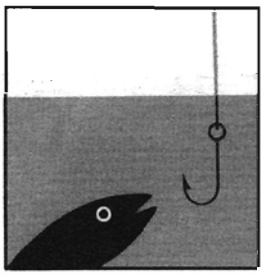

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FISH MANAGEMENT IN NEW YORK PONDS

A. W. Eipper, H. A. Regier,
and D. M. Green

Contents

Cornell Cooperative Extension

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FISH MANAGEMENT IN NEW YORK PONDS

A. W. Eipper, H. A. Regier,
and D. M. Green

There are more than 40,000 ponds in New York State and several hundred new ponds are constructed each year. Fishing is one of the most popular pond uses because it provides recreation for the whole family, and the fish caught are tasty and nutritious.

The purpose of this publication is to discuss:

- Facts to consider in deciding which fish species to stock.
- Design and construction features particularly important in fish ponds.
- Where and how to obtain fish for a pond.
- Growth, survival, reproduction, and yield that can be expected from a fish pond in New York.
- Management practices for obtaining satisfactory fishing from your pond.

Information presented here is based largely on results of 12 years' work on more than 150 ponds in central New York State. The recommendations given should apply to ponds across New York that have surface areas up to 2 acres and maximum depths of 7 to 15 feet.

Kind of Fish to Stock

Ponds can be used for trout if the water does not become too warm during summer months; otherwise, they should be stocked with fish that thrive in warmer water. The only warm-water species recommended at present are a combination of largemouth bass and golden shiners or a combination of bass and bluegill sunfish. This section discusses some of the factors that might influence the pond owner's choice between trout and warm-water species.

Water temperature

For trout, it is important that bottom water in the pond remains *cool;* for bass, shiners, and bluegills, it is important that *surface* water becomes *warm.*

Survival of trout in New York ponds is influenced more by maximum summer water temperature than by any other factor. Although pond trout can withstand water temperatures as high as 80°F for periods of one or two days, prolonged periods of water temperature above 74°F will cause trout to die. Whether a pond will be suitable for trout depends chiefly on how long the coolest water, near the pond bottom, remains above 74°F for any one period.

Bottom water temperature may differ from that of the surface by as much as 12 degrees (F) and so the temperature should be measured within a foot of the bottom to determine if it exceeds 74°F. Three procedures are suggested for measuring the bottom water temperature: 1) Suspend a maximum-minimum thermometer off the bottom; 2) Use an unframed glass thermometer (with degrees marked on stem[1]) suspended in a small can. Punch one pencil-size hole in the top of a soda can (do not open the pop top), empty and rinse the can and insert the thermometer; 3) Use any household thermometer that will work when submersed and suspend it in a one-pound coffee can using the plastic top to seal the can. If using procedure 2 or 3, punch three small holes in the top rim of the can and attach a wire bridle, as shown. Obtain a long, stout pole and attach enough heavy twine, as illustrated, so that the thermometer can be lowered to within a foot of the bottom.

Fill the can with water to make it sink. With the pole, hold the can out over the deepest part of the pond (usually about 16 ft out from the middle of the dike) and lower it to the bottom. Leave the can near the bottom for at least three hours to allow the water in it to reach the temperature of its surroundings. Then carefully raise the can to the surface, disturbing the water in it as little as possible. Bring the can to the shore and read the thermometer immediately, keeping the bulb well immersed in the can of water.

Taking a series of bottom water temperatures during the last two or three weeks of July will give you an idea of what to expect from your pond.

[1]Thermometers of this kind are stocked or can be ordered at hardware and photographic supply stores.

Figure 1. Temperature of the pond's deepest water can be accurately measured with thermometer suspended in an empty can. See directions in text.

Satisfactory growth and reproduction of warm-water species occur when the surface water of the pond becomes warm enough. For bass and shiners the temperature should be above 72°F and for bluegills 80°F for several weeks each summer. New York ponds probably never get too warm for these species. To determine a pond's suitability for warm-water species, the owner should measure surface temperatures periodically during the summer. This can be done by placing a thermometer in undisturbed water, 12 inches below the surface, but not touching the bottom. Read the thermometer, still immersed, after about five minutes.

New York ponds can be divided into three groups according to their summer water temperatures. *Cold-water ponds* are those whose surface temperatures seldom, if ever, rise above 72°F; trout should be stocked in all of these. *Cool-water ponds* are those whose bottom temperatures rise above 74°F for only short periods and whose surface temperatures exceed 72°F for periods of several weeks but only infrequently reach 80°F or above; trout or the bass-shiner combination will do well in these. *Warm-water ponds* are those whose surface temperatures remain above 80°F for considerable periods in summer; these should be stocked with the bass-shiner or bass-bluegill combination.

Source of water

If a pond has a permanent supply of spring water—that is, if there is some water running out of the pond at all times—and the pond has a maximum depth of at least 8 feet, then it is practically certain to support trout in almost any year. Many ponds fed entirely by runoff water from the surrounding watershed are excellent trout producers, although trout survival in these ponds may be poor in unusually hot summers. In ponds fed entirely by runoff water, chances of summer trout mortality are less in those located at higher elevations (generally above 1,200 feet), in those having a maximum depth of at least 10 feet, and in those ponds that receive some shade.

In a pond where bluegills are desired, springs will be a liability if they cool the water enough to retard or prevent their spawning.

Pond size

Although ponds as small as one-tenth acre (surface area) may be adequate for stocking trout, the chances are greater for creating a successful fishery if the pond is at least one-sixth acre. The bass-shiner combination will thrive in ponds of one-fourth acre and even one-sixth acre if the pond is deep enough (see page 6). Usually the bass-bluegill combination should be stocked only in ponds larger than one-half acre. This combination may succeed in a pond as small as one-third acre *if* the pond has all the recommended construction features *and* can be carefully managed.

Effect of water plants

Water plants become a problem in most ponds if they are not controlled periodically by mechanical or chemical means. The owner's choice of fish may be influenced by the amount of time and money he or she can spend on control. Information on the control of aquatic plants can be obtained by contacting your county Cornell Cooperative Extension office, by contacting your New York State Department of Environmental Conservation (DEC) regional fisheries office, and in the pamphlet by DEC entitled *Mechanical Control of Aquatic Weeds* (order from the DEC central office, see page 20).

In trout and in bass-shiner ponds, moderate amounts of plants (covering up to one-fourth of the pond's surface area) seem to increase fish production. However, most biologists recommend that a bass-bluegill pond be kept free of plants, and thus the bass-bluegill pond owner must usually practice more intensive control. If the pond is overflowing, a permit must be obtained for the use of any weed control chemical.

Kind of fishing provided

Trout, bass-shiner, and bass-bluegill ponds differ somewhat in the kind of fishing they provide. Because pond trout are usually hard to catch during the summer months, trout ponds offer most fishing during the fall, winter, and spring. Bass and bluegills provide most fishing during the spring and summer months.

Under New York conditions the total pounds of fish produced with the three types of stocking described here is similar.[2] Trout ponds can support average annual harvests of about 20 to 40 pounds per acre (depending on the number stocked), and bass-shiner ponds can provide bass harvests averaging about 25 pounds per acre per year. Bass-bluegill populations can support average harvests of about 15 pounds of bass and 35 pounds of bluegills per year.

Although trout and bass ponds are more commonly underfished than overfished, it is still possible to "fish out" trout and bass. Fishing quality usually deteriorates fairly rapidly in a pond that is subject to uncontrolled fishing.

Main drawbacks with each stocking method

Trout seldom reproduce in farm ponds, seldom survive beyond three or four years, and usually must be restocked every two years to maintain satisfactory fishing.

In bass-shiner ponds, shiners usually become extinct one to five years after stocking. Smaller bass then tend to become too numerous and stunted. If this occurs, some of the smaller bass (8-10 inches) must be harvested. The minimum length for harvesting bass in most waters in New York State is 12 inches. Owners of small ponds are required to obtain a fish-pond license to legally harvest bass under 12 inches (see page 17).

In bass-bluegill ponds, bluegills usually produce more young than the bass will eat. Bluegill growth rates then decrease. If too many of the smaller bluegills are present, fishing deteriorates; moreover the bass population may suffer from bluegill competition for food and space. Crowded bluegill populations need to be thinned by trapping or seining. A person can trap or seine fish only to obtain bait fish for personal use (see DEC fishing regulations) unless the pond owner has a fish-pond license that specifically states that these methods may be used. It may even be necessary to poison (permit required) or drain the pond and begin again. In northern states, bass-bluegill ponds usually require more management effort than most pond owners are willing to expend.

Which species should you stock?

If yours is a *cold-water pond,* stock trout.

If you have a *cool-water pond,* stock either trout or the bass-shiner combination. Remember that trout have to be restocked every two or three years. If you have a new pond and do not know whether to start off with trout or bass-shiners, it might be best to begin with trout; because pond trout are short-lived and almost never reproduce, it is easy to switch from trout to bass-shiners whenever you wish. On the other hand, once warm-water species are established in the pond, it is impossible to change over to trout without first killing off the entire warm-water population by draining or by using chemicals, either of which may present difficulties.

If you have a *warm-water pond,* stock either bass and shiners or bass and bluegills. The bass-shiner combination usually produces more bass fishing (but *only* bass fishing) and requires less management. Bass-bluegill ponds provide fishing for two species, but are usually more time-consuming to manage. In ponds smaller than one-half acre, bluegill numbers may be very difficult to control.

