PREDICTING BREEDING HABITAT
OF THE CONNECTICUT WARBLER (*Oporornis agilis*)

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Gerald J. Niemi

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ABSTRACT

The Connecticut warbler (*Oporornis agilis*) is an uncommon Neotropical migrant that breeds in the north-central United States and south-central Canada. Breeding populations of this species are reported to be declining. I analyzed habitat and landscape at three spatial scales (buffer radii of 100 m, 500 m, and 1,000 m) for 86 sites within 28 forest stands in northern Minnesota for Connecticut Warblers sampled over an 18-year period. I regressed combinations of habitat variables with two response variables, Connecticut Warbler abundance (the total number ever recorded at a site or stand) and Connecticut Warbler frequency (the number of years recorded out of 18 years) using a zero-inflated negative binomial distribution and logistic regression, respectively. A subset of models with $\Delta AIC_c \leq 4.0$ was retained and model-averaged predictions were calculated for each combination of buffer size and response variable. When comparing model-averaged predictions to observed data, the best models were those using Connecticut Warbler frequency at the 1,000 m buffer ($r^2 = 0.52$). These models were used to create a map of predicted Connecticut Warbler breeding habitat in the two national forests sampled. At the 1,000 m scale, Connecticut Warblers were positively associated with large, simple patches of upland coniferous and lowland black spruce forest, and were negatively associated with upland deciduous forest.

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INTRODUCTION

The Connecticut Warbler (*Oporornis agilis*) is a Neotropical migrant wood warbler that breeds in the north-central United States and south-central Canada and winters in central South America. It is considered to be an "additional stewardship species" on a national scale by Partners in Flight because a high percentage of its population can be found in one biome: the Northern Forest Avifaunal Biome (Rich et al. 2004). In addition, Partners in Flight lists the Connecticut Warbler as a species of "regional concern" with "high conservation priority" in the United States portion of Bird Conservation Region 12, the Boreal Hardwood Transition, due to its vulnerability at the regional scale resulting from a combination of limited distribution, high threat, and small and declining populations (Matteson et al. 2009).

The Connecticut Warbler is a relatively uncommon species, breeding from east-central British Columbia across Canada to west-central Quebec and south to south-central Ontario, central Michigan, northern Wisconsin, and northern Minnesota (Degraaf et al. 1991). In Minnesota, Connecticut Warbler breeding habitat consists of mature, lowland coniferous habitats, primarily black spruce and tamarack bogs with dense underbrush, scattered trees, and grassy openings (Forbush and May 1955; Ehrilich et al. 1988; Degraaf et al. 1991; Niemi and Hanowki 1992; Danz et al. 2007). In those bogs where breeding Connecticut Warblers have been confirmed, trees are typically well spaced and there is usually moss ground cover under a layer of low-lying Labrador tea (*Ledum groenlandicum*) and swamp laurel (*Kalmia polifolia*) (Huff 1929; Walkinshaw and Dyer 1961). The wintering habitat of the Connecticut Warbler, though not well studied, consists of dense, shrubby woodlands and second growth forest in northern and central

South America, especially Colombia, Brazil, and Venezuela (Forbush and May 1955; Pitocchelli et al. 1997; Jahn et al. 1999).

Migrating Connecticut Warblers arrive in their northern Minnesota breeding grounds between early May and early June, and courtship and mating occur shortly thereafter (Janssen 1987; Robbins 1991). Following mating, nests are built in June, eggs are laid in June to early July, and hatchlings fledge in late July to August (Robbins 1991). Fall migration begins in Minnesota in late August to early October (Janssen 1987). The nest of a Connecticut Warbler consists of a cup made of leaves on the ground, flush with the surrounding moss, and lined with fine dried grass or weeds (Huff 1929; Walkinshaw and Dyer 1961; Ehrlich et al. 1988; Degraaf et al. 1991). Nests are typically located in open forests with widely spaced trees and concealed underneath thick vegetative cover (Huff 1929; Walkinshaw and Dyer 1961; Ehrlich et al. 1988; Degraaf et al. 1991).

Partners in Flight estimates the breeding population of the Connecticut Warbler in the United States and Canada to total approximately 1,200,000 birds (Rich et al. 2004), and the Canadian Boreal Initiative estimates the post-breeding global population of Connecticut Warblers to total 6,300,000 birds (Blancher 2003). Roadside data from Breeding Bird Surveys indicate that there has been a decline in Connecticut Warbler populations in North America of 2.9% over 103 routes from 1966 to 2007 (Sauer et al. 2008). Annual surveys in the Western Great Lakes National Forests have indicated a decline in Connecticut Warbler populations since the early 1990's (Hanowski et al. 2002). In addition, the Canadian Wildlife Service reports a decline in Connecticut Warbler populations in Canada of 1.9% from 1968 to 2008 and 4.0% from 1998 to 2008 (Collins and Downes 2009). Causes of declines in Connecticut Warbler populations, though not well-documented, have been potentially attributed to nest predation, changes in landscape and loss of nesting habitat as a result of fragmentation and climate change (Hanowski et al. 2002; Danz et al. 2007), changes in habitat due to biomass harvesting (peat mining), and collisions with manmade structures (Robbins 1991). Little is known about the Connecticut Warbler's migratory or wintering habitat, but depletion or degradation of these necessary components may also result in declining numbers.

Though not apparently in immediate danger, the Connecticut Warbler has the potential to become a high priority species due to its specific habitat requirements and threats to its nesting habitat. My goal is to improve understanding of attributes that provide the best breeding habitat for the Connecticut Warbler so conservation efforts can be focused on the sites with those characteristics. My objectives were to derive models that predict the potential breeding habitat of Connecticut Warblers in Minnesota based on long-term annual point count data and environmental variables at several spatial scales (100, 500, and 1,000 m-radius buffers, which correspond to areas of approximately 3.1, 78.5, and 314.2 ha, respectively). Using the best derived models, based on the Akaike Information Criterion (AIC), and their averaged predictions, I have generated a list of variables most important to breeding Connecticut Warblers for management purposes at three different spatial scales. Using the predictive models at the largest scale (1,000 m buffer), I created a map of the predicted breeding habitat of Connecticut Warblers in Northern Minnesota for the purpose of conservation planning. In the future, it may be possible to apply the methodology that I have used in this study to other Neotropical migrant species with similar habitat requirements in Northern Minnesota.

METHODS

Sampling.- I conducted surveys and my analysis on a subset of sites used in the Birds of Western Great Lakes Forests project. This project was established in Chippewa and Superior National Forests in Minnesota in 1991 to monitor breeding bird populations at a regional scale (Hanowski and Niemi 1995; Hanowski et al. 2002; Danz et al. 2007; Niemi et al. 2009). The program currently consists of annual breeding bird surveys at 435 stands (1,271 points) between 1 June and 10 July (Hanowski et al. 2002). When the project's sampling design was initiated, each stand (a set of three survey points, each a minimum of 220 m apart) was located entirely within one forest cover type as identified in each national forest's inventory, and the number of stands of each forest type surveyed was proportional to the land within that national forest of each cover type (Hanowski and Niemi 1995; Hanowski et al. 2002). The Birds of the Western Great Lakes Forest project uses 10-minute point counts at each survey point, conducted by a trained observer who records all birds seen or heard within 100 m of the point. Hanowski et al. (2002) describes the bird sampling and observer training procedures that have been used since the project's initiation.

Additional Sampling of Connecticut Warbler Habitat.- I examined all stands where Connecticut Warblers were recorded from 1991-2008. Of those stands, the most occurrences were recorded in black spruce (*Picea mariana*) forest cover, followed by tamarack (*Larix laricina*) and mixed swamp conifer, respectively. I eliminated from consideration any of these stands where Connecticut Warblers were not observed after the year 2000. I included all stands within the same three forest cover types listed above where Connecticut Warblers were never recorded ("zeroes").

To complete a more detailed field sampling in summer 2009, I limited the number of stands considered through a stratification of "good", "medium", and "poor" habitat based on the number of occurrences of Connecticut Warblers. The stands described above were ranked according to the product of the abundance of Connecticut Warblers (the total number ever recorded at that stand) and the frequency of occurrence of Connecticut Warblers (the number of years in which they were recorded). All stands were then distributed evenly across five categories according to the ranking, with category 5 representing the stands with the highest product of abundance and frequency, and category 1 representing the stands with the lowest product of abundance and frequency (zeroes were not included in the ranking). I chose a subset of 30 stands to be included in model selection: 10 stands with the highest category 5 rankings ("good" habitat), 10 stands with the lowest category 4 rankings ("medium" habitat), and 10 stands where Connecticut Warblers were never recorded (zeroes; "poor" habitat) (Appendix 1). Of the zeroes, there were only 2 stands in black spruce habitat, which were included, and 8 stands were chosen randomly from a group of 14 stands in mixed swamp conifer forest (the only other remaining category of potentially suitable Connecticut Warbler habitat).

Independent variables.- I determined a set of *a priori* environmental variables to consider for model building from existing literature about the Connecticut Warbler's environmental associations (Table 1; Pitochelli et al. 1997 and references therein). The value of each environmental variable was recorded in the field during 2009 surveys or determined with the use of geographic information systems (GIS) in ArcGIS 9.2 (Environmental Systems Research, Inc., Redlands, California) at three different spatial scales (Appendix 3). Points were analyzed at the site of survey or with GIS at a buffer of

100 m (Figure 1). Stands (a complete set of three points) were analyzed with GIS at buffer sizes of 500 and 1,000 m (Figure 1). I included 86 points and 28 stands in the analysis. Two of the 30 stands that were initially included had fewer than three points, and thus were not included in the analysis at the 500 and 1,000 m buffer sizes.

Independent variables analyzed initially included measurements of forest composition and continuity, development, and ecological classification (Table 1). The percent of each land cover type (13 land cover types were considered) within each buffer size was calculated with the use of GIS and data from the Upper Midwest Gap Analysis Program. This program provides land cover data, focusing on forested lands, with a 30 m by 30 m resolution size from the early 1990's, which was approximately the same time at which bird surveys were initiated (Lillesand et al. 1998). Any land cover types that did not constitute more than 10% of any site or stand buffer were not included in the analysis of that buffer size. Forest stand age information was obtained from forest inventory data measured in the field by foresters that was integrated from several forest management groups within the state of Minnesota (Skally 2000).

Other measurements from the forest composition variables were gathered during field surveys in 2009 and were point-specific. I collected soil moisture and pH data using a Kelway Soil pH and Moisture Meter. Tree density and basal area per hectare were measured at each point count location using a 10 BAF wedge prism, and these values were averaged for each stand of three points to be included in the 500 m buffer analysis. In addition, I recorded the density of vegetation at ground and mid-ground (approximately 1 m above ground) levels, percent canopy cover, and the primary plant species present at ground, mid-ground, and canopy levels at each point count location.

Vegetation density at ground and mid-ground levels was classified on a scale of 1 to 5, with 5 being the highest density, and percent canopy cover was estimated at 10% intervals.

For all forest continuity measurements, land cover types were aggregated into lowland coniferous forest, lowland deciduous forest, upland coniferous forest, upland deciduous forest, open wetland, and other. Patches were considered to be these aggregated land cover types. I determined the type of patch in which a point occurred, distance to nearest upland habitat, distance to nearest open wetland, and forest stand size using GIS. I used the Patch Analyst 4 application for ArcGIS to calculate various patch metrics within each buffer. The patch metrics analyzed included: number of patches within each buffer, patch size, total edge of patches, edge density of patches, and three measurements of shape complexity: mean perimeter-area ratio, mean shape index, and mean patch fractal dimension (McGarigal and Marks 1995). For each patch metric, I calculated the average and standard deviation of the metric for all patches within the buffer (Figure 1).

I included a measurement of development by analyzing the distance to the nearest road from each point count location using GIS. To account for potential biogeographic differences, I included Land Type Association, a classification based on a combination of biotic and environmental factors, from the Minnesota Department of Natural Resource's Ecological Classification System (MDNR 2010). All of the GIS data used to determine the values of environmental variables at each point and stand was obtained from the Minnesota Department of Natural Resource's Data Deli (MDNR 1999-2008).

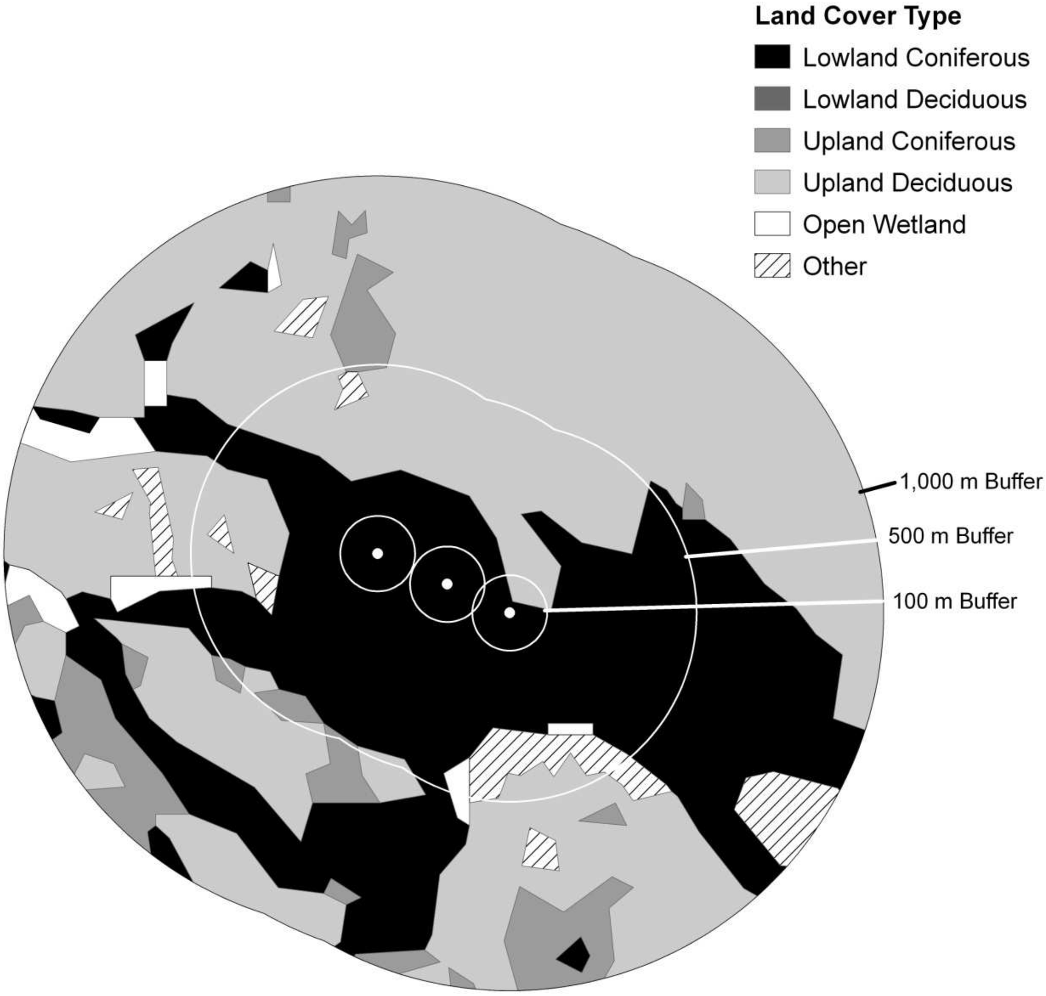


FIGURE 1. Depiction of stand (three points) with three buffer sizes used in analysis and land cover patches used in forest continuity measurements.

