# An Overview of the Forest Bird Monitoring Program in Ontario, Canada[1]

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**Abstract:** In 1987, the Canadian Wildlife Service (Ontario Region) initiated a program to inventory and monitor trends in forest birds. The Forest Bird Monitoring Program (FBMP) was designed to describe changes in numbers over time for all forest songbirds, to develop a habitat-specific baseline inventory of forest birds (species composition and relative abundance), and to develop regionally accurate habitat association profiles for all common forest birds. It was intended to build upon and augment the broad regional base of the Breeding Bird Survey (BBS). The program relies on volunteers for annual surveys to monitor trends, supplemented by salaried observers to establish sites and conduct baseline inventories. This paper provides an overview of procedures and methodology and some general comments on habitat-specific surveys and volunteers. The paper is intended as a description of the program and does not contain extensive data justifying the protocol. The initial selection of procedures for FBMP was based primarily on scientific literature, field experience, and the opinion of experienced volunteers. An additional section comparing 3-, 5-, and 10-minute counts based on 1992 data has been added to the paper since the 1991 workshop.

## History of Project

In 1987, forty volunteers surveyed 310 stations (62 sites) in a pilot project to examine the feasibility of a volunteer-based program to monitor forest bird trends. The methodology was similar to that currently used, except that observers recorded birds found within an imbedded 50-m radius fixed-distance plot as well as for the unlimited-distance plot. Distance estimation difficulties led to abandoning the 50-m inner plot. The pilot year was successful, and the program has operated at a modest scale of about 200 to 300 stations every year since, expanding somewhat in 1991. The 5-year database is presently being analyzed for trends and to better understand the data set characteristics.

Related projects using the same methodology have concentrated on inventory and habitat associations of bird communities in the boreal forest in relation to forest ecosystems. Over the past 4 years, about 3000 stations have been sampled, and a model to predict bird species composition and abundance in relation to forest type has been developed for Northwestern Ontario.

## Site Selection and Station Layout

Forest stands representative of the major forest habitats of Ontario are selected as study sites. Specific site selection is usually made jointly by the volunteer, Canadian Wildlife Service (CWS), and other agencies and incorporates consideration of permanence and access as well as representativity. CWS has also established more than 100 sites in protected areas during forest bird inventories that volunteers are encouraged to take over. The goal is to have adequate sampling in all major habitat types, and the overall sampling design is controlled by CWS.

Five sampling locations called stations are established in each forest site. Stations are located at least 100 m from the edge of the forest type and at least 250 m apart. Although the actual size of the stand is not specified, an area of at least 25 ha is necessary to locate five stations meeting the guidelines. In exceptional circumstances, stations are located in more than one forest fragment. All stations are clearly marked to facilitate relocation in subsequent surveys, and most bear permanent markers and have linking trails between stations which are flagged as well.

## Bird Survey Procedures

The survey procedure used is an unlimited-distance point count based, in general, on the approach described by Blondel and others (1970) and used by numerous other investigators (Fuller and Moreton 1987, Robbins and others 1989). Our procedure is as follows:

(1) Counts begin as soon as possible after observers arrive at the station. Normally they require a short 10- to 30-second rest to get their breathing slowed down and their ear "attuned."

(2) Observers record all birds seen and heard during a 10-minute sample period, ensuring that each individual is counted only once. Counting is done by mapping all records on the map sheets provided, keeping track of movements as best they can, and paying particular attention to simultaneous records. We find that mapping (marking the exact location and noting movements) is the best way to minimize duplicate records. Data mapping forms used are similar to those included in *Field Methods for Monitoring Landbirds* (Ralph and others 1993) and in the Monitoring Avian Productivity and Survivorship (MAPS) program instructions (DeSante 1992). Standardized species abbreviations are used, and different symbols record the status of each bird (e.g., singing male, pair, female, nest, calling bird, etc.). We emphasize that it is critical to record status symbols accurately because they determine the assigned breeding evidence; some levels assume a pair, others only a single bird. A special effort is made to record all species by guarding against "tune-out." Tune-out

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is missing an individual or species even though it is singing clearly. It seems to occur most often when the observers are having problems identifying one bird and concentrate so hard that they miss others. Common, constantly singing birds, like Red-eyed Vireo (*Vireo olivaceous*), seem to be the easiest to tune out.

