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A Bacteriological Survey of the Montague River During 1972 and 1973, Prince Edward Island Shellfish Area 5

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Atlantic Region

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A BACTERIOLOGICAL SURVEY OF THE MONTAGUE RIVER DURING 1972 and 1973, PRINCE EDWARD ISLAND, SHELLFISH AREA 5

by

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ABSTRACT

This report presents the results of bacteriological water quality surveys of that portion of the Montague River downstream from the town of Montague, Kings County, Prince Edward Island (Shellfish Area P.E.I. - 5). The surveys were conducted in June 1972, July 1973 and November 1973, to permit a review of the classification of the area that is closed for the harvesting of shellfish and were initiated after construction in 1971 of sewage treatment facilities for the town of Montague.

The data indicate that in general there has been a significant improvement in the water quality of the river since the area was last surveyed (1970), but the densities of bacteriological indicators vary considerably from day to day and increase greatly in response to rainfall.

It is concluded that under adverse conditions the entire area does not meet the criteria for approval of shellfish growing areas and it is recommended that no change be made in the regulations prohibiting shellfishing in this area.

RÉSUMÉ

Ce rapport présente les résultats des relevés bactériologiques de la section de la Rivière Montague en bas de la ville de Montague, Comté de Kings, Ile du Prince-Edouard (Secteur de Pêche de Coquillages PEI - 5). Ces relevés ont été menés aux mois de juin, juillet et novembre, 1973, pour permettre une revue de la classification de la fermeture de la pêche de Coquillages. Ces relevés ont été recommendés après la construction en 1971, d'une usine pour le traitement des eaux d'égout pour la ville de Montague.

Les résultats indiquent qu'il y a eu de l'amélioration significative dans la qualité de l'eau de la rivière depuis les dernières études (1970). Cependant la densité des indicateurs bactériologiques change considérablement d'un jour à l'autre et la densité augmente beaucoup après une pluie substantielle.

Il faut conclure que durant telles conditions adverses, le secteur ne satisfait pas le critère necessaire pour l'approbation des Secteurs de Pêche de Coquillages. Il est donc recommendé qu'on doit maintenir la fermeture présentement établie pour cet endroit.

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1 INTRODUCTION

To re-evaluate the degree of fecal pollution in the estuary of the Montague River, the Environmental Protection Service conducted bacteriological water quality surveys in June of 1972, June of 1973 and November of 1973. The prime objective of these surveys was to review the need for the prohibition of shellfishing in the river after the installation of sewage treatment facilities for the town of Montague.

At present, the Fisheries Act prohibits shellfishing in the river and the contaminated area is defined in Schedule F of the Prince Edward Island Fishery Regulations (PC 1972-520) as follows:

> 5-6 The waters of Montague River, Kings County, westerly of a straight line drawn across the river from Oyster Survey Monument No. 6, as shown on the plan showing Oyster Leases in the St. Mary's Bay area, to Oyster Survey Monument No. 7, as shown on that plan.

In June, 1970, a bacteriological survey of the river was conducted (1) by the Public Health Engineering Division of National Health and Welfare. They found the river to be grossly polluted and identified the town of Montague as the prime source of fecal pollution to the river. Since late summer of 1971, the Montague sewage has been passed through a primary treatment plant. The effects of the installation of this treatment facility on the river water quality is discussed in this report in terms of the criteria for the classification of shellfish growing waters.

This assessment is part of a continuous review of closure regulations governing shellfish growing areas, which is carried out by the Environmental Protection Service in

accordance with the procedures described in the National Shellfish Sanitation Program Manual of Operations (2).

The coliform test is the principal bacteriological criterion used for the classification of shellfish growing waters although fecal coliform tests provide additional information and are included in this report. With the coliform test, water is considered unacceptable when the median of the results exceeds 70 per 100 ml and/or more than ten percent of the results exceed 230 per 100 ml. There is no universally accepted standard for the fecal coliform test but a median of 23 with a 90-percentile of 76 may be used in comparing the two parameters.

2 METHODS

2.1 Sampling

Water samples were collected in sterile glass bottles using a rod sampling device to lower the bottles to a depth of about two feet. Samples were not iced but were kept in an insulated container and processed in a mobile laboratory less than six hours after collection.

2.2 Bacteriological Analyses

Coliform and fecal coliform tests were performed on all samples using "most probable number" (MPN) techniques. Three or more five-tube MPN series were inoculated with appropriate aliquots of sample (decimal dilutions). In the first stage of the procedure, Bacto Lauryl Tryptose Broth was the growth medium used and the tubes were incubated at 35°C for about 48 hours, or if gas formation was detectable sooner, for 24 hours. Gas-positive cultures were transferred to Bacto Brilliant Green Bile Broth (BGB) and Bacto-EC medium.

Gas formation in BGB after 24 or 48 hours of incubation at 35°C constituted the confirming stage of the coliform test. For the fecal coliform test the EC tubes were examined after 24 hours of incubation at 44.5°C. The incubator in this case was a water bath equipped with a stirring device.

2.3 Additional Data

To facilitate interpretation of the bacteriological data, the salinity of selected samples was determined (hydrometric) and water temperatures were recorded at selected sampling stations. The tidal stage was estimated and recorded for each sampling run and estimates of the daily precipitation at Charlottetown were obtained from the Atmospheric Environment Service and are included in the Appendix.

Some observations of surface water drifters in the lower part of the estuary were provided by Mr. E. Roy Clow, Fisheries Warden, and are included in this report.

3. AREA DESCRIPTION

The Montague River rises in the central hills of southeastern Queens County and discharges in Cardigan Bay near Georgetown, on the eastern shore of Kings County. About nine miles upstream from Georgetown, the Montague River is joined by the Valleyfield River. Shortly below this junction, the town of Montague is located (pop. 15000). Much of the drainage area is farmland, and there is a scattering of homes throughout the area along the roads.

Since 1971, the town of Montague has provided secondary treatment for its sewage in a treatment plant located in the southern section of the town near the river bank. The collection system combines sanitary and storm flow; the design capacity of the plant is 200000 gallons/day (3) and

the final effluent is chlorinated and discharged just east of the bridge at Montague. About half a mile east of Montague, Langley Foods Ltd. operates a food processing plant which processes potatoes and other vegetables. The process wastes are fed to a primary treatment plant with a clarifier and then discharged unchlorinated to the Montague River.

A third potential pollution source in this area is a piggery operation located on the crest of a hill approximately half a mile south of Montague. Each week, about 100 bushels of waste are generated and spread over the farm which extends over approximately eighty acres.

A more complete description of the sanitary conditions in the drainage area, including a description and evaluation of the Montague Sewage Treatment Plant, is provided in a report by Donnelly (3) after a 1973 sanitary survey.

4 RESULTS

Samples for bacteriological analyses were collected at thirty-nine sampling stations (Figure 1) in the Montague River: on six sampling days in June, 1972; on four days in July-August, 1973, as well as on four days in November, 1973. The results of coliform MPN tests performed on these samples are listed in Table 1-A of the Appendix while the fecal coliform MPN values are recorded in Appendix Table 1-B. The tidal stages at times of sampling (Table 1-C) and salinity determinations (Table 1-D) are also presented in Appendix I. The distribution of coliform medians (figure2) and coliform maximum values (figure 3) are illustrated for each of the survey periods.