TABLE 1. Environmental variables considered for model building of habitat associations of the Connecticut Warbler in Northern Minnesota.

Environmental group	Variable	Buffer size(s) (m)
Forest composition	Lowland black spruce forest (%)	100, 500, 1,000
	Tamarack forest (%)	100, 500, 1,000
	Lowland northern white-cedar forest (%)	100, 500, 1,000
	Lowland mixed coniferous forest (%)	100, 500, 1,000
	Lowland deciduous forest (%)	100, 500, 1,000
	Upland coniferous forest (%)	100, 500, 1,000
	Mixed deciduous-coniferous forest (%)	100, 500, 1,000
	Upland deciduous forest (%)	100, 500, 1,000
	Sedge fen (%)	100, 500[a], 1,000[a]
	Muskeg (%)	100, 500[a], 1,000[a]
	Alder willow (%)	100, 500, 1,000
	Developed, including agriculture (%)	100[a], 500[a], 1,000[a]
	Other (%)	100, 500, 1,000
	Stand age	100
	Soil moisture[b]	100
	Soil pH[b]	100
	Tree density (trees / ha)[b]	100, 500[c]
	Basal area (m^2 / ha)[b]	100, 500[c]
	Ground and mid-ground (approximately 1 m) vegetation density and percent canopy cover[b]	100
	Primary plant species at ground, mid-ground, and canopy levels[b]	100
Forest continuity[d]	Patch type (in which point count occurred)	100
	Number of patches within buffer	100, 500, 1,000
	Mean and SD of patch size within buffer	100, 500, 1,000
	Mean and SD of patch mean shape index within buffer	100, 500, 1,000

Environmental group	Variable	Buffer size(s) (m)
	Mean and SD of patch perimeter-to-area ratio within buffer	100, 500, 1,000
	Mean and SD of mean patch fractal dimension within buffer	100, 500, 1,000
	Mean and SD of total patch edge within buffer	100, 500, 1,000
	Mean and SD of patch edge density within buffer	100, 500, 1,000
	Distance to nearest upland land cover type (m)	100
	Distance to nearest open wetland cover type (m)	100
	Stand size	500
Development	Distance to nearest road (m)	100
Ecological Classification	Land Type Association	100, 500, 1,000

[a] Land cover variable was not included in analysis for given buffer size because cover type did not constitute more than 10% of buffer for any point or stand.

[b] Measurements taken in field during 2009 breeding bird surveys. Measurements of tree density and basal area were taken using a 10 BAF wedge prism.

[c] Values were averaged for all three points within a stand. Mean values and variances were used in modeling.

[d] Forest continuity measurements were obtained after aggregating all lowland coniferous forest, lowland deciduous forest, upland coniferous forest, upland deciduous forest, open wetland, and other.

Statistical analysis.- Initially, there were 41 variables considered at the 100 m buffer size, 29 at the 500 m buffer size, and 24 at the 1,000 m buffer size (Table 1). All of the variables were examined for normality and heteroscedasticity and transformed accordingly if needed. I reduced the number of variables to be considered in model building at each buffer size using two methods in PC-ORD Version 5 (McCune and Mefford 2006). A correlation matrix of the variables at each buffer was examined. Those pairs of variables with a correlation greater than 0.8 were reviewed, and the one with less interpretability relative to Connecticut Warblers or high correlation with other variables included was removed from consideration. I then conducted a principal components analysis at each buffer size. For each axis with an eigenvalue greater than 1.0, I retained the variable that had the highest or second-highest correlation with the principal component, depending on interpretability. All other variables were discarded from model building.

Following the variable reduction procedure described above, I conducted model building and selection by regressing two response variables from data from all of the years (1991 – 2008) of the Birds of the Western Great Lakes Forests project using SAS/STAT 9.2 (SAS Institute Inc.). The frequency of Connecticut Warbler occurrences (the number of years in which they were detected out of the number of years that a site was surveyed) was modeled using logistic regression, and the abundance of Connecticut Warblers (the total number ever recorded at a point or stand) was modeled using zero-inflated negative binomial regression, which had the best distribution qualities of these data. I initially also considered Poisson, zero-inflated Poisson, and negative binomial distributions for the Connecticut Warbler abundance data. Both response variables were examined at all three buffer sizes, using individual point data at the 100 m buffer level and using combined stand data at the 500 and 1,000 m buffer levels.

For each response variable, I considered a set of models by regressing different combinations of environmental variables. I ranked models from lowest to highest second-order Akaike's Information Criterion (AIC_c), which is adjusted for small sample size (Burnham and Anderson 2002). Seventy models were considered at the 100 m buffer level, 55 at the 500 m buffer level, and 35 at the 1,000 m buffer level. I calculated the difference between the best AIC_c model (the model with the lowest AIC_c) and all other models in the set (ΔAIC_c). All of those models with a $\Delta AIC_c \leq 4.0$ were included in the subset of best models for that response variable, which gives an approximate 95% confidence set of models on the Kullback-Leibler best model (Burnham and Anderson 2002). I calculated the Akaike weight (w_i) of each model in the subset of best models to get the relative likelihood of each given the data and the candidate set of models (Burnham and Anderson 2002; Johnson and Omland 2004). To establish the relative importance of each explanatory variable within a subset of models ($w_+(j)$), I added the Akaike weight of each model in which that parameter appeared (Burnham and Anderson 2002). I computed the predictions of Connecticut Warbler abundance and frequency for each point and stand using every model in the subset at each buffer size. Following Burnham and Anderson (2002), I averaged the predictions, using the Akaike weights as calculated above, across each subset of models so that the internal structure of each model in the subset would be retained and an average outcome from the subset could be reached.

RESULTS

Independent Variables

Initially, I considered 41 *a priori* environmental variables in the 100 m buffer analysis, 29 in the 500 m buffer analysis, and 24 in the 1,000 m buffer analysis. After reducing the number of variables to be considered with principal components analysis, 11 variables remained in the 100 m buffer analysis, 8 variables remained in the 500 m buffer analysis, and 6 variables remained in the 1,000 m buffer analysis (Table 2).

100 m buffer size.- In a zero-inflated negative binomial regression of the abundance of Connecticut Warbler occurrences to various combinations of the environmental variables described above at the 100 m buffer size, 10 models had a $\Delta AIC_c \leq 4.0$ (Appendix 4). The best model ($w_i = 0.24$) included percent lowland deciduous forest and ground cover vegetation density. The subset of best models did not include the percent muskeg or distance to upland habitat variables. In the subset of best models, the variables with a relative weight ($w_+(j)$) greater than 0.5 were ground cover vegetation density ($w_+(j) = 1.0$), percent lowland deciduous forest ($w_+(j) = 0.83$), and percent canopy cover ($w_+(j) = 0.62$) (Table 2). Ground cover density was positively associated, percent lowland deciduous forest was negatively associated, and percent canopy cover was either positively or negatively associated with Connecticut Warbler abundance, depending on what other variables were in the equation (Table 2).

Logistic regression of Connecticut Warbler frequency at the 100 m buffer size resulted in a subset of 19 models with $\Delta AIC_c \leq 4.0$ (Appendix 4). All of the variables listed above at the 100 m buffer size were included in the subset of best models, and the best model ($w_i = 0.12$) included all variables except percent upland deciduous-coniferous forest, percent alder willow, and distance to open wetland habitat. In the subset of best models, the variables with a relative importance greater than 0.5 were percent canopy cover ($w_+(j)$ = 1.0), percent lowland mixed coniferous forest ($w_+(j)$ = 1.0), ground cover vegetation density ($w_+(j)$ = 0.96), percent tamarack forest ($w_+(j)$ = 0.91), percent lowland deciduous forest ($w_+(j)$ = 0.89), and distance to upland habitat ($w_+(j)$ = 0.73) (Table 2). Percent canopy cover and percent lowland deciduous forest were negatively associated with Connecticut Warbler frequency, and percent lowland mixed coniferous forest, ground cover vegetation density, percent tamarack forest, and distance to upland habitat were all positively associated (Table 2).

500 m buffer size.- At the 500 m buffer size, a zero-inflated negative binomial regression of Connecticut Warbler abundance yielded a subset of 9 models with $\Delta AIC_c \leq 4.0$ (Appendix 4). The best model in the subset (w_i = 0.25) included percent lowland black spruce forest and tree density variance, and the subset of best models also included percent alder willow, tree density, and number of patches within the buffer. Those variables with a relative importance ($w_+(j)$) greater than 0.5 were percent lowland black spruce forest ($w_+(j)$ = 0.88), and tree density variance ($w_+(j)$ = 0.60), both of which were positively associated with abundance, and percent alder willow ($w_+(j)$ = 0.57), which was negatively associated with Connecticut Warbler abundance (Table 2).

Logistic regression of Connecticut Warbler frequency at the 500 m buffer size resulted in a subset of 5 models with $\Delta AIC_c \leq 4.0$ (Appendix 4). Average mean patch fractal dimension was the only variable not present in the subset of best models. The best model in the subset (w_i = 0.39) included percent lowland black spruce forest, percent alder willow, tree density, and tree density variance. Percent lowland black spruce forest and tree density variance both had a relative importance ($w_+(j)$) of 1.0 and were positively associated with Connecticut Warbler frequency (Table 2). Percent alder willow and tree density also both had a relative importance ($w_+(j)$) of 1.0 and were both negatively associated with frequency (Table 2). There were no other variables in the subset with a relative importance greater than 0.5.

1,000 m buffer size.- Zero-inflated negative binomial regression of Connecticut Warbler abundance at the 1,000 m buffer level resulted in a subset of 11 models with $\Delta AIC_c \leq 4.0$ (Appendix 4). All six of the variables analyzed at this buffer size were included in the subset, and the best model (w_i = 0.21) included percent upland deciduous forest and average total edge of patches within the buffer. The variables with a relative importance ($w_+(j)$) greater than 0.5 were percent upland deciduous forest ($w_+(j)$ = 0.91), average total edge of patches in the buffer ($w_+(j)$ = 0.88), and percent upland coniferous forest ($w_+(j)$ = 0.62) (Table 2). Both percent upland deciduous forest and average total edge of patches were negatively associated and percent upland coniferous forest was positively associated with Connecticut Warbler abundance (Table 2).

Logistic regression of Connecticut Warbler frequency at the 1,000 m buffer size resulted in a subset of 8 models with $\Delta AIC_c \leq 4.0$ (Appendix 4). All six of the variables analyzed were included in the subset of models, and the best model (w_i = 0.28) included percent upland coniferous, upland deciduous, and lowland black spruce forests, number of patches within the buffer, and average total edge of patches within the buffer. Percent upland deciduous forest and average total patch edge in the buffer both had a relative importance ($w_+(j)$) of 1.0 and were negatively associated with the response variable, and percent upland coniferous forest also had a relative importance of 1.0 but was positively associated with Connecticut Warbler frequency (Table 2). The number of patches within the buffer ($w_+(j)$ = 0.63) was negatively associated, and the percent lowland black spruce forest ($w_+(j)$ = 0.56) was positively associated with the response variable (Table 2). The final variable within the subset, percent lowland mixed coniferous forest, did not have a relative importance greater than 0.5 ($w_+(j)$ = 0.27) (Table 2).

TABLE 2. Summary of predictor variables included in “best” models for Connecticut Warbler abundance and frequency at each buffer size. $w_{+}(j)$ = relative Akaike weight of variable in set of “best” models, Estimate (SE) = parameter estimate for variable in best model in which it occurs (SE), +/- = relationship of Connecticut Warbler abundance or frequency with predictor variable, No. Models = number of models in which variable occurs / total number of “best” models in the set.

