

Jean-Luc DesGranges
Alain Desrosiers

Breeding distribution and population trends of the Great Blue Heron in Quebec, 1977–2001

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Front cover

It is an amazing spectacle to see trees filled with large nests and observe Great Blue Herons going back and forth from the heronry. They return to the same heronry to nest for several consecutive years.

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Abstract

Regular surveys of Great Blue Heron *Ardea herodias* colonies in Quebec, conducted between 1977 and 2001, resulted in the discovery of 705 colonies, mostly in the western part of the province. While single breeding pairs were occasionally found (9% of Quebec “heronries”), the colonies were generally composed of fewer than 16 breeding pairs, with sometimes over 50 (18 known colonies), as was the case on several islands in the St. Lawrence River. Close to one-third (1919 of the 6481 active nests) of the Quebec Great Blue Heron population was associated with heronries in the St. Lawrence system. Half of the St. Lawrence heronries that were active during two adjacent survey periods (1975–1983 and 1984–1990, or 1984–1990 and 1991–2001) increased in size between periods, while one-third of the colonies decreased in size. One-sixth of the colonies remained the same size during the study period.

Great Blue Herons periodically abandon their colonies and settle elsewhere. Our data show that 50% of known Quebec colonies ($n = 377$ colonies visited more than once) were abandoned after being discovered as active colonies, and, on average, all nests in colonies that are abandoned disappear 7 years after discovery of the colony. On the basis of thorough inventories conducted on the St. Lawrence, we found that all nest platforms in 14 of the 70 colony sites had disappeared in less than 25 years.

Since 1977, when regular surveys began, 50–90% of breeding attempts have been successful, yielding an average of over 2.2 chicks per pair. This productivity rate suggests that the Quebec population of Great Blue Herons may be increasing and may explain the recent expansion in its range. Following our 25 years of investigation on the Great Blue Heron in the province, we estimate the current late-summer Great Blue Heron population of Quebec at some 27 000 individuals (6500 pairs producing 2.2 young per pair per year).

Acknowledgements

The senior author dedicates this article to the late Father Rosaire Corbin, educator and environmentalist, who inspired many young people in Quebec to pursue a career in science. It was in the enchanting setting of his Port-au-Saumon retreat, overlooking the majestic St. Lawrence estuary and backing onto the Charlevoix mountains, that this paper was written.

We thank the biologists of the Canadian Wildlife Service and of the Ministère des Ressources naturelles et de la Faune du Québec and the many volunteer amateur naturalists who conducted the some 2200 surveys of heronries on which this study is based. The data are stored in a database at the Canadian Wildlife Service, Quebec Region. The database is regularly updated and is available for consultation. We thank Benoît Jobin, Réjean Benoit, Yves Grégoire, and Édith Labbé for the data preparation and statistical analyses, and we thank François Boudreau and Michel Melançon for producing the map. We also thank Robert W. Butler, Erica Dunn, John P. Kelly, Donald A. McCrimmon, and Jean Rodrigue, whose comments on this paper enabled us to make improvements to it.

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1. Introduction

In the spring, most Great Blue Herons *Ardea herodias* gather in colonies, called heronries. They often return to the same location for several successive years. Given the small number of these perennial nesting sites and the number of breeding pairs that gather there year after year, these heronries may be very important for the conservation of the species.

Concerned about the conservation of the Great Blue Heron, the Canadian Wildlife Service initiated an inventory of Great Blue Heron colonies in Quebec in 1977 (DesGranges et al. 1979). The 10-year study consisted of seven inspection tours (1977–1982 and 1986) of a subset of the known heronries (DesGranges 1980). Along the St. Lawrence River, regular extensive censuses of all colonial waterbird colonies along the shorelines and islands located in the area upstream from the Gulf of St. Lawrence were conducted nearly every 5 years. Over the years, these inventories made regular monitoring possible, and several new colonies were discovered. In 1987, the Quebec government passed the Act Respecting the Conservation and Development of Wildlife (*Loi sur la conservation et la mise en valeur de la faune*), which includes guidelines for the protection of heron nesting grounds in forested areas (Ministère de l'Énergie et des Ressources du Québec 1986). Since then, regional biologists with the Ministère des Ressources naturelles et de la Faune du Québec have been monitoring known heronries (and finding new colonies while so doing) in southern Quebec at regular intervals, most recently in the summer of 2001.

This paper makes use of these data, collected over more than 25 years, to establish the first comprehensive study of the breeding distribution and the reproductive performance of the Great Blue Heron in Quebec, with special reference to the St. Lawrence River heronries.

2. Methods

At the start of the project in 1977, we identified approximately 100 known heronries, based on information gathered by means of questionnaires published in specialized publications in the fields of natural science, forestry, agriculture, and outdoor recreation. This inventory has been updated regularly with data from several sources. Impact studies, especially those conducted in conjunction with proposed hydroelectric developments in the James Bay lowlands, constitute an important source of data for large areas in northern Quebec. In addition, federal and provincial wildlife biologists have conducted aerial surveys all along the St. Lawrence River and much of southern Quebec (as well as scattered areas in northern Quebec), visiting areas suspected or known from previous surveys to be rich in focal wildlife species. In this way, many new heron colonies were discovered in the course of winter big game surveys, spring waterfowl surveys, and seabird colony surveys in different parts of Quebec, thus contributing information on the location and approximate size of Great Blue Heron colonies. In the St. Lawrence region, federal and/or provincial biologists conducted thorough searches of potential waterbird colony sites within 2 km of the river annually from 1977 to 1982 and at intervals of approximately 5 years thereafter, in 1986, 1992, 1997, and 2001. These searches were conducted by air and/or boat and normally covered every square kilometre of shoreline along the St. Lawrence River and its islands.

In addition, every 5 years since 1992, the provincial wildlife department has conducted a thorough survey of all known Great Blue Heron colonies throughout southern Quebec (both east and west) using aircraft (usually helicopters, but sometimes fixed-wing aircraft) (see Desrosiers 1993 for survey details). All heronries discovered since 1977 are included in subsequent provincial surveys. For all heronries found by provincial surveyors in southern Quebec, the number of nests was counted from the air, and, when possible, nests (i.e., platforms) found in the breeding season were reported separately as “active” or “inactive” (occupied by herons or not). In some cases, the number of young in each nest could be recorded. Since 1977, all historic colony sites have been checked at least once to determine their status. From 1977 to 1994, wildlife biologists and experienced volunteers conducted ground visits to more than half of the province’s heronries known to be in use at any time since 1977 (more than 2209 visits in all to 705

colony sites). The number of sites visited, number of visits to each colony, and intervals between site visits all varied considerably from region to region, particularly for areas beyond the St. Lawrence region.

Colony visits (no more than one per year, contrary to Moul et al. 2001) usually took place 2–3 weeks prior to the expected date of fledging, when it was easy to distinguish between active and inactive nests. In most colonies, especially the larger ones (>25 nests), we did systematic searches. Nest trees in the only colony that had more than 100 nests were permanently tagged (starting in 1977), which increased the precision of our succeeding nest counts by reducing the risk of missing nests or counting some more than once. Active nests were defined as those stained white by excrement, indicating that they were being used by breeding adults that year (whether or not the attempt was successful), and generally contained large young that were easy to count (productive nests) (DesGranges 1980; Moul et al. 2001). Inactive (unoccupied) nests, on the other hand, were defined as those that appeared virtually spotless. (Some of these might have been occupied early in the season but had been abandoned so early that we were not able to distinguish them from unused nests.) Inactive nests were usually in poor condition, since much of their material had been used by actively breeding birds to build nests (DesGranges 1980, 1996; Moul et al. 2001). The number of active nests constitutes only an estimate of the number of pairs attempting to breed, because of undetected failures, early or late initiations, and renestings (at different nest sites). Visiting the nests at the end of the breeding period was less harmful to the birds, since breeding was at a more advanced stage and the adults were less likely to abandon their nests (DesGranges 1980). In addition to data on colony size and reproductive performance, observers noted the habitat type (beaver pond, shore, cliff, riparian forest, and deep forest) and the other colonial waterbird species present in the colony.

Because the number of visits to each colony site varied, we calculated the size of each colony as the average annual number of active nests counted during all visits within selected time periods. Using maximum (instead of mean) numbers might have overestimated colony size, given the possibility of movement of breeding pairs between colonies situated close together. The number of colonies active within an interval was the total number of colonies with nests counted at any time during that interval. Because most of our data were not normally distributed, we used the Kruskal-Wallis test to compare independent samples and the Wilcoxon signed rank test for comparisons involving matched-pair samples (Zar 1984).

Colonies with more than 50 nests were classified as “very large”; those with 5 or fewer nests were considered “very small.” Colonies were classified according to their nesting success (percentage of active nests that produced fledglings) and according to their productivity rate (number of fledglings produced per successful nest). Colonies for which nesting success was below 50% were categorized as having “low” nesting success, and those for which nesting success was 50% or higher were considered to have “good” nesting success. Colonies that produced fewer than 1.9

fledglings per successful nest were considered to have a “low” productivity rate, and those that produced 1.9 or more fledglings per successful nest were considered to have a “good” productivity rate. Henny (1972) estimated that 1.9 young per breeding pair (i.e., young per active nest) must be fledged in order to maintain a stable Great Blue Heron population in the northern United States. Our cut-off for “low” productivity is somewhat higher than this figure, because we estimated success as young per successful nest instead of young per active nest (some of which were unsuccessful). Nonetheless, this cut-off is a reasonable dividing line between good and low productivity.

Contingency tests were performed to determine whether productivity rate and nesting success were affected by the size of the colonies or by population trends of the colonies. Contingency tests were also performed to determine whether productivity rate and nesting success differed from the expected distribution when the colonies were at their largest. Only colonies that had been visited in at least 3 consecutive years, including the year of peak size, were considered in this analysis. Contingency tests were used to determine whether there was a difference between productivity rate and nesting success of colonies in the peak year and the year immediately preceding it. When the contingency test was significant, a Neu test (Legendre and Legendre 1998) was used to determine whether colony size or change in numbers between years was correlated with the 1-year change in nesting success and/or productivity rate.

3. Results

Geographical position and demographic summary data for the known Quebec Great Blue Heron colonies are presented in Appendix 1. All the survey data presented here are available in the database Banque informatisée des oiseaux marins du Québec, held by the Canadian Wildlife Service, Quebec Region, Sainte-Foy, Quebec.

3.1 Numbers of colonies and nests

Although breeding pairs were found throughout southern Quebec (south of the 53rd parallel; DesGranges 1996), the majority of the 705 colonies active at any time between 1929 and 2001 were located in the western part of the province (Table 1, Outaouais region; Appendix 1). Most known colonies were in beaver ponds (281 out of 396) in the lower Outaouais, while most of the known colonies in Northern Quebec (85 out of 102) were on islands in large lakes (Table 2).

Although the size of the heronries varied from year to year and 9% of Quebec “heronries” consisted of solitary breeding pairs, most colonies contained fewer than 16 breeding pairs (Table 3). Occasionally the number of active nests in a colony exceeded 50 (18 known colonies; 2.5% of all colonies) — for example, several islands located offshore from the main marshlands of the fluvial lakes and estuary of the St. Lawrence River. One heronry in the Berthier-

Sorel islands in Lac Saint-Pierre (a fluvial lake) had over 1000 breeding pairs (1300 at its peak in 1992, almost 1.6% of the estimated North American population; calculated from Milko et al. 2003). This surely must be among the largest known monospecific colonies of this species. Given the large size of several colonies in the St. Lawrence, our results indicate that close to one-third (1919 of the 6481 active nests) of the known Quebec Great Blue Heron population is associated with heronries in the St. Lawrence in Quebec (see Table 1).

Table 4 shows the rate of abandonment of colonies between 1977 and 2001, as well as the status of the Great Blue Heron colonies in the main sectors of the St. Lawrence River in Quebec during the period 1990–2001. Our estimate of the number of breeding pairs in these areas during the 1990s is approximately 2500 pairs, distributed unevenly among about 50 active colonies (Fig. 1). More than half (55%) of the active heronries in the St. Lawrence were found in the estuary, and close to three-quarters (72%) of the active nests occur in the freshwater fluvial section of the river (Fig. 1). Over the period 1977–1990, 14 of the 70 colony sites in the St. Lawrence disappeared, while inactive nests remained at 7 more colony sites. The larger size of colonies located in the fluvial section of the St. Lawrence River may be attributable (at least in part) to the paucity in that highly urbanized section of the river of secluded forested islands largely free of terrestrial predators.

Table 1
Status of active Great Blue Heron colonies in Quebec, 1929–2001^a

Region	Number of colonies with nest counts	Number of platforms		Number of colonies with active nest counts	Number of occupied (active) nests	
		Total	Median		Total	Median
Northern Quebec	102	1026	6.0	102	881	5.0
James Bay	89	627	5.0	89	532	4.0
Abitibi	13	399	34.0	13	349	30.0
Outaouais	408	3971	7.0	258	2466	6.0
Upper Outaouais	23	399	14.5	23	354	13.4
Lower Outaouais	385	3572	6.7	235	2112	6.0
Laurentians	66	1067	10.8	53	829	9.4
Appalachians	59	716	7.6	43	386	5.5
St. Lawrence River	70	2237	17.8	65	1919	16.0
Freshwater section	17	1206	40.0	14	1039	39.5
Estuary	36	668	16.0	36	583	15.0
Gulf	17	363	17.8	15	297	16.4
Total	705	9017	7.5	521	6481	6.0

^a The majority of counts were done between 1977 and 2001. For colonies surveyed more than once, we used the average number of platforms and active nests over all visits.

