



APPENDIX C-1. AVIAN BASELINE REPORT

Wedgeport Wind Farm Project

Avifauna Biophysical Baseline Report

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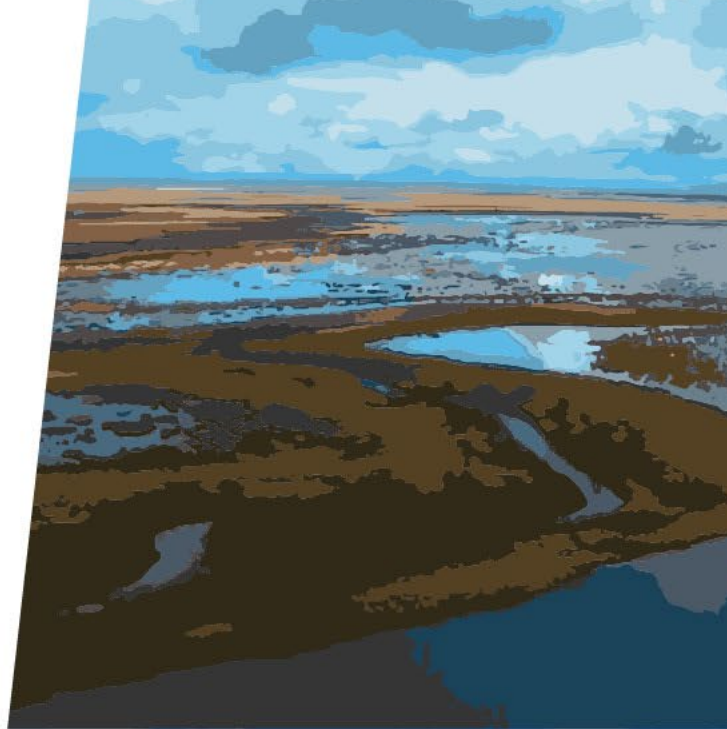
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AVIAFAUNA BIOPHYSICAL BASELINE REPORT

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EXECUTIVE SUMMARY

McCallum Environmental Ltd. (MEL) was retained by Wedgeport Wind Farm GP Inc. (Wedgeport Wind) to complete avifauna bird surveys for the proposed Wedgeport Wind Farm Project (the Project), located in the Municipality of the District of Argyle, Nova Scotia. These assessments are to support the preparation and submission of the provincial Environmental Assessment Registration Document (EARD).

The Project Area comprises a mosaic of habitats including open barrens/heathland, ATV trails, immature and mature softwood, hardwood, and mixedwood stands, and open and forested wetlands (i.e., saltmarshes and treed swamps). The Project Area provides a range of habitats suitable for a variety of bird species with different habitat requirements. Open water habitat borders the Project Area along the coast on the south and eastern areas and provides habitat for various species of waterfowl and shorebirds. Forests and shrub-dominated areas with stand heterogeneity (i.e., stands with different height classes) provide suitable habitat for foraging and breeding for many passerine species.

The objective of the avifauna species surveys was to:

- Identify species and habitat usage, including Species at Risk (SAR) and Species of Conservation Interest (SOCI) within and surrounding the Project Area, and
- Determine trends in species composition and bird group usage throughout different seasons where possible.

The results of these surveys will be carried forward to the EARD and discussed in the effects assessment.

In spring 2022, biophysical field surveys were initiated and continued through October 2022 and a total of 202.6 hours of surveys were completed by biologists. The field studies were completed as follows:

- Spring migration surveys (April – May);
- Breeding bird surveys (June);
- Fall migration surveys (August – October);
- Nightjar surveys (June – July);
- Nocturnal owl surveys (April – May), and
- Waterfowl surveys (April – October).

Biophysical surveys resulted in the observation of 16,020 individuals, representing 100 bird species within the Project Area.

The most abundant bird group observed (by total number of individuals) was shorebirds accounting for 61% of total individuals, followed by passerines (29%), waterfowl (5.6%), other



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landbirds (2.1%), diurnal raptors (1.3%), other waterbirds (0.94%), and nocturnal raptors (0.069%).

Passerines had the highest species diversity with 51 species observed, followed by shorebirds (19 species), diurnal raptors (9 species), waterfowl (7 species), other landbirds (7 species), other waterbirds (4 species), and nocturnal raptors (3 species).

Throughout the avifauna baseline surveys, no colonies of birds were observed within or adjacent to the Project Area. During the fall migration, no distinct migration corridors or patterns were noted by surveyors within the Project Area. Overall, the same behaviour from spring migration and breeding bird seasons was noted.

Open habitat such as barrens/heathlands and saltmarshes provided suitable foraging habitat for willets (*Tringa semipalmata*) and various types of warblers, sparrows, and predatory birds such as Northern harrier (*Circus hudsonius*), turkey vultures (*Cathartes aura*), and various buteo species.

During the spring, fall, and breeding bird surveys, survey locations associated with saltmarsh and/or coastline had the highest species richness and abundance (most of which are outside the Project Area). The proposed turbine layout for this Project is mostly centered down the middle of the Comeaus Hill peninsula. The Project footprint excludes the coastline, protected areas and far south parts of the peninsula where a higher occurrence of fly-overs were observed. Survey locations along the coastline generally had the highest species abundance and diversity.

A general trend of fall migration counts that are, on average 24% higher than the spring migration counts at the same point count (PC) locations. Overall, Fall Migration counts had 924 more individuals (38%) than the overall Spring Migration counts. But the percent of individuals across all point counts remained consistent, averaging 2.3% at all PCs.

The trend line shows that spring migration counts were highest at PCs located on the southern extent of the Project Area, within crown lands and generally trended lower the further north from the ocean and more inland. The trend line shows that fall migration followed a similar trend but the counts were generally higher than the spring counts. The highest counts were at PC 47, which is outside the Project Area, and located on the shoreline of the Tusket Island Wilderness Area (TIWA), where counts had the highest diversity and individual count with 24 species observed and 561 individuals. This PC was on the coastline where various flocks of shorebirds and seabirds were observed that resulted in a high individual count (e.g., herring gull, great black-backed gull, sanderling, short-billed dowitcher, etc.). PC 47 also had a variety of habitat including open ocean off the coast, saltmarsh, barren/heathland with high shrub cover, and forested habitats located behind the PC location. This diversity of habitat would attract a variety of shorebirds, waterfowl, passerines, raptors, and more.



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During avifauna baseline surveys, most bird groups were observed flying under 100 m in height and observations of groups of passerines, shorebirds, and waterfowl close to the coastline were common. This suggests the coastline is being used as a streamlined way to move around the area. Observations during surveys suggest coastline is the predominant habitat used for movement around the peninsula. There was some evidence of flyover of the Project Area, but shoreline movement clearly outnumbered overland flyovers.

All bird groups were observed flying over the peninsula; however gulls, herons, and diurnal raptors had the highest occurrences of fly-overs above 100 m during the avifauna baseline surveys. Fly-over activity was recorded during all seasons and the most common fly-over height recorded for all bird groups was between 50-100 m.

No common nighthawk (*Chordeiles minor*) were observed during the nightjar surveys. This was expected due to the lack of suitable breeding habitat for this species throughout the Project Area. No Eastern whip-poor-will were observed either during the nightjar surveys. During the nocturnal owl surveys, the northern saw-whet owl and great horned owl were detected. No SAR or SOCI owl species were observed.

The barn swallow (*Hirundo rustica*) was the only avian SAR observed during the avifauna baseline surveys. The barn swallow was observed at a coastal location situated on the Wedgeport peninsula, approximately 1.8 km east of the Project Area. Although there is foraging habitat for this species within the Project Area, such as swamps and open barrens/heathlands, there is no suitable breeding habitat for the barn swallow within the Project Area.

Across all survey seasons, a total of 16 avian SOCI were observed however these SOCI were mostly observed in habitats that do not represent what is found within the Project Area.

Overall, there is consistency in use by birds based on habitat types in all seasons. The highest bird counts were outside the Project Area and along the coastlines. There was no evidence of fly-over/migration corridors over the Project Area, but birds do fly through the area. The total abundance of birds is not considered high relative to other Projects that have been approved in Nova Scotia¹, and the results are consistent with those found for the 2012 EARD (Stantec 2012).

¹ The Amherst Wind Project, currently operational, counted 20,677 birds during all seasons.
<https://novascotia.ca/nse/ea/amherst.wind.energy.project.asp>



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ACRONYMS LIST

ACCDC	Atlantic Canada Conservation Data Centre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DWC	Diurnal Watch Count
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
EC/ECCC	Environment and Climate Change Canada
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
MBBA	Maritime Breeding Bird Atlas
MBS	Migratory Bird Sanctuary
MEL	McCallum Environmental Ltd.
NSDNRR	Nova Scotia Department of Natural Resources and Renewables
NS	Nova Scotia
NSE/NSECC	Nova Scotia Environment and Climate Change
NSESA	<i>Nova Scotia Endangered Species Act</i>
NWA	National Wildlife Area
PC	Point Count
SAR	Species at Risk
SARA	<i>Species at Risk Act</i>
SOCI	Species of Conservation Interest
TIWA	Tusket Islands Wilderness Area



1 INTRODUCTION

McCallum Environmental Ltd. (MEL) was retained by Wedgeport Wind Farm GP Inc (Wedgeport Wind) to complete avifauna bird surveys for the proposed Wedgeport Wind Farm Project (the Project), located in the Municipality of the District of Argyle, Nova Scotia. These assessments are to support the preparation and submission of the provincial Environmental Assessment Registration Document (EARD).

The objective of the avifauna species surveys was to:

- Identify species and habitat usage with a focus on Species at Risk (SAR) and Species of Conservation Interest (SOCI) within and surrounding the Project Area, and
- Determine trends in species composition and bird group usage throughout different seasons.

The results of these surveys will be carried forward in the EARD to evaluate the Project's effect to avifauna.

1.1 Regulatory Context

In April 2022, the Canada Wildlife Service (CWS) released an advice update for Environmental Assessment (EA) and monitoring of wind energy in the Atlantic Region (EC CWS 2007a; EC CWS2007b; CWS 2018). Within this update, CWS states that projects with wind turbines greater than 150 m in height are “Very High” in site sensitivity and thereby categorize as Level or Category 4 concern. This level requires comprehensive baseline surveys that, at minimum, cover a calendar year.

The Project also has potential to interact with avifauna species that may be protected under several federal and provincial legislations. The avifauna surveys were designed to detect species that may be listed in these documents. Legislation that may direct resource development and conservation of avifauna species and their habitat include:

- **Federal Legislation:**
 - *Species at Risk Act.*
 - *Migratory Bird Convention Act.*
- **Provincial Legislation:**
 - *Nova Scotia Wildlife Act,* and
 - *Nova Scotia Endangered Species Act.*



The Project is also driven by policies, guidelines and standards that provide guidance on the development of the Project and the survey design. These guidance documents and policies include:

- Environment and Climate Change Canada’s Canadian Wildlife Service (Atlantic Region) – Wind Energy & Birds Environmental Assessment Guidance Update (CWS 2022);
- Wind Turbines and Birds – Updated Guidance for Environmental Assessment and Monitoring Canadian Wildlife Service – Atlantic Region (CWS 2018);
- Wind Turbines and Birds: A Guidance Document for Environmental Assessment (EC-CWS 2007a);
- Recommended Protocols for Monitoring Impacts of Wind Turbines in Birds (EC-CWS 2007b);
- Nova Scotia Wetland Conservation Policy (NSE 2019);
- The Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE 2009), and
- Various Nova Scotia Department of Natural Resources and Renewables (NSDNRR) Special Management Practices (SMP) and Environment and Climate Change Canada (ECCC) Species at Risk Management Plans.

1.2 Project Area

The Project Area is bounded by the communities of Little River Harbour to the west, Comeaus Hill to the south, and Wedgeport to the east (Figure 1, Appendix A). The Project Area is situated south of Goose Lake and is delineated by Comeaus Hill Road along its western boundary and the Tusket Islands Wilderness Area along its eastern boundary. The Project Area is 918 ha in size and has an approximate centre located at 19T 740697 m E 4845376 m N.

The avifauna survey program occurred within and immediately adjacent to the Project Area.

1.3 Project Team

A Project Team consisting of terrestrial ecologists proficient in avifauna identification were selected to complete the field studies and reporting for these surveys. Team members with integral roles in the surveying, reporting and project management are listed below (Table 1-1).

Table 1-1: Project Team

Team Member	Role and Duties
Robert McCallum, P.Biol.	Senior review, project management, reporting, regulatory consultation
Jeff Bonazza, M.Env.Sci.	Project management, reporting, regulatory consultation



Team Member	Role and Duties
Mark MacDonald, M.Sci.F.	Bird surveys and reporting
Jessica Lohnes, B.Sc.H.	Bird surveys and reporting
Nicholas Doane, B.Sc.	Bird surveys
Melvin Pothier (MEL contractor)	Bird surveys

1.4 Regulatory Consultation

Avifauna survey methods were shared via email with CWS and NSDNRR on May 12 and 13, 2022, respectively. Survey methods were adjusted based on these responses and will be addressed throughout Section 2.2.

1.4.1 Nova Scotia Department of Natural Resources and Renewables

NSDNRR indicated that the proposed survey methods and timing windows are adequate, however, NSDNRR recommended completing acoustic monitoring for birds to supplement the proposed radar monitoring (May 18, 2022, pers. comm. with MEL, Mark McGarrigle, Species at Risk Biologist, NSDNRR). NSDNRR also recommended an extended fall migratory period and provided MEL with the Environment and Climate Change Canada’s Canadian Wildlife Service (Atlantic Region) – Wind Energy & Birds Environmental Assessment Guidance Update (CWS 2022; May 18, 2022, pers. comm. with MEL, Mark McGarrigle, Species at Risk Biologist, NSDNRR). MEL did not propose acoustic monitoring because previous CWS guidance documents (EC CWS 2007a; EC CWS 2007b; CWS 2018) suggested radar or acoustic monitoring was required. Based on recommendations from NSDNRR and CWS (2022), MEL has incorporated an acoustic monitoring program for birds during the fall migration window. This information is included in a separate report.

MEL confirmed with NSDNRR that the extended fall migratory period (i.e., until the end of November) is specific for radar monitoring and MEL’s field survey window is adequate (May 31, 2022, pers. comm. with MEL, Mark McGarrigle, Species at Risk Biologist, NSDNRR).

MEL informed NSDNRR that CWS recommended following the Birds Canada 2022 Canadian Nightjar Survey Protocol. MEL proposed to adapt this protocol and complete two rounds of surveys as recommended by NSDNRR (May 2022, pers. comm. with MEL, Mark McGarrigle, Species at Risk Biologist, NSDNRR).

1.4.2 Canadian Wildlife Service

CWS commented on various topics and stated that the Project Area is significant for waterfowl and shorebirds for breeding, migratory stop-overs, and overwintering sites (June 3, 2022, pers. comm. with MEL, Stephen Zwicker, Environmental Assessment Coordinator, CWS). Three important shorebird staging sites are nearby: Cook’s Beach (approximately 4.3 km away), Melbourne Game Sanctuary (Melbourne Lake specifically; approximately 4.3 km away), and



Pinkney’s Point (approximately 3.4 km away). Cook’s Beach and Melbourne Game Sanctuary are candidates for the Western Hemisphere Shorebird Network. The ocean surrounding the peninsula on which the Project Area is located is within foraging range of the Roseate Tern (*Sterna dougallii*), which is listed as Endangered under Schedule 1 of SARA (June 3, 2022, pers. comm. with MEL, Stephen Zwicker, Environmental Assessment Coordinator, CWS).

All CWS recommendations were considered during the avian survey methods design for this Project and an effort was made to incorporate applicable recommendations. Refer to Table 1-2 for a summary of CWS recommendations and notes on their inclusion/exclusion from the avifauna survey program.

Table 1-2: Canadian Wildlife Service Comments on Proposed Avifauna Methods

CWS Recommendation	Incorporated into Survey Program (Y/N)	Notes or Justification
Spring migration survey window of March 15 - June 7	N	Survey window had passed when comments were received by CWS. CWS (2022), which referenced the extended spring migration window, was released in April 2022. Spring migration surveys commenced in April 2022. Information on radar and acoustic monitoring are presented in separate reports.
Fall migration survey window of July 15 – November 30	N	Fall migration point count and diurnal watch counts were completed within this window.
Targeted surveys for short-eared owl (<i>Asio flammeus</i>)	N	Suitable habitat for short-eared owl is not present within the Project Area. Recommended survey window had passed when suggestions from CWS were received.
Winter surveys	N	Birds overwintering within the Project Area are believed to be captured during the spring, breeding, and fall survey programs. Winter surveys were not completed.
Salt marshes in the Project Area should be included in survey design to detect breeding willets (<i>Tringa semipalmata</i>)	Y	Survey locations were placed at saltmarshes adjacent to or within proximity to the Project Area. Willetts were detected throughout the area during avifauna baseline surveys (Section 3.2).
Follow Birds Canada (2022) nightjar survey protocol	Y	MEL adapted the Birds Canada survey protocol recommended by CWS in consultation with NSDNRR.
Follow Atlantic Canada Shorebird Survey Protocol	N	Bird surveys in bogs and salt marshes were completed under the migration and breeding bird point counts and migration diurnal watch counts.



2 METHODOLOGY

Completion of the avifauna surveys is a two-part process consisting of a desktop review and field surveys.

2.1 Desktop Review Methodology

A review of the Canada Important Bird Areas database, Atlantic Canada Conservation Data Centre (ACCDC) report, Maritime Breeding Bird Atlas (MBBA), old forest GIS database, and Canada Wildlife Service Migratory Bird Sanctuaries (MBS) was completed to support bird survey design.

The Provincial Landscape Viewer (<https://nsgi.novascotia.ca/plv/>) was also reviewed to determine whether the Project Area is within, or adjacent to special features, such as protected areas. To ensure the Project Area is not located within any ecologically sensitive regions, the following databases were also reviewed:

- Nova Scotia Department of Natural Resources and Renewables (NSDNRR) Significant Habitats;
- Maritime Breeding Bird Atlas (MBBA);
- Canada Wildlife Service Migratory Bird Sanctuary (CWS-MBS);
- Canada Important Bird Area (IBA);
- SARA Critical Habitat layers;
- SARA Recovery strategies, and
- Special Management Practice (SMPs) layers.

An EARD was prepared in 2012 for a wind project in a similar location to the proposed Project (Stantec 2012). The 2012 EARD (Stantec 2012) was reviewed by MEL. Additionally, a report prepared for NSECC on protecting coastal habitat for migrating birds (Kearney 2022) was reviewed by MEL.

2.1.1 Priority Species List

Development of a priority species list for birds was completed based on a compilation of listed species from the following sources:

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and *Species at Risk Act* (SARA): All species listed as Endangered, Threatened or Special Concern;



- *Nova Scotia Endangered Species Act (NSESA)*: All species listed as Endangered, Threatened or Vulnerable, and
- Atlantic Canada Conservation Data Centre (ACCDC) Conservation Rank: All Species designated as S1, S2, or S3 as defined by the ACCDC.

Species listed under SARA and/or NSESA are termed Species at Risk (SAR) and species listed under COSEWIC and/or ACCDC are termed Species of Conservation Interest (SOCI). The priority list of species was first narrowed by a broad geographic area and then further narrowed by identifying specific habitat requirements for each species. For example, if a listed species on the NSESA required abandoned or cultivated fields, and that habitat is not present inside the Project Area, this species was not carried forward to the final list of priority species.

The data sets and reports described above and in Section 2.1 were reviewed and used to develop the priority species list. The ACCDC report was one of the key documents used in the development of the priority species list, as this report summarizes known and observed occurrences of rare species in the general location of the Project Area.

The final priority species list is included in Appendix B, the ACCDC report is included in Appendix C, and a list of birds observed during the MBBA atlas in the Project Area within the Wedgeport region (squares 19GJ34, 19GJ44, and 20KP54) is provided in Appendix D.

2.2 Survey Design Methodology

Prior to conducting field surveys, a preliminary desktop survey design was developed to target suitable habitat for avifauna species or groups of interest (e.g., breeding birds, nightjar, owls, etc.). Survey methods were consistent with the guidelines stated in CWS (2018), EC CWS (2007a), and EC CWS (2007b)². These documents provided instruction in the following areas: survey site selection, survey location spacing, number of point counts, survey duration, and season selection.

Based on the CWS guidelines (EC CWS 2007a, EC CWS 2007b, and CWS 2018), *The Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE 2009), and results from the priority species list and the ACCDC report, the following avifauna survey types were chosen:

- Spring and fall migration point count surveys;
- Spring and fall migration diurnal watch count surveys;
- Breeding bird point count surveys;

² Please note that during initial survey design the Environment and Climate Change Canada's Canadian Wildlife Service (Atlantic Region) - Wind Energy & Birds Environmental Assessment Guidance Update (April 2022) was not yet released.



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- Nocturnal owl surveys;
- Nightjar surveys, and
- Waterfowl surveys.

To determine suitable avifauna survey locations the following databases were used:

- Aerial imagery (provided by Google Earth);
- Nova Scotia Department of Natural Resources and Renewables (NSDNRR) Forest Inventory;
- Nova Scotia Environment and Climate Change Canada (NSECC) Depth-to-Water (DTW) Model;
- NSECC Wet Areas Mapping (WAM) and Flow Accumulation;
- NSECC Wetland Inventory;
- Nova Scotia Topographic Database (NSTDB) which includes road, watercourse and topography layers, and
- Province of Nova Scotia Geographic Data Directory – Canopy Height Model (CHM).

These aforementioned databases were used, and the major vegetation communities and habitat types listed below were identified using a habitat model (referred to as the MEL habitat model) created in QGIS using the forestry, depth-to-water (DTW) and canopy height model (CHM) databases. Depending on the target avifauna species or species groups, a subset or all of the following habitat types were targeted for field surveys:

- Hardwood forests;
- Hardwood wet forests;
- Mixedwood forests;
- Mixedwood wet forests;
- Softwood forests;
- Softwood wet forests;
- Open areas/barrens;
- Shrubs/alders;



- Cutovers;
- Cutover Wetlands;
- Open Wetlands (i.e., open canopy swamps, fens, bogs, etc.);
- Anthropogenic (e.g., urban/developed - buildings, roads, quarries, etc.);
- Open waterbodies; and,
- Areas with edge habitat.

The Tusket Islands Wilderness Area (TIWA) borders the Project Area to the east. The TIWA is 715 hectares and includes a mixture of forested land, saltmarshes, headlands, and coastal islands around the mouth of the Tusket River. Shorebirds and waterfowl use this area year-round for migration and overwintering and colonial seabirds use the islands for breeding (NSECC n.d.). This area was included in the PC locations for the breeding bird and spring and fall migration surveys.

Additionally, effort was made to design a survey layout that could be compared to the findings from the 2012 EARD (Stantec 2012). When comparing MEL survey locations with the Stantec EARD (Stantec 2012), MEL migration PCs are within 500 m of 4 out of 6 of Stantec's migration transects and within 1 km of all 6 (which include bird and raptor watch count locations). Approximately 20 MEL migration PCs are within 500 m of Stantec's bird and raptor watch count locations. All MEL's breeding bird PCs are within 500 m of Stantec's and all MEL's owl PCs are located in similar habitat as Stantec's (all 3 owl PCs are within 1 km of Stantec survey locations). Based on aerial imagery and comparing maps (Figures 2, 3, and 5, Appendix A), MEL targeted the same habitats as Stantec (Stantec 2012).

2.2.1 Spring and Fall Migration and Breeding Bird Surveys

2.2.1.1 *Point Count (PC) Surveys*

Point count (PC) locations were selected in representative habitats within the Project Area and the surrounding areas. These surveys are not species-specific, as avifauna species have different habitat requirements for breeding and migratory purposes, therefore a representative number of all major habitats listed in Section 2.2 were targeted. PC locations were spaced a minimum of 250 m depending on the complexity of habitat types and to reduce, and hopefully eliminate, the risk of double-counting individuals, as recommended in *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (EC CWS 2007b).

PCs were selected as the preferred method for avian usage surveys due to the large extent of the Project Area and they allow identification of a broad range of species while minimizing the possibly of double counting individuals. Attempts were made to establish PCs within and surrounding the Project Area, should post-construction avifauna monitoring be required. At the



time of spring migration survey design, the placement of Project infrastructure was not finalized. Survey design primarily focused on habitat coverage rather than area coverage. PC locations were selected based on a MEL generated habitat model and were spread throughout the Project Area to provide representative coverage for the diversity of habitats identified. The habitat model, also discussed in Section 2.2.

2.2.1.2 Diurnal Watch Count (DWC) Surveys – Spring and Fall Migration

Diurnal watch count surveys (i.e., passage migration surveys) were completed to determine migratory patterns of bird species/bird groups within the Project Area and surrounding areas. The methods and results for these surveys are included in the spring and fall migration sections.

Diurnal watch count surveys were conducted from three observation points established within and surrounding the Project Area (Figure 2; Appendix A). One observation point was within the northern extent of the Project Area, one was located on the west side of the peninsula bordering the Project Area, and one was located to the east of the Project Area on the Wedgeport peninsula. Two coastline locations were selected to observe the peninsula on which the Project Area is located and potential migratory patterns.

These observation points were selected via aerial imagery based on local topography and adjacent land cover with the intention of allowing for a 360-degree view around the Project Area. Locations were chosen with high visibility of the sky, to observe fly-overs, and coastline and areas that could potentially serve as stop over sites during migration were also incorporated. All points were verified in the field prior to commencement of surveys.

2.2.2 Nightjar Surveys

The common nighthawk (*Chordeiles minor*) is listed as Special Concern by COSEWIC and Threatened by the *Species at Risk Act* (SARA) and the *Nova Scotia Endangered Species Act* (NSESA). The common nighthawk prefers to nest in gravelly substrates and is best detected while foraging for insects shortly after sunset (MBBA, 2008). The Project Area does not have an abundance of suitable habitat for the common nighthawk (*Chordeiles minor*), such as open bogs, grasslands, barren areas with low shrub cover, rocky bluffs, open forests, urban areas, clear-cut areas, or other disturbed areas (Birds Canada 2022; COSEWIC 2018). In addition to common nighthawk these surveys were completed to target Eastern whip-poor-will (*Antrostomus vociferus*), which is listed as Threatened by COSEWIC, SARA, and NSESA. The Eastern whip-poor-will uses a mixture of open lands for foraging and wooded areas for nesting and perching (Birds Canada 2022). Examples of suitable habitat for Easter whip-poor will include shrubbed wetlands, clearcuts, agricultural fields, rock or sand barrens with scattered trees, savannahs, burned areas, conifer plantations, and various types of forests at early stages of succession or edges of dense forests with similar ground-level structure. This species is found in habitat with moderate tree, shrub, and herbaceous cover (ECCC 2018). There is a higher percentage of forested area in



the northern parts of the Project Area and the PC locations for the nightjar surveys were spread throughout this area as feasible.

Potentially suitable common nighthawk and eastern whip-poor-will breeding and foraging habitat, such as roadside areas/gravel areas, forested areas, marsh, cutovers, and heathland/barrens (Birds Canada 2022; ECCC 2018b; MBBA 2008), were selected as PC locations both within the Project Area and the area bordering the Project Area. A minimum of 1.6 km spacing was used to provide adequate coverage of the area while minimizing overlapping observations (i.e., hearing the same individual at multiple locations). Six PC locations were selected in the preliminary desktop review (one within the Project Area and the remaining five bordering it). All point count locations were roadside except one PC that was on an ATV trail within the Project Area. PCs being along roads or ATV trails also alleviates safety concerns for the surveyor during nocturnal surveys.

2.2.3 Nocturnal Owl Survey Design

Survey locations were selected within and outside the Project Area along roads and adjacent to mature forests and tall shrub areas. Survey locations were spaced a minimum of 1.6 km to minimize overlapping observations (i.e., detecting the same owl from multiple stations). For example, the barred owl (*Strix varia*), can be heard at distances of two kilometers or more (Takats *et al.* 2001). However, most of the smaller owls cannot be heard as far or as clearly. PCs were adjacent to roads and access trails to allow for easy and safe access during the nocturnal owl surveys. In total, the survey design included three PCs (one within and two bordering the Project Area).

2.2.4 Waterfowl Survey Design

Two waterfowl survey locations were selected: one at Goose Lake to the north of the Project Area (within 1 km) and one at Black Pond, which borders the northwestern Project Area boundary. Despite both water bodies being outside the Project Area, these surveys were completed to understand which waterfowl, shorebirds, and other waterbird species may use the area. Survey locations were selected for their strong vantage points and for suitable habitat with potential to support these species. Goose Lake was surveyed throughout spring migration, breeding bird, and fall migration periods and Black Pond was added during the breeding bird surveys and continued into the fall migration surveys.

2.3 **Field Program Methods**

Survey locations determined in the desktop survey design (Section 2.2) were visited and adjusted if required. A breakdown of the time of year and survey rationale is described in Table 2-1. Survey dates were selected to provide representative coverage of important stages of avifauna ecology. As an example, by spreading out survey dates the widest variety of migrating birds will be observed. Effort was made to spread rounds across survey periods (e.g., spring migration, breeding bird, and fall migration) to represent that whole period.



Table 2-1: Avian Surveys Completed within the Project Area

Survey Type	Survey Rounds	Dates	Rationale	Reference for Survey Dates and Methods
Spring migration (with diurnal watch count surveys)	1	Apr. 21, 2022 Apr. 22, 2022 Apr. 23, 2022 Apr. 24, 2022 Apr. 25, 2022	Bird species begin to migrate back to Canada to breed this time of year. Resident species may begin to breed on March 30. Surveying during this time period will detect any early nesters and the beginning of spring migration.	Nesting Periods – Government of Canada (ECCC 2018a)
	2	Apr. 26, 2022 May 1, 2022 May 2, 2022		
	3 ³	May 10, 2022 May 11, 2022 May 12, 2022		
	4 ³	May 11, 2022 May 12, 2022 May 14, 2022		
	5	May 25, 2022 May 26, 2022		
Breeding bird	1	Jun. 8, 2022 Jun. 10, 2022	June is peak breeding season in Nova Scotia. Different species breed on different schedules, therefore, spreading surveys out within June allowed for greater chances to detect species.	Maritimes Breeding Bird Atlas (2020)
	2	Jun. 29, 2022 Jun. 30, 2022		
Fall migration (with diurnal watch count surveys)	1	Aug. 15, 2022 Aug. 16, 2022 Aug. 19, 2022	Bird species begin to migrate south for the winter months from late August to September. Survey rounds began in mid-August and extended into late October to accommodate five survey rounds and potential early/late migrants.	Maritimes Breeding Bird Atlas (2020)
	2	Aug. 29, 2022 Aug. 30, 2022 Aug. 31, 2022 Sept. 1, 2022		
	3	Sept. 14, 2022 Sept. 15, 2022 Sept. 16, 2022		
	4	Oct. 4, 2022 Oct. 5, 2022 Oct. 6, 2022 Oct. 7, 2022 Oct. 9, 2022		

³Based on the table, there appears to be an overlap of dates for spring migration rounds 3 and 4. Effort was made to finish round three before commencing round 4 but there was overlap on May 11 and 12, 2022 due to two survey types (PC and DWCs) and multiple surveyors being on-site. There was no overlap of PC locations.



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Survey Type	Survey Rounds	Dates	Rationale	Reference for Survey Dates and Methods
	5	Oct. 23, 2022 Oct. 25, 2022 Oct. 26, 2022 Oct. 27, 2022		
Nocturnal owl	1	Apr. 20, 2022	Different species breed on different schedules, therefore, spreading surveys out within allowed for greater chances to detect species.	ACCDC, 2022 (ACCDC report in Appendix C)
	2	May 1, 2022		
	3	May 24, 2022		
Waterfowl	12	Apr. 21 – Oct. 24, 2022 (aligned with spring migration, breeding bird, and fall migration surveys)	Two freshwater waterbodies (Goose Lake and Black Pond) are located close to or bordering the Project Area. Surveys were completed to understand which waterfowl species use this area.	No specific reference
Nightjar	1	Jun. 15, 2022	To understand the use of the land within and surrounding the Project Area by common nighthawk and Eastern whip-poor-will.	ACCDC, 2022 (ACCDC report in Appendix C)
	2	Jul. 7, 2022	The ACCDC reported a common nighthawk sighting within 16.7 ± 0 km and an Eastern whip-poor-will sighting within 5.4 ± 7.0 km of the Project Area. Suitable habitat exists surrounding the Project Area (and within for Eastern whip-poor-will).	

Habitat descriptions at each PC were recorded and each field-verified PC location was georeferenced by a handheld Garmin GPS. General observations including temperature, visibility, wind speed, date, and start and end time were also recorded during each survey. Bearings were recorded for priority species observed during dedicated survey periods and incidentally.

Bird species were identified based on functional bird groups to understand how each group uses the Project Area. These functional groups include:

1. **Waterfowl:** Ducks, geese, or other large aquatic birds, especially when regarded as game;
2. **Shorebirds:** Waders, from the Order Charadriiformes;



3. **Other waterbirds:** Includes seabirds (i.e., marine birds), grebes (Order Podicipediformes), loons (Order Gaviiformes), Ciconiiformes (i.e., storks, herons, egrets, ibises, spoonbills, etc.), pelicans (Order Pelicaniformes), flamingos (Order Phoenicopteriformes), Gruiformes (i.e., cranes and rails), kingfishers, and dippers (the only family of passerines considered waterbirds);
4. **Diurnal Raptors:** Birds within the families Accipitridae (i.e., hawks, eagles, buzzards, harriers, kites, and old-world vultures), Pandionidae (i.e., osprey), Sagittariidae (i.e., secretary bird), Falconidae (i.e., falcons, caracaras, and forest falcons), Cathartidae (i.e., new world vultures) and one species from the Order Strigiformes (i.e., hawk owl);
5. **Nocturnal Raptors:** Birds of the Order Strigiformes (i.e., owls; with exception of the hawk owl, which is a diurnal species of owl);
6. **Passerines:** Any bird of the Order Passeriformes, which includes more than half of all bird species. This is with exception of the dippers, which are a passerine considered a waterbird, and
7. **Other Landbirds:** Birds within the Orders Galliformes (i.e., quail, pheasant, and grouse), Columbiformes (i.e., pigeons and doves), Cuculiformes (i.e., cuckoos), Caprimulgiformes (i.e., nighthawks and whip-poor-wills), Apodiformes (i.e., swifts and hummingbirds) and Piciformes (i.e., woodpeckers, flickers, and sapsuckers).

Survey specifics varied for each survey type are described in detail below.

2.3.1 Spring and Fall Migration Surveys

Five rounds of spring migration were completed between April 21 and May 26, 2022.

Five rounds of fall migration surveys were completed between August 15 and October 27, 2022.

Refer to Table 2-1 for specific timing of each survey round. Point count (PC) surveys and diurnal watch count (DWC) surveys were completed during both seasons (Figure 2, Appendix A).

2.3.1.1 *Point Count (PC) Surveys*

The same 43 PC locations (Table 2-2; Figure 2, Appendix A) were surveyed for both spring and fall migration⁴. Spring and fall surveys each had 35.8 hours of effort, totaling 71.6 hours between the two migration seasons for PC surveys.

Surveys began at, or within half an hour of, sunrise and were completed within four-and-a-half hours. Each PC was surveyed for a duration of 10 minutes. At each PC, a handheld Garmin GPS

⁴ PC locations were readjusted after the first survey day of round 1 of spring migration due to lack of access within the Project Area and the difficult terrain for the surveyors. Survey redesign focused on habitat coverage rather than area coverage. All data collected before the survey redesign has been incorporated into the results presented within this report. Due to survey redesign, the numbers read to PC 47 but there are actually 43 PCs (PCs 14-18 were removed).



unit was used to geo-reference the location (if micro-sited). During each survey, weather conditions (i.e., temperature, wind speed, precipitation, and visibility) were monitored and bird observations were recorded at three distance regimes: within a 50 m radius, 50 to 100 m radius, and outside the 100 m radius. All birds identified (auditory and/or visual) will be recorded by species, including age and sex if known. Breeding behaviour and fly-overs were also documented (e.g., altitude and flight direction). Surveys were not conducted in wind speeds over 3 on the Beaufort scale (12-19 km/hr), when noise levels make it difficult to hear or distinguish bird calls, or in rain that was more than a light drizzle (EC CWS 2007b). Incidental observations, those observed outside PC locations or outside allocated survey time, were recorded for novel (e.g., not observed during any other survey) and priority species (SAR/SOCI) or species displaying breeding or other noteworthy behaviour(s).

Overall, the MEL habitat model had high accuracy for placing PCs in representative habitats during survey design for spring and fall migration surveys. Upon field verification, five out of forty-three PCs had slightly different habitat than the model predicted. The differences were related to height of vegetation (e.g., shrub or treed) and forest type (e.g., dry/wet and softwood, hardwood, or mixedwood). Approximately 37% of PCs had open habitat such as barrens/heathland and areas with low to high shrub cover and 11% were wetland (e.g., treed swamp, saltmarsh, or fen habitat on the edge of a pond). The remaining 52% of PCs are forested areas of various types and maturity stages. Refer to Table 2-2 for habitat types at each migration PC location.

Table 2-2: Spring and Fall Migration Point Count Locations and Associated Habitats

Point Count	Coordinates (NAD 83 UTM 20)		Habitat Type(s)
	Easting	Northing	
1	256334.7	4844129.8	ATV trail. Barren/heathland, low shrub cover and softwood dominant trees.
2	256537.5	4844278.8	Barren/heathland, low shrub cover and softwood dominant forest edge.
3	256733.8	4844436.7	Barren/heathland with high shrub cover.
4	256962.4	4844531.1	Barren/heathland with medium shrub cover.
5	257192.6	4844573.9	Barren/heathland, low shrub cover, wetter ground, and softwood dominant forest edge.
6	257449.2	4844545.8	High shrub cover, mixedwood (more softwood dominant) mature forest.
7	257531.9	4844306.8	Medium shrub cover, mixedwood (more softwood dominant) mature forest.
8	257351.9	4844134.2	Treed swamp, medium, shrub cover and softwood dominant forest.
9	257135.0	4843995.6	Barren/heathland with low shrub cover by treeline.
10	256912.3	4843896.7	Barren/heathland with low shrub cover.
11	257639.2	4846085.5	ATV trail. Barren/heathland, medium shrub cover, softwood dominant trees scattered.
12	257635.1	4846306.2	Barren/heathland with medium shrub cover, near edge of mixedwood forest.



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Point Count	Coordinates (NAD 83 UTM 20)		Habitat Type(s)
	Easting	Northing	
13	257555.5	4846556.9	Barren/heathland with medium shrub cover, near edge of mixedwood forest.
19	258074.7	4846726.6	Softwood dominant forest with medium shrub cover.
20	258167.7	4846492.0	Barren/heathland with high shrub cover and softwood trees scattered.
21	258254.0	4846251.6	Barren/heathland, low shrub cover, close to coast with mixedwood trees scattered.
22	258700.9	4849306.9	Hardwood dominant forest.
23	258471.6	4849361.6	Mixedwood forest.
24	258241.3	4849357.9	Softwood forest.
25	257957.4	4849293.6	Softwood dominant forest with medium shrub cover.
26	257654.5	4849270.7	Edge of barren/heathland with medium shrub cover by softwood dominant forest. Some noise from existing turbine detectable.
27	257383.8	4849267.2	Treed swamp in softwood dominant forest. Some noise from existing turbine detectable.
28	257095.4	4849224.0	Open canopy treed swamp. Surrounded by softwood dominant forest. Some noise from existing turbine detectable.
29	257262.1	4849000.8	Softwood dominant forest with medium shrub cover.
30	257597.2	4849017.6	Softwood dominant forest.
31	257894.4	4849041.0	Hardwood dominant forest and early successional/disturbed.
32	258141.8	4849087.3	Various beaver ponds. Surrounded by mixedwood forest with medium shrub cover.
33	257519.1	4848166.5	Mixedwood forest with medium shrub cover. Some noise from existing turbine detectable.
34	257281.5	4848223.0	Wet mixedwood forest (more softwood dominant). Some noise from existing turbine detectable.
35	257054.8	4848343.8	ATV trail. Wet softwood dominant forest. Some noise from existing turbine detectable.
36	256846.7	4848188.6	Wet mixedwood mature forest. Some noise from existing turbine detectable.
37	256844.9	4847935.4	Wet mixedwood forest. Some noise from existing turbine detectable.
38	256610.3	4847850.8	Edge small pond (Black Pond) with open fen wetland around edges. Edge of wet softwood dominant forest. Some noise from existing turbine detectable.
39	256649.5	4847609.6	Wet softwood dominant forest. Some noise from existing turbine detectable.
40	256648.2	4847360.4	Softwood dominant forest with medium shrub cover. Some noise from existing turbine detectable.
41	256650.0	4847112.2	Softwood dominant forest with medium shrub cover. Some noise from existing turbine detectable.
42	256553.9	4846883.3	Softwood dominant forest with medium shrub cover. Some noise from existing turbine detectable.
43	256414.1	4846670.7	Softwood dominant with medium shrub cover. Near road.
44	257046.5	4846005.4	ATV Trail. Softwood dominant forest.



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Point Count	Coordinates (NAD 83 UTM 20)		Habitat Type(s)
	Easting	Northing	
45	257334.9	4846115.4	ATV Trail. Barren/heathland with low/medium shrub cover. Softwood trees scattered.
46	257965.4	4846135.6	ATV Trail. Barren/heathland with medium shrub cover. Softwood trees scattered.
47	258405.0	4846060.0	Saltmarsh by coastline. Barren/heathland behind PC with low/medium shrub cover. Softwood trees scattered.
48	257836.1	4846636.8	Barren/heathland with low/medium shrub cover. Mixedwood trees scattered.

Note: 43 PCs total (PCs 14-18 were removed during survey re-design during spring migration round 1). “Low”, “medium” and “high” descriptors refer to shrub height (low - <0.5m, medium - 0.5-1.5m, high - >1.5m).

Table 2-3: Spring and Fall Migration PC Surveys Dates and Weather Conditions

Survey Round	Dates	Temperature (°C)	Wind (Beaufort Scale)	Precipitation
Spring Migration				
Round 1	April 21, 23, 24, and 25, 2022	0-9	0-2	0
Round 2	May 1 and 2, 2022	2-11	1	0
Round 3	May 10 and 11, 2022	5-12	1-3	0
Round 4	May 11 and 12, 2022	8-16	0-1	0
Round 5	May 25 and 26, 2022	4-17	0-1	0-2
Fall Migration				
Round 1	August 16 and 19, 2022	16-22	0-2	0
Round 2	August 29 and September 1, 2022	10-22	0-1	0
Round 3	September 15 and 16, 2022	11-16	2-3	0
Round 4	October 6, 7, and 9, 2022	5-17	0-2	0
Round 5	October 23 and 27, 2022	6-16	0-3	0-1

Note: Weather conditions represent the entire survey (surveyors recorded weather conditions at the start and end of each survey). Precipitation scale is as follows: 0 = none, 1 = drizzle, and 2 = light/moderate. Wind scale (Beaufort scale) is as follows: 0 = <1 km/hr, 1 = 1-5 km/hr, 2 = 6-11 km/hr, and 3 = 12-19 km/hr.



2.3.1.2 Diurnal Watch Count (DWC) Surveys

Three diurnal watch count (DWC) locations were surveyed during the five rounds of spring migration surveys and five rounds of fall migration surveys⁵. The total survey effort was 90 hours (45 hours during spring migration and 45 hours during fall migration). Each survey was three hours in length (30-minute time blocks, completed in sets of 6). Diurnal watch counts occurred either in the morning or after the point count surveys were completed (late morning to mid afternoon). Data collection was the same as the migration PC surveys, with a focus on fly-over activity (e.g., altitude and flight direction). Refer to Figure 2, Appendix A for survey locations.

During each survey, weather conditions (i.e., temperature, wind speed, precipitation, and visibility) were monitored and bird observations were recorded at three distance regimes: within a 50 m radius, 50 to 100 m radius, and outside the 100 m radius. Fly-overs were documented, with a focus height, direction, and any migration behaviour. Surveys were not conducted in wind speeds over 3 on the Beaufort scale (12-19 km/hr), when noise levels make it difficult to hear or distinguish bird calls, or in rain that was more than a light drizzle (EC CWS 2007b). Survey round, date, location, and weather conditions are listed below in Table 2-4.

The locations for the DWC surveys are as follows (coordinates are in NAD 83 UTM 20 – easting, northing):

- DWC 1 (257525.0, 4848483.1) – located in the northern extent of the Project Area, south of Black Pond Road. Existing wind turbine site surrounded by mature mixedwood forest. Slight noise from turbine when operating.
- DWC 2 (256228.8, 4846566.3) – bordering west side of Project Area. DWC 2 is on Comeaus Hill Road, along the west coast of the peninsula with saltmarsh located on both sides of the road. Surrounded vegetated area has tall shrub and mature mixedwood forest.
- DWC 3 (259587.4, 4844189.7) – outside Project Area to the east (on Wedgeport peninsula coastline, parallel to the peninsula the Project Area is located). Coastline at a fish processing facility. View of the Project Area coastline from this location.

Table 2-4: Diurnal Watch Count (DWC) Survey Dates and Weather Conditions

Survey Round	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation	Notes
Spring Migration					
Round 1	April 21 and 22, 2022	7-10	2-3	0	-

⁵ During Round 2 of spring migration, DWC1 was missed by surveyors.



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Survey Round	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation	Notes
Round 2	April 26 and May 1, 2022	6-10	1-2	0	-
Round 3	May 10, 11, and 12, 2022	15-19	2-3	0	Disturbance to birds - DWC 2 had clam harvesters on the mudflats and DWC 3 had blood worm harvesters on the mudflats.
Round 4	May 12 and 14, 2022	10-20	1-2	0	Disturbance to birds - DWC 3 had speed boat activity and blood worm harvesters on the mudflats.
Round 5	May 25 and 26, 2022	10-13	2	0-2	Disturbance to birds - DWC 2 had activity from two speed boats and clam harvesters on the mudflats.
Fall Migration					
Round 1	August 15 and 16, 2022	22-26	2-3	0	Disturbance to birds - DWC 2 had speed boat activity for seaweed and clam harvesting.
Round 2	August 30 and 31, 2022	19-25	1-3	0	-
Round 3	September 14 and 15, 2022	15-20	2-3	0	-
Round 4	October 4, 5, and 7, 2022	13-17	2-3	0	-
Round 5	October 25 and 26, 2022	16-19	0-3	0-1	-

Note: Weather conditions represent the entire survey (surveyors recorded weather conditions at the start and end of each survey). Precipitation scale is as follows: 0 = none, 1 = drizzle, and 2 = light/moderate. Wind scale (Beaufort scale) is as follows: 0 = <1 km/hr, 1 = 1-5 km/hr, 2 = 6-11 km/hr, and 3 = 12-19 km/hr. DWC 1, spring migration round 2 missed by surveyors.



2.3.2 Breeding Bird Surveys

Two rounds of Breeding bird surveys were completed. The first round was conducted on June 8 and 10, 2022 and the second round was conducted on June 29 and 30, 2022. In total, 31 breeding bird PC locations were surveyed for a total effort of 10.3 hours (Table 2-5; Figure 3, Appendix A). Area searches during round 1 lasted between 1.5 to 2 hours (one area search aligned with an early botany survey and, being longer as a result, was 5.75 hours in length). Area searches during round 2 were approximately 1 hour. Survey round, date, location, and weather conditions are listed below in Table 2-6.

Overall, the MEL habitat model had high accuracy for selecting PCs during survey design for breeding bird surveys. Upon field verification, eleven out of thirty-one PCs had slightly different habitat than the model predicted. The differences were related to height of vegetation (e.g., shrub or treed) and forest type (e.g., dry/wet and softwood, hardwood, and mixedwood). Approximately 52% of PCs had open habitat such as barrens/heathland and areas with low to high shrub cover, 45% of PCs are forested areas of various types and maturity stages and one PC was at a saltmarsh.

The methods for breeding bird surveys mirror those described for spring and fall migration PC surveys (Section 2.3.1) with the addition of area searches and observing breeding evidence within the Project Area. Area searches are recommended by CWS during the breeding season to visit more habitat types and/or search habitats more thoroughly for species use during the breeding season (EC CWS 2007b). Qualified biologists conducted area searches after the morning breeding bird surveys. Meandering, non-standardized transects were completed and focused on new habitat or habitat with notable high activity (within or bordering the Project Area). Novel species, priority species, and breeding evidence were recorded in a similar manner to the PC location method. Area searches do not require standardized effort (EC CWS 2007b); however, there was a minimum of one hour per search and GPS tracks were recorded (Figure 3, Appendix A). In total, approximately 1,015 minutes (16.9 hours) of area searches were completed during breeding bird surveys.

To understand this, the breeding status of all bird species observed during breeding bird surveys was also recorded. The surveyor documented bird behaviour observed, including distraction display, carrying food, and carrying nesting material. The MBBA has various breeding evidence codes that are used to determine the breeding status based on field observations (MBBA n.d.). The following are examples of the breeding status indicators described in *Atlassing for Species at Risk in the Maritime Provinces* (MBBA 2008):

- **Observed** - species observed in its breeding season;
- **Possible** - species observed during breeding season in suitable nesting habitat or singing males or breeding calls heard, in suitable nesting habitat during breeding season;



- **Probable** – pair observed in suitable nesting habitat during nesting season, agitated behaviour or anxiety calls of an adult, and
- **Confirmed** - nest building (including adult carrying nesting material), adult carrying food, distraction display, courtship display or territorial behaviour between two individuals, behaviour indicating active nest, nest containing eggs, recently fledged young (nidicolous species), or downy young (nidifugous species), including incapable of sustained flight.

Table 2-5: Breeding Bird Point Count Locations and Associated Habitats

Point Count	Coordinates (NAD 83 UTM 20)		Habitat Types(s)
	Easting	Northing	
1	257056.8	4848476.7	Mixedwood forest. Some noise from existing turbine detectable.
2	257011.2	4848232.0	Mixedwood forest. Some noise from existing turbine detectable.
3	257166.4	4848000.4	Mixedwood forest. Disturbed area (cut-over in areas). Some noise from existing turbine detectable.
4	257362.0	4847878.3	Barren/heathland with high shrub cover. Softwood trees scattered. Some noise from existing turbine detectable.
5	257604.9	4847956.3	Mixedwood forest with medium/high shrub cover. Some noise from existing turbine detectable.
6	257847.9	4848010.3	Edge of barren/heathland with medium/high shrub cover. Mixedwood trees scattered. Some noise from existing turbine detectable.
7	257841.9	4848263.0	Edge of mixedwood forest turning to barren/heathland with medium/high shrub cover. Some noise from existing turbine detectable.
8	258080.4	4848344.6	Mixedwood forest with medium/high shrub cover. Some noise from existing turbine detectable.
9	258320.0	4848439.3	Barren/heathland with medium/high shrub cover. Mixedwood trees. Some noise from existing turbine detectable.
10	258320.9	4848695.6	Hardwood dominant forest with medium/high shrub cover. Area with ponded water scattered and swamps. Signs of groundwater/aquifer source. Black Pond Road appears to split through this habitat type and it continues to North side of road.
11	257664.0	4846267.1	Edge of mixedwood forest turning to barren/heathland with medium shrub cover.
12	257636.2	4846643.1	Barren/heathland with low/medium shrub cover. Mixedwood trees scattered.
13	257639.6	4846893.5	Mixedwood forest.
14	257639.5	4847132.3	Mixedwood forest.
15	257621.5	4847384.2	Barren/heathland with high shrub cover. Softwood trees scattered.
16	257363.5	4847383.5	Barren/heathland with high shrub cover. Softwood trees scattered.
17	257214.1	4847184.6	Barren/heathland with medium shrub cover. Mixedwood trees scattered.



Point Count	Coordinates (NAD 83 UTM 20)		Habitat Types(s)
	Easting	Northing	
18	257204.5	4846923.2	Edge of mixedwood forest turning to barren/heathland with low/medium shrub cover.
19	257197.7	4846657.8	Barren/heathland with low/medium shrub cover. Mixedwood trees scattered.
20	257187.1	4846376.2	Barren/heathland with low/medium shrub cover. Mixedwood trees scattered.
21	257334.9	4846115.4	Barren/heathland with low shrub cover. Mixedwood trees scattered.
22	257344.3	4845850.5	Barren/heathland with medium shrub cover. Mixedwood trees scattered.
23	257192.8	4845625.4	Barren/heathland with medium shrub cover. Mixedwood trees scattered.
24	257314.2	4845415.3	Barren/heathland with medium shrub cover. Edge of hardwood dominant forest.
25	257565.8	4845417.6	Barren/heathland with high shrub cover. Few hardwood dominant trees scattered.
26	257824.4	4845407.8	Wet hardwood dominant forest.
27	258031.9	4845540.5	Mixedwood forest with high shrub cover.
28	258053.4	4845783.3	Barren/heathland with high shrub cover. Hardwood trees scattered.
29	258100.0	4846031.1	Mixedwood forest with high shrub cover.
30	258405.0	4846060.0	Saltmarsh on coastline. Heathland/barren behind PC with low/medium shrub cover. Softwood trees scattered.
31	257860.4	4846101.5	Softwood dominant forest with high shrub cover.

Note: “Low”, “medium”, and “high” descriptors refer to shrub height (low - <0.5m, medium - 0.5-1.5m, high - >1.5m).

Table 2-6: Breeding Bird PC Survey Dates and Weather Conditions

Survey Round	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation
1	June 8 and 10, 2022	12-17	1-2	0-1
2	June 29 and 30, 2022	12-21	0-2	0

Note: Weather conditions represent the entire survey (surveyors recorded weather conditions at the start and end of each survey). Precipitation scale is as follows: 0 = none, 1 = drizzle, and 2 = light/moderate. Wind scale (Beaufort scale) is as follows: 0 = <1 km/hr, 1 = 1-5 km/hr, 2 = 6-11 km/hr, and 3 = 12-19 km/hr.

2.3.3 Nightjar Surveys

Based on ECCC-CWS recommendations (June 3, 2022, pers. comm. with MEL, Stephen Zwicker, Environmental Assessment Coordinator, ECCC-CWS), playback recordings were not used and the Canadian Nightjar Survey Protocol by Birds Canada (2022) was implemented into the field program. Nightjars are crepuscular and the best time to detect these species, particularly common nighthawk, is while they are foraging for insects shortly after sunset (MBBA 2008). Targeted



surveys were selected for nightjars because they are not reliably detected during the breeding bird PC surveys due to their crepuscular nature (Birds Canada 2022).

The 2022 protocol by Birds Canada recommends one survey round but NSDNRR prefers two rounds (May 2022, pers. comm. with MEL, Mark McGarrigle, Species at Risk Biologist, NSDNRR). Dedicated surveys for were conducted on June 15 and July 7, 2022 at six PC locations (Table 2-7; Figure 4, Appendix A). These dates were selected because common nighthawk and Eastern whip-poor-will tend to breed between early June and late July in the Maritimes (MBBA 2020). Survey timing started within 7 days on either side of a full moon (due to potential for Eastern whip-poor-will observations) (Birds Canada 2022) and surveys were completed between 1 hour before sunset and 2 hours after sunset when nightjars are most active (June 3, 2022, pers. comm. with MEL, Stephen Zwicker, Environmental Assessment Coordinator, ECCC-CWS). Surveys had a total of 1.2 hrs of survey effort. Survey round, date, location, and weather conditions are listed below in Table 2-8.

At each nightjar PC location (hereafter CONI PC), surveys consisted of a six-minute passive surveying period. This survey had no call playback or use of flashlights, as per survey protocol by Birds Canada (2022). Due to lack of access within the Project Area itself, most of the PCs were on roads bordering the Project Area. As per survey protocol, effort was made to choose PC locations with little noise and surveys were completed between June 15 and July 15 (Birds Canada 2022). Surveys were not completed in wind speeds greater than Beaufort scale 3, when rain was heavier than a light drizzle, or if noise levels were high enough to affect the surveyor’s hearing. Site conditions were recorded included weather conditions, cloud cover, time effort, number of cars passing by, and if the moon was visible. All individual nightjar observations were recorded, including behaviours such as vocalizations or wing booms, as well as the gender, distance to surveyor, bearing, and time the observation occurred in (e.g., what type of observation or behaviour was observed when) (Birds Canada 2022). Any other birds observed during the nightjar surveys were also recorded as incidentals.

Table 2-7: Nightjar Point Count Locations and Associated Habitats

Point Count	Coordinates (NAD 83 UTM 20)		Habitat Types
	Easting	Northing	
CONI1	259046.8	4848971.8	Roadside with gravel. Mixedwood forest. Residential properties nearby.
CONI2	257452.3	4848735.3	Roadside with gravel. Mixedwood forest. Nearby wind turbine pad and gravel roads.
CONI3	255942.4	4848158.9	Roadside with gravel. Mixedwood forest.
CONI4	256214.2	4846567.6	Roadside with gravel. Coastline with saltmarsh and high shrub cover surrounded by mixedwood forest.
CONI5	256312	4844966.5	Roadside with gravel. High shrub cover with softwood dominant tree stands. Clearings and residential property nearby.
CONI6	257763.6	4846089.3	ATV trail. Barren/heathland with high shrub cover and surrounded by softwood dominant tree stands.



Note: “Low”, “medium”, and “high” descriptors refer to shrub height (low - <0.5m, medium - 0.5-1.5m, high - >1.5m).

Table 2-8: Nightjar Survey Dates and Weather Conditions

Survey Round	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation	Notes
1	June 15, 2022	11-15	0	0	0% cloud cover, no moon, little traffic (0-2 cars at each CONI PC), and moderate noise at CONI 2 (wind turbine noise, 4 and 5 (frogs and barking dog noise)
2	July 7, 2022	15-17	0-1	0	0% cloud cover, moon visible, little traffic (0-2 cars at each CONI PC), and moderate noise at CONI 3 (distant noise from fireworks for half of survey time)

Note: Weather conditions represent the entire survey (surveyors recorded weather conditions at the start and end of each survey). Precipitation scale is as follows: 0 = none, 1 = drizzle, and 2 = light/moderate. Wind scale (Beaufort scale) is as follows: 0 = <1 km/hr, 1 = 1-5 km/hr, 2 = 6-11 km/hr, and 3 = 12-19 km/hr.

2.3.4 Nocturnal Owl Surveys

The methods for monitoring nocturnal owls followed the *Guideline for Nocturnal Owl Monitoring in North America* (Takats *et al.* 2001). Nocturnal owl surveys occurred when vocal activity of most owl species is greatest (typically between April and May), as identified by Takats *et al.* (2001). Surveys were conducted between half an hour after sunset and midnight (Takats *et al.* 2001). Three rounds of nocturnal owl surveys occurred at three PC locations on April 20, May 1, and May 24, 2022. Two PC locations were beyond the Project Area and one was within the Project Area (Figure 5, Appendix A). In total, there were 1.43 hours of survey effort for owls. Survey round, date, location, and weather conditions will be listed at the end of this section in Table 2-9.

The locations for the Owl PC locations are as follows (coordinates are in NAD 83 UTM 20 – easting, northing):

- Owl 1 PC location (256990, 4849007.9) – gravel road surrounded by mature mixedwood forest (more softwood dominant) and low noise from an existing wind turbine nearby.
- Owl 2 PC location (256670.6, 4845846.6) – property MEL was granted access too; gravel road surrounded by softwood dominant forest and high shrub cover.
- Owl 3 PC location (256396.9, 4843235.3) – roadside, wetland on west side and high shrub cover on both sides; softwood dominant stands close-by.



Prior to starting the survey, equipment was tested to ensure that owl calls were audible and recognizable at 400 m. Ensuring that the broadcast could not be heard beyond 400 m minimized bias at the next survey station due to owls hearing the recording from the previous station (Takats *et al.* 2001). The broadcaster test was carried out under weather and noise conditions similar to those that are likely to be encountered during the survey.

The Bird Studies Canada (BSC) Nova Scotia Nocturnal Owl Survey program broadcast was used, which consists of a 9.5-minute track with the following format and owl data recording method (Bird Studies Canada – Atlantic Region 2019):

- Initiates with a beep to indicate the start of the first silent listening period, which lasts 1 minute. All owls heard or seen are recorded. Only if an owl is calling during this period, estimate a distance and bearing, then immediately proceed approximately 300 m along the road (toward the owl if possible) and record a second distance and bearing to permit triangulation of the owl and facilitate habitat association. Another beep marks the end of the first silent listening minute.
- A second silent listening minute will follow. All new owls seen or heard in the second minute are recorded, as well as any owls that continue to call from the first silent listening minute. As described above, if a new owl is heard during the second silent listening minute record a second distance and bearing to permit triangulation of the owl and facilitate habitat association.
- During each of the following 20-second broadcasts, rotate the speakers fully (if applicable).
- A 20-second boreal owl (*Aegolius funereus*) broadcast begins, which is followed by a one-minute silent listening period. All owls heard or seen during this period are to be recorded separately and it is important to keep track of whether the owls heard in the first two-minutes continue to call as well as any new owls.
- The boreal owl broadcast is repeated, which is again followed by a one-minute silent listening period. All owls heard or seen during this period continue to be recorded separately.
- A 20-second barred owl (*Strix varia*) broadcast begins, which is followed by a two-minute silent listening period. All owls heard or seen during this period continue to be recorded separately.
- The barred owl broadcast is repeated, which is again followed by another two-minute silent listening period. All owls heard or seen during this period continue to be recorded separately.
- A beep marks the end of the broadcast track.
- Other birds observed during the nocturnal owl surveys may also be recorded as incidentals.



Table 2-9: Nocturnal Owl Survey Dates and Weather Conditions

Survey Round	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation	Notes
1	April 20, 2022	3-7	1	0	Moon visible (¾ full), 0-10% cloud cover, moderate noise at OWL 1 (little noise from wind turbine), and little noise at OWL 2 and 3 (frogs and gulls)
2	May 1, 2022	4	0	0	0% cloud cover, moderate noise at OWL 3 (frogs), and no noise at OWL 1 and 2
3	May 24, 2022	8-9	0-1	0	No moon visible, moderate noise at OWL 1 (wind turbine and frogs), and little noise at OWL 2 and 3 (frogs)

Note: Weather conditions represent the entire survey (surveyors recorded weather conditions at the start and end of each survey). Precipitation scale is as follows: 0 = none, 1 = drizzle, and 2 = light/moderate. Wind scale (Beaufort scale) is as follows: 0 = <1 km/hr, 1 = 1-5 km/hr, 2 = 6-11 km/hr, and 3 = 12-19 km/hr.

2.3.5 Waterfowl Surveys

Waterfowl surveys were completed at Goose Lake during all survey seasons (breeding bird and spring and fall migration). Another survey location was added at Black Pond for breeding bird and fall migration surveys (Figure 6, Appendix A). Location coordinates and descriptions are as follows:

- Black Pond (coordinates in NAD 83 UTM 20 – easting, northing: 256543.7, 4847978.4) has wetland around its edges and is surrounded by mixedwood forest, and
- Goose Lake (coordinates in NAD 83 UTM 20 – easting, northing: 256929.5, 4849714.6) is surrounded by mixedwood forest and the survey location is on property that MEL was granted access to.

In total, Goose Lake was surveyed 12 times (6 times for spring migration (surveyed twice during round 2), 2 for breeding bird, and 5 for fall migration) and Black Pond was surveyed 7 times (2 times for breeding bird and 5 for fall migration). During each round of breeding bird, additional



canoe surveys of the entirety of Goose Lake were done to represent extra effort during breeding season. Waterfowl surveys, aligning with spring/fall migration and breeding bird survey rounds, occurred between April 21st and October 24th, 2022.

There was no set effort or required time of day for the survey. Surveys lasted anywhere from 10-30 minutes. Although this was a waterfowl focused survey, all bird species observations were recorded. The time of day for the surveys varied to observe different activity but mainly occurred in the morning or evening when the highest activity levels were observed. On two occasions during the breeding season (on June 4 and July 7, 2022), the surveyor used a canoe to survey the entirety of Goose Lake more thoroughly (approximately 2 hours/survey). Both canoe surveys occurred in the morning. Overall, the total effort for waterfowl surveys was approximately 11.18 hours. Date, survey round, effort, count of individuals per species, weather conditions, and any other relevant information (e.g., bird behaviour) was recorded (similar data collection to the PC location method). The focus of the waterfowl survey was to record birds in bird groups 1, 2, and 3 (waterfowl, shorebirds, and other waterbirds). Other birds (bird groups 4-7) were recorded as incidentals and will be included in the incidentals section (Section 3.2.7). Survey round, date, location, and weather conditions are listed below in Table 2-10.

Table 2-10: Waterfowl Survey Dates and Weather Conditions

Survey Round	Location	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation	Notes
Spring Migration						
Round 1	Goose Lake	April 21, 2022	8	1-2	0	5:10-5:30pm. High activity at north end of lake (small islands).
Round 2	Goose Lake	April 22 & May 3, 2022	10-12	1-2	0	April 22: 2:20 – 2:40pm. May 3: 10:45 am – 11:15 am.
Round 3	Goose Lake	May 12, 2022	16	1	0	7:10 – 7:30 pm.
Round 4	Goose Lake	May 14, 2022	14	2	0	4:10 – 4:20 pm. Observed one beaver. Disturbance to birds by two speed boats.
Round 5	Goose Lake	May 30, 2022	15	2	0	7:00 – 7:20 pm.
Breeding Bird						



**WEDGEPORT WIND FARM PROJECT
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Survey Round	Location	Date(s)	Temperature (°C)	Wind (Beaufort Scale)	Precipitation	Notes
Round 1	Goose Lake & Black Pond	June 4 (Goose Lake) and 10 (Black Pond), 2022	15-16	1	0	Goose Lake regular survey: 11:17 – 11:35 am. Goose Lake canoe survey: 9 – 11:15 am. Black Pond: 10:28 – 10:43 am.
Round 2	Goose Lake & Black Pond	June 30 (Goose Lake regular survey and Black Pond) and July 7 (Goose Lake canoe survey), 2022	14-18	0-1	0	Goose Lake regular survey: 9:25 – 9:45 am. Black Pond: 8:38 – 8:55 am. Goose Lake canoe survey: approx. 2 hours. Ended 10am. Observed 2 deer and 1 muskrat.
Fall Migration						
Round 1	Black Pond & Goose Lake	August 15, 2022	18	1	0	Black Pond: 9:25 – 9:43 am. Goose Lake: 10:15 – 10:45 am.
Round 2	Black Pond & Goose Lake	August 30, 2022	20-22	3	0	Black Pond: 9:27 – 9:48 am. Goose Lake: 11:14 – 11:34 am.
Round 3	Black Pond & Goose Lake	September 14, 2022	20	3	0	Black Pond: 11:28 – 11:48 am. Goose Lake: 12:40 – 1:00 pm.
Round 4	Black Pond & Goose Lake	October 4, 2022	9-16	1-2	0	Black Pond: 9:47 – 10:07 am. Goose Lake: 11:40 am – 1:01 pm.
Round 5	Black Pond & Goose Lake	October 24, 2022	16	2	0	Black Pond: 9:17 – 9:38 am. Goose Lake: 10:12 – 10:35 am.

Note: Weather conditions represent the entire survey (surveyors recorded weather conditions at the start and end of each survey). Precipitation scale is as follows: 0 = none, 1 = drizzle, and 2 = light/moderate. Wind scale (Beaufort scale) is as follows: 0 = <1 km/hr, 1 = 1-5 km/hr, 2 = 6-11 km/hr, and 3 = 12-19 km/hr. Goose Lake was surveyed twice during spring migration, round 2. Black Pond was not added until breeding bird surveys.



3 RESULTS

Results from the desktop review, and field surveys are described below.

3.1 Desktop Results

The ACCDC (Appendix C) identified three avian SAR and 23 avian SOCI within 5 km of the Project Area (Figure 1, Appendix A). The SAR birds recorded within 5 km by the ACCDC are:

- Bank swallow (*Riparia riparia*, SARA Threatened, NSESA Endangered);
- Barn swallow (*Hirundo rustica*, SARA Threatened, NSESA Endangered), and
- Red knot rufa subspecies - Tierra del Fuego / Patagonia wintering population (*Calidris canutus rufa*, SARA Endangered, NSESA Endangered).

3.1.1 Important Bird Areas

The closest Important Bird Area (IBA) to the Project Area is The Brothers IBA (NS003), located approximately 18 km southeast from the Project Area (Figure 1, Appendix A).

The habitat in this IBA consists of two low islets (covered with graminoid and herbaceous vegetation), mud/sand flats, coastal sand dunes, beaches, coastal/inlet areas, rocky shorelines, and open ocean. Tides range from 4-5 m (Birds Canada n.d.). The two islets have consistently supported one of Canada's largest roseate tern (*Sterna dougallii*) populations. Roseate terns are listed as Endangered under SARA, COSEWIC and NSESA and have an ACCDC SRank of S1B. The roseate tern population within this IBA represents approximately half of Canada's entire population, with 50-60 nesting pairs recorded in recent years. Common terns (*Sterna hirundo*) and arctic terns (*Sterna paradisaea*), both with an ACCDC SRank of S3B, also have nesting colonies within this IBA, ranging from 300-500 pairs. All three tern species have nested within this IBA for, at least, the last 60 years (Birds Canada n.d.). Although the Project Area is on a peninsula surrounded by rocky coast, mudflats, and open ocean, the habitat associated with this IBA is not consistent with the habitat found within the Project Area itself.

3.1.2 Migratory Bird Sanctuaries

The closest CWS Migratory Bird Sanctuary (MBS) in Nova Scotia is the Sable River Island MBS, which is 260 hectares in size and located approximately 80 km east of the Project Area and within 1 km of Sable River in Shelburne County, Nova Scotia.

This MBS is part of the Nova Scotia South Shore (Port Joli Sector) IBA and provides habitat for resting and breeding waterfowl species. A portion of the Sable River estuary is covered by this MBS.



3.1.3 National Wildlife Area

The closest National Wildlife Area (NWA) in Nova Scotia is the Sand Pond NWA, which is 531 hectares in size and located approximately 17 km northeast of the Project Area and approximately 3 km northeast of Argyle, Nova Scotia. Habitat within this NWA consists of a bog, two shallow freshwater ponds with wetland complexes and forested and heathland areas (ECCC n.d. NWA).

3.1.4 Wilderness Areas

A section of the Tusket Islands Wilderness Area (TIWA) borders the eastern boundary of the Project Area. The TIWA is 715 hectares and protects a mixture of forested land, saltmarshes, headlands, and coastal islands around the mouth of the Tusket River. Shorebirds and waterfowl use this area year-round for migration and overwintering and colonial seabirds use the islands for breeding (NSECC n.d.).

3.1.5 Significant Habitat

There is a small portion of one NSDNRR significant habitat polygon within the Project Area and three outside the Project Area. All are migratory bird significant habitat polygons (Figure 1, Appendix A). Approximately 17.5 hectares of the land-based polygon YA367, also known as the Comeau Hill Significant Ecological Area, enters the southern tip of the Project Area. Polygon YA100 borders the peninsula on the east side and mainly consists of open water. Polygon YA372 borders the peninsula on the west side and mainly consists of open water, mudflats, saltmarsh, and estuaries. Polygon YA99 is land-based and on the west side of Black Pond, outside of the Project Area.

3.1.6 Maritime Breeding Bird Atlas

Three Maritime Breeding Bird Atlas (MBBA) squares (19GJ34, 19GJ44, and 20KP54) encompass the entirety of the Project Area (results are provided in Appendix D). Observations for each square are listed below:

- MBBA square 19GJ34: first atlas has 5 possible, 15 probable, and 21 confirmed breeders. Second atlas 5 possible, 29 probable, and 25 confirmed breeders. Of these species, there were three SAR: bank swallow, barn swallow, and bobolink (*Dolichonyx oryzivorus*).
- MBBA square 19GJ44: first atlas has no breeding evidence recorded. Second atlas has 3 possible, 17 probable, and 21 confirmed breeders. No breeding evidence was recorded for any SAR.
- MBBA square 20KP54: first atlas has no breeding evidence recorded. Second atlas has 11 possible, 30 probable, and 28 confirmed breeders. Of these species, there was one SAR: barn swallow.
- SOCI observations within these MBBA squares (or SAR recorded with no breeding evidence) are presented in Appendix D.



All MBBA summary squares (19GJ34, 19GJ44, and 20KP54) had common nighthawk observations and one observation of an Eastern whip-poor-will in summary square 19GJ34. Both the common nighthawk and Eastern whip-poor-will are also documented within 17 km of the Project Area by ACCDC (results for the ACCDC report and MBBA squares are provided in Appendix C and D).

3.1.7 Previous Environmental Assessments Completed at the Project Area

Stantec submitted an EARD in June 2012⁶ and the avifauna sections were reviewed by MEL for the desktop analysis in this baseline report. In total, 83 bird species were identified during Stantec's bird surveys completed between June 2011 and May 2012. Landbirds were the most abundant species recorded but not as large flocks (Stantec considers a flock as 30 or more individuals). Fall had the highest number of flocks and individuals. Seabirds and waterbirds, mainly gulls, were the most prevalent for flying through the area. The most observed species throughout all surveys were the American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), cedar waxwing (*Bombycilla cedrorum*), common raven (*Corvus corax*), turkey vulture (*Cathartes aura*), great black-backed gull (*Larus marinus*), and herring gull (*Larus argentatus*) (Stantec 2012).

Multiple SOCI were observed by Stantec (2012), including the willet (*Tringa semipalmata*), turkey vulture (*Cathartes aura*), Canada jay (*Perisoreus canadensis*), Wilson's snipe (*Gallinago delicata*), and boreal chickadee (*Poecile hudsonicus*). During the spring and fall migration periods, landbirds flying at or below tree level were the most prevalent. Raptors flew mainly above tree level and seabirds and waterbirds, mainly gull species, frequently flew above tree level and were most prevalent during the migration periods. Large flocks of birds were recorded mainly in late October and early November (between 25 and 100 individuals).

Breeding bird surveys used the PC method, similar to MEL's method, and were completed in June 2011. Stantec (2012) reported observing 54 species and 48 of these species being potential breeders. The most abundant species during Stantec (2012) surveys included the white-throated sparrow (*Zonotrichia albicollis*), magnolia warbler (*Setophaga magnolia*) in forested habitats, and common yellowthroat (*Geothlypis trichas*) in open habitats. These three species were also the most frequently encountered, including the black-and-white warbler (*Mniotilta varia*). Three SAR were also observed: Eastern whip-poor-will (*Antrostomus vociferus*), Eastern wood-pewee (*Contopus virens*), and olive-sided flycatcher (*Contopus cooperi*) (Stantec 2012).

Fall migration surveys were completed using transects with stop-over counts (PCs along a transect), watch counts, and raptor surveys (a raptor focused watch count). Surveys were completed between August and November 2011. Stantec (2012) reported observing 62 species during transects, the most prominent group being "landbirds." Stantec (2012) also reported that a low abundance of birds were observed flying above 120 m. Most birds were observed flying

⁶ <https://novascotia.ca/nsc/ea/wedgeport-wind-farm.asp>



between 10-40 m above ground level. Gulls and raptors generally flew between 40-120m. Species that were observed flying in large flocks were Canada geese (*Branta canadensis*), American robin (*Turdus migratorius*), yellow-rumped warbler (*Setophaga coronate*), red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), and American goldfinch (*Spinus tristis*). Numbers of species were not reported for watch counts or raptor surveys in the 2012 EARD (Stantec 2012).

Spring migration surveys were completed by Stantec (2012) using transects with stop-over counts and watch counts (same locations as fall migration). Surveys were completed between April - May 2012. Stantec (2012) reported observing 57 species during transects, with “landbirds” and “waterbirds” being most abundant. Stantec (2012) reported observing 14 species during watch count surveys. No birds were observed flying above 120 m (from ground level) throughout all spring migration surveys (Stantec 2012).

Winter surveys were completed between December 2011 - March 2012 by Stantec (2012) using transects and watch counts (at each transect). Stantec (2012) reported observing 15 species during transects and 17 species during watch counts. Large flocks of American black ducks (*Anas rubripes*), cedar waxwings (*Bombycilla cedrorum*), and Canada geese (*Branta canadensis*) were recorded (Stantec 2012).

Owl surveys were completed by Stantec (2012) between March – April 2012 using the PC survey method. Stantec (2012) reported observing five Northern saw-whet owls (*Aegolius acadicus*) throughout the Project Area (mainly along Comeaus Hill Road) and by Goose Lake. One great horned owl (*Bubo virginianus*) was also observed within close proximity to Goose Loose (Stantec 2012).

3.1.8 Report on Protecting Coastal Habitat for Migrating Birds

Kearney (2022) established six monitoring sites spanning ~ 80 km along the southern coast of Nova Scotia (Deerfoot Trail, Cranberry Head, Melbourne Lake, Comeau’s Hill, St. John’s Island, and Goodwin’s Island). The Comeau’s Hill monitoring site is located on the same peninsula and approximately 1.7 km south of the Project Area. Acoustic monitors were placed at all sites (August 8 to October 17, 2021) and were set to record during five time periods (2.5 hours before dawn, sunrise to 10 mins after sunrise, 30-40 mins after sunrise, 60-70 mins after sunrise, and 22:00-24:00) to capture calls during nocturnal migration and morning flight (Kearney 2022).

