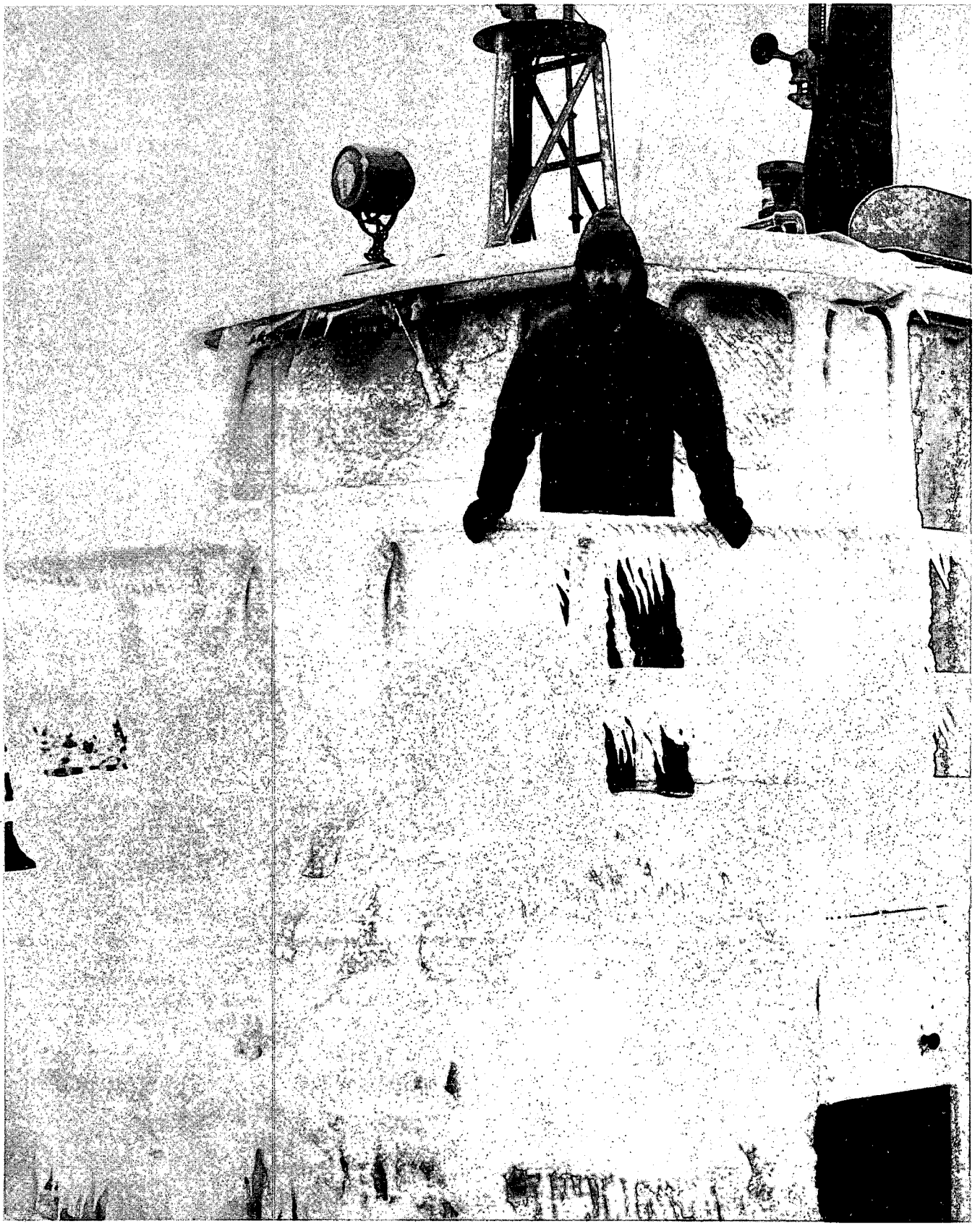
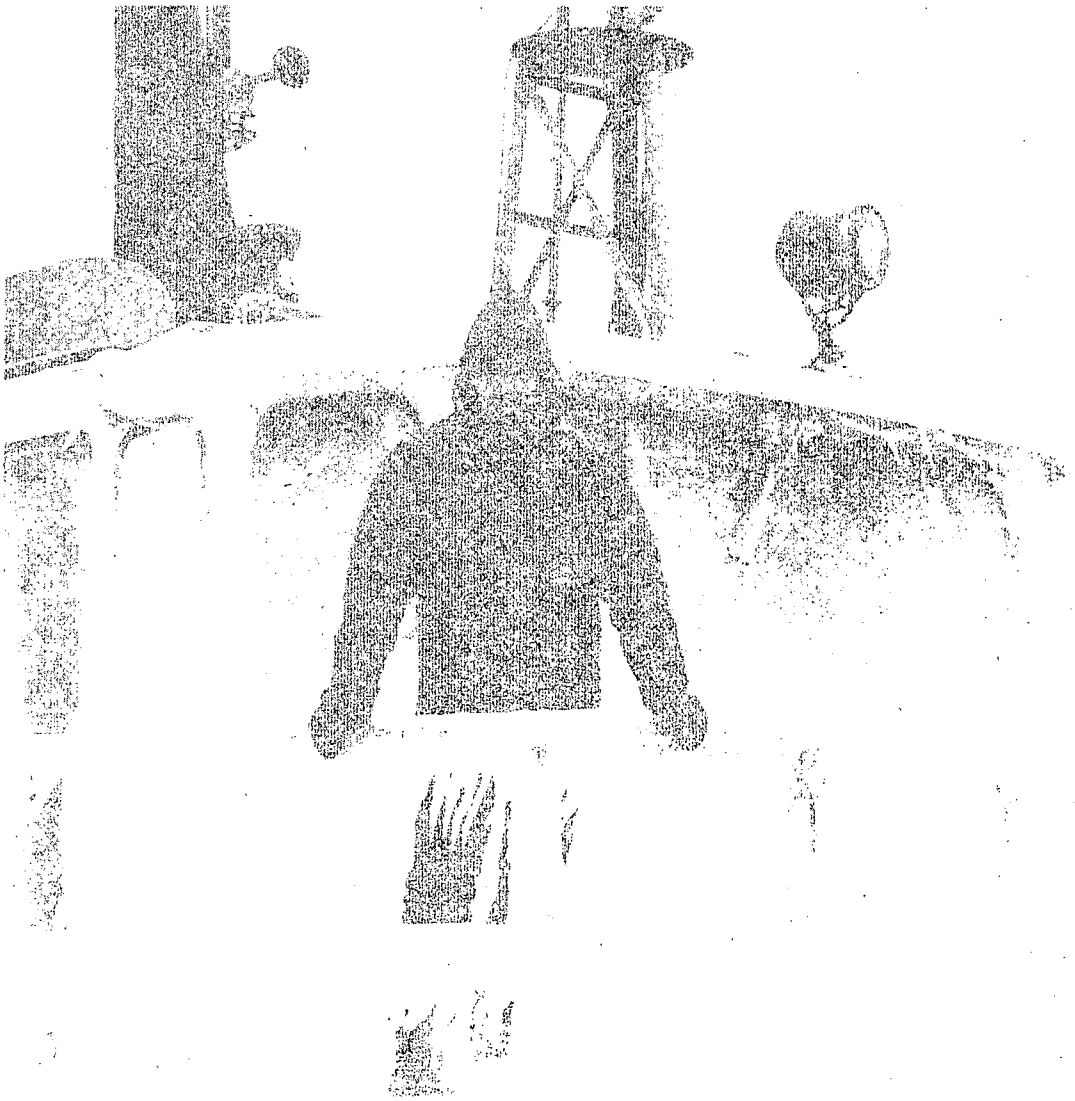
CANADA CENTRE FOR INLAND WATERS
TECHNICAL OPERATIONS SUBDIVISION

ANNUAL REPORT
1972



FRONTISPIECE: Winter Operations MV LAC ERIE



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APPENDIX D. Station Positions (Charts and Tables)

Field Activities

As in previous years, the 1972 field season was long and hectic -- much longer than normal, since with the CCIW's committment to the International Field Year for the Great Lakes (IFYGL) on Lake Ontario, the cruises continue through the winter until the end of March 1973 -- a short rest, then on with the 1973 field season. The nature of the field activities engaged in by Technical Operations staff encompassed nearly every scientific discipline at the Centre. Basically, they can be divided into three broad categories -- 1. major ship operations, 2. launch operations, and 3. support for shore based operations.

Major Ship Operations

Two major vessels, the CSS LIMNOS and the chartered vessel MV MARTIN KARLSEN, were used for Great Lakes Studies in 1972.

The LIMNOS is owned by the Department of the Environment and operated by the Marine Sciences Directorate (MSD). The MARTIN KARLSEN was chartered on 1 April, 1969 for three years with an option for a further two years. On 6 May, 1972, this option was exercised, so that the KARLSEN will be carrying on research work for the Centre until at least 31 March, 1974.

Although not considered a major research vessel, the launch MV LAC ERIE, chartered from McKiel Work Boats Ltd. played a very important role during the field year, not only in carrying out many of the "special" cruises listed below, but also in supporting many of the shore based field programs. Although not very large, she always managed to get the job done, often despite adverse conditions (see FRONTISPIECE).

In addition to these vessels, another, the CSS ADVENT, was delivered during the latter half of 1972 and is expected to be in operation with the rest of the CCIW "fleet" by early 1973.

The CCGS PORTE-DAUPHINE, in addition to carrying out work for the Great Lakes Institute (GLI), University of Toronto, was under contract when our major ships were unavailable for monitor work. These cruises, staffed by personnel from GLI and CCIW, were coordinated by Technical Operations and augmented the regular monitor program.

Detailed information on the cruises, description of the vessels and their equipment are covered in separate sections below.

Summary of Ship Operations

This year, the MV MARTIN KARLSEN participated in various IFYGL programs in addition to monitor cruises in Lake Erie and the upper lakes. The IFYGL committment amounted to approximately 60% of the total ship time.

For IFYGL (April 1972 - March 1973), the KARLSEN successfully completed seven Ontario Organic Particle Study (O.O.P.S.) cruises and one full monitor of Lake Ontario. Two more O.O.P.S. cruises and one additional monitor cruise on this lake are scheduled before the end of March 1973.

O.O.P.S. cruises consisted of two phases, each lasting one week. The first phase included "in depth" sampling of 32 stations along three transects, with a 24 hr stop at a mid-lake station for an intensive study of particle settling rates and biological productivity. The second phase called for occupying each of two stations for a 48 hr period for intensive study of daily variations in plankton distribution and migration. This multidisciplinary study of Lake Ontario involved personnel from CCIW and two universities (McMaster and Guelph). The monitor cruise conducted on this lake as part of IFYGL consisted of 95 stations.

Although the above programs made up the most significant part of the KARLSEN's contribution to IFYGL, the ship also participated in the launching of DECCA and meteorological buoys, DECCA chain calibrations, Heat Content surveys, as well as two intercomparison studies (Canada & U.S.) of ship data acquisition systems and methods. Eight additional cruises completed the year's activities. Five of these were conducted into Lake Erie and the remaining three were extended monitor cruises into Lake Huron. In addition to just Lake Huron, Northern Lake Michigan and Georgian Bay were monitored in the spring and Lake Michigan was again monitored in the fall, representing the first time a major research vessel from CCIW has monitored these regions.

During the Lake Huron monitor, a current meter mooring was established in Main Channel, between Lake Huron and Georgian Bay. During the November cruise, this mooring was refurbished and set in position for the winter, to be recovered next spring.

Technical Operations personnel coordinated all ship's activity including sampling, moorings, manual chemical analyses and some primary data analyses. The year saw improvements in the methods and instrumentation used for measuring some parameters (pH, conductivity, pumped water sampler), as well as further development in the use of the Hewlett-Packard 9800 series calculators for data handling and display.

The 1972 field season aboard the CSS LIMNOS proved to be most successful, with only one week of downtime due to mechanical failure. During the year, she carried out a great variety of specialized cruises, totalling 30 in all. These included five mooring cruises, nine temperature surveys, three temperature transects, six dye diffusion cruises, four bathymetric surveys along with several various smaller additional surveys including Engineering instrument trials and two intercomparison studies (Canada & U.S.) of shipboard data aquisition systems and methods.

The year was one of the most successful yet with respect to mooring operations, with 100% recovery of all stations. Lake Ontario, being the focal point for IFYGL, had the heaviest concentration of moorings ever launched in the Great Lakes during 1972.

Excellent cooperation was enjoyed between ship's personnel and scientific staff, helping to make the overall year-long operation both very enjoyable and productive. It should be noted that very few problems arose with the data acquisition systems onboard and problems that did arise were only of a minor nature and quickly rectified by the Engineering Division.

Fig. 1. Operational Table 1972

Ship	Began Operations	Ended Operations	Cruises	Miles Steamed	Total Days	Active Days	%
MARTIN KARLSEN	Mar 13/72	Dec 2/72	24	15,835	265	180	68
LIMNOS	Mar 27/72	Dec 20/72	30	17,480	270	169	63

(Complete schedules are given in Tables 1,2,3, and 4.)

GREAT LAKES STUDIES - IFYGL

1972 - MV MARTIN KARLSEN

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JAN	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
FEB	30	31	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
MAR	27	28	29	1	2	3	4
	5	6	7	8	9	10	11
	12	13 Depart CCIW 1115 hrs	14 Lake Ontario	15 DECCA Buoys	16 Arrive CCIW 1000 hrs	17 CCIW	18 CCIW
	19 CCIW	20 CCIW	21 Depart CCIW 0930 hrs	22 Lake Ontario	23 Met. Buoys	24 Arrive CCIW 0840 hrs	25 CCIW
	26 CCIW	27 CCIW	28 CCIW	29 Depart CCIW 1405 Lake Ontario	30 Met. Buoys Arr. CCIW 1335	31 CCIW	1 CCIW
APR	2 CCIW	3 Depart CCIW 1023 hrs	4 Lake Ontario DECCA Chain	5 Arrive CCIW 1145 hrs	6 Depart CCIW 1900 hrs	7 Lake Ontario	8 DECCA Chain Calibration
	9 Arrive CCIW 1615 hrs	10 Depart CCIW 1425 hrs	11 Lake Ontario	12 Organic Particle	13 Study	14 Arrive CCIW 2310 hrs	15 CCIW
	16 CCIW	17 Depart CCIW 1110 hrs	18 Lake Ontario	19 Organic	20 Particle	21 Study	22 Arrive CCIW 0850 hrs
	23 CCIW	24 Depart CCIW 0950 hrs	25 Lake Erie	26 Monitor	27 Lake Erie	28 Arrive Sarnia 2250 hrs	29 Sarnia
MAY	30 Sarnia	1 Depart Sarnia 1740 hrs	2 Lake Huron	3 and Georgian Bay	4 Monitor and	5 Moorings	6 Lake Huron
	7 and Georgian Bay	8 Monitor	9 Moorings	10 Lake Huron and	11 Georgian Bay	12 Arrive CCIW 0830 hrs	13 CCIW
	14 CCIW	15 CCIW	16 CCIW	17 Depart CCIW 1215 hrs	18 Lake Ontario Equipment Trials	19 Arrive CCIW 1705 hrs	20 CCIW
	21 CCIW	22 CCIW	23 Depart CCIW 1110 hrs	24 Lake Ontario	25 Organic Particle	26 Study	27 Arrive CCIW 1230 hrs
	28 CCIW	29 Depart CCIW 1135 hrs	30 Lake Ontario	31 Organic	1 Particle	2 Study	3 Arrive CCIW 0730 hrs
JUNE	4 CCIW	5 Depart CCIW 0945 hrs	6 Lake Erie	7 Monitor	8 Lake Erie	9 Monitor	10 Lake Erie
	11 Arrive CCIW 1440 hrs	12 CCIW	13 CCIW	14 Re-fitting	15 CCIW	16 CCIW	17 CCIW
	18 CCIW	19 Depart CCIW 1150 hrs	20 Lake Ontario	21 Organic Particle	22 Study	23 Arrive CCIW 1440 hrs	24 CCIW
	25 CCIW	26 Depart CCIW 1010 hrs	27 Lake Ontario	28 Intercomparison and	29 Organic Particle	30 Studies	1 Arrive CCIW 1245 hrs
JULY	2 CCIW	3 CCIW	4 CCIW	5 CCIW	6 CCIW	7 CCIW	8 CCIW
	9 CCIW	10 CCIW	11 CCIW	12 CCIW	13 CCIW	14 CCIW	15 CCIW
	16 CCIW	17 Depart CCIW 1040 hrs	18 Lake Ontario	19 Organic Particle	20 Study	21 Arrive CCIW 1515 hrs	22 CCIW
	23 CCIW	24 Depart CCIW 1040 hrs	25 Lake Ontario	26 Organic	27 Particle	28 Study	29 Arrive CCIW 0630 hrs
	30 CCIW	31 Depart CCIW 0940 hrs	1 Lake Erie	2 Monitor	3 Lake Erie	4 Monitor	5 Arrive Sarnia 2240 hrs
AUG	6 Sarnia	7 Sarnia	8 Depart Sarnia 1545 hrs	9 Lake Huron	10 Monitor	11 and	12 Moorings
	13 Lake	14 Huron	15 Monitor	16 and	17 Moorings	18 Arrive Sarnia 1645 hrs	19 In transit
	20 Arrive CCIW	21 CCIW	22 CCIW	23 CCIW	24 CCIW	25 CCIW	26 CCIW
	27 CCIW	28 Depart CCIW 0830 hrs	29 Lake Ontario DECCA Chain	30 Arrive CCIW 0400 hrs	31 CCIW	1 CCIW	2 CCIW
SEP	3 CCIW	4 CCIW	5 Depart CCIW 1113 hrs	6 Lake Ontario	7 Organic Particle	8 Study	9 Arrive CCIW 1455 hrs
	10 CCIW	11 Depart CCIW 1035 hrs	12 Lake Ontario	13 Organic	14 Particle	15 Study	16 Arrive CCIW 0540 hrs
	17 CCIW	18 Depart CCIW 0900 hrs	19 Lake Ontario	20 Intercomparison	21 Study and	22 Monitor	23 Arrive CCIW 2040 hrs
	24 CCIW	25 CCIW	26 CCIW	27 Depart CCIW 0915 hrs	28 Lake Erie	29 Monitor	30 Lake Erie
OCT	1 Monitor	2 Arrive CCIW 2350 hrs	3 Depart CCIW 1213 hrs	4 Lake Ontario	5 Heat Content Survey Eutrophication Study	6 Arrive CCIW 1630 hrs	7 CCIW
	8 CCIW	9 CCIW	10 CCIW	11 Depart CCIW 1035 hrs	12 Lake Ontario	13 Moorings	14 Lake Ontario
	15 Moorings	16 Arrive CCIW 1655 hrs	17 Depart CCIW 1315 hrs	18 Lake Ontario	19 Organic Particle	20 Study	21 Arrive CCIW 1545 hrs
	22 CCIW	23 Depart CCIW 1135 hrs	24 Lake Ontario	25 Organic	26 Particle	27 Study	28 Arrive CCIW 1020 hrs
NOV	29 CCIW	30 Depart CCIW 1455 hrs	31 Lake Huron	1 and Lake Michigan	2 Monitor	3 and	4 Moorings
	5 Lake Huron and	6 Lake Michigan	7 Monitor	8 and	9 Moorings	10 Arrive Sarnia 0845 Depart Sarnia 0930	11 Lake Erie
	12 Monitor	13 Lake Erie	14 Monitor	15 Arrive CCIW 1340 hrs	16 CCIW	17 CCIW	18 CCIW
	19 CCIW	20 Depart CCIW 1105 hrs	21 Lake Ontario	22 Organic Particle	23 Study	24 Arrive CCIW 1050 hrs	25 CCIW
	26 CCIW	27 Depart CCIW 1225 hrs	28 Lake Ontario	29 Organic	30 Particle	1 Study	2 Arrive CCIW 0345 hrs
DEC	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30

TABLE 1

GREAT LAKES STUDIES - IFYGL

1972 - CSS LIMNOS

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JAN	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
FEB	30	31	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
MAR	27	28	29	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27 Dep. CCIW 0846 Lake Ontario	28 Met. Buoys Arr. CCIW 1445	29 CCIW	30 CCIW	31 CCIW	1 CCIW
APR	2 CCIW	3 CCIW	4 Dep. CCIW 1154 hrs.	5 Lake Ontario	6 Heat Content Survey	7 Arr. CCIW 1005 hrs.	8 CCIW
	9 CCIW	10 Dep. CCIW 1215 hrs.	11 Lake Ontario	12 Heat Content Survey	13 Arr. CCIW 1035 hrs.	14 CCIW	15 CCIW
	16 CCIW	17 Dep. CCIW 1151 hrs.	18 Lake Ontario	19 Heat Content Survey	20 Arr. CCIW 1212 hrs.	21 CCIW	22 CCIW
	23 CCIW	24 Dep. CCIW 1150 hrs.	25 Lake Ont. Heat Content Survey	26 Arr. CCIW 2215 hrs.	27 CCIW	28 CCIW	29 CCIW
MAY	30 CCIW	1 Dep. CCIW 1152 hrs.	2 Lake Ontario	3 Heat Content Survey	4 Arr. CCIW 0612 hrs.	5 CCIW	6 CCIW
	7 CCIW	8 Dep. CCIW 1153 hrs.	9 Lake Ontario	10 Heat Content Survey	11 Arr. CCIW 1145 hrs.	12 CCIW	13 CCIW
	14 CCIW	15 Dep. CCIW 0920 hrs.	16 Lake Ontario	17 Moorings	18 Moorings	19 Arr. CCIW 1544 hrs.	20 CCIW
	21 CCIW	22 CCIW	23 CCIW	24 CCIW	25 CCIW	26 CCIW	27 CCIW
	28 CCIW	29 Dep. CCIW 1019 hrs.	30 Lake Ont. Diffusion Study	31 Arr. CCIW 2050 hrs.	1 CCIW	2 CCIW	3 CCIW
JUNE	4 CCIW	5 Dep. CCIW 0853 hrs.	6 Lake Ontario	7 Energy Budget Study	8 Heat Content Survey	9 Arr. CCIW 1842 hrs.	10 CCIW
	11 CCIW	12 Dep. CCIW 0915 hrs.	13 Lake Ontario	14 Bathymetric	15 Survey	16 Bathymetric	17 Survey
	18 Bathymetric	19 Survey	20 Bathymetric	21 Survey	22 Arr. CCIW 2230 hrs.	23 CCIW	24 CCIW
	25 CCIW	26 Dep. CCIW 0851 hrs.	27 Lake Ontario	28 Inter-comparison	29 & Diffusion Study	30 Arr. CCIW 1511 hrs.	1 CCIW
JULY	2 CCIW	3 CCIW	4 Dep. CCIW 1020 hrs.	5 Lake Ontario	6 Moorings	7 Moorings	8 Arr. CCIW 0236 hrs.
	9 CCIW	10 Dep. CCIW 1033 hrs.	11 Lake Ontario	12 Temperature	13 Transects	14 Arr. CCIW 1525 hrs.	15 CCIW
	16 CCIW	17 Dep. CCIW 0915 hrs.	18 Lake Ontario	19 Diffusion Study	20 Arr. CCIW 2250 hrs.	21 CCIW	22 CCIW
	23 CCIW	24 CCIW	25 CCIW	26 CCIW	27 CCIW	28 CCIW	29 CCIW
AUG	30 CCIW	31 CCIW	1 CCIW	2 CCIW	3 CCIW	4 CCIW	5 CCIW
	6 CCIW	7 CCIW	8 Dep. CCIW 0930 hrs.	9 Lake Ontario	10 Temperature	11 Transects	12 Arr. CCIW 1615 hrs.
	13 CCIW	14 Dep. CCIW 1150 hrs.	15 Lake Ontario	16 Diffusion Study	17 Diffusion Study	18 Diffusion Study	19 Arr. CCIW 1024 hrs.
	20 CCIW	21 Dep. CCIW 1020 hrs.	22 Lake Ontario	23 Moorings	24 Arr. CCIW 1610 hrs.	25 CCIW	26 CCIW
	27 CCIW	28 Dep. CCIW 0905 hrs.	29 Lake Ontario	30 Diffusion Study	31 Diffusion Study	1 Diffusion Study	2 Arr. CCIW 1402 hrs.
SEPT	3 CCIW	4 CCIW	5 Dep. CCIW 0915 hrs.	6 Lake Ontario	7 Diffusion Study	8 Diffusion Study	9 Arr. CCIW 0805 hrs.
	10 CCIW	11 Dep. CCIW 0915 hrs.	12 Lake Ontario	13 Bathymetric	14 Survey	15 Bathymetric	16 Survey
	17 Bathymetric	18 Survey	19 Bathymetric	20 Survey	21 Bathymetric Survey	22 Arr. CCIW 1345 hrs.	23 CCIW
	24 CCIW	25 Dep. CCIW 0958 hrs.	26 Lake Ontario	27 Diffusion Study	28 Diffusion Study	29 Diffusion Study	30 Arr. CCIW 1415 hrs.
OCT	1 CCIW	2 Dep. CCIW 0940 hrs.	3 Lake Ontario	4 Temperature	5 Transects	6 Arr. CCIW 1515 hrs.	7 CCIW
	8 CCIW	9 CCIW	10 CCIW	11 CCIW	12 CCIW	13 CCIW	14 CCIW
	15 CCIW	16 Dep. CCIW 1000 hrs.	17 Lake Ontario	18 Diffusion	19 Study	20 Arr. CCIW 1430 hrs.	21 CCIW
	22 CCIW	23 Dep. CCIW 0900 hrs.	24 Lake Ontario	25 Bathymetric	26 Survey	27 Arr. CCIW 1600 hrs.	28 CCIW
NOV	29 CCIW	30 Dep. CCIW 0900 hrs.	31 Lake Ontario	1 Bathymetric	2 Survey	3 Arr. CCIW 1330 hrs.	4 CCIW
	5 CCIW	6 Dep. CCIW 0900 hrs.	7 Lake Ontario	8 Bathymetric	9 Survey	10 Arr. CCIW 1220 hrs.	11 CCIW
	12 CCIW	13 CCIW	14 CCIW	15 Dep. CCIW 0903 Lake Ontario	16 Met. Buoys Arr. CCIW 1845	17 CCIW	18 CCIW
	19 CCIW	20 Dep. CCIW 0903 hrs.	21 Lake Ontario	22 Moorings	23 Lake Ontario	24 Moorings	25 Arr. CCIW 1448 hrs.
DEC	26 CCIW	27 Dep. CCIW 1100 hrs.	28 Lake Ontario	29 Bathymetric Survey	30 and	1 Decca Calibration	2 Arr. CCIW 1225 hrs.
	3 CCIW	4 CCIW	5 Dep. CCIW 1354 hrs.	6 Lake Ontario	7 Heat Content Survey	8 and	9 Met. Buoy Recovery
	10 Arr. CCIW 0145 hrs.	11 Dep. CCIW 1204 hrs.	12 Lake Ontario	13 Heat Surveys and	14 Met. Buoy Recovery	15 Arr. Toronto 1112 hrs.	16 CCIW
	17 CCIW	18 Dep. CCIW 1306 hrs.	19 Lake Ont. Heat Content Survey	20 Arr. CCIW 2055 hrs.	21	22	23
	24	25	26	27	28	29	30

