The background of the entire page is composed of several overlapping, stylized silhouettes of fish, likely panfish, rendered in a light gray, stippled texture. The fish are oriented in various directions, creating a layered effect.

**CHEMICAL TREATMENT WITH FINTRON (ANTIMYCIN)  
FOR SELECTIVE CONTROL OF STUNTED PANFISH  
SILVER LAKE, COLUMBIA COUNTY**

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**BUREAU OF FISH AND WILDLIFE MANAGEMENT  
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By: James Congdon

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ABSTRACT

Silver Lake (Columbia County), a hard water lake with high pH, was treated with Fintrol (Antimycin A) to selectively reduce a stunted panfish population. A predictable kill was achieved by treating the lake in late fall after water temperature and pH declined. A bioassay procedure was developed using enclosures constructed with polyethylene plastic which simulated conditions in the lake. Recommendations for the conduct of selective chemical treatment projects are given.

INTRODUCTION

Control of stunted panfish populations is a nearly universal problem for fish managers. Chemical treatment with low concentrations of the fish toxicant Fintrol (Antimycin A) to selectively reduce panfish populations appears to be one of the more promising techniques for restoring a population to a balanced state. Extensive studies have shown that fish vary in sensitivity to antimycin according to species and size (Berger, Lennon and Hogan, 1969). Because of this property, antimycin can be used to selectively kill more sensitive species without significantly affecting other species present. Yellow perch, bluegill and crappie (the most frequent problem species in stunted panfish populations) are quite sensitive to antimycin, while largemouth bass have a higher threshold toxicity level.

Field studies have corroborated the results obtained in laboratory tests and shown that antimycin can be effectively used to selectively thin panfish populations. Most trials, however, have been conducted in ponds or small lakes during warm-water periods, and generally in soft waters with low or moderate pH (Radonski and Wendt, 1966; Burress and Luhning, 1969; Burress, 1970 and others).

The development of procedures for achieving a predictable selective kill of panfish in large bodies of water under varying conditions is necessary before fish managers can use this technique as a regular management tool. Silver Lake in Columbia County offered an opportunity to test antimycin as a selective toxicant under field conditions typical of those found in central and southern Wisconsin (hard water, high pH).

It was originally planned to conduct the treatment on Silver Lake in early September, 1974, while water temperature was high, but this plan was abandoned when it was found that the results obtained in bioassay could not be duplicated in a cove that was test treated. Mr. Joseph Hunn, Fish Control Laboratory, La Crosse, Wisconsin (pers. comm.) suggested that the erratic results were probably due to rapid degradation of the antimycin due to high pH and possible absorption of the toxicant by vegetation. It was recommended that the treatment be delayed until fall when chemical conditions in the lake should become more favorable. It was also suggested that it may not be possible to use antimycin with the extreme pH condition present.

It was decided to delay the treatment and monitor water chemistry conditions. The treatment would be rescheduled when pH conditions became more favorable. It was also felt that an improved bioassay procedure was badly needed if bioassay results were to be reliably applicable to treatment of the lake as a whole. It was the author's opinion that bioassay conducted in plastic bags or small stock tanks (used during first bioassay) was not adequate for this purpose.

Because of the early failure, the objective of the project became twofold: (1) To determine if antimycin could be used to selectively control panfish in hard-water lakes with high pH in cold water, and (2) To develop a bioassay procedure that will produce results that can be reliably reproduced in a whole lake treatment.

#### STUDY AREA

Silver Lake is a natural land-locked kettle lake located in the glacial terminal moraine at Portage, Columbia County. The 73.6-acre lake is shaped like an irregular figure 8 with the two lake basins connected by a shallow channel. The lake is 0.55 mile long with a maximum width of 0.37 mile (Figure 1). The shoreline is 2.39 miles in length. Thirteen percent of the lake is less than 3 feet in depth and 37 percent is greater than 20 feet.

