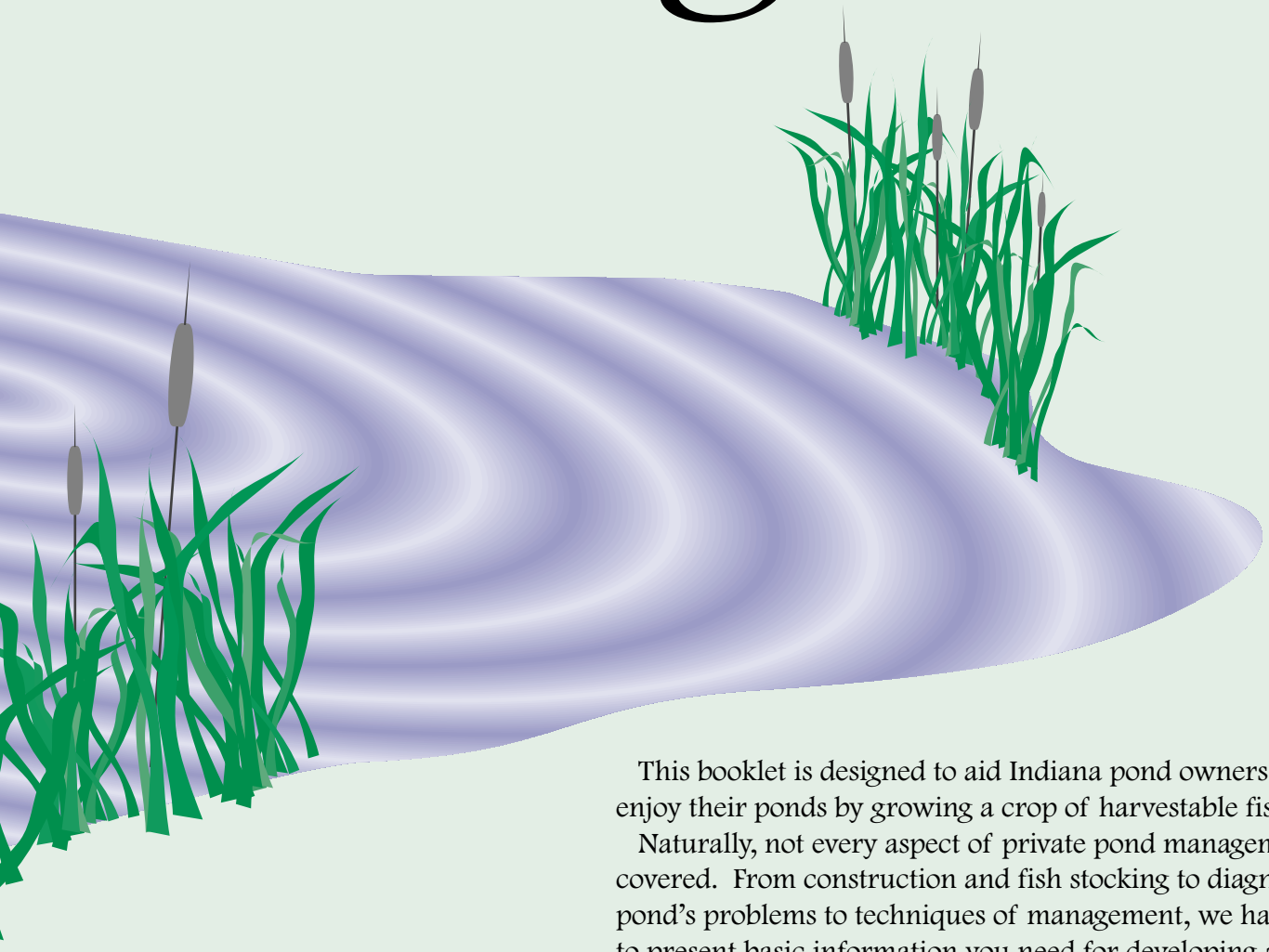
Indiana

Fish Pond Management



This booklet is designed to aid Indiana pond owners who wish to enjoy their ponds by growing a crop of harvestable fish.

Naturally, not every aspect of private pond management can be covered. From construction and fish stocking to diagnosing your pond's problems to techniques of management, we have attempted to present basic information you need for developing and maintaining a good fish pond. Some aspects require detailed or additional information, and you may wish to contact a district fisheries biologist or go to your local library for more information.

Private pond management is far from being an absolute science. However, by basing an active management program on proven principles and guidelines, you can expect to make the most of the fishing potential your pond offers.

Presented by

DNR
Indiana Department of Natural Resources

INDIANA DIVISION OF FISH & WILDLIFE
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INTRODUCTION

Private ponds, also called farm ponds, represent tremendous fishing potential in Indiana. There are over 40,000 ponds in the state. Average pond size is about one acre. Many new ponds continue to be constructed each year. While most ponds are found in southern Indiana, they are widely distributed throughout the Hoosier state.

Besides fishing, ponds provide many important and practical benefits: erosion control, fire control, livestock watering, irrigation, swimming, picnicking and wildlife enhancement. This booklet has been prepared for pond owners who wish to make the most of their pond's **fishing** potential.

Unfortunately, many Indiana ponds do not provide the kind of fishing they're capable of producing. Good fishing doesn't just happen. It's the result of proper fish management. By managing your pond wisely, you can look forward to many enjoyable hours of good fishing.

YOUR POND

- *Good fish management begins with an understanding of your pond's physical, chemical and biological features.*

Good fish management begins with an understanding of your pond's physical, chemical, and biological features. These three features determine the quality of fishing your pond can produce and the kinds of problems you may encounter.

Physical Features

If you are planning to construct a pond, contact the local Natural Resources Conservation Service (U.S. Department of Agriculture) office at the county seat. The NRCS can provide the technical engineering advice you need to properly design and construct a pond. But remember, there may be some legal aspects of pond construction that you should consider. Contact your county surveyor, planning commission, or the Indiana Department of Natural Resources prior to pond construction to obtain any necessary permits. The NRCS office can also help in making sure your pond meets the legal qualifications. Since you are interested in managing the pond for fishing, several factors should be considered when planning a new pond.

Fish ponds should be at least one surface acre in size. Ponds smaller than one acre seldom support a satisfactory fish population over many years. They usually require much more intensive fish management and may not justify the costs.

Fishing ponds should have a drain line so the pond can be completely drained. The additional construction cost will result in dollars saved over the years. A pond that can be drained is more easily and economically managed for good fishing. Water-level drawdowns can be effective in controlling overabundant small fish. Because few ponds provide high quality fishing indefinitely, it may become necessary to eliminate a poor fish population.

Some pond owners believe that a deep pond provides better habitat (living space) for fish. This is seldom true. Most deep ponds in Indiana don't contain enough oxygen for fish in water greater than 15 feet deep during the summer. Only during the spring and fall months, when the water temperatures are changing, does the pond water circulate enough to supply oxygen to the deeper holes. Under ice and snow cover in winter, oxygen concentrations in the deep water drop again.

Certain ponds, especially gravel pits, may contain sufficient oxygen at depths where water temperatures are cool (less than 70^0 F). These ponds can be managed for trout fishing. Most ponds, however will support only "warm water" fish like bass, bluegill and channel catfish.

To ensure good water quality in your pond, do not allow livestock to wade in it. They trample the banks and muddy the water. If you need to water livestock at the pond, fence in a small area along the bank. Don't allow runoff from a barnyard or feedlot into the pond. Runoff from these sources adds excessive nutrients to the water and can produce obnoxious weed problems and cause fish kills. Avoid letting agricultural fertilizers and pesticides into the pond. Avoid plowing near the pond and reduce areas where soil erosion carries silt into the pond.

Once you have a pond, it is important to know the exact acreage, maximum depth, average depth, and water volume. This information becomes useful in calculating the amount of herbicide needed for weed control and the number of fish needed for stocking.

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Chemical Features

The amount of oxygen dissolved in your pond's water is the most important chemical feature. Without oxygen, fish simply suffocate. If oxygen levels drop low, fish become stressed. Stress can then trigger secondary problems, such as poor growth, poor reproduction and diseases. So it is vitally important to maintain adequate amounts of oxygen in the water.

The amount of oxygen needed depends on the kinds of fish in the pond. Bass, bluegill and channel catfish require more than five parts per million (ppm) of oxygen. When oxygen is less than five ppm, fish may show signs of stress. Fish kills can occur when oxygen is less than three ppm. Oxygen levels below one ppm are catastrophic.

Some fish species survive low oxygen concentrations better than others. Unfortunately, these are usually undesirable species, such as common carp and bullheads. If your pond undergoes periods of low oxygen concentrations (hot cloudy days in August or during mid-winter snow storms), game fish will likely die and be replaced by undesirable fish.

To measure the amount of oxygen in your pond, a small chemical kit (sold by Hach Chemical Company) can be purchased. It is a relatively simple test using pre-measured chemical powders.

