



Tiffin Conservation Area Forest Bird Monitoring Program: 2005 to 2018

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Nottawasaga Valley
Conservation Authority

Acknowledgements

This report would not have been possible without the efforts that Dave Featherstone has put into conducting the Forest Bird Monitoring Program at the Tiffin Conservation Area since 2005.

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1.0 Introduction

Birds provide a useful proxy in assessing general biodiversity trends within forest habitats as they are easy to monitor, sensitive to ecological change, and have the additional advantage of public recognition, interest, and empathy (Venier and Pearce, 2004). Further, bird monitoring programs provide valuable information on population status, species associations, and species or community trends in abundance (Schalk, et al., 2002). In addition, trends in forest bird populations can be used to infer changes in the environment as they are high in the food chain and are sensitive to both anthropogenic and natural environmental changes (Gregory & van Strien, 2010). In recognition of this, the Canadian Wildlife Service implemented the Forest Bird Monitoring Program (FBMP) in 1987 for the purpose of formalizing a protocol for monitoring forest bird populations (Welsh, 1995). The main goals of the program are: to describe long-term, habitat-specific population trends for forest songbirds; to develop a habitat-specific baseline inventory of forest bird species composition and relative abundance; and to develop regionally accurate habitat association profiles for all common forest birds (Cadman, et al., 1998; Welsh, 1998).

The Nottawasaga Valley Conservation Authority (NVCA) has participated in the FBMP annually and continuously since 2005 with one site consisting of five stations located at the Tiffin Conservation Area (TCA). Along with the NVCA, there are five other Conservation Authorities participating in the program: Toronto and Region Conservation Authority (TRCA), Conservation Halton, Hamilton Conservation Authority, Central Lake Ontario Conservation Authority (CLOCA), and the Ganaraska Region Conservation Authority (GRCA).

The objective of this report is to summarize and assess the FBMP data collected at the TCA between 2005 and 2018 through analyzing trends in species presence, species abundance and richness by guilds, indicator species, and species at risk.

2.0 Tiffin Conservation Area

Located in Essa Township, the TCA covers 194 hectares, encompassing a variety of natural habitats (NVCA, 2005). It is situated at the junction of two physiographic regions: the Simcoe Lowlands and the Simcoe Uplands. The local surficial geological features found at the TCA consist of glacial meltwater deposits in the Simcoe Lowlands, whereas the Simcoe Uplands are marked by low permeable till plains. Hydrologically, the TCA is bisected by Bear Creek and its associated tributaries. Further, several wetland features mark the TCA, typically associated with the base of the Simcoe Uplands, including the Tiffin Swamp Provincially Significant Wetland (PSW).

Table 1 provides an areal breakdown of vegetation cover types described within the TCA, including a variety of upland and wetland forest types, as well as open wetlands

and successional upland communities. Upland forests contain a mosaic of late-successional Sugar Maple-dominated communities, early-successional Aspen-dominated communities, and large swaths of pine plantations (NVCA, 2005). Swamp forests are dominated by mixed coniferous and deciduous cover (Table 1). The expanse of large forests is decreasing on the landscape with increasing fragmentation. Remaining forest tracts such as those at the TCA provide interior habitats that support many area-sensitive neotropical migrant and interior-specialist bird species. These species require sheltered conditions away from the forest edge to successfully forage and reproduce (OMNR, 2000).

Table 1: Natural Heritage Ecological Land Classification (ELC) of the TCA (NVCA, 2005).

	Natural Heritage Feature	ELC Community Series	Total Area (hectares)	Percent of Natural Heritage Cover	Percent of Feature Type
Forest					Percent of Total Forest Cover
	Cultural Woodland	CUW	1.6	0.8	1.0
	Cultural Plantation	CUP	25.5	13.4	16.3
	Coniferous Forest	FOC	2.2	1.2	1.5
	Deciduous Forest	FOD	53.0	27.9	34
	Mixed Forest	FOM	7.4	3.9	4.8
	Conifer Swamp	SWC	2.7	1.4	1.7
	Deciduous Swamp	SWD	3.0	1.6	1.9
	Mixed Swamp	SWM	60.3	31.8	38.8
	Total Forest		155.7	82.0	100
Open Canopy Wetlands					Percent of Total Open Canopy Wetland Cover
	Meadow Marsh	MAM	0.7	0.3	6.4
	Shallow Marsh	MAS	2.9	1.5	31.9
	Swamp Thicket	SWT	3.4	1.8	38.3
	Shallow Water	SA	2.1	1.1	23.4
		Total Open Wetland		9.1	4.7
Successional Upland					Percent of Total Successional Upland Cover
	Cultural Meadow	CUM	8.0	4.2	31.8
	Cultural Thicket	CUT	17.1	9.0	68.2
		Total Successional Upland		25.1	13.2
	Natural Heritage Total		189.9	100	

Previous bird monitoring analysis at the TCA is limited to the bird data presented in the Tiffin Conservation Area Management Plan 2005-2010 (NVCA, 2005) and includes the bird assemblage that has been recorded at the TCA.

3.0 Forest Bird Monitoring Program Tiffin Conservation Area site description and methodology

The FBMP collects data in forests with at least three stations (five for large, > 25 ha forests) located a minimum of 250 m apart and 100 m from the edge of the woodland (Canadian Wildlife Service, 2018). Each station is set up to be completely within a relatively homogeneous forest type (Canadian Wildlife Service, 2018). These stations are generally self-selected (rather than randomly) with an effort to be representative of the different cover types within the province (Cadman, et al., 1998). Using this methodology, the FBMP at the TCA consists of five stations, depicted in Figure 1 and detailed in Table 2.

Each station was surveyed twice annually, ideally by the same observer, with the first visit occurring between May 24th and June 17th and the second visit between June 13th and July 10th, with at least 6 days between visits (Canadian Wildlife Service, 2018). All stations were visited on each survey date between dawn and 10:00 am, ideally on the same day each year, during weather conditions which are favorable for calling activity (i.e., winds less than 15 km/h and no rain). At each station, the surveyor recorded all observed/detected birds that are potentially associated with the forest habitat located both within and in excess of a 100 m radius of the station (Canadian Wildlife Service, 2018). Other species that may be in transit (such as a loon or gull) were not be included in the survey data as it would not have been actively using the forest habitat. In addition to tracking the presence of individual birds, the breeding status of each individual was also estimated based on specific behavioral indicators (e.g., singing or calling, gender if observed, observed pair, nest, etc.) (Welsh, 1995). The total time spent at each station was 10 minutes, following the FBMP protocols, broken up into successive 5 minute intervals to allow for comparisons with external surveys that only use 5 minute counts (Canadian Wildlife Service, 2018). While shorter count periods have stronger statistical power due to an increase in number of samples, longer counts are more precise (Welsh, 1995). Welsh (1995) also states that participants that may only conduct several bird surveys annually may require more than 5 minutes, but perform well with 10-minute count periods.



