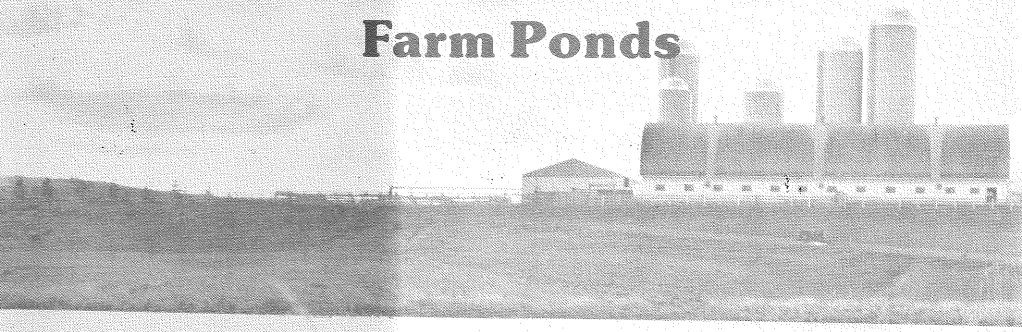
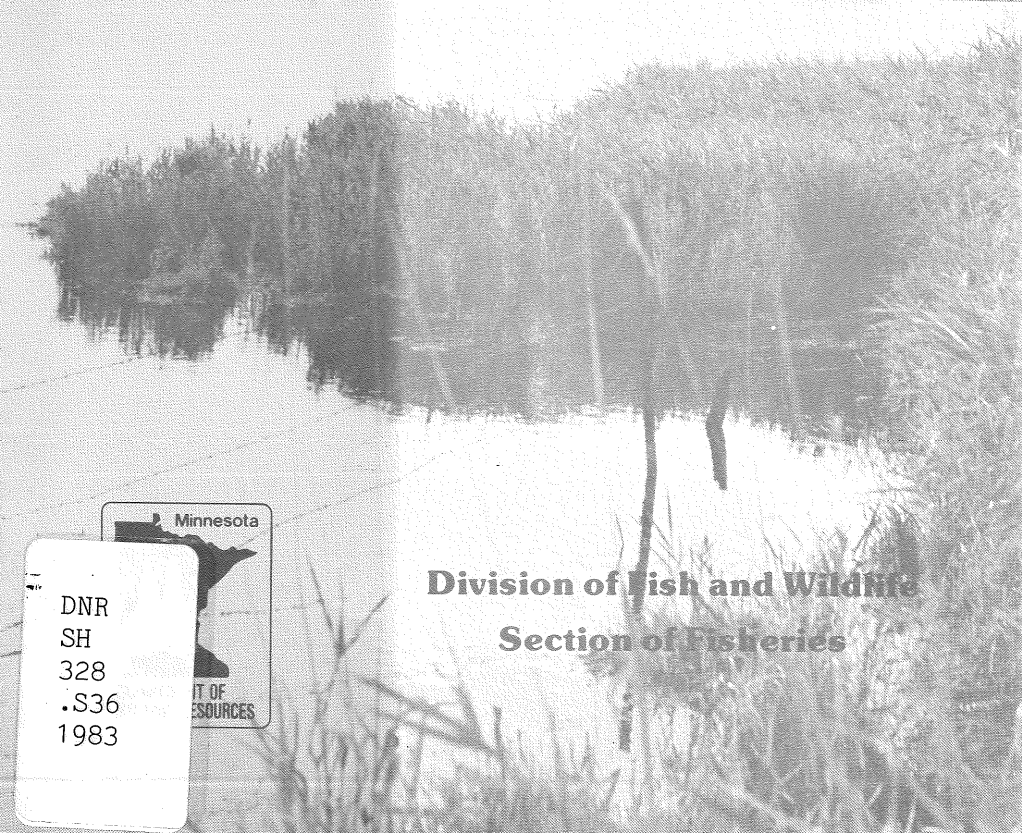
# A Fish Management Guide for Northern Prairie Farm Ponds





Division of Fish and Wildlife
Section of Fisheries

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# A FISH MANAGEMENT GUIDE FOR NORTHERN PRAIRIE FARM PONDS

By

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Rochester, Minnesota 55904

# INTRODUCTION

This pamphlet began as a response to requests for information from farm pond owners in Minnesota. Since the biology of farm ponds is not restricted by political lines such as state boundaries, it was written in a fashion to be useful throughout the northern prairie states. Many states already have recreational pond management guides designed specifically for their waters and problems. Where that is the case, this pamphlet may be useful as additional information. The language and concepts used in this pamphlet are designed to be understood by the average pond owner. Training in biology or chemistry is not necessary to understand or use what you will find inside. Good luck and Good Fishing!

# ACKNOWLEDGMENTS

This Guide was written in response to requests for information from hundreds of pond owners across southern Minnesota. In collecting information, the author researched scores of publications written by various authors. Instead of attempting to individually recognize all of these professional fisheries workers across the nation, the author would like to dedicate this Guide to all who love fish and have contributed to the continued need for information and management techniques.

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# FARM POND FISHERIES MANAGEMENT

## THE WATER

The northern prairie states contain a wide variety of soil types, most of which share two common characteristics — high fertility and intensive agricultural use. Agricultural use directly affects the quality of most surface waters. Fertilizer applied to fields and lawns is a common cause of overfertility in ponds and often results in algae and weed problems. It washes in with rain or snow melt and immediately begins providing nutrients for plants which respond naturally by turning the water green or over-running the pond with rooted vegetation.

A certain amount of nutrients and resulting vegetation is necessary for a healthy, productive fish pond. Too much is often big trouble! The dividing line between enough and too much is very fine. There is usually enough inherent fertility in prairie pond water to perform well without added nutrients but unfortunately most ponds depend on runoff to maintain satisfactory water levels. Where this is the case, the pond manager should strive to make incoming water as free from nutrients as possible.

Maintaining high quality (runoff) water usually means practicing good land management. Erosion control measures such as conservation tillage, check dams, terracing, grassed waterways and contour strips are all tools of a concerned land manager. Livestock should not have free access to the water or the pond banks. If stock watering is necessary, make sure the area is fenced and the bottom and banks are protected with gravel.

