TEXAS A&M
AGRILIFE
EXTENSION

PO Box 38, Overton, TX 75684
903-834-6191; FAX 903-834-6257
b-higginbotham@tamu.edu

June 17, 2014

Mr. Bobby McAlpin
PO Box 190
Grand Saline, TX 75140

Dear Mr. McAlpin:

Please find the attached water analyses sheets (4 samples) from your two lakes. Please note the pH of both lakes is at or below the acid death point for fish.

Given the long history of low pH in the two lakes as evidenced by the "liming barge" built by the previous landowner, I would like to analyze a sample of water from the upstream reservoir to determine if the cause is site-specific to your property.

As I told you yesterday, I would also contact that Natural Resources Conservation Service to determine if there are any subsoil characteristics that could cause this level of acidity.

I have also attached some additional information for your use.

Sincerely,

Billy Higginbotham

Dr. Billy Higginbotham
Professor & Extension Wildlife and
Fisheries Specialist

TEXAS A&M AGRILIFE EXTENSION

East District 5 Headquarters
PO Box 38, Overton, TX 75684
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FISHERIES WATER QUALITY ANALYSIS SHEET

Name: Bobby McAlpin Date: 6/16/14

Address: ______________________

____

Pond Name: Dam Surface Acres: 5.0 Fish Dying: ______

pH: 4.5 Total Alkalinity (ppm): ______ Total hardness (ppm): ______

Ammonia (ppm): ______ Nitrites (ppm): ______ Other: ______

Recommendations:

______ pH and alkalinity are okay for fish production.

X Increase pH and alkalinity for fish production by adding a minimum of:

______ 1 ton of agricultural limestone* per surface acre
______ 2 tons of agricultural limestone* per surface acre
______ 3 tons of agricultural limestone* per surface acre
X 4 tons of agricultural limestone* per surface acre

*Calcium carbonate only - Do not use liming materials containing hydrated, burnt or quick lime.

Comments: See other sheet 4 tons per acre is a starting point.

Sincerely,

Billy Higginbotham
Professor & Extension Wildlife
and Fisheries Specialist

☞ SEE BACK FOR MORE INFORMATION ☜

Understanding Water Quality Analyses

Without good water quality, your fish cannot survive, grow and/or reproduce at their potential. The following explanations, with a minimum of scientific jargon, will help you to better understand your water analyses.

To Determine Fish Production Potential:

① **pH**: Measures the acidity or basicity of your water on a scale of 0 (very acid) to 14 (very basic) with a pH of 7.0 being neutral. The good range for pH is 6.5 to 9.0. Fish can seldom survive a pH below 4.0 or above 11.0. However, pH alone cannot be used to determine agricultural limestone requirements.

② **Total Alkalinity**: This is the measure of the amount of bases in your water and is normally made up of carbonates, bicarbonates and hydroxides. It is often referred to as the "buffering capacity" of a pond because the higher the total alkalinity, the more buffered the pond will be against wild fluctuations in pH. Your pond should have a total alkalinity of 20 ppm minimum. At this level, carbon dioxide is trapped and becomes more available for photosynthesis. This is very important to make your food chain develop properly, especially if you plan to fertilize. Correction is less important if you supplementally feed.

Agricultural limestone will increase both pH and total alkalinity. However, because the calcium carbonate in agricultural limestone becomes insoluble at a pH level above 8.3, the pH cannot be increased too high if applications beyond the recommended levels are applied. However, if the pH and alkalinity are low but fish are present, the total lime application should be made in stages--especially for ponds less than 0.10 surface acres.

If Fish are Sick/Dying:

If multiple fish species present are dying, then water quality, not disease, is the likely cause. If you suspect some type of pollution entered or was dumped in your pond, contact the nearest TCEQ (Look under "Texas-State Govemment" in your phone directory.) If you suspect a parasite or disease problem, call a fisheries biologist or the TAMU Vet Diagnostic Lab (1-888-646-5623) and they can provide a list of vendors that conduct fish diagnostics.

Here are the common tests we conduct (and one we don't) if water quality is suspected as causing fish losses:

① **Ammonia**: Due to natural fish metabolism and decay of organic matter, ammonia can be caused by too many fish (over 1000 pounds of fish per surface acres), over-feeding or over-fertilization. Ammonia levels over 2 ppm can cause slow death loss and over 5ppm can accelerate death losses. Ammonia toxicity increases as pH and/or temperature increase. Addition of freshwater or removal of pondwater off the pond bottom can help alleviate ammonia toxicity.

② **Nitrites**: Nitrites are an intermediate stage in the decomposition of compounds containing nitrogen. High levels of nitrites can cause "brown blood disease," where affected fish have blood that is dark or chocolate rather than bright red in color. Nitrite levels above 0.5 ppm may cause problems. Stock salt can be added to increase the chloride to nitrite ratio present. However, the source of the elevated organic matter should be reduced whenever possible.

③ **Oxygen**: Oxygen levels (less than 3ppm) kill more fish in Texas ponds each year than all other causes combined. However, oxygen cannot be accurately checked from a sample; it must be monitored on-site. If you have more than 1000 pounds of fish per surface acre and cloudy weather during the summer, prepare to aerate with a boat/motor in a fixed position should fish begin to surface in the early morning hours.

Revised 4/9/12

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FISHERIES WATER QUALITY ANALYSIS SHEET

Name: Bobby McAlpin Date: 6/16/14

Address: ______

______

Pond Name: Upper End Surface Acres: 5 Fish Dying: ______

pH: 4.0 Total Alkalinity (ppm): 0 Total hardness (ppm): ______

Ammonia (ppm): ______ Nitrites (ppm): ______ Other: ______

Recommendations:

______ pH and alkalinity are okay for fish production.

X Increase pH and alkalinity for fish production by adding a minimum of:

- ______ 1 ton of agricultural limestone* per surface acre
- ______ 2 tons of agricultural limestone* per surface acre
- ______ 3 tons of agricultural limestone* per surface acre
- X 4 tons of agricultural limestone* per surface acre

*Calcium carbonate only - Do not use liming materials containing hydrated, burnt or quick lime.

