REPORT ON WATER QUALITY IN THREE MILE LAKE

1972

Ontario

Ministry
of the
Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister

Ontario

Ministry of the Environment

Water Resources Branch,
Limnology & Toxicity Section,
P.O. Box 213,
Rexdale, Ontario.

Mr. G. Mills

August 7, 1974

Dear Sir,

Please find appended a copy of our study entitled "Report of Water Quality in Three Mile Lake, 1972".

Three Mile Lake was found to have good bacteriological water quality with the exception of three inlets which will be investigated further. The chemical water quality was satisfactory and small amounts of suspended algae were present in the water. However, the total phosphorus and Kjeldahl nitrogen concentrations in the surface waters were sufficient to support nuisance growths of algae. Dissolved oxygen concentrations in the bottom waters, in the summer, were insufficient to maintain fish and fish food organisms.

Additionally the report contains a section entitled "Information of General Interest to Cottagers" which we hope will be widely read and serve as a useful reference on such topics as natural lake processes, boating regulations, water treatment, septic tank installations, etc.

If you have questions or comments concerning the study, feel free to contact me. Additional copies of the report are available upon request.

Yours truly.

G.H. Mills,
Director.

REPORT OF WATER QUALITY
in
THREE MILE LAKE

1972

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PREFACE

The Province of Ontario contains many thousands of beautiful small inland lakes which are most attractive for recreational use. Lakes close to urban areas and accessible by road often receive heavy use in terms of cottage development, camp sites, trailer parks and picnic areas.

A heavy influx of people may subject a lake and it's surrounding environment to great stress. In many cases, developments are carried out on attractive lakes only to find that when this is complete the lake qualities which were initially so appealing have been damaged. The appearance of the shoreline can be marred by construction, fishing ruined by over harvesting or the growth and decay of excessive amounts of algae and weeds. Motor boats introduce noise and petroleum pollution. Inadequate disposal of human wastes can place a great stress on the lake environment.

The accepted custom of having "a place at the lake" continues to apply pressure for more development, giving rise to an even greater expansion of problems.

The Ontario Ministry of the Environment is attempting to bring some of these stress factors under control with a variety of programs. The cottage pollution program was initiated in 1967 and was expanded in 1970 in order to solve the cottage waste disposal problem in recreational lakes. There are three ongoing studies carried out by the Ministry:

1. Evaluation of existing waste disposal systems and enforcement of repairs to those found to be unsatisfactory;

2. Research to improve the knowledge of septic tank operation and effects in shallow soil areas and evaluation of alternative methods of private waste disposal;

3. Evaluation of present water quality in a number of recreational lakes. A totally undeveloped lake near Huntsville was studied in 1972, in order to obtain more information about natural water quality conditions within a Precambrian Lake, which would assist in defining any unnatural conditions encountered in the developed lakes surveyed.

This report on Three Mile Lake is one of a series dealing with the water quality aspects of the recreational lakes studied in 1972. As well as defining the present status of water quality in the lakes, the data are meant to provide a historical reference for comparison of conditions at any future time.

SUMMARY

Surveys were carried out in Three Mile Lake in 1972 to evaluate the present status of the water quality with respect to bacteria, algae and aquatic plant growths. Additionally, plant nutrient and dissolved oxygen concentrations in the surface and bottom waters were determined.

Three Mile Lake is located in the District Municipality of Muskoka and lies within the Precambrian Shield. The surrounding topography is characterized by rolling to steep hills and shallow overburden comprised of loam and sand glacial till.

Three Mile Lake was found to have good bacteriological water quality well within the Recreational Use Criteria. However, pollution inputs were detected at three inlets on the southern and eastern shores. The bacterial levels at these inlets exceeded the Ministry of the Environment (M.O.E.) Recreational Use Criteria and indicated a possible health hazard. Further investigations to determine the source of this pollution will be carried out by staff of the M.O.E.'s Recreational Lakes Program. Bacterial levels generally increased from May to August probably as a result of increased rainfall inducing runoff, and also, greater recreational use during the August survey.

The chemical water quality was satisfactory and small amounts of suspended algae were present in the water despite relatively high total phosphorus and Kjeldahl nitrogen concentrations in the surface waters. Mid-summer oxygen levels in the bottom waters of Station 30, a mid-lake sampling location, were insufficient to maintain fish and fish-food organisms at those depths.

PURPOSE OF THE SURVEYS

The surveys were designed, and tests selected in order to evaluate the present conditions in the lakes with respect to:

- concentration of bacteria
- plant nutrients and algae
- water quality with depth
- inventory of shoreline development

As a result of human activity in the recreational lake environment, some wastes may reach the lake itself and this can lead to either or both of two major types of water quality impairment, microbial contamination and excessive growths of algae and aquatic plants. The two problems can result from a common or different source of pollution, but the consequences of each are quite different.

Microbial contamination by raw or inadequately treated sewage does not significantly change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. This type of pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions since most disease causing bacteria do not persist in the lake.

Nutrient enrichment, or eutrophication, results from the addition of plant fertilizers which occur naturally and are also present in virtually all forms of raw or treated human wastes. High concentrations of these fertilizers (plant nutrients), mainly nitrogen and phosphorus, support extensive growths of rooted aquatic plants and of microscopic free-floating plants called algae. Eutrophication greatly affects the lake appearance but generally does not pose a health hazard. Problems due to nutrient enrichment are generally long lasting and may become irreversible.

Changes in water temperature, dissolved oxygen and quality with depth are very important characteristics of a lake and were examined in the surveys.

Aquatic weed beds provide shelter and food for many kinds of fish. Too much growth is undesirable since it can upset the oxygen balance in the lake and can interfere with recreational uses of the lake.

DESIGN OF THE SURVEYS

Timing

Five day bacteriological, chemical and biological surveys were carried out from May 10 to 14 and from August 1 to 5. Chemical and biological samples only were collected from October 17 to 19.

A proper estimation of the bacterial population requires several measurements over a period of time, which can then be averaged as a geometric mean. Measurements over 5 consecutive days at each station are regarded as the minimum number which will give reliable bacterial data.

Chemical samples were collected on the first and last days of the surveys at inlet and outlet stations and at the mid-lake stations. Chlorophyll samples were collected each day at the inlet and mid-lake stations.

Selection of Sample Locations

Forty-four bacteriological samples sites were established over the whole lake.

Chemical samples were collected at the six inlet stations, the outlet station and at three mid-lake stations. In addition to these surface samples chemical and bacteriological samples were taken from the bottom water at the mid-lake stations.

Field Tests

The variation in temperature and dissolved oxygen values with depth were measured at the three deep water stations with an electronic probe lowered into the lake and water clarity was measured with a Secchi disc, (Figure 1). The pH and conductivity of the samples were measured in the field.

Bacteriological Tests

Three groups of bacteria were determined on each sample: total coliforms, fecal coliforms, fecal streptococci. These organisms are used as "indicators" of fecal contamination. Many diseases common to man can be transmitted by feces, consequently, the probability of occurrence of these diseases is usually highest in areas where the water is contaminated. The total coliforms, fecal coliforms and fecal streptococci organisms are all indigenous to man and other warm blooded animals and are found in the colon and feces in tremendous numbers. These indicator organisms in the water denote the presence of fecal contamination and hence the risk of disease causing organisms.

Chemical Tests

Hardness, alkalinity, chloride, iron and conductivity were measured in order to define the mineral composition of the water. The types of plants and animals which thrive, effects of toxic materials and suitability of the lake for various management techniques depend on the mineral content.

