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Analysis of Breeding Bird Survey Coverage in Quebec

Gilles Falardeau

Quebec Region

Canadian Wildlife Service
Technical Report Series Number 498
March 2009

Canada 



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ANALYSIS OF BREEDING BIRD SURVEY COVERAGE IN QUEBEC

Gilles Falardeau¹

**Technical Report Series No. 498
March 2009
Canadian Wildlife Service
Quebec Region
Environmental Stewardship Branch**

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Library and Archives Canada Cataloguing in Publication

Falardeau, Gilles

Analysis of breeding bird survey coverage in Quebec
[electronic resource] / Gilles Falardeau.

(Technical report series ; no. 498E)

Electronic monograph in PDF format.

Issued also in French under title: Analyse de la couverture du relevé des oiseaux nicheurs au Québec.

Issued by: Québec Region.

Issued also in printed form.

Includes bibliographical references:

ISBN 978-1-100-11707-2

Cat. no.: CW69-5/498E-PDF

1. North American Breeding Bird Survey--Evaluation. 2. Bird surveys--Québec (Province)--Evaluation. 3. Bird populations--Québec (Province). 4. Birds--Québec (Province)--Geographical distribution. I. Canadian Wildlife Service II. Canadian Wildlife Service. Quebec Region III. Title. IV. Series: Technical report series (Canadian Wildlife Service : Online) no. 498E

QL685.5 Q4 F35 2008

333.95'81109714

C2009-980025-X

© Her Majesty the Queen in Right of Canada, represented by the Minister of Environment, 2009.
Catalogue No. CW69-5/498E-PDF
ISBN 978-1-100-11707-2

This report may be cited as follows:

Falardeau, G. 2009. Analysis of Breeding Bird Survey Coverage in Quebec. Canadian Wildlife Service, Quebec Region. Technical Report Series No. 498, ix + 35 p.

A copy of this report can be obtained by contacting:

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Aussi disponible en français

ABSTRACT

The Breeding Bird Survey (BBS) is a survey conducted primarily by volunteers from roadsides across North America. The BBS was initiated in 1966 in order to monitor bird population trends continent-wide. In 2007, there were 4,443 BBS routes in North America, at least 2,929 of which were surveyed that year. The BBS has proven its usefulness and, for example, was instrumental in detecting the decline in neotropical migrants in the 1980s and in grassland birds in the 1990s.

There were 150 active routes in Quebec in 2007, 73 of which were surveyed. Obviously, most of these routes are located in the southern part of the province, in the most densely populated areas where there are more birders likely to participate in these surveys. Again with reference to 2007, 60% of the 73 routes surveyed were located south of the 47th parallel (approximate latitude of the city of Québec) and only six routes were surveyed north of the 49th parallel (approximate latitude of the city of Matane).

The largest number of routes surveyed in 2007 was in Bird Conservation Regions (BCRs) 12 and 14, with 27 and 21 routes, respectively. Fewer routes (15) were surveyed in BCR 13, despite the fact that it is the most densely populated in the province, since it is also by far the smallest BCR in Quebec. Finally, only 10 routes were surveyed in BCR 8 and none in BCRs 7 and 3, the most northerly. A statistical power analysis showed that with the number of routes currently surveyed, a 50% decline over a 20-year period could be detected with a power of 0.8 and a significance level α of 0.1 for several dozen species in each of BCRs 12, 13 and 14, but for only two species in BCR 8.

Coverage could very likely be increased to approximately 90 routes in Quebec without a significant additional investment of time, money or effort. For example, participation could be increased in the Lower St. Lawrence, Gaspé Peninsula, Saguenay–Lac-Saint-Jean and Abitibi regions through appropriate promotional efforts since these regions have good pools of experienced birders and a number of non-surveyed BBS routes. However, it would probably be very difficult to achieve a target of more than 90 to 100 surveyed routes without a significant investment of time and money. Targets for the numbers of routes in each BCR are provided in this report.

The road network and the concentration of the population in the southern part of the province also impose a northern limit on the area that the BBS could adequately cover. For instance, the most northerly significant population concentrations (Abitibi, Saguenay–Lac-Saint-Jean, North Shore) are located in the southern portion of BCR 8. It is therefore possible to properly cover the Boreal Hardwood Transition (BCR 12) with the help of volunteers, but much more difficult to cover the Boreal Softwood Shield (BCR 7) and the Taiga Shield and Hudson Plains (BCR 8). This is reflected in the current BBS trend data for most boreal species, which have a high variance and a low statistical power for detecting significant trends. Having CWS employees survey the BBS routes appears to be the most effective way of obtaining data in BCRs 7 and 8, and would be one option to consider. Indeed, this possibility is suggested in a proposal currently under development to establish a national boreal bird monitoring program. The southern boreal forest would be covered by using paid employees to improve BBS coverage, while the northern boreal forest would be surveyed by other monitoring programs that remain to be determined.

Despite its strengths, the BBS also has its limitations and weaknesses, and it does not adequately monitor all bird species in all regions of North America. Ideally, additional monitoring programs should be established in order to more effectively monitor landbird species that are not well covered by the BBS, such as nocturnal species, colonial species, rare species, species that breed very early in the spring, high elevation species, northern boreal forest species and tundra species.

RÉSUMÉ

Le Relevé des oiseaux nicheurs (ou BBS) est un inventaire effectué principalement par des bénévoles à partir des bordures de routes de l'Amérique du Nord et qui a été instauré en 1966 pour suivre les tendances des populations d'oiseaux à la grandeur du continent. En 2007, on comptait 4443 trajets d'inventaire en Amérique du Nord, dont au moins 2929 ont été inventoriés cette même année. Le BBS a prouvé son utilité et a permis, par exemple, de détecter la baisse des migrateurs néotropicaux dans les années 1980 et des oiseaux des prairies dans les années 1990.

Au Québec, on dénombrait 150 parcours actifs en 2007 dont 73 ont été inventoriés. La majorité de ces parcours se retrouvaient évidemment dans le sud de la province, dans les régions le plus densément habitées où on trouve davantage d'observateurs d'oiseaux susceptibles de participer à ces inventaires. Toujours en 2007, 60 % des 73 parcours inventoriés se trouvaient au sud du 47^e parallèle (latitude approximative de la ville de Québec) et seulement six trajets ont été inventoriés au nord du 49^e parallèle (latitude approximative de la ville de Matane).

C'est dans les régions de conservation des oiseaux (RCO) 12 et 14 que l'on retrouvait le plus grand nombre de parcours inventoriés en 2007 avec 27 et 21 respectivement. On retrouvait un nombre moindre de trajets inventoriés (15) dans la RCO 13 malgré qu'elle soit la plus densément peuplée de la province car c'est aussi, de loin, la plus petite RCO au Québec. Finalement, seulement dix parcours avaient été inventoriés dans la RCO 8 et aucun dans les RCO 7 et 3, les plus nordiques. Une analyse de puissance statistique a montré qu'avec le nombre de parcours actuellement inventoriés, on pourrait détecter un déclin de 50 % sur une période de 20 ans avec une puissance de 0,8 et un seul de signification α de 0,1 pour quelques dizaines d'espèces dans chacune des RCO 12, 13 et 14, mais seulement deux dans la RCO 8.

Il serait vraisemblablement possible d'augmenter la couverture jusqu'à environ 90 parcours au Québec sans avoir à investir considérablement plus d'effort, de temps et d'argent. Il serait possible, par exemple, d'augmenter la participation dans les régions du Bas-Saint-Laurent, de la Gaspésie, du Saguenay – Lac-Saint-Jean et de l'Abitibi par des efforts de promotion adéquats car ces régions possèdent de bons bassins d'observateurs d'oiseaux expérimentés et plusieurs trajets BBS non inventoriés. Par contre, il serait probablement très difficile d'aller au-delà de 90 à 100

parcours inventoriés sans investissement important de temps et d'argent. Des objectifs de nombres de tracés par RCO sont présentés dans le rapport.

Le réseau routier et la concentration de la population dans le sud de la province imposent aussi une limite nord à la zone que peut couvrir adéquatement le BBS. Ainsi, les régions habitées d'importance les plus nordiques (Abitibi, Saguenay – Lac-Saint-Jean, Côte-Nord) se trouvent dans le sud de la RCO 8. Il est donc possible de bien couvrir la forêt boréale mixte (RCO 12) à l'aide de bénévoles, mais beaucoup plus difficile d'atteindre la forêt boréale de conifères (RCO 7 et 8). Ceci se reflète dans les données de tendances BBS actuelles de la plupart des espèces boréales qui ont une variance élevée et une faible puissance statistique à détecter des tendances significatives. L'inventaire de parcours BBS par des employés du SCF semble la façon la plus efficace d'obtenir des données dans les RCO 7 et 8 et serait une avenue à considérer. Une proposition présentement en préparation pour établir un programme national de surveillance des oiseaux de la forêt boréale fait d'ailleurs état de cette possibilité. Le sud de la forêt boréale serait couvert par l'amélioration de la couverture du BBS par des employés payés et le nord serait inventorié par d'autres programmes de surveillance qui restent à déterminer.

Malgré ses forces, le BBS a aussi ses limites et ses faiblesses et il n'assure pas un suivi adéquat de toutes les espèces d'oiseaux dans toutes les régions d'Amérique du Nord. Un certain nombre de programmes de surveillance additionnels devraient idéalement être établis pour mieux suivre les espèces d'oiseaux terrestres qui ne sont pas bien couvertes par le BBS comme les espèces nocturnes, les espèces coloniales, les espèces rares, les espèces qui nichent très tôt au printemps, les espèces de haute altitude, les espèces du nord de la forêt boréale et les espèces de la toundra.

ACKNOWLEDGEMENTS

I would like to thank Brian Collins, senior biostatistician at the National Wildlife Research Centre of the Canadian Wildlife Service (CWS), who provided me with various data concerning BBS coverage in Quebec and elsewhere in Canada and who performed the statistical power analyses presented in this report. Brian also answered many of my questions concerning the analysis of BBS data and the factors that affect the ability to detect significant trends in bird populations. I would also like to thank Connie Downes and Bev McBride, who are responsible for coordinating the BBS in Canada for the CWS and who answered my many questions, in addition to agreeing to read and comment on this report. I would also like to thank my colleagues Bruno Drolet and Vincent Carignan of the CWS, Quebec Region, for their helpful suggestions and insightful comments. Thanks also to the many birders who have participated, usually on a fully volunteer basis, in surveying the BBS routes since 1966. I would also like to acknowledge the contribution of all those who have previously been involved in coordinating the BBS in Quebec, namely: Anthony Erskine, Henri Ouellette, Raymond McNeil, Raymond Cayouette, André Cyr, Daniel St-Hilaire and Daniel Jauvin. I hope that I have not overlooked anyone.

