

The Ontario Forest Bird Monitoring Program (1987-1997):

Goals, methods and species trends observed

SK
470
742
No. 325

Michael D. Cadman

Canadian Wildlife Service, 75 Farquhar St., Guelph, ON, Canada N1H 3N4

Heather J. Dewar

Canadian Wildlife Service, 49 Camelot Dr., Nepean, ON, Canada K1A 0H3

Daniel A. Welsh

Canadian Forest Service, 580 Booth St., 7th Floor, Ottawa, ON, Canada, K1A 0E4

Canadian Wildlife Service Technical Report Series No. 325

This series may be cited as:

Cadman, M.D.; Dewar, H.J.; Welsh, D.A.; 1998. The Ontario Forest Bird Monitoring Program (1987-1997): Goals, methods and species trends observed. Technical Report Series No. 325, Canadian Wildlife Service.

Issued under the Authority of the
Minister of the Environment
Canadian Wildlife Service

©Minister of Supply and Services Canada 1998
Catalogue No. CW 69-5/325E
ISBN 0-662-27074-6

Copies may be obtained from:

Heather J. Dewar
Environmental Conservation Branch
Canadian Wildlife Service
49 Camelot Dr.
Nepean, ON
K1A 0H3

Ph: (613) 941-5913
FAX: (613) 952-9027
e-mail: heather.dewar@ec.gc.ca

Abstract

The Ontario Forest Bird Monitoring Program (FBMP) is a volunteer-based program of Environment Canada's Canadian Wildlife Service (CWS), Ontario Region. It is an ongoing venture that was started in 1987. The goals of the program are to: 1. Compile a habitat-specific baseline inventory of forest songbirds; 2. Describe changes over time in the numbers of forest songbirds in relation to habitat and landscape characteristics; and 3. Contribute to an understanding of population trends for forest birds in Ontario. This report summarises progress to date in achieving the third goal, which has been the primary emphasis of the early years of the program. We apply the FBMP data in an examination of the population trends of forest birds on the sites that we monitor.

Monitoring sites are self-selected in large, fairly mature forests, in which little or no active forest management is underway: of the 298 sites surveyed 109 are in provincial parks, 16 are in national parks, and 39 are on Conservation Authority lands. While sites have been established with a goal of representing all major forest habitat types in southern Ontario, the adequacy of representation of each habitat type has yet to be determined. There are 130 sites in the Boreal Shield Ecozone (BSE) and 168 in the Mixedwood Plains Ecozone (MWPE). Sites typically consist of five monitoring stations 200 metres or more apart. Ten minute, unlimited distance point counts are undertaken twice in the breeding season by experienced volunteers. The number of sites covered each year increased from 40 in 1987 to 162 in 1993, and has been fairly stable since that time. Population trends were calculated for sites visited by the same observer for at least two years. An overall trend for each species was determined using Estimating Equations. Sample sizes were adequate to determine a trend for 69 species: 35 showed increasing trend (11 significant), and 34 showed decreasing trend (9 significant). Four forest interior species showed significant declines, warranting further investigation. There were no significant differences in the number of species with increasing or decreasing trends within migration strategy, forest-use classification or ecozone.

Résumé

Le Programme de surveillance des oiseaux forestiers de l'Ontario (PSOF) est un programme bénévole du Service canadien de la faune (SCF) de la Région de l'Ontario. Il s'agit d'un projet permanent commencé en 1987 et dont voici les objectifs: 1. Dresser l'inventaire de référence des oiseaux chanteurs des forêts suivant l'habitat; 2. Décrire les changements survenant dans le temps au nombre d'oiseaux chanteurs des forêts en fonction des caractéristiques d'habitat et de paysage; et 3. Contribuer à la compréhension des tendances de la population pour les oiseaux forestiers de l'Ontario. Ce rapport résume les progrès accomplis jusqu'ici dans la réalisation du troisième objectif, sur lequel on a particulièrement mis l'accent pendant les premières années du programme. Nous appliquons les données du PSOF dans l'examen des tendances de la population des oiseaux forestiers dans les sites que nous surveillons.

Les sites de surveillance sont choisis de façon libre dans de grandes forêts ayant atteint un bon niveau de maturité et pratiquement exemptes de gestion forestière active en cours: sur les 298 sites étudiés, 109 se trouvent dans des parcs provinciaux, 16 dans des parcs nationaux et 39 dans des terres de l'Office de protection de la nature. En délimitant les sites, on a cherché à représenter tous les types d'habitats forestiers du sud de l'Ontario, mais on n'a pas encore établi si chaque type d'habitat est bien représenté. Il existe 130 sites dans l'écozone du bouclier boréal (EBB) et 168 dans l'écozone des plaines à peuplement mixte (EPPM). En principe, les sites comptent cinq stations de surveillance situées à au moins 200 mètres de distance les unes des autres. Pendant la saison de la couvaison, des bénévoles expérimentés procèdent, sur une distance illimitée, à des dénombrements de dix minutes. Le nombre des sites étudiés chaque année est passé de 40 en 1987 à 162 en 1993. Depuis, le nombre a été assez stable. C'est le même observateur qui, pendant au moins deux ans, visite les sites qui servent à calculer les tendances de la population. Suivant des équations d'estimation, on dégage la tendance générale de chacune des espèces. La taille des échantillons a suffi à déterminer la tendance de 69 espèces: 30 suivent une tendance à la hausse (11 hausses importantes) et 34 une tendance à la baisse (9 baisses importantes). Quatre espèces de l'intérieur des forêts ont subi de gros déclin, ce qui appelle d'autres études. Il n'y a pas eu de grosses différences dans le nombre d'espèces suivant les tendances à la hausse ou à la baisse dans la stratégie de migration, la classification de l'utilisation des forêts ou l'écozone.

Dedication

The Ontario Forest Bird Monitoring Program, and all of the other programs under the Landbird Monitoring Strategies, are volunteer-based. Amateur birders and professional biologists who contribute as volunteers to these programs deserve a great deal of credit for their efforts in making the FBMP and other programs possible and successful. By applying their knowledge of birds and donating the time and resources required to undertake field surveys and data compilation, these volunteers are adding considerably to the knowledge and conservation of bird populations. This report is dedicated to those volunteers, whose efforts are gratefully acknowledged. The list of FBMP volunteers who contributed to this program between 1987 and 1997, and the sites they covered during that period, is provided in Appendix A.

Table of Contents

Abstract	i
Résumé	ii
Dedication	iii
Introduction.....	1
Methods.....	4
Site Selection.....	4
Point Counts	5
Data Analysis.....	6
Results	8
Coverage	8
Descriptive Bird Results.....	11
FBMP Trends 1987-97	13
Discussion	20
Acknowledgements	24
Literature Cited.....	24
Appendix A	A - 1
Appendix B	B - 1
Appendix C	C - 1

Introduction

The Ontario Forest Bird Monitoring Program (FBMP) is a volunteer-based program of Environment Canada's Canadian Wildlife Service (CWS), Ontario Region. It is an ongoing venture that was started in 1987. The goals of the program are to: 1. Compile a habitat-specific baseline inventory of forest songbirds (determining species composition and relative abundance) that will allow CWS to generate habitat-association profiles that are regionally accurate; 2. Describe changes over time in the numbers of forest songbirds in relation to habitat and landscape characteristics; and 3. Contribute to an understanding of population trends for forest birds in Ontario. This report summarises progress to date in achieving the third goal, which has been the primary emphasis of the early years of the program. We apply the FBMP data in an examination of the population trends of forest birds on the sites that we monitor. More detailed publications on all aspects of the program will be produced in the coming years.

The government of Canada has a strong interest in the conservation of the nation's wildlife and has a number of policies, programs and activities which provide a framework for the FBMP and other bird monitoring programs. The Migratory Birds Convention Act of 1916 provides the mandate for Environment Canada to protect migratory birds. The need for a national program to monitor the status of, and trends in, biodiversity is recognised in *A Wildlife Policy for Canada* and the *Canadian Biodiversity Strategy* (1994). *The Canadian Landbird Conservation Program* (Partners in Flight - Canada), produced by Environment Canada and its partners, provides a strategic approach to conserving birds across Canada. *Towards Conserving the Birds of Ontario* (Cheskey 1995) is a provincial counterpart of the national framework. Both documents recognise that an essential first-step in bird conservation is to monitor species' populations, distributions and habitat-associations over time, and call for a strategic approach to monitoring birds that will maximise efficiency and coverage.

Birds are an important component of Ontario's biodiversity, with almost 300 species known to breed in the province. They inhabit a wide diversity of habitat types, are well known and relatively easy to monitor because they are both visually and aurally conspicuous. Monitoring their populations can provide insight into the state of the environment. Although there is a long-established and growing interest in birds in Ontario, only recently have efforts been made to co-ordinate monitoring activities. The first organised bird survey in the province occurred in 1900 with the first Christmas Bird Count (Cadman 1994). Systematically observing birds to detect population changes over time expanded with programs such as the Breeding Bird Census, starting in 1937, and began in earnest in the 1960s with the establishment of the Breeding Bird Survey, and Migration Monitoring at Long Point Bird Observatory (Wallace 1990). Over the last

ten to 15 years there has been a proliferation of programs in Ontario such as the Breeding Bird Atlas (Cadman *et al.* 1987), FBMP, Ontario Birds at Risk (Austen *et al.* 1994), and the Marsh Monitoring Program (Long Point Bird Observatory & Environment Canada 1997). The Canadian Landbird Monitoring Strategy (Canadian Wildlife Service 1994) and the Ontario Landbird Monitoring Strategy (Cadman 1995) have been produced to integrate monitoring efforts and maximise efficiency. Both strategies incorporate the Forest Bird Monitoring Program.

The primary source of population information for neotropical migrants and other landbirds, is the North American Breeding Bird Survey (BBS) (Sauer and Droege 1990, Downes & Collins 1996, Villard & Mauer 1996). The strength of BBS is that it is a broad-based survey designed to detect trends occurring over large geographic areas. The BBS is conducted in roadside areas, relies on three minute counts and currently does not have habitat information associated with the routes. One of the frequently discussed limitations of the BBS is that limited inferences can be made about trends in species that breed in habitats away from roadsides (Thomas 1996), such as forest interior. The FBMP was designed to augment the broad regional base of the BBS by: 1. Covering forest interior within relatively mature, unmanaged woodland habitats; 2. Using 10 minute counts (which have lower variation, and therefore require fewer samples to detect a trend) and 3. Collecting habitat information at sample locations with the aim of combining trend estimates with habitat and landscape variables to look at possible correlations.

Breeding Bird Survey route locations were determined using a randomized sampling system designed to ensure even and representative coverage, while FBMP sites were chosen to ensure inclusion of selected forest types, or established at sites of interest to volunteers. Therefore, until further analysis determines the extent to which FBMP sites are representative of forests in the province, our results should be considered pertinent only to the sites sampled. Although representativeness is as yet undetermined, statistically significant declines of forest interior species on FBMP sites are ecologically significant and require further attention.

The determination of changes in population abundance at a provincial or ecoregional scale requires accurate trend information over a long time period and a large geographic area. There are a wide variety of techniques that have been used to estimate the relative abundance of bird species (Ralph & Scott 1981). The most widely used are probably modifications of unlimited distance point counts developed by Blondel (Blondel *et al.* 1981, Ralph *et al.* 1995). Common characteristics of the procedure include: 1. Quantitative recording of bird occurrence (by sight or song); 2. Sample durations of five to 20 minutes; and 3. Collection of a sufficient number of samples to obtain a measure of the dispersion around the mean, so that results can be objectively compared using statistical tests. A comparison of three, five and ten minute sample durations demonstrated that for Ontario the best compromise between collection effort and the precision

and accuracy of samples (and hence population trends) for an off-road forest bird count was obtained with ten minute samples (Welsh 1995).

The probability of detecting birds is influenced by many factors, including habitat structure, weather (e.g. wind, rain), time of day, season, observer skill level, and species-specific differences in behaviour (Robbins 1981, Verner 1985, Sauer *et al.* 1994). To obtain the most accurate estimate of the status of bird populations it is essential to remove as many of the non-biological sources of variation as possible. With less variation in individual counts fewer samples are required to calculate a trend. Unfortunately the determination of changes in population size from this kind of data is not straightforward. There is currently no consensus as to which of the available analysis methods is most appropriate. For an overview of the analysis methods and a discussion on how to evaluate them see Thomas (1996). We have chosen to use the same method as the Canadian Breeding Bird Survey, which has recently adopted a method called Estimating Equations. This technique was first presented by Link and Sauer (1994), and was developed to improve the ability to predict trends for less abundant species relative to results previously obtained using linear route regression.

