ENVIRONMENT
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WATER TEMPERATURE AND EVAPORATION REGIMES AND FREEZE–UP CHARACTERISTICS OF SELECTED LAKES IN NORTHERN ONTARIO

BY

T.L. RICHARDS AND M.S. WEBB

CLIMATOLOGICAL STUDIES
NUMBER 18

TORONTO ONTARIO

U.D.C. 551.579 (713)

Price $1.50

Price: $1.50 Catalogue No. En 57-7/18

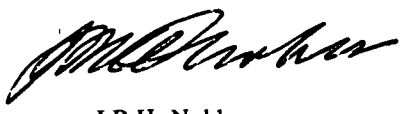
Price subject to change without notice

Information Canada
Ottawa, 1971

FOREWORD

From 1966 to 1969, the Hydrometeorological Section, Canadian Meteorological Service undertook twenty-three aerial surveys of the surface water temperatures of thirty-five representative and relatively inaccessible lakes in Northern Ontario using an infra-red radiation thermometer. This very large fund of new data has been used to establish, for the first time, temperature and evaporation regimes for each of these lakes. Ice observations, taken primarily during the freeze-up period, have also been used to describe the freeze-up characteristics of the individual lakes. This unique set of analyzed water temperature, evaporation and ice data should prove highly valuable to the hydrologists, meteorologists, limnologists and engineers responsible for the proper management of Northern Ontario's Water Resources.

This paper is part of the Canadian Meteorological Service's commitment to a federal-provincial study of the region's water resources and also serves as a contribution to the Canadian International Hydrological Decade (IHD) program as Project BD–L–4, NORTH–1.



J.R.H. Noble,
Administrator,
Canadian Meteorological Service.

TABLE OF CONTENTS

TABLES

LAKE DATA SHEETS

FIGURES

WATER TEMPERATURE AND EVAPORATION REGIMES AND FREEZE-UP CHARACTERISTICS OF SELECTED LAKES IN NORTHERN ONTARIO

T.L. Richards and M.S. Webb

INTRODUCTION

There are thousands of lakes in Canada, many of them still nameless, of which little or nothing is known relative to their water resources potential. To date, progress has been slow in establishing the hydrometeorological characteristics of these lakes due mainly to their sheer numbers and to the relative inaccessibility of much of Canada's lake country. Recently, however, newly developed infra-red sensing techniques combined with aerial surveys have made possible the fast and convenient measurement of surface water temperatures of such water bodies from the air. The resulting water temperature data have, in turn, led directly to improved estimates of evaporation losses from the same lakes. In addition, these aerial surveys have also provided observations of ice cover during the appropriate seasons. This paper describes a project which has successfully employed aerial survey techniques in support of a major water resources study and presents a wealth of new information concerning the water temperature and evaporation regimes and the freeze-up characteristics of a group of representative lakes in Northern Ontario.

The Northern Ontario Project

After a thorough test and evaluation of the usefulness of the infra-red thermometer as an airborne indicator of surface water temperatures in 1965, the Lakes Investigation Unit, Canadian Meteorological Service deemed the ART technique operationally feasible (1) (2). As a result, the Unit began regular survey flights over the Great Lakes in 1966 which have already been reported upon (3) and at the same time embarked on a four-year survey program of a number of comparatively smaller lakes in Northern Ontario. This latter project was undertaken as a part of a Meteorological Service commitment to a federal-provincial study of water resources in Northern Ontario and also served as a contribution to the Canadian International Hydrological Decade (IHD) Program as Project BD–L–4, NORTH–1.

The major objectives of the project were:

(i) to establish the surface water temperature regimes of a number of lakes in Northern Ontario representing a variety of such physical features as latitude, depth and area,
(ii) to establish the evaporation regimes of the same lakes from the observed water temperatures and other climatological data, and
(iii) to observe ice cover during freeze-up and break-up, when and if possible.

Instrumentation

An infra-red sensing instrument manufactured by the Barnes Engineering Company (Model IT–2S later replaced by Model IT–3S) was selected on the basis that it was readily available, conveniently partable and reasonably priced. This particular model has an advertised mid-scale sensitivity of ¾°F (0.4°C) and an absolute accuracy of 1½°F (0.8°C). The field of view is a 3° cone and the temperature is read directly from a meter on an electronics console to which a recorder is attached. The power requirement is 105–125 volts, 60 cycles per second and 25 watts.

The instrument package, installed on a chartered twin-engined aircraft, consists of a sensor or sensing head, an electronics console with temperature meter, a recorder and a power inverter. With the exception of the sensor, all the equipment was shock-mounted on an instrumental panel in the aircraft cabin. The sensor itself was mounted on a bracket on the aircraft floor with a field of view through a specially shielded opening in the floor.

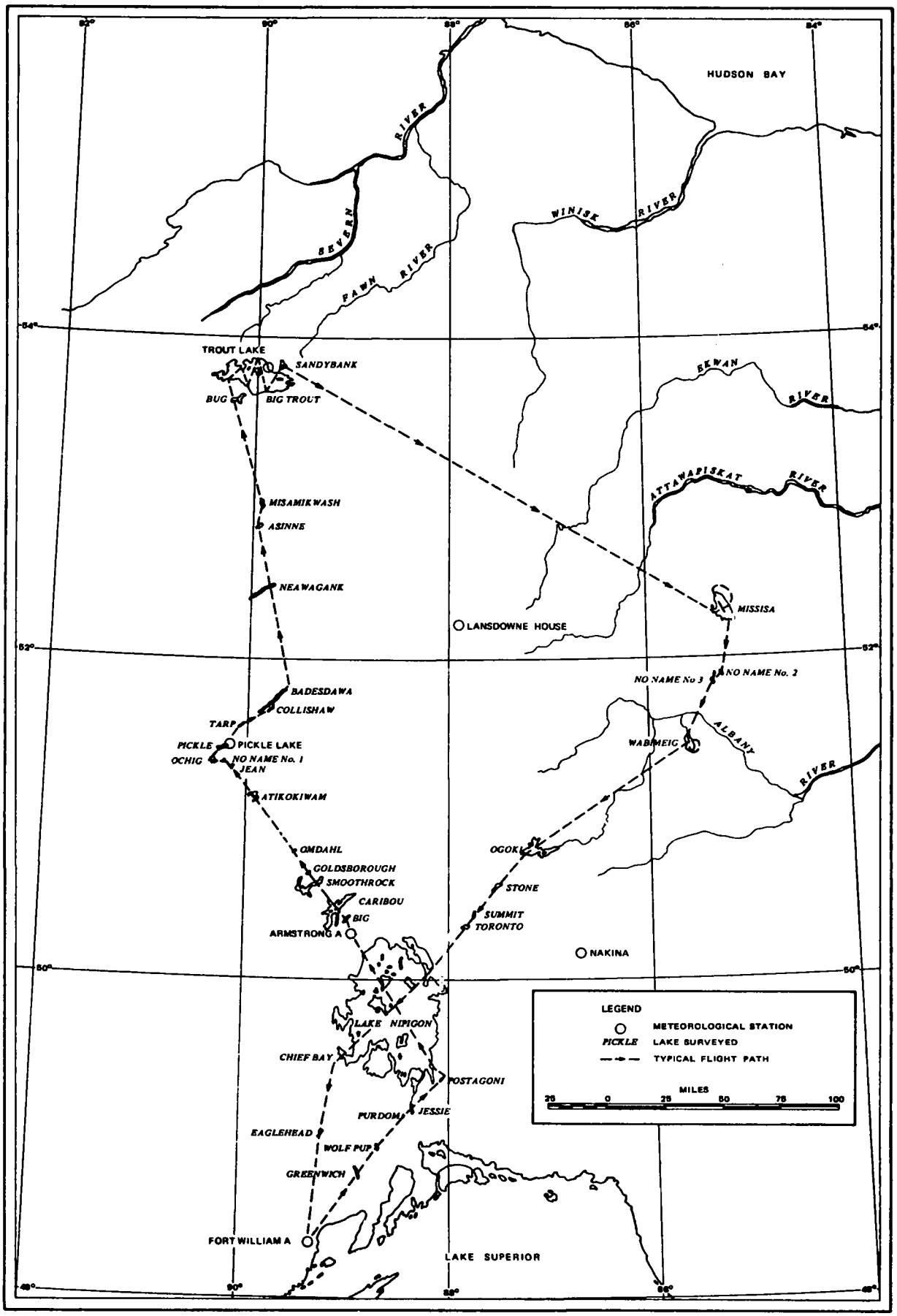


Figure 1. Typical Flight Path and Lakes Observed on ART Surveys of Surface Temperatures of Northern Lakes.

Survey Technique

The usual ART survey technique consists of flying over a fixed route at a height of 1,000 feet above the ground. The technique is weather dependent and to be reliable there must be no cloud below the flight level, visibility must be three miles or greater and no precipitation should be falling. In-flight water-bath calibrations are made periodically during the flight, preferably about every 20 minutes. A series of corrections is also made for the environmental error introduced by the layer of atmosphere between the aircraft and the water surface. These latter corrections are based on a method developed by Shaw (4) while he was associated with the original Meteorological Service ART Test and Evaluation Project.

Accuracy

The present instrumentation and calibration techniques provide an absolute accuracy of ±1.0°C with a relative accuarcy of better than ±0.5°C. It is important however, to realize that the infra-red thermometer senses the temperature of the micro-surface or "skin" of the water, whereas the more conventional bucket thermometer is more likely to read the average temperature of the top 6–12 inches of the surface water. Preliminary studies have reported an average difference of 0.6°C between skin and bucket temperatures. The Meteorological Service test and evaluation studies found that an infra-red thermometer mounted on a research vessel recorded readings which averaged 0.4°C lower than the simultaneous bucket temperatures with individual readings ranging from 0 to 0.8°C below the bucket temperatures. These differences pose no problem for this particular study since the rate of evaporation is related directly to the skin temperature of the water surface.

THE NORTHERN ONTARIO PROJECT

ART Surveys

The Northern Ontario ART surveys were made over a relatively fixed 1000-mile route designed to observe thirty-five representative lakes between Lake Superior and Hudson Bay. Each flight started and ended at Thunder Bay (Fort William) and passed over Armstrong, Pickle Lake, Trout Lake and Lake Missisa. Survey times averaged six and a half hours. A typical flight pattern is shown in Figure 1.

The lakes were selected to provide as wide a variety of physical features, as possible, – i.e. shape, area, depth, latitude and physiography of the surrounding land. Just over five degrees of latitude were covered between the most southerly lake (Greenwich, 48° 48′ N) and the most northerly one (Sandybank, 53° 50′ N). Physiographical features varied from the typical rock formations of the Laurentian Shield in the southern and western portions of the route to the Hudson Bay and James Bay lowlands in the extreme northeast. Only five of the lakes had been previously sounded and of this group mean depths ranged from 52 feet for Big Trout Lake to only 3.6 feet for Sandybank Lake. Areas varied from 0.8 square miles for Lake Purdom to 250 square miles for Big Trout Lake. (One or two crossings of Lake Nipigon (1870 square miles) were also made on each survey. The data from these crossings have been tabulated, but they are insufficient for analysis purposes and will not be included in the discussion).

Table 1

ART SURVEYS – NORTHERN ONTARIO WATER RESOURCES STUDY

Year/Month	May	June	July	Aug.	Sept.	Oct.	Nov.
1966			26	24	21	19–20	
1967		21–22	26	23	13	4	7
1968				14	5,26	21	5
1969	29	11–12,24		12	17	7,22	4

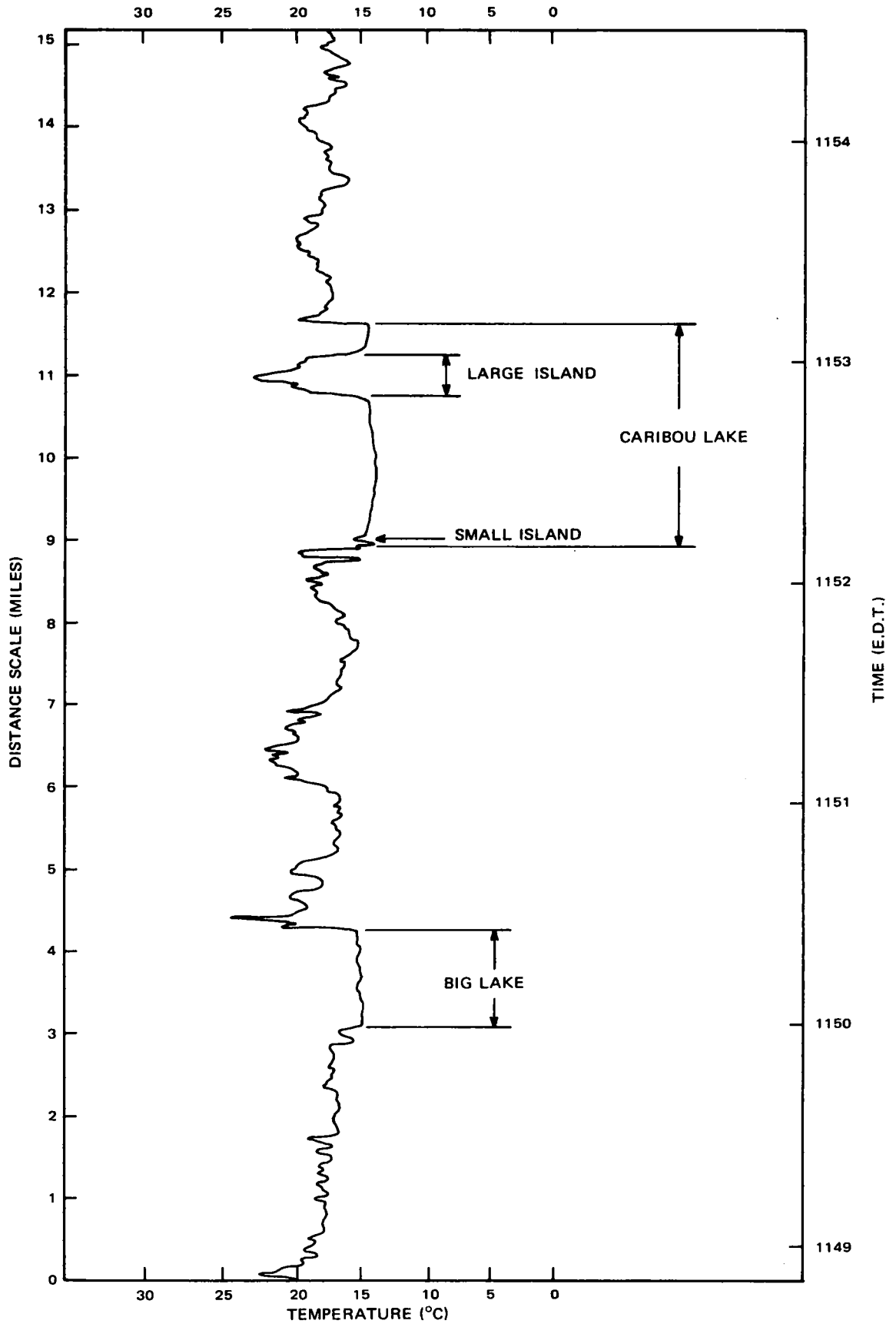


Figure 2. Typical ART Recording of Surface Temperature of Two Lakes in Northern Ontario, 24 June 1969.

The four-year program originally contained plans for seven survey flights a year from 1966 to 1969 inclusive. This objective was not met in its entirety due partly to adverse flying conditions particularly in the spring of each year and partly due to budgetary restrictions notably in 1968. However, a total of 23 surveys were completed as indicated in Table 1 and as a result a large volume of totally new data is now available.

Basic ART Data

Most of the lakes included in the surveys were sufficiently small that a single ART crossing could be considered as representative. In these cases the basic water temperature data were in the form of a short analogue trace from which a corrected mean temperature could be readily obtained. Figure 2 shows an example of such traces for Caribou Lake and Big Lake.

For a few relatively larger lakes such as Big Trout, Missisa and Wabimeig flight patterns consisting of several crossings per lake were made to ensure a representative survey. Significant temperatures were then abstracted from the analogue traces and these were corrected, plotted and analyzed for isotherm patterns. The mean lake surface water temperature was then found by means of planimetering. Figure 3 shows the flight pattern used for Big Trout Lake and an example of an isotherm analysis for the same lake. A series of four tables in Appendix A displays all the corrected surface water temperatures for all the lakes covered in the 23 surveys.

Data Analyses

The remainder of the paper deals with the analysis and adaptation of the observed data followed by a presentation and brief discussion of the results. The analyzed data have been condensed into a one-page Lake Data Sheet for each of the thirty-five lakes that were surveyed. In addition to the basic information such as location, area and depth (where known), each Data Sheet includes a table of mean monthly surface water temperatures and observations of freeze-up, and a table of estimated monthly evaporation losses. Each Data Sheet also includes a condensation of the tabulated information in the form of a graph illustrating the annual water temperature regime and a set of histograms representing the evaporation regime of the lake.

SURFACE WATER TEMPERATURES

The basic corrected surface water temperature data in Appendix A were first plotted as a set of four annual temperature graphs for each lake. Mean surface water temperatures for each month of each of the four years were then extracted from the graphs and these are displayed in the first table of each of the Lake Data Sheets. The resultant averages were taken as four-year monthly "normals" and were used as the basis of the subjectively prepared graphical presentation of the surface water temperature regimes shown in the figures in the lower portion of each of the Lake Data Sheets.

During three of the four years under study the survey program included flights in early November. Although there were not sufficient data to establish a mean November temperature it was possible to estimate a mean temperatute for November 5 and this information has been included in each water temperature table. A single set of May (29) observations obtained in 1969 has also been included.