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INTRODUCTION

With the increased use of pesticides such as DDT in the mid-1900s, bird mortalities caused by the use of these products began to be observed. At the time, there were no tools for monitoring bird populations and it was not known whether the impact of pesticides was highly localized or whether populations could be affected regionally or even nationally. In response to this concern, Chandler Robbins and his colleagues at the Patuxent Wildlife Research Center suggested establishing a North American network for monitoring bird populations using surveys conducted mainly by volunteers from roadsides (USGS 2001). And so the Breeding Bird Survey (BBS) was launched in 1966. Approximately 600 survey routes were surveyed in the first year. Since then, the program has grown steadily in popularity, with 4,443 survey routes in North America in 2007, at least 2,929 of which were surveyed that year (Ziolkowski and Pardieck 2008). There were 150 active routes in Quebec in 2007, 73 of which were surveyed that year. At the time of writing of this report, all data for 2008 were not available.

The BBS has since proven its usefulness and, for example, was instrumental in detecting the decline in neotropical migrants in the 1980s and in grassland birds in the 1990s. Despite its strengths, the BBS also has its limitations and is not an equally effective tool for monitoring all bird species in all regions of North America. This report examines coverage of the Breeding Bird Survey in Quebec and potential ways to improve coverage and increase the number of routes surveyed annually in the province.

METHODOLOGY

The BBS is a survey conducted from roadsides in North America. A BBS route is composed of 50 equidistant survey stations (or stops) 0.8 km (or 0.5 mile) apart. Throughout the entire continental United States and southern Canada, nearly every block of one degree of latitude by one degree of longitude has at least one active – but not necessarily regularly surveyed – BBS route.

The location of the starting point for each route is selected randomly and must be situated at an easily identifiable landmark, such as an intersection or bridge. The starting direction for the route is also selected randomly. The routes must remain within the degree block in which they

are begun and also cannot follow part of another established route. The survey is conducted only on provincial, county or municipally maintained secondary roads in order to avoid high-traffic primary roads and poorly maintained roads.

In Canada, there is usually one established route per degree block in the more remote areas, two routes per block in low-density populated areas where there are alternating covered and non-covered blocks, and up to four routes in densely populated areas where there are many volunteer participants. For data analysis in Canada, each route is assigned a weight that is inversely proportional to the number of routes surveyed in the block so that each block has the same weight regardless of the number of surveyed routes in that block.

The survey is conducted during the period when the largest number of species can be detected by song, i.e. from May 28 to July 7 in Canada (CWS 2007). The survey begins one-half hour before sunrise under conditions conducive to bird observation (no precipitation, light winds). The observation period at each station is only three minutes, during which the observer must record all the birds heard and seen within a 400-m radius. Ideally, the survey should last four to five hours.

CURRENT BBS COVERAGE IN QUEBEC

As mentioned earlier, there were 150 active routes in 2007, 73 of which were surveyed that year. Table I shows the distribution of routes by status and by Bird Conservation Region (BCR) in 2007. In the case of the 15 or so routes that extend over two BCRs, the route is allocated to the BCR in which most of the route is located. An assigned route is a route that was assigned to a participant but was not surveyed.

BCRs 12 and 14 are the regions in which the largest number of routes were surveyed in 2007, i.e. 27 and 21, respectively (Table I). Although BCR 13 is the most densely populated region in Quebec, its small size (see Table II) limits the number of routes that can be established in this BCR and, consequently, there are fewer surveyed routes (15) than in BCRs 12 and 14. The number of routes surveyed then drops sharply as one moves further north, with only 10 in BCR 8 and none in BCRs 7 and 3. In addition, no routes have ever been established in BCR 3 since there is virtually no road network there (Table II).

Table I. Number and status of BBS routes by BCR in 2007

BCR	Status			Total	Surveyed/ Total
	Surveyed	Assigned	Available		
13	15	2	2	19	79%
14	21	4	14	39	54%
12	27	7	16	50	54%
8	10	5	24	39	26%
7	0	0	3	3	0%
3	0	0	0	0	0%
Total	73	18	59	150	49%

Table II. Area and length of the road network by BCR

BCR	Area (km ²)*	Length of the road network (km) [†]
13	31,200	24,893
14	65,930	23,428
12	170,080	22,675
8	462,360	19,197
7	561,720	1,868
3	207,400	80
Total	1,498,690	92,142

* Rounded to the nearest 10 km²

† According to digital maps with a scale of 1:250,000

Figure 1 shows the location of the BBS routes in Quebec and the BCR boundaries. It is immediately obvious that the vast majority of the routes surveyed in 2007 are in the southern part of the province. Also evident is the total absence of surveyed routes in Abitibi, as well as a large proportion of available routes in the northern part of Témiscamingue, the Outaouais and Mauricie regions, in Saguenay–Lac-Saint-Jean, in the Gaspé Peninsula and even in the Lower

St. Lawrence region. This pattern is even more pronounced in Table III: 60% (44/73) of the surveyed routes were located south of the 47th parallel while only six were located north of the 49th parallel. In all, there are only three established routes north of the 51st parallel and they have not been surveyed since the mid-1980s. However, there is good potential for establishing new routes between the 51st and 54th parallels on road sections not currently used by the BBS, mainly in the James Bay territory. This point will be discussed later. However, it will be difficult to recruit volunteer participants to survey these routes.

Table III. Number of BBS routes in Quebec by latitude in 2007

Latitude	Status			Total	Surveyed/ Total
	Surveyed	Assigned	Available		
45°0' -	44	6	4	54	81%
47°0' -	23	7	41	71	32%
49°0' -	6	5	11	22	27%
51°0' -	0	0	2	2	0%
53°0' -	0	0	1	1	0%
Total	73	18	59	150	49%



Figure 1. Location and status of BBS routes in Quebec in 2007

Bart et al. (2004) estimated the number of routes required by province and state to ensure adequate BBS coverage of at least 80% of the landbird species that warrant monitoring. Under current conditions, with the current potential bias, which the authors estimated at ± 0.008 , 265 routes should be surveyed in Quebec, which is unrealistic and represents a larger number of routes than currently exist. By reducing the potential bias to ± 0.003 , the number of routes to be surveyed in Quebec would be reduced to 110, which is still high, but more feasible.

The same authors point out that it would be more effective to reduce the current potential bias of the BBS than to increase the number of routes surveyed, although both objectives are desirable. O'Connor et al. (2000) suggested various options for reducing the bias of the BBS by using distance sampling and multiple observers methods, for example, which would allow detection probabilities to be calculated for many species. It is hoped that this methodology could also

make it possible to conduct analysis of data sets despite observer changes. The 2006-2010 BBS strategic plan (USGS 2007) also recommends a review and testing of new protocols that would make it possible to estimate detection probabilities. However, some experts do not share this opinion and believe instead that estimating detection probabilities will be accompanied by its own problems and additional biases (B. Collins and C. Downes, CWS, pers. comm.) and that increasing coverage is the best way to improve the BBS.

In Canada, a trend analysis for a species is run only if that species is found in 15 or more routes each year for the time interval concerned and only if at least 40 individuals were reported in all of those years (Downes and Collins 2003). The primary objective should therefore be to increase to at least 15 the number of routes surveyed each year in the BCRs for which this threshold has not yet been attained (obviously, where this is possible) in order to be able to at least conduct trend analyses for the most common species. In order to ensure good representativeness, these routes should also be distributed fairly uniformly in the BCR and not be concentrated in one part of the BCR.

To demonstrate this even more clearly, Brian Collins, senior biostatistician at the National Wildlife Research Centre of the Canadian Wildlife Service (CWS) in charge of BBS statistical analyses, performed statistical power analyses to assess the capacity to detect population trends for birds in the four Quebec BCRs for which we have sufficient data. The graphs in Figure 2 represent the cumulative number of species for which a 50% decline over a 20-year period could be detected with a power of 0.8 (probability of correctly detecting an actual decline) and a significance threshold α of 0.1 (probability of reporting a decline that does not actually exist). The power analyses were performed with real data from the 1968-2006 and 1986-2006 periods and therefore consider factors that reduce the power of the sampling design, such as observer changes, routes that are not surveyed in certain years and routes that are no longer surveyed. In principle, one would expect to detect a decline for a larger number of species for the 1986-2006 period because the analyses are based on a larger number of routes and data per species. On the other hand, one would also expect to see trend changes in more species over a longer period, which increases the standard error of the trend and reduces the capacity to detect significant declines. This may be what happened with BCR 14, where more declines can be detected in the shorter 1986-2006 period than in the 1968-2006 period (Figure 2).

