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FISH POND MANAGEMENT IN GEORGIA


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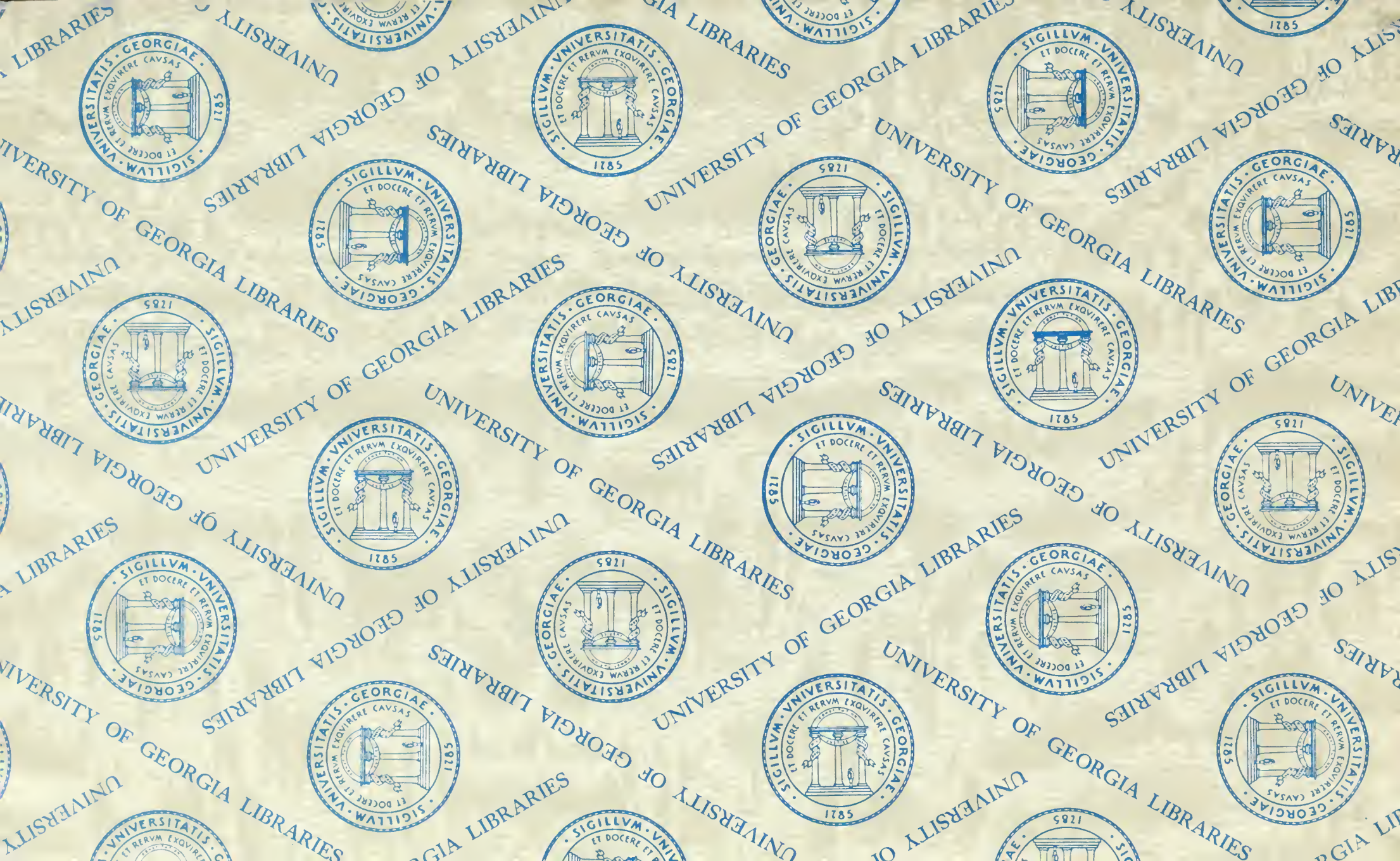
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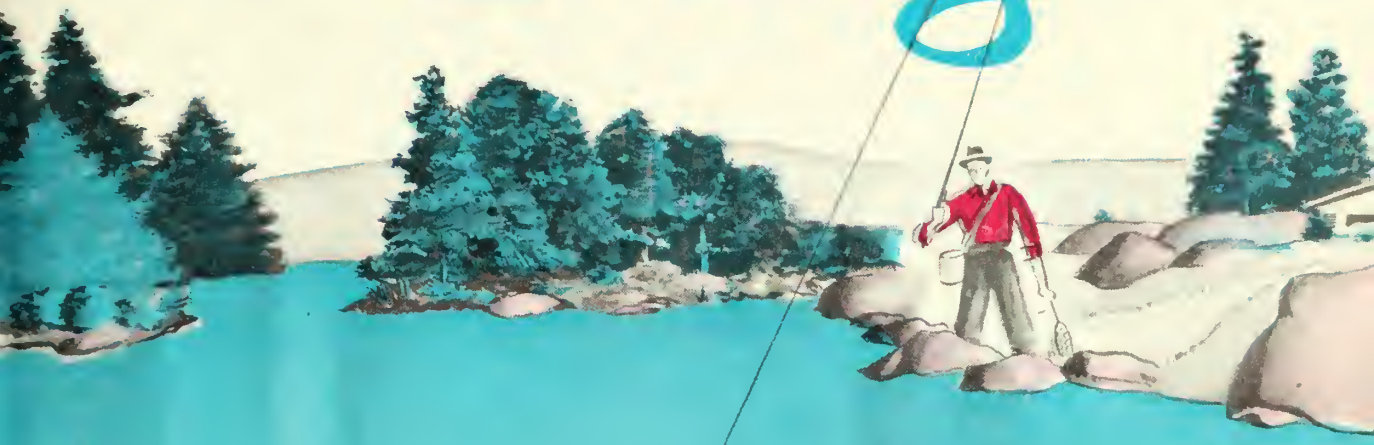
in Georgia



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Fish Pond Management in Georgia

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BOB SHORT DIV. CHIEF

TO THE PEOPLE OF GEORGIA:

Georgia's ever expanding number of farm fish ponds continue to fulfill a vital purpose in the growth and development of the state.

Today's farm pond is almost a necessity, since it provides a source for watering livestock, irrigation, flood control and recreation. Backyard fishing ponds provide excellent recreational opportunities for thousands of Georgians. They can provide excellent fishing throughout the year if managed properly.

This book, Georgia Fish Pond Management, is designed to help Georgians manage their ponds scientifically in order to obtain best results. It is a compilition of proven fish management methods collected from years of research on Georgia farm ponds.

Georgia Fish Pond Management will not only be beneficial to those who already have farm fish ponds, but also to those who contemplate building one in the future.

Fulton Lovell

FULTON LOVELL, Director
State Game & Fish Commission.

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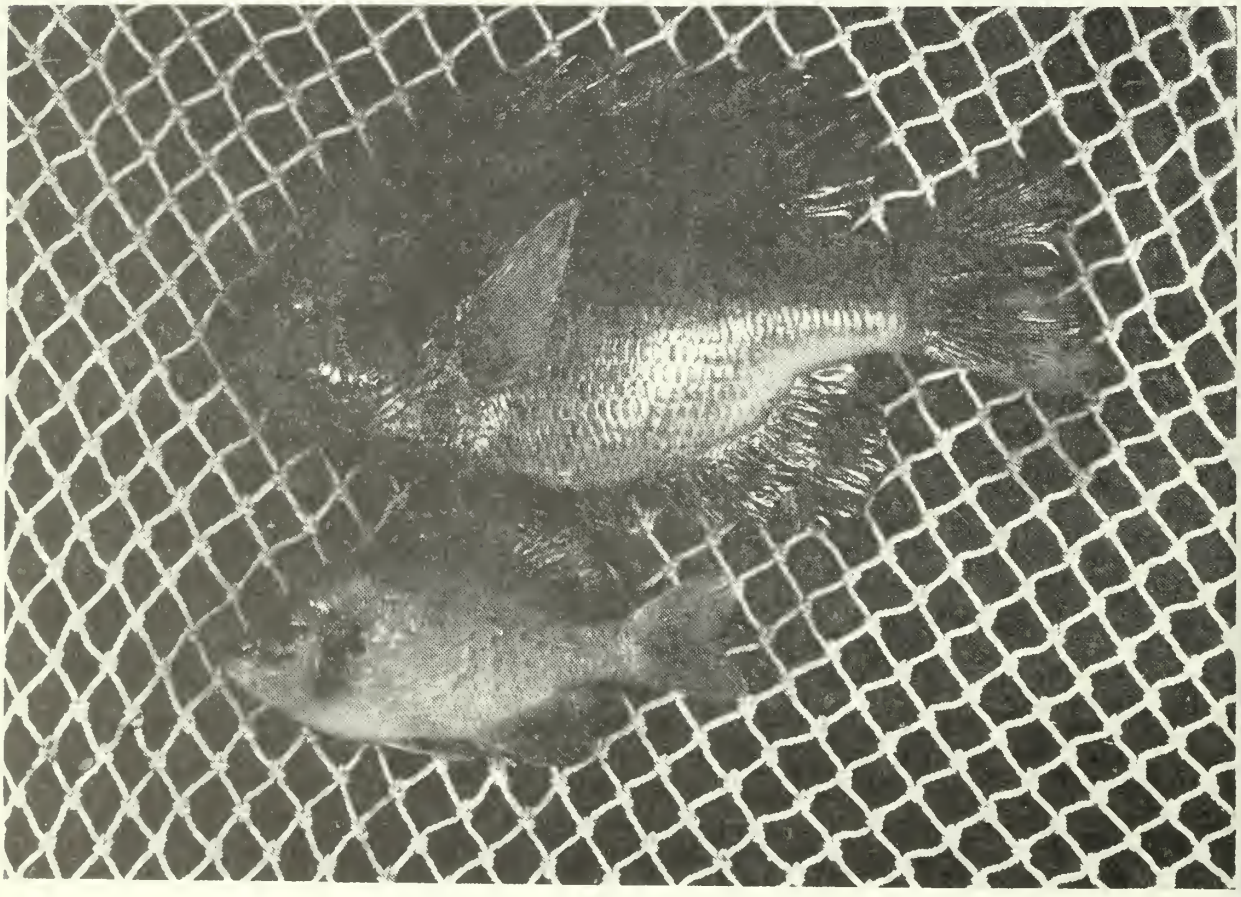
CHAPTER 1

MANAGEMENT PRINCIPLES

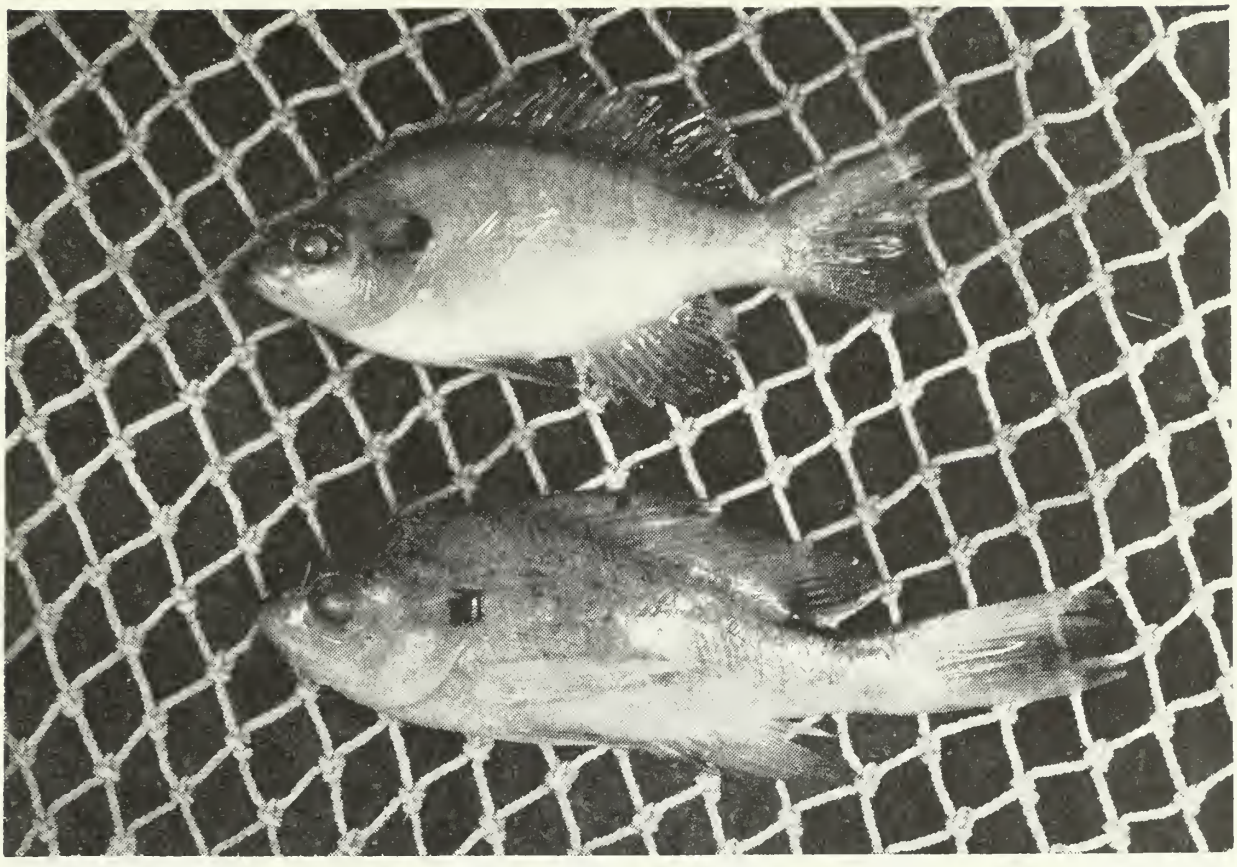
Many ponds produce good fishing only during the first two years because the owners do not know or do not practice proven management principles. Everyone following these principles of management reports success.

1. **The weight of fish an unfertilized pond can support is dependent upon the fertility of the watershed.** This weight ranges from 35 pounds to 200 pounds per acre, according to poorness or richness of the watershed or lands that drain into the pond.

2. **The number of pounds of fish that a pond can produce can be increased by the use of fertilizers.** Fertilizer produces a plankton that is food for microscopic animal life, water insects and small fish. The diet of a bluegill throughout the year consists approximately 84 percent of the midge larvae (blood red-worm). If a pond is fertilized properly it will support from 400 to 600 pounds of fish per acre.



Effect of fertilization on the size of fish. **Above:** Average size (4.0 ounces) in a fertilized pond. **Below:** Average size (1.1 ounces) in unfertilized pond. Both ponds were stocked with 1,500 bluegill fingerlings per acre.



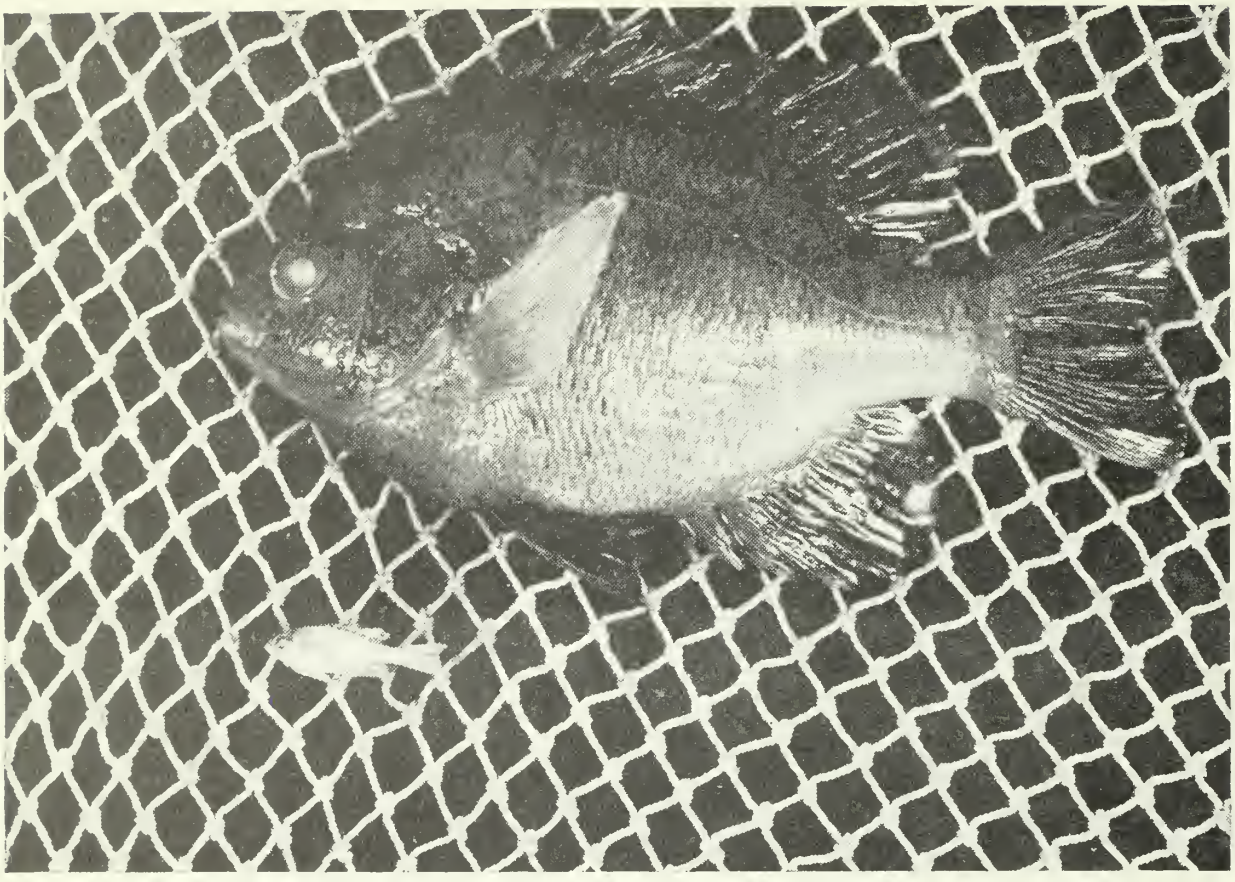
Rate of growth in a pond stocked with 6,500 bluegill bream per acre. **Above:** Average size (0.8 ounce) 6 months after stocking. **Below:** Average size (0.9 ounce). 2 years later.

3. **Fish grow rapidly if they have plenty of food, but very slowly if food is scarce.** If the bluegills get plenty of food and are properly stocked they will average about 4 ounces within one year after stocking. The bass, if properly stocked, will average about one pound in one year.

