weather when they will not be severely stressed by being handled at high temperatures. For best results, stock between February and April when water temperatures are rising and catfish fingerlings are beginning to feed actively.

The size of fingerling to stock depends on availability, cost and how quickly you want them to reach an edible size. A 5-inch fingerling is the minimum size that can reach an edible size (more than $^3/_4$ pound) in one growing season. Most catfish growth occurs between April and October. Many pond owners prefer to stock as large a fingerling as possible in order to get maximum growth. Of course, rapid growth depends on pond fertility, supplemental feeding and the overall stocking density.

Number of catfish to stock

One of the most important management decisions is the number of catfish to stock. The stocking number should reflect how much time and money you want to spend managing the pond, whether you will feed or only fertilize, and how many fish you want to remove from the pond each year. Table 3 should help you decide how many catfish to stock. Most pond owners should not stock at the "Heavy" and "Very heavy" rates listed in Table 3 unless they have catfish management experience.

Do not confuse commercial stocking rates used by experienced fish farmers with the lower rates suitable for recreational ponds. Even the lowest commercial catfish stocking rates are too high for recreational ponds.

Table 3. Guidelines for stocking recreational catfish ponds.

Density[a]	No. of fish per acre	Management[b]
Very light	Up to 100	No fertilizer or feed necessary
Light	100 to 350	Regular fertilization or occasional feeding
Moderate	350 to 700	No fertilization; feed 3 to 6 times per week
Heavy[c]	700 to 1,000	Do not fertilize; feed 4 to 6 times per week
Very heavy[c,d]	1,000 to 1,500	Do not fertilize; feed 5 to 7 times per week

[a]Densities are for first year only; density will be higher in following years if fish are not harvested and reproduction occurs.

[b]See Tables 4 and 5; do not exceed a maximum feeding rate of 35 lb/acre/day.

[c]Ponds stocked at these rates must be harvested heavily to prevent overcrowding; some supplemental aeration and water quality testing may be necessary.

[d]Not recommended for ponds larger than 2 acres.

An important consideration in determining stocking rate is fishing or harvesting pressure. Most catfish pond owners say they harvested fewer fish than they intended when they stocked the pond. Consider these questions:

- How much fishing pressure will the pond receive?
- Will the anglers be novices or experienced?
- Will most of the fish caught be harvested?
- Does the family regularly eat catfish and do you want to use the pond as a primary source of meat?

Some pond owners practice "catch-and-release," which is the same as not harvesting at all. If you do not plan to harvest many catfish or you want to practice catch-and-release, then stock at low levels.

Consider the pond's size when determining a stocking rate. For family recreation, ponds larger than 1 acre should rarely be stocked at the higher stocking densities. If you stock a 2-acre pond with 1,000 catfish per acre and feed them appropriately, you will have around 2,000 pounds of fish after the first year. The second year the pond could easily have more than 4,000 pounds of catfish. What are you and the family going to do with all that fish?

You should also consider the cost of production. Producing catfish for recreation does not have to be expensive. Before stocking, decide how much you are willing to spend. The cost of fingerlings and feed are the two major expenses (Table 4).

Fingerling prices depend on the number purchased, their size and the supplier. Pelleted feed is usually the

Table 4. Cost per pound of producing catfish based on various fingerling and feed prices.[a]

Cost per fingerling ($)	Feed costs ($ per 50-pound bag)						
	7.50	8.50	9.50	10.50	11.50	12.50	14.00
0.10	0.37	0.41	0.44	0.48	0.51	0.55	0.60
0.15	0.42	0.46	0.49	0.53	0.56	0.60	0.65
0.20	0.47	0.51	0.54	0.58	0.61	0.65	0.70
0.25	0.52	0.56	0.59	0.63	0.66	0.70	0.75
0.30	0.57	0.61	0.64	0.68	0.71	0.75	0.80
0.35	0.62	0.66	0.69	0.73	0.76	0.80	0.85
0.40	0.67	0.71	0.74	0.78	0.81	0.85	0.90
0.50	0.77	0.81	0.84	0.88	0.91	0.95	1.00

[a]Calculated in cents/pound for producing a 1-pound catfish at a feed conversion rate of 1.8 pounds of feed to produce a pound of fish.

single largest expense. On average, between 1 1/2 and 2 pounds of feed produces 1 pound of live catfish. Careless feeding makes the conversion from pounds of feed to pounds of catfish less efficient. Do not:

- Allow the feed to wash up on the bank or into weeds where fish cannot get it;
- Allow large fish to accumulate in the pond; or
- Let the pond become overpopulated by wild fish.

