

M A N A G E M E N T O F
R E C R E A T I O N A L

CATFISH PONDS

I N A L A B A M A

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Recreational catfish ponds are almost as common in the southeastern-United States as bass and bream recreational ponds. Catfish are ideal for stocking recreational fishing ponds, because (1) they can be grown at higher densities than other sportfish; (2) they readily consume pelleted feeds; and (3) they are well suited for use in small ponds that allow easy fishing access to anglers of all ages and skill levels. Although often overshadowed by more "glamorous" sportfishes, such as largemouth bass or crappie, the channel catfish is an excellent fighter on light to medium tackle. Many landowners also like catfish ponds for the excellent quality of catfish flesh. This publication is designed to help landowners who are trying to decide if a recreational catfish pond is what they want and to assist pond owners in managing their recreational catfish ponds.

It is generally **not** recommended that ponds smaller than 1/2 acre be stocked with bass and bream because of the difficulties in managing them. However, ponds of almost any size can be managed as recreational catfish ponds.

Pond Preparation

Good pond management begins with pond preparation. A landowner may want to use an existing pond or to build a new pond. In either case attention must be paid to properly constructing the pond, finding the water source, controlling wild fish, liming, fertilizing (if necessary), and controlling aquatic weeds.

If you are considering constructing a new pond, technical assistance may be available from the USDA Soil Conservation Service (SCS). The SCS maintains offices in most counties, and many SCS offices can assist landowners with site selection, design, and supervision of pond construction.

Water Source

One of the first considerations for any fish pond is the quality of the water source available to fill the pond. Recreational ponds are usually filled from rain runoff. The area that channels runoff water to the pond is called the **watershed**. Ponds should **not** be built in watersheds that have excessive livestock, particularly feedlots, or industrial or mining activities that could contaminate the pond. Other sources of water that can be used to fill the pond include wells or surface water pumped from a nearby creek. Well water is usually an uncontaminated source of water. Creek water must be filtered as it enters the pond to remove fish and fish eggs so that the pond will not become populated with undesirable species.

Unwanted Fish

A common frustration when managing ponds for catfish is the invasion and overpopulation of unwanted fish. Catfish ponds are often invaded by sunfish (bream), common carp, bullheads, shiner minnows, and shad. These species overpopulate, compete with the catfish for available food and oxygen, and increase the likelihood of disease. Before stocking catfish, carefully check the pond for unwanted fish. If any fish are found eliminate them, using rotenone.

Rotenone is the only registered pesticide for the removal of fish. Rotenone was reclassified as a "**restricted use**" pesticide by the U.S. Environment Protection Agency (EPA) in **1991**. This classification means that rotenone can only be purchased by individuals with a pesticide applicators permit. Check with your county Extension office for assistance in obtaining a permit or confer with a fisheries consultant about having the pond renovated. See your county Extension office or Ex-

tension Fisheries or Aquaculture Specialist for additional information on the use of pesticide applications in ponds.

Liming

Most soils in Alabama are acidic. Acidic soils cause pond water to be acidic, which can be stressful to fish and make it difficult for a "bloom" to develop. A bloom (microscopic algae that give ponds their typically greenish or brownish color) provides some food to catfish but, more importantly, a bloom helps control water quality and aquatic weed problems. Manage acidic soils by adding **agricultural limestone**.

The amount of limestone needed to neutralize acidic soils depends upon the soil characteristics. A soil or mud sample should be analyzed to determine the amount of limestone needed to neutralize acidity. For information on collecting pond soil samples and on spreading limestone in ponds, see your county Extension Agent and ask for Circular ANR-232, "Liming Fish Ponds." Once a pond mud sample has been properly collected, send it to the Auburn University Soil Testing Laboratory for analysis.

Agricultural limestone applied over the entire pond will neutralize acidic pond mud and slowly dissolve into the pond water, causing an increase in alkalinity. Over time, the dissolved limestone is washed out of the pond with overflowing water. Ponds usually need to be limed every 2 to 4 years, depending on the amount of limestone added to the pond and the amount of water that flows through the pond. To increase the interval between limestone applications, many pond owners find it practical to increase the liming rate by two to three times the amount recommended by soil tests.

Liming increases alkalinity, which encourages production of an algae bloom when fertility is good. Most ponds require the application of chemical fertilizer or the feeding of commercial fish feeds to develop a good algae bloom. For information on fertilization of ponds, ask your county Extension agent for Circular ANR-249, "Fertilizing Fish Ponds." As noted before, the algae bloom provides some food for the fish, helps control water quality, and may help control nuisance aquatic weeds. **Do not fertilize ponds with existing weed problems**

Controlling Aquatic Weeds

Controlling aquatic weeds once they have become established is one of the most perplexing problems faced by pond managers. **The best weed control is prevention!** Preventive measures include

- Constructing pond banks that slope rapidly to a depth of at least 2% feet.
- Stocking grass carp.
- Fertilizing to establish a bloom **before** weeds invade the pond.

Stocking grass carp is the best overall method of weed prevention and control. Grass carp will readily consume most types of rooted aquatic weeds and are inexpensive, given the length of time that they will control weeds (usually 5 to 7 years). A general recommendation for lightly fed catfish ponds (less than 15 pounds per acre per day) is to stock at least 5 grass carp per surface acre in a new pond or a pond with a slight weed problem. If a severe weed problem exists, it may be necessary to stock higher numbers of grass carp (10 to 20 per acre) or to apply a herbicide. Most ponds will need a barrier across the emergency spillway to keep grass carp from escaping during heavy rains. For more information on controlling aquatic weeds using herbicides, stocking of grass carp, and preventing escape of grass carp, ask your county Extension office for Circulars ANR-48, "Chemical Weed Control For Lakes And Ponds"; ANR-452, "Using Grass Carp For Controlling Weeds In Alabama Ponds"; and ANR-326, "Spillway Barriers For Farm Ponds."

