

AN EVALUATION OF SPECIES COVERAGE BY THE CANADIAN MIGRATION MONITORING NETWORK

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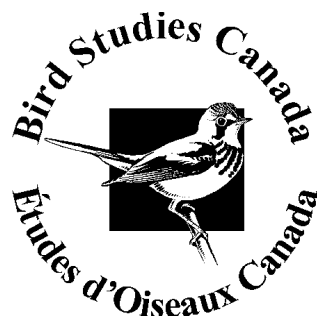
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for the

Canadian Migration Monitoring Network

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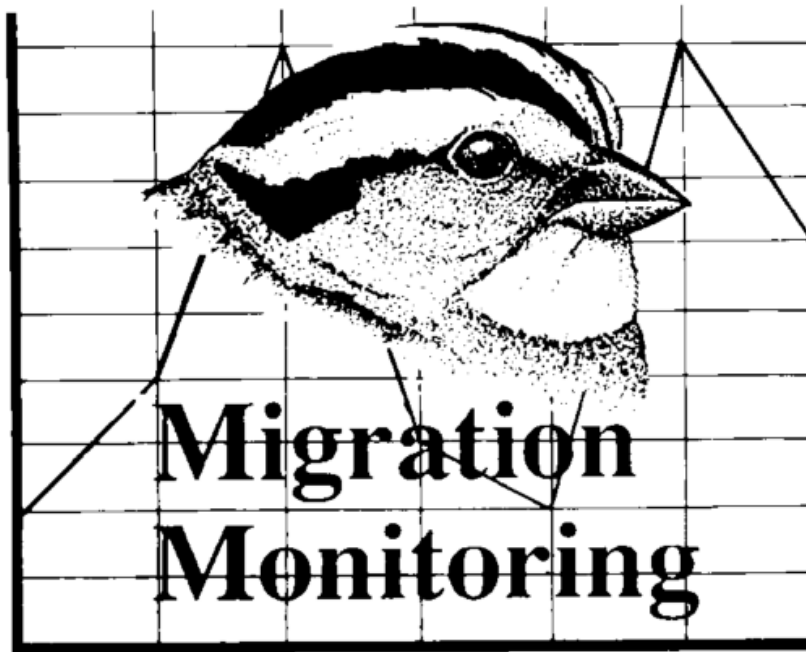


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Executive Summary

The main objective of the Canadian Migration Monitoring Network (CMMN) is to monitor priority species that are not being adequately monitored by other programs, such as the Breeding Bird Survey (BBS) and Christmas Bird Count (CBC). Migration monitoring may be an effective means of monitoring species that nest in remote northern areas of Canada, species whose habitat is rarely sampled by roadside surveys and species that are otherwise difficult to detect during the breeding season.

Data from 19 CMMN stations or sites in five geographic regions (British Columbia, Prairies, Great Lakes, St. Lawrence, and Atlantic Coast) were analyzed to determine which priority species were being monitored and to identify gaps in coverage by the CMMN. Species were ranked by priority level, based on the proportion of their range that is covered by other monitoring programs such as BBS or CBC. High priority species have <60% of their Canadian breeding range covered by BBS.

Species were considered potentially well monitored by a station if a mean of at least 10 individuals were detected on an average of 5 days per season. Wherever possible, daily estimated totals were used to calculate species coverage. The effects of a local breeding population were also considered when determining whether or not a species is potentially monitored at a station.

At the regional level, there are many gaps in species coverage. Coverage is best in Ontario, where there are 10 CMMN stations, and the greatest number of gaps occur in the Atlantic region, where there are only 2 stations. Fifty-two percent of priority species are being potentially monitored in British Columbia, 69% in the prairies, 94% in the Great Lakes region, 74% in the St. Lawrence region, and only 57% in the Atlantic Coast region. In addition, many of the prairie stations are monitoring a large number of resident breeders, which complicates trend analyses. We have incomplete information on species coverage in British Columbia because data were available for only one CMMN station.

At the national level, the CMMN is covering most of the species designated as targets for migration monitoring. Only 14 of 108 priority species are definitely not being monitored by any of the CMMN stations. However, there are likely other species that are not being adequately monitored because coverage consists mainly of local resident breeders or because they are considered unsuitable candidates for migration monitoring. It is not clear whether counts that include local residents can be used to estimate population trends of migrants, because local population fluctuations may obscure changes that are occurring in the migrant population. In addition, migration monitoring may be inappropriate for species that are diurnal migrants (e.g. swallows, blackbirds), irruptive (e.g. redpolls, finches, grosbeaks) or only partially migratory (e.g. crows, woodpeckers, titmice, some finches). Several grassland species are also not being adequately monitored, likely because the census areas of most CMMN stations do not contain grassland habitat.

Introduction

One of the main goals of the Canadian Migration Monitoring Network (CMMN) is to track national population trends of species that are not adequately monitored on the breeding grounds, particularly by the Breeding Bird Survey (BBS). Because the North American breeding range of many migratory landbird species is in remote northern areas of Canada that are inaccessible by road, many bird species are missed by the BBS, or are not recorded in sufficient numbers for trend analyses (Dunn and Hussell 1995). Furthermore, the BBS may be less effective at monitoring species whose habitat is poorly sampled by roadside surveys (e.g. grassland and forest interior species), and species that are difficult to detect due to their behaviour (e.g. secretive birds, birds that breed at low density).

Although some of these species winter mainly within the continental U.S. and Canada, and can thus potentially be monitored on the wintering grounds, the most widespread, multi-species winter survey, the Christmas Bird Count (CBC), is not currently well standardized. So, it is important to obtain additional information on population trends for these species.

Many of the species not adequately covered by the BBS can potentially be monitored on migration when they pass through southern Canada, traveling between their breeding and wintering grounds. In addition to being able to sample species that breed in inaccessible areas, migration monitoring can also sample all segments of the population – unlike BBS which counts mostly singing males (Francis and Hussell 1998). Of course, migration monitoring is not without limitations. There is high variance in counts due to the strong influence of weather conditions on the numbers of birds migrating by, or stopping at, a particular monitoring site each day. However, methods have been developed to reduce this variation by log-transforming daily counts and including covariates to control for weather and time of year (Hussell 1981, Hussell et al. 1992, Francis and Hussell 1998). After making these adjustments, trends in the numbers of birds monitored at Long Point Bird Observatory (LPBO) are positively correlated with trends from the Ontario BBS (Hussell et al. 1992, Francis and Hussell 1998). Similarly, Dunn et al. (1997) found that trends derived from migration banding data in southern Michigan were positively correlated with BBS trends for Michigan and Ontario.

In September 1993, a workshop was convened in Simcoe, Ontario, to consider the merits of a North American Migration Monitoring Program (Blancher et al. 1994). One of the outcomes of this meeting was the development of a set of standards for intensive migration monitoring in North America (Hussell and Ralph 1996). On the basis of these guidelines, and a developing momentum for migration monitoring, the Canadian Migration Monitoring Network (CMMN) was formed. The network is intended to promote standardization of methods, including both field and data analysis methods, and to improve coordination of migration monitoring in Canada.

An important component of any monitoring effort should be regular evaluation. How well is the CMMN achieving its goal of monitoring priority species in Canada? What species are currently being monitored, and which species are not? Is this coverage adequate? What actions might be needed to fill the gaps? The purpose of this document is to provide a preliminary

assessment of species coverage in the network, that can be used to start addressing some of these important questions.