An important concept in trend analysis is the power of the analysis used, i.e. the probability of rejecting the null hypothesis when it is false. The United States Geological Survey Biological Resources Division produces a DOS-based free-ware program called Monitor. This software package allows users to assess whether the program they are using or designing can deliver the precision necessary to detect the types of expected changes they desire. It is available at (<http://www.mp1-pwrc.usgs.gov/powcase/monitor.html>). This software uses linear regression to estimate the statistical power of population monitoring programs relative to:

1. the number of plots/sites monitored;
2. the magnitude of counts per plot/site;
3. count variation;
4. plot/site weighting schemes;
5. the duration of monitoring;
6. the interval of monitoring;
7. the strength and nature of ongoing population trends; and,
8. the significance level associated with trend determination.

We use Monitor to assess the power of FBMP trend analyses to detect populations change. The one weakness of this application with respect to the FBMP is that it assumes that there is the same interval between visits to all sites.

Monitoring forest bird populations is of particular importance in Ontario, whose one million square kilometre landmass is largely forested. Terrestrial portions of central and northern Ontario are almost entirely forested, and road-accessible portions are being managed for forest products. The area south of the Canadian Shield, which was largely forested prior to settlement and extensive land clearing in the 18th and 19th centuries, consists of an agricultural landscape with fragmented woodland covering between approximately three and 30 percent of the land in the area's 28 counties and regional municipalities (Riley and Mohr 1994). Forest management, reforestation, urban expansion and rural development all continue to affect forest cover in southern Ontario. With forests and forest products being such an important part of the Ontario landscape, ecology, and economy, good information on forest ecology, such as that provided by the FBMP, is required so that forests can be managed in an ecologically sustainable manner.

Methods

Site Selection

The locations of sites in the FBMP are self-selected rather than randomly selected. In the absence of a systematic survey of the abundance and distribution of vegetation types within the province, a working list of potential cover types was compiled prior to the 1987 field season. An effort was made (and still is) to establish sample sites that are distributed across the province and are representative of the frequency of occurrence of the different cover types. Sites are usually located in mature forest stands that are relatively homogeneous and large enough to accommodate at least five sampling stations (i.e. 25 ha or more). Multiple sites have been established in a number of larger wooded areas. In 1995 the first stations established in smaller forest fragments were incorporated into the program. Monitoring in small woodlots is not the focus of the program, but these data will be maintained and analysed independently of the current data set to address questions of forest fragmentation.

An annotated list of prospective sites for the Forest Bird Monitoring Program was compiled in 1986. Using this information, and input from a number of experts in the field, a list of potential sites was prepared. These sites were visited, and where appropriate, flagged and baseline bird survey data were collected. Between 1988 and 1990 approximately 100 sites were established by professional staff. The majority of these sites are on land with some form of protection from disturbance, i.e., located in parks or Conservation Areas. A few sites in northern Ontario that were established for other research projects have been taken over by volunteers or birding organisations. Prior to, and concurrent with these activities, individuals active in the birding

community were contacted and given the opportunity to adopt existing sites or to establish sites at locations of interest to them. By the end of 1997, over 200 sites had been set up by volunteers. Volunteer commitment is key to the success of this program and we maintain that people are more likely to contribute over the long-term, and expand their involvement, if they are working in locations that are important to them.

At each site typically five stations (but occasionally three or four) are positioned such that there is at least 200 metres between stations and no station is within 100 metres of an edge. Here, edge is defined as any major discontinuity in stand age or tree-species composition, any boundary between forest and fields, or any body of water. The 200 metre distance between stations is sufficient to minimise the likelihood of hearing the same individuals on adjacent stations, and is based on extensive field experience in Ontario. Since 1993, volunteers have been instructed to put stations 250 metres or more apart because some people have tended to underestimate distances.

Permanent markers are available to be posted at each station, and are in use at about half of the sites. Typically they are nailed to trees, but experience has shown that attaching them with screws is preferable as the screws can be loosened as the tree grows. The markers are soft blue plastic tags labelled with the name and telephone number of the program, the site number and the station letter. The routes between stations, and the station locations, are also usually marked with flagging tape.

Point Counts

The methods used for the FBMP point counts are loosely based on the approach described in Blondel *et al.* (1970, 1981). Experience gained from extensive field work in Ontario has resulted in some modifications.

Each station is visited twice during the breeding season; the first visit is done in the period May 24th - June 17th and the second is done in the period June 13th - July 10th, with at least six days between visits. Counts are ten minutes long, and are conducted between a half hour before sunrise and five hours after sunrise. All stations within a site are visited on the same morning and in the same order on each visit. Counts are not performed in weather that is likely to reduce counts.

Observations are made only by the person recorded as the observer on the data sheet, although assistants may participate in data transcription or navigation. The samples are unlimited distance

point counts. All birds associated with the forest that are seen or heard during the sample period are recorded, and every effort is made to ensure that each individual is counted only once. Birds flying over a station, or flocks of birds not associated with the forest are not recorded. Likewise, calls considered to be from a neighbouring field, lake or woods are also excluded. The location and type of observation, such as type of vocalisation and/or sex of bird, are mapped on the data forms using standard symbols (Appendix B). The circle on the data forms does not represent a fixed distance and is present only to assist in mapping the locations of birds. Information is transferred from the data forms onto summary sheets (Appendix B). Observers return the data forms and summary sheets to CWS for verification and processing. Any errors or inconsistencies are verified with observers before the data are used.

Data Analysis

Trends were analysed by site. Stations, or occasionally years, were dropped from the analysis as necessary to ensure that sites had the same number of stations over time. For each visit, the number of individuals of each species observed at each station within a site was summed, and the visit with the higher number of individuals was used in the analysis.

An estimate of trend is calculated for every site in which there is at least one 'site-block' with two or more observations (equivalent to two or more years), and at least two non-zero counts. A site-block is a set of observations that is defined as comparable. For the FBMP this indicates that the same observer collected the data in all years, and that there were two visits each year within the time periods specified. The sample size (n) refers to the number of sites that are included in the analysis and does not indicate how many years of data were used.

The method used here for trend analysis is the same as that recently adopted for use by the BBS in Canada. There has been considerable debate about the most appropriate analysis method, and the application of various weighting factors, for BBS data (e.g. Sauer & Droege 1990, James *et al.* 1990, Link & Sauer 1994, Thomas 1996, James *et al.* 1996). At this time, no publications of Canadian BBS data have been produced using Estimating Equations, but trends calculated for 1966 to 1996 using this method have been put on the Environment Canada Bird Trends web page (<http://www1.ec.gc.ca/~cws/>). For further information on this analysis technique see Link & Sauer (1994).

Since the trends reported apply only to the sites that were sampled, and are not used to generate a provincial trend, neither area nor abundance weighting were used in the analysis. The standard analysis of the BBS requires that at least 40 individuals of a species be observed on a minimum of

15 routes. The same restrictions are used for the FBMP analysis, using 40 individuals and 15 sites. These restrictions are to ensure that there is sufficient data on a species to warrant an analysis. Because the analysis examines the consistency of trends among routes to ascertain the significance of the observed trend, a set of 15 numbers is required to have a reasonable sample size for calculating the among-site variance term (Collins 1997).

We report three significance levels: $p \leq 0.05$, 0.1, and 0.2. We use $p \leq 0.2$ to ensure that potentially important trends are not overlooked. In situations where species with significant trends are compared to species with non-significant trends the lowest level of significance ($p \leq 0.2$) is used.

To evaluate the power of the trend estimates obtained using Estimating Equations the Monitor program was used. Simulations were run using a coefficient of variation of 0.5, a significance level of 0.2, two-tailed tests, linear growth, whole number rounding, ten years of monitoring and varying the number of sites and the monitoring interval.

Trends were also determined by ecozone, attributing sites to either the Mixedwood Plains or Boreal Shield Ecozone based on maps of the ecoregions of Canada (Ecological Stratification Working Group 1994).

Species were grouped into forest-use classes (Forest Interior, Interior/Edge, and Edge) and migration classes (Resident, Short-distance Migrant and Neotropical Migrant) based on Freemark & Collins (1992) to determine whether there was a tendency for species in these groups to be increasing or decreasing. The forest-use classes were defined as follows: Forest interior species nest primarily within the interior of forests and rarely occur near the edge; Interior/Edge species have territories located entirely within the forest, but can utilise forest edge, or in some cases can extend a single territory across more than one forest fragment; Edge species typically use forest perimeters, nearby fields or large clearings within a forest during the breeding season.

Results

Coverage

Figure 1 shows the location of FBMP sites established from 1987 through 1997, and the division between the Boreal Shield (BSE) and Mixedwood Plains (MWPE) Ecozones. Most sites are within southern and central Ontario. There are few sites in remote areas of northern Ontario because of the lack of volunteers in that area. Of the sites that met the criteria to be included in the analysis, there are 130 in the BSE and 168 in the MWPE. More than half of these 298 sites are located on land with some form of protection from disturbance: Provincial Parks (109 sites), National Parks (16 sites), Conservation Authority lands (39 sites).

The number of volunteers and sites covered increased from 1987 until 1993 and has been relatively stable since then (Figure 2). By 1993, approximately 100 volunteers were providing data annually and about 160 sites were being monitored. The number of species observed each year has remained relatively constant, while the number of individuals detected has increased with the addition of more sites, and also fluctuates between years (Figure 2). Site fidelity is high among volunteers. For sites with five or more years of coverage ($n=112$) the maximum number of observers per site is three, with an average of 1.2. Most counts are done between 06:00 and 08:00 hours (Figure 3). The majority of surveys done after 08:00 hours are on sites which are the second one visited on a particular day.

Over the past 11 years of the program birds have been observed at 329 sites (1,585 stations). In 1993, we began surveying each site to collect information on the vegetation, and to obtain a precise latitude-longitude location for each station using Global Positioning System (GPS) technology. To date, we have surveyed and obtained latitudes and longitudes for about 70 percent of the sites that were established prior to 1995 ($n=275$), and about 95 percent of the sites with three or more years of data. Further data on sites established since 1995 will be collected as resources permit, and added to the existing vegetation and GPS databases. This information will be summarised with trends presented by habitat type in a future publication.

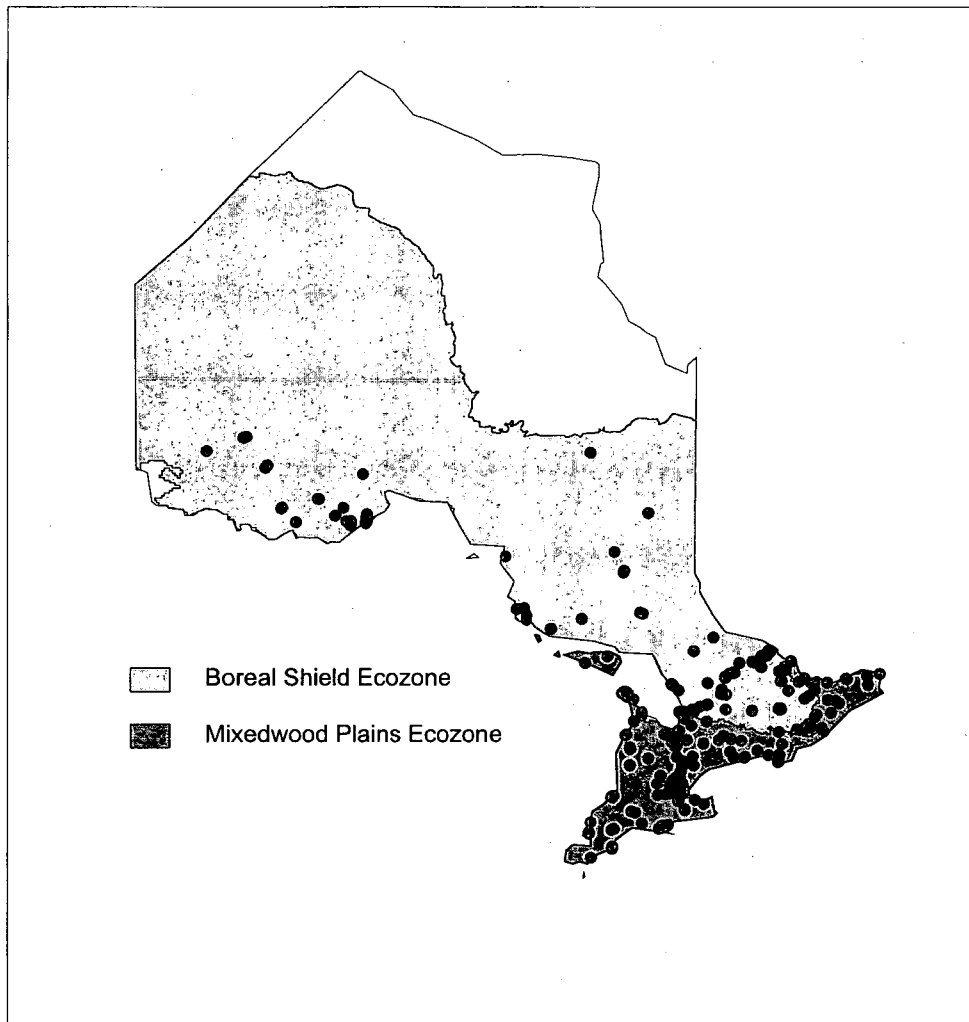


Figure 1: Location of FBMP sites and delineation of the Boreal Shield and Mixedwood Plains Ecozones.