Stocking The Pond

Catfish fingerlings are available year-round and can be stocked into recreational ponds at any time of the year. However, relatively little growth is achieved during the winter months and response to feeding is inconsistent. Typically, recreational ponds are stocked from March through May when water temperatures are warming rapidly and catfish fingerlings begin to feed aggressively.

Determining the proper size fingerling to stock depends primarily upon how quickly you want the fish to reach a harvestable size and whether or not bass are present in the pond. At a moderate stocking density with regular feeding, a 5-inch (35 pounds per 1,000, Table 1) fingerling would be the minimum size fingerling to stock in the spring if you want the majority of fish to reach an average size of 1.0 to 1.25 pounds by fall.

Because the cost of fingerlings is relatively low compared to the cost of feed, many pond owners prefer to stock large (6 to 9 inch) fingerlings, which, with adequate feed, will easily reach harvestable size (more than 1 pound) in one growing season. Another advantage of large fingerlings is that their immune systems are better developed, making them less susceptible to diseases than

Table 1. Length-Weight-Cost Relationship For Fingerling Channel Catfish Comparing Cost Per Inch To Cost Per Thousand.

Size (inches]	Weight (lb./1000)	Number of fish (per lb.)	Cost Per Inch of Fingerling (\$)						
			0.005	0.01	0.015	0.02	0.03	0.04	0.05
1	0.7	1428.6	5	10	15	20	30	40	50
2	3.1	322.6	10	20	30	40	60	80	100
3	8.8	113.6	15	30	45	60	90	120	150
4	19.1	52.4	20	40	60	80	120	160	200
5	35.3	28.3	25	50	75	100	150	200	250
6	58.8	17.0	30	60	90	120	180	240	300
7	91.0	11.0	35	70	105	140	210	280	350
8	133.3	7.5	40	80	120	160	240	320	400
9	187.1	5.3	45	90	135	180	270	360	450
10	328.0	3.0	50	100	150	200	300	400	500
11	395.0	2.5	55	110	165	220	330	440	550
12	509.0	1.9	60	120	180	240	360	480	600

smaller fingerlings. Large catfish fingerlings are not easily preyed upon by largemouth bass. A fingerling at least 8-inches long should be stocked in ponds that have established bass populations.

Determining The Number Of Fish To Stock

One of the first and most important decisions to be made in managing a recreational catfish pond is how many catfish to stock. **There is no single stocking rate that is right for every pond owner.** Important considerations **before** stocking the pond include measuring pond size, examining your fishing habits, estimating the availability of time for managing the pond, and determining the amount of money you are willing to spend to produce your fish. When these considerations have

been satisfactorily addressed, identify the amount of catfish that your pond will safely support at the level of management that you are willing to provide (see Table 2). With this information, you will be able to determine the number of catfish to stock that is right for your fishing habits, available time and money, and pond size.

The first consideration when deciding on a stocking rate is to determine the amount of fishing pressure that you expect the pond to receive. Keep in mind that many new catfish pond owners don't fish their ponds as heavily as they initially thought they would. Similarly, some owners practice "catch and release," which, from a management standpoint, is the same as **not** fishing at all. Catch and release is acceptable as long as stocking rates are

Table 2. Guidelines For Stocking Recreational Catfish Ponds.

Density(a)	No. Fish Per Acre	Management(b)
Very Light	up to 100	No fertilizer or feed necessary.
Light	100 to 350	Regular fertilization or occasional light feeding.
Moderate	350 to 700	NO FERTILIZATION; feed 3 to 6 times per week.
Mod./Heavy	700 to 1,000	DO NOT FERTILIZE; feed 4 to 6 times per week.
Heavy(c)	1,000 to 1,500	DO NOT FERTILIZE; feed 5 to 7 times per week.
Very Heavy(c,d)	1,500 to 2,000	DO NOT FERTILIZE; feed 6 to 7 times per week.
Commercial Rates(e)	more than 2,000	DO NOT FERTILIZE; feed 7 times per week. Not recommended for recreation ponds. Emergency aeration required. Test water quality regularly.

- (a) Density level descriptions are for first year only; density will be higher in following years if fish are not harvested regularly.
- (b) See Tables 4 and 5, "Feeding Catfish in Recreational Ponds"; do not exceed a maximum feeding rate of 35 lb./acre/day.
- (c) Ponds stocked at these rates must be fished heavily to prevent overcrowding.
- (d) Not recommended for ponds larger than 1 acre.
- (e) Not recommended for recreational ponds.

maintained low enough to reflect this practice. However, the term "fishing" as used in this publication will refer to both the catching and the removing of fish from the pond.

Consider the following questions: How much fishing pressure will your pond receive? Will additional family or friends fish the pond regularly? Will the pond users be primarily novices or experienced anglers? Does your family eat catfish often and hope to use the pond as a primary source of meat? Try to determine the number of anglers who will fish the pond and their fishing frequency

Pond owners should also consider their pond's size when determining a stocking rate. For family recreation, ponds larger than 1 acre should rarely be stocked at the higher densities. For example, a Z-acre pond stocked with 1,750 fish per acre will, with adequate feeding, produce **3,500 pounds** of catfish by the end of the first growing season-an **excessive amount of catfish for most families!** Larger ponds stocked at the higher rates are invariably underfished and suffer from problems associated with overstocking.

