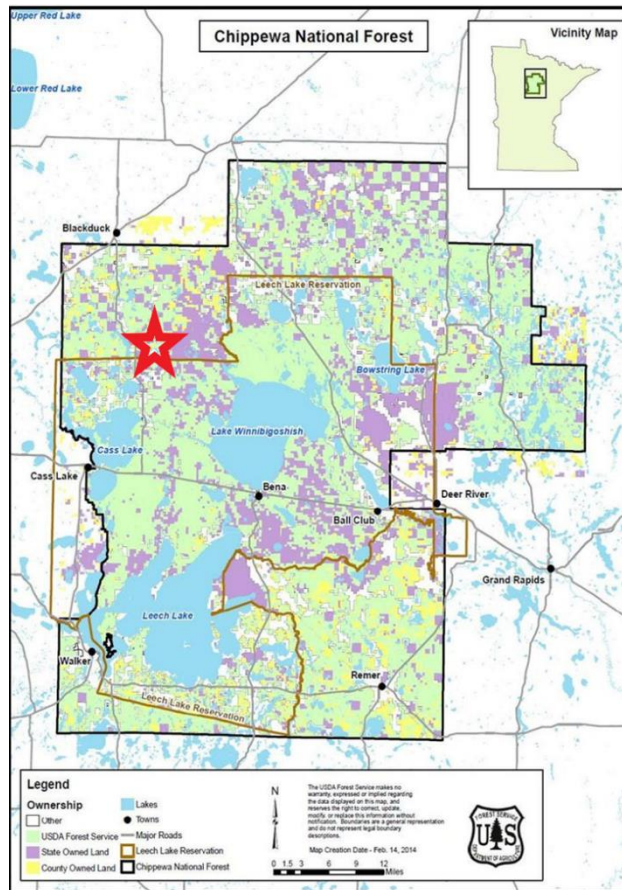


# Chippewa National Forest Hunter Walking Trail Project 2020 – Pre-harvest Results



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## INTRODUCTION

Minnesota's managed forests provide critical habitat for hundreds of resident and migrant bird species. Forest management provides an important opportunity to conserve and cultivate critical habitat for species of management and conservation concern. Recent declines in upland game populations in the state have generated a renewed interest in using forest management to create habitats that not only support breeding adults but also those that maximize juvenile survival and increase recruitment into the populations. Conservation concerns regarding Ruffed Grouse (*Bonasa umbellus*) and American Woodcock (*Scolopax minor*) have been extensively documented:

- North American populations of American Woodcock have declined by over 30% in the last 50 years. In Minnesota, American Woodcock are a Species in Greatest Conservation Need. Approximately 10% of the global population breeds in Minnesota.
- Ruffed Grouse populations in Minnesota are significantly declining. Recent declines in harvest numbers of Ruffed Grouse and potential issues with recruiting birds into the population have caused concern range-wide, including in Minnesota.

American Woodcock and Ruffed Grouse require a matrix of forest size classes throughout the breeding season. Historically, periodic natural disturbances would create habitat for these species—wildfires or flooding from beaver dams produced a patchwork of shrubby openings amid a largely forested landscape. Currently, the major mechanism of disturbance is harvest; this provides an important opportunity for habitat management for these species.

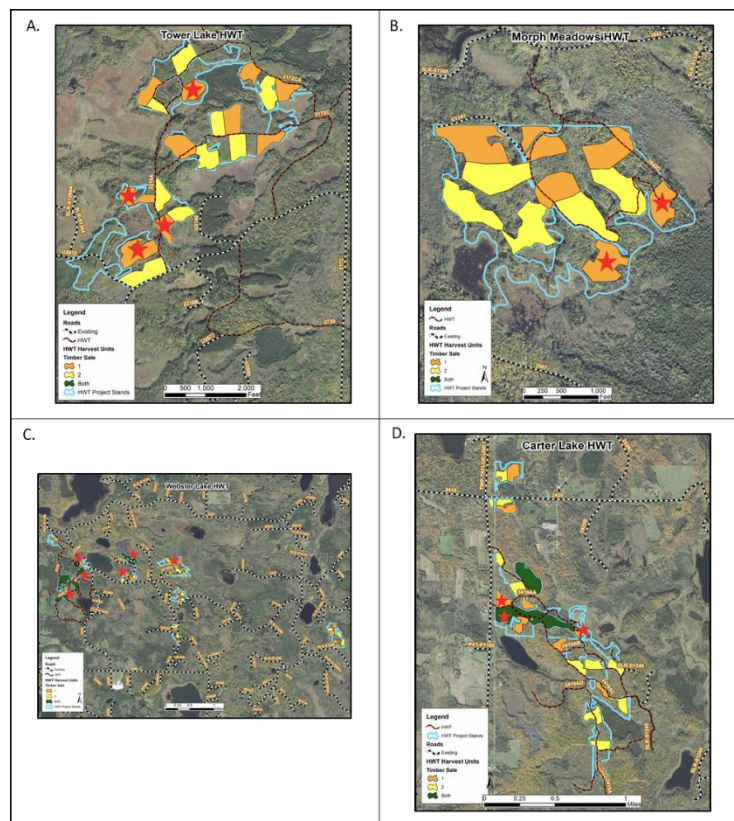
There is increasing interest from forest managers to promote heterogeneous forest matrices that can optimize wildlife occupancy and diversity over time. Chippewa National Forest is planning a long-term habitat improvement project by implementing small-scale, frequent harvests (<5 acres, 5-year intervals) adjacent to hunter walking trails. Currently, there are more than 600 miles of hunter walking trails in Minnesota, and maintaining and enhancing these areas as productive hunting grounds is a priority. The goal of this project is to create and maintain a long-term matrix of habitat in the region that is suitable for Ruffed Grouse while supporting additional game species such as American Woodcock and breeding forest birds.

