DISCUSSION

Reports received from bass clubs probably reflected accurate harvest statistics. Most clubs maintained good catch records in order to qualify their top six fishermen for a prestige state club championship tournament. Even competition between individual club members for trophies, prize monies and/or best fisherman honors was enough incentive for clubs to maintain meticulous tournament records.

In 1972 largemouth bass tournament harvests from Texas lakes, in addition to non-tournament harvests, were probably not detrimental to bass populations. Creel and cove rotenone surveys conducted on Lake Bastrop, a noted bass fishing lake, give some support to this statement. Three cove rotenone samples (acres sampled = 5.8) were made in 1973 and a standing crop of 32.7 lbs. per acre for largemouth bass was estimated (Provine, personal communications). Tournament harvest (1.81 lbs./acre; 1972 harvest estimate based on Lake Bastrop tournament data obtained by this study) was 5 percent of this 1973 standing crop figure. Total estimated harvest (9.85 lbs./acre; 1972 harvest based on Lake Bastrop creel survey data) was 30 percent of the 1973 standing crop (Provine, 1973). No actual estimates of sustainable yield for largemouth bass in Lake Bastrop are known. But, considering the relatively small fraction of the stock being harvested by all fishermen, it is doubtful the level of sustainable yield is being overshot. It appears, at least in Lake Bastrop, fishing has not reached a point that would cause a decline in recruitment of bass.

Accurate tournament statistics may prove to be the most significant contribution bass clubs can make to fish management programs. Few states, if any, have sufficient staff to monitor the bass fishery of all their tournament lakes year after year. But, bass clubs can furnish this service, Bass angling quality indices such as percent of successful tournament fishermen, average weight of fish caught, pounds per man-hour, etc., are obtainable from bass club harvest records. Fish conservation agencies should make efforts to obtain these data for lake management purposes.

THE USE OF ANTIMYCIN (FINTROL) IN FARM PONDS IN GEORGIA[1]

by

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ABSTRACT

The results from the use of antimycin A in Georgia fish ponds as a fish toxicant within the period 1968-1974 are presented in the following paper. Concentrations of antimycin at 0.4 to 0.6 parts per billion (ppb) were found to be the most desirable range for reducing populations of scalefish in attempting to improve balance and/or to improve fishing. For controlling all sizes of scalefish in catfish ponds, concentrations of 2.0 and 4.0 ppb seemed effective. The gravity flow method of application by boat was found to be adequate, but other means of application could be used successfully.

INTRODUCTION

Antimycin A (Fintrol) was first field tested as a piscicide about 10 years ago (Walker, et. al. 1964). In Georgia it was not used extensively prior to 1968. However, since that time it has been widely used in ponds in central and west central Georgia ponds. Antimycin has been used largely for selective removal of excessive numbers of intermediate bluegills (*Lepomis macrochirus*) and to eradicate scalefish populations in ponds managed primarily for channel catfish. Its application in Georgia reservoirs has

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been only moderately explored, but seems promising. Today, there are in excess of 60,000 ponds in Georgia. This represents a significant freshwater fishery for both commercial and sport interests.

Thomaston (1962) reported that unbalanced fish populations caused by overabundance of intermediate size bluegills were a major problem in Georgia ponds. Hooper and Crance (1960) reported that the sport fish harvest was 30 percent less by weight in unbalanced populations than in balanced populations. They also speculated that fishing success probably would have decreased further if the unbalanced condition had been allowed to persist. Today unbalanced ponds in Georgia caused by overcrowding intermediate bluegills and competitive species are still a problem. However, it has been found in the last few years that the percentage of balanced ponds in the Central region of the state has increased.

In the past, the best procedure for correcting unbalanced fish populations was to eliminate the entire population and restock. This is undesirable because the pond is out of production for about 18 months (Swingle, 1949, 1951, 1952). A much better alternate method involves a partial removal of the fish population with or without additional stocking. Swingle, Prather, and Lawrence (1953) and Hooper and Crance (1960) were successful in using rotenone to remove substantial portions of overcrowded bluegill populations in Alabama ponds. These investigators along with Bennett (1962), Thomaston (1965), and Byrd and Crance (1965) introduced methods for partial poisoning with rotenone overcrowded sunfish populations to improve balance.

