Forest Bird Monitoring Protocol

Terrestrial Long-term Fixed Plot Monitoring Program

Regional Watershed Monitoring and Reporting

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Toronto and Region Conservation
for The Living City®

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1.0 INTRODUCTION

Songbirds, being present to varying degrees in all habitats and in all landscapes, provide a readily visible and therefore easily monitored fauna element. By stipulating a series of limitations on count range and duration, a degree of standardization can be achieved that allows for consistency over the many years required to acquire a large enough sample.

The forest bird monitoring protocol used by Toronto and Region Conservation Authority (TRCA) follows the Ontario Forest Bird Monitoring Program (OFBMP) run by the Canadian Wildlife Service. Slight modifications were needed to this protocol in order to be able to answer monitoring questions posed at the TRCA jurisdictional scale. Specifically, smaller forest fragments are included in the study design in order to have monitoring stations distributed evenly across the jurisdiction and to have representation of the various forest conditions present.

2.0 STUDY DESIGN

Ensuring a sample size that is appropriate to detect region wide trends is the primary objective of the monitoring program. However, with additional funds and resources it will also be desirable to increase the sample size in order to have the ability to look at differences between three land-use zones (urban, urbanizing and rural).

Program Objective(s):

- To assess overall trend in forest bird species richness in the TRCA region
- To assess overall trend in forest bird abundance in the TRCA region

An *a priori* power analysis was conducted in 2008 (Zorn 2008) to determine the appropriate number of monitoring plots needed to achieve sufficient power. In 2015, a further power analysis (retrospective) was conducted to ensure the appropriate number of plots are monitored for assessing spatial and temporal trends in forest-dependent bird species richness, forest-dependent bird abundance, and the number of L1-L3 forest bird species. The sample sizes used in this power analysis were based on sample sizes used in TRCA (2015a).

Power was sufficient (>90%) for all analyses comparing the rural and urban zones (11 rural, 9 urban). Power was sufficient for analyzing temporal trends regionally (20 monitoring plots). Power was low for analyzing temporal trends in the rural zone alone but only for the number of L1-L3 species. In order to improve power to an acceptable level (>80%), the effect size will be increased from 15% over 5 years to 17% over 5 years. This means that instead of being able to detect a decline of 15% over 5 years our data are only able to detect a decline of 17% (or greater) over 5 years. Power was low for analyzing temporal trends in the urban zone alone; however, it was decided that it is more important to examine potential losses in the rural zone given the small number of sensitive forest bird species currently in the urban zone. Full details of the 2015 power analysis can be found in TRCA (2015b).

3.0 EQUIPMENT & MATERIALS

Different materials and equipment are needed depending on whether the plot is being set-up for the very first time or if visited for seasonal monitoring (Table 1).

Table 1. List of required equipment and materials for plot set-up and seasonal monitoring.

Set-up Equipment	Seasonal Monitoring and Maintenance Equipment
• Map showing plot locations • Flagging tape • Hand held GPS unit • Data sheets and pencils • ½ to ¾ m posts of iron rebar • Small sledge hammer/mallet • Spray paint • Camera	• Data sheets and pencils • Map showing plot location and UTM coordinates • GPS unit (to navigate to the site) • Thermometer • Binoculars • Compass • Flagging tape • Stop-watch with alarm/timer • Camera • Bug repellant

4.0 PLOT SET-UP METHODOLOGY

Where possible, measures have been taken to ensure that the TRCA monitoring stations satisfy requirements for the OFBMP however there are situations where forest patch size and degree of homogeneity will disqualify the TRCA station from contributing to the larger OFBMP initiative. Smaller forest fragments than what the OFBMP typically monitors are included in the overall study design as many forests within the TRCA jurisdiction have been reduced in size through agricultural and development practices during the past decade. In order to have a somewhat even distribution of sites across the jurisdiction and to have forest blocks that represent the forest condition, these smaller sites must also be included in the program.

Forest bird monitoring stations are ideally centred at least 100 m from the forest edge. Therefore the smallest forest block that can be monitored is a patch that is a circle with a diameter of 200 m. Where possible, each station is located so that the entire count circle is within a single forest type (e.g. conifer plantation, lowland mixed forest, or upland deciduous forest).