Table 2
Distribution of the known Great Blue Heron colonies in Quebec, 1929–2001

Region	Habitat							Total
	Beaver pond	Island	Shore	Cliff	Riparian forest	Deep forest	Unknown	
Northern Quebec	0	85	0	1	14	1	1	102
James Bay	0	73	0	1	14	1	0	89
Abitibi	0	12	0	0	0	0	1	13
Outaouais	284	45	20	3	13	17	37	419
Upper Outaouais	3	17	1	0	1	1	0	23
Lower Outaouais	281	28	19	3	12	16	37	396
Laurentians	10	18	17	2	1	24	9	81
Appalachians	31	1	3	3	3	18	6	65
St. Lawrence River	4	49	4	4	6	12	1	80
Freshwater section	4	9	0	0	4	2	0	19
Estuary	0	35	2	3	0	2	1	43
Gulf	0	5	2	1	2	8	0	18
Total	329	198	44	13	37	72	54	747

Table 3
Size and ecological location of Great Blue Heron colonies in Quebec, 1977–2001

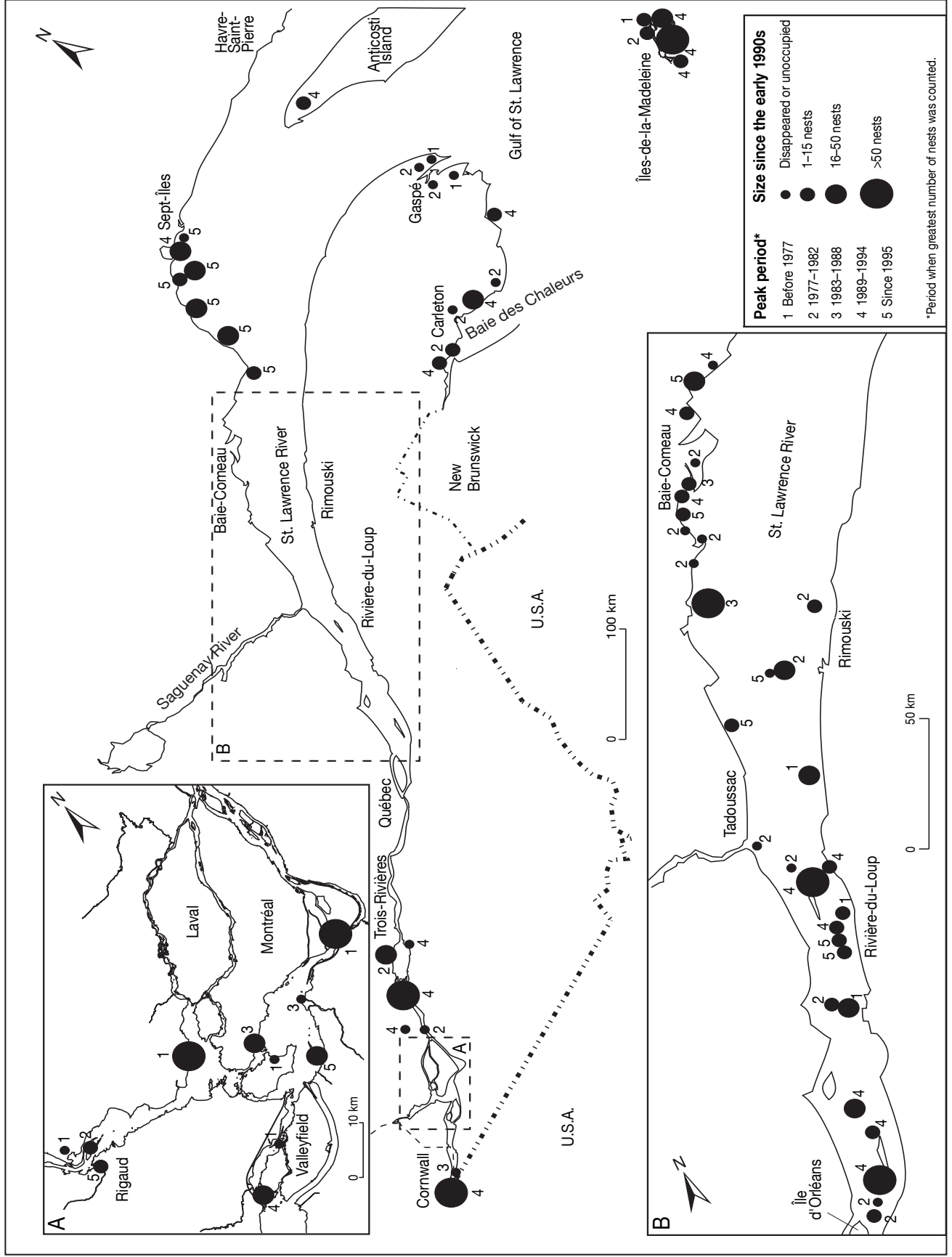
	Colonies		Active nests	
	<i>n</i>	%	<i>n</i>	%
Size (number of active nests)				
Solitary nests	63	9.0		
Very small (2–5)	191	27.0		
Small (6–15)	286	40.6		
Medium (16–25)	76	10.8		
Large (26–50)	71	10.1		
Very large (51–100)	15	2.1		
Extremely large (>100)	3	0.4		
Total	705	100		
Altitude				
Sea level (<50 m)	89	12.6	1986	30.6
Low (50–150 m)	41	5.8	441	6.8
Moderate (151–350 m)	446	63.3	3143	48.5
High (351–1000 m)	129	18.3	910	14.1
Total	705	100	6480	100
Vegetation				
Coniferous	154	21.8	1665	25.7
Deciduous	480	68.1	3837	59.2
Mixed	71	10.1	978	15.1
Total	705	100	6480	100
Habitat				
Beaver pond	329	44.0	1888	28.6
Island	198	26.5	3319	50.3
Shore	44	5.9	213	3.2
Cliff	13	1.7	45	0.7
Riparian forest	37	5.0	345	5.2
Deep forest	72	9.6	661	10.0
Unknown	54	7.2	131	2.0
Total	747	100	6602	100

Table 4
Great Blue Heron colony abandonment rate (1977–2001) and estimated population size of the St. Lawrence River heronries in Quebec (1990–2001)

	Freshwater		Saltwater		Total
	Fluvial section		Estuary	Gulf	
1977–2001					
Number of colonies visited within interval		17	36	17	70
Rate of abandonment of colonies (%) since 1977 ^a		35	25	35	30
1990–2001					
Number of colonies with platforms		14	29	13	56
Number of active colonies visited within interval		11	27	11	49
(% of total in St. Lawrence system)		(22)	(55)	(22)	(100)
Total number (median) of platforms in active colonies		1990 (42.2)	584 (16.0)	207 (8.5)	2781 (16.0)
Total number (median) of active nests		1854 (26.5)	540 (14.7)	170 (9.0)	2564 (15.0)
(% of total in St. Lawrence system)		(72)	(21)	(7)	(100)

^a Number of colonies that were abandoned since 1977 divided by total number of colonies that were active at some time in that period.

Figure 1
Recent history of Great Blue Heron colonies of the St. Lawrence River in Quebec



3.2 Mixed colonies

Most of the colonies in the St. Lawrence estuary (90%) included nests of other colonial species: 67% of the colonies in this sector had Herring Gulls *Larus argentatus*, 57% had Common Eiders *Somateria mollissima*, 47% had Double-crested Cormorants *Phalacrocorax auritus*, 33% had Black-crowned Night-Herons *Nycticorax nycticorax*, and 27% had Ospreys *Pandion haliaetus*. Great Egrets *Ardea alba* were present in a few colonies located farther upstream in the St. Lawrence system in Quebec. Outside the St. Lawrence system, the Great Blue Heron rarely shares its heronry with other piscivorous birds: Ospreys were found at 1.2% of the colonies, Herring Gulls at 1.2% of the colonies, Double-crested Cormorants at 0.4% of the colonies, and Black-crowned Night-Herons at 0.2% of the colonies.

3.3 Population dynamics

From 1977 to 2001, changes in the number of active nests per colony could be measured for many colonies that were visited at least once during each of two successive periods: 1) between 1977 and 1983 (period 1) and again between 1984 and 1990 (period 2) or 2) between 1984 and 1990 (period 2) and again between 1991 and 2001 (period 3). A comparison of the number of active nests in each region in two successive survey periods appears in Table 5. There was no significant change in the size of the regional Great Blue Heron populations over the 28 years (Wilcoxon signed rank test: $P > 0.1$).

Since the number of comparable colonies per region and period as well as their relative sizes are quite variable, it is not surprising that the majority of the Wilcoxon signed rank tests were not statistically significant. Nonetheless, the examination of the relative changes between regions and periods may indicate potential trends in Quebec Great Blue Heron populations. Seven comparisons showed an increase of 40% or more in the number of active nests between periods, while only two showed a decrease of 40% or more. However, some of the colonies with large changes had a low number of nests, so chance can play a big part in giving a high percent change. The two most spectacular increases occurred in the fluvial freshwater section of the St. Lawrence and in the upper Outaouais, although the latter involved only two colonies and a relatively small number of nests (Table 5); the only important decrease took place in the Gulf of St. Lawrence. Table 5 suggests that Quebec Great Blue Heron populations may be increasing, even though it is not possible to detect a statistically significant change.

3.4 Reproductive performance

It is rare for all nests in a Quebec Great Blue Heron colony to contain young at the end of June. Some platforms built in previous years may have been abandoned, and others that were occupied early in the breeding season may have been abandoned and/or destroyed during the first few weeks of breeding. Our field experience leads us to believe that the relative proportion of inactive nests from a previous year and

the inactive nests resulting from failed breeding in the current year are not systematically biased with respect to time period (both survey periods and weeks of sampling) or location.

Nesting success of the colony was defined as the percentage of all active nests with at least one young likely to fledge (5–7 weeks old). We have good time series data on this variable for the colonies of the St. Lawrence. On average, nesting success was between 50% and 90% during the period 1977–2001 (Fig. 2). There were no significant changes in nesting success in any region; where sample sizes were largest (estuary), success was fairly stable, at 80%. The average number of young produced per successful nest (productivity rate) provides additional information about breeding success in the colonies (Fig. 3). As with nesting success, the average productivity rate remained stable in the fluvial freshwater section and estuary, at between 2.0 and 2.5 fledglings (overall = 2.2 ± 0.6 ; $n = 162$ colonies; mean of 16 means in Butler [1992] = 2.3 ± 0.3 young per successful nest). We can thus estimate that the breeding population comprises some 6500 pairs and that the current late-summer Great Blue Heron population of Quebec is in the order of 27 000 individuals (6500 males + 6500 females + [6500 pairs \times 2.2 young per pair]).

Henny (1972) estimated that 1.9 young per breeding pair (i.e., young per active nest) must be fledged in order to maintain a stable Great Blue Heron population in the northern United States. Note that Henny's (1972) metric differs from our productivity measurement (our metric is based on successful nesting attempts rather than all nesting attempts); the difference between the two metrics may be significant in northerly populations where the summer is short (north of the boreal forest) and renesting is probably infrequent (Butler 1992).

We calculated the percentage of successful nests and the average productivity of successful nests for 315 colony-years from the 1990s, associated with 96 colonies in the whole province (Fig. 4). In most cases (74%; lower right quadrant of Fig. 4), reproductive performance was very good. Only 33 cases (10%; left side of Fig. 4) indicated low nesting success (<50% of successful nesting attempts in the colony), generally not involving the same years or the same colony in several years. In 59 cases (19%; upper half of Fig. 4), mortality caused a substantial, but not complete, reduction of the broods to <1.9 fledglings. Owen (1960), Pratt (1974), and Hafner (1978) suggested that mortality rates at this level are usually attributable to a shortage of food. Cases in which productivity rate was low were thus twice as common (20%) as cases in which nesting success was low (10%). The two types of problem (low nesting success and low productivity) very rarely occur together (3%; $n = 11$ cases; upper left quadrant of Fig. 4). Nest abandonment is generally associated with regular disturbances within the colony and/or predation (as was likely the case at five of the colonies in the Montréal region: Grande Baie d'Oka in 1980, Île Dowker and Île Saint-Bernard in 1982, Île Bienville in 1990, and Île aux Hérons in 1993). In these cases, it was not unusual to find an abnormal number of dead birds in the colonies (Teal 1965; Werschkul et al. 1976; Simpson and Kelsall 1978; DesGranges and Laporte 1979, 1981, 1983; Tremblay and Ellison 1979).