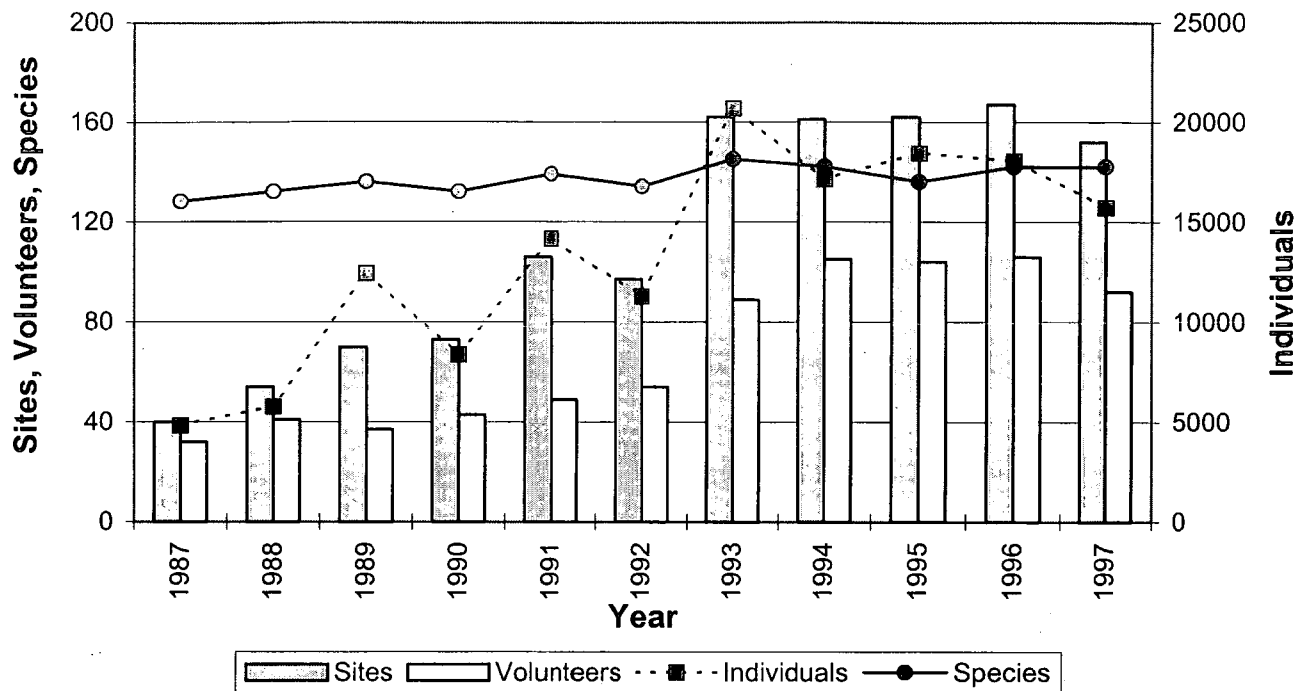


Figure 2: Number of sites, volunteers, species and individuals by year.

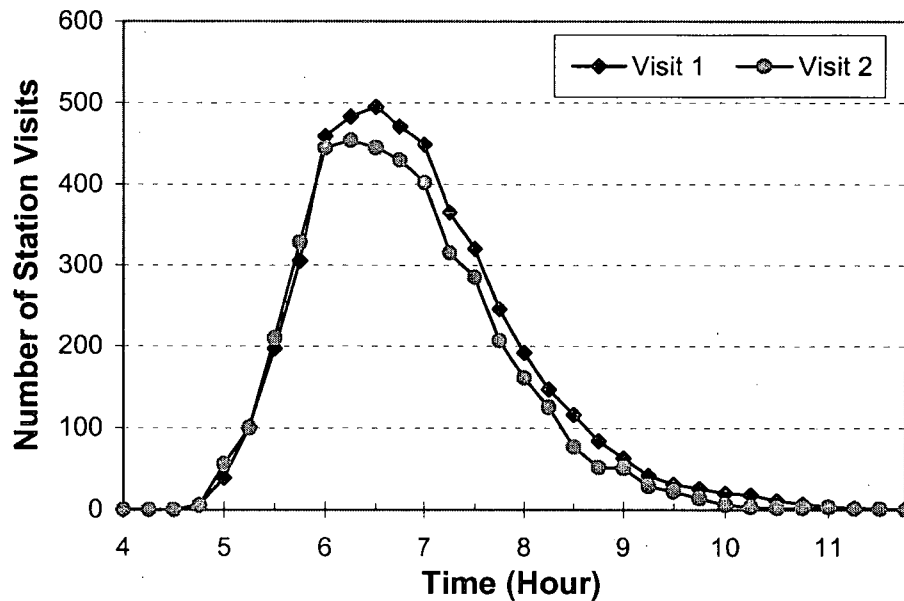


Figure 3: Distribution of visit times to FBMP stations 1987 to 1996 (visit 1: n=4705, visit 2: n=4233).

Descriptive Bird Results

Volunteers recorded a total of 181 bird species at the 298 sites included in this analysis: 158 within the BSE and 163 within the MWPE. The average number (and standard deviation) of species and individuals detected per site visit were 20 (± 7) and 62 (± 29), respectively. Sample sizes adequate to determine trend were achieved for 69 species. Table 1 summarises the occurrences of these species at FBMP sites, and provides an indication of the relative abundance of species. Red-eyed Vireo, Ovenbird, Eastern Wood-Pewee, American Robin, Blue Jay, Veery, Great Crested Flycatcher, Black-capped Chickadee, American Crow and Rose-breasted Grosbeak were the most frequently observed species and were all observed on more than half of site visits.

Table 1: Frequency of occurrence of species* on FBMP sites (n=2380 site visits).

Species	Occurrence (% of site visits)	Maximum Count	Average Count ¹
Ruffed Grouse	13	5	1.6
Mourning Dove	19	12	2.0
Black-billed Cuckoo	8	15	2.5
Yellow-billed Cuckoo	6	9	2.6
Ruby-throated Hummingbird	6	4	1.1
Yellow-bellied Sapsucker	34	12	2.4
Downy Woodpecker	29	10	1.8
Hairy Woodpecker	25	7	1.6
Northern Flicker	26	13	1.8
Pileated Woodpecker	21	7	1.5
Eastern Wood-Pewee	68	18	3.9
Least Flycatcher	30	20	4.5
Eastern Phoebe	6	8	1.4
Great Crested Flycatcher	61	18	2.8
Blue Jay	64	18	2.7
American Crow	57	31	3.4
Common Raven	12	15	2.3
Black-capped Chickadee	58	21	2.4
Red-breasted Nuthatch	25	19	2.0
White-breasted Nuthatch	29	9	1.8
Brown Creeper	20	9	1.8
House Wren	14	19	4.3
Winter Wren	34	10	2.2
Golden-crowned Kinglet	10	7	1.7
Blue-gray Gnatcatcher	4	6	1.8
Veery	62	20	3.9
Swainson's Thrush	18	16	3.2

Species	Occurrence (% of site visits)	Maximum Count	Average Count ¹
Hermit Thrush	34	18	3.1
Wood Thrush	41	19	2.9
American Robin	68	17	3.3
Gray Catbird	10	10	2.3
Cedar Waxwing	23	23	2.2
Blue-headed Vireo	10	6	1.5
Yellow-throated Vireo	5	5	1.5
Warbling Vireo	8	10	2.3
Red-eyed Vireo	90	32	7.1
Nashville Warbler	29	32	3.4
Yellow Warbler	11	23	4.9
Chestnut-sided Warbler	19	11	2.0
Magnolia Warbler	18	13	2.3
Black-throated Blue Warbler	28	10	2.6
Yellow-rumped Warbler	31	13	2.6
Black-throated Green Warbler	47	14	3.5
Blackburnian Warbler	27	14	2.8
Pine Warbler	18	13	2.6
Black-and-white Warbler	32	10	2.0
American Redstart	31	25	3.0
Ovenbird	86	36	8.3
Northern Waterthrush	26	16	2.8
Mourning Warbler	11	11	1.7
Common Yellowthroat	21	17	2.3
Canada Warbler	11	8	2.0
Scarlet Tanager	43	12	2.2
Northern Cardinal	17	15	3.5
Rose-breasted Grosbeak	51	12	2.7
Indigo Bunting	14	13	2.4
Eastern Towhee	7	18	2.3
Chipping Sparrow	25	14	3.1
Song Sparrow	21	22	2.4
Swamp Sparrow	7	15	2.4
White-throated Sparrow	31	21	3.8
Dark-eyed Junco	5	6	1.8
Red-winged Blackbird	16	20	2.7
Common Grackle	21	28	2.6
Brown-headed Cowbird	31	13	2.6
Baltimore Oriole	23	19	3.1
Purple Finch	10	4	1.4
American Goldfinch	23	12	2.0
Evening Grosbeak	9	11	2.1

* only species included in trend analysis

¹ site visits on which the species was present

FBMP Trends 1987-97

About 15 percent of the observations in the FBMP database did not satisfy the criteria for inclusion in the trend analysis, and were excluded. The most frequent problem was the lack of a second visit, followed by visits done outside the recommended time window. The dataset used in the trend analysis was based on visits to 298 sites over 11 years. There are more than two years of data on 167 sites, and more than four years of data on 84 sites. Sixty-nine species were present in sufficient numbers to perform the trend analysis when all years were included (Table 2). Approximately equal numbers of species were increasing or decreasing: 35 showed an increasing trend (11 significant), and 34 showed a decreasing trend (9 significant).

When simulations were run in Monitor, a greater number of sites were always required to detect negative trends relative to positive trends of the same magnitude, so values are reported only for negative trends. The program estimated that for each species there would be a 70 percent chance of detecting a 10 percent decrease, and a 25 percent chance of detecting a two percent decrease if 15 sites were monitored annually. If 50 sites, on which the species was detected, were monitored annually the program predicted a 100 percent chance of detecting a 10 percent decrease, and a 45 percent chance of detecting a two percent decrease; if the monitoring was done every second year the power dropped to 85 percent and 30 percent, respectively.

Of the species with adequate sample sizes, 21 (30%) were Edge species, 29 (42%) were forest Interior/Edge species, and 19 (28%) were forest Interior species. Table 3 summarises trends for the number of species within each of these groups. Of the species included in the trend analysis, 31 (45%) were Neotropical Migrants, 28 (41%) were Short Distance Migrants and 10 (14%) were Permanent Residents (Table 4). Chi-square tests ($p \leq 0.05$) revealed that there were no differences in number of species with increasing and decreasing trends by forest-use category when all species were considered, nor when just those species with significant trends were compared (Table 3). Similarly migration strategy did not exhibit any influence on the tendency of the population trend for a species to increase or decrease (Table 4).

Table 2: Trends of species detected at FBMP sites 1987 - 1997.

