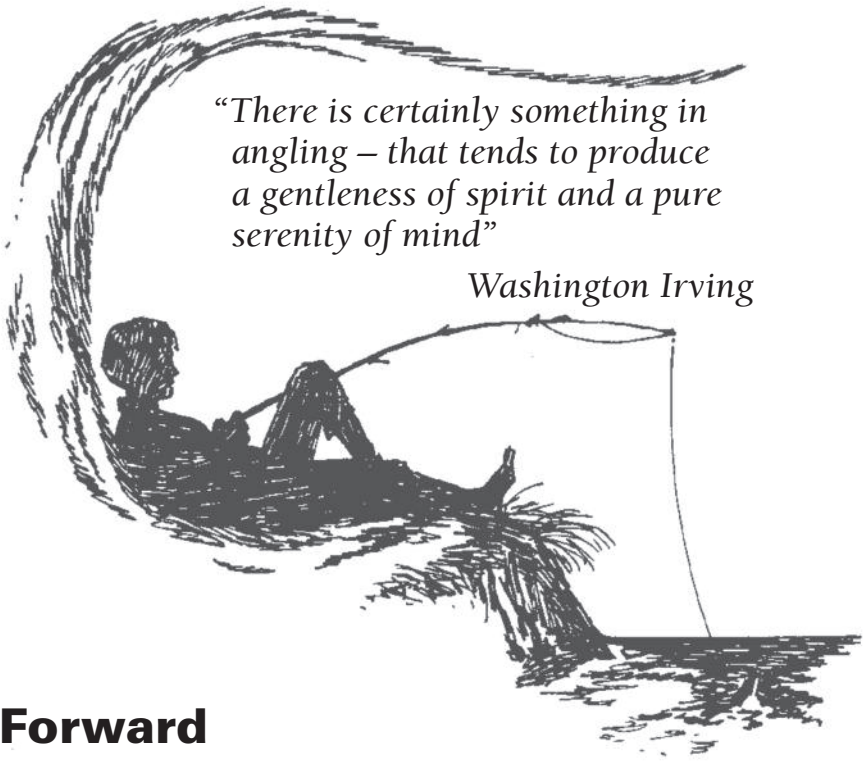
State of Illinois
Illinois Department of Natural Resource

Management of Small Lakes and Ponds in Illinois



Forward

The purpose of this booklet is to inform the public on the proper management of ponds, lakes, and impoundments. The term "pond" is used in the booklet to refer to all ponds, lakes or impoundments.

Printed by the Authority of the State of Illinois; printed on recycled paper.
IOCI 17-0141 • DNR 023 – 2M – 01/17

Management of Small Lakes and Ponds in Illinois

Third Edition

Revised 2017

Illinois Department of Natural Resources
Division of Fisheries

www.dnr.illinois.gov

www.ifishillinois.org

This publication can also be found online in PDF format at
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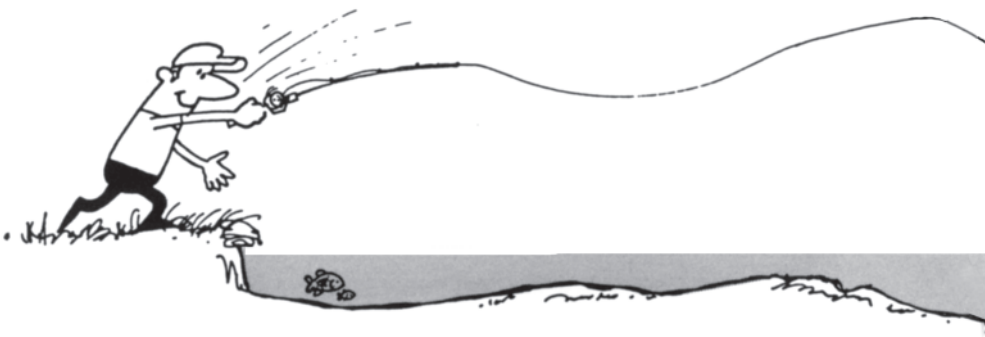
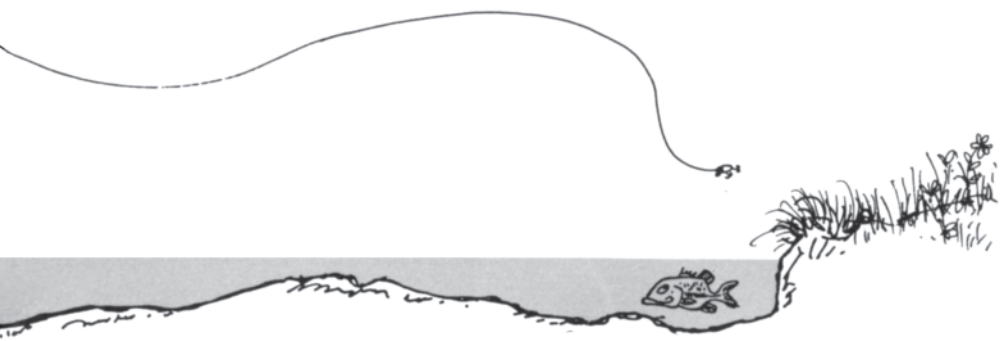
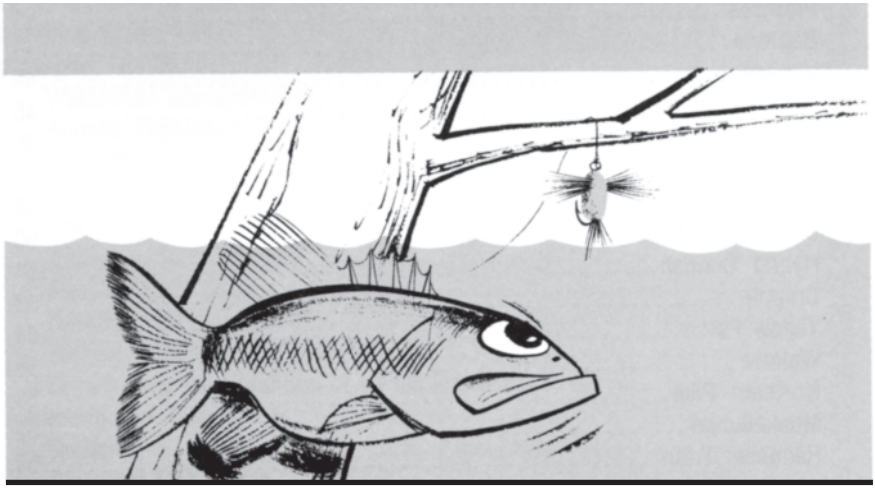






INTRODUCTION

By themselves, ponds may not look like much, but counted in the tens of thousands, these waters add up to a lot of fishing. In Illinois over 500 new ponds are being built each year. There are currently over 90,000 ponds in Illinois ranging from 0.1 acres and greater. The majority of these are not managed for fishing. They would be, if their owners knew what they were missing.

Wise anglers enjoy good ponds, for they mean close-to-home action with big bass, and stringers of fat, fighting bluegills. At a time when good fishing is so highly prized, a good Illinois pond is the answer to a fisherman's prayer. Whether that angler is a freckled kid or a crusty old bass specialist, a good fishing pond means wonderful sport fishing not soon to be forgotten.

That's what this booklet is all about-making your pond a good place to fish and keeping it that way.

Good luck, and tight lines!

THE POND ITSELF

Fish, like all other animals, need suitable shelter and food for survival and reproduction. However, not all ponds can support game fish populations. To produce and maintain good sport fishing, the pond must be managed. Good pond management begins with proper shape and depth (pond design) and proper living conditions (water quality) within that pond.

Proper construction and maintenance of the dam and spillway are essential. The dam must be built so that it will not wash out or develop leaks. The spillway should be designed to handle excessive amounts of water during heavy rainfall. Persons wishing to construct a pond should contact the county office of the U.S. Natural Resources Conservation Service for assistance.

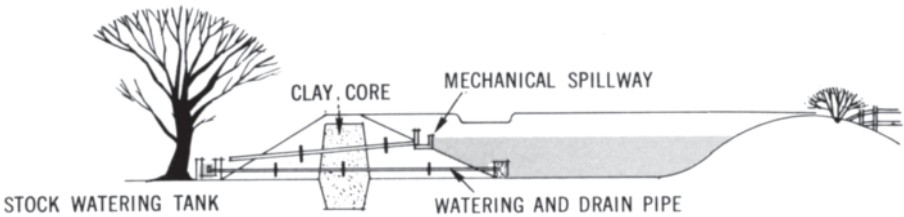
The ideal pond should be at least 1 acre in size when full. Smaller ponds are difficult to manage for any length of time. Their fish populations tend to be unstable and unpredictable. Excessive aquatic plants can seriously interfere with recreational uses of the pond, and also, can provide too many hiding places for small fish. Summer and winter fish kills occur more frequently in small ponds because they are often shallow. Small ponds can seldom support enough fishing pressure to make management worthwhile. They are likely to dry up or provide marginal habitat during extended periods of below average rainfall.

BRUSH REMOVAL

Before impounding water in a new pond basin, dense stands of trees and brush should be removed. Trees and brush in small ponds furnish too much cover for small fish. Moderate brush in ponds over two acres is usually not detrimental.

POND CONSTRUCTION

A minimum depth of at least 10 (south) to 12 (north) feet should be maintained in one fourth of the pond. Depths which range from 10 to 15 feet are even more desirable. The water along the shoreline should be 3 feet deep to reduce the growth of shallow water plants.



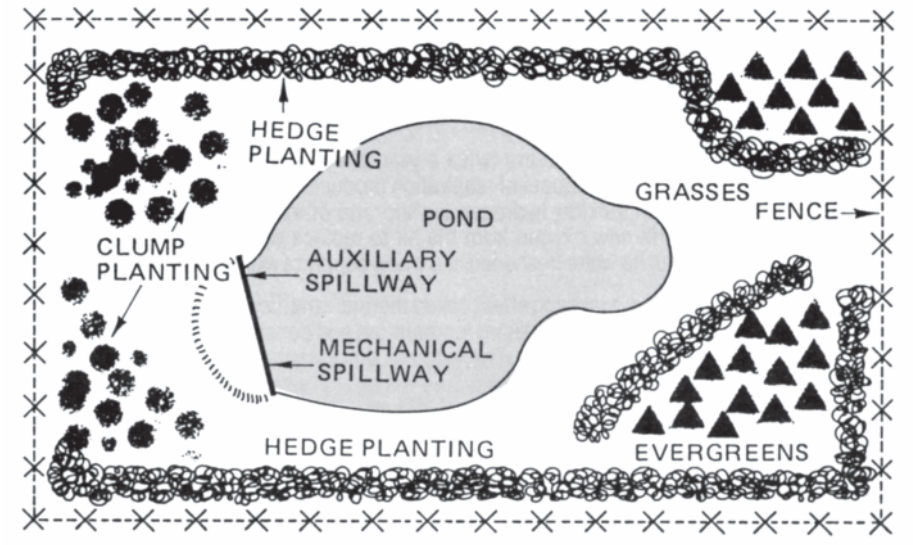
The watershed of the pond should furnish enough water to keep the pond full throughout the year with limited flow over the spillway. For most Illinois ponds the ideal watershed to lake ratio is 10 to 20 acres of watershed per surface acre of water. When the watershed to lake ratio is larger than the recommended 20 to 1, problems may develop such as: turbidity due to siltation, low productivity, dam failure, and sedimentation.

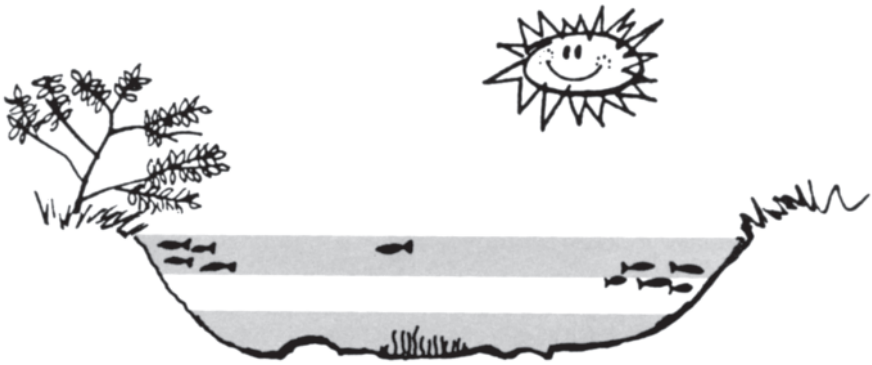
A pond drainpipe and valve at least 4 inches in diameter is recommended to permit complete draining of the pond in 1 or 2 weeks. A drainpipe offers several advantages. The pond's water level can be lowered in the summer or fall (see section on drawdowns) to reduce overpopulations of small fish, to drain the pond when undesirable fish are present, to dredge the pond basin if siltation is excessive, or to permit complete fish harvest in a commercial minnow, crayfish or catfish raising operation.

The appearance of the pond can be enhanced by proper landscaping, also benefiting wildlife. A hedge row can be planted around the pond as a fence. Consider using shrubs which make good hedges, such as gray or silky dogwood, or hazelnut. Shrubs, trees and evergreens can be planted in small clumps around the pond inside the fenced area, but not within 100 feet of the shoreline. Mixed clumps of shrubs can include gray or silky dogwood, hazelnut or high bush cranberry. Also, clumps of small trees such as Washington Hawthorn or American plum and evergreens such as white pine, Norway spruce, Douglas-fir or concolor fir can be included. Ornamental plantings can be used to add additional color and variety to the area.

The dam, earthen spillway and immediate shoreline should be planted with grasses or a grass and legume mixture, such as brome, timothy and alsike or ladino clover. If burning is planned to be used on the area, a better choice is a prairie grass, such as switchgrass (Cave-in-Rock variety) or little or big bluestem. Woody vegetation should not be planted or allowed to become established on these areas. Mowing should be delayed until after August 1, since wildlife may use the area to nest.

In summary, when ponds are constructed, certain precautions should be taken to help prevent the growth of excessive aquatic vegetation. The pond should be located in a site where drainage does not permit pollutants to reach the pond. The shoreline edges should be deepened to 3 feet or more at the time of construction. This will help prevent the growth of excessive aquatic vegetation.





The Water

With the exception of Lake Michigan, the surface waters of Illinois are classified as "warm water". These are waters that have a midsummer surface temperature of 70° F or higher. Temperature is one of the key factors which governs the lives of fish and regulates the kinds of species which can live in our ponds. The amount of dissolved gases that water holds varies with the temperature. The warm water of summer holds much less oxygen than cold winter water. Temperature affects fish in many ways, including feeding, growth and spawning. Most warmwater fishes grow faster at temperatures above 70° F and dissolved oxygen content of 5 to 8 parts per million (ppm).

Temperature is also one of the principle factors influencing the pond cycle through the year. At 39° F, water reaches its greatest density and weight. Water warmer or colder than 39° F is lighter. **If not for this fact, life on earth would not exist. If water just kept on getting denser as it got colder until it froze, ice would sink and all bodies of water, including the oceans, would be permanently frozen solid! Fortunately for us, the lightest water of all is ice and it floats.**

Let us look at the annual temperature cycle of a typical pond. In the spring, just after the ice thaws, the coldest water is on top at 32° F and the warmest water is on the bottom, at about 39° F. As the warm breezes of spring begin to blow, the cold surface layers of water begin to warm. As they get warmer, they get heavier and sink into the depths of the impoundment, replacing the lighter, colder layers beneath. Eventually, all the water reaches 39° F. Up to this point, there have been layers of water at different temperatures and densities in the pond, making them difficult to mix. Now that the water is all the same temperature and density, it mixes easily bringing the water which has been on the bottom all winter to the surface. This is called the **spring turnover.**

Ponds can be thought of as breathing twice a year, once in the spring and once in the fall, breathing out the waste products of respiration produced by aquatic life. These waste products include carbon dioxide, hydrogen sulfide, and other gases. At the same time, the pond is breathing in new oxygen from the air to replace what was used up. So the pond starts the year with its water freshened and a new supply of oxygen from top to bottom.

During the summer period, a layering effect called thermal stratification sets up, separating the impoundment into 3 zones of differing temperature and density called the epilimnion, the thermocline, and the hypolimnion. These terms simply mean the upper lake, the transition zone, and the lower lake. The thermocline is a layer in which the temperature drops rapidly, at a rate of 0.5° F or greater per foot of increasing depth. Most people diving into a pond or lake experience the thermocline. Often, they come to the surface thinking they dove into a spring!

The thermocline ends where the temperature ceases to drop rapidly. Once these layers set up in the summer, they are almost as difficult to mix as oil and water and tend to

remain stable throughout the warm weather. The upper 2 layers then effectively seal the lower lake off from contact with the atmosphere.

In a deep lake (50-60 feet or more), the temperature of the lower layer may remain in the low 40's during the hottest of summer weather. During this time, the aquatic life gradually uses up the dissolved oxygen present in the lower lake. In about mid·July, the oxygen is used up entirely. This is why you cannot have trout in your lake over the summer, even though the temperatures on the bottom are plenty cold enough for them.

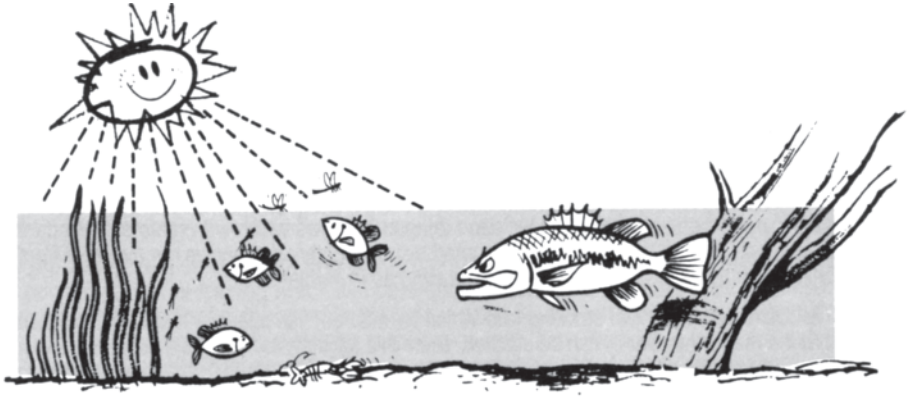
As fall comes, the warm surface waters of the pond begin to cool off. Being cooler than the layers below them, they are also denser. This cooler, denser water sinks, displacing the lighter, warmer water below. This process breaks up the thermal stratification which has been so stable all summer, and the pond takes its second breath of the year, the **fall turnover**. The deoxygenated water of the lower layer is brought to the surface, where its oxygen supply is renewed, and all the waste product gases which accumulated in the lower layer during the summer are expelled to the atmosphere. The process is complete when all the water in the pond is once again at 39° F.

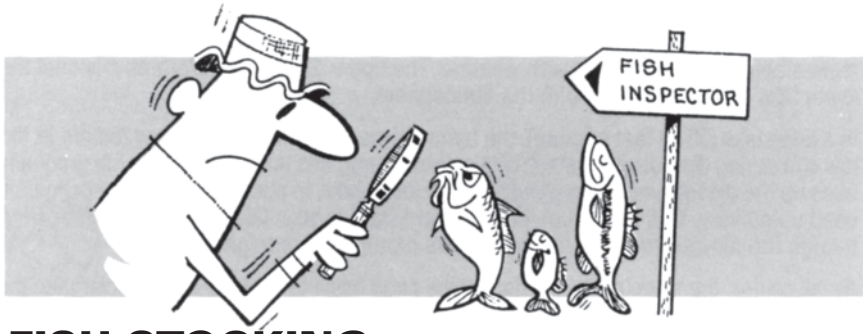
So the pond begins the winter period as it began the summer period, with its water freshened and oxygen from top to bottom. As the air temperatures continue to cool, water colder than 39° F floats on the warmer water below it. This provides a relatively warm refuge for the fish, frogs and turtles of the impoundment to survive the winter. Believe it or not, our fish would die of what we would call exposure, if they were at temperatures below about 35° F for very long during the winter.

The Food Chain

Life in a pond is a complex, interlocked chain of plants and animals. The food supply for fish depends upon the presence of plant nutrients (organic matter and minerals) dissolved in the water. These food materials enter the pond as dust carried by winds or with water runoff from the surrounding lands. Nutrients stimulate the growth of small aquatic plants called **algae. Photosynthesis** is the process by which green plants use sunlight, carbon dioxide and water to produce carbohydrates and oxygen. The green plants grow and multiply serving as food for microscopic animals. These tiny animals multiply and become forage for larger animals such as small crustaceans and insect larvae. Small bluegill, redear sunfish, and young largemouth bass eat these crustaceans and insect larvae. Small fish, crayfish, and insect larvae are consumed by larger fish. Then we eat the fish! Thus, the **food chain** is completed with continuous links extending from basic plant nutrients to predator fish to us.

The ratio of deep water to shallow water in a pond has an important bearing on the total weight of fish produced. Shallow water areas produce more food than deep water areas because greater sunlight penetration to the bottom results in a greater abundance of plant growth and thus, more available dissolved oxygen.





FISH STOCKING

Ponds in Illinois vary greatly in their fish stocking needs. The owners, managers and users of these ponds also may differ in their sport fishing objectives, and require a wide selection of stocking options. **Therefore, it is important to discuss pond stocking with a District Fisheries Biologist.** Visit *http://ifishillinois.org/* to find the District Fisheries Biologist for your County.

Most Illinois ponds provided habitat that is suited for "warmwater" fish. The warmwater fish species that are stocked with success are the largemouth bass, bluegill, redear and channel catfish. The stocking of "cool" and "coldwater" fish as an addition to the basic fish stocking, under the proper conditions and timing, also produce good fishing.

Before the fish stocking decision is made, careful analyses of pond characteristics and angler preference must be made. Some of the factors affecting the decision include pond type, size, depth, water chemistry, fertility, existing fish population, expected fishing pressure and harvest, and most importantly, what fish do the fishermen want? Surveys by the Division of Fisheries reveal that the largemouth bass, channel catfish, black and white crappies, bluegill and redear sunfish are the most fished for species in the State of Illinois.

The most widely used and successful stocking combination for ponds in Illinois is the largemouth bass, channel catfish, bluegill and redear sunfish. These species are popular among fishermen, and are biologically adapted to a wide variety of pond conditions. These species effectively utilize natural and artificial foods, and are compatible with many other species that might be stocked later. The concept of this stocking combination is that the bluegill eat small aquatic insects and in turn serve as a food for bass. The bass control the numbers of small fish so that those remaining grow to size.