Variable	Connecticut Warbler Abundance $w_{+}(j)$	Abundance +/-	Abundance No. Models	Connecticut Warbler Frequency $w_{+}(j)$	Frequency +/-	Frequency No. Models
100 m Buffer						
Ground cover vegetation density	1.0	+	10/10	0.96	+	17/19
Lowland deciduous (%)	0.83	-	7/10	0.89	-	18/19
Canopy cover (%)	0.62	+/-	7/10	1.0	-	19/19
Alder willow (%)	0.18	-	1/10	0.04	-	1/19
Tamarack (%)	0.11	-	2/10	0.91	+	16/19
Sedge fen (%)	0.11	-	1/10	0.43	-	7/19
Distance to open wetland (m)[a]	0.10	+	1/10	0.03	+	1/19
Lowland mixed coniferous (%)	0.07	-	2/10	1.0	+	19/19
Upland deciduous-coniferous (%)	0.05	+	1/10	0.09	-	3/19
Muskeg(%)				0.41	+	8/19
Distance to upland (m)[b]				0.73	+	13/19
500 m Buffer						
Lowland black spruce (%)	0.88	+	8/9	1.0	+	5/5
Tree density variance (#/ha)[a]	0.6	+	5/9	1.0	+	5/5
Alder willow (%)[b]	0.57	-	5/9	1.0	-	5/5
Tree density (#/ha)	0.19	+	3/9	1.0	-	5/5
Number of patches	0.17	+/-	3/9	0.23	+	2/5
Mean patch total edge (m)				0.43	-	3/5

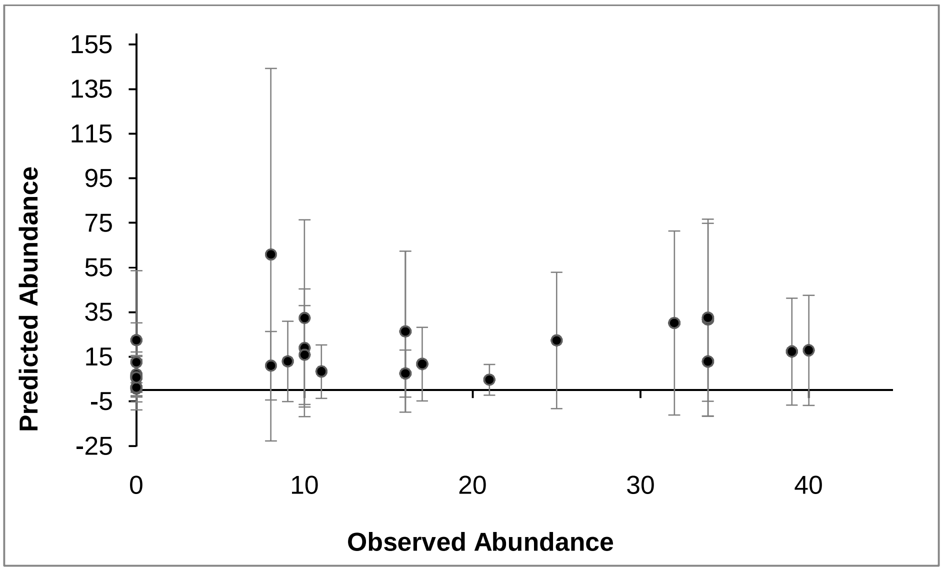
Lowland northern white-cedar (%)[b]				0.06	-	1/5
		1,000 m Buffer				
Upland deciduous (%)	0.91	-	9/11	1.0	-	8/8
Mean patch total edge (m)	0.88	-	10/11	1.0	-	8/8
Upland coniferous (%)[a]	0.62	+	8/11	1.0	+	8/8
Lowland black spruce (%)	0.33	+	5/11	0.56	+	4/8
Number of patches	0.15	+/-	3/11	0.63	-	4/8
Lowland mixed coniferous (%)	0.08	+/-	2/11	0.27	+	4/8

[a] Log (base 10) transformed before analysis.

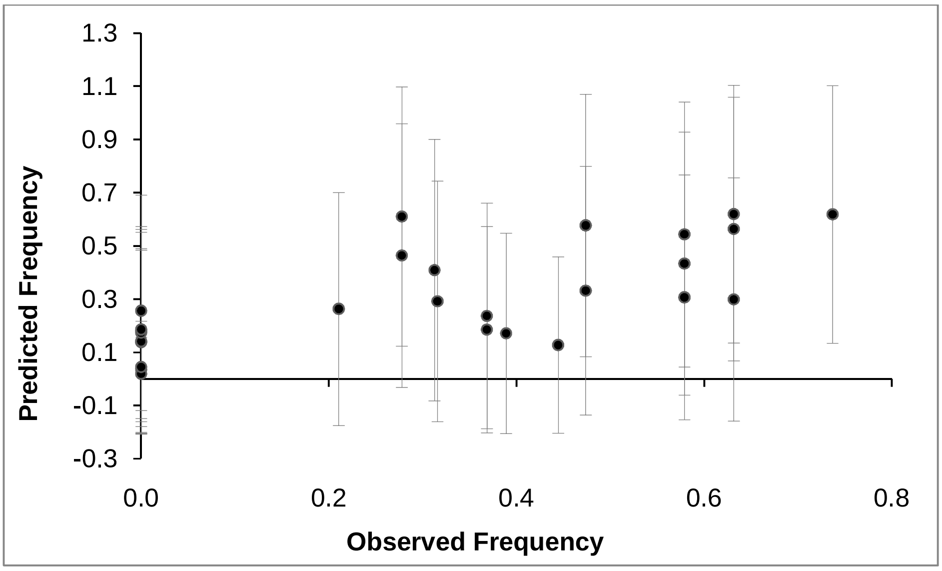
[b] Square-root transformed before analysis.

Model Predictions

I calculated the model-averaged predictions and standard deviations of Connecticut Warbler abundance and frequency at all points (n = 86) and stands (n = 28) used in the analysis. These predictions were plotted against the actual data recorded during the Forest Birds of the Western Great Lakes project (Figures 2A and B show plots for 1,000m buffer size), and the resulting R^2 values were examined to determine the predictive strength of the models (Figure 3). The predictive strength of models of Connecticut Warbler abundance was relatively low at all three spatial scales (R^2 = 0.10 – 0.15) (Figure 3). The predictive strength of models of Connecticut Warbler frequency (the number of years of occurrence out of the number of years surveyed) improved with each increase in buffer size, with R^2 = 0.22 at 100 m, R^2 = 0.36 at 500 m, and R^2 = 0.52 at 1,000 m (Figure 3). The set of models derived for Connecticut Warbler frequency at the 1,000 m buffer size performed most closely to actual data collected at the stands included in the analysis (Figure 2B).



A



B

FIGURES 2A AND B. Observed and model-averaged predictions of Connecticut Warbler abundance (A) and frequency (B) at the 1,000m buffer size. Error bars show model-averaged SD.

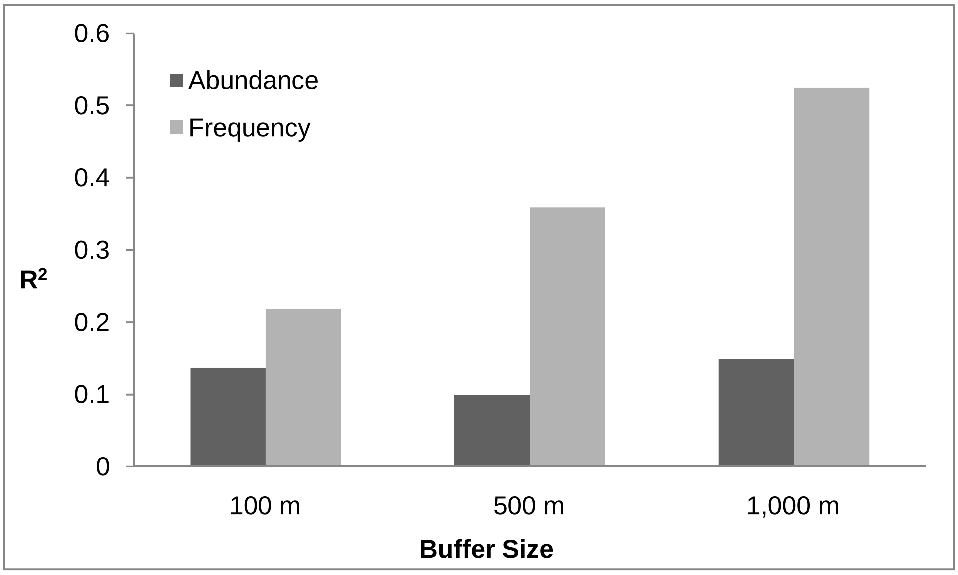
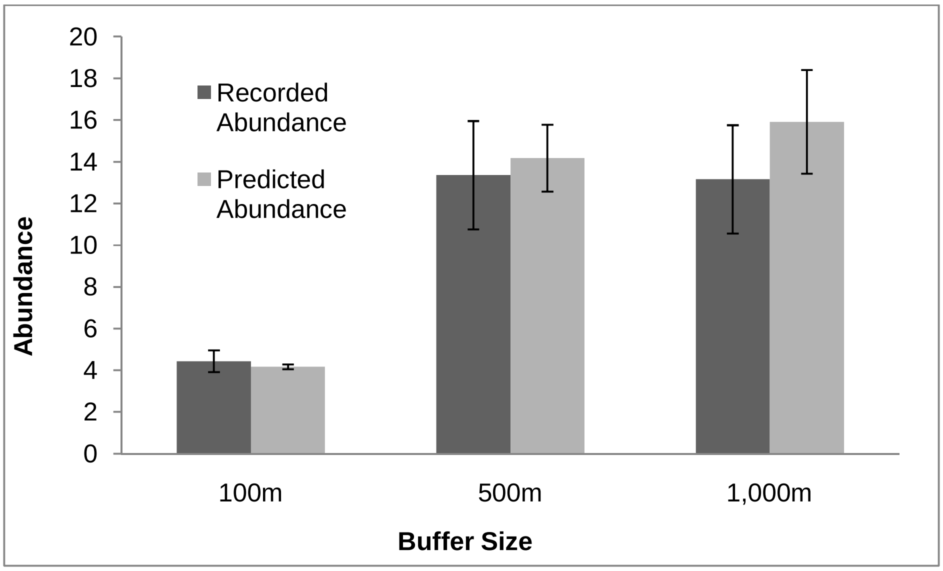
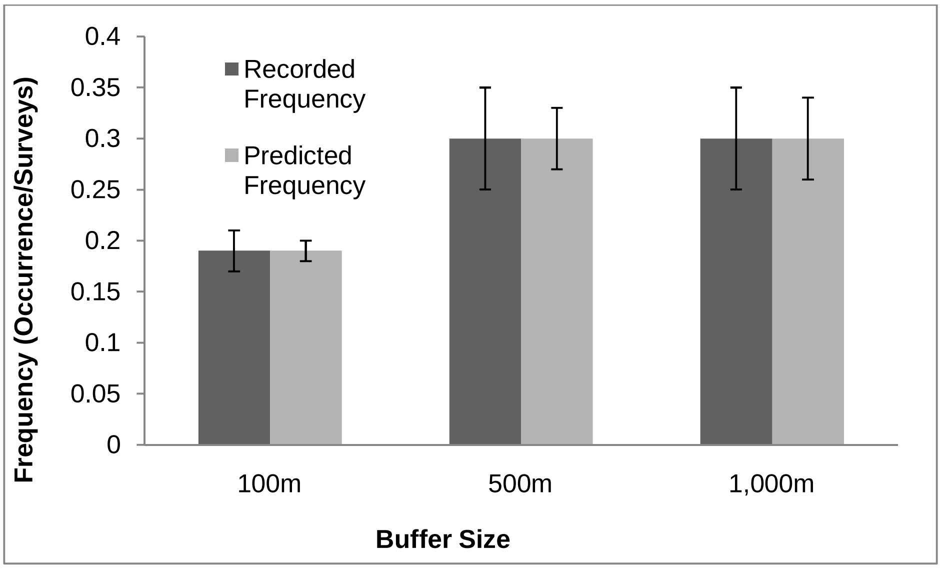


FIGURE 3. R^2-value of model-averaged predictions of Connecticut Warbler abundance and frequency plotted against real observations at each buffer size.

The model-averaged predictions were overdispersed for both abundance and frequency of Connecticut Warblers. Both response variables were over-predicted in "poor" habitat and under-predicted in "good" habitat (Figures 2A and B). Although the model-averaged predictions were overdispersed, the average values of actual abundance and frequency compared to average values of predicted abundance and frequency over all points and stands included in the analysis were overlapping (Figures 4A and B).



A



B

FIGURES 4A AND B. Recorded and model-averaged predicted Connecticut Warbler abundance (A) and frequency (B) averaged over all points (100 m buffer) and stands (500 and 1,000 m buffers) included in analysis. Error bars show SE.

The subset of eight models for Connecticut Warbler frequency at the 1,000 m scale was used in ArcGIS to create a map of the predicted breeding habitat of Connecticut Warblers in Chippewa and Superior National Forests. Using the focal statistics tool in Model Builder, I created eight separate raster datasets predicting Connecticut Warbler breeding habitat, one to represent each model in the subset (Appendix 4). These datasets were then averaged using Akaike weights (Burnham and Anderson 2002), to generate a final, averaged raster dataset and map of predicted breeding habitat of Connecticut Warblers (Figure 5).

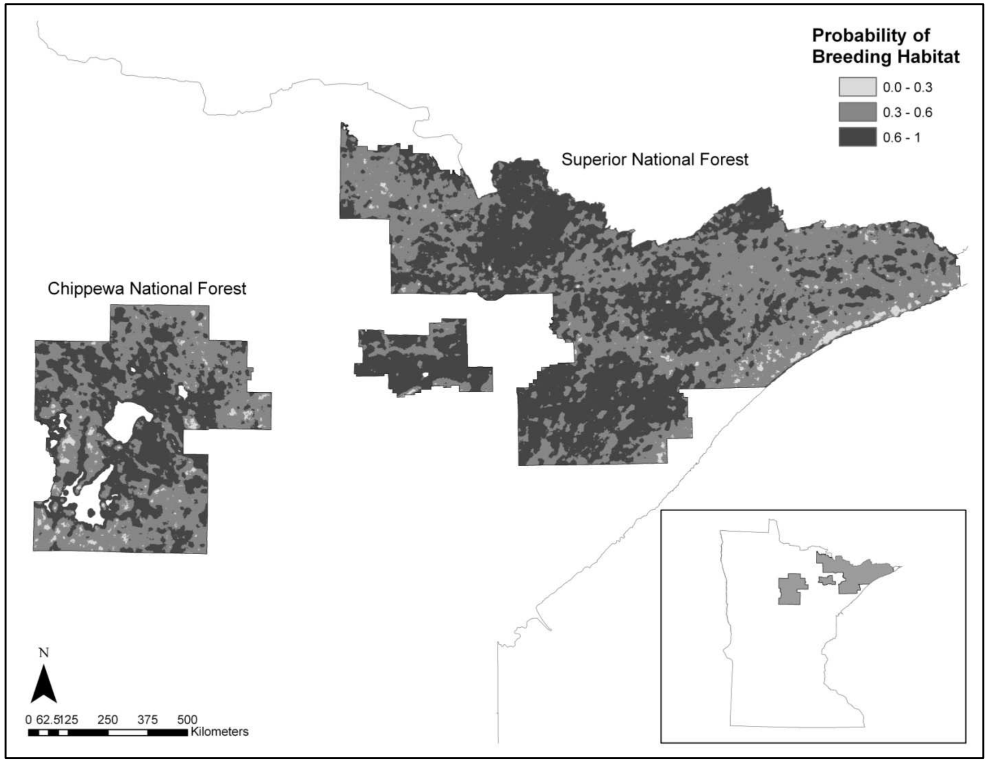


FIGURE 5. Model-averaged predicted breeding habitat of Connecticut Warblers in Chippewa and Superior National Forests. A subset of eight models was used, logistically regressing environmental variables to Connecticut Warbler frequency at a 1,000 m-radius buffer size. Model predictions were averaged according to Burnham and Anderson (2002).