All participants have a high skill level in bird identification, and observers are encouraged to eliminate species-identification errors by tracking down problem birds. We recommend that a count-down timer be used to eliminate the difficulty of watch-checking during the count period. Wind direction and the orientation of the map sheet are recorded.

(3) Counts are done early in the morning from soon after dawn until approximately 4 hours after dawn. Observers conduct surveys only in weather that is unlikely to reduce count numbers, similar to the guidance given to Breeding Bird Survey (BBS) participants. Generally, the better the weather, the better to count. We request that birds be counted when winds are calm to light (<15 km/h) and that counts not be conducted in the rain. All stations for each site are completed in one day to make them as comparable as possible.

(4) Observers may have as many helpers as they require for navigation and data-recording purposes, but there must be only one listener per station. In trend analysis, we use only data from the same observer in subsequent years on the same site.

(5) Each site is sampled twice during the season; once during the end of May or early June (approximately May 27 to June 12) and once during the latter part of June (approximately June 14 to June 24). The number and date of counts we use are based on regional phenology and may have to be adjusted for other areas.

(6) Data coding is done soon after the survey, ideally on the same day. The observers transcribe the mapping data onto a coding sheet. The level of breeding evidence determines whether a bird is assumed to indicate a pair or a single; a singing male, observed pair, occupied nest, and a family group are all considered a pair. All other individuals seen or heard calling are counted as singles. Observers return the map and coding sheet for each series to CWS for verification and processing.

## Data Analysis

The higher value for each species during the breeding season is used as the station estimate. Station values can be summed to obtain site values which must be used to relate bird abundance to some forest variables that are only available on a stand basis.

The number of stations required to develop significant trends is difficult to specify precisely. The magnitude of change and the variance patterns of individual species dramatically affect the sample size required for statistical significance. There could theoretically be a different sample size value for each species, taking into account the amount of change we want to detect over a certain time period. Using BBS route regression methodology (Collins and Wendt 1990, Geissler and Noon 1981), statistically significant trends, in cases of dramatic change, occur with as few as 20 stations over the 1987-to-1991 5-year period, and frequently with 40 or more stations.

## Habitat-Specific Surveys

The decision of whether to stratify surveys by habitat must always be based on the nature of the data required. Some general comments based on our experience may be useful.

(1) Habitat-based approaches are most valuable at local and regional levels and obviously become more difficult to design effectively as scale increases, the major problem being geographic changes in forest vegetation patterns.

(2) Habitat information can be ignored in analysis if not needed, but is often difficult and expensive to collect a posteriori. Habitat-specific data can produce forest-specific as well as aggregated regional, provincial, and national roll-ups (but could be subject to bias if not complete-see Item 4).

(3) Habitat-based sampling protocols should be viewed from a statistical perspective as stratification to deal with heterogeneous distribution. Bird species turnover across forest stand gradients is high, so there are considerable statistical benefits in examining trend within similar habitats.

(4) To effectively estimate population size, all habitats in which a species occurs must be adequately sampled, and the extent of each habitat should be known. To monitor trends, changes in both bird species abundances within habitats and the extent of the habitats must be monitored.

(5) Results and conservation recommendations (where and perhaps why) can be related to forest management and other land use plans. Bird trend data can thus provide effective input into land management decisions. Many landscape changes, both natural and human-induced, are habitat-specific, so information is often most valuable when expressed in terms of landscape units.

(6) Volunteers and volunteer organizations are more ready to cooperate and provide financial support to data collected on a locally interpretable basis as well as integrated to a larger scale. For example, data could be collected on sugar maple stands for townships and also used on a provincial basis, as long as local sampling is adequate and relative habitat proportions are known.

(7) Habitat-specific data can also meet the strong requirement for inventory and habitat association information as well as for monitoring.

