

NOAA Data Report ERL GLERL-9



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LAKE ONTARIO CHEMICAL AND PHYSICAL  
CHARACTERISTICS DATA FOR 1972

Gerald L. Bell

Great Lakes Environmental Research Laboratory  
Ann Arbor, Michigan  
January 1980

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**UNITED STATES**  
**DEPARTMENT OF COMMERCE**  
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# LAKE ONTARIO CHEMICAL AND PHYSICAL CHARACTERISTICS DATA FOR 1972\*

Gerald L. Bell

Water samples at standard depths, were collected in Lake Ontario at established stations in the course of four cruises during the 1972 open-water season. The sampling program and analytical methods are described. Chemical characteristics of the water are listed by cruise for each station and sampling depth. The statistical summaries showing lake-wide means, standard deviations, and sample sizes of selected variables are presented by depth for each cruise period.

## 1. INTRODUCTION

This basic data report presents data collected aboard the NOAA Research Vessel *Researcher* in Lake Ontario by the Water Characteristics Branch of the Lake Survey Center, U.S. Department of Commerce, NOAA, National Ocean Survey, between 31 July and 16 November 1972.

As part of the International Field Year for the Great Lakes (IFYGL) Chemistry and Biology Program, in 1972 data was collected systematically so that the vertical and lateral distribution of the chemical and physical properties of Lake Ontario and its immediate environment, as well as their variations with respect to time, were measured and examined. The project was designed to complement existing data and continuing programs on Lake Ontario. The sampling program was designed to provide the basic data necessary to define relationships of significant water characteristics and to develop a materials balance in Lake Ontario.

Interpretations of the data are not within the scope of this report and will be presented in subsequent publications. Meteorological conditions, as well as profiles of water temperature and dissolved oxygen recorded at each station, are not included in this report, but are available from the IFYGL Data Archive, National Climatic Center, Asheville, N.C.

