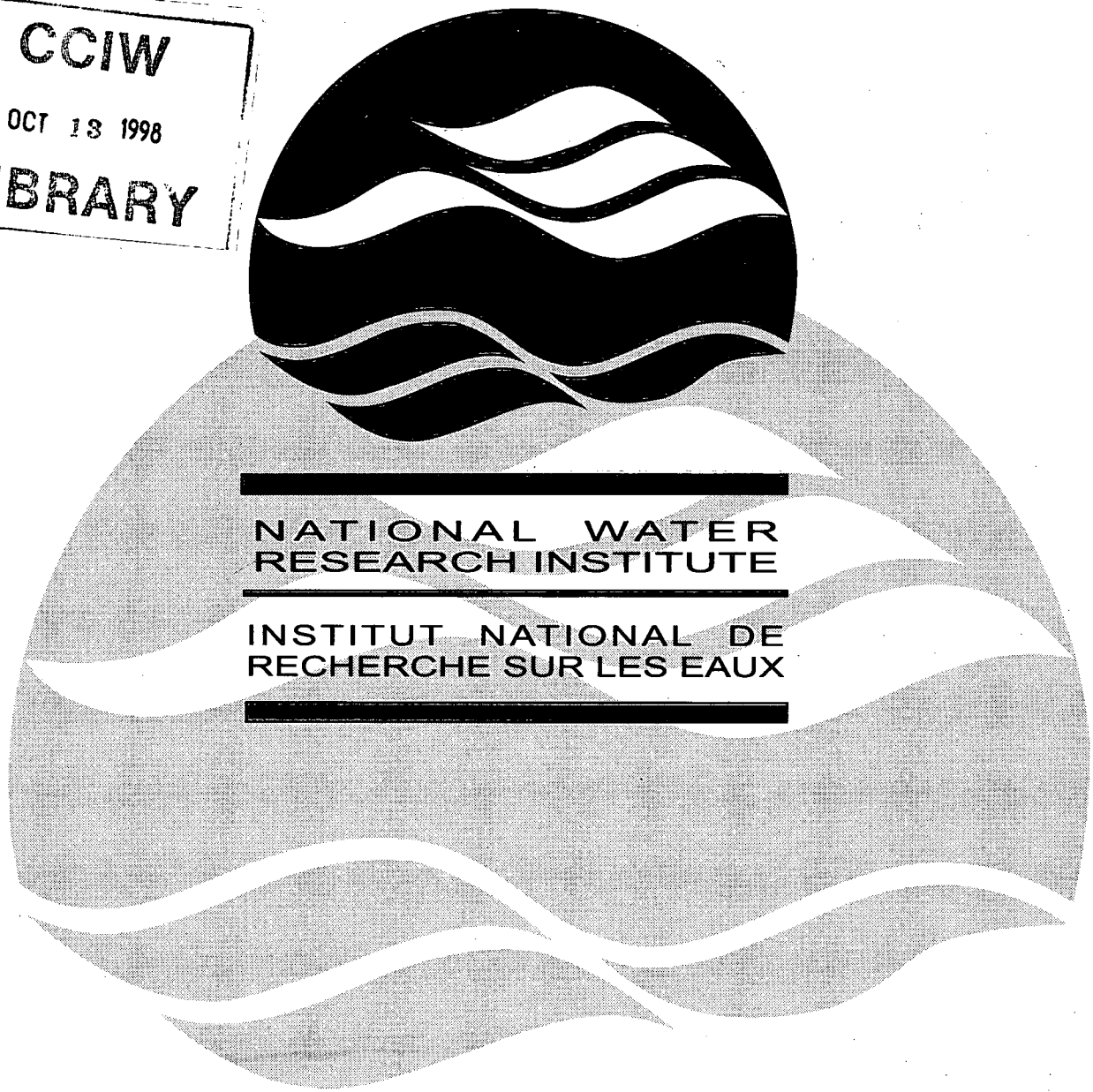
NWRI – ANNUAL REPORTS/Current Research section
1997 ANNUAL ACTIVITY SUMMARY



1997
ANNUAL ACTIVITY SUMMARY
TECHNICAL OPERATIONS SECTION
RESEARCH SUPPORT BRANCH
NATIONAL WATER RESEARCH INSTITUTE

TABLE OF CONTENTS

INTRODUCTION

The Technical Operations Section of the Research Support Branch has its headquarters at the National Water Research Institute in Burlington, Ontario. The mandate of this section is to provide logistical and technical support to the scientific community at this Institute and to various other governmental and educational groups on a national scale.

The technical staff of this section is involved in shipboard programs which are carried out from major ships on the Great Lakes and St. Lawrence River and in shore-based field projects which put them into field situations from coast to coast and into the high Arctic. As the scientific component of this Institute embraces global environmental problems and increasingly lends its resources and expertise to Third World and other countries, this section also finds itself conducting field programs in other countries and on other continents. This unusual opportunity, to work and gain valuable field-related experience in such a varied sphere of operation, develops within the section a tremendous collective wealth of technical expertise unique to this support group.

The Diving Operations Unit is ever expanding its capacity to give scientific programs the up-to-date technological support they require underwater—the most recent advances being in digital underwater video capability and the continuing refit and upgrade of the Mobile Underwater Reconnaissance Vehicle (MURV). Annual diver training and certification courses are also conducted to maintain a high level of competence among Institute divers.

The Rigging Shop personnel provide for repair and maintenance of the NWRI fleet of vehicles as well as trailers and mechanical field gear. They also handle heavy equipment transport to field sites, operate the Field Equipment Stores and when required assist as members of field parties.

Staffing actions taken this year included one retirement and one staff addition. Mr. L.E. Benner was a mainstay of this section, having joined Technical Operations at its inception in 1968. Larry's enthusiasm and energy will be missed in this section and by his many friends throughout the Centre. We wish him a very long and happy retirement. Mr. D. Gilroy was welcomed into the group this year and will add considerably to the capabilities of the section.

This report is intended as an overview of the field activities of this section during the 1997 field season.

STAFF LIST

RESEARCH SUPPORT BRANCH

Director (Acting)	P.M. Healey J.A. Bull R.A. Duffield
Secretary	S.R. Mitchell
Administrative Officer	J. McAvella
Administrative Clerk	M.T. Solvason

TECHNICAL OPERATIONS SECTION

Head, P.M. Healey	Prairies, Turkey Lakes

OPERATIONS OFFICERS

M.R. Mawhinney	Lake Superior, Cornwall, Prairies, Turkey Lakes, Quebec, Ontario Harbours
B.H. Moore	OIC CCGS LIMNOS, Vancouver
S.B. Smith	OIC CCGS LIMNOS; Malawi, Africa; Halifax, Nova Scotia; Montreal, Quebec
F.H. Don	Diving, Japan, Cornwall, Prairies, Port Dover, Tobermory

MARINE TECHNOLOGISTS

L.E. Benner	Field Stores, retired July 30, 1997
E.H. Walker	CCGS LIMNOS, Cayuga, Groundwater, Turkey Lakes
G.G. LaHaie	OIC Turkey Lakes Study Area, CCGS LIMNOS
J.A. Kraft	CCGS LIMNOS, Kapuskasing, Kingston, New Brunswick, Thunder Bay, Dryden
K.J. Hill	New Brunswick, CCGS LIMNOS, Diving, Turkey Lakes, Cayuga, Cornwall
R.J. Hess	CCGS LIMNOS, St. Clair River, Humber Bay, Lake Ontario, Cornwall, Turkey Lakes
B.L. Gray	Diving, Prairies, Cornwall, Tobermory, Strathroy

ASSISTANT MARINE TECHNOLOGISTS

R.D. Neureuther	CCGS LIMNOS, Wildlife Service, Kapuskasing, Wye Marsh
M.F. Dahl	Diving, CCGS LIMNOS, Tobermory, Cornwall, Port Dover
C.H. Talbot	Groundwater
T.G.D. Breedon	CCGS LIMNOS, Diving, Cornwall, Prairies, Tobermory, Strathroy, Port Dover
J.E. Milne	Hamilton Harbour, Turkey Lakes

MARINE TECHNICIAN

D.A.D. Gilroy	Cornwall, Toronto

RIGGING UNIT

C.J. Lomas	Senior Rigger, Cornwall
T.C. Gilliss	Vehicle Maintenance Co-ordinator, London, Ontario

NWRI FIELD STORES

L.E. Benner
C.J. Lomas

STUDENTS

H.A. Crichton	CCGS LIMNOS
M. Mathé	CCGS LIMNOS
M.A. Nelson	CCGS LIMNOS
K. Law	CCGS LIMNOS

CCGS LIMNOS

1997 JANUARY

SUN	MON	TUE	WED	THUR	FRI	SAT
			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	28	29	30	31	

FEBRUARY

SUN	MON	TUE	WED	THUR	FRI	SAT
						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	28	

MARCH 1997

SUN	MON	TUE	WED	THUR	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23 30	24 31	25	26	27	28	29

APRIL

SUN	MON	TUE	WED	THUR	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15 L. Erie	16 Reynoldson	17 Charlton	18	19
20 CCIW	21	22 Lake Ontario	23 Charlton Murthy Schertzer	24	25 CCIW	26 CCIW
27 CCIW	28 CCIW	29 L. Ont	30 Murthy			

MAY

SUN	MON	TUE	WED	THUR	FRI	SAT
				1	2	3
4 CCIW	5 Lake Erie NSERC Charlton	6	7	8	9	10 Lake Erie Reynoldson
11 Sarnia	12 Lake Sup Surveillance	13	14	15 L'Italien / Organics	16	17
18	19 Strachan	20	21 Thunder Bay Dry Dock	22	23	24
25 Lake Superior	26	27	28 L. Erie Reynoldson	29	30 Port Colborne	31 Port Colborne

JUNE

SUN	MON	TUE	WED	THUR	FRI	SAT
1 Port Colborne	2	3	4	5 L. Erie Charlton Reynoldson	6	7 CCIW
8 CCIW	9	10 Lake Ontario	11 Schertzer	12	13 CCIW	14 CCIW
15 CCIW	16	17	18	19 Lake Ontario NSERC	20	21
22	23	24	25	26 Lake Erie NSERC	27	28
29 Port Colborne	30					

JULY

SUN	MON	TUE	WED	THUR	FRI	SAT
		1 Lake Erie NSERC Charlton	2	3	4	5 Port Colborne
6 Port Colborne	7	8 Lake Erie Reynoldson	9	10	11	12 Port Colborne
13 Port Colborne	14 L. Erie	15 Reynoldson	16	17 CCIW	18 CCIW	19 CCIW
20 CCIW	21 L. Ont.	22 Charlton	23 Schertzer	24 King	25	26 CCIW
27 CCIW	28 Lake Erie NSERC Charlton	29	30	31		

AUGUST

SUN	MON	TUE	WED	THUR	FRI	SAT
					1	2 Sarnia
3 Sarnia	4 Sarnia	5 Lake Huron Reynoldson	6	7 L Sup	8 Surveillance	9
10 L Superior Surveillance L'Italien Reynoldson King	11	12	13	14	15 Lake Huron Reynoldson	16
17 Port Colborne	18 St. Clair R and Detroit R King L. Erie Charlton Reynoldson	19	20	21	22	23 Port Colborne
24 Port Colborne 31	25 Lake Erie Reynoldson	26	27	28 Lake Erie NSERC Charlton	29	30 Port Colborne

SEPTEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
	1 Port Colborne	2	3	4 Lake Erie Hecky Charlton	5	6 Port Colborne
7 Port Colborne	8	9	10	11 Lake Erie NSERC Lake Erie	12	13
14	15	16	17	18 Lake Erie NSERC Lake Erie	19 Port Colborne	20 Port Colborne
21 Port Colborne	22	23	24	25 Great Lakes Reynoldson	26	27
28	29 Great Lakes	30				

OCTOBER

SUN	MON	TUE	WED	THUR	FRI	SAT
			1 Reynoldson	2	3	4 Port Colborne
5 Port Colborne	6 Lake Erie	7	8 Reynoldson	9	10 CCIW	11 CCIW
12 CCIW	13 CCIW	14	15 Lake Ontario NSERC	16	17	18
19	20	21 Lake Ontario NSERC	22	23	24	25 CCIW
26 CCIW	27	28 Lake Ontario	29 Murthy	30 Schertzer	31	

NOVEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23 30	24	25	26	27	28	29

DECEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
	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
28	29	30	31			

NWRI | EC - OR | NSERC U of T | NSERC U of W

SHIPBOARD PROGRAMS

CCGS LIMNOS

LAKE ONTARIO

LAKE ONTARIO TROPHIC TRANSFER

UNIVERSITY OF TORONTO, DR. G. SPRULES
GLLFAS, DR. M. MUNAWAR, DR. O.E. JOHANNSSON, E.S. MILLARD
D.O. STUDY 12003, DR. J.H. CAREY

This is an ongoing multidisciplinary and international initiative to characterize the Lake Ontario ecosystem at different trophic levels including the zebra mussel invasion. This project plans to simultaneously estimate for the first time the biomass of all pelagic organisms from bacteria to fish on a lake-wide basis. The results will: a) provide important baseline information about the status of Lake Ontario; b) provide a basis of computing estimates of growth and production of all component organisms; c) permit a rigorous test of particle size theory; d) contribute directly to the management of fish stocks in Lake Ontario; e) assess the impact of the zebra mussel on the Lake Ontario ecosystem.

Two cruises were carried out onboard the CCGS LIMNOS to support this project. These were completed June 16 - 21 and October 14 - 24.

The majority of the work was carried out on stations in the Western Basin with transects 3 and 5 being sampled on the October cruise.

Parameters sampled during the cruises were: EBT/transmission profiles, SeaBird oxygen profiles, pH, conductivity, chlorophyll a, particulate organic carbon, particulate organic nitrogen, total phosphorus, total filtered phosphorus, soluble reactive phosphorus, nitrate + nitrite, chlorides, dissolved inorganic carbon, silicate, primary productivity, ^{32}P-kinetics, phytoplankton, ciliates, microbial loop (bacteria, autotrophic picoplankton), size fractionated primary productivity, quantum meter light profiles, Secchi disc, zooplankton, towed acoustics and fluorometer system, bottom and mid-water fish trawls, PONAR grab samples and mini box core samples.

The study leader for this program was Dr. G. Sprules, University of Toronto, through NSERC funding. Other agencies involved in this study were the Department of Environment, Department of Fisheries & Oceans, State University of New York, NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, Michigan and the University of Windsor.

STATISTICS SUMMARY

CRUISE NO.		**SHIP**	CCGS LIMNOS
DATE: FROM	**TO**	**REGION**	LAKE ONTARIO
CRUISE TYPE	Lake Ontario Trophic Transfer	**N.MI. STEAMED**	1182.2

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	41	Moorings Established	
EBT/Transmissometer Casts	41	Moorings Retrieved, Temperature Logger	1
Rosette Casts	5	Moorings Established, Current Meter	1
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved, Current Meter	1
Secchi Disc Observations	5	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls, 64µ	4		
Zooplankton Hauls, 500µ	6		
Integrator 10 m			
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles			
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	
Water Samples Collected (D.O.)		Cores Taken, Piston	
Water Samples Collected (Cond/pH)		Cores Taken, Benthos	
Water Samples Collected (TP uf)		Grab Samples Taken, Shipek	
Water Samples Collected (TKN)		Grab Samples Taken, PONAR	17
Water Samples Collected ( )		Bulk Centrifuge Samples	
Water Samples Collected ( )		CTD Casts	36
Water Samples Collected ( )		Acoustic and OPC Tows, Miles	212.1
Water Samples Filtered (Chlorophyll a)	8	Mid-Water Trawls, Miles	14.7
Water Samples Filtered (POC/TPN)			
Water Samples Filtered (Seston)		Observations, Weather	
Water Samples Filtered (TP f)			
Water Samples Filtered (Nutrients)	17		
Water Samples Filtered (Major Ions)	17	**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

LAKE ONTATIO TROPHIC TRANSFER

STATION POSITIONS

LAKE ONTARIO

1997-1998

STATION NUMBER	LATITUDE N.	LONGITUDE W.
6A	43° 30' 40"	79° 25' 54"
7	43° 32' 50"	79° 29' 24"
8	43° 37' 24"	79° 27' 12"
9	43° 35' 12"	79° 23' 42"
12	43° 30' 12"	79° 21' 12"
13F	43° 25' 05"	79° 20' 31"
16	43° 15' 13"	79° 21' 37"
17	43° 13' 30"	79° 16' 18"
18	43° 18' 12"	79° 16' 42"
19	43° 23' 00"	79° 17' 06"
39	43° 29' 12"	78° 00' 00"
40	43° 35' 24"	78° 00' 42"
41	43° 43' 00"	78° 01' 36"
42	43° 50' 24"	78° 02' 12"
43	43° 57' 00"	78° 03' 00"
61	43° 47' 12"	77° 09' 30"
62	43° 52' 48"	77° 00' 00"
63	43° 43' 54"	77° 01' 00"
64	43° 31' 30"	76° 55' 36"
65	43° 25' 24"	76° 53' 00"
66	43° 20' 00"	76° 50' 24"
96	43° 12' 26"	79° 26' 45"
715	43° 38' 00"	76° 58' 00"
735	43° 29' 26"	79° 11' 00"
736	43° 31' 12"	79° 03' 06"

ASTERISK SURVEY

LAKE ONTARIO

1997-1998

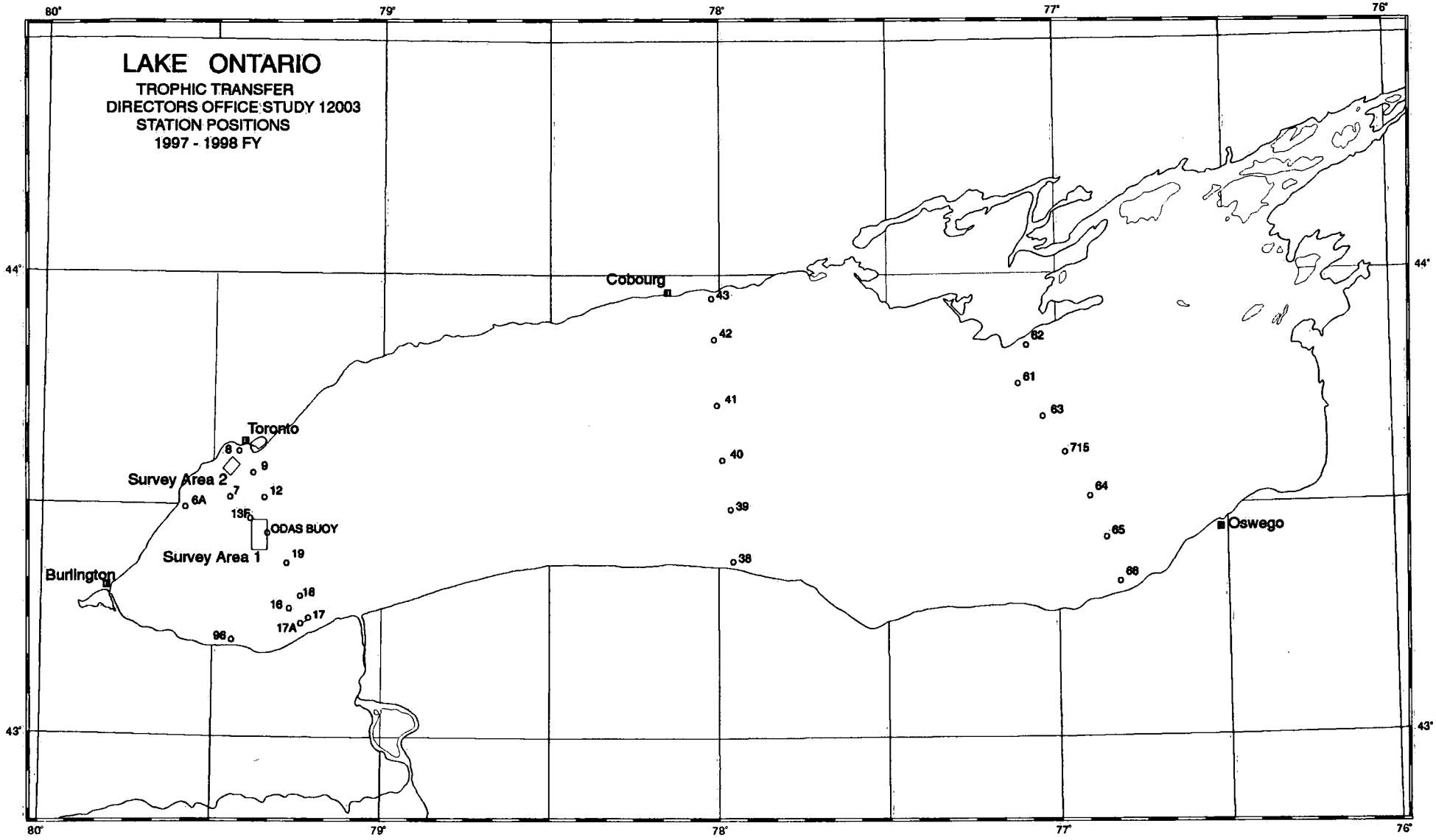
STATION NUMBER	LATITUDE N.	LONGITUDE W.
A	43° 23' 39"	79° 22' 24"
B	43° 27' 24"	79° 24' 03"
C	43° 27' 00"	79° 21' 23"
D	43° 24' 06"	79° 25' 06"
E	43° 26' 00"	79° 25' 54"
F	43° 25' 06"	79° 20' 36"

SURVEY AREAS

LAKE ONTARIO

1997-1998

STATION NUMBER	LATITUDE N.	LONGITUDE W.
1N	43° 27' 06"	79° 23' 54"
2N	43° 28' 39"	79° 24' 32"
3N	43° 30' 12"	79° 25' 31"
4N	43° 33' 08"	79° 27' 02"
5N	43° 33' 54"	79° 27' 26"
6N	43° 32' 29"	79° 26' 34"
7N	43° 31' 40"	79° 27' 59"
8N	43° 35' 56"	79° 25' 41"
9N	43° 25' 49"	79° 22' 36"
1S	43° 24' 01"	79° 22' 38"
2S	43° 22' 28"	79° 21' 52"
3S	43° 20' 52"	79° 21' 13"


LAKE ONTARIO
TROPHIC TRANSFER
DIRECTORS OFFICE STUDY 12003
STATION POSITIONS
1997 - 1998 FY
80°
79°
78°
77°
76°
44°
43°
Cobourg
Toronto
Burlington
Oswego
Survey Area 2
Survey Area 1
ODAS BUOY
43
42
82
61
41
63
715
40
64
39
65
38
66
8
9
7
12
6A
13F
19
18
16
17
17A
96

METEOROLOGICAL AND TEMPERATURE MOORINGS
AECB STUDY 12374, W.M. SCHERTZER

The purpose of this study was to deploy meteorological and temperature moorings to give detailed vertical temperature measurements at the deep hole of Lake Ontario. To accomplish this, two meteorological buoys were installed at station 586 during the cruise April 21 - 25 and retrieved on October 30. The two temperature moorings had been winter moorings installed in October of 1996, refurbished as U-shaped moorings in April of 1997 and then reinstalled as winter moorings in October to be retrieved in the spring of 1998. Mysis net hauls were done at 10 stations in the deep hole on the October cruise.

One additional task was performed during this study which included the installation and refurbishment of a sediment trap mooring at station 403 for M.N. Charlton, AERB study 12240.

MOORING POSITIONS

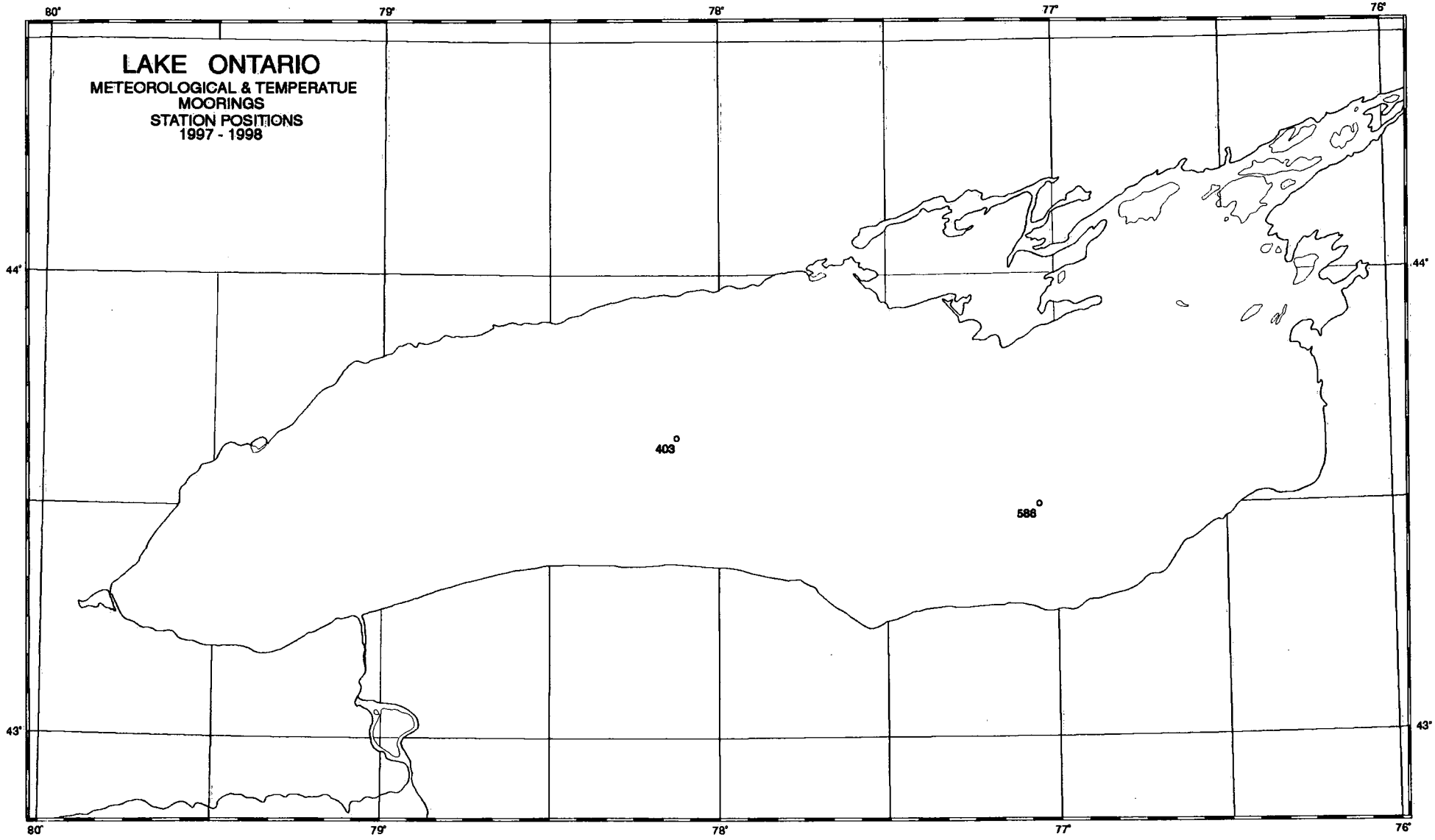
1997 - 1998

STATION NO.	MOORING NUMBER	LATITUDE N.	LONGITUDE W.	INST/DEPTH
586	97-00M-33A	43° 29' 32"	77° 03' 21"	MET T (2 m)
	97-00M-34A	43° 29' 27"	77° 03' 21"	MET
	97-00T-35A	43° 29' 24"	77° 03' 21"	T (4,6,8,10 m)
	97-00T-35B	43° 29' 01"	77° 03' 10"	T (12,21,31, 41,51,81,141, 223 m)
	97-00T-36A	43° 29' 29"	77° 03' 25"	T (12,16,20, 24,30,40,100, 221 m)
	97-00T-36B	43° 29' 07"	77° 03' 04"	T (10,16,26, 36,46,61,101, 181 m)
	97-00T-37A	43° 28' 56"	77° 02' 57"	ADCP(50m)
403	97-00A-65A	43° 35' 56"	78° 14' 07"	ST(20,60.100, 140,166,174m)

STATISTICS SUMMARY

CRUISE NO.		**SHIP**	CCGS LIMNOS
DATE: FROM	**TO**	**REGION**	LAKE ONTARIO
CRUISE TYPE	Moorings	**N.MI. STEAMED**	885.25

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	48	Moorings Established, Meteorological	4
EBT/Transmissometer Casts	14	Moorings Retrieved, ADCP	1
Rosette Casts	3	Moorings Established, Cesium Dispenser	1
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved, Current Meter	7
Secchi Disc Observations	4	Moorings Established, Current Meter	7
Transmissometer Casts		Moorings Retrieved, Thermograph	6
Zooplankton Hauls, 500µ	37	Moorings Established, Thermograph	5
Zooplankton Hauls, 64µ	4	Moorings Established, Current Meter Therm.	2
Integrator 10 m		Moorings Established, Sediment Trap	2
Integrator 20 m	2	Moorings Retrieved, Meteorological	4
Phytoplankton Samples	2		
D.O. Profiles		Primary Productivity Moorings	
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	10
Water Samples Collected (D.O.)	1	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	2	Cores Taken, Benthos	
Water Samples Collected (TP uf)	8	Grab Samples Taken, Shipek	
Water Samples Collected (TKN)	8	Grab Samples Taken, PONAR	
Water Samples Collected (Alkalinity)	8	Bulk Centrifuge Samples	
Water Samples Collected (Halo Acetic Acid)	1		
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)	15		
Water Samples Filtered (POC/TPN)	2		
Water Samples Filtered (Seston)	12		
Water Samples Filtered (TP f)	2		
Water Samples Filtered (Nutrients)	2		
Water Samples Filtered (Major Ions)	2	**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	4
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	


LAKE ONTARIO
METEOROLOGICAL & TEMPERATUE
MOORINGS
STATION POSITIONS
1997 - 1998
80°
79°
78°
77°
76°
44°
43°
403
586

LAKE ONTARIO MOORINGS AND TRITIUM SAMPLING
ATOMIC ENERGY COMMISSION LIMITED, K. KING
RSB STUDY 12631, S.B.SMITH

One cruise was carried out on Lake Ontario to update background tritium. Sampling in the other Great Lakes was piggbacked on scheduled NWRI cruises.

There is a need to update the tritium concentrations in lake water in order to calculate public doses due to ingestion of water drawn from local water supply plants. The current reference number was published in the 1983 International Joint Commission (IJC) Annual Report.

At all stations, water samples were collected from the 5-metre depth for tritium concentrations. Samples were processed onboard by personnel from AECL. In addition, at stations 33 and 44, tritium samples were collected at surf, 5, 15, 30, 60, 100 and bottom -2 metres. At the request of the study leader, benthos cores were also collected at stations 9, 21, 30, 32, 33, 40, 79, 80, 85A, and 403.

Some of the additional tasks performed during the cruise included the collection of a mysid net haul for Dr. O. Johannsson, GLLFAS; monitoring meteorological buoys for W Schertzer, AECB and the refurbishment of a sediment trap mooring for M. Charlton, AERB.

STATISTICS SUMMARY

CRUISE NO.	97 - 00 - 004	**SHIP**	CCGS LIMNOS
DATE: FROM	July 21 **TO** July 24, 1997	**REGION**	LAKE ONTARIO
CRUISE TYPE	Moorings and Tritium Sampling	**N.MI. STEAMED**	411.8

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	22	Moorings Established, Sediment Trap	1
EBT/Transmissometer Casts	22	Moorings Retrieved, Sediment Trap	1
Rosette Casts	7	Moorings Established	
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved	
Secchi Disc Observations	9	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls, 110µ	11		
Integrator 10 m	1		
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples	11	Mysid Net Hauls	4
D.O. Profiles			
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	
Water Samples Collected (D.O.)	3	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	52	Cores Taken, Benthos	13
Water Samples Collected (TP uf)		Grab Samples Taken, Shipek	
Water Samples Collected (TKN)		Grab Samples Taken, PONAR	
Water Samples Collected ( )		Bulk Centrifuge Samples, 600 litres	4
Water Samples Collected ( )			
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)	6		
Water Samples Filtered (POC/TPN)			
Water Samples Filtered (Seston)			
Water Samples Filtered (TP f)			
Water Samples Filtered (Nutrients)			
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

STATION POSITIONS

LAKE ONTARIO

1997-1998

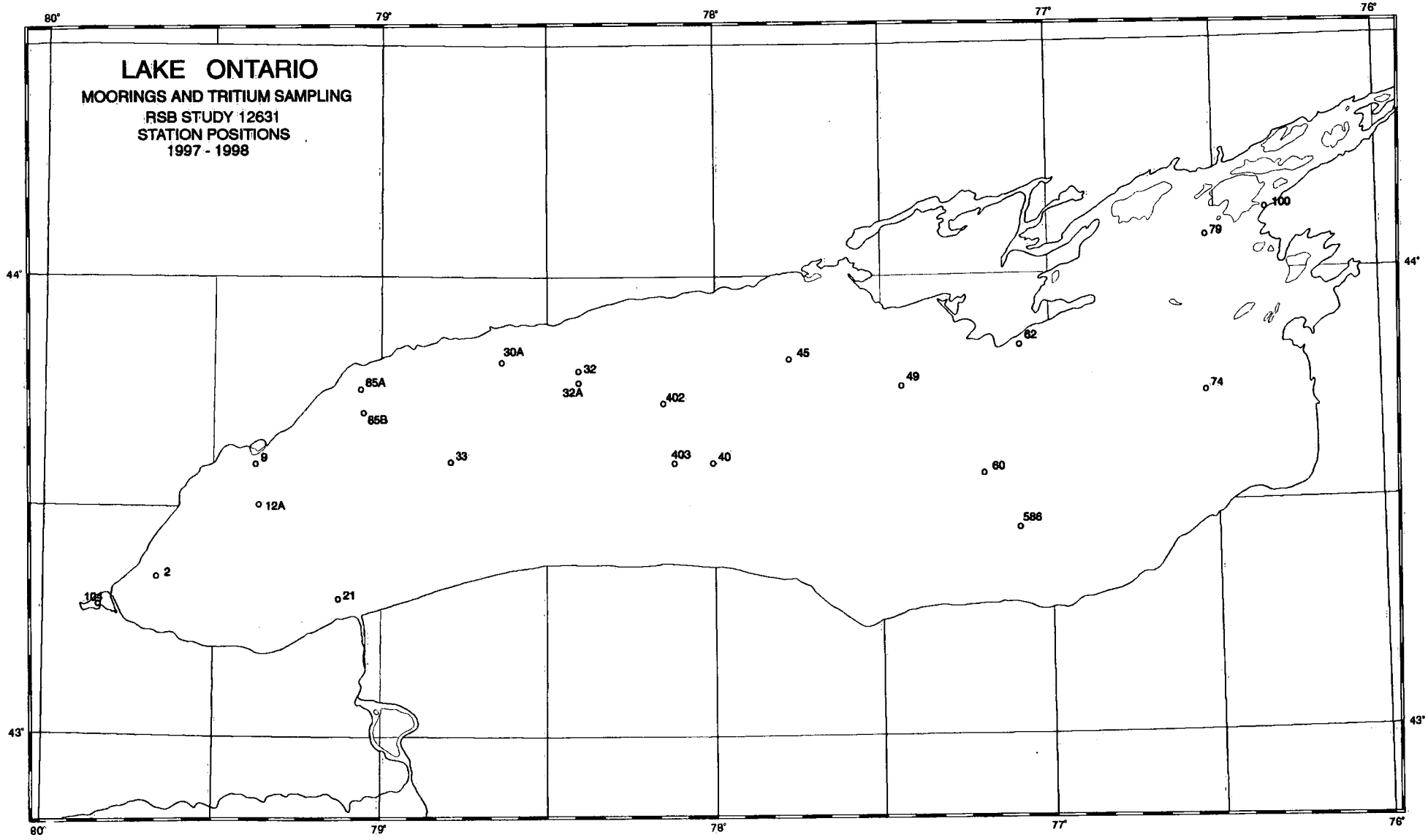
STATION NUMBER	LATITUDE N.	LONGITUDE W.
2	43° 20' 24"	79° 39' 55"
9	43° 35' 17"	79° 23' 41"
12A	43° 28' 38"	79° 21' 22"
21	43° 18' 08"	79° 07' 05"
30A	43° 45' 58"	78° 38' 31"
32	43° 47' 00"	78° 26' 18"
32A	43° 43' 29"	78° 25' 33"
33	43° 35' 52"	78° 48' 03"
40	43° 35' 23"	78° 00' 32"
45	43° 49' 20"	77° 47' 07"
49	43° 46' 16"	77° 26' 21"
60	43° 34' 48"	77° 12' 01"
62	43° 52' 49"	76° 59' 58"
74	43° 45' 02"	76° 31' 05"
79	44° 04' 30"	76° 31' 18"
85A	43° 43' 29"	79° 01' 03"
85B	43° 38' 29"	79° 03' 27"
100	44° 08' 13"	76° 19' 48"
104	43° 17' 20"	79° 49' 50"
402	43° 39' 02"	78° 15' 26"
403	43° 36' 14"	78° 13' 40"
586	43° 29' 10"	77° 03' 06"

MOORING POSITIONS

LAKE ONTARIO

1997-1998

STATION NO.	MOORING NUMBER	LATITUDE N.	LONGITUDE W.	INST/DEPTH
403	97-00A-65B	43° 35' 56"	78° 14' 07"	ST(20,60,100 140,166,174)
403	97-00A-65C	43° 35' 04"	78° 13' 42"	ST(20,60,100 140,165,173)
586	97-00M-33A	43° 29' 10"	77° 03' 06"	MET T (2 m)
	97-00M-34A	43° 29' 02"	77° 03' 07"	MET


LAKE ONTARIO
MOORINGS AND TRITIUM SAMPLING
RSB STUDY 12631
STATION POSITIONS
1997 - 1998
80°
79°
78°
77°
76°
44°
43°
100
79
62
45
30A
32
32A
65A
65B
402
49
74
9
33
403
40
60
12A
586
2
21

LAKE ERIE

LAKE ERIE TROPHIC TRANSFER

UNIVERSITY OF TORONTO, DR. G. SPRULES
GLLFAS, DR. M. MUNAWAR, DR. O.E. JOHANNSSON, E.S. MILLARD
D.O. STUDY 12003, DR. J.H. CAREY

This is an ongoing multidisciplinary and international initiative to characterize the Lake Erie ecosystem at different trophic levels, including the zebra mussel invasion. This project plans to simultaneously estimate for the first time the biomass of all pelagic organisms from bacteria to fish on a lake-wide basis. The results will: a) provide important baseline information about the status of Lake Erie; b) provide a basis of computing estimates of growth and production of all component organisms; c) permit a rigorous test of particle size theory; d) contribute directly to the management of fish stocks in Lake Erie; e) assess the impact of the zebra mussel on the Lake Erie ecosystem.

