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EVALUATION OF FINTROL AS A FISH TOXICANT IN DEEP SOFTWATER LAKES

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EVALUATION OF FINTROL AS A FISH TOXICANT IN DEEP SOFTWATER LAKES

By

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ABSTRACT

Successful rehabilitation of four, deep, softwater trout lakes totaling 24,709 acre-feet of water was accomplished with Fintrol at a concentration of 1 ppb active ingredient. The toxicant was applied during the fall turnover to assure rapid mixing, and both sand grain and liquid formulations were used to achieve effective coverage. Treatment was lethal for all target species of fish but had no long-term effects on invertebrates. The total cost of treatment was $.77 per acre-foot. Survival and growth of the planted trout was excellent and a substantial sport fishery developed within two years following stocking. Rehabilitation of large, deep softwater lakes with Fintrol at fall turnover shows considerable promise as a fisheries management technique.

INTRODUCTION

Lake trout populations in many of the lakes of northeastern Minnesota have declined or disappeared following the introduction of warm water species in the 1930's. While some of the warm water species are game fish that provide a limited summer fishery, lake trout offer greater potential for a quality fishery in these lakes and should be re-established as the primary species where practicable.

In light of past experience with trout stocking, the best survival can be anticipated where competing species are removed. What is needed is a fish toxin which is effective for all species in the region, can be uniformly applied over large, deep basins, is not prohibitively expensive, and detoxifies in a reasonably short time.

Antimycin A, or Fintrol[2/], an antibiotic producted by molds of the genus Streptomyces, promised to be such a toxin. The development and use of Antimycin as a fish toxicant has been reviewed by Lennon and Berger (1970), and Lennon, Hunn, Schneck, and Burress (1970). It is most effective in soft water and persists far longer in water at pH 5 to 8 (Berger, Lennon and Hogan 1969). In the soft waters of northeast Minnesota, it can be used at one-fifth the concentration needed in other waters of the state. At this concentration, Antimycin is toxic to fish, but has little effect on other vertebrates or invertebrates (Gilderhus, Berger and Lennon 1969).

STUDY LAKES

Four lakes in Cook County of northeastern Minnesota were selected for rehabilitation with Antimycin based on their lake trout history and their potential for trout. These lakes are located on the Continental Divide along the Gunflint Trail. Mayhew and Little Mayhew lakes flow into the Hudson Bay drainage, and Birch and Moss Lakes flow into the Lake Superior drainage. The four lakes totaled 645 surface acres and 24,709 acre feet of water and their maximum depths ranged from 31 to 93 feet. Total alkalinity ranged from 24 to 28 ppm and secchi disc readings ranged from 12 to 19 feet (Table 1). The lakes are typical of the oligotrophic lakes located in this area. The lakes also had no adjoining waters within the watershed that would require treatment

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[2/] Trade-name, Ayerst Laboratories, New York, Registered Fish Toxicant

to protect them from re-infestation, and there was sufficient drop in the outlet streams to protect against re-invasion from downstream lakes.

Table 1. - Physical characteristics of the study lakes midsummer 1969.

Lake	Surface Acres	Maximum Depth (feet)	Volume (Acre-Feet)	Total Alkalinity (PPM)	Secchi Disc (Feet)
Birch	266	75	6,777	24	17
Moss	136	93	10,642	24	19
Mayhew	202	80	6,568	24	18
Little Mayhew	41	31	722	28	12
Total	645		24,709		

The amount and quality of trout water available in midsummer in each lake was determined by making temperature profiles (thermistor thermometer) and oxygen profiles (Winkler method) during June. Satisfactory temperature ranges were assumed to be 70°F or lower for stream trout and 55°F or lower for lake trout. Minimum oxygen levels for all trout were considered to be five parts per million. These conditions are generally most critical for trout during the midsummer period of stratification.