Of the sites monitored, Comeau’s Hill had the second lowest total calls (57.60 calls/hr), total species (n=64), evening migration calls (8.33 calls/hr) and morning flight calls (538.13 calls/hr) (Table 3-1). The Comeau’s Hill monitoring site recorded the third most morning migration calls (20.61 calls/hr) of the six sites (Table 3-1).



Table 3-1. Acoustic Results (Kearney 2022)

Monitoring Site	Total Calls (calls/hr)	Total Species	Nocturnal Migration – Evening (calls/hr)	Nocturnal Migration – Morning (calls/hr)	Morning Flight (calls/hr)
Deerfoot Trail	131.02	79	95.51	37.71	810.67
Cranberry Head	81.66	67	44.24	13.52	646.80
Melbourne Lake	80.36	78	14.44	46.16	646.80
Comeau’s Hill	57.60	64	8.33	20.61	538.13
St. John’s Island	70.30	61	7.51	8.03	758.40
Goodwin’s Island	40.13	68	10.16	14.83	346.53
AVERAGE	76.85	69.50	30.03	23.48	624.56
Comeau’s Hill monitoring site is highlighted as it is the closest monitoring site to the Project Area (~1.7 km to the south).					

Three SAR, barn swallow (n=1), bobolink (n=1), and Canada warbler (n=13) were identified at the Comeau’s Hill monitoring site (Kearney 2022).

3.2 Field Results

The following subsections outline the survey results of the point count surveys (spring migration, breeding season, fall migration, nocturnal owl, and nightjar surveys), diurnal watch count surveys (included with spring and fall migration surveys), waterfowl surveys, and all incidental observations.

ACCDC breeding bird status qualifiers were used to determine whether a species is a priority species, based on the time of year in which the species was observed. If a species has only one seasonal ranking, such as S3B, it was considered a SOCI regardless of the time of year it was observed. However, if the species had an alternate ranking, such as a SRank of S2S3B, S5N, the species was considered a priority species if observed during the breeding season. Outside of breeding season, this species was not considered a priority species.

3.2.1 Spring Migration Surveys

3.2.1.1 *Point Count (PC) Results*

During spring migration, a total of 2,458 individuals representing 66 species were observed during dedicated surveys.

Five avian SOCI (boreal chickadee, Canada jay, common eider, common tern, and willet) were observed during the spring migration surveys (Figure 7, Appendix A; Table 3-1). No SAR were observed. The turkey vultures observed are not considered a priority species due to the SRank code (S4S5M during migration season). All avian SAR and SOCI are discussed in Section 3.3.



Passerines comprised 72.7% of the species observed, followed by shorebirds (13.2%), other landbirds (7.5%), waterfowl (3.9%), diurnal raptors (1.6%), and other waterbirds (0.9%). Unknown species that were able to be identified to a bird group are included in these percentages. White-throated sparrow (n=413) was the most abundant species observed, followed by herring gull (n=216), palm warbler (n=170), and American crow (n=154). All the species identified are native species in this region of Nova Scotia and the province in general. Typical and common habitat to support these species is present within the Project Area and surrounding landscape.

PC 1 (Figure 2, Appendix A) had the largest number of individuals observed (n=115). PC 1 was located on an ATV trail surrounded by barren/heathland with low shrub cover and softwood dominant trees. PC 1 had a high occurrence of flocks of gulls flying over the peninsula. The PCs with the highest species diversity were PCs 38 and 32 (n=27), followed by PC 47 (n=26). These PCs provide a higher diversity of habitat that would attract a variety of birds such as passerines, diurnal raptors, waterfowl, and shorebirds (e.g., mixed wood forest, softwood dominant forest, pond, fen, saltmarsh, and barren/heathland). Observations of common eider and common tern, two of the coastal-based SOCI, were limited to PC 47. Results are presented in Table 3-1 and Table 3-2 below.

The highest abundance of fly-overs occurred from PCs 1 to 10 and 47 (coastal PC; Figure 2, Appendix A). These PCs are farther south on the Project Area peninsula and the fly-overs consisted mostly of birds moving up and down the coastline or crossing back and forth over the peninsula. Most fly-overs recorded were birds flying at or below 100 m (on average at or below 60 m). There were only two observations of a herring gull and turkey vulture flying above 100 m. Two large flocks (40 individuals) of herring gulls were also observed during spring migration surveys. The analysis, including statistics, of fly-overs observed during the spring migration PC surveys is included below.

During spring migration surveys 105 fly-overs were observed (31 of which were passerines (group 6) or other landbirds (group 7) and 74 of which were shorebirds (group 2), waterfowl (group 1), and diurnal raptors (group 4)). Out of the 105 fly-overs observed, only 2 were above 100 m in height (herring gull and turkey vulture) and 6 were at 100 m in height (gulls, great blue heron, turkey vulture, and broad-winged hawk). Out of 105 fly-overs, 97 were under 100 m in height. Approximately 69% of all fly-overs were flying east/west and 31% were flying north/south. Most fly-overs were observed farther south on the peninsula (74% - which includes all PCs except PCs 22-41; Figure 2, Appendix A). Approximately 56% of fly-overs were observed at the southern-most PCs (PCs 1-10).



During spring migration surveys, there were multiple recordings of early breeding evidence, which includes (refer to Figure 2, Appendix A for PC references)⁷. Breeding status was determined by matching bird behaviour observations with the breeding evidence codes by the MBBA (MBBA n.d.)⁷:

- A female American black duck had an active nest with seven eggs at PC 10. This is close to the coast and in an area with high shrub cover. The same duck and nest were observed during two different survey rounds.
- Two brown creepers were observed collecting nesting material.
- A black-throated green warbler pair was observed.
- Five common yellowthroat pairs were observed throughout the southern part of the Project Area (barren/heathland and shrub covered areas).
- Common eider pairs were also observed by the coast at PC 47.
- Palm warblers were observed fighting and collecting nesting material.
- There was also a willet pair at PC 12 displaying agitated and distraction behaviour, indicating a possible nest nearby.

3.2.1.2 *Diurnal Watch Count (DWC)*

During DWC surveys, a total of 1,300 individuals representing 55 species were observed.

One SAR (barn swallow) and three SOCI (Canada jay, common eider, and willet) were observed during these surveys. Note that the turkey vulture (S4S5M) and common goldeneye (S5M) were observed but are not considered priority species due to their ACCDC SRank during migration season (Table 3-3; Figure 7, Appendix A). All avian SAR and SOCI are discussed in Section 3.3.

Shorebirds comprised 60.1% of the species observed (due to the two coastal DWCs and the flocks and fly-overs observed), followed by passerines (18.6%), waterfowl (11.3%; most of them common eider), diurnal raptors (6.1%; most of them turkey vultures), other waterbirds (3.2%; most of them great blue heron), and other landbirds (0.8%). Unknown species that were able to be identified to a bird group are included in these percentages. Herring gull (n=598) was the most abundant species observed followed by great black-backed gull (n=113), and common eider (n=112). Results are presented in Table 3-3.

Two of the DWCs are along coastline (Figure 2, Appendix A) and the high abundances of shorebirds and waterfowl are expected. All the species identified, except for the European starling, are native species in this region of Nova Scotia and the province in general. Typical and common habitat to support these species are present within the Project Area and surrounding landscape.

⁷ Agitated behaviour or anxiety calls of an adult and observing pairs in suitable nesting habitat during nesting season yields a probable breeding status. Carrying nesting material yields a confirmed breeding status (MBBA).



DWC 1 had 253 individuals, DWC 2 had 571 individuals, and DWC 3 had 476 individuals. DWC 1 had 29 species, DWC 2 had 39 species (does not include unknowns), and DWC 3 had 25 species (does not include unknowns). Although DWC 3 had a higher number of individuals observed, the species abundance was not as high as DWC 1. DWC 1 had various species passing over between coastal habitats and forested habitat which could be a leading factor to this. DWC 2 had the highest individual and species abundance. This could be due to the higher habitat diversity at DWC 2 since it is coastal, like DWC 3, but also has a large saltmarsh at this location and forested habitat nearby (Figure 2, Appendix A).

Breeding evidence was observed during the spring migration DWC surveys, which includes a Canada goose adult observed with a young juvenile (confirmed breeding status) and multiple pairs of common eider were observed as well (probable breeding status).

The largest flocks of birds observed were 20 great-black backed gulls, two flocks of common eiders (12 and 15 individuals) at the coast, and many flocks of herring gulls of various sizes (10-80 individuals). Most flocks of herring gulls observed were flying at 100+ m in height.

Raptors were flying at an average of 50-100+ m in height. Most passerines observed flying were under 50 m in height. Gulls, particularly herring and great black-backed gulls, were observed flying on average between 40-100+ m in height.

All fly-overs for common eiders were groups of 2-12 individuals flying up and down the coastline. The highest amount of fly-overs observed were herring gulls (355 individuals), great black-backed gulls (71 individuals), and turkey vultures (50 individuals). Other fly-overs included waterfowl, raptors and various passerines. The analysis, including statistics, of fly-overs observed during the spring migration DWC surveys is included below.

During spring diurnal watch count (DWC) surveys 217 fly-overs were observed (26 of which were passerines (group 6) and other landbirds (group 7) and 191 of which were shorebirds (group 2; gulls and double-crested cormorant), diurnal raptors (group 4), and other waterbirds (group 3; e.g., belted kingfisher and great blue heron)). Out of the 217 fly-overs observed, 44 were above 100 m in height (gulls, diurnal raptors, great blue heron, and one American crow) and 31 were at 100 m in height (gulls, double-crested cormorants, diurnal raptors, and one American crow). Out of 217 fly-overs, 142 were under 100 m in height. Approximately 56% of all fly-overs were flying east/west and 44% were flying north/south. Most fly-overs were observed at DWCs 2 and 3, which are farther south on the peninsula (only 46 fly-overs were observed farther north at DWC 1; Figure 2, Appendix A).



3.2.1.3 *Spring Migration Summary*

There were no specific migration patterns or travel corridors observed within the Project Area during these surveys.

Throughout the spring migration PC and DWC surveys, it was noted that movement would occur across the Project Area peninsula depending on the tide to access feeding areas (e.g., saltmarsh and mudflats) or depending on activity at local fishing operations (e.g., DWC 3; Figure 2, Appendix A).

The highest number of fly-overs occurred at PCs south of Black Pond Road. This was especially common for waterfowl and shorebird groups further south in the Project Area, farther down the peninsula where the highest occurrence of fly-overs occurred. The highest abundance of fly-overs included shorebirds, gulls, and raptors.

While surveying coastal PCs (e.g., DWC 2; Figure 2, Appendix A), surveyors often recorded occurrences of fly-overs of birds flying north and south along the coast. In general, bird behaviour recorded during field surveys indicated that the coast is a streamlined way to migrate in the area, especially for passerines, waterfowl, and shorebirds.

No observations were made of large colonies within the Project Area. Large colonies are more likely to occur along the coast, on islands, and on the surrounding open water. A local bird surveyor conducted a brant goose (*Branta bernicla*) survey of Lobster Bay and Tusket Islands on May 3, 2022 (area south of Project Area peninsula) and reported 197 individuals on seven islands. Western Bar is the closest island to the Project Area and 103 brant were identified during the survey. This island is approximately 5 km southeast of Wedgeport and visible from the southern parts of the Project Area (May 2022, pers. comm. with MEL, Melvin Pothier, MEL contractor – local bird surveyor).



Table 3-2: Individual Abundance and Species of Birds Observed During Spring Migration Surveys

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group
BOCH	Boreal chickadee	<i>Poecile hudsonica</i>	-	-	S3	9	A	-	4, 13, 19, 20, 32, 41	6
CAJA	Canada jay	<i>Perisoreus canadensis</i>	-	-	S3	6	A	-	12, 38, 45, 46, 47, 48	6
COEI	Common eider	<i>Somateria mollissima</i>	-	-	S3B, S3M, S3N	7	A	3 M, 4 F	47	1
COTE	Common tern	<i>Sterna hirundo</i>	-	-	S3B	1	A	-	47	2
WILL	Willet	<i>Tringa semipalmata</i>	-	-	S3B	80	A	1 M, 1 F	5, 6, 7, 8, 9, 10, 11, 12, 13, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 36, 37, 38, 39, 40, 44, 45, 46, 47, 48	2
ALFL	Alder flycatcher	<i>Empidonax alnorum</i>	-	-	S5B	19	A	-	1, 2, 4, 6, 9, 11, 12, 20, 21, 31, 45, 46, 47, 48	6
ABDU	American black duck	<i>Anas rubripes</i>	-	-	S5B, S5N	17	A	1 F	10, 28, 38, 47	1
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	154	A	-	All PCs except 26	6
AMGO	American goldfinch	<i>Carduelis tristis</i>	-	-	S5	16	A	-	8, 12, 13, 21, 22, 23, 26, 31, 32, 35, 44, 47	6
AMRE	American redstart	<i>Setophaga ruticilla</i>	-	-	S5B	5	A	-	21, 22, 24, 25, 46	6
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	47	A	-	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 19, 20, 21, 22, 23, 24, 25, 27, 29, 30, 31, 32, 37, 38, 40, 44, 45, 46, 47, 48	6
BEKI	Belted kingfisher	<i>Megaceryle alcyon</i>	-	-	S4S5B	1	A	-	12	3
BTBW	Black-throated blue warbler	<i>Setophaga caerulescens</i>	-	-	S5B	1	A	-	44	6
BTNW	Black-throated green warbler	<i>Dendroica virens</i>	-	-	S5B	11	A	1 M, 1 F	7, 22, 31, 34, 35, 36, 46	6
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	27	A	-	1, 8, 11, 12, 13, 19, 20, 22, 23, 26, 27, 32, 34, 36, 38, 39, 40, 41, 45, 46, 48	6
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	129	A	-	All PCs except 3, 10, 12, 24, 26, 45	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	99	A	-	All PCs except 13, 34, 45, 46, 47	6
BHVI	Blue-headed vireo	<i>Vireo solitarius</i>	-	-	S5B	6	A, 1 J	-	23, 28, 29, 35, 37	6
BWHA	Broad-winged hawk	<i>Buteo platypterus</i>	-	-	S5B	3	A	-	33, 42	4
BRCR	Brown creeper	<i>Certhia americana</i>	-	-	S5	3	A	-	20, 39	6
CAGO	Canada goose	<i>Branta canadensis</i>	-	-	SUB, S4N, S5M	22	A	-	6, 8, 27, 33, 38, 39, 41, 42	1
CEDW	Cedar waxwing	<i>Bombycilla cedrorum</i>	-	-	S5B	1	A	-	19	6
CSWA	Chestnut-sided warbler	<i>Setophaga pensylvanica</i>	-	-	S5B	13	A	-	2, 3, 5, 6, 19, 21, 27, 31, 46, 47	6
COGR	Common grackle	<i>Quiscalus quiscula</i>	-	-	S5B	7	A	-	4, 10, 36	6
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	2	A	-	1, 9	3
CORA	Common raven	<i>Corvus corax</i>	-	-	S5	4	A	-	6, 10, 19, 32	6
COYE	Common yellowthroat	<i>Geothlypis trichas</i>	-	-	S5B	111	A	5 M, 5 F	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 32, 34, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48	6
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	-	-	S4S5	54	A	-	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 19, 22, 23, 24, 25, 26, 28, 29, 31, 32, 33, 34, 38, 39, 43, 45, 46, 47, 48	6
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	9	A	-	2, 8, 21, 36, 47	2
DOWO	Downy woodpecker	<i>Dryobates pubescens</i>	-	-	S5	2	A	-	21, 22	7
GCKI	Golden-crowned kinglet	<i>Regulus satrapa</i>	-	-	S5	20	A	-	1, 7, 8, 22, 35, 37, 38, 39, 40, 41, 43, 44	6
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	17	A	-	2, 3, 4, 9, 10, 13, 21, 34, 37	2



Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	19	A	-	2, 3, 4, 5, 6, 7, 10, 12, 13, 20, 34, 38, 47	3
HAWO	Hairy woodpecker	<i>Picoides villosus</i>	-	-	S5	2	A	-	28, 45	7
HETH	Hermit thrush	<i>Catharus guttatus</i>	-	-	S5B	133	A	-	All PCs except 8, 19, 38	6
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	216	A	-	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 19, 20, 21, 26, 29, 30, 31, 39, 40, 41, 42, 43, 44, 46, 47, 48	2
LBBG	Lesser black-backed gull	<i>Larus fuscus</i>	-	-	SNA	1	A	-	32	2
MAWA	Magnolia warbler	<i>Dendroica magnolia</i>	-	-	S5B	28	A	-	13, 19, 20, 24, 32, 34, 35, 37, 38, 39, 40, 41, 43, 44, 45, 47, 48	6
MALL	Mallard	<i>Anas platyrhynchos</i>	-	-	S5B, S5N	10	A	1 M, 2 F	5, 10, 32, 38, 47	1
MERL	Merlin	<i>Falco columbarius</i>	-	-	S5B	2	A	-	37, 38	4
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	110	A	-	1, 4, 8, 10, 11, 12, 13, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 44, 45, 48	7
NAWA	Nashville warbler	<i>Vermivora ruficapilla</i>	-	-	S4B, S5M	4	A	-	12, 25, 28	6
NOCA	Northern cardinal	<i>Cardinalis cardinalis</i>	-	-	S4	3	A	-	1	6
NOFL	Northern Flicker	<i>Colaptes auratus</i>	-	-	S5B	40	A	-	1, 2, 4, 5, 7, 8, 10, 11, 12, 13, 19, 20, 22, 23, 24, 27, 28, 29, 30, 32, 35, 36, 37, 38, 41, 42, 45	7
NOHA	Northern harrier	<i>Circus hudsonius</i>	-	-	S4B, S4S5M	6	A	-	1, 4, 5, 9	4
NOPA	Northern parula	<i>Parula americana</i>	-	-	S5B	3	A	-	37, 38, 44	6
OSPR	Osprey	<i>Pandion haliaetus</i>	-	-	S4S5B, S5M	5	A	-	10, 22, 32, 44	4
OVEN	Ovenbird	<i>Seiurus aurocapilla</i>	-	-	S5B	21	A	-	7, 9, 19, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 40, 44, 45	6
PAWA	Palm warbler	<i>Dendroica palmarum</i>	-	-	S5B	170	A	-	All PCs except 36, 37	6
PUFI	Purple finch	<i>Carpodacus purpureus</i>	-	-	S4S5B, S3S4N, S5M	40	A	-	1, 3, 4, 6, 11, 12, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 36, 38, 39, 40, 41, 43, 44, 47, 48	6
RWBL	Red-winged blackbird	<i>Agelaius phoeniceus</i>	-	-	S4B	2	A	-	38	6
RBNU	Red-breasted nuthatch	<i>Sitta canadensis</i>	-	-	S4S5	24	A	-	1, 26, 27, 28, 29, 30, 33, 34, 35, 36, 37, 38, 39	6
REVI	Red-eyed vireo	<i>Vireo olivaceus</i>	-	-	S5B	1	A	-	34	6
RNDU	Ring-necked duck	<i>Aythya collaris</i>	-	-	S5B	22	A	6 M	38	1
RCKI	Ruby-crowned kinglet	<i>Regulus calendula</i>	-	-	S4B, S5M	3	A	-	29, 35, 40	6
RUGR	Ruffed grouse	<i>Bonasa umbellus</i>	-	-	S5	30	A	-	3, 4, 6, 7, 8, 23, 25, 27, 28, 30, 31, 32, 35, 36, 37, 39	7
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	19	A	-	8, 9, 10, 21, 22, 32, 44, 47, 48	6
SWSP	Swamp sparrow	<i>Melospiza georgiana</i>	-	-	S5B	37	A	-	1, 3, 5, 10, 11, 12, 26, 27, 28, 32, 38, 46, 47, 48	6
TRES	Tree swallow	<i>Tachycineta bicolor</i>	-	-	S4B	2	A	-	7	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	23	A	-	4, 6, 8, 9, 10, 28, 30, 41, 42	4
WBNU	White-breasted nuthatch	<i>Sitta carolinensis</i>	-	-	S4	2	A	-	13, 28	6
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	413	A	-	All PCs	6
WWCR	White-winged crossbill	<i>Loxia leucoptera</i>	-	-	S4S5	10	A	-	4, 11, 22, 30, 44, 48	6
WIWR	Winter wren	<i>Troglodytes troglodytes</i>	-	-	S5B	30	A	-	3, 6, 7, 8, 10, 11, 13, 19, 21, 29, 31, 32, 33, 34, 35, 36, 38, 44, 45, 48	6
YWAR	Yellow warbler	<i>Dendroica petechia</i>	-	-	S5B	4	A	-	9, 21, 47	6



Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	92	A	-	2, 3, 7, 8, 9, 11, 12, 13, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 48	6
-	Unknown	-	-	-	-	4	A	-	24, 28, 29	-
-	Unknown buteo	-	-	-	-	1	A	-	10	4
-	Unknown duck	-	-	-	-	18	A	-	1, 11, 47	1
-	Unknown passerine	-	-	-	-	2	A	-	1	6
-	Unknown sparrow	-	-	-	-	1	A	-	7	6
-	Unknown warbler	-	-	-	-	2	A	-	22, 23	6
Total Number of Individuals				2,458	Total Number of Species (does not include unknowns)					66

Notes: Incidental observations not included (those observed outside of point count locations). A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022). "-" represents no federal or provincial designation.



Table 3-3: Individual Abundance and Species Abundance by PC Location – Spring Migration

PC Locations	Total # of Individuals	Total Number of Species
1	115	21
2	75	16
3	99	17
4	68	22
5	57	16
6	48	20
7	50	19
8	64	22
9	67	19
10	74	23
11	81	20
12	62	21
13	63	20
19	50	22
20	47	18
21	85	23
22	93	23
23	52	18
24	50	16
25	52	17
26	66	16
27	47	19
28	59	22
29	45	20
30	27	16
31	37	19
32	55	27
33	53	15
34	41	18
35	45	19
36	34	19
37	35	17
38	98	27
39	52	20
40	41	17
41	50	18
42	35	14
43	26	13
44	49	23
45	42	18
46	37	18
47	75	26
48	57	22



**WEDGEPORT WIND FARM PROJECT
AVIAFAUNA BIOPHYSICAL BASELINE REPORT**

PC Locations	Total # of Individuals	Total Number of Species
Total	2,458	66*

*Notes: Total number of individuals observed include observations that were not able to be identified at the species level. * Total number of unique species observed (does not include unknowns).*



WEDGEPORT WIND FARM PROJECT
AVIAFAUNA BIOPHYSICAL BASELINE REPORT

Table 3-4: Individual Abundance and Species of Birds Observed During DWC Surveys (Spring Migration)

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	DWC Observations	Group
BARS	Barn swallow	<i>Hirundo rustica</i>	T	E	S3B	3	A	=	DWC 3	6
CAJA	Canada jay	<i>Perisoreus canadensis</i>	-	-	S3	1	A	-	DWC 2	6
COEI	Common eider	<i>Somateria mollissima</i>	-	-	S3B, S3M, S3N	112	A	4 M, 7 F	DWC 2, 3	1
WILL	Willet	<i>Tringa semipalmata</i>	-	-	S3B	10	A	-	DWC 2	2
ABDU	American black duck	<i>Anas rubripes</i>	-	-	S5B, S5N	6	A	-	DWC 2	1
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	73	A	-	DWC 1, 2, 3	6
AMGO	American goldfinch	<i>Carduelis tristis</i>	-	-	S5	6	A	-	DWC 2, 3	6
AMRE	American redstart	<i>Setophaga ruticilla</i>	-	-	S5B	1	A	-	DWC 3	6
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	5	A	-	DWC 1, 2, 3	6
BAEA	Bald eagle	<i>Haliaeetus leucocephalus</i>	-	-	S5	6	A	-	DWC 1, 2, 3	4
BEKI	Belted kingfisher	<i>Megaceryle alcyon</i>	-	-	S4S5B	2	A	-	DWC 2, 3	3
BTNW	Black-throated green warbler	<i>Dendroica virens</i>	-	-	S5B	3	A	-	DWC 1, 2	6
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	3	A	-	DWC 1, 3	6
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	14	A	-	DWC 1, 2, 3	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	7	A	-	DWC 1, 2	6
BHVI	Blue-headed vireo	<i>Vireo solitarius</i>	-	-	S5B	3	A	-	DWC 1	6
BWHA	Broad-winged hawk	<i>Buteo platypterus</i>	-	-	S5B	2	A	-	DWC 2	4
CAGO	Canada goose	<i>Branta canadensis</i>	-	-	SUB, S5M, S4N	15	A, 1 J	-	DWC 2	1
CSWA	Chestnut-sided warbler	<i>Setophaga pensylvanica</i>	-	-	S5B	1	A	-	DWC 1	6



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	DWC Observations	Group
COGO	Common goldeneye	<i>Bucephala clangula</i>	-	-	S2S3B, S5N, S5M	4	A	-	DWC 2	1
COGR	Common grackle	<i>Quiscalus quiscula</i>	-	-	S5B	14	A	-	DWC 2, 3	6
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	5	A	-	DWC 3	3
CORA	Common raven	<i>Corvus corax</i>	-	-	S5	1	A	-	DWC 2	6
COYE	Common yellowthroat	<i>Geothlypis trichas</i>	-	-	S5B	3	A	-	DWC 1, 2	6
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	-	-	S4S5	8	A	-	DWC 1, 2, 3	6
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	51	A	-	DWC 1, 2, 3	2
EUST	European starling	<i>Sturnus vulgaris</i>	-	-	SNA	2	A	-	DWC 3	6
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	113	A	-	DWC 1, 2, 3	2
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	34	A	-	DWC 1, 2, 3	3
HETH	Hermit thrush	<i>Catharus guttatus</i>	-	-	S5B	1	A	-	DWC 1	6
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	598	A	-	DWC 1, 2, 3	2
LBBG	Lesser black-backed gull	<i>Larus fuscus</i>	-	-	SNA	2	A	-	DWC 2	2
MAWA	Magnolia warbler	<i>Dendroica magnolia</i>	-	-	S5B	5	A	-	DWC 1, 2	6
MALL	Mallard	<i>Anas platyrhynchos</i>	-	-	S5B, S5N	5	A	-	DWC 3	1
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	1	A	-	DWC 2	7
NOCA	Northern cardinal	<i>Cardinalis cardinalis</i>	-	-	S4	1	A	-	DWC 2	6
NOFL	Northern Flicker	<i>Colaptes auratus</i>	-	-	S5B	9	A	-	DWC 1, 2	7
NOHA	Northern harrier	<i>Circus hudsonius</i>	-	-	S4B, S4S5M	1	A	-	DWC 2	4
NOPA	Northern parula	<i>Parula americana</i>	-	-	S5B	3	A	-	DWC 2, 3	6
OSPR	Osprey	<i>Pandion haliaetus</i>	-	-	S4S5B, S5M	5	A	-	DWC 1	4
OVEN	Ovenbird	<i>Seiurus aurocapilla</i>	-	-	S5B	1	A	-	DWC 1	6
PAWA	Palm warbler	<i>Dendroica palmarum</i>	-	-	S5B	8	A	-	DWC 1, 2	6



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	DWC Observations	Group
PUFI	Purple finch	<i>Carpodacus purpureus</i>	-	-	S4S5B, S3S4N, S5M	9	A	-	DWC 1, 2	6
RSHA	Red-shouldered hawk	<i>Buteo lineatus</i>	-	-	SNA	1	A	-	DWC 2	4
RTHA	Red-tailed hawk	<i>Buteo jamaicensis</i>	-	-	S5	2	A	-	DWC 1	4
REVI	Red-eyed vireo	<i>Vireo olivaceus</i>	-	-	S5B	2	A	-	DWC 1	6
RBGU	Ring-billed gull	<i>Larus delawarensis</i>	-	-	SUB, S5N	3	A	-	DWC 2	2
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	23	A	-	DWC 2, 3	6
SWSP	Swamp sparrow	<i>Melospiza georgiana</i>	-	-	S5B	1	A	-	DWC 1	6
TRES	Tree swallow	<i>Tachycineta bicolor</i>	-	-	S4B	5	A	-	DWC 2, 3	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	62	A	-	DWC 1, 2, 3	4
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	22	A	-	DWC 1, 2	6
WIWR	Winter wren	<i>Troglodytes troglodytes</i>	-	-	S5B	1	A	-	DWC 1	6
YWAR	Yellow warbler	<i>Dendroica petechia</i>	-	-	S5B	3	A	-	DWC 3	6
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	8	A	-	DWC 1, 2, 3	6
-	Unknown duck	-	-	-	-	5	A	-	DWC 2	1
-	Unknown gull	-	-	-	-	4	A	-	DWC 3	2
-	Unknown swallow	-	-	-	-	1	A	-	DWC 3	6
Total Number of Individuals				1,300	Total Number of Species (does not include unknowns)					55

Notes: Incidental observations not included (those observed outside of point count locations). A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webanks/NSall.htm> (October 2022). "-" represents no federal or provincial designation.



3.2.2 Breeding Bird Surveys

During breeding bird PC surveys, a total of 632 individuals representing 48 species were observed during dedicated surveys.

Five avian SOCI (boreal chickadee, Canada jay, common eider, Nelson's sparrow, and willet; Table 3-4; Figure 7, Appendix A) were observed during the breeding bird surveys. No avian SAR were observed. All avian SAR and SOCI are discussed in Section 3.3.

Passerines comprised 61.1% of the species observed, followed by shorebirds (25%), other landbirds (6.3%), waterfowl (3.8%), other waterbirds (3.3%), and diurnal raptors (0.3%). Herring gull (n=108) was the most abundant species observed, followed by common yellowthroat (n=77), hermit thrush (n=47), and white-throated sparrow (n=46). All the species identified are native species in this region of Nova Scotia and the province in general. Typical and common habitat to support these species is present within the Project Area and surrounding landscape.

PC 30 (Figure 3, Appendix A) had the largest number of individuals observed (n=69), which was not ranked highest for diversity (10 species observed). PC 30 is at a saltmarsh located on the coastline of the Project Area (with heathland/barren behind the PC location) and this is where most large flocks were observed. This PC did have a novel species, such as the Nelson's sparrow observed in the saltmarsh. Most birds from groups 2 and 3 were observed at PC 30.

PC 6 (Figure 3, Appendix A) had the highest species diversity (16 species observed), which had 20 individuals. This PC was located on the edge of a barren/heathland area with shrub over and mixed wood trees. Willets and herring gulls were observed there due to the close proximity to the coast, but overall, this type of habitat would attract various passerines as well (specifically warblers and sparrows). All species, their abundance and observed PC locations, are listed in Table 3-4 and Table 3-5 (below). All avian SAR and SOCI are discussed in Section 3.3.

During breeding bird surveys, surveyors recorded a high occurrence of gulls and great blue herons flying between 20-50 m. Almost all of the fly-overs recorded were in the southern part of the Project Area (PCs 21-30; Figure 3, Appendix A). Similar to spring migration observations, most of the fly-overs observed birds crossing the peninsula or flying up and down the coast. The largest flocks observed were 20 common eiders and four flocks of herring gulls ranging from 15-30 individuals each. All flocks were observed at or close to the coastline. The analysis, including statistics, of fly-overs observed during the breeding bird surveys is included below.

During breeding bird surveys 36 fly-overs were observed (2 of which were passerines (group 6) and 34 of which were gulls, willets, double-crested cormorants, great blue herons, and diurnal raptors (group 4)). Out of the 36 fly-overs observed, only 2 were at 100 m in height (both herring gulls) and 34 were under 100 m in height. Approximately 69% of all fly-overs were flying



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east/west and 31% were flying south. Most fly-overs were observed farther south on the peninsula (97% - which includes breeding bird PCs 11 and 20-31; Figure 3, Appendix A).

Breeding status are listed in Table 3-4 based on observations in the field. Breeding evidence observed during the breeding bird surveys includes (refer to Figure 3, Appendix A for PC references):

- Seven pairs of American goldfinch observed.
- Three common yellowthroat pairs and agitated common yellowthroats were observed at various PCs in the Project Area.
- A ruby-throated hummingbird and golden-crowned kinglet was observed collecting nesting material.
- A female ruffed grouse with eight downy feathered chicks was observed at PC 1. The female was also doing a distraction display.
- A swamp sparrow and white-throated sparrow pair was observed.
- Two willet pairs and multiple agitated individuals were observed, all close to the coast (in barren/heathland area with shrub cover).
- Breeding evidence observed during other seasons/survey types was recorded but will not be included in Table 3-4. This will be further discussed in the individuals sections within the field results section (Section 3.2).



Table 3-5: Individual Abundance and Species of Birds Observed During Breeding Bird Surveys

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group	Breeding Status
BOCH	Boreal chickadee	<i>Poecile hudsonica</i>	-	-	S3	1	A	-	5	6	Possible
CAJA	Canada jay	<i>Perisoreus canadensis</i>	-	-	S3	3	A	-	4, 19, Area Search	6	Possible
COEI	Common eider	<i>Somateria mollissima</i>	-	-	S3B, S3M, S3N	20	A	-	Area Search	1	Possible
NSTS	Nelson's sparrow	<i>Ammospiza nelsoni</i>	-	-	S3S4B	7	A	-	30, Area Search	6	Possible
WILL	Willet	<i>Tringa semipalmata</i>	-	-	S3B	33	A	2 M, 2 F	4, 6, 7, 8, 13, 14, 28, 29, 30, 31, Area Search	2	Probable
ALFL	Alder flycatcher	<i>Empidonax alnorum</i>	-	-	S5B	14	A	-	11, 17, 22, 23, 24, 25, 27, Area Search	6	Possible
ABDU	American black duck	<i>Anas rubripes</i>	-	-	S5B, S5N	4	A, 1 J	-	Area Search	1	Possible
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	18	A	-	2, 3, 5, 6, 8, 9, 10, 16, 18, 19, 21, 22, 28, 30, Area Search	6	Possible
AMGO	American goldfinch	<i>Carduelis tristis</i>	-	-	S5	10	A	7 M, 7 F	1, 27, Area Search	6	Probable
AMRE	American redstart	<i>Setophaga ruticilla</i>	-	-	S5B	1	A	-	2	6	Possible
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	2	A	-	13, 20	6	Possible
BTNW	Black-throated green warbler	<i>Dendroica virens</i>	-	-	S5B	11	A	-	1, 2, 3, 4, 5, 6, 10, 14, 25, 27, Area Search	6	Possible
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	17	A	-	3, 4, 9, 19, 21, 23, 25, 26, 27, 28, 29, 31, Area Search	6	Possible
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	12	A	-	6, 7, 10, 11, 15, 26, 31, Area Search	6	Possible
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	5	A	-	4, 6, 13, 24, 27	6	Possible
BHVI	Blue-headed vireo	<i>Vireo solitarius</i>	-	-	S5B	2	A	-	27, Area Search	6	Possible
CSWA	Chestnut-sided warbler	<i>Setophaga pensylvanica</i>	-	-	S5B	7	A	-	6, 7, 10, 15, 19, 25	6	Possible
CORA	Common raven	<i>Corvus corax</i>	-	-	S5	2	A	-	4	6	Possible
COYE	Common yellowthroat	<i>Geothlypis trichas</i>	-	-	S5B	77	A	3 M, 3 F	2, 3, 4, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, Area Search	6	Probable
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	-	-	S4S5	1	A	-	11	6	Possible
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	12	A	-	30, Area Search	2	Possible
DOWO	Downy woodpecker	<i>Dryobates pubescens</i>	-	-	S5	1	A	-	6	7	Possible
GCKI	Golden-crowned kinglet	<i>Regulus satrapa</i>	-	-	S5	3	A	-	5, 17, 18	6	Confirmed
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	5	A	-	21, 22, Area Search	2	Possible
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	21	A	-	11, 20, 21, 22, 23, 28, 29, 30, Area Search	3	Possible
HETH	Hermit thrush	<i>Catharus guttatus</i>	-	-	S5B	47	A	-	All PCs (including Area Search) except PCs 3, 5, 19, 20, 28, 30	6	Possible
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	108	A	-	6, 9, 17, 21, 23, 25, 27, 28, 30, Area Search	2	Possible
LEFL	Least flycatcher	<i>Empidonax minimus</i>	-	-	S4S5B, S5M	1	A	-	3	6	Possible
MAWA	Magnolia warbler	<i>Dendroica magnolia</i>	-	-	S5B	24	A	-	2, 3, 4, 5, 6, 7, 8, 10, 21, 22, 23, 24, 27, 28, 29, 31	6	Possible
MERL	Merlin	<i>Falco columbarius</i>	-	-	S5B	1	A	-	1	4	Possible
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	25	A	-	2, 3, 4, 6, 7, 8, 9, 10, 11, 14, 15, 19, 20, 21, 25, 26, Area Search	7	Possible
NOFL	Northern Flicker	<i>Colaptes auratus</i>	-	-	S5B	2	A	-	3, 18	7	Possible
NOPA	Northern parula	<i>Parula americana</i>	-	-	S5B	2	A	-	2, Area Search	6	Possible



Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group	Breeding Status
OSPR	Osprey	<i>Pandion haliaetus</i>	-	-	S4S5B, S5M	1	A	-	Area Search	4	Possible
OVEN	Ovenbird	<i>Seiurus aurocapilla</i>	-	-	S5B	23	A	-	1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 13, 15, 26, 27, Area Search	6	Possible
PAWA	Palm warbler	<i>Dendroica palmarum</i>	-	-	S5B	9	A	-	4, 22, 23, 24, 25, Area Search	6	Possible
PUFI	Purple finch	<i>Carpodacus purpureus</i>	-	-	S4S5B, S5M, S3S4N,	7	A	-	13, 15, 16, 25, 26, 29, Area Search	6	Possible
REVI	Red-eyed vireo	<i>Vireo olivaceus</i>	-	-	S5B	1	A	-	1	6	Possible
RTHU	Ruby-throated hummingbird	<i>Archilochus colubris</i>	-	-	S5B	2	A	-	19, Area Search	6	Confirmed
RCKI	Ruby-crowned kinglet	<i>Regulus calendula</i>	-	-	S4B, S5M	1	A	-	1	6	Possible
RUGR	Ruffed grouse	<i>Bonasa umbellus</i>	-	-	S5	12	A, 8 J	-	1, 2, 3, 24	7	Confirmed
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	11	A	-	30, Area Search	6	Possible
SWTH	Swainson's thrush	<i>Catharus ustulatus</i>	-	-	S4B, S5M	1	A	-	1	6	Possible
SWSP	Swamp sparrow	<i>Melospiza georgiana</i>	-	-	S5B	3	A	1 M, 1 F	5, 6	6	Probable
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	46	A	1 M, 1 F	1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 22, 24, 25, 27, 28, 29, 30, 31, Area Search	6	Probable
WIWR	Winter wren	<i>Troglodytes troglodytes</i>	-	-	S5B	1	A	-	1	6	Possible
YWAR	Yellow warbler	<i>Dendroica petechia</i>	-	-	S5B	6	A	-	13, 30, Area Search	6	Possible
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	8	A	-	1, 3, 4, 5, 6, 7, 8, 9	6	Possible
-	Unknown	-	-	-	-	1	A	-	19	-	Possible
Total Number of Individuals				632	Total Number of Species (does not include unknowns)						48

Notes: Incidental observations not included (those observed outside of point count locations). A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022). "-" represents no federal or provincial designation. Breeding status qualifiers are defined in the Maritime Breeding Bird Atlas (<http://www.mba-aom.ca/jsp/codes.jsp?lang=en&pg=breeding>). Where multiple observations of breeding evidence were observed, the highest breeding evidence is presented in the table.



Table 3-6: Individual Abundance and Species Abundance - Breeding Bird Surveys

PC Locations	Total # of Individuals	Total Number of Species
1	20	12
2	13	11
3	16	11
4	19	14
5	11	8
6	20	16
7	15	10
8	14	9
9	13	8
10	19	10
11	12	8
12	5	3
13	11	8
14	6	6
15	11	8
16	8	5
17	6	5
18	4	4
19	7	6
20	4	4
21	21	10
22	16	9
23	24	8
24	10	8
25	25	11
26	13	7
27	44	12
28	34	8
29	17	8
30	69	10
31	11	7
Area Search	114	28
Total	632	48*

Notes: Total number of individuals observed include observations that were not able to be identified at the species level. * Total number of unique species observed (does not include unknowns).



3.2.3 Fall Migration Surveys

3.2.3.1 *Point Count (PC) Results*

During fall migration PC surveys, a total of 3,382 individuals representing 61 species were observed.

Seven avian SOCI (arctic tern, boreal chickadee, Canada jay, common tern, sanderling, short-billed dowitcher, and willet; Figure 7, Appendix A) were observed. No avian SAR were observed. Note that American kestrel (S4S5M), greater yellowlegs (S4M), and turkey vulture (S4S5M) were identified but are not considered priority species due to their ACCDC SRank during the migration season. All species, their abundance, and observed PC locations are listed in Table 3-6 and Table 3-7 (below). All avian SAR and SOCI are discussed in Section 3.3.

Shorebirds were the most abundant bird group and comprised 53.8% of the species observed. Passerines were the second most abundant bird group and comprised 41.3% of the species observed, followed by waterfowl (2.2%), other landbirds (1.98%), diurnal raptors (0.4%), other waterbirds (0.1%), and nocturnal raptors (0.06%). Unknown species that were able to be identified to a bird group are included in these percentages. Herring gull (n=1,517) was the most abundant species observed, followed by black-capped chickadee (n=186), American crow (n=178), and yellow-rumped warbler (n=169). All the species identified are native species in this region of Nova Scotia and the province in general. Typical and common habitat to support these species is present within the Project Area and surrounding landscape.

PC 47 (Figure 2, Appendix A) had the highest diversity and individual count with 24 species observed and 561 individuals. This PC was on the coastline where various flocks of shorebirds and seabirds were observed that resulted in a high individual count (e.g., herring gull, great black-backed gull, sanderling, short-billed dowitcher, etc.). PC 47 also had a variety of habitat including open ocean off the coast, saltmarsh, barren/heathland with high shrub cover, and forested habitats located behind the PC location. This diversity of habitat would attract a variety of shorebirds, waterfowl, passerines, raptors, and more.

PC 11 had the second highest diversity with 18 species and 83 individuals observed. This PC was located halfway across the peninsula in a barren/heathland area with shrub cover, surrounded by forested habitat. Overall, a higher number of individuals observed were in the southern-most PCs (PCs 1-10). A high number of fly-overs and flocks were observed at these locations, leading to a higher number of individuals observed. All species, their abundance, and observed PC locations, are listed in Table 3-6 and Table 3-7. All avian SAR and SOCI are discussed in Section 3.3.

During the fall migration surveys, a higher number of flocks were observed amongst the fly-over recordings. Gulls, consisting mainly of herring gulls and great black-backed gulls, were the most



common fly-over species recorded (flocks ranging from 10-179 individuals). During both spring and fall migration periods, it was evident that there is a large gull population in the area. Flocks of shorebirds were also observed moving around the Project Area, ranging from 8-20 individuals (e.g., willet, greater yellowlegs, sanderling, and short-billed dowitcher). Flocks of American robin (groups of 5-55 individuals) and yellow-rumped warbler (groups of 5-30 individuals) were observed in the southern part of the Project Area, indicating migration behaviour for the passerine group. One flock of 50 common grackle was also observed. Surveyors specifically noted that groups of American robins were observed close to the coastline, which could indicate passerines using the coast as a streamlined way to migrate. The most common fly-over direction was across the peninsula (east to west and vice-versa), although a high number of fly-overs were recorded heading south as well. This was similar behaviour to what was recorded during the spring migration and breeding season. Across all seasons (spring/fall migration and breeding), it was evident during the field surveys that a higher number of fly-overs occur over the peninsula (i.e., flyovers were identified at the PCs south of Black Pond Road; Figure 2, Appendix A). The farther south on the peninsula, the higher number of fly-overs were recorded. Overall, passerines and gull species were observed flying at or below 100 m. Raptors were observed flying between 35-100 m. The analysis, including statistics, of fly-overs observed during fall migration PC surveys is included below.

During fall migration surveys 203 fly-overs were observed (55 of which were passerines (group 6) and other landbirds (group 7) and 148 of which were shorebirds (group 2) and diurnal raptors (group 4)). Out of the 203 fly-overs observed, only 10 were above 100 m in height (diurnal raptors, shorebirds, and one American crow) and 193 were under 100 m. Approximately 60% of all fly-overs were flying east/west and 40% were flying north/south. Most fly-overs were observed farther south on the peninsula (77% - which includes all PCs except PCs 22-41; Figure 2, Appendix A). Approximately 46% of fly-overs were observed at the southern-most PCs (PCs 1-10).

Breeding evidence was observed during the first round of fall migration surveys and includes:

- A pair of common yellowthroat (also agitated behaviour during multiple common yellowthroat observations) and yellow-rumped warbler was observed.
- A suspected pileated woodpecker (*Dryocopus pileatus*) nest was observed at PC 30, which is located within the Project Area and not the Project footprint. The nest was not active but looked to be recently used, perhaps during the breeding season.

3.2.3.2 Diurnal Watch Count (DWC) Results

During diurnal watch count (DWC) surveys that occurred during the fall migration season, a total of 6,211 individuals representing 50 species were observed.

Six avian SOCI (black-bellied plover, Canada jay, common eider, common tern, purple sandpiper, and willet; Table 3-8; Figure 7, Appendix A) were observed during these surveys. No avian SAR



were identified. Note that American bittern (S4S5M), American kestrel (S4S5M), greater yellowlegs (S4M), least sandpiper (S4M), semipalmated plover (S4M), and turkey vulture (S4S5M) were observed but are not considered priority species due to their ACCDC SRank during the migration season. All species, their abundance, and observed DWC locations are listed in Table 3-8 (below). All avian SAR and SOCI are discussed in Section 3.3.

Surveyors observed 20 species at DWC 1 (212 individuals), 39 species (does not include the unknown hawk) at DWC 2 (811 individuals), and 26 species at DWC 3 (5,188 individuals). DWC 1 was located at an existing turbine and had forested habitat surrounding the location. Higher species diversity was observed at DWC 2 and 3 due to a variety of habitat, including forested habitat and coastline, open ocean, and saltmarsh (at DWC 2). Open water habitat and coastline allows for abundances of shorebirds and other waterbirds to roost, forage, and gather before migration. Refer to Figure 2, Appendix A for PC references.

Shorebirds comprised 87.3% (mostly herring gull) of the species observed due to the two coastal DWCs and the flocks and fly-overs observed, followed by passerines (7.7%), waterfowl (3.5%), diurnal raptors (0.8%), other waterbirds (0.4%), and other landbirds (0.2%). Unknown species that were able to be identified to a bird group are included in these percentages. Herring gull (n=4,694) was the most abundant species observed, followed by great black-backed gull (n=429), American black duck (n=168), European starling (n=150), and black-bellied plover (n=150). These high counts of individuals are due to flocks observed during these surveys. Results are recorded in Table 3-8. Two of the DWCs are along coastline and the high abundances of shorebirds and waterfowl are expected due to the flocks observed, similar to what was observed during spring migration DWC surveys. All the species identified, except for the European starling, are native species in this region of Nova Scotia and the province in general. Typical and common habitat to support these species are present within the Project Area and surrounding landscape.

During the fall migration DWCs, no distinct migration corridors or patterns were noted by surveyors within the Project Area. Overall, the same behaviour from spring migration and breeding bird seasons was noted (e.g., shorebirds flying across the Project Area peninsula or up and down the coastline to various feeding areas). DWC 2 and 3, the coastal DWCs, had the highest number of fly-overs. There was potential migration behaviour based on the higher number of flocks observed during the fall migration period. Flocks were observed throughout all rounds of fall migration and higher numbers of flocks of shorebirds and passerines were observed near the end of the season. The analysis, including statistics, of fly-overs observed during fall migration DWC surveys is included below.

Herring gulls were the species of highest abundance observed during the DWCs, mainly due to the large number of flocks observed at the coast (e.g., 4300 observed at DWC 3). A high number of flocks were observed for herring gulls, ranging from 5-2000 individuals. Flocks of 5-300 great black-backed gulls were often observed separate or combined with herring gull flocks. Flocks of



various types of shorebirds and waterfowl species were also observed: American black duck (6-60 individuals), black-bellied plover (50-100 individuals), semipalmated plover (25 individuals), greater yellowlegs (6 individuals), American goldfinch (21 individuals), and European starling (50-100 individuals). Most flocks of shorebirds observed were flying or foraging along the coast on the various mudflats or saltmarshes, likely depending on the tidal cycle. Common eider females were observed during round 2 with juveniles, giving this species a confirmed breeding status into the fall migration season as well.

Gull species (herring gull and great black-backed gull) had the highest number of fly-overs recorded. Shorebirds were recorded flying at heights of 100 m or below (only 2 instances of herring gulls flying above 100 m). All waterfowl and other waterbirds were observed flying at or below 100 m. Passerines were observed flying at or below 50 m. Raptors were observed flying between 50-100 m (only 4 instances of raptors flying above 100 m). At DWC 1, it was noted that turkey vultures flying at the height of the turbine blades were flying around the wind turbine and did not approach it.

During fall migration diurnal watch count (DWC) surveys 161 fly-overs were observed (27 of which were passerines (group 6) and other landbirds (group 7) and 134 of which were shorebirds (group 2), waterfowl (group 1), and diurnal raptors (group 4)). Out of the 161 fly-overs observed, only 3 were above 100 m in height (turkey vulture, broad-winged hawk, and herring gull) and only 11 were at 100 m in height (bald eagle, turkey vulture, herring gull, double-crested cormorant, and American black duck). Out of 161 fly-overs, 147 were under 100 m in height. Approximately 41% of all fly-overs were flying east/west and 59% were flying north/south. Most fly-overs were observed at DWCs 2 and 3, which are farther south on the peninsula (only 39 fly-overs were observed farther north at DWC 1, 28 of which were flying east/west or south; Figure 2, Appendix A).

3.2.3.3 *Fall Migration Summary*

Throughout the PC and DWC fall migration surveys, surveyors recorded similar observations to spring migration surveys. No migration patterns were recorded within the Project Area and only along the coast.

Observations were made that indicate passerines are using the coastline, especially barrens/heathlands and saltmarsh habitat, to streamline migration process (i.e., large groups of American robin (5-55 individuals) closer to coast during fall migration surveys).

A high abundance of fly-overs were observed on the mid to southern portions of the Project Area (birds flying across, west to east, and vice-versa). While completing various DWC surveys at the turbine location (DWC 1), surveyors noted that birds appear to fly around and avoid the existing turbine (passerines) or at heights far above the turbine (greater than 150 m; common for gulls and



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raptors). During all the surveys at DWC 1 (during all seasons), no bird mortalities were observed during DWC and it is important to note that mortality surveys were not conducted.

No colonies were observed during fall migration in the Project Area, however, habitat in the surrounding area is ideal for overwintering birds (e.g., open water that will not completely freeze over). Canada geese (*Branta canadensis*) and greater scaup (*Aythya marila*) are known to stage by the thousands on the tidal/mudflats over the winter (August 2022, pers. comm. with MEL, Melvin Pothier, MEL contractor – local bird surveyor). High abundances of common loon (*Gavia immer*) and common eider (*Somateria mollissima*) are also observed in Goose Bay throughout the winter (August 2022, pers. comm. with MEL, Melvin Pothier, MEL contractor – local bird surveyor).



Table 3-7: Individual Abundance and Species of Birds Observed During Fall Migration Surveys

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group
ARTE	Arctic tern	<i>Sterna paradisaea</i>	-	-	S3B	2	A	-	47	2
BOCH	Boreal chickadee	<i>Poecile hudsonica</i>	-	-	S3	1	A	-	7	6
CAJA	Canada jay	<i>Perisoreus canadensis</i>	-	-	S3	17	A	-	11, 13, 21, 24, 26, 28, 44, 45	6
COTE	Common tern	<i>Sterna hirundo</i>	-	-	S3B	2	A	-	47	2
SAND	Sanderling	<i>Calidris alba</i>	-	-	S2N, S3M	40	A	-	47	2
SBDO	Short-billed dowitcher	<i>Limnodromus griseus</i>	-	-	S3M	30	A	-	47	2
WILL	Willet	<i>Tringa semipalmata</i>	-	-	S3B	35	A	-	4, 21, 47	2
ALFL	Alder flycatcher	<i>Empidonax alnorum</i>	-	-	S5B	4	A	-	10, 21, 47	6
ABDU	American black duck	<i>Anas rubripes</i>	-	-	S5B, S5N	68	A	-	38, 47	1
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	178	A	-	All PCs except 5, 30	6
AMGO	American goldfinch	<i>Carduelis tristis</i>	-	-	S5	32	A	-	1, 3, 4, 6, 11, 20, 21, 24, 27, 29, 30, 46, 47	6
AMKE	American kestrel	<i>Falco sparverius</i>	-	-	S3B, S4S5M	3	A	-	8, 9, 10	4
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	166	A	-	2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 22, 23, 24, 25, 26, 27, 31, 34, 35, 37, 39, 41, 44, 45, 47, 48	6
BDOW	Barred owl	<i>Strix varia</i>	-	-	S5	1	A	-	35	5
BTBW	Black-throated blue warbler	<i>Setophaga caerulescens</i>	-	-	S5B	3	A	-	6, 7	6
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	16	A	-	6, 7, 11, 12, 23, 34, 36, 39, 40, 45, 48	6
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	186	A	-	All PCs except 1, 2, 3, 20, 33, 42	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	166	A	-	All PCs except 5, 7, 30	6
BWHA	Broad-winged hawk	<i>Buteo platypterus</i>	-	-	S5B	5	A	-	9, 42	4
BRCR	Brown creeper	<i>Certhia americana</i>	-	-	S5	2	A	-	19, 35	6
CEDW	Cedar waxwing	<i>Bombycilla cedrorum</i>	-	-	S5B	44	A	-	1, 2, 3, 6, 9, 10, 11, 12, 13, 22, 24, 28, 29, 34, 38, 39, 42, 45	6
COGR	Common grackle	<i>Quiscalus quiscula</i>	-	-	S5B	50	A	-	10	6
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	1	A	-	1	3
CORA	Common raven	<i>Corvus corax</i>	-	-	S5	15	A	-	11, 12, 21, 22, 23, 24, 27, 31, 48	6
COYE	Common yellowthroat	<i>Geothlypis trichas</i>	-	-	S5B	104	A	-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 19, 20, 21, 26, 28, 30, 32, 33, 34, 38, 45, 46, 47, 48	6
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	-	-	S4S5	29	A	-	22, 25, 27, 30, 32, 35, 36, 44, 45, 47	6
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	17	A	-	9, 10, 47	2
DOWO	Downy woodpecker	<i>Dryobates pubescens</i>	-	-	S5	2	A	-	4, 23	7
GCKI	Golden-crowned kinglet	<i>Regulus satrapa</i>	-	-	S5	21	A	-	6, 7, 33, 35, 36, 37, 38, 39, 48	6
GRCA	Gray catbird	<i>Dumetella carolinensis</i>	-	-	S4B	3	A	-	8, 32	6
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	45	A	-	1, 3, 4, 5, 6, 9, 21, 26, 47	2
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	4	A	-	40, 47	3
GHOW	Great horned owl	<i>Bubo virginatus</i>	-	-	S4	1	A	-	38	5
GRYE	Greater yellowlegs	<i>Tringa melanoleuca</i>	-	-	S3B, S4M	10	A	-	5, 43, 47	2



Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	PC Observations	Group
GWTE	Green-winged teal	<i>Anas crecca</i>	-	-	S4S5B, S5M	4	A	-	38	1
HAWO	Hairy woodpecker	<i>Picoides villosus</i>	-	-	S5	8	A	-	13, 23, 27, 28, 29, 34, 45	7
HETH	Hermit thrush	<i>Catharus guttatus</i>	-	-	S5B	24	A	-	2, 7, 8, 11, 12, 19, 22, 23, 26, 28, 29, 30, 31, 40, 45, 48	6
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	1517	A	-	All PCs except 28, 31, 33	2
ICGU	Iceland gull	<i>Larus glaucooides</i>	-	-	S4N	1	A	-	47	2
MAWA	Magnolia warbler	<i>Dendroica magnolia</i>	-	-	S5B	1	A	-	4	6
MALL	Mallard	<i>Anas platyrhynchos</i>	-	-	S5B, S5N	3	A	-	28	1
MERL	Merlin	<i>Falco columbarius</i>	-	-	S5B	1	A	-	38	4
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	23	A	-	1, 5, 11, 13, 19, 23, 25, 26, 27, 28, 30, 37, 38, 41, 42, 43, 44, 45	7
NAWA	Nashville warbler	<i>Vermivora ruficapilla</i>	-	-	S4B, S5M	6	A, 1 J	-	13, 20, 28, 47, 48	6
NOFL	Northern flicker	<i>Colaptes auratus</i>	-	-	S5B	25	A	-	1, 12, 19, 22, 24, 25, 26, 29, 31, 33, 34, 35, 38, 41, 43, 44, 45, 48	7
NOHA	Northern harrier	<i>Circus hudsonius</i>	-	-	S4B, S4S5M	2	A	-	5, 38	4
NOPA	Northern parula	<i>Parula americana</i>	-	-	S5B	1	A	-	26	6
PAWA	Palm warbler	<i>Dendroica palmarum</i>	-	-	S5B	23	A	-	4, 7, 10, 11, 22, 29, 30, 31, 32, 33, 36, 37, 38, 39, 42, 43	6
RBNU	Red-breasted nuthatch	<i>Sitta canadensis</i>	-	-	S4S5	46	A	-	3, 11, 12, 13, 19, 20, 21, 23, 24, 25, 26, 28, 29, 31, 32, 36, 37, 40, 44, 45, 46	6
REVI	Red-eyed vireo	<i>Vireo olivaceus</i>	-	-	S5B	2	A	-	32, 41	6
RBGU	Ring-billed gull	<i>Larus delawarensis</i>	-	-	SUB, S5N	11	A	-	12, 23, 26, 27, 31, 47	2
RIPH	Ring-necked pheasant	<i>Phasianus colchicus</i>	-	-	SNA	1	A	-	30	7
RTHU	Ruby-throated hummingbird	<i>Archilochus colubris</i>	-	-	S5B	6	A	-	3, 5, 7, 8, 36, 40	6
RCKI	Ruby-crowned kinglet	<i>Regulus calendula</i>	-	-	S4B, S5M	1	A	-	13	6
RUGR	Ruffed grouse	<i>Bonasa umbellus</i>	-	-	S5	8	A	-	7, 29, 30, 35, 37	7
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	13	A	-	12, 21, 22, 23, 25, 27, 28, 31, 45, 47	6
SWSP	Swamp sparrow	<i>Melospiza georgiana</i>	-	-	S5B	10	A	-	5, 11, 13, 21, 32, 46, 47	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	4	A	-	10, 11, 43	4
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	58	A	-	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 20, 22, 23, 25, 31, 33, 34, 38, 41, 42, 43, 45, 46, 48	6
WIWR	Winter wren	<i>Troglodytes troglodytes</i>	-	-	S5B	1	A	-	35	6
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	169	A, 2 J	1 F	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 25, 28, 29, 32, 33, 34, 35, 38, 40, 41, 42, 43, 44, 46, 48	6
-	Unknown gull*	-	-	-	-	100	A	-	47	2
-	Unknown sandpiper	-	-	-	-	10	A	-	47	2
Total Number of Individuals				3,382	Total Number of Species (does not include unknowns)					61
					*Unknown gulls – likely a mix of HERG and GBBG					

Notes: Incidental observations not included (those observed outside of point count locations). A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022). “-” represents no federal or provincial designation.



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Table 3-8: Individual Abundance and Species Abundance by PC - Fall Migration Surveys

PC Locations	Total # of Individuals	Total Number of Species
1	182	12
2	225	9
3	264	12
4	231	14
5	103	11
6	114	13
7	51	14
8	113	12
9	119	13
10	146	15
11	83	18
12	79	16
13	41	14
19	27	10
20	25	8
21	71	14
22	35	13
23	32	15
24	39	11
25	38	12
26	86	14
27	28	12
28	27	14
29	23	13
30	22	10
31	21	12
32	23	12
33	15	8
34	22	12
35	32	13
36	25	10
37	26	10
38	98	17
39	22	9
40	40	10
41	26	10
42	18	9
43	37	11
44	45	11
45	65	17
46	37	10
47	561	24
48	65	14
Total	3382	61*



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*Notes: Total number of individuals observed include observations that were not able to be identified at the species level. * Total number of unique species observed (does not include unknowns).*



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Table 3-9: Individual Abundance and Species of Birds Observed During DWC Surveys (Fall Migration)

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	DWC Observations	Group
BBPL	Black-bellied plover	<i>Pluvialis squatarola</i>	-	-	S3M	150	A	-	DWC 2, 3	2
CAJA	Canada jay	<i>Perisoreus canadensis</i>	-	-	S3	1	A	-	DWC 2	6
COEI	Common eider	<i>Somateria mollissima</i>	-	-	S3B, S3M, S3N	45	A, J	-	DWC 2, 3	1
COTE	Common tern	<i>Sterna hirundo</i>	-	-	S3B	12	A	-	DWC 2, 3	2
PUSA	Purple sandpiper	<i>Calidris maritima</i>	-	-	S3S4N	1	A	-	DWC 2	2
WILL	Willet	<i>Tringa semipalmata</i>	-	-	S3B	8	A	-	DWC 2	2
ABDU	American black duck	<i>Anas rubripes</i>	-	-	S5B, S5N	168	A	-	DWC 2, 3	1
AMBI	American bittern	<i>Botaurus lentiginosus</i>	-	-	S3S4B, S4S5M	1	A	-	DWC 2	3
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	133	A	-	DWC 1, 2, 3	6
AMGO	American goldfinch	<i>Carduelis tristis</i>	-	-	S5	40	A	-	DWC 1, 2, 3	6
AMKE	American kestrel	<i>Falco sparverius</i>	-	-	S3B, S4S5M	1	A	-	DWC 2	4
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	14	A	-	DWC 1, 2, 3	6
AMWO	American woodcock	<i>Scolopax minor</i>	-	-	S5B	1	A	-	DWC 2	2
BAEA	Bald eagle	<i>Haliaeetus leucocephalus</i>	-	-	S5	3	A	-	DWC 2	4
BEKI	Belted kingfisher	<i>Megaceryle alcyon</i>	-	-	S4S5B	9	A	-	DWC 2, 3	3
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	1	A	-	DWC 1	6
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	36	A	-	DWC 1, 2, 3	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	36	A	-	DWC 1, 2, 3	6
BOWA	Bohemian waxwing	<i>Bombycilla garrulus</i>	-	-	S4N	2	A	-	DWC 1	6
BWHA	Broad-winged hawk	<i>Buteo platypterus</i>	-	-	S5B	8	A	-	DWC 2	4
CEDW	Cedar waxwing	<i>Bombycilla cedrorum</i>	-	-	S5B	9	A	-	DWC 1, 2	6



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	DWC Observations	Group
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	1	A	-	DWC 2	3
CORA	Common raven	<i>Corvus corax</i>	-	-	S5	3	A	-	DWC 2	6
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	-	-	S4S5	3	A	-	DWC 1	6
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	68	A	-	DWC 2, 3	2
EUST	European starling	<i>Sturnus vulgaris</i>	-	-	SNA	150	A	-	DWC 3	6
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	429	A	-	DWC 1, 2, 3	2
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	16	A	-	DWC 2, 3	3
GRYE	Greater yellowlegs	<i>Tringa melanoleuca</i>	-	-	S3B, S4M	16	A	-	DWC 2, 3	2
HAWO	Hairy woodpecker	<i>Picoides villosus</i>	-	-	S5	1	A	-	DWC 2	7
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	4,694	A	-	DWC 1, 2, 3	2
LESA	Least sandpiper	<i>Calidris minutilla</i>	-	-	S1B, S4M	1	A	-	DWC 2	2
LBBG	Lesser black-backed gull	<i>Larus fuscus</i>	-	-	SNA	5	A	-	DWC 1, 2	2
MALL	Mallard	<i>Anas platyrhynchos</i>	-	-	S5B, S5N	6	A	-	DWC 2, 3	1
MERL	Merlin	<i>Falco columbarius</i>	-	-	S5B	1	A	-	DWC 2	4
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	5	A	-	DWC 1, 3	7
NOFL	Northern Flicker	<i>Colaptes auratus</i>	-	-	S5B	5	A	-	DWC 2, 3	7
NOHA	Northern harrier	<i>Circus hudsonius</i>	-	-	S4B, S4S5M	3	A	-	DWC 2, 3	4
OSPR	Osprey	<i>Pandion haliaetus</i>	-	-	S4S5B, S5M	3	A	-	DWC 1, 2	4
PAWA	Palm warbler	<i>Dendroica palmarum</i>	-	-	S5B	1	A	-	DWC 3	6
PUFI	Purple finch	<i>Carpodacus purpureus</i>	-	-	S4S5B, S3S4N, S5M	1	A	-	DWC 1	6
RBGU	Ring-billed gull	<i>Larus delawarensis</i>	-	-	SUB, S5N	12	A	-	DWC 1, 2	2
RIPH	Ring-necked pheasant	<i>Phasianus colchicus</i>	-	-	SNA	1	A	-	DWC 3	7
SAVS	Savannah sparrow	<i>Passerculus sandwichensis</i>	-	-	S4S5B, S5M	10	A	-	DWC 3	6
SEPL	Semipalmated plover	<i>Charadrius semipalmatus</i>	-	-	S1B, S4M	27	A	-	DWC 2	2



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	DWC Observations	Group
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	19	A	-	DWC 1, 2, 3	6
TRES	Tree swallow	<i>Tachycineta bicolor</i>	-	-	S4B	4	A	-	DWC 2	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	31	A	-	DWC 1, 2, 3	4
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	2	A	-	DWC 1	6
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	13	A	-	DWC 1, 3	6
-	Unknown hawk	-	-	-	-	1	A	-	DWC 2	4
Total Number of Individuals				6,211	Total Number of Species (does not include unknowns)				50	

Notes: Incidental observations not included (those observed outside of point count locations). A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022). "-" represents no federal or provincial designation.



3.2.4 Nightjar Surveys

No common nighthawks or Eastern whip-poor-will were observed during the targeted surveys. Other birds observed will be included in the incidentals section (Section 3.2.7).

As discussed in Section 2.3.3, the Project Area does not have an abundance of suitable habitat for the common nighthawk and does have suitable habitat for the Eastern whip-poor-will. Examples of suitable habitat for common nighthawk include open bogs, grasslands, barren areas with low shrub cover, clear-cut areas, or other disturbed areas (COSEWIC 2018). Examples of suitable habitat for Easter whip-poor-will include shrubbed wetlands, clearcuts, agricultural fields rock or sand barrens with scattered trees, savannahs, burned areas, conifer plantations, and various types of forests at early stages of succession or edges of dense forests with similar ground-level structure. This species is found in habitat with moderate tree, shrub, and herbaceous cover (ECCC 2018b).

3.2.5 Nocturnal Owl Surveys

Two owl species, consisting of eight individuals, were observed during the surveys in 2022. The species observed during the surveys were northern saw-whet owl (*Aegolius acadicus*) and great horned owl (*Bubo virginianus*). The Northern saw-whet owl had the highest abundance with five individuals. There were no SAR or SOCI bird observations during the nocturnal owl surveys. Other birds observed will be included in the incidentals section (Section 3.2.7).

All owls recorded were auditory observations at distances of approximately 100-450 m from the surveyor. Great horned owls were detected during two different surveys rounds at Owl 2 PC location and Northern saw-whet owls were detected during two different surveys rounds at Owl 1 and 2 PC locations (May 1st and May 24th). Refer to Figure 5, Appendix A for Owl PC locations.

There are patches of mature coniferous and mixedwood forests around all three Owl PC locations, which provide appropriate breeding habitat (Takats *et al.* 2001). Both owl species observed can be designated as possible breeders due to observing them and hearing them in appropriate habitat during the breeding season.

Table 3-9 lists the results of the nocturnal owl surveys. Gulls, likely a variety of species, were heard at Owl 3 PC location during two different survey rounds. The number of individuals was not recorded for this observation and therefore not included as an incidental observation.

Table 3-10: Nocturnal Owl Survey Results

Code	Common Name	Scientific Name	SRank	#	Point Count Observations	Group
GHOW	Great horned owl	<i>Bubo virginatus</i>	S4	3	2, 3	5
NSWO	Northern saw-whet owl	<i>Aegolius acadicus</i>	S4B	5	1, 2	5
Total Species		2	Total Individuals		8	



Notes: Incidental observations not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. No observations of age or sex were recorded. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022).

3.2.6 Waterfowl Surveys

Note that waterfowl, shorebirds, and other waterbirds (groups 1-3) will be included in the results of this section. Other birds observed (in groups 4-6) will be included in the incidentals section (Section 3.2.7).

3.2.6.1 *Spring Migration*

Waterfowl surveys were completed during the spring migration, breeding bird and fall migration seasons (Table 3-10). During spring migration waterfowl surveys at Goose Lake, all large flocks observed were herring gulls (ranging between 15-60 individuals) and one flock of great black-backed gull (16 individuals). No migration patterns were observed.

The highest percentage (61.5%) of fly-overs recorded were gull species (herring and great black-backed gulls), most of which were flying at approximately 50 m above ground level (incidental fly-overs for bird groups 4-6 are included in this calculation). No priority species were observed during spring migration season waterfowl surveys. In total, 333 individuals representing 5 species were observed during spring migration surveys (169 of which were herring gull and 124 of which were unknown gulls).

3.2.6.2 *Breeding Bird*

During the breeding bird waterfowl surveys (when the Black Pond location was added) there were 110 individuals representing 8 species: 5 species and 15 individuals were only observed at Goose Lake and 95 individuals representing 3 species were observed at both Black Pond and Goose Lake. No migratory patterns were observed during waterfowl surveys during the breeding season.

Goose Lake had the highest species abundance and number of individuals (8 species, 107 individuals at Goose Lake and 3 species, 3 individuals at Black Pond). Goose Lake is larger than Black Pond and provides habitat for flocks to gather and it is surrounded by forest that gives protection for waterfowl during the breeding season (e.g., common loon with juveniles were recorded). A higher number of gulls were observed at Goose Lake and the largest flocks observed were at Goose Lake and consisted of herring gulls varying from 15-20 individuals. Black Pond is smaller, but it is surrounded by forest and has a fen wetland type bordering the outside of the pond. This habitat would attract various sorts of waterfowl, shorebirds, and passerines as seen in the survey results. Two SOCI were observed during the breeding season at Goose Lake: common tern



and spotted sandpiper (Table 3-10; Figure 7, Appendix A). There was breeding evidence observed during waterfowl surveys conducted during breeding season. Common loons were observed with recent juveniles at Goose Lake (3 juveniles total). This gives this species confirmed breeding status. Refer to Figure 6, Appendix A for waterfowl survey location references.

3.2.6.3 *Fall Migration*

Flocks of various species of birds were recorded during fall migration waterfowl surveys but no specific migration corridor or path was observed.

During the fall migration waterfowl surveys there were 1139 individuals representing 12 species: Black Pond had 235 individuals and 4 species observed and Goose Lake had 904 individuals and 10 species observed. American black duck and herring gull were the only two species observed at both locations. Three SOCI were observed during the fall migration season at Goose Lake: black-bellied plover, semipalmated sandpiper, and short-billed dowitcher (Table 3-10; Figure 7, Appendix A). Goose Lake had a higher individual and species count compared to Black Pond, similar to what was observed during the breeding season. The highest abundance of birds observed were herring gulls, with the most being in flocks observed at Goose Lake (393 herring gulls at Goose Lake). This is also similar to what was observed during the breeding season. Note that semipalmated plover (S4M) and spotted sandpiper (S5M) were observed but are not considered priority species due to their ACCDC SRank during the migration season. Common loon would be considered to have confirmed breeding status due to two adults and one juvenile observed at Goose Lake, however, it is possible that this is the same one observed during the breeding season.

The highest number of flocks were gulls and shorebirds recorded at Goose Lake. Flocks of 6-100 herring gulls (all at Goose Lake, except one flock of 15 at Black Pond) and one flock of 20 great black-backed gulls was observed at Goose Lake. During round 1 at Goose Lake, an observation of a mixed flock of shorebirds was observed roosting: 35 semipalmated plovers, 10 semipalmated sandpiper, 300 black-bellied plover, and 25 short-billed dowitcher. Most flocks observed during the waterfowl surveys were roosting or foraging at Goose Lake or Black Pond. Flocks of 8-100 American black duck were observed in both locations (2 flocks at Goose Lake and 3 at Black Pond). Black Pond is sheltered by forest and provides safety for waterfowl flocks. Multiple flocks of 10-21 green-winged teal were observed at Black Pond (Figure 6, Appendix A). The only potential migratory behaviour observed during the waterfowl surveys was a flock of 150 common grackles flying south over Black Pond during the fall migration season (included in the incidental section, Section 3.2.7). Overall, waterfowl species flew below 50 m, gulls flew under 100 m (under 60 m on average), raptors flew at or below 100 m, and passerines flew at or below 50 m. This is similar to what was observed during spring migration and breeding season. During spring migration, all fly-overs during the waterfowl surveys were at 100 m or under. This is the same as the breeding season, except for one observation of a turkey vulture flying above 100 m. The analysis, including statistics, of fly-overs observed during waterfowl surveys is included below.



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During waterfowl surveys 74 fly-overs were observed across all three seasons (spring/fall migration and breeding bird). Out of these 72 fly-overs, 16 were passerines (group 6) and other landbirds (group 7) and 58 were shorebirds (group 2), diurnal raptors (group 4), waterfowl (group 1), and great blue heron. Note that this fly-over analysis includes bird groups 1-6 (including bird groups 4-6, which were considered incidentals during the waterfowl surveys). Out of the 74 fly-overs observed, 64 were below 100 m in height (only turkey vulture was observed above 100 m and 9 fly-overs were at 100 m in height: great blue heron, gulls, and diurnal raptors). Approximately 49% of all fly-overs were flying east/west and 51% were flying north/south.

Throughout all seasons, spring/fall migration and breeding season, the fall migration season had the highest species diversity and individuals observed with 12 species and 1139 individuals. During breeding and migration seasons, a variety of bird species would be using both locations for breeding and foraging and flocks of birds would use these locations for roosting and foraging. A total of 1582 individuals and 15 species were observed across all waterfowl surveys during all seasons. Overall, more bird observations occurred at Goose Lake. The higher number of individuals and species can be attributed to the larger size of this water body and the number of flocks observed at Goose Lake.

Shorebirds comprised 77.4% of the species observed across all seasons of waterfowl surveys, followed by waterfowl (20.7%; most of them American black duck), and other waterbirds (2%). Herring gull (n=657) was the most abundant species observed, followed by black-bellied plover (one flock of n=300), and American black duck (n=273). Overall, gull species (e.g., herring gull and great black-backed gull) were the most common species observed with 848 individuals across all seasons, most of which were part of flocks observed at Goose Lake.



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Table 3-11: Waterfowl Survey Results

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Location	Group
Spring Migration Season										
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	6	A	-	Goose Lake	3
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	1	A	-	Goose Lake	2
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	23	A	-	Goose Lake	2
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	4	A	-	Goose Lake	3
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	169	A	-	Goose Lake	2
-	Unknown duck	-	-	-	-	6	A	-	Goose Lake	1
-	Unknown gull*	-	-	-	-	124	A	-	Goose Lake	2
Total Number of Individuals for Spring Migration				333	Total Number of Species for Spring Migration (does not include unknowns)					5
					*Unknown gulls – likely a mix of HERG and GBBG					
Breeding Bird Season										
COTE	Common tern	<i>Sterna hirundo</i>	-	-	S3B	1	A	-	Goose Lake	2
SPSA	Spotted sandpiper	<i>Actitis macularius</i>	-	-	S3S4B, S5M	1	A	-	Goose Lake	2
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	10	A, 3 J	-	Goose Lake	3
DCCO	Double-crested cormorant	<i>Nannopterum auritum</i>	-	-	S5B	2	A	-	Goose Lake	2
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	15	A	-	Goose Lake, Black Pond	2
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	5	A	-	Goose Lake, Black Pond	3
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	75	A	-	Goose Lake, Black Pond	2
MALL	Mallard	<i>Anas platyrhynchos</i>	-	-	S5B, S5N	1	A	1 F	Goose Lake	1
Total Number of Individuals Observed for Breeding Bird				110	Total Number of Species Observed for Breeding Bird					8
Fall Migration Season										
BBPL	Black-bellied plover	<i>Pluvialis squatarola</i>	-	-	S3M	300	A	-	Goose Lake	2
SESA	Semipalmated sandpiper	<i>Calidris pusilla</i>	-	-	S3M	10	A	-	Goose Lake	2



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Location	Group
SBDO	Short-billed dowitcher	<i>Limnodromus griseus</i>	-	-	S3M	25	A	-	Goose Lake	2
ABDU	American black duck	<i>Anas rubripes</i>	-	-	S5B, S5N	273	A	-	Goose Lake, Black Pond	1
BEKI	Belted kingfisher	<i>Megaceryle alcyon</i>	-	-	S4S5B	1	A	-	Goose Lake	3
COLO	Common loon	<i>Gavia immer</i>	-	-	S4B	5	A, 1 J	-	Goose Lake	3
GBBG	Great black-backed gull	<i>Larus marinus</i>	-	-	S4S5	29	A	-	Goose Lake	2
GWTE	Green-winged teal	<i>Anas crecca</i>	-	-	S4S5B, S5M	46	A	-	Black Pond	1
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	413	A	-	Goose Lake, Black Pond	2
MALL	Mallard	<i>Anas platyrhynchos</i>	-	-	S5B, S5N	1	A	-	Black Pond	1
SEPL	Semipalmated plover	<i>Charadrius semipalmatus</i>	-	-	S1B, S4M	35	A	-	Goose Lake	2
SPSA	Spotted sandpiper	<i>Actitis macularius</i>	-	-	S3S4B, S5M	1	A	-	Goose Lake	2
Total Number of Individuals for Fall Migration				1139	Total Number of Species for Fall Migration					12

Notes: Incidental observations not included (those observed outside of point count locations). A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022). “-” represents no federal or provincial designation.



