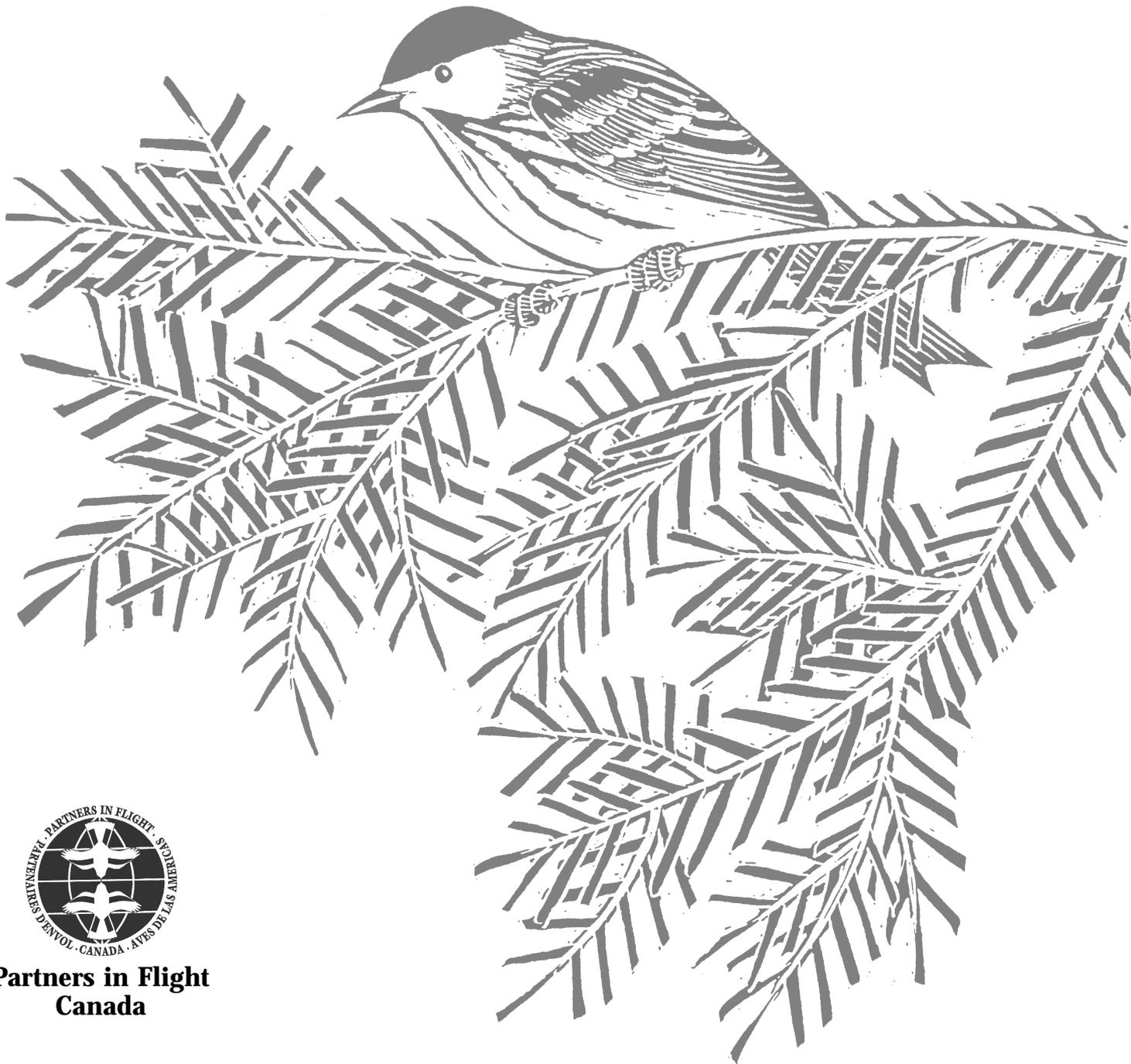


MARCH 2000

# *Canadian Landbird Monitoring Strategy*

Monitoring needs and priorities  
into the new millennium



**Partners in Flight  
Canada**

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*Monitoring needs and priorities into the new millennium*



## **Partners in Flight—Canada**

March 2000

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# Executive Summary

The Canadian Landbird Monitoring Strategy (CLMS) has been prepared by Partners in Flight–Canada to provide a strategic framework and an action plan for the long-term monitoring of Canada’s landbirds and selected waterbirds. The action plan is intended as a working document, subject to ongoing revision and updating as work progresses, additional needs become clear, and resources become available.

The following goals and objectives are defined:

**Goal 1: Monitor the status of all Canadian landbirds including distribution, abundance, demography, and habitat, at a variety of geographic scales.**

*Objective 1.1:* Identify species, species groups, and geographic areas that lack or require additional monitoring, especially for distribution and trends.

*Objective 1.2:* Set priorities for new or improved monitoring.

*Objective 1.3:* Improve or expand existing surveys, or develop new surveys, to address priority gaps in species or geographic coverage.

*Objective 1.4:* Train and encourage volunteers to participate in monitoring surveys.

*Objective 1.5:* Encourage research on monitoring to ensure continued improvement in sampling design, data collection protocols and analysis procedures.

*Objective 1.6:* Develop capacity to monitor habitat to supplement and complement bird population monitoring.

*Objective 1.7:* Develop a set of recommended protocols for small-scale monitoring.

**Goal 2: Ensure that results of monitoring are available and used for research and conservation**

*Objective 2.1:* Establish electronic databases and provide ready access to user-friendly analysis programs, while protecting the rights of those who collected the data.

*Objective 2.2:* Institutionalize processes for conducting regular summary analyses of population trends and for making these results widely available to the public, especially to contributors to the surveys and wildlife managers.

*Objective 2.3:* Regularly summarize status of all Canadian landbird species, integrating results across surveys and highlighting species of concern.

*Objective 2.4:* Work with PIF partners and others to ensure that monitoring results lead to appropriate research, conservation and management activity

Each goal and objective is discussed in the text, giving current status, recent progress, and justification for the recommendations that follow.

Objective 1.3 (Improve or expand existing surveys, or develop new surveys, to address priority gaps in species or geographic coverage) is given extra attention in a separate portion of the report, which describes many of the more widespread existing surveys, and presents text and recommendations for action on those surveys.

Partners In Flight Canada has appointed a Monitoring Working Group to implement this action plan.



# 1 Introduction

The Canadian Landbird Monitoring Strategy (CLMS) provides a framework and an action plan for the long-term monitoring of Canada's landbirds and selected waterbirds. The action plan is intended as a working document, subject to ongoing revision and updating as work progresses, resources become available, opportunities arise, and additional needs become clear. The document is posted on the PIF-Canada web site ([http://www.cws-scf.ec.gc.ca/canbird/pif/p\\_intro.htm](http://www.cws-scf.ec.gc.ca/canbird/pif/p_intro.htm)), where updates may be posted from time to time.

While the goals and recommendations of the CLMS are intended to improve broad participation in surveys and dissemination of results to the public, the document itself is aimed at groups specifically involved in bird monitoring and assumes a basic knowledge of existing surveys. The strategy is focused mainly on landbirds but also addresses monitoring needs for those waterbirds that are not well covered by waterfowl, shorebird, or seabird surveys and that are amenable to being covered by volunteer-based survey techniques. The taxa considered in this report include: loons; grebes; raptors; grouse, ptarmigan, and quail; herons, egrets and bitterns; cranes; rails and coots; pigeons and doves; cuckoos; nighthawks; swifts; hummingbirds; kingfishers; woodpeckers; and passerines. For ease of reference, this report will refer to these species collectively as "landbirds," despite the inclusion of a variety of waterbirds.

An earlier version of the CLMS was prepared by the Canadian Wildlife Service (CWS), both to help that agency review its own monitoring activities and to serve as a guide to others on the means available to address major monitoring needs (CWS 1994; Downes 1994; Downes and Welsh 1997). That document reviewed the status of major active surveys, gave a preliminary assessment of which broad-scale surveys were most effective in covering Canada's species and land mass, and made recommendations for improvement.

Considerable progress has been made since, and it is time to re-assess our direction and priorities. One of the biggest changes since the first CLMS has been the organization of Partners in Flight-Canada (PIF), whose goal is to enhance the conservation of Canada's landbirds through cooperation and communication among the many groups with an interest in Canadian birds and their habitats ([http://www.cwsscfc.gc.ca/canbird/pif/-p\\_title.htm](http://www.cwsscfc.gc.ca/canbird/pif/-p_title.htm)). Because good monitoring is a cornerstone for achieving PIF goals, it was felt appropriate to revise the CLMS as a PIF-Canada project. The document has been circulated widely among PIF partners, and has been extensively revised based on their comments. It has been endorsed by the PIF National Working Group, and is intended to be widely distributed and adopted by partners to help achieve PIF conservation objectives.

Recommendations of the CLMS are focused on improving the coverage, quality and analysis of monitoring data, and on ensuring that results are disseminated broadly and will help lead to appropriate research and conservation activity. It therefore constitutes an important step in meeting responsibilities outlined in Canada's National Framework for the Conservation of Species at Risk, which arose from a federal-provincial accord and calls for reporting on the status of all species every 5 years (<http://www.cwsscfc.gc.ca/es/forum/frame.htm>). The CLMS is also coordinated with international efforts. The strategic directions are similar to those adopted by the monitoring working group of the North American Bird Conservation Initiative, as well as by PIF-U.S., which is developing a monitoring strategy for the U.S.

Goals and surveys of the CLMS are similar to those likely to be included in the U.S. strategy, such that the two strategies should complement each other. Nevertheless, there are a number of differences in emphasis and implementation, based partly upon the fact that Canada has a larger land base and fewer volunteers. (For example, the CLMS places greater emphasis on migration surveys to cover species breeding in remote northern regions where breeding season surveys are difficult.)

The remainder of this document consists of several parts. First, the importance of monitoring to achieve conservation goals is described, and a strategic framework is presented that includes specific goals and objectives for the CLMS. An action plan follows, giving the current status of each objective (highlighting progress in the last 5 years), and outlining recommendations for future activities that would help to achieve the goals of the strategic framework. The next section summarizes status of the major Canadian landbird monitoring programs and gives recommendations for their improvement. This section does not review all monitoring programs in Canada—a task beyond the scope of this document—but rather treats those surveys that have broad geographic coverage, that cover multiple species (with a few exceptions), or that are currently regional in scope but have the potential to fill previously identified gaps in monitoring coverage. Monitoring is required at various geographic scales, however, and the action plan also touches briefly on monitoring at regional or smaller scales.

## 2 Strategic framework

The results of landbird monitoring programs assist wildlife managers by providing information on population status and trends that identify species or populations needing attention, help define appropriate conservation actions, and track the success of management activities. Changes in distribution, status, productivity and survivorship serve as an "early-warning system" for environmental problems and as an indication of general trends in biological diversity.

Habitat-specific surveys provide more detailed information about habitat-associations of birds and how population changes in particular habitats contribute to overall trends. Although clues on the causes of population change can be derived from monitoring data, targeted research will usually be required to explain the causes of population change. Monitoring results serve an important function in defining research priorities.

Here we outline the guiding principles for a monitoring program, based closely on those of the monitoring group of the North American Bird Conservation Initiative, the Integrated Population Approach adopted by Bird Studies Canada (BSC), and the PIF-U.S. National Monitoring Working Group. We then list specific goals and objectives for monitoring landbirds in Canada that follow from these principles.



## 2.1 Guiding Principles and Assumptions

- There should be effective monitoring of all Canadian bird species to identify the status of each and to determine potential conservation needs.
- Long-term monitoring programs that cover extensive geographic regions or even the entire continent; that provide basic information on distribution, habitat use and availability, and abundance (absolute or relative); and that also provide data on changes in these parameters over time, are fundamental elements of bird conservation programs and should be given high priority
- Programs to monitor demographic parameters (e.g., productivity, recruitment, survival) and changes in those parameters over time are needed to provide information on habitat quality (e.g. differentiating source and sink populations), as well as to identify potential causes of observed changes in population size or distribution. Local or regional management initiatives require carefully designed monitoring programs so that the effects of management on bird populations can be assessed and evaluated. Depending upon the specific objectives of local/regional management actions, such monitoring programs may require different methods from long-term large-scale surveys and may have limited applicability beyond the local/regional study.
- Monitoring programs should be designed with explicit, quantitative objectives, and these objectives should be revisited periodically so that survey effort can be focused where it is needed most and will be most effective.
- Survey methods should be standardized whenever possible to facilitate aggregation of survey data across projects or across regions, thereby enabling assessment of population patterns at different geographical scales.
- Data computerization, management, analysis, and delivery of interpreted results to managers and others are essential features of monitoring programs and should be considered in the design of each program. All data should be geo-referenced and original databases should be available to researchers and others to ensure critical evaluation of analysis methods and maximum use of the data.
- International coordination of monitoring programs should be pursued to determine the status of migratory bird species throughout the annual cycle, to share expertise and use limited resources effectively, and to design surveys that are directly comparable across borders.
- Monitoring initiatives under this strategy will be developed to complement, supplement or adapt existing monitoring programs, and to the maximum extent possible will be carried out in collaboration with existing organizations involved in monitoring.
- Whenever possible, two or more independent estimates for trends in population size should be obtained, because many potential or existing surveys are likely to have bias of uncertain magnitude that could potentially lead to incorrect conclusions.
- An Integrated Population Approach should be taken to ensure that results of monitoring lead to identifying probable causes of population change and to developing and implementing management plans that incorporate appropriate remedial or conservation measures to address problems.

## 2.2 Goals and Objectives

**GOAL 1: Monitor the status of all Canadian landbirds including distribution, abundance, demography, and habitat, at a variety of geographic scales.**

*Objective 1.1:* Identify species, species groups, and geographic areas that lack or require additional monitoring, especially for distribution and trends.

*Objective 1.2:* Set priorities for new or improved monitoring.

*Objective 1.3:* Improve or expand existing surveys, or develop new surveys, to address priority gaps in species or geographic coverage.

*Objective 1.4:* Train and encourage volunteers to participate in monitoring surveys.

*Objective 1.5:* Encourage research on monitoring to ensure continued improvement in sampling design, data collection protocols and analysis procedures.

*Objective 1.6:* Develop capacity to monitor habitat, to supplement and complement bird population monitoring.

*Objective 1.7:* Develop a set of recommended protocols for small-scale monitoring.

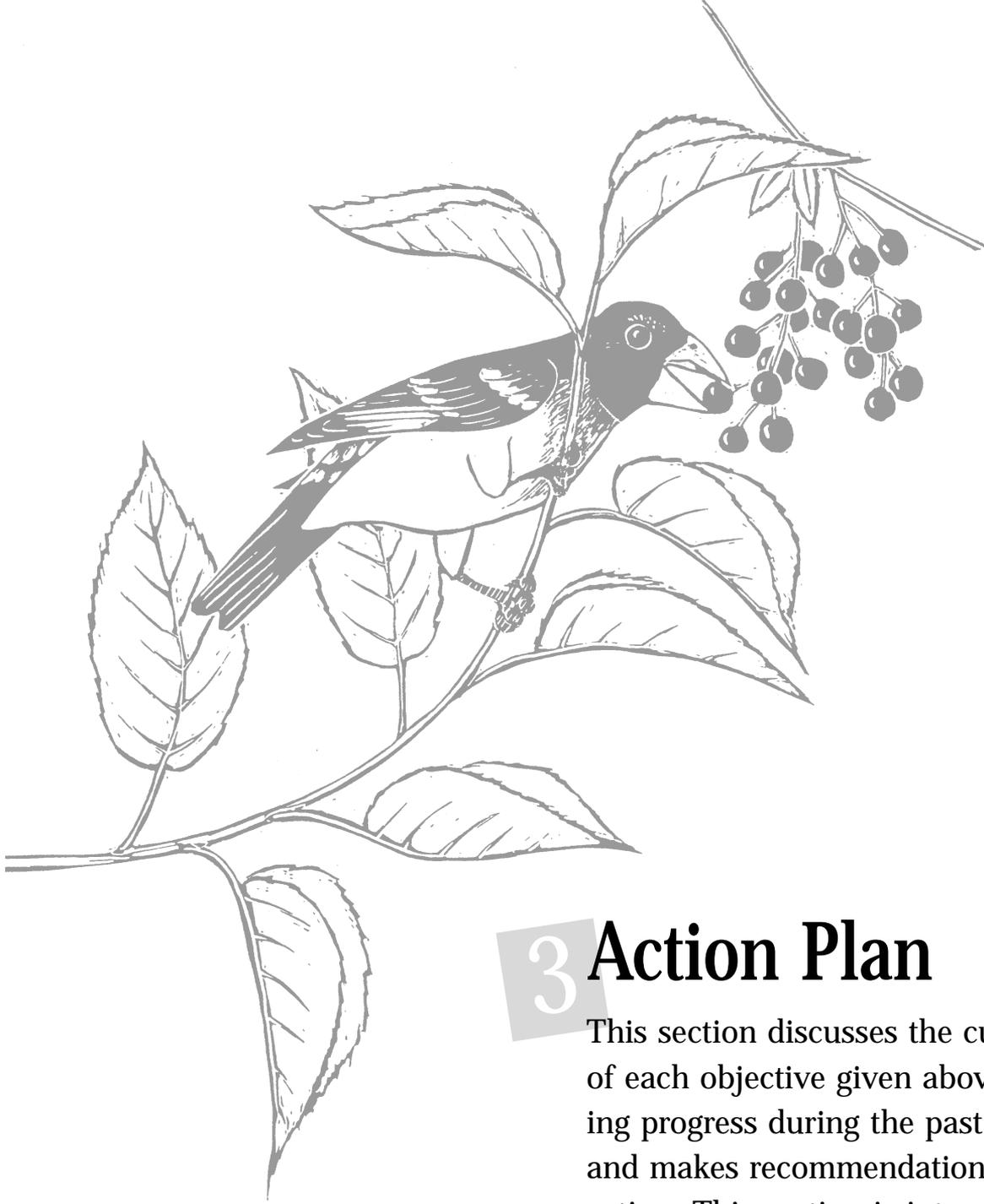
**GOAL 2: Ensure that results of monitoring are available and used for research and conservation**

*Objective 2.1:* Establish and provide ready access to electronic databases and user-friendly analysis programs, while protecting the rights of those who collected the data.