Tiffin Centre ELC and Bird Survey Locations

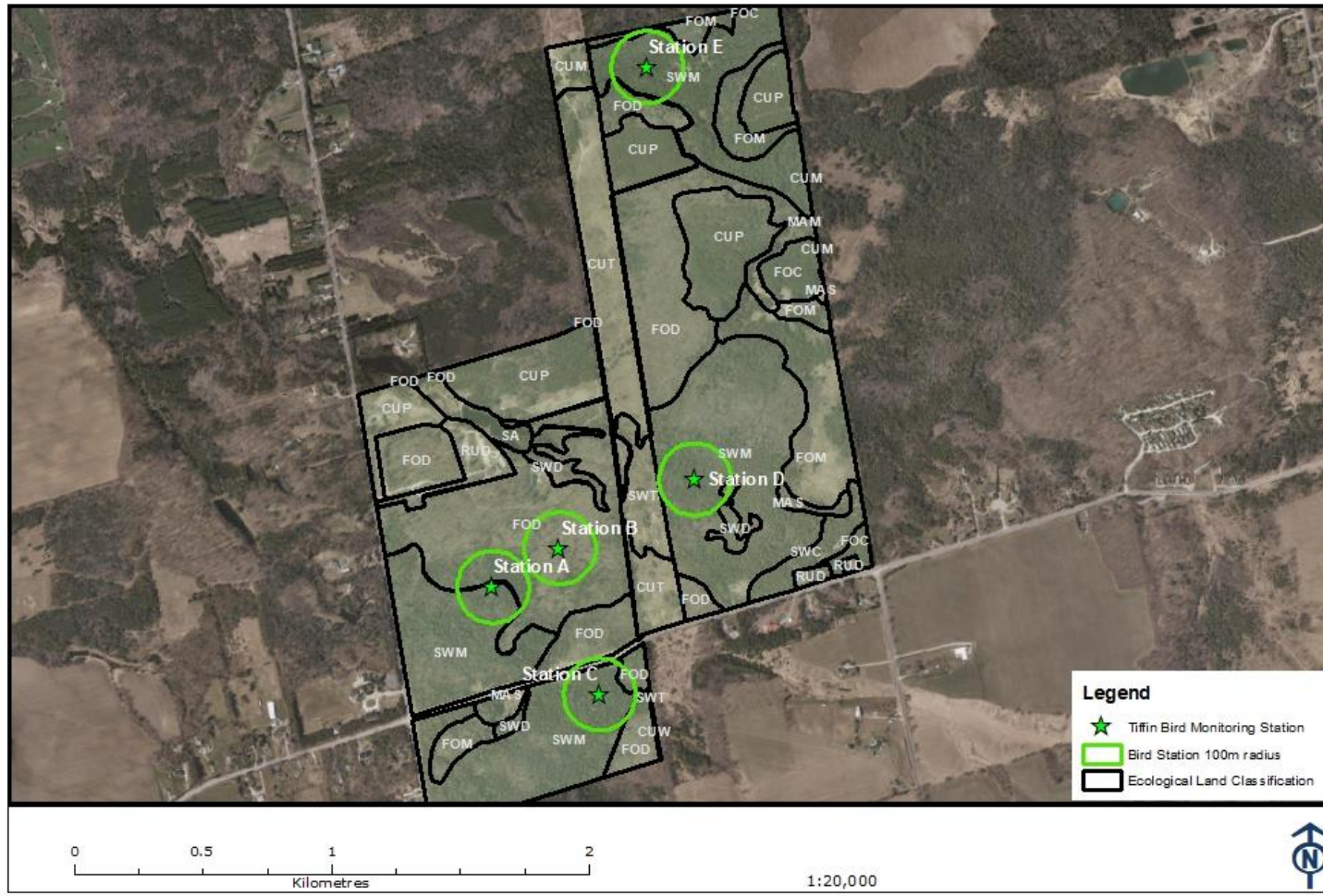


Figure 1: Base map of the Tiffin Conservation Area with the delineated Ecological Lands Classification polygons following Lee et al. (1998), modified from NVCA (2005) illustrating the five FBMP stations with the associated 100 m radius.

Each station was surveyed twice annually, ideally by the same observer, with the first visit occurring between May 24th and June 17th and the second visit between June 13th and July 10th, with at least 6 days between visits (Canadian Wildlife Service, 2018). All stations were visited on each survey date between dawn and 10:00 am, ideally on the same day each year, during weather conditions which are favorable for calling activity (i.e., winds less than 15 km/h and no rain). At each station, the surveyor recorded all observed/detected birds that are potentially associated with the forest habitat located both within and in excess of a 100 m radius of the station (Canadian Wildlife Service, 2018). Other species that may be in transit (such as a loon or gull) were not included in the survey data as it would not have been actively using the forest habitat. In addition to tracking the presence of individual birds, the breeding status of each individual was also estimated based on specific behavioral indicators (e.g., singing or calling, gender if observed, observed pair, nest, etc.) (Welsh, 1995). The total time spent at each station was 10 minutes, following the FBMP protocols, broken up into successive 5 minute intervals to allow for comparisons with external surveys that only use 5 minute counts (Canadian Wildlife Service, 2018). While shorter count periods have stronger statistical power due to an increase in number of samples, longer counts are more precise (Welsh, 1995). Welsh (1995) also states that participants that may only conduct several bird surveys annually may require more than 5 minutes, but perform well with 10-minute count periods.

The analysis methodology by Conservation Halton was used to calculate species richness and abundance of forest birds over time within nesting, habitat, and migration guilds (Dunn, 2016). Species abundance is defined as the number of individuals of each species observed (Conservation Halton, 2017). Species richness is defined as the number of (unique) species observed in an area (Ricklefs, 2008), and is presented here as a proportion of annual records. A guild is defined by Root (1967) as a group of species that exploit the same class of environmental resources in a similar way. See Appendix B for guild parameters

Table 2: Ecological Land Classification of the FBMP stations at the Tiffin Conservation Area.