The primary objective of the Chippewa National Forest Hunter Walking Trail Project is to assess the effects of experimental harvesting on Ruffed Grouse and breeding bird species. The results from the pre-harvest study will establish baseline data for future reference. Here, we report the results from pre-harvest line transect and ARU (Autonomous Recording Unit) surveys conducted during the 2020 breeding bird season. These two survey methods are complementary to one another and provide a comprehensive assessment of Ruffed Grouse and breeding bird communities. Specific objectives include:

1. Assess Ruffed Grouse abundance and characterize breeding bird communities before harvest treatments planned for winter 2021-2022; and
2. Summarize preliminary results as a part of the National Forest Bird Monitoring Project annual report and provide data to Chippewa National Forest.

## METHODS AND ANALYSIS

*Line Transects.* Line transect surveys were conducted along hunter walking trails in the four core areas (Carter Lake, Morph Meadows, Tower Lake, and Webster Lake) of the Blackduck Ruffed Grouse Habitat Improvement Project (Figure 1). Tower Lake (5300 m) was the longest survey transect, followed by Carter Lake (4200 m), Webster Lake (3900 m), then Morph Meadows (2900 m). Observers surveyed the established transect lines at a rate of 10 m/minute and recorded type of observation (e.g., singing, calling) and distance of birds observed on or adjacent to the line. Observers used the Collector app on iPads for ArcGIS to record spatial locations of bird observations. Surveys were conducted by trained observers from approximately 0.5 h before to 5 h after sunrise on days with little wind ( $< 15 \text{ km hr}^{-1}$ ) and little or no precipitation. The first round of line transect surveys were completed in late April (April 29-30, 2020), while the second round were completed in June (June 1-2, 2020) to obtain a complete assessment of Ruffed Grouse activity and breeding bird communities in the study area. For the April surveys, we included all observations of Ruffed Grouse, while the June surveys focused on all breeding bird species that were observed within 100 m of the hunter walking trails.



**Figure 1.** Maps of the four hunter walking trail study areas in Chippewa National Forest – A. Tower Lake, B. Morph Meadows, C. Webster Lake, and D. Carter Lake. Locations of the Autonomous Recording Units (ARUs) are denoted by red stars.

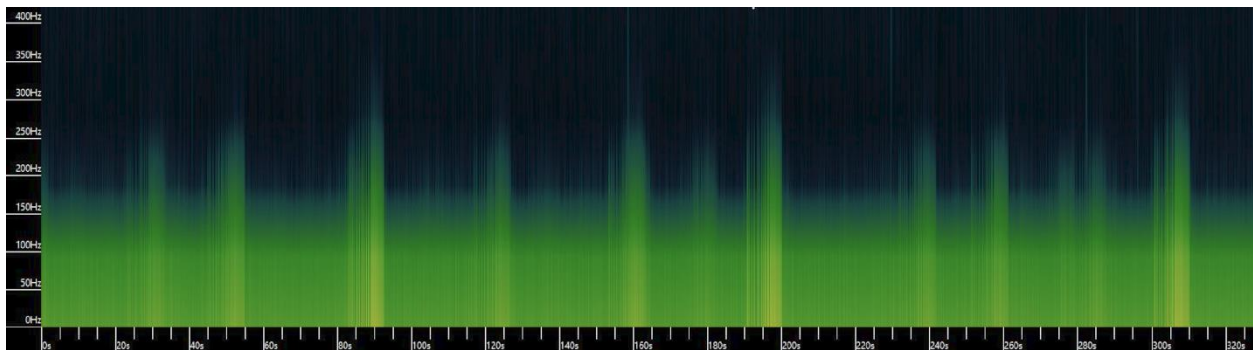
*Autonomous Recording Units.* ARUs ( $n=15$ ) were placed in each of the four project areas (Figure 1) on 29 or 30 April 2020 and were removed on 22 May 2020. Deployment stands were determined via stratified random design; the number of ARUs assigned to each project area was proportionate to the number of stands prescribed to be cut in each project area. We then randomly assigned ARUs to a given stand within each project area. A single ARU remained deployed at each project area through the summer and fall and was retrieved on 10 November 2020. All units were programmed to record two