Crappies, though popular with anglers, are not generally suitable for stocking in small lakes and ponds. Crappies are prolific spawners and produce large numbers of offspring which can quickly overpopulate. High numbers of bass, which results in slow growth rates, must be maintained to provide desired rates of predation on crappie.

Some pond owners are reluctant to stock bluegill because of their reputation for overpopulating. The cause for most bluegill problems is traceable to overharvest of largemouth bass and/or to the overharvest of large bluegill. Redear sunfish, in limited situations are substituted for bluegill. In most cases, they are generally stocked in combination with the bluegill at a ratio of 70 percent bluegill to 30 percent redear. The redear is a southern species and generally doesn't survive the winter, north of interstate 80. Bass and bluegill are sometimes stocked alone if redear and channel catfish are not desired.

Fingerling fish (1 to 3 inches) are recommended for the initial stocking of new or rehabilitated ponds. It is essential that no fish exist in the pond before the initial stocking. The single exception is to stock breeder sized fathead minnows which will create an abundant food supply that will eventually be eliminated by bass. Fathead minnows are available from private fish dealers. Other minnow species can cause problems.

The recommended initial stocking rate varies for different fish species. It is very important that the proper number of fish be stocked, since this original stocking must support the first four to five years of fishing.

FERTILITY MAP OF ILLINOIS IMPOUNDMENTS BASED ON ALKALINITY OF THE WATER

Alkalinity	Fertility Rating	Fertility Key	Approximate Carrying Capacity (Lbs/Acre)	
			LM Bass	Bluegill
More than 100 PPM*	Good		100	400
50 to 100 PPM*	Average		50	200
Less than 50 PPM*	Fair		25	75

*Parts per million

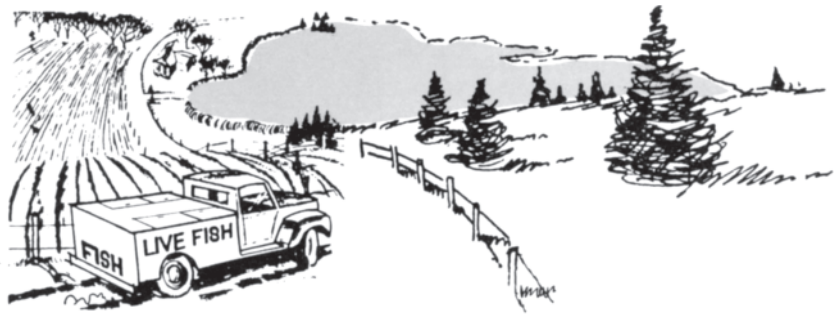
Locate your pond in the black, crosshatched, or clear areas in the map above. Use the following chart as a guide for its initial stocking.

Initial Fish Stocking Guide

Fertility Key									
Soil Type of Pond	Black	Light	Forest	Black	Light	Forest	Black	Light	Forest
Number of fingerling fish stocked per surface acre									
Largemouth Bass	100	80	60	90	70	50	80	60	40
Channel Catfish	100	80	60	90	70	50	80	60	40
Bluegill	1000	700	500	800	600	400	700	500	300
Bluegill/Redear Combination									
Bluegill	700	560	490	490	420	350	350	310	245
Redear	300	240	210	210	180	150	150	140	105

The above pond stocking guide is based on the utilization of natural food and does not consider artificial feeding which can potentially increase the stocking rates. By initially stocking the correct numbers of fingerlings, a pond or lake will produce sport fishing in less time than by releasing smaller numbers of adult fish. Stocking a few adult fish in a new pond results in an excessive first spawn and stunted fish. If properly managed, bass, bluegill and redear need only an initial stocking as their natural spawning success is adequate to maintain sufficient numbers. Channel catfish do not normally maintain a population by natural reproduction in ponds in the presence of bass and bluegill. Therefore, supplemental stocking of 8 inch or larger channel catfish must be completed to sustain a fishable population.

After the initial stocking, there are numerous other fish stocking situations that may be used to develop or maintain a sport fishery. However, these more complex stocking options should only be pursued under the supervision of a fisheries biologist. Important note: A great deal of money is wasted each year by pond owners stocking the incorrect size, species or numbers, so contact your District Fisheries Biologist before stocking. Some of these stocking options and examples are as follows:



Corrective Stocking - Restoring balance to "unbalanced" fish populations requires the partial removal of the stunted fish and a corrective stocking of either the predator or prey species. Impoundments with a stunted 7 to 11 inch bass population require harvesting of part of these small bass and possible stocking of adult bluegill. A stunted 3 to 5 inch bluegill population requires the stocking of 50-75, 6 to 8 inch bass per acre for 3-5 consecutive years. Corrective stocking is an effective fishery management tool when applied under the proper situation.

Diversification Stocking - Many different physical, chemical and biological conditions occur within Illinois ponds. It is usually possible to stock additional fish species to diversify the sport fishery. Most of these newly stocked species compete with the existing fish population for food and space. This decreases the numbers and total weight of the existing population. Examples of this type of stocking might include 8 inch walleye stocked at 10 per acre, 8 to 10 inch muskellunge stocked at 1 per acre, or 6 inch hybrid striped bass stocked at 3 to 5 per acre. Maintenance of these non-recruiting populations requires periodic supplemental stockings of non-vulnerable sized fish and is more suited to larger impoundments than small ponds.

Food Chain Utilization Stocking - Illinois ponds have complex food chains which serve a variety of fish species. In many ponds, parts of this food chain are not used because certain fish are absent. Adult redear sunfish, for example, eat freshwater snails and in many ponds having an abundance of snails, their introduction improves the utilization of an existing food source. This type of stocking situation requires releasing up to 50 or more adult fish per acre.

Food Chain Improvement Stocking - This type of stocking is done in an attempt to improve the production of an existing or future fish population by increasing and diversifying the food chain. In some cases, the initial growth of bass in a new stocking is doubled by the introduction of 2 pounds of adult fathead minnows per acre. Threadfin shad are also used with some success in large impoundments to provide an increased forage base for the larger predator fish. Threadfin shad however, will not overwinter in most ponds in Illinois where winter water temperatures dip below 45° F for extended periods of time. Stocking freshwater shrimp may also be successful in food-chain improvement.

Hybrid Sunfish Stocking - Hybrid sunfish are stocked extensively in small impoundments throughout Illinois with mixed results. They are generally stocked with the idea that they do not overpopulate like the bluegill, grow at a faster rate than other sunfish species, and are easier to catch.

Experience with hybrid sunfish revealed several distinct disadvantages. Their major problem is an inability to produce enough young to maintain desirable largemouth bass growth. Most waters stocked with a combination of largemouth bass and hybrid sunfish develop a stunted bass population along with a virtual disappearance of the hybrids. To maintain the hybrid sunfish population, they must be restocked periodically at a costly 3 to 5 inch size.

The bluegill (male) x green sunfish (female) hybrid is the best choice to stock in small ponds less than 1 acre where the fish will be artificially fed and the management objective is to produce very large sized panfish. Initial stocking rates for hybrid sunfish vary between 500 and 1000 fingerling fish per acre. Channel catfish fingerlings, stocked at rates from 100 to 200 per acre, can be included with the hybrid sunfish. In addition, adult fathead minnows can be stocked to provide forage.

If artificial food is not to be used, a combination of bluegill x green sunfish hybrids and redear x green sunfish hybrids produce the best results. A lower stocking rate is suggested for the non-fed hybrid sunfish populations. As with any hybrid sunfish, a periodic stocking is required to sustain their population. Hybrid sunfish have reduced growth potential when stocked in the presence of existing non-hybrid sunfish populations or in combination with other species.

Seasonal Trout Stocking - Because of the lower water temperatures in ''warm water" impoundments during the fall, winter and spring seasons, it is possible to stock (10 inch or larger) rainbow trout for the creation of a unique "coldwater" sport fishery. In Illinois, rainbow trout live in most small impoundments from mid-October to mid-May. The stocking rate for this put-and-take trout fishing program is 100 to 500 per acre depending on the expected amount of fishing pressure. Stocked rainbow trout must be certified disease free.

Harvest Stocking - This type of stocking is very expensive and is comparable to the hunting club that releases pen-reared game birds in front of the hunter. This technique involves the purchase and stocking of various fish species at a catchable size with the expectation that they will be harvested in a very short period. This type of stocking is designed for small ponds that receive heavy fishing pressure and strip-mine waters which are typically low in fertility.

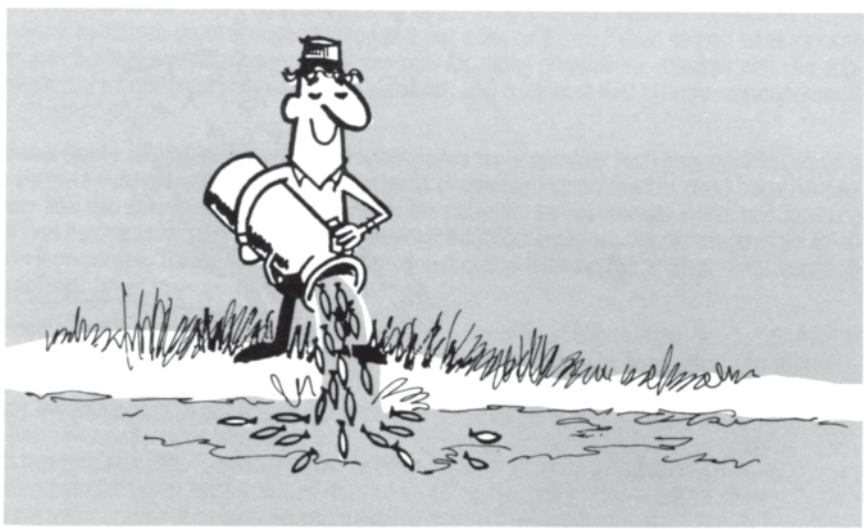
Sources of Fish

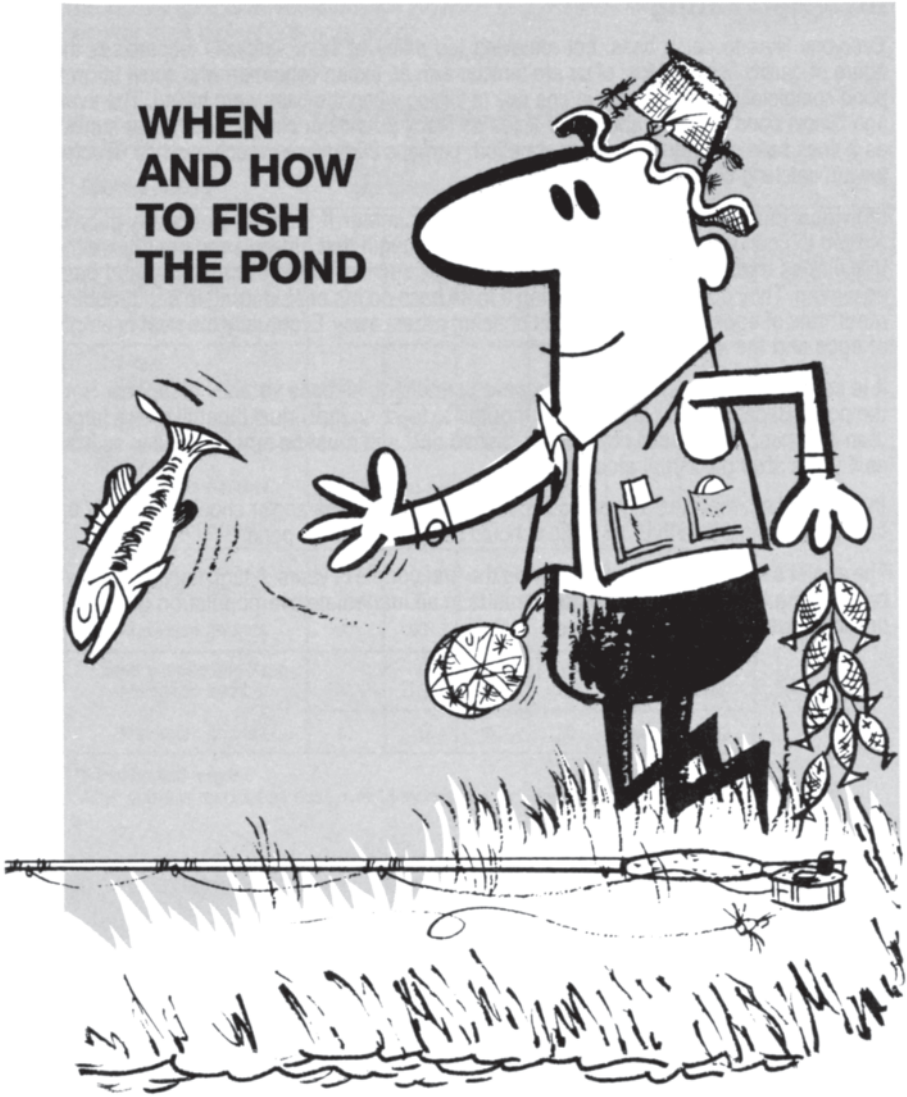
Pond and lake owners may desire to purchase fish for stocking purposes from a private source. The Illinois Department of Natural Resources, Division of Fisheries no longer sells fish for private pond stockings, however there are numerous Illinois private dealers and out-of-state private dealers that raise and supply fish for stocking purposes. Their prices vary according to the species, size, availability, and delivery method.

Refer to the Aquatic Life Approved Species List on the I Fish Illinois website *http://ifishillinois.org/* for a complete list of species that are approved for stocking in private waters in Illinois.

The Illinois Department of Natural Resources does not assume any responsibility, recommend, or endorse the Private Fish Dealer and Pond Consultant List, but provides this for the convenience of those who may desire a private source of fish for stocking purposes. To view this list visit: http://ifishillinois.org/. Contact the County Soil and Water Conservation District or local farm store for spring or fall fish sale schedules. It is recommended that those who desire to purchase fish consult with a District Fisheries Biologist or the local Natural Resources Conservation Service Office.

In some cases, Triploid Grass Carp may be desirable to control aquatic vegetation in a pond. Refer to page 12 for information about the Triploid Grass Carp Stocking Policy.





After the water area has been properly stocked with fingerling fish, it is a good idea to allow the fish two complete years for growth before any harvest. In the second year following the bass stocking, sometime in the period of May to July, the bass spawn for their first time. Bass do not reproduce until they are two years old. Remember that the main cause of pond failure in Illinois is the excessive harvest of bass, especially in the early years after initial stocking.

Following the initial stocking, ponds reach their carrying capacity during the second year (total pounds of fish that it can support). Initial panfish harvest is permissible by mid-July of the second year following the bass stocking. Remember that channel catfish do not usually reproduce in ponds so harvest should keep pace with restocking plans. In a new pond there is a great tendency to over-harvest bass in the early years. The young bass are gullible and easily caught on hook and line. Bass harvest is permissible in mid-July of the third year following their introduction, usually when they are 15 inches or larger.

Fish Harvesting

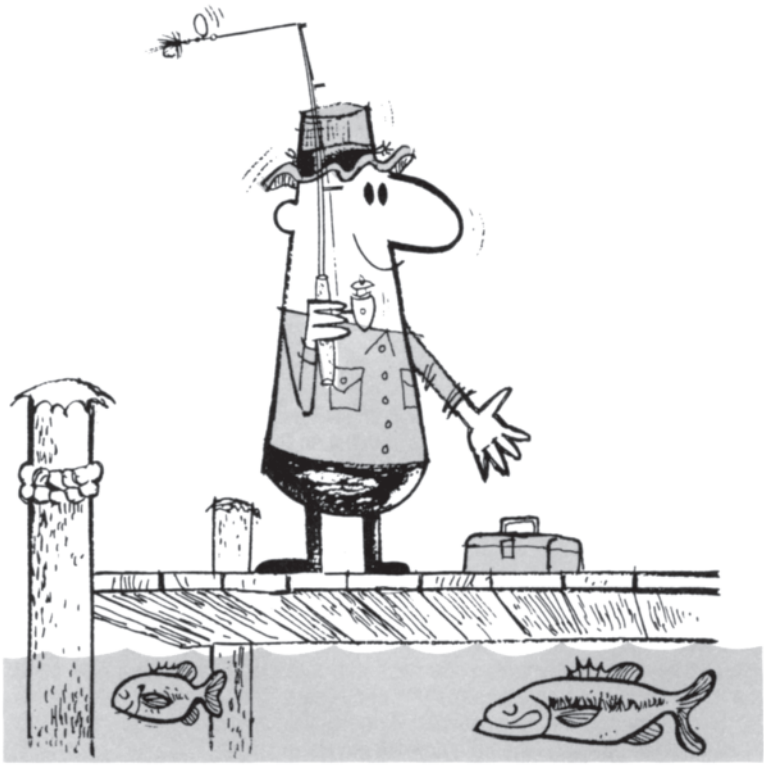
Everyone likes to catch bass, but removing too many of them seriously jeopardizes the future of quality fishing. Most of us are familiar with an expert fisherman who could throw a pond completely out of balance in one day of fishing when the bass were hitting. The average Illinois pond supports about four times as many pounds of bluegill and redear sunfish as it does bass. Therefore, much more effort, perhaps 20 times as much must be directed toward catching bluegill than toward bass.

Individual bluegills can reproduce 2 to 4 times a summer. If there are not plenty of bass around to prey upon this reproduction, the only bluegills that grow up and get big are the initial ones that are stocked. If too many bluegills survive, they prevent successful bass spawning. They do this by surrounding a male bass on his nest, darting in and grabbing mouthfuls of eggs and fry while he is chasing others away. Eventually the nest is empty of eggs and the spawn fails.

It is common for this situation to become permanent, as bass virtually disappear from the pond. Because there are so many mouths to feed, no individual bluegill grows larger than 4 inches. The pond is considered "fished out" and must be rehabilitated in as little as 4 years after the initial stocking.

In order to help maintain a good balanced fish population, the angler should keep only the larger bass. Bass less than 14 inches should be returned to the pond.

The angler's success is often high during the first couple of years. A high harvest of small bass during the first two years often results in an immediate overpopulation of bluegill or redear sunfish.

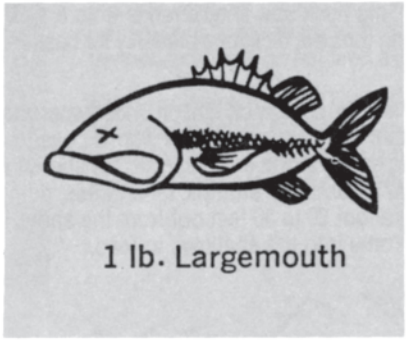


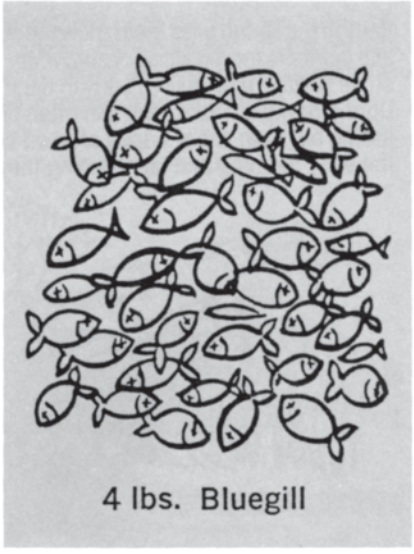
The following recommendations are provided as guidelines for maximum angling harvest per year for a typical one acre pond:

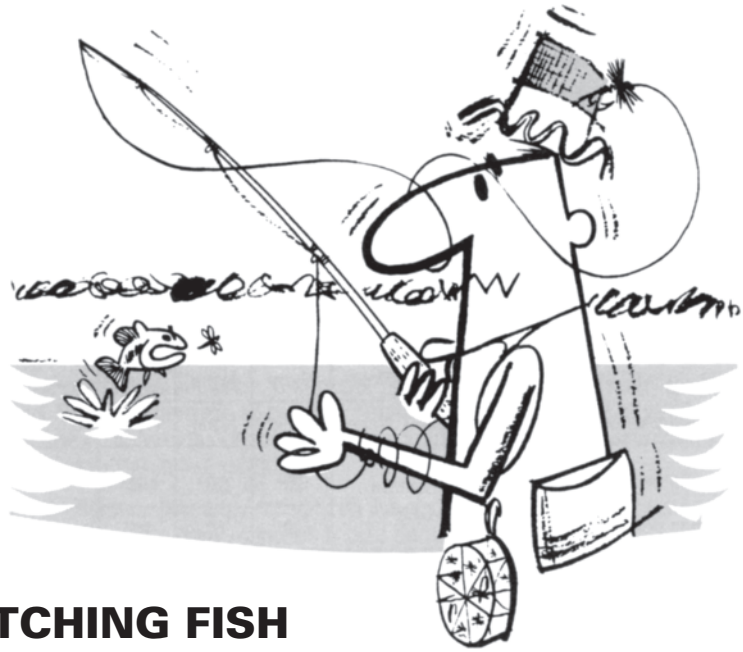
FISH HARVESTING GUIDE

Species of Fish	Largemouth Bass			Bluegill and/or Redear Sunfish			
Carrying Capacity of Pond (Pounds per acre)	25	50	100	75	200	400	SEE PAGE 11 FERTILITY MAP OF ILLINOIS
Fertility Map Key							
Angler Harvest: (fish/acre)							
1st Year Maximum number	None	None	None	None	None	None	
or Maximum pounds	None	None	None	None	None	None	
2nd Year Maximum number	Catch and Release Fishing Only			120*	320*	640*	
or Maximum pounds				30	80	160	
3rd Year Maximum number	10	20	40	120*	320*	640*	
or Maximum pounds	10	20	40	30	80	160	
Each succeeding Year Maximum number	10**	20**	40**	120*	320*	640*	
or Maximum pounds	10	20	40	20	80	160	

*6 inches and larger
**After quota is reached all bass over 18 inches can be harvested.







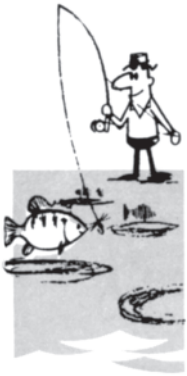
CATCHING FISH

Many anglers do not catch fish simply because they do not know how. About half the people who go fishing fail to catch fish. Of the other half, 10 percent of the fishermen catch 90 percent of the fish. Success in catching fish requires the proper selection of equipment, a knowledge of when and where to use it, and some knowledge of the fish itself.

Largemouth Bass

The best Illinois bass fishing is in spring and early summer. Artificial lures such as plugs, spoons, spinners, and poppers are often more attractive than live bait. If natural baits are used (minnows, crayfish, frogs, night crawlers), the hook size should range from 6 to 1/0. Certain sizes and weights of casting and spinning rods are designed primarily for bass fishing and for handling artificial lures.