Total and soluble phosphorus were measured in the inlet and bottom water samples, while total phosphorus only was measured in the mid-lake and outlet surface samples. Soluble phosphorus concentrations are used mainly to substantiate various interpretations of the total phosphorus concentrations.

The total Kjeldahl nitrogen is essentially the amount of nitrogen contained in organic material. It was measured in all of the chemical samples. The soluble forms of nitrogen, ammonia, nitrite and nitrate were measured in the inlet and bottom water samples. They are particularly important in bottom waters since nitrogen may be regenerated from decaying organic matter in these forms.

Chlorophyll a concentrations are an indication of the amount of suspended algae in the water. The live algae are confined mainly to the illuminated surface waters, which extend down to a depth of about twice the Secchi disc reading. The chlorophyll a samples were collected by raising the sample bottle through the depth of the illuminated zone as it filled. The sample was then representative of the algal density through the sampling depth.

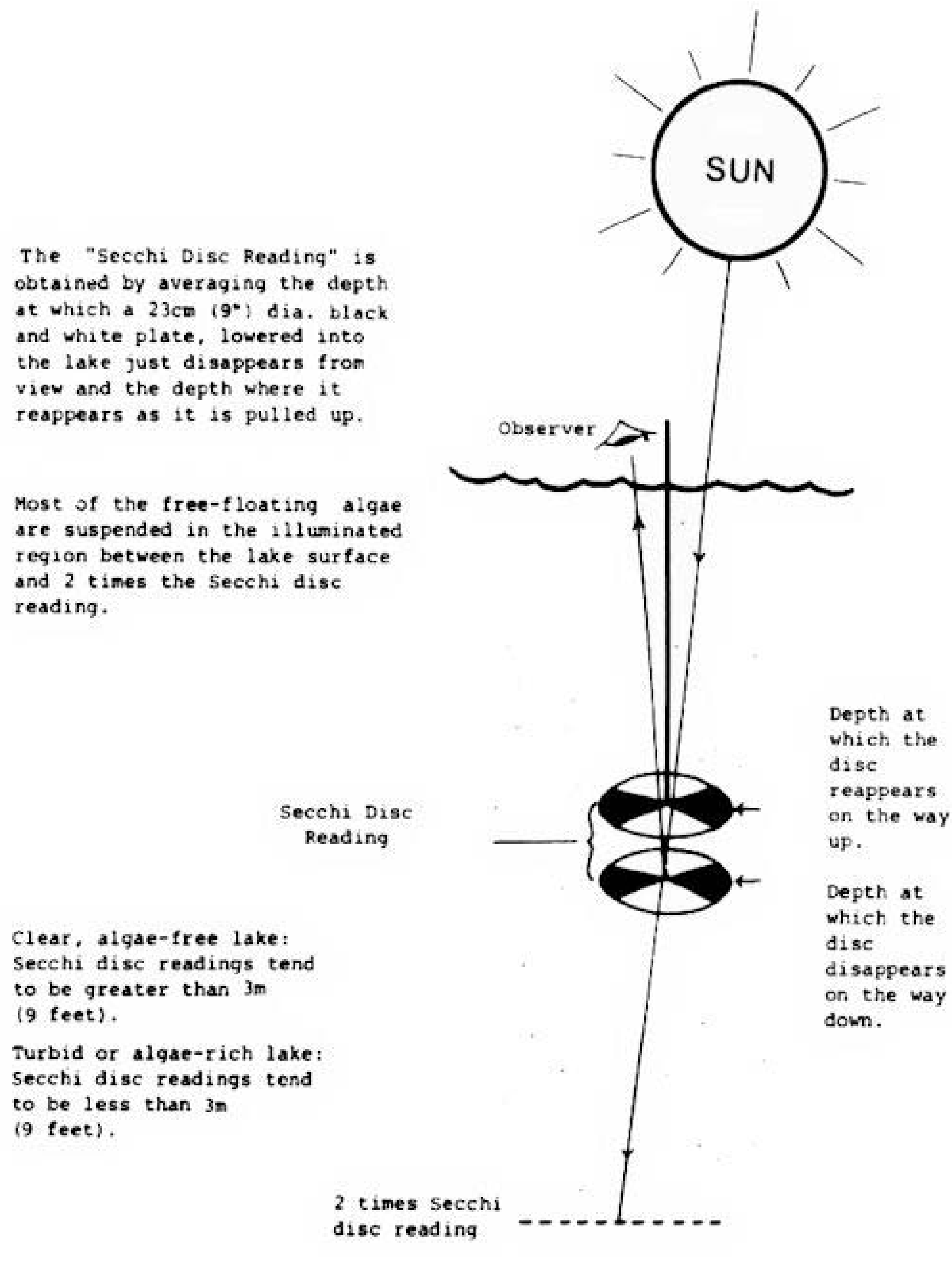

FIGURE 1: Use Of The Secchi Disc To Determine Water Clarity.

DESCRIPTION OF THREE MILE LAKE AREA

Lake and Soil Characteristics

Three Mile Lake is situated in the Township of Muskoka Lakes in the District Municipality of Muskoka, approximately 40 kilometers (25 miles) south-west of the Town of Huntsville.

The lake lies in the Precambrian Shield at an elevation of 246 meters (810 feet) above sea level (Figure 2) . The surrounding topography is characterized by rolling to steep hills with some rising to 305 meters (1000 feet) above sea level. Bedrock surrounding the lake consists of a granitized Bonded Hornblend migmatite.

At the north end of Hammel Bay, the bedrock is exposed, forming cliff faces that rise 22-30 meters (75-100 feet) from the water surface. On the west and south slopes of the lake the shoreline is much smoother with more soil cover and less outcroppings of rock. Generally, the overburden is shallow and is composed of loam and sand glacial till with a moderate amount of stone.

Except for Hammel Bay the lake bottom is flat with a maximum depth of 4.5 meters (14.4 feet) . The colouration of the water is murky brown or sandy. However, in Hammel Bay, the maximum depth is 13 meters (42 feet) and the water appearance is much clearer. An extensive sand bar reaches two-thirds to three quarters of the way across the entrance to the bay with water depth diminishing to less than 1 meter (3 feet). This sand bar acts as a breakwater to the bay.

The surface area of Three Mile Lake is 8.8 square kilometers (3.4 square miles) including three small islands. These are Balthaycock Island at the east end of the lake,

