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THE EFFECT OF THE INTRODUCTION OF IMPORTED PARASITES IN THE CONTROL OF THE LARCH CASEBEARER (COLEOPHORA LARICELLA Hbn.)

by

Dell F. Bracken

TECHNICAL REPORT 1957, 1958, 1959.

FOREST BIOLOGY LABORATORY

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RESEARCH BRANCH

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I. INTRODUCTION

During the period from 1942 to 1947 two species of imported parasites, Chrysocharis laricinellae (Ratz.) and Agathis pumila (Ratz.), were released against the larch casebearer, Coleophora laricella Hbn., at various points in the southwestern part of the Province of Quebec (Fig. 1).

Table I gives the complete liberation data for the two species of parasites released against the larch casebearer in Quebec up to 1955. This data was compiled from the original records concerning the release of these parasites, and supplied to the author by the Entomology Research Institute for Biological Control, Belleville, Ont.

Research was begun in 1957 in the general vicinity of the release points, in an attempt to evaluate the effectiveness of the parasites in natural control. This report deals with the relative abundance of the parasites recovered during 1957 to 1959, with notes on the host populations at or near the release points. Emphasis is placed on relating the presence of the introduced parasites to existing host populations.

II. LIFE CYCLE OF HOST

The adults emerge from the last of May to the latter part of June. Eggs are deposited indiscriminately on the foliage, one or more to a needle. On hatching, the larva bores directly into the leaf, feeds as a miner until September, and then constructs its case, utilizing a

Table I. Liberation data on the parasites Agathis pumila (Ratz.) and Chrysocharis laricinellae (Ratz.)

Name	Location	Date	Number
Agathis pumila (Ratz.)	Pompe de Lanoraie, Berthier County	July 9, 1943	447
" " "	St. Agapit, Lotbinière County	July 17, 1945	2623
Chrysocharis laricinellae (Ratz.)	Berthierville, Berthier County	July 4, 1942	309
" "	Massiwipi Lake, Standstead County	July 17, 1943	1033
" "	Mileage 44, C.P.R. Megantic County	May 24, 1947	1080
" "	Pompe de Lanoraie, Berthier County	July 9, 1943	2250
" "	St. Agapit, Lotbinière County	July 17, 1945	2363
" "	St. Felix de Valois, Joliette County	July 26, 1946	2368
" "	Selby Lake, Missisquoi County	July 7, 1945	1053
" "	Weedon, Wolfe County	May 24, 1947	900

mined needle for this purpose. As cold weather approaches, it prepares for hibernation by migrating to the twig, frequently at the base of a fascicle, where it fastens the case securely from within. Feeding resumes as soon as the foliage begins to develop, generally in April, and the larvae attain full growth about the latter half of May. Injury is seldom conspicuous in the fall, the greatest devastation being in the spring when the injured foliage shrivels and dries.

III. METHODS AND PROCEDURE

During the latter part of May and early June of the three years concerned, collections of the late larval and pupal stages of the casebearer were made at several points in the southwestern sector of the province (Fig. 1). Although every effort was made to sample at or near the original release points, insufficient host populations frequently necessitated the selection of alternate sites.

In 1957 populations of C. laricella were estimated by counting the number of casebearers per 50 fascicles of the previous years growth. For this, one branch was removed from the lower crown of each of 20 trees, placed in plastic bags, and brought to the laboratory at Quebec where counts were made. During 1958 and 1959 the technique as outlined by F.E. Webb (1957) was employed. This method consists of collecting one branch from the lower crown of each of ten trees and counting the number of casebearers on twigs of the previous years growth. Entire twigs are examined until the fascicle or bud count equals or exceeds 100, but final numbers are computed on the basis of 100 fascicles. If one shoot does not contain 100 fascicles, the entire opposite or next lower shoot is included to obtain counts of 100 or more fascicles.

Since the initiation of this work, further refinements have been made in the sampling technique (Webb, 1959). Sequential sampling tables have been developed on the basis of numbers of casebearers per 100 fascicles, for five population levels, namely, very light infestation, light infestation, moderate infestation, heavy infestation, and very heavy infestation. Within each population level there is a further breakdown into three infestation classes, namely low, moderate and high. Using these sequential tables, a sufficient number of trees is sampled to classify the infestation at each collection point in accordance with the sequential table chosen for defined population levels. However, the writer found that by taking one sample from each of ten trees the requirements were in all cases adequately fulfilled. This eliminated the necessity of making counts in the field and thus speeded up the collection of material. At the laboratory the material can be placed in refrigeration and counts made when time is available and under more favourable conditions, thus giving greater accuracy.

