BIOLOGY AND CONTROL OF AQUATIC NUISANCES IN RECREATIONAL WATERS

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ABSTRACT

The control of aquatic nuisances has been in effect in Wisconsin since the early 1900's. Algae populations that have become so expanded that they contribute odors and unsightly conditions are temporarily abated through the use of copper sulphate. This chemical quickly reacts with natural carbonate ions in the water and precipitates into biologically inactive copper carbonate.

Nuisance growths of higher plants have been controlled both mechanically, with commercial weed-cutting equipment, and chemically, first with sodium arsenite and then beginning in the early 1960's with organic herbicides.

Organisms which cause swimmers' itch occur in many lakes throughout the state. Treatment of such lakes has consisted of annual applications of copper sulphate along relatively small areas of beach or shoreline.

Records have been systematically kept since 1950 on the use of chemicals in the control of aquatic nuisance growths on Wisconsin recreational waters.

BIOLOGY AND CONTROL OF SELECTED AQUATIC NUISANCES IN RECREATIONAL WATERS

By

Lloyd A. Lueschow

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CONTENTS

INTRODUCTION

Wisconsin lakes have been formed under a wide variety of chemical and physical conditions. Some are deep and others shallow, some are in igneous rocks, some in sedimentary rocks, and some in glacial drift. Essentially all lakes have an inherent "age," dictated by features of the basin and water quality. But lakes are seldom static. They pass through several recognizable stages in an aging process known as eutrophication which specifically relates to the accumulation of plant nutrients. A lake with low concentrations of plant nutrients is infertile and relatively unproductive. This type of lake is described as oligotrophic. As time passes, a lake progresses from a low nutrient oligotrophic condition to a nutrient-rich, eutrophic condition. This nutrient change brings about subsequent changes in biological composition which affect the recreational use potential of a lake.

NUTRIENT SOURCES

There are at least three basic nutrient sources. Surface water drainage is perhaps the most important since it carries not only sewage and sewage effluents but farm drainage, fertilizer runoff, storm sewers and industrial waste directly to surface waters. Sewage and sewage effluents have long been a target of nutrient abatement efforts because even a well-operated sewage plant probably removes only one-third to one-half of the available nitrogen and phosphorus in raw sewage. When one considers that treated sewage effluent retains approximately 10 parts per million of total phosphorus and approximately 20 parts per million of inorganic nitrogen, it is apparent that where these effluents reach lake waters they are a major source of nutrients. Industrial waste sources also may be significant nutrient sources: wastes from milk plants, canning factories, and even pulp and paper mills.

Barnyard drainage is apparently as significant a nutrient source as raw sewage when it reaches surface waters. General farm drainage from crop and pasture lands is more difficult to evaluate since the contributions are dependent on climatic conditions, soil types, physical features and many other variables.

Municipal storm sewers usually discharge directly to surface waters. This discharge has a relatively high nutrient concentration from sources such as lawn fertilization, debris accumulations, soil losses and numerous other chemicals. Sanitary sewers usually have overflow connections to storm sewers. During periods of heavy runoff, surface and ground waters enter the sanitary sewers, exceeding their capacity and causing overflow of raw sewage into the storm sewer system with direct discharge to surface waters.

A second major source of nutrients to surface waters is directly from the atmosphere. This is a major source of available nitrogen compounds but is probably not a significant source of phosphorus. Precipitation from the atmosphere is principally composed of "rained out" compounds but may also include dust and wind-blown debris which originate on land. Studies conducted on nutrients in rainfall suggest in a latitude like Wisconsin with approximately 30 inches of annual rainfall, one might expect 10 pounds per acre of nitrogen from atmospheric sources exclusive of dust and wind-blown debris. This would be comparable to the nitrogen contribution from one person per year in the form of raw sewage nutrients.

Ground water is the third major source of nutrients and reflects the availability from natural sources as well as man-induced sources. As water percolates through soil, it leaches soluable substances which are carried into the ground water. Nitrates, being readily water soluable, are easily transported by ground water. Phosphorus forms insoluble complexes with iron, aluminum, and calcium compounds and these compounds are not readily transported in ground waters. It is likely that septic tanks that operate well as soil absorption systems contribute nitrates (approximately 8 pounds of nitrogen per person per year) to the ground water, but the phosphorus (approximately two pounds per person per year) is retained in the immediate vicinity of the septic tank. A disposal unit that overflows to the surface may contribute both nitrogen and phosphorus compounds.

Nutrients are also available from numerous other sources but the impact is more difficult to evaluate. Waterfowl contribute nutrients to a lake and one study has suggested that the contribution from eight ducks is comparable to one person. Marsh drainage contributions are probably high in nitrogen but relatively low in phosphorus. Perhaps one of the least understood sources of nutrients is the bottom ooze itself. During the winter months when standing crops are low, the nutrients tend to precipitate by various processes into the bottom muds. In summer, as growths utilize the available nutrients in the water, some of the nutrients in the bottom ooze are partitioned back into the water and again made available for growth. Regardless of whether the nutrient source was a "classical" pollution source or pollution from natural sources, the results of nutrient accumulation are the same. Nuisance growths of weeds and algae in surface waters are the resultant normal expression of a high nutrient status or eutrophic water.

OUTLOOK FOR EUTROPHICATION CONTROL

In general, efforts to control the accumulation of nutrients and thus reduce nuisance growths have not been technologically feasible. There have been extensive efforts to reduce nuisance growths by sewage diversion. This has been an effective preventive, but in highly eutrophic lakes where overabundant plant growth has already developed, the diversion of nutrients has not abated the nuisance condition. Although research is currently underway to work out methods for reversing eutrophication, economically feasible methods are not yet available to actually abate nuisance developments. Until such control is possible, those interested in managing water resources are left only with the possibility of symptomatic treatment.

ALGAE

BIOLOGY

In Wisconsin surface waters, relatively few genera of algae develop to the point of becoming an economic nuisance. The planktonic blue-green algae, a few genera of filamentous green algae, and *Chara* most frequently require nuisance abatement in Wisconsin waters.

The blue-green algae (Cyanophyta) and specifically the genera *Anabaena, Aphanizomenon,* and *Anacystis* are most often responsible for the unsightly nuisance "blooms" and odor that develop in Wisconsin lakes during the summer months. An algae "bloom" is most often defined as an unusually large number of algae units (cells or colonies or filaments) that are visually noticeable as a green or blue-green color or as they produce turbid waters. Lackey (1949) arbitrarily defined a bloom as 500 individuals per ml of raw water. Lueschow et al. (1969) suggested that noticeable algae conditions occur when the plankton exceeds 500 µg/l total solids when captured in a standard 20-mesh plankton net. Fitzgerald (1966) indicated a "heavy bloom" in lakes as 5-10 mg/l of solids.

Typically shoreline areas accumulate windrows of algae which often become so thick one cannot see the water. During these unusual accumulations, the algae is typically associated with a blue-colored bacteria *(Chromatium okeni).* The algae and bacteria appear so blue that it is often referred to as a "paint pot" condition. Under these conditions, the oxygen demand is often sufficient to reduce the dissolved oxygen levels in the water to zero and produce fish kills or the algae may release metabolic toxins such that the water is unsafe for both wild and domestic animals.

There are numerous recorded instances of toxic algae in surface waters (Gorham, 1960). Although it is generally felt that most of the blue-green algae species are capable of the phenomenon, it appears to be relatively rare in Wisconsin waters. These conditions have been recorded on Lake Delton, Sauk County, (Lueschow, 1967) and on Lake Mendota (Mackenthun et al., 1945). It is likely that many cases of toxic blue-green algae are not recorded since users view the water as uninviting and animals will drink it only if there is no other water source available to them.

As with an agricultural crop, a host of nutrients are essential for the development of blue-green algae. In general, most of the nutrient substances are required in such minute concentrations that all surface waters are able to provide ample quantities. Inorganic nitrogen and ortho-phosphates are most usually considered limiting. Sawyer (1947) in an investigation of southeast Wisconsin lakes observed that lakes which had at least 0.3 parts per million of total inorganic nitrogen (NH_3-N, NO_2-N and NO_3-N) and 0.015 mg/l of soluble phosphorus could be expected to produce blue-green algae blooms during the ensuing summer. Lueschow et al., (1969) observed in twelve Wisconsin lakes that when the annual mean concentration of total inorganic nitrogen concentration was less than 0.3 mg/l, algae blooms were only local or nonexistent (Table 1). The same lakes which revealed algae blooms also had an annual mean concentration of total phosphorus of over 0.6 mg/l.

In general, the blue-green algae population during the winter months does not pose nuisance conditions for two basic reasons. First, the physical conditions of temperature and light are far from optimum, and secondly, the recreational demand on water during the winter months is not nearly as great. Swimmers and boaters are comfortably relocated; the ice fisherman is still plying his trade but associates himself with a rather limited view of the water. The ice fisherman, however, does note an occasional bloom of a blue-green algae known as *Oscillatoria rubescens.* This particular species appears red and has the capacity to develop at the low winter temperatures and the reduced light intensity. There has been no effort made to control this species in Wisconsin waters during the winter months.

As the spring water temperature increases, the blue-green algae population generally expands and in eutrophic lakes may develop to nuisance conditions quickly and remain a nuisance during the entire summer. Some feature of their physiology or physical environment, however, apparently prohibits further expansion. Even in sewage stabilization ponds, where there is no lack of nutrients, the blue-green algae populations do not expand indefinitely. Unfortunately, these natural population checks do not exercise their influence until after the algae have already become a nuisance to recreational lake users.

As a means of evaluating the plankton population in terms of nuisance conditions, Lueschow et al., (1969)

Windrow Accumulations of Planktonic Blue-Green Algae. (Round Lake, Burnett County)

TABLE 1. Trophic Rank of Twelve Wisconsin Lakes Based on Seven Parameters.

	Dissolved Oxygen Hypolimnion	mg/1 1 M. Off Bottom	Plankton No. 20 Mesh Net	µg/l Total Solids	Transparency Secchi Disc	Seasonal Mean	Organic Nitrogen	Mo. Mean mg/1	Total Inorganic Nitrogen	Mo. Mean mg/1	Soluble Phosphorus	Mo. Mean mg/1	Total Phosphorus	Mo. Mean mg/1
Most Oligotrophic	Big Green	8.1*	Round	60.3	Crystal	7.7	Crystal	.162	Crystal	.124				
	Crystal	3.15	Pine	64.5	Big Green	5.4	Trout	.251	Geneva	.170	Round	.014	Crystal	.027
	Trout	1.9	Crystal	68.0	Geneva	4.6	Big Green	.358	Trout	.176	Crystal	.018	Geneva	.041
	Geneva	1.0	Geneva	77.5	Middle	4.4	Geneva	.379	Pine	.210	Geneva	.018	Big Green	.051
↑	Round	0.15	Trout	81.7	Oconomowoc	4.4	Oconomowoc	.460	Big Green	.245	Trout	.018	Trout	.053
			Big Green	83.4	Trout	4.1	Round	.495	Middle	.263	Big Green	.027	Round	.057
	Oconomowoc Pine	0.0 0.0	Middle	252	Round	3.9	Middle	.545	Oconomowoc	.276	Winnebago	.031	Winnebago	.129
			Oconomowoc	426	Mendota	3.1	Mendota	.614	Winnebago	.354	Mendota	.066	Mendota	.149
↓			Mendota	751	Pine	2.7	Pine	.663	Pewaukee	.421	Delavan	.075	Delavan	.170
			Pewaukee	1004	Delavan	1.6	Pewaukee	.827	Delavan	.470				
	Mendota Middle	0.0 0.0	Delavan	1637	Pewaukee	1.5	Winnebago	.982	Mendota	.579				
Most Eutrophic	Delavan Pewaukee	0.0 0.0	Winnebago	2118	Winnebago	.7	Delavan	1.195	Round	.788				

*Middle of hypolimnion.

quantitated the plankton from 12 popular, recreational lakes that represented a broad range of trophic conditions (Table 1). Three of the lakes examined were more or less plagued with algae nuisances during most of the summer months. Lake Delavan had the most consistently high plankton level (approximately 2,500 µg/l), dominated by blue-green algae. The visual clarity on Delavan Lake was typically less than one foot (secchi disc). These conditions were clearly a nuisance to boaters and other recreational users all summer. Lake Mendota plankton populations were far more variable than on Lake Delavan and the nuisance conditions were more sporadic, usually associated with onshore wind conditions. Other lakes such as Geneva and Trout did not reveal unusual algae populations during the summer months.

CONTROL

Control is necessary when algae populations become so expanded that they contribute odors and unsightly conditions. Such lakes are also routinely inhabited by rough fish which further add to the undesirable features of the lake. Currently chemical treatment is the only practical method of algae control. Chemical control is merely a temporary nuisance abatement procedure, since at this time there are no mechanical control methods or methods for reversing or retarding eutrophication. Ultimate control will have to be brought about by nutrient removal.

Copper sulphate has been used for algae control since the early 1900's. In Wisconsin, it has been used since the mid-1930's and some lakes such as Monona and Waubesa have received hundreds of tons of this chemical.

When copper sulphate is applied directly to the surface algae, the chemical acts to interfere with vital physiological processes; often the algae cells turn grey shortly after treatment and decompose. Copper sulphate is also toxic to fish and fish food organisms at approximately one part per million. However, in the hard waters of Wisconsin the copper sulphate quickly reacts with available carbonate ions to precipitate as copper carbonate. Copper carbonate is biologically inactive when compared to copper sulphate—its threshold of toxicity approaches 50 parts per million. Once this conversion has taken place the chemical is no longer effective in algae control and no longer a danger to fish. Therefore, the nuisance algae located in the trophic zone relatively near the surface can be sprayed with one part per million copper sulphate and be killed before chemical precipitation deactivates the chemical. It is then essentially only deactivated copper carbonate that is available to fish and fish food organisms.

The use of copper sulphate for algae control, however, is not without some risk to the general lake ecology. The difficulty is usually not from chemical toxicity but rather from the after effects of chemical application. The decomposition of nuisance algae in a shallow, warm lake may result in the depletion of dissolved oxygen and a resultant die-off of fish and lower organisms.

A second difficulty involves toxic algae. It is well established that accumulations of algae can trigger a metabolic or decomposition product that is highly toxic to fish and other animals. This condition, however, may develop as readily when no treatment has been conducted.

In general, copper toxicity and residues have not been responsible for any undesirable effects in Wisconsin waters. Copper residues appear to "drift" to the deepest portion of the lake where they are slowly covered by organic sediments and rendered unavailable to the biological community. Direct toxicity is avoided by the chemical precipitation and deactivation.

Type of Treatment

Algae control treatments may be marginal or complete. A complete treatment is generally used where the affected area is relatively small—e.g. water supply reservoirs, lagoons, channels, bays, ponds, and small lakes. The period of nuisance control is greatly increased by a complete treatment over a marginal treatment—up to 4 to 6 weeks of control on a small lake after a complete treatment.

A marginal treatment, on the other hand, is designed to obtain temporary relief from algae accumulations in shoreline and protected bay areas that are usually extensively developed by high value properties. The duration of freedom from algae nuisances following marginal treatment is governed by the rate of reinfestation from wind and wave action. Generally, marginal control is applied weekly or bimonthly. The application is typically conducted on a 200 to 400 foot margin around a large lake where the wind-blown accumulations cause the nuisance conditions.

Equipment and Application

Copper sulphate is marketed as a granular material commonly known as "blue vitrol". The compound must, of course, be brought into solution before spraying since the application of granular material is difficult to control at the low dosages necessary. A diagram of the equipment most widely used in algae control is shown in Figure 1. The power source is usually a 3 to 5 horsepower gasoline-driven, centificial, single unit pump. This type of unit has ample pumping capacity to deliver approximately 400 pounds of copper sulphate per hour as a 2 to 3 percent copper sulphate solution. The pump intake hose is at least 1½ inches in diameter, and the spray hose also is 1½ inches with a ½ inch nozzle to deliver a good spray pattern. A water return line to the chemical reservoir keeps the chemical soluble.

The speed of the treatment barge and the spray distance is taken into consideration when determining the quantity of material going through the nozzle. Usually the concentration at the nozzle can be determined reasonably accurately by the color of the spray solution. The blue color first begins to appear at about a 2 percent solution. If additional accuracy is desired, standard solutions can be developed at 1 to 5 percent $CuSO_4$-5 H_2O. They are acidified slightly to prevent precipitation, but once they are set, the color standards are reasonably stable. Samples may then be collected from the reservoir return line and compared with the standards to determine the exact concentration of the application. Uniform and accurate distribution of the chemical is extremely important. Therefore, accurate maps of the treatment area are necessary so that a continuous back calculation can be made to evaluate the chemical applied.