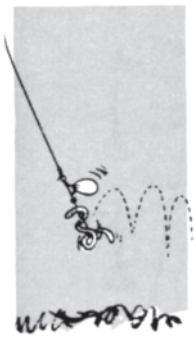
Early in the spring bass feed below the surface and are usually caught on underwater baits and spinners moved slowly. Later, when the water temperature is 68° or warmer, bass will strike surface lures fished early in the morning or late in the evening near the shoreline. During daylight hours bass can often be found around tree stumps, fallen trees, points jutting out from shore, edges of weed beds or about 20 to 30 feet out from the shore. In the early morning and late evening they will come into the shallows to feed.



Bluegill

These sporty little fish provide most of the fishing in a pond. They are most easily caught while on the spawning beds, but are also found along weed beds and around submerged brush. In the winter, bluegills are caught through the ice using an ice fly or jig to which a grub or small worm has been attached. In cold water, bluegills tend to concentrate in groups near the bottom.

The simplest type of fishing gear for bluegill is the cane pole with a small bobber and size 8 to 12 hook baited with small earthworms, crickets, catalpa worms, leeches, or maggots. Fly rod casting with black flies, small floating poppers, and rubber spiders is highly productive. Early morning and late evening fishing are more rewarding than other times but the time of day is of little importance when fishing over spawning beds. Remember, a bluegill has a small mouth and it takes a small hook to catch him.



During hot summer days bluegills can be found in deep water or in weed beds, where they may be caught on weighted black artificial flies or on small earthworms trolled deep behind a slow-moving boat.

Redear Sunfish

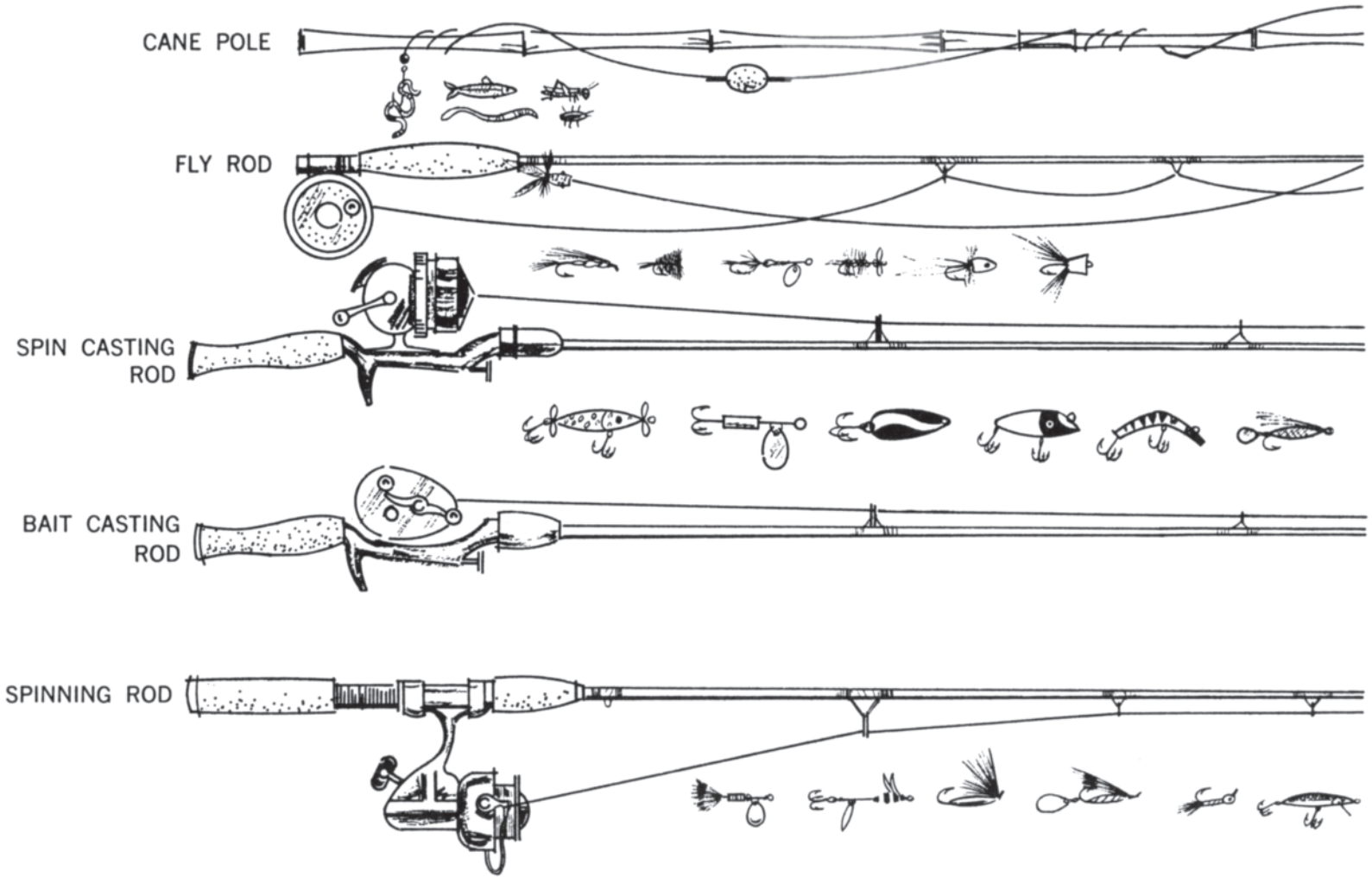
The redear sunfish is often more difficult to catch than the bluegill because it inhabits deep water and is a cautious biter. The most successful fishing method is to use a small spinner and hook, such as a number 8 or 10, baited with a red worm, cockroach, or cricket fished deep with the bait jigged up and down right off the bottom. Sometimes the bait is left motionless on the bottom. Whether using a cork or fishing a "tight-line," the hook is set at the first sign of a bite.

Unlike the bluegill, the redear sunfish usually will not make a pronounced "run" with the bait. Redears are also caught while on their spawning beds in shallow water. Anglers using light tackle can expect many exciting catches of redear sunfish.

Channel Catfish

Successful channel catfish fishing in ponds is more difficult than in streams or river lakes. They are usually found in deep water during the day. Most of their feeding activity takes place at night, so night fishing provides a higher rate of catch. In the summer channel catfish are usually easier to catch than in the spring or winter because they are sensitive to low temperatures and do not feed actively at such times.

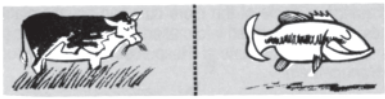
A cane pole and a strong line with a number 2 or 4 hook attached and baited with pieces of fish (shad is best), crayfish, prepared blood bait, chicken entrails, cheese, or stink baits will give good results. Still fishing is probably the best method for ponds although bank lines or small trot lines are productive when used in shallow areas after dark.


CANE POLE
FLY ROD
SPIN CASTING ROD
BAIT CASTING ROD
SPINNING ROD

MANAGING THE POND

Good fishing does not just happen. It is the result of careful stocking and proper management. It takes more than a dam and a few fish to assure good fishing.

The pond owner is off to a good start if he will remember that the cattle in a pasture and the fish in the pond have much in common. Both cattle and fish are crops to be harvested. Both can be harvested to produce a sustained yield as long as the seed stock is maintained and the habitat not overgrazed. There is nothing to be gained by overcrowding either cattle or fish. In fact, excessive numbers result in an inferior product. This is a basic principle of farm management, but strangely enough, many people cling doggedly to the conviction that the aquatic pasture will support an unlimited fish crop. If two similar ponds were stocked, one with 1,000 fish and the other with 10,000 fish, both would contain about the same poundage of fish one year later. However, fish from the pond stocked with 1,000 individuals would be much larger than those from the pond stocked with 10,000.



The study of interrelationship between animals and their environment is known as the science of ecology. Manipulation of the animals, the habitat, or both, is management. When applied to fish, it is fisheries management, producing sustained annual crops of fish for recreational and commercial uses. Some phases of management have already been discussed. They include stocking and proper harvesting of the fish by angling. But there are other types of management that the pond owners must practice if they are to maintain successful fishing.

WATERSHED MANAGEMENT

Many ponds have ground water seepage, sometimes called springs, but the majority of the water that fills most ponds comes from the watershed. The watershed of a pond may be defined as the land area from which water drains into the pond. Agricultural activities occurring in the watershed of a pond have a direct impact upon the water quality and the well-being of the resident fish population present in the pond.

Activities such as the spraying of herbicides and pesticides onto farmland or near the pond in a manner inconsistent with the chemical label directions or just prior to a rainfall event can cause chemical runoff into the pond. The results can be devastating to the fish population. Extreme caution must be exercised when using chemicals adjacent to or in the watershed of ponds.

To prevent the inflow of muddy water and excessive siltation, the watershed should be protected from erosion with permanent vegetative cover in waterways leading to the pond. Throughout Illinois the single most significant factor damaging ponds is soil erosion.

No pollution of any kind should be allowed to enter the water. Barnyard, feedlot, and sewage effluents may kill fish by oxygen depletion or direct poisoning. (See section on fish kills.)

The pond should be fenced from livestock. Grazing activities tear down the shoreline and bank vegetation resulting in erosion and muddy water. Silt entering the pond settles in the basin and eventually fills it. Continuous muddy water also ruins the habitat for fish because bass and certain other game species cannot see their food. Sunlight penetration, so necessary for the growth of plankton algae, may be limited. If water is used for livestock, it should be piped to a tank located outside the fence and below the dam.

AQUATIC VEGETATION MANAGEMENT

Aquatic vegetation becomes a problem when it takes up more than 20 percent of the water surface area. Excessive aquatic vegetation can quickly choke a pond, damaging it for both fish and fishermen.

When large numbers of small bluegill find protection in extensive beds of vegetation, bass growth can become slow and bluegills are subject to overpopulation and stunting. Extensive beds of aquatic plants are a nuisance to the angler and they cause fish kills when large amounts of vegetation decomposes or in the winter under the ice. Some kinds of vegetation emit offensive odors and give the fish a bad taste. There are blue-green algae that produce deadly poisons that can kill fish, birds and livestock, and weed choked shallow bays that spawn clouds of mosquitoes.

COMMON AQUATIC PLANTS

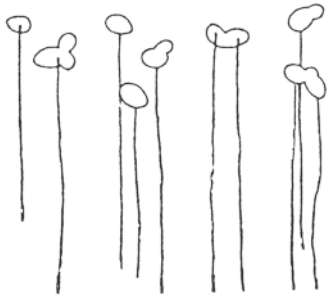
The following are drawings of some of the more common aquatic plants found in Illinois small lakes and ponds. For more detailed information regarding aquatic plant identification, refer to the Illinois Department of Natural Resources booklet, *"Aquatic Plants, Their Identification and Management."*

Algae are small, primitive plants with no true leaves or flowers. Algae can be found floating or attached to submersed surfaces.

Filamentous Algae
(Pond Scum)

Chara

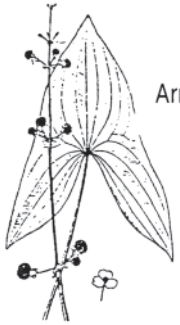
Floating plants are not rooted to the bottom. Instead, they float freely upon the surface of the water.



Duckweed

Watermeal

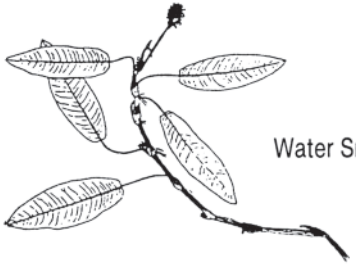
Emergent plants are rooted in the bottom with their leaves rising above or floating upon the surface.



Arrowhead

Creeping Water Primrose

Cattail



Water Smartweed

Submergent plants are rooted in the bottom with their stems and leaves rising to the surface or just beneath the surface.

American Pondweed

Leafy Pondweed

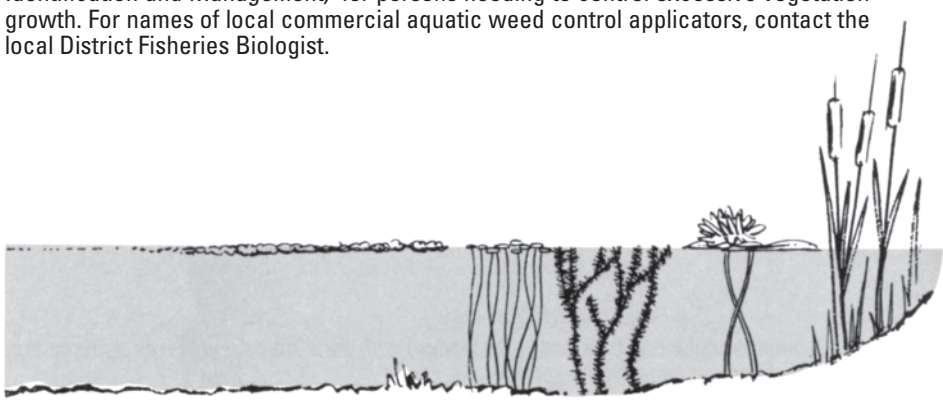
Sago Pondweed

Coontail

Southern Naiad

CHEMICAL CONTROL

The Department of Natural Resources has a booklet available, *"Aquatic Plants, Their Identification and Management,"* for persons needing to control excessive vegetation growth. For names of local commercial aquatic weed control applicators, contact the local District Fisheries Biologist.



BIOLOGICAL CONTROL

In 1979, the Illinois Department of Natural Resources funded the Illinois Natural History Survey to investigate the use of biological methods (grass carp, reproductively sterile grass carp, and hybrid grass carp) for control of nuisance aquatic vegetation. Based on

Background

There are several species of fish that have been used as a biological control of aquatic vegetation; however the only species that is allowed in Illinois is the Triploid Grass Carp.

In 1979, the Illinois Department of Natural Resources funded the Illinois Natural History Survey to investigate the use of biological methods (grass carp, reproductively sterile grass carp, and hybrid grass carp) for control of nuisance aquatic vegetation. Based on the results of the research, the reproductively sterile (triploid) grass carp was selected as the biological method control which will control some types of aquatic vegetation effectively.

The reproductively sterile (triploid) grass carp is nearly identical to the pure (diploid) grass carp in its physical characteristics as well as in its ability to consume aquatic vegetation. The main difference in the two grass carps is that the triploid form of the grass carp is sterile and cannot reproduce in nature. Unrestricted reproduction of the grass carp (diploid) and the potential for destruction of desirable aquatic vegetation in bottomland lakes and river backwater areas was the main concern of the Department of Natural Resources in the early 1970's when the grass carp became illegal in Illinois.

Triploid Grass Carp Stocking Policy

It is the policy of the Department of Natural Resources to not permit the stocking of triploid grass carp into any natural body of water including glacial lakes, slough potholes, bottomland lakes, streams, or rivers; water areas known to harbor rare, threatened or endangered animals or plants on the official National or State listing; any State inventory natural area; any State Nature Preserve; or any wetland.

As with any method of nuisance aquatic vegetation control, **results are not guaranteed.** The private lake owner should give careful consideration before stocking triploids as results have been variable, ranging from no vegetation control, to total eradication of aquatic vegetation. **Potentially serious impacts to sportfish populations can result from overstocking of grass carp and the subsequent elimination of aquatic weeds.**

Triploid Grass Carp Permit Program

Beginning in February, 1986, the triploid grass carp became legalized for stocking in Illinois' waters. Importation of triploid grass carp into Illinois from other states and transportation/stocking within the State require a "Restricted Species Transportation/Stocking Permit" which may be obtained from the Illinois Department of Natural Resources or from a private fish dealer for a pond owner.

Permit applications may be requested by writing to the Aquaculture Specialist, Illinois Department of Natural Resources, Aquatic Nuisance Species and Aquaculture Program, One Natural Resources Way, Springfield, IL 62702 or by calling (217) 785-8772 or emailing *dnr.aquaculture@illinois.gov*. Illinois licensed fish dealers will be permitted to sell triploid grass carp to the lake or pond owner for stocking purposes provided: 1) a "Restricted Species Transportation/Stocking Permit' has been obtained by the fish dealer for the particular water body from the Department of Natural Resources; 2) the owner obtains a "Bill of Sale" from the Illinois licensed dealer stating the fish are triploid; and 3) the triploid grass carp have been tested for sterility at a certified laboratory.

Triploid Grass Carp Stocking Rates

The Illinois Department of Natural Resources bases the number of triploid grass carp to stock on the latest available research conducted by the Illinois Natural History Survey, Southern Illinois University, and the numerous years of experience with grass carp stockings.

Table 1 provides general stocking guidelines for an "average" aquatic plant problem in the "average" pond under 10 acres. These guidelines take into account an "average" aquatic plant community (in the context of grass carp food preference). Distribution is expressed as a percentage of the entire surface acreage. For ponds greater than 10 acres or in cases where the pond owner desires more precise stocking rate calculations, the pond owner must contact the local District or Regional Fisheries Biologist for assistance in calculating the appropriate stocking rate.

In order to calculate a more precise stocking rate the following information about the pond must be accurately collected by the owner and transmitted by phone or in writing to the appropriate District Fisheries Biologist:

1. Determine the size (in acres) of the pond or lake to be stocked.
   Example: The pond to be stocked is 10 acres.
2. Determine the percentage of the pond that is vegetated when the plants are at their peak.
   Example: The pond has 40% of it area covered with plants.

3. Determine the percentage of the pond that is less than 8 feet deep.
   Example: 50 % of the pond area is less than 8 feet deep.
4. Determine the county of the State where the pond is located.
   Example: The pond is located in Saline County.
5. Determine the dominant plant (the one targeted for control).
   Example: The dominant plant is sago pondweed.

If the lake or pond owner is in doubt as to the desirability or need to stock triploid grass carp, or how many to stock, contact the local District Fisheries Biologist or write to the Division of Fisheries, Illinois Department of Natural Resources, One Natural Resources Way, Springfield, Illinois 62702, or call 217-782-6424 or you can email to *dnr.fisheries@illinois.gov*.

Suggested regional stocking rates for grass carp (8-12", if bass are present) into lakes and ponds in Illinois.

Percent Plant Coverage	No. of Triploid Grass Carp Per Lake Acre		
10 - 20	Stocking not recommended, mechanical or chemical spot treatment as necessary.		
20 - 40	3 (South)	4 (Central)	5 (North)
40 - 60	5 (South)	7 (Central)	10 (North)
over 60	7 (South)	10 (Central)	15 (North)

Remember that aquatic vegetation control with triploid grass carp will take time. Monitoring the changes in the abundance of aquatic vegetation following stocking should be done each year. If the desired results are not achieved within three summers following stocking, consider increasing the number of triploid grass carp in the lake or pond, but do not exceed the maximum shown in the above table. Triploid grass carp will live for many years in your lake or pond, however, sometime in the future (approximately 7 years), restocking will probably become necessary to continue the desired level of control.

Grass carp are a cheaper alternative to aquatic plant herbicides, BUT, they seem to provide an all-or-none effect. It is extremely difficult to obtain a partial reduction of plants with grass carp. This usually results in the eradication of rooted aquatic plants and the release and/or non-use of nutrients (nitrogen and phosphorus) which will result in an overabundance of microscopic algae (phytoplankton bloom). These algae blooms make a pond more susceptible to summer fish kills due to low oxygen at night. Grass carp are often indirectly responsible for summer fish kills, as grass carp consume and metabolize rooted aquatic vegetation.

HARVESTING AND CONTROLLING BLUEGILLS

Bluegill have the capability of producing large numbers of young each year. Production of young bluegill can cause the pond owner problems, if there are excessive amounts of aquatic vegetation which interferes with predation by bass on bluegill; or if there are too few largemouth bass to keep these small bluegill under control. Only three methods have proven effective in controlling these small bluegill; predator control by largemouth bass; chemical control with fish toxicants; and water level fluctuations. Seining, trapping and fishing to remove excess bluegill are not as effective, but have worked in some instances.

PREDATOR CONTROL

The most desirable and effective method for controlling young bluegill is to maintain a well-structured and abundant largemouth bass population where all sizes of bass are present. Abundance of bass is difficult to estimate. An experienced angler fishing in a pond with a good bass population should have no trouble catching six 8-12" bass per hour of fishing.

Other species of fish occasionally mentioned as desirable predators for controlling bluegill include northern pike, muskie or walleye. These species, while highly desirable from a fisherman's perspective, are generally ineffective in controlling young bluegill and are very expensive. They are sometimes stocked to provide variety in a fish population in association with an already present largemouth bass population.

WATER LEVEL FLUCTUATIONS

Ponds that have watersheds of 15 to 25 acres of land per acre of water-and drainpipes of four inches in diameter or larger-can be manipulated to control excessive populations of small bluegill and other sunfishes.

Drawing a pond down to one-half of its normal volume in August or September will force small fishes into open water where larger fish can capture them. Such a drawdown reduces the total poundage of fish in the pond and favors the survival of bass and larger bluegills. When the pond refills, each fish surviving the drawdown will have an abundance of food organisms and the growth rate is increased. However, a successful drawdown depends on the presence of enough bass in the pond to significantly reduce the excessive numbers of small fish.

Management drawdowns should begin in late summer to early fall while bass are actively feeding. The pond should be held at a low level for at least two months. Drawdowns should not be made in ponds less than one acre in size. Enough water should be left to prevent winter kill in case there are no fall rains.

FERTILIZATION

Many state, especially in the southeast-recommend fertilization of farm ponds for fish production. In Illinois, however, fertilization of fish ponds has not produced the desired results for several reasons.

1. The addition of fertilizer often produces aquatic plant growths of nuisance proportions.
2. Such an increase in plant growth increases the chance of winter or summer kill.
3. Fertilization is expensive and usually not justified.
4. Plankton blooms stimulated by the fertilizer reduce the aesthetic and recreational values of the pond.

New ponds sometimes have clay basins and infertile watersheds and in the early years fertilization might increase the carrying capacity. For such ponds, fertilization may be practical.

Fertilization produces a bloom of microscopic plants and animals which provides food for small fish. This higher reproduction of fish food increases the carrying capacity of the pond. If a dense bottom of plankton algae is produced, it helps block sunlight and retard the growth of submersed aquatic plants. **Before any fertilization program, contact your District Fisheries Biologist.**

Inorganic fertilizers with a formula such as 8-8-2,10-6-4, or 20-20-5 are used. These fertilizers are applied in shallow water at the rate of 100 pounds per surface acre for the first two formulations and 40 pounds per surface acre for the last. Similar applications are added every two or three weeks through the plant growing season (April through September) until a "bloom" is produced and the water becomes green. Ponds receiving some fertility from the watershed can be fertilized with superphosphate (18-20%) or triple superphosphate (45-52%) at the rate of 40 and 18 pounds per surface acre, respectively, on the schedule previously mentioned. Alfalfa pellets may also be utilized at a rate of 350 pounds per surface acre followed by 175 pounds per surface acre every two weeks through the plant growing season.