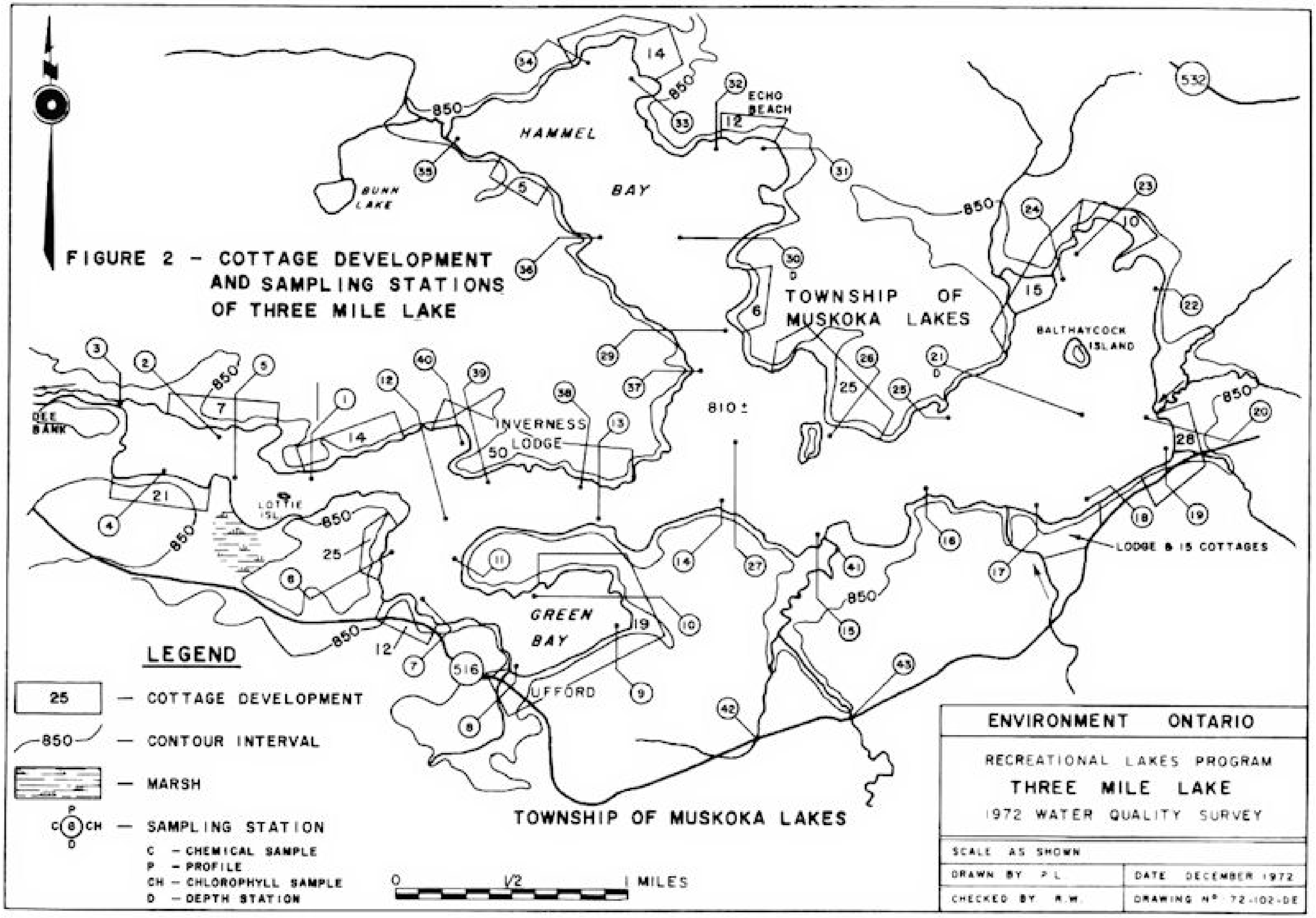

FIGURE 2 - COTTAGE DEVELOPMENT AND SAMPLING STATIONS OF THREE MILE LAKE

Lottie Island at the west end and an unidentified island at the entrance to Hammel Bay.

Three Mile Lake is situated in the Muskoka Lakes watershed which is part of the Muskoka River Drainage Basin. The Dee River which exits the lake at Dee Bank drains to Lake Rosseau and from there to Georgian Bay. The Lake has three named and four unnamed inlets draining an area of approximately 71 square kilometers (50 square miles). According to a monitoring station located at Dee Bank, the high flow for the year occurred on April 20, 1972, at 20,000 litres/second (720 cfs) and the low flow occurred on September 29, 1972, at 200 litres/second (7.5 cfs).

Water Usage

Although there are a few private wells, most cottagers use the lake as their source of domestic water supply. The cottagers enjoy most forms of recreational activity including boating and angling. According to information available from the Ministry of Natural Resources, sport fish found in the lake are walleye and smallmouth bass. Other fish are white sucker, yellow perch, pumpkinseed, brown bullhead, lake herring and shiners.

Shoreline Development

The shoreline of Three Mile Lake is developed to varying degrees since topographical features make some areas unsuitable for development. There are approximately 300 cottages and six resorts situated on the lake. The majority of the cottages are located on the middle of the north, south and east shores.

RESULTS AND DISCUSSION

Bacteriology

The quantities of bacteriological data necessitated statistical methods to summarize the results into a concise presentation without the inconsistency associated with manual interpretation. The methods used are based on the analysis of variance and Barlett's test of homogeneity by which stations on a lake can be grouped into areas with the same bacterial level. Areas or stations with only slight differences in bacterial concentration can be isolated. It was found on previous work that areas, or stations, with significantly higher bacterial numbers generally indicated a pollution input. Details of statistical methods and data are available on request.

During the May survey, most of the lake (Group A) was homogeneous with geometric mean bacterial levels of 8 total coliforms (TC), 1 fecal coliform (FC), and 1 fecal streptococcus (FS)/100ml (Figure 3). Two inlets (Stations 20 and 19), entering the eastern part of the lake showed higher mean bacterial levels of 84 TC and 17 FS/100ml. The eastern inlet adjacent to a peninsula (Station 20) had higher mean FC levels of 12 FC/100ml. A southern inlet station (Station 15) had higher mean bacterial levels of 264 TC, 11 FC and 40 FS /100ml. These higher mean levels were due to a pollution source from the inflowing stream as indicated by Station 41, 100 feet upstream of Station 15, which was characterized by higher mean bacterial levels (510 TC, 32 FC and 43

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(1) Water Quality Criteria, Ontario Ministry of the, Environment, 1973.