*Objective 2.2:* Institutionalize processes for conducting regular summary analyses of population trends and for making these results widely available to the public, especially to contributors to the surveys and wildlife managers.

*Objective 2.3:* Regularly summarize status of all Canadian landbird species, integrating results across surveys and highlighting species of concern.

*Objective 2.4:* Work with PIF partners and others to ensure that monitoring results lead to appropriate research, conservation and management activity.



## 3 Action Plan

This section discusses the current status of each objective given above, highlighting progress during the past 5 years, and makes recommendations for further action. This section is intended to be dynamic, subject to ongoing revision and updating as work progresses and additional needs become clear.

## ***Goal 1. Monitor the status of all Canadian landbirds, including distribution, abundance, demography, and habitat, at a variety of geographic scales.***

**OBJECTIVE 1.1:** Identify species, species groups, and geographic areas that require additional monitoring, especially for distribution and trends.

A variety of surveys are being run in Canada (many run also in the United States) that provide information useful for monitoring bird populations. Table 1 lists some of the major programs that target multiple species and cover broad geographic areas, and shows the kind of monitoring information contributed by each. Section 4 of this document provides greater detail on each of these surveys.

Our knowledge of breeding range for Canadian landbirds is good in southern Canada, although completion of each regional Breeding Bird Atlas provides greater detail on local patterns. Data from the northern parts of provinces and especially in NWT and Nunavut are sparse, but may improve now that checklist projects have started in some of those areas. Many surveys designed

to document distribution also generate some information on relative density across a species' range, although Breeding Bird Atlases so far completed in Canada have collected few data of this sort.

In contrast to our understanding of breeding distribution, there is less information on the migratory routes, stopover sites, and wintering distribution of most species within Canada. Broad-scale information is available from range maps in general texts (e.g., Godfrey 1986). Distributions and relative densities in late December and early January can be estimated for many Canadian species from Christmas Bird Counts (Root 1988). Migration monitoring provides some information on migratory routes, for a limited number of species and sites. Although checklist projects provide more detailed information, only in Quebec has adequate data been assembled to generate a seasonal atlas (Cyr and Larivée 1995).

**Table 1. Potential monitoring contribution of some of the major, multi-species landbird surveys or survey types in Canada.** "Density" in all surveys refers to relative rather than absolute density.

Survey	Main Contribution
Atlas and other distribution-mapping projects	Distribution, (density)
Christmas Bird Count	Distribution, density, trends
Project FeederWatch	Distribution, density, trends
Checklist projects	Distribution, density, trends
Breeding Bird Survey	Trends, distribution, density
Nocturnal Bird Monitoring	Trends, distribution, density
Migration Monitoring	Trends, distribution, (productivity)
Forest Bird Monitoring	Habitat-specific distribution, density and trends
Grassland Bird Monitoring	Habitat-specific distribution, density and trends
Marsh Bird Monitoring	Habitat-specific distribution, density and trends
Coastal Waterbirds Survey	Habitat-specific distribution, density and trends
Monitoring Avian Productivity and Survivorship	Productivity, survivorship
Nest Records Schemes	Productivity

Population trends are available from Breeding Bird Survey (BBS) or from Christmas Bird Counts (CBC), for about 91% of the 297 species that regularly breed in Canada (Appendix 2). However, 54% of landbirds (159 species) have been identified as needing additional data, including 5% that have no information on population trends from any survey (Appendix 3). Those needing additional information include species for which less than half the Canadian range is currently sampled by BBS; that have trends only from CBC (a semi-standardized survey); or that are not adequately monitored by BBS, CBC or any other long-running survey. For some species, knowledge of population status is based solely on “expert” opinion. Birds breeding in the arctic, species with large portions of their range in northern Canada, owls, diurnal raptors, grebes, grouse, and certain rare species stand out as groups considered in need of better monitoring. For a few of these species, breeding ground data are available from provincial surveys (e.g. Sharp-Tailed Grouse Lek Counts, Ruffed Grouse Drumming Counts) or from various small-game hunter surveys (Dibblee 1996), but most such data have not yet been compiled nationally, and may not be standardized among regions.

Some progress has been made towards improving information on poorly sampled species. For example, about 57% of the species needing additional monitoring (91 species) are targets for the Canadian Migration Monitoring Network (CMMN), although the migration monitoring technique is less standardized than BBS and the power and precision of this method are not known (because trend estimates are so far available only for a few stations in the network). Some species of owls are covered by nocturnal bird surveys in part of their range (in Ontario, Manitoba and Alberta). Certain other raptors are monitored by regional or species-specific surveys (e.g., Red-shouldered Hawk survey in Ontario, Burrowing Owl and Peregrine Falcon surveys by CWS, migration counts). A North American Raptor Monitoring Strategy is currently being developed for both nocturnal and diurnal raptors

(<http://www.im.nbs.gov>; Holroyd, pers.comm.; Holroyd and Takats, 1997), and that strategy will supplement the CLMS when it is complete.

Although Appendix 2 indicates which species have had population trends calculated from BBS, this tally did not consider precision of the estimates. Trends are calculated for any species meeting an arbitrary minimum sample size. However, the minimum sample size required to meet target levels of precision in detecting trends of a given size can vary among species. For example, when counts fluctuate widely between years, larger samples are needed to detect significant trends. Thus, some of the species that we currently consider “covered” by BBS may not be sufficiently well sampled to meet target levels of precision, particularly in certain regions.

A variety of standards have been defined for classifying a population as adequately monitored. Examples of goals are 80% power to detect a decline at a rate of 2% per year after 25 years of monitoring (migration monitoring), or ability to detect a 50% reduction in population size over a 25-year period with  $\alpha = 0.10$  and  $\beta = 0.20$  (Butcher 1992; Holroyd and Takats 1997). It may be appropriate to consider power over shorter time periods, as 25 years could be considered an excessively long time frame for planning management actions. PIF-U.S. suggests 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 3% range-wide or 5% at a regional level (Partners in Flight 1998). A preliminary assessment suggests it would be feasible to achieve that target for about 60% of species in the U.S. (Partners in Flight 1998), but a similar assessment has not yet been done for Canada. Power analysis is underway for BBS (see Section 4) and has been carried out for certain other projects. Further evaluation of the monitoring potential, and power, is still needed for most other existing or proposed surveys, including CBC.

Information on productivity and survivorship is generally lacking for most Canadian landbirds. Some intensive programs have been designed to gather these data (e.g., MAPS, BBird), but there are so few participants that analyses specific to Canada are unlikely to yield adequate precision. Age ratios from mist net captures during migration monitoring and data from Nest Record Schemes both have the potential to provide indices of productivity, but neither method has been developed to realize this potential in Canada.

### Recommendations

1. Identify alternative sources of trend information for species inadequately monitored by large-scale standardized surveys (e.g. provincial wildlife agencies or waterfowl monitoring databases, single species surveys), and compile the relevant information.
2. Establish targets for precision and sensitivity of trend monitoring.
3. Calculate the precision of trend estimates available for each species at the scale of provinces, biomes, and Bird Conservation Regions, for all existing surveys targeted by this report, and determine whether they meet the established targets for precision.
4. Revise list of monitoring needs as additional information on coverage becomes available.

### OBJECTIVE 1.2: Set priorities for new or improved monitoring.

Although it is desirable to know the status of all landbirds in Canada in detail, it is unrealistic to try to accomplish this with the limited human and financial resources currently available. It is therefore necessary to set priorities for monitoring so that limited resources are used most effectively and are focused on species of greatest importance to Canadians and in greatest need of monitoring. Also, because severely endangered species are difficult and expensive to conserve, it is critical to identify species facing difficulties before their problems reach crisis proportions. A priority-setting exercise that addresses both these needs at the national scale was recently completed by CWS as a contribution to PIF-Canada, with input from individuals in many other organizations (Dunn 1997). It is closely comparable with U.S. priority-setting (Dunn 1999), and is used extensively in this report to help identify monitoring priorities. All data and scores for the priority-setting database are available in MS Access format (J. Kennedy, CWS). The database is complete at the national level and includes some data for the provincial level.

The priority-setting system calculates two separate sets of ranks for landbird species. The first is a *Supervisory Responsibility* rank, which at the national level is based on the proportion of a species' North American breeding range in Canada. Birds that breed almost wholly in Canada are ranked highly because Canadians have a responsibility for preserving our most characteristic habitats and fauna. Ideally the proportion of the total population in a jurisdiction should be the criterion for scoring, instead of proportion of range. However, for most species this information is not readily available, especially for northern Canada. Thus, proportion of range is used as a surrogate.

The second set of ranks is based on *Concern*. This preliminary ranking depends on two factors equally: *Population Trend* and *Vulnerability* (a composite score that reflects global abundance, and breadth of breeding and of wintering range). *High Vulnerability* score indicates that a species could be severely impacted by fairly local events, while high *Trend* score is an early warning of actual trouble for a species (whether it is widespread or not). The *Trend* score reflects degree of statistical certainty, but quality of data source is scored separately (*Trend Uncertainty*). These scores need to be revised as statistical reviews of surveys and power analyses are conducted. *Concern* scores are preliminary and for many purposes will need to be refined after considering additional criteria.

The *Supervisory Responsibility*, *Trend Uncertainty* and *Concern* scores are used here to assess priorities for species monitoring. Used in this way the priority scheme accomplishes two objectives:

- a) it provides an assessment of the quality of data now available for each species, and
- b) it guides priority-setting for monitoring. Highest priority species for improved monitoring are those with inadequate monitoring that also rank high on *Concern* and *Responsibility*.

Appendix 3 lists all 297 species of landbirds that regularly breed in Canada, grouped by priority for action, and provides suggestions for the highest priority action(s) needed. As shown in the summary below (Table 2), about 53% of all landbirds require some improvements to monitoring.

Relatively few species (about 5%) have no data or highly uncertain data on population trends (*Trend Uncertainty*= 5; Appendix 3). Among these are three species that are considered highest priority for action: Bicknell's Thrush, Smith's Longspur and Yellow-billed Loon. Work is already underway to research the status and examine ways of improving monitoring for Bicknell's Thrush (D. Busby, J.- P. Savard pers. comm.) and Smith's Longspur (E. Dunn, pers. comm.). The NWT Checklist program occasionally records Yellow-billed Loons, and data on the status of loons in Alaska may be useful in assessing status of Canadian populations (B. Andres, pers. comm.).

About 91 (57%) of the species needing improved monitoring (*Trend Uncertainty*> 3) are northern-nesting species that may be insufficiently covered by BBS in at least half their Canadian breeding range. Another group (13 species or about 8%, most of which rank high on Canadian *Responsibility*) are targets for improved winter counts or better analysis of existing winter counts.

**Table 2. Actions needed by Canada's 297 landbirds (summary of Appendix 3)**

Priority for action	Scores		Number of species needing <sup>a</sup>		Number of species
	Concern	Responsibility	Improved Monitoring	Additional Research/ Conservation Action	
High	High	High	19	18	22
Medium	Medium/High	Medium	25	11	36
Medium	Medium	High	57	1	58
Medium/Low	High	Low	8	29	45
Low	Medium	Low	24	9	96
Very Low	Low	Low to High	26	0	40
<b>Totals</b>			<b>159</b>	<b>68</b>	<b>297</b>

<sup>a</sup> "Research/conservation" means there is conservation concern, requiring thorough status assessment or investigation of causes for well-documented declines to ensure that conservation action will be effective. Note that 25 species have been identified as needing both improved monitoring and research/conservation.

Several of the localized species that are poorly monitored are in British Columbia (e.g. White-tailed Ptarmigan, Black-throated Gray Warbler, Red-naped Sapsucker, Dusky Flycatcher and Mountain Chickadee). Most of those and some other species with few data (Yellow Wagtail, Siberian Tit and Northern Wheatear) rank very low on Canadian *Responsibility* and therefore rank low in priority for special monitoring efforts at the national scale. However, regional priorities may differ from national priorities based on local *Responsibility* and *Concern* scores, and it is important that priority-setting take place at a variety of geographic scales.

#### Recommendations

5. Revise priority table at National level as reviews of survey coverage and precision are completed.
6. Complete priority-setting exercise for monitoring needs at the regional and/or biome level, to the extent possible using species densities rather than range maps to determine *Responsibility* level. Work closely with PIF-U.S. to ensure cross-border comparability of priority species.
7. Prepare synopses for all high priority species and species groups, reviewing the quality of data and needs for action.

#### OBJECTIVE 1.3: Improve or expand existing surveys, or develop new surveys, to address priority gaps in species or geographic coverage.

Although the priority-setting exercise indicates which gaps in monitoring data need to be rectified most urgently, much more needs to be done before making specific recommendations for expanding existing surveys or developing new ones. Additional factors must be considered, such as cost, logistic feasibility, and availability of organizers and volunteers. Choices must be made among the many gaps identified to ensure that the most important are addressed first, and among the available surveys that might fill those gaps.

With limited volunteer and financial resources, recommendations for meeting CLMS goals must focus on the set of surveys that can accomplish these goals in the most effective and efficient manner. For this reason, it is important to carry out critical reviews of both existing and proposed surveys, to determine how well they meet their objectives, and to identify means by which they can be improved. For example, MAPS recently underwent outside evaluation (see Section 4), and the BBS is currently (1999) undergoing a rigorous peer review. Such reviews need to be repeated periodically, to ensure that previous recommendations have been addressed and that advances in the field of monitoring have been incorporated where appropriate. New surveys should not be started without pre-consideration of design and statistical power. All reviews should consider whether recording of habitat or other non-bird data could enhance the value of results in meeting CLMS goals without discouraging volunteer participation.

It should be noted that surveys may have a variety of objectives in addition to contributing to monitoring of high priority landbirds in Canada. These could include answering specific research questions or addressing issues that are a high priority at a local or regional scale. It may sometimes be appropriate to develop surveys that are otherwise low in priority if they can be developed efficiently and cheaply and there is considerable public enthusiasm for participation. However, organizers of such surveys still have a responsibility to their participants to ensure that the data achieve project objectives, and all surveys should be subject to reviews.

Recommendations for improvement in specific surveys are presented and discussed in Section 4.

#### Recommendations

8. Develop detailed recommendations for new and improved monitoring, considering species priorities, geographic gaps, survey precision and potential bias, cost, logistics, volunteer availability and other relevant factors.
9. In carrying out these recommendations, encourage close communication and cooperation among all groups involved in landbird monitoring in Canada to ensure that priorities and their justification are understood.
10. Institute regular review of major monitoring programs, involving outside experts and statisticians, to evaluate sampling design, field protocol, training procedures, data management, analysis methods and precision of trends produced.

#### OBJECTIVE 1.4: Train and encourage volunteers to participate in monitoring surveys.

All of the surveys discussed in this report rely heavily on volunteer participation. Written instructions and study guides are available for individual surveys to explain survey methods, but few programs incorporate formal training programs, and no volunteer survey tests skill level of participants.

The most common skill needed for participation in monitoring surveys is an ability to identify species both by sight and by sound. For surveys that rely on identification of birdsong there are regional cassettes and computer programs to assist birders in self-training. However, although song-identification skills have improved in recent years (Sauer et al. 1994), there is still a need for additional highly-skilled birders. "BirdQuest," a program to train young people in bird-identification skills, has met with limited success due to inadequate marketing and a lack of skilled adult leaders.

There are good training opportunities for banders (needed at many migration monitoring stations and for certain demographic studies), and bander workshops are becoming regular events. The North American Banding Council is developing standardized training and evaluation materials for banders and bander trainers to help raise skill levels, as well as a certification procedure. The first set of training manuals for passerines, raptors and hummingbirds, as well as a general guide and a trainer's guides, is nearly complete (L. Métras, CWS, pers. comm.).

In addition to building a supply of skilled birders and banders, there is a need to encourage greater participation in monitoring surveys. The American Birding Association publishes an annual directory to volunteer projects that includes many of the Canadian surveys. Various Canadian publications also advertise opportunities for participation, including some produced by naturalists' organizations and two published by CWS (*Bird Trends* and *Wildlife Watchers*). A *Landbird Monitoring Manual* is now in preparation by CWS and others that is intended to promote development of, and participation in, those volunteer programs that contribute most to achieving the goals of the CLMS.

#### Recommendations

11. Promote skill testing of participants in particular surveys to identify training needs.
12. Improve training for specific programs requiring a certain skill level, making optimal use of existing commercial or public domain materials (such as bird song guides).
13. Complete and distribute the Landbird Monitoring Manual now in progress.
14. Increase awareness of the opportunities for birders of all skill levels to participate in bird monitoring, through naturalist clubs and other non-government organizations.
15. Develop participants' materials in both official languages for all national surveys.
16. Explore opportunities for using new technology such as the World Wide Web, as well as older methods such as the media, to promote training and participation in surveys.

#### OBJECTIVE 1.5: Encourage research on monitoring to ensure continued improvement in sampling design, data collection protocols and analysis procedures.

There is a steady stream of publications in scientific journals identifying biases in monitoring programs, testing data collection protocols and the assumptions behind them, and describing new analytic procedures. Despite this activity, crucial questions are often not investigated, perhaps because the problems have not been clearly identified or because the questions are difficult to study. Furthermore, there is often a lag between the development of new statistical methods and their routine use in monitoring programs. Organizers of monitoring programs are often not researchers or statisticians themselves, and there is frequently insufficient communication between monitoring and research personnel. Such divisions can be overcome in various ways. For example, the Canadian Migration Monitoring Network is a partnership among member stations (largely run by non-scientists), CWS and BSC (which contribute scientific advice, data-handling and analysis services). The responsibilities for stations and BSC are clearly defined, and the network encourages close cooperation.