A final consideration is that not all catfish stocked can be removed by angling. Typically, only 60 percent of the catfish stocked will ever be harvested by hook-and-line. Even with heavy fishing pressure, many catfish are never harvested. These "nonbiters" will continue to grow and use pond space, food and dissolved oxygen. To remove this group, you will need to drain or renovate (apply rotenone) the pond, or use other harvest methods (see Harvesting techniques).

Fishing in a catfish pond is best at the end of the first growing season and generally continues through the end of the second growing season. Angling is less successful after this period. Generally, the longer the catfish remain in the pond, the poorer the angling. This is true even if the pond has not been fished much. To maintain good fishing, clean out the pond by seining, draining or renovating at the end of the second or third year. Then the process can begin again.

Probably the best reason to harvest all the fish within 3 years of stocking is the food quality. A 1- to 2-pound catfish is considered prime for eating. Larger fish tend to be fatty, tough and more likely to be off-flavor.

Stocking fathead minnows

It is common to add fathead minnows to catfish ponds that are stocked at low densities (less than 350 catfish per acre). Fathead minnows (or the "rosy red" variety) swim slowly enough to be captured by catfish. However, stock fathead minnows only in catfish ponds that are fertilized and fed only occasionally. Stock between 500 and 1,000 fatheads per acre. **Buy only fathead minnows.** If shiners are mixed in with the fathead minnows, then problems will develop from overpopulation of the shiners.

Acclimation at stocking

Catfish fingerlings should be examined closely before purchasing to make sure they appear healthy (see Diseases). To remain healthy, fish must be stocked correctly. Often fish are transported in cool water of low pH. Temper the catfish fingerlings brought to the pond in hauling tanks by adding pond water to the hauling tank to slowly bring the transport water to the same temperature as the pond (or at least within 2 to 3 ^{o}F of the pond water). This also adjusts the pH of the hauling water to close to that of the pond. The adjustment period should be at least an hour for each 10 ^{o}F difference between hauling water and pond water.

If the catfish are in bags, float the transport bags in the pond for 10 to 15 minutes. **Keep the bag out of direct sunlight.** A plastic bag acts as a magnifying glass and quickly heats the water inside. Next, open the bag and slowly splash water from the pond into the bag. Check the water temperature in the bag and the pond with a thermometer or your fingers. Once the water temperatures are the same (within 2 or 3 ^{o}F), release the fish into the pond. The fish should swim and behave normally after release.

Overstocking and underharvesting

Overstocking and underharvesting are the two most common problems for recreational catfish ponds. These problems can be interrelated and can occur in the same pond.

Overstocking can result from overestimating the size of the pond, the number of catfish you can use, or the carrying capacity of the pond. **Never guess the size of a pond.** Most people overestimate the size of their pond. Measure it carefully. The local Extension or NRCS office can help you measure your pond accurately (see Southern Region Aquaculture Center Publication No. 103, "Calculating Area and Volume of Ponds and Tanks").

Most recreational ponds should not be stocked at more than 1,000 fish per acre, because of the extra time, money, management skills and aeration equipment needed to support this population. Consider that most well-fertilized bass and sunfish ponds can naturally support only 200 to 300 pounds of fish per acre. If you stock a pond with 1,000 catfish per acre, and feed them regularly, the pond will probably have 1,000 pounds of fish after the first year and possibly 2,000 or more pounds of fish after the second year (unless you are harvesting heavily). Somewhere during that second year the pond probably will have surpassed its maximum carrying capacity, unless you are using aeration and have experience in this level of management. For most pond owners, this situation is a fish kill waiting to happen.