Station	Easting	Northing	ELC Code	ELC Community Unit	Description
A	595981	4907374	SWM3-1	Birch Conifer Mineral Mixed Swamp Type	Hemlock forest surrounded by mixed swamp
B	596154	4907693	FOD5-1	Fresh Sugar Maple Deciduous Forest	Sugar Maple Forest
C	596313	4907140	SWM6-2	Poplar-Conifer Organic Mixed Swamp Type	Black Ash inclusion within black spruce dominated swamp
D	596750	4907695	SWM 3-2	Poplar-Conifer Mineral Mixed Swamp Type	Cedar mixed swamp
E	596512	4909001	SWM1-1	White Cedar-Hardwood Mineral Mixed Swamp	Cedar mixed swamp, lowlands

4.0 Results

Since FBMP data collection began in 2005, 64 species of birds have been recorded at the TCA. Of these 64 species, 14 have been observed at one or more stations each year, including one Species at Risk (Eastern Wood-Pewee, *Contopus virens*, EAWP – special concern), and three indicator species (Ovenbird, *Seiurus aurocapillus*, OVEN; Veery, *Catharus fuscescens*, VEER; and Winter Wren, *Troglodytes hiemalis*, WIWR). All species observed over the study period and the associated years of observation are presented in Table 3. See Appendix A for complete list of species code, common name, and scientific nomenclature for all detected species.

The species were divided into three guilds based on the location of their nests (canopy, understory/shrub, ground, or cavity), their habitat preferences (forest interior, interior/edge generalists, or forest edge), and how they migrate (resident, short distant migrant, or neotropical migrant). Species richness in each guild was calculated as a proportion of the total species richness for all guilds combined and the abundance was calculated based on the total number of individuals in each guild (Dunn, 2016). Since the FBMP requires two visits per year, the visit with the maximum count observed for a particular species was used for its abundance and richness calculations for that year. This assumes that individuals of a particular species recorded on the first visit were also recorded during the second visit.

A subset of the 2005-2018 data set was used for the calculation of the species richness and abundance, summarized for each guild (Figures 2 to 4). The 8 year data subset allows for broad trend analysis and characterization. Note that species abundance by guild is presented as total abundance, while species richness is presented as a proportion of annual records.

Table 3: Composite bird species that were observed (black cells) at the TCA, by visit, as part of the FBMP, 2005-2018 study period.

Species Code	09-06-05	08-07-05	06-06-06	26-06-06	31-05-07	26-06-07	30-05-08	27-06-08	25-05-09	16-06-09	25-05-10	25-06-10	03-06-11	21-06-11	07-06-12	20-06-12	05-06-13	18-06-13	29-05-14	19-06-14	02-06-15	25-06-15	10-06-16	30-06-16	07-06-17	22-06-17	08-06-18	19-06-18	
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Species Code	09-06-05	08-07-05	06-06-06	26-06-06	31-05-07	26-06-07	30-05-08	27-06-08	25-05-09	16-06-09	25-05-10	25-06-10	03-06-11	21-06-11	07-06-12	20-06-12	05-06-13	18-06-13	29-05-14	19-06-14	02-06-15	25-06-15	10-06-16	30-06-16	07-06-17	22-06-17	08-06-18	19-06-18	
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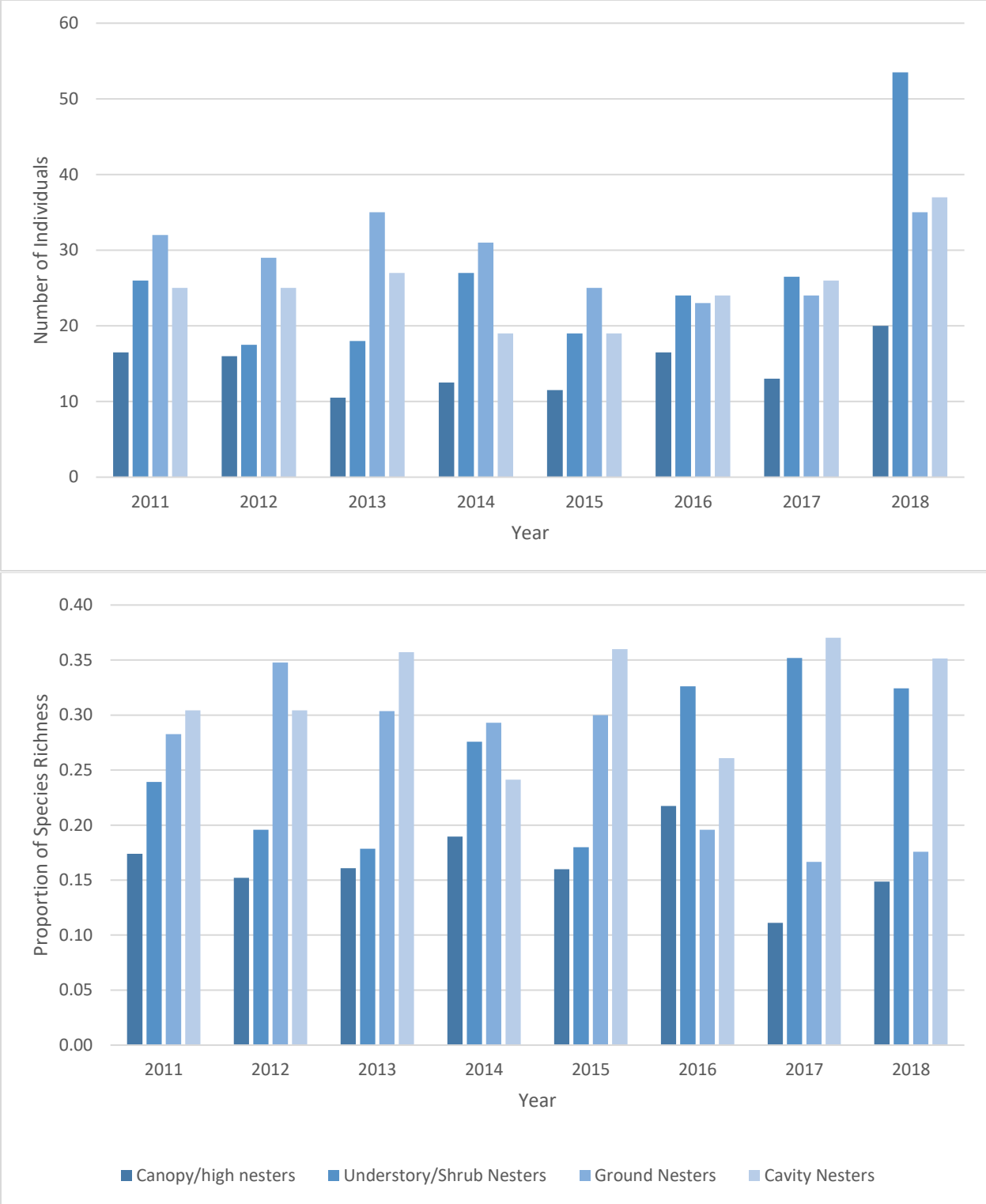


