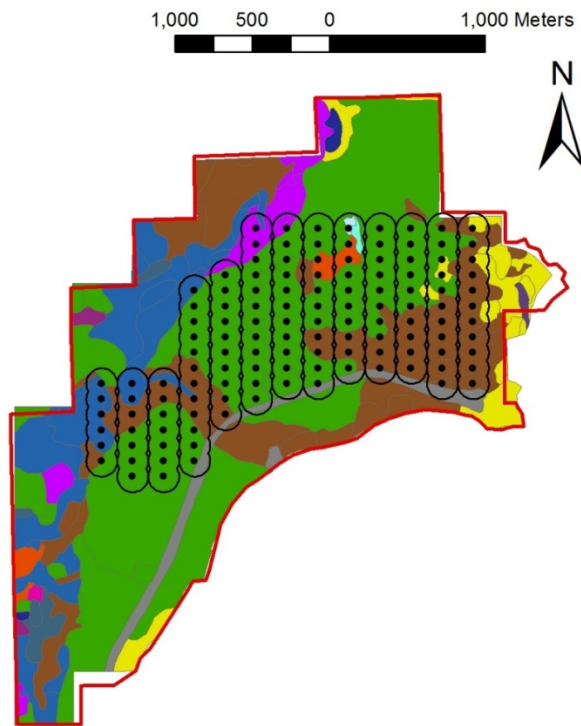


**Encampment Forest:
Breeding Bird Species Composition – 2014-2015**

The Nature Conservancy and Encampment Forest Association

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Summary

During the summers of 2014 and 2015, we completed point count surveys for breeding birds along transects within a selected portion of the Encampment Forest during the breeding season (June) and the post-breeding season (late July-early August). The main objectives of these surveys were to determine the species composition of breeding birds within this old-growth forest area and identify the habitats and landscape characteristics associated with these species. During the breeding season a combined total of 66 species were observed within the 644 acre area that was sampled in 2014 and 2015. These included four species that flew over while sampling (Common Loon, Canada Geese, Turkey Vulture, and Ring-billed Gull). As expected, detectability decreased during the post-breeding period where we observed about 20 fewer species (44 species in both 2014 and 2015) and an average of about 500 fewer individuals with the same effort. During the breeding season we observed 18 species of warblers, four species of thrush, and five species of woodpeckers. Thirty-two of the 66 breeding species or 48 % were long-distance, Neotropical migrants. Of the 32 species of long-distance migrants observed were large numbers of Ovenbirds (mean of 124 individuals in 2014 and 2015), Nashville Warblers (111), Black-throated Green Warblers (111), Red-eyed Vireos (79), Chestnut-sided Warblers (84), American Redstarts (64), Mourning Warbler (43), and Blackburnian Warbler (37).

We did not identify any bird species that are listed as endangered or threatened in Minnesota or in the United States. However, two Golden-winged Warbler, a species of considerable interest in Minnesota and North America, were observed in 2015. The species is being considered for endangered status in the United States and is threatened in Canada. The observation is interesting, but somewhat limited habitat is available in the Encampment Forest for this species, so we do not recommend any additional management activity for this species at the Encampment Forest. Several other species found at the Encampment Forest have also been identified as Species of Greatest Conservation Need in Minnesota including the Veery, Black-billed Cuckoo, Common Loon, American Woodcock, Cape May Warbler, Purple Finch, Black-throated Blue Warbler, Evening Grosbeak, and Winter Wren. These are native Minnesota species with populations that are rare, declining or vulnerable to decline, and are below levels desirable to insure their long-term health and stability. Overall, the avifauna of Encampment Forest is healthy and comprised of an avifauna highly representative of the region. They are indicative of species associated with northern semi-boreal, coniferous ecosystems and a mix of young, intermediate, and old-growth forests. Future analysis will compare the habitats and birds at Encampment Forest with other forested habits in this region.

Introduction

There is substantial public interest in the conservation of birds. These include long-distance Neotropical migrants that over-winter in Central and South America and recent concerns for common resident and semi-permanent resident birds in Minnesota. Most breeding bird species select their breeding habitats using a combination of vegetation structure and tree species composition. Many bird species in North America are associated with forests and because of the loss of old growth forest, they are of particular interest. Studies of large forested areas are extremely rare but they offer the best opportunity to examine the distribution of forest birds on a landscape scale.

The goal of this project was to document the spatial distribution of breeding birds within the landscape mosaic of Encampment Forest, Minnesota. Encampment Forest is an ideal ecosystem to study because of the lack of human-induced disturbance, especially logging. The area will also provide a contrast to several forested areas that the Natural Resources Research Institute at the University of Minnesota-Duluth has been studying in more intensively managed forests. The results will build on the previous breeding bird biodiversity studies that have been done by Jim Lind in 2007, 2008, and 2010 that documented 68 summer resident species (presumed breeding) in the Encampment Forest area.

Objectives

1. Establish a large plot (approximately 640 acres) within the Encampment Forest.
2. Sample breeding birds within this plot using a modified territory mapping technique during the breeding seasons of 2014 and 2015.
3. Digitize all locations of breeding birds observed and forest cover type patches within the Encampment Forest plot.
4. Summarize the breeding bird species and their relative abundance according to forest cover types within the Encampment Forest.

Methods

We established a large study plot to maximize the coverage of key forest cover types in the Encampment Forest. In particular, we were interested in coverage of the older, mature forest comprised of coniferous tree species (e.g., white pine, white spruce, and white cedar) and older deciduous species (e.g., aspen, birch, or ash). A grid system of point count stations and line transects were pre-determined with a geographic information system (GIS) and global positioning system (gps).