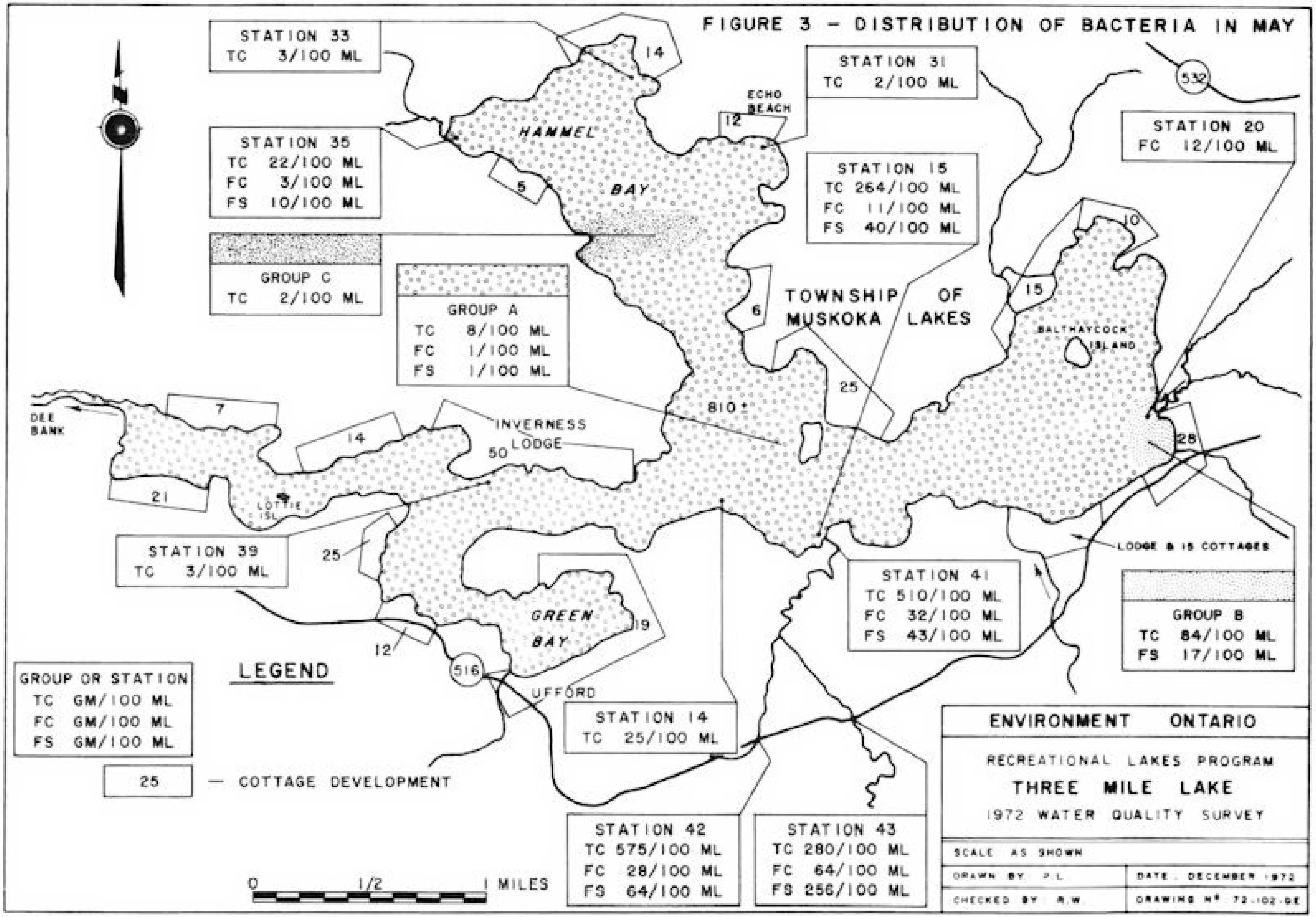
FIGURE 3 - DISTRIBUTION OF BACTERIA IN MAY
STATION 33
TC 3/100 ML
STATION 35
TC 22/100 ML
FC 3/100 ML
FS 10/100 ML
GROUP C
TC 2/100 ML
GROUP A
TC 8/100 ML
FC 1/100 ML
FS 1/100 ML
STATION 31
TC 2/100 ML
STATION 15
TC 264/100 ML
FC 11/100 ML
FS 40/100 ML
STATION 20
FC 12/100 ML
HAMMEL BAY
ECHO BEACH
TOWNSHIP OF MUSKOKA LAKES
BALTHAYCOCK ISLAND
532
DEE BANK
INVERNESS LODGE
LOTTIE ISL
810±
STATION 39
TC 3/100 ML
GREEN BAY
UFFORD
516
STATION 41
TC 510/100 ML
FC 32/100 ML
FS 43/100 ML
LODGE & 15 COTTAGES
GROUP B
TC 84/100 ML
FS 17/100 ML
LEGEND
GROUP OR STATION
TC GM/100 ML
FC GM/100 ML
FS GM/100 ML
25 — COTTAGE DEVELOPMENT
STATION 14
TC 25/100 ML
STATION 42
TC 575/100 ML
FC 28/100 ML
FS 64/100 ML
STATION 43
TC 280/100 ML
FC 64/100 ML
FS 256/100 ML
0 1/2 1 MILES
ENVIRONMENT ONTARIO
RECREATIONAL LAKES PROGRAM
THREE MILE LAKE
1972 WATER QUALITY SURVEY
SCALE AS SHOWN
DRAWN BY P.L.
DATE DECEMBER 1972
CHECKED BY R.W.
DRAWING Nº 72-102-9E

FS/100 ml) than noted at Station 15. An inlet from Bunn Lake (Station 35) had higher levels of 22 TC, 3 FC and 100 FS/100 ml. The elevated bacterial levels noted at the inlets during the May survey reflect definite sources of pollution to the lake.

In the August survey, most of the lake (Group A) was homogeneous with geometric mean bacterial levels of 37 TC, 2 FC and 4 FS/100 ml (Figure 4). Results from Station 20 showed mean bacterial levels of 779 TC, 54 FC and 637 FS/100 ml in the eastern inlet. The second inlet in the eastern region of the lake (Station 19) had FS mean levels of 41 FS/100 ml. The southern inlet (Station 15) again showed excessively high bacterial levels with means of 1666 TC, 294 FC and 552 FS/100 ml far exceeding the Ministry of the Environment's Recreational Use Criteria for all three parameters. The inlet entering into Green Bay (Station 8) had mean bacterial levels of 1286 TC, 63 FC and 449 FS/100 ml exceeding the Ministry of the Environment's TC and FS criteria. The eastern (Station 20) and southern inlets (Stations 8 and 15) all had excessively high bacterial levels, indicating that a definite pollution source and health hazard existed within the influence of each of these inlets during the August survey.

Bacterial levels were generally higher in August than in May, especially at the inlets (Figures 3 and 4). These higher bacterial levels may have been partially a result of the "rainfall effect" (see Appendix A-2) since the Huntsville meteorological station recorded 0.99 inches of rainfall during the August survey. Further investigations to determine the source and extent of the pollution found in the inlets will be carried out by staff of the Ministry of the Environment's Recreational Lakes program.

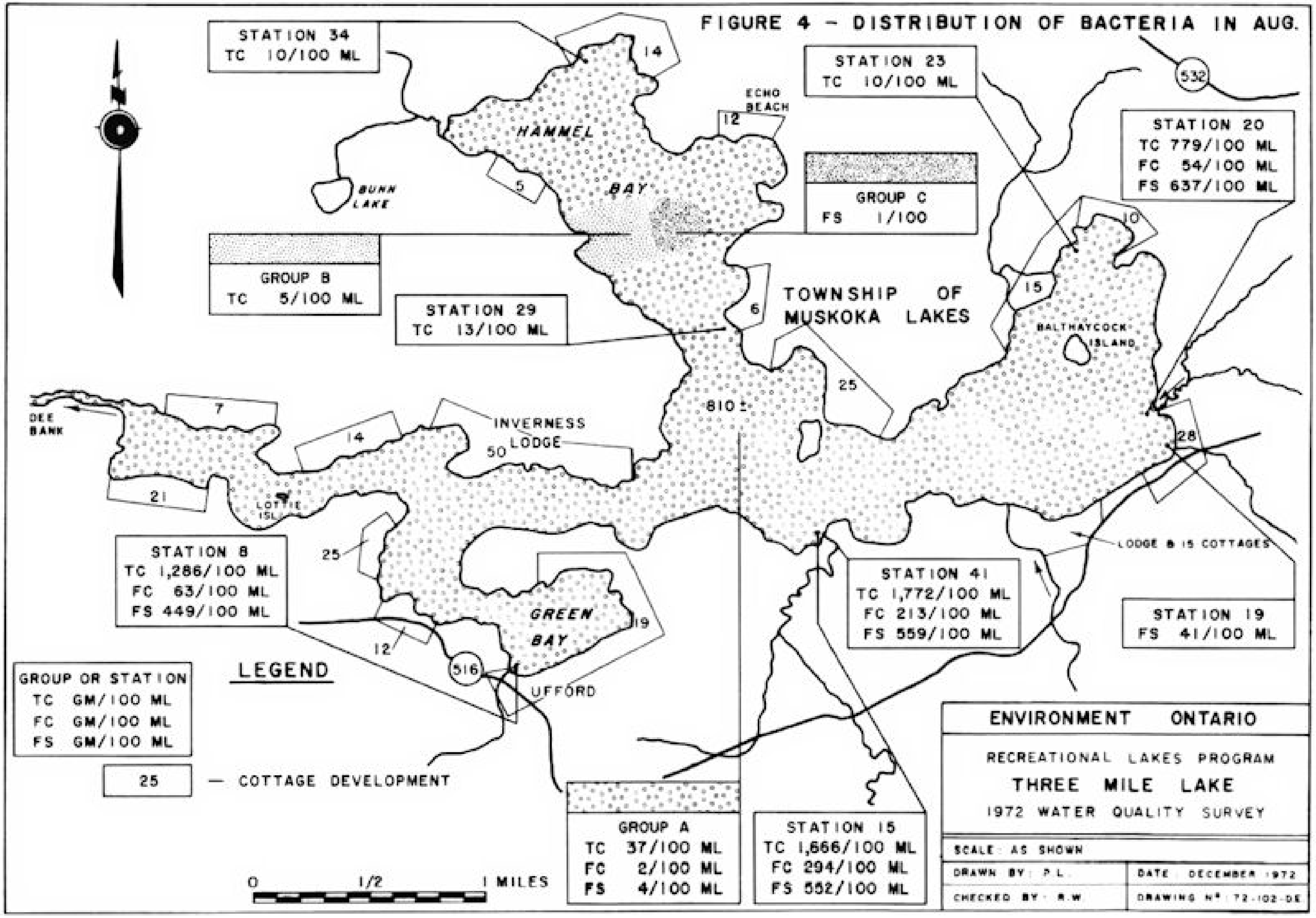
FIGURE 4 - DISTRIBUTION OF BACTERIA IN AUG.
STATION 34
TC 10/100 ML
STATION 23
TC 10/100 ML
STATION 20
TC 779/100 ML
FC 54/100 ML
FS 637/100 ML
GROUP C
FS 1/100
GROUP B
TC 5/100 ML
STATION 29
TC 13/100 ML
TOWNSHIP OF
MUSKOKA LAKES
HAMMEL
BAY
BUNN
LAKE
ECHO
BEACH
BALTHAYCOCK
ISLAND
DEE
BANK
INVERNESS
LODGE
LOTTIE
ISL.
810±
STATION 8
TC 1,286/100 ML
FC 63/100 ML
FS 449/100 ML
STATION 41
TC 1,772/100 ML
FC 213/100 ML
FS 559/100 ML
STATION 19
FS 41/100 ML
LODGE & 15 COTTAGES
GREEN
BAY
UFFORD
516
532
LEGEND
GROUP OR STATION
TC GM/100 ML
FC GM/100 ML
FS GM/100 ML
25 — COTTAGE DEVELOPMENT
GROUP A
TC 37/100 ML
FC 2/100 ML
FS 4/100 ML
STATION 15
TC 1,666/100 ML
FC 294/100 ML
FS 552/100 ML
0 1/2 1 MILES
ENVIRONMENT ONTARIO
RECREATIONAL LAKES PROGRAM
THREE MILE LAKE
1972 WATER QUALITY SURVEY
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DRAWING Nº: 72-102-DE