Figure 2: Species abundance (top) and species richness (bottom) in each nesting guild by year (2011-2018)

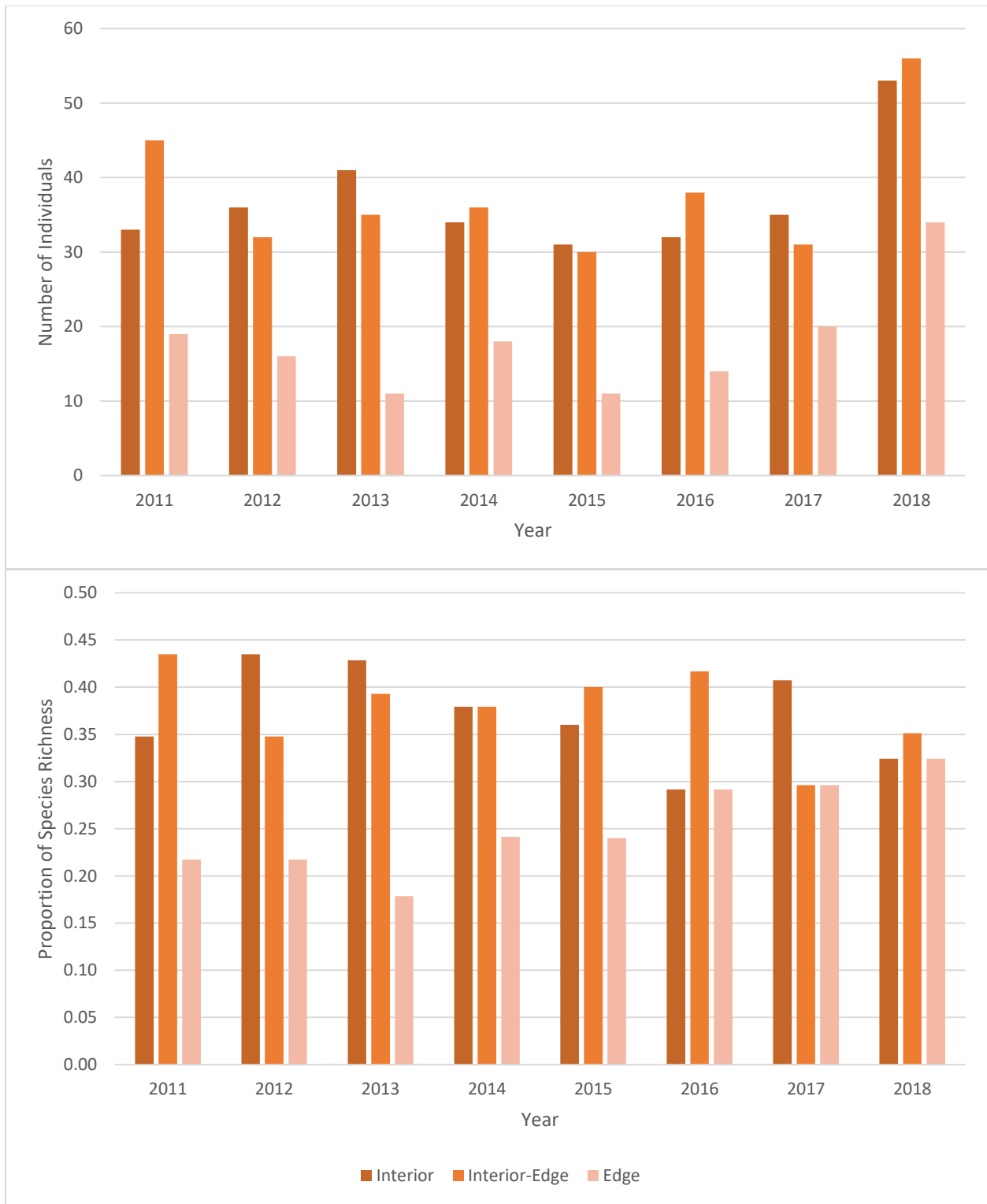


Figure 3: Species abundance (top) and species richness (bottom) in each habitat guild by year (2011-2018)



Figure 4: Species abundance (top) and species richness (bottom) in each migrant guild by year (2011-2018)

4.1 Indicator Species

Birds have many characteristics that make them desirable as habitat indicators; they are highly diverse and have the potential to detect unexpected environmental changes (Gregory & van Strien, 2010; Järvinen & Väisänen, 1979). Birds are diverse, generally high in the food chain, and, when combined with the efficiency of simultaneously sampling many species (through point counts for example), they allow for detection of change and stressors (Gregory & van Strien, 2010; Venier & Pearce, 2004). However, migratory species may be less indicative of Ontario’s breeding habitat than resident species as they are also impacted by conditions in their wintering grounds and migration route (McLaren et al., 1998).

The Ontario Ministry of Natural Resources (OMNR) Significant Wildlife Habitat Technical Guide (2000) describes the habitat for native Ontario birds (among other flora and fauna) and outlines habitat requirements, in addition to whether a species is at risk or “area-sensitive” (meaning that these species require large areas of suitable habitat for long term population survival and experience population decline as a result of habitat fragmentation). The schedule for Ecoregion 6E provides guidelines to evaluate significant wildlife habitat (SWH) for woodland area-sensitive bird breeding habitat through the presence of 14 indicator species (see Appendix C; OMNRF, 2015). The OMNRF (2015) states that if breeding pairs of at least three indicator species, or if the Canada Warbler (CAWA) is breeding, then the habitat is considered (SWH). An overview of the habitat requirements and population trends of these species is provided in Appendix D. Figure 5 illustrates when any of these indicator species were recorded during both the first and second surveys annually (all stations combined) and provides the minimum number of individuals recorded over the two annual surveys (e.g., in 2008, 11 Ovenbirds were recorded during visit 1, but only 5 were recorded during visit 2, therefore there were at least 5 Ovenbirds that were likely present for both surveys).