The count transects varied from 700-1200 meters in length and were separated by 200 meters. Bird counts were completed over a two or three day period by two observers with each surveyor sampling three to four transects per morning between 0445 and 0930. Transects were sampled by placing point counts locations at 100 m intervals and completing a 5 minute count during that period. Each individual bird observed was identified to species, its behavior noted (e.g., singing, calling, flyover, drumming or visual observation), and its position estimated within the study area. All counts were completed during good weather conditions (e.g., no precipitation and minimal wind).

All bird surveyors were required to pass a test of 85 bird songs and verified that their hearing was within normal ranges, as determined by an audiology test. The first breeding bird counts in 2014 were completed on June 8th, 9th and 19th, 2014 and the second round to determine post-breeding distribution was completed July 31st and August 1st, 2014. In 2015, the breeding bird counts were completed on June 15th, 16th, and 23rd and the post-breeding bird counts in July 30th, 31st, and August 5th. All bird observations were digitized with an overlay of a forest cover type map of the Encampment Forest plot at the GIS facility at NRRI.

We calculated habitat selectivity for all species that were observed more than ten times throughout the large plot and only included observations that indicated territoriality; for most

bird species this included singing observations only. We analyzed selectivity by comparing the percentage of bird observations in each habitat with the percentage of each habitat available in the study area using two statistical analyses. We first used a Chi-square test to compare expected frequencies against observed frequencies of bird species within each habitat type. Expected frequencies were determined by the proportion of each available habitat within the survey area. We also calculated Savage's selectivity index for every habitat and every bird species. Savage's selectivity index is an indication of whether a bird species is using a given habitat disproportionately to what would be expected given its availability on the study plot. These were completed as an exploratory technique only in 2014.

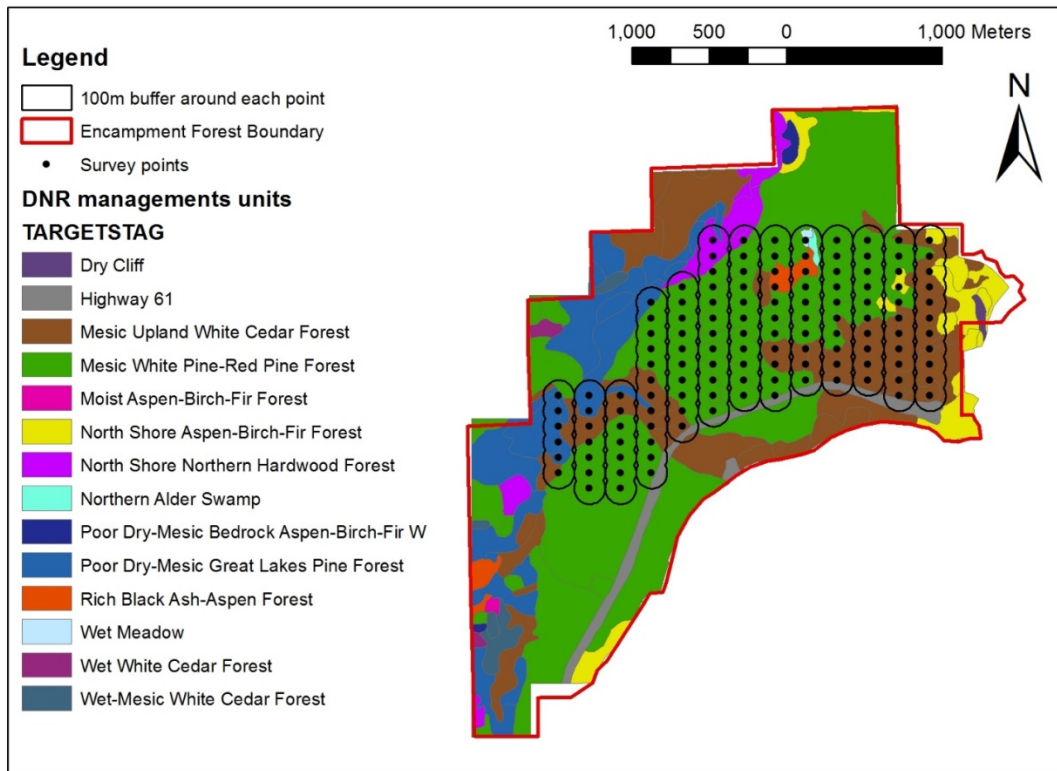


Figure 1. Habitat coverage and point count locations at Encampment Forest.

Results and Discussion

During the first sampling period in June of 2014, we observed a total 55 species representing 1167 individual bird observations, while in June of 2015 we observed 52 species of 969 individuals (Table 1). In July-August post-breeding counts we detected a total of 44 species and 434 individual birds in 2014. In July-August of 2015 we also observed 44 species and 614 individual birds (Table 1). There were many unidentified birds in the second round in both years (e.g., 24% of individual birds observed in the post-breeding season were unknown compared with only 8% in the first round). This is to be expected because vocalizations begin to wane during latter stages of the breeding season and makes identification more difficult in forested vegetation. Birds sing to defend territories during the breeding season, but as they are incubating

or feeding young during the later stages of the breeding season they become more inconspicuous to protect the young from predators.