Chemistry

Temperature and dissolved oxygen measurements were taken at the three mid-lake stations (21, 27 and 30) during the spring, summer and fall surveys.

Owing to the shallow water depth of Stations 21 and 27, vertical mixing processes resulted in relatively uniform temperatures and dissolved oxygen concentrations (Figure 5). Dissolved oxygen values remained at or near saturation for all three surveys. However, Station 30 with a depth of 13 meters (43 feet) stratified during the summer, thus preventing vertical mixing throughout the water column (see Page A-8 for explanation). During this period, oxygen values were as, low as 5% saturation in the bottom waters (Figure 5), and probably resulting from decomposition of organic matter. By the fall survey, the temperature stratification had broken down and dissolved oxygen values were restored to saturation levels.

Three Mile Lake is a soft water lake with hardness values ranging from 17 to 24 mg/L as $CaCO_3$, typical of many Precambrian lakes. The alkalinity and conductivity values at the mid-lake stations correlate well with variations in the hardness and along with the chloride and pH data indicate no unusual mineral characteristics. Slightly higher concentrations of the above parameters were observed at inlet Station 44.

		Overall Range	Overall Mean
Alkalinity (mg/L as $CaCO_3$)		8-18	13
Conductivity (µmhos/cm^3)		50-77	58
Chloride (mg/L)		3-6	4.8
pH	Surface Units	6.1-7.9	6.8
	Bottom Units	5.7-7.3	6.8

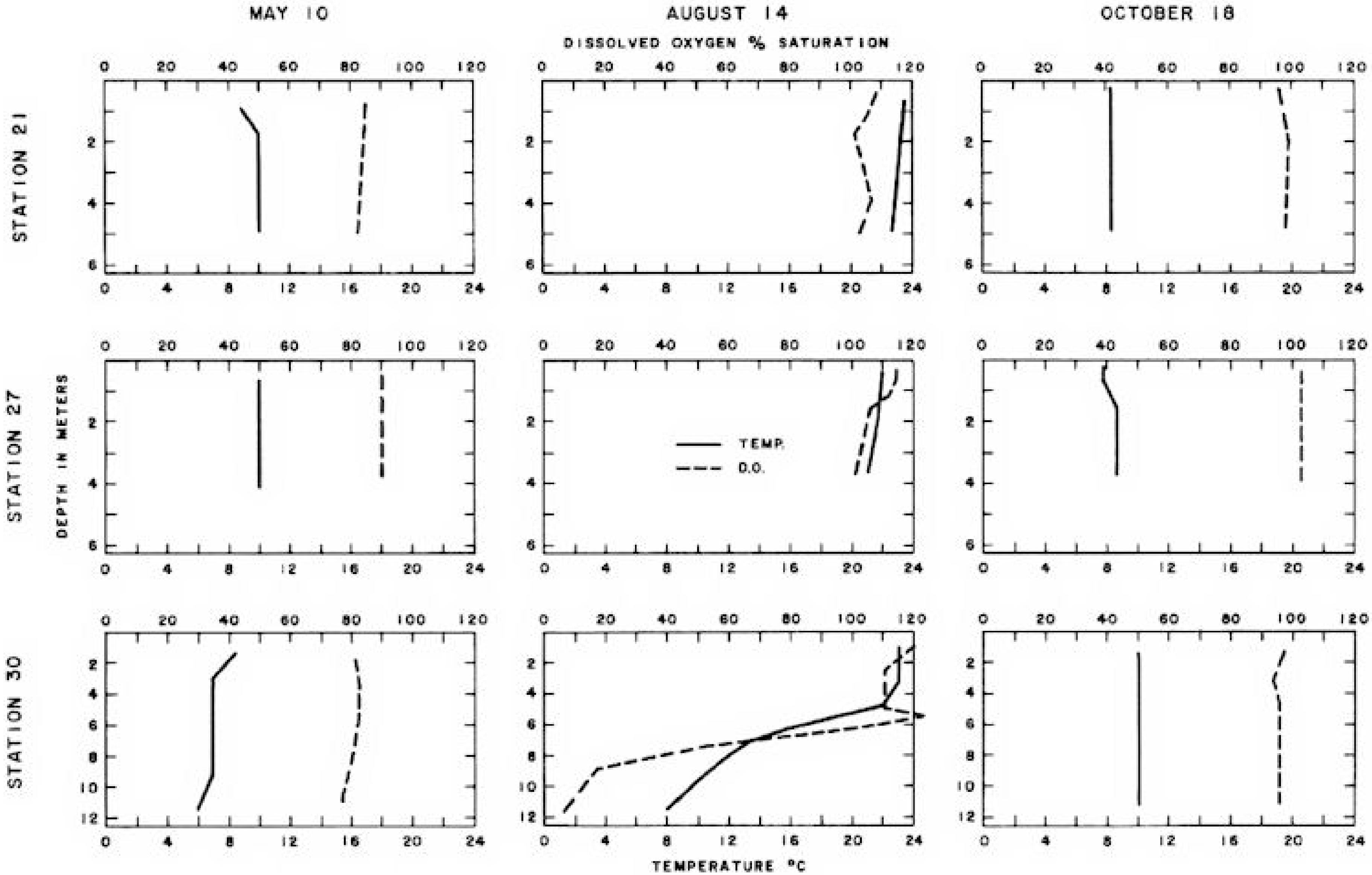

FIGURE 5: Dissolved Oxygen And Temperature Profiles.

