



Forest Birds at Risk of the Carolinian Forest in Southwestern Ontario

2019 Summary Report



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LIST OF ABBREVIATIONS

ACFL – Acadian Flycatcher
BMP – Best Management Practices
CA – Conservation Authority
CCCA – Catfish Creek Conservation Area
CERW – Cerulean Warbler
EAB – Emerald Ash Borer
ECCC – Environment and Climate Change Canada
ERCA – Essex Region Conservation Authority
HCA – Hamilton Conservation Authority
HNC – Hamilton Naturalist Club
LOWA – Louisiana Waterthrush
LPBLT – Long Point Basin Land Trust
LPRCA – Long Point Region Conservation Authority
LTCA – Lower Thames Conservation Authority
MNRF – Ontario Ministry of Natural Resources and Forestry
NCC – Nature Conservancy of Canada
NGO – Non-government Organization
OFBAR – Ontario Forest Birds at Risk
PROW – Prothonotary Warbler
SAR – Species at Risk
TTLT – Thomas Talbot Land Trust

ACKNOWLEDGEMENTS

Thank you to the many landowners who make this project possible, and especially to those taking action to support SAR and SAR habitat on their properties.

Thank you to the 2019 Birds Canada field staff, Matt Timpf, Jenny Andrews, and Sean Jenniskens, who collected and entered the data for this report and prepared materials for landowners. Special thanks to volunteers Don Wills and Dean Ware who monitor Prothonotary Warbler breeding success at several sites throughout southwestern Ontario. Thank you to the volunteers Tanya Barker, Neil Dunning, Betty Hubble, Jenni Kaija, James Lees, Emma Radziul, Joe Stephenson, and Becky Stewart for aiding in occupancy and point count surveys and to the many other Birds Canada staff who provided input and commentary.

Finally, this endeavour would not be possible without the continued financial support of:



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PROJECT GOALS AND OBJECTIVES

Our goal is to improve the conservation status of four high priority forest birds at risk in southwestern Ontario's forests: Acadian Flycatcher (ACFL; Endangered), Louisiana Waterthrush (LOWA; Threatened), Cerulean Warbler (CERW; Endangered), and Prothonotary Warbler (PROW; Endangered). Project results are intended to direct conservation and stewardship efforts over the short and long term.

Primary project objectives are to:

- Determine and monitor site occupancy of the four target SAR in the Long Point Walsingham Forest Priority Place and elsewhere throughout southwestern Ontario (e.g., federally-identified Critical Habitat);
- Search for and monitor nests to determine productivity for three target SAR in the Long Point Walsingham Forest Priority Place and elsewhere throughout southwestern Ontario;
- Identify threats to the target SAR in the Long Point Walsingham Forest Priority Place and elsewhere throughout southwestern Ontario;
- Increase key audiences' awareness and understanding of the target SAR and conservation needs, and to engage land owners and managers in stewardship for SAR.

In 2019, we also had the following secondary objective to:

- Increase our understanding of CERW habitat preferences in southwestern Ontario.

METHODS

Site Occupancy Surveys

Target SAR were searched for in forest tracts with known and potential breeding habitat for one or more of the four target SAR. Sites surveyed included: “known” sites (occupied by target species within the last five years), “historic” sites (occupied by target species over five years ago, but not since), and new sites (sites with potential habitat that have not been previously surveyed, or have never had target SAR detected). Sites were surveyed at least once during the breeding season and most were surveyed multiple times throughout the season to account for differences in timing of breeding amongst target species (e.g., LWA breeding season: May to June, ACFL breeding season: June to August). Birds Canada staff surveyed each site with area searches, recording target species locations and breeding evidence and assessing habitat quality. Nests were searched for when time permitted. See Appendix A for a copy of the occupancy data form used in the field. Further details of survey methodology, including levels of breeding evidence, can be obtained by contacting speciesatrisk@birdscanada.org.

Point Counts

Point counts were included in 2019 to increase species detectability while covering as much area as efficiently as possible in a standardized approach that will allow us to determine abundance estimates for the four target species. Within southwestern Ontario property boundaries, we established a stratified random sample of survey points separated by a minimum 300-m radius. Due to open canopy habitat preferences, Cerulean Warbler can be heard upwards of 400 m but detectability is reduced by half at distances greater than 150 m. Whereas, Acadian Flycatcher, Louisiana Waterthrush, and Prothonotary Warbler prefer interior closed canopy habitat and detectability is reduced as distance increases. We established a fixed-radius distance sampling method where distances are estimated in 50-m circular plots and restricted to ≤ 150 m to reduce detectability errors and of double counting the same male of each species singing within their territory. We completed one round of point counts at each site throughout the Long Point-South Walsingham Forest Priority Place and southwestern Ontario. Point counts were not completed in moderate to heavy precipitation, heavy fog, and winds exceeding a Beaufort scale of 4 (see Appendix B).

Detection probability of target species is no more significant at 8 minutes as it is at 20 minutes; therefore, our sampling periods were 10 minute point counts. All species of singing and visually observed birds were recorded during the survey period and the observer provided a best distance estimate within 50-m range estimates (Figure 1).

Observers arrived at the survey site for local sunrise time and point counts began as soon as possible and continued until all points were completed or 11:00 pm, whichever occurred first. The observer navigated themselves using a GPS and when a point could not be reached due to some feature (e.g., body of water), the survey was completed as close as possible to the original point and a new GPS point was taken and recorded on the data sheet. Once the observer had navigated to the survey point, they directed themselves to face north and orient the field sheet so north is facing upwards. Before the survey began, the observer recorded: the start and end time of each point count, weather information

(i.e., temperature, precipitation, cloud cover, and wind speed using the Beaufort scale), and exact UTM coordinates using a GPS (NAD83).

During the survey, every species heard or observed was recorded using its four-letter AOU code (if the AOU code was unknown a note on the margins was made and changed when the code could be properly verified) in the appropriate direction and estimated distance from the observer's location. Solid and dashed lines were used to indicate the same or different individuals of the same species, respectively. Individuals flying through or out of the survey area were recorded with a solid-line arrow in the direction it flew (Figure 1).

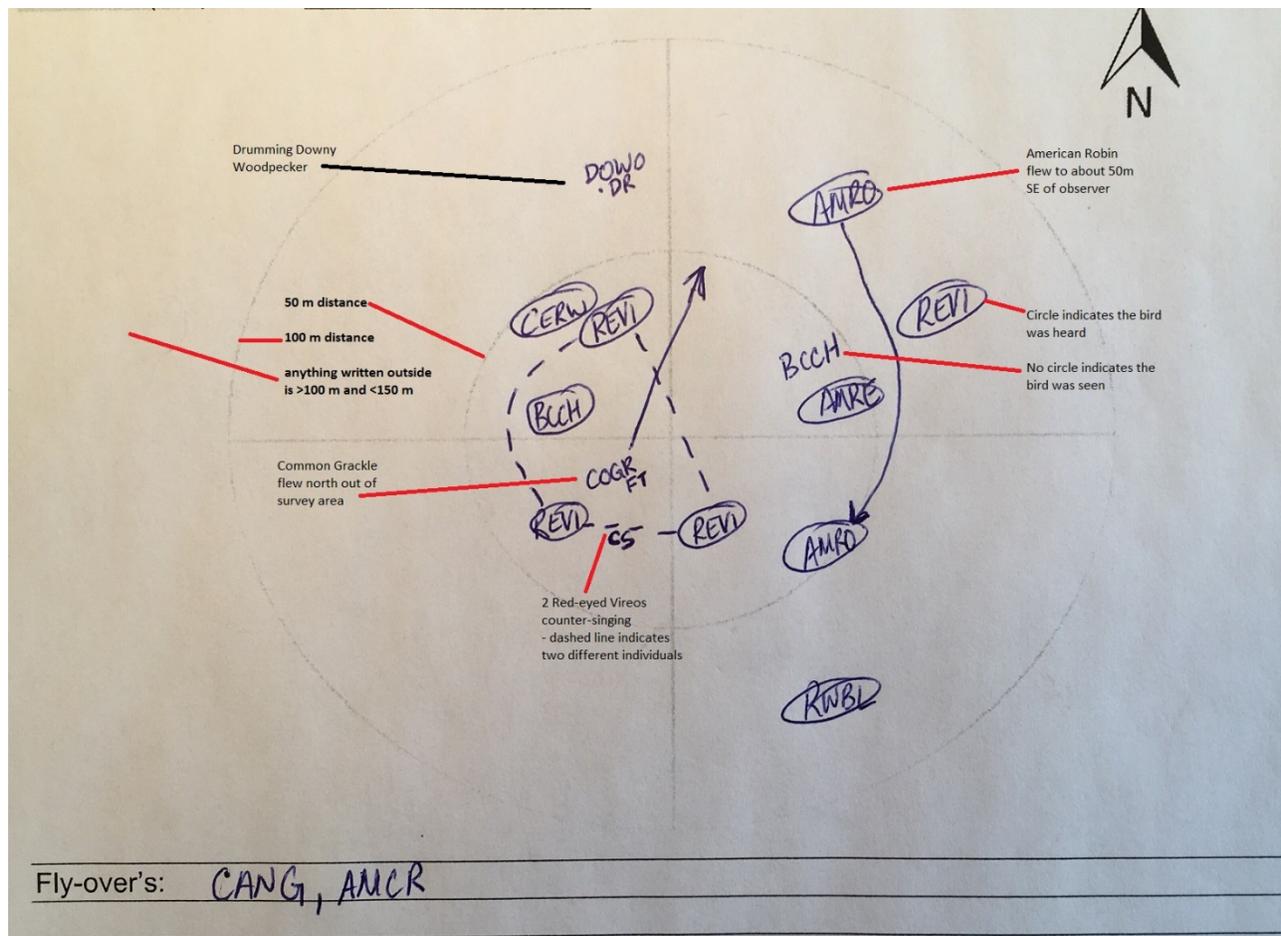


Figure 1. Point Count Data Form Example

Conservation Priority

A conservation ranking was determined for each site that had been surveyed at least two years. In 2019, we chose to develop a conservation ranking based on weighted averages. We weighted the occupancy and breeding evidence of each target SAR detected. An assumption we had to recognize was that, between each year, occupancy surveys were conducted similarly and search efforts were consistent within each site. If an individual singing male was detected with no evidence of a female nearby during a survey it was given a score of 1. A female or pair were given a score of 2; and, a nest or fledged young were given a score of 3. The score for each species from each site were totaled and averaged over the number of years the site had been surveyed. This provided us with a ranking based on

breeding evidence which suggests a site may be more productive for our target SAR and as such, our priorities should be focused on conserving and protecting these areas.

We were able to develop 5 different levels to prioritize our conservation efforts at each site. We determined that if a site scored 0 – 0.5, it was considered currently unsuitable habitat for our target SAR; our efforts should be focused elsewhere and the site is to be reassessed in 5 years. If the site scored 0.5 – 1, we considered it less than ideal habitat for individual species and an attempt to find indicators as to why the target species have declined at these sites should be considered unless apparent. A site that scored 1 – 2 was still considered less than ideal habitat, but the site may be either increasing towards potentially good breeding habitat and the focus should be to maintain the site under its current condition. Although, if a site scored 1 – 2 but had recently had large scale disturbance, the species may be losing habitat. A site scoring 2 – 3 is potentially ideal habitat for a particular target SAR. If breeding has been consistently monitored and the score has not changed, it may indicate a couple site condition limitations: 1) site size is not large enough to accommodate more target SAR; or, 2) the site is an ecological sink in which case there is potential for improved management at the site. Sites that scored >3 were considered ideal breeding habitat; our focus is to maintain this habitat and increase our conservation efforts towards securement of unprotected land.

In 2019, we also added a yearly percent change column that allows us to assess how these sites have changed over time with regards to our target SAR. To determine the yearly change, we found the percent change based on the yearly total weighted conservation ranking for each site. The division between the current and previous years was determined for each year the site was surveyed and the yearly percent change calculated. All years were averaged to determine the overall yearly percent change.

Avian Diversity

Avian diversity was measured using our occupancy and point count surveys. The highest number tallied for each species was used for each site and analysed using the 'vegan' package in Program R. We assessed each site by four measures of diversity: species richness, evenness, Shannon-Wiener index, and effective number of species (ENS or True Diversity). Species richness also provides environmental and ecological importance depending on the functionality of the site (e.g., a pine plantation for harvesting versus a site for conservation purposes only).

Species richness is a measure of the number of species at a given site. Sites with a greater species richness could be more structurally complex and provide more ecological function provided by various habitat types. Species richness is an important factor to consider for environmental and ecological functionality. This estimation of species richness of a site depends on environmental heterogeneity as well as person search-effort for each site. Ecological complexity contributes to an increase in species richness through such factors as size of the area, transitions of ecosystems, different types of ecosystems, and forest vertical structural complexity.

Evenness refers to how homogeneous a site is with regards to the abundance of species. The index is dependent on the Shannon-Wiener index (see below) to the maximum possible diversity. The evenness index is constrained between 0 and 1 and a location with a

low species evenness suggests there is great disparity between the numbers of individuals within each species. A site with a high species evenness suggests the number of individuals within each species are spread evenly across the landscape. In other words, a site with greater ecological complexity will likely have low evenness compared to a site that is ecologically homogeneous.

The Shannon-Wiener index is the most commonly used measure of diversity in ecology. This index increases as species richness and evenness of the community increases; however, it is not a measure of diversity but an index of diversity. While it provides a decent summary of each site's species, it makes it difficult to use the index to compare between communities or sites. Additionally, the Shannon-Wiener index is highly non-linear and makes comparative analyses between sites difficult to recognize. Instead, we used ENS as the measure of diversity to compare sites.

Effective number of species is a much more effective way to establish the true diversity of a site. Since the Shannon-Wiener index is non-linear (i.e., exponential), we can apply the exponential function (e^x) to the Shannon-Wiener index. Ecosystems that express the same measures of diversity should have the same true diversity (i.e., ENS). This allows for an equivalency between sites and as such a reference ecosystem where species are all equally common. Thus, sites with similar Shannon-Wiener indices can now be considered to have equivalent diversities.

Cerulean Warbler (CERW) Habitat Measurements

In 2018, the OFBAR program initiated the collection of CERW habitat information in their Carolinian Forest range and the Frontenac Forests Important Bird and Biodiversity Area (FF IBA) in eastern Ontario. Developing a clear understanding of local and/or regional habitat preferences/needs is important from a forest management perspective in that CERW populations in southwestern Ontario may need to be managed distinctly from the CERW population in the Frontenac region and a Best Management Practice (BMP) for CERW may not be universal across the species' Ontario range. Thus, in 2019, we continued gathering habitat information to better determine habitat preferences as well as our ability to detect potential differences between the two regions. To help ensure that the information gathered could be related to potential BMP forest prescriptions, we used standard forestry measurement techniques and worked with the OMNRF to identify key variables to be measured. We measured habitat at CERW occupied and unoccupied (control) sites in their Carolinian Forest range and the FF IBA (Appendix C). For the purpose of this report, only the southwestern Ontario results will be reported.

Forest composition was measured using a 2M basal prism sweep. A basal prism sweep measures the basal area of the forest in a 0.04-ha (400-m²) plot from some random point within the forest. However, our priority with the prism sweep was to determine the forest composition of the local area around male CERW song posts by noting tree species and size. Individual trees that had been counted "in" during a prism sweep were identified to species and basal size of a tree was categorized into one of four size classifications: saplings (0-9 cm); polewood (10-24 cm); small to medium sawlog (25-50 cm); large to x-large sawlog (>50 cm). Forest vertical structure at occupied and unoccupied CERW locations was determined by separating the vertical structure into four canopy heights (<6 m, 6-12 m, 12-

18 m, and >18 m high) and proportion of foliage density was estimated within those four vertical areas. Average canopy cover at occupied and unoccupied locations was determined using a densiometer. Canopy cover was measured at five locations and averaged. The observer recorded canopy cover with the densiometer at a central point. Then, the observer took two large steps due north and recorded canopy cover. This was repeated for all four cardinal directions and the average canopy cover density was reported. Tree height was measured using a Suunto clinometer from the tree in which the male CERW was first located as singing; or in the case of a control location where no CERW was present, the height of the tallest tree counted “in” within the basal prism sweep was measured. Finally, CERW habitat suitability was scored on a scale from 1 to 5.

When a male CERW was detected during an occupancy survey, its location was determined and habitat measurements were taken directly under from where the male was singing. Habitat measurements for unoccupied sites would be taken after an occupancy survey had been completed and no CERW were observed or detected. Measurements were taken at a random point ≥ 100 m from the forest edge. The distance chosen is based on previous information suggesting CERW are interior forest species.

Analyzing Cerulean Warbler Habitat

CERW absence and presence was identified as the binomial dependent variable, vertical structure was categorized as the nested random effect factor and all other habitat covariates were fixed effects. The decision to assign vertical structure as a nested random effect allowed us to obtain the hierarchical structure among foliage densities from which male CERW prefer to sing. Species of trees were retained but we also summed tree genera (e.g., red, sugar, and silver maple were summed into *Acer* spp.) that are considered important to CERW ecology based on literature and included tree genera as habitat covariates.

Covariates were scaled around the mean and we used a first and second order polynomial approach to select covariates that explain shape variation that best fit CERW presence to the forest stand characteristics. To reduce the number of variables, we considered covariates at a significance value of $p \leq 0.10$. We then conducted a correlation analysis to assess collinearity on the remaining covariates. Significant correlated covariates ≥ 0.60 were exchanged to assess which covariate best fit the CERW response but only one correlated covariate at a time was used for model building.

