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FARM FISH PONDS AND THEIR MANAGEMENT

LOCATION AND CONSTRUCTION OF FARM PONDS

Farm ponds are usually constructed where there is a sufficient water supply that can be diverted into the pond in the amount required. An ideal location is on bottom land that is not subject to flooding. Ponds formed by damming a stream are ordinarily not successful because it is almost impossible to prevent the escape of large numbers of fish or the introduction of undesirable species. Ponds may be constructed on spring runs not subject to severe floods, or where storm waters can be by-passed.

Flowing water is not essential for pondfishes. In general, the most successful ponds are those which receive only enough water to maintain a constant level. In localities where the subsoil is naturally impervious, ponds supplied only by runoff from adjacent land may be successful. As such ponds depend directly upon rainfall for maintenance of water levels, they may become low during dry periods, and should be deeper than those where a constant water supply is available. In dry regions, as the southwest, allowance must be made for considerable fluctuation in water levels. This requires greater depth in proportion to surface area. In parts of the country with abundant rainfall, ponds are often constructed high up on the watershed, and the water supply is furnished by runoff from adjacent lands.

Farm ponds may vary widely in size, in accordance with topography and water supply. Small ponds of about 1 to 3 acres are to be preferred, as they are more easily fished at the proper rate and easier to control. Good fishing can be produced in fertilized ponds as small as one-half acre. It is recommended that ponds less than one-third acre should not be built with the idea of managing them for fishing, and, if they are not to be fertilized, they should not be less than an acre in area

The pond should be at least 18 inches to 3 feet in depth in the shallow portions, and where there is abundant rainfall and little likelihood of the pond freezing for long periods, the maximum depth should be about 6 to 8 feet.

In dry sections of the country, or where ponds freeze over and are covered with snow, the depth should be much greater, if possible up to 12 or 15 feet. In any case, the pond should be constructed so that it can be drained easily and quickly; the cost is slightly greater, but the advantages compensate for the additional expense 2/.

Ponds should be constructed so that the edges slope rather steeply to the depth contour of 18 inches, at least, in the shallow portions. This makes it easier to control vegetation and provides deeper water for the fish to forage in close to shore, thus assisting in the control of mosquito larvae. It also creates good fishing from the bank, as there is sufficient depth of water for fish to feed there. It is recommended that the banks be planted with short grasses, such as centipede grass, which will not grow into the water and provide harborage for mosquito larvae.

STOCKING THE FARM POND

The proper number and species of fishes with which to stock a farm pond depend upon conditions within each pond and on the section of the country in which it lies. The number of fish that can be stocked in a 1-acre pond to produce edible sizes within a year depends on the natural productive capacity and fertilization. Much greater production and better control of conditions are possible in fertilized ponds. Higher production can be expected in the south, than in the north, because the growing season is longer and water temperatures average higher throughout the year.

The most suitable species for stocking in farm ponds are the bluegill sunfish or bream (Lepomis macrochirus) and the largemouth black bass (Huro salmoides). The first, an excellent pan fish, spawns throughout the summer and produces numerous young. Because of its extended spawning season, it may quickly overpopulate a pond unless a predacious fish, as the bass, is present to feed upon the young. For this reason, ponds should not be stocked with bluegill sunfish alone.

Bluegills are efficient utilizers of the natural food supply and should reach a size suitable for human consumption within 4 to 12 months after stocking. Bass feed upon the numerous young bluegills and grow rapidly. Experiments indicate that the largemouth black bass is a better fish for maintaining a proper balance in ponds than is the smallmouth. Another advantage of the largemouth bass is that it spawns readily in the shallows of ordinary ponds whereas the smallmouth prefers gravel beds.

Investigations at the Leetown, West Virginia, experimental station indicated that in fertilized ponds, best results can be obtained by stocking at the rate of 800 to 1,000 fingerling bluegill sunfish to 100 bass per surface-acre of water The same proportion has been found to exist in natural waters in five Florida lakes which showed a ratio of 2.6 pounds of supporting fish to 1 pound of predato fish 3/. It appears, therefore, that the balanced ratio of the two fishes does

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2/ Construction of farm ponds, Fishery Leaflet 17, giving directions for building a small pond, is obtainable from the Fish and Wildlife Service,

3/ Fish population of five Florida lakes. By O. Lloyd Meehean. Transactions of American Fisheries Society, vol. 71, pp. 185-194, 1942, Washington, D. C.

not differ greatly in fertilized and unfertilized waters. The latter should be stocked less heavily, however, about half as many fish being used, depending on the natural productivity of the ponds. It is recommended that unfertilized farm ponds be stocked with not more than 500 bluegill sunfish fingerlings and 50 largemouth bass fingerlings per acre.