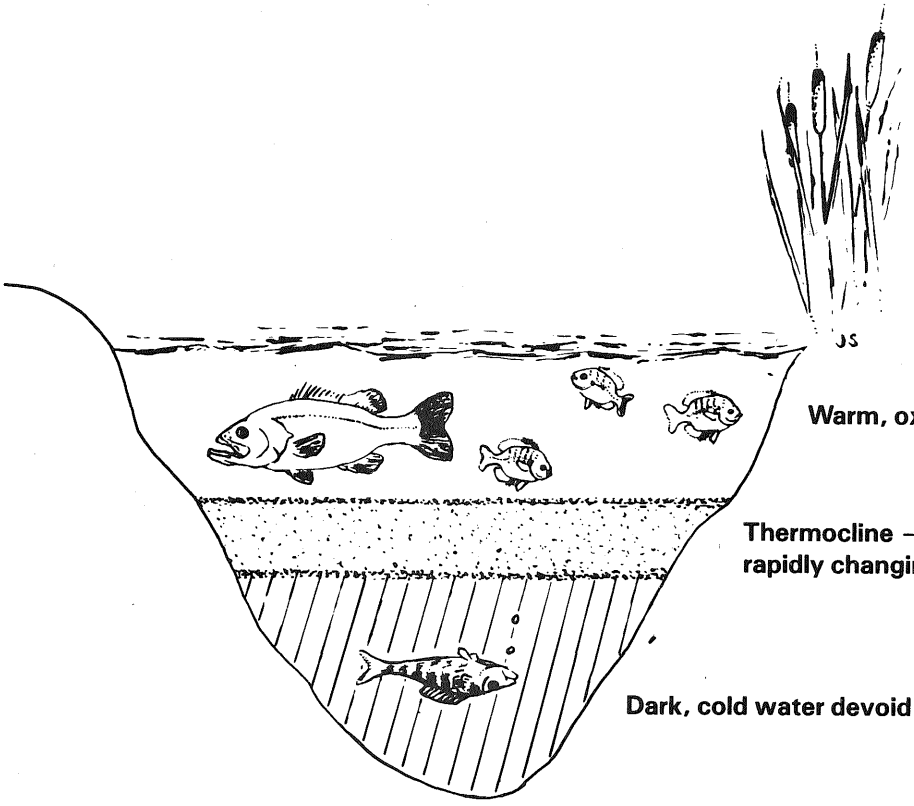
Managers relying on spring water to maintain their fish pond system are cautioned that not all springs contain good water. Many springs lack oxygen and require aeration before the water is useful for maintaining aquatic life. Some springs contain gases and dissolved elements that are harmful to fish health. Spring water should be tested before (new) development plans are very far along. Have the tester measure the dissolved oxygen level ($O_2$)*, sulphate, iron, ammonia, pH (acidity) and

*Dissolved oxygen, or $O_2$ as it is usually referred to by fisheries workers, is the most important "positive" gas in your pond. "Positive", as used here, means supportive of aquatic life. It is not part of the water molecule ($H_2O$). It is a gas within the water and is extracted by aquatic animals to sustain metabolic processes (life).

available phosphorus. If all of this is beyond your means, at least test the spring water for oxygen content. The next step is to have a qualified fisheries biologist look at the results. It is unlawful in some states, such as Minnesota, for state personnel to expend state time on private waters. However, simple advice is usually provided free of charge. The biologist will advise you whether the water is usable as is or if it requires treatment. You should also test your pond water for oxygen during the winter when the pond is sealed by ice and particularly snow. It will indicate whether oxygen levels will remain high enough to sustain life through the entire winter period. Because ice and snow seal the pond for so much of the year, maintaining adequate oxygen to sustain aquatic life is a major concern. A large part of winter (under ice) oxygen present in water is maintained by the winter vegetation present in the water (algae). This vegetation requires light for photosynthesis and when the incoming light is obstructed by snow cover on the ice (or several hot, still, cloudy summer days), the vegetation uses more oxygen than it manufactures. Since just about everything living in the pond (bacteria, fish, zooplankton) needs and uses oxygen, it will slowly but surely run out. When that happens, the pond "dies".

A situation similar to winterkill also exists in many ponds during summer months. It is caused by a thermal barrier in the pond depths called a "thermocline". Large, shallow ponds (less than 8 or 10 feet in depth) rarely develop thermoclines since the thermal action of the sun aided by wind action keeps the pond turning over. Deeper ponds with limited surface area usually do develop a thermocline. Simply stated, the thermocline is a narrow layer of water between the warm surface water and the cold bottom water. Its characteristics are narrowness in depth, usually less than 5 feet, and rapidly changing temperatures, sometimes more than 1 °F. per foot.

The thermocline effectively prevents exchange of water between surface and bottom. Decay of organic matter below the thermocline in fertile pond waters soon uses up available dissolved oxygen with the result being desired organisms either die or move up into good water. It is possible to keep a thermocline from forming by moving water from the bottom and releasing it on or near the surface. The effect is to allow production to occur throughout the entire pond volume during the warm (most productive) months of the year. Although significant production gains may be realized, perhaps even double or more in selected ponds, such gains must be balanced against the cost of equipment and operation. Frankly, there are many ramifications to summer aeration of




**THERMOCLINE**

ponds for the purpose of preventing thermocline formation. Instead of attempting to deal with them in this generalized publication, we suggest that readers who may be interested in such ultra-intensive management seek a more sophisticated information source such as an aquatic biologist with experience and training in pond ecology.

## THE POND

Ponds come in a variety of sizes, shapes and locations in the watershed. For warmwater fish management, such as sunfish, bass and catfish, a pond should be at least one-half acre in surface area. If you are able to go bigger, so much the better. Generally speaking, the more water, the more fish the pond can produce.

In order to allow bass and bluegill to spawn, a shallow "shelf" area of sand and gravel between 18-24 inches deep should be left around the edge. It does not have to be a large area — 10 feet x 10 feet (100 square feet) will suffice for most ponds up to several acres. This is not necessary in trout ponds where steep, deep banks are desirable. Where fathead minnows are desired, it is necessary to supply some sort of spawning habitat. Since they require small shelters, one or more rock piles in shallow water will suffice.