Fertilizer is sometimes applied by placing it on one or more submerged platforms. These platforms, made of wood and anchored about 12 inches below the water surface near the shore, must be large enough so that they hold the amount of fertilizer needed for each application. On small ponds, one to two platforms per acre are sufficient. Wave action and water currents dissolve the fertilizer and distribute it throughout the pond. Once such fertilization is begun, it is important that it be continued throughout the growing season at regular intervals. The total amount of fertilizer needed for an entire season **should not** be added at one time.

FEEDING FISH

Several animal food manufacturers offer fish food pellets for sale. These foods are used most successfully in trout and catfish culture. However, pelleted fish food can also be used by the pond owner to feed bluegill. Bluegill do not usually concentrate in one place to feed; therefore, the pelleted food would have to be scattered in the shallow water areas or placed on floating feeders around the entire pond. Pelleted fish food can be fed at the rate of about 2 pounds per acre per feeding. Once the fish begin taking the food, the amount can be increased, not exceeding 10 pounds per acre per day. The best guide in feeding fish is to use no more than they consume in 15-20 minutes. Feeding bluegill may result in larger and fatter fish, but not necessarily better fishing. Bass do not take pelleted food very readily unless they learn to do so when very young (2 inches).

Feeding is not recommended as a normal procedure in pond management. Caution must be exercised not to use too much food. It may cause a fish kill from decomposition of the unused food.

HOW TO DETERMINE THE CONDITION OF A FISH POPULATION FROM THE FISHERMAN'S CATCH

The fisherman's catch indicates the condition of a pond's fish population. The following can be used to determine the condition of the fish population based on the catch.

	Fish Caught by Anglers	Condition of Fish Population
1.	Bluegill 6 inches and larger Largemouth bass from 1 to 2 pounds although smaller or larger sizes are also caught.	Desirable fish population.
2.	Primarily small bluegill of 3 to 5 inches in size. Very few largemouth bass are caught and when caught are larger than 2 pounds in size.	Undesirable population with bluegill overcrowded.

RECOMMENDED MANAGEMENT: Impose a minimum length limit on the largemouth bass which are allowed to be caught and kept by fishermen. In this situation you should consult your local DISTRICT FISHERIES BIOLOGIST.

3.	Bluegill average in excess of 0.3 pound. Largemouth bass average less than 1 pound and are very thin.	If large bluegill are preferred do nothing. If larger bass are desired, see recommended management below.

RECOMMENDED MANAGEMENT: Fish harder for largemouth bass. Keep all largemouth bass caught until size and condition improve. Consult your local DISTRICT FISHERIES BIOLOGIST.

4.	Small crappie, sunfish, bullheads, carp or other undesirable fish of any size.	Undesirable fish population.

RECOMMENDED MANAGEMENT: Remove all fish in the pond either by draining and/or by treatment of the pond with a fish toxicant and restock. In this situation you should consult your local DISTRICT FISHERIES BIOLOGIST.

CORRECTING POOR FISHING

Poor fishing in a pond can be corrected. If desirable fish are present but are undersized, one of several management methods already described should correct the situation. If undesirable species or great numbers of stunted fish are present, it is necessary to remove the existing population and restock with the recommended species. The undesirable fish can be removed by two methods: draining and chemical treatment.

Draining

If the pond can be completely drained, the pond bottom should be left to dry for several weeks. If any water is left, in the pond after draining, it should be treated with a fish toxicant to assure a complete fish kill.

Chemical Treatments

Permit to Remove Undesirable Fish must be obtained from the Department of Natural Resources' Division of Fisheries to allow use of aquatic pesticides. Since aquatic pesticides are listed by the USEPA as "Restricted Use Pesticides," they may only be received and possessed by a Division of Fisheries District Biologist. Treatment of water areas with fish toxicants must be done by the District Fisheries Biologist per Illinois Administrative Rule 890. The Permit to Remove Undesirable Fish and a detailed explanation of Rule 890 may be obtained from the District Fisheries Biologist.

Emulsifiable rotenone is very effective for the reduction or eradication of undesirable fish populations. The chemical inhibits a biochemical process at the cellular level making it impossible for the fish to use oxygen in the release of energy needed for body processes. The fish cannot be revived by transferring it to untreated water. Rotenone affects all species of fish although susceptibility to the chemical varies between species. Emulsifiable rotenone, 5 percent or 2.5 percent synergized, is generally used at a minimum concentration of 3 parts per million (1.0 gallon per acre foot). A stronger concentration may be required in waters that are very alkaline and highly turbid, caused by either algae or silt.

Determining Volume of Water in Pond to be Treated

The volume of water in the pond can be expressed in acre-feet, which is calculated by multiplying the surface area in acres by the average depth in feet. For example, if a pond covers 2 acres and has an average depth of 6 feet, it contains 12 acre-feet of water. The average depth of most ponds is about one-half of the maximum depth. The average depth of large ponds is determined by making soundings with a long pole or weighted rope marked off in feet. To calculate the acreage of an area, multiply the average length in feet by the average width in feet and divide by 43,560. If the pond is triangular in shape, multiply the base length (dam) in feet times the total length (the height of the triangle) in feet and divide by two. The resulting figure is then divided by 43,560 (1 acre = 43,560 square feet).

To determine the amount of rotenone needed, multiply the acre-feet of water to be treated by the recommended chemical dosage required per acre foot of water.

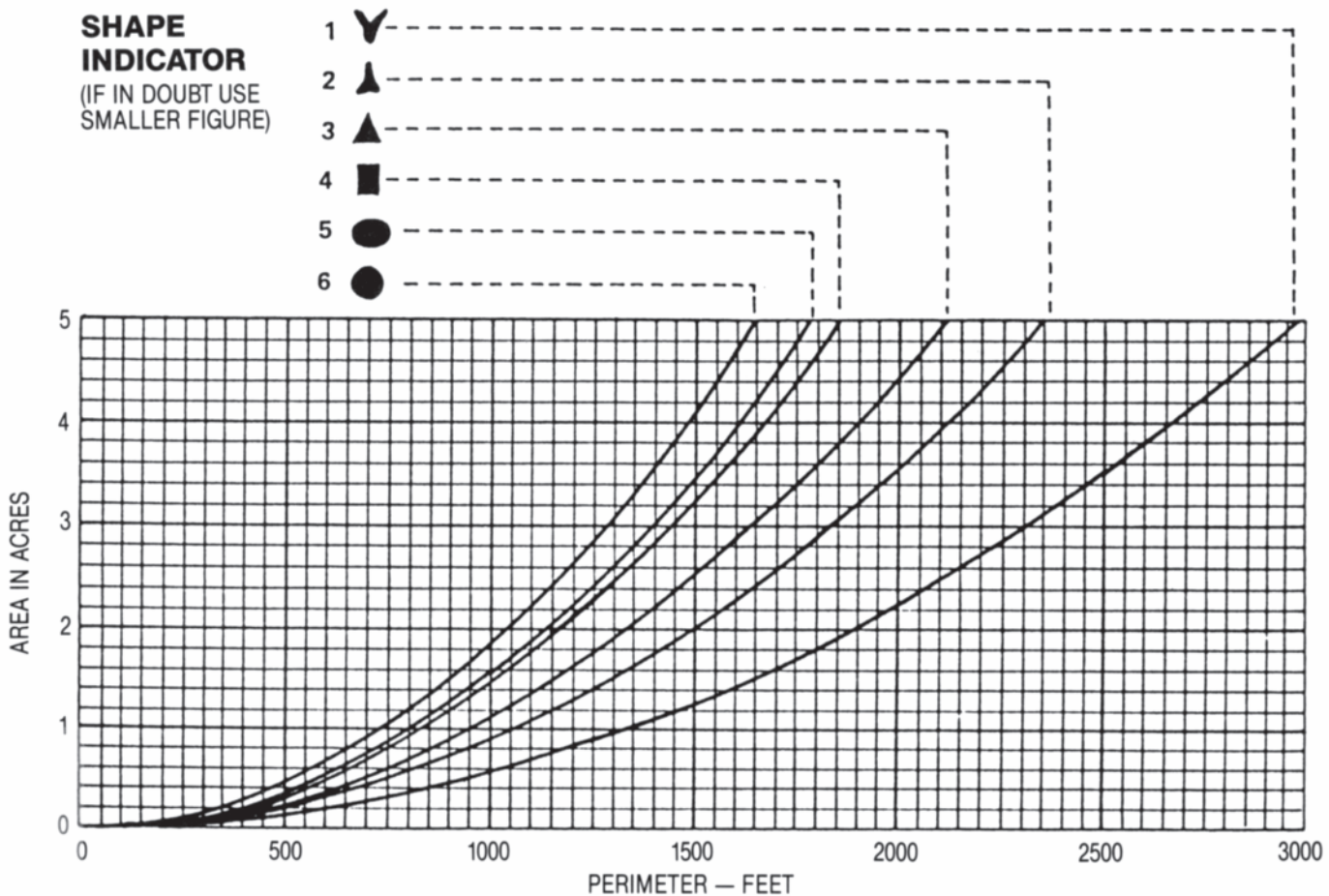
AREA IN ACRES

LENGTH — Feet

WIDTH

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	23.06

POND AREA ESTIMATOR



Types of Chemical Treatments

Warmwater Treatment: All warmwater treatments should be done when the water temperature is above 65° F. Complete treatments should not be attempted in deeper ponds during the months of summer stratification; if so, the rotenone must be pumped below the thermocline and into the hypolimnion waters. The concentration of rotenone required is dependent upon the target species, total alkalinity and turbidity. Excessive algae blooms or high sediment suspension neutralize 50 to 90 percent of the rotenone applied, often within a few hours after application. Under **ideal** conditions of high water clarity, low alkalinity and the absence of carp and bullheads, a complete kill can be obtained with a rotenone concentration of 3 ppm. If carp, goldfish or bullheads are present and conditions for rotenone treatment are less than ideal, additional rotenone is required (see chart). Rotenone dissipates quickly in warm water and is usually not lethal after 2 weeks; in the warmer days of summer detoxification may occur within 2 or 3 days. Neutralization of rotenone depends on water temperature, exposure to light, water alkalinity and turbidity.

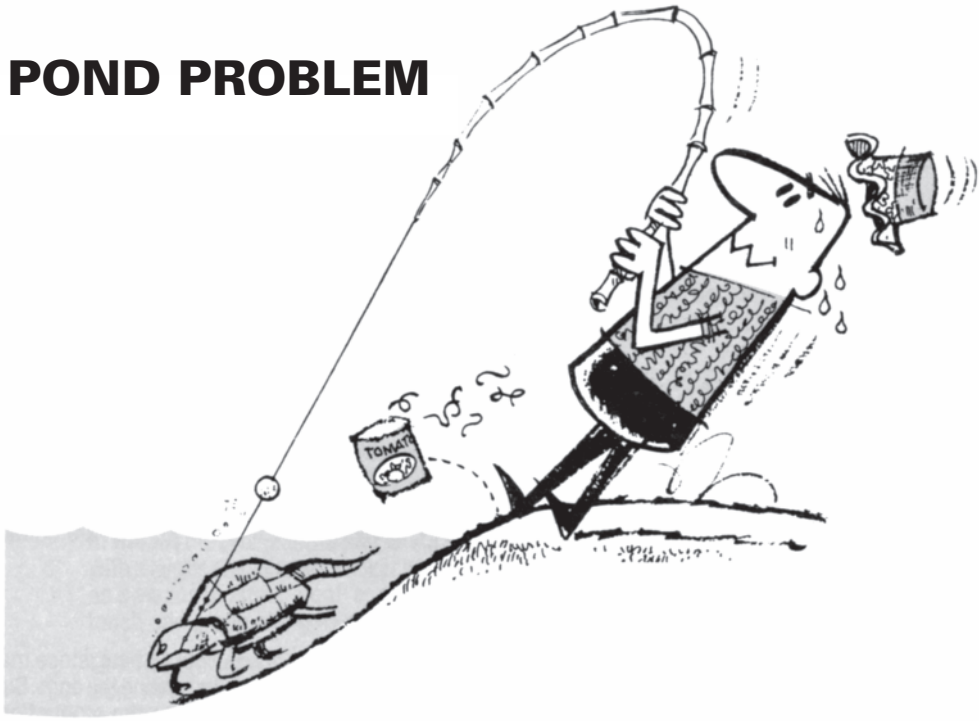
Coldwater Treatment: Coldwater treatment has proved to be an effective method for eradicating undesirable fish populations. Whether or not the coldwater method should be used is based on the answer to several questions. Is the fish population dominated by carp, goldfish and/or bullheads? Does the lake contain springs which may enable fishes to minimize the effects of rotenone? Do underground drainage tiles from fields, streets or residential areas enter the lake (these areas provide refuge for tolerant species)? Is alkalinity high? Is the lake water turbid? Are algae blooms excessive? Although a considerable amount of the rotenone applied initially will be neutralized by organic and/or inorganic influences, once the rotenone demand created by these influences is met, the active rotenone will remain toxic from 30 to 90 days. The effectiveness of coldwater rotenone application directly relates to the length of time the chemical remains toxic.

Behavior of Treated Fish: When water temperatures are above 65° F, fish generally respond within a few minutes to one-half hour from the time treatment begins. The affected fish often come to the surface, swim rapidly or jump in an aimless manner. They soon lose equilibrium and die. The dead fish sink and may not be seen for a day or two. If the dosage and distribution of the chemical has been figured correctly, all fish should be dead within 24 hours. The dead fish can be collected and buried, or left to decay in the lake. In warm weather they will disintegrate rapidly, with little odor apparent after two weeks.

Restocking: Ponds receiving complete treatment should be restocked with largemouth bass, bluegill, redear sunfish and channel catfish fingerlings as recommended by the District Fisheries Biologist of the Department of Natural Resources. If fish of a suitable size are not available from the Department of Natural Resources, larger fingerlings may be purchased from a private fish dealer.

The Department of Natural Resources recommends that fish killed from exposure to chemical toxicants not be eaten by humans or other animals.

POND PROBLEM



Fish That Can Ruin Fishing

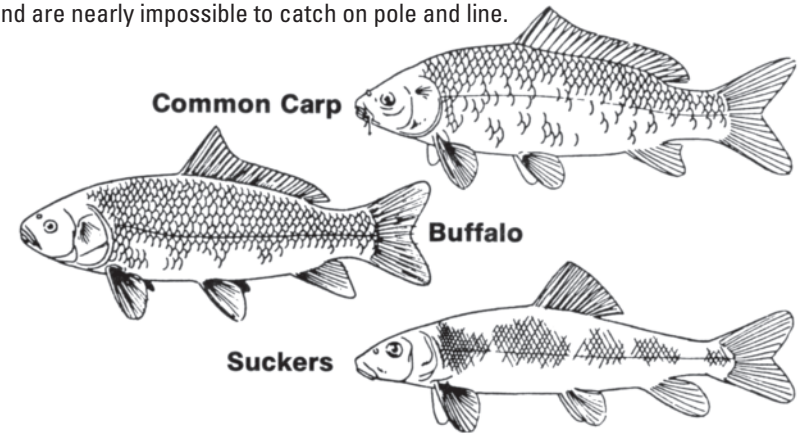
The following fish species can cause serious problems for sport fish in ponds:

BULLHEADS

Illinois has three species of bullheads; black, brown, and yellow. Of the three, the black bullhead is the most common. Bullheads are not recommended for pond stocking because they have a high reproductive potential which generally results in an over-population. Since they are bottom feeders, large populations of bullheads cause the pond waters to become turbid–a phenomenon similar to that produced by a carp population.

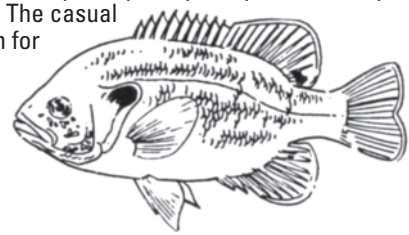
COMMON CARP, BUFFALO, AND SUCKERS

Carp, buffalo and suckers are found primarily in rivers and river lakes. When stocked in ponds, they compete directly with bluegill and small bass for food. Large numbers of carp cause the water to become extremely turbid. Buffalo feed on microscopic food and are nearly impossible to catch on pole and line.



GREEN SUNFISH

Green sunfish are commonly found in streams and lakes. In a pond they readily become overabundant due to a very high reproductive capability. They compete intensely with small bass and bluegill for food and space. The casual fisherman often mistakes the green sunfish for bluegill, but the green sunfish has a mouth larger than the bluegill's and has no markings on the sides of its body. Many fins of the green sunfish are bordered with white and yellow.



Muddy Water

Muddy water retards the growth of sport fish and causes poor fishing, since many sport fish must see to eat. Silt in the water can suffocate fish eggs by coating the eggs. Suspended silt can clog the gills of fish, conceal forage fish, and decrease the production of food organisms. The average total weight of fish which a pond can produce is usually five times greater in clear ponds than muddy ponds. In some cases newly constructed ponds require 1 or 2 years before silt completely settles. Therefore, it is important to seed shorelines and dams as soon after construction as possible. Muddy water can also be caused by soil erosion from overgrazed woods or cultivated crops in the watershed or from wind action along the shoreline, by bottom feeding fish such as carp and bullheads, by livestock, or by clay particles that will not settle out of the water column. The clay suspensions require a special approach, for they are composed of very fine particles which have similar electrical charges and therefore, repel each other and do not settle.

A simple test can be conducted to determine if fine charged particles are the problem. Simply take a water sample from the pond in a clean glass jar. Let the jar sit in an undisturbed location for 1 to 2 days. If the muddy water settles to bottom of jar, then the muddy pond water is caused by some source other than having electrical charges. If the water does not clear in the jar, apply Gypsum (hydrated calcium sulfate) to the pond at a rate of 12 pounds per 1,000 cubic feet of water (525 pounds per acre-foot of water). The electrical charge of the particles is neutralized allowing them to settle to the bottom.

Green hay or dry straw, which stimulate bacterial growth, can also cause the clay particles to clump and settle. In addition, an agricultural lime can be used with success. In both of these cases, there are not any standard application rates that can be recommended to successfully break up the charged particles.

Muskrats

Burrowing muskrats can cause the loss of a pond dam. They dig burrows about a foot below the water surface, sloping upward into the embankment for 4 to 6 feet so that their den chambers are above the water line. If such burrows penetrate a dam, the pond's dam can fail.

Muskrats can be discouraged by removing their source of food such as cattails and other immersed vegetation along the shoreline. Keeping the pond banks mowed will also limit their activities. The dam can also be rip·rapped with rock extending from two feet up on the dam to three feet below the water line. However, if broken concrete is simply dumped along the face of the dam it may create natural cover that is highly attractive to muskrats.

Muskrats can be trapped during the trapping season. Contact your local District Wildlife Biologist to obtain a nuisance furbearers removal permit.

Leeches

Among all of the different forms of animal life common to Illinois, few are looked upon with such misunderstanding as are the leeches or "bloodsuckers;' as they are often called. The leeches are a group of invertebrates (animals without back bones) which live primarily in fresh water, but there are many marine as well as land species. The land leeches are found mostly in the tropics. About 44 fresh water species are found in the U.S.

Leeches abound in warm, sheltered shallows where there is little wave action and where plants, stones, and debris afford concealment. Members of the same species may occur in lakes, ponds, slow streams, springs, and marshes. Close examination of the habitat during the day may reveal only a small number of leeches, as they are chiefly nocturnal.

The bodies of all leeches are divided into 34 true internal segments. The mouth is located in the first few segments and is surrounded by an oral sucker. The tail end is equipped with a larger, disc-shaped sucker on the underside of the body. This sucker is used primarily as a means of attachment, and it can be used in coordination with the oral sucker so the leech can creep along much like an inchworm.

Leeches are known collectively as "bloodsuckers;' but only a few species will take blood from warm-blooded animals. Many leeches are scavengers, feeding on dead animal matter. Others feed primarily on small invertebrates such as snails and worms. One entire family of leeches is known as "fish leeches". They feed on the surface mucus, blood, and tissue fluids of fish.

As previously mentioned, one family is parasitic on fish. Large infestations of this leech can cause fish mortality, but this is an unusual situation and does not occur often.

The remaining three families are of no real importance to fish although some species have been found to be of great value as food.

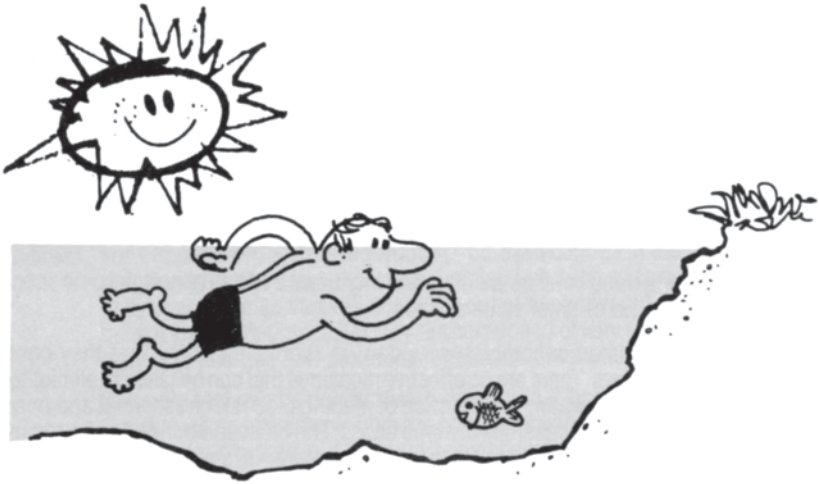
Leeches sometimes become so abundant in swimming areas that they constitute a nuisance to swimmers. There are no effective measures that can be taken to eliminate leeches in a sizable body of water. The practice of placing pieces of fresh meat and bones in the water has worked successfully in some cases. The meat and bones can be removed from the water periodically and the leeches destroyed. In small ponds, leeches may be controlled successfully by placing a pair of domestic ducks on the pond. The domestic white duck is a voracious leech eater!

Swimmer's Itch

Skin eruptions, known as schistosome dermatitis or swimmer's itch, results when man accidentally becomes involved in the life cycle of a trematode worm. The small larvae or cercariae emerge as the water warms up, which often coincides with the swimming season. The free swimming cercariae seek its intermediate host-an adult snail. When coming into contact with a swimmer, the larvae penetrates the skin thus causing the irritation.