Species	n	Trend (%)	Sig. ¹	Confidence Interval	
				Lower (%)	Upper (%)
Ruffed Grouse	54	-1.3		-13.4	12.5
Mourning Dove	73	2.8		-11.6	19.4
Black-billed Cuckoo	23	3.8		-22.9	39.8
Yellow-billed Cuckoo	22	4.7		-9.3	20.8
Ruby-throated Hummingbird	17	18.1	**	-2.1	42.4
Yellow-bellied Sapsucker	88	4.8	**	0.8	8.9
Downy Woodpecker	99	-4.4		-12.8	4.8
Hairy Woodpecker	92	-2.4		-9.2	5.0
Northern Flicker	87	-9.2	***	-17.1	-0.5
Pileated Woodpecker	85	-5.4	*	-13.4	3.4
Eastern Wood-Pewee	163	-1.9		-5.7	2.1
Least Flycatcher	75	1.1		-7.7	10.7
Eastern Phoebe	22	0.2		-18.9	23.8
Great Crested Flycatcher	166	4.2	***	1.6	6.7
Blue Jay	181	1.4		-2.6	5.7
American Crow	155	1.5		-4.2	7.6
Common Raven	43	-4.0		-12.7	5.7
Black-capped Chickadee	169	-4.3	**	-8.0	-0.4
Red-breasted Nuthatch	82	7.9	*	-9.9	29.1
White-breasted Nuthatch	93	-3.0		-9.4	3.7
Brown Creeper	68	-5.5	*	-13.2	2.9
House Wren	40	-6.6	*	-19.3	8.0
Winter Wren	91	-3.3		-7.6	1.2
Golden-crowned Kinglet	30	-10.0	**	-20.3	1.7
Blue-gray Gnatcatcher	15	4.8		-11.6	24.4
Veery	148	2.2	*	-0.9	5.4
Swainson's Thrush	51	-4.2	*	-10.9	3.0
Hermit Thrush	95	1.5		-5.8	9.3
Wood Thrush	116	-1.3		-6.3	4.0
American Robin	178	-2.9	***	-5.9	0.3
Gray Catbird	38	-2.9		-16.0	12.3
Cedar Waxwing	76	-5.5		-15.0	5.0
Blue-headed Vireo	27	4.6		-8.1	19.1
Yellow-throated Vireo	16	-5.9		-18.8	9.1
Warbling Vireo	26	-4.0		-14.8	8.3
Red-eyed Vireo	202	2.5	**	0.0	5.0
Nashville Warbler	94	-1.6		-7.5	4.6
Yellow Warbler	29	15.1	***	6.9	23.9
Chestnut-sided Warbler	56	-0.2		-9.0	9.5
Magnolia Warbler	52	1.0		-6.1	8.6
Black-throated Blue Warbler	71	4.4		-1.5	10.6
Yellow-rumped Warbler	84	1.9		-3.9	8.1
Black-throated Green Warbler	103	-0.2		-3.0	2.8
Blackburnian Warbler	73	-2.2		-6.8	2.7
Pine Warbler	48	6.0		-1.8	14.4
Black-and-white Warbler	86	2.4		-4.6	9.9

Species	n	Trend (%)	Sig. ¹	Confidence Interval	
				Lower (%)	Upper (%)
American Redstart	88	7.6	***	0.7	14.9
Ovenbird	192	-0.6		0.6	-1.7
Northern Waterthrush	71	4.1		-3.7	12.5
Mourning Warbler	36	-7.2		-23.1	12.0
Common Yellowthroat	64	-2.3		-10.8	7.0
Canada Warbler	30	-2.1		-14.3	11.7
Scarlet Tanager	115	-0.4		-9.4	9.5
Northern Cardinal	56	8.3	***	0.7	16.4
Rose-breasted Grosbeak	133	-0.9		-4.2	2.5
Indigo Bunting	47	3.4		-9.9	18.7
Eastern Towhee	22	-3.9		-19.7	15.0
Chipping Sparrow	71	0.2		-6.1	7.0
Song Sparrow	57	-12.9	***	-23.1	-1.4
Swamp Sparrow	17	2.7		-9.8	17.1
White-throated Sparrow	88	-1.6		-6.5	3.5
Dark-eyed Junco	17	-11.1		-35.8	23.2
Red-winged Blackbird	51	4.8		-11.0	23.5
Common Grackle	75	5.6	*	-4.3	16.5
Brown-headed Cowbird	86	1.2		-5.2	8.0
Baltimore Oriole	71	3.5		-3.3	10.7
Purple Finch	41	11.1	**	1.8	21.2
American Goldfinch	82	3.0		-6.9	14.0
Evening Grosbeak	33	12.4		-4.4	32.0

1. ***: $p \leq 0.05$, **: $0.05 < p \leq 0.1$, *: $0.1 < p \leq 0.2$

Table 3: Number of species in each forest-use category showing increasing and decreasing trend.

	Interior		Edge		Interior/Edge	
	All species	Sig. Sp.	All Species	Sig. Sp.	All Species	Sig. Sp.
Increasing	7	2	12	3	16	6
Decreasing	12	4	9	3	13	2
Chi-square probability	0.25	0.41	0.51	1.0	0.58	0.16

Table 4: Number of species in each migration category showing increasing and decreasing trend.

	Permanent Resident		Short Distance Migrant		Neotropical Migrant	
	All species	Sig. Sp.	All Species	Sig. Sp.	All Species	Sig. Sp.
Increasing	3	2	16	3	16	6
Decreasing	7	2	12	6	15	1
Chi-square probability	0.21	1.0	0.45	0.32	0.86	0.06

A trend analysis was also performed at the ecozone level, and these results were tabulated for the same 69 species as the overall analysis: sample sizes were adequate for 53 species in each ecozone (Table 5). Chi-square tests ($p \leq 0.05$) revealed that there were no differences in number of species with increasing and decreasing trends when all species were considered, nor when just those species with significant trends were compared (Table 6).

Table 5: Trends of Forest Bird Monitoring Program species detected at sites in the Boreal Shield and Mixedwood Plains Ecozones.

Species	Boreal Ecozone					Mixedwood Plains Ecozone				
	n	Trend (%)	Sig. ¹	Confidence Interval		n	Trend	Sig. ¹	Confidence Interval	
				Lower (%)	Upper (%)				Lower (%)	Upper (%)
Ruffed Grouse	32	-3.4		-19.7	16.3	22	0.8		-13.3	17.3
Mourning Dove						62	2.7		-14.8	23.9
Yellow-billed Cuckoo						18	6.7		-9.6	26.0
Yellow-bellied Sapsucker	61	4.9	**	0.0	10.1	27	7.9		-6.9	25.0
Downy Woodpecker	29	-1.6		-15.4	14.4	70	-5.5		-13.1	2.7
Hairy Woodpecker	47	-4.0		-14.2	7.5	45	-2.0		-16.1	14.5
Northern Flicker	33	2.5		-9.7	16.3	54	-13.2	***	-22.4	-2.8
Pileated Woodpecker	50	0.0		-11.5	12.9	35	-5.2		-22.2	15.5
Eastern Wood-Pewee	56	-3.7	**	-7.9	0.7	107	-1.1		-6.0	4.0
Least Flycatcher	49	-1.4		-8.4	6.0	26	6.1		-17.3	36.0
Great Crested Flycatcher	60	4.7	**	-2.0	11.8	106	4.7	**	1.2	8.2
Blue Jay	74	1.8		-9.0	13.9	107	0.8		-3.3	5.1
American Crow	53	1.5		-3.7	7.0	102	1.8		-3.8	7.8
Common Raven	41	-3.5		-13.1	7.2					
Black-capped Chickadee	78	-4.3		-11.2	3.1	91	-4.9	**	-10.8	1.5
Red-breasted Nuthatch	60	-1.3		-11.1	9.6	22	11.5		-9.0	36.7
White-breasted Nuthatch	33	8.0	*	-0.4	17.2	60	-6.0		-12.3	0.8
Brown Creeper	44	-5.8	*	-14.2	3.5	24	-4.2		-19.2	13.5
House Wren						36	-6.8	*	-21.1	9.9
Winter Wren	52	-4.7	**	-10.4	1.3	39	-1.9		-12.6	10.0
Golden-crowned Kinglet	28	-10.8	**	-21.5	1.5					
Blue-gray Gnatcatcher						15	4.8		-11.6	24.4
Veery	70	0.4		-5.4	6.6	78	2.4		-2.8	7.9
Swainson's Thrush	47	-3.3		-8.7	2.5					
Hermit Thrush	71	-0.7		-5.8	4.8	24	8.0		-7.2	25.7
Wood Thrush	25	4.0		-10.5	21.0	91	-1.7		-6.7	3.7

Species	Boreal Ecozone					Mixedwood Plains Ecozone				
	n	Trend (%)	Sig. ¹	Confidence Interval		n	Trend	Sig. ¹	Confidence Interval	
				Lower (%)	Upper (%)				Lower (%)	Upper (%)
American Robin	68	4.3		-4.4	13.7	110	-5.3	***	-8.6	-1.9
Gray Catbird						31	-2.0		-17.6	16.6
Cedar Waxwing	34	-7.1		-18.9	6.3	42	-2.2		-13.0	9.9
Blue-headed Vireo	22	4.0		-10.3	20.7					
Warbling Vireo						19	-5.2		-21.2	14.1
Red-eyed Vireo	91	3.1	***	-0.1	6.5	111	2.0		-0.9	5.0
Nashville Warbler	66	-2.5		-8.6	4.0	28	3.1		-15.7	26.2
Yellow Warbler						21	19.5	***	6.8	33.7
Chestnut-sided Warbler	42	4.5		-6.7	17.0					
Magnolia Warbler	43	1.7		-5.7	9.8					
Black-throated Blue Warbler	56	2.6		-2.5	8.0	15	15.5		-8.1	45.1
Yellow-rumped Warbler	67	-1.3		-1.7	18.3	17	9.0		-14.4	38.9
Black-throated Green Warbler	61	-0.8		-3.9	2.4	42	1.2		-6.5	9.6
Blackburnian Warbler	60	-2.4		-6.9	2.3					
Pine Warbler	29	9.3	*	-2.9	23.0	19	1.9		-6.3	10.7
Black-and-white Warbler	57	3.1		-3.5	10.2	29	1.2		-10.8	14.8
American Redstart	42	4.2		-2.0	10.7	46	9.2	**	-1.4	21.0
Ovenbird	91	-1.5	*	-4.2	1.4	101	0.3		-4.9	5.7
Northern Waterthrush	32	7.6	**	0.6	15.1	39	-0.4		-10.2	10.4
Mourning Warbler	20	-1.0		-28.1	36.3	16	-12.8		-31.9	11.7
Common Yellowthroat	21	-0.1		-11.3	12.5	43	-3.0		-13.5	8.7
Canada Warbler	24	-1.7		-15.3	14.0					
Scarlet Tanager	44	-1.9		-9.2	6.0	71	0.3		-12.1	14.5
Northern Cardinal						54	8.8	***	0.9	17.3
Rose-breasted Grosbeak	52	2.6		-4.9	10.7	81	-1.6		-6.1	3.1
Indigo Bunting						40	1.7		-11.2	16.5
Eastern Towhee						17	-10.6	*	-33.1	19.5
Chipping Sparrow	41	7.2	*	-2.2	17.6	30	-5.4	**	-11.2	0.8
Song Sparrow	19	1.9		-6.4	11.0	38	-16.8	***	-28.4	-3.3
White-throated Sparrow	59	-1.1		-6.8	4.9	29	-3.9		-16.0	10.0

Species	Boreal Ecozone					Mixedwood Plains Ecozone				
	n	Trend (%)	Sig. ¹	Confidence Interval		n	Trend	Sig. ¹	Confidence Interval	
				Lower (%)	Upper (%)				Lower (%)	Upper (%)
Dark-eyed Junco	17	-11.1		-35.8	23.2					
Red-winged Blackbird	16	5.4		-5.8	18.0	35	5.9		-9.8	24.3
Common Grackle	17	3.7		-10.4	19.9	58	4.5		-4.0	13.7
Brown-headed Cowbird	21	-1.1		-11.9	11.1	65	2.0		-6.6	11.4
Baltimore Oriole						61	3.7	*	-2.6	10.4
Purple Finch	35	8.1		-6.6	25.1					
American Goldfinch	22	0.7		-8.6	11.0	60	5.7		-8.4	21.9
Evening Grosbeak	32	12.3		-4.5	32.0					

1. ***: $p \leq 0.05$, **: $0.05 < p \leq 0.1$, *: $0.1 < p \leq 0.2$

* only species included in trend analysis (there were insufficient numbers of Black-billed Cuckoo, Eastern Phoebe, Ruby-throated Hummingbird, Swamp Sparrow, and Yellow-throated Vireo to run the analysis at the ecozone level)

Table 6. Number of species increasing and decreasing in Boreal Shield and Mixedwood Plains Ecozones.

	Boreal Ecozone		Mixedwood Plains	
	All Species	Significant Sp.	All Species	Significant Sp.
Increasing	27	7	30	7
Decreasing	26	5	23	5
Chi-square probability	0.89	0.56	0.34	0.56

Discussion

Setting up and managing a project of this type is challenging, and we are very pleased with the development of the Forest Bird Monitoring Program. We have a broad range of sites across the province and a dedicated group of volunteers. There are 16 volunteers (out of the 68 that started in 1987 or 1988) that have contributed at least ten years of data. This level of commitment is impressive and essential if we are to achieve our goals. The primary goal of examining the habitat associations of forest birds has required considerable ground work. Soon there will be 200 sites with vegetation data, at least three years of bird surveys, and a precise geographic location obtained using GPS.

We are approaching our secondary goals of describing changes in the populations of forest birds over time with caution. Due to the nature of the program the sites are selected rather than randomly located throughout the province. This imposes statistical constraints because the biases involved in selecting them may have resulted in a sample which is not necessarily representative of the forest types available. Once the vegetation information from the sites has been summarised and adequate information on the distribution and abundance of different forest types on the landscape has been obtained, we can assess how well the FBMP sites represent the provincial forests. Until that time, however, we assume that any trend analysis is applicable only to the sites that the data were collected from. Therefore the trend results reported in this paper provide a baseline of population changes on FBMP sites, which are located within larger, fairly mature, unmanaged woodlands.

The FBMP is designed primarily to provide information on forest interior birds, and from 1987-1997 adequate sample sizes were obtained to determine trends for 19 forest Interior species. However, because forest Interior/Edge species are found throughout the forest they are also well represented on FBMP stations, and adequate sample sizes were obtained for 29 species. Trends for 21 Edge species were also obtained. The presence of Edge species on 'interior' forest sites likely indicates that some stations are closer to forest edge than would be optimal, or that Edge species are using small forest openings within the forest interior. It probably also indicates that categorisations such as Interior and Edge species are convenient for some purposes, but do not fully reflect the variety of ways in which birds use forest habitat. Six of the ten most common species on FBMP plots are Interior/Edge species, two are Edge (American Robin, American Crow) and two are Interior (Ovenbird and Veery).