3.2.7 Incidentals

Incidental observations include those made during dedicated bird surveys (i.e., observation outside of point count time or survey location) and those made during non-bird related surveys (e.g., wetland delineation). No incidental observations were made during dedicated bird surveys. Table 3-11 summarizes incidental bird observations.

Across all three seasons (spring/fall migration and breeding bird), 48 species and 447 individuals were observed incidentally during various non-bird related biophysical surveys across the Project Area. Passerines was the most abundant bird group with 361 individuals (80.8% of individuals). Breeding bird season had the highest species abundance (36 species) and fall migration season had the highest individual count (251 individuals; 150 of which was a flock of common grackles). Four avian SOCI (American kestrel, Nelson’s sparrow, turkey vulture, and willet; Table 3-11; Figure 7, Appendix A) were observed incidentally. No avian SAR were observed. All avian SAR and SOCI are discussed in Section 3.3. Out of all incidentals, only the spruce grouse was a novel species (e.g., not observed during any other surveys). The turkey vulture was not considered a priority species during the spring and fall migration surveys due its SRank during the migration season (S4S5M).

The Northern harrier observed during wetland delineation surveys was at the radar location (refer to the radar technical report). The spruce grouse observed during early botany surveys (early June, 2022) was an adult female with 4 downy feathered chicks. This observation gives this species confirmed breeding status (MBBA, n.d.). This observation was on an ATV trail near the coast and close to PC 30 for breeding bird surveys (Figure 3, Appendix A) or PC 47 for spring and fall migration surveys (Figure 2, Appendix A). There was also breeding evidence observed during waterfowl surveys conducted during breeding season. A downy woodpecker had an active nest with 3 young at Goose Lake (confirmed breeding status). A swamp sparrow was observed carrying food (confirmed). There was also a palm warbler displaying agitated behaviour (probable breeding status). During wetland delineation surveys, a pileated woodpecker nest was observed in wetland number 43 as well. The only potential migratory behaviour observed during the waterfowl surveys was a flock of 150 common grackles flying south over Black Pond during fall migration waterfowl surveys (Figure 6, Appendix A).

Table 3-12: Incidental Bird Observations During Various Surveys

Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Type	Survey Location	Group
Spring Migration Season											
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	5	A	-	Waterfowl Survey	Goose Lake	6
BAEA	Bald eagle	<i>Haliaeetus leucocephalus</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	4



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Type	Survey Location	Group
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	3	A	-	Waterfowl Survey	Goose Lake	6
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	5	A	-	Waterfowl Survey	Goose Lake	6
CAGO	Canada goose	<i>Branta canadensis</i>	-	-	SUB, S5M	2	A	-	Nocturnal Owl Survey	OWL 1	1
HETH	Hermit thrush	<i>Catharus guttatus</i>	-	-	S5B	5	A	-	Waterfowl Survey, Nocturnal Owl Survey	Goose Lake, Owl 1	6
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	1	A	-	Nocturnal Owl Survey	OWL 1	2
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	7
NOFL	Northern flicker	<i>Colaptes auratus</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	7
NOPA	Northern parula	<i>Parula americana</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	6
OVEN	Ovenbird	<i>Seiurus aurocapilla</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	6
RUGR	Ruffed grouse	<i>Bonasa umbellus</i>	-	-	S5	4	A	-	Waterfowl Survey	Goose Lake	7
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	6
TRES	Tree swallow	<i>Tachycineta bicolor</i>	-	-	S4B	2	A	-	Waterfowl Survey	Goose Lake	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	2	A	-	Waterfowl Survey	Goose Lake	4
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	4	A	-	Waterfowl Survey, Nocturnal Owl Survey	Goose Lake, Owl 1, 3	6



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Type	Survey Location	Group
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	3	A	-	Waterfowl Survey	Goose Lake	6
Total Number of Individuals for Spring Migration				43	Total Number of Species for Spring Migration						18
Breeding Bird Season											
AMKE	American kestrel	<i>Falco sparverius</i>	-	-	S3B, S4S5M	1	A	-	Nightjar Survey	CONI 6	4
NSTS	Nelson's sparrow	<i>Ammodramus nelsoni</i>	-	-	S3S4B	1	A	-	Nightjar Survey	CONI 4	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	1	A	-	Waterfowl Survey	Goose Lake	4
WILL	Willet	<i>Tringa semipalmata</i>	-	-	S3B	5	A	-	Nightjar Survey	CONI 6	2
ALFL	Alder flycatcher	<i>Empidonax alnorum</i>	-	-	S5B	2	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	2	A	-	Waterfowl Survey, Nightjar Survey	Goose Lake, CONI 4	6
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	2	A	-	Waterfowl Survey, Nightjar Survey	Goose Lake, CONI 5	6
BAEA	Bald eagle	<i>Haliaeetus leucocephalus</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	4
BTNW	Black-throated green warbler	<i>Dendroica virens</i>	-	-	S5B	2	A	-	Waterfowl Survey	Goose Lake	6
BAWW	Black-and-white warbler	<i>Mniotilta varia</i>	-	-	S5B	2	A	-	Waterfowl Survey	Goose Lake	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	6
BWHA	Broad-winged hawk	<i>Buteo platypterus</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	4



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Type	Survey Location	Group
COYE	Common yellowthroat	<i>Geothlypis trichas</i>	-	-	S5B	19	A	-	Waterfowl Survey, Nightjar Survey	Goose Lake, Black Pond, CONI 5, 6	6
DOWO	Downy woodpecker	<i>Dryobates pubescens</i>	-	-	S5	4	1 A, 3 J	-	Waterfowl Survey	Goose Lake	7
GBHE	Great blue heron	<i>Ardea herodias</i>	-	-	S4B, S4S5M	4	A	-	Nightjar Survey	CONI 6	3
GHOW	Great horned owl	<i>Bubo virginianus</i>	-	-	S4	1	A	-	Nightjar Survey	CONI 3	5
HETH	Hermit thrush	<i>Catharus guttatus</i>	-	-	S5B	10	A	-	Waterfowl Survey, Nightjar Survey	Goose Lake, Black Pond, CONI 4, 5, 6	6
HERG	Herring gull	<i>Larus argentatus</i>	-	-	S5	23	A	-	Nightjar Survey	CONI 4, 5, 6	2
MAWA	Magnolia warbler	<i>Dendroica magnolia</i>	-	-	S5B	2	A	-	Waterfowl Survey	Goose Lake	6
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	3	A	-	Waterfowl Survey	Goose Lake	7
NOFL	Northern Flicker	<i>Colaptes auratus</i>	-	-	S5B	2	A	-	Waterfowl Survey	Goose Lake	7
NOPA	Northern parula	<i>Parula americana</i>	-	-	S5B	5	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
OSPR	Osprey	<i>Pandion haliaetus</i>	-	-	S4S5B, S5M	3	A	-	Waterfowl Survey, Early Botany	Goose Lake, Unknown (Early Botany)	4
OVEN	Ovenbird	<i>Seiurus aurocapilla</i>	-	-	S5B	3	A	-	Waterfowl Survey	Goose Lake	6
PAWA	Palm warbler	<i>Dendroica palmarum</i>	-	-	S5B	3	A	-	Waterfowl Survey	Black Pond	6
RWBL	Red-winged blackbird	<i>Agelaius phoeniceus</i>	-	-	S4B	1	A	-	Waterfowl Survey	Black Pond	6
RBNU	Red-breasted nuthatch	<i>Sitta canadensis</i>	-	-	S4S5	1	A	-	Waterfowl Survey	Goose Lake	6
REVI	Red-eyed vireo	<i>Vireo olivaceus</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	6



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Type	Survey Location	Group
RTHU	Ruby-throated hummingbird	<i>Archilochus colubris</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	6
RUGR	Ruffed grouse	<i>Bonasa umbellus</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	7
SOSP	Song sparrow	<i>Melospiza melodia</i>	-	-	S5B	5	A	-	Waterfowl Survey	Goose Lake	6
SPGR	Spruce grouse	<i>Falcapennis canadensis</i>	-	-	S4	5	1 A, 4 J	-	Early Botany	ATV Trail Near Breeding PC 30 or Migration PC 47	7
SWSP	Swamp sparrow	<i>Melospiza georgiana</i>	-	-	S5B	15	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
TRES	Tree swallow	<i>Tachycineta bicolor</i>	-	-	S4B	4	A	-	Waterfowl Survey	Goose Lake	6
WIWR	Winter wren	<i>Troglodytes troglodytes</i>	-	-	S5B	1	A	-	Waterfowl Survey	Goose Lake	6
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	15	A	-	Waterfowl Survey, Nightjar Survey	Goose Lake, Black Pond, CONI 4, 5, 6	6
Total Number of Individuals Observed for Breeding Bird				153	Total Number of Species Observed for Breeding Bird						36
Fall Migration Season											
AMCR	American crow	<i>Corvus brachyrhynchos</i>	-	-	S5	9	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
AMGO	American goldfinch	<i>Carduelis tristis</i>	-	-	S5	2	A	-	Waterfowl Survey	Goose Lake	6
AMRO	American robin	<i>Turdus migratorius</i>	-	-	S5B, S3N	17	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
BAEA	Bald eagle	<i>Haliaeetus leucocephalus</i>	-	-	S5	2	A	-	Waterfowl Survey	Goose Lake	4
BCCH	Black-capped chickadee	<i>Poecile atricapilla</i>	-	-	S5	7	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
BLJA	Blue jay	<i>Cyanocitta cristata</i>	-	-	S5	22	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
CEDW	Cedar waxwing	<i>Bombycilla cedrorum</i>	-	-	S5B	3	A	-	Waterfowl Survey	Goose Lake, Black Pond	6



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Code	Common Name	Scientific Name	SARA	NSESA	SRank	#	Age	Sex	Survey Type	Survey Location	Group
COGR	Common grackle	<i>Quiscalus quiscula</i>	-	-	S5B	150	A	-	Waterfowl Survey	Black Pond	6
COYE	Common yellowthroat	<i>Geothlypis trichas</i>	-	-	S5B	2	A	-	Waterfowl Survey	Black Pond	6
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	-	-	S4S5	6	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
GCKI	Golden-crowned kinglet	<i>Regulus satrapa</i>	-	-	S5	3	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
HAWO	Hairy woodpecker	<i>Picoides villosus</i>	-	-	S5	1	A	-	Waterfowl Survey	Black Pond	7
MODO	Mourning dove	<i>Zenaida macroura</i>	-	-	S5	1	A	-	Waterfowl Survey	Goose Lake	7
NOFL	Northern Flicker	<i>Colaptes auratus</i>	-	-	S5B	2	A	-	Waterfowl Survey	Goose Lake, Black Pond	7
NOHA	Northern harrier	<i>Circus hudsonius</i>	-	-	S4B, S4S5M	4	A	-	Waterfowl Survey, Wetland Delineation	Black Pond, Radar Location	4
SWSP	Swamp sparrow	<i>Melospiza georgiana</i>	-	-	S5B	5	A	-	Waterfowl Survey	Black Pond	6
TUVU	Turkey vulture	<i>Cathartes aura</i>	-	-	S2S3B, S4S5M	9	A	-	Waterfowl Survey	Goose Lake	4
WTSP	White-throated sparrow	<i>Zonotrichia albicollis</i>	-	-	S4S5B, S5M	2	A	-	Waterfowl Survey	Goose Lake, Black Pond	6
YRWA	Yellow-rumped warbler	<i>Dendroica coronata</i>	-	-	S5B	4	A	-	Waterfowl Survey	Black Pond	6
Total Number of Individuals for Fall Migration				251	Total Number of Species for Fall Migration						19

Notes: A=Adult; J=Juvenile. Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Bolded and underlined species are SAR. ACCDC rankings retrieved from: <http://accdc.com/webranks/NSall.htm> (October 2022). "-" represents no federal or provincial designation.

3.3 Spring and Fall Results Comparison

The following table (Table 3-12) is taken from Table 3-2 and Table 3-7 above and compares the results from spring migration and fall migration surveys and is represented in Figure 3-1, below. As stated in the footnotes of the original tables, the total number of individuals include



observations that were not able to be identified at the species level. The total number of species does not include unknowns.

Table 3-13: Spring and Fall Migration Results Comparison – Individual Abundance and Species Abundance by PC

PC Locations	Total # of Individuals - Spring	Total # of Individuals - Fall	Total Number of Species - Spring	Total Number of Species - Fall
1	115	182	21	12
2	75	225	16	9
3	99	264	17	12
4	68	231	22	14
5	57	103	16	11
6	48	114	20	13
7	50	51	19	14
8	64	113	22	12
9	67	119	19	13
10	74	146	23	15
11	81	83	20	18
12	62	79	21	16
13	63	41	20	14
19	50	27	22	10
20	47	25	18	8
21	85	71	23	14
22	93	35	23	13
23	52	32	18	15
24	50	39	16	11
25	52	38	17	12
26	66	86	16	14
27	47	28	19	12
28	59	27	22	14
29	45	23	20	13



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PC Locations	Total # of Individuals - Spring	Total # of Individuals - Fall	Total Number of Species - Spring	Total Number of Species - Fall
30	27	22	16	10
31	37	21	19	12
32	55	23	27	12
33	53	15	15	8
34	41	22	18	12
35	45	32	19	13
36	34	25	19	10
37	35	26	17	10
38	98	98	27	17
39	52	22	20	9
40	41	40	17	10
41	50	26	18	10
42	35	18	14	9
43	26	37	13	11
44	49	45	23	11
45	42	65	18	17
46	37	37	18	10
47	75	561	26	24
48	57	65	22	14
Total	2,458	3382	66*	61*

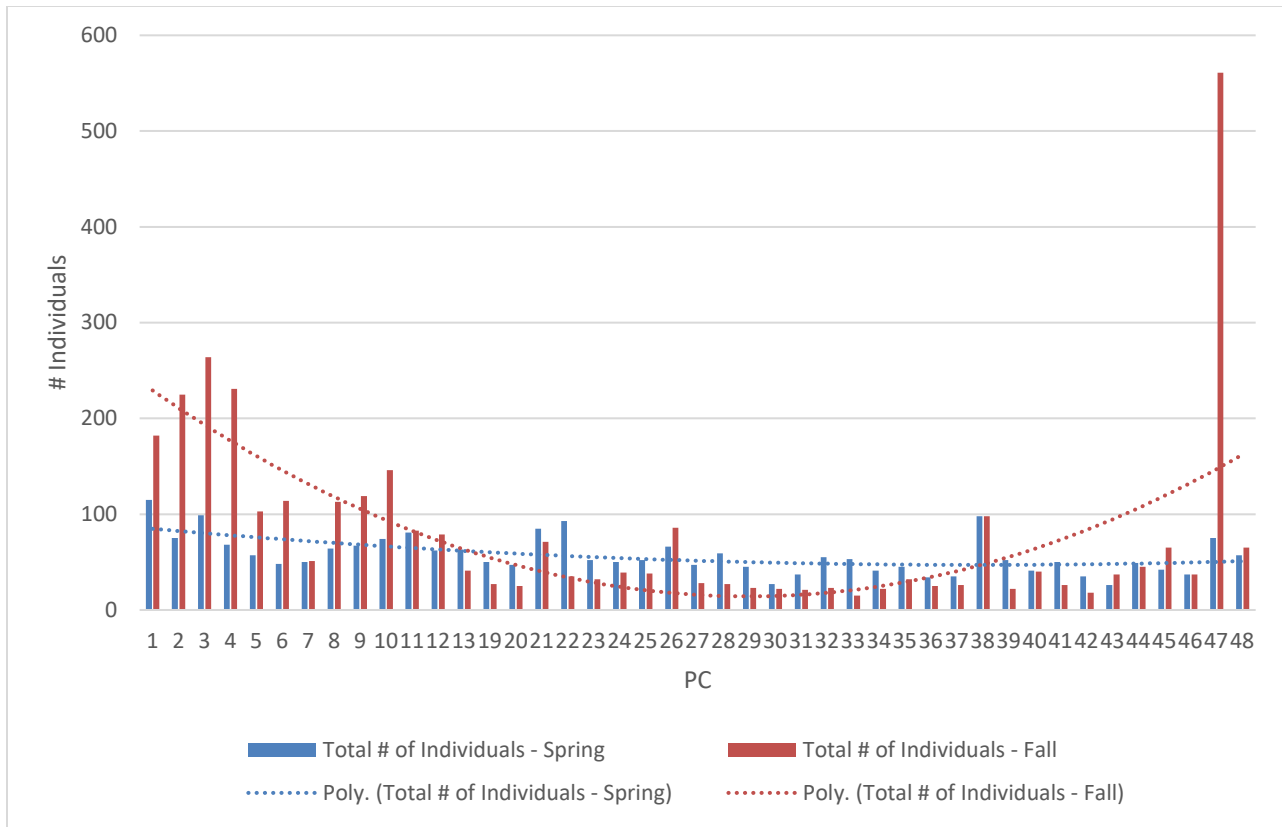


Figure 3-1: Total # of Individual Birds by PC Location - Spring Migration vs Fall Migration

Figure 3-1 above shows a general trend of fall migration counts that are, on average 24% higher than the spring migration counts at the same PC locations. Overall, Fall Migration counts had 924 more individuals (38%) than the overall Spring Migration counts.

The polynomial trend line shows that spring migration counts were highest between PCs 1- 10, all located on the southern end of the Project Area, within crown lands and generally trended lower the further north from the ocean and more inland.

The polynomial trend line shows that fall migration followed a similar trend but the counts were higher on PCs 1-10 than the spring counts. The U-shaped parabola is a result of the high counts at PC 47, which is outside the Project Area, and located on the shoreline of the TIWA, where counts had the highest diversity and individual count with 24 species observed and 561 individuals. This PC was on the coastline where various flocks of shorebirds and seabirds were observed that resulted in a high individual count (e.g., herring gull, great black-backed gull, sanderling, short-billed dowitcher, etc.). PC 47 also had a variety of habitat including open ocean off the coast, saltmarsh, barren/heathland with high shrub cover, and forested habitats located behind the PC



location. This diversity of habitat would attract a variety of shorebirds, waterfowl, passerines, raptors, and more.

The average percentage of birds counted at each point count in spring migration was 2.3% of the total number in spring (n=57 per point count). The average percentage of birds counted at each point count in fall migration was also 2.3% of the total number (n=78 per point count), and in fall migration, PC 47 accounted for 16% of all birds counted.

3.4 Priority Species

ACCDC breeding bird status qualifiers were used to determine whether a species is a priority species, based on the time of year in which the species was observed. If a species has only one seasonal ranking, such as S3B, it was considered a SOCI regardless of the time of year it was observed. However, if the species had an alternate ranking, such as a SRank of S2S3B, S5N, the species was considered a priority species if observed during the breeding season. Outside of breeding season, this species was not considered a priority species.

3.4.1 Species at Risk (SAR)

One avian SAR was observed during surveys throughout the dedicated survey period in 2022. The SAR, its habitat requirements, and the habitat present within the Project Area, are described below.

3.4.1.1 *Barn swallow*

The Barn swallow (*Hirundo rustica*; ACCDC: S3B, SARA: Threatened, NSESA: Endangered) is a medium-sized bird belonging to the passerine bird group. Barn swallows are aerial insectivores, an ecological guild that is declining globally due to a variety of reasons (e.g., habitat loss and human disturbance at roosting sites) (COSEWIC 2021).

Breeding habitat requires open areas for foraging such as fields, ponds, wetlands, forest clearings, roads, etc. Barn swallows will nest on cliffs, rock overhangs, and in caves but prefer to nest in or on human-made structures (e.g., boats, stables, barns, houses, and bridges). Barn swallows nest individually or in colonies and require a mud source for nest building material (COSEWIC 2021).

The Project Area has foraging habitat available for the barn swallow (e.g., open wetlands). Except for approximately 6 hunting blinds, the Project Area does not contain nesting habitat for the barn swallow. During DWC surveys completed during the spring migration season, one observation was made of three barn swallows foraging. The barn swallows were observed at DWC 3, a coastal location situated on the Wedgeport peninsula, approximately 1.8 km east of the Project Area. Potential nesting habitat such as a fish processing facility and wharf are present at DWC 3 as well as other structures (e.g., houses) in close proximity (Figure 7, Appendix A).



3.4.2 Species of Conservation Interest (SOCI) Observed

Across all survey seasons, a total of 16 avian SOCI were observed (Figure 7, Appendix A). Note that certain bird species are considered SOCI during certain seasons due to their ACCDC SRank, as explained throughout field results in Section 3.2 (e.g., turkey vulture). The species and the survey season/type when they were observed are as follows:

- American kestrel (*Falco sparverius*; nightjar survey incidental 2022);
- Arctic tern (*Sterna paradisaea*; fall 2022);
- Barn swallow (*Hirundo rustica*; spring DWC 2022);
- Black-bellied plover (*Pluvialis squatarola*; fall DWC and fall waterfowl 2022);
- Boreal chickadee (*Poecile hudsonica*; spring, breeding, and fall 2022);
- Canada jay (*Perisoreus canadensis*; spring, spring DWC, breeding, fall, and fall DWC 2022);
- Common eider (*Somateria mollissima*; spring, spring DWC, breeding, and fall DWC 2022);
- Common tern (*Sterna hirundo*; spring, breeding bird waterfowl, fall, and fall DWC 2022);
- Nelson's sparrow (*Ammodramus nelsoni*; nightjar survey incidental and breeding 2022);
- Purple sandpiper (*Calidris maritima*; fall DWC 2022);
- Sanderling (*Calidris alba*; fall 2022);
- Semipalmated sandpiper (*Calidris pusilla*; fall waterfowl 2022);
- Short-billed dowitcher (*Limnodromus griseus*; fall and fall waterfowl 2022);
- Spotted sandpiper (*Actitis macularius*; breeding bird waterfowl 2022);
- Turkey vulture (*Cathartes aura*; breeding bird waterfowl incidental 2022), and
- Willet (*Tringa semipalmata*; spring, spring DWC, nightjar survey incidental, breeding, fall, and fall DWC 2022).

4 AVIFAUNA SUMMARY

Based on other data sources (e.g., ACCDC, MBBA, eBird, Christmas Bird Count, etc.), the bird species observed during the biophysical studies for this EARD were normal for this area throughout the spring migration, breeding, and fall migration seasons.

The Project Area comprises a variety of habitats including open canopy barrens/heathland, ATV trails, immature and mature softwood, hardwood, and mixedwood stands, and open and forested wetlands (i.e., saltmarshes and treed swamps). Stand heterogeneity and diversity of landscapes observed within the Project Area provide a range of habitats suitable for a variety of bird species with different habitat requirements. Open habitat such as barrens/heathlands and saltmarshes provided suitable foraging habitat for willets (*Tringa semipalmata*) and various types of warblers, sparrows, and predatory birds such as Northern harrier (*Circus hudsonius*), turkey vultures (*Cathartes aura*), and various buteo species. Open water habitats surround the peninsula on which the Project Area is located and provide habitat for various species of waterfowl and shorebirds.



Forests and shrub-covered areas with stand heterogeneity (i.e., stands with different height classes) provide suitable habitat for foraging and breeding activities for many passerine species. During the spring, fall, and breeding bird surveys, PC locations associated with wetland habitats (e.g., saltmarsh) or coastline had some of the highest species richness and abundance, most of which are outside the Project footprint area.

Baseline avifauna surveys were completed from April to October 2022 by MEL biologists. A total of 202.6 hours of dedicated avifauna surveys were completed.

Biophysical surveys resulted in the observation of 16,020 individuals, representing 100 bird species within the Project Area⁸.

The most abundant bird group observed was shorebirds (group 2; the most abundant being herring gull) accounting for 61% of total individuals, followed by passerines (group 6; 29%), waterfowl (group 1; 5.6%), other landbirds (group 7; 2.1%), diurnal raptors (group 4; 1.3%), other waterbirds (group 3; 0.94%), and nocturnal raptors (group 5; 0.069%) of total individuals.

Passerines had the highest species diversity with 51 species observed, followed by shorebirds (19 species), diurnal raptors (9 species), waterfowl (7 species), other landbirds (7 species), other waterbirds (4 species), and nocturnal raptors (3 species).

Through desktop analysis and field observations, it is apparent that the general area supports various life stages for migratory birds due to the variety of habitats (e.g., barrens/heathlands, lakes, ponds, saltmarsh, bogs, swamps, mudflats, estuaries, forested areas, etc.). The peninsula upon which the Project Area is located is surrounded by habitat suitable for flocks of waterfowl and shorebirds, especially for foraging and overwintering.

There were no common nighthawk observed during the dedicated surveys. This was expected due to the lack of suitable breeding habitat for the common nighthawk (e.g., not many clear cuts, ROW clearings, etc.). Additionally, no eastern whip-poor-will observed during nightjar surveys.

During the nocturnal owl surveys, the northern saw-whet owl (*Aegolius acadicus*) and great horned owl (*Bubo virginianus*) were observed. No SAR or SOCI owl species were observed.

One avian SAR, the barn swallow (ACDC: S3B; SARA: Threatened; NSESA Endangered), was observed outside the Project Area during spring migration season. The location is on the coastline, close to a fish processing facility. Although there is foraging habitat for this species within the

⁸ Note that incidental observations (Section 3.2.7) were carried forward into these calculations due to most incidentals being recorded during waterfowl surveys (with the exception of 7 individuals during early botany and wetland delineation) and only one species, the spruce grouse observed during early botany, was a novel avifauna observation.



Project Area, such as swamps and barrens/heathlands, there is no suitable breeding habitat for the barn swallow within the Project Area.

Across all survey seasons, a total of 16 avian SOCI were observed. There were several SOCI observed only at Goose Lake or along the coastline/saltmarsh along the coast (black-bellied plover, common tern, common eider, purple sandpiper, sanderling, spotted sandpiper, semipalmated sandpiper, and short-billed dowitcher). Four of these species were only observed outside the Project Area (black-bellied plover, purple sandpiper, semipalmated sandpiper, and spotted sandpiper). The species and the survey season/type when they were observed are as follows (includes both SAR and SOCI):

- American kestrel (*Falco sparverius*; nightjar survey incidental 2022);
- Arctic tern (*Sterna paradisaea*; fall 2022);
- Barn swallow (*Hirundo rustica*; spring DWC 2022);
- Black-bellied plover (*Pluvialis squatarola*; fall DWC and fall waterfowl 2022);
- Boreal chickadee (*Poecile hudsonica*; spring, breeding, and fall 2022);
- Canada jay (*Perisoreus canadensis*; spring, spring DWC, breeding, fall, and fall DWC 2022);
- Common eider (*Somateria mollissima*; spring, spring DWC, breeding, and fall DWC 2022);
- Common tern (*Sterna hirundo*; spring, breeding bird waterfowl, fall, and fall DWC 2022);
- Nelson's sparrow (*Ammodramus nelsoni*; nightjar survey incidental and breeding 2022);
- Purple sandpiper (*Calidris maritima*; fall DWC 2022);
- Sanderling (*Calidris alba*; fall 2022);
- Semipalmated sandpiper (*Calidris pusilla*; fall waterfowl 2022);
- Short-billed dowitcher (*Limnodromus griseus*; fall and fall waterfowl 2022);
- Spotted sandpiper (*Actitis macularius*; breeding bird waterfowl 2022);
- Turkey vulture (*Cathartes aura*; breeding bird waterfowl incidental 2022), and
- Willet (*Tringa semipalmata*; spring, spring DWC, nightjar survey incidental, breeding, fall, and fall DWC 2022).

The boreal chickadee, Canada jay, common eider, turkey vulture, and willet were observed the most throughout the field surveys.

Throughout the avifauna baseline surveys, no SAR and one SOCI was observed within or close to wetlands within the Project Area. Willets was observed within or close to a limited number of wetlands but overall, willets were observed in a variety of habitats in and within close proximity to the Project Area during migration and breeding periods (e.g., Black Pond, barren/heathland, saltmarsh, forested areas, treed swamps, mudflats, and coastline).



There were avian SOCI observed in other wetlands outside and bordering the Project Area. These wetlands will not be impacted by the Project footprint. Willet, common eider, Canada jay, common tern, arctic tern, sanderling, short-billed dowitcher, and Nelson's sparrow are SOCI that were observed at a saltmarsh that borders the eastern edge of the Project Area. Canada jay and willet were two SOCI observed at Black Pond, which has fen wetland habitat around the edges and borders the western edge of the Project Area. Seven SOCI were observed at a saltmarsh that borders the western edge of the Project Area.

There were field observations of various shorebird and waterfowl flocks and the fly-over behaviour of birds flying to different feeding areas across the peninsula on which the Project Area is located. A higher occurrence of fly-overs were observed farther south in the Project Area, closer to the tip of the peninsula.

Surveyors also noted that groups of passerines, shorebirds, and waterfowl close to the coastline were common. This indicates the coastline being used as a streamlined way to move around the area.

Saltmarshes and mudflats line both sides of the peninsula and the open water habitat on both sides is sheltered by land and islands. Flocks of gulls were the most common observed during the avifauna surveys, but flocks of common eider, American black duck, black-bellied plover, willet, and more were observed along the coastline and in the water surrounding the Project Area. Although bird colonies are known to be nearby and various flocks were observed during the field surveys, no colonies were observed within or in the surrounding waters surrounding the Project Area (including Goose Lake) during the avifauna baseline surveys.

During avifauna baseline surveys, most bird groups were observed flying under 100 m in height. There were minimal observations of gulls and raptors flying above 100 m. The proposed turbine layout for this Project is mostly centered down the middle of the Comeaus Hill peninsula. A high percentage of the Project footprint avoids the coastline, protected areas, and the far south parts of the peninsula where a higher occurrence of fly-overs were observed. Survey locations along the coastline generally had the highest species abundance and diversity as well. All bird groups were observed flying over the peninsula but gulls, great blue herons, and diurnal raptors in particular had the highest occurrences of fly-overs above 100 m during the avifauna baseline surveys. The most common fly-over height recorded during all seasons, however, was between 50-100 m across all bird groups.

- Approximately 85% percent of fly-overs were under 100 m in height.
- Approximately 56% percent of fly-overs were flying in an east to west (and vice-versa) direction.
- Approximately 78% of flyovers were farther south on the peninsula on which the Project Area is located.



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- Approximately 49% of observed fly-overs during the spring and fall migration surveys were observed at the southern-most PCs.
- Approximately 80% of observed fly-overs were birds belonging to waterfowl, shorebirds, other waterbirds, and diurnal raptors.



5 LIMITATIONS

Limitations incurred at the time of the assessment include:

- MEL has relied in good faith upon the evaluation and conclusions in all third-party assessments. MEL relies upon these representations and information provided but can make no warranty of its accuracy.
- MEL has relied in good faith upon regulators in the various regulatory agencies and methodologies used in the design of this assessment may have been based upon regulatory guidance.
- There are a potentially infinite number of methods in which human activity can influence wildlife behaviours and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors.
- A limitation with field surveys is that if no migration patterns are observed, it does not mean they do not exist in the area. Radar and acoustic monitoring have a higher likelihood of observing migration behaviour, and migration conversations are qualitative in nature.
- Lack of access within the Project Area and difficult terrain was a constraint for field surveyors and survey design had to be readjusted during round 1 of spring migration surveys.
- Surveys protocols followed appropriate methods and were adjusted, when possible, in response to correspondence from CWS.
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.
- Bird detectability depends on (i) species biology and behaviour (abundance, activity, species body size and conspicuousness, and ecological traits), (ii) individual characteristics within the species (sex and age), (iii) environmental factors (habitat, weather, phase of season, and time of day), and (iv) methodology of counts and skills of observers.
- An essential assumption of distance sampling methods is that distances to individuals are accurately estimated, a task not easy to accomplish under normal field conditions and are based on the perspective of the observer.



6 CLOSING

This Report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

The undersigned has considered relevant factors and influences pertinent within the scope of the assessment and written and combined and referenced the report accordingly.

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7 REFERENCES

- Atlantic Canada Conservation Data Centre (ACCDC). 2022. Rank Definitions. Retrieved from: <http://accdc.com/en/ranks.html>.
- Audubon. N.d. Listening to Migrating Birds at Night May Help Ensure Their Safety. Retrieved from: <https://www.audubon.org/magazine/september-october-2013/listening-migrating-birds-night-may>.
- Birds Canada. 2022. Canadian Nightjar Survey: Protocol 2022. Based on an original document written by Elly Knight. Published in collaboration with Environment and Climate Change Canada. 23 pages.
- Birds Canada. N.d. IBA Site Summary: The Brothers. Retrieved from: <https://www.ibacanada.com/site.jsp?siteID=NS003>.
- Birds Studies Canada – Atlantic Region. 2019. Nova Scotia Nocturnal Owl Survey Guide for Volunteers. Bird Studies Canada. Sackville, NB.
- Burger, J., Howe, M.A., Hahn, D.C., and Chase, J. 1977. Effects of Tide Cycles on Habitat Selection and Habitat Partitioning by Migrating Shorebirds. *The Auk* 94: 743-758.
- Canadian Wildlife Service (CWS). 2018. Wind Turbines and Birds Updated Guidance for Environmental Assessment and Monitoring. Canadian Wildlife Service – Atlantic Region.
- COSEWIC. 2021. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 60 pp. (<https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>).
- COSEWIC. 2018. COSEWIC assessment and status report on the Common Nighthawk (*Chordeiles minor*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 50 pp. ([Species at Risk Public Registry](#)).
- Environment and Climate Change Canada (ECCC). N.d. Migratory bird sanctuaries (MBS). Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/migratory-bird-sanctuaries.html>.
- Environment and Climate Change Canada (ECCC). N.d. National wildlife areas (NWA). Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas.html>.



- Environment and Climate Change Canada (ECCC). 2018a. Nesting Periods. Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html>.
- Environment and Climate Change Canada (ECCC). 2018b. Recovery Strategy for the Eastern Whip-poor-will (*Antrostomus vociferus*) in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. vi + 107 pp.
- Environment Canada – Canadian Wildlife Service (EC CWS). 2007a. Wind Turbines and Birds – A Guidance Document for Environmental Assessment.
- Environment Canada – Canadian Wildlife Service (EC CWS). 2007b. Recommended Protocols for Monitoring Impacts of Wind turbines on Birds.
- Kearney, John. 2002. Protecting Coastal Habitat for Migrating Birds in Kespukwitk. Prepared for: Nova Scotia Environment and Climate Change and Nova Scotia Crown Share Land Legacy Trust. February 2022. Retrieved online: [Protecting Coastal Habitat for Migratory Birds in Kespukwitk.pdf \(johnfkearney.com\)](https://www.novascotia.ca/conservation/protecting-coastal-habitat-for-migratory-birds-in-kespukwitk.pdf)
- Maritime Breeding Bird Atlas (MBBA). 2008. Atlassing for Species at Risk in the Maritime Provinces: A supplement to the Maritimes Breeding Bird Atlas Guide for Atlassers. 2nd Edition. Government of Canada. Habitat Stewardship Program for Species at Risk.
- Maritime Breeding Bird Atlas (MBBA). N.d. Breeding Evidence Codes. Retrieved online: <https://www.mba-aom.ca/jsp/codes.jsp?lang=en&pg=breeding>.
- Maritime Breeding Bird Atlas. 2020. Breeding Dates Retrieved from: <https://www.mba-aom.ca/downloads/breedingdates.pdf> on October 20, 2020.
- Nova Scotia Bird Society. 1976. Where to Find the Birds in Nova Scotia. P.R. Dobson.
- Nova Scotia Environment (NSE). 2009. Guide to Addressing Wildlife Species and Habitat in an EA Registration Document. Policy and Corporate Services Division. Environmental Assessment Branch. Retrieved from: <https://www.novascotia.ca/nse/ea/docs/EA.Guide-AddressingWildSpecies.pdf>.
- Nova Scotia Environment and Climate Change (NSECC) - Environmental Assessment Branch. 2007. Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia.



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Nova Scotia Environment and Climate Change (NSECC). N.d. Tusket Island Wilderness Area. Retrieved from: https://novascotia.ca/nse/protectedareas/wa_tusketislands.asp on October 17, 2022.

Stantec. 2012. Wedgeport Wind Farm Environmental Assessment. <https://novascotia.ca/nse/ea/wedgeport-wind-farm.asp>

Takats, L., Francis, C., Holroyd, G., Duncan, J., Mazur, K., Cannings, R., Harris, W., and Holt, D. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp.









APPENDIX A. FIGURES

FIGURE 1

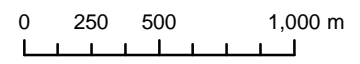
Project Area and Significant Information

Little River Harbour, NS

-  ACCDC Report Data
 -  Tusket Islands Wilderness Area
 -  Significant Habitat
 -  Crown Land
 -  NSECC Wetland of Special Significance
 -  Project Area
- The Brothers IBA (NS003) displayed within locator map below



Coordinate System: NAD 1983 CSRS UTM Zone 19N
 Projection: Transverse Mercator
 Datum: North American 1983 CSRS
 Units: Meter



1:28,000 Scale when printed @ 11" x 17"

Drawn By: JL Project Number: 21-576
 Reviewed By: JB Date: 2022-11-09



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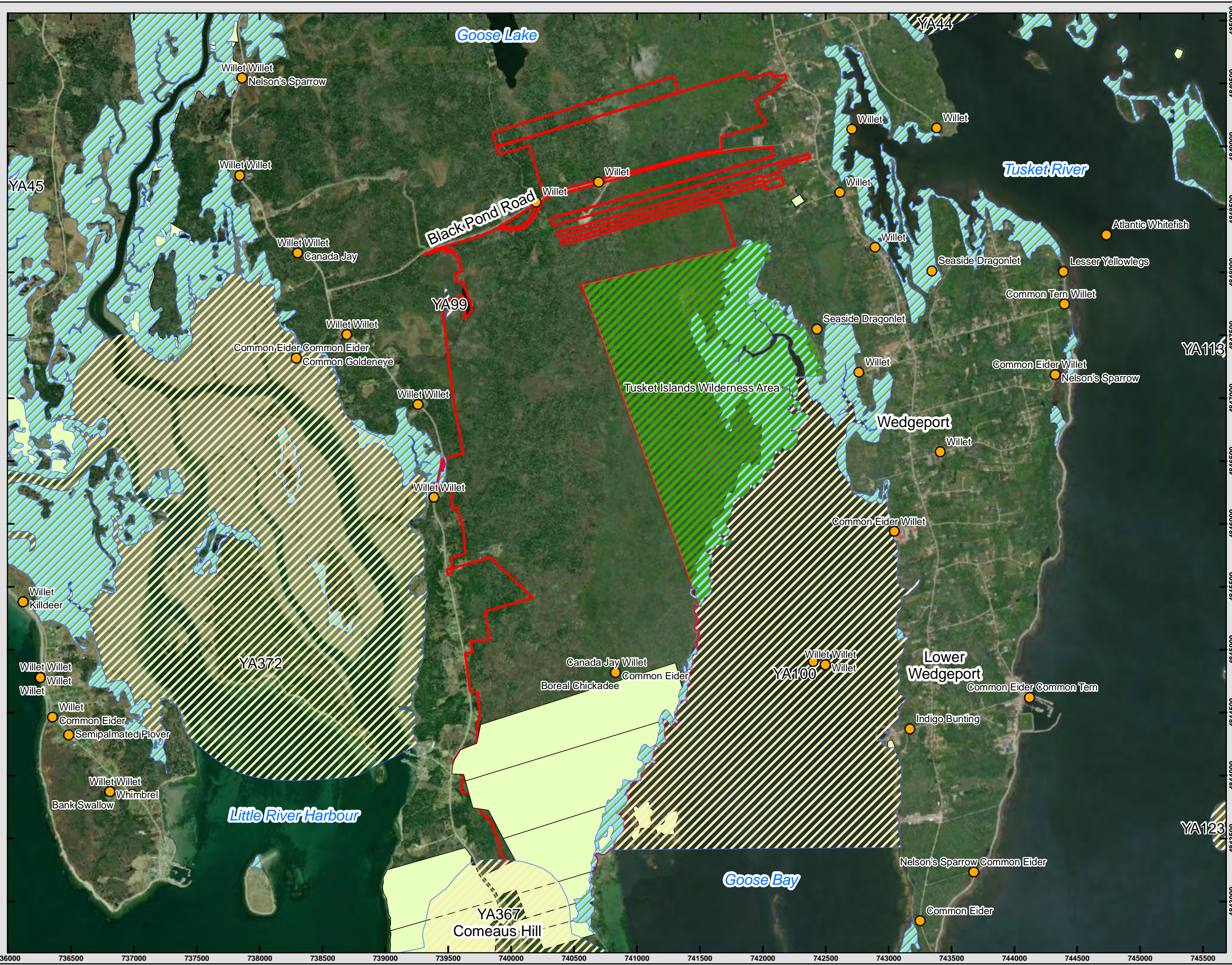





FIGURE 2

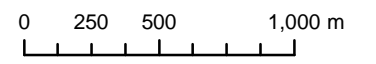
Spring and Fall Migration Survey
 Point Count (PC) and Diurnal
 Watch Count (DWC) Locations

Little River Harbour, NS

-  Spring and Fall Migration PCs
-  DWC Locations
-  Project Area



Coordinate System: NAD 1983 CSRS UTM Zone 19N
 Projection: Transverse Mercator
 Datum: North American 1983 CSRS
 Units: Meter

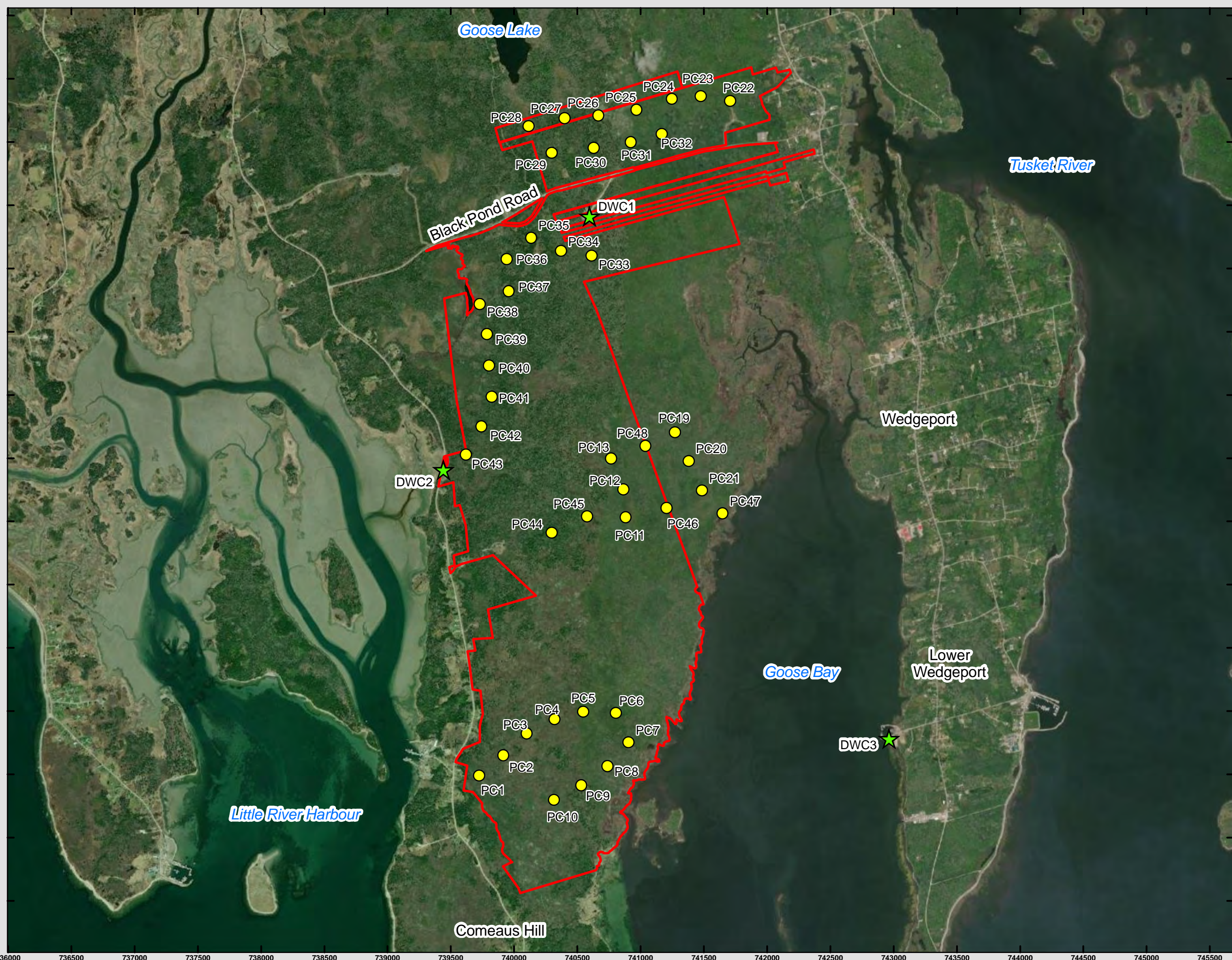


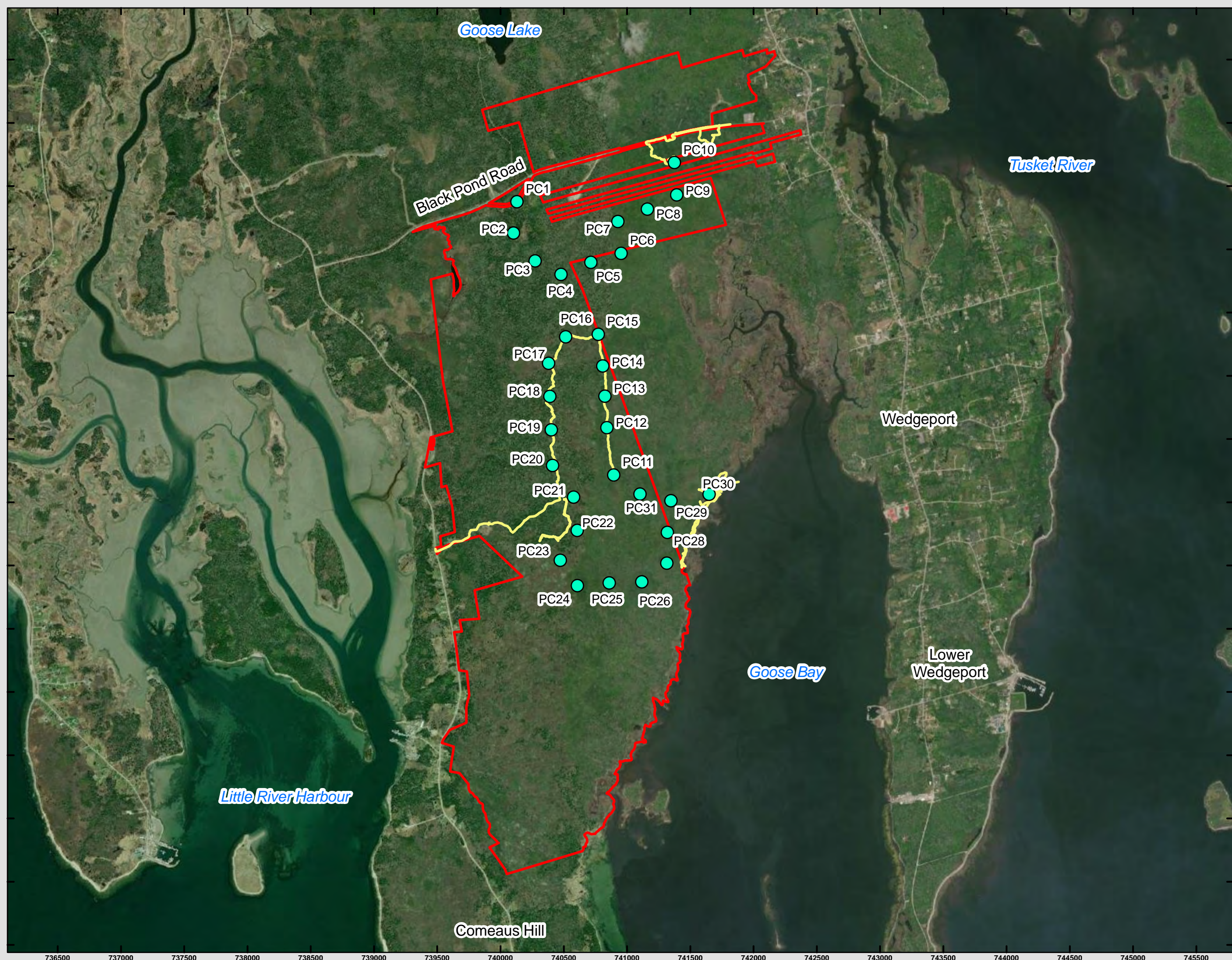
1:28,000 Scale when printed @ 11" x 17"

Drawn By: JL Project Number: 21-576
 Reviewed By: JB Date: 2022-11-09



McCallum Environmental Ltd.








Prepared For:
 WEDGEPORT WIND FARM

FIGURE 3

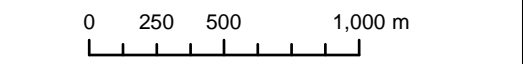
Breeding Bird Survey Point Count (PC) Locations and Area Search Tracks

Little River Harbour, NS

-  Area Search Tracks
-  Breeding Bird PCs
-  Project Area



Coordinate System: NAD 1983 CSRS UTM Zone 19N
 Projection: Transverse Mercator
 Datum: North American 1983 CSRS
 Units: Meter



1:28,000 Scale when printed @ 11" x 17"

Drawn By: JL Project Number: 21-576
 Reviewed By: JB Date: 2023-02-23





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FIGURE 4

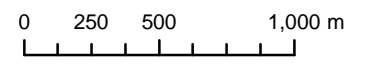
Nightjar
Survey Point Count
Locations

Little River Harbour, NS

-  Common Nighthawk (CONI) PCs
-  Project Area



Coordinate System: NAD 1983 CSRS UTM Zone 19N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter



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Drawn By: JL Project Number: 21-576
Reviewed By: JB Date: 2022-11-09





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FIGURE 5

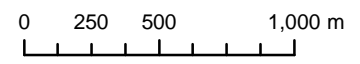
Nocturnal Owl Survey
Point Count Locations

Little River Harbour, NS

-  Owl PCs
-  Project Area



Coordinate System: NAD 1983 CSRS UTM Zone 19N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter



1:28,000 Scale when printed @ 11" x 17"

Drawn By: JL Project Number: 21-576
Reviewed By: JB Date: 2022-11-09



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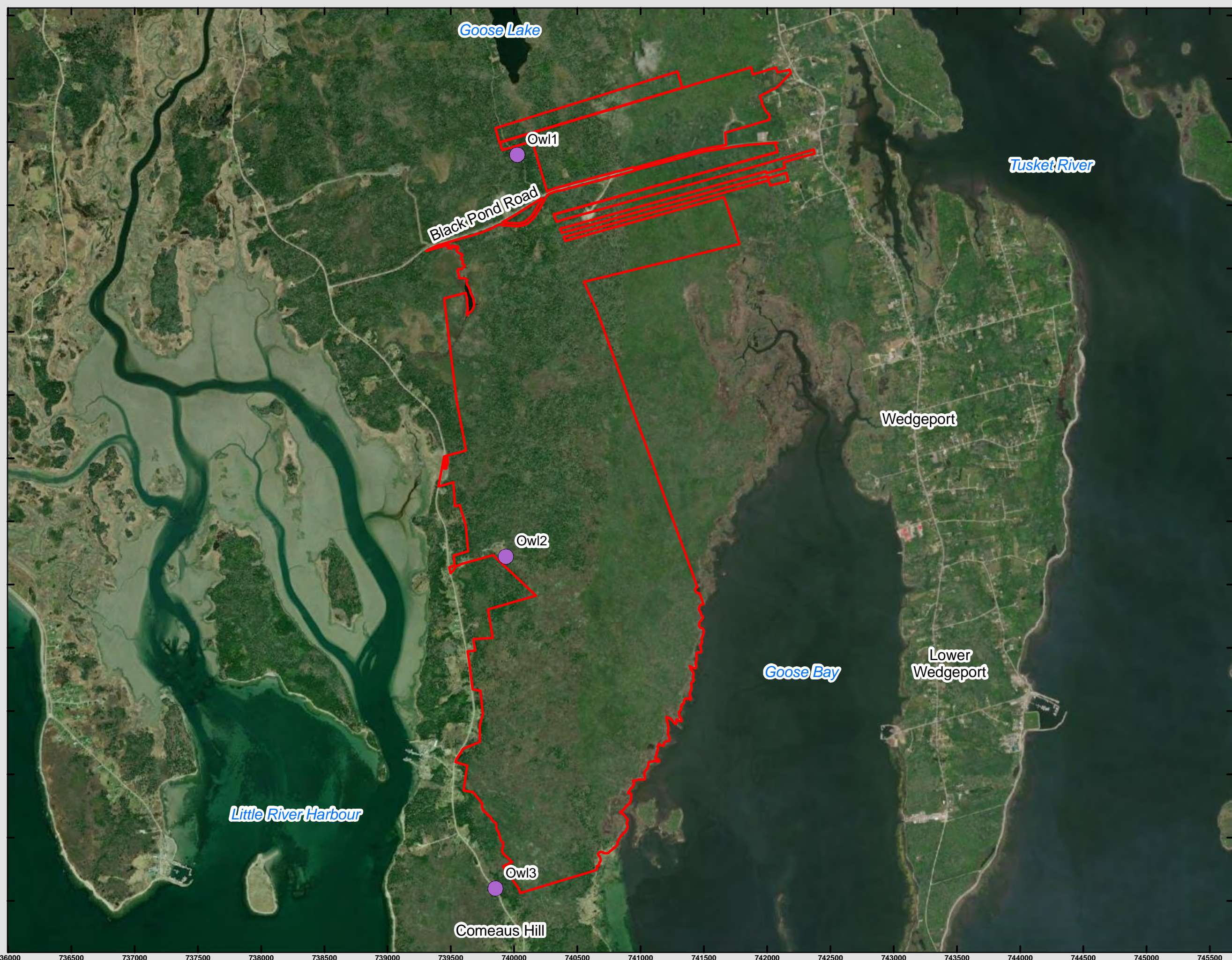




FIGURE 6

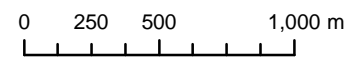
Waterfowl Survey Locations

Little River Harbour, NS

-  Waterfowl Locations
-  Project Area



Coordinate System: NAD 1983 CSRS UTM Zone 19N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter



1:28,000 Scale when printed @ 11" x 17"

Drawn By: JL Project Number: 21-576
Reviewed By: JB Date: 2022-11-09






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FIGURE 7

Priority Avifauna Species
(SAR and SOCI) Distribution

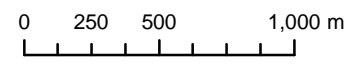
Little River Harbour, NS

-  SAR/SOCI Observations
-  Fied Delineated Wetlands (WLs)
-  Project Area

Species Displayed by Bird Code
 Breeding Bird Area Search Observations
 (Figure 3): 1 CAJA, 20 COEI, 6 NSTS
 and 8 WILL



Coordinate System: NAD 1983 CSRS UTM Zone 19N
 Projection: Transverse Mercator
 Datum: North American 1983 CSRS
 Units: Meter

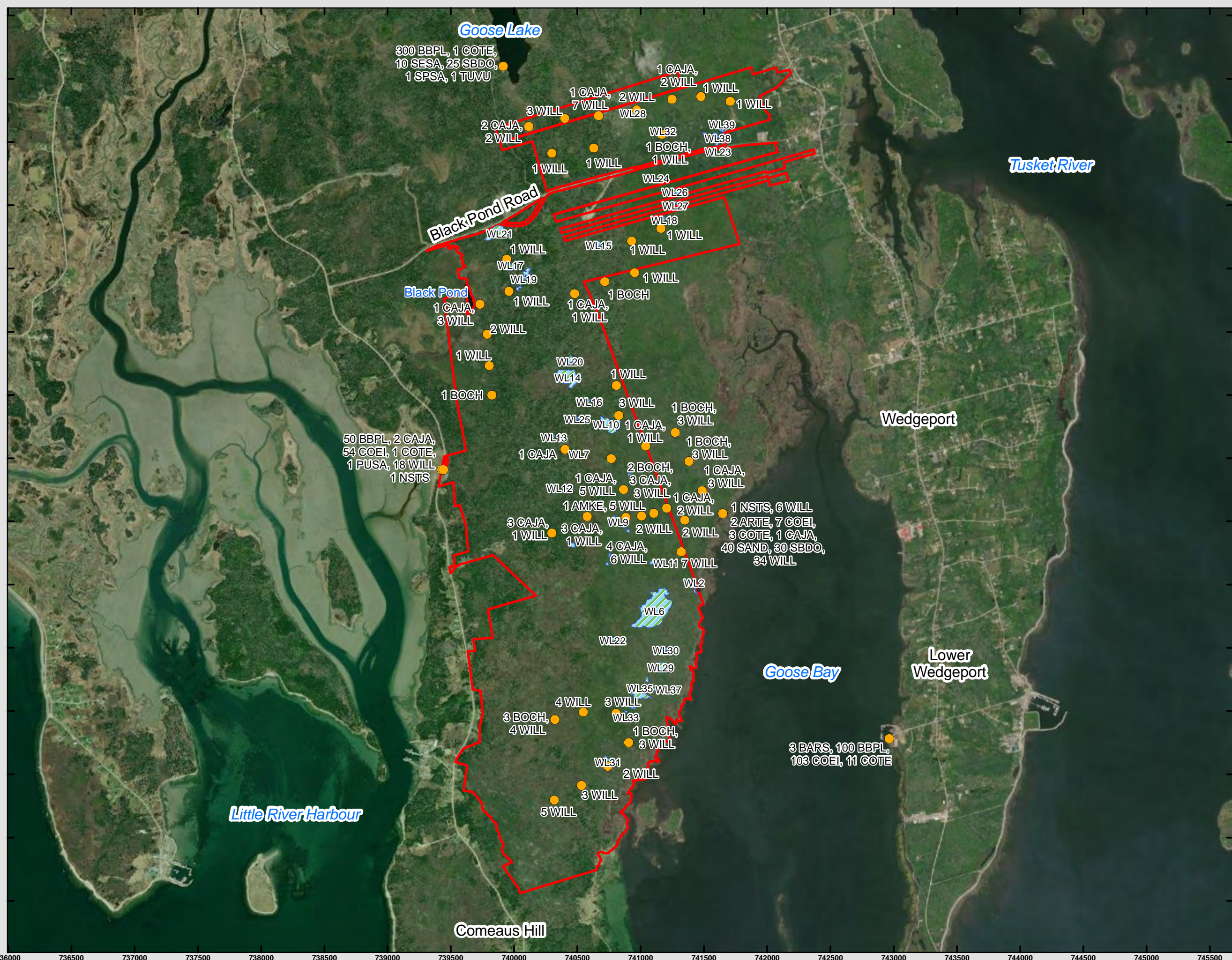


1:28,000 Scale when printed @ 11" x 17"

Drawn By: JL Project Number: 21-576
 Reviewed By: JB Date: 2022-11-10



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APPENDIX B. PRIORITY SPECIES LIST

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
Avifauna							
<i>Accipiter cooperii</i>	Cooper's Hawk	S1?B,S UN,SU M				Not common in Nova Scotia but does breed in the province. Found in mature forest, open woodlands, wood edges and river groves. Nests in coniferous, deciduous and mixed woods, typically those with tall trees and with openings or edge habitat nearby. Also found among trees along rivers through open country, and increasingly in suburbs and cities where tall trees exist for nesting (e.g. parks, open fields and even backyards with feeders). Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Accipiter gentilis</i>	Northern Goshawk	S3S4				Found in coniferous and mixed forests. Generally restricted to wooded areas (along riparian corridors) but may be in relatively open woods or along edges. Often more common as a breeding bird in mixed woods (e.g. mature and old-growth forests with more than 60% closed canopy). In the East, goshawks seek out nest sites in mixed-hardwood forests where beeches, birch, hemlock and maples dominate. Goshawks often build nests near breaks in the canopy, such as a forest trail, road or opening created by a downed tree and prefer sites with a creek, pond or lake nearby. Breeds between April and July. May mate for life (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Alca torda</i>	Razorbill	S2B				Year-round resident along the coasts of Nova Scotia and also winters farther off-shore (pelagic). Winter distribution varies, depending on food supply and weather. Tends to forage in cool waters less than 200' deep, so often concentrates over offshore shoals or ledges; sometimes closer to shore than other large auks. Nests in colonies and may mate for life. Pair formation may take place within flocks on water or on common ground near the colony. Nests on islands or mainland on cliffs or rocky shorelines. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Ammospiza nelsoni</i>	Nelson's Sparrow	S3S4B				They spend most of their time on or near the ground in dense marsh vegetation. Nelson's Sparrow breed mainly in fresh and saltwater marshes in the northern Great Plains and along the northern Atlantic Coast. Breeds between April and July (Audubon and The Cornell Lab)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds:

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
							https://www.audubon.org/field-guide/bird
<i>Anas acuta</i>	Northern Pintail	S1B,SUM				Found in marshes, prairies, fresh ponds, lakes and salt bays. Summers in wide variety of open habitats, including prairies, farmland, northern tundra and near bodies of water. Breeds in seasonal wetlands, open areas with short vegetation, wet meadows, grasslands and crop fields. During the nonbreeding season they use flooded and dry agricultural fields, lakes, reservoirs, estuaries, saltmarshes, freshwater and brackish wetlands and bays. Pintails also use different habitats depending on time of day (e.g. tend to forage in wetlands during the day). Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Arenaria interpres</i>	Ruddy Turnstone	S3M				Common migrant in Nova Scotia. Favours beaches (with lots of seaweed or debris), lake shorelines, mudflats, jetties and rocky shores (and tundra in the summer). Mostly coastal in migration and winter. May also feed on mudflats or on plowed fields near the coast. Ruddy Turnstones breed along rocky coasts and in the tundra across the High Arctic. In North America they breed in sparsely vegetated tundra near marshes, streams and ponds. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Asio flammeus</i>	Short-eared Owl	S1B	T	SC		Short-eared Owls breed primarily in well-drained grasslands near coastal wetlands. In areas with extensive coastlines, some caution is warranted in summarizing breeding habitat as inland marshes and bogs are less frequently monitored and thus may be under-represented in assessments of breeding habitat (COSEWIC Assessment and Status Report).	COSEWIC. 2008. COSEWIC assessment and update status report on the Short-eared Owl <i>Asio flammeus</i> in Canada. Committee on the Status of E Wildlife in Canada. Ottawa. vi + 24 pp. (www.sararegistry.gc.ca/status/status_e.cfm).
<i>Asio otus</i>	Long-eared Owl	S2S3				Known to breed throughout Nova Scotia. They occur at elevations ranging from near sea level to above 6,500 feet. May be nomadic at times, moving about in response to changing food supplies. Favored habitat includes dense trees for nesting and roosting and open country (e.g. grasslands and	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds:

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
						shrublands) for hunting. Inhabits a wide variety of such settings, including forest with extensive meadows to groves of conifers or deciduous trees. Generally avoids unbroken forest. Known to be an early breeder. Breeds between April and July (Audubon and The Cornell Lab).	https://www.allaboutbirds.org
<i>Botaurus lentiginosus</i>	American Bittern	S3S4B, S4S5M				Found in marshes and reedy lakes. Breeds in freshwater marshes, mainly large, shallow wetlands with a large amount of tall marsh vegetation (cattails, grasses and sedges) and areas of open shallow water. Sometimes feeds in dry grassy fields. They are rarely seen out in the open, prefers vegetation cover. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Branta bernicla</i>	Brant	S3M				Found throughout all of Nova Scotia during migration (winter to spring breeding season). Most migrating and wintering Brant in eastern North America use coastal waters, especially lagoon systems behind barrier beaches, where eelgrass, sedges, and algae are plentiful. When not feeding, Brant roost on mudflats, barrier islands and sand spits near their foraging areas. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Bucephala clangula</i>	Common Goldeneye	S2S3B, S5N, S5M				Winters in Nova Scotia along the coast. Generally migrates late in fall and early in spring. Males tend to winter farther north than females. Found in shallow coastal bays, estuaries that offer good foraging sites: sand, gravel, rock and boulder substrates supporting mollusks and crustaceans. In the interior, wintering flocks gather on large lakes and rivers as far north as open water occurs. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Bucephala islandica</i>	Barrow's Goldeneye	S1N, S1UM	SC	SC		Barrow's Goldeneye wintering habitat extends along the shores of the Atlantic provinces.	Species Profile (Barrow's Goldeneye) - Species at Risk Public Registry (canada.ca)

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Buteo lagopus</i>	Rough-legged Hawk	S3N				Common across Nova Scotia during nonbreeding (winter). Spends the winter in open country, including grasslands, coastal prairies, marshes, farmland and dunes. In tree-covered areas they hunt over open bogs and other clearings. Breeds mostly on tundra, in areas having cliffs for nest sites; some breed along northern edge of coniferous forest zone. Rough-legged Hawks breed in open country of the arctic, both in North America and Eurasia. Breeds between April and July. May mate for life (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Calcarius lapponicus</i>	Lapland Longspur	S3?N,S UM				They winter in vast agricultural fields that are often devoid of other birdlife in that season in southern area, and head up to the tundra to breed in the summer. Breeds between April and July (Cornell Lab, Audubon).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Calidris alba</i>	Sanderling	S2N,S3 M				Common migrant in Nova Scotia and will winter in Nova Scotia sometimes on sandy beaches (not common). Favours outer beaches, tideflats and lake shores. Mainly (during any season) found on sandy beaches washed by waves and sometimes found on rocky shorelines, less often on mudflats. Typically coastal, but a few stop over on inland bodies of water such as lakes, streams, reservoirs and ponds. Studies show that many individuals return year after year to same wintering sites. Much of migration is accomplished in long nonstop flights between key stopover points. In breeding season, they are mostly far above the Arctic Circle on rather dry, rocky tundra with growth of moss, lichens and short plants (generally close to lakes or ponds). Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Calidris canutus</i>	Red Knot	S2M	SC/E/E		E	Red Knots migrate through Nova Scotia along the coast in the summer and fall. Adults in faded breeding plumage are observed in July and August, while juveniles are mainly seen from August to October. Red Knots use different habitats during the breeding, wintering, and migration seasons. In the Arctic, they nest in extremely barren habitats, such as windswept ridges, slopes, or plateaus. Nesting sites are usually located in dry, south-facing locations, near wetlands or lakes, where the young are led after hatching. Red Knots generally feed in damp or barren areas that can be as far as 10 km from the nest. Migratory stopovers and wintering grounds are vast coastal zones swept by tides twice a day, usually sandflats but sometimes mudflats. In these areas, the birds feed on molluscs, crustaceans, and other invertebrates. The species also frequents peat-rich banks, salt marshes, brackish lagoons, mangrove areas, and mussel beds.	
<i>Calidris maritima</i>	Purple Sandpiper	S3S4N				Generally winters in Nova Scotia. In winter, prefers rocky shores or rock jetties and breakwaters, foraging in zone below high-tide mark. Sometimes in areas of seaweed washed up on beaches. In summer they are found on barren northern tundra, especially in rocky areas or ridges. Usually follows rocky coast during migration (goes father north than other shorebirds), seldom appearing inland (but they are sometimes seen on rocky edges (natural or artificial) of bays, lakes and rivers). Fall migration is much later for this species than that of most sandpipers, not appearing on wintering grounds until November. They forage and roost among rocks, sometimes sheltering from severe storms in nearby harbors, bays or grassy island interiors. Spring migrants often use muddy or sandy shorelines, especially where there are invertebrate prey. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Calidris melanotos</i>	Pectoral Sandpiper	S3M				Common migrant in Nova Scotia. Compared to other shorebirds, migration is relatively early in spring and late in fall (adults before juveniles). During migration, they prefer wet, grassy environments such as prairie pools, muddy shores, fresh and tidal marshes. They prefer tundra in the summer. Migrants favor grassy places rather than open mudflats. Often seen along grassy edges of shores, at edges of tidal marshes, in flooded fields or wet meadows. Sometimes on dry prairie or even plowed fields. On breeding grounds, favours wet grassy areas of tundra dominated by grasses and sedges. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Calidris minutilla</i>	Least Sandpiper	S1B,S4M				Common migrant (generally in flocks) in Nova Scotia. In Nova Scotia, Least Sandpipers are known to nest in sand dunes. During migration they stop on coastal mudflats, rocky shorelines and inland habitats including wet meadows, flooded fields, and muddy edges of lakes, ponds and ditches. On the coast they usually avoid sandy beaches and wide-open tidal flats, preferring narrow tidal creeks and the edges of salt marshes. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Calidris pusilla</i>	Semipalmated Sandpiper	S3M				Common migrant in Nova Scotia. Migrates in flocks (adults before juveniles). May make very long nonstop flights between major feeding areas on migration. Semipalmated Sandpipers nest in low tundra, usually not far from marshes or ponds (both dry upland habitats with sufficient vegetation cover). In preparation for migration, they gather into flocks in shallow-water mudflats or lakeshores. Migrating birds stop over at sewage ponds, ephemeral wetlands (rain pools), beaches, inlets, estuaries, tidal mudflat, sandbars and freshwater impoundments with shallow margins (edges of lakes and marshes). Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Cardellina canadensis</i>	Canada Warbler	S3B	SC	T	E	Forest undergrowth, shady thickets. Breeds in mature mixed hardwoods of extensive forests and streamside thickets. Prefers to nest in moist habitat: in luxuriant undergrowth, near	Nova Scotia Department of Lands and Forestry. 2021.



Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
						swamps, on stream banks, in rhododendron thickets, in deep, rocky ravines and in moist deciduous second-growth.	Recovery Plan for the Canada Warbler (<i>Cardellina canadensis</i>) in Nova Scotia [Final]. Nova Scotia E Species Act Recovery Plan Series.
<i>Cardellina pusilla</i>	Wilson's Warbler	S3B,S5M				Found in thickets along wooded streams, moist tangles, low shrubs, willows, alders. Breeds in thickets, second-growth, bogs, or in alder and willow groves near streams and ponds. In migration and winter, occurs from hot lowland thickets up to cool mountain woods; always in scrubby overgrown clearings and thin woods, not in the interior of dense forest. Breeds between April and July (Cornell Lab, Audubon).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Cathartes aura</i>	Turkey Vulture	S2S3B, S4S5M				In past was not surveyed/very rare to see Turkey Vultures in Nova Scotia, but as the climate warms they are now sighted across the province (MBBA and Nova Scotia Bird Society). Look for Turkey Vultures as they soar high over open areas. They are particularly noticeable along roadsides and at landfills. At night, they roost in trees, on rocks and other high secluded spots. Most common over open or semi-open country (including mixed farmland, forest, rangeland and even small offshore islands), especially within a few miles of rocky or wooded areas providing secure nesting sites. Generally avoids densely forested regions. Breeds between April and July (Audubon and The Cornell Lab)	Nova Scotia Bird Society: https://www.nsbirdsociety.ca/library/resources/the-of-birds-of-ns , Maritime Breeding Bird Atlas (MBBA): https://www.mba-aom.ca/jsp/map.jsp , Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Chaetura pelagica</i>	Chimney Swift	S2S3B, S1M	T	T	E	The chimney swift is associated with urban and rural areas where chimneys are available for nesting and roosting. In their northern breeding range, Chimney Swifts look for sites with a relatively constant ambient temperature.	COSEWIC 2007. COSEWIC assessment and status report on the Chimney Swift <i>Chaetura pelagica</i> in Canada. Committee on the Status of E Wildlife in Canada. Ottawa. Vii + 49 pp. (www.sararegistry.gc.ca/status/status_e.cfm)
<i>Charadrius semipalmatus</i>	Semipalmated Plover	S1B,S4M				Known as a migrant and sometimes a breeder in Nova Scotia (known to breed in more northern or southern areas of the province). Favours very open habitats (little vegetation) for foraging during migration, including broad mudflats, sandy/stony beaches, lake shores, pools in salt marsh; sometimes in flooded fields or even plowed fields with other shorebirds. Tends to avoid flats overgrown with too much marsh vegetation. Migrates mostly late in spring and early in fall. During high tides, and at night, they roost in upper parts of beaches and high hummocks in marshes. Breeds in the north, mostly on open flats of sand or gravel near water. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Charadrius vociferus</i>	Killdeer	S3B				Favours fields, sandbars, lawns, river banks, coastal estuaries, mudflats and shores. Often found on open ground, such as pastures, plowed fields and large lawns, even at a great distance from water. This species does well in areas disturbed by humans and is commonly spotted on roads, lawns, airports, parking lots, golf courses, fields and in gravel areas. Most successful nesting areas have some shallow water closeby or other good feeding area for the chicks. Generally the vegetation in fields inhabited by Killdeer is no taller than one inch. You can find Killdeer near water, but unlike many other shorebirds, they are also common in dry areas. Spring migration is very early, returning to some northern areas in February or March. Breeds between March and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Chlidonias niger</i>	Black Tern	S1B				Uncommon migrant and breeder in Nova Scotia; has mainly been seen in Cumberland County. Migrants turn up in many sorts of wetland habitats: sewage lagoons, river edges, lakes, marshes, lagoons, beaches and over open ocean waters, even far out to sea. Black Terns nest in large freshwater wetlands, usually in dense marshes on the edges of shallow lakes associated with open prairies or northern forests (sometimes in rice fields or on river islands). Breeds in scattered colonies between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Chordeiles minor</i>	Common Nighthawk	S3B	SC	T	T	Common Nighthawk breeds in a range of open and partially open habitats, including forest openings and post-fire habitats, prairies, bogs, and rocky or sandy natural habitats, as well as disturbed areas. It is also found in settled areas that meet its habitat needs, those with open areas for foraging and bare or short-cropped surfaces for nesting. The species use of a wide range of habitats makes it difficult to estimate trends in habitat availability, except in urban habitats, where their main nesting sites – flat graveled roofs – are disappearing.	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/common-nighthawk-2018.html

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Chroicocephalus ridibundus</i>	Black-headed Gull	S3N				Most of this species in Nova Scotia likely comes from Iceland (followed by a sudden growth of the Icelandic nesting population in the 1930s). In winter, found primarily along seacoasts, estuaries and protected bays (generally rare on fresh waters well inland). Breeds along lakes, rivers, bogs, moors, grasslands, swamps and coastal marshes. Usually nests in colonies, sometimes in isolated pairs. Breeds in scattered colonies between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Coccothraustes vespertinus</i>	Evening Grosbeak	S3B,S3N,S3M	SC	SC	V	Evening Grosbeak breeding habitat generally includes open, mature mixedwood forests, where fir species and/or White Spruce are dominant, and Spruce Budworm is abundant. Outside the breeding season, the species seems to depend largely on seed crops from various trees such as firs and spruces in the boreal forest, but is also attracted to ornamental trees that produce seeds or fruit, and bird feeders stocked with sunflower seeds.	Species at Risk Public Registry - The COSEWIC Summaries of Terrestrial Species Eligible for Addition or Reclassification on Schedule 1 - January 2018 (sararegistry.gc.ca).
<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo	S3B				Black-billed Cuckoos are birds of woodlands and thickets, including aspen, poplar, birch, sugar maple, hickory, hawthorn and willow. They tend to occur more frequently in larger and denser woodlands than the Yellow-billed Cuckoo. On their wintering grounds, they live in forest, woodlands and scrub. A long-distance migrant, going to South America for the winter. Migrates at night; sometimes heard calling in flight overhead at night during the spring. During migration, they seek any kind of dense vegetation cover (e.g. young trees or tall shrubs). Common breeder in Nova Scotia. Breeds mostly in deciduous thickets and shrubby places, often on the edges of woodland or around marshes. Also in second growth of mixed deciduous-coniferous woods, or along their brushy edges. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Contopus cooperi</i>	Olive-sided Flycatcher	S3B	SC	T	T	Olive-sided Flycatcher has been widely observed in open coniferous or mixed coniferous forests, often located near water or wetlands with the presence of tall snags or trees from which the species sallies for prey and advertises its territory. Mature conifer stands within patchy landscapes influenced by natural disturbance (e.g., recent burns) support the highest densities of Olive-sided Flycatcher. Nests are generally placed toward the tip of coniferous branches (although other tree types have been used).	Nova Scotia Department of Lands and Forestry. 2021. Recovery Plan for the Olivesided Flycatcher (<i>Contopus cooperi</i>) in Nova Scotia [Final]. Nova Scotia E Species Act Recovery Plan Series.
<i>Contopus virens</i>	Eastern Wood-Pewee	S3S4B	SC	SC	V	The Eastern Wood-pewee is mostly associated with the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in forest stands of intermediate age and in mature stands with little understory vegetation. During migration, a variety of habitats are used, including forest edges, early and successional clearings.	Species Profile (Eastern Wood-pewee) - Species at Risk Public Registry (canada.ca)
<i>Coturnicops noveboracensis</i>	Yellow Rail	SUB	SC	SC		Yellow rail is distributed along northern Nova Scotia. Nesting Yellow Rails are typically found in marshes dominated by sedges, true grasses, and rushes, where there is little or no standing water (generally 0-12 cm water dept), and where the substrate remains saturated throughout the summer. They can be found in damp fields and meadows, on the floodplains of rivers and streams, in the herbaceous vegetation of bogs, and at the upper levels (drier margins) of estuarine and salt marshes. Nesting habitats usually have a dry mat of dead vegetation from previous growing seasons. A greater diversity of habitat types is used during migration and winter than during the breeding season. In winter, the rails are known to use coastal wetlands and rice fields. (COSEWIC Assessment and Status Report).	Species Profile (Yellow Rail) - Species at Risk Public Registry (canada.ca)
<i>Dolichonyx oryzivorus</i>	Bobolink	S3B	SC	T	V	Bobolink has nested in forage crops (e.g., hayfields and pastures dominated by a variety of species, such as clover, Timothy, Kentucky Bluegrass, and broadleaved plants). The Bobolink occurs in various grassland habitats including wet prairie, graminoid peatlands and abandoned fields dominated by tall grasses, remnants of uncultivated virgin prairie (tall-grass prairie), no-till cropland, small-grain fields, restored	Species Profile (Bobolink) - Species at Risk Public Registry (canada.ca)



Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
						surface mining sites and irrigated fields in arid regions. It is generally not abundant in short-grass prairie, Alfalfa fields, or in row crop monocultures (e.g., corn, soybean, wheat), although its use of Alfalfa may vary by region.	
<i>Empidonax traillii</i>	Willow Flycatcher	S2B				Uncommon breeder throughout mainland Nova Scotia, not Cape Breton (MBBA, as of July 2021). In winter, they use shrubby clearings, pastures and woodland edges often near water. Migrates relatively late in spring and early in fall. Breeds in thickets of deciduous trees and shrubs, especially willows, or along woodland edges. Often near streams or marshes and may be found in drier habitats than the Alder Flycatcher. Breeds between April and July (Audubon and The Cornell Lab).	Maritime Breeding Bird Atlas (MBBA): https://www.mba-aom.ca/jsp/map.jsp , Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Euphagus carolinus</i>	Rusty Blackbird	S2B	SC	SC	E	Breeding habitat is characterized by coniferous-dominated forests adjacent to wetlands, such as slow-moving streams, peat bogs, sedge meadows, marshes, swamps and beaver ponds. On migration, the Rusty Blackbird is primarily associated with wooded wetlands. In winter, it occurs primarily in lowland forested wetlands, cultivated fields and pecan groves. Suitable habitat for the species appears to be decreasing on its breeding range and wintering grounds, due mainly to the loss and degradation of wetlands by human activities.	https://wildlife-species.canada.ca/species-risk-registry/species/speciesDetails_e.cfm?sid=907



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<i>Falco sparverius</i>	American Kestrel	S3B,S4 S5M				Breeds in Nova Scotia but also can be a permanent resident. American Kestrels favor open areas with short ground vegetation and sparse trees (e.g. meadows, wood edges, grasslands, deserts, parks, farm fields, cities and suburbs). When breeding, kestrels need access to at least a few trees or structures that provide appropriate nesting cavities. American Kestrels are attracted to many habitats modified by humans, including pastures and parkland, and are often found near areas of human activity including towns and cities. In winter, females may occupy open habitats more so than males. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Fratercula arctica</i>	Atlantic Puffin	S2B				Year-round resident along the coast and offshore of Nova Scotia and commonly breeds in colonies in Northern Cape Breton, middle-mainland Nova Scotia and Southern Nova Scotia. They spend most of the year at-sea (pelagic) in cooler waters. Outside of breeding season usually well offshore, even far out in mid-ocean. Capable of moving long distances; young birds banded in Iceland and Europe have been recovered in eastern Canada. Birds often have the same mates each year. Atlantic Puffins nest in burrows on rocky islands with short vegetation and on sea cliffs with rock crevices. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Gallinago delicata</i>	Wilson's Snipe	S3B,S5 M				Common across Nova Scotia during breeding and also known as a permanent resident in the southern areas of the province. Wilson's Snipes can be found in all types of wet, marshy settings, including wet fields, bogs, fens, swamps, wet meadows and along muddy edges of rivers and ponds. They avoid areas with tall, dense vegetation, but need patches of cover to hide in and to provide a safe lookout for predators. During the breeding season they are mainly found around fresh marshes and bogs, shrubby streambanks and northern tundra. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

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<i>Hirundo rustica</i>	Barn Swallow	S3B	SC	T	E	Barn Swallows forage over a wide range of open and semi-open habitats including natural and anthropogenic grasslands, other farmland, open wetlands, open water, savannah, tundra, highways and other cleared right-of-ways, and cities and towns. They avoid forested regions and high mountains. Barn Swallows throughout the world have adapted to nesting in or on human structures, including buildings, barns, bridges, culverts, wells and mine shafts. Use of natural nest sites such as caves or rock cliffs with crevices or ledges protected by overhangs is rarely reported. Nocturnal roosts are typically in reed or cane beds or other dense vegetation, usually in or near water.	Nova Scotia Department of Lands and Forestry. 2020. Recovery Plan for the Barn Swallow (<i>Hirundo rustica</i>) in Nova Scotia [Final]. Nova Scotia E Species Act Recovery Plan Series.
<i>Histrionicus histrionicus pop. 1</i>	Harlequin Duck - Eastern population	S2S3N, SUM	SC	SC	E	Winters along the Nova Scotia coastline. The harlequin duck is typically found close to shore where the surf breaks along exposed rocky headlands, reefs, and offshore islands. Congregates in coastal marine areas near rocky shorelines or subtidal ledges. Found close to the shore in turbulent places where the surf breaks against the rocks and there are low levels of ice. Harlequin Ducks are typically observed from November until April in turbulent areas along the coast. They are often seen in the Eastern Shore Islands Wildlife Management Area, Port L'Hebert, Chebucto Peninsula and along the Digby Neck.	Species at Risk in Nova Scotia: Identification & Information Guide https://novascotia.ca/natr/wildlife/conserva/harlequin-duck.asp#:~:text=The%20harlequin%20duck%20is%20typically,animals%20among%20the%20churning%20waters.
<i>Hydrobates leucorhous</i>	Leach's Storm-Petrel	S3B	T			Leach's Storm-Petrel breeds on vegetated islands generally free of mammalian predators, and prefers well-drained habitats suitable for excavating underground burrows, such as low forest and meadow. Atlantic Leach's Storm-Petrel usually nests on islands occupied by other seabirds, often including large gulls, and tends to use different habitat from other burrow-nesting species. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/leachs-storm-petrel-2020.html	https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/leachs-storm-petrel-2020.html#toc2

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<i>Icterus galbula</i>	Baltimore Oriole	S2S3B, SUM				Baltimore Orioles are often very common in open woods and groves in summer. Found in open woods, riverside groves, elms, shade trees. Breeds in deciduous or mixed woodland, generally in open woods or edges rather than interior of dense forest. May be common in trees in towns (Audubon). Breeds between April and July (Audubon and The Cornell Lab).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Ixobrychus exilis</i>	Least Bittern	SUB	T	T		The Least bittern has been observed in every Province in Canada. However, it is only probable to be located in Nova Scotia. The Least Bittern breeds strictly in marshes dominated by emergent vegetation surrounded by areas of open water. Most breeding grounds in Canada are dominated by cattails, but breeding also occurs in areas with other robust emergent plants and in shrubby swamps. The presence of stands of dense vegetation is essential for nesting because the nests of Least Bittern sit on platforms of stiff stems. The nests are almost always within 10 m of open water. This small heron prefers large marshes that have relatively stable water levels throughout the nesting period. Needs for wintering habitat are less specific, and appear to be met by a wide variety of wetlands—not only emergent marshes like those used for breeding, but also brackish and saline swamps (Environment Canada Recovery Strategy)	Environment Canada. 2014. Recovery Strategy for the Least Bittern (<i>Ixobrychus exilis</i>) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada. Ottawa. vi + 41 pp.
<i>Lanius borealis</i>	Northern Shrike	S3S4N				They occur in open but brushy habitats, and on calm, sunny days they may sit up on utility wires, bushes, and trees (Cornell Lab). Nests are usually placed in a low tree or large shrub, often in spruce or willow, usually 6-15' above the ground. Breeds between April and July (Audubon and The Cornell Lab).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird

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<i>Limnodromus griseus</i>	Short-billed Dowitcher	S3M				Common migrant in Nova Scotia that prefers coastal habitats. Migrants are opportunistic in their choice of habitat, turning up in man-made environments such as impoundments, sewage ponds and flooded farm fields as well as in muddy margins of rivers, lakes and bays. Migrants also rest on rocky and sandy shorelines (beaches) and occasionally feed in such places, but they forage mostly where there is a fine muddy bottom covered by a few inches of water (pond edges, mudflats and tidal marshes). Breeds far north, mostly in open bogs, marshes and edges of lakes within coniferous forest zone. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Limosa haemastica</i>	Hudsonian Godwit	S2S3M	T			Hudsonian Godwit occurs regularly during breeding or migration in all three territories and in provinces from British Columbia to Québec, as well as occasionally in the fall in all of the Atlantic provinces. Hudsonian Godwit breeds in wetland habitats (sedge meadows and muskeg) in sub-Arctic and Boreal regions. It uses a wide variety of habitats on migration, including freshwater marshes, saline lakes, flooded fields, shallow ponds, coastal wetlands and mudflats (COSEWIC Assessment and Status Report).	COSEWIC. 2019. COSEWIC assessment and status report on the Hudsonian Godwit <i>Limosa haemastica</i> in Canada. Committee on the Status of E Wildlife in Canada. Ottawa. xi + 50 pp. (Species at Risk Public Registry).
<i>Loxia curvirostra</i>	Red Crossbill	S3S4				Found throughout the entire province year-round. Red Crossbills can be found in conifer forests and groves, and breeds in pines (predominately), spruce, hemlock, Douglas-fir, or other evergreens. Breeding occurs from April to July (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird

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<i>Mareca strepera</i>	Gadwall	S2B,S UM				Not common in Nova Scotia but there have been recent confirmed sightings, based on the distribution list by county in this file (MBBA, as of July 2021) - Found in lakes, ponds and marshes. They choose well-vegetated wetlands for foraging and concealing themselves. Gadwall breed mainly in prairie potholes (small ponds scattered throughout the Great Plains and Canadian prairies, hence why they are uncommon in Nova Scotia). Will also breed on tundra, deltas and wetlands in boreal forests farther north. Equally important for breeding are adjacent uplands with vegetation to conceal nests and ducklings. Breeds between April and July (but compared to most ducks, nesting begins rather late) (Audubon and The Cornell Lab)	Maritime Breeding Bird Atlas (MBBA): https://www.mba-aom.ca/jsp/map.jsp , Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Mergus serrator</i>	Red-breasted Merganser	S3S4B, S5M,S 5N				Common in Nova Scotia throughout the year in lakes and open water. During the winter, mainly found along the coast in open waters or in coastal bays and estuaries. Red-breasted Mergansers breed in the boreal forest on fresh, brackish and saltwater wetlands (typically close to the coast). They tend to use saltwater, including estuaries and bays, more often than the Common Merganser. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Mimus polyglottos</i>	Northern Mockingbird	S1B				Year-round resident throughout Nova Scotia, less common in Cape Breton. Found year-round in areas with open ground and shrubby vegetation (e.g. dense, low shrubs - hedges, fruiting bushes and thickets). When foraging on the ground, it prefers grassy areas, rather than bare spots. Common places include roadsides, parkland, cultivated land, suburban areas, woodland edges and in second-growth habitat at low elevations. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Molothrus ater</i>	Brown-headed Cowbird	S2B				Found in farms, fields, prairies, wood edges, river groves. Favors open or semi-open country at all seasons. In winter often concentrates in farmland, pastures, or cattle feedlots. More widespread in breeding season, in grassland, brushy country, forest edges, even desert, but tends to avoid dense unbroken forest. Breeds between April and July, and lays eggs in nests of other birds (Audubon and The Cornell Lab).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird

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<i>Myiarchus crinitus</i>	Great Crested Flycatcher	S1B				Uncommon breeder throughout mainland Nova Scotia, not Cape Breton (MBBA, as of July 2021). Migrates mostly at night. Breeds mainly in deciduous forest or mixed forest, but avoids pure stands of conifers. May be found in either continuous deep forest or in more open wooded areas, around edges of clearings or abandoned orchards. Dead snags and dying trees are important sources of the cavities they need for nesting (will even search out cavities in old orchards and in woody urban areas like parks, cemeteries and golf courses). If there are enough trees, they will claim territories in pastures, along streams and rivers, and in swamps and wetlands. Breeds between April and July (Audubon and The Cornell Lab).	Maritime Breeding Bird Atlas (MBBA): https://www.mba-aom.ca/jsp/map.jsp , Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Numenius borealis</i>	Eskimo Curlew	SXM	E	E		This species have not been recorded in Nova Scotia since 2007. On spring and fall migration, a wide variety of habitats was used historically, including both inter-tidal and terrestrial habitats, the latter including anthropogenic landscapes. As on the breeding areas, the Eskimo Curlew commonly used ericaceous heathland on fall migration in southern Quebec, Labrador, Newfoundland and the Maritime Provinces. On spring migration, they were found in tallgrass and eastern mixed grass prairies, often in areas that had been recently burned or disturbed by grazing bison, and in cultivated fields. (COSEWIC Assessment and Status Report).	COSEWIC. 2009. COSEWIC assessment and status report on the Eskimo Curlew <i>Numenius borealis</i> in Canada. Committee on the Status of E Wildlife in Canada. Ottawa. vii + 32 pp. (www.sararegistry.gc.ca/status/status_e.cfm).
<i>Numenius phaeopus hudsonicus</i>	Whimbrel	S2S3M				Common migrant in Nova Scotia. Migrating whimbrels feed mostly on tidal mudflats and sandflats; they also forage in saltmarshes, lagoons, estuaries and on reefs and rocky shorelines where small crabs are available. When not feeding, Whimbrels roost in flocks in marshes, meadows, fields, dunes and oyster beds, as well as on small islands and even in mangrove trees. Migrating Whimbrels are known to also use coastal tundra and heath in Alaska and Canada. North American Whimbrels breed in subarctic and alpine tundra and taiga, nesting in drier upland environments (heath) or (mainly) wetter lowlands with grasses, sedges, mosses, lichens, small shrubs and stunted trees. Breeds between April and July (The Cornell Lab and eBird).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , eBird: https://ebird.org

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<i>Nycticorax nycticorax</i>	Black-crowned Night-heron	S1B				Not common in Nova Scotia and only has been observed in the southern counties - Requires aquatic habitat for foraging and terrestrial vegetation for cover. Found in wetlands, including saltmarshes, freshwater marshes, swamps, streams, rivers, lakes, ponds, lagoons, tidal mudflats, canals, reservoirs and wet agricultural fields. Roosts in trees and nests in groves of trees, in thickets, or on ground (usually on islands or above water). Breeds throughout the year, but mostly spring to late summer (April to August). May breed or nest earlier than other herons (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Passerculus sandwichensis princeps</i>	Ipswich Sparrow	S1B	SC	SC		The breeding range of Ipswich sparrows is almost exclusively restricted to Sable Island, Nova Scotia. The birds winter in coastal dune habitats, particularly those with direct seaward exposure, from southern Nova Scotia to northern Florida. Ipswich sparrows breed in nearly all vegetated areas on Sable Island, particularly heathy areas dominated by shrubs, which are characteristic of stable terrain on the island, as well as areas where Marram Grass (<i>Ammophila breviligulata</i>) is particularly dense. During winter, Ipswich sparrows are found strictly on coastal beaches and dunes, particularly their seaward portions (COSEWIC Assessment and Status Report).	COSEWIC. 2009. COSEWIC assessment and status report on the Savannah Sparrow <i>Passerculus sandwichensis princeps</i> subspecies <i>Passerculus sandwichensis princeps</i> in Canada. Committee on the Status of E Wildlife in Canada. Ottawa. vi + 21 pp.
<i>Passerella iliaca</i>	Fox Sparrow	S3S4B, S5M				Found year round in Cape Breton, and throughout the migration season (late March and early November) in the rest of the province. Migrates at night. Found in wooded areas, undergrowth, brush. Breeds in brushy areas including woodland edges and clearings, streamside thickets, scrubby second growth, stunted coastal forest. Winters in similar habitats, also in brushy fields, chaparral, well-vegetated suburbs and parks. Breeds from April to July (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Passerina cyanea</i>	Indigo Bunting	S1?B,SUM				This species favors brushy edges rather than unbroken forest. Indigo Buntings breed in brushy and weedy areas. They're common on the edges of woods and fields; along roads, streams, rivers, and powerline cuts; in logged forest plots, brushy canyons, and abandoned fields where shrubby growth is returning. They are also in clearings within deciduous woods, edges of swamps. Breeds between April and July (Audubon and The Cornell Lab).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird

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<i>Petrochelidon pyrrhonota</i>	Cliff Swallow	S2S3B				Breeds throughout Nova Scotia. A long-distance migrant that migrates in flocks, traveling by day. Typically nests in colonies, sometimes with hundreds of nests crowded close together. These colonies are close to a water source, open fields or pastures for foraging, and a source of mud for nest building. Nest site is usually on vertical surface with some overhead shelter. Natural sites were on cliffs. Most sites today are on the sides of buildings, under bridges, in culverts or similar places. They now live in grasslands, towns, broken forest and river edges, but avoid heavy forest and deserts (e.g. open to semi-open land, farms, river bluffs and lakes). Still unaccountably scarce or missing in some seemingly suitable areas. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Phalacrocorax carbo</i>	Great Cormorant	S2S3B, S2S3N				Habitat is mainly over shallow waters close to shore, especially in sheltered bay areas. Nests on rocky sea cliffs of coasts and islands. In recent years, as population has increased, has been found in winter on large rivers inland. Breeds throughout the year, but mostly spring to late summer (April to August) (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	S3B				Look for these birds in forest edges and woodlands. Rose-breasted Grosbeaks breed in moist deciduous forests, deciduous-coniferous forests, thickets, and semiopen habitats. They gravitate toward second-growth woods, suburban areas, parks, gardens, and orchards, as well as shrubby forest edges next to streams, ponds, marshes, roads, or pastures. They favor edges or openings with combination of shrubs and tall trees, rather than unbroken forest. Breeds from April to July (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Pinicola enucleator</i>	Pine Grosbeak	S3B,S5N,S5M				Found throughout the province year-round. Pine grosbeaks can be found in conifers; in winter, other trees. Breeds in open coniferous forest, especially of spruce and fir. In winter often found in deciduous trees (especially fruiting trees), also in groves of pines and other conifers. Breeding occurs from April to July (The Cornell Lab, Audubon).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird



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<i>Pluvialis dominica</i>	American Golden-Plover	S2S3M				Uncommon migrant across Nova Scotia. Found in prairies, mudflats and shores (tundra in the summer). During migration, usually found on short-grass prairies, flooded pastures, plowed fields and, less often, on shorelines, mudflats and beaches (also found in disturbed areas - airports, golf courses and tilled farmland for example). Breeds on Arctic tundra, especially in low vegetation on rocky slopes. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Pluvialis squatarola</i>	Black-bellied Plover	S3M				Migrates through Nova Scotia. Found in mudflats, open marshes and beaches (tundra in the summer). Nesting occurs in drier tundra, often more barren ridges above lowland lakes and rivers (sometimes in lower wet tundra near coast). In winter, found mostly on open sand beaches and tidal flats. During migration will often stop in short-grass prairie or plowed fields, especially during high tides, when mudflats are underwater. In some places, they forage on rocky shorelines. Black-bellied Plovers roost together at high tide and overnight on beaches, saltmarshes and sometimes upland habitats such as farm fields. Most migrate along coast or over sea, but numbers stop over regularly at some inland sites. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Podiceps auritus pop. 2</i>	Horned Grebe - Western population	S3N,SUM				The Horned Grebe winters on the coast of Nova Scotia. It has been observed on lakes, rivers and marshes. Some birds follow coastlines as part of their migration. Horned Grebes generally winter in marine habitats, mainly estuaries and bays. Birds are found in greatest numbers in coastal habitats, including areas that offer some degree of protection. Some birds winter on inland lakes and rivers in areas where the minimum temperature in January is higher than -1°C (Species at Risk Public Registry)	Horned Grebe (<i>Podiceps auritus</i>) (sararegistry.gc.ca)

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Poecile hudsonicus</i>	Boreal Chickadee	S3				Year-round resident throughout Nova Scotia. Occasional small southward invasions in fall, with a few appearing south of breeding range (similar to Black-capped Chickadees invasions). Boreal Chickadees inhabit mostly mature coniferous forests (sometimes mixed forests), usually spruce and balsam fir, often near water. During late fall and winter irruptions, they tend to be found mostly in areas dominated by coniferous trees. Occurs in low stunted spruces as far North as treeline (e.g. spruce bogs). May mate for life, the birds remaining together all year. Nests in a hole in a tree, either a natural cavity or one they created (or from another species). Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Poocetes gramineus</i>	Vesper Sparrow	S1S2B, SUM				Vesper Sparrows breed in open areas with short, sparse grass, areas where there are a few taller plants for use as song perches, and scattered shrubs including, old fields, pastures, weedy fencelines and roadsides, hayfields, and native grasslands. Can be found in meadows, fields, prairies, roadsides, open grassy or weedy fields. May be in weedy roadsides, gravel pits, stubble fields, grassy areas just above sandy beaches. Breeds from April to July (The Cornell Lab, Audubon).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Puffinus puffinus</i>	Manx Shearwater	S1?B				Pelagic seabird present in numbers off northeastern North America from May to October. Comes to shore to breed, mainly on uninhabited offshore islands. Generally occurs over cooler waters. Often feeds closer to shore than other shearwaters. Movements of this species are not well known. Breeds between March and August (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Rallus limicola</i>	Virginia Rail	S2S3B				Breeds across Nova Scotia, but more common in the northern region. Nests in a variety of marshy situations, mostly fresh, but also brackish marshes near the coast. Where this species and Sora breed in same marshes, Virginia Rail typically nests in drier spots. Often moves into salt marshes in winter. During migration, sometimes found in odd spots, even city streets. Virginia Rails occupy shallow (sometimes deeper) freshwater wetlands with tall stands of cattails and rushes (need areas with standing water typically less than 6 inches deep with a	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
						muddy bottom). They are most common in wetlands with 40–70% coverage of tall emergent vegetation, mixed with open water, mudflats and areas with matted vegetation. During the nonbreeding season, Virginia Rails use similar habitat, but may venture into more open areas. Breeds between April and July (Audubon and The Cornell Lab).	
<i>Riparia riparia</i>	Bank Swallow	S2B				As with other swallow species, migratory stopover points are usually centred on large marshes where birds roost at night and disperse to forage throughout the day. There is little information available for Bank Swallows in terms of the importance of area requirements of these disparate habitats and their proximity to each other.	Nova Scotia Department of Lands and Forestry. 2020. Recovery Plan for the Bank Swallow (<i>Riparia riparia</i>) in Nova Scotia [Final]. Nova Scotia E Species Act Recovery Plan Series.
<i>Rissa tridactyla</i>	Black-legged Kittiwake	S2S3B				Uncommon along the shores of mainland Nova Scotia during non-breeding (winter) season, but is common year-round on the North to East shores of Cape Breton. Most migration is offshore. Nests in dense colonies on ledges of seaside cliffs, islands, abandoned buildings, headlands and other sites free of predators. Favours areas of upwellings (concentrations of prey), sometimes the edge of the continental shelf, and may occur from the coast to hundreds of miles offshore. When not breeding, kittiwakes seldom come to land, although juvenile kittiwakes often appear singly on shore. Unlike many North American gulls, they do not visit landfills. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Setophaga castanea</i>	Bay-breasted Warbler	S3S4B, S4S5M				Bay-breasted warblers are found in woodlands, conifers in summer. Usually breeds in northern coniferous forest, in thick stands of spruce and fir. They are predators of spruce budworm, and are abundant in spruce forests during outbreaks. Where spruce is not found, will nest in deciduous or mixed second-growth woods of birches, maples, firs, and pines. Breed from April to July, typically in the latter half of the breeding window (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Setophaga pinus</i>	Pine Warbler	S2S3B, S4S5M				Pine Warblers live in pine or mixed pine-deciduous forest. Also sometimes in cedar or cypress. Various sightings throughout Nova Scotia, generally in the southern portion of the province. Breeds April to July (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Setophaga striata</i>	Blackpoll Warbler	S3B,S5 M				The blackpoll warbler can be found in conifers; broadleaf trees in migration. Breeds in low northern spruce forest. In migration, moves through forests, parks and gardens, they stop over in scrubby thickets and mature evergreen and deciduous forests. Found in the southern half of Nova Scotia during migration and the northern half during the breeding season. Breeding occurs from April to July (The Cornell Lab, Audubon).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Setophaga tigrina</i>	Cape May Warbler	S3B,S UM				The Cape May Warbler can be found in spruce forest; other trees in migration. Breeds in spruce forest, especially during spruce budworm outbreaks, either in pure stands or mixed with firs or other trees, generally in more open woods or near the forest edge. During migration often favors conifers, but also forages in deciduous trees and thickets. Breeding occurs from April to July (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird



Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Sialia sialis</i>	Eastern Bluebird	S3B				Uncommon breeder throughout Nova Scotia. In the north, arrives quite early in spring, and lingers late in fall. These birds live in semi-open country with scattered trees, but with little understory and sparse ground cover. Original habitats probably included open, frequently burned pine savannas, beaver ponds, mature (but open) woods and forest clearings/openings. Today, they are most common along pastures, roadsides, agricultural fields, suburban parks, backyards and golf courses. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Somateria mollissima</i>	Common Eider	S3B,S3M,S3N				Found in marine waters (rarely on fresh water), usually near rocky seacoasts. During nesting, this species favours islands (with vegetation cover) or coasts with rocky shorelines, either barren or forested, or coastal lagoons in tundra regions. On islands, they nest near small lakes, usually those close to saltwater. During preparation or the process of migration, large eider flocks sometimes use freshwater lakes and lagoons. Winter habitat includes areas with rocky seafloors and strong tides, which are generally rich in mollusks. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Spatula clypeata</i>	Northern Shoveler	S2B,SUM				Migrates through all parts of Nova Scotia, except Cape Breton (uncommon for this species to breed in Nova Scotia). Migratory period is quite prolonged in both spring and fall, with many birds moving late in spring and early in fall. Northern Shovelers use shallow wetlands with submerged vegetation during the breeding season, nesting along the margins and in the neighboring grassy fields. Outside of the breeding season they forage in saltmarshes, estuaries, lakes, flooded fields, wetlands, agricultural ponds and wastewater ponds (and fields in vicinity of shallow water) with extensive muddy margins, including stagnant or polluted waters not much favored by other ducks. Pair formation begins in winter and continues during spring migration. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Spatula discors</i>	Blue-winged Teal	S3B				Found mainly in fresh ponds and marshes. In summer they use shallow freshwater marshes and ponds in open country, as well as brackish marshes near coast. In migration and winter they forage and stop in any kind of shallow waters, whether inland or coastal. Flocks in migration are sometimes seen over ocean, many miles offshore. They are flightless during their late summer molt, and they spend this time in prairie potholes or large marshes. Blue-winged Teal nest among grasses or herbaceous vegetation. Pair formation begins in early winter and continues during spring migration. Breeds between April and July (Audubon and The Cornell Lab)	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Spinus pinus</i>	Pine Siskin	S3				Found throughout the province year-round. Pine Siskins can be found in conifers, mixed woods, alders, weedy areas. Breeds mostly in coniferous and mixed woods, often around edges or clearings; sometimes in deciduous woods, isolated conifer groves. In migration and winter occurs in many kinds of semi-open areas, woodland edges, weedy fields. Breeding occurs from April to July (The Cornell Lab, Audubon)	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Sterna dougallii</i>	Roseate Tern	S1B				Only three colonies are known to have had more than 20 pairs in the last 10 years: The Brothers, Grassy Island, and Country Island. In some years, have bred at a variable subset of other sites, including three of the Magdalen Islands, Québec, Machias Seal Island, NB, and about 21 other sites in Nova Scotia. Roseate Terns nest in colonies almost exclusively on small islands with low vegetation, but will occasionally nest on mainland spits. They generally select nest sites with vegetated cover but will also nest under beach debris and driftwood. Roseate Terns generally forage in shallow areas close to shore, near shoals and tide rips, although little is known about their foraging ecology in Canada.	Nova Scotia Department of Lands and Forestry. 2021. Recovery Plan for Roseate Tern (<i>Sterna dougallii</i>) in Nova Scotia [Final]. Nova Scotia E Species Act Recovery Plan Series.
<i>Sterna hirundo</i>	Common Tern	S3B				Common on-shore in Nova Scotia for the breeding season and common off-shore during migration. Nests in colonies (sometimes with other tern species), sometimes in isolated pairs (on undisturbed rocky islands, barrier beaches and saltmarshes). This species forages over both coastal and inland waters in low-lying, open country, where shallow waters are close to nesting sites. After breeding, may move a short	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
						distance north before beginning southward migration. Common Terns are not known to overwinter in North America, although fall migrants may linger to the beginning of January. During the winter, they gather primarily over marine habitats, foraging at sea and resting on boats and beaches. Breeds between April and July (Audubon and The Cornell Lab).	
<i>Sterna paradisaea</i>	Arctic Tern	S3B				Common on-shore in Nova Scotia for the breeding season and common off-shore during migration. At sea for most of year, in wide variety of situations, but seems to spend most time over cold waters and well offshore. Rarely found inland. They tend to migrate offshore although some individuals may migrate overland. They forage over streams, ponds, lakes, estuaries and the open ocean. Nests in colonies (sometimes with other tern species), sometimes in isolated pairs (in treeless areas with little to no ground cover (coastal tundra), in open boreal forests and on undisturbed small islands and barrier beaches). Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Tringa flavipes</i>	Lesser Yellowlegs	S3M				Common migrant throughout Nova Scotia. Occurs widely in migration, including coastal estuaries, salt and fresh marshes, mudflats, shores/edges of lakes and ponds; typically more common on freshwater habitats. Often in same places as Greater Yellowlegs, but may be less frequent on tidal flats. Wetland habitats ranging from tidal flats to sewage ponds to flooded fields; often in the company of other shorebird species. Breeds in open boreal forests and meadows interspersed with marshes and bogs. Breeds between April and July (Audubon and The Cornell Lab).	
<i>Tringa melanoleuca</i>	Greater Yellowlegs	S3B,S4M				Common migrant in Nova Scotia (migrates in flocks). During migration and throughout the winter, Greater Yellowlegs use a wide variety of fresh and brackish wetlands, including mudflats, estuaries, beaches, marshes, lake and pond edges, wet meadows, sewage ponds and flooded agricultural fields. Breeds in boggy and marshes places within northern coniferous forest. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org

Scientific Name	Common Name	SRank	COSEWIC	SARA	NSESA	Habitat Description	Reference
<i>Tringa semipalmata</i>	Willet	S3B				Willetts inhabit open beaches, wet meadows, bayshores, marshes, mudflats and rocky coastal zones. During the breeding season, these birds seek saltmarshes, barrier islands and barrier beaches for breeding. Often nests in colonies, especially along Atlantic Coast (prefers to nest in extensive salt marsh habitat). Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Uria aalge</i>	Common Murre	S1?B				Coastal bird - year-round resident in Northern Nova Scotia and a common migrant throughout the rest of the province (also known to breed at the Southern tip of the province). When not breeding, they remain on the ocean rather than coming ashore to rest or roost (but are known to come close to shore). Favours cool ocean waters, both offshore and near the coast, generally over the continental shelf. Where their range overlaps with the Thick-billed Murre, that species tends to forage over deeper waters, farther from shore (Common Murres also avoid areas of pack ice). Nests in colonies on the coast, islands, rocky cliffs and headlands at the edge of the ocean. During the breeding season, they forage at sea, normally over waters deeper than 100 feet and well away from land, at places where warm and cool currents meet and concentrate fish. Breeds between April and July (Audubon and The Cornell Lab).	Audubon: https://www.audubon.org/bird-guide , The Cornell Lab - All About Birds: https://www.allaboutbirds.org
<i>Vireo gilvus</i>	Warbling Vireo	S1B,SUM				Occurs in deciduous and mixed woods, aspen groves, poplars, shade trees. Breeds in open deciduous or mixed woodland; also in orchards, shade trees of towns (Audubon). They stay high in deciduous trees (Cornell Lab). Breeds between April and July (Audubon and The Cornell Lab).	The Cornell Lab - All About Birds: https://www.allaboutbirds.org , Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird
<i>Vireo philadelphicus</i>	Philadelphia Vireo	S2?B,SUM				Occurs in second growth; poplars, willows, alders. Breeds in deciduous and mixed woodlands, especially near their edges, or in the young growth of overgrown pastures. Also nests in willows and alders along streams, lakes, and ponds. Breeds between April and July (Audubon).	Audubon Guide to North American Birds: https://www.audubon.org/field-guide/bird



WEDGEPORT WIND FARM PROJECT
AVIAFAUNA BIOPHYSICAL BASELINE REPORT

APPENDIX C. ACCDC REPORT

DATA REPORT 7250: Wedgeport, NS

Prepared 5 May 2022

by J. Churchill, Data Manager

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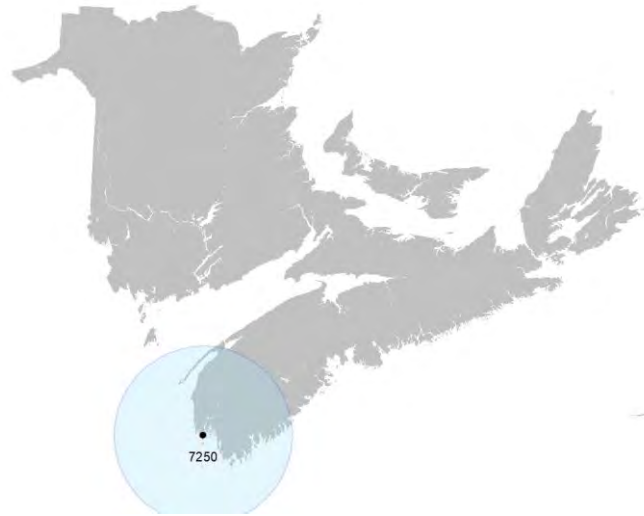
4.2 Flora

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5.1 Source Bibliography



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename

WedgeportNS_7250ob.xls

WedgeportNS_7250ob100km.xls

WedgeportNS_7250msa.xls

Contents

Rare or legally-protected Flora and Fauna in your study area

A list of Rare and legally protected Flora and Fauna within 100 km of your study area

Managed and Biologically Significant Areas in your study area

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

- a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
- b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
- c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
- d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
- e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
- f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
- g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries

Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)

John Klymko
Zoologist
(506) 364-2660
john.klymko@accdc.ca

Data Management, GIS

James Churchill
Conservation Data Analyst / Field Biologist
(902) 679-6146
james.churchill@accdc.ca

Billing

Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

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(902) 541-0081
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Eastern: Elizabeth Walsh
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Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

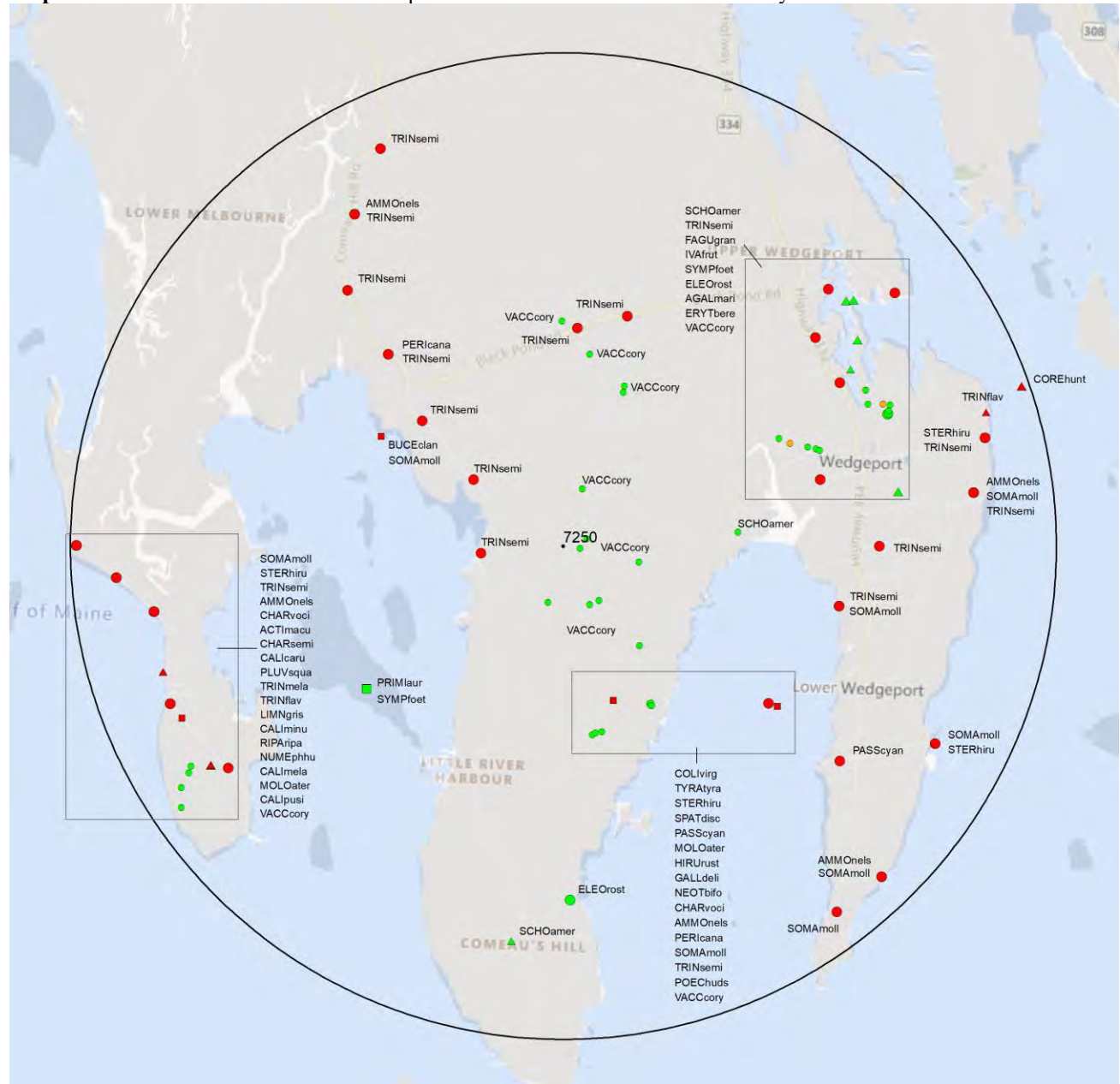
2.1 FLORA

The study area contains 46 records of 9 vascular, no records of nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 143 records of 28 vertebrate, 2 records of 1 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



RESOLUTION

- 4.7 within 50s of kilometers
- 4.0 within 10s of kilometers
- 3.7 within 5s of kilometers
- △ 3.0 within kilometers
- △ 2.7 within 500s of meters
- ◇ 2.0 within 100s of meters
- ◇ 1.7 within 10s of meters

HIGHER TAXONII

- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

3.0 SPECIAL AREAS

3.1 MANAGED AREAS

The GIS scan identified 4 managed areas in the vicinity of the study area (Map 3 and attached file: *msa.xls).

3.2 SIGNIFICANT AREAS

The GIS scan identified 2 biologically significant sites in the vicinity of the study area (Map 3 and attached file: *msa.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding “location-sensitive” species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (\pm the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
P	<i>Agalinis maritima</i>	Saltmarsh Agalinis				S2	7	2.7 \pm 0.0
P	<i>Iva frutescens</i>	Big-leaved Marsh-elder				S3	1	3.4 \pm 0.0
P	<i>Primula laurentiana</i>	Laurentian Primrose				S3	1	2.5 \pm 7.0
P	<i>Eleocharis rostellata</i>	Beaked Spikerush				S3	4	2.4 \pm 0.0
P	<i>Schoenoplectus americanus</i>	Olney's Bulrush				S3	6	1.8 \pm 0.0
P	<i>Neottia bifolia</i>	Southern Twayblade				S3	4	1.8 \pm 0.0
P	<i>Vaccinium corymbosum</i>	Highbush Blueberry				S3S4	20	0.2 \pm 0.0
P	<i>Fagus grandifolia</i>	American Beech				S3S4	1	3.4 \pm 0.0
P	<i>Symplocarpus foetidus</i>	Eastern Skunk Cabbage				S3S4	2	2.5 \pm 7.0

4.2 FAUNA

	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	<i>Coregonus huntsmani</i>	Atlantic Whitefish	Endangered	Endangered	Endangered	S1	1	4.9 \pm 1.0
A	<i>Colinus virginianus</i>	Northern Bobwhite	Endangered	Endangered			2	2.6 \pm 0.0
A	<i>Riparia riparia</i>	Bank Swallow	Threatened	Threatened	Endangered	S2B	2	4.2 \pm 1.0
A	<i>Tringa flavipes</i>	Lesser Yellowlegs	Threatened			S3M	8	4.2 \pm 0.0
A	<i>Hirundo rustica</i>	Barn Swallow	Special Concern	Threatened	Endangered	S3B	1	2.7 \pm 5.0
A	<i>Sterna hirundo</i>	Common Tern	Not At Risk			S3B	4	2.7 \pm 5.0
A	<i>Ammospiza nelsoni</i>	Nelson's Sparrow	Not At Risk			S3S4B	6	2.7 \pm 5.0
A	<i>Calidris canutus rufa</i>	Red Knot rufa subspecies - Tierra del Fuego / Patagonia wintering population	E,SC	Endangered	Endangered	S2M	1	4.3 \pm 0.0
A	<i>Passerina cyanea</i>	Indigo Bunting				S1?B,SUM	2	2.7 \pm 5.0
A	<i>Charadrius semipalmatus</i>	Semipalmated Plover				S1B,S4M	8	4.2 \pm 0.0
A	<i>Calidris minutilla</i>	Least Sandpiper				S1B,S4M	6	4.2 \pm 0.0
A	<i>Molothrus ater</i>	Brown-headed Cowbird				S2B	2	2.7 \pm 5.0
A	<i>Bucephala clangula</i>	Common Goldeneye				S2S3B,S5N,S5M	1	2.2 \pm 5.0
A	<i>Numenius phaeopus hudsonicus</i>	Whimbrel				S2S3M	1	4.2 \pm 0.0
A	<i>Perisoreus canadensis</i>	Canada Jay				S3	3	1.6 \pm 5.0
A	<i>Poecile hudsonicus</i>	Boreal Chickadee				S3	3	1.6 \pm 5.0
A	<i>Spatula discors</i>	Blue-winged Teal				S3B	1	2.7 \pm 5.0
A	<i>Charadrius vociferus</i>	Killdeer				S3B	6	2.7 \pm 5.0
A	<i>Tringa semipalmata</i>	Willet				S3B	38	0.8 \pm 0.0
A	<i>Tyrannus tyrannus</i>	Eastern Kingbird				S3B	1	2.7 \pm 5.0
A	<i>Somateria mollissima</i>	Common Eider				S3B,S3M,S3N	15	1.6 \pm 5.0
A	<i>Tringa melanoleuca</i>	Greater Yellowlegs				S3B,S4M	10	4.2 \pm 0.0
A	<i>Gallinago delicata</i>	Wilson's Snipe				S3B,S5M	1	2.7 \pm 5.0
A	<i>Pluvialis squatarola</i>	Black-bellied Plover				S3M	4	4.2 \pm 0.0
A	<i>Calidris pusilla</i>	Semipalmated Sandpiper				S3M	7	4.2 \pm 0.0
A	<i>Calidris melanotos</i>	Pectoral Sandpiper				S3M	1	4.2 \pm 0.0
A	<i>Limnodromus griseus</i>	Short-billed Dowitcher				S3M	5	4.2 \pm 0.0
A	<i>Actitis macularia</i>	Spotted Sandpiper				S3S4B,S5M	3	4.3 \pm 0.0
I	<i>Erythrodiplax berenice</i>	Seaside Dragonlet				S3S4	2	2.5 \pm 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with “YES”.

Nova Scotia

Scientific Name	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
<i>Fraxinus nigra</i>	Black Ash		Threatened	No
<i>Emydoidea blandingii</i>	Blanding's Turtle - Nova Scotia pop.	Endangered	Vulnerable	No
<i>Glyptemys insculpta</i>	Wood Turtle	Threatened	Threatened	No
<i>Falco peregrinus pop. 1</i>	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Vulnerable	No
Bat hibernaculum or bat species occurrence		[Endangered]'	[Endangered]'	YES

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
59	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
34	Morrison, Guy. 2011. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Ottawa, 15939 surveys. 86171 recs.
28	Paquet, Julie. 2018. Atlantic Canada Shorebird Survey (ACSS) database 2012-2018. Environment Canada, Canadian Wildlife Service.
19	LaPaix, R.W.; Crowell, M.J.; MacDonald, M. 2011. Stantec rare plant records, 2010-11. Stantec Consulting, 334 recs.
15	Pardieck, K.L., Ziolkowski Jr., D.J., Lutmerding, M., Aponte, V.I., and Hudson, M-A.R. 2020. North American Breeding Bird Survey Dataset 1966 - 2019: U.S. Geological Survey data release, https://doi.org/10.5066/P9J6QUF6
13	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
5	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
5	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
4	Robinson, S.L. 2014. 2013 Field Data. Atlantic Canada Conservation Data Centre.
3	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
3	Nova Scotia Dept Natural Resources, Forestry Branch. 2007. Restricted & Limited Use Land Database (RLUL). , http://www.gov.ns.ca/natr/FORESTRY/rlul/downloadrlul.htm .
2	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.
2	eBird. 2020. eBird Basic Dataset. Version: EBD_reiNov-2019. Ithaca, New York. Nov 2019, Cape Breton Bras d'Or Lakes Watershed subset. Cornell Lab of Ornithology.
1	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
1	Canadian Wildlife Service. 2019. Canadian Protected and Conserved Areas Database (CPCAD). December 2019. ECCC. https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas/protected-conserved-areas-database.html .
1	Edge, Thomas A. 1984. Status report on the Atlantic Whitefish (<i>Coregonus huntsmani</i>). Committee on the Status of Endangered Wildlife in Canada.
1	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
1	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 26892 records of 138 vertebrate and 269 records of 30 invertebrate fauna; 14181 records of 182 vascular, 4607 records of 122 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including “location-sensitive” species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (\pm the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	<i>Coregonus huntsmani</i>	Atlantic Whitefish	Endangered	Endangered	Endangered	S1	5	4.9 \pm 1.0	NS
A	<i>Myotis lucifugus</i>	Little Brown Myotis	Endangered	Endangered	Endangered	S1	215	4.6 \pm 0.0	NS
A	<i>Myotis septentrionalis</i>	Northern Myotis	Endangered	Endangered	Endangered	S1	44	24.5 \pm 0.0	NS
A	<i>Perimyotis subflavus</i>	Tricolored Bat	Endangered	Endangered	Endangered	S1	97	41.9 \pm 0.0	NS
A	<i>Emydoidea blandingii</i>	Blanding's Turtle	Endangered	Endangered	Endangered	S1	4411	68.7 \pm 24.0	NS
A	<i>Salmo salar pop. 1</i>	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered		S1	2	95.0 \pm 1.0	NS
A	<i>Salmo salar pop. 6</i>	Atlantic Salmon - Nova Scotia Southern Upland population	Endangered			S1	11	9.3 \pm 1.0	NS
A	<i>Charadrius melodus melodus</i>	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	1769	5.1 \pm 0.0	NS
A	<i>Sterna dougallii</i>	Roseate Tern	Endangered	Endangered	Endangered	S1B	111	5.6 \pm 0.0	NS
A	<i>Morone saxatilis pop. 2</i>	Striped Bass - Bay of Fundy population	Endangered			S2S3B,S2S3N	1	54.4 \pm 1.0	NS
A	<i>Protonotaria citrea</i>	Prothonotary Warbler	Endangered	Endangered		SNA	4	22.5 \pm 0.0	NS
A	<i>Icteria virens</i>	Yellow-Breasted Chat	Endangered	Endangered		SNA	2	14.5 \pm 0.0	NS
A	<i>Caretta caretta</i>	Loggerhead Sea Turtle	Endangered	Endangered		SNA	1	72.6 \pm 0.0	NS
A	<i>Colinus virginianus</i>	Northern Bobwhite	Endangered	Endangered			5	2.6 \pm 0.0	NS
A	<i>Antrostomus vociferus</i>	Eastern Whip-Poor-Will	Threatened	Threatened	Threatened	S1?B	4	5.4 \pm 7.0	NS
A	<i>Asio flammeus</i>	Short-eared Owl	Threatened	Threatened	Special Concern	S1B	7	11.4 \pm 0.0	NS
A	<i>Glyptemys insculpta</i>	Wood Turtle	Threatened	Threatened	Threatened	S2	2	59.5 \pm 5.0	NS
A	<i>Riparia riparia</i>	Bank Swallow	Threatened	Threatened	Endangered	S2B	432	4.2 \pm 1.0	NS
A	<i>Thamnophis saurita</i>	Eastern Ribbonsnake	Threatened	Threatened	Threatened	S2S3	1415	49.3 \pm 0.0	NS
A	<i>Chaetura pelagica</i>	Chimney Swift	Threatened	Threatened	Endangered	S2S3B,S1M	157	11.7 \pm 7.0	NS
A	<i>Limosa haemastica</i>	Hudsonian Godwit	Threatened			S2S3M	204	5.1 \pm 0.0	NS
A	<i>Dolichonyx oryzivorus</i>	Bobolink	Threatened	Threatened	Vulnerable	S3B	62	5.4 \pm 7.0	NS
A	<i>Hydrobates leucorhous</i>	Leach's Storm-Petrel	Threatened			S3B	64	11.5 \pm 5.0	NS
A	<i>Tringa flavipes</i>	Lesser Yellowlegs	Threatened			S3M	478	4.2 \pm 0.0	NS
A	<i>Anguilla rostrata</i>	American Eel	Threatened			S3N	253	76.9 \pm 0.0	NS
A	<i>Ixobrychus exilis</i>	Least Bittern	Threatened	Threatened		SUB	1	45.2 \pm 0.0	NS
A	<i>Hylocichla mustelina</i>	Wood Thrush	Threatened	Threatened		SUB	14	10.1 \pm 7.0	NS
A	<i>Passerculus sandwichensis princeps</i>	Ipswich Sparrow	Special Concern	Special Concern		S1B	5	11.2 \pm 0.0	NS
A	<i>Bucephala islandica</i>	Barrow's Goldeneye	Special Concern	Special Concern		S1N,SUM	1	13.7 \pm 0.0	NS
A	<i>Euphagus carolinus</i>	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	91	11.7 \pm 7.0	NS
A	<i>Balaenoptera physalus</i>	Fin Whale	Special Concern	Special Concern		S2S3	1	79.6 \pm 50.0	NS
A	<i>Phalaropus lobatus</i>	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	14	19.5 \pm 2.0	NS
A	<i>Histrionicus histrionicus pop. 1</i>	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S2S3N,SUM	34	7.0 \pm 0.0	NS
A	<i>Chelydra serpentina</i>	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	115	13.4 \pm 0.0	NS
A	<i>Hirundo rustica</i>	Barn Swallow	Special Concern	Threatened	Endangered	S3B	497	2.7 \pm 5.0	NS
A	<i>Cardellina canadensis</i>	Canada Warbler	Special Concern	Threatened	Endangered	S3B	256	14.2 \pm 0.0	NS
A	<i>Chordeiles minor</i>	Common Nighthawk	Special Concern	Threatened	Threatened	S3B	206	16.7 \pm 0.0	NS
A	<i>Contopus cooperi</i>	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B	453	14.0 \pm 0.0	NS
A	<i>Coccothraustes vespertinus</i>	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	319	18.1 \pm 7.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	<i>Podiceps auritus</i>	Horned Grebe	Special Concern	Special Concern		S3N,SUM	7	42.5 ± 10.0	NS
A	<i>Contopus virens</i>	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	538	8.1 ± 0.0	NS
A	<i>Phocoena phocoena</i>	Harbour Porpoise	Special Concern			S4	13	11.5 ± 16.0	NS
A	<i>Chrysemys picta picta</i>	Eastern Painted Turtle	Special Concern	Special Concern		S4	145	10.1 ± 10.0	NS
A	<i>Calidris subruficollis</i>	Buff-breasted Sandpiper	Special Concern	Special Concern		SNA	65	8.7 ± 0.0	NS
A	<i>Accipiter cooperii</i>	Cooper's Hawk	Not At Risk			S1?B,SUN,SUM	3	44.0 ± 0.0	NS
A	<i>Fulica americana</i>	American Coot	Not At Risk			S1B	1	58.6 ± 0.0	NS
A	<i>Falco peregrinus pop. 1</i>	Peregrine Falcon - anatum/tundrius	Not At Risk	Special Concern	Vulnerable	S1B,SUM	7	43.3 ± 0.0	NS
A	<i>Lynx canadensis</i>	Canada Lynx	Not At Risk		Endangered	S2S3	1	47.6 ± 1.0	NS
A	<i>Hemidactylium scutatum</i>	Four-toed Salamander	Not At Risk			S3	8	22.2 ± 0.0	NS
A	<i>Megaptera novaeangliae</i>	Humpback Whale	Not At Risk			S3	13	23.4 ± 0.0	NS
A	<i>Sterna hirundo</i>	Common Tern	Not At Risk			S3B	261	2.7 ± 5.0	NS
A	<i>Sialia sialis</i>	Eastern Bluebird	Not At Risk			S3B	22	7.4 ± 0.0	NS
A	<i>Buteo lagopus</i>	Rough-legged Hawk	Not At Risk			S3N	2	38.6 ± 0.0	NS
A	<i>Accipiter gentilis</i>	Northern Goshawk	Not At Risk			S3S4	15	18.1 ± 7.0	NS
A	<i>Glaucomys volans</i>	Southern Flying Squirrel	Not At Risk			S3S4	8	82.9 ± 0.0	NS
A	<i>Lagenorhynchus acutus</i>	Atlantic White-sided Dolphin	Not At Risk			S3S4	2	67.3 ± 0.0	NS
A	<i>Ammospiza nelsoni</i>	Nelson's Sparrow	Not At Risk			S3S4B	93	2.7 ± 5.0	NS
A	<i>Calidris canutus rufa</i>	Red Knot rufa subspecies - Tierra del Fuego / Patagonia wintering population	E,SC	Endangered	Endangered	S2M	319	4.3 ± 0.0	NS
A	<i>Morone saxatilis</i>	Striped Bass	E,SC			S2S3B,S2S3N	8	7.6 ± 1.0	NS
A	<i>Alces alces americana</i>	Moose			Endangered	S1	116	24.8 ± 1.0	NS
A	<i>Uria aalge</i>	Common Murre				S1?B	5	11.2 ± 0.0	NS
A	<i>Passerina cyanea</i>	Indigo Bunting				S1?B,SUM	23	2.7 ± 5.0	NS
A	<i>Nycticorax nycticorax</i>	Black-crowned Night-heron				S1B	23	20.5 ± 7.0	NS
A	<i>Gallinula galeata</i>	Common Gallinule				S1B	1	45.2 ± 0.0	NS
A	<i>Myiarchus crinitus</i>	Great Crested Flycatcher				S1B	20	18.1 ± 7.0	NS
A	<i>Cistothorus palustris</i>	Marsh Wren				S1B	2	13.4 ± 0.0	NS
A	<i>Mimus polyglottos</i>	Northern Mockingbird				S1B	12	10.1 ± 7.0	NS
A	<i>Toxostoma rufum</i>	Brown Thrasher				S1B	5	10.1 ± 7.0	NS
A	<i>Charadrius semipalmatus</i>	Semipalmated Plover				S1B,S4M	1230	4.2 ± 0.0	NS
A	<i>Calidris minutilla</i>	Least Sandpiper				S1B,S4M	841	4.2 ± 0.0	NS
A	<i>Anas acuta</i>	Northern Pintail				S1B,SUM	4	11.7 ± 7.0	NS
A	<i>Vireo gilvus</i>	Warbling Vireo				S1B,SUM	12	13.1 ± 0.0	NS
A	<i>Vespertilionidae sp.</i>	bat species				S1S2	85	13.1 ± 0.0	NS
A	<i>Vireo philadelphicus</i>	Philadelphia Vireo				S2?B,SUM	8	8.4 ± 0.0	NS
A	<i>Alca torda</i>	Razorbill				S2B	20	5.4 ± 7.0	NS
A	<i>Fratercula arctica</i>	Atlantic Puffin				S2B	48	5.4 ± 7.0	NS
A	<i>Empidonax traillii</i>	Willow Flycatcher				S2B	17	11.9 ± 1.0	NS
A	<i>Molothrus ater</i>	Brown-headed Cowbird				S2B	56	2.7 ± 5.0	NS
A	<i>Spatula clypeata</i>	Northern Shoveler				S2B,SUM	4	31.8 ± 7.0	NS
A	<i>Mareca strepera</i>	Gadwall				S2B,SUM	8	31.5 ± 5.0	NS
A	<i>Piranga olivacea</i>	Scarlet Tanager				S2B,SUM	22	23.2 ± 0.0	NS
A	<i>Calidris alba</i>	Sanderling				S2N,S3M	819	5.1 ± 0.0	NS
A	<i>Martes americana</i>	American Marten			Endangered	S2S3	19	37.8 ± 0.0	NS
A	<i>Asio otus</i>	Long-eared Owl				S2S3	8	36.2 ± 7.0	NS
A	<i>Rissa tridactyla</i>	Black-legged Kittiwake				S2S3B	1	22.4 ± 0.0	NS
A	<i>Petrochelidon pyrrhonota</i>	Cliff Swallow				S2S3B	65	5.4 ± 7.0	NS
A	<i>Phalacrocorax carbo</i>	Great Cormorant				S2S3B,S2S3N	40	37.7 ± 9.0	NS
A	<i>Cathartes aura</i>	Turkey Vulture				S2S3B,S4S5M	23	17.6 ± 0.0	NS
A	<i>Setophaga pinus</i>	Pine Warbler				S2S3B,S4S5M	6	39.0 ± 7.0	NS
A	<i>Bucephala clangula</i>	Common Goldeneye				S2S3B,S5N,S5M	63	2.2 ± 5.0	NS
A	<i>Icterus galbula</i>	Baltimore Oriole				S2S3B,SUM	33	10.1 ± 7.0	NS
A	<i>Pluvialis dominica</i>	American Golden-Plover				S2S3M	142	5.1 ± 0.0	NS
A	<i>Numenius phaeopus hudsonicus</i>	Whimbrel				S2S3M	398	4.2 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	<i>Phalaropus fulicarius</i>	Red Phalarope				S2S3M	14	45.2 ± 0.0	NS
A	<i>Perisoreus canadensis</i>	Canada Jay				S3	160	1.6 ± 5.0	NS
A	<i>Poecile hudsonicus</i>	Boreal Chickadee				S3	186	1.6 ± 5.0	NS
A	<i>Spinus pinus</i>	Pine Siskin				S3	77	10.1 ± 7.0	NS
A	<i>Salvelinus fontinalis</i>	Brook Trout				S3	10	63.3 ± 0.0	NS
A	<i>Pekania pennanti</i>	Fisher				S3	2	56.9 ± 0.0	NS
A	<i>Calcarius lapponicus</i>	Lapland Longspur				S3?N,SUM	2	45.2 ± 0.0	NS
A	<i>Spatula discors</i>	Blue-winged Teal				S3B	18	2.7 ± 5.0	NS
A	<i>Charadrius vociferus</i>	Killdeer				S3B	381	2.7 ± 5.0	NS
A	<i>Tringa semipalmata</i>	Willet				S3B	1559	0.8 ± 0.0	NS
A	<i>Sterna paradisaea</i>	Arctic Tern				S3B	109	5.6 ± 0.0	NS
A	<i>Cephus grylle</i>	Black Guillemot				S3B	3	91.8 ± 40.0	NB
A	<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo				S3B	28	10.1 ± 7.0	NS
A	<i>Tyrannus tyrannus</i>	Eastern Kingbird				S3B	61	2.7 ± 5.0	NS
A	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak				S3B	77	10.1 ± 7.0	NS
A	<i>Alosa pseudoharengus</i>	Alewife				S3B	20	5.4 ± 1.0	NS
A	<i>Somateria mollissima</i>	Common Eider				S3B,S3M,S3N	469	1.6 ± 5.0	NS
A	<i>Tringa melanoleuca</i>	Greater Yellowlegs				S3B,S4M	1069	4.2 ± 0.0	NS
A	<i>Falco sparverius</i>	American Kestrel				S3B,S4S5M	44	17.5 ± 7.0	NS
A	<i>Gallinago delicata</i>	Wilson's Snipe				S3B,S5M	189	2.7 ± 5.0	NS
A	<i>Setophaga striata</i>	Blackpoll Warbler				S3B,S5M	47	8.3 ± 0.0	NS
A	<i>Cardellina pusilla</i>	Wilson's Warbler				S3B,S5M	26	18.1 ± 7.0	NS
A	<i>Pinicola enucleator</i>	Pine Grosbeak				S3B,S5N,S5M	45	28.0 ± 7.0	NS
A	<i>Setophaga tigrina</i>	Cape May Warbler				S3B,SUM	31	13.2 ± 0.0	NS
A	<i>Branta bernicla</i>	Brant				S3M	13	5.5 ± 10.0	NS
A	<i>Pluvialis squatarola</i>	Black-bellied Plover				S3M	1062	4.2 ± 0.0	NS
A	<i>Arenaria interpres</i>	Ruddy Turnstone				S3M	566	5.1 ± 0.0	NS
A	<i>Calidris pusilla</i>	Semipalmated Sandpiper				S3M	1237	4.2 ± 0.0	NS
A	<i>Calidris melanotos</i>	Pectoral Sandpiper				S3M	202	4.2 ± 0.0	NS
A	<i>Limnodromus griseus</i>	Short-billed Dowitcher				S3M	700	4.2 ± 0.0	NS
A	<i>Chroicocephalus ridibundus</i>	Black-headed Gull				S3N	3	22.5 ± 0.0	NS
A	<i>Picoides arcticus</i>	Black-backed Woodpecker				S3S4	29	29.7 ± 7.0	NS
A	<i>Loxia curvirostra</i>	Red Crossbill				S3S4	101	14.2 ± 1.0	NS
A	<i>Botaurus lentiginosus</i>	American Bittern				S3S4B,S4S5M	61	10.1 ± 7.0	NS
A	<i>Setophaga castanea</i>	Bay-breasted Warbler				S3S4B,S4S5M	125	8.2 ± 0.0	NS
A	<i>Actitis macularius</i>	Spotted Sandpiper				S3S4B,S5M	519	4.3 ± 0.0	NS
A	<i>Leiothlypis peregrina</i>	Tennessee Warbler				S3S4B,S5M	44	11.7 ± 7.0	NS
A	<i>Passerella iliaca</i>	Fox Sparrow				S3S4B,S5M	33	8.1 ± 7.0	NS
A	<i>Mergus serrator</i>	Red-breasted Merganser				S3S4B,S5M,S5N	26	8.1 ± 7.0	NS
A	<i>Calidris maritima</i>	Purple Sandpiper				S3S4N	50	19.4 ± 0.0	NS
A	<i>Lanius borealis</i>	Northern Shrike				S3S4N	2	37.4 ± 0.0	NS
A	<i>Morus bassanus</i>	Northern Gannet				SHB	10	11.2 ± 0.0	NS
A	<i>Leucophaeus atricilla</i>	Laughing Gull				SHB	4	42.3 ± 0.0	NS
A	<i>Progne subis</i>	Purple Martin				SHB	1	45.2 ± 0.0	NS
A	<i>Eremophila alpestris</i>	Horned Lark				SHB,S4S5N,S5M	4	14.0 ± 0.0	NS
I	<i>Bombus bohemicus</i>	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1	2	40.1 ± 5.0	NS
I	<i>Danaus plexippus</i>	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	132	8.4 ± 0.0	NS
I	<i>Danaus plexippus plexippus</i>	Monarch	Endangered	Special Concern		S2?B,S3M	1	37.6 ± 0.0	NS
I	<i>Bombus suckleyi</i>	Suckley's Cuckoo Bumble Bee	Threatened			SH	1	40.0 ± 0.0	NS
I	<i>Bombus terricola</i>	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	26	10.9 ± 0.0	NS
I	<i>Pachydiplax longipennis</i>	Blue Dasher				S1	1	45.2 ± 0.0	NS
I	<i>Atlanticoncha ochracea</i>	Tidewater Mucket				S1	1	62.4 ± 0.0	NS
I	<i>Pantala hymenaea</i>	Spot-Winged Glider				S2?B	2	45.2 ± 0.0	NS
I	<i>Nymphalis l-album</i>	Compton Tortoiseshell				S2S3	3	14.3 ± 2.0	NS
I	<i>Hippodamia parenthesis</i>	Parenthesis Lady Beetle				S3	1	31.1 ± 0.0	NS
I	<i>Naemia seriata</i>	Seaside Lady Beetle				S3	4	10.9 ± 0.0	NS
I	<i>Chilocorus stigma</i>	Twice-stabbed Lady Beetle				S3	1	97.1 ± 0.0	NS

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I	<i>Myzia pullata</i>	Streaked Lady Beetle				S3	1	10.9 ± 0.0	NS
I	<i>Astylopsis sexguttata</i>	Six-speckled Long-horned Beetle				S3	1	80.6 ± 0.0	NS
I	<i>Satyrrium calanus</i>	Banded Hairstreak				S3	1	53.1 ± 2.0	NS
I	<i>Strymon melinus</i>	Gray Hairstreak				S3	1	57.0 ± 0.0	NS
I	<i>Ophiogomphus aspersus</i>	Brook Snaketail				S3	2	79.6 ± 0.0	NS
I	<i>Epitheca princeps</i>	Prince Baskettail				S3	3	87.3 ± 1.0	NS
I	<i>Polygona interrogationis</i>	Question Mark				S3B	15	12.8 ± 2.0	NS
I	<i>Amblyscirtes hegon</i>	Pepper and Salt Skipper				S3S4	1	14.8 ± 2.0	NS
I	<i>Argynnis aphrodite</i>	Aphrodite Fritillary				S3S4	4	38.4 ± 0.0	NS
I	<i>Polygona faunus</i>	Green Comma				S3S4	1	78.1 ± 20.0	NS
I	<i>Aeshna clepsydra</i>	Mottled Darner				S3S4	15	35.7 ± 0.0	NS
I	<i>Aeshna constricta</i>	Lance-Tipped Darner				S3S4	1	72.3 ± 0.0	NS
I	<i>Boyeria graefiana</i>	Ocellated Darner				S3S4	5	18.9 ± 0.0	NS
I	<i>Gomphaeschna furcillata</i>	Harlequin Darner				S3S4	1	57.6 ± 0.0	NS
I	<i>Erythrodiplax berenice</i>	Seaside Dragonlet				S3S4	32	2.5 ± 0.0	NS
I	<i>Nannothemis bella</i>	Elfin Skimmer				S3S4	4	51.6 ± 0.0	NS
I	<i>Enallagma vesperum</i>	Vesper Bluet				S3S4	3	35.7 ± 0.0	NS
I	<i>Amphiagrion saucium</i>	Eastern Red Damsel				S3S4	3	39.6 ± 1.0	NS
N	<i>Erioderma mollissimum</i>	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1	304	13.7 ± 0.0	NS
N	<i>Erioderma pedicellatum</i> (Atlantic pop.)	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	52	20.4 ± 0.0	NS
N	<i>Pannaria lurida</i>	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	63	28.5 ± 0.0	NS
N	<i>Pannaria lurida ssp. russellii</i>	Wrinkled Shingle Lichen	Threatened	Threatened		S2S3	1	96.7 ± 0.0	NS
N	<i>Anzia colpodes</i>	Black-foam Lichen	Threatened	Threatened	Threatened	S3	180	13.7 ± 0.0	NS
N	<i>Fuscopannaria leucosticta</i>	White-rimmed Shingle Lichen	Threatened			S3	394	33.4 ± 0.0	NS
N	<i>Pectenaria plumbea</i>	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	757	12.9 ± 0.0	NS
N	<i>Sclerophora peronella</i> (Atlantic pop.)	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S3S4	95	48.6 ± 0.0	NS
N	<i>Pseudevernia cladonia</i>	Ghost Antler Lichen	Not At Risk			S2S3	13	15.0 ± 30.0	NS
N	<i>Fruillaria selwyniana</i>	Selwyn's Scalewort				S1	8	38.7 ± 0.0	NS
N	<i>Harpalejeunea molleri ssp. integra</i>	a liverwort				S1	3	39.1 ± 0.0	NS
N	<i>Homalotheciella subcapillata</i>	Few-haired Moss				S1	1	44.0 ± 0.0	NS
N	<i>Orthotrichum pallens</i>	Pale Bristle Moss				S1	1	97.5 ± 0.0	NS
N	<i>Sphagnum carolinianum</i>	Carolina Peat Moss				S1	1	64.0 ± 0.0	NS
N	<i>Cyrto-hypnum minutulum</i>	Tiny Cedar Moss				S1	1	97.7 ± 0.0	NS
N	<i>Umbilicaria vellea</i>	Grizzled Rocktripe Lichen				S1	3	88.6 ± 0.0	NS
N	<i>Heterodermia leucomela</i>	Elegant Fringe Lichen				S1	4	39.2 ± 0.0	NS
N	<i>Flavoparmelia baltimorensis</i>	Rock Greenshield Lichen				S1	1	95.7 ± 1.0	NS
N	<i>Ephebe hispidula</i>	Dryside Rockshag Lichen				S1	1	98.7 ± 1.0	NS
N	<i>Parmotrema perforatum</i>	Perforated Ruffle Lichen				S1	4	93.6 ± 0.0	NS
N	<i>Sticta limbata</i>	Powdered Moon Lichen				S1	9	29.3 ± 0.0	NS
N	<i>Leptogium hibernicum</i>	Hibernia Jellyskin Lichen				S1	53	38.6 ± 0.0	NS
N	<i>Hypotrachyna horrescens</i>	Hairy-spined Shield Lichen				S1	4	29.0 ± 0.0	NS
N	<i>Hypogymnia hultenii</i>	Powdered Honeycomb Lichen				S1	3	63.4 ± 0.0	NS
N	<i>Campylostelium saxicola</i>	a Moss				S1?	1	98.7 ± 1.0	NS
N	<i>Grimmia anodon</i>	Toothless Grimmiid Moss				S1?	2	96.1 ± 3.0	NS
N	<i>Homomallium adnatum</i>	Adnate Hairy-gray Moss				S1?	2	21.8 ± 1.0	NS
N	<i>Sphagnum cyclophyllum</i>	a Moss				S1?	11	37.3 ± 0.0	NS
N	<i>Sphagnum molle</i>	Blushing Peat Moss				S1?	2	23.4 ± 0.0	NS
N	<i>Syntrichia ruralis</i>	a Moss				S1?	1	72.4 ± 0.0	NS
N	<i>Enchylium limosum</i>	Lime-loving Tarpaper Lichen				S1?	1	40.8 ± 0.0	NS
N	<i>Scytinium intermedium</i>	Forty-five Jellyskin Lichen				S1?	1	38.3 ± 1.0	NS
N	<i>Peltigera malacea</i>	Veinless Pelt Lichen				S1?	1	84.0 ± 0.0	NS
N	<i>Metzgeria crassipilis</i>	Hairy Veilwort				S1S2	3	56.3 ± 0.0	NS

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N	<i>Sphagnum trinitense</i>	a peatmoss				S1S2	6	23.4 ± 0.0	NS
N	<i>Tortula mucronifolia</i>	Mucronate Screw Moss				S1S2	1	96.1 ± 3.0	NS
N	<i>Pseudotaxiphyllum distichaceum</i>	a Moss				S1S2	4	32.2 ± 0.0	NS
N	<i>Parmotrema reticulatum</i>	Netted Ruffle Lichen				S1S2	8	21.8 ± 1.0	NS
N	<i>Cladonia subtenuis</i>	Dixie Reindeer Lichen				S1S2	1	42.5 ± 0.0	NS
N	<i>Parmeliella parvula</i>	Poor-man's Shingles Lichen				S1S2	40	67.7 ± 0.0	NS
N	<i>Umbilicaria polyrhiza</i>	Ballpoint Rocktripe Lichen				S1S3	1	95.7 ± 1.0	NS
N	<i>Usnea fragilesceus</i>	Inflationary Beard Lichen				S1S3	2	31.0 ± 40.0	NS
N	<i>Stereocaulon grande</i>	Grand Foam Lichen				S1S3	1	53.4 ± 0.0	NS
N	<i>Anacamptodon splachnoides</i>	a Moss				S2	1	95.3 ± 0.0	NS
N	<i>Sphagnum platyphyllum</i>	Flat-leaved Peat Moss				S2	1	37.6 ± 0.0	NS
N	<i>Sphagnum subnitens</i>	Lustrous Peat Moss				S2	4	91.3 ± 0.0	NS
N	<i>Usnea flavocardia</i>	Blood-splattered Beard Lichen				S2	1	90.7 ± 1.0	NS
N	<i>Cystocoleus ebeneus</i>	Rockgossamer Lichen				S2	2	95.3 ± 0.0	NS
N	<i>Hypotrachyna catawbiensis</i>	Powder-tipped Antler Lichen				S2	30	63.4 ± 0.0	NS
N	<i>Nephroma resupinatum</i>	a lichen				S2	3	64.8 ± 0.0	NS
N	<i>Atrichum angustatum</i>	Lesser Smoothcap Moss				S2?	6	87.0 ± 3.0	NS
N	<i>Ptychostomum pendulum</i>	Drooping Bryum				S2?	3	50.6 ± 0.0	NS
N	<i>Drepanocladus polygamus</i>	Polygamous Hook Moss				S2?	1	97.7 ± 0.0	NS
N	<i>Pseudocampylium radicale</i>	Long-stalked Fine Wet Moss				S2?	2	97.4 ± 0.0	NS
N	<i>Climacium americanum</i>	American Tree Moss				S2?	3	95.9 ± 0.0	NS
N	<i>Dicranum condensatum</i>	Condensed Broom Moss				S2?	3	47.0 ± 0.0	NS
N	<i>Ditrichum rhynchostegium</i>	a Moss				S2?	3	95.0 ± 5.0	NS
N	<i>Fissidens bushii</i>	Bush's Pocket Moss				S2?	2	87.0 ± 3.0	NS
N	<i>Fontinalis hypnoides</i>	a moss				S2?	1	97.3 ± 0.0	NS
N	<i>Fontinalis sullivantii</i>	Sullivant's Water Moss				S2?	3	55.7 ± 4.0	NS
N	<i>Grimmia olneyi</i>	a Moss				S2?	8	91.6 ± 15.0	NS
N	<i>Orthotrichum anomalum</i>	Anomalous Bristle Moss				S2?	1	97.5 ± 0.0	NS
N	<i>Physcomitrium collenchymatum</i>	a Moss				S2?	6	64.9 ± 2.0	NS
N	<i>Raiiella scita</i>	Smaller Fern Moss				S2?	15	90.9 ± 0.0	NS
N	<i>Platylomella lescurii</i>	a Moss				S2?	4	97.4 ± 0.0	NS
N	<i>Oxyrrhynchium hians</i>	Light Beaked Moss				S2S3	1	95.0 ± 5.0	NS
N	<i>Plagiomnium rostratum</i>	Long-beaked Leafy Moss				S2S3	3	95.3 ± 0.0	NS
N	<i>Moelleropsis nebulosa</i>	Blue-gray Moss Shingle Lichen				S2S3	148	20.5 ± 0.0	NS
N	<i>Moelleropsis nebulosa ssp. frullaniae</i>	Blue-gray Moss Shingle Lichen				S2S3	8	42.2 ± 0.0	NS
N	<i>Ramalina thrausta</i>	Angelhair Ramalina Lichen				S2S3	1	27.7 ± 2.0	NS
N	<i>Collema leptaleum</i>	Crumpled Bat's Wing Lichen				S2S3	10	55.4 ± 0.0	NS
N	<i>Usnea ceratina</i>	Warty Beard Lichen				S2S3	2	45.0 ± 3.0	NS
N	<i>Usnea rubicunda</i>	Red Beard Lichen				S2S3	7	14.3 ± 0.0	NS
N	<i>Ahtiana aurescens</i>	Eastern Candlewax Lichen				S2S3	4	54.8 ± 0.0	NS
N	<i>Usnocetraria oakesiana</i>	Yellow Band Lichen				S2S3	2	43.1 ± 0.0	NS
N	<i>Cladonia incrassata</i>	Powder-foot British Soldiers Lichen				S2S3	3	21.8 ± 1.0	NS
N	<i>Cladonia mateocyatha</i>	Mixed-up Pixie-cup				S2S3	1	36.0 ± 0.0	NS
N	<i>Cladonia parasitica</i>	Fence-rail Lichen				S2S3	1	89.6 ± 1.0	NS
N	<i>Scytinium tenuissimum</i>	Birdnest Jellyskin Lichen				S2S3	3	82.6 ± 0.0	NS
N	<i>Hypotrachyna minarum</i>	Hairless-spined Shield Lichen				S2S3	3	28.7 ± 0.0	NS
N	<i>Usnea cavernosa</i>	Pitted Beard Lichen				S2S3	2	89.0 ± 0.0	NS
N	<i>Fuscopannaria sorediata</i>	a Lichen				S2S3	17	38.2 ± 0.0	NS
N	<i>Hypotrachyna revoluta</i>	Granulating Loop Lichen				S2S3	18	19.3 ± 2.0	NS
N	<i>Cetraria arenaria</i>	Sand-loving Icelandmoss Lichen				S2S3	1	56.7 ± 1.0	NS