hours each day: the hour surrounding sunrise and the hour surrounding sunset. Deployment details are summarized in Table 1.

**Table 1.** ARU deployment at the four project areas in spring and summer of 2020.

Site	# ARUs Deployed	# ARUs w/data	# ARUs w/full season data
Carter Lake	3	2	0
Morph Meadows	2	2	1
Tower Lake	4	4	0
Webster Lake	6	6	1
<b>Total</b>	<b>15</b>	<b>14</b>	<b>2</b>

ARU recordings were analyzed with Kaleidoscope Pro software (Wildlife Acoustics Inc., Maynard, MA, USA). Bird vocalization “finders” were trained with pre-existing recordings of the target species; the training dataset was then used to automatically detect these species in novel recordings obtained in the project areas. Finders were created for American Woodcock and Ruffed Grouse. After finders were run, trained observers listened to each audio clip to ensure the target species were present. For Ruffed Grouse, visual inspection of the spectrographs was most useful in finding instances of drumming (Figure 2).



**Figure 2.** Spectrograph of 11 Ruffed Grouse drums. Drums are characterized by a low (~250-275 Hz), rhythmic thumping sound that accelerates toward the end of the drum. This spectrograph likely represents three different individuals.

## RESULTS

*Line Transects.* For the spring (April) line transect surveys, we detected a total of 28 drumming grouse among the four HWT locations. Webster Lake had the highest density of Ruffed Grouse (0.21 birds/100 m), followed by Tower Lake (0.19 birds/100 m), Carter Lake (0.14 birds/100 m), and Morph Meadows (0.10 birds/100 m). We did not detect any American Woodcock during our April line transect surveys. We detected a total of 461 non-game individuals and 34 species within 100 m of the hunter walking trails. During this time period, resident and short-distance migrants were moving through the area and beginning breeding season activities. For example, the most common species observed was Yellow-bellied Sapsucker (*Sphyrapicus varius*); we were likely detecting individuals that were moving through the area and some that were using the study area for breeding. A species list of birds observed during the spring surveys is provided in Appendix A.

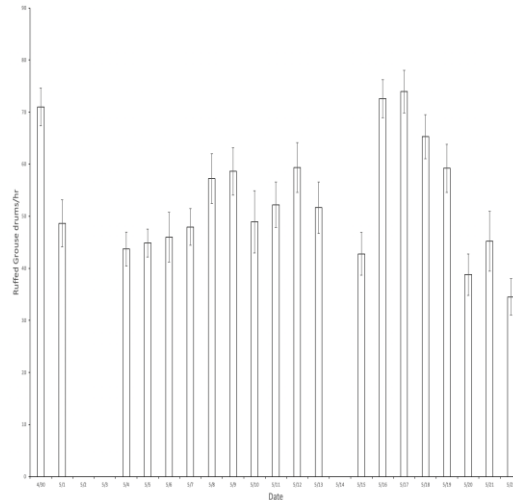
For the June surveys, we detected a total of 15 drumming grouse among the four HWT locations, 11 of which were within 100 m. Webster and Tower Lake had the highest densities of Ruffed Grouse (0.13/100 m), followed by Morph Meadows (0.07/100 m), then by Carter Lake (0.02/100 m). We did detect two American Woodcock during the June line transect surveys at Webster Lake.

Overall, a total of 1278 individuals of 72 bird species were detected within 100 m of all hunter walking trail locations during the June surveys. All locations averaged between 6.5-7.1 individuals per 100 m, with the exception of Webster Lake, which averaged 10.7 individuals per 100 m. Webster Lake had the most species detected (55), while Morph Meadows had the fewest (32). Ovenbird was the most abundant species with 1.67 individuals/100 m, followed by Red-eyed Vireo (1.04), Least Flycatcher (0.44), Chestnut-sided Warbler (0.42), Veery (0.42), and Golden-winged Warbler (0.31) (Appendix B).

