

**Distribution and Habitat Associations of  
Golden-Winged Warblers in Duck Mt., Riding Mt.  
and Porcupine Hills, Manitoba, 1998**



Prepared for

**The Canadian Wildlife Service  
Forest Bird Research Division  
and  
Manitoba Mixedwood Forest Research  
and Advisory Committee**

**Enid E. Cumming, Msc.**

#18, 1605, 7th. St. E.  
Saskatoon, Sk.  
S7H 0Z3

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## Executive Summary:

During May and June of 1998, the Duck Mountains of Manitoba (with small excursions into Riding Mountain and Porcupine Hills, Manitoba) were searched for golden-winged warblers (*Vermivora chrysoptera*). One hundred and fifteen sites were chosen in aspen-dominated forest in a variety of age classes from young (<40), through mature (40-80) and old (>80 yrs.). Golden-winged warblers occurred on 39% of the sites surveyed. Thirty-seven golden-winged warblers were found in Duck Mountain, 7 in Riding Mountain and 1 in the Porcupine Hills. Tape-recorded playback of golden-winged warbler song was used to survey sites for the presence of this species. In addition, playback was used to facilitate capture of the birds by luring them into mistnets. Thirty-nine golden-winged warblers were captured in this manner, banded with numbered aluminum U.S. Fish and Wildlife Service bands and released.

Vegetation structure and species composition was gathered from all sites surveyed. Data were analyzed using principle component analysis (PCA), TWINSPAN, and Logistic Regression. Golden-winged warblers were significantly more likely to be found in habitat that had young, regenerating trembling aspen (*Populus tremuloides*) with a tall (>15m), open canopy of residual trees than in similar habitat without residual trees. In naturally dry, open habitats, golden-winged warblers were found significantly more often in bur oak (*Quercus macrocarpa*) habitat, than in other natural savannah-like habitats. Golden-winged warblers also occurred in old (>80 yrs), hardwood stands with natural gaps and in young (<15 yrs) unsalvaged burned areas.

**\*Authors Note:** This study was designed to find where golden-winged warblers did, or did not occur in the Manitoba Escarpment. As this was only a preliminary investigation, not all stand types found in the escarpment were surveyed. Therefore, it is likely that other pockets of golden-winged warblers exist elsewhere in this region. This study was not designed to compare and contrast the effect of different disturbance regimes (ie. logging vs fire), on golden-winged warblers. Evidence from the data, however, suggests that the amount of standing residual trees in a cut area may affect the occurrence of golden-winged warblers. Further study will be required to determine factors associated with forest harvest that influence the distribution of golden-winged warblers and other neotropical migrant songbirds, and their reproductive success in Manitoba.

**Acknowledgements:**

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**Introduction:**

The golden-winged warbler (*Vermivora chrysoptera*), is a small, (8-11g), neotropical migrant songbird (Confer 1992, Curson et al. 1994), breeding primarily in the northeastern and northcentral United States, and southern Ontario. This species winters in Central America and northern South America (Confer 1992, Dunn and Garrett 1997). Historical records of golden-winged warblers exist for central Manitoba and eastern Saskatchewan, and this appears to be an isolated population at the northern-most edge of their range (Walley 1973, Shadick 1986, Cuthbert et al. 1990). Golden-winged warblers appear to be habitat specialists occurring in regenerating old pastures and fields, gaps in deciduous forest, shrubby regrowth and edges along streams (Confer and Knapp 1981, Curson et al. 1994). They appear to favour a certain stage of regeneration, and once that stage is past, move out of the area (Confer and Knapp 1981).

Golden-winged warblers have declined over much of the southern part of their range. Reasons for the decline appear to be habitat loss, hybridization from the closely related blue-winged warblers (*Vermivora pinus*) and nest parasitism from brown-headed cowbirds (*Molothrus ater*) (Confer 1992, Gill 1997). In recent decades, however, golden-winged warblers have been expanding in the northwestern part of their range and their entire breeding range appears to be shifting northward (Price et al. 1995, Dunn and Garrett 1997).

In 1997, bird species surveys requested of Louisiana Pacific Co., by the Canadian Wildlife Service, discovered pockets of golden-winged warblers in Duck Mountain Provincial Forest (R. Burger, pers. comm.). Golden-winged warblers have been seen periodically in Riding Mountain Park in Manitoba (Walley 1973, Cuthbert et al. 1990), and there are records from

Saskatchewan in Duck Mountain and the Porcupine Hills (Shadick 1986, W. Harris pers. comm.). Evidence from the 1997 Louisiana Pacific study, however, suggested that golden-winged warblers were more abundant in the Duck Mountain area of Manitoba than previously thought. These isolated pockets of golden-winged warblers in western Manitoba are the only known Canadian population outside of southern Ontario. The western Manitoba birds may represent one of the last genetically "pure" groups of golden-winged warblers on the continent. This study was commissioned to conduct a more thorough search of the Duck Mountains to obtain a better understanding of the extent of golden-winged warbler populations in this region, especially in light of current and projected forest harvesting on the Louisiana Pacific Forest Management Area.