Two cruises were carried out onboard the CCGS LIMNOS to support this project. These were completed June 21 - 27 and September 8 - 18.

The majority of the work was carried out on stations in the Eastern Basin with one transect sampled in the Central Basin on the September cruise.

Parameters sampled during the cruises were: EBT/transmission profiles, SeaBird oxygen profiles, pH, conductivity, chlorophyll a, particulate organic carbon, particulate organic nitrogen, total phosphorus, total filtered phosphorus, soluble reactive phosphorus, nitrate + nitrite, chlorides, dissolved inorganic carbon, silicate, primary productivity, ^{32}P-kinetics, phytoplankton, ciliates, microbial loop (bacteria, autotrophic picoplankton), size fractionated primary productivity, quantum meter light profiles, Secchi disc, zooplankton, towed acoustics and fluorometer system, bottom and mid-water fish trawls, PONAR grab samples and mini box core samples.

The study leader for this program was Dr. G. Sprules, University of Toronto, through NSERC funding. Other agencies involved in this study were Department of Environment, Department of Fisheries & Oceans, State University of New York, NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, Michigan and the University of Windsor.

STATISTICS SUMMARY

CRUISE NO. _____ **SHIP** CCGS LIMNOS

DATE: FROM _____ **TO** _____ **REGION** LAKE ERIE

CRUISE TYPE Lake Erie Trophic Transfer **N.MI. STEAMED** 1182.2

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	52	Moorings Established	
EBT/Transmissometer Casts	52	Moorings Retrieved	
Rosette Casts	8	Moorings Established	
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved	
Secchi Disc Observations	27	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls, 64µ	101		
Zooplankton Hauls, 500µ	4		
Integrator 10 m	4		
Integrator 20 m	15	Primary Productivity Moorings	
Phytoplankton Samples	11	Van Dorn Bottle Casts	2
D.O. Profiles			
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	
Water Samples Collected (D.O.)		Cores Taken, Piston	
Water Samples Collected (Cond/pH)	33	Cores Taken, Benthos	
Water Samples Collected (TP uf)	12	Grab Samples Taken, Shipek	
Water Samples Collected (TKN)		Grab Samples Taken, PONAR	18
Water Samples Collected ( )		Bulk Centrifuge Samples	
Water Samples Collected ( )			
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)	320		
Water Samples Filtered (POC/TPN)	299	Acoustic and OPC Tows, Miles	256.1
Water Samples Filtered (Seston)		Mid-Water Trawls, Miles	77.3
Water Samples Filtered (TP f)	12		
Water Samples Filtered (Nutrients)	17		
Water Samples Filtered (Major Ions)	17	**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	34
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

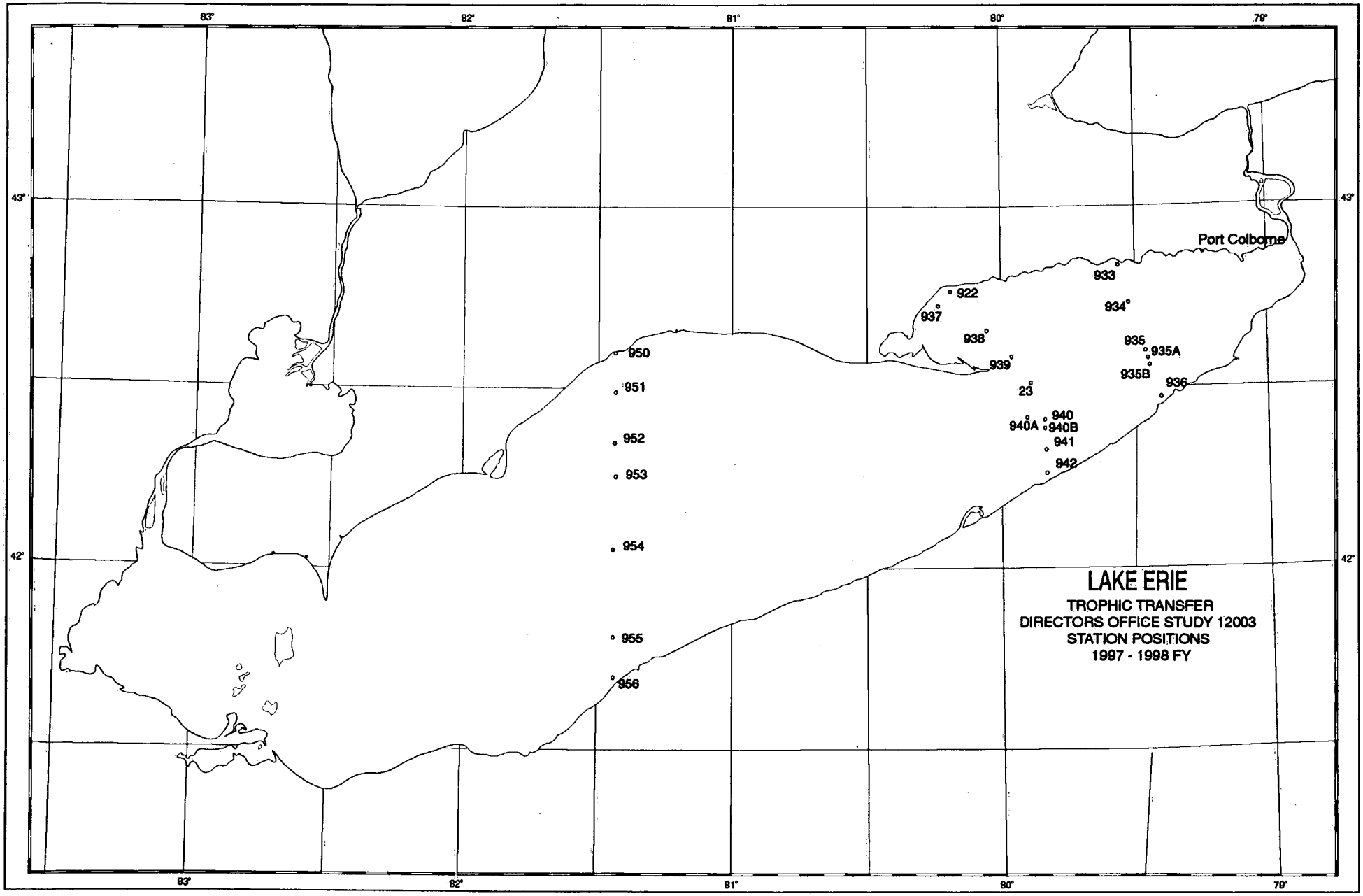
LAKE ERIE TROPHIC TRANSFER

STATION POSITIONS

LAKE ERIE

1997-1998

STATION NUMBER	LATITUDE N.	LONGITUDE W.
23	42° 30' 32"	79° 53' 24"
922	42° 46' 30"	80° 08' 47"
933	42° 49' 12"	79° 34' 36"
934	42° 42' 30"	79° 30' 32"
935	42° 35' 27"	79° 28' 04"
935A	42° 34' 29"	79° 27' 35"
935B	42° 32' 34"	79° 26' 33"
936	42° 28' 30"	79° 24' 28"
937	42° 43' 02"	80° 15' 03"
938	42° 38' 02"	80° 03' 31"
939	42° 34' 03"	79° 54' 54"
940	42° 26' 32"	79° 50' 00"
940A	42° 26' 56"	79° 54' 04"
940B	42° 29' 19"	79° 49' 19"
941	42° 19' 28"	79° 49' 58"
942	42° 15' 35"	79° 50' 06"
950	42° 35' 19"	81° 26' 20"
951	42° 28' 32"	81° 26' 30"
952	42° 21' 26"	81° 26' 34"
953	42° 12' 30"	81° 27' 22"
954	42° 01' 32"	81° 26' 30"
955	41° 48' 00"	81° 26' 30"
956	41° 41' 32"	81° 26' 30"


83°
82°
81°
80°
79°
43°
42°
Port Colborne
933
922
934
937
938
935
935A
939
935B
936
23
940
940A
940B
941
942
950
951
952
953
954
955
956
LAKE ERIE
TROPHIC TRANSFER
DIRECTORS OFFICE STUDY 12003
STATION POSITIONS
1997 - 1998 FY

BENTHIC COMMUNITY STRUCTURE
AERB STUDY 12217, DR. T. B. REYNOLDSON

Seven cruises were carried out onboard the CCGS LIMNOS April 14 - 19, May 05 - 10, May 27 - 29, July 07 - 11, August 18 - 21, September 22 - 24 and October 6 - 9. Cruises in April, August and October were piggybacked on Zebra Mussel Effect cruises. This year station 358 was dropped in the Western Basin, leaving stations 23, 84 and 357 as the primary stations.

At each station, a mini box core was collected and five 10 cm cores were subsampled. These cores were extruded into plastic bags and stored at 4°C until returned to CCIW for analysis. A water sample was collected from a depth of bottom -1 m for dissolved oxygen and pH measurements.

At stations 23, 84 and 357, a DO logger mooring was installed. These three moorings were retrieved and reinstalled several times during the field year to clean zebra mussels from the oxygen membrane.

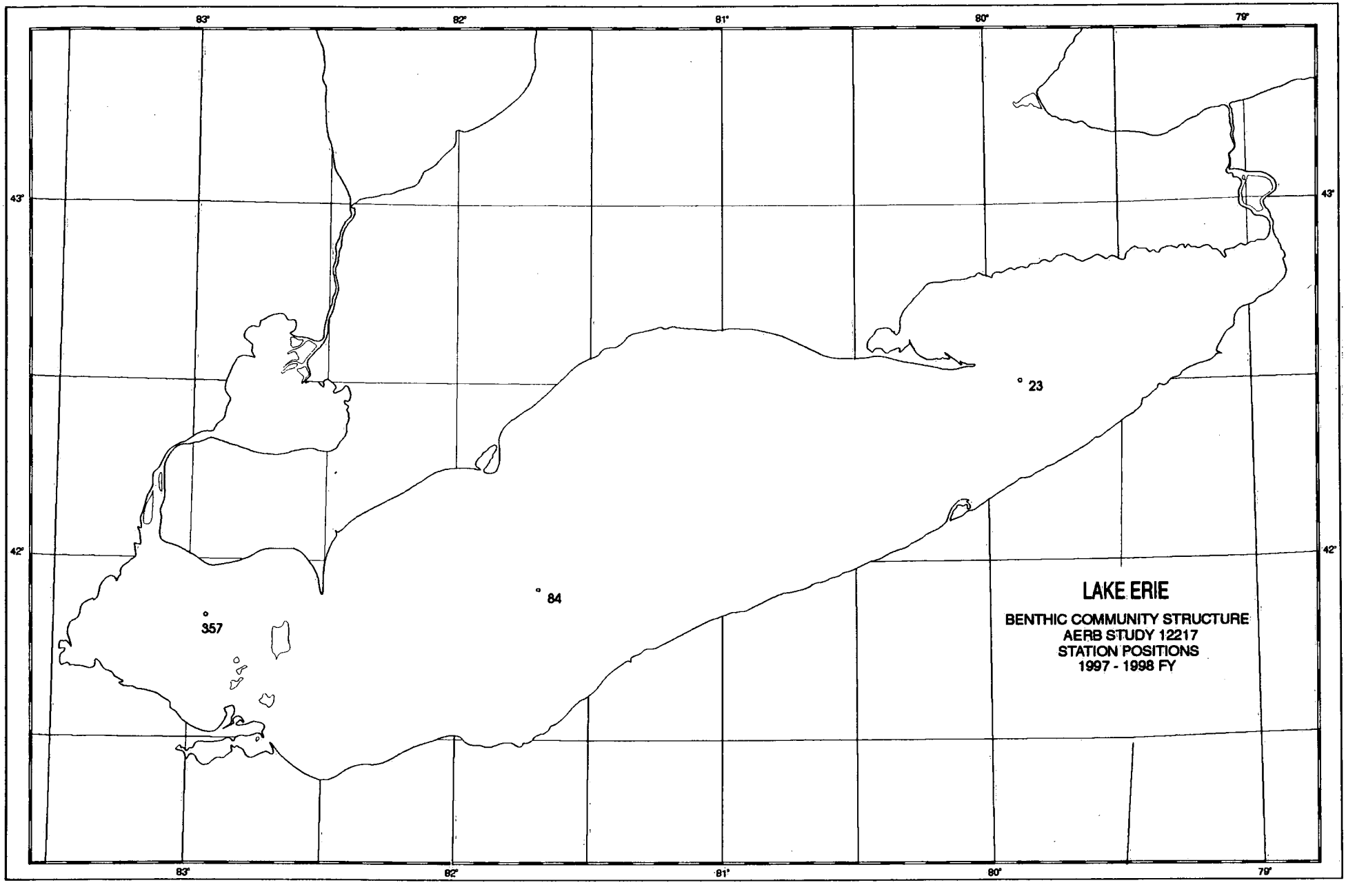
Phytoplankton samples at stations 23, 84 and 357 were collected for Dr. M.A. Zarull, AERB whenever samples were collected for Dr. Reynoldson. Sediment trap moorings were installed for M. Charlton, AERB in support of his Zebra Mussel Effect cruises. These were refurbished once a month on cruises when time was available.

STATION POSITIONS

LAKE ERIE

1997-1998

STATION NUMBER	LATITUDE N.	LONGITUDE W.
23	42° 30' 18"	79° 53' 45"
84	41° 56' 02"	81° 39' 22"
357	41° 49' 35"	82° 58' 11"


83°
82°
81°
80°
79°
43°
42°
23
84
357
LAKE ERIE
BENTHIC COMMUNITY STRUCTURE
AERB STUDY 12217
STATION POSITIONS
1997 - 1998 FY

MOORING POSITIONS

LAKE ERIE

1997-1998

STATION NO.	MOORING NUMBER	LATITUDE N.	LONGITUDE W.	INST/DEPTH
23	97-01S-01A	42° 29' 56"	79° 52' 54"	DO(BTM -1 m)
	97-01A-02A	42° 30' 09"	79° 53' 21"	ST (30, 40, 50, 60 m)
84	97-01S-03A	41° 56' 04"	81° 39' 26"	DO(BTM -1 m)
	97-01A-04A	41° 56' 13"	81° 39' 04"	ST (18, 21 m)
357	97-01S-05A	41° 49' 39"	82° 58' 15"	DO(BTM -1 m)
	97-01S-06A	41° 49' 46"	82° 58' 20"	ST(BTM -1 m)

SEDIMENT SURVEY
AERB STUDY 12217, DR. T.B. REYNOLDSON

One cruise was carried out on Lake Erie to support this program—July 7 - 16. The cruise was to define the present status of the surficial sediment contaminants (most of Tier I and II) and to determine temporal changes that may have occurred since the 1971 sediment survey.

Station sampling for this program was completed in the following manner:

At all stations, where a Shipek sample was collected, a mini box core was collected and subsampled in the following manner:

The box core was subsampled using six 6 cm diameter tubes from which the top 3 cm were collected. Two 3 cm sections were combined to form three samples as follows:

a) Organic contaminants (OC) were collected in prewashed 250 ml glass jars
b) Metals (M) were collected in 250 ml plastic beakers with lids
c) Grain size and nutrients (GSN) were collected in 250 ml plastic beakers with lids

At master stations, the following tasks were performed:

a) Three mini box cores were collected and subsampled, resulting in triplicate samples for OC, M and GSN.

b) From another mini box core, three 7 cm diameter tubes were used to obtain 30 to 40 cm cores for OC, M and GSN profiles. These cores were extruded onboard in 1 cm sections—every 1 cm from 0 to 16 cm, every 2 cm from 16 cm to the bottom of the core.

The Atlas Deso 10 echo sounder in the laboratory was run continuously on the track plot during the cruise. Sounding records were marked with a fix number and time. Fixes were obtained using DGPS on a 10-minute basis and stored on a laptop computer. The Roxann system was run simultaneously with the echo sounder on July 7 and 8.

Additional tasks performed during the cruise included the refurbishment of sediment trap moorings and cleaning DO logger moorings.

STATISTICS SUMMARY

CRUISE NO.		**SHIP**	CCGS LIMNOS
DATE: FROM	**TO**	**REGION**	LAKE ERIE
CRUISE TYPE	Sediment Survey	**N.MI. STEAMED**	934.7

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	84	Moorings Established	
EBT/Transmissometer Casts	84	Moorings Retrieved, Sediment Trap	1
Rosette Casts	23	Moorings Established, Sediment Trap	1
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved, Hydrolab	1
Secchi Disc Observations	50	Moorings Established, Hydrolab	1
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls			
Integrator 10 m			
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles	83		
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	116
Water Samples Collected (D.O.)	24	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	26	Cores Taken, Benthos	9
Water Samples Collected (TP uf)	22	Grab Samples Taken, Shipek	32
Water Samples Collected (TKN)		Grab Samples Taken, PONAR	
Water Samples Collected (Alkalinity)	22	Bulk Centrifuge Samples	
Water Samples Collected (Nutrients)	22		
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)		Sediment Samples Collected (Organic Cont.)	214
Water Samples Filtered (POC/TPN)		Sediment Samples Collected (Metals)	214
Water Samples Filtered (Seston)		Sediment Samples Collected (Grain Size)	214
Water Samples Filtered (TP f)		Sediment Samples Collected (Metal Bio.)	24
Water Samples Filtered (Nutrients)		Sediment Samples Collected (Com. Struct.)	27
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	76
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

STATION POSITIONS

LAKE ERIE

1997-1998

STATION NUMBER	GRID NUMBER	LATITUDE N.	LONGITUDE W.
23		42° 29' 58"	79° 52' 42"
84		41° 56' 13"	81° 39' 00"
357		41° 49' 37"	82° 58' 09"
947	G-24	41° 59' 21"	80° 38' 29"
973	U-39	41° 47' 49"	83° 19' 04"
1033	N-36	42° 37' 09"	79° 10' 12"
1034	O-35	42° 42' 34"	79° 16' 40"
1035	N-34	42° 37' 17"	79° 24' 50"
1036	M-33	42° 31' 59"	79° 32' 22"
1037	O-33	42° 42' 41"	79° 32' 06"
1039	K-31	42° 21' 23"	79° 47' 12"
1040	M-31	42° 32' 00"	79° 47' 00"
1041	O-31	42° 43' 03"	79° 46' 46"
1042	M-30	42° 32' 16"	79° 54' 27"
1043	L-30	42° 26' 52"	79° 54' 20"
1044	K-29	42° 21' 29"	80° 01' 38"
1045	L-28	42° 26' 50"	80° 08' 54"
1046	J-28	42° 16' 15"	80° 08' 58"
1047	K-27	42° 21' 32"	80° 16' 28"
1048	I-26	42° 10' 52"	80° 23' 36"
1049	H-26	42° 05' 30"	80° 23' 22"
1050	H-25	42° 05' 31"	80° 31' 01"
1051	J-24	42° 16' 21"	80° 38' 12"
1052	G-22	42° 00' 08"	80° 52' 41"
1053	I-22	42° 10' 51"	80° 52' 36"
1054	L-22	42° 27' 01"	80° 52' 38"
1055	F-21	41° 54' 39"	80° 59' 51"
1056	G-20	42° 00' 05"	81° 07' 09"
1057	K-20	42° 21' 42"	81° 07' 20"
1058	F-19	41° 54' 45"	81° 14' 23"

STATION NUMBER	GRID NUMBER	LATITUDE N.	LONGITUDE W.
1059	I-19	42° 10' 51"	81° 14' 34"
1060	E-18	41° 49' 20"	81° 21' 36"
1061	K-18	42° 21' 41"	81° 21' 50"
1062	F-17	41° 54' 38"	81° 29' 00"
1063	H-17	42° 05' 27"	81° 29' 08"
1064	C-16	41° 38' 24"	81° 36' 15"
1065	E-16	41° 49' 11"	81° 36' 00"
1066	C-15	41° 38' 24"	81° 43' 20"
1067	I-15	42° 10' 49"	81° 43' 28"
1068	B-14	41° 32' 34"	81° 50' 20"
1069	F-14	41° 54' 25"	81° 50' 39"
1070	D-13	41° 43' 42"	81° 57' 36"
1071	C-12	41° 38' 17"	82° 05' 05"
1072	E-12	41° 48' 59"	82° 05' 00"
1073	B-11	41° 32' 36"	82° 11' 57"
1074	G-11	41° 59' 22"	82° 12' 23"
1075	D-10	41° 43' 17"	82° 19' 26"
1076	E-10	41° 48' 41"	82° 19' 29"
1077	A-9	41° 27' 05"	82° 26' 14"
1078	B-9	41° 32' 36"	82° 26' 15"
1079	C-8	41° 37' 52"	82° 33' 46"
1080	B-7	41° 32' 23"	82° 40' 43"
1081	G-7	41° 59' 23"	82° 41' 25"
1082	V-44	41° 51' 11"	82° 44' 50"
1083	W-43	41° 56' 17"	82° 52' 14"
1084	C-5	41° 37' 26"	82° 55' 04"
1085	E-5	41° 48' 22"	82° 55' 29"
1086	D-4	41° 42' 44"	83° 02' 29"
1087	W-41	41° 56' 21"	83° 06' 45"
1088	E-3	41° 48' 04"	83° 10' 04"
1089	F-2	41° 53' 47"	83° 16' 42"
1090	A-8	41° 27' 07"	82° 33' 30"
1091	B-5	41° 32' 05"	82° 54' 57"
1092	B-15	41° 32' 36"	81° 43' 14"
1093	C-17	41° 38' 50"	81° 29' 00"

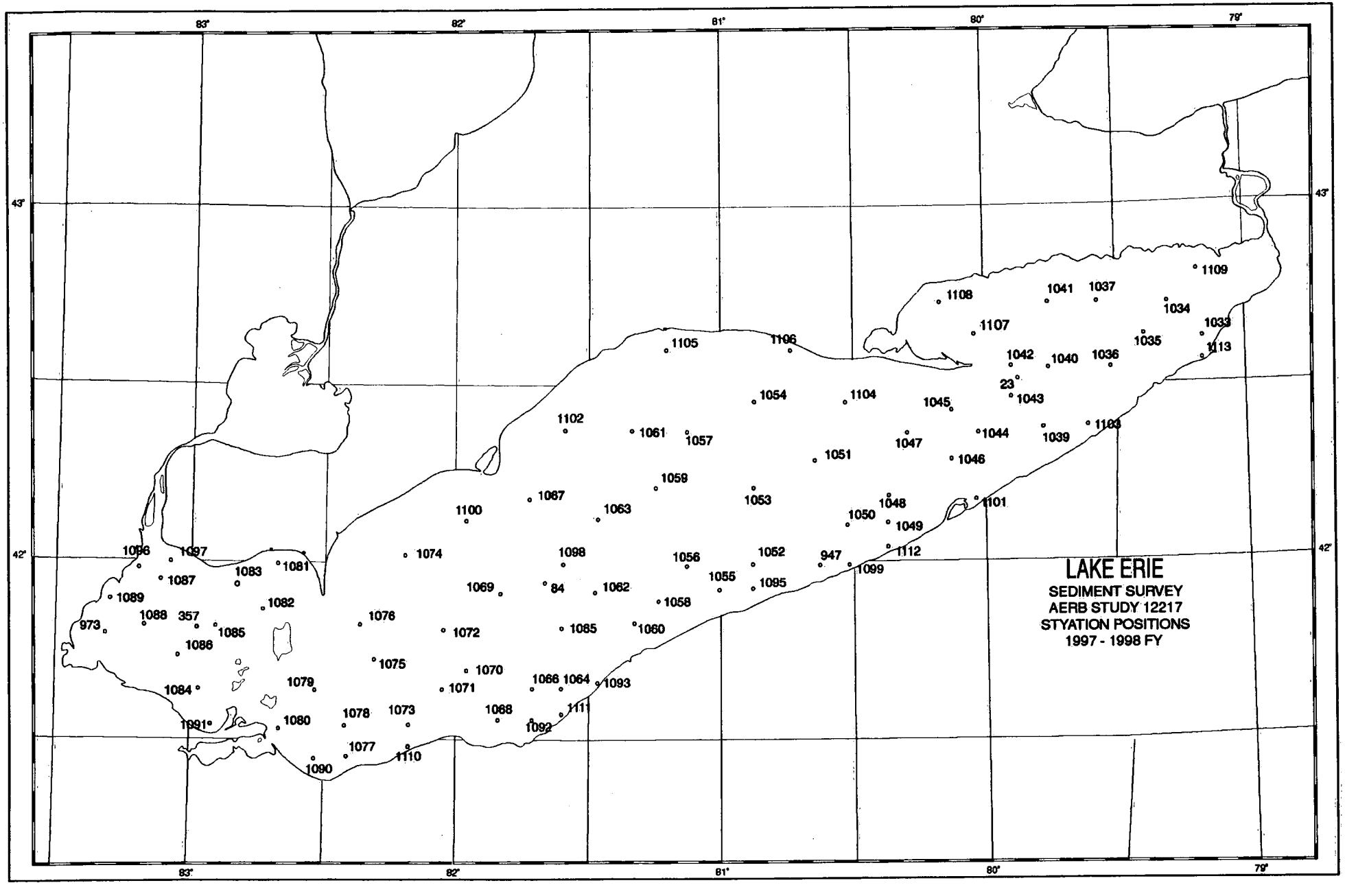
STATION NUMBER	GRID NUMBER	LATITUDE N.	LONGITUDE W.
1094	D-1	41° 42' 11"	83° 24' 07"
1095	F-22	41° 54' 39"	80° 52' 30"
1096	G-3	41° 58' 16"	83° 11' 06"
1097	G-4	41° 58' 54"	83° 03' 00"
1098	G-16	42° 59' 55"	81° 36' 03"
1099	G-25	41° 59' 53"	80° 31' 04"
1100	H-13	42° 05' 04"	81° 58' 01"
1101	I-29	42° 10' 27"	80° 01' 26"
1102	K-16	42° 21' 17"	81° 36' 19"
1103	K-32	42° 21' 22"	79° 39' 05"
1104	L-25	42° 27' 01"	80° 30' 29"
1105	M-19	42° 32' 14"	81° 14' 22"
1106	M-23	42° 32' 18"	80° 45' 14"
1107	N-29	42° 37' 24"	80° 01' 14"
1108	O-28	42° 43' 00"	80° 08' 29"
1109	P-36	42° 47' 55"	79° 09' 54"
1110	R-11	41° 29' 45"	82° 12' 02"
1111	S-16	41° 35' 25"	81° 36' 15"
1112	X-26	42° 02' 22"	80° 23' 47"
1113	DD-36	42° 34' 54"	79° 10' 00"

MOORING POSITIONS

LAKE ERIE

1997-1998

STATION NUMBER	MOORING NUMBER	LATITUDE N.	LONGITUDE W.
84	97-01S-03A	41° 56' 04"	81° 39' 26"
	97-01S-03B	41° 56' 05"	81° 39' 24"
	97-01A-04C	41° 56' 14"	81° 39' 07"
	97-01A-04D	41° 56' 14"	81° 39' 00"



LAKE ERIE

SEDIMENT SURVEY
AERB STUDY 12217
STYATION POSITIONS
1997 - 1998 FY

ZEBRA MUSSEL EFFECTS
AERB STUDY 12240, M.N. CHARLTON

This was an ongoing study to determine the effects of zebra mussels on water quality in Lake Erie.

Five cruises were completed to support this study during the field season--May 5 - 10, June 2 - 6, June 30 - July 4, July 28 - August 1 and August 25 - 29. At each station, water samples were collected as follows: An integrated water sample from the surface to 1 m above the top of the thermocline or to 20 m if the epilimnion was deeper than 20 m or the water column was unstratified. In instances where the sampling depth extended to the substrate, 2 m above the bottom was sampled. Parameters measured were: conductivity, pH, chlorophyll a, Seston weight, total phosphorus, total filtered phosphorus, soluble reactive phosphorus, nitrate + nitrite. At all stations in the Western Basin West of longitude 82° 30' 00", chlorophyll a samples were obtained at discrete depths of 1, 3, 5, 7 and 9 m. Filtration was done as per GLLFAS filtration methods. EBT/transmissometer profiles, DO profiles, surface bucket temperature and Secchi disc (30 cm) observations were made.

At stations 23, 343, 344, 358, 933, 936, 937, 942, 943, 948, 950, 956, 959, 964, 966 and 972, duplicate metered 64µ zooplankton net hauls were taken from bottom -1 m to the surface and preserved in sugared Formalin. Seston samples, phytoplankton samples preserved with 5 mls of Lugol's solution and protozoa samples preserved with 10 mls of a glutaraldehyde solution were collected from the integrated sample for Dr. D. Culver, Ohio State University.

Fluorometer profiles were also collected at stations 23, 84, 340, 341, 343, 344, 935, 946, 953, 954, 957, 958, 961, 963, 964, 965 and all stations in the Western Basin.

At selected stations, samples were collected for the University of Waterloo. Samples collected were for primary production experiments, UVB measurements, fluorescence experiments and 33p uptake for bacteria and protozoa.

STATISTICS SUMMARY

CRUISE NO. _____ **SHIP** CCGS LIMNOS
DATE: FROM _____ **TO** _____ **REGION** LAKE ERIE
CRUISE TYPE Zebra Mussel Effects **N.MI. STEAMED** 2394.0

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	204	Moorings Established, Sediment Trap	8
EBT/Transmissometer Casts	204	Moorings Retrieved, Sediment Trap	9
Rosette Casts	106	Moorings Established, D.O. Logger	1
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved, D.O. Logger	1
Secchi Disc Observations	96	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls, 64µ	197		
Zooplankton Hauls, 153µ	15		
Integrator 10 m	114		
Integrator 20 m	120	Primary Productivity Moorings	
Phytoplankton Samples	95		
D.O. Profiles	193		
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	3
Water Samples Collected (D.O.)	31	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	297	Cores Taken, Benthos	
Water Samples Collected (TP uf)	189	Grab Samples Taken, Shipek	
Water Samples Collected (TKN)		Grab Samples Taken, PONAR	
Water Samples Collected (Protozoa)	91	Bulk Centrifuge Samples	
Water Samples Collected (Primary Production)	9		
Water Samples Collected (Fluorescence)	17	Observations, Weather	
Water Samples Filtered (Chlorophyll a)	629	Fluorometer Profiles	160
Water Samples Filtered (POC/TPN)		Licor Profiles	101
Water Samples Filtered (Seston)	276		
Water Samples Filtered (TP f)	189		
Water Samples Filtered (Nutrients)	189		
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)	12	Manual Chemistry, Tech. Ops.	625
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

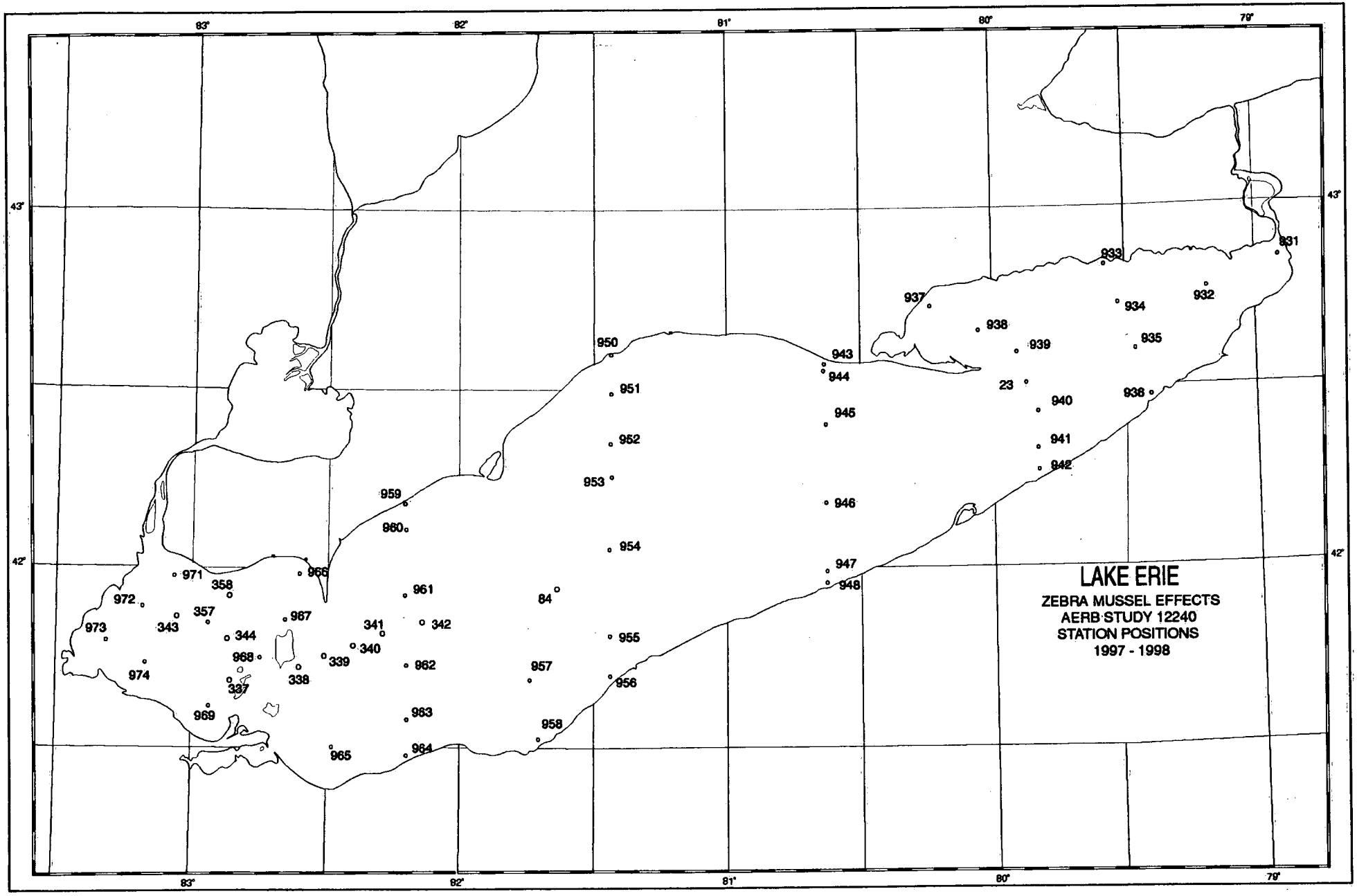
STATION POSITIONS

LAKE ERIE

1997-1998

STATION NUMBER	LATITUDE N.	LONGITUDE W.
23	42° 30' 06"	79° 53' 24"
84	41° 56' 06"	81° 39' 30"
337	41° 41' 00"	82° 51' 18"
338	41° 42' 00"	82° 38' 00"
339	41° 43' 42"	82° 31' 00"
340	41° 45' 24"	82° 24' 00"
341	41° 47' 06"	82° 17' 00"
342	41° 48' 48"	82° 10' 00"
343	41° 50' 48"	83° 05' 00"
344	41° 47' 00"	82° 50' 30"
357	41° 49' 36"	82° 58' 12"
358	41° 53' 39"	82° 52' 00"
931	42° 51' 00"	78° 56' 30"
932	42° 47' 30"	79° 12' 30"
933	42° 49' 30"	79° 34' 00"
934	42° 42' 30"	79° 30' 30"
935	42° 35' 30"	79° 28' 00"
936	42° 28' 30"	79° 24' 30"
937	42° 43' 00"	80° 15' 00"
938	42° 38' 00"	80° 03' 30"
939	42° 34' 00"	79° 55' 00"
940	42° 26' 30"	79° 50' 00"
941	42° 19' 30"	79° 50' 00"
942	42° 15' 30"	79° 50' 00"
943	42° 34' 30"	80° 38' 30"
944	42° 32' 00"	80° 38' 30"
945	42° 24' 00"	80° 38' 30"
946	42° 10' 00"	80° 38' 30"
947	41° 59' 30"	80° 38' 30"
948	41° 57' 24"	80° 38' 30"

STATION NUMBER	LATITUDE N.	LONGITUDE W.
950	42° 35' 18"	81° 26' 30"
951	42° 28' 30"	81° 26' 30"
952	42° 21' 30"	81° 26' 30"
953	42° 12' 30"	81° 26' 30"
954	42° 01' 30"	81° 26' 30"
955	41° 48' 00"	81° 26' 30"
956	41° 41' 30"	81° 26' 30"
957	41° 41' 00"	81° 44' 30"
958	41° 31' 30"	81° 42' 30"
959	42° 11' 42"	82° 11' 00"
960	42° 06' 00"	82° 11' 00"
961	41° 54' 30"	82° 11' 00"
962	41° 43' 00"	82° 11' 00"
963	41° 34' 30"	82° 11' 00:
964	41° 29' 00"	82° 11' 00"
965	41° 30' 00"	82° 30' 00"
966	41° 59' 00"	82° 37' 30"
967	41° 53' 30"	82° 40' 00"
968	41° 44' 30"	82° 44' 00"
969	41° 36' 30"	82° 55' 30"
971	41° 57' 00"	83° 03' 00"
972	41° 52' 00"	83° 12' 00"
973	41° 47' 30"	83° 20' 00"
974	41° 43' 30"	83° 09' 00"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LAKE ERIE
ZEBRA MUSSEL EFFECTS
AERB STUDY 12240
STATION POSITIONS
1997 - 1998

BENTHIC PRIMARY PRODUCTION
AERB STUDY 12241, DR. R. HECKY

One cruise was carried out onboard the CCGS LIMNOS for Dr. R. Hecky September 2 - 5 to measure benthic primary production in Lake Erie. This study will determine whether increases in water clarity is allowing production lost in the water column due to zebra mussels to be replaced by production at the sediment water interface.