EVAPORATION

There are several recognized methods for determining evaporation losses from lakes. These include such established techniques as the Water Budget, Energy Balance, Aerodynamic and Mass Transfer Methods. A detailed description of each these methods may be found in the World Meteorological

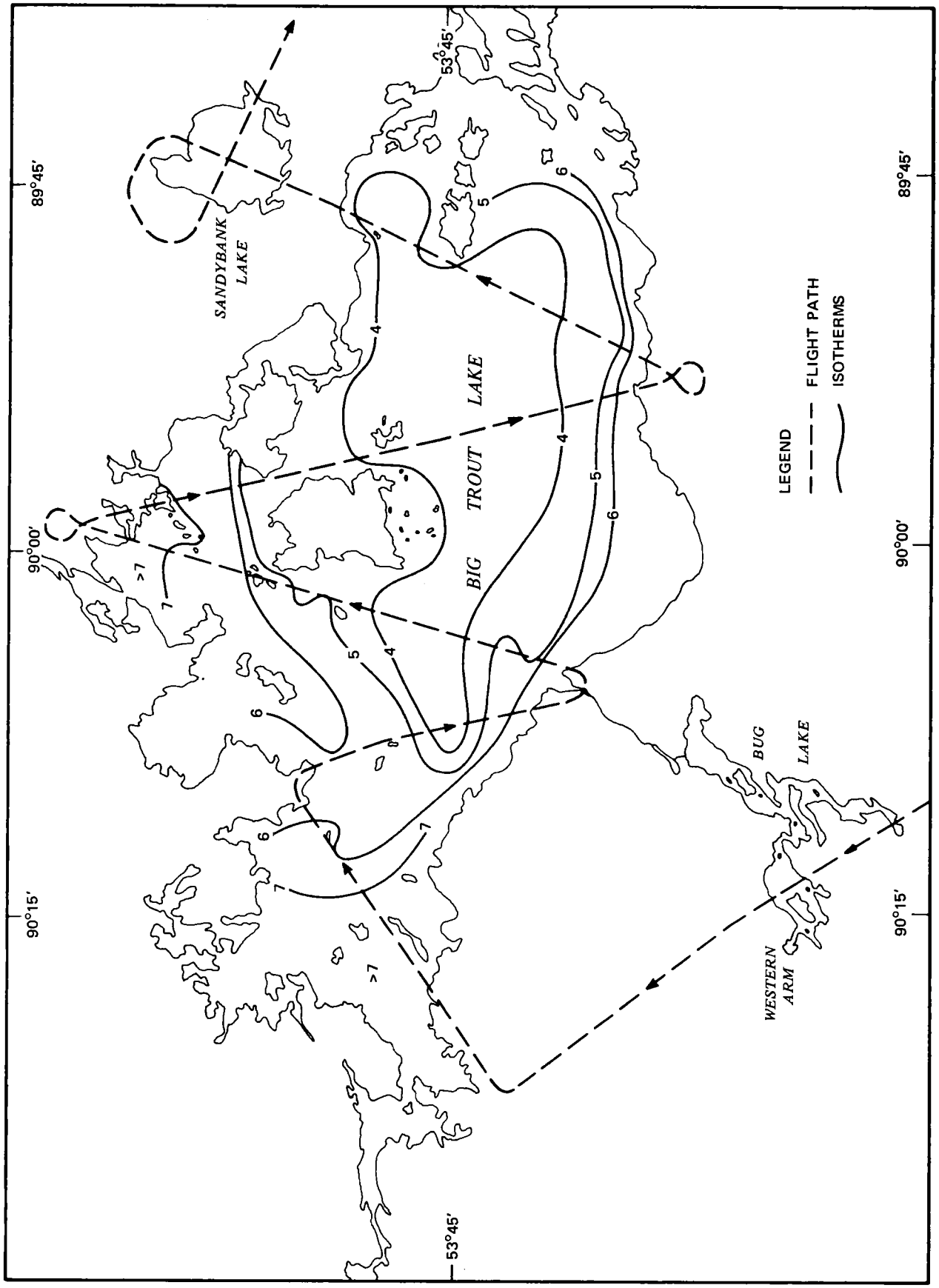


Figure 3. Flight Path of ART Survey of Big Trout Lake on 12 June 1969 and Resulting Isotherm Analysis (°C)

Organization Technical Note #83 (5). Richards (6) has also discussed the relative merits of the same techniques when applied to the Great Lakes. The Mass Transfer Method was chosen for this study because of its proven reliability and ease of application. It was also the only method for which all the necessary data were available.

The equation used in this study was the one developed in the Lake Hefner (USGS, 1954) (7) and Lake Meade (USGS, 1958) (8) studies where it was found that a simple form of the Dalton equation produced reliable results; i.e.

$$E = 0.0024 (e_s - e_{ae}) V$$

where: E = evaporation, inches per day,

e_s = saturation pressure in inches of mercury at surface water temperature (obtained from surface water temperature surveys),

e_{ae} = vapour pressure of air in inches of mercury (obtained from climatological data),

V = wind speed in miles per day (obtained from climatological data).

It is interesting to note that an adaptation of the same equation has also given reliable results for the Great Lakes (9).

In order to make monthly estimates of evaporation losses from the equation the basic data required are monthly means of surface water temperatures which were available from the ART surveys and monthly means of vapour pressure (humidity) and wind speed which were available from the climatological records of the Canadian Meteorological Service. The mean monthly water temperatures were taken from the tables in the Lake Data Sheets and the mean humidity data and wind data were obtained from the records of meteorological observing stations in the survey area, i.e. Armstrong, Thunder Bay (Fort William), Nakina, Pickle, Lake, Lansdowne House and Trout Lake. The locations of these stations are shown in Figure 1 and the data that were employed are tabulated in Appendix B.

The resulting estimated monthly evaporation losses for each of the lakes are displayed in the second table of each of the Lake Data Sheets. The four-year monthly "normals" derived from the tabulated data have been plotted as histograms in the figures at the bottom of each Lake Data Sheet to illustrate the evaporation regime of each lake.

ICE COVER

The ice cover portion of the project was not entirely successful. No springtime observations of ice were obtained due to very poor flying conditions at the time of break-up. However, the early November flights in 1967, 1968 and 1969 were more successful and the ice cover observations have been noted in the final column of the first table of each of the Lake Data Sheets; "F" indicates complete ice cover, "PF" partial ice cover, "O" open water. The dates of the relevant surveys are shown in brackets.

DISCUSSION

It was the original intent of this paper to present four years of basic surface water temperature data for some thirty-five representative lakes in Northern Ontario and to analyze these data to the point of establishing water temperature and evaporation regimes for each of the lakes. This has been achieved with the tabulation of the basic data in Appendix A and the tabulation of the analyzed data in the Lake Data Sheets. Observations of ice cover in early November have also been included in the Data Sheets when available. More comprehensive studies based on the data and analyses presented in the paper have been planned and will be reported upon in subsequent papers. In the meantime, however, a survey of the available information reveals some interesting features that warrant at least a preliminary discussion.

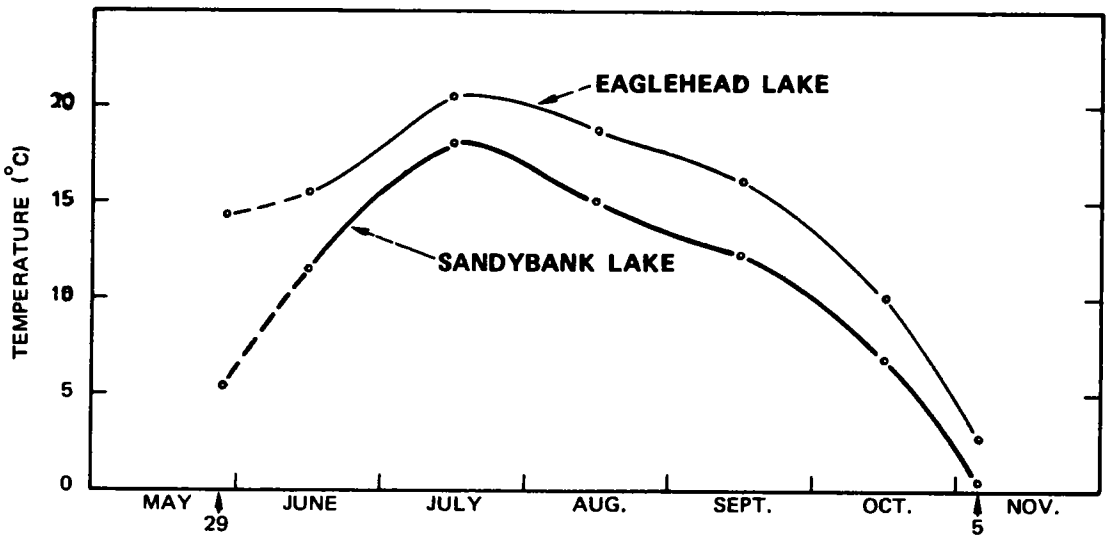


Figure 4. Surface Water Temperature Regimes for Eaglehead (south) and Sandybank (north) Lakes Illustrating Differences Due to Latitude.

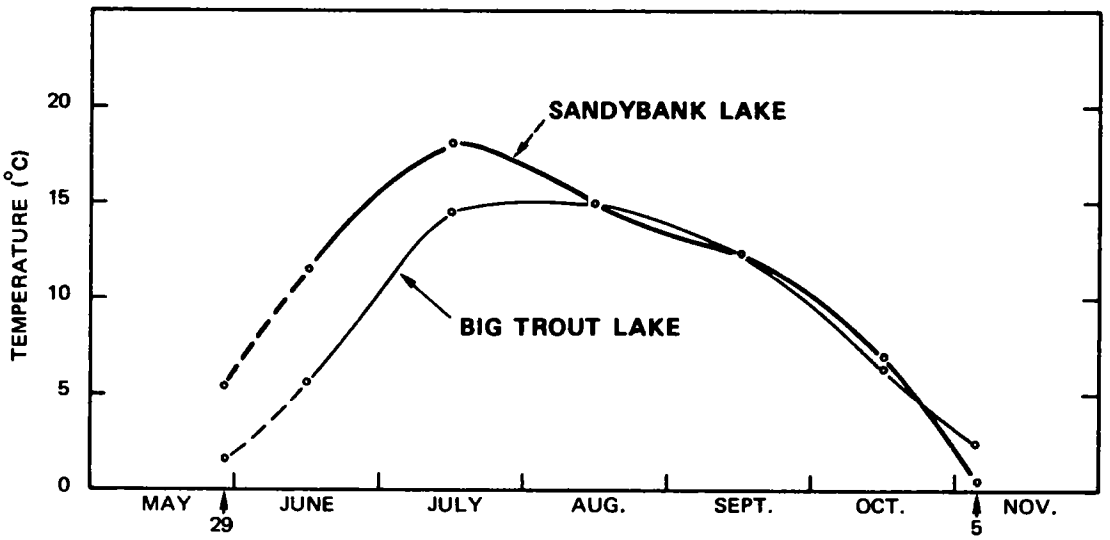


Figure 5. Surface Water Temperature Regimes for Sandybank (shallow) and Big Trout (deep) Lakes Illustrating Differences Due to Mean Depth.

Water Temperature Regimes

Intuitively it would be expected that the surface water temperature regime of each lake would be a function of its latitude and depth; i.e. lakes of equal depth should warm faster and to a higher temperature in the south than in the north, and shallow lakes at similar latitudes should warm faster and to a higher degree than deeper lakes.

The latitudinal effect is well illustrated by comparing the average annual surface water temperature curve for Eaglehead Lake at a latitude of 49°03′ (Data Sheet 10) to that of Sandybank Lake at latitude 53°50′ (Data Sheet 28) in Figure 4. As would be expected the more southerly-situated lake warms faster and to a higher temperature than does the northerly one.

The effect of depth is illustrated in Figure 5 where the average surface water temperature curve for relatively deep Big Trout Lake (mean depth 52.0 feet) is compared to that of nearby and shallow Sandybank Lake (mean depth 3.6 feet). Here it is evident that the shallow lake warms much more quickly and to a higher temperature than the deeper lake. It may also be noted that the shallow lake reaches its highest temperature (18°C) in July whereas the deeper lake does not reach its highest temperature (14.9°C) until August.

Several studies concerned with the surface water temperatures of lakes in Northern Ontario are currently in progress. These are planned to relate mean monthly water temperatures to air temperature and to such physical features as the depth and latitude of each of the lakes. A further study is also planned hopefully to exploit the evident differences between the temperature regimes of deep lakes and shallow lakes by developing a scheme to estimate the depth of the lake from the characteristics of its surface water temperature regime.

Evaporation Regimes

It is implicit in the Mass Transfer Equation that the rate of evaporation from a lake is closely related to its surface water temperature and in general the data in the Lake Data Sheets confirm this. An example of an extreme case may be found where warm Eaglehead Lake, which is both southerly situated and shallow, has an average June to October total evaporation loss of 16.38 inches as compared to an evaporation loss of only 8.02 inches from cool Big Trout Lake which is both northerly and deep.

A good example of the heat storage effect of a larger lake may be found by comparing the evaporation loss histograms from two adjacent lakes, Big Trout (Sheet 5) and Sandybank (Sheet 28). Shallow Sandybank Lake shows highest losses in July whereas the much deeper Big Trout shows highest losses later in the season, i.e. August through to October.

Freeze-up Characteristics

A lake's freeze-up characteristics, like its surface water temperature regime, are also affected by its location and depth. The ice cover data from the Lake Data Sheets confirms that in general, when comparing lakes of equal depth, the northern ones freeze over before the southern ones, i.e. Jessie Lake (latitude 49° 12′) shows no ice cover in early November whereas Sandybank Lake (latitude 53° 50′) was completely ice covered twice and partially frozen over once in the three years of ice observations. On the other hand a deep lake, because of its greater heat storage capacity, will freeze over at a later date than a shallow one, i.e. while Sandybank Lake is ice covered in early November nearby Big Trout remains open.

No further analyses of ice cover data have yet been undertaken, however future studies have been planned which will incorporate these data with observations of ice cover received from satellites.

SUMMARY

A large volume of surface water temperature data collected over a four-year period by means of twenty-three ART surveys covering thirty-five lakes in Northern Ontario has been presented in tabulated and graphical form. This information has been condensed into one page Lake Data Sheets. Evaporation estimates for each lake, derived by the Mass Transfer Technique, and based on the ART temperature data and climatological records of humidity and wind, are similarly displayed on the some Data Sheets. Ice cover information, limited to November observations, has also been included in the tabulations.

While the data are, at best, only a partial record for a relatively short four-year period they do represent much more information converning a wide variety of lakes in Northern Ontario than has been previously available. As a result, both the surface water temperature and evaporation regimes of the thirty-five representative lakes have been defined and briefly discussed. Although preliminary in nature, the discussion cites cases where there are evident relationships between surface water temperatures (and also evaporation losses and ice cover) and such physical factors as the latitude and depth of the individual lakes and the climatological records of air temperature, humidity and wind.

It is recognized that the available data warrant more detailed analyses and more comprehensive discussions. These will form the basis for subsequent studies, some of which are already in progress.

ACKNOWLEDGEMENTS

The authors are deeply indebted to the members of the Lakes Investigation Unit's ART survey team (Research Associate J.G. Irbe and Research Assistants D.G. Massey and T.H. Cutler) without whose depth of experience and tenacity of purpose there would have been little or no data.

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LAKE DATA SHEET 1

ASINNE LAKE

Location: Lat. 52°50′
Long. 89°56′

Depth: Mean Max.
Area: 3.3 sq. mi.

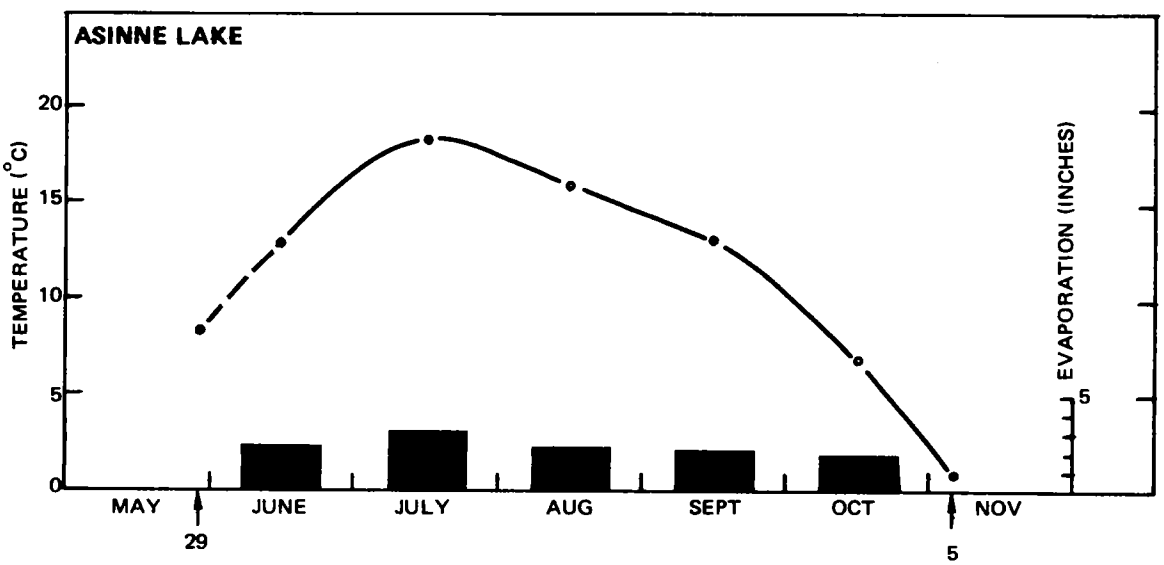
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			18.7	15.0	14.2	6.0		
1967		13.5	18.7	17.6	15.2	9.2	1.0	PF (Nov 7)
1968				13.0	13.3	7.3	1.7	PF (Nov 5)
1969	8.4	12.6	17.6	18.2	10.2	4.7	0.0	F (Nov 4)
Mean	8.4	13.0	18.3	15.9	13.2	6.8	0.9	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		3.07	1.69	3.14	1.93
1967	2.56	3.89	3.49	3.12	2.87
1968			1.30	1.35	1.46
1969	2.34	2.43	3.01	1.45	1.59
Mean	2.45	3.13	2.37	2.27	1.96



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 2

ATIKOKIWAM LAKE

Location: Lat. 51°10′ Depth: Mean Max.
Long. 89°40′ Area: 2.9 sq. mi.

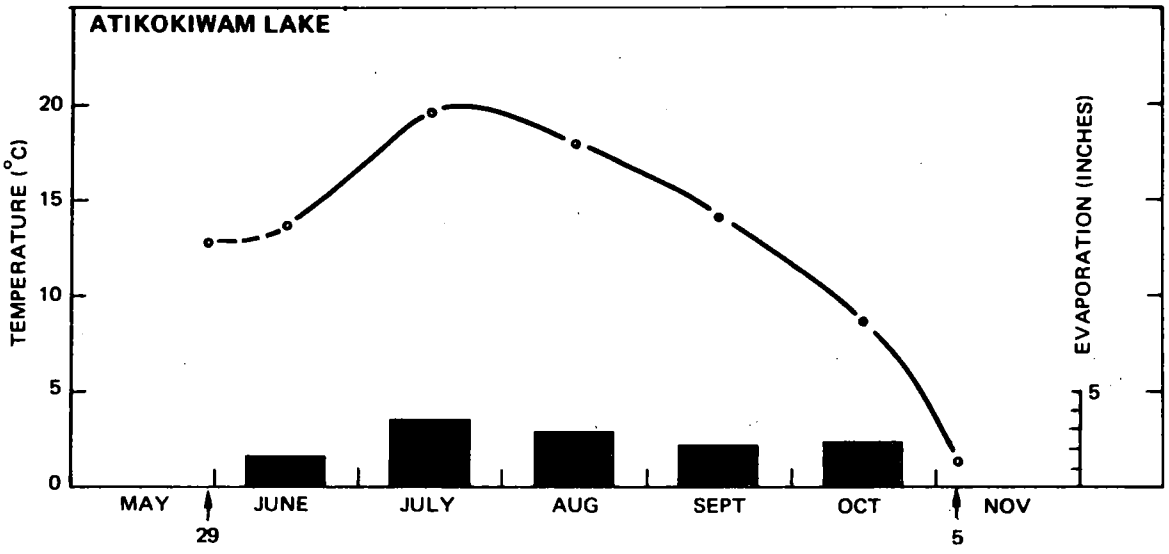
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			18.7	17.6	16.0			
1967		14.0	20.7	19.0	13.6	10.0	1.0	F (Nov 7)
1968				14.8	14.4	8.7	2.6	O (Nov 5)
1969	12.8	13.0	19.5	20.4	12.5	7.4	0.4	O (Nov 4)
Mean	12.8	13.5	19.6	18.0	14.1	8.7	1.3	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		2.89	2.28	3.66	
1967	2.41	4.55	4.19	1.95	2.79
1968			1.61	1.62	2.07
1969	1.23	2.98	3.57	1.33	2.17
Mean	1.82	3.47	2.91	2.14	2.34



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 3

BADESDAWA LAKE

Location: Lat. 51°45′
Long. 89°45′

Depth: Mean 6.2′ Max. 34.0′
Area: 9.5 sq. mi.