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N	<i>Cladonia coccifera</i>	Eastern Boreal Pixie-cup Lichen				S2S3	1	62.9 ± 0.0	NS
N	<i>Cladonia phyllophora</i>	Felt Lichen				S2S3	1	72.5 ± 0.0	NS
N	<i>Hypotrachyna afrorevoluta</i>	Pustulate Revolute Loop Lichen				S2S3	4	67.7 ± 0.0	NS
N	<i>Usnea flammaea</i>	Coastal Bushy Beard Lichen				S2S3	2	94.9 ± 0.0	NS
N	<i>Microlejeunea ulicina</i>	a pouncewort				S3	6	39.1 ± 0.0	NS
N	<i>Anomodon tristis</i>	a Moss				S3	6	39.1 ± 0.0	NS
N	<i>Tetraplodon angustatus</i>	Toothed-leaved Nitrogen Moss				S3	1	83.4 ± 0.0	NS
N	<i>Collema nigrescens</i>	Blistered Tarpaper Lichen				S3	57	30.6 ± 0.0	NS
N	<i>Fuscopannaria ahlneri</i>	Corrugated Shingles Lichen				S3	86	20.0 ± 0.0	NS
N	<i>Heterodermia squamulosa</i>	Scaly Fringe Lichen				S3	23	20.0 ± 0.0	NS
N	<i>Scytinium lichenoides</i>	Tattered Jellyskin Lichen				S3	6	77.9 ± 0.0	NS
N	<i>Leptogium milligranum</i>	Stretched Jellyskin Lichen				S3	42	13.4 ± 0.0	NS
N	<i>Nephroma bellum</i>	Naked Kidney Lichen				S3	10	27.7 ± 2.0	NS
N	<i>Punctelia appalachensis</i>	Appalachian Speckleback Lichen				S3	14	21.6 ± 0.0	NS
N	<i>Viridothelium virens</i>					S3	7	20.5 ± 0.0	NS
N	<i>Peltigera collina</i>	Tree Pelt Lichen				S3	6	91.7 ± 0.0	NS
N	<i>Drummondia prorepens</i>	a Moss				S3?	1	95.3 ± 0.0	NS
N	<i>Cladonia stygia</i>	Black-footed Reindeer Lichen				S3?	2	53.4 ± 0.0	NS
N	<i>Anomodon rugelii</i>	Rugel's Anomodon Moss				S3S4	6	38.3 ± 1.0	NS
N	<i>Dichelyma capillaceum</i>	Hairlike Dichelyma Moss				S3S4	6	96.5 ± 0.0	NS
N	<i>Dicranum leioneuron</i>	a Dicranum Moss				S3S4	2	95.0 ± 0.0	NS
N	<i>Hylocomiastrum pyrenaicum</i>	a Feather Moss				S3S4	1	95.3 ± 0.0	NS
N	<i>Sticta fuliginosa</i>	Peppered Moon Lichen				S3S4	259	13.7 ± 0.0	NS
N	<i>Arctoparmelia incurva</i>	Finger Ring Lichen				S3S4	3	53.4 ± 0.0	NS
N	<i>Scytinium teretiusculum</i>	Curly Jellyskin Lichen				S3S4	6	49.9 ± 0.0	NS
N	<i>Leptogium acadense</i>	Acadian Jellyskin Lichen				S3S4	29	51.3 ± 0.0	NS
N	<i>Scytinium subtile</i>	Appressed Jellyskin Lichen				S3S4	17	28.2 ± 0.0	NS
N	<i>Heterodermia speciosa</i>	Powdered Fringe Lichen				S3S4	33	27.7 ± 2.0	NS
N	<i>Leptogium corticola</i>	Blistered Jellyskin Lichen				S3S4	295	22.9 ± 0.0	NS
N	<i>Melanohalea olivacea</i>	Spotted Camouflage Lichen				S3S4	2	97.2 ± 7.0	NS
N	<i>Parmotrema perlatum</i>	Powdered Ruffle Lichen				S3S4	50	12.7 ± 0.0	NS
N	<i>Peltigera hymenina</i>	Cloudy Pelt Lichen				S3S4	1	35.8 ± 2.0	NS
N	<i>Sphaerophorus fragilis</i>	Fragile Coral Lichen				S3S4	2	56.0 ± 0.0	NS
N	<i>Coccocarpia palmicola</i>	Salted Shell Lichen				S3S4	921	15.4 ± 0.0	NS
N	<i>Physcia caesia</i>	Blue-gray Rosette Lichen				S3S4	1	77.7 ± 20.0	NS
N	<i>Physcia tenella</i>	Fringed Rosette Lichen				S3S4	1	95.7 ± 1.0	NS
N	<i>Anaptychia palmulata</i>	Shaggy Fringed Lichen				S3S4	81	20.0 ± 0.0	NS
N	<i>Heterodermia neglecta</i>	Fringe Lichen				S3S4	233	13.1 ± 0.0	NS
P	<i>Geum peckii</i>	Eastern Mountain Avens	Endangered	Endangered	Endangered	S1	3199	62.5 ± 0.0	NS
P	<i>Rhynchospora macrostachya</i>	Tall Beakrush	Endangered	Endangered	Endangered	S1	50	96.8 ± 0.0	NS
P	<i>Lyonia ligustrina</i>	Maleberry	Endangered			S1	11	22.9 ± 0.0	NS
P	<i>Coreopsis rosea</i>	Pink Coreopsis	Endangered	Endangered	Endangered	S2	468	13.4 ± 0.0	NS
P	<i>Drosera filiformis</i>	Thread-leaved Sundew	Endangered	Endangered	Endangered	S2	919	43.8 ± 0.0	NS
P	<i>Clethra alnifolia</i>	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S2	127	19.5 ± 0.0	NS
P	<i>Sabatia kennedyana</i>	Plymouth Gentian	Endangered	Endangered	Endangered	S2S3	1266	16.5 ± 1.0	NS
P	<i>Fraxinus nigra</i>	Black Ash	Threatened		Threatened	S1S2	15	58.9 ± 0.0	NS
P	<i>Baccharis halimifolia</i>	Eastern Baccharis	Threatened	Threatened	Threatened	S2	174	6.9 ± 0.0	NS
P	<i>Hydrocotyle umbellata</i>	Water Pennywort	Special Concern	Special Concern	Endangered	S2	205	21.7 ± 0.0	NS
P	<i>Eleocharis tuberculosa</i>	Tuberclad Spike-rush	Special Concern	Special Concern	Vulnerable	S2	516	23.3 ± 0.0	NS
P	<i>Lophiola aurea</i>	Goldencrest	Special Concern	Special Concern	Vulnerable	S2	65	63.8 ± 1.0	NS
P	<i>Lilaeopsis chinensis</i>	Eastern Lilaeopsis	Special Concern	Special Concern	Vulnerable	S3	36	13.2 ± 0.0	NS
P	<i>Scirpus longii</i>	Long's Bulrush	Special Concern		Vulnerable	S3	300	24.3 ± 0.0	NS

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P	<i>Isoetes prototypus</i>	Prototype Quillwort	Special Concern	Special Concern	Vulnerable	S3	2	83.1 ± 0.0	NS
P	<i>Toxicodendron vernix</i>	Poison Sumac				S1	10	98.2 ± 0.0	NS
P	<i>Nabalus racemosus</i>	Glaucous Rattlesnakeroot				S1	10	79.4 ± 0.0	NS
P	<i>Lobelia spicata</i>	Pale-Spiked Lobelia				S1	1	39.5 ± 50.0	NS
P	<i>Montia fontana</i>	Water Blinks				S1	3	67.0 ± 0.0	NS
P	<i>Lysimachia minima</i>	Chaffweed				S1	1	98.6 ± 0.0	NS
P	<i>Amelanchier nantucketensis</i>	Nantucket Serviceberry				S1	1	64.0 ± 0.0	NS
P	<i>Veronica catenata</i>	Pink Water-Speedwell				S1	1	78.8 ± 0.0	NS
P	<i>Carex digitalis</i>	Slender Wood Sedge				S1	2	96.7 ± 0.0	NS
P	<i>Carex laxiflora</i>	Loose-Flowered Sedge				S1	2	91.5 ± 10.0	NS
P	<i>Carex prairea</i>	Prairie Sedge				S1	1	90.7 ± 5.0	NS
P	<i>Carex viridula</i> var. <i>saxillitoralis</i>	Greenish Sedge				S1	2	62.6 ± 5.0	NS
P	<i>Cyperus diandrus</i>	Low Flatsedge				S1	7	20.9 ± 0.0	NS
P	<i>Fimbristylis autumnalis</i>	Slender Fimbry				S1	3	93.4 ± 0.0	NS
P	<i>Rhynchospora capillacea</i>	Slender Beakrush				S1	1	23.1 ± 0.0	NS
P	<i>Blysmopsis rufa</i>	Red Bulrush				S1	1	12.3 ± 1.0	NS
P	<i>Sisyrinchium fuscatum</i>	Coastal Plain Blue-eyed-grass				S1	4	21.1 ± 0.0	NS
P	<i>Juncus brachycephalus</i>	Small-Head Rush				S1	2	35.5 ± 2.0	NS
P	<i>Juncus secundus</i>	Secund Rush				S1	1	99.0 ± 3.0	NS
P	<i>Spiranthes casei</i> var. <i>casei</i>	Case's Ladies'-Tresses				S1	1	62.6 ± 5.0	NS
P	<i>Adiantum pedatum</i>	Northern Maidenhair Fern				S1	2	22.4 ± 0.0	NS
P	<i>Selaginella rupestris</i>	Rock Spikemoss				S1	29	85.3 ± 0.0	NS
P	<i>Solidago hispida</i>	Hairy Goldenrod				S1?	3	8.6 ± 7.0	NS
P	<i>Bolboschoenus robustus</i>	Sturdy Bulrush				S1?	1	18.7 ± 7.0	NS
P	<i>Allium schoenoprasum</i>	Wild Chives				S1?	1	67.0 ± 1.0	NS
P	<i>Allium schoenoprasum</i> var. <i>sibiricum</i>	Wild Chives				S1?	2	66.5 ± 0.0	NS
P	<i>Panicum dichotomiflorum</i> ssp. <i>puritanorum</i>	Spreading Panicgrass				S1?	17	19.4 ± 1.0	NS
P	<i>Huperzia selago</i>	Northern Firmoss				S1?	3	62.6 ± 5.0	NS
P	<i>Cornus suecica</i>	Swedish Bunchberry				S1S2	2	96.1 ± 0.0	NS
P	<i>Proserpinaca intermedia</i>	Intermediate Mermaidweed				S1S2	2	20.1 ± 1.0	NS
P	<i>Calamagrostis stricta</i> ssp. <i>stricta</i>	Slim-stemmed Reed Grass				S1S2	1	31.6 ± 0.0	NS
P	<i>Selaginella selaginoides</i>	Low Spikemoss				S1S2	2	64.5 ± 2.0	NS
P	<i>Carex vacillans</i>	Estuarine Sedge				S1S3	1	98.0 ± 0.0	NS
P	<i>Hudsonia ericoides</i>	Pinebarren Golden Heather				S2	17	43.5 ± 0.0	NS
P	<i>Desmodium canadense</i>	Canada Tick-trefoil				S2	7	68.3 ± 7.0	NS
P	<i>Hylodesmum glutinosum</i>	Large Tick-trefoil				S2	4	97.5 ± 0.0	NS
P	<i>Conopholis americana</i>	American Cancer-root				S2	33	91.5 ± 0.0	NS
P	<i>Ranunculus sceleratus</i>	Cursed Buttercup				S2	1	80.9 ± 0.0	NS
P	<i>Agalinis maritima</i>	Saltmarsh Agalinis				S2	51	2.7 ± 0.0	NS
P	<i>Juncus greenii</i>	Greene's Rush				S2	6	43.6 ± 0.0	NS
P	<i>Juncus alpinoarticulatus</i> ssp. <i>americanus</i>	Northern Green Rush				S2	1	39.5 ± 0.0	NS
P	<i>Allium tricoccum</i>	Wild Leek				S2	1	88.0 ± 0.0	NS
P	<i>Platanthera flava</i> var. <i>flava</i>	Southern Rein Orchid				S2	400	8.8 ± 7.0	NS
P	<i>Platanthera flava</i> var. <i>herbiola</i>	Pale Green Orchid				S2	1	25.4 ± 0.0	NS
P	<i>Platanthera macrophylla</i>	Large Round-Leaved Orchid				S2	1	39.2 ± 1.0	NS
P	<i>Piptatheropsis pungens</i>	Slender Ricegrass				S2	2	53.5 ± 10.0	NS
P	<i>Cuscuta cephalanthi</i>	Buttonbush Dodder				S2?	6	13.3 ± 0.0	NS
P	<i>Rumex persicarioides</i>	Peach-leaved Dock				S2?	6	63.0 ± 0.0	NS
P	<i>Thuja occidentalis</i>	Eastern White Cedar			Vulnerable	S2S3	233	22.9 ± 0.0	NS
P	<i>Erigeron philadelphicus</i>	Philadelphia Fleabane				S2S3	1	40.3 ± 1.0	NS
P	<i>Eutrochium dubium</i>	Coastal Plain Joe Pye Weed				S2S3	185	9.6 ± 0.0	NS

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P	<i>Lactuca hirsuta</i>	Hairy Lettuce				S2S3	4	16.4 ± 0.0	NS
P	<i>Oxybasis rubra</i>	Red Goosefoot				S2S3	3	80.9 ± 0.0	NS
P	<i>Hypericum majus</i>	Large St John's-wort				S2S3	1	84.7 ± 1.0	NS
P	<i>Hypericum x dissimulatum</i>	Disguised St. John's-wort				S2S3	7	15.4 ± 10.0	NS
P	<i>Euphorbia polygonifolia</i>	Seaside Spurge				S2S3	10	37.4 ± 0.0	NS
P	<i>Myriophyllum farwellii</i>	Farwell's Water Milfoil				S2S3	8	40.6 ± 0.0	NS
P	<i>Hedeoma pulegioides</i>	American False Pennyroyal				S2S3	42	29.9 ± 5.0	NS
P	<i>Oenothera fruticosa</i> ssp. <i>tetragona</i>	Narrow-leaved Evening Primrose				S2S3	24	28.6 ± 7.0	NS
P	<i>Polygala polygama</i>	Racemed Milkwort				S2S3	9	62.8 ± 0.0	NS
P	<i>Polygonum aviculare</i> ssp. <i>buxiforme</i>	Box Knotweed				S2S3	1	62.6 ± 7.0	NS
P	<i>Polygonum oxyspermum</i> ssp. <i>raii</i>	Ray's Knotweed				S2S3	12	27.4 ± 1.0	NS
P	<i>Amelanchier fernaldii</i>	Fernald's Serviceberry				S2S3	1	64.0 ± 1.0	NS
P	<i>Potentilla canadensis</i>	Canada Cinquefoil				S2S3	11	19.5 ± 1.0	NS
P	<i>Galium obtusum</i>	Blunt-leaved Bedstraw				S2S3	20	15.6 ± 0.0	NS
P	<i>Carex adusta</i>	Lesser Brown Sedge				S2S3	1	82.4 ± 7.0	NS
P	<i>Carex houghtoniana</i>	Houghton's Sedge				S2S3	3	69.7 ± 0.0	NS
P	<i>Carex hystericina</i>	Porcupine Sedge				S2S3	1	21.8 ± 1.0	NS
P	<i>Carex longii</i>	Long's Sedge				S2S3	16	13.5 ± 0.0	NS
P	<i>Eleocharis ovata</i>	Ovate Spikerush				S2S3	5	16.3 ± 0.0	NS
P	<i>Scirpus pedicellatus</i>	Stalked Bulrush				S2S3	1	75.4 ± 5.0	NS
P	<i>Vallisneria americana</i>	Wild Celery				S2S3	3	97.0 ± 0.0	NS
P	<i>Najas gracillima</i>	Thread-Like Naiad				S2S3	15	96.4 ± 0.0	NS
P	<i>Goodyera pubescens</i>	Downy Rattlesnake-Plantain				S2S3	28	67.8 ± 0.0	NS
P	<i>Spiranthes casei</i>	Case's Ladies'-Tresses				S2S3	3	44.5 ± 0.0	NS
P	<i>Spiranthes casei</i> var. <i>novaescotiae</i>	Case's Ladies'-Tresses				S2S3	19	15.8 ± 1.0	NS
P	<i>Spiranthes lucida</i>	Shining Ladies'-Tresses				S2S3	4	28.0 ± 7.0	NS
P	<i>Botrychium lanceolatum</i> ssp. <i>angustisegmentum</i>	Narrow Triangle Moonwort				S2S3	3	35.5 ± 1.0	NS
P	<i>Botrychium simplex</i>	Least Moonwort				S2S3	1	33.3 ± 1.0	NS
P	<i>Ophioglossum pusillum</i>	Northern Adder's-tongue				S2S3	9	8.8 ± 7.0	NS
P	<i>Potamogeton pulcher</i>	Spotted Pondweed			Vulnerable	S3	35	15.6 ± 0.0	NS
P	<i>Conioselinum chinense</i>	Chinese Hemlock-parsley				S3	10	64.9 ± 0.0	NS
P	<i>Hieracium robinsonii</i>	Robinson's Hawkweed				S3	3	8.5 ± 1.0	NS
P	<i>Iva frutescens</i>	Big-leaved Marsh-elder				S3	59	3.4 ± 0.0	NS
P	<i>Senecio pseudoarnica</i>	Seabeach Ragwort				S3	4	12.3 ± 1.0	NS
P	<i>Symphotrichum boreale</i>	Boreal Aster				S3	13	20.1 ± 1.0	NS
P	<i>Symphotrichum undulatum</i>	Wavy-leaved Aster				S3	4	61.6 ± 7.0	NS
P	<i>Symphotrichum ciliolatum</i>	Fringed Blue Aster				S3	1	95.8 ± 0.0	NS
P	<i>Alnus serrulata</i>	Smooth Alder				S3	201	14.0 ± 0.0	NS
P	<i>Betula michauxii</i>	Michaux's Dwarf Birch				S3	13	62.6 ± 5.0	NS
P	<i>Cardamine parviflora</i>	Small-flowered Bittercress				S3	1	64.8 ± 5.0	NS
P	<i>Mononeuria groenlandica</i>	Greenland Stitchwort				S3	4	66.8 ± 0.0	NS
P	<i>Sagina nodosa</i>	Knotted Pearlwort				S3	35	43.8 ± 1.0	NS
P	<i>Sagina nodosa</i> ssp. <i>borealis</i>	Knotted Pearlwort				S3	3	44.8 ± 1.0	NS
P	<i>Stellaria longifolia</i>	Long-leaved Starwort				S3	1	56.3 ± 5.0	NS
P	<i>Ceratophyllum echinatum</i>	Prickly Hornwort				S3	1	18.6 ± 0.0	NS
P	<i>Crassula aquatica</i>	Water Pygmyweed				S3	2	46.1 ± 0.0	NS
P	<i>Vaccinium uliginosum</i>	Alpine Bilberry				S3	3	63.8 ± 0.0	NS
P	<i>Geranium bicknellii</i>	Bicknell's Crane's-bill				S3	5	28.1 ± 0.0	NS
P	<i>Utricularia resupinata</i>	Inverted Bladderwort				S3	31	23.3 ± 0.0	NS
P	<i>Persicaria arifolia</i>	Halberd-leaved Tearthumb				S3	1	21.6 ± 0.0	NS
P	<i>Primula laurentiana</i>	Laurentian Primrose				S3	15	2.5 ± 7.0	NS
P	<i>Samolus parviflorus</i>	Seaside Brookweed				S3	26	8.1 ± 7.0	NS
P	<i>Pyrola minor</i>	Lesser Pyrola				S3	1	98.1 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	<i>Cephalanthus occidentalis</i>	Common Buttonbush				S3	436	33.8 ± 7.0	NS
P	<i>Salix sericea</i>	Silky Willow				S3	47	17.5 ± 0.0	NS
P	<i>Lindernia dubia</i>	Yellow-seeded False Pimperel				S3	4	8.8 ± 0.0	NS
P	<i>Pilea pumila</i>	Dwarf Clearweed				S3	1	54.8 ± 0.0	NS
P	<i>Viola nephrophylla</i>	Northern Bog Violet				S3	1	71.4 ± 1.0	NS
P	<i>Carex cryptolepis</i>	Hidden-scaled Sedge				S3	2	24.4 ± 2.0	NS
P	<i>Carex lupulina</i>	Hop Sedge				S3	23	16.7 ± 1.0	NS
P	<i>Carex swanii</i>	Swan's Sedge				S3	68	8.6 ± 1.0	NS
P	<i>Carex tenera</i>	Tender Sedge				S3	2	49.5 ± 0.0	NS
P	<i>Carex tribuloides</i>	Blunt Broom Sedge				S3	1	96.5 ± 0.0	NS
P	<i>Eleocharis nitida</i>	Quill Spikerush				S3	1	83.4 ± 7.0	NS
P	<i>Eleocharis flavescens</i> var. <i>olivacea</i>	Bright-green Spikerush				S3	12	13.5 ± 0.0	NS
P	<i>Eleocharis quinqueflora</i>	Few-flowered Spikerush				S3	2	65.2 ± 3.0	NS
P	<i>Eleocharis rostellata</i>	Beaked Spikerush				S3	73	2.4 ± 0.0	NS
P	<i>Schoenoplectus americanus</i>	Olney's Bulrush				S3	98	1.8 ± 0.0	NS
P	<i>Neottia bifolia</i>	Southern Twayblade				S3	93	1.8 ± 0.0	NS
P	<i>Platanthera flava</i>	Southern Rein-Orchid				S3	18	17.7 ± 9.0	NS
P	<i>Platanthera grandiflora</i>	Large Purple Fringed Orchid				S3	4	12.4 ± 5.0	NS
P	<i>Platanthera hookeri</i>	Hooker's Orchid				S3	6	39.3 ± 0.0	NS
P	<i>Dichantherium linearifolium</i>	Narrow-leaved Panic Grass				S3	1	57.0 ± 0.0	NS
P	<i>Piptatheropsis canadensis</i>	Canada Ricegrass				S3	12	18.0 ± 0.0	NS
P	<i>Sceptridium dissectum</i>	Dissected Moonwort				S3	8	14.0 ± 0.0	NS
P	<i>Persicaria amphibia</i> var. <i>emersa</i>	Long-root Smartweed				S3?	5	17.1 ± 0.0	NS
P	<i>Spiranthes ochroleuca</i>	Yellow Ladies'-tresses				S3?	22	9.9 ± 0.0	NS
P	<i>Diphasiastrum x sabinifolium</i>	Savin-leaved Ground-cedar				S3?	2	97.9 ± 0.0	NS
P	<i>Bidens vulgata</i>	Tall Beggarticks				S3S4	1	38.9 ± 0.0	NS
P	<i>Hieracium paniculatum</i>	Panicled Hawkweed				S3S4	9	15.8 ± 0.0	NS
P	<i>Bidens beckii</i>	Water Beggarticks				S3S4	25	16.5 ± 0.0	NS
P	<i>Vaccinium corymbosum</i>	Highbush Blueberry				S3S4	762	0.2 ± 0.0	NS
P	<i>Fagus grandifolia</i>	American Beech				S3S4	92	3.4 ± 0.0	NS
P	<i>Bartonia virginica</i>	Yellow Bartonias				S3S4	85	11.7 ± 7.0	NS
P	<i>Proserpinaca pectinata</i>	Comb-leaved Mermaidweed				S3S4	59	17.7 ± 9.0	NS
P	<i>Decodon verticillatus</i>	Swamp Loosestrife				S3S4	302	16.0 ± 0.0	NS
P	<i>Nuphar microphylla</i>	Small Yellow Pond-lily				S3S4	4	29.2 ± 0.0	NS
P	<i>Persicaria pennsylvanica</i>	Pennsylvania Smartweed				S3S4	1	73.4 ± 5.0	NS
P	<i>Fallopia scandens</i>	Climbing False Buckwheat				S3S4	2	78.6 ± 7.0	NS
P	<i>Pyrola asarifolia</i>	Pink Pyrola				S3S4	1	92.9 ± 7.0	NS
P	<i>Endotropis alnifolia</i>	alder-leaved buckthorn				S3S4	1	97.4 ± 0.0	NS
P	<i>Amelanchier spicata</i>	Running Serviceberry				S3S4	9	16.2 ± 2.0	NS
P	<i>Galium aparine</i>	Common Bedstraw				S3S4	5	35.5 ± 2.0	NS
P	<i>Limosella australis</i>	Southern Mudwort				S3S4	13	12.3 ± 5.0	NS
P	<i>Veronica serpyllifolia</i>	Thyme-Leaved Speedwell				S3S4	10	21.4 ± 0.0	NS
P	<i>Ulmus americana</i>	White Elm				S3S4	1	99.4 ± 0.0	NS
P	<i>Viola sagittata</i> var. <i>ovata</i>	Arrow-Leaved Violet				S3S4	22	27.1 ± 0.0	NS
P	<i>Symlocarpus foetidus</i>	Eastern Skunk Cabbage				S3S4	465	2.5 ± 7.0	NS
P	<i>Carex argyrantha</i>	Silvery-flowered Sedge				S3S4	17	21.3 ± 0.0	NS
P	<i>Sisyrinchium atlanticum</i>	Eastern Blue-Eyed-Grass				S3S4	303	13.5 ± 0.0	NS
P	<i>Triglochin gaspensis</i>	Gasp Arrowgrass				S3S4	13	8.0 ± 0.0	NS
P	<i>Juncus acuminatus</i>	Sharp-Fruit Rush				S3S4	11	8.8 ± 0.0	NS
P	<i>Juncus subcaudatus</i>	Woods-Rush				S3S4	26	15.4 ± 5.0	NS
P	<i>Goodyera repens</i>	Lesser Rattlesnake-plantain				S3S4	16	10.7 ± 0.0	NS
P	<i>Liparis loeselii</i>	Loesel's Twayblade				S3S4	7	16.2 ± 1.0	NS
P	<i>Platanthera obtusata</i>	Blunt-leaved Orchid				S3S4	21	8.2 ± 5.0	NS
P	<i>Platanthera orbiculata</i>	Small Round-leaved Orchid				S3S4	5	39.3 ± 0.0	NS
P	<i>Dichantherium clandestinum</i>	Deer-tongue Panic Grass				S3S4	69	14.4 ± 10.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	<i>Coleataenia longifolia</i>	Long-leaved Panicgrass				S3S4	1358	11.7 ± 7.0	NS
P	<i>Panicum philadelphicum</i>	Philadelphia Panicgrass				S3S4	12	20.9 ± 0.0	NS
P	<i>Asplenium trichomanes</i>	Maidenhair Spleenwort				S3S4	1	97.7 ± 1.0	NS
P	<i>Lorinseria areolata</i>	Netted Chain Fern				S3S4	334	16.4 ± 0.0	NS
P	<i>Diphasiastrum complanatum</i>	Northern Ground-cedar				S3S4	1	23.5 ± 0.0	NS
P	<i>Sceptridium multifidum</i>	Leathery Moonwort				S3S4	6	69.7 ± 10.0	NS
P	<i>Botrychium matricariifolium</i>	Daisy-leaved Moonwort				S3S4	1	88.4 ± 10.0	NS
P	<i>Bidens discordea</i>	Swamp Beggarticks				SH	1	95.5 ± 0.0	NS
P	<i>Dichanthelium meridionale</i>	Matting Witchgrass				SH	2	20.1 ± 5.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
9134	Morrison, Guy. 2011. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Ottawa, 15939 surveys. 86171 recs.
4235	McNeil, J.A. 2010. Blandings Turtle (<i>Emydoidea blandingii</i>) sightings, 1946-2009. Parks Canada, 12,871 recs of 597+ individuals.
2997	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
2104	Paquet, Julie. 2018. Atlantic Canada Shorebird Survey (ACSS) database 2012-2018. Environment Canada, Canadian Wildlife Service.
1520	Toms, B. 2018. A census of Eastern Mountain Avens (<i>Geum peckii</i>) in Big Meadow Bog, Brier Island Nova Scotia 2018. Mersey Tobeatic Research Institute, 326 Records.
1439	Pardieck, K.L., Ziolkowski Jr., D.J., Lutmerding, M., Aponte, V.I., and Hudson, M-A.R. 2020. North American Breeding Bird Survey Dataset 1966 - 2019: U.S. Geological Survey data release, https://doi.org/10.5066/P9J6QUF6
1180	McNeil, J.A. 2010. Ribbonsnake (<i>Thamophis sauritus</i>) sightings, 1900-2009. Parks Canada, 2521 recs of 716+ individuals.
990	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
966	iNaturalist. 2020. iNaturalist Data Export 2020. iNaturalist.org and iNaturalist.ca, Web site: 128728 recs.
877	Blaney, C.S. & Mazerolle, D.M. 2011. Atlantic Coastal Plain flora species at risk surveys for Mersey Tobeatic Research Institute. Atlantic Canada Conservation Data Centre, 1724 recs.
783	Toms, B. & Belliveau, A.; LaRue, D.; EMA Recovery Team. 2014. 2013-14 <i>Geum peckii</i> observations. Mersey Tobeatic Research Institute, 783 records.
635	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
630	Blaney, C.S.; Mazerolle, D.M. 2012. Fieldwork 2012. Atlantic Canada Conservation Data Centre, 13,278 recs.
614	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-05-25]. Mersey Tobeatic Research Institute, 668 recs.
593	Toms, B. & Belliveau, A.; LaRue, D.; EMA Recovery Team. 2012. 2012 <i>Geum peckii</i> observations. Mersey Tobeatic Research Institute, 594 records.
558	Neily, T.H. 2017. Nova Scotia lichen records. Mersey Tobeatic Research Institute.
542	Cameron, R.P. 2009. Cyanolichen database. Nova Scotia Environment & Labour, 1724 recs.
496	Belliveau, A.G. 2020. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2019, 2020. E.C. Smith Herbarium.
496	Blaney, C.S.; Mazerolle, D.M. 2010. Fieldwork 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 15508 recs.
442	Blaney, C.S.; Mazerolle, D.M.; Hill, N.M. 2011. Nova Scotia Crown Share Land Legacy Trust Fieldwork. Atlantic Canada Conservation Data Centre, 5022 recs.
434	Clayden, S. Digitization of Wolfgang Maass Nova Scotia forest lichen collections, 1964-2004. New Brunswick Museum. 2018.
412	Toms, B. & Hill, N.M.; Neily, T. 2014. Atlantic Coastal Plain Flora records, 2011. Mersey Tobeatic Research Institute, 430 recs.
396	Belliveau, A. 2012. 2012 Atlantic Coastal Plain Flora observations. Mersey Tobeatic Research Institute, 1543.
393	Amirault, D.L. & Stewart, J. 2007. Piping Plover Database 1894-2006. Canadian Wildlife Service, Sackville, 3344 recs, 1228 new.
379	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.
372	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2015. Atlantic Canada Conservation Data Centre Fieldwork 2015. Atlantic Canada Conservation Data Centre, # recs.
360	eBird. 2020. eBird Basic Dataset. Version: EBD_relNov-2019. Ithaca, New York. Nov 2019, Cape Breton Bras d'Or Lakes Watershed subset. Cornell Lab of Ornithology.
345	Toms, Brad. 2011. Atlantic Coastal Plain Flora records 2010. Mersey-Tobiatic Research Institute, 1074 recs.
332	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
306	Neily, T.H. & Pepper, C.; Toms, B. 2013. Nova Scotia lichen location database. Mersey Tobeatic Research Institute, 1301 records.
302	Phinney, Lori. 2020. Pre- and post White-nose Syndrome bat acoustic monitoring, NS. Mersey Tobeatic Research Institute, 1279 recs.
298	MacDonald, E.C. 2018. Piping Plover nest records from 2010-2017. Canadian Wildlife Service.
294	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2014. Atlantic Canada Conservation Data Centre Fieldwork 2014. Atlantic Canada Conservation Data Centre, # recs.
286	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
273	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
247	Smith, D. 2013. Personal communication concerning <i>Anguilla rostrata</i> trapping results in Kejimikujik NP, NS. Winter 2013. Pers. comm.
245	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
244	Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University, Web site: http://luxor.acadiu.ca/library/Herbarium/project/ . 582 recs.
243	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.

# recs	CITATION
237	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-03-18]. Mersey Tobeatic Research Institute.
225	Hill, N.M. 1994. Status report on the Long's bulrush <i>Scirpus longii</i> in Canada. Committee on the Status of Endangered Wildlife in Canada, 7 recs.
220	Toms, Brad. 2012. Atlantic Coastal Plain Flora records, 2011. Mersey-Tobiatic Research Institute, 1109 recs.
201	Blaney, C.S. & Mazerolle, D.M. 2011. 2011 botanical surveys in Kejimikujik National Park. Atlantic Canada Conservation Data Centre, 820 recs.
199	Mazerolle, D.M. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
197	Neily, T.H. & Pepper, C.; Toms, B. 2015. Nova Scotia lichen location database [as of 2015-02-15]. Mersey Tobeatic Research Institute, 1691 records.
179	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
176	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
176	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
166	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.
164	Belliveau, A.G. 2018. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2018. E.C. Smith Herbarium, 6226 recs.
162	Toms, B. & Neily, T.; Belliveau, A.G.; Newell, R.; Mills, A.; Clapp, H.; Staicer, C.; Anderson, F.; Gray, C.; Beals, L. 2010. Inventory of Nature Conservancy of Canada Lands in Yarmouth and Shelburne Counties. Mersey Tobeatic Research Institute, approx. 1500 recs.
141	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).
135	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
135	MacDonald, E.C. 2018. CWS Piping Plover Census, 2010-2017. Canadian Wildlife Service, 672 recs.
134	Blaney, C.S. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre.
130	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
126	McNeil, J.A. 2011. Ribbonsnake (<i>Thamophis sauritus</i>) sightings, 2010. Parks Canada, 148 recs of 70+ individuals.
122	Cameron, R.P. 2011. Lichen observations, 2011. Nova Scotia Environment & Labour, 731 recs.
120	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database [as of 2018-03]. Mersey Tobeatic Research Institute.
118	MacKinnon, D.S. & O'Brien, M.K.H.; Cameron, R.P. 2002. Fieldwork 2000. Dept of Environment & Labour, Protected Areas Branch, 252 recs.
114	Benjamin, L.K. 2009. NSDNR Fieldwork & Consultants Reports. Nova Scotia Dept Natural Resources, 143 recs.
107	MacKinnon, D.S. 2005. Coastal Plains Flora GIS theme, 1999-2000. Dept of Environment & Labour, Protected Areas Branch, 109 shp files. 109 recs.
105	Bayne, D.Z. 2013. 2013 Plant observations from southwest Nova Scotia. Nova Scotia Department of Natural Resources, 122 recs.
102	Haughian, S.R. 2018. Description of <i>Fuscopannaria leucosticta</i> field work in 2017. New Brunswick Museum, 314 recs.
101	Westwood, A., Staicer, C. 2016. Nova Scotia landbird Species at Risk observations. Dalhousie University.
96	Riley, J. 2020. Digby County lichen observations. Pers. comm. to J.L. Churchill.
95	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
93	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
93	Newell, R. & Neily, T.; Toms, B.; Proulx, G. et al. 2011. NCC Properties Fieldwork in NS: August-September 2010. Nature Conservancy Canada, 106 recs.
90	Benjamin, L.K. 2012. NSDNR fieldwork & consultant reports 2008-2012. Nova Scotia Dept Natural Resources, 196 recs.
89	Blaney, C.S.; Mazerolle, D.M. 2009. Fieldwork 2009. Atlantic Canada Conservation Data Centre. Sackville NB, 13395 recs.
83	Robinson, S.L. 2014. 2013 Field Data. Atlantic Canada Conservation Data Centre.
83	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
82	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
82	Riley, J. 2019. Digby County lichen observations. Pers. comm. to J.L. Churchill, 50 recs.
81	McMullin, R.T.; Anderson, F.; Clapp, H.; et al. 2019. Results from a rare lichen survey at Kejimikujik Seaside National Park in Nova Scotia, Canada. Canadian Museum of Nature, 83 recs.
76	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
67	Benjamin, L.K. 2009. Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. Nova Scotia Dept Natural Resources, 105 recs.
67	Canadian Wildlife Service, Dartmouth. 2010. Piping Plover censuses 2007-09, 304 recs.
67	Parks Canada. 2021. Species at Risk observations from 2019-2020 in Kejimikujik National Park and Historic Site. Parks Canada, 76 records.
65	Toms, B. 2018. Bat Species data from www.batconservation.ca for Nova Scotia. Mersey Tobeatic Research Institute, 547 Records.
64	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
63	Blaney, C.S.; Mazerolle, D.M.; Klymko, J.; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
62	Roland, A.E. 1976. The Coastal Plain Flora of Kejimikujik National Park. Parks Canada Report, 238 pp.
57	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
56	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
54	Herman, T.B. & Power, T.D.; Eaton, B. 1995. Population status of Blanding's Turtle (<i>Emydoidea blandingii</i>) in Nova Scotia. Can. Field-Nat., 109: 182-191. 79 recs.
54	Munro, Marian K. Tracked lichen specimens, Nova Scotia Provincial Museum of Natural History Herbarium. Atlantic Canada Conservation Data Centre. 2019.
52	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
51	Brazner, J. 2016. Nova Scotia Forested Wetland Bird Surveys. Nova Scotia Department of Lands and Forestry.
50	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
50	McNeil, J.A. 2013. Ribbonsnake (<i>Thamophis sauritus</i>) sightings, 2012. Parks Canada, 63 records of 26+ individuals.
50	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
48	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
48	Richardson, D., Anderson, F., Cameron, R., McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (<i>Anzia colpodes</i>). COSEWIC.
43	Klymko, J.J.D.; Robinson, S.L. 2014. 2013 field data. Atlantic Canada Conservation Data Centre.
42	Staicer, C. & Bliss, S.; Achenbach, L. 2017. Occurrences of tracked breeding birds in forested wetlands. , 303 records.

# recs	CITATION
41	Klymko, J. 2018. Maritimes Butterfly Atlas database. Atlantic Canada Conservation Data Centre.
41	MacKinnon, D.S. & Maass, O.C. 1995. Fieldwork 1995. Dept Natural Resources, Parks Division, 45 recs.
41	MacKinnon, D.S. 1999. Fieldwork 1999. Dept of Environment and Labour, Protected Areas Branch, 48 recs.
39	Blaney, C.S. 2019. Sean Blaney 2019 field data. Atlantic Canada Conservation Data Centre, 4407 records.
38	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
38	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
37	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
36	Blaney, C.S.; Mazerolle, D.M.; Hill, N.M. 2011. Fieldwork for Sabatia kennedyana & Coreopsis rosea COSEWIC status reports.
36	McNeil, J.A. 2020. Snapping Turtle and Eastern Painted Turtle records, 2020. Mersey Tobeatic Research Institute.
35	Blaney, C.S. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
34	Bayne, D.Z. 2014. 2014 rare species observations from southwest Nova Scotia. Nova Scotia Department of Natural Resources, 46 recs.
34	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
34	Roland, A.E. 1980. Checklist of Vascular Plants of Kejimikujik National Park in Lichens, Liverworts, Mosses and Flowering Plants of Kejimikujik National Park. Roland, A.E. (ed.) Parks Canada Report, pp. 52-140, 160 pp.
33	Taylor, P.D. 2006. Long-term monitoring of <i>Listera australis</i> in southwestern Nova Scotia; summary report for 2006, year 3. Acadia University, 33.
32	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
32	Newell, R.E. 2000. <i>Eleocharis tuberculosa</i> records in NS, 1994-99. Acadia University, Wolfville NS, Pers. comm. to S.H. Gerriets, Feb. 11. 32 recs.
31	MacKinnon, D.S. 2001. Fieldwork 2001. Dept of Environment & Labour, Protected Areas Branch, 43 recs.
31	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.
29	Nature Conservancy Canada. 2008. <i>Geum peckii</i> on Brier Island. Nature Conservancy Canada, 29 recs.
27	LaPaix, R.W.; Crowell, M.J.; MacDonald, M. 2011. Stantec rare plant records, 2010-11. Stantec Consulting, 334 recs.
26	Bryson, I. 2020. Nova Scotia and Newfoundland rare species observations, 2018-2020. Nova Scotia Environment.
25	Burnie, B. 2013. 2013 <i>Scirpus longii</i> field data. Mount Saint Vincent University, 51 recs.
25	Paquet, Julie. 2019. Atlantic Canada Shorebird Survey ACSS database for 2019. Environment Canada, Canadian Wildlife Service.
25	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
24	Bayne, D.M., Cameron, R.C. 2014. 2014 Lichen records near Little Bon Mature Lake, Queens NS. NS Department of Natural Resources.
24	Broders, H.G. 2006. Unpublished data. , 24 recs.
24	iNaturalist. 2020. iNaturalist butterfly records selected for the Maritimes Butterfly Atlas. iNaturalist.
23	Phinney, L. 2019. Little Brown Myotis maternal colony counts and birdSAR, 2019. Mersey Tobeatic Research Institute.
21	Benjamin, L.K. (compiler). 2010. <i>Baccharis halimifolia</i> observation records. NS Dept of Natural Resources, 40.
20	O'Grady, Sally. 2010. Water Pennywort in Kejimikujik National Park, 2010. Parks Canada, 20 shapefiles.
19	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
18	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
17	MacKinnon, D.S. 2000. Fieldwork 2000. Dept of Environment and Labour, Protected Areas Branch, 17 recs.
16	LaPaix, R.W.; Crowell, M.J.; MacDonald, M.; Neily, T.D.; Quinn, G. 2017. Stantec Nova Scotia rare plant records, 2012-2016. Stantec Consulting.
16	Neily, T.H. Hectanooga, Nova Scotia Liverwort records. T.H. Neily. 2017.
16	Richardson, Leif. 2018. Maritimes <i>Bombus</i> records from various sources. Richardson, Leif.
15	Catling, P.M. 1981. Taxonomy of autumn-flowering <i>Spiranthes</i> species of southern Nova Scotia in Can. J. Bot. , 59:1250-1273. 30 recs.
15	McLean, K. 2020. Species occurrence records from Clean Annapolis River Project fieldwork in 2020. Clean Annapolis River Project, 206 records.
15	Neily, T.H. Tom Neily NS Sphagnum records (2009-2014). T.H. Neily, Atlantic Canada Conservation Data Centre. 2019.
15	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J.; ONHIC, 487 recs.
14	McNeil, J.A. 2014. Blandings Turtle (<i>Emydoidea blandingii</i>) and Snapping Turtle (<i>Chelydra serpentina</i>) sightings, 2014. Mersey Tobeatic Research Institute.
14	McNeil, J.A. 2015. Blandings Turtle (<i>Emydoidea blandingii</i>), Eastern Ribbonsnake (<i>Thamnophis sauritus</i>), and Snapping Turtle (<i>Chelydra serpentina</i>) sightings, 2015. Mersey Tobeatic Research Institute.
14	McNeil, J.A. 2017. Updates to Blanding's Turtle database, 1984-2014. Mersey Tobeatic Research Institute.
14	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
13	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
13	G.Proulx, R. Newell, A. Mills, D. Bayne. 2018. <i>Selaginella rupestris</i> records, Digby Co. Nova Scotia Lands and Forestry, 1387601 recs.
13	Plissner, J.H. & Haig, S.M. 1997. 1996 International piping plover census. US Geological Survey, Corvallis OR, 231 pp.
12	Klymko, J. 2019. Atlantic Canada Conservation Data Centre zoological fieldwork 2018. Atlantic Canada Conservation Data Centre.
12	McKendry, Karen. 2016. Rare species observations, 2016. Nova Scotia Nature Trust, 19 recs.
12	Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada, 36 recs.
10	Boyne, A.W. & Grecian, V.D. 1999. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 23 recs.
10	Cameron, R.P. 2018. <i>Degelia plumbea</i> records. Nova Scotia Environment.
10	Craik, Shawn. 2019. Roseate tern breeding observations from 2017 - 2019. Université Saint-Anne, 10 records.
10	McNeil, J.A. 2017. Eastern Ribbonsnake (<i>Thamnophis sauritus</i>) sightings, 2017. Mersey Tobeatic Research Institute, 36 recs.
10	Nova Scotia Nature Trust. 2013. Nova Scotia Nature Trust 2013 Species records. Nova Scotia Nature Trust, 95 recs.
10	Porter, C.J.M. 2014. Field work data 2007-2014. Nova Scotia Nature Trust, 96 recs.
10	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (<i>Pannaria lurida</i>). COSEWIC.
10	Smith, T.W. 2009. <i>Eleocharis tuberculosa</i> records in Yarmouth, Shelburne Count. COSEWIC. Pers. comm. to D.M. Mazerolle, 10 recs.

# recs	CITATION
9	deGooyer, K. 2019. Snapping Turtle and Eastern White Cedar observations. Nova Scotia Environment.
9	MacKinnon, D.S. & Maass, O.C. 1996. Fieldwork 1996. Dept Natural Resources, Parks Division, 9 recs.
9	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
9	O'Grady, Sally. 2010. Piping Plover Nesting in Kejimikujik Seaside Annex, 2008-10. Parks Canada, 9 recs.
9	Parks Canada. 2010. Specimens in or near National Parks in Atlantic Canada. Canadian National Museum, 3925 recs.
9	Patrick, Allison. 2021. Animal and plant records from NCC properties from 2019 and 2020. Nature Conservancy Canada.
9	Sollows, M.C., 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
8	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
8	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
8	Bryson, I.C. 2020. Nova Scotia flora and lichen observations 2020. Nova Scotia Environment, 139 recs.
8	Cameron, R.P. 2013. 2013 rare species field data. Nova Scotia Department of Environment, 71 recs.
8	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database Update. Mersey Tobeatic Research Institute, 14 recs.
8	Neily, T.H. 2010. Erioderma pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
8	Pepper, C. 2021. Rare bird, plant and mammal observations in Nova Scotia, 2017-2021.
8	Wood, E.W. 2011. Sabatia kennedyana locations in Nova Scotia. Pers. comm. to C.S. Blaney. Gray Herbarium, Harvard University, 8 recs.
7	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
7	Misc. rare species records gathered by NSDNR staff or communicated to NSDNR and forwarded to ACCDC
7	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
6	Belliveau, A. 2013. email to Sean Blaney regarding <i>Listera australis</i> observations in SW Nova Scotia. Mersey Tobeatic Research Institute, 8.
6	Benedict, B. Connell Herbarium Specimens (Data). University New Brunswick, Fredericton. 2003.
6	Toms, Brad. 2011. Species at Risk data from 2011 field surveys. Mersey Tobeatic Research Institute, 17 recs.
5	Blaney, C.S. 1999. Fieldwork 1999. Atlantic Canada Conservation Data Centre. Sackville NB, 292 recs.
5	Keddy, C. 1986. Status report on the eastern mountain avens, <i>Geum peckii</i> , in Canada Ottawa, Ontario, Canada: Committee on the Status of Endangered Wildlife in Canada (COSEWIC).
5	Layberry, R.A. 2012. Lepidopteran records for the Maritimes, 1974-2008. Layberry Collection, 1060 recs.
5	Newell, R.E. 2002. A Botanical Survey of the Sand Pond National Wildlife Area. , 12 recs.
5	Rothrock, P. 2002. <i>Carex longii</i> in NS. Taylor University, Pers. com. to L. Benjamin, forwarded to S. Blaney. 5 recs.
5	Williams, M. Cape Breton University Digital Herbarium. Cape Breton University Digital Herbarium. 2013.
4	Belliveau, A.G. 2019. Maleberry (<i>Lyonia ligustrina</i>) count at Long Lake, Yarmouth Co., NS. E.C Smith Herbarium, Acadia University, Wolfville NS, 4 records.
4	Cameron, R.P. 2009. Nova Scotia nonvascular plant observations, 1995-2007. Nova Scotia Dept Natural Resources, 27 recs.
4	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
4	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
4	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
4	Newell, R.E. 2006. Rare plant observations in Digby Neck. Pers. comm. to S. Blaney, 6 recs.
4	Robinson, S.L. 2011. 2011 ND dune survey field data. Atlantic Canada Conservation Data Centre, 2715 recs.
3	Basquill, S.P. 2009. 2009 field observations. Nova Scotia Dept of Natural Resources.
3	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
3	Bayne, D.M. 2014. 2014 insect field observations.
3	Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
3	Brunelle, P.-M. (compiler). 2010. ADIP/MDDS Odonata Database: NB, NS Update 1900-09. Atlantic Dragonfly Inventory Program (ADIP), 935 recs.
3	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
3	Canadian Wildlife Service, Atlantic Region. 2010. Piping Plover censuses 2006-09. , 35 recs.
3	deGooyer, K. 2019. Eastern White Cedar observations, Norwood, Nova Scotia. Nova Scotia Environment.
3	Hill, N. 1995. Rare & Uncommon Plants of the Kejimikujik Seaside Adjunct. Biology Dept., Mount Saint Vincent University, 15 recs.
3	Holder, M.L.; Kingsley, A.L. 2000. Kingsley and Holder observations from 2000 field work.
3	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
3	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
3	Lock, A.R., Brown, R.G.B. & Gerriets, S.H. 1994. Gazetteer of Marine Birds in Atlantic Canada. Canadian Wildlife Service, Atlantic Region, 137 pp.
3	Olsen, Ervin. 2018. Nova Scotia Atlantic Coastal Plain Flora observations. Halifax Field Naturalists Nova Scotia Nature Archive Facebook Page.
3	Smith, T.W. 2009. Assessment and update status report on the Tubercled Spike-rush (<i>Eleocharis tuberculosa</i>) in Canada. Committee on the Status of Endangered Wildlife in Canada, 3 recs.
3	Staicer, C. 2013. Personal communication concerning <i>Hirundo rustica</i> nesting in and around Kejimikujik NP, NS. Pers. comm.
2	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of <i>C. insculpta</i> sightings. Acadia University, Wolfville NS, 88 recs.
2	Austin-Smith, P. 2014. 2014 Common Nighthawk personal communication report, NS. NS Department of Natural Resources.
2	Benjamin, L.K. 2002. Rare plant observations by P. MacDonald, P. Mills, S. Eaton, H. MacKinnon, B. Colpitts at Sloans Lake, NS. Pers. comm. to L.K. Benjamin, NSDNR, with P. MacDonald, 3 recs.
2	Brunelle, P.-M. 2009. NS Power odonata records for Mersey, Tusket & Sissiboo systems. Nova Scotia Power, 218 recs.
2	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
2	Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (<i>Pseudevernia cladonia</i>). Committee on the Status of Endangered Wildlife in Canada, 27 recs.
2	Edge, Thomas A. 1984. Status report on the Atlantic Whitefish (<i>Coregonus huntsmani</i>). Committee on the Status of Endangered Wildlife in Canada.
2	Elderkin M.F. 2007. <i>Selaginella rupestris</i> , <i>Iris prismatica</i> & <i>Lophiola aurea</i> records in NS. NS Dept of Natural Resources, Wildlife Div. Pers. comm. to C.S. Blaney, 3 recs.
2	Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (<i>Isoetes prototypus</i>). Committee on the Status of Endangered Wildlife in Canada, 111 recs.

# recs	CITATION
2	Hope, P. 2002. Field survey of <i>Goodyera pubescens</i> population at Kejimikujik National Park. Kejimikujik National Park, 3 recs.
2	Klymko, J. Univeriste de Moncton insect collection butterfly record dataset. Atlantic Canada Conservation Data Centre. 2017.
2	Klymko, J.J.D. 2011. Insect fieldwork & submissions, 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 742 recs.
2	Klymko, J.J.D. 2016. 2015 field data. Atlantic Canada Conservation Data Centre.
2	Majka, C.G. & McCorquodale, D.B. 2006. The Coccinellidae (Coleoptera) of the Maritime Provinces of Canada: new records, biogeographic notes, and conservation concerns. <i>Zootaxa</i> . <i>Zootaxa</i> , 1154: 49–68. 7 recs.
2	Marx, M. & Kenney, R.D. 2001. North Atlantic Right Whale Database. University of Rhode Island, 4 recs.
2	McMullin, Troy. 2021. <i>Anzia colpodes</i> observations near Kejimikujik National Park. Canadian Museum of Nature.
2	McNeil, J.A. 2019. Snapping Turtle records, 2019. Mersey Tobeatic Research Institute.
2	Ogden, J. NS DNR Butterfly Collection Dataset. Nova Scotia Department of Natural Resources. 2014.
2	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
2	Phinney, Lori; Toms, Brad; et. al. 2016. Bank Swallows (<i>Riparia riparia</i>) in Nova Scotia: inventory and assessment of colonies. Merser Tobeiatc Research Institute, 25 recs.
2	Proulx, V.D. 2002. <i>Selaginella rupestris</i> sight record at Centreville, Nova Scotia. Virginia D. Proulx collection, 2 recs.
2	Sollows, M.C. 2008. NBM Science Collections databases: herpetiles. New Brunswick Museum, Saint John NB, download Jan. 2008, 8636 recs.
2	Wong, Sarah. 2020. Two Chimney Swift observation made by Sarah Wong. pers. comm. to Sean Blaney.
2	Wong, Sarah. 2021. Chimney Swift observations, Beverly Lake, NS. pers. comm.
1	Arsenault, R. 2009. <i>Goodyera pubescens</i> record in Kejimikujik National Park. Pers. comm. to C.S. Blaney, 1 rec.
1	Basquill, S.P. 2011. Field observations & specimen collections, 2010. Nova Scotia Department of Natural Resources, Pers. comm. , 8 Recs.
1	Basquill, S.P.; Neily, T. 2015. Database of Sphagnum records for Nova Scotia. NS Department of Natural Resources, 4 recs.
1	Belliveau, A.G. 2020. Email to Colin Chapman on new NS locations for <i>Allium tricoccum</i> . Chapman, C.J. (ed.) Acadia University.
1	Bernard, Laurel. 2013. Email to Sean Blaney regarding <i>Listera australis</i> at Lake Rossignol. Nature Conservancy of Canada, 1.
1	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
1	Bradford, R. 2004. <i>Coregonus huntsmani</i> locations. Dept of Fisheries & Oceans, Atlantic Region, Pers. comm. to K. Bredin. 4 recs.
1	Butt, Brad. 2020. Email from Brad Butt to Sean Blaney regarding a Blue Felt Lichen (<i>Pectenia plumbea</i>) from near Deception Lake, Shelburne Co., NS. pers. comm., 1 record.
1	Cameron, R.P. 2008. <i>Erioderma pedicellatum</i> N of Jones Harbour. Nova Scotia Environment & Labour. Pers. comm. to D.M. Mazerolle, 1 rec.
1	Chapman, Cody. Unreported Species at Risk Records across Nova Scotia. Chapman, Cody, 5 records.
1	Churchill, J.L. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre, 2318 recs.
1	Churchill, J.L. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre, 907 recs.
1	Crowell, M.J. 2009. <i>Lilaeopsis chinensis</i> on Roseway River. Jacques Whitford Limited. Pers. comm. to D.M. Mazerolle, 1 rec.
1	deGooyer, K. 2020. Eastern White Cedar observations, Norwood, Nova Scotia. Nova Scotia Environment.
1	Dibble, A. 1992. Rare plant field form for <i>Amelanchier nantucketensis</i> on McLean Is., Shelburne Co., NS in 1992. University of Maine, Orono, 2 pp.
1	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
1	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
1	e-Butterfly. 2018. Selected Maritimes butterfly records from 2016 and 2017. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
1	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
1	Fernald, M.L. 1921. Expedition to Nova Scotia. <i>Rhodora</i> 13: 136-273.
1	Hall, Duane. 2018. <i>Martes americana</i> record by Duane Sabine, emailed to J. Klymko on 13 12 2018. pers. comm.
1	Hill, N.M. 2016. Email communications to Sean Blaney and Alain Belliveau regarding the discovery of <i>Fimbristylis autumnalis</i> on the shores of Loon Lake, Kejimikujik National Park. Pers. comm., 1 rec.
1	Hope, P. 2007. Water-pennywort (<i>Hydrocotyle umbellata</i>) on Ell Island. Parks Canada, Kejimikujik NP, 1 record.
1	Johnstone, D.; Churchill J. 2014. 2014 Chimney Swift observation, Kejimikujik NP, NS. Atlantic Canada Conservation Data Centre.
1	Jotcham, J. 2013. email to Sean Blaney regarding the discovery of a <i>Listera australis</i> population at Port Mouton. , 1.
1	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2011. Atlantic Canada Conservation Data Centre. Sackville NB, 760 recs.
1	Klymko, J.J.D. 2016. 2014 field data. Atlantic Canada Conservation Data Centre.
1	McMahon, R. 2019. Mainland Moose observation. Pers. comm. to A. Belliveau.
1	McNeil, J.A. 2019. Blanding's Turtle records, 2019. Mersey Tobeatic Research Institute.
1	McNeil, J.A. 2020. Blanding's Turtle records, 2020. Mersey Tobeatic Research Institute.
1	NatureServe Canada. 2018. iNaturalist Butterfly Data Export . iNaturalist.org and iNaturalist.ca.
1	Neily, T.N. 2021. <i>Hectanooga Bryophytes</i> . pers. comm., 1 record.
1	Newell, R.E. 2000. Assessment and update status report on the Eastern Mountain Avens (<i>Geum peckii</i>) in Canada. Committee on the Status of Endangered Wildlife in Canada, 1 rec.
1	Parker, G.R., Maxwell, J.W., Morton, L.D. & Smith, G.E.J. 1983. The ecology of <i>Lynx</i> , <i>Lynx canadensis</i> , on Cape Breton Island. <i>Canadian Journal of Zoology</i> , 61:770-786. 51 recs.
1	Proulx, V. 2008. <i>Geum peckii</i> observation. Pers. comm. to D. Mazerolle, 1 rec.
1	Scott, F.W. 1988. Status Report on the Southern Flying Squirrel (<i>Glaucomys volans</i>) in Canada. Committee on the Status of Endangered Wildlife in Canada, 2 recs.
1	Shortt, R. UNB specimen data for various tracked species formerly considered secure. Connell Memorial Herbarium, UNB, Fredericton NB. 2019.
1	Smith, M. 2016. Email regarding additional location of <i>Fimbristylis autumnalis</i> on shores of Loon Lake, Kejimikujik National Park. pers. comm., 1 record.
1	Tummer, Kevin. 2016. Email communication (April 30, 2016) to John Klymko regarding Snapping Turtle observation in Nova Scotia. Pers. Comm.
1	White, S. 2019. Notable species sightings, 2018. East Coast Aquatics.
1	Zinck, M. 2008. Nova Scotia Museum. Pers. comm. to D.M. Mazerolle, 1 rec.



**WEDGEPORT WIND FARM PROJECT
AVIAFAUNA BIOPHYSICAL BASELINE REPORT**

APPENDIX D. MARITIME BREEDING BIRD ATLAS SQUARES



Square Summary (19GJ34)

#species (1st atlas)				#species (2nd atlas)				#hours		#pc done	
poss	prob	conf	total	poss	prob	conf	total	1st	2nd	road	offrd
5	15	21	41	5	29	25	59	31	24.9	6	0

Region summary (#17: Southwest Shore)

#squares	#sq with data		#species		#pc done	target	#pc
	1st	2nd	1st	2nd			
64	40	56	141	157	320		240

Target number of point counts in this square: 12 road side, 3 off road (2 in Mature coniferous, 1 in Open wetlands). Please try to ensure that each off-road station is located such that the entire 100m radius circle is within the prescribed habitat.

SPECIES	Code		%		SPECIES	Code		%		SPECIES	Code		%		
	1st	2nd	1st	2nd		1st	2nd	1st	2nd		1st	2nd	1st	2nd	
Canada Goose		P	5	44	Red-should Hawk †			0	1	Ruby-thr Hummingbird		T	40	66	
Wood Duck			15	21	Broad-winged Hawk			10	21	Belted Kingfisher			47	39	
American Black Duck	FL	T	57	57	Red-tailed Hawk			45	35	Red-head Woodpecker †			2	0	
Mallard		H	15	37	Semipalmated Plover †	DD	H	7	1	Yellow-bellied Sapsucker			17	21	
Blue-winged Teal			7	7	Killdeer	FL	FY	45	32	Downy Woodpecker			47	44	
Northern Pintail ‡			2	0	<u>Spotted Sandpiper</u>	NE		50	44	Hairy Woodpecker		H	45	66	
Green-winged Teal			22	10	Willet	FL	FY	30	30	Black-back Woodpecker ‡			2	7	
Ring-necked Duck			22	26	Upland Sandpiper †			2	0	Northern Flicker	P	T	60	75	
Common Eider §	FL	FY	22	23	<u>Wilson's Snipe</u>	P		35	25	Pileated Woodpecker			22	26	
Hooded Merganser ‡			5	8	American Woodcock			17	17	American Kestrel			22	12	
Common Merganser			20	12	Ring-billed Gull ‡§			0	0	Merlin			7	16	
Red-breast Merganser ‡			5	8	Herring Gull §	FL	AE	30	28	Olive-sided Flycatcher †			20	33	
Northern Bobwhite †			0	1	Great Black-backed Gull §	NE	T	47	39	<u>Eastern Wood-Pewee</u>			37	57	
Chukar †			2	0	Roseate Tern ‡§			2	1	Yellow-bellied Flycatcher			22	41	
Ring-necked Pheasant	FL	T	32	41	Common Tern §			17	26	Alder Flycatcher		T	35	67	
Ruffed Grouse		D	50	51	Arctic Tern ‡§			7	10	<u>Least Flycatcher</u>			37	57	
Spruce Grouse			10	10	Razorbill ‡§	NE		0	1	<u>Eastern Phoebe</u>		H	10	16	
Common Loon		T	50	57	Black Guillemot ‡§			7	5	Gr Crested Flycatcher ‡			2	3	
Pied-billed Grebe ‡			2	5	Atlantic Puffin ‡§		H	2	3	<u>Eastern Kingbird</u>		H	30	10	
Leach's Storm-Petrel ‡§			2	3	Rock Pigeon			27	28	Blue-headed Vireo		T	45	76	
Double-crest Cormorant §		NE	15	25	Mourning Dove	FL	T	30	64	Warbling Vireo †			0	3	
American Bittern			17	19	Black-billed Cuckoo ‡			5	7	Red-eyed Vireo		T	60	85	
Great Blue Heron §	H	NE	32	32	Great Horned Owl			25	17	Gray Jay		P	47	33	
Black-crown N.-Heron † §			2	0	Barred Owl			30	35	Blue Jay		FY	60	78	
Turkey Vulture ‡			2	3	Long-eared Owl †			2	0	American Crow		A	CF	62	76
<u>Osprey</u>		ON	32	33	North Saw-whet Owl			7	8	Common Raven		A	T	62	75
Bald Eagle ♂			12	16	Common Nighthawk †			42	32	Tree Swallow		H	AE	70	73
Northern Harrier		T	45	23	Whip-poor-will ‡		T	0	1	North Rgh-wing Swallow †			2	0	
Sharp-shinned Hawk			22	16	Chimney Swift †			32	19	<u>Bank Swallow §</u>		NB	50	16	

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Maritimes Breeding Bird Atlas - Summary Sheet for Square 19GJ34 (page 2 of 2)

SPECIES	Code		%		SPECIES	Code		%		SPECIES	Code		%	
	1st	2nd	1st	2nd		1st	2nd	1st	2nd		1st	2nd		
<u>Cliff Swallow</u> §	NB		50	14	<u>Northern Parula</u>			52	82	Brown-head Cowbird	FL	T	32	14
<u>Barn Swallow</u>	NB		65	53	Magnolia Warbler	T	T	57	85	Baltimore Oriole			15	10
Black-capp Chickadee	H	FY	60	89	Bay-breasted Warbler ‡			5	17	Pine Grosbeak			12	8
Boreal Chickadee		FY	35	44	<u>Blackburnian Warbler</u>			37	62	Purple Finch	T	FY	42	69
Red-breast Nuthatch		T	47	58	Yellow Warbler	AY	CF	60	80	House Finch †			7	8
White-breast Nuthatch			22	14	<u>Chestn-sided Warbler</u>			37	73	Red Crossbill †			17	8
Brown Creeper			25	35	Blackpoll Warbler			7	5	White-winged Crossbill			17	25
House Wren †			2	0	Black-thr Blue Warbler			27	48	Pine Siskin			20	16
<u>Winter Wren</u>			22	50	Palm Warbler		FY	42	75	American Goldfinch	C	FY	57	71
Golden-crown Kinglet		T	60	78	Yellow-rumped Warbler	A	FY	57	85	Evening Grosbeak			27	23
Ruby-crown Kinglet			47	37	Black-thr Green Warbler		T	62	87	<u>House Sparrow</u>	T		55	7
Eastern Bluebird †			2	5	Canada Warbler †			20	33					
Veery			42	21	Wilson's Warbler			7	5					
<u>Swainson's Thrush</u>			40	55	Chipping Sparrow			20	21					
Hermit Thrush		FY	65	78	Savannah Sparrow	NE	T	52	37					
Wood Thrush †			2	5	Nelson's Sh.-tail Sparrow	T	T	25	16					
American Robin	NE	CF	75	89	Fox Sparrow ‡			2	7					
Gray Catbird		T	40	48	Song Sparrow	AY	FY	80	92					
Northern Mockingbird †			5	0	Swamp Sparrow		T	40	71					
Brown Thrasher †			2	1	White-throat Sparrow	A	FY	67	78					
European Starling	FL	AE	57	60	Dark-eyed Junco	T	CF	70	82					
<u>Cedar Waxwing</u>			45	76	Scarlet Tanager †			5	3					
Ovenbird		T	50	82	Northern Cardinal ‡		S	5	23					
North Waterthrush ‡			5	10	Rose-breast Grosbeak			22	12					
Black-white Warbler		P	52	83	Indigo Bunting ‡			2	5					
Tennessee Warbler			40	3	<u>Bobolink</u>	AY		40	12					
Nashville Warbler			12	30	Red-wing Blackbird	T	T	42	48					
Common Yellowthroat	T	CF	62	80	Rusty Blackbird †			30	8					
American Redstart		A	60	73	Common Grackle	T	CF	65	67					

This list includes all species found during the Maritimes Breeding Bird Atlas (1st atlas: 1986-1990, 2nd atlas: 2006-2010) in the region #17 (Southwest Shore). Underlined species are those that you should try to add to this square (19GJ34). They have not yet been reported during the 2nd atlas, but were found during the 1st atlas in this square or have been reported in more than 50% of the squares in this region during the 2nd atlas so far. "Code" is the code for the highest breeding evidence for that species in square 19GJ34 during the 2nd and 1st atlas respectively. The % columns give the percentage of squares in that region where that species was reported during the 2nd and 1st atlas (this gives an idea of the expected chance of finding that species in region #17). Rare/Colonial Species Report Forms should be completed for species marked: § (Colonial), ‡ (regionally rare), † (rare in the Maritimes) or † (rare in the Maritimes, documentation only required for confirmed records). Current as of 16/10/2022. An up-to-date version of this sheet is available from <http://www.mba-aom.ca/jsp/summaryform.jsp?squareID=19GJ34?lang=en>

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Square Summary (19GJ44)

#species (1st atlas)				#species (2nd atlas)				#hours	#pc done			
poss	prob	conf	total	poss	prob	conf	total	1st	2nd	road	offrd	
0	0	0	0	3	17	21	41	0	18.3	7	0	

Region summary (#17: Southwest Shore)

#squares	#sq with data		#species		#pc done	target	#pc
	1st	2nd	1st	2nd			
64	40	56	141	157	320	240	

Target number of point counts in this square: 5 road side, 10 off road (3 in Mature coniferous, 1 in Mature deciduous, 5 in Upland open country, 1 in Young forest). Please try to ensure that each off-road station is located such that the entire 100m radius circle is within the prescribed habitat.

SPECIES	Code		%		SPECIES	Code		%		SPECIES	Code		%	
	1st	2nd	1st	2nd		1st	2nd	1st	2nd		1st	2nd		
Canada Goose			5	44	Red-should Hawk †			0	1	Red-head Woodpecker †			2	0
Wood Duck			15	21	Broad-winged Hawk			10	21	Yellow-bellied Sapsucker			17	21
<u>American Black Duck</u>			57	57	Red-tailed Hawk			45	35	Downy Woodpecker			47	44
Mallard	P		15	37	Semipalmated Plover †			7	1	<u>Hairy Woodpecker</u>			45	66
Blue-winged Teal			7	7	Killdeer			45	32	Black-back Woodpecker ‡			2	7
Northern Pintail ‡			2	0	Spotted Sandpiper			50	44	Northern Flicker	T		60	75
Green-winged Teal			22	10	Willet	FY		30	30	Pileated Woodpecker			22	26
Ring-necked Duck			22	26	Upland Sandpiper †			2	0	American Kestrel			22	12
Common Eider §	H		22	23	Wilson's Snipe			35	25	Merlin			7	16
Hooded Merganser ‡			5	8	American Woodcock			17	17	Olive-sided Flycatcher †			20	33
Common Merganser			20	12	Ring-billed Gull ‡§			0	0	<u>Eastern Wood-Pewee</u>			37	57
Red-breast Merganser ‡			5	8	Herring Gull §			30	28	Yellow-bellied Flycatcher			22	41
Northern Bobwhite †			0	1	Great Black-backed Gull §			47	39	Alder Flycatcher	T		35	67
Chukar †			2	0	Roseate Tern ‡§			2	1	<u>Least Flycatcher</u>			37	57
Ring-necked Pheasant			32	41	Common Tern §			17	26	Eastern Phoebe			10	16
Ruffed Grouse	H		50	51	Arctic Tern ‡§			7	10	Gr Crested Flycatcher ‡			2	3
Spruce Grouse			10	10	Black Guillemot ‡§			7	5	Eastern Kingbird			30	10
<u>Common Loon</u>			50	57	Atlantic Puffin ‡§			2	3	Blue-headed Vireo	T		45	76
Pied-billed Grebe ‡			2	5	Rock Pigeon			27	28	Warbling Vireo †			0	3
Leach's Storm-Petrel ‡§			2	3	Mourning Dove	T		30	64	Red-eyed Vireo	T		60	85
Double-crest Cormorant §			15	25	Black-billed Cuckoo ‡			5	7	Gray Jay	FY		47	33
American Bittern			17	19	Great Horned Owl	T		25	17	Blue Jay	T		60	78
Great Blue Heron §			32	32	Barred Owl			30	35	American Crow	FY		62	76
Black-crown N.-Heron † §			2	0	Long-eared Owl †			2	0	<u>Common Raven</u>			62	75
Turkey Vulture ‡			2	3	North Saw-whet Owl			7	8	Tree Swallow	P		70	73
Osprey			32	33	Common Nighthawk †			42	32	North Rgh-wing Swallow †			2	0
Bald Eagle ♂			12	16	Chimney Swift †			32	19	Bank Swallow §			50	16
Northern Harrier	H		45	23	<u>Ruby-thr Hummingbird</u>			40	66	Cliff Swallow §			50	14
Sharp-shinned Hawk			22	16	Belted Kingfisher			47	39	<u>Barn Swallow</u>			65	53

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Maritimes Breeding Bird Atlas - Summary Sheet for Square 19GJ44 (page 2 of 2)

SPECIES	Code		%		SPECIES	Code		%		SPECIES	Code		%	
	1st	2nd	1st	2nd		1st	2nd	1st	2nd		1st	2nd	1st	2nd
Black-capp Chickadee	AE		60	89	Bay-breasted Warbler ‡			5	17	Pine Grosbeak			12	8
Boreal Chickadee	FY		35	44	<u>Blackburnian Warbler</u>			37	62	Purple Finch	T		42	69
Red-breast Nuthatch	T		47	58	Yellow Warbler	CF		60	80	House Finch †	V		7	8
White-breast Nuthatch			22	14	Chestn-sided Warbler	CF		37	73	Red Crossbill †			17	8
Brown Creeper			25	35	Blackpoll Warbler			7	5	White-winged Crossbill			17	25
House Wren †			2	0	Black-thr Blue Warbler			27	48	Pine Siskin			20	16
<u>Winter Wren</u>			22	50	Palm Warbler	FY		42	75	American Goldfinch	T		57	71
<u>Golden-crown Kinglet</u>			60	78	Yellow-rumped Warbler	FY		57	85	Evening Grosbeak			27	23
Ruby-crown Kinglet			47	37	Black-thr Green Warbler	T		62	87	House Sparrow			55	7
Eastern Bluebird †			2	5	Canada Warbler †			20	33					
Veery			42	21	Wilson's Warbler			7	5					
Swainson's Thrush	P		40	55	Chipping Sparrow			20	21					
Hermit Thrush	CF		65	78	Savannah Sparrow			52	37					
Wood Thrush †			2	5	Nelson's Sh.-tail Sparrow			25	16					
American Robin	CF		75	89	Fox Sparrow ‡			2	7					
Gray Catbird	CF		40	48	Song Sparrow	FY		80	92					
Northern Mockingbird †			5	0	Swamp Sparrow	T		40	71					
Brown Thrasher †			2	1	White-throat Sparrow	CF		67	78					
European Starling	FY		57	60	Dark-eyed Junco	FY		70	82					
Cedar Waxwing	FY		45	76	Scarlet Tanager †			5	3					
Ovenbird	CF		50	82	Northern Cardinal ‡			5	23					
North Waterthrush ‡			5	10	Rose-breast Grosbeak			22	12					
<u>Black-white Warbler</u>			52	83	Indigo Bunting ‡			2	5					
Tennessee Warbler			40	3	Bobolink			40	12					
Nashville Warbler			12	30	Red-wing Blackbird			42	48					
Common Yellowthroat	CF		62	80	Rusty Blackbird †			30	8					
American Redstart	T		60	73	Common Grackle	FY		65	67					
<u>Northern Parula</u>			52	82	Brown-head Cowbird			32	14					
Magnolia Warbler	CF		57	85	Baltimore Oriole			15	10					

This list includes all species found during the Maritimes Breeding Bird Atlas (1st atlas: 1986-1990, 2nd atlas: 2006-2010) in the region #17 (Southwest Shore). Underlined species are those that you should try to add to this square (19GJ44). They have not yet been reported during the 2nd atlas, but were found during the 1st atlas in this square or have been reported in more than 50% of the squares in this region during the 2nd atlas so far. "Code" is the code for the highest breeding evidence for that species in square 19GJ44 during the 2nd and 1st atlas respectively. The % columns give the percentage of squares in that region where that species was reported during the 2nd and 1st atlas (this gives an idea of the expected chance of finding that species in region #17). Rare/Colonial Species Report Forms should be completed for species marked: § (Colonial), ‡ (regionally rare), † (rare in the Maritimes) or ¶ (rare in the Maritimes, documentation only required for confirmed records). Current as of 16/10/2022. An up-to-date version of this sheet is available from <http://www.mba-aom.ca/jsp/summaryform.jsp?squareID=19GJ44?lang=en>

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Square Summary (20KP54)

#species (1st atlas)				#species (2nd atlas)				#hours	#pc done			
poss	prob	conf	total	poss	prob	conf	total	1st	2nd	road	offrd	
0	0	0	0	11	30	28	69	0	51.5	10	0	

Region summary (#17: Southwest Shore)

#squares	#sq with data		#species		#pc done	target	#pc
	1st	2nd	1st	2nd			
64	40	56	141	157	320	240	

Target number of point counts in this square: 10 road side, 5 off road (2 in Mature coniferous, 1 in Mature deciduous, 2 in Young forest). Please try to ensure that each off-road station is located such that the entire 100m radius circle is within the prescribed habitat.