**Volunteer Observer Considerations**

The use of volunteers dramatically expands the potential scope of monitoring programs and provides potential for long-term continuity of observers. They do introduce a number of additional considerations such as:

(1) The program should have clear overall conservation goals, as people want to contribute to worthwhile conservation efforts that they understand.

(2) It should have rigorous methodology that recognizes habitat differences. Naturalists tend to be suspicious of "average" values from very different habitats.

(3) The survey should give an impression of completeness, as the volunteer observers often have a strong interest in the site they survey and want it done properly. I have noticed that the volunteer observers distrust samples in which they feel rushed while collecting the data. They like to know that they have successfully recorded all birds during the count period. For instance, they are far happier with 10-minute rather than 3-minute counts.

(4) Since volunteers provide long-term continuity, it is important that the methodology be satisfying to them and fun-it is their free time!

(5) Communication is extremely important for long-term support. Volunteer observers need regular feedback on program progress and results. Newsletters seem to work well in this regard.

**Point Count Standards and the Forest Bird Monitoring Program**

In design and approach Forest Bird Monitoring Program (FBMP) is highly compatible with the recommended standards of Ralph and others (in this volume). The program is now in its sixth year of operation using volunteers and seems unlikely to change substantially. Over time it will be adjusted as necessary to fit with integrated North American programs as they are developed.

Some of our practices warrant comment as they appear to differ from the standards:

- FBMP is intended to inventory and monitor on a habitat-specific basis. The landscape pattern of forest habitat distribution and land use have dictated an emphasis on off-road sampling in the regions where FBMP has been implemented to date. In other regions, adequate sample size may well be achieved along roadsides. When overall integrated characterization of the avifauna is a goal, as well as habitat-specific data, particular attention must be directed to ensuring adequate sampling of a full range of habitat units within the study region.

- FBMP is based on a 10-minute count period, and limited data suggest that between-station travel time for volunteers varies from 5 to 25 minutes depending on terrain and the observer's physical condition and schedule. Volunteer observers tell us that they want a sample period long enough to have an impression of completeness. In general, most birds are detected in the first 5 minutes by experienced observers, and although a significant number of new species can be added in the second 5 minutes, they usually occur in low abundance.

  The major difficulty in selecting an optimum period for a volunteer-based program is broad variability in the speed at which they record observations. It is my impression that participants conducting only one or two surveys a year often need more than 5 minutes to record an acceptable number of cues, but they perform well over a 10-minute count period. The results of a 3-, 5-, and 10-minute count comparison are presented in the following section.

- As described in the history overview, FBMP initially used a 50-m fixed-radius plot and unlimited distance, but it was found that problems existed in comparability of distance estimates, making it difficult to use the data effectively.

**Comparison of 3-, 5- and 10-Minute Counts**

The specific interest in counts of 3-, 5- and 10-minute duration in the North American Point Count Standards (Ralph and others, in this volulme) prompted us to conduct a small-scale comparison in 1992. Using our standard survey procedure, a highly experienced observer mapped the count information using different colored pens for each time period. We recorded the period when each bird was first detected and noted if it continued to be detected in subsequent periods.

We conducted 180 songbird surveys in 18 stands in eastern Ontario in the Great Lakes-St. Lawrence forest region (Rowe 1972). Most stands (12) were white pine (*Pinus strobus*) and white pine mixed woods, and several stands (6) were dominated by tolerant hardwoods. Each site (comprised of five stations) was visited twice. The first visit was done June 2 to June 11, and the second was done June 23 to July 11. Surveys ran from 0500 to 1015, and approximately 3 sites (15 stations) were sampled per day.

The length of the travel time between sample points strongly affects the number of counts that can be conducted per hour (Ralph and others, in this volume). If we assume a 5-minute travel period (a reasonable time to walk 250 m in open forest), then an observer could theoretically conduct 7.5 counts of 3 minutes, 6 counts of 5 minutes or 4 counts of 10 minutes an hour. *Table 1* presents calculated results for 1 hour of survey based on the average of three random draws from the 1992 data.