It should be pointed out that the population estimates (Tables II and III) are for the insect at the time of completion of the feeding period. The technique was originally designed to assess the overwintering populations to obtain data useful in predicting the status of the infestations in the spring. However, Webb (personal communication) feels that the same technique can be used at either period in the life history of the insect.

In addition to the collection of material for the evaluation of populations, mass collections were made in order to obtain large numbers of specimens for rearing and recovery of parasites. At the same

time, defoliation estimates were made and recorded in five broad classes, i.e. nil, trace, light, moderate and severe.

Rearing of material for the recovery of parasites was accomplished by cutting the stems bearing the hosts into short lengths and placing them in "Sealrite" containers. A glass or plastic vial inserted in a hole in the top of the carton served to recover adults of both host and parasites on emergence. These cartons proved superior to jelly jars in that they were more convenient and foliage stayed fresh for a longer period of time, thus resulting in better emergence.

IV. RESULTS

1. Population Estimates

The population estimates (Tables II and III) based on the number of larvae that survived the overwintering and feeding periods serve as a basis on which population levels are evaluated and compared from place to place. In addition, defoliation data for the whole stand are recorded, and provide a useful basis for checking on the accuracy of prediction of population levels based on sequential sampling. The information obtained in 1957 (Table II) was separated from that of 1958 and 1959 (Table III), because a different method was used in gathering the data.

In Table III it is necessary to point out that the three categories: low, moderate, and high, under the infestation class, depend upon the sequential sampling table employed and cannot be compared with each other. For example, a "moderate" count from sequential Table 2 would not bear any relation to a "moderate" count from another table. The basis of comparison between populations at different sampling stations

Table II. Larch casebearer population estimates (1957)

Locality	Average no. of case-bearers per 50 fascicles (20 trees)	Defoliation estimates
Magog	6.8	light
Knowlton	1.7	trace
South Stukley	0.6	trace
Richmond	1.1	trace
St. Agapit	0.9	trace
Ste. Catherine	1.2	trace

Table III. Larch casebearer population estimates (1958-59)

Location	Year	Sequential table used *	Infestation class	Av. No. of cases/100 fascicles (10 trees)	Full range infestation category (Table 5)	Defoliation estimate (ocular)
Magog	1958	No. 3	Moderate	7.6	L to M	Light
	1959	No. 4	Moderate	13.0	Moderate	Light
Knowlton	1958	No. 2	Moderate	4.1	Low	Trace
	1959	No. 5	Moderate	23.0	Moderate	Moderate
South Stukley	1958	No. 2	Moderate	4.8	Low	Trace
	1959	No. 4	Moderate	11.1	Moderate	Light
St. Agapit	1958	No. 2	Moderate	5.8	L to M	Trace
	1959	No. 2	Low	1.4	Low	Trace
Ste. Catherine	1958	No. 2	Moderate	4.2	Low	Trace
	1959	No. 1	Low	0.2	Low	Nil
Laurier Station	1958	No. 5	Moderate	18.0	Moderate	Moderate
	1959	No. 4	Moderate	12.7	Moderate	Light
St. Raymond	1958	No. 2	Moderate	5.2	L to M	Trace
	1959	No. 2	Moderate	3.9	Low	Trace
Macdonald College	1958	No. 2	Moderate	4.2	Low	Trace
	1959	No. 5	Moderate	14.1	Moderate	Light

* Based on tables presented by Webb (1959)

and for different years must be the numerical average of the counts, not the arbitrary descriptive categories established for the convenience of the counting method. However, once the numerical averages were obtained, they were re-sorted into categories covering the full range of infestation, i.e. the range used in sequential Table 5. Therefore, in this case the descriptive categories: low, moderate, and high, can be used to compare populations from station to station and year to year, because the same table was used for all of the collection points.

2. Rearing Results

Table IV shows the results of the rearing of the material collected in each of the three years under consideration. In this table the per cent parasitism is based on the total emergence, which assumes that the material which failed to emerge contains approximately the same number of parasitized individuals as the material which emerged. It was impractical, at the time, to determine by dissection the per cent parasitism in the material which did not emerge.