Rotenone has been used successfully in removing intermediate bluegill populations and restoring balance. It was, and probably still is, the best all around fish toxicant for complete removal of fish populations. However, it has distinct disadvantages as a piscicide. Burress (1971) pointed out that the use of rotenone, although effective in thinning forage fish populations, is circumscribed by weather and water conditions and at times undesirably large numbers of catchable size bass, crappie (*Pomoxis spp.*), sunfishes, and channel catfish *(Ictalurus punctatus)* have been killed. It is generally accepted that antimycin is a significantly improved tool for selective eradication of certain species and sizes of fishes. Burress and Luhning (1969) commented that it offered some distinct advantages over rotenone: its considerably greater selectivity among species and size groups of fishes, its lack of repellency, and its greater adaptability to use under a wide range of environmental conditions. Schnick (1974) in the review of antimycin work pointed out that antimycin is not only effective as a general and selective piscicide in total, partial, or spot treatments; but particularly effective in selectively removing scalefish from catfish ponds.

Infestations of scalefish in ponds that are stocked and managed primarily for the production of channel catfish for sport and commercial purposes has been a concern in Georgia. Avault (1968) pointed out that scalefish in channel catfish ponds compete with catfish for food, space, and oxygen, and may introduce parasites. Avault (1968), Avault and Radonski (1968), and Burress and Luhning (1969) have determined antiymcin to be successful in eliminating catfish ponds of scalefish without killing catfish. Berger (1966) reported laboratory tests in which channel catfish were not killed until the concentration of antimycin was increased to 20 ppb, whereas concentrations well below this level are effective for eliminating species of scalefish ordinarily stocked in ponds.

Fisheries personnel of the Game and Fish Division of the Georgia Department of Natural Resources provide technical assistance to pond owners when requested in checking their ponds on general management problems and makes recommendations on corrective measures. State fisheries biologists often assist in the actual treatment of ponds with antimycin for corrective action. Though antimycin has been tested for field use by researchers, it is desirable to know the effectiveness of this chemical in routine management. This paper describes our experiences on the use of antimycin for various pond situations.

Appreciation is expressed to the various work unit personnel of the Soil Conservation Service (SCS) and Wildlife Rangers of this Department for their as-

sistance in providing some of the ponds used in this study and pertinent information needed prior to treating these ponds.

We are indebted to Mr. Ralph Burress for his critical review of the manuscript and his many helpful suggestions.

MATERIALS AND METHODS

The ponds used in this study contained unbalance populations or undesirably high populations of unwanted species of fishes. From 1968 through 1973, 84 antimycin treatments were made in 54 ponds. Evaluations of these treatments were made through July, 1974. The ranges of physical and chemical parameters encountered in various ponds at the time of treatment were as follows: surface area, 0.5 to 23.0 acres; volume, 1.4 to 98.9 acre-feet; surface temperature, 48° to 84°F; pH, 6.3 to 9.3; and total hardness, 7 to 62 ppm.

Fintrol Concentrate, a liquid preparation containing 10 percent active ingredient, was used in 78 treatments, whereas Fintrol-5, a formulation of antimycin and sand containing 1 percent active ingredient, was used in 6 treatments. The concentrations of antimycin used ranged from 0.1 to 10.0 ppb.

The Fintrol Concentrate was prepared by combining the diluent (acetone) and the antimycin (20 percent). In most instances the two solutions were poured into a 5-gallon metal gasoline can and mixed thoroughly before the can was filled with pond water. This mixture was then applied to the pond by pouring it over the side of the boat as it was propelled over the pond by a 9.5 horsepower outboard motor or an electric motor. The stock solution was either applied uniformly over the entire surface area of the pond or uniformly over the upper end of the pond only.

In other instances, the stock solution was prepared by mixing the solution of acetone and antimycin in a 5-gallon plastic bucket, which was then filled with pond water. Most treatments were applied over the entire surface area or in the upper end only by means of an automatic boat bailer. However, a few applications were made from the banks of the ponds by broadcasting the stock solution with a dipper at different points around the pond. A special pump which was operated from a single point on the pond margin, was used to apply antimycin to two ponds.

An attempt was made to evaluate both the immediate and the long-term results of treatments. Fish response may be slow in cold weather, hence, immediate results were evaluated by visual observations or by seining for periods of 1 to 21 days after treatment. The long-term results were evaluated over a period ranging from several months to several years. Evaluations were made by seining to determine population balance (Swingle 1956), by seining or visual observations at feeding time to determine the presence or absence of scalefish in catfish ponds, and by discussions with pond owners concerning post-treatment fishing success. The results of treatment were designated as poor, fair, or good.