**Table 1**--***The number of individuals and number of species of birds detected per hour using point counts of 3-, 5-, and 10-minute duration.***

| Parameter | Duration of Count (minutes) | | |
|---|---|---|---|
| | 3 | 5 | 10 |
| Individuals per hour | 105 | 99 | 78 |
| Species per hour | 32 | 31 | 29 |

**Table 2**--*Bird species occurrence in 3-, 5-, and 10-minute count periods. Species with significantly different distributions from the average overall distribution are presented by count period, with direction of bias.*

| Species | Significance | Duration of Count (minutes) | | |
|---|---|---|---|---|
| | | 3 | 5 | 10 |
| Downy Woodpecker | ** | Lower[1] | Lower | Higher |
| Great Crested Flycatcher | * | Lower | Lower | Higher |
| Yellow-rumped Warbler | * | Lower | Higher | Higher |
| Yellow-bellied Sapsucker | ** | Lower | Higher | Higher |
| Black-capped Chickadee | * | Lower | Higher | Higher |
| Red-breasted Nuthatch | * | Lower | Higher | Higher |
| Golden-crowned Kinglet | ** | Lower | Higher | Higher |
| Pine Warbler | * | Lower | Higher | Higher |
| Red-eyed Vireo | * | Higher | Lower | Lower |
| Least Flycatcher | ** | Higher | Lower | Lower |
| Ovenbird | ** | Higher | Lower | Lower |
| Hermit Thrush | * | Higher | Higher | Lower |

[1] Counts were significantly lower or higher during this time period than expected.

* $P<0.05$

** $P<0.01$

In addition to knowing if the number of species per count changes, it is also important to determine if species are equally likely to occur in counts of different lengths. We examined this question by comparing the distribution of the number of detections of each species in the 3-, 5- and 10-minute counts with the distributions for each other species. Only species that occurred at more than 15 sample points were included in the analysis. Of these 36 species, 24 had similar overall distributions, whereas the overall distributions for 12 species were significantly different from the others. The results for species with significantly different distributions are summarized in *table 2*. Of these, the probability that the overall distribution was significantly different was <0.01 for 5 species (Downy Woodpecker (*Picoides pubescens*), Golden-crowned Kinglet (*Regulus satrapa*), Least Flycatcher (*Empidonax minimus*), Ovenbird (*Seiurus aurocapillus),* and Yellow-bellied Sapsucker (*Sphyrapicus varius*)) and <0.05 for another 7 (Black-capped Chickadee (*Parus atricapillus*), Great-crested Flycatcher (*Myiarchus crinitus*), Hermit Thrush (*Catharus guttatus*), Pine Warbler (*Dendroica pinus*), Red-breasted Nuthatch (*Sitta canadensis*), Red-eyed Vireo, and Yellow-rumped Warbler (*Dendroica coronata*)).

Although most species follow expectations, numbers of vocal long-distance migrants (e.g., Ovenbird, Least Flycatcher) are disproportionately high in the first 3 minutes, whereas several resident and short-distance migrants (e.g., Downy Woodpecker, Golden-crowned Kinglet), mostly cavity nesters, are detected less frequently than expected in the first 3 minutes. For example, Ovenbird, which had a significantly different distribution ($\chi^2$ = 20.1, df = 2, $P<0.005$) from the others, had counts higher in the first 3 minutes and lower in the 5- and 10-minute counts than expected.

One of the purposes of our program is to describe species-habitat associations. It is, therefore, interesting to compare the species accumulation curves for the different count period lengths. Using the 1992 data (90 stations with two visits, treating each as a sample), we randomized the observations and drew the species accumulation curves. Using the maximum number of species observed overall (75 species) as 100 percent, we could expect to observe 90 percent of the species (a proportion often considered acceptable) in 45 samples of 10 minutes, 63 samples of 5 minutes, and 80 samples of 3 minutes.