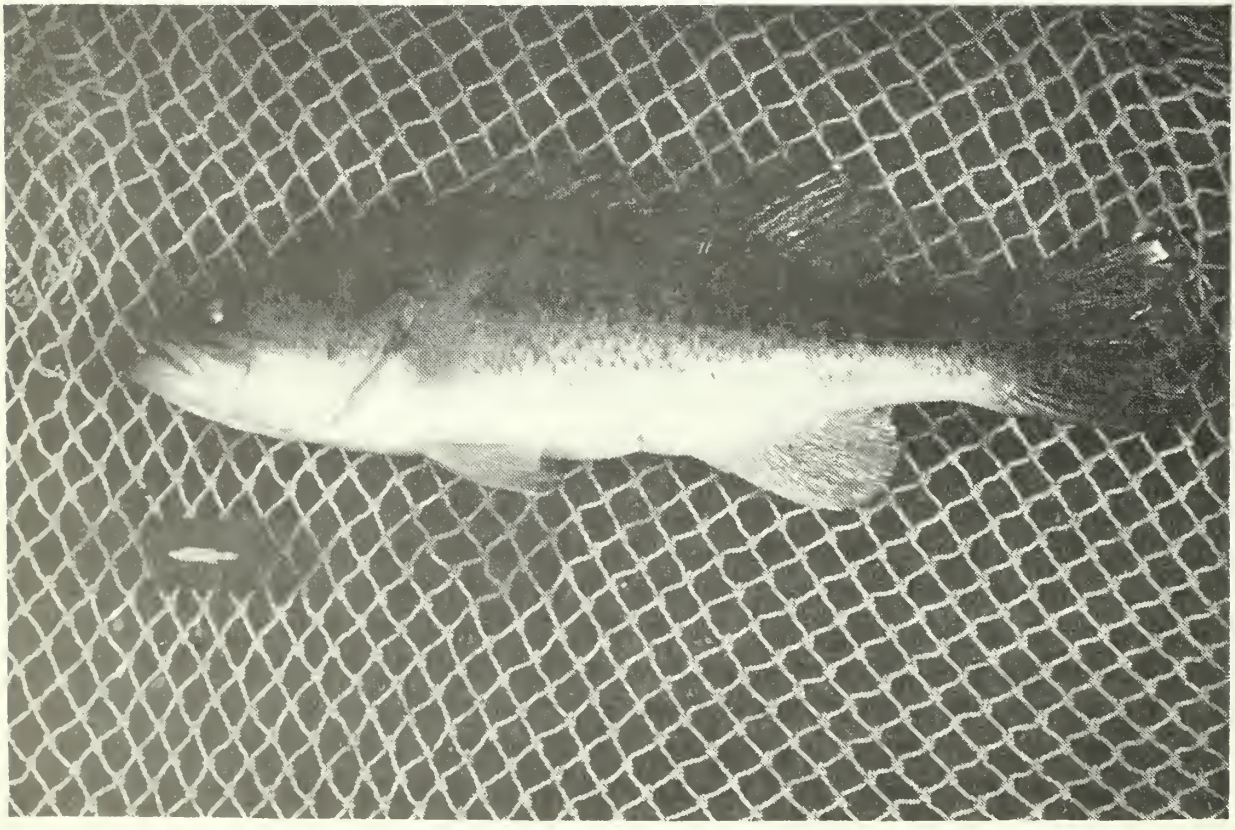
4. **Too many fish in a pond cause small undersized fish and poor fishing.** A pond can support only the weight of fish for which food is available. It can support several thousands of small fish or a much smaller number of large fish. The faster a fish grows the easier it is to catch; the slower it grows the more difficult it is to catch.

5. **Within one year after stocking, a pond is usually supporting close to the maximum weight of fish for which food is available.** After the stocked fish have spawned once, there are more fish in the pond than can be adequately supported by the food that the pond is producing. Therefore, the fish must be reduced by the bass and by heavy fishing. A pond properly fertilized reaches a maximum of fish food production in the same manner as a pasture properly fertilized reaches a maximum of hay production.

6. **If the number of fish in a pond is reduced, the average size of those remaining increases.** The remaining fish get more food. If a man has a



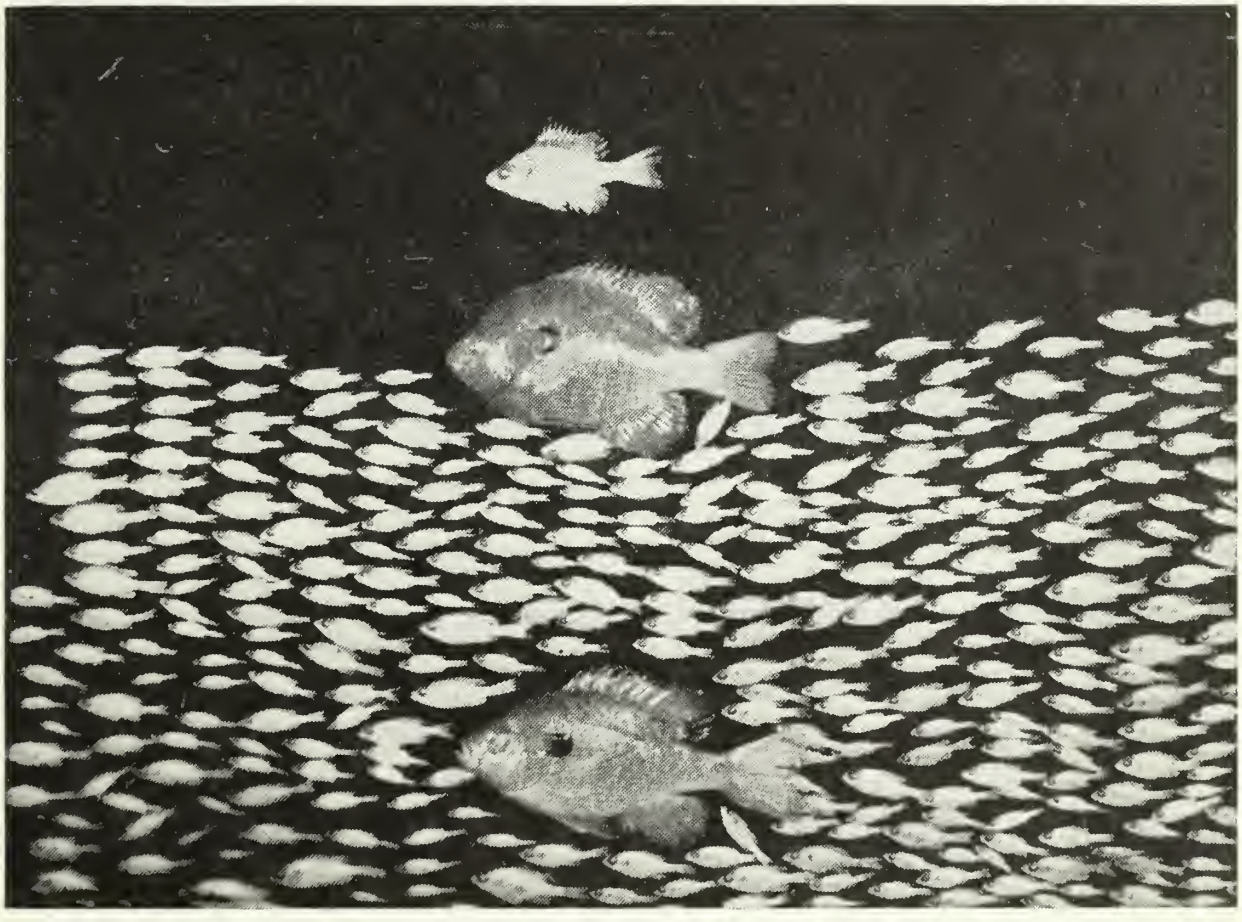
Effect of rates of stocking on the size of bluegill bream. **Above:** Average size (4.0 ounces) 1 year after stocking with 1,500 bluegills per acre. **Below:** Average size (0.02 ounce) 1 year after stocking with 180,000 bluegills per acre.



Growth of largemouth bass (**Micropterus salmoides Lac.**) in a fertilized pond. **Below:** Size (0.0008 pound) of a week-old bass hatched May 1941. **Above:** Size (1 pound) reached when 6 months old, October 1941.

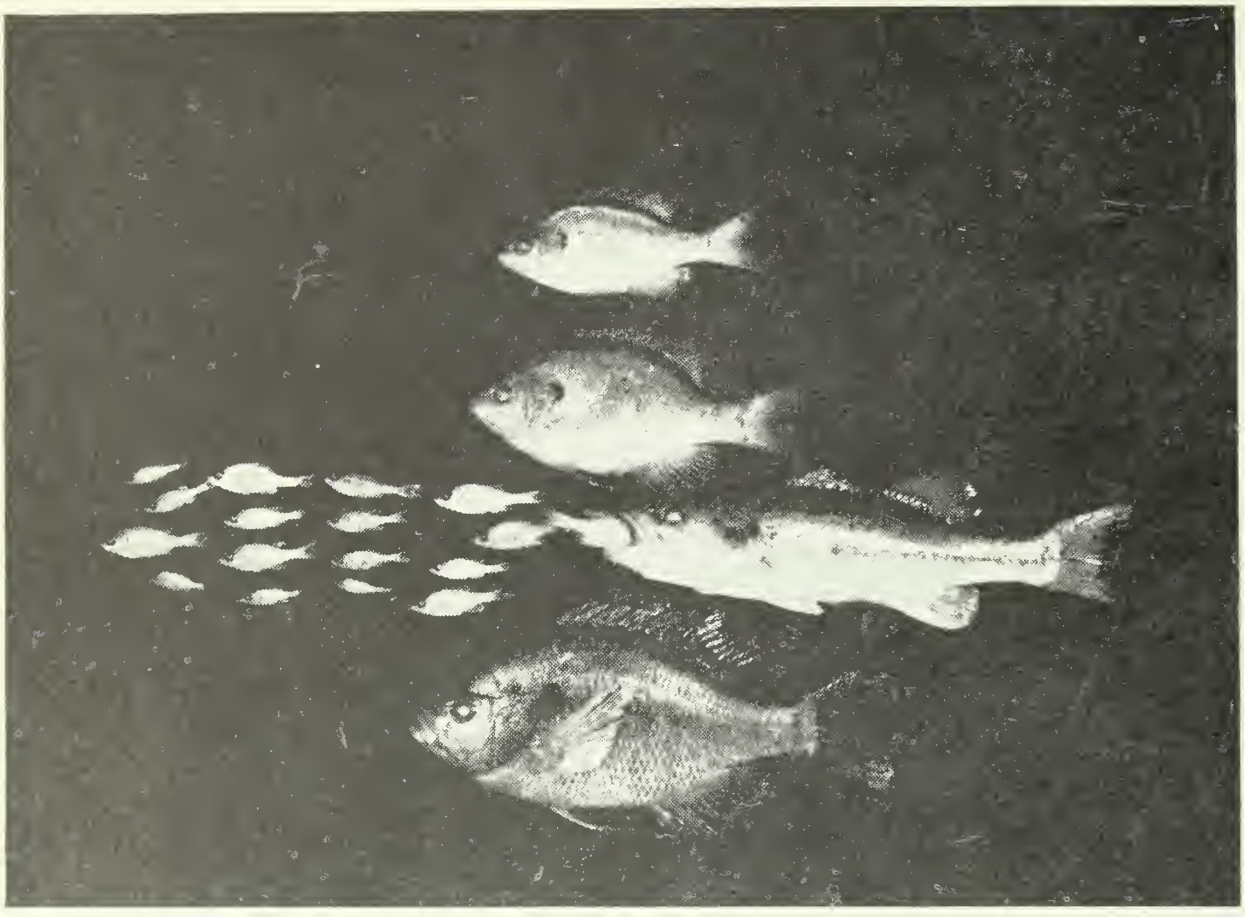
good pasture that will support 100 cows without over-grazing and the cows are left on the pasture until they have calves, he knows he must reduce the number to prevent over-grazing. Fish are thousands of times more prolific than cows; therefore, fish must be drastically reduced in numbers—so enjoy catching and eating them.

7. **Bluegill bream cannot reach a large size generation after generation in ponds containing only bluegills.** Each pair may produce 4,000 or more young fish the first year. This increase causes the weight of fish that the pond can support to consist of very small bream.



—Result of stocking with bluegills only. **Above:** Average size (0.2 ounce) stocked March 1938. **Center:** Average size (2.7 ounces) reached by June 1938, when spawning occurred. Each pair of bream produced an average of 4,000 young. **Below:** When the pond was drained November 1938, the large bream weighed two-thirds as much (1.9 ounces) as in June, because the pond was over-crowded with their own young.

8. **Largemouth bass should be used in ponds with bluegill bream.** The main purpose of adding the bass is to reduce the offspring of the bream. The largemouth bass is the sole carnivorous fish satisfactory for use in ponds. If the pond is stocked properly with bass and bluegills, and there is no very shallow water or weeds, the bass usually eat most of the young bream, which will help prevent the pond from becoming over-populated with bream.



Results of stocking with bluegill and largemouth black bass. **Above:** Average size (0.5 ounce) of bream used in stocking February 1939. **Center:** Average size of bream (1.8 ounces) in June 1939, when spawning occurred. Most of the young fish produced were consumed by the bass. **Below:** Average size of bream (4.2 ounces) in November 1939. Since the bass had reduced the number of young fish, the bream more than doubled in weight after spawning.

9. **Ponds in Georgia fertilized properly should be stocked with 1,000 bluegill fry or fingerlings and 100 bass fry or fingerlings per acre.** Experiments in Alabama and Georgia over thousands of ponds over 30 years have proven this ratio to be the most successful in size of fish and in fishing success when the ponds were properly fertilized.

10. **Unfertilized ponds should be stocked with only 500 bluegill fingerlings or fry and 50 bass fry or fingerlings per acre.** When unfertilized ponds are stocked in this ratio, bream will average about 4 ounces while bass will average about one pound in one year.

11. **When shellcracker bream are used, they should not constitute over 20 percent of the total number of bream.** Shellcracker do not sustain themselves as well as bluegills and sometimes disappear after 3 or 4 years.

12. **Other species of bream as the redbreast, warmouth, green sunfish, stumpknocker, pumpkinseed, longear sunfish may be classified as scrub types.** In ponds they will not put on as much weight as the bluegill and shellcracker bream per ounce of food consumed. Only a very small percentage of such fish attain an edible size in ponds.

13. **Too much water passing through the pond takes out the fertilizer and**

causes a reduction in the amount of food produced. Also too much water encourages the entrance of suckers, shad and other undesirable species.

14. **Speckled bullhead and brown bullhead, catfish and crappies are not recommended because they usually over-populate the pond.** By adding extra species, one reduces the number of fish caught per hour of fishing effort.

FALSE BELIEFS OR IDEAS

LOTS OF WATER

One false idea held by many people is that the more water entering and leaving the pond, the better the conditions will be for the fish. An ideal fish pond receives sufficient water to prevent fluctuation of water level without overflow. Water will not become stagnant if fertilized because fertilizer produces microscopic plant life which gives off oxygen during all daylight hours.

DEEP POND

Others mistakingly believe the deeper the pond the better. In North Georgia a pond should have some of its area 8 feet in depth, while in South Georgia none of the pond area needs to be over 5 or 6 feet in depth. Most of the fish food is produced in water less than 4 feet in depth.

SHADE

Fish do not need shade as much as they need food. Sunlight is as necessary for the growth of the microscopic plant life as are the nutrients. Fish do not require or need shade.

CLOSED SEASON DURING SPAWNING TIME

The old erroneous belief about not fishing while the warm water fish are spawning prevented a great deal of recreation and joy and contributed to an overpopulated fish condition. One catches more fish while fish are spawning than at any other time. Since 50 percent of the total weight of fish are not usually caught by hook and line fishing and since the crop of fish needs to be harvested, people should catch fish at any time of the year, they can.

WEEDS IN THE POND

Some pond owners place water lilies, cattails and other types of weeds in ponds, thinking the little fish need some place to hide from bass or other big fish. The weeds induce overpopulation of bream—smaller fish and poorer fishing. We want large fish and good fishing, so weeds are unnecessary.

THROW THE LITTLE ONES BACK

If each pair of bream produced only one pair of offspring each year, it would probably be wise to throw the little ones back, but their offspring

mount into the thousands during each spawning, and depending on food supply bluegills spawn 2 or 3 times each year. Therefore don't throw back the little ones if you want to improve fishing conditions. There should never be a size limit on bass, bluegills, catfish, crappie, and other warm water fish.

FISH SPAWNING DURING THE FULL MOON

The bluegills start fanning out nests when the temperature of the water is around 73° F. and when the temperature of the water rises to 80° F. and remains there 2 or 3 days, the bluegills will spawn whether the moon is half, one-quarter, dark, or full. Spawning by the different bluegills will occur every month throughout the summer and until the temperature of the water falls below 80° F. Bluegills may spawn when they are one-half ounce in weight. If they are getting plenty of food they may spawn, form new eggs and spawn again within a period of six weeks. The largemouth bass start fanning out their nests at 65° F., and when the water temperature rises to 70° F. and remains there for 2 or 3 days, they will spawn. It is very seldom that bass spawn over once a year. Bass usually form their eggs in the late fall.

FISH PONDS MOSQUITO BREEDING PLACES

Many people say that fish ponds provide breeding places for mosquitoes. Ponds constructed properly, stocked properly, and managed properly produce practically no mosquitoes. You may be around the pond during the day or night without noticing the mosquitoes any more than you would around your home. The small bream eat the mosquito larvae and prevent their reproduction. **Weedy ponds and unfertilized ponds raise many mosquitoes.**

FERTILIZING TWO OR THREE TIMES A YEAR

Very often when I ask a man if he fertilized his pond last year, he will tell me yes. I then usually ask him how many applications he made. Often he reports only 2 or 3 applications of fertilizer. This is insufficient for good results. A pond in Georgia requires from 7 to 15 applications of fertilizer each year for it to produce the maximum amount of fish food. Proper fertilization is needed to produce an abundance of microscopic plankton for fish food, which also gives a greenish cast to the water, thereby shading the bottom and preventing the growth of underwater weeds.

CHAPTER 2

SELECTING A POND SITE

Careful consideration should be given to the selection of a pond site because economy of construction, usefulness, and productivity of the pond depend upon its location.

SIZE OF POND NEEDED

In planning a pond, you should first decide the size of pond you need. You should expect to catch about 45 pounds of bass and 160 pounds of bluegill bream each year from each acre of a well-fertilized and properly managed pond. This means approximately 40 bass and from 400 to 800 bream per acre. If you do not plan to commercialize your pond by selling fishing rights, or to furnish fishing for a large number of people, you need to construct a pond no larger than two or three surface acres of water.

To obtain the most benefits from the fish pond and to insure continued success, certain points should be emphasized. As the pond is a permanent structure, costing from $300.00 up to $25,000.00 to build, it is important that it be constructed properly. The best advice on location and construction should be obtained and followed. The selection of the site and manner of construction will govern the efficiency of management.

Ponds should not be located on areas subject to flood nor should they be built by damming large streams. Precautions should be taken in selection of the site to prevent seepage through the dam or through the subsoil.

A SUITABLE POND SITE SHOULD POSSESS THREE CHARACTERISTICS

1. A SUITABLE TOPOGRAPHY

Topography determines the economy of pond construction. Most ponds are built in natural hollows or draws. These hollows are usually swampy and wet, and usually are covered with hardwoods. Some of these hollows can be turned into productive use if they meet requirements of good ponds. The hollow should have a gentle slope. The highest fish production is in ponds where approximately five-sixths of the area is from 2 feet to 6 feet in depth, and where approximately one-sixth of the pond area is approximately 8 feet or more in depth. Try to find a site as near as you can to

fit these conditions. In the southern part of Georgia, where the winters are much milder than in the middle portion of the State and northward, none of the area of the pond needs be greater than 6 feet in depth unless a great deal of the water is used in irrigation or watering livestock, or if the water level fluctuates one foot or more due to seepage or evaporation. Ponds with a large part of the area 7 to 20 feet deep do not produce a high yield of fish.

2. WATER SUPPLY

A water supply, adequate but not excessive, is desired. All water flowing from a pond is waste, carrying away fertilizer that has been applied to make food for growing fish. An ideal water supply keeps the pond water from fluctuating with no water leaving the pond.

Too much water entering the pond is bad for several reasons: (A) Mature fish are carried over the spillway. (B) Fertilization and high yields of fish are made impossible. (C) The owner is forced to build an expensive dam and spillway. (D) The life of the pond is shortened too rapidly by siltation. (E) Many times, undesirable species of fish such as suckers, carp, bullhead, catfishes, shiners, etc., will enter the pond. All sites on streams that carry much flood-water should be avoided.

Some ponds can be protected by turning the excess water around the pond through a diversion ditch. An ideal location is on bottom land that is not subject to flooding, and where there is a sufficient water supply that can be directed into the pond in the amount required. Ponds formed by damming a large stream are ordinarily not successful because it is almost impossible to prevent the escape of large numbers of adult fish and the introduction of undesirable species. Ponds constructed on small spring-runs not subject to severe floods, or where storm water can be by-passed or diverted from the pond, develop high fish productivity.

Flowing water is not essential for pond fishes. As has been previously stated, fertilizer produces miscroscopic algae that give off oxygen during all the daylight hours. This new supply of oxygen prevents the pond from becoming stagnant.