Each station centre is identified by a ½ to ¾ m length of metal rebar, hammered into the ground. Where possible, enough of the rebar is left standing above ground-level to maintain visibility. However, in situations where there is considerable public access (and where the station marker is likely to be removed) the rebar is hammered into the ground so that it is nearly flush with ground-level. In this way the station centre is still permanently marked but the marker does not pose a trip

hazard to members of the public. The reference coordinates are documented using the hand held GPS unit for each point station.

Before the beginning of each field season, a check on all stations is done to ensure that stations can be found easily during the survey period. Coloured flagging tape is used to guide the observer through the forest to each station.

5.0 DATA COLLECTION METHODOLOGY

The protocol for monitoring forest birds is based largely on the following:

Cadman, M.D., H.J. Dewar and D.A. Welsh. 1998. The Ontario Forest Bird Monitoring Program (1987-1997): Goals, methods and species trends observed. Technical Report Series No. 325, Canadian Wildlife Service. http://ontario.on.ec.gc.ca/wildlife/newsletters/fbmp05-e.html

Monitoring is conducted twice per year with the first visit occurring between May 24 and June 17, and the second visit between June 15 and July 10, with at least 10 days between visits. Counts are conducted between 0500 and 1000 hours and at approximately the same time of day on subsequent visits from year to year. Counts are conducted when weather conditions are such that it is unlikely to reduce count numbers. Winds can not be higher than a three on the Beaufort wind scale (Table 2) and no rain.

Table 2. Beaufort wind codes (adapted from Zorn *et al.* 2004)

Beaufort Scale	Wind Speed (km/h)	Description	Visual Cues
0	2	Calm	Smoke rises vertically
1	3	Light	Smoke drifts
2	8	Light breeze	Leaves rustle
3	16	Gentle breeze	Lighter branches sway
4	24	Moderate breeze	Dust rises, branches move
5	34	Fresh breeze	Small trees sway

After arriving at the site the data sheet is filled in with the site (route) name, pre-assigned site number, observer name, date, and an indication of the weather conditions using the Beaufort wind and sky codes (Table 3) and air temperature reading. In addition the UTM zone, northing and easting are indicated.

Table 3. Beaufort sky codes (adapted from Zorn *et al.* 2004)

Sky Code	Description
0	Clear (no cloud at any level)
1	Partly cloudy (scattered or broken)
2	Continuous layer(s) of cloud
3	Sandstorm, dust storm, or blowing snow
4	Fog, thick dust or haze
5	Drizzle
6	Rain
7	Snow, or snow and rain mixed
8	Shower(s)
9	Thunderstorm

The counts begin as soon as possible after an observer arrives at the station. On the data form the start time and end time is noted for each station along the route along with the visit number (either 1st or 2nd). In addition, the wind direction is indicated. A short "rest" period may be required to recover from the hike to the station and also to get your ear "tuned-in". The point count is conducted by mapping all individual bird observations (both audio and visual) onto the data form over the course of a 10 minute period. The exact location is marked (for those individuals within the 100 m count circle) and movements of each individual are noted. The 10 minute period is split into two 5 minute increments "a" and "b", with each species identified as to when it was first observed (Figure 1). During the count the assistant surveyor indicates the end of the first 5 minute period so that the surveyor can record subsequent species observed accordingly, i.e., BLJAa where BLJA is the species code and "a" depicts that it was heard within the first 5 minutes of the 10 minute survey period. During the 10 minute survey period the surveyor remains standing at the station post but turns to face each of the cardinal directions in order to facilitate the accurate mapping of individual bird positions.

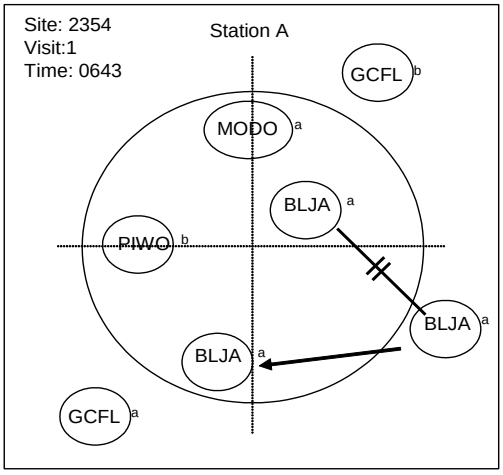

Figure 1. Sample of mapping of each bird observed during a point count.

