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Winter distribution of striped bass (Morone saxatilis) and associated environmental conditions in Kouchibouguac National Park 1996-1997

R. G. Bradford, E. Tremblay, and G. Chaput

1998
Report 003

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Parks Canada - Ecosystem Monitoring and Data Reports 0003

1997

Winter Distribution of Striped Bass (*Morone saxatilis*) and Associated Environmental Conditions in Kouchibouguac National Park during 1996-1997

by

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TABLE OF CONTENTS

ABSTRACT

Bradford, R.G., E. Tremblay, and G. Chaput 1997. Winter distribution of striped bass (*Morone saxatilis*) and associated environmental conditions in Kouchibouguac National Park during 1996-1997. Pks. Can. -Eco. Monit. Data Rep. No. 0003. iv + 59 p.

This report documents the fish distributions and the prevailing hydrographic and atmospheric conditions observed, between November, 1996 and March, 1997, during a biotelemetric-based investigation of the winter habitat requirements of striped bass within the Kouchibouguac River. The report also summarizes the hydrographic conditions observed and the search activities for implanted fish in other southern Gulf of St. Lawrence rivers; specifically, the Richibucto, the St. Louis, the Black, and the Miramichi rivers.

RÉSUMÉ

Le présent rapport traite de la répartition de l'espèce et des conditions hydrographiques et atmosphériques enregistrées entre novembre 1996 et mars 1997, au cours d'une enquête biotélémétrique sur l'habitat hivernal du bar rayé dans la rivière Kouchibouguac. Le rapport résume également les activités de recherche sur le poisson implanté et les conditions hydrographiques enregistrées dans les autres rivières du sud du golfe Saint-Laurent, et plus précisément les rivières Richibucto, Saint-Louis, Black et Miramichi.

INTRODUCTION

Striped bass (*Morone saxatilis*) are an anadromous percid indigenous to, and distributed throughout, the eastern seaboard region of North America (Scott and Scott 1988). Within the southern Gulf of St. Lawrence, spawning occurs predominantly within the Miramichi River estuary (Fig. 1) during May-June (Bradford and Chaput 1996). After spawning, adult striped bass initiate extensive feeding migrations throughout the coastal marine portions of the region (Bradford and Chaput 1996), but return to freshwater habitats at the onset of winter conditions (Hogans and Melvin 1984; Rulifson and Dadswell 1995; Bradford and Chaput 1996). The basis for this overwintering behaviour is presumably to avoid lethally low marine temperatures.

Overwintering sites are not necessarily within the estuary where either previous spawning has occurred or where spawning will occur during the following spring (Bradford et al. 1995a; Bradford and Chaput 1996). Neither the hydrographic traits nor the spatial distribution of preferred, or viable, overwintering habitat within estuaries are known. However, the constricted and interannually persistent distribution of winter commercial fisheries for striped bass, which have occurred in past years up to March, 1996, suggest that the fishes winter habitat requirements are both quite specific and predictable. The Kouchibouguac River estuary (Figs. 1, 2) is a known overwintering site for striped bass with Miramichi origins (Bradford et al 1995; Bradford and Chaput 1996). The striped bass is among the highest conservation priorities in Kouchibouguac National Park (KNP)(Tremblay and Beach 1994). This study was initiated to develop a basis for further improvements to the park's strategy for the conservation, protection and management of this species.

This report documents the fish distributions and the prevailing hydrographic and atmospheric conditions observed, between November, 1996 and March, 1997, during a biotelemetric-based investigation of the winter habitat requirements of striped bass within KNP.

MATERIALS AND METHODS

Nine striped bass ranging in length from 39.8cm fork length (FL) to 69.5 cm FL and in age (years) from 3^+ to 6^+ (Table 1) were obtained from a park index trapnet on the Kouchibouguac River (Fig. 2) during October. The fish were held in a submerged live box until ultrasonic transmitters - or 'pingers' - were surgically implanted into the visceral cavity of the anaesthetised fish through a small (~1.5 cm) incision located just forward and slightly above the insertion point of the pelvic fin. Incision wounds were sutured shut, and each fish was marked externally with individually numbered Floy "T" tags (for identification of any of the implanted fish which might be recaptured after termination of the telemetry experiment). Six fish were implanted on November 5 and three fish on November 22. Pingers transmitted either at the 65.5 KHz or 69 KHz frequencies, but with a pulse period (msec) and pulse rate per minute (ppm) unique to individual fish (Table 1) so that individual fish could be identified and tracked during the winter months. Fish were measured and scale sampled for age determination. The implanted fish were replaced into the live box for recovery from the surgery. All nine fish survived the

implantation procedure and were released back into the wild either on November 15 (six fish) or November 29 (three fish) (Table 1).

A continuously recording receiver (shore station), equipped with an omni-directional hydrophone, was placed at the upstream boundary of the park in order to determine whether or not overwintering fish migrated into tidal portions of the river outside of the park, a region which is not patrolled by park wardens on a regular basis.

Tracking of the implanted fish began shortly after their release into the wild using a battery operated mobile receiver equipped with a directional hydrophone. Tracking during late autumn-early winter (November-early January) was infrequent and was conducted either via boat or from the shore, depending upon the ice conditions of the day. No hydrographic data were collected at this time because systematic surveys of the tidal portions of the river were not possible (i.e., unpredictable distribution and thickness of the ice).

Systematic surveys of fish distribution and their associated hydrographic conditions commenced on January 22, 1997, once ice cover thickness permitted safe transit on the river via either snowmobile or all terrain vehicle (ATV). A series of hydrographic stations fixed in location along the longitudinal axis of the estuary were visited on each day of tracking. Vertical profiles of water temperature (to 0.01°C) and salinity (to 0.01ppt) were obtained with a battery powered conductivity-temperature-depth (CTD) apparatus. Distances between hydrographic sites varied along the longitudinal axis of the river. Generally, between site distances decreased from the downstream to the upstream sections (Fig. 2) in order to resolve the hydrographic traits of the water column associated with the distribution of (implanted and re-located) overwintering striped bass; i.e., to within ±100 m.

Similar sampling procedures were used to both search for implanted fish and to describe the hydrographic conditions of other southern Gulf rivers; specifically, the Richibucto, St. Louis, Black, and Miramichi rivers (Fig. 1).

RESULTS

The three fish released into the wild on November 29 were the only fish which established a prolonged residence within the Kouchibuguac River estuary. None of the six fish released to the wild on November 15 were re-located within the estuary after November 22 (Appendix 1). Four of these six were re-located on 7-11 February (Appendix 2) within the St. Louis River (Fig. 1). In total, seven of the nine fish were re-located after their release to the wild, either within the Kouchibouguac or St. Louis Rivers. Surveys of the Miramichi, Black, and Richibucto Rivers (Table 2) failed to detect the presence of the other two fish.

The January-March distributions of the implanted striped bass were both spatially restricted and persistent for the duration of the tracking experiments in both the Kouchibouguac (Appendix 3) and St. Louis (Appendix 4) rivers. Overwintering habitats were generally observed

as fresh-brackish water (0-15 ppt) environments with average water temperatures of not less than -0.4°C (Appendices 3,4). Neither of the striped bass which overwintered within the Kouchibouguac River occupied the freshwater tidal portions of the estuary above the park boundary. Plots of water temperature (°C) and salinity (ppt) versus depth (m) for hydrographic stations occupied during the experiment are shown in Appendix 5 and Appendix 6 for the Kouchibouguac and St. Louis rivers respectively. Hydrographic conditions remained relatively stable among days within both river systems during the period of ice cover. Typical profiles of water temperature (°C) and salinity along the longitudinal axes of the Kouchibouguac and St. Louis rivers are shown in Appendices 7 and 8 respectively. The relatively high degree of stability of hydrographic conditions within both rivers for the duration of the experiment can probably be attributed to the persistence of cold atmospheric conditions (Appendices 9 and 10) and precipitation predominantly in the form of snow (Appendices 9 and 10). These two factors probably contributed to low freshwater discharge into the estuaries. However, winter freshets are not uncommon within southern Gulf of St. Lawrence rivers. The potential response of overwintering striped bass to higher winter freshwater discharge cannot be evaluated from data collected during this study.

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Table 1. Fish identification number, external tag number, fork length (cm), age (years), and sex of striped bass implanted with hydro acoustic transmitters. The dates of implantation and release back to the wild, transmitter frequency (KHz), pulse period (msec) and pulses per minute (ppm) are listed for each fish.

Fish	Floy	Fork			Date That Fish Was		Transmitter		
ID #	Tag #	Length	Age	Sex	Implanted	Released	KHz	Period	ppm
1	14411	39.8	3+	M	22 Nov-96	29-Nov-96	69.0	1043	58
2	14420	56.0	5+	F	22-Nov-96	29-Nov-96	69.0	1159	52
3	14431	40.7	4+	F	22-Nov-96	29-Nov-96	69.0	1275	47
4	14605	55.2	6+	F	05-Nov-96	15-Nov-96	65.5	1125	53
5	14607	53.5	5+	F	05-Nov-96	15-Nov-96	65.5	1313	46
6	14606	53.8	5+	M	05-Nov-96	15-Nov-96	65.5	1406	43
7	14609	53.5	5+	F	05-Nov-96	15-Nov-96	65.5	1500	40
8	14608	59.5	5+	F	05-Nov-96	15-Nov-96	65.5	1219	49
9	14610	57.0	5+	F	05-Nov-96	15-Nov-96	65.5	1031	58

Table 2. Summary of dates, rivers surveyed and method of transit during the striped bass winter habitat study. Dates for which fish were relocated and for which hydrographic data were collected are also shown.

Date	River	Method	Fish located	CTD profiles
22-Nov-96	Kouchibouguac	Boat	Yes	No
11-Dec-96	Kouchibouguac	Shore	Yes	No
12-Dec-96	Kouchibouguac	Shore	Yes	No
17-Dec-96	Kouchibouguac	Boat	Yes	No
18-Dec-96	Kouchibouguac	Boat	Yes	No
16-Jan-97	Kouchibouguac	Boat	Yes	No
22-Jan-97	Kouchibouguac	Ice	Yes	No
23-Jan-97	Kouchibouguac	Ice	Yes	No
24-Jan-97	Kouchibouguac	Ice	Yes	Yes
27-Jan-97	Kouchibouguac	Ice	Yes	No
29-Jan-97	Kouchibouguac	Ice	Yes	No
30-Jan-97	Kouchibouguac	Ice	Yes	No
31-Jan-97	Kouchibouguac	Ice	Yes	Yes
03-Feb-97	Kouchibouguac	Ice	Yes	Yes
04-Feb-97	Black	Ice	No	No
06-Feb-97	Kouchibouguac	Ice	Yes	Yes
07-Feb-97	St. Louis	Ice	Yes	No
11-Feb-97	Kouchibouguac	Ice	Yes	Yes
11-Feb-97	St. Louis	Ice	Yes	Yes
12-Feb-97	St. Louis	Ice	Yes	Yes
13-Feb-97	St. Louis	Ice	Yes	Yes
14-Feb-97	Kouchibouguac	Ice	Yes	Yes
18-Feb-97	Kouchibouguac	Ice	Yes	Yes
19-Feb-97	St. Louis	Ice	Yes	Yes
24-Feb-97	Kouchibouguac	Ice	Yes	Yes
24-Feb-97	St. Louis	Ice	Yes	Yes
25-Feb-97	Richibucto	Ice	No	Yes
26-Feb-97	St. Louis	Ice	Yes	Yes
28-Feb-97	Miramichi	Ice	No	Yes
13-Mar-97	Kouchibouguac	Ice	Yes	Yes
14-Mar-97	St. Louis	Ice	Yes	Yes

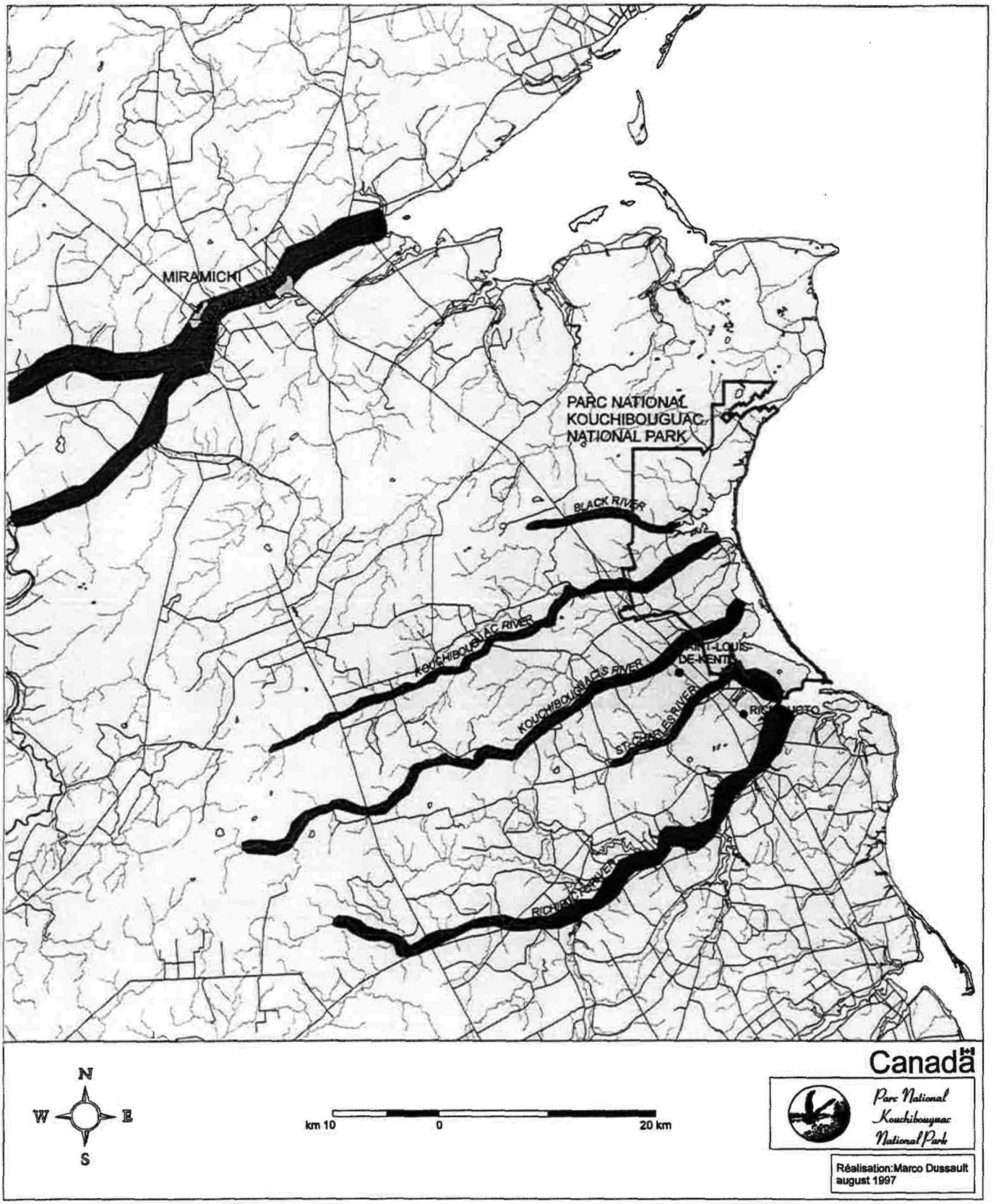


Figure 1. Map of southern Gulf of St.Lawrence showing river locations and place names used in the text.