Progress in developing analysis procedures is greatly accelerated when qualified statisticians can scrutinize the methods and computer programs used for analysis. This generates healthy debate on methodology and elicits suggestions for improvement. Analysis programs for the major monitoring surveys are not generally made publicly available, in part because they are often works in progress and are not well documented, but also because of the need to protect authors' rights and to prevent tampering with programs. These are issues that can, and should, be addressed.

## Recommendations

17. For each major survey, define research projects that are high priority for testing assumptions, improving data-collection protocol or determining most suitable analysis methods.
18. Encourage research of analysis methods and detection of trends.
19. Ensure that computer programs for data analysis and full explanation of analysis methods are publicly available to encourage critical scrutiny of the methods used.
20. Encourage agencies that have separate monitoring and research divisions to institutionalize collaboration between them.

### **OBJECTIVE 1.6: Develop capacity to monitor habitat, to supplement and complement population monitoring.**

Habitat monitoring at a variety of scales is a valuable adjunct to bird monitoring, to aid interpretation of avian population trends and to contribute to sound management. With the exception of some endangered and some “over”-abundant species, management actions for most birds are likely to focus on managing habitat (including potential contaminant problems) rather than on direct management of bird populations themselves.

In some cases, such as for tundra and boreal wetlands, monitoring of habitat quality and availability (using remote sensing technology) may be easier to accomplish than direct monitoring of the species that occupy it. Habitat monitoring is not an ideal substitute for bird monitoring, because a species may be in serious decline even when there is plenty of its habitat available. However, serious loss or degradation of habitat is almost certainly an indication of a decline in the bird populations that occupy it.

It is important to understand habitat selection of each species both at macro- and micro-scales if habitat is to be managed effectively. Habitat selection may vary geographically and temporally. It is also important to know the distribution and availability of habitat types across the country and how these change over time. Finally, habitat at the sites where bird monitoring is conducted should be documented so it can be determined whether changes in habitat are affecting results and whether habitat is being sampled in proportion to its total availability. All these types of information are required to build habitat models of potential and actual bird distributions and density in Canada and their changes over time.

GIS databases of habitat distributions are being developed for various regions across Canada, generally based upon remote sensing information. However, the data being collected are of variable quality (e.g., due to varying efforts put into ground-truthing), and are not necessarily compatible across various jurisdictions within Canada (due to different software, or different material/methods used in their development). Furthermore, for most such databases, there is no process for regular update of the results in order to monitor habitat change.

Independent development of detailed vegetation and habitat maps for Canada is beyond the scope of PIF-Canada or the CLMS. However, it is appropriate to collaborate with agencies and organizations that are engaged in this type of work, to ensure that the data being gathered are appropriate for, and available to, biologists interested in monitoring bird population trends.

Information on avian habitat selection is gathered by a few volunteer-based bird-monitoring programs, including the Breeding Bird Census, the Marsh Monitoring Program, and the Forest Bird Monitoring Program. However, most programs do not request this information, because the effort and/or skills involved might restrict the number of contributors.

Nonetheless, habitat recording for birders has been tested (e.g. pilot projects to record habitat on BBS routes), and the British Trust for Ornithology has a standard habitat recording protocol that it uses for its volunteer surveys (H. Crick, pers. comm.). An alternative approach is to estimate habitat information by accurately geo-referencing the bird observations, and comparing them with GIS maps of habitats. The relative merits of these two approaches should be investigated further. It might be possible to use birders to help ground-truth some of the GIS habitat maps.

#### Recommendations

21. Describe and evaluate the status of existing efforts to track changes in habitat over time using remote sensing data, at scales appropriate to birds.
22. Identify and support opportunities for development of remote-sensing habitat monitoring capability at regional and continental levels.
23. Evaluate the need, value, and feasibility of recording habitat as part of existing bird monitoring programs.



#### OBJECTIVE 1.7: Develop a set of recommended protocols for small-scale monitoring

Most of the monitoring programs discussed in the CLMS are designed to estimate population trends within large regions or across a species' range. Such information is clearly important for assessing the status of a species as a whole. However, there is also a need for protocols that can be used to monitor birds effectively at smaller scales, such as at a specific locality or in a management unit. Such data are needed to assess the effects of specific management actions on birds, to monitor environmental quality in specific areas, and to assess the status of very rare and locally-distributed species that are poorly sampled by broad-scale surveys.

To encourage maximum comparability of results from local studies of various types and in different regions, there should be a set of recommended protocols for small scale monitoring that is widely accepted across North America. Recommended data collection and sampling protocols should be designed to minimize competition with major surveys for financial and volunteer resources, and should complement those of large-scale programs in terms of the data provided.

In many cases, it will not be sufficient for local monitoring purposes to simply participate in a broader-scale survey. A survey protocol designed to detect trends with reasonable power across a large scale is unlikely to provide adequate precision or power for detecting similar trends in a small area. For example, data from a single route on the Marsh Monitoring Program will not provide adequate power to detect trends on an individual marsh, because the protocol was designed to estimate trends through aggregation of data from many routes over a large region.

Protocols for large-scale surveys may sometimes be appropriate for local work, by increasing the sampling intensity (e.g., establishing many stations or routes within the target area). However, it may not be possible to incorporate the results routinely in the larger program if the latter has a randomized sampling frame (e.g., random route selection for BBS). Furthermore, because most of these surveys are index surveys (i.e., they detect an unknown proportion of the birds in the survey area, which varies among observers), they are subject to serious bias if the same observer runs many routes, and then the observer changes. For this reason, it may be more appro-

priate for many intensive surveys to use methods that estimate actual densities, such as the Breeding Bird Census or certain line transect methods.

### Recommendations

24. Determine appropriate quantitative goals and objectives for small-scale monitoring schemes in a variety of habitats, bearing in mind the constraints of available human and financial resources.
25. Develop a set of protocols for small-scale monitoring that can meet those criteria.

## ***Goal 2. Ensure that results of monitoring are available and used for research and conservation.***

**OBJECTIVE 2.1:** Establish and provide ready access to electronic databases and user-friendly analysis programs, while protecting the rights of those who collected the data.

Monitoring data are of no value if they are not used, and to ensure maximum use it is important that databases from the major monitoring programs in Canada be made easily available to researchers and others working in bird conservation. Timely use depends on quick entry into electronic databases, and ready availability of the databases for analysis. Easy access to databases also encourages early detection and correction of errors.

Some monitoring programs have developed electronic data entry programs for use by volunteers (e.g. migration monitoring, bird banding). Others have used scannable data-entry forms (Project FeederWatch [PFW], BBS). Sites for direct data entry over the Internet are being developed for a number of programs (BBS, PFW, some checklist projects). In addition to developing efficient data entry, it is also important to develop efficient

methods of quality control — editing and correcting the data set. Some data entry programs (including some on the World Wide Web) carry out certain types of checks immediately (rare birds, extreme counts), allowing volunteers to verify their own data. Procedures for regional review of rare birds are likely to be required for many programs.

Monitoring surveys vary widely in the availability of their databases. Recently there has been progress in the development of centralized data centres: e.g. for BBS and colonial waterbirds (the latter now in development) by the U.S. Geological Survey/Biological Resources Division (USGS/BRD), for PFW and CBC at the Laboratory of Ornithology (CLO), for the Canadian Migration Monitoring Network by BSC, and for the Forest Bird Monitoring Program by CWS Ontario Region. Discussions on the development of a point-count data centre and a migrant hawk database are ongoing in the U.S. (B. Peterjohn, pers. comm.).

Data from a number of provincial atlases have been computerized, though in different formats in each region. As implied by this last statement, there is a need for much additional work on building databases that are compatible, to allow ready integration of data and results across projects. The National Audubon Society and CLO have been working on developing standards as part of their BirdSource database (<http://bird-source.com>).

Sophisticated analysis programs have been developed for a few surveys (e.g., BBS, migration monitoring). While the analysis programs are occasionally available to outside users (e.g. custom analyses of BBS data can be run by anyone on the BBS web site), most surveys do not have user-friendly analysis programs that are publically available. This restricts the number of analyses that can be carried out, and slows innovation in new applications of monitoring data. Provision of user-friendly analysis programs to researchers along with data would not only encourage greater use of the data, but would ensure that biologists use the most appropriate analysis procedures available.

### Recommendations

26. Develop efficient means for rapid computer data entry, storage, quality control, and management for all surveys.
27. Ensure that for each survey, clear and complete documentation of the database and data collection methods (metadata) are readily available to users.
28. Co-ordinate with U.S. initiatives in planning and building data repositories and/or electronic links to existing repositories.
29. Develop user-friendly analysis programs for the major surveys to be made available along with data.
30. Ensure that data in monitoring databases are geo-referenced and stored with compatible formats and codes, so that data can be integrated across surveys.

**OBJECTIVE 2.2: Institutionalize processes for conducting regular summary analyses of population trends and for making these results widely available to the public, especially to contributors to the surveys and wildlife managers.**

Appropriate analyses and timely publication of results from all programs are needed to realize the maximum value from our monitoring efforts. During analysis of monitoring data, errors in data or weaknesses in methodology may be revealed that can then be corrected. More importantly, feedback on results to those who collected data is a crucial step in keeping participation levels high, while distribution of results to a wider audience is a prerequisite to ensuring results will lead to needed research and conservation action.

CWS publishes Canadian BBS results every two years. The Canadian Migration Monitoring Network has a schedule for analysis of data from member stations, but has no standard venue for publication. These and most other surveys provide regular feedback of some sort to volunteer participants, generally in the form of annual reports, but sophisticated statistical analysis of trends is often not part of that feedback. One reason is that many project organizers are not qualified to undertake analysis, and funds are usually lacking to pay others to do it.

A promising new venue for presentation of monitoring results is the World Wide Web (WWW), because web pages can be updated frequently and inexpensively, and data are more broadly accessible than are printed materials. Separate BBS web pages are maintained by the USGS and CWS, where the public can see summary results or carry out their own analyses. A similar page has been developed for CBC data, although the statistical methods are still under development. Trend analyses for migration data from Long Point Bird Observatory are posted annually on the BSC web page, and similar postings are anticipated for other CMMN stations when sufficient data are available.

### Recommendations

31. Develop capabilities for routine analysis of data, using appropriate analysis methods, from all monitoring surveys.
32. Establish a regular schedule for timely analysis and publication of results from all major surveys through the most appropriate media, including WWW and/or paper publications.

**OBJECTIVE 2.3: Regularly summarize status of all Canadian landbird species, integrating results across surveys and highlighting species of concern.**

Population trend data are the chief means of identifying status of bird species in Canada, and much conservation effort on a variety of scales is guided by results from monitoring surveys. This is the main justification for recommendations in the CLMS aimed at making surveys as accurate and robust as possible. Each survey has its own biases and sources of error, however, and trends from one survey do not always agree with those from another. It is up to the bird monitoring community to determine which sources of data are best for which species, to assess the quality of the monitoring data, and to highlight those species that are most clearly in decline, because the average user rarely has the background needed to make these judgements.

Monitoring results are regularly summarized in the CWS publication *Bird Trends*, which also provides some context and interpretation of results for wildlife managers and the public. Additional summaries will be required to meet the needs of the *National Framework for the Conservation of Species at Risk* (<http://www.cws-scf.ec.gc.ca/es/-forum/frame.htm>). The British Trust for Ornithology has published analyses of bird survey data for a number of species, integrating population trend data with results from demographic surveys that help identify the life stages at which problems are occurring (Crick et al. 1998).

While the extensive demographic data needed for similar reports are lacking in Canada, more could be done to ensure widespread integration and dissemination of existing results.

### Recommendations

33. Develop a regular schedule for periodic status reports for all species, assessing data from all available surveys, assigning a risk status with an indication of confidence level, and indicating what additional work is needed.
34. Synthesize available demographic data to the extent feasible, to identify life stages or time of year when action could be taken most effectively to alter population trends of high priority species.
35. Compare trends for birds sharing particular habitats, breeding areas or wintering areas to identify potential major ecological issues/-threats (e.g. large-scale forest cutting, grassland management, loss of wintering habitat).
36. Integrate data on habitat, disease, toxic chemicals, weather etc. with bird data, to suggest possible causes of population trends.

**OBJECTIVE 2.4: Work with PIF partners and others to ensure that monitoring results lead to appropriate research, conservation, and management activity**

The CLMS is designed to ensure availability of data that are needed to understand and assess changes in population dynamics of landbirds. However, those involved in producing population status information are often not the people who conduct research or implement conservation action, and there have historically not been good links among these groups. PIF-Canada is designed to address this issue and to act as the main vehicle for translating monitoring results into conservation action. Its goals involve development of management plans incorporating appropriate remedial or conservation measures to address problems identified through monitoring and research; identification of agencies, organizations and their partners that can take appropriate actions; and implementation of those actions. It is an express CLMS objective to work within this framework.

Without a coordinating group to guide the implementation of the CLMS, many of its objectives may fail to be addressed. A PIF Monitoring Working Group should serve this function, made up of representatives from across the monitoring community, to take on the following tasks among others:

- Add or update recommendations in the CLMS as necessary.
- Rank according to priority for action those recommendations not already being undertaken, including those for specific surveys listed in Section 4.
- Develop specific plans and a timetable for accomplishing high priority recommended actions.
- Review CLMS in 3 years to ensure that progress is being made on high priority recommendations.
- Provide input to revision of CLMS in 5 years.

Criteria are needed for deciding when monitoring results signal a need for research or conservation action. If the rate or total amount of population decline is used as the main criterion, then it must be decided what span of years to use, and how to deal with short-term fluctuations. Power analyses are needed to ensure that surveys meet target precision levels for detecting such changes.

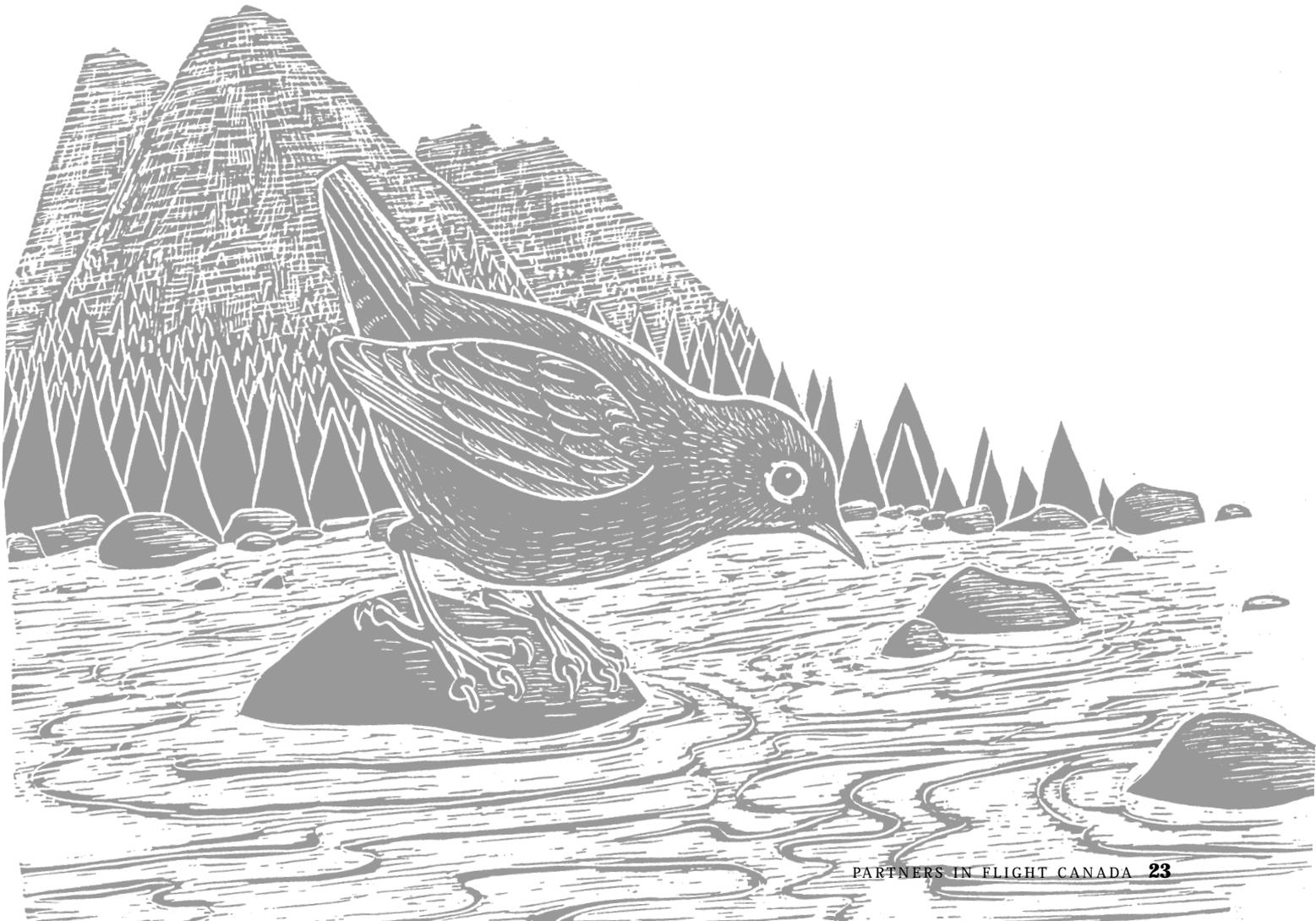
Species-specific conservation plans should include specific population targets so that an increasing species will continue to be of concern until it has reached target levels. However, targets must be measurable using standard monitoring techniques. For example, there is little value in a target that calls for reaching a specific number of individuals in a population if it is only possible to measure an index of relative abundance.