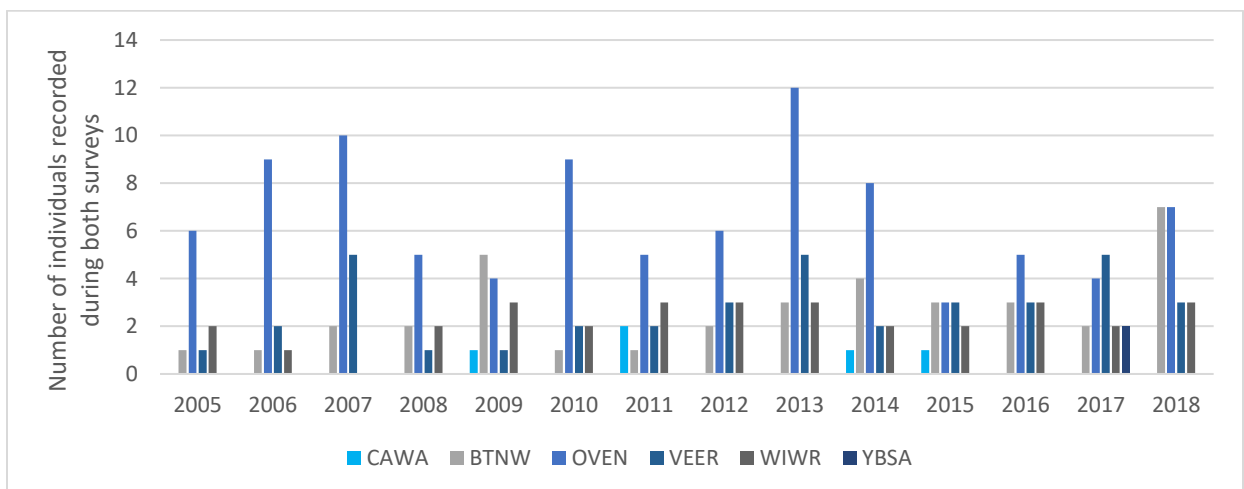


Figure 5: The minimum number of individuals of indicator species that were recorded at TCA for both combined annual surveys

4.2 Species at Risk

The 64 forest bird species detected at TCA were compared to the species at risk (SAR) listed under both the *Ontario Endangered Species Act*, as Species at Risk in Ontario (SARO) (Government of Ontario, 2018), and the federal *Species at Risk Act* (SARA) (Government of Canada, 2018). Four of the recorded species are listed either provincially or federally as SAR (see Table 5). Table 6 outlines the individual occurrences of the identified SAR per year. See Appendix D for habitat preferences.

Table 5: List of SAR found at Tiffin Conservation Area

Bird Code	Common Name	Scientific Name	SARO Status	SARA Status
CAWA	Canada Warbler	<i>Cardellina canadensis</i>	Special Concern	Threatened
EAWP	Eastern Wood-Pewee	<i>Contopus virens</i>	Special Concern	Special Concern
RSHA	Red-shouldered Hawk	<i>Buteo lineatus</i>	Not listed	Special Concern
WOTH	Wood Thrush	<i>Hylocichla mustelina</i>	Special Concern	Threatened

Table 6: The individual SAR occurrences, per station and per year.

Year	Species Code	Station					total
		A	B	C	D	E	
2005	CAWA						
	EAWP	1	2	1			4
	RSHA						
	WOTH	2	1		1		4
2006	CAWA						
	EAWP	1	1				2
	RSHA						
	WOTH	1	1				2
2007	CAWA						
	EAWP	1	2			1	4
	RSHA		1				1
	WOTH			1			1
2008	CAWA				1	1	2
	EAWP	1	1				2
	RSHA						
	WOTH		1				1
2009	CAWA			1	1	1	3
	EAWP	1	2				3
	RSHA						
	WOTH						

Year	Species Code	Station					total
		A	B	C	D	E	
2010	CAWA					1	1
	EAWP		3	1			4
	RSHA				1		1
	WOTH					1	1
2011	CAWA			1	1	1	3
	EAWP	1	3	1			5
	RSHA						
	WOTH						
2012	CAWA				1		1
	EAWP	1	2	1			4
	RSHA						
	WOTH						
2013	CAWA			1			1
	EAWP		2				2
	RSHA						
	WOTH						
2014	CAWA			1		1	2
	EAWP	1	1				2
	RSHA			1			1
	WOTH	1		1	1	1	4
2015	CAWA			1	1		2
	EAWP	1	1	1			3
	RSHA						
	WOTH						
2016	CAWA						
	EAWP		2	1		1	4
	RSHA						
	WOTH					1	1
2017	CAWA						
	EAWP		1				1
	RSHA						
	WOTH						
2018	CAWA						
	EAWP	1	3				4
	RSHA						
	WOTH		2		1		3

5.0 Discussion

5.1 Species Observed Annually

There were 64 unique species detected at the TCA between 2005 and 2018, 14 of which have been observed during at least one survey annually. Of the species observed annually, three (American Crow, *Corvus brachyrhynchos*; Nashville Warbler, *Leiothlypis ruficapilla*; and White-throated Sparrow, *Zonotrichia albicollis*) are classified as 'edge species', defined as typically using forest perimeters and open canopy areas within and adjacent to the forest during the breeding season (Freemark & Collins, 1992). This includes, however, instances where the species was detected from the survey station but exceeding the 100 m radius. Five of these species (Black-throated Green Warbler, *Setophaga virens*; Northern Waterthrush, *Parkesia noveboracensis*; Ovenbird; Veery; and Winter Wren) are classified as interior species, defined as nesting only within forest interior, rarely occurring near the edge (Freemark & Collins, 1992). The remaining six species (Black-capped Chickadee, *Poecile atricapillus*; Blue Jay, *Cyanocitta cristata*; Eastern Wood Pewee, Great Crested Flycatcher, *Myiarchus crinitus*; Red-eyed Vireo, *Vireo olivaceus*; and White-breasted Nuthatch, *Sitta carolinensis*) are classified as interior-edge generalist species, defined as having territories located entirely within the forest, but may use forest edge, or may have territory extend across multiple forest fragments (Freemark & Collins, 1992).

The Ovenbird's presence is quite notable here, as it is a forest interior species that requires extensive interior forest habitat, as noted in Appendix D. The Ovenbird has been detected at each of the five survey stations, frequently with multiple individuals (up to four per station per survey) and often at four of five stations per year.