STATION POSITIONS

LAKE ERIE

1997-1998

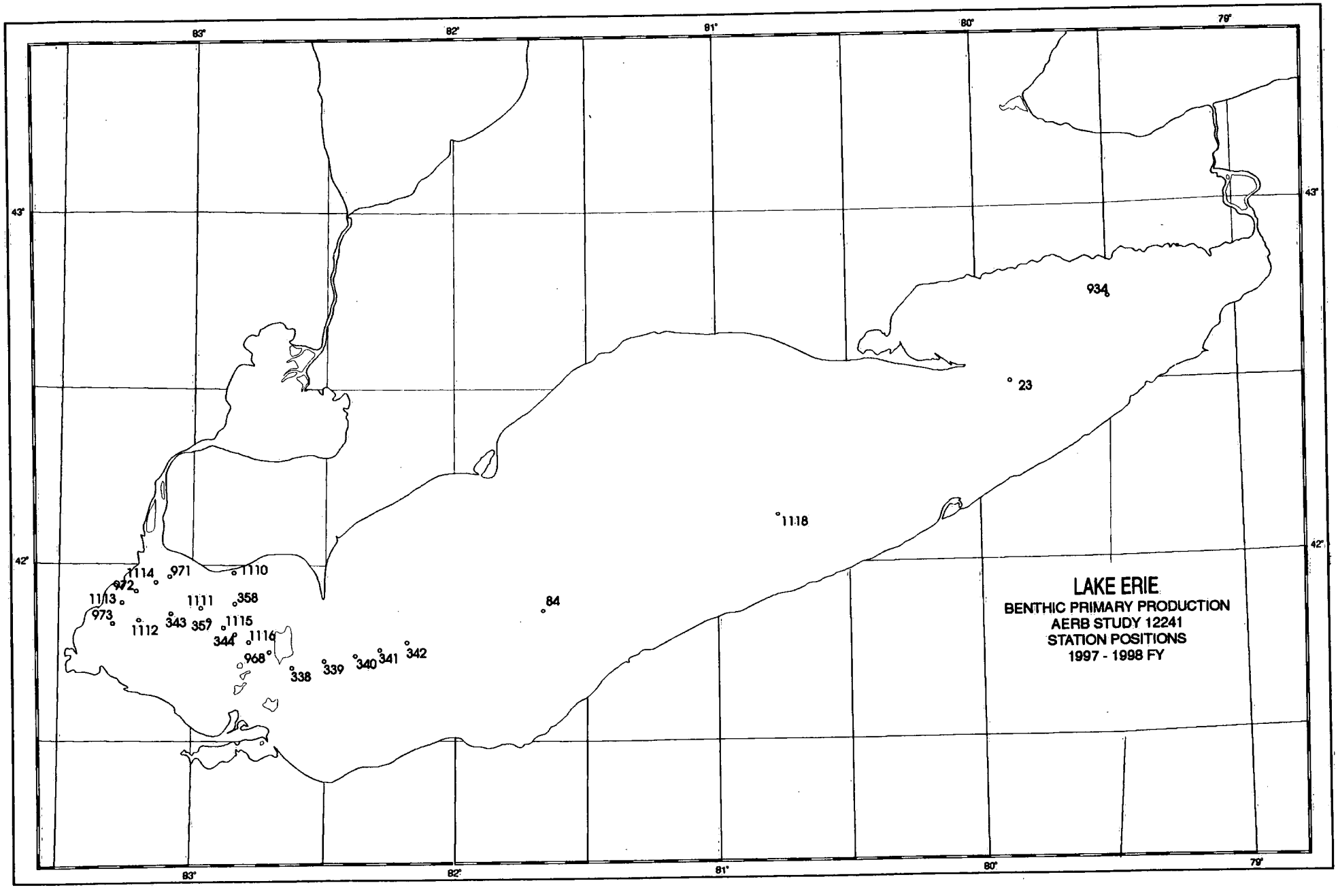
STATION NUMBER	SECCHI DISC DEPTH/COLOUR	XMS % @ 1 m	LATITUDE N.	LONGITUDE W.
23	5.0/14	71	42° 30' 01"	79° 53' 12"
84		67	41° 56' 02"	81° 39' 08"
338	3.5/16	65	41° 42' 00"	82° 38' 01"
339	3.5/18	64	41° 43' 41"	82° 30' 59"
340	3.0/18	62	41° 45' 24"	82° 24' 00"
341	3.0/19	61	41° 47' 05"	82° 16' 57"
342	4.0/12	68	41° 48' 49"	82° 10' 00"
343	1.5/18	48	41° 50' 44"	83° 05' 03"
344	1.8/20	44	41° 46' 58"	82° 50' 34"
357	1.2/12	34	41° 49' 31"	82° 58' 14"
358	1.8/20	44	41° 53' 32"	82° 52' 03"
934	5.0/05	74	42° 42' 24"	79° 30' 27"
968	2.0/19	72	41° 44' 30"	82° 44' 02"
972		35	41° 51' 59"	83° 12' 01"
973	0.2/22	01	41° 47' 49"	83° 19' 41"
1110	2.5/18	57	41° 59' 36"	82° 49' 07"
1111	1.5/19	35	41° 52' 13"	82° 57' 59"
1112	1.0/20	32	41° 49' 25"	83° 10' 57"
1113		37	41° 49' 44"	83° 15' 48"
1114		43	41° 54' 21"	83° 07' 36"
1115	1.6/20	45	41° 48' 06"	82° 53' 58"
1116	2.0/19	52	41° 45' 25"	82° 46' 57"
1117	3.2/14	59	41° 42' 46"	82° 34' 24"
1118		69	42° 14' 20"	80° 45' 32"

STATISTICS SUMMARY

CRUISE NO. 97 - 01 - 011
DATE: FROM September 2 **TO** September 4, 1997
CRUISE TYPE Benthic Primary Prodction

SHIP CCGS LIMNOS
REGION LAKE ERIE
N.MI. STEAMED 432.4

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	27	Moorings Established	
EBT/Transmissometer Casts	27	Moorings Retrieved	
Rosette Casts		Moorings Established	
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved	
Secchi Disc Observations	21	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls			
Integrator 10 m			
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles	27		
Water Samples Collected (Microbiology)		Cores Taken, Box	7
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	
Water Samples Collected (D.O.)		Cores Taken, Piston	
Water Samples Collected (Cond/pH)		Cores Taken, Benthos	
Water Samples Collected (TP uf)		Grab Samples Taken, Shipek	
Water Samples Collected (TKN)		Grab Samples Taken, PONAR	
Water Samples Collected (Virus 250 ml)	27	Bulk Centrifuge Samples	
Water Samples Collected (Virus 100l)	3		
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)		CDTT	27
Water Samples Filtered (POC/TPN)		Licor Light Measurements	21
Water Samples Filtered (Seston)		Spectrometer Measurements	21
Water Samples Filtered (TP f)			
Water Samples Filtered (Nutrients)			
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	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LAKE ERIE
BENTHIC PRIMARY PRODUCTION
AERB STUDY 12241
STATION POSITIONS
1997 - 1998 FY

BIOLOGICAL SEDIMENT GUIDELINES
AERB STUDY 12217, DR. T.B. REYNOLDSON

One cruise was carried out on the Great Lakes to support this program—September 22 - October 3. The cruise verified the reference database created to select key species and toxicity tests that show the most resilient predictive response for the purposes of developing guidelines and to propose a framework for numerical biological sediment guidelines for determining the need for sediment remediation based on the invertebrate fauna and bioassay responses.

At all stations, a mini box core was collected and subsampled in the following manner:

The box core was subsampled using ten 7 cm diameter tubes from which the top 10 cm were extruded into plastic bags. Five samples were sieved using a 250 micron mesh sieve and the remaining five samples were sieved using a 500 micron mesh sieve. Residue was placed in the containers provided and preserved in 5% Formalin.

At all stations, the remainder of the top 5 cm of sediment in the box core was removed and placed in a glass dish. This sample was homogenized and sampled in the following manner:

a) 125 mls were sampled for organic analysis in a hexane rinsed glass bottle covered with a hexane rinsed piece of tin foil before the lid was placed on.

b) 100 mls were sampled for particle size.

c) 500 mls were sampled for major ions, metals, loss on ignition, total organic carbon, total Kjeldahl nitrogen and total phosphorus.

Additional tasks performed during the cruise included:

Forty-foot piston cores were collected at stations 23 and 1101 in Lake Erie for Dr. J.P. Coakley, AERB. These cores were sectioned, sealed and stored by University of Akron personnel.

Two T-frame moorings with marker buoys were installed in the St. Clair River at Sarnia for Dr. N.A. Rukavina, NTRB.

At station 308 in Lake Huron, a zebra mussel sample was collected for Mr. T. Wilson, University of Guelph.

At stations 359 and 362 in Lake Huron and station 385 in Georgian Bay, a water sample was collected, using a Go-Flo bottle from a depth of 1 m for halo acetic acid analysis for Dr. B.F. Scott, AECB.

STATISTICS SUMMARY

CRUISE NO.
DATE:
CRUISE TYPE Biological Sediment Guidelines

SHIP CCGS LIMNOS
REGION LAKE ERIE
N.MI. STEAMED 332.1

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	10	Moorings Established	
EBT/Transmissometer Casts	10	Moorings Retrieved	
Rosette Casts		Moorings Established	
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved	
Secchi Disc Observations	4	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls			
Integrator 10 m			
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles	10		
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	16
Water Samples Collected (D.O.)		Cores Taken, Piston, 40 ft.	2
Water Samples Collected (Cond/pH)		Cores Taken, Benthos	2
Water Samples Collected (TP uf)	4	Grab Samples Taken, Shipek	
Water Samples Collected (TKN)	4	Grab Samples Taken, PONAR	
Water Samples Collected (Alkalinity)	4	Bulk Centrifuge Samples	
Water Samples Collected ( )			
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)			
Water Samples Filtered (POC/TPN)			
Water Samples Filtered (Seston)			
Water Samples Filtered (TP f)			
Water Samples Filtered (Nutrients)			
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

STATISTICS SUMMARY

CRUISE NO. _____ **SHIP** CCGS LIMNOS
DATE: _____ **REGION** LAKE HURON
CRUISE TYPE Biological Sediment Guidelines **N.MI. STEAMED** 804.4

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	8	Moorings Established	
EBT/Transmissometer Casts	6	Moorings Retrieved	
Rosette Casts		Moorings Established	
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved	
Secchi Disc Observations	1	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls			
Integrator 10 m			
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles	4		
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	22
Water Samples Collected (D.O.)	5	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	5	Cores Taken, Benthos	
Water Samples Collected (TP uf)	6	Grab Samples Taken, PONAR	15
Water Samples Collected (TKN)	6	Grab Samples Taken, mini PONAR	11
Water Samples Collected (Alkalinity)	6	Bulk Centrifuge Samples	
Water Samples Collected (Halo Acetic Acid)	2		
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)			
Water Samples Filtered (POC/TPN)			
Water Samples Filtered (Seston)			
Water Samples Filtered (TP f)			
Water Samples Filtered (Nutrients)			
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	10
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

STATISTICS SUMMARY

CRUISE NO. _____ **SHIP** CCGS LIMNOS
DATE: _____ **REGION** GEORGIAN BAY
CRUISE TYPE Biological Sediment Guidelines **N.MI. STEAMED** 265.5

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	7	Moorings Established	
EBT/Transmissometer Casts	5	Moorings Retrieved	
Rosette Casts		Moorings Established	
Reversing Thermometer Obs. (No. of Therm)		Moorings Retrieved	
Secchi Disc Observations	2	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls			
Integrator 10 m			
Integrator 20 m		Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles	4		
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	17
Water Samples Collected (D.O.)	2	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	2	Cores Taken, Benthos	
Water Samples Collected (TP uf)	6	Grab Samples Taken, Shipek	
Water Samples Collected (TKN)	6	Grab Samples Taken, PONAR	
Water Samples Collected (Alkalinity)	6	Bulk Centrifuge Samples	
Water Samples Collected (Halo Acetic Acid)	1		
Water Samples Collected ( )		Observations, Weather	
Water Samples Filtered (Chlorophyll a)			
Water Samples Filtered (POC/TPN)			
Water Samples Filtered (Seston)			
Water Samples Filtered (TP f)			
Water Samples Filtered (Nutrients)			
Water Samples Filtered (Major Ions)		**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)		Manual Chemistry, Tech. Ops.	4
Water Samples Filtered ( )		Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered ( )		Microbiology	

STATION POSITIONS

LAKE ERIE

1997-1998

STATION NUMBER	REYNOLDSON NUMBER	LATITUDE N.	LONGITUDE W.
23		42° 30' 08"	79° 53' 08"
84		41° 56' 07"	81° 39' 30"
193	104	41° 57' 58"	82° 57' 00"
207	106	41° 59' 03"	82° 46' 55"
275	112	42° 14' 59"	81° 49' 00"
279	300	42° 33' 00"	80° 27' 00"
287	313	42° 42' 20"	80° 15' 07"
303	303	42° 33' 54"	80° 02' 28"
357		41° 49' 56"	82° 58' 10"
1101		42° 04' 48"	81° 15' 32"

STATION POSITIONS

LAKE HURON AND NORTH CHANNEL

1997-1998

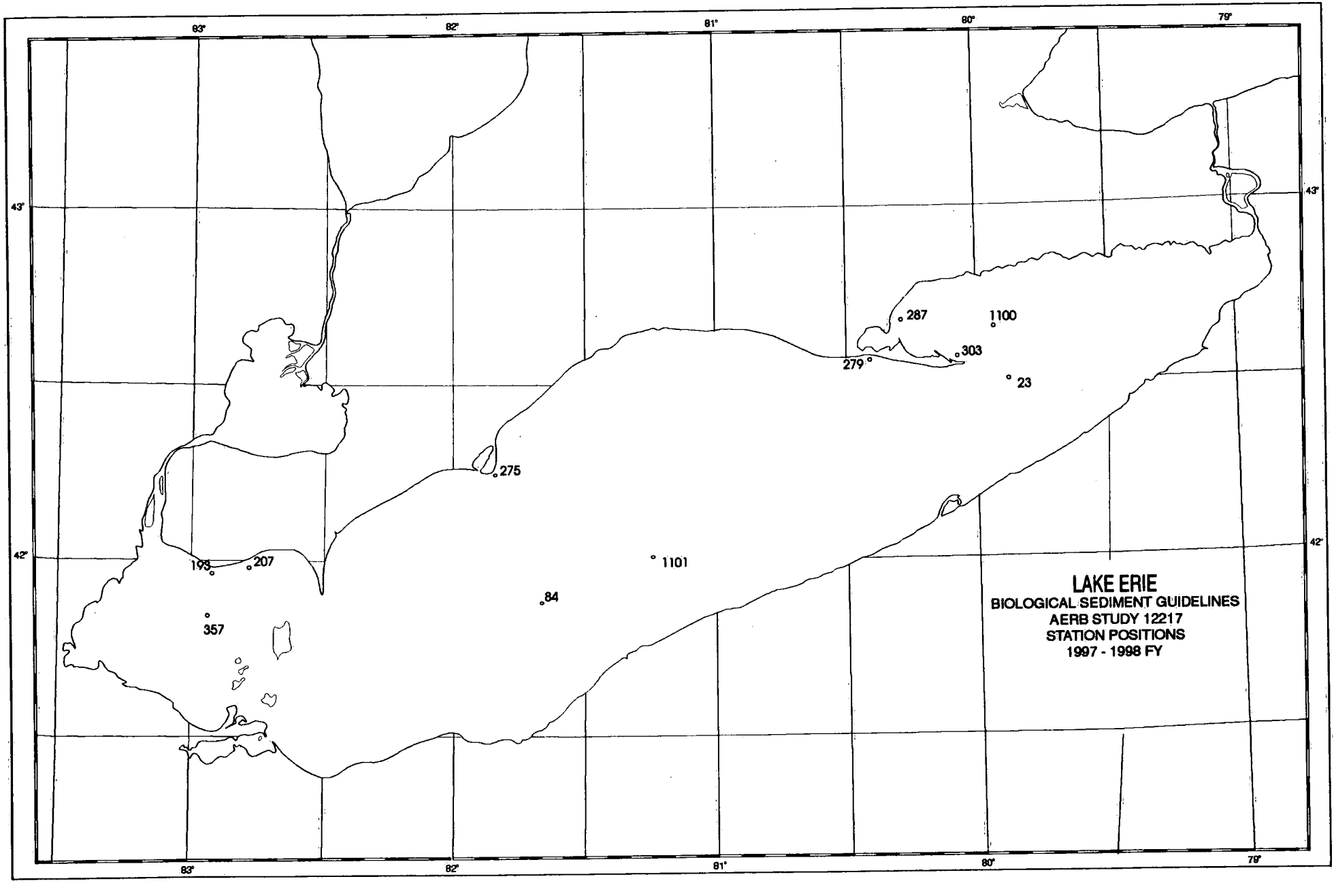
STATION NUMBER	REYNOLDSON NUMBER	LATITUDE N.	LONGITUDE W.
308	505	43° 34' 04"	81° 44' 35"
317	604	45° 04' 58"	81° 35' 32"
352	1403	46° 16' 45"	83° 36' 35"
353	1413	45° 51' 31"	82° 36' 31"
354	1500	46° 00' 13"	81° 30' 58"
381	507	43° 54' 16"	81° 52' 26"
382	513	44° 28' 03"	81° 33' 30"
359		43° 32' 57"	82° 09' 05"
362		44° 22' 51"	82° 02' 53"

STATION POSITIONS

GEORGIAN BAY

1997-1998

STATION NUMBER	REYNOLDSON NUMBER	LATITUDE N.	LONGITUDE W.
333	705	44° 42' 56"	80° 53' 00"
346	1201	44° 42' 02"	80° 03' 59"
355	1214	44° 46' 24"	80° 50' 11"
356	1609	45° 18' 20"	80° 15' 42"
383	610	44° 58' 11"	81° 11' 54"
384	1202	44° 47' 58"	80° 09' 30"
385		45° 21' 29"	80° 59' 47"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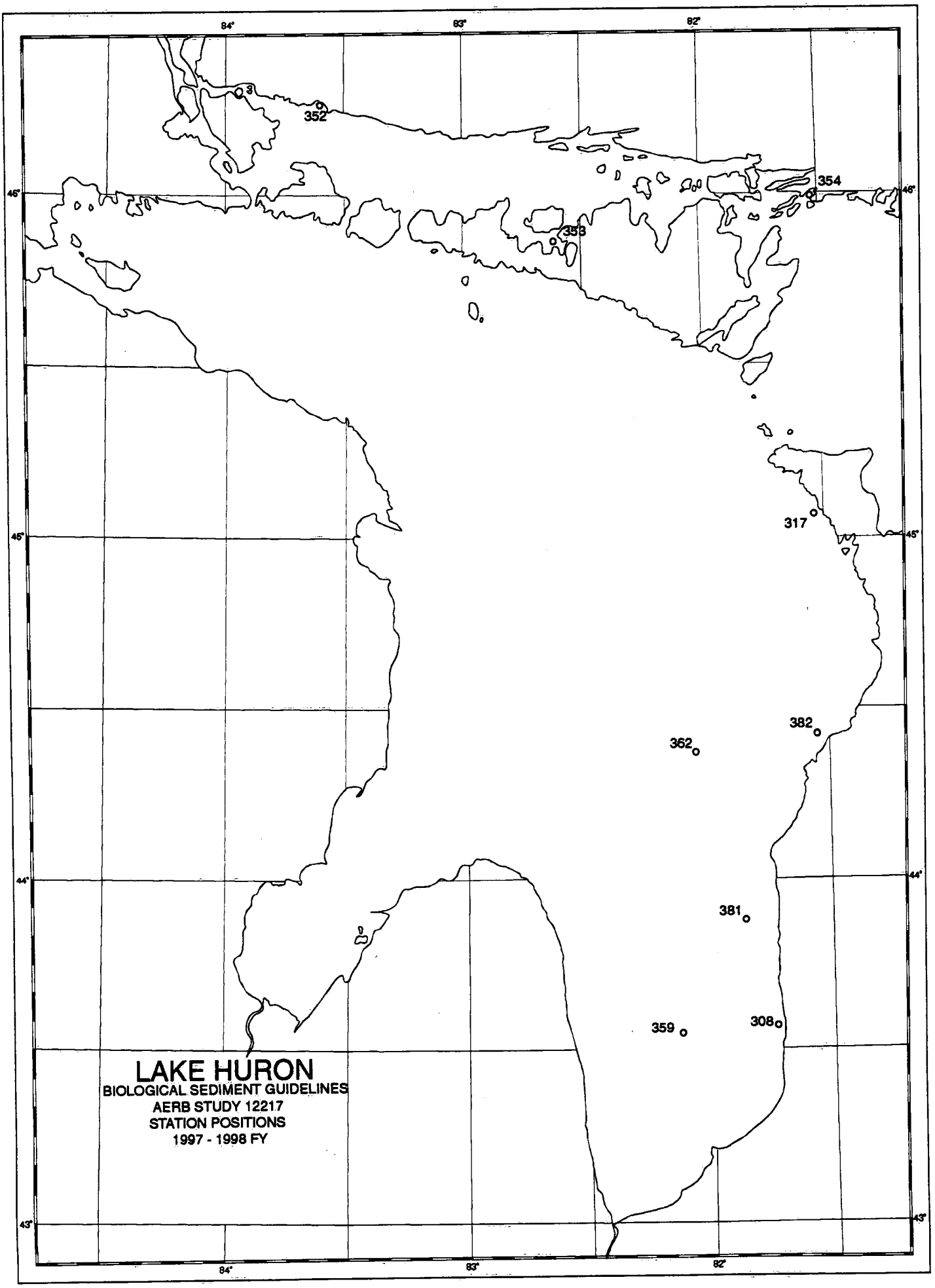
LAKE ERIE
BIOLOGICAL SEDIMENT GUIDELINES
AERB STUDY 12217
STATION POSITIONS
1997 - 1998 FY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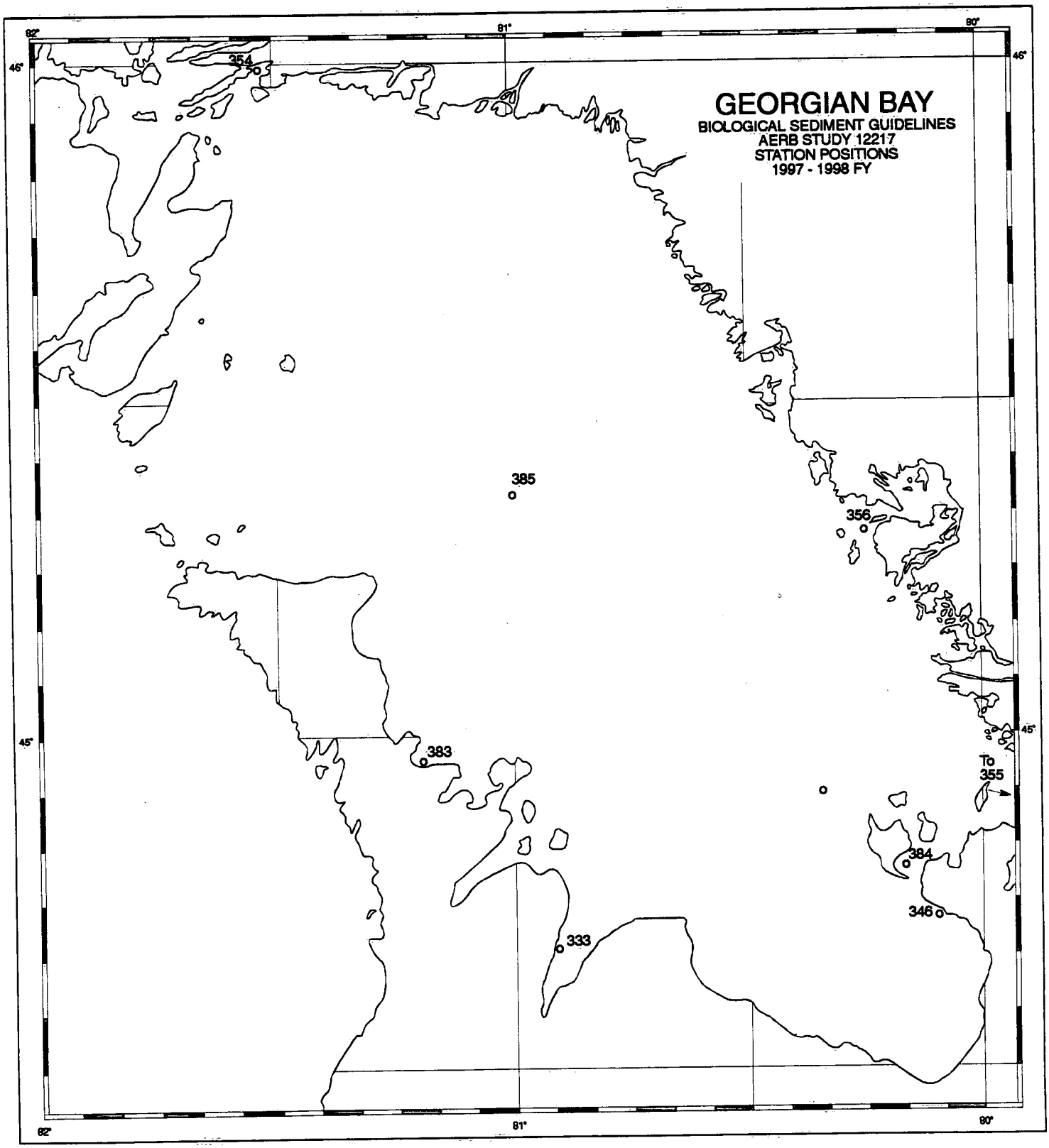
LAKE HURON
BIOLOGICAL SEDIMENT GUIDELINES
AERB STUDY 12217
STATION POSITIONS
1997 - 1998 FY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BIOLOGICAL SEDIMENT GUIDELINES
AERB STUDY 12217
STATION POSITIONS
1997 - 1998 FY
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LAKE SUPERIOR

OPEN LAKES SURVEILLANCE
ECOSYSTEM HEALTH DIVISION, ECB, EC-OR, S. L'ITALIEN
RSB STUDY 12632, B.H. MOORE

The Lake Superior Open Lakes Surveillance Program was designed to provide a continuing report and long-term trend information on water quality and eutrophication parameters in the Great Lakes under the Canada/U.S. Agreement as input to the Water Quality Board Annual Report to the International Joint Commission.

Two cruises were conducted—May 15 - 24 and August 03 - 16, to support this program. Both cruises were organized and completed by Technical Operations personnel for ECB-OR and were conducted from the CCGS LIMNOS. The vessel was equipped with the usual equipment: EBT, rosette water sampler, transmissometer, radar, Loran C, GPS positioning systems and a variety of samplers and winches used for chemical and biological sampling.

The parameters sampled during both cruises were: temperature and transmission profiles, dissolved oxygen, specific conductance, pH, chlorophyll a, particulate organic carbon, particulate nitrogen, total phosphorous filtered and unfiltered, soluble reactive phosphorous, total Kjeldahl nitrogen, alkalinity, SO_4, chloride, reactive silicate, major ions (Mg, K, Ka), meteorological and Secchi disc observations.

During the May cruise samples were collected from the 1 metre depth only. Sampling depths for the August cruise were:

Unstratified Conditions:
1 metre
50 metres if total depth was greater than 70m
100 metres if total depth was greater than 130m
250 metres if total depth was greater than 300m
bottom -10 metres
bottom -2 metres

Stratified Conditions:
1 metre
1 metre above the knee of the thermocline
mid-thermocline
1 metre below the knee of the thermocline
100 metres if total depth was greater than 130m
250 metres if total depth was greater than 300m
bottom -10 metres
bottom -2 metres

Some of the additional tasks performed during the cruises were: water and air samples for AES; biological sediment guideline sediment collected using mini box cores for Dr. T.B. Reynoldson, AERB Study 12216; water samples for suspended sediments as well as organic and inorganic analyses, Dr. W.M.J. Strachan, AECB Study 12310 and tritium water samples for K. King, AECL, Chalk River.

STATISTICS SUMMARY

CRUISE NO. _____ **SHIP** CCGS LIMNOS
DATE: _____ **REGION** LAKE SUPERIOR
CRUISE TYPE Open Lakes Surveillance **N.MI. STEAMED** 3174.0

DESCRIPTION	TOTAL	DESCRIPTION	TOTAL
Stations Occupied	84	Moorings Established	
EBT/Transmissometer Casts	87	Moorings Retrieved	
Rosette Casts	49	Moorings Established	
Reversing Thermometer Obs. (No. of Therm)	20	Moorings Retrieved	
Secchi Disc Observations	37	Moorings Established	
Transmissometer Casts		Moorings Retrieved	
Zooplankton Hauls, 64µ	4		
Integrator 10 m	13		
Integrator 20 m	7		
Integrator 50 m	65	Primary Productivity Moorings	
Phytoplankton Samples			
D.O. Profiles			
Water Samples Collected (Microbiology)		Cores Taken, Box	
Water Samples Collected (Water Quality)		Cores Taken, Mini Box	10
Water Samples Collected (D.O.)	278	Cores Taken, Piston	
Water Samples Collected (Cond/pH)	294	Cores Taken, Benthos	
Water Samples Collected (TP uf)	294	Grab Samples Taken, Shipek	22
Water Samples Collected (TKN)	48	Grab Samples Taken, PONAR	
Water Samples Collected (Trace Metals)	14	Bulk Centrifuge Samples, 3000ℓ	25
Water Samples Collected (Mercury)	14	Bulk Centrifuge Samples, 500ℓ	28
Water Samples Collected (Tritium)	24	Observations, Weather	
Water Samples Filtered (Chlorophyll a)	95	Goulden Sampler Extractions	50
Water Samples Filtered (POC/TPN)	115	Resin Column Extractions	92
Water Samples Filtered (Seston)		Air Sampler, Mercury, Days	16
Water Samples Filtered (TP f)	294	Air Sampler, Organic Contaminants, Days	24
Water Samples Filtered (Nutrients)	306		
Water Samples Filtered (Major Ions)	306	**ONBOARD ANALYSIS**	
Water Samples Filtered (DOC)	14	Manual Chemistry, Tech. Ops.	885
Water Samples Filtered (Organochlorides)	14	Nutrients, EHD, ECB, EC-OR	
Water Samples Filtered (HCH)	23	Microbiology	

STATION POSITIONS

LAKE SUPERIOR

1997-1998

STATION NUMBER	LATITUDE N.	LONGITUDE W.
2	46° 32' 36"	84° 44' 54"
12	47° 02' 11"	85° 06' 12"
22	46° 58' 09"	85° 43' 38"
23	47° 12' 43"	85° 37' 55"
25	47° 27' 17"	85° 16' 28"
31	47° 55' 08"	84° 54' 41"
39	47° 41' 23"	85° 58' 01"
42	47° 19' 25"	86° 22' 18"
43	47° 04' 47"	86° 28' 42"
45	46° 51' 29"	86° 34' 10"
51	46° 31' 03"	87° 20' 11"
57	46° 56' 01"	87° 18' 18"
59	47° 09' 34"	87° 16' 42"
68	47° 00' 57"	88° 10' 57"
76	47° 24' 00"	87° 24' 43"
80	47° 34' 32"	86° 57' 01"
82	47° 51' 27"	86° 38' 01"
95	48° 12' 42"	87° 01' 00"
97	48° 26' 19"	87° 15' 18"
100	48° 45' 21"	86° 58' 33"
113	48° 08' 37"	87° 42' 48"
115	47° 50' 48"	87° 27' 24"
118	47° 36' 24"	87° 42' 42"
125	47° 36' 15"	88° 13' 02"
127	47° 50' 54"	88° 20' 13"
139	48° 15' 12"	89° 10' 50"
152	47° 41' 17"	89° 28' 00"
155	47° 48' 10"	89° 08' 54"
157	47° 36' 47"	89° 00' 00"
160	47° 21' 57"	88° 49' 02"

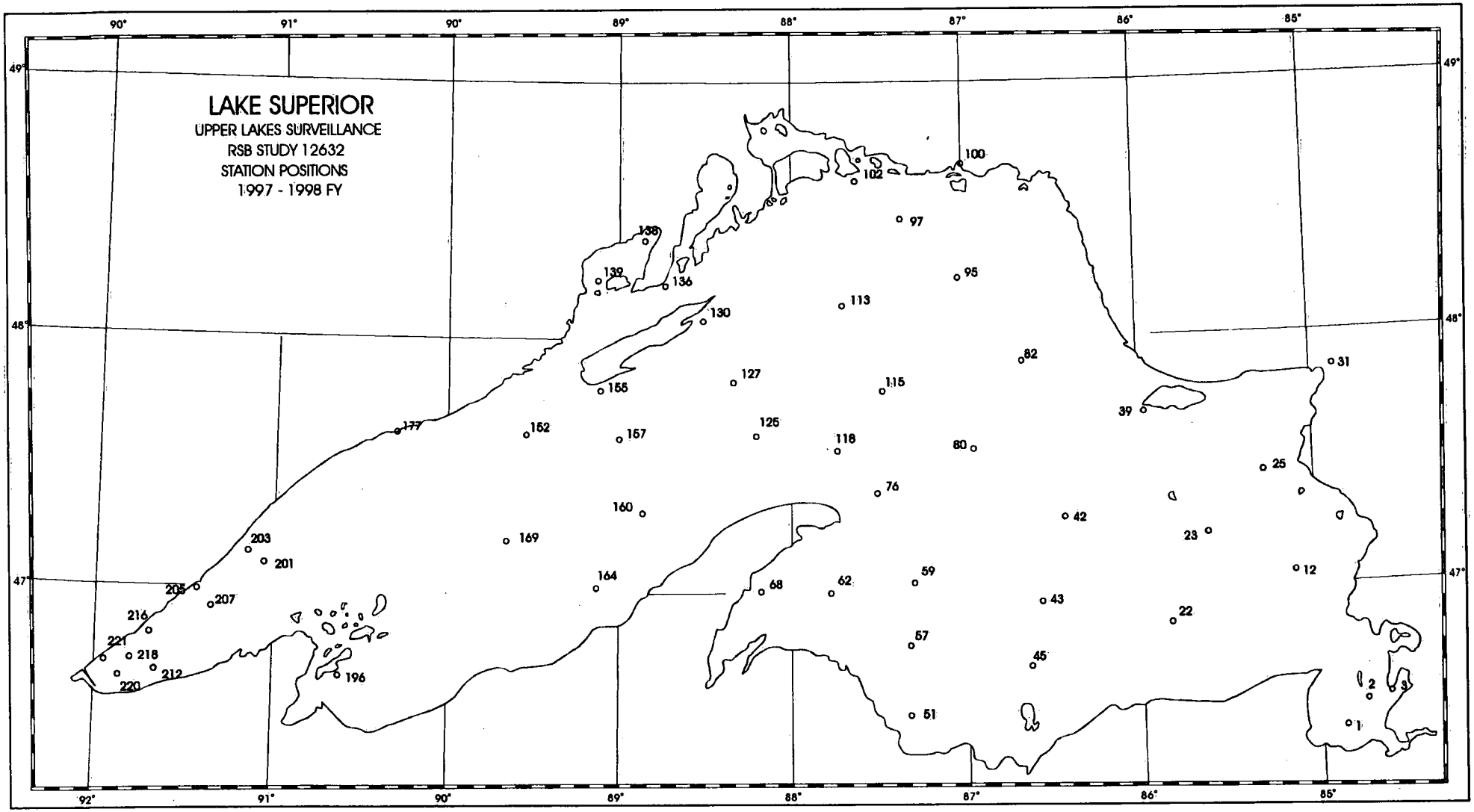
STATION NUMBER	LATITUDE N.	LONGITUDE W.
164	47° 01' 34"	89° 02' 22"
169	47° 12' 08"	89° 40' 29"
177	47° 44' 48"	90° 14' 10"
196	46° 44' 53"	90° 42' 12"
201	47° 07' 53"	91° 06' 43"
221	46° 46' 55"	92° 03' 15"

BIOLOGICAL SEDIMENT GUIDELINES

LAKE SUPERIOR

1997-1998

STATION NUMBER	REYNOLDSON NUMBER	LATITUDE N.	LONGITUDE W.
301	5101	48° 50' 13"	87° 45' 00"
313	5113	48° 21' 35"	88° 39' 40"
317	2500	48° 31' 59"	86° 16' 35"
324	2507	48° 47' 08"	86° 41' 51"
362	2410	47° 23' 00"	84° 43' 16"


LAKE SUPERIOR
UPPER LAKES SURVEILLANCE
RSB STUDY 12632
STATION POSITIONS
1997 - 1998 FY
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SHORE PROGRAMS

NATIONAL LABORATORY FOR ENVIRONMENTAL TESTING

ONSITE CENTRIFUGING
NLET STUDY 12120, M. COMBA

Technical Operations supported this study on numerous occasions throughout the year. Centrifuging was carried out in the Rigging Shop, utilizing a Westfalia centrifuge. After centrifuging the 40ℓ samples, both the water and sediment were retained. The water was then extracted using the Goulden large volume extractor and the sediment quantitatively recovered from the bowls and extracted using soxhlets.

