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Data Sources and Methods for the Trends in Canada's Migratory Bird Populations Indicator

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1 Introduction

The Trends in Canada's Migratory Bird Populations indicator is part of the Canadian Environmental Sustainability Indicators (CESI) (http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=47F48106-1) program, which provides data and information to track Canada's performance on key environmental sustainability issues.

The CESI indicator presents findings from the *State of Canada's Birds 2012* (http://www.stateofcanadasbirds.org/) produced by the North American Bird Conservation Initiative-Canada (NABCI-Canada) (http://www.nabci.net/)[1]. The NABCI report presents a picture of the health of Canada's bird populations, describing population trends, the major threats they face, and conservation solutions that benefit them.

2 Description and rationale of the trends in Canada's migratory bird populations indicator

2.1 Description

The Trends in Canada's Migratory Bird Populations indicator provides population trends for the period 1970 to 2010 for groups of native bird species that winter primarily in one of four areas: Canada (including migratory and resident bird species[2]); United States; Mexico, Central America and the Caribbean; and South America. An overall population trend for "all birds" is also provided[3].

2.2 Rationale

Changes in species abundance are due to habitat loss, pollution, climate change, or other factors, and tracking the status of Canada's birds can help to identify overall impacts of these changes on environmental health. Tracking can also help to set priorities, evaluate management actions, and track the recovery of species at risk.[4] The Trends in Canada's Migratory Bird Populations indicator presents the best available population data for native bird species in Canada, as drawn from the State of Canada's Birds 2012 (http://www.stateofcanadasbirds.org/).

Because birds are sensitive to environmental changes such as habitat loss and pollution, they make good indicators of the health of an ecosystem. The majority of bird species are also easily detectable and observable, and many long term monitoring programs have been developed, so that historical data allow for their status and trends to be assessed over long periods.

[1] NABCI-Canada aims to ensure that the populations and habitats of North America's birds are protected, restored and enhanced through coordinated efforts at the international, national, regional and local levels guided by sound science and effective management. NABCI website . Retrieved on 28 March, 2012. Avaliable from: http://www.nabci.net/.
[2] Some bird species wintering in Canada are migratory and travel from such places as the Arctic to spend the winter months in warmer areas of Canada, while resident species do not travel long distances. Both resident and migratory birds are captured in the indicator.
[3] The "all birds" trend is based on 318 native bird species for which there are sufficient data. It includes species that winter across more than one area.
[4] [NABCI-Canada] North American Bird Conservation Initiative-Canada (2012) State of Canada's Birds 2012. Retrieved on 27 June, 2012. Avaliable from: http://www.stateofcanadasbirds.org/.

3 Data

3.1 Data source

Data on Canada's migratory bird species populations are drawn from many different monitoring programs that use methods designed to survey different bird species or types of bird habitat. Many monitoring programs are designed by professionals, but engage highly skilled volunteers to help collect data. Some volunteer programs, like the North American Breeding Bird Survey, breeding bird atlases, nocturnal owl surveys and marsh monitoring surveys take place in the breeding season. Others such as the Canadian Migration Monitoring Network and shorebird migration surveys, monitor birds during migration, or in winter (e.g. the Christmas Bird Count and Project FeederWatch). Checklist programs like, eBird and Étude des populations d'oiseaux du Québec (ÉPOQ) are less formal, year-round programs that encourage birders to record all of their observations every time they go birding[4].

Other programs, such as breeding waterfowl, arctic shorebird and colonial seabird surveys are conducted entirely by professional biologists.

Environment Canada's Canadian Wildlife Service (CWS) collates the data from many of these programs, collaborating with others to incorporate the results into the State of Canada's Birds 2012 report (http://www.stateofcanadasbirds.org/). For more detailed information on the population status of each species of bird in Canada, see Environment Canada's Status of Birds in Canada (http://www.ec.gc.ca/soc-sbc/index-eng.aspx?sY=2011&sL=e).

3.2 Spatial coverage

The indicator provides national coverage, but for some species data only exist from a portion of their national range.

3.3 Temporal coverage

The indicator reports the best available estimate of the average population status across species for groups of native bird species in Canada from 1970 to 2010.