The lakes were test-netted with 250-foot graduated mesh gill nets (five mesh sizes) and with trap nets during the summer of 1969 to determine the species present. Observations were also made of fish taken by residents who were allowed to net the lake prior to treatment.

Mayhew, Birch and Moss were found to have excellent habitat for lake trout and were suitable for primary management with this species. Little Mayhew Lake had good potential for rainbow trout in the absence of warm water fishes, and was scheduled for treatment as an added assurance that warm water fish would

not re-invade Mayhew Lake from downstream. A list of all species taken in the lakes by all sampling methods is shown in Table 2. The suckers and northerns were the major target species in all lakes, along with cisco in Moss Lake.

Table 2. - Species of fish in the four study lakes prior to rehabilitation with Fintrol

Common Name	Scientific Name
Cisco	Coregonus artedii
Lake Whitefish	Coregonus clupeaformis
Lake Trout	Salvelinus namaycush
Northern Pike	Esox lucius
Golden Shiner	Notemigonus crysoleucus
Bluntnose Minnow	Pimephales notatus
Fathead Minnow	Pimephales promelas
White Sucker	Catostomus commersoni
Brook Stickleback	Eucalia inconstans
Black Crappie	Pomoxis nigromaculatus
Yellow Perch	Perca flavescens
Walleye	Stizostedion vitreum

METHODS

The time of treatment was originally scheduled for the summer of 1969, but there remained the question of whether or not the toxicant would spread evenly throughout the deeper water during the stratified period before the Antimycin degraded into a non-toxic form. Dispersion of the toxicant below the thermocline was tested during the 1969 treatment of 55 acre Taylor Lake in Aitkin County. Chemical conditions here were similar to those in the study lakes. Rhodamine-WT dye was added to the diluted Fintrol for the deep layers in an amount to give a final concentration of five parts per billion dye in the 15 to 35 foot depths of the lake.

Water samples taken during the seven days after treatment were tested by Philip Gilderhus of the Bureau of Sport Fisheries and Wildlife Fish Control Laboratory, LaCrosse, Wisconsin, using a photocell fluorometer and the method of Noble and Ayers (1961). In spite of pumping the diluted mixture of Fintrol and dye to each ten-foot layer in bands ten feet wide that were no more than one hundred feet apart on a grid pattern of runs, there was very little mixing for the first two days after treatment. Almost no dye appeared in samples taken between bands. There was still a wide variation in dye concentration on the seventh day, but all deep water samples were toxic enough to kill guppies within 48 hours. By this time, however, the surface water had detoxified and offered a possible refuge for fish which could have escaped a lethal dose in the deep water.

To avoid similar conditions that would jeopardize the effectiveness of the larger job of treating the lake trout lakes, the application was postponed until the beginning of the fall overturn in late October. At this time the lakes would be uniformly 42°F from top to bottom and could be expected to mix thoroughly until the lake temperature reached 39°F or lower.

Fintrol was bioassayed for toxicity on four of the target species at a concentration of 1.0 part per billion Antimycin, a level generally found to be toxic in lakes of this type (Walker, Lennon, and Berger 1964). Because of the similarity of water chemistry in all four lakes, only the water from Mayhew Lake was tested, and the results were assumed to be repesentative of the other lakes. Four plastic bags of twenty gallon capacity were filled with surface water at a 65°F temperature. The required amount of Fintrol to make 1.0 ppb Antimycin was added to each of three bags, and one bag was left untreated as a control. To the bags containing Antimycin were added a small northern pike, a white sucker, a yellow perch, and a bluntnose minnow. The

control bag contained yellow perch and bluntnose minnows. All bags were checked periodically and any dead fish were removed.

The pre-treatment bioassay of Mayhew Lake water killed the bluntnose minnow and yellow perch within three hours, and the northern pike and white sucker within twenty four hours, at a concentration of one part per billion Antimycin. All fish in the control group were alive after twenty-four hours. One part per billion was considered to be an acceptable dose to eliminate all target species.