At Alabama Polytechnic Institute, Auburn, Alabama, Swingle and Smith have determined that the proper stocking rate for farm ponds in Alabama is 100 bass and 1,500 bluegills per acre of water 4/. This is based upon a plan to produce bluegills (bream) weighing 4 ounces within one year. A reduction in the number of bluegills stocked in proportion to bass will result in increased size of the bluegills and will lessen the possibility that the pond may become over-stocked. Recent experimental work of the Fish and Wildlife Service at Welaka, Florida, and Leetown, West Virginia, as well as experience with farm ponds in other sections of the country seems to indicate that a ratio of 100 bass to 800 bluegills may be expected to give satisfactory results. The number to be used depends upon local conditions and on how well the pond is managed. In general, 100 bass to 1,000 bluegills is a satisfactory rate of stocking.

Both species may be introduced at the same time, or the sunfish may be stocked in the fall and the bass early the following spring. Bass fry planted in the spring grow rapidly and reach legal size at about the same time as fingerlings stocked the previous fall. Observations in the southern States show that bluegills spawn very early and that delivery of bass as late as June 1 may result in over-populations of bluegills due to their survival in excessive numbers when free from predation. In the North the spawning season is later, which makes it easier to deliver bass before the bluegills have spawned. If both species are stocked at the same time it is preferable to have them as uniform in size as possible.

Recent experiments at the Welaka, Florida, experimental station indicate that in the South the shellcracker or red-ear sunfish (Lepomis microlophus) is a desirable fish for farm ponds. It can be substituted for bluegills and stocked at the same rate. It is considered more difficult to catch than the bluegill but if the bait is fished by moving it slowly along or near the bottom, better results are obtained.

Fish stocked in a pond move about considerably until they become accustomed to their new surroundings. If there is an overflow of water at the outlet it should be screened to prevent the fish from leaving. The screens can be removed in about a week after the planting is done. In ponds subject to overflow during floods, the fish may escape during high water.

Although white crappie (Pomoxis annularis) and black crappie (Pomoxis nigromaculatus) have been stocked in farm ponds, they have a tendency to become predominant or are reduced in numbers within two or three years because they cannot compete successfully with largemouth bass. Bennett 5/ in reporting on Illinois

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4/ Management of farm fish ponds. By H. S. Swingle and E. V. Smith. Bulletin No. 254, 23 pp., 1942. Alabama Polytechnic Institute, Auburn, Ala.

5/ Management of small artificial lakes. By George W. Bennett. Bull. Ill. Nat. Hist. Survey, vol. 22, art. 3, Urbana, Illinois, 1943.

lakes stated that there are marked fluctuations in the production of bass and crappie where the two are stocked together. Small bass populations are associated with large crappie populations and vice versa, probably because of competition for the same foods.

Minnows are not recommended for small ponds where a maximum production of food fishes is desired. Some State laws require that the proper species of minnows for mosquito control be stocked in all newly established ponds. Experience has shown that little harm may be done by using the mosquito fish, or top minnow (Gambusia) for this purpose, except that these small but voracious fish will devour fish fry as well as mosquito larvae and, if bass fry are used to stock the pond there may be some losses so that additional bass may be required over the ordinarily recommended number. If the edges of the pond are kept free of vegetation, game species are as effective as these so-called mosquito-eating species in controlling mosquito larvae. Furthermore, minnows disappear from the properly managed pond after the first or second year.

If bullheads or catfish are desired in the farm pond, the brown bullhead (Ameiurus nebulosus) or the yellow bullhead (Ameiurus natalis) may be stocked at the rate of 100 per acre. These bottom feeders, although omnivorous, apparently compete very little for food with bluegill sunfish and bass. They are prolific and their young are readily consumed by largemouth bass. In experimental ponds at the Leetown, West Virginia, station brown bullheads stocked with bass and bluegills reached a length of 11.3 inches within a year after stocking. At the same time, largemouth bass averaged 10.3 inches in length, and bluegill sunfish 6.1 inches. Bullheads will disappear from the properly managed pond in a year or two. Should bullheads become established first and become numerous, they may stir up the bottom sufficiently to make the water roily. This prevents the production of fish foods from fertilizers so that it will be difficult to establish desirable species. It may, under these conditions, be necessary to remove all the bullheads. Channel catfish will not reproduce in ponds except under special conditions. Maintenance of this species may be dependent upon restocking at regular intervals.