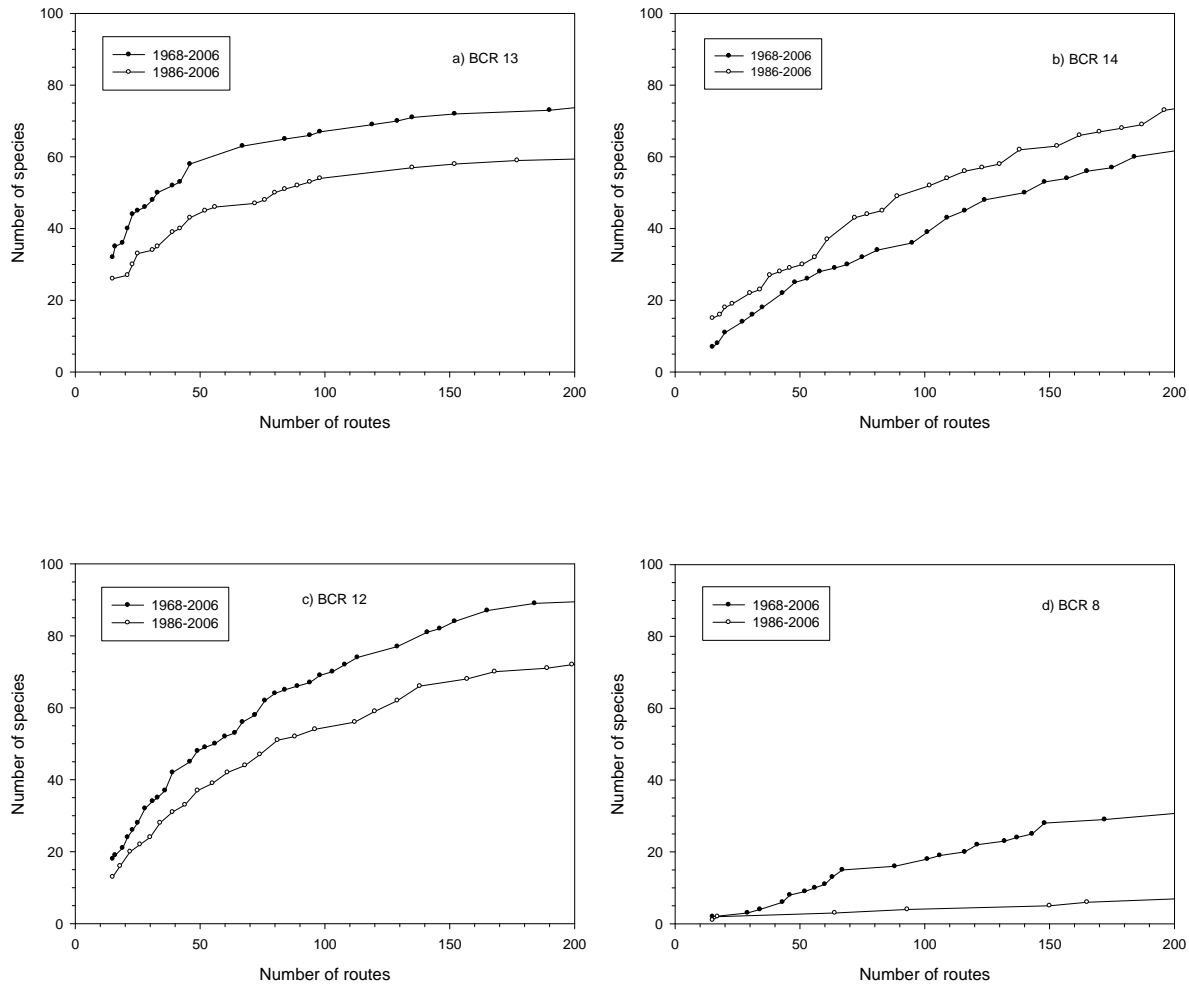


Figure 2. Number of species for which a 50% population decline over a 20-year period can be detected with a power of 0.8 and a significance level of 0.1 as a function of the number of routes by BCR in Quebec

For the 1968-2006 period, BCR 13 is the region in which declines for the largest number of species could be detected, i.e. 32, with the minimum (and current) number of 15 routes (Figure 2). By comparison, declines could be detected for 18 species in BCR 12, seven species in BCR 14 and only two species in BCR 8 for the same period with 15 routes. However, if we consider instead the number of routes surveyed by BCR in 2007, population declines could be detected for 28 species in BCR 12, 11 in BCR 14 and none in BCR 8. As noted earlier, and in contrast with the other BCRs, a larger number of declines could be observed in BCR 14 during the 1986-2006 period, i.e. 15 species with 15 routes and 18 species with the current number of 21 routes.

It should be noted that a large proportion of the routes surveyed in BCR 8 from 1968 to 2006 are located in the southern portion of this BCR and come mainly from the inhabited regions of Abitibi and Saguenay–Lac-Saint-Jean. Most of the data therefore do not come from the truly boreal areas of this region and are not fully representative of the BCR as a whole. This is also reflected in the ranking of the species for which a decline could be detected (Appendix 1). The species for which a decline could be detected with the smallest number of routes are, in order, the American Robin, White-throated Sparrow, Song Sparrow, Common Yellowthroat and Killdeer. The first real boreal species, Swainson's Thrush, is in eleventh place, with at least 60 routes.

A very large number of surveyed routes would be required in BCRs 8 and 12 in Quebec in order to detect a significant decline for many boreal species, such as the Bay-breasted Warbler (BCR 8: 931; BCR 12: 1,904), Boreal Chickadee (BCR 8: insufficient data for estimation; BCR 12: 321) or Rusty Blackbird (BCR 8: insufficient data for estimation; BCR 12: 414). The situation for these species is similar in the same BCRs in Ontario (P. Blancher and B. Collins, CWS, pers. comm.). At first glance, one might think that it will be virtually impossible to detect declines for these species in BCRs 8 and 12, but the power analysis, which is based on existing data, underestimates the real trend detection potential in these BCRs. As mentioned earlier, the routes in BCR 8 surveyed in the past do not provide genuinely adequate coverage of the truly boreal areas where these species are more common, and this is also true for the northern portion of BCR 12. There are also few surveyed routes and they have rarely been run by the same observers over long periods. It is known that observer changes and missing data (routes not surveyed for several years) significantly reduce the capacity to detect population changes (Brian Collins, CWS, pers. comm.). It would be reasonable to assume that several dozen routes always run by the same observers over 20 years in a truly boreal environment would be a much more effective sampling design. However, it is impossible to perform this calculation because we obviously do not have these data, but BCR 13 proves that it is nonetheless possible to detect a large number of declines with a small number of regularly surveyed routes. Since it will always be much more difficult to recruit, retain and replace observers in the most remote BCRs, we will have to consider the possibility of reimbursing the travel expenses of volunteers or even sending CWS employees to these BCRs, which is also a recommendation made in the BBS strategic plan (USGS 2007).

The fact remains that trends for boreal species are often imprecise even for Canada as a whole (Machtans and Schmiegelow in prep.), that the situation still remains worrisome and that a better

understanding of the causes will be necessary. It is also possible that the BBS is less effective in monitoring the populations of these species due to various factors. The Rusty Blackbird, Boreal Chickadee and Bay-breasted Warbler are species that are more difficult than average to detect, especially from a greater distance. Certain boreal forest species may also vary their range from year to year depending on the availability of food or logging activity, which would increase the variance of the trend data. The Rusty Blackbird and Boreal Chickadee are early-breeding species, making them even more difficult to detect during the BBS survey period. In addition, spruce budworm specialist species, such as the Bay-breasted Warbler, reversed their trends during the 1968-2006 period, which also increases the variance of the trend data.

Brian Collins has suggested a potentially promising solution for maximizing coverage in remote areas. An observer who is willing to survey more than one route per year would be assigned responsibility for more routes than he could run in a single year and would survey them on a rotating cycle. For example, instead of always surveying the same two routes, the observer would be responsible for three routes and would run two per year. For instance, he would run two routes the first year; he would re-survey one of these two routes and survey the third route in the second year; in the third year, the observer would re-survey the third route and the previous year's non-surveyed route; and would begin the cycle over again the next year. This would provide better geographic coverage as well as improving statistical power.

However, it is recognized that the BBS alone is not capable of providing effective monitoring of boreal forest birds in both Quebec and Canada (Machtans and Schmiegelow in prep.; CWS in prep.), the main reason being that the road network and the available routes cover only the southern portion of the boreal region. Monitoring the boreal forest is a complex subject that goes beyond the scope of this report. However, we note that a proposal is under development to institute a national boreal bird monitoring program (CWS in prep.). Nevertheless, improving BBS coverage in the boreal region is an objective of both the USGS plan (2007) and the report by Machtans and Schmiegelow (in prep.) on the monitoring of boreal forest birds. The BBS has the advantage that it is already well established, has a good administrative and data management structure, and uses a standardized peer-reviewed methodology. It could provide coverage of the southern portion of the boreal forest, while the northern portion would be covered by other survey programs, yet to be determined.

The use of microphones and digital recordings is not yet allowed for the BBS, but the USGS (2007) is proposing to use these methods to supplement the survey in remote regions. Using microphones offers a number of advantages and research on this subject is currently under way. Microphones can be operated by individuals who are not fully (or even not at all) familiar with bird songs if experts subsequently listen to the recordings. The time series can continue to be used despite changes in observers in the field provided that the individuals listening to the recordings are always the same. A permanent archive of the surveys is also kept which can be analyzed using new analytical methods that might be developed in the future. It is even possible that software for recognizing bird songs and calls may be developed in the coming years, which would significantly reduce the time needed to process the recordings.

QUEBEC'S CONTRIBUTION TO CANADIAN TREND ANALYSES

Table IV presents the number of routes surveyed in Quebec and in Canada since 1994. During this period, the number of routes surveyed in Quebec accounted for 11% to 15% of the Canadian total. A fairly high number of routes were run in our province from 1995 to 2000, followed by a slight decline until the CWS took over responsibility for managing coordination of the BBS in Quebec in 2005. The 73 routes surveyed in 2006 and in 2007 represent the historical peak for our province. Ontario was the province with the largest number of surveyed routes in 2007, with 96, followed closely by Alberta with 94. The record number for a province was reached in 2006 in Ontario with 107 routes.

The question is sometimes asked about how significant a contribution Quebec data make to trend analyses in certain BCRs, particularly the more northerly ones. Table V presents the number of routes and blocks surveyed by BCR in Quebec and in Canada in 2007. For that year, our region contributed just over one third of the data for BCRs 12 and 14 and approximately one quarter of the data for BCRs 8 and 13. We did not contribute to the data for BCRs 3 and 7, but even Canada-wide coverage is deficient. The percentage of routes surveyed in Quebec relative to the rest of Canada in 2007 in BCR 12 was exactly the same (36%) as for the entire 2001-2007 period. However, the province's relative contribution in 2007 was slightly higher than average for the 2001-2007 period in BCR 13 (25% versus 21%) and BCR 14 (36% versus 31%) and much higher in BCR 8 (26% versus 12%). This is attributable to a larger increase in participation in these BCRs in Quebec for the last several years rather than a decline in the rest of the country.

Table IV. Number of BBS routes surveyed in Quebec and in Canada, 1994-2007

Year	Quebec	Canada	Quebec / Canada
1994	47	389	12%
1995	60	441	14%
1996	58	413	14%
1997	62	431	14%
1998	57	427	13%
1999	56	446	13%
2000	58	465	12%
2001	53	475	11%
2002	46	435	11%
2003	51	428	12%
2004	53	441	12%
2005	61	449	14%
2006	73	486	15%
2007	73	501	15%

Table V. Number of routes and blocks surveyed in Quebec and in Canada in 2007

BCR	Route			Blocks		
	Quebec	Canada	Qc / Can	Quebec	Canada	Qc / Can
13	15	60	25%	7	25	28%
14	21	59	36%	10	30	33%
12	27	74	36%	16	42	38%
8	10	39	26%	8	35	23%
7	0	5	0%	0	6	0%
3	0	1	0%	0	1	0%
Total	73	238	31%	41	139	29%

However, in order to more effectively analyze the contribution of our region to the trend data, a longer timeframe must be considered, and the manner in which the analyses are performed and the weighting factors used must be examined. In Canada, when an analysis is performed for a given period, the data from all the routes surveyed at least twice by the same observer under favourable conditions (light winds, weather conditions, date, start time) during this period – without necessarily being consecutive years – are included in the analysis (B. Collins, CWS, pers. comm.). The data from a route are then weighted based on the number of routes surveyed in the same block and also based on the size of the block. Since it would be very complicated to consider all the weighting factors, only the factor that has the greatest influence on data analysis will be considered (according to B. Collins, CWS, pers. comm.), namely the number of years in which the data for a route can be used for trend analysis. We will arbitrarily call this unit “route-year.” For example, the data collected on a route by the same observer under favourable conditions for 20 years are equivalent to 20 route-years. It is important to note that this number differs from the total number of routes surveyed since the data from a route run only once by an observer cannot be used in trend calculations and are not included in the route-year total. Table VI presents the number of route-years used for the trend analyses by BCR and by province from 1968 to 2007. The overall contribution of our region relative to Canada as a whole is significant in the four most southerly BCRs, namely 35% in BCR 12 and 20% to 23% in BCRs 8, 13 and 14. The overall ratio of BCR 12 is similar to that of the routes surveyed in 2007 (Table V), whereas it is slightly lower in BCRs 8 and 13, and significantly lower in BCR 14, where the 2007 contribution is clearly higher. The overall contribution of our region will increase if the current participation level is maintained and if participants are retained for as long as possible.