The purpose of the study was to determine the effect of tributaries on the seasonal loading of organics in Lake Ontario. Samples were collected from six Lake Ontario tributaries—Trent River, Ganaraska River, Humber River, Credit River, 20 Mile Creek and 12 Mile Creek. The samples were analyzed for PAH's, organochlorine, pesticides and conger PCB's. A comparison of the six tributaries will be made.

LABORATORY QUALITY ASSURANCE/QUALITY CONTROL WATER COLLECTION
NLET STUDY 12163, H. ALKEMA

Large water samples were collected for H. Alkema in support of his Quality Assurance/Quality Control Study. Samples were collected from several rivers throughout the prairie provinces, particularly Saskatchewan and Manitoba.

All samples were collected by pump directly into 200-litre barrels. Measurements were taken for pH, conductivity and temperature at each site. A 1-litre water sample was also collected for major ions and nutrients analysis on return to CCIW. The water samples were stored at 4°C for a period of time to allow excessive amounts of sediment to precipitate out of the samples. The samples were then centrifuged utilizing a Westfalia centrifuge. The samples were analyzed and utilized as standards.

The rivers were sampled at the following locations:

1. Qu'appelle River downstream of Sask. Hwy 210 bridge at Echo Valley Provincial Park
2. Swift Current Creek at the City park (6th Avenue S.E and Gladstone Street)
3. South Saskatchewan River upstream of Alberta Hwy #41 bridge
4. Red Deer River above Alberta Hwy #41
5. Battle River at Battleford, upstream of the railway bridge located between Sask. Hwy #4 and 2nd Avenue bridge
6. North Saskatchewan River 1 Km downstream of Sask. Hwy #16A
7. Assiniboine River at the rest area at Manitoba Hwy #83 downstream of the town of Minoita, Manitoba

8. Souris River at Victoria Park in the town of Souris upstream of Manitoba Hwy #22
9. Pembina River downstream of Manitoba Hwy #242 (Maurice Ridley) Bridge in the town of La Riviére, Manitoba
10. Red River downstream of the Manitoba Hwy #205 bridge in the town of Aubigny, Manitoba
11. Winnipeg River at Minaki Lodge property

AQUATIC ECOSYSTEM RESTORATION BRANCH

HAMILTON HARBOUR SANDCAP
AERB STUDY 12214, A. ZEMAN

Sandcapping an area of contaminated sediments has been tested in the U.S.A. as an alternative method of sediment remediation. As part of the Hamilton Harbour Remediation Program, a test site was chosen just West of the LaSalle Marina. The test area is 100 metres square and was covered with a layer of clean sand approximately 35 cm thick during the summer of 1995. Technical Operations provided support in the areas of moorings, instrumentation refurbishment and diving operations.

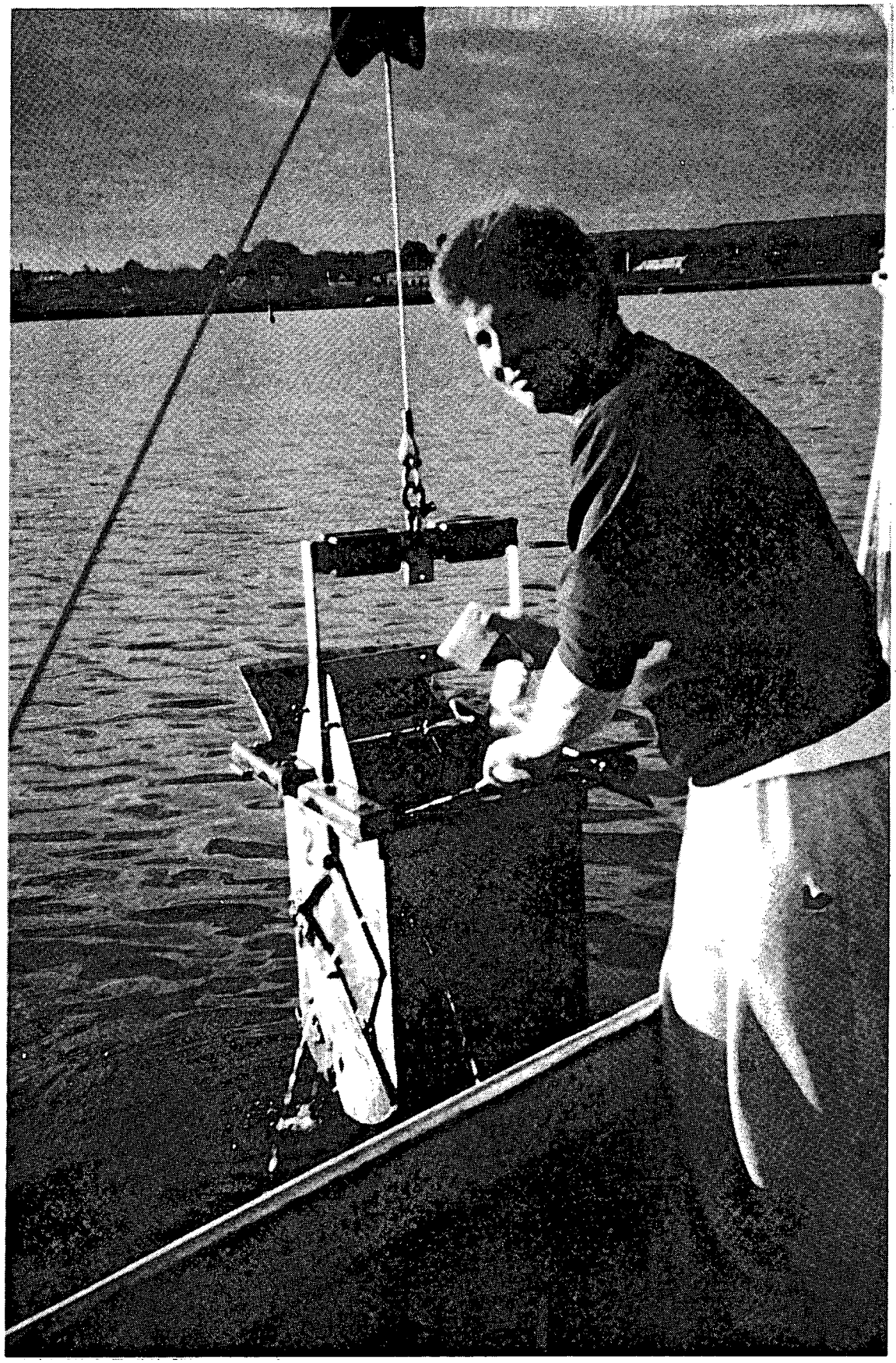
The corner marker spars were installed around the sandcap on April 22 and removed for the winter on December 3.

OPEN PIT MINE EFFECTS ON UPSALQUITCH LAKE, NEW BRUNSWICK
AERB STUDY 12215, DR. H. WONG

Technical Operations staff assisted this study June 16 - 20 with the collection of centrifuged water samples and sediment cores from this lake and stream system receiving runoff water from a new open pit lead and zinc mine.

Field party members from Burlington were met in Bathurst, New Brunswick by Mr. A. Gauthier and proceeded to the sampling site at Upsalquitch Lake. Mr. Gauthier supplied a boat and motor, local knowledge and, since he is a mine inspector, full co-operation from the mine officials. Access to the lake was obtained from a small fishing camp. The first day water was centrifuged for four hours at a rate of 6 litres per minute from a small bridge near the mouth of Charlotte Brook which flows into the lake and carries effluent from the mine. Seven bottom sediment cores were collected from the lake using the Tech Ops corer at a point in mid-lake opposite the fishing camp. One core was approximately 50 centimetres long and was sectioned every centimetre to the bottom. The remaining cores had only the top ten centimeters extruded for benthic analysis. Another site on Charlotte Brook just upstream of and adjacent to the Restigouche open pit mine was centrifuged the same day but was limited to only three hours due to the commencement of blasting operations. The next day the Southeast Upsalquitch River (which flows from the lake) was centrifuged for four hours at the camping area just upstream of the highway 180 bridge. At each centrifuge site, the following water samples were collected:

2 x 100 ml LPE bottles of whole water
1 x 100 ml LPE bottle of filtered water (0.2 µM) preserved with clean nitric acid for metals analysis.
1 x 500 ml glass bottle, filtered and preserved for Mercury analysis
1 x 1ℓ LPE bottle whole water for other measurement



SUBSAMPLING FROM THE MINI BOX CORER IN COLLINGWOOD

A Hydrolab profile was done in the lake at the coring site to the bottom depth of 13.4 metres, recording the usual parameters of temperature, depth, conductance, pH, dissolved oxygen and % saturation. Hydrolab readings were also recorded from the stream at the Upsalquitch River site.

SEDIMENT REMEDIATION, HAMILTON HARBOUR
AERB STUDY 12216, DR. T.B. REYNOLDSON

Mini box core samples and Hydrolab profiles were collected at two stations in Hamilton Harbour. Stations HH3 (Western Basin) and HH19 (Deep Basin) were chosen to study community structure in the area. Samples were collected in the middle of the month from May to November with a total of 7 samples collected.

Two DataSonde 3 loggers were deployed in the Western Basin and one in the deep basin to monitor dissolved oxygen during the months of June to October.

STATION NUMBER	NORTHING	EASTING
DATUM NAD 27		
HH3	4792243.1	591398
HH19	4793303.0	593038

DATASONDE 3 LOGGERS

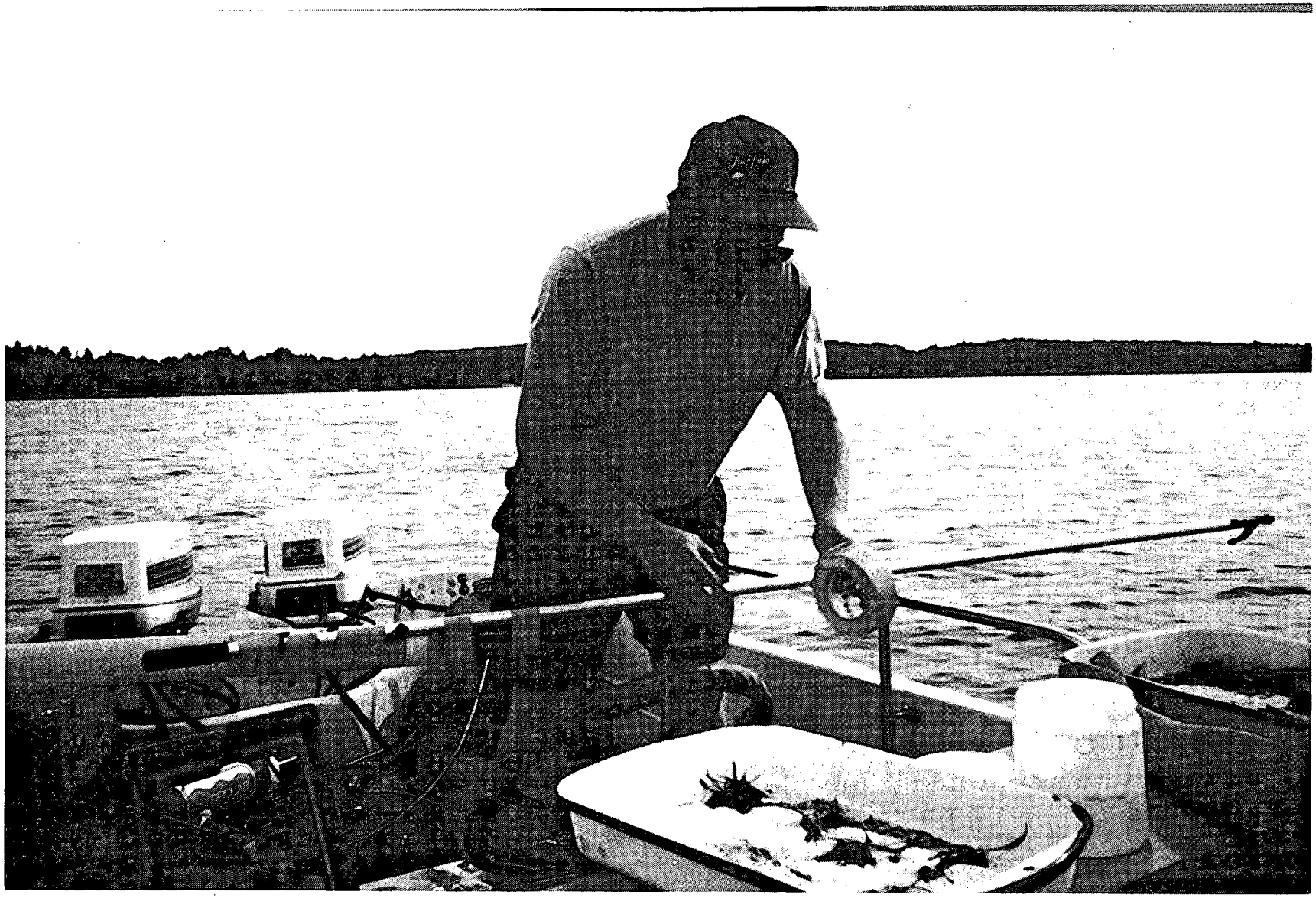
MOORING NUMBER	LATITUDE N.	LONGITUDE W.
97-50E-21A	43° 16' 44"	79° 52' 13"
97-50E-22A	43° 17' 11"	79° 50' 45"

SEDIMENT SAMPLING IN COLLINGWOOD, ONTARIO AND ROUYN-NORANDA, QUEBEC
AERB STUDY 12216, DR. T.B. REYNOLDSON

This project led by Dr. T.B. Reynoldson was supported by assisting in the collection of water and bottom sediments from 17 sites in Collingwood Harbour and several lakes in the Rouyn-Noranda area of Quebec. The lakes sampled in the Rouyn-Noranda area were: Vaudray, Joannes, Dufault, Flavrian, Opasatica and D'Alembert.

On arrival at each station, a Hydrolab probe was lowered to 1 metre above bottom and measurements for oxygen, conductivity, pH and temperature were logged. Water samples for total phosphorus, nutrients and metals were also collected from 1 metre above the sediment water interface. While sampling in Collingwood an NWRI box corer was collected at each site and subdivided for the following: benthic community structure, metals and organics. Five mini PONAR's were also collected for bioassay studies.

LAUNCHING THE WHALER IN FLAVIAN LAKE, QUEBEC



ASSEMBLING A PUSH CORER

At each site in Collingwood Harbour, photographs of the box corer contents were taken to show the amount of sediment and the depth of penetration of the sampler. MOE personnel accompanied the study leader to observe sampling of the top layers of sediment—if any existed.

Sediment from Collingwood and Rouyn-Noranda were also collected for high metal stress on the community structure. Chironomids and Oligochaetes were screened from the sediments and will be analyzed for metals at a later date. Positions for the sites were plotted by the study leader.

As an example of true leadership, the study leader visually confirmed the sediment water interface in Collingwood Harbour was indeed redistributed, as previously reported by NWRI staff.

SEDIMENT COLLECTION IN GEORGIAN BAY
AERB STUDY 12217, DR. T.B. REYNOLDSON

Technical Operations supported this project August 26 - 27 by assisting with the collection of bottom sediment from two sites in Georgian Bay. At site #1201 about 4 miles Northwest of the Daults Bay boat ramp in Nottawasaga Bay, 18 PONAR grabs were done to collect three plastic buckets of bottom sediment. The next day another three buckets of sediment were collected from site #1600 near Waubaushene.

HAMILTON HARBOUR SANDCAP - SEDIMENT CHEMISTRY
AERB STUDY 12217, F. ROSA

As part of a long-term assessment of the migration of contaminants up through the sand layer, peepers were installed on and near the Northwest corner of the sandcap. On April 23, a TOS dive team, accompanied by Mr. F. Rosa, travelled to the Hamilton Harbour sandcap site. Three new peepers were installed. Two peepers were placed on the sandcap and the third was installed in undisturbed sediment twenty feet Northwest of the corner spar buoy. The third peeper was used as a control site. Since the installation of the peepers, the sand has packed tightly around them; combine this with their fragile construction and it makes retrieval very difficult. One peeper was removed from the cap on June 11. Another peeper was removed from the cap on September 3. The control peeper was retrieved on September 4.

LAKE REMEDIATION, HAMILTON HARBOUR
AERB STUDY 12240, M.N. CHARLTON

One Hydrolab profile and one water sample were taken from stations 1001 and 1178 to 1181 in Hamilton Harbour monthly from January until March 31. A water sample was collected at the Burlington Water Intake Plant (station 1182). Water was collected at station 1182 monthly after April. The purpose of this study was to monitor Seston and phosphorus trends during the winter months due to upgrades in the Burlington sewage treatment plant.

Zooplankton, Phytoplankton, water samples and Hydrolab profiles were taken at 4 stations in Hamilton Harbour. This was supervised by Dr. Pat Chow-Fraser from McMaster University in co-operation with M.N. Charlton. The purpose of this study was to determine the effects of the Hamilton Harbour RAP on zooplankton communities. Also the data will help establish a baseline in order to observe any changes in the future. Samples were collected between April and August, with a total of 5 sampling days.

On September 5, clams were installed at 7 stations in the Dofasco Slip. A Hydrolab profile was taken at each station. On September 29, 2 PONAR's were taken at each station and the clams removed.

Water samples were collected at stations 901 to 926 for bacteria analyses.

STATION POSITIONS

STATION NUMBER	LATITUDE N.	LONGITUDE W.
1001	43° 17' 19"	79° 51' 11"
1182	43° 20' 00"	79° 46' 30"

STATION POSITIONS

CHARLTON/McMASTER
WATER, HYDROLAB, ZOOPLANKTON, PHYTOPLANKTON
DATUM NAD 27

STATION NUMBER	NORTHING	EASTING
252 (50)	4792986.4	596313.76
270 (51)	4792243.1	591398.00
258 (52)	4793303.0	593038.00
4 (53)	4792986.4	596313.76

BENTHIC PHOTOSYNTHESIS, LAKE ERIE
AERB STUDY 12241, DR. R. HECKY

On August 19, a TOS dive team, (Breedon and Don) accompanied by Dr. R. Hecky, AERB and Mr. J.M. Davies, DFO-FWI, travelled to Pt. Dover. The purpose of the trip was to develop methodologies to determine the net benthic photosynthesis rates at the water sediment interface in Lake Erie.

Site surveys were made along shore West of Pt. Dover. Site number one was chosen at 42° 46' 28.4" N., 80° 14' 20.9" W. (4736069. N and 563382. E) in 5 m of water. Twelve benthic chambers were installed into the sediments. Two chambers were covered with dark sleeves. At each chamber samples were collected with syringes for dissolved oxygen and evacuated glass bottles for DIC. Samples were returned to a lab at the Pt. Dover MNR office.

The following day easterly winds had stirred up the water creating very poor visibility for the divers. It was decided to move the operation to the Turkey Point area. An excellent site was found near a sunken tire reef at 42° 40' 12.6" N., 80° 18' 15" W. (4726629. N 556987. E) in 7.0 m of water. Again, twelve chambers were installed and sampled. The cylinders were left in overnight and sampled again the next day at 0900 and 1400 hours. Following the last sampling period, the chambers were removed.

The next week the program continued using rock bottom sites. On August 25, TOS divers Gray and Breedon, accompanied by Dr. R. Hecky, installed benthic photosynthesis chambers and sampled them. Site #1 was located near Port Dover (E 562542. N 4734233.). During the next two days the chambers were sampled twice and underwater video was obtained. The next day, after collecting the morning samples, the chambers were retrieved.

A second site near Turkey Point was selected (E 556983. N 4726624.) and the chambers were installed and sampled. Samples were collected, underwater video obtained and the chambers were removed.

COASTAL EXCHANGE AND MODELLING, WESTERN LAKE ONTARIO
AERB STUDY 12242, DR. C.R. MURTHY

By conducting coastal physical experiments in conjunction with thermal structure, meteorological and limnological data collection, recommendations can be made relevant to the proposed Halton/Skyway sewage treatment plant. The study was expanded this year to include ADCP current transects, temperature and water quality profiles, Lagrangian current measurements and sediment transport/resuspension surveys. This was accomplished during three intensive two-week sampling periods throughout the year—May 5 - 16, July 21 - August 1 and September 15 - 26)

Time-Series Current Measurements

In 1996, one ADCP and five current meter moorings were placed along the North shore for the winter from Bronte Creek to Stoney Creek. These moorings were refurbished in the spring at the same locations, with an additional ADCP and three current meter moorings. Station 7 was relocated to station 10 in June. Two thermistor chains were added to the array in the spring.

Sediment Transport/Resuspension

This study by Dr. J. Coakley will identify pathways of STP outfall plumes in the area and add input to the proposed relocation of the Halton/Skyway STP outfall. Using a small launch, water was centrifuged from four locations on the North shore—Oakville, 16 Mile Creek, Bronte Creek and Burlington Canal, for suspended solids. These areas represent sources of contamination during heavy rainfall.

In May, a cesium tracer dispenser was placed at the proposed STP outfall. Sediment samples were collected from 40 sites in the area on several occasions to monitor the tracer dispersion in the sediments.

Activities During Sampling Periods

Acoustic Doppler Current Profiles

Three sampling transects were established in the area for the ADCP current measurements. The system was mounted on the launch WAGTAIL and the navigational package Navtrek was used to display digital charts for positioning.

Lagrangian Current Measurements

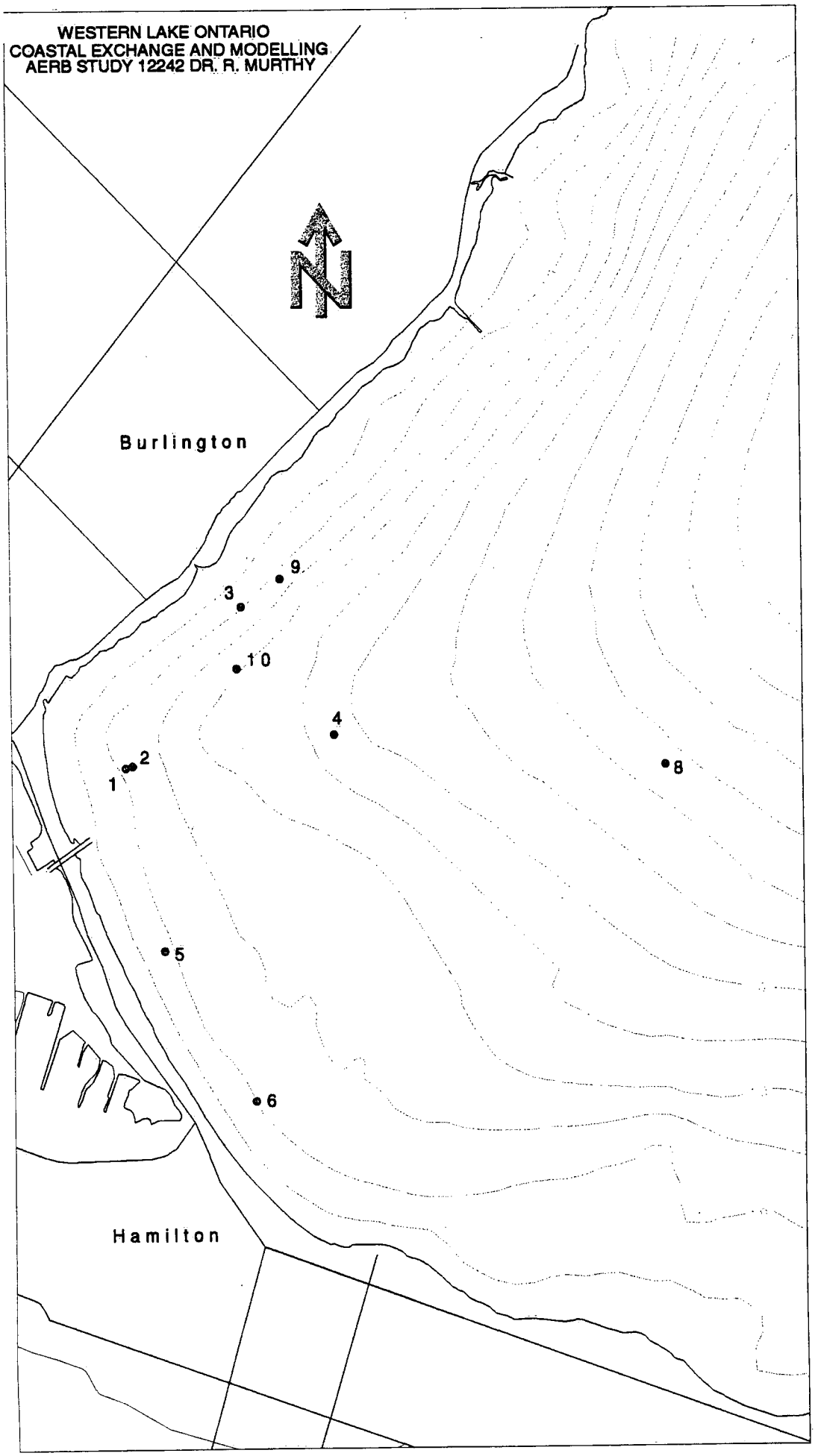
During the three intensive periods, satellite-tracked drogues were launched at station 1 and in September, at station 10. Near real-time position monitoring was accomplished via Telnet connection to Service ARGOS.

Limnological/Meteorological

A Hydrolab water quality profiler was used to collect nearshore data with separate conductivity measurements. Discrete water samples were collected for chlorophyll, Seston and total phosphorous analysis. A second Hydrolab sonde was used for vertical temperature profiles taken at stations along the three transects. Two meteorological buoys were placed at station 8 for data collection throughout the year.

MOORING POSITIONS

Mooring Number	Station Number	Type	Latitude N.	Longitude W.	Sounding
97-00C-13A	1	CM	43° 18' 29"	79° 47' 00"	15.7 m
97-00C-01A	2	ADCP	43° 18' 42"	79° 47' 02"	16.2 m
97-00C-12A	2	CM	43° 18' 40"	79° 47' 57"	17.4 m
97-00C-11A	3	CM	43° 20' 03"	79° 45' 34"	12.7 m
97-00CT-16A	4	CM/T	43° 18' 32"	79° 44' 20"	28.4 m
97-00C-14A	5	CM	43° 17' 13"	79° 46' 30"	12.5 m
97-00C-15A	6	CM	43° 16' 07"	79° 45' 24"	13.1 m
97-00C-17A	7	CM	43° 24' 31"	79° 40' 40"	11.9 m
97-00C-18A	8	ADCP	43° 18' 54"	79° 40' 26"	48.1 m
97-00T-19A	8	T	43° 18' 59"	79° 40' 38"	47.6 m
97-00M-20A	8	M	43° 18' 50"	79° 40' 31"	47.7 m
97-00M-21A	8	M	43° 18' 58"	79° 40' 29"	47.6 m
97-00C-22A	9	CM	43° 21' 11"	79° 44' 02"	10.2 m
97-00S-38A		CS	43° 18' 40"	79° 47' 08"	14.0 m
97-00C-17A	10	CM	43° 18' 50"	79° 45' 49"	22.0 m


WESTERN LAKE ONTARIO
COASTAL EXCHANGE AND MODELLING
AERB STUDY 12242 DR. R. MURTHY
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Burlington
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RV USIPA DOCKED AT CHILUMBA ON LAKE MALAWI, AFRICA

METEOROLOGICAL STATIONS AND THERMOGRAPH MOORINGS, LAKE MALAWI/NYASA, MALAWI, AFRICA

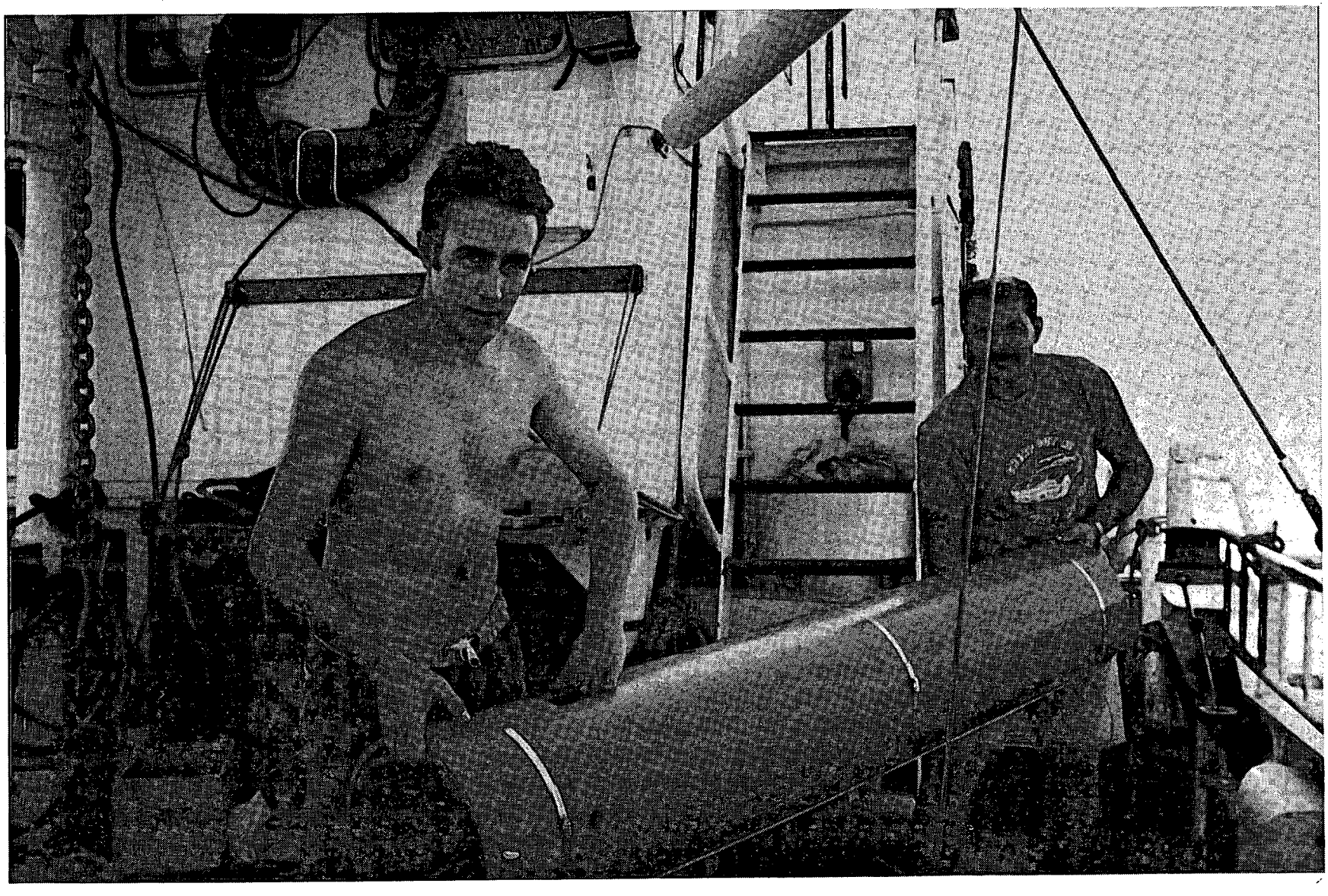
AERB STUDY 12245, DR. P.F. HAMBLIN

This project involved the placement of four thermograph moorings and the installation of four meteorological monitoring stations in and on the shoreline of Lake Malawi. This project was funded through the Global Environmental Facility (GEF), the Canadian International Development Agency (CIDA) and the Overseas Development Administration (ODA) and was called the Southern Africa Development Agency/Global Environmental Facility (SADC/GEF) Lake Malawi/Nyasa Biodiversity Conservation Project. The main purpose of this project was to do research to determine the condition of fisheries and the quality of water in Lake Malawi/Nyasa and in the rivers that flow into the lake. This project was broken down into three main studies: 1) Systematics, to determine the different types of fish in the lake; 2) Ecology, to determine where the different types of fish live, what they eat, when and where they breed and what their life history cycles are; and 3) Limnology, to determine the quality of water in the lake and in the rivers and to determine if the water is good for the fish and safe for humans.

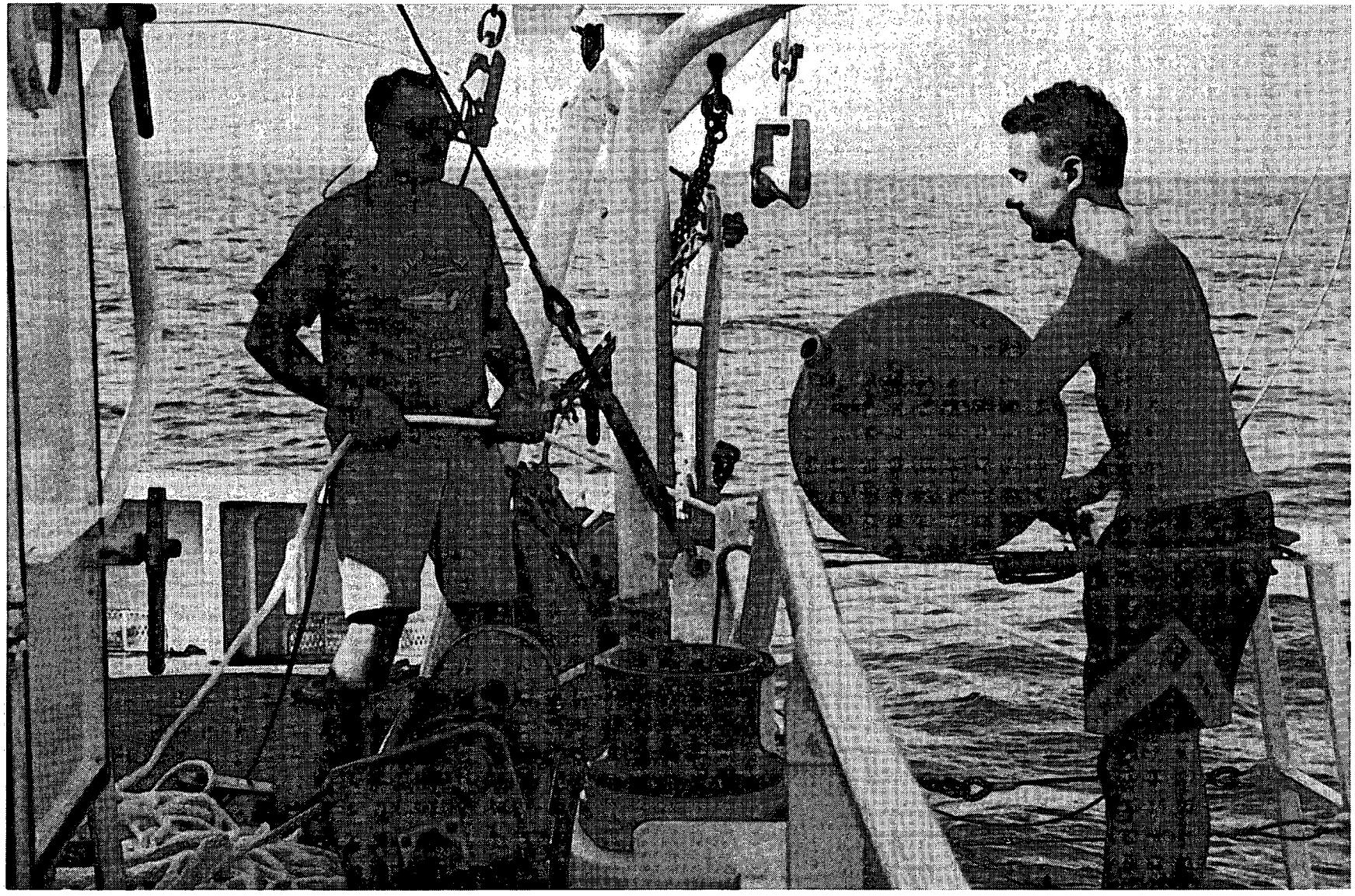
This project involved four trips to Malawi by TOS staff—February 4 - March 7, May 4 - 23, September 6 -15 and November 28 - December 22. During the February/March field trip, only one thermograph and one thermograph/sediment trap mooring was installed due to mechanical problems with the R.V. USIPA which was the only suitable sampling platform. Two meteorological stations were also installed--one at the town of Chilumba in the northern portion of the lake and one onboard the R.V. USIPA. These stations complemented the stations already in operation at Senga Bay and at Likoma Island.

During the May trip, the two moorings installed in February were serviced and two other thermograph and thermograph/sediment trap moorings were installed. The thermograph/ sediment trap moorings were located in the deeper centre portion of the lake. On the September trip, the Northern thermograph mooring was removed due to lack of thermographs due to failing batteries in the Onset Stowaways that were left over from a previous project. Large sediment traps installed on the two previous trips were also replaced with smaller and easier handled traps. On the December trip, all four moorings were again installed as batteries were replaced in all thermographs as well as the purchase of three new thermographs capable of being deployed at deeper depths.