Spawning can also lead to overpopulation. Catfish usually do not spawn until age 3 or 4, but once they spawn, the pond will be overpopulated. The simplest way to avoid this is to harvest all the catfish before they reach sexual maturity. Another

method is to stock 20 to 30 largemouth bass fry per acre the second year after the catfish are stocked. Although the bass may grow slowly, they will prey on any young catfish spawned. The bass also help suppress other unwanted fish species that find their way into the pond.

Finally, do not add tires, drums or other structures that encourage catfish to spawn. Catfish spawn in any kind of cavity or hole.

Underfishing or underharvesting is the other common problem with recreational catfish ponds. You would never plant and tend a vegetable garden but not harvest the crop. Unfortunately, this situation is all too common in many recreational catfish ponds. Underharvesting usually leads to an overcrowded catfish pond that exceeds its carrying capacity. Overcrowded ponds eventually have water quality or disease problems that drastically reduce the catfish population. Do not make catfish your pets just because you enjoy feeding them. **Harvesting catfish is an essential part of successful management.**

Feeding catfish

Feeding catfish can greatly increase production and allows for higher stocking rates. Feeding the right feed in the correct amounts is critical. The quality and amount of feed directly affects not only the catfish growth and health of the catfish, but also the water quality. Poor water quality is usually caused by poor feeding practices.

Pond owners can be confused by the differing protein, fat, vitamin and mineral contents of commercially available fish feeds. Commercially available catfish feeds marked **complete** contain all essential nutrients for good growth. These complete feeds are usually 26 to 36 percent protein and are labeled specifically for catfish. Do not feed bread, corn, dog food, etc., and expect good growth. In fact, feeds other that those manufactured specifically for catfish usually cause more water quality problems than catfish feeds and can cause nutritional diseases.

Floating and sinking pelleted feeds are available for feeding catfish, but floating feeds are generally best. Sinking feeds are usually less expensive, but do not allow the pond owner to readily observe feeding behavior. Observing feeding behavior is the best way to determine the overall health and vitality of the catfish, and helps the manager know how much to feed.

Catfish usually respond best if fed in early morning or late afternoon, but they can be trained to eat anytime. Feed them where the wind does not push the feed into shore, or use feeding rings to contain it (Figure 3). Catfish do not readily eat at the surface if the water is less than 50 ^{o}F. Therefore, in cold weather, catfish are usually not fed.

Figure 3. Floating feeding ring.

Tables 5 and 6 offer research-based guidelines for feeding catfish according to water temperature and pounds of fish per acre of pond. The feeding rates in these tables are generally between 2 and 3 percent of body weight during optimum temperature periods. These rates produce rapid growth during the first and second growing seasons.

Most ponds can support a feeding rate of up to 35 pounds per acre per day during warm weather without having critical water problems. However, some emergency aeration may be needed even at these feeding rates. **A general rule of thumb is to feed all that the fish will eat in 10 to 15 minutes, but not more than 35 pounds per acre.**

To maintain feed quality, it is vital to store it properly. Store feed in a cool, dry place away from insect and rodent contamination. Bacteria and fungi can destroy the feed's nutritional value and can produce toxins that stress or kill catfish.

Note that at lower temperatures, catfish are fed either every other day or only twice a week. Many managers mistakenly believe that catfish do not eat when the water is cool, because they see that the catfish stop feeding in the fall. Catfish stop feeding for a few days or even weeks in the fall after water temperatures drop rapidly after a cold front. However, they start feeding again as they adjust to the lower temperatures.

If you want to feed the fish in the winter, test their feeding response a week or so after a cold front. Pick warm, sunny days to feed during the winter. **Winter feeding is not absolutely necessary.** Catfish will survive the winter without any feed except the natural pond food they find. In fact, recent research suggests that not feeding the catfish from January through March may stimulate their immune system, which helps them resist diseases better in the spring.

Catfish can be fed for rapid growth or for maintenance. Usually, catfish are fed for rapid growth the first year and possibly the second. After they have grown to the desired size, feed them only a maintenance ration to keep them healthy, yet prevent rapid growth. A maintenance

Table 5. Common feeding rates for first-year (spring-summer-fall) catfish ponds stocked with 5-inch fingerlings.

