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Third tour of inspection of Quebec heronries, 1979

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Abstract

During this third tour of inspection, 64 heronries were visited and their nests counted. Fifty of those colonies had previously been the subject of a similar inventory. This year, we conducted experiments to measure the accuracy of values arrived at through the method used in the tours and to obtain more complete statistics on breeding ecology.

The 1979 data reveal an increase in the number of occupied nests in slightly over half the previously inspected heronries. These increases in the size of certain colonies, however, are not large or numerous enough for us to conclude that our Great Blue Heron stocks are growing. Nevertheless, the survey as a whole showed a net gain in numbers for a second year. We examined the contents of 160 nests and collected 47 eggs in 13 heronries. At the time of hatching, the average number of eggs in a clutch was 4.5 ($S_{\bar{x}}$ = 0.1). The egg hatching rate was about 90% and the average number of young herons per successful brood was approximately 2.3 ($S_{\bar{x}}$ = 0.2). The average number of young herons per occupied nest, however, was approximately 1.9 ($S_{\bar{x}}$ = 0.1).

Great Blue Heron nesting seems to have been normal in the majority of heronries this year. The average thickness of shell fragments was normal and contaminant concentrations in eggs were low for most of the heronries studied. Many broods were abandoned or lost because of excessive disturbance at some colonies and the destruction of several nests, which were blown from diseased trees by the wind.

Introduction

Inspection tours of Quebec heronries started in 1977 (DesGranges *et al.* 1979, DesGranges and Laporte 1979). Volunteers as well as ornithologists participate in this collective effort coordinated by the Quebec office of the Canadian Wildlife Service. This 10-year study should enable us to monitor better the fluctuations in Great Blue Heron populations in Quebec and to measure the degree to which heron eggs are contaminated by toxic substances in the environment. We hope this study will enable us to detect possible changes caused by pollution or by alterations in the environment, so that corrective measures may be taken in time.

This report concerns the changes which have occurred within Quebec heronries between 1978 and 1979.

Methods

The data collection methods and the field sheets used are described in another publication (DesGranges 1980*a*). We visit the colonies each year during the last week in June or the first week in July. We usually inspect the heronries in southwestern Quebec before those located farther north.

In 1979, a professional climber collected fresh eggs from nests and checked the accurcy of the estimates made by participants at ground level in the inspection tours.

Inspection tour participants tend to overestimate slightly the number of active nests. This error is offset, however, by our underestimation of the number of active nests for which some doubt exists. The compilation method used during inspection tours of heronries assumes that half the nests of uncertain occupancy are probably active. In fact, three fifths are active. Since these two detected sources of error run counter to each other and are comparable in degree, it follows that the method used generally provides data of acceptable accuracy (DesGranges 1980*a*).

A helicopter flight over six heronries enabled us to assess the accuracy of our counts of young herons per nest. We toured those same heronries on the ground during the week after the aerial tour, and thus we could compare the average productivity of nests calculated from both types of visits. In general, the ground visits revealed the presence of 0.02 more young herons per nest than did helicopter flyovers. This minimal difference allows us to assume that, in many cases, the number of young herons per nest can be counted accurately by observers on the ground (DesGranges 1980*a*).

Results

Highlights of the tour

We visited 64 heronries in 1979, thirty more than in 1978 (Fig. 1, Table 1). The method advocated for inspection tours was applied in 56 of these, while very incomplete data were collected in the remainder. Those data are nevertheless published for information purposes. Eighteen of the colonies studied in 1977 (year of the first tour of inspection) and 28 of those studied in 1978 were again visited. Finally, five other colonies had been surveyed during the past six years. As in 1978, the largest numbers of heronries inspected were in the Outaouais region and the St. Lawrence estuary. Special efforts were made to locate and visit all colonies in the St. Lawrence estuary and along the North Shore. We