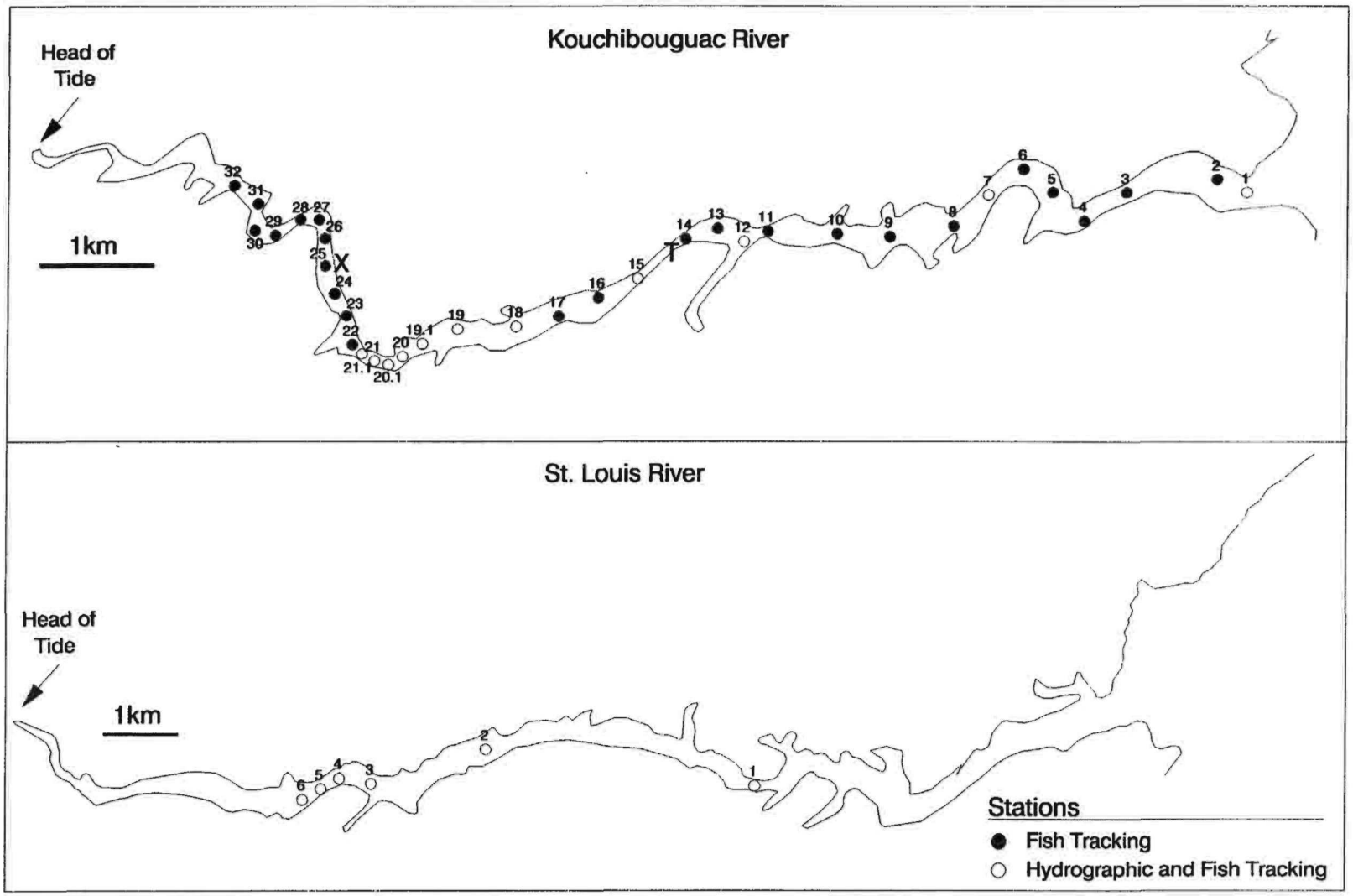


Figure 2. Maps of the Kouchibouguac and St. Louis Rivers showing the locations of the tracking and hydrographic stations (T =trapnet; X =fixed listening site).

APPENDIX 1

Appendix 1. Tracking and CTD data for Kouchibouguac River. Fish location codes: 1 =upstream, 2 =downstream, 3 =none detected. Temp =temperature.

Date	Station	Time	Tracking method	Fish id#	Fish location	CTD cast	Depth Averaged	
							temp. (oC)	salinity (ppt)
22-Nov-96	1	04:10 PM	Boat	0	3	No		
22-Nov-96	2	Not Recorded	Boat	0	3	No		
22-Nov-96	3	Not Recorded	Boat	0	3	No		
22-Nov-96	4	Not Recorded	Boat	0	3	No		
22-Nov-96	6	Not Recorded	Boat	0	3	No		
22-Nov-96	8	Not Recorded	Boat	0	3	No		
22-Nov-96	9	Not Recorded	Boat	0	3	No		
22-Nov-96	10	Not Recorded	Boat	0	3	No		
22-Nov-96	11	Not Recorded	Boat	0	3	No		
22-Nov-96	13	Not Recorded	Boat	0	3	No		
22-Nov-96	15	Not Recorded	Boat	0	3	No		
22-Nov-96	17	Not Recorded	Boat	0	3	No		
22-Nov-96	19	Not Recorded	Boat	0	3	No		
22-Nov-96	20	Not Recorded	Boat	0	3	No		
22-Nov-96	21	Not Recorded	Boat	0	3	No		
22-Nov-96	22	05:00 PM	Boat	7	1	No		
22-Nov-96	23	05:05 PM	Boat	7	2	No		
22-Nov-96	24	05:10 PM	Boat	0	3	No		
11-Dec-96	1	02:30 PM	Shore	0	3	No		
11-Dec-96	3	02:55 PM	Shore	0	3	No		
11-Dec-96	5	03:10 PM	Shore	0	3	No		
11-Dec-96	6	03:20 PM	Shore	0	3	No		
11-Dec-96	11	03:32 PM	Shore	0	3	No		
11-Dec-96	13	03:45 PM	Shore	3	2	No		
11-Dec-96	16	04:05 PM	Shore	1,2	2	No		
11-Dec-96	18	04:30 PM	Shore	0	3	No		
12-Dec-96	13	12:00 PM	Shore	2,3	1	No		
12-Dec-96	14	11:45 AM	Shore	2,3	2	No		
12-Dec-96	16	11:30 AM	Shore	0	3	No		
12-Dec-96	18	11:15 AM	Shore	0	3	No		
12-Dec-96	19	11:00 AM	Shore	0	3	No		
17-Dec-96	11	04:07 PM	Boat	0	3	No		
17-Dec-96	12	04:04 PM	Boat	0	3	No		
17-Dec-96	13	04:00 PM	Boat	0	3	No		
17-Dec-96	14	03:58 PM	Boat	0	3	No		
17-Dec-96	15	03:56 PM	Boat	0	3	No		
17-Dec-96	16	03:51 PM	Boat	0	3	No		
17-Dec-96	17	03:41 PM	Boat	0	3	No		
17-Dec-96	18	03:37 PM	Boat	0	3	No		
17-Dec-96	19	03:34 PM	Boat	0	3	No		

Appendix 1 continued

Date	Station	Time	Tracking method	Fish id#	Fish location	CTD cast	Depth Averaged	
							temp. (oC)	salinity (ppt)
17-Dec-96	20	03:30 PM	Boat	0	3	No		
17-Dec-96	21	03:27 PM	Boat	0	3	No		
17-Dec-96	22	03:25 PM	Boat	0	3	No		
17-Dec-96	23	03:15 PM	Boat	0	3	No		
17-Dec-96	27	03:00 PM	Boat	0	3	No		
18-Dec-96	1	10:05 AM	Boat	0	3	No		
18-Dec-96	2	10:09 AM	Boat	0	3	No		
18-Dec-96	3	10:15 AM	Boat	0	3	No		
18-Dec-96	4	10:20 AM	Boat	0	3	No		
18-Dec-96	5	10:27 AM	Boat	0	3	No		
18-Dec-96	6	10:34 AM	Boat	0	3	No		
18-Dec-96	7	10:38 AM	Boat	0	3	No		
18-Dec-96	8	10:43 AM	Boat	0	3	No		
18-Dec-96	9	10:48 AM	Boat	0	3	No		
18-Dec-96	10	10:52 AM	Boat	0	3	No		
18-Dec-96	11	10:56 AM	Boat	0	3	No		
18-Dec-96	12	11:00 AM	Boat	0	3	No		
18-Dec-96	13	11:03 AM	Boat	0	3	No		
18-Dec-96	14	11:08 AM	Boat	0	3	No		
18-Dec-96	15	11:13 AM	Boat	0	3	No		
18-Dec-96	16	11:19 AM	Boat	0	3	No		
18-Dec-96	17	11:28 AM	Boat	0	3	No		
18-Dec-96	18	11:35 AM	Boat	3	1	No		
18-Dec-96	19	11:47 AM	Boat	3	2	No		
18-Dec-96	20	11:55 AM	Boat	1,2	1	No		
18-Dec-96	21	12:07 PM	Boat	0	3	No		
18-Dec-96	22	12:04 PM	Boat	0	3	No		
18-Dec-96	23	12:09 PM	Boat	0	3	No		
18-Dec-96	24	12:12 PM	Boat	0	3	No		
18-Dec-96	25	12:19 PM	Boat	0	3	No		
18-Dec-96	27	12:33 PM	Boat	0	3	No		
18-Dec-96	28	12:37 PM	Boat	0	3	No		
18-Dec-96	29	12:42 PM	Boat	0	3	No		
18-Dec-96	30	12:45 PM	Boat	0	3	No		
18-Dec-96	31	12:50 PM	Boat	0	3	No		
18-Dec-96	32	12:55 PM	Boat	0	3	No		
16-Jan-97	1	09:48 AM	Boat	0	3	No		
16-Jan-97	2	10:00 AM	Boat	0	3	No		
16-Jan-97	3	10:08 AM	Boat	0	3	No		
16-Jan-97	4	10:15 AM	Boat	0	3	No		
16-Jan-97	5	10:22 AM	Boat	0	3	No		

Appendix 1 continued

Date	Station	Time	Tracking method	Fish id#	Fish location	CTD cast	Depth Averaged	
							temp. (oC)	salinity (ppt)
16-Jan-97	6	10:32 AM	Boat	0	3	No		
16-Jan-97	7	10:39 AM	Boat	0	3	No		
16-Jan-97	8	10:46 AM	Boat	0	3	No		
16-Jan-97	9	10:52 AM	Boat	0	3	No		
16-Jan-97	10	10:58 AM	Boat	0	3	No		
16-Jan-97	11	11:05 AM	Boat	0	3	No		
22-Jan-97	14	04:46 PM	Ice	0	3	No		
22-Jan-97	16	04:37 PM	Ice	0	3	No		
22-Jan-97	18	04:28 PM	Ice	0	3	No		
22-Jan-97	20	02:30 PM	Ice	2,3	1	No		
22-Jan-97	20	04:20 PM	Ice	2,3	1	No		
22-Jan-97	20.1	02:42 PM	Ice	3	2	No		
22-Jan-97	20.1	04:12 PM	Ice	2,3	2	No		
22-Jan-97	21.1	02:03 PM	Ice	0	3	No		
22-Jan-97	22	03:00 PM	Ice	0	3	No		
22-Jan-97	22	03:55 PM	Ice	0	3	No		
22-Jan-97	24	03:06 PM	Ice	0	3	No		
22-Jan-97	24	03:50 PM	Ice	0	3	No		
22-Jan-97	26	03:42 PM	Ice	0	3	No		
22-Jan-97	27	03:17 PM	Ice	0	3	No		
22-Jan-97	28	03:30 PM	Ice	0	3	No		
23-Jan-97	1	02:40 PM	Ice	0	3	No		
23-Jan-97	3	02:52 PM	Ice	0	3	No		
23-Jan-97	4	03:00 PM	Ice	0	3	No		
23-Jan-97	6	03:07 PM	Ice	0	3	No		
23-Jan-97	7	03:14 PM	Ice	0	3	No		
23-Jan-97	9	03:20 PM	Ice	0	3	No		
23-Jan-97	10	03:30 PM	Ice	0	3	No		
23-Jan-97	11	03:35 PM	Ice	0	3	No		
23-Jan-97	12	03:40 PM	Ice	0	3	No		
23-Jan-97	13	03:45 PM	Ice	0	3	No		
23-Jan-97	14	03:53 PM	Ice	0	3	No		
23-Jan-97	16	04:00 PM	Ice	0	3	No		
23-Jan-97	18	04:07 PM	Ice	0	3	No		
23-Jan-97	19	04:15 PM	Ice	0	3	No		
23-Jan-97	20	02:10 PM	Ice	2	1	No		
23-Jan-97	20	04:20 PM	Ice	2	1	No		
23-Jan-97	20.1	02:00 PM	Ice	2	2	No		
23-Jan-97	21	01:50 PM	Ice	3	2	No		
24-Jan-97	7	12:00 PM	Ice	0	3	Yes		
24-Jan-97	10	12:15 PM	Ice	0	3	Yes		

Appendix 1 continued

Date	Station	Time	Tracking method	Fish id#	Fish location	CTD cast	Depth Averaged temp. (oC)	Depth Averaged salinity (ppt)
24-Jan-97	13	12:30 PM	Ice	0	3	Yes		
24-Jan-97	15	12:40 PM	Ice	0	3	Yes		
24-Jan-97	18	12:47 PM	Ice	0	3	Yes		
24-Jan-97	20	12:55 PM	Ice	2	2	Yes		
24-Jan-97	21	01:05 PM	Ice	3	1	Yes		
24-Jan-97	21.1	01:15 PM	Ice	3	2	Yes		
27-Jan-97	19	03:46 PM	Ice	0	1	No		
27-Jan-97	20	03:32 PM	Ice	3	2	No		
27-Jan-97	21	03:22 PM	Ice	0	3	No		
29-Jan-97	19	11:15 AM	Ice	2	1	No		
29-Jan-97	19.1	11:05 AM	Ice	2,3	2	No		
29-Jan-97	20	10:50 AM	Ice	2,3	2	No		
29-Jan-97	20.1	10:35 AM	Ice	2	2	No		
29-Jan-97	21	10:20 AM	Ice	0	3	No		
30-Jan-97	19.1	11:11 AM	Ice	2,3	2	No		
30-Jan-97	20	10:54 AM	Ice	2,3	2	No		
30-Jan-97	20.1	10:45 AM	Ice	0	3	No		
30-Jan-97	21	10:40 AM	Ice	0	3	No		
30-Jan-97	21.1	10:33 AM	Ice	0	3	No		
31-Jan-97	1	12:30 PM	Ice	0	3	Yes	-1.29	26.44
31-Jan-97	18	01:15 AM	Ice	0	3	Yes	-0.33	21.84
31-Jan-97	19.1	01:22 AM	Ice	2	2	Yes	-0.21	12.86
31-Jan-97	21	01:38 AM	Ice	3	1	Yes	-0.17	17.77
31-Jan-97	21.1	01:49 AM	Ice	3	2	Yes	-0.11	16.91
03-Feb-97	12	11:15 AM	Ice	0	3	Yes	-0.49	20.6
03-Feb-97	15	11:35 AM	Ice	0	3	Yes	-0.43	21.9
03-Feb-97	18	12:44 PM	Ice	0	3	Yes	-0.22	14.74
03-Feb-97	19	12:46 PM	Ice	2	1	No		
03-Feb-97	19.1	12:25 PM	Ice	2	2	No		
03-Feb-97	20.1	12:16 PM	Ice	3	1	Yes	0.01	0.31
03-Feb-97	21	12:05 PM	Ice	3	2	Yes	0.01	1.31
03-Feb-97	21.1	11:46 AM	Ice	0	3	Yes	0.02	1.11
06-Feb-97	1	02:25 PM	Ice	0	3	Yes	-1.50	29.09
06-Feb-97	13	02:50 PM	Ice	0	3	Yes	-0.87	24.39
06-Feb-97	18	03:07 PM	Ice	0	3	Yes	-0.39	20.09
06-Feb-97	19.1	04:07 PM	Ice	2,3	2	Yes	-0.24	14.70
06-Feb-97	20	03:56 PM	Ice	2,3	2	No		
06-Feb-97	20.1	03:42 PM	Ice	3	4	Yes	-0.20	17.26
06-Feb-97	21.1	03:25 PM	Ice	0	3	Yes	-0.08	18.76
11-Feb-97	1	10:17 AM	Ice	0	3	Yes	-1.26	25.42

Appendix 1 continued

Date	Station	Time	Tracking method	Fish id#	Fish location	CTD cast	Depth Averaged temp. (oC)	Depth Averaged salinity (ppt)
11-Feb-97	8	11:03 AM	Ice	0	3	Yes	-0.67	18.44
11-Feb-97	12	11:25 AM	Ice	0	3	Yes	-0.52	19.32
11-Feb-97	15	11:35 AM	Ice	0	3	Yes	-0.44	19.11
11-Feb-97	18	11:45 AM	Ice	2	1	Yes	-0.15	8.42
11-Feb-97	20	12:14 PM	Ice	3	1	Yes	-0.09	10.74
11-Feb-97	21	12:23 PM	Ice	3	2	Yes	-0.01	0.19
14-Feb-97	1	10:30 AM	Ice	0	3	Yes	-1.38	25.76
14-Feb-97	8	10:15 AM	Ice	0	3	Yes	-0.42	15.17
14-Feb-97	18	11:45 AM	Ice	0	3	Yes	-0.40	19.69
14-Feb-97	19.1	12:20 PM	Ice	3	1	No		
14-Feb-97	20.1	12:12 PM	Ice	0	3	No		
14-Feb-97	21.1	11:55 AM	Ice	0	3	Yes	0.01	0.20
18-Feb-97	1	01:41 PM	Ice	0	3	Yes	-1.55	29.56
18-Feb-97	8	01:25 PM	Ice	0	3	Yes	-0.82	23.07
18-Feb-97	15	12:30 PM	Ice	0	3	Yes	-0.37	18.58
18-Feb-97	18	12:05 PM	Ice	2	1	Yes	-0.08	2.89
18-Feb-97	19	12:10 PM	Ice	2	1	No		
18-Feb-97	19.1	11:50 AM	Ice	3	2	Yes	0.03	0.32
18-Feb-97	21.1	11:30 AM	Ice	0	3	Yes	0.08	0.17
24-Feb-97	15	12:08 PM	Ice	0	3	Yes		
24-Feb-97	18	12:22 PM	Ice	0	3	Yes	-0.10	5.66
24-Feb-97	19	12:47 PM	Ice	2	1	Yes	-0.02	0.32
24-Feb-97	19.1	12:57 PM	Ice	2	2	Yes	0.02	0.15
24-Feb-97	20.1	01:11 PM	Ice	3	1	Yes	0.01	0.11
13-Mar-97	1	12:20 PM	Ice	0	3	Yes	-1.39	28.16
13-Mar-97	8	12:35 PM	Ice	0	3	Yes	-0.83	21.66
13-Mar-97	15	12:50 PM	Ice	0	3	Yes	-0.33	18.00
13-Mar-97	18	01:03 PM	Ice	0	3	Yes	-0.18	10.29
13-Mar-97	19	01:25 PM	Ice	2,3	1	No		
13-Mar-97	19.1	01:41 PM	Ice	2,3	2	Yes	0.02	0.26
13-Mar-97	20.1	01:52 PM	Ice	0	3	Yes	0.01	0.23