To facilitate the discussion of the data, the surveyed area is divided into four sectors as follows:

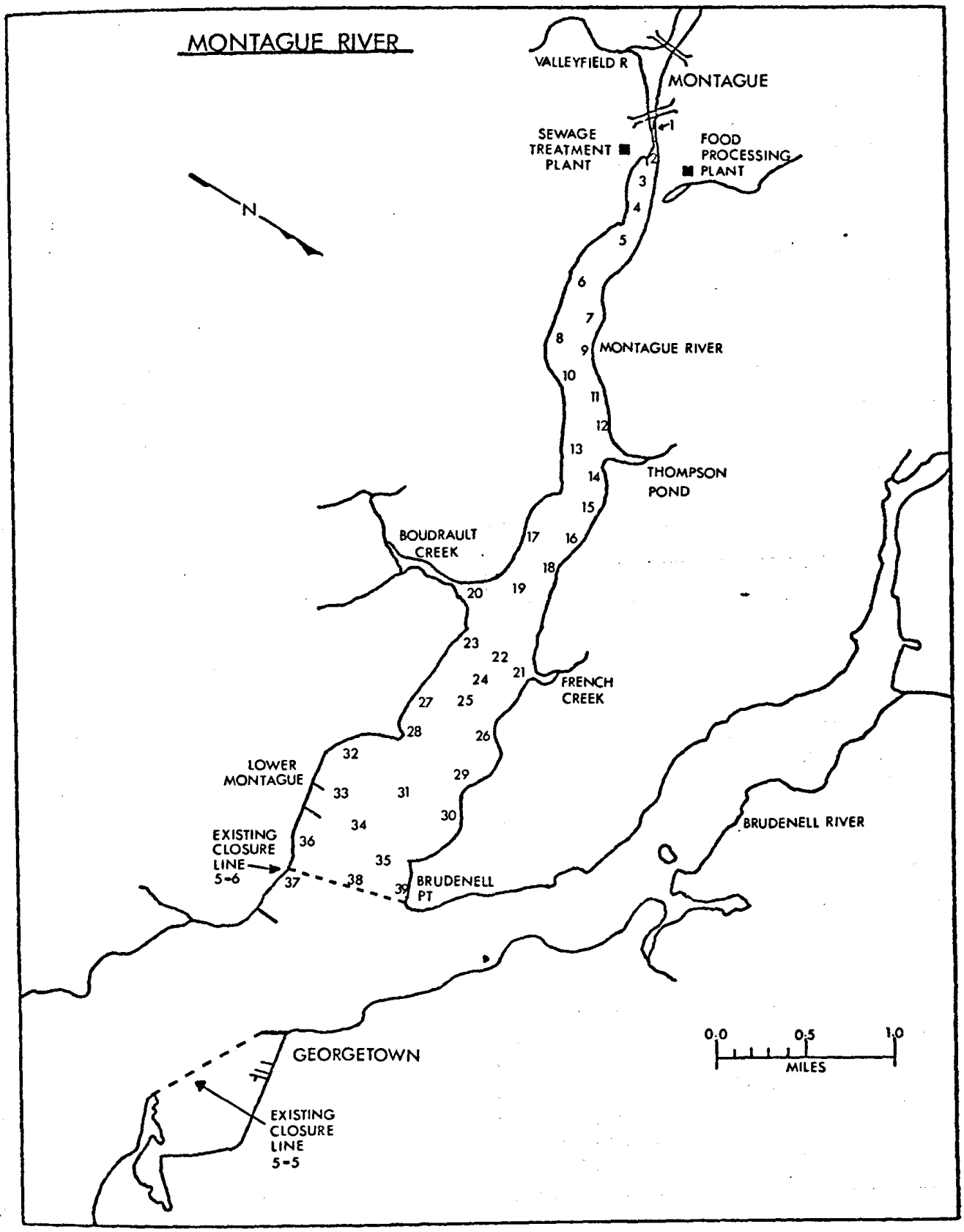
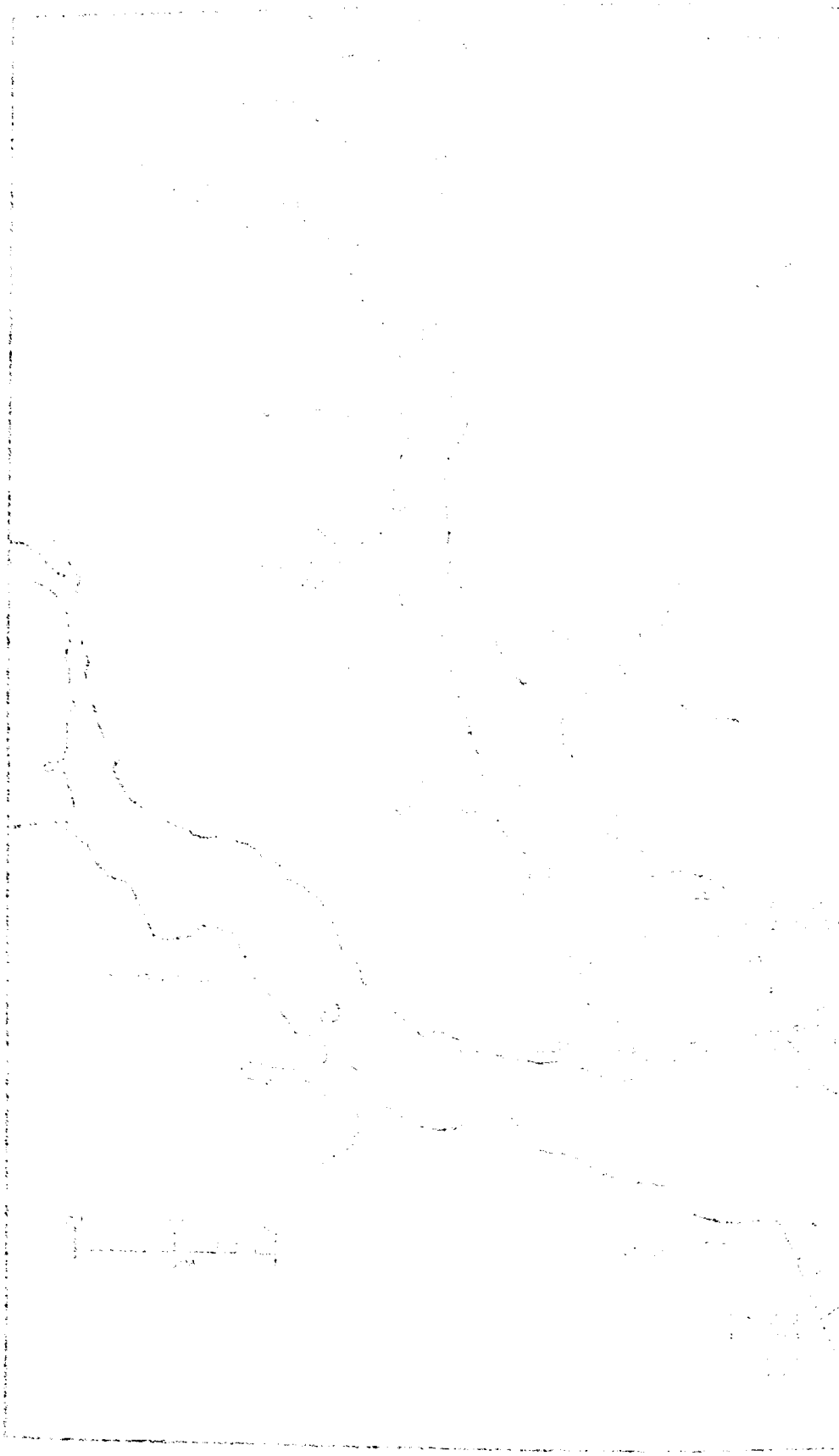