The simplest method of control for swimmers' itch for the individual swimmer is the rubbing of the body with a rough towel before the water film dries on the skin's surface. Such action will crush the cercaria before they have an opportunity to penetrate the skin. A fresh-water shower taken immediately after leaving the water is also effective. Swimming in deeper water farther from the shore appears to greatly reduce the potential of being effected by swimmers' itch. The common practice of alternately swimming and sun bathing should be avoided since this activity provides an excellent opportunity for a bather to receive a severe infection, if infective cercariae are abundant in the water.

Some limited biological control may be achieved by stocking adult (6 inches or larger) redear sunfish. This species of sunfish is also known as the "Shell Cracker" due to the inclusion of snails in their diet.



SPILLWAY ESCAPEMENT

The use of barriers to keep fish from entering streams and impoundments has been practiced for many years. Newly constructed small impoundments often have a vertical drop in the spillway or other type of barrier to keep wild or unwanted fish from entering the pond from downstream.

The use of barriers to keep fish from leaving ponds has created considerable controversy. Several investigations concerning the loss of fish over spillways of ponds have been conducted and substantiate that significant losses can occur.

An effective spillway barrier keeps harvestable fish from leaving a pond, is self-cleaning, and relatively easy to maintain. Wire mesh is ineffective since it easily clogs with debris. The numerous fish barrier designs offer varying degrees of effectiveness and ranges of applicability. The devices are divided into two categories: those that impose an absolute physical barrier to fish movement and those that restrict a specific size fish. In the category of structures intended to be absolute barriers are the revolving drum screens, perforated plate screen, perforated pipe filters, and barrier dams. The parallel bar barrier, rotating disc screen, link belt screen, and horizontal traveling screen are examples of size selective barrier designs.

Fish barriers are a useful part of fish management, particularly with larger ponds. However, they may be expensive to construct and more expensive to maintain. Each pond must be considered as a separate situation, and all factors must be studied and given full consideration before a fish barrier can be recommended.

For additional information regarding specific types of barriers and their potential use with your impoundment, contact your Illinois Department of Natural Resources, District Fisheries Biologist.

Fish Kills

Many things can cause the death of fish in ponds, and when the fish are dying it is usually too late to stop the kill. However, many fish kills can be anticipated, and measures taken to prevent them. The pond owner should note that 10%-20% of the fish die in the pond each year to natural causes (#6 below). Young are hatched each Spring to replace them. This type of fish kill will likely go unnoticed. Other kills listed below are catastrophic in nature that the pond owner will be very aware of.

1. Winter Kill

Cause:
During winter, the oxygen supply under the ice depends upon the passage of light and the production of oxygen by tiny plants in the water. If snow covers the ice, sunlight cannot penetrate and the plants produce no oxygen. The supply of oxygen is gradually used up by decay processes and by the respiration of fishes and other aquatic animals. If the snow remains on the ice long enough, oxygen is depleted and the fish suffocate. Winter kill is most likely to occur in fertile, shallow, weed-filled ponds.

Effect:
Fish die from suffocation, and the dead fish are usually found in the spring after the ice melts. However, if the kill occurs early in the winter, there may be few, if any, dead fish observed when the pond opens in the spring.

Prevention:
Deepening the pond, and removing fertile organic matter, will help. Removing the snow cover from the ice will permit light to penetrate to the underlying plants. Making holes in the ice **will not help.**

Aeration:
Artificial aeration can help fish survive and prevent oxygen depletion. Compressed air systems should be utilized in depths which exceed eight feet.

2. Summer Kill (Aquatic Plant Die-Off)

Cause:
Ponds that contain an abundance of submersed aquatic plants or algae sometimes have a fish kill when these plants die suddenly from natural causes or from herbicides. Aquatic plants frequently die during midsummer and use up the oxygen in the water as they decay. This type of summer kill almost always occurs about sunrise when the dissolved oxygen is at its low point for the day. Natural die-offs of phytoplankton (algae) blooms are a common cause of summer kill.

Effect:
Fish suffocate from a lack of dissolved oxygen in the water. On rare occasions fish may die or be in distress in midafternoon because of increased pH of water, super saturation of oxygen (gas bubble disease), or toxic algae blooms.

Prevention:

Control the rooted aquatic vegetation and algae so that they never become dense. If the stand is dense, treat only a part of it at anyone time and allow that part of the vegetation to decay before further treatment.

Aeration:
Artificial aeration can help fish survive and prevent oxygen depletion. Compressed air systems should be utilized in depths which exceed eight feet. In lakes and ponds where depths do not exceed eight feet, blower systems are more efficient.

3. Summer Kill (Temperature)

Cause:
Water temperatures in shallow ponds may reach 90 to 95° during hot summer months. Water holds very little oxygen when its temperature is above 90° F. On days with little breeze, little or no oxygen is added to the water, and the dissolved oxygen may disappear entirely just before dawn.

Effect:
Fish die from lack of oxygen.

Prevention:
Deepen the pond, so that 25 percent of the area is 7 to 10 feet deep or deeper.

Aeration:
Artificial aeration can help fish survive and prevent oxygen depletion. Compressed air systems should be utilized in depths which exceed eight feet. In lakes and ponds where depths do not exceed eight feet, blower systems are more efficient.

4. Organic Pollution

Cause:
Barnyard, feedlot, silo, and sewage drainage that consumes oxygen as it decays, quickly depleting the oxygen content of the pond.

Effect:
Fish die from lack of oxygen. Fish kills from organic pollution often occur after a rain has washed quantities of these materials into the pond.

Prevention:
Prevent organic wastes from entering ponds by the use of proper livestock confinement practices and appropriate agricultural practices.

5. Pesticides

Cause:
Farm crops on the watersheds of ponds are often sprayed with pesticides. Rain may wash this material into the pond and readily cause a fish kill.

Effect:
Fish die from direct effect of the pesticide.

Prevention:
Exercise caution in the selection and application of pesticides, and in the time of treatment. Don't wash spray equipment in or near ponds.

6. Natural Mortality

Cause:
In the spring a few large fish may be found dead along the shoreline. Such mortalities are often the result of natural causes. The natural resistance of fish to disease is lower in the early spring than at any other time of the year. Larger fish often seem to be more susceptible to disease than smaller fish.

Prevention:
None.

7. Industrial and Mining Wastes

Cause:
Many industrial wastes are toxic to fish. Other industrial wastes are organic, consuming dissolved oxygen and killing fish by oxygen depletion. Mining wastes kill fish by the direct effects of acids and sulfur compounds.

Prevention:
Prevent the wastes from mines and industrial plants from entering the pond.

FISH DISEASES

MOST FISH DISEASES AND PARASITES ARE NOT HARMFUL TO MAN. THIS IS ESPECIALLY TRUE IF THE FISH FLESH IS PROPERLY COOKED BEFORE IT IS EATEN.

Disease is anything that makes a living thing depart from a state of well-being. Bacteria, fungus, parasites, cancer and viruses are not the only causes. Such things as bad environment, poor nutrition and for fish, even sudden changes in temperature cause disease, sometimes followed by death.

Dr. Stanislaw F. Sniezko, recently honored by his native Poland, was the father of fish pathology in the U.S.A. He was the first to point out that most disease organisms are not so overpowering that sickness automatically happens in fish.

The "bugs" which cause many diseases are always present. For the most part, the fish's defenses are perfectly adequate to resist whatever disease agents happen to be around. The fish may become infected with the disease agent, but they are not diseased (sick). It is stress that tips the balance in favor of sickness. It can be truthfully said that the stress is the primary **cause** of disease. Bacteria, parasites and so on, often are signs that this stress has happened. In fact, many times the only treatment needed for disease control in fish is to remove the stress that is causing them to get sick!

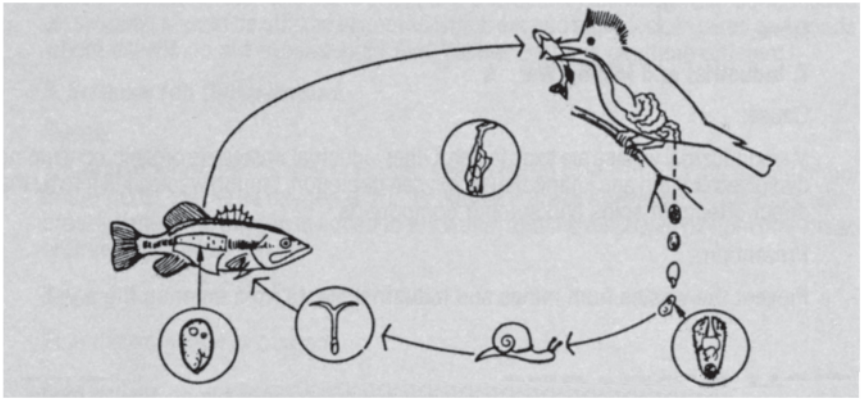
Diseases which occur in the wild are often the result of stresses that are not under our control. Winter is a period of starvation, when the fish's food is not available to them. Added to this, the repair of wear and tear takes a back seat in the spring to the fish's preparation for spawning. Also, the fish's immune response has been suppressed by the winter's cold. Bacteria are capable of responding quickly to the rapidly rising temperatures of

The fish become diseased due to all these stresses which combine to break down their defenses. Columnaris disease is one that commonly breaks out in the spring in lakes. It is caused by the bacterium *Flexibacter columnaris*. They are soil bacteria that are always present in the environment. The disease can cause the loss of several thousand fish, just at spawning time. These will be mostly large bluegill along with a few bass and catfish. There is nothing practical that can be done to treat the disease in the wild, except to let it run its course. The effect on the lake's fish population is usually unnoticeable a month or two later.

Many disease organisms are associated with the fish they infect for such a long time that little or no disease actually occurs. Both the fish and the disease organism conduct their life cycles with little interference with one another. This is the case with many of the worm parasites.

Worm Parasites

Many worm parasites spend part of their life cycle in one or two animals other than fish.



YELLOW GRUB, the adult worm lives in a heron's mouth. They lay eggs in the saliva, which wash out of the bird's mouth as it feeds. Upon entering the water, the eggs hatch and the larvae must invade the flesh of a particular type of snail of the genus *Helisoma*. If these snails are not present in the lake, the life cycle is broken. If this genus of snail **is** present, the larvae invade its flesh and multiply themselves many fold. When they mature, they burst out of the snail, penetrate the fish's skin and become encysted in the muscle. This encysted form may be white or yellow and 1/8 to 1/4 inch long. When teased out of its cyst, it wiggles, squirms and crawls about. The large size and active behavior of this grub causes universal comment when anglers fillet infected fish! The life cycle is completed when the fish containing these encysted grubs is eaten by a feeding heron. Dissolved out of their cysts by the digestive juices of the heron, they mature into adult worms, which migrate up the bird's gullet to its mouth, where the life cycle begins again.

In **BLACK SPOT,** the adult grub lives in a kingfisher's intestine, depositing eggs that enter the water via the bird's feces. Upon entering the water, the eggs hatch and the larvae enter the body of a snail. In this case, any snail will do. This is the reason that BLACK SPOT is so much more common than yellow grub. When they mature, the larvae burst out of the body of the snail and swim to the nearest fish. They become encysted in the fins, under the scales and in the meat. The fillets of an infected fish may appear to have been "peppered". The black pigment is actually provided by the fish. The tiny grub itself is white.

THESE TWO WORM PARASITES CAUSE MORE TELEPHONE CALLS TO BE MADE TO BIOLOGISTS OF THE FISHERIES DIVISION THAN ALL OTHER FISH DISEASES COMBINED!

BASS TAPEWORM has a simple, more direct life cycle. Adult tapeworms in the gut of the bass lay eggs, which pass out into the water via the feces. The eggs are eaten by tiny crustaceans called copepods, which become infected. The copepods are in turn eaten by bluegill or little bass. If eaten by a bluegill, the larvae encyst in the muscle and can live several years.

If the bluegill is eaten by a bass, the life cycle is completed. The encysted larvae become an adult in the bass's gut. If the infected copepod is eaten by a young bass, the life cycle is short-circuited. The larvae, finding no place to encyst, wander through the bass's internal organs, lacing them together with scar tissue. Heavily infected bass become sterile. The wandering worms destroy the ovaries of the females. These bass suffer severe weight loss and may be "nothing but skin and bones". Once this parasite becomes established in a pond, all bass can become sterile. If this happens, the only remedy is to remove all fish and start over with parasite free stock.

WHITE GRUB is a parasite of the internal organs of sunfishes. This tiny grub is very common but is often unrecognized by fishermen because of its small size and location. It infects mostly the liver and heart, but may be found anywhere in the body cavity. Sunfish are capable of carrying great numbers of these parasites with little effect on growth or reproduction. Occasionally deaths occur if they interfere with the heartbeat.

NONE OF THESE PARASITES IS A PARASITE OF MAN. FISH INFECTED WITH THEM ARE EDIBLE.

Leeches

Leeches are aquatic segmented worms. They attach themselves to the fins and inside the mouth of fish, and to the legs of turtles. They are not serious parasites.

Crustaceans

ANCHOR WORM *(Learnea)* is a small thread-like parasite that burrows its anchor-like head into the flesh of fish. It often chooses fin bases as its place of attachment, but may attach anywhere. Occasionally it blinds the fish when it chooses an eye. At the point of attachment, it causes a bloody, inflamed sore the size of a pea. People with sharp eyes will see that the parasite appears to have a forked tail. These are a pair of egg sacks. In this parasite, only the females attach to fish.

Fish Lice

Argulus, the fish louse, is a very large copepod parasite up to one-half inch in diameter. It is disc shaped, flattened, and rather transparent. It is equipped with suckers and can cling tightly to the surface of the fish. It causes a bloody rash as it grazes on the skin. They are most often noticed when they skitter over the surface of the fish, swiftly changing positions. A fish moderately infected with them is so irritated it is unlikely to bite on hook and line. The louse is most often seen on channel catfish.

Gill Lice

There are three species of parasitic copepods which might be called gill lice. They are all about the size of a grain of rice. They are white and are found on the gills. *Salmonicola* is found on the gills and body of cold water fish. *Ergasilus* and *Achtheres* are found on the gills of warm water fish, mostly in rivers. Normally, they do not cause a problem.

Fungus

There are several types of fungus which affect the eggs and surfaces of fish. These are usually all lumped together as *Saprolegnia*. It is a white, gray, or dirty brown fuzzy growth anywhere on the fish. *Saprolegnia* is **always** secondary to some type of injury which opens the way for infection.

Protozoa

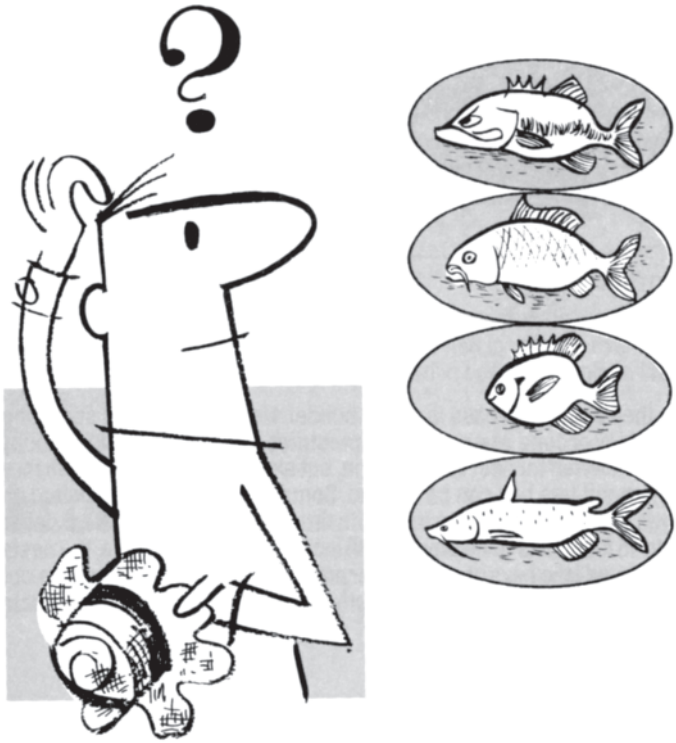
Protozoa are one celled animals. Many species of them cause serious disease in fish. The only type that a person without a microscope is likely to identify with any accuracy is "ICH;' which is short for *Ichthyophthirius*. The reason for this is that "ICH" gets big enough for the naked eye to see easily. Up to 1 mm in diameter, fish with "ICH" appear to have been "salted" with a salt shaker. Channel catfish and goldfish are very susceptible to this disease. Uncounted numbers have been killed by this parasite, especially in fish hatcheries.

Bacteria

Many kinds of bacteria are important in fish disease. Only a diagnostic laboratory can tell them apart with any accuracy. Combination infections of bacteria and protozoa, or bacteria and viruses are common. You can't tell that this is happening by just looking at the fish. Again, a diagnostic laboratory is needed.

Viruses

For the most part, the diseases caused by viruses are difficult to separate from those caused by bacteria. They also must be the province of the diagnostic laboratory with the possible exception of *Lymphocystis*. This disease could be called fish warts. It occurs on many kinds of fish, but seems to be reported more when it occurs on largemouth bass, walleye, and crappie. Occasionally, walleyes will have a very large number of them on their body and fins. In the normal course of events, these grow over the course of the year, with some getting one-half inch across. They are irregular in shape, just like warts on people. At some point, the wart breaks down and sloughs off, releasing the virus to infect other fish. The sores heal and leave no trace.



FISH LIFE HISTORIES

It is important to know something of the life histories of fish used in pond stocking. Pond management must be closely geared to the basic needs of the fish stocked in the pond. Fortunately, the needs of several excellent food and game fish can be met with a single program of pond management. The following fish species may be utilized in various pond stocking situations. As mentioned earlier, we recommend stocking plans be discussed with your District Fisheries Biologist before proceeding.

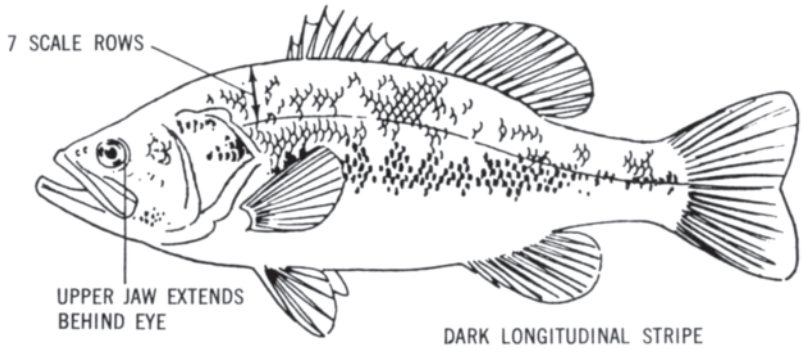
LARGEMOUTH BASS

Description

The color of the largemouth bass, although variable, is usually dark green on the back, becoming lighter green on the sides. Generally there is a broad continuous stripe on the midline which may become indistinct in large adults and individuals from turbid waters. Environmental differences, especially water clarity, exert an influence on bass coloration. The largemouth most closely resembles the spotted bass in color but does not have the series of prominent, horizontal streaks along the lower sides that are characteristic of the spotted bass.

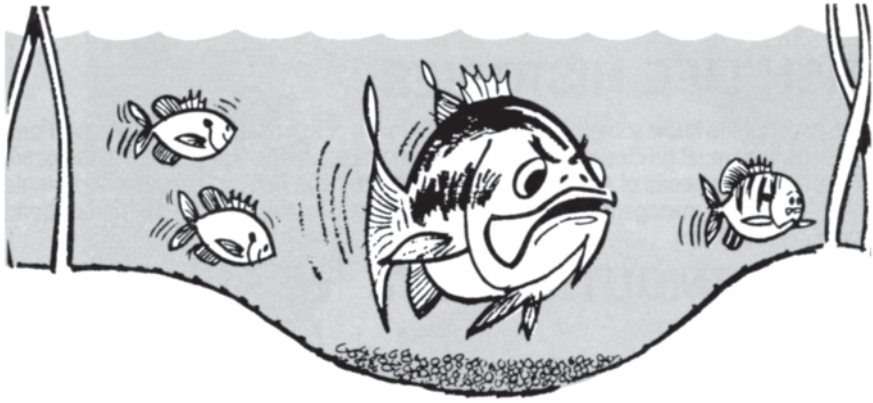
The largemouth bass, spotted bass, and smallmouth bass are sometimes misidentified. With the largemouth bass the upper jaw (mouth closed) reaches far beyond the rear margin of the eye; the end of the upper jaw reaches to or slightly beyond the rear margin of the eye in the spotted bass; in the small mouth bass the end of the upper jaw extends to about the center of the eye.

The spinous and soft parts of the dorsal fin are almost completely separated by a deep notch in the largemouth. These parts of the dorsal fin are broadly connected with only a shallow notch between them in the other 2 basses.



Reproduction

Like other sunfishes the largemouth bass is a nest builder. Nest building and spawning activities commence in May or June when water temperatures run from 63° to 68° F. Rocky or gravelly bottoms are preferred for nest construction, but almost any type of bottom may be used as long as a firm silt-free bed can be created. Sometimes eggs are deposited on plant rootlets or leaves of submerged vegetation with little nest preparation. Nest depth may vary from a foot to 15 feet but is generally from 18 inches to 3 feet. As a rule, the nests are constructed in sheltered lake bays or quiet-water areas in streams. The male fans out a 2 to 3 foot diameter depression. As the ripe female deposits eggs, the male ejects milt for fertilization.



The eggs hatch in 3 to 6 days and the fry rise from the nest and begin to feed on tiny plants and animals 5 to 8 days later. A sudden drop in water temperature of only 10° to 12°F is sufficient to kill the eggs or newly hatched fry. A light deposit of silt on the eggs after heavy rainfalls may cause the male to desert the nest.

In Illinois, the largemouth usually reaches sexual maturity as a two-year-old at a length of 9 to 10 inches, although there have been instances of spawning by yearlings displaying exceptionally rapid growth.

Food Habits

The largemouth bass feeds on a variety of animal life. The young fish feed on very small animal life such as crustaceans, insect larvae and fish fry. Fish and crayfish are extremely important food items. The largemouth is the top predator in most ponds.