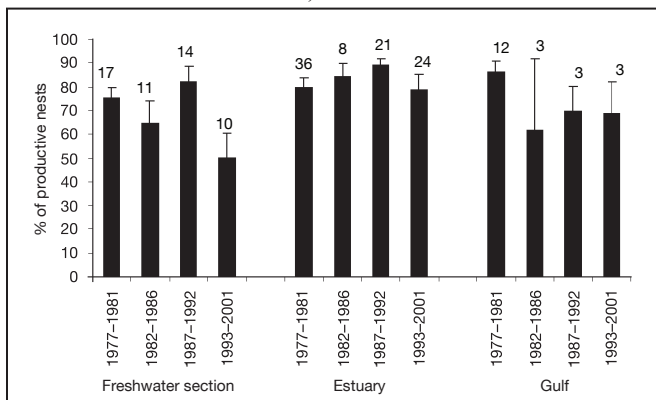
Table 5

Comparative number of occupied nests in Quebec Great Blue Heron colonies between 1973 and 2001

	Periods compared ^a	Number of colonies with data from both periods	Total number of active nests ^b		Relative change (%)		Trend ^c
			Before	After	Period 1 vs. period 2	Period 2 vs. period 3	
Northern Quebec	Period 1 vs. period 2	3	50	82	+64		=
	Period 2 vs. period 3	51	442	535		+21	=
Upper Outaouais	Period 1 vs. period 2	2	19	41	+116		=
	Period 2 vs. period 3	15	179	289		+61	+
Lower Outaouais	Period 1 vs. period 2	28	296	194	-34		-
	Period 2 vs. period 3	75	807	785		-3	=
Laurentians	Period 1 vs. period 2	8	186	265	+42		=
	Period 2 vs. period 3	15	465	487		+5	=
Appalachians	Period 1 vs. period 2	6	82	91	+11		=
	Period 2 vs. period 3	25	296	213		-28	=
St. Lawrence River	Period 1 vs. period 2	29	1096	1543	+41		=
	Period 2 vs. period 3	35	1719	2287		+33	=
Fluvial freshwater section	Period 1 vs. period 2	6	572	1186	+107		=
	Period 2 vs. period 3	9	1280	1792		+40	=
Saltwater estuary	Period 1 vs. period 2	16	320	275	-14		=
	Period 2 vs. period 3	18	292	406		+39	=
Gulf	Period 1 vs. period 2	7	204	83	-59		-
	Period 2 vs. period 3	8	148	89		-40	=
Total	Period 1 vs. period 2	76	1729	2216	+28		=
	Period 2 vs. period 3	216	3907	4596		+18	=
Trend^c					=	=	

^a Period 1: 1973–1983; period 2: 1984–1990; period 3: 1991–2001.^b The total of all colony-specific averages of annual counts made during the survey period.^c Wilcoxon's signed rank tests on relative change. “=” indicates no significant change, “+” indicates increase, and “-” indicates decrease.**Figure 2**

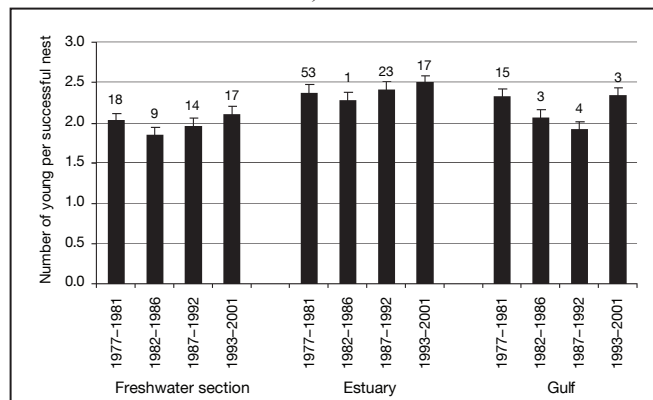
Nesting success (% of active nests that were productive) of Great Blue Herons along the St. Lawrence River, Quebec, for four different time periods. Within-colony means for each time period were averaged across colonies. Bars show mean and standard error, with number of colonies above.



Nesting success was not related to population size or the previous year's reproductive performance (nesting success, survival rate, or the combination of both) (contingency tests on conditional probabilities; $P > 0.05$). By contrast, changes in productivity rate appeared to indicate the future fate of a colony. Two years after colonies reached their maximum size, productivity rate (number of fledglings per successful nest) was lower than normally observed in these colonies ($\chi^2 = 6.259$; $P < 0.05$). Large colonies with a declining number of active nests exhibited a lower productivity rate than the other colonies ($\chi^2 = 4.128$; $P < 0.05$). Finally, the proportion of colonies with low previous productivity that continued to have low productivity for the succeeding 2 years was significantly higher than the proportion of colonies with low previous productivity that later had higher productivity ($\chi^2 = 5.220$; $P < 0.05$).

Figure 3

Nesting productivity (number of young per successful nest) of Great Blue Herons along the St. Lawrence River, Quebec, for four different time periods. Within-colony means for each time period were averaged across colonies. Bars show mean and standard error, with number of colonies above.



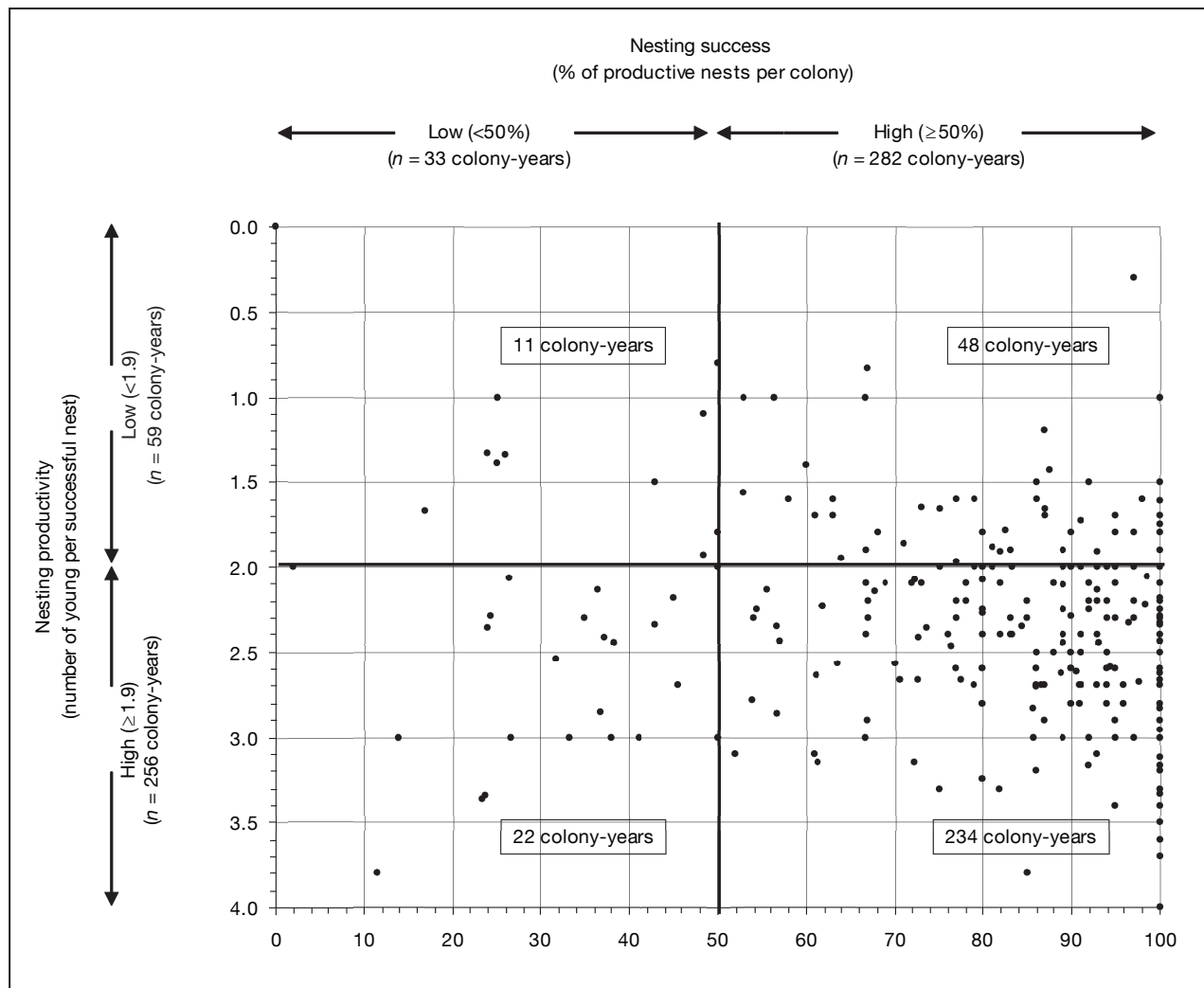
3.5 Persistence of colonies

The oldest known Quebec heronry is on Île aux Hérons near Montréal. Champlain was amazed at the large number of herons he saw on 8 June 1611 on that island in the Rapides de Lachine, noting that his crew members killed so many young herons that they filled an entire rowboat (Laverdière 1870 in Ouellet 1974). However, this site does not appear to have been used on a continuous basis by Great Blue Herons during the past 400 years: at the end of the 19th century, only Black-crowned Night-Herons were nesting on Île aux Hérons (Wintle 1896).

We are almost certain of the continuous presence of the Great Blue Heron for a period of at least 73 years on Île aux Basques in the St. Lawrence estuary. However, such persistence is rare, as only 50% of colonies still have

Figure 4

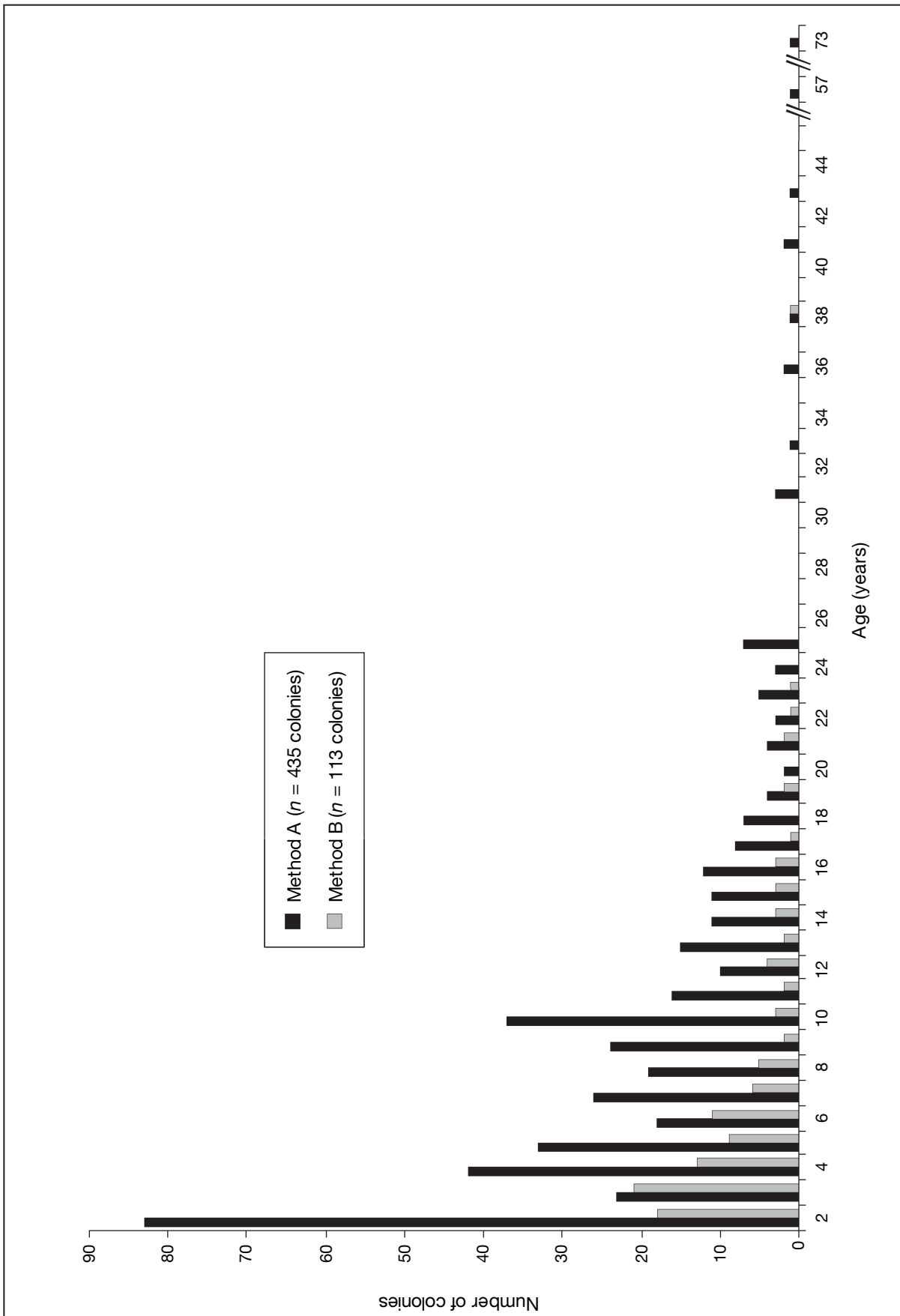
Nesting productivity and nesting success for 315 Great Blue Heron colonies where both types of reproductive data are available (paired data)



at least a few active nest platforms 5 years after first being discovered (Fig. 5). After 7 years, 50% of the colonies have no platforms left at all. These figures suggest that, on average, most platforms (some of which contain as many as 2000 sticks and weigh close to 45 kg; J.-L. DesGranges, pers. obs.) are destroyed within 2 years of nest abandonment. Fewer than 10% of the colonies in our data set persisted for more than 16 years. Some sites may, however, be reused, as was the case for 19 colonies, one of which (Îles de la Paix in Lac Saint-Louis) was abandoned and recolonized twice in 8 years. In 10 of these colonies, all of the platforms had disappeared between the year of abandonment and the year of recolonization.

The oldest colonies are located, for the most part, at elevations less than 150 m (Kruskal-Wallis χ^2 for difference in proportions = 19.1; $P < 0.001$) and often have more than 25 platforms ($\chi^2 = 124.0$; $P < 0.001$). While the type of habitat in which a heronry is established does not appear related to persistence ($\chi^2 = 5.4$; $P < 0.37$), our data did show that mixed colonies generally last longer than heronries that contain only Great Blue Herons (14.9 vs. 7.5 years; $\chi^2 = 28.6$; $P < 0.001$).