5.2 Guild Richness and Abundance

The notable change in species abundance in 2018 for nesting, habitat, and migration guilds may be the result of observer bias as these surveys were not conducted by the same individual as in previous years. The nesting guild analysis indicates that ground nesters had the highest abundance from 2011 to 2015 (Figure 2), yet cavity nesting species represent the greatest proportion in species richness. In 2018, there was an increase in the abundance for each nesting guild, most notably for the understory/shrub nesters (Figure 2). Canopy/high nesters had the lowest abundance and proportion of species richness for every year examined.

Interior specialists and interior/edge generalists dominate the habitat guild analyses, for both absolute abundance and species richness, with fewer edge-habitat species recorded (Figure 3). These results are to be expected as the FBMP survey design places stations within the forest interior, a minimum of 100 m away from the edge of a large opening in the woodland (LandOwner Resource Center, 2000). The relative proportion of edge specialist species richness, however, has been increasing since 2013.

Neotropical migrants were the most abundant migration guild every year from 2011 to 2018. In contrast, resident species dominate the species richness proportional analysis (Figure 4), followed by Neotropical migrants. Short distance migrants were generally both the least abundant and least proportionately represented, though this may be expected since most short-distance migrants are seed-eating grassland or shrubland species rather than forest species (Cadman, et al., 2007).

5.3 Indicator Species

The OMNRF (2015) states that an area is considered SWH if there are breeding pairs of at least three indicator species, or if the Canada Warbler is breeding on site (see Appendix D). While the surveys conducted at the TCA may not accurately confirm breeding status of individuals detected, observing the same species on two visits is indicative that they are likely breeding at a site. Results indicate that of the 14 recommended indicator species, 10 have been recorded at Tiffin during at least one survey, 4 species have been detected on both surveys annually (Black-Throated Green Warbler, Ovenbird, Veery, and Winter Wren), and the Canada Warbler has been observed during both surveys during 4 years. Therefore, the forest of the TCA provides significant wildlife habitat for woodland area-sensitive breeding birds. This is likely an under representation of the species using the site, as they may be present but not detected during the 10-minute survey period.

5.4 Species at Risk

Many of Ontario's SAR birds are designated as such from loss of habitat, including loss of large, contiguous tracts of forest. The TCA provides over 150 ha of forested habitat, much of which occurs in large blocks that provide suitable conditions for certain SAR forest birds. Of the four SAR recorded in the FBMP surveys, the Eastern Wood Pewee was observed during all survey years. The population of Eastern Wood Pewees in Ontario seems to be stable (COSSARO, 2013) which, combined with the relatively small required territory, could explain why it is the most common SAR observed at Tiffin. The Canada Warbler and Wood Thrush were recorded during at least one survey for 8 out of 14 years, and the Wood Thrush was the only SAR observed at every station at some point through the study period. The Red Shouldered Hawk was only recorded in 3 out of the 14 years; however, its hunting methods and frequent soaring above the canopy (Cornell Lab of Ornithology, 2017) may contribute to a reduced detection rate during the surveys as they have been observed using the property outside conducting the surveys.

6.0 Conclusion and Recommendations

This report provides a characterization summary of the FBMP data collected at the TCA between 2005 and 2018 to identify species presence, abundance, and richness by guilds and presence of forest bird indicator species and species at risk. Since the FBMP began at the TCA, annual surveys have detected probable breeding activity of

at least three area-sensitive indicator species. As per standard provincial criteria (OMNR 2000), this data indicates that the TCA provides SWH for woodland breeding birds. Additionally, the annual presence of at least one SAR species further supports the importance of this site for forest bird populations.

Additional and/or future statistical and analytical methods should be applied to the full dataset of FBMP data collected at the TCA, e.g., nesting/breeding behavior comparable to CLOCA (2013). Species diversity measurements such as the Shannon Index or the Simpsons Index could be applied to the FBMP data, given that species richness and abundance data already exists. The data analyzed in this report includes only the total number of species detected at each station. With the number of edge-habitat species increasing in both abundance and species richness, perhaps the analysis for habitat guilds should be restricted to birds detected within 100 m of the survey station, as individuals recorded > 100 m may have been calling from edge habitat impacting the results of how many forest edge species are detected. Additional analyses could include evaluating long-term population trends, potentially identifying historic species which are no longer detected at TCA, or new species which were not detected in the earlier years of the program, and whether the apparent increase in edge-habitat species is statistically significant. Such information may provide insight on changing distribution patterns and areas of suitable habitat for Ontario bird species, potentially relating to long-term climate change pressures.

On its own, the FBMP provides very limited understanding of population trends of sensitive bird species within the NVCA watershed as it is limited to the one site at TCA. The FBMP is designed to contribute to a larger provincial monitoring program. NVCA's contribution to this program would benefit from having additional bird monitoring sites throughout the watershed to provide more robust data on the status of birds as indicators of ecosystem (forest) and watershed health. For comparison, the Credit Valley watershed is 1000 km² and they maintain 25 FBMP sites (Credit Valley Conservation, 2010), while the Nottawasaga Valley watershed is approximately 3700 km² with only one FBMP site. The NVCA owns multiple properties throughout the watershed that could host additional FBMP sites. Not all species at risk nor species with specific habitat requirements use forest interior habitat. In addition to the one FBMP site at the TCA, there are two marsh monitoring program (MMP) sites monitoring birds located at Marl Lake and the Minesing Wetlands. There has been a loss of grassland habitat resulting from urbanization and changing agricultural practices that has put increased pressure on species such as the Eastern Meadowlark (*Sturnella magna*) and Bobolink (*Dolichonyx oryzivorus*). Adding a grassland bird component to NVCA's bird monitoring program is therefore also recommended. Bird monitoring should become an integrated part of the NVCA Natural Heritage Monitoring Program.