To determine the amount and type of Fintrol needed for each lake, the volume of the lake was calculated for each of four zones using a polar planimeter and contour map (Table 3). The zone from the shoreline out to the three foot depth was sprayed with diluted liquid Fintrol concentrate, rather than a sand grain formulation, to avoid deposition of most of the chemical in the bottom muds. Fintrol-5 sand formulation was spread on the surface by battery-operated cyclone seeder (Lennon, Berger and Gilderhus 1967) between the three and ten foot contours. Fintrol-15 sand formulation was broadcast on the rest of the lake surface to treat to a depth of 15 feet. The water deeper than 15 feet was subdivided by volume into ten-foot layers and treated proportionately with liquid Fintrol concentrate pumped as a dilute solution into each layer.

Table 3. Volume of water and amount of Fintrol used in rehabilitation of study lakes

Depth	Moss	Birch	Mayhew	Little Mayhew	Total	Units of Fintrol[1]
Shore to 3 feet	20	38	8	-	66	4 F.C.
3 to 10 feet	204	330	110	30	674	4 F-5

Table 3 (contd.). - Volume of water and amount of Fintrol used in rehabilitation of study lakes

Depth	Moss	Birch	Mayhew	Little Mayhew	Total	Units of Fintrol[1]
10 to 15 feet	3,096	2,932	2,625	498	9,151	10.5 F-15
15 feet and deeper	7,322	3,477	3,825	194	14,818	394 F.C.
Total acre feet	10,642	6,777	6,568	722	24,709	

[1] One unit of Fintrol is: ½ pint of Fintrol Concentrate (liquid); or, an 8.25 pound can of Fintrol-5 (sand formulation); or, a 7.0 pound can of Fintrol-15 (sand).

To determine the effect of the toxicant on zooplankton populations, plankton samples were collected in Mayhew Lake on September 20, 1969, (before treatment) and on November 20, 1969, (following treatment) and again one year later in September, 1970. Shallow water samples (15 to 30 feet deep) and deep water samples (40 to 60 feet deep) were taken with a series of timed tows using, in turn, a small tow net with a 10-inch diameter opening and 6XX bolting cloth, and a 36-inch diameter net with No. 20 grit gauze. Each plankton sample was treated with chloroform to settle the organisms for a volumetric measurement, and the volume was then divided by the minutes of towing to reach a comparative value of milliliters of plankton per minute of tow.

Bottom samples were collected with a Peterson dredge from several places in Mayhew Lake and preserved in formalin for analysis in the laboratory. Pretreatment samples were taken in September 1969, and post-treatment samples were taken one year later in September 1970.

Little Mayhew Lake was stocked in 1970 with Donaldson-strain rainbow trout and the other three lakes were stocked with lake trout (Table 3).

Summer test netting and winter creel census were conducted during the three years following treatment to determine possible survival of target species and to measure the survival and growth of the stocked trout. The census methods used are described by Hawkinson and Krosch (1972).

Table 3. - Summary of stocking in rehabilitated study lakes, 1970

Lake	Date	Species	No. Stocked	Rate No. to the Pound
Mayhew	May 27	Lake Trout	5,000 Yrl.	25
Birch	June 3	Lake Trout	10,410 Fgl.	1,041
	Nov. 12	Lake Trout	1,248 Fgl.	708
Moss	June 3	Lake Trout	10,010 Fgl.	1,041
	Nov. 12	Lake Trout	1,248 Fgl.	708
Little Mayhew	June 3	Rainbow Trout	1,900 Fgl.	1,900

FINDINGS

As expected, the lakes became isothermal in mid-October when sub-freezing air temperatures cooled the upper waters to the 42°F temperature of the bottom. The cold weather continued during the application of the Fintrol, and mixing was aided by the continued cooling at the water surface and by strong winds which stirred the water to all depths under the isothermal conditions. The freezing weather caused no problems in either method of application of chemical.