Average Length and Weight by Age for Largemouth Bass in Illinois

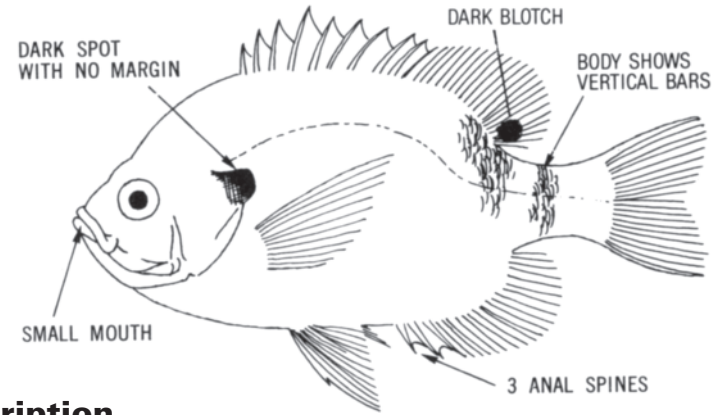
Age in Years	1	2	3	4	5	6	7	8	9	10
Length in Inches	6.3	9.0	11.6	13.5	15.8	17.4	18.9	19.8	20.3	20.7
Weight in Pounds	0.1	0.4	0.8	1.1	2.0	2.5	3.0	4.0	5.0	5.5

Growth of the largemouth bass is extremely variable, depending on the pond conditions. In Illinois, the average life span is about 4 years. Few survive more than 8 or 10 years. In southern states, because of the longer growing season, the largemouth has been known to attain 22 pounds.

Desirability

The largemouth bass can live and thrive under a wide variety of environmental conditions throughout Illinois. Its reputation as a sport fish is without rival in many sections of the country. The largemouth is universally used in pond stocking. In Illinois it is our most effective predator.

BLUEGILL



Description

The bluegill's color varies depending on sex, age, and habitat. Bluegill from turbid waters lack the vivid coloration of their clear-water counterparts. Generally, the body is light to dark olive with a touch of purple in older individuals. Breeding males are frequently bright yellow or reddish-orange on the throat and belly. The gill covers are sometimes bright blue, from which the bluegill gets its name. The sides are marked by 6 to 8 dusky vertical bars which are best developed in juveniles and in males. The bluegill has a prominent dark blotch at the posterior base of the dorsal fin (usually not present in young fish). The opercular lobe (ear flap) is uniformly black. The adult bluegill most closely resembles the redear sunfish, but differs by lacking red or orange on the margin of the ear flap. Young redear lack the vertical bars of the juvenile bluegill.

Reproduction

Bluegill spawning activities occur from June through August and even into early September. The spawning peak is usually in June. The males construct the nests in water a foot or two in depth. Almost any type of bottom is used for nesting, but sand or gravel is preferred. The nests are round depressions with a diameter about twice the length of the male that builds it. Bluegills construct nests close together forming "colonies", Males spawn with several females in a single nest. The male fish vigorously guards the nest. The eggs hatch in 2 to 5 days depending upon water temperature.

The male remains with the newly hatched fry until they disperse from the nest. Bluegills are very prolific. Dependent upon size, a female may carry from 2,000 to 67,000 eggs with an average of about 18,000. Because nearly all carnivorous fishes prey upon bluegill, the high productivity is probably nature's way of perpetuating the species. Bluegill stocked in new or rehabilitated ponds can become sexually mature in 1 year. Bluegill commonly hybridize with green sunfish, redear sunfish, longear sunfish, pumpkinseed and warmouth.

Food Habits

The diet of the bluegill consists largely of insects and their larvae. Throughout their entire life they feed on minute plants and animals. As they increase in size, freshwater shrimp, small crayfish, snails, and insects, principally mayflies, damselflies and midges become more important as a food source. Algae and other vegetation are eaten when animal food becomes scarce during midsummer, when the supply of favored foods reaches its lowest point of the year. Bluegill feed entirely by sight.

Average Length and Weight by Age for Bluegill in Illinois

Age in Years	1	2	3	4	5	6	7
Length in Inches	3.2	4.6	5.7	6.6	7.4	8.4	9.2
Weight in Ounces	0.5	1.0	2.0	3.0	5.0	7.5	8.1

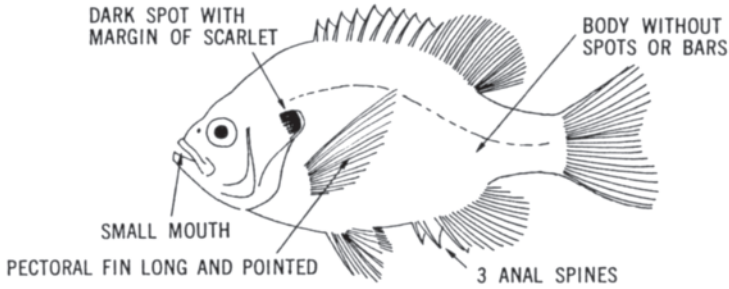
Growth of the bluegill varies considerably from one body of water to another. Growth is rapid in new ponds and reservoirs and slowest in turbid or overpopulated ponds. Stunting occurs commonly in the latter situation. Generally, growth is rather slow, especially in older lakes with established complex populations where a combination of ecological factors often inhibits growth potential. In Illinois, a 1·pound bluegill is exceptional. In most waters adults from 7 to 9 inches are considered good catches. The life span of the bluegill is generally about 5 years but a few live up to 10 years of age, weighing 2 to 3 pounds. The world record bluegill is 4 pounds.

Desirability

Until the fly rod and the spinning rod came along, relatively few adults enjoyed the sport of catching bluegill, although the cane pole angler had long been aware of its scrappy disposition at the end of a line. Its fighting ability and its tasty fillets make it one of the most prized little game fish around.

Back in the early 1930's when fish management was a new concept, the bluegill was intensively researched in artificial ponds. From these early studies evolved the largemouth bass-bluegill stocking combination now used extensively throughout the country in artificial impoundments. The combination has proved successful when a few basic principles of fish management (aquatic animal husbandry) are applied.

REDEAR SUNFISH



Description

The redear sunfish is a deep, compressed fish with an oblong body the shape of a human hand. It has a small mouth similar to the bluegill and a yellow-green colored body. It may be separated from other sunfishes by the scarlet-red margin on the edge of the dark gill cover flap or "ear flap". The pectoral fin (the fin located just behind the gill cover on each side of the body) is very long and pointed. The length of this fin is usually more than one third the length of the body from the tip of the mouth to the base of the tail fin. The rear portion of the fin on the fish's back does not show a dark spot like the bluegill or green sunfish.

The redear sunfish resembles the pumpkinseed but can be distinguished by its body coloration, length of the pectoral fin, and color of the "ear flap". The pumpkinseed's pectoral fin is less than one third the length of the body. The cheeks are prominently striped with blue and orange, whereas the redear's are not. The ear flap of the pumpkinseed is colored with a red spot rather than a margin along the entire edge of the "ear flap" as with the redear.

Breeding male redear are distinguished from the females by the darker colored head, gill covers and body, in addition to a brighter scarlet-red "ear flap".

The redear sunfish is also called the shell cracker, stump knocker, strawberry bass, brim, bream sunfish and redear perch.

Reproduction

Redear sunfish reproduce when they are one year old. Redear nests in colonies similar to bluegill and if submerged plants are available, they nest in the midst of, or near this vegetation. Spawning begins when the water temperature reaches 68° to 70° F. The male red ear fans the shallow water nest with his fins to keep eggs aerated and to keep silt from smothering the eggs.

Nest building concludes in one or two days. The male redear then locates a female and drives her to the nest. The two fish swim around the nest in a circular manner and form a V-shaped figure with their tails close together. The female releases eggs into the water over the nest and the male simultaneously releases milt which fertilizes the eggs as they fall into the nest.

Several spawnings may occur after which the female leaves and the male redear takes up a position over the nest to guard the eggs from predators. The eggs hatch in 6 to 10 days depending upon the water temperature. After hatching, the red ear fry remain in the nest for about a week with the male red ear standing guard. After this initial period, the small redear fingerlings leave the nest in search of food and thereafter are on their own. Female redear typically lay from 2,000 to 10,000 or more eggs depending on size and body condition.

Redear sunfish produce fewer young than do bluegill. This is due in part to the shorter

Food Habits

The redear sunfish eats different food at different times in its life. When they first leave the nest, the foods eaten are mainly small plants and animals called plankton. As red ear grow larger they eat many different kinds of insects, insect larva, crustaceans (crayfish) and snails. When eating snails the shell is completely crushed and expelled from the redear's mouth. The red ear inhabits the deeper waters of a pond or lake and seldom feeds on the surface as do the bluegill.

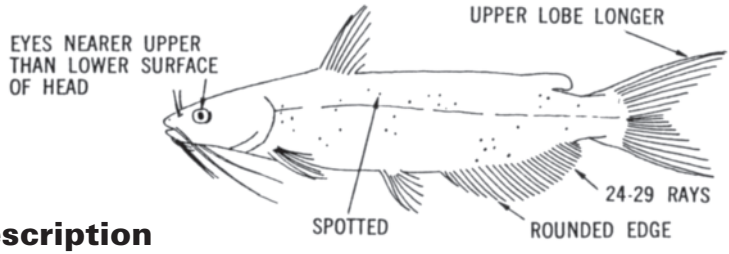
Average Length and Weight by Age for Redear Sunfish in Illinois

Age in Years	1	2	3	4	5	6	7
Length in Inches	5.2	6.4	7.1	7.8	9.2	9.3	9.5
Weight in Ounces	2.0	3.8	4.6	6.7	10.0	10.2	10.7

Desirability

The redear sunfish with its rapid rate of growth has been stocked in combination with bluegill into many private ponds and lakes throughout Illinois. It has also been stocked into many Department of Natural Resources lakes and ponds which annually produce many of the largest sunfish caught in Illinois.

CHANNEL CATFISH



Description

The channel catfish is a slender fish having a deeply forked tail, 8 barbels around the mouth, a rounded (convex) anal fin containing 24 to 29 rays and 3 serrated spines at the front of the dorsal and pectoral fins. Similar to other members of the catfish family, a channel catfish's scaleless skin is smooth. Color varies depending upon habitat, but is generally a slate-gray or olive brown variation on the back, blending to a silvery-white belly. During early summer, the spawning male channel catfish acquires a deep blue color that confuses its identity with that of the blue catfish. Intermediate sized channel catfish (often called fiddlers) possess small, black spots on their body which may be absent in young and older fish.

Food Habits

The channel catfish is an omnivorous feeder, consuming both plant and animal material. Food is located by its highly developed sensory system and to a lesser extent, by sight. Their diversified diet includes insects and their larvae, crayfish, snails, small clams, worms, fish, seeds and various seasonal fruits that drop into the water when ripe. Channel catfish readily accept artificial pelleted food as their major food source or as a supplement to their regular diet and convert this food into fish flesh more efficiently than most domesticated livestock. Feeding activity is highest during the low light periods of dawn, dusk and night.

Channel catfish reach sexual maturity at 4 to 5 years of age and a length of 14 to 16 inches. Some fish attain an age of over 10 years, but most do not exceed 6 to 7 years. Channel catfish reach a weight of up to 45 pounds; however, most small impoundment

fish seldom exceed 10 pounds. Spawning in Illinois occurs from about the last week in May to the third week of July with the peak of activity at a water temperature of 75° F. The male catfish selects a secluded and darkened nest site which is normally a bank cavity, hollow log or stump. A 10 gallon milk can or other cylindrical container closed on one end and placed on its side in 3 to 4 feet of water serves as channel catfish nesting sites. Females do not normally participate in the selection of nest sites or in care of the eggs or young. The male guards the fertilized eggs for the 7 day incubation period and then guards the hatched fry for another week until they leave the nest. Survival of the young channel catfish is very poor or nonexistent in small impoundments where clear water and other fish species exist. Periodic stockings of an 8 inch minimum sized channel catfish are necessary to maintain a fishable population in most small impoundments. Many large lakes and reservoirs maintain self-sustaining catfish populations and do not require restocking. Channel catfish stocked alone (without other fish species) in small impoundments generally exhibit unlimited spawning and survival of young and within a few years become overpopulated with small, stunted fish.

Growth

The following table represents an average rate of growth for Illinois channel catfish collected from various ponds, lakes, reservoirs, streams and rivers.

Average Length and Weight by Age for Channel Catfish in Illinois

Age in Years	1	2	3	4	5	6	7	8	9	10
Length in Inches	6.4	9.6	12.6	14.3	16.7	18.5	21.0	22.6	25.6	26.6
Weight in Pounds	0.3	0.5	0.8	1.3	2.0	3.0	4.0	5.5	6.8	8.0

Desirability

The channel catfish is one of the most highly prized and stocked sport and food fishes in Illinois. A 1986 survey of Illinois sport fishermen demonstrates that catfish (channel catfish and flathead catfish) ranked in second place statewide as the most preferred fish. The same survey shows catfish ranking in third place below sunfish and crappie as being the most frequently caught fish species. Illinois commercial fishermen harvest 713,000 pounds of channel catfish annually and they are the most commonly grown species in the rapidly expanding aquaculture industry.

Because of their importance to sport fishermen and their adaptation to the small pond and lake environments, the channel catfish is an ideal small impoundment stocking selection.

HYBRID SUNFISH

Description

The term hybrid sunfish is extremely general, referring to any number of potential crosses involving the Centrarchidae (Sunfish) family.

What is a hybrid? A hybrid is a crossbreed resulting from mixed parentage· the male of one species and the female of another species. As long as the two species are closely related, hybridization is possible. The young produced from the hybridization of two species is designated as an F_1 hybrid.

When identifying a hybrid, the male parent species is listed first followed by the female parent species. Thus a bluegill x green sunfish hybrid reflects the crossbreeding of a male bluegill with a female green sunfish. The F_1 bluegill x green sunfish hybrid will exhibit outward body characteristics of both parent species.

Natural hybridization is common among members of the sunfish family, where some species practice colonial nesting. Natural hybridization is the result of any situation where the two species involved in the act of spawning are unable to achieve species recognition. Low visibility caused by plankton blooms, suspension of silt particles, or thick aquatic plant growth reduce recognition of different sunfish species spawning patterns.

Reproduction

The limited reproductive capability of hybrids is attributed to the fact that some F_1 hybrid populations produced are predominately male, while other hybrid crosses produce sterile offspring. The table below indicates sex ratios of six different sunfish hybrid crosses.

Male x Female	F_1 Males (%)	F_1 Females (%)
Green Sunfish x Redear Sunfish	48	52
Redear Sunfish x Green Sunfish	70	30
Green Sunfish x Bluegill	70	30
Bluegill x Green Sunfish	97	03
Bluegill x Redear Sunfish	97	03
Redear Sunfish x Bluegill	100	00

(W.F. Childers and G.W. Bennett, Hybridization Between Three Species of Sunfish, INHS, Biological Notes No. 46)

Food Habits

The diet of hybrids reflects the respective food habits of the parental species. If the pond owner desires to feed fish artificially, the bluegill x green sunfish hybrid is an excellent choice. For non·fed populations, a combination of the bluegill x green sunfish and red ear x green sunfish hybrids produce a desirable sport fishery.

Desirability

Hybrids are considered potentially desirable because of characteristics such as: fast growth, hybrid vigor, increased vulnerability to angling, and their ability to occupy different niches. The fact that hybrids disappear from mixed populations containing various predators and one or both of the parent species is a distinct disadvantage.

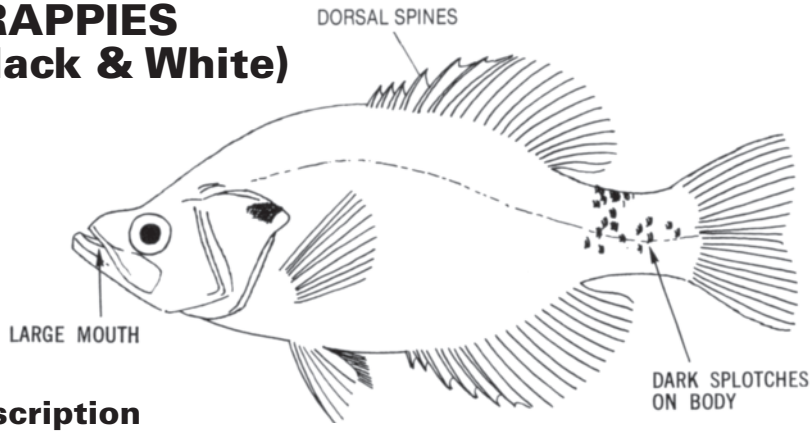
The reduction and eventual disappearance is caused by overfishing, predation, and the reduced reproductive potential of the F_1 hybrid. To compound the problem, hybrid sunfish are unable to maintain a forage base suitable for largemouth bass which results in poor growth, reproduction and recruitment in the bass population.

The selection and utilization of any hybrid must be well thought out. The pros and cons of each cross must be taken into consideration along with the fact that periodic stockings are necessary to sustain the hybrid population.

Average Length and Weight by Age for Hybrid Sunfish in Illinois

Growth rates vary according to the specific cross, geographical location within the state, and competition for food and space within the pond.

CRAPPIES (Black & White)



Description

The two species of crappies are differentiated by the number of dorsal spines present. The white crappie usually has 6 dorsal spines whereas the black crappie has 7 or 8. Both have more silvery colored and deeper bodies than the other sunfish. The white crappie has dark vertical barring on its sides, whereas the black crappie has a speckled body with blackish to blackish-green spots.

Reproduction

Like all sunfishes, crappie males build and defend their nests. Spawning occurs from late April to early June when the water temperature rises above 60° F. Depending on their size and health (body condition), a single female spawns anywhere from 15,000 to more than 200,000 eggs in nests located 2 to 15 feet deep. The eggs hatch within three to five days. Within 4 days after hatching, the young fry disperse from the nest and move to deeper water where they are less subject to heavy predation.

Food Habits

After absorbing the yolk sac, young crappie feed almost solely on zooplankton such as rotifers, copepods, and daphnia during the first year. Although zooplankton remains a significant food throughout their life, at about three inches, crappie begin feeding on small insects (Chironomids) and the small fry of other fishes. Insects, worms, minnows and other small fish comprise the bulk of an adult crappie's diet.

Growth

The growth of crappie is governed largely by three factors: the kinds and abundance of suitable foods, water quality, and food competition with other fishes. Although the growth rate of black and white crappies differ somewhat, the following tables present an average of length and weight attained for various age crappies.

Average Length and Weight by Age for Black Crappie In Illinois

Age in Years	1	2	3	4	5	6	7
Length in Inches	2.8	5.9	7.5	9.1	10.3	11.2	12.5
Weight in Ounces	0.15	1.5	3.1	5.5	8.5	11.1	15.5

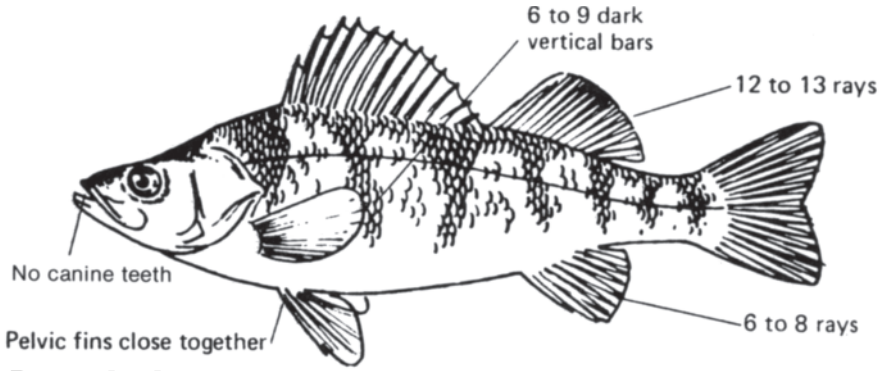
Average Length and Weight by Age for White Crappie In Illinois

Age in Years	1	2	3	4	5	6	7
Length in Inches	3.1	7.3	8.9	10.2	11.1	12.9	13.7
Weight in Ounces	0.2	2.9	5.4	8.0	10.8	16.9	20.2

Desirability

Black and white crappies are not recommended for stocking of any ponds less than 25 acres. Because of their tendency to overpopulate, they compete aggressively for available foods and space, often resulting in poor growth and/or stunting. Many good bass-bluegill ponds have been ruined by stocking crappies.

YELLOW PERCH



Description

The yellow perch is deep-bodied and slab-sided with a hump just behind the head. It is easily recognized by its distinctive pattern of 6 to 9 regularly spaced dark bars that extend vertically on the back and sides. Coloration varies but the back is generally olive-greenish, the sides are golden-yellow and the belly is whitish. A moderately large mouth contains many small teeth but lacks the large canine teeth of its relatives, the walleye and sauger. The upper jaw extends about to the middle of the eye. The bone just ahead of the gill cover is strongly saw-toothed both behind and below. Fins are usually yellowish or white.

Reproduction

Males become sexually mature at the age of 1 year, females at the age of 2 or 3 years. Spawning takes place in April and May at depths up to 10 feet, when the water temperature is 45 to 52° F. Spawning usually occurs at night over weeds, brush or gravel areas. In Lake Michigan spawning occurs in depths up to 70 feet or more in May and June. Depending on fish size, a yellow perch deposits 3,000 to 48,000 eggs on the bottom in gelatinous strings 2 to 7 feet long. They remain attached after deposition. Under good conditions one-fourth to one-half of the eggs hatch within 8 to 21 days. Eggs and young receive no care by the parents.

Food Habits

Perch feed on a variety of organisms. Small crustaceans, crayfish, insects, and small fish, including the young of its own species are the principal items in its diet.

Average Length and Weight by Age for Yellow Perch In Illinois

Age in Years	1	2	3	4	5	6	7
Length in Inches	4.1	5.8	7.7	8.6	10.0	11.0	14.3
Weight in Ounces	0.5	1.5	3.5	5.0	8.0	12.0	16.0

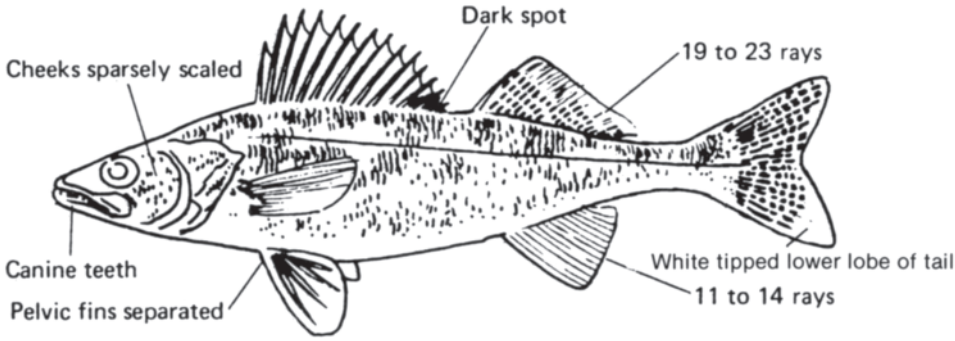
Growth of the yellow perch is variable, depending on local conditions. Stunting as a result of overpopulation commonly occurs. During its second and third years, the yellow perch provides good forage for other fish. This hazard of life accounts for a population loss as high as 60 to 80 percent each year. Thereafter, the usual annual loss may be in the range

of 50 to 70 percent. Few yellow perch exceed a length of 12 inches or a weight of 1 pound. The world record yellow perch is 4 pounds, 3 ounces.