Comments: This is a starting point. Additional lime may be needed. ~~With~~ Lake will not support fish at present time

Sincerely,

Billy Higginbotham
Professor & Extension Wildlife
and Fisheries Specialist

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Understanding Water Quality Analyses

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FISHERIES WATER QUALITY ANALYSIS SHEET

Name: Bobby McAlpin Date: 6/26/14

Address: ____________________

____

Pond Name: Dam Surface Acres: 15 Fish Dying: ______

pH: 4.0 Total Alkalinity (ppm): ______ Total hardness (ppm): ______

Ammonia (ppm): ______ Nitrites (ppm): ______ Other: ______

Recommendations:

______ pH and alkalinity are okay for fish production.

__X__ Increase pH and alkalinity for fish production by adding a minimum of:

______ 1 ton of agricultural limestone* per surface acre
______ 2 tons of agricultural limestone* per surface acre
______ 3 tons of agricultural limestone* per surface acre
__X__ 4 tons of agricultural limestone* per surface acre

*Calcium carbonate only - Do not use liming materials containing hydrated, burnt or quick lime.

Comments: This Recommendation is a starting point. Will not support fish at this pH level.

Sincerely,

Billy Higginbotham
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and Fisheries Specialist

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Understanding Water Quality Analyses

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FISHERIES WATER QUALITY ANALYSIS SHEET

Name: Bobby McAlpin Date: 6/16/14

Address: ______________________

____

Pond Name: Upper End Surface Acres: 15 Fish Dying: ______

pH: 4.5 Total Alkalinity (ppm): ______ Total hardness (ppm): ______

Ammonia (ppm): ______ Nitrites (ppm): ______ Other: ______

Recommendations:

______ pH and alkalinity are okay for fish production.

__X__ Increase pH and alkalinity for fish production by adding a minimum of:

______ 1 ton of agricultural limestone* per surface acre
______ 2 tons of agricultural limestone* per surface acre
______ 3 tons of agricultural limestone* per surface acre
__X__ 4 tons of agricultural limestone* per surface acre

*Calcium carbonate only - Do not use liming materials containing hydrated, burnt or quick lime.

Comments: This recommendation is a starting point. Will not support fish at this pH level.

Sincerely,

Billy Higginbotham
Professor & Extension Wildlife
and Fisheries Specialist

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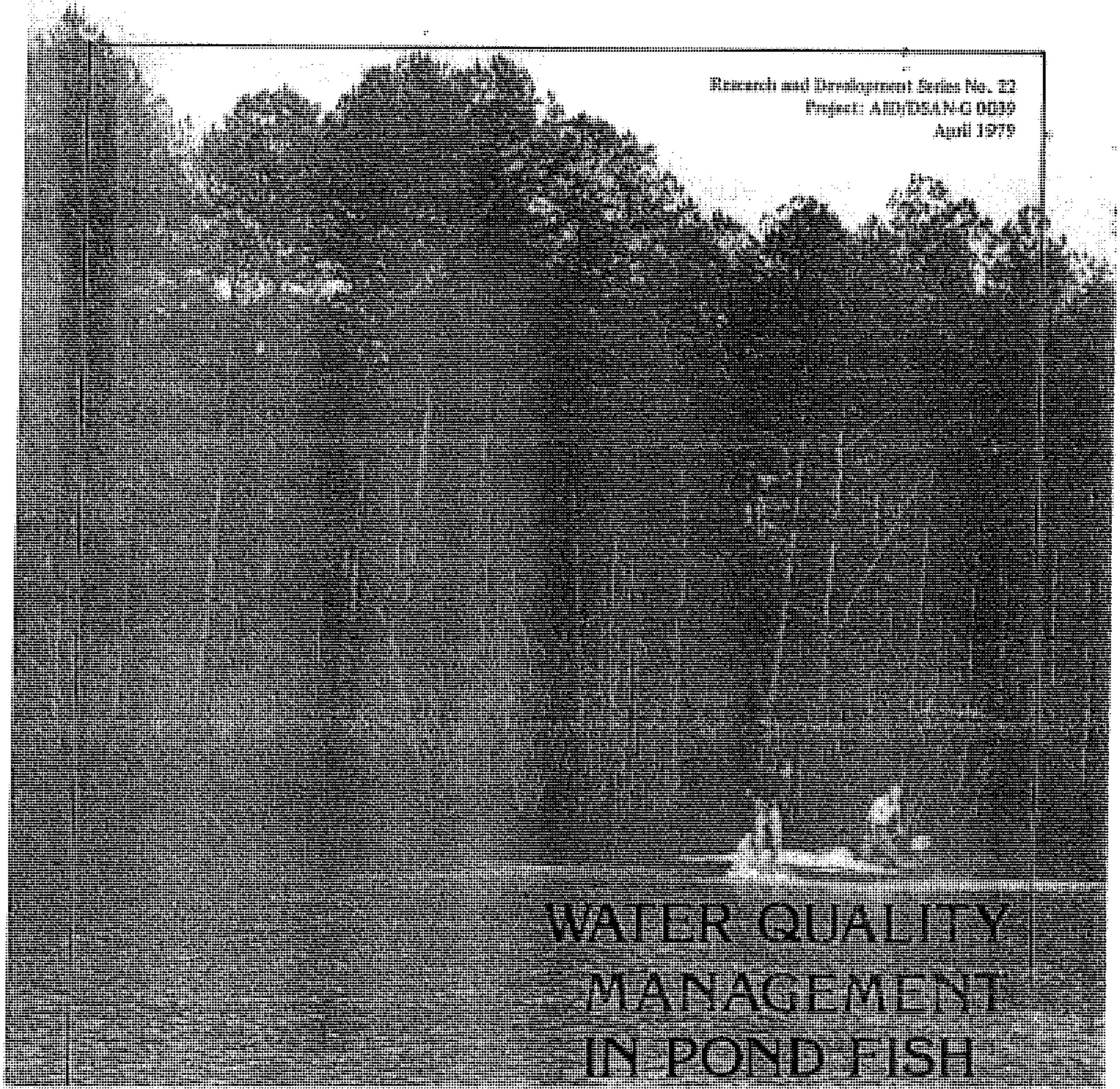
Understanding Water Quality Analyses