In addition to installing and servicing the moorings and meteorological systems, TOS staff participated in full lake limnological cruises onboard the R.V. USIPA. A total of 27 stations were visited when the full lake sampling cruises were done. Sampling at most stations included a CTD cast to near bottom, an integrated sample from surface to 50 m and a Licor light measurement. Zooplankton net hauls were also done at selected stations. In addition, at five stations, a depth profile was done by bottle cast from up to 20 depths for dissolved nutrients, major ions, dissolved silicate, carbon/nitrogen, DOC, DIC, chlorophyll a and phytoplankton. A surface temperature reading and Secchi disc reading were also obtained at each station where possible.



SEDIMENT TRAP USED IN LAKE MALAWI, AFRICA



SURFACE MARKER AND LINE DEPLOYMENT ON LAKE MALAWI, AFRICA

Additional sampling was done on the May cruise for Dr. L. Lockhart, DFO, Winnipeg, on the September cruise for Ms. P. Ramlal, University of Waterloo. Ms. Ramlal was onboard the R.V. USIPA for the December cruise to sample for 13C and 14C DOC, size fractionated DOC, 15N ammonium/nitrate/DON, 13C methane and DIC, 13C particulate carbon, 15N particulate nitrogen, 13C zooplankton, 13C and 15N sediment trap material as well as DOC measurements. Dr. R.F. Weiss and Mr. M.K. Volmer, Scripps Institute of Oceanography were onboard for the September cruise and sampled for chlorofluorocarbons, heliu-3/low level tritium, radiocarbon and nitrogen/argon at selected depths on profile stations.

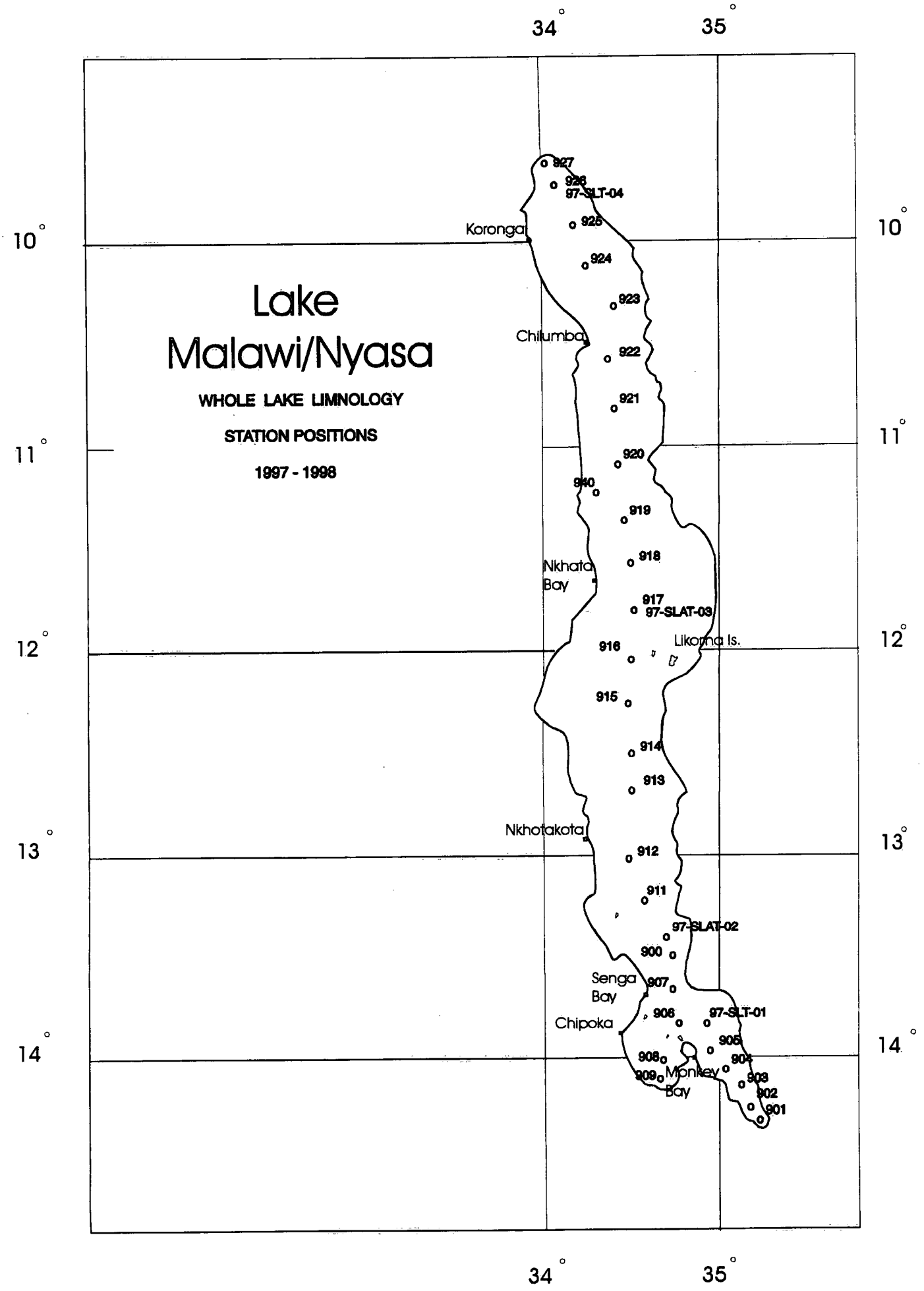
On the February/March and December trips, TOS staff assisted in sample collection from the rivers flowing into Lake Malawi/Nyasa. Samples were collected from the Linthipe, Lifidzi, Madzipulu, Kamkogwe, Songwe, Lufrya, North Rukuru, North Rumphi, South Rukuru, Luweya, Dwangbazi and Dwangwa rivers and from the outflow from Chia Lagoon.

MOORING POSITIONS

MOORING NUMBER	LATITUDE S.	LONGITUDE E.	INSTRUMENTS
97-SLT-01	13° 52' 07"	34° 51' 57"	T (10, 25, 35, 45, 55, 65, 80, 95, 105, 115)
97-SLAT-02	13° 25' 58"	34° 44' 30"	T (6, 12, 18, 24, 32, 40, 50, 65, 85, 110, 143, 170, 198) SED (100, 140, 180)
97-SLAT-03	11° 49' 48"	34° 29' 42"	T (6,1 2, 22, 35, 50, 70, 103, 142, 200, 260, 320, 361) SED (100, 180, 300)
97-SLT-04	9° 42' 18"	34° 03' 39"	T (10, 30, 50, 75, 100, 150, 210)

STATION LOCATIONS FOR WHOLE-LAKE LIMNOLOGICAL SAMPLING CRUISES

STATION NUMBER	LATITUDE S.	LONGITUDE E.	DEPTH m
900	13° 30' 00"	34° 44' 04"	170
901	14° 21' 12"	35° 13' 54"	22
902	14° 15' 30"	35° 09' 48"	43
903	14° 09' 18"	35° 06' 00"	56
904	14° 03' 00"	35° 01' 18"	72
905	13° 56' 34"	34° 57' 54"	93
906	13° 52' 20"	34° 47' 44"	122
907	13° 40' 34"	34° 44' 05	148
908	14° 00' 00"	34° 42' 46"	93
909	14° 09' 11"	34° 40' 08	47
911	13° 14' 14"	34° 37' 20"	205
912	13° 00' 04"	34° 33' 40"	255
913	12° 43' 00"	34° 30' 00"	285
914	12° 32' 27"	34° 30' 00"	286
915	12° 18' 23"	34° 30' 00"	365
916	12° 04' 26"	34° 30' 00"	360
917	11° 49' 44"	34° 29' 35"	362
918	11° 36' 30"	34° 30' 00"	440
919	11° 21' 02"	34° 28' 42"	530
920	11° 05' 17"	34° 27' 37"	685
921	10° 49' 13"	34° 26' 46"	560
922	10° 33' 35"	34° 25' 43"	460
923	10° 17' 54"	34° 24' 49"	500
924	10° 07' 11"	34° 18' 34	466
925	09° 55' 59"	34° 12' 20"	340
926	09° 42' 25"	34° 04' 05	254
927	09° 33' 58"	34° 00' 16"	112


34°
35°
10°
11°
12°
13°
14°
Lake
Malawi/Nyasa
WHOLE LAKE LIMNOLOGY
STATION POSITIONS
1997 - 1998
927
926
97-SLT-04
925
Koronga
924
923
Chilumba
922
921
920
940
919
918
Nkhata
Bay
917
97-SLAT-03
Likoma Is.
916
915
914
913
Nkhotakota
912
911
97-SLAT-02
900
Senga
Bay
907
906
97-SLT-01
Chipoka
905
908
904
909
Monkey
Bay
903
902
901

CESIUM TRACER SAMPLING
AERB STUDY 12247, DR. J.P. COAKLEY

The purpose of this study was to determine dispersal patterns of a cesium tracer in the bottom sediments from a dispenser at a location in the Burlington Basin of Western Lake Ontario. Dive support was used for inspection and refurbishment of the cesium dispenser, as outlined below, while the study was in progress in order to protect the integrity of the site.

DATE	JOB DESCRIPTION
June 19	Inspect, video and retrieve dispenser
June 26	Redeploy, video
July 4	Redeploy dispenser
July 21	Retrieve and redeploy dispenser (no cesium added)
August 15	Inspect dispenser, install "rocker arm" (no cesium added)
September 2	Retrieve and redeploy dispenser
September 29	Retrieve dispenser
September 30	Redeploy dispenser
October 15	Inspect dispenser

On Oct. 08th two technologists from this section assisted Dr. Coakley with a sediment sampling survey aboard the GOOSE III in and around the cesium dispenser. Sampling consisted of Shipek grabs, utilizing the winch and crane on the GOOSE III. Positioning was obtained using the Magnavox suitcase unit in NAD 27. The differential antennae were placed on top of the crane's block for optimum positioning accuracy. Light winds and intermittent fog occurred during sampling.

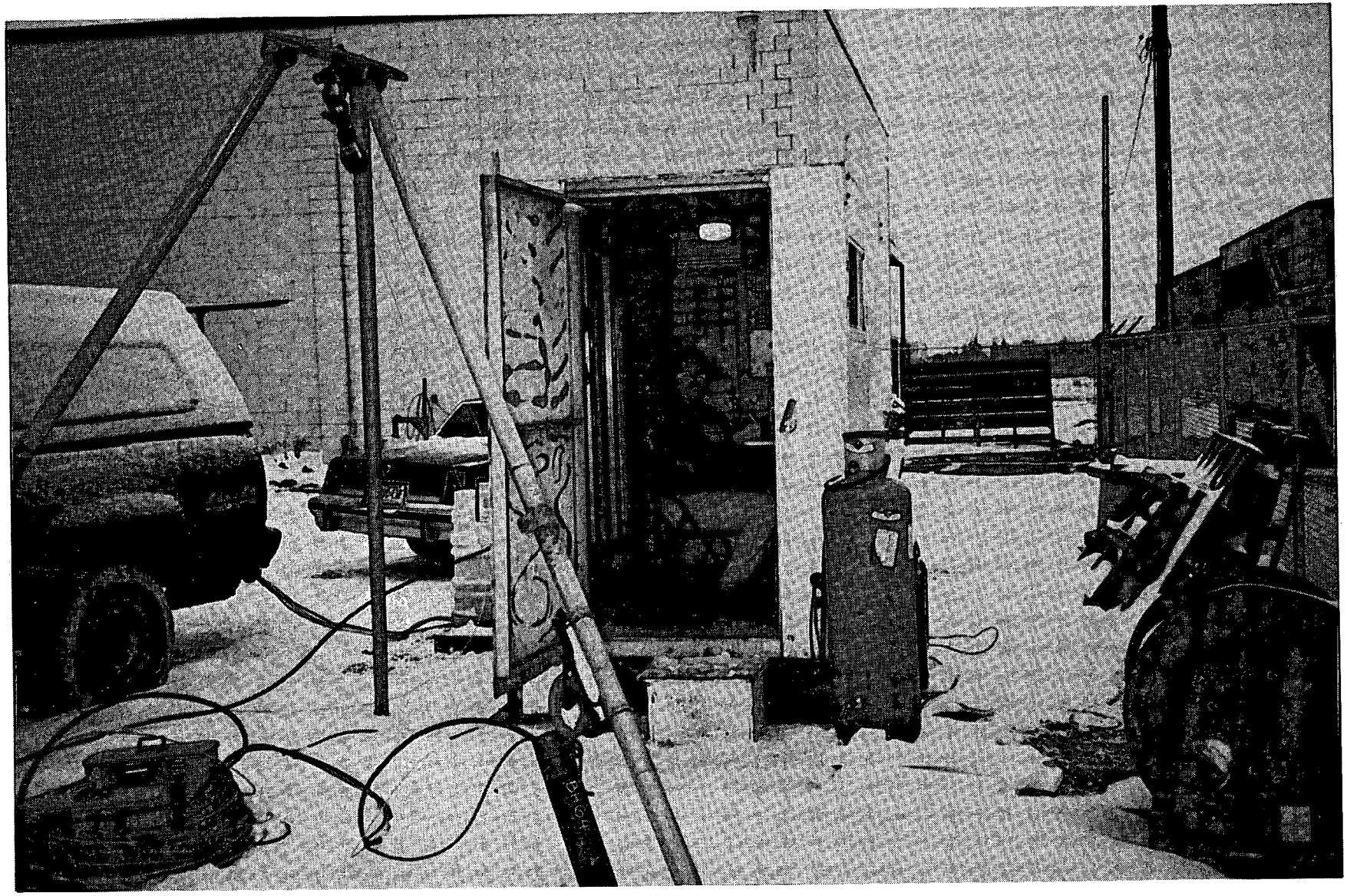
A second sediment survey was completed on November 18th from the launch PETREL under breezy but relatively calm conditions.

STATION POSITIONS - OCTOBER SURVEY

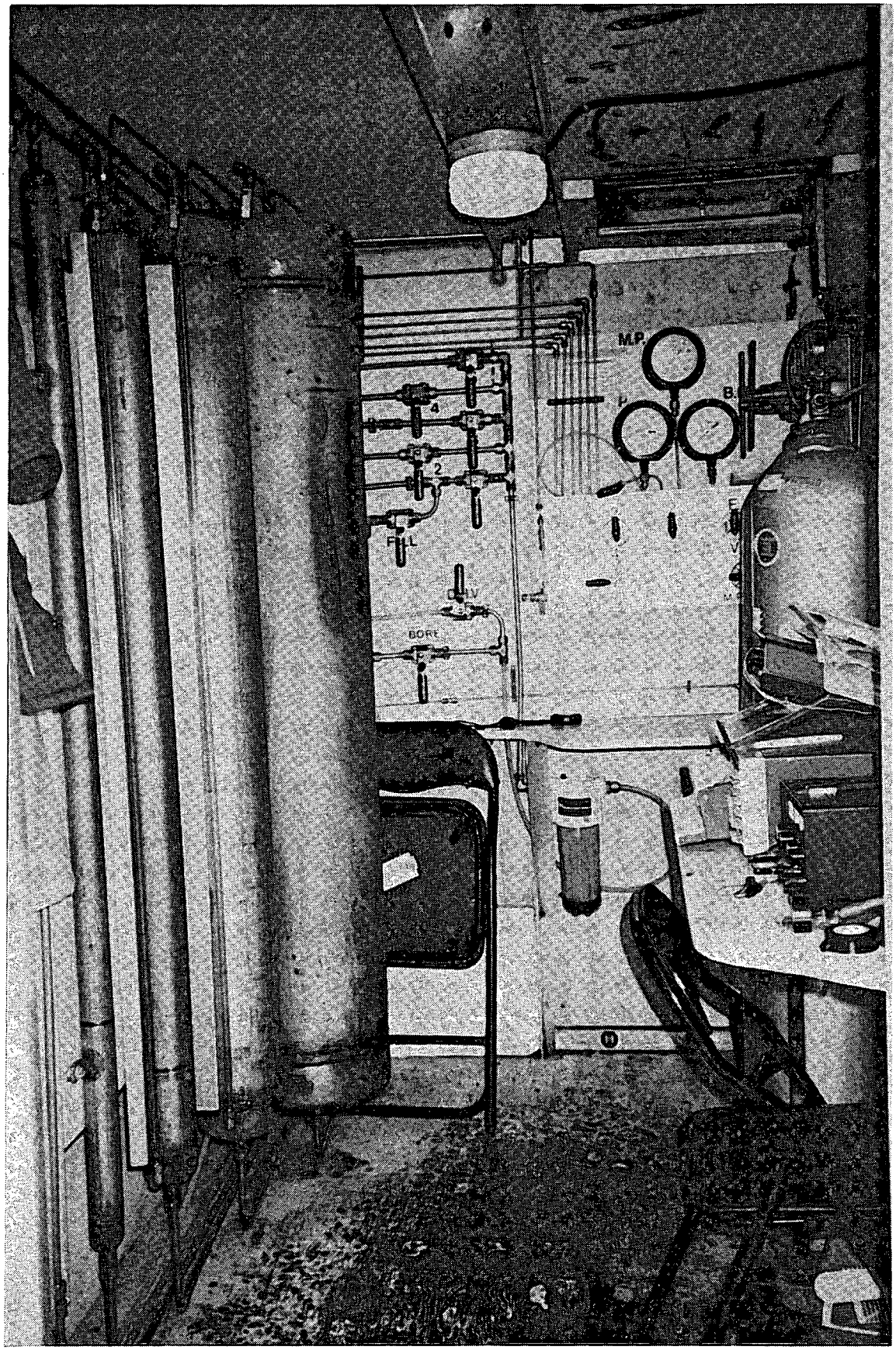
SAMPLE ID	NORTHING	EASTING
1-1	4795880	598443
1-1	4795871	598457
1-1	4795880	598449
1-2	4795961	598458
1-3	4796366	598477
2-1	4795888	598474
2-2	4796156	598582
3-1	4795872	598471
3-2	4795922	598543
3-3	4796231	598871
4-1	4795876	598500
4-2	4795975	598760
5-1	4795862	598480
5-1	4795862	598478
5-2	4795860	598570
5-3	4795870	599077
6-1	4795848	598501
6-2	4795745	598764
7-1	4795856	598480
7-2	4795790	598544
7-3	4795490	598844
8-1	4795833	598470
8-2	4795562	598587
9-1	4795850	598472
9-2	4795760	598469
9-3	4795471	598468
10-1	4795832	598459
10-2	4795557	598352
11-1	4795858	598465
11-2	4795787	598399
11-3	4795487	598086
12-1	4795849	598440
12-2	4795744	598180
13-1	4795861	598461
13-2	4795867	598377
13-3	4795864	597868
14-1	4795875	598441
14-2	4795980	598168
15-1	4795866	598460
15-2	4795932	598399
15-3	4796269	598084
16-1	4795892	598463
16-2	4796154	598345

STATION POSITIONS - OCTOBER SURVEY

SAMPLE ID	NORTHING	EASTING
1-1	4795880	598443
1-1	4795871	598457
1-1	4795880	598449
1-2	4795961	598458
1-3	4796366	598477
2-1	4795888	598474
2-2	4796156	598582
3-1	4795872	598471
3-2	4795922	598543
3-3	4796231	598871
4-1	4795876	598500
4-2	4795975	598760
5-1	4795862	598480
5-1	4795862	598478
5-2	4795860	598570
5-3	4795870	599077
6-1	4795848	598501
6-2	4795745	598764
7-1	4795856	598480
7-2	4795790	598544
7-3	4795490	598844
8-1	4795833	598470
8-2	4795562	598587
9-1	4795850	598472
9-2	4795760	598469
9-3	4795471	598468
10-1	4795832	598459
10-2	4795557	598352
11-1	4795858	598465
11-2	4795787	598399
11-3	4795487	598086
12-1	4795849	598440
12-2	4795744	598180
13-1	4795861	598461
13-2	4795867	598377
13-3	4795864	597868
14-1	4795875	598441
14-2	4795980	598168
15-1	4795866	598460
15-2	4795932	598399
15-3	4796269	598084
16-1	4795892	598463
16-2	4796154	598345



HYDRAULIC TESTING AT SMITHVILLE, ONTARIO



THE HYDRAULIC TESTING TRAILER

GROUNDWATER REMEDIATION PROJECT
AERB STUDY 12260, K. NOVAKOWSKI

Technical Operations Section supported the Groundwater Remediation Project throughout the year with one technician being permanently assigned with additional personnel as required.

Again, most of this year was spent in Smithville, Ontario at the Chemical Waste Management Site (CWML). This is an orphaned chemical waste storage and transfer facility that had been leaching contaminants into surrounding aquifers which has now been taken over by the Ministry of Environment and Energy. Remediation is in progress with a continual pump and treat technique being used through wells in the overburden. Three angled boreholes were installed approximately 180 feet into the bedrock this year by Longyear Drilling Inc. A total of eighteen wells have been installed for GRP/AERB over the past two years. Technical Operations staff assisted in logging, surveying, sampling, hydraulic testing and regular monitoring of the boreholes. Two laboratory trailers, generators, an ATV, snowmobiles, an Argo and vehicles have been implemented to accommodate studies at this field site. The purpose of this study is to develop a conceptual model of groundwater flow in the bedrock beneath the site. This is necessary in developing future remediation or containment methods.

Point Pelee was another ongoing project started in 1993 and continued into this year. Since then, one hundred and fifteen monitoring wells have been installed along two cross-sections and at three septic bed sites, of which five wells were completed this year. These and all wells and test holes have been logged and located with the information recorded on the appropriate water well record form. This study is part of a joint project between Parks Canada and AERB which is investigating high nutrient concentrations in the marsh. These wells are being monitored and sampled on a regular basis. Cores and water samples have also been obtained from the lake and marsh periodically.

Another ongoing project started in 1996 was at the Pinery Provincial Park. Four water table and two multi-level sampling wells were installed this year for a total of twenty monitoring wells. These were all surveyed and had well protectors installed this year. This was done as part of a joint project between AERB and the University of Western Ontario, the purpose of which is to investigate high nutrient levels found in surface water samples of the park. MOEE water well record forms were completed for all wells and forwarded to MOEE in Toronto for filing.

These projects will continue to be supported throughout the winter months.

Technical Operations Section also supported Jeff Markle, MOEE with the removal of a temperature logger mooring installed in the Huron County Township Quarry on County Road #31 East of the town of Bayfield, Ontario. This was done as part of an ongoing joint project with AERB and the Ontario Ministry of Environment and Energy, which is attempting to determine the direction and temperature of groundwater flow from the quarry lake, and its effects on trout spawning beds in neighbouring Trick Creek.

The three Brancker loggers were removed on November 21. The mooring has been in place since June 1993. This project is now completed and should no longer require support.

AQUATIC ECOSYSTEM CONSERVATION BRANCH

LONG RANGE TRANSPORT OF AIRBORNE CONTAMINANTS
AECB STUDY 12310, DR. W.M.J. STRACHAN

Technical operations supported this project which will produce a mathematical model to aid in the study of how organic contaminants transported long distances in the atmosphere enter and affect Lake Superior. Data collected will indicate the loading of both organic and inorganic contaminants by several large rivers systems into Lake Superior. The river mouths were sampled from small boats while the lake itself was sampled from the CCGS LIMNOS.

Eleven rivers were selected for sampling in the following manner: The launch was anchored on station. A water sample was collected for inorganic analysis from a small inflatable plastic boat. At each site on the Canadian shore, water was pumped through a Westfalia centrifuge to remove the suspended sediments and a volume of 320 litres was collected in 4 40-litre stainless steel cans for extractions of organics by both Goulden and resin column extractors. A suspended sediment sample was collected from 1200 litres of centrifuged water and frozen for organic analysis. A sediment sample was collected, using a mini Shipek and frozen for organic analysis.

The three-ton truck was utilized as the tow vehicle for the boat and as lab facilities for the extractions and storage of samples. A dual wheel 4X4 crewcab was used to launch and retrieve the boat at the selected river sites.

The rivers sampled were: Sturgeon River, Michigan; Montreal River, Ontario; Michipicoten River, Ontario; White River, Ontario; Pic River Ontario; Nipigon River, Ontario; Kaministiquai River, Ontario; St. Louis River, Minnesota; Nemadji River, Wisconsin; Bad River, Wisconsin and the Ontonogan River, Michigan.

LONG RANGE TRANSPORT OF AIRBORNE POLLUTANTS-TURKEY LAKES WATERSHED
AECB STUDY 12315, R.G. SEMKIN

The Turkey Lakes Watershed Study is an ongoing project monitoring the movements and effects of Long Range Transport of Airborne Pollutants (LRTAP) on the sensitive aquatic ecosystems of the watershed. The chemical and hydrological monitoring of the study area was begun in 1980 and has been supported by Technical Operations staff throughout this period.

The study site is located on the Canadian Shield 50 km North of Sault Ste. Marie and 25 km East of Lake Superior. The watershed consists of five small lakes from 6 ha to 52 ha in size. The area is in the very rugged Algoma Highlands, totally forested, uninhabited and receiving the highest amounts of precipitation in Canada, East of the Rockies.

Technical Operations' staff support consisted of one full-time technician stationed in Sault Ste. Marie. Equipment support included one full-time 4-wheel- drive vehicle used for transport to the

study area. In addition, 4 snowmobiles and 4 all-terrain vehicles were supplied and maintained for use as transportation throughout the watershed. All tools, sampling and safety equipment for the study were also supplied.

A security system on the camp at the work site and a 2-way radio system were operated by Tech. Ops. staff and maintained by Quattra Communications in Sault Ste. Marie. All roads and trails in the watershed were maintained with assistance from the Canadian Forestry Service at Sault Ste. Marie.

The Department of Fisheries & Oceans support consisted of six small aluminium boats and one canoe (14 - 16 ft.). One outboard motor and items to make the boats safe and operational were also supplied. Tech. Ops. supplied 2 electric motors.

Tech. Ops. staff supported Aquatic Ecosystem Conservation Branch staff in chemical and hydrological monitoring of the watershed. Hydrological monitoring consisted of gauging and sampling seven stream locations throughout the watershed on a weekly basis. The samples were analyzed for numerous chemical parameters. Five lakes were sampled on a bi-weekly schedule for the same chemical parameters with the exception of the spring and fall when they were sampled once a week. During the winter, snow cores were collected at 14 locations on a weekly basis. During the year, rain and snow volume samplers (Nipher) were measured and changed weekly. Isco samplers at two locations in the watershed are operated year round. Samples were collected every 12 hours.

To supplement hydrological and chemical data, a full meteorological station and solar radiation unit were operated on a year round basis. A new MET III system is in operation. This system allows data to be dumped to a disk on site and the generation of a backup disk. The data disk is shipped to CCIW each month and on site data processing is performed. The MET III system also allows MET program changes to be made on site and the MET datalogger can be erased to provide continued use with no interruption of data collection. This system also includes a UVB sensor with continuous data recorded on the Campbell datalogger.

The Batchawana Lake datalogger site was decommissioned this summer due to funding cuts to the study. Soil temperature and soil moisture values are no longer available from this site. The datalogger and other related equipment was removed and returned to CCIW.

The camper lab set up at the Batchawana Lake location for storage and emergency survival was destroyed this past winter due to the heavy snowfall. The snow roof was salvaged and will be re-used. The plans are to construct another building at the site and equip it with emergency supplies. Until this building is constructed, emergency supplies are being stored in the snow cave shed to be used during an emergency when necessary.

Service was provided by Tech. Ops. to 1 Campbell datalogger, 2 storage modules and 2 solar power panels.

A snow melt cave constructed at the Batchawana Lake location will be in service during the winter months until the end of the spring runoff period. In addition, at this same location, a bulk precipitation sampler was installed and will be serviced year round on a weekly basis.

All maintenance and repairs to equipment, buildings and vehicles were performed by Tech. Ops. staff.

Two portable radio systems for the Turkey Lakes Watershed were used by personnel when working alone. These radios allow calls to be made to Sault Ste. Marie from anywhere in the watershed.

A winter cover was constructed and installed at stream site S6. This will prevent the weir pipes from freezing and causing extensive damage to the weir wall over the winter and through the spring. The cover appears to be working well.

A new winter trail has been brushed through to access 2 snow core sites and groundwater wells at the Batchawana Lake location.

No spring runoff intensive sampling took place this year since funding to carry out the work required was not available. Instead, staff at the site managed to continue spring sampling during the spring melt on a reduced schedule. TOS staff was required to commute to and from the site on a daily basis instead of living at the camp—again due to funding cuts. This travel was done during very adverse spring road conditions.

Over the summer, equipment support and accommodations at the camp were provided to various Government and private studies occurring in the watershed. As well, the road and trail system within the watershed was greatly improved this year as part of the requirements of a Forestry Canada Tolerent Hardwood Ecosystem Research Project which took place over the summer months. The study itself was limited to various sub-basins on the lower half of the watershed. The trees harvested were trucked out of the bush on a daily basis from August to October. NO problems occurred between the logging trucks and the TOS vehicle since both were equipped with radio communications and thus were able to avoid each other when necessary.

A mercury precipitation sampler for W.J. Strachan was installed on the MET Hill in August. The sampler was serviced every 2 weeks by TOS and AECB staff. The samples collected were shipped via courier to CCIW immediately after collection. The sampler was dismantled and returned to CCIW in December.

WATER AND SEDIMENT SAMPLING, MOOSE RIVER WATERSHED
AECB STUDY 12340, DR. K. MUNKITTRICK

Technical Operations Section supported this project August 18 - 23 with field support on the Groundhog River at Fauquier and the Mattagami River at Smooth Rock Falls in the Kapuskasing area. The Groundhog River is a tributary of the Mattagami River which joins the Moose River above Moose River Crossing.

The sampling routine on each river consisted of identifying transects and collecting samples at from three to seven points across each transect. Typically, at a point midstream, a Hydrolab profile was done for water quality parameters such as depth, temperature, pH, specific conductance and dissolved oxygen . Zooplankton net hauls, a Secchi disk observation, bulk

water, DIC and phytoplankton collections were also done. Benthic samples and surficial sediment was collected near the river banks and also at points further out where sediment was found. Sediment was collected using a mini PONAR grab and the Technical Operations surficial sediment sphincter corer. The sediment grabs were sieved onboard as they were collected.

The Groundhog River was sampled upstream of the Carmichael Falls hydro station. The Boston Whaler was launched at a good boat ramp on the right bank of the river just upstream of the dam and transects were completed to a point about eight kilometres upstream. The following day the boat was launched at a good ramp on the right bank of the Groundhog River just below the Hwy 11 bridge in Fauquier. Transects were completed upstream of the bridge as far as the rapids and several kilometres downstream. The Mattagami River was sampled next. The boat ramp on the right bank of the river just upstream of the Hwy 11 bridge was used to launch the Whaler and the river was sampled upstream approximately ten kilometres. The next day the field party travelled to the Missinaibi River at Mattice. Water levels in the Missinaibi were very low—too low to launch the boat or travel the river. Instead the Mattagami was revisited and sampled to a point approximately five kilometres downstream of the Smooth Rock Falls Pulp and Paper Mill. The boat was launched at a ramp on the right bank of the river a short distance downstream of the mill.

Water levels in these rivers were especially low this year due a lack of precipitation in July which caused considerable wear and tear on the outboard motor propellers given the darkly stained water. The rivers were passable with care with the exception of the Missinaibi which was too low to navigate.

PULPMILL EFFLUENT SAMPLING AT THUNDER BAY AND DRYDEN, ONTARIO
AECB STUDY 12340, DR. K. MUNKITTRICK

Technical Operations Section assisted Dr. M. Tavendale with the collection of centrifuged pulpmill effluent samples and bottom sediment cores and grab samples from two Avenor pulpmills in Northwestern Ontario from June 28 - July 4. The samples were required for use in experiments investigating the effects of effluents collected at several points in the treatment process on the survivability of rainbow trout.

The field party departed from Burlington in the three-ton truck with a Starcraft aluminum boat in tow. In Thunder Bay, three 120-litre plastic barrels of effluent were collected from the Avenor Mill—one of secondary Kraft mill effluent, one of secondary newsprint mill effluent and one of a blended effluent. A 140-litre sample of the blended effluent was centrifuged using a Westfalia separator to facilitate pressure filtering back in the lab. A 500 ml bottle of sludge was collected from each effluent stream. Bleach plant samples were collected by Avenor environmental staff. The aluminum boat was launched at a public boat ramp about one kilometre downstream of the mill in the Kaministiquia River. Sediment grab samples were collected both up and downstream of the mill's outfall and a Tech. Ops. core was collected downstream of the outfall. The core was required to look for evidence of compounds found in the effluent before the introduction of modern treatment techniques and was sectioned at the boat ramp.

The field party travelled to the Avenor mill in Dryden. The boat was launched from the bank of the Wabigoon River adjacent to the Margerite Street bridge and taken upstream to the effluent outfall. Grab samples were collected by PONAR above and below the outfall. A Tech. Ops. core was collected downstream of the outfall and sectioned at the bridge.

The following day a safety indoctrination was attended at the main gate to the mill. Four litre samples of the acid, basic and blended bleach plant effluents were collected from the bleach plant. Three 120-litre samples of secondary effluents were collected and three 140-litre samples were also collected but only one was centrifuged due to time constraints; the remaining two were processed later on the dock in Burlington. Avenor staff were to collect effluent and sludge samples from their treatment pond system but due to the heavy rain and high wind this sampling was put off until later when the samples will be collected and shipped to Burlington. Sludge samples were collected from three sites near the pond walls.

LAKE REMEDIATION, HAMILTON HARBOUR
AECB STUDY 12344, DR. J. SHERRY

The purpose of this study was to examine biological end points of fish exposed to areas of sewage and high PAH's.

On April 14, potential site locations were chosen for installation of fish moorings. On April 21, trial cages with 5 Rainbow Trout were deployed at 3 test sites in Hamilton Harbour. The fish were retrieved 4 days later. All fish were alive and healthy. On May 13, 5 cages, consisting of 20 fish, were installed at 6 sites in the harbour. On May 17, an additional 3 cages were added to each of the 6 sites. On May 23, SPMD's were also installed. Between May 20 to June 6, one cage was retrieved from each site. Water and sediment samples were collected at the 6 sites on May 29. Water samples were pumped from 4 m at each site on June 5. On May 23, one cage was missing due to vandalism.

On November 4, 3 cages, consisting of 5 fish, were installed on 3 moorings in Hamilton Harbour. They were retrieved on November 25.

STATION POSITIONS

STATION NUMBER	LATITUDE N.	LONGITUDE W.
LAX	43° 16' 31"	79° 52' 27"
Randle Reef	43° 16' 32"	79° 49' 57"
Windermere	43° 16' 20"	79° 47' 26"
Dofasco	43° 16' 33"	79° 47' 38"
WAVES Tower	43° 16' 13"	79° 45' 33"
LaSalle	43° 18' 11"	79° 50' 00"
2	43° 18' 24"	79° 48' 34"
Burlington STP	43° 18' 29"	79° 48' 28"

SAINT JOHN RIVER ICE JAM STUDY
AECB STUDY 12376, DR. S. BELTAOS

Work on the Saint John River was a continuation of a study started in 1991. The project is interested in the formation of ice jams upstream of Grand Falls and the potential interruption of hydro-electric power generation. Traditionally the study involved 3 distinct parts:

1. The ice thickness is measured at locations where the ice has formed jams. Between February 24 and March 7 a survey crew measured ice thickness at 18 different locations between St. Leonard, N.B. and Dickey, Maine. Ice thickness was measured first by drilling holes, using the 6" powered ice auger and then using calibrated rods to measure the thickness as well as the bottom depth. Water levels and ice elevations were then determined, using the electronic level in conjunction with existing TBM's which had previously been established along the river.

2. Observations of the ice-jam breakup are made. Dr. Beltaos and 2 staff from TOS returned to Edmunston on April 21 to monitor the breakup and measure the changes in water levels. In addition, water samples were collected from the bridges at Edmunston and Clair during the breakup event which were later analyzed for sediment content.

3. River cross-section measurements are made in areas where ice jams have occurred. This year a TOS survey team returned in May and completed cross-sectional surveys at 4 sites near Allagash Maine. Cross-sections were done using the T-1600/DI-3000 Distomat for the land portion, while a Lowrance sounder mounted on the inflatable Zodiac was used to measure bottom depths. Distance across the river was determined using a Microfix positioning system borrowed from CHS.

CAYUGA ICE JAM STUDY
AECB STUDY 12376, DR. S. BELTAOS

A large ice jam formed in the Grand River at Cayuga during the month of February and staff from TOS visited the area to make observations and mark water levels. A survey team returned to the area from June 9 - 20 to survey a total of 15 river cross-sections near the area of the jam.

Cross-sectional surveys were done, using the T1600/DI-3000 Distomat system for the land portion while a Lowrance sounder mounted on the 26' canoe was used for the river depths. Distance across the river was determined using a Microfix positioning system borrowed from CHS. The cross-section elevations were all tied into a DOT bench mark, using the Wild NA-2000 automatic level.

SURVEYING AN ICE JAM ON THE GRAND RIVER NEAR CAYUGA, ONTARIO

MALVERN SURVEY ON THE SAINT JOHN RIVER, NEW BRUNSWICK
AECB STUDY 12376, DR. S. BELTAOS

Technical Operations supported this project May 6 -12 on the upper Saint John River in New Brunswick. As part of the Saint John River Ice Jam Study, samples of suspended sediment and in situ particle size data were required as soon as practically possible after the river was free of ice.