**Recommendations**

37. Implement the CLMS through a PIF Monitoring Working Group.
38. Use trend data and priority criteria to develop a list of high priority research questions and publicize these to appropriate researchers.
39. Develop “trigger” criteria for using monitoring results to signal need for further assessment, applied research or direct conservation activity.
40. Ensure that management/recovery plans include population targets measurable using standard monitoring protocols.
41. Improve dissemination of integrated monitoring results and their interpretation (via the World Wide Web and by other means) to the public, researchers, government agencies, land-use planners, conservation groups and others who can play a role in implementing goals of PIF – Canada.

## 4 Specific Surveys

This section discusses status and makes recommendations for improvement of those monitoring surveys that are currently believed to contribute, or have the potential to contribute, most broadly to accomplishing CLMS goals. These are mainly multi-species, range-wide surveys, but some regional and more narrowly-focussed programs are included, especially if they fill conspicuous gaps in coverage.



A few recommendations are listed for surveys that have so far only been suggested. Projects are listed in a sequence that progresses roughly from surveys that contribute primarily distribution data to those monitoring abundance and demography. In some cases, however, several surveys are grouped together under the same heading for convenience of presentation (specialized surveys, demographic surveys). The groupings are not meant to imply any ranking of surveys with respect to their relative merits, or their priorities for funding. The latter, in particular, could be influenced by many factors in addition to their contribution to CLMS, and needs to be determined by those organizations or agencies running the surveys or providing funds. Furthermore, as noted in Section 3, under Objective 1.3, many of these surveys still require evaluation to determine how well they meet the quantitative objectives of the CLMS.

Many of the general recommendations from Section 3 apply to each of the surveys covered below, but in the interest of brevity, this section is focussed on additional recommendations that are specific to individual surveys. Clearly, the general recommendations also need to be considered in determining priorities for action on each survey. Recommended or planned activities of a particular agency or partner are noted, indicating who is intending to carry them out. As with Section 3, recommendations are intended as a working list, subject to regular revision as recommendations are implemented or new needs are identified.

## ***4.1 Breeding Bird Atlases and other distribution mapping projects***

### **Status**

Breeding bird atlases and other distribution-mapping projects contribute to the CLMS by providing detailed information on the distribution of all species of birds. Breeding bird atlases aim to cover entire geographic areas with systematic coverage during the breeding season, usually assigning volunteers to conduct field work in specific "grid blocks." Some have incorporated existing data from museum records and published literature, but most are focussed on a particular time period for field work. Other distribution mapping projects may also map bird distribution on a grid basis, but are not focussed on breeding birds alone and do not attempt such systematic coverage or rely on an organized volunteer effort. In many respects, there is overlap between distribution-mapping projects and checklists, which also provide information on the location of birds at a particular point in time (see Section 4.4). Because of differences in the historical development and current emphasis of the latter survey methods, they are treated separately here, but it is possible in future that checklists may be more closely integrated with atlas projects, especially with general distribution mapping projects.

Analyses of distribution-mapping data allow definition of avian communities, and correlation of bird distribution with habitat type and land use. If repeated, they may provide clues on the causes of change, by monitoring the rate and pattern of distribution changes. The potential of atlases to assist in detecting changes in bird populations has been demonstrated by the British Trust for Ornithology with the publication of their second atlas (Crick et al. 1998).

The potential of atlas projects to estimate relative abundance has not been thoroughly developed in Canada. Both the Ontario and Maritimes atlas projects asked volunteers to estimate the approximate abundance of each species in a square, but the results were rather variable and subjective. The second British atlas relied on subsampling within each square to provide an index of relative abundance for each species. The Maryland atlas used mini-BBS routes in each square to provide a separate index of abundance.

A North American Atlas Committee (NORAC) has been established to help standardize and coordinate atlas methods throughout North America. Their most recent meeting was in August 1999. Some atlases are due to be repeated soon, and this has led to identification of a number of research needs, including development of database standards, appropriate means for recording effort, and recommended methods for monitoring abundance. Subcommittees (including CWS and BSC representatives) have been established to develop these recommendations, which will later be circulated within NORAC for approval.

Atlas projects appeal to skilled birders because they have a relatively flexible sampling protocol, allowing birders to use general birding activities to contribute to knowledge of bird populations in their region. The competitive element of trying to record as many species as possible in a square enhances interest in the project. Less skilled birders can also contribute to atlases, provided they can reliably identify at least some of the species in their region. Attempts to find breeding evidence encourage birders to focus more on the life history and behaviour of birds, in addition to developing identification skills.

### Progress

All provincial breeding bird atlas projects so far completed have been published (Cadman et al. 1987 - Ontario; Gauthier and Aubry 1995 and 1996 -Quebec; Semenchuk 1992 - Alberta; and

Erskine 1992-Maritimes), and some have electronic databases available for further research (e.g. Ontario, Alberta, Maritimes, Quebec). Other distribution-mapping projects have been completed in Saskatchewan (Smith 1996) and are in progress in Yukon (Sinclair, in prep), Manitoba (Holland, in prep) and Newfoundland (Montevicchi, in prep). Three volumes of *The Birds of British Columbia* (Campbell et al. 1990, 1997) have been completed and the final volume is nearing completion with a planned release in autumn 2000 (Campbell et al. in prep). A seasonal atlas of bird distribution based on data from Quebec's checklist project ÉPOQ has been published (Cyr and Larivée 1995). Although no atlas or atlas-like project has started in the NWT, a revised Bird Checklist was published in 1994 (Sirois and McCrae 1995) and a bird checklist project was started in 1995 that will provide some information on bird distribution. No Canadian atlas project has as yet been repeated, but the Ontario Breeding Bird Atlas is scheduled to be repeated in 2001, twenty years after the first. A project to create a GIS database of distribution maps based on Canadian breeding bird atlas data is in progress (J. Kennedy, pers.comm.)

### Recommendations and Planned Activities

42. Complete distribution mapping/atlas projects in Yukon, Newfoundland, Manitoba and BC. (CWS and others)
43. Work towards repeating the Ontario breeding bird atlas starting in 2001. (Planned - CWS, BSC, Federation of Ontario Naturalists, Ontario Ministry of Natural Resources, Ontario Field Ornithologists and others)
44. Improve coverage in distribution-mapping in the territories and the northern portions of the provinces.
45. Investigate feasibility of incorporating measures of abundance in future atlas projects (Planned - NORAC, CWS, BSC, others).

46. Evaluate the feasibility of establishing a continental atlas database or developing database standards so that atlas data from different areas are compatible and can be easily combined (Planned – NORAC).
47. Investigate methods for linking checklist programs and atlas projects and/or their data storage.

## 4.2 Christmas Bird Counts

### Status

CBC is the best available multi-species, broad-scale survey on winter distribution. Because it is relatively unstandardized, and because most species it samples are also sampled by the more standardized BBS, CBC is considered mainly as a supplementary source of trend information. CBC has the potential to provide trend information for more than 230 species (Dunn and Sauer 1997), but coverage is inadequate for coastal birds, owls (Holroyd and Takats 1997), other nocturnal species and species with limited or very sparse distribution (such as Smith's Longspur) and cryptic or secretive species. However, CBC is the only, or the major source, of trend data for 6 of the 43 high- and medium-high priority Canadian species (Long-eared Owl, American Tree Sparrow, Harris' Sparrow, Golden-crowned Sparrow, Smith's Longspur and Snow Bunting). CBC should also be useful as a source of independent data for other Canadian species that are estimated to be sampled in < 50% of their range by BBS (Appendices 2 and 3).

CBC effort is not standardized, and counts are not systematically distributed, being concentrated near cities and in special preserves such as national parks. Because coverage is not even, especially south of the U.S. where it is very sparse, a change in winter distribution can be mistaken for a change in population abundance.

Moreover, birds from many parts of the breeding range may mix in winter, so it is not possible to separate population trends of regional breeding populations using CBC data. Canadian count sites are concentrated in southern Canada and mainly sample residents, whereas the wintering sites of migratory species important to Canada are concentrated in the U.S. and Mexico (Dunn 1997).

Preliminary estimates of CBC population trends from 1959 to 1988 are available on the Internet (<http://www.mbr.nbs.gov/bbs/cbc.html>). More rigorous trend analyses are planned for 1959 to present (the period in which CBC was most standardized). The complete database has now been computerized, and raw data from the start of the CBC in the 1900s to 1996 can be downloaded over the Internet (<ftp://ftp.nmt.edu/pub/people/john/cbc/>). Convenient access to data for individual count circles is provided through the National Audubon Society (NAS) and the Cornell Laboratory of Ornithology (CLO) BirdSource web page, where data up to and including the 1998/1999 count are available (<http://www.bird-source.com>). Sophisticated software has been developed for data entry, and various summaries of the data can be viewed, though the data have not yet been thoroughly checked for errors. Much more sophisticated query capability should be available by Christmas 1999.

Some Canadian counts are missing from the historical database because the participation fee has deterred groups from formally submitting their data. An attempt should be made to compile and incorporate these data and ensure that they are included in analyses.

Because the CBC is a group activity, it provides an opportunity for a large number of birders of all skill levels to participate in an appealing and low-intensity birding activity. The opportunity of teaming beginner birders with experienced birders creates an introduction to bird surveys and is an excellent educational opportunity.

### Progress

Only recently has there been an attempt to conduct sophisticated trend analysis. A recent review of CBC's ability to monitor Canadian bird populations found that population trends derived from CBC and BBS were positively correlated (Dunn and Sauer 1997).

Complications related to the analyses are known to exist (e.g. changes in effort for counting of feeder species, Dunn 1995a; non-linear increase in numbers counted as effort increases, Butcher and McCulloch 1990), but these are not currently considered by most analysts. New and better analysis methods are currently being developed (J. Sauer & W. Link, pers. comm.). There has been discussion of increasing standardization of count methods after the 100th year of counts, but no concrete plans have been made.

### Recommendations and Planned Activities

48. Update trend analyses using more appropriate methods, and make them available over the web. (Planned - USGS/BRD, CLO, NAS).
49. Continue to develop analytical methods to control for variation in data that is unrelated to population change. (Planned - USGS/BRD)
50. Examine ways to compile and incorporate Canadian data that have historically not been submitted to Audubon into the database.
51. Conduct detailed evaluation of CBC data for Canadian species not covered by other surveys, and for high-priority species with uncertain trends.

52. Work with NAS, USGS/BRD and other groups to design a more standardized methodology after the 100th count, and if such efforts fail, evaluate the need for and feasibility of a new, more standardized winter survey.
53. Work with U.S. and Mexico to promote standardized winter counts in areas where high priority Canadian breeding species spend the winter.

## 4.3 Project FeederWatch

### Status

Project FeederWatch (PFW) provides data on winter populations on far fewer species than does the CBC, but has the advantage of covering the entire winter season. This allows better assessment of annual abundance indices for irruptive and wandering species, mainly northern-nesting finches that are poorly-covered by other surveys. Population trends are especially difficult to detect in these birds due to large annual fluctuation both in abundance and distribution.

Data-collection is semi-standardized. Sites are not randomly selected, but are distributed in accordance with human population density. Thus, there are gaps in northern Canada, and weak coverage in the prairie provinces and Rocky Mountain states. Data are submitted on scannable forms or entered directly via the Internet by the observer, making possible the rapid analysis and distribution of annual results that is unique to this survey (<http://www.bsc-eoc.org>). Data are available for research by others on request to the CLO, which serves as the data centre for the continent and conducts routine analyses.

PFW is an excellent entry-level program for volunteers because the number of species that must be recognized is limited, and data are collected from home. An educational program has been developed that makes use of PFW data collection and analyses for classroom exercises.

### Progress

PFW has been shown to reflect geographic variation in distribution and relative abundance in a similar fashion to BBS for resident bird species, and can also detect important population trends (Wells et al. 1998). Annual variation in PFW abundance and trends is similar to that in CBC (Dunn 1986 and unpubl., D. Lepage and C. M. Francis, unpubl.).

### Recommendations and planned activities

54. Link PFW to broader checklist survey databases. (Planned, CLO, NAS).
55. Develop more sophisticated methods for calculation of annual indices, considering area weighting, habitat-specific analysis, estimation of variance, and covariates to allow for changes in geographic distribution over time (in progress, BSC).

## 4.4 Checklist projects

### Status

Checklist projects are compilations of birders' observations from birding trips at any time of year or at any location. Some projects collect only presence-absence data, while others record all birds detected. Both size of reporting area and length of time covered by a single checklist can vary tremendously. To ensure that data are maximally useful for a variety of scientific purposes, recommendations were made that checklists record numbers of each species detected on a single day in a single birding locality (Dunn 1995b). All the Canadian checklist projects mentioned below follow the recommended guidelines.

Several formal programs to collect data from checklists have been set up across Canada, including in Quebec (coordinated by the Association québécoise des groupes d'ornithologues), Alberta (coordinated by the Federation of Alberta Naturalists) and NWT /Nunavut (coordinated by CWS). The checklist project in Quebec, Étude des populations d'oiseaux du Québec (ÉPOQ), has published a seasonal atlas (Cyr and Larivée 1995). The NWT Checklist Survey, started in 1995, has supplemented the database by including historical records of bird sightings. Electronic databases from all three programs are available to researchers now or will be in the near future. The ÉPOQ checklist ([http://www.ntic.qc.ca/~nellus/cbcp\\_can.html](http://www.ntic.qc.ca/~nellus/cbcp_can.html)) has been set up to allow data entry from across the country, but there has been no coordinated effort to promote this program nationally, or to develop a system for data quality checking or regular analyses of data from outside of Quebec. Checklist surveys have the potential to document distribution in all seasons, and also regularity of presence in a region (an index of population status). When checklists are collected in sufficient numbers and spatial distribution they can be used to assess phenology, community structure, species richness and biogeographic patterns (Cyr and Larivée 1995, Droege et al. 1998). They can also detect changes in bird populations that may supplement more standardized surveys. With sufficient sampling intensity, they could also play a role in local monitoring efforts (e.g. determining status of species in a park over time) (Droege et al. 1998).

When properly marketed, checklists are a widely popular program for birders of all skill levels. They provide an opportunity for birders to contribute to a conservation project as part of their regular birding activities and thus make use of information that is already being collected by a great number of birders. They are a good opportunity for training participants in bird survey skills and introducing them to other more standardized programs.

Checklist projects may be particularly valuable for gathering information from remote areas where it might not be cost-effective or feasible to organize more standardized surveys (e.g., birders visiting an area for other reasons can contribute data without feeling constrained to fit within a formal sampling scheme).

### Progress

Several publications have produced population trends based on checklist data and showed them to be significantly correlated with independently-derived trends from BBS and CBC (Dunn et al. 1996; Cyr and Larivée 1995). Although there are a number of recognized potential biases in the checklist methodology, and there was a positive bias in checklist trends relative to BBS in some species (Dunn et al. 1996), there are ways to decrease the sampling biases. A standardized checklist program with regular coverage of specific sites may generate more precise population trends (Dunn unpubl.).

CLO/NAS have developed an Internet database called BirdSource (<http://birdsource.com>) that has the potential to integrate general checklists with specific projects and provide rapid feedback to users. This technology is being developed for Project FeederWatch, Christmas Bird Counts, and Project HawkWatch (to be available by Fall 1999), as well as a series of trial one-time projects (Winter Bird Survey, Warbler Watch). In 1999, the Winter Bird Survey attracted over 30,000 participants. There is a need to coordinate such international, web-based efforts with current Canadian checklist programs in order to decrease overlap among programs and competition for participants, and to ensure adherence to international standards so data are comparable among programs. Atlas projects could also be linked to checklist databases (see recommendation under 4.1).

### Recommendations and Planned Activities

56. Evaluate needs and priorities for specialized projects that use checklist methodology to address specific questions (e.g. site-specific programs to monitor trends).
57. Coordinate checklist programs (including those in U.S.), working toward common protocols, adhering to recommended standards and contributing to a common database so results can be used at all spatial scales; while maintaining local control of regional programs.
58. Investigate establishment of a Canada-wide checklist program and/or national coordination of provincial checklist programs, and evaluate need for provincial checklist programs in Manitoba and Saskatchewan.
59. Develop and evaluate analysis methods for checklist data to control for variation unrelated to population change.

## 4.5 Breeding Bird Survey

### Status

The BBS is the core survey in the CLMS for population trends, because it has the most statistically justifiable sampling frame and trends can be tied to specific breeding populations. It is the only source of long-term, continental information available on landbird populations from a standardized survey in the U.S. or Canada. BBS provides population trends and annual indices for 73% of landbird species (Dunn and Downes 1998; Appendix 2), including trends for 26% of the high- and medium-priority species (Appendix 3). The BBS also provides detailed distribution information and relative abundance within its coverage area, although coverage varies among ecozones and provinces and some species are covered in less than 50% of their Canadian range.

The BBS is coordinated in Canada by CWS and in the U.S. by the Patuxent Wildlife Research Centre (USGS/BRD). Results are analyzed and published by both countries. Volunteer provincial/state coordinators assist with coordination and recruitment of participants.

BBS methods are standardized and there is a statistically justifiable sampling scheme, giving results an authority beyond that of all other broad-scale, multi-species surveys for landbirds. Analysis methods are sophisticated, and constantly being upgraded (e.g. Link and Sauer 1998). Continental trends are calculated annually from BBS data by the U.S., and in recent years Canadian trends have been calculated every two years by CWS (Downes and Collins, 1996; (CWS: <http://www.ec.gc.ca/cws-scf/-nwrhc.htm>; USGS/BRD: <http://www.mbr.nbs.gov/bbs/bbs.html>). Trends are regularly published and are available on both the USGS/BRD and CWS websites. A computer program for running trend analyses has been written by Brian Collins (CWS) that is available for researchers who wish to run custom analyses. Electronic copies of raw data are available from either office and are expected to be available on the Internet by 1999.