Research and Development Series No. 22
Project: AID/DSAN-G 0039
April 1979



WATER QUALITY MANAGEMENT IN POND FISH

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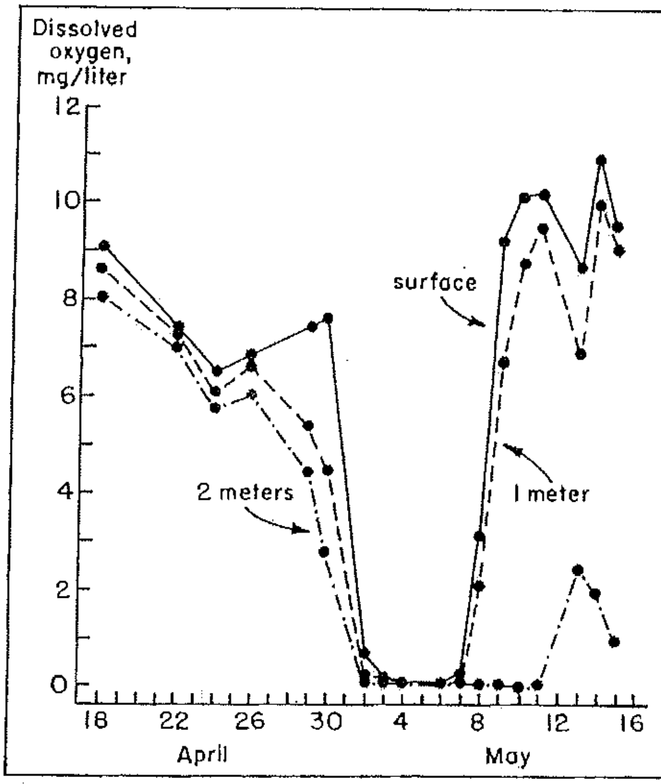


FIG. 10. Concentrations of dissolved oxygen before and after a phytoplankton die-off in a fish pond. The phytoplankton began dying on April 29. After Boyd et al. (19).

sudden death of phytoplankton in a fish pond. The dissolved oxygen concentration quickly dropped below a detectable level, figure 10. Dissolved oxygen concentrations did not return to normal levels until a new phytoplankton community was established (examine figures 9 and 10). Phytoplankton die-offs usually occur during calm, clear, warm weather. One can recognize a die-off because the algal scum deteriorates and the water takes on a brown or gray appearance.

Winds or heavy, cold rains may break up thermal stratification in ponds *(64)*, causing complete mixing ("overturn") of the oxygenless waters of the hypolimnion and the oxygenated water of the epilimnion. If the pond contains a large volume of oxygenless water, oxygen depletion may result.

Fish require adequate concentrations of dissolved oxygen for survival and growth. The minimum concentration for fish survival varies with time of exposure. A fish may tolerate a particularly low concentration of dissolved oxygen for a few hours without ill effect, but will die if exposed to this same concentration for several days. The concentration of dissolved oxygen tolerated by pond fishes is illustrated in figure 11, with additional data on oxygen requirements presented in table 5. Low dissolved oxygen concentrations adversely affect fish even at levels which do not cause mortality, making them more susceptible to parasites and diseases *(49)*. In addition, fish do not feed or grow as well when dissolved oxygen concentrations remain continuously below 4 or 5 milligrams per liter *(4)*. Daily fluctuations of dissolved oxygen in fish ponds apparently have little effect on feeding and growth as long as the minimum dissolved oxygen concentration for the day does not drop below 1 or 2 milligrams per liter in the early morning and then rises near saturation within a few hours after sunrise. If dissolved oxygen concentrations remain at less than 3 or 4 milligrams per liter for prolonged periods, fish cease to feed or grow well.

TABLE 5. REPORTED LETHAL CONCENTRATIONS OF DISSOLVED OXYGEN FOR SELECTED SPECIES OF POND FISH—DATA FROM DOUDOROFF AND SHUMWAY *(24)*

Species	Lethal level, mg/liter
Carassius auratus (goldfish)	0.1 to 2.0
Catla catla (catla)	0.7
Cirrhina mrigala (mrigal)	0.7
Ctenopharyngodon idella (grass carp)	0.2 to 0.6
Cyprinus carpio (common carp)	0.2 to 0.8
Hypophthalmichthys molitrix (silver carp)	0.3 to 1.1
Labeo rohita (rohu)	0.7
Ictalurus punctatus (channel catfish)	0.8 to 2.0
Lepomis macrochirus (bluegill)	0.5 to 3.1
Micropterus salmoides (largemouth bass)	0.9 to 3.1