*Autonomous Recording Units.* ARUs deployed in the four HWT project areas collected 636 hours of recordings between 29 April and 22 May 2020. ARUs deployed between 22 May and 10 November 2020 collected an additional 690 hours of recordings. Three of the ARUs did not record properly in 2020; it is unclear whether this is due to operator error, SD card failure, or recorder failure. We are troubleshooting the units to address issues for the 2021 season. American Woodcock were detected at only one out of the 14 ARU deployment locations (Morph Meadows) for one evening only. Ruffed Grouse were detected in all project areas and by all 14 ARUs in the spring of 2020 (Table 2). A total of 14,590 drums were counted between 30 April and 22 May 2020. Drumming was detected on every day the ARUs were deployed except during inclement weather (Figure 3); there were three days of rain and/or storms during the spring season. We calculated a Ruffed Grouse drumming index for each project area as the average number of drums per hour for the period between 30 April and 22 May excluding days of inclement weather (Table 2).

**Table 2.** Average number of Ruffed Grouse drums per hour during spring 2020.

Site	Average drums per hour
Carter Lake	41.2
Morph Meadows	49.7
Tower Lake	58.4
Webster Lake	54.3



**Figure 3.** Average number of Ruffed Grouse drums per hour for combined project areas in spring 2020. Error bars represent standard errors. Rain and/or storms on 2-3 and 14 May precluded any bird activity on those dates.

## DISCUSSION

*Line Transect Surveys.* The results from the line transect surveys show consistent Ruffed Grouse abundance among all four hunter walking trail locations during the April and June surveys. The June surveys were still able to detect Ruffed Grouse, however, at a lower rate. Carter Lake had the biggest drop in detections between April and June surveys (0.12/100 m), followed by Webster Lake (0.08/100 m), Morph Meadows (0.07/100 m), and then by Tower Lake (0.06/100 m). We did not detect American Woodcock on our line transect surveys; this result was expected due to the timing of our surveys (mornings), in conjunction with the mature forest cover type that was present.

Ovenbird was the most common breeding bird species observed during our June surveys. This is consistent with results from the National Forest Bird Monitoring Program throughout the Chippewa National Forest. Four of the top six most-abundant species are of conservation concern or are showing local/continental population declines (Red-eyed Vireo, Least Flycatcher, Veery, and Golden-winged Warbler). All hunter walking trail species abundances were similar among locations, with the exception of Webster Lake. This location had higher densities of birds (~3 birds/100 m) and had 10 additional species detected than the next-closest hunter walking trail location. We suspect the site/stand level heterogeneity is likely driving this trend, as there appears to be a greater amount of conifer and/or forested wetlands near the walking trail.

*Autonomous Recording Units.* Unsurprisingly, very few American Woodcock were detected in the project areas despite ARUs recording during the peak spring evening display season. American Woodcock require forest openings in which they conduct their spring displays. It is likely that American Woodcock do use the project areas for nesting and post-fledging dispersal, but these activities are silent and largely undetectable without targeted projects utilizing telemetry. Once harvests are completed, however, we anticipate many male American Woodcock will use the new openings as display areas. Our



previous research assessing the effect of tree retention to wildlife revealed that all harvests attracted displaying male American Woodcock within the first few years post-harvest.

It appears that all project areas currently support at least small numbers of breeding Ruffed Grouse. Once harvests are completed, we will continue to deploy ARUs and use the drums per hour index to represent breeding activity in each of the project areas. This metric will allow easy comparison between years and will allow us to assess male drumming behavior in response to small-scale disturbance in the project areas.

*Method Assessment.* The results from the line transect surveys and ARUs are consistent among hunter walking trail locations. The ARU-derived drumming index and in-person surveys show general agreement in that Webster Lake and Tower Lake have the highest number of pre-harvest Ruffed Grouse. These methods are complimentary to one another: line transect surveys can identify and inform us about individual ruffed grouse, while the ARUs can tell us about the frequency at which grouse drum. ARUs appear to be an excellent method with which to sample drumming Ruffed Grouse. The noise from grouse drums travel well through forested landscapes due to their low frequency, and thus a single ARU is able to detect multiple males drumming (Figure 2). It is unknown how far away ARUs are able to pick up Ruffed Grouse drums and the effect of landscape features (e.g. topography, cover type) on this distance. Hence, conducting line transects can inform us which grouse are drumming on the ARUs. Future work in the project areas will allow us to understand the link between spring Ruffed Grouse drumming, nest density, nesting success, and post-fledging dispersal and recruitment.