To do this, we needed to decide upon a minimum level of coverage necessary to monitor a species. Every time a species is counted at a station, some information is gleaned on its population status. However, if only one bird is detected every few years, this will obviously not provide us with sufficient information to detect population trends. Ideally, we should base the assessment on the precision and accuracy of trend estimates by examining the bias-corrected confidence limits of trend estimates for species at each station. If precision is poor (i.e. very wide confidence limits) then we would consider coverage at that station to be inadequate. Unfortunately, insufficient data are currently available to estimate trends for most stations in the network. So, it is necessary to develop a surrogate. Hussell and Ralph (1996) suggested that, to monitor a species, a station should detect, on average, a minimum of 10 and preferably 20 individuals each year. Because many species travel in flocks, the presence of a single large flock of a species in one year will raise the average for several years, even if it is never seen again. Thus, we have refined the criteria, following Francis and Hussell (1998), to require that an average of at least 10 individuals be recorded on an average of at least 5 different days each year. Because stations may be monitoring different populations in spring and fall, these criteria are applied separately to each season. Even then, we cannot be sure that monitoring this number of birds will produce trends with useful precision. Furthermore, the ability of a station to detect trends is predicated on the assumption that the station is consistently following well standardized methods. For both of these reasons, we refer to species that meet these criteria as “potentially monitored.”

A complication of migration monitoring is that migration counts may include a high proportion of individuals that breed in the area (Dunn and Hussell 1995). Counts of these species may reflect changes in the local breeding population but not accurately reflect changes in the larger population, breeding north of the station, that we are hoping to sample. Furthermore, one of the assumptions of the standard analyses, is that most of the time the same individuals are not being counted each day. This assumption would be violated if birds remain through the season around the sampling area. Consequently, if individuals of a species that are primarily breeding residents at a migration monitoring station are included in trend analyses, the results will not represent the population of interest.

In this report, we summarize species coverage by the CMMN in each region of Canada, with emphasis on those species that are highest priority for coverage (those with <60% of Canadian breeding range covered by BBS – categories A-D), although we also list all other species that are potentially monitored at a station. Whenever possible, we consider the effects of local breeding populations of species on whether that species is potentially monitored at a station.

Methods

Station Data

Data from 15 CMMN stations in five geographic regions (British Columbia, Prairies, Great Lakes, Quebec, and Atlantic Coast) were analyzed to determine which priority species were

being monitored, and hence to identify gaps in coverage by CMMN stations across Canada (Table 1). With the exception of Last Mountain Bird Observatory in Saskatchewan, daily estimated totals (DETs) were used to calculate species coverage. Last Mountain Bird Observatory is no longer calculating DETs (as of 1998). Although there is some debate about the relative merits of DETs versus standardized banding, we shall assume for this report that a species is potentially monitored if sufficient numbers are counted in DETs.

There was considerable variation among stations in the amount, type, and number of years of data available (Table 1). For stations with few data, our estimate of which species are potentially monitored is likely to be less accurate, because some species may have been atypically rare or common during the years of coverage.

Table 1 – Summary of type of data that were available to us from each CMMN member station for this analysis, and the number of years and seasons of coverage. Data that were used to calculate species coverage are marked with an asterisk.

CMMN Station	Season	Daily Estimated Totals (DETS)	Banding Totals
Rocky Point	F	none	none
Mackenzie	F	1997-1999*	1995-1999
Lesser Slave Lake	S/F	1994-1999*	1994-1999
Beaverhill	S/F	1992-1999*	1992-1999
Inglewood	F	1995-1999*	1995-1999
Last Mountain	S/F	1993-1997	1992-1999*
Delta Marsh	S	1995-1999*	1995-1998
	F	1993-1999*	1993-1999
Thunder Cape	S/F	1991-1999*	1991-1999
WPBO – Whitefish Point	S	1999*	1999
	F	1989-1999*	1991-1999
WPBO – Vermillion	S/F	1993, 1996-1998*	1993-1995
LPBO – Tip	S/F	1961-1999*	1961-1999
LPBO – Breakwater	S/F	1961-1999*	1961-1999
LPBO – Old Cut	S/F	1984-1999*	1984-1999
Haldimand – Ruthven	S/F	1998-1999*	1996-1999
Haldimand – Selkirk	S	1996-1999*	1996-1999
	F	1999*	1999
Prince Edward Point	S	1999*	1995-1999
Innis Point	S	1997-1999*	1997-1999
Tadoussac	F	1997-1999*	1997-1999
Atlantic – Seal	S/F	1997-1999*	1997-1999
Atlantic – Bon Portage	S/F	1997-1999*	1997-1999

Priority Species

Species were ranked into priority classes based on the proportion of each species' range covered by other monitoring programs such as BBS or CBC (Francis and Dobbyn 1997). Birds that are not well covered by other programs rank highest (A), while species that are well covered by both the BBS and CBC rank lowest (F). Species that are non-migratory and therefore not considered suitable candidates for migration monitoring are given priority level X. Target species for the CMMN are those species not adequately monitored on the breeding grounds because less than 50% of their North America breeding range (priority levels A, B) or less than 60% of their Canadian breeding range (C, D) are within the area covered by BBS. Some of these species winter mainly (>60% of range) within North America north of Mexico (priority levels B and D) and hence are potentially monitored during winter by CBC. However, because CBC is not well standardized, these species were also considered priority targets for the CMMN. One species, that breeds in northern Canada, but winters in the Old World (the Northern Wheatear) was excluded from consideration.

Raptors, including both diurnal (hawks, falcons, eagles, osprey) and nocturnal migrants (owls) were excluded from analysis for two reasons. First, the most appropriate methods of monitoring these species are not necessarily the same as those used for most other migratory landbirds, especially nocturnal migrant passerines. Second, although they are counted at many CMMN stations, there are also many additional stations monitoring these species (especially diurnal migrants), which were not considered in this analysis. It may be appropriate to consider them in the future.

Species Coverage

A species was considered potentially monitored by a CMMN station if a mean of at least 10 individuals per year were detected on an average of at least 5 separate days per year. Spring and fall were analyzed separately. Ideally, this should not include individuals that were counted on more than one day within a season, but in most cases, these could not be differentiated in the DET data. As a result, some species may be classified as adequately monitored that would not meet the criteria if repeat sightings were excluded. This is most likely for locally breeding species that complicate migration monitoring anyway. One criterion we did not consider was whether the migration period of a species was adequately sampled. Hussell and Ralph (1996) suggest that at least 75% of the period when most birds migrate should be covered. However, in most cases, we did not have migration data for periods when stations were not operating, so could not consistently estimate how much of the migration was missed for any given species.

A list of species that met the above criteria was generated and sent to each CMMN station so that species could be classified into one of the following three categories:

- a) Most individuals of this species are passage migrants, and few or none of the birds recorded in DETs breed within 1 km of the station.
- b) Most individuals of this species counted in DETs breed within 1 km of the station (seasonal or permanent residents), such that migratory individuals cannot be readily

distinguished from migrants in daily totals.

- c) There are local breeders but the number of individuals recorded increases significantly during migration due to the presence of passage migrants and numbers drop off following migration.

All species were classified into one of the above categories; however, we acknowledge that boundaries between these categories are rather imprecise, and may not have been interpreted in the same way by all stations. Furthermore, there may be year-to-year variation in the proportion of a species that is breeding locally, and there is some ambiguity in the definition of residents. For example, some species may not breed in the immediate vicinity of a station (i.e. within 1 km), but may breed within a few km, such that many post-breeding dispersers are detected at the station. The interpretation of this situation may have varied among stations but, in most cases, these species were likely classified in category b. Irruptive species such as finches and waxwings did not fit well into any categories.