Pond Location and Construction Features

The importance of proper location, design, and construction of any pond cannot be overemphasized. Technical assistance on these matters can be obtained from the Natural Resources Conservation Service (NRCS, formerly known as Soil Conservation Service)–County Soil and Water Conservation District (SWCD). Every prospective pond owner should consult the county Cooperative Extension office, the NRCS, or the SWCD for specific information on the pond services available in the county and on the design and construction of ponds. Permits to construct ponds

[2]Detailed stocking recommendations are given in later sections.

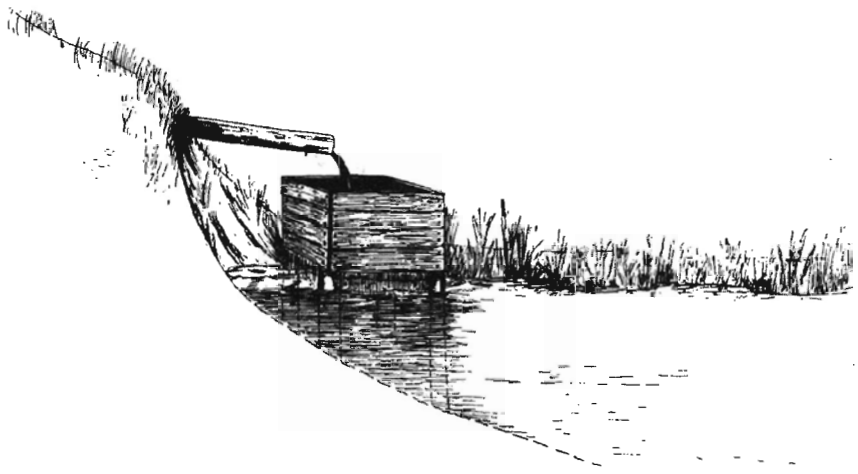

Figure 2. If a bypass water supply must be used, a box with screened bottom may keep out unwanted fish.

are required from the DEC under *any* of the following circumstances: 1) the height of the dike exceeds 15 feet, 2) the watershed draining into the pond exceeds 200 acres, 3) the pond is over 10 acres, 4) water is artificially diverted into the pond from a stream, 5) the pond is constructed in a state-regulated wetland, 6) the pond impounds more than 1.5 million gallons. Maps of lands designated as wetlands are available from each town office. A one-acre pond averaging 4.6 feet deep is 1.5 million gallons.

The following discussion is limited to those aspects of the location and construction of ponds of particular importance in fish management.

Location

For satisfactory fish production, the pond should be located where sufficient depth and the best possible water supply can be obtained.

A location near the house is essential if the pond is needed for fire protection. This location also lessens the chance that unauthorized persons will fish or stock the pond; either action can have adverse effects. Fish ponds should not be located where they will receive barnyard or septic tank drainage.

A pond to be used for fish production should not be located where it will receive silty runoff from land regularly cultivated. Such runoff interferes with production of fish food organisms and reduces fish production. As silt deposits build up, the pond gradually becomes too shallow.

Size, depth, and slope

If properly constructed and intensively managed, ponds as small as one-tenth acre are suitable for trout, ponds down to one-sixth acre are satisfactory for bass and shiners, and ponds of one-half (occasionally one-third) acre or larger can be used for bass and bluegills. Of course, the larger the pond, the more fish it will support and the more fishing it will provide.

Trout require cool and cold water, even in midsummer. The deeper the pond, the cooler its bottom water will remain. For trout, NE ponds with a year-round supply of spring water should have a maximum depth of at least 8 feet. Seven feet is occasionally enough when springs feeding the pond are exceptionally large. Runoff ponds should be 10 feet deep for trout, although somewhat shallower ponds will give good results in some years.

Bass and shiners thrive in cool or warm water, bluegills in warm water. Thus ponds fed by large springs will seldom be suitable for these species. When most of the pond's water comes from runoff, the water level and, consequently, the water depth tend to fluctuate. The water level is usually lowest in late summer. For satisfactory production of bass or bluegills or both, fluctuations in water level should not be severe, and the pond's maximum depth should never be less than about 7 feet. This means that maximum depth in late spring should be at least 8 feet for 25 percent of its surface area.

It follows that if a pond is to be used for irrigation, maximum depth after water withdrawals should be at least 7 or 8 feet.

All sides of the pond should have 2:1 to 3:1 slopes out to a point where the water is always at least 3 feet deep. This minimizes the area of shallow water where plants thrive and lessens plant problems considerably. In trout ponds shallow water is also undesirable because it warms up quickly during sunny weather and warms the whole pond when mixed with the deeper water by wind action.

Water supply

For one-acre ponds fed entirely by runoff water, a 5- to 40-acre watershed may be required, depending on location within the state and average depth of the pond. If there is some permanent supply of spring water, the watershed area can be reduced proportionately. If the watershed is too large, the excess water flushing through the pond interferes with the fish's food chain by carrying out nutrients and plankton. Large outflows may also permit the fish to leave the pond and may endanger the dike. Unneeded runoff water can be kept out of the pond by constructing a diversion ditch.

Whenever possible, water bypassed from an adjacent stream should not be used to supply a farm pond used for fish production. Practically all streams contain undesirable fish of various kinds, and some of these eventually find their way into most bypass ponds. Streams frequently carry heavy silt loads, especially after heavy rains. In many cases the stream water becomes too warm for trout.

If it is essential to use bypass water for a fish pond, contamination by unwanted fish can be prevented or minimized if the water enters the pond through a pipe whose outlet is at least 2½ feet above the maximum pond level (fig. 2). The water falls into a box about 2 feet square, or larger if large amounts of water enter the pond. The sides can be wood or sheet metal and are about 16 inches high. The top of this box is open, but the bottom consists of plastic window screening (about 15 meshes to the inch), or Saran® monofilament screen thoroughly reinforced from below by wooden or metal slats. The box is mounted securely on four legs; water from the inflow pipe falls directly onto the screening. The screen should be at least 6 inches above maximum water level. The construction must be sturdy, and all parts should be protected against rust and rot. A long sock-like bag of Saran® screen clamped over the inlet pipe can also be used to prevent entry of unwanted fish and fish eggs (see your county NRCS for information on Saran® screens). Experience will determine how often the screened box or "sock" must be cleaned of debris. This will vary with the season.

Use pipe to lead spring water from the place where it first appears above ground into a trout pond. This method can keep the inflowing spring water as much as 15 degrees (F) cooler than if it were allowed to trickle into the pond above ground. The pipe need not be buried much below ground level, but should be 2 feet deep if it will be driven over.

Water control structures

A combination trickle tube and drain pipe is particularly desirable in any pond to be managed for fish production. Although this structure is expensive, fish are less likely to escape through it than over a spillway. If only a spillway is used, it should be as wide and level as possible to spread the outflowing water in a thin sheet. A small wooden dam 2 to 4 inches high across the spillway tends to prevent escapes. If a screen is used for this purpose, it should not be more than 4 inches high because it soon becomes clogged and merely acts as a dam.

A drain pipe is an important asset in any fish pond. If the pond develops leaks, it can be drained and repaired. If undesirable fish enter the pond, it is often easiest to remove them by draining. If bluegills become seriously overcrowded, or if partial winterkill occurs in bass-bluegill ponds, it may be best to drain the pond and begin again. The ability to drain the pond may also be useful for weed control.

Fencing

Livestock should not have access to a farm pond used for fish production. Their trampling and wading activities endanger the dike, add organics and nutrients, keep the water turbid, and reduce the production of fish food organisms. Livestock can be watered through the use of a siphon device below the dike, or watering facilities can be built in during pond construction.

Stocking Regulations and Sources of Fish

Before fish can be stocked or restocked in any pond or other water, permission to do so must be obtained from the State Department of Environmental Conservation through the regional fish manager.[3] The procedure is simple, and there is no charge for the permit.

Fish for stocking privately owned ponds must be obtained from commercial hatcheries. Your local NRCS-SWCD office or the regional fish manager for your area can provide a list of commercial hatcheries in New York and neighboring states. A list of these hatcheries is also available from the New York State Department of Environmental Conservation, Bureau of Fisheries, 50 Wolf Road, Albany, New York 12233. Hatcheries operated by the New York State Department of Environmental Conservation do not supply fish for privately owned fish ponds.

In some counties the Soil and Water Conservation District has coordinated a group purchase of fish from reliable suppliers. Check with your local SWCD office to see if such a program is available in your area. The major advantage of a group purchase is a reduction in shipping costs and, possibly, a large quantity discount in price.

[3] A directory of regional offices in New York State is given on page 20 of this bulletin.

Biology and Management of Trout Ponds

Kinds of trout

Brook trout (fig. 3) or rainbow trout (fig. 4) are equally suitable for New York ponds. Many people consider the brook trout to be better eating. Although neither species is difficult to catch in the cooler months of the year, it is easier to "fish out" a brook trout population. On the other hand, rainbows are generally considered to be more spectacular fighters. A mixture of these two kinds of trout can be stocked in a pond to provide greater variety of fishing. If both kinds of trout are stocked, they should be roughly the same size so that one group will not prey heavily on the other.

Brown trout (fig. 5) *are generally unsatisfactory in New York ponds* because they are more difficult to catch than either brook or rainbow trout. Thus browns provide poor to mediocre fishing and a low yield on the investment. Also, the old brown trout remaining in a pond prey heavily on the fingerlings introduced for restocking.

Trout are unable to compete successfully with most other fish in a pond because these other fish multiply rapidly and monopolize the food. Fish species other than trout will ruin the pond for trout production until the entire fish population is killed off and a new trout population established. There are a few kinds of small, nonprolific minnows that might not interfere with trout production; however, it is very difficult to obtain these "harmless" minnows without getting some harmful ones as well. For these reasons, no minnows or other fish of any kind should be stocked. Pond trout thrive on an insect-rich, fish-free diet.