The BBS has some limitations, in that the sampling frame is restricted to roadsides where population trends may not be representative of the greater landscape. Furthermore, like all other surveys discussed in the CLMS, it is an index survey, and hence is susceptible to bias due to changes in the proportions of birds being detected (e.g., due to improved observer skills – Sauer et al. 1994).

BBS requires a long-term commitment from highly-skilled birders. Historically, the average volunteer participates in the BBS for 8 years, although some long-term participants have continued for up to 30 years.

The limited number of birders with such qualifications in Canada, especially in remote areas, is the main limit to expansion of BBS.

### Progress

In CLMS (1994), several recommendations were made to increase route coverage, improve analytical methods, assess geographic and species gaps in coverage, and incorporate the collection of habitat data.

Participation increased by 6% between 1995 and 1997, although coverage is still poor in northern areas. In 1996 the CWS changed the analytical methods for BBS from the use of route regression (Collins and Wendt, 1989) to a system of estimating equations based on the statistics developed by Link and Sauer (1994) (Collins, 1998). Link and Sauer (1998) described methods for calculating annual indices based on over-dispersed Poisson models. B. Collins (pers. comm.) is exploring an alternative technique that uses non-parallel ANOVA.

Preliminary power analyses of BBS data have been conducted. A more complete assessment is expected to be completed in 1999 (incorporating additional sources of variation and alternative models of population change such as range contractions vs. general population decline). This will allow a better evaluation of the adequacy of current BBS coverage, and what would be needed to improve coverage. The proportion of the range of Canadian species monitored by BBS has been estimated (Francis and Dobbyn 1997a), and results were used for a preliminary assessment of which species might need to be covered by alternative surveys.

In 1997 BBS developed a new data-entry system that allows data for all 50 point counts to be entered rather than the previous system of entering five 10-count subtotals. A digital database of the starting points of BBS routes in Ontario has been completed (L. Venier pers. comm.) and work is underway to digitize the starting points of routes in the rest of Canada. An assessment of the possibilities for digitizing the locations of each of the 50 stops along BBS routes has been completed (Dobbyn and Couturier 1998). This remains an expensive and time-consuming task and is not likely to be completed in the near future.

A system for collecting habitat information by volunteers along BBS routes was devised in 1996 and habitat classifications were received for approximately 40% of the BBS routes run in 1996 (Blancher 1996; Blancher 1997). There are plans to develop habitat profiles of all BBS routes using satellite imagery (AVHRR land cover data), and to compare those with habitat classifications derived by volunteers. The completion of the digital database of BBS routes and habitat profiles for routes will provide opportunities for further investigations of the extent to which BBS routes are representative of the landscape.

A detailed peer review of BBS is being conducted in 1999 by a team of biologists from outside and within the USGS/BRD. They have examined all aspects of the BBS, from data management and processing to data analysis and report preparation is underway.

### Recommendations and Planned Activities

60. Address recommendations resulting from the 1999 peer review of BBS, when complete. (Planned - CWS, USGS/BRD)
61. Compare trend estimates from methods used by CWS and those used by U.S. and assess the relative merits of the methods (including different weighting and route selection criteria). (Planned - CWS)
62. Carry out power analysis of the BBS, at various geographic scales, to determine whether sample size for "covered" species is sufficient to meet target levels of sensitivity in detecting trends (Planned - CWS)
63. Compare habitat profiles of routes based on volunteer-collected data to remote-sensing data. Investigate how well BBS covers the surrounding landscape by comparing landscape-level habitat classifications to habitat profiles derived from BBS routes within a similar geographic area. (Planned - CWS)
64. Investigate the importance of supporting expert birders to run available BBS routes in some areas of the north where volunteers are scarce.
65. Work with appropriate agencies and non-government organizations to recruit participants for regular BBS wherever possible and to adopt this program as part of their monitoring schemes



## ***4.6 Specialized surveys (habitat, taxon or area specific)***

This section includes a diverse mixture of surveys that are grouped here for convenience. All these surveys are specific to habitat, or focus on species groups or geographic areas that are poorly monitored by other surveys.

Habitat-specific surveys help fill monitoring gaps for species in habitats that are poorly covered by other surveys. In addition, differences between population trends in specific habitats and overall trends can help in formulating hypotheses on the effect of habitat quality on population change, especially if data are available on changes in availability of various habitat types.

### ***4.6.1 Forest bird monitoring***

#### **Status**

FBMP tracks trends in forest songbirds in selected, relatively mature forests that may be under-represented by other surveys, and provides data on habitat associations of individual species at a regional level.

The FBMP, coordinated by the CWS, has been running in Ontario since 1987. The majority of sites are in areas where human-induced habitat disturbances are minimal. Vegetation and landscape characteristics are measured at each site to determine how these factors affect the composition of the bird community and how they influence trends of birds in mature forest habitat (Cadman 1998). Results of analyses have been published in newsletters and technical reports. Metadata and site locations can be found on the internet (< <http://www.cciw.ca/green-lane/wildlife/wildspace> > ).

Evaluations of the 10-minute point count system used in FBMP have been conducted (Welsh 1995). FBMP plots are well represented in southern and south-central Ontario but, like many other volunteer-based surveys, the northern parts of the province are not well covered. FBMP has recorded 181 species over 11 years and has produced trends for 69 species (Cadman et al. 1998). Of these, only the Blue-gray Gnatcatcher is not covered at all by BBS. The FBMP methodology may be more effective than BBS at monitoring forest species with voices that are difficult to detect from roadsides (e.g. Brown Creeper, Cape May Warbler). However, because of the non-random selection of FBMP sites, the trends may not be representative of the region as a whole.

It may be possible to improve trend estimates by comparing the forest habitat types at survey sites with those available in the general landscape. Once we know the proportion of each forest type sampled by FBMP, comparisons of trends in stable, mature forests with trends in the general landscape (derived from BBS or Migration Monitoring) may provide a more complete understanding of population changes and indications of their cause. Comparisons may also be made among forest types and between forest-interior and forest-edge to determine whether population trends differ within species across forest habitat.

FBMP is a popular program in Ontario that provides an opportunity for skilled birders to participate in a bird monitoring survey. Many research programs elsewhere in Canada use the same or compatible methodology to FBMP, and it may be possible to integrate these into a national program and/or database.

### Recommendations and Planned Activities

66. Conduct analyses to identify bird-habitat associations for Ontario forest birds, and to test for the presence of habitat-specific trends. (Planned - CWS-Ontario Region)
67. Assess the representativeness of FBMP plots in the forested landscape of Ontario, and consider the merits of adopting a stratified-random sampling scheme to improve it. (Planned - CWS-Ontario Region).
68. Based on results of the above activities, evaluate the need for, and make recommendations on, implementation of a national-scale forest bird monitoring program.
69. Consider changing FBMP methods to record birds detected in first 5 minutes separately from the second 5 minutes so that data could be compared with other point count studies using shorter count times.

## 4.6.2 Grassland bird monitoring

### Status

Grassland birds as a group are declining more rapidly than any other habitat group in Canada or North America (Peterjohn and Sauer 1993; Dunn and Downes 1998). However, many grassland species are not well covered by current monitoring programs. The Canadian BBS produces trends for 14 of the 18 species of grassland birds (Appendix 2) and the others are covered by other surveys. However, 6 species are listed as priorities for additional monitoring because less than 50% of the Canadian range is covered. Furthermore, several grassland species (e.g. Baird's Sparrow, Lark Bunting) exhibit extreme variability because of nomadic habits, so the precision of the trend estimates from BBS is low.

### Progress

A CWS project to assess the potential for using the BBS method to improve the monitoring of

grassland birds on the prairies will be completed in 1999 (Dale 1998). BBS-style routes ("GBM" routes) were selected following the BBS protocol but with increased sampling intensity in those Alberta and Saskatchewan degree blocks where grassland is still a prevalent cover type. The GBM routes had 23% to 93% grass cover throughout southern Alberta and Saskatchewan. Preliminary results indicate that the relative abundance of grassland species per GBM route was up to 17 times higher than on regular BBS routes. Because 80% of the grasslands in the Prairie provinces are broken, BBS data are dominated by these broken areas and may not reflect trends in the remaining tracts of unbroken grassland.

Data from GBM routes cannot be included in the routine BBS analyses without introducing a habitat bias, so results from GBM routes should be analyzed separately, or combined with other BBS routes only in custom analyses. Comparison between regular BBS and GBM trends would provide insights as to the reasons for population change and suggest directions for research. Because habitats along GBM routes have been classified, the relationships between bird populations and habitat can be examined in more detail.

It may be difficult to find volunteers for GBM routes because they are located in remote areas of the southern Prairies. However, GBM routes may be especially appealing to some volunteers because they target native-prairie habitat and require identification skills for relatively few species.

### Recommendations and Planned Activities

70. Summarize results of project and make recommendations for improvements to grassland bird monitoring in the prairies. (Planned - CWS)
71. If assessment of GBM method so warrants, work with U.S. partners to expand GBM across the border.

### 4.6.3 Marsh bird monitoring

#### Status

Marsh birds and selected waterbirds are included under the definition of “landbirds” for the CLMS, because they are not targeted by the bodies responsible for monitoring seabirds, shorebirds or waterfowl, and their monitoring needs would otherwise not be addressed. This group includes loons, grebes, herons, egrets and bitterns, cranes, and rails and coots. While some of these are well sampled by BBS, most marsh birds, especially secretive species such as rails, moorhens and gallinules, are difficult to detect and inhabit areas that are not often sampled by BBS routes.

#### Progress

The Marsh Monitoring Program (MMP) was tested in 1994 and established in 1995 by the CWS and BSC as a volunteer-based survey to monitor marsh bird and amphibian populations throughout the Great Lakes basin. Major objectives of the program are to monitor marsh birds at site-specific to basin-wide scales, investigate habitat associations, and compare species composition and abundance in areas of conservation concern with those at control sites. Although the program is too young to have produced population trends, it has undergone a preliminary evaluation (Francis and Chabot 1997b). Conclusions were that, although improvements to sampling methods could be made, MMP provided a fairly sound basis for long-term monitoring of marsh birds in the Great Lakes basin and was more effective in this than any existing alternative program. MMP is less appropriate for monitoring populations at individual sites. The program was also successful in providing data on habitat associations.

A workshop on marsh bird monitoring in April 1998 recommended the development of a federally-coordinated, volunteer-based monitoring program in the U.S. (USFWS/USGS 1999). CWS and BSC are represented on the implementation group. The U.S. Patuxent Wildlife Research Centre is funding several studies aimed at developing better marsh bird monitoring techniques. One of these is a study of the effects of vocal playback on statistical bias and variance in marsh bird counts, an issue identified by the workshop as the highest priority for marsh bird research (M. Howe pers.comm.). Interim guidelines for marsh monitoring are similar to those used by the Marsh Monitoring Program in the Great Lakes area.

Appendix 3 indicates that the only high-priority species for Canadian action targeted by the proposed marsh bird survey is Yellow Rail — a species not likely to be well sampled by a volunteer survey because much of the Canadian breeding grounds are believed to be along arctic coastlines. However, coverage of additional marsh species by BBS (Appendix 3) may prove to be inadequate once power analyses have been completed. Other species that would be covered by the new program are of medium priority for action by Canada (two of which score high on *Canadian Responsibility*: American Bittern and Sora). Nonetheless, several waterbirds of high *Canadian Responsibility* (arctic-nesting loons, certain grebes) will not be targeted by this survey.

MMP is likely to be a popular program with the birding public because the time commitment is relatively short and the survey can likely be done during the evening. Participation in MMP requires a knowledge of bird identification, but of relatively few species, so may be attractive to a wide birding population.

### Recommendations and Planned Activities

72. When the recommendations from the U.S. marsh monitoring review are complete, consider the merits of adopting them into the MMP (starting, if appropriate, with a double sampling protocol to measure the effect of any changes in protocols).
73. Evaluate the need for a national Marsh Monitoring Program in Canada, and consider the merits of expanding the program to include other types of wetlands (e.g. swamps, bogs, etc.).

### 4.6.4 Other waterbird monitoring

#### Status

In addition to the MMP, several other surveys have been or are being developed that cover various marsh and waterbirds. These include the Coastal Waterbirds Survey in B.C., the Canadian Lakes Loon Survey, the Ontario Heronry Inventory and various species-specific surveys (e.g., Sandhill and Whooping Cranes). Some waterfowl surveys also record information on selected other waterbirds.

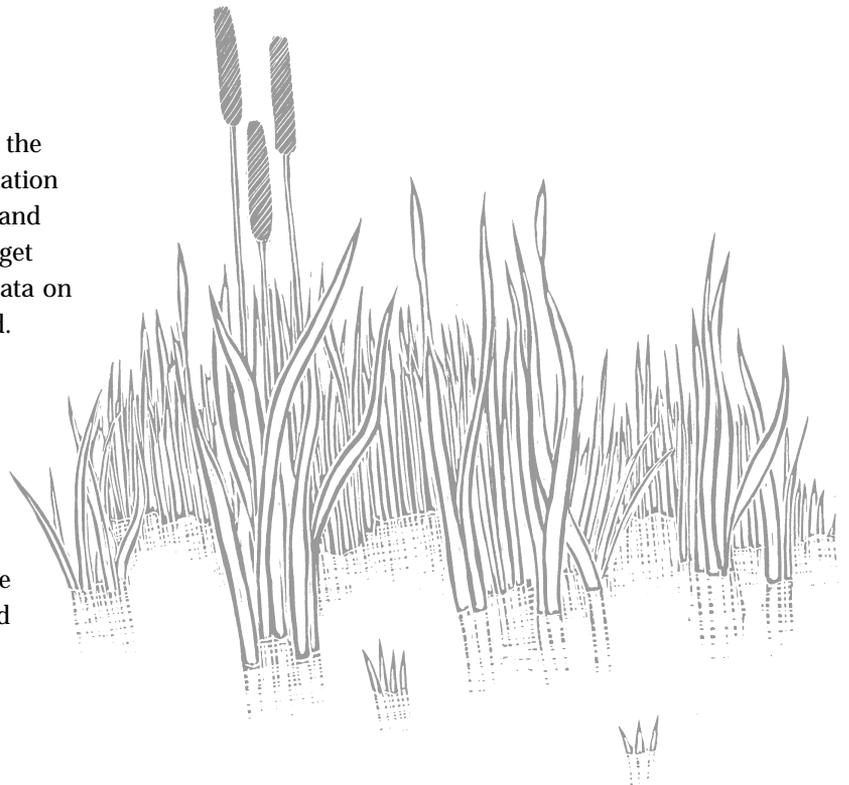
#### Progress

A variety of waterfowl surveys, including the May breeding surveys, also record information on other waterbirds such as coots, loons and grebes. Apart from coots (which are a target species), the amount and quality of the data on non-target species has not been evaluated.

The Ontario Heronry Inventory has been repeated every 10 years, starting in 1970, and provides an atlas-style map of the distribution and abundance of herons throughout the province (Dunn et al. 1985). The current plan is to postpone the survey that would otherwise be scheduled for 2000 until the year 2001, to coincide

with the next Ontario Breeding Bird Atlas. CWS carries out special surveys of Whooping Cranes, primarily with respect to their mandate to protect endangered species.

The Canadian Lakes Loon Survey was begun in 1981 by BSC and was expanded nationally in the early 1990s. It was originally designed to monitor the effects of lake chemistry, especially acidification, on loon populations and breeding success (and conversely to use loons as indicators of lake quality). It is thus one of the few surveys in the CLMS that focuses on measures of productivity rather than on population change. Recent analyses indicate that it has good power to detect changes in productivity in Ontario. Survey results indicate that productivity has been declining on many Ontario lakes, with the greatest declines on the most strongly acidified lakes (R. Weeber & C. M. Francis, unpubl.). Survey needs include gathering better data on changes in the proportion of lakes that have loons, perhaps through additional sampling, and perhaps expansion of the protocol to include additional waterbird species.



CWS and BSC are collaborating on the development of a volunteer-based Coastal Waterbirds Survey in British Columbia. This survey will ask volunteers to survey stretches of coastline on a monthly basis to monitor temporal changes in distribution of waterbirds. While focusing on shorebirds, waterfowl (especially sea ducks) and sea birds, it will also record loons, grebes and some raptors. The survey is scheduled to begin in October 1999.

#### Recommendations and Planned Activities

74. Evaluate the contributions made to meeting CLMS goals for marsh/waterbirds of waterfowl surveys, Ontario Heronry Inventory, Sandhill and Whooping Crane counts and other miscellaneous surveys.
75. Improve the ability of the Canadian Lakes Loon Survey to monitor trends in populations and productivity.
76. Continue to develop the Coastal Waterbirds Survey in British Columbia, and consider the merits of expansion to the Atlantic Coast and/or the Great Lakes.

### 4.6.5 Nocturnal birds surveys

#### Status

Information on the distribution and abundance of nocturnal birds (owls and nightjars) is generally lacking in Canada. Although BBS covers Common Nighthawks in > 50% of their Canadian range (Trend Uncertainty= 3, Appendix 3) it is likely that power analyses will indicate these species are not well covered.

#### Progress

Recently, breeding season surveys for nocturnal owls were started in Ontario, Manitoba and Alberta. The Ontario survey focuses on boreal forest owls in northern and central Ontario. Its objective is to gather information on the breeding distribution and abundance of owl species

that may be sensitive to forest management activities. The main species monitored are Great Gray, Boreal, Barred, Northern Saw-whet, and Great Horned Owls. Since 1991 the Manitoba Nocturnal Owl Survey has had volunteers running approximately 20 standardized, non-random routes that focus on Boreal Owl, Great Gray Owl, Great Horned Owl, Barred Owl, Northern Saw-whet and Long-eared Owl, with some limited data collected on Northern Hawk-Owl. In 1997, the Alberta Conservation Association started a province-wide owl monitoring survey in which volunteers select standardized routes and count prairie and boreal/montane owls. There are differences in techniques among these surveys which should be resolved to improve standardization.