Another chemical feature of your pond is pH or acidity. Indiana ponds usually have a pH of 7.5 to 9.0. Fish do well within this pH range. Recent evidence indicates that normal rainfall is becoming increasingly acidic from industrial pollutants in many areas east of Indiana. At present, Indiana's soils are able to buffer acid rain before it enters lakes and ponds. However, there may be periods immediately after the spring thaw that your pond can receive an increase in acidic runoff, but it is unlikely fish will be affected.

Biological Features

A pond is like the land around it. There is a limit to what it can produce. While a certain field can produce 100 bushels of corn per acre or a pasture can support two cows per acre, a pond also has a limit to the pounds of fish it can support. Just like the land, the upper limit or "carrying capacity" of a pond is influenced by fertility (nutrients available), climate and the type of crop being grown.

In a detailed study of 14 Indiana ponds, the total weight of fish ranged from 109 to 703 pounds per acre. The average pond supported 320 pounds of fish per acre. This "standing crop" consisted of 224 pounds of bluegill, 36 pounds of largemouth bass, and 60 pounds of miscellaneous fish per acre.

A standing crop of 320 pounds might consist of 320 one-pound fish, or any combination totalling 320 pounds. The important fact is that each pond has a limit

to the pounds of fish that it can sustain. The pond owner who understands the concept of carrying capacity will be better able to manage and use the fish crop that the pond produces.

Stocking Your Pond

After you have a properly constructed pond and a basic understanding of its features, it is time to stock your pond. You must consider what kinds of fish you want, how many and what size of fish you need to stock, when and how to stock, and potential stocking problems. Proper stocking can make a world of difference in fishing quality in years to come.

WHAT FISH TO STOCK

- *The stocking strategy you choose should be geared to the kind of fishing you want.*

The stocking strategy you choose should be geared to the kind of fishing you want. If your chief interest is to raise an annual food crop, then channel catfish or common carp would be best. If you simply want something in the pond to catch, just about any stocking combination will do. For both sport and table fare, the largemouth bass-bluegill-channel catfish combination is hard to beat.

Other combinations involving smallmouth bass, walleye and northern pike can be used if the pond owner is willing to pay for periodic and expensive restocking. A few deep, well-oxygenated ponds may be able to support trout. However, this is a "put-grow-and-take" proposition as with walleye or northern pike. There are many other species of fish that will live and grow in Indiana fish ponds. However, many of them require specialized management that most pond owners can't afford.

The use of hybrid sunfish in combination with largemouth bass is a popular technique. Hybrids are fast-growing and do not overpopulate as bluegill often do. In fact, so few hybrids reproduce, regular restocking is required. One important drawback to hybrids is that they will crossbreed with other sunfish (bluegill, redear, green sunfish). When this occurs, hybrid identity and vigor are soon lost. Where other sunfish are present or there is a good chance they may enter a pond, a hybrid stocking program will have little success.

The best all-around stocking combination for Indiana ponds has proven to be largemouth bass, bluegill and channel catfish. All three provide excellent sport in addition to fine eating. Occasionally, redear are substituted for bluegill because they seldom overpopulate. However, redear are caught less frequently and may disappear altogether from small ponds.

How Many Fish to Stock and What Size

- *The initial stocking ratio widely successful in Indiana consists of five bluegill fingerlings to one largemouth bass fingerling, not to exceed 1000 bluegill and 200 bass per acre.*

Considerable effort has been made over the years to determine the best stocking rates for new fish ponds. Stocking too many fish leads to poor fish growth and is a waste of money. Stocking too few fish promotes fast growth initially, but increases the risk of initial overharvest, especially bass. Both problems can lead to an unbalanced fish population and corrective fish management may be needed.

The initial stocking ratio widely successful in Indiana consists of five bluegill fingerlings to one largemouth bass fingerling, not to exceed 1,000 bluegill and 200 bass per acre. For a low fertility pond, it is advisable to maintain the 5:1 ratio but reduce the number stocked to 500 bluegill and 100 bass per acre. The desirable stocking size for bluegill is one to two inches and three to four inches for bass. Four to six inch channel catfish should be stocked at a rate of 100 fish per acre. If redear are desired, replace one-fourth of the bluegill fingerlings with one to two inch redear fingerlings. If hybrid sunfish are desired instead of bluegill or redear, a 10:1

ratio of sunfish to bass would probably be more suitable. In this case, the maximum stocking rates would be 1,000 sunfish and 100 bass per acre.

For ponds larger than five acres, you may stock as if the pond was only five acres in size: 5,000 bluegill, 1,000 bass, and 500 catfish. If costs are not prohibitive, stocking more fish will provide better fishing sooner. Once again, be sure to maintain the 5:1 ratio and do not exceed 1,000 bluegill and 200 bass per acre. For ponds smaller than a half acre, hybrid sunfish or channel catfish only may be stocked at a rate of 500-1,000 fish per acre. Stocking size in this instance is not as important as when the fish are stocked in combination with largemouth bass.

Simply stocking a few adult fish to populate a new pond is risky and not advised. First-year production of young fish from these adults is unpredictable. For example, bluegill may spawn more successfully than bass and the pond will immediately be "out of balance." Fishing quality will become poor in a hurry and will probably stay that way.

How and When to Stock Your Pond

After you have decided what to stock, the next step is to locate a good source. While catching adult fish from a nearby pond or creek and stocking them in your pond may be inexpensive and convenient, it can lead to several problems. Fish identification can be difficult, particularly of small sunfish. Stocking green sunfish that you thought were bluegill, or bullheads that were supposed to be channel catfish, will certainly make for unpleasant surprises later on. Other problems include difficulty in catching the proper number and size of fish, as well as increasing the chances of introducing unhealthy fish that may be diseased or injured. To invest a lot of money into the proper construction of your fish pond and follow it with poor stocking practices won't give you the return on your dollars that you expect.

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Fish for private ponds are no longer available from federal hatcheries or from Indiana state fish hatcheries. All fish raised at these facilities are used for stocking public waters that have guaranteed public access to all Hoosier fishermen. The best source of fish for private ponds is a reputable commercial fish hatchery. Several hatcheries are located in Indiana as well as in surrounding states. A list of commercial fish hatcheries is available from the Division of Fish and Wildlife.

Getting your fish from the hatchery to the pond in good shape is extremely important. Avoid rough handling and large temperature changes. If water in the hauling container differs by more than 10˚F from the pond water, the fish should be carefully acclimated. Place the hauling container (plastic bag) into the pond water or gradually exchange the water in the container with pond water until the temperatures are similar.

Stocking should not be delayed once a new pond has filled. As soon as the pond has adequate water in it, contamination by unwanted fish is possible before a good fish population develops. Some pond owners believe unwanted fish eggs are carried into their pond attached to birds' feet or within a bird's digestive system. This is simply not true. However, many good fish ponds have been ruined through indiscriminate stockings by others or by emptying unused bait minnows into the pond.

The time of year a pond is stocked is not important. However, most commercial fish hatcheries are geared to growing fish during summer for stocking during autumn. If you plan to stock fish in your pond during the fall and the pond is not completely filled, you should consider water depth. Unless the pond has at least five feet of water, you may risk fish loss during winter.

Other Stocking Needs

- *By placing milk cans, sections of large diameter, field tile or culvert in the pond at depths of three to four feet, catfish can be induced to spawn.*

Properly managed, the initial stocking of bass and bluegill is the only stocking you should ever have to make. However, regular restockings of channel catfish are usually necessary. This species requires a darkened enclosure such as a hollow log or undercut bank in which to spawn. Since this type of habitat is lacking in most ponds, channel catfish seldom reproduce. By placing milk cans, sections of large diameter field tile or culvert in the pond at depths of three to four feet, catfish can be induced to spawn. However, small catfish are a preferred food item for bass so even this will not guarantee more catfish. In most cases, it is necessary to add catfish from time to time. These should be at least six and preferably eight inches or longer so they're not simply a free meal for your bass. Depending on how fast you remove the initial stocking, a second stocking of catfish should not be needed for two or three years.

PROBLEM FISH

Pond owners should be aware of potential problem fish species. These fish, once established in a pond, can harm good fishing and cause the pond to fall far short of its fishing potential. Fish that are considered problem species are bullhead, common carp, buffalo, sucker, crappie, perch and miscellaneous sunfish species.

Bullheads

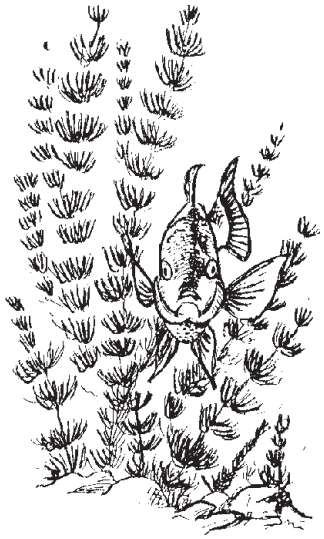
Bullheads, often called "mudcats" or "yellow-bellies," are not desirable in ponds because they often overpopulate and roil the bottom, making the water muddy. Overabundant bullhead populations produce few bullheads of desirable size. In addition, their presence often limits the success of channel catfish.