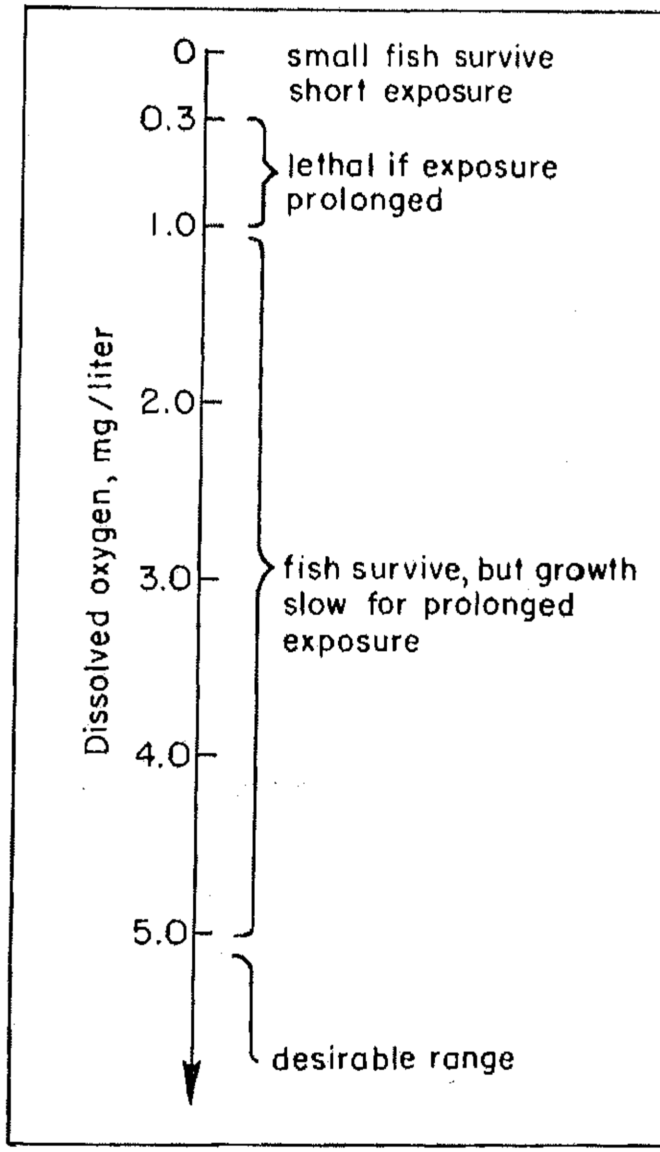


FIG. 11. Effects of dissolved oxygen concentrations on pond fish.

pH

The pH is a measure of the hydrogen ion concentration and indicates whether the water is acidic or basic in reaction. The pH

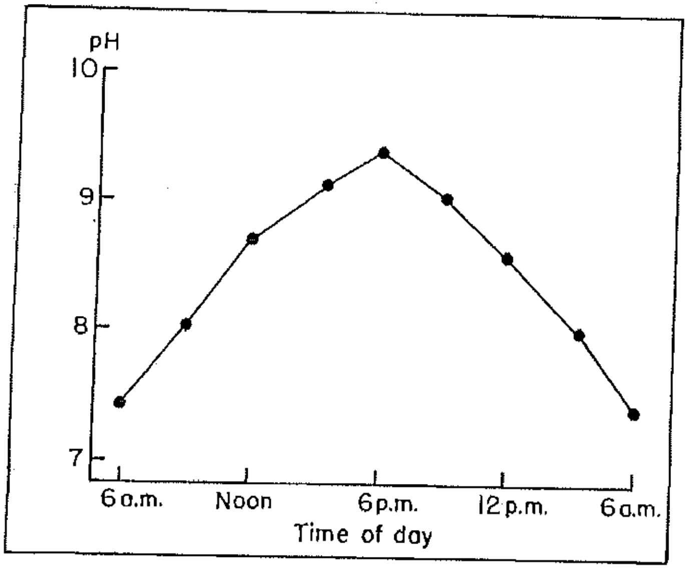


FIG. 12. Daily fluctuations in pH in a fish culture pond.

scale ranges from 0 to 14, with pH 7 being the neutral point. Thus, a water of pH 7 is neither acidic nor basic, while a water with pH below 7 is acidic and one with a pH above 7 is basic. The greater the departure from pH 7, the more acidic or basic a water. The pH of natural waters is greatly influenced by the concentration of carbon dioxide, an acidic substance. Phytoplankton and other aquatic vegetation remove carbon dioxide from the water during photosynthesis, so the pH of a body of water rises during the day and decreases during the night, figure 12. Waters with low total alkalinity often have pH values of 6 to 7.5 before daybreak, but when phytoplankton growth is heavy, afternoon pH values may rise to 10 or even higher *(63)*. Fluctuations in pH are not as great in water with higher total alkalinity where pH values normally range from 7.5 or 8 at daybreak or 9 or 10 during the afternoon. In some water with extremely high total alkalinity, and particularly in waters with high total alkalinity and low total hardness, pH values may rise above 11 during periods of rapid photosynthesis *(63)*. Obviously, pH measurements should be made in the early morning and again in the afternoon to assess the typical pH pattern for a pond. Waters with pH values of about 6.5 to 9 at daybreak are considered best for fish production. Some ponds which receive drainage from acid soils or swamps may be too acid for fish production. Waters with extremely high total alkalinity may have pH values too high for fish culture. Methods for increasing or decreasing the pH of pond water will be given later.

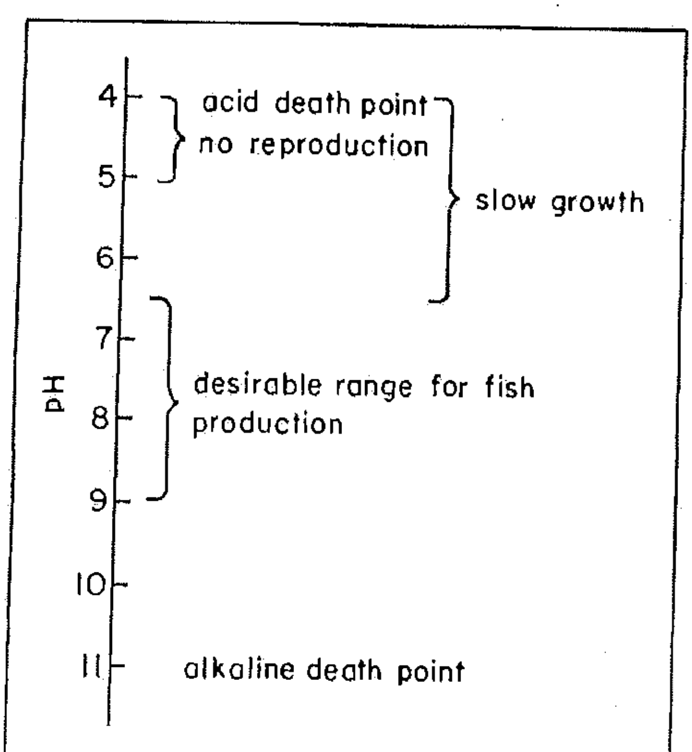


FIG. 13. Effect of pH on pond fish.