Since copper sulphate is moderately corrosive to metal pumping equipment, the equipment is cleaned thoroughly after use. Under normal operating circumstances, the extent of corrosion in equipment can be retarded to such an extent that equipment is usable for 6 to 8 years.

It is usually desirable to treat before the major algae bloom develops in order to avoid excessive decomposition of the algae which consumes so much dissolved oxygen. Marginal control does not normally deplete the dissolved oxygen, but for a complete treatment, no more than one-half of a lake is treated on any one day.

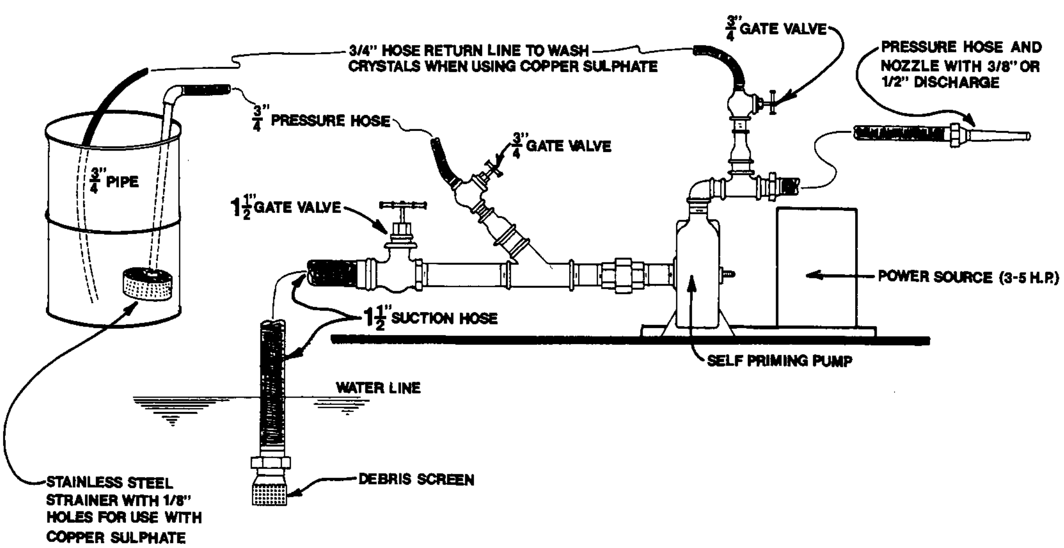
Although copper sulphate is not normally toxic to fish or fish-food organisms, spraying is generally arranged so that fish are not trapped in shallow treated areas. Normally the treatment is conducted from the shore toward open water with the spray passes made parallel to shore. The direct treatment of fish in live boxes or other traps is avoided.

Specific Measures

Blue-green planktonic algae: The most usual application for planktonic algae is 5.4 pounds copper sulphate per surface acre (one part per million for the upper two feet).

Filamentous Algae: *Cladophora* sp. and related greens are perhaps the most common types of attached filamentous algae producing nuisance growths in Wisconsin lakes. In general, the nutrient levels need not be as high

FIGURE 1. Equipment for Applying Chemicals for Weed and Algae Control Projects



Chemical Spraying Equipment used in Weed, Algae, and Swimmers' Itch Control Program.

Granular applicating equipment. This relatively inexpensive equipment is used only on large projects. Areas of 10 acres or less are most usually treated by simple hand-broadcasting techniques.

in the media as for the development of planktonic forms. The filamentous varieties do not produce the highly turbid water of planktonic algae but cause distinct nuisance conditions in relatively clear lakes. The usual control procedure is through the application of copper sulphate at 10 pounds per surface acre. The application must normally be repeated at weekly intervals for 3 to 5 weeks.

Chara: The application of copper sulphate for Chara control is usually at the rate of 10 pounds per acre and is applied as close to the bottom as practical to get the chemical directly to the plant before the conversion to copper carbonate. The chemical is normally applied in early spring before the growths have had an opportunity to break free from their attachment and float to the surface. Three to five treatments are often necessary to achieve adequate control of these growths particularly in deep water.

Diatoms: Diatoms have occasionally been reported as nuisances and indeed have been treated on occasion. However, treatment procedures for the planktonic diatoms are similar to planktonic blue-green algae and attached diatoms are treated like Chara or filamentous greens.

Use on Wisconsin Lakes

Algae control on Wisconsin recreational waters is practiced only with copper sulphate. Between 1950 and 1969, 130 lakes have been treated at least one time (Table 2, App.). A total of 1,585,059 pounds of copper sulphate has been recorded. It is unlikely that significant quantities of copper sulphate are used for algae control without being recorded since equipment is relatively bulky and the operation is noticeable. The Madison lakes have received far more copper sulphate for algae control than any other state recreational waters and indeed, most of the copper sulphate applied to Lakes Kegonsa, Monona, and Waubesa was recorded prior to Department of Natural Resources record-keeping. Treatment of these lakes was essentially discontinued by 1954 in favor of other programs designed to reduce nutrients (sewage effluent diversion).

The Chetek Chain of Lakes in Barron County, Pewaukee Lake in Waukesha County, Nepco Lake in Wood County and Wapogasset Lake in Polk County, have all received over 100,000 pounds but all are relatively large lakes where algae control is confined to developed shoreline areas and conducted during the active growing season as necessary to prevent accumulation of growing and decaying algae. Half Moon Lake in Eau Claire County is unique in that it receives virtually a complete treatment weekly during the active growing season. In spite of this tremendous per acre application of copper sulphate, there appears to be no unusual side effects and there is no detectable copper in the water. The sediments reflect the presence of copper but there seems to be no apparent effect on the bottom organisms or fish.

An accumulation of filamentous green algae. These wind-blown accumulations continue to develop during the summer months and although they appear to be dried and dead, the underside of the clump shows the algae are still alive and represent an accumulation of several inches. (Lake Michigan, Manitowoc County)

HIGHER PLANTS

Aquatic plant growths are normal constitutents of freshwater environments and it is only when the growths become excessive that they cause nuisance conditions and are collectively referred to as "weeds". The rooted plants which contribute to the majority of the nuisance conditions on Wisconsin recreational waters require not only nutrients and sunlight as with algae, but also the penetration of sunlight to the bottom where the growths begin. Naturally turbid or colored waters reduce the light penetrations so that the trophic zone is limited to much shallower water. Algae growths also reduce light penetrations and consequently, limit the water depth where higher plants can grow. In Wisconsin, there are numerous examples of this type of mutual exclusion. Lake Winnebago (Winnebago County) and Lake Delavan (Walworth County) are good examples.

Rooted plants are dependent on an acceptable bottom for attachment. The root system of aquatic plants is usually much less elaborate than terrestrial plants since the water medium both suspends the plant and provides the water and essential nutrients. The roots, therefore, function principally as a holding mechanism. The holding strength, however, is not nearly as efficient as that for terrestrial plants and many environmental factors such as unusual wave action, boat waves and even gas formation in the bottom muds can free many varieties of aquatic plants so that they may drift and decompose or reestablish in a different location. Aquatic plants may also develop roots and establish from a cut portion of stem, such as might occur after nuisance removal by cutting or motor boat operation in weed beds.

BIOLOGY

Free Floating Plants

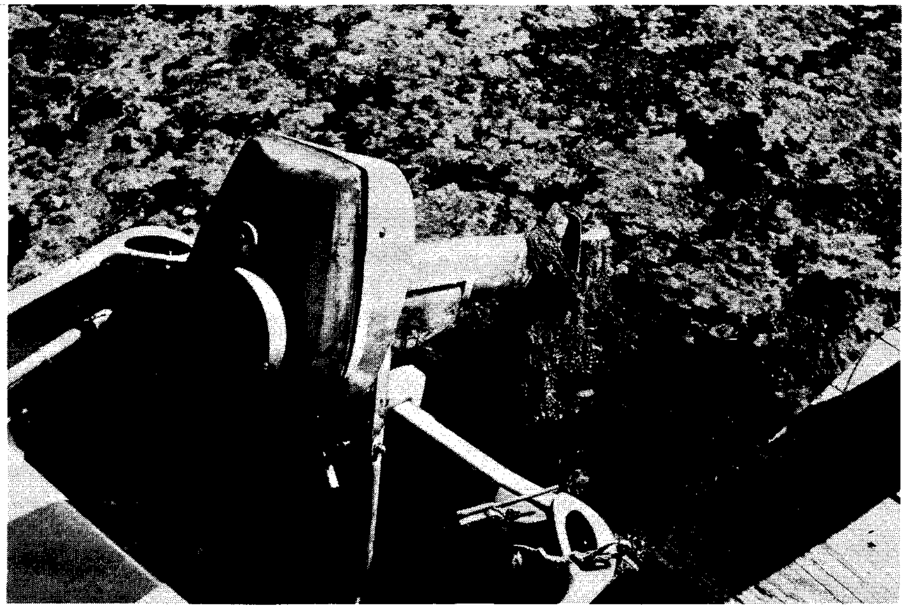
Free floating species such as lesser duckweed *(Lemna minor)* have a root system, but the short roots are not attached. Vegetative growth is initiated by lateral branching and ultimate separation into two separate plants. Free floating nuisances usually develop on relatively shallow, fertile waters. The nuisance conditions are typically worse near shorelines since the plants are easily windblown. Duckweed accumulations may also develop in open waters of a shallow lake where attached growths reach the surface and provide an entrapment mesh for the free floating plants.

In Wisconsin, nuisance duckweed may be observed on Mirror and Delton Lakes (Sauk County) and on Onalaska Lake (La Crosse County). Many other lakes have nuisance duckweed growths, but the condition is usually confined to limited shoreline areas. Wisconsin is fortunate to be free of the worst free floating nuisances, water hyacinth and alligator weed, which are prominent in southeastern United States.

Emergents

Emergent aquatics are rooted in relatively shallow water so that most of the growth occurs above the water line. They are spread by an underground root system and new emergent plants can occur almost anywhere in the network. Common examples of these growths are cattails *(Typha)*, arrowhead *(Sagittaria latifolia)* and bulrushes *(Scirpus)*.

The cattails and bulrushes are common on many Wisconsin recreational lakes. Generally the growths are confined to immediate shoreline areas, but occasionally they develop on several acres of shallow water. Arrowhead, on the other hand, is not as common a nuisance plant as cattail and bulrush, but where it does develop in relatively shallow lakes it often infests extensive areas. The emergent aquatics virtually destroy the water area for almost all recreational pursuits. Although there may be some value to wildlife asso-



Weed nuisances on recreational waters can develop to such an extent that typical recreational pursuits are virtually impossible.

ciated with these growths, most recreational pursuits such as boating, fishing and swimming are essentially eliminated in these areas.

Submergents

The pondweeds are one of the major subdivisions of submergent aquatics and belong mostly to the genus *Potamogeton.* They are distinguished from other submerged types in that they have a definite but diverse leaf form. The leaves vary from thin and threadlike to membranous and broad. Most of the Potamogetons have extensive root systems and runners so that new growths can develop vegetatively as well as from seeds.

One of the most widespread nuisance pondweeds is Sago pondweed *(Potamogeton pectinatus).* The plant has a much branched stem and threadlike leaves. It developes nuisance conditions in both hard and moderately soft water lakes. In clear waters, Sago pondweed is common to a depth of 10-12 feet. Curlyleaf pondweed *(Potamogeton crispus),* a common, membranous-leaved representative, is typically observed surviving through the winter months. It can develop distinct nuisance conditions early in the spring, disappear for a couple of months in early summer, only to develop new growths again in July and August. This growth pattern is also common of other species of Potamogetons, and positive identification is often essential to good control recommendations. These species are most commonly associated with relatively clear waters and are observed to depths of 12-14 feet.

There is a taxonomically complex series of Potamogetons known as fine-leaved pondweeds. These species are characterized by grass-like leaves and usually inhabit shallow waters. The identification of the various species of fine-leaved pondweeds is difficult and in some growth stages is virtually impossible. However, the species distinctions are not usually important in control recommendations since they respond to control as a group and not independently.

Another type of submergent vegetation is characterized by no distinct leaf form. Water milfoil *(Myriophyllum)* and coontail *(Ceratophyllum)* are the most common representatives of this group. They are rooted but the root systems are typically not extensive so they break free readily and drift with the wind. Consequently, they may clutter a shoreline to the point where hand raking is the only removal method available. To compound the nuisance problems further, these plants have the ability to reroot from a cut stem or portion. Cutting without raking and removal can, therefore, produce a worse nuisance condition than originally existed. Motor boat usage in weed beds can also aggravate the situation and cause nuisance infestation where it did not originally occur.

Floating-leaved Plants

A fourth growth type includes the rooted plants with large, floating leaves. Some of the pondweeds fall into this group, but most typical are the water lilies *(Nymphaea* and *Nuphar)* and American lotus. Lotus is protected in Wisconsin and it is illegal to initiate a control program without special authorization (Wisconsin Statutes 29.546). American lotus can be distinguished from common lily pads by the fact that the stem is attached to the middle of the leaf. Since the leaf of water lilies has a narrow deep incision, the stem is actually attached to the leaf edge.

CONTROL

Navigation interests were perhaps the first aquatic plant control practitioners to develop efficient weed removal equipment, but in recent years, hydrologists, game and fish management teams, as well as recreational interests, have all contributed to the development of practical control methods.

Mechanical Control

The earliest and simplest endeavors in aquatic plant control consisted of mere raking and pulling of the nuisance growths. Ultimate disposal involved hauling the plants to a land disposal site. Anyone who has practiced this type of control on a fertile lake is familiar with the effort necessary to relieve even a small area of nuisance weeds!

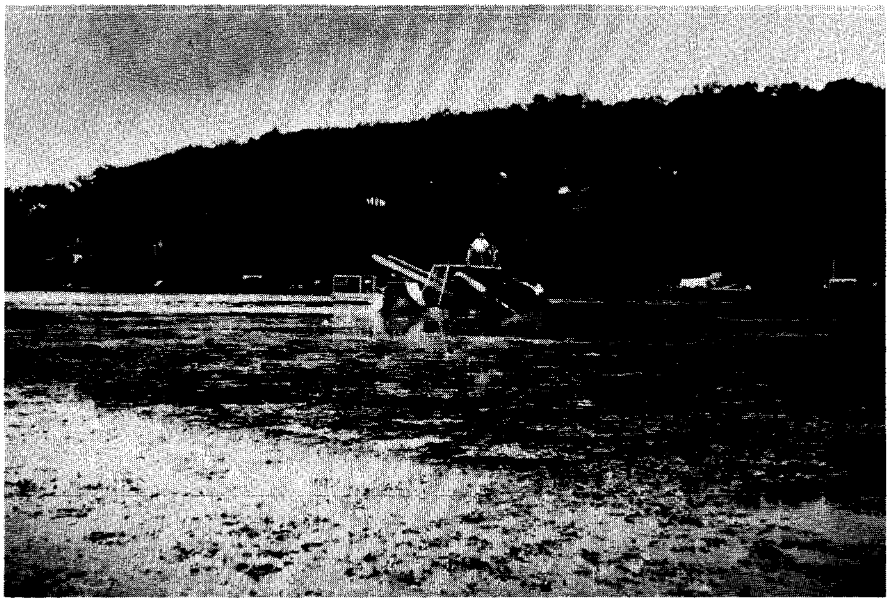
Other mechanical removal methods included the dragging of chains or bed springs through plant growths to dislodge them followed by collection and disposal. In recent years, aquatic weed-cutting equipment has been improved to the extent that the equipment simultaneously removes the plants from the water so they can be transported to shore and then disposed in an appropriate disposal site. This more elaborate equipment may process 400 tons per year of wet weeds (City of Madison experience). This equipment is much more efficient in deep, open waters than in shoreline areas.

The commercial cutting equipment now available generally cuts to a 4-foot depth. For greatest efficiency, it operates in such a way that the plants are transferred to a transport barge which carries them to shore and empties them onto a loader and truck for hauling to a suitable disposal site.

The entire operation requires substantial technical and operational support so that these operations are usually feasible only when underwritten by a municipality or strong cooperative agency.

The mechanical control of weeds is essentially not regulated by state or local agencies. The only pertinent regulation in Wisconsin concerning mechanical removal of aquatic plants identifies cut weeds as a nuisance and requires that they be removed (Wisconsin Statutes–Section 30.125). There is no permit necessary but specific legislation regarding specific plants and areas must be considered:

1. Section 29.544 concerned with wild rice preservation.
2., Section 29.545 concerned with aquatic weed protection in certain sections of the Wolf and Fox Rivers.
3. Section 29.546 concerned with the preservation of American lotus.



Modern weed harvesters both cut and remove nuisance weeds.