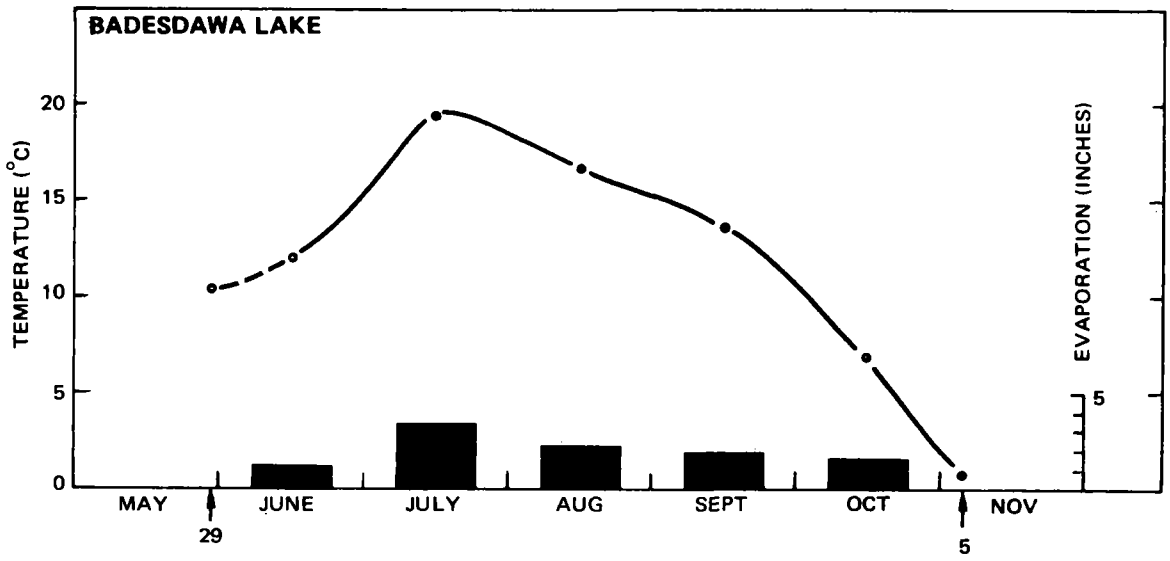
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			18.7	15.5	14.8	6.0		
1967		12.0	20.0	17.6	14.2	7.6	0.7	F (Nov 7)
1968				13.5	14.0	8.0	1.5	O (Nov 5)
1969	10.3	12.0	19.6	19.8	11.3	5.6	0.2	PF (Nov 4)
Mean	10.3	12.0	19.4	16.6	13.6	6.8	0.8	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		2.89	1.46	3.02	1.66
1967	1.58	4.11	3.43	2.21	1.97
1968			1.10	1.54	1.31
1969	0.84	3.03	3.25	1.03	1.65
Mean	1.21	3.34	2.31	1.95	1.66



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 4

BIG LAKE

Location: Lat. 50°24′
Long. 88°59′

Depth: Mean Max.
Area: 4.1 sq. mi.

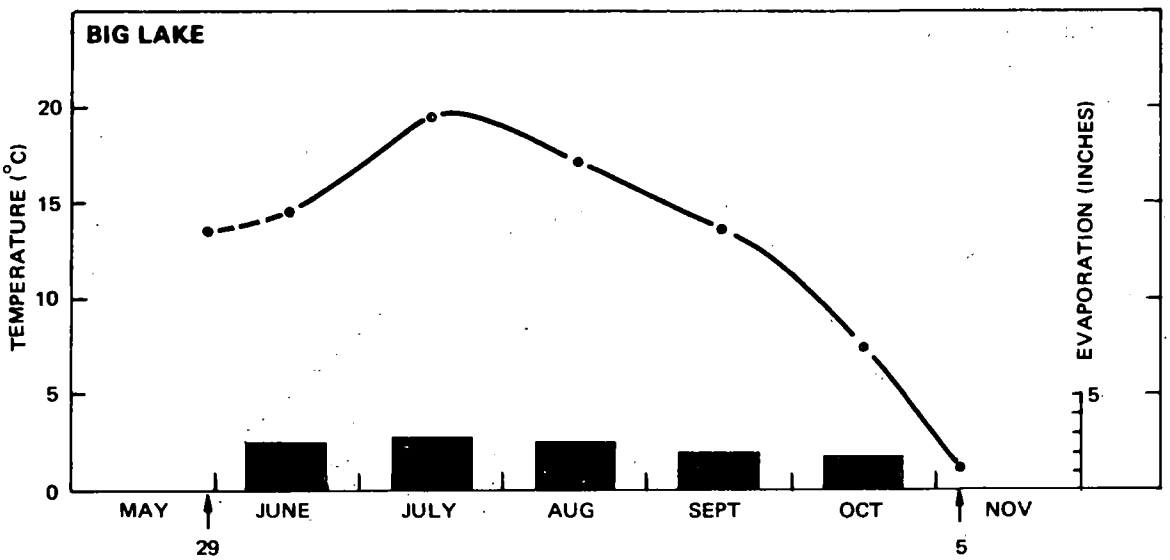
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				16.0	15.5	5.5		
1967		17.0	20.1	17.5	13.3	8.8		F (Nov 7)
1968				14.8	13.7	9.0	2.3	O (Nov 5)
1969	13.7	12.0	18.7	20.4	13.0	7.0	0.0	F (Nov 4)
Mean	13.7	14.5	19.4	17.1	13.8	7.5	1.2	

*Temp on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			1.89	3.33	1.45
1967	3.47	3.74	2.98	1.99	2.16
1968			1.69	1.32	1.75
1969	1.64	1.86	4.06	1.43	1.99
Mean	2.55	2.80	2.65	2.01	1.83



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 5

BIG TROUT LAKE

Location: Lat. 53°45′
Long. 90°00′

Depth: Mean 52.0′ Max. 134.0′
Area: 250 sq. mi.

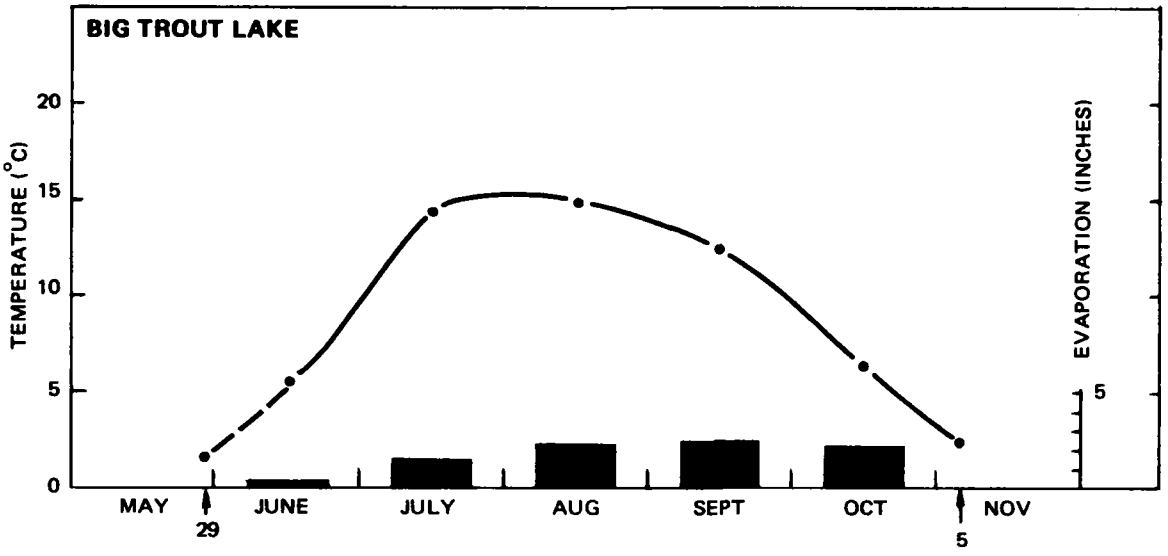
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			16.0	14.8	13.1	5.4		
1967		5.2	14.2	15.6	14.8	9.0	4.8	PF (Nov 7)
1968				11.8	12.0	6.6	3.2	O (Nov 5)
1969	1.5	5.9	13.0	17.6	9.8	4.5	0.5	O (Nov 4)
Mean	1.5	5.5	14.4	14.9	12.4	6.3	2.8	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		1.64	2.05	2.83	2.02
1967	-0.54	1.73	2.39	3.28	3.13
1968			1.20	0.79	1.63
1969	0.91	0.51	3.10	2.11	1.71
Mean	0.18	1.29	2.18	2.25	2.12



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 6

BUG LAKE (WESTERN ARM)

Location: Lat. 53°37′ Depth: Mean Max.
Long. 90°14′ Area: 1.6 sq. mi.

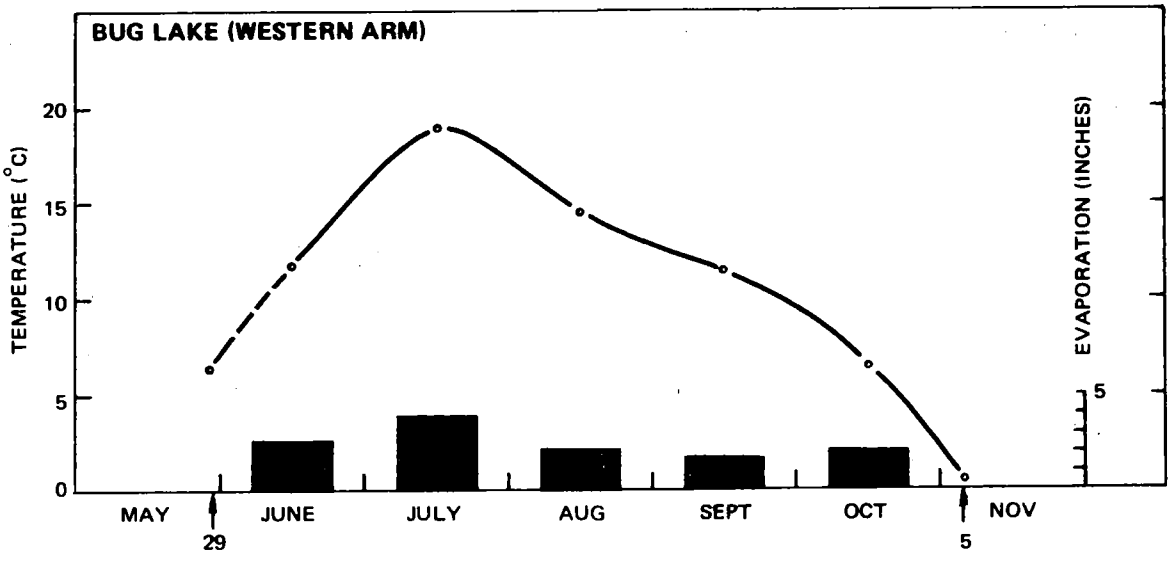
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				13.4	11.9			
1967		11.5	18.5	15.8	14.9	10.2	2.0	F (Nov 7)
1968				9.5	11.5	4.5	0.0	F (Nov 5)
1969	6.3	12.0	19.6	20.0	8.0	4.5	0.0	F (Nov 4)
Mean	6.3	11.7	19.0	14.6	11.5	6.4	0.7	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			1.40	2.14	
1967	1.85	4.27	2.49	3.36	3.67
1968			0.23	0.57	0.91
1969	3.62	3.70	4.78	1.42	1.71
Mean	2.73	3.98	2.22	1.87	2.09



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 7

CARIBOU LAKE

Location: Lat. 50°27′
Long. 89°06′

Depth: Mean Max.
Area: 34 sq. mi.

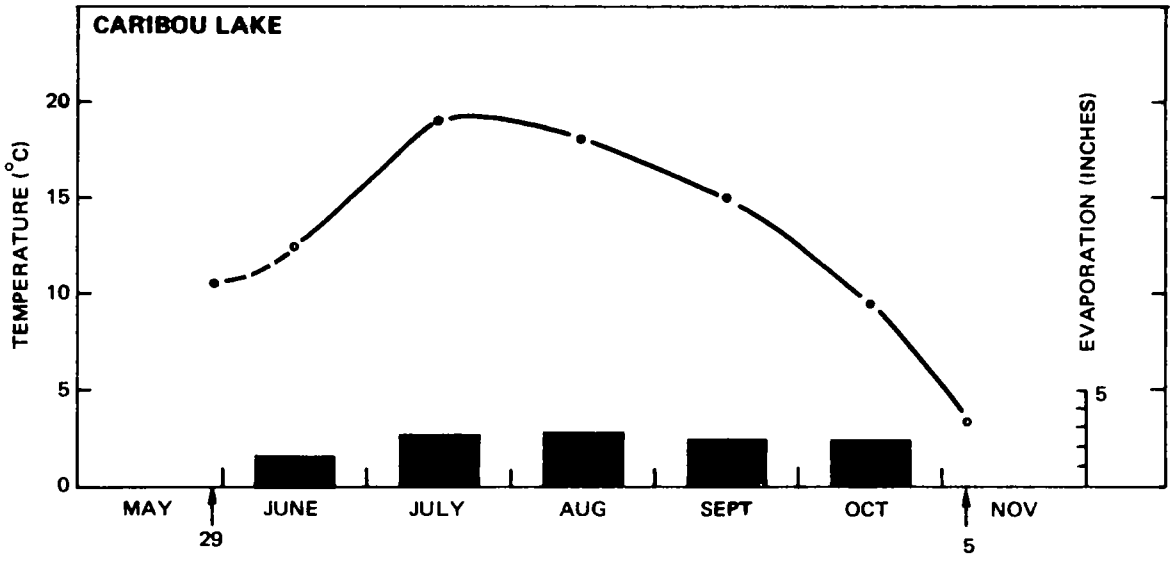
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				17.5	16.2	9.0		
1967		14.0	20.0	18.0	14.7	9.9	4.4	O (Nov 7)
1968				16.4	14.8	11.0	5.8	O (Nov 5)
1969	10.7	11.0	18.1	20.7	15.0	8.0	0.0	O (Nov 4)
Mean	10.7	12.5	19.0	18.1	15.1	9.4	3.4	

*Temp. on data indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			2.56	3.69	2.62
1967	2.05	4.00	3.23	2.59	2.55
1968			2.46	1.70	2.47
1969	1.35	1.65	3.46	2.06	2.33
Mean	1.70	2.82	2.92	2.51	2.49



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 8

CHIEF BAY (LAKE NIPIGON)

Location: Lat. 49°34′
Long. 89°01′

Depth: Mean Max.
Area: 10.0 sq. mi.

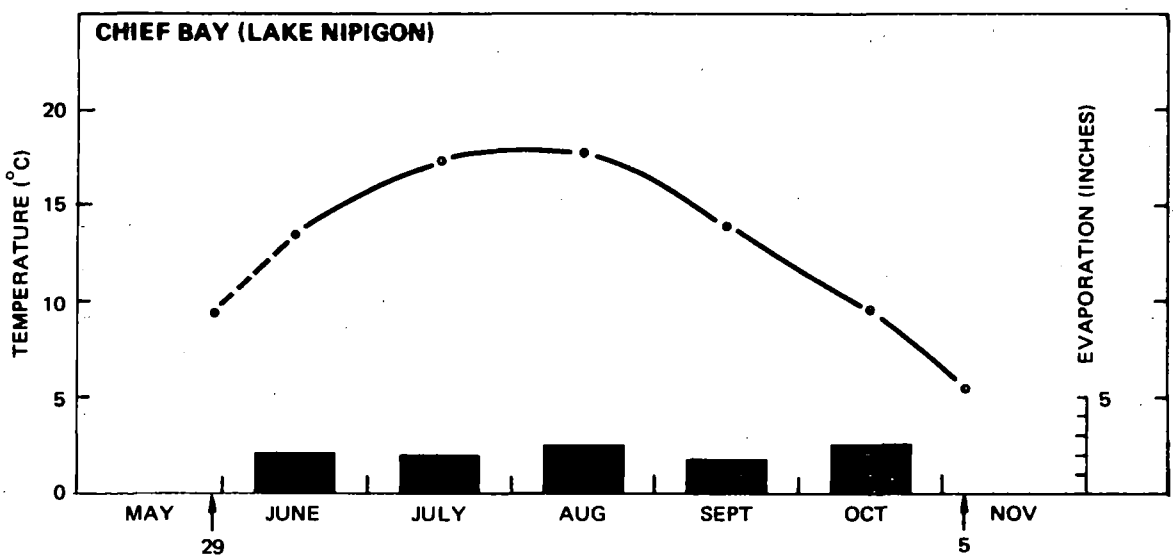
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		15.6	16.0	16.4	13.6	10.0	7.4	O (Nov 7)
1968					14.1	10.6	5.9	O (Nov 5)
1969	9.4	11.4	18.7	19.3	14.4	8.6	3.2	O (Nov 4)
Mean	9.4	13.5	17.3	17.8	14.0	9.7	5.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966					
1967	2.82	1.88	2.11	2.26	3.18
1968				1.31	2.29
1969	1.36	2.16	2.89	2.17	2.46
Mean	2.09	2.02	2.50	1.91	2.64



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 9

COLLISHAW LAKE

Location: Lat. 51°42′
Long. 89°46′

Depth: Mean Max.
Area: 4.0 sq. mi.