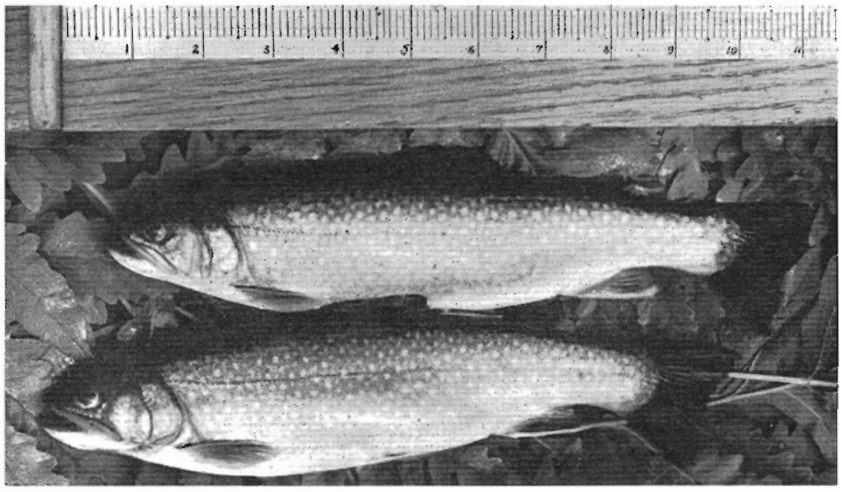

Figure 3. Brook trout.

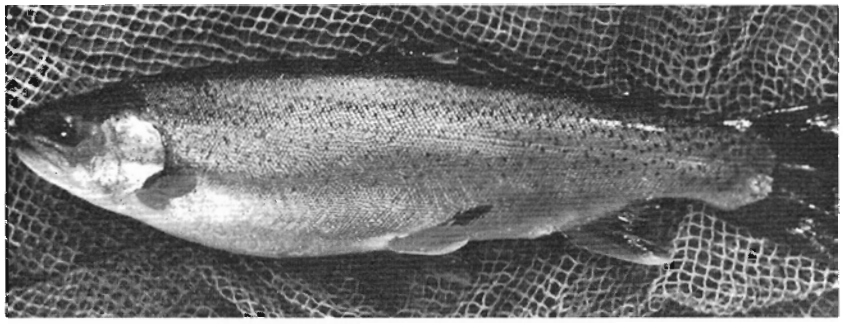

Figure 4. Rainbow trout.

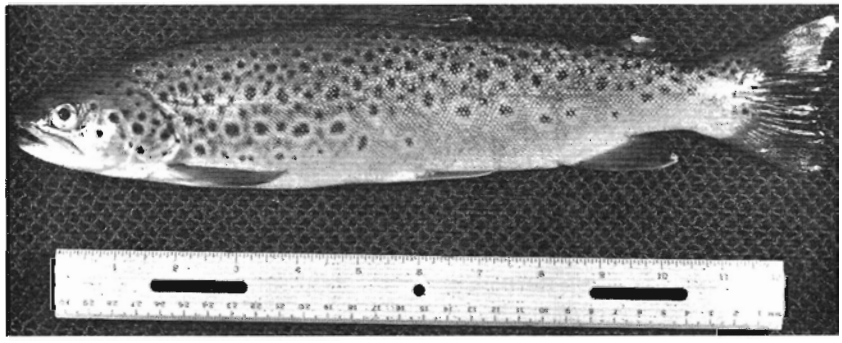

Figure 5. Brown trout.

Stocking recommendations

Either spring fingerlings (2 to 3 inches long, 2 or 3 months old) or fall fingerlings (5 to 6 inches long, 7 or 8 months old) can be used in stocking ponds with trout. Both types reach catchable size about the same time, that is, in the spring following stocking. However, results with spring fingerlings are much more variable and unpredictable than with fall fingerlings, except in ponds containing no fish and fed by strong, permanent springs.

When trout are obtained from commercial hatcheries in the East, spring fingerlings usually sell for about $40 to $65 per hundred, and fall fingerlings for about $70 to $100 per hundred, FOB. At these prices, fall fingerlings usually provide considerably more catchable size trout per dollar invested than will spring

fingerlings. It is very uneconomical to purchase trout larger than about 6 inches for pond stocking.

Thus, it is usually best to use fall fingerlings for trout stocking in New York ponds.

Trout should never be stocked during the warm season. Spring fingerlings, if stocked, should be planted no later than May 1; fall fingerlings should be planted after September 30.

In most New York ponds, 600 fall fingerlings (or 2,000 spring fingerlings) per acre of pond surface should be stocked to produce the maximum yield of fish consistent with satisfactory growth. Some ponds that are ideal for trout can be stocked at rates of 700 fall fingerlings per acre. Occasionally trout in ponds located on exceptionally low-lime soils at high elevations (above 1,200 feet) will show satisfactory growth only when stocked at 400 fall fingerlings per acre. Very low fertility waters in the Adirondacks and Catskills may show satisfactory growth only when stocked at 100 or fewer fall fingerlings per acre.

When the pond owner obtains stock, he or she should take special precautions that the trout will enter the pond in good condition. The hatchery person may advise the owner concerning number and size of containers to bring along. Thoroughly clean plastic garbage cans with covers can be used to transport trout (100 fall fingerlings per 30-gal can), although larger tanks, with covers, are often more satisfactory. Large, heavy duty garbage or leaf bags (double bagged) in a supporting container (e.g., box) may also be used.

Trout should be transported only in the cool or cold weather of spring or fall. If there is danger that the tank's water temperature will rise above 55°F during transit, then ice should be packed around the tank. If ice is to be placed in the water used for carrying fish, it is absolutely essential to use ice made from nonchlorinated water since very minute quantities of chlorine will kill fish. If the fish are to be transported considerable distances, then the water should receive oxygen. Oxygen-producing tablets (2 tablets per 5 gallons of water) can be used and are available in sport and bait shops.

When stocking trout, place the can or bucket in the pond and tip it gently on its side so that the fish can swim out. Do not plant them near the overflow structure. If the temperature of the water in the pond differs from the temperature of water in the transport tank by more than 5 degrees (F) the fish should be "tempered" gradually to the pond temperature over a period of 1 to 2 hours. Tempering can be done by adding pond water slowly to the transport tank. Be sure to obtain a state permit before transporting or stocking fish.

Growth

Brook and rainbow trout grow at about the same rate in New York ponds. Average lengths and weights in spring and fall for three years after stocking are given in table 1. In a pond stocked with either 2,000 spring fingerlings or 600 fall fingerlings per surface acre, the trout generally average about 8 inches long by the following spring. Growth rate generally decreases as the fish grow older and is usually somewhat faster in summer than in winter.

Growth rates vary considerably from one pond to the next. Trout probably grow a little more slowly in the first few months after a pond has filled, before it has built up a large supply of aquatic insect life, the trout's principal food. Also trout tend to grow more slowly in soft (acid) water than in hard (alkaline) water.

Survival

Survival of pond trout tends to fluctuate with annual variations in average summer temperature. In the first year after stocking, survival also varies with the size of fingerlings stocked. During the summer following stocking as spring fingerlings, the survival is highly variable, averaging only about 30 percent. In the two succeeding summers, average survival is about 50 percent. Overwinter survival of trout in each year of pond life is commonly 60 and 80 percent.

The dotted line in figure 6 shows the average number of brook or rainbow trout remaining in an unfished pond during the three years following stocking at a rate of 600 fall fingerlings (or 2,000 spring fingerlings) per acre. If lower stocking rates are used, the number of survivors at any time will be proportionately less.

From the graph it is clear that few trout remain after three years in a pond, and four-year-olds are a rarity, as is also the case in most other trout waters of the state. Fish mortality from natural causes is normally a gradual process and takes place more or less continuously, even though the dead fish are very seldom seen.

Reproduction

Because most ponds lack a suitable spawning site, pond trout rarely reproduce, although they may go through the act of spawning. A suitable spawning site for trout consists of a gravel area through which a good flow of water percolates during the incubation period, supplying the eggs in the gravel with fresh, oxygen-rich water and keeping them from being smothered by silt de-

Table 1. Average lengths and weights of pond trout in the first three years following stocking.

	First year		Second year		Third year	
	Spring	Fall	Spring	Fall	Spring	Fall
Length, inches	8.1	10.1	11.1	12.8	13.5	14.2
Weight, ounces	4	8	10	14	17	22

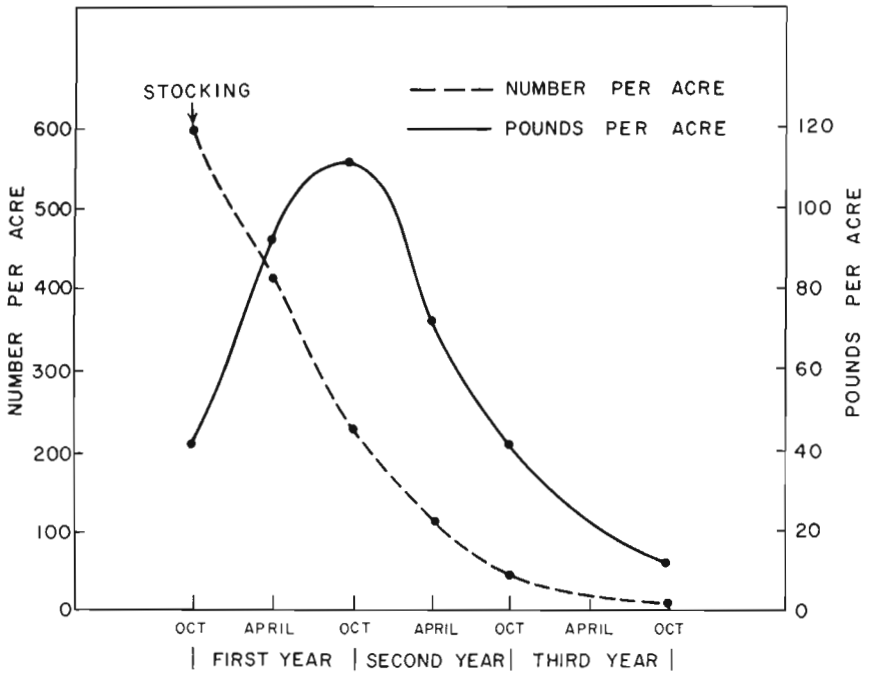

Figure 6. Numbers and pounds of trout remaining in an unfished pond after stocking with 600 fall fingerlings per acre.