Trends determined by FBMP represent the trends on FBMP sites which are primarily in interior areas of large, fairly mature, unmanaged forests. FBMP trends are more likely to represent the provincial population trends of forest interior species than they are Interior/Edge or Edge species, a larger proportion of whose populations occur in habitats not covered by FBMP.

The relationship between FBMP and BBS is complementary. However, the optimal manner of combining and interpreting the trends obtained from the two programs to better understand the dynamics of forest bird populations is still under investigation. Breeding Bird Survey routes go through forest, and virtually all the species covered by FBMP are detected frequently enough on BBS routes to calculate a trend. One exception in the current analysis is the Blue-gray Gnatcatcher. The Forest Bird Monitoring Program monitors forest interior species in relatively stable patches of their prime habitat. The Breeding Bird Survey obtains a more general trend that incorporates populations in peripheral and prime habitat as well as populations that are changing as habitat changes. The Forest Bird Monitoring Program may be more effective at monitoring Interior species with faint voices like Brown Creeper and Golden-crowned Kinglet as the observer standing at the roadside is usually not close enough to hear them.

Observer effects are often cited as a major concern when estimating trends for BBS (*Peterjohn et al.* 1995, Link & Sauer 1997, Link & Sauer 1998). Effects such as lower than expected counts in the first year of an observer's adoption of a route (Kendall *et al.* 1996) and that new recruits tend to count more individuals and species than the observers they replace (Sauer *et al.* 1994) result in artificially positive trends. Both of these effects are of less concern in the FBMP for three reasons: 1. The rate of observer turnover is lower (the program is 'younger' and sites tend to be dropped rather than passed on to another observer); 2. The first-year effect should be less with five ten-minute counts than it is with BBS' 50 three minute counts; and, 3. This program started when the general expertise of birders had already grown, and many of the FBMP volunteers have had

experience with BBS. Researchers have also noted that there are declines in counts associated with hearing loss as observers age (Kendall et al 1996, Link & Sauer 1997), which results in artificially negative trends, especially for species with high frequency calls. The relevance of this to FBMP is under investigation.

In 1997, CWS introduced a new component called Streamlined FBMP where relatively inexperienced volunteers adopt a site ($n=11$ for 1997), undertake training and testing using taped vocalisations, and survey a limited number of readily identified species (12 or 13, depending upon location). This data will be analysed to compare trends for these species with experienced volunteers, and we will investigate how best to have volunteers progress to covering full sites.

From the distribution of FBMP sites on Figure 1, it is clear that any FBMP analyses has the potential to be pertinent to the Mixedwood Plains Ecozone (MWPE) and the southern portion of the Boreal Shield Ecozone (BSE), but not to the northern portion of the BSE. This is true of all volunteer-based landbird monitoring programs in the province except for migration monitoring, and is the result of the very uneven distribution of the human population. Together with Ministry of Natural Resources staff, CWS is working to increase the number of sites in the northern part of the province.

For the trend analysis a significance (α) level of 0.2 was selected rather than the conventional 0.05. The reason for this selection lies in our goals. In most experimental situations if a statement is made that there is a "statistically significant difference" between or among the things being compared it is important to be very confident that what one says is happening in fact is. When monitoring populations (rather than running experiments on populations), there are different motivations. It is essential that no important changes in populations are missed because the standards for detecting trends have been set too high (by setting the α level too low). Consequently, the penalty of potentially being wrong 20 percent of the time in our statements regarding the presence of "significant change" is a risk we are willing to take so that other 'true' trends can be detected earlier. It also easier and more effective to implement conservation actions when a species is in decline rather than endangered. If the α levels are set too low, there is a risk of not detecting changes until they are critical, especially if the power of the surveys is sub-optimal.

Brian Collins, a statistician with Canadian Wildlife Service Headquarters will soon be evaluating the power of the BBS using the Estimating Equations technique, and has agreed to assist in the assessment of the FBMP. The results of the power analysis that have been done using Monitor suggest that the sample sizes used in these trend analyses (15 or more sites) are appropriate.

There were no clear patterns discernible in trend direction either when all sites were pooled or when sites were attributed to ecozone. Similarly, approximately equal numbers of species were determined to be increasing and decreasing (both significantly and overall) across migration strategy and habitat use classifications. The relatively high number of significant trends (20/69) is somewhat surprising given the size, maturity and relative stability of the forest stands containing FBMP sites, but is reassuring in that it is indirect evidence that the program has sufficient power to detect trends.

Four Interior species (Pileated Woodpecker, Brown Creeper, Golden-crowned Kinglet and Swainson's Thrush) showed significant declines. Because FBMP sites generally represent core habitat for interior species, these declines warrant additional investigation. Of the four species, one is a Permanent Resident, two are Short-distance Migrants and one is a Neotropical Migrant, suggesting that a variety of causes might be involved in the declines. The sharp decline of the Golden-crowned Kinglet (-10%, $p < 0.1$) is particularly notable. Because of the high frequency of the song of the Golden-crowned Kinglet we are also investigating the effect of age of observer on the trend for this species.

Two other species showed sharp negative trends in the overall analysis: Northern Flicker (-9.2%, $p < 0.05$), and Song Sparrow (-12.9, $p < 0.05$). For both species this trend was limited to the sites in the Mixedwood Plains Ecozone, where they also showed highly significant negative trends. These species are widespread across a variety of forest and edge habitats, so their decline on FBMP sites may or may not be representative of a broader decline.

Although this report is restricted to a discussion of forest bird population trends, the FBMP will also provide quantitative information on habitat use of forest birds. Habitat associations will be determined in the near future using both vegetation (species composition and structure) and landscape characteristics (e.g., size, shape, degree of connectedness and isolation of woodlands). A habitat-specific baseline inventory will allow us to generate habitat-association profiles that are regionally accurate. These profiles can then be provided to forest managers for consideration in forest management planning. These data will also be used for investigations within habitat type. Any efforts to compare between habitats will be approached with caution as biases in detection of bird vocalisations among different forested habitats has been shown very clearly (Schiek 1997).

By combining these habitat data with trend analyses, we will investigate the effects of habitat on species trend and thereby provide insight into the relative importance of various habitats for each species, and perhaps into the dynamics of significant population declines of forest birds.

Acknowledgements

This program would not be possible without the contribution of time and expertise by volunteers, for whose efforts we are greatly indebted. Volunteer observers are listed in Appendix A. Special thanks also to landowners who permit access to their properties, and to the Ontario Ministry of Natural Resources, Heritage Canada and Conservation Authorities for permission to establish and run sites in their parks and conservation areas. Jarmo Jalava and Reinder Westerhoff helped set up new sites. Sharon Bradford provided timely administrative assistance. Numerous Canadian Wildlife Service staff and contractors have made significant contributions to the program: Barbara Campbell, Rosalind Chaundy, Sandy Dobbyn, Don Fillman, Dawn Phillips, Susan Hammond, Jon McCracken, Chris Michener, Annette Page, Chris Spytz, Richard Russell, John Haselmayer, John Pedlar, Don Sutherland, Lisa Venier, John Woodcock, and Valerie Wyatt. Sylvia Esterby and Brian Collins provided statistical advice, and Brian provided a customized copy of the BBS Estimating Equations program. Peter Blancher, Brian Collins, Connie Downes, Erica Dunn, Don Fillman, David Hussell and Valerie Wyatt provided comments on an earlier version of this report. We also acknowledge the contributions of the Federation of Ontario Naturalists and Long Point Bird Observatory.

Literature Cited

- Austen, M.J.W., M.D. Cadman & R.D. James. **1994**. Ontario birds at risk: status and conservation needs. Federation of Ontario Naturalists and Long Point Bird Observatory. Don Mills, Ontario.
- Blondel, J., C. Ferry, & B. Frochot. **1970**. La méthode des indices ponctuels d'abondance (I.P.A.) ou des relevés d'avifaune par stations d'écoute. *Alauda* 38: 55-71.
- Blondel, J., C. Ferry, & B. Frochot. **1981**. Point counts with unlimited distance. *Studies in Avian Biology* 6: 414-420.
- Cadman, M.D. **1994**. Cooperative studies in Ontario Ornithology. Pp. 150-161, In, *Ornithology in Ontario*. M.K. McNicholl and J.L. Cranmer-Byng. Special publication No. 1., Ontario Field Ornithologists, Burlington, Ontario.
- Cadman, M. **1995**. The Ontario landbird monitoring strategy: improving our ability to conserve the province's birds. *Wildlife Watchers Report on Monitoring*, Issue 1, February 1995. Environment Canada, Ontario Region, Guelph.
- Cadman, M.D., P.F.J. Eagles, & F.M. Helleiner. **1987**. *Atlas of the breeding birds of Ontario*. Waterloo, Ontario: University of Waterloo Press. 617 pp.
- Canadian Landbird Conservation Working Group. **1996**. *Framework for landbird conservation in Canada - Partners in Flight*. Canadian Landbird Conservation Working Group. Hull, Quebec. 23pp.

- Canadian Wildlife Service, Migratory Bird Population Division **1994**. Canadian landbird monitoring strategy. Unpublished Report, 13 pp.
- Cheskey, E.D. **1995**. Towards conserving the birds of Ontario. A discussion document for Federation of Ontario Naturalists, Long Point Bird Observatory, Canadian Wildlife Service and Ministry of Natural Resources. Federation of Ontario Naturalists. 48 pp.
- Collins, B.T. **1997**. A program to analyse Forest Bird Monitoring Program data for trends. User guide and documentation. Unpublished Report. 18 pp.
- Downes, C.M., & B.T. Collins. **1996**. The Canadian Breeding Bird Survey, 1966-1994. Canadian Wildlife Service. Progress Note. 210, 36 pp.
- Ecological Stratification Working Group. **1996**. A national ecological framework for Canada: terrestrial ecozones and ecoregions of Canada. Report and national map at 1:7,500,000 scale. Centre for Land and Biological Resources Research, Research Branch, Agriculture and AgriFood Canada, Ottawa; and Ecozone Analysis Branch, State of Environment Directorate, Environment Canada, Hull.
- Environment Canada. **1995**. Canadian biodiversity strategy: Canada's response to the convention on biological diversity. Biodiversity Convention Office, Environment Canada. 80 pp.
- Freemark, K.E., & B. Collins. **1992**. Landscape ecology of birds breeding in temperate forest fragments. pp. 443-454 In: J.M.I. Hagan & D.W. Johnston (Eds.), *Ecology and Conservation of Neotropical Migrant Landbirds*. Washington: Smithsonian Institution Press.
- James, F.C., C.E. McCulloch, & L.E. Wolfe. **1990**. Methodological issues in the estimation of trends in bird populations with an example: the Pine Warbler. pp. 84-97 In: Sauer, J.R. & S. Droege (Eds.) *Survey Designs and Statistical Methods for the Estimation of Avian Population Trends*. U.S. Fish Wildl. Serv., Biol. Rep. 90(1). 166 pp.
- James, F.C., C.E. McCullough, & D.A. Wiedenfeld. **1996**. New approaches to the analysis of population trends in land birds. *Ecology* 77: 13-27.
- Kendall, W.L., B.G. Peterjohn, & J.R. Sauer. **1996**. First-time observer effects in the North American Breeding Bird Survey. *Auk* 113: 13-21.
- Link, W.A., & J.R. Sauer. **1994**. Estimating equations estimates of trends. *Bird Populations* 2: 23-32.
- Link, W.A., & J.R. Sauer. **1997a**. Estimation of population trajectories from count data. *Biometrics* 53: 63-72.
- Link, W.A., & J.R. Sauer. **1997b**. New approaches to the analysis of population trends in land birds: Comment. *Ecology* 78: 2632-2634.
- Link, W.A., & J.R. Sauer. **1998**. Estimating population change from count data: Application to the North American Breeding Bird Survey. *Ecological Applications* 8: 258-268.
- Long Point Bird Observatory & Environment Canada. **1997**. Marsh Monitoring Program training kit and instructions for surveying marsh birds, amphibians and their habitats. Revised Edition. Long Point Bird Observatory and Environment Canada. 40 pp.
- Peterjohn, B.G., J.R. Sauer, & C.S. Robbins. **1995**. Population trends from the North American Breeding Bird Survey. In T.E. Martin & D. Finch (Eds.), *Ecology and management of*

