Original: Fish Division
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October 27, 1953

Report No. 1388

EXPERIMENTAL TREATMENT OF BARTON AND GEDDES LAKES WITH HERBICIDES IN 1953

By

Frank F. Hooper

Abstract

Tests of effectiveness of six commercially available herbicides in controlling water weeds were made on Barton and Geddes lakes, impoundments of the Huron River near Ann Arbor, during the summer of 1953. The Detroit Edison Company, owner of these impoundments, sponsored the project. Compounds tested were: Polyborchlorate, Borascu, Sodium T-C-A, Ammate, C-M-U weed killer and sodium arsenite. These compounds were applied to small plots of submerged water weeds. After treatment with a weed killer each plot was treated with Cutrine, an organic copper algaecide.

None of the compounds tested except sodium arsenite proved effective in controlling weeds of these plots. Polyborchlorate and Sodium T-C-A caused a temporary discoloration of Elodea growing in shallow water where dilution of the chemical was low. Sodium arsenite applied at a concentration of 22.4 p.p.m. appears to have killed all the weeds on a treated plot and also on an adjacent untreated area. These areas remained free of weeds during the succeeding summer and fall.

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The studies of Levardsen (1951) have shown that a variety of chemicals have, at least, limited toxicity to higher aquatic plants. However, the only compound proven effective in controlling submerged vegetation in Michigan lakes is sodium arsenite. Because of its toxicity to fish and to warm-blooded animals including man this chemical can be used only under carefully controlled conditions. An effective, yet somewhat less hazardous herbicide, is needed if chemical control of aquatic vegetation is to be undertaken on a large scale. Weed control in waters used for domestic water supplies presents further problems. In this case the herbicide must not only be harmless in drinking water but also must not influence the taste and odor of the water supply.

This report records the results of treatments made of experimental plots on Barton and Geddes lakes between May 19 and 21, 1953, with sodium arsenite and 5 other commercially available herbicides. These lakes are impoundments of the Huron River near Ann Arbor, built by the Detroit Edison Company for hydroelectric power. Barton Lake is one source of water for the City of Ann Arbor.

The rooted aquatic plants of these impoundments have for many years created nuisances. On Barton Lake weeds have overgrown swimming beaches despite attempts at control by cutting. On Geddes Lake decaying weeds have, on occasions, created an odor nuisance. As a result of an expression of interest on the part of property owners in the vicinity, the Detroit Edison Company sponsored the present project to test the effectiveness of these herbicides on the vegetation of these impoundments.

The project was directed by Dr. John Piper, Head of the Chemical Division, Engineering Laboratory and Research Department of Detroit Edison. The staff of the Institute for Fisheries Research, Professor Frederick K. Sparrow of the Botany Department, University of Michigan, and Walter Muhlitner of the Ann Arbor Water Department cooperated in the project.

Experimental Plots.

The locations of plots selected for treatment are shown in Figs. 1 and 2. Plot A included the Barton Hills swimming beach and yacht club dock. The shoreward one-fourth of this plot had a firm sandy bottom that was only sparsely colonized by plants. The outer three-fourths of the plot had a dense growth of *Elodea* and various species of *Potamogeton* (see Table 2). Although there was little river current along this shore, the area was exposed to westerly and northwesterly winds so that there was considerable wave action and water movement. Plot B consisted of a narrow strip of lake adjacent to the golf course drain and pumping station (Fig. 1). The lakeward margin of this plot bordered on the river channel. Here the water was 10 to 15 feet deep and the bottom was of firm sand and gravel. The shoreward two-thirds of this plot had a soft organic bottom and a dense growth of coontail, potamogetons and filamentous algae. Plot D, located just east of Geddes Road about 200 yards north of the bridge, is a part of a shallow backwater. It had a soft, organic bottom and a dense growth of water crowfoot, potamogetons, and coontail. Plots E and F were parts of the backwater west of Geddes Road, opposite Plot D. Here the water was shallow (0-3 feet). The bottom was of soft ooze covered with a dense growth of potamogetons, Elodea and water crowfoot. Except perhaps during drawdowns of the reservoir the water of these backwaters mixes very little with the rest of the lake. Plot G was located in a backwater of the south-central section of Geddes Lake near the entrance of the Pittsfield drain. This backwater was connected by a narrow drain to the main lake basin. During June and July the water was highly turbid from the silt load and pollutants carried in by Pittsfield drain. On June 26 the Secchi disc reading here was 14 inches. Most of the bottom was of fine silt and sand. The high turbidity seemed to exclude many species of rooted aquatics. Water smartweed (Polygonum natans) was moderately abundant and a few water ~~lilies~~ lilies appeared at the surface late in the summer (after treatment).