FIGURE 1. SAMPLING STATIONS - MONTAGUE RIVER, P.E.I. 1973



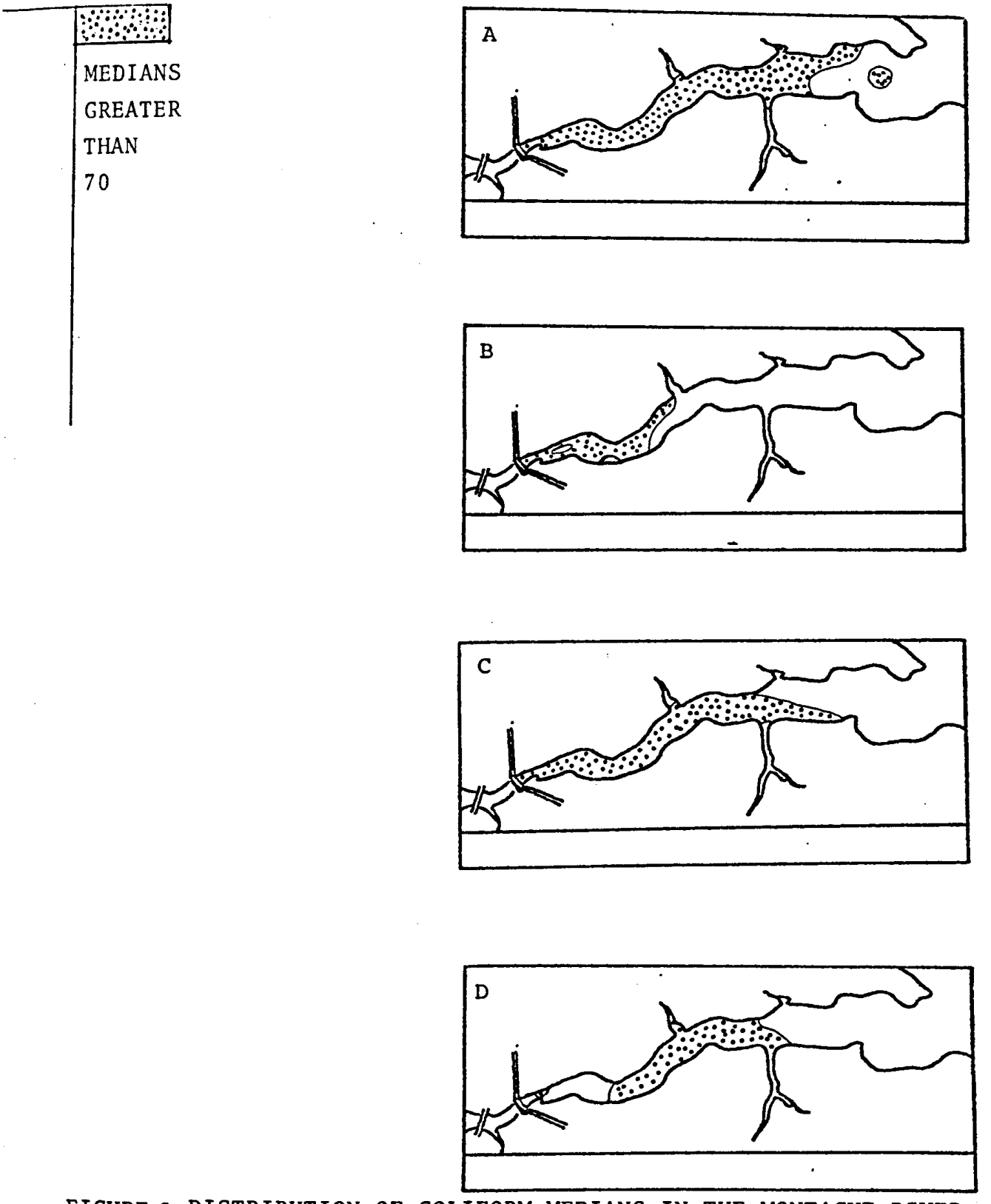


FIGURE 2 DISTRIBUTION OF COLIFORM MEDIANS IN THE MONTAGUE RIVER DURING JUNE 1970 (A), JUNE 1972 (B), AUGUST 1973 (C), AND NOVEMBER 1973 (D).

MPN's GREATER THAN 1000 PER 100 ML

MPN's GREATER THAN 230 PER 100 ML

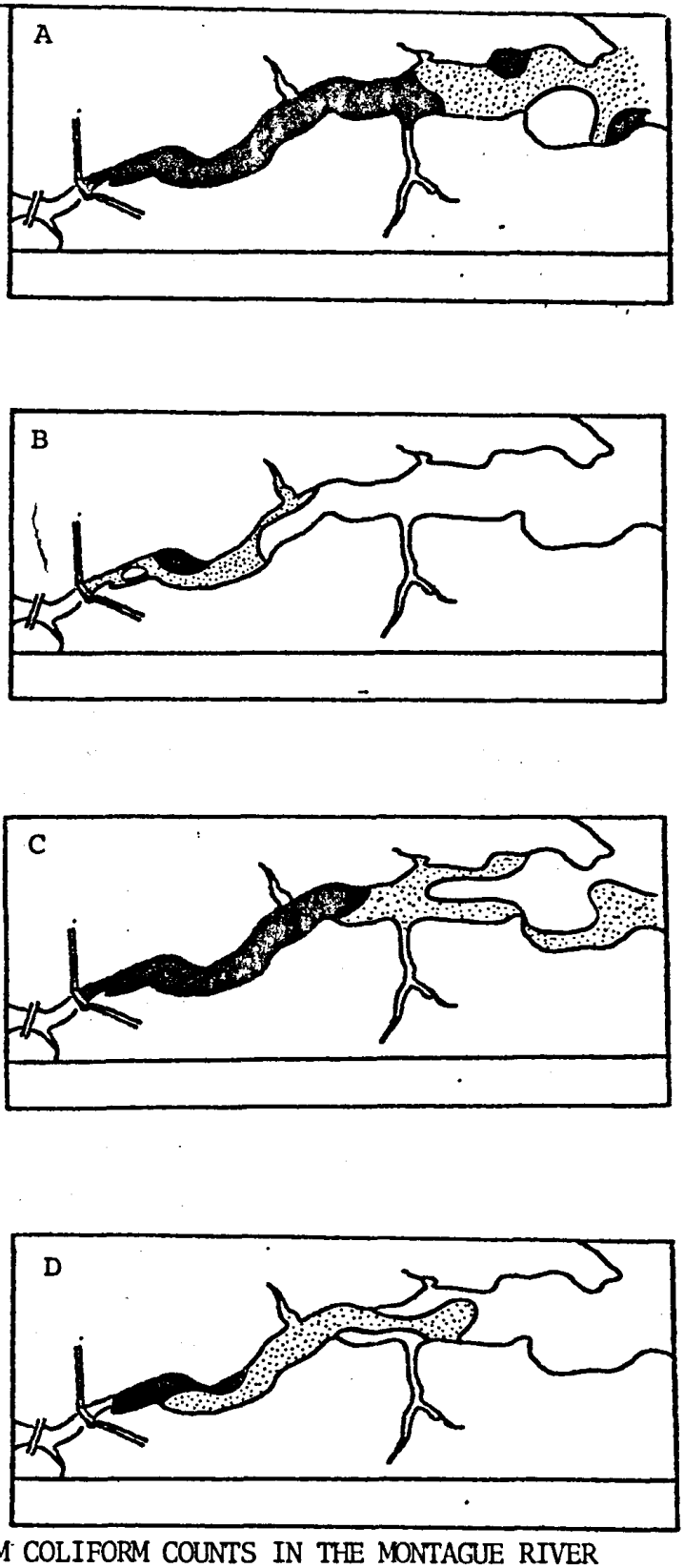
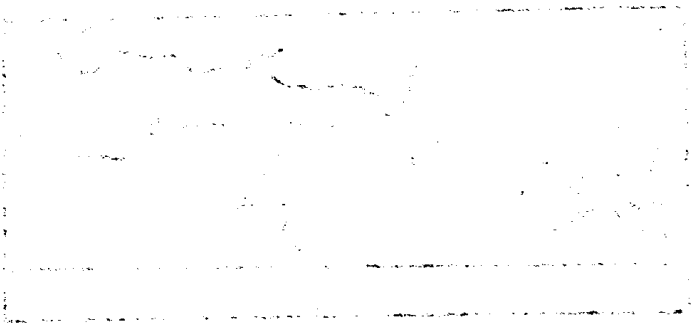
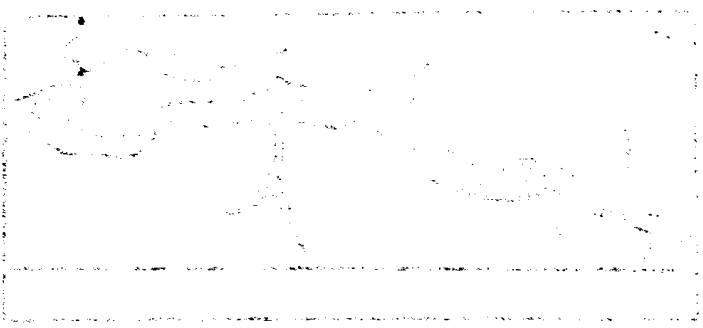
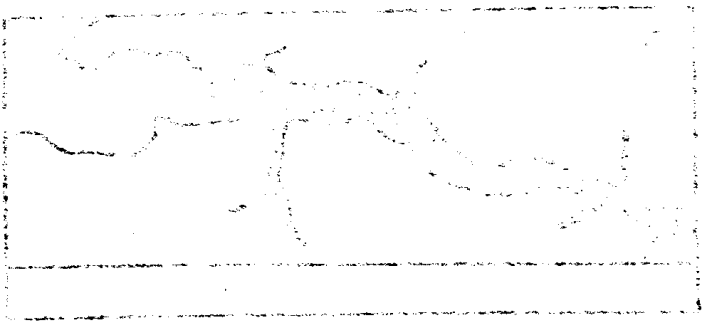