In 1997, a workshop in Winnipeg focused on the development of techniques to determine the status and assess trends of nocturnal owls in Canada and the U.S. (Holroyd and Takats, 1997). A further workshop on owl monitoring techniques in September 1999, with representatives from all three Canadian surveys, was aimed at developing standards that can be adopted by all the programs and that will be incorporated into the North American Raptor Monitoring Strategy that is currently under development.

#### Recommendations and Planned Activities

77. Modify the Ontario, Alberta and Manitoba provincial surveys to adopt similar standards, and to use compatible database structures so that data can be shared.
78. Conduct more detailed evaluation of current and potential coverage by volunteers of owls ranking high on Canadian Responsibility.
79. Ensure that owls are included in the North American Raptor Monitoring Strategy. (Planned - CWS)
80. Assess monitoring needs for nightjars.

### ***4.6.6 Other single species surveys***

Surveys of individual species will be needed occasionally to achieve the goals of the CLMS, particularly for birds that are too locally distributed to be well sampled by multi-species, broad-scale surveys. This type of work may require complete counts of all individuals in a population, and is often done under the auspices of endangered species recovery programs. While such work may often be carried out by professionals, some single-species surveys are run primarily by volunteers (e.g., the Canadian Lakes Loon Survey). The Ontario Wood Thrush Monitoring Project is an example of a much smaller-scale volunteer-based, single-species survey, in this case collecting demographic information. Ontario's 'Birds at Risk' program involves volunteers in work on several rare species within a single framework.

#### **Recommendations**

81. Find ways to address species-specific monitoring needs of high priority species currently lacking adequate coverage.
82. Evaluate techniques for tracking population change and total numbers in rare species.

### ***4.6.7 Early spring surveys***

#### **Status**

BBS is usually run too late in the breeding seasons to detect many species of woodpeckers, diurnal owls and grouse. However, surveys run earlier in the year, perhaps using BBS-like methodology, could be designed to sample these species. The use of mini-routes similar to those being considered for the north would help reduce demands on volunteer participants, but other methods (such as off-road counts) may also be useful in early spring.

BSC and the Ontario Ministry of Natural Resources have developed a Red-shouldered Hawk survey, using a roadside sampling method with playback, that also gathers data on woodpeckers. The relative merits of this survey in relation to other survey methods such as migration monitoring have not yet been considered.

#### **Recommendations**

83. Evaluate need for special spring surveys across Canada, taking overall monitoring priorities into account.

### ***4.6.8 Northern breeding season surveys***

#### **Status**

No existing program. There are difficulties in monitoring breeding bird populations in large portions of Canada where there are no road networks and relatively small populations of skilled bird watchers. These areas include central and northern Yukon, Northwest Territories, Nunavut, Newfoundland, Labrador, the northern sections of most provinces, and high-altitude areas; regions where many tundra and boreal species breed. In some cases, (e.g. southern Yukon, Newfoundland, population centres in NWT) increased promotion and recruitment for regular BBS routes may be all that is needed to meet coverage requirements. However, in other less accessible areas this will not be possible. Migration Monitoring is designed to target northern species that are not well sampled in the breeding season, but it doesn't cover all of them, and in any case it is desirable to also obtain breeding season data on distribution and population trends specific to particular regions.

## Progress

An on-going research project by Boreal Partners in Flight in Alaska is investigating the optimal sampling design and methodology for a co-operative, regional program to monitor population trends of landbirds breeding in boreal regions of North America. The study is designed to examine the relative effects of time of day, season, year, location, and observer on the variability in detection of birds during point counts, as well as the inter-annual variability in detection across broad geographic scales. About 200 “mini-routes”, similar in design to BBS routes although shorter in distance, have been surveyed for one to six years in roadless areas, encompassing all biogeographic regions of Alaska (<http://www.absc.usgs.gov/research/bpif/bpif.html>). Results of this study will be used in recommending breeding season survey techniques for northern areas.

In 1997, NWT National Parks adopted a different type of modified BBS methodology as part of their bird monitoring program. Routes designed following BBS methods were divided in two parts and successfully conducted on foot on two consecutive days (Henry 1997). However, the logistics involved in this effort meant that it likely could not be repeated on an annual basis.

## Recommendations and Planned Activities

84. Evaluate the utility of the Boreal-PIF “mini-route” technique for use in Canada and compare to other possible methods for surveying northern birds, taking overall monitoring priorities into account.
85. Coordinate development of northern survey methods with CWS Shorebird Committee and other bird groups to maximize the possibilities of meeting monitoring needs for all birds using the same protocol(s).

## 4.7 Migration Monitoring

Migration monitoring can include any of several methods to monitor birds on passage migration. Recommended methods have been developed for both extensive and intensive monitoring (Dunn 1995b, Hussell and Ralph 1996). The extensive monitoring techniques are essentially the same as checklists, so this section will focus only on intensive monitoring stations.

### 4.7.1 Programs focused on small landbirds (mainly nocturnal migrants)

#### Status

Migration monitoring is a means of documenting changes in abundance of northern-nesting species that are relatively inaccessible for breeding season surveys. Targets for migration monitoring include the 91 species sampled by BBS in < 50% of their breeding range (Appendix 3), including 29 (67%) of the 43 species in that group that are listed as medium-high to high priority for additional monitoring. A coordinated national program has been developed to meet this need: the Canadian Migration Monitoring Network (CMMN). CMMN is a cooperative venture among independent migration monitoring stations, CWS, and BSC. BSC is to carry out trend analyses for member stations. Results are intended to be published regularly, but so far have been completed only for the few stations that have operated for at least 5 years. Recent results for LPBO have been published (Francis and Hussell 1998) and are also updated regularly on the BSC web page (<http://www.bsc-eoc.org>).

Migration monitoring trends from different stations cannot be pooled to produce national trends, because breeding locations of sampled birds are unknown and hence it is unknown whether birds counted at different stations sample the same populations. Change across broad geographic scales can only be deduced from similarity of trends from different stations. Migration monitoring requires substantial effort by skilled volunteers, and ongoing financial support for infrastructure and staff. Participants receive training at banding stations and the training and exposure to organized birding that they provide often encourages participation in additional projects. Many bird observatories conduct research and education projects that make them much more than monitoring stations alone. Stations are usually established and run by enthusiasts who are eager to participate in a national project that usually involves bird-banding, and appear not to draw volunteers away from other kinds of surveys.

### Progress

A U.S./Canada workshop on migration monitoring (Blancher et al. 1994) led to development of standards for operating migration monitoring stations for the purpose of trend monitoring (Hussell and Ralph 1996). The Ontario Ministry of Natural Resources has developed a standardized migration monitoring protocol for use on nocturnally-migrating owls (Northern Saw-whet and Long-eared Owl), based on the same principles as Hussell and Ralph (1996).

Several reviews of migration monitoring have been published (Hussell 1997, Dunn and Hussell 1995, Dunn et al. 1997). These papers compared population trends derived from Migration Monitoring stations to those from the BBS and found significant, positive correlations between the two. Marked discrepancies for individual species are hypothesized to be related to different populations being sampled by BBS and migration counts.

The CMMN currently includes 13 formal members, operated by a variety of government and non-government organizations and individuals, as well as several pilot operations. An informal communications bulletin board has been set up, species and geographical gaps in coverage have been identified, and a data-entry program has been developed and distributed. A first meeting of CMMN members and associated stations was held in March 1998, and a second meeting in September 1999. BSC is currently developing the capacity to carry out routine trend analyses for all stations. CWS is working with partners in the U.S. to develop a similar program of coordinated migration monitoring in the U.S.

### Recommendations and Planned Activities

86. Assess coverage of target species and representativeness of regional coverage, and develop a strategy to fill gaps (in progress, BSC).
87. Coordinate with U.S. efforts to develop networks similar to CMMN.
88. Conduct isotope ratio and other studies to determine origin of migrants passing through specific monitoring stations. (Planned – Ontario Ministry of Natural Resources, CWS).
89. Examine potential for separating data on locally breeding birds from passage migrants to expand the number of species that can be monitored at stations with moderate numbers of local breeders.

### 4.7.2 Programs focused on raptors (mainly diurnal migrants)

#### Status

Hawk watching stations may provide data on population trends of diurnal raptors (including hawks, falcons, eagles, and vultures), by monitoring numbers of birds observed at migration concentration points. Species that pass through these concentration points may originate from many different areas, and hence neither their breeding nor wintering areas are well defined. Availability of data varies among stations. Annual reports are provided by each station and occasional technical papers have been published. Raptor migration is monitored at many sites in the U.S. but at few sites in Canada. Currently, five hawk-watching stations are operating in Ontario, and two in Alberta. Hawk watching stations are currently not included in the CMMN, as it was originally conceived for songbirds, but it could easily accommodate hawk watching.

Standards have been developed for collecting and maintaining data by the Hawk Migration Association of North America (HMANA). Some data have been computerized, by USGS/BRD and/or HMANA. A new project called Project HawkWatch is being developed on BirdSource, in cooperation with HMANA, that will allow stations to enter their data directly over the Internet and get rapid feedback on the results, and was put into operation in September 1999.

#### Recommendations and Planned Activities

90. Assess how well raptors breeding in Canada are monitored by migration counts, and make recommendations for improvement.
91. Encourage standardization and regular computerization and analysis of results from raptor watching stations.
92. Coordinate Canadian raptor monitoring with the North American Raptor Monitoring Strategy.

## 4.8 Demographic surveys

Monitoring demographic characteristics (reproductive success, survival) of bird populations is an important component of an integrated monitoring scheme. Demographic data can help identify factors that limit or regulate populations, and indicate whether regional populations are viable and self-sustaining, which in turn guide further research and conservation action.

While tracking demographic events is included in monitoring goals, there are limited prospects for gathering useful demographic data in Canada for a wide variety of species on a broad geographic scale (see below). However, demographic studies may be feasible for individual high priority species, as in Ontario's Wood Thrush Monitoring Project (which attempts to track breeding success and levels of cowbird parasitism; Wildlife Watchers 1997).

#### Status

Monitoring Avian Productivity and Survivorship (MAPS) and BBird are the only surveys in North America that are specifically designed to monitor productivity or survivorship of a range of species.

MAPS was established to provide spatial and temporal information on patterns in productivity and survivorship at local and regional scales. The project has run primarily in the U.S. with the few (26) stations operating in Canada constituting only 6% of the total stations (DeSante 1998). Data and results are available from the California-based Institute for Bird Populations. The impressive coverage in the U.S. is in large part due to the U.S. Dept. of Defence and the U.S. Dept. Agriculture Forest Service who adopted the program and established sites on U.S. federal land. The logistical difficulties and intensive effort required makes it difficult to imagine a widespread volunteer-based MAPS program in Canada. In both countries, MAPS efforts should focus on a small number of species and areas recognized as priorities (especially common species that have high recapture possibilities).

BBird is a U.S.-based collaborative program that provides standardized methods for studying nest success and habitats and aims to identify the causes of variation in nesting success (Martin and Geupel 1993). The database now contains data on more than 3000 nests, but the number of BBird plots in Canada is unknown.

Nest Record Schemes, although not specifically designed for monitoring, have the potential to monitor nesting success, provided that nests are visited multiple times. Nest record schemes are active in all provinces, but only some data have been computerized, mainly from Ontario, Saskatchewan, and British Columbia. Many cards in existing schemes consist of data from only a single visit, and hence are not useful for monitoring nest success.

Despite their shortcomings, all these surveys may be important for the CLMS, because they can be used to study reproductive success and survival in special studies of a particular region or species. MAPS provides an opportunity for birders interested in banding to focus their efforts in a conservation program. Birders of all skill levels can participate in the Nest Record Scheme and it is an excellent educational opportunity.

### Progress

A review and evaluation of the first 5 years of the MAPS pilot project concluded that field and statistical methods were sound and MAPS was a valuable contribution to understanding bird populations (Geissler et al. 1997). The main weakness of the program is the non-random location of stations with the result that estimates of survival and productivity over large-scale may not truly represent the landscape. The statistical power and precision of estimates at small scales is much lower than that at larger spatial scales. Rosenberg (*in* Geissler et al. 1997) recommended an intensive allocation of stations within selected physiographic regions and targeting common species with high recapture possibilities.

Alternatively, sites that are believed to be representative of the surrounding landscape should be selected.

Collins (1997) analyzed the sample sizes required to monitor changes in productivity within a population and to compare productivity levels between populations at 80% power. While Canadian participation in MAPs will contribute to North American regional coverage, it is insufficient to produce results specific to Canada. He recommended placing the stations in a wide variety of habitat types and covering a wide geographic range in the hope that seeing a consistent trend across many habitat types could substitute for randomly placing the samples.

Since 1994, little progress has been made on the evaluation or standardization of Nest Record Schemes, largely because most of the data are not computerized. Evaluations of the British scheme determined that a minimum of 100 cards/-year/species were needed to detect changes in productivity over time (Baillie, 1990). In Canada, only about 10% of the Maritimes nest record cards have sufficient data to determine nest fate (Erskine, pers. comm.). Co-ordinators in other projects estimated from 1% to "less than half" of the cards are for nests followed to completion (Dale 1993). However, most contributors of nest record data have likely not appreciated the value of these data. Further evaluations of Canadian nest record data are required, followed by efforts to promote collection of additional data, with appropriate computerization and feedback.

Age ratios from mist net captures during migration monitoring may also have the potential to provide indices of annual variation in productivity (age ratios in autumn), or possibly even annual variation in first-year survival (e.g., through comparison of age ratios in spring with those the previous autumn). Analyses of data from the Long Point Bird Observatory showed trends in productivity indices in certain species (Hussell in press), but the biological significance of these indices requires further investigation (Dunn et al. in press).

#### Recommendations and Planned Activities

93. Evaluate the role of the BBird program in CLMS.
94. Evaluate the role of MAPS in the CLMS.
95. Make recommendations on improving the value of Canadian Nest Record Schemes (including data-collection standards and computerization). (Planned, BSC).
96. Evaluate the ability of age ratios collected during Migration Monitoring to track productivity.
97. In the process of evaluating the status of high-priority species, develop recommendations for sites and species to be targeted in focused productivity/survival programs. Encourage volunteer groups to adopt these projects.
98. Evaluate the importance to CLMS priorities of collecting demographic data via nest box monitoring projects, and depending on outcome, make recommendations for improving those surveys.

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# Appendices

*Appendix 1: Key to Acronyms  
and Internet Web Sites*

*Appendix 2: Coverage of Each Species  
for Population Trend Monitoring*

*Appendix 3: Table of Status Ranking  
and Priority Actions for Canadian Landbirds*



## Appendix 1

# Key to Acronyms and Internet Web Sites

### Acronyms used in this document:

BBS	Breeding Bird Survey	HMANA	Hawk Migration Association of North America
BSC	Bird Studies Canada	MAPS	Monitoring Avian Productivity and Survivorship
CBC	Christmas Bird Count	MMP	Marsh Monitoring Program
CLMS	Canadian Landbird Monitoring Strategy	NAS	National Audubon Society
CLO	Cornell Laboratory of Ornithology	NORAC	North American Breeding Bird Atlas Committee
CMMN	Canadian Migration Monitoring Network	PFW	Project FeederWatch
CWS	Canadian Wildlife Service	PIF	Partners in Flight
FBMP	Forest Bird Monitoring Program	USGS/BRD	U.S. Geological Survey/Biological Resources Division
GBM	Grassland Bird Monitoring		

### Web sites referred to in text:

<a href="http://www.cws-scf.ec.gc.ca/canbird/pif/p_intro.htm">http://www.cws-scf.ec.gc.ca/canbird/pif/p_intro.htm</a>	Partners in Flight – Canada; CLMS posted here
<a href="http://www.PartnersInFlight.org">http://www.PartnersInFlight.org</a>	Partners in Flight – U.S. (general information)
<a href="http://www.ntic.qc.ca/~nellus/cbcp_can.html">http://www.ntic.qc.ca/~nellus/cbcp_can.html</a>	Canadian checklist
<a href="http://birdsource.cornell.edu/bswork/Feature.html">http://birdsource.cornell.edu/bswork/Feature.html</a>	Backyard Bird Count
<a href="http://www.mbr.nbs.gov/bbs/cbc.html">http://www.mbr.nbs.gov/bbs/cbc.html</a>	Christmas Bird Count results
<a href="ftp://ftp.nmt.edu/pub/people/john/cbc/">ftp://ftp.nmt.edu/pub/people/john/cbc/</a>	Site for downloading CBC data
<a href="http://birdsource.cornell.edu/pfw/index.html">http://birdsource.cornell.edu/pfw/index.html</a>	Project FeederWatch site
<a href="http://www.mbr.nbs.gov/bbs/bbs.html">http://www.mbr.nbs.gov/bbs/bbs.html</a>	BBS results and graphic displays, individual route information, relative density maps, custom analysis
<a href="http://www.ec.gc.ca/cws-scf/nwrc.htm">http://www.ec.gc.ca/cws-scf/nwrc.htm</a>	CWS site for Canadian BBS results
<a href="http://absc.usgs.gov/research/bpif/bpif.html">http://absc.usgs.gov/research/bpif/bpif.html</a>	Boreal PIF
<a href="http://www.im.nbs.gov">http://www.im.nbs.gov</a>	North American Raptor Monitoring Strategy
<a href="http://www.bsc-eoc.org">http://www.bsc-eoc.org</a>	Bird Studies Canada
<a href="http://birdsource.cornell.edu">http://birdsource.cornell.edu</a>	BirdSource
<a href="http://www.cws-scf.ec.gc.ca/es/forum/frame.htm">http://www.cws-scf.ec.gc.ca/es/forum/frame.htm</a>	<i>National Framework for the Conservation of Species at Risk</i>
<a href="http://www.cciw.ca/green-lane/wildlife/wildspace">http://www.cciw.ca/green-lane/wildlife/wildspace</a>	Forest Bird Monitoring Program

## Appendix 2

# Coverage of Each Species for Population Trend Monitoring

List of species indicating whether or not they are potentially adequately monitored for population trends by selected national and regional surveys. Note that only partial information is available from some surveys. Table will be updated as survey evaluations continue to become available.