TABLE 2

GREAT LAKES STUDIES - IFYGL

1972 - MV LAC ERIE

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JAN	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
FEB	30	31	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
MAR	27	28	29	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16 Dep. CCIW 0800 Arr. CCIW 1700	17 CCIW	18 CCIW
	19 CCIW	20 Dep. CCIW 0800 Lake Ontario	21 MOSES Arr. CCIW 1700	22 CCIW	23 CCIW	24 CCIW	25 CCIW
	26 CCIW	27 CCIW	28 CCIW	29 CCIW	30 CCIW	31 CCIW	1 CCIW
APR	2 CCIW	3 CCIW	4 CCIW	5 Dep. CCIW 0845 hrs.	6 Lake Ontario	7 Met. Buoys	8 Lake Ontario
	9 Met. Buoys	10 Lake Ontario	11 Arr. CCIW 1930 hrs.	12 CCIW	13 CCIW	14 CCIW	15 CCIW
	16 CCIW	17 In Transit	18 Dep. Cobourg 0600 hrs.	19 Lake Ontario	20 Met. Buoys	21 Lake Ontario	22 Met. Buoys
	23 Lake Ontario	24 Met. Buoys	25 Arr. CCIW 1600 hrs.	26 CCIW	27 CCIW	28 CCIW	29 CCIW
MAY	30 Dep. CCIW 0700 hrs.	1 Lake Ontario	2 Met. Buoys	3 and F.T.P.	4 Arr. CCIW 1700 hrs.	5 CCIW	6 CCIW
	7 CCIW	8 CCIW	9 CCIW	10 CCIW	11 CCIW	12 CCIW	13 CCIW
	14 CCIW	15 Dep. CCIW 0915 hrs.	16 Lake Ontario	17 Met. Buoys	18 and F.T.P.	19 Arr. CCIW 1600 hrs.	20 CCIW
	21 CCIW	22 CCIW	23 CCIW	24 CCIW	25 CCIW	26 CCIW	27 CCIW
	28 CCIW	29 Dep. CCIW 0845 hrs.	30 Lake Ontario	31 Met. Buoys	1 Lake Ontario	2 Arr. CCIW 2045 hrs.	3 CCIW
JUNE	4 CCIW	5 CCIW	6 CCIW	7 CCIW	8 CCIW	9 CCIW	10 CCIW
	11 CCIW	12 Dep. CCIW 0905 hrs.	13 Lake Ontario	14 Met. Buoys	15 Lake Ontario	16 Arr. CCIW 2045 hrs.	17 CCIW
	18 CCIW	19 CCIW	20 Dep. CCIW 1020 Lake Ontario	21 Pesticide Monitor	22 Arr. CCIW 1830 hrs.	23 CCIW	24 CCIW
	25 CCIW	26 Dep. CCIW 1015 Arr. CCIW 1930	27 Dep. CCIW 1015 hrs.	28 Lake Ontario	29 Met. Buoys	30 Lake Ontario	1 Arr. CCIW 0100 hrs.
JULY	2 CCIW	3 CCIW	4 CCIW	5 Dep. CCIW 0810 Lake Ontario	6 Pesticide Monitor	7 Arr. CCIW 1845 hrs.	8 CCIW
	9 CCIW	10 Dep. CCIW 0855 hrs.	11 Lake Ontario	12 Pesticide	13 Monitor	14 Arr. CCIW 1615 hrs.	15 CCIW
	16 CCIW	17 Dep. CCIW 0900 Lake Ontario	18 NTA Monitor Arr. CCIW 1030	19 CCIW	20 CCIW	21 CCIW	22 CCIW
	23 CCIW	24 Dep. CCIW 0840 hrs.	25 Lake Ontario	26 Met. Buoys	27 and F.T.P.	28 Arr. CCIW 1530 hrs.	29 CCIW
	30 CCIW	31 CCIW	1 Dep. CCIW 0945 hrs.	2 Lake Ontario	3 F.T.P. and IRLS	4 Arr. CCIW 0300 hrs.	5 CCIW
AUG	6 CCIW	7 CCIW	8 Dep. CCIW 1050 hrs.	9 Lake Ontario	10 Met. Buoys	11 and F.T.P.	12 Arr. CCIW 1815 hrs.
	13 CCIW	14 CCIW	15 CCIW	16 CCIW	17 CCIW	18 Dep. CCIW 0915 Lake Ontario	19 NTA Monitor Arr. CCIW 1920
	20 CCIW	21 Dep. CCIW 0905 hrs.	22 Lake Ontario	23 Met. Buoys and F.T.P.	24 Arr. CCIW 1730 hrs.	25 CCIW	26 CCIW
	27 In Transit	28 Dep. Kingsville 0735	29 Lake Erie	30 Iron-Manganese Study	31 Arr. Port Colborne 1935	1 In Transit	2 CCIW
SEPT	3 CCIW	4 CCIW	5 Dep. CCIW 0900 hrs.	6 Lake Ontario	7 Met. Buoys	8 Lake Ontario	9 Met. Buoys
	10 Arr. CCIW 0130 hrs.	11 CCIW	12 Dep. CCIW 0945 hrs.	13 Lake Ontario	14 F.T.P.	15 Arr. Oshawa 1215 Dep. Oshawa 1230	16 NTA Monitor Arr. CCIW 1230
	17 CCIW	18 Dep. CCIW 1010 hrs.	19 Lake Ontario	20 Met. Buoys	21 and F.T.P.	22 Lake	23 Ontario
	24 Arr. CCIW 1520 hrs.	25 CCIW	26 CCIW	27 CCIW	28 CCIW	29 CCIW	30 CCIW
OCT	1 CCIW	2 Dep. CCIW 0910 hrs.	3 Lake Ontario	4 Met. Buoys	5 Lake Ontario	6 Arr. Kingston 0900 hrs.	7 Kingston
	8 Kingston	9 Kingston	10 Dep. Kingston 1315 hrs.	11 Lake Ontario Met. Buoys	12 Arr. CCIW 1700 hrs.	13 CCIW	14 CCIW
	15 CCIW	16 CCIW	17 CCIW	18 CCIW	19 Dep. CCIW 0935 hrs.	20 Lake Ontario	21 Met. Buoys
	22 Lake Ontario	23 Met. Buoys	24 Arr. CCIW 1630 hrs.	25 Dep. CCIW 0900 Lake Ontario	26 NTA Monitor Arr. CCIW 1130	27 CCIW	28 CCIW
NOV	29 CCIW	30 Dep. CCIW 0945 hrs.	31 Lake Ontario	1 Met. Buoys	2 Lake Ontario	3 Arr. Kingston 1000 hrs.	4 Kingston
	5 Kingston	6 Dep. Kingston 0700 hrs.	7 Lake Ontario Met. Buoys	8 Arr. CCIW 1430 hrs.	9 CCIW	10 CCIW	11 CCIW
	12 CCIW	13 CCIW	14 CCIW	15 CCIW	16 CCIW	17 CCIW	18 CCIW
	19 CCIW	20 CCIW	21 Dep. CCIW 0930 Lake Ontario	22 NTA Monitor Arr. CCIW 1920	23 CCIW	24 CCIW	25 CCIW
	26 CCIW	27 CCIW	28 CCIW	29 CCIW	30 CCIW	1 CCIW	2 CCIW
DEC	3 Dep. CCIW 0800 hrs.	4 Lake Ontario	5 Kingston	6 Kingston	7 Met. Buoys	8 Arr. CCIW 2400 hrs.	9 CCIW
	10 CCIW	11 Dep. CCIW 0900 Arr. Niagara 1500	12 Dep. Port Dalhousie 1030	13 Lake Ontario NTA	14 Arr. CCIW 1535 hrs.	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30

TABLE 3

GREAT LAKES STUDIES - IFYGL

1972 - CCGS PORTE DAUPHINE

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JAN	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
FEB	30	31 Dep. Toronto 1055 hrs.	1 Lake Ontario	2 Monitor	3 Lake Ontario	4 Monitor	5 Lake Ontario
	6 Monitor	7 Lake Ontario	8 Monitor	9 Lake Ontario Monitor	10 Arr. Toronto 1955 hrs.	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
MAR	27	28	29	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
APR	26	27	28	29	30	31	1
	2	3	4 Dep. Toronto 0936 hrs.	5 Lake Ontario	6 Heat Content	7 Survey	8 Arr. Toronto 0010 hrs.
	9	10 Dep. Toronto 0938 hrs.	11 Heat Content Survey L.Ont.	12 Arr. Toronto 1450 hrs.	13	14	15
	16	17 Dep. Hamilton 0620 hrs.	18 Heat Content Survey L.Ont.	19 Arr. Toronto 1610 hrs.	20	21	22
	23	24 Dep. Toronto 0927 hrs.	25 Heat Content Survey L.Ont.	26 Arr. Toronto 1517 hrs.	27	28	29
MAY	30	1 Dep. Toronto 0945 hrs.	2 Heat Content Survey L.Ont.	3 Arr. Toronto 1617 hrs.	4	5	6
	7	8 Dep. Toronto 0955 hrs.	9 Heat Content Survey L.Ont.	10 Arr. Toronto 1625 hrs.	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
JUNE	28	29	30	31	1	2	3
	4	5 Weigh Anchor, Oshawa, 1705	6 Lake Ontario	7 Heat Content Survey	8 Arr. Toronto 0010 hrs.	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
JULY	25	26 Dep. Port Colborne, 2255	27 Lake Erie	28 Monitor	29 Lake Erie Monitor	30 Arr. Windsor 0725 hrs.	1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
AUG	23	24	25	26	27	28	29
	30	31	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
SEPT	20	21	22	23	24	25	26
	27	28 Dep. Port Colborne, 0323	29 Lake Erie	30 Monitor	31 Lake Erie Monitor	1 Arr. Port Colborne 0555	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
OCT	24	25	26	27	28	29	30
	1	2	3 Dep. Toronto 1145 hrs.	4 Lake Ontario Monitor	5 Arr. Toronto 2150 hrs.	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
NOV	22	23	24	25	26	27	28
	29	30	31	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
DEC	19	20	21	22	23	24	25
	26	27	28	29	30	1	2
	3	4 Dep. Toronto 0755 hrs.	5 Heat Content	6 Survey	7 Lake Ontario	8 Arr. Toronto 0905 hrs.	9
	10	11 Dep. Toronto 1400 hrs.	12 Heat Content Survey	13 Lake Ontario	14 Arr. Toronto 0510 hrs.	15	16
	17	18 Dep. Toronto 0930 hrs.	19 Heat Content Survey L.Ont.	20 Lake Ontario	21 Arr. Toronto 1450 hrs.	22	23
	24	25	26	27	28	29	30

TABLE 4

Summary of Cruise Descriptions

Personnel from the Technical Operations Subdivision were assigned to both major ships on a continuing basis. This usually meant spending 85 - 90% of the time (often including week ends) away from home. Other scientific and technical personnel from various agencies joined the vessels for much briefer periods in accordance with pre-arranged schedules.

Operations staff were generally responsible for the following:

1. Coordination of all shipboard activity of a technical or scientific nature.
2. All technical deck operations entailing sampling procedures (biological, chemical, geological, bacteriological and physical) and measurement and recording of physical parameters.
3. Manual chemistry (determination of dissolved oxygen, conductivity, turbidity and pH).
4. All mooring operations.
5. Weather observations and reports.
6. Some primary data manipulation.

On all cruises, Technical Operations personnel were also responsible for the continuous monitoring (strip chart recorders) of air temperature, relative humidity, near surface water temperature and solar radiation.

The cruise descriptions that follow attest to the multidisciplinary nature of the work supported, and in many cases carried out, by this Subdivision. In the process, Technical Operations staff must become familiar with a multitude of sampling equipment, methods and techniques to meet the requirements of all these disciplines. Cruise types for the 1972 field season included:

1. Monitor cruises
2. OOPS cruises
3. Mooring cruises
4. Heat content and eutrophication surveys
5. Cross lake temperature transects
6. DECCA chain calibrations
7. Bathymetric surveys
8. Dye diffusion studies
9. Launch and shore base programs
    a. Lake Ontario meteorological buoy program
    b. Fixed temperature profile program

9. (cont.)

c. NTA program
d. Pesticide surveys
e. Fe - Manganese study
f. Lake Ontario shore sensor program
g. Wave climatology study
h. Beach stability investigation
i. Oshawa dye diffusion project
j. Niagara bar project

Some of these special cruises were part of the launch program as described later.

Monitor Cruises

Monitor cruises can be looked upon as general limnological surveys of the Great Lakes. Combined with mooring cruises, they represent one of the major roles of the Technical Operations Subdivision and the CCIW in Great Lakes water quality surveillance. The types of parameters routinely measured on these cruises are listed in fig. 2. (The 1972 station positions are listed in APPENDIX D.)

A total of 9 monitor cruises were carried out during the 1972 season -- one on Lake Ontario; 5 on Lake Erie; 3 into the upper lakes (Huron, Michigan and Georgian Bay). Two additional monitor cruises were run on Lake Erie by GLI (see APPENDIX D for track plot and Lat and Long references).

A new inovation to the monitor program this year was the introduction of the statistical evaluation program for comparing and evaluating sampling and analytical techniques (ex. pumped samples vs water bottle samples) to determine the "representatives" of analyzed water samples. In addition, Technical Operations took over some of the responsibility for preliminary data reduction, such as contour plots of DO, conductivity, cross-lake temperature structure, turbidity and pH. Much greater use was made of the Hewlett-Packard 9800 series calculators and plotter. Programs were developed to aid in IFYGL navigation (DECCA-geographic-DECCA conversions; Lat-Long plotting ability for each of the lakes); to aid in manipulating raw data (specific conductance, % Saturation DO, chlorophyll a, b and c concentrations, corrected reversing thermometer readings); to aid in statistical analysis of data (histogram generation of data, linear regression, numerical integration), to mention only a few (fig. 3)

Fig. 2. Monitor Cruises, Chemical Parameters Observed

Shipboard Analyses	Shore Analyses
Dissolved oxygen	Total Phosphate (unfiltered) PO_4
Conductivity	Total Phosphate (filtered) PO_4
Turbidity	Organic Phosphate PO_4
pH	Soluble Phosphate PO_4
Eh	Total Nitrogen (unfiltered) N
Carbon Dioxide (CO_2)	Organic Nitrogen (filtered) N
Nitrate	Organic Nitrogen (unfiltered) N
Ammonia	Total Carbon C
Soluble Reactive Phosphate	Inorganic Carbon C
Silica	Organic Carbon C
Total Alkalinity	
	Major Ions
	Trace Elements
	Mineral Suspension
	Hardness

Continuous surface chlorophyll measurement on selected cruises
Bacteriological samples on selected cruises
Plankton haul and surface sample on selected cruises
Temperature (in situ) at all sampling stations and depths
Secchi disc at all daylight stations
EBT cast at all stations
Surface water temperature at all stations

Fig. 3. Hewlett-Packard 9800 Series Programs

1. Chlorophyll a, b, and c concentrations in μg/l or mg/M^3
2. Histogram generation of data (mean; std. deviation)
3. % Saturation of Oxygen for Lake Ontario (conversion from mg/l)
4. % Saturation of Oxygen for the Upper Lakes (conversion from mg/l)
5. Reversing thermometer corrections
6. Specific conductance at 25 C
7. Plot Lat. and Long. Lake Ontario
8. Plot Lat. and Long. Lake Erie
9. Plot Lat. and Long. Lake Huron
10. Plot Lat. and Long. Lake Superior
11. Plot Lat. and Long. Georgian Bay
12. DECCA co-ordinates to geographic
13. Geographic co-ordinates to DECCA
14. Linear Regression
15. Root Finder
16. Fourier Series
17. Numerical Integration
18. Differential Equations
19. Eight programs dealing with polynomials
20. Nine programs dealing with matrices ans systems of simultaneous equations
21. Statistics of single variable analyses

Programs 1-6 can be used for processing scientific data aboard ship
Programs 7-13 are used as aids to navigation and to plot small charts
Programs 14-21 are miscellaneous programs for various mathematical analyses

Ontario Organic Particle Study (OOPS) Cruises

These multidisciplinary cruises were aimed at determining the average settling velocities of particulate organic materials and suspended mineral materials at different depths below 15 M in Lake Ontario. Coincident studies were aimed at determining primary production, as well as nutrient distribution in the lake.

As indicated previously, these cruises were divided into two phases; each phase lasting one week (see Summary of Ship Operations). (Station positions and Lat and Long references are listed in APPENDIX D). A total of seven such cruises were run during 1972.

One Technical Operations staff was seconded full time to the Descriptive Limnology Section for the duration of this program. It was his responsibility to collect and help filter the large volumes of water collected during each cruise and to assist in establishing and retrieving the sedimentation and primary productivity moorings. Laboratory assignments included the preparation of standards and samples for particulate phosphorus analysis and operation of the Technicon Auto-analyzer and the Perkin-Elmer Elemental Analyzer used to obtain particulate organic carbon and nitrogen values for the samples collected on each OOPS cruise.

After the samples for each cruise were analyzed, the mean and standard deviations were calculated and graphs were plotted to establish settling velocities and primary productivity rates.

Prior to the start of the IFYGL program, he assisted in some data interpretation on particulate organic carbon, nitrogen and phosphorus values for the 1970 Lake Erie Time Study (LETS) data. In addition, suspended mineral analyses are currently being done on samples collected by Technical Operations personnel from four Lake Erie monitor cruises in 1972.

Mooring Cruises

During the year, there were a total of 63 mooring stations in the Great Lakes with 62 of these being located in Lake Ontario and the remaining one located in Main Channel between Lake Huron and Georgian Bay. The following is a breakdown of the mooring types and their locations. The Technical Operations staff were responsible for the launching, recovery and maintenance of all moorings and mooring equipment.

a. Current Meter Moorings and Coastal Chains

A total of 17 current meter moorings were placed in Lake Ontario and Lake Huron. Nine of these were deep water moorings in Lake Ontario and

one in Lake Huron. Two coastal chains were run this year for the University of Waterloo. These consisted mainly of flag stations, although five current meter moorings were placed in the Oshawa chain and two in the Presquile chain. (APPENDIX D)

b. Lake Ontario Auxilliary Moorings

There were nine additional moorings in Lake Ontario than originally planned for IFYGL. Two experimental current meter moorings (2-OC-65 and 2-OC-66) were moored at Niagara-on-the-Lake. Two current meters (2-OC-69 and 2-OC-71) were used in the dye studies being conducted at Oshawa. Mooring 2-OT-62 was a thermograph located in the deep hole in Lake Ontario off Rochester. Moorings 2-OM-63 and 2-OM-64 were wave rider buoys used to measure wave height in conjunction with the Wave Climate Study (see d. below). Mooring 2-OS-67 was the IRLS (Interrogating Ranging and Locating Systems) buoy. This was a free floating instrument used to study surface currents to a depth of 5 M. Position and other data such as surface water temperature, were relayed twice daily via satellite. Mooring 2-OS-68, ERTS (Earth Resources Technology Satellite) buoy also collected and relayed data via satellite. Unlike the IRLS buoy however, the ERTS buoy was moored to the bottom on the Niagara Bar.

Several of the main current meter moorings were removed in the fall, refurbished and then placed back in the water for the winter. Positions of these winter current meter moorings are given in APPENDIX D.

c. Meteorological and FTP Moorings (see below)

d. DECCA buoys and Wave Climate Study Moorings

A total of 12 DECCA buoys were placed in Lake Ontario in the spring by the MARTIN KARLSEN. These were used as reference markers for the DECCA navigation system erected by the Marine Sciences Directorate for IFYGL navigation on Lake Ontario.

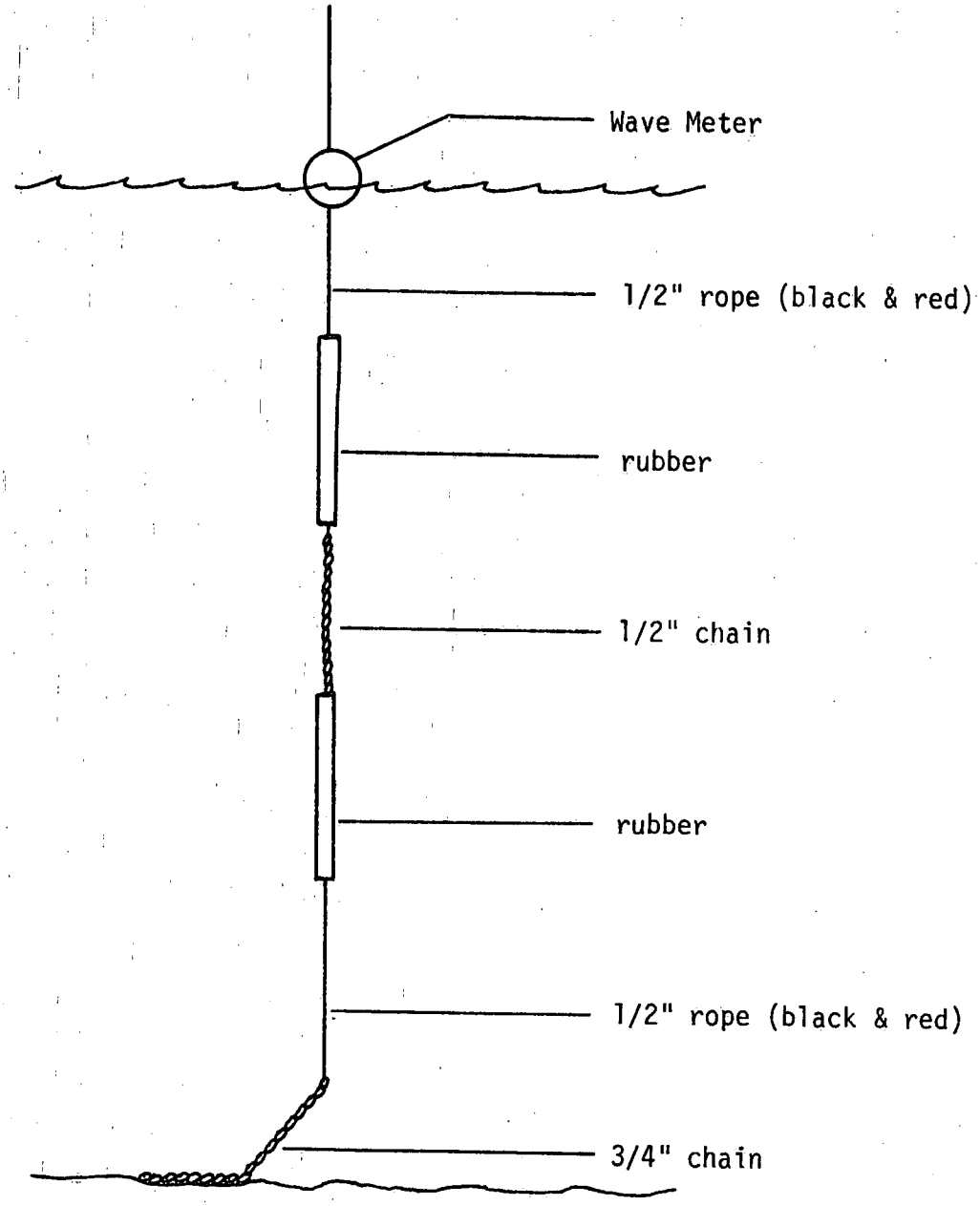
In April, three wave climate buoys were moored in Lake Ontario by LIMNOS, one off Toronto, another off Cobourg and the third South of Duck Island. Fig. 4. is a diagram of this type of mooring. (Positions are referenced in APPENDIX D).

Heat Content and Eutrophication Cruises

These surveys were part of the energy balance program for Lake Ontario. Heat storage and its changes must be known to describe energy fluxes; the temperature field in the lake at a given time is

Fig. 4. Wave Rider Buoy

In April, three wave meters were moored in Lake Ontario by the LIMNOS--one off Toronto, another off Cobourg, and the third south of Duck Island.



an indication of many other lake processes such as water movements and vertical mixing. The heat content and eutrophication surveys were aimed at determining the quantity of heat stored in the lake as a function of time and describing the seasonal change in temperature distribution in the lake by means of repeated temperature-depth profiles. The cruises also included a study of the particle and chlorophyll distribution at the surface as functions of time and space. Both purposes required that the surveys be completed as rapidly as possible (within 48 hrs.).

The station locations are listed in APPENDIX D. Twenty one cruises of this type were run during 1972; 11 by the GLI and 10 by CCIW (Technical Operations). Nearly all the field work for these surveys was done by Technical Operations Subdivision personnel.

Cross Lake Temperature Transects

These cruises formed part of the experiment to detect long internal wave motion in Lake Ontario. Data from temperature-depth profiles collected by Technical Operations staff over a 5 day period on a transect running from Oshawa to Olcott N.Y., were assembled into temperature cross sections of the upper active layer of the lake (epilimnion and thermocline) showing the evolution of the temperature profile in time at fixed points. Combined with the data from moored current meters, fixed temperature profile moorings and additional measurements of meteorological parameters during the cruises, the results will be examined for evidence of large scale, near inertial period internal waves and their relationship to the lake wind stress. All field work was coordinated and conducted by Technical Operations personnel. Three cruises of this type were run during 1972.

DECCA Chain Calibration

DECCA lambda (6f) is a transportable electronic positioning system capable of transmitting frequencies in the 100 KHz range. It was the system selected for use during IFYGL for the positioning of all vessels, moorings and towers on Lake Ontario. Since the system did not incorporate a lane identification feature common to systems used for greater ranges than required for Lake Ontario, the Technical Operations Subdivision was charged with mooring 12 DECCA buoys (see Mooring Cruises) for MSD, to aid in establishing and checking the zone and lane count (see APPENDIX D for positions).

Atmospheric disturbances, water temperature and conductivity are only some of the factors which can affect the velocity of propagation

of electromagnetic waves -- the major non-controllable element required for best accuracy. On the DECCA chain calibration cruises, in addition to the normal continuously measured parameters, staff of the Technical Operations Subdivision continuously monitored wet and dry bulb air temperature and measured specific conductance every hour. The cruises were part of a continuing program to calibrate the DECCA (6f) system and to determine the "fixed errors", if any, inherent in the chain as the field year progressed.

Bathymetric Surveys

The Canadian Hydrographic Service, MSD, conducted a series of four bathymetric surveys in the offshore areas of Lake Ontario. The data collected during this project will result in the production of new navigational charts. In addition, the information obtained will be made available for use to scientific agencies. On these cruises, in addition to the normal continuously measured meteorological parameters and weather reports, temperature-depth profiles and conductivity measurements for sounder calibration purposes were taken by Technical Operations staff.

Dye Diffusion Study Cruises

Six of these cruises were run by LIMNOS in conjunction with the Oshawa dye diffusion project (described below). This project had as its objective, the study of the horizontal diffusion phenomenon in the epilimnion of the open lake (Lake Ontario) using Lagranian techniques. Two types of tracers were used to identify the fluid parcels in the lake -- drogues and rhodamine B dye. Technical Operations staff aboard LIMNOS were charged with the responsibility of tracking drogues by radar and vertical concentration distribution within the diffusing dye patch by towing the Batfish *in situ* fluorometer. LIMNOS also provided the necessary navigation and communication assistance to the launches and to the aircraft which were used for time sequence aerial photography of the diffusion dye patch.

Launch and Shore Based Programs

In addition to their role on the major ships' programs, Technical Operations Subdivision staff supported and often carried out the bulk of the field work in many of the launch and shore based projects. The scope of the work, in many cases, varied from over-all coordination of the programs to carrying out the actual sampling work and monitoring of data acquisition

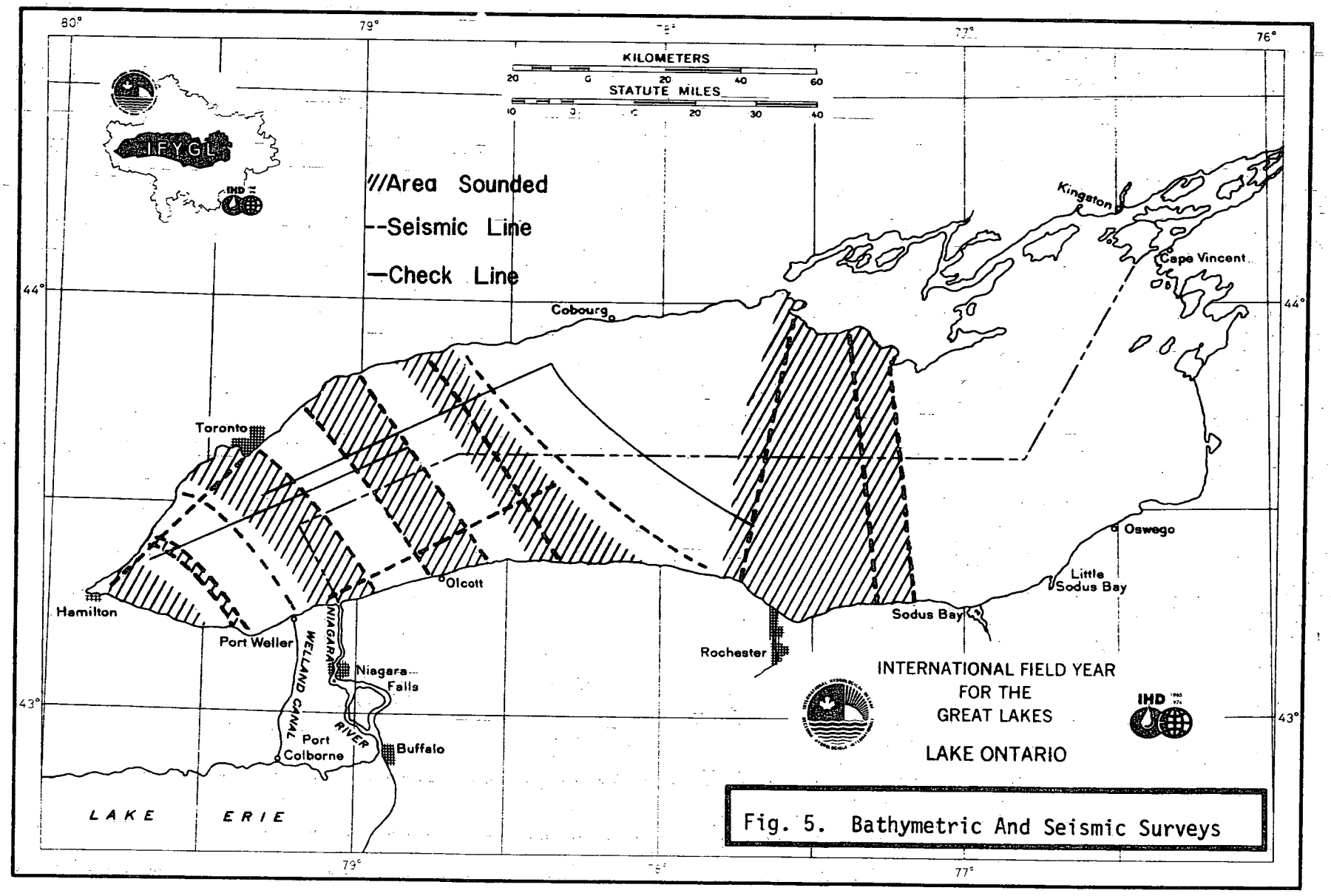


Fig. 5. Bathymetric And Seismic Surveys

systems (Met buoys, shore stations), to compiling and assisting in the analysis of the resulting data.

Brief descriptions of these programs are given below.

Lake Ontario Meteorological Buoy Program

Two staff members from Technical Operations Subdivision coordinated and maintained the meteorological field program throughout IFYGL. This program was initiated on 5 April, with the establishment of 11 Geodyne buoy moorings (see APPENDIX D) in Lake Ontario by the Technical Operations personnel aboard CSS LIMNOS. The main purpose was to collect meteorological data from which estimates of area averages and spatial distributions of the surface fluxes of momentum, heat and water vapour over the surface of the lake could be calculated. This data will also be used to supplement that collected in many other IFYGL programs.

The buoy platforms provided atmospheric measurements of wind speed and direction, air temperature, relative humidity and surface water temperature. Atmospheric pressure and solar radiation were also measured on three buoy stations along the axis of the lake. These parameters were recorded automatically on magnetic tape at ten minute intervals. The recorder was sealed in a weatherproof can and mounted on the buoy platform (see fig. 6.). This self-contained, battery operated unit required changing every four weeks. In order to maintain a close check on the system, monitors were run every two weeks for the duration of the field season.

Two Technical Operations personnel, working from the chartered vessel, MV LAC ERIE, maintained the system throughout the field season often operating under very adverse conditions (see FRONTISPIECE).

Although data translation has not yet been completed, the program appears to have been very successful.

Fixed Temperature Profile Program

The Technical Operations Subdivision was also responsible for the installation and field servicing of the FTP program, run in conjunction with the Meteorological Buoy project. Four Nun type buoys, modified to accomodate a Geodyne recording system were located near the meteorological buoys.

The system consisted of a thermistor array measuring water temperature at different depths. The recorder collected temperature data on magnetic tape and required changing periodically. These changes were

generally coordinated with the monitoring of the meteorological buoys above.

NTA Program

The NTA monitor program was national in scope and entirely unrelated to IFYGL.

The CCIW's contribution was to monitor the trends in the concentration of NTA in Hamilton Harbour over the winter of 1971-72 and to monitor the harbour and the western portion of Lake Ontario during the 1972 field season for the same purpose. While the harbour was found to vary between 10 and 150 ppb NTA, no trend was apparent during the period studied.

A total of 6 cruises, each lasting two days were completed by the vessel MV LAC ERIE. During these, Technical Operations staff collected and treated samples for NTA analysis from seven stations in the harbour and from seven stations in the lake. (See APPENDIX D).