Figure 5
 Longevity of Great Blue Heron colonies along the St. Lawrence River, calculated with two different methods. Method A = (last year with platforms – year of discovery) + 1;
 Method B = (year with no active nest – first year with active nests) (see text for details).



4. Discussion

In Quebec, most Great Blue Heron breeding colonies (especially the older and larger ones) are located in the lower portion of drainage systems. At low altitudes, rivers (including the St. Lawrence) and lakes are often larger in area and/or have a greater discharge and are therefore more likely to contain predator-free islands that can be used as breeding sites, as well as shallow, fish-rich water bodies that provide suitable feeding sites for adults and young. In addition, the biological productivity of these water bodies is often higher than that of lakes located at the head of the drainage basins, where lakes are more subject to the harmful effects of acid rain (DesGranges and Darveau 1985).

Close to one-third of Quebec's known breeding population of Great Blue Herons occurs in the fluvial section of the St. Lawrence River and its three fluvial lakes in Quebec. Northern populations may be substantially underestimated, due to lower search effort for colonies and underestimation of colony size from aerial surveys (often 50% lower than ground counts; Dunn et al. 1985). However, northern colonies were much smaller (median = 5 nests, vs. 16 nests in the St. Lawrence; Table 1), and colony size in Ontario is known to decrease with latitude (Dunn et al. 1985). Even if better figures were available from the north, therefore, it is likely that the St. Lawrence would still hold a high proportion of the province's heron colonies. The alkaline, nutrient-rich waters and large aquatic grass beds that partially border the slow-flowing parts of the fluvial section of the St. Lawrence result in an abundance of several species of gregarious fish, including yellow perch *Perca flavescens* and pumpkinseed *Lepomis gibbosus*, a large component of the Great Blue Heron's diet in this sector of the St. Lawrence River (DesGranges 1981 and unpubl. data). The salt marshes of the estuary and the gulf, primarily those that contain pans and channels into which tidal water flows, are also of strategic importance (DesGranges 1978).

Our data, collected over 25 years, indicate that in Quebec, breeding success of the Great Blue Heron varied little among years. Although numerous heronries were abandoned over that period, others were formed, sometimes in habitat located near abandoned heronries. Moreover, in the past few years, our surveys show that the breeding range of this species in Quebec has expanded, primarily northwest towards James Bay and northeast towards the Moyenne-Côte-Nord (the section of the north shore of the St. Lawrence

between Sept-Îles and Havre-Saint-Pierre), Anticosti Island, and the Îles-de-la-Madeleine (Magdalen Islands).

We estimate the number of breeding adults to be in the range of 13 000 individuals (6500 pairs) for the whole province. In Ontario, Dunn et al. (1985) estimated that a minimum of 13 022 pairs of Great Blue Herons nested in at least 376 colonies in 1980 and 1981. From 1976 to 1991 in Ontario, there was a 98% increase in the number of active colonies and a 55% increase in the number of heron pairs (Graham et al. 1996), indicating that population increase has not been limited to Quebec. Milko et al. (2003) estimated the total North American population at 83 000 pairs (10–30% in Canada); therefore, the Quebec population may represent 5–10% of the estimated continental population, while its range in Quebec represents nearly 15% of the breeding range of the species indigenous to North America (estimated from the range map published in Butler 1992). Milko et al. (2003) considered the Great Blue Heron not to be currently at risk in North America.

In Ontario, Dunn et al. (1985) reported that 140 out of 689 known colonies (20%) were abandoned in 6 years, while in British Columbia, Butler et al. (1995) found a rate of disappearance of colonies equal to 14% in 6 years. These abandonment rates are fairly high compared with the 8% in 6 years (i.e., 30% of 70 colonies in 24 years, as indicated in Table 4) reported for the St. Lawrence in this study.

Since regular surveys began in 1977, the majority of breeding attempts have been successful, yielding an average of over 2.2 chicks per successful pair. Henny (1972) estimated that 1.9 chicks per active nest were needed to maintain population stability. The productivity rate in Quebec is therefore relatively high and, combined with good survival rates of adults and juveniles, is likely contributing to the recent expansion northward of the Quebec breeding range.

Nonetheless, there has been a constant decline in wetlands in the fluvial section of the St. Lawrence, and the few wooded islands in this area that are suitable for the establishment of new colonies are gradually being deforested. Besides that, the freshwater section of the St. Lawrence is further worsening due to increasingly frequent disturbances during the breeding season attributable to the rise in raccoon *Procyon lotor* populations in inhabited areas in the southwest of the province. In addition, the increase

in water sports and ecotourism in the many archipelagos of the lower St. Lawrence is responsible for disturbance near heron breeding sites (St. Lawrence Centre 1996). We believe that it is becoming more and more difficult for the Great Blue Heron to nest in the freshwater section of the river. Unless we quickly implement a mitigation program that will help restore treed swamps on several of the larger and more secluded islands making up the archipelagos of the three St. Lawrence fluvial lakes, and unless we adopt a predator control policy targeting the raccoon, it is very likely that we will notice an important decline of the Quebec Great Blue Heron breeding population, considering that close to one-third of Quebec's known breeding population of Great Blue Herons currently breeds in the fluvial section of the St. Lawrence River.

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Appendix 1. Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Colonies are in reverse order of longitude and increasing order of latitude. Each location constitutes a single colony. The number of subcolonies, if applicable, appears in parentheses following the name of the heronry.

Latitude

Example: 4724 = 47°24'N

Longitude

Example: 7933 = 79°33'W

Active nests

Nests stained white by excrement, indicating that they were being used by breeding adults that year (whether or not the attempt was successful), and generally containing large young that were easy to count (productive nests). The number of active nests constitutes only an estimate of the number of pairs attempting to breed, because of undetected failures, early or late initiations, and renestings (at different nest sites).

Number of visits

Total number of years when total number of active nests in a colony was estimated (not including multiple visits within a year)

Discovery (Year)

First time the colony was surveyed for total number of active nests

Peak (Year)

The year when the colony had reached its largest size (number of active nests)

Last visit (Year)

Last year the colony was surveyed (for total number of active nests)

Trend

Indicates the proportion (in %) of the number of active nests at the last visit relative to that reached at peak year

Inactive (unoccupied) nests

Nests that appeared virtually spotless. Some of these might have been occupied early in the season but had been abandoned so early that we were not able to distinguish them from unused nests. Inactive nests were usually in poor condition, since much of their material had been used by actively breeding birds to build nests.

Total number of platforms

Sum of active and inactive nests

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Northern Quebec — James Bay										
5052	7927	Rivière Harricana (<i>n</i> = 3)	2	1990	13	1991	16	1991	16	100
5106	7915	Rivière Missisicabi	1	1991	3	1991	3	1991	3	100
5030	7905	Rivière Harricana (<i>n</i> = 2)	2	1990	3	1990	3	1991	1	33
5110	7852	Rivière Nottaway (<i>n</i> = 6)	1	1991	1	1991	1	1991	1	100
5119	7845	Rivière Broadback (<i>n</i> = 5)	2	1990	1	1990	1	1991	1	100
5136	7845	Rivière Pontax (<i>n</i> = 4)	1	1990	3	1990	3	1990	3	100
5105	7843	Rivière Nottaway (<i>n</i> = 5)	2	1990	25	1991	27	1991	27	100
5136	7843	Rivière Pontax (<i>n</i> = 3)	2	1990	1	1991	6	1991	6	100
5119	7837	Rivière Broadback (<i>n</i> = 4)	2	1990	14	1991	16	1991	16	100
4942	7835	Rivière Harricana	1	1990	18	1990	18	1990	18	100
5053	7835	Rivière Kitchigama (<i>n</i> = 3)	2	1990	2	1991	3	1991	3	100
5132	7833	Rivière Pontax (<i>n</i> = 2)	1	1991	11	1991	11	1991	11	100
5001	7832	Rivière Nottaway	2	1990	6	1990	6	1991	5	83
5118	7831	Rivière Broadback (<i>n</i> = 3)	2	1990	3	1990	3	1991	3	100
5131	7826	Rivière Pontax	1	1991	2	1991	2	1991	2	100
5304	7823	Lac Kapwakami	1	1992	1	1992	1	1992	1	100
5043	7820	Rivière Kitchigama (<i>n</i> = 2)	1	1990	6	1990	6	1990	6	100
5039	7816	Rivière Kitchigama	2	1990	6	1991	7	1991	7	100
5011	7813	Lac Paul-Sauvé	1	1991	9	1991	9	1991	9	100
5214	7812	Rivière Eastmain	1	1981	1	1981	1	1981	1	100
5117	7811	Rivière Broadback (<i>n</i> = 2)	1	1991	1	1991	1	1991	1	100
5047	7800	Rivière Nottaway (<i>n</i> = 4)	1	1991	5	1991	5	1991	5	100
5025	7750	Rivière Nottaway (<i>n</i> = 3)	2	1990	8	1991	9	1991	9	100
5052	7748	Lac Chaboulié	1	1991	1	1991	1	1991	1	100
4953	7743	Lac Matagami (<i>n</i> = 3)	2	1990	12	1991	13	1991	13	100
4950	7740	Lac Matagami	1	1990	9	1990	9	1990	9	100
5048	7740	Lac Desorsons	3	1981	7	1991	17	1991	17	100
5018	7738	Rivière Nottaway (<i>n</i> = 2)	2	1990	2	1990	2	1991	1	50
5018	7737	Lac Soscumica (<i>n</i> = 2)	2	1990	3	1990	3	1991	3	100
4936	7727	Rivière Bell	1	1991	10	1991	10	1991	10	100
5015	7727	Lac Soscumica	2	1990	37	1991	48	1991	48	100
4951	7726	Lac Matagami (<i>n</i> = 2)	1	1991	17	1991	17	1991	17	100
4956	7726	Baie du Nord	2	1990	16	1990	16	1991	10	63
4957	7726	Baie du Nord (<i>n</i> = 2)	1	1991	4	1991	4	1991	4	100
5112	7723	Rivière Broadback	2	1990	6	1990	6	1991	4	67
5102	7720	Lac du Tast	2	1990	10	1990	10	1991	7	70
5030	7705	Lac Chabinoche	2	1990	13	1990	13	1991	13	100
5054	7705	Lac Evans (<i>n</i> = 3)	2	1990	5	1990	5	1991	5	100
5117	7705	Lac Naquiperdu	2	1990	5	1990	5	1991	4	80
5003	7701	Lac Poncheville	2	1990	5	1990	5	1991	5	100
5134	7659	Lac Kamichisuchistunuch	2	1990	1	1991	3	1991	3	100
5007	7658	Lac Poncheville (<i>n</i> = 2)	2	1990	5	1991	8	1991	8	100
5045	7658	Lac Evans	1	1991	4	1991	4	1991	4	100
5049	7658	Lac Evans (<i>n</i> = 2)	1	1991	3	1991	3	1991	3	100
5058	7658	Lac Evans (<i>n</i> = 5)	2	1990	7	1991	10	1991	10	100
5131	7657	Lac Jolliet	2	1990	6	1990	6	1991	5	83
4904	7656	Lac Quévillon	2	1986	10	1991	17	1991	17	100
5108	7655	Lac Giffard	2	1990	15	1990	15	1991	14	93
5122	7650	Lac Nemiscau	2	1990	6	1990	6	1991	6	100
5013	7649	Lac Poncheville (<i>n</i> = 3)	2	1990	1	1990	1	1991	1	100
5017	7649	Lac Poncheville (<i>n</i> = 4)	2	1990	10	1990	10	1991	9	90
4924	7648	Lac Madeleine	1	1991	11	1991	11	1991	11	100
4940	7648	Baie Ramsay	2	1990	1	1991	6	1991	6	100
5040	7648	Lac Sans Nom	1	1991	6	1991	6	1991	6	100
5056	7647	Lac Evans (<i>n</i> = 4)	1	1991	16	1991	16	1991	16	100
5006	7645	Lac Chensagi	1	1991	3	1991	3	1991	3	100
5007	7645	Lac Chensagi (<i>n</i> = 2)	1	1991	2	1991	2	1991	2	100
4943	7643	Lac au Goéland	2	1990	5	1990	5	1991	3	60
4857	7642	Lac Holmes	2	1986	8	1986	8	1992	6	75
5021	7642	Lac Opataouaga	1	1991	9	1991	9	1991	9	100
5140	7642	Lac Chenukamishish	2	1990	3	1990	3	1991	3	100
4955	7641	Lac Maicasagi	1	1991	5	1991	5	1991	5	100
4958	7637	Lac Maicasagi (<i>n</i> = 2)	1	1991	3	1991	3	1991	3	100
5039	7635	Lac Salamandre	2	1990	2	1991	4	1991	4	100
4930	7633	Lac Waswanipi	1	1991	12	1991	12	1991	12	100
5056	7633	Lac Le Gardeur	1	1991	3	1991	3	1991	3	100