Another important factor for catfish pond owners to consider is that not all of the catfish stocked can be removed by fishing. Typically, **only about 60 percent of the catfish stocked will be harvested by hook-and-line.** This factor must be considered when determining a stocking rate, because, even with heavy fishing pressure, many of the fish will remain unharvested. This inventory of "non-biters" will continue to grow, consuming feed and taking up pond space but will **not** be harvested by traditional fishing methods. They may, however, be harvested by other means (see Alternative Harvesting Methods, page 12).

The cost of producing the crop of catfish should also be considered. Raising catfish for personal recreation does not have to be expensive. However, pond owners should decide how much money they are willing to spend on the project

before stocking fish. The two primary production costs are fingerlings and feed, with feed being the most significant of the two costs. The price of catfish fingerlings for stocking generally ranges from about 5 to 40 cents each, depending upon size, number purchased, and the supplier. The cost of growing catfish varies with the cost of fingerlings, feed, and the feed conversion rate (see Table 3). On average, catfish consume 1.8 to 2 pounds of feed per pound of gain. Careful feeding can achieve better results, whereas wasteful feeding practices or the presence of many large catfish (more than 3 pounds) or wild fish in the pond will result in poorer feed conversions.

Stocking rates are based on the amount of pond surface area. Water depth is generally not a consideration as long as the pond area will retain a water depth of 3 to 4 feet throughout the year. Deep ponds will not support more fish and are more likely to have low dissolved oxygen problems resulting from "pond turnover," an event more common to deep ponds (see Pond Turnover, page 11).

Stocking Based On Fish Consumption

Some pond owners may wish to stock their pond based on regular fishing and consumption of the fish. The following formula may be helpful to those pond owners who eat catfish regularly and wish to stock a pond to meet their needs.

Two pounds (liveweight) of catfish will yield a **very generous** serving of approximately 1.2 pounds (60 percent yield) of dressed whole fish or about 0.7 pounds (35 percent yield) of boneless fillet. To estimate an average yearly family consumption of catfish, we multiply 2 (pounds) by the number of people to be served, then multiply that by the number of days per month catfish will be served, and multiply that by 12 (months per year). Next, we divide by the average size of catfish desired (to be eaten) and multiply by 1.66 (a conversion factor taking into account that only 60 per-

Table 3. Cost (\$) Per Pound Of Producing Catfish Based On Various Fingerling And Feed Prices.(a)

Cost per fingerling (\$)	Feed costs (\$ per 50-pound bag)					
	7.20	8.20	9.20	10.20	11.20	12.20
0.05	0.31	0.35	0.38	0.42	0.45	0.49
0.10	0.36	0.40	0.43	0.47	0.50	0.54
0.15	0.41	0.45	0.48	0.52	0.55	0.59
0.20	0.46	0.50	0.53	0.57	0.60	0.64
0.25	0.51	0.55	0.58	0.62	0.65	0.69
0.30	0.56	0.60	0.63	0.67	0.70	0.74
0.35	0.61	0.65	0.68	0.72	0.75	0.79
0.40	0.66	0.70	0.73	0.77	0.80	0.84

(a) Calculated in cents/pound for producing a 1-pound catfish at a feed conversion rate of **1.8: 1.**

cent of fish will be readily catchable); this gives us the number of catfish needed for a 1-year supply (harvested by fishing). Finally, since the pond will need to be restocked every 2 or 3 years, we multiply by the restocking interval to get the total number of fish to stock initially.

Example

The Griswolds are a family of four who enjoy fishing for and eating farm-raised catfish. They eat catfish an average of 3 times per month and prefer fish of the 1.25 pound liveweight size. How many catfish should they stock in their 1-acre pond to meet their needs over the next 2 years?

2	(lb./person)
x	
4	(People)
x	
3	(meals/month)
x	
12	(months/year)
288	pounds
.	
1.25	(pound preferred fish size)
230	fish
x	
1.66	(conversion factor)
382	(catfish/year)
x	
2	(years before restocking)
764	catfish to stock for a 2-year supply to be harvested.
764	fish
x	
1.25	pound average size
955	total pounds of production in the 1 acre pond.

Table 1 shows this production rate within the “moderately heavy” range of fish density. This rate is acceptable **only if the pond is harvested regularly** by either fishing, trapping, or seining.

Note: Total number of fish stocked and pounds produced should always remain within the “safe” range for the carrying capacity of the pond. For information on pond stocking rates see Stocking the Pond, page 4.

Most of the fish in the example should grow to the desired average size of 1.25 pounds each within the first growing season. After the first season

catfish should be fed at a maintenance level to limit further growth yet maintain fish health and condition (see Feeding Catfish, page 8).

The best fishing will occur near the end of the first growing season, as fish reach harvestable size, and should continue throughout the second growing season. Fishing success will decline substantially by the third growing season following stocking. Generally, the longer the catfish remain in the pond the poorer the fishing will become. This is true even in ponds that have received little fishing pressure. To maintain excellent fishing we recommend that catfish ponds be “cleaned out” by seining, draining, or renovating (see Pond Preparation, page 3) at the end of the second or third growing season and restocked, starting the process over.

Two Common Problems To Avoid: Overstocking And Underfishing

The two most common problems associated with recreational catfish ponds are those of overstocking and underfishing (or underharvesting). These two problems are closely associated, often occurring together in the same pond.