Pond depths in northern states are a critical consideration. The greater the volume of water, the more oxygen is present. If you stack the volume up so the pond is deep in comparison to the area, the oxygen will tend to last longer when the pond is sealed from air and light as is common under ice and snow cover. In northern ponds, at least 25 percent of the pond should be 14 feet or more in depth. If high quality water, not loaded with nutrients and vegetation is maintained, the pond oxygen will usually last the winter without special aeration or snow removal efforts.

When pond water becomes dangerously low in oxygen and/or high in other gases, it may be necessary to correct the situation. One method used to maintain oxygen in winter ponds is keeping the ice clear of snow. How you do this depends on what available equipment can be effectively used without falling through the ice. If you do use the snow removal method, be sure you start **before** the oxygen falls below 4 ppm.

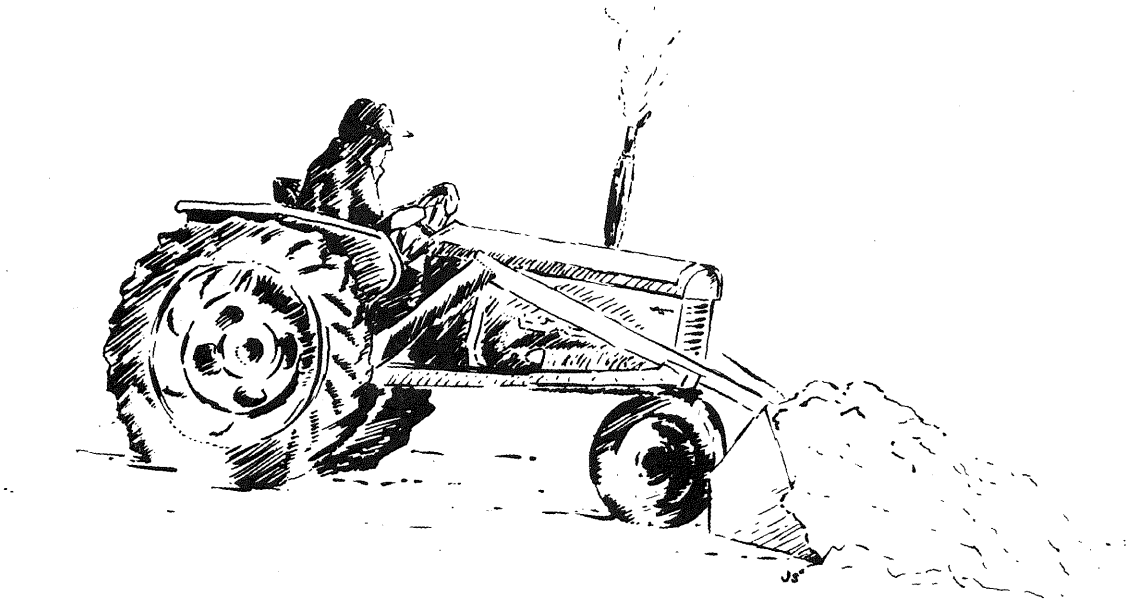

# ROCK PILES

Once the oxygen level starts down, it is very difficult to stop and increase with such a basic method. Several aeration methods are available to keep oxygen levels high enough, generally over two parts per million (ppm), to sustain most pond life. Devices are available that pump air or water and use any number of energy sources including windpower. For information about these devices, I suggest subscribing to a fish farming magazine for at least a year. One such is *Farm Pond Harvest,* P.O. Box AA, Momence, Illinois 60954. While most of the articles and management advice in that magazine are oriented toward southern and mid-America, there is enough useful information including advertisements for pond management equipment and fish food to make it worthwhile. Other publications are also listed in the appendix to this pamphlet.

A danger with aerators that sit on the pond bottom is waiting too long before they are started. If most of the lower strata of a pond is already devoid of oxygen (it is used up near the bottom first) and probably contains other noxious gases, the entire pond can be "killed" very quickly by turning on a sealed-in aeration device. Incidentally, this is an effective and cheap way to purposely kill a pond if that should become necessary.

If I owned a farm pond with an occasional oxygen problem and my farm equipment included a good sized pump, I would construct a permanent "baffle" system on the shore of my pond. Very simply, it consists of pumping "bad" water out of the depth of the pond and over a step-like baffle to aerate it on its way back down to the pond where it not only supplies immediate oxygen to the water but opens up some of the ice cover on the pond which further enhances oxygen transfer. The advantage of this system is:

(1) simplicity;
(2) many pond owners already have access to the necessary equipment;
(3) you can wait until the oxygen is very low before start-up since it does not function by turning over sealed-in water;
(4) it can bring oxygen levels up in a small pond in a matter of hours and pumping can be slowed or stopped until levels drop again; and finally
(5) in my opinion, it is safer as it does not cause dangerous thin ice conditions over an extended time period.



**SNOW REMOVAL**

Summer aeration can also be useful and necessary. It is generally used in one of two cases:

(1) the pond is very rich with a high aquatic "bio-load" (vegetation, fish, plankton, bacteria, etc.); and/or
(2) the pond is deep and "stratified", losing its oxygen below the thermocline. This latter problem was discussed earlier in the Water Section and will not be expanded further here.

An aquatic biologist with proper laboratory facilities can actually measure the biological oxygen demand (B.O.D.) and use the information to determine future management options. The average pond owner, however, is not that well equipped and will have to depend on observation. If the pond is obviously biologically "loaded" and/or has developed a thick, usually green algae population, it is in danger of summer oxygen depletion. You should monitor the oxygen levels early in the morning before the sun causes photosynthesis to start in the pond. If oxygen levels are below 2 ppm near the pond surface, you should probably look into an aeration system for the pond. Another indication of low summer oxygen is fish gasping or gaping at the surface.

## THE NEW POND

Filling and beginning management on a brand new pond requires more than just stocking fish as soon as there is water. The very first thing you should do is invest in a nontechnical pond biology field book, such as Putman's *Field Book of Ponds and Streams.* If necessary, your high school librarian or biology teacher may be able to help you with this purchase.