Pesticide Surveys

As a continuation of the 1971 Pesticide Research Program, two cruises of this type were carried out by Technical Operations staff aboard the MV LAC ERIE. The objective of these cruises was to collect plankton samples from ten of the IFYGL Organic Particle (OOPS) stations for PCB (Polychlorinated biphenyls) analyses. (see APPENDIX D for station positions).

Iron - Manganese Study

The purpose of this cruise was to evaluate the environment of precipitation of Fe-Mn (oxides) nodules in Lake Erie. Samples obtained during the single cruise were also used in an exploratory study of the oxygen demand potential of the lake sediments. Sufficient sediment and water samples were collected to define the most probable areas of nodule formation in the lake and to make a preliminary assessment of the principle parameters controlling the formation of these. Field work was carried out by Staff of the Technical Operations Subdivision aboard the vessel MV LAC ERIE. (See APPENDIX D for station positions).

Lake Ontario Shore Sensor Program

During the spring of 1972, seven shore stations for continuous measurement of near surface and bottom lake water temperature using platinum-resistance bulb thermometers were established at various locations

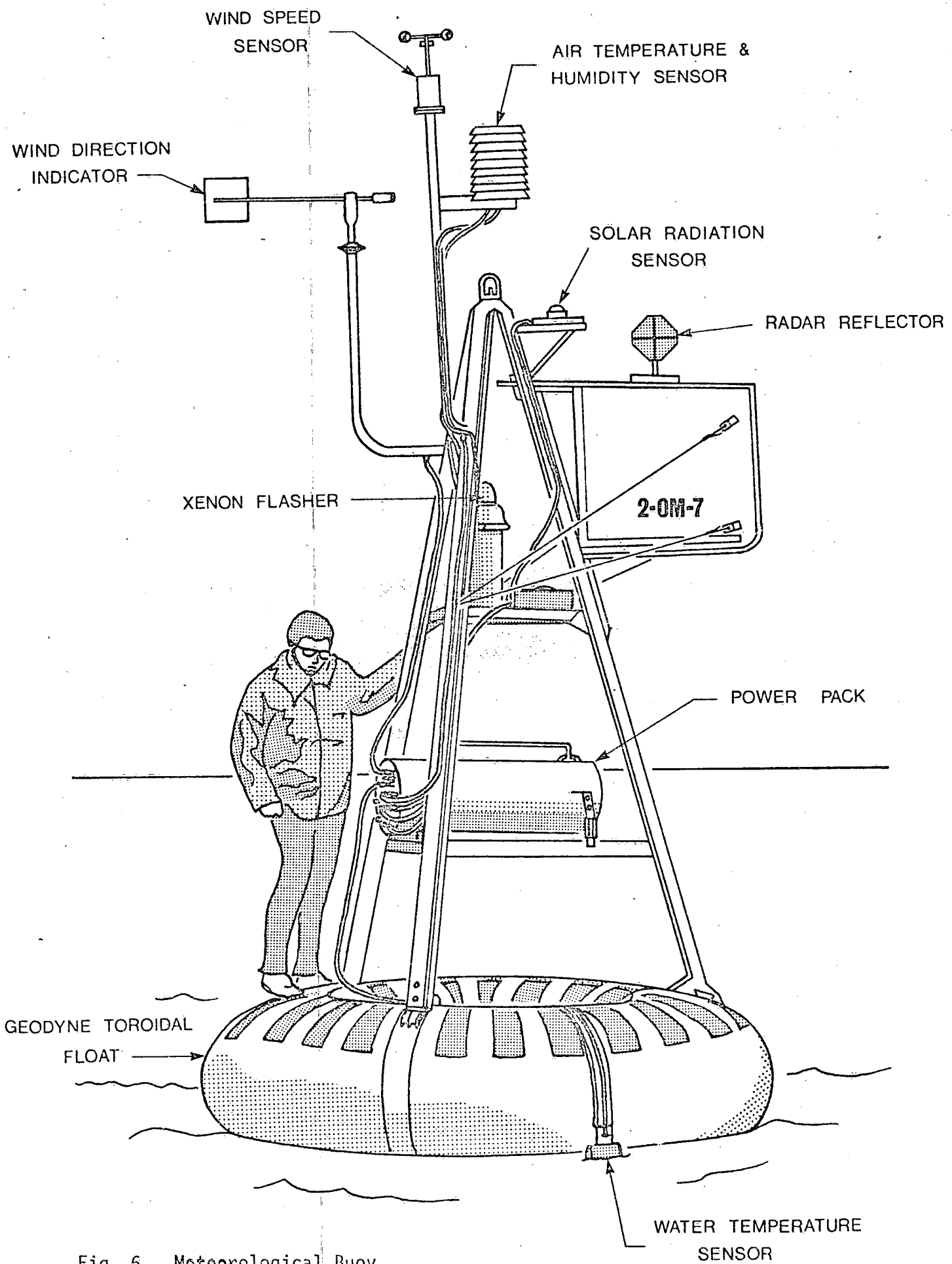


Fig. 6. Metecrological Buoy

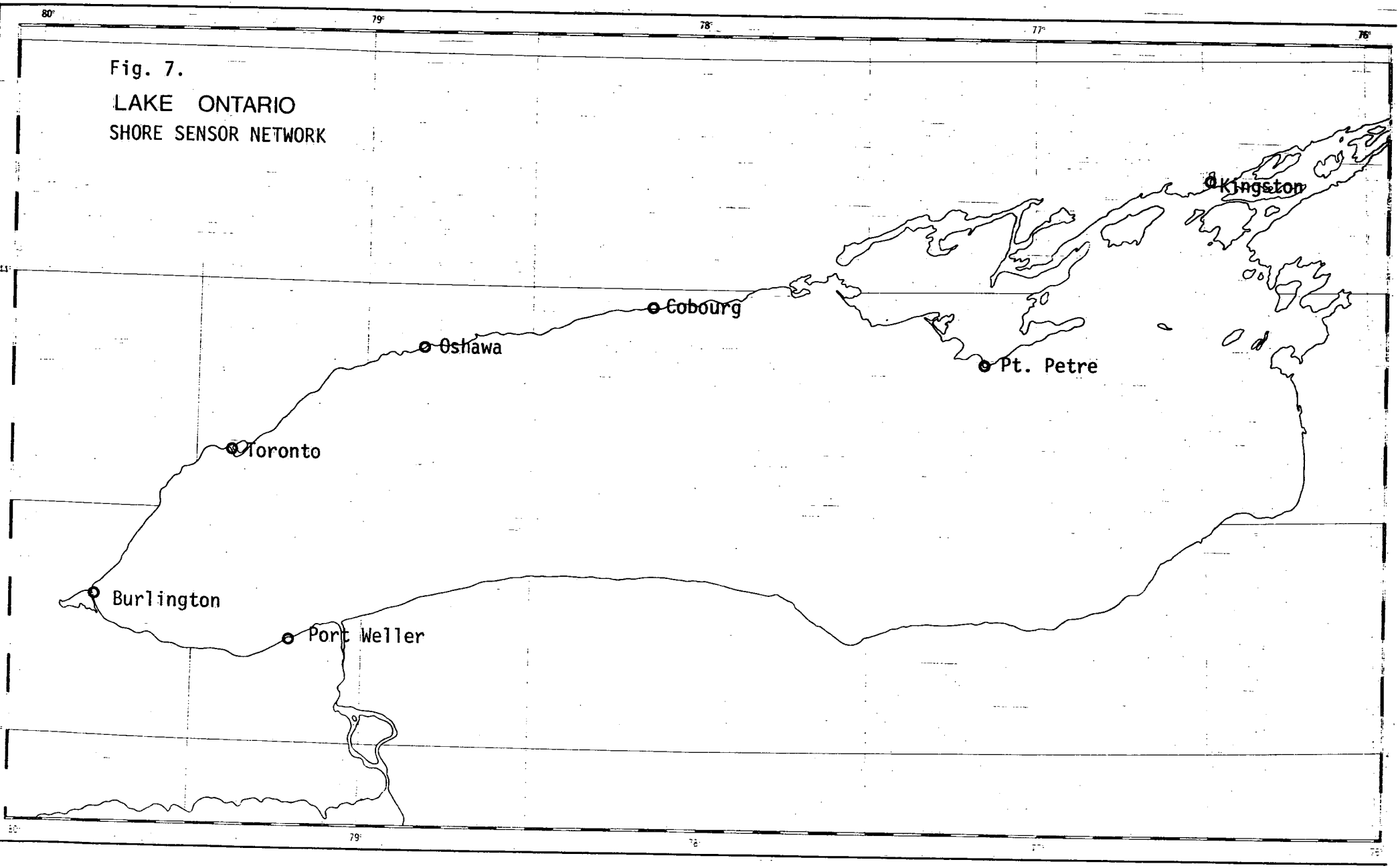
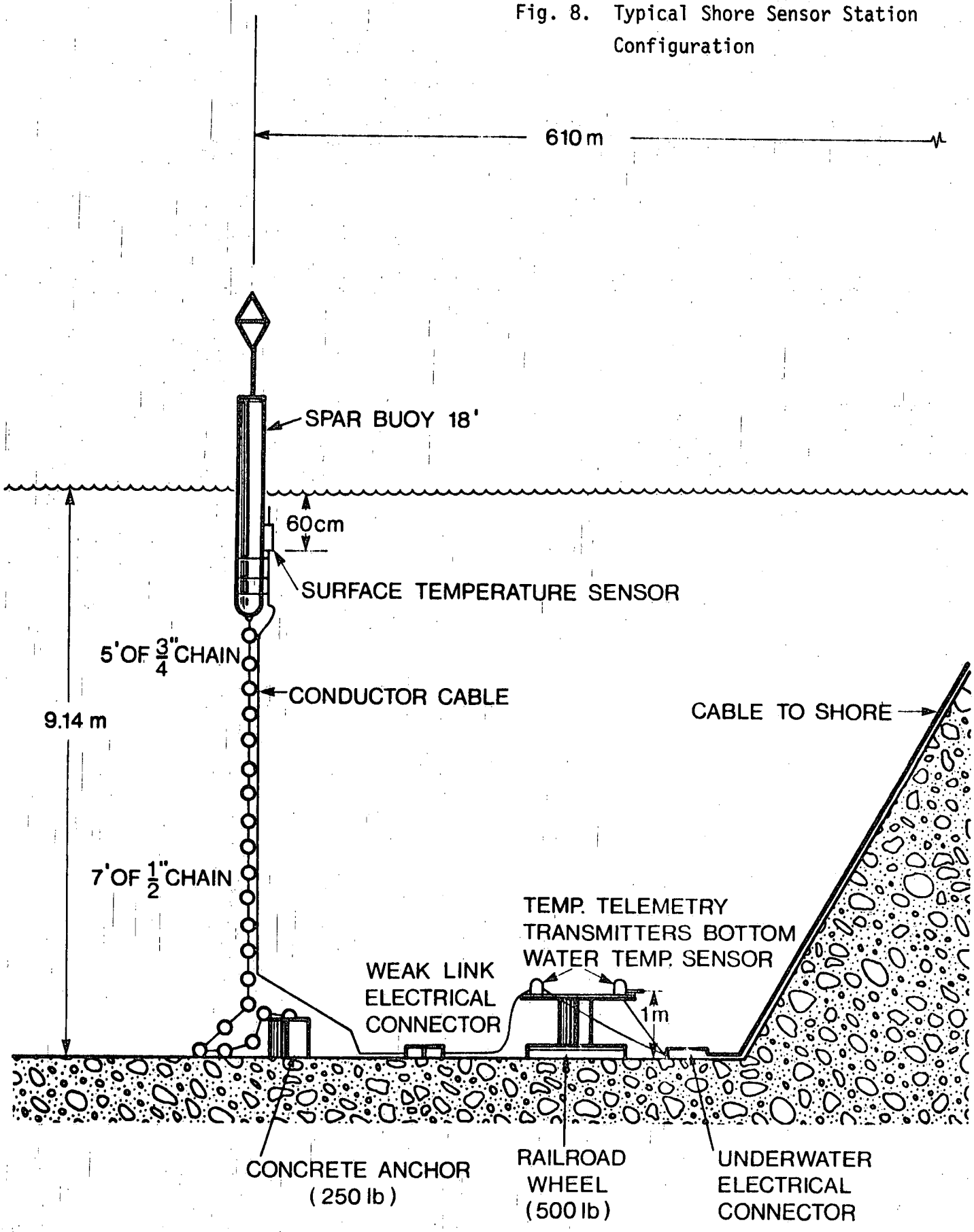

80°
79°
78°
77°
76°
Fig. 7.
LAKE ONTARIO
SHORE SENSOR NETWORK
Kingston
Cobourg
Oshawa
Pt. Petre
Toronto
Burlington
Port Weller
44°
43°
79°
78°

Fig. 8. Typical Shore Sensor Station Configuration



along the Canadian shore of Lake Ontario (see fig. 7.). A typical station configuration is illustrated in fig. 8.

The anchor and spar buoy were placed in approximately 9 meters of water with the result that the distances from the shore varied from 274 to 975 meters.

At six of the seven locations (Kingston excepted), a detachment from the Atmospheric Environment Service, in conjunction with Lakes Research Division, erected weather stations for the collection of meteorological parameters. Wind speed and direction, precipitation, air temperature, relative humidity and solar radiation data were all collected on punch paper tape.

Technical Operations took over the responsibility for running the entire program during 1972.

Wave Climatology Study

During IFYGL, a program of visual wave observations from the major research vessels at C.C.I.W. was initiated to establish the climatological characteristics of wind waves in Lake Ontario. The data was based on an estimated total of 10,000 individual visual observations made from five major research vessels (Canada and U.S.). A comparison of data collected from wave gauge records was made with visual wave observations and estimates by the Sverdrup, Munk and Bretschneider (SMB) wave hindcasting techniques based on surface lake wind records.

Technical Operations staff aboard the Canadian research vessels were responsible for taking the meteorological observations, and one staff member has assumed the responsibility for analysis and interpretation of the results.

Beach Stability Investigation

The purpose of this program was to investigate the vertical profile change of a beach related to the longshore component of wave energy. The sight chosen was Van Wagner's Beach in the western end of Lake Ontario. During the study period - (August - November 1972), the physical parameters of the littoral environment such as breaking wave height, significant wave height and period, wave angle, longshore current velocity, bottom current velocity were measured.

One staff member from Technical Operations was seconded to the Geo-limnology section for the duration of this program to coordinate and carry out the field work as well as assist in the analysis and interpretation of the data.

Oshawa Dye Diffusion Project

The purpose of this five month project, as outlined previously, was to study the horizontal diffusion phenomenon in the epilimnion of the open lake (Lake Ontario) using Lagrangian experimental techniques. This essentially meant tagging the parcels of water with tracers and following their movement with time as the lake currents and eddies caused the fluid parcels to disperse. Two types of markers were used -- drogues and rhodamine B dye.

The first technique consisted of releasing a group of drogues at mid depth in the epilimnion and tracing their movement in time by RADAR. The second technique consisted of releasing an instantaneous blob of rhodamine B dye solution at the same depth as the drogues and tracking the horizontal and vertical concentration distribution within the diffusing dye patch by fluorometric sampling from launches and ships.

Technical Operations coordinated and supported this project. One staff member was seconded full time to the Physical Limnology Section for its duration. The dye barge, shore headquarters, current meter moorings (for Eularian technique comparison) and flag stations were all installed and removed by Technical Operations.

Niagara Bar Project

This project was carried out by the cooperative efforts of C.C.I.W., Atmospheric Environment Service (A.E.S.), Bedford Institute of Oceanography, and Penn State University. The main objective of the program was the direct measurement of energy transfer at the air/water interface.

For this purpose, three towers and the chartered barge HANDY BOY (fitted out to scientific requirements by Staff of Technical Operations and M.S.D.) were located just off Niagara-on-the-Lake in Lake Ontario (position 43° 17'N. and 79° 08' W.). The barge was on site from April 29 to October 18, 1972. During this time, four intensive periods, each lasting approximately 4 weeks, were run for the collection of data.

C.C.I.W. had basically three systems -- the turbulence system and the flux system for measuring the vertical and horizontal components of air and water energy; and, the profile system for measuring atmospheric gradients above the water surface. Bedford Institute and the group from A.E.S. made essentially the same measurements as C.C.I.W. Two other agencies from A.E.S. measured SO_2 and CO_2 content in the air and Penn State recorded wind data at two different levels on each of the three towers.

During the month of July, McMaster University also used the barge for a special project to investigate upwelling and downwelling along the windstreaks on the water surface. In addition, they also collected data on surface water temperature, chlorophyll concentration, dissolved oxygen (oxygraphs) and wind speed.

Technical Operations coordinated and supported the project. One staff member was seconded full-time to the Physical Limnology Section for this purpose. The site location including barge, towers, electrical cables and equipment were installed and removed by Technical Operations. Upon completion of the program, Technical Operations also assisted in the calibration of the scientific equipment in the A.E.S. wind tunnel in Toronto.

Miscellaneous

Because many of the IFYGL projects would require the combination of data gathered by the different methods and analyzed by the different techniques of various participating agencies, it was suggested that a number of intercomparisons of IFYGL measuring systems be made in order to determine what biases, if any, were present in the data due to the peculiarities of the systems involved. Accordingly, two intercomparison studies were participated in by the major research vessels of both Canada and the U.S. to compare the shipboard data acquisition systems. These were run on June 26 and September 18, 1972. The Technical Operations Subdivision was responsible for organizing and coordinating these two studies and staff from this Subdivision carried out the bulk of the sampling program.

Although no bacteriological or geological cruises as such were run during the 1972 field season, samples were collected for both the Microbiology and Geolimnology Sections by Technical Operations Staff on several cruises. In addition, one cruise was run in May, 1972 for equipment trials carried out by the Engineering Division of C.C.I.W.

International Field Year for the Great Lakes (IFYGL)

The purpose of the Field Year (April 1972 - March 1973) was to obtain basic data to increase the understanding of one of the world's largest fresh water lakes -- Lake Ontario.

During the early planning stages, Technical Operations became heavily involved in the translation of scientific needs into operational requirements. Program planning began early in 1971 and by February 1972, the Field Year appeared to be finally shaping up in finalized form. The

work involved producing ship and launch schedules and cruise plans, the writing of VOL. III of the IFYGL Technical Plan, assisting in, supporting and coordinating the various programs.

The bulk of the field work for C.C.I.W. was carried out by the staff of the Technical Operations Subdivision.

Rigging Unit/Stores

The rigging unit of Technical Operations gave season long assistance to both the major research vessels and shore-based parties, especially those located at Oshawa and Niagara. Activities included construction of all the cedar spar buoys for the Coastal Chains; maintenance of all the Geodyne and Nun buoys; responsibility for all C.C.I.W. winches, generators and coring equipment; responsibility for two of the trailers formerly belonging to the Geophysical Limnology Subdivision; re-organization of the workshop/storage area to make optimum use of limited space.

The 1972 field season saw 100 per cent recovery of all field supplies and mooring equipment, much of which can be attributed to this unit.

Diving Section

During the 1972 field season, the diving section supported twenty programs, totalling 184 diving days in Lakes Ontario, Erie and Huron. Tasks performed ranged from the mechanical installation and recovery of towers and moorings, to the selective sampling and description of the sediment/water interface. Diving depths ranged from near surface to 110 ft.

In preparation for the year, a diving course, arranged and instructed by the Senior Diving Officer, was held at CCIW during February and March. The eight successful candidates represented the Technical Operations, Engineering and the scientific divisions of the Centre. Due to the extensive non-diving committments in their specialized fields, however, the scientific and engineering divers were not available for general diving duties. The available diving staff was, therefore, limited to two marine technologists from Technical Operations (who were also essential members of major ship operations and hence not often available for diving duties) and the Senior Diving Officer. As a result, a contract was awarded to a commercial diving team in order to help meet the increasing demands for diving assistance with CCIW projects.

The initially programmed requirements for 1972 totalled 120 diving days. The actual total came to 184. A partial list of tasks completed for CCIW included the assembly, installation and testing of towers and ancillary equipment; the testing, observation and recovery of instruments and moorings; the installation, inspection and recovery of electronic cables; the obtaining of selective hand cores for sediment/water interface analyses; underwater photography; search and recovery of equipment; testing and evaluating new diving gear.

Two agencies other than CCIW were also given diving support during 1972:

a. Ministry of Transport - ice problems around the rudder stock of GRIFFON in Georgian Bay

b. Tides and Water Levels - Pt. Petre instrument installation

The diving section was also responsible for the study and evaluation of jack-up type platforms for use as scientific bases in long term studies of the nearshore areas.

All diving in Lake Ontario was supported by the diving tender CSL SHARK with a compliment of two crew and two divers.

Staff:

- Technical Operations Subdivision

Head - H. B. Macdonald

Secretary -

D. J. Cooper - Senior Operations Officer
J. T. Roe - Senior Diving Officer
D. H. Hanington - Operations Officer, MV MARTIN KARLSEN
D. J. Brooks - Operations Officer, CSS LIMNOS
D. J. Williams - A/Standards and Development Officer
P. R. Youakim - IFYGL Centre; special projects
L. E. Benner - Meteorological Buoy Program
T. J. Carew - Dye Diffusion Program
H. K. Cho - Lake Erie Shore Erosion; Hamilton Beach Study
B. E. Clemmens - seconded to Descriptive Limnology
F. J. deVree - LIMNOS and MARTIN KARLSEN
F. H. Don - LIMNOS and MARTIN KARLSEN; diving
H. Greencorn - rigger
P. M. Healey - LIMNOS
R. D. Hore - LIMNOS and MARTIN KARLSEN (resigned 31 Oct.)
J. R. Irwin - LIMNOS and MARTIN KARLSEN
G. J. Koteles - LIMNOS and MARTIN KARLSEN
J. Lomas - Foreman/rigger
M. R. Mawhinney - Niagara Bar Program
B. H. Moore - MARTIN KARLSEN
H. K. Nicholson - Shore Sensor Program
G. M. Perigo - rigger
J. E. Ross - LIMNOS and MARTIN KARLSEN; diving
S. B. Smith - LIMNOS
W. B. Taylor - electronics technician; Meteorological Buoy Program
M. R. Thompson - LIMNOS and MARTIN KARLSEN
S. P. Withers - MARTIN KARLSEN

Summer Students

Miss S. Hannon
W. Hyatt
I. McLaurin
R. McMinn
R. Peeling
L. VanVeen

Scientific Agencies Reported

Department of the Environment - Lakes Research Division, Inland Waters Branch
- Water Quality Division, Inland Waters Branch
- Fisheries Research Board
- Microbiology Unit, Environmental Protection Service
- Marine Sciences Directorate

Energy Mines and Resources - Geological Survey of Canada

York University

University of Waterloo

McMaster University

University of Guelph

University of Toronto

Penn State University

Lamont - Doeherty Geological Observatory

National Oceanic and Atmospheric Administration

Reports and Publications

Clemmens, B. E.	Sedimentation mooring report. Unpublished Report. 1972.
_____	An Evaluation of the Conductivity Measurements used at CCIW. Unpublished Report. 1972.
Coakley, J. P. and H. K. Cho	Shore Erosion in Western Lake Erie, Canada. Presented at 15th Conf. Great Lakes Res., April, 1972. Madison, Wisconsin.
Compton-Smith, J. and W. Stage	Dissolved Oxygen and Temperature in Lake Huron. Unpublished MS. 1971.
Hannon, S. and W. Hyatt	The Benthic Community of Hamilton Harbour. Unpublished Report. 1972.
Healey, P. M.	Bottom Sediment Sampling aboard CSS LIMNOS and MV MARTIN KARLSEN in 1971. Unpublished Report. 1972.
Hore, R. D.	Relationship in categorized lakes of mean depths to mean surface temperatures in various physical combinations. Unpublished Report. 1972.
Moore, B. H.	Techniques for mooring surface and underwater instruments on the Great Lakes. Unpublished Report. 1972.
Taylor, W. B.	Buoy intercomparisons with National Oceanic and Atmospheric Administration, Rochester, N.Y. Unpublished Report. 1971.
Williams, D. J.	General Limnology of the Mainstem Lakes in the Okanagan Valley, British Columbia. Submitted to the Canada-British Columbia Okanagan Basin Study Committee. 1972.
Withers, S. P.	The Otter trawl as a means of sampling Great Lakes Fish. Unpublished Report. 1972.

APPENDIX A. DESCRIPTION OF RESEARCH SHIPS, LAUNCHES AND EQUIPMENT

1. CSS LIMNOS
2. M.V. MARTIN KARLSEN
3. CSL SHARK
4. M.V. LAC ERIE
5. LEMOYNE
6. STURDY
7. SURGE
8. AQUA
9. AGILE
10. BOSTON WHALERS

3.1. Major Ships

3.1.1. *C.S.S. LIMNOS*

Affiliation

Operated by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Two 500 B.H.P. at 1250 RPM Paxman Diesels, keel cooled, direct drive to twin 360 rotatable Harbourmaster units.

Fixed pitch propellers, right angle drive gears and vertical shafting.

Bridge controlled; the vessel is steered by turning the propeller assemblies, thus eliminating need for rudder.

Bunker capacity – 53.65 tons No. 2 Diesel.

Electrical Power

Ship's system, three phase 60 cycle a-c. All three phase power 460 volts.

Transformer requirements – 240v, three phase
– 120v, three phase.

Two laboratory controlled frequency stabilized units rated at 5 kva, output supply 115 volts, 1 phase, 60 cycles.

Ship's power – 2 Cummins Diesels – 150 kw each.

Emergency generator – Cummins Diesel – 100 kw. Arranged to start automatically in case of failure of either main generator which happens to be in use. (Can be paralleled with main generators). Summer Sea Load 110 kw, Winter Sea Load 168 kw.

Remainder can be used for scientific apparatus and instruments.

Type	*Transformer Capacity*	*Available for Laboratory Purposes*
460v–60Hz–3Ø	–	100 kw
230v–60Hz–3Ø	72 kw	10 kw
120v–60Hz–3Ø	135 kw	30 kw

10 kw of 120v 60Hz, 1Ø at 0.002% frequency regulation and 2% voltage regulation is available.

Navigation, Communication and Echo Sounding Equipment

Navigation

Decca Radar Model 429.
Decca Radar Model 426 with Alpine Precision Ranging System.
Arma-Brown Gyro-Compass MK.1c, master compass in Operations Control Centre.

8 repeaters: 2 in radar displays, 3 steering repeaters in wheelhouse, remote control starboard bridge wing, and engine room control consol. 3 bearing repeaters on bridge, one repeater starboard laboratory.

Gyro compass course recorder.
Sperry automatic pilot.
Standard magnetic compass.
Bergen-Nautik retractable Pitometer log, type FEN-2.
Searchlight.
Wind speed and direction indicators on bridge and in laboratory.
Weatherfax.

Communications

2 – Marconi CH25 IF/AM Transceiver
1 – Marconi VHF/FM Clipper III Transceiver
1 – Marconi AM CN 86 Transceiver

Echo Sounders

1 – Kelvin Hughes Model MS26B
2– Simrad Model EP2BN
1 – Atlas Deso 10

Hydrographic Winches and Equipment

All winches are mounted on portable bases, which enables them to be positioned anywhere on the deck over the 22" centre, 1" diameter holes provided. The winches are placed on board as required.

One single drum heavy duty electro-hydraulic winch. J. Swann, Series '0'–329 MK. 2. Model 80. 40 hp. Two speed. Rating, 4 tons-low speed, 2 tons – high speed. Capacity – 500 ft. ½" wire or equivalent. Twin readouts – one portable. Free-fall clutch with brake. May be fitted with slip rings (max. 10). Rotatable, automatic spooling, remote control available.

One wire winding winch, electro-hydraulic. J. Swann, Series '0'–325, 5 hp. Various drum capacities from 30,000 feet of 3/32" to 2,500 feet of 5/8" wire. Detachable drum. May be used for light duty oceanographc work. Automatic spooling.

One light duty oceanographic winch, electro-hydraulic or diesel powered. J. Swann, Series '0'–365. 10 hp. Two speed. Rating, 800 lbs. – low speed, 400 lbs. high speed. Drum capacity – 2,500 feet, 5/32" wire. Free-fall clutch with brake. May be fitted with slip rings. Rotatable, automatic spooling, remote control available.

Two light duty BT winches, electro-hydraulic. J. Swann, Series '0'–315, hp. Drum capacity – 4,000 feet of 3/32" wire, Speed – 540 feet per radius (maximum radius 35 feet). Capable of 360 rotations, drum capacity 270 feet, of ½" wire. Located amidships.

Two Fixed "A" frames	1000 lbs.
Two portable "A" frames	3000 lbs.
Two portable Gallows	3000 lbs.

One Austin Western Model 410-P electro-hydraulic crane – 40 hp. 6000 lbs. lift at 26 feet working radius and 10,000 lbs. lift at 12 feet working radius (maximum radius and 35 feet). Capable of 360 rotation, drum capacity 270 feet of ½" wire. Located amidships.

Acoustic Characteristics

Vessel cannot be put in noiseless condition for listening.

Laboratories

Laboratory amidships, 670 square feet with Alden P.G.R. gyro-repeater, wind speed and direction and access to port and starboard main deck. Storage limited. Wet lab. 90 square feet starboard side connecting to main lab.

Habitability

A system of high velocity air-conditioning is provided for all living and operational spaces, including labs, operations control centre and wheelhouse. Individual room thermostats for electric heating. One double cabin for female scientists. Double and single cabin accommodation for scientists and officers. Not more than two crewmen in any cabin. Limited recreational facilities.

Fresh water capacity – 60 tons. Chlorination system for treating lake water. No distillation capacity.

Other Features

Provision made for carrying portable labs on deck. Alternately, vessel may carry four 26 foot sounding launches for hydrographic work; 17 foot Boston Whaler, 35 hp. outboard motor.

Type of Observations

Vessel equipped to carry out lake pollution research and surveillance including studies of lake bottom geology, geophysics, lake sediments, air-water interaction, temperatures, currents and other physical and chemical characteristics of the Great Lakes.

Remarks

Because of limited space, all disciplines cannot be performed simultaneously, but the vessel has been designed for rapid switching from one set of activities to another.

M.V. MARTIN KARLSEN

Affiliation:

Operated under charter by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion:

Singlescrew, reversible pitch and wheelhouse or crowsnest control. Powered by Burmeister and Wains diesel 6-cylinder engine to develop 1200 I.H.P.

Bunker capacity 260 tons.

Electrical Power:

Two main generators: 120 kw at 240v d-c driven by 180 hp 3 cylinder Burmeister and Wain diesel engine - 150 kw at 240v d-c driven by 220 hp 6 cylinder D334 Caterpillar marine diesel engine.