A pond fed by small springs, which will fill it in 2 to 6 months, is ideal for good management and utilization of the fertilizer. If the water comes only from the watershed, there should be sufficient but not excessive acreage. The ratio of the watershed area to the size of the pond should be from 10 to 20 acres of pasture land or 20 to 35 acres of woodland per acre of impounded water. The entire drainage area should be well vegetated to prevent erosion. If the pond water often becomes muddy, poor fishing will result regardless of the amount of fertilizer applied to the pond.

Streams bold enough to fill the pond in one month or less supply too much water for proper utilization of the fertilizer, which governs production in pounds of fish. Therefore a diversion ditch is required in such cases

to reduce the flow to permit high production. If artesian wells are used, the water should flow over a bed of gravel to aerate it before it enters the pond.

3. SOIL AND AREA SURVEY

When selecting a pond site, sometimes one may depend upon the eye but it is much better and safer to check the area with a surveying level. Make certain that the soil will hold water before you start building the pond, because a successful pond cannot be built on the wrong kind of land. The subsoil should be checked by taking soil samples with a soil auger or a post hole digger. Enough samples should be taken to make certain there is three-to-four-foot layer of clay under the dam site. The way to test the clay to see if it is suitable is to take a handful of the moist soil from the hole and compress it into a firm ball. If, after a little handling, the ball does not crumble, the soil contains sufficient clay for building the dam. Avoid sites with rock out-croppings along the bank or with rock or shale ledges near the surface. Also avoid sites having sand, gravel, peat, limestone, or marl through which the water might seep.

From your findings on the topography, water supply, subsoil, and pond area, it is easy to determine the suitability of the proposed site.

4. TECHNICAL ASSISTANCE AVAILABLE

The Soil Conservation Work Unit Technician in each county, and the County Agent will be glad to advise one in selecting a pond site and in the proper construction of the pond.

CHAPTER 3

POND CONSTRUCTION

A pond should be completed only a short period of time before the fish are available from the hatcheries. Late summer or early fall is the best time of the year to construct a pond. At that time of the year, there is usually the least amount of rainfall; therefore heavy equipment can work economically without bogging down or being stopped by bad weather. A pond completed during the early fall has time to fill sufficiently to allow bluegills to be stocked in the late fall or early winter.

PROPER TIME FOR IMPOUNDMENT

The time of the year the pond is filled with water is an important factor in pond management. If a pond is constructed and filled with water in the spring, fish will not be available until late fall or winter. The pond owner is unwilling to fertilize the pond that has no fish in it. Consequently, underwater weeds—needle rush, coon-tail moss, parrot feather, or other undesirable plants—are likely to grow from the pond bottom everywhere sunlight penetrates to the bottom.

If the pond is constructed during the winter, spring, or summer, and is not allowed to fill with water, weeds, bushes, and brush will cover the bottom before fall; thus, the bottom must be cleared again before the pond is filled by late fall and winter rains. But this clearing is cheaper than getting rid of underwater weeds after the pond has been filled.

The importance of completing the entire job of pond construction before water is impounded cannot be over-emphasized. A pond must be constructed properly to produce a high yield of large fish. And it is cheaper to have the pond construction complete before the water is impounded.

CLEARING THE SITE OR POND AREA

Trees, brush, and other litter within the **dam site area** must be removed in their entirety—roots, trunk and limbs. No woody material that will rot should be left in the dam area to later cause a leak. **All trees and brush should be removed from the pond site or pond proper.**

The balance of **the pond site** should have the trees and brush removed. These may be piled and burned. Two areas, approximately 50 to 75 feet wide and 100 feet long in water less than 5 feet in depth, should have all stumps removed and the bottom fairly smooth (no abrupt holes) in order that a pond analysis may easily be made in the future. If these cleared areas are not provided, an analysis by seining is impossible. These test areas should be clearly marked with posts or signs. Every pond should be analyzed by the end of the second year by a Fishery Biologist.

—In the layout of proposed base of dam shown here, the two straight lines of stakes across the hollow outline the width of top of the dam when it is completed. The outside rows of stakes (toe-stakes) outline the area that the base of the dam will cover.

All trees and brush on the bank above the water level should be cut at least 20 feet from the water line to comply with public health regulations. Clearing the banks of trees, brush, high grass, and weeds reduces the number of snakes and holds down the breeding of mosquitoes. And finally, every foot of the edge of the pond becomes usable for fishing.

CONSTRUCTION OF THE DAM (STEP BY STEP)

REMOVAL OF TOPSOIL FROM BASE AREA OF THE DAM

Topsoil must be removed to a depth of one foot or more below the surface to dispose of roots and other organic matter that destroy the bond between the soil of the pond bottom and the base of the dam. Bonding is necessary to prevent seepage.

DIGGING THE CORE TRENCH

After the removal of the topsoil within the base-area, the core trench is cut. Good clay must extend the full length of the dam and be used from the subsoil of the pond bottom to a point slightly above the highest of the water level of the dam. The trench should be dug approximately 10 feet wide if it is in impervious clay. If the base material is slightly porous, the width of the core trench must be increased to twice the proposed water depth at that point. The depth of the core trench should be dug at least 3 feet or more into the subsoil. An old stream bed may be too boggy for heavy equipment to work. Then, it is cheaper, quicker, and better to blast that portion of the core trench with ditching dynamite (used by an experienced worker), rather than to dig it by hand or with a drag line. After blasting, be certain to check to see that the clay subsoil has been fully exposed across the bottom and that the trench is wide enough. If the clay

Tractor with bulldozer attachment pushes topsoil from base of the dam to the down stream toe. This operation is done prior to cutting the core trench.

subsoil has not been fully exposed, additional blasting should be done until the clay subsoil has been fully exposed.

When ditching dynamite explodes, it exerts a downward and sidewise pressure that breaks up and packs the soil in the bottom and sides. This packing of the soil collapses and closes small water channels in the subsoil and reduces seepage of water beneath the core.

TYING THE DAM INTO THE SUBSOIL

After the core trench across the wet area has been cleared out, it is refilled with good clay. Usually this good clay can be obtained from the

All undesirable materials have been blasted from trench in the boggy area. The tractor is now starting to cut the trench on the hillside. This good clay is used to fill the trench across the bottom.

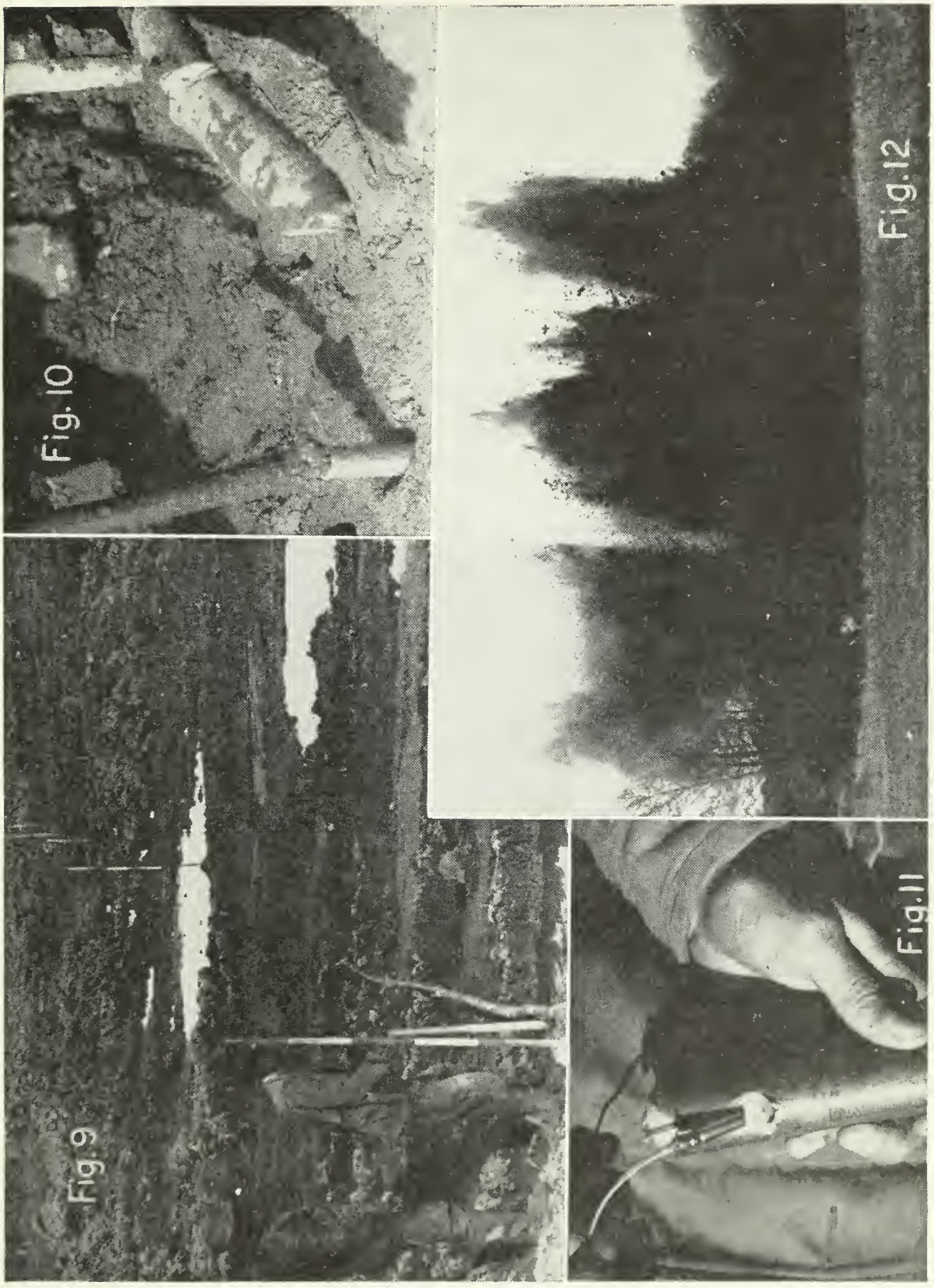


FIGURE 9.—Guide stakes are set along center of core preparatory to setting dynamite. **FIGURE 10.**—Close-up of method of punching holes and inserting sticks of ditching dynamite. **FIGURE 11.**—Electric cap is inserted in hole punched in side of dynamite stick. This hole should be about 3 inches deep and one-half inch in diameter. **FIGURE 12.**—Cap is ignited and entire line of dynamite is exploded. Note the height to which mud and dirt are thrown. Since most of this material falls outside of trench, no one should be nearer than 500 feet.

ends of the hillside core trench. The hillside trenches need to be cut from 4 to 6 feet in depth into the clay to break up underground seepage channels. The depth of the cut can be determined only by examination of the sides of the cut while it is being made.

When the core trench of the dam is cut from the water level on one side to the water level on the other side, the portion that is still open should be refilled with good clay, and then one-half of the length of the dam may be filled in to a depth of approximately 3 feet.

INSTALLATION OF DRAIN

A drain pipe is installed to permit lowering the water level when repairs are necessary, and to provide facilities for piping water to stock-watering tanks or troughs, and to empty the pond completely for removing undesirable species of fish.

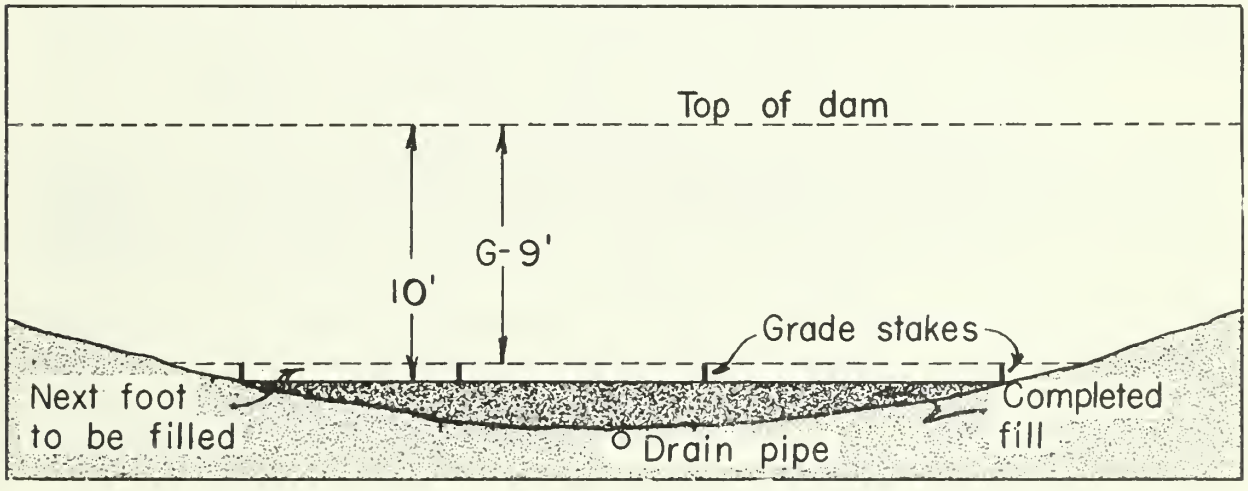
Joints of cast iron soil pipe are laid in the ditch. Here the line is being straightened and held in place with dirt preparatory to caulking and concreting the joints. The flap valve at the right will be placed later in the bell joint of the drain pipe in foreground.

POSITION OF DRAIN PIPE

Water may be diverted around the other side while the drain pipe is installed. The drain pipe should be installed at the lowest point in the pond so that all the water may be drained. Before the pond is filled, a check should be made to make certain that no low places remain where fish can gather when the water is drawn off. Low areas filled with water make more difficult the removal of all the fish. Therefore low places should be filled in and sloped toward the drain.

DRAIN PIPE LENGTH REQUIRED FOR DIFFERENT HEIGHT DAMS HAVING A TOP WIDTH OF 12 FEET, ALLOWING 3 FEET OF PIPE EXTENDING UPSLOPE AND 3 FEET DOWNSLOPE FROM THE BASE OF DAM.

PIPE LENGTHS			PIPE LENGTHS		
HEIGHT OF DAM FEET	SLOPE 2-to-1 FEET	SLOPE 3-to-1 FEET	HEIGHT OF DAM FEET	SLOPE 2-to-1 FEET	SLOPE 3-to-1 FEET
5	38	48	13	70	96
6	42	54	14	74	102
7	46	60	15	78	108
8	50	66	16	82	114
9	54	72	17	86	120
10	58	78	18	90	126
11	62	84	19	94	132
12	66	90	20	98	138



—Diagram is a side view of incomplete dam, showing grade stakes set for the next foot of fill. "G" is the remaining height of dam to be built above the established 1-foot grade stakes.

The ditch for the drain pipe should be straight and sloped approximately one foot per 100 linear feet.

SIZE OF DRAIN PIPE

The size of the drain pipe depends upon the size of the pond and upon the volume of water coming into the pond. A 4-inch pipe takes approximately 60 hours to drain a one-acre pond that has an average depth of 3 to 4 feet if no water enters the pond during the time of draining. A 6-inch drains the same pond in half that time, while a 12-inch drain requires one-ninth as much time. For ponds with areas up to 3 acres, use a 4-to-6-inch drain. For ponds up to 15 or 20 acres, use a 8-to-12-inch drain.

TYPES OF DRAIN PIPE

After the drainage ditch is dug and given the proper slope, the drain

pipe is laid. There are several different types of pipes adapted to use as drains. Asbestos-cement pipe, commonly called transite, is probably the best type to use because it is very durable, comes in long lengths, and may be obtained in various diameters. Cast iron pipe, with the joints sealed with oakum and lead, makes a very good drain. Galvanized pipe may be used in small ponds and minnow hatcheries.

Terra cotta pipe and concrete tile should never be used as a pond drain pipe because they will crack under slight pressure or movement.

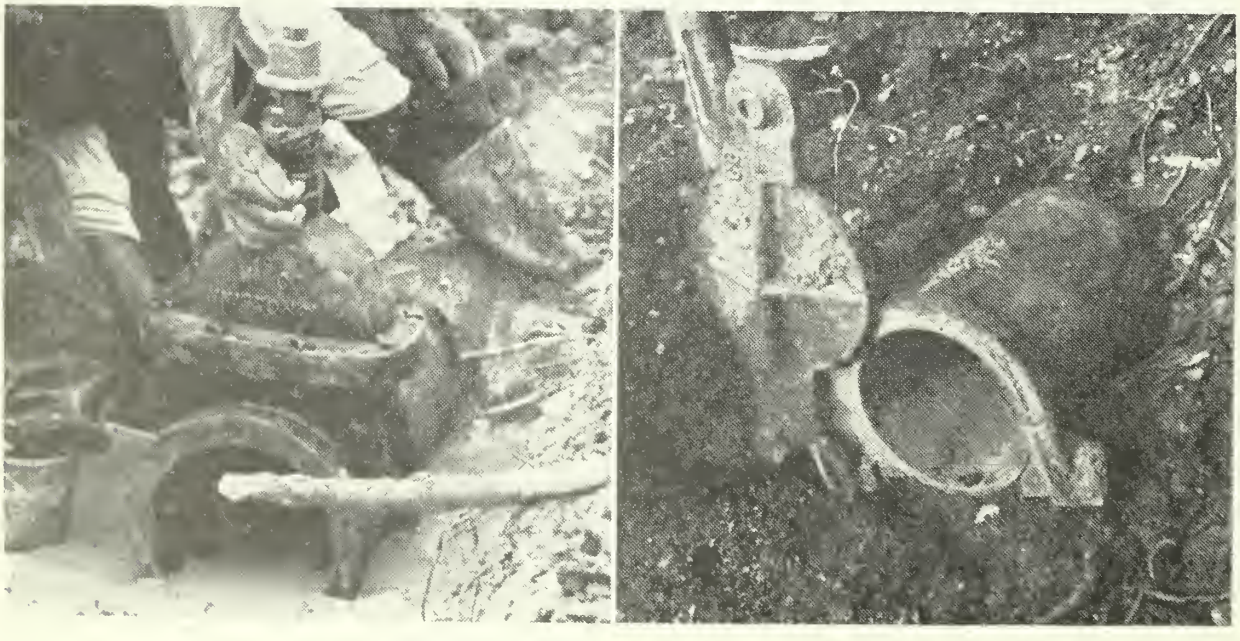
PREVENT SEEPAGE ALONG DRAIN PIPE

Several ponds have had serious trouble from seepage along the drain pipe that slowly and gradually became larger until the ponds had to be drained and the drain pipes fixed properly. Therefore, all asbestos-cement pipe drains and cast-iron pipe, assembled with mechanical or prepared joints, should be anchored in the sides and the bottom by concrete cut-off collars, spaced at 15-foot or less intervals along the pipe to prevent seepage. Clay should be packed around the pipe.