Because the migrant population is not being sampled for species classified as category b (which we shall call “residents” acknowledging that many are only seasonal residents), these species were considered not adequately monitored irrespective of the number of birds counted or the number of days the species was recorded. However, they are still mentioned and included in regional and station analyses, and are listed in Appendix 2.

Species Range

The range of each species was examined using maps in the Birds of North America Species Accounts (if available) or else Godfrey (1986), and used to select species that normally migrate through each region, and hence are potentially targets for coverage in that region. When evaluating coverage within a region, only species that potentially migrate through that region are considered. For individual stations, coverage is generally evaluated relative to species within the region as a whole, but in some cases, the regions were defined in a more restricted manner for evaluating individual species coverage (e.g., species found only in Alberta were not considered relevant to Manitoba stations).

Regional Results

British Columbia

Table 2- Number of priority species in British Columbia that are or are not being potentially monitored at Mackenzie Nature Observatory. Species that are being counted in sufficient number but are mainly local breeders or permanent residents at a station are considered not covered.

Priority Code	Species Coverage	
	Number of species potentially monitored at Mackenzie	Number of species not monitored at Mackenzie
A	11	3
B	11	10
C	15	17
D	11	14

Bird Studies Canada has not yet received any computerized data from the other CMMN member station in B.C. (Rocky Point). B.C. stations are currently dealing with a large backlog of banding and DET data entry. Data entry is ongoing, and we expect to receive some DET data from Rocky Point in the near future.

Mackenzie Nature Observatory, British Columbia

Mackenzie Bird Observatory is potentially monitoring 79% (11/14) of priority A species, 52% (11/21) of priority B species, 47% (15/32) of priority C species, and 44% (11/25) of priority D species in British Columbia (Table 2). Twenty-three of the 48 priority species being potentially monitored at Mackenzie are complete passage migrants whereas coverage of the other 25 species includes a mix of resident and migrant individuals (Appendix 1). Priority species that migrate through British Columbia that are not being monitored include: Gray-cheeked Thrush (A), Yellow-bellied Flycatcher (A), Boreal Chickadee (B), Common Redpoll (B), Golden-crowned Sparrow (B), Harris' Sparrow (B), Lapland Longspur (B), Northern Shrike (B), Pine Grosbeak (B), Snow Bunting (B), Swamp Sparrow (B), Bank Swallow (C), Black-and-white Warbler (C), Blue-headed Vireo (C), Black Swift (C), Brewer's Sparrow (C), Black-throated Gray Warbler (C), Clay-coloured Sparrow (C), Ovenbird (C), Red-eyed Vireo (C), Say's Phoebe (C), Yellow-headed Blackbird (C), Brewer's Blackbird (D), European Starling (D), Gray-crowned Rosy Finch (D), Horned Lark (D), Marsh Wren (D), Townsend's Solitaire (D), Vesper Sparrow (D), and Winter Wren (Appendix 2). Furthermore, Yellow-bellied Sapsucker (A), Varied Thrush (B), Common Nighthawk (C), Eastern Kingbird (C), Olive-sided Flycatcher (C), Tree Swallow (C), Western Tanager (C), Western Wood-Pewee (C), Cedar Waxwing (D), Downy Woodpecker (D), Hairy Woodpecker (D), Red-breasted Nuthatch (D), Red-bellied Sapsucker (D), and Red-winged Blackbird (D) are being monitored as local breeders at Mackenzie and therefore are likely unsuitable for use in trend analyses.

Mackenzie is monitoring at least four species (Cassin's Vireo (C), Hammond's Flycatcher (C), Rufous Hummingbird (C), Townsend's Warbler (C), and Violet-green Swallow (C)) that are not being monitored anywhere else in Canada due to their westerly distribution.

Prairie Region

Table 3 - Number of priority species in the prairies that are being potentially monitored at 1 CMMN station, 2-3 CMMN stations, more than three CMMN stations and the number of species that are not being monitored at any of the prairies stations. Species that are being counted in sufficient number but are mainly local breeders or permanent residents at a station are considered not covered.

Priority Code	Species Coverage			
	1 station	2-3 stations	>3 stations	no coverage
A	6	0	9	2
B	3	4	4	10
C	10	7	6	4
D	5	4	4	12

In the Prairie region, 88% (15/17) of priority A species, 52% (11/21) of priority B species, 85% (23/27) of priority C species and 52% (13/25) of priority D species whose migratory route crosses the prairies are being potentially monitored by at least one of the five CMMN stations. One priority A species (Connecticut Warbler) is not being counted in adequate numbers at any of the prairie CMMN stations and Savannah Sparrow (A) is being monitored as a local breeder at only one station (Appendix 2). In addition, 10 priority B species (Boreal Chickadee, Bohemian Waxwing, Common Redpoll, Lapland Longspur, Le Conte's Sparrow, Northern Shrike, Rusty Blackbird, Smith's Longspur, Snow Bunting and White-winged Crossbill), 3 priority C species (Common Nighthawk, Olive-sided Flycatcher and Say's Phoebe) and 3 priority D species (Brewer's Blackbird, Horned Lark and Vesper Sparrow) are not being monitored at any of the prairie stations (Appendix 2).

In addition to species listed above, there are 15 priority species that are being monitored as local breeders (Appendix 2). The majority of coverage for priority C and D species on the prairies consists of either resident species or species that are classified as both resident and migrants. Few prairie stations are monitoring purely migratory populations of priority C and D species.

Lesser Slave Lake Bird Observatory, Alberta (LSLBO)

Species coverage for Lesser Slave Lake Bird Observatory was estimated from five years of data (1994-1999) (Table 1). LSLBO is potentially monitoring 39 species of priority level A-D, 27 of which have a local breeding population but many passage migrants also recorded in the daily estimated totals. Only 12 of the potentially monitored priority species are complete passage migrants (Appendix 1). LSLBO is the only prairie station potentially monitoring

American Pipit (A), Yellow-bellied Sapsucker (A), and Western Tanager (C) (Appendix 2).

Beaverhill Bird Observatory, Alberta (BBO)

Species coverage for Beaverhill Bird Observatory was based on eight years of DET data (1992-1999) (Table 1). Because Beaverhill is in operation from late April to the end of September with no breaks in coverage, local breeders were easily identified by looking for species that show no substantial decrease in numbers over the summer.

Beaverhill is potentially monitoring 20 priority species (8 priority A, 6 priority B, 3 priority C, 3 priority D) (Appendix 1). Eighteen of these priority species are primarily passage migrants at the station, while 2 are classified as both residents and migrants (Alder Flycatcher and Red-eyed Vireo). Many priority species that are being counted at Beaverhill are local residents (20 priority A-D species) (Appendix 2).

Inglewood Bird Sanctuary, Alberta (IBS)

Five years of data (1995-1999) were used to determine species coverage at Inglewood (Table 1). Seven priority A species, 6 priority B species, 11 priority C species and 8 priority D species are being potentially monitored at Inglewood. Of these 32 priority species, 20 are classified as passage migrants and the remaining 12 species are a mix of resident and migrant individuals (Appendix 1). Many priority D species that are being counted in adequate numbers at Inglewood are local breeders (Appendix 1). Inglewood is the only CMMN station in Canada that is potentially monitoring Western Wood Peewee (C) migrants, and one of only two stations in Canada (the other is Mackenzie in B.C.) that is potentially monitoring MacGillivray's Warbler (C) (Appendix 2). Inglewood is also the only prairie station that is counting large numbers of migrant Eastern Kingbirds (C). Coverage of Eastern Kingbirds at other prairie stations consists of local breeding populations.