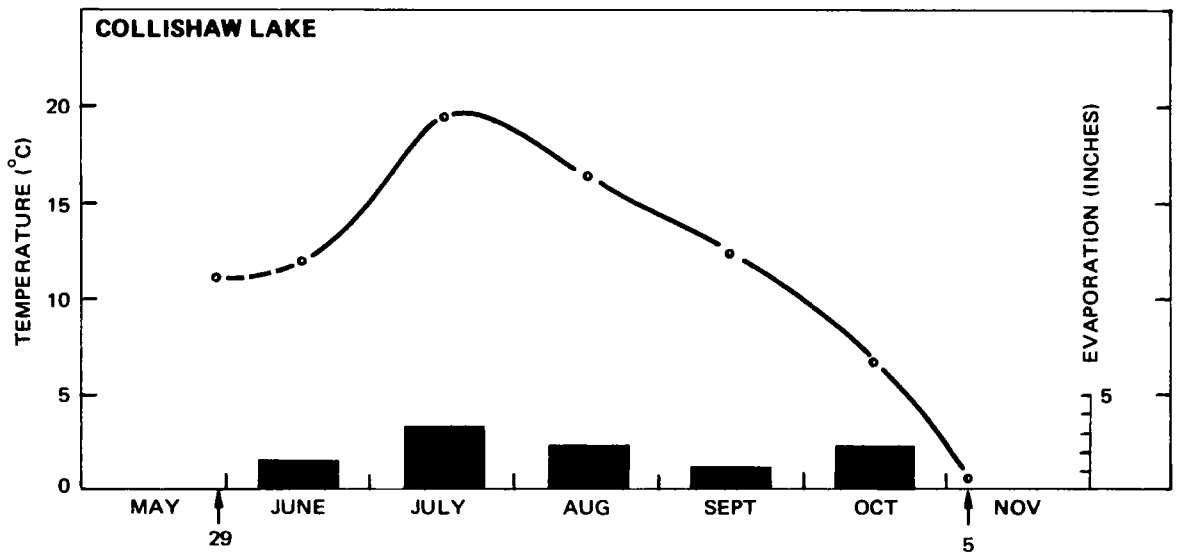
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		12.0	18.9	17.0	13.2	8.2	1.8	F (Nov 7)
1968				12.3	12.9	7.0	0.0	F (Nov 5)
1969	11.1	___	20.0	19.7	10.5	5.4	0.0	F (Nov 4)
Mean	11.1	12.0	19.4	16.3	12.2	6.8	0.6	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966					
1967	1.58	3.48	3.12	1.79	4.51
1968			0.67	1.16	1.02
1969	___	3.20	3.22	0.84	1.59
Mean	1.58	3.34	2.33	1.26	2.37



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 10

EAGLEHEAD LAKE

Location: Lat. 49°03′
Long. 89°12′

Depth: Mean Max.
Area: 4.0 sq. mi

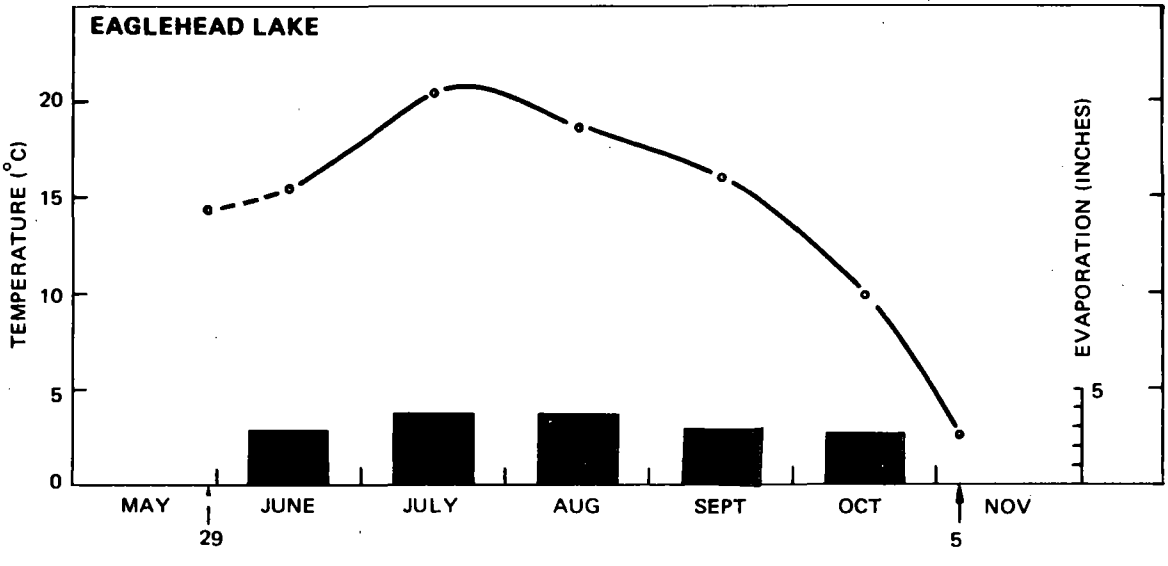
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		17.0	20.8	18.5	16.0	8.8	4.2	PF (Nov 7)
1968				16.8	17.0	12.4	3.3	O (Nov 5)
1969	14.3	14.0	20.1	21.1	15.5	8.6	0.6	O (Nov 4)
Mean	14.3	15.5	20.4	18.8	16.1	9.9	2.7	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966					
1967	3.63	4.89	3.24	3.45	2.63
1968			4.21	2.81	3.12
1969	2.32	2.79	4.16	2.67	2.46
Mean	2.97	3.84	3.87	2.97	2.73



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 11

GOLDSBOROUGH LAKE

Location: Lat. 50°42′
Long. 89°21′

Depth: Mean Max.
Area: 3.3 sq. mi.

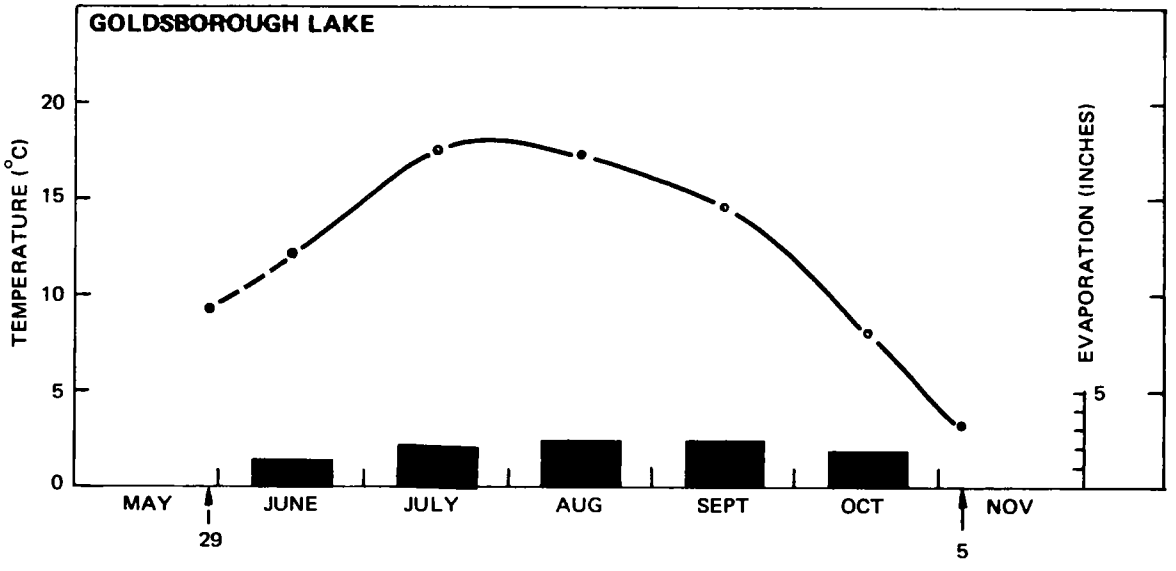
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				16.8	16.2	6.0		
1967		13.6	18.7	17.8	14.3	8.3	3.7	PF (Nov 7)
1968				15.6	14.6	10.5	4.9	0 (Nov 5)
1969	9.3	10.5	16.5	19.2	13.8	7.3	0.9	PF
Mean	9.3	12.0	17.6	17.3	14.7	8.0	3.1	

*Temp. on date indicated O=Open PF=Partly Frozen F=Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			2.23	3.69	1.59
1967	1.60	3.29	3.13	2.40	1.99
1968			2.07	1.65	2.29
1969	1.22	1.15	2.60	1.67	2.07
Mean	1.41	2.22	2.50	2.35	1.98



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 12

GREENWICH LAKE

Location: Lat. 48°48′
Long. 88°51′

Depth: Mean Max.
Area: 2.5 sq. mi.

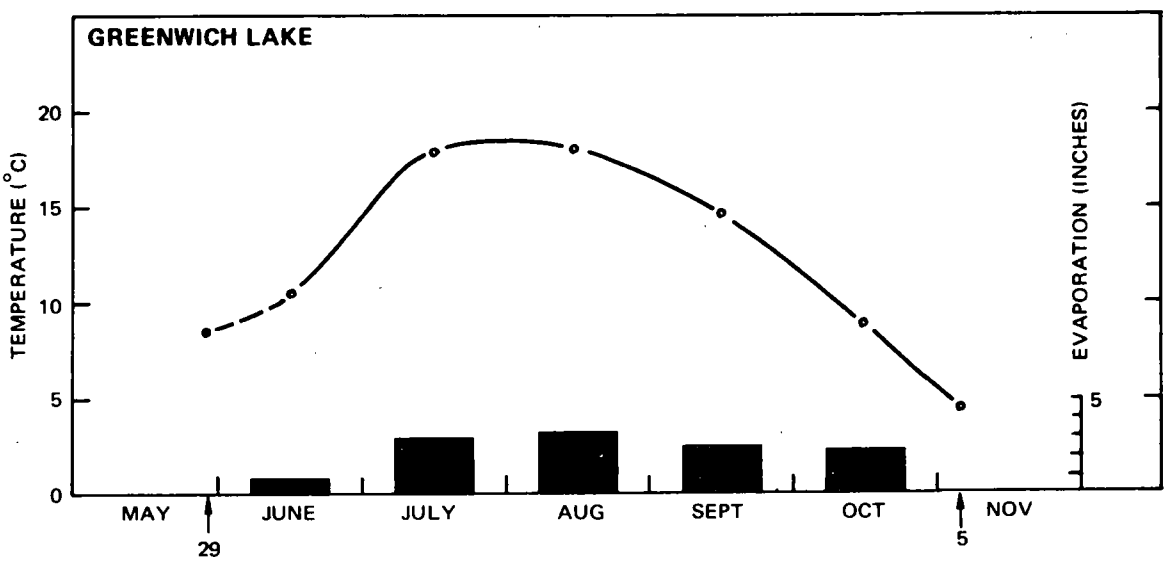
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			20.2	18.8	15.5	7.0		
1967		11.5	18.2	17.9	13.8	10.2	5.8	
1968				16.2	15.5	11.2	7.6	
1969	8.7	9.6	15.8	19.2	14.0	7.7	0.6	
Mean	8.7	10.5	18.0	18.0	14.7	9.0	4.6	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		4.22	3.45	3.54	2.07
1967	0.92	3.54	3.23	2.44	4.11
1968			2.61	2.16	2.83
1969	0.83	1.17	3.18	2.26	0.37
Mean	0.87	2.97	3.11	2.60	2.34



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 13

JEAN LAKE

Location: Lat. 51°21′
Long. 90°08′

Depth: Mean Max.
Area: 2.4 sq. mi.

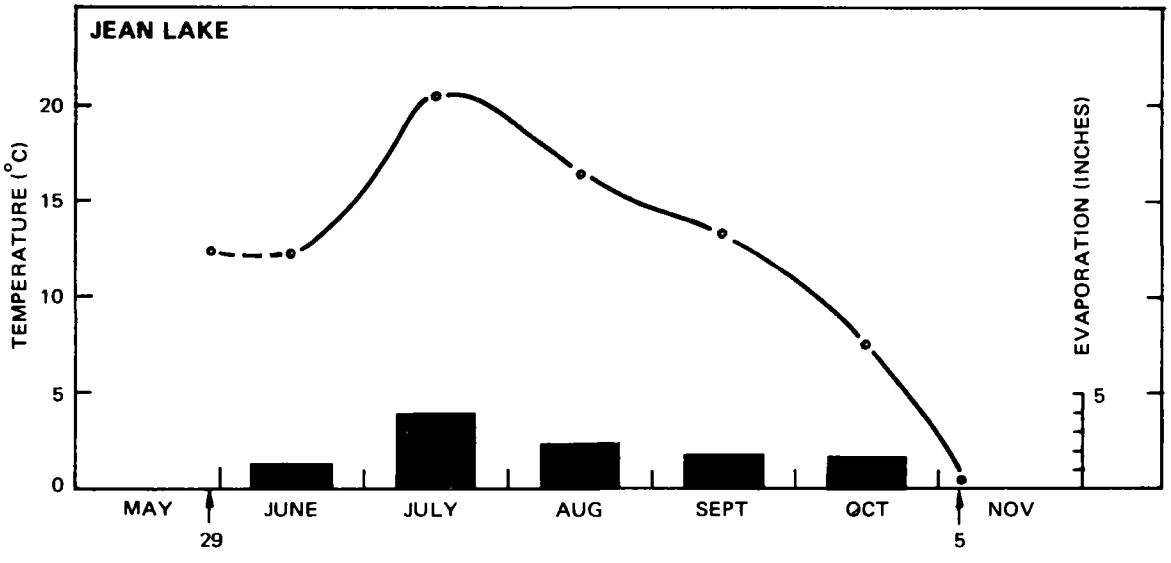
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr./Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				14.3	15.7			
1967		11.5	20.0	18.2	12.8	8.7	1.6	F (Nov 7)
1968				12.8	13.5	7.3	0.0	F (Nov 5)
1969	12.5	13.0	21.0	20.6	11.5	6.3	0.0	F (Nov 4)
Mean	12.5	12.2	20.5	16.4	13.3	7.4	0.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			1.02	3.51	
1967	1.38	4.11	3.76	1.63	2.35
1968			0.82	1.37	1.09
1969	1.09	3.67	3.70	1.07	1.83
Mean	1.23	3.89	2.32	1.89	1.75



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 14

JESSIE LAKE

Location: Lat. 49°12′
Long. 88°20′

Depth: Mean Max.
Area: 2.9 sq. mi.

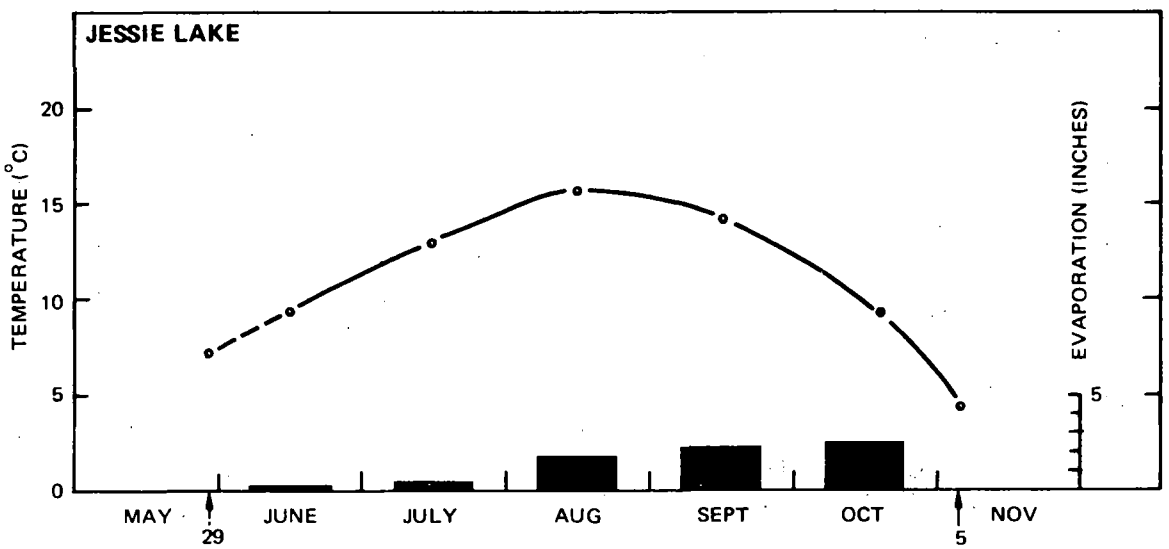
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				17.4	15.5	8.1		
1967		10.0	13.6	15.2	14.5	10.7	5.9	O (Nov 7)
1968				14.1	13.7	10.5	7.2	O (Nov 5)
1969	7.2	8.4	12.2	15.6	13.0	7.5	0.1	O (Nov 4)
Mean	7.2	9.2	12.9	15.5	14.1	9.2	4.4	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			2.34	3.37	2.34
1967	0.18	0.64	1.56	2.67	3.54
1968			2.78	1.12	2.23
1969	0.41	-0.16	0.69	1.59	2.04
Mean	0.29	0.40	1.84	2.18	2.53



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 15

MISAMIKWASH LAKE

Location: Lat. 52°59′
Long. 89°54′

Depth: Mean Max.
Area: 3.2 sq. mi.

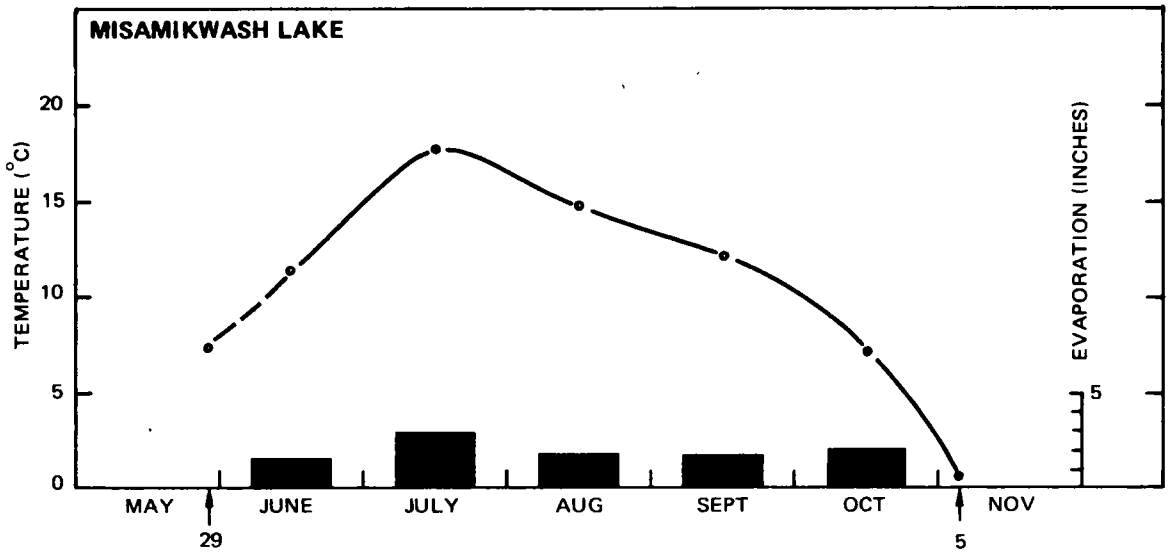
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				12.6	13.2			
1967		12.0	18.6	16.8	14.0			F(Nov 7)
1968				11.5	12.5	7.0	1.4	PF (Nov 5)
1969	7.3	10.6	16.8	18.4	9.6	4.0	0.0	F (Nov 4)
Mean	7.3	11.3	17.7	14.8	12.3	7.1	0.7	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			0.74	2.59	
1967	1.86	3.82	3.04	2.50	3.34
1968			0.67	1.05	1.38
1969	1.46	2.06	3.10	1.25	1.38
Mean	1.66	2.94	1.88	1.84	2.03



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 16

MISSISA LAKE

Location: Lat. 52°19′
Long. 85°12′

Depth: Mean 5.7′ Max. 23.0′
Area: 73 sq. mi.