All birds that are potentially associated with the forest should be mapped, including birds that are flying around that seem to be associated with the canopy (e.g. grosbeaks, crossbills). Birds that are clearly not associated with the forest habitat should not be counted (e.g. distant loon calls, fly-over gulls). In smaller forest blocks it is likely that the observer will hear species from the surrounding fields and hedgerows, or perhaps even from neighbouring woods, but it is important to record only those birds associated with the forest block that contains the station – and neither the field species nor individuals from more distant forest blocks should be included.

Individual birds encountered within the 100 m radius circle are mapped within the "range circle" on the provided data form; the surveyor endeavours to represent the individual in an approximation of its real position. Birds are mapped using their four letter species code and a variety of standard symbols are used to indicate the birds' behaviour and whether or not it was a male or female (Appendix A and B). Birds encountered beyond the 100 m radius are listed on the data form outside of the "range circle" but not mapped to scale. Note that the completion of the summary forms for each station which are submitted to the national Forest Bird Monitoring Program requires that only the first position and time (i.e. first or second five minute period) of each individual bird is transcribed onto the summary forms from the field data sheets ("range circles"). However, if an individual bird is initially reported from beyond count circle but then subsequently moves into the circle, it is important to note this latter position (and time period) since the TRCA analysis will be considering only those observations from within the count circle. Such double observations can be noted on the original data sheets (and referred to on the final summary sheets), highlighted for TRCA use. Obvious family groups should be registered as 2 adults (a note of family size can be made on the data sheet).

Fly-over individuals that are known to be associated with the forest block containing the monitoring station are to be included in the summary sheet. For the purpose of the TRCA's analysis these flyovers should be noted in the ">100 m" field unless the individual subsequently lands within the 100 m radius circle.

Note that during the survey:

- No pishing! The surveyor and assistant must remain silent for the entire 15 minute broadcast period.
- The assistant is not permitted to point out any birds or bird behaviour (or nests) to the surveyor. Again, it is important that observer ability/competence is standardized (consistent) so as to achieve meaningful observation of trends.

6.0 DATA MANAGEMENT AND ANALYSIS

Data Management

At the end of each field season all the data collected is sent to Canadian Wildlife Services to support this larger initiative (OFBMP). In addition, all data are entered into a corporate TRCA access database and all field collection forms are stored in a corporate filing system.

Data Analysis for the 2015 Terrestrial Long-term Monitoring Program Report (TRCA 2015a)

The TRCA Natural Heritage Monitoring database was queried and manually searched to ensure that two visits were conducted at each site over the season in each year. Bird data were retrieved using the 'Bird Yearly Analysis' link on the main page of the TRCA Natural Heritage Monitoring database. Using the Bird Yearly Analysis link ensures that the data do not include flyovers, species detected outside the 100 m radius and species that were likely migrating. Category and year were selected to retrieve relevant data. Data were then arranged into sheets in excel by site. Variables (species richness, # L1-L3 species, etc.) were calculated for each site in each year between 2008 and 2014. These data were arranged into excel tables with the site name shown in each row and year running across the top as columns. If a site contained more than one point count station, an average value was used. For example, if a specific site had 2 stations surveyed in a specific year with station 1 having 3 individuals and station 2 having 4 individuals, the average abundance for that site would be 3.5. This calculation only applies to sites with >1 station. For analysis of forest-dependent species, downy woodpecker was included as forest-dependent.

For both temporal and spatial analysis, summary tables with site as row and year as column were used. For temporal trends, data analysis attempted to maximize the number of years with the same list of sites consistently surveyed each year. This often resulted in limiting the number of sites included because new sites were added in more recent years. Keeping the same group of sites studied in each year allows for valid comparisons among years. The list of sites and years included for the temporal analysis can be found in the appendix of TRCA (2015a). The current baseline year for the temporal data is 2008 but in future years a later baseline year may be used in order to increase the number of sites included in the analysis.