3.4 Data completeness

There are 451 native species of birds that occur regularly in Canada, 357 of which can be clearly assigned to a single primary wintering area. Of the 357, sufficient population data are available for 292 for the period 1970 to 2010. The Trends in Canada's Migratory Bird Populations indicator reports on 292 species by wintering area. An overall population trend for "all birds" is also provided based on 318 native bird species for which there are sufficient data. The "all birds" trend includes species with wintering populations spread relatively evenly across more than one area.

Table 1: Distribution of Canada's native bird species by wintering area

Wintering Area	Species with One Primary Wintering Area	Species with One Wintering Area and >20 Years Data
Canada	78	52
United States	122	111
Central America	96	74
South America	61	55
Other*	30	N/A
Total	**357**	**292**

*"Other" includes species that travel to Europe or Asia or spend long periods of time at sea

Species that have been excluded from the indicator include those species with significant portions of their populations that migrate to more than one of the four wintering areas (i.e., they cannot be clearly assigned to any of the four areas), are difficult to survey (e.g., breed in remote areas), or for which surveys have only recently been developed and do not yet have long-term trend information (e.g., many owls and pelagic seabirds)[4].

4 Methods

Annual population indices, relative to a base year of 1970 were first calculated for each species. Composite annual indices across species were then calculated for species grouped by wintering area to represent an estimate of the average percentage change across species within each group. Overall, long-term trends for each wintering area were determined based on the change in the indicator in the final year relative to 1970. Species were only included if they could be assigned as predominantly wintering in a single area (*i.e.* species with wintering populations spread relatively evenly across more than one area were excluded) and had adequate data (*i.e.*, a long-term monitoring program that provided annual estimates of population status over the past 20 or more years).

The most appropriate data source for each species was selected from the available monitoring programs. Different programs provide information in different units, so to be comparable among species and data sources, species population trends were modelled as a proportional change from a base year to create a species index. These were combined into a composite index for each wintering area. The method uses a Bayesian hierarchical model (Sauer and Link 2011)[5] to generate an estimate of the average population status across all species in the species group, while accounting for the varying precision of each species' population estimates.

Each index by wintering area was then plotted on a percentage change axis to reflect changes in species' populations since the base year 1970. The scale was adjusted (non-linear scaling) so that negative percent changes would be visually comparable to the corresponding positive change required to return the index to its original value (population status in 1970). For example, a group of species that decreased by 50% (i.e., reduced to half its original level) must then increase by 100% (i.e., double) to return to zero net change, the groups' population status in 1970.

[5] Sauer, JR and Link WA (2011) Analysis of the North American Breeding Bird Survey Using Hierarchical Models. *The Auk* 128:87-98. Retrieved on 16 April, 2012. Avaliable from: http://www.jstor.org/stable/10.1525/auk.2011.128.issue-1.

Averaging across species gives an overall estimate of a group's population status, but species vary within groups. For example, a stable trend may result from a group of species with small changes, or it may reflect a group of species with large but balanced increases and decreases. For this reason, species individual trends were assigned to five categories to provide further detailson population trends: strong increase; increase; little change; decrease; and strong decrease.

Bird species whose populations increased by more than 33% over the 40-year period from 1970 to 2010 were considered to be increasing, whereas species that declined by more than 25% were considered to be decreasing. Species that experienced smaller increases or decreases during the period were assigned to the little-change category.

These thresholds were used to reduce the influence of natural population fluctuations and data uncertainties on the categorizations.

5 Caveats and Limitations

For some bird species, a best estimate of their population status was imprecise and/or based on a small proportion of the Canadian population, most often for species that breed in isolated northern regions. Species with insufficient data to estimate indices were excluded, including those that were either difficult to survey (e.g., breed in remote areas or very rare) or species for which surveys had only recently been developed and did not yet have long-term trend information (e.g., many owls and pelagic seabirds).

6 References and further reading

6.1 References

[NABCI-Canada] North American Bird Conservation Initiative-Canada (2012) State of Canada's Birds 2012. Retrieved on 27 June, 2012. Available from: http://www.stateofcanadasbirds.org/.

Sauer, JR and Link WA (2011) Analysis of the North American Breeding Bird Survey Using Hierarchical Models. *The Auk* 128:87-98. Retrieved on 16 April, 2012. Available from: http://www.jstor.org/stable/10.1525/auk.2011.128.issue-1.

6.2 Further reading

United States of America (2009) The State of the Birds. Retrieved on 16 April, 2012. Available from: http://www.stateofthebirds.org/2009/.

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