Chemical Control

The chemical control of aquatic plants is an outgrowth of comparable activities widely practiced in agriculture. Prior to the 1960's, the only product utilized in aquatic plant control was sodium arsenite, an agricultural herbicide. However, in the late 1950's, extensive investigations were initiated on the efficiency of other agricultural chemicals as well as products not used in agriculture. These products were all moderately biodegradable so that there was less potential accumulation of residues expected after repeated usage. Furthermore, the chemicals were carefully screened by both industry representatives and federal and state regulatory agencies to insure that at the effective use level there were no unusual hazards to resident fish populations or to other aspects of the lake ecology. Organic herbicides gradually replaced sodium arsenite in aquatic plant control activities. In 1961, Wisconsin lakes were treated with nearly 200,000 pounds of sodium arsenite; by 1965, this quantity had been reduced to 90,000 pounds; and by 1970 to zero.

The conditions for chemical use in the aquatic environment are substantially more restrictive than for agricultural uses. A commercial firm desiring to distribute a particular product must provide an extensive series of investigations and data in support of their request for federal and state use registrations.

An ideal aquatic herbicide must meet the following criteria:

1. Quick and efficient destruction of the nuisance plant.
2. Nontoxic (acute and chronic) to other desirable aquatic organisms (fish, arthropods, etc.)
3. Nontoxic to water users.
4. Easy and safe to apply.
5. Readily confined to specific areas.
6. Breakdown to harmless products with no residue potential.

Only a very few aquatic herbicides have met the above criteria sufficiently to be accepted for use on recreational waters. There will be a continuing effort by industry and government to develop new products that more completely meet the use criteria listed.

Four aquatic herbicides are currently registered for general supervised use on Wisconsin recreational waters: 2,4-D, and Silvex (2,4,5-TP), diquat, and the salts of some endothal compounds marketed as Aquathol.

2,4-D

The common agricultural herbicide 2,4–D (2,4–dichlorophenoxy acetic acid), has proven to be an effective aquatic herbicide. It kills a plant by disrupting the pattern of cell division in the actively reproducing portion of leaf, stem, and roots. This type of hormone-killing action usually requires more time to effect a kill than do contact herbicides. Most 2,4-D applications are made in late May or early June and as long as 4 to 6 weeks may be required for the plants to die and go down.

2,4-D is commercially available as a salt or ester and the formulation utilized is usually dependent on where plant absorption will take place. Plant roots absorb polar forms (salts) more readily, and leaves absorb nonpolar forms (esters) more readily. Since most absorption in aquatic plants is provided by the leaves, the 2,4-D esters are more widely used than the salts. There are a host of esters available for agricultural purposes, but only the iso-octyl ester (hexyl ethyl ester) is accepted by the Wisconsin Department of Natural Resources since this formulation possesses the least toxicity to aquatic fish and fish-food organisms.

The iso-octyl ester of 2,4-D is available from most agricultural chemical supply houses as either a liquid or granular formulation. It is most efficient in broadleaf plant control and has been used extensively in Wisconsin on the following species at 2 to 4 ppm of acid equivalent:

Water milfoil (*Myriophyllum* spp.)
Water Buttercup (*Ranunculus* sp.)
White Water Lily (*Nymphaea odorata*)
Yellow Water Lily (*Nuphar* spp.)
Coontail (*Ceratophyllum demersum*)
Willow (*Salix* spp.)

Best results are obtained when the application of 2,4-D is made at a time when the plants are actively growing. The treatment season in southern Wisconsin is typically late May and in northern Wisconsin, early June. The prinicpal difficulty with 2,4-D is that with treatment this early, the cold water reduces the effectiveness, or, if control is achieved that early, regrowth of the nuisance weeds are apparent before the end of the recreational season.

The federal labeling of 2,4-D restricts water users in treated areas. Swimming is restricted for one day and other uses such as public drinking water, stock watering, and irrigation are restricted for three days. These restrictions are applicable only to the treated area and a relatively small marginal or buffer zone around the treated areas.

Silvex

Silvex (2-2,4,5-Trichlorophenoxy propionic acid), like 2,4-D, is a phenoxy compound that kills a plant by overstimulation of the meristem regions of the root, leaves, and stem. The material is marketed as a low volatile iso-octyl ester or potassium salt either in liquid or granular formulation. Silvex is seldom used alone as an aquatic herbicide but is more often used in combination with endothal compounds to give these products a broader spectrum by insuring translocation of herbicide to the root system and preventing regrowth after the stalk and leaves have been killed by the contact herbicide. Silvex is most widely used on the following species usually in combination with a contact herbicide:

Arrowhead (*Sagittaria* spp.)
Eelgrass (*Vallisneria americana*)
Elodea (*Elodea canadensis*)

Labeling restrictions on Silvex (2,4,5-TP) are the same as 2,4-D; one day restriction against swimming, and three days for other water uses.

Diquat

Diquat is a quaternary ammonia compound that is particularly safe to fish and fish-food organisms. It acts as a contact herbicide and is absorbed quickly by plant tissue effecting a rapid kill. Typically the treated weeds will be brown the day following treatment. The chemical is rapidly absorbed onto silt particles and is essentially deactivated. Turbid waters cannot be successfully treated because of this feature. Diquat is effective on filamentous algae as well as a wide variety of plants. Since Diquat is a contact herbicide, it is most efficient on those plants without extensive root systems where the ability of the plant to initiate regrowth from the root is reduced. Diquat is used as a broad spectrum herbicide in Wisconsin recreational waters and is particularly successful on the floating plants. Plants controlled include:

Duckweed (*Lemna* sp.)
Eelgrass (*Vallisneria americana*)
Elodea (*Elodea canadensis*)
Potamogetons

Aquathol

The potassium salt of endothal (1,2-dicarboxy-3,6-endoxoxy cyclohexane) is perhaps the most widely used aquatic herbicide currently on the market. It was first used in Wisconsin waters in the early 1960's and has undergone extensive use evaluation. The material is marketed as Aquathol ® and also as Aquathol® Plus, a mixture of endothal and silvex.

Endothal compounds are contact herbicides that cause the plants to die and go down 3 to 5 days after treatment. There is a wide margin of safety between the use rates and toxicity to desirable fish and fish-food organisms. The addition of silvex to the endothal effectively broadens the species spectrum and adds to efficiency by preventing regrowth from roots that are difficult to control with a contact herbicide.

The potassium and sodium salts are not the only formulations of endothal. The dimethylcocoamine derivation is even more effective in aquatic weed control but its high toxicity to desirable fish species prevents its use as an aquatic herbicide. The endothal compounds with silvex are perhaps the most broad spectrum aquatic herbicides currently on the market. Table 3 is a summary of these plants controlled with Aquathol as well as other currently acceptable products.

Use on Wisconsin Lakes

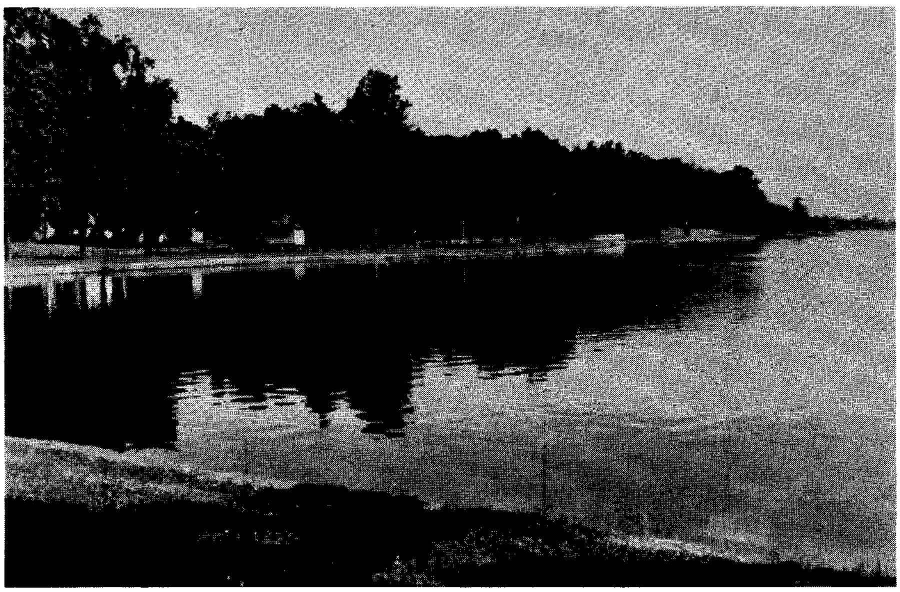
Control of higher plants on Wisconsin recreational waters between 1950 and 1960 was essentially practiced only with sodium arsenite. Typically, the treatment was sponsored by an organization or municipality rather than an individual since the application of the chemical was difficult and required experience and equipment to safely effect a good treatment. In the early 1960's, the organic herbicides came into prominence and it was possible to confine treatment to small areas by techniques available to every property owner. The potential of damage to desirable fish in these relatively small treatments with chemicals that displayed a wide margin of safety was almost nil and consequently, the regulatory agency relaxed the supervisory restrictions on these projects. The agency, however, did continue to record all chemical applications and Tables 4 and 5 (App.) summarize the chemical plant control activities between 1950 and 1969. It is unlikely that unrecorded sodium arsenite is a factor in this tabulation since the application required experience and equipment. However, it is probable that small quantities of the organics have been used by cottage owners without a Department of Natural Resources permit and subsequently, those applications do not get recorded. As will be noted from Table 4, the use of sodium arsenite declined between 1959 and 1968 until in 1970, it was totally discontinued.

By the same token, the organic herbicides increased between 1958 and 1969 but the pattern of treatment changed. Rather than relatively large treatments over extensive lake areas by strong sponsoring organizations, the treatments were designed to improve small areas for beach development and boat access by single property owners. A few large programs continued but even these programs developed more selectivity on treatment areas because of the cost factor associated with the organic herbicides.

TABLE 3. Aquatic Weed Control with Organic Herbicides.

Aquatic Plant	Aqua. K	Aqua. +	Ortho Diquat	Iso-Octyl 2,4-D	Silvex-4# 2,4,5-TP	Potassium Silvex 6#	Hydro. 47
Largeleaf Pondweed *Potamogeton amplifolins*	C	C	NC	NC	NC	NC	--
Sago Pondweed *P. pectinatus*	C	C	C	NC	NC	NC	--
American Pondweed *P. nodosus*	C	C	CC	NC	NC	NC	--
Small Pondweed *P. pusillus*	C	C	C	NC	NC	NC	--
Floating Leaf Pondweed *P. natans*	C	C	C	NC	NC	NC	--
Waterthread Pondweed *P. diversifolium*	C	C	NC	NC	NC	NC	--
Flatstem Pondweed *P. zosteriformis*	C	C	NC	NC	NC	NC	--
Curlyleaf Pondweed *P. crispus*	C	C	C	NC	NC	NC	--
Narrowleaf Pondweed *P. strictifolius*	C	C	C	NC	NC	NC	--
Claspingleaf Pondweed *P. Richardsonii*	C	C	NC	NC	NC	NC	--
Leafy Pondweed *P. foliosus*	C	C	C	NC	NC	NC	--
Horned Pondweed *Zannichellia spp.*	C	C	NC	NC	CC	CC	--
Bushy Pondweed *Najas flexilis*	NC	NC	C	NC	CC	C	--
Southern Naiad *Najas guadalupensis*	NC	NC	C	NC	CC	C	--
Burreed *Sparganium spp.*	C	C	NC	NC	NC	NC	--
Waterstar Grass *Heteranthera spp.*	C	C	C	NC	CC	CC	--
Coontail *Ceratophyllum spp.*	C	C	C	C	C	C	--
Water Milfoil *Myriophyllum spp.*	NC	C	C	C	C	C	--
Bladderwort *Utricularia spp.*	NC	CC	C	NC	CC	C	--
Fanwort *Cabomba spp.*	NC	C	NC	NC	C	C	--
Water Cress *Rorippa spp.*	NC	CC	NC	C	CC	C	--
Smartweed *Polygonum spp.*	NC	CC	NC	C	CC	C	--
Water Buttercup *Ranunculus spp.*	NC	NC	C	NC	NC	NC	--
Canada Waterweed *Elodea spp.*	NC	CC	C	NC	CC	C	--
Widgeon Grass *Ruppia spp.*	NC	CC	C	NC	CC	C	--
Duckweed *Lemna spp.*	NC	NC	C	NC	NC	NC	--
Watermeal *Wolffia spp.*	NC	NC	C	NC	NC	NC	--
Watershield *Brasenia spp.*	NC	NC	NC	C	C	C	--
Spatlerdock *Nuphar spp.*	NC	NC	NC	C	CC	C	--
Sweetflag *Acorus spp.*	NC	NC	NC	C	C	C	--
Eel Grass *Vallisneria spp.*	NC	NC	NC	NC	CC	CC	CC
Arrowhead *Sagittaria spp.*	NC	CC	NC	C	C	C	--
Spikerush *Eleocharis spp.*	NC	CC	NC	NC	C	C	--
Lotus *Nelumbo spp.*	NC	C	NC	CC	C	C	--
Water Lily *Nymphaea spp.*	NC	C	NC	CC	C	C	--
Cattails *Typha spp.*	NC	NC	C	CC	C	C	--
Bulrush *Scirpus spp.*	NC	NC	NC	C	CC	C	--
Wildrice *Zizania spp.*	NC	NC	NC	NC	NC	CC	--
Water Willow *Dianthera spp.*	NC	NC	NC	CC	CC	C	--

C = Controlled by Herbicide.
CC = Conditionally Controlled by Herbicide
NC = Not Controlled by Herbicide.



Aquatic Plant Nuisance Before and Five Days after Chemical Control on Rice Lake, Barron County (Courtesy of The Lake Biologist, Inc.)

Comparison of Methods

Mechanical control techniques with current equipment available are most readily utilized in combination with chemical control methods. Cutting equipment efficiency is greatest in deep waters. Since chemical control costs increase with increasing depth chemicals are used in shallow water and adjacent to piers where the efficiency of mechanical equipment is reduced.

Mechanical control methods have specific advantages over chemical control methods in that there is no chance of a chemical residue and since the weeds are actually removed, the nutrients that would be recycled if the weeds were killed are also removed. Even though the potential of nutrient reductions through weed removal is small, it is one of the few methods available that provides any nutrient removal.

Some of the disadvantages of mechanical weed removal over chemical weed control include:

1. A relatively high initial investment in commercial-size equipment.
2. A seasonal operation with extensive maintenance and support demands.
3. Developing suitable disposal sites for the weeds.
4. Relatively rapid regrowth of the cut weeds, particularly in shallow water.
5. Operationally inefficient in shallow water and around piers where most effective weed control is desired.

SWIMMERS' ITCH

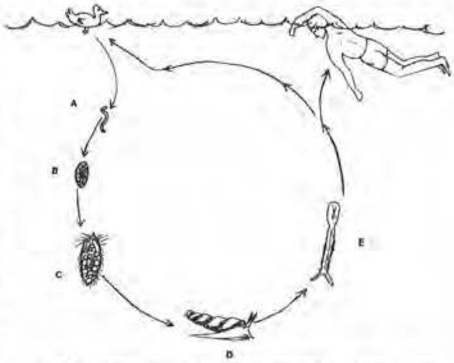
One of the best known of the Egyptian papyri, "Papyrus Ebers" which dates back to 1550 B.C. deals with a disease referred to as the AAA disease. The symptoms described and the hieroglyph used lead modern medical interpreters to believe that this ancient disease was the same as what we know today as bilharziasis or schistosomiasis. The principal symptoms are blood in the urine caused by a parasitic flatworm (Schistosoma) in the urinary bladder or ureter. The causative organisms are host specific, and the most serious disease-producing species occur in tropical and subtropical regions of the earth. In Wisconsin, however, there are species present that attack various animals and often accidently attack swimmers, causing an uncomfortable dermatitis.

DEVELOPMENT OF THE ORGANISM

The adult worm lives as a parasite in the tissue of a suitable mammal or bird, and produces eggs which pass with the droppings of the host animal into the water. Upon hatching, the embryo develops into a ciliated organism called a miracidium which swims about in search of a second host animal, a particular type of snail. If the snail is located within a few hours, the miracidium will penetrate into the soft tissues and pass through a second reproductive phase. The organism that is released from the snail is called a "cercaria" and is an active swimming stage again seeking the primary host animal or bird.