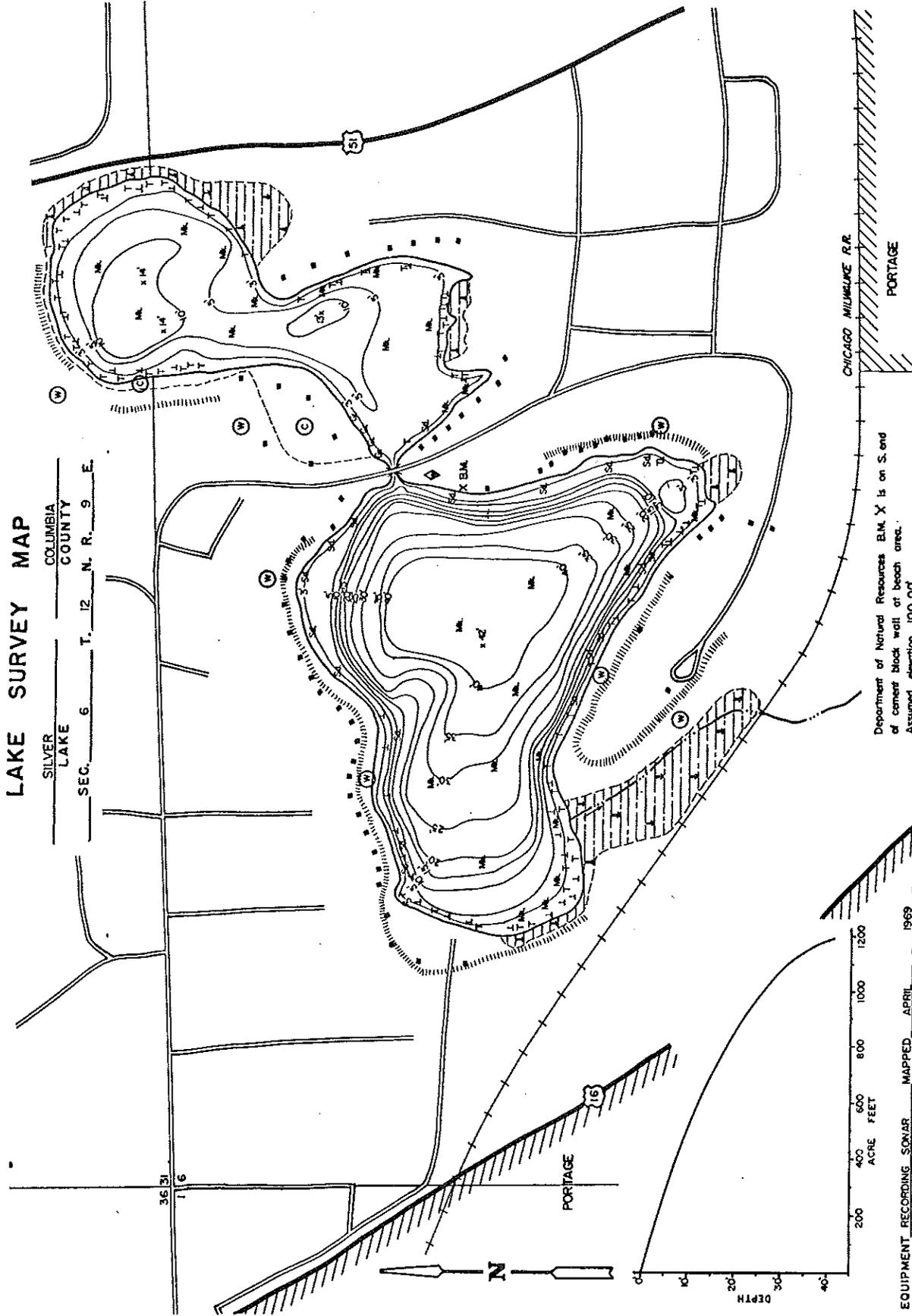
The west basin has a maximum depth of 42 feet and the bottom material is primarily sand. Submergent vegetation is present in moderate amounts, but does not develop to problem levels. This basin thermally stratifies at about 10-15 feet in depth.