One auxiliary generator: 26 kw at 110v a-c single phase driven by 4 cylinder lister Blackstone HW4 diesel.

Two converters; an 18 kw 110v a-c single phase and a 1.9 kw 110v a-c single phase (emergency).

Shorepower facilities; 220v d-c

Navigational Equipment:

Radar - Kelvin-Hughes marine radar Model 1912, 3cm. pulse length, range 64 miles.

- Decca relative motion marine radar Model RM 1226, 3 cm. pulse length, range 48 miles.

Decca C 81 Survey receiver and track plotter

Anschutz Gyro Model K8051 with bridge wing and crowsnest repeaters

Anschutz Gyro automatic pilot

Standard magnetic compass

Wind speed and direction indicators

Searchlights

Communication Equipment:

2-HF AM and single sideband Marconi CH 25 transceivers

1-VHF FM Marconi Clipper LL transceiver

1-CN8 AM Marconi "Seaway" transceiver
1-Robertson Master 100 Duplex Simplex AM transmitter
1-all band tuneable Electromekano Model M97 AM receiver

Echo Sounders:

2-Kelvin Hughes MS26B
1-Furuno FNV 750

Hydrographic Winches and Equipment:

The ship can be fitted with various hydrographic and oceanographic winches. The following are carried routinely:

1 - Swann series 0 365, 10 hp two speed oceanographic winch rated 800 lbs. at low speed. Drum capacity of 5,000 ft. of 5/32 in. wire. Electrical pumping unit.
1 - Swann series 0 36B, and others
1 - HAP/2 articulate crane
1 - capstan, New England Trawler, single speed, two direction
4 - derricks - capacity 5 tons
1 - derrick - capacity 20 tons

Laboratories:

Portable laboratories are constructed over #2 hatch with 'tween deck below converted to laboratories, providing ample room for many limnological studies. Laboratories are connected by a stairway and a dumbwaiter-type lift of 1-ton capacity.

Habitability:

Living accomodations consist of single, double, and multi-berth cabins, providing berthing for 24 scientific/technical personnel.

Types of Observations:

The vessel is equipped to carry out lake pollution research and surveillance, including lake-bottom geology, geophysics, lake sediment, air-water interaction, temperature, currents and other physical, chemical and biological characteristics of the Great Lakes. Similarly, the vessel is equipped for many overside operations including the laying and retrieving of buoys, and piston coring.

Scientific Equipment:

The M/V MARTIN KARLSEN routinely has the following equipment on board for the following observations:

1) Analogue recorders for continuous measurement of

   a. near surface water temperature
   b. air temperature
   c. relative humidity
   d. solar radiation
   e. long-wave (Infra-red) radiation

2) An electronic bathythermograph to obtain water temperature profiles to 400 metres.

3) An electronic bathythermograph in conjunction with a water pumping sampler, to 100 metres.

4) Knudsen bottles, fitted with reversing thermometers, to obtain water samples and temperatures.

5) Van Dorn bottles to obtain water samples

6) Instruments for the analyses of dissolved oxygen, specific conductance, turbidity and pH.

7) Secchi disc for measurement of water transparency.

8) Auto-analyzers for the measurement of:

   a. soluble (filtered) phosphorus
   b. soluble (filtered) nitrate and nitrite
   c. soluble (filtered) silica
   d. ammonia (filtered)
   e. chloride (filtered)
   f. total alkalinity (filtered)
   g. total nitrogen (filtered)

9) Facilities for the preparation of samples for shore analyses of:

   a. total phosphorus (filtered)
   b. total phosphorus (unfiltered)
   c. particulate carbon and nitrogen
   d. trace elements (filtered and unfiltered)

10) Other samplers, for various observations, may be carried on board depending on the type of investigation required.

SHARK

AFFILIATION	– Operated by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.
PROPULSION	– One GM Diesel 6.71 – Bunkers 189 gal. – Endurance 72 hrs. – Deckhouse control – Single screw with bronze propeller 36 x 32 – 4 blades.
ELECTRICAL POWER	– All wiring 110v, 32v and 24v in aluminum conduit with breaker panels. – wired for shore power – Delco Remy Alternator with 32v standby generator on main engine.
NAVIGATIONAL EQUIPMENT	– magnetic compass – Bromn gyro compass
COMMUNICATIONS EQUIPMENT	– Pye AM Ship to Shore Radiophone – VHF/FM Marconi Clipper II
SOUNDING EQUIPMENT	– Long range Ferrograph Marconi Echo sounder (Recorder & Dial Indicator)
EQUIPMENT	– electrical winch mounted on working platform on stern, 12v motor – large capacity compressor – spotlight (range 2 miles) – Vulcan Electric Rectifier battery charging system.
HABITABILITY	– sleeps 5 comfortably – 2 fresh water tanks 200 imp. gal. – Buchanan electric hot water system – stove and refrigerator – hot and cold water pressure system (with sink)
TYPE OF OBSERVATIONS	– this tug serves as a diving tender for scuba divers.

M.V. LAC ERIE

Affiliation

Operated under charter to the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Single screw and wheelhouse control. Powered by Cummins V12 diesel engine generating 600 hp.

Bunker capacity 3000 gals.
Bridge Controls.

Electrical Power

2 Cummins generators – 30 kw at 220 a-c single phase, convertor to supply 12v and 24v d-c.

Facilities for shore power hookup 220v a-c.

Navigation, Communications, and Echo Sounding Equipment

Navigation

gyro compass Anschutz (no repeaters)
radar Kelvin Hughes model 17, 24 mile range
standard magnetic compass
searchlight

Communications

VHF/FM Marconi Clipper II
AM Marconi CN 26

Echo Sounders

Kelvin Hughes model 32 M
Kelvin Hughes model 26 F

Hydrographic Winches and Equipment

Can be fitted with various hydrographic and oceanographic winches for cruises at user's request.

Boom capacity 2 tons.

Habitability

Living accommodation for a total of 6 people, heated cabins. Fresh water capacity 1200 gals.

Type of Observations

Vessel equipped to carry out small lake pollution research and surveillance, including studies of lake bottom geology, geophysics, lake sediments, and other characteristics of the Great Lakes.

Remarks

Because of limited space, not all disciplines can be carried out simultaneously.

LEMOYNE

Affiliation

Operated by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Twin screws driven by 2 – 354 Perkins diesel engines generating 200 hp.

Endurance 20 hrs.
Deckhouse controls

Electrical Power

Main generator – 120v a-c 3 kw diesel generator
2 generators, from main engines (rectified a-c system) to produce 36v d-c 3.5 kw each.
1 converter for sounder operating from main generator 24v d-c 32 amps.

Navigation, Communications and Echo Sounding Equipment

Navigation

Radar: Decca RM 416 fitted with Decca Accurate Ranging Unit.
Standard Magnetic Compass.
A. Brown Gyro compass.

Communications

IF/AM Radio Marconi CH25
VHF/FM Marconi Clipper II

Echo Sounders

Kelvin Hughes MS32M Mk3
Kelvin Hughes MS36M

STURDY

Affiliation

Operated by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Twin screws driven by 2 in-line 453 G.M.C. diesel engines.
Bunkers 200 gal.
Endurance 16 hrs.
Deckhouse control.

Electrical

Generators on main engines 7.5 kw at 24 d-c, or 11v a-c.

Navigational Equipment

Standard Magnetic compass.
Gyro compass – Arma Brown Mk30 with one repeater.
Radar – Kelvin Hughes 17/9.

Communications Equipment

IF/AM Radio – Marconi CH25
VHF/FM Marconi Clipper II

Sounding Equipment

Kelvin Hughes 36 F

Hydrographic Winches and Equipment

An "A" Frame is fitted across the stern, allowing the use of a winch such as a gas-powered Swann Series 490 for sampling.

Vessel may be fitted with additional navigational or electronic equipment at user's request.

One Hydro Products winch.

Type of Observations

This launch is equipped to study near shore areas, lake bottom geology, geophysics, lake sediments, and other physical characteristics of the Great Lakes Region.

Remarks

The launch operates in near shore or protected waters only on a daylight basis. No sleeping accommodations.

Because of limited space, all disciplines cannot be carried out simultaneously.

Hydrographic Winches and Equipment

Vessel has an "A" frame fitted over the bow and Reimann and Georger 1000 TT winch, gas powered 6 hp. Briggs and Stratton engine.

Can be fitted with small portable self-powered winches as required.

1 hydraulic winch
1 4 cylinder volvo.

Laboratory

There is a small laboratory (150 square feet) suitable for some physical and chemical measurements.

Type of Observations

Vessel equipped to study near shore areas, lake bottom geology, geophysics, lake sediments and other physical characteristics of the Great Lakes Region.

Remarks

The launch operates near shore or in protected areas on a daylight basis. No sleeping accommodation.

Because of limited space, all disciplines cannot be carried out simultaneously.

SURGE

Affiliation

Operated by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Twin screws driven by 2 – 185 V-8 Cummins engines.
Bunkers 200 gal.
Endurance 16 hrs.
Deckhouse control.

Electrical

Generators on main engines 7.5 kw at 24v d-c, or 110v a-c.

Navigational Equipment

Standard magnetic compass
Gyro compass – Arma Brown Mk30 with one repeator
Radar – Decca 217

Communications Equipment

IF/AM Radio – Marconi CH25
VHF/FM Marconi Clipper II

Sounding Equipment

Kelvin Hughes 26 A

Hydrographic Winches and Equipment

An "A" Frame is fitted across the stern, allowing the use of a winch such as a gas powered Swann Series 490 for sampling.

Vessel may be fitted with additional navigational or electronic equipment at user's request.

One Hydro Products winch.

Type of Observations

This launch can be equipped to study near shore areas, lake bottom geology, geophysics, lake sediments, and other physical characteristics of the Great Lakes Region.

Remarks

The launch operates in near shore or protected waters only on a daylight basis. No sleeping accommodation.

Because of limited space, all disciplines cannot be carried out simultaneously.

2.5 *AQUA*

Affiliation

Operated by the Marine Sciences Branch for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Twin screws driven by 2 – 6 cylinder Perkins diesels generating 200 hp.

Bunkers – 200 gals.
Endurance – 20 hrs.
Deckhouse control.

Electrical Power

7.5 kw single phase at 110v a-c or 24v d-c.

Navigational Equipment

Standard magnetic compass
Radar-Decca 217
Arma Brown Gyro compass

Communications Equipment

IF/AM Radio – Marconi CH25
VHF/FM Marconi Clipper II

Sounding Equipment

Edo 9040

Hydrographic Winches and Equipment

The launch may be fitted with small self-powered winches at user's request. Additional electronic equipment may also be added as required.

1 Swann winch

Type of Observations

This launch is used to study near shore lake bottom geology, geophysics, lake sediments, and other physical characteristics of the Great Lakes Region.

Remarks

The launch operates in near shore or protected waters only on a daylight basis, no sleeping accommodation.

AGILE

Affiliation

Operated by the Marine Sciences Branch, for the Inland Waters Branch, Department of the Environment, Canada Centre for Inland Waters, Burlington, Ontario.

Propulsion

Twin screws driven by 2 V-8 Cummins diesels generating 200 hp.

Bunkers – 200 gals.
Endurance – 20 hrs.
Deckhouse control.

Electrical Power

7.5 kw single phase as 110v a-c or 24v d-c.

Navigational Equipment

1 Brown – Gyro compass
Radar-Decca 217
Motorola R.P.S. system

Communications Equipment

IF/AM radio – Marconi CH25
VHF/FM Marconi Clipper II

Sounding Equipment

Kelvin Hughes 26A

Hydrographic Winches and Equipment

This launch may be fitted with small self-powered winches at user's request. Additional electronic equipment may also be added as required.

"A" Frame at stern.

Type of Observations

This launch is used to study near shore lake bottom geology, geophysics, lake sediments, and other physical characteristics of the Great Lakes Region.

Remarks

The launch operates in near shore or protected waters only on a daylight basis, no sleeping accommodations.

APPENDIX B. Major Ship and Launch Schedules

TABLE 5

1972 FIELD PROGRAM - MAJOR SHIPS

Lake	Ship	Cruise	Dates	Type of Cruise
Ontario	KARLSEN	72-00-101	March 13 - 16	Decca Mooring
		72-00-102	March 21 - 30	Met Buoy Mooring
		72-00-152	April 3 - 9	Decca Calib.
		72-00-103	April 10 - 14	OOPS - Phase I
			April 17 - 22	OOPS - Phase II
		72-00-104	May 17 - 19	Engineering trials
		72-00-105	May 23 - 27	OOPS Phase I
			May 29 - June 23	OOPS Phase II
		72-00-106	June 19 - 23	OOPS Phase I
		72-00-156	June 26	Intercomparison
		72-00-106	June 26 - July 1	OOPS Phase II
		72-00-107	July 17 - 21	OOPS Phase I
			July 24 - 29	OOPS Phase II
		72-00-157	Aug. 28 - 30	Decca Calib.
		72-00-108	Sept. 5 - 9	OOPS Phase I
			Sept. 11 - 16	OOPS Phase II
		72-00-109	Sept. 18 - 22	Monitor
		72-00-110	Oct. 3 - 6	Heat Content & Surface Eutrophication
		72-00-160	Oct. 11 - 16	Moorings
		72-00-111	Oct. 17 - 21	OOPS Phase I
			Oct. 23 - 28	OOPS Phase II
		72-00-112	Nov. 20 - 24	OOPS Phase I
			Nov. 27 - Dec. 2	OOPS Phase II
Erie	KARLSEN	72-01-101	April 24 - 28	Monitor
		72-01-102	June 5 - 11	Monitor
		72-01-103	July 31 - Aug. 5	Monitor
		72-01-105	Sept. 27 - Oct. 2	Monitor
		72-01-155	Nov. 10 - 15	Monitor
Huron	KARLSEN	72-02-101	May 1 - 12	Monitor & Moorings
		72-05-101		
		72-02-102	Aug. 8 - 18	Monitor & Moorings
		72-02-103	Oct. 30 - Nov. 10	Monitor & Moorings
		72-05-102		
Ontario	LIMNOS	72-00-002	Mar. 27 - 28	Met Buoy Moorings
		72-00-003	April 4 - 7	Heat Content & Eutrophication Study
		72-00-004	April 10 - 13	"
		72-00-005	April 17 - 20	"
		72-00-006	April 24 - 26	"
		72-00-007	May 1 - 4	"
		72-00-008	May 8 - 11	"
		72-00-009	May 15 - 19	Current Meters & Coastal Chain Dye Barge

Lake	Ship	Cruise	Dates	Types of Cruises
Ontario	LIMNOS	72-00-010	May 29 - 31	Dye Diffusion Study
		72-00-011	June 5 - 9	Energy Budget & Heat Content and Eutrophication Study
		72-00-012	June 12 - 22	Bathymetric Survey
		72-00-062	June 26	Intercomparison
		72-00-013	June 26 - 30	Dye Diffusion Study
		72-00-014	July 4 - 8	Current MeterMoorings
		72-00-064	July 10 - 14	Cross Lake Temp. Transect
		72-00-015	July 17 - 20	Dye Diffusion Study
		72-00-016	Aug. 8 - 12	Cross Lake Temp. Transect
		72-00-017	Aug. 14 - 19	Dye Diffusion Study
		72-00-018	Aug. 21 - 24	Current Meter Moorings
		72-00-019	Aug. 28 - Sept. 9	Dye Diffusion Study
		72-00-020	Sept. 11 - 22	Bathymetric Study
		72-00-021	Sept. 25 - 30	Dye Diffusion Study
		72-00-022	Oct. 2 - 6	Cross Lake Temp. Transect
		72-00-024	Oct. 16 - 20	Dye Diffusion Study & Moorings
		72-00-025	Oct. 23 - Nov. 10	Bathymetric Survey
		72-00-026	Nov. 15 - 17	Met Buoys and Coastal Chain
		72-00-027	Nov. 20 - 25	Current Meter Moorings
		72-00-028	Nov. 27 - Dec. 2	Decca Calib. & Bathymetric Survey
		72-00-029	Dec. 5 - 9	Heat Content and Eutrophication Study
		72-00-030	Dec. 11 - 15	"
		72-00-031	Dec. 18 - 21	"
Ontario	PORTE DAUPHINE	72-00-201	April 4 - 8	Heat Content
		72-00-202	April 10 - 12	"
		72-00-203	April 17 - 19	"
		72-00-204	April 24 - 26	"
		72-00-205	May 1 - 3	"
		72-00-206	May 8 - 10	"
		72-00-256	June 5 - 8	"
		72-00-207	Oct. 3 - 5	"
		72-00-208	Dec. 3 - 8	"
		72-00-209	Dec. 11 - 14	"
		72-00-210	Dec. 18 - 20	"
Erie	PORTE DAUPHINE	72-01-201	June 26 - 30	Monitor
		72-01-251	Aug. 28 - Sept. 1	Monitor
Ontario	LAC ERIE	72-00-301	Jan. 10 - 14	NTA & MOSES
		72-00-302	Feb. 14 - 18	NTA & MOSES
		72-00-303	Mar. 16 - 24	NTA & MOSES
		72-00-304	Apr. 5 - 11	Met Buoy Instrumentation
		72-00-305	Apr. 10 - 25	" " " & Monitor

Lake	Ship	Cruise	Dates	Types of Cruises
Ontario	LAC ERIE	72-00-307	April 30 - May 4	Met Buoy and FTP
		72-00-308	May 15 - 19	" "
		72-00-309	May 29 - June 2	" "
		72-00-310	June 12 - 16	" "
		72-00-311	June 20 - 22	Pesticide Monitoring
			July 5 - 7	" "
		72-00-361	June 6	Intercomparison
		72-00-312	June 27 - July 1	Service Met Buoys & FTP
		72-00-313	July 10 - 14	" "
		72-00-363	July 17 - 18	NTA
		72-00-314	July 24 - 28	Service Met & FTP
		72-00-364	Aug. 1 - 5	FTP
		72-00-315	Aug. 8 - 12	Service Met & FTP
		72-00-366	Aug. 18 - 19	NTA
		72-00-317	Aug. 21 - 24	Service Met & FTP
		72-00-318	Sept. 5 - 10	Service Met
		72-00-319	Sept. 12 - 15	FTP
		72-00-369	Sept. 15 - 16	NTA
		72-00-320	Sept. 18 - 24	Service Met
		72-00-322	Oct. 2 - 6	Service Met
			Oct. 10 - 12	" "
		72-00-323	Oct. 19 - 24	Service Met
		72-00-373	Oct. 25 - 26	NTA
		72-00-324	Oct. 30 - Nov. 3	Service Met Buoy
			Nov. 6 - Nov. 8	" "
		72-00-374	Nov. 21 - 22	NTA
		72-00-375	Dec. 3 - 8	Remove Met Buoy Gear
Erie	LAC ERIE	72-01-301	Aug. 28 - 31	Iron-Manganese Nodule Study

1972 FIELD ACTIVITIES OF SHIPS AND LAUNCHES

VESSELS	AREA OF OPERATIONS	SECTION	SCIENTIST OR OFFICER	MASTER OR COXWAIN	RADAR	TELEPHONE	ECHO SOUNDERS
C.S.S. LIMNOS	L. Ontario	Technical Operations	D. J. Brooks	R. Young N. Keeping	Decca 426 Decca 429	(2) SSB CH 25 AM CN 86 VHK CLIPPER III	Atlas Deso 10 K & H 26B (2) Simrad
M.V. MARTIN KARLSEN	L. Ontario L. Erie L. Huron	Technical Operations	D. H. Hanington	H. Brandal K. Maro	K & H 1912 Ratheon 10 CM	SSB CH 25 AM CN 86 VHF CLIPPER II VHF PYE	(2) 26B Furuno
SHARK	L. Ontario	Technical Operations	J. T. Roe	M. Bunting		AM PYE VHF CLIPPER II	Ferrograph
LAC ERIE	L. Erie L. Ontario	Technical Operations	B. Taylor	B. Kennedy	K & H 17	AM CN 26 VHF CLIPPER II	K & H 32 M K & H 26 F
LEMOYNE	L. Ontario	Physical	R. Murthy	L. Acker R. Martin	Decca 416	SSB CH 25 VHF CLIPPER II	K & H 36 K & H 32 M
SURGE	L. Ontario Hudson Bay	Hydrographic		B. McNea	Decca 217	SSB CH 25 VHF CLIPPER II	K & H 26 A
AQUA	L. Ontario	Physical Limnology	R. Murthy E. Nagy	D. Ashdown	Decca 217	SSB CH 25 VHF CLIPPER II	EDO 9040
M - 58 (Charter)	L. Erie	Limnogeology	D. St. Jacques	None			
SORA	Trent	OWRC			Marconi LN 55	SSB CH 25	K & H 26 A

TABLE 6

1972 FIELD ACTIVITIES OF SHIPS AND LAUNCHES

VESSELS	AREA OF OPERATIONS	SECTION	SCIENTIST OR OFFICER	MASTER OR COXWAIN	RADAR	TELEPHONE ECHO SOUNDERS
WASUCA III	L. Ontario (Niagara River)	Water Survey of Canada	C. E. Russell	J. Stewart		VHF CLIPPER II
HUNT	Lakes in Northwestern Quebec	Limnogeology	R. L. Thomas	B. McNea		SSB CH 25
SLICKER	C.C.I.W.	Stand-by				VHF CLIPPER II
AGILE	L. Ontario	Physical	M. Donelon	K. Boadway	Decca 217	SSB CH 25 K & H 26 A VHF CLIPPER II
BOSTON WHALERS						
#13	L. Ontario	Hydraulics	T. M. Dick	None		
#15	LIMNOS	Technical Operations	D. H. Hanington	None		
#17	MARTIN KARLSEN	Technical Operations	D. J. Brooks	None		
FRB	L. Ontario	Technical Operations	J. T. Roe	S. Brame		

TABLE 6

TABLE 7

LAUNCH SCHEDULE, 1972

Launch	Scientist/Officer-in-Charge	Date to be Commissioned	Operations From	Operations To	Additional Equipment	Remarks
"LeMoyne"	Dr. C.R. Murthy	Apr. 24	May 1	Oct. 31	2 Boston Whalers, plus outboards and equipment.	Boathouse required at Oshawa Yachthaven, rental for perio indicated (plus 2 office trailers delivered on site).
"Aqua"	"	"	"	"		
"Sturdy"	"	"	"	"	Mounting for 15-foot boom for towed thermistor.	Will be used mainly for Dr. Murthy's studies, and occasionally in conjunction with Dr. Thompson's over-flight series (dates will be mutually arranged Thompson/ Murthy).
M-58 (Charter)	Dr. N.A. Rukavina	Apr. 10-19	Apr. 20	Sept. 15	Motorola R.P.S. Gyro Compass. Atlas Deso 10 with 210 Khz, 30 Khz, & 10 Khz transducers. Innerspace digitizer, Model 410 with metric scale. Three 10 watt Motorola F.M. radios.	Details of these requirement are contained in Dr. Rukavina's memo dated Nov. 19, 1971, File # 4330. Lake Erie, Peacock Point to Port Burwell.
"Agile"	Dr. N.A. Rukavina	Apr. 14	June 12 July 3	June 23 Aug. 4	Radar with 2 X-band transponders. K-H sounder 26F. Hydroproducts winch H-50/100 ft. per min. speed.	Nearshore coring program, Lake Ontario, based from Niagara to Wellington (Brighton). Schedule between dates indefinite.

Launch	Scientist/Officer-in-Charge	Date to be Commissioned	Operations		Additional Equipment	Remarks
			From	To		
"Agile"	Dr. M. Donelon	Apr. 14	Apr. 20 May 14 June 6 June 24 Aug. 8 Aug. 26 Sept. 26 Oct. 14	May 3 May 18 June 11 June 28 Aug. 13 Aug. 30 Oct. 1 Oct. 24	1 Boston Whaler and 1 Zodiac rubber dinghy or equivalent (required from Apr. 20 to Oct. 24).	Support craft for Niagara Bar experiments, based Niagara-on-the-Lake Boston Whaler to have 6-foot flat deck extending from bow sternwards. Deck to be covered with non-slip material (for tower boarding purposes).
"Bruce" (or equivalent with speed).	F. Elder	May 29	June 1	Oct. 27	--	Services Bedford Towers eve 7-10 days from C.C.I.W.
"Shark"	J. Roe	Mar. 13	Mar. 20	Dec. 15	--	Various locations on diving operations.
"Slicker"	Dr. E. Nagy	S.A.P.	--	--	--	Oil contingency operations.
Hunt	Various	May 8	--	--	Trailer	Intermittent use between Microbiology Section and Limnogeology - no definite dates. To be available on 24-hour basis.
"Handy-Boy" (or equivalent)	F. Elder Dr. M. Donelon	Apr. 24	Apr. 30 June 11 Aug. 13 Oct. 1	May 14 June 24 Aug. 26 Oct. 14	Two air-conditioned shelters. 1 - 5KW generator 1 - 3KW generator Heads - internal system.	Crane to be removed.

APPENDIX C STATISTICS

GREAT LAKES SURVEY 1972

SUMMARY OF ACTIVITIES

C.S.S. LIMNOS, M.V. MARTIN KARLSEN, LAC ERIE and PORTE DAUPHINE
Lakes Ontario, Erie, Huron, Michigan and Georgian Bay

STATISTICS

Total number of cruises	100
Distance steamed, miles	50,000
Monitor stations occupied	2,594
Total number of water samples	20,409
Plankton hauls	1,065
Chemical analyses	72,761
Mechanical bathythermograph casts	110
Electronic bathythermograph casts	2,879
Bacteriological analyses	1,050
Grab samples	53
Cores, diver and gravity	89
Drogues tracked	27
Moorings established	174
Moorings retrieved	149
Reversing thermometer observations	1,908
Weather observations every half hour	33
Weather observations every three hours (A.E.S.)	2,236
Weather observations every hour	5,815
Continuous days recording of:	
air temperature	293
solar radiation	377
relative humidity	298
water temperature in hull	326
water temperature towed	320
solar (I.R.) radiation	315
conductivity	21
fluorometer	3
Echo soundings, days	35
Transmissometer (for turbidity)	23
Carbon samples	421
Plankton samples	1,051
Secchi disc observations	821
Light profiles	97
Wave observations	30
Integrated samples	8
Mercuty samples	3
Engineering test	1
Power load test	1
Digitizer replacement in fixed temp. profile	7
Suspended mineral samples	107
Particulate C-H-N samples	107
Monitor of fixed temperature profiles	17
Met buoy hymet cans (replace & monitor)	89
Met buoy hymet cans (monitor)	88

Table 8

M.V. MARTIN KARLSEN
GREAT LAKES
1972
STATISTICS

Total number of cruises	24
Distance steamed, miles	15,835
Monitor stations occupied	1,026
Total number of water samples	17,802
Plankton hauls	1,013
Chemical analyses	70,361
Mechanical bathythermograph casts	14
Electronic bathythermograph casts	1,172
Grab samples	8
Cores, gravity	51
Moorings established	66
Moorings retrieved	52
Reversing thermometer observations	1,588
Weather observations every three hours (A.E.S.)	1,082
Weather observations every hour	2,678
Continuous days recording of:	
solar radiation	180
air temperature	144
relative humidity	149
water temperature in hull	142
water temperature towed	133
solar (I.R.) radiation	172
Carbon samples	421
Plankton samples	971
Secchi disc	536
Light profile	97
Wave observations	28
Integrated samples	8
Mercury samples	3
Engineering test	1
Power load test	1

Table 9

M.V. MARTIN KARLSEN

LAKE ONTARIO

1972

STATISTICS

Total number of cruises	16
Distance steamed, miles	7,229
Monitor stations occupied	447
Total number of water samples	10,764
Plankton hauls	817
Chemical analyses	45,156
Mechanical bathythermograph casts	1
Electronic bathythermograph casts	601
grab samples	4
cores, gravity	9
Moorings established	62
Moorings retrieved	48
Reversing thermometer observations	838
Weather observations every three hours (A.E.S.)	708
Weather observations every hour (A.E.S.)	2,678
Continuous days recording of:	
solar radiation	122
air temperature	97
relative humidity	97
water temperature in hull	97
water temperature towed	92
solar (I.R.) radiation	114
Plankton samples	867
Secchi disc	281
Light profile	97
Wave observations	22
Engineering test	1
Power load test	1
Integrated sample	8

Table 10

M.V. MARTIN KARLSEN

LAKE ERIE

1972

STATISTICS

Total number of cruises	5
Distance steamed, miles	3,940
Monitor stations occupied	307
Total number of water samples	2,051
Plankton hauls	101
Chemical analyses	6,789
Mechanical bathythermograph casts	
Electronic bathythermograph casts	304
Grab samples	
Cores, gravity	20
Moorings established	1
Moorings retrieved	1
Reversing thermometer observations	424
Weather observations every three hours (A.E.S.)	162
Continuous days recording of:	
solar radiation	30
air temperature	19
relative humidity	24
water temperature in hull	17
water temperature towed	22
solar (I.R.) radiation	30
Carbon samples	421
Secchi disc	123
Wave observations	6
Mercury samples	3
Plankton samples	68

Table 11

M.V. MARTIN KARLSEN

LAKE HURON

1972

STATISTICS

Total number of cruises	3
Distance steamed, miles	4,665
Monitor stations occupied	270
Total number of water samples	4,987
Plankton hauls	95
Chemical analyses	18,416
Mechanical bathythermograph casts	13
Electronic bathythermograph casts	267
Bacteriological analyses	3,323
Grab samples	4
Cores, gravity	22
Moorings established	3
Moorings retrieved	3
Reversing thermometer observations	326
Weather observations every three hours	212
Continuous days recording of:	
solar radiation	28
solar (I.R.) radiation	28
air temperature	28
relative humidity	28
water temperature in hull	28
water temperature towed	19
phytoplankton samples	36
secchi disc	132

Table 12

C.S.S. LIMNOS
GREAT LAKES
1972 - STATISTICS

Total number of cruises	30
Distance steamed, miles	17,480
Monitor stations occupied	604
Total number of water samples	774
Plankton hauls	2
Chemical analyses	1,538
Mechanical bathythermograph casts	24
Electronic bathythermograph casts	1,122
Bacteriological analyses	1,050
Cores, gravity	5
Drogues tracked	27
Moorings established	107
Moorings retrieved	95
Reversing thermometer observations	164
Weather observations every hour	2,511
Weather observations every three hours (A.E.S.)	904
Weather observations every half hour	33
Continuous days recording of:	
solar radiation	149
air temperature	149
relative humidity	149
water temperature in hull	144
water temperature towed	134
solar (I.R.) radiation	143
fluorometer	3
Digitizer replacement	1
Echo sounding days	35
Transmissometer (for turbidity)	10
Secchi disc observations	45