During the active swimming state, the life cycle may be interrupted when the cercaria accidently penetrates the outer layer of skin of bathers. The cercariae are soon destroyed by natural body defense mechanisms, but the site of penetration is apparent by a small red welt, discomfort and itching. The degree of discomfort and bodily reaction resulting from penetration varies with the sensitivity of the individual and the degree of infestation. In some persons, the reaction may be hardly noticeable. Other persons have considerable pain, fever, severe itching

Typical swimmers' itch injury. Note the random scatter of the attack points. (The skinned elbow is not related to cercariae attack). Courtesy of The Lake Biologist, Inc.



Life cycle of swimmers' itch cercariae: (A) blood fluke carried by water bird; (B) egg; (C) miracidia; (D) snail host; (E) cercariae seeking host.

and swelling. The swelling will usually subside within a week but the red coloration can persist for some time longer. The skin irritation is not contagious.

Many of Wisconsin's finest recreational beaches are plagued by this flatworm pest every year. Other lakes have the nuisance in a particular year with no recurrence. The absence of an infected host bird or animal population or of a suitable species of snail to provide the alternate host may contribute to the sporadic distribution of the nuisance organisms.

The swimmers' itch organisms are most commonly noted in early summer, about the time summer water temperatures reach a seasonal maximum. In the southeast Wisconsin lake region, the incidence of swimmers' itch is most prominent in late June and early July. The season is usually relatively short since water temperatures approach the high eighties and the cercariae are released from the snails during a period of relatively few days. In the northern portion of the state, the water temperatures are slightly lower so the swimmers' itch season is delayed to perhaps early or mid-July. Since the cercariae are not released from the snails as readily at the low temperatures, the infective season, rather than lasting a few days, may last throughout the remainder of the swimming season.

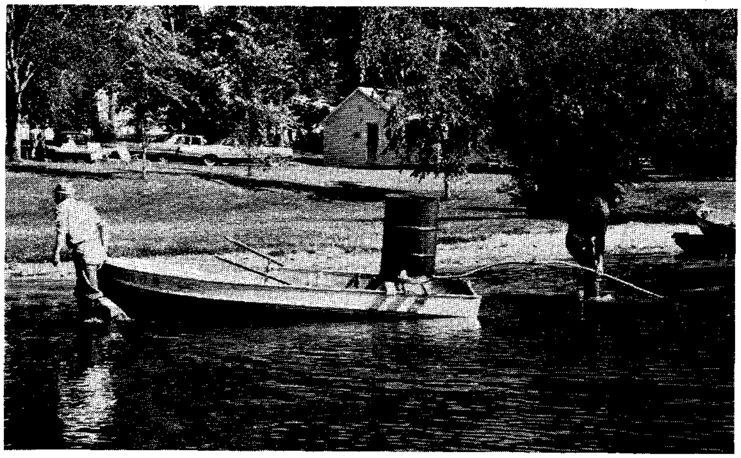
After the cercariae have penetrated the skin, there is little that can be done in the way of treatment. Some relief from the itching may be obtained through the use of a soothing lotion such as calamine or lotions that have additives such as antihistamines and/or local anesthetics.

In past years, there have been lotions marketed as preventatives against cercariae penetration but the effectiveness of these products leave much to be desired. Some simple preventive measures are possible, however. The cercariae are delicate little animals which when deprived of water will dry up and die. Furthermore, there is some evidence that actual penetration takes place after emerging from the water. Consequently, a brisk rubdown with a towel immediately after emerging from the water will minimize the number of successful penetrations. This procedure, of course, is impractical for small children that dabble at the shoreline or for bathers that are continuously in and out of the water.

CHEMICAL CONTROL

Procedure

With our basic knowledge of the relationship between Schistosome cercariae and snails, it has been possible to devise control procedures that eliminate both the host snails and the cercariae. Since the host snail and the free swimming cercariae move only short distances, the control procedure can be confined to the immediate area of the beach and there is no need to destroy extensive snail populations.



Simplified equipment for applying chemicals for swimmers' itch control mounted and operational in an aluminum fishing boat. This equipment can be modified for extensive projects by using a 3 horsepower centrifugal pump to keep the chemical mixed and pump the material through the distribution system.

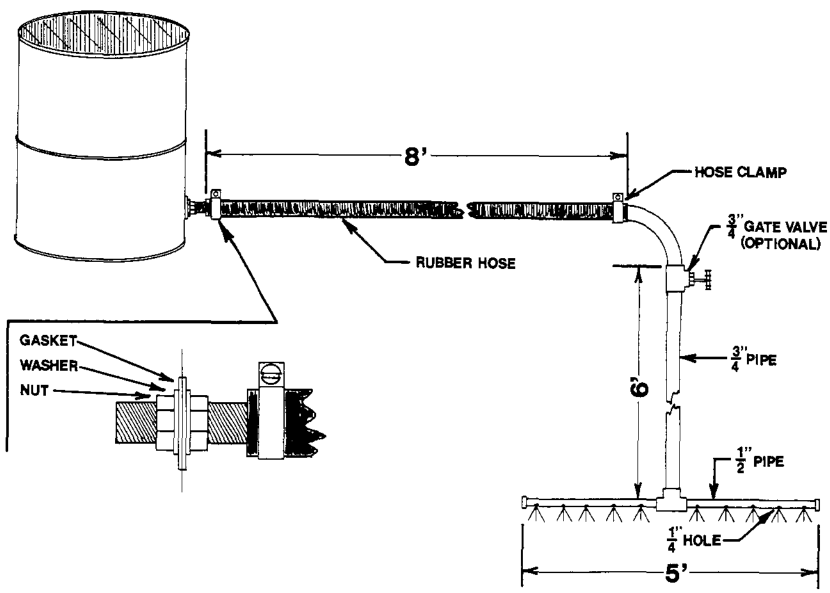
Several chemicals have been utilized, but copper sulphate has been by far the most widely used for snail control. The chemical is usually used at a rate of 80 pounds copper sulphate per surface acre of the beach. Since both snails and cercariae have some mobility, treatment areas encompass at least one acre and include 50-100 feet of shoreline on both sides of the beach. To avoid undue toxicity to fish at this high rate, the copper sulphate is usually mixed with ½ as much lime to effectively precipitate the chemical and force it to settle onto the bottom muds where the snails are thoroughly exposed. The fish in the upper water layers are, therefore, not affected .

The application of the chemical is most readily accomplished by draining the slurry of copper sulphate, lime and water from a barrel through a hose or "T" bar onto the bottom (Fig. 2). The chemical is not harmful to bathers but better results are obtained if swimmers are excluded from the beach for a few hours to permit the chemical to settle. Applications are not made when rough water is present, since this would tend to disperse the chemical more widely.

This treatment is a relatively violent ecological manipulation and for that reason, is usually confined to relatively small areas of a lake. However, even where extensive shoreline areas are treated annually, there is no apparent ecological damage to the lake. The very nature of applying the chemical as a settleable solid provides that the chemical is quickly incorporated into bottom muds and effectively lost to the lake as an active toxicant.

This type of chemical control is practiced on many Wisconsin lakes annually as a preventative and/or solution to the swimmers' itch nuisance. In general, it is successful. However, even after a beach has been treated, there may be incidences of swimmers' itch. This will most usually be associated with a relatively strong onshore wind where water currents transport cercariae from untreated areas to the swimming beach.

FIGURE 2. Simplified Equipment for Applying Chemicals for Swimmers' Itch Control



Use on Wisconsin Lakes

A total of 48 lakes have received some type of swimmers' itch control (Table 6, App.). Most lakes that are plagued with the problem are treated on an annual basis. Typically the treatment is confined to a relatively small swimming beach but in at least two cases, Lake Metonga in Forest County, and Lake Noquebay in Marinette County, the control program is applied to extensive shoreline areas. The treatment is usually in mid-June in the southern part of the state, and in early July in the north.

The incidence of swimmers' itch is more noticeable in the northern part of the state. This is perhaps due to the fact that water temperatures do not reach the same levels as in the south and consequently, the release of cercariae by snails is extended over a greater period of time with a higher probability of affecting bathers. Treated beaches can usually be cleared of infected snails but when bathing on days when the wind is onshore, the water currents bring different cercariae onto the beach. Beaches must, therefore, be carefully selected during the swimmers' itch season to avoid the infection even on treated beaches.

DEVELOPMENT OF CONTROL PROGRAM

Every year, complaints about aquatic nuisances and requests for assistance in controlling them are investigated by the Department of Natural Resources. The conditions observed are not unique. Man has been plagued with nuisance aquatic growths in surface waters for a long time as may be attested by publications regarding the problem which appeared in the mid-19th century.

Investigators active in the early 1900's promoted the use of copper sulphate for the control of planktonic algae in water reservoirs. Copper sulphate came into more or less general use as a reservoir algicide. In 1918, the City of Madison began using it on recreational waters. In 1925, the systematic treatment of an entire 3,000-acre lake was accomplished with copper sulphate. In the mid-1920's, the effectiveness of arsenic trioxide on terrestrial plants was expanded successfully to the aquatic community, and in 1926, the City of Madison first used sodium arsenite in the control of an aquatic nuisance for the enhancement of recreational values of an area. By the early 1930's, several published reports had substantiated the effectiveness of arsenic trioxide for aquatic plant control on recreational waters with a relatively substantial margin of safety for fish and fish-food organisms. By the mid-1930's, chemical aquatic nuisance control activities centering around copper sulphate and sodium arsenite had expanded to many Wisconsin recreational waters and in 1938, there developed a controversy between sportsmen's groups and property owners on a particular Wisconsin lake. Following this controversy, an executive order established a committee to review the problem of algae and aquatic plant control in public waters. This Interdepartmental Committee continued in existence as a Subcommittee of the Committee on Water Pollution. Late in 1966, the newly created Department of Resource Development Board reestablished this Interdepartmental Committee as an Advisory Committee to the Director of the Department of Resource Development.

The Interdisciplinary Advisory Committee concept of regulating chemical control of aquatic nuisances was also adopted when the activity was incorporated into the operation of the Department of Natural Resources in 1968. The principal functions of the original committee were three-fold:

1. To supervise aquatic nuisance control activities on Wisconsin public waters.
2. To investigate the technical aspects of chemical applications to Wisconsin public waters when applied for purposes of aquatic nuisance control.
3. To perform educational services to sponsoring organizations and insure proper planning of aquatic nuisance control activities so as to obtain the most possible benefit without damage to desirable aspects of the environment.

The functions of the current Advisory Committee are essentially the same. Shortly after the executive committee was appointed in 1938, to assist in resolving technical and public relation difficulties concerned with chemical aquatic nuisance control, a permit system was implemented and has continued to the present.

In 1941, the Wisconsin Legislature passed an act calling upon the Committee on Water Pollution "...To supervise chemical treatment of waters for the suppression of algae, aquatic weeds, swimmers. itch and other nuisance producing plants and organisms. It may purchase equipment and may make a charge for the use of the same and for materials furnished together with a per diem charge for services performed in such work. The charge shall be sufficient to reimburse the Committee for the use of equipment, the actual cost of materials furnished and the actual cost of services rendered, plus ten percent for overhead and development work." This legislation was basically carried into Chapter 614, Laws of 1965, under Section 144.025.

During the 1940's, the Committee purchased and operated chemical spraying equipment which was made available to sponsoring organizations on a rental basis. As the program expanded, the demand for state-owned equipment became impractical and in 1949, the use of state-owned equipment was discontinued. By 1950, comprehensive records were maintained concerning important phases of chemical control activities.

Since the inception of the program, the principal chemicals used have been copper sulphate for algae control and arsenic trioxide for weed control. During the last ten years, new organic herbicides have been brought on the market to replace sodium arsenite as an aquatic herbicide. Before a product can be used on Wisconsin waters, it must be registered by the U.S. Environmental Protection Agency, the Wisconsin Department of Agriculture, and must further be approved by the

Advisory Committee on Aquatic Nuisance Control. The use of chemicals in the control of aquatic nuisance growths on Wisconsin recreational waters since records were begun in 1950 is summarized in Table 7 (App.).

The use of chemicals on lakes is very carefully regulated to prevent undue ecological damage and the Wisconsin Department of Natural Resources is charged with this responsibility. Sponsoring organizations such as resort owners, municipalities or private individuals must first obtain a permit from the Department of Natural Resources before application of chemical can proceed. Application blanks for a permit may be obtained by writing to the Department of Natural Resources, Box 450, Madison, Wisconsin 53701. Once a permit has been issued, a representative of the Department (if required by the permit) will be present at the time chemicals are actually applied to insure that dosage computations are accurate and the chemicals are not misused. The sponsoring organization is required to pay a nominal fee for this supervisory service.

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TABLE 2. Lakes Treated with Copper Sulphate for Algae Control.

		Pounds of Copper Sulphate																				
Lake	County	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Total
Aageson	Oconto																		20			20
Altoona	Eau Claire												800	1,490[2]	1,400	1,000	800	1,100				6,590
Barney	Dane																225					225
Bass	Oneida		25			25					25		20									95
Bear Trap	Polk									700	1,200[2]	1,700[2]	1,700[3]	1,600[3]	2,100[5]	2,100[5]	1,800[5]	2,000[4]	2,500[4]	1,200[5]		18,600
Beaver Dam	Barron										2,500[2]						2,350[3]	1,700	700	900	1,350[3]	9,500
Beulah	Walworth	50												500								550
Big Butternut	Polk									3,800[2]	1,700		1,500	1,000	1,700[2]	2,200[2]	850	500	800[2]			14,050
Big Cedar	Washington											1,800[2]	3,800[4]	2,900[4]	3,550[5]	3,540[5]	3,750[7]	1,800[3]	300			21,440
Big Silver	Waushara												50									50
Bing	Waushara				66																	66
Blue Spring	Jefferson					250																250
Boot	Iron			970[2]																		970
Brown's	Racine	100						150				575	400									1,225
Bugh	Waushara																				62	62
Cable	Bayfield																10					10
Camp	Marinette														70	70	70					210
Camp McCoy Ponds	Monroe																				13*	13
Cedar	Polk	800		1,600[2]	1,600[2]	800	800	800		1,600	1,000			1,600[2]								10,600
Chetek Chain	Barron								18,775[4]	10,800[3]	2,400	15,200[2]	9,200[4]	11,800[11]	9,800[8]	10,800[10]	10,300[9]	13,500[13]	8,700[10]	7,600[10]	10,150[9]	139,025
Clear	Polk							225	225	525[2]			300				50		35	100	295[5]	1,755
Coleman	Marinette																	1,300[2]	1,590[3]	900	800	4,590
Crane	Forest																			200	200[2]	400
Crystal	Sheboygan	175	700[2]	400	400	400		400	400	400	400	400	400	400	400	400	400	400	400	300[2]	390[2]	7,565
Dallas	Polk																	85			50	135
Deer	Polk	350																			580[4]	930
Delavan	Walworth	1,710	2,500	1,800	2,050	1,000	1,100	700	480	5,200[9]	3,000[5]	7,600[13]	6,900[13]	8,200[14]	7,900[14]	7,550[13]	6,400[13]	4,200[11]	4,625[13]	6,005[14]	2,193[6]	81,113
Delton	Sauk														300	600[2]			900[3]	1,270[4]	225	3,295
Eagle	Racine								1,800		1,200	2,000[2]	4,500[7]	3,300[6]	700[2]	400	400	950[2]	800[2]	1,000[2]	1,600[7]	18,650
Eagle Spring	Waukesha		20		30																200	250
Eau Claire	Eau Claire																900	800[2]				1,700
Elk Creek	Dunn									300		300				150		300	400[2]		200	1,650
Emery	Marquette														100	150						250
English	Manitowoc																				200[2]	200
Fin "N" Feather	Jefferson																			40	49.5[2]	89.5
Fish	Waushara														150[3]	540					125[2]	815
Five	Washington	600		600	500		500						500			400	200				350[2]	3,650
Flora Dell	Monroe																	25			50[2]	75
Fowler & Oconomowoc R.	Waukesha							300	300	306	300	300	500		275						225[2]	2,506
Geneva	Walworth	1,050	1,365	1,280	660	1,410	770	1,000	1,800	1,450	1,800	1,550	1,400		1,200		1,720[4]	400			60	18,915
George	Kenosha																		10	10	140[3]	160
Gilbert	Waushara										15											15
Goose	Adams												350		120					230		700
Green Bay	Door											200										200
Half Moon	Eau Claire		480	480	2,090	5,200	4,000	3,700	7,200	6,500[8]	3,400[5]	5,600[7]	8,000[11]	8,000[10]	4,800[11]	12,100[18]	4,505[10]	4,600[11]	4,800[12]	4,600[11]	3,080[10]	93,135
Hills	Waushara																			10	5	15
Horseshoe	Manitowoc																400[3]	100	200[2]	110[2]	350[4]	1,160
Iola	Waupaca																		225			225
Keating	Waupaca												100	35								135
Keesus	Waukesha												1,985[2]			1,600[3]	1,710[2]	2,420[3]	1,500[3]*	700[2]	495[3]	10,410
Kegonsa	Dane	55,420	48,928	46,515	41,189	25,102																217,154
Kettle Moraine	Fond du Lac													400			500[2]					900
La Belle	Waukesha									200		475	700	120	175						45	1,715
Lauderdale Chain	Walworth																	33	85		27	145
Lazy	Columbia																		300	175		475
Lincoln Park	Kenosha																			40	20	60
Lion's Beach	Rock	75	75	75	75	75	75				75	75	75	75	75	75	75	75	75	50		1,175
Little Cedar	Washington																700					700
Little Long	Manitowoc																				100	100
Little Muskego	Waukesha									200[2]												200
Little St. Germain	Vilas										4,200	5,000[2]	2,900	3,800[4]		7,200[4]		1,600		2,300[2]	1,400	28,400
Long	Fond du Lac																			100		100
Long	Manitowoc															800[2]	750[2]	1,100[3]	1,600[4]	800[2]	800[3]	5,850
Long	Polk												700		930		700		1,700[3]	900[2]	800[2]	5,730
Lorraine	Walworth						300	300														600
Lower Phantom	Waukesha											100	100								45	245
Marion Mill Pond	Waupaca									50												50
Mendota	Dane	176	738		127												49					1,090
Menomin	Dunn													4,600[4]	9,000[9]	8,800[10]	6,900[8]	7,500[8]	3,900[5]			40,700
Menomonee Park Pond	Waukesha																				50	50
Mercer	Oneida																		400[2]	600		1,000
Mid	Oneida						1,200	1,200	1,200	1,200		1,050	1,100[2]									6,950
Mirror & Delton	Sauk	700	700		900	1,400	1,300	1,300	1,400	2,800[2]	1,200	1,100	3,000[2]	• 55	600	600	1,800[4]	650[2]				19,505
Mirror	Waupaca																		50			50
Monona	Dane	20,823	12,245	6,341	4,894		918	2,194			375								249.5[4]		60	48,099.5
Mt. Hope Pond	Grant																			22[2]		22
Mukwonago Park	Waukesha																				31	31
Mullet River	Sheboygan															700[2]				180	15	895
Muskego Park	Waukesha																				50	50
Nagawicka	Waukesha	20	15								200	250	300	400	1,400	2,200[3]	1,400[2]	1,440[2]	1,150[3]		405[2]	9,180
Nehmabin	Waukesha													200	100							300
Nepco	Wood	4,000	5,500	2,800	5,200	8,850	4,750	9,500	9,000	5,900[2]**	8,050[3]	5,300[2]	5,100[2]	4,600[2]	3,900[3]	4,350[4]	2,350[3]	4,100[4]	4,400[4]	3,900[4]	2,200[2]	103,750
North	Waukesha			300																		300
Oconomowoc	Waukesha							50		200	100				900[2]						357[4]	1,607
Okauchee	Waukesha									800	500	1,895[2]	3,600[2]	3,000[2]	3,700	21,000[7]	700[2]	1,100[3]	20	500[2]	168[3]	36,983
Onalaska	La Crosse										400											400
Paddock	Kenosha											30	700									730