FIGURE 3 DISTRIBUTION OF MAXIMUM COLIFORM COUNTS IN THE MONTAGUE RIVER DURING JUNE, 1970(A), JUNE 1972 (B), AUGUST 1973 (C) AND NOVEMBER 1973 (D).







Sector 1 - the upper river, within a mile of Montague (Stations 1-7);
Sector 2 - the next mile downstream to Thompson Pond (Stations 8-14);
Sector 3 - the river below Thompson Pond, including Boudrault and French Creek (Stations 15-28);
Sector 4 - the remaining area near Lower Montague and Brudenell Point (Stations 29-39).

During June 1972, coliform counts in Sector 1 exceeded 70 per 100 ml in 57% of the samples and 24% of the counts exceeded 230 MPN/100 ml (Table 1). In this sector, over 85% of the samples had fecal coliform counts in excess of 23. In Sector 2, the coliform counts in 47% of the samples exceeded 70. Over 14% of the samples had coliform counts in excess of 230 per 100 ml. Also within this sector, 40% of the fecal coliform counts exceeded 23. In Sectors 3 and 4, no coliforms were detected in 60% of the samples. At one station, number 5, in Sector 1, coliform as well as fecal coliform counts were greater than 2400/100 ml on three sampling days, June 21, 27 and 29. The densities decreased rapidly at adjacent stations, however, indicating a low volume source affecting this location.

The results of bacteriological tests conducted in July, 1973 indicated greatly increased bacterial densities throughout the survey area. In Sector 1 and 2, almost all coliform counts (98%) were greater than 70 per 100 ml and a majority (71%) exceeded 700/100 ml. Conditions were particularly bad on August 2 when coliform MPN's at Stations 1-15 were greater than 2400/100 ml (Figure 4). Rainfall on August 1 was slightly more than one inch. On July 25, high (230/100 ml) bacterial densities were also detected

TABLE 1 FREQUENCY DISTRIBUTION OF COLIFORM AND FECAL COLIFORM COUNTS FOR THE JUNE 1972, JULY 1973, AND NOVEMBER, 1973 SURVEY PERIODS.

Stations:		1-7	8-14	15-28	29-39	1-7	8-14	15-28	29-39	1-7	8-14	15-28	29-39
Survey Period:		June 72	June 72	June 72	June 72	July 73	July 73	July 73	July 73	Nov. 73	Nov. 73	Nov. 73	Nov. 73
Coliform MPN's													
> 70	No.	24	20	0	0	27	25	22	7	13	20	22	4
	%	57.1	47.6	0	0	96.4	89.3	40	18.9	46.4	71.4	39.3	9.1
> 230	No.	10	6	0	0	23	20	12	5	8	11	5	0
	%	23.8	14.3	0	0	82.1	71.4	21.8	13.5	28.6	39.3	8.9	0
> 700	No.	4	1	0	0	20	17	6	2	6	0	1	0
	%	9.5	2.4	0	0	81.4	60.7	10.9	5.4	21.4	0	1.8	0
>2400	No.	3	0	0	0	14	13	3	0	4	0	0	0
	%	7.1	0	0	0	50	46.4	5.6	0	14.3	0	0	0
Fecal Coliform MPN's													
> 23	No.	36	17	0	0	24	20	9	3	17	21	28	5
	%	85.7	40.5	0	0	85.7	76.9	18.4	8.1	60.7	75	50	11.4
> 76	No.	14	6	0	0	21	18	5	3	11	13	15	2
	%	9.5	14.3	0	0	75	80.8	10.4	8.1	39.3	46.4	26.8	4.5
> 230	No.	7	4	0	0	18	16	4	3	7	5	3	0
	%	16.7	9.5	0	0	64.3	61.5	8.2	8.1	25	17.9	5.4	0
>2400	No.	3	0	0	0	2	2	0	0	2	0	0	0
	%	7.1	0	0	0	7.1	7.7	0	0	74	0	0	0

(Figure 4) throughout the survey area, although there had been no rain during the week preceeding the sampling time.

In November 1973, the river was generally less contaminated than in July of that year. However, the counts, in particular in the downstream regions, were not as low as those indicated in June, 1972. In Sectors 1, 2 and 3, more than 39% of the coliform MPN's were greater than 70 while 50% of the fecal coliform counts exceeded 23 per 100 ml. (Table 1). There were few high counts in Sector 4 and only four coliform MPN's were greater than 70 per 100 ml. However, coliforms were detected in all but one sample and fecal coliforms in all but four samples. The highest coliform densities of this survey period were detected on November 9, following about 0.2 inches of rain on November 8 and the early hours of November 9.

It was noted that in November, 1973, fecal coliforms at many stations formed a larger portion of the coliform population than during other survey periods.

5 DISCUSSION AND CONCLUSIONS

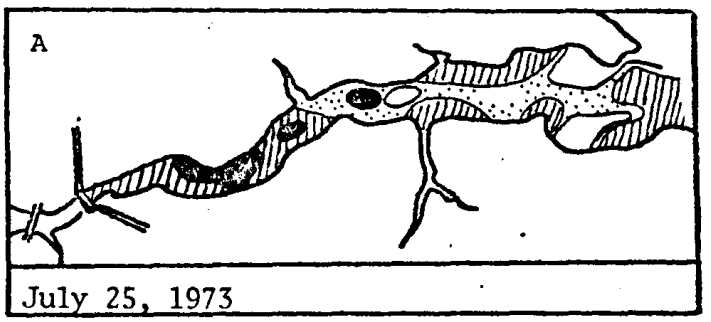
There is no doubt that there has been a significant improvement in the water quality of the Montague River since the town of Montague installed sewage treatment facilities. It is also clear, however, that there is little consistency in the degree of improvement. There is an extreme difference, for example, between results of bacteriological tests conducted in June, 1972 (low) and in the summer of 1973 (high). To some extent, these differences may be attributed to effects of rainfall. The efficiency of the Montague sewage treatment plant decreases considerably after rainfall (3) because of the addition of storm flow to the collection system. This, apparently, is what occurred on August 2, 1973 (figure 4) when the upstream regions of the Montague