Table VI. Total number of route-years that can be used for trend calculation by BCR and by province, 1968-2007

	Province							
BCR	Newfoundland	Nova Scotia	Prince Edward Island	New Brunswick	Quebec	Ontario	Manitoba	Quebec / Canada
13	-	-		-	346	1,196	-	22%
14	-	702	107	712	452	-	-	23%
12	-	-	-	-	566	972	97	35%
8	169	-	-	-	103	160	71	20%

POTENTIAL FOR ESTABLISHING NEW ROUTES AND INCREASING PARTICIPATION

Most of the current routes in Quebec were established in the late 1960s or early 1970s (C. Downes, CWS, pers. comm.) when the project was launched, and to date, little effort has been made to take advantage of the new roads built in the northern region, in BCRs 7 and 8, where there was no access only a few decades ago. One example that comes to mind is the new roads in the James Bay territory. Figure 3 illustrates this unused portion of the northern road network. At least 22 new routes could be established, which would bring the total for Quebec to more than 170.

In terms of recent initiatives to improve participation in the BBS, an article published in the magazine *QuébecOiseaux* (Falardeau 2005) was particularly effective, attracting a number of new participants to the BBS in Quebec, proving more successful than several oral presentations, which enlisted only one or two new volunteers per presentation. Since 2005, several CWS – Quebec Region employees have also offered to survey from one to three routes. For instance, in 2007, two indeterminate employees, one temporary employee and one CWS retiree surveyed a total of six BBS routes.

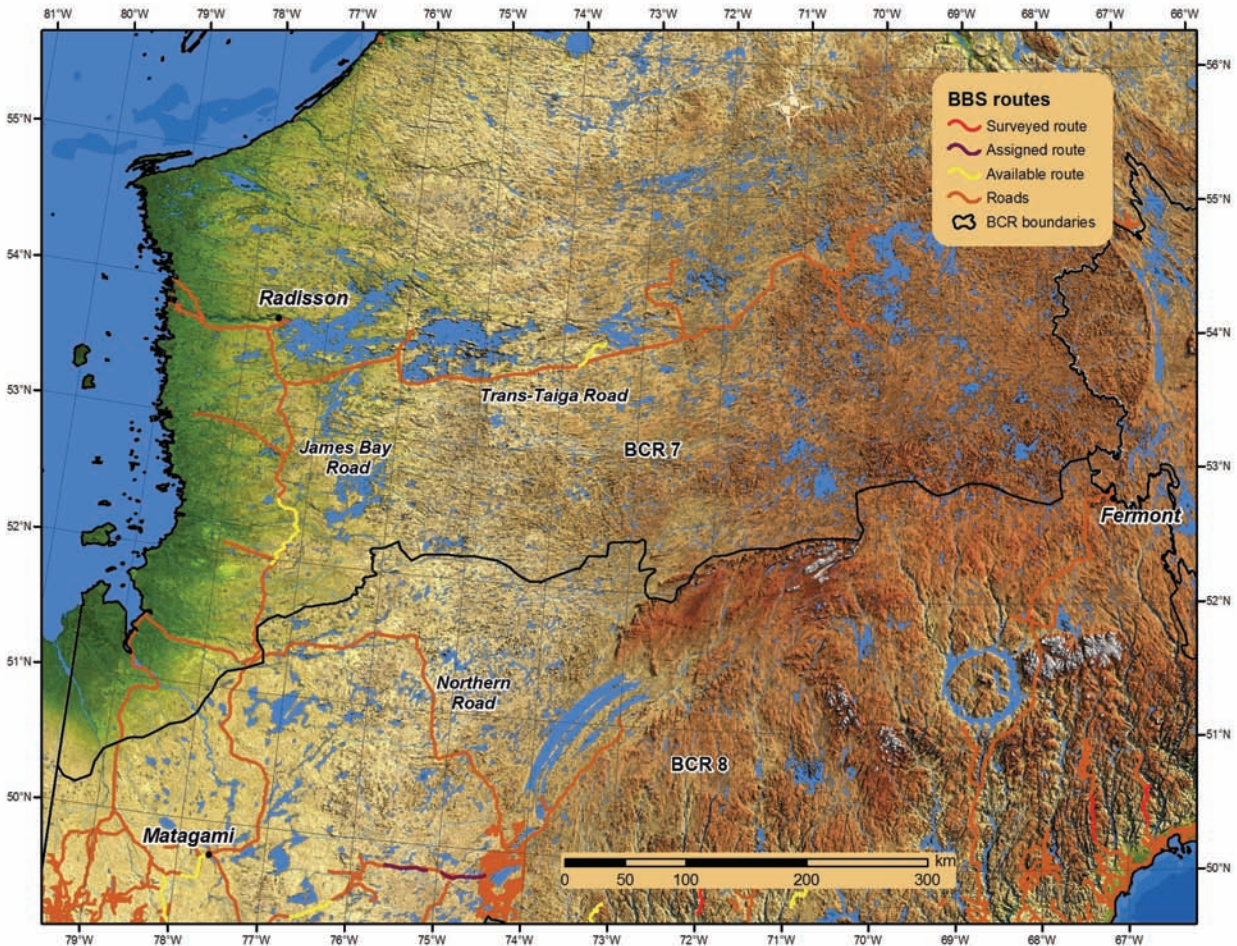


Figure 3. Blocks where additional BBS routes could be established in northern Quebec

BCR 13

We are close to full coverage in this BCR, with 17 of the 19 routes either surveyed or assigned. The strength of this BCR is that virtually all the routes are surveyed each year, a number of them by the same observers for many years. However, the number of routes currently surveyed (15) is barely adequate and could benefit from being increased, but it is currently impossible to add new routes to BCR 13 since the Canadian BBS coordination office has adopted a temporary limit of four routes per block of one degree of latitude by one degree of longitude in order to “spread out” participation and prevent volunteers from limiting themselves primarily to the routes close to the most densely populated areas. However, this is an interim measure and the USGS plan (2007) recommends developing directives aimed at the regional coordinators in order to optimally distribute the survey effort. It may then be possible to add at least four or five new routes in the

Quebec portion of this BCR, which would make it possible to obtain more accurate trends for the common species and to detect trends for an additional number of less common species. In the meantime, in this BCR, it is important to have loyal and reliable participants in order to derive maximum benefit from the limited number of routes that can be surveyed.

BCR 14

Coverage of the southern portion of this BCR is very good as far as Montmagny, which corresponds to the area covered by the hardwood forest in this BCR. Ideally, it would be necessary to have a larger number of routes surveyed in the Lower St. Lawrence and Gaspé Peninsula. Participation in this BCR could be increased by promoting the BBS since there is a pool of birders in these two regions. It would be desirable to have about 30 routes surveyed annually in this BCR.

BCR 12

As in BCR 14, the southern portion is well covered and the northern half would benefit from better coverage. However, the northern sector of this BCR is sparsely populated and it will be difficult to find participants there, except south and west of Lac-Saint-Jean. Participation must be maintained in at least 30 routes annually in this BCR in addition to improving coverage of its northern portion. If volunteers cannot be found to survey the northern part of this BCR, it may be necessary to consider the possibility of eventually sending CWS employees to conduct the BBS survey. However, the issue of employee-conducted surveys will be addressed in more detail in the section on BCR 8 which follows.

BCR 8

Ten routes were run in this BCR in 2007: six on the North Shore and four in Saguenay–Lac-Saint-Jean. This is a substantial improvement since six routes were surveyed in 2006 and none in 2005 and 2004. This is the BCR in which coverage has improved the most in the last few years. Nonetheless, there are still some major gaps, since no routes have been surveyed for years in the western portion, in Abitibi.

A first step was taken in 2008 with the survey of three routes in Abitibi, but priority must nonetheless be given to promoting the BBS in this region so that at least several additional routes are surveyed. Promotion efforts should also be carried out in Saguenay–Lac-Saint-Jean, where

there is a good pool of skilled and very active birders. The goal would be to attain a minimum of 15 routes surveyed each year – the same target set for the Ontario portion of this BCR (Ontario Partners in Flight 2006) – and these routes would have to be distributed in all the sectors where routes are available and not only in the populated areas of Abitibi and Saguenay–Lac-Saint-Jean, in order to ensure better geographic representativeness of the BCR.

Another problem with this BCR is that even the available routes are nearly all located in the southern portion. New routes could be added further north along the road connecting Baie-Comeau and Fermont (at least three), on the Northern Road connecting Chibougamau and the James Bay Road (at least five), as well as along the southern part of the James Bay Road (at least one) connecting Matagami and Radisson (Figure 3). However, it will be difficult to recruit volunteers to conduct surveys on these new routes without reimbursing their travel expenses. We will also have to consider the possibility of having the surveys carried out by permanent CWS employees who would be able to complete these surveys for at least 10 to 20 years. Indeed, we must target a sufficiently long period of time in order to be able to detect trends in many species that experience abundance cycles (Bart et al. 2004). It is also important to be able to keep the same observers and manage the project ourselves in order to control the factors of variation associated with observer changes, weather conditions and the survey period, which reduce the capacity to detect trends, so that the highest possible statistical power can be attained. However, the use of microphones and new techniques for estimating detection probabilities could make it possible in the future to overcome the problems associated with observer changes and allow this work to be carried out by seasonal or less qualified personnel rather than by regular employees. It will also be important to target the best time of the year to conduct the surveys in these less well known regions.