The total phosphorus and total Kjeldahl nitrogen concentrations in the surface waters were moderately high with values of 0.027 and 0.51 mg/L, respectively. Nuisance levels of algae may develop in the lake with nutrient levels this high. Nutrient recycling from the sediments was not observed at Station 30 even though the bottom waters were almost anoxic in the summer. Higher concentrations of total phosphorus and total Kjeldahl nitrogen were detected at the inlet stations. These higher concentrations may be attributed to surface runoff and land drainage from adjacent agricultural areas.

The iron concentrations averaged 0.37 mg/L in the surface waters at the mid-lake stations. Slightly higher levels were detected at the inlet stations. Water used for domestic purposes containing this amount of iron can cause staining of plumbing fixtures.

Chlorophyll a and Water Clarity

As indicated by chlorophyll a, the deep water sampling stations were characterized by low to moderate quantities of suspended algae in the illuminated zone of the lake. The mean concentration of chlorophyll a over the three surveys was 3 µg/L and ranged from 0.3 to 11 µg/L. Water clarity, which is measured by means of a Secchi disc was poor, with an average value of 1.7m. This water clarity was somewhat less than expected from the low to moderate algal levels and was probably a result of the colouration of water as well as particulate matter suspended in the euphotic zone.

On a scale of lake enrichment as indicated by mean chlorophyll a concentrations and water clarity (Figure 6), Three Mile Lake demonstrates a low to moderate status of enrichment and is far removed from such highly enriched bodies of water as the Bay of Quinte and the Western Basin of Lake Erie.

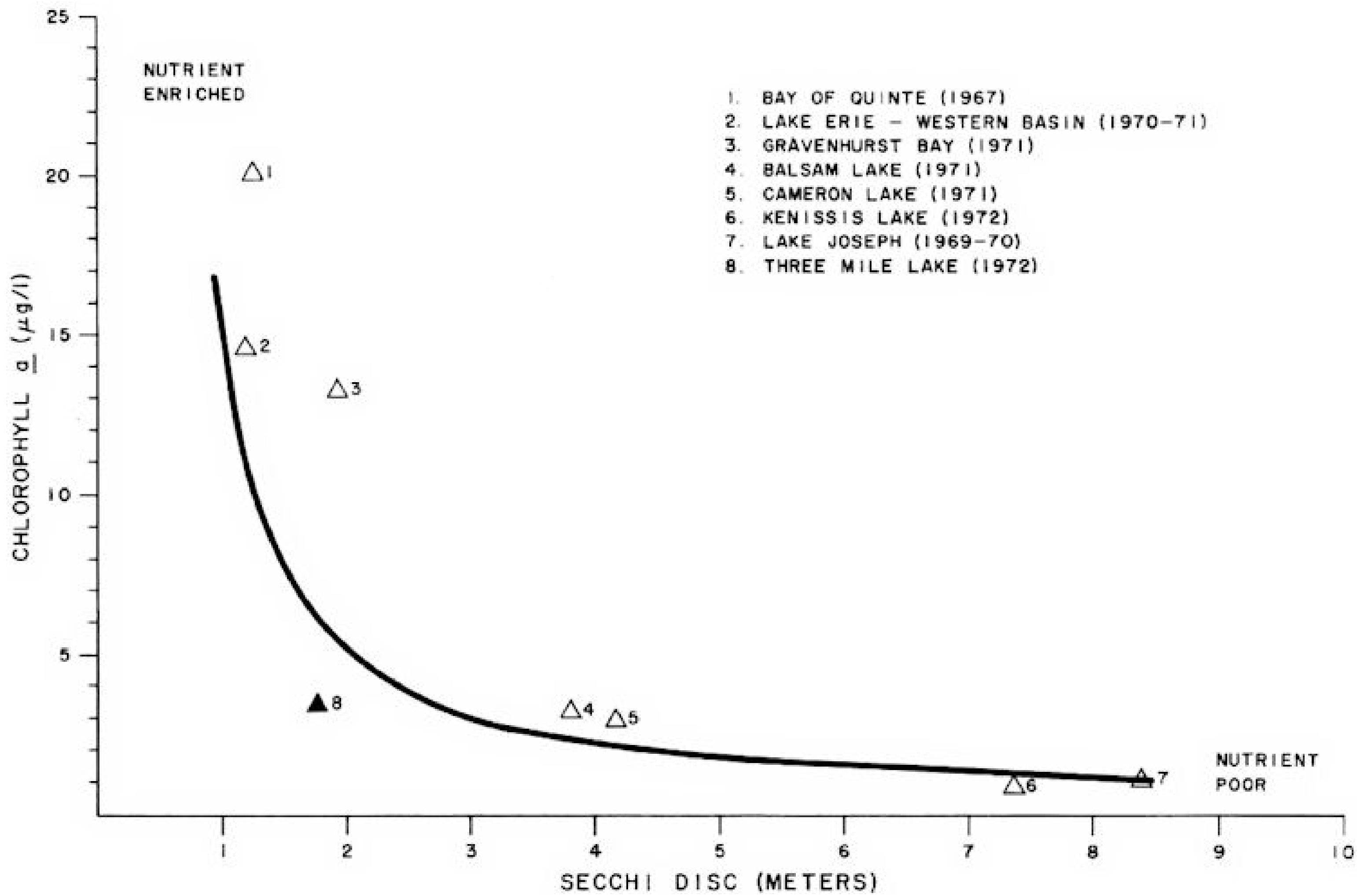

FIGURE 6: The Mean Of Chlorophyll a And Secchi Disc Measurements In Three Mile Lake Relative To A Curve Describing The Chlorophyll a - Secchi Disc Relationship In Many Ontario Lakes. Seven Other Well Known Lakes Are Included For Comparison With Three Mile Lake.

However, it should be realized that the concentration of 11 µg/L observed during the summer survey would indicate that larger amounts of suspended algae (than indicated by the yearly mean) can arise if optimum conditions for growth are met.

Cottagers should ensure that their waste disposal systems are functioning properly, so that seepage to the lake of bacteria and nutrients which stimulate algal growth and thereby decrease water clarity does not occur.

INFORMATION OF GENERAL INTEREST TO COTTAGERS

MICROBIOLOGY OF WATER

For the sake of simplicity, the microorganisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing microorganisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but pose an immediate public health hazard if the water is used fro drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborne infections such as typhoid fever, polio or hepatitis, but he may catch less infections of gastroenteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, subclinical infections usually associated with several water born viruses. These viral infections leave a person not feeling well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions within a relatively short time (approximately 1 year) since disease causing bacteria usually do not thrive in an aquatic environment.

The rest of the bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. Any organic matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Natural organic matter as well as that from sewage, kitchen wastes, oil and gasoline are readily attached by these lake bacteria. Unfortunately, biodegradation of the organic wastes by organisms uses correspondingly large amounts of the dissolved oxygen. If the organic matter content of the lake gets high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep water fish species.

The standard plate count (SPC) populations given in the text supply an indication of the number of these bacteria in the lake.

RAINFALL AND BACTERIA

The "Rainfall Effect" referred to in the text, relates to a phenomena that has been documented in previous surveys of the Recreational Lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses which inhabit human waste disposal systems, can be washed into the lake, In Precambrian areas where there is inadequate soil cover and in fractured limestone areas where fissures in the rocks provide access to the lake, this phenomenon is particularly evident.