Collectively we identified a total of 66 species in the Encampment Forest area among all the counts in 2014 and 2015. This compares very well with the 68 species that were identified by counts that Jim Lind completed in the area in 2007, 2008, and 2010. Presumably, our list along with those of Jim Lind’s previous counts represent the primary breeding avifauna of the forested areas in the Encampment Forest; however, additional species associated with the water areas along the Lake Superior shoreline, those near dwellings, or species that are rare or uncommon in the region may be encountered with earlier sampling times or more intensive efforts. Among species that may breed in small numbers include Sharp-shinned Hawk, Merlin, American Kestrel, Great Horned Owl, Barred Owl, Northern Saw-whet Owl, Tree Swallow, Brown Thrasher, Gray Catbird, European Starling, Black-throated Blue Warbler, and Clay-colored Sparrow.

In June of 2010 Jim Lind conducted 68 point counts along roads and trails in Encampment Forest. He detected 593 individuals representing 46 species. We detected more species and individuals during the June period, but this was due to increased effort with point counts.

Table 1. Summary statistics of birds identified during the June breeding season and during the July-August post-breeding season at the Encampment Forest in 2014 and 2015. All individual counts do not include unidentified species.

Bird Detection Summary	June	July-Aug	June/July/Aug combined
Total number of birds detected in 2014	1,167	434	1,601
Total number of birds detected in 2015	969	614	1,583
Total number of species detected in 2014	55	44	59
Total number of species detected in 2015	52	44	56
Number of survey locations in 2014 and 2015	128	128	256

Encampment Forest Bird Species

The avifauna of the Encampment Forest has a definite coniferous, boreal mixture of bird species (Table 2). Bird species primarily associated with boreal, coniferous forests included the Black-throated Green Warbler, Blackburnian Warbler, Canada Warbler, Golden-crowned Kinglet, Magnolia Warbler, Hermit Thrush, Yellow-rumped Warbler, Northern Parula, Winter Wren, Red-breasted Nuthatch and Yellow-bellied Flycatcher. Many species typical of more deciduous forests were also found in relatively large numbers such as the Ovenbird and Red-eyed Vireo. However, the forest also has high numbers of species associated with shrubby, younger forests such as Chestnut-sided Warblers, American Redstarts, White-throated Sparrow, Mourning Warbler, and Common Yellowthroat. The forest has many species that are often associated with human settlements such as American Crow, American Robin, Blue Jay, Cedar Waxwing, Chipping Sparrow, Mourning Dove, Northern Flicker, and Song Sparrow. With the exception of

the American Crow and Mourning Dove, all of these species are found in remote forests of Minnesota and often far from human settlements.

We only identified one species that would be of considerable interest with respect to its conservation status in Minnesota, the Golden-winged Warbler. We did not observe this species in 2014 but observed two singing males in 2015. Both birds were defending territories within large forest openings in mesic white pine-red pine forest. Over 50 % of the Golden-winged Warbler global population occurs in Minnesota. The species has had over a 60 % decline in its population since 1966 when the federal breeding bird survey was initiated. The species is listed as threatened in Canada and has been under consideration for endangered status in the United States. This species primarily is found in shrubby swamps and often in association with young forests intermixed with more mature forest types. Its primary range in Minnesota is in the northcentral regions of the state. We do not recommend active management for this species at the Encampment Forest. The area is a prime example of serving a naturally, diverse mature deciduous-coniferous forest avifauna highly representative of this region.

No other bird species that are listed as endangered or threatened in Minnesota or in the United States were found at Encampment. In addition to Golden-winged Warbler, several other species found at the Encampment Forest have been identified as Species of Greatest Conservation Need in Minnesota including Veery, Black-billed Cuckoo, Common Loon, American Woodcock, Cape May Warbler, Purple Finch, Black-throated Blue Warbler, Evening Grosbeak, and Winter Wren. These are native Minnesota species with populations that are rare, declining or vulnerable to decline and are below levels desirable to insure their long-term health and stability. Most of these species are listed because of declining populations (often for unknown reasons), threats to their breeding habitat, their populations in Minnesota represent a substantial portion of their global population, or, in the case of the Common Loon, contaminant issues.

Table 2. Number of individuals identified for bird species detected at Encampment Forest in June and July-August sampling periods in 2014 and 2015, * Neotropical migrant..

Species common name	Abundance June 2014	Abundance July 2014	Abundance June 2015	Abundance July 2015	Average June	Average July
Alder Flycatcher*	7	0	3	3	5	2
American Crow	16	6	10	6	13	6
American Goldfinch	1	7	3	21	2	14
American Redstart*	71	8	57	12	64	10
American Robin*	13	15	34	14	24	15
American Woodcock	0	1	0	0	0	1
Baltimore Oriole*	0	0	1	0	1	0
Black-and-white Warbler*	17	1	20	2	19	2
Black-billed Cuckoo*	0	1	0	0	0	1
Black-capped Chickadee	41	82	19	83	30	83
Blue-headed Vireo*	2	1	2	3	2	2
Blackburnian Warbler*	33	1	41	1	37	1
Blue Jay	20	1	12	15	16	8
Brown Creeper	8	1	2	0	5	1
Black-throated Blue Warbler *	0	0	1	0	1	0
Black-throated Green Warbler*	126	57	96	13	111	35
Broad-winged Hawk*	1	1	0	1	1	1
Canada Goose	10	0	0	0	5	0
Canada Warbler*	12	1	7	0	10	1
Cedar Waxwing	17	13	13	113	15	63
Chipping Sparrow	12	7	15	12	14	10
Cape May Warbler*	1	0	5	0	3	0
Common Loon	1	0	0	0	1	0
Common Raven	10	2	1	2	6	2
Common Yellowthroat*	19	8	19	7	19	8
Chestnut-sided Warbler*	81	6	86	12	84	9
Downy Woodpecker	1	3	2	18	2	11
Evening Grosbeak	5	0	1	4	3	2
Golden-crowned Kinglet	7	1	1	3	4	2
Golden-winged Warbler*	0	0	2	0	1	0
Gray Jay	4	0	0	0	2	0
Hairy Woodpecker	2	2	2	4	2	3
Hermit Thrush*	4	2	19	3	12	3