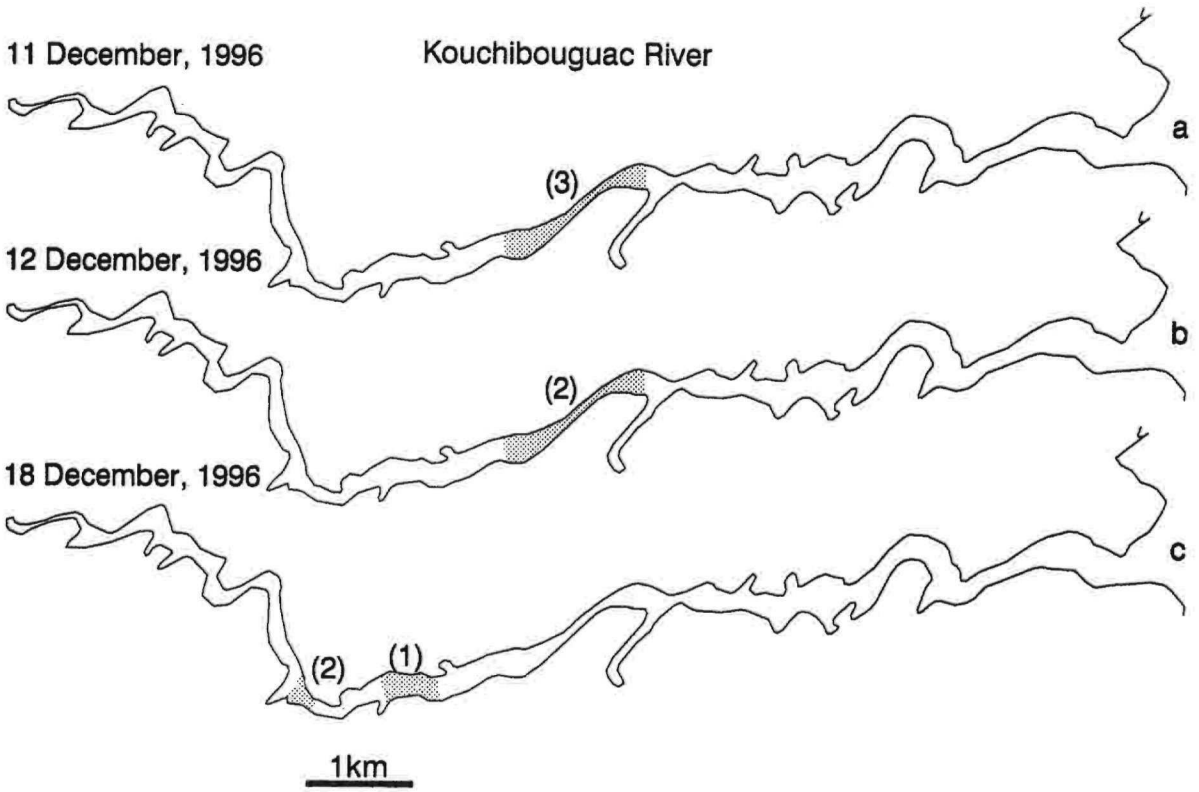
APPENDIX 2

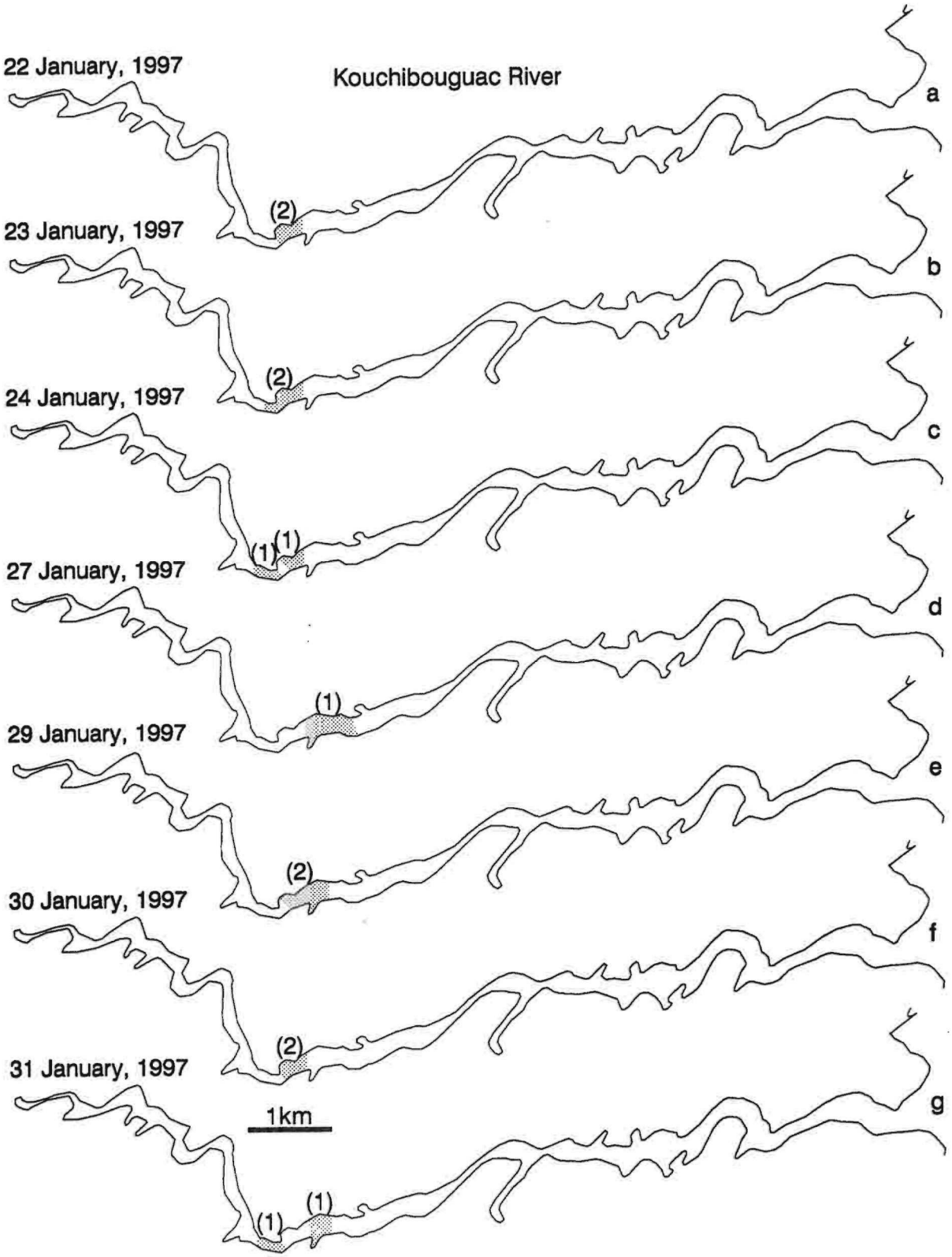
Appendix 2. Tracking and CTD data for St. Louis River. Fish location codes: 1 =upstream, 2 =downstrean, 3 =none detected. temp. =temperature.

Date	Station	Time	Tracking method	Fish id#	Fish location	CTD cast	Depth Averaged temp. (oC)	Depth Averaged salinity (ppt)
07-Feb-97	4	12:10 PM	Ice	4,7	1	No		
07-Feb-97	5	12:30 PM	Ice	4,6,7	2	No		
11-Feb-97	4	03:55 PM	Ice	0	3	Yes	0.20	2.43
11-Feb-97	5	03:30 PM	Ice	4,5,6,7	1	No		
12-Feb-97	1	11:35 AM	Ice	0	3	Yes	-1.12	25.95
12-Feb-97	2	12:30 PM	Ice	0	3	Yes	-0.59	21.88
12-Feb-97	4	02:08 PM	Ice	4,5,6,7	1	Yes	-0.02	1.92
13-Feb-97	1	10:05 AM	Ice	0	3	Yes	-0.96	25.02
13-Feb-97	2	10:35 AM	Ice	0	3	Yes	-0.59	21.64
13-Feb-97	3	11:30 AM	Ice	0	3	Yes	-0.55	22.23
13-Feb-97	4	11:35 AM	Ice	0	3	Yes	-0.17	10.18
13-Feb-97	5	12:25 PM	Ice	4,5,6,7	1	Yes	-0.14	3.27
13-Feb-97	5	12:35 PM	Ice	6,7	1	No		
13-Feb-97	5	12:07 PM	Ice	6,7	1	No		
13-Feb-97	5	12:17 PM	Ice	6,7	2	No		
19-Feb-97	1	12:00 PM	Ice	0	3	Yes	-0.90	25.69
19-Feb-97	2	11:35 AM	Ice	0	3	Yes	-0.49	22.79
19-Feb-97	3	10:48 AM	Ice	0	3	Yes	-0.19	19.96
19-Feb-97	4	10:32 AM	Ice	4,5,6,7	1	Yes	0.03	0.61
19-Feb-97	5	10:22 AM	Ice	4,5,6,7	2	Yes	0.03	0.32
19-Feb-97	6	10:20 AM	Ice	0	3	Yes	0.04	4.84
24-Feb-97	3	02:55 PM	Ice	5	1	Yes	-0.12	18.99
24-Feb-97	4	03:07 PM	Ice	5	2	Yes	0.02	0.29
26-Feb-97	3	11:29 AM	Ice	0	3	Yes		
26-Feb-97	4	11:24 AM	Ice	4,5,7	1	Yes		
26-Feb-97	6	11:18 AM	Ice	0	3	Yes		
14-Mar-97	1	11:41 AM	Ice	0	3	Yes	-0.82	21.91
14-Mar-97	2	12:02 PM	Ice	0	3	Yes	-0.50	19.05
14-Mar-97	3	12:18 PM	Ice	0	3	Yes	-0.35	19.71
14-Mar-97	4	01:06 PM	Ice	4,5,6,7	1	Yes	-0.02	1.25
14-Mar-97	5	01:19 PM	Ice	5,6	2	No		
14-Mar-97	5	01:19 PM	Ice	4,7	1	No		

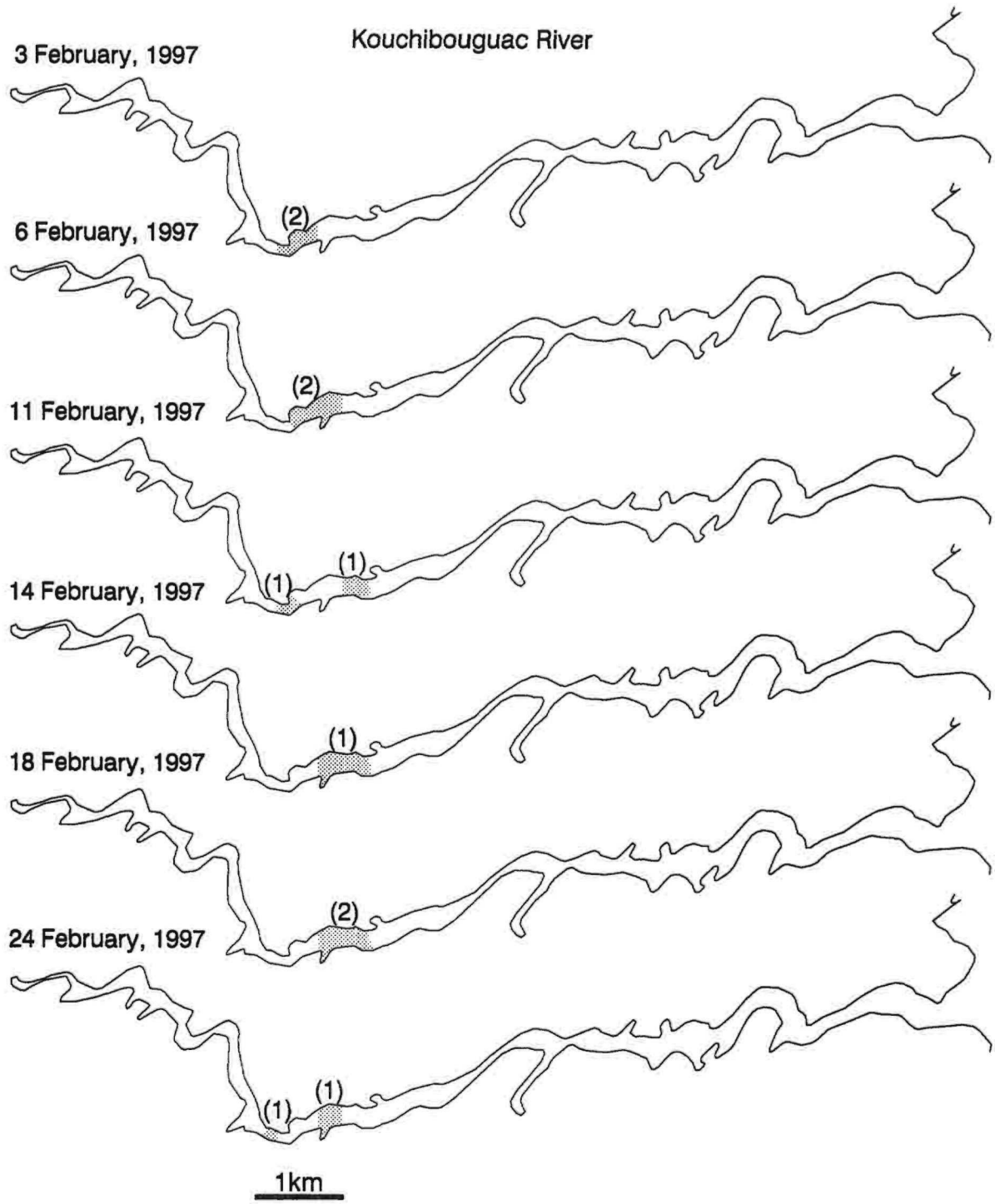
APPENDIX 3

Distribution within the Kouchibouguac River of striped bass implanted with transmitters during December (Appendix 3.1), January (Appendix 3.2), February (Appendix 3.3), and March (Appendix 3.4). Numbers in parentheses represent the number of fish relocated on any given survey date.


11 December, 1996
Kouchibouguac River
a
(3)
12 December, 1996
b
(2)
18 December, 1996
c
(2)
(1)
1km

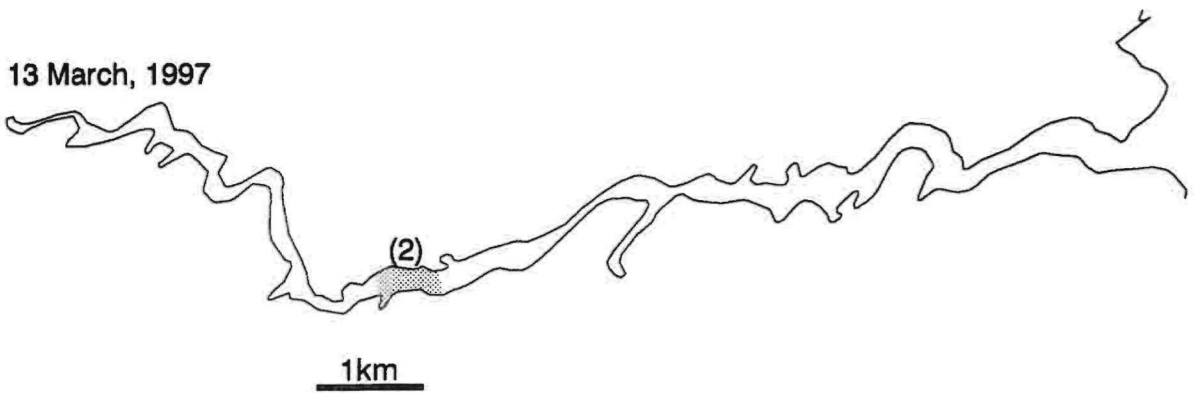

22 January, 1997
Kouchibouguac River
a
(2)
23 January, 1997
b
(2)
24 January, 1997
c
(1)
(1)
27 January, 1997
d
(1)
29 January, 1997
e
(2)
30 January, 1997
f
(2)
31 January, 1997
g
1km
(1)
(1)

Appendix 3.2


Kouchibouguac River
3 February, 1997
6 February, 1997
11 February, 1997
14 February, 1997
18 February, 1997
24 February, 1997
(2)
(2)
(1)
(1)
(1)
(2)
(1)
(1)
1km