Over-stocking is one of the hazards in fish-pond management. It cannot be emphasized too strongly that adding fish beyond the recommended number, in the hope that fishing will be improved or brought about more quickly, is a fallacy. Over-populations, thus created, will result in stunted fishes and poor fishing.

Failure to keep the pond properly fished may result in a condition similar to that produced by over-stocking. This appears to be a common fault in farm-pond management. Just as with other crops, fish should be harvested as they mature, in order to obtain maximum yields. If this is not done, the pond may become over-crowded and the growth rate reduced through lack of food. If the fish are taken only with hook and line there is little possibility of over-fishing as a considerable number of fish of spawning size are usually left, even after the most intensive angling. An effort should be made to remove as many bass and sunfish of legal size as possible so that the balance between the two species may be maintained. However, with every precaution, the balance may be upset sooner or later, resulting in a decline in the number of edible fish. Sometimes the condition may be corrected by minor remedial measures, but if ponds can be drained, the proper balance may be brought about much more quickly.

It is always better to remove all fish and restock in the proper proportions. This is one of the chief reasons for constructing ponds so that they can be drained with little trouble.

FERTILIZATION OF FARM PONDS

Every farmer knows that land crops require proper fertilization to produce maximum yields, but it is not generally understood that ponds must also be fertilized if the best results are to be obtained. Dense growths of rooted vegetation and thick scums of algae on the surface of ponds are objectionable because they reduce the productivity of the pond and make fishing difficult or impossible. They can, however, be controlled by the proper use of fertilizer. Fertilization does not spoil the ponds for swimming and recreation.

Fertilization should begin during the first warm weather of spring, and should be continued through the summer and early fall. In the far South it may be advisable to fertilize monthly during the winter.

The object in fertilizing is to supply enough nutrient to induce the growth of microscopic plants which gives the water a green or brown tinge. It is, therefore, necessary to apply the fertilizer frequently enough to build up a surplus of minerals. Applications should be made at weekly or 10-day intervals and should be continued until the water becomes so turbid (as a result of these microscopic organisms) that the bottom cannot be seen at a depth of more than 12 to 15 inches. Fertilization should then be stopped until the water begins to clear. Then, the fertilizing schedule should be resumed. The object is to maintain about a constant amount of turbidity in the water. 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.

Each application of fertilizer should consist of 100 pounds of fertilizer of approximately an 8-8-4 formula for each acre of water surface. This means that each hundred pounds of fertilizer contains 8 pounds of water-soluble nitrogen, 8 pounds of phosphate, and 4 pounds of potash. If fertilizer of this formula cannot be purchased, regular garden or farm fertilizer may be supplemented with nitrate of soda, ammonium nitrate, superphosphate, or other chemicals. Any fertilizer dealer can give information for modifying regular fertilizers to obtain the proper formula. The 8-8-4 formula was first worked out by Swingle and Smith at Alabama Polytechnic Institute (see footnote 4, page 3) and is generally applicable.

However, there is some variation in fertilizer requirements according to the chemical content of the water. For instance, in very hard water at the Leetown, West Virginia, station and surrounding territory, it was found that a 12-5-5 mixture gave best results. In general, hard waters require more nitrogen and less phosphorus and soft waters less nitrogen and more phosphorus. Under acid conditions it may be advisable to use lime. At the present time, there is insufficient knowledge to make specific recommendations for all conditions. One can obtain the desired results simply by increasing the quantity per application, if necessary, where a "water bloom" is not obtained within a reasonable time. Generally 6 to 12 treatments are required through the summer, depending upon the fertility of the water, length of the season, the amount of runoff, and other conditions.

It is believed that, in general, inorganic fertilizers are preferable to organic types as barnyard manure and cottonseed and soybean meals, although under proper conditions a water bloom may be produced with these also. Barnyard manure should not be used where the pond is utilized for watering stock, swimming, or water supply as certain diseases may be transmitted.

CONTROL OF WEEDS

One of the objectives in the management of fish ponds is the control of aquatic vegetation, which should be eliminated because it serves as a hiding place for small sunfish which may eventually over-populate the pond. Vegetation which is not consumed by most species of fish, also uses up the nutrients supplied by fertilizer and thus prevents them from being utilized for fish production. Vegetation may be controlled either by the use of fertilizers or chemicals. Where fertilizers are used for the purpose there is the advantage that added fertility will increase fish production.