THE TIME AND PLACE TO INSTALL VALVE

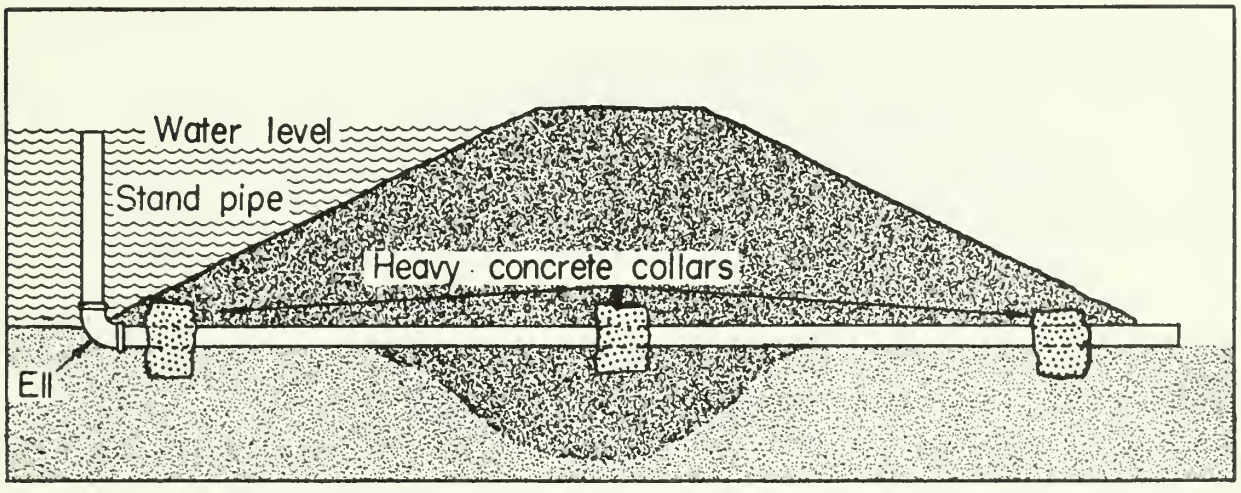
The valve may be placed on the drain pipe when it is laid, or it may be installed after the dam is completed. The location of the valve, whether inside or outside the pond, depends upon the type of valve and the type of connections of the drain pipe. If the joints are sealed with concrete collars, the valve needs to be located on the upstream end of the pipe because water pressure may be great enough to start a leak and seepage if the valve is on the downstream end. If the joints of the pipe are leaded or mechanical,

CONNECTING THE VALVE TO DRAIN PIPE



The brass-fitted gate valve at left is being set into place over the pond end of an asbestors-cement drain pipe. Shown at the right is a brass-fitted shear gate valve. The wedges hold the flap tightly closed.

it is safe to locate the valve on the downstream end, provided, a gate valve is used. The shear gate valve, the flap valve, and the ell with a stand pipe must be placed inside the pond on the upstream end of the drain pipe.



Cross-sectional diagram shows how threaded pipe with an ell may be used for a pond drain, eliminating the use of a valve. Heavy concrete collars must be placed at about 15-foot intervals to prevent the pipe from turning and prevent water from seeping along side of the pipe.

After the valve is connected, whether by collar and bolts or by oakum and lead, a heavy concrete footing must be poured around the collar to withstand the pressure that will be exerted when the valve is opened.

WATER SUPPLY FOR LIVESTOCK

Cattle, hogs, and horses should never be allowed to wade in the pond; they trample the pond edges, roil the water, and cause the water to become muddy. The pond should be fenced off to make it inaccessible to livestock.

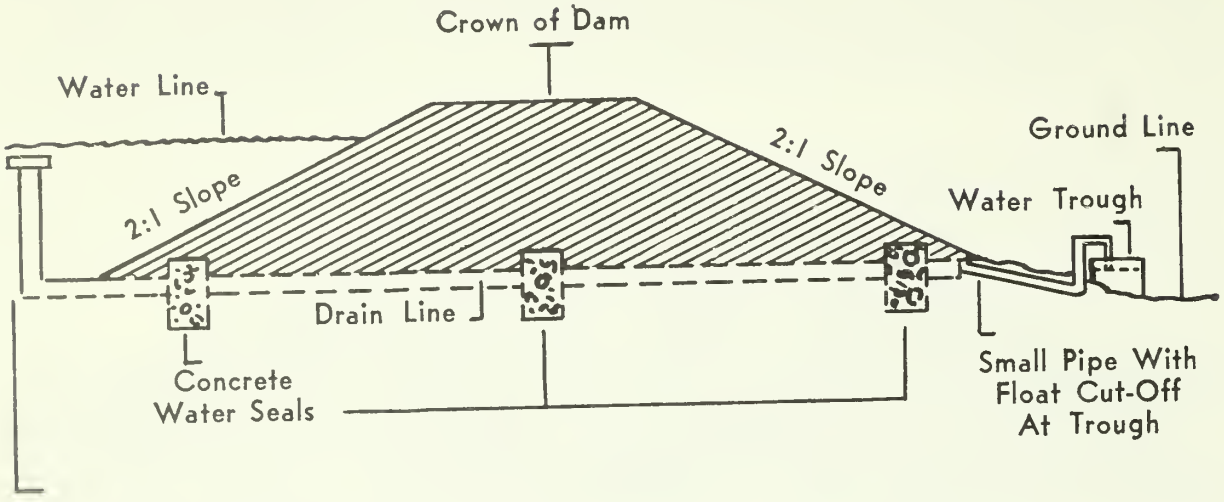
The stock water tank should be located on the downstream side of the dam. The tank or watering trough may be made of concrete, metal, or wood, depending on the desires of the owner. It should be equipped with a float valve to control the flow of water into the tank. Provision should be made for draining the tank during the winter months to protect it adequately from freezing and to facilitate cleaning.

The water line should be laid at the same time the drain pipe is laid. A 1½-to-2-inch galvanized pipe will usually be large enough to carry an ample supply of water for livestock. Protection against seepage should be taken by installing concrete collars spaced at 15-foot intervals.

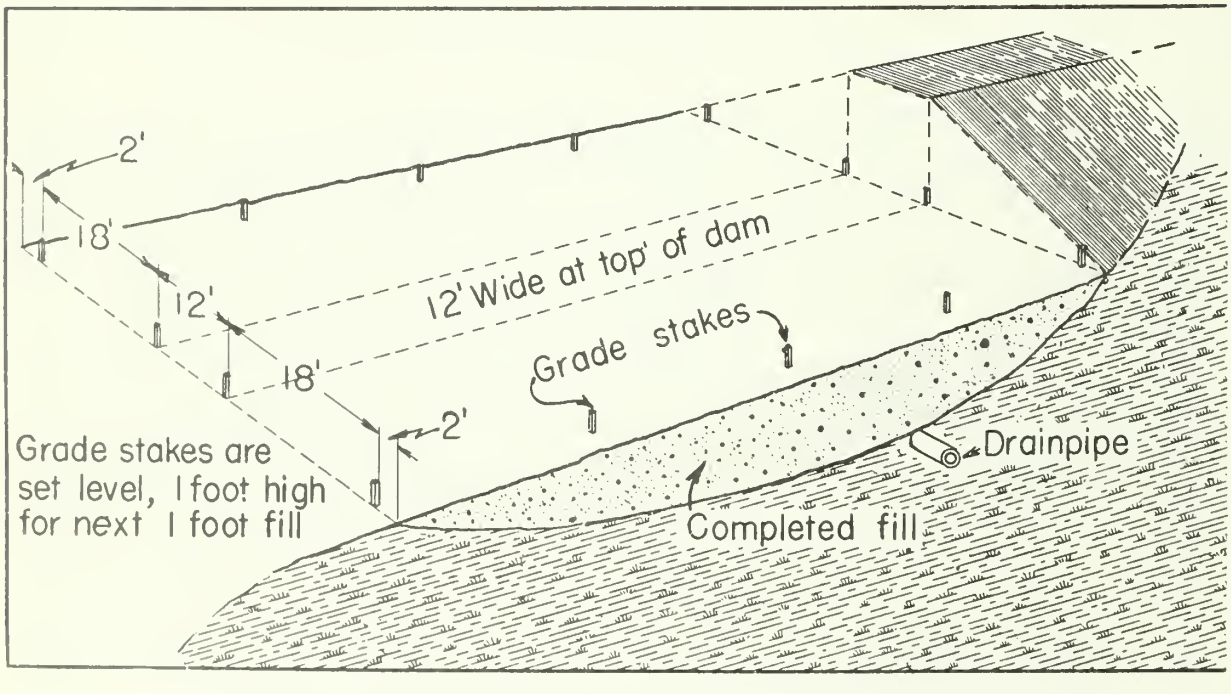
Outlets for irrigation, fire protection and other farmstead purposes may be installed in a similar manner.

FILLING THE DAM

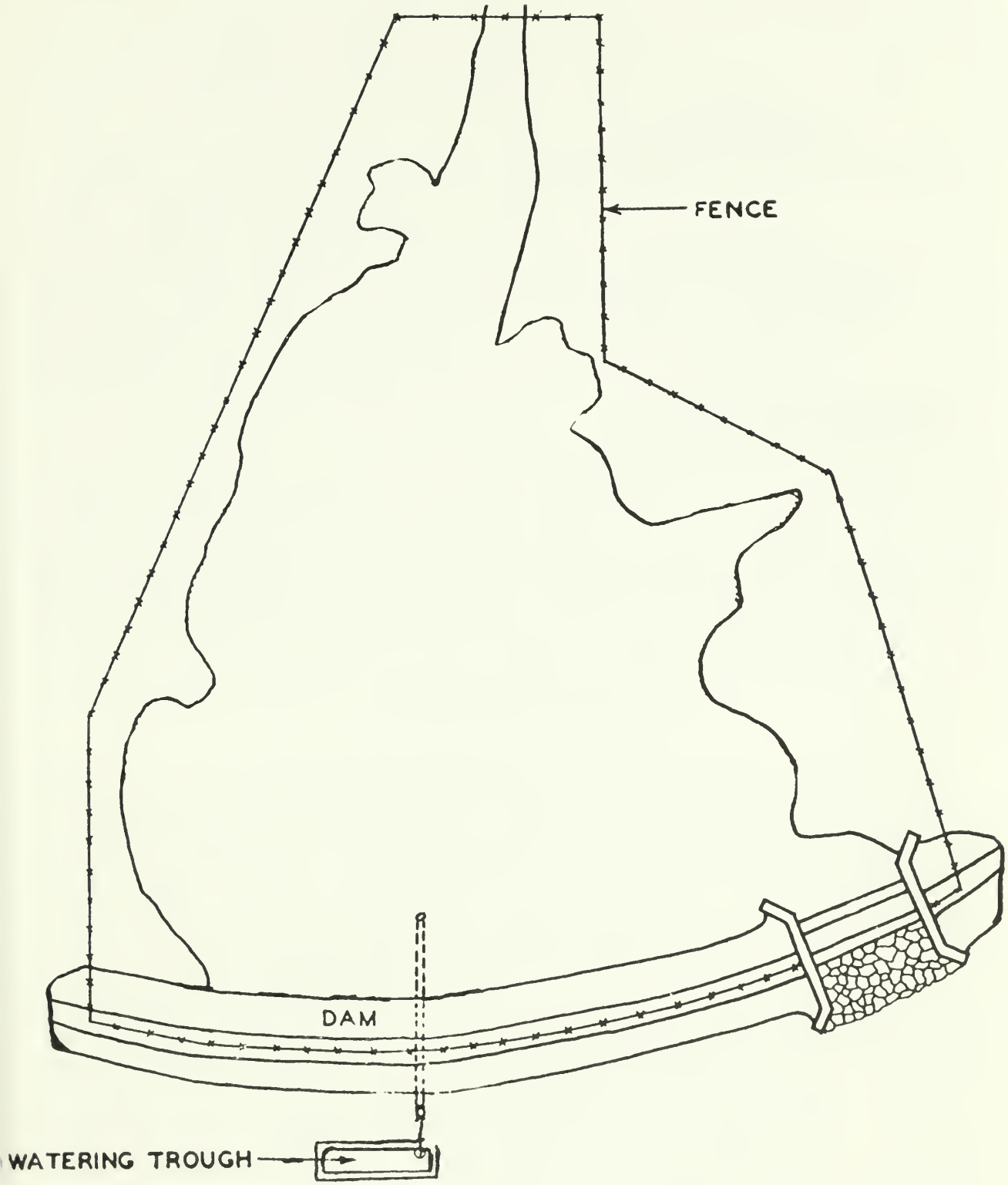
A good type clay is needed to build the above ground portion of the dam. Best results are obtained when the clay is applied in thin layers and well packed. The clay should be free of leaves, roots and trash.



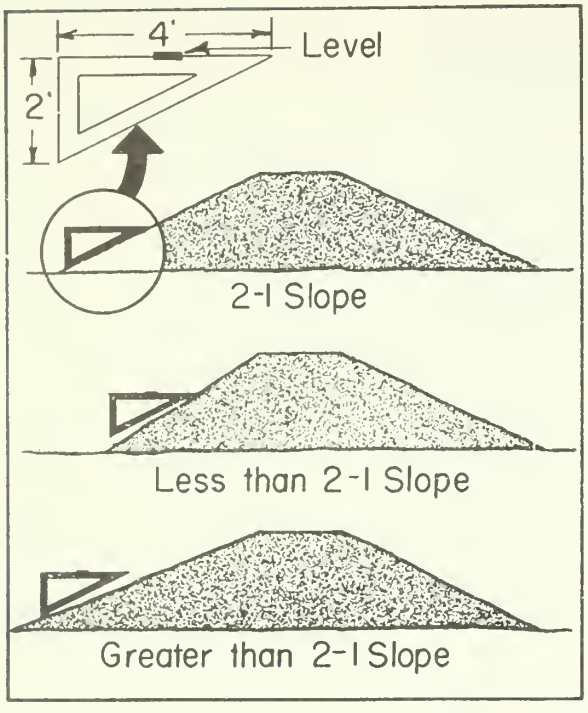
CROSS SECTION OF DAM
Showing
Water Line And Water Trough For Watering Livestock



Perspective view of Figure 14 shows position of stakes on fill.



—Drawing of assumed lake showing how pond should be fenced. Notice spillway is placed to side to release water sufficiently downstream to prevent water current from back washing levee.



—Diagram shows use of home-built triangle-level that may be used in maintaining the 2-to-1 slope.

PROPER SLOPE OF DAM

Dams up to 20 feet in height need a 2-to-1 slope on both the upstream and downstream side to hold dirt in place and prevent slides when wet. One of the common faults in constructing earth dams is failing to make the base wide enough to allow for adequate slopes and top width. All dams constructed above 20 feet in height must have a 3-to-1 slope. The top width of a dam should be 12 feet if the dam is to be built with large and heavy equipment. If teams and slip-scrapes are used to build the dam, the top width should not be less than 6 feet. When the dam is completed the top should be level from one end to the other. Be sure to pack firmly the topmost 3 or 4 feet of filling to prevent settling of the dam. If heavy equipment isn't used, one can expect a 10 percent shrinkage in new dams.

FREE BOARD

The height of a dam above the water level is known as free board. Ponds that have from one to 3 acres of water should have 2 feet of free board. The ponds that are larger than 3 acres in size should have at least a 3-foot free board because of wind-wave action.

DEEPENING THE POND EDGE

A most serious mistake pond owners made in the past was failing to deepen the edge all around the pond, especially in the upper end. Where water runs out to a feather-edge in depth, weeds are always going to grow.

As stated before, underwater weeds in a pond cause an overcrowded fish population and make for poor fishing. Therefore, steps should be taken while constructing the pond to deepen the edges all the way to the upper end. This is done by staking the water line and then cutting the dirt away from inside the stakes until at least 18 inches and preferably 2 feet in depth is reached. If the pond is to be used for irrigation or watering stock, deepen the edges to 3 feet to take care of fluctuation. This excess dirt may be used either to fill other areas where it is too boggy for the tractors to work or to spread above the water line to give a higher bank. In small ponds, a goodly portion of the pond edge may be deepened and the dirt used in the dam. The deepening of the edges slightly increases the area of the pond and volume of water.

THE SPILLWAY

The main cause of dams being washed away after big rains is that the spillways are not wide enough. Since the spillway is the main insurance of the dam, it should be wide enough to take care of the maximum amount of flood water that can be expected. The water should never pass over the spillway at a greater depth than 3 to 6 inches.

Another important and interesting thing to know is that a large percentage of the fish population leave a pond where the spillway is so narrow that the water goes out at great depths. As an example, over 95 percent of the fish left a half-acre experimental pond of the Alabama Agricultural Experiment Station Fishery School during one heavy rain when the water flowed out of the spillway to a depth of 2 feet. Practically no loss of large fish occurred in a nearby pond where the spillway capacity was large enough for the water to pass out at a depth no greater than a few inches.

DANGER OF SCREENS

The danger of putting screens in the spillway is that they invaribaly become clogged with leaves and trash during heavy downpours. The final result is a washed out screen or flood water over-tops and washes out the dam. Providing adequate width in the spillway offers a much safer and more satisfactory solution. Be certain to construct a spillway wide enough so that the heaviest floods will not pass over the spillway to more than 3 to 6 inches in depth. Screens are needed only during the first year to keep small bream and bass from escaping during heavy rains.

ESTIMATING SPILLWAY WIDTH

A good method of estimating the necessary width of a spillway is to observe the driftwood and trash on the banks of the stream for indications of the highest flood in the area. Measure the width and get the average depth of water that produced this drift. From these measurements, the width of the spillway necessary to handle this volume of water in a thin sheet may be estimated. Suppose, for example, after an extremely heavy rain a stream flooded and left deposits of driftwood on the banks that were 12 feet apart. The average depth of water across this area during the crest of the flood was one foot. This one-foot depth is divided by 3 inches (desired depth of flow in spillway) to give a workable factor of 4. The 12-foot width is then multiplied by 4 to give a spillway width of 48 feet.

Another method to determine the width of a spillway if the drainage area is less than 50 acres is to take the total number of acres and divide it by 2 and add 10 more feet as a safety margin. As an example, suppose that the drainage area is 40 acres. Dividing 40 by 2 gives 20 and adding 10 feet of safety margin gives a spillway of 30 feet in width.

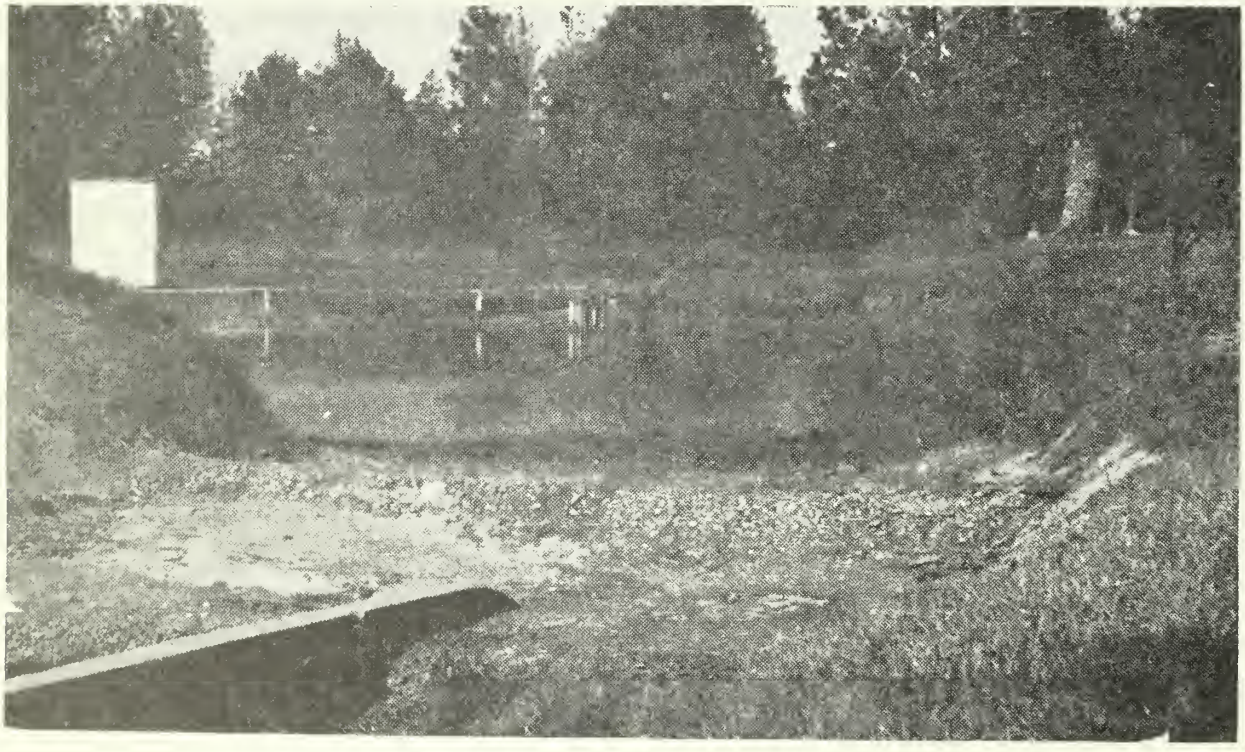
LOCATION OF SPILLWAYS

The hillsides at ends of the dam are natural places to locate spillways. Sometimes a great deal of grading has to be done to get the necessary

width to handle the flood water in a thin sheet. However, this grading is well worth its cost in providing protection to the fish and to the dam. The spillway may be located at one end or both ends of the dam or at a convenient point along the side or sides of the pond.