In new ponds, there will not be a natural food supply available for warmwater fish species and if you are stocking the usual bass/bluegill combination, there will be no protective vegetation for the bluegill which means you will shortly end up with a few very fat and happy bass and no bluegill. If the new pond is within a few miles of existing ponds or lakes, it will populate naturally with aquatic insect larvae and vegetation. However, most people with new ponds are impatient to get

# POND BIOLOGY LITERATURE

started. Begin by selecting some vegetation from another pond. Most pond owners are happy to help out fellow fish raisers. Don't plant vegetation that is obviously a nuisance (rank and taking over the entire pond) but look for the larger leafed varieties. During June, separate the root system of these plants from the bottom and transport in buckets while keeping the leaves and stems wet. Plant it in habitat similar to that it was removed from. A few plants should do the job. Trout ponds do not require special plant introductions. In fact, for trout production the opposite goal is desirable as aquatic vegetation is usually a nuisance in trout ponds.

## THE FISH

All waters have a production limit. It can be reached by manipulating water quality (fertility), vegetation, fish species and sizes, water volumes and flows, temperatures and feeding but there is a biological limit and it **isn't ever as high as the pond operator expects!**

In the northern regions, fish production is negatively affected by the lower (annual) average water temperature as most fish grow slower in cool or cold waters. With the possible exception of some sort of homemade solar energy heating device, it isn't feasible to heat water for the purpose of fish production. The cost/benefits of such operations are terrible and getting worse! Therefore, you must work with what you have.

If you are managing a pond fed by a substantial spring, you should consider raising trout. You must measure the summer oxygen and temperature of your pond waters to decide whether to try trout or warmwater species. For trout, the water should rarely, if ever, reach 75°F. and should not contain less than 4 or 5 ppm of dissolved oxygen. Some strains of rainbow and brown trout can tolerate slightly more marginal conditions but you will always be fighting disease problems and worrying about low oxygen.

## STOCKING TROUT

There are four major decisions when stocking your pond with trout or any species for that matter:

(1) the strain or species of trout to stock;

(2) the size of fish to stock;
(3) the number of fish to stock; and
(4) the time of year.

The first thing to do is locate a reputable commercial outlet for trout fingerlings. The owner or manager of such an operation will help you make your stocking decisions. He will want to know your pond or raceway sizes, the volume and temperature of your water and what your plans are for the fish. Managers of small ponds with limited water flows are advised to choose rainbow trout. They are attractive and easy to work with. With limited flow, you will not be able to maintain nearly as high a population of fish as you will see in raceways of major trout raising facilities. This has to do with factors such as water flow, metabolic waste, feeding rates, space, disease control, fish handling, training and experience. Don't be disappointed in setting somewhat lower goals than the commercial operators.

A common error made by trout pond owners is assuming that trout need "minnows" on which to feed. Actually, minnows compete with trout for natural food and their presence can negatively affect the health and well-being of trout. The natural (non-fish) food chain and if necessary supplemental feeding of dry, pelleted food is the best choice. Since trout will not reproduce naturally in ponds, stocking to replace harvested fish is necessary. To this writer's knowledge, there is no source of "free" trout for the private pond operator. You will have to buy them from another private operator. Summarizing the trout stocking section is very simple. Locate a reputable dealer in live trout, solicit advice, follow it and evaluate results.

## STOCKING WARMWATER FISHES

Determining which species of fish to stock can be quite a problem. Many pond owners think of their pond in the same way they do their vegetable garden. Why not have a little of everything? Unfortunately for the fish smorgasbord approach, many fish species do not do well together in ponds. Trial, error and research have shown that pond managers will do well to stock relatively few fish species. A combination that has proven successful over the years is bluegill and largemouth bass. Fish that do not perform well in ponds are top or near top predators that will not accept artificial foods such as northern pike or walleye. Catfish, on the other hand, make a very adequate pondfish

since they accept artificial (pellet) food and will not generally reproduce (overpopulate). A discussion of the relative merits of common warmwater pond fish, stocking methods and numbers to stock follows.

**Bluegill** are a fast growing, prolific, attractive panfish that do well in most ponds. In fact, overproduction is the major problem with bluegill and is difficult to control. Too many bluegill will cut growth rates and quickly result in a "stunted" population. Ideally, you should maintain only enough bluegill to harvest about 40 to 80 pounds per acre per year. Not much, is it? There are bluegill feeding devices available with various claims to effectiveness that may significantly increase your annual yield. You will find them advertised in the pond management magazines.

Since there is no way of predicting what a bluegill population will be from year to year, the stocking rates will have to be adjusted as time progresses. There are several approaches depending on time of year and availability of fish, including predator species if any are planned for stocking. We will outline several stocking plans by situation. For the **initial** stocking of a new (or rehabilitated) pond, the following stocking plans are usually suggested.

1. Spring stocking of sexually mature "brood" fish requires relatively few fish. The offspring of just one average sized bluegill female will suffice for a one-half acre pond. To be sure of success, however, at least two pairs (female and male) should be introduced. This method requires little expenditure since the fish can be transported in a five-gallon bucket from the nearest lake (you should check the legality of this method in your state first). However, given the stunting problem of bluegill, it is taking quite a chance on the outcome of such uncontrolled husbandry. If you have access to a smaller pond from which the bluegill young can be readily harvested after hatching, you can transplant the exact number of fingerlings you wish into the larger pond(s) which brings us to a second method.
2. Fingerling sized (2-3 inch) bluegill should be initially stocked at about 300 to 500 fish per acre of pond surface. When this is done, it is not wise to stock bass for population control until the year that the first bluegill reach sexual maturity. If you do stock bass fingerlings, they will have little to eat since the bluegill are probably too large to be eaten and the bass will have difficulty competing with the bluegill for available insects. If large bass are stocked with fingerling bluegill, be sure to overstock enough bluegill to feed the bass plus allow a surplus for yourself. Stocking other forage species, such as fathead minnows, will

also work in many ponds. You should check with a fisheries biologist on the habitat requirements of any species before introducing it in your pond.