The acid and alkaline death points for pond fish are approximately pH 4 and pH 11, respectively *(63)*. Even though fish may survive, production will be poor in ponds with early morning pH values between 4 and 6 and between 9 and 10, figure 13. The afternoon pH in many fish culture systems rises to 9 or 10 for short periods without adverse effect on fish.

Carbon Dioxide

High concentrations of carbon dioxide can be tolerated by fish, although fish avoid levels as low as 5 milligrams per liter. Most species will survive in waters containing up to 60 milligrams per liter carbon dioxide, provided dissolved oxygen concentrations are high *(30)*. When dissolved oxygen concentrations are low, the presence of appreciable carbon dioxide hinders the uptake of oxygen by the fish. Unfortunately, carbon dioxide concentrations are normally quite high when dissolved oxygen concentrations are low. This results because carbon dioxide is released in respiration and utilized in photosynthesis. When dissolved oxygen is low, photosynthesis is not proceeding rapidly. Therefore, carbon dioxide concentrations rise because carbon dioxide released by respiration is not absorbed by phytoplankton for use in photosynthesis. Because of the relationship of carbon dioxide to respiration and photosynthesis, carbon dioxide concentrations usually increase during the night and decrease during the day. Particularly high concentrations of carbon dioxide occur in ponds after phytoplankton die-offs, after destruction of thermal stratification, and during cloudy weather.

Ammonia

Ammonia reaches pond water as a product of fish metabolism and decomposition of organic matter by bacteria. In water, ammonia nitrogen occurs in two forms, un-ionized ammonia and ammonium ion. Un-ionized ammonia is toxic to fish, but the ammonium ion is harmless except at extremely high concentrations. The toxic levels for un-ionized ammonia for short-term exposure usually lie between 0.6 and 2.0 milligrams per liter for pond fish, and sublethal effects may occur at 0.1 to 0.3 milligram per liter *(25, 52)*. The pH and temperature of the water regulate the proportion of total ammonia which occurs in un-ionized form. A pH increase of 1 unit causes roughly a tenfold increase in the proportion of un-ionized ammonia *(71)*. At 28°C, the percentages of total ammonia in un-ionized form are: pH 7, 0.70; pH 8, 6.55; pH 9, 41.23; and pH 10, 87.52. Fortunately, ammonia concentrations are seldom high enough in fish ponds to affect fish growth. The greatest concentrations of total ammonia nitrogen usually occur after phytoplankton die-offs, at which time pH is low because of high concentrations of carbon dioxide.

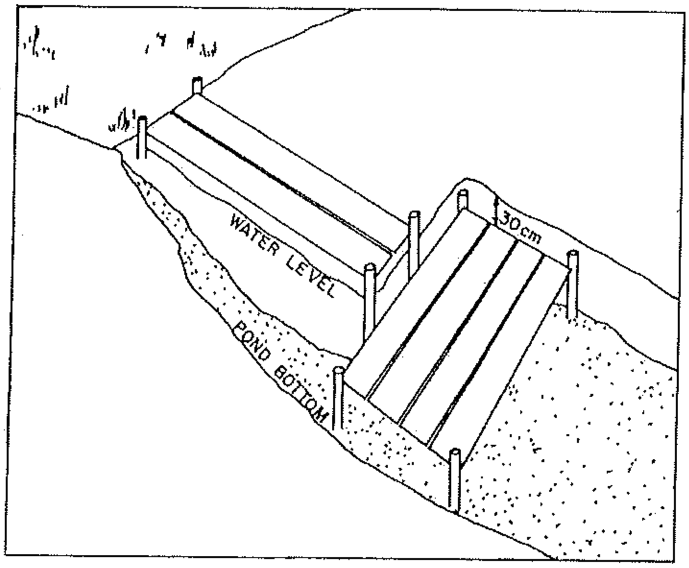


FIG. 15. A fertilizer platform.

Ponds with muddy water or water stained with humic substances in which the Secchi disk visibility is less than 30 centimeters will not respond to fertilizer nutrients because of inadequate light for plankton growth. Weed control must be effected in ponds that are choked with macrophytes, otherwise fertilizers will stimulate macrophytes instead of plankton. If the retention time of water in a pond does not exceed 3 or 4 weeks, fertilizer nutrients will be flushed out of the ponds before they produce plankton. Finally, ponds with acid muds and total alkalinities below 15 or 20 milligrams per liter may not respond to inorganic fertilization unless lime is first applied.

Some other factors must also be considered when using fertilizers. New ponds which have never been fertilized may require more fertilizer than older ponds that have a history of fertilization. Obviously, fertilization is not effective in flowing waters. In ponds where fish obtain their food almost entirely from feeds, little or no fertilizer should be applied. Some fertilizers are acid forming (urea, ammonium sulfate, ammonium nitrate) and their continued use may result in decreased alkalinity and pH. The acidity of nitrogen fertilizers can be counteracted by liming.