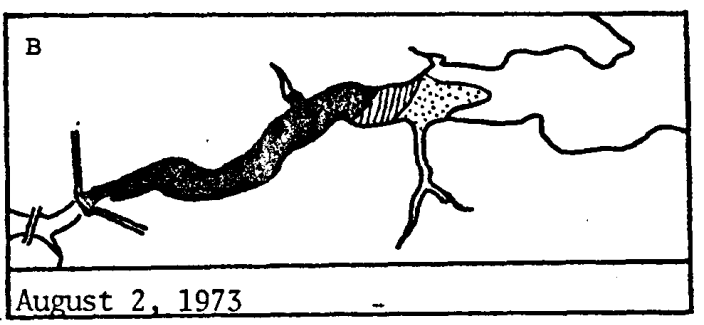
COLIFORM MPN's PER 100 ML

GREATER THAN 2400

GREATER THAN 230

GREATER THAN 70



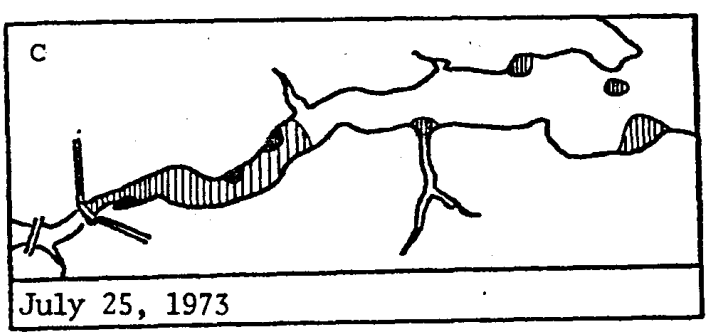


FECAL COLIFORM MPN's PER 100 ML

GREATER THAN 700

GREATER THAN 230

GREATER THAN 23



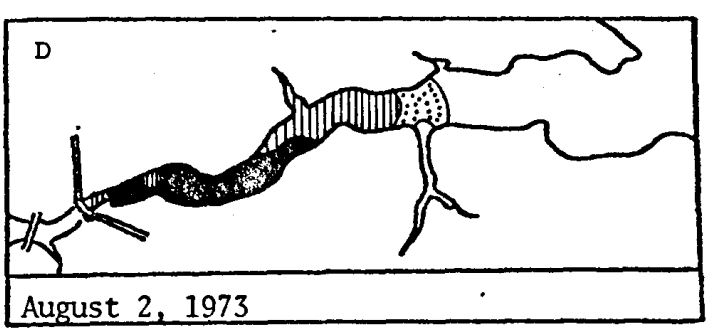


FIGURE 4 DISTRIBUTION OF COLIFORM COUNTS ON JULY 25 (A), AUGUST 2 (B), 1973 AND THE DISTRIBUTION OF FECAL COLIFORM COUNTS ON JULY 25 (C), AND AUGUST 2 (D), 1973, IN THE MONTAGUE RIVER

River were grossly polluted after more than one inch of rain fell on the previous day. Similarly, the increase in bacterial densities from November 7 to November 9, 1973, may be attributed to rainfall-induced runoff (Figure 1-B) as well as some reduction in the effluent quality at the treatment plant. High bacterial densities, however, are not found only after rainfall, and it is apparent that there are additional factors contributing to variations in the degree of fecal pollution of the river. Donnelly (3) has found high bacterial densities in the sewage treatment plant effluents on days when rainfall was insignificant and such temporary reductions in effluent quality appear to be related to the operation of the plant rather than its design. Langley's food processing plant is also a fecal pollution source of variable significance. Samples by Donnelly (3) of plant effluents as well as of the wash water showed high bacteriological densities. High coliform data at Station 5 on several days in June, 1972 may be attributed to effluents from the food processing plant. On other days, however, it is often difficult to attribute high bacterial densities in the river to either one of these main sources as their effluents mix a fairly short distance downstream.

Samples were not collected upstream from the town of Montague, but it is apparent that river water is by no means free from fecal pollution in the upstream regions. Donnelly (3) found more than 2400 fecal coliforms per 100 ml in a sample from the lower Valleyfield River and also some samples from the upstream Montague River showed high (>76/100 ml) fecal coliform densities.

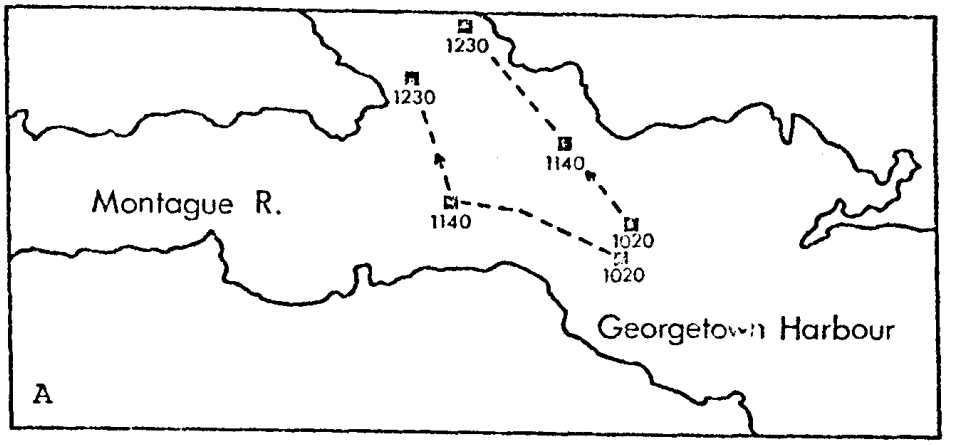
The Montague River and its tributary, the Valleyfield River, drain a large area containing a multitude of minor and diffuse sources of indicator bacteria. The cumulative effect of these sources would at times impair the water quality in the lower regions of the Montague River.

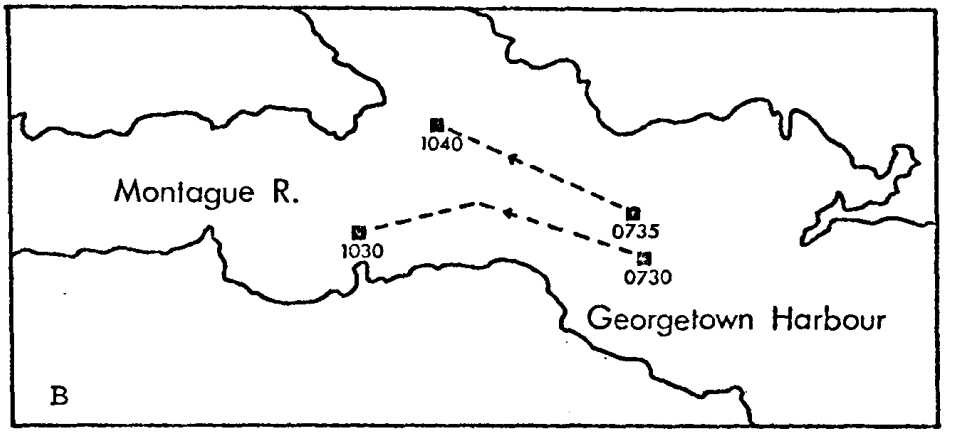
It is clear, however, that the most significant addition of fecal pollution would be caused by a "washout" of the Montague sewage treatment plant.

When the data are viewed in terms of criteria for shellfish growing waters, it is immediately apparent that the water quality in Sectors 1 and 2 (Stations 1-19) does not meet these criteria. In Sector 3, even under favourable conditions (eg. June, 1972), considerably more than ten percent of the coliform MPN's were greater than 230 per 100 ml (Table 1). In Sector 4, the water quality was quite good on all sampling days except July 25. In this area, the Montague River water is considerably diluted by presumably unpolluted waters from the Brudenell River and Cardigan Bay. Effects of sewage on this sector were not shown to be contributed by Georgetown, although the paths of drifters suggest this possibility (Figure 5). All samples collected at high tide in Sector 4 indicated acceptable water quality. It should be noted, however, that on the only sampling day that followed considerable rainfall (August 2), sampling was carried out at high tide while upstream regions of the survey area were grossly polluted. Had sampling been carried out at low tide on that day, the grossly contaminated area would have extended much further downstream. It is likely that under these circumstances, the bacterial densities in Sector 4 would exceed permissible levels.

High bacterial densities were detected in Sector 4 on July 25, 1973, but the general coliform distribution on that day is difficult to correlate with other data, particularly in view of the absence of rainfall at that time. The possibility of analytical errors cannot totally be excluded, although there is no substantial reason to conclude that this would explain those results.