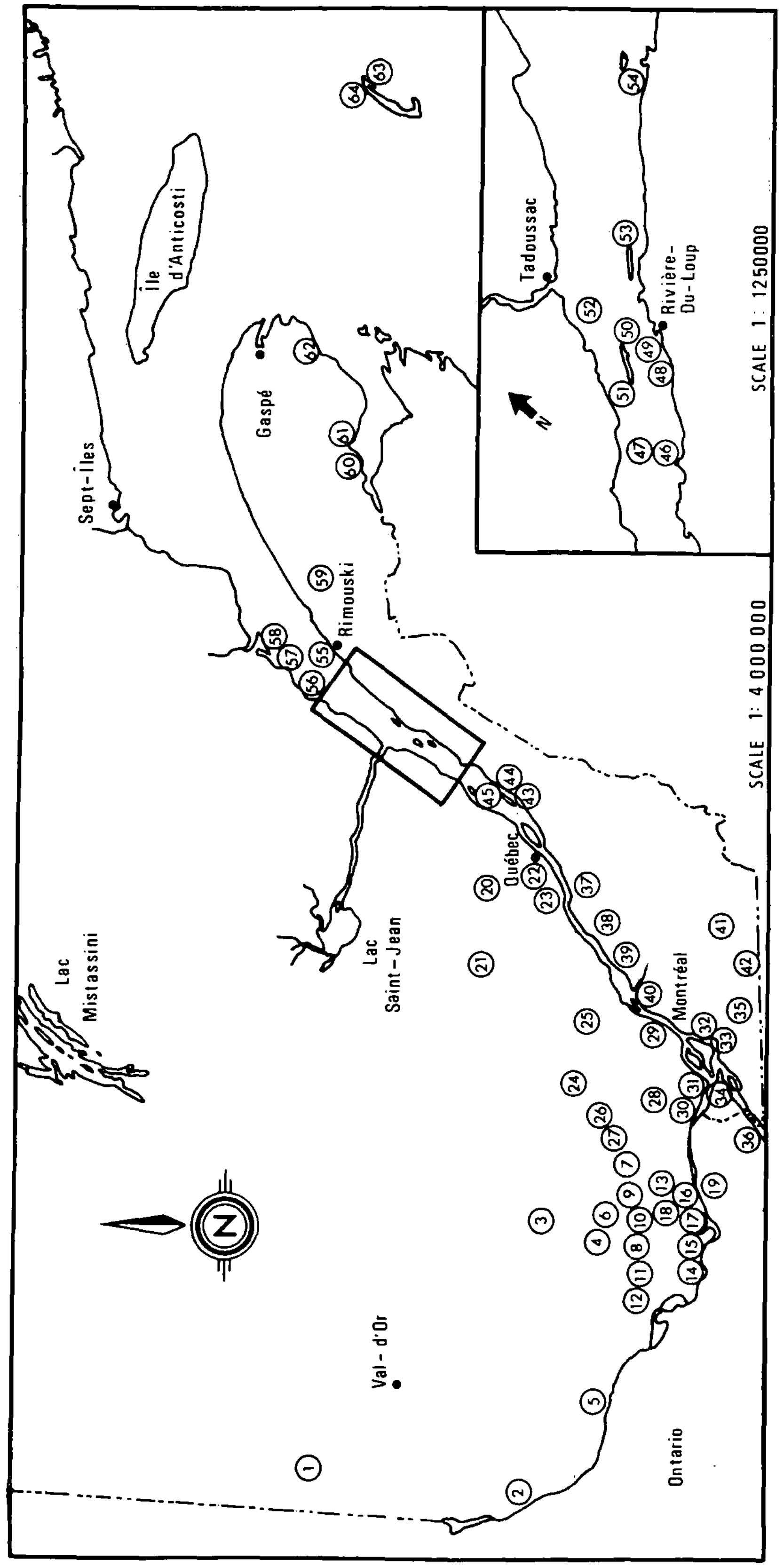

Figure 1
Southern Quebec region. Numbers indicate heronries inspected in 1979, as listed in Table 1.

thus hope to determine whether the losses in the colonies studied may have contributed to populating or creating other colonies, or whether the decline in the size of certain colonies represents an actual drop in populations. Seventy-six people participated in the third tour of inspection, compared to 37 in the second tour.

Additions to and deletions from the list of Quebec heronries

In 1979, thirteen heronries were added to the list of known heronries in Quebec (Table 1), raising the current total to 133 (DesGranges in prep.). Most of these "new" heronries had been in existence for several years, since some participants had visited them previously or found nests in them which were several years old. The Compass Lake heronry, abandoned since 1977, was reused in 1979.

Four sparsely populated heronries no longer exist: at Lac Saint-Joseph, Sabrevois, Île le Long Pèlerin and Île Blanche. The colony located at Lac Cayamant was deserted in 1979.

Population trends

In 1979, the number of occupied nests increased in slightly more than half the heronries for which we already have data. These increases, however, are not large enough and do not involve a sufficient number of colonies to allow us to conclude that the Quebec Great Blue Heron population is on the rise (sign and Wilcoxon tests, $p > 0.05$) (Sokal and Rohlf 1969).

The largest decline occured at Maria, where 21 active nests (−26%) were lost from 1978 to 1979; this is probably due to the presence of film-makers at this colony during the 1978 nesting season.

Three heronries increased remarkably during the same period: Grande Île de Berthier active nests by 92 (+63%), Lac Wayagamac, 46 (+112%), and Île du Pot à l'Eau-de-Vie, 23 (+329%). A significant share of the new pairs on Île du Pot à l'Eau-de-Vie likely are former residents of Île le Gros Pèlerin, an island some 15 km away where colonial birds have been studied and filmed for four years, resulting in a progressive decline in its population. The competition between Double-crested Cormorants and Great Blue Herons for the possession of nests may also have favoured such a move (DesGranges 1980*b*). The colony on Grande Île de Berthier grew spectacularly, with the number of active nests increasing by 374% from 50 to 237 in only 2 years.