Date	Water temperature °F	Water temperature °C	Fish size (lb.)	Feed allowance per day, % of fish weight	Pounds of feed per 350 fish[a]	Pounds of feed per 1,000 fish[b]
4/15	68	20.0	0.04	2.2	0.3	0.9
4/30	72	22.2	0.06	2.8	0.6	1.7
5/15	78	25.5	0.11	3.0	1.2	3.3
5/30	80	26.7	0.16	3.0	1.7	4.8
6/15	83	28.3	0.21	3.0	2.2	6.3
6/30	84	28.9	0.28	3.0	2.9	8.4
7/15	85	29.4	0.35	3.0	3.7	10.5
7/30	85	29.4	0.42	2.8	4.2	11.8
8/15	86	30.0	0.60	2.4	5.0	14.4
8/30	86	30.0	0.75	2.0	5.2	15.0
9/15	83	28.3	0.89	1.8	5.5	16.0
9/30	79	26.1	1.01	1.6	5.5	16.0
10/15	73	22.8	1.10	1.2	4.5	13.2

[a]Feed only 3 days/week.

[b]Feed 6 days/week.

Table 6. Ranges of feeding rates for recreational catfish ponds.

Pounds of fish per acre	Temperature 45-50[a]	51-64[b]	65-85	86-90[c]
	Pounds of feed per acre per day			
	low–high	low–high	low–high	low–high
250	0.5-1.0	2-5	5-7	3-5
500	1-2.5	3-10	10-15	6-10
750	2-3.5	4-15	15-22	9-15
1,000	2.5-5	7-20	20-30	12-20
1,500	3.5-7.5	10-30	30-35 (45)[d]	18-30

[a]Feed only twice a week at these temperatures.

[b]Feed every other day at these temperatures.

[c]Feed is reduced at high water temperatures because of potential oxygen problems.

[d]Pounds of feed **only** if emergency aeration equipment is available (in parenthesis).

ration is 0.5 to 1 percent of body weight per day when water temperatures are above 65 °F. For example, if you estimate that the pond contains 1,000 pounds of catfish, then a maintenance ration would require feeding only between 5 and 10 pounds of feed a day. They will still grow some even on a maintenance ration, because of natural food.

Never feed moldy feeds. Moldy feeds can cause an anemic condition in catfish called "no-blood" disease. A catfish with no-blood has clear, not red blood. No-blood can kill catfish. If you encounter no-blood disease, stop feeding, throw away that batch of feed and buy new feed.

Feed quality, particularly vitamin and mineral content, deteriorates over time. Always buy feed from a reputable manufacturer and dealer. Check the date of manufacture. Feeds start to lose vitamin and mineral content 60 days after the manufacture date and probably should not be fed. **Do not use feed left over from a previous year.**

Several years after stocking, it becomes very difficult to know the number and weight of catfish in a pond. One way to estimate the total weight of fish in a pond is to use an assumed feed conversion. **This method requires good feeding records.** Generally, 2 pounds of feed produce 1 pound of catfish. Therefore, if 2,000 pounds of feed have been fed, then the stocked catfish have gained 1,000 pounds. If you add this estimated gain to the original stocking weight and subtract the total weight of all catfish you have harvested from the pond, you can come up with an estimated weight of fish remaining in the pond:

Estimated fish weight = (total feed fed ÷ 2) + original stocking weight – fish weight harvested

You can double-check this estimate by using the feeding rates in Table 6 and measuring the amount of feed they eat in a day. For example, if you estimate that the pond contains 1,000 pounds of fish based on the above formula, then on a day when water temperature is between 80 and 85 °F, if you're right, the catfish will eat about 30 pounds of feed (based on Table 6). It is probably best to take an average feed consumption over several days, to make sure weather is not a factor on a single day.

If the catfish are eating much less than Table 6 estimates, then fish are missing. You may have a predator problem (birds, otters, humans) or death losses from disease or poor water quality. If they eat much more than Table 6 estimates, then you have more fish or larger fish than you thought.