It is therefore difficult to contemplate obtaining adequate BBS coverage of the northern portion of this BCR without considerable investments of time and money. The USGS plan (2007) and the draft document on monitoring in the boreal forest (Machtans and Schmiegelow in prep.) both call for allocating additional resources to the BBS in order to obtain better coverage of the northern routes. They also suggest encouraging and increasing the participation of paid employees in conducting surveys in remote regions. In our region, some thought will have to be given to the issue of setting monitoring priorities and the allocation of resources to this end in the northern portion of BCR 8 and also in BCR 7, whether or not resources are obtained. The

possibility of partnerships will also have to be examined, but there appear to be fewer such opportunities than in BCR 7.

BCR 7

There are only three established routes in BCR 7 and they have not been surveyed since the mid-1980s. To increase coverage, additional routes could be established along the James Bay Road (at least four) and on the Trans-Taiga Road (at least eight) that connects Radisson to Caniapiscau. Again it is not possible to consider obtaining adequate coverage of this BCR with the BBS without considerable investments of time and money. CWS employees could conduct annual surveys in this BCR. It would also probably be possible to find volunteers interested in conducting surveys in the James Bay area if their travel expenses were reimbursed. As in the northern portion of BCR 8, some thought will have to be given to the issue of setting monitoring priorities and whether to allocate resources for monitoring boreal forest birds. Once the national directives and priorities have been more firmly established, it will also be easier to set goals and priorities for our region.

Of the various possible partnerships, we could endeavour to negotiate an agreement with Hydro-Québec to obtain free accommodation and meals for observers at Hydro-Québec camps and residences. Hydro-Québec technicians or biologists could perhaps conduct BBS surveys. There are also three outfitters along the Trans-Taiga Road. If these outfitters have wildlife technicians who are very familiar with bird songs, they might be interested in surveying a route. The possible use of microphones and recordings in the future could also facilitate this collaboration since the people involved would not even have to know the bird songs.

However, only the southern portion of this BCR can be surveyed using the BBS since north of the 55th parallel, there are not even any roads long enough to establish routes there! The draft documents on the monitoring of boreal forest birds in Canada (CWS in prep.; Machtans and Schmiegelow in prep.) include suggestions to supplement the BBS in the northern boreal forest, where there are no roads, and suggest trying to maximize the BBS survey in the southern portion of the boreal forest.

BCR 3

There are two fairly long stretches of road on which two BBS routes could be established in the regions of Kattiniq, Purtuniq and Déception in Quebec's Far North. However, it is highly

unlikely that we will manage to find volunteer observers. There are possibly other roads or trails not indicated on the maps in this BCR. The Kativik Regional Government could possibly provide this information, but there is no reason to believe that we will find enough sufficiently long stretches of road. The USGS plan (2007) recommends examining the feasibility of incorporating shorter routes (20 or 30 stops, for example) in remote regions. If this option is adopted, it would thus be possible to incorporate a certain number of “mini BBS routes” on short stretches of road. It will continue to be difficult to have them surveyed.

However, it appears to be more worthwhile to join the Program for Regional and International Shorebird Monitoring (PRISM) and conduct surveys of landbirds at the same time as shorebirds in the Far North (Dunn et al. 2005a; Dunn and Downes in prep.). In fact, the survey methods and dates are also suitable for landbirds. Indeed, surveys of shorebirds, waterbirds and landbirds using the PRISM method were conducted in 2002 in the Puvirnituk region in Ungava with the collaboration of the CWS – Quebec Region in order to assess the feasibility of this method and gather more detailed data about breeding birds in the area (Andres 2006). See Bart (2006) for more details on PRISM.

WEAKNESSES OF THE BBS

The main strength of the BBS is its coverage of a large proportion of inhabited North America at low cost considering the quantity of information collected. The data are used to produce distribution and density maps and to obtain analyses of trends that are valid for a large number of North American bird species for the 1966-2007 period. However, since the surveys are always conducted early in the morning from late May to early July, it is known that the BBS does not provide effective coverage of nocturnal species such as nightjars and owls (O'Connor et al. 2000) and very early breeding species such as jays, woodpeckers and chickadees, for example. Because of the random distribution of the routes along roads, the BBS also does not provide effective coverage of colonial birds, especially seabirds (murrelets, puffins, etc.); nor does it effectively cover rare, localized and cryptic species and most aquatic species (rails, bitterns, gallinules, etc.), all of which require adapted and “specialized” surveys. As mentioned earlier, it is also a well known fact that the BBS provides poor coverage of remote regions, where the pool of volunteer participants is small, and that it does not cover the most northerly regions of Canada since the BBS cannot be conducted where there are no roads. Dunn et al. (2005a) have drawn up a list of

landbirds that regularly breed in North America and that are not currently well monitored by one of the monitoring programs under way, and these authors provide recommendations for improving the monitoring of these birds.

O'Connor et al. (2000) examined the weaknesses and biases of the BBS. For instance, the BBS is carried out only along roadsides, for practical reasons. This can pose representativeness problems if the roadside habitats are different compared to the area as a whole and especially if their characteristics change over time at different rates. However, an unpublished study by O'Connor and other colleagues, mentioned in O'Connor et al. (2000), found only minor differences between remotely sensed land cover data in spatial units along nearly 1,200 BBS routes in the United States compared to the same data for more than 11,000 other spatial units of the same size as their study area. In addition, according to another unpublished study, this time by Peter Blancher of the CWS (O'Connor et al. 2000), there was a good match between on-road and off-road habitats in the ecozones that are well sampled by the BBS in Canada, while there was a bias in the poorly sampled ecozones such as the boreal forest zone. Another study conducted in New Brunswick found that there were significantly fewer mature forests along roadsides from 1974 to 2001 (Betts et al. 2007). The results therefore seem to vary from region to region, and a similar study should be conducted in Quebec as soon as possible.

It might also be thought that the bird assemblages detected along roadsides might differ from those encountered off road. However, according to certain studies reviewed by O'Connor et al. (2000), this has little effect on bird abundance and would be limited to differences observed for a few species only. O'Connor et al. (2000) nevertheless expressed some reservations about these studies since this is a somewhat surprising finding considering that roadside areas have structures that attract birds or make them more easily detectable, such as power lines, fences, houses and farm buildings, bird feeders, etc.

However, since the primary goal of the BBS is to calculate trends, the potential non-representativeness of roadside habitat is not a major problem if it does not bias the bird population trend results, i.e. if the trends observed near routes are similar to those that occur for the area as a whole. At least two studies, one in Ohio and the other in Ohio and Maryland (Bart et al. 1995; Keller and Scallan 1999), did not find any major differences in the changes over time of roadside habitats compared to the rest of the study area. However, Keller and Scallan (1999) note that while the rates of change of the landscape over time are similar, certain habitat

characteristics evolve differently. Roadsides tend to become urbanized more quickly and to contain more houses and other buildings and, conversely, there is a faster increase in streams and drainage channels distant from roads in agricultural areas, for example. For its part, the previously mentioned study by Betts et al. (2007) in New Brunswick demonstrated that in the 1970s and 1980s, mature forests disappeared at a faster rate distant from the routes than along the routes. Similar analyses should be repeated in other regions and with a more detailed habitat classification (Bart et al. 1995). In order to better compare roadside habitats along BBS routes with off-road habitats and monitor changes affecting them over time, both past and future, it was suggested that the stops of all the BBS routes be georeferenced (O'Connor et al. 2000; USGS 2007) and that analyses be carried out using satellite imaging. A similar directive was also given at a meeting of North America BBS coordinators held in 2005. Similar comparisons should also be carried out in Quebec once all the survey stops have been georeferenced.

Another consequence of urbanization is that many routes have been abandoned in the last few decades because of the significant increase in traffic and noise interfering with bird observation. These routes have been replaced by routes located on quieter, less urbanized secondary roads where the habitats are not as “degraded” as along the original routes. This could have the effect of understating the negative trends for certain species (O'Connor et al. 2000).

The BBS data also pose analysis and interpretation problems caused by observer changes (Sauer et al. 1994), by improvement in observers' skills as they become familiar with their routes (Kendall et al. 1996), by the large proportion of routes not surveyed annually and by the uneven coverage from region to region (Thomas 1996). As they gain experience, observers can also improve their skills in detecting and identifying birds or, conversely, they may also, with age, detect fewer birds, and in particular certain species with very high-pitched songs, due to reduced auditory acuity (O'Connor et al. 2000). Little effort has also been invested in reducing variation between observers, which can also be another source of bias. The development of training programs for observers could be beneficial in reducing variation in species identification skills and species detection probabilities between observers (O'Connor et al. 2000). It is also hoped that a new methodology for estimating detection probabilities could compensate, at least in part, for the differences in skills between observers.

When trends are calculated over a long time period, it must be assumed, among many suppositions, that the bird detection probability does not change during the period. However, it is

known that this probability can vary as a function of changes to the habitat (for example, sound transmits less well as a forest stand grows taller and closes in) or as a function of changes in the observers' skills, as mentioned earlier. That is why O'Connor et al. (2000) suggested that studies be conducted in order to more effectively evaluate the effect of possible changes in bird detection probability and the changes that could be made to the survey and trend calculation methods.

There are various approaches to analyzing BBS data (Thomas 1996; O'Connor et al. 2000) and the different methods yield results that can differ even if there are many more similarities than differences. For instance, there are differences between the analysis method used in Canada by the CWS and the method used in the United States by the Patuxent Wildlife Research Center. The differences concern the covariables, weighting factors, how variations between observers are controlled, how variance is calculated, etc. It should be noted that data analysis is far from simple and is complicated by a host of factors such as observer changes and the fairly significant level of missing data (routes not surveyed) that occur each year. It is obviously recommended that both countries work together to harmonize their analysis methods.

PARTICIPANT PROFILE

A constant challenge with this type of survey based primarily on volunteer participation is recruiting and especially retaining participants, particularly since retention of participants over long periods on a large number of routes is a key factor in increasing the capacity (power) to detect long-term trends in bird populations (B. Collins, CWS, pers. comm.).

A participant profile can be established from a survey of Canadian participants conducted in 2004. This survey indicated that 73% of respondents were 46 years or older at the time and that only 10% were 35 years or younger, which points to likely problems attracting a new generation of observers once the baby boomers retire from the BBS. It is imperative that we find ways of interesting young people in bird watching and involving them in similar volunteer activities. However, there is some good news, namely that average number of years during which the first route assigned to a volunteer is surveyed by the same volunteer is 10 years. However, this duration is highly variable. For instance, while 25% quit after the first year, 11% remain for more than 20 years.