Last Mountain Bird Observatory, Saskatchewan (LMBO)

Species coverage for Last Mountain was calculated from eight years of banding data (1992-1999) (Table 1). We used banding data for our analysis of Last Mountain because the station stopped recording DETs after 1997, and DET components were not available. Last Mountain is potentially monitoring 9 priority A species, 5 priority B species, 10 priority C species, and 4 priority D species (Appendix 1). Clay-colored Sparrow (C), Eastern Kingbird (C), and Warbling Vireo (C) are the only priority species that are classified as primarily residents at LMBO. Additionally, there are five priority species (Chipping Sparrow (C), Common Yellowthroat (C), Least Flycatcher (C), Yellow Warbler (C), American Robin (D)) whose migration counts include both residents and passage migrants

Delta Marsh Bird Observatory, Manitoba (DMBO)

Seven years of DET data from Delta Marsh (1993-1999) were used to calculate species coverage (Table 1). A total of 49 species are being potentially monitored at Delta (13 priority A, 9 priority B, 17 priority C, 10 priority D). Of these 49 species, 10 are classified as both residents and migrants and the other 39 are passage migrants (Appendix 1). Delta is also counting an additional 13 priority species that are mainly local residents (e.g. Barn Swallow (C), Eastern Kingbird (C), Warbling Vireo (C), Hairy Woodpecker (D)) (Appendix 2).

Delta is monitoring several priority species that are not being monitored elsewhere in the prairies. These species are: Bay-breasted Warbler (A), Cape May Warbler (A), Gray-cheeked Thrush (A), Yellow-bellied Flycatcher (A), Fox Sparrow (B), Harris' Sparrow (B), Bank Swallow (C), Blue-headed Vireo (C), Black-throated Green Warbler (C), Cliff Swallow (C), Yellow-headed Blackbird (C), Brown Creeper (D), Golden-crowned Kinglet (C) and Purple Finch (D) (Appendix 2).

Great Lakes Region

Table 4 - Number of priority species in the Great Lakes region that are potentially monitored at one CMMN station, 2-3 CMMN stations, or more than three CMMN stations, and the number of species that are not being adequately monitored at any of the CMMN stations. Species that are being counted in sufficient numbers but are mainly local breeders or permanent residents at a station are considered not covered.

Priority Code	Species Coverage			
	1 station	2-3 stations	>3 stations	no coverage
A	0	2	14	1
B	1	6	12	1
C	1	2	19	0
D	0	1	20	3

In the Great Lakes region, 94% (16/17) of the priority A species, 95% (19/20) of priority B species, 100% (22/22) of priority C species and 88% (21/24) of priority D species whose migratory routes include the Great Lakes are being potentially monitored by one or more of the 10 CMMN station in the region. Connecticut Warbler (A), Le Conte's Sparrow (B) and Brewer's Blackbird (D) are not being adequately monitored by any of the CMMN stations in the Great Lakes region. In addition, Harris' Sparrow (B) and Olive-sided Flycatcher (C) are being monitored at only one CMMN station (WPBO and TCBO respectively). Unlike the prairies, only two of the species in the Great Lakes region are being counted solely as local residents (Downy Woodpecker (D) and Hairy Woodpecker (D)) (Appendix 2).

Thunder Cape Bird Observatory, Ontario (TCBO)

Thunder Cape species coverage was calculated from 9 years of DET data (1991-1999) (Table 1). Thunder Cape Bird Observatory is monitoring 16 priority A species, 17 priority B species, 19 priority C species and 18 priority D species in adequate numbers. Of these 70 species, counts of 33 include both local breeding resident and migrant individuals. The remaining 37 species are passage migrants (Appendix 1). Hairy Woodpecker (priority D) is also being counted in sufficient number but is a local resident. Thunder Cape is the only CMMN station in the Great Lakes region potentially monitoring Olive-sided Flycatcher (C) and one of only two stations monitoring Bohemian Waxwing (B), Northern Shrike (B), Pine Grosbeak (B) and Clay-colored Sparrow (C) (Appendix 2).

Whitefish Point Bird Observatory, Michigan, USA (WPBO)

Species coverage was calculated using 11 years of data from Whitefish Point (1989-1999) (Table 1). Whitefish Point is potentially monitoring 52 priority species in adequate numbers (15 priority A, 15 priority B, 11 priority C, 11 priority D). Of these 52 species, 18 are a mix of residents and migrants and the remaining 34 species are being monitored as passage migrants (Appendix 1). Whitefish Point is additionally monitoring many other priority species that are local residents (e.g. Dark-eyed Junco (B), Myrtle Warbler (B), Common Yellowthroat (C), Red-eyed Vireo (C), Hermit Thrush (D)) (Appendix 2).

Vermilion, Michigan, USA

Species coverage for Vermilion, a station run by Whitefish Point Bird Observatory, was based on 4 years of data (1993, 1996-1998). Data for 1994 and 1995 are not compiled and so were not included in our analysis. Vermilion is counting sufficient numbers of 10 priority A species, 7 priority B species, 8 priority C species and 10 priority D species. DETs for 18 of these 35 species include both residents and migrant individuals, whereas only passage migrants are being counted for the other 17 species.

Long Point Bird Observatory (LPBO), Ontario, Site 1 (Tip)

The Tip station of Long Point Bird Observatory has been operating since 1961, so 39 years of DET data were used to determine species coverage (Table 1). Fourteen priority A species, 11 priority B species, 19 priority C species and 21 priority D species are potentially being monitored at the 'Tip' station. Of these 64 priority species, only 7 are classified as a mix of residents and migrants, and the remaining 57 are passage migrants (Appendix 1). With the exception of Tree Swallow (C) and Downy Woodpecker (D), none of the potentially monitored priority species are local residents (Appendix 2).

Long Point Bird Observatory, Ontario, Site 2 (Breakwater)

Thirty-nine years of data (1961-1999) were used to calculate species coverage at the Breakwater station of Long Point Bird Observatory (Table 1). Breakwater is potentially monitoring 53 priority species (13 priority A, 7 priority B, 17 priority C, 18 priority D). Of these 53 species, 8 species (1 priority C, 7 priority D) are classified as both residents and migrants and 46 are classified as passage migrants at Breakwater (Appendix 1). At Breakwater, Tree Swallow (C) and Downy Woodpecker (D) are the only two priority species that are summer and permanent residents respectively (Appendix 2).

Long Point Bird Observatory, Ontario, Site 3 (Old Cut)

The Old Cut station has been in operation since 1984, so 16 years of data were used to calculate species coverage (Table 1). Old Cut is potentially monitoring 15 priority A species, 10 priority B species, 19 priority C species and 20 priority D species. Migration counts for 13 of the 63 monitored priority species include resident and migrant individuals, whereas the other 50 species are complete passage migrants (Appendix 1). Old Cut is also counting 1 priority species that is mainly a summer resident (Tree Swallow (C)), and 1 species that is a permanent resident (Downy Woodpecker (D)) (Appendix 2).