One of the most important things to remember is to not overfeed. A pond can process or decompose only a certain amount of fish waste and uneaten feed per day. **Overfeeding causes most water quality problems, and poor water quality leads to disease outbreaks and possibly**

fish kills. That is why the 35 pounds of feed per acre per day is the maximum recommended for recreational ponds. Even then, some emergency aeration may be needed. Many recreational catfish pond owners like to feed only 4 to 6 days a week, to give the pond more time to process or decompose wastes.

Water quality

Each pond is unique and behaves slightly differently from others, depending on seemingly minor differences in soils, watersheds, nutrients and algal blooms. Blooms are made up of many species of microscopic algae, and these species constantly interact and change. Some species are dying out; others are undergoing population explosions. Although we know that some of these changes are governed by temperature, available nutrients, competition and light intensities, the overall the process is poorly understood. All these physical, chemical and biological variables affect water quality.

Dissolved oxygen

Dissolved oxygen is probably the single most important water quality factor that pond managers must understand. First, oxygen dissolves in water at very low concentrations. Our atmosphere is 20 percent oxygen (or 200,000 ppm), but seldom will a pond have more than 0.001 percent (10 ppm) oxygen dissolved in its water.

Dissolved oxygen concentrations below 3 ppm stress most warmwater species of fish, and concentrations below 2 ppm will kill some species. Catfish are stressed by dissolved oxygen concentrations between 2 or 3 ppm, making them susceptible to disease. Concentrations from 1 to 2 ppm will kill many if not all catfish in a pond, depending on how long the depletion lasts.

Oxygen dissolves into water from two sources: from the atmosphere and from plants in the water. Its primary source is phytoplankton, which produce oxygen, through photosynthesis in the presence of sunlight, and release it into the pond water. At night and on very cloudy days, algae remove oxygen from the water for respiration. Normally, algae produce more oxygen than they consume, thus providing oxygen for the fish and other organisms in the pond.

Oxygen depletions are the most common cause of fish kills in ponds. Most oxygen depletions occur in the summer, because warm water holds less dissolved oxygen than does cool or cold water. Oxygen depletions can kill some or all the fish in a pond. In a partial fish kill, the dissolved oxygen level drops low enough to suffocate sensitive species and large fish, but many small fish and hardy species survive. Most oxygen depletions cause partial fish kills; total fish kills are relatively rare in recreational ponds except for those with extremely high numbers of fish (more than 1,000 pounds per acre).

Low oxygen is often caused by an imbalance in the phytoplankton community. Although an oxygen depletion can sometimes be predicted before it occurs, it can develop suddenly without warning. The following are descriptions of the most common causes of oxygen depletions.

Excessive phytoplankton

The abundance of planktonic algae in a pond is generally related to the amount of nutrients, mainly phosphorus, in the water. This is why we use fertilizers with high phosphorus percentages to stimulate a phytoplankton bloom. Aside from fertilizers, other nutrients can wash into the pond from woods, pastures, fields or human activities in the watershed.

Generally, the more nutrients, the more the planktonic algae will grow or bloom. Although this phytoplankton is good in that it produces much oxygen and natural food, it can become too abundant or excessive. When it becomes so abundant that water visibility is limited to less than 12 inches (Figure 1), the oxygen is in danger of becoming depleted. These heavy or dense blooms use much dissolved oxygen at night and on very cloudy/overcast, windless days, depleting oxygen and killing some fish. This problem is often caused by overfertilizing, overfeeding or excessive nutrients from livestock.

Phytoplankton die-off

Phytoplankton populations or blooms can grow rapidly, particularly on sunny days when the water is warm and nutrients are available. They also can die off quickly, especially in the spring and fall as water temperatures change rapidly with weather fronts. However, a bloom die-off can occur at any time of the year with little or no warning.

Typically during a bloom die-off, the color of the water starts to change. Leading up to a bloom die-off, the pond water may have a "streaky" appearance. Streaks of brown or gray-black through the otherwise green water of the pond indicate that the algae are starting to die. As the die-off progresses, the whole pond turns from green to gray, brown or clear. The pond water typically clears after a die-off as the dead algae settle to the bottom.