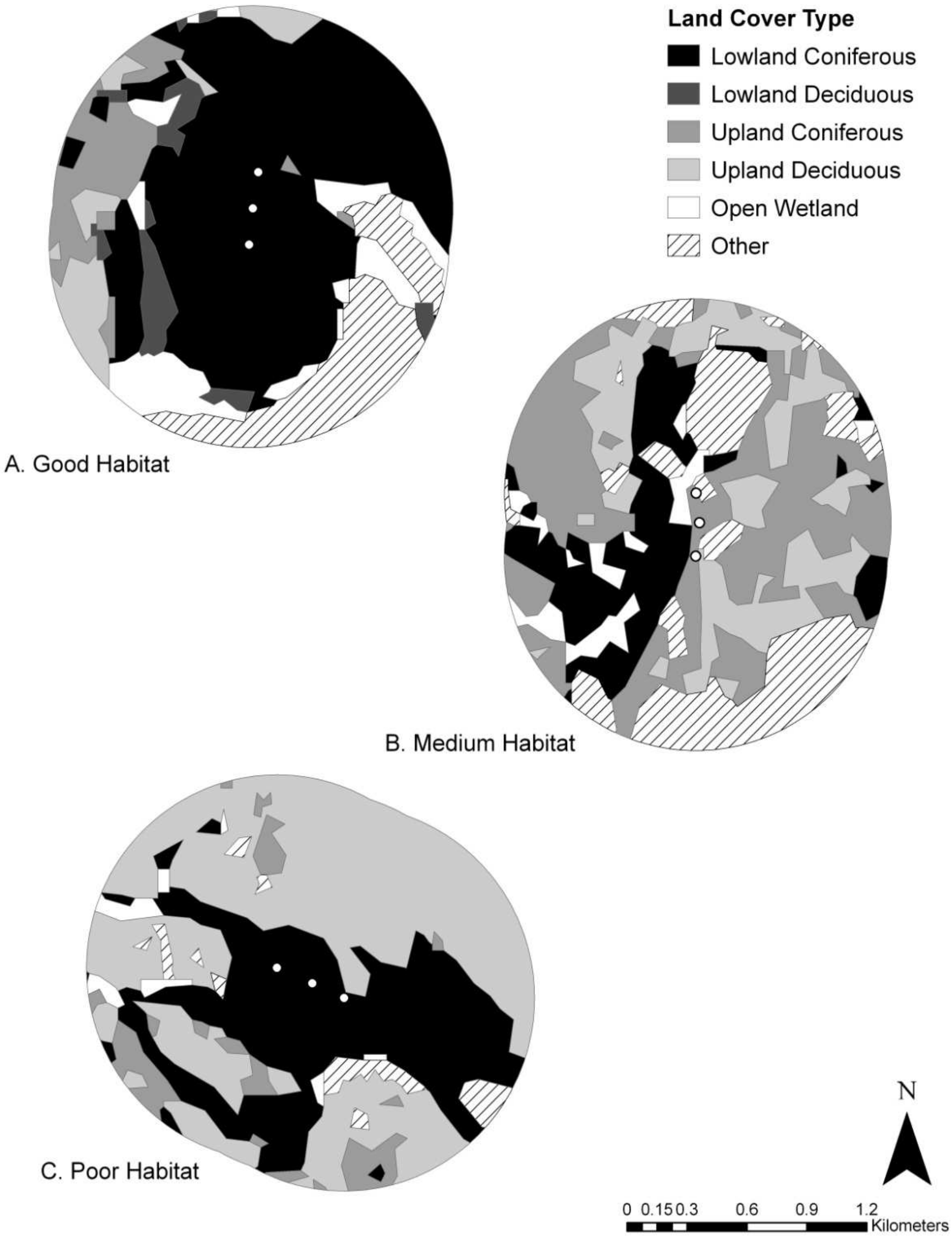
Discussion

The model selection, variable weighting, and model averaging used in this assessment created a list of habitat variables important for Connecticut Warbler breeding at several spatial scales, though the models created for the largest spatial scale performed the best. At the smallest spatial scale (100 m buffer), models of Connecticut Warbler abundance and frequency agree that high ground cover vegetation density, low percentage canopy cover, and low percentage of lowland deciduous forest are important for Connecticut Warblers. These results agree with numerous habitat descriptions that have been documented for the Connecticut Warbler (Forbush and May 1955; Ehrlich et al. 1988; Degraaf et al. 1991; Niemi and Hanowski 1992; Welsh and Logheed 1996; Danz et al. 2007).

At the 500 m scale, predicted Connecticut Warbler abundance and frequency was positively associated with percent lowland black spruce forest and negatively associated with percent alder willow habitat. Connecticut Warblers are more commonly associated with habitats consisting of a ground layer of Sphagnum spp., Labrador tea, and swamp laurel, than with alder willow habitat (Forbush and May 1955; Ehrlich et al. 1988; Degraaf et al. 1991; Niemi and Hanowski 1992; Danz et al. 2007). In addition, models at this spatial scale predicted that Connecticut Warblers are associated with low tree density and high tree density variance. These conditions are present in mature bogs, where larger, widely spaced trees are present on the interior and smaller, more densely spaced trees exist toward bog edges (Glaser 1992).

At the largest and best-performing spatial scale examined, the 1,000 m buffer, there was a high degree of concurrence between the model subsets for Connecticut

Warbler abundance and frequency. Presence of upland coniferous forest and lowland black spruce forest and absence of upland deciduous forest were important predictors of Connecticut Warbler breeding habitat at this scale. Danz et al. (2007) reported that Connecticut Warblers are associated with coniferous forests but that they are most abundant in mature, lowland coniferous forest. In addition, Connecticut Warblers were negatively associated with the number of patches within the buffer and the mean total edge of patches within the buffer, meaning that they are dependent on habitats with fewer and less complex patches. Given these results, Connecticut Warblers would most likely be found in large, unfragmented stands of upland and mature lowland coniferous forests. Figures 6A, B, and C provide an example of these land cover type and patch characteristics for the 1,000 m buffer size for three stands that were used in the analysis, one each of good (Figure 6A), medium (Figure 6B), and poor (Figure 6C) Connecticut Warbler habitat, as described previously.



FIGURES 6A, B, AND C. Land cover type and patch configuration for three stands (good (A), medium (B), and poor (C) Connecticut Warbler habitat) included in the analysis. Steps taken to determine habitat quality are described in methods.

The models for the largest spatial scale performed best when comparing model-averaged to observed Connecticut Warbler data. This implies that Connecticut Warblers rely on large landscape characteristics when selecting breeding habitat, even when small-scale habitat variables appear to be suitable. Hannon (1999 and 2005) suggested that modeling for Connecticut Warbler presence was best when considering habitat variables at local spatial scales, but that several variables from larger scales (500 m radius buffer) should also be included. Venier and Pearce (1997) concluded that considering landscape context variables, in addition to forest structure and overstory, are important in the development of breeding bird habitat models for forest management. Pearson and Niemi (1998) found that Neotropical migrant species in northern Minnesota that exhibited specific forest type associations, especially coniferous associated species, depended on landscape rather than local scale habitat variables. This finding is supported by the improved performance of the models derived for the largest buffer size and because the Connecticut Warbler is a relatively rare species that shows a strong association with lowland coniferous forests. Due to its dependence on landscape level habitat factors, the Connecticut Warbler could be strongly and possibly negatively impacted by forest management practices. Although the primary breeding habitat of this species, lowland coniferous forests, is infrequently altered by forestry practices, upland forest management could also have implications for habitat availability.

The models created for Connecticut Warbler frequency at the largest spatial scale performed better than those created for abundance when comparing model-averaged predictions to observed data (Figures 2A, B, and 3). One possible explanation for the relatively low R^2 value for the predictions of Connecticut Warbler abundance is the outlier in Figure 2A, which shows an observed abundance of 8 Connecticut Warblers and a predicted abundance of approximately 61. This particular stand of survey points is one-half located in a mature black spruce plantation with the other half having been logged in the mid-1990s. The plantation consists of closely spaced, mature black spruce 10-15 m in height where very few birds of any type were observed, and the regrowth consists of a thick shrub layer with randomly spaced, immature trees 1-2 m in height. Some Connecticut Warblers have been observed in the regrowth area, but this stand does not represent ideal breeding habitat due to the lack of tall, mature, widely spaced trees. The model may be grossly overpredicting the Connecticut Warbler abundance at this site as a result of habitat characteristics that appear in the GIS data. For example, this stand is located in a relatively remote area with fewer, large habitat patches and a high proportion of black spruce forest (37.7 % of 1,000 m buffer), which makes it a strong candidate given the habitat variables chosen as important through model selection and averaging.

The set of models that performed the best, those created for Connecticut Warbler frequency at the 1,000 m scale, were used to create a model-averaged map of predicted breeding habitat of Connecticut Warblers in Chippewa and Superior National Forests (Figure 5). The map might be used to reduce potential negative impacts to Connecticut Warblers while planning forest management in these national forests, namely by focusing forest harvesting practices in both lowland and upland coniferous forest away from areas of high potential Connecticut Warbler breeding habitat. It accounts for the relative weight of each model in the subset as well as the relative weight of each predictor variable at the 1,000 m buffer size to give the potential breeding habitat of Connecticut Warblers.

There are several advantages to being able to use large, landscape-level variables to create prediction models. One is that the independent variables required for model creation and selection are easy and relatively inexpensive to gather with the use of GIS and multiple public databases. Another is that the resulting predictions can potentially be applied broadly to large areas where it might be logistically unfeasible to conduct surveys. Such predictions are inexpensive and fast to produce when their intended use is to establish the locations of highest probability of occurrence of a species of concern. Finally, habitat modeling involving landscape-level variables can easily be modified to include new variables at the same spatial scales, such as macroclimate (Venier et al. 1999).

Additional investigations into the usefulness of these Connecticut Warbler prediction models and mapping must be validated through field surveys. If these model subsets prove to be useful at predicting Connecticut Warbler breeding habitat in the Chippewa and Superior National Forests, it may be useful to extrapolate and validate to additional areas in northern Minnesota, such as the Red Lake Peatland. Management of Connecticut Warbler breeding habitat to maintain the characteristics on which they depend may become critical to stop current population declines. As identified in this report, this will involve preserving large, unfragmented tracts of upland and mature lowland coniferous forests. Partners in Flight identifies the importance of preserving large, contiguous tracts of forest to meet the needs of area-sensitive species, such as the Connecticut Warbler (Matteson et al. 2009). They also state that more research must be done to understand the breeding ecology of Connecticut Warblers, to identify and protect population source areas of bird species in the Boreal Hardwood Transition, and to identify the landscape-scale factors that they require so that those factors can be managed for given current land cover and land use (Matteson et al. 2009). In addition, there is a call to better understand the migratory and wintering habitat used by this species to prevent any population declines resulting from losses when Connecticut Warblers are not on their breeding grounds (Pitocchelli et al. 1997).

The methodology used in this study could be applied to other bog-nesting bird species to create model-averaged predictions and understand locations of probable occupancy. The information resulting from models for multiple bird species could be used to support forest management decisions that strive to mimic landscape characteristics reflecting the forest variation used by multiple breeding bird species, thus promoting their conservation.

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APPENDIX 1. Records of Connecticut Warbler detections at all Forest Birds of the Western Great Lakes sites and stands included in analysis.

National Forest	Stand	Cover Type	Site	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
CNF	151	Bl. spruce/ Tamarack	234	2	0	0	0	1	1	3	2	0	0	0	0	0	1	0	0	0	0
			235	1	1	0	0	1	1	4	1	0	0	0	0	0	0	2	0	2	0
			236	1	2	0	0	0	0	1	1	1	0	0	0	0	1	1	0	1	0
CNF	167	Bl. spruce/ Tamarack	322	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	2
			323	1	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	1
			324	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
CNF	193	1991: Fir/ Aspen/Pine Barrens 2001: Open 2002: Aspen	368	0	0	NA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
			369	0	0	NA	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0
			370	1	0	NA	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1
CNF	196	Mixed swamp conifer	908	0	0	NA	0	0	0	0	NA	0	0	0	0	0	0	0	NA	0	NA
			909	0	0	NA	0	NA	0	0	NA	0	0	0	0	0	0	0	NA	0	NA
			910	0	0	NA	0	NA	0	0	NA	0	0	0	0	0	0	0	NA	0	NA
CNF	197	Mixed swamp conifer	905	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			906	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			907	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA

National Forest	Stand	Cover Type	Site	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
CNF	209	Bl. spruce/ Tamarack	343	0	0	1	1	1	0	0	1	1	1	2	1	0	0	0	0	0	1
			344	1	0	2	2	2	0	0	0	1	0	1	1	0	0	0	1	0	2
			345	0	0	2	1	1	0	1	0	1	1	2	1	0	0	0	0	0	1
CNF	215	Bl. spruce/ Tamarack	331	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
			332	0	1	0	0	1	1	0	0	0	0	1	NA	0	0	0	0	0	0
CNF	222	1991: Bl. spruce/ Tamarack 1997: Open 2000: Aspen 2007: Bl. Spruce/ Tamarack	278	0	0	1	0	0	NA	0	0	0	0	0	0	0	1	0	0	2	0
			279	0	0	1	0	1	NA	0	0	0	0	0	0	0	0	0	0	0	NA
			280	0	0	0	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	2
CNF	223	Bl. spruce/ Tamarack	275	0	0	0	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0
			276	0	0	1	0	1	NA	0	0	0	0	0	0	1	1	0	1	1	1
			277	0	0	0	0	0	NA	0	0	0	0	0	0	1	1	0	0	1	1
CNF	225	Mixed swamp conifer	269	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA
			270	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA
			271	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA
CNF	226	Bl. spruce/ Tamarack	281	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0

National Forest	Stand	Cover Type	Site	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
			282	0	1	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0
			283	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
CNF	229	Mixed swamp conifer	284	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
			285	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0
			286	0	0	0	0	0	0	0	NA	0	0	2	0	0	0	NA	0	1	0
CNF	233	Mixed swamp conifer	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CNF	238	Mixed swamp conifer	37	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			38	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			39	0	0	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CNF	250	Bl. spruce/ Tamarack	396	1	0	0	0	2	1	1	2	1	0	0	1	2	0	1	1	2	0
			397	1	1	1	0	1	0	2	1	0	0	0	0	1	0	2	0	1	0
			400	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	1	0
CNF	252	Tamarack/ Bl. spruce	395	1	0	1	0	2	0	2	2	1	0	0	0	2	0	0	0	0	0
			398	2	0	2	0	1	1	1	2	0	0	1	2	1	0	2	0	0	0
			399	1	2	2	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0
CNF	253	Tamarack/ Bl. spruce	392	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
			393	1	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0