Species	BBS	CBC	CMMN	MMP	OWL	Other	Species	BBS	CBC	CMMN	MMP	OWL	Other
Red-throated Loon		t					Red-shouldered Hawk	t	t	c			c
Pacific Loon		t					Broad-winged Hawk	t	t	c			
Common Loon	t	t				c	Swainson's Hawk	t	t	p			
Yellow-billed Loon							Red-tailed Hawk	t	t	c			
Pied-billed Grebe	t	t		p			Ferruginous Hawk	t	t	c			
Horned Grebe	t	t					Rough-legged Hawk		t	c			
Red-necked Grebe	t	t					Golden Eagle		t	c			
Eared Grebe	t	t					American Kestrel	t	t	c			
Western Grebe							Merlin	t	t	c			
Clark's Grebe							Gyr Falcon		t	p			
American Bittern	t	t		p			Peregrine Falcon		t	c			
Least Bittern		t		p			Prairie Falcon		t	c			
Great Blue Heron	t	t					Chukar		t				
Great Egret		t					Gray Partridge	t		t			
Snowy Egret		t					Ring-necked Pheasant	t	t				
Little Blue Heron		t					Ruffed Grouse	t	t				
Cattle Egret		t					Sage Grouse		t				
Green Heron							Spruce Grouse		t				
(Green-backed Heron)	t	t					Willow Ptarmigan						
Black-crowned Night-Heron	t	t					Rock Ptarmigan						
Turkey Vulture	t	t	c				White-tailed Ptarmigan						
Osprey	t	t	c				Blue Grouse	t	t				
Bald Eagle	t	t	c				Sharp-tailed Grouse		t				
Northern Harrier	t	t	c				Wild Turkey		t				
Sharp-shinned Hawk	t	t	c				Mountain Quail		t				
Cooper's Hawk	t	t	c				California Quail		t				
Northern Goshawk		t	c				Northern Bobwhite		t				

Species	BBS	CBC	CMMN	MMP	OWL	Other	Species	BBS	CBC	CMMN	MMP	OWL	Other
Yellow Rail				p			Vaux's Swift	t		c			
King Rail		t		p			White-throated Swift		t	p			
Virginia Rail		t		p			Ruby-throated Hummingbird	t	t	c			
Sora		t		p			Black-chinned Hummingbird		t	c			
Common Moorhen		t					Anna's Hummingbird		t				
American Coot		t		p			Calliope Hummingbird	t		c			
Sandhill Crane		t					Rufous Hummingbird	t	t	c			
Whooping Crane					c		Belted Kingfisher	t	t	c			
Rock Dove	t						Lewis's Woodpecker		t	p			
Band-tailed Pigeon	t	t	c				Red-headed Woodpecker	t	t	c			
Mourning Dove	t	t					Red-bellied Woodpecker		t				
Black-billed Cuckoo	t		c				Yellow-bellied Sapsucker	t		c			
Yellow-billed Cuckoo	t	t	p				Red-naped Sapsucker	t		c			
Barn Owl		t					Red-breasted Sapsucker	t		p			
Flammulated Owl			p				Williamson's Sapsucker		t	p			
Western Screech-Owl		t					Downy Woodpecker	t	t	c			
Eastern Screech-Owl		t					Hairy Woodpecker	t	t	c			
Great Horned Owl	t	t			c		White-headed Woodpecker		t				
Snowy Owl		t	p				Three-toed Woodpecker		t				
Northern Hawk Owl		t					Black-backed Woodpecker	t	t				
Northern Pygmy-Owl		t					Northern Flicker	t	t	c			
Burrowing Owl		t	p			c	Pileated Woodpecker	t	t				
Spotted Owl		t				c	Olive-sided Flycatcher	t		c			
Barred Owl	t	t			c		Western Wood-Pewee	t		c			
Great Gray Owl		t			c		Eastern Wood-Pewee	t		c			
Long-eared Owl		t	c		c		Yellow-bellied Flycatcher	t		c			
Short-eared Owl	t	t	c				Acadian Flycatcher			c			
Boreal Owl					c		Alder Flycatcher			c			
Northern Saw-whet Owl		t	c		c		Willow Flycatcher	t		c			
Common Nighthawk	t		c				Least Flycatcher	t		c			
Common Poorwill		t		p			Hammond's Flycatcher	t		c			
Chuck-will's-widow		t		c			Gray Flycatcher		t				
Whip-poor-will	t	t	c				Dusky Flycatcher	t		c			
Black Swift	t		p				( <i>Western Flycatcher</i> )			c			
Chimney Swift	t		c				Cordilleran Flycatcher						

Species	BBS	CBC	CMMN	MMP	OWL	Other	Species	BBS	CBC	CMMN	MMP	OWL	Other
Pacific-slope Flycatcher	t						Gray-headed Chickadee ( <i>Siberian Tit</i> )						
Eastern Phoebe	t	t	c				Chestnut-backed Chickadee	t	t				
Say's Phoebe	t	t	p				Boreal Chickadee	t	t	c			
Great Crested Flycatcher	t	t	c				Tufted Titmouse		t				
Western Kingbird	t	t	c				Bushtit		t				
Eastern Kingbird	t	t	c				Red-breasted Nuthatch	t	t	c			
Loggerhead Shrike	t	t	c				White-breasted Nuthatch	t	t	c			
Northern Shrike		t	c				Pygmy Nuthatch		t				
White-eyed Vireo		t	c				Brown Creeper	t	t	c			
Yellow-throated Vireo	t	t	c				Rock Wren		t	p			
( <i>Solitary Vireo</i> )	t	t	c				Canyon Wren		t				
Cassin's Vireo							Carolina Wren		t				
Blue-headed Vireo							Bewick's Wren	t	t	c			
Hutton's Vireo	t		c				House Wren	t	t	c			
Warbling Vireo	t	c					Winter Wren	t	t	c			
Philadelphia Vireo	t		c				Sedge Wren	t	t	c			
Red-eyed Vireo	t		c				Marsh Wren	t	t	c			
Gray Jay	t	t					American Dipper		t				
Steller's Jay	t	t					Golden-crowned Kinglet	t	t	c			
Blue Jay	t	t	c				Ruby-crowned Kinglet	t	t	c			
Clark's Nutcracker	t	t					Blue-gray Gnatcatcher		t	c			
Black-billed Magpie	t	t					Northern Wheatear						
American Crow	t	t	c				Eastern Bluebird	t	t	c			
Northwestern Crow	t	t					Western Bluebird		t	p			
Common Raven	t	t					Mountain Bluebird	t	t				
Skylark ( <i>Eurasian Skylark</i> )							Townsend's Solitaire	t	t	p			
Horned Lark	t	t	c				Veery	t		c			
Purple Martin	t		c				Gray-cheeked Thrush	t	t	c			
Tree Swallow	t	t	c				Bicknell's Thrush			p			c
Violet-green Swallow	t	t	c				Swainson's Thrush	t	t	c			
N. Rough-winged Swallow	t	t	c				Hermit Thrush	t	t	c			
Bank Swallow	t		c				Wood Thrush	t	t	c			
Cliff Swallow	t		c				American Robin	t	t	c			
Barn Swallow	t	t	c				Varied Thrush	t	t	c			
Black-capped Chickadee	t	t					Gray Catbird	t	t	c			
Mountain Chickadee	t	t					Northern Mockingbird	t	t				

Species	BBS	CBC	CMMN	MMP	OWL	Other	Species	BBS	CBC	CMMN	MMP	OWL	Other
Sage Thrasher		t	p				Ovenbird	t	t	c			
Brown Thrasher	t	t	c				Northern Waterthrush	t	t	c			
European Starling	t	t					Louisiana Waterthrush			c			
Crested Myna							Connecticut Warbler	t		p			
Yellow Wagtail							Mourning Warbler	t		c			
American Pipit		t	c				MacGillivray's Warbler	t		c			
Sprague's Pipit	t	t	p				Common Yellowthroat	t	t	c			
Bohemian Waxwing		t	c				Hooded Warbler			c			
Cedar Waxwing	t	t	c				Wilson's Warbler	t	t	c			
Blue-winged Warbler			c				Canada Warbler	t		c			
Golden-winged Warbler	t		c				Yellow-breasted Chat		t	c			
Tennessee Warbler	t	t	c				Scarlet Tanager	t		c			
Orange-crowned Warbler	t	t	c				Western Tanager	t	t	c			
Nashville Warbler	t	t	c				<i>(Rufous-sided Towhee)</i>	t	t	c			
Northern Parula	t	t	c				Spotted Towhee	t					
Yellow Warbler	t	t	c				Eastern Towhee						
Chestnut-sided Warbler	t		c				American Tree Sparrow		t	c			
Magnolia Warbler	t	t	c				Chipping Sparrow	t	t	c			
Cape May Warbler	t	t	c				Clay-coloured Sparrow	t	t	c			
Black-throated Blue Warbler	t	t	c				Brewer's Sparrow		t	p			
Yellow-rumped Warbler	t		c				Field Sparrow	t	t	c			
(Myrtle Warbler)		t					Vesper Sparrow	t	t	c			
(Audubon's Warbler)							Lark Sparrow		t	c			
Black-throated Gray Warbler	t	t	p				Lark Bunting	t	t	c			
Black-throated Green Warbler	t	t	c				Savannah Sparrow	t	t	c			
Townsend's Warbler	t	t	c				Grasshopper Sparrow	t	t	c			
Blackburnian Warbler	t		c				Baird's Sparrow	t	t	p			
Pine Warbler	t	t	c				Le Conte's Sparrow	t	t	p			
Prairie Warbler		t	c				Henslow's Sparrow	tc					
Palm Warbler	t	t	c				(Sharp-tailed Sparrow)		t				
Bay-breasted Warbler	t	t	c				Nelson's Sharp-tailed Sparrow			p			
Blackpoll Warbler	t		c				Fox Sparrow	t	t	c			
Cerulean Warbler			c				Song Sparrow	t	t	c			
Black-and-white Warbler	t	t	c				Lincoln's Sparrow	t	t	c			
American Redstart	t	t	c				Swamp Sparrow	t	t	c			
Prothonotary Warbler		c											

Species	BBS	CBC	CMMN	MMP	OWL	Other	Species	BBS	CBC	CMMN	MMP	OWL	Other
White-throated Sparrow	t	t	c				Red Crossbill	t	t				
Harris's Sparrow		t	c				White-winged Crossbill	t	t	c			
White-crowned Sparrow	t	t	c				Common Redpoll		t	c			
Golden-crowned Sparrow		t	c				Hoary Redpoll		t	p			
Dark-eyed Junco	t		c				Pine Siskin	t	t	c			
(Slate-coloured Junco)		t					American Goldfinch	t	t	c			
McCown's Longspur	t	t	p				Evening Grosbeak	t	t	c			
Lapland Longspur		t	c				House Sparrow	t	t				
Smith's Longspur		t	p										
Chestnut-collared Longspur	t	t	c										
Snow Bunting		t	c										
Northern Cardinal	t	t											
Rose-breasted Grosbeak	t	t	c										
Black-headed Grosbeak	t	t	c										
Lazuli Bunting	t		c										
Indigo Bunting	t	t	c										
Dickcissel		t	c										
Bobolink	t		c										
Red-winged Blackbird	t	t	c										
Eastern Meadowlark	t	t	c										
Western Meadowlark	t	c											
Yellow-headed Blackbird	t	t	c										
Rusty Blackbird	t	t	c										
Brewer's Blackbird	t	t	c										
Common Grackle	t	t	c										
Brown-headed Cowbird	t	t	c										
Orchard Oriole	t	t	c										
(Northern Oriole)	t		c										
Baltimore Oriole		t											
Bullock's Oriole	t												
(Rosy Finch)		t											
Gray-crowned Rosy-Finch	p												
Pine Grosbeak		t	c										
Purple Finch	t	t	c										
Cassin's Finch	t	t	c										
House Finch	t	t	c										

**Notes:**

BBS North American Breeding Bird Survey (national)

CBC Christmas Bird Count (national – trends from U.S. and Canada of populations that may or may not breed in Canada)

CMMN Canadian Migration Monitoring Network (national)

MMP Marsh Bird Monitoring Program (currently regional, potentially national)

OW Nocturnal Owl Survey (currently regional, potentially national)

Other any of several species-specific surveys (regional or national)

t trend estimates available (precision not considered)

c covered by a survey but national trend not yet available

p potentially covered by survey (i.e. future target for survey)

Species that have been split recently are marked in italics and brackets with the new species appearing directly below and slightly indented.

Species that have had a recent name change have the old name following the new name in small type in brackets in italics.

Species that have data collected for a particular "sub-group" (e.g., Slate-coloured Junco) appear slightly indented and in brackets below the species name.

## Appendix 3

# Table of Status Ranking and Priority Actions for Canadian Landbirds

Please note: This table is continually being updated and modified as new information on species priorities is assessed and comments from various people are incorporated. Note that adequacy of methodology and coverage varies among species and surveys.

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
<b>High: high concern, high responsibility (22 species)</b>						
American Pipit	4	4	3	4*	3	Confirm CBC trend/trend for north (MM?)
American Tree Sparrow	4	4	3	4*	3	Confirm CBC trend/trend for north (MM)
Bicknell's Thrush	5	5	5	?	5	Research/monitoring/(conservation?)
Black Swift	4	4	4	4**	3	Research/confirm trend/(conservation?)
Blackpoll Warbler	5	4	2	5*	3	Trend for north (MM)/research
Blue Grouse	4	5	4	5**	3	Research/confirm trend/(conservation?)
Boreal Chickadee	5	4	2	5**	3	Confirm CBC trend/trend for north/research
Clay-colored Sparrow	5	4	3	4*	3	Research
Harris's Sparrow	5	4	4	4*	3	Confirm CBC trend/ research/(conservation?)
Horned Grebe	5	4	3	4**	3	Confirm trend/research
Northwestern Crow	4	4	4	3	3	Confirm trend/research
Purple Finch	4	4	3	4**	3	Trend for north (MM?)
Rufous Hummingbird	4	4	4	3	3	Trend for north (MM)/research
Rusty Blackbird	5	4	3	5**	3	Research/trend for north
Sharp-tailed Sparrow	5	4	4	3	1	Research
Smith's Longspur	4	4	4	3	5	Improve monitoring/research
Snow Bunting	4	4	3	4	3	Confirm CBC trend
Sprague's Pipit	4	5	4	5**	1	Research/conservation
White-throated Sparrow	5	4	3	4*	3	Trend for north (MM)/research
Whooping Crane	5	5	5	1	1	Continued conservation
Yellow Rail	5	4	4	3	3	Confirm trend/research
Yellow-billed Loon	5	4	4	?	5	Improve monitoring/research/(conservation?)

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
<b>Medium: medium-high concern, medium responsibility (36 species)</b>						
American Crow	3	3	2	3	3	Trend for north
American Robin	3	3	2	3	3	Trend for north (MM)
Baird's Sparrow	3	4	4	3	1	Research
Bank Swallow	3	3	2	3	3	Trend for north (MM?)
Barred Owl	3	3	2	3*	1	Confirm decline
Belted Kingfisher	3	3	2	3**	3	Trend for north (MM?)/research
Black-and-white Warbler	3	3	3	3	1	Continued monitoring
Blackburnian Warbler	3	3	3	3	1	Continued monitoring
Bobolink	3	3	2	4*	1	Research
Brown Creeper	3	3	2	3	3	Trend for north (MM)
Chestnut-backed Chickadee	3	4	4	4	1	Research
Chestnut-sided Warbler	3	3	3	3	1	Continued monitoring
Chipping Sparrow	3	3	2	3	3	Trend for north (MM)
Dark-eyed Junco	3	3	2	3*	3	Trend for north (MM)/confirm decline
Eastern Phoebe	3	3	3	3	3	Trend for north (MM)
European Starling	3	3	1	4*	1	Research
Golden Eagle	3	3	2	3	3	Trend for north (MM)
Golden-crowned Sparrow	3	4	4	3	3	Confirm CBC trend/trend for north (MM)
Hammond's Flycatcher	3	3	3	3	3	Trend for north (MM)
Hermit Thrush	3	3	3	2	3	Trend for north (MM)
Long-eared Owl	3	3	2	4*	3	Trend for north (MM, owl survey)/research
MacGillivray's Warbler	3	3	3	3	3	Trend for north (MM)
McCown's Longspur	3	4	4	4*	1	Research/(conservation?)
Nashville Warbler	3	3	3	3	1	Continued monitoring
Northern Flicker	3	3	2	4*	3	Trend for north (MM)/research
Northern Saw-whet Owl	3	3	2	3	5	Improve monitoring (MM?)
Northern Waterthrush	3	3	2	3	3	Trend for north (MM)
Olive-sided Flycatcher	3	4	3	4**	3	Trend for north (MM?)/research
Ovenbird	3	3	3	3	3	Trend for north (MM)
Red-breasted Sapsucker	3	3	4	2	3	Trend for north (MM)
Song Sparrow	3	3	2	4*	3	Trend for north (MM)/research
Vaux's Swift	3	4	4	3	3	Trend for north (MM?)