The east basin has a maximum depth of 14 feet and does not thermally stratify. The bottom substrate is primarily peat and silt. Much of this basin has extensive growth of cattail, white and yellow water lilies, and several species of submergent vegetation which develop to problem proportions.

Silver Lake is a moderately fertile hard-water lake (total alkalinity 160-170 ppm). The pH varies from 8.0 to 9.5. Conductance ranges from 260-398 mho/cm<sup>2</sup>. A moderate planktonic bloom develops in the west basin which limits

# LAKE SURVEY MAP

SILVER LAKE  
COLUMBIA COUNTY  
SEC. 6 T. 12 N. R. 9 E.



Department of Natural Resources B.M. X is on S. end of cement block wall of beach area.  
Assumed elevation 100.00'  
Water elevation 98.80'

STATE OF WISCONSIN  
DEPARTMENT OF NATURAL RESOURCES

1969  
APRIL  
LAKE BOTTOM SYMBOLS  
P. Peat  
Mk. Muck  
C. Clay  
M. Marl  
Sd. Sand  
Sl. Silt  
Gr. Gravel  
R. Rubble  
Bc. Bedrock

- EQUIPMENT RECORDING SONAR MAPPED
- TOPOGRAPHIC SYMBOLS
- ① Brush
  - ② Partilly wooded
  - ③ Wooded
  - ④ Cleared
  - ⑤ Pastured
  - ⑥ Agricultural
  - ⑦ B.M. Bench Mark
  - ⑧ Dwelling
  - ⑨ Resort
  - ⑩ Camp
- LAKE BOTTOM SYMBOLS
- B. Boulders
  - S. Stumps & Snags
  - R. Rock danger to navigation
  - T. Submergent vegetation
  - 1. Emergent vegetation
  - A. Floating vegetation
  - ↔ Brush shelters

Figure 1 Hydrographic map of Silver Lake, Columbia County, Wisconsin.

visibility in the water to 3-4 feet. Winter secchi disc readings exceed 10 feet. The water in the east basin is more turbid with visibility limited to 1-2 feet. This turbidity is primarily attributed to carp activity in the mucky bottom substrate. Filamentous algae blooms have not been observed.

The lake supports a relatively high standing crop of fish and has a diverse species composition (Table 1). Sampling prior to treatment indicated that largemouth bass and northern pike were the dominant predators and natural reproduction of both occurred. Walleye and smallmouth bass were also present. Black crappie and bluegill were the dominant panfish species and yellow perch were present in small numbers. Carp were present in moderate numbers, but did not appear to be a major problem.

The panfish population structure was typical of lakes exhibiting overpopulation. Black crappies, the dominant species, exhibited poor growth rate and condition. Bluegill and yellow perch were present in smaller numbers, but also exhibited poor growth and condition.

The structure of the predator population in Silver Lake was typical of lakes with stunted panfish populations. The largemouth bass population was comprised of a number of large adults, but reproduction was poor and the younger year classes were poorly represented. Northern pike and walleye were present in small numbers. Some natural reproduction of northern pike was evident.