National Forest	Stand	Cover Type	Site	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
			394	0	1	1	0	1	0	1	0	0	1	0	1	1	0	0	0	0	0
CNF	258	Tamarack/ Bl. spruce	133	1	2	0	0	0	0	0	1	0	0	0	1	2	1	0	1	0	0
			134	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0
			135	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	0	1
CNF	261	Bl. spruce/ Tamarack	139	0	0	1	0	0	0	1	1	0	NA	0	0	0	0	0	0	0	0
			140	0	2	1	0	0	1	1	1	0	NA	0	0	0	0	0	0	0	0
			141	1	1	2	2	0	2	1	1	0	NA	0	0	0	2	0	0	0	0
SNF	355	Red pine	497	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
			498	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
			499	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0
SNF	371	Bl. spruce/ Tamarack	3021	NA	NA	NA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			3022	NA	NA	NA	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0
			3023	NA	NA	NA	1	1	0	0	0	NA	0	0	1	0	0	0	1	1	0
SNF	473	Mixed swamp conifer	407	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			408	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			409	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNF	475	Mixed swamp conifer	404	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			405	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			406	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNF	484	Bl. spruce/ Tamarack	413	0	1	2	1	0	0	1	2	0	1	2	0	0	1	0	0	0	2

National Forest	Stand	Cover Type	Site	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
			414	0	2	2	1	0	0	1	2	0	2	1	0	1	0	0	0	0	2
			417	2	1	1	1	0	0	1	1	0	2	1	0	0	1	0	0	0	2
SNF	485	Bl. spruce/ Tamarack	415	0	2	1	1	1	0	2	2	0	2	1	0	0	0	0	0	0	1
			416	1	2	1	0	1	1	1	2	0	3	1	0	0	0	0	0	0	1
			418	0	0	0	1	1	0	1	1	0	0	0	0	0	1	0	0	0	2
SNF	486	Bl. spruce/ Tamarack	419	0	1	0	1	0	1	0	0	0	0	2	1	0	0	0	0	0	1
			420	1	0	0	1	0	1	0	0	0	2	1	1	0	1	0	0	0	1
			421	1	0	1	1	1	0	0	0	0	1	2	1	0	0	0	0	0	1
SNF	494	Mixed swamp conifer	428	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			429	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNF	495	Bl. spruce/ Tamarack	431	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			435	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			436	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	0	0	0
SNF	519	Bl. spruce/ Tamarack	884	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	0	0
			885	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			886	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX 2. Abbreviations used for environmental variables.

Environmental Variable	Abbreviation
Lowland black spruce forest (%)	LowBlSp
Tamarack forest (%)	Tam
Lowland northern white-cedar forest (%)	LowNWC
Lowland mixed coniferous forest (%)	LowMxCon
Lowland deciduous forest (%)	LowDecid
Upland coniferous forest (%)	UplCon
Upland deciduous-coniferous forest (%)	UplMxd
Upland deciduous forest (%)	UplDecid
Sedge fen (%)	SedgFen
Muskeg (%)	Muskeg
Alder willow (%)	AldWillo
Developed, including agriculture (%)	Devel
Other (%)	Other
Stand age (years)	StAge
Soil moisture	SoilMois
Soil pH	SoilpH
Tree density and mean tree density (for 3 sites) (trees/ha)	TrDens
Tree density variance (for 3 sites) (trees/ha)	TrDenVar
Basal area and mean basal area (for 3 sites) (m^2/ha)	BAmpha
Basal area variance (for 3 sites) (m^2/ha)	BAVar
Ground vegetation density (1-5)	GCDens
Mid-ground vegetation density (1-5)	MGCDens
Canopy cover (%)	CanCov
Primary ground cover species (categorical)	PriGCSp
Primary mid-ground cover species (categorical)	PriMGCSp
Primary canopy species (categorical)	PriCanSp
Patch Type (categorical)	PchType
Number of patches within buffer	NumPch
Mean patch size within buffer (ha)	PAreaMn
SD of patch size within buffer (ha)	PAreaSD
Mean patch shape index within buffer	PMSIMn
SD of patch shape index within buffer	PMSISD
Mean of patch perimeter-to-area ratio within buffer	PMPARMn
SD of patch perimeter-to-area ratio within buffer	PMPARSD
Mean patch fractal dimension within buffer	PMPFDMn
SD of patch fractal dimension within buffer	PMPFDSD
Mean of total patch edge within buffer (m)	PTEMn

Environmental Variable	Abbreviation
SD of total patch edge within buffer (m)	PTESD
Mean of patch edge density within buffer	PEDMn
SD of patch edge density within buffer	PEDSD
Distance to nearest upland (m)	DistUpl
Distance to nearest open wetland (m)	DistOWl
Stand size (ha)	StandSz
Distance to nearest road (m)	DistRd
Land Type Association (categorical)	LTAssn

APPENDIX 3. Values for all environmental variables considered at sites (100m buffer) and stands (500 and 1,000 m buffers) included in analysis. All data is untransformed. See Appendix 2 for variable abbreviations.

100 m Buffer, Part 1

Site	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
22	0	0.23	0.47	0	0	0.07	0	0.12
23	0	0.13	0.47	0	0	0.03	0.06	0.29
24	0	0.26	0.50	0	0	0.09	0.15	0
37	0	0	0.32	0	0	0	0	0.68
38	0.08	0	0.88	0	0.03	0	0	0.01
39	0	0	0.79	0.05	0.15	0	0	0
133	0	0.96	0	0	0	0	0	0
134	0	0.57	0	0	0	0	0	0.06
135	0	0.35	0	0	0	0	0	0
139	0	0.82	0	0	0	0	0	0.18
140	0.61	0.39	0	0	0	0	0	0
141	0.85	0.15	0	0	0	0	0	0
234	0.71	0	0.05	0.24	0	0	0	0.00
235	1	0	0	0	0	0	0	0
236	1	0	0	0	0	0	0	0
269	0	0	0.02	0	0.49	0	0	0.43
270	0	0.02	0.32	0.35	0.30	0	0	0.01
270	0.47	0	0.37	0.07	0	0	0	0.09
275	1	0	0	0	0	0	0	0
276	1	0	0	0	0	0	0	0
277	1	0	0	0	0	0	0	0
278	1	0	0	0	0	0	0	0
279	1	0	0	0	0	0	0	0
280	1	0	0	0	0	0	0	0
281	0	0.47	0	0.01	0	0	0	0
282	0	0.05	0.13	0.20	0.00	0	0	0
283	0.00	0.20	0	0.47	0.04	0	0	0.18
284	0.09	0.31	0	0	0.25	0	0	0.11
285	0	0.14	0	0.18	0.08	0	0	0
286	0	0.02	0	0.32	0.55	0	0	0.00
322	0.79	0	0	0	0	0	0	0.05
323	0.73	0	0	0	0	0	0	0
324	0.68	0	0	0	0	0	0	0.32
331	0.20	0.09	0	0	0	0	0	0.71
332	0.61	0	0	0	0	0	0	0.39

Site	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
343	0.25	0	0	0.10	0.35	0	0	0
344	0.79	0.05	0	0	0	0	0	0.15
345	0.98	0.02	0	0	0	0	0	0
368	0	0	0	0	0	0.69	0.31	0
369	0	0	0	0	0.03	0.88	0.09	0
370	0	0	0	0.08	0.25	0.31	0.35	0
392	0	0.24	0	0.70	0.05	0	0	0
393	0	0.63	0.03	0.33	0	0	0	0
394	0	0.22	0.28	0.50	0	0	0	0
395	0.14	0.57	0.11	0.19	0	0	0	0
396	0.38	0.31	0.31	0	0	0	0	0
397	0.35	0	0.32	0.33	0	0	0	0
398	0.09	0.59	0	0.33	0	0	0	0
399	0.34	0.46	0.19	0.01	0	0	0	0
400	0.30	0	0.54	0.16	0	0	0	0
404	0	0	0	0	0	0	0.11	0.89
405	0.14	0	0.06	0	0	0	0.31	0.49
406	0.03	0	0.05	0	0	0	0.27	0.64
407	0	0	0	0	0	0.16	0.27	0.58
408	0	0	0	0	0	0	0.16	0.84
409	0	0	0	0	0	0	0.61	0.39
413	0.72	0	0.16	0	0	0	0.04	0.09
414	0.60	0	0.22	0	0	0.16	0	0
415	0.41	0	0	0	0	0	0.08	0.52
416	0.30	0	0	0	0	0.11	0.58	0.00
417	0.52	0	0.24	0	0	0.04	0.03	0.17
418	0.09	0	0	0	0	0	0.59	0.32
419	0.50	0	0	0	0	0.52	0	0
420	0.90	0	0	0	0	0.10	0	0
421	0.88	0	0	0	0	0.02	0.11	0
428	0.23	0	0.77	0	0	0	0	0
429	0.91	0	0	0	0	0	0.04	0.06
430	0.01	0	0.54	0	0	0	0.09	0.36
431	0.20	0	0.14	0	0	0.28	0.34	0
435	0	0	0.76	0	0	0	0.24	0
436	0	0.07	0.93	0	0	0	0	0
497	0	0	0	0	0	0.15	0	0.84
498	0	0	0	0	0	0.29	0.18	0.44
499	0.12	0	0	0	0	0.07	0.08	0.31
884	0.74	0	0	0	0	0	0	0.26

Site	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
885	1	0	0	0	0	0	0	0
886	1	0	0	0	0	0	0	0
905	0	0	0.49	0	0.07	0	0.08	0.36
906	0	0	0	0	0.55	0	0.19	0.26
907	0	0	0.66	0	0.19	0	0.12	0.03
908	0	0.20	0.17	0	0.17	0	0.43	0.03
909	0	0.43	0.02	0	0.10	0	0.45	0.01
910	0.00	0.09	0.45	0	0	0	0.19	0.27
3021	0.00	0	0	0	0	0.34	0	0
3022	0.07	0	0	0	0	0.69	0	0
3023	0.24	0	0.07	0	0	0.29	0	0.16

100 m Buffer, Part 2

Site	SedgFen	Muskeg	AldWillo	Other	StAge	SoilMois	SoilpH	TrDens
22	0	0	0	0.12	103	40	5.9	165.80
23	0	0	0.02	0	103	100	7	375.60
24	0	0	0	0	103	80	6.8	431.00
37	0	0	0	0	186	70	7	313.60
38	0	0	0	0	186	70	7	218.40
39	0	0	0.01	0	186	100	7	195.50
133	0.04	0	0	0	49	100	6.4	327.90
134	0.15	0	0.21	0	49	60	5.4	1,220.90
135	0.30	0	0.35	0	49	100	7.2	126.00
139	0	0	0	0	159	100	5.5	1,488.80
140	0	0	0	0	159	100	4.8	1,384.80
141	0	0	0	0	159	100	4.8	557.00
234	0	0	0	0	105	100	5.6	307.40
235	0	0	0	0	105	100	5.4	596.80
236	0	0	0	0	105	100	5.4	1,335.80
269	0	0	0.05	0	77	80	6.5	142.60
270	0	0	0.02	0	94	100	7	828.30
270	0	0	0	0	94	100	7.1	101.10
275	0	0	0	0	77	100	5.5	92.40
276	0	0	0	0	77	100	5.6	0.00
277	0	0	0	0	77	100	4.9	196.90
278	0	0	0	0	77	100	5.5	326.70
279	0	0	0	0	2	80	5	0.00
280	0	0	0	0	2	80	5	0.00
281	0	0	0.51	0	120	60	7	37.60

Site	SedgFen	Muskeg	AldWillo	Other	StAge	SoilMois	SoilpH	TrDens
282	0	0	0.62	0	120	90	7	277.30
283	0	0	0.10	0	120	80	7	163.60
284	0	0	0.24	0	120	100	7	501.40
285	0	0	0.60	0	120	90	7	535.50
286	0	0	0.11	0	120	80	7	108.50
322	0	0.16	0	0	35	100	6	1,603.20
323	0	0.28	0	0	63	100	5.6	218.40
324	0	0	0	0	70	90	5.8	1,030.90
331	0	0	0	0	102	100	6.8	47.20
332	0	0	0	0	102	60	6	474.20
343	0	0.14	0.16	0	87	70	6	126.80
344	0	0	0.00	0	61	100	5.2	0.00
345	0	0	0	0	61	100	4.8	747.70
368	0	0	0	0	109	0	7.1	53.90
369	0	0	0	0	55	20	7	0.00
370	0	0	0	0	55	50	7	0.00
392	0	0	0	0	99	50	6.8	264.60
393	0	0	0	0	99	50	6.8	685.50
394	0	0	0	0	92	70	6.6	1,028.20
395	0	0	0	0	99	40	6.8	559.40
396	0	0	0	0	112	80	5.5	307.40
397	0	0	0	0	112	70	5.8	92.40
398	0	0	0	0	112	50	6.8	787.50
399	0	0	0	0	99	50	6.8	842.90
400	0	0	0	0	99	70	7	1,362.50
404	0	0	0	0	172	60	6	70.90
405	0	0	0	0	108	55	6	269.80
406	0	0	0	0	172	50	6.3	322.50
407	0	0	0	0	178	50	7	81.10
408	0	0	0	0	178	25	7	116.10
409	0	0	0	0	178	5	7	330.10
413	0	0	0	0	115	70	6	237.20
414	0	0	0.02	0	115	70	6.5	375.60
415	0	0	0	0	115	70	5.4	416.10
416	0	0	0	0	42	70	5.7	645.90
417	0	0	0	0	115	100	7	327.70
418	0	0	0	0	42	55	6	286.90
419	0	0	0	0	117	60	5.3	196.90
420	0	0	0	0	117	60	5.8	628.10
421	0	0	0	0	117	70	6.5	557.20

Site	SedgFen	Muskeg	AldWillo	Other	StAge	SoilMois	SoilpH	TrDens
428	0	0	0	0	89	50	6.8	537.90
429	0	0	0	0	89	80	6.8	666.90
430	0	0	0	0	89	70	6.5	373.60
431	0	0	0.04	0	179	30	6.8	619.50
435	0	0	0	0	179	60	6.7	777.60
436	0	0	0	0	179	70	7	1,377.10
497	0	0	0.00	0	92	10	7	153.20
498	0	0	0.10	0	92	0	7.1	17.80
499	0	0	0.20	0.23	92	50	6.9	239.20
884	0	0	0	0	112	25	6.1	939.20
885	0	0	0	0	112	50	6.9	1,124.30
886	0	0	0	0	112	65	6.7	927.60
905	0	0	0	0	127	100	6.9	1,096.20
906	0	0	0	0	8	100	7.2	126.80
907	0	0	0	0	127	100	7.1	901.40
908	0	0	0	0	94	50	6.6	237.70
909	0	0	0	0	94	100	6.7	126.00
910	0	0	0	0	94	100	6	464.60
3021	0.07	0	0.25	0.34	82	25	6.1	923.20
3022	0.17	0	0	0.06	82	40	7	754.40
3023	0	0	0	0.25	84	60	5.4	208.80