Organic Fertilizers

Organic fertilizers consist of various animal manures or plant wastes and are usually called manures. Organic materials may serve as direct sources of food for fish food organisms and fish, or they may decompose and the inorganic nutrients released may cause plankton blooms. Organic fertilizers have low N, P_2O_5, and K_2O contents, table 8, and tremendous quantities are required to supply the same amounts of fertilizer nutrients found in small quantities of chemical fertilizers. When added to ponds, manures decay and exert an oxygen demand. Thus, excessive applications may result in depletion of dissolved oxygen *(56)*. The rate of oxygen consumption by manure varies with the type of manure and water quality, so the fish culturist must work out safe application rates for a particular manure through trial and error or experimentation.

TABLE 8. FERTILIZER CONSTITUENTS IN FRESH MANURE OF SELECTED FARM ANIMALS — AFTER MORRISON *(46)*

Type of manure	Average composition, percent			
	Moisture	N	P_2O_5	K_2O
Dairy cattle	85	0.5	0.2	0.5
Beef cattle	85	.7	.5	.5
Poultry	72	1.2	1.3	.6
Swine	82	.5	.3	.4
Sheep	77	1.4	.5	1.2

TABLE 9. PRODUCTION OF BLUEGILL *(LEPOMIS MACROCHIRUS)* IN PONDS FERTILIZED WITH ORGANIC FERTILIZERS AND INORGANIC FERTILIZER — AFTER SMITH AND SWINGLE *(60, 62)*

Type of fertilization	Bluegill, kg/ha
Cottonseed meal, 1,160 kg/ha	423
Cow manure, 9,000 kg/ha	272
Kudzu hay, 9,000 kg/ha	176
Inorganic fertilization, 8-8-8, 1,100 kg/ha	341

Organic fertilizers are not widely used in the United States, but they receive extensive use in many other countries *(47, 50)*. Manures frequently represent waste products and may be beneficially used in fish culture. However, because of labor and transport costs they are usually more expensive per unit of N, P_2O_5, and K_2O than chemical fertilizers. Fish production may be similar or even greater in ponds treated with manures than in ponds treated with chemical fertilizers, table 9. This is especially true with species such as the tilapia that will feed directly on the manure.

Liming

Total Alkalinity and the Need for Lime

Phytoplankton growth in waters with low alkalinity is often limited by inadequate carbon dioxide and bicarbonate ion. Some waters of low alkalinity are so acid that fish do not survive or grow well. Muds in ponds with low total alkalinity are acid and strongly adsorb the phosphorus added in fertilizer. The addition of a liming material increases the pH of bottom muds and makes phosphorus more available. Liming also increases the availability of carbon for photosynthesis by raising the total alkalinity of the water. The greater total alkalinity after liming results in a higher concentration of bicarbonate ion which is in equilibrium with carbon dioxide. Liming also increases the pH and total hardness of pond waters. Ponds with total alkalinity values less than 10 milligrams per liter seldom produce adequate plankton for good fish production unless they are limed. Responses to fertilization are variable in unlimed ponds with waters containing 10 to 20 milligrams per liter total alkalinity, but unlimed ponds with waters above 20 milligrams per liter total alkalinity consistently produce adequate plankton after fertilization to allow good fish production provided all other factors are favorable *(68)*.

The decision to lime a pond should always be based on total alkalinity measurements rather than guesswork. Ponds in the same general area may differ greatly in total alkalinity. For example, most ponds near Auburn will benefit from liming, but among these are a few which have total alkalinity values well above 20 milligrams per liter. The "rule of thumb" recommendation that all ponds in the vicinity need lime would result in unnecessary and wasteful application of lime to some ponds. In determining whether to lime a pond, it should be remembered that there is no single total alkalinity value below which lime is undoubtedly needed. Experience has shown that liming is of little or no benefit if total alkalinity is above 20 milligrams per liter. At total alkalinity values below 20 milligrams per liter, judgment must be used to decide whether to lime because the need for lime increases with decreasing total alkalinity. In ponds with total alkalinity values between 15 and

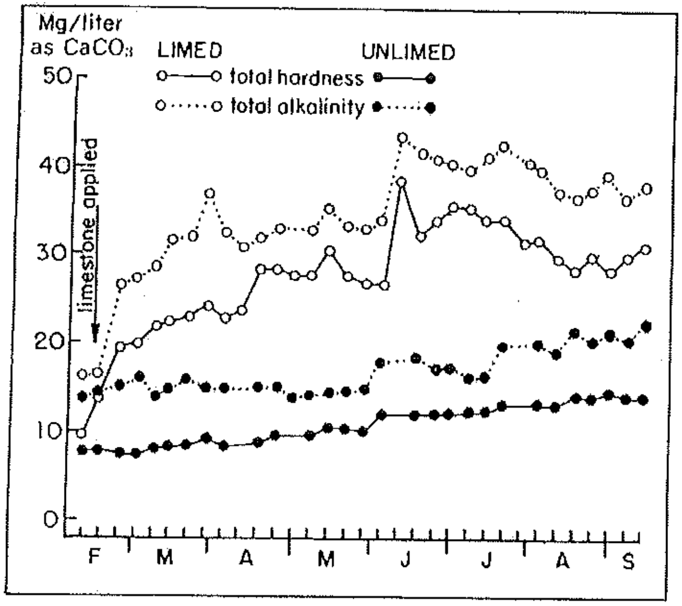


FIG. 16. Effect of application of agricultural limestone on total hardness and total alkalinity in fish ponds. After Arce and Boyd (5).

20 milligrams per liter, the response to liming may be too slight to justify the effort and expense. Lime should not be used in a pond that is not to be fertilized because liming alone will not appreciably increase fish production, except in waters that are so acid that fish will not survive or grow at normal rates. Furthermore, lime is seldom needed in ponds where fish are supplied feed and do not depend on naturally occurring organisms for food.