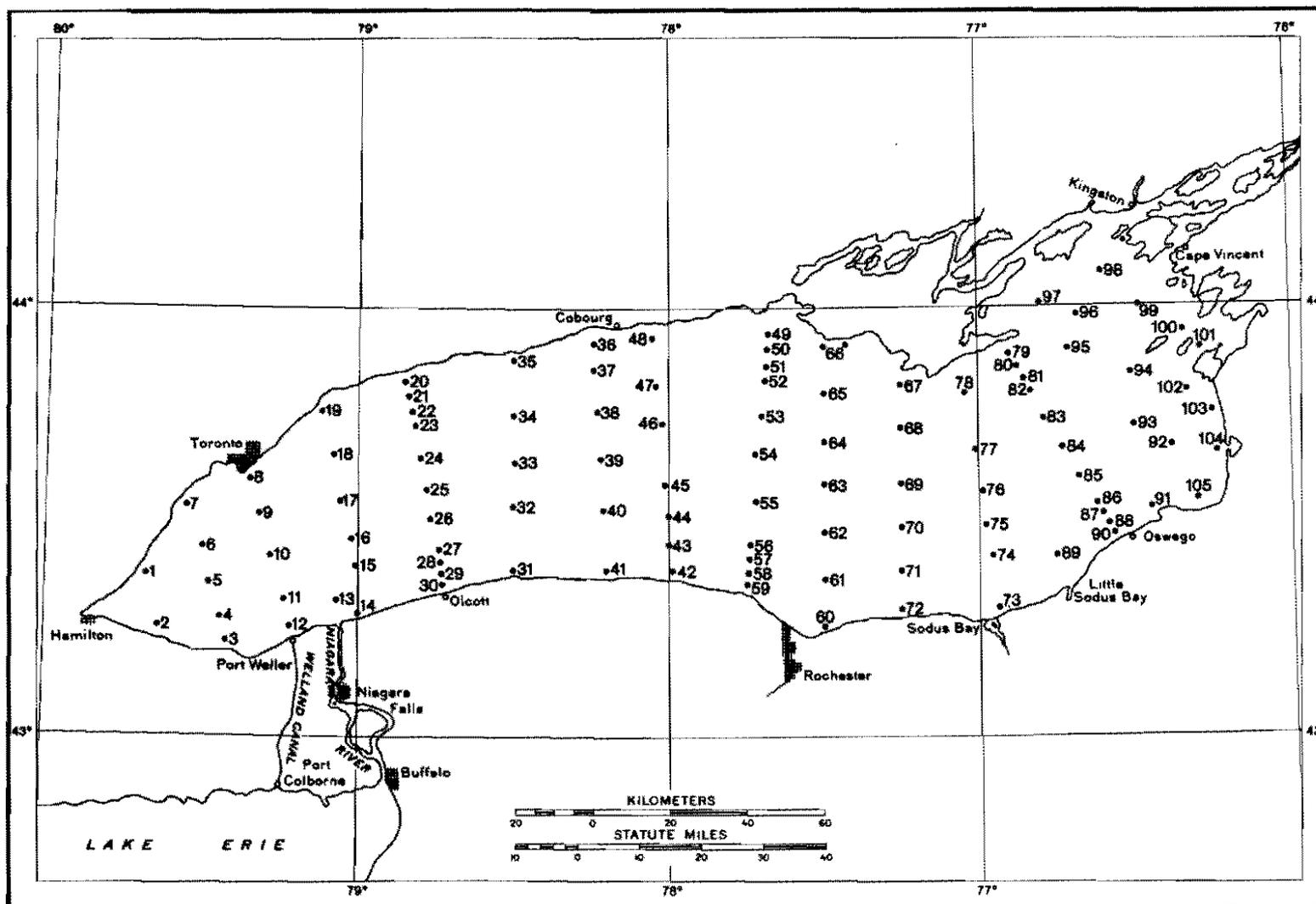
## 2. METHODS

### 2.1 Sampling Program

Chemistry cruises were conducted by the *Researcher* during IFYGL cruises 14, 20, 25, and 29 from 31 July to 3 August, from 11 to 14 September, from 16 to 19 October, and from 13 to 16 November (Table 1). About 60 of the 105 stations (Figure 1, Table 2) were sampled at multiple levels during each cruise. The data includes station location and time, sample depth and temperature, phosphate, nitrate, sulphate, silica,

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\*GLERL Contribution No. 172.



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Figure 1. Station locations in Lake Ontario during 1972.

Table 1. Cruise Schedule

Cruise	Date
14	31 July-3 Aug.
20	11 Sept.-14 Sept.
25	16 Oct.-19 Oct.
29	13 Nov.-16 Nov.

chloride, calcium, magnesium, sodium, potassium, alkalinity, specific conductance, pH, Eh (oxidation-reduction potential), and total suspended material (Table 3).

Water samples were collected in Niskin bottles attached to a General Oceanics Rosette Sampler, and those to be analyzed in the Detroit laboratory were preserved with chloroform. All meters were calibrated daily. The dissolved oxygen meter was calibrated in air, and the pH meter standardized with pH 7.0 and 4.0 buffers. Specific conductance was determined with an Industrial Instruments Conductivity Bridge, Model RC-16B2J. Temperature profiles were determined with a Guildline Electronic Bathythermograph, Model 1800.

## 2.2 Chemical Analyses

The methods used in the water analysis are those described in Standard Methods (American Public Health Association, 1965), Rainwater and Thatcher (1960), Fishman and Skougstad (1965), and Perkin-Elmer Corporation (1971).

Water samples were analyzed immediately in the *Researcher* laboratory for dissolved oxygen, specific conductance, phenolphthalein and total alkalinity, pH, and Eh.

Dissolved oxygen values were determined with a Beckman Dissolved Oxygen Analyzer, Model 777. After two separate tests were made on each sample, the highest partial pressure and the lowest sample temperature readings were used for calculating the dissolved oxygen. The *in situ* temperature was recorded by the Guildline Electronic Bathythermograph at the sampling depth.

Two separate tests for specific conductance were made on each sample and the average expressed in micromhos at 25°C.

Chloride concentrations were determined by the argentometric method and titration of a 50-ml sample of lake water. The silver nitrate was standardized and the reagent blank value determined at the beginning of each day.

Table 2. Station Locations in Lake Ontario during 1972 for the NOAA Ship Researcher (by Latitude and Longitude)