House Wren	0	0	2	2	1	1
Indigo Bunting*	4	3	8	1	6	2
Least Flycatcher*	2	1	7	0	5	1
Magnolia Warbler*	13	2	27	0	20	1
Merlin	0	0	0	1	0	1
Mourning Dove	2	0	0	0	1	0
Mourning Warbler*	44	1	41	7	43	4
Myrtle Warbler	17	1	10	6	14	4
Nashville Warbler*	139	1	83	1	111	1
Northern Flicker	2	7	0	17	1	12
Northern Parula*	14	2	15	3	15	3
Ovenbird*	151	2	96	8	124	5
Pine Siskin	0	2	0	1	0	2
Pine Warbler	6	0	9	0	8	0
Pileated Woodpecker	14	4	7	8	11	6
Purple Finch	3	0	3	51	3	26
Rose-breasted Grosbeak*	3	2	3	3	3	3
Ring-billed Gull	1	0	0	0	1	0
Red-breasted Nuthatch	18	26	16	41	17	34
Red Crossbill	0	2	0	0	0	1
Red-eyed Vireo*	86	67	72	36	79	52
Ruby-throated Hummingbird*	0	0	1	7	1	4
Ruffed Grouse	5	2	0	0	3	1
Song Sparrow	4	4	4	5	4	5
Swamp Sparrow	1	0	0	0	1	0
Swainson's Thrush*	3	1	8	0	6	1
Tennessee Warbler*	2	0	1	0	2	0
Turkey Vulture*	7	0	1	0	4	0
Veery*	21	0	12	4	17	2
Winter Wren	12	2	6	3	9	3
White-throated Sparrow	49	74	54	50	52	62
Yellow-bellied Sapsucker	2	0	3	3	3	2
Yellow-bellied Flycatcher*	0	0	7	4	4	2
Totals	1167	434	969	614		
Number of Species	55	44	52	44		

Habitat Use

Encampment Forest is dominated by two habitat types as categorized by Minnesota DNR (abbreviations provided in Table 3), mesic white pine-red pine forest and mesic upland white cedar forest. Combined these two dominant habitat types comprise over 85% of the area surveyed, and also contain both the highest bird diversity as measured by the number of species and abundance in both the June and July-August surveys.

Most bird species had a large proportion of detections in these two habitats (Table 4), which indicates that within Encampment Forest they were using what was available, rather than selecting for specific habitat types. In other words, their usage of habitats was proportional to the availability of habitat types.

Table 3. Habitat types and abbreviations as defined by the Minnesota Department of Natural Resources classification.

Habitat type	Abbreviation
Mesic Upland White Cedar Forest	MUWCF
Mesic White Pine-Red Pine Forest	MWPRPF
North Shore Aspen-Birch-Fir Forest	NSABFF
North Shore Northern Hardwood Forest	NSNHF
Northern Alder Swamp	NAS
Poor Dry-Mesic Great Lakes Pine Forest	PDMGLPF
Rich Black Ash-Aspen Forest	RBAAF
Wet Meadow	WM
Uncategorized (road)	R

Table 4. Summary of habitat types with species richness (SR) and abundance (Ab) of birds from Encampment point counts in 2014.

Habitat type	% coverage	SR June	SR July	Ab June	Ab July
Mesic White Pine-Red Pine Forest	56.66	48	33	765	343
Mesic Upland White Cedar Forest	28.46	39	23	348	174
Poor Dry-Mesic Great Lakes Pine Forest	5.29	21	7	52	22
Uncategorized (road)	3.04	13	5	28	5
North Shore Northern Hardwood Forest	2.52	12	4	29	6
North Shore Aspen-Birch-Fir Forest	1.84	11	4	22	12
Rich Black Ash-Aspen Forest	1.65	11	3	18	6
Northern Alder Swamp	0.33	4	1	5	1
Wet Meadow	0.21	4	1	5	1

Spatial Distribution of Breeding Birds

One of our primary objectives for sampling the birds of Encampment Forest is to better understand how bird species are spatially distributed across the landscape. Issues such as habitat fragmentation or sensitivity to edges are not well documented or studied for bird species within a contiguous forest environment. Most of the studies on habitat fragmentation have occurred in agricultural or urbanized settings in which forest patches are surrounded by unfavorable habitat (farmland or houses) to forest-associated species. We present two examples in Figures 2 and 3 on the spatial distribution of 1) two species, Ovenbird and Black-throated Green Warbler, that have been suggested as sensitive to patch size or what is referred to as “forest interior” species, and 2) two species, Chestnut-sided Warbler and Mourning Warbler, that are thought to be associated with edges and young, regenerating forests. More sophisticated spatial analyses will allow us to identify whether these distributions are random or have a spatial component relative to forest interiors or edges between two different habitats.