Haldimand Bird Observatory (HBO): Selkirk Provincial Park (SPP), Ontario

Species coverage at Selkirk Provincial Park was calculated using 4 years of spring data (1996-1999) and 1 year of fall data (Table 1). Selkirk is potentially monitoring 14 priority A species, 13 priority B species, 17 priority C species and 20 priority D species. Of these 64 species, 18 are classified as being residents and migrants and the other 46 species are classified as complete passage migrants at Selkirk (Appendix 1). Downy Woodpecker (D) and Hairy Woodpecker (D) are the only two priority species being counted as mainly residents at SPP (Appendix 2).

Haldimand Bird Observatory: Ruthven Site

Species coverage at Ruthven was calculated from 2 years of DET data (1998-1999) (Table 1). Ruthven is potentially monitoring 8 priority A species, 8 priority B species, 9 priority C species, and 11 priority D species. Migration counts for 12 of the 36 species include resident and migrant individuals whereas the other 24 species are passage migrants at Ruthven (Appendix 1). Ruthven is also monitoring 16 local resident species: Swamp Sparrow (B), American Redstart (C), Barn Swallow (C), Canada Warbler (C), Common Yellowthroat (C), Eastern Kingbird (C), Red-eyed Vireo (C), Warbling Vireo (C), American Robin (D), American Crow (D), Black-capped Chickadee (D), Belted Kingfisher (D), Downy Woodpecker (D), Eastern Phoebe (D), Hairy Woodpecker (D), and Song Sparrow (D). (Appendix 2).

Prince Edward Point Bird Observatory, Ontario (PEPBO)

Prince Edward Point species coverage was calculated using only 1 year of DET data (1999). DET data from previous years are not yet computerized (Table 1). Prince Edward Point is potentially monitoring 10 priority A species, 10 priority B species, 15 priority C species, and 15 priority D species in sufficient numbers. For 14 of the monitored priority species, both residents and migrant individuals are being counted, and 36 are classified as complete passage migrants (Appendix 1). Additionally, Clay-colored Sparrow (C), Cliff Swallow (C), Belted Kingfisher (C), Downy Woodpecker (D) and Hairy Woodpecker (D) are local residents that are being counted at Prince Edward Point (Appendix 2).

Innis Point Bird Observatory, Ontario (IPBO)

Three years of DET data (1997-1999) were used to calculate species coverage at Innis Point (Table 1). Innis Point is currently monitoring 5 priority A species, 6 priority B species, 8 priority C species, and 4 priority D species. Of these 23 species that are being potentially monitored, only three are classified as being both residents and migrants and the remaining 20 are passage migrants (Appendix 1). There are an additional 17 species that are being counted in sufficient numbers, but are mainly breeding residents at IPBO (Appendix 2).

St. Lawrence Region

Table 5 - Number of priority species in the St. Lawrence region that are potentially monitored at Observatoire d'oiseaux de Tadoussac in Québec. Species that are being counted in sufficient number but are local breeders are considered not covered.

Priority Code	Species Coverage	
	monitored at Tadoussac	not monitored at Tadoussac
A	12	5
B	17	1
C	14	6
D	14	8

At present, Tadoussac is the only migration monitoring station in the St. Lawrence region of Canada. Tadoussac is in the process of becoming a CMMN member station, and has supplied BSC with three years (1997-1999) of DET data (Table 1). OOT is potentially monitoring 71% (12/17) of priority A species, 94% (17/18) of priority B species, 70% (14/20) of priority C species, and 64% (14/22) of priority D species. There are 15 priority species that are not being monitored in the St. Lawrence region (Cape May Warbler (A), Connecticut Warbler (A), Gray-cheeked Thrush (A), Orange-crowned Warbler (A), Yellow-bellied Sapsucker (A), Swamp Sparrow (B), Bank Swallow (C), Barn Swallow (C), Common Nighthawk (C), Eastern Kingbird (C), Olive-sided Flycatcher (C), Tree Swallow (C), Eastern Phoebe (D), Red-winged Blackbird (D), Vesper Sparrow (D) (Appendix 2). There are an additional five species that are being counted in sufficient number at OOT, but are local residents (Belted Kingfisher (D), Downy Woodpecker (D), Hairy Woodpecker (D), Hermit Thrush (D), and Song Sparrow (D)).

Observatoire d'oiseaux de Tadoussac (OOT), Québec

Tadoussac is potentially monitoring 12 priority A species, 17 priority B species, 14 priority C species, and 14 priority D species (Table 5). Migration counts of 36 of these potentially monitored species include both residents and migrants, and the remaining 21 are classified as complete passage migrants (Appendix 2).

Tadoussac is one of two CMMN stations that is monitoring "Yellow" Palm Warbler (B), and one of three CMMN stations monitoring Northern Shrike (B) and Pine Grosbeak (B) (Appendix 2). Atlantic Bird Observatory is the other CMMN station that is potentially monitoring "Yellow" Palm Warbler. Northern Shrike (B) and Pine Grosbeak (B) are also being potentially monitored at TCBO in western Ontario and WPBO in Michigan, USA.

Atlantic Region

Table 6 - Number of priority species in the Atlantic region that are potentially monitored at one, both, or neither of the Atlantic Bird Observatory sites. Species that are being counted in sufficient number but are local breeders at a station are considered not covered.

Priority Code	Species Coverage		
	1 site	2 sites	no coverage
A	5	4	6
B	0	8	7
C	3	7	10
D	4	10	8

The Atlantic Bird Observatory is presently the only CMMN member station in the Atlantic region of Canada. There are two stations associated with the Atlantic Bird Observatory: Seal Island and Bon Portage Island. At the Atlantic Bird Observatory 60% (9/15) of priority A species, 53% (8/15) of priority B species, 50% (10/20) of priority C species and 64% (14/22) of priority D species are being potentially monitored at one or both Atlantic Bird Observatory sites. There are 18 species that are not being covered by the two Atlantic sites: Alder Flycatcher (A), Cape May Warbler (A), Gray-cheeked Thrush (A), Tennessee Warbler (A), American Tree Sparrow (B), Northern Shrike (B), Pine Grosbeak (B), Rusty Blackbird (B), Snow Bunting (B), Bank Swallow (C), Canada Warbler (C), Cliff Swallow (C), Common Nighthawk (C), Olive-sided Flycatcher (C), Philadelphia Vireo (C), Downy Woodpecker (D), Horned Lark (D), Hairy Woodpecker (D), and Vesper Sparrow (D) (Table 6 and Appendix 2).

In addition to the priority species listed above, there are a number of species that are being monitored in sufficient number but for which many individuals are local residents at both Seal and Bon Portage Island. These species include: Savannah Sparrow (A), Swainson's Thrush (A), Boreal Chickadee (B), Fox Sparrow (B), Barn Swallow (C), Chipping Sparrow (C), Tree Swallow (C), Yellow Warbler (C), American Crow (D), American Robin (D), European Starling (D), and Golden-crowned Kinglet (D). Counts of several other species in the Atlantic region contain both resident and migrant individuals (Appendix 2).

Seal Island, Nova Scotia

Although the Atlantic Bird Observatory has been in operation since 1995, its protocol was not standardized in the first two years of operation. Therefore, species coverage was calculated based on DETs from 1997-1999 only (Table 1). Seal Island is potentially monitoring 4 priority A species, 8 priority B species, 7 priority C species, and 12 priority D species. Ten of these 31 priority species are classified as both residents and migrants and the remaining 21 are passage migrants at Seal Island (Appendix 1). There are an additional 10 priority species being monitored that are local breeders (Appendix 2).