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
Veery	3	4	3	4*	1	Research
Vesper Sparrow	3	3	3	3	1	Continued monitoring
Warbling Vireo	3	3	3	2	3	Trend for north (MM)
White-tailed Ptarmigan	3	4	4	3	3	Confirm trend
<b>Medium: medium concern, high responsibility (58 species)</b>						
Alder Flycatcher	4	3	3	3	3	Trend for north (MM)
American Bittern	4	3	3	3*	1	Confirm decline
American Redstart	4	3	3	3	3	Trend for north (MM)
Bay-breasted Warbler	5	3	3	3*	3	Trend for north (MM)/confirm decline
Black-throated Green Warbler	4	3	3	3	3	Trend for north (MM)
Bohemian Waxwing	4	3	3	3	3	Trend for north
Boreal Owl	4	3	2	3	5	Improve monitoring
Canada Warbler	5	3	3	3	3	Trend for north (MM)
Cape May Warbler	5	3	3	2	3	Trend for north (MM)
Common Loon	5	3	3	2	3	Confirm trend
Common Redpoll	4	3	2	3	3	Confirm CBC trend
Connecticut Warbler	5	3	3	3	3	Trend for north (MM)
Fox Sparrow	4	3	3	3	3	Trend for north (MM)
Golden-crowned Kinglet	4	3	2	3	3	Trend for north (MM)
Gray Jay	5	3	2	3	3	Confirm trend
Gray-cheeked Thrush	4	3	3	3	5	Improve monitoring (MM)
Great Gray Owl	4	3	2	3	3	Confirm trend
Gyr Falcon	4	3	3	3	3	Confirm trend (MM)
Hoary Redpoll	4	3	2	3	3	Confirm CBC trend
Lapland Longspur	5	3	3	3	3	Confirm CBC trend
Le Conte's Sparrow	5	3	4	2	3	Trend for north (MM)
Least Flycatcher	4	3	3	3	3	Trend for north (MM)
Magnolia Warbler	5	3	3	3	3	Trend for north (MM)
Mourning Warbler	5	3	3	3*	3	Trend for north (MM)/confirm decline
Northern Goshawk	4	3	2	3**	3	Trend for north (MM)/confirm decline
Northern Hawk Owl	5	3	2	3	5	Improve monitoring
Northern Shrike	4	3	3	3	3	Confirm CBC trend

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
Orange-crowned Warbler	4	3	3	3	3	Trend for north (MM)
Pacific Loon	4	3	3	3	3	Confirm trend
Palm Warbler	5	3	3	3	3	Trend for north (MM)
Philadelphia Vireo	5	3	3	3	1	Continued monitoring
Pine Grosbeak	4	3	2	3**	3	Trend for north/confirm decline
Pine Siskin	4	3	2	3	3	Trend for north
Red Crossbill	4	3	2	3	3	Trend for north (MM?)
Red-necked Grebe	4	3	3	2	3	Confirm trend
Red-throated Loon	5	3	3	3	3	Confirm trend
Rock Ptarmigan	4	3	3	3	3	Confirm trend
Rough-legged Hawk	4	3	3	3	3	Confirm CBC trend (MM)
Ruby-crowned Kinglet	4	3	2	3*	3	Trend for north (MM)/confirm decline
Ruffed Grouse	4	3	2	4	3	Confirm trend
Sandhill Crane	5	3	3	3	3	Confirm trend
Savannah Sparrow	4	3	2	3	3	Trend for north (MM)
Sharp-tailed Grouse	4	3	2	3**	3	Confirm decline
Short-eared Owl	4	3	2	4**	3	Trend for north/research
Snowy Owl	5	3	3	3	3	Confirm CBC trend
Sora	4	3	2	3	3	Confirm trend
Spruce Grouse	5	3	2	3	3	Confirm trend
Swainson's Thrush	4	3	2	3	3	Trend for north (MM)
Swamp Sparrow	5	3	3	3	3	Trend for north (MM)
Tennessee Warbler	5	3	3	3*	3	Trend for north (MM)/confirm decline
Three-toed Woodpecker	4	3	2	3	3	Confirm trend
Tree Swallow	4	3	3	3	3	Trend for north (MM?)
White-crowned Sparrow	4	3	2	4*	3	Trend for north (MM)/confirm CBC decline
White-winged Crossbill	5	3	2	3	5	Improve monitoring
Wilson's Warbler	4	3	3	3	3	Trend for north (MM)
Winter Wren	4	3	2	3	3	Trend for north (MM)
Yellow-bellied Flycatcher	5	3	3	3	3	Trend for north (MM)
Yellow-bellied Sapsucker	5	3	3	3	3	Trend for north (MM)

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
<b>Medium/low: high concern, low responsibility (45 species)</b>						
American Coot	2	4	2	5	1	Research
American Dipper	2	4	3	5**	3	Confirm trend/research
Anna's Hummingbird	1	4	4	3	1	Continued monitoring
Band-tailed Pigeon	1	4	3	5*	1	Research
Black-throated Blue Warbler	2	4	4	3	1	Continued monitoring
Black-throated Gray Warbler	1	4	4	3	3	Confirm trend
Blue-winged Warbler	1	4	4	3	1	Continued monitoring
Brown Thrasher	1	4	3	4**	1	Research
Bushtit	1	4	3	4*	1	Research
California Quail	1	4	4	3	1	Continued monitoring
Calliope Hummingbird	2	4	4	3	1	Continued monitoring
Canyon Wren	1	4	3	4**	1	Research
Cerulean Warbler	1	4	3	5**	1	Research
Chestnut-collared Longspur	2	4	4	3	1	Continued monitoring
Chimney Swift	1	4	3	5**	1	Research
Chuck-will's-widow	1	4	3	4*	1	Research
Chukar	1	5	4	5*	1	Research/(conservation?)
Common Grackle	1	4	3	4*	3	Trend for north (MM?)
Crested Myna	1	5	4	5	1	Research
Dickcissel	1	4	3	4*	1	Research
Eared Grebe	2	4	3	4	3	Confirm trend
Eastern Meadowlark	1	4	3	5**	1	Research
Eastern Wood-Pewee	1	4	3	4**	1	Research
Eurasian Skylark	1	5	4	5	3	Research/confirm trend
Flammulated Owl	1	4	4	3	5	Improve monitoring
Henslow's Sparrow	1	5	4	5**	1	Research
Hutton's Vireo	1	4	4	3	1	Continued monitoring
King Rail	1	4	3	4**	1	Research
Lark Bunting	1	4	3	4*	1	Research
Least Bittern	1	4	3	4*	1	Research
Lewis's Woodpecker	1	4	3	4	1	Research
Little Blue Heron	1	4	4	3**	1	Research

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
Loggerhead Shrike	1	4	2	5**	1	Research
Gray Catbird	1	4	3	4*	1	Research
Mountain Quail	1	4	4	3	1	Continued monitoring
Northern Bobwhite	1	4	3	4**	1	Research
Prairie Warbler	1	4	3	4**	1	Research
Prothonotary Warbler	1	4	3	4*	1	Research
Pygmy Nuthatch	1	4	4	3	1	Continued monitoring
Red-naped Sapsucker	1	4	4	3	3	Confirm trend
Sage Grouse	1	4	4	3*	1	Research
Sage Thrasher	1	4	4	3	1	Continued monitoring
Siberian Tit	1	4	4	?	5	Improve monitoring
Spotted Owl	1	5	4	5	3	Research/confirm trend
Wood Thrush	1	4	3	4**	1	Research
<b>Low: medium concern, low responsibility (96 species)</b>						
Acadian Flycatcher	1	3	3	3	1	Continued monitoring
American Goldfinch	2	3	2	3	1	Continued monitoring
Barn Owl	1	3	2	3	5	Improve monitoring
Barn Swallow	2	3	1	4*	3	Trend for north (MM?)
Bewick's Wren	1	3	3	3	1	Continued monitoring
Black-billed Cuckoo	2	3	3	3	1	Continued monitoring
Black-billed Magpie	2	3	2	3	1	Continued monitoring
Black-chinned Hummingbird	1	3	3	3	1	Continued monitoring
Black-crowned Night-Heron	1	3	2	3	1	Continued monitoring
Black-headed Grosbeak	1	3	3	3	1	Continued monitoring
Blue Jay	1	3	2	3	1	Continued monitoring
Blue-gray Gnatcatcher	1	3	3	2	1	Continued monitoring
Brewer's Blackbird	2	3	2	3	1	Continued monitoring
Brewer's Sparrow	2	3	3	2	3	Confirm trend
Broad-winged Hawk	2	3	2	3	1	Continued monitoring
Brown-headed Cowbird	2	3	2	4*	1	Research
Burrowing Owl	1	3	2	4*	1	Research
Carolina Wren	1	3	3	3	1	Continued monitoring

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
Cassin's Finch	1	3	3	3	1	Continued monitoring
Cattle Egret	1	3	3	3	1	Continued monitoring
Clark's Grebe	2	3	3	3	5	Improve monitoring
Cliff Swallow	2	3	2	3	3	Trend for north (MM?)
Common Moorhen	1	3	2	3*	1	Confirm trend
Common Poorwill	1	3	3	2	1	Continued monitoring
Common Yellowthroat	2	3	2	3	3	Trend for north (MM)
Cooper's Hawk	1	3	3	3*	1	Continued monitoring
Dusky Flycatcher	2	3	3	3	3	Confirm trend
Eastern Bluebird	1	3	3	3	1	Continued monitoring
Eastern Kingbird	2	3	2	3	3	Trend for north (MM)
Eastern Screech-Owl	1	3	3	2	3	Confirm trend
Field Sparrow	1	3	3	3	1	Continued monitoring
Golden-winged Warbler	1	3	4	1	1	Continued monitoring
Grasshopper Sparrow	1	3	3	3*	1	Continued monitoring
Gray Partridge	2	3	3	3	1	Continued monitoring
Great Crested Flycatcher	1	3	3	3	1	Continued monitoring
Great Egret	1	3	2	3	1	Continued monitoring
Green-backed Heron	1	3	3	3	1	Continued monitoring
Hooded Warbler	1	3	3	3	1	Continued monitoring
Horned Lark	1	3	2	3**	3	Trend for north (MM?)/research
House Sparrow	2	3	1	4**	1	Research
Indigo Bunting	1	3	3	3	1	Continued monitoring
Lark Sparrow	1	3	3	3	1	Continued monitoring
Louisiana Waterthrush	1	3	3	3	1	Continued monitoring
Mountain Bluebird	2	3	3	3	1	Continued monitoring
Northern Cardinal	1	3	3	3	1	Continued monitoring
Northern Mockingbird	1	3	2	3	1	Continued monitoring
Northern Oriole	2	3	3	3	1	Continued monitoring
Northern Parula	1	3	3	3	1	Continued monitoring
Northern Pygmy-Owl	2	3	3	3	5	Improve monitoring
N. Rough-winged Swallow	1	3	3	2	1	Continued monitoring
Orchard Oriole	1	3	3	3	1	Continued monitoring

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trendb	Trend Uncertain			
Pied-billed Grebe	2	3	1	4**	3	Confirm trend/research
Pine Warbler	1	3	3	3	1	Continued monitoring
Prairie Falcon	1	3	3	3	1	Continued monitoring
Purple Martin	1	3	2	3	1	Continued monitoring
Red-bellied Woodpecker	1	3	3	3	1	Continued monitoring
Red-headed Woodpecker	1	3	3	3**	1	Research
Red-shouldered Hawk	1	3	3	3	1	Continued monitoring
Red-winged Blackbird	2	3	2	3	3	Trend for north (MM)
Ring-necked Pheasant	1	3	3	3	1	Continued monitoring
Rock Dove	2	3	2	3	1	Continued monitoring
Rock Wren	1	3	3	3	1	Continued monitoring
Rose-breasted Grosbeak	2	3	3	3*	1	Continued monitoring
Rosy Finch	2	3	3	3*	3	Confirm CBC trend
Ruby-throated Hummingbird	1	3	3	3	1	Continued monitoring
Rufous-sided Towhee	1	3	2	3	1	Continued monitoring
Say's Phoebe	1	3	3	3	3	Trend for north (MM)
Scarlet Tanager	1	3	3	3**	1	Research
Sedge Wren	2	3	3	2	1	Continued monitoring
Steller's Jay	1	3	3	2	1	Continued monitoring
Swainson's Hawk	2	3	3	3	3	Confirm trend (MM)
Townsend's Solitaire	2	3	3	3	3	Trend for north (MM)
Townsend's Warbler	2	3	3	3	3	Trend for north (MM)
Tufted Titmouse	1	3	3	3	1	Continued monitoring
Varied Thrush	2	3	3	3	3	Trend for north (MM)
Virginia Rail	2	3	3	3	1	Continued monitoring
Western Bluebird	1	3	3	3	1	Continued monitoring
Western Grebe	2	3	3	3	1	Continued monitoring
Western Kingbird	1	3	3	2	1	Continued monitoring
Western Meadowlark	1	3	2	4*	1	Research
Western Screech-Owl	1	3	3	2	3	Confirm trendWestern
Tanager	2	3	3	3	3	Trend for north (MM)
Western Wood-Pewee	2	3	2	3	3	Trend for north (MM)
Whip-poor-will	2	3	3	3	1	Continued monitoring

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
White-breasted Nuthatch	1	3	2	3	1	Continued monitoring
White-eyed Vireo	1	3	3	3	1	Continued monitoring
White-headed Woodpecker	1	3	4	1	1	Continued monitoring
White-throated Swift	1	3	3	3**	1	Research
Wild Turkey	1	3	3	2	1	Continued monitoring
Williamson's Sapsucker	1	3	4	2	1	Continued monitoring
Willow Flycatcher	1	3	3	3	1	Continued monitoring
Willow Ptarmigan	2	3	2	3	5	Improve monitoring
Yellow-billed Cuckoo	1	3	2	3	1	Continued monitoring
Yellow-breasted Chat	1	3	3	3	1	Continued monitoring
Yellow-headed Blackbird	2	3	3	2	1	Continued monitoring
Yellow-throated Vireo	1	3	3	3	1	Continued monitoring

**Very low: low concern, low to high responsibility** (40 species)

American Kestrel	3	2	1	3	3	Trend for north (MM)
Bald Eagle	4	2	3	1	3	Trend for north (MM)
Black-backed Woodpecker	4	2	2	2*	3	Confirm trend
Black-capped Chickadee	3	2	2	2	3	Trend for north
Cedar Waxwing	3	2	2	2	3	Trend for north (MM)
Clark's Nutcracker	1	2	3	1	1	Continued monitoring
Common Nighthawk	1	2	1	3*	3	Trend for north (MM)
Common Raven	4	1	1	1	3	Confirm trend
Downy Woodpecker	2	2	2	2	3	Trend for north (MM)
Evening Grosbeak	4	2	2	2*	1	Continued monitoring
Ferruginous Hawk	1	2	3	1	1	Continued monitoring
Gray Flycatcher	1	2	3	1	1	Continued monitoring
Great Blue Heron	2	2	2	2	1	Continued monitoring
Great Horned Owl	3	2	1	3*	3	Confirm trend
Hairy Woodpecker	3	2	2	2	3	Trend for north (MM)
House Finch	1	2	2	1	1	Continued monitoring
House Wren	2	2	2	2	1	Continued monitoring
Lazuli Bunting	1	2	3	1	1	Continued monitoring
Lincoln's Sparrow	4	2	2	1	3	Trend for north (MM)

Species	PIF-Canada score for <sup>a</sup>					Highest needs (if action to be taken) <sup>c</sup>
	Responsibility Concern	Vulnerability Trend <sup>b</sup>	Trend Uncertain			
Marsh Wren	1	2	3	1	1	Continued monitoring
Merlin	4	2	2	2	3	Trend for north (MM)
Mountain Chickadee	2	2	3	1	3	Trend for north
Mourning Dove	1	2	2	2	1	Continued monitoring
Northern Harrier	3	2	1	3	3	Trend for north (MM)
Northern Wheatear	2	2	2	?	5	Improve monitoring
Osprey	4	2	2	2	3	Trend for north (MM)
Peregrine Falcon	1	2	2	1	3	Trend for north (MM)
Pileated Woodpecker	2	2	2	1	3	Trend for north
Red-breasted Nuthatch	4	2	2	1	3	Trend for north (MM)
Red-eyed Vireo	3	2	2	2	1	Continued monitoring
Red-tailed Hawk	2	2	2	2	3	Trend for north (MM)
Sharp-shinned Hawk	3	2	1	3*	3	Trend for north (MM)
Snowy Egret	1	2	2	2	1	Continued monitoring
Solitary Vireo	3	2	3	1	3	Trend for north (MM)
Turkey Vulture	1	2	2	1	1	Continued monitoring
Violet-green Swallow	2	2	3	1	3	Trend for north (MM)
Western Flycatcher	1	2	3	1	1	Continued monitoring
Yellow Wagtail	1	2	2	?	5	Improve monitoring
Yellow Warbler	3	2	2	2	3	Trend for north (MM)
Yellow-rumped Warbler	4	2	2	2	3	Trend for north (MM)

<sup>a</sup> All scores range from 1 (very low) to 5 (very high). See section 3, objective 1.2 in report for explanation

<sup>b</sup> \*\* indicates statistically significant decline >50% from 1966-96 (Breeding Bird Survey) or 1959-88 (Christmas Bird Count).

\* indicates statistically significant decline of 25-49% over same period, OR non-significant decline >50%, OR significant short-term decline >50% (BBS 1980-96).

<sup>c</sup> Need for "Research" implies conservation concern, and required action is for thorough status assessment or to investigate cause of a well-documented decline so that conservation action will be effective.

"Conservation" indicates that immediate protection is warranted even if research is also needed. "Trend for north" indicates need for trend information from the 50+% of the Canadian range lying north of BBS coverage.

CBC = Christmas Bird Count.

MM = Migration monitoring (MM? indicates that MM may be inadequate for this species).