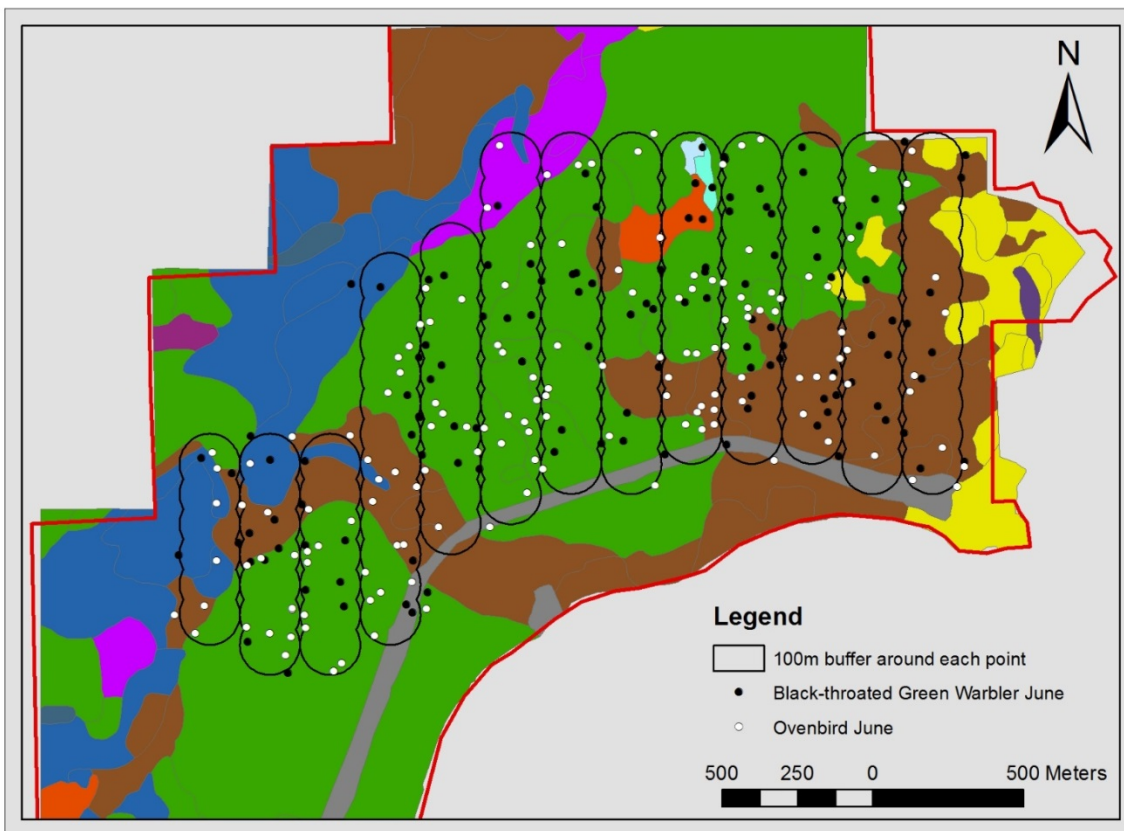


Figure 2. Spatial distribution of Ovenbird and Black-throated Green Warbler, two “forest interior” bird species, at Encampment Forest in June 2014.

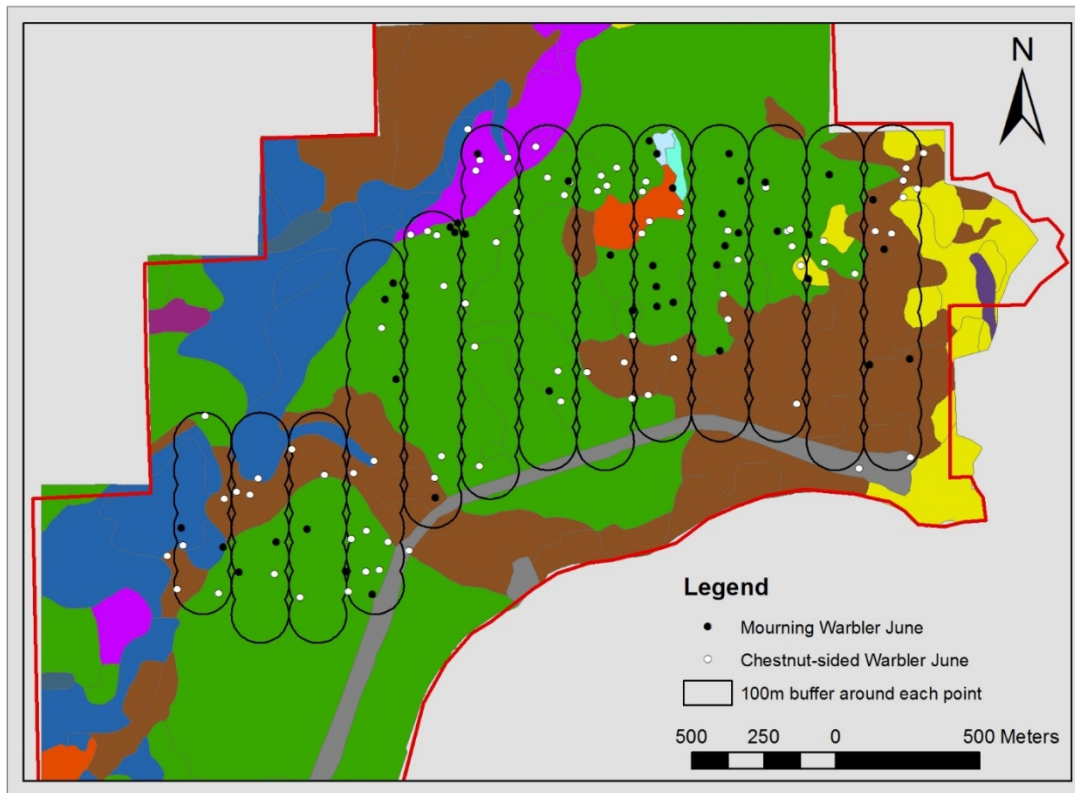


Figure 3. Spatial distribution of Mourning Warbler and Chestnut-sided Warblers, two edge associated bird species, at Encampment Forest in June 2014.