TABLE 2 (Cont.)

Lake	County	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Total
Paquette Park	Columbia																			13	12^{2}	25
Park	Columbia																	1,250	$1,020^{3}$	$1,430^{4}$		3,700
Perch	Monroe												175	160	110^{2}	176	180	200	225^{2}			1,226
Peter's	Walworth																250			350^{3}	480^{5}	1,080
Pewaukee	Waukesha	11,300	4,200	5,000	7,000	8,700	13,000	10,950	5,955	$9,105^{10}$	$7,575^{8}$	$6,600^{7}$	$6,750^{7}$	$7,600^{8}$	$6,215^{7}$	$5,440^{14}$	$6,150^{14}$	$2,464^{7}$		$1,250^{5}$	200	125,454
Pickerel	Portage									600^{3}	600^{3}	100	250	110	150		200		250	150^{2}	200^{2}	2,610
Pike	Marathon	1,000	850	1,000											850	$1,600^{2}$	800	800	$1,900^{3}$	250	$1,125^{2}$	10,175
Pine	Waukesha	450	800	800	1,500	1,200	400	2,180	2,050	450	800^{2}	995^{3}	$1,175^{3}$	802	850^{2}	570^{2}	330^{2}	$1,057^{3}$	$1,025^{3}$			17,434
Pokegama	Washburn													500^{3}								500
Potter's	Walworth												400	$1,200^{2}$	$1,130^{2}$		750			550	650^{2}	4,680
Pretty	Waushara																	100			100	200
Redstone	Sauk																				$2,300^{6}$	2,300
Ragner	Washington																				12	12
Rib	Taylor								425													425
Round	Burnett												1,000	$1,000^{2}$	600				$1,000^{3}$		825^{3}	4,425
Sand	Polk																	80^{3}	140^{2}	120^{3}	40	380
Sandow	Marquette														20				50		30	100
School Section	Waukesha							300													72	372
Shangrila	Kenosha											350	800		275	550	600	400			35	3,010
Silver	Columbia																		90	85		175
Silver	Waupaca																		400^{2}			400
Springbank	Monroe											40	35	35					109^{8}	98^{7}	45^{3}	362
Squaw	St. Croix																				400	400
Swan	Columbia																				5	5
Token Creek Pond	Dane																				19.5	19.5
Tomah	Monroe													$1,100^{1}$		500		700	575^{2}	805^{2}	$1,250^{2}$	4,930
Trade	Burnett																				550	550
Trempealeau River	Trempealeau																			25	25	50
Troy Mill Pond	Walworth																	25				25
Upper Nehmabin	Waukesha											200^{2}								42^{2}	50	292
Wapogasset	Polk	2,740	4,360	5,400	2,800		5,600	2,700		2,300	$4,050^{2}$	$4,400^{2}$	$7,200^{3}$	$5,265^{5}$	$11,100^{5}$	$10,200^{5}$	$9,750^{5}$	7,800	$10,550^{4}$	$3,000^{5}$	$3,525^{8}$	102,740
Waubesa	Dane	52,965	53,050	49,103	54,359	46,697																256,174
Wausau	Marathon													410^{2}								410
White Ash	Polk																				200	200
Whitewater	Walworth						2,000				2,000		900	600	$1,200^{2}$	$1,200^{2}$	$1,000^{2}$	1,200	$1,700^{3}$	$1,800^{2}$	$1,370^{2}$	14,970
Whitnall Park	Milwaukee																	26				26
Wilkie	Manitowoc												300									300
Wind	Racine									100												100
Windfall	Forest																				4.5	4.5
Wingra	Dane								50													50
Winnebago	Winnebago	69	70	75	100																60	374
Wisconsin	Columbia				40						5,150	700	1,900	$1,550^{2}$	200	1,300			50			10,890
Zoo Ponds	Racine																				8	8
TOTAL		154,573	136,621	124,539	125,580	101,109	36,713	37,949	51,060	55,486	54,215	65,885	81,565	78,407	78,045	110,861	72,774	69,880	61,519	44,710	43,603	1,585,094

* 1.5 gallons of Hydrothall 47
** Plus Cuprose – 125 lb.
Exponents refer to the total number of treatments in any one year.

8-16-71
bmb

TABLE 4. Control of Aquatic Plants with Sodium Arsenite, 1950-1969.

Lake	County	Pounds Arsenic Trioxide																				
		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	TOTAL
Alexander	Lincoln													2,700								2,700
Angelo Pond	Monroe																	720	2,880	1,980		5,580
Antigo Ponds	Langlade													2,160	540	180	2,160	2,160				7,200
Ashippun	Waukesha				400																	400
Bass	Oneida		750			750		720			780		720		900		900		900	900		7,320
Bear Trap	Polk										32											32
Beaver Dam	Barron										1,080						1,980	1,890				4,950
Beck	Washington	200																				200
Beulah	Walworth	200					140			8,460				15,216	6,732							30,748
Big	Polk									752(2)												752
Big Cedar	Washington	60					1,120	3,480	14,940	34,920	23,040	3,240	10,740	12,636	28,446	13,854	15,840	11,718	3,750	540	840	179,164
Big Rock-a-Cri	Adams										3,720	5,220		4,500	1,620	1,800		2,700				19,560
Big Silver	Waukesha										3,420	3,960	1,980	720		3,780	1,980					15,840
Bing	Waushara				1,072																	1,072
Blue Spring	Jefferson			5,620	5,200	5,540																16,360
Bohner's	Racine		376							360		1,260	1,260									3,256
Brown's	Racine	540					1,600	4,360	480	9,660		19,800	20,160									56,600
Cahokia	Waushara			660																		660
Camp	Marinette														1,800							1,800
Campbell's Pond	Oconto								220	340												560
Cary Mill Pond	Waupaca								720	1,272												1,992
Cedar	Manitowoc						300	300	420													1,020
Cedar	Polk								280													280
Center	Kenosha										20											20
Chetek Chain	Barron								5,988	3,964	3,048	9,800			540	1,320						24,660
Chilton Pond	Calumet								1,540	1,060	1,540				1,620	1,620	1,620	1,620	1,620			12,240
Clintonville Pond	Waupaca								2,640	1,760												4,400
Cox Hollow	Iowa													180								180
Crooked	Oconto					620		1,400								2,160						4,180
Crystal	Sheboygan																		360			360
Decorah	Juneau															360		181				541
Deer	Polk						350		332	360						1,260						2,302
Delavan	Walworth	1,400	1,800	1,600	1,696	1,500	1,080	840	480													10,396
Delton	Sauk													900(2)								900
Denoon	Waukesha	304	304	304	304		468	516														2,200
Dyer	Kenosha													450								450
Eagle	Racine										4,680	2,700										7,380
Eagle Spring	Waukesha		400	600	600			600					720	720	720							4,360
Easton Pond	Adams									1,180	1,800											2,980
Ehne's	Washington		1,600																			1,600
Elizabeth	Kenosha																		360			360
Elk Creek	Dunn										288											288
Elkhart	Sheboygan																360	90				450
Emery	Marquette														1,620							1,620
Fay	Florence														360							360
Fin "N" Feather	Jefferson																		990			990
Flora Dell	Monroe																	900		540		1,440
Forest	Fond du Lac			2,460	2,600																	5,060
Fowler & Oconomowoc R. 78	Waukesha	532	2,400	2,800	3,200	6,840	8,384	10,740	12,060	11,160	8,820	5,580	7,200		7,740							87,456
Fox R. (Buena)	Racine					2,160				1,908	1,980	2,540	2,540	2,520	3,240							16,888
Fox	Dodge			10,620																		10,620
Fox R. & Tichigan	Racine													5,340				3,600	4,230			13,170
Friendship	Adams											7,160	3,240									10,400
Geneva	Walworth	1,200	2,600	1,188	1,004	720	960	2,360	2,084	1,920	1,920	2,160		3,060	3,240		3,240		1,440			29,096
George	Kenosha										780	1,880	1,800					60	120			4,640
Gilbert	Waushara									72												72
Goose	Adams											1,760		900								2,660
Green	Green Lake	320		168																		488
Green	Walworth										900				360							1,260
Half Moon	Eau Claire				3,400	1,560	5,240		1,120	4,028			680									16,028
Hartford Mill	Washington	1,000	1,200	1,200	1,200	1,200	1,440		1,596	1,400												10,236
Hartlaub's	Manitowoc									220						360						580
Hill's	Waushara	32	32	32	40	32	40	48	36		60	32	48	48	90	60		60	90			780
Katrine	Dane											280										280
Keating	Waupaca												360	180								540
Kee Non Go-Mong	Racine					900																900
Keesus	Waukesha			4,684	1,900																	6,584
Kettle Moraine	Fond du Lac											1,100	1,100			1,100						3,300
Kiel Pond	Manitowoc										780		768									1,548
Knight's Pond	Waukesha								220	440	392	360	268	360		360						2,400
La Belle	Waukesha				400	1,508	2,520	8,640	16,536	10,220	7,740	4,860	12,240	3,366	4,800	1,260	1,260	1,248	1,260			77,858
La Crosse Park	La Crosse										280											280
Lauderdale	Walworth		468					480	928	600			800	1,710	1,350	2,610(3)	3,150(7)	3,070(4)	2,340(3)	540		18,046
Lincoln Park	Kenosha	600	600	600	600								660	630	540	540	540	540	540			6,390

TABLE 4 (Cont.)

Lake	County	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	TOTAL
Little	Door											2,160	1,800	1,620	1,980							7,560
Little Green	Green Lake																			7,560		7,560
Little Long	Manitowoc																		360			360
Little Muskego	Waukesha	4,600		1,000	2,000	600	4,640	4,120	3,200	3,112	3,104	2,860	2,980	1,080	3,360	3,060	1,620	4,140(2)	1,620			47,096
Little St. Germaine	Vilas										1,440		1,000	1,800		2,160						6,400
Long	Polk										3,300	2,380	2,304			3,372		3,762	2,160			17,278
Long	Waushara						600															600
Lorraine	Walworth			1,200	600									900								2,700
Lost	Vilas						1,400	1,100	1,320	1,272	1,320	1,000	1,200	1,260	1,260	1,260						12,392
Lower Phantom	Waukesha										1,080	1,260	1,176	360								3,876
Lower Post	Langlade										60											60
Mallalieu	St. Croix												2,860	660		1,800	1,200					6,520
Manawa	Waupaca														540	360	480					1,380
Marinuka	Trempealeau																		3,780	2,520		6,300
Marion Mill Pond	Waupaca								1,060	1,484												2,544
McGill	Portage																		540			540
Mendota	Dane		664		664	776	776	920	772	752		776	780		1,188	900						8,968
Mercer	Oneida		132																			132
Meta	Vilas									140												140
Mid	Oneida						4,400	4,620			4,400	2,968	3,460			1,100						20,948
Middle Pine	Polk										300											300
Milwaukee River	Milwaukee																1,530(2)	2,700(2)				4,230
Mondeaux Flowage	Taylor									2,160												2,160
Monona	Dane	1,568	2,436	5,400	5,200	2,700	492	400	2,524	2,900		528	520	900		1,800						27,368
Mt. Morris	Waushara									1,420												1,420
Nagawicka	Waukesha	300	200		200	2,560	2,980	2,760	3,216	5,216	2,860	2,100	6,520	5,130	12,240	11,340(4)	11,700(2)	9,702(3)	8,190(3)			87,214
Namekagon	Bayfield														720							720
Neenah Slough	Winnebago	1,548																				1,548
Nehmabin	Waukesha	108												540								648
Nepco	Wood																	4,860	4,860			9,720
North	Waukesha					5,600																5,600
North Pond	Marinette																	1,080				1,080
Oconomowoc	Waukesha	40			416	496	420		6,160	3,756	1,440		540		7,020			6,732	6,300			33,320
Okauchee	Waukesha	8,280	13,300	12,120	2,760	2,180	3,400	1,440	3,904	20,656	23,400	24,120	11,780	10,440	26,100	11,700(3)	3,300(3)	2,700				181,580
Onalaska	La Crosse									5,760	7,844	9,000	9,720	8,910	7,560	6,300(2)	1,620	6,120(2)	1,842			64,676
Paddock	Kenosha						600	1,500			2,280	2,840	3,600	360	900							12,080
Park	Columbia															720	2,580	3,780(3)				7,080
Patrick	Adams									1,100	1,200											2,300
Pell	Walworth					800	800	880		424												2,904
Perch	Monroe												360		192		1,260	900		2,700		5,412
Peter's	Walworth															1,080	1,260	1,080	1,080			4,500
Pewaukee	Waukesha	15,732	22,284	7,260	9,400	12,976	18,468	27,940	38,620	35,820	28,540	19,680	5,400		23,334	21,792	17,982(7)	2,280	5,400(3)			312,908
Pick's	Washington				480																	480
Pickeral	Portage												360					900				1,260
Pike	Marathon	600													1,260	1,440						3,300
Pine	Waukesha	2,600	3,920	4,400	3,360	30,432	7,240	9,660	10,980	10,260 8,460*	9,600	4,020	4,032	450	3,570	2,970	2,475	1,908	9,000(2)			129,337
Plainfield	Waushara													180								180
Pleasant	Walworth									1,372												1,372
Pokegama	Vilas										960				540	540						2,040
Pokegama	Washburn													318		180						498
Post	Langlade				100								60									160
Potter's	Walworth									80			12,060	6,720	6,720	4,752	3,780(2)					34,112
Poygan	Winnebago																396					396
Rainbow Camp	Waukesha	300																				300
Rice	Barron	2,500		2,600	3,120	3,120																11,340
Richardson	Forest					112																112
Rome Pond	Jefferson					200																200
Ruskin Pond	Waukesha		400																			400
Sand	Oneida									220												220
Sandow	Marquette										480	420	180						720	720		2,520
Sawyer	Langlade	40	92	116	116	116																480
Shangrila	Kenosha										9,020	9,140	8,700		2,070	4,050	5,220	3,240	3,360	14,220		59,020
Shawano	Shawano							1,000											20,880	14,220		36,100
Sheboygan River	Manitowoc							960	768	720				720	792		774	1,446(2)	1,440			7,620
Silver	Washington	108																				108
Silver	Waupaca																4,140					4,140
Silver	Waushara	440	872	1,400			100	100		2,520												5,432
Spaulding's Pond	Rock									1,540				1,920					540			4,000
Springbank	Monroe															540	540					1,080
Stovekin	Marinette			400																		400
Tichigan	Racine	940	1,120	876		1,480	2,840	2,400	1,900	2,800	3,240	4,920	4,980				360					27,856
Tomah	Monroe													7,680	8,640	3,960			3,240			23,520
Tripp	Walworth	200		1,080	1,080		2,424															4,784
Troy Mill Pond	Walworth					300	660	600	600	600		540	1,160	540	540	540	520	540	540			7,680

* 8,460 applied as white arsenic

TABLE 4 (Cont.)