SPECIES	Code		%		SPECIES	Code		%		SPECIES	Code		%		
	1st	2nd	1st	2nd		1st	2nd	1st	2nd		1st	2nd			
Canada Goose		FY	5	44	Red-should Hawk †			0	1	Red-head Woodpecker †				2	0
Wood Duck			15	21	Broad-winged Hawk			10	21	Yellow-bellied Sapsucker				17	21
American Black Duck		FY	57	57	Red-tailed Hawk			45	35	Downy Woodpecker		P		47	44
Mallard		FY	15	37	Semipalmated Plover †			7	1	Hairy Woodpecker		D		45	66
Blue-winged Teal		P	7	7	Killdeer		NY	45	32	Black-back Woodpecker ‡				2	7
Northern Pintail ‡			2	0	Spotted Sandpiper			50	44	Northern Flicker		T		60	75
Green-winged Teal			22	10	Willet		FY	30	30	Pileated Woodpecker				22	26
Ring-necked Duck			22	26	Upland Sandpiper †			2	0	American Kestrel				22	12
Common Eider §		FY	22	23	Wilson's Snipe		H	35	25	Merlin				7	16
Hooded Merganser ‡			5	8	American Woodcock		S	17	17	Olive-sided Flycatcher †				20	33
Common Merganser			20	12	Ring-billed Gull ‡§			0	0	<u>Eastern Wood-Pewee</u>				37	57
Red-breast Merganser ‡			5	8	Herring Gull §		T	30	28	Yellow-bellied Flycatcher				22	41
Northern Bobwhite †		S	0	1	Great Black-backed Gull §		FY	47	39	Alder Flycatcher		T		35	67
Chukar †			2	0	Roseate Tern ‡§			2	1	<u>Least Flycatcher</u>				37	57
Ring-necked Pheasant		FY	32	41	Common Tern §		A	17	26	Eastern Phoebe				10	16
Ruffed Grouse		FY	50	51	Arctic Tern ‡§			7	10	Gr Crested Flycatcher ‡				2	3
Spruce Grouse			10	10	Black Guillemot ‡§			7	5	Eastern Kingbird		P		30	10
Common Loon		FY	50	57	Atlantic Puffin ‡§			2	3	Blue-headed Vireo		D		45	76
Pied-billed Grebe ‡			2	5	Rock Pigeon			27	28	Warbling Vireo †				0	3
Leach's Storm-Petrel ‡§			2	3	Mourning Dove		D	30	64	Red-eyed Vireo		T		60	85
Double-crest Cormorant §			15	25	Black-billed Cuckoo ‡			5	7	Gray Jay		P		47	33
American Bittern			17	19	Great Horned Owl		NY	25	17	Blue Jay		NB		60	78
Great Blue Heron §		H	32	32	Barred Owl			30	35	American Crow		NB		62	76
Black-crown N.-Heron † §			2	0	Long-eared Owl †			2	0	Common Raven		T		62	75
Turkey Vulture ‡⌘			2	3	North Saw-whet Owl			7	8	Tree Swallow		AE		70	73
Osprey		H	32	33	Common Nighthawk †			42	32	North Rgh-wing Swallow †				2	0
Bald Eagle ⌘			12	16	Chimney Swift †			32	19	Bank Swallow §				50	16
Northern Harrier		CF	45	23	Ruby-thr Hummingbird		V	40	66	Cliff Swallow §				50	14
Sharp-shinned Hawk			22	16	Belted Kingfisher			47	39	Barn Swallow		H		65	53

[next page >>](#)

Maritimes Breeding Bird Atlas - Summary Sheet for Square 20KP54 (page 2 of 2)

SPECIES	Code		%		SPECIES	Code		%		SPECIES	Code		%	
	1st	2nd	1st	2nd		1st	2nd	1st	2nd		1st	2nd	1st	2nd
Black-capp Chickadee	T		60	89	Bay-breasted Warbler ‡			5	17	Pine Grosbeak			12	8
Boreal Chickadee	FY		35	44	<u>Blackburnian Warbler</u>			37	62	Purple Finch	FY		42	69
<u>Red-breast Nuthatch</u>			47	58	Yellow Warbler	CF		60	80	House Finch †			7	8
White-breast Nuthatch			22	14	Chestn-sided Warbler	T		37	73	Red Crossbill †			17	8
Brown Creeper	P		25	35	Blackpoll Warbler			7	5	White-winged Crossbill			17	25
House Wren †			2	0	Black-thr Blue Warbler			27	48	Pine Siskin			20	16
Winter Wren	S		22	50	Palm Warbler	H		42	75	American Goldfinch	CF		57	71
<u>Golden-crown Kinglet</u>			60	78	Yellow-rumped Warbler	FY		57	85	Evening Grosbeak			27	23
Ruby-crown Kinglet			47	37	Black-thr Green Warbler	CF		62	87	House Sparrow			55	7
Eastern Bluebird †			2	5	Canada Warbler †			20	33					
Veery			42	21	Wilson's Warbler			7	5					
<u>Swainson's Thrush</u>			40	55	Chipping Sparrow	H		20	21					
Hermit Thrush	CF		65	78	Savannah Sparrow	T		52	37					
Wood Thrush †			2	5	Nelson's Sh.-tail Sparrow	T		25	16					
American Robin	NY		75	89	Fox Sparrow ‡			2	7					
Gray Catbird	CF		40	48	Song Sparrow	CF		80	92					
Northern Mockingbird †			5	0	Swamp Sparrow	T		40	71					
Brown Thrasher †			2	1	White-throat Sparrow	CF		67	78					
European Starling	CF		57	60	Dark-eyed Junco	A		70	82					
Cedar Waxwing	H		45	76	Scarlet Tanager †			5	3					
Ovenbird	T		50	82	Northern Cardinal ‡	A		5	23					
North Waterthrush ‡			5	10	Rose-breast Grosbeak			22	12					
Black-white Warbler	T		52	83	Indigo Bunting ‡	P		2	5					
Tennessee Warbler			40	3	Bobolink			40	12					
Nashville Warbler			12	30	Red-wing Blackbird	T		42	48					
Common Yellowthroat	A		62	80	Rusty Blackbird †			30	8					
American Redstart	T		60	73	Common Grackle	D		65	67					
Northern Parula	T		52	82	Brown-head Cowbird	H		32	14					
Magnolia Warbler	CF		57	85	Baltimore Oriole			15	10					

This list includes all species found during the Maritimes Breeding Bird Atlas (1st atlas: 1986-1990, 2nd atlas: 2006-2010) in the region #17 (Southwest Shore). Underlined species are those that you should try to add to this square (20KP54). They have not yet been reported during the 2nd atlas, but were found during the 1st atlas in this square or have been reported in more than 50% of the squares in this region during the 2nd atlas so far. "Code" is the code for the highest breeding evidence for that species in square 20KP54 during the 2nd and 1st atlas respectively. The % columns give the percentage of squares in that region where that species was reported during the 2nd and 1st atlas (this gives an idea of the expected chance of finding that species in region #17). Rare/Colonial Species Report Forms should be completed for species marked: § (Colonial), ‡ (regionally rare), † (rare in the Maritimes) or ¶ (rare in the Maritimes, documentation only required for confirmed records). Current as of 16/10/2022. An up-to-date version of this sheet is available from <http://www.mba-aom.ca/jsp/summaryform.jsp?squareID=20KP54?lang=en>

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APPENDIX C-2. AVIAN ACOUSTIC MONITORING REPORT

Wedgeport Wind Project Fall 2022 Acoustic Monitoring

Prepared for:

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2 Bluewater Road, Suite 115
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Project No. 107147-01

December 15, 2022

Prepared by:

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1.0 Introduction

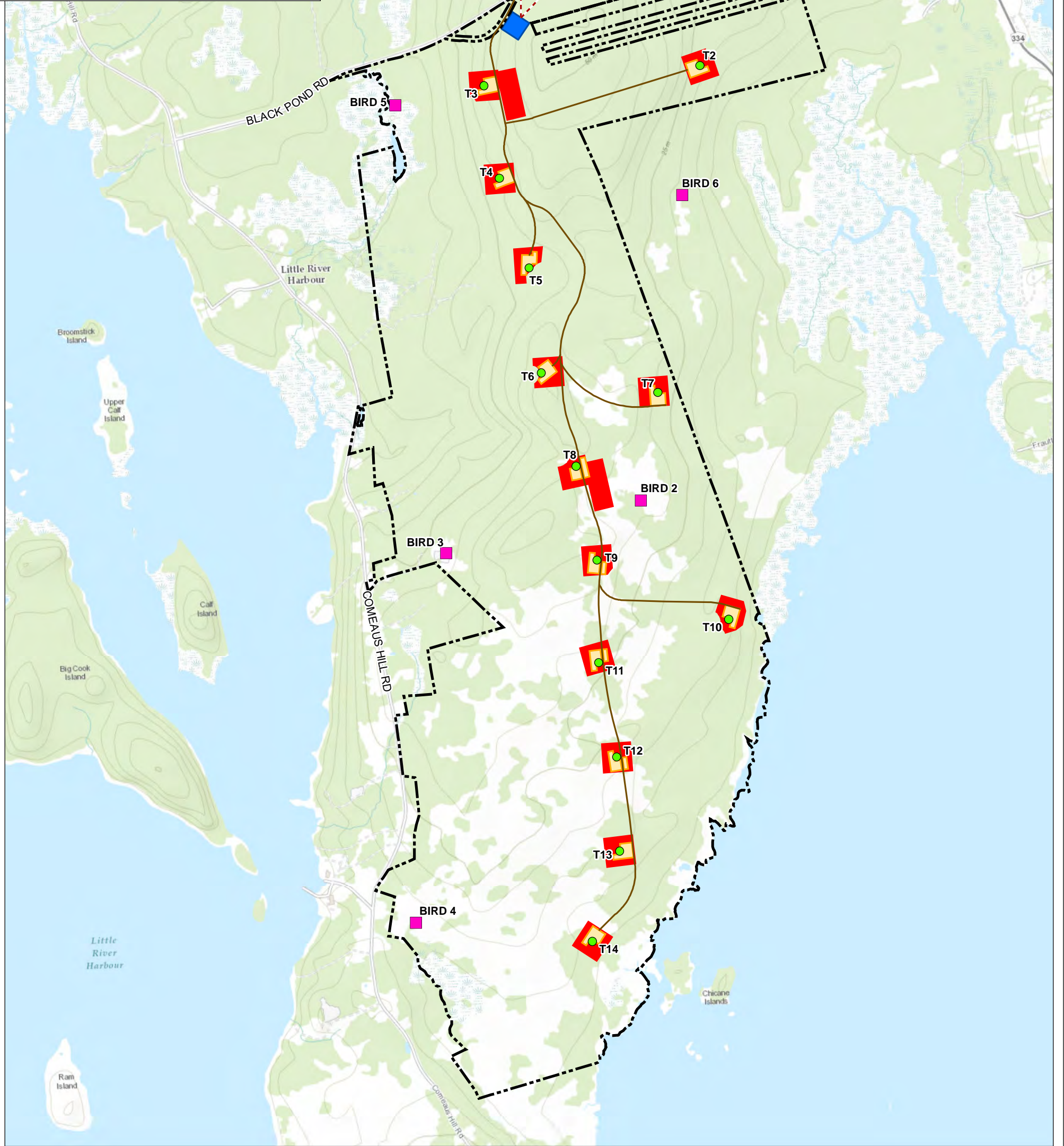
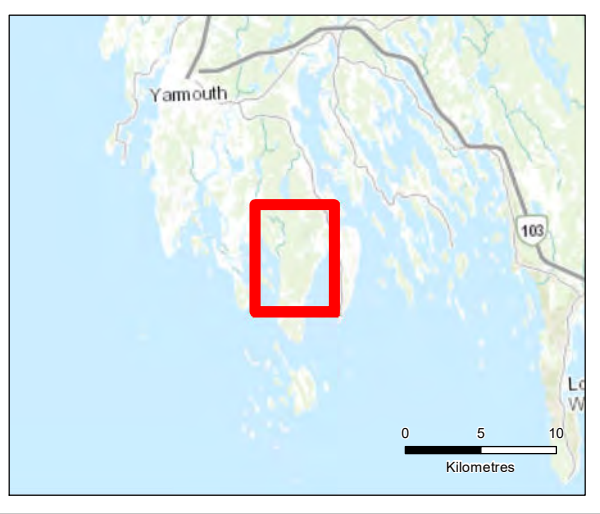
McCallum Environmental Ltd. (MEL), on behalf of Wedgeport Wind Farm LP, retained Ausenco Sustainability Inc. (Ausenco), to conduct fall acoustic monitoring of nocturnal migrating birds at the proposed Wedgeport Wind Farm (the Project) in 2022. The Project is located approximately 20 kilometers (km) southeast (SE) of the Town of Yarmouth, Nova Scotia (NS).

The Canadian Wildlife Service's *Wind Energy & Birds Environmental Assessment Guidance Update* (Environment and Climate Change Canada 2022), created in April 2022, specifies that migratory avian radar and acoustic studies be completed for projects that include turbines greater than 150 m in height. Given that the Project turbine will have a maximum total height greater than 150 m, a radar and acoustic monitoring program was undertaken for the Project and led by MEL. This report represents the acoustic monitoring portion of the larger radar/acoustic program.

All data included in this report was collected by MEL and provided to Ausenco for analysis and interpretation. Ausenco, in partnership with Dr. Phil Taylor of Tabanid Consulting Ltd., processed the fall avian acoustic monitoring data collected at the Project in 2022.

1.1 Project Details

Wedgeport Wind Farm LP is proposing 14 potential turbine locations for the Project (**Figure 1-1**). The turbine model proposed is Siemens Gamesa (SG 6.6-170) which have an output of 6.6 megawatt (MW) each, for a total Project nameplate capacity up to 92 MW. The turbine specifications include a hub height of 110.5 meters (m), blade length of 83.5 m, rotor diameter of 170 m for a total turbine height (i.e., tip of blade) of 194 m above ground level (agl). The rotor swept area (RSA) of the turbines is 22,698 m², between approximately 27 to 194 m agl.



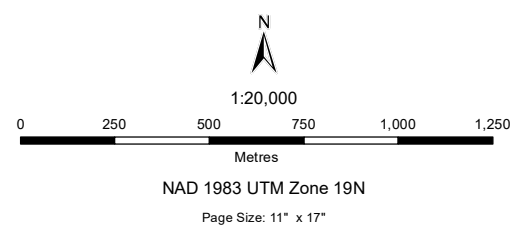
- Legend**
- Audio Sensor Location
 - Turbine Location
 - Access Road
 - Collection Line
 - Construction Area
 - Cleared Area
 - Project Area
 - Substation

Sources

- Contains information licensed under the Open Government Licence(s) - Nova Scotia Government
- Basemap Image: ESRI World Topographic Map

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.



Wedgeport Wind Project
Wedgeport, NS

Project Area

107147-01	Production Date: Nov 2, 2022	Figure 1
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Ausenco McCallum Environmental Ltd.

Path: S:\GIS\MapDocs\107147\107147_01_Figures_221101.mxd

2.0 Methods

The following sections provide a summary of the methodology used to collect and analyse the acoustic data.

2.1 Acoustic Monitoring

The location of the acoustic equipment was chosen by MEL based on access availability, clear sight lines, and even distribution within the Project Area, and were selected prior to the Project layout being finalized. Six acoustic sensors were deployed (**Figure 1-1**), allowing for sampling of nocturnal migrants throughout the Project Area. The sensors were placed a minimum of 1,000 m apart to reduce the potential of duplicate sampling of airspace.

Wildlife Acoustics™ Song Meter Micro acoustic sensors were used to record nocturnal flight calls (NFCs) of migratory birds (primarily Passerines) at the Project Area. Sensors were programmed to record alternate 10-minute (min) periods throughout the fall migration season. Sensors were deployed on July 15, 2022, and were checked approximately every 10 days to download data, replace batteries and conduct maintenance, as needed. The final data check occurred on November 30, 2022. The detection range of each recording unit is variable depending on factors such as volume and direction of the source, humidity, and foliage cover. The sensor's sensitivity is stated by the manufacturer to be 2 dB.

Table 2-1 and **Figure 1-1** provides the location of acoustic sensors.

Table 2-1 Acoustic Sensor Locations

Sensor ID	Latitude	Longitude
Bird 1	43.75195405	-66.01033882
Bird 2	43.72830204	-66.00949281
Bird 3	43.72625904	-66.02162182
Bird 4	43.70972304	-66.02432782
Bird 5	43.74644105	-66.02379182
Bird 6	43.74193405	-66.00624881

2.2 Data Processing and Analysis

All analyses were conducted in Rstudio (V. 2021.09.02) running program R (R Statistical Core team; V 4.0.4) and python V.3.8.

Acoustic data were either sampled or resampled to 22 kilohertz (kHz) (encompassing the frequency range where most NFCs occur), then subset to encompass only the period of time between the end of evening civil twilight and the beginning of morning civil twilight as calculated using the suncalc package in R (v 0.5.1; Thieurmel & Elmarhraoui 2022). It is during this period that birds make NFCs while actively migrating (Evans 2005).

All acoustic files were processed using a custom-built artificial intelligence NFC detection model developed by Dr. Kitzes' laboratory at the University of Pittsburgh using Open Sound Scape python package. The model was trained using NFCs originally identified by John Kearney of John F. Kearney & Associates (see a summary of these data at nocturnalfightcalls.com).

The NFC model assigns a ‘score’ to each species group, which is then related to the probability that a specific acoustic detection actually is that species group. NFCs detected by the model were sampled for validation. Each NFC was assigned to one of 3 categories related to the time of night, either ‘Dusk’, ‘Dawn’ or ‘Night’. NFCs categorized as ‘Dusk’ and ‘Dawn’ were detected during 30 min from the beginning or end of the civil twilight period, respectively. For validation, up to 100 NFCs were randomly selected (weighted by score) from the Dusk/Dawn period, and up to 200 calls from the Night period. These calls were visually assessed (by examining a spectrogram) and/or listened to by an expert (Tabanid Consulting Ltd) to verify the identity of the call or call group.

A statistical model was then fit for each species/species group. A binomial model, with the response being valid/not valid was fit to model score and time of night, with night as a random effect. These models were then used to predict the probability that any given call was of a given species or species group.

For plotting and analysis, all NFCs were selected that had a predicted probabilities of being valid that was greater than 85%. This means that an assumed 15% of the NFCs for each species/group are potentially not valid (i.e., are either miscategorized or are not an NFC). The 85% value was chosen to provide a balance between false positives (an incorrectly classified call) and false negatives (overlooking a call that is truly there).

These classified calls were further assessed (by visually inspecting an additional 200 spectrograms) to ensure that the false positive rate was indeed near 15%. For Canada warbler, all NFCs that were above the 85% threshold for inclusion were visually or acoustically assessed.

The NFC model was designed primarily for passerines; shorebirds and waterfowl were not assessed. **Table 2-2** shows the NFC categories for the species and species groups used by the model.

Table 2-2 Nocturnal Flight Call Species and Species Group

Species / Species Group	Potential Species ^(a)
Cup-Sparrows	<ul style="list-style-type: none"> • Chipping Sparrow • Field Sparrow • American Tree Sparrow
Fox / Song Sparrow Complex	<ul style="list-style-type: none"> • Fox Sparrow • Song Sparrow
Zeep	<ul style="list-style-type: none"> • Bay-breasted Warbler • Blackburnian Warbler • Blackpoll Warbler • Cape May Warbler • Magnolia Warbler • Northern Waterthrush • Yellow Warbler
Single-banded down sweep	<ul style="list-style-type: none"> • Pine Warbler • Northern Parula • Yellow-throated Warbler (rare) • Prairie Warbler (rare)

Species / Species Group	Potential Species ^(a)
Double-up	<ul style="list-style-type: none"> • Black-throated Green Warbler • Tennessee Warbler • Nashville Warbler • Orange-crowned Warbler
Thrushes	<ul style="list-style-type: none"> • Hermit Thrush • American Robin • Gray-cheeked Thrush (rare) • Bicknell’s Thrush (rare) • Eastern Bluebird (rare) • Wood Thrush (rare) • Swainson’s Thrush • Veery • Rose-breasted Grosbeak (rarely calls) • Scarlet Tanager (rare)
Full Species	<p>Sparrows:</p> <ul style="list-style-type: none"> • White-throated sparrow • Savannah Sparrow <p>Warblers:</p> <ul style="list-style-type: none"> • American Redstart • Black-and-white Warbler • Black-throated Blue Warbler • <i>Canada Warbler</i> • Chestnut-sided Warbler • Common Yellowthroat • Mourning Warbler • Ovenbird • Palm Warbler • Yellow-rumped Warbler <p>Other:</p> <ul style="list-style-type: none"> • <i>Common Nighthawk</i> • American Woodcock <p>Poorly detected/classified:</p> <ul style="list-style-type: none"> • Wilson’s Warbler • Red-breasted Nuthatch • Pine Siskin • Golden-crowned Kinglet

(a) Species in italic represent Species at Risk.

Following the analysis, the NFCs identified covered a broad range of warbler, sparrow and thrush species found in the region, and are listed below. For auditory and visual examples of these calls, visit nocturnalfightcalls.com.

- “Zeep”
- “Cup Sparrow” (cupsp)
- “Double-Up” (dubup)
- “Single-banded down sweep” (sbds)
- “Fox Sparrow / Song Sparrow” (fssp)
- “Thrushes” (thrush)
- American Redstart (amre)
- Black and White Warbler (baww)
- Black-throated Blue Warbler (btbw)
- Canada Warbler (cawa)
- Common Yellowthroat (coye)
- Chestnut-sided Warbler (cswa)
- Mourning Warbler (mowa)
- Ovenbird (oven)
- Palm Warbler (pawa)
- Yellow-rumped Warbler (yrwa)
- Savannah Sparrow (savs)
- White-throated Sparrow (wtsp).

3.0 Results

3.1 General Migration Patterns

Acoustic monitoring was conducted at the Project Area during the fall 2022 migration season from July 15 until November 30. While some minor technical issues occurred with the acoustic sensors, data were collected by at least one sensor each night. A total of 821 of a possible 852 (i.e., 96%) detector-nights of monitoring was completed and a total of 28,853 NFCs were detected for an average of approximately 35 NFCs detected per detector-night. When considering detection rates of NFCs it is important to understand that many variables, some of which are poorly understood, affect the number of NFCs detected. For example, species likely have different calling rates, and there is also the potential for double counting individuals that call more than once in a short period of time. Therefore, **the results presented below are considered to be an index of the migratory activity at the site, providing insight into general trends of migration and not a measure of the absolute numbers of migrants.**

The majority of the NFC detections were warblers (83%), followed by sparrows (17%). Most migration was observed across a relatively small proportion of the nights monitored. Approximately 42% of the NFCs were detected across just 7 nights, including August 25, 27 and 28, and September 6, 16, 28 and 29. As seen in **Figure 3-2**, the majority of the NFCs observed during the peak nights were warblers, except for during late September when high numbers of sparrow NFCs (relative to the other nights) were detected. The number of detections shown in **Figure 3-2** represent the total number of calls detected for that group, on that night; also note that the scale differs between groups in **Figure 3-2**.

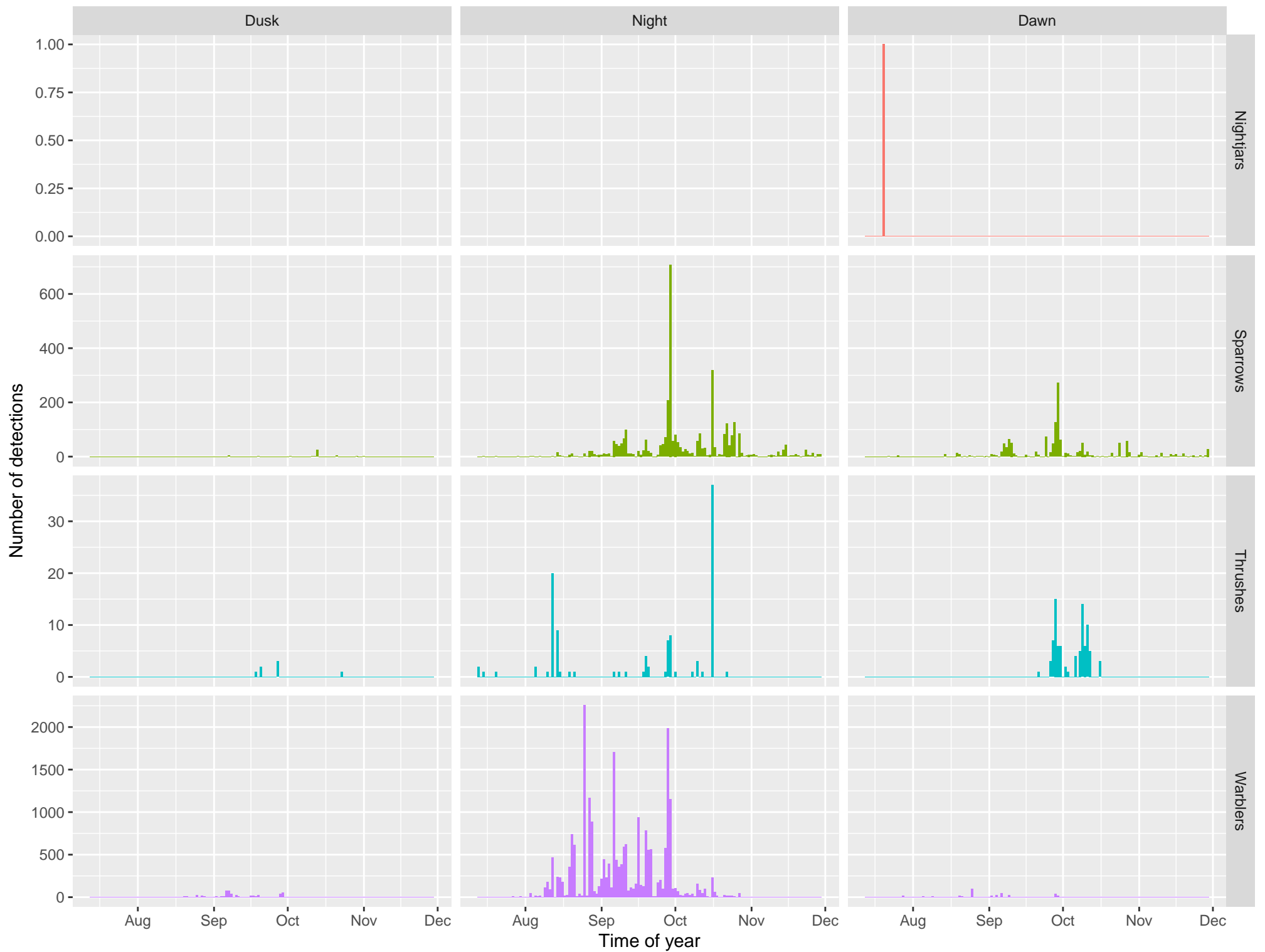


Figure 3-2 Acoustic Detections by Species Group and Time of Night

Most NFCs were detected during the first half of the nights. **Figure 3-3** shows the occurrence of NFCs based on the time of night (hours before sunrise), the month and species group. As expected by the pattern of migration in the region, there was less activity in July and November, indicating that the migration season was adequately assessed by the acoustic sensors.

As indicated above, the majority of NFCs were from warblers, which occurred primarily in August and September and during the middle part of the night. As can be seen in **Figure 3-3**, many of the calls from thrushes were recorded at or near dawn. During July and early August, these are likely calls from individuals breeding in the area. In September and October, these likely represent Thrushes calling as they land (or shortly thereafter), which is a commonly observed phenomena known as the “thrush descent”. A similar, but slightly less striking pattern was observed with sparrow, which were mainly driven by white-throated sparrows calling from the ground after landing.

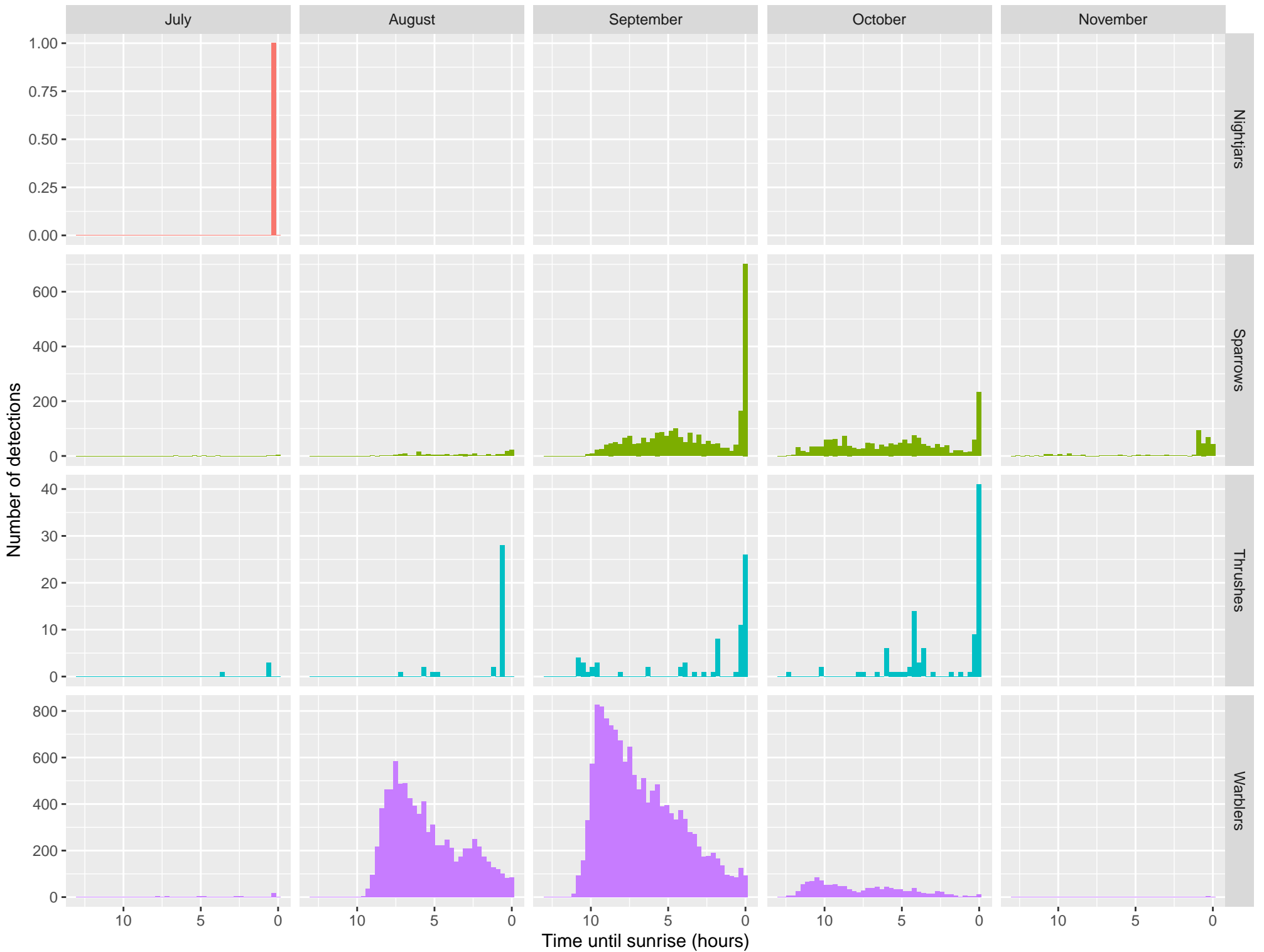


Figure 3-3 Acoustic Detections by Species Group, Month and Time of Night

3.2 Species Composition

The most common species / species group detected was American Redstart, followed by “zeep” and “single banded down sweep”. These three groups comprised 51% of the detections.

Table 3-3 Nocturnal Flight Call Detections by Species and Species Group

Species / Species Group ^(a)	Total Number of Calls Detected	Proportion of Calls Detected
American Redstart	5,438	18.8%
zeep	5,052	17.5%
Single Banded Down Sweep	4,154	14.4%
Black and White Warbler	3,042	10.5%
White-throated Sparrow	2,569	8.9%
Savannah Sparrow	1,662	5.8%
Chestnut-sided Warbler	1,464	5.1%
Double-up	1,337	4.6%
Ovenbird	1,049	3.6%
Yellow-rumped Warbler	882	3.1%
Black-throated Blue Warbler	548	1.9%
Fox / Song Sparrow	494	1.7%
Palm Warbler	408	1.4%
<i>Canada Warbler</i>	352	1.2%
Thrushes	205	0.7%
Common Yellowthroat	76	0.3%
Cup Sparrow	70	0.2%
Mourning Warbler	52	0.2%
<i>Common Nighthawk</i>	1	<0.1%
Total	28,853	100%

(a) “Zeep” species groups includes bay-breasted warbler, blackburnian warbler, blackpoll warbler, Cape May warbler, magnolia warbler, northern waterthrush and yellow warbler; “Single Banded Down Sweep” species group includes pine warbler, northern parula, yellow-throated warble and prairie warbler; “Double Up” species group includes black-throated green warbler, Tennessee warbler, Nashville warbler and orange crowned warbler; “Thrushes” species group includes hermit thrush, American robin, gray-cheeked thrush, Bicknell’s thrush, eastern bluebird, wood thrush, Swainson’s thrush, verry, rose-breasted grosbeak, and scarlet tanager; “Cup Sparrow” species group includes chipping sparrow, field sparrow and American tree sparrow.

Figure 3-4 shows the distribution of acoustic detections by species of warblers (purple), sparrows (green), thrushes (blue) and common nighthawk (orange) across the fall season. The number of detections shown in **Figure 3-4** is the total number of calls detected for that group, on that night; also note that the scale differs between groups. Timing of species detections are as expected with most species (e.g., American redstarts detected primarily in August and early September, yellow-rumped warblers detected primarily in October, and sparrow activity occurring primarily in late September through October) (see Cornell Lab of Ornithology, e-bird bar charts URL <https://ebird.org/barchart?r=CA-NS&yr=all&m=>).



Figure 3-4 Acoustic Detections by Time of Year and Species

Time of year

3.3 Species at Risk

Given our approach to acoustic analysis outline above, Common nighthawk (*Chordeiles minor*) and Canada warbler (*Cardellina canadensis*) are the only Species at Risk (SAR) identifiable via NFCs. Only one common nighthawk was detected at the Project Area via NFCs during the fall migration season.

Table 3-4 provides a summary of the dates and locations where Canada warblers NFCs were detected. A total of 352 NFCs of this species were recorded, which represented less than 1.5% of the total number of NFCs recorded during the entire season. Canada warbler is listed as Threatened by the *Species at Risk Act* (SARA) and Endangered by the Nova Scotia *Endangered Species Act* (NSESA).

Most (83%) Canada warbler detections occurred between August 10 and 25, with peaks in detections occurring in early and late August (i.e., August 10, 12, 20 and 25) (see **Table 3-4**).

With the exception of acoustic sensor “Bird1” and “Bird3”, Canada warbler detections were spread somewhat equally among sensors, suggesting no spatial pattern to the detections within the Project Area. Sensor Bird1 recorded noticeably more background noise compared to other sensors, which may have resulted in fewer detections.

All Canada warbler NFCs were detected during the mid-part of the night and no calls were detected near dawn or dusk, suggesting that Canada warblers do not regularly stop over at the Project Area during migration.

Table 3-4 Canada Warbler Detections by Date and Location

Date	Bird1	Bird2	Bird3	Bird4	Bird5	Bird6	Total
Jul 29	0	1	0	0	0	0	1
Aug 03	0	12	1	0	2	3	18
Aug 09	0	3	0	1	4	3	11
Aug 10	0	11	7	11	5	14	48
Aug 11	0	0	0	3	2	0	5
Aug 12	0	24	2	15	4	24	69
Aug 14	0	4	0	5	8	2	19
Aug 15	1	2	0	0	3	10	16
Aug 16	0	4	0	4	0	1	9
Aug 19	0	1	0	3	4	2	10
Aug 20	0	10	4	9	14	9	46
Aug 21	0	2	1	2	1	4	10
Aug 25	2	27	2	11	8	10	60
Aug 27	0	0	0	1	0	1	2
Aug 28	0	1	0	2	0	0	3

Date	Bird1	Bird2	Bird3	Bird4	Bird5	Bird6	Total
Sep 02	0	0	0	0	2	0	2
Sep 05	0	0	0	0	1	0	1
Sep 06	0	6	0	3	0	1	10
Sep 07	0	1	0	0	0	0	1
Sep 08	0	1	0	0	0	1	2
Sep 10	0	0	0	0	1	0	1
Sep 16	0	1	0	0	1	1	3
Sep 19	0	0	0	0	0	1	1
Sep 20	0	0	0	1	0	0	1
Sep 24	0	1	0	0	0	0	1
Sep 25	0	0	0	0	0	1	1
Sep 28	0	0	0	0	0	1	1
Total	3	112	17	71	60	89	352
Proportion of Observations	1%	32%	5%	20%	17%	25%	100%

4.0 Summary

Continuous acoustic monitoring was completed at the Project Area during the fall 2022 migration season from July 15 until November 30. Considering these dates and data coverage, and when examining the number of detections observed across this time period, adequate coverage of the fall migration season was conducted at the site.

While some level of active migration was observed on all nights, approximately 42% of the migratory activity observed was limited to a few (i.e., seven) nights (August 25, 27 and 28, and September 6, 16, 28 and 29). A pattern of condensed fall migration is in alignment with other migration studies conducted in southwestern Nova Scotia (e.g., Peckford and Taylor, 2008).

Most activity was from warblers and occurred during the middle part of the night. Of the fewer detections observed near dawn, most were thrushes and white-throated sparrows which were believed to be individuals calling from the ground, not during flight.

The composition of the species detected via acoustic sensors was consistent with the range of species known to migrate into and through Nova Scotia in the fall. The timing of those species was also as expected, with most warblers detected during August and September, and sparrows observed later in the season (September through October). Very few NFCs were detected during July.

Canada warblers (listed as endangered under the NSESA and threatened under SARA) were detected at all acoustic sensors, primarily in early August. The proportion of Canada warblers detected was less than 1% of all NFCs, suggesting that while, as expected, the species migrates through the Project Area, the density relative to other migrants is low.

In general, the fall 2022 acoustic monitoring data provided no unusual or unexpected results that indicate an elevated risk to migratory birds from the Project.

4.1 Limitations

While NFC calling rates provide a good representation of migratory activity (e.g., species present, trends in activity), there are many factors that influence calling rates. Several factors that influence NFC detections are provided below that should be considered when evaluating how NFC data may be used to assess avian risk related to wind energy developments:

- Microphone sensitivity (detection rates may change based on weather, background noise, vegetation cover, and technology),
- Time of year (it is unknown how migratory urgency may impact calling rates),
- Time of night (calling rates *may* be higher during the early period of night to entice stopovers to initiate migratory flight, however the extent to which this is true is poorly known),
- Weather conditions (it is unknown how weather conditions may impact calling rates),
- Density of migrants (it is unknown if calling increases or decreases with increased migrant density),
- Species composition (while it is known that not all species call, the calling frequency is unknown for species that do produce NFCs).

5.0 Closure

This work was performed in accordance with the Purchase Order between Hemmera Envirochem Inc. (Hemmera), a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), and McCallum Environmental Ltd., dated February 24, 2022 (Contract). This report has been prepared by Hemmera, based on fieldwork conducted by McCallum Environmental Ltd, for the sole benefit and use by McCallum Environmental Ltd. In performing this work, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. This work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and Project terms of reference; further, the findings are time sensitive and are considered valid only at the time the report was produced. The conclusions and recommendations contained in this report are based upon the applicable guidelines, regulations, and legislation existing at the time the report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

We sincerely appreciate the opportunity to have assisted you with this Project and if there are any questions, please do not hesitate to contact the undersigned.

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6.0 References

- Evans, W.R. (2005). Monitoring Avian Night Flight Calls – The New Century Ahead. *The Passenger Pigeon*, Vol. 67, No. 1, 2005.
- Nova Scotia Government (2021). Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia. Environmental Assessment Branch. URL [EA.Guide-Proponents-WindPowerProjects.pdf](#) (novascotia.ca)
- Peckford, M.L. and Taylor, P.D. (2008). Within night correlations between radar and groundcounts of migrating songbirds. *J Field Ornithol.* 79:207–214. DOI: 10.1111/j.1557-9263.2008.00165
- R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
- Thieurmel, B. and Elmarchraoui, A. (2022). R Package ‘suncalc’. Compute Sun Position, Sunlight Phases, Moon Position and Lunar Phase. URL <https://cran.r-project.org/web/packages/suncalc/suncalc.pdf>



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APPENDIX C-3. RADAR REPORT

Wedgeport Wind Farm Radar Bird Survey

Final

January 27, 2023

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1. Introduction

This report describes the results of a radar bird survey of the 2022 spring and fall migrations inside the Wedgeport project area.

2. Summary

The survey used a small marine radar to count night-migrating birds of all sizes from small passerines to geese and ducks while accurately measuring their range and altitude.

Most migrating birds fly at night so radar data from 106 nights between May 25 and November 30 was processed to capture the tail of the spring migration and all of the fall migration¹. Data was also processed for two to three hours before sunset and after sunrise to show how migration started and ended each night.

The Wedgeport turbine blades will reach 195 meters above the ground. To be conservative, birds flying below 225 meters are considered to have some risk of a collision. Table 1 shows that of the 165,862 tracks counted, 47 percent were considered to be at risk.

Table 1 Migrating tracks counted during the spring and autumn nights.

Season	Nights Surveyed	All Night Tracks	At-Risk Tracks – Below 225 meters	
			Tracks	Percent
Spring	14	8,072	4,339	54 %
Fall	92	150,735	70,469	48 %
Year	106	158,807	76,552	47 %

The particular focus of the survey was to estimate the Migrating Traffic Rate (MTR) which is the number of bird passages per hour flying through a window that is 225 meters high and 1 kilometer wide. The MTR was estimated in four 225 meter altitude bands up to 900 meters plus a final band for all higher birds.

Table 2 shows that the average fall night-time MTR was 58.5 bird passages per hour per kilometer flying below 225 meters. The spring MTR was only 35.8 because it was surveyed after the peak migration had passed.

Table 2 Seasonal night MTR (bird passages per hour per km) of birds flying below 225 meters altitude

Season	At-Risk MTR (< 225 meters) (bird passages per hour per km)
Spring	35.8
Fall	58.5

The seasonal variation in the at-risk night-time MTR is plotted in Figure 1. The late spring traffic declined slightly from 37 bird passages per hour per kilometer in the last week of May to 34 in the first week of June. Traffic was up to 48 as the fall migration started in late July and then almost doubled to 82 in August and peaked at 106 in September. Traffic almost halved in October and reached its minimum of 12 in November.

¹ Migration is March 15 to June 7 and July 15 to November 30. Specified in “Wind Energy & Birds Environmental Assessment Guidance”, Environment and Climate Change Canada (ECCC) Canadian Wildlife Service (Atlantic Region), April 2022

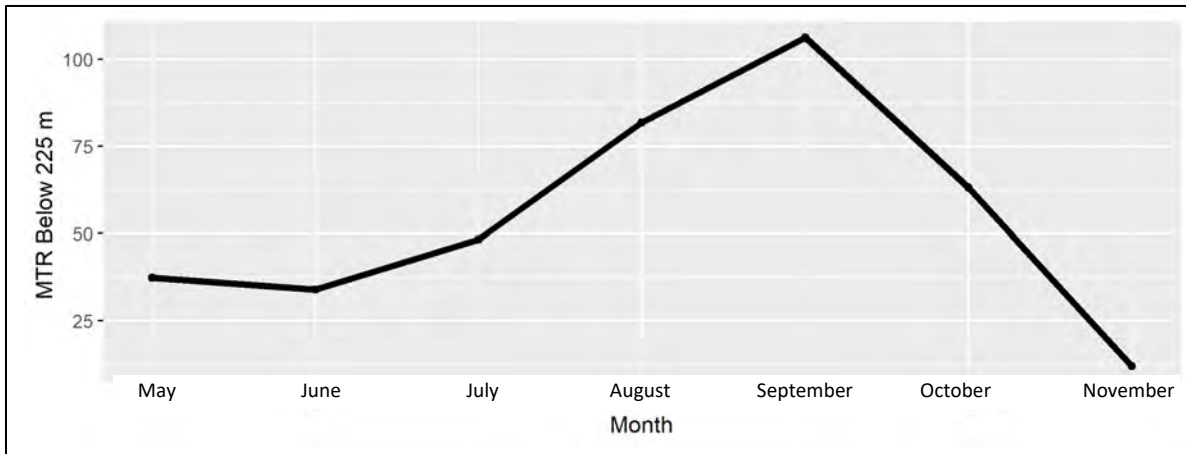


Figure 1 Average night-time MTR (bird passages per hour per km) below 225 meters by month.

3. Survey Methodology

An avian radar system was operated within the Wedgeport Windfarm project area from May 25 to December 2. A Furuno FR-240 radar with a Cognitive Bird Tracker reliably tracked small passerines to 750 meters and ducks to 1450 meters. The focus of this survey was to count migrating birds flying low enough to be at risk of colliding with the proposed turbines. To this end, the radar was mounted vertically to precisely measure range and altitude within a 25 degree sector that was scanned vertically every 2 seconds along the 357 to 177 degree beam axis shown in Figure 4. The radar beam spans 4 degrees in elevation and 25 degrees in azimuth.



Figure 2 Radar installation.

Almost 4 TB of raw radar data was digitized, recorded and then processed into bird tracks by the Cognitive Bird Tracker. The tracker first detects bird-size radar echos (called “plots”) on each scan. Plots that line up with those from preceding scans enable the tracker to estimate a speed and course. As more plots are correlated the

accuracy of the speed and course estimate improves as does the confidence that this is indeed a bird. After five correlated plots the tracker confirms a “track” which will be maintained until there are no correlated plots for six scans.

Birds were counted in four 225 meter-high altitude bands to 900 meters plus a final band for all higher birds. The Migrating Traffic Rate (MTR) was then calculated to estimate the hourly number of birds flying through these windows extending one kilometer across each bird’s flight path. The lowest window (< 225 meters) counts the only birds exposed to any risk of a collision.

The MTR was calculated because it normalizes the traffic rate to be independent of the radar power, antenna size and other characteristics. Larger radars will detect birds at longer ranges but the MTR should be the same if both radars can detect the same sizes of bird.

The radar does not measure the flight direction directly. This was therefore estimated by comparing the radial speed to an assumed flight speed of 50 kilometers per hour, typical of passerines. Whether a bird was flying to the east or the west remained ambiguous.

The strength of each bird’s radar echo is proportional to its weight. Heavier birds can be detected at longer ranges, higher altitudes and further from the north-south radar axis. The size of each bird was therefore derived from its maximum detection range and estimated cross-range travel in three categories:

- Small < 100 grams
- Medium 100 to 1000 grams
- Large > 1000 grams

These categories were chosen because over sixty percent of the birds observed by the on-site ornithologists were small passerines weighing between 10 and 25 grams as shown in Table 3 . These are detectable to 750 meters and classified as “Small”. “Medium” birds such as the Mourning Dove and Northern Flicker are detectable to 950 meters and “Large” birds such as the Merganser, Mallard and Herring Gull to 1450 meters.

Table 3 Common migrating birds observed in the project area.

Size Classification	Bird Species	Bird Weight (grams)	Percent of Observations	Estimated Detection Range (meters)
Small	White-Throated Sparrow Palm Warbler, Hermit Thrush, Yellow-Rumped Warbler Common Yellowthroat Winter Wren	10 to 25	63	750
Medium	Mourning Dove Northern Flicker Common Grackle	100 to 150	15	950
Large	Merganser Mallard (Herring Gull)	1000 to 1500	NA	1450

4. Radar Installation and Coverage

The radar was installed 700 meters west of the proposed line of turbines in the Wedgeport Project Area.

Figure 3 shows the coverage of small, medium and large birds projected onto the ground

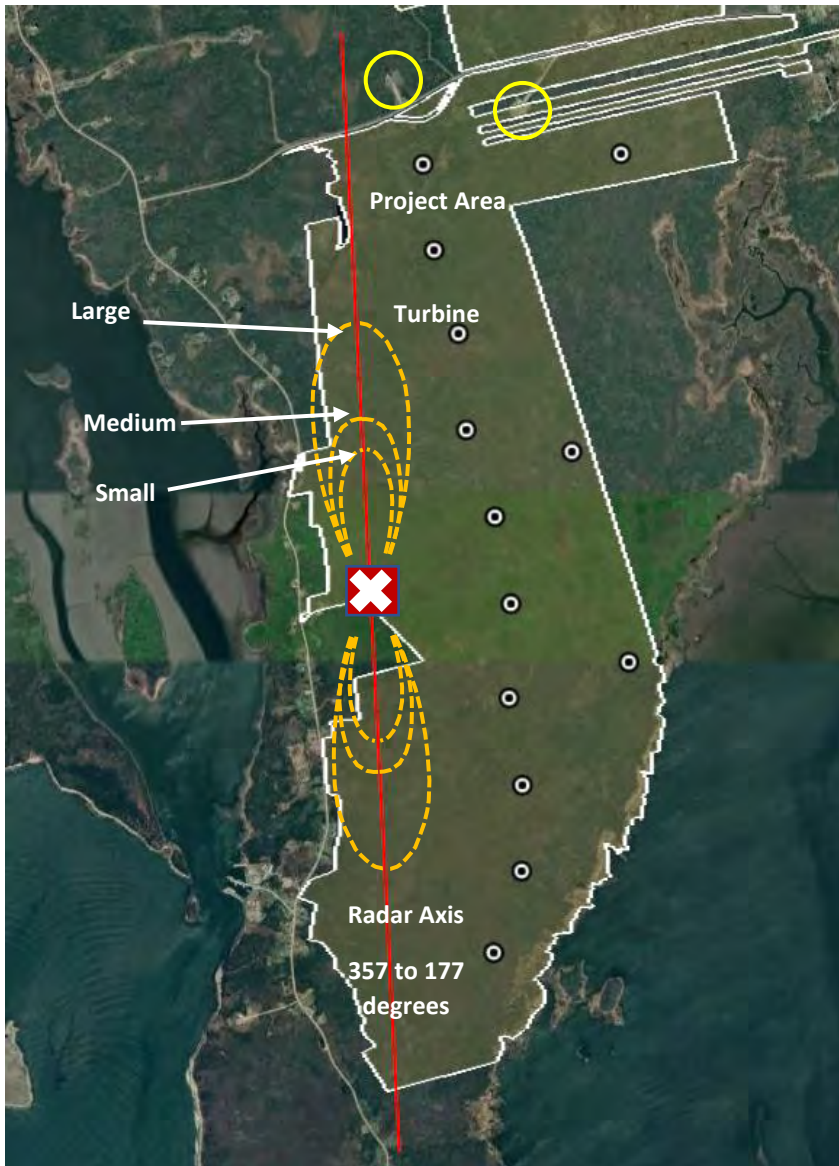


Figure 3 Radar installation and beam coverage (orange) for small, medium and large birds. Nearby turbines to north are circled yellow.

5. Traffic at Turbine Height

The MTR below 225 meters was calculated each week and night from three hours before sunset to three hours after sunrise. The traffic was expected to be mostly migrating birds at night and residents in the day. Figure 4 shows that the average night-time MTR in each week far exceeded the day-time traffic until the last weeks of each migration.

The busiest fall migration months were August, September and early October when five weeks had average MTRs above 100 bird passages per hour per kilometer. The traffic varied significantly from week to week during the peak migration from August to mid-October. Unfortunately, the peak spring migration occurred before this survey. In both the spring and fall, traffic was much steadier at the beginning and end of the migration season.

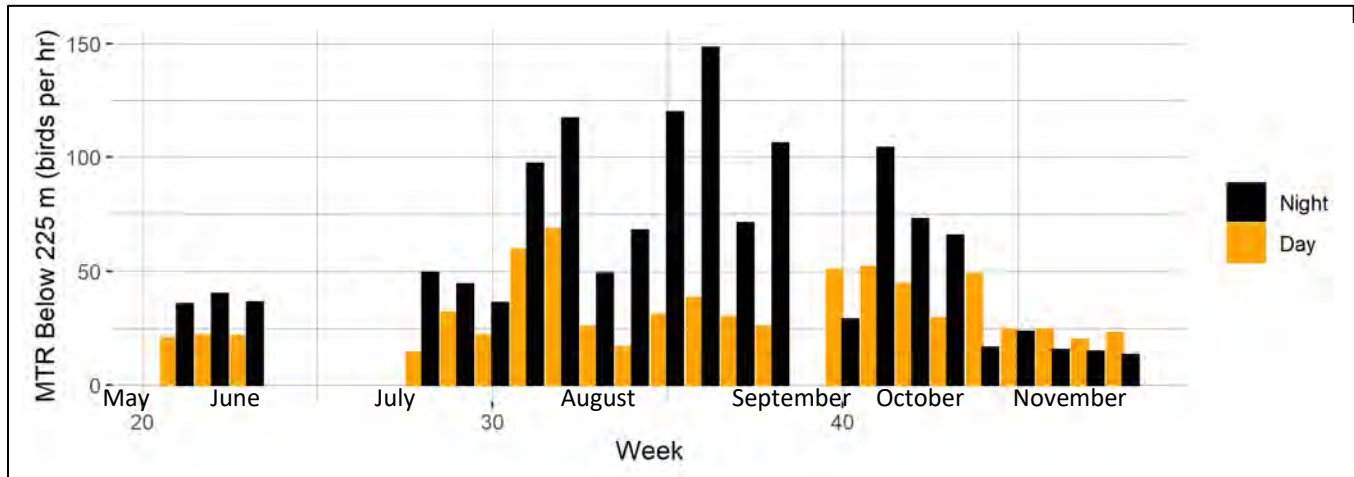


Figure 4 Weekly average day (orange) and night (black) MTR below 225 meters.

5.1. Spring Migration

Traffic in late May and early June was consistently low with average night-time MTRs of only 35.7 bird passages per hour per kilometer. The busiest night was May 30 with 68 bird passages per hour per kilometer. The average MTR in the first and last three hours of day light was only 19.5.

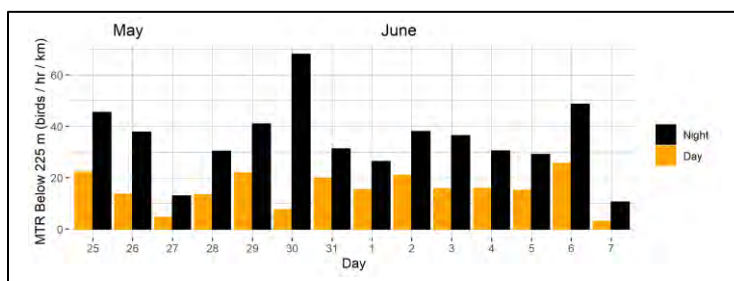


Figure 5 Day (orange) and night (black) MTR in May and June for birds below 225 meters.

5.2. Fall Migration

The night-time at-risk traffic until November almost always exceeded the daytime by a factor of between two and six. This was reversed in November when the average night-time MTR of 20.9 bird passages per hour per kilometer was exceeded by the day-time MTR of 27.7.

There were notable peaks with more than 150 bird passages per hour per kilometer on August 9 and 10 and on September 2, 6 and 19. However, the seasonal average MTR below 225 meters was only 58.9 bird passages per hour per km.

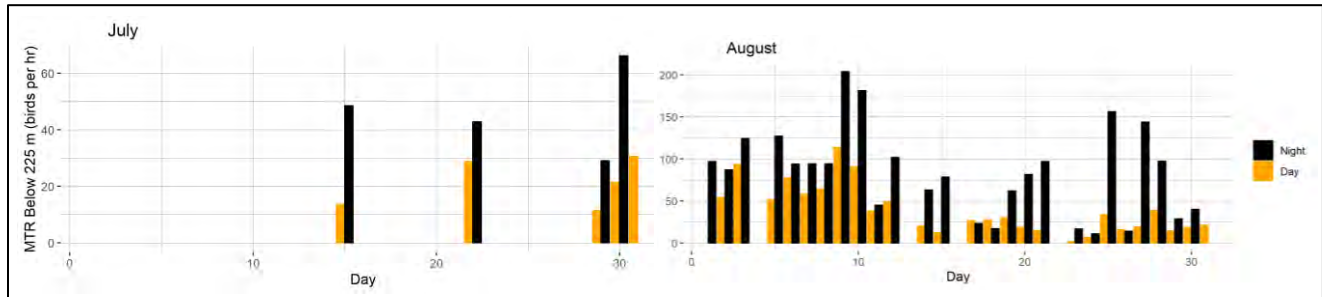


Figure 6 Day (orange) and night (black) MTR in July and August for birds below 225 meters.

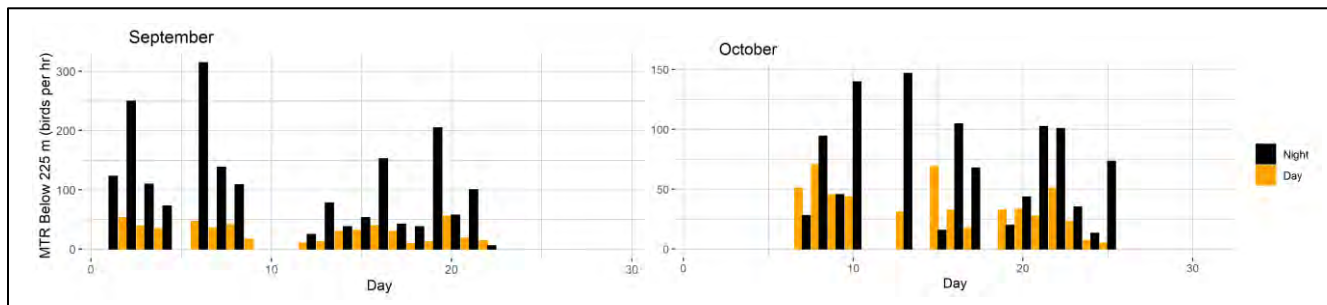


Figure 7 Day (orange) and night (black) MTR in September and October for birds below 225 meters.

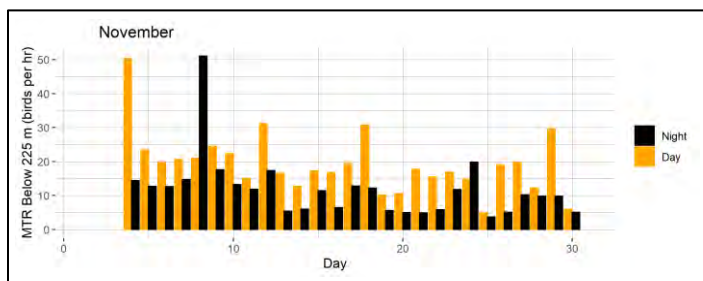


Figure 8 Day (orange) and night (black) MTR in November for birds below 225 meters.

6. Traffic by Hour at Turbine Height

The migration traffic was gated by sunset and sunrise. In both the spring and fall, traffic increased rapidly in the first few hours after sunset and then decreased in the late evening before midnight as shown below in Figure 9.

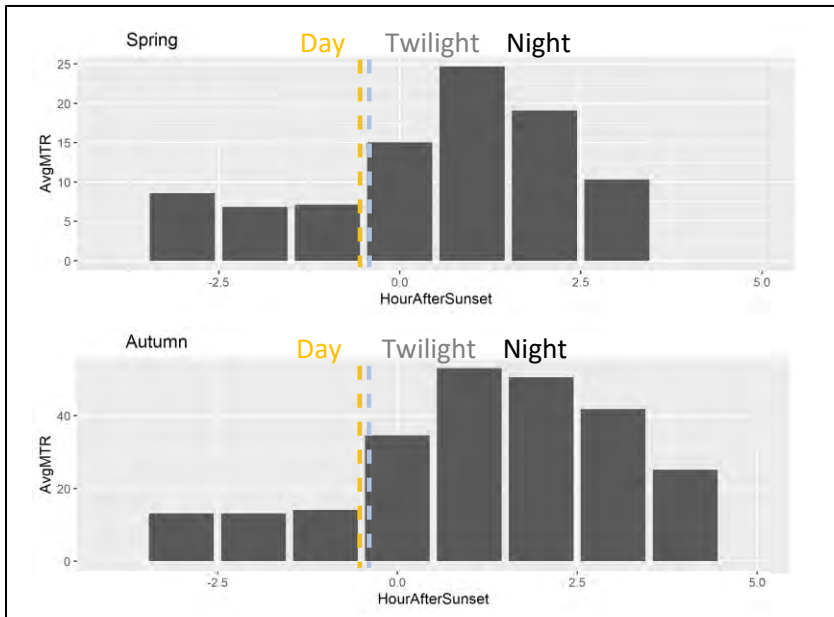


Figure 9 Average MTR below 225 m through sunset in the spring and fall migration seasons

Figure 19 shows that in the spring, night-time traffic increased slowly until twilight, stayed steady for two hours and then dropped one hour after sunrise. In the fall, traffic dropped steadily until twilight and then stayed constant through sunrise into the day.

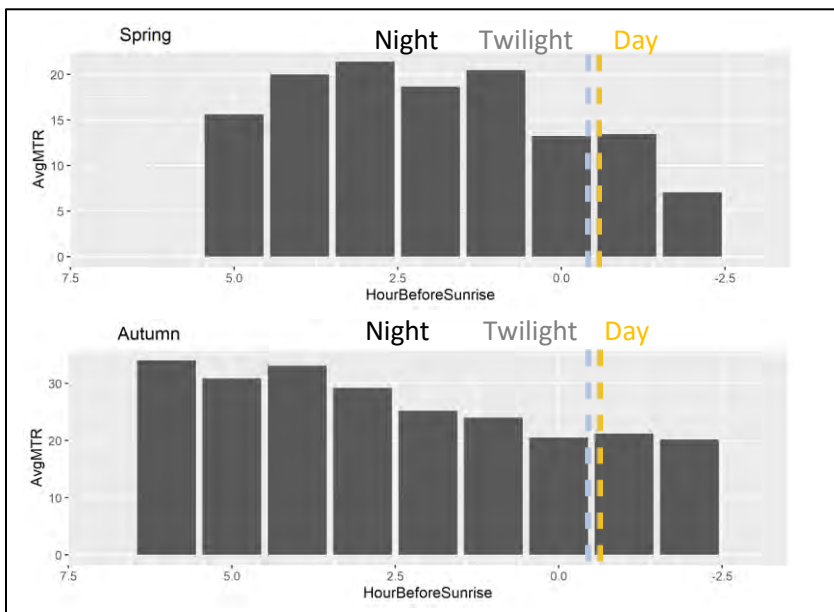


Figure 10 Average MTR below 225 m through sunrise in the spring and fall migration seasons

6.1. Spring Migration

The spring migration in April and May peaked rapidly after sunset and then dropped in the next hour before increasing after midnight to a second larger peak two to four hours before sunrise. In June, traffic after the sunset peak stayed low through the night until it dropped abruptly in the hour after sunrise.

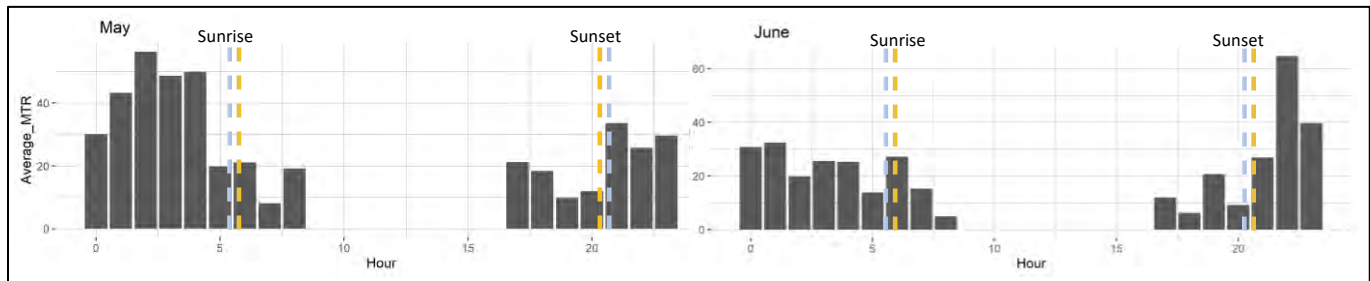


Figure 11 Average hourly MTR below 225 meters in May and June.

6.2. Fall Migration

The fall migration in July to October also started abruptly at sunset. In active months, traffic increased by a factor of three to five in the first hour or two after sunset. After this peak, traffic dropped steadily until sunrise.

The MTR in the first two hours after sunrise was consistently higher than that before sunset.

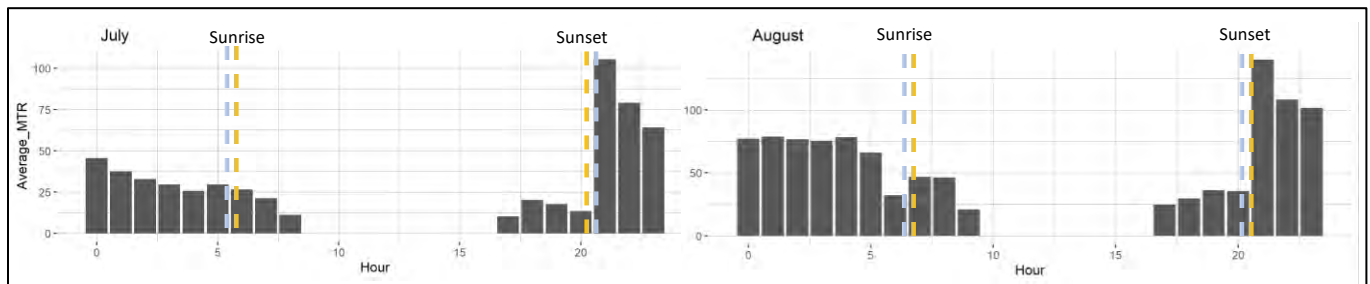


Figure 12 Average hourly MTR below 225 meters in July and August.

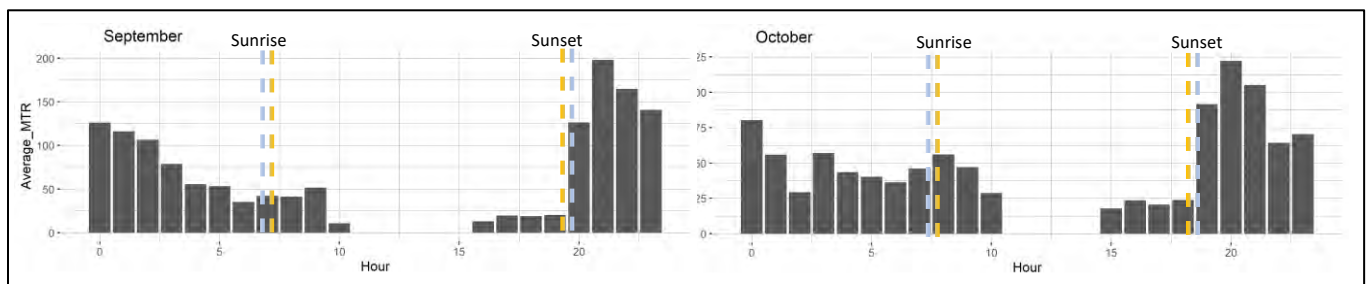


Figure 13 Average hourly MTR below 225 meters in September and October.

November was different with the highest traffic in the day. The MTR dropped abruptly from 25 bird passages per hour per kilometer in the hour before sunset to 13 in the evening twilight and then slowly declined through the night reaching 5 in the morning twilight. Traffic then increased steadily to 20 at sunrise from which it dropped steadily for the next three hours reaching 12 at 11 AM.

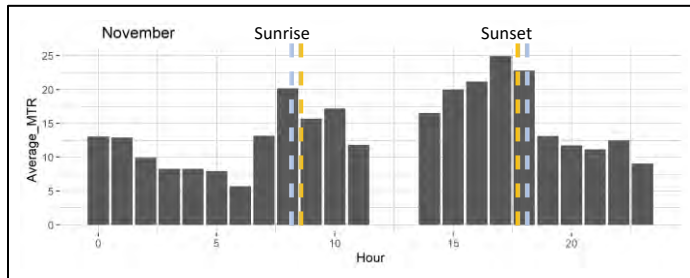


Figure 14 Average hourly MTR below 225 meters in November.

7. Traffic by Height

The radar measures height very accurately so the daily MTR was calculated for birds in five height bands:

- Below 225 m
- 225 to 450 m
- 450 to 675 m
- 675 to 900 m
- Above 900 m

Because the radar cannot detect many small birds above 750 meters, only the first three bands, up to 675 meters, can reliably count birds of all sizes. The traffic in each band is therefore plotted in Figure 15 as a percentage of all the birds flying below 675 meters. Higher birds are plotted above 100 percent because these MTRs undercount the smaller birds and are unlikely to be accurate.

Figure 15 plots the seasonal average MTR by height band showing that more birds are in the at-risk altitude band than in either of the next two higher bands. It also shows that the proportion of at-risk birds increased steadily from 25 percent of all birds below 675 meters in July to 80 percent in November.

Only large birds were detectable at high altitudes above 900 meters. These were mostly detected at the end of the spring and fall migration seasons. Almost none were detected in July through September.

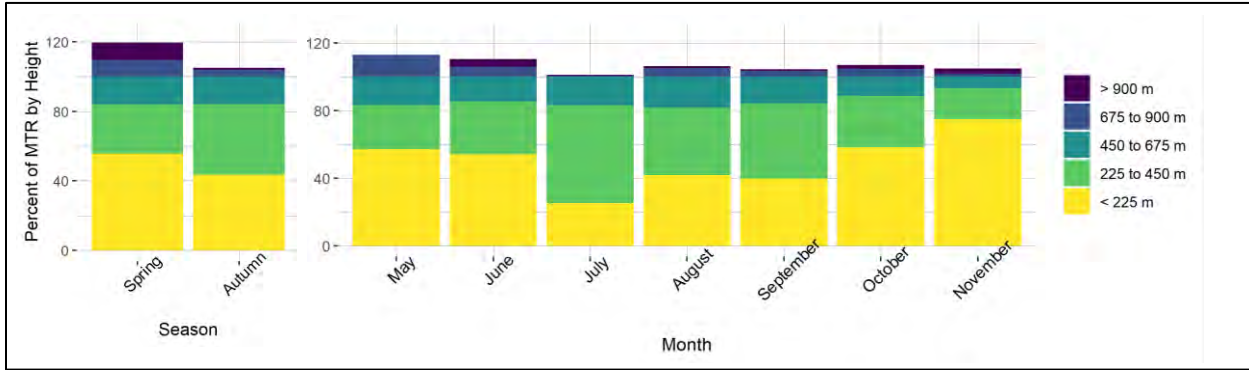


Figure 15 Seasonal and monthly percentage of MTR by height.

7.1. Spring Migration

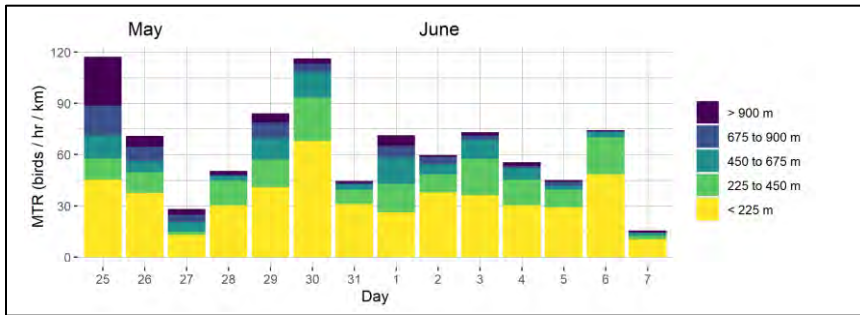


Figure 16 Daily night-time MTR by height in May and June.

7.2. Fall Migration

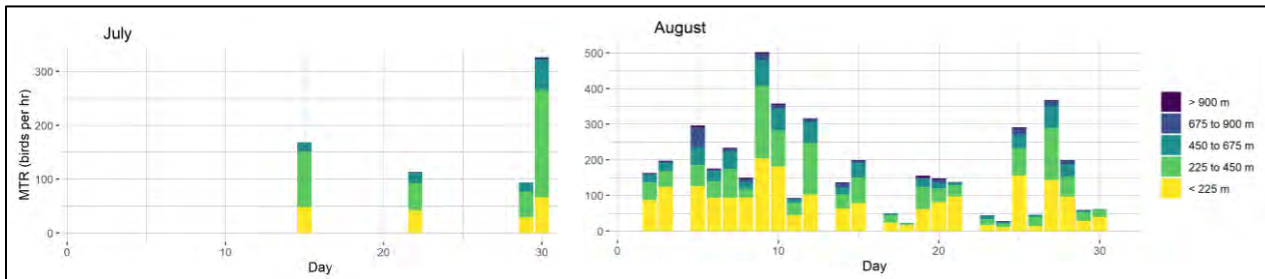


Figure 17 Daily night-time MTR by height in July and August.

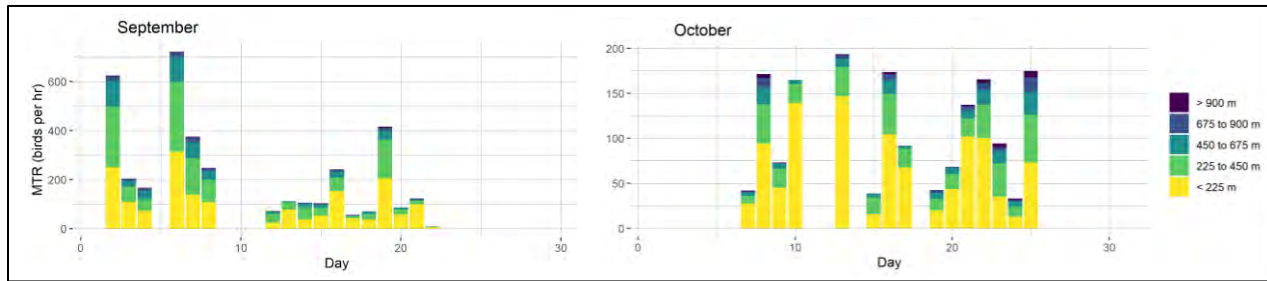


Figure 18 Daily night-time MTR by height in September and October.

At-risk traffic in November was low, averaging 20 and almost entirely in the lowest height band until November 27 when it doubled. At the same time, the proportion of high-flying birds above 900 meters increased substantially.

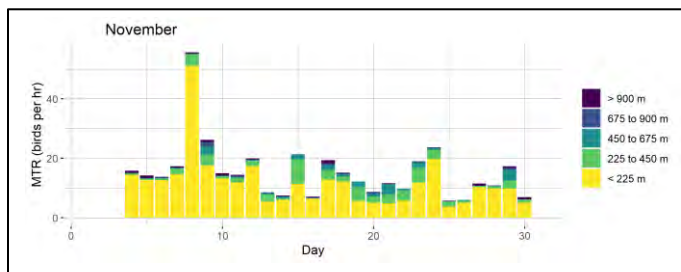


Figure 19 Daily night-time MTR by height in November

8. Traffic by Bird Size

Approximately half the night-time migrants below 225 meters were small birds and one third medium as shown below in Table 4.

Table 4 Mean night Migrating Traffic Rate (MTR - bird passages per hour per km) below 225 meters with bird size percentage.

Season	Total Night MTR	Percent of Migrants by Bird Size		
		Small	Medium	Large
Spring	33.5	61	28	11
Fall	58.9	47	39	14

The proportion of small birds increased with altitude until the 675 to 900 meter band within which the radar reached its maximum range of 750 meters for small birds.