100 m Buffer, Part 3

Site	BAmpha	GCDens	MGCDens	CanCov	PriGCSp	PriMGCSp	PriCanSp	PchType
22	20.7	4	2	0.6	29	2	1	1
23	18.4	5	3	0.4	17	30	1	1
24	18.4	4	2	0.6	17	24	1	1
37	16.1	2	2	0.8	26	26	9	4
38	11.5	5	4	0.8	28	13	2	1
39	11.5	5	2	0.8	17	3	1	1
133	11.5	5	3	0.9	17	24	5	1
134	18.4	5	4	0.1	17	24	1	1
135	2.3	5	5	0.1	35	24	5	5
139	18.4	5	2	0.4	17	2	5	1
140	13.8	5	2	0.5	17	2	5	1
141	6.9	5	3	0.3	17	2	2	1
234	4.6	5	2	0.2	17	2	2	1
235	11.5	5	2	0.5	17	2	2	1
236	23.0	5	2	0.3	17	2	2	1

Site	BAmpha	GCDens	MGCDens	CanCov	PriGCSp	PriMGCSp	PriCanSp	PchType
269	13.8	5	1	0.7	35	3	1	2
270	13.8	5	2	0.6	17	1	1	1
270	4.6	5	3	0.3	17	24	1	1
275	2.3	5	0	0.0	17	26	2	1
276	0.0	5	3	0.0	17	2	2	1
277	4.6	5	1	0.1	17	2	2	1
278	9.2	5	1	0.5	17	2	2	1
279	0.0	5	4	0.0	17	2	26	1
280	0.0	5	3	0.0	17	32	26	1
281	2.3	5	4	0.2	17	23	1	5
282	6.9	5	3	0.8	17	23	2	5
283	9.2	5	3	0.4	17	23	1	1
284	11.5	5	4	0.7	17	23	1	2
285	6.9	5	3	0.5	17	23	5	5
286	4.6	4	4	0.1	17	23	1	1
322	9.2	5	1	0.1	17	2	2	1
323	4.6	5	2	0.0	17	2	2	1
324	9.2	5	1	0.0	17	2	2	1
331	4.6	5	3	0.4	17	24	2	4
332	11.5	5	3	0.1	17	24	2	1
343	4.6	5	2	0.2	17	2	2	5
344	0.0	5	1	0.2	17	2	2	1
345	6.9	5	2	0.2	17	2	2	1
368	6.9	2	5	0.6	35	23	6	3
369	0.0	5	1	0.0	35	32	14	3
370	0.0	5	4	0.0	35	29	26	3
392	9.2	5	4	0.7	17	24	5	1
393	11.5	5	3	0.6	17	1	1	1
394	18.4	5	2	0.8	17	24	1	1
395	4.6	5	3	0.8	17	20	5	1
396	4.6	5	1	0.1	17	5	2	1
397	2.3	5	2	0.2	17	33	2	1
398	11.5	5	2	0.7	17	24	5	1
399	13.8	5	2	0.3	17	30	5	1
400	18.4	5	1	0.7	17	2	2	1
404	16.1	2	2	0.8	31	3	1	4
405	11.5	4	3	0.2	17	23	1	4
406	16.1	4	3	0.6	17	23	1	3
407	13.8	1	2	0.8	9	9	1	3
408	13.8	2	3	0.6	25	25	1	4

Site	BAmpha	GCDens	MGCDens	CanCov	PriGCSp	PriMGCSp	PriCanSp	PchType
409	16.1	1	3	0.7	35	30	10	3
413	4.6	5	4	0.1	17	24	2	1
414	4.6	5	4	0.3	17	23	2	1
415	11.5	5	3	0.2	17	23	2	4
416	6.9	5	1	0.2	17	26	2	3
417	11.5	5	5	0.3	17	23	5	1
418	11.5	2	3	0.7	31	23	4	4
419	4.6	5	3	0.1	17	2	5	1
420	9.2	5	4	0.1	17	24	2	1
421	13.8	5	2	0.2	17	24	2	1
428	20.7	3	4	0.6	17	3	1	1
429	20.7	5	1	0.6	17	3	1	1
430	23.0	4	3	0.7	17	3	1	1
431	16.1	5	2	0.5	17	3	2	3
435	20.7	5	3	0.5	17	3	1	1
436	27.5	5	3	0.8	17	1	1	1
497	20.7	3	1	0.4	28	8	8	4
498	2.3	1	0	0.1	26	24	6	3
499	25.3	1	1	0.6	28	4	6	6
884	13.8	5	4	0.7	17	3	1	1
885	20.7	5	1	0.7	26	26	2	1
886	25.3	5	2	0.6	17	23	2	1
905	16.1	5	4	0.3	17	3	1	1
906	11.5	5	4	0.8	35	30	10	2
907	13.8	5	3	0.6	17	32	10	1
908	6.9	5	5	0.1	17	24	1	1
909	2.3	5	5	0.0	35	36	2	1
910	4.6	5	3	0.1	35	32	1	1
3021	11.5	4	2	0.7	17	3	8	3
3022	13.8	5	2	0.5	17	2	2	3
3023	6.9	2	1	0.1	17	26	2	3

100 m Buffer, Part 4

Site	Num Pch	PArea Mn	PArea SD	PMSI Mn	PMSI SD	PMPAR Mn	PMPAR SD	PMPFD Mn
22	6	0.52	0.81	1.21	0.14	1,065.23	480.97	1.05
23	6	0.52	0.74	1.32	0.23	1,498.73	1,099.17	1.07
24	3	1.05	1.17	1.31	0.24	658.07	232.23	1.06
37	2	1.57	0.78	1.13	0.12	373.45	56.78	1.02
38	3	1.05	1.71	1.08	0.14	1,623.33	1,605.75	1.03

Site	Num Pch	PArea Mn	PArea SD	PMSI Mn	PMSI SD	PMPAR Mn	PMPAR SD	PMPFD Mn
39	3	1.05	1.40	1.19	0.10	1,406.70	1,606.22	1.05
133	2	1.57	2.04	1.33	0.60	1,086.35	1,242.74	1.07
134	3	1.05	0.80	1.25	0.20	654.30	397.18	1.05
135	2	1.57	0.67	1.22	0.23	413.95	164.69	1.04
139	2	1.57	1.43	1.39	0.56	602.85	503.81	1.07
140	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
141	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
234	1	3.14	0.00	0.89	0.00	200.9	0.00	0.98
235	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
236	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
269	6	0.52	0.60	1.36	0.17	1,842.62	2,083.56	1.09
270	4	0.78	1.00	1.20	0.20	1,744.90	1,870.47	1.05
270	2	1.57	1.80	1.11	0.24	584.60	512.09	1.02
275	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
276	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
277	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
278	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
279	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
280	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
281	3	1.05	0.59	1.38	0.39	599.00	239.96	1.06
282	3	1.05	0.97	1.45	0.25	2,361.50	3,193.43	1.09
283	4	0.78	0.90	1.34	0.21	882.60	564.83	1.07
284	7	0.45	0.30	1.27	0.14	1,392.81	1,686.15	1.06
285	5	0.63	0.51	1.23	0.19	708.08	176.66	1.05
286	5	0.63	0.75	1.68	0.46	2,016.54	2,160.26	1.14
322	3	1.05	1.26	1.63	0.39	1,088.03	924.14	1.11
323	2	1.57	1.00	1.13	0.03	392.00	121.62	1.03
324	2	1.57	0.79	1.21	0.15	412.10	157.68	1.04
331	2	1.57	0.92	1.09	0.11	379.45	150.68	1.02
332	2	1.57	0.51	1.15	0.18	379.20	119.22	1.03
343	4	0.78	0.36	1.36	0.19	644.18	117.54	1.07
344	3	1.05	1.40	1.13	0.11	1,644.40	2,040.81	1.04
345	1	3.14	0.00	0.89	0.00	200.4	0.00	0.98
368	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
369	2	1.57	2.10	1.25	0.49	1,185.35	1,384.44	1.06
370	5	0.63	0.86	1.20	0.06	1,255.36	949.76	1.05
392	2	1.57	1.98	1.28	0.30	841.50	839.48	1.06
393	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
394	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98

Site	Num Pch	PArea Mn	PArea SD	PMSI Mn	PMSI SD	PMPAR Mn	PMPAR SD	PMPFD Mn
395	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
396	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
397	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
398	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
399	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
400	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
404	2	1.57	1.73	1.43	0.67	761.65	750.88	1.08
405	4	0.78	0.50	1.16	0.13	561.38	106.22	1.03
406	4	0.78	0.83	1.28	0.36	676.70	134.50	1.05
407	2	1.57	0.33	1.97	0.06	632.10	49.78	1.14
408	3	1.05	1.39	1.37	0.18	968.80	657.62	1.08
409	2	1.57	0.49	2.03	0.43	672.00	244.94	1.15
413	3	1.05	1.48	1.11	0.10	819.03	530.85	1.03
414	3	1.05	1.33	1.14	0.10	841.03	638.62	1.03
415	4	0.78	0.78	1.21	0.15	2,121.83	3,134.42	1.06
416	3	1.04	1.00	1.19	0.12	582.97	259.24	1.04
417	5	0.63	0.99	1.22	0.19	1,115.90	591.48	1.05
418	4	0.78	0.80	1.16	0.21	801.53	487.44	1.03
419	2	1.57	0.10	1.48	0.35	472.40	95.88	1.08
420	2	1.57	1.77	1.39	0.38	720.75	643.26	1.07
421	3	1.05	1.48	1.15	0.12	1,095.93	1,023.58	1.04
428	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
429	4	0.78	1.37	1.20	0.18	1,562.05	1,189.07	1.05
430	4	0.78	0.64	1.14	0.11	599.55	187.31	1.03
431	3	1.05	0.91	1.21	0.13	770.43	664.92	1.05
435	2	1.57	1.15	1.07	0.08	378.90	120.92	1.01
436	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
497	4	0.78	1.26	1.39	0.18	2,443.75	2,408.21	1.10
498	4	0.78	0.63	1.23	0.29	693.13	267.58	1.04
499	6	0.52	0.15	1.37	0.33	796.93	293.88	1.07
884	2	1.57	1.07	1.12	0.03	396.70	154.01	1.02
885	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
886	1	3.14	0.00	0.89	0.00	200.2	0.00	0.98
905	4	0.78	0.64	1.33	0.39	739.23	286.37	1.06
906	4	0.78	0.64	1.37	0.32	696.45	219.17	1.07
907	4	0.78	0.88	1.36	0.39	1,071.88	1,027.96	1.07
908	8	0.39	0.29	1.45	0.56	2,610.54	4,703.93	1.11
909	5	0.63	0.58	1.47	0.27	1,316.28	1,209.72	1.10
910	7	0.45	0.61	1.26	0.19	1,954.03	1,677.27	1.06

Site	Num Pch	PArea Mn	PArea SD	PMSI Mn	PMSI SD	PMPAR Mn	PMPAR SD	PMPFD Mn
3021	3	1.04	0.04	1.54	0.27	601.30	105.44	1.09
3022	5	0.63	0.88	1.29	0.31	1,224.78	917.95	1.06
3023	4	0.78	0.20	1.26	0.16	583.90	112.23	1.05

100 m Buffer, Part 5

Site	PMPFD SD	PTE Mn	PTE SD	PED Mn	PED SD	Dist Upl	Dist OWl	Dist Rd	LT Assn
22	0.03	278.15	163.37	88.65	52.07	50.1	135.5	603.1	1
23	0.06	301.75	247.99	96.18	79.04	28.3	88.3	875.1	1
24	0.03	514.53	403.19	163.99	128.51	6.3	141.1	1023.3	1
37	0.02	563.67	202.20	179.66	64.45	0.0	217.8	915.8	2
38	0.05	296.76	342.36	94.59	109.12	92.3	235.7	899.8	2
39	0.04	370.95	311.55	118.23	99.30	141.0	86.9	935	2
133	0.13	437.17	265.70	139.34	84.69	144.6	83.3	418.7	3
134	0.03	473.76	221.93	151.00	70.74	61.6	20.3	548	3
135	0.04	593.99	19.82	189.32	6.32	149.0	0.0	682.5	3
139	0.10	584.48	73.93	186.29	23.56	65.9	621.1	874.9	3
140	0.00	628.1	0.00	200.20	0.00	143.7	533.6	939.4	3
141	0.00	628.1	0.00	200.20	0.00	100.3	375.8	1,090.4	3
234	0.00	630.1	0.00	200.83	0.00	97.5	336.2	91.9	5
235	0.00	628.1	0.00	200.20	0.00	191.2	302.6	287.5	5
236	0.00	628.1	0.00	200.20	0.00	204.5	234.3	447	5
269	0.05	321.93	232.42	102.61	74.08	3.7	56.3	158.4	6
270	0.06	319.60	272.15	101.86	86.74	91.3	76.3	308.1	6
270	0.05	455.05	251.61	145.04	80.20	68.9	194.6	308.5	6
275	0.00	628.1	0.00	200.20	0.00	391.6	302.5	783.5	6
276	0.00	628.1	0.00	200.20	0.00	476.6	335.1	966.2	6
277	0.00	628.1	0.00	200.20	0.00	691.5	221.9	1,138.8	6
278	0.00	628.1	0.00	200.20	0.00	745.2	190.3	1,242.8	6
279	0.00	628.1	0.00	200.20	0.00	610.2	102.6	1354	6
280	0.00	628.1	0.00	200.20	0.00	635.6	192.0	1,343.4	6
281	0.06	555.54	291.40	177.06	92.88	138.8	0.0	1137	6
282	0.02	529.81	427.90	168.86	136.38	302.9	0.0	1,074.4	6
283	0.04	423.73	281.42	135.05	89.70	30.8	48.3	1,141.2	6
284	0.02	319.87	168.72	101.95	53.77	48.1	20.5	1,290.4	6
285	0.03	378.17	175.76	120.53	56.02	195.3	0.0	1,445.4	6
286	0.10	437.98	369.18	139.60	117.67	97.7	52.5	1,576.6	6
322	0.07	544.44	338.73	173.63	108.03	75.3	10.3	445.2	5
323	0.00	554.23	200.62	176.65	63.94	110.2	19.3	323.5	5