Those population increases offset the losses suffered in many colonies and show a net gain for the survey as a whole for the second consecutive year (Table 2). From 1978 to 1979, the total number of occupied nests for all colonies visited during both years increased by 28%. This is not to say, however, that the Quebec Great Blue Heron population grew by that much in one year but that, considering the limited nature of our sampling, it may have increased between 1978 and 1979.

Reproduction

We visited 13 heronries at the start of the nesting season, examined the contents of 160 nests and collected 47 eggs. We were able to establish the stage of development to within a few days in only 27 nests from 12 colonies; this criterion is required to assess brood success. The development stage could be determined only when the nest contained both eggs and young herons. In the case of unhatched clutches, we were unable to determine whether egg laying was complete or to identify the incubation stage. As for broods comprising only young herons, no data were collected which allowed us to determine the number of days elapsed from hatching.

A variance analysis showed no significant difference among the average brood sizes at the time of hatching for the 12 heronries studied (ANOVA $F = 1.65$, $F_{11,15,0.05} = 2.51$); therefore, we averaged the data from all 12 colonies. At the time of hatching, the average size of broods was 4.5 ($n = 27$, $S_{\bar{x}} = 0.1$), a statistically higher value than the average of 4.0 eggs laid by 69 pairs in the St. Lawrence estuary in 1978 ($t = 1.98$, d.f. = 102, $p = 0.03$).

The egg hatching rate was about 90%. Only 4 of the 19 eggs collected from nests containing young herons were addled or infertile. A total of 80 eggs were laid in these nests (i.e. 43 unhatched eggs and 37 young herons at the time of sampling); by applying the proportion of non-viable eggs in the sample to the other 24 unhatched eggs, we can estimate that 9 of the 80 eggs laid (11%) were non-viable.

By limiting this analysis exclusively to hatched broods, we may overestimate the hatching rate. Many clutches do not hatch and represent a large percentage of the total number of unhatched eggs. Our approach can also underestimate the hatching rate because we do not take into account the many broods in which all eggs had already hatched at the time of sampling. Since these two types of errors offset each other, we feel that our procedure provides a realistic estimate of the hatching rate.

At the end of the nesting season, we visited the 13 heronries for a second time and were able to determine, in the spring, the number of eggs laid in many nests. For all 26 successful broods where the number of eggs laid and the number of young produced were known exactly, the average number of young herons produced per brood was 2.3 ($S_{\bar{x}} = 0.2$); this reproductive success does not seem dependent on the number of eggs laid (x_1 = 1.11, d.f. = 0.23). We did not estimate the average survival rate in occupied nests because, in an undetermined number of nests, the young herons had already left the nest at the time of the second visit.

Table 3 presents statistics on the reproductive success in the 22 heronries for which participants in the inspection tours have supplied data that are for the most part reliable. Although the range of variation is fairly wide, an average number of 2.3 ($S_{\bar{x}} = 0.6$) young herons produced per successful brood in a colony may be calculated; this value is not significantly different from the 2.2 ($S_{\bar{x}}$ = 0.1) obtained in the second inspection (t = 26, d.f. = 34, p = 0.38). The average number of young herons produced per occupied nest in a colony would have been about 1.9 ($S_{\bar{x}}$ = 0.1) in 1979. Henny (1972) calculated that the average survival rate of Great Blue Heron broods living in the northern United States would have to be approximately 1.9 young per active nest for the population to remain stable. In 1979, the Quebec Great Blue Heron population generally produced sufficient young to ensure, in the short term, the stability of the species.

Condition of eggs

Eggshell fragments were collected in 31 heronries. The average thicknesses listed in Table 1 are based on at least 25 measurements of eggshell fragments collected in each colony after the incubation period. These values range from 0.308 mm to 0.400 mm, with an average of 0.352 mm for all colonies. This average was 0.369 mm and 0.367 mm in 1978 and 1979 respectively. Graber *et al.* (1978), using similar material, reported a range of 0.244 to 0.360 mm for two colonies in Illinois.

The data collected in 12 colonies in 1979 may be compared to previous data (Tables 1 and 4). The 1979 measurements are significantly lower than the previous measurements, except in the case of the Miguasha colony where they are higher, and in the case of the colonies at Lac Marguerite, Île Carillon and Lac Matapédia where the differences are not significant. The only factor that can explain these differences is the annual variation in the representativeness of the sampling. Among the 31 colonies studied in 1979, the variation in thickness cannot be explained by the size of the colony, productivity or the degree of contamination; no significant correlation with these variables can be demonstrated.