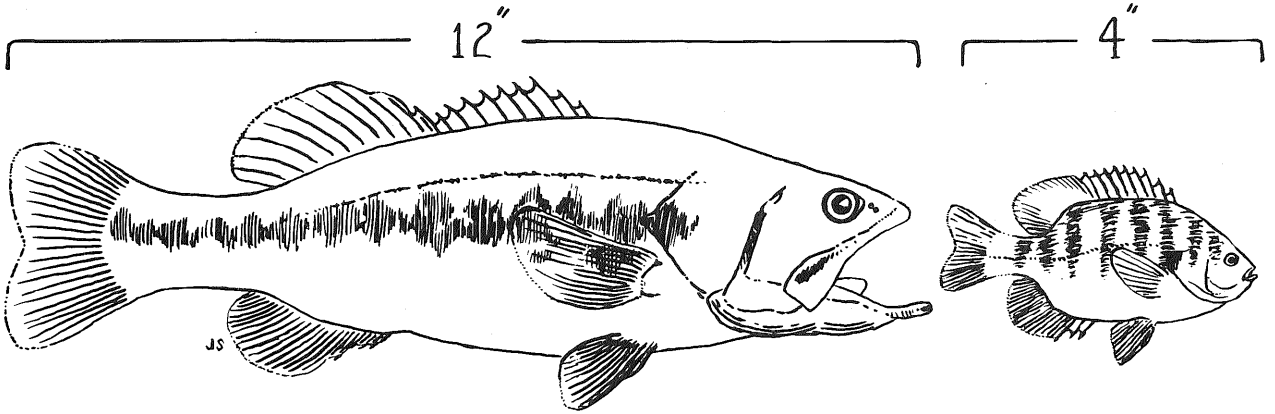
Lightly stocked bluegill fingerlings into a prime pond will result in at least some reproduction the following summer. Plan your bass introductions accordingly, as outlined in the following section. Also, for one more bluegill stocking technique, see the final paragraph of the bass chapter (next).

**Largemouth bass** are popular pond fish and provide a limited sport fishery as well as acting as a "population controller" of bluegill. However, before we suggest stocking rates, a short lesson in bass biology is necessary.

The most common error made by pond owners in their management is removing too many medium-sized bass from the pond. You must exert some control over the sport fishery! You probably won't be able to harvest over 10 to 30 pounds of "keeper" size bass per acre per year without seriously shifting the pond balance toward stunted panfish. On the other hand, be sure enough proper sized bluegill or other forage fish are available to feed whatever bass you do stock! The ratio of largemouth bass to bluegill is difficult to determine because population dynamics is affected by so many variables such as disease, predation, fishing mortality, water quality, etc. If you consider that a bass converts food at about 5:1 (5 pounds of forage fish needed per pound of bass produced) and good growth is perhaps as much as one pound per year, you will have an idea for what you should be managing. Forage sized (bass food) bluegill will run anywhere from young right out of the egg to as large as four or five bluegill per pound. The forage size is determined by the size of the bass. A rule of thumb is "three times the length". If the bluegill are 4 inches long, it will take at least a 12 inch bass to eat them.

You feel this is getting complicated? You're right, it is! No short article on fish population management exists that will tell you exactly how to manage a pond, step-by-step, as there are too many variables. However, understanding the "trophic" system may help you gauge your future management options.

The trophic system of energy intake and resulting numbers and growth of fish and animals is essentially very simple. It begins with recognizing and studying the "food chain". The food chain begins at a very elemental level — down around bacteria. By describing similar feeding



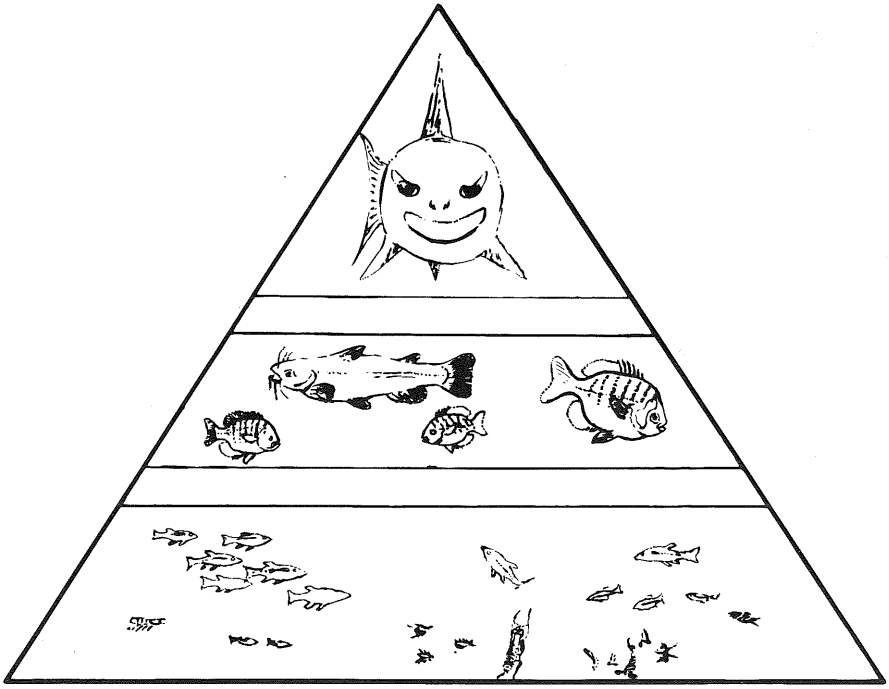

**FORAGE SIZE RANGE**

characteristics of animals based on what is eating what (or whom), it is possible to describe "trophic steps". A cow, for instance, is on the same trophic level as a horse; and a muskellunge is on the same level as a northern pike. The latter two are top level fish eaters. The highly simplified food pyramid shown in the diagram will help you understand this system of energy (food) exchange.

The lower (trophic level) a fish (or whatever) feeds in the food chain, the more efficient the growth is in total weight and/or numbers. The reason bluegill can maintain a higher standing crop than bass in weight per unit of space is they are usually feeding at least one trophic level below bass. Some fisheries experts claim that each time you move up a trophic level in the food chain, you lose up to 80 or 90 percent in growth (numbers or weight) of the fish concerned. That would be close to the ratio of bluegill weight to bass weight you want to have in your pond, too. To put it even plainer, you should strive to maintain around 100-150 pounds of bluegill per 20-30 pounds of bass per acre as a ratio in your pond.