Desirability

Wherever the perch is found it provides hours of fun and pounds of delicious food for fishermen of all types in all seasons of the year. Not renowned for its fighting qualities, the perch makes up for this in numbers and appetite. Because of their tendency to overpopulate in most Illinois ponds, the yellow perch is not generally recommended for stocking.

WALLEYE



Description

The walleye, named for its opalescent eye, is the largest member of the perch family. It is distinguished from its cousin, the sauger by a dark blotch at the base of the rear portion of the spiny dorsal fin and dark irregular blotches on its membrane. Sauger possess rows of black half-moon shaped spots on the membrane adjacent to the spines of the same fin. The walleye's body is more rounded and elongated, with a forked tail whose lower lobe is silvery or white in color. Typical body colors are olive-green or brassy-olive-buff on the back and sides blending to a whitish belly. Walleye common names vary with different regions of the United States and Canada. These common names include pike, walleyed pike, yellow pike, grass pike, pike perch, jack salmon and dore' or dory.

Reproduction

Male walleye become sexually mature at 2 to 3 years of age and 12 to 14 inches in length. Females mature when 3 to 4 years old and 15 to 17 inches in length. Spawning takes place in March and April, when the water temperature is 45 to 50° F. Spawning usually occurs at night near windswept shallow points in large lakes or tributary streams or shallow bars in rivers. Depending on fish size, a walleye deposits 25,000 to 750,000 eggs on the bottom over rock rubble or gravel. Walleye are unlikely to spawn in small lakes or ponds in Illinois. Therefore, in order to establish a population in a small lake or pond it is necessary to stock fingerling walleyes every year or two.

Food Habits

Walleye fry begin feeding on microscopic animals 4 to 5 days after they hatch. As they grow walleye switch to small crustaceans and insects. Insects, particularly mayflies, are a significant food item throughout life in large lakes and rivers. By the time walleye attain a length of several inches, fish become the primary diet. Though spending most of the time in deeper waters, at night walleye move into shore to feed on small fish.

Average Length by Age for Walleye in Illinois

Age in Years	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
Length in Inches	8.59	12.96	15.22	17.38	19.75	21.13	21.72	23.04	25.23	26.02	27.13

Growth of walleye is rapid when compared to other species found in most of Illinois waters. In many locations walleye reach 18 inches at the end of its third year of life, conversely largemouth bass do not reach 18 inches until their 4th or 5th year.

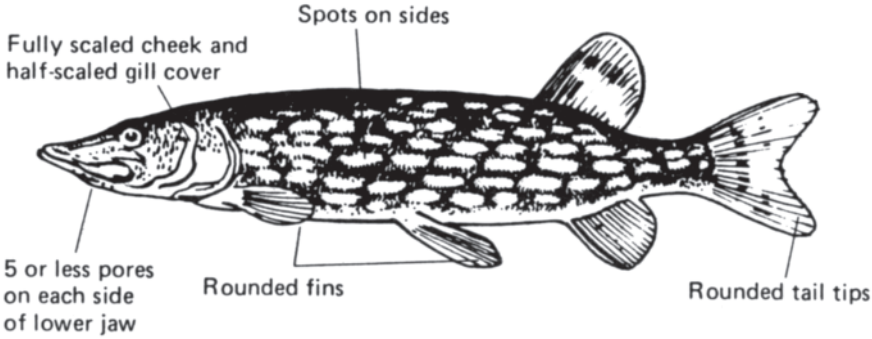
Walleye stockings are successful in many small to intermediate sized lakes (40 to 100 acres) and populations are maintained through periodic stocking of large fingerlings (4 to 8 inches). The life span of walleye exceeds 10 years and they reach a size of 20 pounds or more. The world record walleye is 25 pounds.

Desirability

The walleye is the largest member of the perch family. Its size, sporting qualities, and savory flesh make it one of the most important game species in North America Though first found in the Northern states and Canada, widespread stocking has extended its range.

Originally, walleye were found in large rivers and streams of northern Illinois, which include the Mississippi, Rock and Kankakee Rivers. However, since the mid 1970's walleye have been propagated by the State Fish Hatchery System and introduced into many different state and public waters.

NORTHERN PIKE



Description

The northern pike is an elongated, somewhat laterally compressed fish. The front of the head is shaped like a duck's bill with the top of the head unsealed. The mouth is large with the upper and lower jaws supporting large canine teeth. The back is olive to brownish-green becoming a lighter green on the sides fading to white on the ventral surface. On the sides are many light, bean-shaped horizontal markings dispersed in oblique rows. Northern pike are distinguished from other pikes by the presence of scales on the entire cheek and on the upper half of the gill cover. Northern pike are further differentiated from the pure muskellunge by the number of sensory pores on the lower jaw. The northern pike possess 5 or less mandibular sensory pores on each side while the muskellunge possess 6 to 9. The hybrid northern pike x muskellunge (tiger muskie) possess 5 to 9 mandibular sensory pores.

Reproduction

Spawning usually occurs from mid-March to early April, as soon as the ice begins to break up in the spring. Movement into the spawning areas usually occurs at night and

takes place under the ice. Pike concentrate near the spawning site before there is any visible change in water temperature. This assembling action begins in response to internal stimuli from increased gonad activity and external stimuli such as daily light intensity, temperatures and the presence of suitable vegetation. Spawning sites are located in shallow, flooded marshes and backwater areas associated with lakes and rivers. The spawning habitat is basically submergent aquatic vegetation or flooded emergent vegetation such as grasses, sedges or rushes. Vegetation with fine leaves appear to be the best substrate for egg deposition. Spawning occurs when water temperatures range from 45 to 60° F. The spawning act involves a female and from one to three attendant males. The female deposits eggs in water only 6 to 10 inches deep on vegetation to which the eggs adhere. There is no parental care. The eggs hatch in 12 to 14 days, depending upon water temperature. A single female northern pike produces from 2,000 to 100,000 eggs.

Food Habits

After the young northern pike hatch out in the nursery slough or shallow water area, feeding is principally confined to small aquatic insects. If food is not available in enough quantity, the young northern pike readily eat his brothers and sisters, for "survival of the fittest" is the code of predator fish. After a few weeks, the feeding interest of the young pike changes from insects to larger game, such as small minnows. Adult pike feed on almost anything available including frogs, tadpoles, aquatic birds, muskrats, mice, crayfish and leeches. Yellow perch and suckers are the preferred food when present.

Average Length and Weight by Age for Northern Pike in Illinois

Age in Years	1	2	3	4	5	6	7
Length in Inches	19.0	23.5	25.2	27.8	28.4	31.1	32.5
Weight in Pounds	1.5	3.0	3.5	5.0	5.5	6.5	8.3

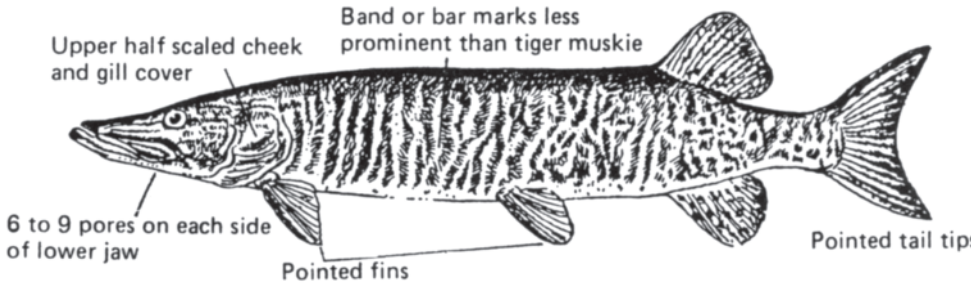
Growth rates vary according to latitude. Traveling from north to south, growth rates increase as one moves south. Northern pike live to be a ripe old age of 12 or 13 years. Growth continues as long as the fish lives, although more goes into the waistline in later years instead of into additional length. The world record is 55 pounds, 15 ounces.

Desirability

Probably no other fish in Illinois has a more variable reputation than the pike. He is condemned by some and praised by others. Anglers who praise the fish would rather catch one pike ice fishing than a tub full of bass. Unfortunately, no other Illinois game fish has been more adversely affected by increased shoreline development than the northern pike. Gone are many of the large northern pike spawning grounds, drained for development or filled in as dredging project spoil sites. Despite these adverse impacts on pike habitat, northerns continue to hang on and provide anglers with the thrill-of-a-lifetime when caught.

MUSKELLUNGE

The muskellunge is a fish with an elongated, somewhat dorsally flattened, moderately compressed body. The front of the head is shaped like a duck's bill with the top of the head unscaled. The mouth is large with the upper and lower jaws supporting large canine teeth. Coloration varies from silvery background with dark, variable markings, spots or color blotches to scarcely any markings. The belly is white with fins which range in color from green to red-brown with dark blotches. The muskellunge can be distinguished from other pikes by the presence of scales on the upper half of the cheek and gill cover. The muskie are further differentiated from northern pike by the number of sensory pores on the lower jaw. The muskie possess 6 to 9 mandibular sensory pores on each side while the northern pike possess 5 or less.



Reproduction

Natural reproduction and recruitment by muskellunge within Illinois is not documented. The potential however does exist. As established populations develop and the number of mature adults increases, so does the potential. Spawning usually occurs at night in shallow bays over a muck bottom covered with chara, dead vegetation or other detritus. Side-by-side the male and female release eggs and milt simultaneously over several hundred yards of substrate in water depths ranging from 1 to 6 feet. There is no parental care. Female muskellunge 30 to 53 inches in length will produce from 28,000 to 180,000 eggs. The number of eggs produced is directly correlated to the size of the female. Spawning begins in water temperatures ranging from 48 to 60° F with the optimum temperature being about 55° F. Females mature when they are 3 to 4 years old and approximately 30 inches in length. Male fish mature at 2 to 3 years of age and approximately 25 inches in length. Egg development varies with water temperature during incubation. The young muskies hatch within 8 to 14 days after fertilization. At a constant hatchery water incubation temperature of 55° F most hatching occurs on the 14th day.

Food Habits

Fry muskie initially consume zooplankton (tiny animals) but soon convert to the fry of other fishes. Generally the preferred fish food of muskellunge is perch, suckers, gizzard shad and small minnows. Cannibalism is common to muskie of all sizes. Occasionally muskellunge consume small muskrats, ducks, shorebirds, shrews, chipmunks, gophers, salamanders, crayfish and large water insects.

Average Length and Weight at Age by Sex for Illinois Muskellunge

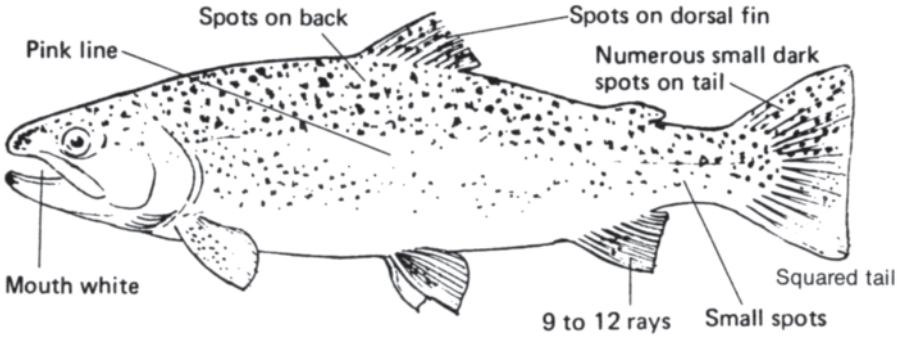
Age (Yrs.)	1	2	3	4	5	6	7	8	9	10	11	12
Male Len. (inches)	12.5	25.1	27.8	31.2	32.7	34.3	35.9	37.5	39.1	40.7	42.3	43.9
Weight (lbs.)	0.45	4.0	5.6	8.25	9.6	11.3	13.1	15.2	17.5	19.9	22.7	25.7
Female Len. (inches)	12.5	26.8	29.5	32.1	34.6	35.4	38.7	39.8	42.6	44.9	47.2	49.5
Weight (lbs.)	0.45	5.0	6.8	9.0	11.6	12.5	16.9	18.5	23.2	27.7	32.6	38.5

Muskellunge growth and longevity are different in various climatic regions and lakes within Illinois. Artificially heated lakes or cooling lakes accelerate growth rates by extending the growing season, but also appear to shorten longevity. Muskellunge can live to a great age with record fish exceeding 30 years of age. The expected life span for Illinois muskellunge is between 7 to 10 years. The world record muskellunge is 69 pounds, 15 ounces and the tiger muskie 51 pounds, 3 ounces.

Desirability

The muskellunge is one of the few fishes which has developed an organized following and an attitude among sport fishermen. Right or wrong the muskie represents a mystique. The status and prominence of this freshwater trophy is derived from its large size and fishing qualities. The muskie is the king of freshwater fish, a true trophy for fishermen of all ages.

RAINBOW TROUT



Description

The rainbow trout is a colorful fish noted for its fighting spirit. The rainbow is a native of the West Coast streams from California to Alaska and has been transplanted to nearly every state and even other continents such as Asia, Europe, South America, Australia and Africa. The rainbow is distinguished by its broad pink stripe that runs the length of its body, blending into dark olive to greenish blue above and a silvery to whitish below. Brightness of color varies with habitat and feeding conditions. There are many small irregularly shaped black spots scattered on the sides, back, dorsal and tail fins. The rainbow trout, like other trout and salmon, has a small fleshy adipose fin on the back just ahead of the tail. The rainbow trout and steelhead are the same species differing only in spawning behavior. The steel head migrates down stream to the ocean or to very large lakes such as the Great Lakes, but being anadromous, returns to a stream to spawn. Steel head are also much more silvery in color, except when spawning.

Different strains of rainbows have been developed. The Kamloops, Shasta and Arlee have been stocked in Illinois. The Skamania strain of steelhead has been stocked in the Illinois waters of Lake Michigan along with the Arlee strain of rainbow.

Reproduction

Rainbow trout spawn in coldwater streams and rivers. They are basically spring (January to April) spawners. The usual spawning site is a bed of fine gravel in a riffle above a pool. Water temperatures are usually between 50° and 60° F. Females dig and spawn in several nests, also called redds. Each female deposit from a few hundred to a few thousand eggs. Eggs usually hatch in approximately 4 to 7 weeks, depending upon water temperature. Natural reproduction is not known to occur in Illinois. Most Illinois streams do not have habitat that is conducive to rainbow reproduction or even survival over the summer months. There are a few exceptions in the extreme northern part of the state.

Rainbow trout generally reproduce from October through February in hatcheries where the water temperatures remain fairly constant. It takes about 50 days for hatchery trout to complete incubation and the fish will be reared to 10 inches in about 16 months.

To provide a limited inland trout fishery in certain public streams and impoundments, the Department of Natural Resources stocks catchable-sized rainbow trout from its hatcheries in the spring and fall. A year-round rainbow trout fishery is maintained by the Department and other states by annually stocking Lake Michigan.

Food Habits

A wide variety of food is consumed by rainbow trout. In general rainbow trout feed on various invertebrates including plankton, larger crustaceans, small mollusks, insects, snails and leeches. Depending on size and location, fish and fish eggs are also important food for trout.

Hatchery trout are known to be caught on kernel corn, cheese balls, night crawlers, angleworms, salmon eggs, minnows, grubs, grasshoppers and other insects.

Average Length and Weight by Age For Rainbow Trout in Illinois

Age in Years	1	2	3	4	5
Length in Inches	3.0	7.5	13.0	15.0	16.0 +
Weight in Pounds	0.1	0.6	1.5	3.5	4.0 +

The above growth estimates are based on conditions in native streams in the western United States. Lake and ocean run rainbow trout (steel head) grow more than twice as fast. Rainbows larger than 20 pounds are caught in the Illinois portion of Lake Michigan, although the average size is about 5 pounds. The world record rainbow trout is 42 pounds, 2 ounces.

Desirability

The rainbow trout is one of America's prettiest and favorite sport and food fishes. It is one of the hardest fighters of the trout and with its wide distribution probably offers more sport to more anglers nationwide than any other trout. It is caught by amateur and expert anglers alike and is a desirable "put and take" fish.

In Illinois there are a limited number of water areas which provide year-round suitable habitat for rainbow trout. Lake Michigan and some spring-fed or well-fed ponds and deep impoundments where there is sufficient oxygen below the thermocline are examples.

Trout live and grow in good quality water between 45° and 70° F. They tolerate colder and warmer temperatures for short periods of time. If the water temperatures do not exceed 70° F six inches below the surface and the dissolved oxygen remains adequate (not less than 5 parts per million), trout will survive. Unfortunately, most Illinois impoundments cannot be managed to maintain these levels during the summer months.

Where these oxygen levels and water temperatures can be maintained and trout are desired, only 8 inch or larger trout should be stocked, so as to be large enough to compete for food and not be eaten by other larger fish. Adult trout may require a supplemental feeding once or twice a day of commercial pelleted food. They should be fed in accordance with the amount they will fully consume at one feeding.

Trout may be purchased from approved hatcheries. However, prior to purchasing them from an out of state source an importation permit is required. This permit is issued by the Department of Natural Resources at no charge, only if the source hatchery is found free of diseases.

The commercial production of trout in Illinois ponds and lakes is for the most part not feasible. Periodic unfavorable conditions relating to water temperatures, dissolved oxygen levels, and the quantity and quality of the water supply prevent commercialization.

In summary, rainbow trout can provide a short term "put and take" fishery in certain Illinois impoundments during the early spring or late fall months when cooler water temperatures and higher oxygen levels can be expected to occur. The rainbow may also provide a year· round fishery where suitable food, oxygen levels and water temperatures are maintained either naturally or by artificial means.

VHS REGULATIONS

Viral Hemorrhagic Septicemia (VHS) is a disease of fish caused by a virus previously unidentified in the Midwest. While it does not affect humans, VHS can kill a substantial number of fish and has been spreading throughout the Great Lakes.

The VHS regulations administered by IDNR are appropriate steps in trying to slow the spread of this dangerous aquatic virus in Illinois. Sport fishing and boating are both very popular and important to the Illinois economy. The cooperation of anglers and boaters is essential in combating VHS.

Regulations being implemented by the Illinois Department of Natural Resources (IDNR) regarding VHS that affect recreational anglers and boaters include:

- Eliminating natural water from all equipment when leaving a body of water.
- Emptying and draining all bait buckets, livewells, baitwells, bilges, etc. or any other compartment capable of holding natural waters when leaving a body of water.
- Not removing live VHS-susceptible species (see below) from any waters. Anglers may harvest VHS-susceptible species, but may not transport those fish live from the waters where caught.
- Use of wild-trapped fishes from within the state as bait will be restricted to the waters where legally captured.

Black crappie
Bluegill
Bluntnose minnow
Brown bullhead
Brown trout
Burbot
Channel catfish
Chinook salmon
Emerald shiner
Freshwater drum
Gizzard shad
Hybrid (Tiger) muskie
Lake whitefish
Largemouth bass
Muskellunge
Shorthead redhorse
Northern Pike
Pumpkinseed
Rainbow trout
Rock bass
Round goby
Silver redhorse
Smallmouth bass
Spottail shiner
Trout-Perch
Walleye
White bass
White perch
Yellow perch

While VHS is not known to be a threat to human health, anglers are still advised to wash their hands after handling fish and to cook thoroughly any fish they plan to eat. If handling dead fish or fish that appear to be diseased, protective gloves should be worn. For more information on VHS and the new Illinois regulations aimed at slowing the spread of the virus in Illinois, check the IDNR web site at *www.dnr.illinois.gov*.

FIGHT THE SPREAD OF AQUATIC INVADERS

REMOVE PLANTS, ANIMALS AND MUD FROM ALL EQUIPMENT.

DRAIN ALL WATER FROM YOUR BOAT AND GEAR.

DRY EVERYTHING THOROUGHLY WITH A TOWEL.

TRANSPORTZERO.ORG

COOKING YOUR CATCH

The basic fish cooking rules are easy to follow, even though each type of fish has individual flavor, texture, and appearance.

If you make allowances for the fat content of fish, you can successfully use any of the cooking methods for almost all species. In other words, lean fish (bass, sunfish) may be cooked by dry heat methods such as baking or broiling, if you baste frequently with melted butter or shortening to prevent drying. (Try combining lemon or garlic with the basting fat, or using a basting sauce.) Fish with high fat content (trout, salmon) don't have to be basted.

Avoid overcooking. The fish should be moist and tender with a delicate flavor. Overcooking causes the flesh to become increasingly dry and chewy. Fish is done when the flesh is translucent and can be easily flaked with a fork.

Don't over handle the fish during cooking and serving. Cooked fish is delicate and will flake apart easily. Turn only once during cooking and transfer carefully to a warm platter to serve.

Never soak fresh fish in water. This causes loss of flavor and makes the flesh flabby. Wash fish quickly, drain, and dry carefully on paper towel.

Broiling

Sprinkle serving-sized portions of fish with salt and pepper. Place on preheated greased broiler pan, skin side up if skin has not been removed from fillets. Brush with melted butter. Broil about 2 inches from heat 5 to 8 minutes or until fish flakes easily with a fork.

Baking

Rub salt on the inside and outside of the cleaned fish; place fish in a greased baking pan. Brush with melted fat (lay slices of bacon over top if desired). Bake in a moderate oven till fish flakes easily with a fork. If fish seems dry while baking, baste with drippings.

Steaming

Salt both sides of the cleaned fish. Place fish in a well-greased steamer pan and cook over boiling water till fish flakes easily with a fork. Serve at once with lemon or a sauce.

Deep fat frying

Sprinkle serving-sized portions of fish with salt and pepper. Dip fish in mixture of 1 tablespoon milk to 1 egg. Roll in bread or cracker crumbs, cornmeal, or flour. Cook fish in vegetable oil (unsaturated) (375°) till golden brown. Drain on absorbent paper. Serve with lemon or sauce.

THREE BASIC CUTS OF FISH

Dressed or pan-dressed
Scaled, drawn with head, tail, and fins removed.

Steaked
Cross-sectional slices are cut from larger fish.

Filleted
Sides of fish are cut lengthwise along backbone.