Forty-seven eggs from 12 colonies were analyzed by the Ontario Research Foundation (Reynolds and Cooper 1975) (Table 5). The degree of incubation of the eggs varied.

The average concentrations of DDE for each colony range from 1.03 ppm to 2.96 ppm, with the exception of Île Villemomble, which had an average of 15.04 ppm based on only two analyses. Dieldrin residue averages followed a distribution pattern similar to that of DDE and ranged from 0.006 to 0.55 ppm (3.20 ppm for Île Villemomble). Average PCB concentrations varied from 3.75 ppm to 26.18 ppm.

Apart from Île Villemomble, average DDE residue concentrations in eggs were below those reported in recent years in Wisconsin (Faber and Hickey 1973), Texas (King *et al.* 1978), the Great Lakes (Ohlendorf *et al.* 1978) and western Canada (Vermeer and Reynolds 1970). Nevertheless, they are close to those observed in the Atlantic coast and Gulf of Mexico region where herons winter (Ohlendorf *et al.* 1978). The PCB concentrations we measured in the eggs are similar to those previously reported for the Great Blue Heron, although they vary more.

Causes of mortality

The data collected in 1979 enabled us to calculate both the percentage of successful broods and the average survival rate of young herons in 22 colonies (Table 3). Of these, 15 (68%) did not suffer greatly from mortality, the survival of broods and young herons both being high. Only a few eggs and a few young herons disappeared, probably due to a variety of causes.

In the Miguasha heronry, a mortality factor causing a substantial reduction in broods was found. A food shortage may have led to this significant decline in the size of broods (see DesGranges and Laporte 1979, DesGranges 1980*a*). Although only three young herons were found dead on the ground, this explanation should not necessarily be rejected. In fact, the data collected in the 13 heronries we visited twice clearly showed that usually corpses are quickly thrown from the nest and disappear within a few days. Moreover, we have never found nests occupied by both live and dead young herons; of the 103 broods inspected, only three contained only dead young. The carcasses on the ground had disappeared by the time of the second visit and, in general, the corpses found were not dehydrated and were about the same age as the live birds in the nests, thus leading us to believe that they had been there only a short time.

There are many possible causes of mortality in the heronries with a low percentage of successful broods. High winds may have caused the majority of failures at the Île Carillon, Pointe aux Outardes and Grosse Île colonies, since the participants who visited these sites a few days after storms found new-fallen trees and many young herons lying on the ground (50, 32 and 22 young herons, respectively). The colonies most subject to wind damage and to falling nests are those with more dead and dying trees. These colonies usually have a high percentage of vacant nests. The number of vacant nests, nevertheless, remains relatively stable from year to year, with part of the materials from old nests being used in the construction of new nests in healthy trees around the perimeter of the heronry. The sometimes sustained increase in the number of vacant nests in some colonies in recent years leads us to believe that, in these locations, many pairs abandoned their nest and deserted the heronry where they planned to nest because they were disturbed too frequently during the 1978 nesting season or early in the 1979 season. This is probably the reason for failures at the following locations: Pointe Comfort, Lac Dumont, Île à Deux Têtes, Île Brulée, Île aux Basques, Île le Gros Pèlerin and Île aux Loups Marins. The abandonment of nests at the last two sites may also have been accelerated by competition with Double-Crested Cormorants for the possession of nests (DesGranges 1980*b*).

Acknowledgements

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Table 1
Characteristics of heronries inspected in 1979