General linear regression (GLM) and generalized linear mixed effects regression (GLMM) from the “lme4” package in Program R were used to build CERW habitat models. Mixed effects models provide a more robust analytical approach than the generalized linear model (GLM) approach and allowed us to assess variables with an associated hierarchical structure (i.e., vertical structure). GLMs and GLMMs were tested using the Hosmer-Lemeshow goodness-of-fit test. Model performance was further tested by determining the area under the curve (AUC) and we considered models to perform well when AUC was ≥ 0.85 . Models that best described CERW presence were evaluated using Akaike’s Information Criteria (AIC) and we considered models with a $\Delta AIC_c \leq 4$ to be supported by the data. All analysis was completed in Program R and the significance level was at 0.10 to account for small sample size and variation within the data.

Landowner Engagement and Stewardship

Private land ownership in the region falls into one of two categories: individual private landowners and conservation organizations (e.g., Nature Conservancy of Canada). Individual landowners manage or conserve their property for various purposes, ranging from conservation, to personal recreation and/or animal harvesting, to active forest harvest, whereas conservation organizations typically work to maintain or restore forests for conservation purposes.

All individual private landowners were contacted preceding the field season either in person or by phone to gain permission to access their land. We also contacted the respective landowner 24-48 hours prior to conducting each survey as a courtesy and as a reminder of the survey. Permission to conduct surveys on public properties (including land managed by Conservation Authorities, provincial and federal parks, and municipal property) was obtained through the appropriate permit process.

After each visit, all landowners were provided with survey results for their property. Private landowners also received thank-you letters along with the list of birds detected on their property. All landowner engagements (e.g. discussions and threat mitigation efforts) were tracked to help maintain strong communicative relationships between Birds Canada and landowners between years, and to enable evaluation of the effectiveness of our outreach and engagement efforts.

Forest Health Risk Surveys

While conducting occupancy and point count surveys, we assessed all sites for risks to target SAR and/or their habitat. Forest health risks (FHR) are classified into one of three categories. Human-related risks include a wide range of threats with varying levels of potential impact to SAR, all of which are directly related to anthropogenic activities. This category includes activities such as garbage dumping, inappropriate trail placement or road placement, all-terrain vehicle use, and forest harvesting. Invasive species also pose a risk to SAR and their habitat by reducing the amount of available suitable habitat. Finally, “natural” risks include risks such as avian and mammalian nest predators, low moisture levels (dried out sloughs), or streambank erosion, which may be indirectly related to human activity.

Upon discovering an incidental FHR observation, observers visually estimated a 20-m x 20-m plot and recorded all forest health risks within the visual plot. Percent cover of those risks were estimated for each FHR and recorded as the risk extent. Due to the vertical structure of FHRs (e.g., garlic mustard and emerald ash borer), percentage of the risk extent of an area could exceed 100%. For species such as garlic mustard and multi-flora rose, ground cover percentage was used for determining risk extent. To determine the risk extent of an ash tree infected with emerald ash borer, for example, the canopy cover percentage was estimated to the best of the observers’ ability.

In addition to recording incidental observations of FHRs, we attempted to standardize our FHR observations. Since bird surveys are the priority for the OFBAR program, we attempted to develop an efficient FHR design that would allow observers to include a significant portion of the immediate area without a large time constraint. Additionally, FHR were taken at point count stations regardless of whether FHR were present.

When immediate risk(s) to target SAR or their habitat were observed during surveys, the appropriate landowner was informed and mitigation options were discussed. Refer to Appendix D for the forest health risk datasheet.

RESULTS AND DISCUSSION

In 2019, we surveyed a total of 112 sites in southwestern Ontario with known, historic, or potential SAR habitat. The total area of the 112 woodlots and forests surveyed was 10,207.7 ha (Table 1). Sites ranged in size from 5.1 to 1743.0 ha with an average area of 91.1 ± 17.3 ha. All sites were visited once and some sites were visited multiple times (Appendix E). A total of 168 site visits were made either for species occupancy surveys, breeding confirmation, or to monitor SAR nests. Total search area covered after multiple surveys per site was 14,347.8 ha and total person-effort to cover this area was 745.7 hours (Table 1). Site visits ranged from 30 minutes (nest check) to 5.2 hours (occupancy/point count surveys) with an average time spent at a site of 2.1 ± 0.1 hours (Appendix E).

Table 1. Survey site details including the total number of sites, total area covered, and total effort by field staff and volunteers.

Landowner*	No. Sites	Total Area (ha)	No. of Visits	Person-effort (hours)	Area Covered per site (ha)
CCCA	4	460.5	5	30.9	655.5
ERCA	3	232.9	11	42.0	232.9
GRCA	2	152.2	2	4.8	152.2
HCA	1	420.0	1	15.0	420.0
HNC	1	243.0	1	4.1	243.0
KCCA	1	111.0	1	7.5	111.0
LPBLT	3	124.2	3	5.0	124.2
LPRCA	31	1729.4	42	123.4	2428.2
LTVCA	1	128.0	1	2.6	128.0
Middlesex Cty	5	472.2	7	25.6	472.2
MNRF	4	392.2	8	43.4	741.9
NCC	5	649.7	17	108.5	3028.4
Norfolk Cty	2	165.5	2	6.6	165.5
Ontario Parks	4	2964.0	6	119.8	2964.0
private	35	1247.6	50	171.9	1739.1
SCRCA	3	376.8	3	14.5	376.8
TTLT	6	252.6	7	17.2	279.0
Waterloo Cty	1	85.9	1	3.1	85.9
TOTAL	112	10207.7	168	745.7	14347.8

* for landowner names see list of acronyms at the beginning of the summary

All 112 sites were either privately or publicly owned and every landowner and manager exhibited either complete land conservation, some degree of forest management (i.e. forest harvesting), or recreation at varying levels (i.e. hiking to ATV use). Private landowners consisted of 35 individual landowners (31.3%) and 4 conservation organizations (e.g. NCC, 2 local land trusts, and a naturalist club) (13.4%). Thirteen public landowners consisted of 8 CAs (41.1%) as well as 3 municipal and 2 provincial government sites in southwestern Ontario (14.3%; Table 1).

CONSERVATION PRIORITY

A total of 108 sites were included in the conservation scoring in 2019, with 22 new sites assessed. Individual landowners comprised 29.6% (n = 32) of the sites; conservation organizations, 15.7% (n = 17); and public landowners, 54.6% (n = 59). Of the 108 sites ranked, 42 had a weighted average of 1.0 or greater (Table 2), indicating that these sites have either consistently supported one or more target SAR in every year they have been surveyed. Additionally, of the 32 privately owned woodlots, 17 of those sites have a ranking ≥ 1.0 . Of the 17 conservation organization sites assessed, 5 sites ranked ≥ 1.0 . Public sites comprised 54.6% of the sites ranked for conservation priority, with 20 sites showing a ranking of ≥ 1.0 .

All 108 sites with a conservation ranking also had their average yearly change calculated. Of the 108 sites assessed, one-third (n = 36) showed positive yearly change and 16.7% (n = 18) showed a negative yearly change. The remaining sites (50.0%) showed no change in target SAR conservation priority since surveys had begun. However, of those sites showing no change, 22.2% (n = 24) have consistently had target SAR, suggesting the landowners of these sites are maintaining habitat for the species occupying the area. Engaging these landowners to ensure site maintenance as well as looking at how to increase habitat for one or more of the target species should be a priority to increase site productivity. Sites that have not had target SAR and where no change has occurred, but have potential for suitable habitat, should be reassessed in five years. Sites that are to maintain their current successional condition and where there is no indication that suitable habitat for target SAR will exist in the future (e.g., pine plantation) may need to be overlooked to focus survey efforts on new sites with suitable habitat for target SAR.

Table 2. Weighted averages of properties in which surveys have occurred in 2 or more years. Refer to Conservation Priority to ascertain how weighted averages were calculated.

Site ID	Landowner	Years Surveyed	ACFL weighted average	CERW weighted average	LOWA weighted average	PROW weighted average	All target SAR weighted average	Average yearly change
LA3z	Ontario Parks	2	2.50	1.00	0.00	0.00	3.50	257%
EL57z	private	4	0.00	1.50	0.00	0.00	1.50	104%
MI3h	Middlesex Cty	5	0.80	1.20	0.00	0.60	2.60	91%
LA2z	SCRCA	4	9.50	2.00	0.75	0.00	12.25	78%
EL45a	private	4	6.25	0.00	3.50	0.00	9.75	71%
EL14z	private	6	0.33	0.00	1.50	0.00	1.83	66%
HN16b	OMNRF	9	0.11	0.00	3.00	0.00	3.11	63%
HN27d	LPRCA	9	2.67	0.11	1.11	0.00	3.89	62%
EL54b	private	3	0.00	0.00	2.00	0.00	2.00	56%
HN111b	LPRCA	3	0.00	2.00	0.00	0.00	2.00	56%
ES5z	ECCC	2	0.00	0.00	0.00	0.50	0.50	50%
KE3	Ontario Parks	2	0.00	0.00	0.00	0.50	0.50	50%
HN27a	LPRCA	9	0.00	0.00	2.00	0.00	2.00	50%
HN21b	LPRCA	8	0.00	1.63	0.00	0.00	1.63	48%

EL20z	TTLT	7	3.43	0.00	0.00	0.00	3.43	46%
KE2z	Ontario Parks	5	1.20	0.00	0.00	3.80	5.00	40%
HN4d	LPRCA	9	2.33	0.11	0.11	0.00	2.56	39%
HN3c	LPRCA	7	0.00	0.00	0.71	0.00	0.71	31%
HN30z	private	7	0.71	0.00	4.00	0.00	4.71	29%
ES2z	ECCC	4	0.00	0.00	0.00	3.25	3.25	27%
BR02z	private	4	0.00	0.00	0.00	3.00	3.00	25%
HN21e	private	3	1.00	0.33	0.00	0.00	1.33	25%
HN31z	LPRCA	4	0.75	0.00	0.50	0.00	1.25	25%
MI3b	Middlesex Cty	5	3.60	0.20	0.00	0.00	3.80	23%
HN114z	LPBLT	6	0.00	0.17	0.00	0.00	0.17	17%
EL45z	private	8	2.38	0.00	2.63	0.00	5.00	14%
HN112b	private	7	0.00	0.00	1.57	0.00	1.57	13%
EL29z	private	4	0.00	0.25	0.25	0.00	0.50	13%
HN27g	NFN	9	3.56	0.00	0.00	0.00	3.56	12%
HN27c	LPRCA	9	4.11	0.11	4.11	0.00	8.33	11%
HN1c	NCC	9	2.67	0.67	3.67	0.22	7.22	10%
HN1b	NCC	9	0.78	3.44	3.89	15.44	23.56	9%
HN81z	LPBLT	9	6.67	0.00	0.00	0.11	6.78	9%
HN37c	LPRCA	7	0.00	0.29	0.00	0.00	0.29	7%
EL46d	private	3	0.00	0.00	2.33	0.00	2.33	4%
HN21a	LPRCA	9	0.00	1.22	0.00	0.00	1.22	2%
EL3z	private	3	0.67	0.00	0.00	0.00	0.67	0%
EL60c	private	2	0.50	0.00	0.00	0.00	0.50	0%
HN27l	LPRCA	2	0.00	0.50	0.00	0.00	0.50	0%
MI3f	LTVCA	2	0.50	0.00	0.00	0.00	0.50	0%
HN19b	LPRCA	8	0.00	0.13	0.25	0.00	0.38	0%
EL16a	CCCA	3	0.00	0.33	0.00	0.00	0.33	0%
HN101b	NCC	3	0.33	0.00	0.00	0.00	0.33	0%
HN102b	private	3	0.33	0.00	0.00	0.00	0.33	0%
HN12e	OMNRF	3	0.33	0.00	0.00	0.00	0.33	0%
HN12f	OMNRF	3	0.33	0.00	0.00	0.00	0.33	0%
HN161z	private	3	0.33	0.00	0.00	0.00	0.33	0%
HN26c	LPRCA	3	0.00	0.33	0.00	0.00	0.33	0%
HN5c	NCC	6	0.17	0.00	0.17	0.00	0.33	0%
HN99z	private	3	0.00	0.33	0.00	0.00	0.33	0%
HN16e	OMNRF	4	0.25	0.00	0.00	0.00	0.25	0%
HN16m	LPEA	4	0.25	0.00	0.00	0.00	0.25	0%
HN96a	NCC	4	0.25	0.00	0.00	0.00	0.25	0%
HW1z	HCA	4	0.25	0.00	0.00	0.00	0.25	0%
HN17b	LPRCA	5	0.00	0.20	0.00	0.00	0.20	0%
HN5b	NCC	5	0.00	0.00	0.20	0.00	0.20	0%
EL43b	CCCA	6	0.17	0.00	0.00	0.00	0.17	0%
HN37a	LPRCA	6	0.00	0.17	0.00	0.00	0.17	0%
MI3k	Middlesex Cty	6	0.17	0.00	0.00	0.00	0.17	0%

EL49z	private	7	0.14	0.00	0.00	0.00	0.14	0%
BR24z	private	2	0.00	0.00	0.00	0.00	0.00	0%
BR80z	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
BR81z	LPRCA	3	0.00	0.00	0.00	0.00	0.00	0%
EL18a	CCCA	2	0.00	0.00	0.00	0.00	0.00	0%
EL22z	private	2	0.00	0.00	0.00	0.00	0.00	0%
EL28z	private	5	0.00	0.00	0.00	0.00	0.00	0%
EL29d	private	6	0.00	0.00	0.00	0.00	0.00	0%
EL50a	private	3	0.00	0.00	0.00	0.00	0.00	0%
EL52z	private	2	0.00	0.00	0.00	0.00	0.00	0%
ES10z	ERCA	4	0.00	0.00	0.00	0.00	0.00	0%
HN113a	NCC	2	0.00	0.00	0.00	0.00	0.00	0%
HN12d	OMNRF	9	0.00	0.00	0.00	0.00	0.00	0%
HN17a	LPRCA	5	0.00	0.00	0.00	0.00	0.00	0%
HN18a	LPRCA	3	0.00	0.00	0.00	0.00	0.00	0%
HN18b	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
HN27j	private	2	0.00	0.00	0.00	0.00	0.00	0%
HN37d	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
HN37e	LPRCA	3	0.00	0.00	0.00	0.00	0.00	0%
HN37z	LPRCA	4	0.00	0.00	0.00	0.00	0.00	0%
HN4a-1	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
HN4a-2	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
HN4b	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
HN7z	LPRCA	4	0.00	0.00	0.00	0.00	0.00	0%
HN8a	LPRCA	2	0.00	0.00	0.00	0.00	0.00	0%
HN90z	LPRCA	3	0.00	0.00	0.00	0.00	0.00	0%
LA5z	Ontario Parks	2	0.00	0.00	0.00	0.00	0.00	0%
MI2a	TTLT	2	0.00	0.00	0.00	0.00	0.00	0%
MI3g	TTLT	3	0.00	0.00	0.00	0.00	0.00	0%
MI4a	TTLT	2	0.00	0.00	0.00	0.00	0.00	0%
HN160a	private	3	0.00	2.33	0.00	0.00	2.33	0%
EL27z	private	7	4.57	0.00	0.86	0.00	5.43	-4%
EL51z	LPRCA	7	0.00	0.29	0.57	0.00	0.86	-5%
HN21c	LPRCA	7	0.00	0.29	0.00	0.00	0.29	-14%
EL14b	private	3	0.00	0.00	4.67	0.00	4.67	-16%
ES20z	ERCA	4	0.00	0.00	0.00	1.75	1.75	-16%
EL15z	CCCA	5	0.20	0.00	0.40	0.00	0.60	-17%
HN12g	OMNRF	9	1.00	3.44	0.00	0.00	4.44	-18%
HN31a	LPBLT	5	0.40	0.00	0.40	0.00	0.80	-18%
HN14z	HNC	9	0.78	0.00	0.11	0.00	0.89	-21%
HN160z	private	4	0.00	0.50	0.00	0.00	0.50	-25%
HN5z	NCC	4	0.25	0.00	0.25	0.00	0.50	-25%
MI6z	Middlesex Cty	5	2.00	0.20	0.00	0.00	2.20	-26%
HN69z	private	3	1.00	1.67	1.00	0.00	3.67	-26%
EL14c	private	3	0.00	0.00	1.00	0.00	1.00	-28%

HN52a	Norfolk Cty	9	0.67	0.00	0.67	0.00	1.33	-29%
EL60z	private	3	1.33	0.00	0.00	0.00	1.33	-31%
HN5a	LPRCA	9	0.67	0.22	0.56	0.00	1.44	-31%
EL46c	private	9	0.56	0.00	0.89	0.00	1.44	-32%

AVIAN DIVERSITY

This is the first year the OFBAR program has reported on avian diversity within the woodlots we survey. In 2019, 104 survey sites had their species richness, evenness, and diversity calculated for birds. Private landowners comprised 29.8% (n=31), conservation organizations, 14.4% (n=15), and public landowners, 55.7% (n=58) of this analysis (Table 3).

Species richness ranged among sites with one site having 80 species while another had 13 species. The median among the sites was 34 species (Table 3). As expected, sites with a higher species richness were negatively correlated with evenness ($\rho = -80$). Evenness ranged from 0.566 to 0.720 with a mean evenness for all sites of 0.652. Several sites (n= 7) had evenness values greater than 0.70. All sites were less than 16 hectares with the exception of HN27c, which is 82 ha. These seven sites had fewer than 25 species, which suggests the ecosystems of these sites were similar across the landscape, likely due to the small area. However, HN27c had a very low search-effort (see below for the importance of survey-effort) which may have underestimated species richness and as a result, overestimated evenness.

Effective Number of Species (ENS) ranged from 6.33 to 14.68 with the mean and median around 10 equally common species. As a result of linearity of ENS identifying equally common species, this allows the analysis for better site comparison. Using the median (9.9) to compare sites, 31.7% (n=33) had a value of greater than 10 equally common species (Table 3). Only two sites, both CCCA properties, were above 14 species, followed closely by two privately-owned sites. An additional comment to include here is that both privately-owned sites are managed for conservation purposes and in one case, EL14z, there have been modifications (e.g., man-made pond) to increase the conservation and diversity value of this site.