CONSTRUCTION OF SPILLWAY

The spillway should be paved with rock, concrete, or covered with a good sod. Whatever method is used, the entire width should be level so water will not go out at different depths. All of a concrete spillway should be poured at one time. The sod spillway should have a grade of 0.2-foot fall for each 100 foot to prevent too much erosion. The floor and slopes should be seeded or sprigged to a good permanent grass to reduce erosion. Centipede grass is recommended for Georgia. The Soil Conservationist or County Agent can well advise as to the type that will do best on a particular soil. The edge of the water at the spillway should be riprapped with stone or rocks.



This concrete spillway for a 1.3-acre pond has a low wall across it to obtain desired water level in the pond. The entire floor is paved to prevent erosion and the end of dam is faced with concrete to prevent flood water damage.

DIVERSION DITCH

It is impractical to fertilize and manage ponds for high fish production where there are excessive amounts of water entering and leaving the pond. Ponds built on sites with too large a drainage area become flooded after heavy rains and often stay muddy most of the year. If the topography of the land is such that a diversion ditch may be constructed around one or both sides of the pond, the water may be controlled for complete utilization of the fertilizer and complete control of the fish population.

A diversion ditch is built on hillside to by-pass excess water around the pond. This ditch is sodded to prevent erosion.

DIVERSION DITCH AND DAM

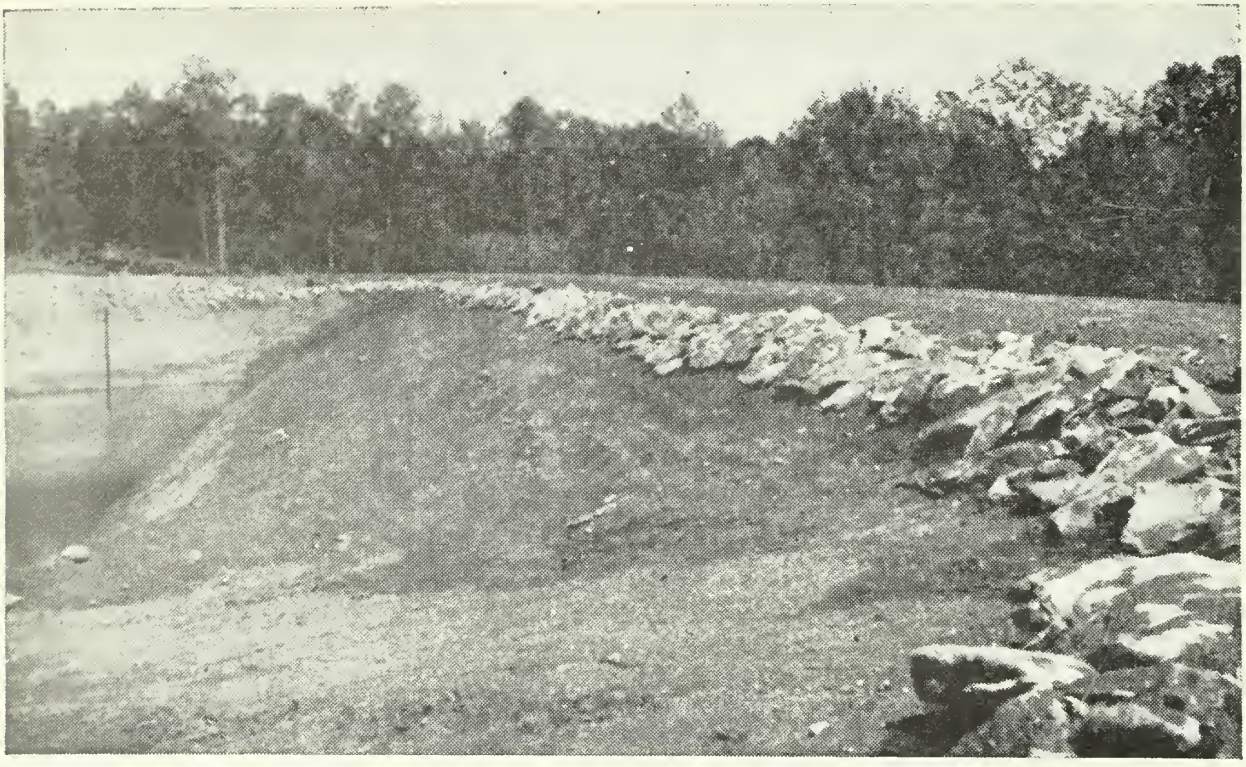
—A pipe with a valve is used for controlling the water entering the pond through the diversion dam.

Plan the diversion ditch and dam prior to constructing the dam, since some of the clay from the ditch may be used in building the dam. In planning a diversion ditch for a pond, the first thing necessary is to locate the site for the diversion dam for collecting the water in the channel before it enters the pond. The diversion dam must be located at a height above the water level along the old water channel to allow 0.2-foor or more of fall per 100 linear feet of ditch around the side of the pond. The diversion ditch is then laid out from the diversion dam around one side of the pond to a safe distance below the main dam to prevent damage.

PREVENTING EROSION OF DAM

Wind-waves are often large enough on big ponds to cause severe erosion above and below the water line. Large rocks or stones laid along the dam approximately a foot above and below the water lines will prevent erosion of the dam. If rocks are not easily obtainable from a nearby source, a concrete apron from 4 to 6 inches thick extending above and below the water line the length of the dam will serve the purpose.

A log wall along the edge of the water of the dam will break the waves and prevent erosion. If logs are used they should be at least 10 inches in



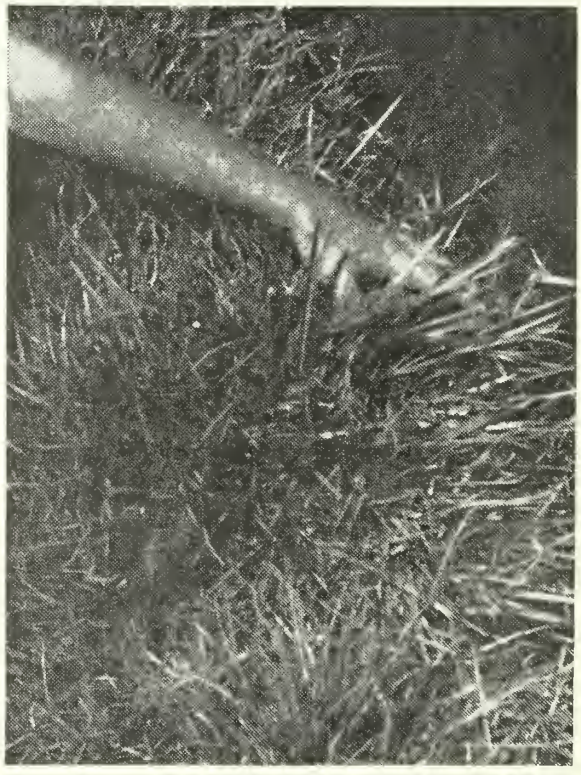
Water line riprapped with rocks 1 foot above and 1 foot below water line.

diameter and as long as you can get them. The logs are held in place by driving stakes on each side, or by driving stakes and tying the logs by means of wire or cable to the stakes.

SODDING DAM AND EDGES

It is wise to spread a thin layer of topsoil over the dam, with the exception of the portion that will be covered with water, and plant grass upon it by seeding or sprigging.

In Georgia, centipede grass has been found to be the best grass to sod the dam and the pond edges. The upkeep of this grass is approximately one-half that of other grasses. Centipede grass is thick sod grass that spreads by runners and does well on moist to dry soils. It seldom grows to a height of 6 inches and requires very little mowing. It is especially good for erosion control. For best results, fertilize it well but do not use heavy applications of nitrogen. Where ponds are located in pastures centipede grass should not be used as it will replace more desirable pasture plants.



Shown here is a pond edge sodded with centipede grass.

Second to centipede grass for sodding dams is bermuda grass. The main objection to bermuda is that it sends runners into the water sometimes for a distance of 3 feet, forming a thick sheath or mass of grass where small bream hide.

KILLING ALL ROUGH FISH

Before the drain valve is closed and the pond begins to collect water, the little branch or spring stream should be poisoned to kill all undesirable fish such as suckers, carp, catfishes, perch, and shad. In very small streams, as small as one foot in width and only a few inches in depth, there are nearly always found a few suckers and catfish. The pond should contain only those species secured from the hatcheries.

FILLING THE POND

Because filling the pond is the main thing, I repeat these precautions: The pond should be constructed during late summer or fall, so the pond will be ready for fish during the fall and to prevent bushes and weeds from covering the pond area again. If the pond is constructed at any other time of the year, the pond should not collect water until early fall because with no fish the owner will not want to fertilize the pond. Therefore, underwater weeds will occur if the pond is full of water and not fertilized. With no water in a pond that was constructed in the early spring, bushes will grow and will have to be removed before the pond is filled; however, the removal of bushes is cheaper and easier than ridding a pond of underwater weeds.

GAMBUSIA MINNOWS (MOSQUITO FISH)

Gambusia minnows help to control mosquitoes the first year. After the first year they are not needed. They can usually be obtained from old ponds that have shallow edges and weeds. Try to secure 100 gambusia minnows for each acre of the new pond. Do not add golden shiners (roaches) or the gizzard shad as they will become too large to be eaten by the bass and are of no value for human consumption.

FLOATING TRASH

A few days after the pond has been filled, the floating trash will be blown to the banks. This trash should be removed with forks or rakes to make mosquito control by the fish more effective.

CHAPTER 4

STOCKING

IMPORTANT THINGS TO KNOW BEFORE STOCKING

Of first importance before stocking a pond is knowing the size of the pond to the nearest one-tenth of an acre. Every pond should be surveyed for two reasons: (1) To stock the proper number of fish so they will grow to a large size in a comparatively short time. (2) To know how much fertilizer should be applied each time so you will not supply too much nor too little with each application.

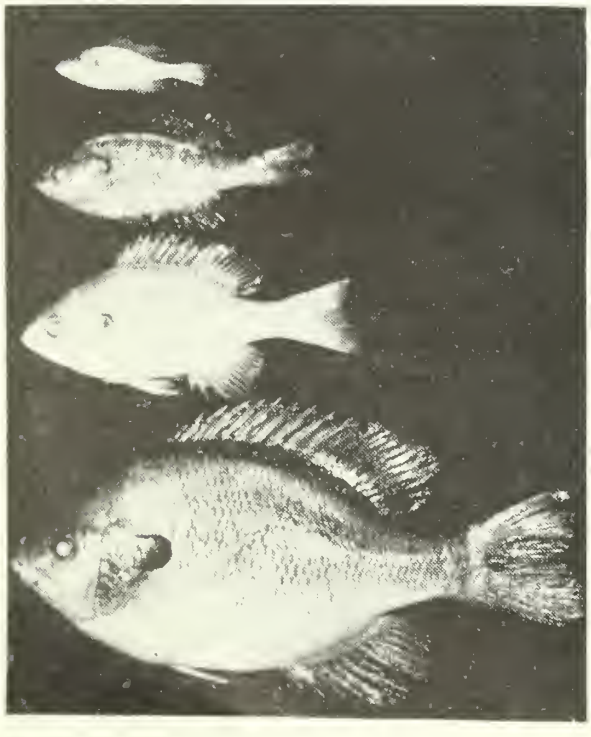
COUNT THE FISH THAT ARE TO BE STOCKED

The number of fish added to a pond should actually be counted to get neither too many nor too few. This can be done without injury to the fish, by using a dipper and counting the fish as they are poured into the pond. It is just as important to get the proper number of fish to reach a high production as it is to plant corn properly to produce corn of a high yield.

USE ONLY HATCHERY REARED FISH

All your stock fish should be hatchery reared fish that are free from diseases. Wild fish secured from a stream, frequently are infected with one or more kinds of diseases. As an example, fish captured from the Chattahoochee River during the year 1951 by several fishermen were stocked in a one acre pond. Within 3 months, most of the fish died from tail-fin rot, eye-fluke, fungus, and anchor parasites.

The fish used to stock a pond should all be fry or fingerlings-size.



Stocking with adult fish vs. stocking with fingerlings. The three bluegills at the top represent the relative average sizes after 1 year (0.06 ounce) 2 years (0.4 ounce) and 3 years (0.8 ounce) in a pond stocked with adult bluegills, crappie, and bass. The fourth bluegill shows average size (4 ounces) reached in 8 months when the pond was stocked with the correct number of fingerling bluegills and bass.

ADULT FISH STOCKING

The stocking of adult fish in ponds is not satisfactory because certain species usually become over-crowded, while other species may fail to reproduce.

MIDSUMMER STOCKING OF BLUEGILLS IN FISH PONDS NOT DESIRED

In seventeen experiences, ponds stocked with bluegills during midsummer and with bass the following spring were found to be over-crowded with bream to such an extent that both bream and bass had stopped reproducing. These ponds furnished practically no fishing.

The main problems in raising fish in ponds are as follows:

(a) Production of fish food.

(b) Management of the fish population so that the correct number are present to efficiently utilize the food produced. In a well managed pond 70 percent by weight, or higher, of the fish population will consist of edible size fish.

RESULTS OF OVERSTOCKING

One of the most popular misconceptions is the belief that placing vast numbers of fish in a pond will increase fishing. Some people, it seems, desire 50% fish and 50% water. In some respects as to food supply, fish are no different from livestock, and a pond (an aquatic pasture) is just like a terrestial pasture, capable of producing so much food for so many livestock. If we had 2 ponds just alike and stocked one with 1,000 fish and the other with 10,000 fish, and drained them after a year, we would find that the total pounds of fish recovered from both ponds would be about the same. Except that the pond having 1,000 fish would have catchable and edible size fish, while the over-crowded pond would have stunted or runted fish.

RESULTS OF UNDERSTOCKING

An understocking of bass cannot prevent an overpopulation of bluegills. When bass are too few, the early-hatched bluegills grow rapidly until they reach the capacity of the pond and stop growing. These halfgrown bluegills, or intermediates, are large enough to multiply. Yet they are not big enough for the frying pan, and they are too big for the bass to eat; therefore, neither bass nor fishermen reduce the blue gills to a reasonable number. The bass will lay eggs, but fail to reproduce because the thousands of half starved bluegills eat the eggs of the bass. Consequently, fishing is poor because few bass have more than they need to eat and the many bluegills are too small for the table.

An understocking of bluegills is also a mistake. A few adults placed in the pond cause an overpopulation condition of blue gills. A single pair may

raise 5,000 to 20,000 fingerlings or 3-inch fish. Since a pond can produce only so much food, even though it is fertilized, the pond cannot have enough food to grow such large numbers to large size bream. It is well to remember that no more than 1,500 bluegills can reach usable size in a properly fertilized one-acre pond.

MANAGE YOUR POND AS YOU WOULD A CORN CROP

The primary purpose of managing a pond is to produce good fishing. To provide good fishing, the pond must be stocked and managed in such a manner that the maximum number of fish will be large enough to catch and large enough to eat. The small fish should be 30 percent or less of the total weight of fish to take the place of those caught. If one allows most of the weight of fish in the pond to be tied up in small undersized fish, one might as well stay at home or at work, as very small fish will be one's catch. One can produce poor fishing in several ways: (1) By stocking too many fish; (2) stocking too few fish; (3) leaving bass out of the stocking combination; (4) not stocking the bluegill bream; (5) improper construction resulting in many underwater weeds; (6) not removing enough fish annually from the pond; (7) stocking with adult fish; (8) improper or no fertilizing if stocked for a fertilized pond; (9) putting in fish that are known not to be suitable; (10) allowing too much water to pass through the pond; (11) and failing to poison out the wild stream fish before stocking with hatchery fish.

Quite a few people seem to think pond waters can be stocked in any way, and nature will overcome all obstacles. It does not work out. Incorrect stocking is the chief cause of poor fishing in most ponds and lakes. There are a hundred ways to stock fish ponds to assure failure, but only a few ways to assure successful fishing.

PROPER SPECIES FOR NEW PONDS

In order to produce good fishing, the pond must be stocked with the proper kinds and numbers of fish. There are several species of bream, as there are several species of cattle. There are only a few species of cattle that are considered good beef types, while there are several species that are considered scrub types. The scrub type will eat as much food as the good beef type, but the scrub type will not put on as much weight per ounce of food consumed as will the good beef type. After careful study of all the bream, biologists consider the bluegill 'the beef type". It is able to sustain itself better year after year than other species of bream. By the end of the first year, if properly stocked, bluegills average about one-quarter of a pound in weight.

Largemouth bass should also be raised in all ponds in Georgia, since their presence has been found necessary to prevent a pond from becoming overcrowded with small bream. By the end of the first year, if properly stocked, the bass average about one pound.

FOR BEST RESULTS IN CATCH, STOCK WITH ONLY BLUEGILL AND BASS

One of the main purposes of a pond is to enable the fisherman to catch as many fish as possible during each hour of fishing effort. Another popular and erroneous idea is to stock the pond with every possible kind of fish. Such persons assume if they cannot catch bass, they should be able to catch bream; if not bream, then crappie; if not crappie, then they feel they should be able to catch catfish or some other species. They are wrong. Ponds stocked only with bass and bluegills give better catches than those stocked with three or more varieties. This means that every time an additional species of fish is added to the bass-bream ratio, one reduces the number of fish that can be caught per hour of effort. This has been proven every time over a period of several years.

Ponds stocked with species other than largemouth bass and bluegill bream very seldom produce continuous fishing. No other combination is as simple to manage as bass and bluegills, and experimental results at the Alabama Agricultural Experiment Station Fisheries School in over 100 ponds over a period of 25 years have proven no combination of fish as successful.

Ponds that are improperly constructed, incorrectly and insufficiently fertilized, will get out of balance. If not enough fish are removed yearly, ponds may become overpopulated by bream or by bass. Either upsets the balance of the pond and causes poor fishing success.

Every new pond before the end of its second year of life should be checked by a Fisheries Biologist to see if the fish ratio is or is not in balance. There are certain steps to take to adjust the ratio of one species to the other if the ratio is out of balance. The sooner the condition is known the easier and quicker it is to correct.

STOCKING RATIO

The correct stocking ratio per acre of water is given below for both fertilized and unfertilized ponds. Small unfertilized ponds have proven unsatisfactory in Georgia because they support a relatively small number of edible size fish, and usually become filled with weeds if the pond doesn't remain muddy most of the time.

COMBINATION A. Bluegill Bream and Largemouth Bass

Fertilized Pond: 1,000 Bream fingerlings added during fall or winter. 100 Bass fingerlings added same fall or winter, or 100 fry the following spring.

Unfertilized Pond: 500 Bream fingerlings added as above. 50 Bass fingerlings or fry added as above.

COMBINATION B. Bluegills, Shellcrackers, and Largemouth Bass

Fertilized Pond: 850 Bluegills added as in previous section. 150 Shell-

cracker fingerlings added the same time as bluegills. 100 Bass fingerlings or fry added as in the previous section.