Treatments.

Treatments of the experimental plots were made by Dr. Bernhard Domogalla of Applied Biochemists and Associates, Butler, Wisconsin between May 19 and 21, 1953. Chemicals used on various plots are listed in Table 1. Sodium T-C-A and polyborchlorate were selected for the Barton Lake plots because they were not considered to be hazardous to drinking water. Polyborchlorate is a compound only moderately soluble in water. This chemical was believed to furnish a high residual effect as it dissolves in the bottom mud. Hence it was believed to be particularly suitable for Plot A where there was considerable water movement. Borascu, another compound of low solubility and presumably having a high residual effect was used on Plot G. Here a compound with a lasting effect was considered to be desirable to kill the stout rhizomes of Polygonum. All compounds with

Fig. 1. Location of experimental plots on Barton Lake

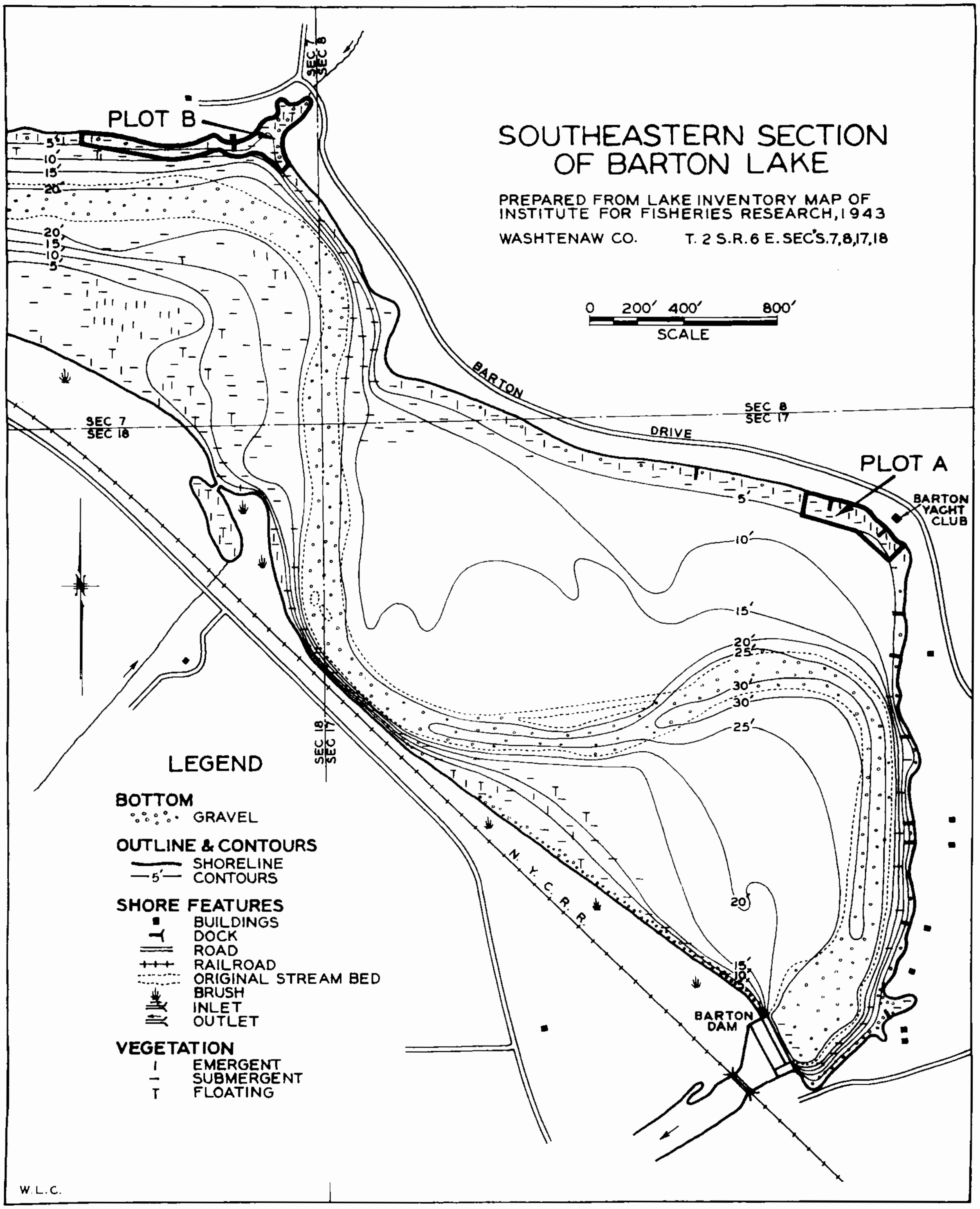
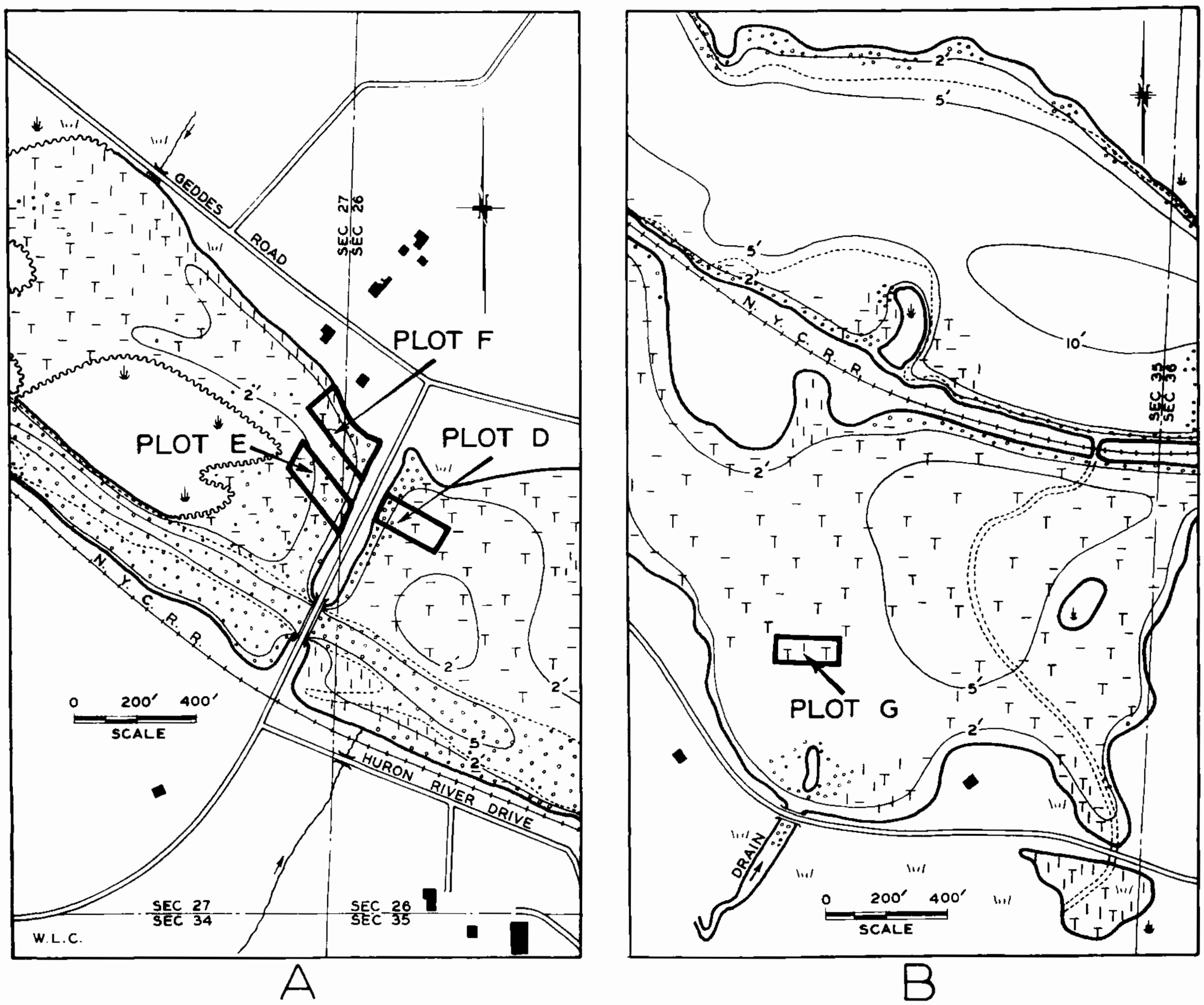