TABLE 1. Species composition of fish population in Silver Lake

<u>Common Name</u>	<u>Scientific Name</u>
Northern pike	<u>Esox lucius</u> Linnaeus
Walleye	<u>Stizostedion vitreum vitreum</u> (Mitchill)
Yellow perch	<u>Perca flavescens</u> (Mitchill)
Johnny darter	<u>Etheostoma nigrum</u> Rafinesque
Largemouth bass	<u>Micropterus salmoides</u> (Lacepede)
Smallmouth bass	<u>Micropterus dolomieu</u> Lacepede
Bluegill	<u>Lepomis macrochirus</u> Farinesque
Black crappie	<u>Pomoxis nigromaculatus</u> (Lesueur)
Pumpkinseed	<u>Lepomis gibbosus</u> (Linnaeus)
Warmouth	<u>Lepomis gulosus</u> (Cuvier)
Brown bullhead	<u>Ictalurus nebulosus</u> (Lesueur)
Yellow bullhead	<u>Ictalurus natalis</u> (Lesueur)
White sucker	<u>Catostomus commersoni</u> (Lacepede)
Lake chubsucker	<u>Erimyzon sucetta</u> (Lacepede)
Carp	<u>Cyprinus carpio</u> Linnaeus
Bluntnose minnow	<u>Pimephales notatus</u> (Rafinesque)
Common shiner	<u>Notropis cornutus</u> (Mitchill)
Golden shiner	<u>Notemigonus crysoleucas</u> (Mitchill)
Brook silverside	<u>Labidesthes sicculus</u> (Cope)
Bowfin	<u>Amia calva</u> Linnaeus

## CHEMICAL TREATMENT PROCEDURES

### Bioassays

Water chemistries were monitored periodically through the fall, 1974. By October 22, the water temperature had dropped to 50°F on the surface and the pH to 8.2. Preparations were again made to conduct a bioassay.

Because of the earlier failure of the bioassay method using stock tanks to produce reliable results, it was desired to develop bioassay procedures that would produce results comparable to those that occur in a lake under natural conditions. With this in mind bioassay enclosures were constructed using holding nets enclosed with polyethylene plastic weighted with iron rod. The bottoms of the enclosures were not covered so that conditions in the enclosures were as near as possible to natural conditions (Fig. 2). The enclosures were approximately 7 feet by 10 feet in size with an average depth of slightly over 2 feet. The volumes ranged from 1135 to 1338 gallons. Fish were collected by electrofishing and placed in the enclosures.

The enclosures were treated with Fintrol Concentrate in amounts to produce concentrations of 0.5, 1.0, and 1.5 ppb antimycin. One enclosure was used as a control. To attain the desired concentration of antimycin in the enclosures, a stock solution was made by diluting 1 ml of Fintrol Concentrate, mixed properly with diluent, with 530 ml of water. This solution was then

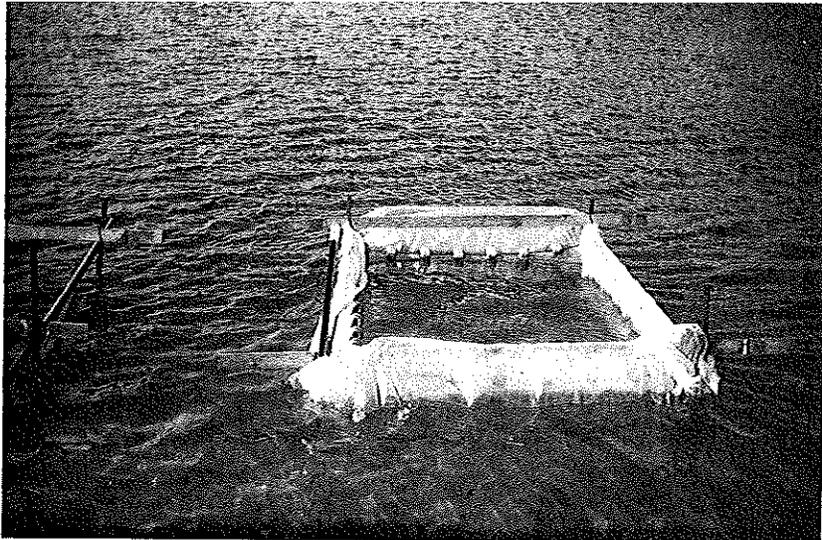


Figure 2 Enclosure used for bioassay. Holding net surrounded by polyethylene plastic weighted with iron rod forms the enclosure. Bottom of the enclosure is not covered.

added to the enclosures at the rate of 0.01 ml per gallon of volume to attain a 0.5 ppb concentration, 0.02 ml per gallon for 1.0 ppb, and 0.03 ml per gallon for 1.5 ppb. All measurements were made with small volume pipette. The water temperature was 51°F and pH 8.2 when the bioassay was started on October 23. Warm weather and rain raised the water temperature to 54°F on October 27 and to 57° on November 1 when the test was concluded. The pH had risen to 9.2 during this time.