Lake	County	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	TOTAL
Twin	Waushara																	90				90
Upper Nemahbin	Waukesha										900											900
Virginia	Waushara															180	120					300
Voltz	Kenosha																360	720	1,240			2,320
Wandewega	Walworth	1,920							3,828						160	120	120					6,148
Wapogasset	Polk				128	160					800											1,088
Waterville	Waukesha													540								540
White River	Waushara									440						180	540					1,160
Whitewater	Walworth	5,600	4,800		2,800					4,860	6,300	5,040	6,480	4,740	5,580	4,860	4,860					55,920
Wilkie	Manitowoc									1,760	2,200		2,200									6,160
Willow Springs	Waukesha															900						900
Willow Mill	Columbia																	1,260				1,260
Wind	Racine									880												880
Wingra	Dane								980	720	840	700	1,000									4,240
Winnebago	Winnebago	200		296	300	400							360	180	582	540						2,858
Winneconne	Winnebago															1,290						1,290
Wisconsin	Columbia			500	800							220		180								1,700
Yellow	Burnett									3,420	1,980	840	868									7,108
Zanders	Green							440														440
		54,012	62,750	71,184	57,140	88,338	75,882	95,324	142,452	222,680	185,988	171,204	165,724	116,424	183,106	128,410	101,767	90,497	97,972	46,440	840	

20-Year Total (167 Lakes) 2,158,354

8-16-71
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TABLE 5. Control of Aquatic Plants with Organic Herbicides, 1958-1969.

		Pounds Active Material												
Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Chemical
Alexander	Lincoln						90	114						Endothall
Amacoy	Rusk												2	2,4-D
Angelo Pond	Monroe									72				Diquat
Antigo Ponds	Langlade							3.6					7.2	Endothall
													10	Silvex
													140	Diquat
Apple River	Polk										2.7	2.9	4.3	Endothall
											3.75	4.0	6.0	Silvex
Arkdale	Adams												80	Diquat
Balsam	Polk			145	60									2,4-D
													40	Diquat
									8.1	8.1	73.9(2)	16.2	165	Endothall
									11.25	11.25	17.5	22.5		Silvex
Baptist Camp Pd.	Marquette									21.6				Endothall
Barnes	Bayfield						90							2,4-D
Bass	Oneida											8		Diquat
													25.2	Endothall
												8	35.0	Silvex
Bear	Oneida											1.5		Endothall
												2.0		Silvex
Beaver	Waukesha	166			120									2,4-D
Beaver Dam	Barron										34		34	Endothall
											48		48	Silvex
											80		20	2,4-D
													12	Silvex
												12	4	Diquat
Beulah	Walworth				32									Silvex
									40					2,4-D
Big Butternut	Polk											10.4	10.8	Endothall
												14.4	15.0	Silvex
Big Cedar	Washington				108.6									2,4-D
Big Roche-a-Cri	Adams								7.2	25.4				Endothall
										35				Silvex
Big Round	Polk												27	Endothall
													37.5	Silvex
									16.2					Endothall
Big Silver	Waushara								22.5					Silvex
Birch	Oneida												3.6	Endothall
													5.0	Silvex
Blacksmith	Menomonee												52	Silvex
Blake	Polk											3.6	2.2	Endothall
Blue	Oneida										1.8	3.6	3.6	Endothall
											2.5		5.0	Silvex
Bohners	Racine												12	Diquat
													4	Silvex
Bond	Douglas									1.8				Endothall
										2.5				Silvex
Bone	Polk											10		2,4-D
										8.5				Endothall
										12				Silvex
													4	Diquat
Bong Ponds	Kenosha								36					Endothall
Boom	Oneida										3.6			Endothall
Brock Pond												28.8		Endothall
												40		Silvex
Bunny	Walworth											1.8		Endothall
												2.5		Silvex
Cable	Bayfield								10.5					Endothall
Camp	Marinette								4					Diquat
Camp McCoy Pds.	Monroe												105.4	Endothall
													148.8	Silvex
Catfish	Vilas					20	17	10	17	12	20	10	10	2,4-D
Chetek Chain	Barron										1.8	32.4	9	Endothall
											2.5			Silvex
													28	Diquat
Chute Pond	Oconto												2	2,4-D
Clam	Burnett												252	Diquat
													15	Endothall
													8	Silvex
Clear	Lincoln											1.5		Endothall
Clear	Polk								90		27		18	Endothall
											37.5			Silvex
													28	Diquat
Clear	Rock							18	106.2		38.7			Endothall
									53.75					Silvex
Content	Vilas											1.8		Endothall
												2.5		Silvex
Cox Hollow	Iowa					30	70	20	91			150	140	2,4-D
Crane	Forest											12	8	Diquat
													6	Endothall
Crawling Stone	Vilas												3.6	Endothall
Crooked	Sheboygan												1.8	Endothall
													2.5	Silvex
Crystal	Columbia & Dane									0.9				Endothall
										1.25				Silvex
										6	110	112		Diquat
Crystal	Sheboygan											21.6	74.4	Endothall
													7.0	Silvex
													20	Diquat

TABLE 5 (Cont.)

Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Chemical
													280	2,4-D
Dallas Pond	Barron								110.7	22.5	43.2			Endothall
									40.9	31.2	60			Silvex
Dana Farm Pond	Kewaunee										3.4			Endothall
											4.8			Silvex
Decorah	Juneau							93.2	160					Diquat
								73						Endothall
Deer	Polk												76	Diquat
													81	Endothall
													3.6	Endothall
													5.0	Silvex
Delton	Sauk									85	103.8		9.9	Endothall
										120	146.5		13.7	Silvex
										80	6			Diquat
Diamond	Oneida			7										2,4-D
Eagle Springs	Waukesha												3.0	Diquat
Elizabeth	Kenosha									43.2	19.8			Endothall
											27.5			Silvex
Elkhart	Sheboygan												60	Diquat
Emery	Marquette									32.4	41.4			Endothall
Fairwood	M									45	57.5			Silvex
Fairwood	Marquette												54	Endothall
Fay	Florence												48	Diquat
													8	2,4,5,-T
Fin 'N' Feather	Jefferson											1.7		Endothall
												2.4		Silvex
												8		2,4-D
													38.3	Dalapon
													24	Diquat
Fish	Waushara												19.8	Endothall
													27.5	Silvex
Five	Washington									173.7				Endothall
										1.25				Silvex
Flora Dell	Monroe											.85		Dowpon
												20		2,4-D
												59.5		Endothall
												90.8		Silvex
Fowler					60								24	2,4,5,-T
													8.8	Diquat
													400	2,4-D
Fox River	Racine					8.5								Delapon
											16	24	4.5	Silvex
												17		Endothall
												40		2,4-D
													63	Diquat
Geneva	Walworth								4	12	12		76	Diquat
								21.6	43.2		155	218.4	87	Endothall
								3.7			168	308	122	Silvex
George	Kenosha									6				Endothall
										60	30			2,4-D
											20		16	Diquat
Gollens Minnow Pd.	Portage											0.4		Diquat
Grass Creek	Columbia												1.7	Endothall
													2.4	Silvex
Gunlock	Vilas											9		Endothall
Half Moon	Eau Claire							18	.9		3.6	3.6	3.6	Endothall
								25	1.25		5.0	5.0	5.0	Silvex
				90	35									2,4-D
					42.5									Radapon
												3.6		Endothall
Harris	Marquette											5		Silvex
Hawyard Park Pond	Sawyer											8		Diquat
												12.75		Dalapon
Hill's	Waushara											4		Diquat
													9	Endothall
Horseshoe	Polk												4.5	Diquat
Iola Millpond	Waupaca											136	807	Diquat
												30	60	Endothall
													4	Silvex
Island	Oneida											5.4		Endothall
												7.5		Silvex
Jacqueline	Portage											100		2,4,5-T
												14.4		Endothall
												20		Silvex
Jerome	Oneida										7.2	3.6		Endothall
											10			Silvex
Johnson	Burnett											6		Diquat
Kawagasaga	Oneida					16.2					12.6	5.4	25.2	Endothall
											12.5	7.5	35	Silvex
Keesus	Waukesha								7.2	21.6	14.4	10.8	6.30	Endothall
											20.0	15	8.75	Silvex
Kegonsa	Dane												18	Diquat
													10.8	Endothall
													15.0	Silvex
Kilby											3.6	1.8		Endothall
Kull	Kenosha										36	14.4		Endothall
												20		Silvex
La Belle	Waukesha							4					82	Diquat
												180	522	2,4-D

TABLE 5 (Cont.)

Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Chemical
Lac Court Oreilles	Sawyer												4	Diquat
Lauderdale Chain	Walworth											24	54	Diquat
												68.6	24	Silvex
												31.4	17	Endothall
													9	Endothall
												60	20	2,4-D
													52	2,4,5-T
Lawrence	Marquette										1.8	28.8	82.8	Endothall
											2.5	40	115.0	Silvex
												36		Endothall
Lazy	Columbia										292	160		Diquat
													108.8	Endothall
													153.6	Silvex
Leftfoot	Marinette												1.4	Endothall
													2.0	Silvex
Legend	Menominee												27	Silvex
Leota	Rock											20	40	2,4-D
													17	Endothall
													24	Silvex
Lion's Beach	Rock											18		Endothall
												25		Silvex
Little Balsam	Polk												2	2,4-D
Little Blacksmith	Menominee												105	Silvex
Little Butternut	Polk				25									2,4-D
											2			Diquat
												3.6		Endothall
												5.0		Diquat
Little Green	Green Lake												64	Diquat
												140		2,4-D
												53		Silvex
												34		Endothall
Little Muskego	Waukesha		20											2,4,5-T
				.5										Silvex
				.36										Endothall
Little Norway	Dane								4.6					Endothall
Little St. Germain	Vilas					40	118							2,4-D
Little Silver	Washington									3.6				Endothall
										5				Silvex
Little Wood	Burnett												7.2	Endothall
													4	Diquat
Long	Columbia										100		100	Diquat
Long	Iron											14.4		Endothall
Long	Polk											80	64	Diquat
													9	Silvex
Long	Waushara										1.8		14.4	Endothall
											2.5			Silvex
Lost	Vilas						23.5				3.6	3.6	10.8	Endothall
											5	5		Silvex
Lower Genesee	Waukesha												0.8	2,4-D
Lower Kaubeshine	Oneida						1.8							Endothall
							7.5							Silvex
Lucas	Washington							7.2	14.4	3.6				Endothall
										5				Silvex
Mallalieu	St. Croix									3.6				Endothall
										5				Silvex
Manawa	Waupaca									12				Diquat
											17.5	17		Endothall
												24		Silvex
Marinuka	Trempealeau											7.2	138.6	Endothall
													8	Diquat
												10	5	Silvex
Marsh-Miller	Chippewa										2	4		Diquat
Maud	Oneida												150	Silvex
McDill	Portage											72	100	Diquat
												3.6		Endothall
Mendota	Dane	34												2,4,5-T
			10											2,4-Dg
			250											4% Simazine
								68						Dowpon
									254.2		64.8		28.8	Endothall
											90		40.0	Silvex
												298.8	356.4	Endothall
Mercer	Oneida											52.2		Endothall
												72.5		Silvex
Mid	Oneida									72		72		Endothall
										100		100		Silvex
Middle Pine Pk.	Polk											256	120	Silvex
Mill Bluff Pk.	Monroe											60	60	2,4-D
Milwaukee R.	Milwaukee								28			40		Diquat
												40		2,4-D
Minocqua	Oneida							12.6	18	14.4	23.7	30.6	21.6	Endothall
											21	32.5	30.0	Silvex
Mirror	Sauk												60	Simex
												30		Diquat

TABLE 5 (Cont.)

Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Chemical
Monona	Dane	28												2,4,5-T
			280	300	240	280			620					2,4-D
							18			122.2	151.2	320.8	284.4	Endothall
										100	210	40	395	Silvex
Montello	Marquette						20							2,4,5-T
											6	120	404	Diquat
											37.8	48.6		Endothall
											52.5	62.5		Silvex
Montesian	Green											7.3		Endothall
Namekagon	Bayfield							21.6	14.4	7.2				Endothall
Neenah Slough	Winnebago								34					Dowpon
									40					Silvex
									140					Diquat
Neenah	Marquette												3.6	Endothall
													5.0	Silvex
Nemahbin	Waukesha											6	4	Diquat
													15	Endothall
Nelson	Sawyer											1.6	2.0	2,4-D
Nepco	Wood											158.4	144	Endothall
												220	200	Silvex
Nocquebay	Marinette												540	2,4-D
												3.6		Endothall
												5		Silvex
North Pond	Marinette											288		Endothall
												40		Silvex
Oconomowa	Waukesha											300	1.8	Endothall
													2.5	Silvex
												100	155	2,4-D
												4	74	Diquat
Okauchee	Waukesha											6	68	Diquat
												20	195	2,4-D
													272	2,4,5-T
												36	177.6	Endothall
												29.6	5.0	Silvex
Onalaska	La Crosse							7.4				180		Diquat
											131	90		Endothall
Paddock	Kenosha												144	2,4-D
										76				Diquat
Pacquette Pk.	Columbia									12	24		16	Diquat
Park	Columbia								2		444	640	288	Diquat
Pearl	Waushara											292		Endothall
Perch	Monroe												120	Diquat
Peshtigo	Menominee												76	2,4,5-T
Peters	Walworth									32				Diquat
												24	29.6	Silvex
Pewaukee	Waukesha					77.3				.94	18.7	1193.6	440	Endothall
										1.3	26.4	1685	550	Silvex
										193				Diquat
											60	1860	360	2,4-D
Phantom (Lower)	Waukesha												128	Diquat
													40	2,4,5-T
													30	Endothall
Pickeral	Forest & Lauglade											120	52	Diquat
													39	Endothall
Pike	Marathon											48.6	51	Endothall
												67.5	72	Silvex
											8.8			2,4-D
Pine	Waukesha						30					580		2,4-D
							5.4			39.4				Endothall
												40	348	Diquat
													25.5	Endothall
													36.0	Silvex
Pokegama	Vilas										7.2			Endothall
Pokegama	Washburn						7.2		9	14.4	5.4		30	Endothall
									12.5		7.5			Silvex
													4	2,4,5-T
Post	Lauglade					3.6	3.6							Endothall
Potters	Walworth				360	40						340		2,4-D
					12									2,4,5-T
									50	96	80	80	40	Diquat
													255	Endothall
Pretty	Waukesha												1.7	Endothall
													2.5	Silvex
Pretty	Waushara											1.8		Endothall
												2.5		Silvex
Private Pond	Ozaukee											1.8		Endothall
												2.5		Silvex
Private Pond	Walworth											1.8	1.8	Endothall
												2.5	2.5	Silvex
Reyner Park Pond	Washington												20	2,4-D
													22	Diquat
Rice	Barron											30		2,4-D
Rice	Walworth											30	40	2,4-D
River Pk. Lagoon	Sheboygan												10	Diquat
Rock	Jefferson					50								2,4-D
												.9		Endothall
												1.25		Silvex
Round	Columbia											.2		Endothall
												.25		Silvex
Round	Waushara											.36		Endothall
												.48		Silvex

TABLE 5 (Cont.)

Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Chemical
Sand	Polk									28.8	28.8			Endothall
											40			Silvex
												60	24	Diquat
Sandow	Marquette										1.8		1.8	Endothall
											2.5		2.5	Silvex
													20	Diquat
School Section	Waukesha												17	Endothall
Shangri-La	Kenosha												25	Silvex
													120	Diquat
												24		Silvex
												120	150	Endothall
												738		Diquat
Shawano	Shawano												315	Endothall
													416	Diquat
											10			2,4-D
												120	1530	Endothall
											28	738	28	Diquat
											32.4		10.8	Endothall
											45	24	15	Silvex
Shishebogama	Oneida											100		Bowpon
												16	160	2,4-D
												14	8	Diquat
													30	Endothall
													3.6	Endothall
													5.0	Silvex
Silver	Columbia								.45	1.8	170		1.1	Endothall
									.62	2.5	240		1.5	Silvex
										4				Diquat
Silver	Waupaca											120		Endothall
S. Twin	Polk									1.8	1.8	7.2		Endothall
										2.5	2.5			Silvex
Spring	Menominee												80	2,4,5-T
Springbank	Monroe											1		Divron
Storrs	Rock									50				2,4-D
Swede	Polk											216		Endothall
													2	2,4-D
Thorn	Portage											3.6	3.6	Endothall
Thunder	Oneida								2.7					Endothall
									3.75					Silvex
Tichigan	Racine												8	Diquat
													22.1	Endothall
													35.2	Silvex
Tomah	Monroe										25.2	3.6		Endothall
											35.1	305		Silvex
Tomahawk	Oneida											1		Endothall
												1.5		Silvex
Tombeau	Walworth				40									2,4-Dg
Trempealeau R.	Trempealeau												16	Diquat
													10.8	Endothall
Troy Mill Pd.	Walworth											12	20	Diquat
													20	2,4-D
Twin	Waushara									3.6				Endothall
Virgin	Oneida									7.2				Endothall
										10				Silvex
Voltz	Kenosha										76	20		2,4-D
												75	30	Endothall
Wapogasset	Polk			70	10								230	2,4-D
							7.2				36.3	463.2	115.8	Endothall
											51	80	27.5	Silvex
											240	100		Diquat
											3.5			Kuron
												4		2,4,5-T
Waterville	Waukesha												204	Endothall
													288	Silvex
Waubesa	Dane											21.6		Endothall
W. Mitchell	Oneida									3.5				2,4-D
White	Langlade									21.6				Endothall
Whitewater	Walworth											64.2	150	Endothall
Wilkie	Manitowoc		40											2,4-D
Willow Springs	Waukesha							14.5						Dalapon
Windfall	Forest												132	2,4-D
Windsor	Dane						21.6							Endothall
Wingra	Dane						18						90.4	Endothall
													125.5	Silvex
White Ash	Polk												120	Diquat
													30	Endothall
													1.7	Endothall
													2.5	Silvex
Wisconsin	Columbia		22											Endothall
Wisconsin R.	Lincoln & Oneida								12	32				Diquat
Wyocena Mill Pd.	Columbia											7.2		Endothall
												160	52	Diquat
												153	113.9	Endothall
												216	160.8	Silvex
Yellow	Burnett										44			Diquat
												10.8	9	Endothall
												15	12.5	Silvex
Yellowstone	Lafayette					30	70	120						2,4-D
Zanders	Green				27.4	30	30	30	30		30	60	30	2,4-D

TABLE 6. Swimmers' Itch Control with Copper Sulphate, 1958-1969.

		Pounds Copper Sulphate and Lime											
Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Antigo Ponds	Langlade							100 50					
Arrowhead	Waukesha												140 (70)
Balsam	Polk			50 25	50 25				100 50	100 50	200 100	200 (100)	100 (50)
Bass	Oneida					200 100							
Bear Trap	Polk		40			100 50							
Beckman	Green											300 (150)	300 (150)
Beulah	Walworth										300 (150)		
Big Cedar	Washington											300 (150)	
Big Round	Polk								300 150	200 100	250 125		300 150
Black Creek Pd.	Outagamie								175 (100)	190 100			
Bohner's	Racine										160 (80)		
Bone	Polk				100 50		200 100	200 (100)	200 100	300 150			
Chetek Chain	Barron											300 (180)	
Deer	Polk											250 (125)+	
Devil's	Burnett										200 100	100 (50)	
Eau Claire Chain	Bayfield									3,800 1,000 (900)		1,200-2,300 (1,150-600)	
Emery	Marquette											200 (100)	
Emily	Florence											200 (100)	400 (200)
Geneva	Walworth	400	400		1,700*2 250		500 250	900 450	900 450	720 (350)	800 (400)	400 200	650 (250)
Half Moon	Eau Claire					100 (50)							
Hunter	Sawyer									200 50 (50)			
Katrine	Dane	340 (170)			260 ((130)				200 (100)				
Keating	Waupaca			100 (50)				50 25					
Klondike Pd.	Sauk						5						
Long	Fond du Lac											100 (50)	150 (75)
Mendota	Dane											200 (100)	
Magnor	Polk												275 (100)
Metonga	Forest				3,500 1,750	3,500 1,750		3,000 1,500	2,000 1,000	2,000 (1,000)	2,200 (1,050)	2,300 (1,150)	3,000 (1,500)
Mill Bluff Pk.	Monroe											150 (75)	150 (75)
Nocquebay	Marinette	1,800 900		900 450	1,400 700		3,200 1,600			2,000 1,000	2,700 1,400**	2,300 1,150	2,000 1,000
Oconomowoc	Waukesha								700 350	800 400	800 400	820 310 100	1,000 500
Pickeral	Portage									400 190			
Pike	Polk					50 35		75 37					
Pine & Grass	Shawano		400 800		800 400		1,000 500		2,100 1,050	1,600 800	1,600 800	1,200 600	
Pokegama	Vilas				300 150								
Pokegama	Washburn				300 150	500 100 70	400 200	600 300	450 225	300 150 200	200 100	600 300	600 (200) 100

TABLE 6 (Cont.)

Lake	County	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Powers	Kenosha								100				
Random	Sheboygan				200 125								
Rock	Jefferson				100 50								
Sand	Oneida						50 25						
Sand	Polk								250 125				
Sandow	Marquette										100 50	350 (160)	350 (200)
Seymour Community	Outagamie											250 (125)	
Shawano	Shawano	240 (120)	240 120	240 120									
Silver	Forest									400 (200)	700 (350)		
S. Twin	Polk		100 50		100 50			80 40		200 100			
Wapogasset	Polk				100 50	200 88							
Wilson	Shawano	60 (30)	100 50	120 60									

TABLE 7. Summary of Aquatic Nuisance Control Activities on Wisconsin Surface Waters, 1970.

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
1	Afterglow	Vilas	32	16.00	-	-	800# lime for pH control.
2	Altoona	Eau Claire	783	150.00	1,450(2)	-	-
3	Apple River	Polk	-	0.10	-	-	12# 2,4-D
4	Apple River	Polk	-	0.09	-	-	10# 2,4-D
5	Apple River	Polk	-	2.50	-	-	3 gals. K Endothal & 4 gals. Diquat.
6	Arkdale	Adams	48	12.00	-	-	25 gals. K Endothal & 7 gals. Diquat.
7	Arrowhead	Waukesha	20		No Treatment		
8	Balsam	Polk	2,054	0.09	-	-	35# Aqua. +
9	Balsam	Polk	2,054		No Treatment		
10	Balsam	Polk	2,054	1.00	-	100 $CuSO_4$ 50 lime	-
11	Balsam	Polk	2,054	5.00	-	-	35 gals. Aqua. +
12	Balsam	Polk	2,054	0.34	-	-	80# Aqua. +
13	Balsam	Polk	2,054	9.00	-	-	3 gals. Silvex, 5 gals. K Endothal & 8 gals. Diquat.
14	Balsam	Polk	2,054	0.10	-	-	50# Aqua. +
15	Bass	Burnett	207	0.23	-	-	50# 2,4-D
16	Bear Trap	Polk	244	0.03	-	-	50# Aqua. +
17	Bear Trap	Polk	244	0.06	-	-	50# Aqua. +
18	Beaver Dam	Barron	1,112	120.00	650	-	-
19	Beechwood	Sheboygan	11	10.00	25	-	7 gals. Diquat & 7 gals. K Endothal
20	Beulah	Walworth	837		No Treatment		
21	Big Butternut	Polk	378	0.34	-	-	75# Aqua. +
22	Big Butternut	Polk	378		No Treatment		
23	Big Butternut	Polk	378	0.46	-	-	1 gal. Diquat
24	Big Butternut	Polk	378	0.11	-	-	100# Aqua. +
25	Big Butternut	Polk	378		No Treatment		
26	Big Butternut	Polk	378	74.00	725(2)	-	-
27	Big Cedar	Washington	378		No Treatment		
28	Big Roche-A-Cri	Adams	205	70.00	189	-	30 gals. Diquat & 20 gals. 2,4-D
29	Big Round	Polk	1,015		No Treatment		
30	Big Round	Polk	1,015		No Treatment		
31	Big Sand	Barron	322		No Treatment		
32	Big South Pond	Douglas	7		No Treatment		
33	Big Wood	Burnett	504	0.50	-	-	50# 2,4-D
34	Birch	Iron	63		Denied		
35	Birch	Vilas	528	0.07	-	-	50# Aquathol
36	Birch Island	Burnett	838	3.00	-	-	1 gal. K Endothal & 3 gals. Diquat.
37	Blake	Polk	292	0.11	-	-	50# Aqua. +.
38	Blake	Polk	292	0.09	-	-	25# Aqua. +.
39	Blue	Oneida	433	0.12	-	-	50# Aquathol
40	Bohners	Racine	124		No Treatment		
41	Bone	Polk	1,676	0.05	-	-	1 quart Diquat.
42	Bone	Polk	1,676		No Treatment		
43	Bone	Polk	1,676	0.17	-	-	20# 2,4-D
44	Bone	Polk	1,676	0.25	-	-	0.5 gal. Diquat.
45	Bone	Polk	1,676	0.23	-	-	0.5 gal. Diquat.
46	Bone	Polk	1,676	0.23	-	-	0.5 gal. Diquat.
47	Bony	Bayfield	200		No Treatment		
48	Brandy	Vilas	110		No Treatment		
49	Brock Pond	Marinette	28		No Treatment		

TABLE 7 (Cont.)

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
50	Bugh	Waushara	25	10.00	100	-	-
51	Cadotte	Burnett	127	62.00	-	-	100 gals. Silvex(4) & 8 gals. Diquat(2)
52	Camelot	Adams	250	58.00	400(2)	-	10 gals. Diquat, 5 gals. K Endothal & 2 gals. Silvex.
53	Camp	Kenosha	461	57.00	-	-	5,750# 2,4-D
54	Catfish	Vilas	991	0.16	-	-	100# 2,4-D
55	Cedar	Manitowoc	142		No Treatment		
56	Cedar Pond	Shawano	3,671		No Treatment		
57	Chetek Chain	Barron	770	300.00	7,150(7)	-	-
58	Chetek	Barron	770	0.50	-	-	50# Aqua. +
59	Chetek	Barron	770	3.50	-	-	3 gals. Diquat, 3 gals. K Endothal & 1 gal. Silvex.
60	Chilton Pond	Calumet	10		No Treatment		
61	Chippewa	Bayfield	319		No Treatment		
62	Clam (Upper)	Burnett	1,207	31.00	50	-	17 gals. Diquat(2), 19 gals. K Endothal(2), 4 gals. Silvex & 3 gals. Hydrothal 47.
63	Clear	Polk	29	47.00	325(8)	-	100# Aqua. +
64	Clear Lake and Pond	Polk	29	5.00	-	-	4 gals. Hydrothal 47.
65	Coleman	Marinette	234	120.00	700	-	-
66	Crawling Stone	Vilas	1,460		No Treatment		
67	Crawling Stone	Vilas	1,460		No Treatment		
68	Crescent	Oneida	612	0.69	-	-	150# Aqua. +
69	Crooked	Sheboygan	65	0.31	-	-	150# Aqua. +
70	Crystal	Columbia and Dane	27		No Treatment		
71	Crystal	Sheboygan	114	70.50	375(2)	-	10 gals. Aqua. +
72	Dallas Pond	Barron	27	8.00	-	-	600# Aqua. +
73	Dana Farm Pond	Kewaunee	0.5		No Treatment		
74	Deer	Polk	807	84.00	400(2)	-	50# 2,4-D, 150# Aqua. + & 12 gals K Endothal.
75	Delavan	Walworth	2,072	360.00	4,095(8)***	-	-
76	Delton	Sauk	254	49.00	-	-	5 gals. Aqua. + & 6 gals. Diquat.
77	Devils	Burnett	972	1.00	-	100 $CuSO_4$ 50 lime	-
78	Eagle	Racine	520		No treatment		
79	Eagle Springs	Waukesha	261		No treatment		
80	East Balsam	Polk	2,054	1.00	-	100 $CuSO_4$ 50 lime	-
81	Eau Claire	Eau Claire	860	120.00	600	-	-
82	Elk Creek	Dunn and Eau Claire	46	37.00	200	-	-
83	Elkhart	Sheboygan	300	7.00	-	-	25 gals, 2,4-D
84	Emery	Marquette	35	20.00	310	-	25 gals.Aqua. + & 2 gals. Diquat
85	Emily	Florence	181	4.50	-	300 $CuSO_4$ 150 lime	-
86	English	Manitowoc	48	20.00	100	-	-
87	Fay	Florence	263	4.25	-	-	5 gals. K Endothal, 1 gal. Silvex & 100# Aqua. +.
88	Fish	Dane	252	1.00	-	-	2 gals. Aqua. + and 1 gal. 2,4-D
89	Five	Washington	102		No Treatment		
90	Flora Dell	Monroe	6	1.50	-	-	18 gals. P.L.L.
91	Fowler	Waukesha	78	17.00	-	-	28 gals. 2,4-D(2), 20 gals. K Endothal & 90# 2,4-D.
92	Geneva	Walworth	5,262	34.50	95(2)	-	32.5 gals. Diquat(4) & 12 gals. K Endothal
93	Geneva	Walworth	5,262	15.00	-	725 $CuSO_4$(2)	600# Aquathol(2)

TABLE 7 (Cont.)

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
94	Geneva	Walworth	5,262	32.40	120 (2)	362 $CuCO_3$ -	54 gals. K Endothal (2), 10 gals. Diquat (2) & 50# Aqua. +.
95	George	Kenosha	59	9.50	110 (2)	-	2 gals. Aquathol and 2 gals. Diquat in combination (50/50) & 2 gals. K Endothal.
96	Gibbs	Rock	71	3.00	-	300 $CuSO_4$ 150 lime	-
97	Green	Green Lake	7,325		No Treatment		
98	Green Bay	Door	-		No Treatment		
99	Gunlock	Vilas	267		Denied		
100	Half Moon	Eau Claire	132	81.00	3,103 (10)	-	3# $CuSO_4$ applied as 1 gal. Cutrine.
101	Half Moon	Polk	579	0.05	-	-	10# 2,4-D
102	Halliday Creek	Portage	-		No Treatment		
103	Harris Pond	Marquette	245		No Treatment		
104	Horseshoe	Manitowoc	22	22.00	-	-	23,000# Alum for PO_4 removal.
105	Horseshoe	Manitowoc	22	10.00	75 (2)	-	-
106	Horseshoe	Polk	282	0.25	- (3)	-	35# 2,4-D
107	Iola Mill Pond	Waupaca	206	67.00	550	-	40 gals. K Endothal & 5 gals. Diquat.
108	Jerome	Oneida	2		No Treatment		
109	Kawagasaga	Oneida	801	0.17	-	-	100# Aqua. +
110	Kawagasaga	Oneida	801	0.17	-	-	100# Aqua. +
111	Kawagasaga	Oneida	801	0.18	-	-	200# Aqua. +
112	Kawagasaga	Oneida	801	1.03	- (2)	-	350# Aqua. +
113	Keesus	Waukesha	237	50.00	475	-	-
114	Keesus	Waukesha	237	5.00	-	-	1 gal. Diquat and 1
115	LaBelle	Waukesha	1,117	3.00	-	-	180# 2,4-D & 25# Aqua. +.
116	LaBelle	Waukesha	1,117	5.00	-	-	15 gals. 2,4-D
117	LaBelle	Waukesha	1,117	9.75	-	-	20 gals. K Endothal (2) & 60# 2,4-D
118	Lac Court Oreilles	Sawyer	5,040	0.92	-	-	100# 2,4-D
119	Lac Court Oreilles	Sawyer	5,040		No Treatment		
120	Lac Court Oreilles	Sawyer	5,040	0.46	-	-	50# 2,4-D
121	Lauderdale	Walworth	5,262	7.00	-	-	5 gals. Diquat (2)
122	Lauderdale	Walworth	5,262	2.00	-	-	4 gals. Diquat
123	Lauderdale	Walworth	5,262		No Treatment		
124	Lauderdale	Walworth	5,262		No Treatment		
125	Lawrence	Marquette	221	20.00	-	-	2,200# Aqua. + (2)
126	Lazy	Columbia	174	27.00	-	-	51 gals. Diquat
127	Legend	Menominee	-		No Treatment		
128	Legend No. 1	Menominee	-	100.30	700 (5)	-	200# Aqua. + 34 gals. Diquat (3), 12 gals. K Endothal (2) & 5 gals. Silvex.
129	Legend No. 2	Menominee	-	8.40	40	-	4 gals. Silvex
130	Leota	Rock	41	7.50	-	-	8 gals. Diquat
131	Lincoln Park Lagoon	Kenosha	5	3.00	15	-	-
132	Little Blake	Polk	292		No Treatment		
133	Little Blake	Polk	292		No Treatment		
134	Little Cedar	Washington	259	1.25	-	-	5 gals. Diquat
135	Little Elkhart	Sheboygan	50	8.50	25	-	14.5 gals. Aqua. + (2) & 5 gals. K Endothal
136	Little Green	Green Lake	466	44.00	105	-	18 gals. Diquat.
137	Little Long	Manitowoc	15	11.00	60	-	-

TABLE 7 (Cont.)