Table 2. Relation between number of trout per acre harvested in the first year and number per acre that could be harvested in the second year after stocking. Average figures for ponds stocked at rates of 300 and 600 fall fingerlings per acre.

Number of trout per acre		
Harvested in first year	Available for harvest in second year	
	When stocking rate was:	
	300/acre	600/acre
0	35	70
50	25	60
100	15	50
150	5	40
200	–	30
250	–	20
300	–	10

posits. In a very few ponds having exceptionally large and concentrated springs, limited trout reproduction has occurred naturally at times or has been achieved by placing beds of gravel in suitable locations. To date, no method has been found for achieving adequate natural reproduction in the average spring-fed pond without resorting to modifications and additional construction.

Trout production

The total poundage of trout present in a pond at any time following stocking is the net result of two opposing trends: growth, which increases poundage; and deaths, which reduce it. When the growth rate exceeds the death rate, there is a net increase in total poundage, and vice versa. The continuous line in figure 6 shows the total pounds of trout present in an average unfished New York pond during the three years following stocking with 600 fall (or 2,000 spring) fingerlings. Under these conditions, total poundage reaches a maximum, averaging about 110 pounds per acre by fall of the first year following stocking, when about 230 trout (dotted line, same graph) remain. One year later only 41 pounds (45 trout) are left.

Fishing trout ponds

Figure 6 shows that usually over 90 percent of the stocked trout in an unfished pond will have died from natural causes two years after stocking. For maximum yield, a pond owner should therefore harvest as many trout as possible in the two years after stocking.

The longer an owner waits before starting to harvest the trout, the lower the harvest will be. Consider the example of a Mr. Dow and a Mr. Jones, who start out with identical one-acre ponds, each stocked with 600 fall fingerlings. Natural deaths occur at the same rate in both ponds. In the first year after stocking, Mr. Dow harvests 165 trout, but Mr. Jones does no fishing in order to let

his fish get larger. The second year both men fish equally hard and catch equal percentages of their remaining trout populations. The number of fish caught and remaining in each pond would be:

	Mr. Dow		Mr. Jones	
	Caught	Left	Caught	Left
First year after stocking	165	115	0	230
Second year after stocking	35	5	70	10
Total Catch	200 (75 lb)		70 (50 lb)	

Although Mr. Jones caught twice as many two-year-old fish as Mr. Dow, Dow's total catch for the two years was nearly three times as great in numbers and about 50 percent more by weight. Furthermore, the difference between the numbers of fish left in the two ponds at the end of the second year was insignificant.

Large two-year-old trout remaining in the pond at restocking usually eat some of the newly introduced fingerlings. To minimize this predation, trout should be fished heavily during the second year following stocking.

The proportions of trout to be harvested in the first and second years after stocking are largely matters of individual preference. Table 2 gives the number of trout most likely to be available for harvest in the second year when some particular number was harvested in the first year. This information is given for *one-acre* ponds stocked with either 300 or 600 fall fingerlings. If yours is a one-quarter-acre pond, you would divide all the numbers in the body of the table by 4 and make proportionate adjustments for ponds of other sizes. Remember that these figures are based on *average* trout survival. In any particular pond, the number of fish available for harvest in the second year is likely to differ from that in the table.

Pond trout are generally much easier to catch in spring and fall than in summer, and it is unwise to count on harvesting large numbers of them between late June and early September. The most successful method of fishing may vary with the season and with the individual fisher's skills. Fly fishing, worm fishing, and spinning are all effective.

New York ponds also afford opportunities for winter ice fishing, with either worms or weighted artificial lures. The latter may give best results when moved up and down in short jerks, a foot or two above the bottom. Instructions can be found in *Let's Go Ice Fishing,* 4-H Leader's Guide L-5-15, and *Let's Go Fishing–A Fish and Fishing Project,* 4-H Leader's Guide L-5-6 (see page 2 to order). Out-of-season fishing for any species can be done only by the holder of a fish-pond license, members of the immediate family, and employees (see page 17).

Minnows should never be used for bait when fishing trout from ponds. If they escape and later reproduce in the pond, they will usually ruin it for trout production.

Restocking trout

From what has already been said about trout survival in ponds, it is clear that a pond should be restocked every other year to maintain adequate fishing.

Fall fingerlings are recommended for restocking. They are much less likely to be eaten by the large "holdover" trout of the previous planting than are the small spring fingerlings.

The pond can be restocked either with 600 fingerlings per acre every two years or with 300 per acre each year. The latter management plan maintains a more even mixture of one- and two-year-old trout. In very low productivity ponds in the Adirondacks and Catskills, highest stocking rates should be no more than 100 fingerlings per acre every two years or 50 per acre each year.

Feeding

At the stocking rates recommended, trout grow rapidly on just the natural food produced in the pond. Although supplemental feeding may increase the growth rate an inch or two per year, it is rather expensive.

Some pond owners may wish to feed their trout, either as a hobby or to maintain much larger trout populations than the 600 per acre recommended. This would be a way to increase the fishing potential, especially in a small pond. Pelleted trout food is available through farm supply stores. Trout usually form the habit of surfacing for pellets that are tossed on the same area of the pond each day. Add only as much food as will be eaten immediately. The use of floating pellets will enable the pond owner to determine when the trout stop feeding. Decomposing food may foul the water and suffocate the trout (see fish kills, page 18). Feeding should probably be done only in ponds having some year-round spring water supply and should not be continued after September 1.

Fertilizing trout ponds

A single application of inorganic fertilizer at the rate of about 300 pounds of 10-10-10 per acre can be applied to a newly dug pond as it is starting to fill. This is not a necessity but tends to hasten the establishment of a natural food supply. More fertilization than this endangers the trout.

Fertilization of New York trout ponds after an initial application following construction may lead to more problems than benefits. Fertilization will stimulate plant growth, and excessive weed growths can restrict fishing and other recreational activities. Decomposition of plants under the ice can deplete the supply of oxygen and result in a winterkill of fish.

Biology and Management of Bass-Shiner Ponds

The bass-shiner combination is recommended for *cool-water* and *warm-water* ponds whose owners desire sport fishing for bass. This combination will likely prove satisfactory in ponds in one-sixth acre or larger where plants are present but not abundant.

Kinds of bass and shiners

In this bulletin "bass and shiners" refers to a combination of largemouth bass (fig. 7) and golden shiners (fig. 8). Largemouth bass are recommended on the basis of their proven ability to grow and reproduce in typical New York cool-water and warm-water ponds. Smallmouth bass might be equally successful and desirable in New York ponds, but this is not yet known.

The golden shiner is one of a number of minnows occurring naturally in New York. It prefers quiet waters with plants on which to deposit eggs and is quite prolific. Many anglers consider it to be the best bait fish of our native minnows. Golden shiners are not always readily available and fathead minnows may be an adequate substitute. Fathead minnows are smaller than golden shiners and therefore may be eliminated by bass sooner than golden shiners. If fathead minnows are substituted for golden shiners, they may have to be stocked more frequently.

Stocking recommendations

Suitable ponds should be stocked with 100 bass fingerlings (1 to 2 inches long) and about 400 golden shiner adults (2½ to 4 inches long) per surface acre. Golden shiner adults are commonly available from bait dealers for $10 to $50 per hundred. Shiners should be stocked in April or May. Bass prices are given on page 14. In most New York ponds smaller than one acre, bass predation usually eliminates the golden shiners in one to five years. Bass populations usually will continue indefinitely without any other fish species present. They will reproduce in normal years and show moderate growth to maximum lengths of 15 or 16 inches.