Bon Portage Island, Nova Scotia

Bon Portage Island has also been involved in migration monitoring since 1995, but the protocol was not standardized until 1997. Species coverage was calculated using DETs from 1997-1999 (Table 1). Thirty-nine priority species are being potentially monitored at Bon Portage Island (9 priority A, 8 priority B, 10 priority C and 12 priority D). Thirteen of the 39 priority species are classified as both migrants and residents whereas the remaining 26 species are passage migrants at Bon Portage Island (Appendix 1). There are an additional 12 species that are considered local breeders (Appendix 2).

National Overview

Table 6 – Number of priority species that are potentially monitored by 1-2, 3-5, 6-8, 9-10 or more than 10 CMMN stations and the number of priority species that the CMMN is not monitoring. CMMN stations with more than one site were counted as separate stations. Species that are counted in sufficient number but are considered summer or permanent residents at a station are considered not covered.

Priority Code	Number of stations					none
	1-2	3-5	6-8	9-10	>10	
A	0	0	2	4	10	1
B	2	8	1	2	7	4
C	11	1	5	3	12	4
D	2	1	2	5	12	5

Despite the fact that Connecticut Warbler breeds from eastern British Columbia west to Quebec, and presumably migrates through southern Canada, it is the only priority A species not being monitored at any of the CMMN stations. However, the Connecticut Warbler is a difficult species to monitor on migration because of its secretive behaviour and preference for dense undergrowth (Pitocchelli et al. 1997). All other priority A species are being monitored by at least six CMMN stations (Table 6), and in most cases, migration counts of priority A species are not confounded by the presence of local breeders (Appendices 1,2). Although Alder Flycatcher is currently being monitored at several CMMN stations, migration monitoring may not be an appropriate method for monitoring this species because of the inherent difficulty in separating Willow and Alder Flycatchers when they are not singing.

Four priority B species (Golden-crowned Sparrow, Hoary Redpoll, Le Conte's Sparrow, and Smith's Longspur) are not being monitored in sufficient numbers by the CMMN (Appendix 2). British Columbia is the only region in Canada that could potentially monitor Golden-crowned Sparrows, and it is likely that Rocky Point Bird Observatory on Vancouver Island, B.C. is monitoring this species. However, we have not received data from Rocky Point, so our evaluation of species coverage in British Columbia is preliminary. Le Conte's Sparrow and Smith's Longspur are also not being adequately monitored by any CMMN stations, although

Beaverhill Bird Observatory is monitoring a resident population of Le Conte's Sparrow (Appendix 2). Le Conte's Sparrow migrates singly or are widely spaced and prefer old field, grassland or marsh edge habitat (Lowther 1996). Similarly, Smith's Longspur prefers grasslands, pastures and airport fields on migration (Briskie 1993). Habitat preferences of these two species likely explains their low numbers in daily estimated totals because grassland is likely an underrepresented habitat type in the census area of most CMMN stations.

Migration monitoring may not be an appropriate method for monitoring Hoary Redpoll (B), Common Redpoll (B), Pine Grosbeak (B), and Boreal Chickadee (B) populations. These species are irruptive migrants that only occur in southern Canada in some years. Because priority B species winter primarily (>60% of their range) within North America, winter monitoring programs may be able to fill in some of the gaps in species coverage. For example, irruptive species could potentially be monitored by Project FeederWatch.

Black Swift, Brewer's Sparrow, Black-throated Gray Warbler, Say's Phoebe and Vaux's Swift are the only priority C species not being monitored by the CMMN. All of these are primarily western species, that could only be monitored in British Columbia, although Say's Phoebe could also potentially be monitored in the prairies. Rocky Point Bird Observatory may be potentially monitoring some of these species.

Gaps in coverage of priority D species include Brewer's Blackbird, Gray-crowned Rosy Finch, Nelson's Sharp-tailed Sparrow, Red-breasted Sapsucker and Townsend's Solitaire. The Gray-crowned Rosy Finch breeds in the Rocky Mountains and, in fall, migrates to lower altitude grassland regions (Semenchuk 1992). Thus, migration monitoring is likely unable to monitor Gray-crowned Rosy Finch. Red-breasted Sapsucker and Townsend's Solitaire are two other species that are not being adequately monitored because of their westerly distribution. Like Le Conte's Sparrow and Smith's Longspur, the preference of Brewer's Blackbird and Nelson's Sharp-tailed Sparrow for grassland habitats on migration likely explains lack of coverage of these species. Furthermore, Brewer's Blackbird may be difficult to distinguish from other blackbird species because it often occurs in large mixed species flocks which may commonly be recorded as unidentified blackbirds in daily estimated totals.

It is also worth noting that migration counts of a number of other priority C species (e.g. Chipping Sparrow, Red-eyed Vireo, Yellow Warbler) and many priority D species (e.g. Common Grackle, Northern Flicker, Red-winged Blackbird) include a mixture of resident and migrant individuals at many stations. It is not yet clear, and may vary among species, how well counts that include local residents can be used to estimate population trends of the migrants. It is possible that fluctuations in the local breeding population may obscure changes that are occurring in the migrant population.

In addition to the complication of local breeders, some other species may not be adequately monitored by standard migration monitoring methods (at least using banding or DET) because of their behaviour. Swifts, swallows, and blackbirds are mainly diurnal migrants that migrate in large flocks, and are rarely captured in substantial numbers in standard mist-nets (although blackbirds can be readily trapped in baited traps). Furthermore, swallows and blackbirds may aggregate into large flocks on staging areas, and remain in those flocks for protracted periods before migrating. Therefore, it may be impossible to distinguish staging birds (that may be

seen on a daily basis) from birds on passage migration, especially if a roosting site of such a flock is near a monitoring station. Furthermore, it would not be possible to recognize turn-over in the flocks (e.g., if 10,000 blackbirds fly over every morning, are they the same birds every day?).

DETs for these species may show large day to day variation, especially if incidental observations are one of the components contributing to the DET. A standardized daily census, or a standardized visible migration count may be reliable for monitoring swifts and swallows, although it may still be difficult to distinguish flocks that are flying back and forth between local roosting and feeding areas from migrating flocks. In the former case, the “migration” count could change dramatically if the birds shift their staging area, even if their true population size did not change.

In addition, a number of species, especially priority D and to a lesser extent priority B (e.g. crows, woodpeckers, titmice, some finches) are only partially migratory. Their “migrations” are often more irruptive, with varying numbers of birds migrating. Thus, the numbers detected are likely to be especially variable, and they may not be adequately monitored by migration counts.

Thus, although only 14 of the 104 priority species are definitely not being monitored by any of the stations we considered in this analysis, it seems likely that coverage for a number of other species is inadequate.

Conclusions

The preceding analysis suggests that, at a national level, the CMMN is managing to provide at least some coverage for most of the species designated as targets for migration monitoring. Many of the exceptions are in categories B and D, which represent species that winter mainly within North America, north of Mexico, and hence can potentially be monitored in winter. Most of the remaining exceptions are western species, particularly in British Columbia. Because we did not have data from all the current B.C. stations, it is possible that some of those species are, in fact, being monitored at one or more stations.

At a regional level, there are still a number of gaps in coverage, especially in the Atlantic region, where there are only two stations in close proximity to one another. However, a number of species are also being missed in the prairies. In particular, species that prefer grassland habitat on migration are not being adequately monitored. Also, a lot of the priority species coverage at prairie stations consists of a mix of resident and migrant individuals. This is particularly true for Lesser Slave Lake and Beaverhill Bird Observatory because they are located further north than most other CMMN stations. Most complete coverage occurs in the Great Lakes region, likely because of the large number of stations. There are 10 CMMN sites in the Great Lakes region as opposed to only 2 in British Columbia, 5 in the prairies, 1 in the St. Lawrence region, and two in Atlantic Canada. Although Tadoussac is the only station in the St. Lawrence region, many of the priority species are being monitored. However, CMMN species coverage would be improved if there were a greater number of stations east of Ontario.