SUMMARY AND RECOMMENDATIONS

Despite its deficiencies, the BBS is the only monitoring program that provides data at the continental, national and regional scale, and it has provided population trends and annual indices for 73% of landbirds in Canada (Downes et al. 2000) for approximately 40 years at low cost. It is also the only or the best source of data on long-term changes in populations of a number of species that are not covered by other monitoring programs. As well, it is the large-scale monitoring program with the most standardized survey methods and sampling plan, which lends its results greater authority (Downes et al. 2000). It is clear that we must continue to promote and improve the BBS in Quebec, in Canada and in North America. In the same way as in elections where each vote counts even though it does not make a difference on its own, each BBS route counts.

A management decision will have to be made in order to determine the extent of the investment of time and money we wish to make in the BBS in Quebec. The BBS currently takes up approximately three to four weeks of the time of one CWS employee in the Quebec Region (the author of this report) and costs \$1,000 to \$2,000 a year in travel expenses. Without significantly increasing the investment in time and money, it would still be possible to increase participation to a more satisfactory level by promoting the BBS in certain targeted regions of Quebec mentioned earlier: Gaspé Peninsula, Lower St. Lawrence, Saguenay–Lac-Saint-Jean and Abitibi. It may therefore be possible to increase participation to at least 90 routes surveyed annually, distributed as follows: approximately 18 to 20 in BCR 13, 25 to 30 in BCR 14, 30 to 35 in BCR 12 and approximately 15 in BCR 8. We will also have to consider preparing a new generation of birders to replace the aging observers who will likely retire within 10 years. Surveying more than 90 to 100 BBS routes in Quebec would probably not be possible without a major investment of time and money in order to reach, for example, the target of 110 routes mentioned by Bart et al. (2004). If this option is adopted, then we will have to seriously consider the possibility of having CWS employees conduct surveys of BBS routes in the northern portion of BCR 12, in BCR 8 and perhaps also in BCR 7.

Due to the known weaknesses of the BBS discussed earlier, it is also essential to supplement the BBS with other surveys specially designed to monitor specific groups of birds. The CWS is already conducting many waterfowl monitoring programs in Quebec, including some in conjunction with the United States Fish and Wildlife Service, which are too numerous to list

here. The CWS also monitors the colonies of many seabird species and other colonial birds. It also coordinates the American Woodcock Singing Ground Survey with the United States Fish and Wildlife Service, and also monitors Chimney Swift sites and the sites of species at risk (*SOS-POP*) with the *Regroupement QuébecOiseaux*. Bird Studies Canada coordinates the Quebec Marsh Monitoring Program and the Nocturnal Owl Survey. There is also the Canadian Migration Monitoring Network, whose members in Quebec are the *Observatoire d'oiseaux de Tadoussac* and the McGill Bird Observatory. As mentioned earlier, in the future, the CWS also hopes to establish a national boreal bird monitoring program (CWS in prep.).

Two other data sources can also be used to monitor bird population trends in North America or Quebec, namely the Christmas Bird Count coordinated by Bird Studies Canada in Canada, and the *Étude des populations d'oiseaux du Québec* (ÉPOQ) database managed by the *Regroupement QuébecOiseaux*. Although both are important and very useful data sources, trend analysis using these data is significantly complicated by the fact that these data come from poorly standardized surveys that have many uncontrolled sources of variation such as observation effort, habitats visited, weather conditions at the time of the survey and, in the case of ÉPOQ, even the geographic origin of the data, the exact delimitation of the area surveyed, the period of the year, the period of the day and the duration of the survey. Various recommendations were recently made in an effort to improve the scientific value of the Christmas Bird Count data (Francis et al. 2004; Dunn et al. 2005b). There have also been various statistical developments to better control the various sources of variation of the data in order to conduct more valid trend analyses (Link and Sauer 1999; Sauer and Link 2002; Sauer et al. 2004; Link et al. 2006). Similar efforts will have to be made in Quebec in order to be able to analyze the ÉPOQ data more efficiently and rigorously with the help of a statistician highly experienced with this type of data, as well as to propose a more standardized survey program for specific sites whose data could be incorporated in ÉPOQ.

Dunn et al. (2005a) have drawn up a list of new monitoring programs that should be set up in order to adequately monitor the populations of landbird species across North America, and Dunn and Downes (in prep.) did the same for Canada. The programs that they identified are as follows:

- Survey of boreal forest species (Boreal Chickadee, Pine Grosbeak, etc.)
- Survey of Arctic species (Snow Bunting, Lapland Bunting, etc.)

- Survey of high elevation species (Bicknell's Thrush, Fox Sparrow, Blackpoll Warbler, etc.); this type of survey has already begun in the Maritimes by Bird Studies Canada [Atlantic Canada High Elevation Landbird Program], and an international survey that will also include Quebec and the states of the Northeastern United States is scheduled to begin within a year or two [Y. Aubry, CWS, pers. comm.]
- Survey of species that breed very early in the spring (woodpeckers, jays, etc.)
- Survey of nocturnal species (the owl survey has already begun, but not the survey of nightjars)
- Specific surveys for species that are not adequately monitored by any survey of other bird groups

To this could be added more specifically for Quebec, monitoring of landbirds and habitats in BCR 13 in order to supplement the BBS information limited by the small size of this BCR in the province and by the limited number of BBS routes that can be established in this BCR. There is already a promising sampling design that could precisely be used to monitor birds and habitats in six landscapes in the St. Lawrence Valley (Jobin et al. 2003). We could also consider monitoring birds and habitats in woodlands of high ecological value identified by Carignan (2006).

Another recommendation made in the USGS strategic plan (2007) is to georeference all the stops in as many BBS routes as possible. This would make it possible, among other things, to obtain remote-sensed data on land cover and habitats bordering the routes using satellite images or orthophotographs. This would also make it possible to compare on-road and off-road habitats, to monitor changes in these habitats over time and to establish links between bird abundance and the main habitats. We would have to be able to georeference all the stops of virtually all the BBS routes already surveyed in Quebec within a couple of years, and an effort to this end was begun in 2008.

Finally, it would be desirable to have an official public website for the BBS in Quebec in the near future. A map would display all the routes in Quebec and their status, allowing potential participants to determine whether there is an available route near them. The site would also provide links to the NWRC's BBS site and CWS publications and would also help promote the BBS. It could even promote other CWS programs aimed at volunteers such as the American Woodcock Singing Ground Survey.

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Appendix 1. Number of BBS routes required to detect a 50% decline over a 20-year period with a power of 0.8 and a significance level α of 0.1 for birds in four Quebec BCRs

BCR 13

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Killdeer	<i>Charadrius vociferus</i>	16	15
Spotted Sandpiper	<i>Actitis macularius</i>	16	15
Mourning Dove	<i>Zenaida macroura</i>	16	15
Northern Flicker	<i>Colaptes auratus</i>	16	15
Eastern Wood-Peevee	<i>Contopus virens</i>	16	15
Eastern Phoebe	<i>Sayornis phoebe</i>	16	15
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	16	15
Eastern Kingbird	<i>Tyrannus tyrannus</i>	16	15
Red-eyed Vireo	<i>Vireo olivaceus</i>	16	15
American Crow	<i>Corvus brachyrhynchos</i>	16	15
Horned Lark	<i>Eremophila alpestris</i>	16	15
Barn Swallow	<i>Hirundo rustica</i>	16	15
Black-capped Chickadee	<i>Poecile atricapillus</i>	16	15
Veery	<i>Catharus fuscescens</i>	16	15
American Robin	<i>Turdus migratorius</i>	16	15
European Starling	<i>Sturnus vulgaris</i>	16	15
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	15	15
American Redstart	<i>Setophaga ruticilla</i>	15	15
Ovenbird	<i>Seiurus aurocapilla</i>	15	15
Common Yellowthroat	<i>Geothlypis trichas</i>	16	15
Chipping Sparrow	<i>Spizella passerina</i>	16	15
Savannah Sparrow	<i>Passerculus sandwichensis</i>	16	15
Song Sparrow	<i>Melospiza melodia</i>	16	15
White-throated Sparrow	<i>Zonotrichia albicollis</i>	16	15
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	15	15
Bobolink	<i>Dolichonyx oryzivorus</i>	16	15
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	16	15
Common Grackle	<i>Quiscalus quiscula</i>	16	15
Brown-headed Cowbird	<i>Molothrus ater</i>	16	15
Purple Finch	<i>Carpodacus purpureus</i>	15	15
American Goldfinch	<i>Carduelis tristis</i>	16	15
House Sparrow	<i>Passer domesticus</i>	16	15
Belted Kingfisher	<i>Ceryle alcyon</i>	14	16
Alder Flycatcher	<i>Empidonax alnorum</i>	15	16
White-breasted Nuthatch	<i>Sitta carolinensis</i>	13	16
House Wren	<i>Troglodytes aedon</i>	14	19
Hairy Woodpecker	<i>Picoides villosus</i>	15	21
Warbling Vireo	<i>Vireo gilvus</i>	16	21
Blue Jay	<i>Cyanocitta cristata</i>	16	21
Black-and-white Warbler	<i>Mniotilta varia</i>	15	21
Gray Catbird	<i>Dumetella carolinensis</i>	15	23

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Vesper Sparrow	<i>Poocetes gramineus</i>	12	23
Eastern Meadowlark	<i>Sturnella magna</i>	15	23
Baltimore Oriole	<i>Icterus galbula</i>	15	23
Mourning Warbler	<i>Oporornis philadelphia</i>	14	25
Hermit Thrush	<i>Catharus guttatus</i>	16	28
Tree Swallow	<i>Tachycineta bicolor</i>	16	31
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	12	31
Bank Swallow	<i>Riparia riparia</i>	15	33
Cedar Waxwing	<i>Bombycilla cedrorum</i>	16	33
Rock Pigeon	<i>Columba livia</i>	16	39
Downy Woodpecker	<i>Picoides pubescens</i>	15	39
Swamp Sparrow	<i>Melospiza georgiana</i>	12	42
Northern Harrier	<i>Circus cyaneus</i>	15	46
American Kestrel	<i>Falco sparverius</i>	15	46
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	16	46
Least Flycatcher	<i>Empidonax minimus</i>	15	46
Wood Thrush	<i>Hylocichla mustelina</i>	14	46
Great Blue Heron	<i>Ardea herodias</i>	13	67
Chimney Swift	<i>Chaetura pelagica</i>	14	67
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	13	67
Brown Thrasher	<i>Toxostoma rufum</i>	13	67
Yellow Warbler	<i>Dendroica petechia</i>	16	67
Upland Sandpiper	<i>Bartramia longicauda</i>	14	84
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	15	84
Scarlet Tanager	<i>Piranga olivacea</i>	13	94
Wilson's Snipe	<i>Gallinago delicata</i>	15	98
Black-throated Green Warbler	<i>Dendroica virens</i>	13	119
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	10	119
American Black Duck	<i>Anas rubripes</i>	13	129
Canada Warbler	<i>Wilsonia canadensis</i>	10	135
Red-breasted Nuthatch	<i>Sitta canadensis</i>	11	152
Nashville Warbler	<i>Vermivora ruficapilla</i>	13	190
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	10	204
Common Raven	<i>Corvus corax</i>	12	279
Winter Wren	<i>Troglodytes troglodytes</i>	12	279
Canada Goose	<i>Branta canadensis</i>	13	313
Indigo Bunting	<i>Passerina cyanea</i>	12	321
Blackburnian Warbler	<i>Dendroica fusca</i>	10	348
Magnolia Warbler	<i>Dendroica magnolia</i>	13	376
Mallard	<i>Anas platyrhynchos</i>	16	434
American Bittern	<i>Botaurus lentiginosus</i>	14	465
Eastern Bluebird	<i>Sialia sialis</i>	13	476
Yellow-rumped Warbler	<i>Dendroica coronata</i>	11	660
House Finch	<i>Carpodacus mexicanus</i>	12	737
Pine Siskin	<i>Carduelis pinus</i>	10	933
Red-shouldered Hawk	<i>Buteo lineatus</i>	11	1087
Northern Mockingbird	<i>Mimus polyglottos</i>	13	2641
Pileated Woodpecker	<i>Dryocopus pileatus</i>	11	2691