Melting snow provides the same transportation function for bacteria, especially in an agricultural area where manure spreading is carried out in the winter on top of the snow. Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

a) Boiling

Boil the water for a minimum of five minutes to destroy the disease causing organisms.

b) Chlorination Using a Household Bleach Containing 4 to $5^{1}/_{4}$% Available Chlorine

Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

c) Continuous Chlorination

For continuous water disinfection, a small domestic hypochlorinator (sometime coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

e) Well Water Treatment

Well water can be disinfected using a household bleach (assuming strength at 5% available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH

per 10 ft depth of water

Diameter of Well Casing In Inches	One to Ten Coliforms	More than Ten Coliforms
4	0.5 oz	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water. Another bacteriological sample should be taken after one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disinfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles if water is periodically turbid and are usually very successful . Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SEPTIC TANK INSTALLATIONS

In Ontario, provincial law requires that you obtain permission in writing to install a septic tank system. Permission can be obtained from the local Medical Officer of Health or in some instances from the Regional Engineer of the Ministry of the Environment. Any other pertinent information such as sizes, types and location of septic tanks and tile fields can also be obtained from the same authority.

(i) General Guidelines

A septic tank should not be closer than:

- 50 feet to any well, lake, stream or pond.
- 5 feet to any building.
- 10 feet to any property boundary

The tile field should not be closer than:

- 100 feet to the nearest dug well.
- 50 feet to a drilled well which has a casing to 25 feet below ground.
- 25 feet to a building
- 10 feet to a property boundary.
- 50 feet to any lake, stream or pond.

The ideal location for a tile field is in a well drained, sandy loam soil remote from any wells or other drinking water sources. For the tile field to work satisfactorily, there should be at least 3 feet of soil between the bottom of the weeping tile trenches and the top of the ground water table or bedrock.

DYE TESTING OF SEPTIC TANK SYSTEMS

There is considerable interest among cottage owners to dye test their sewage systems, however, several problems are associated with dye testing. Dye would not be visible to the eye from a system that has a fairly direct connection to the lake. Thus, if a cottager dye-tested his system and no dye was visible in the lake, he would assume that his system is satisfactory, which might not be the case. A low concentration of dye is not visible and therefore expensive equipment such as a fluorometer is required. Only qualified people with adequate equipment are capable of assessing a sewage system by using dye. In any case, it is likely that some of the water from a septic tank will eventually reach the lake. The important question is whether all contaminants including nutrients have been removed before it reaches the lake. To answer this question special knowledge of the system, soil depth and composition, underground geology of the region and the shape and flow of the shifting water table are required. Therefore, we recommend that this type of study should be performed only by qualified professionals.

BOATING REGULATION

In order to help protect the lakes and rivers of Ontario from pollution it is required by law that sewage (including garbage) from all pleasure craft, including houseboats must be retained in equipment of a type approved by the Ministry of the Environment. Equipment which will be approved by the Ministry of the Environment includes (1) retention devices with or without circulation which retain all toilet wastes for disposal ashore, and (2) incinerating devices which reduce all sewage to ash.

To be approved, equipment shall:

1. be non-portable,
2. be constructed of structurally sound material,
3. have adequate capacity for expected use
4. be properly installed,
5. in the case of storage devices, be equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities (although not specified, a pump-out deck fitting with 1 ½ inch National Pipe Thread is commonly used).

An Ontario regulation requires that marinas and yacht clubs provide or arrange pump-out service for the customers and members who have toilet-equipped boats. In addition, all marinas and yacht clubs must provide litter containers that can be conveniently used by occupants of pleasure boats.

The following "Tips" may be of assistance to you in regards to boating:

1. Motors should be in good mechanical condition and properly tuned.
2. When a tank for outboard motor testing is used, the contents should not be emptied into the water.
3. Fuel hoses must be in good condition and all connections tight.
4. If the bilge is cleaned prior to the boating season, the waste material must not be dumped into the water.
5. Fuel tanks must not be overfilled and space must be left for expansion if the fuel warms up.
6. Vent pipes should not be obstructed and fuel needs to be dispensed at a correct rate to prevent "blow-back".
7. Empty oil cans must be deposited in a leak-proof receptacle.

ICE-ORIENTED RECREATIONAL ACTIVITIES

The Ministry of the Environment is presently preparing regulations to control pollution from ice-oriented recreational activities. In past years, there has been indiscriminate dumping of garbage and sewage on the ice. The bottoms of fish huts have been left on the ice and become a navigational hazard to boaters in the spring. Broken glass has been left on the ice only to become injurious to swimmers. With the anticipated introduction of the regulations, many of these abuses will become illegal.

EUTROPHICATION OR EXCESSIVE FERTILIZATION AND LAKE PROCESSES

The changes in water quality brought about by excessive inputs of nutrients to lakes are usually evidenced by excessive growths of algae and aquatic plants.

Aquatic plants and algae are important in maintaining a balanced aquatic environment. They provide food and a suitable environment for the growth of aquatic invertebrate organisms which serve as food for fish. Shade from large aquatic plants helps to keep the lower water cool which is essential to certain species of fish and also provide protection for young game and forage fish. Numerous aquatic plants are utilized for food and/or protection by many species of waterfowl. However, too much growth creates an imbalance in the natural plant and animal community particularly with respect to oxygen conditions, and some desirable forms of life such as sport fish are eliminated and unsightly algae scums can form.

The lake will not be "dead" but rather abound with life which unfortunately is not considered aesthetically pleasing. This change to poor water quality becomes apparent after a period of years in which extra nutrients are added to the lake and a return to the natural state may also take a number of years after the nutrient inputs are stopped. Changes in water quality with depth are a very important characteristic of a lake. Water temperatures are uniform throughout the lake in the early spring and winds generally keep the entire volume well mixed. Shallow lakes may remain well mixed all summer so that water quality will be the same throughout.

On the other hand, in deep lakes, the surface waters warm up during late spring and early summer and float on the cooler more dense water below. The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water receives no oxygen from the atmosphere during this unmixed period and the dissolved oxygen supply may be all used up by bacteria as they decompose organic matter. Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen and because of the high water temperatures they will not thrive, so that the species will probably die out (see Figure next page).

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution but excessive aquatic plant and algae growth and subsequent decomposition can aggravate the condition and in some cases can result in zero oxygen levels in lakes which had previously held some oxygen in the bottom waters all summer. Although plant nutrients normally accumulate in the bottom waters of lakes, they do so to a much greater extent if there is no oxygen present. These nutrients become available for algae in the surface waters when the lake mixes in the fall and dense algae growths can result. Consequently, lakes which have no oxygen in the bottom water during the summer are more prone to having algae problems and are more vulnerable to nutrient inputs than lakes which retain some oxygen.

CONTROL OF AQUATIC PLANTS AND ALGAE

Usually aquatic weed growths are heaviest in shallow shoreline areas where adequate light and nutrient conditions prevail. Extensive aquatic plant and algal growths sometimes interfere with boating and swimming and ultimately diminish shoreline property values.

Control of aquatic plants may be achieved by either chemical or mechanical means. Chemical methods of control are currently the most practical, considering the ease with which they are applied. However, the herbicides and algicides currently available generally provide control for only a single season.