Plankton die-offs deplete oxygen quickly because:

- Bacteria and fungi consume the remaining dissolved oxygen in the process of decaying the dead algae; and
- Few live phytoplankton remain to produce oxygen.

In many cases of bloom die-offs, the bloom was too dense. Secchi disks can be used to monitor bloom

densities. Any bloom that reduces visibility in the pond to 12 inches or less may cause oxygen problems.

Turnovers

Probably the least understood but most commonly reported cause of an oxygen depletion is a pond turnover. As ponds warm in the spring, they become stratified or layered, with warm water on the surface and cooler water below. This temperature stratification also leads to an oxygen stratification, with the warm surface water containing dissolved oxygen (and fish) while the deeper cool water becomes depleted of oxygen because of decomposition and lack of sunlight for photosynthesis. This is particularly true in deep ponds (more than 8 feet). In fact, the deeper the pond, the more likely a turnover.

The problem occurs when this stratification breaks down quickly, causing the two layers to mix or "turn over." The turnover mixes the oxygen-rich surface water with the deep oxygen-depleted water. The mixed water can have too little dissolved oxygen to support life in the pond. Both fish and plankton can die from low dissolved oxygen after a turnover.

A turnover occurs only if the surface water is cooled quickly so that it is close to the temperature of the deep water; then they can mix. Thus, a turnover can happen if a cold rain and wind cools the surface water, such as with thunderstorms. Many people confuse a turnover with an algae die-off. Although outwardly they can look very similar, without a cold rain and wind there can be no turnover.

Aquatic herbicides and oxygen depletions

Treating a heavy infestation of aquatic weeds with a herbicide during the summer can cause an oxygen depletion. The mass of aquatic weeds quickly decomposes, depleting dissolved oxygen as in a bloom die-off.

It's risky to treat weed infestations with herbicides in hot weather. The risk of an oxygen depletion can be lowered by treating only part of the pond at a time. Treat 25 percent or less at a time, then wait 2 weeks so that decomposition is complete before the next treatment.

Aeration

By following the recommendations discussed previously, you can minimize the risk of a fish kill caused by an oxygen depletion. However, even a lightly stocked pond can suffer an oxygen depletion. Some ponds have a history of fish kills caused by oxygen depletions.

Mechanical aeration usually can save fish during an oxygen depletion. Many types of aerators are available commercially, including tractor PTO-driven paddle wheel and pump-sprayer aerators, which can be purchased commercially or built by a competent welder. Water pumps and bush hogs (blades just touching the surface) can also be used for emergency aeration. If you use a pump, pull water from near the surface (upper foot), not off the bottom of the pond. Many types of electric aerators are available for ponds with electrical service. Generally, $^1/_2$ to 1 horsepower of aeration per surface acre of pond is enough for recreational ponds.

Other water quality considerations

Ammonia and nitrite kill catfish. These toxic compounds come from the digestion of feeds and the decomposition of all types of organic material. Overfertilizing, overfeeding, carrying too many pounds of fish, run-off from large numbers of livestock, or decomposition of blooms or aquatic weeds are the principle ways these compounds reach toxic levels in a pond.

Prevention is the key to managing ammonia and nitrite. If ammonia or nitrite problems develop, flushing with fresh water is one possible solution. Unfortunately, flushing usually is not an option. Have a nitrite test performed to determine if the problem is nitrite. If so, add livestock salt to the pond to counteract its toxic effects (see Table 7). The only other measure a manager can take is to aerate to help to reduce the stress on the fish and to speed decomposition of these toxic substances.

Easy-to-use and inexpensive water quality test kits are available from several manufacturers. These test kits use color changes or comparisons to allow managers to read water quality measures. Pond managers who stock more than 1,000 catfish per acre or have more than 1,000 pounds of fish per acre should buy these test kits and keep them available when water quality or disease problems appear.

Table 7. Guidelines for water quality problems in recreational catfish ponds.