Half of the sites assessed fell below the mean of 10 equally common species (n = 53; Table 3). This was due to factors that varied from site to site, including: very small site size (e.g., sites ≤ 10 ha); limited survey effort; or focused more towards target species occupancy, which is the top priority of the OFBAR program. Due to this variation, attempting to understand diversity at these sites may not be the best solution to instruct management decisions. These sites may be better managed for target species and management decisions should be made to consider these species; or, in the case of a small site, perhaps a tree-planting program could be initiated to increase forest cover and connectivity with other nearby woodlots to increase diversity if habitat for target species is not available.

Three important factors should be considered when assessing diversity of each site: the area of the site surveyed, the timing of the survey, and person search-effort. A site that is smaller is likely to have lower ENS, fewer forest transition ecotypes, and minimal search-

effort and therefore is likely less diverse compared to sites at the opposite end of these factors. For example, EL15z had a species richness of 80 bird species despite being ~195 ha, compared to LA5z and KE2z which are ~1700 and 695 ha, respectively. However, the species richness results indicate LA5z and KE2z had 54 and 56 species, respectively (Table 3). Meanwhile, the search-effort per area at EL15z was 6 times greater than that of LA5z and KE2z. The reason for a greater search-effort was a result of completing regular surveys during an education and outreach bird walk initiated by CCCA that counted towards occupancy surveys. Additionally, the bird walk took place at the tail end of migration so breeders and migrants were being counted. Furthermore, all 4 OFBAR technicians and approximately 15 volunteers joined on the bird walk, all detecting birds. EL15z also has numerous ecotypes ranging from open and treed wetlands, a small lake, old-growth deciduous, pine plantation, open areas representative of a public park, as well as open areas fragmented by development.

If we are to compare avian diversity among sites, we need to control for the three factors mentioned above. First, occupancy surveys should be conducted only during the breeding period after all migrants have immigrated to their breeding grounds. Then, sites should be selected to either have a similar size, or a minimum size (e.g., only assess sites with a minimum of 20 ha), or perhaps a total survey time per site (e.g., survey-effort at 5 minutes per hectare) should be provided. For practical purposes, it is easier to control survey time than manipulate the survey area; plus, manipulating the site size confounds our diversity results. For example, which 20 ha should be surveyed? Random area selection could place the 20 ha in a pine plantation despite the larger portion of the site consisting of mixed or deciduous forest ecosystems, which would not provide a true representation of diversity within the site. The median search-effort for all sites surveyed was 2.7 minutes per ha (Table 3). Only about half (51.9%) of these sites met this criteria which suggests the sites with minimal survey-effort (<2.7 minutes per ha) should have the survey time increased.

Table 3. Diversity results for 104 sites surveyed in 2019.

Site ID	Site Name	Landowner	Site Area (ha)	Search-effort (hrs)	Minutes per ha	Species Richness	Evenness	True Diversity (ENS)
EL15z	Springwater CA	CCCA	195	23.7	7.3	80	0.613	14.68
EL16a	Yarmouth Natural Area	CCCA	94	2.3	1.4	65	0.639	14.41
EL14z	Silver Creek - Passmore	private	60	9.5	9.5	69	0.622	13.94
EL29z	Hotchkiss	private	161	8.0	3.0	63	0.634	13.82
HN5a	Hepburn Tract	LPRCA	111	5.6	3.0	61	0.625	13.05
HW1z	Dundas Valley CA	HCA	420	15.0	2.1	61	0.617	12.61
EL54b	Ketchabaw	private	23	9.3	24.6	48	0.654	12.60
HN14z	Spooky Hollow	HNC	243	4.1	1.0	53	0.638	12.58
MI11a	Sydenham River Nature Reserve	private	63	40.0	38.3	54	0.632	12.46
EL46c	Talbot Line Ravine	private	61	3.6	3.5	49	0.644	12.28
EL43b	Calton Swamp	CCCA	118	3.3	1.6	55	0.625	12.25
HN96a	Lake Erie Farms	NCC	98	4.5	2.8	53	0.630	12.21
HN27d	Armstrong	LPRCA	83	3.5	2.5	56	0.621	12.20
HN16b	Turkey Point Bluffs & Ravine	MNRF	107	3.5	2.0	54	0.626	12.14
HN1b	Backus North	NCC	247	11.7	2.8	58	0.613	12.05

LA2z	Lambton Heritage Forest	SCRCA	306	8.6	1.7	53	0.626	11.99
HN31a	Fishers Glen-South	LPBLT	20	1.5	4.5	50	0.634	11.95
HN21b	Hanson Earl Danylevitch	LPRCA	100	2.7	1.6	55	0.619	11.93
HN19b	Jackson Tract	LPRCA	42	5.4	7.7	51	0.630	11.93
HN31z	Fishers Glen-North	LPRCA	56	3.3	3.5	48	0.637	11.78
EL14b	Silver Creek-VanOverloop	private	56	3.5	3.7	50	0.628	11.68
HN17a	Mckay-Kyte-Laforge	LPRCA	90	2.6	1.7	45	0.642	11.51
HN4d	Burwell Tract	LPRCA	38	4.2	6.6	43	0.647	11.38
HN1c	Backus South	NCC	241	10.2	2.5	54	0.609	11.37
MI3h	Skunk' Misery - NC	Middlesex Cty	212	6.4	1.8	47	0.631	11.35
EL45z	Carson Line Ravine	private	79	5.9	4.5	40	0.658	11.34
HN26c	Roney Tract	LPRCA	33	2.1	3.8	41	0.652	11.27
HN101b	Conklin Tract	NCC	38	5.2	8.4	43	0.644	11.25
HN17b	Vandervyvere-Lipsit-Penner	LPRCA	103	2.6	1.5	45	0.634	11.19
BR04a	Pinehurst CA	GRCA	119	3.0	1.5	45	0.634	11.17
EL45a	Painted Ravine	private	33	7.2	13.2	43	0.641	11.15
EL13a	Dalewood North CA	KCCA	111	7.5	4.1	42	0.643	11.07
HN81z	Arthur Langford	LPBLT	94	2.5	1.6	45	0.631	11.03
WA5a	Sudden Tract	Waterloo Cty	86	3.1	2.2	44	0.632	10.93
HN30z	Shoppe's Creek	private	78	3.8	3.0	45	0.627	10.86
MI4a	Newport Forest	TTLT	43	1.6	2.2	38	0.654	10.81
LA5z	Pinery PP	Ontario Parks	1743	27.1	0.9	54	0.597	10.80
HN37a	Middleton Swamp	LPRCA	96	3.6	2.2	39	0.649	10.79
HN21a	Swick-King Tract	LPRCA	94	5.0	3.2	49	0.611	10.78
HN37z	Anderson Tract	LPRCA	80	3.5	2.6	39	0.649	10.78
HN37e	Parson-Vanderhaeghe	LPRCA	92	2.4	1.6	37	0.656	10.70
BR06a	Harley Tract	LPRCA	33	1.1	2.0	34	0.672	10.70
HN5c	Casier Tract	NCC	27	3.5	7.9	36	0.657	10.55
LA3z	Bickford Woods	Ontario Parks	382	9.3	1.5	47	0.611	10.50
EL18a	Archie Coulter CA	CCCA	54	1.7	1.9	35	0.660	10.47
LA28a	Ferguson Property	private	44	2.1	2.8	34	0.664	10.39
EL28z	South Otter-Grigg	private	62	2.5	2.4	32	0.673	10.29
HN12g	St. Williams NE	MNRF	160	3.7	1.4	41	0.625	10.18
EL57z	Carolinian Woods Area	private	10	1.2	7.0	31	0.674	10.11
EL3c	Wiehle Property	private	19	1.6	4.9	31	0.673	10.10
HN4a-2	Harris Harris Floyd West	LPRCA	62	1.9	1.9	33	0.659	10.03
EL51z	Rugienis Tract	LPRCA	10	0.6	3.7	29	0.682	9.95
HN12d	St. Williams SW	MNRF	97	2.0	1.2	35	0.646	9.95
HN90z	Buchner-Mason	LPRCA	21	1.3	3.6	38	0.629	9.86
HN26d	Long Tract	LPRCA	40	1.8	2.8	32	0.659	9.81
KE2z	Rondeau PP	Ontario Parks	697	13.7	1.2	56	0.566	9.78
HN21c	Smith Tract	LPRCA	42	0.9	1.3	33	0.652	9.78
HN52a	Trout Creek	Norfolk Cty	81	3.9	2.9	34	0.644	9.68
HN37d	Ringland	LPRCA	39	1.2	1.8	29	0.673	9.64
HN111b	Hammond Tract	LPRCA	21	2.0	5.9	31	0.659	9.61

HN4b	Allan Tract	LPRCA	21	1.3	3.5	31	0.659	9.61
HN7z	Monroe London	LPRCA	55	3.8	4.2	32	0.652	9.57
MI3b	Skunk'S Misery - NE	Middlesex Cty	119	5.2	2.6	34	0.639	9.52
MI6z	County Line Woods	Middlesex Cty	59	3.0	3.0	28	0.676	9.52
KE7a	Wilkin's Property	private	17	1.3	4.4	28	0.674	9.46
KE10a	Hubble Property	private	29	4.2	8.8	27	0.682	9.45
MI2a	Wardsville Woods	TTLT	20	0.9	2.6	27	0.681	9.45
HN21e	Griffin Woods	private	21	0.9	2.7	29	0.666	9.41
HN3c	Croton CA	LPRCA	14	1.1	4.6	27	0.678	9.34
MI3f	Mosa Forest	LTVCA	128	2.6	1.2	29	0.664	9.34
HN102b	Fakeburn Tract	private	25	1.0	2.3	28	0.669	9.29
EL14c	Silver Creek-Lindsay	private	25	1.2	2.9	33	0.637	9.28
HN27a	Wilson Tract	LPRCA	87	3.8	2.6	48	0.574	9.23
MI10b	Yarmoschuk Property	private	29	1.7	3.4	28	0.665	9.16
MI6a	Sherwood Forest	private	22	1.4	3.9	24	0.696	9.14
HN18b	Hird-Tarcza-Robertson	LPRCA	40	1.3	1.9	28	0.663	9.10
LA9a	Reid Property	SCRCA	49	2.6	3.1	33	0.630	9.05
MI3a	Beryl Ivey Woods	TTLT	26	2.3	5.3	29	0.652	8.97
BR05a	App's Mills CA	GRCA	33	1.8	3.2	27	0.664	8.93
BR24z	Oakland Swamp-Dunning	private	7	2.8	25.6	24	0.686	8.86
HN4a-1	Harris Harris Floyd East	LPRCA	83	1.5	1.1	31	0.635	8.84
EL5a	Casier Property	private	6	2.3	22.1	21	0.707	8.62
EL60z	Whitting Way	private	19	0.8	2.4	23	0.680	8.44
EL20z	Hawk Cliff	TTLT	81	2.9	2.1	39	0.582	8.43
MI3g	Bebensee 1& 2	TTLT	58	2.2	2.2	24	0.670	8.40
HN160a	Kennedy	private	34	1.1	1.9	21	0.699	8.40
MI10a	Old River Farms	private	23	1.8	4.8	24	0.669	8.39
MI3j	Sack	TTLT	24	1.1	2.7	22	0.683	8.27
HN27g	Rowanwood Tract	private	79	2.5	1.9	27	0.637	8.15
HN114z	Jackson-Gunn	LPBLT	10	1.0	5.8	22	0.678	8.13
HN160z	Serenity	private	14	0.6	2.7	19	0.707	8.02
LA10a	McPhail Tract	SCRCA	22	3.3	9.1	23	0.658	7.87
MI3e	Skunk'S Misery - SW	Middlesex Cty	41	0.8	1.2	21	0.676	7.83
EL3b	Galbraith	private	22	1.8	5.0	22	0.665	7.81
BR06b	Fairfield Plains Tract	LPRCA	17	0.7	2.4	19	0.696	7.77
MI10c	Burgsma Farms	private	16	0.8	2.8	18	0.707	7.72
HN99z	Rhino Woods	private	5	0.8	9.7	18	0.702	7.61
HN37c	Abbot-Townsend	LPRCA	37	1.4	2.2	20	0.674	7.54
HN18a	Vanessa Tract	LPRCA	10	0.8	4.6	17	0.707	7.42
HN16e	Turkey Point Tract - SW Block	MNRF	29	1.2	2.4	20	0.668	7.41
MI3k	Skunk's Misery - Centre	Middlesex Cty	41	1.6	2.3	19	0.674	7.27
HN21f	County Forest C4	Norfolk Cty	84	2.7	1.9	21	0.644	7.10
EL60c	Hoyer Property	private	18	0.5	1.8	15	0.705	6.74
HN27c	Coppens Tract	LPRCA	82	1.8	1.3	13	0.720	6.33

OCCUPANCY SURVEYS

Of the 112 sites surveyed, 157 individual target SAR were detected at 45 separate sites (Table 3 and Table 4). Of the 45 sites in which SAR were detected in southwestern Ontario, ACFL were detected at 22 sites, CERW were detected at 14 sites, LOWA were detected at 14 sites, and PROW at 9 locations. SAR occupied 15 private landowner sites (33.3%), 8 conservation organization sites (17.8%), 13 publicly-managed sites (28.9%), and 9 government-owned sites (20.0%).

Table 4. SAR detected in southwestern Ontario during 2019 occupancy and point count surveys, separated by landowner.

Landowner	Ownership	ACFL	CERW	LOWA	PROW	Total
ERCA	public				4	4
LPBLT	ENGO	3	1			4
LPRCA	public	6	8	8		22
Middlesex Cty	gov't	6	5		3	14
MNRF	gov't		2	4		6
NCC	ENGO	5		3	18	26
Ontario Parks	gov't	8	1		5	14
private	private	11	9	12	6	38
SCRCA	public	20	4			24
TTLT	ENGO	5				5
Total		64	30	27	36	157

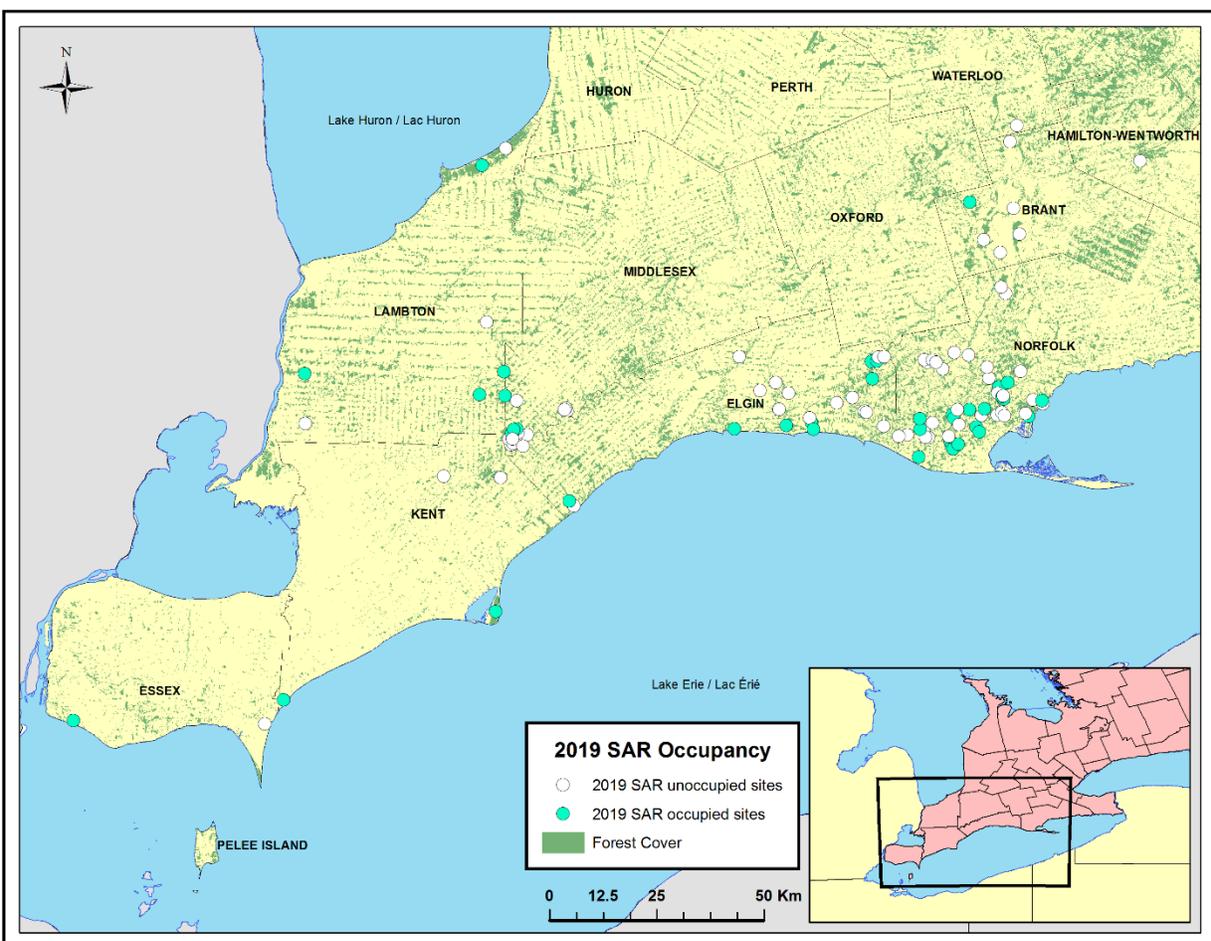


Figure 2. SAR occupancy in southwestern Ontario for 2019. A total of 112 sites were surveyed and 45 sites were identified with priority SAR.

Table 5. Target SAR occupancy by site surveyed in 2019. We were able to identify 45 SAR occupied sites from the 112 total sites surveyed. Bolded sites are newly surveyed sites with target SAR located.