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Northern Quebec — James Bay (continued)										
5050	7623	Lac Storm	2	1990	2	1991	7	1991	7	100
5039	7621	Lac Rocher	2	1990	2	1990	2	1991	2	100
4847	7619	Lac du Cimetière	2	1991	14	1992	15	1992	15	100
5003	7617	Lac Yapououchi	1	1991	11	1991	11	1991	11	100
5032	7617	Lac Gaumont	2	1990	6	1991	10	1991	10	100
4940	7615	Rivière Waswanipi	2	1990	1	1990	1	1990	1	100
5041	7615	Rivière Nipukatasi	2	1990	5	1990	5	1991	4	80
5110	7614	Lac Legoff (<i>n</i> = 2)	1	1991	1	1991	1	1991	1	100
5109	7612	Lac Legoff	1	1991	2	1991	2	1991	2	100
5028	7611	Lac Amisquioumisca	1	1991	20	1991	20	1991	20	100
5050	7608	Lac Sans Nom (<i>n</i> = 2)	1	1991	6	1991	6	1991	6	100
4934	7601	Lac Bachelor	1	1991	2	1991	2	1991	2	100
5014	7551	Lac Monsan	1	1991	7	1991	7	1991	7	100
4917	7528	Lac Father	1	1991	12	1991	12	1991	12	100
4927	7442	Lac Caopatina (<i>n</i> = 2)	1	1991	3	1991	3	1991	3	100
4927	7441	Lac Caopatina	1	1991	7	1991	7	1991	7	100
4940	7441	Lac à l'Eau Jaune	1	1991	3	1991	3	1991	3	100
4950	7437	Lac Scott	1	1991	10	1991	10	1991	10	100
5045	7433	Lac Frotet	1	1991	1	1991	1	1991	1	100
5003	7427	Lac Chevrillon	1	1991	12	1991	12	1991	12	100
5038	7427	Lac De Maurès	2	1990	2	1991	3	1991	3	100
4945	7417	Lac Chibougamau	1	1991	6	1991	6	1991	6	100
5011	7357	Lac Waconichi	1	1991	6	1991	6	1991	6	100
Northern Quebec — Abitibi										
4814	7930	Lac Labyrinth	3	1984	1	1992	13	1992	13	100
4818	7921	Lac Montbray	5	1982	15	1992	72	1992	72	100
4841	7918	Lake Abitibi	4	1983	20	1989	51	1992	38	75
4828	7915	Lac Duparquet	8	1977	20	1993	54	1993	54	100
4849	7858	Lac Macamic	7	1979	14	1989	64	1992	45	70
4834	7844	Lac Lois (île 1)	1	1996	34	1996	34	1996	34	100
4759	7811	Lac Mourier	1	1997	38	1997	38	1997	38	100
4817	7808	Lac Malartic	7	1979	50	1984	86	1992	60	70
4804	7805	Lac Fournière	2	1988	15	1988	15	1992	6	40
4809	7753	Lac Montigny	4	1984	26	1992	63	1992	63	100
4844	7745	Lac Castagnier	4	1985	5	1992	20	1992	20	100
4800	7741	Lac Sabourin	1	1990	23	1990	23	1990	23	100
4826	7649	Lac Martin	2	1978	35	1978	35	1992	26	74
Outaouais — Upper Outaouais										
4724	7933	Lake Timiskaming	2	1986	20	1992	38	1992	38	100
4807	7922	Lac Opasatica	5	1983	30	1984	50	1992	38	76
4734	7916	Ruisseau des Quinze	3	1987	25	1992	52	1992	52	100
4658	7910	Lac Kipawa	5	1979	17	1992	21	1992	21	100
4733	7908	Lac des Quinze/Îles Jumelles	3	1990	21	1992	33	1992	33	100
4717	7904	Lac Brisebois	3	1985	30	1992	33	1992	33	100
4731	7901	Lac des Quinze	3	1987	6	1987	6	1992	1	17
4819	7901	Lac Dufault	1	1992	79	1992	79	1992	79	100
4826	7900	Lac Dufresnoy	1	1992	32	1992	32	1992	32	100
4747	7859	Lac Berval	3	1984	6	1990	18	1992	17	94
4727	7855	Lac Moore	2	1990	3	1994	6	1994	6	100
4721	7854	Lac Lett (<i>n</i> = 2)	1	1992	2	1992	2	1992	2	100
4639	7852	Lac Beauchêne	4	1981	10	1992	31	1992	31	100
4755	7851	Lac Basserode	3	1984	3	1984	3	1992	3	100
4647	7846	Lac Georges	2	1990	4	1990	4	1992	4	100
4626	7843	Étang du Lac Bouleau	1	1993	6	1993	6	1993	6	100
4629	7843	Lac Memewin	6	1975	30	1984	50	1993	4	8
4740	7840	Lac Simard (île 1)	1	1996	15	1996	15	1996	15	100
4659	7827	Lac Duck	1	1996	9	1996	9	1996	9	100
4822	7820	Lac Preissac	4	1984	5	1992	28	1992	28	100
4744	7816	Réservoir Decelles	1	1992	1	1992	1	1992	1	100
4816	7815	Lac Cadillac	3	1984	2	1992	10	1992	10	100
4658	7811	Lac Mason	2	1985	7	1985	7	1986	7	100
Outaouais — Lower Outaouais										
4631	7756	Lac John-Bull Ouest	1	1992	1	1992	1	1992	1	100
4631	7754	Lac John-Bull	2	1990	7	1990	7	1991	1	14
4613	7746	Lac Vaseux	5	1978	23	1978	23	1992	8	35

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Discovery		Peak		Last visit		Trend	
			Number of visits	Year	Number of nests	Year	Number of nests	Year		Number of nests
Outaouais — Lower Outaouais (continued)										
4615	7744	Lac Lernaut	1	1984	2	1984	2	1984	2	100
4627	7732	Lac des Vases	2	1978	22	1978	22	1978	22	100
4657	7731	Lac Croucher	1	1991	1	1991	1	1991	1	100
4658	7731	Lac Gardner	1	1991	1	1991	1	1991	1	100
4630	7725	Lac Petitot	2	1980	6	1980	6	1981	6	100
4617	7719	Lac Acob	2	1980	7	1980	7	1983	2	29
4607	7717	Lac Greer	3	1982	1	1983	5	1983	5	100
4557	7715	Fort William	4	1986	18	1986	18	1992	8	44
4556	7712	Rapides de la Culbute	6	1982	43	1982	43	1992	25	58
4603	7710	Lac Sheen	2	1986	7	1986	7	1992	5	71
4551	7704	Lac aux Allumettes	1	1983	12	1983	12	1983	12	100
4550	7700	Lac Cranson	3	1982	4	1982	4	1984	1	25
4604	7700	Lac du Brochet (<i>n</i> = 2)	3	1979	7	1983	11	1983	11	100
4605	7659	Ruisseau McGillivray	2	1980	7	1983	12	1983	12	100
4605	7657	Lac Whetstone	2	1984	1	1990	43	1990	43	100
4620	7655	Lac Duval	4	1974	10	1979	13	1983	9	69
4635	7655	Lac Philbin	1	1990	1	1990	1	1990	1	100
4555	7654	Waltham Station	4	1986	46	1990	67	1992	51	76
4609	7652	Lac Otter	3	1980	10	1983	12	1983	12	100
4610	7652	Lac Bore	2	1980	12	1980	12	1983	3	25
4555	7651	Lac Frappier	1	1990	8	1990	8	1990	8	100
4558	7650	Lac Siamois	1	1997	8	1997	8	1997	8	100
4603	7650	Lac Baker	2	1988	8	1988	8	1988	8	100
4631	7650	Lac Thomas	2	1991	2	1991	2	1992	1	50
4602	7648	Lac Gillies	8	1973	4	1981	28	1990	9	32
4604	7647	Lac Jim	2	1991	30	1991	30	1992	24	80
4555	7646	Lac Angus-Roy	3	1980	10	1981	14	1983	5	36
4558	7646	Lac Pleau	5	1980	10	1980	10	1992	3	30
4544	7645	Île Lafontaine	8	1974	45	1975	50	1990	2	4
4546	7645	Île Wilson	4	1986	3	1990	11	1992	6	55
4726	7644	Réservoir Cabonga	2	1990	2	1990	2	1992	1	50
4543	7643	Lac Lett	4	1981	5	1982	20	1983	7	35
4559	7643	Lac Gib	1	1989	4	1989	4	1989	4	100
4539	7642	Lac du Rocher Fendu	1	1983	12	1983	12	1983	12	100
4610	7641	Lac Peter	2	1983	1	1983	1	1983	1	100
4533	7640	Lac Elliott	3	1987	21	1992	45	1992	45	100
4541	7640	Lac Kelly	6	1981	2	1982	17	1992	10	59
4614	7639	Lac Osborne	4	1975	16	1983	20	1992	2	10
4533	7638	Île Reid	7	1980	17	1981	20	1990	6	30
4535	7637	Portage-du-Fort	5	1980	12	1992	45	1992	45	100
4551	7636	Lac Archie	4	1986	11	1992	20	1992	20	100
4555	7636	Lac Hart	1	1997	3	1997	3	1997	3	100
4533	7635	Lac Armstrong	1	1992	29	1992	29	1992	29	100
4556	7635	Lac Stephen	2	1984	6	1984	6	1986	2	33
4541	7634	Lac du Don	2	1983	2	1984	3	1984	3	100
4550	7634	Lac Litchfield	5	1983	5	1986	13	1992	9	69
4619	7634	Lac Opal	3	1986	19	1987	36	1992	32	89
4626	7634	Lac Stoney	1	1986	1	1986	1	1986	1	100
4552	7633	Lac Leslie	6	1983	49	1983	49	1992	43	88
4542	7632	Lac Towell	1	1997	2	1997	2	1997	2	100
4556	7632	Lac Huddersfield	1	1984	1	1984	1	1984	1	100
4531	7631	Îles Kennedy	6	1974	5	1987	13	1990	9	69
4545	7631	Lac Ebert	3	1983	4	1984	6	1986	3	50
4556	7631	Lac du Canard Noir	3	1983	2	1983	2	1986	2	100
4554	7630	Lac Gravelin	3	1983	5	1983	5	1984	5	100
4544	7629	Lac Lemay	4	1984	11	1990	23	1992	9	39
4549	7629	Lac McCuaig	3	1983	6	1983	6	1986	2	33
4616	7629	Lac du Dépôt	3	1980	20	1980	20	1986	3	15
4617	7628	Lac Oxo	1	1986	4	1986	4	1986	4	100
4603	7627	Lac Dumont	6	1974	50	1974	50	1983	4	8
4546	7626	Lac Arnot	3	1983	1	1992	19	1992	19	100
4537	7625	Bristol Ridge	3	1983	1	1986	4	1986	4	100
4603	7625	Lac Triangle	1	1987	1	1987	1	1987	1	100
4613	7625	Lac Biby	4	1981	2	1983	4	1986	2	50
4603	7624	Lac Lester	3	1982	10	1982	10	1987	4	40
4642	7624	Lac Morenz	3	1980	10	1991	25	1992	14	56

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Outaouais — Lower Outaouais (continued)										
4535	7623	Lac Caldwell	5	1983	10	1984	12	1992	2	17
4614	7623	Lac June	1	1984	1	1984	1	1984	1	100
4535	7622	Lac Church	8	1979	2	1981	18	1986	5	28
4542	7621	Lac Thorne	4	1976	30	1976	30	1983	4	13
4554	7621	Lac Watson	2	1986	9	1986	9	1990	2	22
4527	7620	Lac Bristol	2	1987	6	1992	9	1992	9	100
4531	7619	Bristol-les-Mines	5	1986	6	1991	37	1997	18	49
4543	7619	Lac Barnes	4	1986	16	1986	16	1992	12	75
4558	7619	Petit lac Cayamant	3	1983	8	1983	8	1986	4	50
4605	7619	Lac Mario	5	1977	11	1977	11	1990	6	55
4552	7618	Lac Greenbay	6	1983	17	1986	27	1992	14	52
4558	7618	Lac Hardwood	1	1997	6	1997	6	1997	6	100
4602	7618	Lac Lefrançois	5	1977	11	1977	11	1984	2	18
4613	7618	Lac de la Mer Bleue	4	1977	12	1977	12	1982	1	8
4632	7618	Lac Auger	5	1990	4	1992	11	1997	2	18
4540	7617	Lac à Breen	3	1983	1	1984	7	1986	4	57
4552	7617	Lac du Rang	4	1980	19	1980	19	1986	2	11
4703	7617	Lac des Chasseurs	3	1978	20	1978	20	1992	14	70
4555	7616	Grove Creek	1	1997	7	1997	7	1997	7	100
4600	7616	Lac Marle	2	1984	7	1984	7	1984	7	100
4611	7616	Lac Ménard	2	1983	1	1984	2	1984	2	100
4617	7615	Lac Ellard	1	1997	1	1997	1	1997	1	100
4638	7615	Lac Riley	1	1983	2	1983	2	1983	2	100
4538	7614	Lac Glynn	12	1975	19	1977	27	1990	8	30
4539	7614	Lac Sandy	15	1974	21	1980	23	1992	7	30
4546	7614	Lac Tilley	4	1980	6	1984	10	1986	4	40
4558	7614	Lac Eardley	5	1980	16	1980	16	1986	6	38
4604	7614	Lac Joy	3	1984	18	1984	18	1992	12	67
4605	7614	Lac Joy (<i>n</i> = 2)	3	1993	1	1998	13	1999	12	92
4616	7614	Lac Roan	5	1980	30	1983	32	1984	29	91
4622	7614	Lac Cairine	2	1987	5	1992	6	1992	6	100
4535	7613	Lac Curley	7	1981	29	1983	36	1992	2	6
4535	7612	Lac la Pêche (<i>n</i> = 2)	1	1992	6	1992	6	1992	6	100
4616	7612	Lac Ezra	1	1997	17	1997	17	1997	17	100
4548	7611	Lac Kileen	7	1968	30	1968	30	1992	12	40
4604	7611	Lac Cayamant	1	1990	21	1990	21	1990	21	100
4604	7611	Ruisseau des Cerises (north)	4	1990	20	1990	20	1993	11	55
4606	7611	Lac Fairburn	3	1977	11	1977	11	1977	11	100
4607	7611	Lac Fairburn Sud	3	1991	8	1991	8	1995	7	88
4611	7611	Lac des Îles	1	1990	8	1990	8	1990	8	100
4550	7610	Lac Dole	1	1992	5	1992	5	1992	5	100
4605	7610	Lac aux Cerises (north)	3	1991	1	1995	3	1995	3	100
4618	7610	Lac Hélène	6	1982	1	1997	5	1997	5	100
4620	7610	Lac à l'Île	2	1984	5	1984	5	1984	5	100
4621	7610	Lac Harry	4	1980	6	1980	6	1992	5	83
4636	7610	Lac Riot	2	1984	9	1984	9	1992	4	44
4530	7609	Lac Harding	4	1980	20	1980	20	1990	4	20
4536	7609	Lac Ben	10	1972	13	1986	26	1990	10	38
4536	7609	Lac Gervais	2	1985	4	1992	8	1992	8	100
4538	7609	Lac la Pêche	6	1981	10	1984	20	1992	14	70
4544	7609	Lac Sellar	2	1983	6	1983	6	1984	1	17
4634	7609	Lac Pontiac	1	1992	4	1992	4	1992	4	100
4640	7609	Lac Lytton	1	1997	4	1997	4	1997	4	100
4536	7608	Lac Hawley	16	1972	25	1972	25	1992	7	28
4544	7608	Lac Janese	2	1991	5	1992	8	1992	8	100
4554	7608	Lac Bohême	11	1976	20	1990	21	1997	8	38
4639	7608	Lac aux Bouillons	1	1997	9	1997	9	1997	9	100
4546	7607	Lac Craig	6	1983	7	1986	14	1997	2	14
4549	7607	Lac Côté	1	1997	7	1997	7	1997	7	100
4632	7606	Lac Legendre	4	1982	11	1984	15	1984	15	100
4546	7605	Lac Cabaret	2	1984	6	1984	6	1992	2	33
4546	7605	Lac Hickey	1	1997	11	1997	11	1997	11	100
4550	7605	Lac Sowden	1	1997	8	1997	8	1997	8	100
4619	7605	Lac des Cèdres	1	1997	39	1997	39	1997	39	100
4544	7604	Lac Motherwell	1	1983	6	1983	6	1983	6	100
4544	7604	Ruisseau Motherwell	3	1984	16	1984	16	1990	12	75