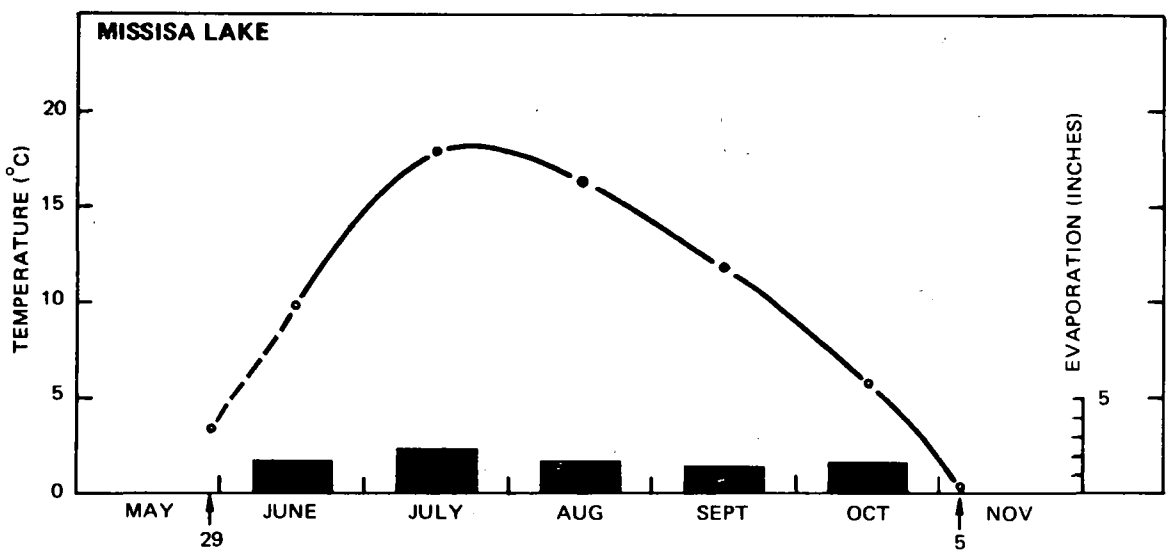
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			18.0	15.5	10.9	4.0		
1967			18.4	16.0	13.3	7.3	0.7	F (Nov 7)
1968					15.0	7.0	0.0	
1969	3.4	9.8	17.8	17.4	8.4	4.5		
Mean	3.4	9.8	18.0	16.3	11.9	5.7	0.4	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		1.69	1.70	1.39	1.32
1967		3.41	2.16	2.05	2.31
1968				1.68	1.68
1969	1.87	1.94	1.95	1.01	1.56
Mean	1.87	2.34	1.93	1.53	1.71



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 17

NEAWAGANK LAKE

Location: Lat. 52°27′
Long. 89°52′

Depth: Mean Max.
Area: 4.9 sq. mi.

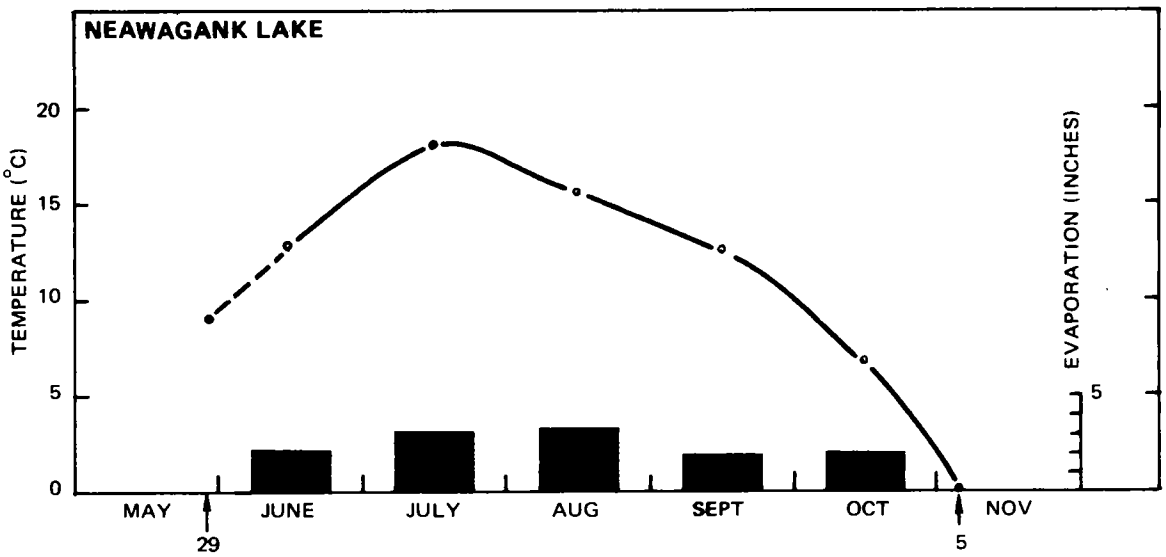
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				14.3	13.8	4.5		
1967		13.5	18.5	17.7	14.1	11.0	0.0	F (Nov 7)
1968				12.2	12.2	6.6	0.0	F (Nov 5)
1969	9.0	11.7	17.6	18.5	10.3	5.4	0.0	F (Nov 4)
Mean	9.0	12.6	18.0	15.6	12.6	6.8	0.0	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			1.39	2.89	1.43
1967	2.56	3.76	3.66	2.54	3.60
1968			0.97	0.94	1.25
1969	1.84	2.43	3.18	1.46	1.79
Mean	2.20	3.09	2.30	1.95	2.01



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 18

LAKE NIPIGON **

Location: Lat. 49°45′ Depth: Mean Max
Long. 88°30′ Area: 1870 sq. mi.

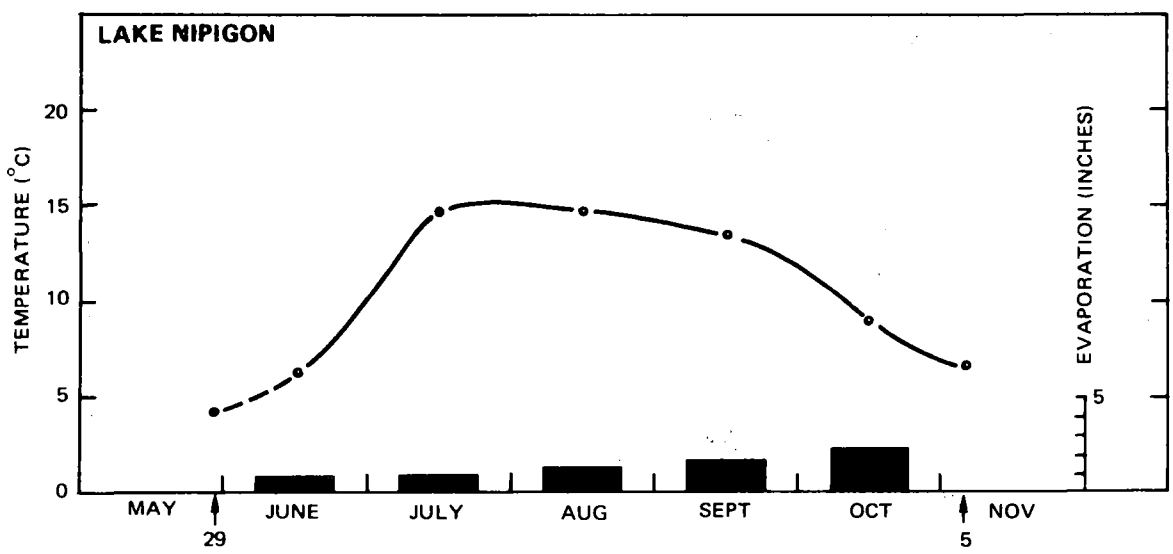
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			16.7	15.3	14.0	7.0		
1967		6.0	12.8	15.4	13.0	9.8	7.8	O (Nov 7)
1968				12.0	13.3	10.4	7.8	O (Nov 5)
1969	4.1	6.5	14.9	16.5	13.8	9.1	5.3	O (Nov 4)
Mean	4.1	6.3	14.8	14.8	13.5	9.0	6.9	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen
**Based on single crossing only. See text.

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		1.54	1.57	2.63	1.91
1967	-0.72	0.60	2.02	1.88	2.50
1968			0.51	1.16	2.25
1969	2.50	0.69	1.21	1.67	2.72
Mean	0.89	0.94	1.32	1.83	2.34



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 19

NO NAME LAKE #1

Location: Lat. 51°22′
Long. 90°12′

Depth: Mean Max.
Area: 2.7 sq. mi.

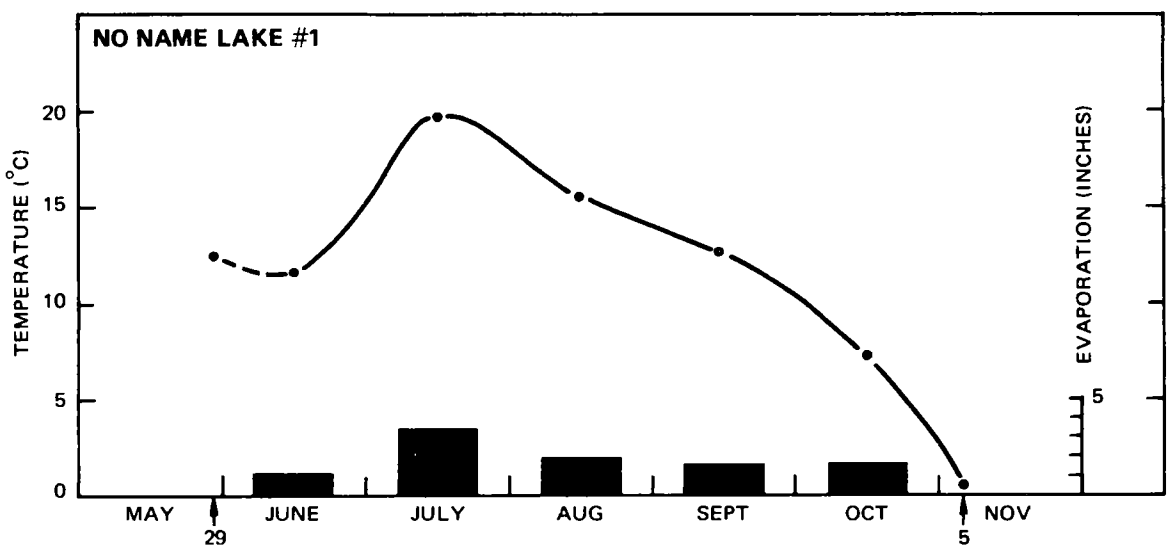
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				13.5	15.8	7.0		
1967		11.0	18.6	17.2	12.5	8.6	1.5	F (Nov 7)
1968				12.3	11.6	6.2	0.0	F (Nov 5)
1969	12.5	12.5	20.8	20.0	10.8	6.6	0.0	F (Nov 4)
Mean	12.5	11.7	19.7	15.7	12.6	7.1	0.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			0.76	3.54	2.00
1967	1.19	3.33	3.23	1.52	2.31
1968			0.63	0.74	0.79
1969	1.04	3.57	3.36	0.91	1.93
Mean	1.11	3.45	1.99	1.67	1.75



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 20

NO NAME LAKE #2

Location: Lat. 51°55′
Long. 85°15′

Depth: Mean Max.
Area: 4.1 sq. mi.

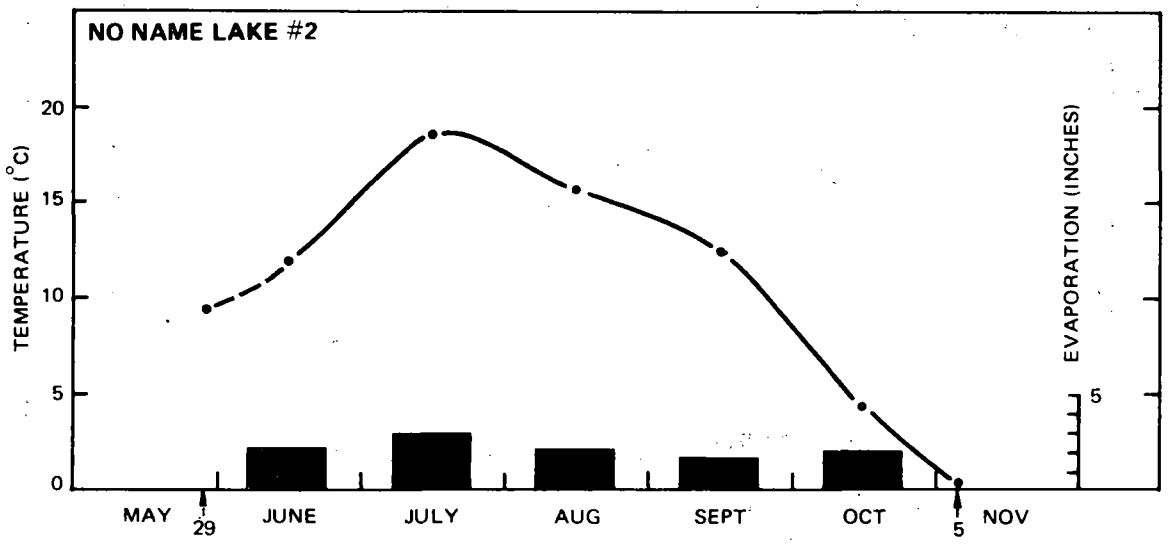
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept.	Oct	Nov 5*	ICE COVER
1966				15.0	10.9	2.5		
1967		14.0	18.6	16.5	13.8	10.0	1.0	F (Nov 7)
1968				13.5	16.0	7.5	0.0	
1969	9.5	10.0	18.9	18.5	9.5	5.5	0.0	
Mean	9.5	12.0	18.7	15.8	12.5	6.3	0.3	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966				1.48	1.39
1967	2.41	3.54	2.40	2.28	2.93
1968			1.44	2.13	1.87
1969	1.96	2.40	2.55	1.41	1.87
Mean	2.18	2.97	2.13	1.82	2.01



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 21

NO NAME LAKE #3

Location: Lat. 51°51′
Long. 85°20′

Depth: Mean Max.
Area: 3.5 sq. mi.

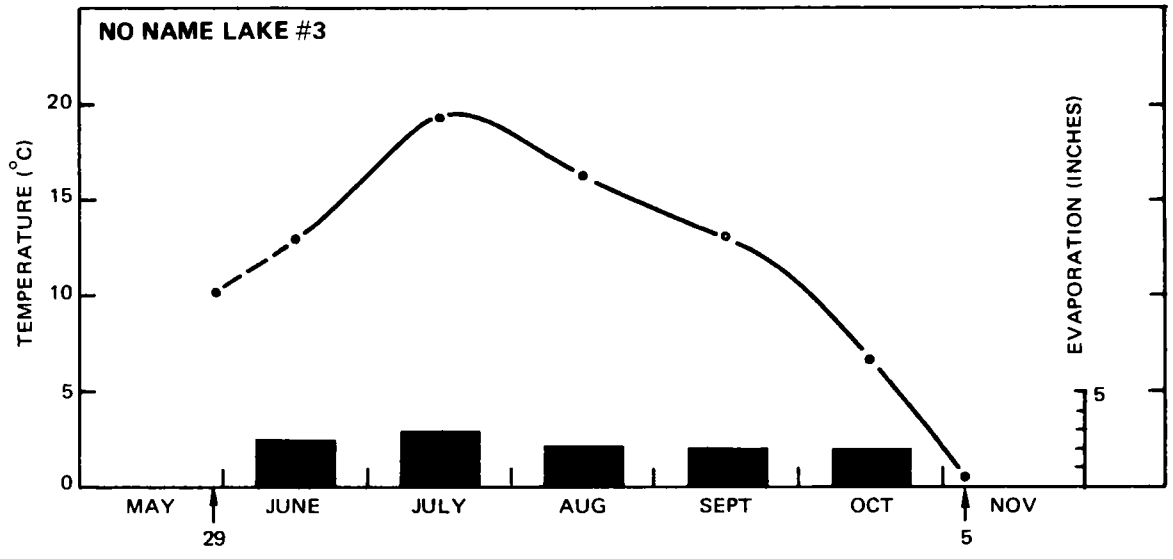
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			19.3	16.2	11.3	3.5		
1967		14.0	19.0	17.2	14.5	10.0	1.0	F (Nov 7)
1968				13.0	16.0	8.0	0.5	
1969	10.2	12.0	19.3	18.5	10.5	5.6	0.0	
Mean	10.2	13.0	19.2	16.2	13.0	6.8	0.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		2.37	2.01	1.56	1.17
1967	2.41	3.78	2.77	2.62	2.93
1968			1.24	2.13	2.08
1969	2.82	2.57	2.55	1.82	1.91
Mean	2.61	2.90	2.14	2.03	2.02



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 22

OCHIG LAKE

Location: Lat. 51°22′
Long. 90°19′

Depth: Mean Max.
Area: 6.0 sq. mi.

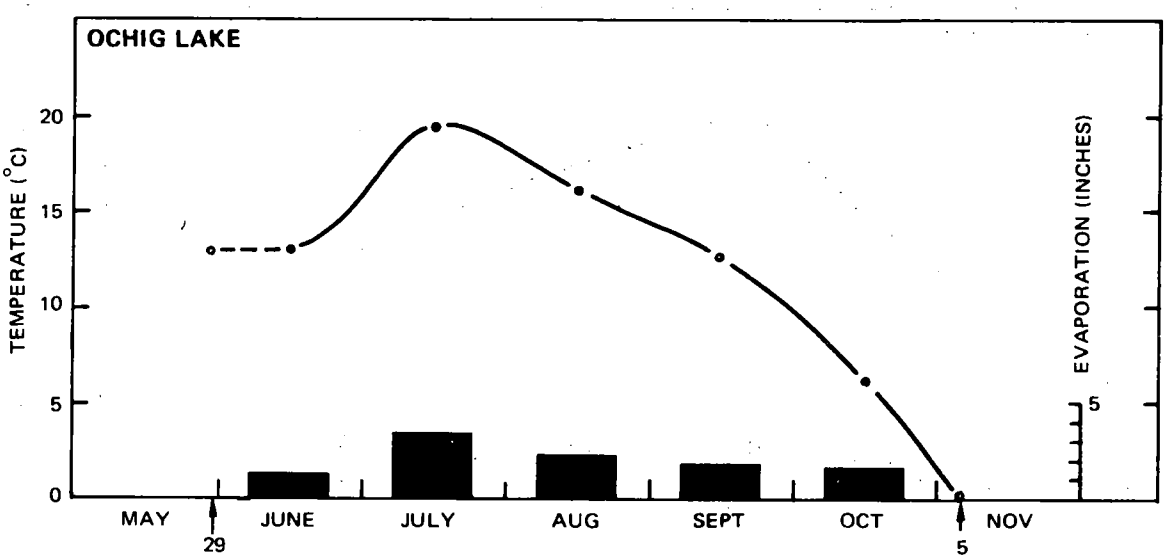
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				14.5	15.6	4.0		
1967			18.6	16.8	12.8	8.5	0.0	F(Nov 7)
1968				12.8	12.0	6.3	0.0	F (Nov 5)
1969	13.0	13.0	20.2	20.5	11.1	6.5	0.0	F (Nov 4)
Mean	13.0	13.0	19.4	16.1	12.8	6.3	0.0	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			1.10	3.44	1.05
1967		3.33	3.01	1.63	2.28
1968			0.82	0.87	0.80
1969	1.23	3.31	3.63	0.98	1.90
Mean	1.23	3.32	2.14	1.73	1.50



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 23

OGOKI LAKE

Location: Lat. 50°49′
Long. 87°10′

Depth: Mean Max.
Area: 30 sq. mi.