Site	PMPFD SD	PTE Mn	PTE SD	PED Mn	PED SD	Dist Upl	Dist OWl	Dist Rd	LT Assn
324	0.03	583.86	79.67	186.09	25.39	22.0	101.8	228.8	5
331	0.02	526.29	110.98	167.74	35.37	0.0	437.7	306.2	7
332	0.03	564.68	4.98	179.98	1.59	31.7	454.3	459.6	7
343	0.03	478.76	163.86	152.59	52.23	117.0	0.0	409	8
344	0.03	349.25	299.64	111.31	95.50	47.1	88.2	460.7	8
345	0.00	628.8	0.00	200.41	0.00	126.6	145.5	519.3	8
368	0.00	628.1	0.00	200.20	0.00	0.0	338.0	624.4	9
369	0.11	408.44	313.00	130.18	99.76	0.0	275.6	826.3	9
370	0.01	309.97	247.28	98.80	78.81	0.0	262.9	958.3	9
392	0.07	491.06	345.34	156.51	110.08	108.6	155.1	1159	7
393	0.00	628.1	0.00	200.20	0.00	251.2	196.1	1,315.3	7
394	0.00	628.1	0.00	200.20	0.00	317.9	172.5	1,456.2	7
395	0.00	628.1	0.00	200.20	0.00	457.8	344.8	1,407.3	7
396	0.00	628.1	0.00	200.20	0.00	381.4	391.6	1,353.5	7
397	0.00	628.1	0.00	200.20	0.00	231.7	306.5	1,174.5	7
398	0.00	628.1	0.00	200.20	0.00	345.9	367.6	1177	7
399	0.00	628.1	0.00	200.20	0.00	307.4	311.4	1,016.3	7
400	0.00	628.1	0.00	200.20	0.00	124.5	281.8	994.1	7
404	0.12	546.74	137.01	174.26	43.67	0.0	1,873.8	387.4	10
405	0.02	405.23	171.39	129.16	54.63	0.0	1,751.8	573.6	10
406	0.05	457.98	382.06	145.97	121.77	0.0	1,814.4	743.5	10
407	0.00	983.33	132.59	313.41	42.26	0.0	1,164.5	97.9	10
408	0.04	447.56	299.21	142.65	95.37	0.0	1,208.9	286.9	10
409	0.05	993.83	52.75	316.76	16.81	0.0	1,365.0	257.9	10
413	0.02	356.39	269.56	113.59	85.92	55.3	255.0	289.4	11
414	0.02	393.28	296.38	125.35	94.47	45.3	70.3	431.9	11
415	0.07	339.45	245.32	108.19	78.19	0.0	138.8	592.8	11
416	0.02	457.46	259.11	145.80	82.58	0.0	285.0	468.6	11
417	0.04	291.56	195.35	92.93	62.26	57.3	363.0	164.1	11
418	0.04	369.22	239.68	117.68	76.39	0.0	373.8	282.7	11
419	0.05	746.09	199.97	237.80	63.74	30.5	424.9	209.5	11
420	0.07	561.19	267.22	178.86	85.17	48.0	452.1	299.5	11
421	0.03	355.75	292.73	113.39	93.30	52.9	318.3	440.1	11
428	0.00	628.1	0.00	200.20	0.00	111.2	333.4	926.5	12
429	0.04	277.07	253.18	88.31	80.70	66.2	258.9	1,089.5	12
430	0.02	385.15	165.03	122.76	52.60	30.9	179.1	1,311.4	12
431	0.03	431.05	215.17	137.39	68.58	0.0	62.9	1,143.7	12
435	0.02	525.11	244.18	167.37	77.83	24.7	206.7	1,000.4	12
436	0.00	628.1	0.00	200.20	0.00	148.7	210.2	875	12

Site	PMPFD SD	PTE Mn	PTE SD	PED Mn	PED SD	Dist Upl	Dist OWl	Dist Rd	LT Assn
497	0.06	355.28	407.26	113.24	129.80	0.0	89.2	972.8	13
498	0.04	425.57	274.00	135.64	87.65	0.0	50.7	853.5	13
499	0.06	384.60	58.78	122.58	18.73	18.3	31.7	767.6	13
884	0.01	540.04	182.19	172.12	58.07	22.8	328.4	1,120.8	20
885	0.00	628.1	0.00	200.20	0.00	150.4	472.7	1,041.9	20
886	0.00	628.1	0.00	200.20	0.00	169.9	450.2	910.2	20
905	0.06	451.12	273.87	143.78	87.29	14.3	201.3	147.9	3
906	0.05	481.99	296.66	153.62	94.55	12.3	115.1	270.2	3
907	0.08	380.90	169.78	121.40	54.11	31.7	270.6	403.3	3
908	0.16	290.52	144.05	92.60	45.91	7.8	220.6	847.2	3
909	0.05	407.69	239.49	129.94	76.33	5.1	172.9	971.6	3
910	0.04	276.30	274.55	88.06	87.51	3.9	173.0	791.6	3
3021	0.04	627.50	114.22	200.00	36.41	0.0	31.1	77.7	15
3022	0.07	316.93	208.18	101.01	66.35	0.0	36.9	151.8	15
3023	0.03	444.64	87.25	141.72	27.81	0.0	140.5	233.8	15

500m Buffer, Part 1

Stand	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
151	0.44	0.00	0.02	0.02	0.49	0.03	0.01	0.34
167	0.15	0.01	0.00	0.00	0.01	0.07	0.00	0.66
193	0.13	0.02	0.03	0.04	0.09	0.34	0.12	0.18
196	0.03	0.07	0.25	0.00	0.13	0.00	0.09	0.21
197	0.02	0.03	0.17	0.00	0.06	0.00	0.04	0.44
209	0.22	0.00	0.02	0.05	0.17	0.10	0.03	0.33
222	0.56	0.00	0.00	0.01	0.05	0.00	0.00	0.00
223	0.64	0.00	0.04	0.03	0.08	0.00	0.00	0.02
225	0.05	0.01	0.07	0.02	0.22	0.00	0.00	0.40
226	0.03	0.12	0.06	0.12	0.35	0.00	0.01	0.08
229	0.09	0.13	0.05	0.10	0.24	0.00	0.03	0.20
233	0.02	0.05	0.08	0.00	0.00	0.03	0.02	0.56
238	0.06	0.01	0.10	0.00	0.05	0.01	0.00	0.52
250	0.24	0.26	0.17	0.24	0.04	0.01	0.00	0.00
252	0.18	0.23	0.16	0.27	0.08	0.04	0.01	0.01
253	0.11	0.17	0.13	0.24	0.11	0.11	0.04	0.05
258	0.00	0.57	0.00	0.00	0.06	0.02	0.01	0.07
261	0.11	0.36	0.00	0.00	0.00	0.01	0.00	0.52
355	0.33	0.01	0.00	0.00	0.00	0.02	0.02	0.50
371	0.26	0.00	0.01	0.00	0.00	0.21	0.09	0.20
473	0.01	0.00	0.00	0.00	0.00	0.04	0.23	0.71

Stand	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
475	0.04	0.00	0.01	0.00	0.00	0.01	0.07	0.87
484	0.34	0.01	0.04	0.00	0.00	0.15	0.13	0.28
485	0.39	0.01	0.06	0.00	0.00	0.16	0.10	0.24
486	0.21	0.01	0.02	0.00	0.00	0.42	0.24	0.05
494	0.21	0.03	0.24	0.00	0.00	0.00	0.09	0.20
495	0.10	0.07	0.15	0.00	0.00	0.02	0.04	0.29
519	0.57	0.01	0.03	0.00	0.00	0.01	0.00	0.33

500 m Buffer, Part 2

Stand	AldWillo	Other	TrDens	TrDenVar	BAmpha	BAVar	NumPch
151	0.05	0.02	747.7	281,246.7	13.0	86.4	21
167	0.40	0.01	950.9	484,225.8	7.7	7.1	20
193	0.05	0.00	18.0	968.4	2.3	15.9	28
196	0.17	0.04	276.1	29,768.4	4.6	5.3	34
197	0.08	0.16	1,138.2	262,948.1	13.8	5.3	31
209	0.04	0.01	291.5	160,108.4	3.8	12.3	26
222	0.32	0.05	108.9	35,577.6	3.1	28.2	17
223	0.15	0.04	96.5	9,704.6	2.3	5.3	12
225	0.24	0.00	357.3	166,787.8	10.7	28.2	22
226	0.21	0.01	159.4	14,376.6	6.1	12.3	35
229	0.15	0.00	381.8	56,310.4	7.7	12.3	29
233	0.13	0.11	342.7	19,569.4	19.1	1.8	27
238	0.07	0.14	242.5	3,922.5	13.0	7.1	21
250	0.02	0.00	681.8	462,102.5	8.4	75.8	11
252	0.03	0.00	790.4	22,578.5	9.9	22.9	14
253	0.03	0.00	659.4	146,280.8	13.0	22.9	20
258	0.07	0.07	558.3	339,503.1	10.7	65.2	20
261	0.00	0.00	1,143.5	260,720.0	13.0	33.5	8
355	0.07	0.04	136.7	12,457.9	16.1	148.1	29
371	0.05	0.17	628.8	139,423.4	10.7	12.3	22
473	0.00	0.00	175.8	18,170.3	14.5	1.8	17
475	0.00	0.00	262.7	17,606.8	14.5	7.1	17
484	0.02	0.02	313.5	4,939.9	6.9	15.9	30
485	0.02	0.03	449.6	33,063.6	16.1	7.1	26
486	0.02	0.02	460.8	53,462.7	9.2	21.2	20
494	0.12	0.11	526.2	21,610.1	21.4	1.8	18
495	0.06	0.26	924.7	159,725.6	21.4	32.9	26
519	0.01	0.05	997.1	12,181.2	19.9	33.5	17

500 m Buffer, Part 3

Stand	PAreaMn	PAreaSD	PMSIMn	PMSISD	PMPARMn	PMPARSD	PMPFDMn
151	5.44	12.25	1.53	0.46	654.19	535.38	1.08
167	5.52	16.12	1.50	0.50	682.97	488.72	1.08
193	4.25	8.20	1.50	0.35	544.74	277.28	1.08
196	3.00	6.27	1.45	0.39	574.82	236.86	1.07
197	3.56	6.11	1.50	0.39	632.98	402.68	1.08
209	4.46	9.25	1.56	0.64	597.52	521.50	1.08
222	7.47	18.37	1.51	0.32	1,022.54	1,261.35	1.09
223	9.98	22.74	1.68	0.52	586.81	423.97	1.10
225	4.75	7.47	1.56	0.47	654.01	676.03	1.08
226	3.20	8.03	1.54	0.57	819.14	823.94	1.08
229	3.70	7.79	1.56	0.63	692.46	741.48	1.08
233	4.66	12.90	1.46	0.53	590.23	566.11	1.07
238	5.63	13.51	1.46	0.37	641.50	542.40	1.07
250	10.40	31.77	1.46	0.28	1,287.42	1,588.90	1.09
252	8.48	24.09	1.47	0.23	993.04	1,507.98	1.09
253	5.79	13.88	1.47	0.26	495.24	256.98	1.07
258	5.58	14.09	1.54	0.41	849.65	1,108.93	1.08
261	13.99	24.40	1.41	0.28	550.84	393.71	1.07
355	3.57	8.21	1.56	0.58	733.52	502.46	1.08
371	5.05	8.22	1.59	0.53	447.49	234.08	1.08
473	6.46	18.97	1.60	0.81	1,247.61	1,722.48	1.09
475	6.89	24.63	1.41	0.32	697.42	598.26	1.07
484	3.87	5.31	1.51	0.33	630.38	742.02	1.08
485	4.38	6.15	1.54	0.35	584.78	631.34	1.08
486	5.61	16.35	1.47	0.55	721.72	677.25	1.07
494	6.50	13.30	1.64	0.58	592.84	308.99	1.09
495	4.06	6.85	1.44	0.44	518.77	339.94	1.07
519	6.88	17.97	1.47	0.29	953.02	840.60	1.08

500 m Buffer, Part 4

Stand	PMPFDSD	PTEMn	PTESD	PEDMn	PEDSD	StandSz	LTAssn
151	0.05	1,094.85	1,287.04	9.59	11.27	63.73	5
167	0.04	1,224.76	2,412.14	11.10	21.86	24.91	5
193	0.04	1,010.97	963.74	8.50	8.10	14.82	9
196	0.04	924.74	1,209.46	9.08	11.88	16.78	3
197	0.04	1,013.72	1,129.88	9.19	10.24	28.31	3
209	0.05	1,290.46	1,985.27	11.13	17.13	23.63	8

Stand	PMPFDSD	PTEMn	PTESD	PEDMn	PEDSD	StandSz	LTAssn
222	0.03	1,170.68	1,733.62	9.22	13.65	33.57	6
223	0.05	1,513.95	1,436.94	12.64	12.00	55.09	6
225	0.05	1,211.68	1,257.38	11.60	12.04	27.76	6
226	0.05	1,021.40	1,727.55	9.13	15.45	35.11	6
229	0.05	1,182.52	1,871.19	11.03	17.46	22.46	6
233	0.04	1,184.13	2,223.48	9.42	17.68	13.62	1
238	0.03	1,178.02	1,861.43	9.96	15.74	21.68	2
250	0.06	910.06	1,541.81	7.95	13.47	8.13	7
252	0.05	1,059.56	1,325.55	8.92	11.16	13.49	7
253	0.04	1,064.57	1,017.71	9.19	8.78	15.73	7
258	0.04	1,091.58	1,268.46	9.77	11.36	133.45	3
261	0.04	1,479.77	1,919.08	13.22	17.15	24.79	4
355	0.05	1,095.43	1,861.91	10.59	18.00	6.91	13
371	0.04	1,395.39	1,740.36	12.56	15.67	16.33	15
473	0.06	1,544.95	3,399.34	14.06	30.93	12.07	10
475	0.04	1,005.22	2,140.46	8.58	18.27	14.50	10
484	0.04	1,091.28	1,064.96	9.41	9.18	12.88	11
485	0.04	1,199.16	1,148.12	10.53	10.08	18.83	11
486	0.05	1,254.44	2,478.85	11.18	22.09	9.47	11
494	0.05	1,458.25	1,899.93	12.46	16.23	41.07	12
495	0.04	1,061.56	1,277.80	10.05	12.09	33.19	12
519	0.05	1,038.12	1,622.31	8.88	13.88	35.81	20