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Discovery		Peak		Last visit		Trend	
			Number of visits	Year	Number of nests	Year	Number of nests	Year		Number of nests
Outaouais — Lower Outaouais (continued)										
4546	7604	Lac Hector	1	1997	6	1997	6	1997	6	100
4604	7603	Rivière Picanoc	1	1983	7	1983	7	1983	7	100
4534	7601	Lac des Épinettes	4	1973	37	1973	37	1977	12	32
4544	7601	Lac Notre-Dame	3	1982	8	1986	13	1990	8	62
4731	7559	Lac Dumoulin	1	1990	5	1990	5	1990	5	100
4600	7558	Lac Quenouille	2	1990	7	1990	7	1997	1	14
4534	7557	Lac Mousseau	5	1973	35	1973	35	1974	5	14
4536	7557	Lac Carman	3	1985	5	1985	5	1986	5	100
4536	7557	Lac Long	14	1973	37	1973	37	1992	16	43
4555	7557	Lac Sainte-Marie	4	1982	20	1983	25	1990	6	24
4602	7557	Lac Désormeaux	5	1982	19	1986	38	1990	12	32
4642	7556	Lac Bitobi	2	1994	16	1997	21	1997	21	100
4805	7556	Lac Capitachouane	1	1994	10	1994	10	1994	10	100
4534	7555	Lac Carman (south)	2	1986	10	1992	16	1992	16	100
4535	7555	Lac Printemps	12	1973	72	1973	72	1990	4	6
4548	7554	Lac Saint-Charles	4	1977	4	1977	4	1986	1	25
4609	7554	Lac des Embarras	1	1997	7	1997	7	1997	7	100
4537	7553	Farm Point	4	1977	20	1983	26	1990	3	12
4610	7553	Lacs en Long	8	1979	5	1983	29	1990	5	17
4551	7552	Lac Canard	3	1983	5	1984	9	1989	2	22
4554	7552	Rivière du Plomb	2	1977	2	1977	2	1977	2	100
4531	7551	Lac Fortune	7	1977	1	1982	10	1986	3	30
4539	7551	Lac Lecomte	4	1983	14	1983	14	1992	9	64
4605	7551	Point Comfort	10	1973	43	1974	46	1986	7	15
4556	7550	Lac Tucker	8	1977	8	1989	23	1992	23	100
4618	7550	Déléage	1	1990	2	1990	2	1990	2	100
4528	7549	Lac Pink	3	1977	7	1977	7	1977	7	100
4553	7549	Lac Bon	4	1979	9	1979	9	1990	1	11
4622	7549	Lac Laframboise	7	1976	25	1976	25	1986	5	20
4624	7549	Ferme-Joseph	2	1991	5	1992	19	1992	19	100
4702	7549	Lac Marguerite	8	1977	25	1980	79	1992	40	51
4545	7548	Petit lac Clair	2	1983	1	1983	1	1984	1	100
4547	7548	Lac Saint-Germain	3	1983	1	1984	2	1989	1	50
4558	7548	Baie à la Vase	2	1986	9	1986	9	1986	9	100
4604	7548	Lac Spittals	3	1980	8	1980	8	1983	5	63
4606	7548	Lac Bertrand	2	1986	7	1986	7	1986	7	100
4634	7548	Lac du Castor Blanc	2	1991	7	1992	21	1992	21	100
4541	7547	Lac François	5	1983	2	1986	20	1992	13	65
4551	7547	Lac Cardinal	4	1977	6	1992	7	1992	7	100
4603	7547	Lac des Chasseurs (island)	5	1977	15	1983	38	1992	8	21
4605	7547	Lac Croche	5	1980	3	1985	4	1986	3	75
4606	7547	Lac Forcier	2	1991	37	1992	44	1992	44	100
4629	7547	Lac Quinn	5	1983	11	1992	18	1992	18	100
4636	7547	Lac Yates	5	1980	8	1986	10	1992	3	30
4554	7546	Lac à la Truite	6	1967	74	1967	74	1983	12	16
4603	7546	Lac à la Loutre	4	1977	15	1977	15	1986	1	7
4608	7546	Lac Saül	1	1992	42	1992	42	1992	42	100
4616	7546	Lac des Trente et Un Milles	8	1974	46	1974	46	1983	16	35
4620	7546	Lac du Brochet	3	1978	15	1978	15	1978	15	100
4632	7546	Lac la Loutre	2	1991	11	1991	11	1992	4	36
4535	7545	Lac Lundy	3	1983	6	1984	14	1990	4	29
4538	7545	Lac Tenpenny	3	1983	4	1984	7	1992	1	14
4542	7545	Lac Grandin	3	1979	3	1980	5	1983	2	40
4606	7545	Lac du Pékan	3	1981	2	1983	14	1983	14	100
4536	7544	Lac Luster	1	1990	45	1990	45	1990	45	100
4539	7544	Lac McGlashan	1	1983	15	1983	15	1983	15	100
4606	7544	Lac à l'Ours	2	1981	2	1983	14	1983	14	100
4608	7544	Lac Tom	2	1990	5	1990	5	1992	2	40
4615	7544	Lac Fiset	1	1991	3	1991	3	1991	3	100
4537	7543	Saint-Joseph-des-Monts	7	1980	6	1983	21	1992	6	29
4553	7543	Lac Brassard	3	1989	18	1989	18	1992	7	39
4620	7543	Lac Castor	3	1985	14	1985	14	1992	1	7
4603	7542	Lac du Poisson Blanc	1	1982	1	1982	1	1982	1	100
4612	7542	Lac au Foin	2	1983	8	1983	8	1984	7	88
4616	7542	Lac au Chien	3	1985	9	1985	9	1992	2	22
4545	7541	Lac Jumeau	4	1983	4	1992	12	1992	12	100

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Outaouais — Lower Outaouais (continued)										
4618	7541	Lac Antoine	1	1981	6	1981	6	1981	6	100
4626	7541	Lac Chaîné	2	1988	5	1988	5	1988	5	100
4642	7541	Lac Windigo	1	1995	6	1995	6	1995	6	100
4541	7540	Lac Bonin	2	1983	3	1983	3	1984	2	67
4554	7540	Lac Rouge	2	1980	9	1980	9	1990	7	78
4557	7540	Lac de la Loutre	4	1981	12	1981	12	1989	4	33
4558	7540	Lac de la Boue	2	1989	7	1992	14	1992	14	100
4625	7540	Lac Kensington	1	1982	17	1982	17	1982	17	100
4626	7540	Lac de l'Île	2	1988	5	1988	5	1988	5	100
4626	7540	Lac Pearson	1	1992	10	1992	10	1992	10	100
4538	7539	Lac McGregor	5	1979	40	1979	40	1990	15	38
4625	7539	Lac à Ménard	2	1984	12	1984	12	1984	12	100
4541	7538	Lac Grand	2	1983	13	1983	13	1983	13	100
4623	7538	Lac à Tanis	3	1984	18	1984	18	1992	18	100
4533	7536	Cantley	1	1997	16	1997	16	1997	16	100
4534	7536	Perkins	1	1997	9	1997	9	1997	9	100
4540	7536	Petit lac McFee	1	1992	1	1992	1	1992	1	100
4615	7536	Lac Butler	2	1990	6	1990	6	1992	2	33
4626	7536	Lac Trudel	2	1988	15	1988	15	1992	8	53
4629	7536	Lac de la Grotte	1	1992	14	1992	14	1992	14	100
4539	7535	Lac Noir	2	1983	1	1984	3	1984	3	100
4629	7535	Lac de la Grotte (n = 2)	2	1989	5	1992	14	1992	14	100
4554	7534	Lac Delphis	1	1989	4	1989	4	1989	4	100
4612	7534	Petit lac des Cèdres	1	1991	2	1991	2	1991	2	100
4622	7534	Lac Mitchell	4	1984	5	1992	11	1992	11	100
4539	7533	Lac de la Mine	4	1981	6	1984	20	1990	3	15
4627	7533	Lac des Îles (Île Major)	1	1982	30	1982	30	1982	30	100
4726	7533	Lac Cormon	1	1990	4	1990	4	1990	4	100
4604	7532	Lac Wabassee	2	1990	6	1990	6	1992	6	100
4606	7532	Lac des Goujons	2	1990	4	1990	4	1992	4	100
4531	7531	Lac Meach	5	1977	1	1982	2	1985	1	50
4538	7531	Lac Fer à Cheval	2	1985	19	1985	19	1990	3	16
4540	7531	Lac Arnold	2	1983	19	1990	32	1990	32	100
4552	7531	Lac Argile	2	1983	9	1983	9	1990	3	33
4617	7531	Lac Castor (n = 2)	1	1990	7	1990	7	1990	7	100
4536	7529	Lac Devine (south)	9	1977	30	1978	40	1993	4	10
4540	7529	Lac Devine (north)	4	1981	32	1981	32	1990	8	25
4553	7528	Lac des Moucherolles	2	1986	7	1986	7	1986	7	100
4551	7527	Lac Lafleur (n = 2)	5	1982	12	1986	16	1990	6	38
4555	7527	Lac Écho	2	1983	9	1983	9	1983	9	100
4531	7526	Rivière du Lièvre	1	1983	8	1983	8	1983	8	100
4546	7526	Lac Garret	1	1989	4	1989	4	1989	4	100
4547	7526	Étang Chim	3	1989	24	1989	24	1992	11	46
4553	7526	Lac Home	1	1983	13	1983	13	1983	13	100
4552	7525	Lac Rowan	2	1980	35	1980	35	1980	35	100
4617	7525	Lac Perras	2	1983	15	1983	15	1983	15	100
4540	7524	Lac Doré	4	1981	6	1983	25	1990	11	44
4542	7524	Lac Sable	3	1983	9	1984	12	1984	12	100
4611	7524	Lac Goose	1	1986	2	1986	2	1986	2	100
4615	7524	Lac Murphy	2	1992	12	1992	12	1992	12	100
4620	7522	Lac Ur	2	1983	1	1984	2	1984	2	100
4637	7522	Lac Desjardins	2	1989	8	1989	8	1992	2	25
4549	7521	Lac Smallian	6	1980	1	1984	6	1986	1	17
4610	7521	Lac Origny	1	1997	11	1997	11	1997	11	100
4620	7521	Lac Kar-Ha-Kon	2	1990	6	1990	6	1992	2	33
4621	7520	Lac Tigy	1	1997	7	1997	7	1997	7	100
4638	7520	Lac Lafleur	5	1983	13	1986	16	1992	11	69
4545	7519	Lac Ida	3	1980	3	1980	3	1980	3	100
4547	7519	Lac Goéland	1	1989	4	1989	4	1989	4	100
4704	7519	Lac Chopin	1	1991	4	1991	4	1991	4	100
4534	7518	Baie de Lochaber	2	1979	7	1979	7	1979	7	100
4553	7518	Lac des Pies	2	1982	4	1982	4	1983	4	100
4609	7517	Lac du Sourd	5	1977	3	1979	12	1987	7	58
4541	7516	Lac à Mémère	1	1989	2	1989	2	1989	2	100
4543	7516	Lac aux Castors	2	1983	60	1983	60	1984	10	17
4545	7516	Lac Britannique	1	1989	4	1989	4	1989	4	100