Cruise	Latitude	Longitude	Cruise	Latitude	Longitude
1	43.38°N	79.68°W	53	43.75°N	77.70°W
2	43.26°N	79.64°W	54	43.66°N	77.72°W
3	43.22°N	79.42°W	55	43.55°N	77.72°W
4	43.28°N	79.44°W	56	43.45°N	77.74°W
5	43.36°N	79.48°W	57	43.42°N	77.74°W
6	43.44°N	79.50°W	58	43.38°N	77.75°W
7	43.54°N	79.55°W	59	43.36°N	77.75°W
8	43.60°N	79.35°W	60	43.26°N	77.50°W
9	43.52°N	79.32°W	61	43.37°N	77.50°W
10	43.42°N	79.28°W	62	43.48°N	77.50°W
11	43.32°N	79.24°W	63	43.59°N	77.50°W
12	43.26°N	79.22°W	64	43.69°N	77.50°W
13	43.32°N	79.07°W	65	43.80°N	77.50°W
14	43.29°N	79.00°W	66	43.92°N	77.43°W
15	43.40°N	79.01°W	67	43.82°N	77.25°W
16	43.46°N	79.02°W	68	43.72°N	77.25°W
17	43.55°N	79.06°W	69	43.59°N	77.25°W
18	43.66°N	79.08°W	70	43.49°N	77.25°W
19	43.76°N	79.12°W	71	43.39°N	77.25°W
20	43.83°N	78.85°W	72	43.30°N	77.25°W
21	43.79°N	78.84°W	73	43.30°N	76.94°W
22	43.76°N	78.83°W	74	43.42°N	76.96°W
23	43.73°N	78.82°W	75	43.49°N	76.98°W
24	43.65°N	78.80°W	76	43.57°N	76.99°W
25	43.58°N	78.78°W	77	43.67°N	77.01°W
26	43.51°N	78.77°W	78	43.80°N	77.04°W
27	43.44°N	78.74°W	79	43.89°N	76.90°W
28	43.42°N	78.75°W	80	43.86°N	76.89°W
29	43.38°N	78.74°W	81	43.83°N	76.87°W
30	43.36°N	78.73°W	82	43.80°N	76.83°W
31	43.39°N	78.90°W	83	43.74°N	76.79°W
32	43.54°N	78.50°W	84	43.67°N	76.73°W
33	43.64°N	78.50°W	85	43.60°N	76.68°W
34	43.75°N	78.50°W	86	43.54°N	76.62°W
35	43.88°N	78.50°W	87	43.51°N	76.61°W
36	43.92°N	78.24°W	88	43.48°N	76.59°W
37	43.86°N	78.24°W	89	43.42°N	76.75°W
38	43.76°N	78.23°W	90	43.47°N	76.57°W
39	43.65°N	78.22°W	91	43.53°N	76.45°W
40	43.53°N	78.21°W	92	43.67°N	76.38°W
41	43.39°N	78.20°W	93	43.72°N	76.50°W
42	43.39°N	77.99°W	94	43.84°N	76.51°W
43	43.45°N	78.00°W	95	43.90°N	76.71°W
44	43.52°N	78.00°W	96	43.98°N	76.68°W
45	43.59°N	78.01°W	97	44.01°N	76.80°W
46	43.73°N	78.02°W	98	44.08°N	76.60°W
47	43.82°N	78.04°W	99	44.00°N	76.48°W
48	43.93°N	78.05°W	100	43.94°N	76.34°W
49	43.94°N	77.68°W	101	43.90°N	76.28°W
50	43.91°N	77.68°W	102	43.80°N	76.33°W
51	43.87°N	77.69°W	103	43.75°N	76.25°W
52	43.83°N	77.69°W	104	43.66°N	76.24°W
			105	43.55°N	76.30°W

Table 3. Shipboard and Laboratory Measurements in Connection with Limnological Studies

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Shipboard Water Measurements (On Station)

Water temperature (°C)  
 Electronic bathythermograph  
 pH  
 Eh (volts)  
 Total and phenolphthalein alkalinity (mg/l CaCO<sub>3</sub>)  
 Specific conductance (micromhos at 25°C)  
 Dissolved oxygen (mg/l and pct. sat.)

Chemistry Laboratory

Dissolved Ions

Nitrate <sup>1</sup>	(Brucine method, A.P.H.A. <sup>2</sup> , 1965)
Phosphate <sup>1</sup>	(Ammonium molybdate method, U.S.G.S. <sup>3</sup> , 1965)
Sulfate <sup>1</sup>	(Turbidimetric method, A.P.H.A. <sup>2</sup> , 1965)
Silica <sup>1</sup>	(Molybdate Blue method, U.S.G.S. <sup>3</sup> , 1960)
Magnesium <sup>4</sup>	(Atomic absorption tech., P.E. <sup>5</sup> , 1971)
Calcium <sup>4</sup>	(Atomic absorption tech., P.E. <sup>5</sup> , 1971)
Sodium <sup>4</sup>	(Atomic absorption tech., P.E. <sup>5</sup> , 1971)
Potassium <sup>4</sup>	(Atomic Absorption tech., P.E. <sup>5</sup> , 1971)
Chloride	(AgNO <sub>3</sub> titration)

Suspended sediment (mg/l)

- 
- <sup>1</sup>Beckman DU-2 spectrophotometer.  
<sup>2</sup>American Public Health Association.  
<sup>3</sup>U.S. Geological Survey.  
<sup>4</sup>Perkin-Elmer Atomic Absorption Spectrophotometer.  
<sup>5</sup>Perkin-Elmer Corporation.