- Neotropical migratory birds: A synthesis and review of the critical issues. (pp. 3-39). Oxford, U.K. Oxford University Press.
- Ralph, C.J. & J.M. Scott. **1981**. Estimating numbers of terrestrial birds. *Studies in Avian Biology* 6.
- Ralph, C.J., J.R. Sauer, & S. Droege. **1995**. Monitoring bird populations by point counts. Gen. Tech. Rep. PSW-GTR-149, Albany, California: Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture; 181 pp.
- Ralph, C.J., J.R. Sauer, & S. Droege. **1995**. Managing and monitoring birds using point counts: Standards and applications. pp. 161-168 In: Ralph, C.J., J.R. Sauer, & S. Droege (Eds.) *Monitoring Bird Populations by Point Counts*. Gen. Tech. Rep. PSW-GTR-149, Albany, California: Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture; 181 pp.
- Riley, J.L. and P. Mohr. **1994**. The natural heritage of southern Ontario's settled landscapes. Ontario Ministry of Natural Resources, Southern Region, Science and Technology Transfer, Technical Report TR-001, Aurora, Ontario.
- Robbins, C.S. **1981a**. Bird activity levels related to weather. In: Ralph, C.J., J.M. Scott, (Eds.) *Studies in Avian Biology* 6: 301-310.
- Robbins, C.S. **1981b**. Effect of time of day on bird activity. In: Ralph, C.J. & J.M. Scott eds. *Studies in Avian Biology* 6: 275-286.
- Sauer, J.R. & S. Droege (Eds.) **1990**. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish Wildl. Serv., Biol. Rep. 90(1). 166 pp.
- Sauer, J.R., B.G. Peterjohn, & W.A. Link. **1994**. Observer differences in the North American breeding bird survey. *The Auk* 111: 50-62.
- Schiek, J. **1997**. Biased detection of bird vocalizations affects comparisons of bird abundance among forested habitats. *The Condor* 99: 179-190.
- Thomas, L. **1996**. Monitoring long-term population change: Why are there so many analysis methods? *Ecology* 77: 49-58.
- Verner, J. **1985**. Assessment of counting techniques. *Current Ornithology* 2: 247-302.
- Villard, M.-A. & B.A. Mauer. **1996**. Geostatistics as a tool for examining hypothesized declines in migratory songbirds. *Ecology* 77(1): 59-68.
- Wallace, G.E. **1990**. Songbird monitoring and conservation research in Canada: The current situation. Unpublished Report for the Canadian Wildlife Service, Environment Canada. 44 pp.
- Welsh, D.A.. **1995**. An overview of the Forest Bird Monitoring Program in Ontario, Canada. pp. 93-97 In: Ralph, C.J., J.R. Sauer, & S. Droege (Eds.) *Monitoring bird populations by point counts*. Gen. Tech. Rep. PSW-GTR-149, Albany, California: Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture; 181 pp.

**Appendix A: Forest Bird Monitoring Program Volunteers 1987-1997
at Full (F) and Streamlined (S) Sites.**

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
Alfred Adamo	424	Sassafras Woods	F	1997	1
Ted Armstrong	268	Chippewa Mixedwoods	F	1988	1
"	284	Northwood Poplar	F	1988	1
Barry Atkinson	266	Cascades Conservation Area	F	1989	3
Madeline Austen	201	Frontenac 3	F	1992	5
"	202	Frontenac 2	F	1992	5
Dennis Barry	279	Minden Sugar Bush	F	1987	11
Chris Bell	121	Manitoulin Maple	F	1987	9
Gordon Bellerby	241	Niagara Oak Grove	F	1988	3
Sylvia Biribauer	355	Hockley Valley	F	1997	1
"	426	Westheuser Woods	F	1997	1
Richard Blacquiere	3	Murphys Point 3	F	1992	5
Peter Blancher	204	Mill Of Kintail Maple	F	1992	6
John Blaney	205	Salmon River Alvar	F	1993	2
"	206	Stoco Fen	F	1993	2
Ray Blower	430	Limehouse	S	1997	1
Mike Bouman	412	Bickford Woods	F	1995	2
Jacques Bouvier	36	Shaw Woods	F	1987	5
"	207	Carillon Provincial Park	F	1993	5
Greg Boxwell	208	Sparks Wood	F	1993	2
Michael Bradstreet	84	Spooky Hollow	F	1994	2
David Bree	5	Bon Echo 1 Shield Trail	F	1992	6
"	6	Bon Echo 2 Hemlock Hardwoods	F	1992	6
"	8	Bon Echo 4 Rocky Birch	F	1992	6
"	9	Bon Echo 7 Essen Lake	F	1993	5
Dawn Brenner	141	Sibley 124	F	1992	1
"	142	Sibley 121	F	1992	1
"	143	Sibley 9N	F	1992	1
"	145	Sibley 99	F	1992	1
"	148	Sibley 77	F	1992	1
"	149	Sibley 9S	F	1992	1
George Bryant	210	South Pine Lake Gravenhurst	F	1993	5
Mike Cadman	211	Badenoch Swamp	F	1992	5
"	212	Arkell Hills	F	1989	5
"	320	Pretty River Southwest	F	1994	1
"	321	Pretty River Valley	F	1994	1
Fred Caloren	109	Lammermoor Mixed Forest	F	1993	5
John Cartwright	178	Skunks Misery North	F	1993	1
"	179	Skunks Misery South	F	1993	1
"	234	Alfred Bog 234	F	1996	2
"	235	Alfred Bog 235	F	1996	2
David Cattrall	175	Wasaga Beach Red Oak	F	1993	4
Ted Cheskey	289	Purple Valley	F	1988	6
"	293	Smokey Head	F	1987	9
Caryl Clark	213	PNFI Pine	F	1993	1
Will Clark	214	PNFI Mixed	F	1993	1
Gary Clay	20	Richmond Wood	F	1987	7

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
Scott Connop	291	Skunks Misery	F	1987	2
Frank Connor	292	Skycroft Maple Forest	F	1988	1
Carl Cooper	31	Maple Yellow Birch	F	1990	1
"	91	Piney Wood Trail	F	1991	2
"	215	Gogama Unit Road	F	1993	1
Tom Cosburn	361	Hilton Falls East	F	1995	3
"	362	Hilton Falls Central	F	1995	3
Rob Crawford	400	Bond Tract	F	1996	2
Bill Crins	110	Arrowhead Hardwoods	F	1993	5
Dorothy Cryslar	255	Kolapore Highlands	F	1989	4
"	270	Epping Swamp	F	1989	2
Robyn Cunningham	269	Claybelt Black Spruce	F	1988	1
Ken Dance	417	Happy Valley	F	1987	1
Ian Davidson	415	Clayton	F	1987	1
Mike Dawdy	179	Skunks Misery South	F	1995	2
Robin Dawes	411	Farabout Peninsula	F	1996	1
Marc Demers	50	North Land	F	1990	1
"	51	Golf Woods	F	1991	4
Bonnie Devillers	386	Georgian Water Forest	F	1995	3
Joanne Dewey	337	Sandbanks Deciduous	F	1994	4
"	338	Sandbanks Plantation	F	1994	4
Al Dextrase	18	Sioux Lookout Balsam	F	1991	2
"	19	Sioux Lookout White Pine	F	1991	2
"	274	Ignace Jack Pine	F	1990	1
"	275	Ignace Red Pine	F	1990	1
Rob Dobos	182	Beverly Swamp	F	1993	3
Gerry Doekes	319	Terra Cotta	F	1996	2
Joan Donnelly	397	Glen Haffy Conservation	F	1995	3
Connie Downes	2	Murphys Point Red Oak	F	1994	3
Bruce Duncan	81	Dundas Valley Martins Road	F	1989	8
"	82	Dundas Valley Merrick	F	1989	8
Erica Dunn	10	Bon Echo 5 Lower Mazinaw	F	1996	2
"	12	Bon Echo 8 Open Oak	F	1997	1
Paul Eagles	264	Branchton Woods	F	1988	4
Chris Earley	334	Guelph Arboretum	F	1994	4
Tony Edwards	341	Noisy River	F	1994	3
Chris Ellingwood	35	Innis Point	F	1987	3
"	429	Ken Reid Conservation	F	1997	1
Nancy Elliot	160	Pinery 160	F	1993	1
Daniel Entz	342	Yellowthroat Lowland	F	1994	4
Nick Escott	128	Sibley White Pines	F	1987	4
"	151	Northwood Bog	F	1987	11
Dave Euler	304	Shore Ridges	F	1993	4
Nancy Evans	391	Baldwin Pond Woods	F	1995	1
Bruce Falls	27	Canisbay Hardwoods	F	1987	1
"	218	Hardwood Ridge	F	1990	8
"	219	Swamp Forest	F	1990	8
Jennifer Fay	336	Helenbar 1	F	1995	1
David Fidler	192	Dorcas Bay 192	F	1994	3
"	196	Emmett Lake 196	F	1994	3

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
"	197	St. Edmunds 197	F	1994	3
"	198	St. Edmunds 198	F	1994	3
"	199	St. Edmunds 199	F	1994	3
Don Fillman	62	Barron Canyon Trail	F	1989	5
"	63	Achray Cn Pw	F	1989	5
"	64	Achray He Ce By Bd	F	1989	5
"	65	Achray Pw	F	1989	1
"	66	Achray Pw 1	F	1991	3
"	67	Achray Pw 2	F	1991	1
"	68	Barron Canyon Main Rd	F	1989	5
"	69	Basin Lake Pw	F	1989	6
"	70	Basin Road Pj	F	1989	5
"	71	Bonnechere Ce Swamp	F	1989	1
"	72	Bonnechere Pw	F	1989	6
"	73	Centenial Bd Creek	F	1989	5
"	74	Centenial R Oak Ridge	F	1989	5
"	75	Corner Strip Cut C	F	1991	1
"	76	Dickson 453	F	1992	2
"	77	Dickson 454	F	1992	2
"	306	Frenches Island	F	1989	5
"	307	Indian Point XMh Be	F	1989	5
"	308	Sharp Curve B	F	1991	1
"	309	Spoor Lake D	F	1991	1
"	310	Turners Island	F	1989	5
"	311	Westmeath Ms Swamp	F	1989	6
"	312	Westmeath Red Pine A	F	1989	6
"	313	Westmeath Red Pine B	F	1989	6
Manson Fleguel	36	Shaw Woods	F	1992	6
James Forrest	170	Wasaga Oak Pine	F	1993	5
"	174	Wasaga Red Pine	F	1993	5
Roy Forrester	384	Ganaraska 1	F	1995	2
Richard Frank	431	Arkell Springs	S	1997	1
Katherine Freemark	37	Renfrew Mixed	F	1988	10
"	38	Lochwinnoch	F	1988	10
Mary Gartshore	92	Rondeau 92	F	1991	2
"	93	Rondeau 93	F	1991	2
"	94	Rondeau 94	F	1991	2
"	95	Rondeau 95	F	1991	2
"	96	Rondeau 96	F	1991	2
"	97	Rondeau 97	F	1991	2
"	98	Rondeau 98	F	1991	2
"	99	Rondeau 99	F	1991	2
"	100	Rondeau 100	F	1991	2
"	101	Rondeau 101	F	1991	2
"	102	Rondeau 102	F	1991	2
"	103	Rondeau 103	F	1991	2
"	104	Rondeau 104	F	1991	2
"	105	Rondeau 105	F	1991	2
"	106	Rondeau 106	F	1991	2
"	303	Wilson Tract	F	1987	6

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
"	421	Sulphur Creek Forest	F	1987	1
Don Graham	294	Springwater 1	F	1988	2
Sue Greenwood	108	Pointe Aux Pins	F	1989	9
Stew Hamill	423	Deercross Farm	F	1997	1
Lynn Hardy	209	PNFI Tolerant Hardwoods	F	1993	2
Paul Harpley	391	Baldwin Pond Woods	F	1997	1
Al Harris	220	Hawkeye Lake	F	1987	11
"	221	Argon East Of Access Road	F	1992	5
"	258	Argon West Of Access Road	F	1992	2
David Hawke	238	Big Chute 238	F	1993	5
"	239	Big Chute 239	F	1993	5
"	240	Buckskin	F	1993	5
Audrey Heagy	190	Macgregor Black Ash	F	1994	1
Elizabeth Heagy	191	Macgregor Red Pine	F	1994	1
Paul Hector	78	Awenda Trail Centre	F	1991	7
"	79	Awenda Second Lake	F	1991	7
"	80	Awenda Toanche	F	1991	7
Helen Hutchinson	399	Island Lake	F	1995	3
Helen Inch	222	Sifton Bog	F	1988	10
"	223	Westminster Ponds	F	1988	10
Ross James	277	Jack Pine Forest	F	1987	6
"	280	Mixed Boreal Forest	F	1987	5
Gwen Jenkins	4	Murphys Point Hoggs Bay	F	1993	3
Joe Johnson	224	Oxenden Gleason Lake	F	1993	5
"	343	Sauble Pine Plantations	F	1994	4
Colin Jones	300	Thunder Cape	F	1992	1
Emily Joyce	345	Baldwin Pond Black River	F	1994	1
Edward Kelly	398	Croche Valley	F	1996	2
Judith Kennedy	4	Murphys Point Hoggs Bay	F	1996	2
Michael King	328	Beamer Conservation Area	F	1994	3
Richard Knapton	89	Backus Woods Plot 89	F	1992	6
"	318	Rockway Falls	F	1994	4
Karl Konze	315	Hilton Falls West	F	1994	3
Cathy Koot	161	Pinery 161	F	1993	1
Brian Lasenby	276	Interdunal Meadow	F	1988	1
"	285	Oak Savanna Pinery 1	F	1988	1
Cheryl Learn	243	Black Oak Heritage Park	F	1988	1
Chris Lemieux	281	Moose Lake Frost Centre	F	1991	1
Mike Lepage	335	Little Tract	F	1994	4
Myron Loback	226	PNFI Jack Pine	F	1993	2
Rick Ludkin	225	Haldimand Slough South	F	1987	9
"	272	Haldimand Slough North	F	1987	2
Don MacAlpine	433	Corrigal PB Jack Pine	S	1997	1
	434	Nipigon Bald Spot Trail	S	1997	1
	435	Hogan Lake Dorion Twp	S	1997	1
Cliff MacFayden	227	Tiffin Forest	F	1993	4
"	317	Tiffin Forest South	F	1994	3
"	404	Clearwater	F	1996	1
Jock MacKay	344	Beaver Creek Woods	F	1994	4
Bill Maddeford	183	Pinery South West	F	1993	1