The regular applications of fertilizers recommended in this leaflet will control vegetation although the method of application will depend somewhat upon the plants involved. Ordinary pond weeds, as Najas (Naiad), Potamogeton (pond-weeds), and others, may be controlled in the South by the application of fertilizer during the winter and in the North by applications beginning early in the spring. Chara, or musk grass, may be controlled by normal summer applications. In some instances, pond-weeds also have been killed by summer fertilizing. However, it is desirable to begin the application of fertilizer early in the spring, to develop the proper degree of turbidity and exclude light so that vegetation does not get started. In making the applications, the fertilizer should be spread largely in parts of the pond where vegetation is growing, or, if vegetation is not present, it should be broadcast over the entire surface, including the shallow areas where vegetation is likely to develop.

Floating or emergent plants, as water-lilies, cow-lilies, and water shield (Brasenia) are destroyed by developing the proper turbidity through the use of fertilizer and subsequent cutting. The first two may have to be cut 5 or 6 times during the season. If the "bloom" is maintained, however, floating plants will eventually disappear. The cuttings should be made at weekly intervals or whenever new leaves are formed. Water shield may normally be controlled by a single cutting. The presence of large amounts of pond scum or algae indicates that insufficient fertilizer was used in the beginning. The "scum" should be treated with sodium arsenite or copper sulfate.

Since soft or "freestone" waters respond more readily to fertilization than do hard waters, it is probable that chemical weed-control in them will, in most instances, not be required. On the other hand, the larger-rooted aquatic vegetation thrives in hard-water ponds, particularly in clear water. Despite relatively heavy applications of fertilizer, the vegetation will sometimes develop into growth that are undesirable for fish, and, when the pond bottoms are covered with dense growths, productivity is greatly reduced.

Plant life, too abundant early in the season, will probably continue to be dominant during most of the year. By early elimination through the use of chemicals, the nutrients become available for desirable forms of life beneficial to fish.

Two readily available weed-killers are sodium arsenite and copper sulphate. Sodium arsenite is most effective in controlling the larger-rooted aquatic plants, as the pondweeds (Potamogeton) and common waterweed (Anacharis or Elodea), and small amounts of copper sulphate will readily kill muskgrass (Chara) and objectionable pond scums.

Fortunately, for the farm-pond operator, the margin of safety is large in the use of these chemicals, particularly where the bluegill sunfish and the largemouth black bass are concerned. In the treatment of ponds with sodium arsenite, 3 to 5 parts per million will ordinarily be required to destroy the larger aquatic vegetation. Most fishes can survive more than double this concentration. With copper sulphate, the proportion required is considerably less, not more than 5 to 2.0 parts per million in hard water. It should not be used in soft water as there is greater danger of killing the fish. Sodium arsenite is more effective than copper sulphate in destroying surface scum. The amount required is the same as for killing submerged water vegetation.

In making calculations of the amounts of sodium arsenite solution or copper sulphate to use, the following basic information will be helpful.

Sodium arsenite solution. (Caustic solution containing 4 pounds of As_2O_3 per gallon.) One part per million (p.p.m.) requires 1 gallon of sodium arsenite solution to each 64,082 cubic feet of water in the pond 6/.

Copper sulphate solution. One part per million requires 8.3 pounds of copper sulphate ($CuSO_4.5H_2O$) to 1,000,000 gallons of water. A cubic foot contains approximately 7.5 gallons.

The sodium arsenite may be sprayed over the surface of the water with a tree sprayer or it can be applied with a long-handled dipper from a large galvanized or unpainted wooden tub. The solution is broadcast with the dipper in such a way as to spread it evenly over the surface. Sodium arsenite should be diluted sufficiently to cover the pond thoroughly. Copper sulphate can be applied efficiently in the same manner, but should be mixed in a painted tub as it corrodes unprotected galvanized containers.

The greatest hazard to the fish in the use of these chemicals occurs about two or three days after treatment when the vegetation is decomposing. If vegetation is present in large quantity its decay may reduce the oxygen content of the water and suffocate the fish. To minimize the possibility of killing fish, it is best to treat only a part of the pond at a time, and wait about five days before treating another area. Only that portion of the pond containing objectionable vegetation need be treated. When using copper sulphate, care should be taken in treating the leeward side or end of the pond as the wind may concentrate the chemical there in a quantity as to be lethal to the fish. If oxygen exhaustion is indicated it can be remedied by supplying fresh water, or reaerating the water by spraying it into the air with pumps. Livestock should be kept away from the pond until after a good rain has washed the chemicals from emergent vegetation around the pond.