Location of colony	Position	Nests occupied* on previous inspection (pi) and year of count	Platforms on previous inspection (pi) and year of count	Nests occupied in 1979	Platforms in 1979	% vacant nests pi/1979	% successful broods† pi/1979	Average survival of successful broods (no. young/nest)† pi/1979	Average thickness of shell fragments (10^{-3} cm) pi/1979‡	Sources ¶
Northwestern Quebec										
1. Lac Macamic	48°49′N; 78°57′W	—	—	11	14	— / 21%	— / 64%	— / —	— /37.0(0.4)#	17
2. Lac Kipawa	46°57′N; 79°12′W	—	—	9	17	— / 47%	— / 44%	— / —	— / —	1, 22
Outaouais										
3. Lac Marguerite	46°57′N; 75°48′W	20(1978)	24(1978)	39	44	17%/ 11%	— / 97%	2.0/2.0(0.2)	35.0(0.6)/34.2(0.7)	3, 33
4. Lac Laframboise	46°23′N; 75°50′W	?(1976)	25(1976)	?	24	— /—	— /—	— / —	— / —	1, 11
5. Lac Duval	46°20′N; 77°55′W	?(1974)	10(1974)	?	13	— /—	— /—	— / —	— / —	13, 36
6. Lac des Trente										11
et un Milles	46°17′N; 75°47′W	?	25(1976)	?	14	— /—	— /—	— / —	— / —	1, 11
7. Lac Robillard	46°11′N; 75°08′W	11(1978)	15(1978)	14	19	27%/ 26%	100%/100%	3.0(0.3)/2.3(0.3)	— /34.1(0.4)	3, 11, 16
8. Lac Lyonnais	46°10′N; 75°53′W	—	—	—	5	— /—	— /—	— / —	— / —	
9. Lac du Sourd	46°10′N; 75°19′W	?	3(1977)	9	12	— / 25%	— / 56%	— / —	— / —	1, 12
10. Pointe Comfort	46°05′N; 75°51′W	12(1977)	30(1977)	12	20	60%/ 40%	— / 67%	— /2.9(0.4)	— / —	2, 36
11. Lac Cayamant	46°04′N; 76°18′W	?(1977)	11(1977)	0	10	— /100%	— / N/A	— / N/A	— / N/A	1, 36
12. Lac Dumont	46°03′N; 76°27′W	36(1977)	36(1977)	15	39	0%/ 62%	— / 0%	2.8(0.2)/0.0	36.3(0.4)/ —	2, 31
13. Lac Clark	45°54′N; 75°14′W	—	—	5	10	— / 50%	— /—	— / —	— / —	11
14. Compass Lake	45°38′N; 76°17′W	0(1978)	14(1978)	4	14	100%/ 71%	— /—	N/A /1.0	— / —	1, 33
15. Glynn Lake	45°38′N; 76°14′W	4(1978)	13(1978)	3	12	69%/ 75%	— /—	2.0(0.0)/ —	— / —	3, 33
16. Prairie de Castor	45°37′N; 75°29′W	?(1978)	50(1978)	28	28	— / 0%	— / 79%	— /2.7(0.2)	— / —	3, 15, 25
17. Power Line Lake	45°36′N; 76°07′W	9(1978)	11(1978)	10	12	18%/ 17%	— /—	2.1(0.3)/2.5	— / —	3, 33
18. Long Lake	45°36′N; 75°57′W	10(1978)	10(1978)	10	12	0%/ 17%	100%/—	2.6(0.3)/2.5	— / —	3, 23, 33
19. Baie Lochaber	45°34′N; 75°18′W	—	—	?	?	— /—	— /—	— / —	— / —	26
Laurentians										
20. Petit Lac Jacques-Cartier	47°24′N; 71°33′W	?(1978)	25(1978)	?	21	— /—	— /—	— / —	— /39.7(0.2)	3, 20
21. Lac Wayagamac	47°21′N; 72°39′W	41(1978)	50(1978)	87	89	18%/ 2%	— /100%	2.2(0.2)/ —	— /36.4(0.4)	3, 5
22. Lac Saint-Joseph	46°54′N; 71°37′W	?	5(1976)	0	0	— /**	— / N/A	— / N/A	— / N/A	9
23. Sainte-Catherine	46°52′N; 71°36′W	29(1977)	31(1977)	8	13	6%/ 31%	— /100%	— /2.0(1.0)	39.2(0.3)/33.2(0.2)	2, 9
24. Grand Lac Collin	46°42′N; 74°10′W	?	3(1977)	1	1	— / 0%	— /—	— / —	— / —	7
25. Lac Saint-Bernard	46°32′N; 73°18′W	29(1978)	35(1978)	27	31	17%/ 13%	86%/ 85%	1.6(0.1)/2.2(0.2)	37.3(0.5)/33.9(0.7)	3, 10, 15, 25
26. Lac Bleu	46°16′N; 74°38′W	5(1977)	11(1977)	3	6	55%/ 50%	— /100%	— /2.0(0.0)	— /36.7(0.4)	2, 15, 25
27. Lac des Trois Montagnes	46°11′N; 74°46′W	—	—	7	9	— / 22%	— /100%	— / —	— / —	29
28. Lac Dye	45°51′N; 74°18′W	5(1978)	5(1978)	5	8	0%/ 38%	100%/100%	2.2(0.4)/2.2(0.2)	— / —	3, 40
Southwestern Quebec										
29. Île Bouchard	45°49′N; 73°19′W	—	—	?	7	— /—	— /—	— / —	— / —	32
30. Île Carillon	45°31′N; 74°17′W	135(1977)	150(1977)	149	152	3%/ 2%	— / 69%	2.8(0.1)/ —	34.2(1.2)/35.1(0.4)	2, 15, 25
31. Baie d'Oka	45°28′N; 74°03′W	50(1978)	63(1978)	?	39	21%/—	— /—	2.7(0.2)/ —	— / —	3, 15, 21
32. Île aux Hérons	45°28′N; 73°35′W	26(1977)	26(1977)	31	40	0%/ 23%	— / 81%	3.4(0.3)/2.0(0.2)	— /30.8(0.6)	2, 15, 30