Overstocking

Overstocking results primarily from overestimating the size of the pond or not understanding the number of fish that can be safely supported by the pond. Pond size should not be determined by “guessing”; if the actual area is much smaller than estimated, the result will be an overstocked pond.

Know the exact area of the pond prior to stocking. Pond area can be calculated by visualizing the pond as a common shape, such as a square or rectangle, and then measuring or pacing the sides and multiplying length by width to determine the total number of square feet. Divide the number of square feet by 43,560 square feet per acre to determine the acreage of the pond (see SRAC Publication No. 103, “Calculating Area and Volume of Ponds and Tanks”). If the pond was built with assistance from either the SCS or the Agricultural Stabilization and Conservation Service (ASCS), your county SCS or ASCS office should have a record of the surveyed pond area.

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

If, for example, you stocked 2,000 fingerling catfish per acre and fed them properly through the first growing season but did not harvest many, you could have well over 4,000 **pounds** of fish per

acre of pond by the end of the second summer. That's more than twice the recommended **maximum** carrying capacity for a recreational pond.

Producing catfish at levels greater than 2,000 pounds per acre is not recommended, because it requires extra time, money, management, and aeration equipment to adequately support the extra production. The additional management problems associated with commercial levels of catfish production (more than 2,000 pounds per acre) would, for most pond owners, take the fun out of having a recreational pond. **It's easier to stock additional fish as needed than it is to remove excess fish from an overstocked pond.**

Underfishing

Most people would never consider planting and tending a vegetable garden without harvesting the crop. Unfortunately, this is all too common an occurrence with many catfish ponds. Underfishing (or underharvesting) can be a serious problem closely related to that of overstocking. A pond stocked within the recommended guidelines with fish fed regularly over one or more years that receives little or no fishing pressure will soon become overcrowded.

For example, a 1-acre recreational pond is stocked at a moderately heavy rate of 1,300 catfish per acre. The fish are fed regularly all they will eat over a period of three growing seasons, and the pond is only lightly fished. The total weight of the fish crop could easily be 3,000 pounds per acre at the end of year two and more than 4,000 pounds per acre by the end of year three—rates well in excess of the 2,000 pounds per acre **maximum** that recreational ponds can typically support without greatly increasing the risk of a major fish kill. **Harvesting your catfish crop by fishing or other means is a step equally as important as stocking and feeding for successful management.**

Fertilization

Catfish can be grown at low densities (up to 350 pounds per acre) without supplemental feeding by applying pond fertilizer at regular intervals. Fertilizer acts to simulate the growth of natural food organisms upon which the catfish feed. In recreational catfish ponds in which the fish are fed commercial fish feeds, applying fertilizer is usually unnecessary and, in fact, undesirable. The practice of **both** regular feeding and fertilization can enrich a pond to the point that a fish kill occurs because of low dissolved oxygen. A bloom normally will establish itself and be maintained from the nutrients in fish wastes. However, early in the

spring before catfish are feeding regularly, it may be necessary to fertilize to establish a bloom to prevent unwanted weed growth. **Once the catfish start feeding actively fertilizer should not be applied to the pond.**

Feeding Catfish

Proper feeding is critical to managing recreational catfish ponds. Pond owners must make decisions about the type of feed to purchase and the amount to feed. The amount and quality of the feed you provide not only directly affects the growth rate and health of the fish but also affects water quality. Poor water quality is often a result of poor feeding practices.

Pond owners can be confused by the different types of feeds available. Commercially available feeds can differ in protein, fat, vitamin, and mineral content and include either floating or sinking formulations. Feed formulations marked **complete** contain all essential nutrients, including vitamins and minerals, to assure adequate nutrition for good growth. **A complete feed should be used so that the fish receive proper nutrition.** Only at very low stocking densities (less than 350 fish per acre) will regular fertilization provide enough natural food to make feeding unnecessary.

Research has shown that feed containing 26 to 32 percent crude protein is sufficient to promote good growth of catfish from fingerlings to adults. Purchasing feeds with a protein content greater than 32 percent is unnecessary.

There are advantages and disadvantages with either floating or sinking formulations. Sinking feeds are usually less expensive, but floating feeds allow the owner to observe the fish. Observation of feeding behavior is one of the best indicators of overall vigor and health of the fish as well as a useful tool in determining the proper amount to feed. Catfish will not feed readily at the surface when water temperatures are cold (less than 50°F). Therefore, many pond owners feed floating feeds during warm weather and sinking feeds during the winter.

Feed storage is extremely important in maintaining the quality of the feed. Feed should be stored in a cool, dry area away from insects and rodents to avoid contamination by bacteria and mold or mildew, which can produce toxins that weaken or kill catfish.

Never feed moldy feeds. Consumption of moldy feed can cause an anemic condition in catfish called "no-blood" disease, which can result in mortalities (see Diseases, page 13). Feed quality, particularly vitamin and mineral content, decreases

Table 4. Common Feeding Rates For First Year (Spring-Summer-Fall) Catfish Ponds, Stocked With 5-inch (35 pounds/l ,000) Fingerlings.

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

Table 5. 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	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
2,000	5-10	12 · 24(35)	35(45)	24(35)

(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 parentheses).

es over time. Always purchase feed from a reputable manufacturer and dealer, check the date of manufacture, and store it properly. **Feed should not be fed after 60 days from the manufactured date. Do not use feed that is left over from the previous season.**

Catfish can be fed for rapid growth or for maintenance. Usually catfish are fed for rapid growth during the first and second years (see Tables 4 and 5). After the fish have grown to the desired size, they should be fed a maintenance ration that will keep them healthy but not allow rapid growth. Continued growth, unless adequate numbers of fish are removed, will result in problems associated with overloading the pond (see Underfishing, page 8).