The principal benefit of a shorter count period should be increased statistical power due to an increased number of samples and a higher number of birds counted per hour. In general, it is assumed that longer counts are more precise so that the benefits of more short counts depend on how variable they are relative to the potential improved power obtained by increasing the number of samples.

One possible way to examine the question is to calculate the Coefficient of Deviation (CD = standard error/mean) for each count period, and then calculate the sample ratio at which they are equal (the break point) for the two methods to be compared. This approach assumes that standard deviation is correctly estimated for the population. *Table 3* presents some sample values from the 1992 data. For the overall data the CD for 3 minutes is 0.024 and for 10 minutes it is 0.013. The break point ratio for 3- and 10-minute samples is 0.200. We can, therefore, conclude that five times as many 3-minute as 10-minute counts would be required to obtain a comparable standard error. Comparison of the 5-minute and 10-minute values gives a break point ratio of 0.299, thus 3.3 times as many 5-minute as 10-minute counts would be required. Using the earlier example, with a 5-minute travel period, 4 counts of 10 minutes should be comparable to 13 counts of 5 minutes and 20 counts of 3 minutes in precision.

If we examine the data for migratory habit groups (*table 3*), the results would be different than those calculated for the

**Table 3**--***Selected summary results from 3-, 5-, and 10-minute counts.***

| Parameter | n | Duration of Count (minutes) 3 Mean | 3 Standard deviation | 5 Mean | 5 Standard deviation | 10 Mean | 10 Standard deviation |
|---|---|---|---|---|---|---|---|
| Overall | 1684 | 0.91 | 0.89 | 1.12 | 0.88 | 1.40 | 0.77 |
| Long-distance migrant | 994 | 1.11 | 0.99 | 1.32 | 0.99 | 1.58 | 0.90 |
| Short-distance migrant | 437 | 0.73 | 0.64 | 0.92 | 0.62 | 1.18 | 0.48 |
| Resident | 205 | 0.47 | 0.56 | 0.71 | 0.56 | 1.11 | 0.31 |

overall data. Grouping species by migratory habit seems desirable, since we have differing expectations of detecting these groups, depending on the duration of the count period (*table 2*). For example, the ratio for long-distance migrants is 0.389 and for residents it is 0.006 between 3-minute and 10-minute counts. Therefore, 260 counts of 3 minutes would compare to 100 counts of 10 minutes for long-distance migrants; but for residents, 1670 counts of 3 minutes would be comparable to 100 counts of 10 minutes.

**Table 4**--***Results of a calculated typical morning's survey effort of 5 hours using point count periods of 3, 5, and 10 minutes in length. Numbers are the average of three values obtained by taking random samples of all stations visited.***

| Parameter | Duration of Count (minutes) 3 | 5 | 10 |
|---|---|---|---|
| Samples | 23 | 20 | 15 |
| Individuals | 319 | 335 | 299 |
| Species | 49 | 52 | 53 |
| Time counting (minutes) | 69 | 100 | 150 |
| Distance walked (km)[1] | 5.75 | 5.00 | 3.75 |

[1] Based on one-way travel, walking a minimum of 250 m between stations.

The appropriate values will vary from place to place, but could be roughly estimated from a preliminary test.

In our program we attempt to maximize the number of 10-minute samples per morning, whenever possible surveying 3 sites of 5 stations each (15 samples). On average this requires 5 to 5.5 hours. For our survey circumstances, the average time between stations is, therefore, 10 to 12 minutes. The time between stations will vary enormously between regions, depending on the amount of driving and walking required, the ease of travel, and the design of the program. Several important aspects of the relative merits are summarized in *table 4,* which represents calculated results of a typical morning of surveying for 5 hours with 10 minutes between stations.

Overall for our region, the lower variability coupled with the improved counts of residents and more complete species profiles suggests that 10-minute counts are better. While the precision with 5-minute counts is higher than with 3-minute counts, the 10-minute counts are preferable for this data set. In other regions with different song frequency and phenology patterns, the relative merits of short versus long counts may be different. It is clearly important to carefully calculate how many samples can be taken in a morning and consider their variability when making a decision about length of count period.