SOUTHEASTERN SECTION
OF BARTON LAKE
PREPARED FROM LAKE INVENTORY MAP OF
INSTITUTE FOR FISHERIES RESEARCH, 1943
WASHTENAW CO. T. 2 S.R. 6 E. SEC'S. 7, 8, 17, 18
0 200' 400' 800'
SCALE
PLOT A
PLOT B
BARTON YACHT CLUB
BARTON DRIVE
BARTON DAM
N. Y. C. R. R.
SEC 7
SEC 8
SEC 18
SEC 17
LEGEND
BOTTOM
GRAVEL
OUTLINE & CONTOURS
SHORELINE
CONTOURS
SHORE FEATURES
BUILDINGS
DOCK
ROAD
RAILROAD
ORIGINAL STREAM BED
BRUSH
INLET
OUTLET
VEGETATION
EMERGENT
SUBMERGENT
FLOATING
W. L. C.

Fig. 2. Location of experimental plots on Geddes Lake



NORTHEASTERN SECTION (A) AND SOUTH-CENTRAL SECTION (B) OF GEDDES LAKES

PREPARED FROM LAKE INVENTORY MAP OF INSTITUTE FOR FISHERIES RESEARCH, 1943
WASHTENAW CO. T. 2 S. R. 6 E. SEC'S. 26, 27, 35, 36