7.0 References

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Appendix A: Complete List of Bird Species Observed during FBMP at TCA from 2005 to 2018

Bird Species Code	Common Name	Scientific Name
ALFL	Alder Flycatcher	<i>Empidonax alnorum</i>
AMCR	American Crow	<i>Corvus brachyrhynchos</i>
AMGO	American Goldfinch	<i>Spinus tristis</i>
AMRE	American Redstart	<i>Setophaga ruticilla</i>
AMRO	American Robin	<i>Turdus migratorius</i>
BAOW	Barred Owl	<i>Strix varia</i>
BAWW	Black-and-white Warbler	<i>Mniotilta varia</i>
BBCU	Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>
BCCH	Black-capped Chickadee	<i>Poecile atricapillus</i>
BHCO	Brown-headed Cowbird	<i>Molothrus ater</i>
BLBW	Blackburnian Warbler	<i>Setophaga fusca</i>
BLJA	Blue Jay	<i>Cyanocitta cristata</i>
BRCR	Brown Creeper	<i>Certhia americana</i>
BTBW	Black-throated Blue Warbler	<i>Setophaga caerulescens</i>
BTNW	Black-throated Green Warbler	<i>Setophaga virens</i>
BWHA	Broad-winged Hawk	<i>Buteo platypterus</i>
CAGO	Canada Goose	<i>Branta canadensis</i>
CAWA	Canada Warbler	<i>Cardellina canadensis</i>
CEDW	Cedar Waxwing	<i>Bombycilla cedrorum</i>
COGR	Common Grackle	<i>Quiscalus quiscula</i>
CORA	Common Raven	<i>Corvus corax</i>
COYE	Common Yellowthroat	<i>Geothlypis trichas</i>
DOWO	Downy Woodpecker	<i>Picoides pubescens</i>
EAKI	Eastern Kingbird	<i>Tyrannus tyrannus</i>
EAWP	Eastern Wood-Pewee	<i>Contopus virens</i>
GCFL	Great Crested Flycatcher	<i>Myiarchus crinitus</i>
GRCA	Gray Catbird	<i>Dumetella carolinensis</i>
HAWO	Hairy Woodpecker	<i>Picoides villosus</i>
HETH	Hermit Thrush	<i>Catharus guttatus</i>
HOWR	House Wren	<i>Troglodytes aedon</i>
INBU	Indigo Bunting	<i>Passerina cyanea</i>
LEFL	Least Flycatcher	<i>Empidonax minimus</i>
MAWA	Magnolia Warbler	<i>Setophaga magnolia</i>
MODO	Mourning Dove	<i>Zenaida macroura</i>
MYWA	Myrtle Warbler	<i>Setophaga coronata coronata</i>
NAWA	Nashville Warbler	<i>Oreothlypis ruficapilla</i>

Bird Species Code	Common Name	Scientific Name
NOCA	Northern Cardinal	<i>Cardinalis cardinalis</i>
NOWA	Northern Waterthrush	<i>Parkesia noveboracensis</i>
OVEN	Ovenbird	<i>Seiurus aurocapilla</i>
PHVI	Philadelphia Vireo	<i>Vireo philadelphicus</i>
PISI	Pine Siskin	<i>Spinus pinus</i>
PIWA	Pine Warbler	<i>Setophaga pinus</i>
PIWO	Pileated Woodpecker	<i>Dryocopus pileatus</i>
RBGR	Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
RBNU	Red-breasted Nuthatch	<i>Sitta canadensis</i>
RBWO	Red-bellied Woodpecker	<i>Melanerpes carolinus</i>
REVI	Red-eyed Vireo	<i>Vireo olivaceus</i>
RSHA	Red-shouldered Hawk	<i>Buteo lineatus</i>
RTHU	Ruby-throated Hummingbird	<i>Archilochus colubris</i>
RUGR	Ruffed Grouse	<i>Bonasa umbellus</i>
SCTA	Scarlet Tanager	<i>Piranga olivacea</i>
SOSP	Song Sparrow	<i>Melospiza melodia</i>
VEER	Veery	<i>Catharus fuscescens</i>
WAVI	Warbling Vireo	<i>Vireo gilvus</i>
WBNU	White-breasted Nuthatch	<i>Sitta carolinensis</i>
WIFL	Willow Flycatcher	<i>Empidonax traillii</i>
WITU	Wild Turkey	<i>Meleagris gallopavo</i>
WIWR	Winter Wren	<i>Troglodytes hiemalis</i>
WODU	Wood Duck	<i>Aix sponsa</i>
WOTH	Wood Thrush	<i>Hylocichla mustelina</i>
WTSP	White-throated Sparrow	<i>Zonotrichia albicollis</i>
YBSA	Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>
YSFL	Northern Flicker yellow-shafted form	<i>Colaptes auratus auratus</i>
YTVI	Yellow-throated Vireo	<i>Vireo flavifrons</i>

Appendix B: Bird Guild Definitions

Nesting Guilds:

Ground = nests average within 30 cm of ground

Understory/shurb = nests average up to 5 m above ground

Canopy/high = nests average more than 5 m above ground

Cavity = nests in tree cavities

For species whose averages range from below 5m to above 5m, or species that nest both on the ground and elevated above 30cm, half of their proportional species richness will be apportioned to the canopy nest guild and half to the understory nest guild.

Habitat Assemblages:

Forest Interior Specialist = nests only within the interior of forests and rarely occurs near the edge

Forest Interior/Edge Generalist = has territories located entirely within the forest, but can utilize forest edge, or in some cases, can extend a single territory across more than one forest fragment

Forest Edge Specialist = typically uses forest perimeters, nearby fields, or large clearings within a forest during the breeding season

Migratory Guilds:

Resident = remains in the study area throughout the year with at most, small-scale movements (i.e., likely to remain in same woodlot in winter as in breeding season)

Short-distance Migrant = winters south of the study area but north of the tropics

Neotropical Migrant = winters in subtropics and tropics (Central and South America)

Appendix C: Significant Wildlife Habitat Criteria Schedule for Ecoregion 6E, Woodland Area-Sensitive Bird Breeding Habitat (Modified from OMNRF, 2015)

Specialized Wildlife Habitat	Wildlife Species	Candidate Significant Wildlife Habitat		Confirmed Significant Wildlife Habitat
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria
<p>Woodland Area-sensitive Bird Breeding Habitat</p> <hr/> <p>Rationale: Large, natural blocks of mature woodland habitat within the settled areas of Southern Ontario are important habitats for area sensitive interior forest song birds</p>	<ul style="list-style-type: none"> • Blackburnian Warbler • Black-throated Blue Warbler • Black-throated Green Warbler • Blue-headed Vireo • Northern Parula • Ovenbird • Red-breasted Nuthatch • Scarlet Tanager • Veery • Winter Wren • Yellow-bellied Sapsucker <p><u>Special Concern:</u></p> <ul style="list-style-type: none"> • Canada Warbler • Cerulean Warbler 	<p>All ecosites associated with these ELC Community Series:</p> <ul style="list-style-type: none"> • FOC • FOM • FOD • SWC • SWM • SWD 	<ul style="list-style-type: none"> • Habitats where interior forest breeding birds are breeding, typically large mature (> 60 years old) forest stands and woodlots > 30 ha • Interior forest habitat is > 200 m from forest edge <p><u>Information Sources:</u></p> <ul style="list-style-type: none"> • Local bird clubs Canadian Wildlife Service (CWS) for the location of forest bird monitoring • Bird Studies Canada conducted a 3-year study of 287 woodlands to determine the effects of forest fragmentation on forest birds and to determine what forests were of greatest value to interior species • Reports and other information available from Conservation Authorities 	<ul style="list-style-type: none"> • Studies confirm: • Presence of nesting or breeding pairs of three or more of the listed wildlife species • NOTE: any site with breeding Cerulean Warblers or Canada Warblers is to be considered SWH • Conduct field investigations in the spring and early summer when birds are singing and defending their territories • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects" • SWH Mitigation Support Tool Index #34 provides development effects and mitigation measures.