Site ID	Site Name	Landowner	ACFL			CERW			LOWA			PROW			
			S	P	N	S	P	N	S	P	N	S	P	N	Y
BR02z	Brant Rd 25 - 3rd Conc	private											1	2	10
EL14b	Silver Creek-VanOverloop	private							1						
EL14z	Silver Creek - Passmore	private							1						
EL20z	Hawk Cliff	TTLT	1												
EL3c	Wiehle Property	private	1												
EL45a	Painted Ravine	private	2	1	1				1	1	1				
EL45z	Carson Line Ravine	private	1							1					
EL54b	Ketchabaw	private								1	1				
EL57z	Carolinian Woods	private				3									
ES20z	Holiday Beach CA	ERCA										1	1	1	5
ES30	Big Creek Hunt Club - Amherstburg	private											1	2	0
ES31	Willowood Management Unit	ERCA										1			
ES32	Mans Marsh	private										2			
HN111b	Hammond Tract	LPRCA				3									
HN114z	Jackson-Gunn	LPBLT				1									
HN12g	St. Williams NE	MNRF				2									
HN160a	Kennedy	private				3									
HN16b	Turkey Point Bluffs & Ravine	MNRF							2	1	1				
HN1b	Backus North	NCC								1	1		7	10	47
HN1c	Backus South	NCC		1	1				1						
HN21a	Swick-King Tract	LPRCA				1									
HN21b	Hanson Earl Danylevitch	LPRCA				2									
HN21e	Griffin Woods	private	1												
HN27a	Wilson Tract	LPRCA							1						
HN27c	Coppens Tract	LPRCA								1	2				
HN27d	Armstrong	LPRCA	1							1					
HN27g	Rowanwood Tract	private	2												
HN27m	Konrad	NCC		1	1										
HN30z	Shoppe's Creek	private		1	1				1	1	1				
HN31z	Fishers Glen-North	LPRCA		1	1					1					
HN4d	Burwell Tract	LPRCA	1	1	1										
HN5a	Hepburn Tract	LPRCA				2			1						
HN5c	Casier Tract	NCC	1												
HN81z	Arthur Langford	LPBLT	1	1	1										
KE2z	Rondeau PP	Ontario Parks	1	3								2	1	1	1
KE3	Wheatley PP	Ontario Parks										1			
LA10a	McPhail Tract	SCRCA	1	3	3										
LA2z	Lambton Heritage Forest	SCRCA	5	4		4									
LA3z	Bickford Woods	Ontario Parks	3	1	1	1									
MI11a	Sydenham River Nature Reserve	private				3									
MI3b	Skunk's Misery - NE	Middlesex Cty	1	1	1										
MI3f	Mosa Forest	LTVCA				1									
MI3h	Skunk's Misery - NC	Middlesex Cty	1			3						3			
MI3j	Sack	TTLT		2											
MI6z	County Line Woods	Middlesex Cty	2			1									
Totals			26	21	12	30	0	0	9	9	7	10	11	16	63

Acadian Flycatcher (ACFL)

ACFL were located at 22 sites throughout southwestern Ontario in 2019, 10 of which are identified as critical habitat. We located 26 territorial males, 21 pairs, and 12 nests (Table 5). Of the 12 nests located, 4 nests were located in far southwestern Ontario and were not regularly monitored and were given an unknown outcome and not included in productivity results. Of the 8 nests regularly monitored, 4 were considered successful and 4 had succumbed to predation.

Sites of high Conservation Priority for ACFL, by county, include Backus Woods, Arthur Langford Land Trust, and the Walsingham forest area in Norfolk County; Hawk Cliff and some private sites in Elgin County; Skunk's Misery and County Line Woods in Middlesex County; Rondeau Provincial Park in Chatham-Kent; and Bickford Woods, Lambton Heritage Forest, and McPhail Tract in Lambton County.

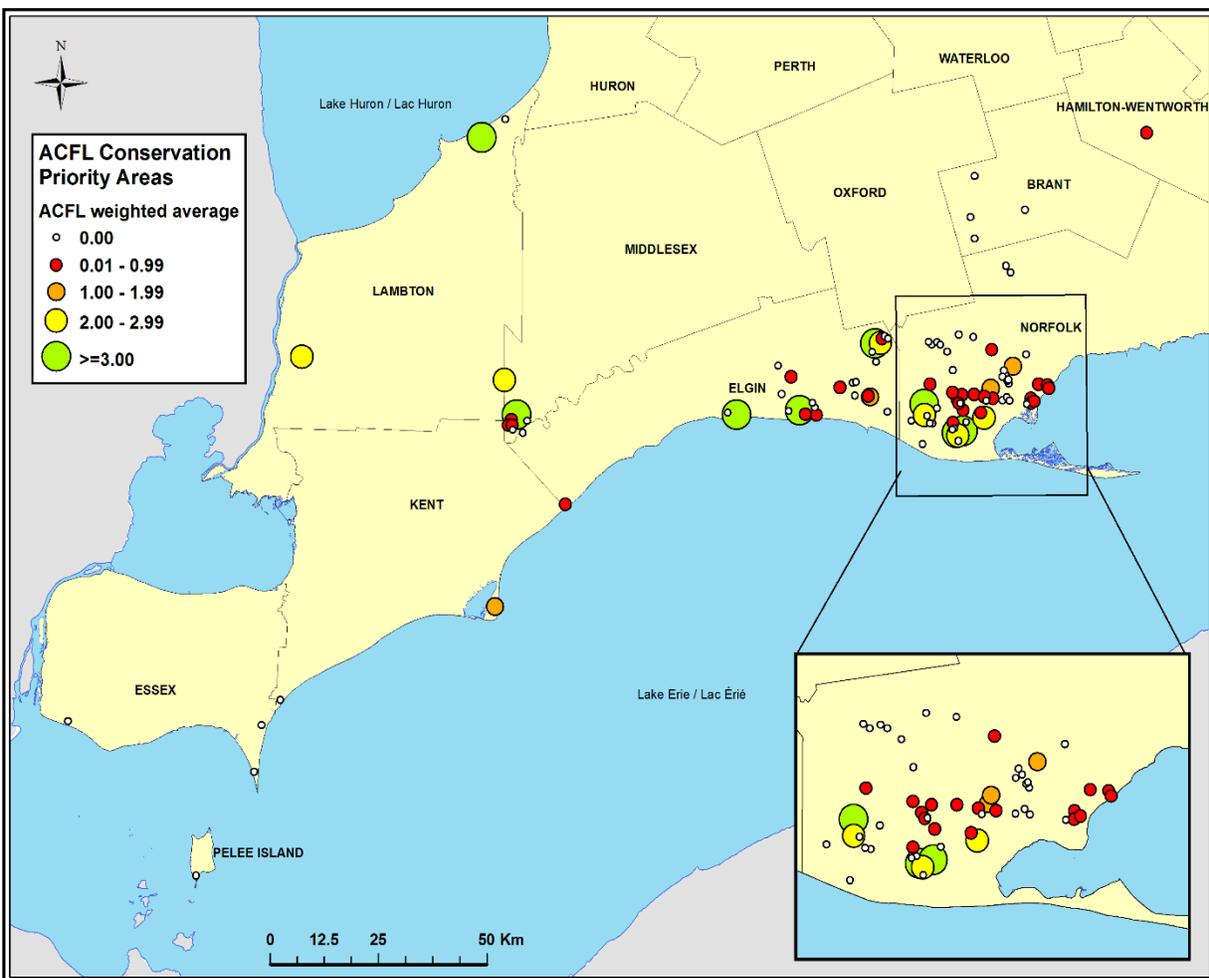


Figure 3. ACFL site occupancy in southwestern Ontario from 2011 – 2019 as represented by each site's weighted average. Refer to Conservation Priority section for legend reference.

Louisiana Waterthrush (LOWA)

We located LOWA at 14 sites in southwestern Ontario in 2019. We were able to observe 9 territorial males and 9 pairs, and locate 7 nests (Table 6). All 7 nests were monitored; 5 were considered successful, fledging 20 young, and the other 2 nests were unsuccessful and reported with empty, damaged nests with probable cause due to predation. Occupancy was low for LOWA in 2019 and extra effort to identify new habitat and LOWA locations will be taken in 2020.

Sites of high Conservation Priority for LOWA primarily are found in Norfolk and Elgin counties and detected at the south end of the Big Creek, South Otter Creek, and Dedrick-Young Creek watersheds. All effort for LOWA occurs within this central location of southwestern Ontario with little to no effort placed outside this general area. The reason for the restricted search effort is due to the short and early breeding time for LOWA. LOWA arrive on their breeding grounds in mid-April and establish territories and initiate breeding almost immediately. Once incubation has begun, males stop singing, making it difficult to detect individuals and pairs.

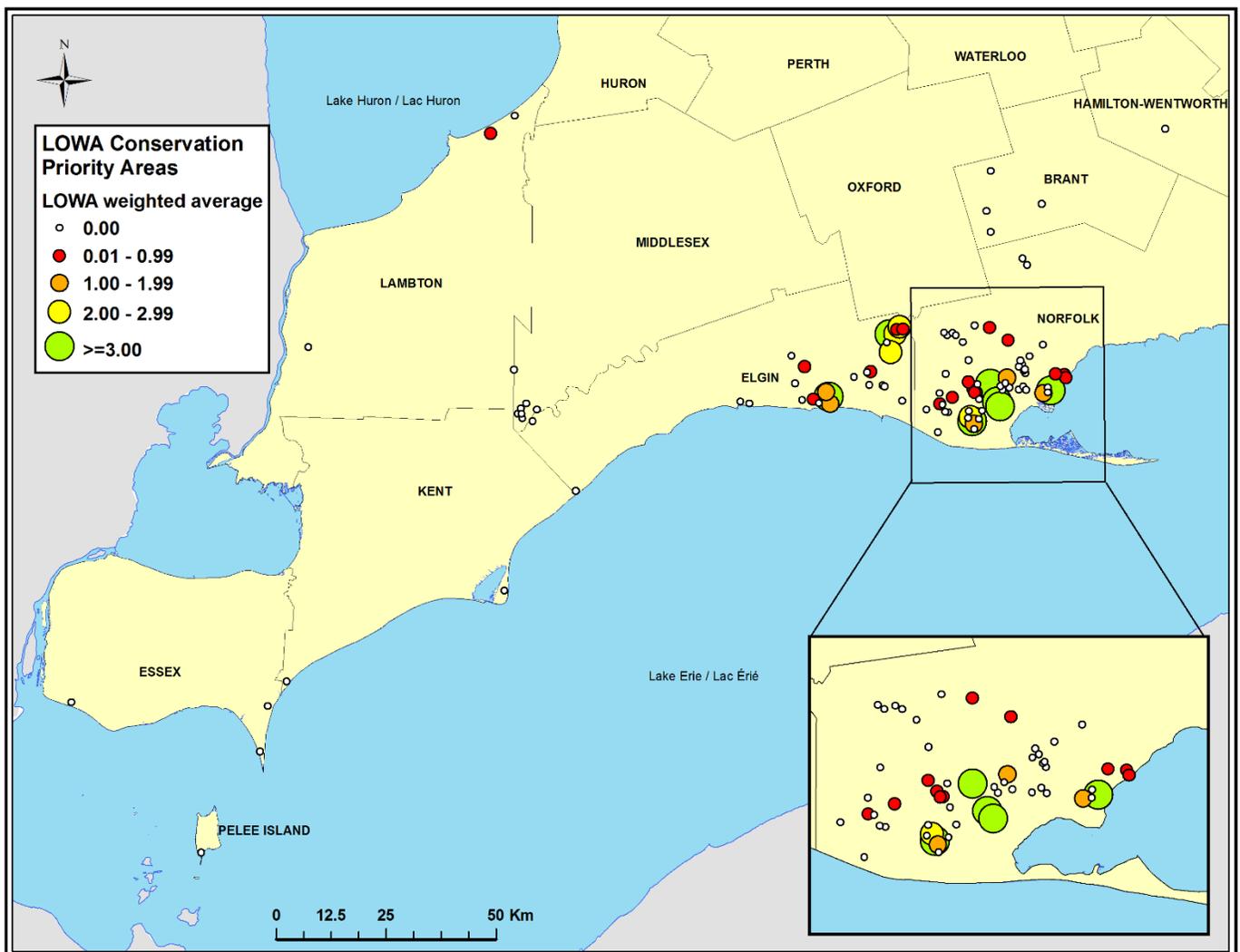


Figure 4. LOWA site occupancy in southwestern Ontario from 2011 – 2019 as represented by each site's weighted average. Refer to Conservation Priority section for legend reference.

Cerulean Warbler (CERW)

During the 2019 breeding season, 30 singing males were located at 7 sites (Table 5). This was a marked increase from 2018 which recorded a low for CERW, with only 11 males detected. While this is the highest number of recorded males since the program's inception it also marks a record low percentage of sites occupied (6.2%).

Some notable areas in which CERW occupy are CA and private landowner properties in contiguous woodlots north of the Long Point area in Norfolk County; a couple of private sites in Elgin County; Skunk's Misery in Middlesex County; and Pinery Provincial Park and Bickford Woods in Lambton County. CERW occupy interior forest habitat (>100 m from a forest edge) and tracts of land that fit this description throughout southwestern Ontario are lacking. The OFBAR program is working to increase forest connectivity and interior forest habitat in the Long Point Walsingham Forest area to increase CERW habitat in southwestern Ontario.

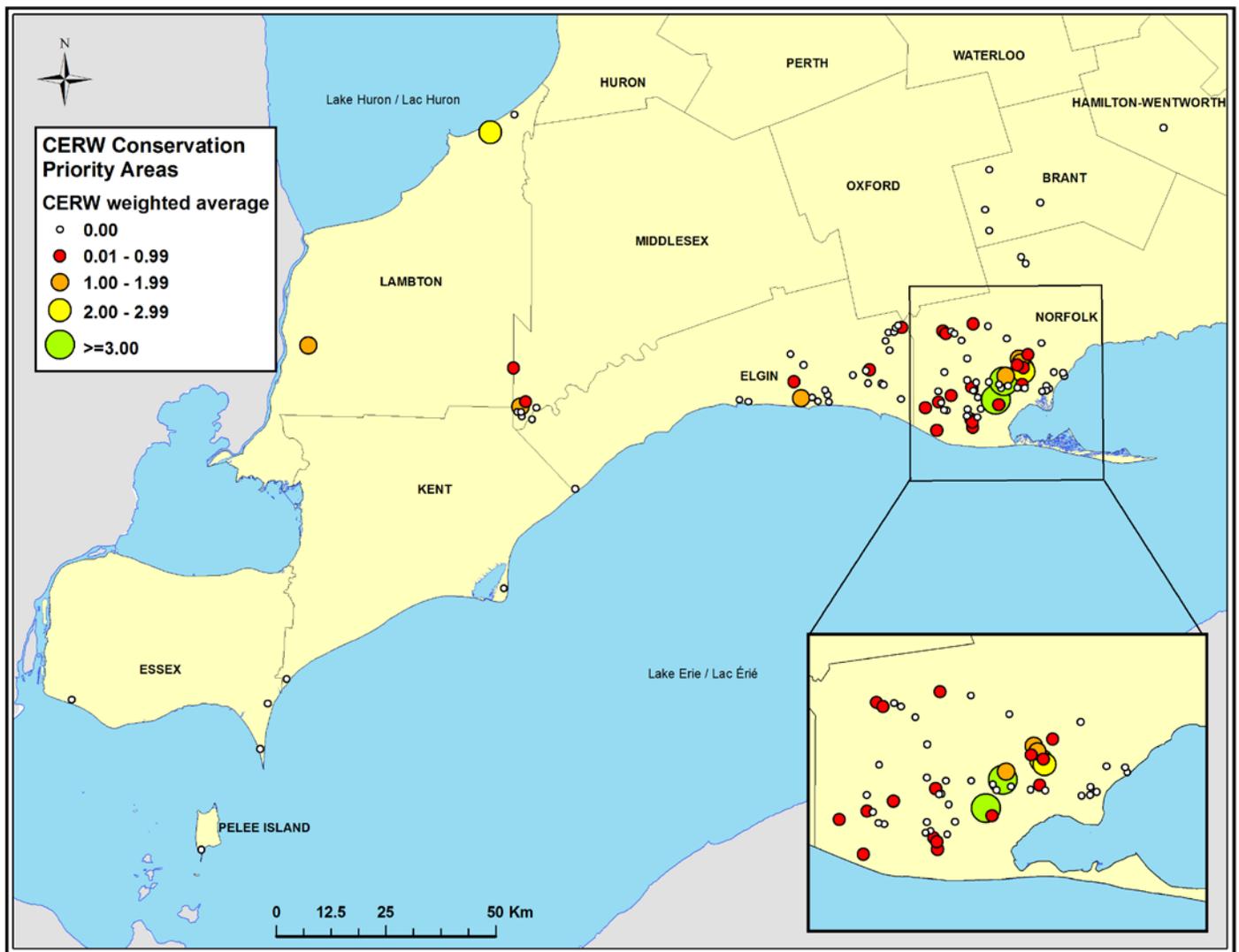


Figure 5. CERW site occupancy in southwestern Ontario from 2011 – 2019 as represented by each site's weighted average. Refer to Conservation Priority section for legend reference.

Prothonotary Warbler (PROW)

PROW were detected at 9 sites in 2019, 4 of which are identified as Critical Habitat. Sixteen active nests were located in nest boxes at 5 locations. Of the nests monitored, 63 young were confirmed to have fledged, making 2019 the most productive year of this project in terms of the number of young fledged (Table 5). Three double broods were observed, contributing to this high productivity. PROW continue to have a strong foothold in Backus Woods (Table 5). A private landowner in Brant County has also had a continuous nesting pair for the past 5 years. Also, populations of PROW are maintained in Rondeau Provincial Park on the north shore of Lake Erie in Chatham-Kent County as well as Pelee National Park. A private landowner in Essex County also has PROW occupying breeding habitat relatively consistently.