The results of these antimycin treatments are expressed by summarizing the data including observations made for all of the treatments to five categories of target fish (See Table 1) and by showing case studies in representative ponds (See Table 2).

The first major category of target fish (Group A) includes species of scalefish that were encountered during attempts to restore balance and improve fishing by partial and/or selective removal. Included in this group are intermediate bluegills and mixed species.[2] The second major category (Group B) includes species of scalefish present in ponds managed for channel catfish in which total removal was the goal. Within this group are bluegills, golden shiners and miscellaneous species.[3]

[2]Includes one or combinations of the following species: golden shiners *(Notemigonus crysoleucas)*, crappie, intermediate bluegills and gizzard shad *(Dorosoma cepedianum)* and threadfin shad *(Dorosoma pretenense)*.

[3]Includes one or combinations of the following species: bluegill and largemouth bass *(Micropterus salmoides)*, redear *(Lepomis microlophus)*, redbreast *(Lepomis auritus)*, green sunfish *(Lepomis cyanellus)*, warmouth *(Chaenobryttus gulosus)*, golden shiners and fathead minnows *(Pimephales promelas)*.

RESULTS

Group A

Intermediate bluegills

Good results were recorded out of a total of 34 treatments on 11 occasions (32%). These successful treatments were noted at a pH range[4] of 6.3-7.9, concentration range of 0.5-1.5 ppb and temperature range of 54-82° F. Poor results were recorded in most instances where the pH was 8.5 or higher at the time of applications. Generally, even when the pH was not high, the results were poor or fair at concentrations below 0.4 ppb. The 0.5-ppb concentration was successful on three occasions.

Mixed species

Out of five total treatments, there were four treatments (80%) considered good and only one considered fair. The pH range[4] was 6.7-7.5 and the temperature range varied from 56-70° F. Concentrations of 0.2 and 0.3 ppb successfully controlled gizzard and threadfin shad. Fishing significantly improved following a partial removal of golden shiners, crappie and intermediate bluegills with 0.4 and 0.5-ppb treatments.

Group B

Bluegills

Almost all (15) of the 16 treatments made in this category were fair (68%) or good (25%). In most instances, the pH[4] was 7.0 or less. The 4.0 ppb concentration was applied most often and was successful in controlling all sizes. However, the 2.0-ppb level was also successful in doing the same. Concentrations of 0.5 and 0.6 ppb were not as effective for removing adult species as the above concentrations.

Golden Shiners

In nine attempts to eliminate golden shiners, four treatments (44%) were recorded as good in this endeavor. Of these four successful treatments, three came as the result of using a 2.0-ppb concentration and the other with a 0.4-ppb concentration. The successful pH[4] and temperature ranges were 6.5-7.0 and 57-72° F. Poor results were recorded when treatments of 0.4, 0.6, and 4.0 ppb concentrations were made in ponds where the pH was 9.0 either immediately prior to the application or apparently rose significantly higher during the day.

Miscellaneous species

Attempts (14) in this category were recorded good success 64% of the time. The successful pH[4] and temperature ranges were 6.5-7.3 and 48-80° F. Again, the 2.0 ppb and 4.0 ppb concentrations seemed to be effective. High pH levels in part were again seemingly responsible for some of the poor to fair results. On one occasion, a 1.0-ppb treatment effectively removed redbreast.

The following ponds are representative of the types of fish populations and related problems found in central and west central Georgia. The various methods and techniques concerning the application of antimycin during this study are represented by these ponds. The results of treatments in the following 10 ponds are fairly representative of the overall results obtained during this study:[5]

Bluebird

This 5-acre pond that was originally stocked with largemouth bass *(Micropterus salmoides)* and bream[6] was found to be overcrowded with intermediate bluegills dur-

[4]The pH immediately prior to application; however, pH was not thought to have risen to 8.5 or higher during the day.

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[5]All treatments represented in the following 10 ponds were made with Fintrol Concentrate only.