LEGEND

BOTTOM
GRAVEL

OUTLINE & CONTOURS
SHORELINE
— 5′ — CONTOURS

SHORE FEATURES
BUILDINGS
ROAD
RAILROAD
ENCROACHING SHORE
ORIGINAL STREAM BED
BRUSH
MARSH
INLET

VEGETATION
I EMERGENT
— SUBMERGENT
T FLOATING

Table 1. Treatments made on Huron River Impoundments July 19-21, 1953

Lake	Plot	Location 1/	Dimensions	Chemicals used				
				Amount	Concentration 3/	Trade Name	Ingredients	
Barton	A	1/2 mile N. of dam at Barton Yacht Club and swimming beach.	500' x 100' x 3'	1,000 lbs.	107 p.p.m. (82 p.p.m. active)	Polyborchlorate (Pacific Coast Borax Corp.)	sodium pentaborate ($NaB_{10}O_{16} \cdot 5\ H_2O$) sodium tetraborate ($Na_2B_4O_7 \cdot 5\ H_2O$) sodium chlorate ($NaClO_3$) Inert	44% 11% 22% 23% 23%
				10 gal.	11 p.p.m.	Cutrine	2/	
Barton	B	N. shore 1 mile N.W. of dam at golf course pumping station	1,000' x 50' x 8'	100 lbs.	4 p.p.m. (3.6 p.p.m. active)	Sodium T-C-A weed killer (Dow Chemical)	sodium trichloracetate Inert	90% 10%
				20 gal.	7 p.p.m.	Cutrine	2/	
Geddes	D	1/4 mile N.E. Geddes Road bridge	250' x 100' x 2'	500 lbs.	155 p.p.m. (124 p.p.m. active)	Ammate (Dow Chemical)	ammonium sulfamate Inert	80% 20%
				2 gal.	5.3 p.p.m.	Cutrine	2/	
Geddes	E	1/4 mile N. of Geddes Road bridge (south plot)	300' x 100' x 2'	30 lbs.	7.9 p.p.m. (6.3 p.p.m. active)	C-M-U weed killer (DuPont)	3 (p-chlorophenyl)-1,1-dimethylurea Inert	80% 20%
				2 gal.	4.4 p.p.m.	Cutrine	2/	
Geddes	F	1/4 mile N. of Geddes Road bridge (north plot)	300' x 100' x 2'	100 gal.	223 p.p.m. (22.4 p.p.m. active)	sodium arsenite	sodium arsenite (as As_2O_3) Inert	9.6% 80%
				4 gal.	8.8 p.p.m.	Cutrine	2/	
Geddes	G	Backwater near mouth of Pittsfield drain	250' x 100' x 2-1/2'	1,500 lbs.	320 p.p.m. (274 p.p.m. active)	Borascu (Pacific Coast Borax Corp.)	anhydrous borax ($Na_2B_4O_7$) Inert	89% 11%
				4 gal.	10.6 p.p.m.	Cutrine	2/	

1/ See Figs. 1 and 2.
2/ Organic copper algaecide made by B. Domogalla, Butler, Wisc.
3/ Theoretical concentration of product and active ingredient(s)

Table 2. Vegetation of experimental plots prior to treatment

Species[1]	Plot A	Plot B	Plot D	Plot E	Plot F	Plot G
Ceratophyllum demersum	+	++++	+++			+
Chara fragilis	+					
Eleocharis sp.	++					
Elodea canadensis	++++	+++	++	+++	++++	
Heteranthera dubia	++					
Myriophyllum sp.				+++		
Najas flexilis	+					
Nuphar variegatum		+	+	+		+
Nymphaea tuberosa		+	++	++	+	+
Peltandra virginica				+	+	
Polygonum natans		+				+++
Potamogeton americanus	++		+	+	+	
Potamogeton amplifolius	++++	++++	++	+++	+	
Potamogeton pectinatus	+++		+++	+		
Potamogeton Richardsonii	++					
Potamogeton zosteriformis	+		++++	++	++++	
Ranunculus longirostris			++++	++++	+	
Sparganium chlorocarpum	++		+			
Filamentous algae		+++	+++	++	++	

+ Sparse
++ Common
+++ Moderately abundant
++++ Very abundant

[1] Professor Frederick K. Sparrow of the Botany Department, University of Michigan, aided in the identification of plants.

the exception of Borascu were mixed with water and sprayed over the plot with a power-sprayer. Borascu was poured by hand into the wake of an outboard motor. All plots were sprayed with an algaecide (Cutrine) following treatment with weed killers. This was done to prevent development of algae in case the higher plants were destroyed.

The calculated concentrations of various chemicals following treatment is given in Table 1. It was assumed in these calculations that each chemical dissolved completely upon application. This clearly was not true in the case of Polyborchlorate and Borascu.

Results of Treatments.