With a few seine hauls and some simple mathematics it is possible to closely estimate the number and weight of fish present in a body of water. It involves capturing, marking, releasing, recapturing, examining and finally calculating by comparing the number of marked fish to the number of unmarked fish. Most fisheries biologists are familiar with this technique (called the "Petersen" mark and recapture method) and would be happy to help school children plan a project for counting fish in a pond. Contact the nearest State Fisheries office for more information.

Another method of checking growth rates and general well-being of fish is to "read" the growth lines on their scales. You might try taking a few larger bluegill to a state fisheries biologist where the fishes' scales can be read and growth rates checked. If growth is abnormally slow, the pond is probably overstocked for the food available. Take the whole fish (on ice) since the scales must be taken from a particular spot on the fish. A technique for initial stocking of bass when bluegill are also desired is to stock bass fingerlings at about 50-100 per acre in the fall and several pair of sexually mature (brood) bluegill the following spring. Bass **fingerlings** feed low on the food chain as they don't require fish as food. By the following spring, when the brood bluegill bring off the first hatch of young, the then bass "yearlings" will be ready to switch over to fish in their diet. Hopefully, if everything works out well, the bass will devour enough small bluegill to keep the population in "balance". Be sure to keep your fingers crossed during the entire operation!



# FOOD PYRAMID

**Northern pike** and **walleye** as well as most other large predators require more space (to do well) than ponds provide. While it probably doesn't do any harm to stock a **limited number** of these species, don't expect much in return.

**Channel catfish** do quite well in most ponds, will readily accept supplemental feeding and are fun to catch and eat. They also seem to do well mixed with other species (polyculture) and will not overpopulate. As with trout, the people who sell catfish fingerlings are the best source of information regarding stocking schedules, rates and the proper food.

Miscellaneous species:

**Bullhead** grow well and are prized as food fish by many people. Unfortunately, like bluegill they tend to overpopulate and stunt. Some control over that problem can be exerted by removing the "swarms" of just hatched fry in the spring with a small mesh dipnet.

**Hybrid sunfish** (crosses) are not readily available in Minnesota but we expect to see more of them in the future. For example, the bluegill/green sunfish cross provides a fast growing, nice sized panfish that readily accepts artificial food. The overproduction problem is almost eliminated which makes for easier management. Unfortunately, it also means you have to continually stock to keep fish in the pond and that requires a nearby source of hybrid fingerlings at a reasonable cost (which doesn't exist in Minnesota at this time).

**White amur** (grass carp) and **Tilapia** are newcomers in North American fish culture. Since **Tilapia** cannot tolerate low temperatures, they will not be discussed. **Grass carp**, a native of northern China, appear to find our waters much to their liking. A grass carp will gain as much as 4 pounds in a single season and does it by eating vegetation! Unfortunately, they also have potential for doing a great deal of environmental harm if allowed to go wild and enter wetlands and lakes which must have vegetation as part of the existing ecosystem. For that reason most states (including Minnesota) prohibit importation of grass carp and have stiff penalties to back up their regulations.

Always check your state laws regarding any fish purchases or movement. More information regarding availability of fish for stocking is provided in the appendix.

### Sources of Fish for Stocking

In Minnesota, the 1982 legislature legalized the sale of bluegill and bass under certain conditions. The seller must possess a "private fish hatchery license" and the fish can be sold for restocking purposes only (not for food). As of our publication date, the law is so recent that few sources of supply have developed. However, you might try contacting a state fisheries headquarters for recent information. They should also be able to advise on the legal technicalities involved.

## POND MANAGEMENT TECHNIQUES AND METHODS

"Gone to pot" ponds are common. Overabundant vegetation, stunted panfish, undesirable fish species, overfertility, underfertility and physical problems such as leaking and sedimentation are all common ailments. Some are easily cured while others force owners to give up and accept a frog pond as the "best management practice". Following are some techniques and methods that have proven useful.

**Overabundant vegetation** is a result of both water and pond bottom fertility. Black plastic can be weighted and spread on the bottom and covered with clean sand where no vegetation at all is desired. This, of course, interferes with biological processes such as fish food production, so it should be used judiciously. Just a heavy sand blanket can also be fairly effective but also fills in your pond.

Cutting or pulling rooted vegetation by any method you can devise also works and provides a fine short term mulch or additive to the compost pile. A problem with this method is the hard work it entails since the pulled or cut vegetation must be removed from the water because its decomposition causes oxygen depletion. Chemical control is popular and again we refer you to the appendix. The pond culture magazine mentioned earlier is another good information source for pond chemicals.

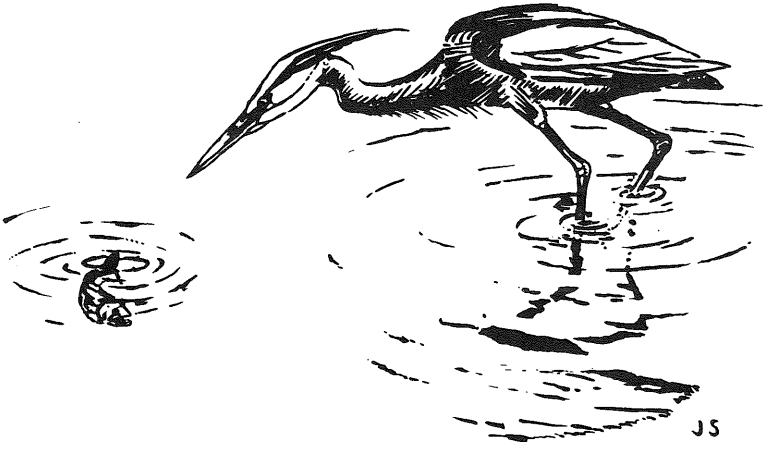
**Stunted panfish** can require drastic action such as draining the pond and starting over. Introduction of predator fish such as largemouth bass which relish small bluegill sometimes works. Sometimes the reason for overabundance of panfish is not so much lack of predators as overabundance of aquatic vegetation which affords refuge to the small fish. Removal of vegetation will force the small panfish into the open where the bass can effectively feed on them. On small (less than one acre), easily seined ponds, you can sometimes exert enough control by simply removing fish by seining.