It has been established that the degree of contamination of the Montague River is subject to extreme vari-





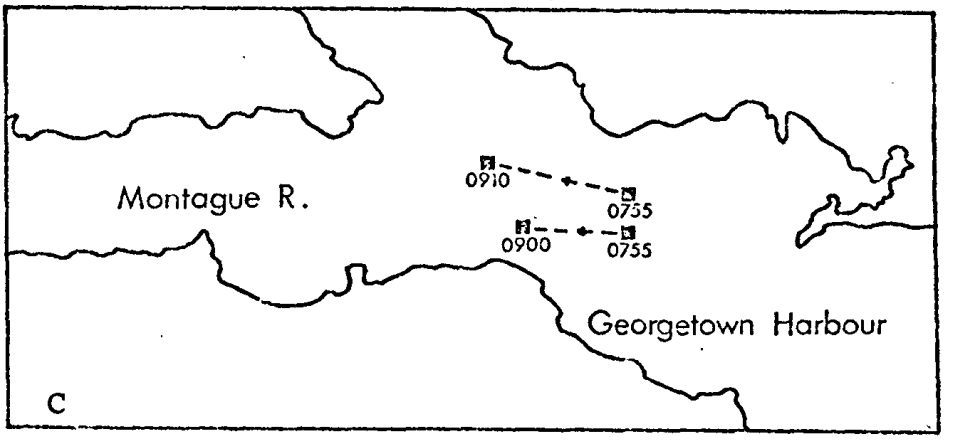
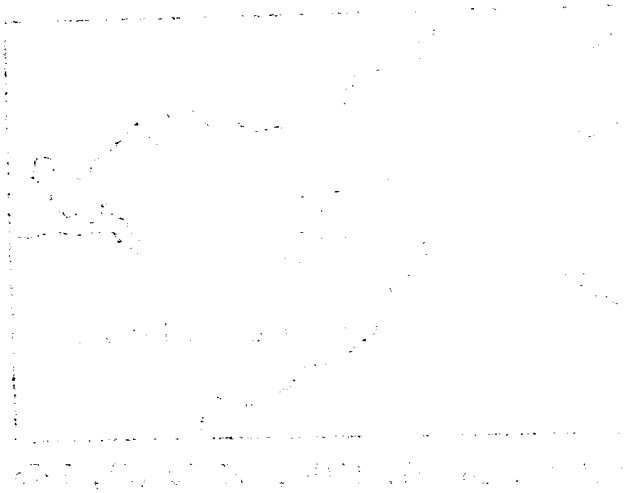


FIGURE 5 THE PATHS OF DRIFTERS RELEASED ON NOV 16 (A), 17(B), AND 19 (C), 1973 IN THE LOWER MONTAGUE RIVER



ations, and at times, all four sectors of the surveyed area are subject to fecal contamination. Thus, it is concluded that the water quality within the existing Montague River closure does not meet the criteria for an approved shellfish growing area.

6 RECOMMENDATION

The existing Montague River shellfish closure (5-6) is adequate and should remain in effect.

ACKNOWLEDGEMENTS

The authors greatly appreciate the technical assistance of Messrs. M. Gauvin and B. Cushing. The assistance of Dr. R.H. Cook in reviewing the manuscript is also acknowledged.

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APPENDIX I

TABLES

TABLE 1-A COLIFORM DATA, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

COLIFORM MPN's PER 100 ML

Date	Station Number						
	1	2	3	4	5	6	7
June 14 1972	240	43	4	93	43	93	210
19	93	23	43	43	43	23	24
20	75	42	23	23	240	23	23
21	75	93	75	93	2400+	43	460
27	170	49	110	140	2400+	49	280
29	240	43	93	240	2400+	1100	210
Median	130	43	59	93	1320+	26	210
July 23 1973	130	130	17	2400^{+}	2400^{+}	2400^{+}	350
25	130	1600	1600	920	2400^{+}	450	2400^{+}
30	1600	1600	920	2400^{+}	350	130	2400^{+}
Aug. 2	2400^{+}	2400^{+}	2400^{+}	2400^{+}	2400^{+}	2400^{+}	2400^{+}
Median	865	1600	1260	2400^{+}	2400^{+}	1470^{+}	2400^{+}
Nov. 7 1973	33	130	7	33	79	140	2400^{+}
8	7	7	12	17	8	14	280
9	33	$1.1 \times 10^{5}+$	2400^{+}	2400^{+}	1600	1600	34
12	33	13	79	33	33	350	110
Median	33	72	45	33	56	245	195

TABLE 1-A COLIFORM DATA, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

COLIFORM MPNs PER 100 ml

Date	Station Number						
	8	9	10	11	12	13	14
June 14 1972	93	75	15	39	93	23	460
19	43	23	23	43	9	23	9
20	240	23	240	93	43	0	93
21	23	93	43	43	150	4	9
27	49	79	95	110	170	8	13
29	150	1100	240	150	240	75	43
Median	71	77	69	68	121	16	28
July 23 1973	2400+	1600	920	280	180	20	9
25	2400+	2400+	540	1600	2400+	920	220
30	2400+	2400+	350	130	39	130	220
Aug. 2	2400+	2400 +	2400+	2400+	2400+	2400+	2400+
Median	2400+	2400+	730	940	1290	525	220
Nov. 7	350	350	14	79	70	33	46
8	170	540	6	170	17	14	8
9	240	350	350	130	170	540	220
12	540	220	540	540	540	220	110
Median	295	350	182	150	120	127	78

TABLE 1-A COLIFORM DATA, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

COLIFORM MPN's PER 100 ml

Date		Station Number						
		15	16	17	18	19	20	21
June 1972	14	20	39	9	23	23	23	<3
	19	<3	4	9	9	<3	9	<3
	20	23	23	23	23	4	43	43
	21	7	43	<3	7	<3	<3	4
	27	23	13	<3	<3	<3	<3	39
	29	9	15	<3	<3	<3	<3	<3
Median		15	19	<6	8	<3	<6	<4
July 1973	23	6	7	9	<2	9	24	<2
	25	130	2400+		27	350	540	350
	30	17	17	79	76	79	21	7
Aug.	2	2400+	2400 +	920	920	150	70	33
Median		73	1208	79	57	115	47	20
Nov. 1973	7	49	70	110	26	240	17	14
	8	40	17	11	12	11	17	6
	9	920	350	79	110	110	170	170
	12	220	170	220	130	79	170	13
Median		135	120	95	68	95	94	14

TABLE 1-A COLIFORM DATA, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

COLIFORM MPN's PER 100 ml

Date	Station Number						
	22	23	24	25	26	27	28
June 14 1972	4	9	<3	<3	<3	<3	<3
19	<3	4	<3	<3	<3	<3	<3
20	9	4	9	23	<3	4	9
21	4	4	<3	4	<3	<3	<3
27	8	<3	4	4	<3	<3	<3
29	<3	<3	<3	9	<3	<3	<3
Median	4	4	<3	4	<3	<3	<3
July 23 1973	4	40	17	27	5	350	14
25	79	540	140	34	1600	110	350
30	13	2	17	49	7	13	11
Aug. 2	70	110	70	170	33	33	23
Median	42	75	44	42	20	72	19
Nov. 7 1973	13	20	32	11	4	7	4
8	17	7	4	17	17	27	15
9	220	70	540	130	79	110	49
12	23	280	32	17	4	79	17
Median	20	45	32	17	11	53	16

TABLE 1-A COLIFORM DATA, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

COLIFORM MPN's PER 100 ml

Date		Station Number						
		29	30	31	32	33	34	35
June 1972	14	9	<3	<3	<3	<3	4	4
	19	4	<3	<3	9	<3	<3	15
	20	4	4	15	3	0	9	9
	21	<3	<3	<3	<3	<3	4	<3
	27	<3	<3	<3	<3	<3	<3	<3
	29	<3	<3	<3	<3	4	23	<3
Median		<3	<3	<3	<3	<3	4	<4
July 1973	23	6	2	4	<2	<2	7	2
	25	920	13	79	43	240	220	540
	30	14	13	33	31	31		
Aug.	2	34	23	22	17		8	<2
Median		24	13	28	24	31	8	2
Nov. 1973	7	79	79	5	4	2	8	26
	8	39	9	7	7	<2	11	13
	9	27	5	110	5	7	79	31
	12	33	17	49	5	13	<2	7
Median		36	13	28	5	5	10	20

TABLE 1-A COLIFORM DATA, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

COLIFORM MPN's PER 100 ml

Date		Station Number			
		36	37	38	39
June 1972	14	<3	<3	<3	<3
	19	<3	<3	<3	<3
	20	<3	4	23	<3
	21	<3	<3	<3	<3
	27	<3	<3	<3	<3
	29	<3	15	<3	<3
Median		<3	<3	<3	<3
July 1973	23	7	4	2	<2
	25	49	540	1600	21
	30				
Aug.	2	14	17	7	13
Median		14	17	7	13
Nov. 1973	7	5	5	13	2
	8	6	5	4	2
	9	23	17	22	31
	12	8	2	5	5
Median		7	5	9	4

TABLE 1-B FECAL COLIFORM DATA 1972 AND 1973, MONTAGUE RIVER, P.E.I.