Appendix 3.3

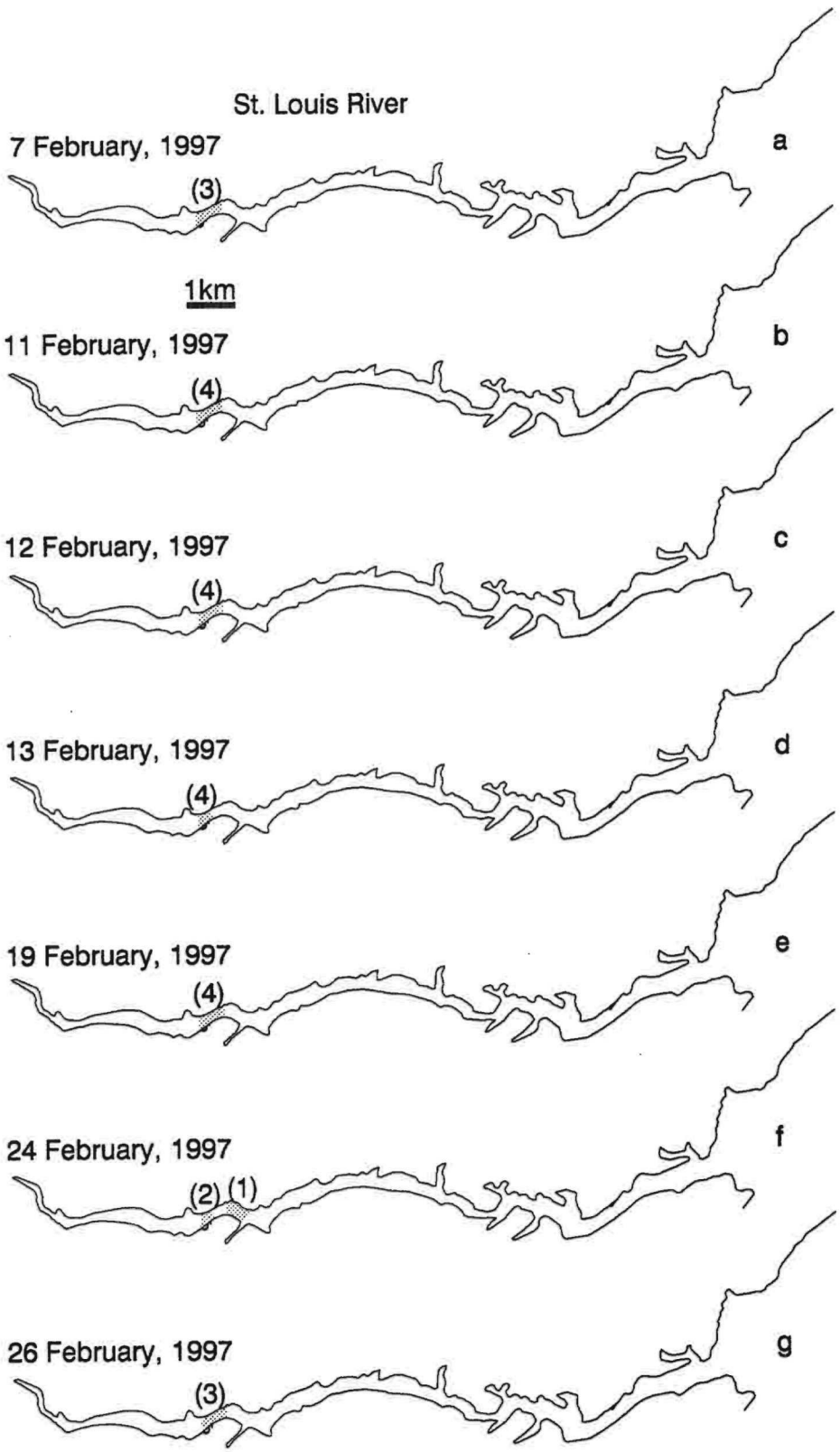
Kouchibouguac River



Appendix 3.4

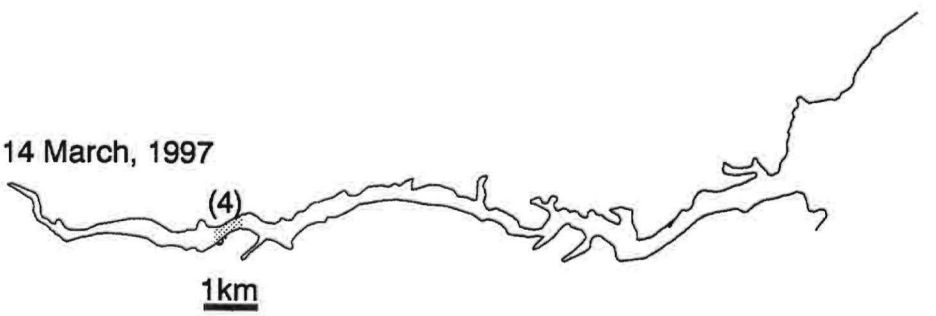
APPENDIX 4

Distribution within the St. Louis River of striped bass implanted with transmitters during February (Appendix 4.1), and March (Appendix 4.2). Numbers in parentheses represent the number of fish relocated on any given survey date.


St. Louis River
7 February, 1997
(3)
a
1km
11 February, 1997
(4)
b
12 February, 1997
(4)
c
13 February, 1997
(4)
d
19 February, 1997
(4)
e
24 February, 1997
(2) (1)
f
26 February, 1997
(3)
g

Appendix 4.1

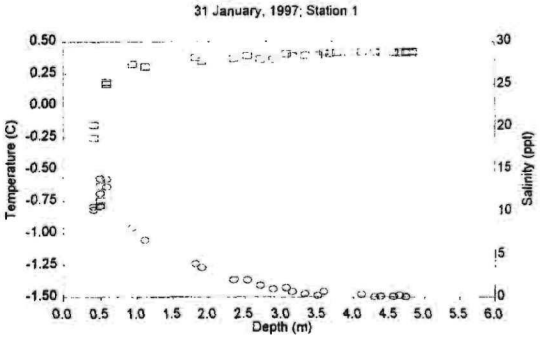
St. Louis River

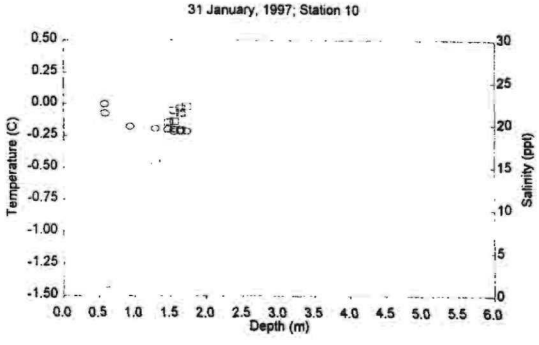


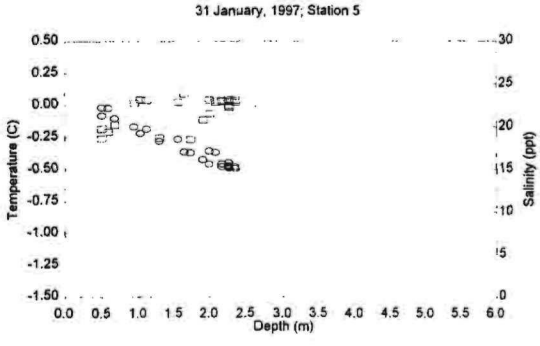
Appendix 4.2

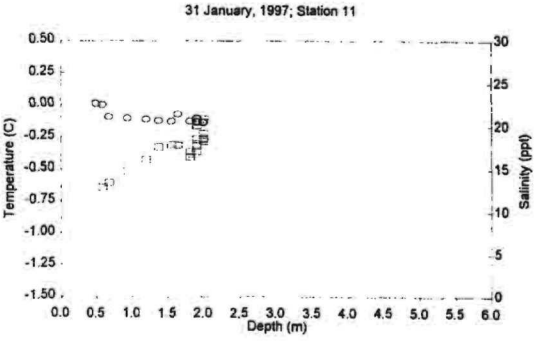
APPENDIX 5

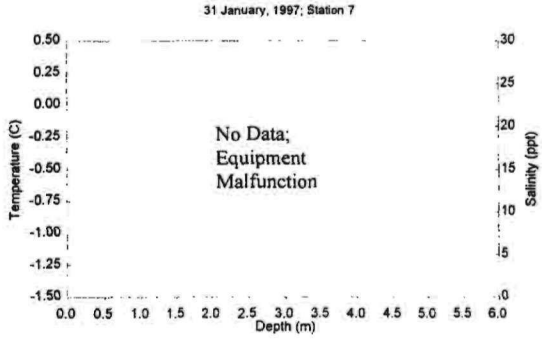
Temperature (^{0}C; circles) and salinity (ppt; squares) versus depth (m) plots for individual hydrographic stations within the Kouchibouguac River by day of sampling. Hydrographic station numbers (bolded text below) correspond to the standard station positions (parentheses) shown in Figure 2 as follows: **1**(1), **2**(7), **3**(12), **4**(15), **5**(18), **6**(19), **7**(10.1), **8**(20), **9**(20.1), **10**(21), **11**(21.1).

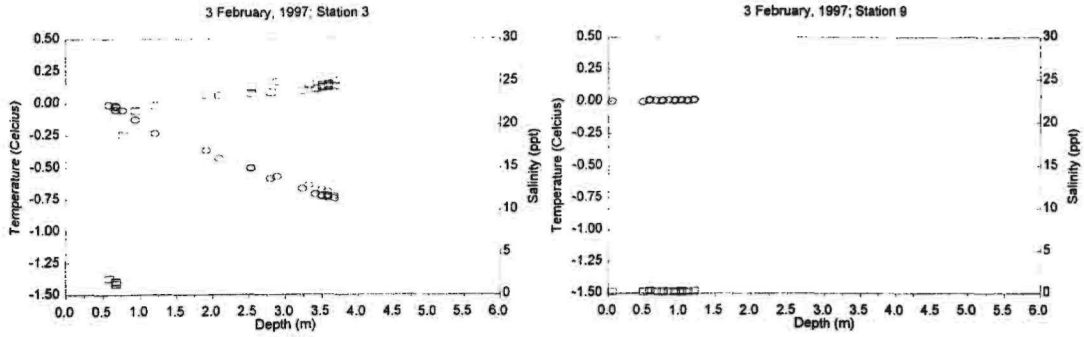

31 January, 1997; Station 1
Temperature (C)
Salinity (ppt)
Depth (m)


31 January, 1997; Station 10
Temperature (C)
Salinity (ppt)
Depth (m)

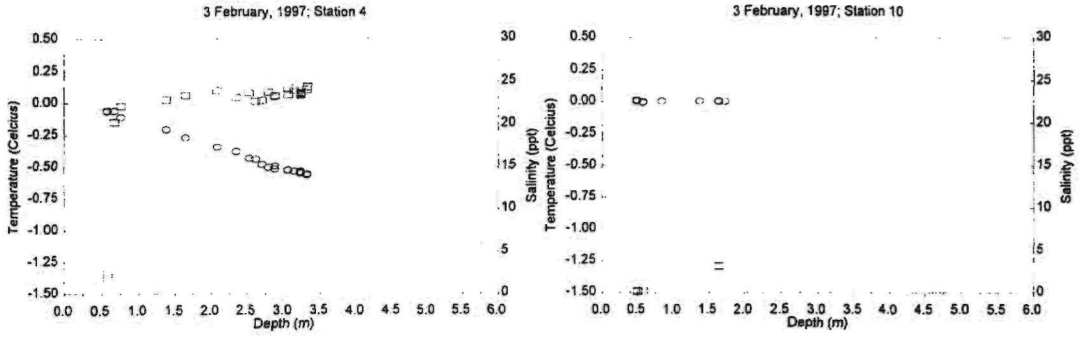

31 January, 1997; Station 5
Temperature (C)
Salinity (ppt)
Depth (m)


31 January, 1997; Station 11
Temperature (C)
Salinity (ppt)
Depth (m)

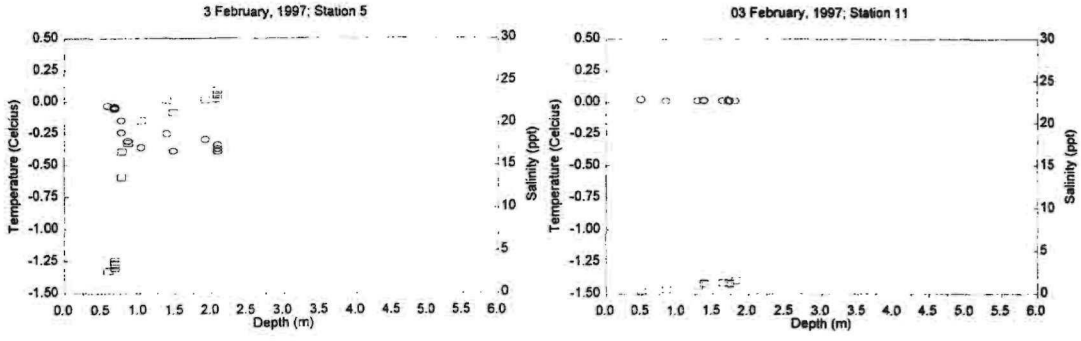

31 January, 1997; Station 7
No Data;
Equipment
Malfunction
Temperature (C)
Salinity (ppt)
Depth (m)


3 February, 1997; Station 3
Temperature (Celcius)
Salinity (ppt)
Depth (m)

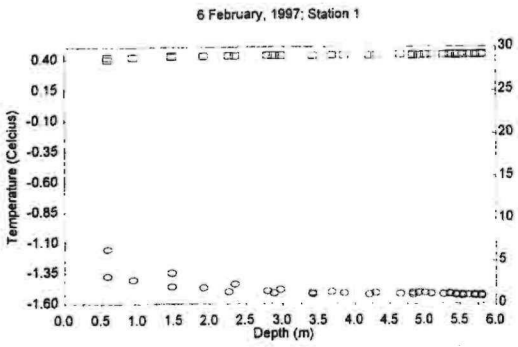
3 February, 1997; Station 9
Temperature (Celcius)
Salinity (ppt)
Depth (m)

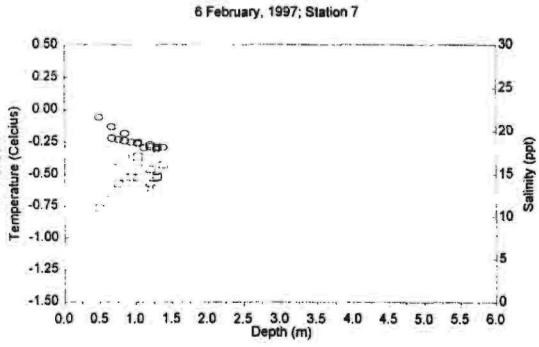

3 February, 1997; Station 4
Temperature (Celcius)
Salinity (ppt)
Depth (m)

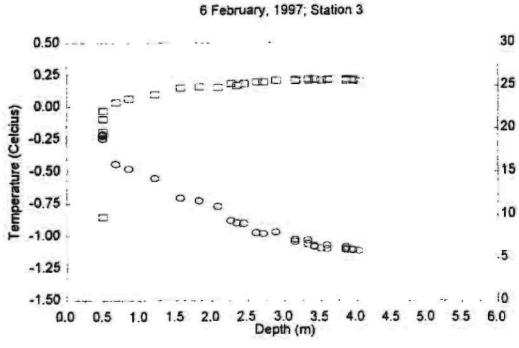
3 February, 1997; Station 10
Temperature (Celcius)
Salinity (ppt)
Depth (m)

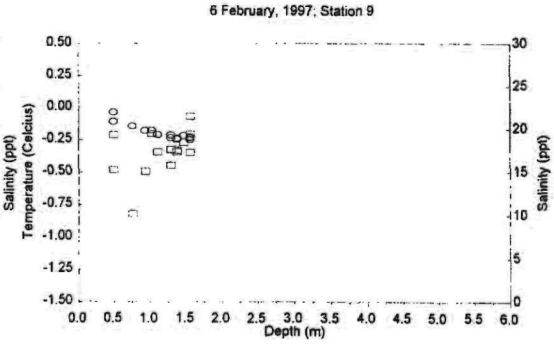

3 February, 1997; Station 5
Temperature (Celcius)
Salinity (ppt)
Depth (m)

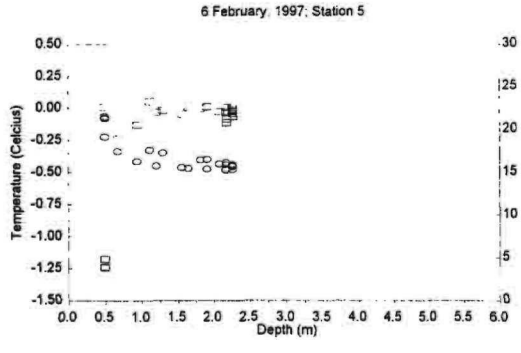
03 February, 1997; Station 11
Temperature (Celcius)
Salinity (ppt)
Depth (m)