3. Parasites

Daviault in 1949 listed the following ten species of parasites which were obtained from material reared at Berthierville: Eulophus sp., Spilochalcis albifrons Walsh., Dimmockia sp., Habrocytus phycidis (Ashm.), Sympiesis sp., Microbracon (Bracon) pygmaeus Prov., Dioctes sp., Gelis tenellus Say., Lissonota parva Cress., Horogenes sp.

From the rearings conducted at Quebec during the past three years a total of eleven species of parasites have been recovered, all belonging to the order Hymenoptera. These are:

TABLE IV. Rearing results for 1957-58-59.

Locality	Magog			Knowlton			South Stukley			St. Agapit			Ste. Catherine			Laurier Station		St.Raymond		Macdonald College		Richmond
Year	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959	1958	1959	1958	1959	1958	1959	1957
Date collected	May 24	May 21	May 18	May 24	May 21	May 20	May 24	May 21	May 20	June 3	June 3	May 25	June 7	June 2	May 23	May 22	May 25	June 25	May 23	May 10	May 20	May 25
Total no. reared	1900	400	500	40	210	500	32	276	500	500	316	62	400	289	54	565	500	254	215	277	500	33
No. of adults emerged	583	201	287	16	197	412	12	243	320	370	131	33	262	83	26	462	254	160	103	215	142	9
No. of parasites emerged	686	40	52	9	8	11	4	21	39	97	114	3	69	146	8	27	22	72	20	1	44	12
Percent (Total) emergence	66.8	60.2	66.8	62.5	97.6	84.6	50.0	95.6	71.8	84.9	77.5	58.1	82.8	79.0	62.6	86.5	55.2	91.3	57.2	77.6	37.2	63.6
Percent parasitism *	54.1	16.6	14.1	36.0	3.9	2.6	25.0	8.0	10.4	20.7	46.5	8.3	20.8	63.8	23.5	5.5	8.0	31.0	12.0	0.5	23.6	57.1

* Based on total emergence.

TABLE V. Parasite complex of larch casebearer in Quebec - Showing relative importance of each species.

Locality	Magog			Knowlton			South Stukley			St. Agapit			Ste. Catherine			Laurier Station		St.Raymond		Macdonald College	Richmond
Year collected	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959	1957	1958	1959	1958	1959	1958	1959	1958	1959	1957
Agathis pumila	82.2	45.0	100.0	100.0		54.5	50.0	76.2	84.6	85.6	22.8	100.0	78.3	8.9	25.0	37.0	9.1	61.1	60.0	100.0	69.8	100.0
Chrysocharis laricinellae	3.4	5.0			75.0			14.3	2.6	4.1	72.8		10.1	90.4	50.0	48.1	50.0	18.0	15.0			
Habrocytus sp.	2.8					9.1											9.1				4.7	
Bracon pygmaeus	3.2				25.0					1.0	0.9		2.9					5.6			18.6	
Campoplex rufipes	7.6	50.0				27.2	50.0	4.8	5.1	3.1	0.9		4.4		25.0	14.8	18.2	11.1	25.0			
Gelis tenellus	0.4									5.2	0.9		2.9					1.4				
Cuderus cushmani	0.4					9.1			2.6	1.0			1.4				4.5				4.7	
Apanteles laricellae								4.8	5.1					0.7								
Gelis sp.											0.9(♀)						9.1(♂)					
Eulophidae																		2.8				
Braconidae											0.9										2.3	

Agathis pumila (Ratz.)

Chrysocharis laricinellae (Ratz.)

Habrocytus sp.

Bracon pygmaeus Prov.

Campoplex rufipes (Prov.)

Gelis tenellus (Say.)

Euderus cushmani (Crawford)

Apanteles laricellae Mason n. sp.

Gelis sp.

Eulophidae

Braconidae

Table V shows the relative part played by each species of parasite for each of the collections made. The figures shown here are percentages based on the total number of parasites obtained from each individual collection.

V. DISCUSSION

Table VI combines the more pertinent information taken from all of the tables presented in this report, and is shown here for purposes of discussion. It is quite apparent from this table that the two introduced parasites Agathis pumila and Chrysocharis laricinellae play a most important role in the parasite complex of the larch casebearer, the former being by far the most common (Table V). However, the importance of C. laricinellae may be underestimated in view of the possibility of three generations per season. Since collections were made during the late larval and pupal stages of the host, information on the first two generations of this parasite are lacking. Thus its complete role in the parasite complex of the host is not shown and should be taken into consideration when judging the importance of this parasite.