No mortality was observed until October 26 (3 days after treatment). Between October 26 and October 28 heavy mortality of bluegill and black crappie occurred in the 1.5 ppb enclosure with only light mortality at 1.0 ppb. No further mortality occurred after October 28, five days after application of the toxicant. Only one bluegill, one black crappie and one golden shiner died in the 0.5 ppb enclosure. No mortality occurred in the control enclosure.

The results of the bioassay are shown in Table 2. In the 1.5 ppb enclosure 100 percent mortality of bluegill and 43 percent mortality of black crappie occurred. At 1.0 ppb only 13 percent and 14 percent mortality of bluegill and black crappie, respectively, occurred. No mortality of largemouth bass occurred at either concentration. The mortality occurring in the 0.5 ppb enclosure was too small to be of significance and might even be attributed to handling mortality. Only one northern pike was captured for use in the bioassay and it survived the 1.5 ppb concentration. Carp were also placed in the test enclosures, but these fish apparently escaped by jumping over the side before being affected by the antimycin.

TABLE 2. Results of Bioassay Conducted October 23-November 1, 1974

Fish Species	Antimycin Concentration (parts per billion)								
	0.5			1.0			1.5		
	No.	Size Range (Inches)	% Mort.	No.	Size Range (Inches)	% Mort.	No.	Size Range (Inches)	% Mort.
Bluegill	25	3.5-6.9	4	31	3.3-7.1	13	16	4.0-6.3	100
Black Crappie	8	4.4-7.8	13	7	5.7-7.9	14	7	6.3-12.0	43
Largemouth Bass	7	6.6-19.5	0	5	6.6-13.6	0	4	8.2-13.5	0
Yellow Perch				2	5.0-6.0	100			
Northern Pike							1	17.6	0

Lake Treatment

Prior to toxicant application the lake was marked with colored buoys to delineate the 3-foot and 10-foot depth contours dividing the lake into three zones: 0-3 foot, 3-10 foot and 10 foot plus. Each zone was divided into smaller segments to facilitate even distribution of the toxicant. The water volume of each segment was determined from a hydrographic map. Water volume in the 10-foot zone was calculated only to the 15-foot contour. The chemical requirement for each segment was calculated, pre-measured and placed in a container marked with a number corresponding to the segment number on a map prior to the day of application.

The application of Fintrol to the entire lake was made on October 30, 1974. Water temperature on the morning of the treatment was 57°F and the pH 9.0 at the surface. Figure 3 shows water temperature and pH profile at the time of treatment. The decision was made to go ahead with the treatment in spite of the increased pH over that present during the bioassay.

A concentration of 1.5 ppb antimycin was applied. The 0-3 foot depth zone was treated with Fintrol Concentrate applied by spray boat. The 3-10 foot and 10-15 foot depth zones were treated with Fintrol-5 and Fintrol-15, respectively, applied by helicopter. The sand formulations were applied undiluted by pouring from a hand-held bucket out the door of the helicopter (Fig. 4). Uranine soluble dye was added to the Fintrol applied by spray. No dye was used with the sand formulations because the fine dye powder would blow back onto the helicopter. Even distribution was dependent upon the pilot's skill, but it was possible to determine where the application was made on the previous run due to a calm "slick" that lasted a short time following the application. Application of the toxicant was completed in 2.5 hours.