Table 13

LAC ERIE
GREAT LAKES
1972
STATISTICS

Total number of cruises	33
Distance steamed, miles	10,000
Monitor stations occupied	367
Total number of water samples	160
Plankton hauls	50
Mechanical bathythermograph casts	50
Grab samples	45
Cores, gravity	33
Cores, diver	33
Moorings established	1
Moorings retrieved	2
Met buoy hymet cans (replace & monitor)	89
Met buoy hymet cans (monitor)	82
F.T.P. buoy monitor	17
F.T.P. digitizer replacement	6

Table 14

LAC ERIE

LAKE ONTARIO

1972

STATISTICS

Total number of cruises	24
Distance steamed, miles	9,000
Monitor stations occupied	344
Total number of water samples	140
Plankton hauls	50
Chemical analyses	
Mechanical bathythermograph casts	50
Electronic bathythermograph casts	
Bacteriological analyses	
Grab samples	20
Cores, piston and gravity	6
Drogues tracked	
Moorings established	1
Moorings retrieved	2
Reversing thermometer observations	
Weather observations every three hours	
Digitizer replacement	6
F.T.P. monitors	17
Met buoy monitor	82
Met buoy change & monitor	89

Table 15

LAC ERIE

LAKE ERIE

1972

STATISTICS

Total number of cruises	1
Distance steamed, miles	1,000
Monitor stations occupied	23
Total number of water samples	20
Plankton hauls	
Chemical analyses	
Mechanical bathythermograph casts	
Electronic bathythermograph casts	
Bacteriological analyses	
Grab samples	25
Cores, piston and gravity	25
Drogues tracked	
Moorings established	
Moorings retrieved	
Reversing thermometer observations	
Weather observations every three hours	

Table 16

PORTE DAUPHINE

GREAT LAKES

1972

STATISTICS

Total number of cruises	13
Distance steamed, miles	6,738
Monitor stations occupied	597
Total number of water samples	1,673
Chemical analyses	862
Mechanical bathythermograph casts	22
Electronic bathythermograph casts	585
Weather observations every three hours (A.E.S.)	250
Weather observations every hour	626
Reversing thermometer observations	156
Secchi disc readings	240
Wave observations	2
Plankton samples	80
Transmissometer readings	13
Particulate C-H-N samples	107
Suspended mineral samples	107
Continuous days recording of:	
solar radiation	48
water temperature in hull	40
water temperature	44
conductivity	21

Table 17

PORTE DAUPHINE

LAKE ONTARIO

1972

STATISTICS

Total number of cruises	11
Distance steamed, miles	5,385
Monitor stations occupied	484
Total number of water samples	976
Plankton hauls	
Chemical analyses	492
Mechanical bathythermograph casts	22
Electronic bathythermograph casts	470
Bacteriological analyses	
Grab samples	
Cores, piston and gravity	
Drift cards launched	
Drogues tracked	
Moorings established	
Moorings retrieved	
Reversing thermometer observations	106
Weather observations every three hours (A.E.S.)	200
Weather observations every hour	520
Continuous days recording of:	
solar radiation	32
air temperature	
relative humidity	
water temperature in hull	35
water temperature towed	34
conductivity	21
Secchi disc	200
Wave observations	2

Table 18

PORTE DAUPHINE

LAKE ERIE

1972

STATISTICS

Total number of cruises	2
Distance steamed, miles	1,353
Monitor stations occupied	113
Total number of water samples	697
Plankton hauls	
Chemical analyses	370
Mechanical bathythermograph casts	
Electronic bathythermograph casts	115
Bacteriological analyses	
Grab samples	
Cores, piston and gravity	
Drift cards, launched	
Drogues tracked	
Moorings established	
Moorings retrieved	
Reversing thermometer observations	227
Weather observations every three hours (A.E.S.)	50
Weather observations every hour	106
Continuous days recording of:	
solar radiation	10
air temperature	
relative humidity	
water temperature in hull	5
water temperature towed	10
Plankton samples	80
Wave observations	1
Secchi disc	40
Transmissometer	13
Particulate C-H-N samples	107
Suspended mineral samples	107

Table 19

APPENDIX D STATION POSITIONS (CHARTS AND TABLES)

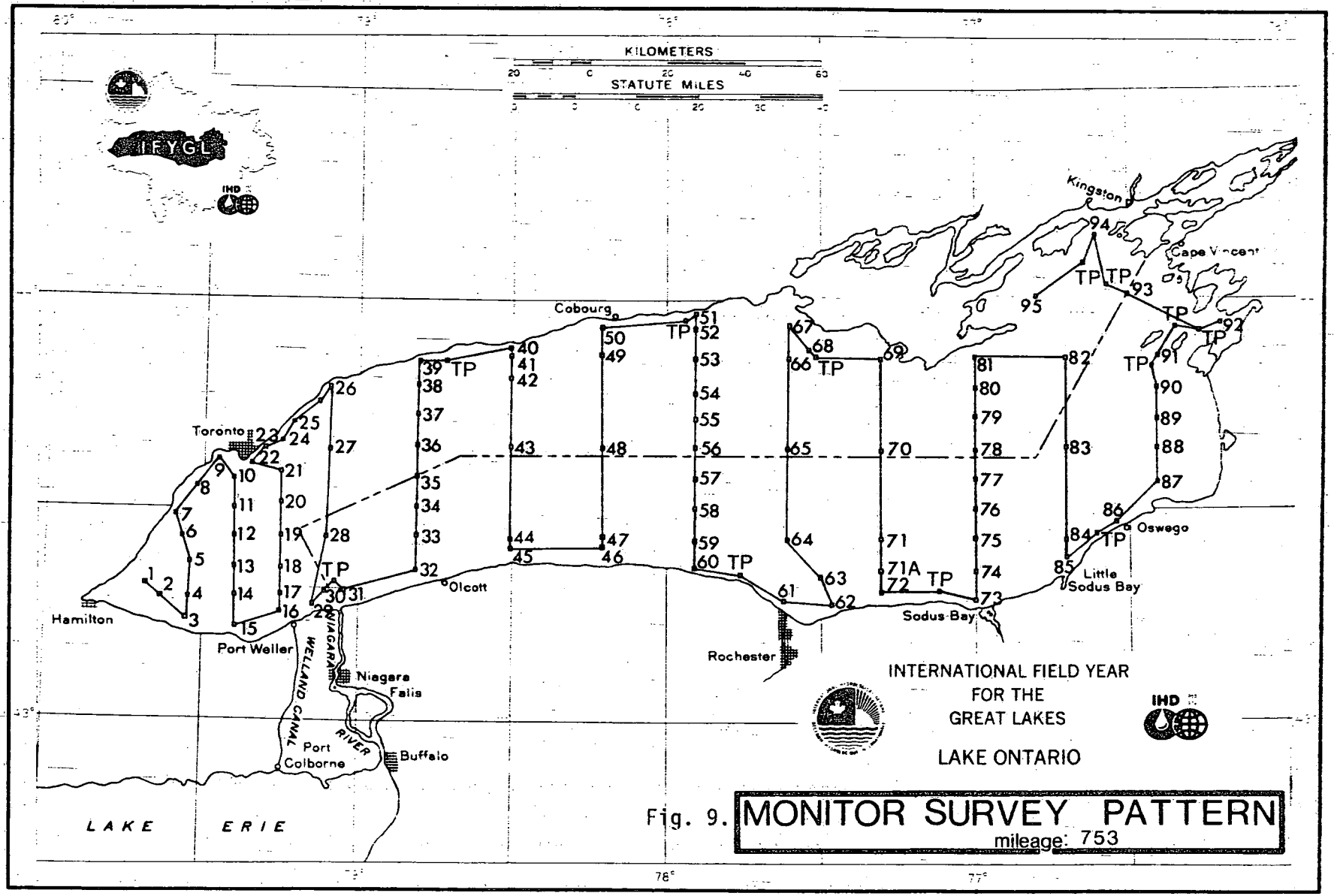


Fig. 9. MONITOR SURVEY PATTERN
mileage: 753

LAKE ONTARIO - 1972/73

IFYGL

MONITOR STATION POSITIONS Aug. 10, 1971

Station Number	Latitude N.	Longitude W.
1	43° 19' 12"	79° 42' 00"
2	43° 17' 18"	79° 39' 06"
3	43° 14' 12"	79° 34' 12"
4	43° 17' 18"	79° 33' 42"
5	43° 22' 00"	79° 33' 00"
6	43° 25' 54"	79° 34' 36"
7	43° 29' 00"	79° 35' 48"
8	43° 33' 06"	79° 31' 36"
9	43° 37' 12"	79° 27' 18"
10	43° 34' 24"	79° 24' 00"
11	43° 30' 18"	79° 24' 00"
12	43° 25' 54"	79° 24' 00"
13	43° 21' 24"	79° 24' 00"
14	43° 17' 18"	79° 24' 00"
15	43° 13' 00"	79° 24' 00"
16	43° 15' 06"	79° 15' 00"
17	43° 17' 18"	79° 15' 00"
18	43° 21' 24"	79° 15' 00"
19	43° 25' 54"	79° 15' 00"
20	43° 30' 18"	79° 15' 00"
21	43° 34' 54"	79° 15' 00"
22	43° 36' 24"	79° 21' 00"
23	43° 38' 54"	79° 18' 00"
24	43° 39' 30"	79° 15' 00"
25	43° 42' 18"	79° 12' 48"
T.P.	43° 45' 06"	79° 07' 48"
26	43° 47' 24"	79° 05' 42"
27	43° 39' 00"	79° 06' 00"
28	43° 26' 00"	79° 06' 00"
29	43° 16' 12"	79° 08' 48"
30	43° 18' 00"	79° 06' 30"
T.P.	43° 19' 24"	79° 04' 24"
31	43° 18' 12"	79° 02' 24"
32	43° 21' 42"	78° 48' 00"
33	43° 26' 00"	78° 48' 00"

Station Number	Latitude N.	Longitude W.
34	43° 30' 18"	78° 48' 00"
35	43° 34' 36"	78° 48' 00"
36	43° 39' 00"	78° 48' 00"
37	43° 43' 18"	78° 48' 00"
38	43° 47' 36"	78° 48' 00"
39	43° 51' 00"	78° 48' 00"
T.P.	43° 51' 18"	78° 42' 06"
40	43° 53' 00"	78° 30' 00"
41	43° 52' 00"	78° 30' 00"
42	43° 48' 36"	78° 30' 00"
43	43° 39' 00"	78° 30' 00"
44	43° 26' 00"	78° 30' 00"
45	43° 24' 24"	78° 30' 00"
46	43° 24' 24"	78° 12' 00"
47	43° 26' 00"	78° 12' 00"
48	43° 39' 00"	78° 12' 00"
49	43° 52' 00"	78° 12' 00"
50	43° 56' 00"	78° 12' 00"
T.P.	43° 57' 12"	77° 55' 48"
51	43° 58' 00"	77° 54' 00"
52	43° 56' 18"	77° 54' 00"
53	43° 52' 00"	77° 54' 00"
54	43° 47' 00"	77° 54' 00"
55	43° 43' 18"	77° 54' 00"
56	43° 39' 00"	77° 54' 00"
57	43° 34' 42"	77° 54' 00"
58	43° 30' 18"	77° 54' 00"
59	43° 26' 00"	77° 54' 00"
60	43° 22' 00"	77° 54' 00"
T.P.	43° 21' 18"	77° 44' 00"
61	43° 17' 18"	77° 36' 00"
62	43° 16' 30"	77° 27' 30"
63	43° 20' 48"	77° 30' 12"
64	43° 26' 00"	77° 36' 00"
65	43° 39' 00"	77° 36' 00"
66	43° 52' 00"	77° 36' 00"
67	43° 56' 18"	77° 36' 00"
68	43° 52' 54"	77° 32' 00"
T.P.	43° 52' 00"	77° 31' 00"
69	43° 52' 00"	77° 18' 00"

Station Number	Latitude N.	Longitude W.
70	43° 39' 00"	77° 18' 00"
71	43° 26' 00"	77° 18' 00"
71A	43° 21' 36"	77° 18' 00"
72	43° 18' 42"	77° 18' 00"
T.P.	43° 18' 42"	77° 06' 30"
73	43° 17' 12"	77° 00' 00"
74	43° 21' 42"	77° 00' 00"
75	43° 26' 00"	77° 00' 00"
76	43° 30' 18"	77° 00' 00"
77	43° 34' 42"	77° 00' 00"
78	43° 39' 00"	77° 00' 00"
79	43° 43' 18"	77° 00' 00"
80	43° 47' 42"	77° 00' 00"
81	43° 52' 00"	77° 00' 00"
82	43° 52' 00"	76° 42' 00"
83	43° 39' 00"	76° 42' 00"
84	43° 26' 00"	76° 42' 00"
85	43° 23' 00"	76° 42' 00"
T.P.	43° 26' 54"	76° 35' 48"
86	43° 28' 36"	76° 32' 06"
87	43° 34' 00"	76° 24' 00"
88	43° 39' 00"	76° 24' 00"
89	43° 43' 12"	76° 24' 00"
90	43° 47' 42"	76° 24' 00"
T.P.	43° 50' 36"	76° 24' 30"
91	43° 52' 00"	76° 24' 00"
T.P.	43° 56' 00"	76° 20' 00"
T.P.	43° 55' 30"	76° 15' 18"
92	43° 56' 18"	76° 12' 00"
T.P.	43° 55' 30"	76° 15' 18"
93	44° 00' 42"	76° 30' 00"
T.P.	44° 02' 12"	76° 33' 36"
94	44° 09' 18"	76° 36' 00"
T.P.	44° 05' 12"	76° 38' 30"
95	44° 00' 36"	76° 48' 00"

19/12/71

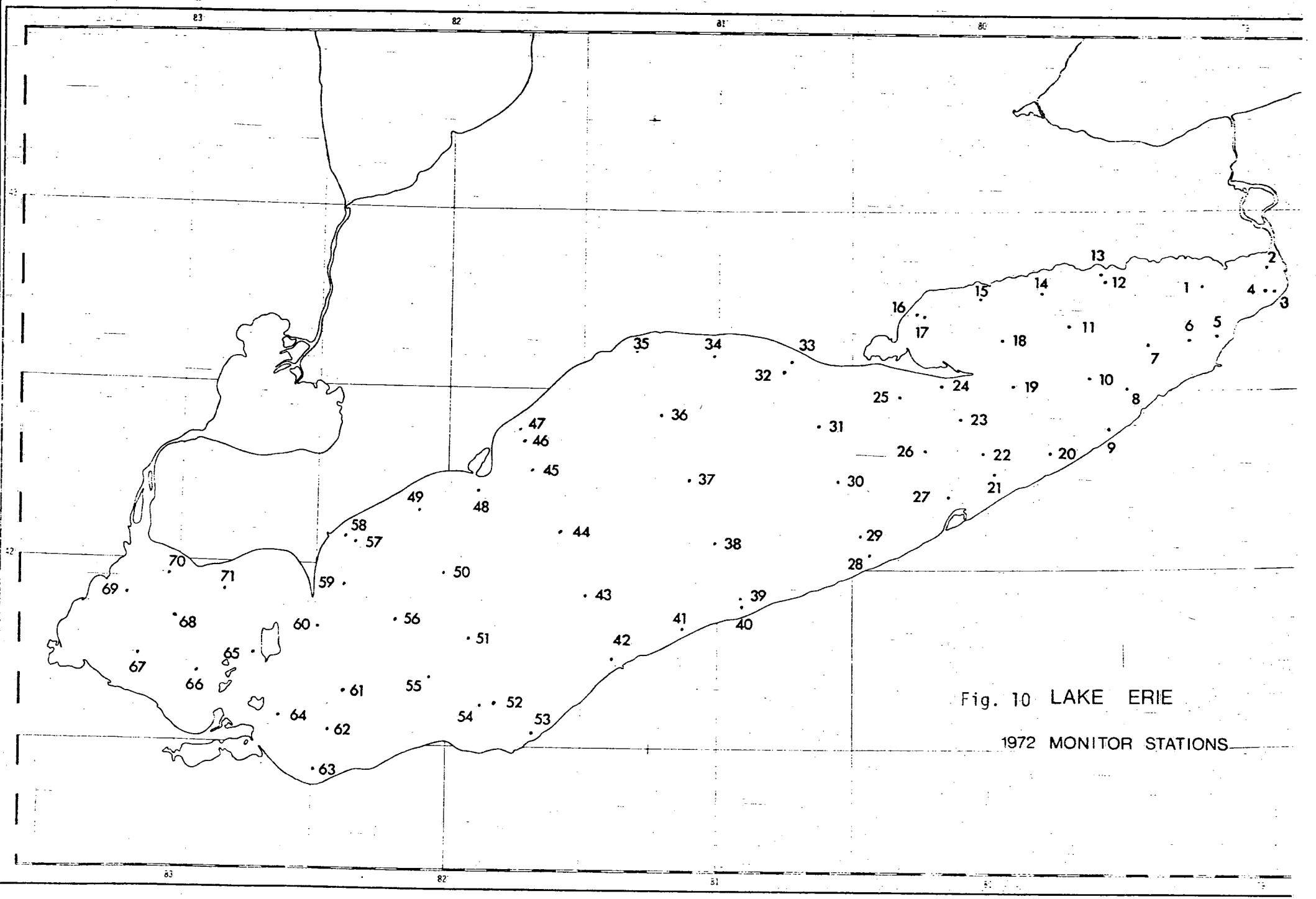


Fig. 10 LAKE ERIE

1972 MONITOR STATIONS

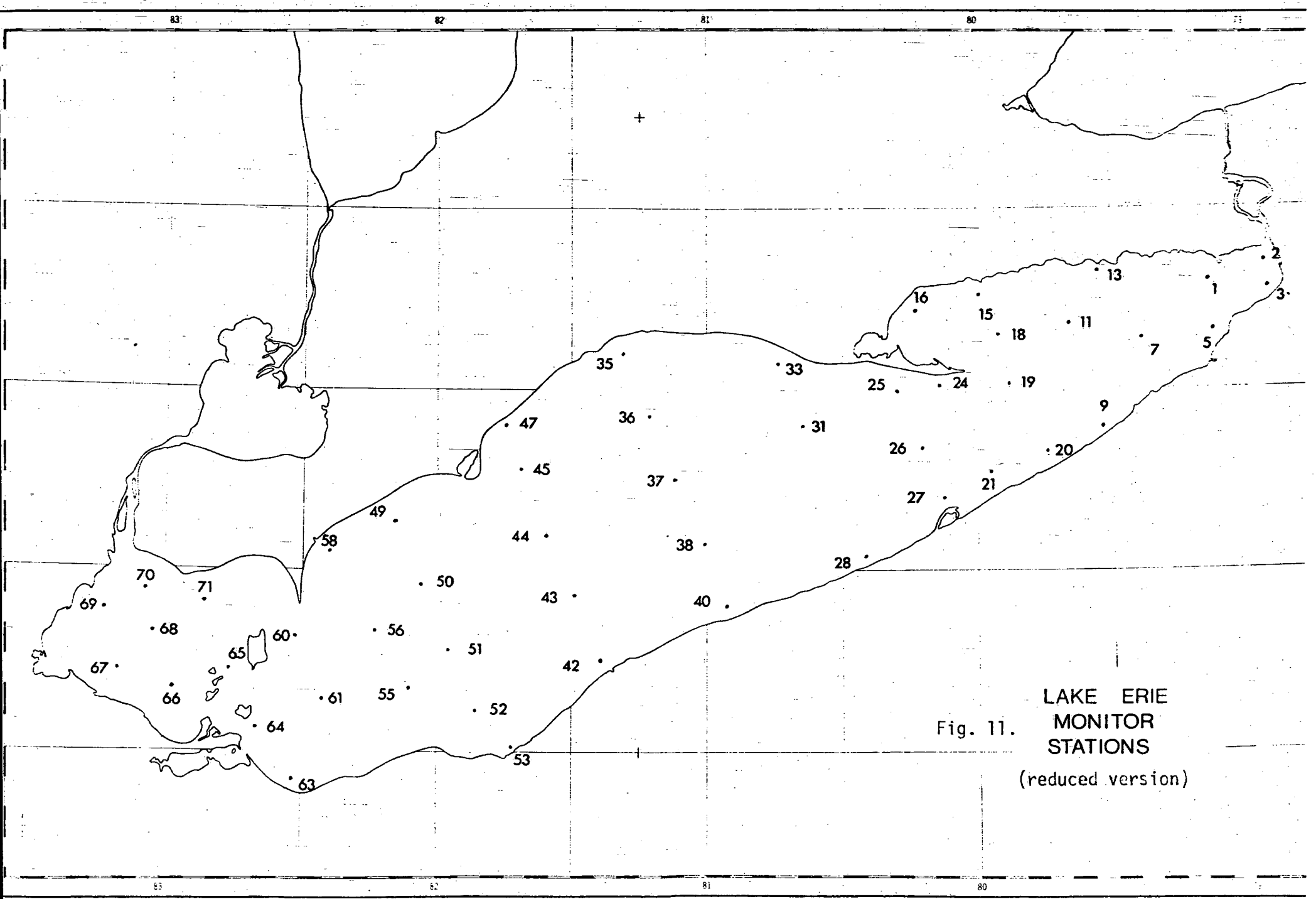


Fig. 11. LAKE ERIE MONITOR STATIONS (reduced version)

LAKE ERIE MONITOR POSITIONS

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
1	1	42° 47' 24"	79° 12' 06"
2	2	42° 50' 36"	78° 57' 30"
T.P.		42° 46' 54"	78° 56' 54"
3	3	42° 46' 42"	78° 55' 30"
4		42° 46' 54"	78° 57' 36"
5	4	42° 39' 06"	79° 08' 00"
6		42° 38' 30"	79° 16' 18"
7	5	42° 37' 54"	79° 24' 00"
8		42° 30' 48"	79° 28' 42"
9	6	42° 23' 54"	79° 32' 48"
10		42° 32' 18"	79° 37' 00"
11	7	42° 40' 48"	79° 41' 30"
12		42° 48' 12"	79° 33' 30"
13	8	42° 49' 30"	79° 34' 30"
14		42° 46' 12"	79° 47' 30"
T.P.		42° 45' 00"	79° 55' 30"
15	9	42° 45' 12"	80° 00' 48"
T.P.		42° 43' 00"	80° 03' 12"
16	10	42° 42' 42"	80° 14' 54"
17		42° 42' 12"	80° 13' 30"
18	11	42° 38' 30"	79° 56' 00"
19	12	42° 31' 00"	79° 53' 36"
20	13	42° 20' 00"	79° 45' 30"
21	14	42° 16' 36"	79° 57' 18"
22		42° 19' 48"	80° 00' 00"
23		42° 25' 18"	80° 04' 48"
24	15	42° 30' 54"	80° 09' 12"
25	16	42° 29' 06"	80° 18' 18"
26	17	42° 20' 18"	80° 12' 48"
27	18	42° 12' 48"	80° 07' 42"
28	19	42° 02' 48"	80° 27' 06"
29		42° 05' 54"	80° 29' 00"
30		42° 14' 54"	80° 33' 36"
31	20	42° 24' 00"	80° 38' 12"
32		42° 32' 54"	80° 45' 30"
33	21	42° 34' 30"	80° 44' 00"
34		42° 35' 30"	81° 01' 00"
35	22	42° 36' 18"	81° 17' 54"
36	23	42° 25' 48"	81° 12' 18"
37	24	42° 15' 12"	81° 06' 24"

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
38	25	42° 04' 54"	81° 00' 42"
39		41° 55' 54"	80° 55' 00"
40	26	41° 54' 24"	80° 55' 00"
41		41° 50' 00"	81° 08' 54"
42	27	41° 45' 48"	81° 23' 00"
43	28	41° 56' 06"	81° 28' 42"
44	29	42° 06' 36"	81° 34' 30"
45	30	42° 16' 54"	81° 40' 18"
46		42° 21' 30"	81° 42' 24"
47	31	42° 23' 48"	81° 44' 00"
T.P.		42° 12' 54"	81° 50' 00"
48		42° 11' 30"	81° 55' 18"
49	32	42° 08' 06"	82° 08' 24"
50	33	41° 57' 54"	82° 02' 30"
51	34	41° 47' 18"	81° 56' 42"
52	35	41° 36' 54"	81° 50' 48"
53	36	41° 31' 48"	81° 42' 30"
54		41° 36' 24"	81° 53' 48"
55	37	41° 40' 54"	82° 05' 12"
56	38	41° 50' 18"	82° 12' 48"
57		42° 02' 48"	82° 21' 54"
58	39	42° 03' 48"	82° 24' 24"
59		41° 55' 54"	82° 24' 30"
T.P.		41° 47' 42"	82° 26' 06"
60	40	41° 48' 48"	82° 30' 06"
61	41	41° 38' 30"	82° 24' 12"
62		41° 31' 54"	82° 27' 12"
63	42	41° 25' 12"	82° 30' 12"
64	43	41° 34' 00"	82° 38' 06"
T.P.		41° 39' 54"	82° 37' 00"
T.P.		41° 38' 18"	82° 43' 42"
65	44	41° 44' 18"	82° 44' 00"
71	45	41° 54' 42"	82° 50' 24"
68	48	41° 49' 54"	83° 01' 06"
66	46	41° 41' 06"	82° 56' 00"
67	47	41° 43' 36"	83° 09' 00"
69	49	41° 53' 30"	83° 11' 48"
70	50	41° 56' 48"	83° 02' 42"

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LAKE ERIE MONITOR POSITIONS

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
1	1	42° 47' 24"	79° 12' 06"
2	2	42° 50' 36"	78° 57' 30"
T.P.		42° 46' 54"	78° 56' 54"
3	3	42° 46' 42"	78° 55' 30"
4		42° 46' 54"	78° 57' 36"
5	4	42° 39' 06"	79° 08' 00"
6		42° 38' 30"	79° 16' 18"
7	5	42° 37' 54"	79° 24' 00"
8		42° 30' 48"	79° 28' 42"
9	6	42° 23' 54"	79° 32' 48"
10		42° 32' 18"	79° 37' 00"
11	7	42° 40' 48"	79° 41' 30"
12		42° 48' 12"	79° 33' 30"
13	8	42° 49' 30"	79° 34' 30"
14		42° 46' 12"	79° 47' 30"
T.P.		42° 45' 00"	79° 55' 30"
15	9	42° 45' 12"	80° 00' 48"
T.P.		42° 43' 00"	80° 03' 12"
16	10	42° 42' 42"	80° 14' 54"
17		42° 42' 12"	80° 13' 30"
18	11	42° 38' 30"	79° 56' 00"
19	12	42° 31' 00"	79° 53' 36"
20	13	42° 20' 00"	79° 45' 30"
21	14	42° 16' 36"	79° 57' 18"
22		42° 19' 48"	80° 00' 00"
23		42° 25' 18"	80° 04' 48"
24	15	42° 30' 54"	80° 09' 12"
25	16	42° 29' 06"	80° 18' 18"
26	17	42° 20' 18"	80° 12' 48"
27	18	42° 12' 48"	80° 07' 42"
28	19	42° 02' 48"	80° 27' 06"
29		42° 05' 54"	80° 29' 00"
30		42° 14' 54"	80° 33' 36"
31	20	42° 24' 00"	80° 38' 12"
32		42° 32' 54"	80° 45' 30"
33	21	42° 34' 30"	80° 44' 00"
34		42° 35' 30"	81° 01' 00"
35	22	42° 36' 18"	81° 17' 54"
36	23	42° 25' 48"	81° 12' 18"
37	24	42° 15' 12"	81° 06' 24"

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
38	25	42° 04' 54"	81° 00' 42"
39		41° 55' 54"	80° 55' 00"
40	26	41° 54' 24"	80° 55' 00"
41		41° 50' 00"	81° 08' 54"
42	27	41° 45' 48"	81° 23' 00"
43	28	41° 56' 06"	81° 28' 42"
44	29	42° 06' 36"	81° 34' 30"
45	30	42° 16' 54"	81° 40' 18"
46		42° 21' 30"	81° 42' 24"
47	31	42° 23' 48"	81° 44' 00"
T.P.		42° 12' 54"	81° 50' 00"
48		42° 11' 30"	81° 55' 18"
49	32	42° 08' 06"	82° 08' 24"
50	33	41° 57' 54"	82° 02' 30"
51	34	41° 47' 18"	81° 56' 42"
52	35	41° 36' 54"	81° 50' 48"
53	36	41° 31' 48"	81° 42' 30"
54		41° 36' 24"	81° 53' 48"
55	37	41° 40' 54"	82° 05' 12"
56	38	41° 50' 18"	82° 12' 48"
57		42° 02' 48"	82° 21' 54"
58	39	42° 03' 48"	82° 24' 24"
59		41° 55' 54"	82° 24' 30"
T.P.		41° 47' 42"	82° 26' 06"
60	40	41° 48' 48"	82° 30' 06"
61	41	41° 38' 30"	82° 24' 12"
62		41° 31' 54"	82° 27' 12"
63	42	41° 25' 12"	82° 30' 12"
64	43	41° 34' 00"	82° 38' 06"
T.P.		41° 39' 54"	82° 37' 00"
T.P.		41° 38' 18"	82° 43' 42"
65	44	41° 44' 18"	82° 44' 00"
71	45	41° 54' 42"	82° 50' 24"
68	48	41° 49' 54"	83° 01' 06"
66	46	41° 41' 06"	82° 56' 00"
67	47	41° 43' 36"	83° 09' 00"
69	49	41° 53' 30"	83° 11' 48"
70	50	41° 56' 48"	83° 02' 42"