It is important to appreciate that this analysis provides a list of species that are only *potentially* being monitored by the CMMN. In order to get reliable trend information, several additional criteria need to be met. In particular, the stations need to maintain consistent coverage, and not change their sampling methods. Changes in the number or arrangement of nets, the census route, or the method of calculating a DET could all affect counts. Many stations have been experimenting with methods, and some stations have changed their methods of calculating DETs in the past year or two. An analysis of the banding data from the 5 stations in the prairie provinces of Canada suggests that between one-third to one-half of the species with adequate numbers detected based on DETs would not be considered adequately monitored, by the same criteria, using banding data alone.

Changes in habitat at a station could also lead to changes in the numbers being monitored, whether by census, banding or DET. All habitats are changing continuously, and it is difficult to predict or define the effects of habitat change on bird counts, and how this will vary among species. In some areas, such as at the tip of Long Point, the average proportion of the survey area covered by cottonwoods, grasses, etc. has probably changed little over the 39 years of coverage. However, the distribution of these habitats has changed frequently, due to erosion by the lake. For example, mature trees have fallen into the lake, while young saplings have matured; and the shape of the point has changed considerably. Consequently, the census area and net locations have also changed, which may have affected counts. In other areas, net locations may have remained unchanged, but trees have grown taller, or vegetation in adjacent areas has changed. This could have quite a large effect on the number of migrants using the sampling area. Unfortunately, even if these habitat changes are well documented, it may be difficult to define what the effect would be. We do not know how or if changes such as these affect the precision of trend estimates. However, they could introduce a serious bias, because changes in the population indices even if measured very precisely, may not accurately reflect changes in the bird populations.

Another limitation is that the criteria we are using to decide what is adequately monitored (i.e. numbers of individuals and numbers of days a species is detected) provide only an index to the precision of the trend estimate for that species. Year-to-year variation in the numbers of a species counted at a station, especially if caused by changes in weather or migration patterns (e.g. proportion migrating, or migration route), will reduce the precision of trend estimates. Species that are detected only occasionally, but in relatively large numbers (i.e. a high average count), will not be monitored as well as species that occur regularly at a station, with similar proportions of the population detected each year. In addition, as noted earlier, some species such as swallows or blackbirds will sometimes congregate in large flocks before migrating. Variation in the location of the roost site could have a greater influence on the count than changes in the population.

Ideally, the criteria should be based on an analysis of the precision of trend estimate from each station for each species. New criteria would then need to be developed to determine what level of precision is required to consider a species adequately monitored. Partners-in-Flight-U.S. have suggested that a survey should achieve bias-corrected, 90% relative confidence intervals for annual proportional change in population size, during the most recent 12 years, of no more than $\pm 3\%$ range-wide or $\pm 5\%$ at a regional level (PIF 1998). Once a similar type of target has been adopted by PIF-Canada, it would be necessary to determine how that relates to the

precision for an individual monitoring station. At that point, it would be desirable to re-evaluate the network coverage based on the number of stations that can achieve the required level of precision for each trend estimate. Unfortunately, there are a number of limitations to this approach.

First, multiple years of data are required to estimate this precision. For example, we would ideally like at least 12 years of data, collected in a standardized fashion, to estimate precision based on the PIF-US criteria. Unfortunately, Long Point is the only CMMN station that has been running for this many years. It may be possible to extrapolate from fewer years of data (the assumptions could be tested with LPBO data), but it would be necessary to have at least 5 years of data, without changes in protocol, to get an estimate of the annual variation in counts at individual stations. Many of the stations in the CMMN that were included in this analysis do not have this many years of data, at least collected using standardized methods, or else have not yet computerized their historic data. However, such data will obviously become available in due course.

Another area for future research is the number of stations needed to monitor each species. It is not appropriate to combine trends from multiple stations, in the same way as is done for other surveys such as the Breeding Bird Survey, because the area being sampled by each station is not known. A station detecting large numbers of a particular species could be sampling a larger or smaller breeding area than a station detecting only small numbers of a species. The breeding areas being sampled by each station may or may not overlap.

If trends cannot be combined, then how does one decide how many stations are adequate? With a single station in a region, it is not possible to separate changes associated with bias (e.g. habitat change or changes in observers) from true population trends. Thus, more than one station is clearly needed to monitor each species. Intuitively, it seems apparent that if multiple stations tend to detect the same trends, then fewer stations are needed to monitor a species than if each station suggested very different patterns. However, what are the limits to this? It is necessary to quantify these criteria in order to decide whether current coverage is adequate.

Once criteria have been developed with respect to the level of precision, and number of stations required to monitor a species adequately, it would be valuable to repeat these analyses to determine what proportion of the species that are potentially being monitored are actually being monitored with sufficient precision. Hopefully, by that time, most of those stations that have not yet computerized their historical data will have had an opportunity to do so, and we will be able to base the analysis on as complete a data set as possible.

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Appendix 1- Summary of priority species (A-D) coverage at each CMMN station. Numbers not in parentheses are number of species being potentially monitored at a station as complete passage migrants, and numbers in parentheses are the number of potentially monitored species whose migration counts include both locally breeding resident and migrant individuals.

CMMN Station	Priority Code				Total
	A	B	C	D	
Mackenzie Nature Observatory	7 (4)	6 (5)	5 (10)	5 (6)	23 (25)
Lesser Slave Lake Bird Observatory	4 (7)	5 (2)	1 (13)	2 (5)	12 (27)
Beaverhill Bird Observatory	6 (1)	6 (0)	2 (1)	3 (0)	17 (2)
Inglewood Bird Sanctuary	7 (0)	6 (0)	4 (7)	3 (5)	20 (12)
Last Mountain Bird Observatory	9 (0)	5 (0)	6 (4)	3 (1)	23 (5)
Delta Marsh Bird Observatory	13 (0)	8 (1)	10 (7)	8 (2)	39 (10)
Thunder Cape Bird Observatory	10 (6)	13 (4)	9 (10)	5 (13)	37 (33)
Whitefish Point Bird Observatory	8 (7)	14 (1)	7 (3)	4 (7)	33 (18)
Vermilion	5 (5)	6(1)	4 (4)	2 (8)	17 (18)
Long Point Bird Observatory:					
The Tip	14 (0)	11 (0)	17 (1)	15 (6)	57 (7)
Breakwater	13 (0)	7 (0)	15 (1)	10 (7)	46 (8)
Old Cut	15 (0)	7 (1)	17 (3)	11 (9)	50 (13)
Haldimand Bird Observatory					
Selkirk	11 (1)	12 (1)	11 (6)	10 (10)	44 (18)
Ruthven	8 (0)	8 (0)	4 (5)	4 (7)	24 (12)
Prince Edward Point	9 (1)	10 (0)	9 (6)	8 (7)	21 (7)
Innis Point	5 (0)	5 (1)	8 (0)	2 (2)	20 (3)
Observatoire d'oiseaux de Tadoussac	5 (7)	13 (4)	1 (13)	2 (12)	20 (36)
Atlantic Bird Observatory:					
Seal Island	2 (2)	4 (4)	6 (1)	9 (3)	21 (10)
Bon Portage Island	7 (2)	4 (4)	6 (4)	9 (3)	26 (13)

Appendix 2 – Summary of species coverage at each of the Canadian Migration Monitoring Network stations. Dark grey areas represent stations counting a species in adequate numbers in one or more season; pale grey cells represent stations beyond the range of a species; white cells represent stations not counting the species in adequate numbers or at which most individuals of the species are seasonal residents. Cells are coded as follows: S= adequate numbers for spring coverage and most individuals of this species are migrants; F= adequate numbers for fall coverage and most individuals of this species are migrants; S/F = adequate numbers for spring and fall coverage and most individuals of this species are migrants; R= species is a summer and/or permanent resident at that station; S/R= adequate numbers for spring coverage but counts include residents and migrants; F/R= adequate numbers for fall coverage but counts include residents and migrants; S/F/R= adequate numbers for spring and fall coverage but counts include residents and migrants. Seasons of operation for each CMMN station are listed in parentheses under the station name (S=spring, F=fall).