## **CONCLUSIONS/FUTURE DIRECTIONS**

Data obtained during this first year of line transect surveys will provide a foundation for long-term monitoring within the four project areas. Long-term monitoring will be important in helping to determine the impacts of management on wildlife populations and will allow us to identify the impacts of these short-term harvests on breeding birds. In addition, we suspect that we will be able to quantify hunter activity using ARUs to monitor gun shots at HWT locations. For any future telemetry studies, it may be important to set up a reporting system for hunters to report banded or un-banded birds that have been harvested at hunter walking trail locations. HWT sites are set to be harvested over the winter of 2021-22, thus the 2021 season will provide an additional year of pre-harvest data, and the first year of post-harvest data will be collected in spring of 2022.

**Appendix A.** Common and scientific name, four-letter abbreviation, migration strategy, nest site, and typical habitat of species observed in April and June transect surveys on all HWTs. All observations are of individuals observed (minus flyovers) within 100 m of the hunter walking trails. Abundance represents the number of individuals/100 m. April surveys largely capture spring migrants, whereas June surveys capture breeding birds in the study area.

Common Name	Migration Strategy	Nest Site	Vegetation Type	April abundance / 100 m	June abundance / 100 m	Total Individuals (April)	Total Individuals (June)
Alder Flycatcher	Long-distance migrant	Subcanopy or Shrub	Shrub swamp	0.00	0.01	0	12
American Bittern	Short-distance migrant	Ground	Shrub swamp	0.01	0.12	1	0
American Crow	Short-distance migrant	Canopy	Deciduous forest	0.02	0.00	4	1
American Goldfinch	Short-distance migrant	Subcanopy or Shrub	Fields and meadows	0.02	0.01	4	8
American Redstart	Long-distance migrant	Subcanopy or Shrub	Early-successional mixed	0.00	0.02	0	17
American Robin	Short-distance migrant	Subcanopy or Shrub	Fields and meadows	0.27	0.00	44	12
American Woodcock	Short-distance migrant	Ground	Deciduous forest	0.00	0.01	0	2
Baltimore Oriole	Long-distance migrant	Canopy	Deciduous forest	0.00	0.01	0	2
Bay-breasted Warbler	Long-distance migrant	Canopy	Coniferous forest	0.00	0.01	0	2
Black-and-white Warbler	Long-distance migrant	Ground	Mixed forest	0.00	0.05	0	48
Black-billed Cuckoo	Long-distance migrant	Subcanopy or Shrub	Deciduous forest	0.00	0.01	0	2
Blackburnian Warbler	Long-distance migrant	Canopy	Coniferous forest	0.00	0.01	0	20
Black-capped Chickadee	Permanent Resident	Cavity, Hole, or Bank	Deciduous forest	0.28	0.12	46	12
Black-throated Blue Warbler	Long-distance migrant	Subcanopy or Shrub	Deciduous forest	0.00	0.02	0	1
Black-throated Green Warbler	Long-distance migrant	Subcanopy or Shrub	Mixed forest	0.00	0.10	0	26
Blue Jay	Permanent Resident	Canopy	Deciduous forest	0.15	0.01	24	17
Broad-winged Hawk	Long-distance migrant	Canopy	Mixed forest	0.02	0.04	3	3
Brown Creeper	Short-distance migrant	Cavity, Hole, or Bank	Deciduous forest	0.09	0.07	14	7