Carp, Buffalo and Suckers

Introduction of these three fish species into fish ponds is a serious mistake, unless you are only interested in growing fish to eat. They compete directly for food with small bass and bluegill, destroy bass and bluegill habitat, and can only be removed by totally draining or chemically treating the pond. Because of their bottom feeding habits, common carp make the water extremely muddy. Common carp reproduce quite successfully in ponds.

Crappies

Although both black and white crappies do well in large lakes, they usually do not do well in small ponds. Once crappies become established, they prey on small bass, compete for food with adult bass and bluegill, and tend to overpopulate. This produces a pond full of small, slow-growing crappies.



Perch

Yellow perch are much like crappies in ponds. They are prolific, compete with other game fish, prey upon small bass and bluegill, and usually don't grow well. Perch are much more suited to large lakes and should not be stocked in ponds.

Miscellaneous Sunfish

Many pond owners have difficulty identifying the seven sunfish species commonly found in Indiana. These include bluegill, redear, longear, warmouth, pumpkinseed, green and orange spotted sunfish. Only bluegill and redear are suited for Indiana ponds. When stocked into fish ponds, the other sunfish usually produce an undesirable fish population. Green sunfish and warmouth are aggressive feeders and compete with bass and bluegill for food. If they get big enough, they even eat small bass.

The pumpkinseed, longear and orange spotted sunfish do not grow big enough to interest fishermen and they overpopulate easily.

FISH BIOLOGY

Bluegill

Bluegills are generally dark olive-green along the back and lighter along the side. They have five to nine dark vertical bars on each side, blue cheeks, and a dark spot at the rear of the dorsal fin. Bluegills do not have a margin on the opercular, "ear"-lobe.

Bluegill feed primarily on insects, both aquatic and terrestrial. However, they will often eat snails, small crayfish, zooplankton (microscopic animals), and other fish and fish eggs. Because of their varied diet, bluegills can be caught on many different kinds of baits, including insect larvae (bee moths, spikes, mousies), crickets, grasshoppers, and worms. Bluegills avidly hit on artificial flies that resemble aquatic insects.

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The amount of food each bluegill eats determines how fast it grows. If food is abundant and bluegill numbers are low, they grow rapidly. If food is scarce and numbers are excessive, they grow poorly, or even not at all. Slow growing bluegill populations are the most serious problem in Indiana fish ponds. The simplest pond management techniques focus on maintaining good bluegill growth.

Bluegills grow more rapidly in southern Indiana ponds than northern Indiana ponds. This is a result of regional differences in the length of the growing season (climate). They usually reach six inches by age four and their typical life span is six years.

AVERAGE GROWTH RATE OF BLUEGILL IN INDIANA

(age in years)	1	2	3	4	5	6
Southern Indiana						
Length (inches)	1.7	4.2	5.5	6.3	7.1	8.0
Weight (pounds)		0.05	0.12	0.18	0.25	0.36
Northern Indiana						
Length (inches)	1.2	2.7	4.5	5.9	6.9	7.4
Weight (pounds)		0.01	0.06	0.15	0.23	0.29

Some bluegills begin spawning in their first year. However, most don't spawn until they are two years old. The older they get, the more eggs they produce. A four year old female produces about 20,000 eggs. Bluegills lay their eggs in shallow depressions, called "beds," fanned in sandy areas. Bluegills will spawn over most types of bottom and often throughout the summer. Eggs hatch in three to four days.

The tremendous reproductive ability of bluegills can cause problems for the fish pond owner. Bluegills often produce more young than the pond can support. When this happens, bluegill growth is very poor and few fish reach sizes desired by the pond owner. Corrective management is then warranted.

Bluegills not only provide good fishing and eating, they are a major food item for largemouth bass. In a well-managed pond, bass abundance should remain high enough to control bluegill overabundance.

Largemouth Bass

Largemouth bass are the major predators in Indiana fish ponds. Largemouth bass are dark olive-green on the back with green sides shading to a white belly. A dark horizontal band extends on each side from the eye to the tail. The most distinguishing characteristic is its large mouth with the upper jaw extending past the rear margin of the eye.

Largemouth bass usually eat smaller fish, primarily bluegills. But often, when crayfish, tadpoles and other minnows are abundant, bass may switch to these food items. On occasion, bass are cannibalistic. Because they are predators, bass bite well on artificial lures that resemble small fish and crayfish.

Like bluegill, food availability determines how well they grow. If forage items are plentiful and accessible, bass grow rapidly. However, many Indiana ponds contain too much cover (aquatic plants usually) that prohibits bass from catching ample food. When this happens, bass growth may decline and prey species become too abundant. Corrective fish management is then needed to increase the efficiency of bass predation.

Bass grow about three inches each year for the first four years in northern Indiana ponds and about four inches each year in southern Indiana ponds. They usually live to be six years old with some reaching 10 years and measuring over 20 inches long.

Some largemouth bass spawn at age two, but most begin spawning at age three. Three and four year old bass usually produce the most viable eggs, averaging about 10,000 eggs per female. After age six, the number of eggs declines.

AVERAGE GROWTH RATE OF LARGEMOUTH BASS IN INDIANA

(age in years)	1	2	3	4	5	6
Southern Indiana						
Length (inches)	4.4	8.3	11.4	14.0	16.0	18.0
Weight (pounds)	0.04	0.26	0.67	1.26	1.90	2.72
Northern Indiana						
Length (inches)	3.1	6.4	9.4	12.0	14.0	16.0
Weight (pounds)	0.01	0.12	0.37	1.18	1.26	1.90

Bass spawn once a year when the water temperature reaches 62^0 F. Bass also build nests, but slightly deeper than bluegill beds. They prefer to spawn in more protected areas than bluegills, usually around aquatic plants. After the eggs hatch, the male keeps young bass schooled for about a week to 10 days.

Bass reproduction in Indiana ponds is influenced by environmental conditions much more than bluegill reproduction. Increases in turbidity (muddiness) and rapid changes in water temperature reduce spawning success. Since bass produce fewer eggs and are more susceptible to environmental changes, bass reproduction fluctuates dramatically from year to year. Weak year-classes can trigger population explosions among other fish, especially bluegills. As bluegill numbers expand, they eat bass eggs and fry, further limiting bass recruitment. The pond manager is once again required to initiate corrective management to restore balance in the fish population. While bass are popular to catch, a pond owner must work to keep ample numbers of bass in the pond to control bluegill. In many cases, a bass in the pond is worth two on a stringer.

Channel Catfish

"Mr. Whiskers," traditionally found in slow-moving rivers, is equally at home in Indiana fish ponds. Channel catfish are characterized by the lack of scales, their deeply forked tail, and 24-29 rays in their anal fin. They can easily be distinguished from bullheads (see section on Problem Fish) since bullheads have blunt tails.

Channel catfish grow well in Indiana fish ponds, usually 3-4 inches per year. They may reach over 20 pounds and are excellent tasting. Unfortunately, reproduc-

tion and survival of young channel catfish are severely limited in many Hoosier ponds. Young catfish make easy prey for other fish. You should not expect channel catfish to maintain good fishing without restocking.

Channel catfish are "omnivores." That is, they eat about anything they find. They usually feed on insects, crayfish, and fish, including dead fish. They feed primarily near the bottom and can be caught using worms or "stink baits" (chicken liver). Although channel catfish eat small bluegills, don't expect them to control bluegill overpopulation.

The channel catfish begins its life in a nest constructed by the male in a secluded, dark, quiet retreat. This may be under a bank or mass of vegetation, or in old tires, tiles or large cans sunk in the water. Spawning occurs in June and July in Indiana when water temperature exceeds 75^0 F. The female catfish produces up to 4,000 eggs per pound of weight.

During their early development, the fry stay packed in a tight ball. This strong schooling instinct is their downfall. Often, the entire school can be consumed by a single bass as the harried fry regroup after each attack. If you want to keep a large channel catfish population, periodic restocking will probably be necessary.

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MANAGING YOUR POND

Successful pond management requires more than just stocking fish. It is also important to maintain the proper environmental conditions, to monitor fish harvest and growth, check for successful fish reproduction, and to keep out unwanted fish. This is the science of fish management, the solid basis for ensuring good fishing.

How to Test Your Pond

The best way to tell how well your fish are doing is to **go fishing.** By catching fish, you can check on how well your fish are growing, how well your fish are reproducing, or whether unwanted fish are now in the pond.

You should fish your pond frequently, not only to learn how well your pond is producing, but also to harvest the crop of older, larger fish before they succumb to natural mortality. Most Indiana ponds are capable of producing many big bluegill. These fish should be harvested to reduce competition for food among the remaining fish. Bluegill fishing can begin within one year following stocking.

Keep a record of the fish you harvest from your pond. This will aid you in determining whether additional management is needed. Record the kind and size of fish you catch. Then, periodically review your catch records. Ask yourself these questions:

1. Is the average size of bluegill declining?
2. Is the largest size of bluegill you catch getting smaller?
3. Do you catch fewer big fish per hour or more little fish per hour?
4. Are bass more difficult to catch?
5. Are crappie, common carp or other non-stocked fish showing up in the catch?