[6]All bass-bream ponds in this tudy were stocked during the fall or winter with 1,000 bream per acre (80 percent bluegills and 20 percent redear *(Lepomis microlophus)* and the following spring with 100 largemouth bass per acre. Channel catfish were stocked at 100 per acre during the fall or winter.

ing the summer of 1969. During the fall of 1969, a treatment of 0.6 ppb antimycin was applied by gravity flow uniformly over the entire pond to selectively reduce the intermediate bluegill population. The immediate results were an apparent over kill including bass up to 5 pounds. This was partially attributed to a constant pH of 7.0 recorded during the 24-hour period immediately after application. Potassium permanganate at 1.0 ppm then was applied and apparently stopped the kill. The following year, the pond was found to be in balance with satisfactory bass reproduction and good bluegill reproduction. The pond was seined during the summer of 1974 and found to be in good balance.

Jarrell

This 4.5-acre pond contained largemouth bass, bream and channel catfish, ans was found to be overcrowded with intermediate bluegills with no bass reproduction during the summer of 1970. In August, a 0.5-ppb treatment was applied by gravity flow uniformly over the pond. The immediate results were apparently good with no dead bass being observed. In the spring of 1971, a temporary balance was indicated by the presence of excessive numbers of sub-intermediate and intermediate bluegills. There was little bluegill reproduction and very few fingerling bass. The immediate results of a retreatment (applied as above) of 0.4 ppb during October, 1971, apparently was poor despite the existence of a favorable pH condition.

However, seining during 1973 showed evidence of a balanced population, and during 1974 balance was found to be good.

Buffington

The upper end only of this 3-acre pond was treated with 0.32-ppb antimycin to remove intermediate bluegills. The pH at the time of application was 6.8, and it remained constant throughout the day. Although a good kill in intermediate (3″ predominantly) bluegills was observed the following few days, seining during the summer of 1974 revealed an excessive intermediate bluegill population. Because neither bass nor bluegill reproduction had occurred, bass fingerlings were stocked at 100 per acre in an attempt to restore balance. However, it is possible that more bluegills will need to be removed.

H. T. Sullivan

In 1971, this 20-acre pond was found to be heavily crowded with large golden shiners *(Notemigonus crysoleucas).* Since no bass reproduction and little bluegill reproduction was found, a 0.5-ppb antimycin treatment was applied uniformly over the pond in January, 1972. At the time of application, the water temperature was 55° F. and the pH was 6.5. A good kill of about 75 pounds per acre of shiners occurred over a period of 17 days. No bass and only a few bluegills were killed. During the spring of 1973, there was a tremendous bass and bluegill spawn, and fishing improved considerably for all species. During 1974, there was another good hatch of bass and bluegill, and at this time, fishing was even better than it was during 1973. Some shiners were left, but there were so few that they were not caught in the seine.

Sample Brown

Brown's pond of approximately 23 acres was formed by constructing a dam on a stream that contained several species of fish other than those recommended for use in ponds. The pond contained black crappie (*Pomoxis nigromaculatus),* bowfin (*Amia* calva), golden shiners, and other sunfishes in addition to largemouth bass and bluegills. Bass fishing, which was excellent for a number of years, was now only fair, and fishing for all other species was poor. During May of 1972, an application of 0.5 ppb antimycin was made over the upper end (approximately half the total acreage) of the pond. A fair kill (about 20 pounds per acre) consisting primarily of crappie and bluegill was observed during the following 2 days. Two largemouth bass weighing approximately 1 pound each were killed and one 6-inch bass was observed in distress. Very few shiners were killed. Fishing during 1972 and 1973 was reported to have been very good for bass with unusual catches of large bass. Bluegill and crappie fishing also improved during this time.

Webb

During April, 1970, 2.0 ppb of antimycin was applied by gravity flow over this 1-acre channel catfish pond for removal of fathead minnows *(Pimephales promelas).* The results appeared good, but later more fatheads were found in the pond. The pond was retreated with 4.0 ppb and no fatheads were found when the pond was drained. No dead or distressed catfish were observed following either application of antimycin.

J. W. Truenell

This pond of 1.6 acres was stocked with channel catfish and became infested with bluegills. The intent was to remove the bluegills without killing any channel catfish. During September, 1969, 4.0 ppb of antimycin was applied by gravity flow over the pond. Immediate observation indicated that most all the bluegills were killed and that no catfish were killed.