Catfish will grow rapidly if fed between 2 and 3 percent of their body weight per day when water temperatures are above 65°F. Tables 4 and 5

can be used to calculate feeding rates. For example, if a Z-acre pond was stocked with 2,000 catfish (1,000 per acre), and the fish weighed an average of 1/2 pound each, or a total of 1,000 pounds, the fish in the pond would be fed (from Table 5) between 20 and 30 pounds of feed per day during warm weather. Another common rule-of-thumb is to feed only what the fish will consume in 10 to 15 minutes:

Note that at lower temperatures catfish are fed either every other day or twice a week. Many managers mistakenly believe that catfish do not eat when water temperatures are cool because they cannot observe any feeding activity. Catfish may stop feeding for a few weeks as temperatures fall rapidly at the onset of cold weather but will start feeding again as they adjust to the lower temperatures.

After a pond has been stocked for several years, it is difficult to know the number and weight of fish remaining in a pond. One way to estimate the total weight of fish in a pond is to use an assumed feed conversion. **Good feeding records are necessary when using this method.** Generally 2 pounds of feed will produce 1 pound of catfish. Therefore, if 1,000 pounds of feed has been fed, the weight of the fish crop has been increased by about 500 pounds. If the initial stocking weight of the fingerlings was 250 pounds, the total weight of catfish in the pond would be 750 pounds (250 + 500). From Table 5 the feeding rate should be between 15 and 22 pounds per day if the temperature is between 65°F and 85°F. The feeding response of catfish can be quite variable. The table is meant only as a guide, and your fish may eat more or less than the amounts listed.

One of the most important factors to keep in

mind is to not overfeed the fish in the pond. A pond can process only a limited amount of fish waste each day. **Overfeeding is the cause of most water quality problems and poor water quality leads to disease problems or direct fish kills.** A good rule-of-thumb is **to not feed more than 35 pounds per acre per day without emergency aeration.** Many recreational pond owners feed only 4 to 6 days a week, which reduces the amount of waste the pond must process. Research has shown that feeding catfish all they want to eat every other day improves growth over underfeeding every day.

If you want to keep the catfish healthy but do not want them to grow rapidly, feed a maintenance ration of only 0.5 to 1 -percent of body weight per day when water temperatures are above 65°F. For example, if a pond contains 2,000 pounds of catfish, feed between 10 and 20 pounds of feed per day. Usually some growth will occur on a maintenance ration, particularly if there is some natural food in the pond.

Managing Water Quality

Different ponds seldom react the same even though they may be stocked and fed similarly. Minor differences in the watershed, soil, and nutrients entering ponds can affect water quality. These seemingly minor differences affect the blooms and make ponds appear quite different. Blooms are made up of many species of algae and these species are constantly changing and interacting. Many of these interactions are poorly understood. Because of the numerous physical, chemical, and biological variables, water quality changes in ponds can be unpredictable. Ponds that have been limed, as discussed in Pond Preparation (page 3), are much more predictable than ponds that have not been limed. Pond owners should observe closely and attempt to understand changes that occur in their ponds.

Dissolved oxygen is probably the single most important water quality factor that pond owners must understand. The primary source of dissolved oxygen in ponds is from the microscopic plants called "phytoplankton" or "algae blooms." These blooms of tiny plants impart the typically green or brown color to pond water. In the presence of sunlight, algae blooms produce oxygen through photosynthesis. However, at night and on very cloudy days, phytoplankton only consume oxygen—as much as three to five times the amount of oxygen that the fish consume.

Oxygen depletions are the most common cause of fish kills in recreational ponds. There are

various degrees of oxygen depletion, ranging from "partial," with few or no fish killed, to "total," killing most or all of the fish in the pond. Most oxygen depletions seem to fall somewhere in the middle—killing a significant number of fish but usually not everything. Larger catfish are always the first to die during an oxygen depletion. And, sometimes only larger fish are lost during an oxygen depletion. Typically, dissolved oxygen concentrations below 3 ppm (parts per million) stress catfish, making them susceptible to disease. Prolonged periods below 2 ppm will cause some mortalities, and concentrations below 1 ppm will produce major die-offs. While many ponds may go 20 years or more without a severe oxygen depletion, others seem to have yearly problems.

Low oxygen is often the result of an imbalance in the amount of phytoplankton present in a pond. Sometimes low dissolved oxygen can be predicted before it occurs, but it may also develop suddenly without warning. The following are descriptions of some of the most common types of oxygen depletions.

Planktonic Algae Die-Off

Phytoplankton populations can grow very rapidly, particularly on sunny days when the water is warm and nutrients are available (from feed or fertilizer). Alternately, they can also die-off quickly, especially in the spring and fall of the year when water temperatures fluctuate widely with passing cold fronts. Although more common in the spring and fall, phytoplankton die-offs can occur at any time of the year and can happen for no apparent reason.

During a phytoplankton die-off, the color of the water will usually change. Just prior to the die-off ponds will sometimes have a streaky appearance with streaks of brown or black throughout the pond. As the die-off progresses, a green pond will often turn gray, brown, or clear. Pond water can start to clear after a phytoplankton die-off as the dead algae settle to the bottom.