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
138	Little Muskego	Waukesha	506	14.00	50	-	5 gals. Diquat & 2 gals. Aqua. +.
139	Little Muskego	Waukesha	506	3.00	-	-	5 gals. Aqua. +
140	Little St. Germain	Vilas	956	350.00	1,450	-	-
141	Little Wood	Burnett	185	0.07	-	-	1 gal. Diquat
142	Little Wood	Burnett	185	0.25	-	-	1 gal. Diquat
143	Long	Columbia	39	15.00	-	-	30 gals. Diquat
144	Long	Iron	373		No Treatment		
145	Long	Manitowoc	117	80.00	1,450[(4)]	-	-
146	Long	Polk	257	197.00	1,000[(2)]	-	13 gals. Aqua. +
147	Long (Channel)	Fond du Lac	409		No Treatment		
148	Long	Washburn	3,290		No Treatment		
149	Long Trade	Polk	257	40.00	200	-	-
150	Loon	Burnett	189		No Treatment		
151	Lost	Vilas	541		No Treatment		
152	Loveless	Polk	123	0.14	-	-	30# Aqua. +
153	Lower Eau Claire	Bayfield	-		No Treatment		
154	Lower Genesse	Waukesha	66	0.07	-	-	12 ounces Diquat
155	Lower Phantom	Waukesha	433	41.00	85.5[(3)]***	-	900# Aqua. +[(2)], 20 gals. K Endothal, 22.5 gals. Diquat & 8 gals. Diquat and 8 gals. Cutrine in combination.
156	Lynxville	Crawford	-		No Treatment		
157	Magnor	Polk	224	2.30	75	200 $CuSO_4$ 100 lime	-
158	Manawa Mill Pond	Waupaca	192	2.00	-	-	3 gals. Diquat
159	Marinuka	Trempealeau	110	14.00	50	-	6 gals. Diquat & 6 gals. K Endothal
160	Mathews	Washburn	268		No Treatment		
161	McDill Pond	Portage	262	13.50	-	-	24.5 gals. K Endothal, 12.5 gals. Diquat[(2)] & 150# Aquathol.
162	Mendota	Dane	9,730	188.52	-	-	310 gals. K Endothal & 900# Aqua. +.
163	Menomin	Dunn	1,405	160.00	3,780[(7)]	-	-
164	Menomonee Park Quarry	Waukesha	-		No Treatment		
165	Mercer	Oneida	253	50.00	200	-	-
166	Metonga	Forest	2,157		No Treatment		
167	Mid	Oneida	215	23.00	-	-	1,500# Aquathol & 800# 2,4-D.
168	Middle Eau Claire	Bayfield	804		No Treatment		
169	Middle Lauderdale	Walworth	259	3.00	-	-	3 gals. Diquat
170	Mill	Walworth	271		No Treatment		
171	Mill	Walworth	271	0.86	-	-	150# Aqua. +
172	Mill	Walworth	271		No Treatment		
173	Minocqua	Oneida	1,258	4.60	-	-	350# Aqua. +
174	Minong Flowage	Douglas	-	0.50	-	-	½ gal. 2,4-D
175	Minooka Park Pond	Waukesha	-		No Treatment		
176	Monona	Dane	3,335	22.25	3	-	125 gals. Aqua. +, 700# Aqua. + & 90 gals. K Endothal
177	Montello	Marquette	286	30.00	-	-	55 gals. Diquat[(2)]
178	Muellers	Washington	10		No Treatment		
179	Mukwonago Park Pond	Waukesha	1.0	1.00	6***	-	-
180	Muskego Park Pond	Waukesha	2.0	2.00	11.5	-	6# $CuSO_4$ applied as 2 gals. Cutrine.
181	Nagawicka	Waukesha	917		No Treatment		
182	Nagawicka	Waukesha	917	100.00	1,930[(4)]	-	-
183	Nagawicka	Waukesha	917		No Treatment		

TABLE 7 (Cont.)

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
184	Nakoma Golf Pond	Dane	1.1		No Treatment		
185	Nepco	Wood	494	215.00	1,900	-	4,050# Aqua. +
186	Noquebay	Marinette	2,162		No Treatment		
187	North Pond	Marinette	74		No Treatment		
188	North Twin	Polk	135		No Treatment		
189	North Twin	Polk	135	0.75	-	-	1 gal. K Endothal & 1 gal. Diquat.
190	O'Brien Springs	Langlade	-		No Treatment		
191	Oconomowoc	Waukesha	767	44.00	225[2]***	1,060 $CuSO_4$ 500 lime	15 gals. K Endothal, 15 gals. 2,4-D & 2 gals. Diquat
192	Okauchee	Waukesha	1,187		No Treatment		
193	Okauchee	Waukesha	1,187	106.90	333[4]***	-	11.5 gals. Diquat, 16 gals. K Endothal & 270# 2,4-D used in combination with Cutrine.
194	Onalaska	La Crosse	8,000	6.00	25[2]	-	8 gals. K Endothal
195	Paddock	Kenosha	112	69.00	120***	-	115 gals. 2,4-D[2] & 4 gals. K Endothal.
196	Paquette Park Pond	Columbia	1.3		No Treatment		
197	Paquette Park Pond	Columbia	1.3	1.30	5.25***	-	2 gals. Diquat
198	Park	Columbia	219	55.00	200	-	33 gals. Aqua. +
199	Pearl	Waushara	101		No Treatment		
200	Pelican	Oneida	3,585		No Treatment		
201	Perch	Monroe	32	12.00	-	-	40 gals. K Endothal & 7.5 gals. Diquat.
202	Peshtigo Mill Pond	Marinette	460	4.50	-	-	3 gals. Diquat & 5 gals. Aqua. +.
203	Peters Lake	Walworth	64		No Treatment		
204	Pewaukee	Waukesha	2,493	90.00	1,475(4)	-	-
205	Pewaukee	Waukesha	2,493	39.50	90***	240 $CuSO_4$ 120 lime	5 gals. K Endothal & 15 gals. 2,4-D
206	Pickeral	Walworth	30	0.18	-	-	4 gals. 2,4-D
207	Pickeral	Portage	52	10.00	50	-	-
208	Pike	Marathon	208	85.00	750[2]	-	1,000# Aqua. +
209	Pike	Marathon	208	1.00	-	-	75# Aqua. +
210	Pike	Marathon	208	0.46	-	-	50# Aqua. +
211	Pike	Polk	148	0.06	-	-	50# Aqua. +
212	Pike	Kenosha	-		No Treatment		
213	Pine	Polk	82	0.11	-	-	20# 2,4-D
214	Pine	Polk	82	0.34	-	-	10# 2,4-D
215	Pine and Grass	Shawano	209	17.00	-	1,700 $CuSO_4$ 850 lime	-
216	Pine	Waukesha	703		No Treatment		
217	Pine	Waukesha	703	50.00	-	-	25 gals. K Endothal, 105 gals. 2,4-D & 660# 2,4-D
218	Pioneer	Vilas	415		No Treatment		
219	Plymouth	Sheboygan	36	8.00	35	-	5 gals. Diquat & 5 gals. K Endothal
220	Pokegama	Washburn	453	-	-	450 $CuSO_4$ 225 lime	50# Aqua. +, 1 gal. Silvex & 4 gals. K Endothal
221	Ponds	Iowa	-		No Treatment		
222	Potters	Walworth	162	29.00	-	-	1,050# Casaron, 55 gals. K Endothal & 5 gals. Diquat.
223	Prairie	Barron	1,534		No Treatment		
224	Pretty	Waukesha	64	0.24	-	-	50# Aqua. +
225	Pretty	Waushara	15		No Treatment		
226	Private Pond	Ozaukee	0.5	0.75	-	-	2# Karamex
227	Pue's Pond	Waupaca	-	1.00	-	-	200# Aqua. +
228	Redstone	Sauk	600		No Treatment		
229	Redstone	Sauk	600	100.00	2,200[7]	-	-

TABLE 7 (Cont.)

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
230	Rice	Barron	828	8.00	-	300 $CuSO_4$ 150 lime	1 gal. Silvex, 5 gals. Diquat & 5 gals. K Endothal
231	Round	Waushara	63	0.30	-	-	50# Aqua. +
232	Round	Burnett	203	80.00	900[3]	-	-
233	Sand	Barron	322		No Treatment		
234	Sand	Polk	187	-	90[2]	-	8 gals. Diquat
235	Sandow	Marquette	19	7.00	-	400# $CuSO_4$ 200 lime	10 gals. K Endothal & 100# Aquathol.
236	Schnurs	Price	146	0.09	-	-	5# Aquathol
237	Seymour Community	Outagamie	3	3.50	-	300 $CuSO_4$ 150 lime	-
238	Shangri-La	Kenosha	154		No Treatment		
239	Shangri-La	Kenosha	154	28.50	195[2]***	-	56 gals. Diquat & 40 gals. K Endothal
240	Shattuck	Chippewa	59	0.50	-	-	50# Aquathol
241	Shawano	Shawano	6,178	126.45	300	-	63 gals. Diquat, 192 gals. K Endothal & 50# Hydrothal 47.
242	Sherwood	Adams	250	30.50	250[2]	-	10 gals. K Endothal & 5 gals. Diquat.
243	Shishebogama	Oneida	716		No Treatment		
244	Shoal	Burnett	247		No Treatment		
245	Silver	Columbia	52		No Treatment		
246	South Twin	Polk	74	2.00	-	200 $CuSO_4$ 100 $CuCO_3$	200# Aqua. +
247	South Twin	Polk	74		No Treatment		
248	Spalding Mill Pond	Rock	28		No Treatment		
249	Spring Bank	Monroe	10	4.50	12	-	9 gals. P.L.L.
250	Spring	Columbia	17		No Treatment		
251	Sturgeon Bay	Door	-	0.01	-	-	20# Aqua. +
252	Squaw	St. Croix	129	80.00	500[2]	-	-
253	Swan	Columbia	419		No Treatment		
254	Swift	Walworth	19	0.41	-	-	1 gal. 2,4-D & 1 gal. Diquat.
255	Tarrant	Columbia	18		No Treatment		
256	Teal	Sawyer	1,049		No Treatment		
257	Thorn	Portage	17	0.25	-	-	50# Aqua. +
258	Tichigan	Racine	891	12.00	50	-	5 gals. Aqua. +
259	Tichigan	Racine	891	0.33	-	-	3.5 gals. Aqua. +
260	Tomah	Monroe	243	120.25	1,250[2]	-	0.5 gals. Silvex
261	Trade	Burnett	432	80.00	400	-	-
262	Troy Mill Pond	Walworth	20	5.00	-	-	3 gals. Diquat
263	Upper Nemahbin	Waukesha	283	7.00	105***	-	-
264	Upper Nemahbin	Waukesha	283	6.08	54[2]***	-	300# Aqua. + 1.5 gals. Diquat
265	Upper Phantom	Waukesha	106	4.75	18[2]***	-	1 gal. Diquat, 117# Aqua. + & 4 gals. K Endothal
266	Verona Park Pond	Dane	8		No Treatment		
267	Voltz	Kenosha	52	3.00	-	-	10 gals. K Endothal
268	Wallace	Washington	50		No Treatment		
269	Wallace	Washington	50	15.00	135***	-	-
270	Wapogassct	Polk	1,186	195.00	4,800[7]	-	3 gals. Hydrothal 47 & 20 gals. P.L.L.
271	Wapogasset	Polk	1,186	0.03	-	-	50# Aquathol
272	Waubesa	Dane	2,113	1.00	-	-	150# Aqua. +
273	West	Columbia	19	2.80	-	-	20 gals. Aqua. +
274	White Ash	Polk	144	33.50	75	-	14.5 gals. K Endothal & 17.5 gals. Diquat.
275	Whitewater	Walworth	640	119.00	1,500[3]	-	45 gals. K Endothal[2]
276	Willow Creek Game Reserve	Washington	-	9.00	-	-	27# Karmex
277	Windfall	Forest	56	14.00	115[2]	-	15 gals. Diquat
278	Wingra	Dane	345	5.00	-	-	1,000# Aqua. +

TABLE 7 (Cont.)

No.	Lake	County	Lake Area (Acres)	Treated Area (Acres)	Algae Control (Lbs. $CuSO_4$)	Swimmers' Itch Control (Lbs.)	Aquatic Weed Control** Quantity of Chemical
279	Winnebago	Winnebago	137,708		No Treatment		
280	Winnebago	Winnebago	137,708		No Treatment		
281	Wisconsin	Columbia	9,000		No Treatment		
282	Wisconsin	Columbia	9,000	5.00	60***	-	-
283	Wisconsin	Columbia	9,000		No Treatment		
284	Wyocena Mill Pond	Columbia	90	21.00	-	-	42 gals. Aqua. +
285	Yellow River	Barron	-	5,00	-	-	1,550# Aqua. +
286	Yellow	Burnett	2,287	0.44	-	-	15# 2,4-D
287	Yellow	Burnett	2,287	0.23	-	-	50# Aqua. +
288	Yellow	Burnett	2,287		No Treatment		
289	Yellow	Burnett	2,287	89.00	1,575 (4)	-	4 gals. Diquat & 4 gals. K Endothal
290	Zoo Pond	Racine	1.5		No Treatment		
		DEPARTMENT OF NATURAL RESOURCES PROJECTS - 1970					
1	Beckman	Green	-	3.50	-	300 $CuSO_4$ 150 lime	-
2	Mill Bluff Park Pond	Monroe	3	3.00	-	150 $CuSO_4$ 75 lime	12# Dalapon
3	Nancy	Bayfield	7		No Treatment		
4	Storr's	Rock	40		No Treatment		

* Number of chemical applications given in parentheses
** Aqua. + = Aquathol +
*** Chelated Copper (applied as Cutrine, 3# $CuSO_4$ per gal.)
K = Potassium

pH Control (to increase productivity)

800 lbs. Lime

Nutrient Removal (to remove PO_4)

23,000 lbs. Alum

Swimmers' Itch Control

6,925 lbs. $CuSO_4$ (100% active)
462 lbs. $CuCO_3$
2,970 lbs. Lime

Algae Control

53,670.25 lbs. $CuSO_4$ (100% active)
1,050 lbs. Casaron
47 gals. P.L.L.

Higher Plant Control

16,957 lbs. Aqua. + (contains 3.6% Endothal Acid + 5% Silvex Acid)
2,255 lbs. Aquathol (contains 7.2% Endothal Acid)
342 gals. Aqua. + (contains 1.7 lbs. Endothal Acid + 2.4 lbs. Silvex Acid per gal.)
2 gals. Aquathol "K" (contains 1.46 lbs. Endothal Acid per gal.)
1,218 gals. Potassium Endothal (contains 4.23 lbs. Endothal Acid per gal.)
675.3 gals. Diquat (contains 2 lbs. of Diquat Cation per gal.)
122.5 gals. Silvex (contains 4 lbs. Active per gal.)
344.5 gals. 2,4-D (contains 4 lbs. Active per gal.)
8,372 lbs. 2,4-D (20% active)
12 lbs. Dalapon (85% active)
29 lbs. Karamex (80% active)
7 gals. Hydrothal 47 (contains 1.5 lbs. Active per gal.)
50 lbs. Hydrothal 47 (contains 5% Endothal Acid)

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The author is Chief of Laboratory Services, Bureau of Standards and Surveys.

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