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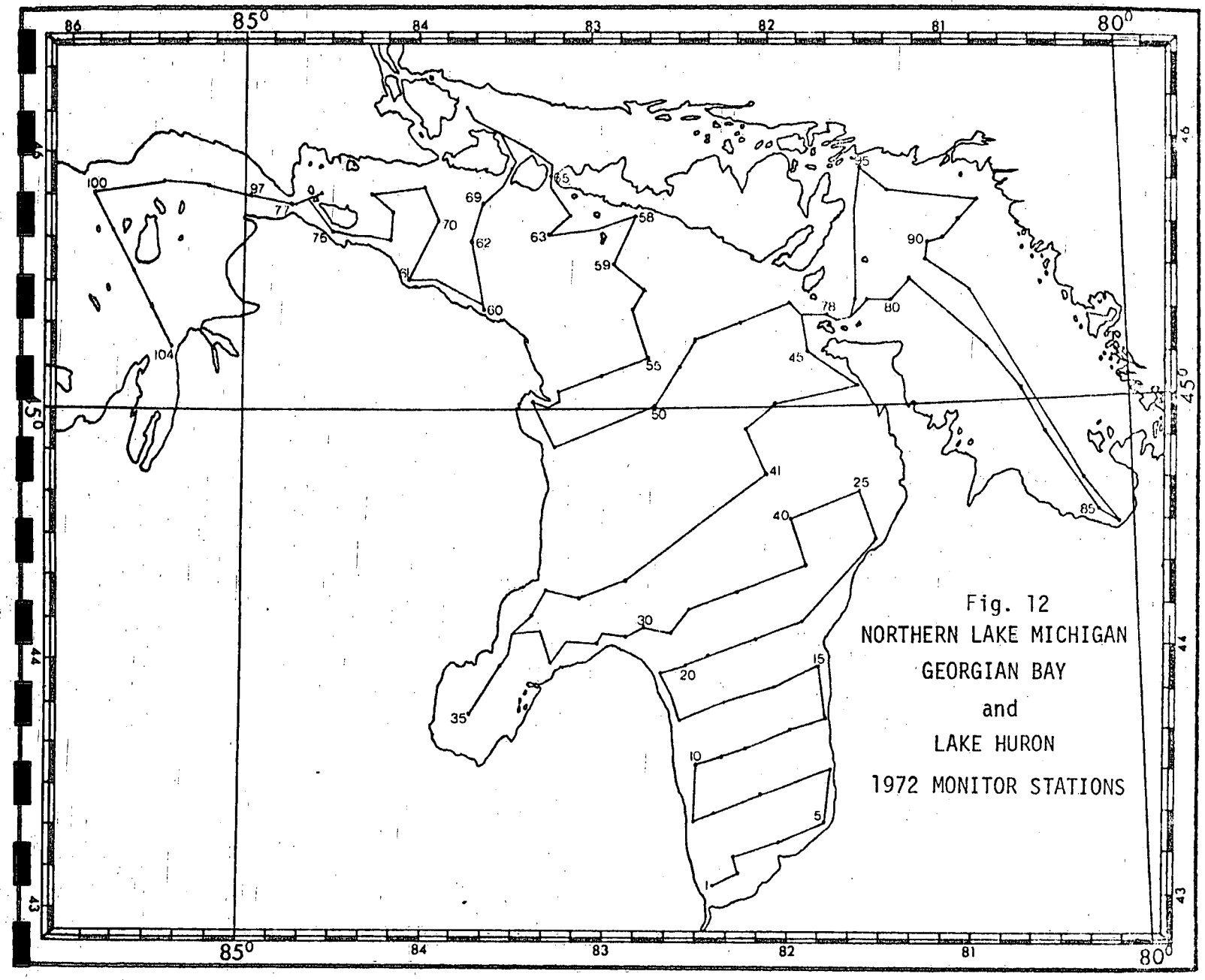

Fig. 12
NORTHERN LAKE MICHIGAN
GEORGIAN BAY
and
LAKE HURON
1972 MONITOR STATIONS

LAKE HURON MONITOR POSITIONS

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
1	1	43° 05' 24"	82° 23' 30"
2		43° 07' 36"	82° 15' 00"
3	2	43° 11' 24"	82° 17' 54"
4	3	43° 15' 24"	82° 02' 18"
5	4	43° 19' 30"	81° 47' 18"
6	5	43° 32' 54"	81° 44' 42"
7	7	43° 26' 42"	82° 07' 48"
8	8	43° 22' 36"	82° 23' 24"
9	9	43° 20' 30"	82° 30' 24"
10	10	43° 34' 00"	82° 29' 00"
11		43° 36' 18"	82° 21' 00"
12	11	43° 38' 00"	82° 13' 12"
13	12	43° 42' 06"	81° 57' 54"
14	13	43° 45' 12"	81° 46' 00"
15	14	43° 57' 24"	81° 47' 54"
16	15	43° 53' 24"	82° 03' 12"
17	16	43° 49' 18"	82° 19' 12"
18	17	43° 45' 12"	82° 34' 36"
T.P.		43° 51' 12"	82° 36' 36"
19	18	43° 56' 30"	82° 40' 06"
20	19	43° 58' 30"	82° 32' 36"
21		44° 00' 42"	82° 25' 00"
22	20	44° 04' 42"	82° 08' 48"
23	21	44° 08' 42"	81° 53' 12"
24	23	44° 28' 00"	81° 27' 12"
25	40	44° 39' 24"	81° 32' 42"
40	37	44° 33' 18"	81° 56' 24"
26	24	44° 22' 12"	81° 50' 54"
27	26	44° 16' 00"	82° 14' 06"
28	27	44° 11' 54"	82° 30' 12"
29		44° 06' 36"	82° 37' 00"
30	28	44° 07' 54"	82° 45' 42"
31		44° 05' 54"	82° 52' 00"
T.P.		44° 06' 24"	83° 00' 00"
32	29	44° 03' 42"	83° 01' 36"
T.P.		44° 04' 48"	83° 11' 42"
33	30	43° 59' 36"	83° 17' 12"
T.P.		44° 07' 12"	83° 20' 00"
T.P.		44° 06' 42"	83° 29' 48"
T.P.		44° 01' 06"	83° 31' 48"

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
34	31	43° 58' 54"	83° 34' 06"
35	32	43° 47' 12"	83° 44' 12"
T.P.		44° 01' 06"	83° 31' 48"
T.P.		44° 06' 42"	83° 29' 48"
36	33	44° 10' 42"	83° 23' 06"
37		44° 16' 24"	83° 18' 30"
38	34	44° 14' 54"	83° 07' 12"
39	35	44° 19' 06"	82° 51' 54"
41	45	44° 44' 24"	82° 03' 36"
42	53	44° 55' 06"	82° 11' 12"
43	54	45° 00' 48"	82° 00' 30"
44	56	45° 05' 00"	81° 32' 18"
45	57	45° 13' 18"	81° 49' 12"
46	73	45° 24' 48"	81° 55' 06"
47	72	45° 20' 42"	82° 11' 30"
48	71	45° 16' 42"	82° 27' 06"
49	70	45° 10' 06"	82° 33' 06"
50	61	45° 01' 00"	82° 41' 06"
51	64	44° 51' 00"	83° 15' 42"
52	65	45° 02' 06"	83° 22' 42"
T.P.		44° 58' 30"	83° 15' 00"
T.P.		45° 02' 12"	83° 09' 18"
53	66	45° 04' 36"	83° 14' 00"
54	68	45° 08' 12"	82° 59' 00"
55	69	45° 12' 24"	82° 43' 18"
56	78	45° 23' 42"	82° 48' 54"
57	79	45° 28' 42"	82° 44' 06"
59	82	45° 35' 00"	82° 54' 54"
58	81	45° 45' 54"	82° 46' 48"
T.P.		45° 43' 00"	83° 00' 00"
63	88	45° 42' 06"	83° 16' 48"
64		45° 46' 30"	83° 09' 36"
T.P.		45° 51' 18"	83° 14' 30"
65	90	45° 55' 30"	83° 14' 30"
T.P.		45° 57' 54"	83° 14' 54"
66	91	46° 02' 06"	83° 22' 36"
T.P.		46° 09' 06"	83° 42' 36"
67	92	46° 11' 42"	83° 44' 30"
T.P.		46° 09' 06"	83° 42' 36"
T.P.		46° 06' 00"	83° 33' 00"

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
T.P.		45° 58' 42"	83° 27' 00"
68		45° 57' 30"	83° 28' 06"
T.P.		45° 53' 24"	83° 32' 24"
69	93	45° 49' 06"	83° 39' 06"
62	87	45° 40' 00"	83° 43' 36"
60	85	45° 23' 30"	83° 39' 06"
T.P.		45° 25' 00"	83° 39' 30"
T.P.		45° 31' 12"	83° 55' 06"
61	86	45° 31' 00"	84° 06' 00"
70	94	45° 45' 00"	83° 55' 00"
71		45° 52' 54"	83° 56' 36"
72	99	45° 51' 48"	84° 17' 42"
73		45° 46' 54"	84° 10' 48"
74	95	45° 40' 30"	84° 11' 12"
T.P.		45° 41' 18"	84° 17' 48"
T.P.		45° 41' 30"	84° 24' 12"
75	96	45° 42' 12"	84° 31' 00"
T.P.		45° 49' 42"	84° 38' 54"
76	98	45° 50' 48"	84° 35' 00"
T.P.		45° 48' 48"	84° 42' 54"
77	97	45° 48' 48"	84° 45' 18"

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LAKE MICHIGAN MONITOR POSITIONS

1972 Station Number	Latitude N.	Longitude W.
97	45° 51' 00"	84° 59' 00"
98	45° 53' 00"	85° 13' 30"
99	45° 54' 00"	85° 27' 30"
100	45° 51' 24"	85° 52' 30"
101	45° 42' 36"	85° 45' 30"
102	45° 33' 48"	85° 38' 42"
103	45° 25' 00"	85° 32' 00"
104	45° 16' 00"	85° 25' 00"

GEORGIAN BAY MONITOR POSITIONS

1972 Station Number	1971 Station Number	Latitude N.	Longitude W.
78	45	45° 20' 42"	81° 43' 00"
T.P.		45° 19' 24"	81° 38' 48"
T.P.		45° 19' 42"	81° 35' 42"
79	43	45° 24' 00"	81° 29' 00"
80	40	45° 23' 42"	81° 21' 30"
81	39	45° 28' 30"	81° 15' 24"
82	25	45° 12' 36"	80° 49' 18"
83	18	45° 03' 00"	80° 38' 12"
84	10	44° 52' 12"	80° 30' 30"
85	3	44° 33' 00"	80° 12' 30"
86		44° 29' 00"	80° 06' 30"
87	2	44° 40' 48"	80° 17' 42"
88	32	45° 26' 30"	80° 54' 42"
89	38	45° 33' 12"	81° 09' 30"
90		45° 37' 48"	81° 07' 48"
91	37	45° 37' 48"	81° 03' 30"
92	36	45° 42' 30"	80° 57' 30"
93	35	45° 47' 00"	80° 51' 30"
94	50	45° 49' 12"	81° 21' 00"
95	53	45° 54' 48"	81° 30' 00"
T.P.		45° 46' 12"	81° 32' 00"
96	44	45° 24' 00"	81° 33' 12"

Issued: July 6, 1972

C.C.I.W.

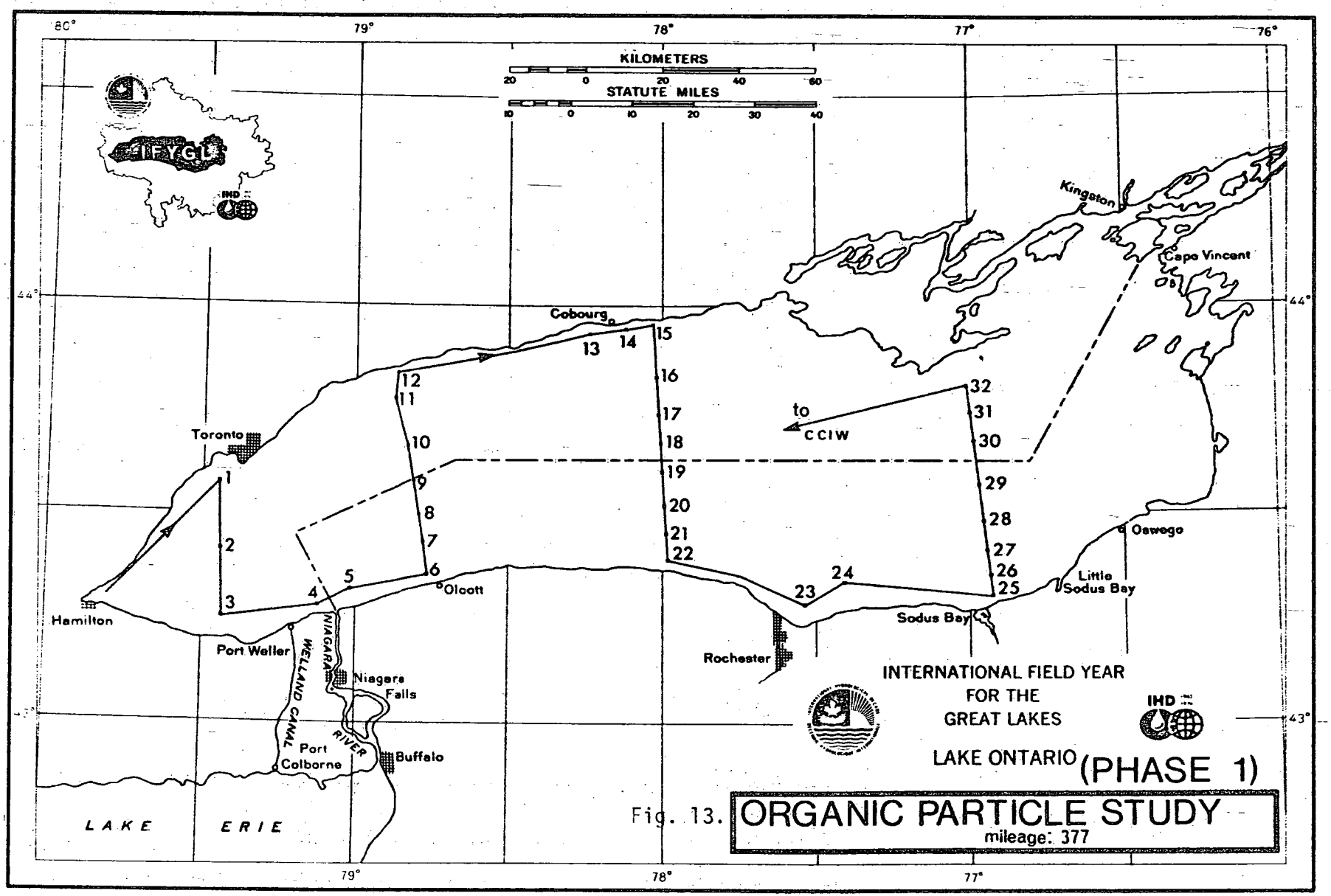


Fig. 13.

IFYGL

ORGANIC PARTICLE STUDY

(or Monitor Research Stations)

PHASE I:

Station Number	Latitude N.	Longitude W.
1	43° 34' 24"	79° 24' 00"
2	43° 25' 54"	79° 24' 00"
3	43° 17' 18"	79° 24' 00"
4	43° 17' 24"	79° 07' 24"
T.P.	43° 19' 36"	79° 04' 30"
5	43° 19' 24"	79° 00' 00"
6	43° 21' 36"	78° 43' 48"
7	43° 26' 00"	78° 45' 06"
8	43° 30' 18"	78° 46' 00"
9	43° 34' 54"	78° 47' 18"
10	43° 38' 54"	78° 48' 12"
11	43° 46' 30"	78° 51' 18"
12	43° 49' 48"	78° 51' 00"
13	43° 55' 12"	78° 14' 24"
14	43° 56' 00"	78° 07' 30"
15	43° 57' 00"	78° 03' 00"
16	43° 49' 12"	78° 02' 06"
17	43° 44' 12"	78° 01' 42"
18	43° 39' 06"	78° 01' 12"
19	43° 35' 24"	78° 00' 42"
20	43° 31' 12"	78° 00' 12"
21	43° 27' 00"	77° 59' 48"
22	43° 23' 00"	77° 59' 24"
T.P.	43° 21' 54"	77° 46' 00"
23	43° 17' 30"	77° 32' 54"
24	43° 21' 12"	77° 26' 00"
25	43° 18' 00"	76° 56' 24"
26	43° 21' 30"	76° 57' 18"
27	43° 25' 12"	76° 58' 00"
28	43° 29' 24"	76° 58' 48"
29	43° 34' 06"	76° 59' 42"
30	43° 40' 12"	77° 00' 54"
31	43° 44' 24"	77° 01' 48"
32	43° 48' 00"	77° 02' 24"

28 April '72

Issued: July 6, 1972

C.C.I.W.

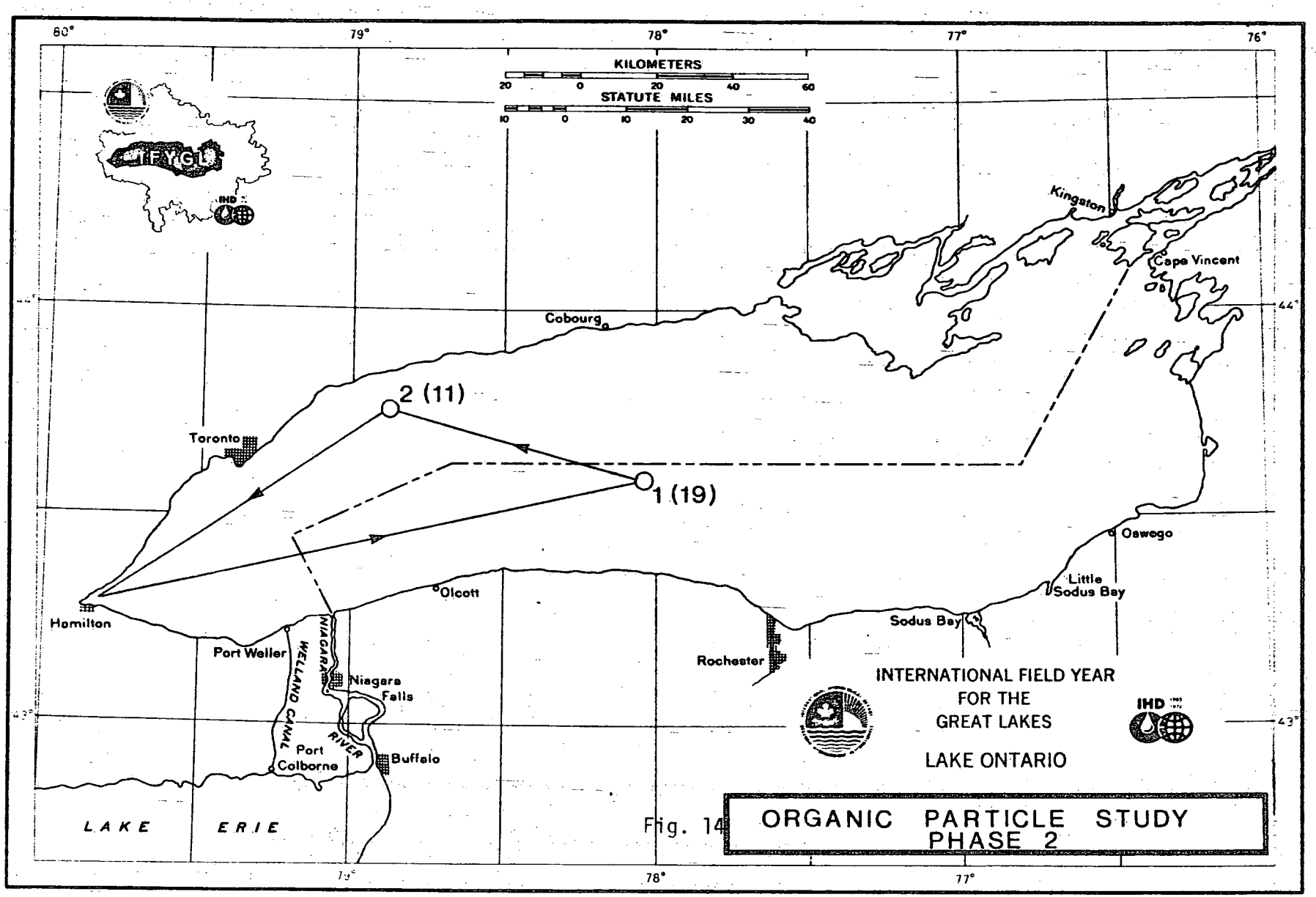


Fig. 14

IFYGL

ORGANIC PARTICLE STUDY

PHASE II:

Station Number	Latitude N.	Longitude W.
(11)	43° 46' 30"	78° 51' 18"
(19)	43° 35' 24"	78° 00' 42"

28 April '72

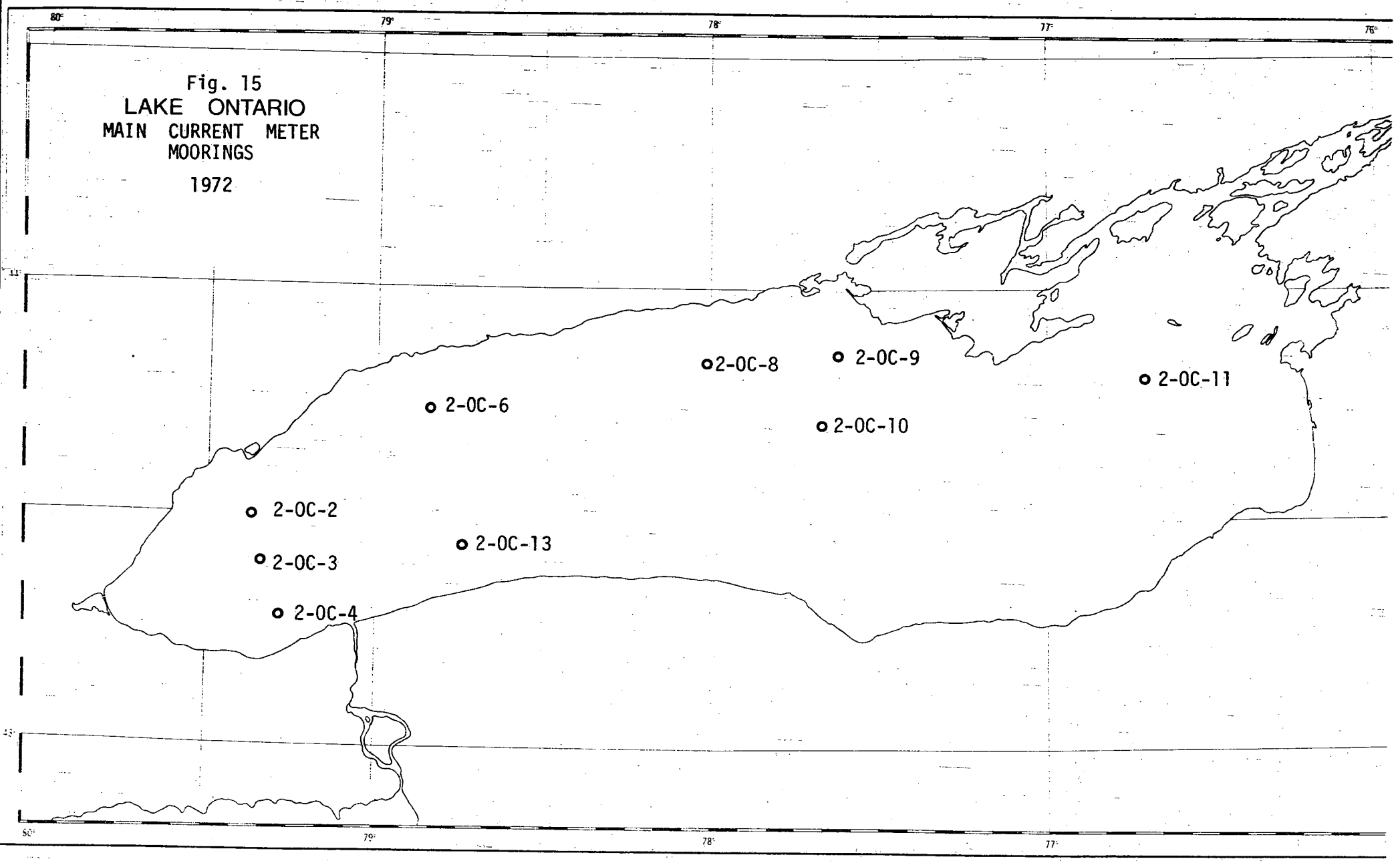


Fig. 15
LAKE ONTARIO
MAIN CURRENT METER
MOORINGS

1972

LAKE ONTARIO

Main Current Meter Moorings

Station	Latitude	Longitude
2-OC-2	43° 30° 55°	79° 19° 28°
2-OC-3	43° 24° 26°	79° 17° 23°
2-OC-4	43° 18° 54°	79° 14° 00°
2-OC-6	43° 44° 03°	78° 49° 10°
2-OC-8	43° 49° 33°	78° 02° 40°
2-OC-9	43° 50° 04°	77° 40° 50°
2-OC-10	43° 40° 17°	77° 43° 20°
2-OC-11	43° 46° 20°	76° 49° 51°
2-OC-13	43° 26° 02°	78° 43° 48°

LAKE ONTARIO

AUXILLIARY MOORINGS

Stations	Latitude	Longitude
2-OC-65	43° 17° 30°	79° 08° 30°
2-OC-66	43° 17° 09°	79° 08° 09°
2-OC-69	43° 50° 38°	78° 43° 54°
2-OC-71	43° 21° 11°	79° 36° 11°
2-OT-62	43° 30° 39°	76° 57° 27°
2-OM-63	43° 49° 32°	78° 02° 49°
2-OM-64	43° 47° 45°	76° 49° 39°
2-OS-67	43° 50° 47°	78° 43° 43°
	43° 40° 03°	77° 46° 55°
	43° 31° 03°	79° 00° 26°
	43° 49° 45°	78° 44° 20°
	43° 19° 10°	79° 45° 10°
2-OS-68	43° 17° 39°	79° 08° 36°
	43° 17° 18°	79° 08° 18°
	LAKE ERIE	
2-15-99	41° 47° 00°	82° 10° 03°

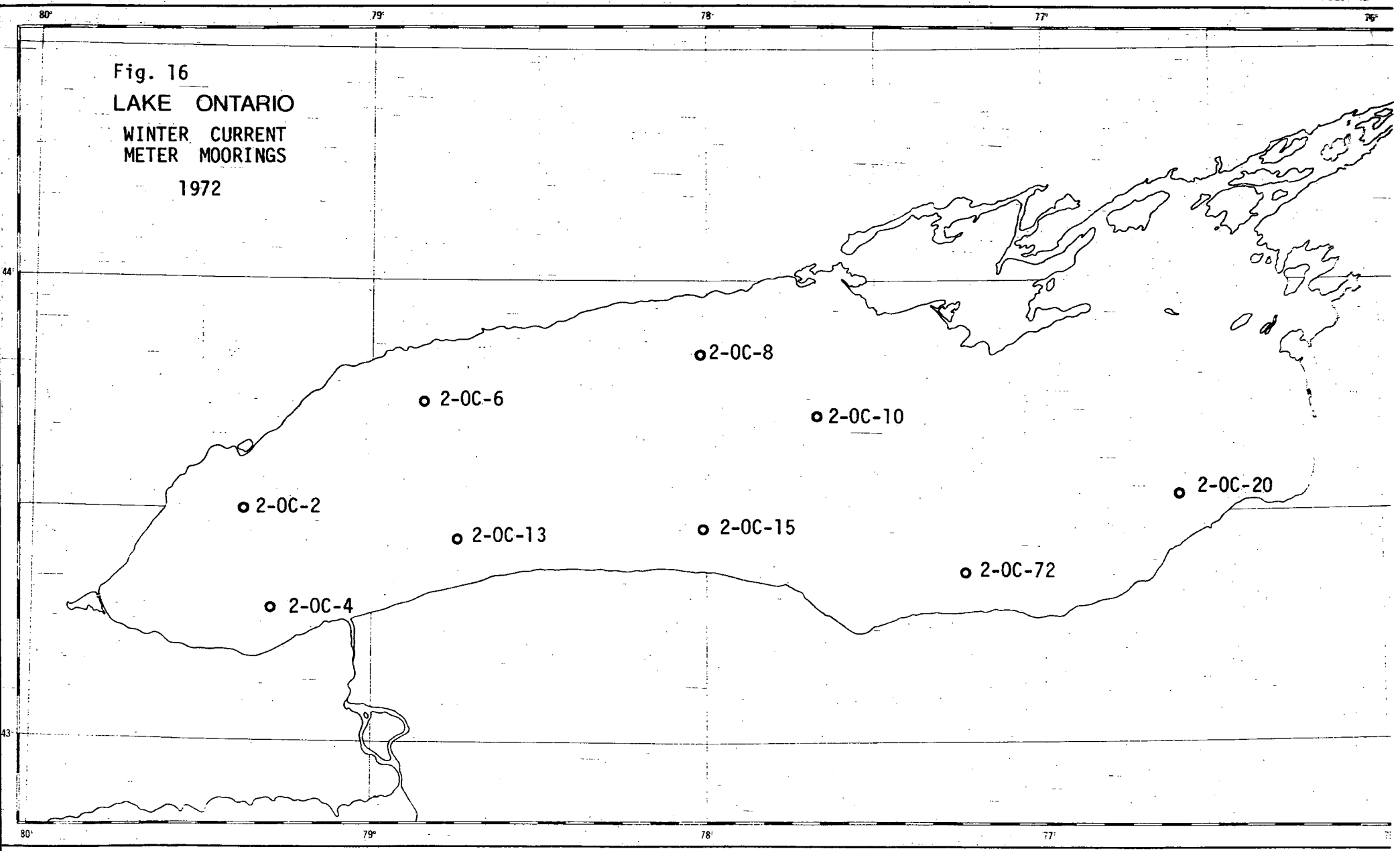


Fig. 16
LAKE ONTARIO
WINTER CURRENT
METER MOORINGS
1972
80°
79°
78°
77°
44°
43°
2-OC-8
2-OC-6
2-OC-10
2-OC-20
2-OC-2
2-OC-13
2-OC-15
2-OC-72
2-OC-4

LAKE ONTARIO

Winter Current Meter Moorings

Stations	Latitude	Longitude
2-OC-2	43° 30° 55°	79° 19° 28°
2-OC-4	43° 18° 54°	79° 14° 00°
2-OC-6	43° 44° 03°	78° 49° 10°
2-OC-8	43° 49° 33°	78° 02° 40°
2-OC-10	43° 40° 17°	77° 43° 20°
2-OC-13	43° 26° 02°	78° 43° 48°
2-OC-15	43° 27° 02°	77° 59° 53°
2-OC-20	43° 31° 58°	76° 37° 56°
2-OC-72	43° 21° 09°	77° 14° 49°