The total cost of the treatment was $18,927, of which $15,823 was for the toxicant (Fintrol). On an acre-foot basis, total cost was $0.77 per acre-foot. Cost of toxicant alone amounted to $0.64 per acre-foot.

Birch Lake and Mayhew Lake were tested for residual toxicity one month after treatment by taking water samples from the surface and from 30 and 60 foot depths and bioassaying with male guppies after warming the water to room

temperature. Other guppies were left in their pet shop water and in French River water as controls. All fish survived for a minimum of 24 hours.

Graduated mesh gill nets were also placed in each lake one month after treatment to check for surviving fish. None were found, indicating that the removal of the target species had been effective. This was confirmed by the continued absence of target species in three lakes in follow up test netting in succeding years. At Little Mayhew Lake, suckers managed to bypass the outlet barrier during the high run-off from snow melt in later years. No minnows were seen in the lakes a month after treatment, but schools of minnows were seen in all lakes the following year. It is not known whether some survived treatment or were reintroduced by fishermen.

Pre-treatment sampling in September with the small tow net collected an average of 11 milliliters of zooplankton per minute of tow in shallow water, and 32 milliliters per minute at the 60 foot depth. The meter net collected an average of 101 milliliters per minute in shallow tows and 80 milliliters per minute at 60 feet. The zooplankton samples consisted entirely of Daphnia and copepods.

There were no zooplankton present in any of a similar series of plankton tows made in November a month after treatment. Because of cyclic lows that sometimes occur in zooplankton populations at this time of year, it is not certain that their absence was a direct result of the Fintrol treatment. In any case, the samples taken in September 1970, again showed Daphnia and copepods at virtually the same abundance as in pre-treatment sampling. The average for all deep and shallow tows of the small plankton net was 15.8 milliliters per minute in 1970 compared to 16.8 milliliters per minute in September 1969. The bottom samples collected with a Peterson dredge contained

43.2 bottom organisms per square foot when sampled in September 1969, and 111.6 organisms per square foot in September 1970. The organisms consisted of Amphipods, Oligochaetes, Diptera, Tricoptera, and Ephemeroptera. The increase in abundance of bottom organisms in the post-treatment sampling probably reflects the reduced level of grazing on the organisms because of the smaller standing crop of fish following treatment.

Survival and Growth of Stocked Trout

Little Mayhew Lake was stocked in June 1970 with one pound of very small fingerlings (1900 per pound) of the Donaldson strain of rainbow trout (Woods 1971). Exactly one year later two graduated gill net sets caught nine rainbows that averaged 11.3 inches in length and almost a pound in weight, with a maximum weight of 1.4 pounds. In October 1971, one and a half years after stocking, gill nets took 11 trout that averaged 18.0 inches and 2.6 pounds.

Published angler's reports showed four-pound rainbows by June 1972[3]. Rainbows in the six to seven pound range were taken by angling later that summer and again the following year, along with many in one to three pound range from subsequent plantings.

Mayhew Lake was stocked with 5 to 6 inch yearling lake trout in May, 1970. Samples taken in test nets averaged 10.6 inches in June, 1971 and 13.1 inches during the summer of 1972. During January and February of 1972, the lake trout taken by anglers averaged 13.8 inches in length and 1.5 pounds in weight.

The fingerling lake trout stocked in Birch and Moss Lakes in June, 1970, were sampled in August, 1972, and averaged 13.8 inches and 14.8 inches respectively. In the two years they had apparently grown faster and overtaken the

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[3] Fred Daugs, Trout Tales, Outdoor News June 30, 1972

yearlings stocked in Mayhew. Mayhew Lake was subjected to earlier fishing, however, and cropping of larger fish may have distorted the apparent growth rate.

Mayhew, Little Mayhew and Birch lakes were monitored as part of the Statewide Creel Census (Hawkinson and Krosch, 1972) during the winter trout season in 1972 and 1973. Estimates of fishing pressure and catch indicated substantial utilization and catches from these rehabilitated lakes (Table 5).