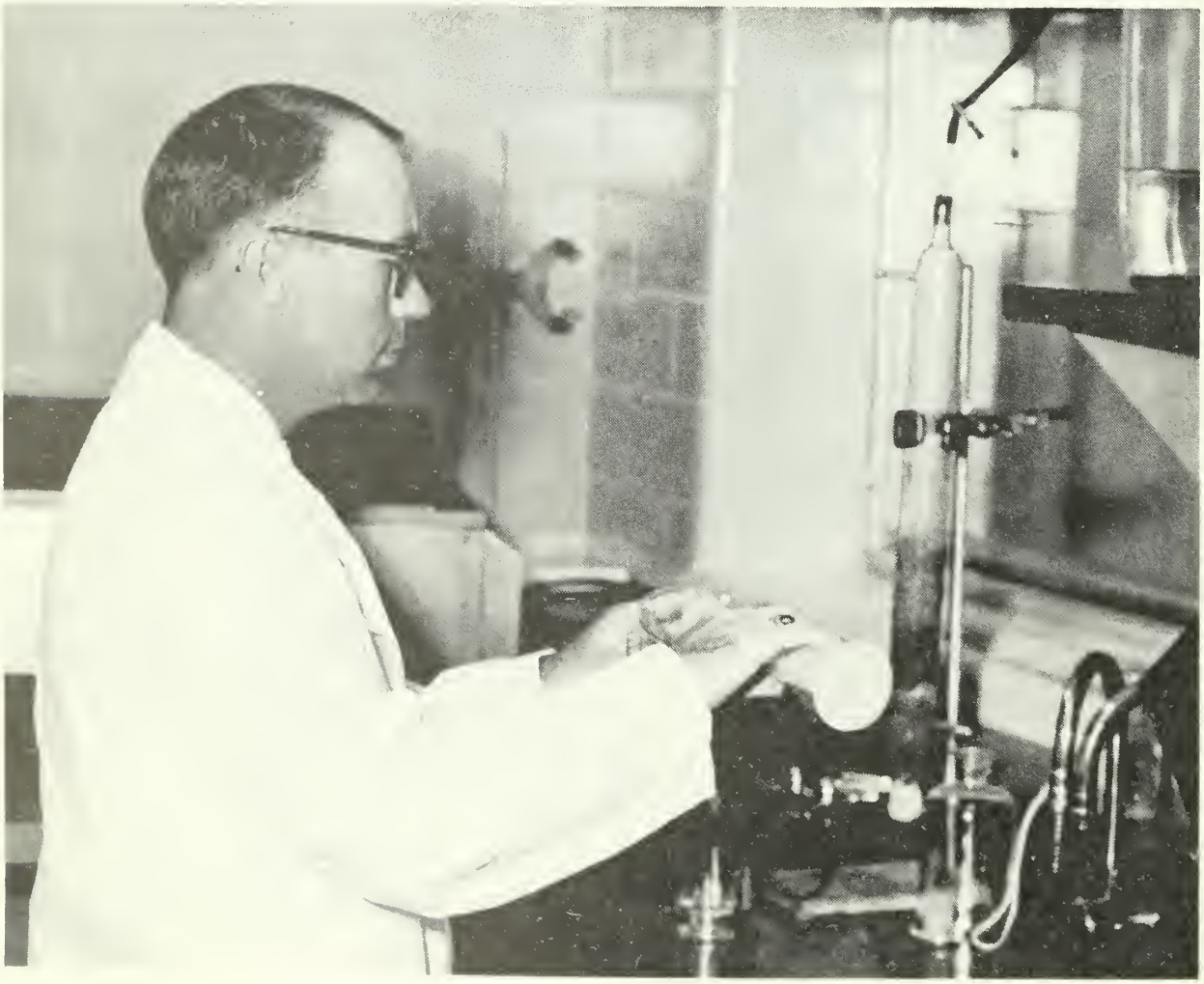
Unfertilized Pond: 400 Bluegills added during fall or winter. 100 Shellcrackers added the same time as bluegills. 50 Bass fingerlings added during same fall, or 50 Bass fry added the following spring.

WHY BREAM AND BASS MUST BE STOCKED

In order to get a yearly high crop of desirable size fish, the pond must be stocked with a type of fish that feeds on insects, microscopic plants and microscopic animals. The bluegill is the sole forage fish recommended. Also, the pond must be stocked with fish that feed on small fish. The largemouth bass is the sole carnivorous fish.

If a pond is stocked with only shellcracker bream and bass, the bass will eat practically all the shellcrackers within 3 years, but if the shellcrackers have the bluegill bream added as a buffer to help supply bass food, then the shellcrackers will be able to reproduce. It is not advisable to have the number of shellcrackers consisting of more than one-fifth of the total bream population.

Golden shiners, carp, or gizzard shad **should not be placed** in ponds intended for the propagation of game fishes. They will overpopulate the pond and use the food the game fish should get. Also, the two latter species become too large for the bass to eat.



CHAPTER 5

FERTILIZATION

IMPORTANCE OF FERTILIZING PONDS

One of the most important factors in fish management is that of providing enough food.

Fertilization of pond waters is the only practical method known by which the weight of fish that the pond can support may be **increased.** Properly fertilized ponds in Georgia support 4 to 20 times as great a weight of fish as unfertilized ponds; consequently, fertilized ponds can give much better fishing.

Three things are accomplished when a pond is fertilized. First, it increases the production of food for fish; second, it controls submerged weeds; and third, it makes fishing more successful.

There are two types of ponds that cannot be fertilized economically—those that stay muddy and those through which excessive amounts of water flow during the growing season. Ponds of the latter type can often be fertilized after the spring rains are over or during dry periods. For best results, there should be little or no overflow from the pond.

HOW FERTILIZING A POND INCREASES FISH PRODUCTION

The fish do not eat the fertilizer; the fertilizer is rapidly dissolved by the water. These nutrients added to the water cause a growth of microscopic plants called algae. The microscopic algae provide food for insect larvae and water animals that are in turn eaten by the forage fish, such as bluegills, catfish, and small crappie.

Nearly everyone is aware that fish eat fish, crayfish, worms, bugs and other animals large enough to be seen and known, but they do not know of the hundreds of species of plants and animals, microscopic or slightly larger in size, that are just as essential to the daily diets of fish as the larger items. They constitute the food eaten by the young fry of all types of fish and by some fish throughout their lives. These small plants and animals are called **plankton** by biologists. In order to distinguish between the plants and animals, scientists have designated the plants as **phytoplankton** and the animals as **zooplankton.** The phytoplankton consist of algae and bacteria. The zooplankton consist most frequently of protozoans (one-celled animals), rotifers (wheel animalcules), and crustaceans (water fleas, copepods, ostracods, etc.). Next in size, we find the benthos organisms that are also known as bottom fauna. This group consists of midge larvae and pupae, also called blood-red worms; large crustaceans such as scuds, the nymphs of dragon flies, damsel flies, may flies, etc. The bottom fauna feeds upon the phytoplankton and zooplankton, and is in turn eaten by the forage fish, which are in turn eaten by the bass and other carnivorous species. The life cycle within a pond runs in a definite order from smaller to larger

organisms, and each succeeding group depends upon the preceding for the synthesis of its food supply. The abundance of these organisms is dependent upon the amount of available inorganic matter, as nitrogen, phosphorous, and potash in the water.

COMMERCIAL FERTILIZER PREFERRED

Better results are obtained in fish production from the use of inorganic or commercial fertilizer than from the use of organic types as manures, cottonseed meal, and hay. Great care must be exercised in the use of organic fertilizers as a serious depletion of the oxygen content of the water is likely to result in death of the fish. Using proper formula and amount of commercial fertilizer produces a quicker effect, is more dependable in shading the bottom, thereby preventing growth of undesirable underwater weeds (pond moss), and is more productive than the organic types. The organic types have a tendency to support the undesirable pond scums, which may have a disagreeable odor.

Feeding fish with stale bread, grain, or other foods is a great deal less efficient than fertilizer and is really not worth the effort or expense. Practically the only benefits that might be derived is the pleasure of watching the fish eat.

THE KINDS AND AMOUNTS OF FERTILIZER TO USE PER ACRE

Two grades of commercial fertilizer is available in Georgia for fish ponds. These are 8-8-2, and 20-20-5. Either is acceptable, but the amount to use per acre will vary with the analysis chosen. With 8-8-2, the amount is 100 pounds per acre per application. With 20-20-5 the rate is 40 pounds per acre per application. Average number of applications of fertilizer for Georgia fish ponds is 10-12 applications annually.

WHEN TO FERTILIZE AND HOW OFTEN

The first application of fertilizer should be made during the first warm weather of spring (usually March in Georgia). Under normal conditions between 24 and 36 hours after fertilizer has been applied, the water develops a good growth of algae. That is, the water will appear green or brown due to the growth of microscopic plants. Sometimes a pond may not turn green or brown after the first application of fertilizer due to the lack of carbon dioxide. Make weekly applications until the greenish or brown cast appears. Subsequent **applications should be made whenever the water begins to lose this green or brown color and becomes clear enough for the bottom of the pond or for your hand to be seen at a depth of 12 to 18 inches of water.** This usually requires an application every 3 to 5 weeks. The last application should be made when the water begins to turn cold. This is usually in the latter part of September or sometime in October. The pond should receive from 7 to 15 applications of fertilizer each year.

HOW TO APPLY THE FERTILIZER

If the pond is one to 3 acres in size, the fertilizer may be broadcast from the bank into the pond by going all the way around the pond. If the pond is larger than 2 acres, the fertilizer may be applied easily from a boat. Place a few short boards across the front end of the boat and place a sack of fertilizer upon them, and let the fertilizer pour out in a thin stream while the boat is paddled or driven around the edge. As an example, if you have a 5 acre pond, you will need to apply bags of fertilizer at each application. Let each bag of fertilizer be applied each one-fifth the distance around the pond. It is best placed in water from 2 to 4 feet in depth. The movement of the water caused by winds will circulate the fertilizer throughout the pond. The winds blow the top water in one direction, causing an undertow in the opposite directions; therefore, there is no need to criss-cross the pond while applying the fertilizer.

COST PER ACRE TO FERTILIZE THE POND EACH YEAR

Costs of fertilizing ponds vary, but the cost is from $20.00 to $30.00 per acre each year on small ponds, and only slightly higher on larger ponds. Ponds that receive nutrients from fertilized pastures certainly will need less fertilizer than a pond that does not receive any nutrients. Where one catches from 150 pounds to 200 pounds of fish from each acre, the cost of fertilizer is more than justified in recreation and food.

FERTILIZER SUPPLEMENTS

In addition to regular fertilizer applications, recent studies by fishery biologists have shown that a large number of ponds in Georgia also need lime treatment. Slight acid conditions in ponds make the fertilizer unavailable, treatment. Slight acid conditions in ponds make the fertilizer uneffective, and treatment with lime is necessary. Ponds and lakes that require excessive amounts of fertilizer to produce a green color probably should be checked by a fishery biologist to determine if lime applications are necessary.

Fisheries work has shown that about one ton of agricultural lime per acre is sufficient to produce good results from fertilization. The lime should be broadcast as evenly as possible over the entire pond. Lime treatment of this nature usually will last 4 or 5 years before re-treatment is needed.

Builders lime or hydrated lime may also be used for pond treatment but the amount should be cut down to 50-100 pounds per acre and re-treatment is usually needed in a year or less. For problems with pond or lake fertilization, contact the Georgia Game and Fish Commission for the services of a fishery biologist.

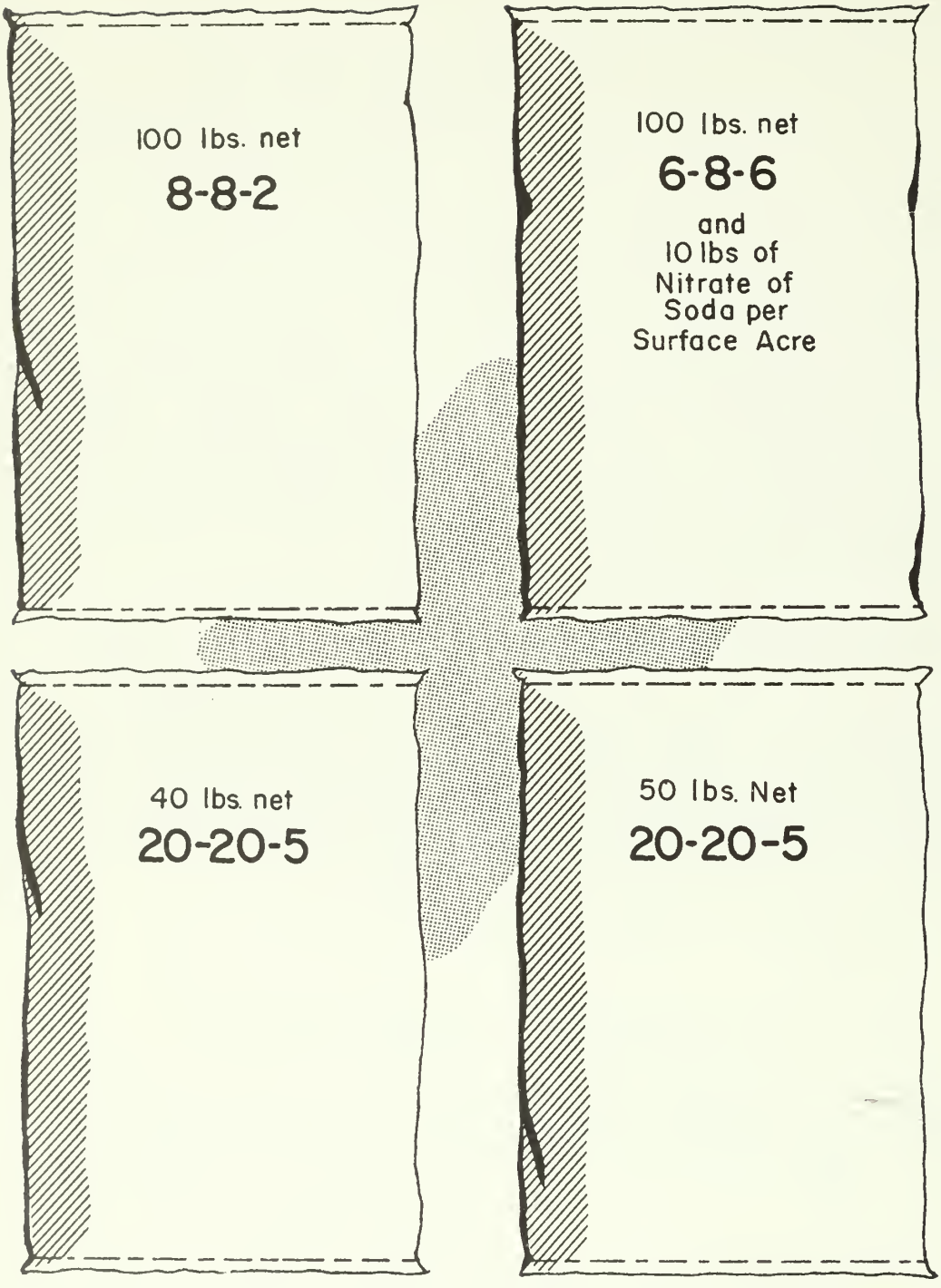


FIGURE 28.—Formulas and amounts of fertilizer to use per surface acre during each application.

DANGER OF NOT FOLLOWING DIRECTIONS IN FERTILIZING

It is undesirable to fertilize irregularly with the intention of reducing the amount recommended. Weeds may get the upper hand and the fish populations thrown out of balance so that it will be necessary to start over again.

Applying several hundreds of pounds of fertilizer per acre at one time has been known to cause many fish to die. Applying more fertilizer than the recommended amount will not greatly increase the poundage of fish produced and **sometimes the poundage produced is lessened.** One should not overfertilize, as the production of too many of certain microscopic organisms will be detrimental to the fish by removing too much oxygen from the water during the night and on cloudy days.

CHAPTER 6

FISHING THE POND

WHEN TO BEGIN FISHING

The bream are stocked during the fall and the bass the following spring. Be certain to start fishing one year after the bass have been stocked. The bass will average about one pound in that time. Remember not to fish at all until then because while fishing for the bream, which may be large enough, one cannot help catching, even with worms, the little bass. None of the bass should be removed until they reproduce. The removal of bass before they reproduce will throw the pond out of balance. When the water becomes 65° F. the males fan out nests, and when the water becomes 70° F. and remains at or above 70° F. for a couple of days, the bass will spawn.

WHAT IS MEANT BY "BALANCE" IN A POND

A pond is in a balance when it has the proper number of bream (forage fish) for the fertility of the water, and the proper number of bass (carnivorous fish) to grow and control the bream. Balance also means the proper number to produce desirable size bream and bass.

IMPORTANCE OF FISHING

All ponds should be fished each year for recreation, food, and to obtain full value of the fertilizer expended. If only bass are fished, an overpopulation of bream will result and fishing will decrease. If only the bream are fished, overpopulation of the bass will result and again fishing will decrease. Three to 7 pounds of bream should and can be caught for each pound of bass. Most pond owners need not worry about fishing each species properly as there will be approximately 20 bream fishermen for every bass fisherman.

CATCH ALL THE FISH YOU CAN WHILE THEY ARE ON BEDS

Fish are very prolific. A bluegill bream, one-half pound in weight, will form and lay as high as 51,000 eggs at one time. Then, according to the food supply, it may spawn two more times during the same year. A bass may lay as high as 40,000 eggs at a time, but very seldom spawns more than once a year. Therefore, one can readily see that fish can be caught while they are upon their beds during the spawning season for three reasons: First, they are easiest to catch during the spawning season; Second, the adult fish need to be harvested; Third, if it were possible to capture all adults with the exception of one pair, this one pair of fish would produce enough young fish to replenish the pond.

THE DOUBTERS

There are, of course, doubters particularly among confirmed bass fishermen and confirmed bream fishermen. They hold their opinions because of

the long history of restrictive measures and the vigorous educational programs conducted to assure their acceptance. Only time and careful observation will convince the doubters that liberalized fishing can and should be maintained.

SPECIES OF LIVE BAIT TO USE AS FISH BAIT

The goldfish, commonly known as Baltimore Minnow, St. Louis Minnow, or Indiana Minnow, is the hardiest of all minnows and requires the least amount of oxygen for survival. Goldfish will not turn into a carp any more than a cow will turn into a horse. The main reason the goldfish is one of the best to use is that if a pair get off the hook they cannot reproduce in a properly managed pond. The goldfish lay their eggs upon any over-hanging grasses or weeds near the surface of the water. The eggs are not guarded and are in wide open view of all other species of fish which will eat these eggs. Experiments at the Alabama Polytechnic Institute

fishery school in more than 100 ponds over a period of 30 odd years where goldfish have been used as live bait have shown they have never been able to reproduce in ponds containing bluegill and bass. Adults usually have been found, but never have there been found a reproduction of young goldfish.

The minnow called the "Fathead" or "Toughie" is all right to be used as live bait in ponds. Next to goldfish they are the most desirable commercial minnow to use; however, they cannot be easily handled in hot weather and are relatively short-lived.

SPECIES OF LIVE BAIT NOT TO USE

The golden shiner (roach) can and will reproduce in great numbers if a pair happen to get off the hook. Several pond owners who allowed the use of golden shiners as live bait in their ponds were dismayed to find, during pond analysis, that approximately 50 percent of the fish population consisted of golden shiners. These fish were consuming food that the bluegill bream should have been getting, thus the fish and the fishing became poor.

The species commonly called "Branch Minnow" will oftentimes consist of small carp, small suckers, and small shad. These species will cause the same harmful effects as the golden shiners.

CHAPTER 7

RENOVATION OF OLD PONDS

The RENOVATION OF OLD PONDS requires the making of structural changes necessary to obtain suitable habitat, as well as fish-population changes that affect the balance between predator (carnivorous) and nonpredator (forage) species. We have a tremendous job for future years as the occurrence of ponds with stunted fish population and poor fishing is apparently common throughout the country. Contact the Game and Fish Commission for advice from a Fishery Biologist after he has analyzed the pond.

Many pond owners become disheartened and disappointed after the second or third year of fishing because they do not know how to manage their ponds.

Ponds may be renovated to produce wonderful fishing if they are situated where the owner can gain control of the water that enters the pond. If the topography of the land permits a diversion ditch to by-pass the excess water, the pond can easily be renovated to produce good fishing. The following directions repeat much that has been said about constructing a new pond. For your convenience, however, applicable procedures are restated here.

CAUSES AND METHODS TO CORRECT POOR FISHING

TOO MUCH WATER PASSING THROUGH THE POND

One cannot get much benefit from fertilizer applied to a pond that has too much water passing through it. The fertilizer washes out of the pond and down the stream. This condition may be corrected by diverting the water around one or both sides of the pond. The diversion ditch should be wide enough to handle the water from the watershed after the biggest flash flood. It should have 0.2-0.5 foot of fall per 100 linear feet of ditch. The ditch should start at the diversion dam and extend around the pond to a point below the main dam.