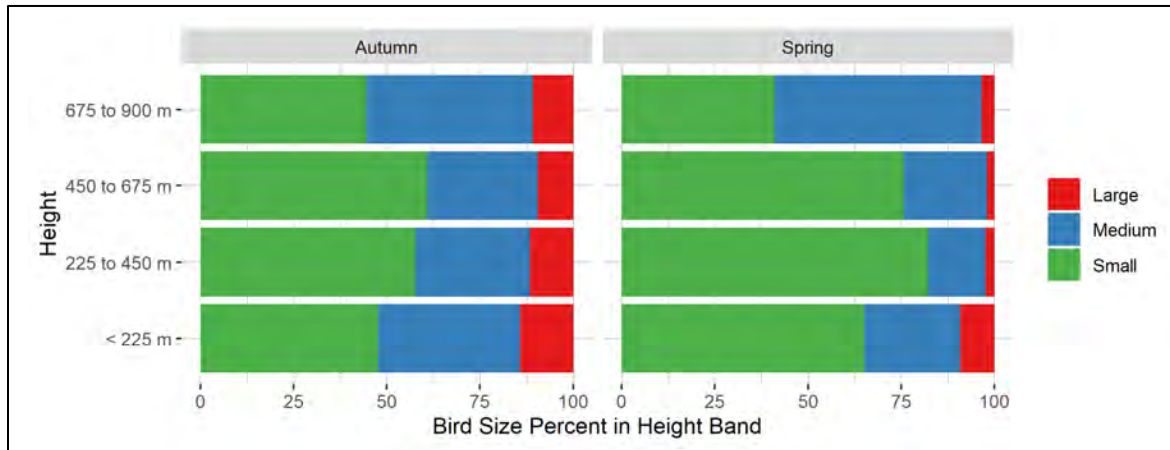


Figure 20 Percent of birds by size versus height.

The nightly percentage of birds flying below 225 meters in the three size categories is plotted in the next two sections to show how the population changed through the spring and fall migration seasons.

8.1. Spring Migration

Small birds comprised 53 percent of the at-risk traffic in late May and early June. The three-day average percentage of small birds decreased steadily in these last days of the spring migration, from 66 percent at the start to 40 percent at the end.

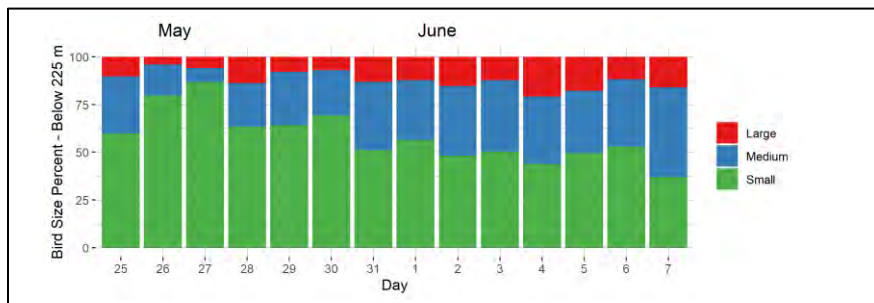


Figure 21 Bird size distribution below 225 meters in May and June.

8.2. Fall Migration

In the fall, the proportion of small birds was 68 percent in July and then dropped to between 44 and 49 percent for the remaining months.

The proportion of large birds was only 6 percent in July but this doubled to between 12 and 14 percent from August to October. November was notable because, although the MTR was low, the proportion of large birds doubled to 29 percent.

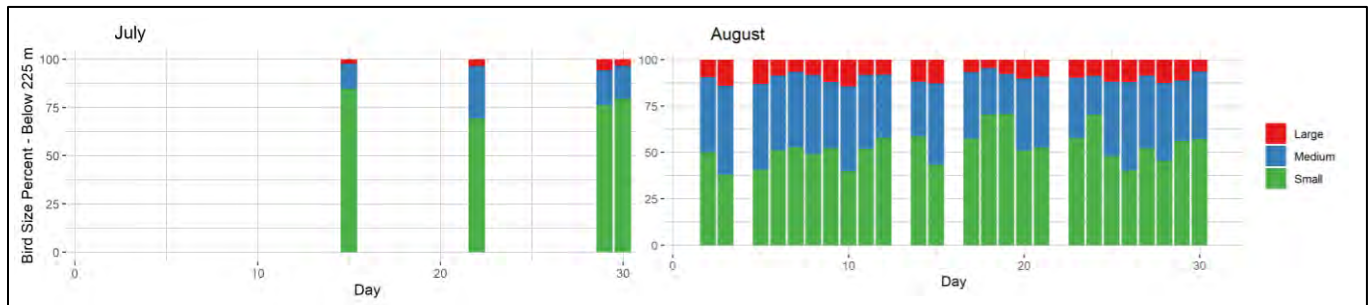


Figure 22 Bird weight distribution in July and August.

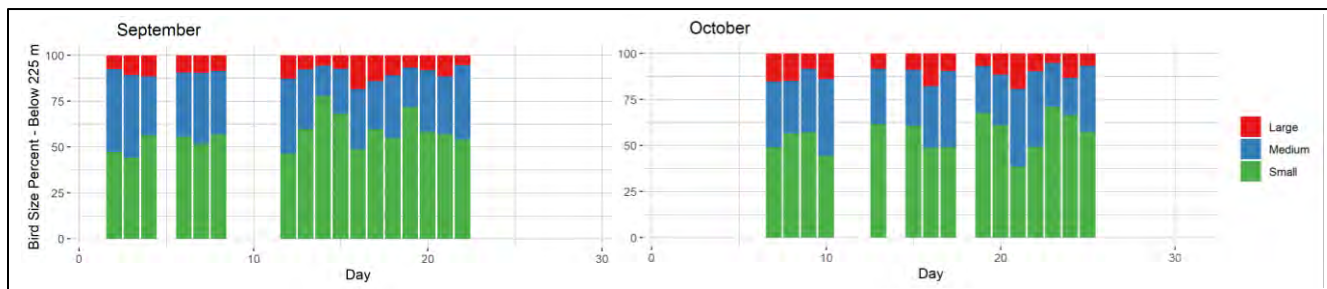


Figure 23 Bird weight distribution in September and October.

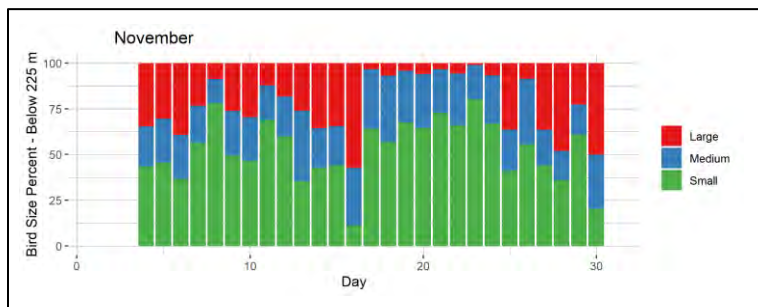


Figure 24 Bird weight distribution in November.

9. Traffic by Wind Speed and Direction

Migration traffic was significantly affected by the surface wind speed and direction.

Figure 25 shows that the MTR was highest in winds below 20 kilometers per hour (kph).

The proposed turbines have a cut-in wind speed of 3 m/sec at the 110 meter-high hub which requires a surface wind speed of approximately 6 kph. Such winds were observed 9.6 percent of the time at the Yarmouth weather station.

Because more birds flew in lighter winds, the turbines would have been stopped for 32 percent of the fall at-risk night-time traffic. This percentage was 12 in the last two weeks of the spring migration but based on only 14 nights of data .

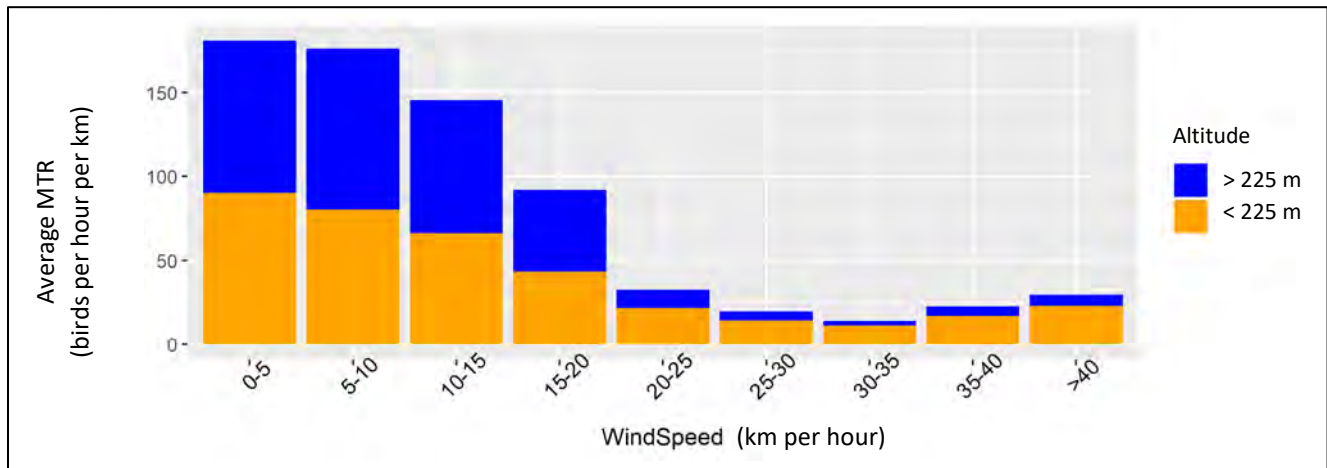


Figure 25 Average night-time MTR versus wind speed for birds flying below 225 meters (orange) and above (blue).

Fall migration was strongest in winds from the north and east suggesting that the birds were using them to ease their migration to the south and west. Traffic was lowest when the winds were from the south.

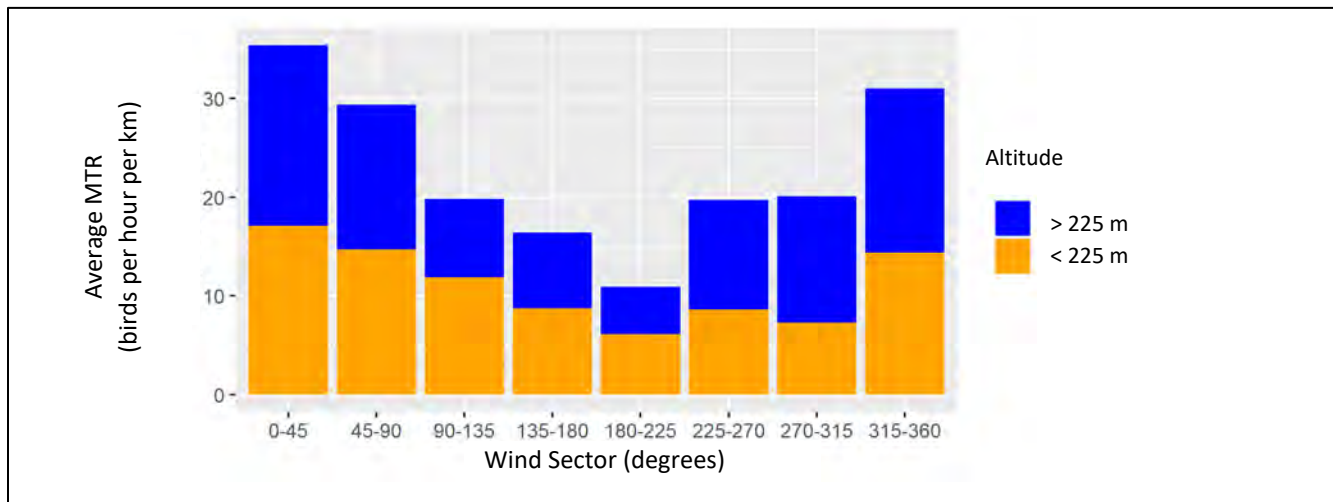


Figure 26 Average fall night-time MTR versus wind sector for birds flying below 225 meters (orange) and above (blue).

Figure 27 divides the wind observation for each bird size category into 45 degree sectors and 5 kph windows to show the average MTR observed in each cell as a percentage of the bird size seasonal average.

The preferred wind speed depended on the bird size. Most small and medium size birds flew in winds below 20 kph but proportionally more large birds flew in higher winds up to 35 kph.

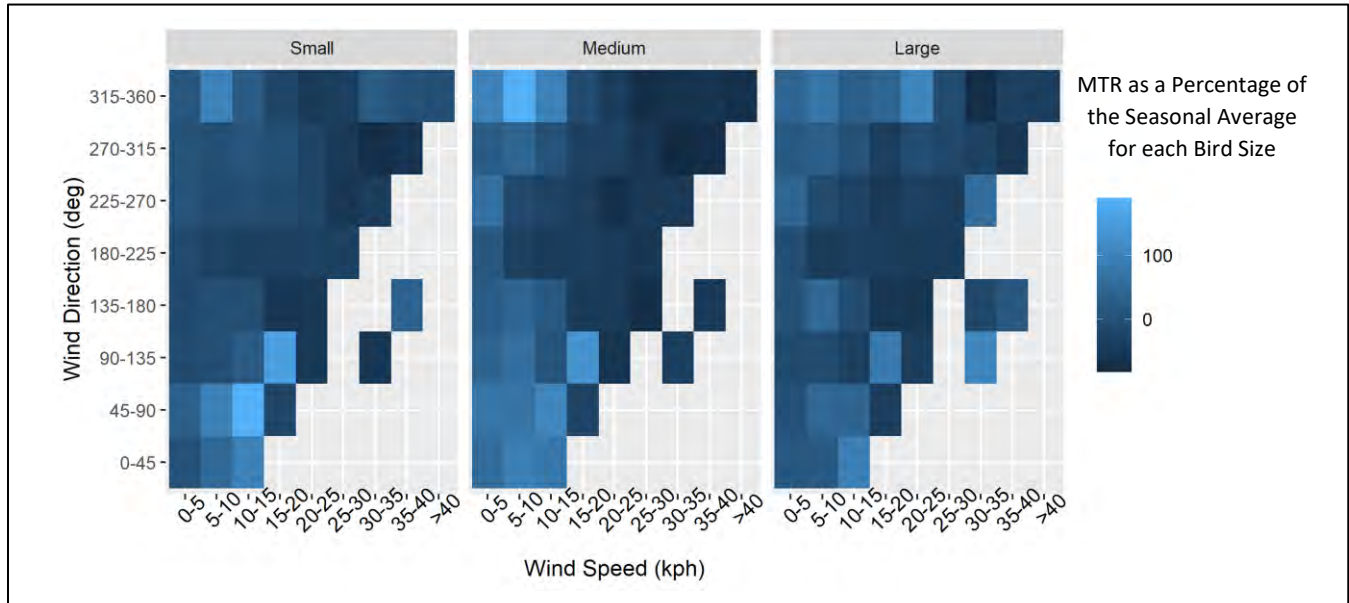


Figure 27 Fall night-time MTR below 225 m as a percentage of the average MTR by bird size relative to the wind speed and direction.

10. Traffic by Flight Direction at Turbine Height

The approximate flight direction was estimated from each bird’s in-air flight speed as described in Appendix D.

Figure 28 shows histograms for birds flying below 225 meters in the day and night.

In the night, most birds were flying across the beam, probably to the east in the spring and west in the fall. July and November were notable for the many birds flying south but this had largely stopped by August and was absent in September and October. Flight directions in November were more dispersed than at any other time with a significant proportion flying to the north

In the day, the flight directions were more random as would be expected for local birds. August was unusual in having a modest concentration of east-west traffic which may be due to birds migrating in daylight.

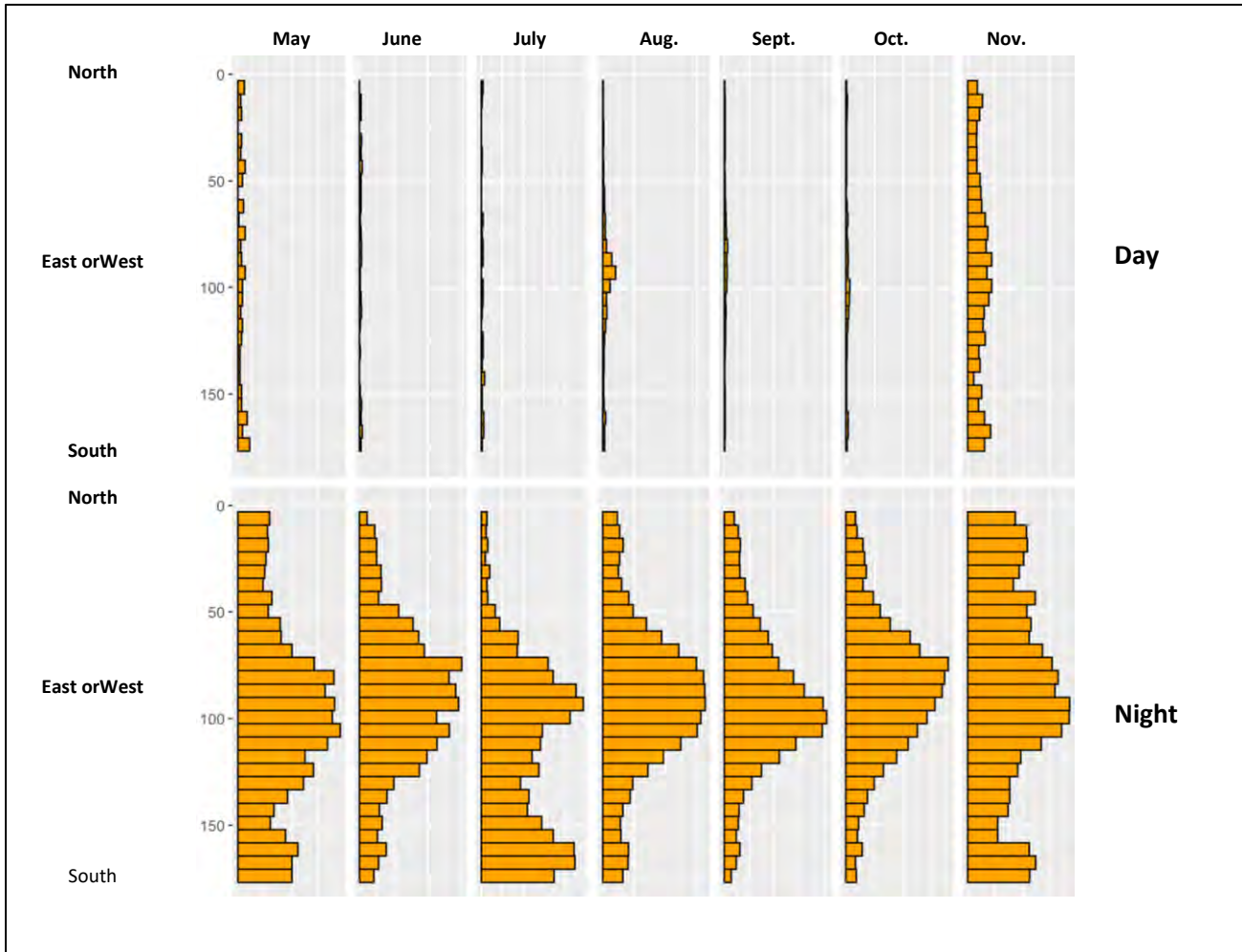


Figure 28 Flight direction below 225 meters in day and night.

Appendices

A. Radar Preparation, Installation, Calibration and Operation

This survey was executed by:

- Cognitive Radar Corporation who provided the radar and tracker
- McCallum Environmental who operated the radar and collected data
- Peter Scarlett, of Radar Insight Limited who installed the system and analyzed the data

The Furuno FR-240 radar and Cognitive Tracker were tested and calibrated at the Cognitive Radar Corporation before installation in Wedgeport.

The radar is an old model but this unit had been stored for many years and was essentially new with less than 100 hours of run-time prior to this survey.

The Cognitive Bird Tracker is a Canadian advanced multiple hypothesis tracker that has been used for bird surveys by Acadia University and two wind energy companies in Israel. It has an extremely sensitive detector with automatic threshold control to detect the weakest discernible returns from the smallest birds. The tracker was configured to reliably initiate tracks on birds with a single-scan probability of detection of 50%. When detections are absent or confusing, Multiple Hypothesis Tracking (MHT) maintains several interpretations of the flight path until the picture becomes clearer. An Interacting Multiple Model (IMM) filter adapts the tracker when birds manoeuvre abruptly. The tracker is highly configurable which makes it compatible with both vertical and horizontal axis radars of all sizes and in all environments.

The radar was installed on the frame shown in Figure 2 and its range calibrated to two turbines, 2.7 kilometers to the north, that were just discernible through the tree tops.

The radar equipment was installed in a weather-proof enclosure as shown in Figure 29. A small UPS was used to enable the system to automatically restart after mains power interruptions.

After the radar was installed and calibrated, the Cognitive Tracker was configured to:

1. mask areas where ground reflections (called clutter) were strong enough to prevent the detection of small birds,
2. reject returns (ie. echos) from targets such as insects that are too small to be birds
3. detect the weakest discernible bird returns whether from the smallest birds or from larger ones at the edge of the radar beam or at their maximum detectable range and
4. track birds that are not detectable on every scan.
 - a. Note that the strength of a bird's radar echo can vary greatly from scan to scan depending on the position of its wings.

Radar images were recorded at the beginning and end of the survey to verify that the transmitter power had not weakened appreciably during the survey. The central bright area in the first 50 meters of Figure 31 was largely due to energy from the transmit pulse reflecting back from imperfections in the circulator, limiter, waveguide and antenna. This power does not therefore change with antenna azimuth and is therefore an excellent indication of the relative transmitter power.

The average signal strength was measured on five scans each on April 13 and November 30 in four 14 x 14 pixel windows centred at 21 meters and 79, 219, 272 and 355 degrees. The average amplitude actually increased slightly from 181 in April to 185 in November indicating that the transmitter power had not decreased through the survey. This small change was most likely because the receiver tuning had drifted slightly with temperature which is normal with all magnetron radars.

The receiver noise figure was also compared by measuring the average amplitude in two 50 x 50 pixel windows at 2853 meters and 36 and 325 degrees to be far above any clutter and other targets. The average amplitude was 18.7 in April and 18.6 in November, demonstrating that the receiver noise floor and sensitivity had not changed during the survey.

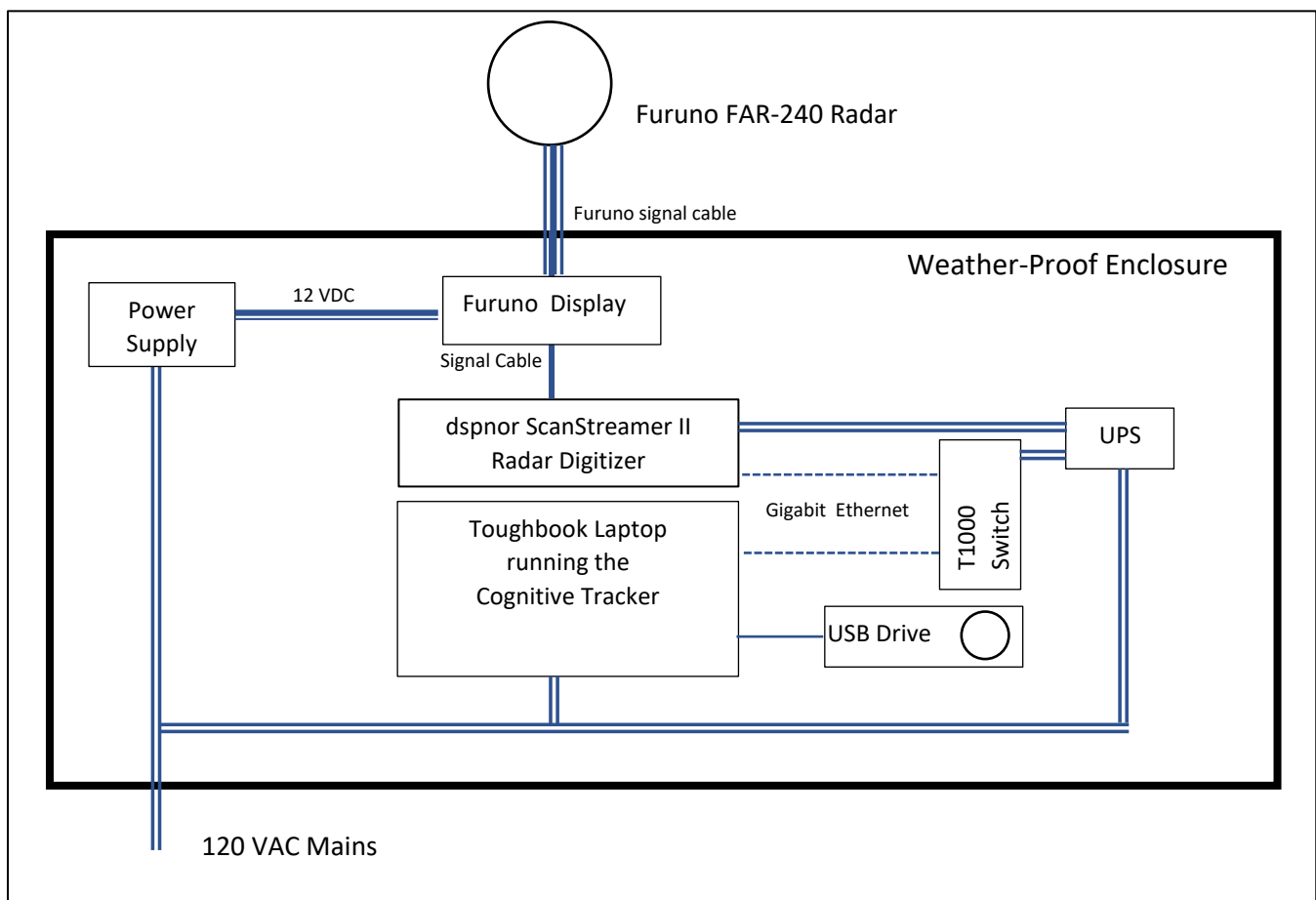


Figure 29 Site equipment

B. Radar Range and Coverage

Research has shown conclusively that heavier birds reflect stronger echoes and can therefore be detected at longer ranges. The radar reflectivity of a bird as modelled as being from a water sphere of identical weight.

The world-wide standard tool for radar modelling is CARPET which was used to estimate the coverage of birds weighing 25, 100, and 1000 grams as shown below in Figure 3. The X axis shows range and the Y cross-range. The Cognitive Tracker reliably starts tracks on birds that are only detected on half the scans so the estimated coverage follows the 50% probability of detection contour. Note however, that the CARPET detection range is an average so it is expected that some birds will be detected at longer ranges and others at shorter.

The radar has a 4 kW transmitter with an 80 nsec pulse at a 3370 Hz pulse repetition frequency. The antenna beamwidth is 4 degrees in elevation and 25 degrees in azimuth.

The radar has bright ground reflections obscuring the first 200 meters (see Figure 30). This is normal for any magnetron radar and why this coverage region is blacked out in Figure 3.

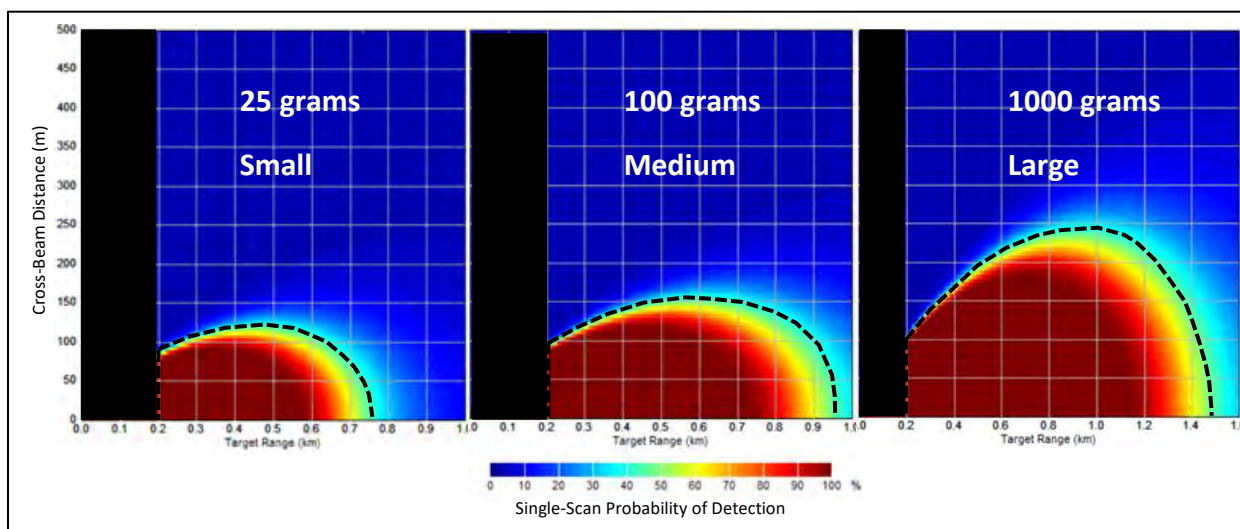


Figure 30 CARPET-modelled tracking coverage (black dashed line) of birds weighing 25, 150 and 1500 grams.

C. Bird Tracking

The Cognitive Tracker detects radar echos that are sufficiently stronger than the background such that they could be birds and then tracks their movement from scan to scan.

The system is configured so that birds will always be detected as clusters of range-elevation pixels called plots. Plots that span enough range-elevation pixels to be birds, rather than insects or noise, are shown as green dots on the radar screen below and sent to the tracker. The tracker correlates plots from the current scan with those from preceding scans looking for a sequence consistent with a bird in steady flight. When there is sufficient evidence, it confirms a track shown below as a red arrow-head.

Plots from each radar scan are matched with all the confirmed tracks which are then moved ahead based on the preceding scans and any correlated plot. Uncorrelated plots are used to initiate new tracks.

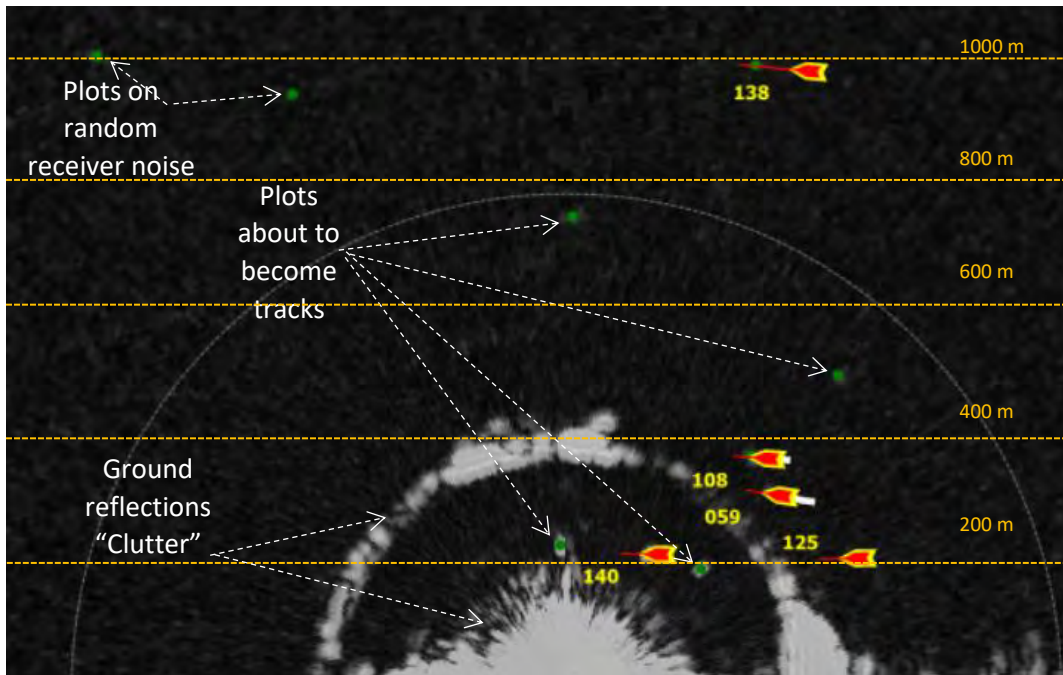


Figure 31 Typical tracker display showing plots (green dots), tracks (red), track trails (white lines) and clutter (light grey).

Confirmed tracks are maintained until there have been six scans with no plots that line up with the track. This can happen when the bird flies outside the beam, is hidden by ground clutter or too far away to be detected.

The track velocity is relative to the (stationary) radar so its component along the radar beam axis is the ground speed. To estimate the (in air) flight speed we use the wind speed and direction from the Yarmouth weather station. The wind speed along the radar beam axis is estimated at each bird’s flight altitude and subtracted from its ground speed.

D. Bird Size Estimation

The bird size is estimated by comparing the maximum estimated on-axis detection range and cross-axis distance travelled to the coverage plotted in Appendix B. The cross-axis distance is estimated by assuming that the birds are flying at 50 kph for the track duration.

E. Flight Direction

The approximate flight direction was estimated from the flight speed (ie. in-air) along the radar beam axis. This was calculated by subtracting the extrapolated radial wind speed at altitude for each bird from its radial over-ground speed. The small, medium and large birds were assumed to be flying at 50, 60 and 70 kilometers per hour. The slowest tracks would be moving to the east or west and the fastest to the north or south.

F. MTR Estimation

The objective of this radar survey is to estimate the hourly number of migrating birds per linear kilometer.

The Migrating Traffic Rate (MTR) contribution of each tracked bird is calculated as follows:

1. Along-axis range is the greater of:
 - a. track initiation range extrapolated back by the average number of scans to confirm track or
 - b. track deletion range or
 - c. the modelled detection range of a small passerine
2. Cross-axis distance is the greater of:
 - a. a typical passerine flight speed of 50 kph for the track duration plus the average number of scans to confirm track or
 - b. the modelled small passerine beam width of 250 meters
3. Mean altitude
4. Flight speed (incorporating the Yarmouth wind velocity extrapolated to the flight altitude)
5. From these we calculate:
 - a. Along axis coverage length assuming horizontal flight
 - b. Net coverage length after subtracting any sections that are obscured by ground clutter
6. Off-axis flight angle by comparing the measured along-axis flight speed to a reference flight speed. The flight angle is determined by the along-axis speed as follows:
 - a. Across the beam axis: flight speed equals the along-axis wind speed
 - b. Along the beam axis: flight speed equals the bird's in-air speed plus the along-axis wind speed
7. Sample window length is the projection of the rectangle defined by the net coverage length and the cross-axis distance onto the beam axis. The window length varies with the off-axis flight angle as follows:
 - a. along the axis: window length is the cross-axis distance
 - b. across the axis: window length is the net coverage length
8. MTR contribution of each bird is the ratio of the standard 1000 m MTR window to its sample window length
 - a. The MTR in the lowest window (< 225 meters) only uses birds above 50 meters because lower ones are increasingly hidden by trees. A normalizing factor of 225/175 was therefore applied.
9. MTR is calculated as the sum of the MTR contributions in each altitude window divided by the hours sampled

G. Rain Effects

Rain echos are much stronger than those from even the largest birds and usually create many spurious tracks. Therefore, the MTR was not calculated within one hour of heavy rain at the Yarmouth weather station.

Figure 32 shows rain falling on October 16 in the same hour that 1.5 mm of rain was measured in Yarmouth.

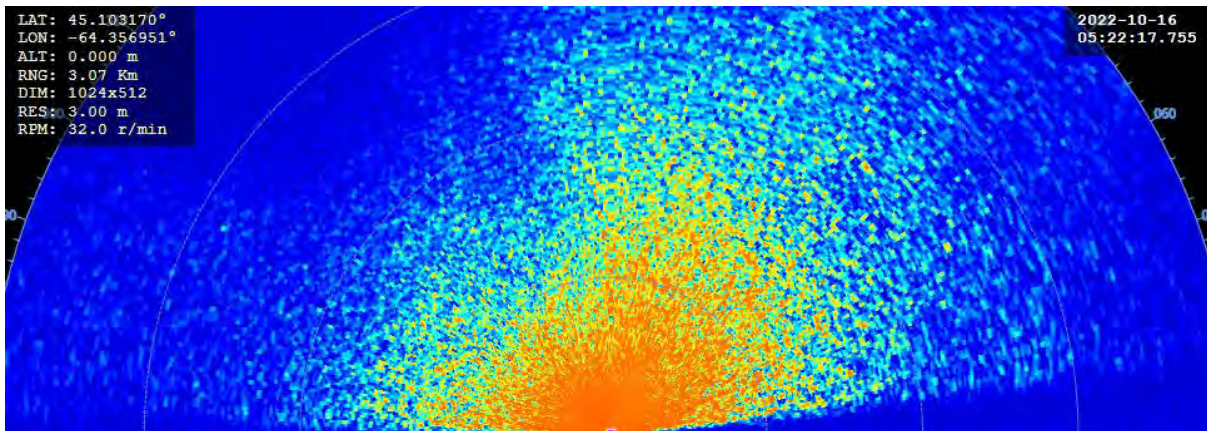


Figure 32 Heavy rain.

In addition:

- isolated bands of rain were often observed many hours before or after rain was measured in Yarmouth,
- moisture-laden clouds also caused spurious tracks, often on days that were otherwise clear with no measured rain.

Figure 28 shows a moisture-laden cloud that passed in three minutes, creating many spurious tracks. Note that the strong cloud returns never reached the ground indicating that little or no rain was falling.

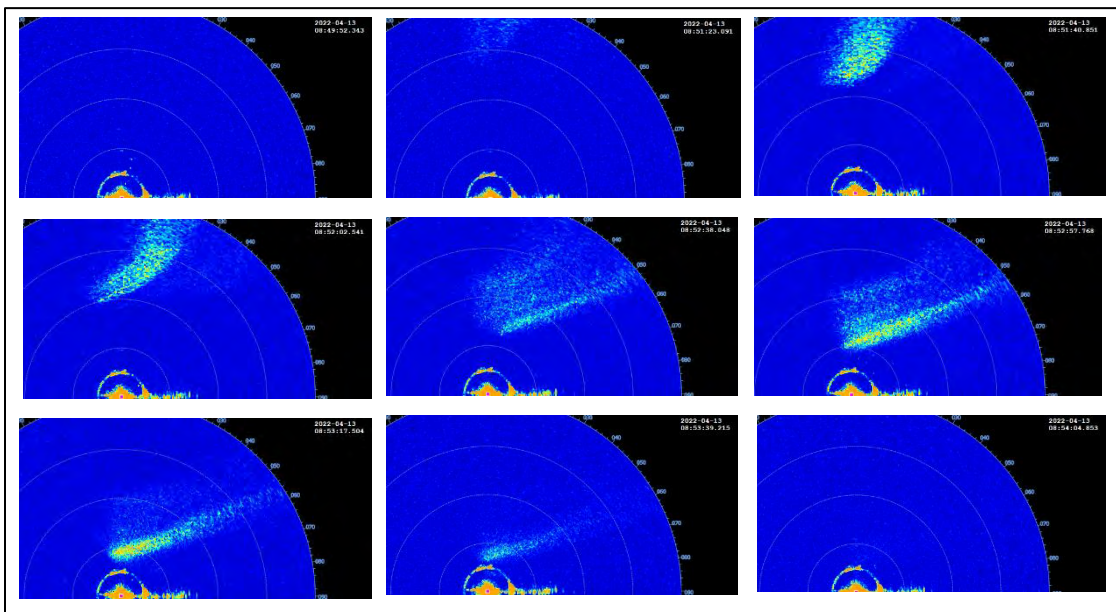


Figure 33 Moisture laden cloud passing overhead.

To avoid counting these tracks, an automatic rain and cloud detector was implemented that monitored for unusual plot count increases in ten-minute windows. Track counting was then inhibited in these windows.

H. Cognitive Bird Tracker

COGNITIVE RADAR
CORPORATION

COGNITIVE BIRD TRACKER - Low Cost Easy to Use
 Rugged Industrial Computers Exceptional Tracking

Modern state-of-art processing and tracking: Detects the smallest birds and bats. Tracks tight turns.

Universal: Connects to any magnetron or solid-state radar

Two Data Recorders: Radar video, plots and tracks. Continuous and at user-set intervals.

Modular: Cognitive Processor and Tracker can be installed anywhere - at radar site or monitoring center

Multiple Displays: Network connected

Rugged: Hardware available to operate -30 to 55 C **No fans. No cooling.**

Standard Open-Source Track Output: NMEA

Four modules for flexible low-cost installation:

Cognitive Digitizer (for Magnetron Radars)

- Universal interface for all magnetron radars - both video/trigger and composite video

Cognitive Processor

- Controls Magnetron or Solid-State Radar (Furuno DRS family)
- Radar Interference Rejection - detects and rejects returns from other radars
- Land Masking - hides land and other non-target areas
- Adaptive Clutter Mapping – improves target detection in clutter
- Scan Averaging - improves detection of small slow targets
- Moving Target Detection – improves detection of birds and other moving targets
- Ordered Statistic Detection - maximizes small target detection

Cognitive Tracker

- Automatic Track Initiation - minimizes false tracks in heavy clutter and in mapped areas
- Multiple Hypothesis Tracker (MHT) –tracks difficult targets: poorly detected or maneuvering
- Interacting Multiple Model (IMM) Track Filtering - retains track on rapidly maneuvering targets
- Automatic Track Deletion - where track quality and confidence are below limit
- 500 Track Capacity

Cognitive Display

- Overlays Radar, Plots and Tracks.

192 SILVERWOOD PLACE, WATERLOO, ONTARIO, CANADA N2T 2R9

Figure 34 Cognitive Bird Tracker data sheet (page 1)

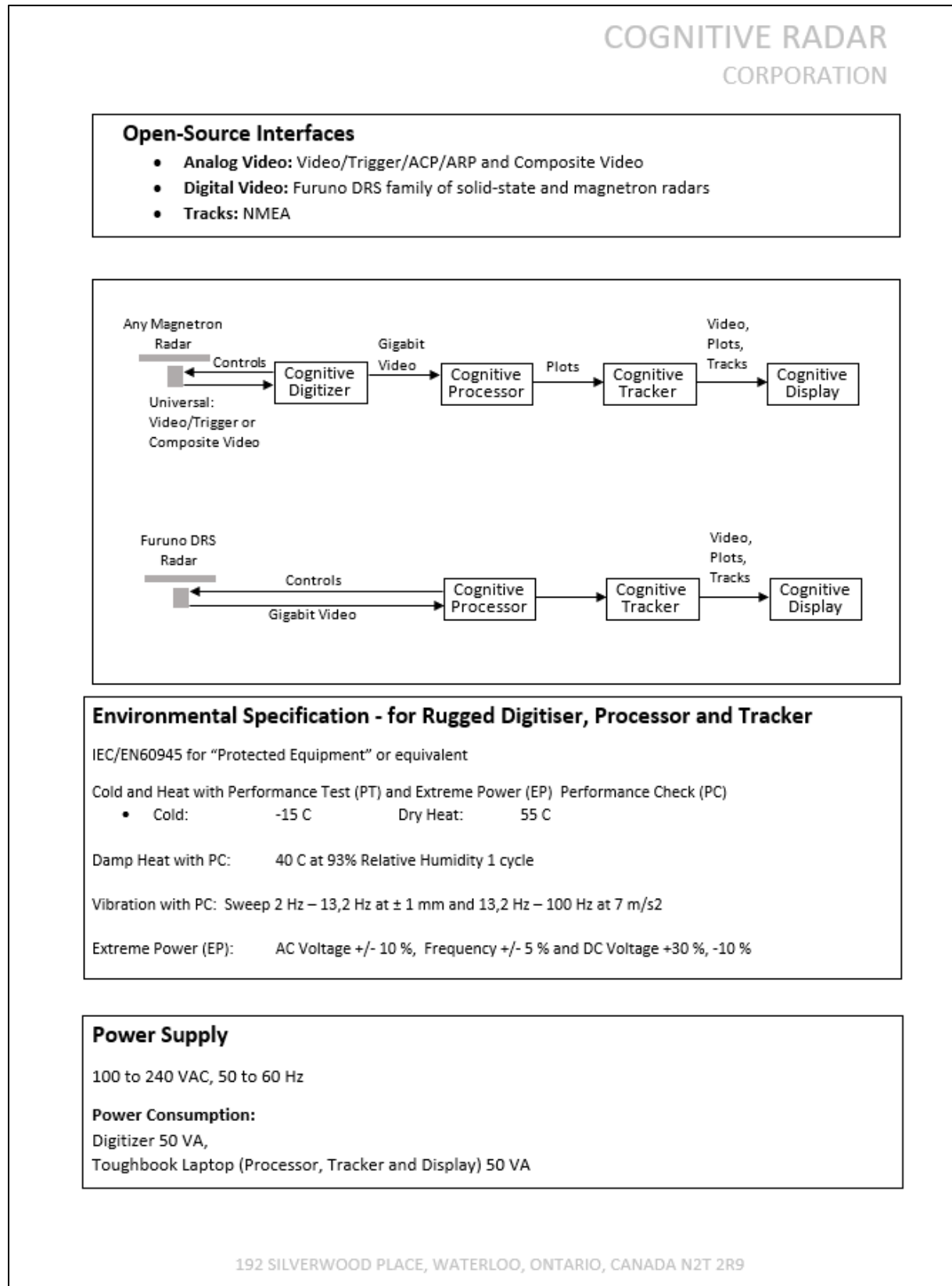


Figure 35 Cognitive Bird Tracker data sheet (page 2).

I. Tabular Plot Data

Table 5 Data for Figure 1 Average night-time MTR (bird passages per hour per km) below 225 meters by month.

	Month	AvgMTR
1	5	37.44345
2	6	33.91261
3	7	48.30688
4	8	81.84451
5	9	106.1995
6	10	63.08777
7	11	12.02729

Table 6 Data for Figure 4 Weekly average day (orange) and night (black) MTR below 225 meters.

	Week	MTR	DayNight		Week	MTR	DayNight
1	21	20.58306	Day	24	21	35.60297	Night
2	22	21.92944	Day	25	22	40.08555	Night
3	23	21.74864	Day	26	23	36.26753	Night
4	28	14.23374	Day	27	28	49.28326	Night
5	29	31.78071	Day	28	29	44.32224	Night
6	30	21.93582	Day	29	30	36.1967	Night
7	31	59.37887	Day	30	31	97.2071	Night
8	32	68.14152	Day	31	32	116.993	Night
9	33	25.68689	Day	32	33	48.96646	Night
10	34	16.65794	Day	33	34	67.61989	Night
11	35	30.76491	Day	34	35	119.7468	Night
12	36	38.43013	Day	35	36	148.1933	Night
13	37	29.76814	Day	36	37	70.88068	Night
14	38	25.55182	Day	37	38	106.0887	Night
15	40	50.65574	Day	38	40	28.94121	Night
16	41	52.1467	Day	39	41	103.9725	Night
17	42	44.51665	Day	40	42	72.70994	Night
18	43	29.38696	Day	41	43	65.56623	Night
19	44	48.90584	Day	42	44	16.5375	Night
20	45	24.29521	Day	43	45	23.28215	Night
21	46	24.28857	Day	44	46	15.43571	Night
22	47	19.99109	Day	45	47	14.71479	Night
23	48	22.83421	Day	46	48	13.16224	Night

Table 7 Data for Figures 5 to 8 Day (orange) and night (black) MTR in Month for birds below 225 meters.

Month	Day	MTR	DayNight	Month	Day	MTR	DayNight
5	25	22.2	Day	9	8	108.1	Night
5	25	45.3	Night	9	9	16.5	Day
5	26	13.6	Day	9	12	10.2	Day
5	26	37.6	Night	9	12	24.2	Night
5	27	4.6	Day	9	13	11.9	Day
5	27	12.9	Night	9	13	77.7	Night
5	28	13.3	Day	9	14	29.5	Day
5	28	30.2	Night	9	14	37.7	Night
5	29	22.0	Day	9	15	31.9	Day
5	29	40.9	Night	9	15	52.7	Night
5	30	7.6	Day	9	16	39.4	Day
5	30	68.0	Night	9	16	152.2	Night
5	31	19.7	Day	9	17	29.6	Day
5	31	31.2	Night	9	17	41.4	Night
6	1	15.3	Day	9	18	8.9	Day
6	1	26.3	Night	9	18	37.7	Night
6	2	20.9	Day	9	19	12.3	Day
6	2	37.9	Night	9	19	204.4	Night
6	3	15.7	Day	9	20	54.9	Day
6	3	36.3	Night	9	20	57.3	Night
6	4	15.9	Day	9	21	18.5	Day
6	4	30.4	Night	9	21	99.6	Night
6	5	15.2	Day	9	22	14.5	Day
6	5	29.1	Night	9	22	5.3	Night
6	6	25.6	Day	10	7	50.7	Day
6	6	48.5	Night	10	7	27.8	Night
6	7	2.9	Day	10	8	70.4	Day
6	7	10.5	Night	10	8	94.2	Night
7	15	13.6	Day	10	9	45.3	Day
7	15	48.4	Night	10	9	45.2	Night
7	22	28.8	Day	10	10	43.3	Day
7	22	42.7	Night	10	10	139.6	Night
7	29	11.3	Day	10	13	30.9	Day
7	29	29.0	Night	10	13	146.7	Night
7	30	21.3	Day	10	15	69.0	Day
7	30	66.1	Night	10	15	15.5	Night
7	31	30.5	Day	10	16	32.2	Day
7	31	59.1	Night	10	16	104.5	Night

8	1	28.7	Day	10	17	17.3	Day
8	1	96.8	Night	10	17	67.6	Night
8	2	54.2	Day	10	19	32.5	Day
8	2	87.1	Night	10	19	19.8	Night
8	3	93.3	Day	10	20	33.3	Day
8	3	124.1	Night	10	20	43.5	Night
8	5	51.4	Day	10	21	27.4	Day
8	5	126.9	Night	10	21	102.2	Night
8	6	77.6	Day	10	22	50.6	Day
8	6	93.6	Night	10	22	100.5	Night
8	7	58.3	Day	10	23	22.7	Day
8	7	94.0	Night	10	23	35.0	Night
8	8	64.1	Day	10	24	7.1	Day
8	8	94.1	Night	10	24	13.0	Night
8	9	113.6	Day	10	25	4.9	Day
8	9	203.7	Night	10	25	73.3	Night
8	10	90.3	Day	11	4	50.3	Day
8	10	181.1	Night	11	4	14.4	Night
8	11	38.1	Day	11	5	23.3	Day
8	11	44.9	Night	11	5	12.7	Night
8	12	49.0	Day	11	6	19.6	Day
8	12	101.8	Night	11	6	12.6	Night
8	14	20.2	Day	11	7	20.6	Day
8	14	62.8	Night	11	7	14.6	Night
8	15	12.2	Day	11	8	21.0	Day
8	15	78.3	Night	11	8	51.1	Night
8	17	26.2	Day	11	9	24.5	Day
8	17	23.2	Night	11	9	17.6	Night
8	18	27.3	Day	11	10	22.4	Day
8	18	17.2	Night	11	10	13.2	Night
8	19	30.1	Day	11	11	15.0	Day
8	19	61.8	Night	11	11	11.9	Night
8	20	18.8	Day	11	12	31.1	Day
8	20	81.6	Night	11	12	17.3	Night
8	21	14.6	Day	11	13	16.6	Day
8	21	96.9	Night	11	13	5.4	Night
8	23	1.9	Day	11	14	12.7	Day
8	23	16.8	Night	11	14	6.0	Night
8	24	6.9	Day	11	15	17.2	Day
8	24	10.9	Night	11	15	11.4	Night
8	25	33.9	Day	11	16	16.7	Day
8	25	156.2	Night	11	16	6.5	Night
8	26	16.0	Day	11	17	19.4	Day

8	26	14.2	Night	11	17	12.8	Night
8	27	19.3	Day	11	18	30.7	Day
8	27	143.6	Night	11	18	12.1	Night
8	28	38.7	Day	11	19	10.1	Day
8	28	97.1	Night	11	19	5.6	Night
8	29	14.5	Day	11	20	10.5	Day
8	29	28.7	Night	11	20	5.0	Night
8	30	18.4	Day	11	21	17.8	Day
8	30	39.9	Night	11	21	4.9	Night
8	31	21.4	Day	11	22	15.5	Day
8	31	58.5	Night	11	22	5.8	Night
9	1	31.7	Day	11	23	16.9	Day
9	1	122.5	Night	11	23	11.8	Night
9	2	53.1	Day	11	24	14.9	Day
9	2	249.5	Night	11	24	19.8	Night
9	3	38.6	Day	11	25	5.0	Day
9	3	109.2	Night	11	25	3.7	Night
9	4	34.3	Day	11	26	19.1	Day
9	4	72.5	Night	11	26	5.1	Night
9	6	46.4	Day	11	27	19.8	Day
9	6	314.3	Night	11	27	10.2	Night
9	7	35.3	Day	11	28	12.1	Day
9	7	137.8	Night	11	28	9.8	Night
9	8	40.6	Day	11	29	29.6	Day
				11	29	9.8	Night
				11	30	5.9	Day
				11	30	5.1	Night

Table 8 Data for Figure 9 Average MTR below 225 m through sunset in the spring and fall migration seasons

Season	HourAfterSunset	AvgMTR	Season	HourAfterSunset	AvgMTR
Autumn	-3	13.1	Spring	-3	8.6
Autumn	-2	13.1	Spring	-2	6.9
Autumn	-1	14.1	Spring	-1	7.1
Autumn	0	34.6	Spring	0	15.1
Autumn	1	53.1	Spring	1	24.7
Autumn	2	50.5	Spring	2	19.1
Autumn	3	41.8	Spring	3	10.3
Autumn	4	25.2			
Autumn	5	12.3			
Autumn	6	1.6			

Table 9 Data for Figure 10 Average MTR below 225 m through sunrise in the spring and fall migration seasons

Season	HourBeforeSunrise	AvgMTR	Season	HourBeforeSunrise	AvgMTR
Autumn	-3	17.7	Spring	-3	7.7
Autumn	-2	20.2	Spring	-2	7.0
Autumn	-1	21.2	Spring	-1	13.4
Autumn	0	20.5	Spring	0	13.2
Autumn	1	24.0	Spring	1	20.4
Autumn	2	25.2	Spring	2	18.7
Autumn	3	29.2	Spring	3	21.4
Autumn	4	33.1	Spring	4	20.0
Autumn	5	30.9	Spring	5	15.6
Autumn	6	34.0			
Autumn	7	19.7			
Autumn	8	6.1			

Table 10 Data for Figures 11 to 14 Average hourly MTR below 225 meters in Month.

Month	Hour	TotalMT	HoursSurveyed	Average_MTR	Month	Hour	TotalMT	HoursSurveyed	Average_MTR
5	0	210.8	7.0	30.1	8	21	3757.4	26.8	140.0
5	1	303.0	7.0	43.3	8	22	2813.0	26.0	108.2
5	2	394.2	7.0	56.3	8	23	2643.8	26.0	101.7
5	3	340.5	7.0	48.6	9	0	2121.8	16.8	126.0
5	4	350.1	7.0	50.0	9	1	1917.6	16.5	116.2
5	5	161.5	8.2	19.8	9	2	1790.7	16.8	106.4
5	6	147.9	7.0	21.1	9	3	1338.3	17.0	78.7
5	7	49.9	6.2	8.1	9	4	944.0	17.0	55.5
5	8	76.5	4.0	19.1	9	5	907.5	17.0	53.4
5	17	14.1	0.7	21.2	9	6	633.8	18.0	35.2
5	18	91.7	5.0	18.3	9	7	717.6	17.0	42.2
5	19	61.6	6.3	9.7	9	8	569.2	13.8	41.1
5	20	95.5	8.0	11.9	9	9	456.2	8.8	51.6
5	21	235.3	7.0	33.6	9	10	5.2	0.5	10.5
5	22	180.3	7.0	25.8	9	16	78.6	6.0	13.1
5	23	207.2	7.0	29.6	9	17	316.3	16.0	19.8
6	0	215.2	7.0	30.7	9	18	355.6	18.7	19.0
6	1	226.7	7.0	32.4	9	19	431.2	21.2	20.4
6	2	138.7	7.0	19.8	9	20	2276.2	18.0	126.5
6	3	178.9	7.0	25.6	9	21	3563.4	18.0	198.0
6	4	176.5	7.0	25.2	9	22	2937.7	17.8	164.7
6	5	112.8	8.2	13.8	9	23	2488.3	17.7	140.8
6	6	190.3	7.0	27.2	10	0	1071.1	13.3	80.3
6	7	83.8	5.5	15.2	10	1	771.5	13.8	55.8
6	8	14.7	3.0	4.9	10	2	410.0	14.0	29.3

6	17	4.0	0.3	11.9	10	3	790.4	13.8	57.1
6	18	21.6	3.5	6.2	10	4	609.9	14.0	43.6
6	19	110.3	5.3	20.7	10	5	524.4	13.0	40.3
6	20	73.1	8.0	9.1	10	6	472.3	13.0	36.3
6	21	187.8	7.0	26.8	10	7	665.5	14.5	45.9
6	22	452.9	7.0	64.7	10	8	719.9	12.8	56.1
6	23	278.0	7.0	39.7	10	9	494.1	10.5	47.1
7	0	227.3	5.0	45.5	10	10	167.5	5.8	28.7
7	1	187.7	5.0	37.5	10	15	59.7	3.3	17.9
7	2	164.0	5.0	32.8	10	16	247.4	10.5	23.6
7	3	148.3	5.0	29.7	10	17	287.8	14.0	20.6
7	4	128.2	5.0	25.6	10	18	408.3	17.2	23.8
7	5	152.6	5.2	29.5	10	19	1373.8	15.0	91.6
7	6	119.6	4.5	26.6	10	20	1710.9	14.0	122.2
7	7	67.2	3.2	21.2	10	21	1471.6	14.0	105.1
7	8	16.8	1.5	11.2	10	22	900.7	14.0	64.3
7	17	3.4	0.3	10.2	10	23	986.3	14.0	70.5
7	18	40.4	2.0	20.2	11	0	306.2	23.5	13.0
7	19	73.8	4.2	17.7	11	1	317.9	24.7	12.9
7	20	78.6	5.8	13.5	11	2	236.9	24.0	9.9
7	21	527.5	5.0	105.5	11	3	195.5	23.7	8.3
7	22	395.5	5.0	79.1	11	4	174.9	21.2	8.3
7	23	321.0	5.0	64.2	11	5	175.6	22.2	7.9
8	0	2008.9	26.0	77.3	11	6	118.7	20.8	5.7
8	1	2046.8	26.0	78.7	11	7	298.1	22.7	13.2
8	2	1992.2	26.0	76.6	11	8	574.2	28.5	20.1
8	3	1915.1	25.3	75.6	11	9	396.9	25.3	15.7
8	4	2013.2	25.7	78.4	11	10	438.4	25.5	17.2
8	5	1717.5	26.0	66.1	11	11	114.3	9.7	11.8
8	6	958.9	29.8	32.1	11	14	46.7	2.8	16.5
8	7	1099.4	23.5	46.8	11	15	531.8	26.7	19.9
8	8	836.1	18.0	46.5	11	16	571.7	27.0	21.2
8	9	136.8	6.5	21.0	11	17	723.1	29.0	24.9
8	17	308.4	12.5	24.7	11	18	642.5	28.2	22.8
8	18	637.3	21.5	29.6	11	19	336.8	25.7	13.1
8	19	962.3	26.5	36.3	11	20	283.6	24.2	11.7
8	20	1103.4	31.0	35.6	11	21	269.4	24.2	11.1
					11	22	314.9	25.3	12.4
					11	23	225.0	24.8	9.1

Table 11 Data for Figure 15 Seasonal percentage of MTR by height.

Season	MTRHt	TotalMT	TotalMTbyHt	PercentbyHt
Autumn	< 225 m	46877.22	107463.2	43.62165
Autumn	> 900 m	1291.421	107463.2	1.201733
Autumn	225 to 450 m	43609.7	107463.2	40.58105
Autumn	450 to 675 m	16976.29	107463.2	15.7973
Autumn	675 to 900 m	4295.492	107463.2	3.997175
Spring	< 225 m	3253.86	5842.047	55.69726
Spring	> 900 m	576.9475	5842.047	9.875776
Spring	225 to 450 m	1660.754	5842.047	28.4276
Spring	450 to 675 m	927.4336	5842.047	15.87515
Spring	675 to 900 m	562.6642	5842.047	9.631284

Table 12 Data for Figure 15 Monthly percentage of MTR by height.

Month	MTRHt	TotalMT	TotalMTbyHt	PercentbyHt	Month
5	< 225 m	1762.5	3085.6	57.1	May
5	> 900 m	453.4	3085.6	14.7	May
5	225 to 450 m	802.3	3085.6	26.0	May
5	450 to 675 m	520.8	3085.6	16.9	May
5	675 to 900 m	401.5	3085.6	13.0	May
6	< 225 m	1491.4	2756.5	54.1	June
6	> 900 m	123.5	2756.5	4.5	June
6	225 to 450 m	858.4	2756.5	31.1	June
6	450 to 675 m	406.6	2756.5	14.8	June
6	675 to 900 m	161.1	2756.5	5.8	June
7	< 225 m	1895.2	7458.7	25.4	July
7	> 900 m	36.5	7458.7	0.5	July
7	225 to 450 m	4302.5	7458.7	57.7	July
7	450 to 675 m	1261.1	7458.7	16.9	July
7	675 to 900 m	43.3	7458.7	0.6	July
8	< 225 m	16569.0	39506.8	41.9	August
8	> 900 m	459.3	39506.8	1.2	August
8	225 to 450 m	15704.0	39506.8	39.8	August
8	450 to 675 m	7233.8	39506.8	18.3	August
8	675 to 900 m	2026.7	39506.8	5.1	August
9	< 225 m	16209.0	40705.4	39.8	September
9	> 900 m	324.9	40705.4	0.8	September
9	225 to 450 m	18090.0	40705.4	44.4	September
9	450 to 675 m	6406.3	40705.4	15.7	September

9	675 to 900 m	1410.9	40705.4	3.5	September
10	< 225 m	9195.9	15772.8	58.3	October
10	> 900 m	353.6	15772.8	2.2	October
10	225 to 450 m	4771.3	15772.8	30.3	October
10	450 to 675 m	1805.6	15772.8	11.4	October
10	675 to 900 m	738.1	15772.8	4.7	October
11	< 225 m	3008.1	4019.5	74.8	November
11	> 900 m	117.0	4019.5	2.9	November
11	225 to 450 m	741.9	4019.5	18.5	November
11	450 to 675 m	269.5	4019.5	6.7	November
11	675 to 900 m	76.5	4019.5	1.9	November

Table 13 Data for Figures 16 to 19 Daily night-time MTR by height in Month.

Month	Day	MTRHt	MTR	Month	Day	MTRHt	MTR	Month	Day	MTRHt	MTR
5	25	< 225 m	45.3	8	20	< 225 m	81.6	10	16	< 225 m	104.5
5	25	> 900 m	28.7	8	20	> 900 m	2.6	10	16	> 900 m	2.4
5	25	225 to 450 m	12.5	8	20	225 to 450 m	38.3	10	16	225 to 450 m	44.7
5	25	450 to 675 m	13.6	8	20	450 to 675 m	15.8	10	16	450 to 675 m	15.8
5	25	675 to 900 m	17.2	8	20	675 to 900 m	9.6	10	16	675 to 900 m	6.1
5	26	< 225 m	37.6	8	21	< 225 m	96.9	10	17	< 225 m	67.6
5	26	> 900 m	6.3	8	21	> 900 m	0.1	10	17	> 900 m	0.0
5	26	225 to 450 m	12.0	8	21	225 to 450 m	32.0	10	17	225 to 450 m	20.8
5	26	450 to 675 m	6.5	8	21	450 to 675 m	7.1	10	17	450 to 675 m	2.8
5	26	675 to 900 m	8.5	8	21	675 to 900 m	1.4	10	17	675 to 900 m	0.3
5	27	< 225 m	12.9	8	23	< 225 m	16.8	10	19	< 225 m	19.8
5	27	> 900 m	3.5	8	23	> 900 m	1.0	10	19	> 900 m	0.1
5	27	225 to 450 m	2.0	8	23	225 to 450 m	17.1	10	19	225 to 450 m	13.0
5	27	450 to 675 m	5.5	8	23	450 to 675 m	8.0	10	19	450 to 675 m	6.6
5	27	675 to 900 m	4.2	8	23	675 to 900 m	1.0	10	19	675 to 900 m	3.0
5	28	< 225 m	30.2	8	24	< 225 m	10.9	10	20	< 225 m	43.5
5	28	> 900 m	2.5	8	24	> 900 m	1.3	10	20	225 to 450 m	17.2
5	28	225 to 450 m	14.4	8	24	225 to 450 m	10.5	10	20	450 to 675 m	6.3
5	28	450 to 675 m	2.8	8	24	450 to 675 m	4.0	10	20	675 to 900 m	1.4
5	28	675 to 900 m	0.6	8	24	675 to 900 m	1.4	10	21	< 225 m	102.2
5	29	< 225 m	40.9	8	25	< 225 m	156.2	10	21	> 900 m	1.7
5	29	> 900 m	5.5	8	25	> 900 m	3.7	10	21	225 to 450 m	20.0
5	29	225 to 450 m	16.2	8	25	225 to 450 m	76.2	10	21	450 to 675 m	8.5
5	29	450 to 675 m	12.5	8	25	450 to 675 m	38.0	10	21	675 to 900 m	4.8
5	29	675 to 900 m	9.0	8	25	675 to 900 m	17.1	10	22	< 225 m	100.5
5	30	< 225 m	68.0	8	26	< 225 m	14.2	10	22	> 900 m	4.1
5	30	> 900 m	3.2	8	26	225 to 450 m	25.1	10	22	225 to 450 m	36.8
5	30	225 to 450 m	25.4	8	26	450 to 675 m	6.2	10	22	450 to 675 m	16.6

5	30	450 to 675 m	14.8	8	26	675 to 900 m	0.2	10	22	675 to 900 m	7.4
5	30	675 to 900 m	4.8	8	27	< 225 m	143.6	10	23	< 225 m	35.0
5	31	< 225 m	31.2	8	27	> 900 m	1.7	10	23	> 900 m	4.3
5	31	> 900 m	1.2	8	27	225 to 450 m	146.0	10	23	225 to 450 m	37.2
5	31	225 to 450 m	8.2	8	27	450 to 675 m	61.2	10	23	450 to 675 m	13.7
5	31	450 to 675 m	3.0	8	27	675 to 900 m	15.7	10	23	675 to 900 m	4.1
5	31	675 to 900 m	0.9	8	28	< 225 m	97.1	10	24	< 225 m	13.0
6	1	< 225 m	26.3	8	28	> 900 m	0.9	10	24	> 900 m	1.7
6	1	> 900 m	6.3	8	28	225 to 450 m	54.7	10	24	225 to 450 m	10.9
6	1	225 to 450 m	16.5	8	28	450 to 675 m	35.4	10	24	450 to 675 m	5.9
6	1	450 to 675 m	15.4	8	28	675 to 900 m	10.8	10	24	675 to 900 m	1.6
6	1	675 to 900 m	6.7	8	29	< 225 m	28.7	10	25	< 225 m	73.3
6	2	< 225 m	37.9	8	29	> 900 m	0.7	10	25	> 900 m	7.3
6	2	> 900 m	0.9	8	29	225 to 450 m	24.8	10	25	225 to 450 m	52.8
6	2	225 to 450 m	10.3	8	29	450 to 675 m	4.6	10	25	450 to 675 m	25.9
6	2	450 to 675 m	5.9	8	29	675 to 900 m	0.1	10	25	675 to 900 m	15.7
6	2	675 to 900 m	4.5	8	30	< 225 m	39.9	11	4	< 225 m	14.4
6	3	< 225 m	36.3	8	30	225 to 450 m	20.0	11	4	> 900 m	0.7
6	3	> 900 m	1.9	8	30	450 to 675 m	1.4	11	4	225 to 450 m	0.5
6	3	225 to 450 m	21.3	8	31	< 225 m	58.5	11	4	675 to 900 m	0.3
6	3	450 to 675 m	11.2	8	31	> 900 m	1.7	11	5	< 225 m	12.7
6	3	675 to 900 m	2.3	8	31	225 to 450 m	113.6	11	5	> 900 m	0.8
6	4	< 225 m	30.4	8	31	450 to 675 m	46.6	11	5	225 to 450 m	0.4
6	4	> 900 m	2.1	8	31	675 to 900 m	2.1	11	5	450 to 675 m	0.2
6	4	225 to 450 m	15.0	9	1	< 225 m	122.5	11	5	675 to 900 m	0.1
6	4	450 to 675 m	6.7	9	1	> 900 m	1.6	11	6	< 225 m	12.6
6	4	675 to 900 m	1.3	9	1	225 to 450 m	333.4	11	6	> 900 m	0.2
6	5	< 225 m	29.1	9	1	450 to 675 m	94.2	11	6	225 to 450 m	0.6
6	5	> 900 m	0.9	9	1	675 to 900 m	9.7	11	6	450 to 675 m	0.1
6	5	225 to 450 m	10.4	9	2	< 225 m	249.5	11	6	675 to 900 m	0.2
6	5	450 to 675 m	2.3	9	2	> 900 m	1.5	11	7	< 225 m	14.6
6	5	675 to 900 m	2.4	9	2	225 to 450 m	248.2	11	7	> 900 m	0.5
6	6	< 225 m	48.5	9	2	450 to 675 m	106.1	11	7	225 to 450 m	1.9
6	6	> 900 m	0.4	9	2	675 to 900 m	19.0	11	7	450 to 675 m	0.2
6	6	225 to 450 m	21.6	9	3	< 225 m	109.2	11	7	675 to 900 m	0.1
6	6	450 to 675 m	2.9	9	3	> 900 m	1.0	11	8	< 225 m	51.1
6	6	675 to 900 m	0.8	9	3	225 to 450 m	63.4	11	8	> 900 m	0.4
6	7	< 225 m	10.5	9	3	450 to 675 m	22.3	11	8	225 to 450 m	3.8
6	7	> 900 m	1.3	9	3	675 to 900 m	7.2	11	8	450 to 675 m	0.3
6	7	225 to 450 m	2.1	9	4	< 225 m	72.5	11	8	675 to 900 m	0.1
6	7	450 to 675 m	1.6	9	4	> 900 m	2.8	11	9	< 225 m	17.6
6	7	675 to 900 m	0.2	9	4	225 to 450 m	46.4	11	9	> 900 m	0.8
7	15	< 225 m	48.4	9	4	450 to 675 m	33.9	11	9	225 to 450 m	3.8

7	15	225 to 450 m	102.5	9	4	675 to 900 m	10.7	11	9	450 to 675 m	2.6
7	15	450 to 675 m	16.8	9	6	< 225 m	314.3	11	9	675 to 900 m	1.5
7	15	675 to 900 m	0.4	9	6	> 900 m	2.0	11	10	< 225 m	13.2
7	22	< 225 m	42.7	9	6	225 to 450 m	285.5	11	10	> 900 m	0.8
7	22	> 900 m	0.5	9	6	450 to 675 m	101.0	11	10	225 to 450 m	0.7
7	22	225 to 450 m	50.1	9	6	675 to 900 m	19.0	11	10	450 to 675 m	0.2
7	22	450 to 675 m	19.6	9	7	< 225 m	137.8	11	10	675 to 900 m	0.1
7	22	675 to 900 m	0.4	9	7	> 900 m	3.8	11	11	< 225 m	11.9
7	29	< 225 m	29.0	9	7	225 to 450 m	148.1	11	11	> 900 m	0.2
7	29	225 to 450 m	47.9	9	7	450 to 675 m	67.4	11	11	225 to 450 m	1.5
7	29	450 to 675 m	16.9	9	7	675 to 900 m	17.6	11	11	450 to 675 m	0.3
7	30	< 225 m	66.1	9	8	< 225 m	108.1	11	11	675 to 900 m	0.5
7	30	> 900 m	1.5	9	8	> 900 m	2.9	11	12	< 225 m	17.3
7	30	225 to 450 m	199.7	9	8	225 to 450 m	91.2	11	12	> 900 m	0.3
7	30	450 to 675 m	55.6	9	8	450 to 675 m	36.5	11	12	225 to 450 m	1.8
7	30	675 to 900 m	2.9	9	8	675 to 900 m	9.1	11	12	450 to 675 m	0.2
7	31	< 225 m	59.1	9	12	< 225 m	24.2	11	12	675 to 900 m	0.2
7	31	> 900 m	1.9	9	12	> 900 m	1.6	11	13	< 225 m	5.4
7	31	225 to 450 m	65.1	9	12	225 to 450 m	35.2	11	13	> 900 m	0.1
7	31	450 to 675 m	26.9	9	12	450 to 675 m	8.5	11	13	225 to 450 m	2.4
7	31	675 to 900 m	1.0	9	12	675 to 900 m	2.1	11	13	450 to 675 m	0.5
8	1	< 225 m	96.8	9	13	< 225 m	77.7	11	13	675 to 900 m	0.1
8	1	> 900 m	0.2	9	13	> 900 m	0.1	11	14	< 225 m	6.0
8	1	225 to 450 m	38.4	9	13	225 to 450 m	28.8	11	14	> 900 m	0.2
8	1	450 to 675 m	20.0	9	13	450 to 675 m	4.5	11	14	225 to 450 m	0.4
8	1	675 to 900 m	1.3	9	13	675 to 900 m	0.4	11	14	450 to 675 m	0.6
8	2	< 225 m	87.1	9	14	< 225 m	37.7	11	14	675 to 900 m	0.1
8	2	> 900 m	1.2	9	14	> 900 m	1.0	11	15	< 225 m	11.4
8	2	225 to 450 m	49.7	9	14	225 to 450 m	49.7	11	15	225 to 450 m	8.2
8	2	450 to 675 m	22.1	9	14	450 to 675 m	14.7	11	15	450 to 675 m	1.6
8	2	675 to 900 m	2.5	9	14	675 to 900 m	2.0	11	15	675 to 900 m	0.1
8	3	< 225 m	124.1	9	15	< 225 m	52.7	11	16	< 225 m	6.5
8	3	> 900 m	1.2	9	15	> 900 m	1.7	11	16	> 900 m	0.1
8	3	225 to 450 m	44.7	9	15	225 to 450 m	32.5	11	16	225 to 450 m	0.0
8	3	450 to 675 m	23.4	9	15	450 to 675 m	11.8	11	16	450 to 675 m	0.1
8	3	675 to 900 m	3.8	9	15	675 to 900 m	4.1	11	16	675 to 900 m	0.4
8	5	< 225 m	126.9	9	16	< 225 m	152.2	11	17	< 225 m	12.8
8	5	> 900 m	5.0	9	16	> 900 m	1.7	11	17	> 900 m	1.0
8	5	225 to 450 m	58.3	9	16	225 to 450 m	55.5	11	17	225 to 450 m	3.2
8	5	450 to 675 m	51.0	9	16	450 to 675 m	23.6	11	17	450 to 675 m	1.7
8	5	675 to 900 m	54.8	9	16	675 to 900 m	8.0	11	17	675 to 900 m	0.6
8	6	< 225 m	93.6	9	17	< 225 m	41.4	11	18	< 225 m	12.1
8	6	> 900 m	1.7	9	17	> 900 m	1.1	11	18	> 900 m	0.3

8	6	225 to 450 m	46.1	9	17	225 to 450 m	9.2	11	18	225 to 450 m	1.7
8	6	450 to 675 m	29.9	9	17	450 to 675 m	1.5	11	18	450 to 675 m	0.9
8	6	675 to 900 m	4.3	9	17	675 to 900 m	1.9	11	18	675 to 900 m	0.2
8	7	< 225 m	94.0	9	18	< 225 m	37.7	11	19	< 225 m	5.6
8	7	> 900 m	2.4	9	18	> 900 m	0.6	11	19	225 to 450 m	4.7
8	7	225 to 450 m	79.6	9	18	225 to 450 m	21.8	11	19	450 to 675 m	1.9
8	7	450 to 675 m	51.1	9	18	450 to 675 m	9.1	11	20	< 225 m	5.0
8	7	675 to 900 m	6.8	9	18	675 to 900 m	1.6	11	20	> 900 m	0.1
8	8	< 225 m	94.1	9	19	< 225 m	204.4	11	20	225 to 450 m	2.1
8	8	> 900 m	3.3	9	19	> 900 m	4.8	11	20	450 to 675 m	0.8
8	8	225 to 450 m	25.0	9	19	225 to 450 m	158.5	11	20	675 to 900 m	0.7
8	8	450 to 675 m	18.6	9	19	450 to 675 m	37.5	11	21	< 225 m	4.9
8	8	675 to 900 m	8.1	9	19	675 to 900 m	10.9	11	21	> 900 m	0.2
8	9	< 225 m	203.7	9	20	< 225 m	57.3	11	21	225 to 450 m	2.9
8	9	> 900 m	3.5	9	20	225 to 450 m	19.9	11	21	450 to 675 m	3.5
8	9	225 to 450 m	204.1	9	20	450 to 675 m	7.3	11	21	675 to 900 m	0.1
8	9	450 to 675 m	71.6	9	20	675 to 900 m	1.1	11	22	< 225 m	5.8
8	9	675 to 900 m	19.0	9	21	< 225 m	99.6	11	22	225 to 450 m	3.2
8	10	< 225 m	181.1	9	21	> 900 m	1.2	11	22	450 to 675 m	0.7
8	10	> 900 m	3.3	9	21	225 to 450 m	13.9	11	22	675 to 900 m	0.0
8	10	225 to 450 m	101.8	9	21	450 to 675 m	4.2	11	23	< 225 m	11.8
8	10	450 to 675 m	60.4	9	21	675 to 900 m	3.5	11	23	> 900 m	0.1
8	10	675 to 900 m	11.2	9	22	< 225 m	5.3	11	23	225 to 450 m	5.1
8	11	< 225 m	44.9	9	22	225 to 450 m	3.8	11	23	450 to 675 m	1.8
8	11	> 900 m	1.0	9	22	450 to 675 m	0.1	11	23	675 to 900 m	0.2
8	11	225 to 450 m	35.1	9	22	675 to 900 m	0.2	11	24	< 225 m	19.8
8	11	450 to 675 m	8.9	10	7	< 225 m	27.8	11	24	> 900 m	0.2
8	11	675 to 900 m	3.1	10	7	> 900 m	0.9	11	24	225 to 450 m	2.9
8	12	< 225 m	101.8	10	7	225 to 450 m	8.5	11	24	450 to 675 m	0.7
8	12	> 900 m	1.4	10	7	450 to 675 m	3.7	11	25	< 225 m	3.7
8	12	225 to 450 m	145.1	10	7	675 to 900 m	1.2	11	25	> 900 m	0.3
8	12	450 to 675 m	59.2	10	8	< 225 m	94.2	11	25	225 to 450 m	1.8
8	12	675 to 900 m	9.0	10	8	> 900 m	4.1	11	26	< 225 m	5.1
8	14	< 225 m	62.8	10	8	225 to 450 m	43.6	11	26	225 to 450 m	0.7
8	14	> 900 m	2.2	10	8	450 to 675 m	19.4	11	26	450 to 675 m	0.2
8	14	225 to 450 m	41.0	10	8	675 to 900 m	9.8	11	27	< 225 m	10.2
8	14	450 to 675 m	20.1	10	9	< 225 m	45.2	11	27	> 900 m	0.7
8	14	675 to 900 m	10.7	10	9	> 900 m	0.8	11	27	225 to 450 m	0.4
8	15	< 225 m	78.3	10	9	225 to 450 m	21.0	11	27	450 to 675 m	0.1
8	15	> 900 m	1.0	10	9	450 to 675 m	5.6	11	28	< 225 m	9.8
8	15	225 to 450 m	72.8	10	9	675 to 900 m	0.5	11	28	> 900 m	0.1
8	15	450 to 675 m	40.3	10	10	< 225 m	139.6	11	28	225 to 450 m	0.8
8	15	675 to 900 m	6.7	10	10	225 to 450 m	21.0	11	28	450 to 675 m	0.2

8	17	< 225 m	23.2	10	10	450 to 675 m	4.3	11	29	< 225 m	9.8
8	17	225 to 450 m	21.8	10	13	< 225 m	146.7	11	29	> 900 m	0.6
8	17	450 to 675 m	4.1	10	13	> 900 m	1.2	11	29	225 to 450 m	2.6
8	17	675 to 900 m	0.1	10	13	225 to 450 m	32.4	11	29	450 to 675 m	3.7
8	18	< 225 m	17.2	10	13	450 to 675 m	9.6	11	29	675 to 900 m	0.6
8	18	225 to 450 m	4.8	10	13	675 to 900 m	3.6	11	30	< 225 m	5.1
8	18	450 to 675 m	0.8	10	15	< 225 m	15.5	11	30	> 900 m	0.7
8	18	675 to 900 m	0.4	10	15	> 900 m	0.1	11	30	225 to 450 m	1.0
8	19	< 225 m	61.8	10	15	225 to 450 m	18.8	11	30	450 to 675 m	0.1
8	19	> 900 m	4.8	10	15	450 to 675 m	3.9				
8	19	225 to 450 m	62.1	10	15	675 to 900 m	0.4				
8	19	450 to 675 m	22.9								
8	19	675 to 900 m	3.7								

Table 14 Data for Figure 20 Percent of birds by size versus height.