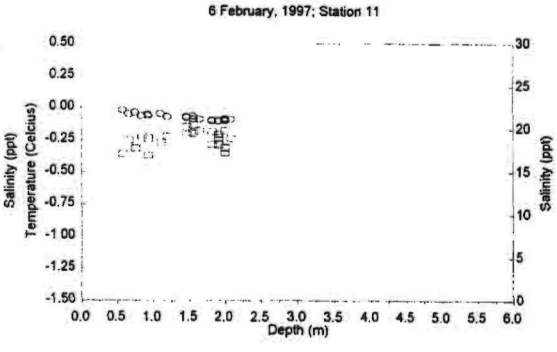

6 February, 1997; Station 1
Temperature (Celcius)
Salinity (ppt)
Depth (m)


6 February, 1997; Station 7
Temperature (Celcius)
Salinity (ppt)
Depth (m)

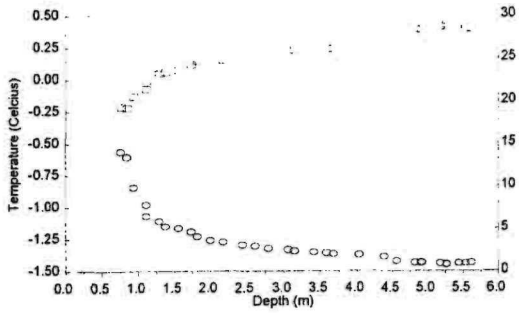

6 February, 1997; Station 3
Temperature (Celcius)
Salinity (ppt)
Depth (m)


6 February, 1997; Station 9
Temperature (Celcius)
Salinity (ppt)
Depth (m)

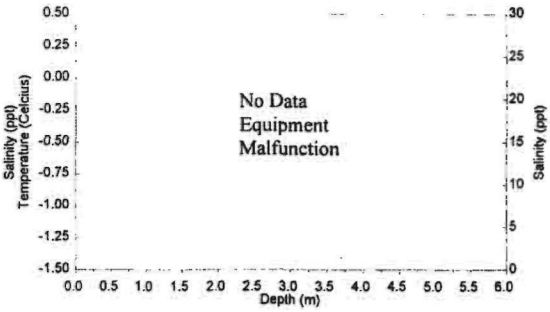

6 February, 1997; Station 5
Temperature (Celcius)
Salinity (ppt)
Depth (m)


6 February, 1997; Station 11
Temperature (Celcius)
Salinity (ppt)
Depth (m)

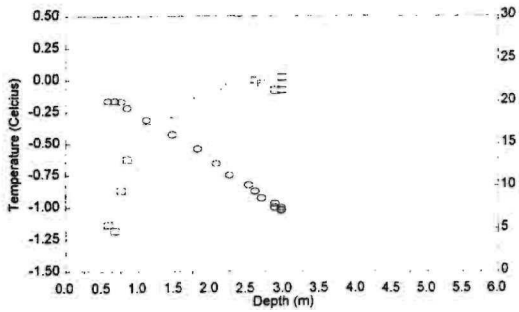
11 February, 1997; Station 1



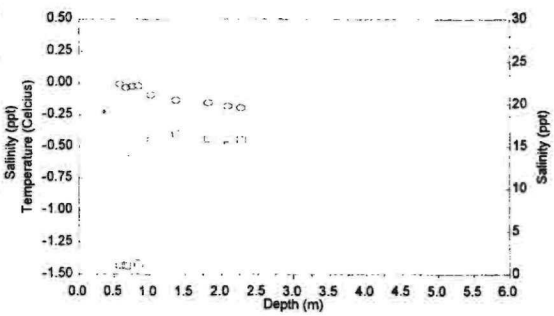
11 February, 1997; Station 5



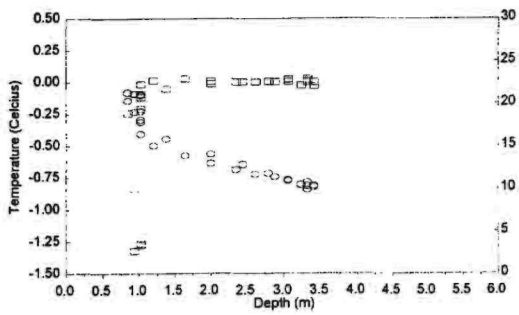
11 February, 1997; Station 2



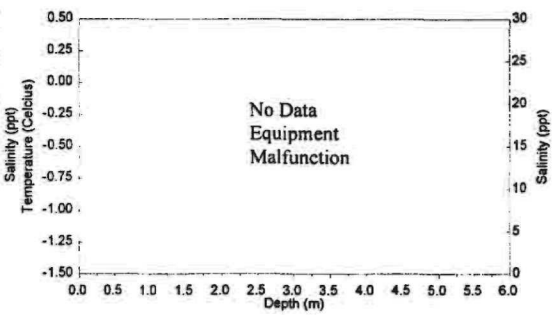
11 February, 1997; Station 8



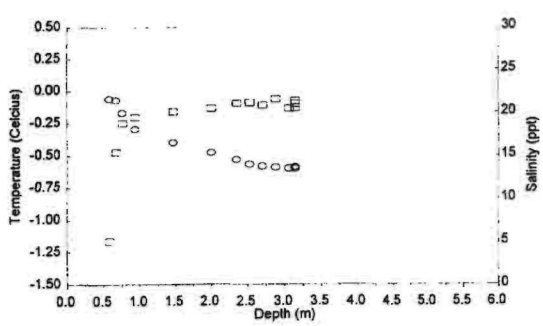
11 February, 1997; Station 3

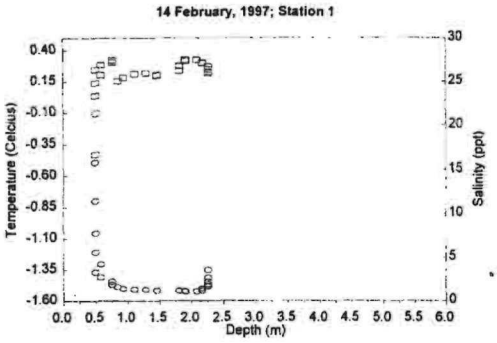


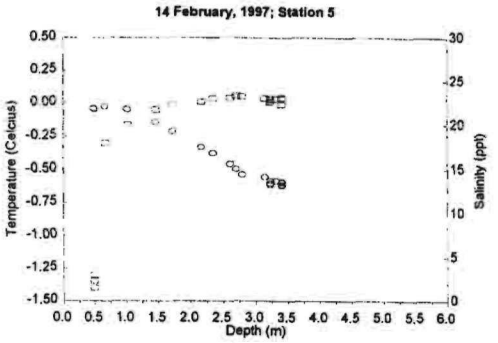
11 February, 1997; Station 10

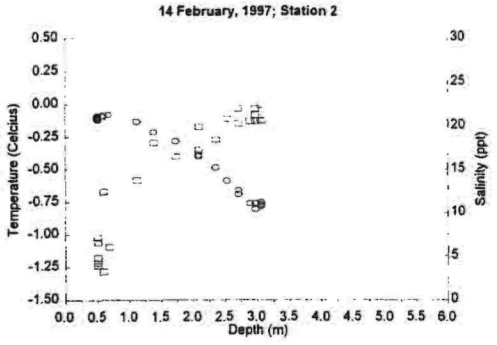


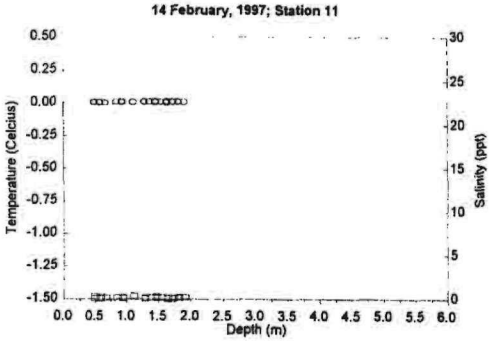
11 February, 1997; Station 4

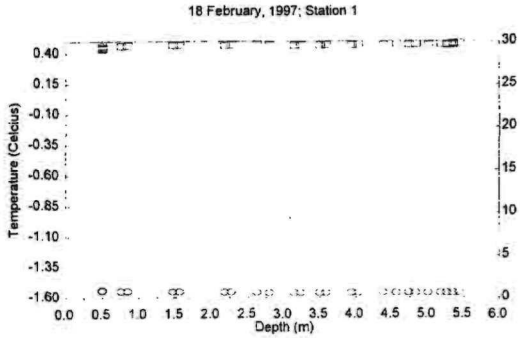


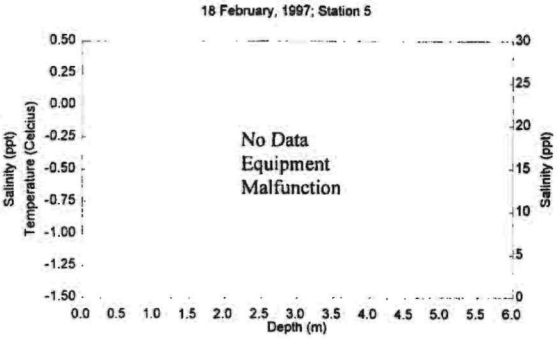

14 February, 1997; Station 1
Temperature (Celcius)
Salinity (ppt)
Depth (m)

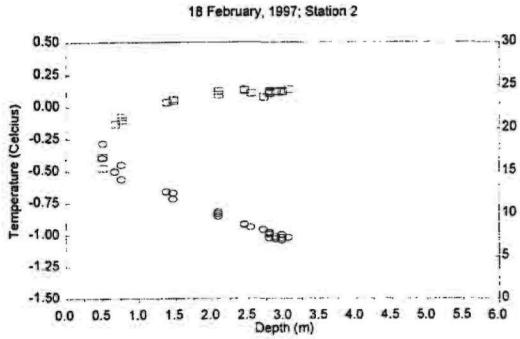

14 February, 1997; Station 5
Temperature (Celcius)
Salinity (ppt)
Depth (m)

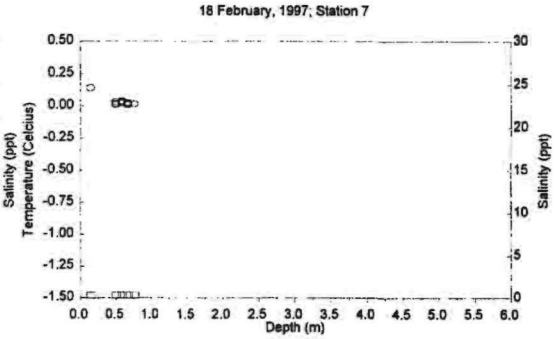

14 February, 1997; Station 2
Temperature (Celcius)
Salinity (ppt)
Depth (m)

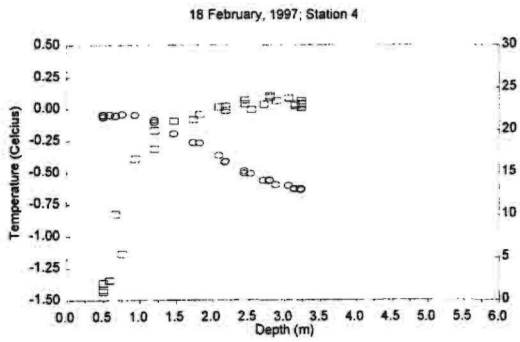

14 February, 1997; Station 11
Temperature (Celcius)
Salinity (ppt)
Depth (m)

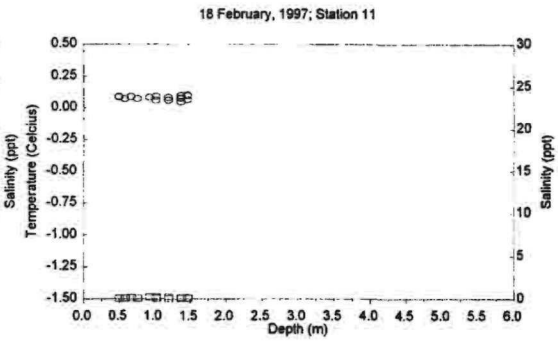

18 February, 1997; Station 1
Temperature (Celcius)
Salinity (ppt)
Depth (m)

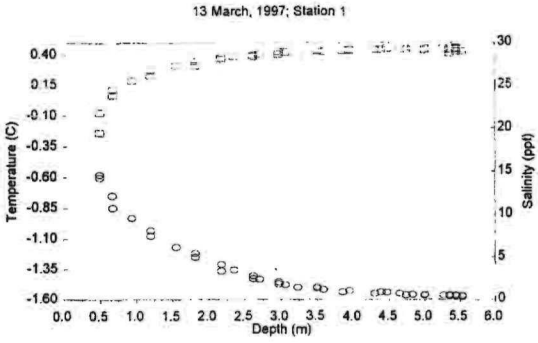

18 February, 1997; Station 5
No Data
Equipment
Malfunction
Temperature (Celcius)
Salinity (ppt)
Depth (m)

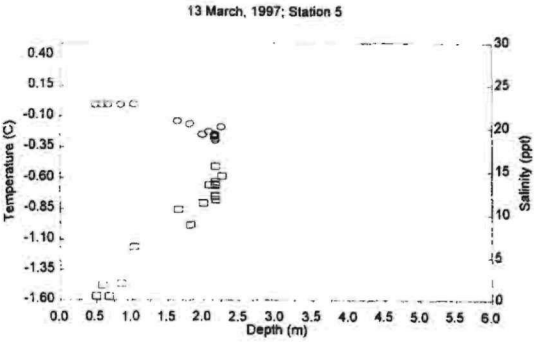

18 February, 1997; Station 2
Temperature (Celcius)
Salinity (ppt)
Depth (m)

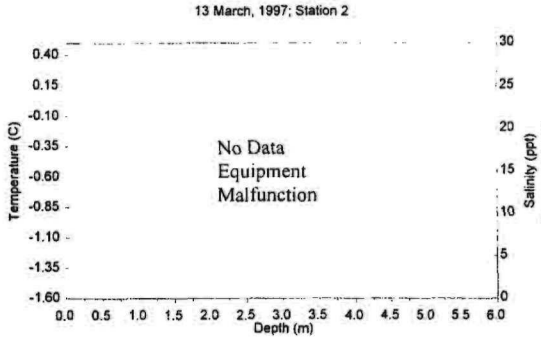

18 February, 1997; Station 7
Temperature (Celcius)
Salinity (ppt)
Depth (m)

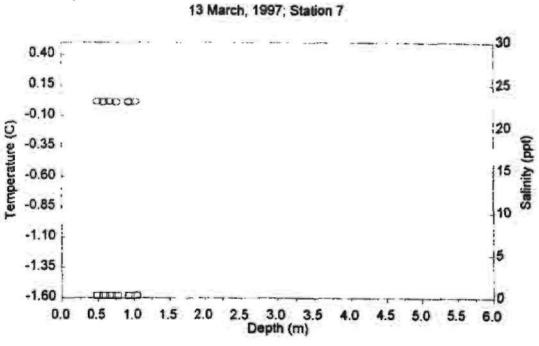

18 February, 1997; Station 4
Temperature (Celcius)
Salinity (ppt)
Depth (m)

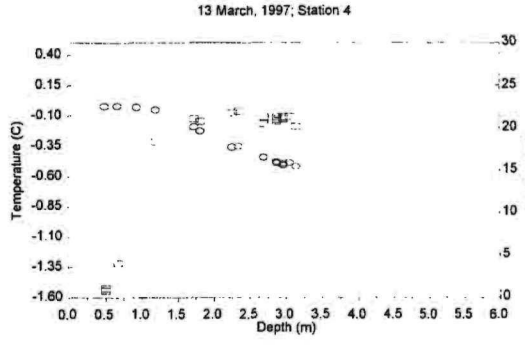

18 February, 1997; Station 11
Temperature (Celcius)
Salinity (ppt)
Depth (m)

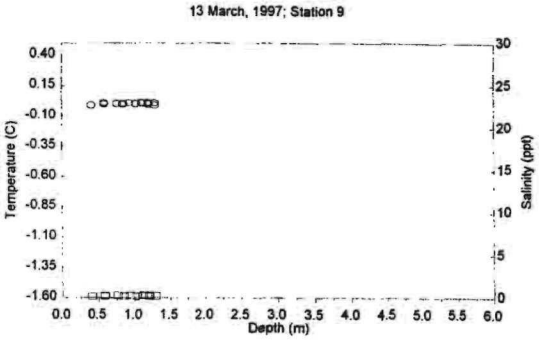

13 March, 1997; Station 1
Temperature (C)
Salinity (ppt)
Depth (m)


13 March, 1997; Station 5
Temperature (C)
Salinity (ppt)
Depth (m)


13 March, 1997; Station 2
No Data
Equipment
Malfunction
Temperature (C)
Salinity (ppt)
Depth (m)

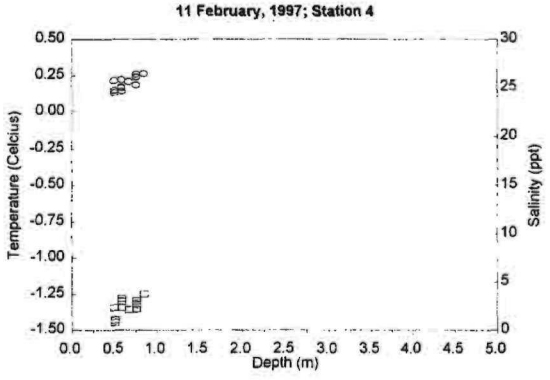

13 March, 1997; Station 7
Temperature (C)
Salinity (ppt)
Depth (m)

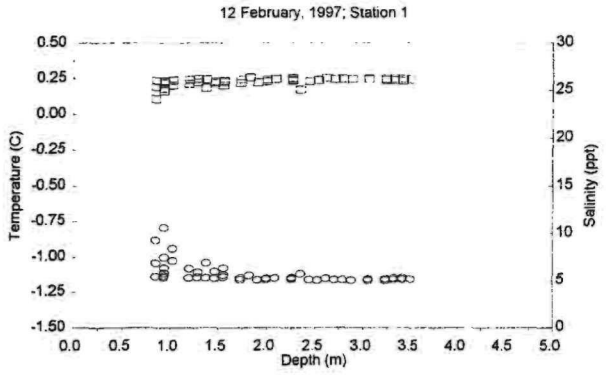

13 March, 1997; Station 4
Temperature (C)
Salinity (ppt)
Depth (m)

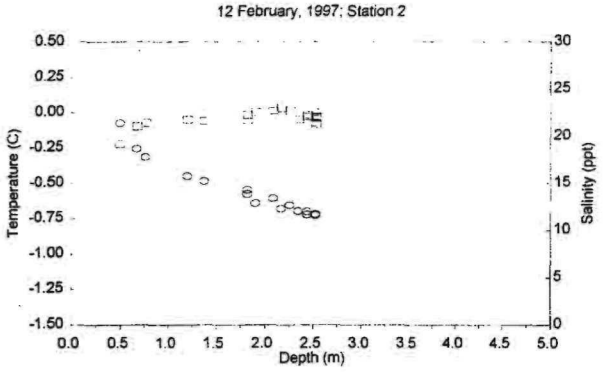