Young

This 0.91-acre pond was stocked with approximately 500 channel catfish, but an attempt to remove golden shiners, green sunfish *(Leposis cyanellus),* warmouth *(Chaenobryttus gulosus),* largemouth bass, and eastern chain pickerel *(Esox niger)* was unsuccessful. During May, 1972, two antimycin treatments were applied by gravity flow over the upper end of the pond. The first treatment (0.6 ppb) was made when a heavy phytoplankton bloom was evident and the pH was 9.0. No kill was observed during the next few days. About 2 weeks later the bloom was reduced with a herbicide, and the second treatment (0.4 ppb) was made. The following total weights of fish were recovered (lbs.): golden shiner, 65.3; green sunfish, 22.0; warmouth, 3.0; two largemouth bass, 3.0; and one 3-inch pickerel. During September, 1972, a third treatment of 1.0 ppb was applied to the pond. Again the fish were picked up and weighed by species: golden shiner, 5.2; green sunfish, 3.2; and warmouth, 2.7. The following week the pond was partially drained and renovated with rotenone. One 10-inch shiner, 19 percent and 83 percent (by weight) of the total populations of green sunfish and warmouth respectively, had survived the antimycin treatments. About 92 percent by weight of the shiners ranging from 3 to 9 inches in length were killed by the 0.4-ppb treatment, thus, the shiners were the least tolerant and the warmouth the most tolerant to the antimycin treatments.

Bell

Bell's channel catfish pond (2.94) acres) was treated with 2.0 ppb of antimycin to remove scalefish. In this case the chemical was prepared as usual, but was applied from the bank at five different areas around the pond. The pH was 6.8 at the time of application and remained constant throughout the day. Immediate results indicated that about 92 pounds per acre of bluegills (primarily) and redear sunfish were killed. Also, one 15-inch largemouth bass and a few tadpoles *(Rana* sp.) were killed. Seine hauls during the following December failed to take any scalefish. The pond was seined during the summers of 1973 and 1974 and no scalefish were found. During these checks relatively abundant populations of aquatic insects were found.

Strickland

This 1.5-acre channel catfish pond was treated with 4.0 ppb of antimycin in an attempt to remove bluegills. It was applied by means of an automatic boat bailer from a 5-gallon plastic bucket filled with pond water and Fintrol Concentrate. Observations during the following few days indicated a good kill of bluegills and no dead catfish. During the following October the pond was seined, but no scalefish were found. However, channel catfish fingerlings were found during this time.

Table 1. Summary of the results of applying antimycin in Georgia ponds.

Target Fish	No. of treatments	Success[5] Poor	Fair	Good	Water temp. (°F)	pH	Concentration (ppb)	Comments
Group A[1] Intermediate bluegills	34	14	9	11	40-82	6.3-9.3	0.2-1.5	Overall good success was 32%. Effective results at pH 6.3-7.9, conc., 0.5-1.5 ppb and temp. 54-82° F. A conc. of 0.5 ppb was successful on 3 occasions.
Mixed species[2]	5	0	1	4	56-70	6.7-7.5	0.2-0.7	Overall good success was 80%. Successful at pH and temp. of 6.7-7.5 and 56-70° F. 0.2 and 0.3 ppb successful on shad. 0.4-0.7 ppb successful for others.
Group B[3] bluegills	16	1	11	4	54-81	6.5-8.0	0.5-6.0	Overall good success was 25%. 2.0 and 4.0 ppb effectively removed all sizes at pH of 7.0 or less. Less than 1.0 ppb not as effective.
Golden shiners	9	3	2	4	57-80	6.5-9.0	0.4-4.0	Overall good success was 44%. 0.4 and 2.0 ppb very successful at total removal at pH of 7.0 or less. Poor results at 0.4, 0.6 and 4.0 ppb at pH of 8.5 or higher.
Miscellaneous species[4]	14	2	3	9	48-81	6.7-8.0	1.0-10.0	Overall good success was 64%. 2.0 and 4.0 ppb was effective at pH and temp. of 6.5-7.3 and 48-80° F. A 1.0 ppb conc. was successful on redbreast.

1. Includes species of scalefish that were encountered during attempts to restore balance and/or improve fishing by partial or selective removal.
2. Includes one or combinations of the following species: golden shiners, crappie, intermediate bluegills and gizzard and threadfin shad.
3. Scalefish present in ponds managed for channel catfish in which total removal was the goal.
4. One or some combinations of the following species: bluegill and largemouth bass, redear, redbreast, green sunfish, warmouth and golden shiners.
5. Determined by immediate and/or long-term evaluations for results following each treatment.