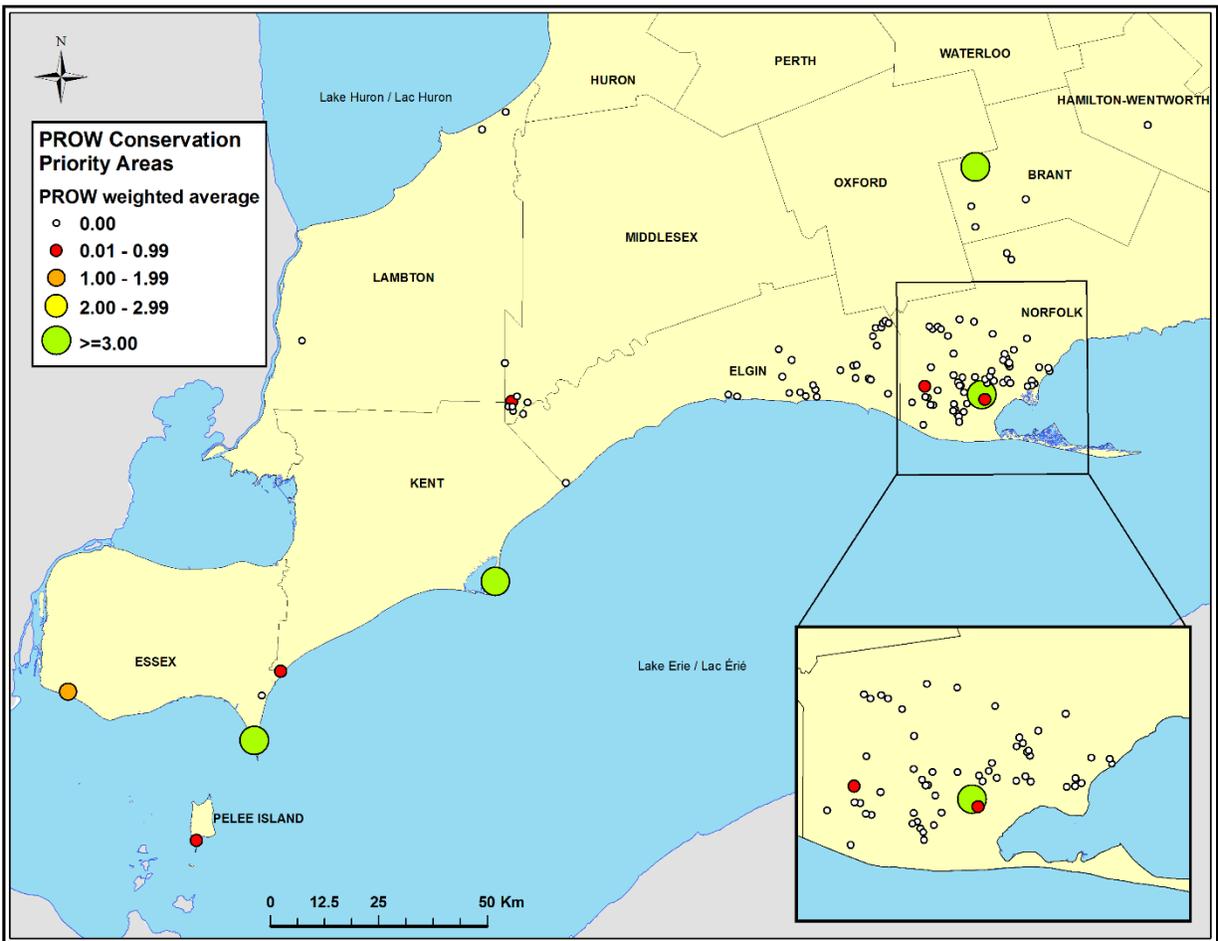


Figure 6. PROW site occupancy in southwestern Ontario from 2011 – 2019 as represented by each site's weighted average. Refer to Conservation Priority section for legend reference.

PRODUCTIVITY

Productivity levels for all SAR measured (ACFL, LOWA, and PROW) show a downward trend since 2011 (Figure 7). LOWA show the steepest decline in productivity (42.9% decline since 2011). ACFL and PROW average a 34.9% and 29.2% decline in productivity since 2011, respectively (Figure 7). ACFL have had very low productivity overall, averaging 0.83 fledgling/nest while PROW have consistently had high productivity levels, averaging 3.71 fledglings/nest (Table 6).

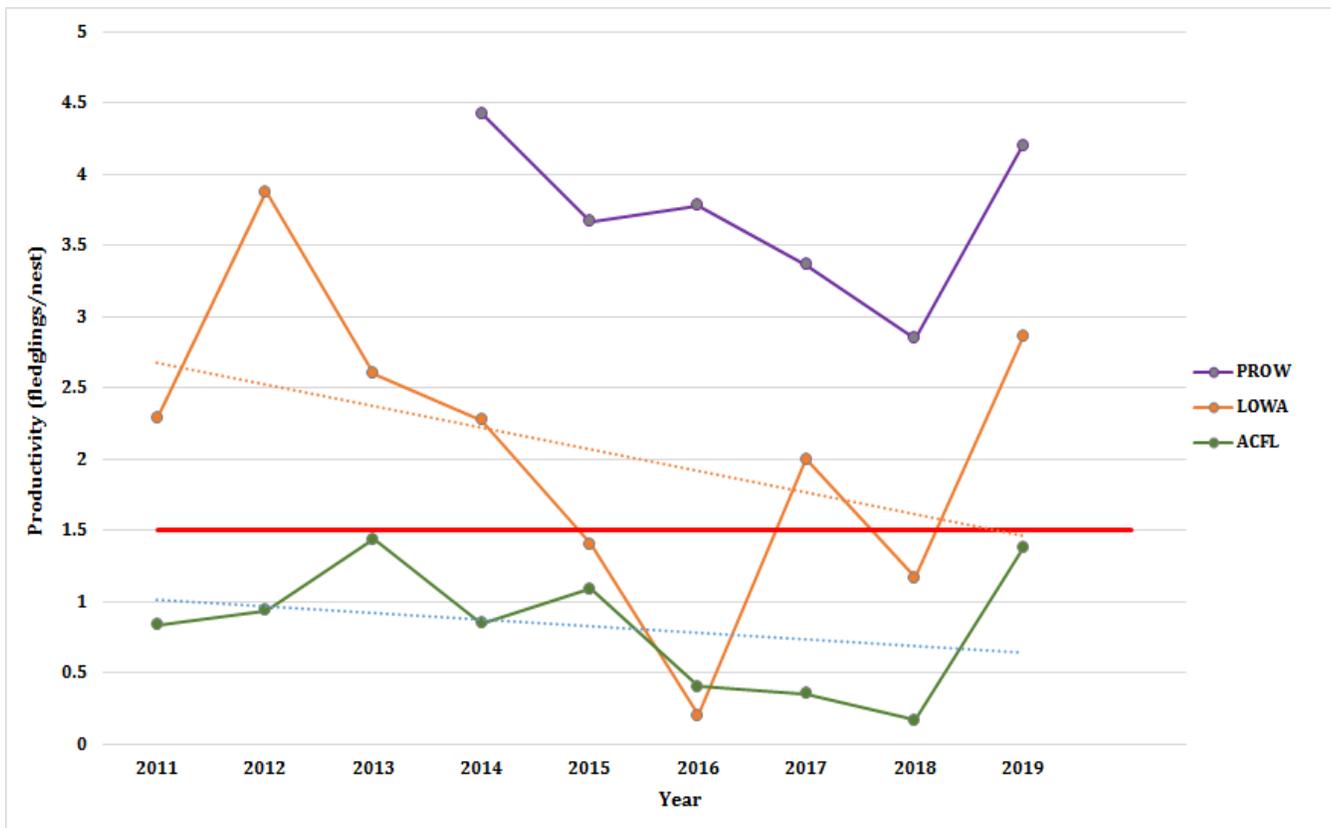


Figure 7. Productivity trends for target SAR between 2011 and 2019. ACFL (green) are showing a 34.9% decline in productivity while LOWA (red) are showing a decline of 42.9%. Despite PROW (purple) showing a decline of 29.2% in number of fledglings per nest, productivity is higher than all other SAR (increased nest monitoring). Nest data between 2011 and 2013 were insufficient to provide a confident productivity estimate. No data to include CERW productivity trends. The red horizontal line indicates the target productivity (1.5 fledglings per nest) we aim for in an effort to increase target SAR population in southwestern Ontario.

Although PROW productivity trends are showing a decline of 29.2%, the number of nests has been increasing steadily, suggesting that suitable habitats in southwestern Ontario are being occupied by young birds or birds emigrating from southern locations. In 2011, 2012, and 2013, there were 1, 5, and 4 recorded nests monitored, respectively, with all young projected as fledged (Table 6). In 2019 there were 16 total nests and 63 fledged young reported (Table 6). This suggests that habitat loss may be the limiting factor for this species' population in the Carolinian region. With the exception of the first few years (data not shown - insufficient), 2019 marks the most productive year for PROW. The increased nest box maintenance and monitoring by local bird conservationists has maintained an average PROW productivity of 3.71 young fledged/per nest (Table 6). No productivity data

were gathered for CERW due to the high level of effort required to locate and monitor nests (typically located within the canopy, at heights > 12m).

Due to various constraints, determining productivity in SW ON was not a high priority in the last three years, so little effort was placed on searching for and monitoring nests of ACFL, LOWA, and CERW; PROW were the exception and productivity was monitored as in years past. Despite the reduced effort, we were able to maintain productivity trends and, in the case of PROW, determine an increase in productivity from previous years. In 2020, the scope of the project will once again include an increased effort to search for and monitor target SAR nests.

Table 6. Productivity (young fledged/nest) for target SAR from 2011 to 2019 in southwestern Ontario.

Species	Year	# Sites	% Sites Occupied	Pairs	Males	Females	Nests	Host Young Fledged	Host Young Fledged/Nest	Nest Parasitism Rate	Cowbird Young Fledged
Acadian Flycatcher	2011	12	32.0%	11	18	12	18	15	0.83	0	0
	2012	17	28.0%	13	20	13	16	15	0.94	0.06	0
	2013	12	22.0%	10	17	10	16	23	1.44	0	0
	2014	18	31.0%	26	37	26	33	28+	0.85	0	0
	2015	17	27.0%	19	31	19	23	25+	1.09	0	0
	2016	13	22.4%	9	11	11	10	4	0.40	0	0
	2017	22	25.3%	29	30	29	34	12+	0.35	0	0
	2018	23	23.7%	6	37	6	6	1+	0.17	0	0
2019	23	20.4%	19	45	19	8	11	1.38	0	0	
Cerulean Warbler	2011	6	16.0%	1	16	1	0	-	-	-	-
	2012	5	8.0%	2	13	2	0	-	-	-	-
	2013	5	9.0%	1	15	1	1	2+	2.00	-	-
	2014	8	14.0%	1	20	1	0	-	-	-	-
	2015	6	10.0%	2	15	2	0	-	-	-	-
	2016	10	17.2%	0	11	0	0	-	-	-	-
	2017	14	17.0%	0	22	0	0	-	-	-	-
	2018	7	7.2%	0	11	0	0	-	-	-	-
2019	7	6.2%	0	30	0	0	-	-	-	-	
Louisiana Waterthrush	2011	11	30.0%	7	13	7	7	16	2.29	0.14	1.0
	2012	17	28.0%	17	24	17	8	31	3.88	0	0
	2013	13	24.0%	11	17	12	10	26+	2.60	0.30	3+
	2014	11	19.0%	13	15	12	11	25	2.27	0.42	2.0
	2015	15	23.0%	9	22	10	10	14	1.40	0.30	4.0
	2016	12	20.7%	8	7	8	5	1	0.20	0	0
	2017	14	17.0%	9	17	9	4	8+	2.00	0	0
	2018	14	14.4%	11	9	11	6	7	1.17	0	0
2019	14	12.4%	18	27	18	7	20	2.86	0	0	
Prothonotary Warbler	2011	1	3.0%	1	2	1	1	5	5.00	0	0
	2012	1	2.0%	4	3	4	5	25	5.00	0	0
	2013	1	2.0%	4	4	4	4	20	5.00	0	0
	2014	3	5.0%	6	6	6	7	31	4.43	0	0
	2015	2	3.0%	8	6	8	9	33	3.67	0	0
	2016	9	15.5%	10	5	10	9	34	3.78	0	0
	2017	7	8.0%	11	3	11	11	36	3.36	0	0
	2018	5	5.2%	13	6	13	13	37+	2.85	0	0
2019	10	8.8%	13	23	13	14	53+	3.79	0	0	

FOREST HEALTH RISKS

Another priority of the OFBAR program is determining the risks to target SAR and their habitat, as well as to overall forest health, by site or property. While addressing immediate risks to target SAR is our highest priority, it is also important to address risks to overall forest health, particularly those that are likely to be of high concern to landowners and

Table 7. Total forest health risks occurrence by landownership. The number recorded under No Risks Detected refers to the total number of sites with respect to the particular landowner. Also, it does not indicate there are no risks at the site, but that no risks were observed.

Landowner	No. of Sites	Human	Invasive Species	Natural	No Risks Detected	Total
CCCA	4	1	23	5	-	29
GRCA	2	1	11	3	-	15
HCA	1	2	16	1	-	19
HNC	1	1	6	1	-	8
KCCA	1	-	10	1	-	11
LPBLT	3	4	18	4	-	26
LPRCA	31	38	98	26	4	166
LTVCA	1	-	-	-	1	1
Middlesex Cty	5	1	7	4	2	14
MINRF	4	4	11	4	2	21
NCC	5	4	11	8	-	23
Norfolk Cty	2	7	5	1	-	13
Ontario Parks	4	2	22	4	-	28
private	35	47	76	34	6	163
SCRCA	3	2	3	3	-	8
TTLT	6	7	24	4	1	36
Waterloo Cty	1	-	-	1	1	2
ERCA*	3	-	-	-	-	-
Total	112	121	341	104	17	566

* risks not assessed at these sites

potential SAR stewards. In doing so, it is possible to encourage practices that may maintain or restore suitable SAR habitat and that will help foster a healthy natural woodlot which, in turn, may benefit target SAR, other SAR, and/or the ecological integrity and resilience of southwestern Ontario's forests.

In 2019, we identified 566 occurrences of risks throughout the 112 sites that were surveyed (Table 7). Invasive species accounted for 60.2% (n = 341) of all occurrences, followed by human-related forest health risks at 21.4% (n = 121), and natural risks with 18.4% (n = 104; Table 7). For an extensive list of each forest health risk per site, see Appendix F.

Human-related Forest Health Risks

Waste pollution was the most common human-related forest risk observed during our surveys accounting for 63.6% (n = 77) of all human-related forest health risk occurrences (Table 8). In general, waste and garbage dumping present a minor issue for target SAR. That said, a local incident of stream pollution in LOWA habitat could have impacts on the breeding season and longer term for one or more pairs. With respect to the landowner, it is suggested by local woodlot associations as well as government and industry professionals

Table 8. Human-related Forest Health Risk

Human-related Forest Risk	Occurrences
Pollution - waste	77
Recent, Active, or Potential Harvest	18
Motorized Vehicle Trails	14
Recreational Use	5
Structure	4
Hunting Structure	3
Total	121

that all waste should be cleared before managing their woodlot to create a safe and effective harvest area. This also makes for an aesthetic woodlot. However, risks associated with pollution are generally related to illegal waste dumping and thus are more difficult to address proactively. Active, recent, and potential (i.e. marked trees) harvest was the next most abundant human-related action. Woodlots currently undergoing, or that have gone through the process of forest management made up 14.9% (n = 18) of human-related forest risks at the sites surveyed (Table 8). Additional

that all waste should be cleared before managing their woodlot to create a safe and effective harvest area. This also makes for an aesthetic woodlot. However, risks associated with pollution are generally related to illegal waste dumping and thus are more difficult to address proactively. Active, recent, and potential (i.e. marked trees) harvest was the next most abundant human-related action. Woodlots currently

considerations during management planning should be made as to the impact harvesting could have for LOWA as they are a ground-nesters and nest in stream banks or in uprooted trees within sloughs. Similar to maintaining cavity trees for wildlife, uprooted trees in sloughs could be retained for LOWA habitat consideration. Motorized vehicle trails followed harvest risk, accounting for 11.6% (n = 14) of human-related forest risks (Table 8). Depending on the species, trails could offer benefits and provide suitable overstory habitat for SAR. CERW often prefer open canopies and vehicle trails may provide an opportunity for recreational activities and SAR to coexist, whereas vehicle trails through streams and swamps could do long-term damage to LOWA and ACFL habitat.

Invasive Species Forest Health Risks

The most prominent invasive species on the landscape was garlic mustard (patches were detected at 120 locations within the sites surveyed; Table 9) which may have deleterious effects to SAR habitat as it typically blankets the forest floor and outcompetes native vegetation SAR and other wildlife would use for foraging and nesting opportunities. emerald ash borer (EAB) and beech bark disease present more direct and immediate forest

Table 9. Invasive Species Forest Health Risks occurrences in 109 sites surveyed in 2019.

Invasive Species	Occurrences
Garlic Mustard	120
Multiflora Rose	106
Emerald Ash Borer	45
European Buckthorn	23
Autumn Olive	15
Beech Bark Disease	11
Japanese Barberry	8
Phragmites	8
Gypsy Moth	2
Dog-strangling Vine	1
Feral Cat	1
Giant Hogweed	1
Total	341

health risks, not only to SAR but to a landowner's woodlot. EAB made up 13.2% (n = 45) of the invasive species threats encountered (Table 9). The invasive insect is responsible for the decline of ash trees throughout Ontario and with regards to SAR, the insect poses an immediate threat by reducing canopy cover and foraging and nesting habitat, especially for LOWA, CERW, and ACFL. Beech bark disease is becoming more prominent in the Carolinian region and also poses a direct risk to SAR and other wildlife by reducing foraging and nesting opportunities.