FECAL COLIFORM MPNS PER 100 ml

Date		Station Number						
		1	2	3	4	5	6	7
June 1972	14	240	43	4	93	15	43	28
	19	93	23	43	43	43	23	23
	20	15	43	23	4	240	23	23
	21	43	93	<3	43	2400^{+}	23	460
	27	29	23	33	29	2400^{+}	13	130
	29	93	43	43	93	2400^{+}	460	93
Median		68	33	28	43	>1320	23	60
July 1973	23	13	27	33	240	920	240	22
	25	79	240	920	240	540	240	2400^{+}
	30	79	540	64	350	11	7	540
Aug.	2	540	1600	1600	540	920	2400^{+}	1600
Median		79	390	492	295	730	240	1070
Nov. 1973	7	33	27	4	23	27	79	350
	8	<2	2	9	2	8	7	110
	9	17	1.6×10^{5}	920	2400^{+}	240	350	27
	12	33	13	79	27	23	240	79
Median		25	20	44	25	25	160	95

TABLE 1-B FECAL COLIFORM DATA 1972 AND 1973, MONTAGUE RIVER, P.E.I.

FECAL COLIFORM MPN'S PER 100 ml

Date	Station Number						
	8	9	10	11	12	13	14
June 14	23	4	4	9	11	9	75
1972 19	43	23	23	43	<3	9	<3
20	240	9	240	21	43	<3	4
21	23	43	43	23	150	4	9
27	8	23	33	49	23	3	5
29	75	460	240	93	43	43	23
Median	33	23	33	33	33	7	7
July 23	350	240	110	8	31	9	2
1973 25	540	350	350	920	350	-	-
30	920	240	46	23	17	13	110
Aug. 2	2400+	2400+	1600	350	920	540	350
Median	730	240	230	187	184	13	110
Nov. 7	120	120	9	33	70	23	14
1973 8	49	49	4	49	14	14	4
9	49	70	240	79	70	140	110
12	240	110	240	540	540	170	110
Median	85	90	125	64	70	82	62

TABLE 1-B FECAL COLIFORM DATA 1972 AND 1973, MONTAGUE RIVER, P.E.I.

FECAL COLIFORM MPN's PER 100 ml

Date	Station Number						
	15	16	17	18	19	20	21
June 14	7	9	9	9	23	23	<3
1972 19	<3	4	9	<3	<3	9	<3
20	23	9	4	<3	<3	<3	7
21	7	43	<3	3	<3	<3	3
27	8	<3	<3	<3	<3	<3	11
29	4	7	<3	<3	<3	<3	<3
Median	6	8	4	<3	<3	<3	<4
July 23	<2	2	2	<2	2	11	<2
1973 25				<2	<2	79	9
30	4	2	13	2	<2	17	6
Aug. 2	240	350	240	64	70	17	8
Median	4	2	13	<2	<2	17	7
Nov. 7	33	49	33	14	79	17	9
1973 8	49	4	2	6	11	9	<2
9	540	350	49	49	70	40	110
12	220	110	130	79	49	110	13
Median	135	80	41	27	60	29	11

TABLE 1-B FECAL COLIFORM DATA 1972 AND 1973, MONTAGUE RIVER, P.E.I.

FECAL COLIFORM MPN's PER 100 ml

Date		Station Number						
		22	23	24	25	26	27	28
June 1972	14	4	4	<3	<3	<3	<3	<9
	19	<3	<3	<3	<3	<3	<3	<3
	20	4	<3	4	<3	<3	4	<3
	21	4	<3	<3	4	<3	<3	<3
	27	<3	<3	<3	<3	<3	<3	<3
	29	<3	<3	<3	<3	<3	<3	<3
Median		<4	<3	<3	<3	<3	<3	<3
July 1973	23	<2	4	5	2	2	12	13
	25					240	7	11
	30	7	13	2	7	17	2	5
Aug.	2	46	46	7	5	2	4	8
Median		7	13	5	5	10	6	10
Nov. 1973	7	13	14	32	11	4	2	2
	8	2	7	<2	8	7	14	6
	9	110	23	140	130	79	46	22
	12	23	280	32	13	4	79	17
Median		18	19	32	12	6	30	12

TABLE 1-B FECAL COLIFORM DATA 1972 AND 1973, MONTAGUE RIVER, P.E.I.

FECAL COLIFORM MPN's PER 100 ml

Date	Station Number						
	29	30	31	32	33	34	35
June 14 1972	9	<3	<3	<3	<3	<3	4
19	4	<3	<3	3	<3	<3	9
20	<3	<3	7	<3	4	4	4
21	<3	<3	<3	<3	<3	<3	<3
27	3	3	3	3	3	3	3
29	<3	<3	<3	<3	<3	4	<3
Median	<3	<3	<3	<3	<3	<3	4
July 23 1973	2	2	<2	<2	<2	<2	<2
25	11	5	5	2	2	8	240
30	11	7	8	8	11	5	-
Aug. 2	5	8	5	6	-	5	<2
Median	8	6	5	5	2	5	<2
Nov. 7 1973	79	79	2	4	2	6	26
8	32	7	7	2	<2	7	5
9	14	5	22	5	5	27	23
12	23	17	14	2	13	<2	7
Median	28	12	11	3	4	7	15

TABLE 1-B FECAL COLIFORM DATA 1972 AND 1973, MONTAGUE RIVER, P.E.I.

FECAL COLIFORM MPN's PER 100 ml

Date		Station Number			
		36	37	38	39
June 1972	14	<3	<3	<3	<3
	19	<3	<3	<3	<3
	20	<3	<3	9	<3
	21	<3	<3	<3	<3
	27	3	3	3	3
	29	<3	7	<3	<3
Median		<3	<3	<3	<3
July 1973	23	2	2	2	2
	25	811	240	2	-
	30	-	-	-	-
Aug.	2	2	7	2	13
Median		2	7	2	-
Nov. 1973	7	5	5	5	<2
	8	4	5	<2	2
	9	13	17	7	13
	12	8	2	<2	2
Median		7	5	<4	2

TABLE 1-C DATE AND TIDE AT TIME OF SAMPLING, 1972 AND 1973, MONTAGUE RIVER, P.E.I.