Answers to these questions can form a "common sense" approach to fish management in your pond.

You may also wish to purchase a minnow seine, about 12 feet long and four feet deep. By dragging the seine along some shallow, shoreline areas, you can

sample your fish population. Seining is especially effective in catching small bass and will aid you in determining how successfully the bass are reproducing.

Another effective method of catching fish is using wire-mesh cylindrical traps. A wire funnel should be attached to one end of the trap while the other end is closed. These traps work best at catching bluegill and redear. By placing one or two traps at various locations and depths throughout your pond for 24 to 48 hours, you can usually catch enough fish to judge their size range.

Once you have examined your fishing records and the seine or trap catches, you can judge how "balanced" the fish community is and whether any problems exist.

Diagnosing Your Pond's Problems

There are three basic reasons why your pond may not produce the quality of fishing you want: your pond may contain the wrong kind of fish, the wrong size of fish, or the wrong number of fish.

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Remember, many kinds of fish found in Indiana lakes and streams are not suited for ponds. Corrective fish management to eliminate undesirable fish usually focuses on completely draining the pond or chemically eradicating all fish in ponds that cannot be drained.

Most pond owners who are not satisfied with the size of bluegill usually complain of catching only "little ones," mainly in the three to five inch range, and seldom any bluegill larger than six to seven inches. By far, this is the most common problem in Indiana ponds. It usually means too much of the pond's standing crop (fish population) is tied up in overcrowded, slow-growing bluegill. Corrective management of this problem centers on removing many of the small bluegill by seining, trapping or fishing and reducing bass harvest to allow the predator (bass) population to increase.

Occasionally, fish pond owners complain about catching only small bass and that no "hawg-bass" are present in their pond. These problems result either from overharvest of bass before they grow to large size or from inadequate forage to sustain good bass growth. If your bass grow at normal rates, merely reducing the number you harvest should allow the remaining bass to grow big. If the bass are growing slowly, simply harvesting more small bass should thin their numbers so those left in the pond grow faster.

Aligned closely with the problem of having the wrong size of fish in your pond is the problem of having the wrong number of fish. Too many fish usually means not enough food is available for each fish to grow at a normal rate. Consequently, only small fish are present. And of course, too many little fish means not enough big fish. The same corrective fish management techniques that address the problem of having the wrong size fish will also correct the problem of having too many fish.

Throughout this discussion of testing and diagnosing your pond's fish problems, one common symptom related to each problem is fish growth. How rapidly fish grow is the best indicator of how well-balanced your fish population is. If your fish grow rapidly, chances are that they are not too numerous and overcrowded. Therefore, if you know the age and growth rate of fish in your pond, you will be more able to diagnose and correct problems.

Managing the Harvest

Biologists and pond fishermen commonly talk about "pond balance" or "population balance." They are simply talking about the relationship between the abundance of predators (largemouth bass) and the abundance of prey (bluegill). When bluegill overpopulate and become slow-growing, the pond is said to be "out of balance." In a "balanced pond," bass remain abundant enough to prevent overpopulation of bluegill.

A balanced pond fishery can be established with the initial stocking. **Maintaining** that balance requires the pond owner to **manage** the harvest. This is usually the most difficult part of pond management. After the cost and effort of pond construction and fish stocking, the owner is understandably anxious to begin reaping the initial fishing benefits. Too often this leads to bass overharvest within the first two years.

When too many bass are removed, bluegill are free to overpopulate. The excessive number of small bluegill that survive in the absence of adequate bass predation quickly outstrip their own food supply. The result is a horde of small, very slow growing bluegill and not much else. This is an extremely common occurrence in ponds. To correct this situation, it is usually necessary to renovate the pond completely and start over with a balanced re-stocking. However, this can all be prevented by conservatively managing the bass harvest.

Channel catfish and bluegill can be harvested as soon as they reach a desirable size. However, **no bass** should be removed during the first two years after stocking. This doesn't mean you shouldn't catch bass. With gentle handling, you can enjoy many hours of catching and releasing these fish with virtually no harm to them. Bass will normally spawn for the first time during their second spring in a new pond. If bass harvest has been prohibited up to this point, the pond should still contain 60 to 80 percent of the bass originally stocked. A new and sizable generation of bass will be produced to maintain the fishery balance as well as to provide enjoyable bass fishing. The bass originally stocked have to provide most of the bass fishing for the first five years. It takes two seasons to grow them to maturity and it will be three more years before their first progeny reach sizes of 10 to 12 inches. If bass harvest is prohibited during the first two years and carefully managed thereafter, your pond can provide many years of quality fishing.

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Although there are no hard and fast rules for managing bass harvest, the key is to practice a conservative harvest. One way is with a minimum size limit of 14 inches. Another helpful guideline is to remove no more than 20 to 25 bass per surface acre each year (after the first two years). This approach emphasizes the quality rather than the quantity of pond fishing. The dividends are large, spunky bluegill, plenty of bass fishing action including some "lunkers," and an occasional bass for the frying pan. But perhaps the greatest dividend of all is to see your management efforts translated into good fishing year after year.

When catching and releasing largemouth bass, there are a few simple rules to follow that improve the chances of the bass surviving. These are:

1. Don't overplay the bass. Retrieve and release it quickly.
2. Don't put it on a stringer and then decide to let it go.
3. Carefully remove hooks so excessive bleeding doesn't start.
4. If the hook cannot be removed, cut the hook or line and release the fish.
5. Keep the bass out of sunlight and in the water.

Correcting Muddy Ponds

A muddy pond does not provide good habitat for fish. Muddy water can adversely affect fish reproduction. Mud also prevents sunlight from penetrating the water and reduces microscopic plant (phytoplankton) growth. Phytoplankton release oxygen into the water during photosynthesis for fish to breathe. Phytoplankton also serve as the first link in the pond's food chain. If your pond is muddy much of the time, look for the cause of the problem and try to correct it. Some common causes of muddy ponds include: 1) soil erosion due to poor land management practices in the watershed, 2) an abundance of bottom feeding fish such as common carp or bullheads, 3) wave action along an unprotected shore, 4) livestock trampling the pond banks, and 5) suspended clay particles. Maintain a buffer strip of terrestrial vegetation around the pond to hold the soil and reduce silt and nutrient inputs.

To reduce bank erosion caused by wave action, you may wish to place large rocks or gravel along the shore. Allowing some aquatic vegetation, such as cattails and lilies, to grow in areas where wave action is greatest can also reduce bank erosion.

If muddy water is caused by common carp or bullheads, complete pond draining or chemical eradication may be warranted. Livestock should be kept out of ponds.

Muddy water caused by suspended clay particles can sometimes be corrected by spreading broken bales of high quality hay around the shoreline. As the hay decays, a weak acid is formed which causes clay particles to settle. Approximately two bales of hay per surface acre should clear the water.

Fertilizing Your Pond

Pond fertilization is based on the notion that the addition of nutrients to the water will increase the production of plankton (microscopic plants and animals). This increase in the amount of fish food then results in increased fish production (pounds of fish per acre).

While fertilization may increase fish production and help control aquatic vegetation due to water clouding caused by dense plankton blooms, the disadvantages of fertilization usually outweigh the advantages.

Fertilization can promote aquatic vegetation growth rather than plankton. Increases in aquatic vegetation can increase chances of summer and winter fish kills as the vegetation decays. Plankton blooms can also occur, damaging the appearance of your pond by making it a soupy, green color. Once fertilization is started, it must become a permanent part of your management program or your pond's carrying capacity is reduced, often resulting in over-crowded, slow-growing fish. Because of these many disadvantages of fertilization, it is not recommended that you initiate a fertilization program.

- *Fish kills in general can be best prevented by properly controlling nutrient inputs and overabundant aquatic vegetation.*

Preventing Fish Kills

The most common cause of fish kills in Indiana ponds is suffocation. Suffocation occurs when aquatic plants do not produce enough oxygen for fish to breathe. This may occur during heavy snow and ice cover in winter, during rapid plant die-offs after a cold rain or several days of cloud cover, or following aquatic plant die-offs from herbicide applications. Once fish suffocation starts, it is too late to stop it.

Fish kills in general can be best prevented by properly controlling nutrient inputs and overabundant aquatic vegetation.

Winter kills can be prevented by removing snow from the pond. Three inches of ice covered by five inches of snow will shut out 99% of the incoming sunlight. To prevent or reduce the severity of winter kills, remove snow from at least 50% of the pond surface. Drilling holes in the ice will not help.

Additional action that can be taken to prevent winterkills includes artificially aerating and circulating the water either by motor-driven air compressors or wind driven baffles. When using an air compressor system, do not allow the air stone (diffuser) to lie on the bottom. This will usually stir up organic materials and result in more oxygen consumption as the materials decay. Suspend the diffuser at least two feet off the bottom.