33. Île Saint-Bernard	45°24′N; 73°46′W	—	—	47	57	— / 18%	— / 87%	— / —	— /32.6(0.2)	15, 19, 35
34. Île Villemomble	45°17′N; 74°03′W	11(1977)	14(1977)	15	15	21%/ 0%	— / 53%	2.6(0.4)/1.0 —	— /37.1(0.6)#	2, 15, 25
35. Sabrevois	45°12′N; 73°14′W	4(1977)	6(1977)	0	0	33%/**	— / N/A	— / N/A	— / N/A	2, 15
36. Saint-François Reserve	45°02′N; 74°30′W	—	—	1	1	— / 0%	— /—	— / —	— / —	15, 19
Eastern Townships										
37. Lac aux Castors	46°48′N; 70°34′W	?	35(1977)	12	14	— / 14%	— / 75%	— / —	— / —	1, 38
38. Rivière Huron	46°31′N; 71°48′W	—	8(1978)	—	6	— /—	— /—	— / —	— / —	6
39. Bois du Boulé	46°15′N; 72°53′W	?(1976)	34(1976)	81	87	— / 7%	— / 90%	— / —	— /32.8(0.2)	4, 15, 25
40. Grande île de Berthier	46°06′N; 72°57′W	145(1978)	182(1978)	237	316	20%/ 25%	— / 77%	— / —	36.0(0.6)/32.6(0.3)	3, 15, 35
41. Mont Chauve	45°22′N; 72°10′W	?(1977)	7(1977)	8	8	— / 0%	— /100%	— /3.3(0.3)	— /34.8(0.4)	1, 8
42. Cowansville	45°11′N; 72°44′W	21(1978)	31(1978)	19	21	32%/ 10%	— / 95%	— /1.8(0.4)	38.5(0.4)/36.6(0.3)	3, 15, 24, 25
Estuary										
43. Île à Deux Têtes	47°04′N; 70°37′W	21(1977)	21(1977)	11	33	0%/ 67%	— /100%	2.1(0.1)/2.0(0.3)	34.6(0.7)/ —	2, 6, 15
44. Île à la Corneille	47°05′N; 70°35′W	—	—	3	4	— / 25%	— /100%	— /2.7(0.3)	— / —	6, 15
45. Battures aux Loups Marins	47°14′N; 70°25′W	8(1978)	8(1978)	12	12	0%/ 0%	75%/ 82%	2.0(0.5)/3.3(0.3)	— /36.3(0.3)	3, 6, 15, 25
46. Île Brûlée	47°37′N; 69°52′W	15(1977)	11(1978)	16	18	— / 11%	— / 69%	1.9(0.3)/2.1(0.2)	— / —	2, 3, 15, 39
47. Grande Ile	47°38′N; 69°51′W	19(1977)	31(1978)	35	38	— / 18%	— / 77%	2.5(0.2)/2.6(0.2)	— /34.7(0.9)	2, 3, 15, 39
48. Île le Long Pèlerin	47°43′N; 69°43′W	1(1977)	2(1977)	0	0	50%/**	— / N/A	2.0/ N/A	— / —	15
49. Île le Gros Pèlerin	47°44′N; 69°41′W	23(1978)	48(1978)	12	72	25%/ 83%	78%/100%	2.1(6.3)/2.5(0.3)	— /34.5(0.5)	3, 15, 34
50. Île du Pot à l'Eau-de-Vie	47°52′N; 69°41′W	7(1978)	7(1978)	30	30	0%/ 0%	— / 97%	— /2.3(0.2)	— /36.1(0.8)	3, 15
51. Île Blanche	47°56′N; 69°41′W	1(1978)	2(1978)	0	0	50%/**	— / N/A	2.0/ N/A	— / —	2, 3, 15
52. Île du Chafaud aux Basques	48°02′N; 69°41′W	?	25(1978)	44	46	— / 4%	— / 91%	1.7(0.2)/2.7(0.2)	— /39.4(0.4)	3, 15
53. Île aux Basques	48°08′N; 69°15′W	29(1978)	29(1978)	23	34	0%/ 26%	— / 61%	1.7(0.2)/3.1(0.6)	38.8(0.5)/36.4(0.4)	3, 15, 25
54. Île du Bic	48°24′N; 68°52′W	24(1977)	26(1977)	24	35	8%/ 31%	— / 75%	2.3(0.1)/3.3(0.3)	42.6(0.5)/34.1(0.3)	2, 6, 15, 25
55. Île Saint-Barnabé	48°26′N; 68°37′W	55(1977)	56(1978)	71	73	— / 3%	— / 89%	2.5(0.7)/2.4(0.1)	38.2(0.3)/33.7(0.7)#	2, 3, 15, 27
North Shore										
56. Île Laval	48°45′N; 69°02′W	—	—	20	21	— / 5%	— / 95%	— /3.4(0.2)	— /32.8(0.4)	15
57. Îlets Jérémie	48°54′N; 68°39′W	—	—	27	30	— / 10%	— /—	— /3.3(0.2)	— /35.5(0.4)	15, 19
58. Pointe aux Outardes	49°03′N; 68°26′W	47(1978)	65(1978)	44	72	28%/ 39%	— / 61%	2.5(0.5)/1.7(0.6)	— /35.7(0.5)	3, 15, 28
Gaspé										
59. Lac Matapédia	48°35′N; 67°37′W	25(1978)	26(1978)	25	26	4%/ 4%	— / 80%	— /2.8(0.4)	35.8(0.8)/34.4(0.2)	3, 15, 25, 27
60. Miguasha	48°04′N; 66°14′W	60(1977)	71(1977)	53	58	15%/ 9%	— / 98%	2.1(0.2)/1.6(0.1)	33.1(0.2)/40.0(0.4)	2, 37
61. Maria	48°13′N; 65°58′W	80(1978)	97(1978)	59	83	18%/ 29%	— / 93%	3.0(0.1)/2.7(0.1)	35.4(0.8)/32.7(0.6)	2, 3, 15, 25
62. Bonaventure	48°18′N; 64°42′W	24(1977)	28(1977)	28	31	14%/ 11%	— / 82%	2.0(0.4)/2.4(0.4)	— /36.8(0.3)	2, 14, 15, 25
Magdalen Islands										
63. Île aux Loups Marins	47°38′N; 61°29′W	16(1978)	?	17	17	— / 0%	— / 35%	— /2.3(1.0)	— / —	3, 18
64. Grosse Île	47°36′N; 61°33′W	—	—	31	31	— / 0%	— / 77%	— /2.2	— / —	18