When lime is applied to a pond, it reacts with the mud. Until enough lime is added to satisfy the lime requirement of the mud, little if any of the added lime will be available to increase the pH, total alkalinity, and total hardness. A lime requirement procedure is available for determining the amount of lime needed to raise the total alkalinity above 20 milligrams per liter in ponds *(12)*. This procedure is based on a chemical analysis of a mud sample. Since many fish culturists and biologists will be unable to use the chemical analysis to obtain a lime requirement value for their ponds, it is suggested that liming material equivalent to about 2,000 kilograms per hectare of calcium carbonate be applied and the total alkalinity determined after 1 or 2 months. If the total alkalinity is still too low, another application equal in amount to the first should be made and the total alkalinity measured again. This procedure should be repeated until enough lime has been applied to maintain the total alkalinity above 20 milligrams per liter. The addition of liming material equal to about 2,000 to 6,000 kilograms per hectare of calcium carbonate should suffice for most ponds. However, some ponds having high concentrations of organic matter in bottom muds or sulfide deposits in bottom muds or on their watersheds may require much greater amounts of lime. Occasionally the lime application rate may be so high that the cost of the lime will be prohibitive and the water will be unsuited for fish culture.

TABLE 10. AVERAGE MUD pH VALUES FOR FIVE LIMED AND FIVE UNLIMED PONDS — LIME APPLIED BETWEEN FEBRUARY 17 AND MARCH 17, 1973

Type pond	November 1972	August 1973	January 1974
Limed	5.2	6.7	6.8
Unlimed	5.4	5.5	5.5

Typical effects of liming may be illustrated by results of experiments conducted at Auburn University *(5)*. Agricultural limestone (finely crushed $CaMg(CO_3)_2$) was applied to five ponds at the rate of 4,000 kilograms per hectare and five ponds served as the unlimed controls. All 10 ponds were fertilized. Liming caused a marked increase in total hardness and total alkalinity, figure 16, and an increase in the pH of bottom muds, table 10.

Tilapia production was 25 percent greater in the limed ponds than in the control ponds. The total alkalinity of these ponds before liming averaged 13.5 milligrams per liter. Even greater responses to liming have been reported in waters which had lower total alkalinity before liming *(17)*.

Applying Lime to Ponds

Agricultural limestone is the best liming material to use in ponds. The material should be finely ground (particles should pass through a sieve with 0.025-centimeter openings) and have a high neutralizing value. Small particle size is necessary so that the agricultural limestone will react quickly with water and mud. The neutralizing values of liming materials refer to the amounts of acid they will neutralize, expressed as a percentage of the amount of acid neutralized by an equal amount of pure calcium carbonate *(1)*. Thus, pure calcium carbonate, with a neutralizing value of 100 percent, is used as a standard in referring to liming rates. For example, if using a liming material having a neutralizing value of 80 percent, to apply at a rate equal to 2,000 kilograms per hectare of calcium carbonate would require an application of 2,500 kilograms per hectare (2,000 kg ÷ 0.80) of the liming material.

Hydrated lime (calcium hydroxide, $Ca(OH)_2$) and burnt lime (calcium oxide, CaO) have higher neutralizing values than agricultural limestone. If applied in large quantities, however, these materials cause excessively high pH and fish mortality. Hydrated lime and burnt lime are sometimes applied to waters which contain no fish or to muds of ponds which have been drained to raise the pH and kill fish disease organisms. Basic slag has been used as a liming material in fish culture, but since its neutralizing value is lower than that of most agricultural limestones, extremely large applications are required *(75)*. Agricultural gypsum (calcium sulfate, $CaSO_4 \cdot 2H_2O$) is not a liming material, although it has incorrectly been used as one by some fish culturists.

Liming materials can be easily broadcast over the bottoms of empty ponds, but application is more difficult when ponds are full of water. Best results may be achieved by broadcasting the liming material over the entire pond surface. Bags of liming material may be emptied from a moving boat. Bulk liming material is cheaper and may be applied from a plywood platform attached between two boats, figure 17. Liming material should be applied during late fall or early winter in temperate regions so that it will react with waters and muds before fertilizers are applied in the spring. In tropical regions, lime should be applied at least 1 month before fertilizer applications are initiated. This is important because liming materials will precipitate phosphorus if applied at or near the same time as fertilizers. However, reaction of liming material with the mud increases availability of phosphorus fertilizer. The residual effect of liming is governed by the rate of water loss to seepage and pond overflow. In ponds with normal rates of water loss, liming will usually last 3 to 5 years. Once a pond has been limed, small annual applications (20-25 percent of the initial application rate) may be used to avoid having to make large applications of lime every few years.

LIMING FARM FISH PONDS IN EAST TEXAS

Joe Lock and James Davis*

Most farm ponds in east Texas have slightly acid water which reduces fish production. Some other ponds are so acid fish die soon after stocking. Spreading sufficient quantities of agricultural limestone over the pond bottom will correct these problems.

Liming ponds prevents stress on or death of fish caused by low pH. Most important, lime increases the availability of phosphorous for plant use. Phosphorus promotes growth of algae, microscopic plants which are the base of natural fish food production in ponds.

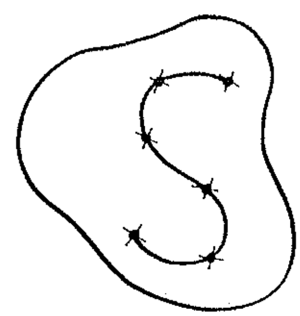
Another benefit of liming is it increases water alkalinity which in turn increases the carbon dioxide available for photosynthesis by algae. Liming a fertilized, acid-water pond can increase fish production.

Need

Ponds with waters of less than 20 parts per million (ppm) total alkalinity, or with pH below 6.5, normally need lime. Generally, the farther the water is below 20 ppm total alkalinity, the better the pond will respond to lime applications. Total alkalinity can be determined with a simple water testing kit available from fish farming supply houses. The total alkalinity test indicates whether a lime application is needed. A chemical analysis of the bottom mud determines the quantity of lime required.