Appendix D: Habitat Requirements and Population Status of Indicator Species and Species at Risk Recorded at Tiffin

Blackburnian Warbler: requires 50 ha of deciduous, coniferous, or mixed forest or swamp (Cornell Lab of Ornithology, 2017; OMNR, 2000). Their populations are stable (Cornell Lab of Ornithology, 2017).

Black-throated Blue Warbler: is a designated interior forest species (Robbins, et al., 1989) that likely requires > 100 ha of forest in areas off the Canadian Shield comprised of deciduous or mixed forest, preferring hemlock within mixed forest, with closed canopy, shrubby undergrowth, and nests close to the ground (OMNR, 2000). Global populations increased by 163% between 1970 and 2014, however long-term population analysis indicates they are recovering from declines in the 1700s and 1800s from resulting from deforestation (Cornell Lab of Ornithology, 2017).

Black-throated Green Warbler: requires > 30 ha, preferring dense mixed or coniferous forest, favouring hemlock and fir species with well-developed shrub layer (OMNR, 2000). Their populations have increased by approximately 41% between 1970 and 2014, but as a forest interior species, they are susceptible to habitat degradation, fragmentation, and loss from both invasive species and deforestation in their wintering grounds (Cornell Lab of Ornithology, 2017).

Canada Warbler (SAR): requires >30 ha of forest, preferring dense mature mixed forest with closed canopy, in lowlands with shrubby undergrowth (OMNR, 2000). They have experienced population decline of 62% between 1970 and 2014, likely resulting from changes in forest structure, management practices that reduce understory growth, and loss of forested wetlands (preferring to nest in shrubby areas with mossy vegetation and near water (Cornell Lab of Ornithology, 2017).

Eastern Wood Pewee (SAR): prefers open forest of various composition with little understory, forest edges and openings (OMNR, 2000), often nesting in deciduous trees within a 2-8 ha territory (Cornell Lab of Ornithology, 2017). They have experienced a 51% decline in population between 1966 and 2015 (Cornell Lab of Ornithology, 2017). Though tolerant to habitat fragmentation, white-tailed deer browsing may change the intermediate canopy where this species forages. It occurs less frequently in woodlots with surrounding development than in those without (Friesen, et al., 1995) and can be used as an indicator of urban intolerance due to its need for mature trees to provide nesting cavities.

Ovenbird: requires > 70 ha of continuous mature deciduous or mixed forest, though they may require nearby forests when the patch is 100-800 ha (Cornell Lab of Ornithology, 2017), that is undisturbed, with little groundcover, many fallen leaves, and logs such as forested ravines, nesting on the ground at the base of a tree or log (OMNR, 2000). They prefer uninterrupted forests with closed canopy 15-20 m above the forest floor (Cornell Lab of Ornithology, 2017). Their populations have been relatively stable since 1966, but are susceptible to forest fragmentation, industrial

noise, forest-road building, and logging (Cornell Lab of Ornithology, 2017). There are also many risks to their nests (e.g., cowbird parasitism and predation of eggs and young (Cornell Lab of Ornithology, 2017).

Red-breasted Nuthatch: requires > 10 ha coniferous and mixed forest, nesting in interior in cavity within dead trees with dbh > 12 cm (OMNR, 2000). Their population has increased since 1966 (Cornell Lab of Ornithology, 2017).

Red-shouldered Hawk (SAR): requires > 10 ha, prefers > 100 ha of mature moist hardwood forest or swamp with > 80% closed canopy and open understory, nesting in the interior of large tracts of forest contiguous wetlands for foraging purposes (NVCA, 2005; OMNR, 2000). Their populations have increased between 1966 and 2015, but are sensitive to deforestation and pesticide use (Cornell Lab of Ornithology, 2017).

Scarlet Tanager: requires > 20 ha of undisturbed mature deciduous or mixed forest, nesting in thick stands of small trees or shrubs that border forests of larger trees (OMNR, 2000). They are interior forest species (Cornell Lab of Ornithology, 2017). Their populations have declined by 14% between 1966 and 2014 and are susceptible to habitat fragmentation (Cornell Lab of Ornithology, 2017).

Veery: needs at least 10 ha of forest, often residing in cool, moist, young or disturbed mixed or deciduous forests with shrubby and fern understory. Can be found near forest edges, but is sensitive to habitat fragmentation (OMNR, 2000). It has had 42% population decline between 1966 and 2014, possibly resulting from destruction of their wintering habitat in South American forests, and fragmentation of their northern breeding habitats (Cornell Lab of Ornithology, 2017).

Winter Wren: requires > 30 ha of conifer forest (upland or wetland), with preference to hemlock-pine stands, cedar swamps, and spruce bogs, with dense undergrowth and fallen trees near streams (OMNR, 2000). They nest in cavities with diameter at breast height (dbh) of > 10 cm (OMNR, 2000). Their populations have been fairly stable since 1966 (Cornell Lab of Ornithology, 2017).

Wood Thrush (SAR): requires undisturbed moist mature deciduous or mixed forest with at least some trees taller than 12 m, and uses forest edge habitat (OMNR, 2000). This species has experienced significant population declines of 2% per year between 1966 and 2015 (62% cumulative) that are thought to be the result of habitat fragmentation in both breeding and wintering grounds, acid rain, and loss of interior lowland tropical forest wintering habitat (Cornell Lab of Ornithology, 2017).

Yellow-bellied Sapsucker: Territory is 2-5 ha with mature deciduous or mixed forest, dead trees with dbh > 25 cm for nesting (OMNR, 2000). They prefer young edge habitat with fast growing trees for feeding during the breeding season (Cornell Lab of Ornithology, 2017). Their populations have increased slightly since 1966, and were once targeted as pests to fruit orchards (Cornell Lab of Ornithology, 2017)