Four transects were sampled on this trip. The first site was situated just above the international bridge at St. Leonard. The Zodiac inflatable was launched from a boat ramp in the small park next to the Canada Customs Office at the bridge. Current measurements were made at 10 points equally spaced across the river—in this case at 20-metre intervals. Three current speed measurements were taken at each interval—at.2, .6 and .8 of the water depth, using a Price current meter. Point Integrating suspended sediment samples were collected, using a P72 at the top, middle and bottom of the water column at each current vertical. Samples were collected from each depth that a Malvern reading was collected as well as from near surface at the middle vertical for organics analysis. Dip samples were collected from each vertical. Finally, Malvern readings were collected at the surface at every second current meter vertical for a total of five. Three more transects were sampled during the following three days in the same manner—at Edmundston above the international bridge, at Clair above the international bridge and above the Dickey Bridge upstream of the Little Black River. The boat was launched from the river bank downstream of the bridge at Edmundston, from the town ramp in Fort Kent, Maine for the Clair transect and from the river bank just below the Dickey bridge. The boat was retrieved from the boat ramp just inside the mouth of the Allagash River when the Dickey transect was completed. This required a steam of several kilometres but the boat ramp here was much better. The personnel from this section remained in the study area to clean up a few surveying tasks and transited to Burlington on May 16th.

UVA AND UVB EFFECTS, DORSET AND TURKEY LAKES, ONTARIO
AECB STUDY 12378, DR. R.A. BOURBONNIERE

Two lakes were chosen from each location to study the affects of UVA and UVB on carbon dioxide and carbon monoxide, dissolved organic and inorganic carbon and CH4 in the water columns. The lakes chosen near the town of Dorset were: Chub and Plastic lakes. The reasoning for sampling these lakes was that there is considerable background data collected on these lakes by the Ministry of the Environment (MOE) for climate change over the past 25 years. The lakes sampled in the Turkey Lakes Watershed were Big Turkey, Little Turkey and Wishart. Again these lakes were chosen because of the significant amount of background data available.

In the Dorset area, Chub lake was the first lake sampled. The boats and equipment, including a meteorological station, were assembled on the shore at the Ministry of the Environment launching site, towed into position at the deep hole and marked by a permanent buoy. While on site, samples were collected from the following depths: 5 cm,10 cm, 25 cm, 75 cm, 125 cm,175 cm, 250 cm, 300 cm, 5 metres, 10 metres and 15 metres. Oxygen, pH, conductivity, and temperature were measured utilizing an Aqua Check instrument. Sampling was conducted

at 1100,1300, 1500 and 1700 hours on August 5th. Samples were transported back to the lab for analysis after two profiles were completed and at the completion of the 1100 and 1300 sampling periods. Lab space was utilized at the MOE Forestry Lab in Dorset.

Plastic lake was sampled on August 7th. The depths sampled were 5 cm, 10 cm, 25 cm, 75 cm, 125 cm, 175 cm, 2.5 m, 3.0 m, 5.0 m, 8.0 m and 13.0 m. Sampling times were: 1000, 1200, 1400 and 1600 hours. The samples were returned to the lab following the same procedure as Chub Lake.

After completion of the sampling, all equipment was dismantled and packed for the return trip to CCIW on August 8. The equipment was stored in the warehouse for use at Turkey Lakes during the weeks of August 11 and 18.

The sampling depths at the Turkey Lakes sites were the same in the top 3 metres as the lakes sampled in the Dorset area. Bottom depths varied due to total depths of the lakes. The samples were collected at two-hour intervals as in the Dorset area. Samples were taken back to the lab trailer for analysis at the Turkey Lakes main camp.

A Hydrolab H2O was utilized instead of the Aqua Check since it was found to be a faster more reliable instrument.

AQUATIC ECOSYSTEM PROTECTION BRANCH

IRGAROL SAMPLING, VANCOUVER, VICTORIA AND ESQUIMALT HARBOURS
AEPB STUDY 12421, DR. J. MAQUIRE

Support was given to this study during the period July 7 - 17 in Vancouver, Victoria and Esquimalt harbours. Sampling was done utilizing a jet boat supplied by Mr. M. Sekela, DOE, Pacific and Yukon Region. All water and sediment samples were collected for Irgarol—an antifouling chemical utilized on vessels from other parts of the world where its use is not regulated.

Sixteen sites were visited to collect water—16 litres from 1 metre, and sediment from the bottom, using a mini PONAR. At station 21A in Victoria Harbour only sediment was collected. The sediment samples were frozen as soon as possible after collection. The water samples were extracted at the lab in North Vancouver using Methylene Chloride. All frozen samples were shipped by air on dry ice by Kel-Ex Agencies Ltd. of North Vancouver. All remaining samples and equipment were shipped by land.

HARBOUR SAMPLING SITES

SAMPLING AREA	STATION NUMBER	LATITUDE N.	LONGITUDE W.
Vancouver Harbour	BI-9W	49° 18'.02"	123° 01' 23"
Vancouver Harbour	BI-7W	49° 18' 14"	123° 02' 46"
Vancouver Harbour	BI-11W	49° 17' 15"	123° 03' 59"
Vancouver Harbour	BI-1WA	49° 18' 41"	123° 07' 11"
Vancouver Harbour	BI-4W	49° 18' 47"	123° 06' 17"
Vancouver Harbour	MC-1W	49° 18' 48"	123° 05' 09"
Vancouver Harbour	PV-1W	49° 17' 10"	123° 05' 01"
False Creek	FC-7W	49° 16' 26"	123° 06' 16"
False Creek	FC-4W	49° 16' 11"	123° 07' 13"
False Creek	FC-2W	49° 16' 27"	123° 08' 18"
English Bay (Kitt's)	KT-1W	49° 16' 28"	123° 09' 09"
Coal Harbour	CH-2WA	49° 17' 41"	123° 07' 00"
Victoria Harbour	20	48° 25' 21"	123° 22' 51"
Victoria Harbour	21	48° 25' 26"	123° 22' 09"
Victoria Harbour	21A	48° 25' 26"	123° 22' 15"
Victoria Harbour	22	48° 26' 02"	123° 22' 25"
Victoria Harbour	23	48° 26' 39"	123° 23' 45"
Esquimalt Harbour	1	48° 25' 55"	123° 26' 05"
Esquimalt Harbour	2	48° 26' 24"	123° 26' 00"

HAMILTON HARBOUR
AEPB STUDY 12421, D. LIU

On September 4, water samples were collected at Macassa Bay, Grindstone Bay, HMC Dock, and Dofasco Slip. Also, on October 16, a water sample was collected near an anchored ship in Hamilton Harbour. The water samples were analyzed for Irgarol--an antifouling chemical utilized on vessels from other parts of the world where its use is not regulated.

STATION POSITIONS

STATION NUMBER	LATITUDE N.	LONGITUDE W.
Macassa Bay	43° 16' 13"	79° 52' 11"
Grindstone Bay	43° 16' 52"	79° 53' 10"
HMC Dock	43° 16' 33"	79° 51' 10"
Dofasco Slip	43° 16' 04"	79° 48' 01"

IRGAROL SAMPLING, HALIFAX, N.S.; SOREL AND MONTREAL, QUEBEC
AEPB STUDY 12421, DR. J. MAQUIRE

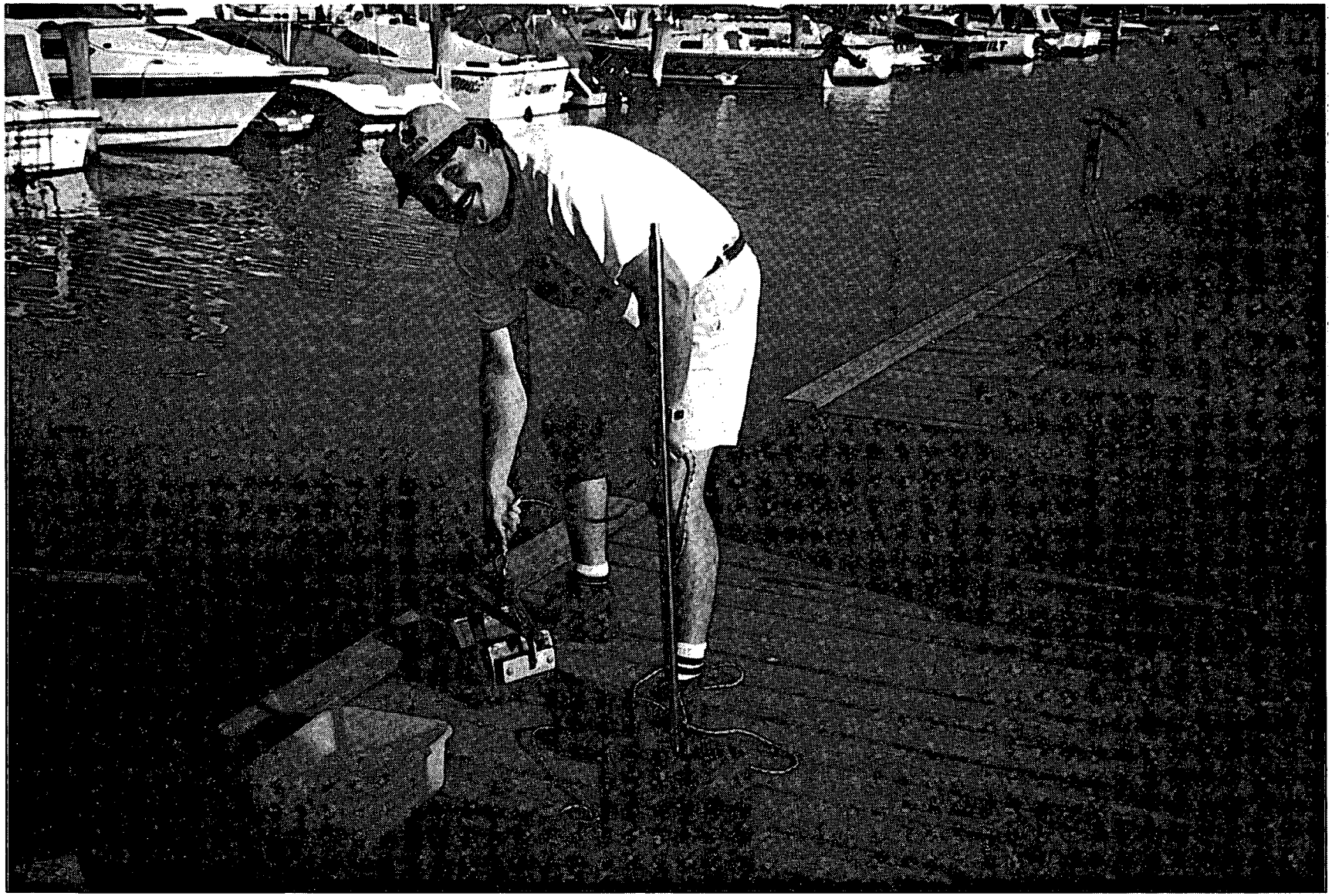
Six sample locations in the Bedford Basin and Halifax Harbour were visited on July 23. A 16-litre water sample and a bottom PONAR sediment sample were taken at each site for testing of Irgarol 1051. A 4-litre sample was also taken at four stations for testing of Tributyltin. Water samples for Irgarol were extracted with methylene chloride. Sediment samples were frozen the same day. Another six sample locations were visited on July 24.

At Sorel, Quebec on July 26, 2 sample locations were visited and sampled as in Halifax. On July 27 at Montreal, six sample locations were sampled as per previous sampling.

TRIBUTYLTIN STUDY, KINGSTON, COLLINGWOOD, HAMILTON, WYE MARSH AND TORONTO
AEPB STUDY 12421, DR. J. MAQUIRE

Sampling was done in support of a study for Dr Maguire that is monitoring the effects of Tributyltin on aquatic snails. Sampling for the study was attempted at several locations including Kingston, Collingwood, Toronto, Wye Marsh and Hamilton Harbour.

At each site sediment samples were collected for bioassay, toxicity and metals analysis. Several grabs were made with oyster tongs to remove large quantities of plant-life and small rocks from the sediment interface. The snails live on the periphyton and rocks. Snails were then picked from the plants and rocks and stored for further analysis. To collect larger, mature snails, rocks along the shoreline were removed from the water and inspected for samples which were then collected.



TAKING A PONAR GRAB SAMPLE IN WINDSOR, ONTARIO

Positions for sampling were located utilizing the Magnavox system in the DGPS and WGS 84 mode. The positions were logged in the field manual in the possession of the researcher.

TRIBUTYLTIN UPTAKE STUDY, WINDSOR TO KINGSTON
AEPB STUDY 12421, D. LIU

Tributyltin was used at one time as an ingredient in marine antifouling paint but is now banned. High levels of this metal are still found in the bottom sediments of many marinas and shipyards where this paint was in use. This study will attempt to determine the rate of uptake of this contaminant by freshwater organisms and identify any toxic effects.

Technical Operations staff supported this study again this year as a follow-up to sampling which occurred in 1996. Sampling was conducted at six sites in the Great Lakes Basin previously identified as having high concentrations of Tributyltin in bottom sediments. The following six harbours were visited: Midland, Kingston, Toronto, Hamilton, Port Stanley and Windsor.

Sixteen litres of water and 500 ml of sediment were collected from each site. The samples were taken back to CCIW for analysis. While in Toronto Harbour additional samples were taken from the Harbour Castle Boat Slip and the Turning Basin near the end of the ship canal. At both stations, surface water and sediment were collected. The following are station positions taken from the hand-held GPS, using the default datum WGS-84:

Harbour Castle Boat Slip: 43° 38' 27" N., 79° 22' 32" W.

The Turning Basin: 43° 39' 09" N., 79° 19' 54" W.

GRAND RIVER SEWAGE EFFLUENT EFFECTS
AEPB STUDY 12422, D. BENNIE

Technical Operations supported this project September 8 - 12 with field support for the collection of water and sediment samples from the Grand River. The study was completed in the vicinity of the Galt Sewage Treatment Plant at the foot of Myers Road in Cambridge. The samples were required to track the movement of certain surfactants released in the sewage effluent as they travel downstream of the sewage treatment plant as well as to identify the presence and effects of estrogen hormones in the sewage effluent on rainbow trout planted in situ at intervals downstream of the plant.

The study area included a stretch of the river from 0.5 kilometres upstream of the Galt STP outfall to a point just downstream of the Glen Morris bridge eight kilometres below the outfall. Seven transects were located on the first day of the survey when a dry run was done. These were a control site at 0.5 km upstream of the outfall, adjacent to the outfall, 0.5 km downstream and at 1, 2, 4 and 8 kilometres downstream. The 16-foot aluminum canoe equipped with a six horsepower outboard motor was launched at the canoe landing in a small park at the control transect. The canoe was paddled, driven and dragged downstream to below the 8 kilometre transect and appropriate sampling sites were selected. The control transect consisted of a single site at midstream, .5 km upstream of the outfall and the outfall transect was sampled in

the effluent stream along the left bank and at midstream. The 0.5 km transect was sampled along the left bank only. The remaining transects were sampled at three points—left bank, mid-channel and right bank. At each site a GPS position was recorded. A four-litre grab sample of surface water was collected as well as a 100 ml sample for major ions. Water chemistry parameters such as temperature, pH, specific conductance and dissolved oxygen were measured. The sampling program was completed three times during the week .

ST. CLAIR RIVER SURVEY
AEPB STUDY 12425, DR. Y.K. CHAU

A short survey was conducted on the St. Clair River. Twelve sites were sampled in the upper river area on June 17 and another four upstream of Chenel Ecarte on the following day. Water samples were collected just below the surface and sediment was obtained by a PONAR grab sampler. Soil and air samples were collected in the vicinity of the Ethyl Corp. plant. Samples are to be analyzed for MMT. This is an organic manganese compound which is used as an octane enhancer in gasoline. Sampling points were determined with a hand-held GPS unit.

MALVERN SURVEY AND CENTRIFUGE SAMPLING AT KINGSTON POND
AEPB STUDY 12440, DR. J. MARSALEK

Technical Operations assisted this study September 15 - 19 at the Stormwater Detention Pond in Kingston.

The field crew travelled to Kingston in a dual wheel crewcab carrying the Malvern gear and in the three-ton truck, carrying the centrifuges, generators and assorted other equipment, towing the Zodiac trailer. The Malvern survey was completed in the same manner as the survey done in November of 1996. A tag line marked at 15-metre intervals was stretched across the pond from steel stakes spaced at 15-metre intervals along a baseline at the inlet end of the pond. The 17.5-foot Zodiac was dragged down the bank and into the pond and readings were taken from it using the Malvern particle size Instrument at predetermined grid points. Three suspended sediment samples were collected at the depth of the Malvern sample at each site. A total of seventeen samples were collected with the Malvern. The Hydrolab was used to collect water quality data from the same sites as the Malvern samples. Water samples were collected at four depths and integrated at each sample site and 4 five-kilogram bottom sediment samples were collected from the grid using a mini PONAR grab.

Water was centrifuged, using a Westfalia separator twice during the week from the inlet and outlet of the pond. The centrifuges processed water at the rate of 6 litres per minute and ran for approximately five hours each day. Brancker loggers at the inlet and outlet of the pond were downloaded and replaced by AEPB personnel and a Hydrolab moored in the pond was refurbished.

WATER SAMPLING ON LAKE MUSKOKA
AEPB STUDY 12460, DR. M. SERVOS

Technical Operations supported this project on May 22nd by assisting with the collection of water and filtered samples from three sites in the Muskoka Bay area of Lake Muskoka.

The field party left Burlington in the morning and arrived at the boat ramp in Gravenhurst about noon. The boat was taken through Lighthouse Narrows at the North end of Muskoka Bay to the first site located in the South Bay area of Lake Muskoka between Lightwood Island and Treasure Island. Sampling on station consisted of pumping approximately 60 litres of water through a 64µ mesh to collect zooplankton into a large plastic barrel from a depth of 2 - 3 metres using a submersible March pump. The water was then pumped through a 20µ glass fibre filter and then through .7µ GF filter. The filters were preserved in methanol and the filtered water retained for further processing in Burlington where it would be put through two tangential flow units taking the particles to .2µ and then to 1000 Daltons.

The second site was located in the mouth of Sunset Bay near Lighthouse Narrows in Muskoka Bay and the third site was in the middle of the main bay. The same sampling program was carried out as at the previous site.

STATION POSITIONS

STATION NUMBER	LATITUDE N.	LONGITUDE W.
1	44° 57' 37"	79° 22' 50"
2	44° 57' 06"	79° 24' 38"
3	44° 55' 42"	79° 24' 01"

HIGHWAY RUNOFF
AEPB STUDY 12464, T. MAYER

Highway rainwater runoff was collected under three local overpasses. The three bridges were: the Burlington Skyway, the bridge West of the main office of the Royal Botanical Gardens on Plains Road in Burlington and the bridge over Fairchilds Creek on Hwy 2 in Brantford. The water flows through the road drainage vents and was collected in 45-gallon plastic drums. The drums were sub-sampled, after a rain, by removing approximately 4ℓ of water which was returned to CCIW for analysis. The drums were emptied and cleaned prior to the next rain event.

The water was analyzed for the following parameters: temperature, pH, specific conductance, TSS, anions, TP, TFP, nutrients, nitrogen, TM-U, TM-F and PAH's. The data collected from

this study will help to determine what volatile contaminants are washed off bridges during and immediately after a rain event. This sampling will continue throughout the winter of '97/98.

LONG-TERM MONITORING OF MUSSEL POPULATIONS, LOWER GREAT LAKES REGION
AEPB STUDY 12465, J. SMITH

Technical Operations personnel supported this project with assistance in the collection of freshwater mussels during the months of June, July and August with 22 days of field support. The study (funded by the World Wildlife Foundation) investigated the decimation of native mussel species by commercial harvesting, habitat destruction and pollution. The project focused on the Lower Great Lakes region where 41 of Canada's 54 mussel species occur and 72% are either threatened, endangered or extinct.

The objective of the study is to develop a database of freshwater mussels in the Lower Great Lakes drainage basin so that species in the greatest risk and areas of species rich habitat can be protected.

The study focused on searching sites along the Grand River, Thames River and the Sydenham River and collecting as many mussel specimens and species as could be found in a four and one-half-hour period. These sites all have historical data, going as far back as 1861, which was compared to present data, looking for trends in species numbers and diversification.

Search techniques included hand searching the bottom in turbid waters, the use of underwater viewers, rakes in soft mud bottoms and Technical Operations divers at the deeper and turbid sites. Most sites on the rivers were located at riffle areas which is the prime habitat of many mussel species.

LONG-TERM MONITORING OF MUSSEL POPULATIONS, LAKE ONTARIO REGION
AEPB STUDY 12465, J. SMITH

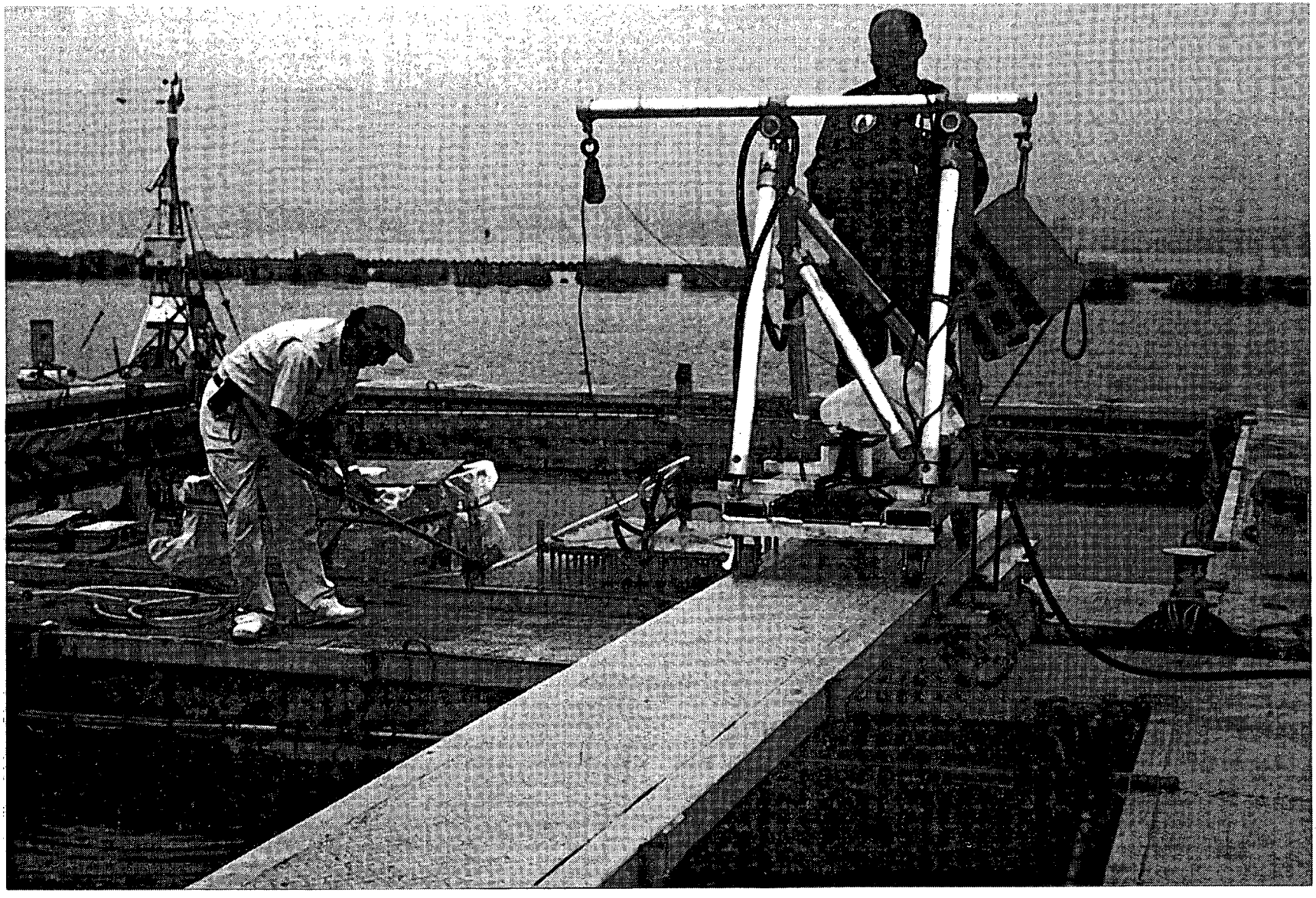
Freshwater mussels have been recognized as one of the most endangered groups of animals in North America. Studies are presently underway to identify those species that are most at risk in the lower Great Lakes drainage basin. The current survey has utilized historical data to help identify sites where 13 target species were once present. Many of these sites will be re-surveyed with the results being used to highlight future direction and emphasis for the project.

During the week of September 22 - 26, B. Gray and T. Breedon, TOS and Shawn Staton, AEBP, travelled to and sampled the following locations:

September 22	Port Maitland/Grand River (diver survey)
	Byng Conservation Authority/Sulphur Cr. (diver survey)
September 23	Syndenham River
September 24	Upper Thames River (2 sites)

September 25	Sydenham River, Bear Cr.
September 26	Thames River (Dorchester, Ingersol area, 2 sites)

The survey consisted of 3 people X 1.5 hours/site. Live mussels were collected, identified, measured and returned to each site. The dead shells of rare or unusual species were also collected. There was an additional collection of select species for a genetic study.



SEDIMENT INJECTION AT LAKE BIWA, OTSU, JAPAN

NEW TECHNOLOGIES RESEARCH BRANCH

SEDIMENT TREATMENT
NTRB STUDY 12920, DR. T.P. MURPHY

The injection of liquid and solid calcium nitrate into the bottom sediments to act as an oxidant is being tested as an alternative to dredging operations. The intent of this project is to develop in situ bioremediation of organic contaminants in sediments for about 20% of the cost of dredging and storage in a confined disposal facility (Murphy et al, 1994). The addition of calcium nitrate will increase microbial activity, creating an oxic environment to assist the biodegradation of oil and coal tar. Small scale injections were continued this year in Lake Biwa, Japan. Two sites in the prairies (Whitewater Lake, Manitoba and Pukowki Lake, Alberta) were surveyed for pre-treatment data collection. A new injection device was designed and built at NWRI. Preliminary field testing took place in November. Modifications and installation of the oxidant delivery system is planned for February 1998.

LAKE BIWA, OTSU, JAPAN

On Saturday, May 24, Mr.H. Don departed CCIW bound for Otsu, Japan. The purpose of the trip was to demonstrate methods of calcium nitrate injection and sediment coring.

Background

The purpose of this study was to minimize the nutrient release from the sediments and reduce eutrophication in Lake Biwa. This was the second year of a five-year program. Lake Biwa is located close to the centre of the Japanese archipelago, in the Shiga Prefecture. Lake Biwa is the largest lake in Japan and one of the oldest lakes in the world, occupying one sixth of the area of the prefecture. It also serves as a significant water resource, providing water for industry and the fourteen million residents of Osaka and Kyoto prefectures.

The worksite was located in Akanoi Bay in the South end of Lake Biwa, eight miles north of Otsu along the Eastern shore. The limnocorral used for the treatment demonstration was one of four enclosures used by the Lake Biwa Research Institute (LBRI) for experiments. This was an excellent facility to support our work. Each corral was surrounded by a one-metre wide steel deck and the curtains could be raised or lowered with small hand winches. The Southwest enclosure was selected for the work because the walkway was smooth enough to allow the injection dolly to roll on it.

Setup

Much of the equipment on the enclosure, such as winches, railings, walkways and sampling davits were removed to better facilitate the injection operation. The walkway from the Southwest enclosure was moved to the Southeast enclosure and the dollies installed under both ends. The sampling dolly was put together and installed onto the walkway. The deck around the enclosure and the moveable walkway was marked in metres to create a sampling grid for the injection.

Diving services were provided by Mikuniya Corp. of Japan. Divers tucked the curtain chain down one foot into the sediments to prevent any exchange of water and checked the bottom in the sampling area for debris. A small quantity of aquatic macrophytes and clams—up to 20 cm., were removed. Divers also reported that the curtain was bowed inward approximately 0.5 metres and one metre off the bottom all the way around the enclosure. During the injection, divers reported that the dipper was flat onto the bottom and no signs of oxidant liquid leaking could be observed.

Engineering Services Section of RSB constructed the injection "dipper", the walkway dollies and the injection dolly. The "dipper" is constructed of two aluminum plates one metre square, separated with a one cm. gasket. The area between the plates acts as a reservoir to feed the oxidant liquid to the injection rods. One hundred rods, mounted on the bottom of the plate in a 10 cm. grid spacing, projected 17 cm. Each rod was equipped with a check valve and had one 1/32" hole drilled into it at 15 cm. Additional hose was installed between the rods to allow water to be pumped into the area between the plate and the sediment to reduce the suction when the plate was being raised. The walkway dollies were designed and constructed to hold the weight of the walkway (550 kg) and to roll the walkway along the enclosure deck. The injection dolly was designed to roll along the walkway and to raise and lower the dipper. The injection dipper was raised and lowered using a sling and a standard 12 volt truck winch with a remote control.

The calcium nitrate (laboratory grade) was supplied by Shinsu Corp. in 25 kg bags. The injection liquid was mixed at a ratio of one bag (25 kg) CaNO3 to 50 litres of water. The mixture was thoroughly mixed before continuing the injection.

The supply system to the injection dipper consisted of the following parts: a mixing tub, pump, flow valve, Y splitter valve, foot valve and 5/8" garden hose.

Injection Procedures

Injection specifications:

1. Pump flow rate was set at 11.5 litres per minute
2. Times:
   - 0 to 35 sec. - pumping CaNO3
   - 35 sec. to 3 min. 35 sec. - sitting on the bottom
   - 3 min. 35 sec. to 4 min. - open atmospheric vent valve
   - 4 min. to 4 min. 30 sec. - sitting on the bottom
   - 4 min. 30 sec. - start the water pump
   - slowly lift the dipper above the bottom
   - move to next station
   - 5 min. - lower dipper into the sediment

The rationale for the times came as a result of the laboratory testing carried out prior to the field work. At a flow rate of 11.5 l/min. for 35 seconds, a volume of 6.7 litres of CaNO3 was injected at each station. For the next three minutes, with the dipper on the bottom, the rods would slowly drip. The atmospheric vent valve was opened to equalize the pressure inside the dipper to atmospheric pressure. It is presumed that the water pressure exerted on the rods was greater than the injection liquid pressure within the dipper; thus further reducing the opportunity

for the CaNO3 to leak into the water. The water pump was used to supply a volume of water to the area between the dipper plate and the sediment interface. As the plate was raised, the pumped water reduced the suction effect, preventing the CaNO3 from being drawn out of the holes left by the rods.

After the system was assembled, a series of tests was carried out using water as the injection liquid. While testing, personnel were trained in their individual tasks to operate the injection pump, water pump, winches and dollies. The testing also eliminated communication problems between Mr. Don and the Japanese workers. In the final injection operation, most communications consisted of hand signals.

On June 2, injection of the sediments with calcium nitrate commenced. All parts of the injection system worked flawlessly and the dollies proved to be very effective. During the movement, between stations, the dipper was exposed to the air for a maximum of 15 seconds. The injection proceeded smoothly with a total of eight complete lines injected by the end of the day. In order to minimize contamination at the site, the CaNO3 was flushed from the system into a holding reservoir. To be sure that the system was clean, it was flushed for ten minutes at full flow. The flushing reservoir liquid was emptied into containers which were returned to the lab for disposal. The next day, the remaining two lines were completed and the system flushed again. Samples of the injection liquid were collected each day and frozen for shipment to CCIW. Field technicians from Shinsu Corp. collected water samples and DO profiles each day, before and after treatment of the enclosure.

Recurring problems with the check valves included the pistons sticking. Even after rinsing with water the valves would stick closed. A tap with a hammer would free the piston and start the valve flowing. The tolerances of the check valves are probably too close. For a flow of liquid they should be open, and close quickly with more space in the cylinder. Supply hoses for both CaNO3 injection liquid and water should be equipped with foot valves to eliminate delays caused by pumps losing their prime. An earlier, more careful inspection of the enclosures would have identified existing problems with the curtain and support structure, thus saving valuable time.

Contamination Prevention

Great pains were taken during the field work to prevent contamination of the water inside the enclosure from other sources than the dipper:

1. The bags of Calcium Nitrate were stored in a box away from the enclosure
2. The mixing reservoir was located away from the enclosure
3. Care was taken when mixing to prevent splashing
4. Shoe soles were rinsed in an area away from the enclosure, on a regular basis
5. The supply pump was located at the mixing reservoir
6. The atmospheric vent valve was equipped with a hose and overflow reservoir to prevent back-pressure from spraying CaNO3 into the enclosure
7. All empty calcium nitrate bags were folded, bagged and placed in the boat for disposal
8. All flushing of the system took place in an area away from the enclosure. The rinse liquid was placed into containers and stored in the boat for disposal

9. Prior to using the injection system, it was checked for leaks, using water

Coring

TOS cores were collected at six stations: B3, B7, D2, D7, F2 and F7. All cores were extruded on site in 2 cm sections. In the majority of the cores, it was noted that, at the 8 cm.. slice, a reddish colour was observed in the sediment. This colour persisted until the 18 cm slice when it disappeared. A bulk sample of 10 litres was collected at the centre of the Pearl Farm. The bulk sample was kept cool and the core samples frozen for shipment back to CCIW on June 5. Shinsu Corp. handled the shipping of the samples which required the use of the Golder import permit (#189750) via Peace Bridge Brokers.

Pearl Farm Sampling And Peepers

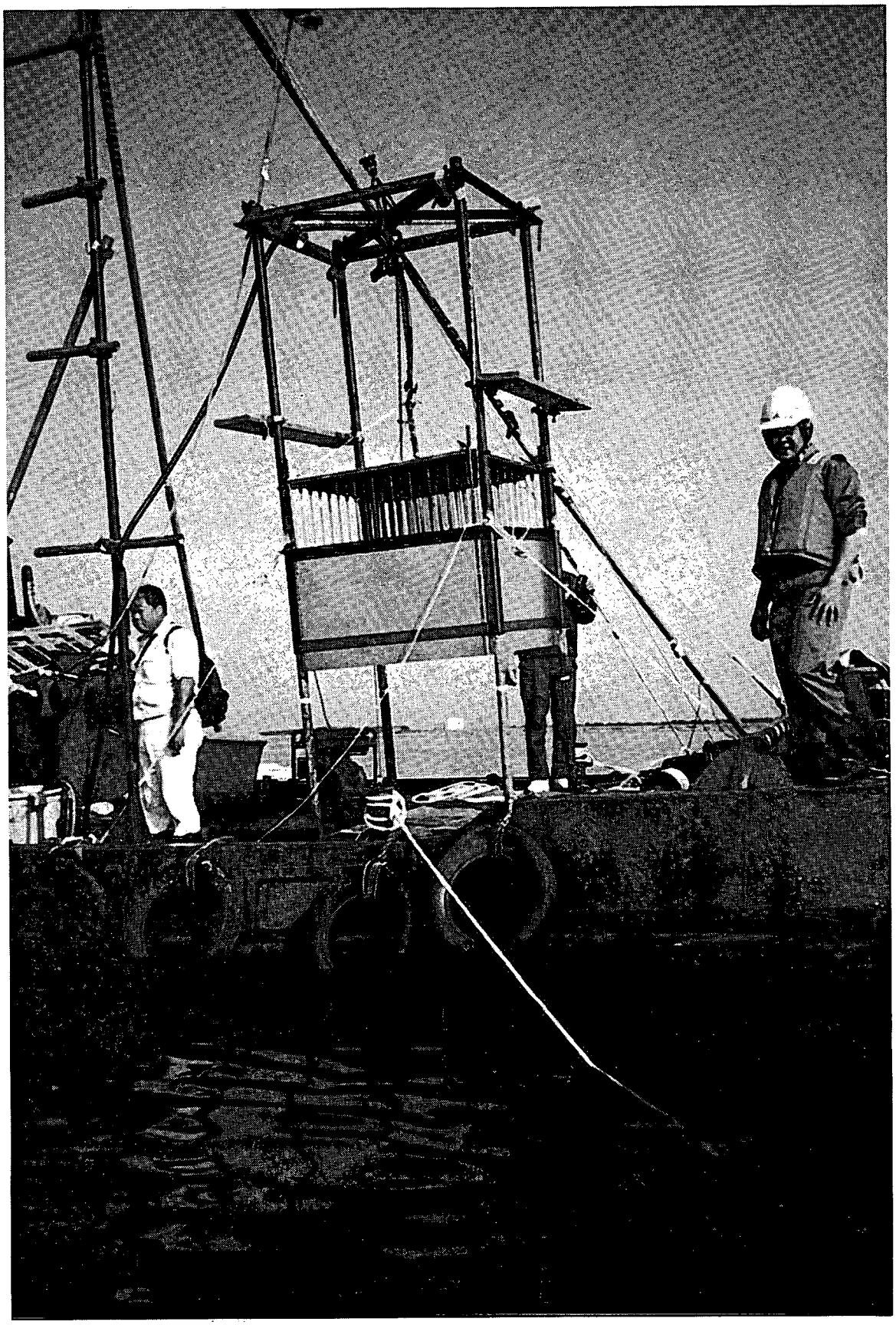
On Tuesday, May 27, personnel from Shinsu Corp. were trained in the methodology of peeper assembly and bubbling. The new, small style peepers were constructed by NWRI Engineering. The new peepers are shorter with six large cells and a plate mounted at the boundary between the first and second row of cells to stabilize penetration into the soft sediments. The peepers were bubbled with nitrogen for 36 hours. The peepers were installed on May 29 at the Pearl Farm in Akanoi Bay. During transport between the museum lab and the worksite, the peepers were continually bubbled. Since delays were the norm when working there, a spare nitrogen cylinder came in handy. The peepers were installed at five sites within the Pearl Farm. Each peeper was marked with the station number and tied onto the barrel frames on the surface. A 10-litre bulk sample was collected at the centre of the Pearl Farm using an Ekman sampler.