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
"	184	Pinery South East	F	1993	1
Sarah Mainguy	401	Nassagaweya Canyon	F	1996	1
Dave Martin	228	Springwater 2	F	1990	8
"	92	Rondeau 92	F	1997	1
"	93	Rondeau 93	F	1997	1
"	94	Rondeau 94	F	1997	1
"	95	Rondeau 95	F	1997	1
"	96	Rondeau 96	F	1997	1
"	97	Rondeau 97	F	1997	1
"	98	Rondeau 98	F	1997	1
"	99	Rondeau 99	F	1997	1
"	100	Rondeau 100	F	1997	1
"	101	Rondeau 101	F	1997	1
"	102	Rondeau 102	F	1997	1
"	105	Rondeau 105	F	1997	1
"	106	Rondeau 106	F	1997	1
Doug Martin	152	MacGregor Point 152	F	1993	5
James Martin	347	West of Eden	F	1994	4
Paul Martin	29	LETE Mixed Woods	F	1990	2
Virgil Martin	229	St. Jacobs	F	1987	11
"	230	Sandy Hills Tract	F	1993	5
Larry Martyn	432	Ken Whillans	S	1997	1
Jeff Matheson	405	Caledon East A	F	1996	1
"	406	Caledon East B	F	1996	1
"	407	Blue Springs Scout Camp	F	1996	1
"	408	Lower Eramosa Watershed	F	1996	1
"	409	Starkey Hill	F	1996	1
Marlene McBrien	231	Beausoleil Island	F	1993	4
Jon McCracken	260	Backus Woods Mature	F	1988	8
Bill McIlveen	232	Speyside	F	1987	11
Irene McIlveen	437	St. Helena's Road	S	1997	1
Ken McIlwrick	314	Crawford Lake	F	1994	2
Margaret McLaren	52	Canisbay 482-488	F	1991	1
"	53	Pewee Lake	F	1991	1
"	54	Canisbay 433	F	1991	1
"	55	Peck 434	F	1991	6
"	57	Peck 658-1	F	1991	6
"	58	Peck 658-2	F	1991	6
"	59	Bracebridge Lot 9 Conc 6	F	1988	10
John McLaughlin	282	NCF Red Pine	F	1987	4
"	287	Peters Woods	F	1987	4
"	387	Depot Lakes 1	F	1995	2
"	388	Depot Lakes 2	F	1995	2
Al McTavish	155	Greenock 155 Plot 23	F	1992	1
Erwin Meissner	336	Helenbar 1	F	1996	2
Annette Mess	233	Tallow Rock West	F	1993	5
Libor Michalak	81	Dundas Valley Martins Road	F	1995	1
"	82	Dundas Valley Merrick	F	1995	1
Chris Michener	283	North Algona	F	1988	5
John Miles	265	Bruce Huron Boundary Road	F	1987	2

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
"	278	Maitland River Valley	F	1987	2
Victor Miller	389	French Portage Trail	F	1995	3
"	390	Wiskey Jack Pines Trail	F	1995	3
Rhonda Millikin	273	Hiawatha Red Pine	F	1988	1
Richard Moore	323	Kettle Lakes South	F	1994	4
"	324	Kettle Lakes North	F	1994	4
André Morin	234	Alfred Bog 234	F	1993	2
"	235	Alfred Bog 235	F	1993	2
Sylfest Muldal	271	Frontenac 1	F	1992	4
Bill Murphy	35	Innis Point	F	1991	5
Deryl Nethercott	162	Pinery 162	F	1993	5
Dwight Neufeld	157	Greenock 157	F	1992	1
Gary Nielsen	352	Donaldson Bay	F	1995	3
Jean Niskanen	113	Killbear Rocklands	F	1993	5
"	114	Killbear Maple Beech 114	F	1993	5
"	115	Killbear Maple Beech 115	F	1993	5
"	195	Snug Harbour Jack Pine Red Oak	F	1993	5
"	200	Killbear Hemlock	F	1993	3
Todd Norris	236	Big Swamp 236	F	1993	2
"	237	Big Swamp 237	F	1993	2
Lynn Paibomesai	263	Blugers Property	F	1993	5
Kathy Parker	153	MacGregor Point 153	F	1993	4
"	154	MacGregor Point 154	F	1993	4
Rob Parker	241	Niagara Oak Grove	F	1993	2
Scott Parker	196	Emmett Lake 196	S	1997	1
Sandra Parsons	242	McAndrews Road Forest	F	1991	6
Mark Peck	277	Jack Pine Forest	F	1990	1
"	280	Mixed Boreal Forest	F	1990	1
Frank Phelan	292	Skycroft Maple Forest	F	1987	1
Ron Pittaway	288	Plastic Lake	F	1987	2
"	296	Stand 477 Hemlock 4	F	1991	1
"	297	Stand 752 Hemlock 2	F	1991	1
"	298	Stand 98 Hemlock 1	F	1991	1
Craig Potter	331	Hanlon Creek	F	1994	4
Paul Pratt	243	Black Oak Heritage Park	F	1988	7
Ted Presant	428	Kelso Conservation Area	S	1997	1
Carey Purdon	244	PNFI Poplar White Birch	F	1993	4
Nick Quickert	427	Riverside Retreat	F	1997	1
Pete Read	178	Skunks Misery North	F	1995	3
Lynne Richardson	255	Kolapore Highlands	F	1994	4
Ron Ridout	392	Pelee South 1	F	1995	3
"	393	Pelee South 2	F	1995	3
"	394	Pelee North 1	F	1995	3
"	395	Pelee North 2	F	1995	3
"	396	Pelee North 3	F	1995	3
Chris Risley	414	Burnham Provincial Park 2	F	1987	1
Jack Romanow	35	Innis Point	F	1990	1
Doug Sadler	413	Burnham Provincial Park 1	F	1987	1
Chris Sanders	245	St Ste Marie 4th Line	F	1988	10
"	262	Black Sturgeon Lake	F	1988	3

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
"	299	Thessalon Bridgland R	F	1987	7
"	410	Stokely Creek	F	1996	2
Al Sandilands	85	White Oak Red Maple Red Pine	F	1993	5
"	87	White Pine White Oak Red Maple	F	1993	5
Peter Satterly	416	Ducks Unlimited Forest	F	1987	1
"	422	Pr Sw Plantation	F	1987	1
Don Scanlan	169	Wasaga Beech Pine 1	F	1993	4
"	173	Wasaga Beach Pine 2	F	1993	4
Ron Scovell	17	Terra Nova	F	1988	10
"	340	Homestead	F	1994	4
Rod Sein	267	Cascades North	F	1989	1
Geoff Semark	385	Dunvegan Deciduous	F	1995	2
Don Shanahan	246	Goodrich Loomis CA	F	1993	5
Al Sinclair	420	Sinclair Woodlot	F	1987	1
Jeff Skevington	160	Pinery 160	F	1994	2
"	165	Pinery Pine Oak Forest 1	F	1995	1
"	286	Oak Savanna Pinery 2	F	1990	3
Jim Spruce	181	Copeland	F	1993	5
Andy Steinberg	200	Killbear Hemlock	F	1996	2
"	403	Drew Bog And Maples	F	1996	2
"	425	30,000 Islands Mainland	F	1997	1
Peter Stinnissen	247	Peat Mountain	F	1991	6
Dan Strickland	27	Canisbay Hardwoods	F	1989	8
"	61	Bat Lake Hemlocks	F	1991	7
"	339	Bat Lake Mixed Woods	F	1994	4
Dan Stuckey	248	Kortright Maple Beech Forest	F	1993	5
Janice Sukhiani	436	Bruce Trail Hardwoods	S	1997	1
Cynthia Suhay	249	Nils Bay	F	1989	9
Don Sutherland	90	Backus Woods Swamp	F	1992	1
Sandy Symmes	319	Terra Cotta	F	1995	1
Ilmar Talvila	316	Kiwanis Tract	F	1994	3
Robin Tapley	171	Wye Marsh 171	F	1993	1
"	189	Wye Marsh 189	F	1993	1
Ron Tasker	107	Manitoulin Spruce	F	1987	11
Ian Thompson	213	PNFI Pine	F	1994	3
"	214	PNFI Mixed	F	1994	3
Steve Thompson	348	Emily Tract	F	1994	2
Ron Tozer	27	Canisbay Hardwoods	F	1988	1
"	28	Found Lake Hardwoods	F	1987	10
Rob Tymstra	301	Walpole Island Public Woods	F	1987	2
"	419	North Walpole	F	1987	1
Gary Ure	271	Frontenac 1	F	1996	2
Marc-André Villard	290	Runtz Woodlot	F	1988	3
"	302	Williams Woodlot	F	1988	3
Chris Wedeles	250	North Halton Niagara Escarp	F	1993	5
Don Weins	254	Pottageville Swamp	F	1993	3
Ron Weir	1	Otter Lake Sanctuary	F	1987	11
Dan Welsh	259	Arnprior	F	1987	7
Steve Wendt	26	GH Ferguson Forest	F	1990	6
Reinder Westerhoff	251	Glen Haffey Extension	F	1991	7

Volunteer	Site #	Site Name	Site Type	First Year	Number of Years
K. Whillans	295	St. Joe Island	F	1988	1
Charlie Whitelaw	252	Nelson Lake	F	1993	4
"	253	Vermilion River	F	1993	5
Bob Whittam	171	Wye Marsh 171	F	1996	2
"	189	Wye Marsh 189	F	1996	2
Dan Whittam	171	Wye Marsh 171	F	1995	1
"	189	Wye Marsh 189	F	1995	1
Mark Wiercinski	166	Cyprus Horse Lake Trail	F	1993	4
"	167	Cyprus Lake Weather Station	F	1993	4
"	168	South Cameron Lake Dunes	F	1993	4
"	192	Dorcas Bay 192	F	1993	1
"	193	Dorcas Bay 193	F	1994	3
"	194	Cameron Lake	F	1992	5
"	255	Kolapore Highlands	F	1988	4
"	270	Epping Swamp	F	1988	1
Steve Wilcox	320	Pretty River Southwest	F	1996	1
"	321	Pretty River Valley	F	1996	1
Don Wilkes	192	Dorcas Bay 192	S	1997	1
Bill Wilson	185	Sudden Tract	F	1993	5
Jim Wilson	256	Loon Bay South	F	1988	10
"	257	Loon Bay North	F	1988	10
Jul Wojnowski	141	Sibley 124	F	1995	1
"	142	Sibley 121	F	1995	1
"	143	Sibley 9N	F	1995	1
"	144	Sibley 97	F	1995	3
"	148	Sibley 77	F	1995	3
"	149	Sibley 9S	F	1996	2
John Woodcock	132	Conmee 75A	F	1989	2
"	133	Conmee 75B	F	1989	2
"	134	Conmee 75C	F	1989	2
"	135	Greenwood Lake 439A	F	1989	4
"	136	Greenwood Lake 439B	F	1989	4
"	137	Greenwood Lake 439C	F	1989	4
"	138	Greenwood Lake 439D	F	1989	3
Al Woodliffe	156	Wheatley	F	1993	2
Terrie Woodrow	83	Turkey Point	F	1993	4
Bryan Wyatt	212	Arkell Hills	F	1987	3
Peter van Dyken	402	Mount Nemo	F	1996	1

Appendix B: Forms and symbols used in data collection and transcription

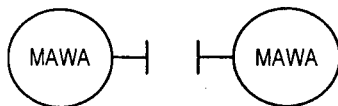
Standard Symbols Used in Mapping (This example uses Magnolia Warbler):



- position of singing male



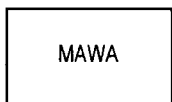
- approximate position of singing male (can be enlarged to indicate area of uncertainty)



- simultaneous registration of song within a short time period indicates two interacting males



- male observed



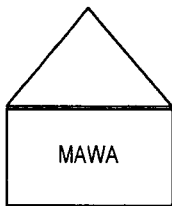
- female observed



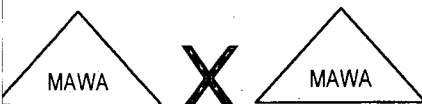
- calling, sex unknown

MAWA

- observed, sex unknown



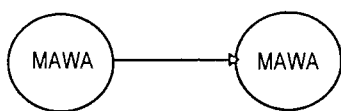
- pair together, assumed mated



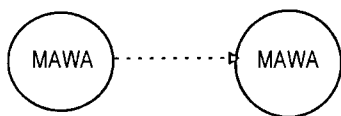
- observed conflict between males; dispute over boundary



- vocal defense of territories between males. This specifically implies a territory boundary.