Temporal trends were statistically analyzed using Mann-Kendall tests in an established Microsoft Excel™ spreadsheet provided by the Ministry of Natural Resources and Forestry. The Mann-Kendall test is a non-parametric test for identifying monotonic trends in time series data. This test was chosen over traditional regression analyses because the data did not meet the assumption of independent samples required for regression analyses. When analyzing time-series data, data collected at the same site from one year to the next are not independent. This made the Mann-Kendall test the best option. The Mann-Kendall test uses the S statistic to determine an associated p-value. If the value of S is zero, there is no trend in the data. If a data value from a later time period is higher than a data value from an earlier time period, S is incremented by one. On the other hand, if a data value from a later time period is lower than a data value sampled earlier, S is decremented by one. The net result of all such increments and decrements yields the final value of S (TRCA 2011). For example, a very high positive value of S is an indicator of an increasing trend, and a very low negative value indicates a decreasing trend (TRCA 2011). A p-value of less than 0.05 denotes a significant trend (increasing or decreasing) and a p-value of greater than 0.05 indicates that there is no increase or decrease over time and that the variable of interest is stable.

For spatial analysis, data analysis attempted to maximize the number of sites. This often resulted in using more recent years of data because new sites were added in more recent years. Often the most recent 2-4 years of data were used because they contained a consistent set of sites in each year. An

average value across the selected years was calculated for each site and this single value per site was used for analysis. The list of sites and years included for the spatial analysis can be found in the appendix of TRCA (2015a).

Spatial trend analysis was conducted using SAS JMP statistical software (SAS Institute Inc. 2008). Differences between urban and rural land use zones were analyzed using independent t-tests. An independent t-test is a parametric test that compares the mean value between two groups (e.g. urban and rural land use zones). This test is reported using the test statistic, t, and an associated p-value where a p-value of less than 0.05 indicates a difference between groups. A p-value of greater than 0.05 indicates that there is no difference between groups. Before performing t-tests, all data were checked for normality and homoscedasticity because these are two assumptions of using parametric statistics. If these assumptions were not met, data transformations were attempted to improve normality or heteroscedasticity. If data transformations were not effective, a Wilcoxon test was conducted (Z-statistic). This is the non-parametric version of an independent t-test and is the appropriate test to proceed with if the data do not meet assumptions. For TRCA (2015a), an independent t-test was used but this may not be the appropriate test to use in the future if the data violate the assumptions of using parametric statistics listed previously.

Although not included in TRCA (2015a), temporal trends were analyzed based on birds being grouped into three different guilds. The guilds within the forest bird group were divided based on where in the forest structure they tend to build their nests. A list of species and their nesting guild can be found in Appendix B. Temporal trends were also analyzed for several individual species including ovenbird (*Seiurus aurocapillus*), wood thrush (*Hylocichla mustelina*), and red-eyed vireo (*Vireo olivaceus*).

7.0 REFERENCES

Cadman, M.D., Dewar, H.J. and 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. http://ontario.on.ec.gc.ca/wildlife/newsletters/fbmp05-e.html

TRCA. 2011. Regional Watershed Monitoring Program: Surface Water Quality Summary 2006-2010. 49 pp + appendices.

TRCA. 2015a. Terrestrial Long Term Monitoring: Spatial and Temporal Trends 2008-2014.

TRCA. 2015b. A Retrospective Power Analysis for the Terrestrial Long Term Monitoring Program.

Zorn, Paul. 2008. A *Priori* Power Analysis for Toronto and Region Conservation Authority's Regional Watershed Monitoring Program. Report prepared for TRCA. Ottawa, ON