Common Name	Migration Strategy	Nest Site	Vegetation Type	April abundance / 100 m	June abundance / 100 m	Total Individuals (April)	Total Individuals (June)
Brown-headed Cowbird	Short-distance migrant	Nest Parasite	Fields and meadows	0.05	0.00	8	2
Canada Goose	Short-distance migrant	Ground	Ponds, lakes, rivers, streams	0.00	0.05	0	5
Canada Warbler	Long-distance migrant	Ground	Mixed forest	0.00	0.01	0	1
Cedar Waxwing	Short-distance migrant	Subcanopy or Shrub	Ponds, lakes, rivers, streams	0.00	0.02	0	6
Chestnut-sided Warbler	Long-distance migrant	Subcanopy or Shrub	Early-successional mixed	0.00	0.04	0	69
Chipping Sparrow	Short-distance migrant	Canopy	Coniferous forest	0.00	0.10	0	2
Common Grackle	Short-distance migrant	Canopy	Fields and meadows	0.00	1.67	0	1
Common Loon	Short-distance migrant	Ground	Ponds, lakes, rivers, streams	0.00	0.42	0	2
Common Raven	Permanent Resident	Canopy	Coniferous forest	0.02	0.07	4	0
Common Yellowthroat	Long-distance migrant	Ground	Shrub swamp	0.00	0.01	0	39
Connecticut Warbler	Long-distance migrant	Ground	Lowland coniferous forest	0.00	0.01	0	1
Dark-eyed Junco (Slate-colored)	Short-distance migrant	Ground	Lowland coniferous forest	0.01	0.01	2	0
Downy Woodpecker	Permanent Resident	Cavity, Hole, or Bank	Deciduous forest	0.10	0.44	16	0
Eastern Kingbird	Long-distance migrant	Canopy	Fields and meadows	0.00	0.16	0	2
Eastern Phoebe	Short-distance migrant	Understory	Ponds, lakes, rivers, streams	0.01	1.04	2	0
Eastern Wood-Pewee	Long-distance migrant	Canopy	Mixed forest	0.00	0.06	0	12
Golden-crowned Kinglet	Short-distance migrant	Canopy	Coniferous forest	0.06	0.02	9	3
Golden-winged Warbler	Long-distance migrant	Ground	Early-successional mixed	0.00	0.31	0	50
Gray Catbird	Long-distance migrant	Subcanopy or Shrub	Early-successional mixed	0.00	0.05	0	5
Great Crested Flycatcher	Long-distance migrant	Cavity, Hole, or Bank	Deciduous forest	0.00	0.03	0	7

Common Name	Migration Strategy	Nest Site	Vegetation Type	April abundance / 100 m	June abundance / 100 m	Total Individuals (April)	Total Individuals (June)
Hairy Woodpecker	Permanent Resident	Cavity, Hole, or Bank	Deciduous forest	0.09	0.10	14	8
Hermit Thrush	Short-distance migrant	Ground	Mixed forest	0.13	0.42	21	5
Least Flycatcher	Long-distance migrant	Subcanopy or Shrub	Deciduous forest	0.00	0.03	0	71
Lincoln's Sparrow	Long-distance migrant	Ground	Lowland coniferous forest	0.00	0.01	0	4
Magnolia Warbler	Long-distance migrant	Subcanopy or Shrub	Coniferous forest	0.00	0.01	0	1
Mallard Duck	Short-distance migrant	Ground	Ponds, lakes, rivers, streams	0.01	0.01	2	2
Mourning Warbler	Long-distance migrant	Ground	Early-successional mixed	0.00	0.06	0	8
Nashville Warbler	Long-distance migrant	Ground	Lowland coniferous forest	0.00	0.01	0	38
Northern Flicker (Yellow-shafted)	Short-distance migrant	Cavity, Hole, or Bank	Fields and meadows	0.07	0.05	11	1
Northern Parula	Long-distance migrant	Canopy	Lowland coniferous forest	0.00	0.07	0	5
Northern Waterthrush	Long-distance migrant	Ground	Lowland coniferous forest	0.01	0.03	1	3
Olive-sided Flycatcher	Long-distance migrant	Canopy	Early-successional mixed	0.00	0.01	0	3
Ovenbird	Long-distance migrant	Ground	Deciduous forest	0.01	0.02	2	272
Palm Warbler (Western)	Long-distance migrant	Ground	Lowland coniferous forest	0.01	0.23	1	0
Pileated Woodpecker	Permanent Resident	Cavity, Hole, or Bank	Deciduous forest	0.02	0.02	3	1
Pine Siskin	Short-distance migrant	Canopy	Coniferous forest	0.06	0.00	10	0
Pine Warbler	Short-distance migrant	Canopy	Coniferous forest	0.02	0.01	3	2
Purple Finch	Short-distance migrant	Canopy	Mixed forest	0.06	0.00	10	0
Red-breasted Nuthatch	Permanent Resident	Cavity, Hole, or Bank	Coniferous forest	0.12	0.00	20	8