Table VI. Degree of infestation, per cent parasitism, and proportion of indigenous to imported parasites for different localities and years under consideration

Locality	Year	Av. no. of cases/ 50 fascicles (20 trees)	Av. no. of cases/ 100 fascicles (10 trees)	Per cent parasitism	Proportion of imported to indigenous parasites (%)	
					Imported parasites	Indigenous parasites
Magog	1957	6.8		54.1	85.6	14.4
	1958		7.6	16.6	50.0	50.0
	1959		13.0	14.1	100.0	-
Knowlton	1957	1.7		36.0	100.0	-
	1958		4.1	3.9	75.0	25.0
	1959		23.0	2.6	54.5	45.4
South Stukley	1957	0.6		25.0	50.0	50.0
	1958		4.8	8.0	90.5	9.5
	1959		11.1	10.4	87.2	12.8
St. Agapit	1957	0.9		20.7	89.7	10.3
	1958		5.8	46.5	95.6	4.4
	1959		1.4	8.3	100.0	-
Ste. Catherine	1957	1.2		20.8	88.4	11.6
	1958		4.2	63.8	99.3	0.7
	1959		0.2	23.5	75.0	25.0
Laurier Station	1958		18.0	5.5	85.1	14.9
	1959		12.7	8.0	59.1	40.9
St. Raymond	1958		5.2	31.0	79.1	20.9
	1959		3.9	12.0	75.0	25.0
Macdonald College	1958		4.2	0.5	100.0	-
	1959		14.1	23.6	69.8	30.2

Among the indigenous parasites obtained from rearings, Campoplex rufipes appears to be the most important. Specimens of this species were originally identified as belonging to the genus Horogenes, but re-examination showed them to be C. rufipes. Also, the individuals described here as Euderus cushmani were at first identified as Sympiesis nigripes. It is quite probable that both these changes also apply to those individuals described as Horogenes sp. and Sympiesis sp. by L. Daviault (1949). It is also interesting to point out here that Apanteles laricellae is a new species described by Mason (1959). Mason (personal communication) also feels that the individuals listed here as Gelis sp., probably represent two different species.

From Table VI it is possible to see how the parasites have seemingly affected the host populations. For example, at St. Raymond, the percent parasitism was high in 1958, possibly accounting for the low host population in 1959, which resulted in a low percent parasitism. At Macdonald College, the parasitism was extremely low in 1958 which may well account for the increased host population in 1959 with a corresponding rise in parasitism. This same general trend seems to show up at the majority of points throughout the sampling area. That is, with an increase or decrease in the host population level, there is corresponding increase or decrease respectively in the level of parasitism.

In general, the populations of the casebearer appear to be relatively low throughout the province, and the regions covered by this report appear to be the only ones where the insect is of any importance whatsoever.