Phenolphthalein and total alkalinity values were determined by titrating 100-ml water samples with standard acid ( $H_2SO_4$ ) to the end-points of pH 8.2 and 4.5, respectively. The end-points were determined with the pH meter and the results expressed in mg/l of calcium carbonate.

Measurements of pH and Eh were made with a Beckman Zeromatic pH Meter, a glass pH electrode, calomel fiber junction reference electrode, and a platinum Eh electrode. As a means of avoiding contamination, the electrodes were rinsed in a sample of the lake water to be tested. Between tests, the electrodes were immersed in distilled water.

Preserved water samples in 500 ml plastic bottles were transferred at the end of each cruise or survey period to the Great Lakes Research Center laboratory in Detroit, Mich., for additional testing. A Beckman DU-2 Spectrophotometer with flame attachment was used to analyze samples for nitrate, phosphate, sulfate and silica, and a Perkin-Elmer Atomic Absorption Spectrophotometer was used to analyze for calcium, magnesium, sodium, and potassium. Standard curves were constructed for each test and cruise. Tests for nitrate and phosphate were made on unfiltered samples upon arrival at the laboratory. Sample anion concentrations were determined by computer application of the absorbancy values to a standard curve that was adjusted by paired test standards run after each set of 10 to 20 samples in order to compensate for any change or drift in the spectrophotometer response. The cation concentrations were also adjusted by paired test standards and read directly from a recorder strip chart.

### 3. PRECISION LIMITS

The degrees of precision were determined for nitrate, phosphate, sulfate and silica (Table 4) by a computer comparison of pairs of test standards to the standard curve used to determine the sample concentrations. A pair of test standards was run after each set of 10 samples for nitrate and after each set of 20 samples for phosphate, sulfate, and silica. Calcium, magnesium, sodium and potassium analyses were run in sets of 10 samples followed by one standard and at least one additional standard bracketing the concentration range after each 20 samples. For both chloride and alkalinity, the estimated precision is based on the change in concentration produced by one drop (0.05 ml) of titrant and on the assumption that the end-point was within  $\pm$  one drop. Two readings were made on each sample for specific conductance, and deviations from the mean of each pair were used to compute the average deviation. The estimated precision of the dissolved oxygen determination is based on the assumption that partial pressure is accurate to 1 mm Hg.

Tests for nitrate and phosphate were made on unfiltered samples. From the end of a cruise to the date of analysis, there was an interval ranging from 2 to 6 days for phosphate and from 7 to 13 days for nitrate. These samples were preserved with  $CHCl_3$  to fix the phosphorus and nitrogen, but were not refrigerated.

Table 4. Measurement Precision

Variable	Units	Estimated precision	Average deviation *
Nitrate-N**	mg/l		±0.003
Phosphate-P**	mg/l		±0.0003
Sulfate	mg/l		±0.15
Silica	mg/l		±0.03
Calcium	mg/l	±0.5	
Magnesium	mg/l	±0.1	
Sodium	mg/l	±0.5	
Potassium	mg/l	±0.1	
Chloride	mg/l	±0.5	
Specific conductance	micromhos at 25°C		±1.6
Total alkalinity	mg/l CaCO <sub>3</sub>	±0.5	
Dissolved oxygen	mg/l	±0.1	
Dissolved oxygen	percent sat.	±1.0	

\* Average of the deviations of the test standards from the standard curve.

\*\*Analysis of unfiltered samples which were CHCL<sub>3</sub> poisoned and stored for variable lengths of time.

#### 4. DATA PRESENTATION

The limnological data are summarized by cruise for each sampling depth at a given station (Appendix A). Nitrogen concentrations were calculated from nitrate by multiplying by a factor of 0.226. Phosphorus concentrations were calculated from phosphate by multiplying by a factor of 0.326.

In the statistical summary, lake-wide means, standard deviations, and sample sizes are presented by depth and cruise period for selected variables (Appendix B).

#### 5. ACKNOWLEDGMENTS

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