The diversion dam must be placed at a height above the water level along the old water channel to allow the proper fall per 100 linear feet of ditch. The dam is constructed by removing all trees, brush, and other debris from the site. It is not necessary to use a clay core to anchor it to the subsoil. The clay core is purposely avoided to allow a certain amount of water seepage under the dam to help keep the pond filled. While constructing the diversion dam, some type of pipe with a valve should be installed to supply water to the pond. A 3-to 4-inch pipe with valve should be used on ponds less than 5 acres in size; a 4- to 6-inch pipe with valve for 5-to 10-acre ponds, and a 6-to 8-inch with valve for 10

acres or larger. The valve controlling waterflow into the pond is left open when the water is clear and the water level in the pond needs to be raised. It is closed when the water supply becomes muddy or when the pond is full.

When the diversion ditch, the dam, and the disposal area below the main dam are completed, they should be sodded immediately with some permanent grass as centipede or bermuda.

IMPROPERLY CONSTRUCTED PONDS

SHALLOW EDGE PONDS always furnish poor fishing after 3 or 4 years. The ponds constructed without deepening the pond edge to a depth of 2 feet usually always have weeds, which are conducive to an overpopulated fish condition. The water level of the pond should be lowered during the latter part of August so that the original shallow-water area can dry out for 6 weeks. Then a bulldozer can deepen the pond edge without bogging down. Another way of getting rid of shallow water that has a depth of less than 2 feet is by using soil that is outside of the pond and pushing it into the pond, filling the area that is less than 2 feet. A dragline can deepen he pond edge at any time of the year. Weeds must be destroyed before you can attain proper balance.

SEEPAGE through main dams is caused by not excavating the core trench and tying the dam to the subsoil with a good type of clay. Seepage oftentimes allows too much water level fluctuation during the summer months. Many times the main seepage is located near the old stream bed. The seepage problem may be corrected by working on the downstream side of the dam. Ditching dynamite, used by an experienced person, will blast out a ditch from 4 to 6 feet deep and 8 to 12 feet wide. After the first charge, if it is found that the clay subsoil has been fully exposed across the bottom, no further blasting is necessary. If the bottom contains sand, silt, and gravel, additional blasting is necessary. If blasting does not remove all the sand and silt from the bottom of the ditch, dig a channel on the downstream side of the core trench to dispose of the muck that is forced through it. The core trench should extend at least 30 feet each side of he visible seepage area with a width of 12 feet.

The tractors should start pushing clay into the ends of the blasted core trench. As the clay is applied and packed it forces the muck into the disposal channel, if the operation is carried on from each end of the dam.

SPILLWAYS that are too narrow are the most frequent cause of dams washing away. Too narrow spillways emit water to a depth greater than 6 inches. Sometimes after flash floods the water will pass out at depths of several feet resulting in a loss of most of the fish in the pond. To correct the spillway, widen it so the water will never go out at a depth greater than 3 to 6 inches. Then contact the Game and Fish Commission requesting that the pond be analyzed for balance between the forage and carnivorous species of fish.

IMPROPERLY STOCKED

The question is often asked "Why are ponds improperly stocked?" Most ponds were improperly stocked through mistake or accident. Many persons believe that the more fish they place in their ponds the better will be the fishing. Therefore, they apply for and receive more fish than their pond can support for good growth. When the bream are over-populated and starved for food, they eat the eggs of the bass and prevent the bass from reproducing. When that condition occurs, which is often, it is only a short time before the pond holds only a few large bass that are very difficult to catch because they have all the small bream they want as food. And a very large percentage of the bream will develop to less than 4 inches in length.

Many ponds are overstocked or understocked because the owner guessed at the size of the pond. Each pond should be accurately surveyed to the nearest one-tenth of an acre before the owner applies for fish. Stocking with too many or too few fish will cause a great percentage of the total pounds of fish production to consist of small fish and poor fishing.

Stocking too many bass always causes the bass to be thin and small. Correcting this condition involves very heavy fishing and seining for bass several times at weekly intervals to bring the stock into a balanced condition. Another way is to drain the pond, capture all the fish, and restock with the correct number of bass and bream. Then fertilize properly and fish the pond hard.

Stocking with too few bass will cause the pond to become overpopulated with bream. A large number of the bream will be of a small size, 2 ounces or less, and the bass will be large but very difficult to catch. To correct this condition, contact the Game and Fish Commission for a pond analysis. It might be best to reduce the bream and to follow with corrective restocking with bass.

Many pond owners cannot understand why their ponds are mysteriously full of undesirable fish. This condition usually is the result of their failure to kill all the undesirable fish that existed in the stream that fed the pond.

Certain species of fish stocked in ponds as warmouth, green sunfish, redbreast bream are unsuitable to ponds because only a very small percentage of their number ever attain a large size. If the pond has large numbers of small crappie, small catfish, shad, suckers, or the golden shiner (roaches), the pond must be drained to kill them all and to permit restocking with the correct number and species of fish.

ACCIDENTS AND OTHER FACTORS INFLUENCING MORTALITY

ACCIDENTS may cause the pond to be understocked. For instance, too many of the bream or bass may die in delivery from the hatchery to pond because of delays on the way. The vehicle transporting fish for

stocking must be kept in motion to keep the fish alive. Sometimes too many bass die shortly after they have been added to the pond for various reasons, or they die before they have a chance to reproduce.

If all or more than half of the number of fish die because of an oxygen depletion, diseases, parasites, cotton dusting, or other chemicals, the best thing to do is to start over by draining or poisoning and restocking. As soon as possible after finding dead and dying fish in your pond, call the Game and Fish Commission; a Fisheries Biologist may find the cause and correct it.

There are several other factors that influence the sudden mortality of fish. Sometimes several of these factors work together to produce a condition which kills many or all the fish in a body of water.

Sudden abnormal temperature changes have, in many instances, caused a destruction of fish populations by causing oxygen deficiency—either by ice or snow formations over shallow lakes, or by aiding in the decomposition of an excess of decaying organic matter. Pollution may kill fish directly or by destroying food supplies and spawning areas. Instances are known where fish have been killed by lightning and toxic algae. When fish are transferred from waters of one pH to another water considerably different in pH, they cannot live.

WEED CONTROL

HEAVY WEED GROWTH usually appears within a year or two in improperly fertilized ponds. Large amounts of underwater or above-water weeds inevitably lead to over-population and stunted fish. Weeds in ponds are undesirable for two other reasons: (1) they provide excellent places for mosquito breeding, (2) the collection of masses of weeds upon the hook causes poor and difficult fishing. Certain weeds such as the water hyacinths and duck weed reduce the oxygen content of the water.

There are two things that need to be done before eliminating the weeds. First, if the pond is fed by too much water, the excess water must be diverted. Second, the pond edges should be deepened so that there will be no water less than 2 feet deep. If these two requirements are met, it will be easy to eliminate and prevent the recurrence of underwater weeds by proper fertilization.

Pond weeds have the same requirements for growth and livelihood as terrestrial plants; namely, fertility, sunlight, and the proper amount of water. Therefore, if the pond weeds don't receive enough sunlight, they die. It is the same principle used to kill grass and grass roots on a lawn by covering it with a tarpaulin to shut out the sunlight.

An often asked question is, how do weeds get into ponds. Most coarse weeds are flowing plants producing seeds, even though they may be very small and inconspicuous, are dispersed by water currents, wind, animals and birds. Some plants like **Elodea** and coontail (**Ceratophyllum**) have brittle stems. Terminal buds at the tips of stems break off and form new plants. Another method of propagation is by means of underground

stems which grow out laterally into the pond bottom mud. These stems, also called rhizomes, have joints or nodes from which new shoots arise. This is why draining the pond and the mechanical mowing of weeds give only temporary results. The only pond weed that draining will greatly help is water shield; but usually where one type is present there will be found several types of weeds. Mechanical mowing of weeds usually has to be repeated weekly or bi-monthly and has proved costly and relatively ineffective.

THREE TYPES OF POND WEEDS

Weeds are classified into three types; submerged, emergent, and floating. The methods of eradication and control of each type is different.

Submerged weeds are those that are rooted in the bottom and their stems and leaves may fill the pond to the surface. This type is commonly called seaweed, parrot feather, coon-tail moss, moss, or grass and includes such plants as najas, myriophyllum, elodea, certain species of potamogeton, needlerush, and chara.

The Emergent type of plant is rooted in the bottom and its leaves either stand above or float on the surface of the water. This type includes spatterdock or yellow water lily, common water lily, lotus or water chinquapin, watershield, cattail, bulrush, and spikerush.

Floating type of weeds are not rooted to the bottom, but float freely upon the water surface. The most common pond weeds of this type are the various species of duck weeds, some species of hyacinth, and bladderwort.

1. ELIMINATION OF SUBMERGED WEEDS

The only certain means of eliminating submerged weeds is by preventing the weeds from getting sunlight and by chemicals. Fertilization has the advantage over chemical weed poisons in that its addition increases productivity of fish, is cheaper, and can be applied by inexperienced personnel.

A. ELIMINATION BY FERTILIZATION

The method of fertilization to destroy submerged weeds cannot be used where the pond receives large amounts of flood water or muddy water during late winter and early spring, nor where the pond has large areas of water that are less than one foot in depth. So during the late summer, lower the water level of the pond and deepen the edges. Also, if there is a large amount of water entering and leaving the pond, divert the water around the pond. The following January begin fertilization while the water is cold. Use for each acre, 100 pounds of 8-8-2 or 40 pounds of 20-20-5 at each application. Broadcast the fertilizer over the weedbeds. The second appli-

cation should be made 2 weeks later and the third 2 weeks after the second. Additional applications should be made at 3-weeks intervals, until the weeds become covered with filamentous algae, commonly known as "old slimy green moss found at springs."

The filamentous algae cover the weeds and shade them so that they become weakened. During normal years, around the first of June movement of the water will break the stems near the base and the weeds and filamentous algae will float to the surface. **After the weeds float to the surface—PRECAUTION—do not broadcast fertilizer over the floating weeds, nor apply fertilizer while most of the weeds are decaying rapidly.** If one applies fertilizer at this time, it may cause such rapid decay of weeds that the available oxygen in the water is depleted, and the fish die. Do not rake or pull out the decaying weeds and filamentous algae as they will release nutrients into the water, and the nutrients will cause a heavy growth of microscopic plants, turning the water green or brown. If the water clears enough to see deeper than 12 inches, put in another application of fertilizer, but put it in the pond a few feet away from the weeds. Unless the pond is fertilized each year thereafter from spring until fall, submerged weeds will reappear.

B. SUBMERGED WEED ELIMINATION BY SODIUM ARSENITE

Sodium arsenite is very effective in the control and eradication of most underwater weeds. Results are usually apparent within a few days if the arsenite is applied before too late in the year. This is the main chemical that has proven consistently successful for most types of underwater weeds. No other feasible methods have been found to replace sodium arsenite when a pond becomes heavily infested. However, other chemicals are being used.

PRECAUTIONS TO BE TAKEN WHEN USING SODIUM ARSENITE

Sodium arsenite is a very poisonous chemical and must be handled with extreme caution. Severe burns may occur if the poison comes in contact with the skin or eyes. Although domestic animals would not drink enough water to be injured, it is almost impossible to spray or treat a pond and not get some chemical on the vegetation on the shoreline. Stock may be attracted by the salty taste of sodium arsenite and eat enough of the treated shoreline vegetation or residue to be poisoned and die. Areas of spillage should be completely and thoroughly rinsed to prevent the stock from being poisoned.

It is extremely important to prevent contact of sodium arsenite with eyes and skin. If unavoidable contact occurs, the affected areas should immediately be flushed thoroughly with water. Following treatment, all spraying equipment and chemical containers should be thoroughly washed. Any remaining chemical must be stored in a safe place away from children and animals. Sodium arsenite is dangerous.

It is considered good practice, as a safety measure, to advise against the use of treated water for bathing, watering lawns, or allowing animals to drink, or for any other purpose for a period of two weeks following treatment. At the end of two weeks the chemical should be sufficiently dissipated by dilution and absorption to make similar precautions no longer necessary.

CAUTION: Read the label on the container of sodium arsenite and adhere strictly to the recommendations. The State Game and Fish Commission is in no way responsible for the results of the use of this chemical, but only suggest it for the benefit of pond owners in eliminating weeds.

WAY TO FIGURE THE AMOUNT OF SODIUM ARSENITE NEEDED

The standard commercial preparation of this chemical contains four pounds of active ingredient per gallon. If this standard preparation is used, one gallon is required for each million pounds of water to be treated.

To calculate the weight of water in a pound, the volume in cubic feet is first determined. This is accomplished by multiplying the average width by the average length by the average depth. All measurements are made in feet. Cubic foot volume is converted to pounds of water by multiplying by 62.5 (the approximate weight in pounds of one cubic foot of water). A pond with a surface area of one acre and an average depth of five feet would have a cubic foot volume of about 218,000, which would weigh approximately 13,600,000 pounds. For this sample pond, 13.6 gallons of sodium arsenite would be required and the cost would be about $15.00.

Sodium arsenite should be applied by the gravity flow method as described under "Methods of Applying Chemicals to Weeds in Ponds."

METHODS OF APPLYING CHEMICALS TO WEEDS IN PONDS

A. THE GRAVITY FLOW METHOD

In the gravity flow method a drum is placed upon a rack in a boat. To the drum is attached a valve which will regulate the flow of chemical through a hose into the water. The desired amount of chemical is placed in the drum along with some water to insure more equal distribution. The boat should be run around or over the lake several times as the chemical drains out. Wind and wave action will distribute the chemical to the areas not covered during the application.

B. THE SPRAY METHOD

In the spray method a boat is equipped with a power spray. Using the proper amount of chemical, the operator moves about over the lake, spraying the entire surface but giving special attention to the heavily infested parts. Sometimes second applications are necessary if infestation is dense.

It is best to apply weed-killers as soon as the weeds appear in the spring because they are easier to kill at that time.

In some cases, several chemicals are listed for a particular weed, any of those listed will do the work.

TYPE WEED	PICTURE	CHEMICAL RECOMMENDED	METHOD OF APPLICATION
Cabomba		4 PPM * Sodium Arsenite	Gravity Flow Method **
Elodea (Waterweed)		4 PPM Sodium Arsenite	Gravity Flow Method
Potamogeton		4 PPM Sodium Arsenite 1 PPM Silvex (Kuron) 1 PPM 2, 4-D	Gravity Flow Method Gravity Flow Method Gravity Flow Method
Parrot Feather (1) Coon-tail (2)		4 PPM Sodium Arsenite 1 PPM Silvex (Kuron) 1 PPM 2, 4-D	Gravity Flow Method Gravity Flow Method Gravity Flow Method

* PPM or Parts per million is a measurement used to determine the amount of chemical to be used.

** Gravity Flow Method is explained on page 51.

TYPE WEED	PICTURE	CHEMICAL RECOMMENDED	METHOD OF APPLICATION
Utricularia (Bladderwort)		4 PPM Sodium Arsenite 1 PPM Silvex (Kuron) 1 PPM 2, 4-D	Gravity Flow Method Gravity Flow Method Gravity Flow Method
Duckweed		4 PPM Sodium Arsenite 75 gallons # 2 diesel fuel or kerosene per acre.	Gravity Flow Method Spray Method ***
Cat-tails		One lb. Dalapon to 5 gallons of water.	Spray Method
Water Lillies		1 gal. 2, 4, 5-T per acre 1 pint 2, 4-D to 10 gals of water during spring time. 1 pint Silvex (Kuron) to 10 gallons water. 1 gal. Silvex (Kuron) per acre.	Spray Method Spray Method Spray Method Gravity Flow Method
Needlerush		6 PPM Sodium Arsenite 2 PPM Kuron	Gravity Flow Method Gravity Flow Method

*** Spray Method is explained on page 51.

TYPE WEED	CHEMICAL RECOMMENDED	METHOD OF APPLICATION
Red Algae	4 PPM Sodium Arsenite	Gravity Flow Method
Hydrodictum (water net)	4 PPM Sodium Arsenite	Gravity Flow Method
Najas (bushy pondweed)	4 PPM Sodium Arsenite	Gravity Flow Method
	1 PPM Silvex (Kuron)	Gravity Flow Method
	1 PPM 2,4-D	Gravity Flow Method
Cut-Grass (Leersia)	1 lb. Dalapon to 5 gals. water	Spray Method
Bull Rushes (Juncaceae)	1 pint Silvex (Kuron) to 10 gals. water	Spray Method

C. COPPER SULPHATE (BLUESTONE)

This poison is the most readily available and easily applied of all aquatic plant poisons, but it is effective against only single filament forms of algae and chara, which is known by the common name "Musk Grass". Copper sulphate can be bought at most hardware and farm supply stores in the pure crystalline or powdered form. Use ½ to 1½ p.p.m. and apply as spray or drag the pure crystals in a cloth sack. Copper sulphate is usually not recommended for use to eliminate filamentous algae or "pond scum" because the algae will decompose by midsummer; also the copper sulphate will kill most of the microscopic algae that is food for microscopice animals and insect life, which in turn are food for bream.

D. CONTROL OF PITHOPHORA AND OTHER ALGAE BY THE CHEMICAL KNOWN AS AMINE D. ACETATE (ADA)

Pithophora is recognized by its cluster-like form of growth and the coarse texture of the strands when handled. It grows primarily during the warmer months of the year, unlike most of the single-filament forms of algae which grow in cold water. Pithophora usually begins its growth in shallow water then spreads rapidly over the entire bottom and surface of the pond. It interferes with high fish production by competing with the phytoplankton (microscopic plants) for the fertilizer added to grow fish food. Some ponds in Georgia have so much pithophora that the pond owners are never able to get a good green or brown color to the water. Pithophora may be controlled by using a chemical known as ADA at a concentration of less than 0.5 p.p.m. Its toxicity to bluegill bream and bass was found to be near 0.7 p.p.m. Use at the rate of 2.5 to 3.0 pounds of active ingredient per surface acre per application. Subsequent applications are made at weekly intervals or whenever sufficient regrowth of pithophora is present to justify another treatment. Other types of algae are also controlled by ADA. Toxicity tests indicate no harm to cattle or other farm animals when this algicide is used as directed.

ADA is produced as ADA 70%, a paste containing 70% active ingredient and as ADA 50-S, a liquid containing 50% active ingredient.

PLACES TO SECURE ADA

ADA is commerically available through Anderson Chemical Company, P. O. Box 1424, Macon, Georgia, as "Anco Liquid Algicide." Also, Industrial Chemical and Supply Company, P. O. Box 10914, Atlanta 10, Georgia, sell algicides based on ADA.

METHODS OF APPLYING THE CHEMICAL

There are two general methods of applying the ADA paste, dragging and floating. The dragging method is accomplished by the use of a boat powered by an outboard motor to tow some loosely woven burlap bags containing the ADA. Use three to four pounds (or pints) of 70% paste per acre, place it in a bag and tow it by the boat over the pond until the paste dissolves from the bag into the water. The chemical should be uniformly distributed over the pond.

The floating method is accomplished by the use of wooden boxes with bottoms covered with a loosely woven burlap bag material instead of wood. The boxes are floated some 10 to 20 feet from the edge of the pond. Put in three to four pounds (or pints) of 70% paste per acre. Small ponds consisting of two to three acres need only two floats to properly treat them. The floats may be moved about the pond from time to time to give better distribution of the chemical.

Another method of application which is particularly applicable to small ponds is to spray a 3 to 5% solution of the liquid ADA to the surface of the pond. Caution should be taken to get complete coverage of all infested areas. This solution which is to be used for spraying the surface, can be made conveniently by diluting the ADA liquid 50-S with water. The solution is made by adding one pint of liquid ADA to one gallon of water.

FIGURE 38.—Spike Rush *(Eleocharis)*.