Breeding and Post-breeding Spatial Distributions

A final objective of interest is to examine the use of forest habitats by bird species during the breeding season where nests are placed and during the post-breeding season where the young are raised after leaving the nest. Some recent evidence suggests that bird species such as the Ovenbird nest in mature forests but raise their young in early-successional forests, while species such as the Golden-winged Warbler nest in shrubby wetlands, young forests, or near the edges of forests, but largely raise their young in intermediate and mature forests. Therefore, we will be examining the Encampment Forest plot in terms of the use by bird species during the June breeding season and compare this to their use during the post-breeding season in the July-August period. Table 2 indicates some major shifts in abundance from the June to July-August sampling periods, generally large reductions in the number of detections for most species. This is expected because singing activity and the ability to observe birds within the forest greatly declines in July and August when birds are primarily feeding their young or are molting. Hence, their focus is less on attraction and primarily on being inconspicuous. For example, the number of Black-throated Green Warblers observed declined from 126 individuals in June to 57 in the July-August sampling period. Figure 4 illustrates the distribution of all bird observations within Encampment Forest from the June to the July-August period. To simplify these relationships, we illustrate the observations of Red-eyed Vireo from June to the July-August period (Figure 5). In contrast with most other species, the number of Red-eyed Vireo observations remained relatively

high between the two periods, 86 individuals to 67 individuals in June and July-August, respectively. This species is one of the few that tends to keep singing later into the summer.

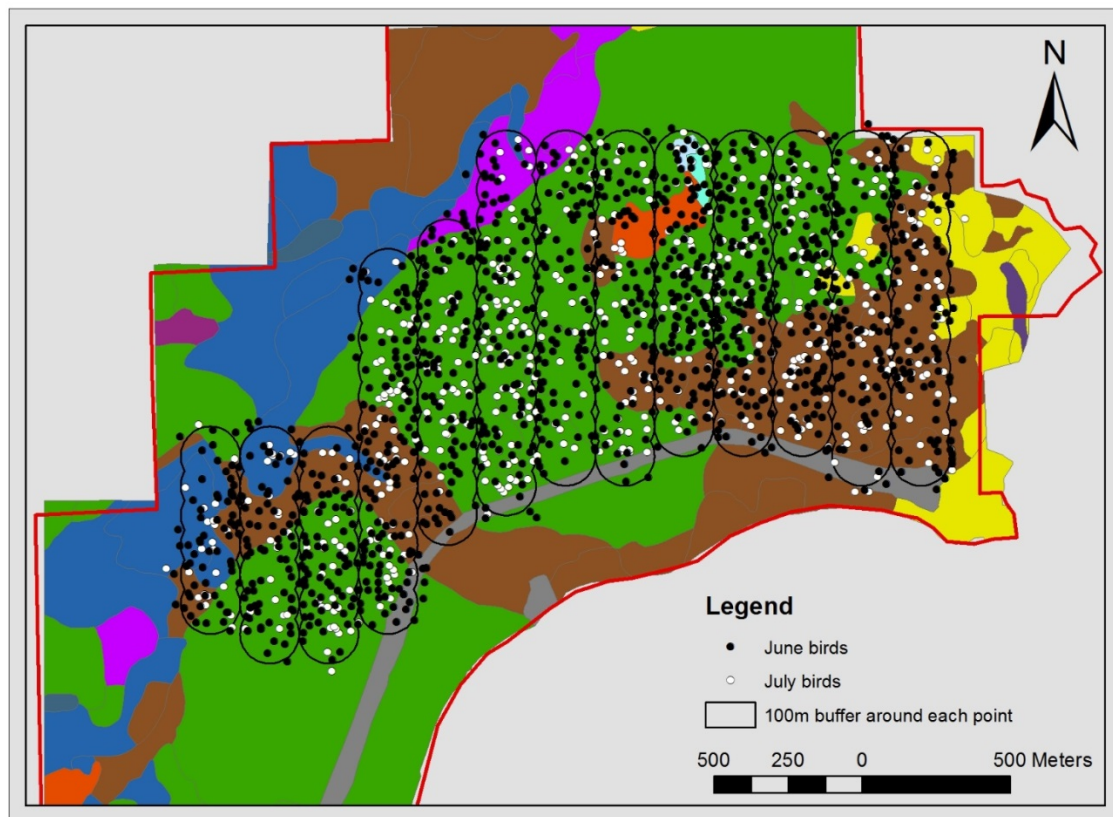


Figure 4. The distribution of all bird observations at Encampment Forest in June and July 2014.