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English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	15	15
Great Blue Heron	<i>Ardea herodias</i>	24	15
American Crow	<i>Corvus brachyrhynchos</i>	33	15
American Robin	<i>Turdus migratorius</i>	33	15
Blackpoll Warbler	<i>Dendroica striata</i>	21	15
Bobolink	<i>Dolichonyx oryzivorus</i>	26	15
White-winged Crossbill	<i>Loxia leucoptera</i>	20	15
American Goldfinch	<i>Carduelis tristis</i>	32	17
Killdeer	<i>Charadrius vociferus</i>	26	20
Wood Thrush	<i>Hylocichla mustelina</i>	20	20
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	31	20
Winter Wren	<i>Troglodytes troglodytes</i>	33	27
Swainson's Thrush	<i>Catharus ustulatus</i>	30	27
Song Sparrow	<i>Melospiza melodia</i>	31	27
Pileated Woodpecker	<i>Dryocopus pileatus</i>	22	31
Blue Jay	<i>Cyanocitta cristata</i>	32	31
Red-eyed Vireo	<i>Vireo olivaceus</i>	32	35
Chipping Sparrow	<i>Spizella passerina</i>	33	35
Tree Swallow	<i>Tachycineta bicolor</i>	32	43
Barn Swallow	<i>Hirundo rustica</i>	27	43
Black-capped Chickadee	<i>Poecile atricapillus</i>	32	43
Common Grackle	<i>Quiscalus quiscula</i>	31	43
Cedar Waxwing	<i>Bombycilla cedrorum</i>	33	48
Savannah Sparrow	<i>Passerculus sandwichensis</i>	28	48
White-throated Sparrow	<i>Zonotrichia albicollis</i>	33	48
Ruby-crowned Kinglet	<i>Regulus calendula</i>	33	53
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	27	58
Hermit Thrush	<i>Catharus guttatus</i>	32	58
European Starling	<i>Sturnus vulgaris</i>	27	64
Northern Harrier	<i>Circus cyaneus</i>	21	69
Northern Flicker	<i>Colaptes auratus</i>	33	75
Veery	<i>Catharus fuscescens</i>	31	75
Wilson's Snipe	<i>Gallinago delicata</i>	28	81
Belted Kingfisher	<i>Ceryle alcyon</i>	28	81
American Redstart	<i>Setophaga ruticilla</i>	33	95
Northern Waterthrush	<i>Seiurus noveboracensis</i>	32	95
Boreal Chickadee	<i>Poecile hudsonicus</i>	25	101
White-breasted Nuthatch	<i>Sitta carolinensis</i>	12	101
Gray Catbird	<i>Dumetella carolinensis</i>	24	101
American Kestrel	<i>Falco sparverius</i>	28	109
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	28	109
Purple Finch	<i>Carpodacus purpureus</i>	33	109
House Sparrow	<i>Passer domesticus</i>	25	109
Eastern Phoebe	<i>Sayornis phoebe</i>	17	116
Fox Sparrow	<i>Passerella iliaca</i>	18	116
American Black Duck	<i>Anas rubripes</i>	22	124

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Black-and-white Warbler	<i>Mniotilta varia</i>	31	124
Mourning Warbler	<i>Oporornis philadelphia</i>	32	124
American Bittern	<i>Botaurus lentiginosus</i>	20	140
Philadelphia Vireo	<i>Vireo philadelphicus</i>	28	140
Least Flycatcher	<i>Empidonax minimus</i>	32	148
Nashville Warbler	<i>Vermivora ruficapilla</i>	33	148
Yellow Warbler	<i>Dendroica petechia</i>	31	148
Canada Warbler	<i>Wilsonia canadensis</i>	27	157
Upland Sandpiper	<i>Bartramia longicauda</i>	17	165
Eastern Meadowlark	<i>Sturnella magna</i>	16	165
Yellow-rumped Warbler	<i>Dendroica coronata</i>	33	175
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	24	184
Hairy Woodpecker	<i>Picoides villosus</i>	26	184
Common Raven	<i>Corvus corax</i>	33	184
Mourning Dove	<i>Zenaida macroura</i>	29	213
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	19	213
Dark-eyed Junco	<i>Junco hyemalis</i>	30	213
Bay-breasted Warbler	<i>Dendroica castanea</i>	23	234
Eastern Kingbird	<i>Tyrannus tyrannus</i>	27	245
Eastern Wood-Pee wee	<i>Contopus virens</i>	25	256
Red-breasted Nuthatch	<i>Sitta canadensis</i>	31	256
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	31	256
Cape May Warbler	<i>Dendroica tigrina</i>	27	256
Ovenbird	<i>Seiurus aurocapilla</i>	31	256
Common Yellowthroat	<i>Geothlypis trichas</i>	33	256
Baltimore Oriole	<i>Icterus galbula</i>	16	256
Northern Parula	<i>Parula americana</i>	29	279
Downy Woodpecker	<i>Picoides pubescens</i>	27	291
Swamp Sparrow	<i>Melospiza georgiana</i>	23	303
Black-throated Green Warbler	<i>Dendroica virens</i>	32	315
Scarlet Tanager	<i>Piranga olivacea</i>	13	315
House Wren	<i>Troglodytes aedon</i>	14	340
Blackburnian Warbler	<i>Dendroica fusca</i>	28	340
Eastern Bluebird	<i>Sialia sialis</i>	11	353
Vesper Sparrow	<i>Pooecetes gramineus</i>	16	353
Pine Siskin	<i>Carduelis pinus</i>	28	366
Spotted Sandpiper	<i>Actitis macularius</i>	26	380
Warbling Vireo	<i>Vireo gilvus</i>	16	380
Golden-crowned Kinglet	<i>Regulus satrapa</i>	25	380
Chimney Swift	<i>Chaetura pelagica</i>	19	393
Brown-headed Cowbird	<i>Molothrus ater</i>	26	407
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	16	421
Wilson's Warbler	<i>Wilsonia pusilla</i>	22	436
Magnolia Warbler	<i>Dendroica magnolia</i>	32	481
Alder Flycatcher	<i>Empidonax alnorum</i>	33	496
Rock Pigeon	<i>Columba livia</i>	26	528
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	31	544
Olive-sided Flycatcher	<i>Contopus borealis</i>	23	560

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Pine Grosbeak	<i>Pinicola enucleator</i>	14	594
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	29	611
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	27	611
Bank Swallow	<i>Riparia riparia</i>	25	646
Blue-headed Vireo	<i>Vireo solitarius</i>	31	663
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	23	718
Brown Thrasher	<i>Toxostoma rufum</i>	16	835
Tennessee Warbler	<i>Vermivora peregrina</i>	27	917
Broad-winged Hawk	<i>Buteo platypterus</i>	22	1003
Merlin	<i>Falco columbarius</i>	19	1336
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	15	1834
Red-tailed Hawk	<i>Buteo jamaicensis</i>	14	2048
Indigo Bunting	<i>Passerina cyanea</i>	11	2548
Gray Jay	<i>Perisoreus canadensis</i>	13	2988
Canada Goose	<i>Branta canadensis</i>	14	3181
Horned Lark	<i>Eremophila alpestris</i>	12	3421
Common Merganser	<i>Mergus merganser</i>	15	3755
Osprey	<i>Pandion haliaetus</i>	13	4562
Mallard	<i>Anas platyrhynchos</i>	20	6524
Ruffed Grouse	<i>Bonasa umbellus</i>	19	6866

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English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Alder Flycatcher	<i>Empidonax alnorum</i>	47	15
Red-eyed Vireo	<i>Vireo olivaceus</i>	45	15
American Crow	<i>Corvus brachyrhynchos</i>	46	15
Tree Swallow	<i>Tachycineta bicolor</i>	46	15
Barn Swallow	<i>Hirundo rustica</i>	43	15
Black-capped Chickadee	<i>Poecile atricapillus</i>	45	15
Veery	<i>Catharus fuscescens</i>	41	15
American Robin	<i>Turdus migratorius</i>	47	15
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	42	15
Yellow-rumped Warbler	<i>Dendroica coronata</i>	46	15
American Redstart	<i>Setophaga ruticilla</i>	44	15
Ovenbird	<i>Seiurus aurocapilla</i>	44	15
Mourning Warbler	<i>Oporornis philadelphia</i>	45	15
Common Yellowthroat	<i>Geothlypis trichas</i>	47	15
Chipping Sparrow	<i>Spizella passerina</i>	44	15
Song Sparrow	<i>Melospiza melodia</i>	44	15
White-throated Sparrow	<i>Zonotrichia albicollis</i>	47	15
Common Grackle	<i>Quiscalus quiscula</i>	44	15
Purple Finch	<i>Carpodacus purpureus</i>	46	16
Belted Kingfisher	<i>Ceryle alcyon</i>	45	19