It is notable that, to date, there have been no records of either hemlock woolly adelgid or oak wilt among our study areas. The presence of the pest and pathogen would pose a substantial risk to the forests upon which target SAR depend at multiple spatial scales. For example, woolly adelgid, which directly attacks eastern hemlock, could reduce or eliminate ACFL and LOWA nesting habitat and

overhead cover throughout the area. Similarly, oak wilt could negatively impact CERW which have been shown to prefer oak species. Red oak species in particular are most susceptible to the fungus that causes oak wilt. Further, the decline of oak trees could change the structure and composition of southwestern Ontario's forests, including opening up the canopy (all target SAR require a relatively closed canopy).

Natural Forest Health Risks

Brown-headed Cowbird, a nest parasite, accounted for the largest proportion of natural risks at the sites surveyed in 2019 (Table 10). Brown-headed Cowbird nest parasitism has been found to have negative effects on the productivity of SAR. Parasitism seems to have

the largest effect on PROW and ACFL. In 2018, dried sloughs accounted for 69.4% of all naturally occurring health risks but also accounted for 17.0% of all 3 risks categories combined. However, 2019 was a very wet year and dry slough accounted for only 1.9% (n = 2) of natural risks (Table 10). All OFBAR target SAR occur in some type of treed wetland habitat for nesting. ACFL will nest in branches of trees that overhang the edge of sloughs. LOWA nest within the soil and roots of an uprooted tree in sloughs. CERW have a

Table 10. Types of natural Forest Health Risks identified on sites surveyed in 2019. Brown-headed Cowbirds are most prevalent as a naturally-occurring risk and pose a substantial threat to all target SAR and their productivity.

Natural Risk	Natural
BHCO - nest parasite	92
Erosion and Sedimentation	8
Avian Predator	2
Dry Slough	2
Total	104

preference for soft maples which grow in treed wetlands, and PROW are a secondary cavity nester in treed wetlands with water at least 1m deep. The cause of dried sloughs within the study area is uncertain and the evidence we are suggesting is anecdotal, but the reduction in slough habitat is likely related to a combination of climate change and increased pressures on the area's water supplies. A consistent lack of rain and snow combined with high average summer temperatures and tile drainage near agricultural areas could all contribute to drying sloughs. Streambank erosion accounted for 7.7% (n = 8)

of the natural risks and poses a threat to ACFL and LOWA as both species also nest in stream ravines (Table 10). Streambank erosion could result in felling preferred trees for ACFL and carving out preferred streambank nesting locations for LOWA. Erosion could be a result of many things. First, streambank erosion is an important natural process and creates meandering streams that maintain the integrity of the waterway by way of water flow, especially after a storm event. However, human development upstream may result in stream straightening, streambank hardening, and increased sedimentation, resulting in amplified bank disturbance and water pollution downstream, and could negatively affect LOWA and ACFL habitat.

Forest Health Risk Extent

Forest Health Risk Extent was calculated for each landowner by determining the extent to which each forest health risk covered an area when observed (Table 11). All forest health risk extents were averaged by landowner. Invasive species showed the greatest risk extent

Table 11. Forest Health Risk Extent by landowner.

Landowner	% Avg. Human-related Risk Extent	% Avg. Invasive Species Risk Extent	% Avg. Natural Risk Extent	Overall % Avg. per Landowner
LPBLT	37.0	31.3	5.8	24.7
SCRCA	33.7	34.0	1.0	22.9
Norfolk Cty	12.8	15.0	30.0	19.3
Ontario Parks	17.0	32.1	1.0	16.7
HCA	1.0	42.5	1.0	14.8
GRCA	5.0	29.1	8.3	14.1
LPRCA	14.0	23.8	2.3	13.4
CCCA	7.5	26.9	1.0	11.8
private	13.4	15.6	6.0	11.7
KCCA	0.0	32.7	1.0	11.2
HNC	30.0	1.0	1.0	10.7
MNRF	11.4	11.2	0.8	7.8
NCC	4.1	16.5	0.8	7.1
TTLT	1.0	15.3	0.7	5.7
Middlesex Cty	0.2	8.8	0.8	3.3
Waterloo Cty	0.0	0.0	1.0	0.3
LTVCA*	0.0	0.0	0.0	0.0
Overall % Avg. per FHR	12.3	19.7	3.7	11.9

* Forest Health Risk surveys were not completed

of the three forest health risks recorded (19.7% average forest cover, n = 341) followed by Human-related (12.3% average forest cover, n = 121) and Natural risks (3.7% average forest cover, n = 104; Table 11).

Human-related Risk Extent

The most pervasive human-related risk was recent, active, or potential harvest at 50.6% average forest cover (n = 18; Table 12). This was followed closely by motorized vehicle use risk extent with 43.6% (n = 14) of the area covered wherever it was detected. The next human-related risk recorded was recreational use (16.0%, n = 5), structure (15.3%, n = 4), and pollution – waste

(8.0%, n = 77; Table 12).

Human-related risks show the greatest potential to disturb or destroy SAR habitat. Furthermore, human-related risks can also contribute to invasive species establishment and natural forest risk occurrences. Sustainable forest management has the potential to create habitat for some of the OFBAR's target species with BMPs put in place where necessary. Motorized vehicle use can also cause severe habitat degradation especially when there are ravine and wetland systems that are very important for the target SAR. Closure of the areas surrounding target SAR habitat and nests should be considered in the future to protect breeding habitat. Recreational use and structures are relatively low impact forest health risks as long as trails and structures do not expand and proper mitigation efforts are used to deter the spread of invasive species (see below). Although pollution was not pervasive, it was by far the most abundant human-related risk detected (Table 8). The most extensive example of this occurred in the past before woodlot and wetlands were appreciated for their resources and acted as garbage dumps in some cases. Unfortunately, this activity still occurs along country roadsides.

Invasive Species Risk Extent

The most pervasive invasive species was Phragmites, occupying 42.5% of the area on average whenever detected (n = 8; Table 12). Beech bark disease, emerald ash borer, and garlic mustard were observed to occupy 34.5% (n = 11), 30.5% (n = 45), and 30.0% (n = 120), respectively whenever they were detected (Table 12).

Conservation Areas and other conservation land showed the greatest invasive species risk extent with HCA, SCRCA, KCCA, Ontario Parks, and LPBLT each recording the greatest risk extent, all above 30.0% average forest cover wherever an invasive species was observed (Table 11). Invasive species risk extent of private landowners was 15.6% average forest cover wherever they were detected. Given that CAs, Land Trusts, and the provincial park system are focused on ecological integrity of our Ontario forests, there are a few possibilities as to the reason invasive species are so pervasive in these areas.

The OFBAR program suggests the number one reason is reflected in the trail system and/or campgrounds of these areas. Perhaps, these organizations could be promoting washing and cleaning personal use items (i.e., hiking boots and poles, campers/tents etc.). This could be accomplished by providing shoe brushes and signage at trail entrances for active invasive species management and as education and outreach opportunities. Additionally, in some cases, CAs harvest their properties for lumber and running large machinery combined with warmer winters greatly disturbs the forest floor, promoting invasive species establishment. The same practical invasive species prevention by having forestry equipment washed/cleaned before entering a woodlot could reduce potential invasive species colonization. Private landowners have considerably less foot traffic and so it is not surprising to find the risk extent of invasive species on these properties is half compared to the risk extent of the areas where foot traffic is highest.

Natural Risk Extent

The most pervasive natural forest health risk was dried slough with 80% (n = 2) forest cover, followed by erosion and sedimentation (50.6%, n = 8). Although Brown-headed Cowbirds were the most numerous risk identified, their extent was minimal (1.0%, n = 92; Table 12).

Although not numerous in 2019, areas where dried sloughs occurred were found to be quite extensive. Many woodlots within the survey area often have wet low-lying areas that dry up later in the summer. However, some recent anecdotal evidence suggests the sloughs are drying up earlier than in previous years. This would have an effect on food resources for target SAR such as LOWA and ACFL that rely on submerged aquatic invertebrates and hatched aquatic invertebrates, respectively. The OFBAR program is looking into incorporating water monitoring stations on properties throughout the Long Point Walsingham Forest area to determine if this natural occurrence is having an effect on target SAR productivity. Additionally, efforts made to quantify aquatic invertebrate abundance within target SAR habitat could help determine reasons for the low productivity we are finding for LOWA and ACFL. The issue is not as prevalent for PROW, as the treed wetlands they often occupy have a water depth between 0.5 – 1.0 m.

Table 12. Average forest health risk extent by type of risk. Natural and Human-related pose the most pervasive risks to target SAR habitat.

Forest Health Risk	FHR Type	% Average Risk
Dry Slough	Natural	80.0%
Feral Cat	Invasive	60.0%
Erosion and Sedimentation	Natural	51.3%
Recent, Active, or Potential Harves	Human	50.6%
Motorized Vehicle Trails	Human	43.6%
Phragmites	Invasive	42.5%
European Buckthorn	Invasive	34.9%
Beech Bark Disease	Invasive	34.5%
Emerald Ash Borer	Invasive	30.5%
Garlic Mustard	Invasive	30.0%
Autumn Olive	Invasive	25.5%
Avian Predator	Natural	25.5%
Gypsy Moth	Invasive	25.0%
Dog-strangling Vine	Invasive	20.0%
Japanese Barberry	Invasive	18.0%
Recreational Use	Human	16.0%
Multiflora Rose	Invasive	15.6%
Structure	Human	15.3%
Pollution - waste	Human	8.0%
Hunting Structure	Human	4.0%
Giant Hogweed	Invasive	1.0%
BHCO - nest parasite	Natural	1.0%

LANDOWNER STEWARDSHIP AND MANAGEMENT

A high proportion of SAR-occupied sites are privately owned and/or managed for activities other than conservation, thus it is critical that the OFBAR program work with private woodlot owners as well as local government agencies and Conservation Authorities, as these groups have great potential to positively (or negatively) impact target SAR, their habitat, and the ecological integrity of the Carolinian forest region.

It is the priority of the OFBAR program to work with all private landowners and establish a working relationship that protects target SAR without adjusting private landowner woodlot economic or conservation opportunities, but perhaps assists or leads the landowner towards sustainable woodlot management that benefits all parties.

Private Land Ownership

In 2019, 31.3% of the sites surveyed, totalling 1247.6 ha, were owned by private landowners (Figure 8, Table 2). These sites contributed 24.2% (n = 38) of the SAR detections (Table 2). Twenty-five new landowners whose properties totaled 980.4 ha had not been previously surveyed. A total of 3 individual target SAR were located on these newly surveyed properties (1 ACFL male and a pair of PROW that made 2 nest attempts but failed as a result of predation and flooding). Raw SAR occupancy data were provided to each of these groups for their properties in support of their monitoring and conservation management efforts. All individual private landowners received a written “thank-you” letter informing them of all species (SAR and non-SAR) identified on their property. Target SAR were highlighted in a table and non-target species of concern were highlighted within the list of species provided to the landowner.

In 2019, 15.2% (n = 17) of the sites surveyed were owned by ENGO private landowners and covered 1269.5 ha (Figure 8, Table 2). Despite the small proportion of sites being ENGO, these sites contributed 22.3% (n = 35) of all SAR detections highlighting the importance of conscious land management practices. All ENGO private landowners received raw data that included a detailed list of species with GPS coordinates for target and non-target SAR, as well as a detailed list of all forest health risks with GPS coordinates so mitigation efforts can be taken, especially regarding invasive species.

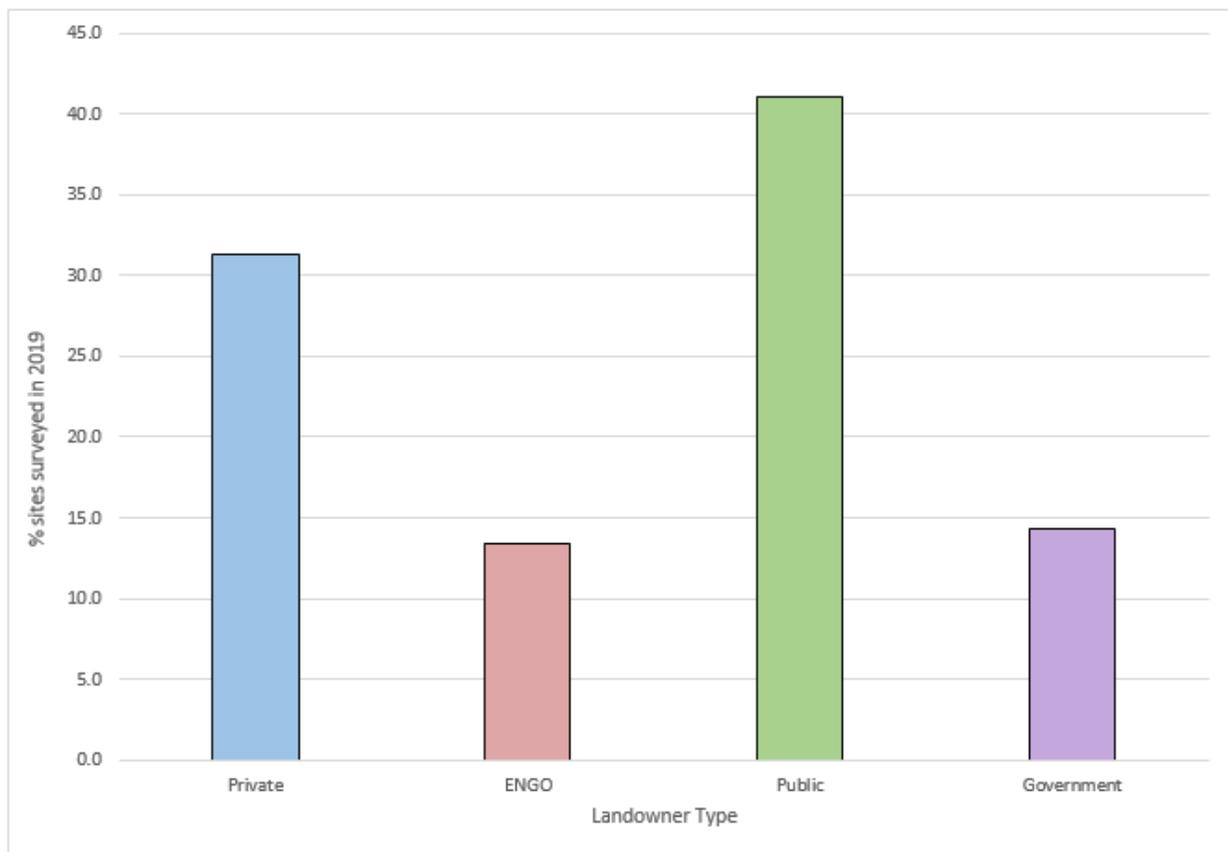


Figure 8. Percentage of 2019 surveyed sites by land ownership. Public landowners accounted for >40% of our surveyed area, primarily consisting of various CAs throughout southwestern Ontario, followed by private landowners at >30%.

Public Land Ownership

In 2019, 55.4% (n = 62) of all sites surveyed, totalling 7690.6 ha, were public land (Figure 8, Table 1). Public land ownership was made up of Conservation Authorities representing 41.1% (n = 46) and government landowners represented 14.3% (n = 16). Most of these properties had been surveyed in previous years with the exception of a few CA properties. Similar to land trusts and naturalist groups, all public landowners received raw survey data regarding target and non-target SAR occupancy and forest health risks detected. Also similar to the ENGOs, public landowners are able to use this information to meet their monitoring mandates as well as inform their forest management practices. A total of 50 individual SAR were found on publicly owned property (ACFL – 26, CERW – 12, LOWA – 8, PROW – 4) and 34 SAR were detected on government land (ACFL – 14, CERW – 8, LOWA – 4, PROW – 8) (Table 13). Of the SAR detections, 31.8% (n = 50) were on land owned by conservation organizations (which is not surprising since these properties were acquired, at least in part, because of the presence of these target SAR and their habitats). Of all SAR detections, 21.7% (n = 34) were on government owned land (Table 13).

Similar to privately-owned woodlots, public sites in the area are subject to various management regimes, including recreation and harvesting. Other sites are managed strictly for conservation purposes, such as Natural Heritage Sites, and are maintained to protect

SAR and SAR habitat. As with other woodlot owners, Birds Canada works with public landowners to encourage as well as support efforts to manage for SAR and SAR habitat, including providing additional monitoring and expertise as needed to help incorporate SAR needs into management objectives and plans.

Table 13. SAR occurrence in 2019 divided by landownership. SAR detected on individual private land accounted for one-quarter (24.2%) of all SAR detection.

Landowner	Ownership	ACFL	CERW	LOWA	PROW	Total
ERCA	public	0	0	0	4	4
LPBLT	ENGO	3	1	0	0	4
LPRCA	public	6	8	8	0	22
Middlesex Cty	gov't	6	5	0	3	14
MNRF	gov't	0	2	4	0	6
NCC	ENGO	5	0	3	18	26
Ontario Parks	gov't	8	1	0	5	14
private	private	11	9	12	6	38
SCRCA	public	20	4	0	0	24
TTLT	ENGO	5	0	0	0	5
Total		64	30	27	36	157

OFBAR's Future

The OFBAR program had a very successful year in 2019. We reported the largest number of PROW nests and total fledglings in southwestern Ontario since the program began. We have firmly establish an important relationship with the Ontario Woodlot Association and their various chapters. This relationship has been integral in providing information about birds and bird conservation to a new community group and the response has been overwhelmingly positive. Our working relationship with private and public landowners continues to get stronger as we move into a new decade and we hope the strength of these relationships continues to build through to 2030.