Summary

The injection of calcium nitrate into the sediments of the enclosure was a success, with a total of less than five percent CaNO3 by volume measured in the water column. The depth of water in the enclosure was 1.75 metres. Also, when calculating the water volume of the enclosure, take into consideration that the perimeter of the curtain is inside the walkway and bulged in approximately one-half metre.

1. Seven bags (25 Kg. each) of calcium nitrate were used
2. Ten litres of liquid calcium nitrate remained in the supply tub on completion of the injection.
3. Two litres of liquid calcium nitrate remained in the hoses and dipper
4. Three litres of liquid calcium nitrate remained in the overflow reservoir
5. Total volume of CaNO3 injected + (7x50) - 15 = 335 litres
6. Volume of the bulge in the curtain = 0.5 x 0.5 x 9.65 x 4 = 9.65 cu. m
7. Volume of the enclosure = (9.65 x 9.65 x 1.75) - 9.65 = 153.31 cu. m

The field work started slowly but came together after a week. The dollies proved to be a great system for moving the dipper quickly and with excellent positioning accuracy. The early arrival of the rainy season did not slow down the work. The personnel provided by Shinsu Corp. and the boat captain were excellent workers and eager to learn. I believe that we reached the limit of this existing dipper injection system. If there must be a further reduction in the post-injection volume of calcium nitrate in the water column, the system will have to be redesigned.



SEDIMENT INJECTION AT NAKAUMI LAGOON, MATSUE, JAPAN

Accommodations at the ILEC centre were excellent, providing access to the museum facilities and the worksite at Akanoi Bay.

NAKAUMI LAGOON, MATSUE, JAPAN

As part of an ongoing sediment remediation program in Japan, Mr.Don was asked to observe an injection trial program at Nakaumi Lagoon, as a consultant to the Mikuniya Corporation. He departed CCIW on October 18 for Kansai, took the airport bus to Kyoto and from there to Matsue via the bullet train. He was accompanied by Ms. Reiko Tanimoto who did an excellent job as guide and interpreter. The Mikuniya Corp. paid all expenses.

The following notes document observations of the Nakaumi Lagoon program:

1. Nakaumi Lagoon is located on the west coast of Japan, near the city of Matsue, in the Shimane Prefecture—a large freshwater lagoon which is open to the Sea of Japan through the Sakaiminato Channel. The injection took place in the Southeast arm of Nakaumi Lagoon in a dredged site called Site B. The injection took place on October 21 and the coring on October 22.

2. The dredged hole has filled with soft sediments over the years. The sand layer below the sediment has an undulating surface and is very compacted. This creates a varying thickness in the soft sediments. Salt water enters the lake from the Sea of Japan and, due to its higher specific gravity, fills the dredged hole. There is a slight current from east to west but not near enough to flush the hole. Once the water in the hole becomes anoxic, increased levels of hydrogen sulphide are produced.

3. The NWRI dipper was modified by adding 34 cm rods and mounting it into a modular frame. As the sketch shows, the frame is basically two frames pinned together with a hoisting device between the dipper sling and the top of the upper frame. Attached to the lower frame is a 60 cm metal skirt which isolates the sample area. This skirt protrudes 5 cm above the sediment/water interface. The lower frame legs penetrate the soft sediments to rest on the harder sand layer. The rods were drilled with a 1/32" drill bit, 30 cm below the bottom of the base plate.

   NOTE: The varying thickness of the soft sediments could become a problem when using the harder sand layer to support the injection frame. The length of the lower legs would have to be adjusted as the soft sediment layer becomes thinner, as it will in some locations of the hole. The need for an accurate sounding survey was discussed with Mr. Watanabe which will record both the depth of the sand layer and the soft sediment interface. This information combined with differential GPS positions can be entered into a 3D graphics display program to plot the thickness of the soft sediment layer.

4. The mixture of calcium nitrate was similar to the mixture used in Lake Biwa; that is, 20ℓ of water to 10 kg of calcium nitrate (in Lake Biwa we used 50ℓ of water to 25 kg of calcium nitrate). The mixture was pumped to the dipper using a 1" Honda pump (gas) and garden hose. The supply hose was fitted with a two-way valve and a return line to the supply reservoir.

NOTE: This is a very good idea to prevent spillage and reduce the line pressures.

5. There was very little concern over spilling the injection mixture into the water column. In fact the test prior to lowering was completed using the mixture. If we were to do that in the enclosure, there would easily be unacceptable high levels of nitrate in the water. During this test the small amount of mixture pumped into the water would be diluted, resulting in a negligible increase in the nitrate levels in the water column. However, for large areas of injection this could be a factor which should not be overlooked.

6. At each site, 10ℓ of calcium nitrate was pumped into the sediment. As the mixture flowed into the sediment, the diver slowly raised the dipper, using a come-a-long. The rationale being to spread the volume of calcium nitrate injected throughout the upper 30 cm of sediment.

   NOTE: This is a good idea to spread the input of the mixture into the sediments. The dipper should not be raised any higher than 10 cm from the interface to avoid any chance for the mixture to escape through the top of the hole and into the water column. The method of using a diver to raise the dipper is very labour intensive. Some thought should be given to raising the dipper from the surface.

7. No cores were collected immediately after the injection but rather the next morning. There could have been lower readings of NO3-N a day after the treatment was completed than were present immediately after injection. A total of sixteen core tubes were installed inside the frame at each site. Four tubes were 10 cm in diameter and 0.8 m long with threaded ends. Eight tubes were 10 cm in diameter and 0.8 m long without threaded ends. Four tubes were 10 cm in diameter and 1.5 m long without threaded ends. Ten tubes were 5 cm in diameter and 0.8 m long without threaded ends. One control core was installed next to the frame. The core tube was 10 cm. in diameter and 2.0 m long. The plan is to return in November and March to retrieve cores for analysis.

8. One core, 10 cm in diameter and 1.5 m long was collected from inside the frame at each site. The cores had a strong odour of hydrogen sulphide. The colour of the cores was predominately jet black but with a few spots of a lighter shade. An attempt was made to collect a two-metre core near the injection site. To achieve the penetration of the hard sand layer an air hammer was used to vibrate the core tube down. Only 1.73 m core was retrieved and that included a 25 cm sand plug at the bottom. This was another indicator of the variability of the sediment thickness in the dredged hole. The divers used bungs to cap the core tubes. The diver working in zero visibility pushed in the bung (slightly larger in diameter than the core tube) and taped it onto the tube before bringing it to the surface.

   NOTE: This system should be designed to operate without using a diver by mounting the core tube and air hammer into a stand. The addition of a one-way valve at the top of the core tube would eliminate the need of a diver to install a bung at the bottom of the tube. Plastic caps should be used instead of bungs to cap the core tubes. They would stay on much tighter than the bungs and would not require taping underwater but rather on the surface after retrieval.

9. The personnel involved with this project were good. They seemed competent, enthusiastic and were well supervised by Mr. Watanabe. The tugboat was well anchored and was easy to move when necessary. The skill level of all the diving personnel was extremely high. They worked hard and long, with poor water visibility and with a good understanding of the work at hand. Overall, it was a very professional job.

PRAIRIE SAMPLING, MANITOBA/ALBERTA, CANADA

Spring Trip

Both Whitewater and Pakowki lakes are experiencing a problem with wildfowl dying. Through the efforts of Dr. T. Murphy, TOS was asked to carry out a field sampling program. The field crew of Todd Breedon and Bruce Gray, TOS, departed CCIW on May 20th and travelled to Winnipeg, Manitoba to pick up Julie Corsini on May 22nd. We then arranged to pick up a boat and motor for use on Whitewater Lake through Bruce Townsend and Terry Short of FWI. This provided backup transportation on the lake in the event that Ducks Unlimited airboats were not operational. We then travelled to Boissivain and met with DU personnel (Dave Clayton, Andrew Pratt) briefly and set up Julie's lab for sampling the following day. Peepers were assembled and bubbling initiated.

The following day, sampling was started on Whitewater Lake using DU STAWSEL airboat. These airboats proved invaluable. Being able to travel as-the-crow-flies over any terrain, they could not have been replaced by conventional boat and motor! The lake, even without submerged or emergent vegetation, would prove too shallow to traverse effectively with a boat and motor. As well, the high suspended sediment load would probably clog cooling ports quickly.

Sites 1 through 5 were established and sampled on the 23rd and site #6 on the 24th. Site locations were chosen and marked with fence posts and flagging tape. A GPS fix was taken, followed by sampling for various water quality parameters and finally, 3 short cores per site. As the depth at each site increased so did the relative amounts of soft sediments. The shallower sites were characterized by firmer bottoms, due possibly to root structures. The DU cells and inflows above them were inspected for potential site locations. It was decided that they were unsuitable due to uncertain water levels. The MET station was constructed that afternoon on a raft provided by DU, for deployment the following day. DU personnel (IWWR) Henry Murkin and Lissette viewed the sampling in the afternoon.

On the 24th, site #6 was sampled and peepers installed at all 6 sites. The MET station was towed approximately 300 m out from the launch area on a straight line to site #4 (no GPS). The station was then anchored approximately 200 m off shore in 0.86 m of water. Later that day the boat was taken to the DU compound in Brandon for storage. Dave Clayton was met and some sampling gear that Julie needed was exchanged.

SITE		GPS	DEPTH (cm)
1.	east of Sexton Isl.	49° 15' 44.1" N 100° 18' 43.1" W	42
2.	west end/open water	49° 13' 10" N 100° 23' 31.1" W	90
3.	SE of new cell	49° 14' 36.2" N 100° 14' 31" W	35.5
4.	west of Sexton Isl.	49° 16' 05.5" N 100° 19' 58.1" W	82
5.	near sand bars	49° 16' 48.3" N 100° 16' 10.3" W	36
6.	west side of cells	49° 14' 50" N 100° 14' 09.8" W	86

On the 25th the lab work was completed, the truck repacked and the field crew drove to Williston ND. The following day, driving continued to Foremost, Alberta, the lab set up and peepers bubbled.

The following day, Brian Peerse from DU was met and Pakowki Lake was sampled using a PANTHER airboat.

SITE		GPS	DEPTH (cm)
1.	central basin	49° 20' 32.9" N 110° 55' 53.1" W	72
2.	east side/central	49° 18' 47" N 110° 54' 14" W	60
3.	north shore	49° 24' 21.4" N 110° 58' 22.3" W	47
4.	north west	49° 23' 17.3" N 111° 02' 04.2" W	47
5.	west of berms	49° 22' 33.4" N 111° 04' 08.2" W	72
6.	west side of Haraga bay	49° 20' 12.8" N 110° 58' 07.1" W	69

The following morning personnel from Alberta EP, Water Monitoring Branch (Ray Walker, Lisa Boucher) were met and sampling and benchmarks for future DGPS were discussed. The field crew then packed and travelled to Brandon. After picking up the boat, we continued on to Winnipeg and returned it to the FWI on the 29th. Travelling north to Stonewall, we debriefed DU personnel at their Oak Hammock Marsh headquarters, dropped Julie off at the airport in Winnipeg and continued on to Kenora that night.

The following 2 days were spent in transit (Kenora->Marquette->CCIW), arriving home and unpacking by 19:30 on the 31st.

Summer Trip

On August 5, Messrs. Gray and Don departed CCIW for Whitewater Lake, Manitoba and Pakowki Lake, Alberta. Ms. J. Corsini was picked up at Winnipeg Airport on August 7 and dropped off at Winnipeg on August 15. Ms. Corsini worked very hard, directing us on sampling techniques, leading the station sampling and working late into the night preparing and analyzing samples. The same sampling program was carried out as on the spring trip with the addition of a spatial coring survey at Whitewater Lake. It is hoped that the analysis of the samples will determine if these areas could be helped with sediment treatment techniques developed at CCIW. All sampling was carried out from air boats supplied by Ducks Unlimited. A GPS base station was used to obtain accurate positions for all stations.

WHITEWATER AND PAKOWKI LAKES

Samples were collected in triplicate from six sites in each lake. DGPS positions were obtained for Whitewater Lake and GPS positions for Pakowki Lake. Stations were marked with fence posts and ribbon markers. Both lakes were shallow (<1m) and samples were collected within 10 ft. of the station marker in undisturbed water.

All samples were collected at "hand depth" by inserting the bottle with the cap on to depth (wearing gloves) and then unscrewing the cap to collect the water. Water/algae samples were collected when encountering an algae bloom.

1. Algal toxins
Water was collected, with gloved hands, at hand depth from six sites in triplicate. Water was collected from five areas around the boat and combined in a 2ℓ bottle. The bottle was shaken and using a graduated cylinder, poured through a 30 micron nitex mesh filter until clogged, to collect the algae. The volume of water filtered was recorded and using distilled water, the algae was washed into a sample bottle and placed in the cooler. Samples were placed in the freezer at the lab.

2. Sediment Cores
Cores were collected in duplicate from six stations in each lake. Cores were extruded at 5-cm intervals up to 10 cm. Redox potential and descriptions were recorded. Samples were placed in plastic zip-lock bags and placed in the cooler.

3. Hydrolab
The hydrolab was used to record DO, conductivity, Redox, pH and temperature at depth intervals of 10 cm.

4. Peepers
At all six stations in each lake, three mini peepers were installed.

Whitewater Lake Only

1. Algal Enumeration
Water samples (100 ml) were collected at hand depth, in triplicate, from the six station sites. Two additional samples were collected in areas showing algal blooms. Samples were preserved with 1 ml of Lugol's solution and placed in coolers.

2. Algal Culturing
Water samples (100 ml) were collected, at hand depth, in triplicate, from the six station sites and placed in coolers.

3. Alkalinity
Water samples (250 ml) were collected, at hand depth, in triplicate, from the six station sites and placed in coolers.

4. Ammonia
Water samples (250 ml per replicate) were collected, at hand depth, in triplicate, from the six station sites. Samples were preserved with 10 ml of phenol solution and placed in coolers.

5. Total Phosphorus, Anions, Metals, Nutrients (TKN, DIC/DOC), Chlorophyll a
Water samples for the above analyses were collected in a 1ℓ bottle per replicate at hand depth. Water sample was sub-divided for analysis in the field lab.

6. Pore Water Collection by Centrifugation
Nine cores were collected from each station. At each station, the top two cm of each core were extruded. Three sections were placed into a single zip-lock bag, creating triplicate samples per station. Samples were prepared and centrifuged in the field lab. Final samples were placed in the cooler.

7. PCR
a) In triplicates at each site, 250 ml bottles were filled one-third with sediment scooped from the surficial sediment. The remainder of the bottle was filled with water collected at hand depth. The sample was shaken, mixing the sediment and water together. The sample was allowed to settle and the water decanted into another 250 ml bottle. The sediment was discarded and the water sample was placed in the freezer.

b) Sediment was scooped from the surficial sediment and placed in ziplock bags in triplicate. Sample bags were placed in the freezer.

8. Contaminated Mud Flat
a) Water samples were collected (100 ml per replicate), for algal enumeration, from the mud flat where the birds were dying. Samples were preserved with 1 ml of Lugol's solution.

b) Three cores were collected for sulphide analysis. Cores were extruded at 5 cm intervals up to 10 cm. Redox readings and core descriptions were recorded.

c) Nine cores were collected for pore water collection by centrifugation. The top 2 cm were extruded and three sections combined per zip-lock bag.

9. Met Station
The Met station was refurbished and a new logger installed. Air temperature was not functioning and no spares were available. The repairs made to the raft in July appear to have stabilized the structure. If the met station is to be reinstalled for the 1998 season, it should be rebuilt to proper standards.

10. Spatial Variability Study
Two cores were collected from each of 38 stations. Stations were spaced throughout the lake and positions recorded using DGPS. The top 2 cm of each core were extruded, placed in a zip-lock bag and stored in a cooler. Samples were returned to the field lab for centrifugation and sulphate/sulphide analysis.

Summary

DGPS fixes were obtained only for Whitewater Lake. At Pakowki Lake the information provided by Alberta Environment Water Sciences Branch was out of date and could not be used. I will follow up on this problem and obtain the proper position for future surveys. The larger cap on the truck was a great benefit for the constant loading and unloading of equipment. All samples were successfully collected as per the operational plan and returned to CCIW. The TOS team returned to CCIW on August 17.

WHITEWATER LAKE SURVEY STATIONS (DGPS WGS-84)

STATION NUMBER	LATITUDE N.	LONGITUDE W.	NORTHING	EASTING
White - 1	49° 15' 54"	100° 21' 09"	5457783.2	401607.8
White - 2	49° 13' 04"	100° 23' 35"	5452610.7	398559.0
White - 3	49° 14' 30"	100° 14' 36"	5455070.2	409495.6
White - 4	49° 16' 05"	100° 19' 59"	5458104.8	403026.3
White - 5	49° 16' 08"	100° 15' 45"	5458139.3	408166.0
White - 6	49° 14' 49"	100° 14' 09"	5455634.6	410061.7

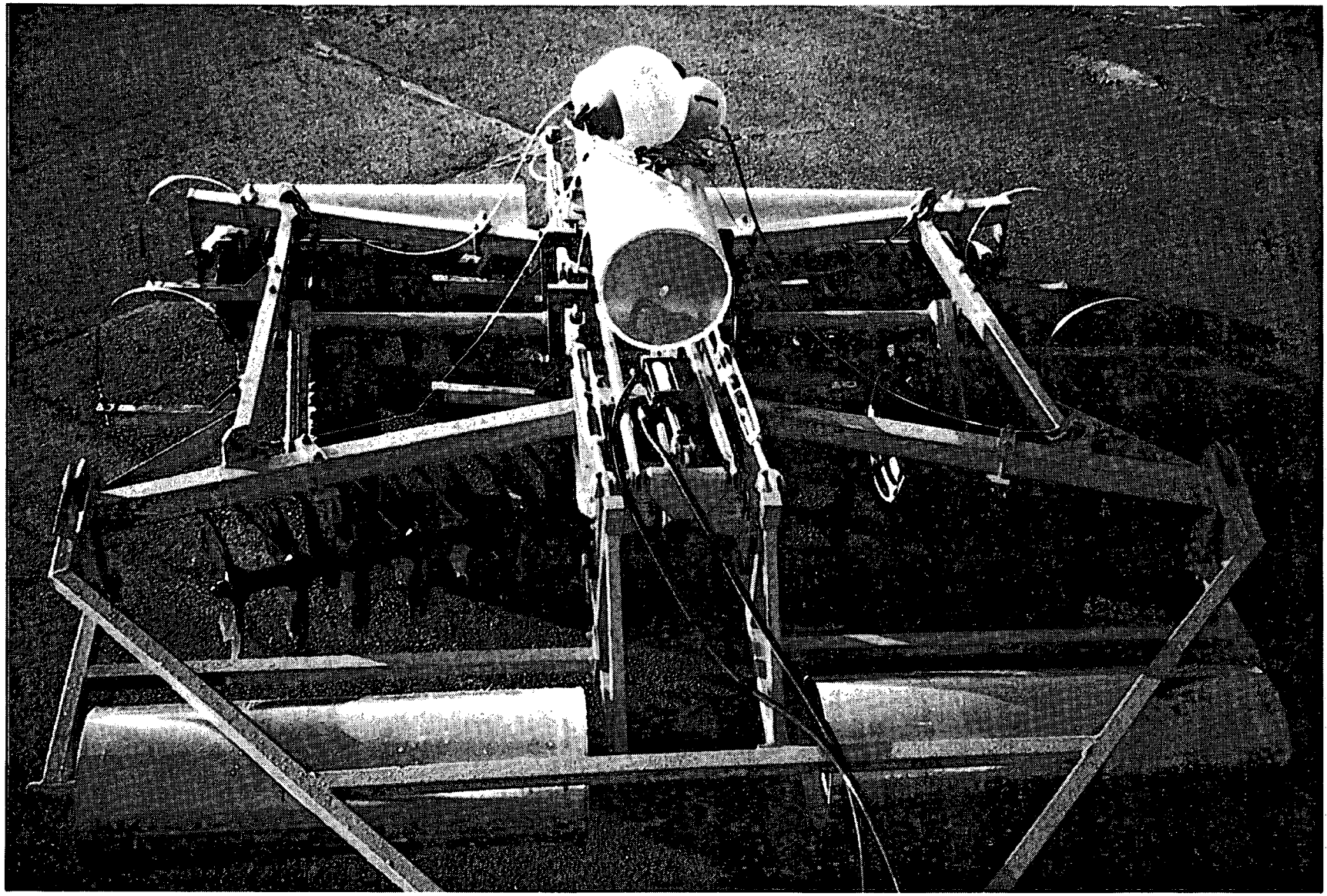
SPATIAL CORING SURVEY (DGPS WGS-84)

STATION NUMBER	LATITUDE N.	LONGITUDE W.	NORTHING	EASTING
1A	49° 14' 22"	100° 23' 49"	5455037.8	398323.5
1B	49° 13' 36"	100° 23' 39"	5453596.4	398498.3
1C	49° 12' 56"	100° 23' 43"	5452345.4	398395.1
2AA	49° 15' 42"	100° 22' 31"	5457465.9	399934.3
2A	49° 15' 19"	100° 22' 29"	5456742.5	399964.8
2B	49° 14' 32"	100° 22' 27"	5455285.4	399985.6
2C	49° 13' 42"	100° 22' 29"	5453733.7	399907.7
2D	49° 12' 44"	100° 22' 19"	5451967.8	400089.3
3AA	49° 15' 47"	100° 21' 11"	5457586.8	401554.6
3A	49° 15' 38"	100° 21' 12"	5457290.8	401525.0
3B	49° 14' 29"	100° 21' 13"	5455175.2	401472.6
3C	49° 13' 41"	100° 21' 13"	5453681.8	401447.1
3D	49° 13' 05"	100° 21' 14"	5452546.9	402739.1
4A	49° 16' 08"	100° 20' 08"	5458220.0	402839.3
4B	49° 15' 21"	100° 19' 57"	5456757.9	403036.7

STATION NUMBER	LATITUDE N.	LONGITUDE W.	NORTHING	EASTING
4C	49° 14' 32"	100° 19' 57"	5455249.8	403010.1
4D	49° 13' 44"	100° 19' 55"	5453760.1	403090.7
4E	49° 12' 50"	100° 19' 52"	5452074.1	403061.1
Algae Stn.	49° 15' 28"	100° 19' 25"	5456967.0	403693.0
5A	49° 15' 51"	100° 18' 47"	5457661.4	404470.5
5B	49° 15' 19"	100° 18' 46"	5456649.2	404482.1
Algae 122	49° 14' 56"	100° 18' 44"	5455957.7	404496.8
5C	49° 14' 31"	100° 18' 44"	5455179.6	404483.3
5D	49° 13' 43"	100° 18' 44"	5453688.0	404463.4
5E	49° 12' 53"	100° 18' 41"	5452151.0	404496.3
6A	49° 16' 17"	100° 17' 31"	5458420.5	406019.0
6B	49° 15' 23"	100° 17' 30"	5456767.5	406010.2
6C	49° 14' 34"	100° 17' 31"	5455235.5	405971.9
6D	49° 13' 41"	100° 17' 29"	5453617.3	405987.9
7AA	49° 16' 44"	100° 16' 16"	5459241.6	407545.1
7A	49° 16' 09"	100° 16' 18"	5458163.9	407490.6
7B	49° 15' 21"	100° 16' 15"	5456682.4	407534.8
7C	49° 14' 32"	100° 16' 15"	5455172.4	407505.8
7D	49° 13' 44"	100° 16' 14"	5453684.5	407490.5
8A	49° 16' 12"	100° 15' 04"	5458238.9	408992.0
8B	49° 15' 23"	100° 15' 02"	5456722.7	409006.9
8C	49° 14' 25"	100° 14' 58"	5454915.1	409046.2
9A	49° 16' 29"	100° 13' 48"	5458717.9	410523.0
9B	49° 15' 41"	100° 13' 46"	5457236.8	410542.5
9C	49° 15' 02"	100° 13' 49"	5456025.9	410474.3

PAKOWKI LAKE SURVEY STATIONS (GPS)

STATION NUMBER	LATITUDE N.	LONGITUDE W.	NORTHING	EASTING
1	49° 20' 33"	110° 55' 53"	5465531.4	504981.9
2	49° 18' 47"	110° 54' 14"	5462263.3	506986.0
3	49° 24' 21"	110° 58' 22"	5472583.4	501968.4
4	49° 23' 17"	111° 02' 04"	5470604.8	497496.2
5	49° 22' 33"	111° 04' 08"	5469252.0	494996.1
6	49° 20' 13"	110° 58' 07"	5464907.1	502277.5



THE INJECTION HARROW

DISC HARROW INJECTOR

Introduction

Sediment injection programs have been ongoing at NWRI for the past eight years. During that time, different types of injection equipment have been designed, built and used for varying site specific conditions. Whitewater Lake, Manitoba is a shallow prairie lake with a large area of its surface covered with weed growth. The sediments in areas of the lake must be treated with a liquid oxidant to control the spread of botulism. The problems with such a project include the large root mass of the weed growth which must be penetrated to allow the oxidant to work. Also, the shallow water depth prevents the use of boats or barges to pull the injection craft. A smaller problem is the delivery system used to supply the injection equipment.

After many meetings with RSB and NTRB, the concept of using a modified farm harrow evolved. Mr. H. Savile, RSB, designed and built the new harrow injector. It is basically a standard small disc harrow. Four cylindrical rollers were added to assist movement through soft sediments and add buoyancy.

Field testing of the injection harrow was completed in two phases. The first, to document all the physical characteristics of the system. This includes items such as physical measurements, strain tests, handling both in water and surface, diver observations and video, and recommendations for phase two. At this point the injection harrow will be returned to the shop to be modified and to have the injection delivery components installed.

The second phase will document actual injection tests in similar conditions to those in Whitewater Lake and to refine the methodology of pulling the harrow, DGPS tracking during injection and oxidant delivery system support.

Physical Measurements

The injection harrow consists of two rows of 50 cm toothed discs mounted on offsets to open and close troughs in the sediment. Two rollers are mounted on both the front and back to provide buoyancy and to restrict the penetration of the discs. A single buoyancy cylinder is mounted on the top front to compensate for the weight of the tow bar. A hydraulic ram located at the top centre is used to deploy and retract the wheels which the harrow moves on when on land.

Size: 4.0 m long, 3.5 m wide and 1.1 m high (length with tow bar is 5.15 m)
Weight: In air - 1310 kg and in water - 230 kg
Buoyancy: Each roller has a buoyancy of 115 kg
Maximum penetration of the discs: 23 cm

Buoyancy Control

During testing, the harrow was deployed using a pull and lift technique. This worked because of a smooth launching ramp and adequate water depth (3m) to allow handling. This technique would not work in Whitewater Lake. Modifications must be made to the buoyancy control of the

harrow to allow it to be rolled into the water and float during a tow to the injection area. The four buoyancy cylinders which were removed prior to testing could be reinstalled. The cylinders would be converted to provide variable ballast for the harrow. Simply put, a valve on the top of the cylinder would allow the air to escape while water flows in through a hole in the bottom, causing the harrow to sink. To float the harrow, compressed air is fed into the top of the cylinder, displacing the water which flows out of the hole at the bottom. The key to such a system is to control the flow of air in and out of the cylinders so they rise and fall at the same rate. The buoyancy cylinders should be plumbed through a common manifold to accomplish this. This type of control would greatly enhance the handling of the harrow at the end of the injection tracklines and moving into position to start the next line. It would also give the flexibility to change the weight of the harrow while on the bottom. A lighter harrow in softer sediments may track better.

Handling System

For the purpose of testing the physical characteristics and cable strain levels, the new barge was used. The barge crane and winch were used to move the harrow into a transit position on the bow. To assist with manouverability, two large rudders were added to either side of the bow. A large 1/2" steel sling was attached to the lifting eyes provided on the harrow. A 120' 5/8" steel tow cable was attached to a swivel on the tow yoke. The barge was used to tow the harrow, both forward and astern.

Strain gauge measurements were taken to determine the force applied vs. engine rpm. The following measurements were collected:

Forward		Astern	
1000 rpm	200 lbs.	1000 rpm	100 lbs.
2000 rpm	800 lbs.	2000 rpm	200 lbs.
3000 rpm	1800 lbs.	3000 rpm	400 lbs.
4000 rpm	2500 lbs.	4000 rpm	600 lbs.

Lake Ontario Testing

The waters of Lake Ontario near the Burlington shoreline were selected for field testing the harrow for two reasons. First, the water clarity was good enough to allow divers to video the harrow as it moved along the bottom. Second, the bottom is composed of sand with a few centimetres of soft silt on top. This type of bottom is hard enough to prevent the harrow from settling too deep into the sediment and creating higher strains on the hardware.

The first deployment was made in 4 m water depth. The barge was powered astern as it towed the harrow. The fore and aft rollers were set two inches above the bottom of the discs. The rear discs penetrated 2" into the sediment. The combination of the rollers being set too low and the lifting component of the tow wire prevented the forward discs from penetrating the sediment. In spite of the poor penetration of the discs, there was a significant amount of resuspension of the fine sediments.

For the second deployment, the rollers were adjusted to their highest position—thirteen inches above the bottom of the discs. This allowed maximum penetration of the discs and minimized the amount of resuspension. Once on the bottom the harrow discs penetrated the sediments by three inches. At engine settings of 3500 rpm (applied force of 500 lbs.), the harrow moved at a speed of 0.012 m/sec. which is much too slow for injection tracklines. The surface rigging was changed and the barge turned around to pull forward, applying more force. At engine settings of 2500 rpm (applied force of 1300 lbs.), the harrow moved at a speed of 0.5 m/sec. The increased speed caused the front row of discs to rise slightly and reduce the amount of penetration. It is entirely possible that to maintain consistent penetration and tow speed the weight of the harrow will have to be increased. It should also be noted that the angle of the tow wire was much steeper than would normally be encountered, causing more lift on the tow yoke. It was more difficult to keep the barge on the trackline when moving forward. Divers obtained forty minutes of video tape during this portion of tests.

Hamilton Harbour Testing

The harrow was deployed near the Burlington sewage treatment plant outfall pipe since there was an abundance of very soft sediments at this location. The rollers were adjusted so that the bottom of the roller was even with the axle of the discs. The barge was powered full astern and the harrow did not budge. After changing the rigging to pull forwards, 3500 rpm (2000 lbs.) was applied to the engines with no resulting movement of the harrow. It was determined to be too dangerous to increase the power any further and the test was halted. Other than the holding power of the harrow in soft sediments, this portion of the testing revealed very little useful information.

Winter 97/98 Refurbishment

1. The injection delivery parts will be added to the harrow
2. Variable ballast cylinders will be added to the harrow frame
3. A DGPS antenna will be mounted on the harrow frame
4. The turnbuckles which control the height of the rollers will be marked. Markings will indicate max., min. and mid penetration of the discs.
5. The locking pin mechanism for the wheels will be repaired.

HAMILTON HARBOUR
NTRB STUDY 12921, DR. I. DROPPO

On May 21, 10 PONAR samples were collected in the Dofasco Slip. The samples were collected for a sediment flume to measure resuspension.

SEDIMENT SAMPLING, HUMBER BAY
NTRB STUDY 12921, DR. I. DROPPO

Personnel from the University of Toronto conducted a short survey to study the effects of the combined sewage outfalls located on the Toronto waterfront. Large sediment samples were collected at two locations to be used in experiments with zooplankton. A PONAR grab sampler was used from a small launch at two sites in the area. One station was located near the Humber Bay sewage outfall and a "clean site" was chosen the following week about a mile offshore of Ontario Place.

STATION POSITIONS

May 22	43º 37' 37.4" N.	79º 28' 08.2" W.
May 28	43º 37' 14.0" N.	79º 25' 12.3" W.

RIVERBED SEDIMENTATION STUDY
NTRB STUDY 12922, DR. N.A. RUKAVINA

CORNWALL AREA

On April 1, a TOS dive team (Gray, Breedon and Don) travelled to Cornwall to search for and install surface buoys on eight scientific moorings in the Cornwall area. Mr. G. Dolanjski, RSB, Engineering met the dive team in Cornwall to assist with the data recovery and refurbishment of the dataloggers. Three moorings along the Courtaulds area of the St. Lawrence River are part of a long-term monitoring of the movement of river sediments.

The search for all moorings required the use of the PINTAIL, divers, DGPS, pinger locator, sounder and a grapnel. Water visibility in the area averaged between twenty to thirty feet.

Site #1, mooring number 97-07S-05A was found in poor condition. The T-frame was covered with aquatic macrophytes and the buoy line was tangled with the groundline. The spar buoy line was partially cleared and a new spar installed. The T-frame was cleared and a new pinger installed. Three sections of track were added to the buoy anchor, increasing the anchor weight to 580 lbs. There has been no instrumentation at this site for one year.

Site #2, mooring number 97-07S-06A was found in good condition. The T-frame was covered with aquatic macrophytes but both transducers were clear. All hardware was in place and undamaged. After connecting to the datalogger, Mr. Dolanjski decided that the entire system should be removed. Divers collected video observations of the site, both prior to the removal of the macrophytes/hardware and during the diver measurements. Three sections of track were added to the buoy anchor, increasing the anchor weight to 580 lbs. The pinger was refurbished with fresh batteries.

At Site #3, mooring number 97-07S-07A, the mooring was found in good condition. Three sections of track were added to the buoy anchor, increasing the anchor weight to 580 lbs. The

pinger was refurbished with fresh batteries. The LCSS sediment trap mooring at this site was cleaned and equipped with a poly ball on the subsurface float.

The PDS200 system was installed at Site #2 on May 6. Measurements were taken at each transducer and a video tape record was made after the completion of the installation. Mr. Jeff Ridal of the St. Lawrence Institute was present for the installation and was trained by Mr. Gilroy to monitor the system.

The T- frame sites along the Courtaulds waterfront were serviced on July 8. At site numbers 1 and 3, divers installed OBS sensors with Brancker loggers. Both frames were cleared of debris. At site #2, the offshore transducer was removed. A new transducer was installed along with an OBS sensor attached to the new datalogger. Underwater video was obtained at site #2.

On September 10, the dive team met with personnel from the St. Lawrence Institute at T-frame site #2. The T-frame was monitored before the divers entered the water. Divers then cleaned the transducers and collected measurements. The monthly data was dumped and the recorders were checked for operation before departing the site.

On September 18, the T-frame at site #2 was monitored.

On November 17, a TOS dive team (Gray, Breedon, Dahl and Gilroy) travelled to Cornwall to remove spar buoys and install winter markers on the three T-frame moorings. Mr. G. Dolanjski, RSB, Engineering met the dive team in Cornwall to assist with the data recovery and refurbishment of the datalogger on mooring number 97-07S-06A (T-frame site #2). As an additional task, diver cores were collected at four stations near Cornwall.

On November 17, dive team B (Gray, Breedon, Dahl and Gilroy), utilizing the PINTAIL, removed the datalogger and battery can from the T-frame at site #2. The electronic equipment was taken back to the motel where Mr. Dolanjski refurbished the units for a four-month winter deployment.

On November 18, dive team B returned to T-frame site #2 and installed the new datalogger, battery can and collected measurements.

On November 19, the Sercel Positioning system was set up at St. Lawrence College and checked at station Lock. The Sercel system operates in NAD 27 datum. Diver cores were collected at four stations. Two stations were located at the Northeast side of Akwasasnee Island—one station at Courtaulds and one station near the launching ramp at Lamereau Park. Dive team B collected cores at station 109 near Courtaulds. Since the sediments at the Courtaulds site are heavily contaminated, the dive stage was used by the divers to work above the bottom while coring.

STATION POSITIONS - CORNWALL AREA CORING (DATUM: NAD 27)

STATION NUMBER	NORTHING	EASTING
166	4984027.0	521105.6
109	4984878.7	523978.8
179	4984798.6	525940.0
182	4984827.9	526295.7

STATION POSITIONS - CORNWALL T FRAMES (DATUM - WGS 84)

STATION NUMBER	LATITUDE N.	LONGITUDE W.	NORTHING	EASTING
1	45° 01' 04.5"	74° 41' 44.7"	4984985.	523971.
2	45° 01' 17.4"	74° 41' 17.3"	4985386.	524571.
3	45° 01' 25.7"	74° 40' 58.9"	4985640.	524978.

HAMILTON HARBOUR T-FRAME

The Hamilton Harbour T-frame—installed in 1993, is part of a long-term plan to monitor the movement of sediments near the sandcap. The T-frame was equipped with two transducers on April 24 and serviced on June 23 and July 10. The spar buoy and transducers were removed on November 13.

HAMILTON HARBOUR STATION POSITION (DGPS - WGS 84)

STATION NUMBER	LATITUDE N.	LONGITUDE W.	NORTHING	EASTING
1	43° 17' 46.5"	79° 50' 57.8"	4794357.	593331.