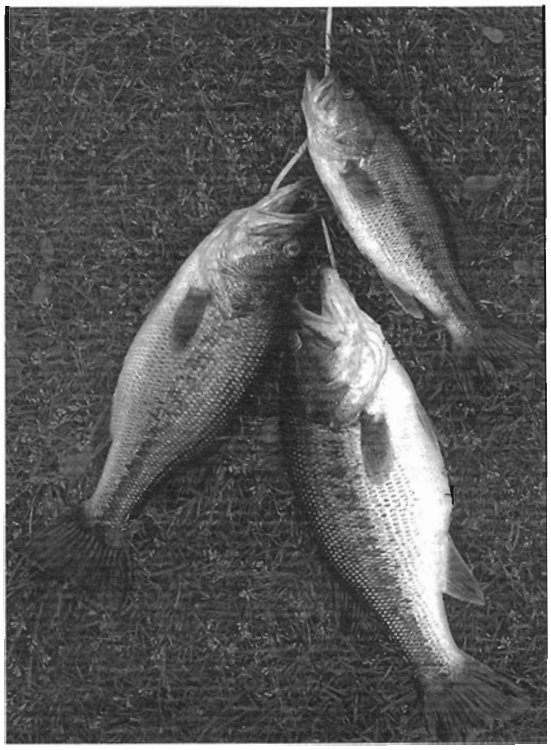

Figure 7. Largemouth bass

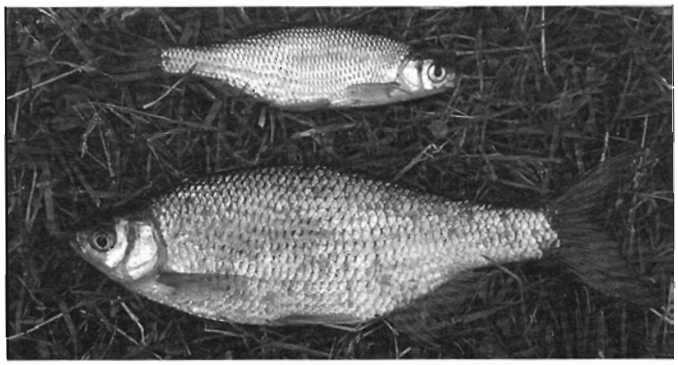

Figure 8. Golden shiner.

Growth

Growth rates vary considerably from pond to pond. Table 3 contains data on average size attained by bass in some experimental New York bass-shiner ponds. Shiners did not grow to a very large size in these ponds; the largest one found was 8.2 inches long. A 16-inch largemouth bass can swallow an 8-inch golden shiner.

Survival

As with growth, survival rates vary considerably from one pond to another and from year to year. In *unfished* experimental bass-shiner ponds, the number of original bass declined from 100 per acre at stocking to an average of about 60 per acre five years later (broken line, fig. 9).

In bass-shiner ponds, shiner populations usually reach a peak about two years after stocking and then diminish, probably because of bass predation. In some of the experimental ponds where this combination has been tested, shiners

Table 3. Average lengths and weights of bass, in experimental bass-shiner ponds at midsummer during years following stocking.

	Year after stocking				
	First	Second	Third	Fourth	Fifth
Length, inches	8.3	11.1	13.1	14.2	15.4
Weight, ounces	5	12	18	22	25

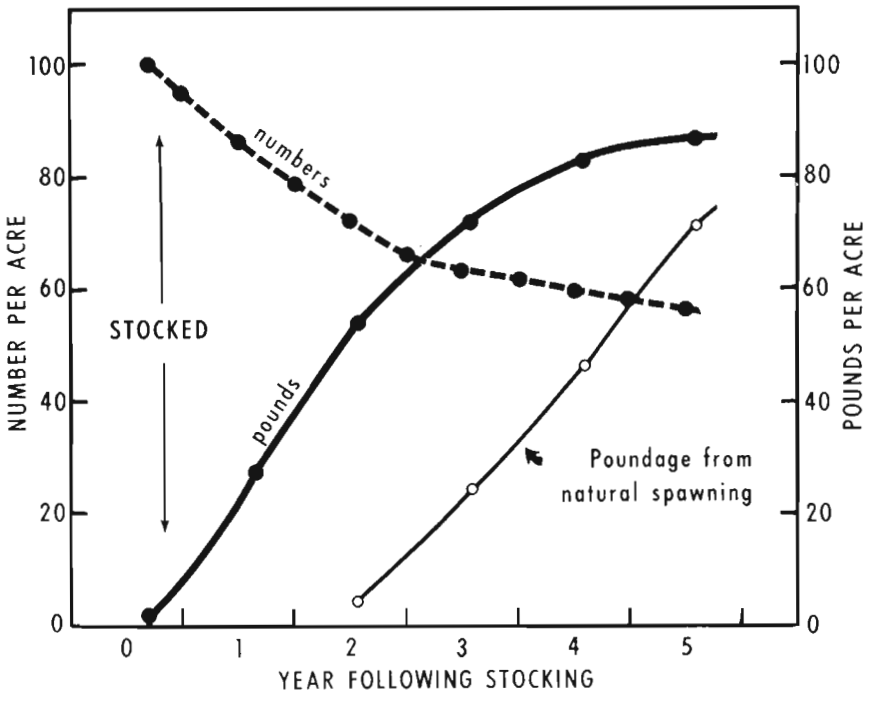

Figure 9. Average total numbers and pounds of largemouth bass in experimental bass-shiner ponds. **Heavy lines:** *stocked bass remaining in an unfished pond.* **Thin line:** *poundage of naturally produced bass in ponds where stocked bass were fished moderately hard.*

have become extinct four years after stocking; in others they have survived for six or seven years. However, bass have continued to thrive in all the tested ponds, even those where shiners have been absent for three years.

Reproduction

Usually bass first reproduce as two-year-olds in New York ponds, but occasionally may not reproduce until they are three or four years old. Once bass have reproduced, they usually spawn successfully in each succeeding year, shiners being present or not.

Shiners reproduce the year following stocking and each year thereafter so long as adults are present. Eggs are laid on aquatic vegetation; in ponds with sparse vegetation, reproduction may be enhanced by placing hay in shallow water.

Bass production

Total poundage of original bass in unfished experimental ponds increased to an average of 85 pounds per acre five years after stocking (heavy solid line, fig. 9). The thin line of figure 9 shows how the average poundage of young bass, spawned in the pond, increased when the originally stocked bass were subjected to moderate fishing pressure.

Fishing bass-shiner ponds

Bass should not be fished until they have reproduced successfully, usually not until two years after stocking. Thereafter, they can be fished intensively, *but for the next two to three years only a limited number of bass should be removed at any one time.* It is quite possible to remove most of the large original bass in a quarter-acre pond in an evening's fishing; if this is done, fishing will be poor for at least a year or two.

Experiments have shown that, on the average, bass spawned in New York bass-shiner ponds reach a 10-inch size when three years old. Since no bass are spawned in the pond until two years after stocking, it follows that the original stock of bass must provide all the bass fishing for at least the first four years after stocking. Knowing the average mortality rate of bass in bass-shiner ponds, it can be determined that the average bass-shiner pond should support harvests of about 22 bass per acre per year from the second through the fourth summer after stocking. Thereafter the bass spawned in the pond should be fished at about this same rate.

Fertilizing bass-shiner ponds

Bass-shiner ponds do not require intensive fertilization. To hasten the development of a natural food supply, a newly constructed pond might be fertilized at the rate of about 400 pounds of 10-10-10 fertilizer per acre for the first year or two. Fertilizer need not be broadcast-applied to the pond; simply cut a large rectangular "window" in one side of the bag and carefully lower it, window up, into 18 inches of water in the windward corner of the pond.

Biology and Management of Bass-Bluegill Ponds

The bass-bluegill combination can be used in warm-water ponds larger than one-half acre. Bass-bluegill ponds also must be deep enough throughout to make plant control practical, and owners must harvest at least 165 bluegills per acre per year (see page 15). Occasionally, bass-bluegill combinations will be successful in ponds as small as one-third acre.

Kinds of bass and sunfish

Largemouth bass has been the species most generally used with sunfish in ponds. The suitability of the smallmouth bass for this purpose is not known. Of the sunfishes in New York the bluegill is the most suitable for pond stocking. Other sunfish either grow more slowly, have a smaller maximum size, or overpopulate ponds more rapidly than bluegills. No sunfish other than bluegills should be stocked, except possibly the redear (see page 17).

Bass-bluegill stocking recommendations

Government agencies have recommended 100 bass fingerlings (1 to 2 inches long) and 1,000 bluegill fingerlings (about 1 inch long) per acre, both to be stocked during the same summer. At present there is no strong evidence that these stocking rates should be changed or that the time of stocking should be altered. Waiting to stock bluegill until the year after bass are stocked may increase the chance that bass will be able to control excess abundance of bluegill. At commercial hatcheries in New York State, 2- to 3-inch bass fingerlings cost $50 to $100 per hundred, and 1- to 2-inch bluegills are available for $35 to $65 per hundred, FOB. Few New York hatcheries are producing bluegills and it may be necessary to obtain them from out of state.

Growth

Table 4 contains data on average size attained by bass and bluegills in experimental bass-bluegill ponds. Bass growth is usually a little slower in these ponds than in bass-shiner ponds.

Survival

The broken lines in figures 10 and 11 show the average numbers of bass and bluegills, respectively, remaining in *unfished* experimental bass-bluegill ponds during the years following stocking. For both bass and bluegills, survival differs markedly from one pond to the next, even among ponds that seem very similar physically and biologically.

Table 4. Average lengths and weights of bass and bluegills in experimental bass-shiner ponds at midsummer during years following stocking.