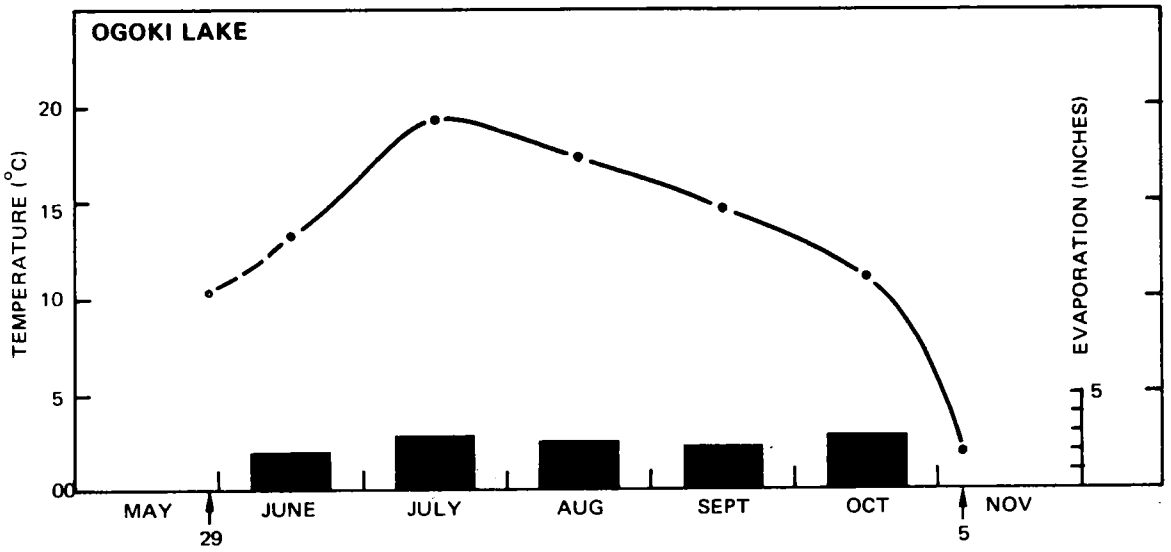
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		14.5	19.4	17.8	16.0	12.5	1.5	F (Nov 7)
1968				15.0	15.4	9.5	2.5	O (Nov 5)
1969	10.3	12.0	19.0	18.9	12.8	___	___	
Mean	10.3	13.3	19.2	17.2	14.7	11.0	2.0	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966					
1967	2.27	3.67	3.13	3.18	3.58
1968			1.79	1.94	1.91
1969	1.64	1.96	2.41	1.37	___
Mean	1.95	2.81	2.44	2.16	2.74



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 24

OMDAHL LAKE

Location: Lat. 50°49′
Long. 89°29′

Depth: Mean Max.
Area: 1.4 sq. mi

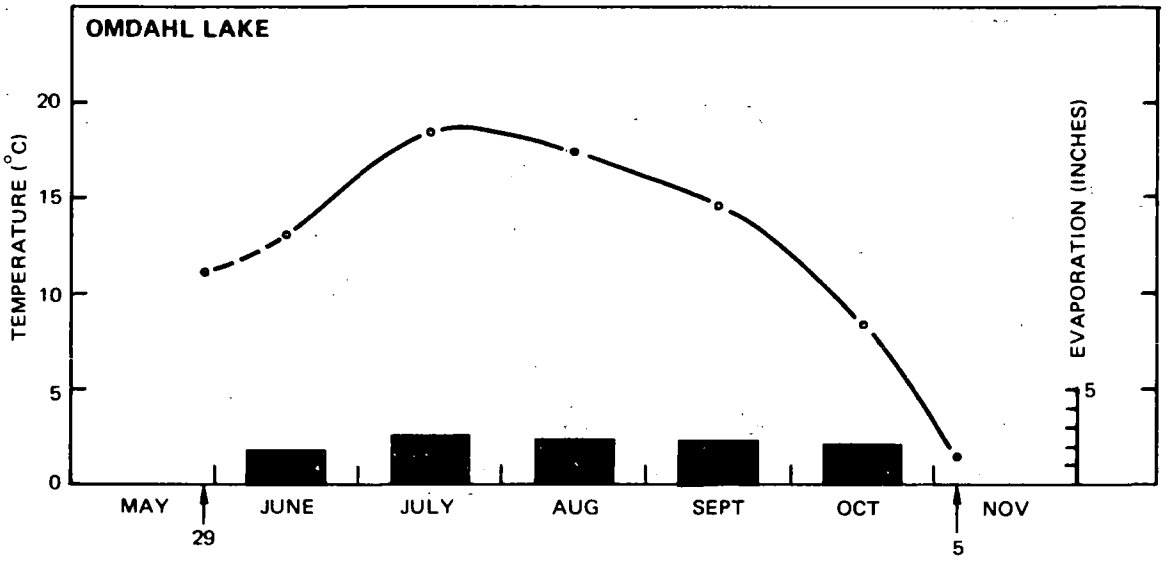
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				17.0	16.0	6.0		
1967		14.8	20.0	18.0	14.5	9.5	0.5	F (Nov 7)
1968				15.6	14.9	10.5	4.0	O (Nov 5)
1969	11.1	11.3	16.8	18.5	13.2	7.1	0.8	PF (Nov 4)
Mean	11.1	13.0	18.4	17.2	14.6	8.2	1.7	

* Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			2.33	3.58	1.59
1967	2.39	4.00	3.23	2.50	2.40
1968			2.07	1.75	2.29
1969	1.44	1.23	2.21	1.49	2.02
Mean	1.91	2.61	2.46	2.33	2.07



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 25

PICKLE LAKE

Location: Lat. 51°27′
Long. 90°15′

Depth: Mean Max.
Area: 3.8 sq. mi.

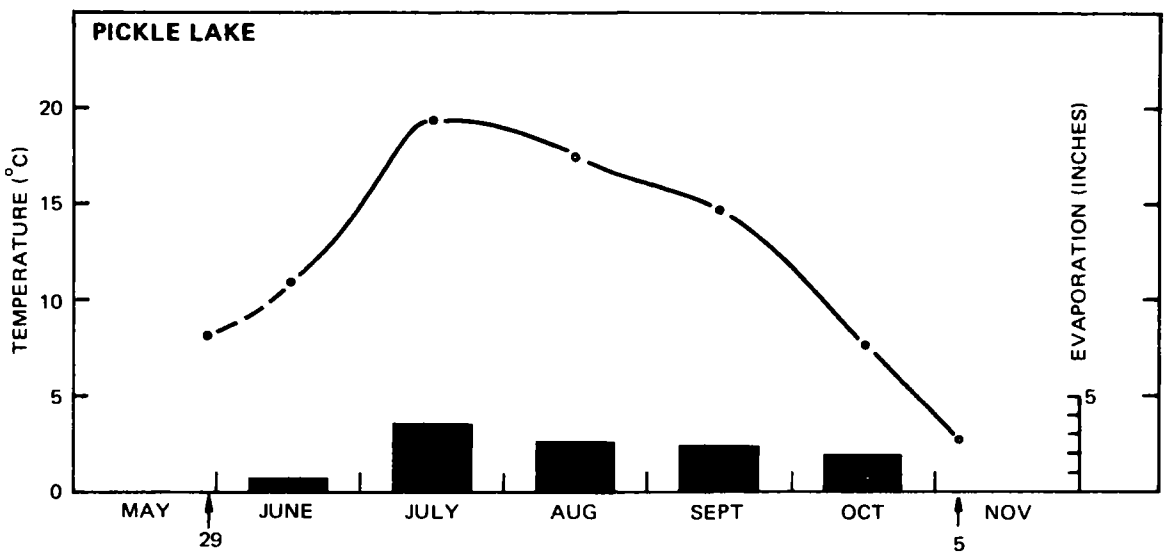
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			19.0	17.0	16.2	6.0		
1967		10.5	19.5	18.0	15.4	8.2	3.6	PF (Nov 7)
1968				15.2	14.1	10.1	4.0	O (Nov 5)
1969	8.1	11.5	19.3	19.8	13.5	6.5	0.8	O (Nov 4)
Mean	8.1	11.0	19.2	17.5	14.8	7.7	2.8	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		3.06	2.04	3.77	1.66
1967	1.02	3.82	3.64	2.71	2.17
1968			1.81	1.57	1.99
1969	0.65	3.84	3.25	1.59	1.90
Mean	0.83	3.57	2.68	2.41	1.93



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 26

POSTAGONI LAKE

Location: Lat. 49°24′
Long. 88°03′

Depth: Mean Max.
Area: 1.7 sq. mi.

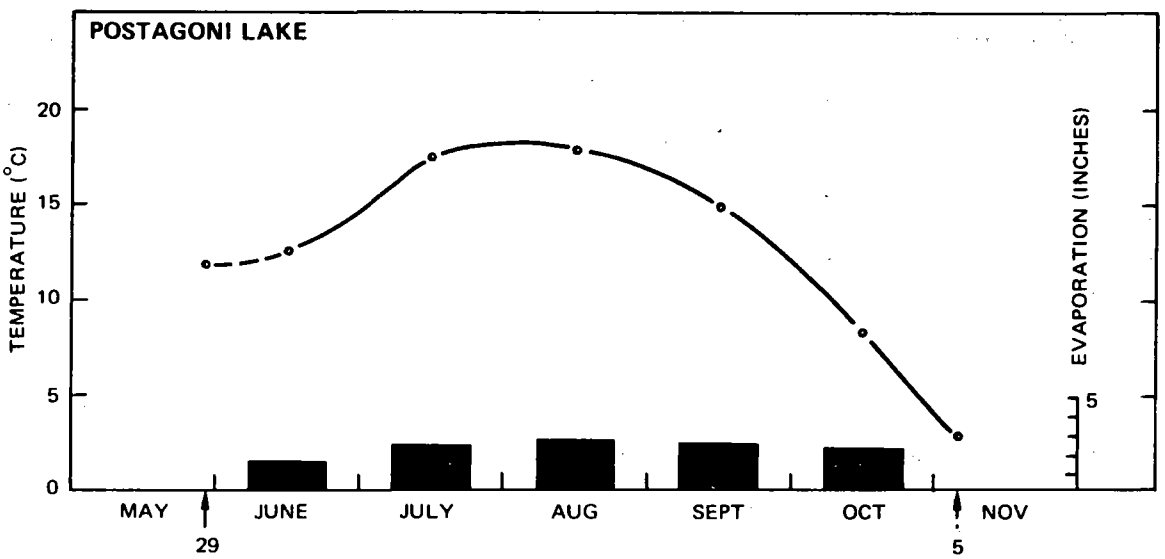
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				18.3	15.3	6.4		
1967		13.2	18.8	17.4	14.6	9.2	3.8	PF (Nov 7)
1968				17.4	15.3	10.8	5.1	O (Nov 5)
1969	11.9	12.2	16.3	18.5	14.8	7.5	0.1	O (Nov 4)
Mean	11.9	12.7	17.5	17.9	15.0	8.4	3.0	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			2.85	3.23	1.65
1967	1.59	3.54	2.63	2.74	2.83
1968			2.96	1.88	2.36
1969	1.65	1.19	2.39	2.34	2.04
Mean	1.62	2.36	2.70	2.54	2.22



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 27

PURDOM LAKE

Location: Lat. 49°09′
Long. 88°25′

Depth: Mean Max.
Area: 0.8 sq. mi.

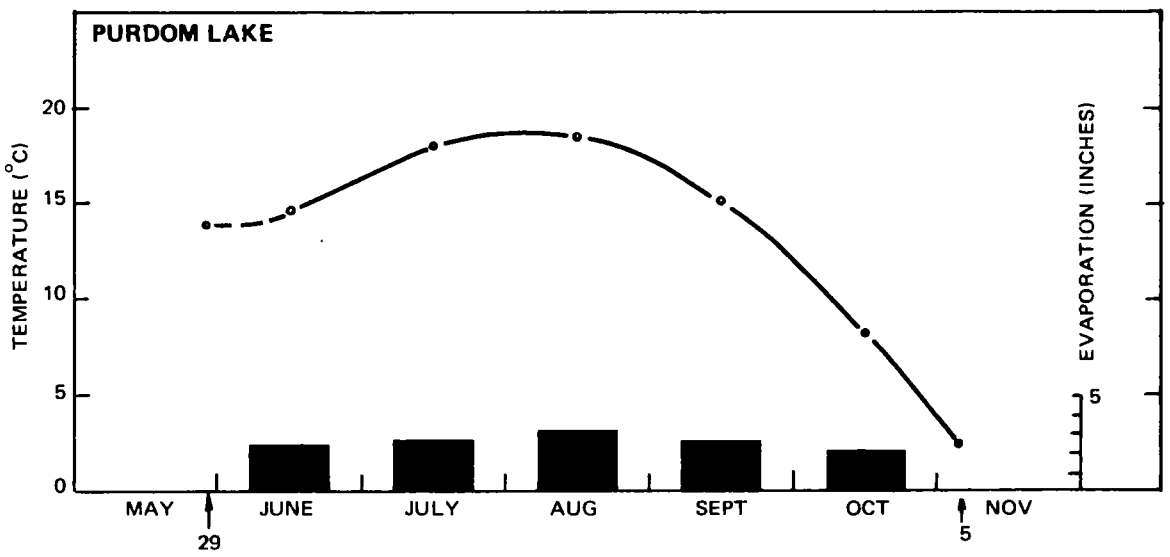
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				19.6	16.2	5.5		
1967		15.7	19.8	18.4	14.7	9.6	2.4	PF (Nov 7)
1968				17.4	15.0	10.3	4.5	O (Nov 5)
1969	13.9	13.3	16.2	18.9	14.6	7.4	0.0	F (Nov 4)
Mean	13.9	14.5	18.0	18.5	15.1	8.2	2.3	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			3.67	3.76	1.31
1967	2.89	4.19	3.17	2.78	3.01
1968			2.96	1.74	2.12
1969	2.03	1.17	2.64	2.27	2.00
Mean	2.46	2.68	3.11	2.63	2.11



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 28

SANDYBANK LAKE

Location: Lat. 53°50′
Long. 89°45′

Depth: Mean 3.6′ Max. 24.0′
Area: 7.5 sq. mi.

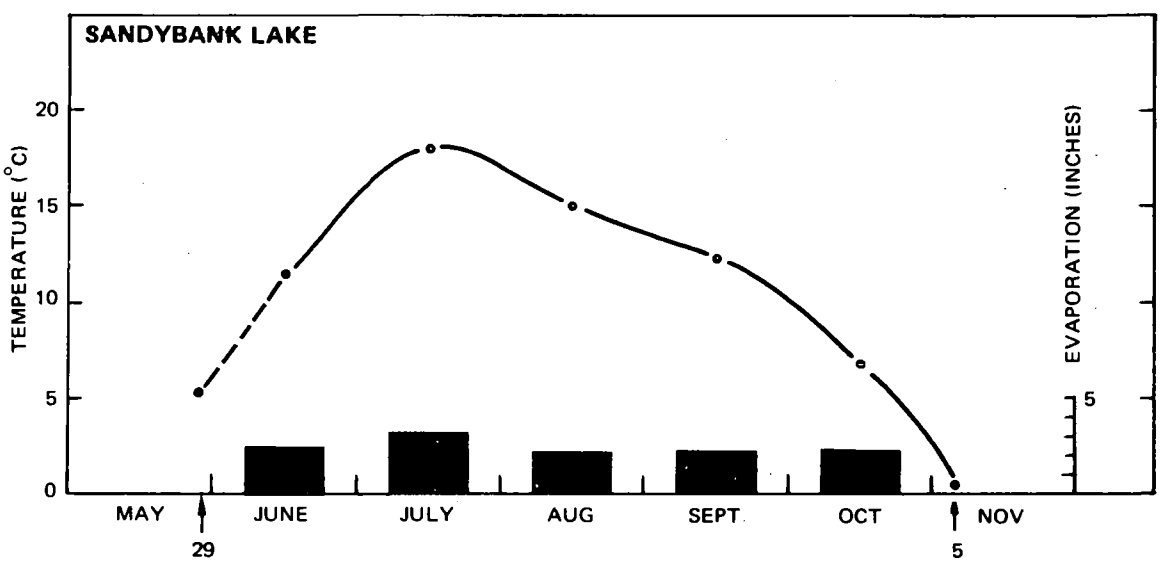
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			17.3	13.8	13.0	6.0		
1967		11.0	17.7	15.5	15.0	10.0	0.5	F (Nov 7)
1968				10.5	12.7	7.2	1.0	PF (Nov 5)
1969	5.2	11.8	19.2	20.2	8.5	4.5	0.0	F (Nov 4)
Mean	5.2	11.4	18.0	15.0	12.3	6.9	0.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		2.36	1.58	2.77	2.24
1967	1.62	3.77	2.35	3.41	3.56
1968			0.65	1.11	1.86
1969	3.50	3.48	4.95	1.61	1.71
Mean	2.56	3.20	2.13	2.22	2.34



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 29

SMOOTHROCK LAKE (LONEBREAST BAY)

Location: Lat. 50°37′
Long. 89°17′

Depth: Mean Max.
Area: 2.9 sq. mi.

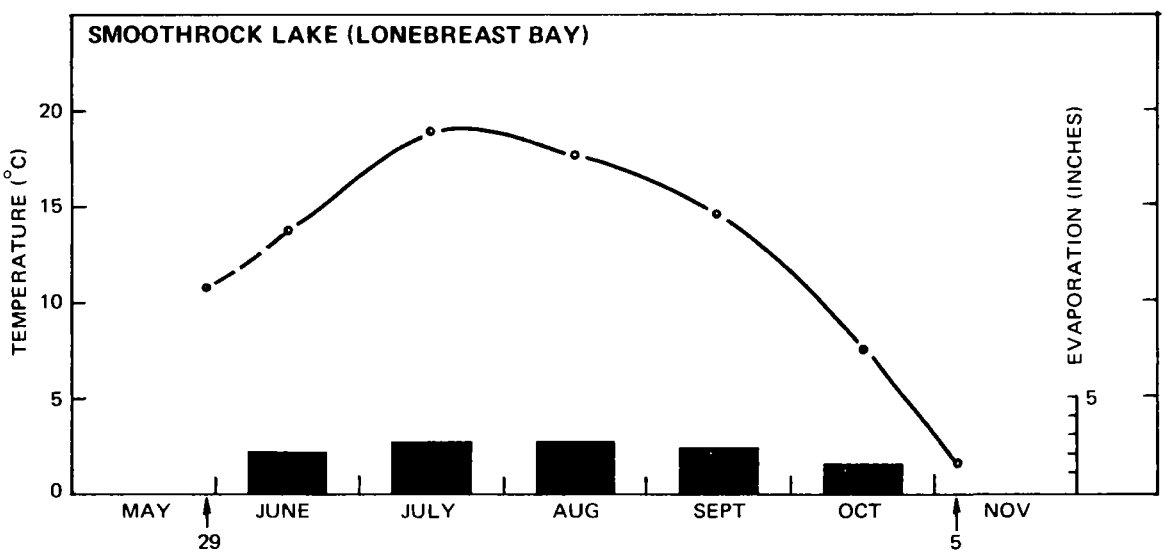
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			19.2	17.3	15.6	4.5		
1967		16.0	20.4	18.2	14.7	8.5	1.0	F (Nov 7)
1968				15.5	14.8	9.5	4.1	O (Nov 5)
1969	11.8	11.6	17.6	19.8	13.3	7.5	0.0	F (Nov 4)
Mean	11.8	13.8	19.0	17.7	14.6	7.5	1.7	

*Temp. on date indicated O=Open PF=Partly Frozen F=Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		2.88	2.46	3.38	1.15
1967	2.98	4.23	3.35	2.59	2.06
1968			2.03	1.63	1.91
1969	1.52	1.49	2.91	2.15	1.53
Mean	2.25	2.86	2.68	2.43	1.66



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 30

STONE LAKE

Location: Lat. 50°37′
Long. 87°30′

Depth: Mean Max.
Area: 4.6 sq. mi

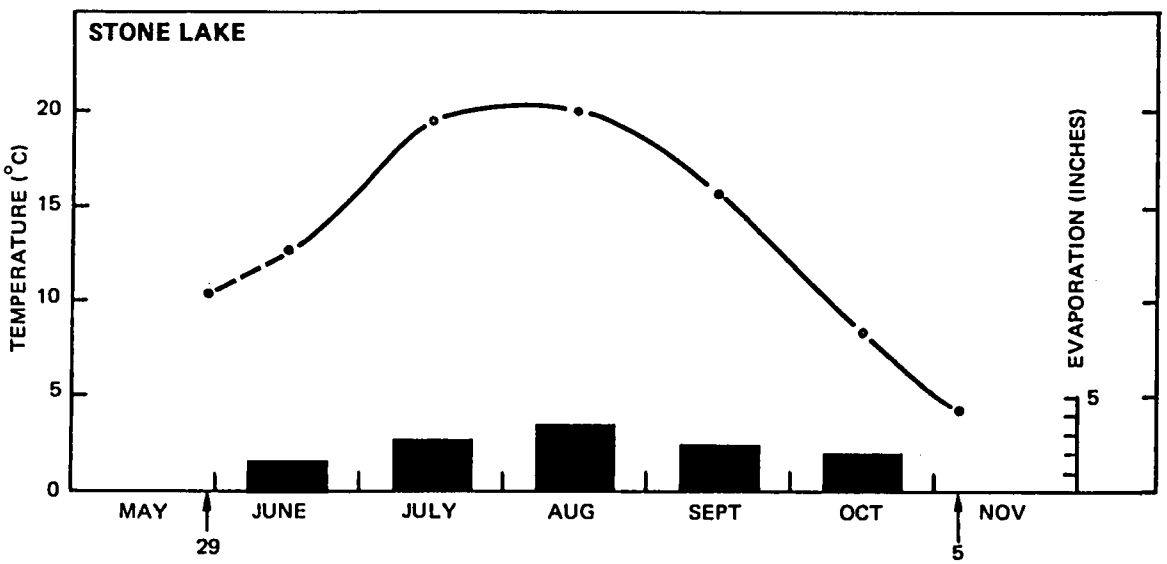
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		14.0	19.8	20.7	17.7	7.5	5.1	PF (Nov 7)
1968					14.8	10.0	3.4	O (Nov 5)
1969	10.4	11.5	18.8	19.1	14.2	7.6		
Mean	10.4	12.7	19.3	19.9	15.5	8.3	4.3	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966					
1967	2.05	3.88	4.58	4.03	1.73
1968				1.70	2.09
1969	1.49	1.89	2.53	1.81	2.19
Mean	1.77	2.88	3.55	2.51	2.00



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 31

SUMMIT LAKE

Location: Lat. 50°26′
Long. 87°44′

Depth: Mean Max.
Area: 2.5 sq. mi.