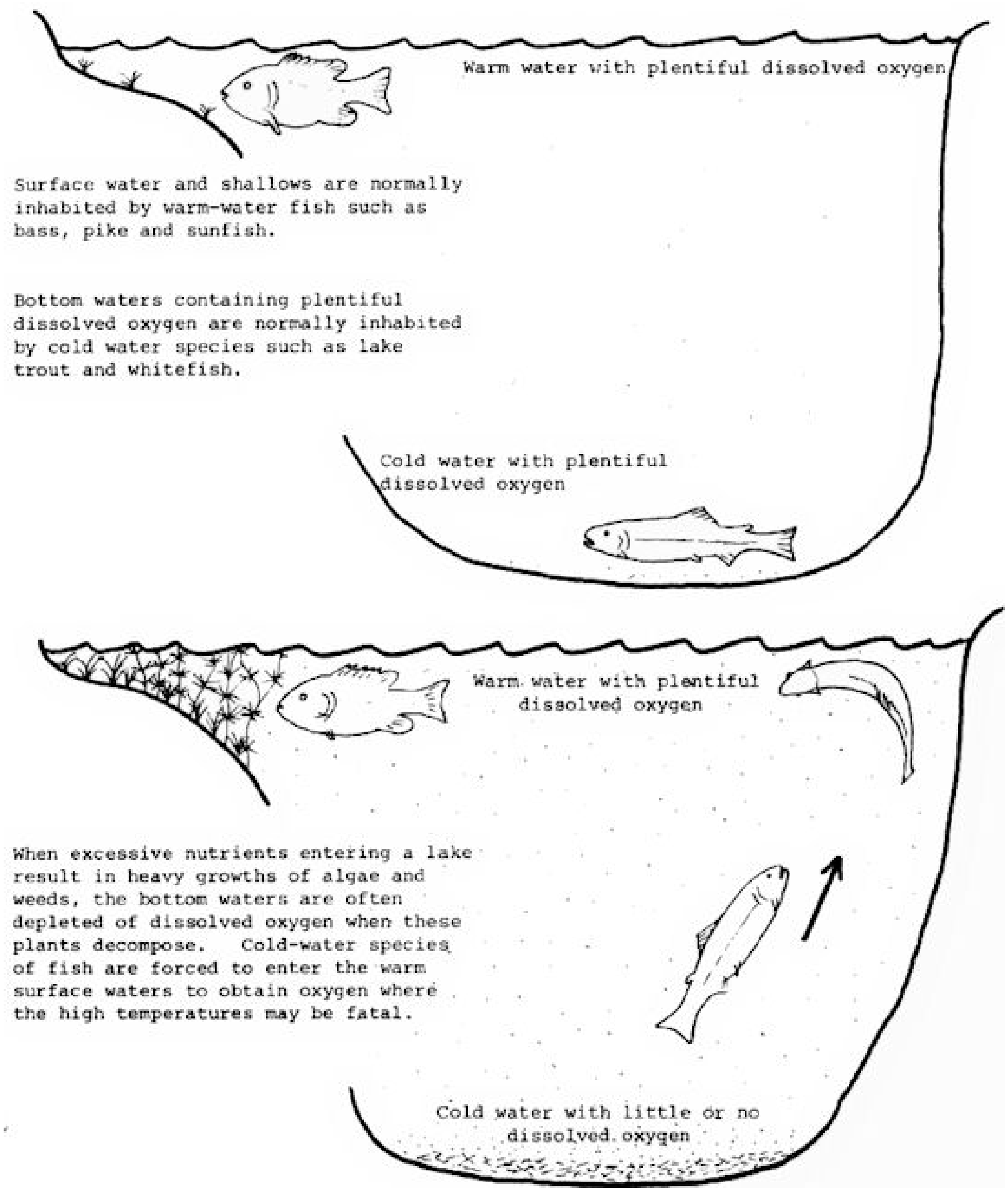

FIGURE A-1: Decomposition Of Plant Matter At The Lake Bottom Can Lead To Death Of Deep-water Fish Species.

It is important to ensure that an algicide or herbicide which kills the plants causing the nuisance, does not affect fish or other aquatic life and should be reasonable in cost. At the present time, there is no one chemical which will adequately control all species of algae and other aquatic plants. Chemical control in the province is regulated by the Ministry of the Environment and a permit must be granted prior to any operation. Simple raking and chain dragging operations to control submergent species have been successfully employed in a number of situations; however, the plants soon re-establish themselves. Removal of weeds by underwater mowing techniques is certainly the most attractive method of control and is currently being evaluated in Chemung Lake near Peterborough. Guidelines and summaries of control methods, and applications for permits are available from the Biology Section, Water Quality Branch, Ministry of the Environment, Box 213, Rexdale, Ontario.

PHOSPHORUS AND DETERGENTS

Scientists have recognized that phosphorus is the key nutrient in stimulating algal and plant growth in lakes and streams.

In the past years, approximately 50% of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced the phosphate content as P_20_5 in laundry detergents from approximately 50% to 20% on August 1, 1970 and to 5% on January 1, 1973.

It should be recognized that automatic dishwashing compounds were not subject to the recently approved government regulations and that surprisingly high numbers of automatic dishwashers are present in resort areas (a questionnaire indicated that about 30% of the cottages in the Muskoka Lakes have automatic dishwashers). Cottagers utilizing such conveniences may be contributing significant amounts of phosphorus to recreational lakes. Indeed, in most of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes.

ONTARIO'S PHOSPHORUS REMOVAL PROGRAM

By 1975, the Government of Ontario expects to have controls in operation at more than 200 municipal wastewater treatment plants across the province serving some 4.7 million persons. This represents about 90% of the population serviced with sewers. The program is in response to the International Joint Commission recommendations as embodied in the Great Lakes Water Quality Agreement and studies carried out by the Ministry of the Environment on inland recreational waters which showed phosphorus to be a major factor influencing eutrophication. The program makes provision for nutrient control in the Upper and Lower Great Lakes, the Ottawa River system and in prime recreational waters where the need is demonstrated or where emphasis is placed upon prevention of localized eutrophication Phosphorus removal facilities must be operational at wastewater treatment plants by December 31, 1973, in the most critically affected areas of the province, including all of the plants in the Lake Erie drainage basin and the inland recreational areas.

The operational date for plants discharging to waters deemed to be in less critical condition which includes plants larger than one million gallons per day (1 mgd) discharging to Lake Ontario and to the Ottawa River system, is December 31, 1975. The 1973 phase of the program will involve 156 plants of which 85 are in the Lake Erie basin and another 30 in the Lake Huron drainage basin. The capacities of these plants range from 0.04 to 214.0 mgd, serving an estimated population of 1,600,000 persons. The 1975 phase will bring into operation another 57 plants ranging in size from 0.3 to 180 mgd serving an additional 3,100,000 persons. Treatment facilities utilizing the Lower Great

Lakes must meet effluent guidelines of less than 1.0 milligrams per litre of total phosphorus in their final effluent. Facilities utilizing the Upper Great Lakes, the Ottawa River Basin and certain areas of Georgian Bay where needs have been demonstrated must remove at least 80% of the phosphorus reaching their sewage treatment plants.

CONTROL OF BITING INSECTS

Mosquitoes and blackflies often interfere with the enjoyment of recreational facilities at the lake-side vacation property. Pesticidal spraying or fogging in the vicinity of cottages produces extremely temporary benefits and usually do not justify the hazard involved in contaminating the nearby water. Eradication of biting fly populations is not possible under any circumstances and significant control is rarely achieved in the absence of large-scale abatement programmes involving substantial funds and trained personnel. Limited use of approved larvicides in small areas of swamp or in rain pools close to residences on private property may be undertaken by individual landowners, but permits are necessary wherever treated waters may contaminate adjacent streams or lakes. The use of repellents and light traps is encouraged as are attempts to reduce mosquito larval habitat by improving land drainage. Applications for permits to apply insecticides as well as technical advice can be obtained from the Biology Section, Water Quality Branch of the Ministry of the Environment, Box 213, Rexdale, Ontario.