Summer-kills can be prevented by making sure no fertilizer, herbicides, insecticides or organic run-off (silage, manure) enter the pond. Chemically treat aquatic vegetation early in the growing season according to the label and avoid treatments in late July and August. Avoid treating large amounts of aquatic vegetation throughout the pond by treating one area at a time.

Aquatic Weed Control

Aquatic plants are essential members of the pond community. They are beneficial to fish and wildlife. Rooted plants provide living areas for fish and fish food organisms such as aquatic insects. Certain plants offer shade to fish from bright sunlight and provide natural fish attractors to larger fish. Some kinds of aquatic vegetation provide food and cover for waterfowl and various mammals. Most types of aquatic vegetation never cause problems in ponds. Control is not recommended if the vegetation covers less than 20-25% of your pond's surface area. This level of aquatic vegetation is generally accepted as optimal for sport fish populations and the ecology of the pond.

When aquatic vegetation becomes overabundant (covering more than 20-25% of the pond), it can cause problems. Excessive amounts of aquatic vegetation detracts from the pond's appearance and makes swimming, boating and fishing difficult. Aquatic vegetation also uses nutrients that could go into producing fish food organisms. Excessive aquatic vegetation offers unneeded protection to small fish from predators and often results in panfish overpopulation. On cloudy, hot summer days or under ice cover, excessive vegetation can lead to fish kills by using up the available oxygen.

There are several ways to control aquatic vegetation in ponds. Hand pulling, cutting or raking aquatic vegetation may be the simplest and least expensive. Placing permeable filter fabric on the bottom can control vegetation in specific areas of the pond. Some Indiana pond owners control vegetation with registered and approved aquatic herbicides. Another alternative may be biological control (see section on Grass Carp).

The first step in chemically controlling aquatic vegetation is to correctly identify the problem plants. There are four basic types of vegetation found in ponds: emergent plants, submergent plants, floating plants and algae. Your choice of herbicide will depend on the types of problem plants you want to control.

Filamentous algae is perhaps the most common vegetation problem in Indiana ponds. It is a stringy, hair-like plant (sometimes mistakenly called "moss") that can completely cover a pond's surface. Algae can be difficult to control and may require several treatments.

If you are unable to correctly identify your problem plants, enclose a damp sample within a plastic bag and mail them to your District Fisheries Biologist (see map and list to locate your fisheries biologist).

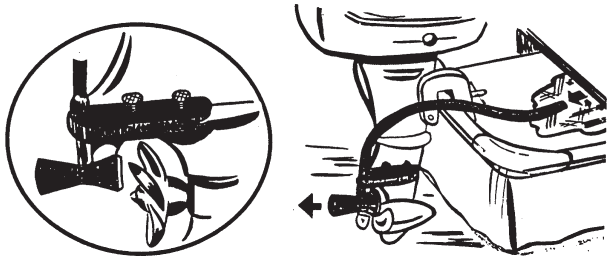
After your problem vegetation has been identified, the next step is to determine the acreage and water volume of the area to be treated. To prevent killing too much vegetation, you may wish to treat the pond in sections. In this case you will need to calculate the area and the volume of only the section you want to treat. (see section on Partial Pond treatment, Figure 2)

Now you are ready to select an appropriate aquatic herbicide that's registered and approved by the EPA and the Indiana State Chemist's Office. Carefully read the entire label to ensure the herbicide will do the job in the manner you expect. Especially note the precautionary statements and directions before using the product. Be sure to wear any safety equipment such as gloves or eye protectors as stated on the product label.

The method(s) of herbicide application is dictated by the formulation and the product label. Liquids are usually sprayed from shore or a boat.

Some liquids can also be injected from a boat mounted tank into the prop wash of an outboard motor with a simple device called a boat bailer (Figure 1). If the vegetation is very thick, spraying may be easier than bailing. Granular herbicides can be broadcast by hand or hand held spreaders. Powders might be dissolved in water and sprayed or poured along the shoreline as a paste or slurry.

Figure 1. Boatbailer



Licensed and certified commercial aquatic pesticide applicators are available to treat pond vegetation for a fee. A list of licensed commercial applicators is available from your District Fisheries Biologist.

Do not apply aquatic herbicides to your pond on rainy or cloudy days or if the weather forecast calls for a period of rainy or cloudy days or else you may cause a fish kill.

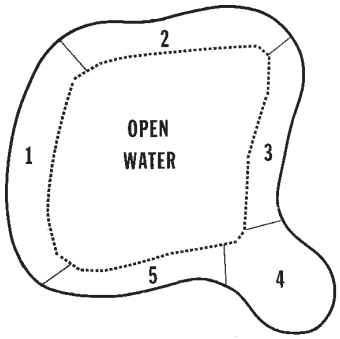
Important points to remember when treating aquatic vegetation are:

1. Identify the problem plant and select the appropriate herbicide.
2. Use only registered, approved herbicides.
3. Carefully read and follow all herbicide label directions.
4. Distribute the herbicide evenly, covering all areas in the treatment zone.
5. Do not over treat or apply the herbicide to an area larger than needed.
6. Treat submergent vegetation and algae early in the growing season.
7. Properly dispose of empty containers and unused herbicide.

Example: Plants are growing from the shoreline to a depth of 10 feet around the entire pond. An easy way to calculate the area (acres) and/or volume (acre feet) to be treated is to divide the pond into five treatment zones (Figure 2).

Treatment Zone	Length (feet)	Width (feet)	Area (acres)	Average Depth (ft.)	Volume (ac. ft.)
1	210	60	0.29	4	1.16
2	150	60	0.21	4	0.83
3	90	60	0.12	4	0.49
4	100	75	0.17	3	0.52
5	85	60	0.12	4	0.47

Figure 2. Partial Pond Treatment



Before you apply the chemical to a treatment zone, you need to know the area (acres). To determine the area, measure the length and width in feet. Multiply the length by the width and divide by 43,560 (the number of square feet in one acre)

Here is the formula:

LENGTH (FEET) X WIDTH (FEET) = AREA IN ACRES.
43,560 SQUARE FEET/ACRE

You may also need to know the **volume (acre feet)** of the treatment zone. To calculate the volume in the treatment zone, determine the average depth in feet and multiply the average depth times the acres (Figure 3). Here is the formula:

Acres of treatment zone X Average depth (feet) of treatment zone = Volume in acre feet.

The label for the chemical you are using will list the amount of product to apply per acre or acre foot.

Example: A pond measuring 175 feet by 135 feet, with an average depth of 4 feet, will hold 2 acre feet of water.

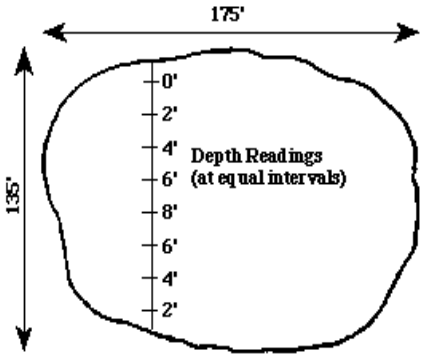
To find area: Multiply 175' x 135' = 23,625 square feet
43,560 sq. ft. = 1 acre

$$43{,}560 \overline{)\ 23{,}625.00} \quad .54 \text{ surface acres}$$

To find Average Depth: Add depth readings
0+2+4+6+8+6+4+2 = 32 feet
Number of readings, incl. 0 for shoreline = 8
Divide: 32 by 8 = 4 ft. average depth

To find capacity of pond: Multiply .5 surface acres X 4 ft. average depth = 2 acre ft.
(see page 23 for pond area estimator chart)

Figure 3. Total Pond Treatment



Guidelines for Obtaining and Using Grass Carp to Control Aquatic Vegetation

Many pond owners are interested in grass carp because they are an alternative to chemical and physical means of aquatic vegetation control. They were first introduced into the U.S. in 1963 by the U.S. Fish and Wildlife Service and were released in Alabama and Arkansas waters for aquatic vegetation control. Today, grass carp can be found in most states between the Appalachians and Rocky Mountains. Rivers are the preferred habitat, although grass carp adapt well to standing bodies of water.

The grass carp is a plant-eating fish that is native to China and Russia. It can grow up to 60 pounds and live 15-20 years. Although it is a relative of the common carp, it neither acts nor looks like the common carp. The grass carp is occasionally caught on hook and line, and some anglers think it tastes better than the common carp.

Grass carp grow rapidly and prefer to feed on rooted vegetation, although after five years of age, both their growth rate and their effectiveness at controlling aquatic plants slow considerably.

Grass carp are able to eat vegetation because of a modification to the back portion of the gill that has taken the form of a tooth-like structure. These pharyngeal teeth are used to grind vegetation so that it can be swallowed and digested.

A major breakthrough came in the 1980s with the development of techniques to produce sterile grass carp, incapable of reproducing. Known as “triploids,” these fish are genetically altered but eat plants as effectively as fertile “diploid” grass carp. This advance greatly reduces the threat of uncontrolled grass carp reproduction and spread.