* A nest is considered occupied if there is no doubt it was used by a pair during the nesting season, even if no young were produced.

** This indicates the nest had disappeared by the 1979 visit to the colony.

† A brood is considered successful if at least one young heron is alive in the nest less than 10 days before the first young herons leave the colony.

‡ These measurements are of fragments from all parts of the eggshells collected (not necessarily of fragments from the belt area, as in conventional measurements).

¶ The following sources are listed in the References: (1) DesGranges, 1978; (2) DesGranges *et al.*, 1979; (3) DesGranges and Laporte, 1979; (4) Gravel and Pageau, 1976; (5) Laplante, 1979. The following sources are personal communications: 6) R. Angers, (7) Y. Aubry, (8) P. Boily, (9) J. Boivin, (10) D. Bordeleau, (11) L. Breton, (12) N. Caton, (13) J. Chabot, (14) R. Chabot, (15) J.L. DesGranges, (16) G. Desjardins, (17) F. Deslongchamps, (18) P. Drapeau, (19) P. Dupuis, (20) C. Fortin, (21) M. Gélinas, (22) Y. Hamel, (23) S.E. Hamill, (24) C. Lapointe, (25) P. Laporte, (26) G. Lauzon, (27) J.P. Lebel, (28) F. Leduc, (29) B. Marcotte, (30) P.P. Morin, (31) D. Paré, (32) C. Pilon, (33) P.A. Roberts, (34) Y. Roy, (35) L.M. Soyez, (36) D. St-Hilaire, (37) R. Tardif, (38) G. Trencia, (39) Y. Turcotte, (40) M. Zazvorka.

‖ A dash indicates no data available. A question mark indicates that the heronry was active, but with the number of occupied nests unknown.

\# Standard deviation of the mean.

Table 2
Comparative number of occupied nests in colonies inspected in two consecutive years

Region	Years	Colonies inspected in each of the years*	Occupied nests 1st year	Occupied nests 2nd year	Change (%) 1977–78	Change (%) 1978–79
Outaouais	1977-78	3	44	23	−48	
	1978-79	6	54	80		+48
Laurentians	1977-78	1	35	29	−17	
	1978-79	3	75	119		+59
Southwestern Quebec	1977-78	1	50	50	0	
Eastern Townships	1977-78	2	70	166	+137	
	1978-79	2	166	259		+56
Estuary	1977-78	4	74	53	−28	
	1978-79	5	68	77		+13
North Shore	1978-79	1	47	44		−6
Gaspé	1977-78	3	83	105	+27	
	1978-79	2	105	84		−20
Magdalen Islands	1977-78	1	24	16	−33	
	1978-79	1	16	17		+6
Total	1977-78	15	380	442	+16	
	1978-79	20	531	680		+28

*This figure includes only those heronries for which such data are available.