DRESSING SUNFISH

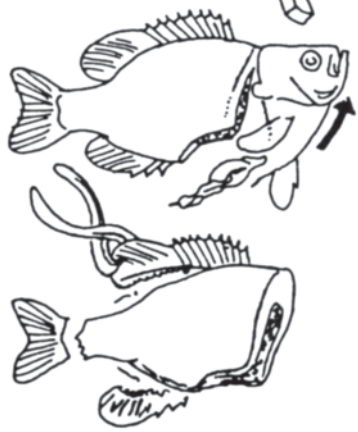
(Use this method for smaller fish.)

1 Using a knife or scraper, scrape off scales toward the head.

2 Hold knife parallel to fins; cut along each side of dorsal and anal fins 1/4 to 1/2 inch deep for later removal.

3 Hold fish upside-down with its back resting on table and cut immediately behind vent. Slip knife forward under skin.

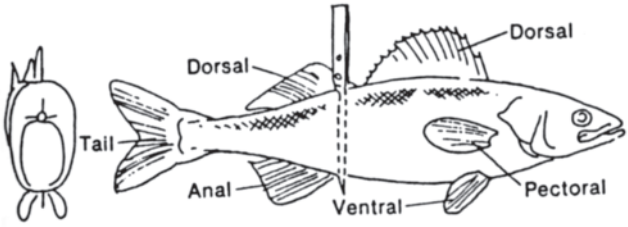
4 Continue cutting to pectoral fin. Lay fish flat and make deep cut on both sides of body behind pectoral fin.



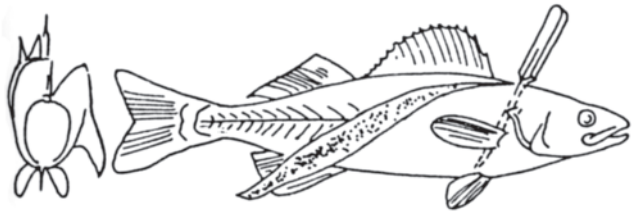
5 Pull head upward to break the backbone. Head will tear loose; entrails, pectoral, and pelvic fins will be removed.

6 Remove dorsal and anal fins, loosened in Step 2, by pulling away and forward from the body. Cut off the tail.

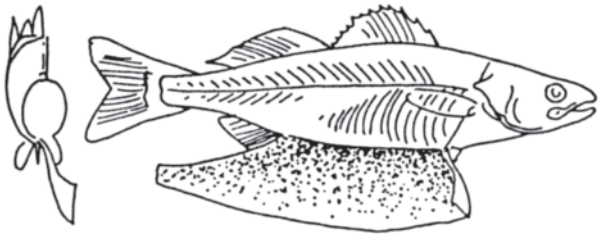
FILLETING PERCH AND BASS



1 To save the most meat and fewest bones try this method: Cut along back on one side of dorsal fin. Insert blade all the way through body and out belly just behind vent. Slice along edge of anal fin, with blade sliding along backbone until reaching tail. Cut fillet loose and repeat on other side.



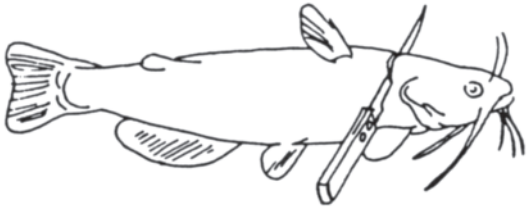
2 Slice on an angle from the top of back to belly just behind head, pectoral fin, and pelvic fin. Repeat slice on other side of body, or finish one side at a time.



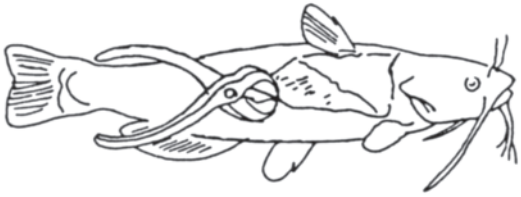
3 Insert knife blade in original cut (Step 1) and slice downward freeing meat from rib cage. After working down over main part of ribs, keep cutting as close against lower ribs as possible until reaching belly. Cut through the belly, separating fillet from body.

4 Lay fillet skin flat on table. With a heavy, flat knife cut down into fillet leaving tab for holding skin. Pull on skin and use knife in a see-saw motion. Don't slice the meat off, but scrape it off with the blade and by pulling the skin.

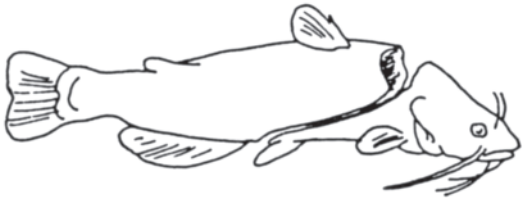
SKINNING BULLHEAD CATFISH



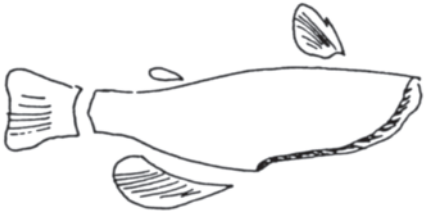
1 A freshly caught fish will skin easier. Cut across top of back to backbone between head and dorsal fin. A short cut toward the top fin helps tear skin.



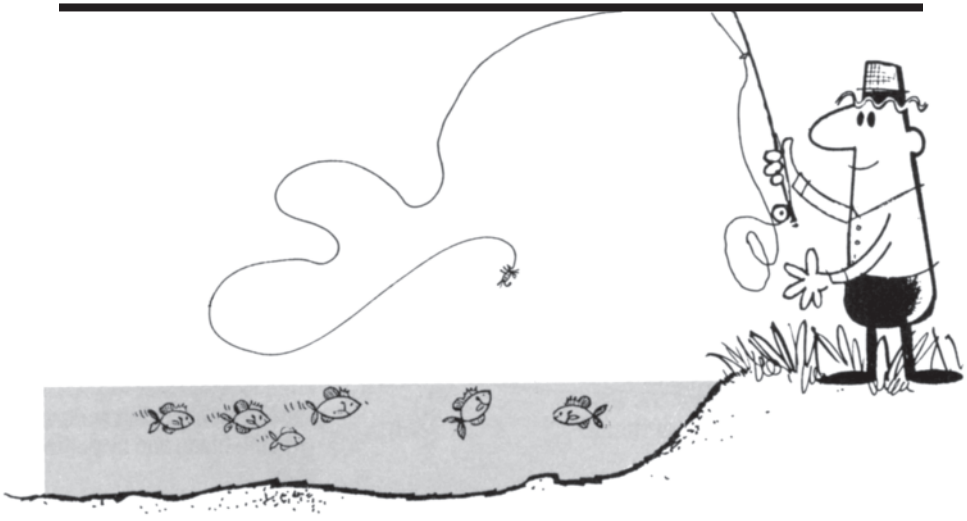
2 Pull skin toward the tail with pliers; one pull on each half should tear off skin. Second side will pick up what skin is missed on tearing off the first side.



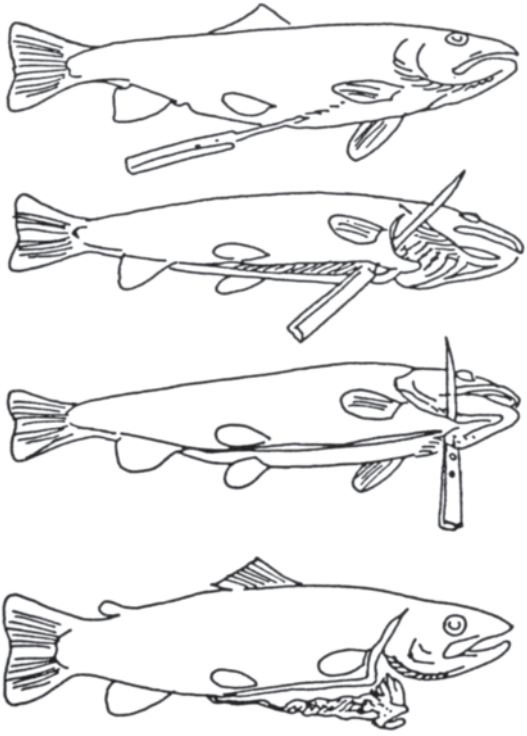
3 Push head downward, breaking backbone where the knife made a cut across back, removing the entrails, belly flesh, and front fins along with head in one motion.



4 If desired, the remaining fins and tail may be removed before cooking. Large catfish need more slitting of skin around head, along back, and belly before skinning.



CLEANING TROUT AND SALMON



1 Clean trout as soon as you can after catching. Insert a knife at the vent and slit the belly forward to the gills.

2 Insert the knife and cut at the point where the gill is attached under the throat at the V joining the lower belly to the head.

3 Place one finger in the belly slit and gill opening and separate the side of the body from the gills and gill rakers. Insert the knife and cut the flesh loose at bottom on both sides.

4 Stick a finger in the gill throat and tear out gills and gill rakers. Entrails will pull out with gills or remove them by hand. Remove the blood streak along spine. Remove all excess fat, especially the belly and dorsal flaps. Remove the skin on large fish. Cook so any remaining fat will be reduced.

USING THE LITTLE POND

Some Illinois ponds are too small or too shallow to maintain sport fish population. Owners of such ponds often desire to stock them with fish for limited fishing or they may desire to raise bait minnows. These ponds can be utilized for such purposes, but require intensive care.

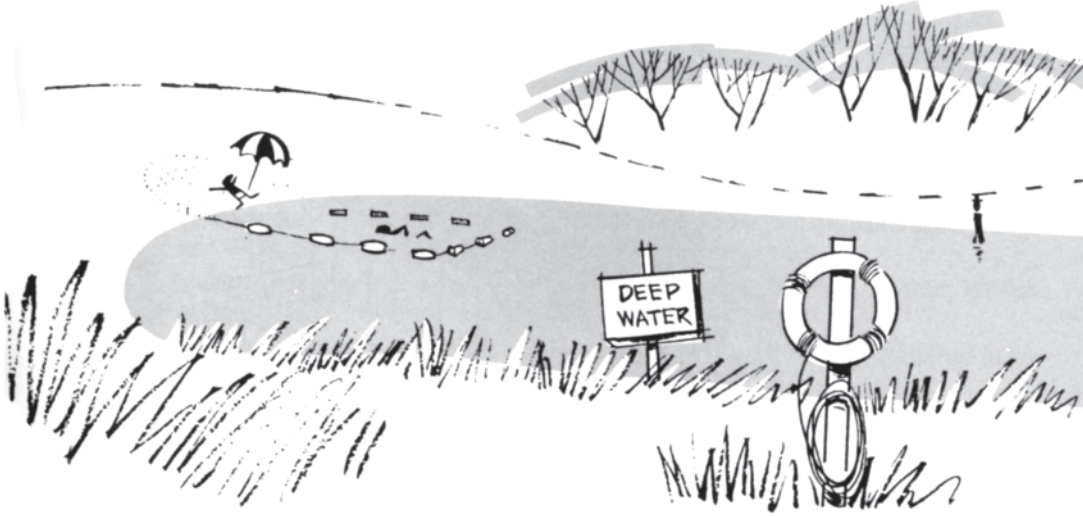
POND SAFETY

Since pond recreation includes fishing, swimming, boating and ice skating, it must also include effective safety measures. It is recommended that pond owners:

1. Place life-saving equipment near the pond, including a life ring with an attached rope of 100 feet in length and a long pole.

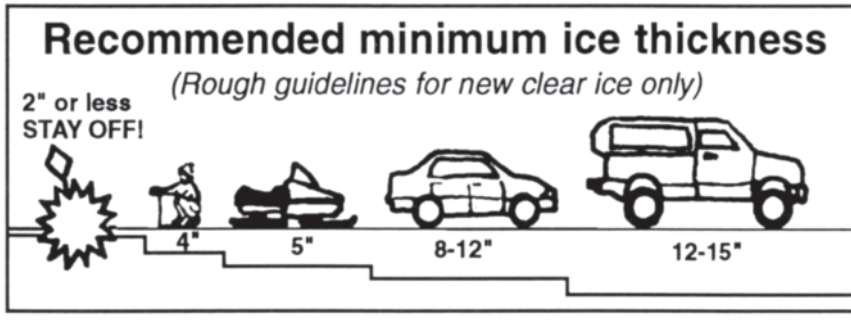
2. Place warning signs near danger areas and deep water areas; indicate locations of life-saving equipment and the nearest telephone; mark overhanging banks, steep slopes, and caving banks.

3. Be sure that all boats used on the pond are in good condition, used properly, and never overloaded. There should be a Coast Guard approved personal flotation device (PFD) for each person in a boat and one throwable life preserver.



Other things to be considered are:

1. A non-swimmer should wear a Coast Guard approved personal flotation device (PFD), such as a vest, when near or on the pond.
2. Mark off safe swimming areas if swimming is permitted.
3. Alcohol and water DO NOT MIX. Alcohol will reduce stability, effect vision and reduce inhibitions in risk taking.
4. When the pond is used for ice skating or ice fishing during the winter, the following safety tips should be followed:
   A. Because ice thickness can vary across the pond, check the ice at several locations before venturing out. Make sure the ice is at least four (4) inches thick.
   B. Wear several layers of loose, insulated or wool clothing which will allow for adjustment to the weather and the activity level.
   C. Always be with or near others.
   D. Always carry ice awls/picks (screwdrivers or a nail in a dowel rod will do) attached to a cord and worn around the neck. Should you accidentally break through, the awls will provide a means to grip the ice.
   E. Above all use COMMON SENSE and remember this rule of thumb: "Thick and blue, tried and true. Thin and crispy, way too risky."



The above figures are recommended minimum ice thickness for clear, blue ice. Extreme caution should be exercised on ice of all types, particularly during the late winter months when rapid changes occur in ice structure; as an added precaution, wear a life preserver (PFD).

FISH FACTS AND FALLACIES

1. When bluegills or other sunfish are overpopulated and crowded, they prey on bass eggs and fry and prevent bass from reproducing successfully.

2. Birds do not stock ponds with fish. Fish eggs eaten by birds are quickly digested. Eggs that cling to the bodies or feet of birds would not survive a long flight through the air. Fish eggs have a thin membrane, thus die quickly when removed from water.

3. When fish seem to appear miraculously in an isolated pond, intense investigation will reveal that someone stocked the pond-and it wasn't birds or rain.

4. Fish have been found in corn fields or streets after a heavy rain, but it does not rain fish. These fish swarm there from nearby creeks or ponds during high water and later became stranded. Cyclonic winds have been known to suck up water and fish from ponds and lakes and scatter the fish over fields. However, this rarely happens.

5. Most warmwater game fish do not live much longer than eight to ten years in the central and southern states.

6. The common carp is the largest member of the minnow family in Illinois and was introduced into the State in 1879 from Germany and is a significant problem in small lakes and ponds. Avoid stocking.

7. Large fish are found more often in shallow water during the spring and fall and in the cooler deep water during the summer.

8. The best hours for catching fish are the early morning and late afternoon during the normal fishing season.

9. The age of fish can be determined by counting the annual growth rings of scales, otoliths (ear stones), rays, or other boney structures.

10. Some fish "sleep" by remaining quiet on the bottom during the night. Others, such as catfish, are most active and feed primarily at night.

11. Many fish can change their color to match their surroundings for protection. The fish see changes in color and expand or contract pigment cells in the, skin.

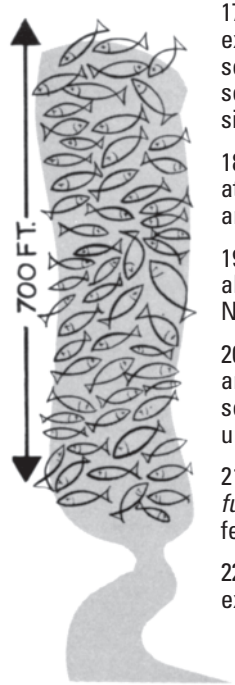
12. It is desirable to wet your hands before handling fish that are to be returned to the water unharmed.

13. If a pair of large bass (one male and one female) were placed in a one acre pond with an average depth of five feet where they produced a normal number of young (20,000), and if all the offspring survived for three generations (considering that only one-half of the offspring (female) would lay eggs), about 2 billion fish would result. If these fish average one pound each, there would be 2 billion pounds of bass in the pond. The described pond would contain about 14 million pounds of water. From this one pair of bass with complete survival of fish for three generations, the fish would not only completely replace the water, but would be piled about 715 feet above the original level of the pond.

14. Fish do not possess a high degree of intelligence. They rely primarily on five senses to survive from day-to-day. These key senses include sight, hearing, vibration detection, smell and taste.

15. Fish have been called super-sniffers. Smell and taste are two senses which are particularly developed in fish that have poor vision (channel catfish for example). Dirty or off-colored waters limit fish vision. Fish which live in these waters rely on their senses of smell and taste to feed.

16. Fish have four nostrils, two on each side of the snout. Water flows into the front nostril, then into the nasal cavity and finally out of the rear nostril. The amount of sensory tissue tends to increase as a fish gets older, which accounts in part for the belief that fish become "wise" with age.



17. A fish is sensitive to sound vibrations and can "hear" in the water. Fish have no external ears, but "hear" with their inner ear and connecting air bladder which serves as an underwater microphone. In addition to their inner ears, fish have a second sensory system known as the lateral-line which extends along the fish's sides and detects water movements.

18. Most species of fish have color vision to a degree and some are much sharper at color discrimination than others. Largemouth bass respond to red above all colors and can even see colors above the surface of the water.

19. Illinois has 203 species of fish representing 87 genera and 30 families. Illinois is also home to 35 endangered or threatened species of fish that may not be taken. Nine species of fish have become extirpated from Illinois.

20. The total diet of turtles is usually 80 percent vegetable matter, about 17 percent animal matter and less than 3 percent fish. Turtles do not harm fish populations and some species are good to eat. Turtles are not dangerous to people when left undisturbed.

21. The largest fish ever captured in Illinois waters was a lake sturgeon (*Acipenser fulvescens*) from Lake Michigan in 1943. The fish weighed 310 pounds and was 7 feet, 11 inches long.

22. Although most fish are considered cold blooded, body core temperatures typically exceed water temperatures.

Springfield Offices

One Natural Resources Way
Springfield, IL 62702-1271
www.dnr.illinois.gov
217-782-6302

Division of Fisheries

(217) 782-6424

Division of Law Enforcement

(217) 782-6431

License Replacement

(217) 782-2965

Chicago Office

James R. Thompson Center
Suite 4-300
100 West Randolph St.
Chicago, IL 60601
(312) 814-2070

Telecommunications Device for the Deaf and Hearing Impaired (TTY)

(217) 782-9175

T.I.P. Target Illinois Poachers

Report Violations to 1-877-2DNRLAW (1-877-236-7529)
24 hours/day, 7 days/week

I FISH ILLINOIS WEBSITE

The website ***www.IFishIllinois.org*** is the one-stop, go-to website for all anglers fishing in Illinois waters!

From fishing reports to lake profile summaries to IDNR press releases and opening notices, IFishIllinois has everything you need for a successful day out fishing on Illinois many water bodies, including:

- Fishing Reports
- Individual Lake Maps
- Information for over 250 lakes, streams and rivers in Illinois
- Fishing Regulations
- Angling Tips
- Illinois Sportfish Species Information
- Taking Kids Fishing
- Tournaments Application Information
- Locate your county biologist
- Tips for stocking your pond
- Angling awards and Fishing Records
- Catch-and-release guidelines
- Opening Day Notices
- IDNR Press Releases

Don't forget to follow us on Facebook and Twitter for all the latest information about Illinois angling!

JOIN THE FIGHT!

93% of Illinois anglers are already fighting the spread of aquatic invaders.*

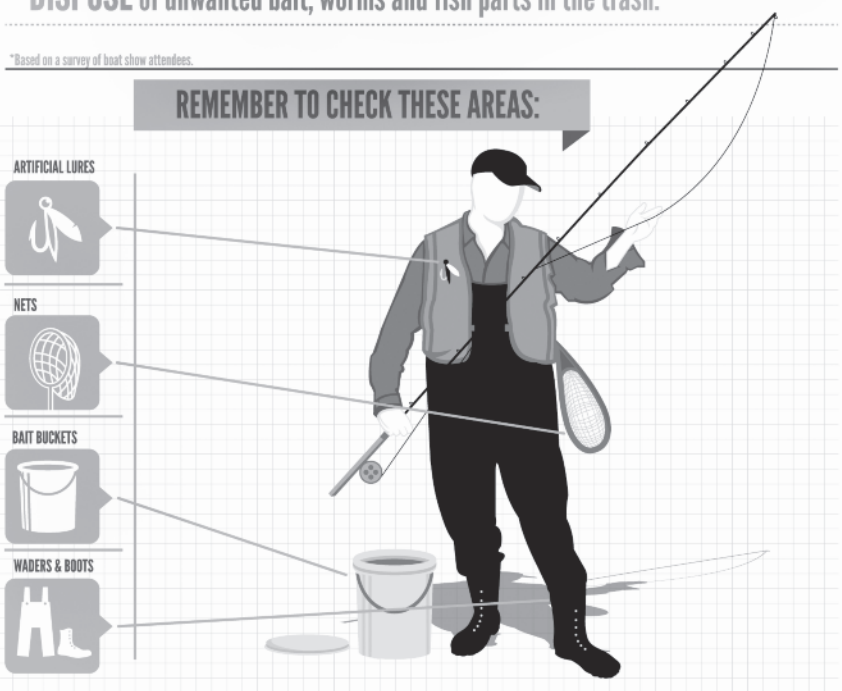
Before fishing in another waterbody:

BE A HERO TRANSPORT ZERO

- **REMOVE** plants, animals and mud from all equipment.
- **DRAIN** all water from your boat and gear.
- **DRY** everything thoroughly with a towel.
- **DISPOSE** of unwanted bait, worms and fish parts in the trash.

*Based on a survey of boat show attendees.

REMEMBER TO CHECK THESE AREAS:



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Produced by Illinois-Indiana Sea Grant and Illinois Natural History Survey, Prairie Research Institute. IISG-14-26

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Donate to the Illinois Wildlife Preservation Fund on your state income tax return (IL1040).

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- The donation can be reported as a charitable contribution on next year's federal tax form.
- You can contribute any amount over $1.00 on your state income tax return to help wildlife.
- After tax season, you can make a tax deductible donation to save Illinois Wildlife by sending a check or money order to: Illinois Wildlife Preservation Fund in care of: Illinois Department of Natural Resources, Natural Heritage Division, One Natural Resources Way, Springfield, IL 62702.

Thank you.

NOTES