The goals and objectives of the OFBAR program continue to grow. Between added support through funding and donations and the relationships we have built, we anticipate our efforts to protect and restore habitat through sound science, education and outreach, and, most importantly, landowner stewardship for the target SAR will also increase. We have identified the following priorities for the OFBAR program in 2020, in addition to the program's goals and objectives as laid out above. We will:

- Continue to engage landowners and land managers, focusing on identifying what motivates them as woodlot owners and stewards;
- Engage forest industry leaders and establish a working relationship to increase stewardship for target Species at Risk at the industry level;
- Have a landowner stewardship index (LaSI) baseline established and continue to add new landowners as they arise; repeat LaSI survey in 2 – 3 years' time;
- Continue our education and outreach efforts throughout southwestern Ontario and beyond. The OFBAR program has had great success through these efforts

- and is beginning to notice a shift in landowner's and manager's perception of Species at Risk;
- Continue to expand our search efforts beyond the localized Long Point area. Surveys extending outwards will increase our chances of identifying areas important for target SAR;
 - Increased search effort for LOWAs through occupancy and point count surveys and monitoring nests when possible;
 - Continue to collect CERW habitat data in 2020 and begin to establish BMPs once the 2020 field season is complete. Establish territories and breeding status of CERW throughout their range to determine patch sizes and mating ratios (largely unknown);
 - Continue to monitor Forest Health Risks, especially invasive species, with an increased effort for other potential invasive species (i.e., oak wilt and hemlock woolly adelgid) that would be detrimental to forest health and target SAR throughout southwestern Ontario;
 - Incorporate the existing Forest Bird Monitoring Program, aimed at long-term population monitoring of all forest birds across Ontario – this program will rely on voluntary Citizen Scientists, which has been an important lacking piece of the Forest Birds program;
 - Identify Red-Headed Woodpecker as a new priority target species and introduce a new survey protocol and habitat experiment for Red-headed Woodpecker.

For more information regarding the Forest Birds at Risk program, visit our website (<https://www.birdscanada.org/bird-science/ofbar/>) or direct any questions through email to Ian Fife at speciesatrisk@birdscanada.org.

Appendix B: Beaufort Wind Scale

Beaufort scale	Class	Characteristics and impacts	Wind speed		
			m.s ⁻¹	km.h ⁻¹	mile.h ⁻¹
0	Calm	No wind, smoke billowing upright	0-0.2	1	1
1	Light Air	The direction of the wind is visible in the direction of smoke, there is no breeze	0.3-1.5	1-5	1-3
2	Light breeze	The wind felt on the face, the leaves lightly rocked	1.6-3.3	6-11	4-7
3	Gentle wind	The leaves and twigs continue to sway	3.4-5.4	12-19	8-12
4	Moderate wind	Dust and paper blowing, twigs and small branches sway	5.5-7.9	20-28	13-18
5	Fresh breeze	Small trees sway, white foam in the sea water	8.0-10.7	29-38	19-24
6	Strong wind	The big branches swayed, the sounds of the electric wire	10.8-13.8	39-49	25-31
7	High wind	The whole tree rocked	13.9-17.1	50-61	32-38
8	Gale	The branches of a broken tree, walking against the wind are quite heavy	17.2-20.7	62-74	39-46
9	Severe gale	The roof of the house is blown and thrown	20.8-24.4	75-88	47-54
10	Strong storm	Trees are uprooted, houses are severely damaged	24.5-28.4	89-102	55-63
11	Violent storm	Storm damage large areas	28.5-32.6	103-117	64-72
12	Hurricane force	Big trees uprooted, houses collapsed	>32.6	>117	>72

Appendix E: Survey effort Table

Site ID	Landowner	Site Size (ha)	No. of Visits	Person-effort (hours)	Area Covered per Site
BR02z	private	19.5	13	13.0	253.5
BR04a	GRCA	119.0	1	3.0	119.0
BR05a	GRCA	33.2	1	1.8	33.2
BR06a	LPRCA	32.7	1	1.1	32.7
BR06b	LPRCA	16.5	1	0.7	16.5
BR24z	private	6.6	1	2.8	6.6
EL13a	KCCA	111.0	1	7.5	111.0
EL14b	private	56.4	1	3.5	56.4
EL14c	private	25.2	1	1.2	25.2
EL14z	private	59.8	1	9.5	59.8
EL15z	CCCA	195.0	2	23.7	390.0
EL16a	CCCA	93.6	1	2.3	93.6
EL18a	CCCA	53.7	1	1.7	53.7
EL20z	TTLT	80.7	1	2.9	80.7
EL28z	private	61.6	1	2.5	61.6
EL29z	private	161.0	2	8.0	322.0
EL3b	private	22.1	1	1.8	22.1
EL3c	private	19.4	1	1.6	19.4
EL43b	CCCA	118.2	1	3.3	118.2
EL45a	private	33.0	2	7.2	66.0
EL45z	private	79.3	2	5.9	158.6
EL46c	private	61.0	1	3.6	61.0
EL51z	LPRCA	9.5	1	0.6	9.5
EL54b	private	22.7	2	9.3	45.4
EL57z	private	9.9	1	1.2	9.9
EL5a	private	6.1	1	2.3	6.1
EL60c	private	17.9	1	0.5	17.9
EL60z	private	19.2	1	0.8	19.2
ES10z	ERCA	147.0	1	0.8	147.0
ES20z	ERCA	75.9	9	40.5	75.9
ES30	private	50.0	4	3.0	50.0
ES31	ERCA	10.0	1	0.8	10.0
ES32	private	10.0	2	1.5	10.0
ES33	private	10.0	1	0.8	10.0
HN101b	NCC	37.6	2	5.2	75.2
HN102b	private	24.8	1	1.0	24.8
HN111b	LPRCA	20.5	1	2.0	20.5
HN114z	LPBLT	10.4	1	1.0	10.4
HN12d	MNRF	96.5	1	2.0	96.5
HN12g	MNRF	160.0	1	3.7	160.0

HN14z	HNC	243.0	1	4.1	243.0
HN160a	private	33.7	1	1.1	33.7
HN160z	private	13.8	1	0.6	13.8
HN16b	MNRF	107.0	4	3.5	428.0
HN16e	MNRF	28.7	2	1.2	57.4
HN17a	LPRCA	90.2	1	2.6	90.2
HN17b	LPRCA	103.0	1	2.6	103.0
HN18a	LPRCA	9.8	1	0.8	9.8
HN18b	LPRCA	40.3	1	1.3	40.3
HN19b	LPRCA	42.0	2	5.4	84.0
HN1b	NCC	247.0	2	11.7	494.0
HN1b	NCC		11	22.0	1358.5
HN1c	NCC	241.0	2	10.2	482.0
HN21a	LPRCA	93.7	2	5.0	187.4
HN21b	LPRCA	100.0	2	2.7	200.0
HN21c	LPRCA	42.3	2	0.9	84.6
HN21e	private	20.5	1	0.9	20.5
HN21f	Norfolk Cty	84.4	1	2.7	84.4
HN26c	LPRCA	32.8	1	2.1	32.8
HN26d	LPRCA	39.8	1	1.8	39.8
HN27a	LPRCA	86.8	2	3.8	173.6
HN27c	LPRCA	81.7	2	1.8	163.4
HN27d	LPRCA	82.8	2	3.5	165.6
HN27g	private	78.5	2	2.5	157.0
HN30z	private	77.6	1	3.8	77.6
HN31a	LPBLT	19.8	1	1.5	19.8
HN31z	LPRCA	56.2	1	3.3	56.2
HN37a	LPRCA	96.4	1	3.6	96.4
HN37c	LPRCA	36.9	1	1.4	36.9
HN37d	LPRCA	39.3	1	1.2	39.3
HN37e	LPRCA	91.9	1	2.4	91.9
HN37z	LPRCA	79.5	1	3.5	79.5
HN3c	LPRCA	14.1	1	1.1	14.1
HN4a-1	LPRCA	83.1	1	1.5	83.1
HN4a-2	LPRCA	61.7	1	1.9	61.7
HN4b	LPRCA	21.2	1	1.3	21.2
HN4d	LPRCA	37.9	2	4.2	75.8
HN52a	Norfolk Cty	81.1	1	3.9	81.1
HN5a	LPRCA	111.0	3	5.6	222.0
HN5c	NCC	26.6	2	3.5	53.2
HN7z	LPRCA	55.2	1	3.8	55.2
HN81z	LPBLT	94.0	1	2.5	94.0
HN90z	LPRCA	20.6	2	1.3	41.2
HN96a	NCC	97.5	2	4.5	195.0
HN99z	private	5.1	1	0.8	5.1
HW1z	HCA	420.0	1	15.0	420.0

KE10a	private	28.5	1	4.2	28.5
KE2z	Ontario Parks	697.0	2	13.7	697.0
KE3	Ontario Parks	142.0	1	2.0	142.0
KE7a	private	17.2	1	1.3	17.2
LA10a	SCRCA	22.0	1	3.3	22.0
LA28a	private	43.9	1	2.1	43.9
LA2z	SCRCA	306.0	1	8.6	306.0
LA3z	Ontario Parks	382.0	1	9.3	382.0
LA5z	Ontario Parks	1743.0	2	27.1	1743.0
LA9a	SCRCA	48.8	1	2.6	48.8
MI10a	private	22.8	1	1.8	22.8
MI10b	private	29.4	1	1.7	29.4
MI10c	private	16.3	1	0.8	16.3
MI11a	private	62.7	1	40.0	62.7
MI2a	TTLT	20.2	1	0.9	20.2
MI3a	TTLT	26.4	2	2.3	52.8
MI3b	Middlesex Cty	119.0	1	5.2	119.0
MI3e	Middlesex Cty	41.0	2	0.8	41.0
MI3f	LTVCA	128.0	1	2.6	128.0
MI3g	TTLT	57.8	1	2.2	57.8
MI3h	Middlesex Cty	212.0	2	6.4	212.0
MI3j	TTLT	24.4	1	1.1	24.4
MI3k	Middlesex Cty	41.2	1	1.6	41.2
MI4a	TTLT	43.1	1	1.6	43.1
MI6a	private	22.0	1	1.4	22.0
MI6z	Middlesex Cty	59.0	1	3.0	59.0
WA5a	Waterloo Cty	85.9	1	3.1	85.9
Totals		10207.7	178.0	501.6	14094.3

*bolded sites are newly surveyed sites

Appendix F: Forest Health Risk Occurrence by Forest Risk Type with SAR Presence

Site ID	Landowner	SAR present	Forest Health Risk	Human-related	Invasive Species	Natural	Total
BR04a	GRCA	No	Autumn Olive		1		1
		No	Emerald Ash Borer		1		1
		No	European Buckthorn		4		4
		No	Gypsy Moth		1		1
		Unknown	BHCO - nest parasite			1	1
BR05a	GRCA	No	Emerald Ash Borer		2		2
		No	Erosion and Sedimentation			1	1
		No	European Buckthorn		1		1
		No	Recent, Active, or Potential Harvest	1			1
		No	European Buckthorn		1		1
		Unknown	BHCO - nest parasite			1	1
BR06a	LPRCA	No	Multiflora Rose		1		1
		No	Pollution - waste	4			4
		No	Recent, Active, or Potential Harvest	1			1
		Yes	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
BR06b	LPRCA	No	Garlic Mustard		1		1
		Yes	European Buckthorn		1		1
		Unknown	BHCO - nest parasite			1	1
BR24z	private	No	Beech Bark Disease		1		1
		No	European Buckthorn		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Emerald Ash Borer		1		1
		Unknown	Recent, Active, or Potential Harvest	1			1
EL13a	KCCA	No	Autumn Olive		1		1
		No	European Buckthorn		3		3
		No	Garlic Mustard		3		3
		No	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Garlic Mustard		1		1
		Unknown	Multiflora Rose		1		1
EL14b	private	No	Multiflora Rose		3		3
		No	Pollution - waste	3			3
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
EL14c	private	Yes	Pollution - waste	2			2
		Unknown	BHCO - nest parasite			1	1
EL14z	private	No	Beech Bark Disease		2		2
		No	Emerald Ash Borer		1		1
		No	Garlic Mustard		1		1

		No	Multiflora Rose		2		2
		Yes	Erosion and Sedimentation Recent, Active, or Potential Harvest			1	1
		Yes		1			1
		Unknown	BHCO - nest parasite			1	1
EL15z	CCCA	No	Beech Bark Disease		1		1
		No	Emerald Ash Borer		1		1
		No	Garlic Mustard		4		4
		No	Multiflora Rose		1		1
		Yes	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			2	2
EL16a	CCCA	No	Autumn Olive		1		1
		No	Emerald Ash Borer		1		1
		No	Garlic Mustard		1		1
		No	Motorized Vehicle Trails	1			1
		No	Multiflora Rose		2		2
		Unknown	BHCO - nest parasite			1	1
EL18a	CCCA	No	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			1	1
EL20z	TTLT	No	Dog-strangling Vine		1		1
		No	Emerald Ash Borer		1		1
		No	Garlic Mustard		3		3
		No	Giant Hogweed		1		1
		No	Multiflora Rose		2		2
		No	Pollution - waste	1			1
		Yes	Garlic Mustard		1		1
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
EL28z	private	No	Emerald Ash Borer		2		2
		No	Garlic Mustard		1		1
		No	Japanese Barberry		1		1
		No	Motorized Vehicle Trails	1			1
		No	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
EL29z	private	No	Beech Bark Disease		3		3
		No	Emerald Ash Borer		3		3
		No	Erosion and Sedimentation			1	1
		No	Garlic Mustard		1		1
		No	Multiflora Rose		2		2
		Unknown	BHCO - nest parasite			2	2
EL3b	private	No	Garlic Mustard		1		1
		No	Multiflora Rose		2		2
		No	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Recent, Active, or Potential Harvest	1			1
EL3c	private	No	Garlic Mustard		2		2

		Yes	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
EL43b	CCCA	No	Autumn Olive		1		1
		No	Beech Bark Disease		1		1
		No	Emerald Ash Borer		3		3
		No	Garlic Mustard		1		1
		No	Multiflora Rose		1		1
		Yes	Emerald Ash Borer		1		1
		Yes	Multiflora Rose		1		1
EL45a	private	Unknown	BHCO - nest parasite			1	1
		No	Pollution - waste	3			3
		Yes	Erosion and Sedimentation			1	1
		Yes	Garlic Mustard		1		1
		Yes	Pollution - waste	6			6
		Unknown	BHCO - nest parasite			1	1
EL45z	private	No	Erosion and Sedimentation			2	2
		No	Garlic Mustard		1		1
		Yes	Avian Predator			1	1
		Yes	Garlic Mustard		1		1
		Yes	Motorized Vehicle Trails	3			3
		Yes	Pollution - waste	1			1
EL46c	private	No	Erosion and Sedimentation			1	1
		No	Garlic Mustard		5		5
		No	Multiflora Rose		2		2
		No	Phragmites		1		1
		No	Pollution - waste	2			2
		Unknown	BHCO - nest parasite			1	1
EL51z	LPRCA	No	Feral Cat		1		1
		No	Motorized Vehicle Trails	1			1
		Unknown	BHCO - nest parasite			1	1
EL54b	private	No	Garlic Mustard		1		1
		No	Pollution - waste	2			2
		No	Recent, Active, or Potential Harvest	1			1
		Yes	Motorized Vehicle Trails	1			1
		Unknown	BHCO - nest parasite			1	1
EL57z	private	No	Garlic Mustard		1		1
		Yes	Emerald Ash Borer		1		1
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
EL5a	private	No	Emerald Ash Borer		1		1
		No	Garlic Mustard		1		1
		No	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
EL60c	private	Unknown	No Risk Detected				0
EL60z	private	No	Hunting Structure	1			1
		Unknown	BHCO - nest parasite			1	1

HN101b	NCC	No	Garlic Mustard		1		1
		No	Pollution - waste	1			1
HN102b	private	Unknown	BHCO - nest parasite			1	1
HN111b	LPRCA	No	Garlic Mustard		1		1
		Yes	Emerald Ash Borer		1		1
		Unknown	BHCO - nest parasite			1	1
HN114z	LPBLT	No	Structure	1			1
		Yes	Garlic Mustard		1		1
		Unknown	Beech Bark Disease		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Emerald Ash Borer		1		1
HN12d	MNRF	No	Garlic Mustard		1		1
		No	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Recreational Use	1			1
HN12g	MNRF	No	Garlic Mustard		1		1
		Yes	Motorized Vehicle Trails	1			1
		Unknown	BHCO - nest parasite			1	1
HN14z	HNC	Yes	Multiflora Rose		6		6
		Yes	Recreational Use	1			1
		Unknown	BHCO - nest parasite			1	1
HN160a	private	Unknown	No Risk Detected				0
HN160z	private	Unknown	No Risk Detected				0
HN16b	MNRF	No	Garlic Mustard		5		5
		No	Multiflora Rose		1		1
		No	Recreational Use	1			1
		Yes	Avian Predator			1	1
		Yes	Beech Bark Disease		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Garlic Mustard		1		1
		Unknown	Pollution - waste	1			1
HN16e	MNRF	Unknown	No Risk Detected				0
HN17a	LPRCA	No	Autumn Olive		1		1
		No	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			1	1
HN17b	LPRCA	Yes	Multiflora Rose		3		3
		Unknown	BHCO - nest parasite			1	1
HN18a	LPRCA	Unknown	BHCO - nest parasite			1	1
HN18b	LPRCA	No	Emerald Ash Borer		1		1
		No	European Buckthorn		1		1
		No	Pollution - waste	1			1
HN19b	LPRCA	No	Hunting Structure	1			1
		No	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Emerald Ash Borer		1		1
HN1b	NCC	No	Beech Bark Disease		1		1
		No	Garlic Mustard		1		1
		No	Multiflora Rose		2		2