Priority Code *	Species Code	B.C. MNO (F)	PRAIRIES					GREAT LAKES										QUEBEC OOT (F)	ATLANTIC	
			LSLBO (S&F)	BBO (S&F)	IBS (F)	LMBO ¹ (S&F)	DMBO (S&F)	TCBO (S&F)	WPBO (S&F)	VERM (S&F)	LPBO1 (S&F)	LPBO2 (S&F)	LPBO3 (S&F)	SPP (S&F)	RUTH (S&F)	PEPBO (S)	IPBO (S)		SEAL (S&F)	BONP (S&F)
A	ALFL	F/R	S/F/R	S/F/R		F	S	F		R			F		S		F/R			
A	AMPI	F	F					F/R	S/F	S/F	S/F		F	F			F	F	F	
A	BBWA						F	S/F/R	F		S/F	F	S/F				F		S	
A	BLPW	F	F	S/F	F	S/F	S/F	F	F	F	S/F	F	S/F	F	F	S	S	F	S/F/R	S/F/R
A	CMWA						S/F	S/F	F/R		S/F	S/F	S/F	F						
A	CONW																			
A	GCTH						S/F	F	F	F	S/F	F	S/F	S/F	F					
A	LISP	F/R	S/F/R	S	F	S/F	S/F	S/F	F/R	S/F/R	S/F	S	S/F	S/F		S		F/R		F
A	MAWA	F	S/F/R	F		F	S/F	S/F/R	F/R	S/F/R	S/F	S/F	S/F	S/F	S	S		F/R	S/F/R	S/F/R
A	NOWA	F/R	S/F		F	F	S/F	S/F	F/R		F	S/F	S/F	F		S		F/R	F	F
A	OCWA	F	S/F	S/F	F	S/F	S/F	S/F	S			F								
A	SAVS	F		R				S/F	F/R	S/F/R	F	S	S	S/F/R	S	S/R	S	F	R	R
A	SWTH	F/R	S/F/R	S	F	S/F	S/F	S/F/R	S/F/R	F/R	S/F	S/F	S/F	S/F	S			F/R		R
A	TEWA	F	S/F/R	S/F	F	F	S/F	S/F/R	S/F	F	F	F	S/F	F	F	S		F/R		
A	WIWA	F	S/F/R	F	F	F	S/F	S/F	S/F	S/F	S/F	S/F	S/F		S	S		F		S/F
A	YBFL						F	F/R	S/F/R	S/F/R	S/F	S/F	S/F	F	F	S		F/R		F
A	YBSA	R	S/R					F	S		S/F	S/F	S/F	S	F	S				F
B	ATSP	F	F	F	F	F		F	S/F		S/F		S/F	S/F	S/F	S		F		
B	AUWA	F/R		F																
B	BOCH							F	S	S								F	R	R
B	BOWA	F						F	S/F									F		
B	CORE							F	S/F					F				F		
B	DEJU	F/R		F	F		S/F	S/F/R	R	R	S/F	S	S/F	S/F	S/F	S	S	F	F	S/F
B	FOSP	F					F		S/F		S/F		S/F	S/F	F	S		F		R
B	GCSP																			
B	HASP						S/F		F											
B	HORE																			
B	LALO							F	S/F	F				S				F		
B	LCSP			R																
B	MYWA	F/R	S/F/R	S/F	F	S/F	S/F	S/F/R	R	R	S/F	S/F	S/F	S/F	S/F	S	S	F/R	S/F/R	S/F/R
B	NSHR							F	F									F		
B	PIGR							F	S/F									F		

Priority Code *	Species Code	B.C. MNO (F)	PRAIRIES					GREAT LAKES										QUEBEC	ATLANTIC	
			LSLBO (S&F)	BBO (S&F)	IBS (F)	LMBO ¹ (S&F)	DMBO (S&F)	TCBO (S&F)	WPBO (S&F)	VERM (S&F)	LPBO1 (S&F)	LPBO2 (S&F)	LPBO3 (S&F)	SPP (S&F)	RUTH (S&F)	PEPBO (S)	IPBO (S)	OOT (F)	SEAL (S&F)	BONP (S&F)
X	MOCH																			
X	NOCA									R	R	R	S/F/R	R						
X	NOCR																			
X	NOMO																			
X	PIWO		R						R	R							R			
X	PYNU																			
X	RBWO												R	R						
X	RECR	R							F	R	R						F			
X	STJA	R																		
X	TTWO																F			
X	WBNU				R		R			R		R	R	R	R	R				
X	WHWO																			

¹ banding data used to calculate species coverage

Station codes are as follows: MNO (Mackenzie Nature Observatory); LSLBO (Lesser Slave Lake Bird Observatory); BBO (Beaverhill Bird Observatory); IBS (Inglewood Bird Sanctuary); LMBO (Last Mountain Bird Observatory); DMBO (Delta Marsh Bird Observatory); TCBO (Thunder Cape Bird Observatory); WPBO (Whitefish Point Bird Observatory); VERM (Vermilion station of WPBO); LPBO1 (Long Point Bird Observatory Tip station); LPBO2 (Long Point Bird Observatory, Breakwater station); LPBO3 (Long Point Bird Observatory, Old Cut station); SPP (Selkirk Provincial Park, site of Haldimand Bird Observatory); RUTH (Ruthven, site of Haldimand Bird Observatory); PEPO (Prince Edward Point Bird Observatory); IPBO (Innis Point Bird Observatory); OOT (Observatoire d'oiseaux de Tadoussac); SEAL (Seal Island, Atlantic Bird Observatory); BONP (Bon Portage Island, Atlantic Bird Observatory).

* Priority codes are defined as follows:

- A. Species with <50% of North American (Canada & U.S. only) breeding range covered by BBS, and <60% of their winter range in U.S. and Canada.
- B. Species with <50% of North American breeding range covered by BBS, but >60% of their winter range in U.S. and Canada.
- C. Species with <60% of their Canadian & Alaskan breeding range (but >50% of North American range) covered by BBS, and <60% of their winter range in U.S. and Canada.
- D. Species with <60% of their Canadian & Alaskan breeding range (but >50% of North American range) covered by BBS, but >60% of their winter range in U.S. and Canada.
- E. Species with >60% of both their Canadian and North American breeding range covered by BBS, and <60% of their winter range in U.S. and Canada.
- F. Species with >60% of both their Canadian and North American breeding range covered by BBS, and >60% of their winter range in U.S. and Canada.
- R. Raptors: not included on chart.
- X. Resident landbirds that are considered to be unsuitable candidates for migration monitoring.