1,000 m Buffer, Part 1

Stand	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
151	0.26	0.00	0.00	0.03	0.02	0.01	0.01	0.38
167	0.09	0.01	0.06	0.01	0.03	0.03	0.01	0.63
193	0.10	0.03	0.05	0.10	0.06	0.26	0.09	0.18
196	0.02	0.04	0.16	0.00	0.17	0.00	0.05	0.30
197	0.03	0.04	0.12	0.00	0.08	0.00	0.04	0.42
209	0.08	0.01	0.01	0.03	0.13	0.12	0.02	0.47
222	0.38	0.00	0.02	0.03	0.10	0.00	0.00	0.09
223	0.32	0.00	0.03	0.02	0.12	0.00	0.01	0.12
225	0.03	0.01	0.02	0.01	0.15	0.00	0.01	0.39
226	0.06	0.10	0.07	0.13	0.24	0.00	0.02	0.23
229	0.05	0.09	0.05	0.10	0.20	0.00	0.01	0.32
233	0.01	0.03	0.05	0.00	0.00	0.03	0.02	0.64
238	0.03	0.01	0.04	0.00	0.03	0.01	0.01	0.67
250	0.12	0.14	0.14	0.15	0.05	0.06	0.03	0.09

Stand	LowBlSp	Tam	LowNWC	LowMxCon	LowDecid	UplCon	UplMxd	UplDecid
252	0.11	0.12	0.13	0.14	0.04	0.08	0.05	0.15
253	0.11	0.11	0.13	0.13	0.05	0.10	0.06	0.16
258	0.02	0.36	0.02	0.00	0.03	0.03	0.00	0.21
261	0.08	0.24	0.01	0.00	0.04	0.00	0.00	0.54
355	0.36	0.03	0.03	0.00	0.00	0.05	0.04	0.39
371	0.18	0.00	0.00	0.00	0.00	0.25	0.10	0.20
473	0.00	0.00	0.01	0.00	0.00	0.03	0.18	0.77
475	0.01	0.00	0.00	0.00	0.00	0.01	0.07	0.91
484	0.29	0.01	0.03	0.00	0.00	0.19	0.13	0.24
485	0.28	0.01	0.03	0.00	0.00	0.22	0.12	0.21
486	0.25	0.00	0.02	0.00	0.00	0.34	0.15	0.17
494	0.17	0.03	0.13	0.00	0.00	0.02	0.08	0.32
495	0.07	0.04	0.11	0.00	0.00	0.01	0.11	0.37
519	0.30	0.01	0.03	0.00	0.00	0.04	0.02	0.54

1,000 m Buffer, Part 2

Stand	AldWillo	Other	NumPch	PAreaMn	PAreaSD	PMSIMn	PMSISD	PMPARMn
151	0.10	0.08	74	5.21	14.24	1.55	0.53	658.38
167	0.07	0.04	67	5.64	28.48	1.50	0.51	749.00
193	0.10	0.03	70	5.63	11.18	1.51	0.43	472.10
196	0.12	0.14	88	4.09	9.59	1.54	0.46	709.33
197	0.11	0.18	79	4.77	14.44	1.52	0.41	643.79
209	0.06	0.04	84	4.63	19.73	1.51	0.58	582.60
222	0.35	0.03	61	6.74	22.59	1.49	0.42	808.70
223	0.35	0.02	49	8.07	19.64	1.67	0.55	765.74
225	0.35	0.02	40	9.12	25.37	1.64	0.61	502.43
226	0.14	0.01	79	4.82	13.26	1.53	0.56	693.73
229	0.16	0.01	78	4.76	16.07	1.51	0.57	898.01
233	0.08	0.15	74	5.53	29.87	1.45	0.55	571.14
238	0.04	0.11	68	5.79	31.76	1.41	0.49	662.38
250	0.08	0.12	45	8.58	29.59	1.51	0.36	558.06
252	0.08	0.09	51	7.75	25.99	1.50	0.35	647.40
253	0.08	0.05	56	6.94	23.25	1.53	0.48	539.66
258	0.03	0.15	51	7.46	22.36	1.53	0.47	549.07
261	0.01	0.04	44	8.65	30.84	1.43	0.39	627.78
355	0.07	0.02	70	5.19	13.43	1.60	0.58	582.63
371	0.04	0.22	60	6.32	14.00	1.58	0.63	579.49
473	0.00	0.01	38	9.88	46.84	1.60	0.75	871.93
475	0.00	0.01	31	12.60	63.14	1.45	0.44	562.65

Stand	AldWillo	Other	NumPch	PAreaMn	PAreaSD	PMSIMn	PMSISD	PMPARMn
484	0.08	0.02	73	5.33	11.80	1.58	0.62	695.11
485	0.10	0.02	77	4.99	10.57	1.53	0.58	1,390.65
486	0.05	0.01	63	6.06	20.86	1.57	0.56	503.05
494	0.10	0.15	66	5.93	13.37	1.61	0.65	617.93
495	0.04	0.25	71	5.19	11.53	1.61	0.61	807.98
519	0.02	0.04	45	8.70	27.88	1.50	0.43	539.85

1,000 m Buffer, Part 3

Stand	PMPAR SD	PMPFD Mn	PMPFD SD	PTEMn	PTESD	PEDMn	PEDSD	LTAssn
151	446.74	1.08	0.04	1,200.08	2,140.45	3.11	5.55	5
167	698.53	1.08	0.05	1,165.24	3,415.91	3.08	9.04	5
193	267.68	1.07	0.04	1,282.10	1,603.92	3.26	4.07	9
196	816.24	1.08	0.05	1,116.88	1,625.13	3.10	4.51	3
197	547.14	1.08	0.04	1,100.45	1,662.85	2.92	4.41	3
209	445.41	1.08	0.04	1,214.29	3,261.13	3.12	8.38	8
222	719.53	1.08	0.04	1,158.44	2,266.14	2.82	5.51	6
223	1,210.73	1.10	0.06	1,509.86	2,194.27	3.82	5.55	6
225	206.44	1.08	0.05	1,702.97	2,801.09	4.67	7.68	6
226	814.65	1.08	0.05	1,216.95	2,338.09	3.20	6.14	6
229	996.46	1.08	0.05	1,172.21	2,663.41	3.15	7.17	6
233	265.16	1.07	0.04	1,192.65	3,918.91	2.91	9.57	1
238	415.10	1.07	0.04	1,110.12	3,799.72	2.82	9.64	2
250	695.64	1.08	0.04	1,330.62	1,841.71	3.45	4.77	7
252	819.85	1.08	0.04	1,285.47	1,978.90	3.25	5.01	7
253	338.64	1.08	0.04	1,321.67	2,084.46	3.40	5.36	7
258	477.31	1.08	0.04	1,392.03	2,382.65	3.66	6.26	3
261	674.72	1.07	0.04	1,256.27	2,635.95	3.30	6.93	4
355	516.44	1.08	0.05	1,380.40	2,501.66	3.80	6.89	13
371	629.51	1.08	0.05	1,505.35	2,735.33	3.97	7.21	15
473	1,339.94	1.09	0.06	1,719.31	5,412.16	4.58	14.41	10
475	165.70	1.07	0.04	1,296.86	3,733.17	3.32	9.56	10
484	1,044.07	1.08	0.05	1,405.41	2,364.91	3.61	6.08	11
485	5,173.17	1.10	0.18	1,304.46	2,140.79	3.40	5.57	11
486	293.19	1.08	0.04	1,426.80	2,876.55	3.74	7.53	11
494	554.04	1.08	0.05	1,470.86	2,612.80	3.76	6.67	12
495	1,386.58	1.09	0.06	1,347.78	2,388.05	3.66	6.48	12
519	237.68	1.07	0.04	1,404.98	2,676.85	3.59	6.84	20

APPENDIX 4. The subsets of best models for each combination of buffer size (100, 500, and 1,000 m) and response variable (Connecticut Warbler frequency and abundance). Numbers listed are the coefficient values for each variable included in the model, as well as the intercept. w_i = Akaike weight for that model. See Appendix 2 for variable abbreviations.

100 m Buffer, Connecticut Warbler abundance

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Intercept	0.51	0.63	0.58	0.49	0.28	0.50	0.57	0.29	0.45	0.44
Tam	0.00	0.00	0.00	0.00	0.00	-0.18	0.00	0.00	-0.10	0.00
LowMxCon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.32	-0.40
LowDecid	-1.34	-0.80	-1.49	0.00	-0.64	-1.38	-1.42	-1.39	0.00	0.00
UplMxd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
SedgFen	0.00	0.00	-3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AldWillo	0.00	-1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCDens	0.30	0.29	0.30	0.30	0.27	0.31	0.30	0.35	0.32	0.31
CanCov	0.00	0.06	-0.14	-0.06	-0.05	0.00	-0.14	-0.10	0.00	0.05
DistOWl	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
w_i	0.24	0.18	0.11	0.10	0.10	0.08	0.07	0.05	0.04	0.03

100 m Buffer, Connecticut Warbler frequency

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Intercept	-2.13	-2.15	-2.13	-2.10	-2.21	-2.24	-2.15	-2.19	-2.24	-2.22
Tam	0.80	0.75	0.62	0.77	0.88	0.73	0.66	0.85	0.00	0.69
LowMxCon	1.57	1.23	1.63	1.56	1.73	1.81	1.64	1.71	1.72	1.80
LowDecid	-2.65	0.00	-2.50	-2.55	-2.94	-2.90	-2.61	-2.84	-2.64	-2.80
UplMxd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
SedgFen	-2.35	0.00	0.00	-2.48	-2.60	0.00	0.00	-2.72	0.00	0.00
Muskeg	2.58	0.00	0.00	0.00	2.63	2.75	2.69	0.00	0.00	0.00
AldWillo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCDens	0.21	0.19	0.21	0.22	0.27	0.27	0.21	0.27	0.24	0.27
CanCov	-1.52	-1.53	-1.55	-1.61	-1.54	-1.48	-1.46	-1.63	-1.43	-1.57
DistUpl	0.02	0.03	0.02	0.02	0.00	0.00	0.02	0.00	0.02	0.00
DistOWl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w_i	0.12	0.11	0.10	0.10	0.07	0.06	0.05	0.05	0.05	0.04

Variables	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18	Model 19
Intercept	-2.11	-2.07	-2.07	-2.14	-2.27	-1.20	-2.04	-1.18	-2.38
Tam	0.67	0.81	0.62	0.62	0.00	0.94	0.68	0.76	0.00
LowMxCon	1.63	1.55	1.61	1.63	1.71	1.72	1.71	1.77	1.94
LowDecid	-2.42	-2.62	-2.46	-2.49	-2.80	-2.49	-2.62	-2.33	-3.10
UplMxd	0.00	-0.24	-0.24	0.00	0.00	0.00	-0.68	0.00	0.00
SedgFen	0.00	-2.44	0.00	0.00	-1.29	-2.25	0.00	0.00	0.00
Muskeg	0.00	2.50	0.00	0.00	2.38	2.74	0.00	0.00	2.50
AldWillo	-0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GCDens	0.21	0.20	0.21	0.21	0.24	0.00	0.24	0.00	0.30
CanCov	-1.55	-1.54	-1.56	-1.55	-1.36	-1.70	-1.59	-1.73	-1.35
DistUpl	0.02	0.02	0.02	0.02	0.02	0.03	0.00	0.03	0.00
DistOWl	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
w_i	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02

500 m Buffer, Connecticut Warbler abundance

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	-0.10	2.35	1.48	0.30	1.90	0.09	-0.06	2.56	1.13
LowBlSp	3.43	2.78	0.00	3.09	2.98	3.44	3.43	2.77	3.33
AldWillo	0.00	-1.63	-2.03	-1.88	-1.52	0.00	0.00	-1.47	0.00
TrDens	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TrDenVar	0.41	0.00	0.34	0.43	0.00	0.33	0.40	0.00	0.00
NumPch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01
w_i	0.25	0.22	0.12	0.10	0.07	0.07	0.06	0.06	0.05

500 m Buffer, Connecticut Warbler frequency

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-5.55	-4.43	-6.00	-4.06	-4.50
LowBlSp	2.86	2.99	3.02	2.92	3.01
LowNWC	0.00	0.00	0.00	-0.50	0.00
AldWillo	-2.45	-2.56	-2.63	-2.49	-2.58
TrDens	0.00	0.00	0.00	0.00	0.00
TrDenVar	1.14	1.17	1.18	1.14	1.18
NumPch	0.00	0.00	0.01	0.00	0.00
PTEMn	0.00	0.00	0.00	0.00	0.00
w_i	0.39	0.32	0.18	0.06	0.05

1,000 m Buffer, Connecticut Warbler abundance

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
Intercept	10.81	9.32	2.56	10.68	9.17	11.91	5.69	9.96	10.63	13.96	4.37
LowBlSp	0.00	0.00	0.00	3.71	3.20	0.00	4.75	0.00	0.00	4.55	5.11
LowMxCon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.54	0.00	6.84
UplCon	0.00	0.58	0.57	0.00	0.58	0.76	0.73	0.00	0.58	0.85	0.67
UplDecid	-4.77	-3.96	-2.64	-4.04	-3.27	-4.28	0.00	-4.65	-4.59	-3.52	0.00
NumPch	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.01	0.00	-0.03	0.00
PTEMn	-0.01	0.00	0.00	-0.01	-0.01	-0.01	0.00	0.00	-0.01	-0.01	0.00
w_i	0.21	0.19	0.12	0.11	0.08	0.06	0.06	0.05	0.05	0.04	0.03

1,000 m Buffer, Connecticut Warbler frequency

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	6.76	6.25	3.38	2.14	3.55	5.29	6.15	2.72
LowBlSp	1.91	0.00	0.00	2.60	1.62	2.40	0.00	0.00
LowMxCon	0.00	0.00	0.00	4.87	0.00	2.85	0.18	2.13
UplCon	0.81	0.78	0.70	0.68	0.71	0.77	0.78	0.68
UplDecid	-3.69	-4.01	-4.07	-2.78	-3.80	-3.13	-3.98	-3.69
NumPch	-0.02	-0.02	0.00	0.00	0.00	-0.02	-0.02	0.00
PTEMn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
w_i	0.28	0.24	0.12	0.11	0.10	0.07	0.05	0.04