**Non-drainable ponds** where the previous measures fail require even more drastic measures. You are forced to the ultimate weapon — chemical control. One such pesticide is rotenone, a biological substance and the most popular fish toxicant in use. There are many sources of this toxicant, two of which are mentioned in the appendix.

**Bird and animal predation** is usually only a serious problem when the fish are crowded or concentrated such as in a trout rearing facility. A few warmwater fish lost to a heron or kingfisher is not something to be concerned about. Having the birds to watch is well worth the few lost fish. Where problems do exist, the following tips may be helpful. Don't pound stakes or posts in or near the pond as they provide a perch for many fish-eating birds. Obvious control measures such as guns or traps are illegal. Where an area is small enough, such as a fingerling pond, bird netting can be strung over the pond. If kingfishers are the problem, the netting must be of quite small mesh (1 inch) or the darn things will fly right through it. Usually the most effective and economical method is to overstock a little and feed a few birds.

**"Leaky" ponds** can be a very difficult problem to cure. The commonest methods are patching or lining with clay or plastic. Albeit hindsight, extreme care during pond construction is about the best advice. The U.S.D.A., Soil Conservation Service has had much experience with pond construction and is a good place to look for help during the planning phase.

**Additional nutrients** are seldom needed in prairie ponds. However, if the pond is usually quite clear, not very weedy and doesn't seem to raise many fish, this may be the problem. Have the water tested for phosphorus as this element is usually the limiting factor in pond production. If it is consistently below 0.05 ppm, you should begin adding nutrients by whatever method is most feasible for you. Be careful! Start in the spring after the water reaches 55°F. with small amounts and do not add nutrients during hot, still weather or you may cause too much algae growth with attendant dieoffs and oxygen depletion. Use inorganic fertilizer high in equal amounts of nitrogen and phosphorus such as 8-8-2. Using 8-8-2, for instance, apply evenly at a rate not exceeding 50 pounds/acre. Wait 3 or 4 days before adding more. You are trying to create slightly green water wherein you can't see a white object much past 18 inches deep.




# BIRD PREDATION

**Undesirable fish** in a pond too big or deep to be seined effectively usually calls for total rehabilitation. Again, we recommend rotenone. Be sure to check with state officials to see whether a permit is required. Of most interest to state officials is whether the pond is truly "private" and what sort of outlet system exists. The people who sell rotenone will have proper instructions as to its use (when, how much and environmental controls).

## STATE AND FEDERAL REGULATIONS

Federal regulations regarding fish movement and sale are few. The federal government depends on states to pass wise and necessary laws to control the importation of most noxious species and the spread of disease. There is a federal law that makes it illegal to ship fish into a state that has laws against it and will prosecute the shipper upon complaint. The penalties are quite severe.

States are another matter. By being forced to regulate their own interstate fish control because of lack of federal regulations, a disparity in laws and regulations between states exists. This not only causes problems for people dealing in interstate fish movements, it is also impossible for an author to explain the various states' changing laws with accuracy. Some of the problems states are concerned about include control of fish movement and sale of privately raised fish. Both are important to combat diseases, poaching, illegal sale of game fish and undesirable fish importation. There are more reasons but these are paramount. As it is, serious diseases of coldwater fishes (trout and salmon) are being spread across the continent by uncontrolled movement of fish and eggs.

As peculiar as it may seem, Minnesota private pond owners are subject to the same fishing regulations as on public waters. Fishing seasons and creel limits must be observed. A fishing license must be in possession the same as on public waters. If this presents a problem in your management plans, a solution might be to purchase a license for private raising of fish. See the first page of the appendix for further information regarding this license.

As a final reminder, be sure to check with the appropriate state agencies — usually the Department of Natural Resources — before transporting live fish. Raising fish for home use, however, is almost like motherhood and apple pie. You will find few restrictions on this activity and if you have young people around to help, pond management can be a very rewarding family experience.


# POND FERTILIZATION

## APPENDIX I

### Permits and licenses

A permit is necessary for transferring live game fish into and within the State of Minnesota. This permit is available free of charge from the Area Fisheries Headquarters of the Department of Natural Resources. One should apply for this permit several weeks prior to the planned stocking date so that necessary signatures can be obtained, etc. The information needed to complete the permit include the source of fish, the legal description (Township, Range, Section) of the destination of the fish, the species, number and size of the fish to be stocked, the date of stocking and the size, license number and route of the truck to be used for hauling the fish.

A private fish hatchery license is required for anyone who grows fish for commercial sale. Application forms for this license are available from the License Section, Division of Fish and Wildlife, Department of Natural Resources, 625 N. Robert St., St. Paul, Minnesota 55155 (296-4506). The fee for this license is $25 or $50 per year depending on the volume of sales.

## APPENDIX II

### Equipment and supplies

**FISH.** Most hatcheries will deliver fish for a charge. Write for current prices.

Trout:

Cedar Bend Trout Farm
Scandia, MN 55073
612-433-3776

Peterson Trout Farm
Peterson, MN 55962
507-875-2216

Seven Pines Fishery
Box 115
Lewis, WI 54851
715-653-2271

Trout-Aire
14536 W. Freeway Dr.
Forest Lake, MN 55025
612-464-2964

Warm water species:

Kalepp Fish Farm
Rt. 1
Dorchester, WI 54425
715-654-5236

North Star Fish Hatchery
Montour, IA 50173
515-492-3490

Peterson Trout Farm
(See above)

*The author does not endorse any product or service listed in this guide.

FEED

Coop Fish Feed: Hennepin Coop Seed Exchange
8140 Golden Valley Road
Minneapolis, MN 55427

Glencoe Fish Feed: Glencoe Mills
Glencoe, MN 55336

Purina Fish Feed: Robbinsdale Farm and Garden
4125 Railroad Ave. N.
Minneapolis, MN 55422 (or a local Purina dealer)

NETS, SEINES, TRAPS, SCALES, ETC.