The chemical requirements were calculated only for the water volume above the 15-foot depth contour. Because the lake is protected from strong winds by high hills surrounding the lake, and because it would only be possible to treat by helicopter in relatively calm weather, it was felt that the toxicant would not mix into the remaining volume at a rapid rate. It was also expected that most of the fish population would be contained within the upper 15 feet of water. This greatly reduced the treatment cost and problems of distributing the toxicant into the deeper water.

#### RESULTS OF TREATMENT

Careful observations were made to determine the extent of mortality, particularly for predator species. Only subjective estimates of mortality of panfish species could be made. Scavenging by humans, dogs, cats, and gulls hampered mortality estimates. The effect of scavenging probably tended to make mortality estimates, for game fish in particular, lower than actually occurred.

On November 1, 3 days after application, crappies and bluegills were observed in distress. A few dead fingerlings and a dead 18-inch carp were found. On November 2, dead bluegills were observed and by November 3, 5 days after application, large numbers of dead crappie and carp were observed. Dead fish pickup was started on November 4 at which time many live but distressed fish were observed. On November 7, 9 days after application, a few distressed crappie and carp were still evident. By November 14, 17 days after treatment, mortality of panfish had ceased but a few distressed carp were still being observed.

The mortality of bluegill was estimated in excess of 90 percent. Seine hauls with a 25-foot seine prior to treatment took an average of over 100 fingerling bluegill per haul. Following treatment, an average of less than 1 bluegill per haul with a 100 foot seine were taken. The mortality of crappie was estimated at 75 percent. Electrofishing indicated that adult bluegill and crappie still remained but these populations were greatly reduced. Mortality of yellow perch appeared to be 100 percent as none were collected by seining or electrofishing following treatment. Warmouth, pumpkinseed, golden shiners, brook silverside, mudminnows and bullheads were collected following the treatment.