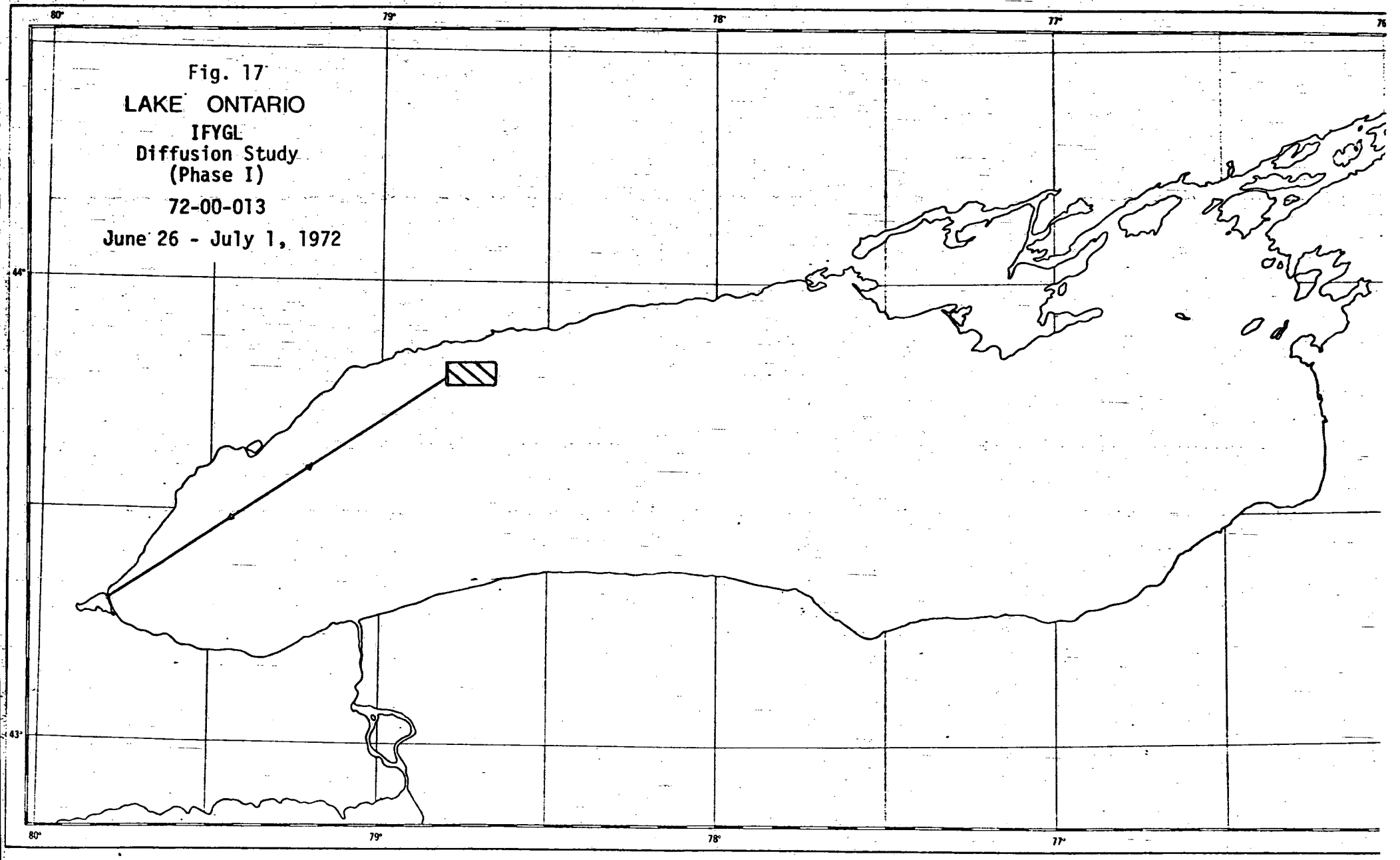


Fig. 17
LAKE ONTARIO
IFYGL
Diffusion Study
(Phase I)
72-00-013
June 26 - July 1, 1972
80°
79°
78°
77°
44°
43°

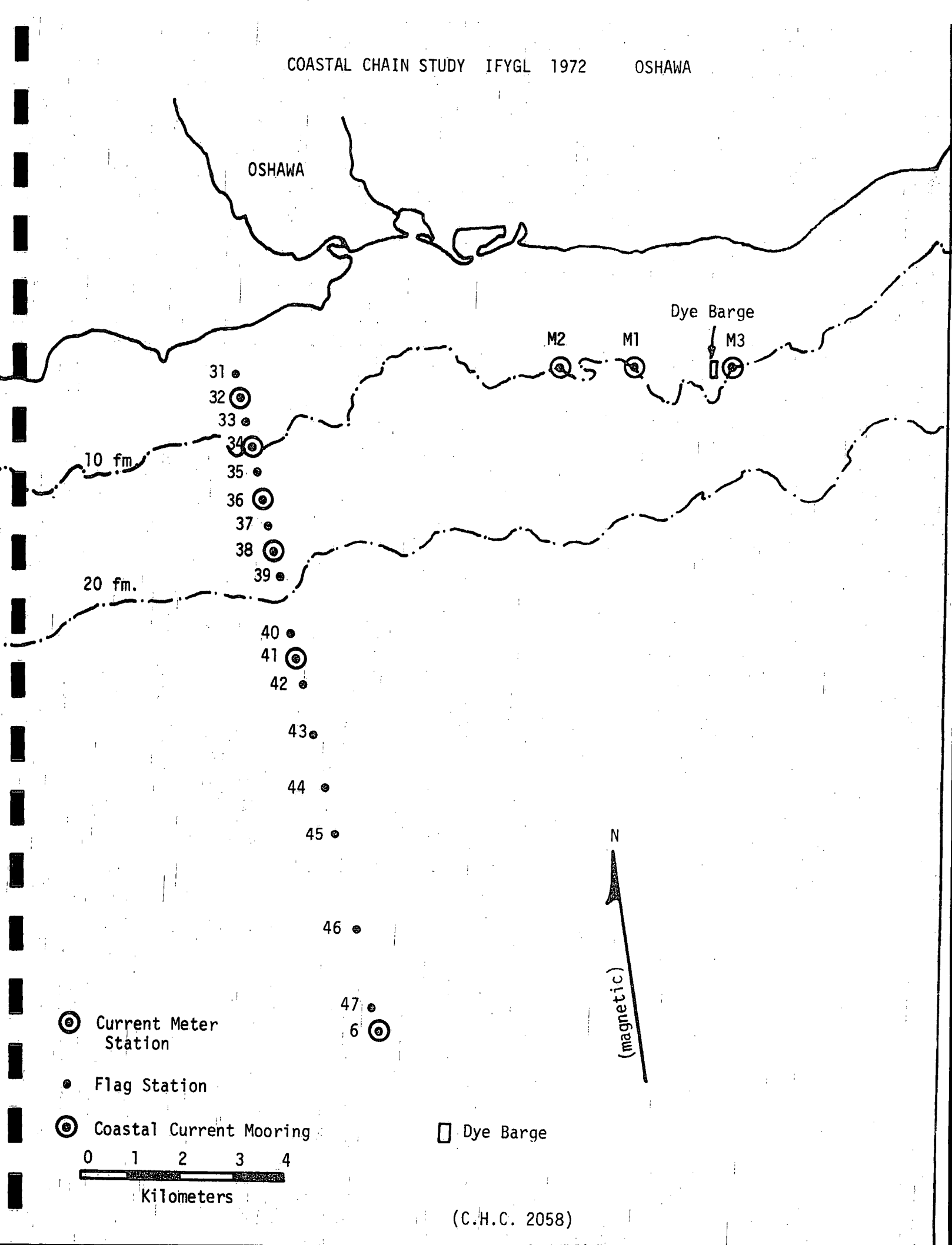

COASTAL CHAIN STUDY IFYGL 1972 OSHAWA
OSHAWA
Dye Barge
M2
M1
M3
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
6
10 fm.
20 fm.
N
(magnetic)
Current Meter Station
Flag Station
Coastal Current Mooring
Dye Barge
0 1 2 3 4
Kilometers
(C.H.C. 2058)

TABLE #III

COASTAL CHAIN STUDY - OSHAWA FLAG STATION

MOORING NUMBER	LATITUDE N.	LONGITUDE W.
2-OF-31A	43° 50' 48"	78° 50' 47"
2-OF-33A	43° 50' 14"	78° 50' 38"
2-OF-35A	43° 49' 45"	78° 50' 30"
2-OF-37A	43° 49' 12"	78° 50' 21"
2-OF-39A	43° 48' 40"	78° 50' 13"
2-OF-40A	43° 48' 07"	78° 50' 05"
2-OF-42A	43° 47' 36"	78° 49' 57"
2-OF-43A	43° 47' 04"	78° 49' 49"
2-OF-44A	43° 46' 32"	78° 49' 41"
2-OF-45A	43° 46' 02"	78° 49' 33"
2-OF-46A	43° 44' 57"	78° 49' 16"
2-OF-47A	43° 44' 14"	78° 49' 04"

LAKE ONTARIO

Coastal Chain Current Meter Moorings

Station	Latitude	Longitude
2-OC-32	43° 50° 31°	78° 50° 49°
2-OC-34	43° 50° 03°	78° 50° 46°
2-OC-36	43° 49° 31°	78° 50° 39°
2-OC-38	43° 48° 52°	78° 50° 27°
2-OC-41	43° 47° 48°	78° 50° 05°
2-OC-55	43° 55° 29°	77° 40° 31°
2-OC-59	43° 53° 13°	77° 40° 41°

TABLE #V

DYE BARGE AND MOORING FLOATS

MOORING NUMBER	LATITUDE N.	LONGITUDE W.	
2-OD-27A	43° 50' 48"	78° 44' 00"	Dye Barge
M-1	43° 50' 48"	78° 45' 14"	Mooring Float
M-2	43° 50' 48"	78° 46' 37"	Mooring Float
M-3	43° 50' 48"	78° 43' 50"	Mooring Float

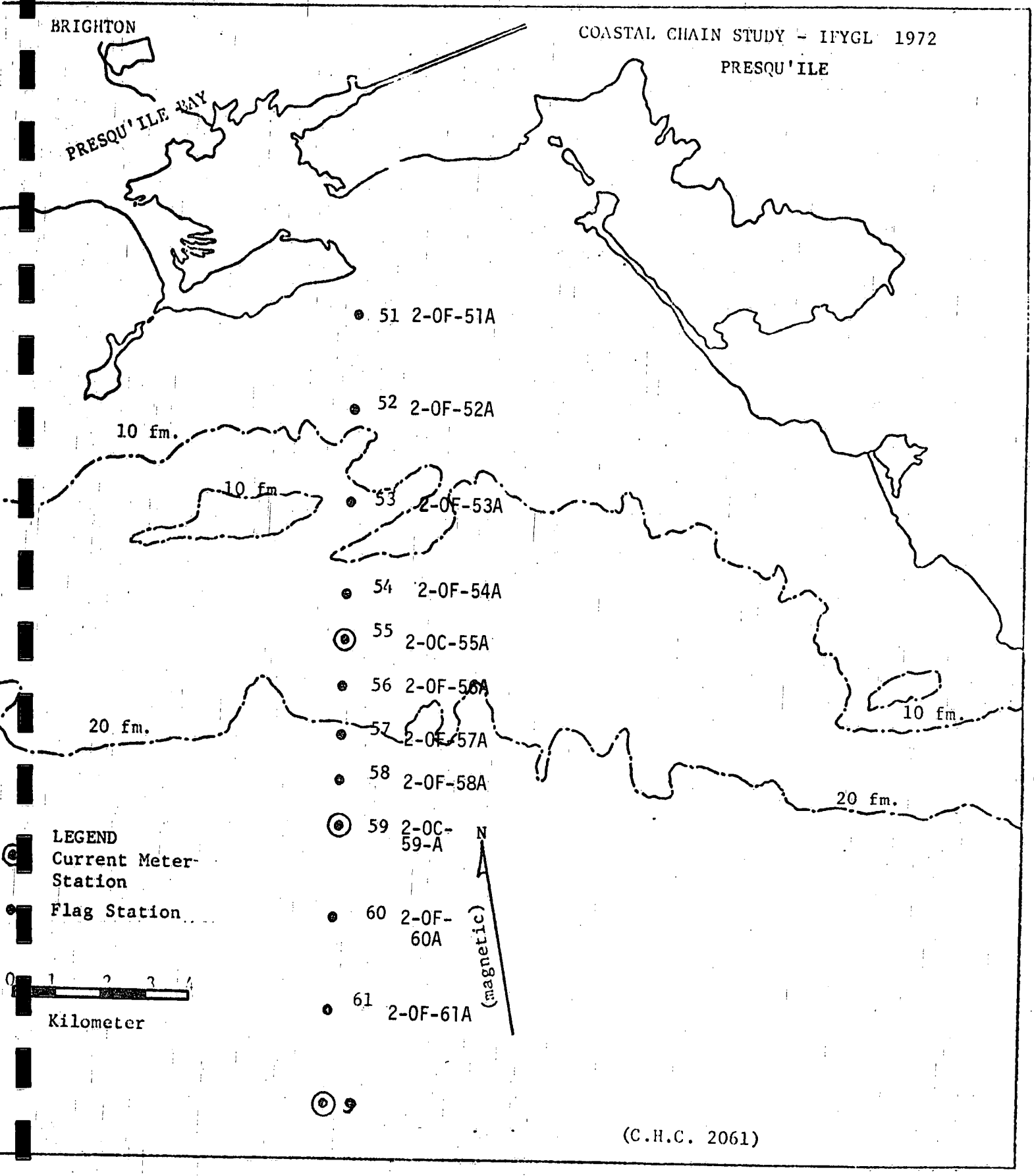

BRIGHTON
COASTAL CHAIN STUDY - IFYGL 1972
PRESQU'ILE
PRESQU'ILE BAY
51 2-OF-51A
52 2-OF-52A
10 fm.
10 fm.
53 2-OF-53A
54 2-OF-54A
55 2-OC-55A
56 2-OF-56A
20 fm.
10 fm.
57 2-OF-57A
58 2-OF-58A
20 fm.
59 2-OC-59-A
N
(magnetic)
LEGEND
Current Meter-Station
Flag Station
60 2-OF-60A
0 1 2 3 4
Kilometer
61 2-OF-61A
9
(C.H.C. 2061)

Fig. 18.

TABLE #IV

COASTAL CHAIN STUDY - PRESQU'ILE FLAG STATION

MOORING NUMBER	LATITUDE N.	LONGITUDE W.
2-OF-51A	43° 59' 18"	77° 40' 31"
2-OF-52A	43° 58' 13"	77° 40' 34"
2-OF-53A	43° 57' 08"	77° 40' 37"
2-OF-54A	43° 56' 03"	77° 40' 40"
2-OF-56A	43° 54' 55"	77° 40' 44"
2-OF-57A	43° 54' 21"	77° 40' 46"
2-OF-58A	43° 53' 48"	77° 40' 47"
2-OF-60A	43° 52' 08"	77° 40' 51"
2-OF-61A	43° 51' 05"	77° 40' 55"

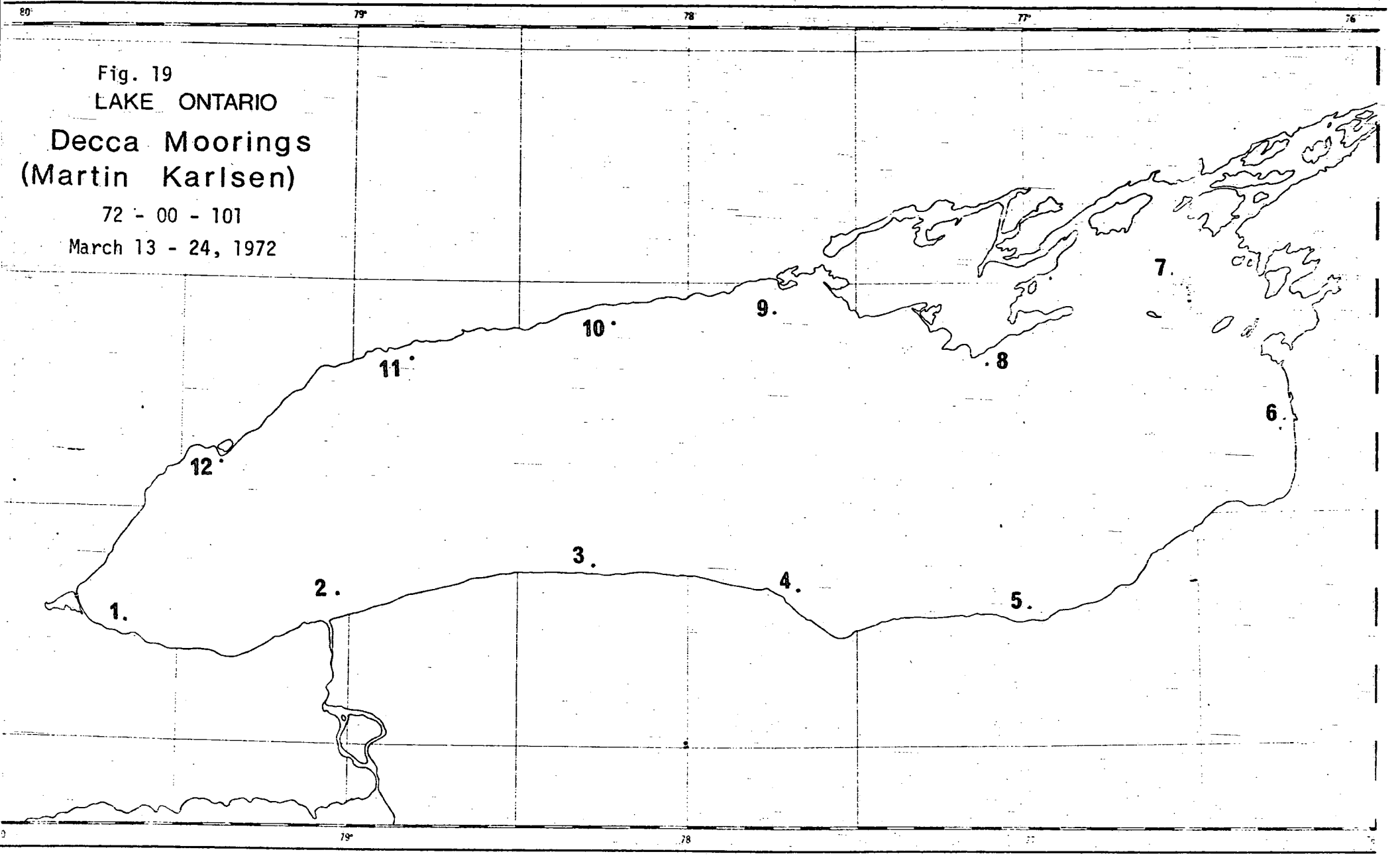


Fig. 19
LAKE ONTARIO
Decca Moorings
(Martin Karlsen)
72 - 00 - 101
March 13 - 24, 1972
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

ADDENDUM TO CRUISE PLAN NUMBER 72 - 00 - 101
March 13 - 24
Lake Ontario
M. V. MARTIN KARLSEN

Regarding No. 6 of the above cruise plan, the mooring locations for the buoys have changed as follows:-

	Position	
Mooring Number	Latitude N.	Longitude W.
2-OS-1A	43° 15' 42"	79° 39' 18"
2-OS-2A	43° 19' 36"	79° 02' 12"
2-OS-3A	43° 23' 30"	78° 16' 30"
2-OS-4A	43° 20' 18"	77° 40' 30"
2-OS-5A	43° 17' 54"	76° 59' 48"
2-OS-6A	43° 40' 36"	76° 14' 00"
2-OS-7A	44° 00' 54"	76° 33' 42"
2-OS-8A	43° 49' 30"	77° 06' 48"
2-OS-9A	43° 56' 18"	77° 44' 36"
2-OS-10A	43° 55' 00"	78° 13' 12"
2-OS-11A	43° 50' 12"	78° 49' 18"
2-OS-12A	43° 36' 30"	79° 23' 00"

The attached map indicates the mooring locations and should also be added to the cruise plan.

rcw
13/3/72

Fig. 20

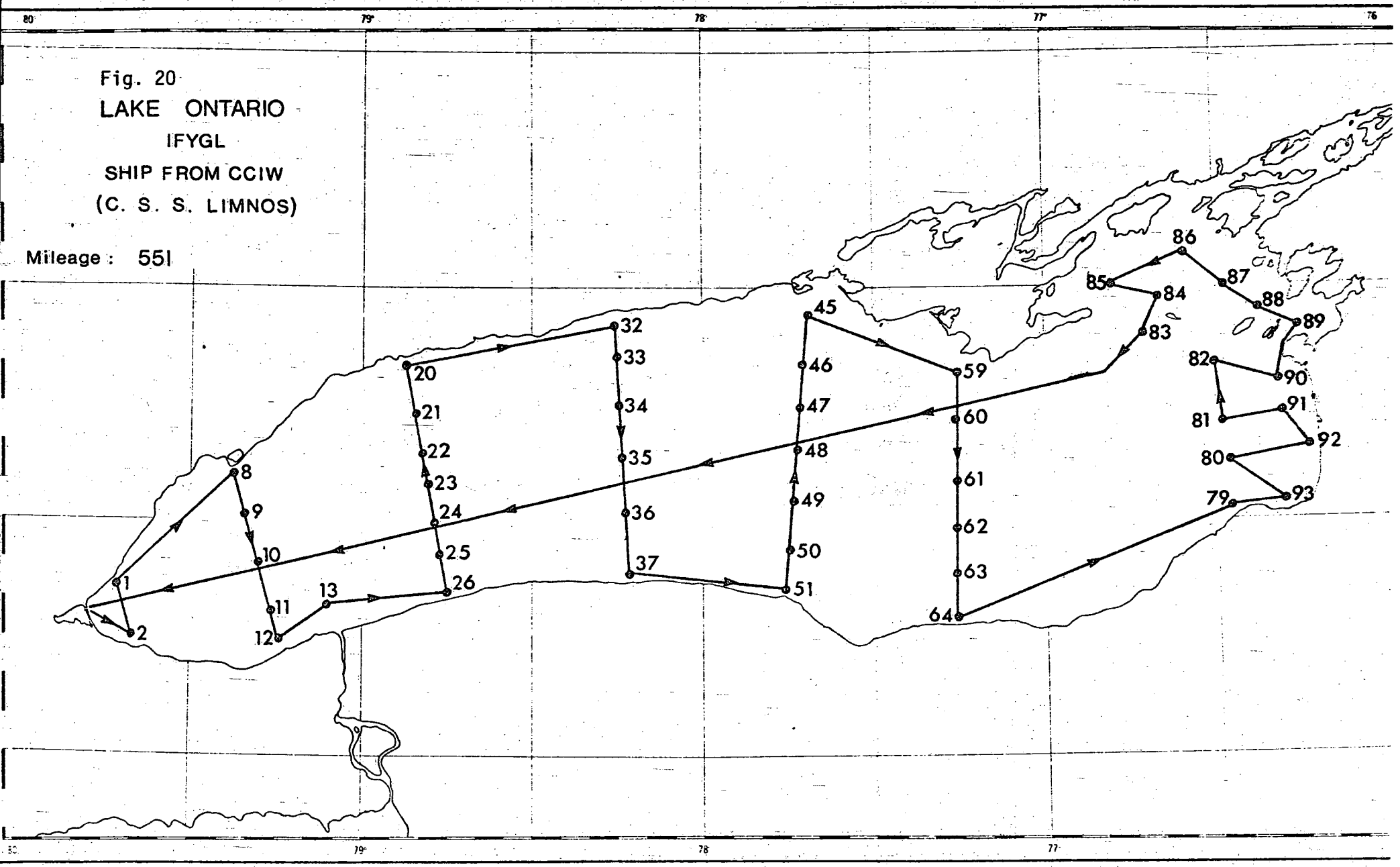
LAKE ONTARIO

IFYGL

SHIP FROM CCIW

(C. S. S. LIMNOS)

Mileage : 551



LAKE ONTARIO
(SHIP FROM CCIW)
STATION LOCATIONS

TEMPERATURE SURVEYS

IFYGL
1972/73

Station Number	Latitude N.	Longitude W.
2	43° 15' 36"	79° 38' 12"
1	43° 22' 42"	79° 40' 36"
8	43° 35' 54"	79° 21' 06"
9	43° 31' 18"	79° 19' 12"
10	43° 25' 00"	79° 16' 30"
11	43° 19' 06"	79° 14' 12"
12	43° 15' 36"	79° 13' 00"
13	43° 19' 12"	79° 04' 12"
26	43° 21' 36"	78° 43' 36"
25	43° 26' 24"	78° 44' 18"
24	43° 30' 36"	78° 45' 48"
23	43° 34' 48"	78° 46' 48"
22	43° 39' 00"	78° 48' 00"
21	43° 43' 48"	78° 49' 12"
20	43° 49' 54"	78° 51' 00"
32	43° 55' 12"	78° 14' 24"
33	43° 51' 36"	78° 14' 18"
34	43° 45' 36"	78° 13' 48"
35	43° 38' 54"	78° 13' 12"
36	43° 31' 42"	78° 12' 36"
37	43° 23' 24"	78° 12' 00"
51	43° 21' 30"	77° 44' 42"
50	43° 26' 54"	77° 44' 00"
49	43° 33' 06"	77° 43' 12"
48	43° 39' 36"	77° 43' 06"
47	43° 45' 00"	77° 42' 30"
46	43° 49' 48"	77° 41' 48"
45	43° 56' 24"	77° 40' 54"
T.P.	43° 52' 30"	77° 33' 00"
59	43° 49' 12"	77° 15' 00"
60	43° 43' 12"	77° 15' 00"
61	43° 35' 24"	77° 15' 00"
62	43° 29' 24"	77° 15' 00"
63	43° 23' 30"	77° 15' 00"
64	43° 18' 00"	77° 15' 00"

Station Number	Latitude N.	Longitude W.
79	43° 31' 48"	76° 27' 12"
93	43° 33' 00"	76° 18' 36"
80	43° 37' 48"	76° 28' 12"
92	43° 39' 48"	76° 14' 06"
91	43° 44' 24"	76° 18' 54"
81	43° 43' 12"	76° 29' 30"
82	43° 50' 24"	76° 30' 36"
90	43° 48' 18"	76° 19' 48"
89	43° 55' 12"	76° 16' 12"
88	43° 57' 36"	76° 23' 12"
87	44° 00' 18"	76° 29' 00"
86	44° 04' 30"	76° 36' 00"
85	44° 00' 36"	76° 48' 36"
84	43° 58' 48"	76° 40' 30"
83	43° 54' 24"	76° 43' 00"

17 December 1971

Fig. 21

LAKE ONTARIO

I F Y G L

SHIP FROM TORONTO

(C. C. G. S. PORTE DAUPHINE)

Mileage: 475

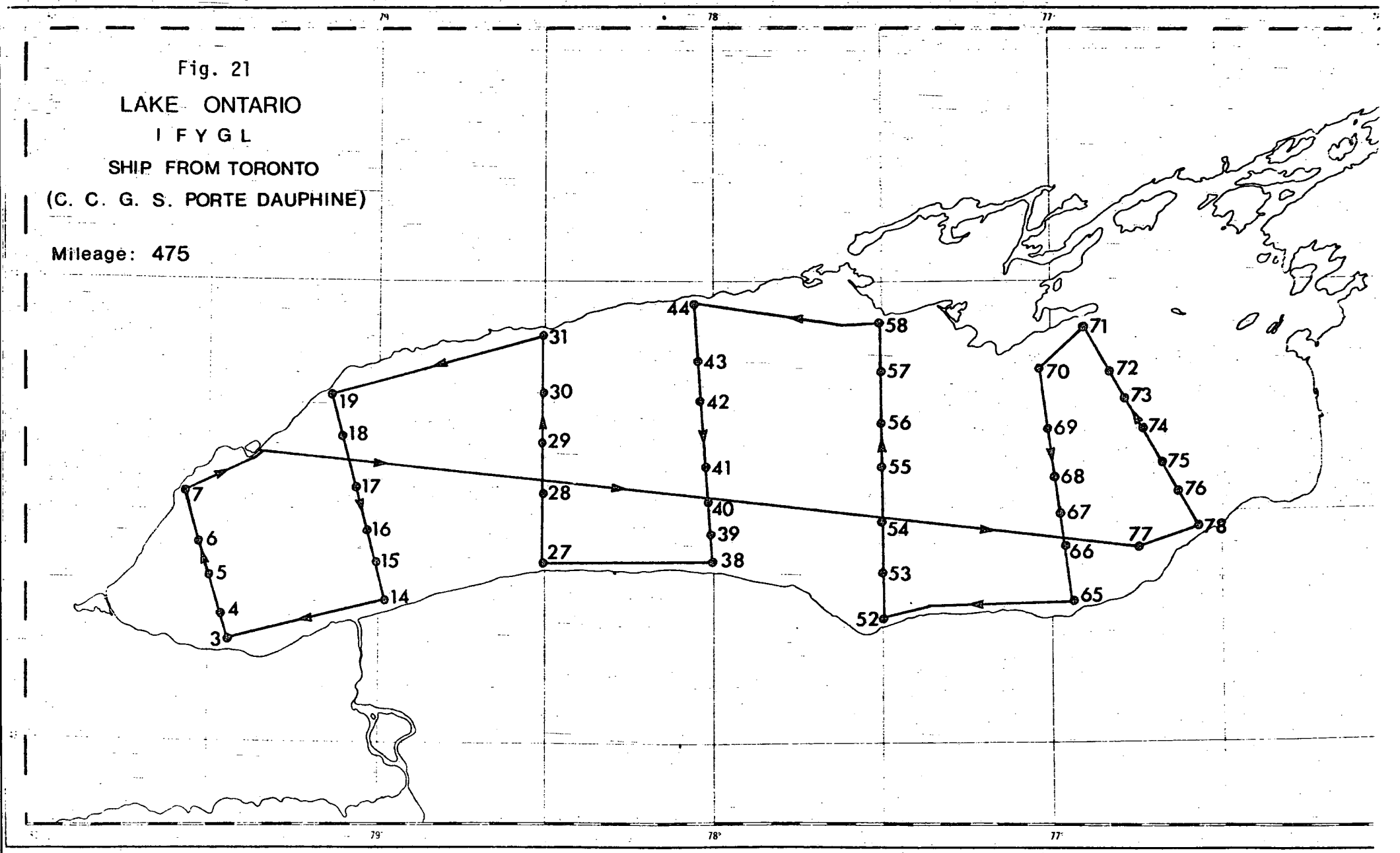


Fig. 22. IFYGL TEMPERATURE TRANSECT SURVEY

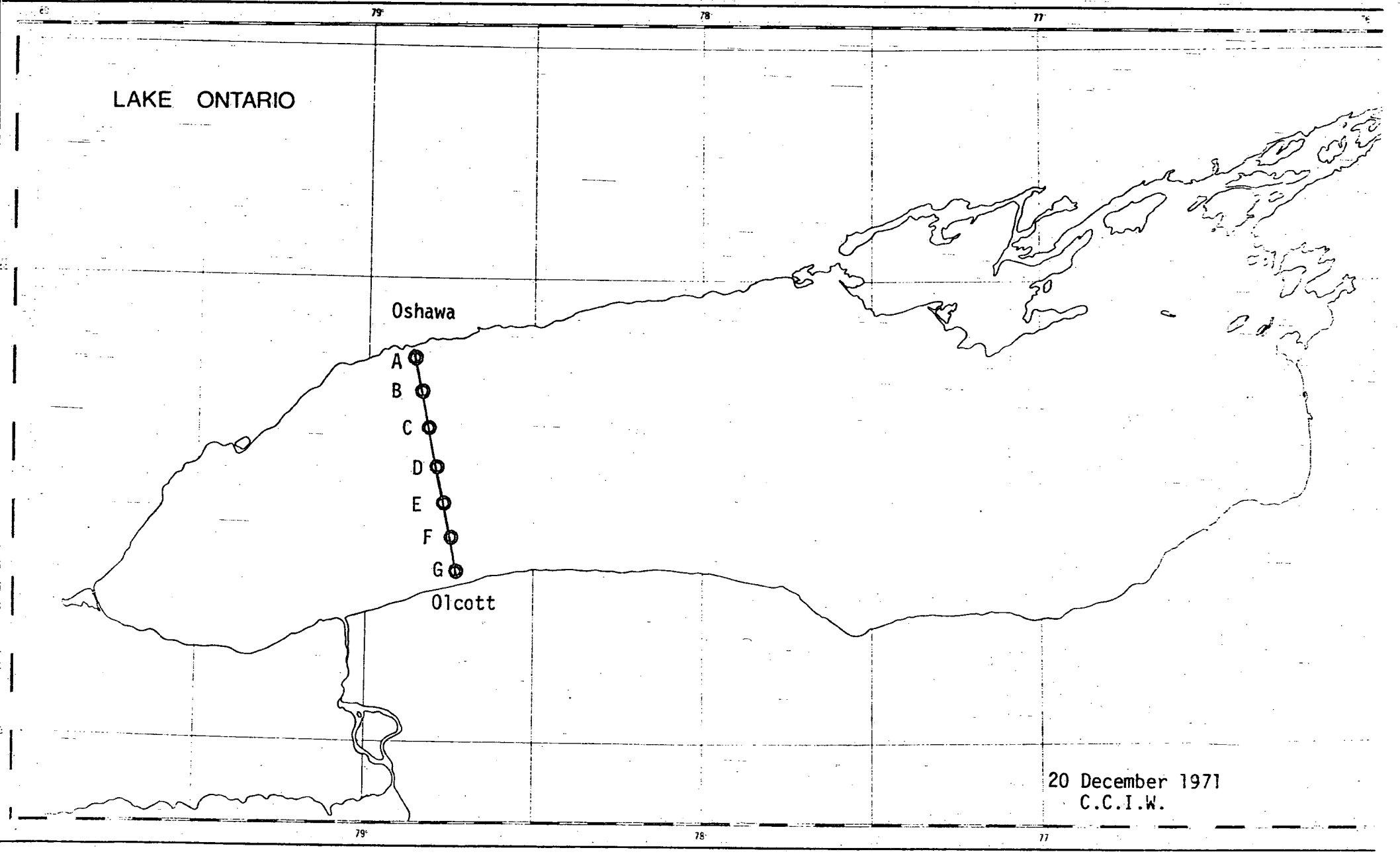


FIGURE 1

LAKE ONTARIO

(SHIP FROM TORONTO)