Table 3
Reproductive success in several Quebec heronries in 1979

Colony*	Hatched clutches	Successful broods (%)	Average survival successful broods (young/nest)	Average survival hatched clutches (young/nest)	Platforms not used in 1979 (%)
Lac Marguerite	39	97	2.0	1.9	11
Lac Robillard	14	100	2.3	2.3	26
Pointe Comfort	12	67	2.9	1.9	40
Lac Dumont	15	0	0.0	0.0	62
Prairie de Castor	28	79	2.7	2.1	0
Lac Saint-Bernard	27	85	2.2	1.9	13
Lac Dye	5	100	2.2	2.2	38
Île aux Hérons	31	81	2.0	1.6	23
Île à la Corneille	3	100	2.7	2.7	25
Île Brûlée	16	69	2.1	1.4	11
Grande Île de Kamouraska	35	77	2.6	2.0	8
Île le Gros Pèlerin	12	100	2.5	2.5	83
Île du Pot à l'Eau-de-Vie	30	97	2.3	2.2	0
Île aux Basques	23	61	3.1	1.9	26
Île Saint-Barnabé	71	89	2.4	2.1	3
Île Laval	20	95	3.4	3.2	5
Pointe aux Outardes	44	61	1.7	1.0	39
Miguasha	53	98	1.6	1.6	9
Maria	59	93	2.7	2.5	29
Bonaventure	28	82	2.4	2.0	11
Île aux Loups Marins	17	45	2.3	1.1	0
Grosse Île	31	77	2.2	1.7	0

*This list comprises colonies for which participants supplied data that are for the most part certain.
†A brood is considered successful if at least one young heron is alive in the nest less than 10 days before the first young herons leave the colony.

Table 4
Average thickness of Great Blue Heron eggshell fragments*
for several colonies in Quebec, 1977–1979†

Colony	Average thickness in 1979 (10^{-3} cm)	Average thickness on previous inspection (10^{-3} cm) (year)	Statistical probability‡
Lac Marguerite	34.2	35.0 (1978)	t = 0.89 p >0.05
Sainte-Catherine	33.2	39.2 (1977)	t = 13.5 p <0.001
Lac Saint-Bernard	33.9	37.3 (1978)	t′ = 3.05 p <0.01
Île Carillon	35.1	34.2 (1977)	t′ = 1.02 p >0.05
Grande Île de Berthier	32.6	36.0 (1978)	t = 3.20 p <0.01
Cowansville	36.6	38.5 (1977)	t′ = 3.22 p <0.01
Île aux Basques	36.4	38.8 (1978)	t′ = 3.00 p <0.01
Île du Bic	34.4	38.2 (1977)	t′ = 3.52 p <0.001
Île Saint-Barnabé	33.7	38.2 (1977)	t′ = 4.63 p <0.001
Lac Matapédia	34.4	35.8 (1978)	t′ = 1.22 p >0.05
Miguasha	40.0	33.1 (1977)	t′ = 6.06 p <0.001
Maria	32.7	35.4 (1977)	t = 2.67 p <0.01

*Thicknesses calculated on the basis of fragments from various parts of the shell (not necessarily from the belt area, as in conventional measurements).
†The colonies listed were sampled in 1979 and at least once in 1977 or 1978.
‡The t (t) test was applied when variances were not significantly different (p >0.05), while the Wilcoxon test (t′) was used in other cases.

Table 5
Organochloride residues found in whole eggs collected
in twelve Quebec colonies

Colony	n	Lipide (%)	H_2O (%)	DDE*	Dieldrin*	Hexachloro-benzene*	PCB*†
Prairie de Castor	4	6.2	81.7	1.81	0.13	0.016	9.54
Lac Saint-Bernard	5	5.2	81.9	1.85	0.13	0.035	3.99
Lac Bleu	1	4.6	81.9	2.74	0.55	0.012	14.7
Île Carillon	5	4.6	82.2	1.26	0.11	0.023	3.75
Île Villemomble	2	6.6	82.2	15.04	3.20	0.035	11.94
Bois du Boulé	5	5.3	82.7	2.01	0.43	0.024	16.27
Battures aux Loups Marins	3	4.5	82.2	1.74	0.17	0.065	21.01
Île aux Basques	4	4.8	82.9	1.84	0.12	0.026	8.73
Île du Bic	5	6.1	81.3	1.24	0.06	0.025	8.12
Matapédia	4	6.4	81.6	1.81	0.09	0.009	2.14
Maria	4	5.4	82.0	2.96	0.11	0.029	26.18
Bonaventure	5	5.6	81.4	1.3	0.08	0.023	4.77

*Values are geometric averages expressed in ppm (wet weight).
†1:1 ratio of Aroclor 1254:1260.