Table 5. - Estimated fishing pressure and catch from the rehabilitated lakes during the winter trout season (1972 and 1973)

1972

Lake	Anglers	Manhours	Catch		Catch per Manhour	Pounds per Acre	Manhours per Acre
			Lake Trout	R'bow Trout			
Mayhew	29	57	34	-	.59	0.2	0.3
Little Mayhew	286	1000	-	90	.09	9.0	24.4

1973

Lake	Anglers	Manhours	Catch		Catch per Manhour	Pounds per Acre	Manhours per Acre
			Lake Trout	R'bow Trout			
Mayhew	893	3314	751	-	.23	5.6	16.4
Birch	351	1717	154	-	.18	1.8	6.5

The winter fishery produced on these lakes was considerably greater than that on nearby lakes for lake trout (Schumacher 1961) and for rainbow trout (Woods, et al 1968). A census during the winter of 1965 on 36 lake trout lakes (Schumacher et al 1966) found no fishing parties on Mayhew Lake. The highest winter pressure during 1965 was on Trout Lake where an estimated nine manhours

per acre of angler use was recorded.

It is concluded that chemical rehabilitation of large, deep, softwater lakes using Antimycin at fall turnover is an economical and effective management technique for eradicating unwanted fish populations in the restoration of quality lake trout fishing.

LITERATURE CITED

Berger, B. L., R. E. Lennon and J. W. Hogan, 1969. Laboratory studies on Antimycin A as a fish toxicant. Bureau of Sport Fisheries and Wildlife, Investigations in Fish Control, Rpt. 26.

Gilderhus, P. A., B. L. Berger and R. E. Lennon, 1969. Field trials of Antimycin A as a fish toxicant. U. S. Bureau of Sport Fisheries and Wildlife, Investigations in Fish Control, Rpt. 27.

Hawkinson, B. W. and H. F. Krosch, 1972. Annual report of the statewide creel census on 80 lakes and 38 trout streams in Minnesota, May 1971 - February 1972. Minnesota DNR, Section of Fisheries.. Investigational Report No. 319.

Lennon, R. E., B. L. Berger and P. A. Gilderhus, 1967. A powered spreader for Antimycin. Prog. Fish-Cult., 29 (2):110-113.

Lennon, R. E. and B. L. Berger, 1970. A resume on field applications of Antimycin A to control fish. U. S. Bureau of Sport Fisheries and Wildlife, Investigations in Fish Control, Rpt. 40.

Lennon, R. E., J. B. Hunn, R. A. Schneck and R. M. Burress, 1970. Reclamation of ponds, lakes, and streams with fish toxicants: A Review. FAO Tech. Paper 100, FAO Rome.

Pennak, R. W., 1953. Fresh water invertebrates of the United States. The Ronald Press Co., New York, 769 ppg.

Schumacher, R. E., 1961. Some effects of increased angling pressure on lake trout populations in four Northeastern Minnesota lakes. Minnesota DNR, Game and Fish Investigations No. 3.

Schumacher, R. E., L. Wroblewski and C. R. Burrows, 1966. Winter anglers use of 36 lake trout lakes in or adjacent to the Boundary Waters Canoe Area in Northeastern Minnesota during the winter of 1965. Minnesota DNR, Section of Fisheries. Investigational Report No. 291.

Walker, C. R., R. E. Lennon, and B. L. Berger, 1964. Preliminary observation on toxicity of Antimycin A to fish and other aquatic animals. U. S. Bureau of Sport Fisheries and Wildlife, Investigation in Fish Control, Rpt. 2.

Woods, D., J. Groebner, J. Maloney, F. Johnson, and R. Hassinger, 1968. Results of the first winter season on stream trout in lakes. Minnesota DNR, Mimeo Rpt. 8 ppg.

Woods, D., 1971. The Donaldson - our dream trout. Minnesota Volunteer Vol. 34, No. 196 ppg 42-46.