- known change in position



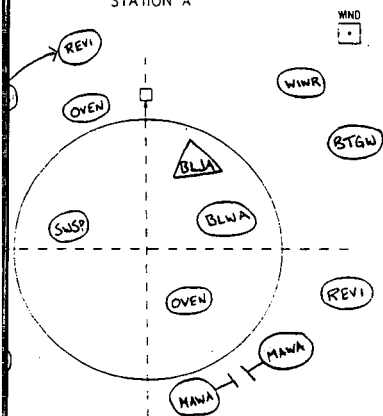
- assumed change in position

MAWA *

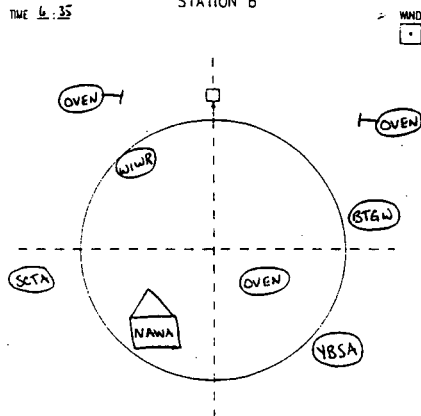
- nest

Field Card

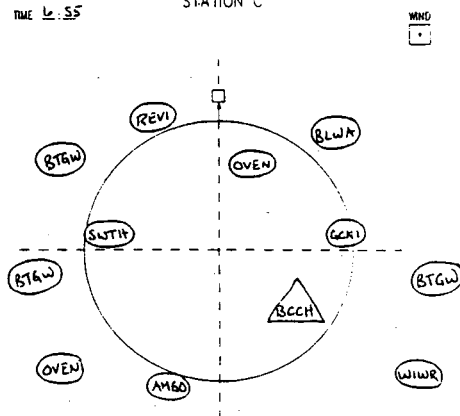
STATION A



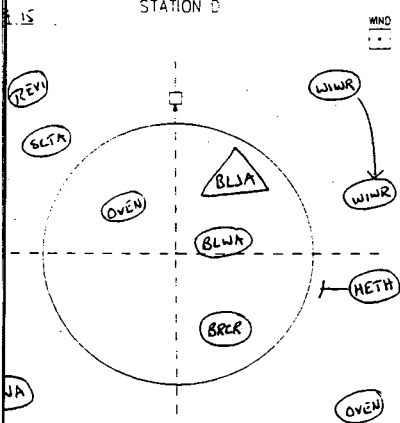
TIME 6:35 STATION B



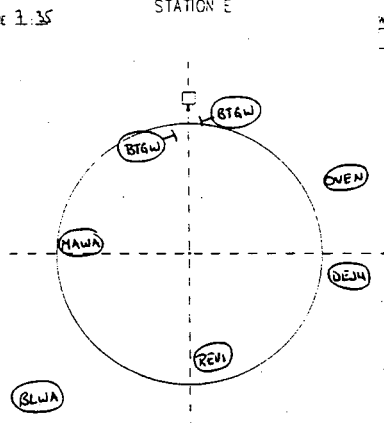
TIME 6:55 STATION C



STATION D



TIME 1:35 STATION E



The Forest Bird Monitoring Program

Site Name: Bat Lake Site No. 461

Observer: Josephine Birdar Date: 06:06:98

Lat: 45:34:42 Long: 78:32:17 Visit No. 1

Weather Conditions: Calm, Sunny

Comments: _____

Return to: Mike Cadman
Canadian Wildlife Service
75 Farquhar St.
Guelph, Ontario
N1H 3N4

MAPPING SYMBOLS

	- position of singing male		- male observed		- calling, sex unknown
	- approximate position of singing male		- female observed		- MAWA - observed, sex unknown
	- simultaneous song < 2 m/sec		- pair together, assumed method		- MAWA - nest
	- known change in position				
	- assumed change in position				

FOREST BIRD MONITORING PROGRAM - DATA SUMMARY SHEET

YEAR: 97

Site No. 461
 Site Name: Bat Lake
 Closest Town: Whitney

Forest Bird Monitoring Program
 Canadian Wildlife Service
 75 Farquhar St.
 Guelph, Ontario
 N1H 3N4

UTM: 11 11 11 11
 Zone Block Easting Northing

Phone (519) 826-2094
 Fax (519) 826-2113

Lat 415 314 142 Long 178 132 117
 Degrees Minutes Seconds Degrees Minutes Seconds

Observer: Josephine Birder
 Address: 123 Robin Cres
CHawa, ON
 PCode: K1S 3S9
 (home) (613) 725 9742 (work) 798 4761

Office use only:
 acknowledged: _____
 checked: _____
 dmf: _____

Visit Date (dd-mm-yy)		Visit 1					Visit 2				
Station Visit Time (h:mm)		6 - June - 97					22 - June - 97				
		6:20	6:35	6:55	7:15	7:35	6:30	6:45	7:05	7:20	7:40
Species Name	Code	A	B	C	D	E	A	B	C	D	E
Great Blue Heron	GBHE										
Broad-winged Hawk	BWHA										
Ruffed Grouse	RUGR										
Mourning Dove	MODO										
Black-billed Cuckoo	BBCU										
Yellow-billed Cuckoo	YBCU										
Ruby-throated Hummingbird	RTHU										
Yellow-bellied Sapsucker	YBSA		1								
Downy Woodpecker	DOWO										
Hairy Woodpecker	HAWO										
Northern Flicker	NOFL										
Pileated Woodpecker	PIWO										
Eastern Wood-Pewee	EWPE										
Yellow-bellied Flycatcher	YBFL										
Alder Flycatcher	ALFL										
Least Flycatcher	LEFL										
Eastern Phoebe	EAPH										
Great Crested Flycatcher	GCFL										
Eastern Kingbird	EAKI										
Tree Swallow	TRSW										
Gray Jay	GRJA										
Blue Jay	BLJA	1			1						
American Crow	AMCR										
Common Raven	CORA										
Black-capped Chickadee	BCCH			1							
Red-breasted Nuthatch	RBNU										
White-breasted Nuthatch	WBNU										
Brown Creeper	BRCR				1						1
House Wren	HOWR										
Winter Wren	WIWR	2	1	1	1		1	1			
Golden-crowned Kinglet	GCKI			1							
Ruby-crowned Kinglet	RCKI										
Veery	VEER										
Swainson's Thrush	SWTH			1			1				
Hermit Thrush	HETH				2		1				
Wood Thrush	WOTH										
American Robin	AMRO										
Gray Catbird	GRCA										
Cedar Waxwing	CEWX										
European Starling	STAR										
Solitary Vireo	SOVI				1			1	1		1
Warbling Vireo	WAVI										

Appendix C: Classification of species according to their migratory status (NT - Neotropical, SD - Short Distance, PR - Permanent Resident), and habitat preference (I/E - Interior/Edge, I - Interior, E - Edge).

Common Name	Scientific Name	AOU	Migratory Status	Habitat Preference
American Crow	<i>Corvus brachyrhynchos</i>	488	SD ²	E
American Goldfinch	<i>Carduelis tristis</i>	529	SD	E
American Redstart	<i>Setophaga ruticilla</i>	687	NT	I/E ²
American Robin	<i>Turdus migratorius</i>	761	SD	E
Baltimore Oriole	<i>Icterus galbula</i>	507	NT	E
Black-and-white Warbler	<i>Mniotilta varia</i>	636	NT	I
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	388	NT	I/E
Black-capped Chickadee	<i>Parus atricapillus</i>	735	PR	I/E
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	654	NT	I/E ²
Black-throated Green Warbler	<i>Dendroica virens</i>	667	NT	I
Blackburnian Warbler	<i>Dendroica fusca</i>	662	NT	I
Blue Jay	<i>Cyanocitta cristata</i>	477	SD ²	I/E
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>	751	NT	I/E
Blue-headed Vireo	<i>Vireo solitarius</i>	629	SD ¹	I ¹
Brown Creeper	<i>Certhia americana</i>	726	SD ²	I
Brown-headed Cowbird	<i>Molothrus ater</i>	495	SD	E
Canada Warbler	<i>Wilsonia canadensis</i>	686	NT	I
Cedar Waxwing	<i>Bombycilla cedrorum</i>	619	SD	E
Chestnut-sided Warbler	<i>Dendroica pennsylvanica</i>	659	NT	E
Chipping Sparrow	<i>Spizella passerina</i>	560	SD	E
Common Grackle	<i>Quiscalus quiscula</i>	511	SD	E
Common Raven	<i>Corvus corax</i>	486	PR	I/E ²
Common Yellowthroat	<i>Geothlypis trichas</i>	681	NT ²	I/E
Dark-eyed Junco	<i>Junco hyemalis</i>	567	SD ¹	I/E ¹
Downy Woodpecker	<i>Picoides pubescens</i>	394	PR	I/E
Eastern Phoebe	<i>Sayornis phoebe</i>	456	SD	I/E
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	587	SD	I/E
Eastern Wood-Pewee	<i>Contopus virens</i>	461	NT	I/E
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	514	PR ¹	I/E ¹
Golden-crowned Kinglet	<i>Regulus satrapa</i>	748	SD	I
Gray Catbird	<i>Dumetella carolinensis</i>	704	SD	I/E
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	452	NT	I/E
Hairy Woodpecker	<i>Picoides villosus</i>	393	PR	I
Hermit Thrush	<i>Catharus guttatus</i>	759	SD	I
House Wren	<i>Troglodytes aedon</i>	721	SD	E
Indigo Bunting	<i>Passerina cyanea</i>	598	NT	E
Least Flycatcher	<i>Empidonax minimus</i>	467	NT	I/E ²
Magnolia Warbler	<i>Dendroica magnolia</i>	657	NT	I/E ²

Mourning Dove	<i>Zenaida macroura</i>	316	SD	E
Mourning Warbler	<i>Oporornis philadelphia</i>	679	NT	E
Nashville Warbler	<i>Vermivora ruficapilla</i>	645	NT	E
Northern Cardinal	<i>Cardinalis cardinalis</i>	593	PR	I/E
Northern Flicker	<i>Colaptes auratus</i>	412	SD	I/E
Northern Waterthrush	<i>Seiurus noveboracensis</i>	675	NT	I/E ²
Ovenbird	<i>Seiurus aurocapillus</i>	674	NT	I
Pileated Woodpecker	<i>Dryocopus pileatus</i>	405	PR	I
Pine Warbler	<i>Dendroica pinus</i>	671	SD	I
Purple Finch	<i>Carpodacus purpureus</i>	517	SD ²	I/E
Red-breasted Nuthatch	<i>Sitta canadensis</i>	728	PR	I
Red-eyed Vireo	<i>Vireo olivaceus</i>	624	NT	I/E
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	498	SD	E
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	595	NT	I/E
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	428	NT	E
Ruffed Grouse	<i>Bonasa umbellus</i>	300	PR	I/E
Scarlet Tanager	<i>Piranga olivacea</i>	608	NT	I
Song Sparrow	<i>Melospiza melodia</i>	581	SD	E
Swainson's Thrush	<i>Catharus ustulatus</i>	758	NT	I
Swamp Sparrow	<i>Melospiza georgiana</i>	584	SD	E
Veery	<i>Catharus fuscescens</i>	756	NT	I
Warbling Vireo	<i>Vireo gilvus</i>	627	NT	E
White-breasted Nuthatch	<i>Sitta carolinensis</i>	727	PR	I
White-throated Sparrow	<i>Zonotrichia albicollis</i>	558	SD	E
Winter Wren	<i>Troglodytes troglodytes</i>	722	SD	I
Wood Thrush	<i>Hylocichla mustelina</i>	755	NT	I/E
Yellow Warbler	<i>Dendroica petechia</i>	652	NT	E
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	402	SD	I/E
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	387	NT	I/E
Yellow-rumped Warbler	<i>Dendroica coronata</i>	655	SD	I
Yellow-throated Vireo	<i>Vireo flavifrons</i>	628	NT	I/E

¹: not included in Freemark and Collins (1992)

²: different than in Freemark and Collins (1992)