Season	MTR Ht	Bird Size	Total MTR	Total MTR by Ht	Percent by Wt	Season	MTR Ht	Bird Size	Total MTR	Total MTR by Ht	Percent by Wt
Autumn	< 225 m	Large	6.2	56.1	11.0	Spring	< 225 m	Large	3.2	29.3	10.7
Autumn	< 225 m	Medium	19.0	56.1	33.8	Spring	< 225 m	Medium	8.1	29.3	27.5
Autumn	< 225 m	Small	31.0	56.1	55.2	Spring	< 225 m	Small	18.1	29.3	61.8
Autumn	225 to 450 m	Large	4.7	52.1	9.0	Spring	225 to 450 m	Large	0.6	15.0	4.2
Autumn	225 to 450 m	Medium	13.3	52.1	25.5	Spring	225 to 450 m	Medium	3.3	15.0	22.3
Autumn	225 to 450 m	Small	34.1	52.1	65.5	Spring	225 to 450 m	Small	11.0	15.0	73.5
Autumn	450 to 675 m	Large	1.5	20.3	7.2	Spring	450 to 675 m	Large	0.4	8.4	4.6
Autumn	450 to 675 m	Medium	5.1	20.3	25.3	Spring	450 to 675 m	Medium	2.2	8.4	25.8
Autumn	450 to 675 m	Small	13.7	20.3	67.5	Spring	450 to 675 m	Small	5.8	8.4	69.6
Autumn	675 to 900 m	Large	0.4	5.1	8.2	Spring	675 to 900 m	Large	0.4	5.1	7.4
Autumn	675 to 900 m	Medium	2.1	5.1	41.5	Spring	675 to 900 m	Medium	2.1	5.1	40.8
Autumn	675 to 900 m	Small	2.6	5.1	50.3	Spring	675 to 900 m	Small	2.6	5.1	51.8

Table 15 Data for Figures 21 to 24 Bird size distribution below 225 meters

Month	Day	BirdSize	MT	MTRSum	PercentSize	Month	Day	BirdSize	MT	MTRSum	PercentSize
5	25	Large	4.7	46.2	10.2	9	12	Large	3.1	24.2	12.7
5	25	Medium	13.9	46.2	30.0	9	12	Medium	10.0	24.2	41.1
5	25	Small	27.6	46.2	59.8	9	12	Small	11.2	24.2	46.2
5	26	Large	1.5	37.6	4.0	9	13	Large	6.8	88.1	7.8
5	26	Medium	6.2	37.6	16.4	9	13	Medium	28.7	88.1	32.6
5	26	Small	30.0	37.6	79.6	9	13	Small	52.5	88.1	59.6
5	27	Large	1.1	18.0	5.8	9	14	Large	2.1	37.1	5.8
5	27	Medium	1.3	18.0	7.5	9	14	Medium	6.1	37.1	16.5
5	27	Small	15.6	18.0	86.7	9	14	Small	28.9	37.1	77.8

5	28	Large	5.4	39.1	13.8	9	15	Large	4.1	56.0	7.3
5	28	Medium	8.9	39.1	22.8	9	15	Medium	13.8	56.0	24.6
5	28	Small	24.8	39.1	63.3	9	15	Small	38.1	56.0	68.1
5	29	Large	3.2	40.9	7.9	9	16	Large	27.7	150.0	18.4
5	29	Medium	11.4	40.9	27.9	9	16	Medium	49.3	150.0	32.9
5	29	Small	26.2	40.9	64.2	9	16	Small	73.0	150.0	48.7
5	30	Large	4.8	68.0	7.0	9	17	Large	6.1	43.3	14.1
5	30	Medium	16.1	68.0	23.7	9	17	Medium	11.3	43.3	26.2
5	30	Small	47.1	68.0	69.3	9	17	Small	25.9	43.3	59.7
5	31	Large	4.1	31.2	13.1	9	18	Large	8.0	72.5	11.0
5	31	Medium	11.1	31.2	35.7	9	18	Medium	24.8	72.5	34.2
5	31	Small	15.9	31.2	51.1	9	18	Small	39.7	72.5	54.8
6	1	Large	3.2	26.3	12.2	9	19	Large	24.6	365.8	6.7
6	1	Medium	8.2	26.3	31.3	9	19	Medium	78.9	365.8	21.6
6	1	Small	14.8	26.3	56.4	9	19	Small	262.3	365.8	71.7
6	2	Large	5.9	38.6	15.4	9	20	Large	4.8	58.1	8.2
6	2	Medium	14.0	38.6	36.3	9	20	Medium	19.6	58.1	33.7
6	2	Small	18.7	38.6	48.3	9	20	Small	33.7	58.1	58.1
6	3	Large	4.6	37.7	12.3	9	21	Large	11.7	101.0	11.6
6	3	Medium	14.1	37.7	37.4	9	21	Medium	31.8	101.0	31.4
6	3	Small	19.0	37.7	50.3	9	21	Small	57.6	101.0	57.0
6	4	Large	6.6	31.6	20.8	9	22	Large	1.2	23.0	5.4
6	4	Medium	11.2	31.6	35.3	9	22	Medium	9.4	23.0	40.7
6	4	Small	13.8	31.6	43.8	9	22	Small	12.4	23.0	53.9
6	5	Large	5.4	30.2	17.9	10	7	Large	4.5	29.3	15.3
6	5	Medium	9.8	30.2	32.5	10	7	Medium	10.5	29.3	35.7
6	5	Small	15.0	30.2	49.6	10	7	Small	14.4	29.3	49.0
6	6	Large	5.7	48.5	11.8	10	8	Large	14.4	96.7	14.9
6	6	Medium	17.1	48.5	35.3	10	8	Medium	27.7	96.7	28.6
6	6	Small	25.7	48.5	52.9	10	8	Small	54.6	96.7	56.5
6	7	Large	4.9	30.8	16.0	10	9	Large	4.6	54.6	8.4
6	7	Medium	14.5	30.8	47.1	10	9	Medium	18.8	54.6	34.4
6	7	Small	11.4	30.8	36.9	10	9	Small	31.2	54.6	57.2
7	15	Large	1.1	49.3	2.3	10	10	Large	19.4	139.6	13.9
7	15	Medium	6.4	49.3	13.0	10	10	Medium	58.3	139.6	41.8
7	15	Small	41.8	49.3	84.7	10	10	Small	61.9	139.6	44.3
7	22	Large	1.6	44.3	3.6	10	13	Large	13.1	154.7	8.4
7	22	Medium	12.1	44.3	27.3	10	13	Medium	46.2	154.7	29.9
7	22	Small	30.7	44.3	69.2	10	13	Small	95.4	154.7	61.7
7	29	Large	2.1	36.2	5.7	10	15	Large	1.8	20.8	8.9
7	29	Medium	6.5	36.2	18.0	10	15	Medium	6.3	20.8	30.5
7	29	Small	27.6	36.2	76.3	10	15	Small	12.6	20.8	60.7
7	30	Large	2.2	66.1	3.4	10	16	Large	28.5	159.9	17.8

7	30	Medium	11.4	66.1	17.3	10	16	Medium	53.5	159.9	33.5
7	30	Small	52.4	66.1	79.3	10	16	Small	77.9	159.9	48.7
7	31	Large	6.7	60.2	11.1	10	17	Large	8.1	83.4	9.7
7	31	Medium	16.8	60.2	27.9	10	17	Medium	34.4	83.4	41.3
7	31	Small	36.7	60.2	60.9	10	17	Small	40.9	83.4	49.1
8	1	Large	13.0	134.5	9.7	10	19	Large	2.1	30.7	6.9
8	1	Medium	52.1	134.5	38.7	10	19	Medium	7.8	30.7	25.5
8	1	Small	69.4	134.5	51.6	10	19	Small	20.8	30.7	67.6
8	2	Large	8.3	87.1	9.5	10	20	Large	5.0	43.5	11.6
8	2	Medium	35.2	87.1	40.4	10	20	Medium	11.9	43.5	27.4
8	2	Small	43.6	87.1	50.1	10	20	Small	26.5	43.5	61.0
8	3	Large	17.4	124.1	14.1	10	21	Large	20.1	103.5	19.4
8	3	Medium	59.6	124.1	48.0	10	21	Medium	43.7	103.5	42.2
8	3	Small	47.1	124.1	38.0	10	21	Small	39.8	103.5	38.4
8	5	Large	16.9	129.1	13.1	10	22	Large	10.0	101.8	9.8
8	5	Medium	59.7	129.1	46.3	10	22	Medium	41.6	101.8	40.9
8	5	Small	52.5	129.1	40.6	10	22	Small	50.2	101.8	49.3
8	6	Large	8.1	93.6	8.7	10	23	Large	4.6	88.2	5.2
8	6	Medium	37.7	93.6	40.3	10	23	Medium	21.1	88.2	23.9
8	6	Small	47.8	93.6	51.1	10	23	Small	62.5	88.2	70.9
8	7	Large	6.2	94.0	6.6	10	24	Large	1.8	13.7	13.2
8	7	Medium	38.2	94.0	40.6	10	24	Medium	2.8	13.7	20.4
8	7	Small	49.6	94.0	52.7	10	24	Small	9.1	13.7	66.4
8	8	Large	7.7	94.1	8.2	10	25	Large	4.9	73.3	6.7
8	8	Medium	40.2	94.1	42.8	10	25	Medium	26.4	73.3	36.0
8	8	Small	46.2	94.1	49.0	10	25	Small	42.0	73.3	57.3
8	9	Large	24.7	203.7	12.1	11	4	Large	5.7	16.5	34.6
8	9	Medium	72.9	203.7	35.8	11	4	Medium	3.6	16.5	22.1
8	9	Small	106.1	203.7	52.1	11	4	Small	7.2	16.5	43.4
8	10	Large	26.1	181.1	14.4	11	5	Large	4.6	15.2	30.4
8	10	Medium	82.9	181.1	45.8	11	5	Medium	3.7	15.2	24.1
8	10	Small	72.1	181.1	39.8	11	5	Small	6.9	15.2	45.4
8	11	Large	4.2	51.8	8.2	11	6	Large	5.6	14.3	39.3
8	11	Medium	20.6	51.8	39.8	11	6	Medium	3.4	14.3	24.1
8	11	Small	26.9	51.8	52.0	11	6	Small	5.2	14.3	36.6
8	12	Large	8.4	103.6	8.1	11	7	Large	4.0	17.3	23.3
8	12	Medium	35.1	103.6	33.9	11	7	Medium	3.5	17.3	20.4
8	12	Small	60.0	103.6	57.9	11	7	Small	9.7	17.3	56.2
8	14	Large	7.5	62.8	12.0	11	8	Large	4.5	51.1	8.7
8	14	Medium	18.5	62.8	29.5	11	8	Medium	6.8	51.1	13.2
8	14	Small	36.8	62.8	58.6	11	8	Small	39.8	51.1	78.0
8	15	Large	10.2	80.3	12.8	11	9	Large	5.0	19.2	26.3
8	15	Medium	35.2	80.3	43.8	11	9	Medium	4.7	19.2	24.4

8	15	Small	34.9	80.3	43.4	11	9	Small	9.5	19.2	49.3
8	17	Large	1.8	26.3	6.7	11	10	Large	5.4	18.1	29.6
8	17	Medium	9.4	26.3	35.7	11	10	Medium	4.3	18.1	23.8
8	17	Small	15.1	26.3	57.5	11	10	Small	8.4	18.1	46.5
8	18	Large	0.9	19.4	4.6	11	11	Large	2.9	24.0	12.2
8	18	Medium	4.9	19.4	25.1	11	11	Medium	4.5	24.0	18.9
8	18	Small	13.6	19.4	70.3	11	11	Small	16.5	24.0	68.8
8	19	Large	4.8	62.8	7.7	11	12	Large	3.7	20.2	18.4
8	19	Medium	13.5	62.8	21.6	11	12	Medium	4.4	20.2	21.8
8	19	Small	44.4	62.8	70.8	11	12	Small	12.1	20.2	59.8
8	20	Large	8.4	81.6	10.3	11	13	Large	2.9	11.1	26.0
8	20	Medium	31.7	81.6	38.8	11	13	Medium	4.3	11.1	38.8
8	20	Small	41.5	81.6	50.9	11	13	Small	3.9	11.1	35.2
8	21	Large	8.7	95.4	9.2	11	14	Large	3.7	10.5	35.6
8	21	Medium	36.5	95.4	38.2	11	14	Medium	2.3	10.5	21.7
8	21	Small	50.2	95.4	52.6	11	14	Small	4.5	10.5	42.7
8	23	Large	1.7	17.4	9.8	11	15	Large	4.2	12.1	34.5
8	23	Medium	5.6	17.4	32.4	11	15	Medium	2.6	12.1	21.3
8	23	Small	10.0	17.4	57.8	11	15	Small	5.3	12.1	44.2
8	24	Large	1.1	12.0	8.8	11	16	Large	5.9	10.3	57.3
8	24	Medium	2.5	12.0	20.7	11	16	Medium	3.2	10.3	31.4
8	24	Small	8.5	12.0	70.4	11	16	Small	1.2	10.3	11.3
8	25	Large	18.7	156.2	12.0	11	17	Large	1.1	32.1	3.3
8	25	Medium	62.7	156.2	40.1	11	17	Medium	10.5	32.1	32.7
8	25	Small	74.8	156.2	47.9	11	17	Small	20.6	32.1	64.0
8	26	Large	2.7	22.3	12.1	11	18	Large	1.7	24.7	6.9
8	26	Medium	10.6	22.3	47.6	11	18	Medium	9.0	24.7	36.3
8	26	Small	9.0	22.3	40.3	11	18	Small	14.1	24.7	56.9
8	27	Large	18.8	218.9	8.6	11	19	Large	0.4	8.5	4.2
8	27	Medium	85.7	218.9	39.1	11	19	Medium	2.4	8.5	28.2
8	27	Small	114.4	218.9	52.3	11	19	Small	5.8	8.5	67.6
8	28	Large	12.1	95.6	12.6	11	20	Large	0.7	11.7	6.1
8	28	Medium	40.0	95.6	41.8	11	20	Medium	3.4	11.7	29.4
8	28	Small	43.6	95.6	45.6	11	20	Small	7.5	11.7	64.5
8	29	Large	3.3	29.6	11.2	11	21	Large	0.8	22.6	3.4
8	29	Medium	9.7	29.6	32.7	11	21	Medium	5.4	22.6	23.8
8	29	Small	16.6	29.6	56.1	11	21	Small	16.5	22.6	72.8
8	30	Large	2.9	45.3	6.5	11	22	Large	0.6	11.1	5.7
8	30	Medium	16.5	45.3	36.4	11	22	Medium	3.2	11.1	28.5
8	30	Small	25.9	45.3	57.2	11	22	Small	7.3	11.1	65.8
8	31	Large	4.2	58.5	7.2	11	23	Large	0.1	13.7	1.0
8	31	Medium	17.9	58.5	30.6	11	23	Medium	2.6	13.7	18.8
8	31	Small	36.4	58.5	62.2	11	23	Small	10.9	13.7	80.1

9	1	Large	8.5	122.5	6.9	11	24	Large	1.7	25.0	6.7
9	1	Medium	30.9	122.5	25.2	11	24	Medium	6.6	25.0	26.4
9	1	Small	83.1	122.5	67.8	11	24	Small	16.7	25.0	66.9
9	2	Large	20.0	265.9	7.5	11	25	Large	3.2	8.7	36.4
9	2	Medium	120.4	265.9	45.3	11	25	Medium	2.0	8.7	22.4
9	2	Small	125.5	265.9	47.2	11	25	Small	3.6	8.7	41.2
9	3	Large	11.9	109.2	10.9	11	26	Large	0.7	8.4	8.5
9	3	Medium	49.2	109.2	45.1	11	26	Medium	3.0	8.4	36.0
9	3	Small	48.1	109.2	44.1	11	26	Small	4.7	8.4	55.4
9	4	Large	8.2	71.4	11.5	11	27	Large	6.5	17.8	36.5
9	4	Medium	23.0	71.4	32.2	11	27	Medium	3.5	17.8	19.4
9	4	Small	40.2	71.4	56.3	11	27	Small	7.9	17.8	44.1
9	6	Large	29.9	314.3	9.5	11	28	Large	6.4	13.4	48.1
9	6	Medium	109.9	314.3	35.0	11	28	Medium	2.1	13.4	16.0
9	6	Small	174.6	314.3	55.5	11	28	Small	4.8	13.4	35.9
9	7	Large	13.3	139.9	9.5	11	29	Large	3.6	15.8	22.7
9	7	Medium	54.2	139.9	38.7	11	29	Medium	2.6	15.8	16.4
9	7	Small	72.4	139.9	51.7	11	29	Small	9.6	15.8	60.9
9	8	Large	9.4	109.8	8.5	11	30	Large	4.3	8.5	50.1
9	8	Medium	38.0	109.8	34.6	11	30	Medium	2.5	8.5	29.8
9	8	Small	62.4	109.8	56.9	11	30	Small	1.7	8.5	20.1

Table 16 Data for Figure 25 Average night-time MTR versus wind speed for birds flying below 225 meters (orange) and above (blue).

Season	AtRisk	WindSpeed	TotalMT	HoursperSeason	AvgMTRperHour
Autumn	Above	>40	58.1	8.7	6.7
Autumn	Above	0-5	14783.7	163.5	90.4
Autumn	Above	10-15	17416.1	219.5	79.3
Autumn	Above	15-20	7781.3	160.7	48.4
Autumn	Above	20-25	1224.1	114.8	10.7
Autumn	Above	25-30	343.2	65.5	5.2
Autumn	Above	30-35	106.3	38.7	2.7
Autumn	Above	35-40	90.3	15.7	5.8
Autumn	Above	5-10	24370.2	254.3	95.8
Autumn	Within	>40	197.7	8.7	22.8
Autumn	Within	0-5	14753.5	163.5	90.2
Autumn	Within	10-15	14472.8	219.5	65.9
Autumn	Within	15-20	6966.9	160.7	43.4
Autumn	Within	20-25	2495.2	114.8	21.7
Autumn	Within	25-30	933.7	65.5	14.3
Autumn	Within	30-35	430.3	38.7	11.1
Autumn	Within	35-40	263.1	15.7	16.8
Autumn	Within	5-10	20392.7	254.3	80.2

Table 17 Data for Figure 26 Average fall night-time MTR versus wind sector for birds flying below 225 meters (orange) and above (blue).

Season	AtRisk	Wind Sector	TotalMT	HoursperSeason	AvgMTRperHour
Autumn	Above	0-45	1023.942	56	18.28469
Autumn	Above	135-180	1082.745	140.3333	7.715521
Autumn	Above	180-225	1026.425	212.5	4.830238
Autumn	Above	225-270	1840.045	165.5	11.1181
Autumn	Above	270-315	2223.924	173.3333	12.83033
Autumn	Above	315-360	1883.574	113.3333	16.61977
Autumn	Above	45-90	1118.852	76.33333	14.65744
Autumn	Above	90-135	829.3753	104	7.974762
Autumn	Within	0-45	957.8499	56	17.10446
Autumn	Within	135-180	1223.248	140.3333	8.716731
Autumn	Within	180-225	1294.556	212.5	6.092031
Autumn	Within	225-270	1424.814	165.5	8.609151
Autumn	Within	270-315	1260.615	173.3333	7.272778
Autumn	Within	315-360	1633.26	113.3333	14.41111
Autumn	Within	45-90	1123.055	76.33333	14.71251
Autumn	Within	90-135	1233.584	104	11.86139

Table 18 Data for Figure 27 Fall night-time MTR below 225 m as a percentage of the average MTR by bird size relative to the wind speed and direction.

Wind Speed	Wind Sector	Bird Size	MTR Percent to Avg	Wind Speed	Wind Sector	Bird Size	MTR Percent to Avg	Wind Speed	Wind Sector	Bird Size	MTR Percent to Avg
>40	315-360	Large	-14.6	15-20	135-180	Large	-48.4	30-35	135-180	Large	-57.6
>40	315-360	Medium	-66.9	15-20	135-180	Medium	-47.5	30-35	225-270	Large	-37.5
>40	315-360	Small	-10.7	15-20	135-180	Small	-60.7	30-35	270-315	Large	-32.6
0-5	0-45	Large	29.3	15-20	180-225	Large	-35.9	30-35	270-315	Medium	-83.4
0-5	0-45	Medium	59.8	15-20	180-225	Medium	-37.1	30-35	270-315	Small	-78.4
0-5	0-45	Small	7.6	15-20	180-225	Small	-36.9	30-35	315-360	Large	-46.7
0-5	135-180	Large	22.1	15-20	225-270	Large	-31.5	30-35	315-360	Medium	-71.1
0-5	135-180	Medium	21.4	15-20	225-270	Medium	-37.8	30-35	315-360	Small	14.9
0-5	135-180	Small	-9.7	15-20	225-270	Small	-16.1	30-35	90-135	Large	-35.7
0-5	180-225	Large	6.9	15-20	270-315	Large	-25.8	30-35	90-135	Medium	-80.0
0-5	180-225	Medium	15.5	15-20	270-315	Medium	-31.8	35-40	270-315	Large	-55.8
0-5	180-225	Small	-15.8	15-20	270-315	Small	4.6	35-40	270-315	Medium	-77.6
0-5	225-270	Large	58.2	15-20	315-360	Large	18.7	35-40	270-315	Small	-68.2
0-5	225-270	Medium	77.3	15-20	315-360	Medium	-15.7	35-40	315-360	Large	-46.4
0-5	225-270	Small	14.7	15-20	315-360	Small	-12.0	35-40	315-360	Medium	-62.7
0-5	270-315	Large	36.2	15-20	45-90	Large	-28.8	35-40	315-360	Small	4.2
0-5	270-315	Medium	41.1	15-20	45-90	Medium	-35.3	5-10	0-45	Large	42.1
0-5	270-315	Small	12.8	15-20	45-90	Small	-11.4	5-10	0-45	Medium	106.7
0-5	315-360	Large	57.3	15-20	90-135	Large	113.4	5-10	0-45	Small	50.8

0-5	315-360	Medium	88.5	15-20	90-135	Medium	121.3	5-10	135-180	Large	62.6
0-5	315-360	Small	21.3	15-20	90-135	Small	142.0	5-10	135-180	Medium	43.9
0-5	45-90	Large	12.6	20-25	135-180	Large	-64.4	5-10	135-180	Small	-3.7
0-5	45-90	Medium	74.0	20-25	135-180	Medium	-51.4	5-10	180-225	Large	-34.3
0-5	45-90	Small	44.9	20-25	135-180	Small	-56.2	5-10	180-225	Medium	-33.3
0-5	90-135	Large	-7.5	20-25	180-225	Large	-44.7	5-10	180-225	Small	-25.6
0-5	90-135	Medium	39.4	20-25	180-225	Medium	-45.8	5-10	225-270	Large	7.3
0-5	90-135	Small	-2.0	20-25	180-225	Small	-43.3	5-10	225-270	Medium	-14.6
10-15	0-45	Large	102.3	20-25	225-270	Large	-20.3	5-10	225-270	Small	-3.8
10-15	0-45	Medium	76.8	20-25	225-270	Medium	-63.4	5-10	270-315	Large	49.3
10-15	0-45	Small	121.9	20-25	225-270	Small	-39.8	5-10	270-315	Medium	49.4
10-15	135-180	Large	8.7	20-25	270-315	Large	10.2	5-10	270-315	Small	-0.7
10-15	135-180	Medium	15.6	20-25	270-315	Medium	-32.9	5-10	315-360	Large	92.4
10-15	135-180	Small	-5.1	20-25	270-315	Small	-22.1	5-10	315-360	Medium	183.9
10-15	180-225	Large	-37.4	20-25	315-360	Large	53.2	5-10	315-360	Small	113.7
10-15	180-225	Medium	-39.6	20-25	315-360	Medium	-20.5	5-10	45-90	Large	52.3
10-15	180-225	Small	-33.1	20-25	315-360	Small	-47.2	5-10	45-90	Medium	69.5
10-15	225-270	Large	-14.0	20-25	90-135	Large	-46.9	5-10	45-90	Small	85.8
10-15	225-270	Medium	-21.5	20-25	90-135	Medium	-54.7	5-10	90-135	Large	-1.4
10-15	225-270	Small	-1.3	20-25	90-135	Small	-53.8	5-10	90-135	Medium	66.6
10-15	270-315	Large	15.0	25-30	135-180	Medium	-74.2	5-10	90-135	Small	0.8
10-15	270-315	Medium	7.6	25-30	180-225	Large	-38.9				
10-15	270-315	Small	14.5	25-30	180-225	Medium	-55.4				
10-15	315-360	Large	33.5	25-30	180-225	Small	-42.5				
10-15	315-360	Medium	106.0	25-30	225-270	Large	-32.1				
10-15	315-360	Small	24.5	25-30	225-270	Medium	-57.2				
10-15	45-90	Large	55.3	25-30	225-270	Small	-57.8				
10-15	45-90	Medium	81.0	25-30	270-315	Large	-49.5				
10-15	45-90	Small	177.2	25-30	270-315	Medium	-56.4				
10-15	90-135	Large	-40.2	25-30	270-315	Small	-53.4				
10-15	90-135	Medium	-3.4	25-30	315-360	Large	-10.0				
10-15	90-135	Small	-0.1	25-30	315-360	Medium	-74.4				
				25-30	315-360	Small	-44.6				

Table 19 Data for Figure 28 Flight direction below 225 meters in day and night

DayNight	Month	FltDirSector	Count	DayNight	Month	FltDirSector	Count
Day	5	(0,6]	4	Night	5	(0,6]	29
Day	5	(6,12]	8	Night	5	(6,12]	39
Day	5	(12,18]	2	Night	5	(12,18]	30
Day	5	(18,24]	3	Night	5	(18,24]	35
Day	5	(30,36]	4	Night	5	(24,30]	30
Day	5	(36,42]	5	Night	5	(30,36]	25

Day	5	(42,48]	6	Night	5	(36,42]	29
Day	5	(48,54]	5	Night	5	(42,48]	35
Day	5	(54,60]	3	Night	5	(48,54]	37
Day	5	(60,66]	3	Night	5	(54,60]	48
Day	5	(66,72]	1	Night	5	(60,66]	48
Day	5	(72,78]	8	Night	5	(66,72]	57
Day	5	(78,84]	3	Night	5	(72,78]	83
Day	5	(84,90]	4	Night	5	(78,84]	105
Day	5	(90,96]	8	Night	5	(84,90]	94
Day	5	(96,102]	4	Night	5	(90,96]	105
Day	5	(102,108]	5	Night	5	(96,102]	102
Day	5	(108,114]	4	Night	5	(102,108]	112
Day	5	(114,120]	4	Night	5	(108,114]	98
Day	5	(120,126]	4	Night	5	(114,120]	75
Day	5	(126,132]	1	Night	5	(120,126]	78
Day	5	(132,138]	4	Night	5	(126,132]	73
Day	5	(138,144]	1	Night	5	(132,138]	56
Day	5	(144,150]	5	Night	5	(138,144]	46
Day	5	(150,156]	2	Night	5	(144,150]	30
Day	5	(156,162]	11	Night	5	(150,156]	45
Day	5	(162,168]	3	Night	5	(156,162]	67
Day	5	(168,174]	8	Night	5	(162,168]	60
Day	5	(174,180]	14	Night	5	(168,174]	59
Day	6	(6,12]	2	Night	5	(174,180]	74
Day	6	(12,18]	1	Night	6	(0,6]	9
Day	6	(18,24]	1	Night	6	(6,12]	16
Day	6	(24,30]	1	Night	6	(12,18]	28
Day	6	(30,36]	2	Night	6	(18,24]	18
Day	6	(36,42]	2	Night	6	(24,30]	25
Day	6	(42,48]	4	Night	6	(30,36]	32
Day	6	(48,54]	2	Night	6	(36,42]	33
Day	6	(54,60]	2	Night	6	(42,48]	32
Day	6	(60,66]	2	Night	6	(48,54]	58
Day	6	(66,72]	3	Night	6	(54,60]	70
Day	6	(78,84]	3	Night	6	(60,66]	94
Day	6	(84,90]	3	Night	6	(66,72]	100
Day	6	(90,96]	1	Night	6	(72,78]	137
Day	6	(96,102]	1	Night	6	(78,84]	132
Day	6	(102,108]	2	Night	6	(84,90]	131
Day	6	(108,114]	3	Night	6	(90,96]	138
Day	6	(114,120]	1	Night	6	(96,102]	111
Day	6	(126,132]	1	Night	6	(102,108]	124
Day	6	(150,156]	1	Night	6	(108,114]	114

Day	6	(156,162]	5	Night	6	(114,120]	97
Day	6	(162,168]	1	Night	6	(120,126]	85
Day	6	(168,174]	4	Night	6	(126,132]	58
Day	6	(174,180]	2	Night	6	(132,138]	37
Day	7	(6,12]	2	Night	6	(138,144]	33
Day	7	(12,18]	1	Night	6	(144,150]	28
Day	7	(30,36]	1	Night	6	(150,156]	27
Day	7	(36,42]	1	Night	6	(156,162]	34
Day	7	(66,72]	3	Night	6	(162,168]	36
Day	7	(78,84]	2	Night	6	(168,174]	17
Day	7	(84,90]	2	Night	6	(174,180]	23
Day	7	(96,102]	2	Night	7	(0,6]	10
Day	7	(102,108]	2	Night	7	(6,12]	3
Day	7	(114,120]	1	Night	7	(12,18]	10
Day	7	(120,126]	2	Night	7	(18,24]	6
Day	7	(126,132]	2	Night	7	(24,30]	6
Day	7	(138,144]	3	Night	7	(30,36]	8
Day	7	(144,150]	3	Night	7	(36,42]	7
Day	7	(156,162]	3	Night	7	(42,48]	12
Day	7	(162,168]	3	Night	7	(48,54]	13
Day	7	(168,174]	1	Night	7	(54,60]	28
Day	7	(174,180]	1	Night	7	(60,66]	40
Day	8	(0,6]	5	Night	7	(66,72]	42
Day	8	(6,12]	10	Night	7	(72,78]	82
Day	8	(12,18]	9	Night	7	(78,84]	86
Day	8	(18,24]	17	Night	7	(84,90]	108
Day	8	(24,30]	8	Night	7	(90,96]	117
Day	8	(30,36]	15	Night	7	(96,102]	105
Day	8	(36,42]	9	Night	7	(102,108]	70
Day	8	(42,48]	19	Night	7	(108,114]	72
Day	8	(48,54]	19	Night	7	(114,120]	56
Day	8	(54,60]	29	Night	7	(120,126]	70
Day	8	(60,66]	23	Night	7	(126,132]	53
Day	8	(66,72]	37	Night	7	(132,138]	43
Day	8	(72,78]	40	Night	7	(138,144]	56
Day	8	(78,84]	58	Night	7	(144,150]	68
Day	8	(84,90]	140	Night	7	(150,156]	68
Day	8	(90,96]	201	Night	7	(156,162]	112
Day	8	(96,102]	113	Night	7	(162,168]	101
Day	8	(102,108]	57	Night	7	(168,174]	96
Day	8	(108,114]	65	Night	7	(174,180]	112
Day	8	(114,120]	44	Night	8	(0,6]	210
Day	8	(120,126]	24	Night	8	(6,12]	229

Day	8	(126,132]	22	Night	8	(12,18]	298
Day	8	(132,138]	16	Night	8	(18,24]	292
Day	8	(138,144]	17	Night	8	(24,30]	253
Day	8	(144,150]	10	Night	8	(30,36]	245
Day	8	(150,156]	19	Night	8	(36,42]	332
Day	8	(156,162]	28	Night	8	(42,48]	403
Day	8	(162,168]	42	Night	8	(48,54]	505
Day	8	(168,174]	25	Night	8	(54,60]	721
Day	8	(174,180]	40	Night	8	(60,66]	931
Day	9	(0,6]	7	Night	8	(66,72]	1213
Day	9	(6,12]	12	Night	8	(72,78]	1456
Day	9	(12,18]	16	Night	8	(78,84]	1563
Day	9	(18,24]	18	Night	8	(84,90]	1572
Day	9	(24,30]	13	Night	8	(90,96]	1578
Day	9	(30,36]	12	Night	8	(96,102]	1530
Day	9	(36,42]	15	Night	8	(102,108]	1452
Day	9	(42,48]	7	Night	8	(108,114]	1241
Day	9	(48,54]	13	Night	8	(114,120]	968
Day	9	(54,60]	16	Night	8	(120,126]	753
Day	9	(60,66]	28	Night	8	(126,132]	495
Day	9	(66,72]	30	Night	8	(132,138]	435
Day	9	(72,78]	37	Night	8	(138,144]	365
Day	9	(78,84]	59	Night	8	(144,150]	264
Day	9	(84,90]	50	Night	8	(150,156]	264
Day	9	(90,96]	55	Night	8	(156,162]	366
Day	9	(96,102]	44	Night	8	(162,168]	396
Day	9	(102,108]	25	Night	8	(168,174]	326
Day	9	(108,114]	32	Night	8	(174,180]	573
Day	9	(114,120]	22	Night	9	(0,6]	162
Day	9	(120,126]	16	Night	9	(6,12]	219
Day	9	(126,132]	23	Night	9	(12,18]	281
Day	9	(132,138]	8	Night	9	(18,24]	336
Day	9	(138,144]	10	Night	9	(24,30]	293
Day	9	(144,150]	16	Night	9	(30,36]	323
Day	9	(150,156]	12	Night	9	(36,42]	395
Day	9	(156,162]	19	Night	9	(42,48]	477
Day	9	(162,168]	15	Night	9	(48,54]	588
Day	9	(168,174]	7	Night	9	(54,60]	693
Day	9	(174,180]	16	Night	9	(60,66]	872
Day	10	(0,6]	8	Night	9	(66,72]	919
Day	10	(6,12]	8	Night	9	(72,78]	1055
Day	10	(12,18]	11	Night	9	(78,84]	1360
Day	10	(18,24]	9	Night	9	(84,90]	1522

Day	10	(24,30]	6	Night	9	(90,96]	1897
Day	10	(30,36]	5	Night	9	(96,102]	1934
Day	10	(36,42]	8	Night	9	(102,108]	1917
Day	10	(42,48]	11	Night	9	(108,114]	1420
Day	10	(48,54]	5	Night	9	(114,120]	1112
Day	10	(54,60]	5	Night	9	(120,126]	766
Day	10	(60,66]	14	Night	9	(126,132]	532
Day	10	(66,72]	15	Night	9	(132,138]	418
Day	10	(72,78]	13	Night	9	(138,144]	325
Day	10	(78,84]	17	Night	9	(144,150]	257
Day	10	(84,90]	24	Night	9	(150,156]	236
Day	10	(90,96]	21	Night	9	(156,162]	296
Day	10	(96,102]	37	Night	9	(162,168]	243
Day	10	(102,108]	37	Night	9	(168,174]	182
Day	10	(108,114]	28	Night	9	(174,180]	133
Day	10	(114,120]	17	Night	10	(0,6]	77
Day	10	(120,126]	13	Night	10	(6,12]	96
Day	10	(126,132]	12	Night	10	(12,18]	138
Day	10	(132,138]	9	Night	10	(18,24]	177
Day	10	(138,144]	7	Night	10	(24,30]	199
Day	10	(144,150]	9	Night	10	(30,36]	191
Day	10	(150,156]	5	Night	10	(36,42]	180
Day	10	(156,162]	16	Night	10	(42,48]	317
Day	10	(162,168]	24	Night	10	(48,54]	369
Day	10	(168,174]	16	Night	10	(54,60]	456
Day	10	(174,180]	20	Night	10	(60,66]	666
Day	11	(0,6]	15	Night	10	(66,72]	775
Day	11	(6,12]	25	Night	10	(72,78]	1053
Day	11	(12,18]	21	Night	10	(78,84]	986
Day	11	(18,24]	23	Night	10	(84,90]	963
Day	11	(24,30]	19	Night	10	(90,96]	893
Day	11	(30,36]	15	Night	10	(96,102]	831
Day	11	(36,42]	16	Night	10	(102,108]	712
Day	11	(42,48]	20	Night	10	(108,114]	641
Day	11	(48,54]	18	Night	10	(114,120]	535
Day	11	(54,60]	25	Night	10	(120,126]	414
Day	11	(60,66]	27	Night	10	(126,132]	291
Day	11	(66,72]	31	Night	10	(132,138]	219
Day	11	(72,78]	35	Night	10	(138,144]	203
Day	11	(78,84]	34	Night	10	(144,150]	142
Day	11	(84,90]	42	Night	10	(150,156]	114
Day	11	(90,96]	33	Night	10	(156,162]	154
Day	11	(96,102]	44	Night	10	(162,168]	109

Day	11	(102,108]	37	Night	10	(168,174]	111
Day	11	(108,114]	30	Night	10	(174,180]	120
Day	11	(114,120]	28	Night	11	(0,6]	78
Day	11	(120,126]	28	Night	11	(6,12]	96
Day	11	(126,132]	24	Night	11	(12,18]	105
Day	11	(132,138]	24	Night	11	(18,24]	107
Day	11	(138,144]	11	Night	11	(24,30]	95
Day	11	(144,150]	20	Night	11	(30,36]	83
Day	11	(150,156]	19	Night	11	(36,42]	88
Day	11	(156,162]	33	Night	11	(42,48]	116
Day	11	(162,168]	34	Night	11	(48,54]	101
Day	11	(168,174]	37	Night	11	(54,60]	119
Day	11	(174,180]	40	Night	11	(60,66]	110
				Night	11	(66,72]	133
				Night	11	(72,78]	150
				Night	11	(78,84]	155
				Night	11	(84,90]	156
				Night	11	(90,96]	182
				Night	11	(96,102]	175
				Night	11	(102,108]	162
				Night	11	(108,114]	135
				Night	11	(114,120]	107
				Night	11	(120,126]	83
				Night	11	(126,132]	81
				Night	11	(132,138]	75
				Night	11	(138,144]	69
				Night	11	(144,150]	65
				Night	11	(150,156]	47
				Night	11	(156,162]	90
				Night	11	(162,168]	116
				Night	11	(168,174]	118
				Night	11	(174,180]	163



APPENDIX C-4. AVIAN MORTALITY ESTIMATES



Appendix C-4 – Avian Mortality Estimates

1.1 Introduction

The following sections outline the methods used for calculating avian mortality estimates that may result from interactions with Project infrastructure. An overview of avoidance rates and collision risks used in these estimates is also provided as these variables, and their associated assumptions, play heavily in our calculations.

1.2 Overview of Avoidance Rates / Collision Risk

The SNH Collision Risk Model (CRM) (also known as the Band model) is a method based on vantage point data to estimate the number of birds with the potential to collide with turbines at a proposed wind project (Scottish Natural Heritage, October 2016). The guidance is intended for anyone involved with collision risk modelling for birds at onshore wind projects

Although birds may avoid a wind project (for example, some may be displaced from the area, while others may avoid turbines or take other evasive action to prevent a collision), the CRM accounts for this by applying an avoidance rate.

The guidance provided by SNH recommends avoidance rates for a number of key species for use in the SNH CRM (Scottish Natural Heritage, October 2016). It replaces the previous version (2010) and incorporates robust new information, where available, on some species. The recommended default avoidance rate for species not listed specifically in the guidance document is 98%, and has been used in the avoidance rate calculations.

Band et al. (2007) stated that birds with flight heights coinciding with the rotor swept area (RSA) of turbines have a higher likelihood of collision. However, it should be noted that having the highest collision exposure index, does not allow us to predict which species are most prone to collision, as species-specific behaviours may affect collision rates. Fatality rates do not depend on bird abundance alone, but on other factors, such as differential use of areas within a wind farm (Ferrer, et al., 2012). Collision mortality has been shown to not simply increase with abundance alone; factors such as frequency of passage, flight behaviour, weather, and topography influence collision risk (Lucas, Janss, Whitfield, & Ferrer, 2008). Verification of collision impacts can only be confirmed through post-construction mortality monitoring.

In Canada, 69% of bird fatalities recorded from wind power projects were passerines (Bird Studies Canada, 2016). It is likely that passerines make up an even larger percentage of fatalities than estimated, due to the difficulty in detection of individuals during surveys



than larger birds (Erickson, Wolfe, Bay, Johnson, & Gehring, 2014), as well as rapid scavenger removal (70-80% within two days) (Lekuona & Ursua, 2007).

Avoidance behaviour varies between species (Whitfield, 2009), with raptors appearing to be more vulnerable to collision with turbines than most other avian groups [(Erickson W., et al., 2002) (Young, Erickson, Strickland, Good, & Sernka, 2003)]. Behaviour of diurnal migrants such as raptors makes them potentially more vulnerable to collisions with wind turbines, particularly during hunting (Higgins , Osborne, & Naugle, 2007), or while utilizing thermal updrafts to increase altitude and conserve energy. Barrios and Rodriguez (2004) reported increased mortality during fall/winter migration, with birds flying closer to turbines. Some studies have also correlated raptor abundance with a higher collision risk; breeding grounds and areas with foraging habitat have been identified as sites that increase high flight abundance [(Bevanger, et al., 2010) (Eichhorn, Johst, Seppelt, & Drechsler, 2012)]. Additionally, diurnal migrants (raptors, vultures, etc.) are more constrained by topographical features than nocturnal migrants – they tend to be concentrated along linear features such as rivers, ridges, and valleys (Richardson, 2000); resulting mitigation suggests turbine placement away from such features.

Ferrer et al. (2012) further suggests there is clear evidence that the likelihood of bird collisions with turbines depends critically on species behaviour and topographic factors, and not only on local abundance. Birds do not move over the area at random, but follow main wind currents, which are affected by topography. Therefore, certain locations of wind turbines could be harmful for birds even where there is a relatively low density of birds, whereas other locations would be relatively risk free even with higher densities of birds (Ferrer, et al., 2012).

The risk to avian species for collision with wind turbines is highest during migration periods (Alberta Environment and Parks, 2016), when the most fatalities tend to be reported. Fatalities can also occur from MET towers and guywires, or through nest mortality/disturbance from clearing of vegetation/loss of habitat (Band, Madders, & Whitfield, 2007). Bird fatalities due to turbine collision have been consistently identified as a leading ecological shortcoming to wind energy (Drewitt & Langston, 2006), however, mitigating for this consequence is not forthright, due to the complexity of factors influencing collisions (Marques, et al., 2014).

Bird collision likelihood depends on species, turbine height and elevation, implicating species-specific and topographic factors in collision mortality. There was no evidence of an association between collision likelihood and turbine type or the position of a turbine in a row (Lucas, Janss, Whitfield, & Ferrer, 2008).

Populations of several groups vulnerable to collisions are increasing across Canada (e.g., waterfowl, raptors). This suggests collision mortality at current levels does not limit



population growth. The factors that contribute to a species' vulnerability to collisions include species that flock, have rapid flight, and are large with slow maneuverability (high wing loading and low wing aspect ratio) (Rioux, Savard, & Gerick, 2013).

1.3 Mortality Estimates

To estimate bird mortality associated with this project, a guidance document from Scottish Natural Heritage (2000) was followed. This estimating method was previously used in the Environmental Effects Assessment of the Stirling Wind Project, Alberta that was conducted by McCallum Environmental Ltd. That project was subject to an Alberta Utility Commission (AUC) regulatory hearing and was subsequently approved. That project is currently under construction. The Stirling Wind Project determined appropriate amendments to calculations, which have subsequently been carried forward here.

The guidance document from Scottish Natural Heritage (2000) provides guidance on calculating a theoretical collision risk for birds and wind power projects assuming there's no avoidance behaviour (Scottish Natural Heritage, 2000).

However, in reality, most birds do use avoidance behaviours to avoid the turbine structures. Therefore, the results of the no avoidance calculations are moderated by an important factor that represents the proportion of birds often hit which are likely to take effective avoiding action. There are approaches that may be appropriate depending on the species and flight behaviour to determine the probability of birds flying through a RSA, and using the guidance document the assumption is where a bird population makes regular flights through the wind farm in a reasonably defined direction (Scottish Natural Heritage, 2000).

Avian species were surveyed at the Wedgeport Wind Farm Project using point count plots and radar tracking methods. The data sets generated by these surveys differ to a large degree in timing, area coverage, and resolution, among others, resulting in incompatibility when calculating mortality estimates. For this reason, estimates were made separately using each data set as a means to highlight information unique to those surveys. Multiple estimates also provide a measure by which we can scrutinize our outputs.

The calculations are completed in two stages and adapted as follows (Scottish Natural Heritage, 2000):

Stage 1:

1. Identify a 'risk window': i.e. a window of width equal to the length of the windfarm across the general flight direction of the birds, and of height extending from the minimum height of the rotor to the maximum height of the highest turbine. The cross-sectional area $W = \text{width} \times (\text{maximum rotor height} - \text{minimum rotor height})$.



2. Estimate the number of bird flights (n) flying through this risk window per hour. This data was taken from the total bird species counted and the subsequent population estimate. The population estimate calculated as follows:
 - a. Number of sampling plots
 - b. Individual plot areas (πR^2) was calculated
 - c. SWP area (m^2)
 - d. Average # birds / plot = total birds counted / (a)
 - e. Population = (c / b) x (d)

3. For estimates based on point count data, the total hour time estimates for spring, fall and summer frames are based on a specific number of hours within the assessment season. The assumption of 12 hours of flight time per day was used.

For estimates using radar data, survey time was 24 hours a day during the survey period and estimates were extrapolated to a yearly average. See appended report on radar surveys for further detail.

4. Number of birds in the risk window was calculated by multiplying the total number of bird flights per hour by the total number of survey hours.
5. Calculate the area presented by the wind farm rotors: Assuming the rotors are aligned in the plane of the risk window as, any reduction in cross-sectional area because the rotors are at an oblique angle is offset by the increased risk to birds which have to make a longer transit through the rotors. Where rotors overlap when viewed in cross-section, allow for the full cross-sectional area of separate rotors as the risk to birds is doubled if passing through two successive rotors:

$$A = N \times \pi R^2 \text{ where } N \text{ is the number of rotors and } R \text{ is the rotor radius}$$

6. Express the total rotor area as a proportion A / W of the risk window.
7. Number of birds passing through rotors = number of birds through risk window x proportion occupied by rotors = $n \times (A / W)$
8. The weighted average within the rotor swept area was multiplied by the total bird flights in the risk area to estimate the number of bird flights through the rotor swept area. This number was carried forward into stage 2.

Stage 2: Probability (pr) of bird collision when flying through the rotor swept area



This stage computes the probability of a bird being hit when making a transit through a rotor. The probability depends on the size of the bird (both length and wingspan), the breadth and pitch of the turbine blades, the rotation speed of the turbine, and of course the flight speed of the bird.

To facilitate calculation, many simplifications have to be made. The bird is assumed to be of simple cruciform shape, with the wings at the halfway point between nose and tail. The turbine blade is assumed to have a width and a pitch angle (relative to the plane of the turbine), but to have no thickness.

For ease of use, the calculations are provided on a pre-formatted spreadsheet at Scottish Natural Heritage Society website (<http://www.snh.gov.uk/planning-and-development/renewable-energy/onshore-wind/bird-collision-risks-guidance/>). The spreadsheet calculates $p(r)$ at intervals of $0.05 R$ from the rotor centre (ie evaluating equation (2)), and then undertakes a numerical integration from $r=0$ to $r=R$ (ie evaluating equation (1)). The spreadsheet is set out as follows:

1. The input parameters are in the first two columns. Bird aspect ratio β is calculated.
2. Collision probabilities are then calculated for radii at intervals of $0.05 R$ from the hub to the tip. Each radius is represented by a row in the table, with the value of the radius r/R in the first column.
3. The second column of the table is the chord width at radius r as a proportion of the maximum chord width. The taper profile here is that of a modern Aerpac turbine blade. The taper will differ for different turbine blades.
4. Factor α is calculated.
5. The 'collide length' is the entire factor within square brackets within equation (2) above, using the upwind case.
6. $p(\text{collision})$ is p at radius r , as calculated by equation (2). It is however limited to a maximum value of 1.
7. 'contribution from radius r ' is the integrand of equation (1) (including the factor 2) prior to integration.
8. The total risk is then the summation of these contributions.
9. The calculation is then repeated for the downwind case.
10. The spreadsheet then shows a simple average of upwind and downwind values.
11. The result is an average collision risk for a bird passing through a rotor.

The inputs provided for the models are based upon average characteristics of species as follows:



1. Waterfowl: Bird Length¹ = 0.6 m
Wingspan = 0.8 m
F: Flapping (0) or Gliding (1) = 1
Bird Speed² = 20 m/sec

2. Shorebirds: Bird Length = 0.3 m
Wingspan = 0.4 m
F: Flapping (0) or Gliding (1) = 0
Bird Speed³ = 14 m/sec

3. Passerines Bird Length = 0.2 m
Wingspan = 0.35 m
F: Flapping (0) or Gliding (1) = 0
Bird Speed⁴ = 15 m/sec

The inputs for the models for the turbines as follows:

K: [1D or [3D] (0 or 1)	1	
No of Blades	3	
MaxChord	2.431	m
Pitch (degrees)	30	
Rotor Diameter	170	m
Rotation Period	3	sec

Mortality estimates for point count plot data was calculated by bird group, five in total, as resolution of this data set allowed for analysis at this scale. Estimates using radar tracking data are made based on all bird passes as this survey does not differentiate to the species level.

Model Testing

In an effort to determine the validity of the above noted mortality estimating method, the mortality estimate method as described above was tested using an existing Alberta wind power project. In November of 2016, McCallum Environmental Ltd. requested mortality

1 All lengths and wingspan taken from Cornell Lab of Ornithology. 2016. All about birds. www.allaboutbirds.org

2 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. - Mallard

3 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. - Killdeer

4 R. Meinertzhagen, 1954. Speed and Altitude of Bird Flight. Journal of Avian Science. Vol 97. – Horned Lark



data collected from post construction monitoring for the Halkirk Wind Power PWP, owned by Capital Power Corporation. Following a FOIP request from AEP, bird and bat mortality data was provided in the form of annual reports, from 2013, 2014, and 2015 (bat data only). Additionally, McCallum Environmental Ltd. obtained copies of the pre-construction environmental assessment from public databases, with relevant population counts, species counts and identifications, and relevant inputs to be used in the aforementioned calculations. This was completed to determine if the mortality estimating model was a valid method for further use. The results of those inputs, calculations estimates are provided as follows:

Species group	Total Collision Estimates using above calculation methods ⁵	Estimated Mortality: Birds / Turbine / Year
Waterfowl	126.21	1.26
Shorebirds	10.84	0.11
Passerines	247.68	2.48
Raptors	8.68	0.09
Total	393.41	3.93

2013 corrected mortality obtained from Annual Report ⁶	5.32 birds / turbine / year
2014 corrected mortality obtained from Annual Report ⁷	4.30 birds / turbine / year

1.3.1 **Results – Point Count Data**

The estimated results for the Wedgeport Wind Project are presented in Table 1 to Table 17, below.

1.3.1.1 *Waterfowl*

As per the methods of analysis previously provided, the following population estimates were estimated for waterfowl:

⁵ Base line data used in for the calculations was collected from Greengate Halkirk Wind Project. A Report to ASRD in Support of an AUC Rule 007 Application: Vegetation and Wildlife Overview. Jacques Whitford Stantec Axys Ltd., February 2009.

⁶ *Halkirk Wind Project – Bird and Bat Monitoring, 2013 Annual Report*. January 2014. Prepared by Hemmera

⁷ *Annual Report Halkirk Wind Project – Bird and Bat Monitoring 2014*. January 2015. Prepared by Hemmera Envirochem Inc.



Table 1. Population estimate for waterfowl - Spring/Fall

Sampling Plots	43
Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	2
Population	115

Table 2. Population estimate for waterfowl – Summer

Sampling Plots	31
Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	2.35
Population	172

Table 3. Estimated mortality for waterfowl

Characteristic	Notes	Value
Rotor Diameter (m)		170
Hub Height (m)		110.5
Maximum Rotor Height (m)		195.54
Minimum Rotor Height (m)		25
Actual Rotor Height (m)		170.54
Rotor swept area (?R2)		22698
Number of Turbines (N)		13
Length of wind farm (m)	Lateral distance from Project boundaries west to east	5,373
Survey Time (mins)	Spring: 5 rounds x 10 minutes / location x 43 locations	2,150
	Fall: 5 rounds x 10 minutes / location x 43 locations	2,150
	Summer: 2 rounds x 10 minutes x 31 locations	620
Survey Time (hrs)		82
Total number of birds identified in survey time (Tn)	Fall	23



Characteristic	Notes	Value
	Spring	45
	Summer	73
Population estimate (n)		287
Fall	% within RSA	9.2%
Spring	% within RSA	46.8%
	Weighted Average within RSA	34.1%
STAGE 1		
Risk Window (W)	Length of wind farm x max turbine height	916,328
Birds Flights per hour (bch)	Tn / hrs	3.50
Total hours estimate for Spring (Sh)	March 15 - May 30 = 76 days x 12hrs flight time / day	912
Total hours estimate for Fall (Fh)	Sept 1 - October 15 = 45 days x 12 hrs flight time / day	540
Total hours estimate for Summer (Su)	June 1 - August 31 = 92 days x 12hrs flight time / day	1,104
Number of birds in risk window (n)	bch*(Sh+Fh)	8,947
Area presented by wind farm rotors (A) m ²	N x π R ²	295,074
Total rotor area (TRA)	proportion A / W	0.322
Birds in Risk Area		2,881
Weighted Average within RSA	Wrsa	0.34
Number of birds through rotors	n x Wrsa	982
STAGE 2		
Probability of Collision (Band Model)		0.066
Collisions during study period with 100% operation and no avoidance	Number of birds through rotors x Probability of Collision	65
Collisions during study period with 75% operation and no avoidance	75% x above number	49
SNH recommended avoidance rate	98.00%	0.020
Collisions during study period with 75% operational rate and 98% avoidance		0.97
Bird Mortality / Turbine / Year		0.07



The estimated mortality for waterfowl associated with the Project at 98% avoidance is 1 waterfowl bird (or approximately 0.07 birds/turbine/year).

1.3.1.2 *Shorebirds*

As per the methods of analysis previously provided, the following population estimates were determined for shorebirds:

Table 4. Population estimate for shorebirds – Spring/Fall

Sampling Plots	43
Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	8
Population	594

Table 5. Population estimate for shorebirds – Summer

Sampling Plots	31
Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	5.10
Population	372

Table 6. Estimated mortality for shorebirds

Characteristic	Notes	Value
Rotor Diameter (m)		170
Hub Height (m)		110.5
Maximum Rotor Height (m)		195.54
Minimum Rotor Height (m)		25
Actual Rotor Height (m)		170.54
Rotor swept area (?R2)		22698
Number of Turbines (N)		13
Width of wind farm (m)	Lateral distance from Project boundaries west to east	5,373
Survey Time (mins)	Spring: 5 rounds x 10 minutes / location x 43 locations	2,150



Characteristic	Notes	Value
	Fall: 5 rounds x 10 minutes / location x 43 locations	2,150
	Summer: 2 rounds x 10 minutes x 31 locations	620
Survey Time (hrs)		82
Total number of birds identified in survey time (Tn)	Fall	26
	Spring	324
	Summer:	158
Population Estimate		965
Fall	% within RSA	36.3%
Spring	% within RSA	51.9%
	Weighted Average within RSA	50.7%
STAGE 1		
Risk Window (W)	width of wind farm x max turbine height	916,328
Birds Flights per hour (bch)	Tn / hrs	11.77
Total hours estimate for Spring (Sh)	March 15 - May 30 = 76 days x 12hrs flight time / day	912
Total hours estimate for Fall (Fh)	Sept 1 - October 15 = 45 days x 12 hrs flight time / day	540
Total hours estimate for Summer (Su)	June 1 - August 31 = 92 days x 12hrs flight time / day	1,104
Number of birds in risk window (n)	bch*(Sh+Fh)	30,085
Area presented by wind farm rotors (A) m ²	N x π R ²	295,074
Total rotor area (TRA)	proportion A / W	0.322
Birds in Risk Area		9,688
Weighted Average within RSA	Wrsa	0.51
Number of birds through rotors	n x Wrsa	4,916
STAGE 2		
Probability of Collision (Band Model)		0.071
Collisions during study period with 100% operation and no avoidance	Number of birds through rotors x Probability of Collision	349
Collisions during study period with 75% operation and no avoidance	75% x above number	262



Characteristic	Notes	Value
SNH recommended avoidance rate	98.00%	0.020
Collisions during study period with 75% operational rate and 98% avoidance		5.24
Bird Mortality / Turbine / Year		0.403

The estimated mortality for shorebirds associated with the Project at 98% avoidance during Spring and Fall migration periods is 5 birds per year or approximately 0.4 birds/turbine/year.

1.3.1.3 *Passerines*

As per the methods of analysis previously provided, the following population estimates were determined for passerines:

Table 7. Population estimate for passerines– Spring/Fall

Sampling Plots	43
Plot area (m ²)	125,664
Project Area(m ²)	9,163,020
Avg # Birds / plot	46
Population	3,356

Table 8. Population estimate for passerines – Summer

Sampling Plots	31
Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	12.42
Population	906

Table 9. Estimated mortality for passerines

Characteristic	Notes	Value
Rotor Diameter (m)		170
Hub Height (m)		110.5
Maximum Rotor Height (m)		195.54



Characteristic	Notes	Value
Minimum Rotor Height (m)		25
Actual Rotor Height (m)		170.54
Rotor swept area (?R2)		22698
Number of Turbines (N)		13
Width of wind farm (m)	lateral distance from Project boundaries west to east	5,373
Survey Time (mins)	Spring: 5 rounds x 10 minutes / location x 43 locations	2,150
	Fall: 5 rounds x 10 minutes / location x 43 locations	2,150
	Summer: 2 rounds x 10 minutes x 31 locations	620
Survey Time (hrs)		82
Total number of birds identified in survey time (Tn)	Fall	192
	Spring	1,787
	Summer	385
Population Estimate		4,261
Fall	% within RSA	1.8%
Spring	% within RSA	76.5%
	Weighted Average within RSA	69.3%
STAGE 1		
Risk Window (W)	width of wind farm x max turbine height	916,328
Birds Flights per hour (bch)	Tn / hrs	51.97
Total hours estimate for Spring (Sh)	March 15 - May 30 = 76 days x 12hrs flight time / day	912
Total hours estimate for Fall (Fh)	Sept 1 - October 15 = 45 days x 12 hrs flight time / day	540
Total hours estimate for Summer (Su)	June 1 - August 31 = 92 days x 12hrs flight time / day	1,104
Number of bird flights in risk window (n)	bch*(Sh+Fh)	132,833
Area presented by wind farm rotors (A) m2	N x π R2	295,074
Total rotor area (TRA)	proportion A / W	0.322



Characteristic	Notes	Value
Birds in Risk Area		42,775
Weighted Average within RSA	Wrsa	0.69
Number of birds through rotors	n x Wrsa	29,623
STAGE 2		
Probability of Collision (Band Model)		0.060
Collisions during study period with 100% operation and no avoidance	Number of birds through rotors x Probability of Collision	1,777
Collisions during study period with 75% operation and no avoidance	75% x above number	1,333
SNH recommended avoidance rate	98.00%	0.020
Collisions during study period with 75% operational rate and 98% avoidance		26.66
Bird Mortality / Turbine / Year		2.051

The estimated mortality for passerines associated with the Project at 98% avoidance rates is 26.7 birds per year or approximately 2.1 birds/turbine/year.

1.3.1.4 *Raptors*

As per the methods of analysis previously provided, the following population estimates were determined for raptors:

Table 10. Population estimate for raptors– Spring/Fall

Sampling Plots	43
Plot area (m ²)	125,664
Project Area(m ²)	9,163,020
Avg # Birds / plot	1
Population	83

Table 11. Population estimate for raptors – Summer

Sampling Plots	31
Plot area (m ²)	125,664
Project Area(m ²)	9,163,020



Avg # Birds / plot	0.06
Population	5

Table 12. Estimated mortality for raptors

Characteristic	Notes	Value
Rotor Diameter (m)		170
Hub Height (m)		110.5
Maximum Rotor Height (m)		195.54
Minimum Rotor Height (m)		25
Actual Rotor Height (m)		170.54
Rotor swept area (?R2)		22698
Number of Turbines (N)		13
Width of wind farm (m)	lateral distance from Project boundaries west to east	5,373
Survey Time (mins)	Spring: 5 rounds x 10 minutes / location x 43 locations	2,150
	Fall: 5 rounds x 10 minutes / location x 43 locations	2,150
	Summer: 2 rounds x 10 minutes x 31 locations	620
Survey Time (hrs)		82
Total number of birds identified in survey time (Tn)	Fall	10
	Spring	39
	Summer	2
Population Estimate		88
Fall	% within RSA	50.0%
Spring	% within RSA	13.5%
	Weighted Average within RSA	20.9%
STAGE 1		
Risk Window (W)	width of wind farm x max turbine height	916,328
Birds Flights per hour (bch)	Tn / hrs	1.07
Total hours estimate for Spring (Sh)	March 15 - May 30 = 76 days x 12hrs flight time / day	912



Characteristic	Notes	Value
Total hours estimate for Fall (Fh)	Sept 1 - October 15 = 45 days x 12 hrs flight time / day	540
Total hours estimate for Summer (Su)	June 1 - August 31 = 92 days x 12hrs flight time / day	1,104
Number of bird flights in risk window (n)	$bch*(Sh+Fh)$	2,737
Area presented by wind farm rotors (A) m ²	$N \times \pi R^2$	295,074
Total rotor area (TRA)	proportion A / W	0.322
Birds flights in Risk Area		881
Weighted Average within RSA	Wrsa	0.21
Number of bird flights through rotors	$n \times Wrsa$	185
STAGE 2		
Probability of Collision (Band Model)		0.165
Collisions during study period with 100% operation and no avoidance	Number of birds through rotors x Probability of Collision	30
Collisions during study period with 75% operation and no avoidance	75% x above number	23
SNH recommended avoidance rate	99.00%	0.010
Collisions during study period with 75% operational rate and 98% avoidance	All	0.23
Bird Mortality / Turbine / Year		0.018

The estimated mortality for raptors associated with the Project at 99% avoidance rate is 0.23 birds per year or approximately 0.018 birds/turbine/year.

1.3.1.5 Other landbirds

As per the methods of analysis previously provided, the following population estimates were determined for other landbirds:

Table 13. Population estimate for other landbirds– Spring/Fall

Sampling Plots	43
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Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	5
Population	383

Table 14. Population estimate for other landbirds – Summer

Sampling Plots	31
Plot area (m ²)	125,664
Project Area (m ²)	9,163,020
Avg # Birds / plot	1.45
Population	106

Table 15. Estimated mortality for other landbirds

Characteristic	Notes	Value
Rotor Diameter (m)		170
Hub Height (m)		110.5
Maximum Rotor Height (m)		195.54
Minimum Rotor Height (m)		25
Actual Rotor Height (m)		170.54
Rotor swept area (?R2)		22698
Number of Turbines (N)		13
Width of wind farm (m)	lateral distance from Project boundaries west to east	5,373
Survey Time (mins)	Spring: 5 rounds x 10 minutes / location x 43 locations	2,150
	Fall: 5 rounds x 10 minutes / location x 43 locations	2,150
	Summer: 2 rounds x 10 minutes x 31 locations	620
Survey Time (hrs)		82
Total number of birds identified in survey time (Tn)	Fall	42
	Spring	184
	Summer	45
Population Estimate		489
Fall	% within RSA	1.8%



Characteristic	Notes	Value
Spring	% within RSA	76.5%
	Weighted Average within RSA	62.6%
STAGE 1		
Risk Window (W)	width of wind farm x max turbine height	1,050,656
Birds Flights per hour (bch)	Tn / hrs	5.96
Total hours estimate for Spring (Sh)	March 15 - May 30 = 76 days x 12hrs flight time / day	912
Total hours estimate for Fall (Fh)	Sept 1 - October 15 = 45 days x 12 hrs flight time / day	540
Total hours estimate for Summer (Su)	June 1 - August 31 = 92 days x 12hrs flight time / day	1,104
Number of bird flights in risk window (n)	bch*(Sh+Fh)	15,245
Area presented by wind farm rotors (A) m ²	N x π R ²	295,074
Total rotor area (TRA)	proportion A / W	0.281
Birds in Risk Area		4,282
Weighted Average within RSA	Wrsa	0.63
Number of birds through rotors	n x Wrsa	2,681
STAGE 2		
Probability of Collision (Band Model)		0.066
Collisions during study period with 100% operation and no avoidance	Number of birds through rotors x Probability of Collision	177
Collisions during study period with 75% operation and no avoidance	75% x above number	133
SNH recommended avoidance rate	98.00%	0.020
Collisions during study period with 75% operational rate and 98% avoidance		2.65

**Bird Mortality /
Turbine / Year 0.204**

The estimated mortality for other landbirds associated with the Project at 98% avoidance is 2.7 birds or approximately 0.2 birds/turbine/year.



1.3.1.6 Total Mortality Estimates for Point Count Data

The above point count plot data estimates that total mortality associated with the Project on an annual basis will be approximately 35.8 birds, or 2.8 birds/turbine/year (Table 16).

Table 16. Summary of collision and mortality estimates

Species Group	Total Collision Estimates	Estimated mortality Birds/Turbine/Year
Waterfowl	1.0	0.1
Shorebirds	5.2	0.4
Passerines	26.7	2.1
Raptors	0.2	0.0
Other landbirds	2.7	.2
Total	35.8	2.8

1.3.2 Radar tracking data

As per the methods of analysis previously provided, the following mortality estimates were determined for all bird passes using radar tracking data.

Due to radar limitations, radar captures ‘target’ signals. There is a broad assumption in the results that the targets are birds. In addition, targets (assuming they are birds), cannot be broken down easily by size, and also there is no method to determined species. Therefore, the below estimate includes all radar targets and applies the 98% avoidance rate. The below estimate would then represent total estimated mortality.

Table 17. Estimated mortality for total bird passes using radar tracking data

Characteristic	Notes	Value
Rotor Diameter (m)		170
Hub Height (m)		110.5
Maximum Rotor Height (m)		195.54
Minimum Rotor Height (m)		25
Rotor swept area (?R2)		22698
Number of Turbines (N)		13
Length of wind farm (m)	Lateral distance from Project boundaries west to east	5,373
Survey Time (hrs)		8,760
STAGE 1		



Characteristic	Notes	Value
Risk Window (W)	Length of wind farm x max turbine height	1,050,656
Birds Flights per hour (bch)	Tn / hrs	40.00
Number of bird flights in risk window (n)	bch*(Sh+Fh)	127,424
Area presented by wind farm rotors (A) m ²	N x π R ²	295,074
Total rotor area (TRA)	proportion A / W	0.281
Birds in Risk Area		35,787
Weighted Average within RSA	Wrsa	0.69
Number of birds through rotors	n x Wrsa	24,783
STAGE 2		
Probability of Collision (Band Model)		0.060
Collisions during study period with 100% operation and no avoidance	Number of birds through rotors x Probability of Collision	1,487
Collisions during study period with 75% operation and no avoidance	75% x above number	1,115
SNH recommended avoidance rate	98.00%	0.020
Collisions during study period with 75% operational rate and 98% avoidance		22.30
Bird Mortality / Turbine / Year		1.716

The estimated mortality for all bird passes associated with the Project as detected from radar and using a 98% avoidance is 22.30 birds per year or approximately 1.72 birds/turbine/year.



2 REFERENCES

- Band, W., Madders, M. & Whitfield, D.P. 2007. Developing field and analytical methods to assess avian collision risk at wind farms. In Lucas, M., Janss, G.F.E. & Ferrer, M. (eds.), *Birds and Wind Farms. Risk Assessment and Mitigation*, 259–275. Quercus, Madrid.
- Barrios, L., & Rodriguez, A. (2004). *Behavioural and environmental correlates of soaring-bird mortality at on-shore turbines*. *Journal of Applied Ecology* 41:72-81.
- Bevanger, K, Berntsen, F, Clausen, S, Dahl, E.L., Flagstad, Ø, Follestad, A et al. 2010. Pre- and post-construction studies of conflicts between birds and wind turbines in coastal Norway (Bird-Wind). Report on findings 2007–2010. Norwegian Institute for Nature Research (NINA) (ed.), Trondheim, Norway.
- Carrete, M., Sánchez-Zapata, J.A., Benítez, J.R., Lobón, M., Donázar, J.A., 2009. Large scale risk-assessment of wind-farms on population viability of a globally endangered long-lived raptor. *Biol. Conserv.* 142, 2954–2961.
- Carrete, M. et al. “Mortality at wind-farms is positively related to large-scale distribution and aggregation in griffon vultures”. *Biological Conservation* 145 (2012); 102-108.
- Chamberlain, Dan & Rehfisch, Mark & Fox, A. & Desholm, Mark & ANTHONY, SARAH. (2006). The effect of avoidance on bird mortality predictions made by wind turbine collision risk models. *Ibis*. 148. 198 - 202. 10.1111/j.1474-919X.2006.00507.x.
- De Lucas, M., Ferrer, M., Bechard, M.J., Muñoz, A.R., 2012. Griffon vulture mortality at wind farms in southern Spain: distribution of fatalities and active mitigation measures. *Biol. Conserv.* 147, 184–189.
- Drewitt, A.L., Langston, R.H.W., 2008. Collision effects of wind-power generators and other obstacles on birds. *Annals of the New York Academy of Sciences* 1134, 233–266.



- Erickson, W. P., Wolfe, M. M., Bay, K. J., Johnson, D. H., & Gehring, J. L. (2014). A comprehensive analysis of small-passerine fatalities from collision with turbines at wind energy facilities. *PLoS ONE*.
- Ferrer, M., de Lucas, M., Janss, G., Casado, E., Munoz, A., & Bechard, M. (2012). Weak Relationship between risk assessment studies and recorded mortality in wind farms. *Journal of Applied Ecology*, 49, 38-46.
- Higgins, K. F., R. Osborn, and D. E. Naugle. 2007. Effects of wind turbines on birds and bats in southwestern Minnesota, USA. Pages 153-175 in M. de Lucas, G. F. E. Janss, and M. Ferrer, editors. *Birds and wind farms: risk assessment and mitigation*. Quercus, Madrid, Spain.
- Hötker, H., K.-M. Thomsen, and H. Jeromin. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines
- Lekuona, J. & C. Ursua. 2007. Avian mortality in wind power plants of Navarra (Northern Spain). In *Birds and Wind Farms: Risk Assessment and Mitigation*. M.de Lucas, G.F.E. Janss & M. Ferrer, Eds.: 177–192. Quercus. Madrid.
- Lucas, M. d., Janss, G. F., Whitfield, D., & Ferrer, M. (2008). Collision fatality of raptors in wind farms does not depend on raptor abundance. *Journal of Applied Ecology*(45), 1695-1703.
- Mabee, T. J., B. A. Cooper, J. H. Plissner, and D. P. Young. 2006 Nocturnal bird migration over an Appalachian Ridge at a proposed wind power project. *Wildlife Society Bulletin* 34:682-690. [http://dx.doi.org/10.2193/0091-7648\(2006\)34\[682:NBMOAA\]2.0.CO;2](http://dx.doi.org/10.2193/0091-7648(2006)34[682:NBMOAA]2.0.CO;2)
- Marques, Ana Teresa et al. “Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies.” *Biological Conservation* 179 (2014): 40-52.



- Plonczkier, Pawel & Simms, Ian. (2012). Radar monitoring of migrating pink-footed geese: Behavioural responses to offshore wind farm development. *Journal of Applied Ecology*. 49. 1187-1194. 10.2307/23353485.
- Richardson, W.J. 2000. Bird migration and wind turbines: Migration timing, flight behaviour, and collision risk. In *Proceedings of National Avian - Wind Power Planning Meeting III*, San Diego, California, May 1998. Prepared for the Avian Subcommittee of the National Wind Coordinating Committee by LGL Ltd., King City, Ontario. 202 pp.
- Rioux, S., Savard, J., & Gerick, A. A. (2013). Avian Mortalities due to transmission line collisions: a review of current estimates and field methods with an emphasis on applications to the Canadian electric network. *Avian Conservation and Ecology*, 8(2), 7.
- Scottish Natural Heritage. (2000). *WINDFARMS AND BIRDS: Calculating a theoretical collision risk assuming no avoiding action*. Scottish Natural Heritage.
- Scottish Natural Heritage. (October 2016). *Avoidance Rates for the Onshore SNH Wind Farm Collision Risk Model*. Scottish Natural Heritage.
- Young, D.P.J., Erickson, W.P., Strickland, M.D., Good, R.E., Sernka, K.J., 2003. Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines. National Renewable Energy Laboratory, Washington, DC.
- Whitfield, D. (2009). *Collision Avoidance of Golden Eagles at Wind Farms Under the 'Band' Collision Risk Model*. Report by Natural Research Ltd.
- Zimmerling, J. R., A. C. Pomeroy, M. V. d'Entremont, and C. M. Francis. 2013. Canadian estimate of bird mortality due to collisions and direct habitat loss associated with wind turbine developments. *Avian Conservation and Ecology* 8(2): 10. <http://dx.doi.org/10.5751/ACE-00609-080210>