Plot A (Polyborchlorate). The vegetation had not changed noticeably 4 days after treatment. On May 27 (8 days after treatment) the *Elodea* growing in shallow water (1-2 feet) appeared slightly limp and discolored. All other species as well as the *Elodea* growing in deeper water appeared normal. No further harmful effects were noted. In late August vegetation was dense over the outer two-thirds of the plot. In shallow water *Elodea* appeared normal. The treatment appears to have had little, if any, lasting effect.

Plot B (Sodium T-C-A). The treatment seemed to have had little, if any, lasting influence. As in the case of Plot A the *Elodea* growing in shallow water appeared to be slightly discolored 8 days after treatment. Thereafter no further harmful effects were noted. Although treatment with Cutrine killed much of the filamentous algae present on May 19 a thick scum developed near shore late in the summer.

Plot D (Ammate). This treatment was completely ineffective as far as could be detected. Luxuriant vegetation was present all summer and fall on this plot.

Plots E (C-M-U) and F (sodium arsenite). On the 4th day following treatment all the weeds of these 2 plots except a small patch at the northwest corner of Plot E had fallen to the bottom. After 8 days all submerged species were dead on the bottom and had started to decay. Some floating-leaf species were standing on the northwest corner of Plot E but they appeared discolored. Both plots remained clear of weeds for the remainder of the summer. Removal of vegetation from Plot E cannot be attributed to the action of C-M-U weed killer. This plot was separated from Plot F by an untreated strip 50 feet wide. Weeds in this untreated strip, those of an untreated area between Plot E and the river channel, and those of Plot F all died at about the same time. The pattern of the dead vegetation following treatment suggests that water movements toward the stream channel (resulting perhaps from a drawdown of the impoundment) carried the sodium arsenite over the 2 untreated areas mentioned above as well as over all except the northwest corner of Plot E. Although the effects of these 2 treatments cannot be clearly separated because of an unfortunate choice of experimental plots, there is some indication that sodium arsenite was the more effective weed killer.

Plot G (Borascu). This treatment apparently was completely ineffective. *Polygonum* increased in abundance in July; all plants appeared healthy.

Discussion.

None of the contact herbicides tested except sodium arsenite appears to be useful in control of submerged aquatic plants. All are marketed as weed killer for land plants. Levardsen (1951) found that Ammate, Sodium T-C-A and other contact herbicides were not effective on emergent and floating-leaf types (*Typha*, *Sagittaria*, *Pontederia*, *Nymphaea* and *Nuphar*) because the food reserves in rootstocks were large enough to provide for regrowth after the tops are killed. The transitory discoloration of the

Elodea of plots treated with Polyborchlorate and Sodium T-C-A suggests that these chemicals were present in sufficient concentration to affect plants only in shallow water where dilution of the chemical was low. Apparently higher concentrations must be used, particularly in areas where there are strong water movements.

The sodium arsenite treatment seems to have completely cleared a dense stand of weeds in a short time and prevented regrowth during the summer. The area treated was not used extensively for recreation and contained few game fish. A concentration of spawning carp moved out of the backwater following treatment. With the decay of weeds, dissolved oxygen disappeared from the water. An oxygen test made on May 21 at 8:30 a.m. (22 hours after treatment) gave a value of 2.2 p.p.m. On May 22 at 8:15 a.m. a reading of 0.2 p.p.m. was obtained. Four dead carp were noted just to the south of Plot E at this time. On May 23 at 8:30 a.m. the oxygen concentration near shore on Plot F was 2.4 p.p.m. One dead bullhead, 2 dead pumpkinseeds and 1 dead tadpole were noted. Apparently most of the fish were able to avoid the low oxygen condition by migrating out of the backwater. Taste and odor tests made by the staff of the City of Ann Arbor water treatment plant gave no indication that the 2 chemicals used on Barton Lake had any influence upon the city's water supply.

Literature Cited

Levardsen, Norman O.

Studies on chemical methods of aquatic plant control in freshwater lakes and ponds, 114 pp., 1951. Typewritten thesis; Michigan State College.

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