Common Name	Migration Strategy	Nest Site	Vegetation Type	April abundance / 100 m	June abundance / 100 m	Total Individuals (April)	Total Individuals (June)
Red-eyed Vireo	Long-distance migrant	Subcanopy or Shrub	Deciduous forest	0.00	0.02	0	170
Red-tailed Hawk	Short-distance migrant	Canopy	Fields and meadows	0.00	0.07	0	1
Red-winged Blackbird	Short-distance migrant	Subcanopy or Shrub	Open wetlands	0.04	0.00	6	2
Rose-breasted Grosbeak	Long-distance migrant	Subcanopy or Shrub	Deciduous forest	0.00	0.29	0	26
Ruby-crowned Kinglet	Short-distance migrant	Canopy	Coniferous forest	0.03	0.01	5	1
Ruby-throated Hummingbird	Long-distance migrant	Canopy	Ponds, lakes, rivers, streams	0.00	0.03	0	6
Ruffed Grouse	Permanent Resident	Ground	Deciduous forest	0.10	0.16	16	11
Sandhill Crane	Short-distance migrant	Ground	Wetland	0.00	0.00	0	2
Scarlet Tanager	Long-distance migrant	Canopy	Deciduous forest	0.00	0.01	0	19
Sedge Wren	Short-distance migrant	Understory	Wetland	0.00	0.04	0	5
Song Sparrow	Short-distance migrant	Ground	Fields and meadows	0.10	0.03	17	10
Swamp Sparrow	Short-distance migrant	Ground	Shrub swamp	0.07	0.01	11	7
Veery	Long-distance migrant	Ground	Deciduous forest	0.00	0.07	0	68
White-breasted Nuthatch	Permanent Resident	Cavity, Hole, or Bank	Deciduous forest	0.08	0.01	13	3
White-throated Sparrow	Short-distance migrant	Ground	Early-successional mixed	0.04	0.02	6	5
Wilson's Snipe	Short-distance migrant	Ground	Open wetlands	0.02	0.01	4	4
Wilson's Warbler	Long-distance migrant	Understory	Shrub swamp	0.00	0.03	0	3
Winter Wren	Short-distance migrant	Ground	Lowland coniferous forest	0.01	0.01	2	0
Wood Thrush	Long-distance migrant	Subcanopy or Shrub	Deciduous forest	0.00	0.01	0	10
Yellow Warbler	Long-distance migrant	Subcanopy or Shrub	Shrub swamp	0.00	0.01	0	2

<b>Common Name</b>	<b>Migration Strategy</b>	<b>Nest Site</b>	<b>Vegetation Type</b>	<b>April abundance / 100 m</b>	<b>June abundance / 100 m</b>	<b>Total Individuals (April)</b>	<b>Total Individuals (June)</b>
Yellow-bellied Flycatcher	Long-distance migrant	Ground	Lowland coniferous forest	0.00	0.03	0	1
Yellow-bellied Sapsucker	Short-distance migrant	Cavity, Hole, or Bank	Deciduous forest	0.43	0.04	70	17
Yellow-rumped Warbler (Myrtle)	Short-distance migrant	Canopy	Coniferous forest	0.13	0.29	22	1
Yellow-throated Vireo	Long-distance migrant	Canopy	Deciduous forest	0.00	0.05	0	4

**Appendix B.** Species observed during June line transect surveys at four hunter walking trail locations. Transect lengths were as follows: Carter Lake (4200 m), Morph Meadows (2900 m), Tower Lake (5300 m), and Webster Lake (3900 m). Only birds observed (minus flyovers) within 100 m of the line transect were included in the summary.