Plankton die-offs cause rapid drops in dissolved oxygen levels for two reasons: (1) few live plankton algae remain to produce oxygen; and (2) much of the remaining oxygen is consumed through the decay of dead algae.

Excessive Plankton Algae

The abundance of planktonic algae in a pond is generally related to the amount of nutrients, mainly phosphorous, present in the water. Nutrients can enter the pond either indirectly through runoff from pastures and fields or nutrients may be added directly through pond fertilizer

or fish waste. Generally, the more nutrients available the more the phytoplankton will grow or "bloom." When the phytoplankton becomes so abundant that pond visibility is limited to less than 12 inches, the danger of an oxygen depletion increases. A heavy or dense bloom uses large amounts of oxygen at night and on cloudy days. This condition is often a consequence of overfertilizing or overfeeding.

Pond Turnover

As ponds warm in the spring they become stratified or layered with regard to temperature and dissolved oxygen. A stratified pond has a layer of warm water near the surface that contains adequate dissolved oxygen to support fish. The volume of water below the top few feet will be cooler and will contain little or no oxygen.

The problem occurs when the stratification is broken down quickly, causing the two layers to mix or "turnover." The turnover dilutes the dissolved oxygen to a concentration that will severely stress or kill fish and often kills the algae bloom. Spring and summer thunderstorms are usually the culprits: the mixing action from the cool wind and rain causes turnovers that result in fish kills.

Improper Use Of Aquatic Herbicides

Use of aquatic herbicides on heavy infestations of aquatic weeds will almost always result in an oxygen depletion, especially during hot summer months.

When aquatic weeds die as a result of herbicide treatments, they undergo rapid decomposition, particularly during the summer. The decomposition process consumes large amounts of oxygen as bacteria break down the dead weeds, similar to what happens after a plankton bloom die-off.

Treating heavy weed infestations with herbicides in hot weather is risky. To lower the risk of oxygen depletion, treat not more than 25 percent of the weed coverage at one time, allowing ample time for the weeds to decompose between treatments.

Oxygen Depletion Summary

Any of the conditions previously discussed can result in fish losses because of low dissolved oxygen. Also, it is not uncommon to have fish kills as a consequence of two or more conditions occurring together. For example, a heavy plankton algae bloom will sometimes contribute to a rapid die-off of the plankton algae. Also, pond turnovers will usually kill more fish in ponds with dense phytoplankton blooms.

Keeping fish alive during a severe oxygen

depletion is difficult. Most recreational pond owners don't have the sophisticated aeration equipment that is available on commercial catfish farms. Equipment commonly found on farms that can be used to help aerate ponds during an emergency includes bushhogs, gasoline or electric powered pumps, and outboard motors. **It is important not to stir up the bottom mud when trying to aerate the pond.**

Not all fish kills from an oxygen depletion are preventable. However, pond owners can substantially reduce the risk of low dissolved oxygen problems by understanding the various types of depletions and following the recommended guidelines with respect to fish stocking densities, feeding rates, and aquatic weed control.

Aeration

The risk of a fish kill because of an oxygen depletion is greatly minimized when catfish production is kept within the recommended guidelines discussed earlier. However, even in lightly stocked ponds oxygen depletions can occur. Some ponds have a history of fish kills and the owners of those ponds may wish to purchase an aerator. Paddlewheel aerators that operate off the power-take-off (PTO) of a farm tractor are commonly used to aerate catfish ponds. PTO paddlewheels can be purchased from commercial sources or can be built by any one who is a competent welder.

For ponds with electric service there are several types of electric aerators available including vertical pump, propeller aspirator, and paddlewheel models. Generally, 1/2 to 1 horsepower of aeration per surface acre of pond is adequate for recreational ponds. A quick die-off of a heavy bloom or a turnover in a deep pond may require additional aeration. (See SRAC Publication No. 370, "Pond Aeration," and No. 371, "Pond Aeration: Types and Uses of Aeration Equipment.")

Off-Flavor

Off-flavor is a pond condition in which the fish will have an earthy, musty, or other undesirable flavor. Off-flavor is usually caused by certain types of pond algae or bacteria that emit odorous compounds that are readily absorbed by the fish and taint the flavor of the meat. The most common time of the year for occurrences of off-flavor is May through October; however, off-flavor can occur during any month of the year. There is no known cure for off-flavor. Pond conditions will change over time and off-flavor will eventually leave the flesh. Waiting out the problem is usually the only practical method of off-flavor management.

Fishing Techniques

When compared to other southeastern fresh-water fishes, the angling qualities of catfish are second to none. Of course the qualities of channel catfish as table fare are legendary, with demand for farm-raised catfish supporting the largest aquaculture industry in the United States today.

Fishing techniques for catfish are as numerous and varied as the anglers themselves. If "there is more than one way to skin a cat," there is certainly more than one way to catch one. Expensive tackle is not necessary for catfishing. Anglers successfully catch catfish with nothing more sophisticated than a baited hook-and-line on a cane pole. All common types of rod and reel combinations (including a fly rod) can be used to catch catfish.

Bait Selection

Although channel catfish can see food when water conditions allow, it is their highly developed sense of taste that enables them to locate food items in murky water. Taste buds literally cover the entire surface of the catfish. Anglers take advantage of this acute sense of taste by using baits that emit strong odors. Baits in this category include the ever popular chicken livers and the commercially available blood or "stink" type baits.