VI. ACKNOWLEDGMENTS

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VII. REFERENCES

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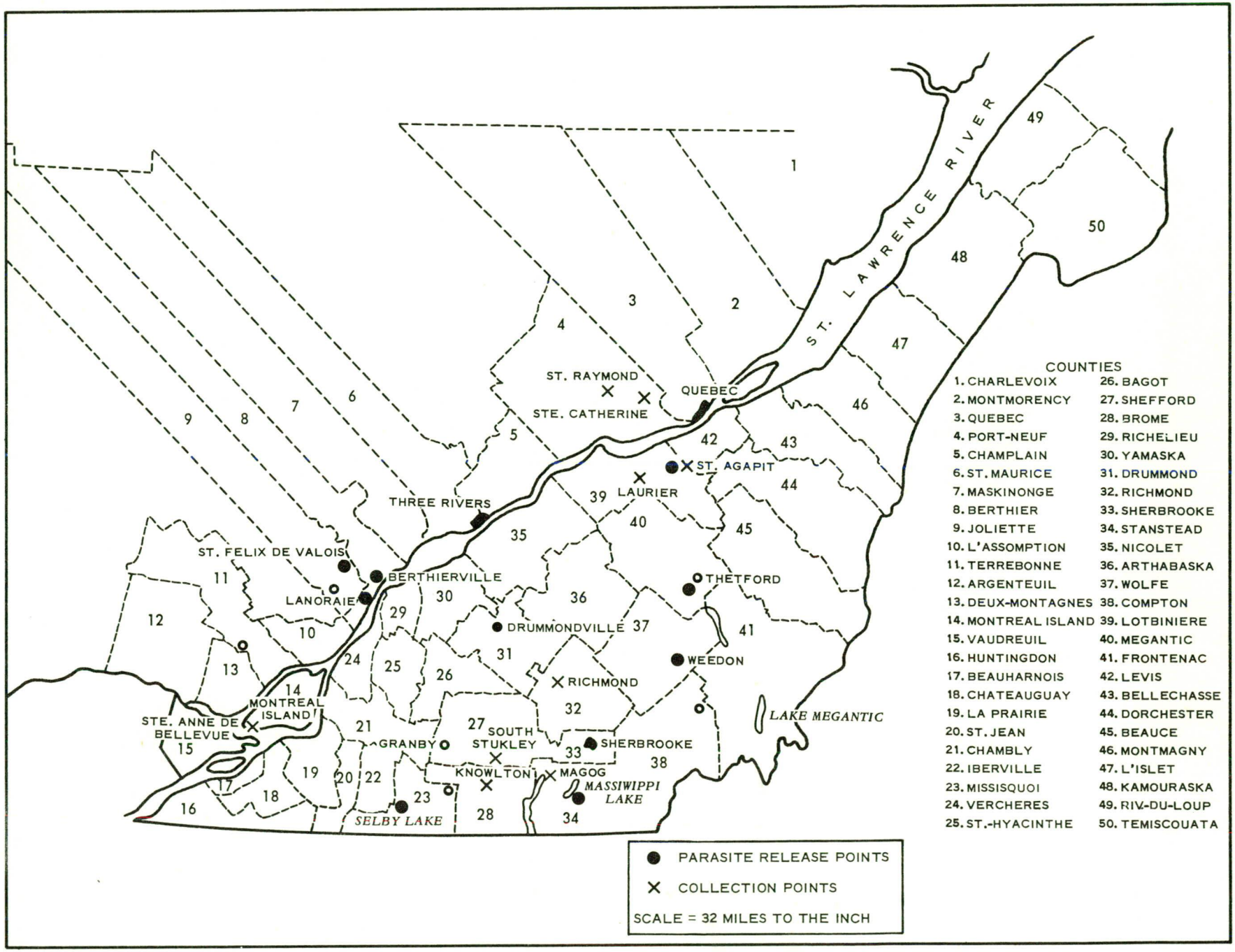
ST. LAWRENCE RIVER
ST. RAYMOND
STE. CATHERINE
QUEBEC
ST. AGAPIT
LAURIER
THREE RIVERS
ST. FELIX DE VALOIS
BERTHIERVILLE
LANORAIE
DRUMMONDVILLE
THETFORD
WEEDON
RICHMOND
MONTREAL ISLAND
STE. ANNE DE BELLEVUE
GRANBY
SOUTH STUKLEY
SHERBROOKE
KNOWLTON
MAGOG
MASSIWIPPI LAKE
LAKE MEGANTIC
SELBY LAKE
PARASITE RELEASE POINTS
COLLECTION POINTS
SCALE = 32 MILES TO THE INCH
COUNTIES
1. CHARLEVOIX
2. MONTMORENCY
3. QUEBEC
4. PORT-NEUF
5. CHAMPLAIN
6. ST. MAURICE
7. MASKINONGE
8. BERTHIER
9. JOLIETTE
10. L'ASSOMPTION
11. TERREBONNE
12. ARGENTEUIL
13. DEUX-MONTAGNES
14. MONTREAL ISLAND
15. VAUDREUIL
16. HUNTINGDON
17. BEAUHARNOIS
18. CHATEAUGUAY
19. LA PRAIRIE
20. ST. JEAN
21. CHAMBLY
22. IBERVILLE
23. MISSISQUOI
24. VERCHERES
25. ST.-HYACINTHE
26. BAGOT
27. SHEFFORD
28. BROME
29. RICHELIEU
30. YAMASKA
31. DRUMMOND
32. RICHMOND
33. SHERBROOKE
34. STANSTEAD
35. NICOLET
36. ARTHABASKA
37. WOLFE
38. COMPTON
39. LOTBINIERE
40. MEGANTIC
41. FRONTENAC
42. LEVIS
43. BELLECHASSE
44. DORCHESTER
45. BEAUCE
46. MONTMAGNY
47. L'ISLET
48. KAMOURASKA
49. RIV.-DU-LOUP
50. TEMISCOUATA

Fig. 1