Many agencies in the United States, both federal and state, began investigating the use of biological methods for control of aquatic vegetation in the 1970s. Based on the results of that research, the reproductively sterile (triploid) grass carp was selected as the biological method that will best control some types of aquatic vegetation in most Indiana ponds with the least ecological risk to aquatic environments.

Determining where Grass Carp Stocking Permits are Not Required

The Department of Natural Resources allows triploid grass carp stocking, without a stocking permit, only in private ponds and lakes. A stocking permit is not required if a pond or lake meets the following criteria:

1) The land surrounding the lake is wholly in private ownership. No portion of the land is owned by a public entity, including a public access site, city park or public road crossing.

2) A state fishing license is not required to fish the lake and state fishing regulations do not apply to fish caught from the lake.

3) The Department of Natural Resources has never stocked fish into the lake.

If your pond or lake does not meet these criteria or you are in doubt request a stocking permit application from the Fisheries Section, Division of Fish and Wildlife, 402 W. Washington Street, Room W273, Indianapolis, IN 46204. Send the completed stocking permit application along with a $3 processing fee back to the same address. State fisheries personnel will determine if a permit is needed and if so, under what conditions grass carp may or may not be stocked.

The Division of Fish and Wildlife will not issue permits for stocking triploid grass carp into any natural body of water including glacial lakes, slough potholes, bottomland lakes, streams, rivers, water areas known to harbor rare, threatened or endangered animals, or plants on the official national or state listing, any state nature preserve, or any wetland.

Obtaining Triploid Grass Carp for Stocking

Triploid grass carp may only be purchased from holders of an Indiana aquaculture permit. A list of permit holders is available from the Division of Fish and Wildlife and district fisheries offices. Pond owners are not allowed to pick up grass carp and stock their own ponds. The aquaculture permit holder must deliver and stock the fish, and present the purchaser with a bill of sale and copy of triploid certification. It is the responsibility of the purchaser to retain these documents for at least two years.

Triploid Grass Carp Stocking Guidelines

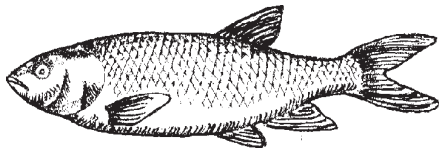
Grass carp are not a cure-all for aquatic vegetation control. Excess vegetation is a result of nutrient buildup in ponds, and the source of these nutrients will have to be controlled for best long-term results. As grass carp consume aquatic vegetation, the water is likely to become more turbid and less desirable plants or algae may become dominant in the pond. Grass carp may also seriously affect sport fish populations if they are overstocked. Vegetation control with grass carp is extremely variable and desired results are difficult to obtain and **are not guaranteed.**

- *As grass carp consume aquatic vegetation, the water is likely to become more turbid and less desirable plants or algae may become dominant in the pond.*

Based on research done by Indiana, the following general guidelines offer the best chance for successful use of grass carp in most Indiana ponds and lakes.

1. It sometimes takes years to see changes in aquatic vegetation abundance following grass carp stockings. Monitoring of changes in aquatic vegeta tion following stocking should be done each year.
2. If less than 20 percent of your pond is covered by aquatic vegetation, stocking grass carp is not recommended. Use chemical or mechanical spot treatments as necessary. This level of aquatic vegetation is generally accepted as optimal for sport fish populations and the ecology of the pond.

3. All grass carp stocking recommendations are based on an accurate determination of the acres of aquatic vegetation covering the pond's surface plus the areas covered by submerged vegetation as far as you can see into the water. The best way to do this is to physically measure and calculate the square feet of vegetation covering your pond. Divide the number of square feet by 43,560 to determine acres of aquatic vegetation. An alternative method is to determine the entire surface area of the pond in acres, then estimate the percent of aquatic plant coverage from a vantage point where you can see the entire pond. Take the surface area of your pond times the percent of plant coverage to determine acres of aquatic vegetation.



4. Stocking rates are based on the use of 8-12 inch long triploid grass carp. When using fish less than eight inches long, increase the stocking rate by 40 percent, except in ponds that do not contain largemouth bass. In these ponds, stock at standard rates. For fish larger than 12 inches, decrease the stocking rate by 30 percent.

5. If your objective is to totally eliminate aquatic vegetation, stock 30 grass carp per acre of vegetation. If significant vegetation reduction has not occurred by the end of the third summer, stock an additional 15 fish per acre of vegetation. Mechanical and chemical methods can be used for initial control, however, be careful not to kill the grass carp. Keep in mind that total elimination of aquatic vegetation will seriously affect sport fish populations and normal pond ecology.

6. The recommended objective is to maintain some vegetation in your pond. Reducing the grass carp stocking rate to 15 per acre of vegetation generally offers the best chance of meeting this objective. If no improvement in vegetation coverage has occurred after four summers, stock an additional 7 grass carp per acre of vegetation. These stocking rates were developed in the absence of any supplemental chemical or mechanical vegetation control measures. Any interim measures taken should be very selective and cover only small areas, otherwise elimination of all vegetation may occur. Results of using this approach for vegetation control will be highly variable. No two ponds will react the same way. You will have to refine your vegetation management strategies over the years on an individual basis

Numbers of 8-12 inch triploid grass carp needed for various acres of aquatic vegetation at the two standard stocking rates.

	Acres of Aquatic Vegetation						
Stocking Rate	1/4	1/2	1	2	3	4	5
15/Acre	4	8	15	30	45	60	75
30/Acre	8	15	30	60	90	120	150

7. Grass carp will not control cattails, spatterdock (yellow water lily) or filamentous algae (pond moss) without first eliminating most other plants in the pond. If these plants are your problem and elimination of all plants is acceptable, use the method described in number 5, otherwise, spot treatments by chemical or mechanical methods are recommended.
8. Stocking grass carp in a lake that normally has high discharges is not recommended. In this situation, grass carp will leave the lake. Fish barriers should not be used unless the dam and spillway have been designed to account for the reduced spillway efficiency and blockage that will occur during high flows. A professional engineer should be consulted to evaluate barrier impact on dam safety if a fish barrier is considered.

Correcting Poor Fishing

If your pond contains the wrong kind of fish (carp, bullheads, unwanted sunfish) or is dominated by over-crowded, slow-growing bluegills, you should consider having the fish eradicated. Total fish eradication is a severe measure but often it is the only way to improve fishing.

Fish can be eradicated by completely draining the pond or by applying a chemical fish toxicant. Draining, of course, is the least expensive if your pond was properly constructed so that it can be drained. The pond should be drained during fall and refilled with spring run-off.

If you cannot completely drain the pond, then a fish toxicant may be used. Because this fish toxicant is classified as a restricted use pesticide by the U.S. EPA, only pesticide applicators certified and licensed with the Office of Indiana State Chemist in pest control may use this product. According to the Office of Indiana State Chemist, a person holding a private applicator's permit may purchase and apply this restricted use pesticide, but only to their privately owned pond. A person may not use this product in a pond which empties into a public waterway without holding a commercial pesticide applicator license in Category 5 (Aquatic Pest Control). Should there be a question regarding whether or not your pond empties into a public waterway, you may contact a District Fisheries Biologist to discuss your situation. You may also contact the Office of Indiana State Chemist at (317) 494-1594 or a District Fisheries Biologist to secure the names of licensed aquatic pest control businesses.

Installing Fish Attractors

If your pond contains very little fish cover, you may wish to add cover by providing artificial fish attractors. Not only do fish attractors provide cover, they also provide a substrate for aquatic insects, and they concentrate fish for better fishing.

Brush piles are the most common type of fish attractor. Any type of woody brush, such as branches or discarded Christmas trees, can be anchored together in a pile. Hardwoods resist decay longer than softwoods and are recommended. Another type of fish attractor is the stake-bed, constructed from discarded lumber slats or old boards.

Fish attractors can be constructed on the ice during winter and allowed to sink. The attractors should be heavily weighted to prevent floating. Cable or nylon rope works best to secure the materials.

- *If the pond owner wishes to supplementally feed fish, it should only be done to provide a small boost to fish growth in an already-balanced pond.*

Feeding Your Fish

"Should I feed my fish?" is a question often asked by pond owners. In most cases, the answer is "no" if you're managing your pond for bluegill and bass. While feeding fish may be entertaining, it is not recommended for most pond owners.

The natural fertility of ponds is usually sufficient for providing enough food organisms for normal fish growth. Supplemental feeding costs money and takes time. Fish must first learn to eat commercial pellets and for optimum learning, feed should be offered daily in the same places. Feeding "just when you feel like it" is a waste of time and money. Many fish never learn to take artificial feed and feed that isn't consumed falls to the bottom to decompose.

If the pond owner wishes to supplementally feed fish, it should only be done to provide a small boost to fish growth in an already-balanced pond. Trying to make "slab" bluegills out of thousands of five-inchers by artificial feeding does not always work.

A bluegill needs to eat 2 percent of its body weight per day for maintenance of good health and growth. And remember, the average standing crop of bluegills in Indiana ponds is 224 pounds per acre. This means that pond owners would have to add about five pounds of feed per acre per day to get improvements in growth.