DISCUSSION

The first five representative ponds (bass-bream ponds) were treated in attempts to restore balance and improve fishing by selectively and/or partially removing intermediate bluegills, golden shiners, crappie and other sunfish (Group A). A balanced population is defined as producing succeeding annual crops of harvestable fish (Swingle, 1956). It has been pointed out by Thomaston (1965) that in attempting to correct an overcrowded intermediate bluegill population, the poundage of intermediate bluegill that should be removed will vary with each population. It is not the poundage removed, but rather the remaining fish that are important in restoring balance.

Concentrations of antimycin used in Group A varied from 0.2 to 1.5 ppb, and were successful 39 percent of the time. Burress (1968) found that concentrations of 0.4 to 0.6 ppb of antimycin were adequate for thinning populations of sunfishes, gizzard shad *(Dorosoma cepedianum)* and golden shiners. We also found this range (that occurred most often in successful treatments) to be quite effective in partially removing these species. However, 0.2 and 0.3 ppb concentrations were very successful in removing both gizzard and threadfin shad (*Dorosoma petenense*) from Middle Georgia Sportsmen Club ponds. In most instances, we found that concentrations below 0.4 ppb were inadequate for partial removal of intermediate bluegills. At levels above 0.6 ppb, the results at times seemed too severe. However, the results of a kill with 0.6 ppb of antimycin in the Bluebird pond apparently were very severe, yet it came into balance the following year. Even when treated within the desirable range to remove intermediate bluegills, an additional treatment is sometimes needed to further reduce the excessive forage fish. Concentrations of 0.5 ppb were found to be successful both in reducing intermediate bluegill populations and in thinning fingerling and intermediate sizes of golden shiners and crappie. The success of these treatments was measured in part by the quality of fishing following the treatments. Fishing significantly improved soon after 0.5-ppb treatments in Sullivan and Brown ponds.

The remaining five representative ponds were treated in attempts to remove scalefish in ponds managed for channel catfish (Group B). Burress and Luhning (1969) concluded that antimycin was very effective in removing competing scalefish in channel catfish ponds in Mississippi without killing catfish. These investigations also found a net return of $2.48 for each dollar invested in toxicant. Ponds intensively stocked with channel catfish in Georgia are primarily marketed through sport fish-out operations and, to some extent, directly to fish processors. The removal of scalefish in some cases resulted in increases in fishing success for catfish.

Antimycin was applied at concentrations from 0.4 ppb to 10.0 ppb in Group B. Burress and Luhning (1969) found that 5.0-ppb levels of Fintrol-5 effectively and economically controlled heavy infestations of green sunfish and golden shiners in channel catfish ponds. The most frequently occurring scalefish in this group included bluegills and golden shiners. Fair or good results were achieved in almost every case when the concentrations of antimycin were 1.0 ppb or higher. The 4.0-ppb level was applied initially and found to be quite successful for eliminating all sizes and species of scalefish. Subsequent applications of 2.0 ppb were also effective for the same. However, a concentration of 4.0 ppb or more might be required when the pH is 8.5 or higher. In this case, the higher concentration (4.0 ppb) would offset the faster rate of degradation causd by the high pH. If shiners are the primary target species, lower concentrations of antimycin seemed very effective. A 0.4 ppb concentration in the Young pond eliminated 92 percent by weight of the shiner population which ranged in sizes from 3 to 9 inches. Indications are that the 1.0 ppb concentration would be sufficient for shiner control as well as control of fingerling and intermediate size ranges of most scalefish.

Table 2. Summary of the results of applying antimycin to 10 central and west central Georgia ponds.

Date	Pond	Size acres	Method of application	Concentration (PPB)	pH	Water temp. (°F)	Target fish	Results	
								Immediate	Long-term
10/1/69	Bluebird	5.0	Gravity flow uniformly over pond	0.6	7.0	-	Intermediate bluegills	Fair-over kill harvestable bluegill and bass	Good-1970 balance 1974-balance
8/12/70	Jarrell	4.5	Same	0.5	6.5	-	Intermediate bluegills[1]	Good-no bass killed	1971-temporary bal. heavy bluegill pop.
10/13/71	Jarrell[2]	4.5	Same	0.4	7.0	67	Intermediate bluegills	Poor-mainly 1" - 2" bluegills no bass	1973-balance 1974-balance
10/3/73	Buffington	3.0	Gravity flow upper end only	0.3	6,8	73	Intermediate bluegills	Fair-intermediate bluegills still excessive	1974-still unbalanced with excessive bluegills.
1/ /72	Sullivan	20.0	Gravity flow uniformly over pond.	0.5	6.5	55	Golden shiners	good-estimated 75 lbs./acre killed-few bluegills	1973-74—fishing very good and improved
5/9/72	Brown	23.0	Gravity flow upper end only	0.5	7.0	69	Crappie, golden shiners, and misc. sunfish	Fair-mainly bluegills and crappie	Good-fishing vastly improved during 1972-73
4/17/70	Webb	0.6	Gravity flow	2.0	6.7	-	Fathead minnow	Good-but fatheads observed post treatment	---