13 March, 1997; Station 9
Temperature (C)
Salinity (ppt)
Depth (m)

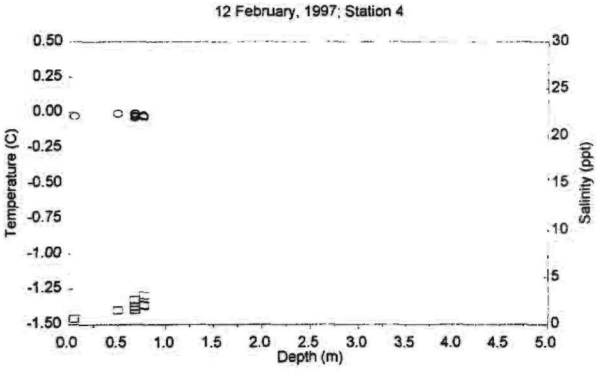
APPENDIX 6

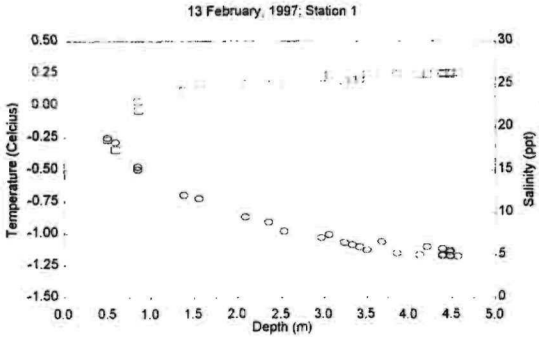
Temperature (^{0}C; circles) and salinity (ppt; squares) versus depth (m) plots for individual hydrographic stations within the St. Louis River by day of sampling. Station positions are as shown in Figure 2.

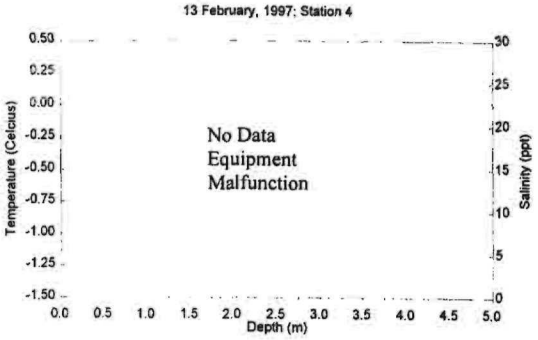

11 February, 1997; Station 4
Temperature (Celcius)
Salinity (ppt)
Depth (m)
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

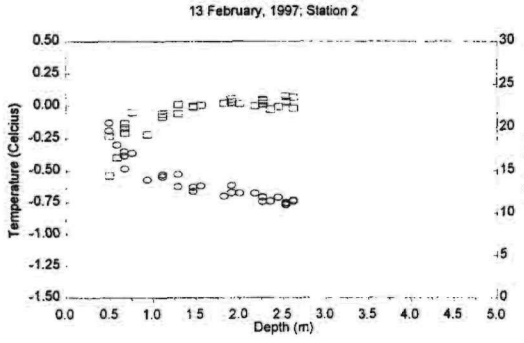

12 February, 1997; Station 1
Temperature (C)
Salinity (ppt)
Depth (m)
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

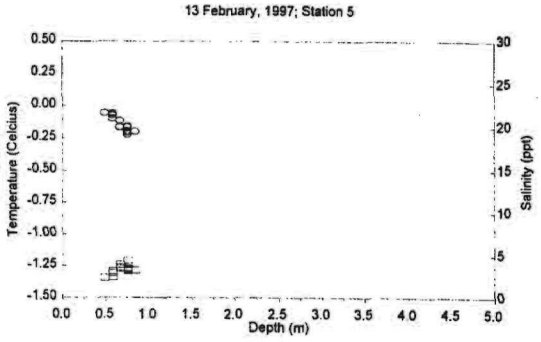

12 February, 1997; Station 2
Temperature (C)
Salinity (ppt)
Depth (m)
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

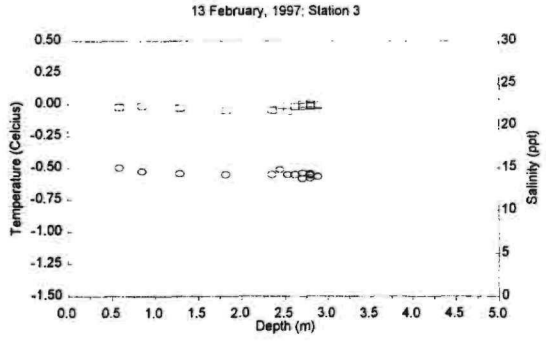

12 February, 1997; Station 4
Temperature (C)
Salinity (ppt)
Depth (m)
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

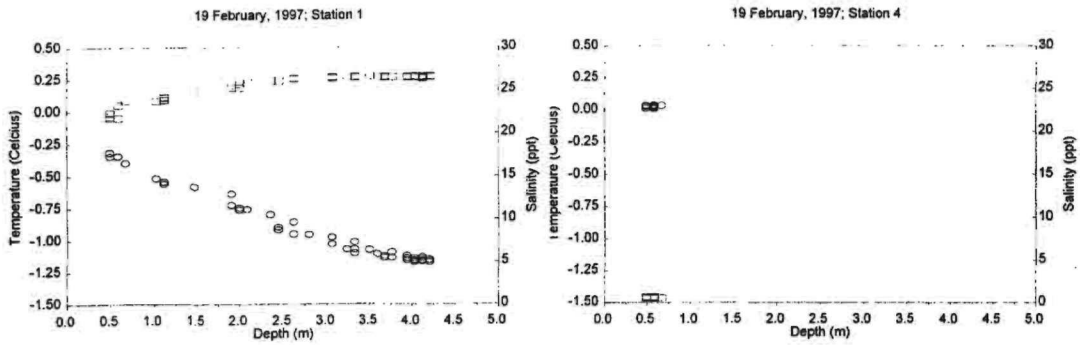

13 February, 1997; Station 1
Temperature (Celcius)
Salinity (ppt)
Depth (m)

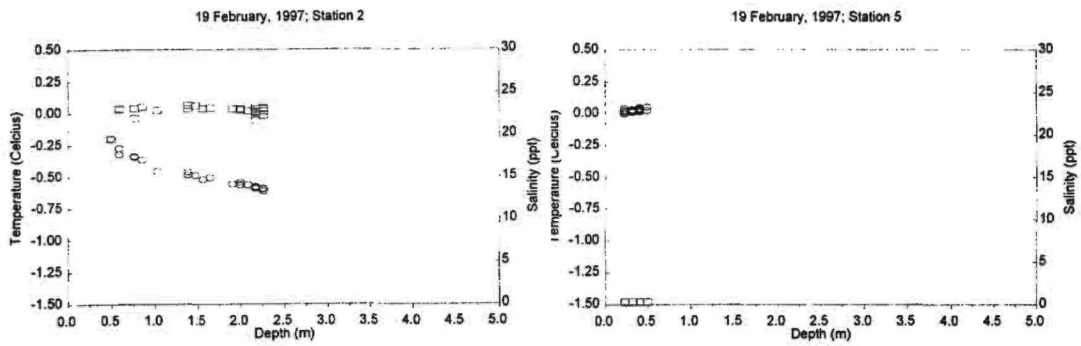

13 February, 1997; Station 4
No Data
Equipment
Malfunction
Temperature (Celcius)
Salinity (ppt)
Depth (m)

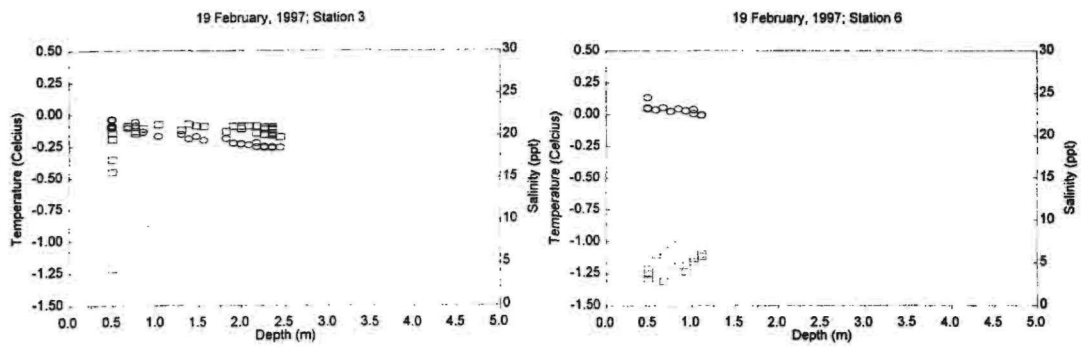

13 February, 1997; Station 2
Temperature (Celcius)
Salinity (ppt)
Depth (m)


13 February, 1997; Station 5
Temperature (Celcius)
Salinity (ppt)
Depth (m)


13 February, 1997; Station 3
Temperature (Celcius)
Salinity (ppt)
Depth (m)


19 February, 1997; Station 1
Temperature (Celcius)
Salinity (ppt)
Depth (m)

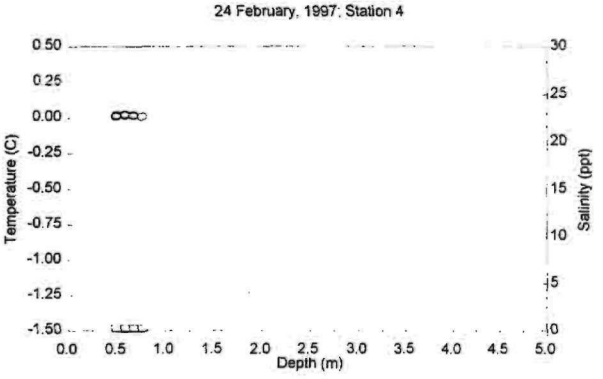

19 February, 1997; Station 2
Temperature (Celcius)
Salinity (ppt)
Depth (m)

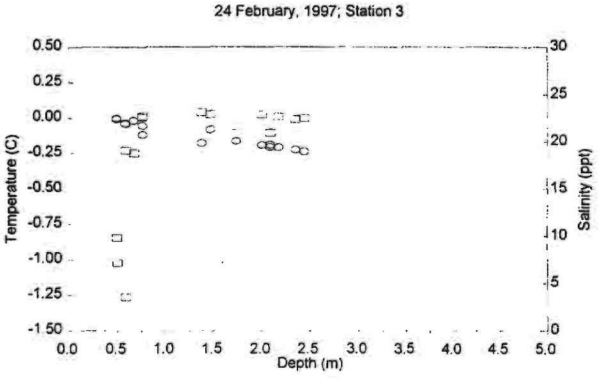

19 February, 1997; Station 3
Temperature (Celcius)
Salinity (ppt)
Depth (m)

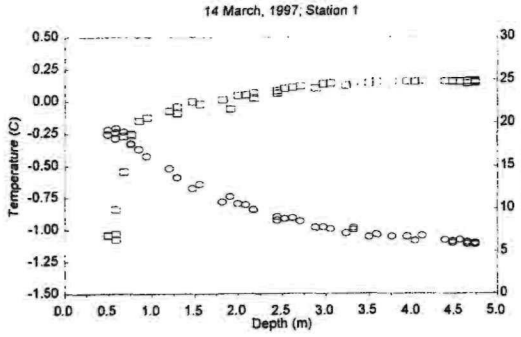
19 February, 1997; Station 4
Salinity (ppt)
Depth (m)

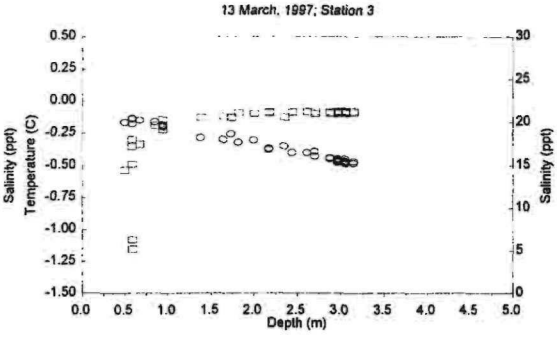
19 February, 1997; Station 5
Salinity (ppt)
Depth (m)

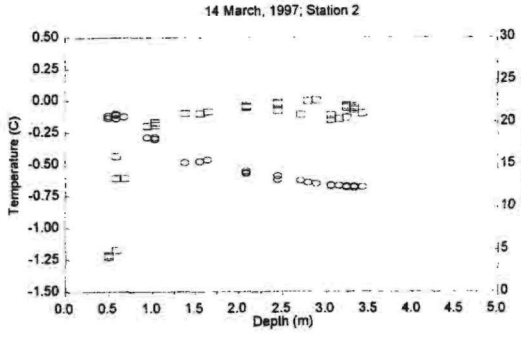
19 February, 1997; Station 6
Temperature (Celcius)
Salinity (ppt)
Depth (m)

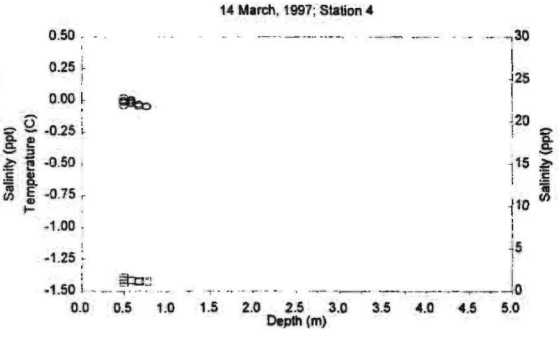

24 February, 1997; Station 4
Temperature (C)
Salinity (ppt)
Depth (m)
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0


24 February, 1997; Station 3
Temperature (C)
Salinity (ppt)
Depth (m)
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0


14 March, 1997; Station 1
Temperature (C)
Salinity (ppt)
Depth (m)


13 March, 1997; Station 3
Temperature (C)
Salinity (ppt)
Depth (m)

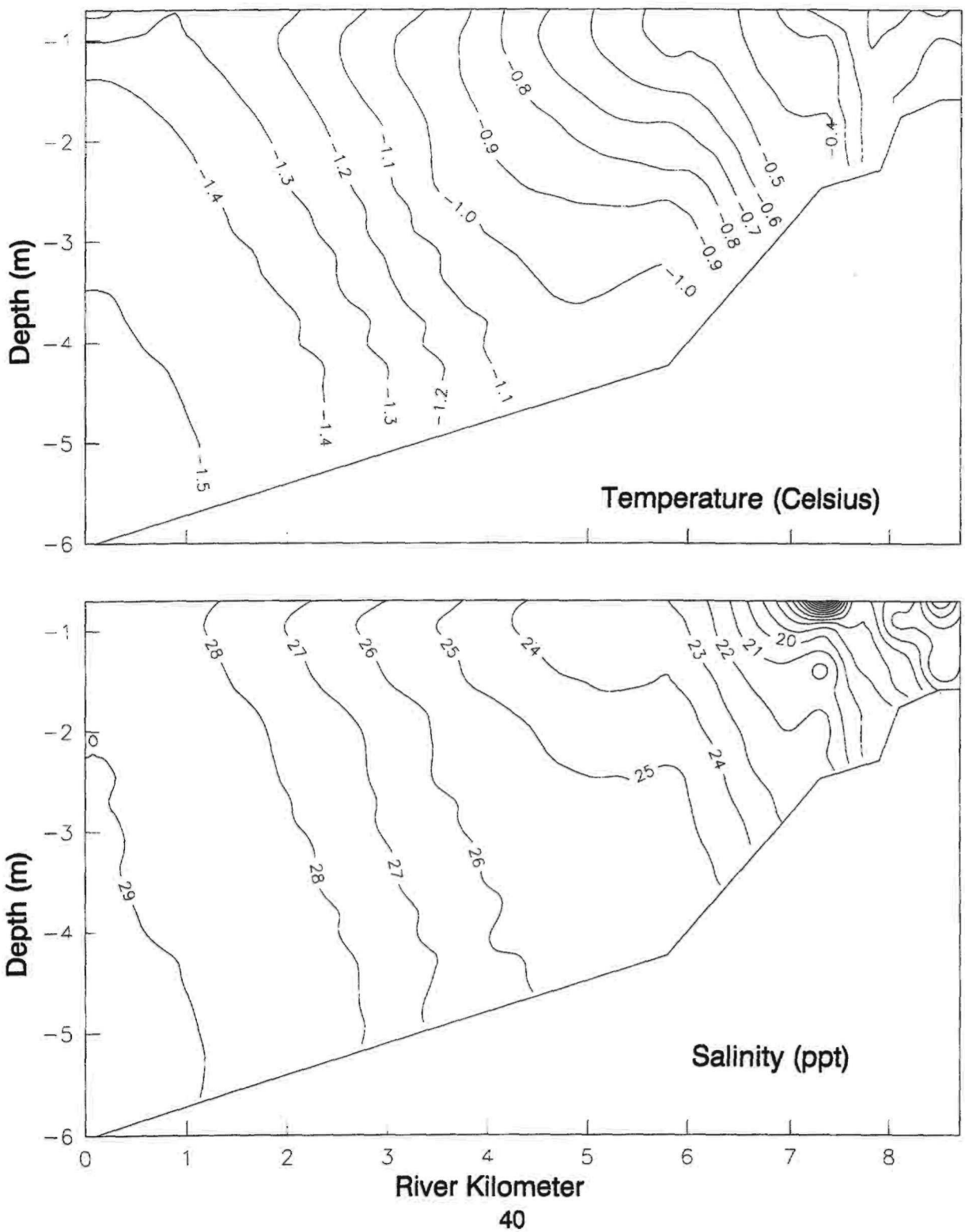

14 March, 1997; Station 2
Temperature (C)
Salinity (ppt)
Depth (m)


14 March, 1997; Station 4
Temperature (C)
Salinity (ppt)
Depth (m)

APPENDIX 7

Isotherms (upper panel) and isohalines (lower panel) relative to depth (m) and river kilometer on 6 February, 1997, Kouchibouguac River.