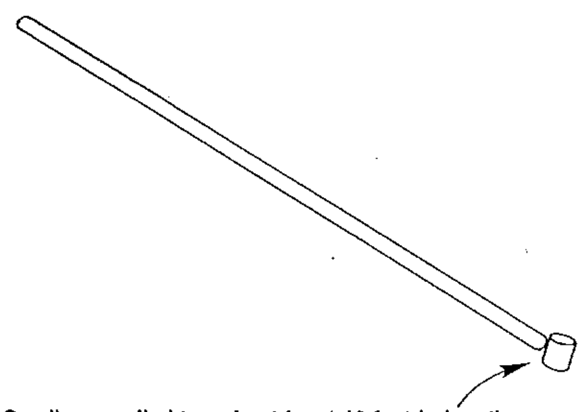
Mud samples are easily collected from dry ponds. Since the lime requirement of mud from shallow areas is generally less than that of mud from deep areas, take samples randomly in an S-shaped pattern along the length of the pond (Figure 1). Take three to six samples of equal volume, about 1 cup per acre, from ponds larger than 5 acres and a minimum of 10 samples per acre from small ponds.

Soil samples can be taken in a full pond by using a boat and a sampler made by attaching a can to the end of a long pole (Figure 2). Follow the same sampling procedure described for dry ponds. Mix individual samples together in a container. Then, spread the combined sample on aluminum foil to dry. After drying the sample, gently pulverize it; then place it in a soil testing box. Soil sample boxes, information sheets and instructions are available at your county Extension office. Clearly write "Fishpond" on the soil information sheet and soil box and send the sample to the address on the box. A minimal fee is charged for the analysis. The lime recommendation will be stated in tons of agricultural limestone per acre.



Sketch—X indicates sample points.

Figure 1. Mud sampling locations in a pond.



Small can nailed to pole at least 10 feet in length.

Figure 2. Mud sampler for use when pond is full of water. Can be used from a boat or from the shore.

*Extension fisheries specialists. The Texas A&M University System.

Materials

The most common pond liming materials are agricultural limestone (calcium carbonate or dolomitic) and slaked or hydrated lime. Pure calcium carbonate has a 100 percent neutralizing value. Other liming materials are measured against this standard. Dolomitic limestone ranges from 95 to 108 percent; slaked lime is 136 percent; and basic slag has a neutralizing value of about 50 to 79 percent. Do not use silicate slag in fishponds. Lime must meet the state fineness standard which regulates its reaction rate in the mud.

Agricultural limestone is best for fishponds. Slaked lime can raise the water pH so high that fish may die. If fish are not present, slaked lime may be used provided fish are not stocked until the pH returns to a tolerable level, possibly several weeks. Liquid lime, a finely ground suspension of agricultural limestone, may be convenient to apply, but normally has about one-half ton of actual lime per ton; therefore, twice as much liquid lime by weight is required per acre as regular agricultural limestone.

Requirements

To calculate the amount of liming material required, divide the lime requirement by the neutralizing value. For example, suppose your soil test analyst recommends 2 tons of agricultural limestone per acre and the liming material you have selected has an 85 percent neutralizing value. Two tons divided by .85 equals 2.4 tons of liming material needed per acre.

Application

New ponds or ponds with the water removed can be limed before they are filled. Spread the required amount of limestone evenly over the dry pond bottom. A disk harrow can be used to mix the lime into the pond soil. This will speed the lime's reaction with the soil. In ponds which contain water, apply limestone evenly across the surface. In small ponds, distribute bagged limestone from a boat. In larger ponds, where several tons of lime are required, a platform can be constructed on the front of a large boat or between boats lashed together (Figure 3). Bulk limestone can be loaded on the platform and distributed across the pond surface with a shovel. Do not overload the boat or it may capsize.

If spreading the lime over the pond surface is impractical, pile the liming material in the water along the shallow pond edges or dump it into a feeder stream. Wave action and currents will help dissolve the material and spread it through the pond. Results are not very predictable using this method.

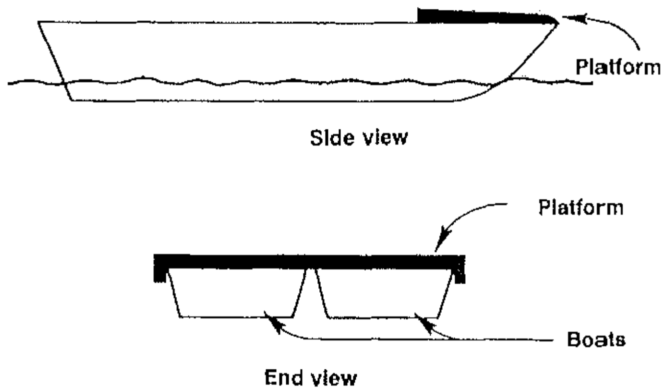


Figure 3. Boats lashed together to form floating platform for applying lime or fertilizer.

Timing

The best times for lime application are during late fall and winter when fertilization is suspended. This allows the lime to react with the acid bottom muds before the spring fertilizer application. Do not apply limestone while the pond is being fertilized. Limestone settles phosphorous from the water, making it unavailable to algae.

Frequency

A liming treatment will last almost indefinitely if no pond water outflows. Most ponds, however, have excess water which flows through the spillway or pipe sometimes. Seepage, pond draining and use of acid forming fertilizers also increase the required liming frequency. Most ponds in acid soils with moderate water outflow will require lime every 3 to 5 years. To continually satisfy the lime requirement, initially apply the total amount needed and then apply one-fourth that rate each year.

This material was adapted in part from *Liming Fish Ponds* by John Jensen of the Alabama Cooperative Extension Service and used with his permission.

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