5/17/70	Webb[2]	0.6	Same	4.0	6.5	-	Same	Good	Good-fatheads eradicated
9/3/69	Truenell	1.6	Gravity flow uniformly over pond.	4.0	t6.9	-	Bluegill of all sizes	Good-no catfish killed	---
5/2/72	Young	0.91	Gravity flow upper end only	0.6	9.0	71	Golden shiners	Poor-no fish killed	---
5/15/72	Young[2]	0.91	Same	0.4	6.7	72	Golden shiners	Good-shiners, green sunfish, warmouth, largemouth bass, pickerel killed—total 92.3 lbs.	Good-killed 92 percent of shiners by weight
9/11/72	Young[2]	0.91	Same	1.0	6.8	75	All scalefish	Good-killed shiners, green sunfish, and warmouth 11.0 lbs.	Good-killed remaining shiners (3″-9″)
5/23/72	Bell	2.94	Broadcast from bank of pond	2.0	6.8	69	All scalefish	Good-kill included bluegill, redear, one 15″ largemouth bass and tadpoles	Good-no fish found by seining during 1972-74 abundant insect pop. found
6/8/73	Strickland	1.5	Automatic boat bailer	4.0	7.0	78	All scalefish	Good-all size bluegills killed	Good-during October no scalefish were found by seining

1. Refers to 3″, 4″, and 5″ bluegills (total length).
2. Retreatment.

The gravity flow method of application of antimycin seemed adequate for manipulating fish populations. The only apparent advantage of dispersion by mechanical means is that the antimycin can be more easily applied by one person. The techniques of application in this study involved applying the chemical uniformly as possible over the entire pond, uniformly over the upper end only, and from the bank at different points around the pond. Altough each of these techniques were effective in killing fish to some degree, each variation must be considered for each particular situation of fish control. During the first part of the study, the antimycin was applied uniformly over the pond in every case. In retrospect, this was appropriate in attempting to eliminate all scalefish because contact was made between the antimycin and target fishes before degradation of the toxicant could occur. However, in reducing overcrowded bluegill populations, the results seemed severe on occasions. Burress (1971) reported that overcrowded sunfish populations could be successfully reduced by treating the shallow upper ends of ponds. The method, involving only the volume of the treated area, offered an increased safety factor in not eliminating all forage fish and significant numbers of bass and lower costs than for whole pond treatments. No partial pond (volume) treatments were made during this study. However, on some occasions amounts of antimycin calculated for whole pond volumes were applied in the upper end only. In small ponds (1 acre or less) this did not seem to make any difference in the results. In one treatment, a 0.5-ppb concentration (based on whole pond volume of the epilimnion only) was applied over the upper end (approximately half the total acreage). The pH increased from 7.0 to 9.0 from daylight to noon. It seemed that the antimycin was degraded or significantly diluted before reaching the lower end of the pond. The kill was considered severe for adult bluegills (no bass killed), but apparently was confined mainly to the upper end.

The bank application of antimycin for control of scalefish in channel catfish ponds (3 acres or less) was found to be effective. For the fish farmer, this method would be most practical and economical since a boat and motor would not be needed. One should be cautious when applying antimycin from the bank to avoid formation of a "hot" spot that would result from broadcasting the antimycin in only one small area of the pond.