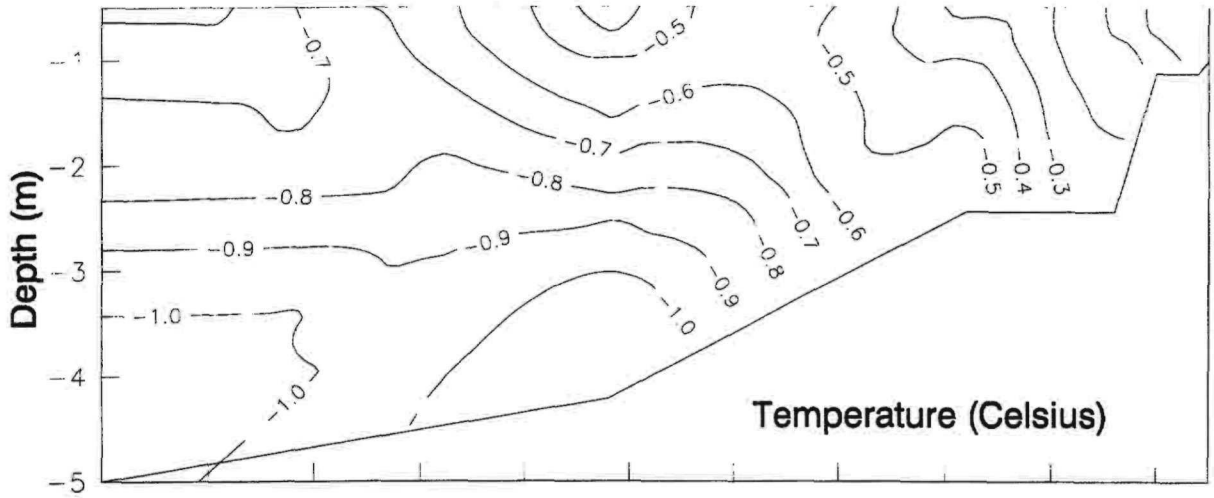
Kouchibouguac River: 6 November, 1997

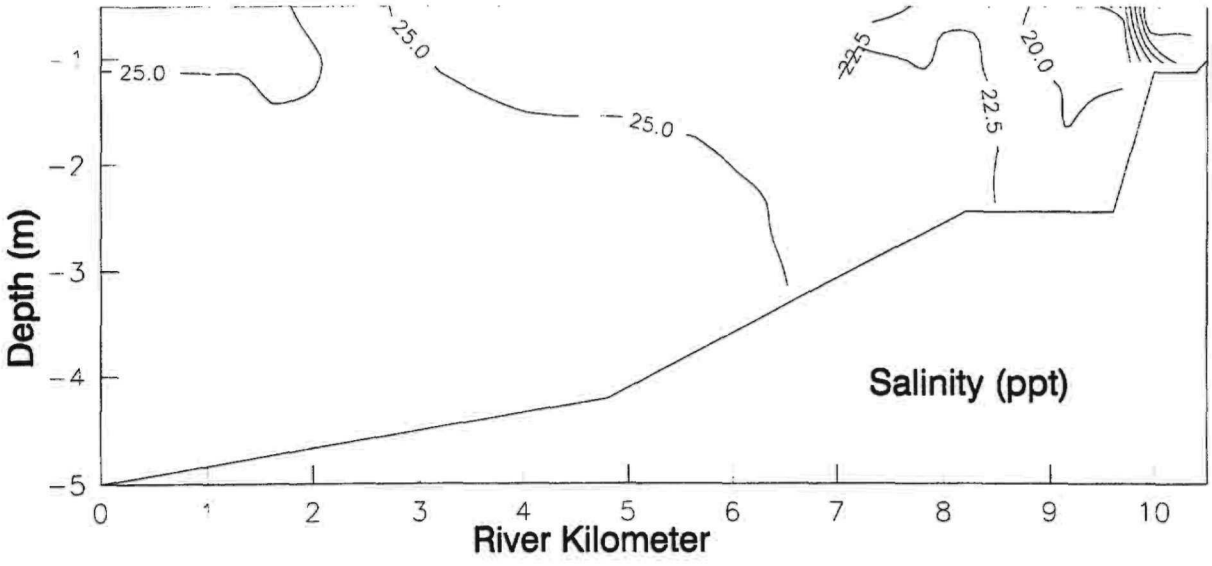


APPENDIX 8

Isotherms (upper panel) and isohalines (lower panel) relative to depth (m) and river kilometer on 19 February, 1997, St. Louis River.

St. Louis River: 19 February, 1997





APPENDIX 9

Daily means, minimuns, and maximums for air temperature (^{0}C), relative humidity (%), dew point, and snowfall (mm) as observed in Kouchibouguac National Park between 15 October, 1996 - 15 March, 1997.

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
05-Nov-96	Mean	-2.2	95.0	-2.9	0.0	167.1
	Minimum	-5.2	79.4	-5.6	0.0	164.7
	Maximum	2.9	100.4	-0.3	0.0	172.5
06-Nov-96	Mean	1.5	92.0	0.2	0.0	171.8
	Minimum	-2.2	70.7	-2.4	0.0	170.8
	Maximum	6.5	102.7	2.1	0.0	172.5
07-Nov-96	Mean	-0.8	97.3	-1.3	0.0	171.8
	Minimum	-4.5	70.5	-4.1	0.0	171.0
	Maximum	6.2	104.6	2.1	0.0	172.5
08-Nov-96	Mean	0.5	101.2	0.6	0.0	171.7
	Minimum	-4.2	85.7	-3.7	0.0	170.5
	Maximum	8.2	104.9	6.5	0.0	172.7
09-Nov-96	Mean	10.6	95.3	9.7	0.0	173.7
	Minimum	4.0	78.3	4.3	0.0	171.9
	Maximum	19.1	103.6	15.2	0.0	174.8
10-Nov-96	Mean	15.1	91.5	13.7	0.0	174.0
	Minimum	9.7	79.7	9.9	0.0	173.4
	Maximum	19.3	102.8	16.1	0.0	174.9
11-Nov-96	Mean	12.6	99.4	12.5	0.0	181.5
	Minimum	10.0	90.6	10.5	0.0	173.6
	Maximum	16.2	103.1	15.4	0.0	197.6
12-Nov-96	Mean	7.4	96.1	6.7	0.0	205.4
	Minimum	0.9	78.1	0.5	0.0	198.5
	Maximum	10.2	103.8	10.7	0.0	207.1
13-Nov-96	Mean	-0.3	83.4	-3.1	0.0	206.2
	Minimum	-3.3	55.5	-7.3	0.0	205.4
	Maximum	3.0	100.5	0.1	0.0	207.6
14-Nov-96	Mean	-2.8	68.2	-8.2	0.0	206.3
	Minimum	-6.5	47.4	-11.5	0.0	205.6
	Maximum	1.2	94.7	-5.8	0.0	207.2
15-Nov-96	Mean	-6.2	69.8	-11.3	0.0	206.2
	Minimum	-9.6	42.2	-14.2	0.0	205.1
	Maximum	-2.1	91.0	-9.2	0.0	206.9

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
16-Nov-96	Mean	-8.5	74.9	-12.4	0.0	206.1
	Minimum	-12.9	49.3	-14.8	0.0	205.3
	Maximum	-0.5	88.6	-9.3	0.0	206.9
17-Nov-96	Mean	-4.1	74.9	-8.0	0.0	206.2
	Minimum	-10.3	58.1	-12.5	0.0	205.3
	Maximum	2.2	86.8	-4.1	0.0	206.9
18-Nov-96	Mean	-0.2	74.9	-4.9	0.0	206.4
	Minimum	-4.8	32.4	-7.3	0.0	205.6
	Maximum	8.2	99.1	-1.7	0.0	207.1
19-Nov-96	Mean	3.0	89.6	1.4	0.0	206.6
	Minimum	1.2	74.2	-2.0	0.0	205.4
	Maximum	3.8	104.3	3.8	0.0	208.6
20-Nov-96	Mean	3.1	104.4	3.7	0.0	210.7
	Minimum	2.6	102.9	3.3	0.0	209.2
	Maximum	3.9	105.1	4.5	0.0	212.4
21-Nov-96	Mean	3.7	104.2	4.3	0.0	214.3
	Minimum	2.8	102.9	3.4	0.0	211.4
	Maximum	5.0	104.7	5.5	0.0	217.7
22-Nov-96	Mean	2.6	101.2	2.8	0.0	222.8
	Minimum	1.0	93.7	1.5	0.0	218.2
	Maximum	4.8	104.2	4.4	0.0	224.5
23-Nov-96	Mean	0.9	99.1	0.8	0.0	225.8
	Minimum	-1.9	79.3	-1.8	0.0	223.3
	Maximum	4.8	104.1	2.6	0.0	227.3
24-Nov-96	Mean	0.7	82.7	-2.2	0.0	227.3
	Minimum	-1.1	48.8	-5.3	0.0	226.5
	Maximum	4.7	102.6	0.4	0.0	228.1
25-Nov-96	Mean	-3.6	78.9	-6.9	0.0	228.1
	Minimum	-9.4	57.5	-12.2	0.0	226.5
	Maximum	1.3	102.5	0.7	0.0	229.8
26-Nov-96	Mean	-6.8	75.5	-10.4	0.0	228.6
	Minimum	-10.0	63.0	-11.8	0.0	227.5
	Maximum	-1.6	87.0	-7.7	0.0	229.6

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
27-Nov-96	Mean	-4.2	90.3	-5.6	0.0	231.3
	Minimum	-5.4	76.0	-8.9	0.0	227.8
	Maximum	-3.2	100.7	-4.0	0.0	242.0
28-Nov-96	Mean	-5.1	90.8	-6.4	0.0	250.2
	Minimum	-8.2	73.0	-10.5	0.0	244.0
	Maximum	-2.8	102.1	-2.5	0.0	252.7
29-Nov-96	Mean	-6.4	85.9	-8.5	0.0	251.2
	Minimum	-10.5	71.1	-12.4	0.0	249.9
	Maximum	0.4	98.1	-4.2	0.0	252.5
30-Nov-96	Mean	-8.1	89.7	-9.6	0.0	251.0
	Minimum	-12.1	67.2	-12.8	0.0	249.6
	Maximum	-1.4	97.8	-6.1	0.0	252.1
01-Dec-96	Mean	-12.3	86.3	-14.3	0.0	251.1
	Minimum	-20.9	64.2	-22.7	0.0	250.3
	Maximum	-1.4	97.3	-7.3	0.0	252.1
02-Dec-96	Mean	-4.8	97.7	-5.1	0.0	251.5
	Minimum	-12.3	88.9	-12.9	0.0	250.4
	Maximum	2.6	104.0	1.1	0.0	255.5
06-Dec-96	Mean	1.6	90.5	2.0	-0.0	263.3
	Minimum	0.0	63.5	0.0	-0.9	257.5
	Maximum	5.0	104.6	5.6	2.0	267.0
07-Dec-96	Mean	No Data	83.6	No Data	-0.1	266.1
	Minimum		72.9		-1.6	265.2
	Maximum		95.4		0.7	266.9
08-Dec-96	Mean	No Data	88.6	No Data	-0.2	266.4
	Minimum		78.2		-1.2	265.2
	Maximum		101.7		0.6	267.2
09-Dec-96	Mean	No Data	100.3	No Data	0.5	270.0
	Minimum		93.0		-1.0	265.4
	Maximum		107.4		3.1	279.8
10-Dec-96	Mean	No Data	101.6	No Data	-0.1	282.5
	Minimum		96.7		-1.4	280.8
	Maximum		105.9		1.4	283.8

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
11-Dec-96	Mean	No Data	91.9	No Data	0.1	284.1
	Minimum		76.2		-1.2	283.1
	Maximum		103.0		2.5	285.2
12-Dec-96	Mean	No Data	86.6	No Data	-0.1	284.4
	Minimum		55.4		-3.2	283.4
	Maximum		97.0		1.6	285.2
13-Dec-96	Mean	No Data	93.9	No Data	0.8	284.0
	Minimum		71.7		-1.3	282.8
	Maximum		103.2		2.8	285.3
14-Dec-96	Mean	No Data	96.2	No Data	0.6	284.7
	Minimum		89.3		-3.3	282.8
	Maximum		106.6		2.2	287.3
15-Dec-96	Mean	No Data	102.7	No Data	0.5	289.9
	Minimum		97.9		-0.9	287.3
	Maximum		105.9		1.6	292.3
16-Dec-96	Mean	No Data	101.4	No Data	0.8	291.2
	Minimum		95.0		-0.2	290.1
	Maximum		108.4		2.0	292.7
17-Dec-96	Mean	No Data	99.8	No Data	0.2	291.4
	Minimum		91.2		-2.3	290.2
	Maximum		103.8		3.7	292.4
18-Dec-96	Mean	No Data	101.5	No Data	0.2	291.6
	Minimum		92.3		-0.6	290.3
	Maximum		106.0		1.2	293.9
19-Dec-96	Mean	No Data	100.9	No Data	-0.6	299.0
	Minimum		91.8		-3.9	293.6
	Maximum		108.4		1.2	301.1
20-Dec-96	Mean	No Data	102.9	No Data	-1.2	300.5
	Minimum		99.8		-3.3	298.8
	Maximum		107.8		0.6	302.8
21-Dec-96	Mean	No Data	88.8	No Data	0.0	319.7
	Minimum		54.7		-1.7	303.9
	Maximum		106.3		0.9	327.4

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
22-Dec-96	Mean	No Data	54.6	No Data	-0.1	326.1
	Minimum		44.8		-3.5	324.9
	Maximum		62.1		1.5	327.4
23-Dec-96	Mean	No Data	65.2	No Data	0.1	326.0
	Minimum		45.5		-2.4	324.8
	Maximum		80.8		1.5	327.1
24-Dec-96	Mean	No Data	78.4	No Data	0.9	325.7
	Minimum		62.4		-0.2	324.4
	Maximum		96.2		2.1	326.6
25-Dec-96	Mean	No Data	100.6	No Data	3.0	328.2
	Minimum		91.6		-1.0	324.8
	Maximum		106.9		6.8	332.5
26-Dec-96	Mean	No Data	89.2	No Data	0.2	347.7
	Minimum		57.7		-0.9	334.1
	Maximum		105.5		1.7	355.6
27-Dec-96	Mean	No Data	54.9	No Data	0.4	354.6
	Minimum		48.4		-3.0	353.3
	Maximum		61.8		2.6	355.4
28-Dec-96	Mean	No Data	85.1	No Data	1.6	356.5
	Minimum		57.4		-1.5	354.1
	Maximum		101.6		4.6	358.7
29-Dec-96	Mean	No Data	90.7	No Data	3.6	357.5
	Minimum		75.6		0.2	356.1
	Maximum		98.4		8.0	358.5
30-Dec-96	Mean	No Data	101.5	No Data	5.7	362.1
	Minimum		97.1		3.0	357.9
	Maximum		106.0		8.1	363.8
31-Dec-96	Mean	No Data	85.8	No Data	1.2	371.0
	Minimum		55.4		-1.4	365.4
	Maximum		105.7		6.5	372.8
01-Jan-97	Mean	No Data	54.0	No Data	0.6	371.6
	Minimum		48.7		-3.6	370.4
	Maximum		57.6		4.1	372.7