2. ELIMINATION OF EMERGENT WEEDS

The emergent weeds are those that grow above the surface of the water as cattails; the various rushes as spikerush, bulrush, and round-stem bulrush; willow; and arrowheads. The growth of cattails and rushes need to be pulled and thrown out of the pond, or sprayed with 2,4-D (2,4-dechlorophenoyacetic). Each time when spraying weeds in a pond, do not cover over one-third of the surface area if an oil base is used. There is no danger to fish from the use of 2,4-D due to the dilution when it is mixed with pond waters. The 2,4-D is more successfully used with diesel fuel or kerosene as an oil base. A rain immediately after spraying with an oil base will not wash the chemical from the weeds. You should purchase the 40 perecnt 2,4-D ester.

Trade Names of 2,4-D:

Ester forms of 2,4-D are Weed-No-More 40 or Dow Esteron.

Isopropyl ester of 2,4-5T or Esteron 2-4-5 (Dow Chemical Company).

The proper mixture of the spray should be one cupful (8 fluid ounces) of either of the above materials with 5 gallons of diesel fuel or kerosene. The spray mixture should be applied in a coarse spray to all portions of

plants as completely as possible. It will take at least 2 sprayings to kill all the weeds. The spray may be applied by the use of a power sprayer or a bac-pak type. It normally takes from 36 to 48 hours to kill the plants, while grasses sometimes takes longer.

3. ELIMINATION OF FLOATING WEEDS

Floating weeds are those that float upon the surface of the water—lilies, lotus, and watershield. These weeds may be eliminated by taking a scythe and cutting their leaves or by the use of 2,4-D. It will usually be necessary to clip the leaves from 5 to 6 times the first summer and from 1 to 2 times the next summer to get rid of the plants. Thereafter, as new plants appear, pull them and throw them out of the pond. The floating weeds may also be eliminated by 3 to 4 sprayings with 2,4-D, using the 40 percent ester form.

BALANCED AND UNBALANCED POPULATION

Dr. H. S. Swingle states "the interrelationship in fish populations are satisfactory if the populations yield, year after year, crops of harvestable fish that are satisfactory in amount when the basic fertilities of the bodies of water containing these populations are considered. Such populations are considered to be 'balanced populations' and the species within such a population are in balance". A balanced population must have the ability to reproduce, at least annually, in order to replace the harvested individuals. Balance implies a carnivorous species (bass) with the bream. To produce annual harvestable crops of fish, the number of young fish must be reduced by the bass along with the harvesting of the large fish. Balance implies that a great percentage of the total weight of the fish population consist of a desirable size for harvesting.

Unbalanced populations are those unable to produce succeeding yearly crops of fish of an edible size. Unbalanced populations are mainly due to over crowding, but it may be due to the inability of breeders to provide sufficient replacements.

The Fisheries Division of the Georgia Game and Fish Commission analyze ponds by two main methods. One is by the use of seines and the other is by the use of a chemical. The best time of the year for analysis is late spring and summer, after the bass and bream have had time to reproduce. Each new pond should have an analysis made of the fish population before the end of the second year by Fisheries Biologists.

CHAPTER 8
TURTLES

Many ponds in Georgia are heavily infested with turtles. The slider or or basking type turtle are commonly referred to as terrapins, the soft shell, snapper, and logger head are the main kinds found in ponds. The main harmful effect they create is in becoming a general nuisance by taking the bait off fish hooks and eating fish which are placed on stringers and allowed to remain in the water. Many people believe turtles actually decrease the yield of fish in ponds by consuming large numbers of fish eggs as well as young fish. Actually, research studies conducted at the Agricultural Experiment Station, Fisheries School, Auburn, Alabama, on the effects of turtles on fish production in farm fish ponds indicated that the food of the slider turtle consisted of approximately 80 percent vegetable matter and 20 percent animal matter. **Fish made up less than three percent of the total diet.** Dead fish, however, are frequently observed around the edges of lakes. Examination of the dead fish may show that they had been fatally injured by being hooked or that they probably died as the result of old age and occasionally, close examination will reveal that death was due to a weakened condition brought about by an infestation of parasites or to some disease.

BENEFICIAL EFFECTS OF TURTLES

A few turtles in a pond or lake may be beneficial in providing valuable janitorial service by killing diseased or weakened fish, and by cleaning up dead or decaying fish and other animals. Moreover, the turtles provide excellent food for man.

METHODS USED TO REDUCE THE NUMBERS

1. TRAPPING is the most practical and effective method of removing turtles from fish ponds.
2. SHOOTING provides the most sport. Unfortunately, a considerable quantity of ammunition and time is required by this method. Also, it may be dangerous and unwise because of the presence of livestock and human habitation.
3. SEINING may be done in small shallow ponds. However, in the larger and deeper ponds seining is impractical.
4. DRAINING is not practical except in hatchery ponds.

KINDS OF TRAPS NEEDED

UNDERWATER OR SUBMERGED TRAPS needed to capture the snapper or logger head and soft shell trurtles. Figure 40. This trap is

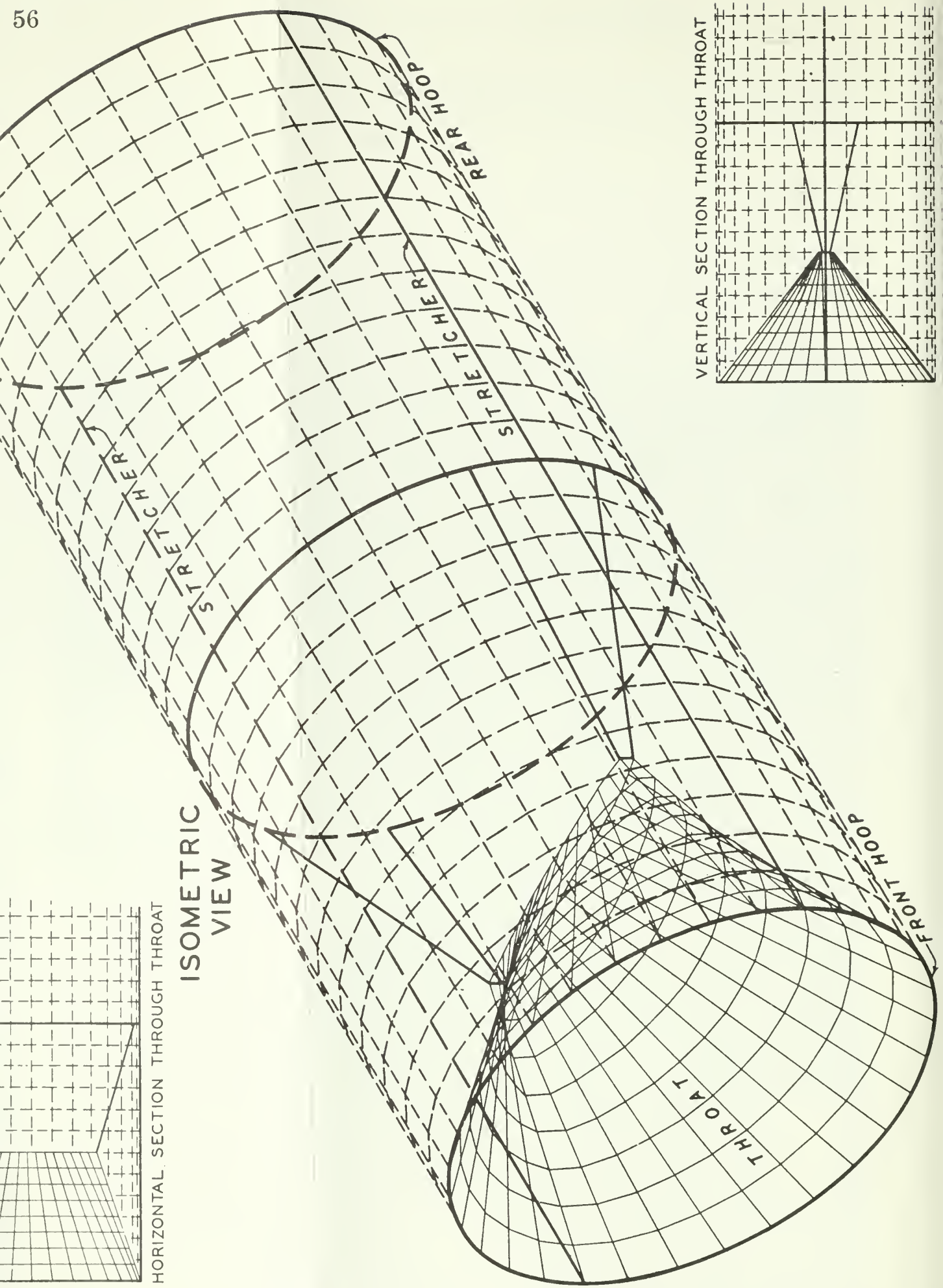


FIGURE 40.—Hoop end turtle trap.

constructed similar to a fish basket or trap with exceptions as to size and shape of the funnel. These barrel-shaped traps may sometimes be bought on the market under the name of fyke or hoop nets. They may be made from two inch square mesh of Number 24 linen seine twine. The length of the trap should be from four to six feet from front to back hoop. There should be from three to five hoops per trap, 30 inches in diameter, made of wood or six-guage steel wire with welded joints, may be used. The funnel-shaped mouth should be 18 inches deep from front hoop to the opening inside. The entrance opening of the funnel is one inch by twenty inches. The corners of the opening are tied by twine to the middle hoop. The rear or "box" end may be closed with a purse string. The net, after the hoops have been installed, should be treated with a preservative of copper oleate, tar, or asphalt. To keep the trap extended, stretches of wood or steel wire, approximately nine guage or larger, are fastened along each side. Coarse mesh poultry wire may be substituted for the twine. If this is done, the frame will be about 30 inches square. The shape and dimensions of the entrance as specified should be the same in all traps, as it is easily negotiated by the turtles. A door 12 by 18 inches in size may be installed in the top to facilitate baiting and removal of turtles. Entrance funnels may be placed on each end if desired.

SURFACE TRAPS are needed to capture the slider or basking type turtles (cooters). Because of their habits, the manner of capture of the cooters is different from that of the snapping and soft shelled turtles. Cooters cannot be taken in numbers during the winter as readily as snappers are, because they do not congregate in their hibernating places. Neither do they respond as readily to baiting as the snapper and soft-shelled turtles. In the summer cooters are gregarious, crowding together in numbers on projecting logs and banks. By taking advantage of this fact, the "basking" species may be taken by sinking a box in a place turtles are using. The turtles crawl upon the top side of the box to "bask" in the sun and many of them manage to fall into the trap. (Figure 41).

The top frame of the box may be constructed from discarded telephone poles, imperfect ties, or logs about eight inches in diameter. The logs are mitered at each end to fit together and make the inside enclosure two to three feet square. About half of each log from the top center to the inside under center is lined with zinc or galvanized metal. From the outside water edge to the top of each log, cleats can be nailed or the logs made rough, so turtles can easily climb on top. Galvanized wire, with a one inch mesh is desired to form a wire basket fitting the opening between the logs. Staples, hooks, or wire may be used for fastening the basket to the logs. Turtles that have dropped into the trap are unable to climb over the zinc or galvanized metal covering. The trap should be fastened to some permanent anchor.

TRAP-BOARD TRAP consists of a box with an inclined board for a slide leading up to it. The turtles climb up the slide to bask and drop off into the box. Figure 42 shows the same trap with pivotal boards so placed that turtles crawling out on the boards overbalance on the terminal end and are dropped into the box. A trap three feet long by three feet wide and three feet deep is convenient to handle and move about and still large

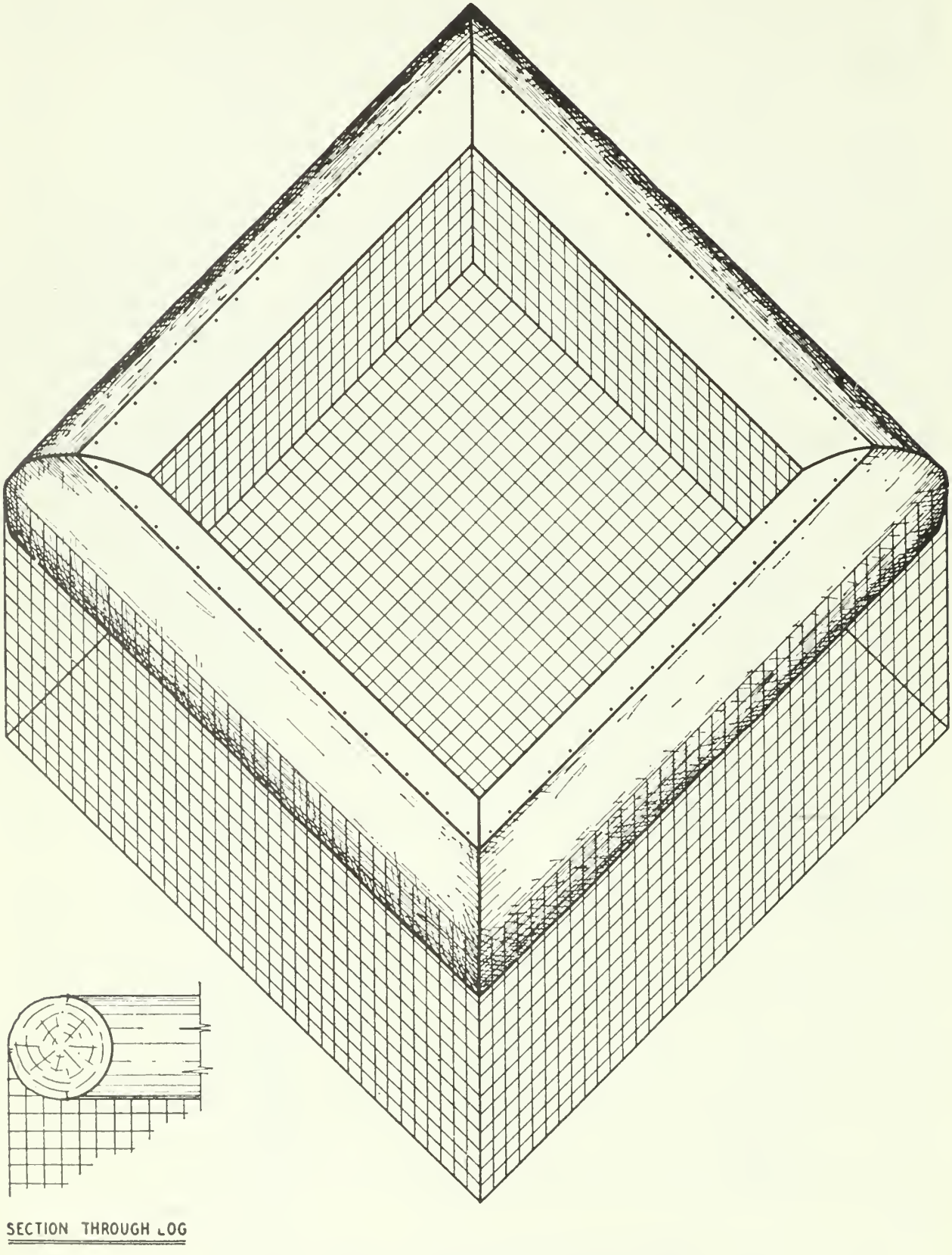


FIGURE 41.—Sink box turtle trap.

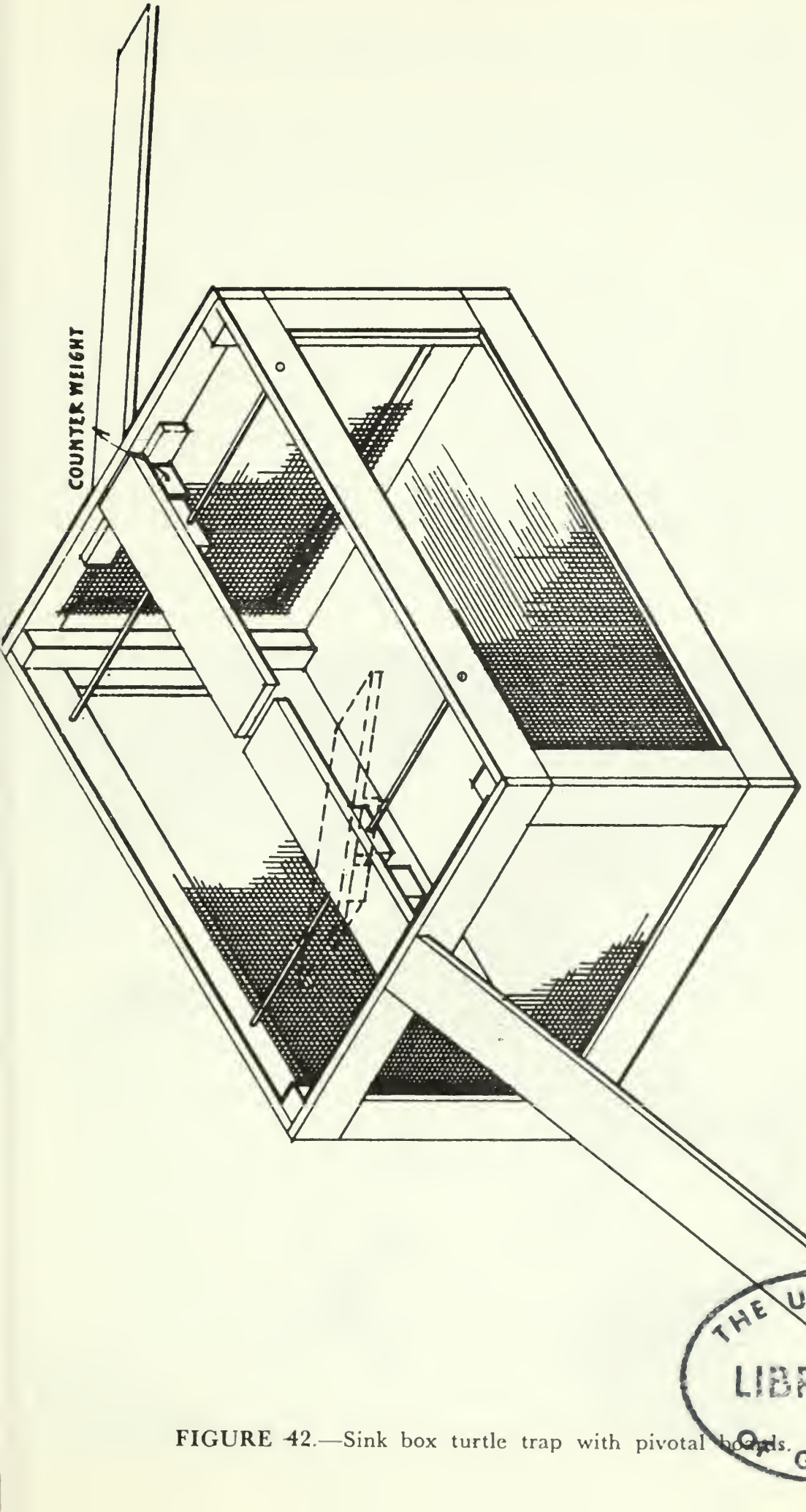


FIGURE 42.—Sink box turtle trap with pivotal boards.

enough to hold a large number of turtles. Two by four inch lumber may be used for the frame. If the lumber is creosoted the trap will last for several trapping seasons.

After the hardware cloth has been tacked to the wooden frame, the pivotal boards are installed. These boards need to be from six to twelve inches wide and are attached to the top of the frame in such a way that they pivot freely.

BAITING THE TRAPS

The underwater traps should be freshly baited and the dead turtles removed every day or every two days. Bait the traps with fish or fish heads, chicken entrails, cotton-seed cake, soy-bean-cake, or peanut-meal-cake. These baits should be fresh to attract the turtles. It should be contained in one-half gallon syrup pails. The pails should be perforated to permit the flavor of the bait to escape the can and to prevent the bait from being eaten by turtles or being washed away. These traps should be placed on the bottom of the pond at a depth of from three to eight feet.

The bait should be placed on the pivotal boards of the trap board trap, secured by string or wire so it will not fall when the board pivots.

Let's go Fishin'