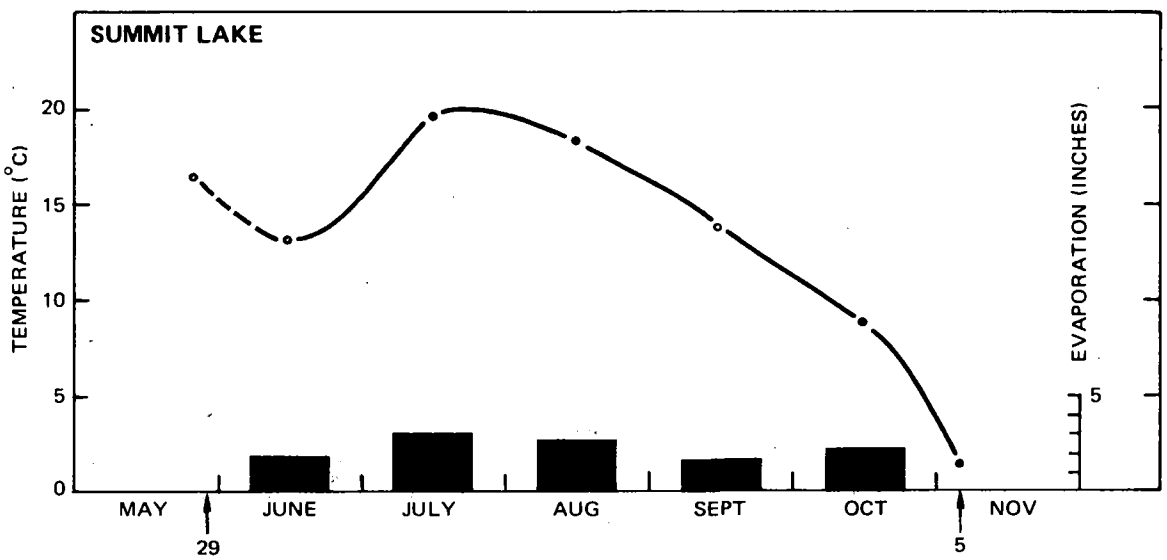
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		14.0	20.5	18.2	14.5	10.0	1.5	F (Nov 7)
1968					15.3	9.0	1.4	PF (Nov 5)
1969	16.6	12.5	19.0	18.6	11.8	8.0		
Mean	16.6	13.2	19.7	18.4	13.8	9.0	1.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966					
1967	2.05	4.30	3.35	2.50	2.58
1968				1.89	1.75
1969	1.80	1.96	2.26	1.08	2.33
Mean	1.92	3.13	2.80	1.82	2.22



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 32

TARP LAKE

Location: Lat. 51°35′
Long 90°07′

Depth: Mean Max.
Area: 3.5 sq. mi.

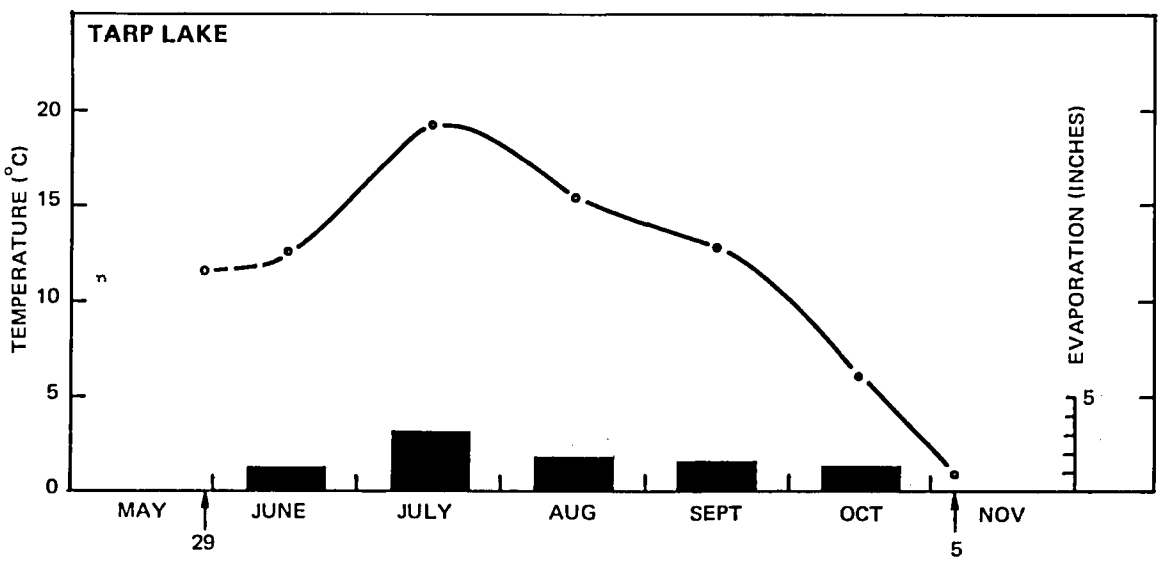
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966				13.6	15.9	5.0		
1967		12.5	19.2	17.0	13.0	7.5	1.4	F (Nov 7)
1968				12.5	12.5	6.7	0.0	F (Nov 5)
1969	11.5	13.0	19.5	19.6	10.5	5.4	1.5	PF (Nov 4)
Mean	11.5	12.7	19.3	15.6	12.9	6.1	1.0	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966			0.80	3.60	1.34
1967	1.78	3.67	3.12	1.71	1.94
1968			0.71	1.03	0.93
1969	1.01	2.98	3.17	0.84	1.59
Mean	1.39	3.32	1.95	1.79	1.45



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 33

TORONTO LAKE

Location: Lat. 50°21′
Long. 87°50′

Depth: Mean Max.
Area: 3.3 sq.mi.

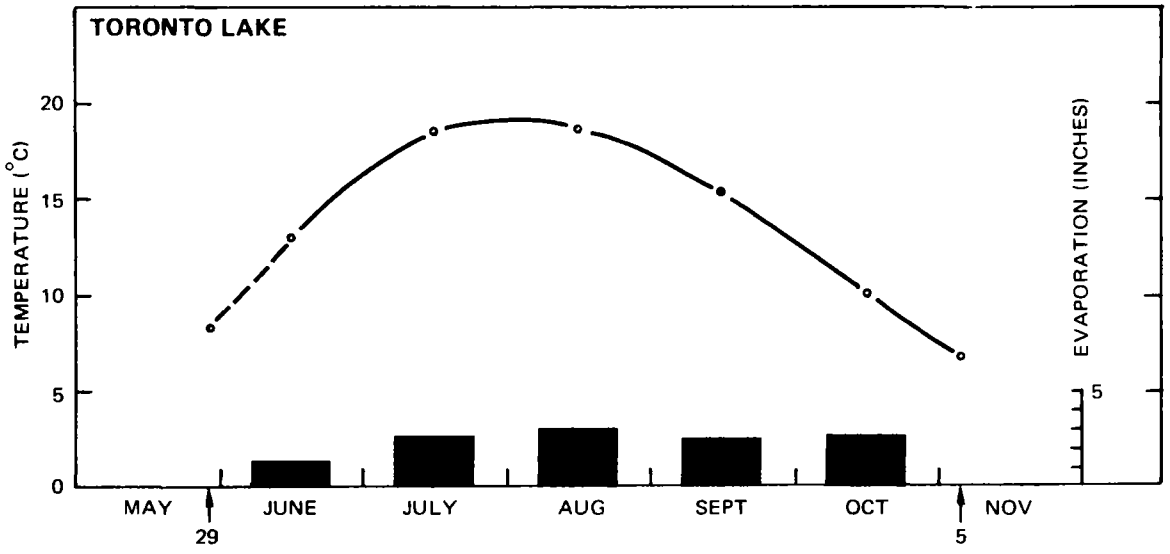
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966								
1967		13.0	19.7	18.7	16.7	12.6	7.7	O (Nov 7)
1968					15.4	10.5	6.1	O (Nov 5)
1969	8.3	10.0	17.8	18.9	14.4	7.5	—	
Mean	8.3	11.5	18.7	18.8	15.5	10.2	6.9	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1967					
1967	1.63	3.84	3.60	3.52	3.63
1968				1.94	2.29
1969	1.08	1.55	2.41	1.87	2.15
Mean	1.35	2.69	3.00	2.44	2.69



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 34

WABIMEIG LAKE

Location: Lat. 51°28′
Long. 85°35′

Depth: Mean 4.2′ Max. 7.0′
Area: 19 sq. mi.

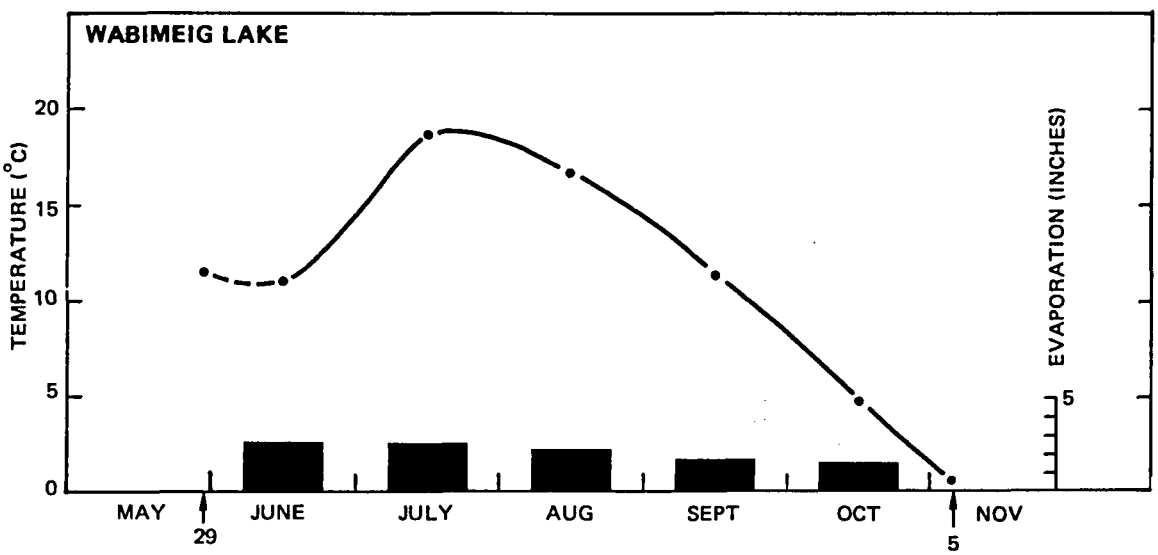
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			17.6	15.2	11.0	2.5		
1967			19.2	15.8	13.5	5.0	0.5	F (Nov 7)
1968								
1969	11.5	11.0	19.6	18.9	10.0	6.8	—	
Mean	11.5	11.0	18.8	16.6	11.5	4.7	0.5	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		1.49	1.58	1.42	0.86
1967		3.91	2.04	2.16	1.48
1968					
1969	2.62	2.29	2.76	1.61	2.29
Mean	2.62	2.56	2.12	1.73	1.54



Surface Water Temperature and Evaporation Regimes

LAKE DATA SHEET 35

WOLF PUP LAKE

Location: Lat. 48°58′
Long. 88°40′

Depth: Mean Max.
Area: 1.3 sq. mi.

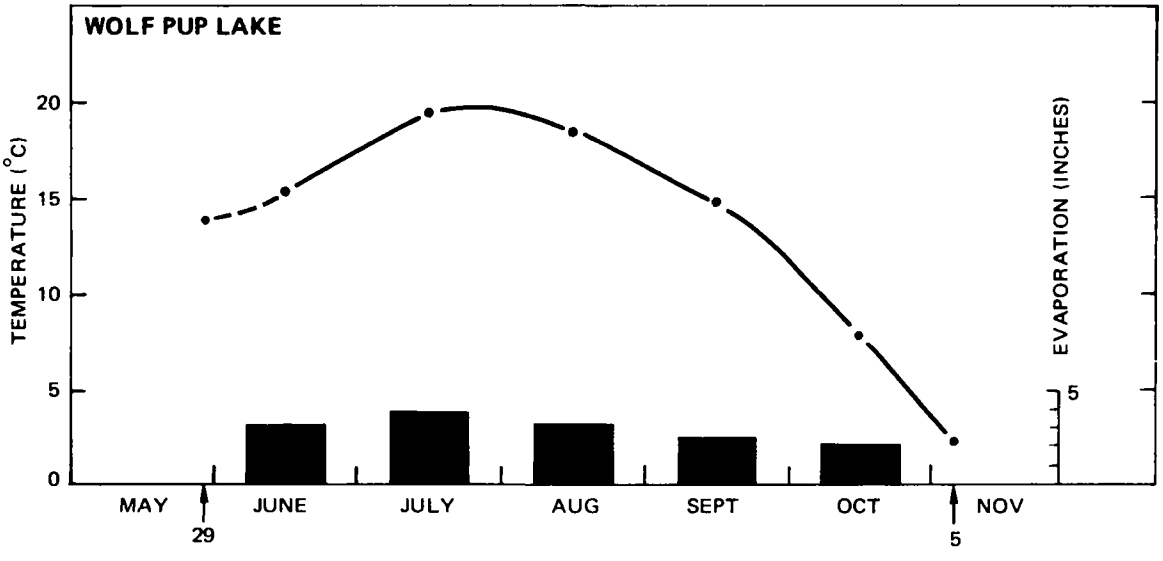
MEAN SURFACE WATER TEMPERATURES (°C) and ICE COVER

Yr/Mo	May 29*	June	July	Aug	Sept	Oct	Nov 5*	ICE COVER
1966			21.7	19.6	16.3	6.0		
1967		17.6	20.9	18.9	14.3	9.0		PF (Nov 7)
1968				17.0	15.3	10.0	4.3	O (Nov 5)
1969	13.9	13.0	15.8	18.5	13.8	6.0	0.0	F (Nov 4)
Mean	13.9	15.3	19.4	18.5	14.9	7.7	2.2	

*Temp. on date indicated O = Open PF = Partly Frozen F = Frozen

ESTIMATED MONTHLY EVAPORATION (INCHES)

Yr/Mo	June	July	Aug	Sept	Oct
1966		5.25	3.89	3.91	1.57
1967	4.33	5.30	3.67	2.62	3.08
1968			2.92	1.99	2.12
1969	2.01	1.09	2.53	2.03	1.57
Mean	3.17	3.88	3.25	2.63	2.08



Surface Water Temperature and Evaporation Regimes

APPENDIX A

A.R.T. SURFACE TEMPERATURES (°C) OF NORTHERN ONTARIO LAKES

A-1 1966	SURVEY DATES 1966			
LAKE	July 26	Aug. 24	Sept. 21	Oct. 19-20
Greenwich	20.2	18.0	14.6	5.9
Wolf Pup	21.6	18.3	16.0	3.4
Purdom	M	19.2	15.5	3.8
Jessie	M	17.2	14.9	6.8
Postagoni	M	17.8	15.1	4.9
Nipigon	17.4	14.5	13.8	6.3
Big	M	16.3	15.6	3.6
Caribou	M	17.2	15.6	5.2
Smoothrock	19.3	16.6	15.6	2.6
Goldsborough	M	16.6	16.3	4.4
Scrag	20.1	M	M	M
Omdahl	M	16.9	15.7	4.1
Webster	19.2	M	M	M
Atikokiwam	18.9	15.6	16.2	1.8
Jean	M	15.0	15.8	1.1
No Name #1	M	14.0	16.1	0.0
Ochig	M	14.3	16.0	1.5
Pickle	19.3	16.3	16.3	4.0
Tarp	M	14.2	16.2	0.0
Badesdawa	18.4	14.8	14.6	1.1
Neawagank	17.4	13.3	14.3	0.7
Asinne	18.8	13.5	14.4	0.8
Misamikwash	M	13.0	13.8	0.6
Bug	M	13.3	M	0.8
Big Trout	16.9	14.0	12.8	3.7
Sandy Bank	17.5	12.8	12.9	0.7
Winiskisis Channel	M	13.4	M	M
Missisa	17.9	14.0	9.9	0.5
No Name #2	M	14.0	10.0	0.8
No Name #3	19.3	14.9	10.5	1.6
Wabimeig	17.5	14.1	10.1	1.4
No Name #4	18.1	15.2	M	1.6
Chief Bay	M	M	M	4.7
Wabinosh	M	M	M	6.1
Lowry	M	M	M	1.7
Collishaw	M	M	M	0.5
Albany River	M	M	M	2.6
Kaiashk Bay	M	M	M	5.1
Ogoki	M	M	M	2.8