Other popular catfish baits include the various types of commercially available worms (night crawlers, wigglers, red worms, and pink worms), tuffy or fathead minnows, shrimp, crawfish, cut bait, and catalpa worms (caterpillars.) As channel catfish grow larger, fish become a more important part of their diet, making cut bait a good choice when selectively fishing for big catfish.

Although not typically finicky about the type of bait, catfish can be quite selective at times. When fish are biting slowly, try changing bait types. The chicken or turkey livers that caught fish so well in June may give way to catalpa worms or nightcrawlers in August. Some anglers will "chum" or bait an area with catfish feed to concentrate catfish in the area they wish to fish. Successful anglers are persistent but they're also flexible. Changing bait selections or fishing depths or locations around the pond may be necessary to improve catches.

One caution: do not use live shiner minnows, bream, or shad as bait. These species can escape into the pond to breed and cause problems (see Unwanted Fish, page 3).

Alternative Harvesting Methods

Sometimes pond owners desire to catch large quantities of fish quicker than can typically be

done by hook-and-line. There are several options available for large-scale harvesting depending upon the configuration of the pond and the resources of the owner.

Seining And Trapping

If not too deep or if equipped with a drain, ponds with smooth, unobstructed bottoms can be harvested by seining. The seine should be 3 feet long for every 2 feet of pond width. Use the same ratio for pond depth-3 feet of seine depth for every 2 feet of water depth to be seined. Unfortunately, many ponds require a seine several hundred feet long, which is an expensive piece of equipment for only occasional use.

A less expensive alternative would be to use a trap net or corral seine. A corral seine is basically a short seine net that is set either parallel to the shore or in a corner of the pond where the bottom is smooth and gently sloping. Ropes tied to each end of the net extend to shore. The idea is to get the catfish accustomed to feeding in the area between the net and shore. To harvest, the ends of the seine are quickly pulled to shore with the ropes as the fish begin to feed, trapping the fish between the net and shoreline. The net is then pulled into shore. A net of 100 feet in length is sufficient for trapping in a small pond. For more information on this harvest method see Circular ANR-257, "Corral Seine For Trapping Catfish."

Trotlines And Fish Traps

A trotline is a single long main line from which multiple hooks are attached on short drop lines. The main line is either weighted on each end and marked with a float or is tied to a tree or other object. Trotlines are usually set and baited from a boat, allowed to "fish" for several hours, then "run" or checked to remove any captured fish and to rebait. Trotlines can be an effective method of removing significant numbers of catfish from a pond during periods when fish are biting well.

Catfish box traps or tunnel traps are made of either wood slats or from wire or plastic mesh and contain one or more funnel openings or "throats" at one end. The traps are baited to attract fish, typically with either cottonseed meal cakes or scrap cheese. The fish enter the trap by swimming through the gradually narrowing throat, but once in the trap they are unable to escape. Although more effective for use in streams and rivers, catfish traps can be used with some success in ponds.

Catfish Reproduction

Catfish reproduction can be a major problem in recreational catfish ponds. Reproduction can

lead to overcrowding, stunting, increased occurrence of disease, and increased likelihood of an oxygen depletion.

Channel catfish become sexually mature at 2 to 4 years of age. By the beginning of the second growing season after stocking, some fish may be capable of spawning, and many will reach maturity and spawn by the third season. Contrary to what some believe, catfish can and will spawn in ponds with or without any particular structure on the pond bottom to encourage them.

Survival of the spawned eggs through fry and fingerling stages is highly variable between ponds. In ponds containing other fish, such as bluegill, green sunfish, or largemouth bass, survival of small catfish will usually be low, because of predation by the other species. Also, larger catfish are often cannibalistic on their young. Another factor affecting survival is the number of aquatic insects present, such as diving beetles and dragonfly larvae, which prey upon newly hatched catfish fry.

Pond spawning is usually not a reliable means of replenishing catfish stocks because of variability in survival of the offspring. However, if pond conditions are favorable, survival can be too good and result in overcrowding. Encouraging catfish spawning by providing containers for egg laying is **not** recommended because of the possibility of overcrowding if survival is good. Reproduction can be reduced by stocking a predator into the pond. Largemouth bass have been successfully used to prey on juvenile catfish (fingerlings). Stocking 20 to 30 bass per acre is usually sufficient to control catfish reproduction. The Fisheries Section of the Alabama Department of Conservation and Natural Resources (ADC&NR) will sell bass fingerlings to catfish pond owners. Contact your District Fisheries Biologist with ADC&NR for further information. **Do not stock sunfish (breem) into a catfish pond.**

Restocking

The high catch rates associated with well-managed catfish ponds cannot be sustained indefinitely from a single stocking of fingerlings. Following the second season of growth, fishing success will usually decline substantially. To assure continued good fishing, ponds should be cleaned out of the remaining slow-biting fish after a 2- to 3-year cycle and restocked with fingerlings, starting the cycle over. (See Seining and Trapping, page 12.)

Another good reason to "renovate" (remove existing fish and restock) is to rid the pond of any wild fish that may have accumulated in the pond since the last stocking. Many ponds are fed by wet

weather streams or are subject to frequent overflow at the spillway, both of which allow passage of wild fish into the pond. Wild fish are considered undesirable in catfish ponds as they often carry diseases and will compete with catfish for food and oxygen. Wild fish, such as sunfish and bullheads, are prone to reproduce rapidly in ponds, resulting in an overpopulation of stunted, undesirable fish. These "bait stealers" interfere with catfishing and are considered to be a nuisance by most anglers.