One situation where supplemental fish feeding is recommended is for small ponds used to produce harvestable-size channel catfish.

SPECIAL PONDS

Not all Indiana ponds are suited for growing just bass, bluegill, and catfish. Certain ponds, such as those smaller than 1/2 acre, deep gravel pits, or those larger than 5 acres can be managed in special ways to provide different types of fishing. Still others can be used for growing fish for food only or for growing bait minnows or frogs. However, since this booklet is intended for the pond owner whose main interest is sport fishing, we will discuss only management of special ponds for fishing. Pond owners who would like more information on raising fish for food, either for themselves or commercially, should contact:

Aquaculture Extension Specialist
Department of Animal Science
Purdue University
West Lafayette, IN 49707
(765) 494-6264

Catfish Ponds

Small, shallow ponds can be used to provide fishing for channel catfish. Each year, a pond owner may wish to buy small channel catfish fingerlings for stocking. They should be stocked at densities up to 1,000 three-inch fingerlings per acre. Catfish will grow rapidly (and can be artificially fed for even faster growth) and will provide fishing as well as “good eating.” Stocking larger fingerlings at lower numbers will provide fishing sooner and larger fish by the end of the summer. Aeration may be required to overwinter fish in small, shallow ponds.

Trout Ponds

Deeper, well-oxygenated ponds can be used to provide trout fishing. However, several environmental requirements must be met before trout should be stocked. There must be water cool enough (less than 70˚F) that contains ample amounts of dissolved oxygen (greater than five parts per million) throughout the year. Just because you think you have a cool, underground spring that flows in your pond, don’t be misled into thinking it will support trout. Underground springs do not contain oxygen. Temperature and dissolved oxygen should be measured at two foot intervals from top to bottom in late August or early September to determine a pond’s suitability to support trout.

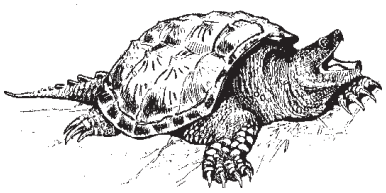
Trout stocked in small lakes with the proper conditions grow rapidly and bite readily on artificial lures or live bait. Since they will not reproduce, restocking is necessary. Even if your pond does not maintain ideal trout conditions throughout the year, you may wish to consider stocking trout in the fall when water temperature drops below 70˚F. Trout bite so well that nearly all may be caught before the following spring when the water temperature rises again. Ponds containing rainbow trout should not be treated with copper sulfate because it is very toxic to them.

OTHER POND PROBLEMS

Indiana pond owners are likely to encounter several other problems that will require attention such as: turtles, muskrats, fish parasites and disease organisms.

Turtles

Turtles are one of the first inhabitants to appear in new ponds. Quite often, their first sighting is viewed with alarm by the pond owner who sees turtles as a threat to good fishing. However, most turtles are vegetarians and pose no threats to fish. In fact, turtles are beneficial in ponds as scavengers.



Occasionally the common snapping turtle can become a nuisance. The "snapper" feeds on fish and can eat small ducklings. It has extremely strong jaw and neck muscles and an ability to quickly lash out at its prey.

Snapping turtles can be caught in traps. Wire funnel traps, set partially in the water at the pond's edge and baited with fresh meat, are effective if the pond owner does not want to harm the turtle. Coil-spring traps are effective when mounted to a wooden board and floated upside-down. Position the trap over two feet of water and anchor them to the bank. As with the other method, bait should consist of fresh meat.

Turtles can also be caught on baited hooks or caught by hand during early ice-cover. Turtles can often be spotted in shallow water before snow covers the ice. By simply chopping a hole through the ice, you can reach down and grab them by the tail. Because of the cold temperature, they are very lethargic. Be sure the ice is safe and be sure you grab them by the tail.

Muskrats

Muskrats build dens in burrows along steep banks of a pond. Entrances are usually 6-18 inches below the water line with burrows penetrating into the bank up to 10 feet. Where muskrats become abundant, they can cause damage to the pond's banks and dam.

Properly constructed ponds usually discourage muskrats from digging into the banks. The dam should have a minimum slope of 3:1 on the water side, be above the water level by three feet, and be at least 20 feet wide at the water level.

There are several ways to control muskrats. The first is simply eliminating starchy water plants, such as cattails, bulrushes and arrowhead. These are favorite foods of muskrats. Muskrats can also be trapped or repelled by chemicals.

Trapping is the most effective and economical way to control muskrats. If possible, trapping should be done during the legal trapping season. Selling muskrat pelts can earn the pond owner extra income and quickly pay for the traps.

If you have a muskrat problem and need to take the animal(s) out of season, Indiana Fish and Wildlife Administrative Rules allow the resident landowner or tenant to take a muskrat at any time, without a permit, if the animal is damaging property when discovered. A landowner or tenant must report the taking to the Division Director or to a Conservation Officer within seventy-two (72) hours of the taking.

To chemically repel muskrats, place calcium carbide, moth balls, or napthalene flakes in each hole and seal it with dirt or sod. These chemicals temporarily prevent muskrats from digging into the dam. Muskrats move from pond to pond in the spring and fall. Preventive treatment with chemicals should be made in early April and in August.

FISH PARASITES AND DISEASES

Fish, like any animal, are exposed and susceptible to a wide range of diseases and parasites. In fact, it is unusual to find a fish completely free of disease organisms. It is normal to see a few dead fish from time to time. These fish usually die as the result of natural causes. Severe losses of fish due to disease organisms are rare in a natural environment. Most severe losses occur when fish are stressed due to unfavorable conditions, such as poor water quality.

Disease problems are most noticeable in the spring when fish are in a weakened state after winter and during the stressful spawning period. Also, as the water warms in spring, living conditions are better for growth of disease organisms.

There are no practical, and few safe methods, for treating disease problems in ponds. Disease outbreaks in ponds simply must run their course. Prevention or repression of disease is best accomplished by stocking only healthy fish from reputable sources and by maintaining a favorable pond environment.

With the exception of the broad fish tapeworm, fish parasites are not harmful to humans. Proper cooking destroys parasites, including tapeworms. Some of the more common parasites and diseases are described below.

- *Disease problems are most noticeable in the spring when fish are in a weakened state, after winter and during the stressful spawning period.*

Black-spot disease

These parasitic flatworms appear as tiny black spots on the skin, fins and flesh of fish. No method of control is available for the elimination of this problem. This organism does little harm to the fish. The main problem associated with black-spot is the unsightly appearance it may cause. Skinning infected fish will remove most black spots.

The life cycle of the parasite is quite complex. A fish-eating bird (typically a great blue heron or kingfisher) eats an infected fish. The black spot or worms are released and grow to sexual maturity in the bird's intestine. The adult worms pass eggs with the bird's droppings. When the eggs reach water, they hatch into free-swimming organisms which then penetrate snails for further development. Finally, after leaving the snails they burrow into the skin of fish and form a cyst. The fish surrounds the cyst with black pigment that gives the disease its name. If an infected fish is consumed by a bird, the cycle repeats itself.

Yellow grub

The yellow grub (or white grub) is also a larval flatworm with a life cycle similar to parasites causing black-spot disease. The parasite appears as yellow or white spots in the flesh, often 1/4 inch long. While unsightly, it is harmless to man and in many cases can be removed during the cleaning process.

Fungus

The most common fungus is saprolegnia and appears as gray-white threads resembling cotton balls growing on fish or fish eggs. Fungus usually occurs as a secondary infection caused by handling, parasites or bacterial attack. There is no practical way to control fungus in pond situations. Fungus rarely causes a fish to die, but can often be found on weakened or stressed fish before they die.

Ichthyophthirius "Ich"

Ich is a large, ciliated, single celled animal (protozoan) that can be positively identified under a microscope by its horseshoe shaped nucleus (center). It is common on warm-water fish, and occasionally found on cold-water fish.

In the early stages of Ich, infected fish usually rub against the pond bottom in an effort to rid themselves of the parasite. This protozoan can be very harmful to fish. Losses due to "Ich" often occur.

The elimination of "Ich" in a pond situation is virtually impossible. Problems resulting from the parasite can be minimized by maintaining good water quality in the pond and by making sure only healthy fish are stocked

Lymphocystis

Lymphocystis is a viral disease that causes a yellow or white wart like growth on the fish's body. Lymphocystis subsides naturally only to return, much like a cold-sore in humans. Generally, little harm is done to the fish but the infection is unsightly.