	Year after stocking				
	First	Second	Third	Fourth	Fifth
Bass					
Length, inches	8.3	10.1	12.0	13.6	14.8
Weight, ounces	5	10	15	20	24
Bluegills					
Length, inches	5.0	6.4	7.4	7.8	8.2
Weight, ounces	2	4	6	7	8

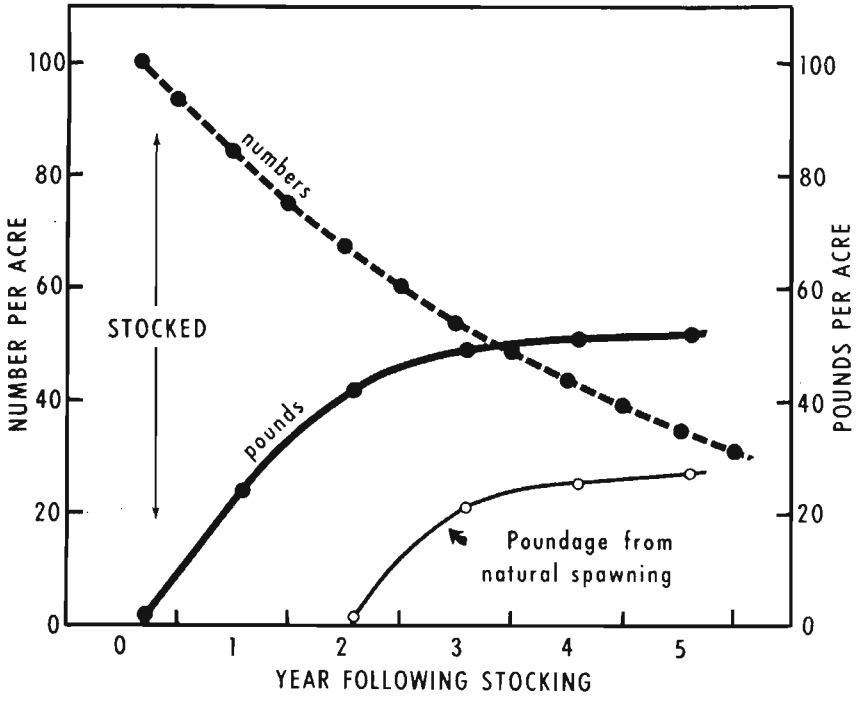

Figure 10. Average total numbers and pounds of largemouth bass in experimental bass-bluegill ponds. **Heavy lines:** *stocked bass remaining in an unfinished pond.* **Thin line:** *poundage of naturally produced bass in ponds where stocked bass were fished moderately hard.*

Reproduction

In bass-bluegill ponds, bass generally first reproduce as two-year-olds and fairly regularly thereafter. Bluegills usually first reproduce as yearlings, and regularly thereafter. In New York ponds bass spawn once, in late spring or early summer in shallow water when water temperature is 60°–75°F. Bluegills may spawn more than once during the summer, depending on water temperatures. Bluegill reproduction is frequently so successful that bass cannot keep them under control; this leads to overpopulation and stunting of bluegills.

Bass and bluegill production

The heavy continuous lines in figures 10 and 11 show standing crops, in pounds per acre, of original bass and bluegills, respectively, in average unfished experimental bass-bluegill ponds. The thin lines show how populations of bass and bluegills, spawned in the average pond, increased when original stocks were subjected to moderate fishing pressure.

Fishing bass-bluegill ponds

Essentially the same considerations apply to bass fishing in bass-bluegill ponds as were stated for bass-shiner ponds (page 13). The bass harvests from bass-bluegill ponds will likely average less than bass harvests from bass-shiner ponds. The two reasons for this are that apparently bass survival is usually lower in bass-bluegill ponds, and that it takes four years for bass spawned in the average bass-bluegill pond to reach 10 inches but only three years to do this in most bass-shiner ponds. Thus the average bass-bluegill pond can support annual harvests of only about 11 bass per acre (*only 3–4 bass for a one-third acre pond!*) from the second through fifth year after stocking. Perhaps bass fishing might improve somewhat after five years, but reliable information on this is lacking.

Because bluegills usually first spawn as yearlings, and their young reach a size of about 6½ inches when three years old, the original bluegill stock must provide all bluegill fishing for the first three years following stocking. In the average, well-managed bass-bluegill pond, about 165 bluegills per acre can and should be removed annually during the first three years following stocking. If the pond owner prefers to wait until the original bluegills are two years old and therefore larger, then she or he should harvest about 215 bluegills per acre during each of the second and third years following stocking. If the pond does not become crowded with small bluegills, fishing should continue at about this level. In terms of weight, average bass-bluegill populations can support annual harvests of about 15 pounds of bass and 35 pounds of bluegills per acre.

Two important points follow from these findings. The first is that *New York bass-bluegill ponds will not support unlimited catches.* The second point is that after the second year *about 15 times as many bluegills as bass can and should be harvested.* On a weight basis this is about 2 to 3 pounds of bluegills for every pound of bass removed. It is important that some adult bass remain in the pond to control bluegill numbers.

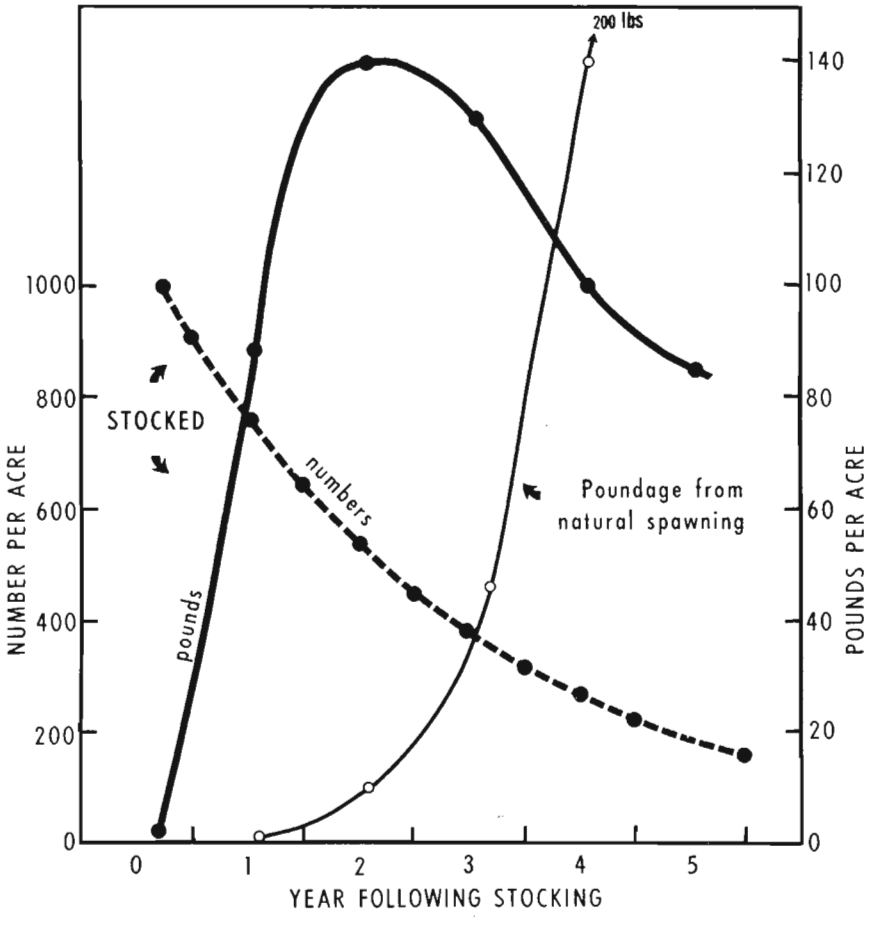

Figure 11. Average total numbers and pounds of bluegills in experimental bass-bluegill ponds. **Heavy lines:** *stocked bluegills remaining in an unfinished pond.* **Thin line:** *poundage of naturally produced bluegills in ponds where stocked bluegills were fished moderately hard.*

If bluegills become crowded, as they frequently do, large numbers of them should be removed either by angling, with seines, or with traps. Figure 12 shows a chicken-wire trap that is easy to build and operate. Several such traps should be used, with the number depending on pond size and the speed with which a bluegill reduction is desired. The traps should be fished for at least two weeks during June, July, or August and emptied daily. Baiting them with cottage cheese suspended in a cloth mesh bag may increase the catch. Bass usually do not enter the traps. A fish-pond license is required to capture fish by methods other than angling.

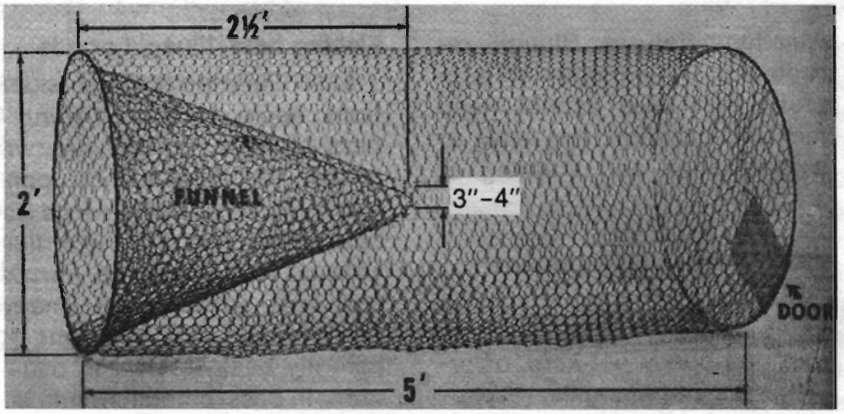

Figure 12. Trap for harvesting bluegills. Made from chicken wire of one-inch mesh. Door is for removing fish.

Fertilizing bass-bluegill ponds

Heavy fertilization is generally recommended for bass-bluegill ponds in southern states. One purpose of such fertilization is to produce dense plankton blooms which serve to shade out plants and prevent their growth. Another purpose is to increase production of bluegills and possibly bass.

In New York ponds, fertilization does not always result in plankton blooms, and the fertilizer then merely serves to increase plant growth. Also, the large amounts of organic matter formed may use up all the oxygen in the pond while decomposing in winter and thus suffocate the fish. For these reasons heavy fertilization is not recommended for most New York ponds. An initial application of fertilizer following the completion of a pond may hasten the development of a natural food supply (see page 13).