Nichols Net & Twine
Rt. 3, Bend Road
E. St. Louis, IL 62201

McCrary's Farm Supply
114 Park St.
Loanoke, AR 72086

Memphis Net and Twine
2481 Matthews Ave., Box 8331
Memphis, TN 38108

Delta Net and Twine
619 E. Clay St., Box 356
Greenville, MS 38701

Poirot Farm Industry
Golden City, MO 64748

ROTENONE

Crescent Research Chemicals, Inc.
Dept. F.P.M., 5301 N. 37th Place
Paradise Valley, AZ 85253
602-945-4733

John B. Fitzpatrick, Fishery Management Service
214 E. North Street
Dwight, IL 60420
815-584-2524

McCrary's Farm Supply
Loanoke, AR 72086
1-800-643-8720

FISH FEEDERS

Sweeney Enterprises, Inc.
Rt. 2, Box 2452
Bourne, TX 78006

Will-O-the-Wisp, Hedlunds of Medford
Box 305
Medford, WI 54451

WATER TESTING MATERIALS

Abu-Garcia Inc., Electronics Division
3151 Oradell
Dallas, TX 75220

Hach Chemical Company
Box 883
Ames, IA 50010

AERATORS

Aquaculture Research/Envir. Assoc.
Box 1303
Homestead, FL 33030

Aquaerator/Aquatic Mgt. Inc.
6354 Low Road
Lisbon, OH 44432

Aquatic Control
Box 100
Seymour, IN 47274

Kembro, Inc.
Box 205
Mequon, WI 53092

Fresh Flo Corporation
Rt. 1
Cascade, WI 53011

Otterbine/Rodale Ind.
576 North St.
Emmaus, PA 18049

Peter A. Freeman Assoc.
Box 2210
Berlin, MD 21811

Pondmaster/Wadler Mfg. Co.
Rt. 2, Box 76
Galena, MS 66739

Schramm, Inc.
800 E. Virginia Ave.
W. Chester, PA 19380

Unfreezer Fabreth Ind. Inc.
2083 Main St., Box 396
Rye, CO 81069

## APPENDIX III

### Selected references

FEDERAL EXTENSION PUBLICATIONS:

Available from the Minnesota Agricultural Extension Service, Hodson Hall, 1980 Folwell Ave., St. Paul, MN 55108.

*Building a Pond.* Farmer's Bulletin 2256.
*Catfish Farming.* Farmer's Bulletin 2260.
*Trout Farming: Could Trout Farming Be Profitable For You?* Leaflet 552.
*Trout Ponds for Recreation.* Farmer's Bulletin 2249.
*Warm Water Fish Ponds.* Farmer's Bulletin 2250.

STATE EXTENSION PUBLICATIONS:

Several states have a series of pamphlets on fish farming and most are FREE. Write for complete lists.

**Colorado Extension Service,** CSU, Ft. Collins, CO 80521. Pond Culture of Bait Fishes. Flickinger. 50¢.

**Iowa Conservation Commission,** Wallace State Office Building, Des Moines, IA 50319. Iowa's Farm Ponds.

**Pennsylvania Coop Ext. Service,** Service, PSU, University Park, PA 16802. Fish Ponds, Construction and Management in Pennsylvania.

Circ. 216.

MAGAZINES AND PERIODICALS:

*Aquaculture Magazine,* Subscription Dept., Box 2451, Little Rock, AR 72203.

*The Catch.* Central Minn. Fish Farmers Assoc., Box 39, Waverly, MN 55390.

*Farm Pond Harvest.* Box AA, Momence, IL 60954.

*Trout Grower's Creel.* Wisconsin Trout Growers, Box 115, Lewis, WI 54851.

BOOKS AND MANUALS: (prices subject to change)

**General Aquaculture**

*Aquaculture: The Farming and Husbandry of Marine and Freshwater Organisms.* Bardach, Ryther and McLarney. 1973. Wiley. Interscience, Box 092, Somerset, NJ 08873. 868 pp.

*Fish Farming Handbook.* Brown and Gratzek. 1980. AVI Publishing, Westport, CT 06880. 392 pp.

*Freshwater Fish Pond Culture and Management.* Chakroff. 1976. VITA, 3706 Rhode Island Road, Mt. Rainier, MD 20822. 191 pp.

*Getting Food from Water.* Logsdon. 1978. Rodale Press, Emmaus, PA 18049. 371 pp.

*Management of Lakes and Ponds.* Bennett. 1979. Reinhold Publishing, New York, NY. 375 pp.

*Small Farm Water Management Project Technical Bulletin Series.* 1980. AMITY Foundation, Box 11048, Eugene, OR 97440. 5 pamphlets.

*Use of Farm Ponds for the Production of Food Fish for Home Use and Specialized Marketing.* Lewis. 1981. S. Ill. University, Carbondale, IL 62901. 30 pp. Free.

**Catfish/Trout Farming**

*Commercial Catfish Farming.* Lee. 1973. Interstate Printers and Publishers, Danville, IL. 263 pp.

*Trout Farming Handbook.* Sedgwick. 1978. Scholium International, Inc., 261 Great Neck Road, Great Neck, NY 11021. 170 pp.

*Trout and Salmon Culture: Hatchery Methods.* Lietritz. 1980. Ag. Sci. Publ., Univ. of California, 1422 Harbour Way S., Richmond, CA 94802.

**Water Quality and Weed Control**

*How to Identify and Control Water Weeds and Algae.* Applied Biochemists, Inc., Box 155, Mequon, WI 53092. 64 pp.

*Water Quality in Warmwater Fish Ponds.* Boyd. 1979. Ag. Exp. Station, Auburn University, Auburn, AL 36830. 359 pp.

**Fish Diseases**

*Parasites and Diseases of Warmwater Fishes.* Meyer and Hoffman. 1976. Fish Farming Experimental Station, Stuttgart, AR 72160. 20 pp. Free.

*Principle Diseases of Farm-Raised Catfish.* Plumb, ed. Alabama Ag. Exp. Sta., Auburn University, Auburn, AL 36830. 92 pp. Free.

*Textbook of Fish Diseases.* Amlacher. TFH Publications, Box 33, Jersey City, NJ 07303.

*Treatment Tips.* Meyer. 1968. U.S. Fish and Wildlife Service, Aylesworth Hall, CSU, Ft. Collins, CO 80523. 17 pp. Free.