Common Name	Carter Lake (per 100 m)	Morph Meadows (per 100 m)	Tower Lake (per 100 m)	Webster Lake (per 100 m)	Total (per 100 m)
Alder Flycatcher	0.14	0.00	0.08	0.05	0.07
American Crow	0.00	0.00	0.00	0.03	0.01
American Goldfinch	0.19	0.00	0.00	0.00	0.05
American Redstart	0.07	0.00	0.23	0.05	0.10
American Robin	0.00	0.10	0.02	0.21	0.07
American Woodcock	0.00	0.00	0.00	0.05	0.01
Baltimore Oriole	0.05	0.00	0.00	0.00	0.01
Black-and-white Warbler	0.17	0.41	0.30	0.33	0.29
Black-billed Cuckoo	0.05	0.00	0.00	0.00	0.01
Bay-breasted Warbler	0.02	0.00	0.02	0.00	0.01
Black-capped Chickadee	0.12	0.00	0.06	0.10	0.07
Brown-headed Cowbird	0.05	0.00	0.00	0.00	0.01
Blackburnian Warbler	0.26	0.00	0.00	0.23	0.12
Blue Jay	0.05	0.07	0.09	0.21	0.10
Brown Creeper	0.02	0.10	0.00	0.08	0.04
Black-throated Blue Warbler	0.00	0.00	0.00	0.03	0.01
Black-throated Green Warbler	0.10	0.03	0.06	0.46	0.16
Broad-winged Hawk	0.00	0.00	0.00	0.08	0.02
Canada Goose	0.00	0.03	0.00	0.10	0.03
Canada Warbler	0.00	0.00	0.02	0.00	0.01
Cedar Waxwing	0.10	0.00	0.02	0.03	0.04
Chipping Sparrow	0.00	0.00	0.00	0.05	0.01
Common Grackle	0.02	0.00	0.00	0.00	0.01
Common Loon	0.00	0.00	0.02	0.03	0.01
Connecticut Warbler	0.00	0.00	0.00	0.03	0.01
Common Yellowthroat	0.10	0.14	0.42	0.23	0.24
Chestnut-sided Warbler	0.45	0.28	0.43	0.49	0.42
Eastern Kingbird	0.00	0.00	0.00	0.05	0.01
Eastern Wood-Pewee	0.05	0.14	0.04	0.10	0.07
Great Crested Flycatcher	0.07	0.00	0.02	0.08	0.04
Golden-crowned Kinglet	0.02	0.00	0.00	0.05	0.02
Gray Catbird	0.05	0.00	0.06	0.00	0.03
Golden-winged Warbler	0.48	0.14	0.30	0.26	0.31
Hairy Woodpecker	0.07	0.03	0.02	0.08	0.05
Hermit Thrush	0.02	0.00	0.02	0.08	0.03
Least Flycatcher	0.45	0.76	0.11	0.62	0.44
Lincoln's Sparrow	0.00	0.00	0.08	0.00	0.02
Mallard Duck	0.00	0.00	0.00	0.05	0.01
Magnolia Warbler	0.00	0.03	0.00	0.00	0.01
Mourning Warbler	0.10	0.03	0.02	0.05	0.05
Nashville Warbler	0.19	0.00	0.17	0.54	0.23
Northern Flicker (Yellow-shafted)	0.00	0.00	0.02	0.00	0.01
Northern Parula	0.02	0.07	0.00	0.05	0.03
Northern Waterthrush	0.00	0.03	0.00	0.05	0.02
Olive-sided Flycatcher	0.00	0.00	0.06	0.00	0.02

Common Name	Carter Lake (per 100 m)	Morph Meadows (per 100 m)	Tower Lake (per 100 m)	Webster Lake (per 100 m)	Total (per 100 m)
Ovenbird	1.14	1.62	1.66	2.28	1.67
Pine Warbler	0.02	0.00	0.02	0.00	0.01
Pileated Woodpecker	0.02	0.00	0.00	0.00	0.01
Rose-breasted Grosbeak	0.21	0.03	0.11	0.26	0.16
Red-breasted Nuthatch	0.07	0.03	0.00	0.10	0.05
Ruby-crowned Kinglet	0.00	0.03	0.00	0.00	0.01
Red-eyed Vireo	0.98	0.83	1.11	1.18	1.04
Red-tailed Hawk	0.00	0.00	0.02	0.00	0.01
Ruby-throated Hummingbird	0.05	0.03	0.02	0.05	0.04
Ruffed Grouse	0.00	0.07	0.11	0.08	0.07
Red-winged Blackbird	0.02	0.00	0.00	0.03	0.01
Sandhill Crane	0.00	0.03	0.00	0.03	0.01
Scarlet Tanager	0.12	0.00	0.09	0.23	0.12
Sedge Wren	0.02	0.07	0.04	0.00	0.03
Song Sparrow	0.05	0.00	0.11	0.05	0.06
Swamp Sparrow	0.00	0.00	0.11	0.03	0.04
Veery	0.29	0.48	0.51	0.38	0.42
White-breasted Nuthatch	0.02	0.03	0.00	0.03	0.02
Wilson's Snipe	0.00	0.03	0.00	0.08	0.02
Wilson's Warbler	0.02	0.00	0.02	0.03	0.02
Wood Thrush	0.00	0.14	0.00	0.15	0.06
White-throated Sparrow	0.05	0.03	0.00	0.05	0.03
Yellow-bellied Flycatcher	0.00	0.00	0.00	0.03	0.01
Yellow-bellied Sapsucker	0.05	0.07	0.09	0.21	0.10
Yellow Warbler	0.00	0.07	0.00	0.00	0.01
Yellow-rumped Warbler (Myrtle)	0.00	0.00	0.00	0.03	0.01
Yellow-throated Vireo	0.05	0.00	0.00	0.05	0.02
<b>Individuals (per 100 m)</b>	<b>7.10</b>	<b>6.55</b>	<b>7.02</b>	<b>10.72</b>	<b>7.84</b>
<b>Total individuals</b>	<b>298</b>	<b>190</b>	<b>372</b>	<b>418</b>	<b>1278</b>
<b>Total species</b>	<b>45</b>	<b>32</b>	<b>39</b>	<b>55</b>	<b>73</b>