6/ Further information on the subject may be obtained from Fishery Leaflet 10, Use of sodium arsenite for controlling submerged vegetation in fish ponds. Obtainable from the Fish and Wildlife Service,

MANAGEMENT OF OLD PONDS

Many old ponds and lakes are suitable for management, but these are usually choked with vegetation and populated with stunted fish and in most cases cannot be drained to remove the fish. If the fish present can be destroyed and the pond restocked in the proper proportions, fishing may be expected to improve in about one year. The population can be brought into balance by other methods but it will require a longer time.

The first step in renovating an old pond which cannot be drained is to start a regular fertilizing program. If the pond is weedy, fertilization should start in the winter or as soon as the ice goes out, unless there is excessive overflow. This will produce food rapidly so that the undersized fish will grow faster to catchable size. It will also control vegetation in the pond so that the smaller fish will be eaten by the larger predacious kinds. By limiting the population of fish, both types will grow faster. If the pond already contains bass and blue gills, it may only be necessary to add the proper number of bass fingerlings at the proper time.

As soon as the fertilizing program gets under way, the pond should be fished heavily and regularly to remove the excess of under-sized fish. If there is a population of stunted sunfish or crappie, it is desirable to remove as many as possible with a seine so that there will be space and food sufficient to stimulate growth. Fish once caught should not be returned to the pond. If large bass are present it may be unnecessary to stock with this species as they will spawn the next spring, if populations of other fishes are reduced.

If there are no bass, or if those present fail to spawn, it is desirable to stock this species at the rate of 100 to 150 per acre. Where there are predatory fishes, as the green sunfish or crappie, it may be necessary to stock bass during two or more successive years in order to obtain a proper ratio of bass to other fishes.

Fishing in the pond, after the fertilization program has been undertaken, should be directed to the removal of undesirable species. These include stunted bluegills or crappies, other sunfish, such as the green and pumpkinseed sunfishes and other species, except bass. By the combined process of heavy fishing and removal of those caught, over-populations may be gradually controlled. By this method, fishing will improve in about two years.

After the first spawning season following initiation of a management program, one may determine more accurately whether or not corrective stocking is required. At the end of the summer following the first spawning season, the edges of the pond may be seined with a minnow seine to determine the balance of population. If the bass have reproduced and bluegills are reproducing, it is an indication that the population is coming into balance. In succeeding years, the balance should be accurately checked by seining. If all sizes of bluegills are to be found and there is an evident gradation from the smaller to the larger sizes, the pond is in a healthy condition. If, on the other hand, certain sizes are missing or all of the fish are of about the same size, it is an indication that the population is out of balance. The process of bringing ponds into balance without draining them may require three or four years.

ADMONITIONS

In order to obtain the most benefit from the fish pond and to insure continued success certain points should be emphasized. As the pond is a permanent structure which costs considerable to build, it is important that it be built properly. The best advice on location and construction should be obtained and followed. Ponds should not be located on areas subject to flood nor should they be built by damming streams. Precautions should be taken to prevent seepage or other loss of water. Construction of a pond, no matter how small, is an engineering problem. Provision should be made for draining the pond as many things may happen that will necessitate its being drained. Draining is simple if the pond is properly constructed, and any added cost to provide for ready drainage is worthwhile.

Follow directions in stocking the pond. Using more fish than recommended, or putting in fish that are not known to be suitable, may delay or even prevent good fishing and necessitate draining and restocking. The pond should be stocked as soon as possible after it is filled. Apply through only one source for fish to stock the pond just before or as soon as it is completed. Proper early stocking will minimize the possibility of undesirable fish becoming established, thus causing unbalanced populations and poor fishing. If there is an interval of several months between the time the pond is filled with water and the date of stocking, examine the pond with a minnow seine to determine if undesirable fish have become established. If fish are present, it is probable that the pond should be drained and refilled before it is stocked. Goldfish and carp should not be placed in ponds intended for the propagation of game fishes.

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

All ponds should be fished regularly for all of the species of fish present. In order to obtain full value for the fertilizer expended, it is essential that as many fish of edible size as possible should be captured. If bass only are fished, over-population of sunfish will result, and fishing will decrease. It may then be necessary to begin anew. More ponds suffer from under-fishing than over-fishing. Legal-sized fish that are not removed for food are a loss. It is impossible to remove all of the breeding stock from the pond by hook and line fishing.

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