Ponds that have not been invaded by wild fish and those in which catfish reproduction has been controlled by stocking bass may not need to be renovated every 2 or 3 years. Also, many pond owners are not willing to renovate their ponds so often. In these cases catfish fingerlings can be restocked into the pond to replace those that have been fished-out. It is important to keep records on the numbers of catfish that have been removed from the pond so the appropriate number can be restocked. **Remember, do not overstock the pond.** Fingerlings at least 8-inches long should be stocked if bass are present in the pond.

Diseases

Diseases can be a problem in recreational catfish ponds, but disease outbreaks are usually associated with poor water quality, overcrowded conditions, or poor nutrition. Owners of catfish ponds should watch for

- Rapid color changes in the pond water.
- A sudden change in catfish feeding behavior.
- Catfish lying lazily in shallow water or at the surface.
- Catfish flashing or swimming erratically.

Sudden or rapid changes in pond water color can be a sign of an algae bloom die-off. A bloom die-off usually leads to an oxygen depletion. An oxygen depletion can kill or severely stress the fish. Fish that have been severely stressed are susceptible to disease.

At the first sign of stress check for poor water quality. **Check dissolved oxygen, ammonia, and nitrite concentrations** (see Table 6). Catch a few **stressed** fish using a dip net or cast net (do not use hook-and-line). Look for open sores, eroded areas on the fins and gills, pale or swollen gills, heavy mucous (slime) covering the body, or swollen or sunken bellies. **If any of these symptoms are present, take or ship two or three fish exhibiting the symptoms and a water sample to a trained fish disease diagnostician.** For additional information about collecting and shipping diseased fish ask your county Extension

Table 6. Guidelines For Water Quality Problems In Recreational Catfish Ponds(a)

Parameter	Concentration	Possible Management
Dissolved oxygen (D.O.)	Below 3 ppm	Aerate.
Total ammonia	Above 1 .0	Aerate pond if D.O. is below 5 ppm. Flush with fresh water (if available).
Nitrite	Above 0.5	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).

(a) For additional information on water quality, see, Circular ANR-195, "Channel Catfish Production In Ponds."

office for Circular ANR-562, "Guidelines For Collecting And Shipping Diseased Fish."

A nutritionally related (non-infectious) disease known as "no-blood" can cause severe anemia and death in catfish. No-blood gets its name from the little or no red blood that is visible when an affected fish is cut open. Also, the gills and internal organs will be very pale in color.

No-blood disease has been linked to feeding of moldy feeds. Molds growing on feed destroy folic acid, a vitamin essential to catfish. No-blood is frequently observed in recreational catfish ponds where old feed (past 60 days of manufacture) or improperly stored feed has been used. Therefore, the only currently recommended treatment for no-blood is to discontinue feeding the old feed and resume feeding new feed from either another brand or a different lot number of the same brand. However, no-blood is not fully understood and there may be other factors involved in the occurrence of the disease.

Simple to use and inexpensive water quality tests are available from several manufacturers. These test kits employ color changes and color comparisons to read the concentrations of water quality parameters like dissolved oxygen, ammonia, and nitrite. It is recommended that pond owners who stock more than 1,000 fish per acre or have more than 1,000 pounds per acre of catfish in a pond purchase these test kits and have them available when disease or water quality problems appear.

Controlling Predators

Predators are not considered a serious problem for most recreational catfish ponds. However, there are steps that should be taken to reduce fish losses to predators and lessen damage done to pond banks.

Water snakes will eat fish but are not usually present in high enough numbers to cause concern (other than that many people don't like them). Muskrats can do tremendous damage to pond

banks and dams through their burrowing activities. **Controlling muskrats is strongly recommended.** Keeping grass and weeds closely mowed around the pond will help eliminate habitat for snakes and muskrats. Also, muskrats can be removed by trapping or shooting.

Turtles are commonly present in ponds. Snapping turtles will eat fish occasionally, but most other turtles are not a threat to catfish. Turtles will eat some catfish feed, and anglers may have problems with them biting baited hooks. Although not necessary, turtles may be reduced through trapping. Turtle traps are available through commercial fishing supply companies or may be constructed from plans available through your county Extension office. It is important to point out that some turtles are protected. For information on protected turtle species, check with the Wildlife Section of the Game and Fish Division of the Alabama Department of Conservation and Natural Resources.

Permit To Sell Pond-Raised Game Fish

During pond harvest or renovation some pond owners may wish to sell their remaining catfish along with other fish in the pond (bass and bream). There are no restrictions on selling catfish but the sale of game fish for food is restricted in the state of Alabama. However, there is an exception for largemouth bass and bluegill or shellcracker grown in private ponds. The pond owner can sell these fish in conjunction with either pond draining, seining, or trapping.

The Game and Fish Division of the Alabama Department of Conservation and Natural Resources regulates the sale of bass and bream from private ponds at the time of pond draining, etc., through the issuance of a no-cost permit. Pond owners wishing to sell game fish from their ponds should request an application for **Permit to Sell Pond Raised Game Fish** by contacting the Director, Game and Fish Division, Alabama Depart-

ment of Conservation and Natural Resources, J. E. Folsom Administration Building, Montgomery, AL 36130.

Conclusions

Recreational catfish ponds managed at low to moderate stocking and feeding levels require minimum record-keeping and monitoring and are a lot of fun. They are great places to take friends and family who enjoy fishing and being outdoors. As an added bonus, you can serve a wonderful meal with those fresh, chemical free, home-grown, fantastic tasting catfish. **It just doesn't get much better than that!**



ANR-826

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Use pesticides **only** according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label.

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