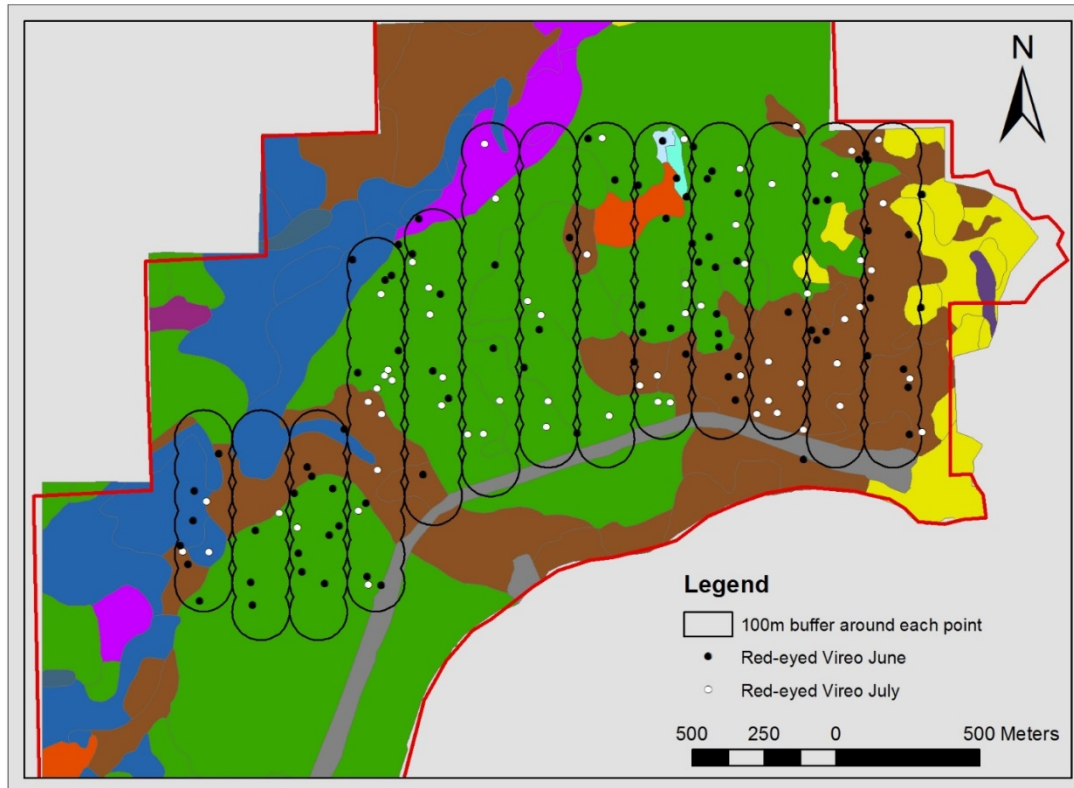


Figure 5. The distribution of Red-eyed Vireos at Encampment Forest in June and July 2014.

Bird Habitat Use with Availability

We tested for habitat selection in 24 species of which six were significant (Table 5). The Chestnut-sided Warbler, Common Yellowthroat, Mourning Warbler, Yellow-rumped Warbler, Ovenbird, and Winter Wren were significantly selecting habitats not in proportion to their availability in Encampment Forest during the June surveys. For example, Ovenbirds were significantly selecting for specific habits at Encampment Forest and out of proportion to their availability on the landscape. Savage’s selectivity index showed that Ovenbirds were avoiding mesic upland white cedar forest, selecting mesic white pine-red pine forest and avoiding the road (Table 5). In contrast, the Black-throated Green Warbler exhibited no habitat selection in the large plots in June.

In July, there were only six bird species with sufficient sample size to determine whether or not they were exhibiting habitat selection: Black-capped Chickadee, Black-throated Green Warbler, Cedar Waxwing, Red-eyed Vireo, Red-breasted Nuthatch, and White-throated Sparrow. The chi square test indicated that no bird species were exhibiting selection during the second round of surveys; however, Savage’s selectivity index showed that every bird species displayed some preferences and avoidances of habitat types (Table 6). All birds that we analyzed for July were avoiding the road. Other than road avoidance, Black-capped Chickadees were distributed across the habitat types as would be expected given the proportion of available habitat. The next most abundant bird on the July surveys, White-throated Sparrow, was avoiding poor dry-mesic Great Lakes pine forest and the road but was distributed as expected across the remaining habitat types. Red-eyed Vireos were positively associated with mesic white pine-red pine forest.

Table 5. Results from Savage's selectivity and chi-square analyses for June bird detections. Numbers in the body of the table are from Savage's selectivity; if bird species was significantly selecting for or against a particular habitat type its probability of selection is in bold. The positive and negative signs indicate the direction of the association (e.g. a negative sign indicates a bird species was avoiding a habitat type). Significant chi-square results are in bold in the column furthest to the right. We only included birds that were detected more than ten times at Encampment Forest for the survey period.