STATION LOCATIONS

TEMPERATURE SURVEYS

IFYGL

1972/73

Station Number	Latitude N.	Longitude W.
77	43° 25' 24"	76° 44' 42"
78	43° 28' 00"	76° 34' 18"
76	43° 32' 06"	76° 37' 54"
75	43° 36' 06"	76° 40' 48"
74	43° 40' 24"	76° 44' 06"
73	43° 44' 24"	76° 47' 36"
72	43° 47' 48"	76° 50' 24"
71	43° 53' 24"	76° 54' 36"
70	43° 48' 18"	77° 02' 24"
69	43° 40' 12"	77° 00' 48"
68	43° 34' 12"	76° 59' 24"
67	43° 29' 24"	76° 58' 48"
66	43° 25' 24"	76° 58' 00"
65	43° 18' 00"	76° 56' 24"
T.P.	43° 17' 30"	77° 26' 06"
52	43° 15' 54"	77° 30' 00"
53	43° 22' 00"	77° 30' 00"
54	43° 28' 48"	77° 30' 00"
55	43° 35' 24"	77° 30' 00"
56	43° 41' 24"	77° 30' 00"
57	43° 48' 00"	77° 30' 00"
58	43° 54' 36"	77° 30' 00"
T.P.	43° 53' 24"	77° 31' 48"
44	43° 56' 54"	78° 03' 00"
43	43° 49' 24"	78° 02' 06"
42	43° 44' 00"	78° 01' 42"
41	43° 35' 36"	78° 00' 48"
40	43° 31' 06"	78° 00' 06"
39	43° 27' 00"	78° 00' 00"
38	43° 23' 18"	77° 59' 24"

Station Number	Latitude N.	Longitude W.
27	43° 23' 12"	78° 30' 06"
28	43° 32' 00"	78° 29' 54"
29	43° 38' 42"	78° 30' 00"
30	43° 45' 06"	78° 30' 00"
31	43° 52' 42"	78° 29' 48"
19	43° 45' 30"	79° 07' 12"
18	43° 39' 30"	79° 04' 54"
17	43° 33' 06"	79° 02' 42"
16	43° 27' 18"	79° 00' 48"
15	43° 23' 18"	78° 59' 18"
14	43° 18' 00"	78° 57' 42"
T.P.	43° 20' 42"	79° 04' 42"
3	43° 13' 12"	79° 25' 06"
4	43° 16' 48"	79° 26' 24"
5	43° 21' 36"	79° 28' 48"
6	43° 26' 18"	79° 30' 18"
7	43° 32' 18"	79° 33' 00"

17 December 1971

TABLE 1

List of Station Positions

Station Number	Latitude N.	Longitude W.	
A	43° 49' 18"	78° 51' 36"	
B	43° 44' 00"	78° 49' 00"	(CM Buoy #6)
C	43° 39' 30"	78° 47' 45"	
D	43° 35' 00"	78° 46' 30"	(CM Buoy #12)
E	43° 30' 30"	78° 45' 15"	
F	43° 26' 00"	78° 44' 00"	(CM Buoy #13)
G	43° 21' 48"	78° 43' 12"	

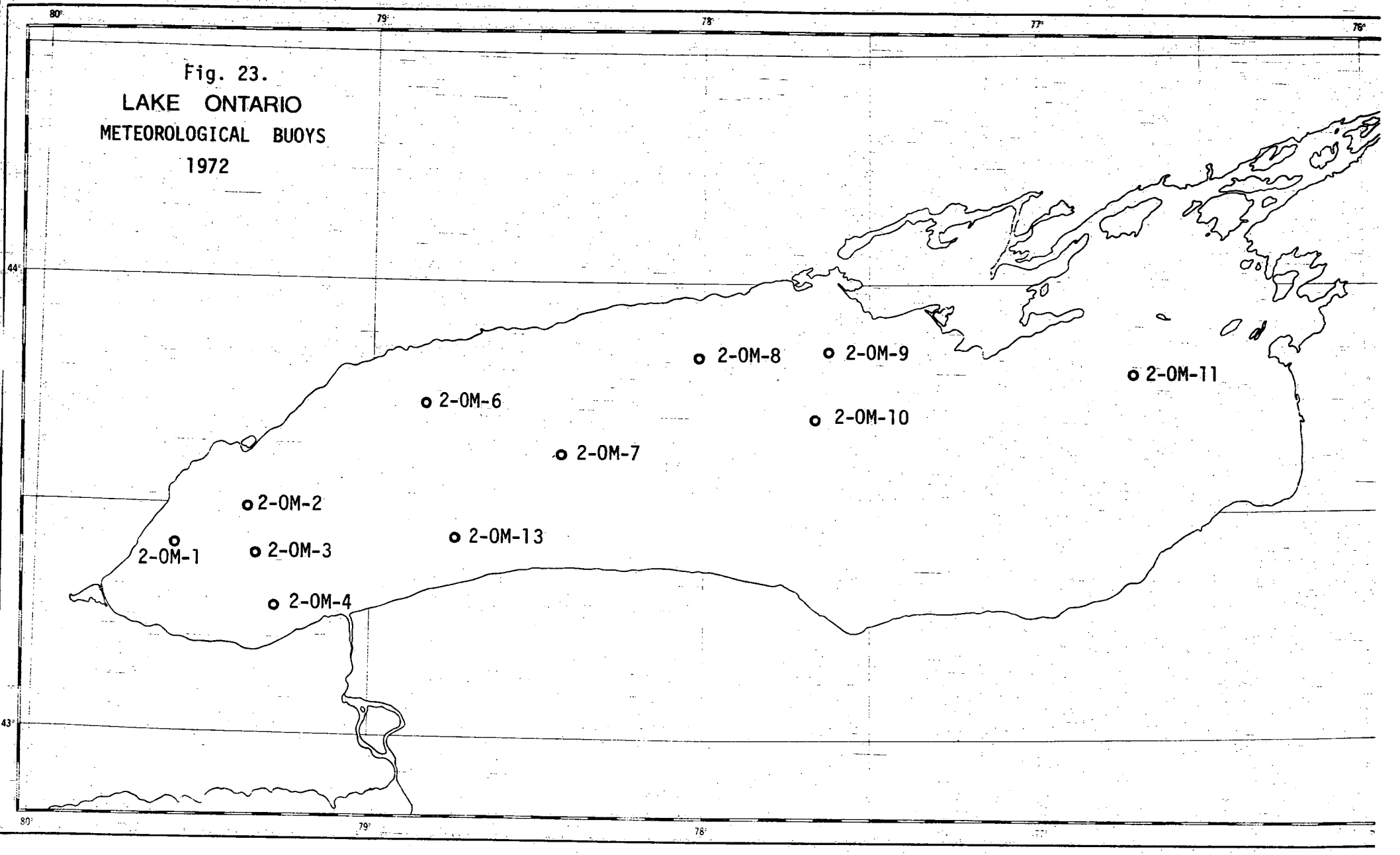


Fig. 23.
LAKE ONTARIO
METEOROLOGICAL BUOYS
1972
80°
79°
78°
77°
76°
44°
43°
2-OM-1
2-OM-2
2-OM-3
2-OM-4
2-OM-6
2-OM-7
2-OM-8
2-OM-9
2-OM-10
2-OM-11
2-OM-13

LAKE ONTARIO

Met Buoys

Station	Latitude	Longitude
2-OM-1	43° 25° 34°	79° 30° 51°
2-OM-2	43° 30° 53°	79° 19° 01°
2-OM-3	43° 24° 23°	79° 17° 20°
2-OM-4	43° 17° 31°	79° 07° 55°
2-OM-13	43° 26° 03°	78° 43° 40°
2-OM-6	43° 43° 56°	78° 49° 23°
2-OM-7	43° 38° 48°	78° 29° 30°
2-OM-8	43° 52° 00°	78° 01° 30°
2-OM-9	43° 51° 10°	77° 41° 09°
2-OM-10	43° 39° 20°	77° 42° 20°
2-OM-11	43° 47° 28°	76° 50° 31°

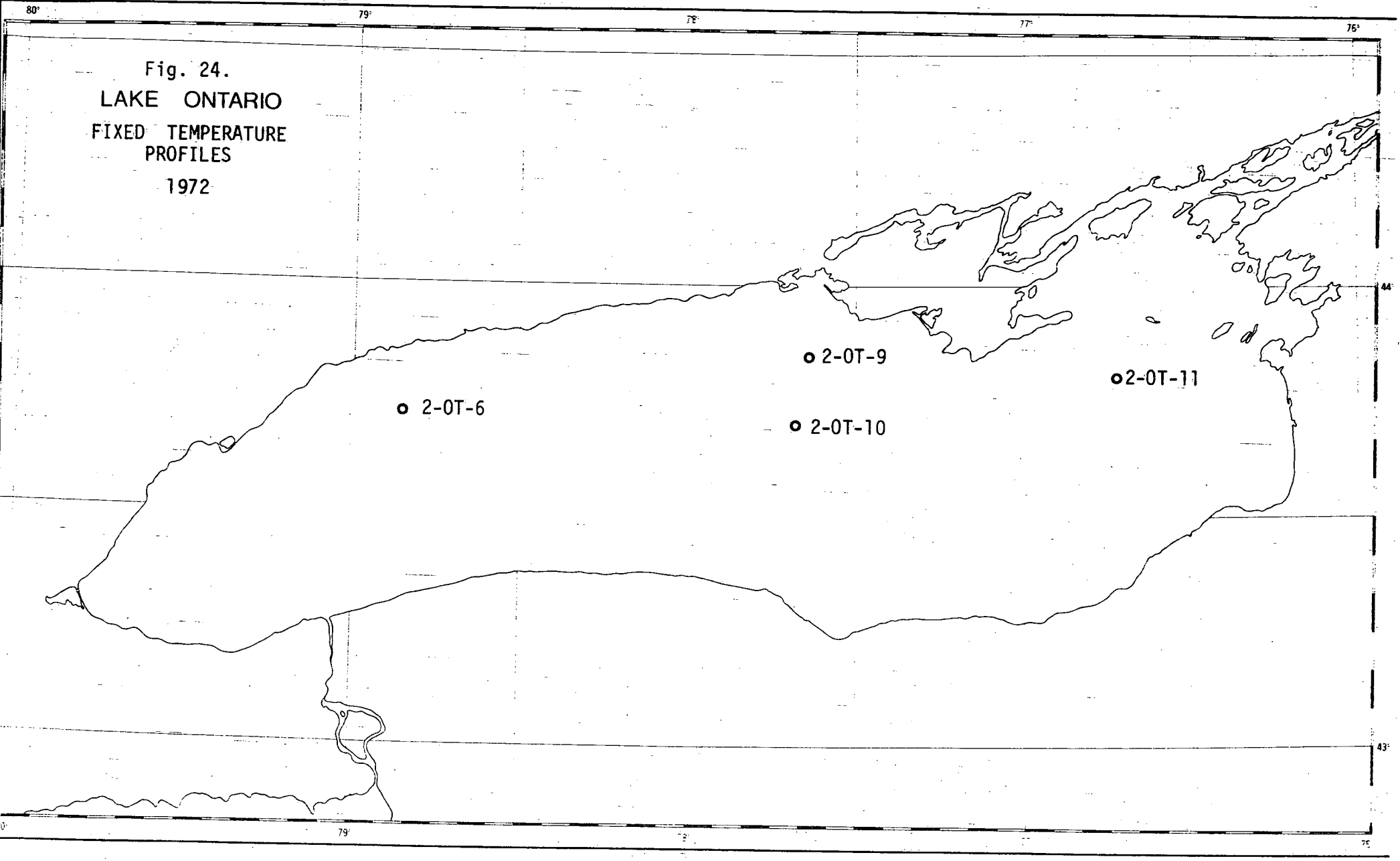


Fig. 24.

LAKE ONTARIO

FIXED TEMPERATURE PROFILES

1972

TABLE #11

THERMISTOR CHAIN MOORINGS

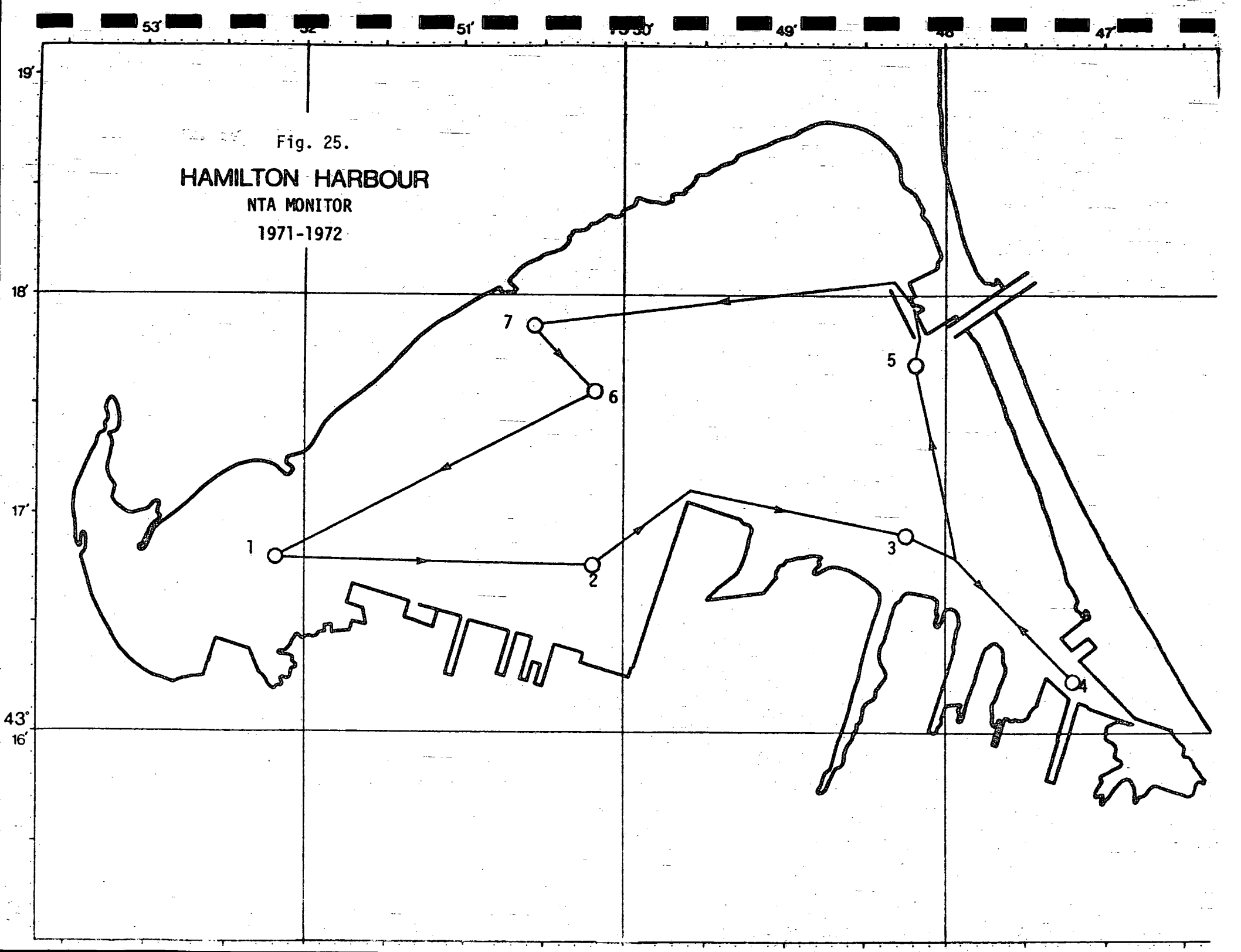
MOORING NUMBER	LATITUDE N.	LONGITUDE W.
2-0T-6A	43° 44' 00"	78° 49' 00"
2-0T-9A	43° 50' 00"	77° 41' 00"
2-0T-10A	43° 39' 30"	77° 42' 30"
2-0T-11A	43° 47' 00"	76° 49' 30"

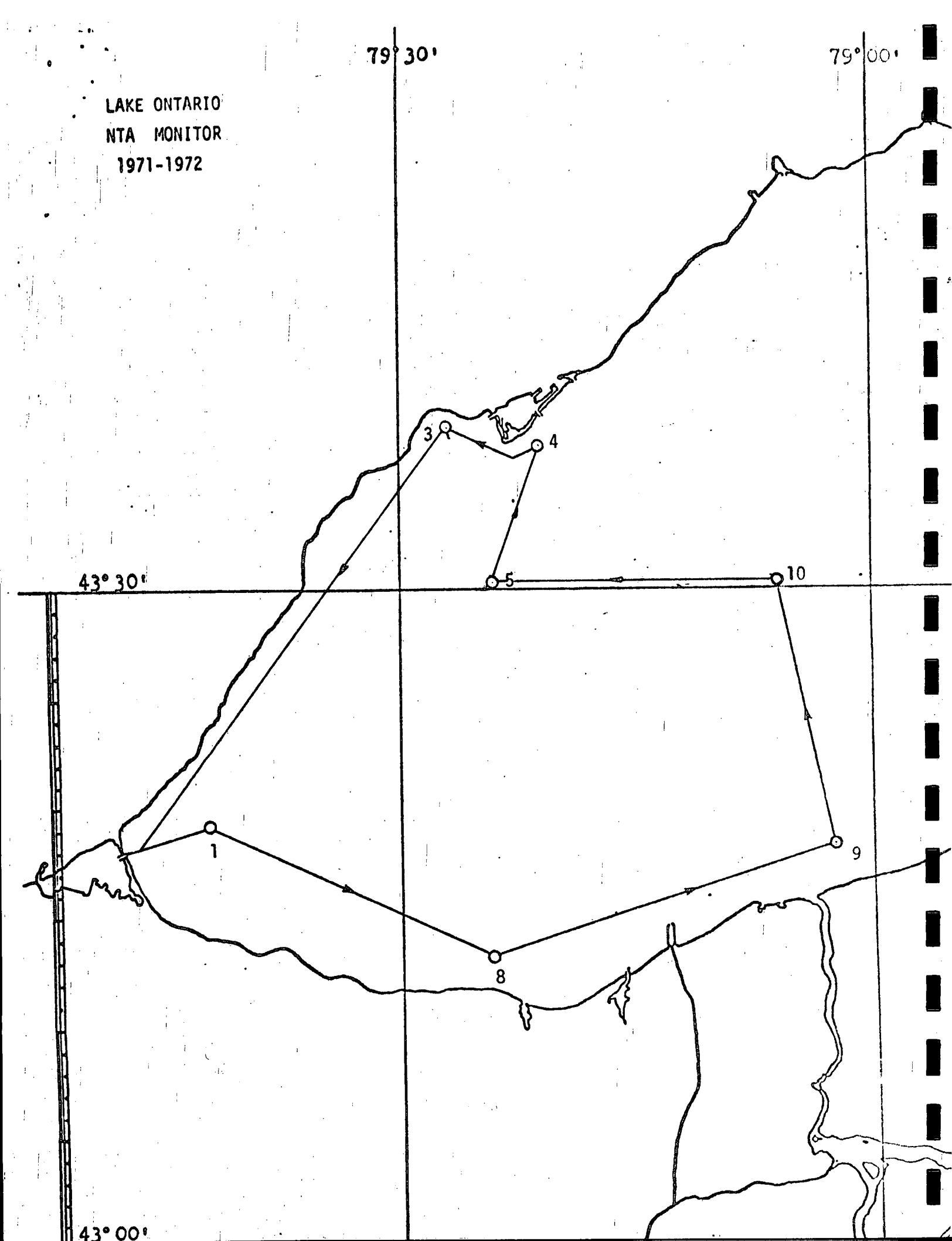
Fig. 25.

HAMILTON HARBOUR

NTA MONITOR

1971-1972




LAKE ONTARIO
NTA MONITOR
1971-1972
79° 30'
79° 00'
43° 30'
43° 00'
1
3
4
5
8
9
10

LAC ERIE
NTA MONITOR STATIONS
WESTERN LAKE ONTARIO

Station No.	GEOGRAPHIC Latitude N.	Longitude W.	DECCA Red	Green
1	43° 20' 21"	79° 38' 40"	1E 7.20	A 37.01
8	43° 13' 01"	79° 24' 01"	1D 16.60	A 41.67
9	43° 18' 12"	79° 02' 24"	1A 22.17	A 43.92
10	43° 30' 18"	79° 06' 00"	1A 2.66	A 37.61
5	43° 30' 18"	79° 24' 01"	1B 18.88	A 35.38
4	43° 36' 24"	79° 21' 01"	1A 19.40	A 33.77
3	43° 37' 13"	79° 27' 19"	1B 4.95	A 33.12

LAC ERIE
NTA MONITOR STATIONS
HAMILTON HARBOUR

Station Number	Latitude N.	Longitude W.
7	43° 17' 52"	79° 50' 35"
6	43° 17' 34"	79° 50' 10"
1	43° 16' 48"	79° 52' 12"
2	43° 16' 50"	79° 50' 12"
3	43° 16' 54"	79° 48' 15"
4	43° 16' 15"	79° 47' 12"
5	43° 17' 41"	79° 48' 11"

Fig. 26 LAKE ONTARIO

Pesticide Monitoring Program

Station	Latitude	Longitude
1	43° 34° 24°	79° 24° 00°
2	43° 25° 54°	79° 24° 00°
3	43° 17° 18°	79° 24° 00°
4	43° 17° 24°	79° 07° 24°
15	43° 57° 00°	78° 03° 00°
18	43° 39° 06°	78° 01° 12°
23	43° 17° 30°	77° 32° 54°
26	43° 17° 30°	76° 57° 18°
29	43° 34° 06°	76° 59° 42°
32	43° 48° 00°	77° 02° 24°

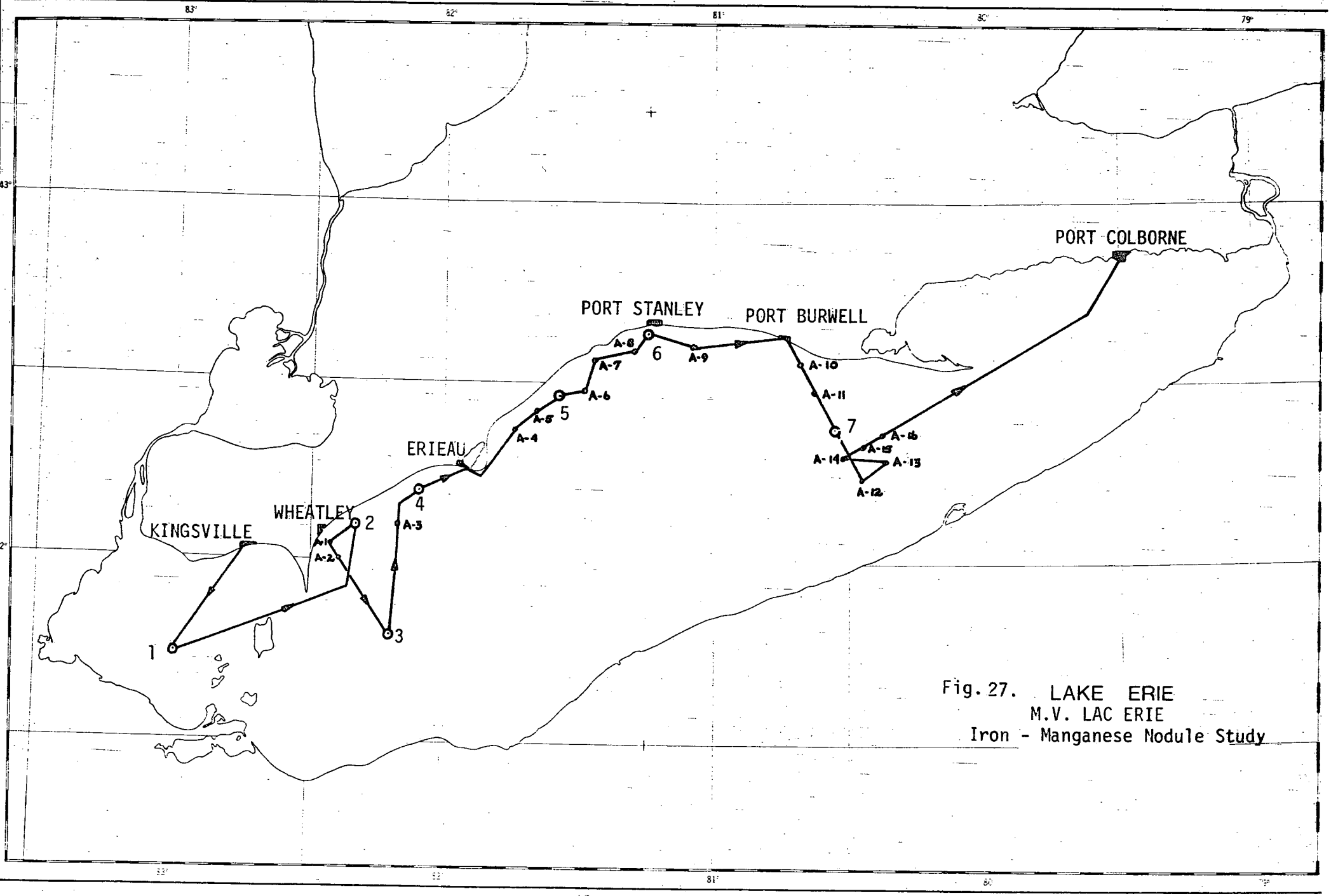


Fig. 27. LAKE ERIE
M.V. LAC ERIE
Iron - Manganese Nodule Study

STATION POSITIONS

M. V. LAC ERIE

72-01-301

Station Number	Latitude N.	Longitude W.
1	41° 45' 42"	82° 59' 00"
2	42° 05' 36"	82° 22' 12"
3	41° 49' 00"	82° 12' 00"
4 (relocated)	42° 10' 00"	82° 10' 48"
5 (relocated)	42° 26' 48"	81° 35' 00"
6	42° 38' 24"	81° 15' 00"
7	42° 22' 00"	80° 31' 00"
8 - omitted		

Auxiliary Shipek Station Number	Latitude N.	Longitude W.
A-1	42° 03' 30"	82° 25' 36"
A-2	42° 02' 00"	82° 24' 18"
A-3	42° 05' 54"	82° 12' 06"
A-4	42° 20' 54"	81° 46' 00"
A-5	42° 23' 42"	81° 41' 00"
A-6	42° 28' 00"	81° 33' 00"
A-7	42° 32' 30"	81° 30' 12"
A-8	42° 05' 30"	81° 18' 30"
A-9	42° 06' 30"	81° 08' 12"
A-10	42° 34' 36"	80° 44' 30"
A-11	42° 28' 48"	80° 39' 00"
A-12	42° 15' 00"	80° 24' 48"
A-13	42° 16' 12"	80° 23' 00"
A-14	42° 18' 00"	80° 27' 30"
A-15	42° 19' 12"	80° 25' 30"
A-16	42° 20' 24"	80° 23' 36"