M – Missing Observation

F – Frozen Lake

A.R.T. SURFACE TEMPERATURES (°C) OF NORTHERN ONTARIO LAKES

A-2 1967	SURVEY DATES 1967					
LAKE	June 21-22	July 26	Aug. 23	Sept. 13	Oct. 4	Nov. 7
Greenwich	13.2	19.9	16.8	13.8	12.3	5.4
Wolf Pup	18.8	21.4	17.4	M	11.9	M
Purdom	16.6	20.6	17.4	M	12.9	1.6
Jessie	10.7	14.9	15.2	14.8	12.9	5.5
Postagoni	14.8	19.9	16.2	15.0	12.2	3.3
Nipigon	7.4	14.6	15.3	13.2	11.0	7.7
Big	17.8	21.0	16.0	13.5	M	F
Caribou	15.8	20.5	16.9	15.0	M	3.7
Smoothrock	16.9	21.3	16.7	14.9	M	F
Goldsborough	14.5	20.1	16.7	14.6	M	3.3
Omdahl	15.9	20.8	16.8	14.8	M	F
Atikokiwam	16.0	21.2	16.2	13.8	M	F
Jean	14.1	20.1	15.2	12.8	M	F
No Name #1	12.8	19.8	14.7	12.6	M	F
Ochig	13.6	20.3	14.9	13.1	M	F
Pickle	13.4	20.1	17.2	15.7	M	3.4
Tarp	14.2	20.1	14.7	13.5	M	F
Collishaw	13.9	19.9	14.7	13.5	M	F
Badesdawa	15.4	20.5	16.2	14.6	M	F
Neawagank	14.5	19.9	16.4	14.3	M	F
Asinne	15.4	19.5	16.5	15.5	M	F
Misamikwash	13.9	19.8	15.6	14.4	M	F
Bug	13.2	19.1	14.8	15.2	M	F
Big Trout	7.0	15.6	15.6	15.0	M	4.6
Sandy Bank	12.7	18.3	14.9	15.1	M	F
Missisa	13.9	19.0	13.4	13.8	M	F
No Name #2	15.3	19.9	14.1	14.2	M	F
No Name #3	15.8	20.0	15.6	14.9	M	F
Wabimeig	15.2	19.9	14.6	14.4	M	F
Ogoki	16.3	20.6	16.5	16.5	M	F
Stone	15.9	20.8	16.7	17.1	M	5.1
Summit	16.1	21.3	17.0	15.8	M	F
Toronto	15.2	20.8	17.4	16.8	M	7.1
Eaglehead	M	21.0	17.6	16.5	11.1	3.6
Chief Bay	16.2	16.1	16.4	13.8	11.1	7.1
Black Sturgeon	13.3	M	M	M	M	M
Shillabeer	16.3	M	M	M	M	M
Albany River	16.7	M	M	16.1	M	4.6
No Name #4	17.1	20.8	M	M	M	M
Coles	M	21.3	M	M	M	M
DeCourley	M	M	M	M	M	4.3

A.R.T. SURFACE TEMPERATURES (°C) OF NORTHERN ONTARIO LAKES

A-3 1968	SURVEY DATES 1968				
LAKES	Aug. 14	Sept. 5	Sept. 26	Oct. 21	Nov. 5
Greenwich	16.2	16.3	14.6	10.0	7.6
Wolf Pup	17.1	15.9	14.4	M	4.3
Purdom	17.4	15.8	14.1	9.0	4.5
Jessie	14.1	14.1	13.4	9.7	7.2
Postagoni	17.5	16.0	14.8	9.5	5.1
Big	14.8	14.6	12.7	7.8	2.3
Caribou	16.5	15.2	14.3	9.4	5.8
Smoothrock	15.5	15.5	13.8	8.0	4.1
Goldsborough	15.7	14.6	14.4	9.0	4.9
Omdahl	15.6	15.2	14.4	8.6	4.0
Atikokiwam	14.4	15.6	12.6	7.1	2.6
Jean	12.3	14.4	11.0	6.4	F
No Name #1	12.1	13.5	9.1	5.6	F
Ochig	12.3	13.7	9.2	5.7	F
Pickle	15.3	14.6	13.5	8.3	4.0
Tarp	12.3	13.6	10.6	5.5	F
Collishaw	11.7	14.0	10.8	5.5	F
Bedesdawa	13.0	14.6	12.8	6.0	1.5
Neawagank	11.5	13.6	M	5.8	F
Asinne	12.4	13.9	M	5.8	1.7
Misamikwash	11.5	13.5	M	5.6	1.4
Bug	8.8*	13.2	M	3.6	F
Big Trout	11.3*	12.7	M	M	3.2
Sandy Bank	8.9*	13.6	M	M	1.0
Missisa	10.1*	16.9	M	4.8	M
No Name #2	12.0*	17.5	M	5.6	M
No Name #3	12.1*	17.6	M	6.1	M
Wabimeig	12.1*	17.8	M	5.7	M
Ogoki	14.6*	16.3	M	8.4	2.5
Stone	14.9*	16.0	M	8.7	3.4
Summit	14.6*	16.9	M	7.4	1.4
Toronto	15.1*	16.8	M	9.5	6.1
Nipigon	12.0*	13.2	13.1	9.5	7.8
Eaglehead	16.6*	15.8	M	9.0	3.3
Black Sturgeon	13.0*	M	M	M	M
Chief Bay	M	14.8	M	9.7	5.9
Blob	M	M	M	M	2.3
Marshall	M	M	M	M	1.8
Slipper	M	M	M	M	5.8
Pijitawabik Bay	M	M	M	M	5.1
Ara	M	M	M	M	3.7

* Instrument Accuracy Questionable

A.R.T. SURFACE TEMPERATURES (°C) OF NORTHERN ONTARIO LAKES

A-4 1969	SURVEY DATES 1969							
LAKE	May 29	June 11-12	June 24	Aug. 12	Sept. 17	Oct. 7	Oct. 22	Nov. 4
Greenwich	8.7	9.0	10.9	19.7	13.6	9.6	7.8	1.0
Wolf Pup	13.9	12.8	13.1	19.7	13.4	8.8	3.1	F
Purdom	13.9	12.8	13.6	19.6	14.2	9.8	4.8	F
Jessie	7.2	8.3	8.6	16.0	13.0	7.9	7.3	0.5
Postagoni	11.9	11.6	13.3	19.0	14.6	10.3	5.5	0.1
Nipigon	4.1	4.3	10.9	16.9	13.5	10.2	8.1	5.5
Big	13.7	10.8	14.1	21.5	12.3	8.6	M	F
Caribou	10.7	9.7	13.3	20.9	13.8	10.3	M	0.0
Smoothrock	11.8	10.3	13.7	20.6	12.9	9.2	M	F
Goldsborough	9.3	9.1	12.6	19.7	13.4	9.8	M	1.2
Omdahl	11.1	10.1	13.5	19.0	12.8	9.5	M	1.0
Atikokiwam	12.8	10.3	15.9	21.1	11.9	8.7	M	0.7
Jean	12.5	9.6	18.0	21.5	10.5	7.7	M	F
No Name #1	12.5	9.3	17.1	21.6	9.8	7.9	M	F
Ochig	13.0	9.7	17.2	21.8	10.1	7.7	M	F
Pickle	8.1	8.9	16.3	20.3	13.0	8.5	M	1.0
Tarp	11.5	9.4	16.9	20.5	9.9	6.8	M	1.6
Collishaw	11.1	9.9	17.8	20.5	9.7	6.8	M	F
Badesdawa	10.3	10.0	16.1	20.3	11.0	7.0	M	0.4
Neawagank	9.0	10.5	14.4	19.5	9.3	6.8	M	F
Asinne	8.4	11.4	14.7	18.6	9.8	6.3	M	F
Misamikwash	7.3	9.7	13.1	19.5	8.8	5.4	M	F
Bug	6.3	10.8	14.5	21.4	6.4	5.8	M	F
Big Trout	1.5	5.3	8.3	18.6	9.2	6.4	M	0.6
Sandy Bank	5.2	10.0	14.9	20.7	6.1	6.0	M	F
Missisa	3.4	7.6	14.7	18.1	7.9	5.6	M	M
No Name #2	9.5	8.0	15.7	19.4	8.7	6.7	M	M
No Name #3	10.2	8.3	16.2	19.9	9.5	7.0	M	M
Wabimeig	11.5	7.6	16.5	19.7	9.7	7.9	M	M
Ogoki	10.3	8.2	15.7	19.6	12.4	8.1	M	M
Stone	10.4	8.9	15.1	19.4	13.5	8.9	M	M
Summit	16.6	8.8	16.6	19.6	11.4	9.1	M	M
Toronto	8.3	8.3	14.1	19.3	13.9	9.2	M	M
Eaglehead	14.3	12.4	16.2	21.8	15.1	10.7	M	0.9
Chief Bay	9.4	10.1	14.9	19.7	13.9	10.5	M	3.4

APPENDIX B

CLIMATOLOGICAL DATA USED IN CALCULATIONS OF EVAPORATION LOSSES

B.1 MEAN MONTHLY TEMPERATURES (°F)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ARMSTRONG A LAT: 50° 17′ LONG: 88°54′													
1966	-9.9	0.1	15.4	27.3	39.7	56.3	63.9	56.7	49.7	34.6	10.8	1.6	28.9
1967	-6.6	-12.2	10.3	28.0	37.8	55.9	59.0	56.7	50.6	36.0	20.0	7.3	28.6
1968	-4.3	- 1.8	20.2	32.1	44.1	52.6	59.1	55.7	52.1	40.1	20.6	4.7	31.3
1969	-1.2	4.0	9.7	34.2	41.0	46.8	59.5	61.7	47.1	31.8	18.7	8.7	30.2
1931–1960 Mean	-2.8	0.9	12.4	31.3	44.1	56.0	62.0	59.2	48.9	37.5	19.8	3.3	31.3
FORT WILLIAM (THUNDER BAY) A LAT: 48°22′ LONG: 89°19′													
1966	-0.5	10.1	24.9	35.1	45.0	58.9	67.4	60.4	54.0	39.5	22.4	10.8	35.7
1967	5.1	-1.7	20.9	35.1	42.1	57.1	61.7	59.9	53.5	40.9	24.4	16.6	34.6
1968	6.0	7.2	26.9	38.0	46.1	55.3	61.8	59.2	55.4	43.8	28.7	12.0	36.7
1969	7.9	10.7	18.6	39.5	46.1	51.4	62.8	66.7	53.2	37.9	26.4	15.6	36.4
1931–1960 Mean	7.2	9.9	20.5	35.8	47.5	57.3	63.5	62.0	52.8	42.6	27.0	13.5	36.6
LANSDOWNE HOUSE LAT: 52°14′ LONG: 87°53′													
1966	-10.8	-0.7	12.3	26.8	38.7	57.2	63.9	58.7	51.2	33.9	88.7	-2.7	28.1
1967	-9.4	-12.9	8.5	26.9	35.8	56.9	61.5	59.8	54.5	35.5	17.4	3.9	27.8
1968	-9.2	-4.8	15.9	30.7	46.6	55.1	58.3	56.2	56.6	38.1	18.4	2.2	30.3
1969	-3.8	2.6	4.8	31.6	39.6	47.8	6.31	64.0	45.2	32.0	19.6	7.2	29.5
1931–1960 Mean	-7.9	-2.0	9.5	27.1	41.8	56.0	62.7	60.1	49.0	38.0	18.7	0.3	29.4
NAKINA A LAT: 50°11′ LONG: 86°42′													
1966	- 7.8	4.6	16.5	29.8	41.0	58.3	63.6	56.6	50.1	34.2	13.1	3.5	30.3
1967	- 4.6	-7.9	11.7	28.6	38.4	57.5	59.5	56.9	52.9	35.9	M	M	M
1968	Station Closed November 1967												
1969													
1931–1960 Mean	-0.5	3.5	13.8	31.7	44.3	56.5	62.6	59.4	49.7	39.2	21.8	6.0	32.3
PICKLE LAKE LAT: 51°27′ LONG: 90°12′													
1966	-11.2	-0.4	15.8	28.6	40.3	58.3	65.1	58.6	52.6	34.7	9.1[e]	-1.6	29.2[e]
1967	-7.2	-12.6	13.0	25.8	38.1	58.2	61.8	59.9	54.9	35.5	18.4	5.2	29.3
1968	-6.2	-3.0	19.1	31.7	45.5	55.1	60.0	56.7	55.5	39.7	19.6	2.4	31.3
1969	-3.7[e]	4.6	10.8	37.5	43.0	49.4	63.0	65.2	48.0	32.4	21.6	10.6	31.9[e]
1931–1960 Mean	-6.0	-1.0	12.3	28.8	43.7	56.0	63.3	59.6	50.0	38.6	16.5	0.1	30.2
TROUT LAKE LAT: 53°50′ LONG: 89°52′													
1966	-15.0	-3.5	9.2	25.0	37.7	53.9	62.1	57.2	50.2	31.9	5.4	-6.4	25.6
1967	-12.0	-15.9	3.3	15.7	33.1	53.8	59.5	58.2	54.0	33.9	15.5	1.7	25.1
1968	-11.8	-8.5	12.8	28.8	43.7	52.8	56.0	53.5	54.9	36.6	17.0	-0.5	27.9
1969	-7.5	1.6	2.0	29.0	37.1	46.2	61.8	61.9	42.2	30.7	19.1	4.9	27.4
1931–1960 Mean	-11.0	-6.5	6.0	23.7	38.4	52.2	60.7	58.5	47.6	35.3	16.0	-2.8	26.5

CLIMATOLOGICAL DATA USED IN CALCULATIONS OF EVAPORATION LOSSES

B.2 MEAN MONTHLY DEW POINT (°F)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ARMSTRONG A													
1966	-13	-3	12	23	30	48	55	50	42	30	8	-2	
1967	-10	M	8	21	28	46	51	49	44	32	17	4	
1968	M	-6	14	24	35	44	51	50	47	37	18	1	
1969	-4	-1	5	25	33	40	52	55	43	28	17	7	
1931–1960 Mean	-11	-6	7	23	34	46	53	50	42	33	16	-3	
FORT WILLIAM (THUNDER BAY) A													
1966	-4	6	18	26	31	50	56	54	45	33	16	4	
1967	-1	-9	13	25	30	48	52	52	45	33	19	10	
1968	-1	-3	19	28	35	48	54	51	51	39	23	7	
1969	3	5	10	28	35	43	54	57	48	33	21	12	
1931–1960 Mean	-1	3	15	26	36	47	54	53	46	36	23	7	
LANSDOWNE HOUSE													
1966	-17	-5	6	19	28	48	57	51	44	29	6	-5	
1967	-12	-17	5	16	27	45	52	51	45	31	14	1	
1968	M	-9	11	24	36	45	50	48	50	34	15	-2	
1969	-8	-2	-1	21	31	39	54	55	40	27	16	6	
1931–1960 Mean	-14	-9	3	19	32	46	54	51	43	33	14	-6	
NAKINA A													
1966	-10	1	11	23	29	48	54	50	43	30	10	-1	
1967	-10	-13	7	21	28	46	51	50	44	32	M	M	
1968	Station Closed November 1967												
1969													
1931–1960 Mean	-8	-3	8	22	34	45	52	50	43	33	17	1	
PICKLE LAKE													
1966	M	M	11	21	28	48	54	50	44	M	M	M	
1967	M	M	M	18	26	44	51	48	M	M	14	1	
1968	M	M	11	21	36	M	M	M	47	36	14	M	
1969	M	M	M	24	33	39	51	M	42	27	14	M	
1931–1960 Mean	-11	-5	8	20	33	44	52	50	41	30	14	-3	
TROUT LAKE													
1966	-19	-9	5	18	29	45	54	50	44	28	1	-10	
1967	-16	M	-1	11	25	43	51	50	45	30	12	-2	
1968	M	-14	7	20	34	42	48	47	49	33	14	-4	
1969	-11	-4	-4	20	28	36	52	54	38	27	15	3	
1931–1960 Mean	-17	-13	-1	17	30	43	52	49	41	31	10	-9	

CLIMATOLOGICAL DATA USED IN CALCULATIONS OF EVAPORATION LOSSES

B.3 MEAN MONTHLY WIND SPEED (MPH)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ARMSTRONG A													
1966	7.4	7.3	9.8	7.5	9.2	8.4	7.8	7.1	8.5	9.1	6.5	6.6	
1967	6.6	6.4	8.3	8.2	8.1	8.2	7.5	7.3	7.9	9.7	8.1	8.2	
1968	6.4	9.2	8.7	8.4	7.5	8.1	8.2	8.0	6.8	8.5	7.5	5.6	
1969	6.6	4.2	5.6	5.4	7.4	6.3	4.8	5.8	5.5	5.9	6.0	4.6	
1955–1966 Mean	6.7	7.3	7.3	8.7	9.1	8.1	7.6	7.3	8.1	8.2	8.4	7.0	7.8
FORT WILLIAM (THUNDER BAY) A													
1966	12.5	11.2	14.5	12.4	13.6	10.2	9.5	9.3	10.1	12.1	10.8	10.8	
1967	12.0	11.0	12.5	13.0	12.7	10.9	10.2	8.9	9.4	13.7	9.8	12.9	
1968	10.0	14.6	12.5	13.3	11.6	10.4	11.5	10.3	9.7	11.1	12.7	12.0	
1969	10.5	6.9	8.6	8.3	9.4	8.0	7.0	7.9	7.4	8.4	7.9	6.7	
1955–1966 Mean	9.1	9.0	8.6	9.9	9.9	8.0	7.4	7.2	8.0	8.6	10.0	9.6	8.8
LANSDOWNE HOUSE													
1966	8.8	8.7	10.0	8.8	9.0	8.5	7.5	7.2	9.9	10.9	8.4	7.1	
1967	7.3	7.5	8.8	8.9	8.2	8.9	8.2	8.1	8.8	11.0	9.7	9.3	
1968	7.4	10.1	9.0	8.8	7.8	9.1	9.5	7.4	7.7	10.6	8.7	6.5	
1969	9.7	7.5	7.8	7.0	10.0	9.6	6.0	7.9	9.4	9.7	10.1	7.5	
1955–1966 Mean													
NAKINA A													
1966	6.8	8.4	9.7	7.7	8.9	8.9	7.4	6.7	7.3	7.9	7.9	7.2	
1967	6.6	7.2	8.2	8.9	8.4	7.8	6.6	7.2	7.2	8.8	M	M	
1968	Station Closed November 1967												
1969													
1955–1966 Mean	7.1	7.6	7.4	8.5	8.9	8.1	7.0	7.0	7.7	8.1	8.3	7.1	7.7
PICKLE LAKE													
1966	6.7	6.9	8.0	6.8	7.6	7.8	8.0	6.2	9.1	M	M	M	
1967	M	M	M	M	M	8.3	7.7	7.8	7.8	8.5	8.1	8.4	
1968	5.9	8.3	8.1	6.8	5.6	7.3	8.6	7.4	6.7	7.9	6.4	M	
1969	M	4.2	5.9	5.7	8.1	8.0	6.0	M	5.3	8.4	8.4	M	
1955–1966 Mean													
TROUT LAKE													
1966	9.7	10.0	10.8	10.2	10.0	10.0	9.0	M	11.6	11.3	8.8	7.5	
1967	M	M	M	M	M	M	M	M	M	M	M	M	
1968	M	M	M	9.8	9.2	10.2	10.3	9.3	9.2	10.4	9.3	7.3	
1969	9.5	7.1	8.7	8.1	10.9	11.2	7.7	9.8	10.0	10.0	12.1	7.3	
1955–1966 Mean													