Largemouth or smallmouth bass alone

It was found that experimental largemouth bass-golden shiner ponds tend to become bass-only ponds because the shiners often become extinct. But bass continue to thrive after shiners are no longer present. Bass-only ponds, containing either largemouths or smallmouths, might provide enough fishing for many New York pond owners. Whether bass-only ponds would provide as much fishing as bass-shiner ponds during the first two to four years is not known. A suggested trial stocking is 150 bass fingerlings per acre.

Managing your bass pond by fishing

The most common problem occurring in small largemouth bass ponds is the crowding of 7- to 11-inch bass, a condition that may occur in as little as four to five years after the pond is first stocked. If this occurs, a good proportion of the smaller bass should be caught and removed to give those remaining a chance to grow. (A fish-pond license is required to remove bass under 12 inches.) If the bass that are larger than 12 inches are returned to the pond, they will help thin out the population of smaller ones; a 15-inch bass can swallow an 8-inch bass.

Harvesting the smaller bass and returning the larger ones will maximize both the sport and the total catch from your pond.

Keeping a log of your fishing and catch is the best way to determine if small bass are crowding your pond. Record the length of each bass you catch (don't guess; measure the fish from the tip of the mouth to the tip of the tail) and the amount of time you spend fishing. If more than 25 to 35 percent of your catch consists of bass in the 7- to under 12-inch size range and you are catching more than three to four bass per hour, your pond is probably becoming crowded with small bass. It is time to start removing the small bass.

Sometimes you have to remove many bass before you see results. In an attempt to increase the size of the bass in a 1-acre western New York pond, two anglers removed 537 largemouth bass that were 7 to under 12 inches while releasing all bass 12 inches and larger during two and a half years of fishing. When they began removing fish, only 10 percent were larger than 12 inches, 7 percent were larger than 15 inches, and 4 percent were larger than 20 inches. When they completed removal, 80 percent were larger than 12 inches, 26 percent were larger than 15 inches, and 14 percent were larger than 20 inches. Their catch rate of bass 12 inches and larger increased from 0.17/hour the first year to 0.90/hour the third year to 2.37/hour the fourth year.

If you have a bass-bluegill pond and you wish to catch mainly large bluegills, it is best to allow the bass population to become crowded. Of course, most of the bass you catch will be small, but the bass will help prevent crowding of the bluegills and allow the bluegills to grow to a large size. It also may be necessary for you to remove some additional bluegills of small and intermediate size to encourage fast growth of the remaining bluegills.

Biology and Management of Other Species

What are the alternatives to the given stocking and management recommendations? Can other species be added to the given combinations? These and similar questions are often asked; some suggestions follow.

Channel catfish

This species has been tested in some New York ponds. Survival immediately following stocking was very low in most ponds. Where survival was good, catfish attained quite large sizes (up to 12 pounds) as they reached ages of eight and nine years. Reproduction was spotty; in one pond it first occurred when fish of the original stock were three years old, in another when stock was eight years old, and in another no reproduction occurred during the first nine years. Channel catfish may be difficult to obtain in New York, but they may be purchased from hatcheries in southern states and by mail order for $50 to $150 per hundred. A stocking permit or fish-pond license is required, and any fish ordered must come from hatcheries approved for delivery to New York.

Brown bullhead

Bullheads (sometimes called "catfish") are quite popular in New York. Many pond owners are interested enough in this species to add it (usually illegally) to whatever species were stocked in the pond. Usually the results are unsatisfactory.

Bullheads often reproduce in ponds. They frequently overpopulate the pond and stunt at a small size. Bullheads stir up the mud of the pond searching for insects living there. If the bullheads are crowded, they may keep the pond almost permanently roiled. The muddiness interferes with growth and reproduction of other species in the pond and also reduces the value of the pond for swimming and as a source of domestic or stock water.

Yellow perch

Yellow perch have been tried in a few New York ponds. They are very good to eat, and populations that are not crowded can furnish good pan-fishing. Information available indicates that perch tend to reproduce abundantly and soon overpopulate the pond with stunted fish. Apparently they are not cannibalistic enough to control their own numbers when stocked either alone or with species that are not fish eaters.

It has been suggested that perch might act as a buffer in a bass-perch-bluegill combination in ponds by serving as an alternate forage species for bass and also as an additional predator on bluegills. This is probably partly true, but it is likely an oversimplification of what the effects really are when these three species are stocked together. As yet there is no firm basis for conclusions about this species combination in New York ponds.

Redear sunfish

Redear sunfish (also called "shellcrackers") are popular pond fish in the Midwest and South, in combination with largemouth bass or bass and bluegills. They have not been tested in New York. In other areas they grow somewhat faster than bluegills, are less prolific, but sometimes are more difficult to catch than bluegills. Perhaps this species might be used as an alternative to bluegills in suitable ponds of southwestern New York.

Other species

Walleye, northern pike, muskellunge, pickerel, and crappie are not recommended for stocking in farm ponds where the intent is to produce recreational fishing.

Pond Maintenance

Fish-pond license

According to Section 11-1911 of the Fish and Wildlife Law, the holder of a license or any member of the license holder's immediate family, and any person actually employed by the license holder in the cultivation of the license holder's farm or the management of the licensed pond may . . . take fish of any size, in any number, at any time, in any manner permitted by the Department (DEC).

Application for a fish-pond license should be made to the regional office (see page 20). There is no charge for the license. Privately owned ponds used in connection with camps, motels, or hotels are not eligible for this license. Fish that have been caught from a pond may be transported off the pond owner's property only when certain regulations are observed. For these and other regulations, see Section 11–1911 of the Fish and Wildlife Law.

The pond license described above permits owners to plan fishing and management to suit themselves. Thus, trout may be fished in fall, winter, and spring when they are most readily caught. Similarly, bass may be fished in spring before plants become a problem. If warmwater species become crowded, small fish may be removed. There are, therefore, important advantages in possessing such a license.

Clearing muddy water

If the pond is still muddy with suspended clay three months after it has filled, the clay can usually be precipitated by adding *ground agricultural limestone* (calcium carbonate). This material is commonly available in farm supply stores. An application of 1,000 pounds per acre will usually suffice to clear the water and keep it clear for two or more years. There is no danger of an "overdose" since limestone is harmless to fish and in fact tends to increase the pond's productiveness. Other chemicals, such as gypsum and alum, will also settle out suspended clay, but these substances tend to acidify the water. Fish production is lower in acid waters.

Do not use lime or quicklime (calcium oxide) which may kill the fish.

Preventing fish kills

Partial or complete fish kills are not uncommon in New York ponds. After a kill as occurred, it is often difficult or impossible to determine its cause with certainty. Information in this section may assist a pond owner in making an educated guess about the cause of a fish kill, and also indicates how the risk of kills can be lessened.

1. Oxygen depletion

For respiration, fish depend on oxygen that is dissolved in the water; if there is insufficient oxygen in the water, the fish suffocate. Suffocating fish can be seen struggling and gasping at the surface. All or most of the fish are affected at the same time. The fish die with the mouths open and gills flared out.

Summer kills caused by suffocation usually occur between 4 a.m. and 8 a.m. During the night, green plants, fish, insects, bacteria, and other animals remove oxygen from the water, and so the oxygen concentration in the water reaches its lowest point in early morning.

The process of decay also requires oxygen. During the winter months when the pond is ice covered, the animals, higher plants, and most bacteria and fungi are dependent on the oxygen in the trapped water, plus any oxygen that may enter with inflowing water or may be given off by well-lighted green plants living under the ice. Large amounts of decomposing animal or plant matter in the pond may then use up the oxygen and cause fish to suffocate.

Kills from oxygen depletion, either in summer or in winter, occur most frequently in New York ponds that are small and shallow and have dense plant growths or in ponds treated with large amounts of fertilizer or manure. The chances of kills from suffocation can therefore be lessened by building deeper ponds; by avoiding heavy fertilization, including barnyard drainage and septic tank seepage; and by controlling weed growths, particularly in late summer. Chemical weed killers should not be used later than mid-September. Heavy snow cover on the pond ice can contribute to oxygen depletion and increase the chance of winterkill.

2. High water temperature

Of the fish species recommended for New York ponds, only trout suffer kills caused by high temperature. When water temperatures throughout the pond remain warmer than about 74°F for more than a few days, trout begin to die. This type of kill is usually progressive rather than sudden as with suffocation. At any particular time during the hot spell, some dead fish may be noted on the bottom or floating on the surface. Dying fish behave in an abnormal manner; they appear sluggish or very inactive, or may swim slowly in circles or in spirals.

Because high-temperature kills usually are gradual and because carcasses that float usually drift ashore and are soon disposed of by raccoons, skunks, and other animals, it is possible for a large or complete temperature kill to take place without the owner's knowledge.

If a temperature kill occurs in a trout pond during a summer with approximately average temperature, the owner should consider restocking with bass and shiners or bass and bluegills.

3. Toxic substances

Occasionally fish are killed by the introduction of poisonous materials into the pond. Such substances include various insecticides, sprays containing large amounts of copper compounds, and many chemicals containing chlorine. The dying fish show various symptoms, depending on the kind and amount of toxic material introduced.

To avoid such kills, pesticides, unless permitted by DEC regulations, should not be used on the pond watershed. Equipment used for applying pesticides should never be filled, emptied, or rinsed in the pond or its tributaries.