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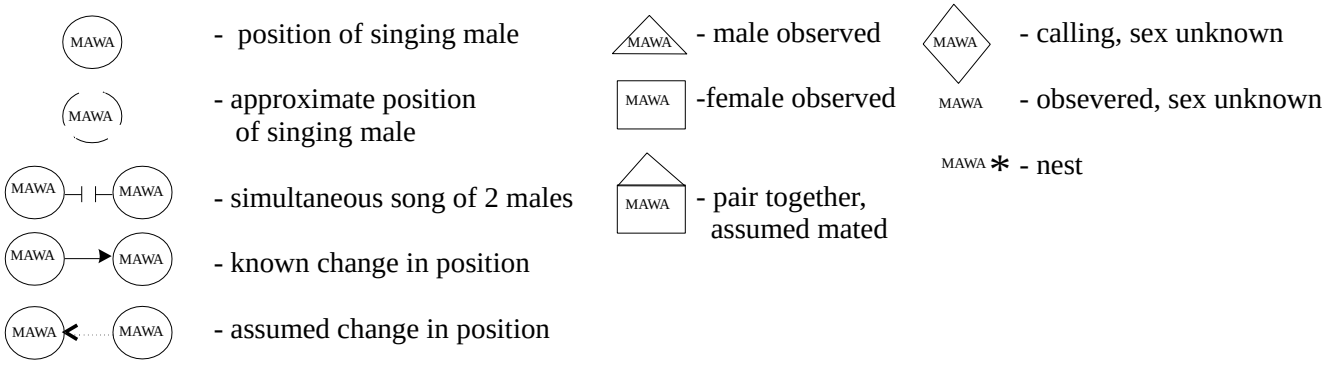
APPENDICES

Appendix A: Standard Symbols Used for Mapping

(Magnolia Warbler in this example)



APPENDIX B : Forest Bird Guild Species

Scientific Name	Common Name	Code	Low-nester	Mid-nester	Upper-nester
Caprimulgus vociferus	whip-poor-will	WPWI	X		
Helmitheros vermivorus	worm-eating warbler	WEWA	X		
Mniotilta varia	black and white warbler	BAWW	X		
Wilsonia canadensis	canada warbler	CAWA	X		
Bonasa umbellus	ruffed grouse	RUGR	X		
Catharus guttatus	hermit thrush	HETH	X		
Seiurus aurocapillus	ovenbird	OVEN	X		
Catharus fuscescens	veery	VEER	X		
Troglodytes troglodytes	winter wren	WIWR	X		
Wilsonia citrina	hooded warbler	HOWA		X	
Dendroica caerulescens	black-throated blue warbler	BTBW		X	
Certhia americana	brown creeper	BRCR		X	
Dendroica magnolia	magnolia warbler	MAWA		X	
Hylocichla mustelina	wood thrush	WOTH		X	
Vireo olivaceus	red-eyed vireo	REVI			X
Strix varia	barred owl	BADO			X
Buteo platypterus	broad-winged hawk	BWHA			X
Falco columbarius	merlin	MERL			X
Accipiter gentilis	nothern goshawk	NOGO			X
Buteo lineatus	red-shouldered hawk	RSHA			X
Empidonax virescens	Acadian flycatcher	ACFL			X
Dendroica fusca	Blackburnian warbler	BLBW			X
Dendroica virens	black-throated green warbler	BTNW			X
Vireo solitarius	blue-headed vireo	BHVI			X
Regulus satrapa	golden-crowned kinglet	GCKI			X
Asio otus	long-eared owl	LEOW			X
Aegolius acadicus	northern saw-whet owl	NSWO			X
Dryocopus pileatus	pileated woodpecker	PIWO			X
Dendroica pinus	pine warbler	PIWA			X
Piranga olivacea	scarlet tanager	SCTA			X
Accipiter striatus	sharp-shinned hawk	SSHA			X
Loxia leucoptera	white-winged crossbill	WWCR			X
Aix sponsa	wood duck	WODU			X
Sphyrapicus varius	yellow-bellied sapsucker	YBSA			X
Vireo flavifrons	yellow-throated vireo	YTVI			X
Polioptila caerulea	blue-grey gnatcatcher	BGGN			X

Accipiter cooperii	Cooper's hawk	COHA			X
Scientific Name	**Common Name**	**Code**	**Low-nester**	**Mid-nester**	**Upper-nester**
Otus asio	eastern screech-owl	EASO			X
Contopus virens	eastern wood-pewee	EAWP			X
Myiarchus crinitus	great-crested flycatcher	GCFL			X
Picoides villosus	hairy woodpecker	HAWO			X
Sitta canadensis	red-breasted nuthatch	RBNU			X
Sitta carolinensis	white-breasted nuthatch	WBNU			X