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Brown-headed Cowbird	<i>Molothrus ater</i>	34	19
Ruby-crowned Kinglet	<i>Regulus calendula</i>	43	21
Nashville Warbler	<i>Vermivora ruficapilla</i>	47	21
American Goldfinch	<i>Carduelis tristis</i>	39	21
Eastern Kingbird	<i>Tyrannus tyrannus</i>	30	23
Hermit Thrush	<i>Catharus guttatus</i>	46	23
Wilson's Snipe	<i>Gallinago delicata</i>	35	25
Magnolia Warbler	<i>Dendroica magnolia</i>	46	25
Killdeer	<i>Charadrius vociferus</i>	29	28
Northern Flicker	<i>Colaptes auratus</i>	46	28
Red-breasted Nuthatch	<i>Sitta canadensis</i>	46	28
Dark-eyed Junco	<i>Junco hyemalis</i>	45	28
Least Flycatcher	<i>Empidonax minimus</i>	44	31
Bobolink	<i>Dolichonyx oryzivorus</i>	25	31
Swamp Sparrow	<i>Melospiza georgiana</i>	42	33
European Starling	<i>Sturnus vulgaris</i>	33	36
Pine Siskin	<i>Carduelis pinus</i>	33	36
Winter Wren	<i>Troglodytes troglodytes</i>	46	39
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	37	39
Northern Waterthrush	<i>Seiurus noveboracensis</i>	42	39
Savannah Sparrow	<i>Passerculus sandwichensis</i>	30	39
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	45	39
Great Blue Heron	<i>Ardea herodias</i>	37	46
Eastern Phoebe	<i>Sayornis phoebe</i>	30	46
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	39	46
Common Raven	<i>Corvus corax</i>	47	49
Wood Thrush	<i>Hylocichla mustelina</i>	25	49
Tennessee Warbler	<i>Vermivora peregrina</i>	36	49
Turkey Vulture	<i>Cathartes aura</i>	21	52
Eastern Meadowlark	<i>Sturnella magna</i>	17	56
Cedar Waxwing	<i>Bombycilla cedrorum</i>	47	60
Scarlet Tanager	<i>Piranga olivacea</i>	29	60
American Bittern	<i>Botaurus lentiginosus</i>	30	64
Mourning Dove	<i>Zenaida macroura</i>	27	67
Warbling Vireo	<i>Vireo gilvus</i>	19	67
Gray Catbird	<i>Dumetella carolinensis</i>	33	67
Bank Swallow	<i>Riparia riparia</i>	28	72
Canada Warbler	<i>Wilsonia canadensis</i>	40	72
Pileated Woodpecker	<i>Dryocopus pileatus</i>	32	76
Blue Jay	<i>Cyanocitta cristata</i>	38	76
Swainson's Thrush	<i>Catharus ustulatus</i>	46	76
Black-throated Green Warbler	<i>Dendroica virens</i>	44	76
Hairy Woodpecker	<i>Picoides villosus</i>	36	80
Baltimore Oriole	<i>Icterus galbula</i>	18	80
American Woodcock	<i>Scolopax minor</i>	13	84
House Sparrow	<i>Passer domesticus</i>	20	89
Philadelphia Vireo	<i>Vireo philadelphicus</i>	42	94
Blue-headed Vireo	<i>Vireo solitarius</i>	43	98

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Black-and-white Warbler	<i>Mniotilta varia</i>	41	98
American Kestrel	<i>Falco sparverius</i>	29	103
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	26	108
Wilson's Warbler	<i>Wilsonia pusilla</i>	24	108
Brown Thrasher	<i>Toxostoma rufum</i>	22	113
Indigo Bunting	<i>Passerina cyanea</i>	23	113
Eastern Wood-Peevee	<i>Contopus virens</i>	21	129
Blackburnian Warbler	<i>Dendroica fusca</i>	44	129
Lincoln's Sparrow	<i>Melospiza lincolni</i>	28	129
Spotted Sandpiper	<i>Actitis macularius</i>	34	141
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	37	141
Downy Woodpecker	<i>Picoides pubescens</i>	39	141
Yellow Warbler	<i>Dendroica petechia</i>	37	141
Chimney Swift	<i>Chaetura pelagica</i>	24	146
Northern Harrier	<i>Circus cyaneus</i>	19	152
Olive-sided Flycatcher	<i>Contopus borealis</i>	34	152
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	23	165
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	20	165
House Wren	<i>Troglodytes aedon</i>	19	165
Northern Parula	<i>Parula americana</i>	34	184
Pine Warbler	<i>Dendroica pinus</i>	18	184
Ruffed Grouse	<i>Bonasa umbellus</i>	33	218
Golden-crowned Kinglet	<i>Regulus satrapa</i>	42	263
Cape May Warbler	<i>Dendroica tigrina</i>	35	288
Brown Creeper	<i>Certhia americana</i>	28	304
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	29	321
Boreal Chickadee	<i>Poecile hudsonicus</i>	23	321
White-winged Crossbill	<i>Loxia leucoptera</i>	27	321
Broad-winged Hawk	<i>Buteo platypterus</i>	41	330
Red-tailed Hawk	<i>Buteo jamaicensis</i>	21	339
Gray Jay	<i>Perisoreus canadensis</i>	22	339
Vesper Sparrow	<i>Poecetes gramineus</i>	15	339
Blackpoll Warbler	<i>Dendroica striata</i>	15	348
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	46	366
Rusty Blackbird	<i>Euphagus carolinus</i>	18	414
Common Merganser	<i>Mergus merganser</i>	33	434
Rock Pigeon	<i>Columba livia</i>	22	553
Mallard	<i>Anas platyrhynchos</i>	27	635
Canada Goose	<i>Branta canadensis</i>	25	672
Eastern Bluebird	<i>Sialia sialis</i>	21	724
Pine Grosbeak	<i>Pinicola enucleator</i>	10	724
Field Sparrow	<i>Spizella pusilla</i>	10	790
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	29	804
Fox Sparrow	<i>Passerella iliaca</i>	10	846
Common Goldeneye	<i>Bucephala clangula</i>	18	933
Wood Duck	<i>Aix sponsa</i>	15	1039
American Black Duck	<i>Anas rubripes</i>	26	1135
White-breasted Nuthatch	<i>Sitta carolinensis</i>	27	1393

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Ring-necked Duck	<i>Aythya collaris</i>	17	1800
Bay-breasted Warbler	<i>Dendroica castanea</i>	37	1904
Merlin	<i>Falco columbarius</i>	22	1925
Black-backed Woodpecker	<i>Picoides arcticus</i>	17	2011
Sharp-shinned Hawk	<i>Accipiter striatus</i>	14	3218
Osprey	<i>Pandion haliaetus</i>	17	4316
Hooded Merganser	<i>Lophodytes cucullatus</i>	10	5906

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English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
American Robin	<i>Turdus migratorius</i>	15	15
White-throated Sparrow	<i>Zonotrichia albicollis</i>	15	15
Song Sparrow	<i>Melospiza melodia</i>	14	29
Common Yellowthroat	<i>Geothlypis trichas</i>	14	34
Killdeer	<i>Charadrius vociferus</i>	12	43
American Crow	<i>Corvus brachyrhynchos</i>	15	43
Veery	<i>Catharus fuscescens</i>	12	46
Ovenbird	<i>Seiurus aurocapilla</i>	14	46
Tree Swallow	<i>Tachycineta bicolor</i>	14	52
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	15	56
Swainson's Thrush	<i>Catharus ustulatus</i>	15	60
Chipping Sparrow	<i>Spizella passerina</i>	14	63
Common Grackle	<i>Quiscalus quiscula</i>	14	63
Alder Flycatcher	<i>Empidonax alnorum</i>	15	67
Ruby-crowned Kinglet	<i>Regulus calendula</i>	13	67
Red-eyed Vireo	<i>Vireo olivaceus</i>	15	88
Northern Flicker	<i>Colaptes auratus</i>	15	101
Magnolia Warbler	<i>Dendroica magnolia</i>	15	101
Nashville Warbler	<i>Vermivora ruficapilla</i>	14	106
Yellow Warbler	<i>Dendroica petechia</i>	13	116
Winter Wren	<i>Troglodytes troglodytes</i>	15	121
American Goldfinch	<i>Carduelis tristis</i>	15	121
European Starling	<i>Sturnus vulgaris</i>	11	132
Cedar Waxwing	<i>Bombycilla cedrorum</i>	14	137
Least Flycatcher	<i>Empidonax minimus</i>	15	143
Tennessee Warbler	<i>Vermivora peregrina</i>	14	148
Yellow-rumped Warbler	<i>Dendroica coronata</i>	15	148
Dark-eyed Junco	<i>Junco hyemalis</i>	14	148
Barn Swallow	<i>Hirundo rustica</i>	11	172
American Redstart	<i>Setophaga ruticilla</i>	15	205
Northern Waterthrush	<i>Seiurus noveboracensis</i>	13	205
Wilson's Snipe	<i>Gallinago delicata</i>	13	218
Savannah Sparrow	<i>Passerculus sandwichensis</i>	12	225
Hermit Thrush	<i>Catharus guttatus</i>	14	247

English common name	Latin name	Number of routes where the species was reported	Number of routes to detect the decline
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	13	270
Bobolink	<i>Dolichonyx oryzivorus</i>	10	277
Black-capped Chickadee	<i>Poecile atricapillus</i>	11	326
Black-throated Green Warbler	<i>Dendroica virens</i>	11	343
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	14	343
Common Raven	<i>Corvus corax</i>	13	361
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	14	388
Philadelphia Vireo	<i>Vireo philadelphicus</i>	14	417
Purple Finch	<i>Carpodacus purpureus</i>	14	417
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	11	436
American Kestrel	<i>Falco sparverius</i>	11	456
Wilson's Warbler	<i>Wilsonia pusilla</i>	12	486
Swamp Sparrow	<i>Melospiza georgiana</i>	12	486
House Sparrow	<i>Passer domesticus</i>	12	486
Mourning Warbler	<i>Oporornis philadelphia</i>	13	497
Spotted Sandpiper	<i>Actitis macularius</i>	10	573
Blackburnian Warbler	<i>Dendroica fusca</i>	10	584
Black-and-white Warbler	<i>Mniotilta varia</i>	13	642
American Bittern	<i>Botaurus lentiginosus</i>	11	654
Hairy Woodpecker	<i>Picoides villosus</i>	11	741
Canada Warbler	<i>Wilsonia canadensis</i>	11	754
Brown-headed Cowbird	<i>Molothrus ater</i>	10	847
Bay-breasted Warbler	<i>Dendroica castanea</i>	11	931
Blue Jay	<i>Cyanocitta cristata</i>	10	1158
Pine Siskin	<i>Carduelis pinus</i>	10	1536
Cape May Warbler	<i>Dendroica tigrina</i>	10	1630
Belted Kingfisher	<i>Ceryle alcyon</i>	11	4076
Eastern Kingbird	<i>Tyrannus tyrannus</i>	10	6558

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