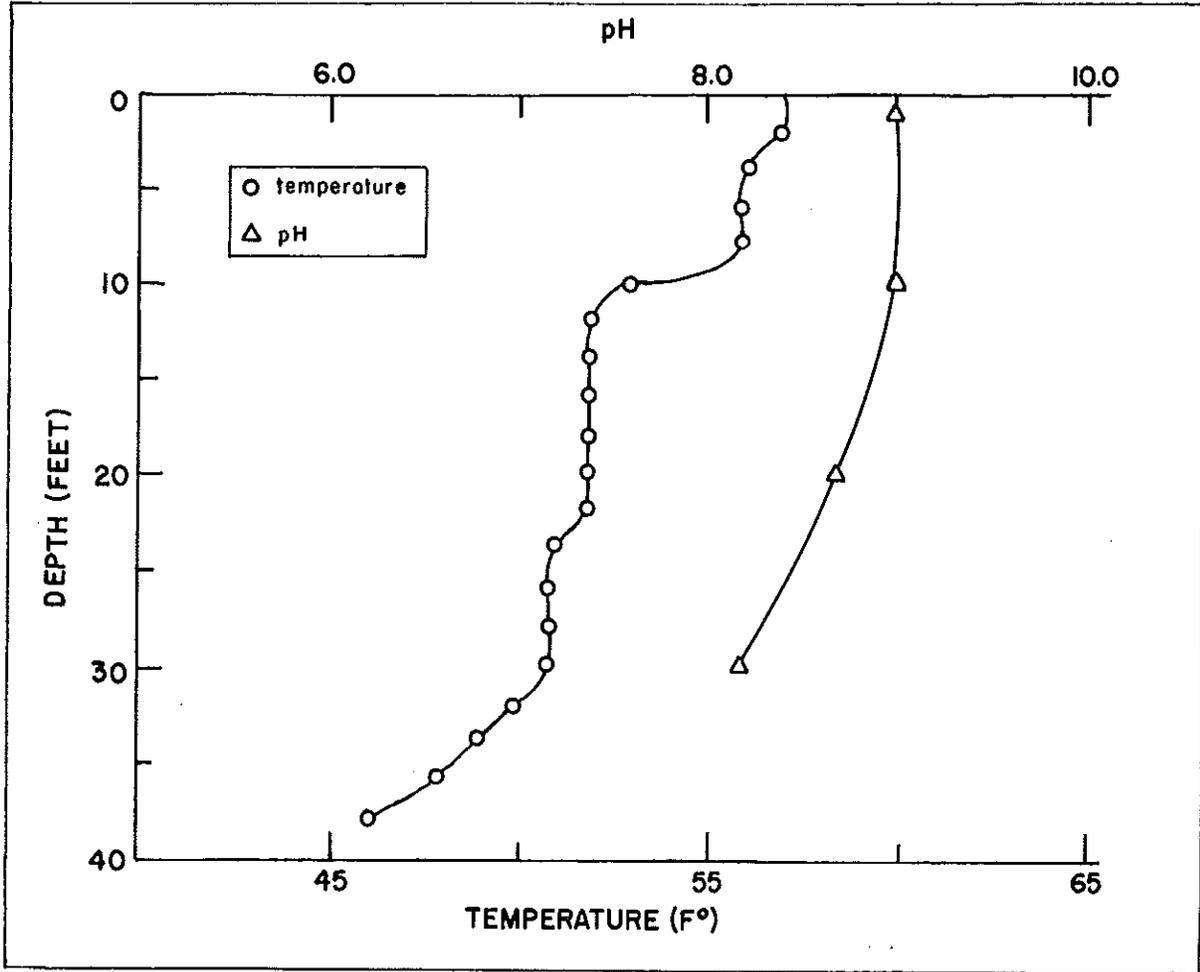


Figure 3 Water temperature and pH profile of Silver Lake at time of chemical treatment.



Figure 4 Toxicant being applied by helicopter in the 10-15 foot depth zones.

An unanticipated high mortality of carp occurred, estimated in excess of 75 percent. A total of 810 carp averaging about 5 pounds were picked up and many dead were observed in deep water where they could not be reached. Five live carp were observed in two hours of electrofishing following treatment compared to 75 to 100 in the same time period prior to treatment.

Twenty northern pike (6.0-27.0 inches), 8 walleye (14.0-27.0 inches), 4 largemouth bass (4.0-19.4 inches) and 3 smallmouth bass (7.0-12.0 inches) were found dead. Electrofishing and seining conducted following the treatment indicated that the mortality of largemouth bass was insignificant. A wide size range of specimens, including young-of-year, were found. All appeared in excellent condition. The northern pike and walleye mortality was more significant as the populations were small prior to treatment. However, electrofishing following treatment revealed that live, healthy northern pike and walleye were still present in the lake.

COST OF CHEMICAL TREATMENT

A breakdown of the costs of the chemical treatment (not including travel costs) are as follows:

Bioassay

Set up bioassay enclosures, obtain fish, measure chemical, check and record mortality  
3.5 man days @ \$4.00/hr. \$112.00

Materials (reusable) 35.00  
\$147.00

Chemical Application

Determine water volumes and chemical requirements  
1 man day @ \$6.25/hr. \$ 50.00

Place marker buoys in lake  
2 man days @ \$4.00/hr. 64.00  
\$114.00

Application of toxicant  
1.25 man days @ \$4.00/hr. \$ 40.00

Helicopter time for toxicant application  
2.5 hours @ \$90.00/hr. 225.00

Helicopter ferry time  
2.25 hr. @ \$90.00/hr. 202.50  
\$467.50

Toxicant  
Fintrol Concentrate 280 ml. 0.6 units \$ 14.23  
Fintrol-5 7.1 units 168.41  
Fintrol-15 7.0 units 700.00  
\$882.64

Fish Pick-Up

Pick-up and dispose of dead fish, observations of fish mortality  
8 man days @ \$4.00/hr. \$256.00  
\$256.00