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Outaouais — Lower Outaouais (continued)										
4557	7516	Étang Sebec	1	1984	2	1984	2	1984	2	100
4613	7516	Lac de l'Averse	2	1990	1	1990	1	1990	1	100
4720	7515	Lac Duplessis	1	1992	3	1992	3	1992	3	100
4540	7514	Lac Galipeau	1	1989	3	1989	3	1989	3	100
4543	7514	Lac à Pépère	3	1989	5	1989	5	1992	1	20
4550	7514	Lac Baril	3	1986	9	1986	9	1990	5	56
4552	7514	Lac des Pins Rouges	3	1980	1	1980	1	1980	1	100
4554	7514	Lac Clark	3	1979	10	1979	10	1981	3	30
4650	7514	Lac Michaud	1	1996	3	1996	3	1996	3	100
4600	7513	Lac Mercredi	1	1983	6	1983	6	1983	6	100
4614	7513	Lac du Quai	4	1982	7	1990	12	1992	10	83
4559	7512	Lac Francine	5	1983	4	1989	13	1992	7	54
4618	7512	Lac Joinville	2	1990	10	1992	12	1992	12	100
4540	7511	Lac Bernier	1	1989	4	1989	4	1989	4	100
4547	7511	Lac Neuf	1	1989	7	1989	7	1989	7	100
4600	7511	Lac Elmitt	1	1989	2	1989	2	1989	2	100
4644	7511	Lac Pérodeau	2	1982	9	1982	9	1992	3	33
4700	7511	Lac de la Dam	1	1996	6	1996	6	1996	6	100
4537	7510	Lac Valdor	6	1982	3	1992	132	1992	132	100
4556	7510	Lac Mort	2	1989	6	1989	6	1992	4	67
4604	7510	Lac Lafontaine	2	1989	6	1989	6	1992	6	100
4628	7510	Lac Lacordaire	4	1978	25	1992	57	1992	57	100
4725	7510	Lac Clover	2	1986	5	1992	12	1992	12	100
4611	7509	Lac Avon	2	1982	4	1982	4	1983	3	75
4614	7509	Lac des Perdreaux	3	1982	4	1982	4	1989	2	50
4615	7509	Lac Alos	3	1983	8	1983	8	1992	1	13
4620	7509	Lac Bourgeois	2	1979	1	1979	1	1979	1	100
4640	7509	Réservoir Kiamika	4	1969	28	1969	28	1983	8	29
4542	7508	Lac à Larouche	1	1989	2	1989	2	1989	2	100
4550	7508	Lac Montreuil	3	1989	8	1990	12	1992	12	100
4610	7508	Lac Robillard	11	1977	25	1979	29	1986	7	24
4617	7508	Lac Montjoie	4	1982	3	1983	8	1992	1	13
4620	7508	Lac Primeau	2	1979	1	1979	1	1979	1	100
4621	7508	Lac Bruchési	2	1982	1	1983	3	1983	3	100
4641	7508	Lac Jean	2	1981	3	1983	8	1983	8	100
4556	7507	Lac Simon	3	1980	3	1982	5	1983	2	40
4544	7506	Lac Belisle	3	1986	7	1986	7	1989	2	29
4638	7506	Île aux Perdrix	2	1988	6	1992	8	1992	8	100
4616	7504	Lac à Joe	1	1997	4	1997	4	1997	4	100
4557	7501	Lac Trois	1	1989	3	1989	3	1989	3	100
4559	7459	Lac des Pins	2	1989	8	1989	8	1992	1	13
4600	7459	Lac à l'Île (<i>n</i> = 2)	1	1989	2	1989	2	1989	2	100
4546	7458	Lac Chartrand	1	1981	2	1981	2	1981	2	100
4557	7458	Lac Tremblant	1	1989	2	1989	2	1989	2	100
4601	7458	Lac Welches	2	1986	5	1992	7	1992	7	100
4609	7458	Lac des Roches (<i>n</i> = 2)	1	1992	2	1992	2	1992	2	100
4545	7457	Lac Green	1	1981	1	1981	1	1981	1	100
4601	7457	Lac Belisle (<i>n</i> = 2)	4	1984	13	1984	13	1992	8	62
4604	7457	Lac de l'Île (<i>n</i> = 2)	5	1992	1	1993	11	1998	11	100
4608	7457	Lac des Roches	6	1982	22	1983	31	1999	15	48
4633	7455	Lac Mousseau (<i>n</i> = 2)	2	1990	8	1990	8	1990	8	100
4612	7454	Lac Larouche	1	1995	14	1995	14	1995	14	100
4540	7453	Lac Presseau	3	1981	6	1981	6	1989	1	17
4700	7453	Lac Ribereys	2	1990	8	1990	8	1992	4	50
4700	7453	Lac Seagull	1	1991	3	1991	3	1991	3	100
4627	7452	Lac Valade	1	1991	4	1991	4	1991	4	100
4550	7451	Lac du Loup	2	1983	1	1983	1	1984	1	100
4601	7451	Lac du Chevreuil	1	1995	5	1995	5	1995	5	100
4540	7450	Lac Côté	1	1983	2	1983	2	1983	2	100
4548	7450	Lac à l'Orignal	1	1982	6	1982	6	1982	6	100
4611	7450	Lac Boisseau	1	1997	5	1997	5	1997	5	100
4542	7449	Lac Maholey	5	1983	7	1990	55	1997	1	2
4547	7449	Lac Taunton	2	1989	4	1989	4	1997	4	100
4549	7449	Lac Jackson	4	1981	6	1981	6	1989	1	17
4551	7449	Lac à la Croix	4	1981	3	1997	23	1997	23	100
4617	7449	Lac Baillargé	1	1995	8	1995	8	1995	8	100

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Outaouais — Lower Outaouais (continued)										
4541	7448	Lac des Îles (<i>n</i> = 2)	6	1981	10	1989	27	1992	9	33
4548	7448	Lac du Héron	2	1983	2	1983	2	1989	1	50
4611	7448	Lac des Trois Montagnes	2	1979	9	1979	9	1995	7	78
4627	7447	Lac Chaud	1	1976	14	1976	14	1976	14	100
4540	7446	Lac Robinson	1	1992	5	1992	5	1992	5	100
4545	7446	Lac Double	3	1989	7	1990	21	1992	6	29
4615	7446	Lac Bélanger	1	1995	8	1995	8	1995	8	100
4549	7445	Lac Spring	3	1989	11	1992	21	1992	21	100
4551	7445	Lac de la Mine (<i>n</i> = 2)	1	1989	1	1989	1	1989	1	100
4557	7444	Lac Diane	3	1989	6	1989	6	1992	3	50
4607	7443	Lac Olivier	1	1995	5	1995	5	1995	5	100
4541	7440	Lac Robinson (east)	3	1989	18	1990	19	1992	1	5
4616	7438	Lac Bleu	3	1974	50	1974	50	1979	6	12
4625	7438	Lac Labelle	2	1991	7	1991	7	1992	3	43
4540	7434	Grenville	1	1994	6	1994	6	1994	6	100
4610	7433	Chemin du lac Gauthier	1	1996	7	1996	7	1996	7	100
4552	7432	Lac Harrington	1	1995	4	1995	4	1995	4	100
4543	7431	Lac Croissant	1	1997	6	1997	6	1997	6	100
4548	7430	Lac Farmer	1	1995	2	1995	2	1995	2	100
4559	7429	Lac des Écorces	1	1995	14	1995	14	1995	14	100
4603	7429	Lac du Cordon	1	1995	6	1995	6	1995	6	100
4610	7429	Lac Caché	1	1977	10	1977	10	1977	10	100
4617	7429	Lac Bagsly	2	1992	4	1993	5	1993	5	100
4619	7428	Ruisseau Poisson	2	1988	4	1988	4	1989	3	75
4625	7428	Lac Escalier	4	1989	2	1991	6	1993	5	83
4544	7427	Pine Hill	1	1995	2	1995	2	1995	2	100
4541	7426	Roussillon	1	1995	2	1995	2	1995	2	100
4547	7426	Lac Louisa	1	1995	14	1995	14	1995	14	100
4633	7426	Lac Tinkler	3	1981	10	1981	10	1988	10	100
4635	7426	Lac des Mocassins	4	1989	4	1992	26	1992	26	100
4550	7424	Lac No Man	2	1989	15	1989	15	1996	5	33
4557	7424	Lac du Cœur	1	1977	8	1977	8	1977	8	100
4604	7424	Nantel	2	1938	31	1938	31	1939	22	71
4627	7424	Lac Bowden	1	1990	4	1990	4	1990	4	100
4551	7423	Lac Saint-Victor	1	1995	14	1995	14	1995	14	100
4542	7422	Lac Carillon	1	1992	23	1992	23	1992	23	100
4626	7422	Lac Trap	3	1989	1	1990	4	1991	1	25
4541	7421	Lachute	1	1991	16	1991	16	1991	16	100
4542	7421	Ruisseau Hutt	1	1992	50	1992	50	1992	50	100
4550	7421	Lac de la Montagne	2	1981	5	1992	9	1992	9	100
4631	7420	Lac Impérial	3	1991	1	2000	2	2000	2	100
4526	7419	Mont Rigaud	2	1997	15	1997	15	2001	15	100
4548	7419	Lac Manitou	1	1995	7	1995	7	1995	7	100
4551	7419	Lac Dyer	4	1978	5	1981	11	1992	7	64
4553	7419	Lac Bigras	1	1992	8	1992	8	1992	8	100
4633	7417	Lac du Diable	5	1989	26	1990	32	1996	3	9
4543	7415	Hill Head	1	1995	13	1995	13	1995	13	100
4543	7414	Lac Sir-John	1	1997	21	1997	21	1997	21	100
4548	7413	Lac Fiddler	1	1977	8	1977	8	1977	8	100
4549	7411	Lac Tamaracouta	2	1992	6	1992	6	1995	4	67
4549	7410	Lac Strong	2	1991	24	1991	24	1992	22	92
4550	7410	Lac Ouimet	1	1992	15	1992	15	1992	15	100
4549	7409	Lac Paul	2	1990	23	1990	23	1992	16	70
Laurentians										
4654	7620	Lac à Roger	1	1997	27	1997	27	1997	27	100
4607	7451	Lac la Boîte	2	1990	24	1990	24	1997	9	38
4544	7423	Dalesville	1	1992	3	1992	3	1992	3	100
4656	7419	Lac du Castor	1	1977	30	1977	30	1977	30	100
4701	7418	Lac Dons	2	1997	10	1997	10	2001	5	50
4733	7407	Lac Manouane	4	1978	25	1992	60	2001	2	3
4631	7406	Lac Garrot	5	1977	10	1983	23	1989	10	43
4735	7406	Lac Manouane (île Green)	1	2001	16	2001	16	2001	16	100
4642	7405	Lac Collin	2	1977	3	1977	3	1979	1	33
4601	7402	Lac Pitt	1	1995	17	1995	17	1995	17	100
4601	7358	Lac Baulne	2	1997	7	1997	7	1997	7	100
4602	7358	Lac Burton	2	1997	4	1997	4	2001	1	25