Berger, Lennon and Hogan (1969) stated that the effect of antimycin of fish is influenced substantially by the pH of the medium. The manufacturer of antimycin cautions the user that pH is one of the most significant factors affecting the efficiency of this fish toxicant. However, most successful treatments to all categories of target fish were made at a pH range of 6.3-7.9. In most instances the pH was 7.0 or less and did not rise significantly during the day. Ponds that are fertilized adequately or fed heavily support blooms of phytoplankton that cause the pH to rise rapidly during the day. Where these situations occurred during this study, treatments were made as early as possible in the mornings. This allowed longer exposure times before the rapid rise in pH caused degradation of toxicant. If the pH is high (8.5 or higher) at the time of application, the manufacturer recommends that a compensatory increase of one-half the total antimycin so calculated, be applied provided the temperature is 60° F or higher. In the Young pond no fish were killed when a 0.6-ppb treatment was applied when the pH was 9.0 On the other hand, at a pH of 7.0 in the Bluebird pond, a 0.6-ppb treatment killed fish for 2 or 3 days. Even when pH fluctuations were not significant, most applications were made between 8:00 and 9:00 a.m. Water temperature in most cases seemed to affect only the duration of the kill rather than the overall efficiency of the treatment as successful treatments were made in a 48-80° F range. Fish mortalities occurred over a period of 17 days after an application of 0.5 ppb of antimycin to the Sullivan pond, because the water temperature at the time of application was only 55° F.

Treatments made with Fintrol-5 during the first part of the study were inconclusive because the concentrations used (0.1 to 0.36 ppb) were somewhat low. Furthermore, the average depths were less than 5 feet, so that the full release of toxicant was not achieved before the sand upon which it was formulated sank into a soft, muddy bottom.

The results of this study have been very encouraging in furthering the abilities of fishery workers in Georgia to manipulate fish populations in restoring balance, eliminating catfish ponds of unwanted scalefish, and improving fishing. Antimycin was found to be very versatile in its efficiency under a variety of weather and water quality conditions. It was found to be quite selective at low concentrations against populations of cyprinids and smaller centrarchids as compared to those of largemouth bass. It also is highly selective against scalefish that commonly invade channel catfish ponds.

In summary, the following points may be noted from the results of this study:

1. Antimycin concentrations of 0.4 to 0.6 ppb were found to be most desirable for reducing populations of scalefish for correction of unbalanced populations and for improving fishing.
2. At concentrations of 2.0 ppb and 4.0 ppb, all sizes of largemouth bass, bluegill, redear sunfish, redbreast sunfish, green sunfish, warmouth and golden shiners were adequately controlled in catfish ponds. The 4.0-ppb level seemed better for high pH situations. The 1.0-ppb level seemed adequate for control of shiners and fingerling and intermediate sizes of most scalefish.
3. The gravity flow method whereby the antimycin stock solution is poured over the side of a moving boat from a 5-gallon can was effective for manipulating fish populations. In some cases, whole pond treatments for partial removal of bluegills resulted in greater mortalities than desired. By contrast, partial pond treatments afford a margin of safety against inadvertant overkills. For control of scalefish in catfish ponds, the bank application method seemed to be most practical and economical.
4. Both pH and temperature conditions must be taken into consideration in selecting proper application rates. However, the pH factor is the most important consideration. A pH of 7.0 would be desirable at the time of application.
5. Antimycin is a very effective tool for manipulating fish populations.

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THANITE (ISOBORNYL THIOCYANOACETATE) AS AN AID FOR LIVE COLLECTION OF FISHES IN FLORIDA PONDS

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ABSTRACT

Applications of 1.5 mg/l of Thanite were made in a 0.68-hectare hard-water pond and a 3.64-hectare soft-water pond in Florida. The 19 species of fishes collected alive represented the following families: Lepisosteidae; Anguillidae; Esocidae; Cyprinidae; Catostomidae; Ictaluridae; Aphredoderidae; Cyprinodontidae; Poeciliidae; Atherinidae; and Centrarchidae. The treatment was not effective for collecting bowfin (*Amia calva*), yellow bullheads (*Ictalurus natalis*), or brown bullheads (*I. nebulosus*). Thanite eliminated all but 20 fish (0.4 percent) in the small pond and 100 (1.4 percent) in the large pond.

INTRODUCTION

During the past 35 years, American fishery workers have tested not less than 66 compounds or combinations of compounds to determine their potential as aids in the live collection of fish. To date, none have been registered with the U.S. Environmental Protection Agency for use as a collecting aid. With the exception of Thanite, an insecticide of low mammalian toxicity, each of the compounds has proved to have disadvantages or limitations such as high cost, undesirable effects on target and nontarget organisms, or distinct hazards to users.