ST. CLAIR RIVER T-FRAMES

On October 1, TOS divers (Gray, Dahl and Gilroy) travelled to Sarnia to install two T-frames. Working in conjunction with the CCGS LIMNOS, divers conducted site surveys at two locations, utilizing the CCGL PUFFIN. The current at both sites was between 1 - 3 knots. Marker floats were installed to assist the LIMNOS while installing both T-frames and spar anchors. Divers installed 50 ft. groundlines between the anchors and placed transducers on the T-frames. Cables from the transducers were ty-wrapped onto the buoy line for attachment to the monitor box. All transducers, cables and spars were removed on December 11.

ST. CLAIR RIVER STATION POSITIONS

STATION NUMBER	NORTHING	EASTING
1	42° 56' 33"	82° 26' 12"
2	42° 56' 37"	82° 26' 05"

ROXANN SEDIMENT SURVEYS, CORNWALL AND SCARBOROUGH
NTRB STUDY 12922, DR. N.A. RUKAVINA

Bottom sediment mapping, using Roxann, was done at two locations—the St. Lawrence River at Cornwall, Ontario and Lake Ontario near the Scarborough Bluffs. The CCGL PUFFIN, equipped with the Sercel GPS and Microplot navigation system was used for all the Roxann work again this year. Two trips were made to Cornwall with the Roxann system:

During the first trip in July, bottom sediment mapping was one on the Canadian side of Cornwall Island, starting ½ km downstream of the international bridge and continuing in a zig-zag pattern to an area 1 km downstream of Pilon Island. Detailed surveys were later done in areas that showed evidence of mud deposits.

The second trip in October was centred near the abandoned Courtaulds factory on the Canadian side of the river. Work consisted of a repeat of survey lines done over the past three years in order to see if any sediment movement had taken place in the survey area. Underwater TV was done at selected sites in order to ground truth the Roxann data.

The Scarborough survey was done on a contract for the Metro Toronto Region Conservation Authority. Shore protection is constantly being added to the shoreline East of Bluffer's Park marina in order to slow the erosion of the high bluffs in the area. Rapid residential growth in the area has made this a necessity. The Conservation Authority required a bottom survey of an area just off shore so that future changes to the bottom sediment structure could be accurately measured. During three days in early November, sounding lines with a 10-metre spacing were done in an area between Highland Creek and the Rouge River. Lines were run, starting inshore and running offshore to about 300 metres. Some UW-TV was done to ground truth the Roxann data.

T-FRAME BOTTOM MONITORING, SARNIA
NTRB STUDY 12922, DR. N.A. RUKAVINA

Transducers were installed to monitor the deposition/erosion of sediment on the St. Clair River bottom downstream of two storm sewer outfalls near Sarnia. Two T-frames, each equipped with 2 transducers, were deployed in October. The transducer cables were attached to a surface marker to allow for periodic monitoring.

RESEARCH SUPPORT BRANCH

ST. LAWRENCE RIVER SEDIMENT SURVEY, CORNWALL, ONTARIO

RESTORATION PROGRAMS DIVISION, ECB, EC-OR, H. BIBERHOFER
RSB STUDY 12631, S.B. SMITH

Water and sediment was collected from 29 sites on the St. Lawrence River in the Cornwall area during the week of October 20 - 25. The sediment samples were to be analyzed for organics, metals and bioassays as well as benthic community structure identification. Cores were also collected from each site for sediment structure x-rays.

Before each site was sampled, the bottom was examined by Roxann and underwater camera to ensure that the sediment was of the proper type and depth. Five stations were omitted when the sediments proved to be too thin or the wrong type (rock or sand). A total of 24 stations were visited and sampled At the end of each day, all sediment samples collected for RPD, OR were frozen for transport to CCIWI. MOEE samples were homogenized and stored for transport to the MOEE lab in Toronto.

Long cores were to be collected from a sediment deposit on the North side of Cornwall Island. After examining the Roxann data it was decided that longer cores could be collected by divers. The divers collected the cores during the week of November 17.

All positions locating the sites were done in NAD 27 and are recorded on the field sheets in possession of the study leaders.

BENTHOS CORES, RANDLE REEF

WATER TECHNOLOGY INTERNATIONAL CORPORATION, D. PHAGOO
RSB STUDY 12631, S.B. SMITH

On May 23, benthos cores were collected from the Randle Reef area. The cores were placed in 5-gallon pails. Three pails were collected at four stations for a total of 12 pails. The pails were transported to WTI for analyses.

STATION POSITIONS

STATION NUMBER	LATITUDE N.	LONGITUDE W.
S6	43° 16' 29"	79° 49' 56"
S9	43° 16' 31"	79° 49' 57"
S14	43° 16' 28"	79° 50' 02"
S26	43° 16' 29"	79° 50' 06"

PRODUCTIVE CAPACITY OF FISH HABITAT
GREAT LAKES LABORATORY FOR FISHERIES AND AQUATIC SCIENCES,
V. CAIRNS, J. FITZSIMONS
RSB STUDY 12631, S.B. SMITH

This project was a continuation of past studies to investigate the factors which affect fish and fish habitat associations in Great Lakes areas of concern; thereby addressing the terms of the 1988 Great Lakes Water Quality Act (Annex 2). Technical Operations provided diver, diver equipment and underwater television/video support to this study. The long-term objectives of the work include:

1. To develop habitat assessment and analysis methods (based on GIS technology) which integrate biological, chemical and physical components of the ecosystem

2. To develop predictive models of fish habitat requirements in relation to fish production for use as management tools in the assessment of proposed changes to fish habitats throughout the Great Lakes

3. To evaluate fish habitat restoration methods

TECH. OPS DIVE SUPPORT

DATE	LOCATION
April 7	Aqua Park
April 9	Stoney Creek
April 21	Stoney Creek
April 30	Pt. Weller
May 12	Pt. Weller
May 12-13	Lake Opeongo
June 4	Pt. Weller
June 6	Stoney Creek
July 14-18	Tobermory
November 10-13	Tobermory
December 9	Credit River
December 10	Pt. Weller
December 18	Pt. Weller

TOBERMORY STUDIES

On July 14, a TOS Dive Team (Breedon, Gray and Don) accompanied by Mr. J. Fitzsimons and Mr. T. Hieman of GLLFAS, DFO, travelled to Tobermory to search for potential Lake Trout spawning sites and install egg collection nets which would be recovered in the fall.

Collection Sites and Positions

1. Driftwood Bay: 45° 14' 38.2' 81° 34' 47.2"5010227.0 N 454498.4 E Traps 1-35 datalogger installed
2. Lapdaddy Cove: 45° 14' 57.1" N 81° 34' 52.9" W, 5010795. N 454384. E
3. NW Bank Shoal: 45° 16' 06.7" N 81° 45' 41.3" W, 5013122. N 440387. E datalogger installed
4. S Middle Bank Shoal: 45° 15' 31.6" N 81° 44' 43" W, 5011968. N 441525. E
5. SW Bank: 45° 14' 31.2" N 81° 45' 08.3" W, 5010108. N 440957. E 251 - 286
6. SE Russell Island: 45° 15' 41.1" N 81° 41' 35.9" W, 5012226. N 445605. E 143 - 148
7. SE Flowerpot Island: 45° 17' 36.6" N 81° 37' 36.7" W, #215-250
8. SW Bears Rump Island: 45° 18' 23.6" N 81° 34' 29.8" W, 5017164. N 454932. E #287-321, datalogger installed

LONG-TERM SENSING SITES (LTSS), CORNWALL REGION
RESTORATION PROGRAMS DIVISION, ECB, EC-OR, H. BIBERHOFER
RSB STUDY 12631, S.B. SMITH

A program has been developed to assess the long-term effectiveness of remedial work in the region as a whole. A network of Long-Term Sensing Sites (LTSS) has been jointly developed by Environment Canada (Quebec and Ontario regions), the Quebec Ministry of Environment and Wildlife and the Ontario Ministry of Environment and Energy.

The objective of the program is to study the quality of the sediments and suspended solids in order to assess the transport of contaminated material downstream from Massena, N.Y. sources.

On April 1, a TOS dive team (Gray, Breedon and Don) travelled to Cornwall to search for and install surface buoys on eight scientific moorings in the Cornwall area. Six moorings or Long-Term Sensing Sites (LTSS) for the Ontario Region are located at three sites—one in Lake St. Lawrence, two downstream of Courtaulds and three in Lake St. Francis. All Ontario Region moorings are comprised of four sediment traps to monitor the quality of the sediments and suspended solids from Massena sources. Four sites are also equipped with S-4 current meters. This program has been developed to assess the long-term effectiveness of remedial work in the region as a whole.

The search for all moorings required the use of the PINTAIL, divers, DGPS, pinger locator, sounder and a grapnel. Water visibility in the area averaged between twenty to thirty feet.

Only one Ontario Region mooring was found successfully. Pilot Island site, mooring number 97-07S-08A was found in good condition. A spar buoy and poly ball were installed. The pinger was refurbished with fresh batteries. Both Lake St. Francis and Lake St. Lawrence were open water in the centre but access to the lakes at both marinas was impeded by heavy ice conditions.

On May 6, a TOS dive team (Gray, Breedon and Don) travelled to Cornwall to search for and install surface buoys on four scientific moorings in the Cornwall area. Spar buoys and poly balls were installed on three moorings in Lake St. Francis. In Lake St. Lawrence, a single mooring was equipped with a spar and poly ball.

On June 16, a TOS dive team (Gray and Don) travelled to Cornwall to change light batteries on eight surface buoys in the Cornwall area.

On July 7, a TOS dive team, (Gray, Breedon and Don) accompanied by Mr. D. Gilroy, NTRB, travelled to Cornwall. Along the Cornwall waterfront, two sediment trap moorings were installed in the St. Lawrence River for Ontario Region. One mooring is located just downstream of the artificial reefs and the second, upstream of St. Lawrence College. Both moorings are single point style. Since both moorings were installed using the PINTAIL, railway track anchors were used to safely handle the weight. The spar buoy is attached to the subsurface float.

On September 10, sediment traps were installed on two new moorings at Cornwall (97-07S-13A and 97-07S-14A). Each mooring had a new groundline and buoy line installed.

On November 17, a TOS dive team (Gray, Breedon, Dahl and Gilroy) travelled to Cornwall to remove spar buoys and install winter markers on all LTSS moorings in the Cornwall area.

CORNWALL RAP TELEVISION SPECIAL

On September 8, a TOS dive team (Gray, Dahl and Don) travelled to Cornwall to provide diving support to EC Ontario Region. TOS support was co-ordinated through Mr. H. Biberhofer, Ontario Region and Mr. D. Gilroy, NTRB assisted during the second week. Support included underwater video from MURV and the new diver held digital camera. The purpose of this trip was to assist the local RAP committee with a live television special which was beamed through the local cable TV network to six Cornwall High Schools.

During the winter of 95/96, an artificial reef was constructed along the waterfront, West of the Civic Complex to create a habitat for local species of fish and other aquatic species. The reefs were constructed of 1.5-metre rounded boulders, piled on top of each other for lengths of 10, 20 and 30 metres. The reefs have large crevices between the boulders to provide shelter for many small fish.

After setting up the Haulmark trailer as the surface control room, divers began to obtain stock video footage of the reef and its inhabitants. The diver cam was equipped with a video output cable to the surface. The SCUBAphone was modified to incorporate the link between the cellular phone network and the diver's transducer. All diving operations required two divers in the water—one diver using the digital camera and the other tending cables from MURV and the diver cam. The diving supervisor controlled MURV and diver communications while a fourth person tended the cables at the water's edge. During the dives, the cameras showed a large diversity of fish and aquatic species. Most of the fish were good actors and provided a good show for the students. The video pictures from the new digital diver cam are the clearest, sharpest images that we have ever recorded underwater. It is hoped with the right software some of these images can be processed into posters and slides for lectures.

A DEFORMED CORMORANT CHICK

A HERRING GULL ON ITS NEST

The first week was spent setting up equipment and smoothing out the bugs associated with interfacing the various audio/video systems. The local cable company caused endless grief with their lack of support. The live broadcast took place September 17 at 1300 hours. During the broadcast, the students watching the live underwater video asked questions of the divers. The questions were answered by the divers as MURV and the diver cam sent the video to the surface. The show also combined surface interviews describing the diving equipment, MURV, remedial action programs and the biology of the artificial reef. The show went well and comments from the schools were positive. Future projects, involving other RAP areas, are being planned along similar lines.

TRENT RIVER WATER SAMPLING STATION

On July 7, a TOS dive team, (Gray, Breedon and Don) accompanied by Mr. D. Gilroy, NTRB, travelled to Trenton to install a water intake mooring in the Trent Canal for MOEE. The mooring consisted of a 180 lb. anchor with a 70 lb. subsurface float installed in 12 ft. of water. The subsurface float is located 5 ft. below the surface and forty feet offshore. The mooring is located 300 m upstream of Trenton Lock #1 on the West side of the Trent/Severn canal. The intake line was placed inside 6 inch "Big O" tubing and fastened to the mooring wire 6 ft. above the rock bottom. Between the anchor and shore, the hose was secured with track anchors and rocks. At the shore end, the line was secured to the Gabien basket wall and into a prefab. shed.

On September 18, the dive team stopped at Trenton to install an organic sampler and temperature logger on the water intake mooring.

The entire water intake mooring was retrieved for the winter on November 20.

CANADIAN WILDLDIFE SERVICE
DR. C. WESELOH
RSB STUDY 12631, S.B. SMITH

Technical Operations Section continued to support the Canadian Wildlife Service (CWS) field program on the Great Lakes and connecting waterways. The purpose of this program is to determine, or aid in the determination of the biological effects of toxic chemicals in Herring Gulls, Cormorants and Terns. The research involves eggs and chicks with a relatively short timespan between the nesting and fledging of the chicks. This, combined with the vast study area, kept field personnel very busy. Depending on weather conditions, colonial birds begin to nest in late April and the chicks have normally abandoned the nesting area by early to mid-July. During this time, many colonies covering all of the Great Lakes and the Kawartha area were studied. Most colonies required several visits during the nest building, egg laying and chick rearing process.

Two field parties were normally required to carry out the work, each consisting of two or more full-time staff with the help of students and volunteers. This year more intensive Caspian and Black Tern research was done and a complete count of Cormorant nesting sites on the Great Lakes was undertaken. As in past years, Herring Gull monitoring and egg collection were

A GREAT EGRET CHICK

FORSTERS TERN ON ITS NEST

completed to add to the existing database of contaminant levels and to determine spatial and temporal trends of these birds.

The two field parties, often afield at the same time, utilized either the CCGL THUNDERBIRD or the CCGL McKEE #2. Work completed in shallow water or marsh conditions required the use of canoes. Gulls, Caspian Terns and Cormorants usually nest on off-shore islands while Black Terns nest in marshes and swamps on floating vegetation.

During the field season, many kilometers were travelled by land and water to reach the study areas. Although this extensive amount of trailering and boating was carried out in a variety of conditions, it was again successfully completed without injury or damage.

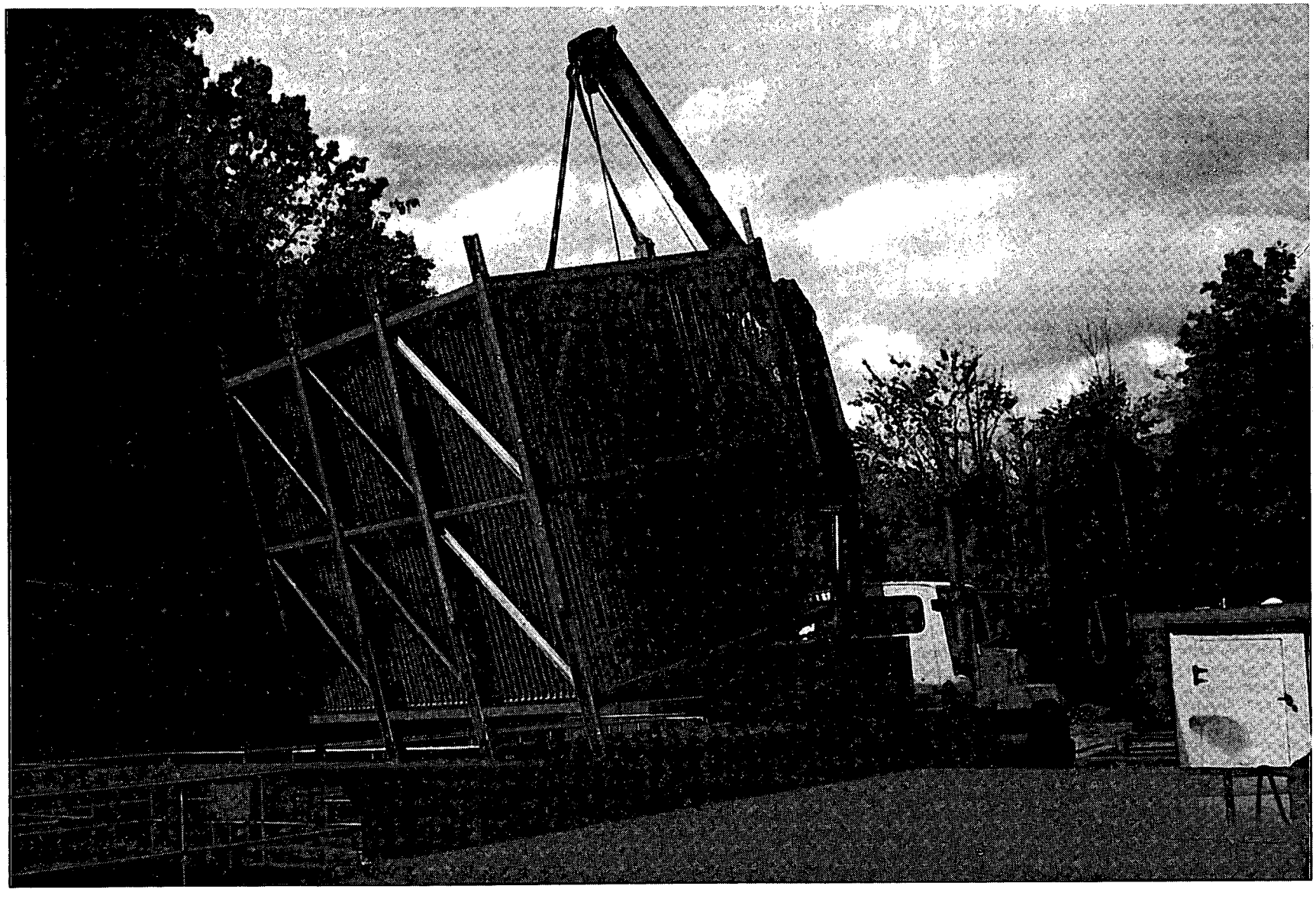
VEHICLE SUMMARY
COMMON-USER SUPPORT
RSB STUDY 12633, M.R. MAWHINNEY

The 1997 field season was an extremely busy one. The downtime on any vehicle has been minimal. Ever-increasing downsizing of the NWRI fleet due to departmental budget restraints resulted in the loss of two staff wagons and one full size van. It is predicted that the loss of these vehicles will be felt immensely with the start of the 1998 field season.

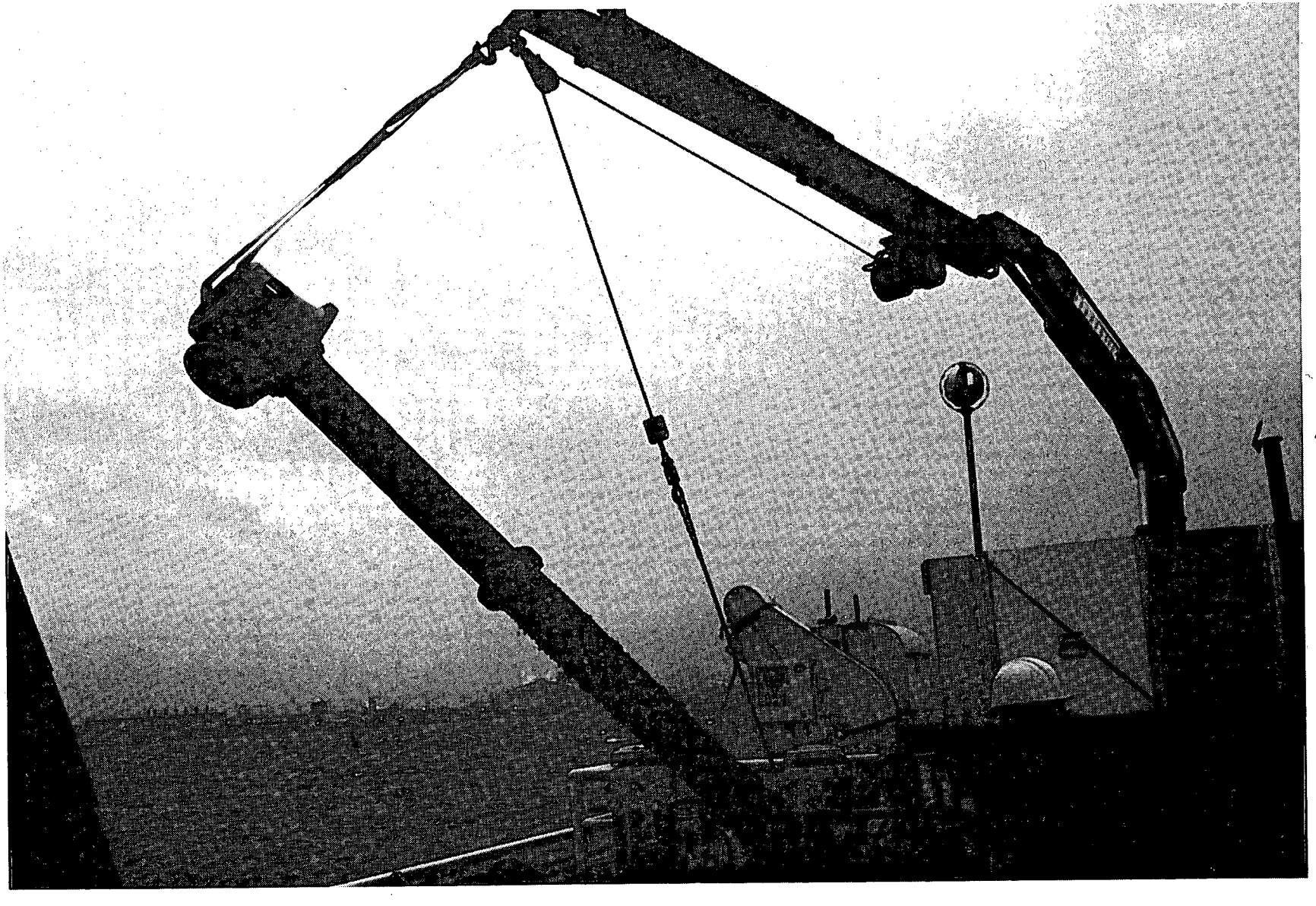
We had our first full year with the new VRA (Vehicle Refuel Appliance) natural gas machines which are located on the dock by the helicopter pad. Initially the concept of a dual fuel system vehicle caused concern among a large majority of the staff at the Centre and it was met with much hesitation. During the course of the year, staff have gradually come to understand how the system operates. And in return staff have come to feel more comfortable with operating a dual fuel vehicle. The conversions were completed as part of the proposed greening of the Environment Canada fleet as our contribution to the reduction of greenhouse gases. The aim was to have the converted vehicles operate on the alternate fuel as much as possible. The use of alternative fuels is paramount to improving air quality and it is also the cleanest and most economical way to operate the fleet.

Also introduced into the fleet this year were two new 4x4 extended cab pickups. The two new vehicles replace a 4x4 extended cab that was utilized for the Turkey Lakes Study and a passenger van stationed at NWRI for common-user status. The vehicle at the Turkey Lakes was aging and was also beyond economical repair due to harsh off-road operating conditions. Since the introduction of this 4x4 into the fleet at Sault Ste Marie, its operation has been primarily on propane and it has been incorporated into the national demonstration program. The second extended cab has not been converted to dual fuels as yet. A new dual wheel crewcab will be added to the fleet later this fiscal year.

A.R.I. Canada, "Automotive Rentals Incorporated" are still handling billing of all NWRI vehicle repairs. This company is responsible for keeping and maintaining all vehicle records; such as, mileage, fuel consumption, incidentals, repair costs, etc. Records are also kept internally by the Technical Operations Section. Vehicle information is sent to A.R.I. on a monthly basis. This



LOADING CRANE TRUCK WITH FILTER FRAME AT WATERDOWN



COOLING WATER PUMP REMOVAL AT CCIW

has been a very efficient and satisfying organization to deal with. It has cut down considerably on the amount of time and effort spent doing paper work for each and every vehicle in the fleet.

Extensive areas travelled this season ranged from Halifax, Nova Scotia to Calgary, Alberta. Some U.S. destinations included Montana, Minnesota, North Dakota, Wisconsin, Michigan, Washington, Buffalo and Niagara Falls, N.Y. From April 1997 to December 1997, NWRI vehicles logged a combined total mileage of 320,322 km. On average NWRI vehicles travel over half a million kilometres per fiscal year.

RIGGING SHOP
COMMON-USER SUPPORT
RSB STUDY 12633, M.R. MAWHINNEY

The Rigging Shop was operated by two Shop personnel with the assistance of other Technical Operations staff members.

The Rigging Shop staff are responsible for the care of Shop facilities, warehouse storage, outside storage shed and long-term outside storage areas as well as maintaining all mooring equipment, buoys, generators, power tools, winches, forklifts, vehicles and various other pieces of research equipment.

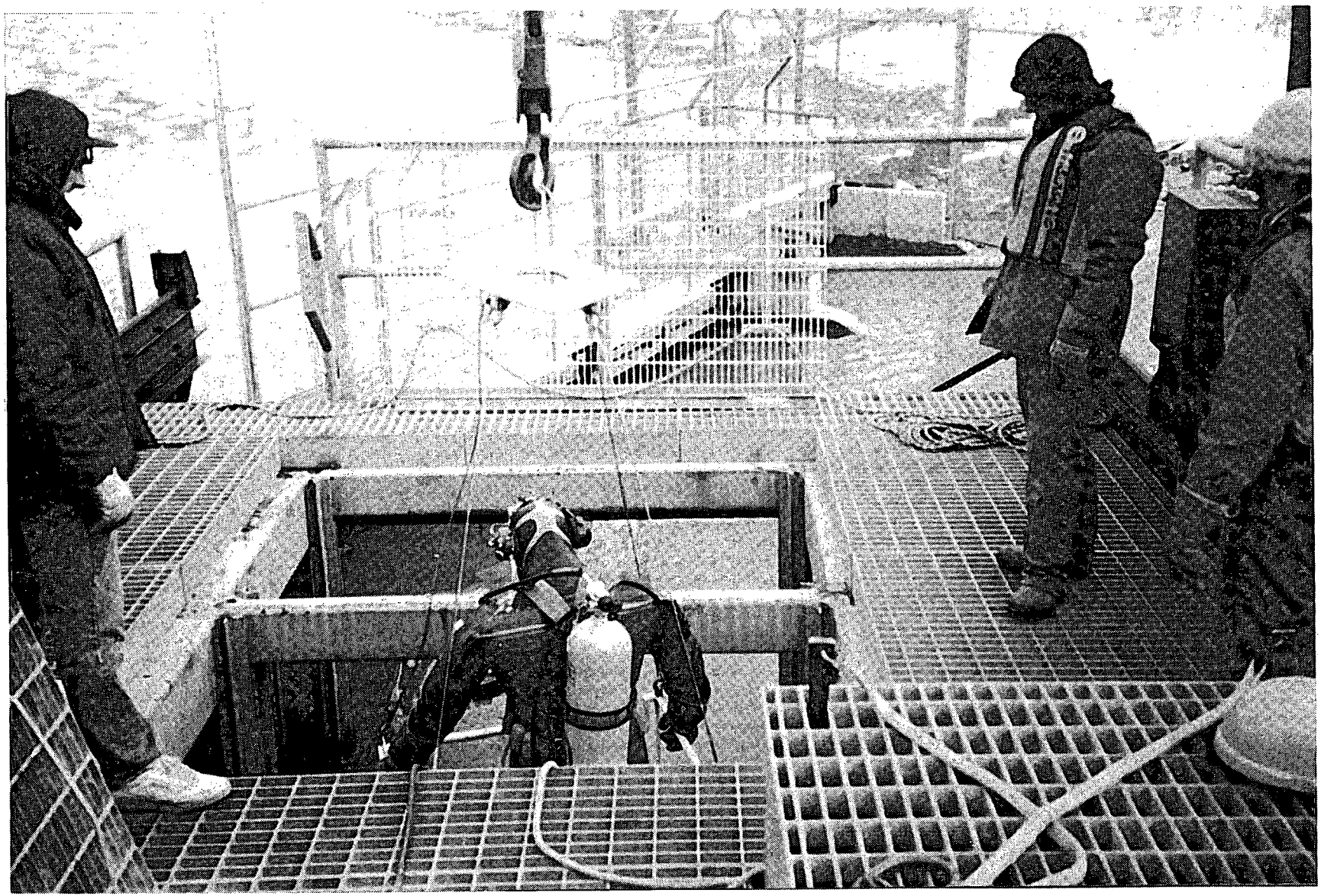
Rigging Shop staff are responsible for the delivery of scientific equipment to major ships and field programs throughout the Great Lakes Basin and the St. Lawrence River. They erect towers, operate boats, forklifts and the heavy crane truck while assisting with scientific studies when required.

FIELD STORES
COMMON-USER SUPPORT
RSB STUDY 12633, M.R. MAWHINNEY

Field Stores is operated for the use of the staff within the National Water Research Institute. Staff from other government departments and organizations such as EC-Ontario Region, Fisheries & Oceans, Provincial and Municipal governments and universities also use the Stores facility when arrangements are made with the Head, Technical Operation Section and approval is granted by the Executive Director of NWRI.

Field Stores personnel issue project chiefs and study leaders with a variety of specialty equipment such as safety clothing, sediment and water samplers, ph and conductivity meters, cameras and vehicles. On return, the items are inspected for damage, repaired if necessary and re-issued. Repairs are made in house or at outside shops. A computer inventory database has been implemented this year to provide a more efficient service and record system.

Passenger vehicles are scheduled and issued through Stores. Three station wagons, two sedans, a minivan, an 8-passenger van, seven five passenger vans, four 4x4 pickups, two 1-ton



CARP BARRIER INSPECTION

crewcabs and a variety of other specialized vehicles are included in the fleet. On average, 150 bookings are made each month for vehicles.

Field stores has been operated since August by Rigging Shop personnel with assistance from other Technical Operations staff members.

DIVING OPERATIONS
RSB STUDY 12634, F.H. DON

The Diving Operations Unit of Technical Operations Section provided national and international support to various scientific studies in areas of diver certification, inspections, installations and retrievals of hardware, sample collection, videography, television surveys with video documentation, equipment demonstrations/trials, search and recovery, lectures and diver training. The Diving Operations Unit supported 11 divers at Burlington. A total of 590.5 hours (accident free) were logged in support of scientific projects for: NWRI, EC-OR-ECB-EHD, EC-OR-ECB-RPD BINST and GLLFAS, DFO. A total of 34 hours were logged on MURV—the remotely operated mini-rover underwater camera system. MURV is used for deep water and long duration video recording. Projects have included wreck mapping, sonar surveys, documentation of geological formations and live educational documentaries. The Dive Shop also has the capability to edit and copy all raw footage for scientific purposes into any desired format.

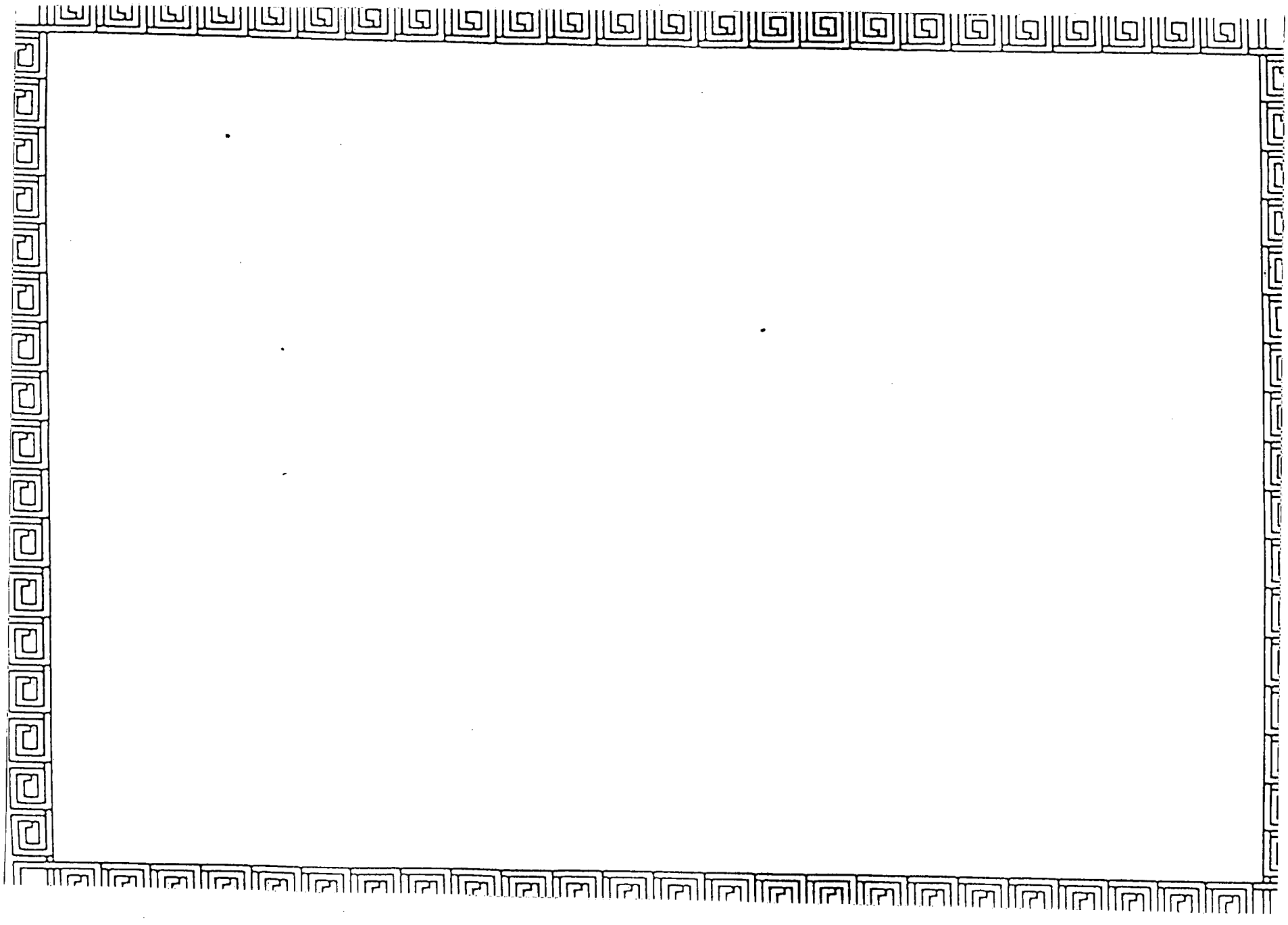
The Head of the Diving Operations Unit, F.H. Don represented research/scientific diving as a member of the CSA Standards Technical Committee on Diving Safety and the Ontario Construction Safety Association Task Force on "Diving in Contaminated Environments". Mr. Don is also a member of the Canadian Standards Association Sub-committee on Diving Competency as Chairperson of the Contaminated Environment working group. Mr. Don is Chairperson of the Federal Interdepartmental Committee for Diving Safety. The annual meeting of the Department of Environment Diving Safety Committee was held in April in Ottawa, Ontario.

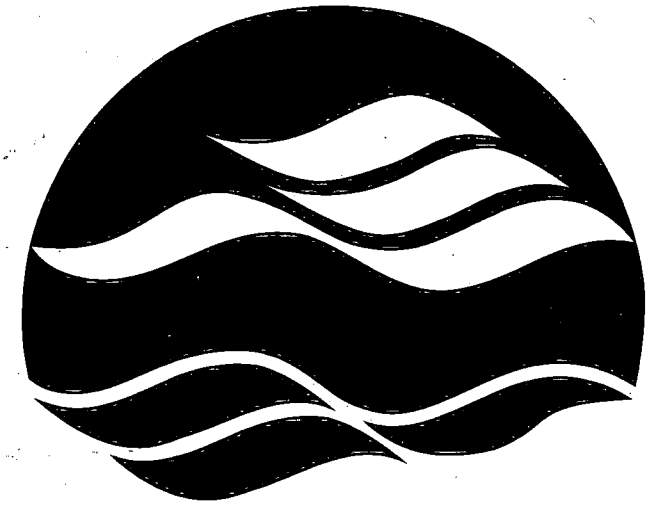
The Diving Operations Unit has a complete inventory of modern diving and diver support equipment which, when used and operated by highly skilled TOS divers, can complete even the most difficult of sub-sea operations.

Projects supported during 1997 included:

STUDY NUMBER	STUDY TITLE
12214	AERB - Hamilton Harbour Sandcap
12217	AERB - Sediment Remediation, Hamilton Harbour
12241	AERB - Lake Erie
12247	AERB - Lake Ontario
12465	AEPB - Mussels, Lake Ontario Region
12920	NTRB - Hamilton Harbour, Japan, Manitoba and Alberta
12922	NTRB - Hamilton Harbour, Cornwall and Sarnia

STUDY NUMBER	STUDY TITLE
12631	Outside Agencies: GLLFAS, BINST, DFO, Fitzsimons, Fish Habitat Studies GLLFAS, BINST, DFO, Cairns, RBG Carp Barrier Marine Division, BINST, DFO, Hull inspections/repairs RPD, ECB, EC-OR, Biberhofer, Cornwall





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