Parameter	Concentration	Possible management
Dissolved oxygen (D.O.)	Below 3 ppm	Aerate
Total ammonia	Above 1 ppm	Aerate pond if D.O. is below 5 ppm; flush with fresh water (if available)
Nitrite	Above 0.5 ppm	Aerate pond if D.O. is below 5 ppm; Add 135 pounds of salt per acre foot of water for each ppm of nitrite or flush with fresh water (if available)

Off-flavor

Fish that smell and taste earthy, musty or some other undesirable flavor are said to be off-flavor. Most off-flavor is caused by certain types of bacteria and algae common to ponds. It is most common during warm months. There is no known cure or management. Pond conditions will change over time and off-flavor will eventually be purged from the fish.

Harvesting

If you have stocked moderately to heavily and fed the catfish regularly, then it is prudent to harvest at least half the fish before the next year's growing season. Otherwise, the pond will exceed its carrying capacity, and you're likely to lose fish because of poor water quality.

Fish can be harvested by seining, trapping, trotlines, bank hooks, angling, or a combination of all these methods.

Seining and trapping

A $1^1/_4$- to $1^1/_2$-inch seine mesh is best for harvesting food-size catfish. Seines can be ordered in almost any length and depth from netting companies. The seine should be 50 percent longer and deeper than the pond width and depth. This allows the seine to bow as it is pulled through the pond. Treat the seine with a commercial net coating to help keep the catfish spines from tangling in the net. Seining is more successful if the pond's water level is lowered to concentrate the fish and reduce the area to be seined.

An alternative to seining the entire pond is to use a trap seine (Figure 4). A seine is set up parallel to the shore or in a corner of the pond in an area with a smooth bottom. Stretch out the seine except for a length of seine equal to the distance to shore, which is bunched-up at each end. Tie ropes to the ends of the seine and extend them to the shore. Then feed the catfish between the shore and the seine until they are no longer afraid of the seine (usually a week or two).

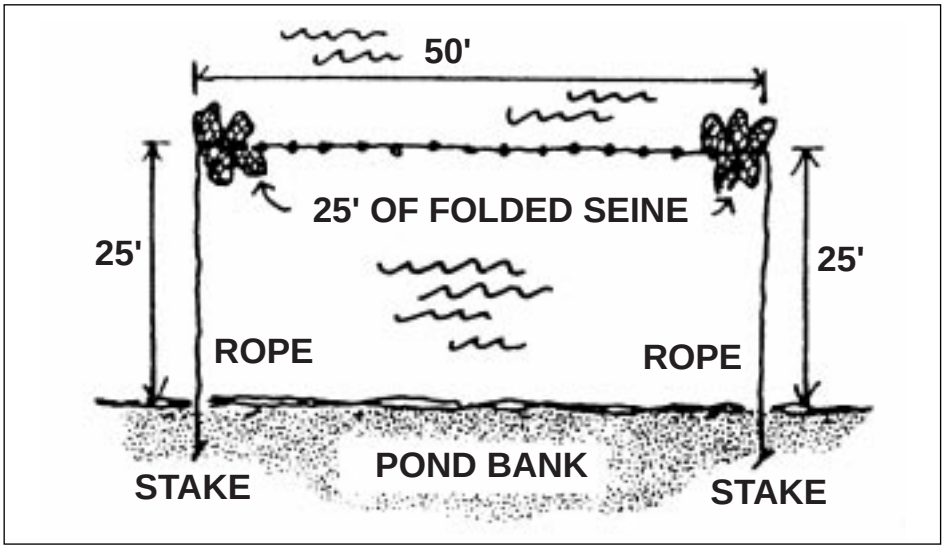

Figure 4. Trap seine layout.

To harvest, introduce a little feed in the trap area, then pull the ropes in when the fish are in the trap until the ends of the seine are to shore, thus trapping the catfish. Then pull the seine into the shore and harvest the catfish. A 100-foot-long seine is usually enough to trap a small pond.

Although trap seining will not catch all the catfish in the pond, it can be used over time to catch 70 to 90 percent of them. Once the trap is used, it takes several days to weeks before the catfish feed aggressively in the trap area so the trap can be used again.