Eliminating undesirable fish

When a pond has become contaminated with fish species other than those stocked, it may be necessary to eliminate them and start over again. Often this is most easily accomplished by removing all the water from the pond by draining, siphoning, or pumping. It is important that the pond bottom become *dry*.

If the pond cannot be dried, the fish can be killed with rotenone, an inexpensive chemical which interrupts oxygen transfer in the gills. In the very low concentrations used for killing fish, rotenone is entirely harmless to animals *except* for swine, which might be poisoned by drinking treated water. It is *illegal* to use rotenone in any body of water without first obtaining a permit to do so from your regional fish manager of the Department of Environmental Conservation. Special permission must be obtained each time it is necessary to poison a pond. Detailed information on treating ponds with rotenone is available from your county agricultural agent and from your regional DEC fish manager.

Controlling muskrats

Muskrats damage ponds by burrowing into the banks. The burrow starts about 6 inches below the water line, slopes upward, and is usually 4 to 5 feet long. Such burrows may cause leaks and dangerous amounts of erosion. When the burrows collapse these problems are magnified.

If possible, the prospective builder should locate the pond in an area well removed from other water bodies, including streams, which are potential sources of muskrat infestation.

Whether muskrats are present or not, the pond banks should be kept mowed so that if damage occurs, it can be seen and corrected promptly. Mowing also reduces the amount of protective cover for muskrats. Cattails and other emergent vegetation should be removed from

the pond since these plants provide both food and cover.

Muskrats should be removed at once when there is evidence that they are damaging a farm pond. They are most likely to move in during the spring or fall when the official trapping season is usually closed. The simplest approach is to obtain a 'rider' on your fish-pond license authorizing you to trap muskrats from your pond at any time for nuisance control purposes. A pond owner who does not have a pond license can obtain a *temporary* trapping permit from the regional DEC wildlife manager.

Steel traps[4] are relatively inexpensive, and are effective if set properly. Of these, the "stop-loss" or "killer" models are more efficient although more expensive. Number 1½ foot hold traps set in a drowning set, number 110 body gripping traps, or a floating trap[5] should be used.

Individuals inexperienced in trapping techniques can use cage-type live traps with spring-action doors to remove muskrats. The traps are baited with carrot slices. Although the cost per trap is several times more than for steel traps, only a few live traps are necessary to effectively trap a pond; and since they catch the muskrats alive, pond owners can release the animals at some distant point if they wish. Pond owners should check with the DEC wildlife manager before moving muskrats to another location.

If a pond is constantly invaded and damaged by muskrats from nearby water areas or if the dike is especially narrow, the pond owner may wish to rip-rap the shoreline with small rocks or heavy gravel. These materials should be extended at least 1 foot above normal water level and at least 3 feet below it, in a layer about 3 inches thick. Areas so treated have fairly complete and lasting protection from muskrats. The barrier also protects the shoreline against wave erosion and improves the area for swimming.

Miscellaneous pond animals

Frogs or salamanders (newts) or sometimes both are common in many ponds. Yet frogs, tadpoles, and salamanders are rarely found in the stomachs of pond trout, bass, or bluegills. These animals are entirely harmless to humans and are a natural and interesting part of any aquatic environment. There is no practical way of eliminating them from the pond that would not also eliminate the fish. Even if total eradication were achieved, the pond would very soon become repopulated. Although frogs and salamanders consume a portion of the pond's plant and animal life that might otherwise become fish food, their effect on management of a pond for fishing is negligible. Furthermore, they serve an important function as food for various predatory birds and reptiles that may visit the pond and which, without this ready source of food, might make more serious inroads on the fish population.

Occasionally water snakes take up residence near a pond, although this is common only in ponds located close to streams. To date there is no evidence that these snakes noticeably affect pond fish populations, although they do eat fish. Water snakes are less docile than some other kinds and may strike if cornered and sufficiently provoked. However, they are nonvenomous.

Snapping turtles occasionally inhabit larger ponds and, in a few instances, have been known to do some damage to fish populations. Snappers can be distinguished from other turtles by the saw-tooth rear edge of the upper shell. Other kinds of turtles are more common in New York ponds and are entirely harmless. Information on pond turtles and their capture is found in *Turtle Trapping*, Fishery Leaflet 190, available from the United States Fish and Wildlife Service, Washington, D.C. 20240.

Various wild birds occasionally visit farm ponds. As far as is known, most of them do not seriously affect the fish population, with the exception of the great blue heron and kingfisher. There have been occasional instances of ponds well removed from roads or buildings where herons or kingfishers have killed considerable numbers of fish and inflicted wounds on many of the remainder. However, it is virtually impossible for these birds to eliminate a fish pond population unless the pond is extremely small and shallow. Herons and many other migratory birds are protected under federal law. Requests for information or assistance on protecting a pond from these birds should be directed to the regional game manager for your county (see page 20 for addresses).

By far the most damaging bird predator noted in New York ponds has been the domestic Muscovy duck. In farm ponds where Muscovies have been present, trout survival over a five-month summer period has frequently been as low as 10 percent. If it is necessary to give these ducks access to a fish pond, they should be fenced and wingclipped so that their activities are confined to a very small fraction of the total pond area.

Moles are occasional farm pond pests. Their tunneling activities may destroy patches of the sod cover on pond banks, with consequent erosion. Mole control by trapping and information on the habits of moles are presented in Cornell Cooperative Extension Information Bulletin 176, *Control of Wildlife Damage in Homes and Gardens*. Moles can be successfully killed with poisoned bait.

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[4]This is the type consisting of 2 steel jaws that snap shut.

[5]The floating trap is described in the muskrat section (B61-70) of *The Great Plains Wildlife Damage Control Manual*, available from Cooperative Extension, University of Nebraska, Lincoln, NE 68583.

Commercial fish ponds

Sometimes individuals become interested in the possibility of operating a fish pond for financial profit.[6] At present there is little information available from such ventures in New York State. However, certain general considerations and precautions can be mentioned.

For any kind of commercial operation, owners should obtain as much detailed information as possible about the actual profits they can expect. For this, they would need accurate information on the existing or potential market for their product. Using the average figures on growth, survival, and prices of fish given in this bulletin, owners can estimate the expected cost and yield. They should try to determine as accurately as possible the profit they might realize, taking all of the above factors into consideration, balanced against the cost of the pond and its maintenance. For production on a commercial scale, higher stocking rates than those given here can be employed if supplemental feeding is done or if the fish are cropped heavily and fairly continuously.

For a variety of reasons, New York fish ponds, as defined in this bulletin, are not well adapted to raising and harvesting fish for sale to restaurants, hotels, and the like. Anyone contemplating such a venture should first obtain information from the state Department of Environmental Conservation on legal requirements for this sort of commercial operation.

If fish ponds can be successfully managed for profit, it appears most likely that this management will be in the form of offering fishing for a set fee or for a certain price per fish caught or perhaps a combination of the two. Operation of a fish pond for this purpose (referred to in the Fish and Wildlife Law, Section 11–1913 as a "fishing preserve") requires an annual license from the Department of Environmental Conservation ($50.00 fee in 1996), and no fish from federal or state hatcheries can be used in such a venture. There are a number of detailed regulations concerning operation of fishing preserves, particularly with regard to fishing, transporting fish caught, posting, and maintenance and submission of records and reports by the operator. A pond owner considering embarking on a fee-fishing venture should become thoroughly acquainted with Section 11–1913 of the Fish and Wildlife Law.

[6]A useful reference on this general topic is *Third Report to the Fish Farmer.* U.S. Fish and Wildlife Service, Washington, D.C. 1984. 270 pages. Available from the Superintendent of Documents, Government Printing office, Washington, D.C. 20402 for $8.00. Doc. No. S/N 024-010-00654-4. For further information on fish raising, a list of current publications on aquaculture and fish culture can be obtained from the American Fisheries Society, 5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814-2199.

Addresses of Regional Fisheries Offices of the New York State Department of Environmental Conservation

Central Office—Albany
Bureau of Fisheries
50 Wolf Rd., Room 552
Albany, NY 12233-4753
(518) 457-5420

Region 1—Stony Brook
Loop Rd.
Building 40, SUNY
Stony Brook, NY 11790-2356
(516) 444-0280

Region 3—New Paltz
21 South Putt Corners Rd.
New Paltz, NY 12561-1696
(914) 256-3161

Region 4—Stamford
Route 10, Jefferson Rd. HC01
Stamford, NY 12167-9503
(607) 652-7366

Region 5—Ray Brook
Route 86
PO Box 296
Ray Brook, NY 12977-0296
(518) 897-1333

Warrensburg Suboffice
Hudson St.
PO Box 220
Warrensburg, NY 12885-0220
(518) 623-3671

Region 6—Watertown
State Office Building
317 Washington St.
Watertown, NY 13601-3787
(315) 785-2261

Utica Suboffice
State Office Building
207 Genesee St.
Utica, NY 13501
(315) 793-2554

Region 7—Cortland
1285 Fisher Ave.
Cortland, NY 13045-1090
(607) 753-3095, Ext. 213

Region 8—Avon
6274 E. Avon-Lima Rd.
Avon, NY 14414-9519
(716) 226-2466

Region 9—Olean
128 South St.
Olean, NY 14760-3632
(716) 372-8676

To contact (1) the county Natural Resources Conservation Service—County Water and Soil Conservation District, or (2) the county Cornell Cooperative Extension office:

Look in your telephone book under United States Government, Dept. of Agriculture, (1) Natural Resources Conservation Service or Soil Conservation Service, or (2) Cornell Cooperative Extension Association of (your county), or call information at your county offices.