DATE		TIME	TIDE
June 1972	14	10:00 - 12:00	High Rising
	19	11:30 - 13:30	High Falling
	20	11:00- 12:30	High Falling
	21	13:00 - 14:30	Low Falling
	27	16:00 - 17:30	Low Falling
	29	10:30 - 12:00	Low Rising
July 1973	23	10:30 - 12:00	Mid Rising
	25	08:15 - 10:00	Mid Falling
	30	10:00 - 11:00	High Falling
Aug.	2	14:00 - 15:30	High Falling
Nov. 1973	7 .	10:30 - 11:30	High Falling
	8	15:10 - 16:00	Low Falling
	9	13:00 - 16:00	Mid Falling
	12	11:15 - 12:30	Low Rising

TABLE 1-D SALINITIES (ppt) AT SELECTED STATIONS DURING NOVEMBER, 1973

Date		Station Number		
		4	22	38
Nov.	7	25.9	27.3	28.6
	8	23.9	25.6	26.1
	9	19.9	24.6	25.8
	12	22.1	24.6	26.0

APPENDIX II

FIGURES

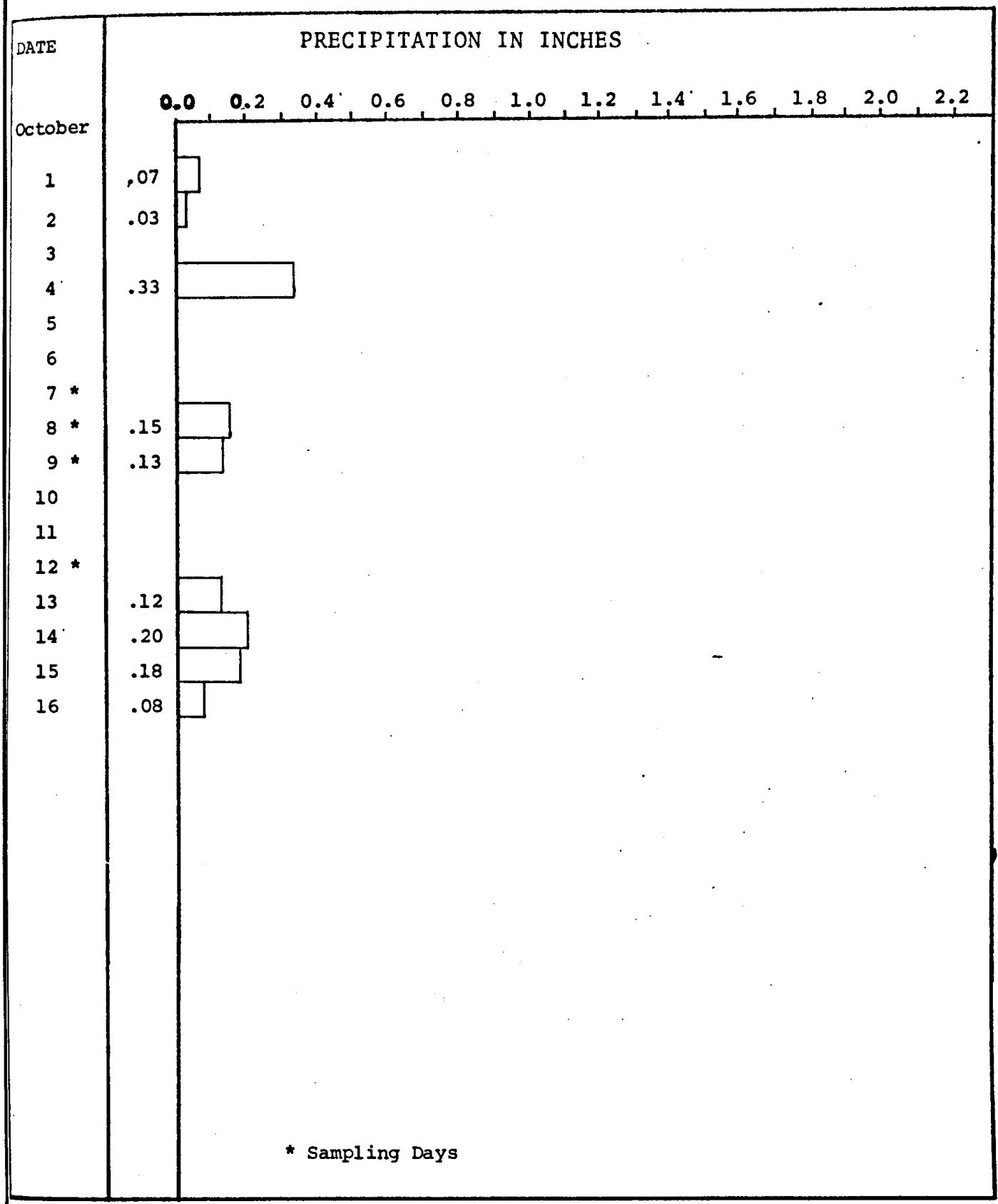

FIGURE 1-A DAILY PRECIPITATION DATA FOR THE JUNE 1972 SURVEY PERIOD, CHARLOTTETOWN, P.E.I.

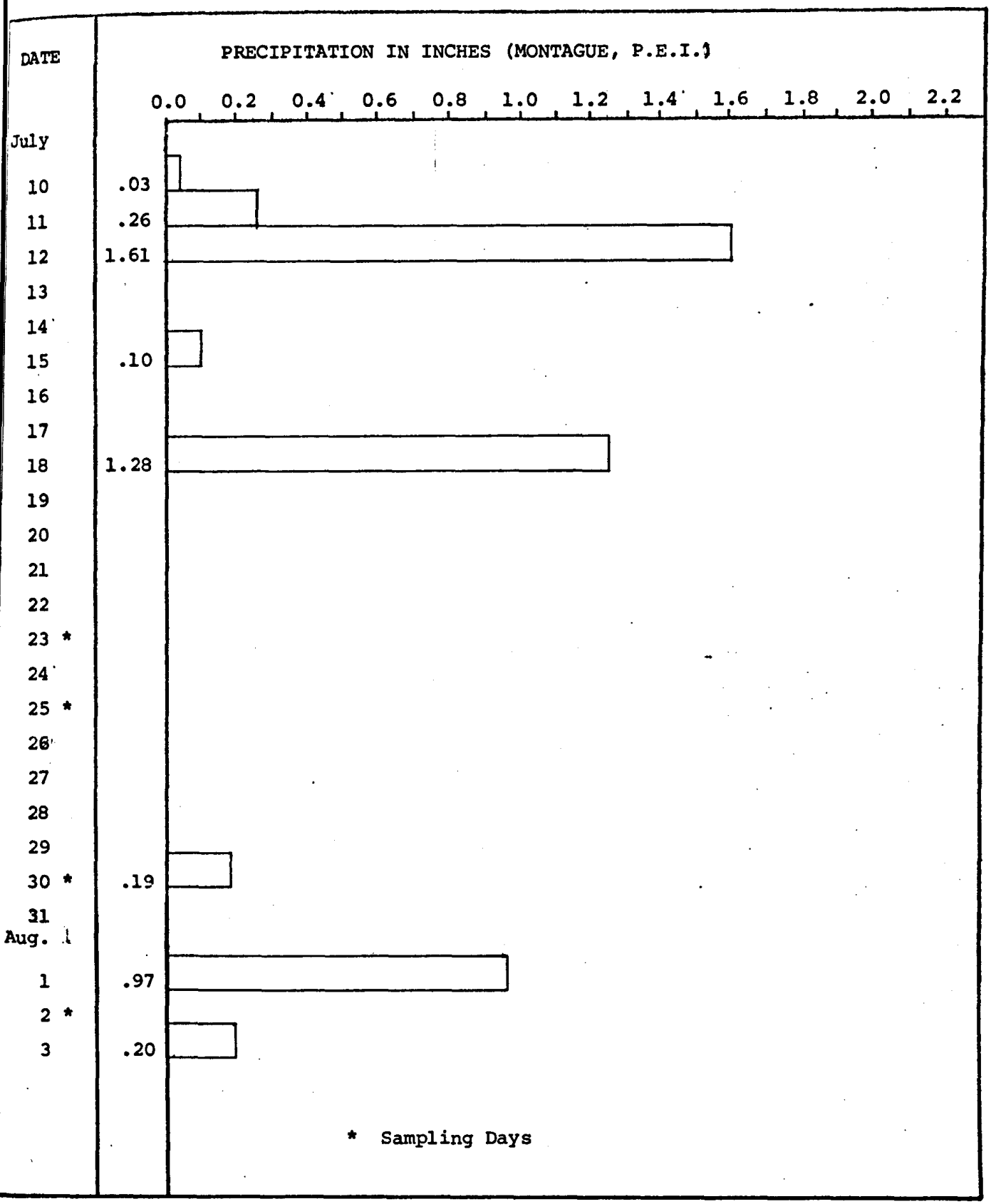

FIGURE 1-B DAILY PRECIPITATION DATA FOR THE JULY-AUGUST, 1973 SURVEY PERIOD, CHARLOTTETOWN, P.E.I.