Angling

Most pond owners prefer to harvest their catfish by angling. Catching catfish even from a heavily stocked pond can be difficult. Catfish become wary of angling techniques over time. In most cases, catfish bite better in well-fed ponds. In fact, one way to catch catfish is to fish with bait near the surface (1 to $1^1/_2$ feet deep) while feeding a floating feed.

Earthworms, catalpa worms, shrimp, crayfish, cut bait and dough or stink baits are all good catfish baits. Do not use minnows or live sunfish as bait because you might introduce diseases or unwanted species to the pond.

Trotlines, bank hooks and traps

Trotlines and bank hooks can be used successfully to harvest catfish. They are best if baited then left "set" for several hours then "run" or checked and rebaited. Usually these are best if fished at night. Do not leave trotlines and bank hooks baited after fishing is finished.

Box or tunnel traps are wooden or wire traps with one or more funnel openings or "throats." These traps are usually placed in 3 to 4 feet of water, marked with a float, and baited to attract fish. Baits usually include either scrap cheese, cottonseed meal or fish feed. Fish attracted to the bait enter the trap through the throat but cannot escape.

Diseases

Diseases can be a problem in recreational catfish ponds. However, disease outbreaks are usually associated with poor water quality, overpopulation or poor nutrition. Man-

agers of catfish ponds should watch for:

- Sudden color changes in the pond water;
- Sudden changes in catfish feeding behavior;
- Catfish flashing or swimming erratically; and
- Catfish lying in shallow water, at the surface or near in-flowing water.

Sudden changes in water color can signal a bloom die-off. Changes in feeding behavior can indicate that the fish are stressed, unless the weather has changed drastically (such as with a cold front). Any kind of erratic behavior, whether swimming or staying near the surface, is a sign of stress or disease.

At the first sign of stress, check for poor water quality. **Check dissolved oxygen, ammonia and nitrite concentrations** (see Table 7). Catch a few fish using a dip net, seine or cast net (not hook-and-line). Look for open sores, swollen or eroded areas on the body, fins and gills or a heavy slime covering the body. **If you spot any of these symptoms, take or ship a water sample and two or three fish with the symptoms to a trained fish disease diagnostician.**

Controlling pond pests

Predators are not usually a serious problem in most recreational catfish ponds. However, you can take steps to discourage predators, reduce fish losses and lessen damage to pond banks.

Although water snakes eat fish, ponds usually have too few of them to cause serious problems, except that people typically dislike being around snakes. The burrowing activities of nutria, muskrats and beavers can seriously damage pond dams and banks. Keep the grass and weeds closely mowed around the pond to help eliminate the habitat for snakes and muskrats.

Turtles are another common pond inhabitant. Snapping turtles occasionally eat fish, but most other turtle species do not threaten catfish. Turtles eat catfish feed and often are a nuisance to anglers who fish with bait. You can build or buy traps to catch turtles. Remember: Some turtle species are protected because of their threatened or endangered status. Check with Texas Parks and Wildlife Department biologists if you have questions about protected turtle species.

Most wading and diving birds are fish predators. Cormorants, anhingas, herons and egrets are the most notable fish eaters. Each cormorant, for example, eats about 3 pounds of fish per day, and they often travel in flocks. All of these birds are migratory and therefore protected by federal and state laws. However, while it is against the law to kill these birds, it is legal to scare or harass them. Gunfire, firecrackers, noise makers, scarecrows, and owl or hawk models have been used to scare these birds away from ponds. Also, removing dead standing timber from in and around ponds will eliminate perching and roosting sites for some of these species.

Conclusions

Catfish ponds managed at low to moderate stocking and feeding levels require minimum management effort, yet provide highly enjoyable angling and excellent fish flesh. If the fish are stocked, fed and harvested properly and the water quality is kept high, the ponds will offer outdoor recreation for family and friends as well as fresh, farm-raised, contaminant-free, great-tasting catfish.

Cover photograph by Jerrold Summerlin

Produced by Agricultural Communications, The Texas A&M University System

Extension publications can be found on the Web at: http://agpublications.tamu.edu

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Chester P. Fehlis, Deputy Director, Texas Agricultural Extension Service, The Texas A&M University System.

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