		Unknown	BHCO - nest parasite			2	2
HN1c	NCC	No	Multiflora Rose		2		2
		Unknown	BHCO - nest parasite			2	2
HN21a	LPRCA	Unknown	BHCO - nest parasite			1	1
		Unknown	Garlic Mustard		1		1
		Unknown	Pollution - waste	1			1
HN21b	LPRCA	No	Multiflora Rose		2		2
		Unknown	BHCO - nest parasite			1	1
HN21c	LPRCA	No	Garlic Mustard		1		1
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Recent, Active, or Potential Harvest	1			1
HN21e	private	No	Garlic Mustard		1		1
		No	Recreational Use	2			2
		Unknown	BHCO - nest parasite			1	1
HN21f	Norfolk Cty	No	Dry Slough			1	1
		No	Emerald Ash Borer		1		1
		No	Garlic Mustard		2		2
		No	Motorized Vehicle Trails	1			1
		No	Pollution - waste	2			2
HN26c	LPRCA	Unknown	BHCO - nest parasite			1	1
HN26d	LPRCA	No	Garlic Mustard		1		1
		No	Pollution - waste	2			2
		Yes	Recent, Active, or Potential Harvest	1			1
		Unknown	Emerald Ash Borer		1		1
HN27a	LPRCA	No	Garlic Mustard		4		4
		No	Multiflora Rose		8		8
		No	Pollution - waste	1			1
		Yes	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			1	1
HN27c	LPRCA	No	Autumn Olive		1		1
		No	Garlic Mustard		1		1
		No	Multiflora Rose		5		5
		No	Pollution - waste	5			5
		Yes	Garlic Mustard		1		1
		Unknown	Garlic Mustard		1		1
HN27d	LPRCA	No	Autumn Olive		1		1
		No	Dry Slough			1	1
		No	Multiflora Rose		5		5
		No	Pollution - waste	5			5
		Unknown	BHCO - nest parasite			1	1
HN27g	private	No	Autumn Olive		1		1
		No	Emerald Ash Borer		1		1
		No	Garlic Mustard		4		4
		Yes	Garlic Mustard		1		1
		Yes	Pollution - waste	1			1

HN30z	private	No	Garlic Mustard		3		3
		No	Multiflora Rose		1		1
		No	Pollution - waste	4			4
		Yes	Garlic Mustard		1		1
		Yes	Pollution - waste	3			3
		Unknown	BHCO - nest parasite			1	1
HN31a	LPBLT	No	Garlic Mustard		2		2
		No	Multiflora Rose		4		4
		No	Pollution - waste	2			2
		Yes	Emerald Ash Borer		1		1
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Erosion and Sedimentation			1	1
HN31z	LPRCA	No	Garlic Mustard		2		2
		No	Japanese Barberry		1		1
		No	Multiflora Rose		7		7
		No	Pollution - waste	2			2
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Emerald Ash Borer		1		1
HN37a	LPRCA	No	Autumn Olive		1		1
		No	Garlic Mustard		1		1
		No	Hunting Structure	1			1
		No	Pollution - waste	2			2
		No	Structure	1			1
		Yes	Emerald Ash Borer		1		1
		Yes	Garlic Mustard		1		1
HN37c	LPRCA	Unknown	No Risk Detected				0
HN37d	LPRCA	No	Garlic Mustard		2		2
		No	Motorized Vehicle Trails	1			1
		No	Multiflora Rose		2		2
		No	Pollution - waste	1			1
HN37e	LPRCA	No	Emerald Ash Borer		1		1
		No	Garlic Mustard		1		1
		No	Multiflora Rose		1		1
HN37z	LPRCA	No	Motorized Vehicle Trails	1			1
		Yes	Garlic Mustard		1		1
		Yes	Multiflora Rose		1		1
		Yes	Pollution - waste	1			1
		Unknown	BHCO - nest parasite			1	1
HN3c	LPRCA	No	Garlic Mustard		1		1
HN4a-1	LPRCA	No	Garlic Mustard		2		2
		Yes	Garlic Mustard		2		2
		Yes	Motorized Vehicle Trails	1			1
		Unknown	BHCO - nest parasite			1	1
HN4a-2	LPRCA	No	Garlic Mustard		1		1
		Yes	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			1	1

HN4b	LPRCA	No	Multiflora Rose		1		1
		No	Phragmites		1		1
HN4d	LPRCA	No	Garlic Mustard		1		1
		Yes	Emerald Ash Borer		1		1
		Yes	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			2	2
HN52a	Norfolk Cty	No	Garlic Mustard		1		1
		No	Gypsy Moth		1		1
		No	Pollution - waste	4			4
HN5a	LPRCA	No	Garlic Mustard		2		2
		No	Multiflora Rose		3		3
		No	Recent, Active, or Potential Harvest	1			1
		Yes	Garlic Mustard		1		1
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			2	2
HN5c	NCC	No	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			2	2
HN7z	LPRCA	No	Garlic Mustard		3		3
		Yes	Emerald Ash Borer		1		1
		Unknown	BHCO - nest parasite			1	1
HN81z	LPBLT	No	Emerald Ash Borer		1		1
		No	Garlic Mustard		2		2
		Yes	Garlic Mustard		2		2
		Yes	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Emerald Ash Borer		2		2
HN90z	LPRCA	Yes	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			2	2
HN96a	NCC	No	Garlic Mustard		1		1
		No	Multiflora Rose		2		2
		No	Pollution - waste	3			3
		Unknown	BHCO - nest parasite			2	2
HN99z	private	Unknown	BHCO - nest parasite			1	1
HW1z	HCA	No	Autumn Olive		1		1
		No	Emerald Ash Borer		2		2
		No	European Buckthorn		3		3
		No	Garlic Mustard		4		4
		No	Japanese Barberry		1		1
		No	Multiflora Rose		3		3
		No	Pollution - waste	1			1
		No	Structure	1			1
		Unknown	BHCO - nest parasite			1	1
		Unknown	European Buckthorn		1		1
		Unknown	Multiflora Rose		1		1
KE10a	private	Yes	Multiflora Rose		1		1

		Unknown	BHCO - nest parasite			1	1
		Unknown	Emerald Ash Borer		1		1
KE2z	Ontario Parks	No	Autumn Olive		1		1
		No	Garlic Mustard		2		2
		No	Japanese Barberry		3		3
		No	Multiflora Rose		2		2
		No	Phragmites		3		3
		Yes	Autumn Olive		1		1
		Unknown	BHCO - nest parasite			2	2
		Unknown	Phragmites		1		1
KE7a	private	No	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Recent, Active, or Potential Harvest	1			1
LA10a	SCRCA	No	Multiflora Rose		1		1
		No	Pollution - waste	1			1
		Unknown	BHCO - nest parasite			1	1
LA28a	private	No	Garlic Mustard		1		1
		Unknown	BHCO - nest parasite			1	1
LA2z	SCRCA	No	Garlic Mustard		1		1
		Yes	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
LA3z	Ontario Parks	No	Emerald Ash Borer		2		2
		No	European Buckthorn		3		3
		No	Phragmites		1		1
		No	Pollution - waste	1			1
		Yes	Emerald Ash Borer		1		1
		Unknown	BHCO - nest parasite			1	1
LA5z	Ontario Parks	No	European Buckthorn		1		1
		No	Japanese Barberry		1		1
		Unknown	BHCO - nest parasite			1	1
		Unknown	Motorized Vehicle Trails	1			1
LA9a	SCRCA	Yes	European Buckthorn		1		1
		Unknown	BHCO - nest parasite			1	1
MI10a	private	No	Emerald Ash Borer		1		1
		No	European Buckthorn		1		1
		No	Garlic Mustard		3		3
		Unknown	BHCO - nest parasite			1	1
MI10b	private	Unknown	BHCO - nest parasite			1	1
MI10c	private	Unknown	BHCO - nest parasite			1	1
MI11a	private	No	Garlic Mustard		2		2
		No	Motorized Vehicle Trails	1			1
		No	Pollution - waste	1			1
		Unknown	BHCO - nest parasite			1	1

MI2a	TTLT	Unknown	BHCO - nest parasite			1	1
MI3a	TTLT	No	Autumn Olive		1		1
		No	Multiflora Rose		1		1
		No	Pollution - waste	1			1
MI3b	Middlesex Cty	No	Japanese Barberry		1		1
		Yes	European Buckthorn		1		1
		Unknown	BHCO - nest parasite			1	1
MI3e	Middlesex Cty	No	Multiflora Rose		2		2
		No	Phragmites		1		1
		No	Pollution - waste	1			1
		Unknown	BHCO - nest parasite			1	1
MI3f	LTVCA	Unknown	No Risk Detected				0
MI3g	TTLT	No	Garlic Mustard		1		1
		No	Multiflora Rose		2		2
		No	Pollution - waste	1			1
		Yes	Multiflora Rose		1		1
MI3h	Middlesex Cty	Unknown	BHCO - nest parasite			1	1
MI3j	TTLT	No	Emerald Ash Borer		1		1
		No	Multiflora Rose		1		1
		No	Pollution - waste	3			3
		No	Structure	1			1
		Unknown	BHCO - nest parasite			1	1
MI3k	Middlesex Cty	No	Autumn Olive		1		1
		No	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
MI4a	TTLT	No	Autumn Olive		1		1
		No	Garlic Mustard		2		2
		No	Multiflora Rose		1		1
		Yes	Emerald Ash Borer		1		1
		Yes	Multiflora Rose		1		1
		Unknown	BHCO - nest parasite			1	1
MI6a	private	No	Emerald Ash Borer		1		1
		No	Garlic Mustard		2		2
		No	Pollution - waste	1			1
		No	Recent, Active, or Potential Harvest	1			1
		Unknown	BHCO - nest parasite			1	1
MI6z	Middlesex Cty	Unknown	No Risk Detected				0
WA5a	Waterloo Cty	Unknown	BHCO - nest parasite			1	1
Grand Total				121	341	104	566

Appendix G: Avian Species Richness and Diversity per survey site in 2019.

Site ID	Site Name	Landowner	Species Richness	Evenness	Shannon-Wiener Index (H')	True Diversity (ENS)
BR04a	Pinehurst CA	GRCA	45	0.63	2.41	11.17
BR05a	App's Mills CA	GRCA	27	0.66	2.19	8.93
BR06a	Harley Tract	LPRCA	34	0.67	2.37	10.70
BR06b	Fairfield Plains Tract	LPRCA	19	0.70	2.05	7.77
BR24z	Oakland Swamp-Dunning	private	24	0.69	2.18	8.86
EL13a	Dalewood North CA	KCCA	42	0.64	2.40	11.07
EL14b	Silver Creek-VanOverloop	private	50	0.63	2.46	11.68
EL14c	Silver Creek-Lindsay	private	33	0.64	2.23	9.28
EL14z	Silver Creek - Passmore	private	69	0.62	2.63	13.94
EL15z	Springwater CA	CCCA	80	0.61	2.69	14.68
EL16a	Yarmouth Natural Area	CCCA	65	0.64	2.67	14.41
EL18a	Archie Coulter CA	CCCA	35	0.66	2.35	10.47
EL20z	Hawk Cliff	TTLT	39	0.58	2.13	8.43
EL28z	South Otter-Grigg	private	32	0.67	2.33	10.29
EL29z	Hotchkiss	private	63	0.63	2.63	13.82
EL3b	Galbraith	private	22	0.66	2.06	7.81
EL3c	Wiehle Property	private	31	0.67	2.31	10.10
EL43b	Calton Swamp	CCCA	55	0.63	2.51	12.25
EL45a	Painted Ravine	private	43	0.64	2.41	11.15
EL45z	Carson Line Ravine	private	40	0.66	2.43	11.34
EL46c	Talbot Line Ravine	private	49	0.64	2.51	12.28
EL51z	Rugienis Tract	LPRCA	29	0.68	2.30	9.95
EL54b	Ketchabaw	private	48	0.65	2.53	12.60
EL57z	Carolinian Woods Area	private	31	0.67	2.31	10.11
EL5a	Casier Property	private	21	0.71	2.15	8.62
EL60c	Hoyer Property	private	15	0.70	1.91	6.74
EL60z	Whitting Way	private	23	0.68	2.13	8.44
HN101b	Conklin Tract	NCC	43	0.64	2.42	11.25
HN102b	Fakeburn Tract	private	28	0.67	2.23	9.29
HN111b	Hammond Tract	LPRCA	31	0.66	2.26	9.61
HN114z	Jackson-Gunn	LPBLT	22	0.68	2.10	8.13
HN12d	St. Williams SW	MNRF	35	0.65	2.30	9.95
HN12g	St. Williams NE	MNRF	41	0.62	2.32	10.18
HN14z	Spooky Hollow	HNC	53	0.64	2.53	12.58
HN160a	Kennedy	private	21	0.70	2.13	8.40
HN160z	Serenity	private	19	0.71	2.08	8.02
HN16b	Turkey Point Bluffs & Ravine	MNRF	54	0.63	2.50	12.14
HN16e	Turkey Point Tract - SW Block	MNRF	20	0.67	2.00	7.41
HN17a	Mckay-Kyte-Laforge	LPRCA	45	0.64	2.44	11.51

HN17b	Vandervyvere-Lipsit-Penner	LPRCA	45	0.63	2.42	11.19
HN18a	Vanessa Tract	LPRCA	17	0.71	2.00	7.42
HN18b	Hird-Tarcza-Robertson	LPRCA	28	0.66	2.21	9.10
HN19b	Jackson Tract	LPRCA	51	0.63	2.48	11.93
HN1b	Backus North	NCC	58	0.61	2.49	12.05
HN1c	Backus South	NCC	54	0.61	2.43	11.37
HN21a	Swick-King Tract	LPRCA	49	0.61	2.38	10.78
HN21b	Hanson Earl Danylevitch	LPRCA	55	0.62	2.48	11.93
HN21c	Smith Tract	LPRCA	33	0.65	2.28	9.78
HN21e	Griffin Woods	private	29	0.67	2.24	9.41
HN21f	County Forest C4	Norfolk Cty	21	0.64	1.96	7.10
HN26c	Roney Tract	LPRCA	41	0.65	2.42	11.27
HN26d	Long Tract	LPRCA	32	0.66	2.28	9.81
HN27a	Wilson Tract	LPRCA	48	0.57	2.22	9.23
HN27c	Coppens Tract	LPRCA	13	0.72	1.85	6.33
HN27d	Armstrong	LPRCA	56	0.62	2.50	12.20
HN27g	Rowanwood Tract	private	27	0.64	2.10	8.15
HN30z	Shoppe's Creek	private	45	0.63	2.39	10.86
HN31a	Fishers Glen-South	LPBLT	50	0.63	2.48	11.95
HN31z	Fishers Glen-North	LPRCA	48	0.64	2.47	11.78
HN37a	Middleton Swamp	LPRCA	39	0.65	2.38	10.79
HN37c	Abbot-Townsend	LPRCA	20	0.67	2.02	7.54
HN37d	Ringland	LPRCA	29	0.67	2.27	9.64
HN37e	Parson-Vanderhaeghe	LPRCA	37	0.66	2.37	10.70
HN37z	Anderson Tract	LPRCA	39	0.65	2.38	10.78
HN3c	Croton CA	LPRCA	27	0.68	2.23	9.34
HN4a-1	Harris Harris Floyd East	LPRCA	31	0.63	2.18	8.84
HN4a-2	Harris Harris Floyd West	LPRCA	33	0.66	2.31	10.03
HN4b	Allan Tract	LPRCA	31	0.66	2.26	9.61
HN4d	Burwell Tract	LPRCA	43	0.65	2.43	11.38
HN52a	Trout Creek	Norfolk Cty	34	0.64	2.27	9.68
HN5a	Hepburn Tract	LPRCA	61	0.62	2.57	13.05
HN5c	Casier Tract	NCC	36	0.66	2.36	10.55
HN7z	Monroe London	LPRCA	32	0.65	2.26	9.57
HN81z	Arthur Langford	LPBLT	45	0.63	2.40	11.03
HN90z	Buchner-Mason	LPRCA	38	0.63	2.29	9.86
HN96a	Lake Erie Farms	NCC	53	0.63	2.50	12.21
HN99z	Rhino Woods	private	18	0.70	2.03	7.61
HW1z	Dundas Valley CA	HCA	61	0.62	2.53	12.61
KE10a	Hubble Property	private Ontario	27	0.68	2.25	9.45
KE2z	Rondeau PP	Parks	56	0.57	2.28	9.78
KE7a	Wilkin's Property	private	28	0.67	2.25	9.46
LA10a	McPhail Tract	SCRCA	23	0.66	2.06	7.87
LA28a	Ferguson Property	private	34	0.66	2.34	10.39
LA2z	Lambton Heritage Forest	SCRCA	53	0.63	2.48	11.99

LA3z	Bickford Woods	Ontario Parks	47	0.61	2.35	10.50
LA5z	Pinery PP	Ontario Parks	54	0.60	2.38	10.80
LA9a	Reid Property	SCRCA	33	0.63	2.20	9.05
MI10a	Old River Farms	private	24	0.67	2.13	8.39
MI10b	Yarmoschuk Property	private	28	0.66	2.21	9.16
MI10c	Burgsma Farms	private	18	0.71	2.04	7.72
MI11a	Sydenham River Nature Reserve	private	54	0.63	2.52	12.46
MI2a	Wardsville Woods	TTLT	27	0.68	2.25	9.45
MI3a	Beryl Ivey Woods	TTLT	29	0.65	2.19	8.97
MI3b	Skunk'S Misery - NE	Middlesex Cty	34	0.64	2.25	9.52
MI3e	Skunk'S Misery - SW	Middlesex Cty	21	0.68	2.06	7.83
MI3f	Mosa Forest	LTVCA	29	0.66	2.23	9.34
MI3g	Bebensee 1& 2	TTLT	24	0.67	2.13	8.40
MI3h	Skunk' Misery - NC	Middlesex Cty	47	0.63	2.43	11.35
MI3j	Sack	TTLT	22	0.68	2.11	8.27
MI3k	Skunk's Misery - Centre	Middlesex Cty	19	0.67	1.98	7.27
MI4a	Newport Forest	TTLT	38	0.65	2.38	10.81
MI6a	Sherwood Forest	private	24	0.70	2.21	9.14
MI6z	County Line Woods	Middlesex Cty	28	0.68	2.25	9.52
WA5a	Sudden Tract	Waterloo Cty	44	0.63	2.39	10.93