- *Bacterial diseases are common in all fish and occur most when environmental conditions, such as water quality, are not favorable.*

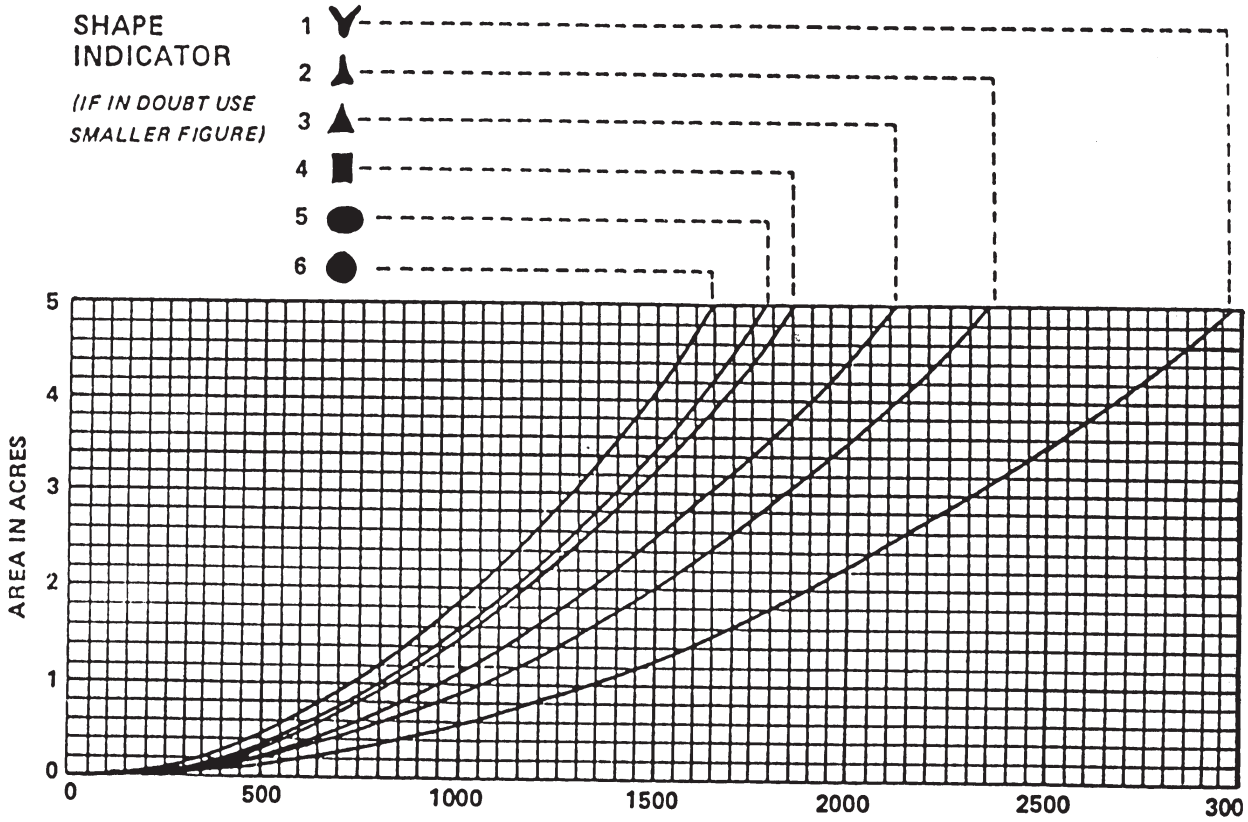
Bacterial Diseases

Bacterial diseases are common in all fish and occur most often when environmental conditions, such as water quality, are not favorable. Inadequate oxygen levels in the pond can stress fish and make them susceptible to bacteria infections. These infections are often associated with spring die-offs in fish ponds. As the water warms during the spring, fish weakened by the winter months are often invaded by harmful bacterial that can cause death. This weakened condition can also be enhanced by frenzied spawning activity that further stresses the fish.

Bacterial losses are one of the most commonly noted causes of fish loss during May and June. No control is available for the treatment of bacterial problems in ponds. Fortunately, bacterial problems rarely reach epidemic proportions in ponds.

Area In Acres

WIDTH	LENGTH — Feet																		
Feet	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
100	.230	.344	.459	.574	.689	.803	.918	1.03	1.15	1.26	1.38	1.49	1.61	1.72	1.84	1.95	2.07	2.18	2.30
150	.344	.517	.689	.861	1.03	1.21	1.38	1.43	1.72	1.89	2.07	2.24	2.41	2.58	2.75	2.93	3.10	3.27	3.44
200	.459	.689	.918	1.15	1.38	1.61	1.84	2.07	2.30	2.53	2.75	2.98	3.21	3.44	3.67	3.90	4.13	4.36	4.59
250	.574	.861	1.15	1.43	1.72	2.01	2.30	2.58	2.87	3.16	3.44	3.73	4.02	4.30	4.59	4.88	5.17	5.45	5.74
300	.689	1.03	1.38	1.72	2.07	2.41	2.75	3.10	3.44	3.79	4.13	4.48	4.82	5.17	5.51	5.85	6.20	6.54	6.89
350	.803	1.21	1.61	2.01	2.41	2.81	3.21	3.62	4.02	4.49	4.82	5.22	5.62	6.03	6.43	6.83	7.23	7.63	8.03
400	.918	1.38	1.84	2.30	2.75	3.21	3.67	4.13	4.59	5.05	5.51	5.97	6.43	6.89	7.35	7.81	8.26	8.72	9.18
450	1.03	1.43	2.07	2.58	3.10	3.62	4.13	4.65	5.17	5.68	6.20	6.71	7.12	7.75	8.26	8.78	9.30	9.81	10.3
500	1.15	1.72	2.30	2.87	3.44	4.02	4.59	5.17	5.74	6.31	6.89	7.46	8.03	8.61	9.18	9.76	10.3	10.9	11.5
550	1.26	1.89	2.53	3.16	3.79	4.42	5.05	5.68	6.31	6.94	7.58	8.21	8.84	9.47	10.1	10.7	11.4	12.0	12.6
600	1.38	2.07	2.75	3.44	4.13	4.82	5.51	6.20	6.89	7.58	8.26	8.95	9.64	10.3	11.0	11.7	12.4	13.1	13.8
650	1.49	2.24	2.98	3.73	4.48	5.22	5.97	6.71	7.46	8.21	8.95	9.70	10.4	11.2	11.9	12.7	13.4	14.2	14.9
700	1.61	2.41	3.21	4.02	4.82	5.62	6.43	7.12	8.03	8.84	9.64	10.4	11.2	12.0	12.9	13.7	14.5	15.3	16.1
750	1.72	2.58	3.44	4.30	5.17	6.03	6.89	7.75	8.61	9.47	10.3	11.2	12.0	12.9	13.8	14.6	15.5	16.4	17.2
800	1.84	2.75	3.67	4.59	5.51	6.43	7.35	8.26	9.18	10.1	11.0	11.9	12.9	13.8	14.7	15.6	16.5	17.4	18.4
850	1.95	2.93	3.90	4.88	5.85	6.83	7.81	8.78	9.76	10.7	11.7	12.7	13.7	14.6	15.6	16.5	17.6	18.5	19.5
900	2.07	3.10	4.13	5.17	6.20	7.23	8.26	9.30	10.3	11.4	12.4	13.4	14.5	15.5	16.5	17.6	18.6	19.6	20.7
950	2.18	3.27	4.36	5.45	6.54	7.63	8.72	9.81	10.9	12.0	13.1	14.2	15.3	16.4	17.4	18.5	19.6	20.7	21.8
1000	2.30	3.44	4.59	5.74	6.89	8.03	9.18	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4	19.5	20.7	21.8	23.0



*This estimator was obtained from the Missouri Department of Conservation.

Table of Equivalents

1 acre foot	= 1 acre of surface area covered by 1 foot of water = 43,560 cubic feet = 2,700,000 pounds of water (approximately) = 326,000 gallons of water
1 cubic foot	= 7.5 gallons = 62.4 pounds of water = 28,355 grams of water
1 gallon	= 8.34 pounds of water = 3,800 cubic centimeters = 3,800 grams of water = 231 cubic inches
1 quart	= 946 cubic centimeters = 946 grams of water
1 pound	= 453.6 grams = 16 ounces
1 ounce	= 28.35 grams
1 ppm requires:	2.7 pounds per acre foot 0.0038 grams per gallon 0.0283 grams per cubic foot 0.0000623 pounds per cubic foot 1,233 grams per acre foot 0.0586 grains per gallon 8.34 pounds per million gallons of water 1 milligram per liter

Units	Gallons	Quart	Pint	Pound	Ounces	Fluid Ounces
1 gal	1.0	4.0	8.0	8.345	133.52	128
1 qt.	0.25	1.0	2.0	2.085	33.36	32.0
1 pt.	0.125	0.5	1.0	1.043	16.69	16.0
1 lb.	0.12	0.48	0.96	1.0	16.0	15.35
1 oz.	0.0075	0.03	0.06	0.0625	1.0	0.96
1 fl. oz.	0.0078	0.031	0.062	0.065	1.04	1.0
1 cu. in.	0.0043	0.017	0.035	0.036	0.576	0.554
1 cu. ft.	7.481	29.922	59.844	62.426	998.816	957.51
1 cc	-	0.001	0.002	-	-	0.034
1 liter	0.264	1.057	2.1134	2.205	35.28	33.81
1 gram	-	-	0.002	0.0022	0.0353	0.034