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
02-Jan-97	Mean	No Data	48.7	No Data	1.1	371.7
	Minimum		35.5		-3.1	370.0
	Maximum		56.5		4.4	372.7
03-Jan-97	Mean	No Data	58.8	No Data	1.2	371.9
	Minimum		43.1		-1.9	370.3
	Maximum		74.5		2.9	373.0
04-Jan-97	Mean	No Data	76.7	No Data	1.2	372.0
	Minimum		69.8		-2.1	371.0
	Maximum		95.8		3.9	373.1
05-Jan-97	Mean	No Data	89.8	No Data	0.7	372.4
	Minimum		68.9		-1.8	371.2
	Maximum		97.0		2.2	373.1
06-Jan-97	Mean	No Data	93.1	No Data	4.0	374.0
	Minimum		88.5		1.0	371.0
	Maximum		98.4		11.2	380.5
07-Jan-97	Mean	No Data	100.9	No Data	12.6	393.0
	Minimum		95.0		10.4	381.5
	Maximum		106.2		15.4	398.7
08-Jan-97	Mean	No Data	93.2	No Data		398.9
	Minimum		82.6			397.6
	Maximum		102.8		17.4	400.5
09-Jan-97	Mean	No Data	82.2	No Data	10.3	399.7
	Minimum		73.4		-7.0	398.2
	Maximum		90.2		18.9	400.7
10-Jan-97	Mean	No Data	79.7	No Data	-5.1	399.8
	Minimum		69.4		-6.2	398.6
	Maximum		86.7		-2.5	400.7
11-Jan-97	Mean	No Data	97.7	No Data	-2.8	403.0
	Minimum		84.2		-6.2	398.4
	Maximum		107.8		5.7	416.1
12-Jan-97	Mean	No Data	87.7	No Data	4.8	418.2
	Minimum		68.6		1.9	416.6
	Maximum		109.1		7.2	419.7

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
13-Jan-97	Mean	No Data	79.9	No Data	3.8	418.0
	Minimum		66.4		2.1	416.6
	Maximum		86.8		6.7	419.7
14-Jan-97	Mean	No Data	84.2	No Data	3.1	418.2
	Minimum		72.7		0.1	416.9
	Maximum		91.1		7.5	419.2
15-Jan-97	Mean	No Data	83.8	No Data	1.9	418.3
	Minimum		63.3		1.1	417.1
	Maximum		97.9		3.5	419.2
16-Jan-97	Mean	No Data	74.9	No Data	1.9	418.4
	Minimum		56.6		1.2	417.6
	Maximum		89.7		3.6	419.2
17-Jan-97	Mean	No Data	94.5	No Data	1.6	418.6
	Minimum		77.9		-0.9	417.6
	Maximum		104.0		3.1	420.2
18-Jan-97	Mean	No Data	73.8	No Data	-3.6	431.2
	Minimum		42.0		-5.4	423.5
	Maximum		106.3		0.1	433.8
19-Jan-97	Mean	No Data	54.9	No Data	-5.0	431.5
	Minimum		41.9		-8.8	430.3
	Maximum		71.1		-1.1	432.9
20-Jan-97	Mean	No Data	55.9	No Data	-4.4	431.5
	Minimum		41.8		-8.5	430.6
	Maximum		67.4		-0.3	432.7
21-Jan-97	Mean	No Data	65.1	No Data	-4.6	432.4
	Minimum		51.3		-7.0	430.9
	Maximum		82.9		-1.7	433.0
22-Jan-97	Mean	No Data	72.8	No Data	-4.2	432.7
	Minimum		28.1		-6.9	431.6
	Maximum		98.4		-1.8	433.7
23-Jan-97	Mean	No Data	72.7	No Data	4.5	433.6
	Minimum		47.9		-4.8	432.0
	Maximum		101.6		15.2	436.8

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
24-Jan-97	Mean	No Data	84.0	No Data	7.1	438.7
	Minimum		55.2		4.2	436.9
	Maximum		100.3		13.4	440.9
25-Jan-97	Mean	-16.5	57.0	-23.1	5.3	439.5
	Minimum	-21.2	43.7	-26.8	4.7	438.7
	Maximum	-11.7	78.9	-19.9	5.6	440.6
26-Jan-97	Mean	-4.9	92.5	-5.9	6.1	442.8
	Minimum	-16.0	80.2	-18.2	4.5	438.9
	Maximum	6.4	102.2	6.7	8.0	450.6
27-Jan-97	Mean	0.3	80.9	-3.0	-128.6	452.1
	Minimum	-10.8	44.4	-20.1		449.4
	Maximum	8.1	102.2	8.4	5.2	453.2
28-Jan-97	Mean	-15.1	49.7	-23.3	3.2	451.5
	Minimum	-19.3	37.8	-26.3	2.8	450.6
	Maximum	-8.3	70.0	-19.9	3.4	452.5
29-Jan-97	Mean	-10.5	90.6	-11.8	6.8	455.5
	Minimum	-17.5	77.8	-19.9	3.1	450.6
	Maximum	0.7	102.2	0.9	15.6	466.3
30-Jan-97	Mean	-12.1	68.6	-16.7	14.8	465.2
	Minimum	-16.0	51.6	-22.5	14.3	463.9
	Maximum	-2.3	86.9	-4.2	15.3	466.3
31-Jan-97	Mean	-20.5	55.3	-27.1	14.1	464.3
	Minimum	-25.8	47.6	-31.2	13.4	463.5
	Maximum	-15.1	67.2	-23.4	14.6	465.1
01-Feb-97	Mean	-16.1	77.6	-19.1	13.8	464.4
	Minimum	-23.6	68.6	-26.8	13.2	463.3
	Maximum	-7.9	96.1	-8.4	14.8	466.5
02-Feb-97	Mean	-3.8	98.0	-4.1	27.2	475.0
	Minimum	-7.6	91.6	-8.0	16.2	466.2
	Maximum	0.7	101.5	-0.1	32.2	480.6
03-Feb-97	Mean	-1.8	94.5	-2.6	32.6	482.4
	Minimum	-4.5	78.0	-6.4	29.8	480.4
	Maximum	-0.0	102.8	-1.2	33.7	484.4

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
04-Feb-97	Mean	-6.8	86.2	-8.8	31.7	483.1
	Minimum	-10.8	70.7	-11.9	30.7	482.2
	Maximum	-1.8	94.3	-6.1	32.6	483.9
05-Feb-97	Mean	-12.7	84.4	-14.9	29.9	482.9
	Minimum	-19.5	60.8	-21.1	28.9	482.1
	Maximum	-6.0	95.4	-10.3	30.8	483.7
06-Feb-97	Mean	-11.0	93.3	-11.8	-98.3	487.6
	Minimum	-18.5	84.8	-20.2		482.1
	Maximum	-1.6	102.7	-1.2	40.9	504.7
07-Feb-97	Mean	-3.3	90.2	-4.8	38.7	506.4
	Minimum	-6.8	68.6	-7.4	37.5	504.9
	Maximum	0.8	103.2	-0.4	40.5	507.5
08-Feb-97	Mean	-6.7	77.7	-10.3	36.8	506.1
	Minimum	-12.7	48.4	-15.7	36.0	505.2
	Maximum	-0.7	94.6	-6.7	37.6	507.0
09-Feb-97	Mean	-16.1	64.2	-21.7	35.6	505.6
	Minimum	-23.6	35.3	-26.6	34.9	504.9
	Maximum	-8.5	80.1	-15.1	36.1	506.3
10-Feb-97	Mean	-16.8	63.9	-22.7	35.1	505.6
	Minimum	-27.4	33.2	-30.5	34.1	504.7
	Maximum	-0.3	79.0	-13.2	35.9	506.3
11-Feb-97	Mean	-7.0	64.8	-12.7	34.2	408.8
	Minimum	-12.0	51.1	-16.0	33.7	117.9
	Maximum	0.0	78.5	-8.6	35.3	506.8
12-Feb-97	Mean	-13.1	66.3	-18.1	33.2	117.7
	Minimum	-21.7	54.3	-24.3	32.2	116.6
	Maximum	-4.3	80.9	-8.6	33.9	118.4
13-Feb-97	Mean	-15.3	73.7	-19.1	32.8	117.9
	Minimum	-24.3	54.2	-27.1	32.1	117.1
	Maximum	-1.7	85.5	-9.5	33.1	118.8
14-Feb-97	Mean	-7.6	67.5	-13.7	32.9	118.5
	Minimum	-13.4	28.5	-25.0	32.2	117.4
	Maximum	-5.0	100.9	-4.9	33.3	119.6

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
15-Feb-97	Mean	-13.2	54.8	-20.4	32.5	118.5
	Minimum	-22.8	41.7	-28.1	32.3	117.3
	Maximum	-2.2	66.1	-8.2	32.8	119.2
16-Feb-97	Mean	-1.1	98.4	-1.3	37.8	126.6
	Minimum	-4.8	90.6	-5.7	33.1	119.1
	Maximum	1.8	103.3	0.9	40.0	129.2
17-Feb-97	Mean	-8.9	74.1	-13.1	36.1	128.3
	Minimum	-17.0	44.1	-24.2	35.4	127.4
	Maximum	-1.7	96.9	-2.2	36.6	129.1
18-Feb-97	Mean	-18.3	59.1	-24.6	35.5	128.3
	Minimum	-26.4	37.5	-29.9	35.0	127.3
	Maximum	-9.0	73.3	-20.6	36.0	129.6
19-Feb-97	Mean	-10.2	67.8	-15.1	35.8	128.6
	Minimum	-21.3	56.9	-24.5	35.5	127.4
	Maximum	0.9	87.2	-5.9	36.4	130.2
20-Feb-97	Mean	-0.0	81.6	-2.9	35.6	129.6
	Minimum	-4.7	67.9	-5.3	35.3	128.3
	Maximum	3.1	96.7	-0.5	36.2	130.2
21-Feb-97	Mean	-8.0	81.0	-11.1	48.4	146.0
	Minimum	-14.4	45.4	-16.6	37.0	130.4
	Maximum	-2.4	98.2	-5.4	52.8	152.2
22-Feb-97	Mean	-5.6	93.3	-6.5	51.2	152.4
	Minimum	-17.4	87.9	-18.8	49.1	150.7
	Maximum	2.3	101.2	1.7	51.8	154.2
23-Feb-97	Mean	-6.4	97.5	-6.7	53.6	164.9
	Minimum	-10.5	92.3	-11.5	48.8	152.5
	Maximum	1.1	103.0	1.2	61.0	172.7
24-Feb-97	Mean	-10.6	82.0	-13.3	57.6	177.5
	Minimum	-14.6	60.1	-15.7	56.2	175.3
	Maximum	-7.5	96.6	-10.2	59.9	179.6
25-Feb-97	Mean	-11.9	69.9	-16.5	55.5	178.5
	Minimum	-16.6	48.3	-18.8	54.8	177.6
	Maximum	-5.4	82.9	-13.8	56.2	179.9

Appendix 9 continued.

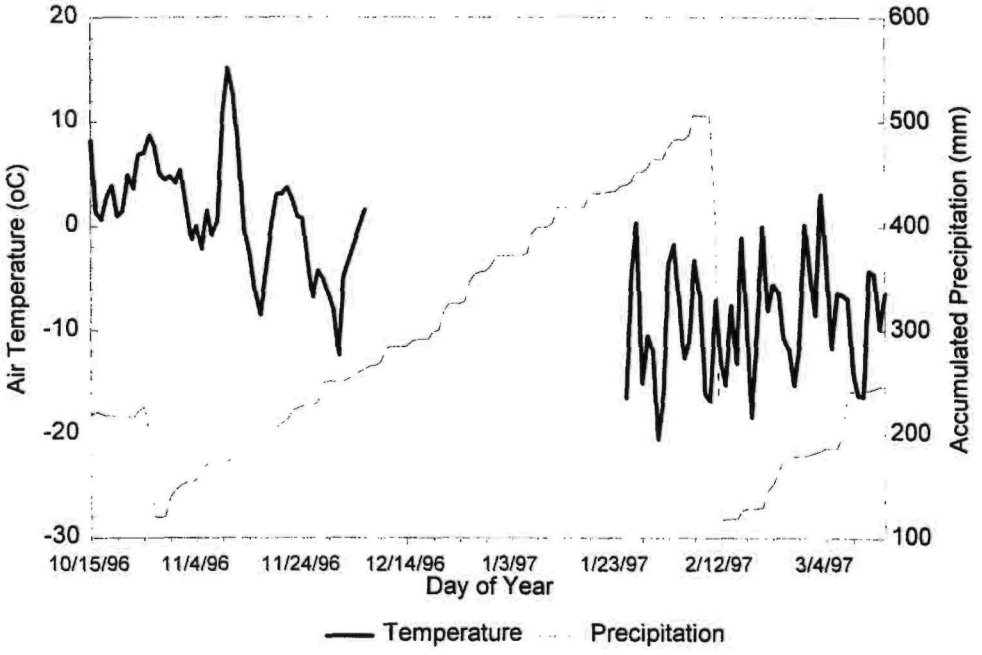
Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
26-Feb-97	Mean	-15.3	61.9	-21.3	54.6	178.6
	Minimum	-20.1	40.8	-23.3	54.1	177.1
	Maximum	-10.6	80.1	-17.3	55.0	179.4
27-Feb-97	Mean	-11.4	63.6	-17.0	54.3	179.2
	Minimum	-19.7	53.0	-25.6	54.0	177.8
	Maximum	-0.4	78.0	-7.3	54.7	180.4
28-Feb-97	Mean	0.2	78.3	-3.3	53.9	179.3
	Minimum	-4.0	63.2	-7.2	52.8	178.6
	Maximum	5.5	98.1	0.4	54.3	180.4
01-Mar-97	Mean	-4.5	82.0	-7.4	56.2	181.0
	Minimum	-10.5	47.3	-12.9	53.1	179.4
	Maximum	2.6	98.6	-3.1	59.0	182.9
02-Mar-97	Mean	-8.5	82.1	-11.2	55.1	182.6
	Minimum	-17.8	66.2	-19.2	54.4	181.2
	Maximum	1.0	94.0	-4.0	55.5	184.4
03-Mar-97	Mean	3.0	98.0	2.8	52.6	184.5
	Minimum	-0.8	86.4	-2.6	47.3	183.2
	Maximum	6.1	100.8	5.8	55.7	186.6
04-Mar-97	Mean	-2.9	54.7	-11.6	46.1	187.0
	Minimum	-9.6	25.3	-21.1	45.0	185.8
	Maximum	4.7	99.2	4.6	47.0	187.8
05-Mar-97	Mean	-11.7	63.6	-17.6	45.5	186.7
	Minimum	-19.0	30.8	-21.8	45.0	186.0
	Maximum	-2.1	79.6	-11.8	45.8	187.8
06-Mar-97	Mean	-6.4	87.4	-8.2	46.2	186.7
	Minimum	-13.6	69.7	-14.5	45.1	185.9
	Maximum	0.1	95.7	-2.0	47.4	187.4
07-Mar-97	Mean	-6.6	99.9	-6.6	55.6	198.0
	Minimum	-10.8	97.5	-11.1	46.0	186.5
	Maximum	-3.2	102.2	-3.1	79.2	235.4
08-Mar-97	Mean	-7.0	77.8	-10.7	84.2	241.2
	Minimum	-10.7	46.3	-16.4	79.9	236.6
	Maximum	-1.9	101.2	-5.5	87.4	243.1

Appendix 9 continued.

Date		Air temperature (oC)	Relative humidity (%)	Dew point	Snow depth (cm)	Accumulated precipitation (mm)
09-Mar-97	Mean	-14.1	63.8	-19.9	80.7	241.4
	Minimum	-22.3	38.2	-25.1	79.3	240.3
	Maximum	-5.9	84.1	-16.1	81.8	242.5
10-Mar-97	Mean	-16.3	62.8	-22.9	78.6	241.4
	Minimum	-27.1	25.3	-29.8	77.5	240.2
	Maximum	-2.9	82.8	-17.5	79.4	243.0
11-Mar-97	Mean	-16.4	73.2	-20.3	77.4	241.5
	Minimum	-27.4	48.5	-30.4	76.2	240.2
	Maximum	-5.4	95.4	-7.6	78.2	243.0
12-Mar-97	Mean	-4.3	92.8	-5.4	-54.1	242.3
	Minimum	-6.7	80.4	-7.0		241.1
	Maximum	-0.3	99.7	-3.0	78.4	243.4
13-Mar-97	Mean	-4.6	87.7	-6.4	79.7	244.2
	Minimum	-7.4	63.3	-12.5	76.6	241.9
	Maximum	-0.7	100.7	-4.1	80.4	247.3
14-Mar-97	Mean	-9.8	58.0	-16.8	78.4	246.7
	Minimum	-14.6	40.2	-19.2	75.5	245.7
	Maximum	-3.0	70.7	-13.3	80.1	248.2
15-Mar-97	Mean	-6.4	49.0	-15.5	74.0	246.7
	Minimum	-12.4	33.7	-19.8	72.2	245.7
	Maximum	5.5	67.6	-7.5	75.7	247.9

APPENDIX 10

Mean daily air temperature (°C) and mean daily accumulated precipitation (mm) versus day of year as observed at Kouchibouguac National Park during the telemetric investigations.



Appendix 10. Mean daily air temperature (oC) and mean daily accumulated precipitation (mm) versus day of year as observed at Kouchibouguac National Park during the telemetric investigations.