Habitat type	Mesic Upland White Cedar Forest	Mesic White Pine Forest	North Shore Aspen-Birch-Fir Forest	North Shore Forest	Northern Alder Swamp	Poor Dry-Mesic Great Lakes Pine Forest	Rich Black Ash-Aspen Forest	Wet Meadow	Uncategorized (road)	Chi square
American Crow	0.48	<0.05(-) <0.05(+)	0.12	0.07	0.52	0.63	0.14	0.60	<0.05(+)	0.07
American Redstart	<0.05(-)	<0.05(+)	0.12	0.07	0.52	<0.05(-)	0.90	0.60	0.41	0.11
American Robin	<0.05(-)	<0.05(+)	0.12	<0.05(+)	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.86
Black-and-white Warbler	0.65	<0.05(+)	0.12	0.07	0.52	0.49	0.14	0.60	<0.05(-)	0.99
Blackburnian Warbler	0.28 <0.05(+)	<0.05(+)	0.12	0.07	0.52	<0.05(-)	0.14	0.60	0.79	0.77
Black-capped Chickadee	)	0.21	0.12	0.95	0.52	<0.05(-)	0.48	0.60	<0.05(-)	0.41
Black-throated Green Warbler	0.85	0.47 <0.05(+)	0.34 <0.05(+)	0.70	0.52	0.41	0.77	0.60	0.21	0.91
Blue Jay	<0.05(-)	)	)	0.07	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.63
Cedar Waxwing	0.09	0.07	0.12	0.07	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.93
Chestnut-sided Warbler	0.21 <0.05(+)	0.79 <0.05(+)	<0.05(+)	<0.05(+)	0.52	<0.05(-)	<0.05(+)	<0.05(+)	<0.05(-)	<0.05
Chipping Sparrow	)	<0.05(-) <0.05(+)	0.12	0.07	0.52	0.12	0.14	0.60	<0.05(-)	0.88
Common Raven	<0.05(-)	)	0.12	0.07	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.79
Common Yellowthroat	<0.05(+)	<0.05(-)	<0.05(+)	0.07	0.52	<0.05(-)	<0.05(+)	<0.05(+)	<0.05(+)	<0.05

Table 5. Results from Savage's selectivity and chi-square analyses for June bird detections. Numbers in the body of the table are from Savage's selectivity; if bird species was significantly selecting for or against a particular habitat type its probability of selection is in bold. The positive and negative signs indicate the direction of the association (e.g. a negative sign indicates a bird species was avoiding a habitat type). Significant chi-square results are in bold in the column furthest to the right. We only included birds that were detected more than ten times at Encampment Forest for the survey period.

Mourning Warbler	0.48	0.27	<0.05(+)	0.07	0.52	<0.05(-)	<0.05(+)	<0.05(+)	<0.05(-)	<0.05
Yellow-rumped Warbler	0.48	0.93	0.12	0.07	0.52	<0.05(-)	0.14	<0.05(+)	<0.05(+)	<0.05
Nashville Warbler	0.93	0.66	0.43	0.90	0.25	0.61	0.14	0.60	0.42	0.80
Northern Parula	0.22	<0.05(-)	0.12	0.07	0.52	0.12	0.14	0.60	<0.05(+)	0.35
Ovenbird	<0.05(-)	<0.05(+)	0.37	0.90	0.52	0.48	0.44	0.60	<0.05(-)	<0.05
Pileated Woodpecker	<0.05(-)	<0.05(+)	0.12	0.07	0.52	0.35	<0.05(+)	0.60	<0.05(-)	0.73
Red-breasted Nuthatch	<0.05(+)	<0.05(-)	<0.05(+)	0.07	0.52	0.77	0.14	0.60	<0.05(-)	0.45
Red-eyed Vireo	0.49	0.06	0.47	0.40	0.52	0.19	0.35	0.60	<0.05(-)	0.66
Veery	<0.05(-)	<0.05(+)	0.12	0.07	0.52	<0.05(-)	<0.05(+)	0.60	<0.05(-)	0.36
White-throated Sparrow	<0.05(-)	0.07	<0.05(+)	0.07	0.52	<0.05(-)	<0.05(+)	0.60	0.95	0.22
Winter Wren	<0.05(+)	<0.05(-)	0.12	0.07	0.52	<0.05(+)	0.14	0.60	<0.05(-)	<0.05

Table 6. Results from Savage's selectivity and chi-square analyses for July/August bird detections. Numbers in the body of the table are from Savage's selectivity: if bird species was significantly selecting for or against a particular habitat type its probability of selection is in bold. The positive and negative signs indicate the direction of the association (e.g. a negative sign indicates a bird species was avoiding a habitat type). Significant chi-square results are in bold in the column furthest to the right. We only included birds that were detected more than ten times in the entire large plot sampling area for the survey period.

Habitat type	Mesic Upland White Cedar Forest	Mesic White Pine-Red Pine Forest	North Shore Aspen-Birch-Fir Forest	North Shore Northern Hardwood Forest	Northern Alder Swamp	Poor Dry-Mesic Great Lakes Pine Forest	Rich Black Ash- Aspen Forest	Wet Meadow	Uncategorized (road)	Chi square
Black-capped Chickadee	0.42	0.07	0.12	0.07	0.52	0.41	0.14	0.60	<0.05(-)	0.30
Black-throated Green Warbler	<0.05(+)	0.27	0.12	0.07	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.77
Cedar Waxwing	<0.05(+)	<0.05(-)	0.12	<0.05(+)	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.57
Red-breasted Nuthatch	0.18	0.27	0.12	0.34	0.52	<0.05(+)	0.14	0.60	<0.05(-)	0.83
Red-eyed Vireo	<0.05(-)	<0.05(+)	0.15	0.07	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.18
White-throated Sparrow	0.09	0.24	0.36	0.07	0.52	<0.05(-)	0.14	0.60	<0.05(-)	0.72

Conclusion

This report represents a summary of the results of our sampling in Encampment Forest in 2014 and 2015. In the future we are planning on comparing these results with similar counts we have completed in other forested areas in north-central and northeastern Minnesota that are under different forest management strategies. Locations include bird counts in the Chippewa National Forest, Pine County, the Superior National Forest, and at Wolf Ridge Environmental Learning Center. In particular we are interested in differences in bird species composition as a result of these forest management strategies as well as their spatial distribution with respect to edges and patch sizes in different forest cover types.

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