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronomy	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Laurentians (continued)										
4554	7355	Domaine-Breton	1	2001	34	2001	34	2001	34	100
4605	7345	Lac à Shields (south)	2	1997	3	2001	4	2001	4	100
4730	7340	Lac Minet	2	1992	21	1992	21	2001	11	52
4700	7339	Lac Lachance	3	1990	1	1993	2	1993	2	100
4658	7336	Lac Poucette	5	1991	7	1995	33	2001	17	52
4805	7335	Lac du Droit	4	1981	9	1992	115	2001	115	100
4617	7333	Lac Noir (<i>n</i> = 2)	1	1970	10	1970	10	1970	10	100
4721	7333	Lac Saint-Arnaud	3	1986	9	1986	9	2001	1	11
4702	7331	Lac à la Chienne	2	1995	1	1995	1	1995	1	100
4643	7330	Grand lac des Îles	1	1986	2	1986	2	1986	2	100
4648	7326	Lac Verso	3	1976	3	1976	3	1981	1	33
4851	7319	Lac Béland	1	1991	2	1991	2	1991	2	100
4634	7318	Lac Saint-Bernard	9	1971	67	1971	67	2001	21	31
4702	7316	Lac du Caribou	2	1992	3	1992	3	1992	3	100
5000	7311	Lac Hertel	3	1997	19	1997	19	2000	16	84
4840	7310	Lac du Mâle	3	1984	19	1984	19	1984	19	100
4648	7307	Lac Anticagamac	1	1992	1	1992	1	1992	1	100
4830	7301	Lac Rivard	2	1995	2	1995	2	1995	2	100
4656	7250	Lac Caribou	6	1977	15	1980	28	2001	23	82
4713	7243	Lac Houle	3	1992	6	1993	11	1994	11	100
4805	7243	Lac Davenne	2	1984	4	1984	4	1984	4	100
4703	7240	Lac Mékinac	2	1981	2	1981	2	1986	2	100
4721	7239	Lac Wayagamac (île Steamboat)	10	1971	135	1971	135	2001	41	30
4827	7225	Lac du Curé	1	2001	29	2001	29	2001	29	100
4735	7222	Lac Édouard	4	1982	29	1992	132	2001	128	97
4822	7220	Lac Ross	4	1986	43	1986	43	1986	43	100
4701	7213	Lac à Charles	1	2001	2	2001	2	2001	2	100
4746	7212	Lac Baptiste	2	1985	20	1985	20	1986	4	20
4714	7209	Lac O'Neil	2	1996	8	2001	31	2001	31	100
4722	7204	Lac Danielle	2	1996	11	1996	11	2001	11	100
4806	7200	Lac de la Chaîne	3	1988	25	1988	25	1989	11	44
4808	7157	Lac Rond	4	1984	7	1984	7	1985	7	100
4814	7152	Lac à la Carpe	6	1984	35	1984	35	2001	30	86
4723	7146	Lac Croche (<i>n</i> = 2)	1	1992	3	1992	3	1992	3	100
4933	7146	Lac Gicopec	1	1983	6	1983	6	1983	6	100
4654	7137	Lac Saint-Joseph	2	1976	5	1976	5	1976	5	100
4652	7136	Sainte-Catherine	7	1960	15	1977	31	1982	4	13
4840	7134	Lac Gosselin	1	2001	8	2001	8	2001	8	100
4724	7131	Petit lac Jacques-Cartier	18	1978	25	1992	113	2001	20	18
4823	7129	Lac Kénogami	8	1974	5	1991	67	1995	35	52
4656	7123	Lac Saint-Charles	1	1981	10	1981	10	1981	10	100
4819	7117	Île Verte	3	1993	18	2001	51	2001	51	100
4812	7114	Lac des Islets	2	1997	8	1997	8	1997	8	100
4845	7110	Réservoir Lamothe	1	2001	21	2001	21	2001	21	100
4737	7100	Lac à Jack	8	1983	30	1986	53	1989	16	30
4744	7045	Étang Malbaie	1	1993	23	1993	23	1993	23	100
4916	7040	Lac Rond	2	1997	21	2001	51	2001	51	100
4907	7036	Lac Vanel	3	1995	10	1995	10	1996	5	50
4844	7035	Lac Maingard	3	1987	32	1987	32	1987	32	100
4853	7035	Lac Barrin	3	1994	13	1994	13	1994	13	100
4745	7020	Lac des Marais	2	1997	2	1997	2	1997	2	100
4907	7018	Lac Portneuf	2	1997	13	2001	21	2001	21	100
4918	6822	Rivière Manicouagan (Manic 2)	3	1996	15	1997	17	2001	8	47
Appalachians										
4504	7418	Godmanchester	1	2001	18	2001	18	2001	18	100
4502	7404	Herdman	4	1992	5	1993	12	2001	1	8
4504	7401	Rivière aux Outardes Est	1	2001	8	2001	8	2001	8	100
4506	7358	Ormstown	2	1997	25	1997	25	2001	1	4
4506	7354	Saint-Pierre	1	2001	8	2001	8	2001	8	100
4503	7343	Covey Hill	1	2001	3	2001	3	2001	3	100
4503	7332	Hemmingford	1	2001	14	2001	14	2001	14	100
4507	7317	Saint-Paul-de-l'Île-aux-Noix	2	1938	46	1938	46	1938	46	100
4512	7314	Sabrevois	2	1977	6	1977	6	1977	6	100
4502	7306	Philipsburg	2	1972	1	1977	8	1977	8	100
4507	7255	Stanbridge East	1	1959	38	1959	38	1959	38	100

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
Appalachians (continued)										
4507	7251	Meigs Corners	3	1989	10	1992	13	1992	13	100
4511	7244	Cowansville	11	1959	38	2001	51	2001	51	100
4524	7236	Yamaska	2	1997	19	1997	19	2001	3	16
4517	7234	Lac Brome	6	1985	8	1987	9	1988	6	67
4529	7234	Roxton-Sud	2	1997	5	2001	7	2001	7	100
4516	7230	Ruisseau Quilliams	2	1988	2	1992	16	1992	16	100
4521	7228	Frost Village	2	1997	9	1997	9	2001	2	22
4521	7228	Lac Brousseau	1	2001	1	2001	1	2001	1	100
4523	7228	Warden	2	1997	5	2001	7	2001	7	100
4523	7226	Sainte-Anne-de-la-Rochelle	2	1990	10	1992	17	1992	17	100
4504	7225	Mansonville	3	1986	3	1990	5	1992	2	40
4516	7225	Foster	3	1988	45	1988	45	1992	25	56
4517	7225	Ruisseau Quilliams (<i>n</i> = 2)	2	1992	15	1992	15	2001	15	100
4509	7224	Étang Fullerton	5	1976	3	1986	6	1988	3	50
4522	7223	Stukely-Sud	2	1997	8	1997	8	2001	2	25
4526	7223	West Ely	2	1997	2	2001	3	2001	3	100
4510	7220	Bolton-Sud	3	1987	3	1992	12	2001	1	8
4510	7220	Étang George	1	2001	3	2001	3	2001	3	100
4520	7220	Lac Parker	2	1997	5	1997	5	2001	4	80
4516	7217	Mont Chagnon	3	1987	5	1987	5	1988	5	100
4521	7213	Étang Fer de Lance	2	1997	2	1997	2	2001	2	100
4522	7213	Mont Chauve	7	1977	7	1981	10	1987	1	10
4520	7211	Étang de la Cuvette	6	1986	31	1988	38	2001	1	3
4532	7210	Kingsbury	6	1977	12	1986	28	1992	3	11
4537	7210	Gallup Hill	3	1991	15	1992	39	1992	39	100
4516	7207	Magog	3	1988	50	1988	50	2001	19	38
4536	7206	Colline Melbourne	2	1992	25	1992	25	1992	25	100
4536	7206	Colline Melbourne	1	2001	5	2001	5	2001	5	100
4534	7205	Saint-François-Xavier	2	1992	16	1992	16	1992	16	100
4511	7201	Bacon's Bay	1	2001	4	2001	4	2001	4	100
4536	7150	Watopeka	8	1986	106	1986	106	2001	38	36
4631	7145	Rivière Huron	6	1977	10	1977	10	1989	8	80
4538	7142	Lac Watopeka	2	1997	20	1997	20	1997	20	100
4543	7132	Lac Fer à Cheval	3	1988	1	1990	3	1990	3	100
4550	7132	Saints-Martyrs-Canadiens	2	1989	15	1989	15	1989	15	100
4518	7118	Bellefeuille	2	1982	12	1982	12	1986	5	42
4549	7116	Lac de la Héronnière	4	1986	3	2001	5	2001	5	100
4549	7113	Lac Champoux	7	1980	20	1980	20	1997	2	10
4547	7112	Lac des Îles	3	1986	5	1986	5	1987	2	40
4551	7112	Lac des Ours	7	1981	25	1992	57	2001	35	61
4547	7108	Baie Felton	2	1983	4	1983	4	1986	2	50
4527	7105	Mont Mégantic	5	1982	15	1985	17	1987	4	24
4526	7053	Lac Mégantic	5	1982	7	1982	7	1992	3	43
4647	7035	Lac aux Castors (<i>n</i> = 2)	15	1977	35	1983	38	1993	29	76
4647	7010	Lac Talon	1	2001	20	2001	20	2001	20	100
4646	7001	Lac Leverrier	1	1993	9	1993	9	1993	9	100
4813	6827	Lac Ferré	3	1996	66	1996	66	1997	34	52
4835	6736	Île Matane	6	1977	22	1992	41	2001	18	44
St. Lawrence — Freshwater										
4502	7435	Île Dickerson	6	1985	50	1996	207	1996	207	100
4502	7430	Réserve Saint-François	1	1979	1	1979	1	1979	1	100
4533	7424	Pointe-Fortune	4	1992	62	1993	87	2001	10	11
4531	7418	Île Carillon	14	1937	10	1979	152	1992	14	9
4517	7410	Île Bienville	6	1989	6	1992	51	2001	42	82
4517	7403	Île Villemoble	8	1968	36	1968	36	1980	4	11
4528	7400	Grande baie d'Oka	18	1966	18	1976	88	2001	73	83
4522	7357	Île Perrot	1	1938	40	1938	40	1938	40	100
4524	7354	Île Dowker	9	1981	29	1987	132	1993	118	89
4520	7351	Iles de la Paix (Île de la Plaine)	6	1987	5	2001	64	2001	64	100
4523	7346	Île Saint-Bernard	12	1979	57	1986	205	1992	10	5
4525	7335	Île aux Hérons	18	1963	10	1993	359	2001	176	49
4557	7326	Crabtree	1	1993	8	1993	8	1993	8	100
4549	7319	Île Bouchard	5	1979	7	2001	21	2001	21	100
4607	7301	Grande île de Berthier	13	1975	20	1992	1300	1992	1300	100
4615	7253	Bois-du-Boulé	9	1976	34	1982	90	1996	2	2
4610	7241	Pointe aux Pois	2	1985	10	1994	12	1994	12	100

Appendix 1 (continued)

Description of the 705 Quebec Great Blue Heron colonies visited between 1977 and 2001

Latitude	Longitude	Heronry	Number of visits	Discovery		Peak		Last visit		Trend
				Year	Number of nests	Year	Number of nests	Year	Number of nests	
St. Lawrence — Estuary										
4702	7040	Îles Brothers	5	1980	1	2001	11	2001	11	100
4704	7037	Île à Deux Têtes	7	1977	21	1979	33	1981	6	18
4705	7036	Île de la Corneille	6	1979	4	2001	83	2001	83	100
4714	7026	Battures aux Loups Marins	8	1978	8	1990	24	2001	21	88
4712	7024	Le Pilier de Bois	2	1991	2	1991	2	1991	2	100
4736	6953	Île Brûlée	12	1966	50	1966	50	2001	3	6
4737	6952	Grande île de Kamouraska	9	1977	19	1980	42	2001	35	83
4742	6945	Le Petit Pèlerin	8	1979	3	2001	13	2001	13	100
4744	6944	Le Pèlerin du Jardin	2	1992	8	1992	8	1992	8	100
4743	6943	Le Long Pèlerin	6	1977	2	2001	4	2001	4	100
4745	6942	Le Gros Pèlerin	14	1969	75	1969	75	2001	18	24
4752	6941	Le Gros Pot	8	1977	3	1991	112	2001	62	55
4752	6941	Le Petit Pot	1	1992	16	1992	16	1992	16	100
4756	6941	Île Blanche	5	1977	4	1977	4	1978	2	50
4802	6941	Île du Chafaud aux Basques	6	1977	9	1979	46	1981	45	98
4825	6919	Îlets Boisés	3	1992	7	2001	11	2001	11	100
4809	6915	Île aux Basques	19	1929	65	1929	65	2001	49	75
4845	6902	Île Laval	11	1979	21	1986	80	2001	47	59
4825	6853	Île Bicquette	1	2001	34	2001	34	2001	34	100
4824	6852	Île du Bic	6	1977	26	1980	49	2001	5	10
4852	6847	Îlets Jérémie	6	1979	30	1980	61	1988	3	5
4854	6840	Pointe à Michel	3	1980	6	1980	6	1992	1	17
4901	6839	Rivière de Papinachois	2	1978	10	1978	10	1978	10	100
4901	6837	Île de l'Anse des Aulnes	1	2001	4	2001	4	2001	4	100
4828	6833	Île Saint-Barnabé	9	1971	90	1980	91	2001	8	9
4903	6833	Île de la Mine	10	1983	9	1993	24	1995	13	54
4903	6831	Île la Boule	5	1990	9	1990	9	1993	1	11
4903	6826	Pointe aux Outardes	5	1978	65	1979	72	1981	18	25
4916	6803	Pointe Saint-Panrace	2	1992	18	1992	18	2001	16	89
4920	6759	Havre Mistassini	5	1984	1	1989	14	1992	8	57
4917	6758	Rocher Mistassini	1	2001	26	2001	26	2001	26	100
4919	6725	Grande anse Saint-Augustin	1	2001	6	2001	6	2001	6	100
4937	6711	Île aux Œufs	3	1992	22	2001	39	2001	39	100
4949	6702	Île du Petit Caoui	2	1992	14	2001	20	2001	20	100
5001	6649	Île à Bois	1	1995	13	1995	13	1995	13	100
5001	6649	Île aux Cormorans	1	2001	19	2001	19	2001	19	100
St. Lawrence — Gulf										
4808	6625	Ruisseau des Anglais	9	1983	8	1991	16	2001	5	31
5006	6624	Île Manowin	2	1992	31	1992	31	2001	31	100
5006	6624	Île Manowin (<i>n</i> = 2)	1	2001	6	2001	6	2001	6	100
4805	6619	Miguasha	9	1977	71	1977	71	1992	11	15
4812	6558	Maria	9	1977	70	1981	104	1990	2	2
4811	6550	New Richmond	5	1956	24	1991	61	1993	25	41
4805	6531	Bonaventure	7	1977	28	1979	31	1986	15	48
4820	6442	Île Beauséjour	4	1977	3	1992	15	2001	14	93
4848	6431	Rivière York	3	1981	14	1981	14	1981	14	100
4851	6427	Ruisseau Beaudry	2	1977	20	1977	20	1978	9	45
4851	6424	Ruisseau à l'Eau	2	1974	12	1974	12	1974	12	100
4950	6419	Anticosti Island	2	1993	15	1993	15	1993	15	100
4716	6159	Pointe à Canot	2	1990	5	1992	12	1992	12	100
4724	6152	Grand-Ruisseau	3	1988	60	1992	67	1992	67	100
4737	6131	Grosse-Île	5	1979	31	1979	31	1992	6	19
4737	6129	Mont Moore	1	1992	21	1992	21	1992	21	100
4738	6129	Île aux Loups Marins	9	1976	37	1976	37	1990	2	5

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