TOTAL COST \$1,867.14

A breakdown of the treatment cost on a per acre basis and a per acre-foot basis are as follows:

Cost of toxicant alone:	\$11.94 per acre treated
	1.26 per acre-foot of volume treated
Total cost of treatment:	\$25.37 per acre treated
	2.67 per acre foot of volume treated

These costs were calculated using the price of \$23.72 per unit of Fintrol Concentrate, \$23.72 per unit of Fintrol-5 and \$100.00 per unit of Fintrol-15 formulation.

#### DISCUSSION

The results of the treatment of Silver Lake indicate that Fintrol (antimycin) can be used successfully to thin panfish populations in hard-water lakes with high pH in cold water conditions. Despite a pH of 9.0 at the time of treatment the toxicant was effective, and a predictable kill was achieved. However, approximately 2-3 times the concentration of antimycin was required to achieve the same results as in soft-water lakes (Radonski and Wendt, 1966; Burress ad Luhnig, 1969).

Selective treatments should be conducted at cool or cold water temperatures when working with lakes with high pH to take advantage of lower pH occurring at this time and extended toxicity of the antimycin. Marking (1975) reported that toxicity of antimycin decreases significantly as pH increases from 6.5-9.5. The greatest decrease was found between pH of 8.5 and 9.5, where a 6-22 fold increase in 96 hr. LC 50 for bluegill and green sunfish was found. The decline in toxicity was found to be a result of biological unavailability due to ionization of the antimycin at high pH rather than actual degradation of the chemical. It appears from the results obtained on Silver Lake that cold water temperature somewhat negates the effect of pH on the toxicant, at least in part. The degradation of antimycin appears to be slowed at low temperatures. Of critical importance, however, is the seasonal low for pH which so drastically affects the biological activity of antimycin. In high pH ranges small decreases in pH have a very significant effect on toxicant effectiveness and consequently cost and results of the treatment.

The importance of a reliable bioassay procedure cannot be over-emphasized. Bioassays using small tanks were found to be inadequate to accurately determine the concentration desired. The dividing line between toxicant concentrations that cause total mortality and those that result in only a partial kill of desired species is quite narrow. At low concentrations the effect of the toxicant is strongly affected by many environmental factors. The more closely the bioassay procedure resembles the conditions found in the lake, the more accurate the bioassay and subsequently the more predictable the results. The bioassay enclosures used on Silver Lake satisfied this need.

The importance of conducting a bioassay for each partial treatment project cannot be over-emphasized because of the effect of small environmental differences. Much more research is needed before this technique can be considered a standard management practice. It is doubtful that standard "cookbook" procedures can be developed for selective treatments.

The effect on non-target fish species must be considered when deciding to use this technique. The use of antimycin for selective control of panfish may only be applicable in lakes in which largemouth bass are the primary predator species. Because of the sensitivity of northern pike and walleye to the toxicant, a heavy mortality of these species may occur. If the northern and walleye populations are small the mortality that occurs may be offset by stocking and the loss may then be a fair "trade off" for control of the panfish population. Though mortality of minnow species did occur, no species was eliminated from the lake.

The potential for use of the fish toxicant antimycin as a standard management technique to selectively control stunted panfish appears excellent. The cost of partial treatment is very moderate in comparison to the cost of a total treatment, approximately 1/3 to 1/6 depending on concentration used. The loss of recreational opportunity as a result of the treatment was small. There were predator species and some panfish remaining in the lake to provide fishing opportunity through the winter. The summer following the treatment fishermen reported good bass fishing.

The ultimate objective of the chemical treatment of Silver Lake was to reestablish a "balanced" fish population in the lake. Observations the summer following treatment indicate that the largemouth bass reproduction had improved following the reduction of panfish. Studies are being conducted to follow the development of the population. This study will be reported at a later date.

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