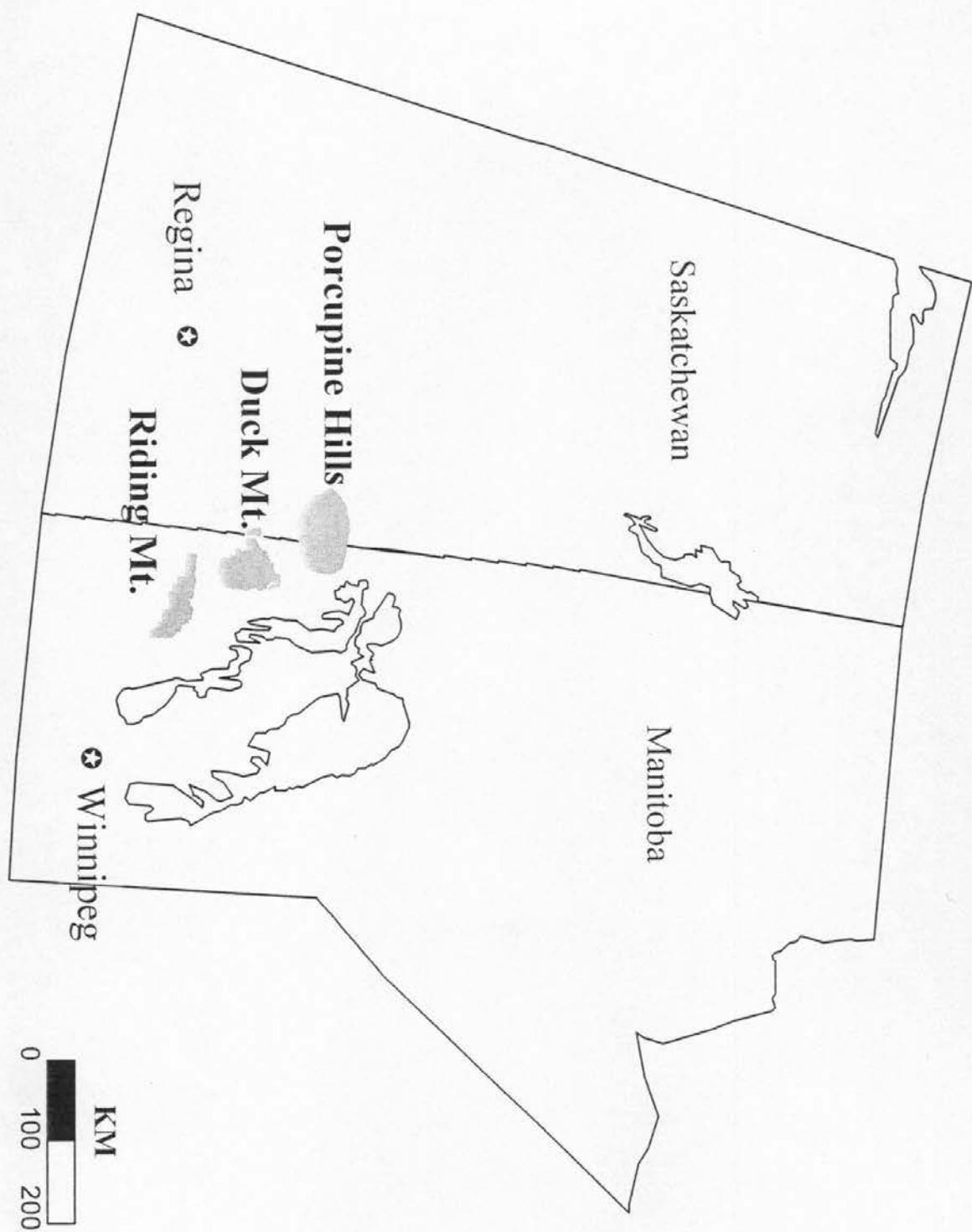
#### **Objectives:**

1. To determine the relative abundance and distribution of golden-winged warblers in western Manitoba, primarily in Duck Mountain.
2. To determine the habitat associations of golden-winged warblers in Manitoba.
3. To determine potential effects of different management regimes on golden-winged warblers.

#### **Study Area:**

The study area covered over 20,000 km<sup>2</sup>; approximately 220 km from north to south and 80 km from east to west. Because of the enormous distances involved, surveys were concentrated in the Duck Mountains with side excursions into Riding Mountain and Porcupine Hills (Figure 1). These three uplands, along with the Pasquia Hills in Saskatchewan, form the Manitoba Escarpment. The Manitoba Escarpment is a series of glacial till uplands that are several hundred meters higher than the surrounding plains and are covered with Mid-boreal upland vegetation (Knapik et al. 1988, Acton et al. 1998). Elevation averages 600 - 700 m to a max. of over 820 m on Baldy Mt (located in the Duck Mts.); the highest point in Manitoba. These uplands are characterized by rolling hills with moderate to steep slopes, knob and kettle topography and many small lakes and bogs. Most of the area is covered in a mixedwood forest. The main tree species are trembling aspen (*Populus tremuloides*), white (*Picea glauca*) and black spruce (*P. mariana*), jack pine (*Pinus banksiana*), balsam poplar (*Populus balsamea*) and white birch (*Betula papyrifera*) (Acton et al. 1998). Over the past 100 years, human activity has removed a

Figure 1: Location of study areas in Manitoba and Saskatchewan



large proportion of the white spruce from the Duck Mountains. As a result, large areas, especially along north slope of the Ducks, are now a hardwood dominated forest comprised mainly of trembling aspen, white birch and balsam poplar.

Using the Forest Ecosystem Classification for Manitoba devised by Zoladeski et al. (1995), most sites surveyed in this study were located in class V5, Aspen Hardwood, V3, Miscellaneous Hardwood or V1, Balsam Poplar Hardwood. The V3 sites in this study were mainly bur oak (*Quercus macrocarpa*) forest. The main shrubby species in the V1 and V5 sites were mountain maple (*Acer spicatum*), beaked hazelnut (*Corylus cornuta*), and low-bush cranberry (*Viburnum edule*), while the main shrubby species in the V3 sites were young bur oak, Saskatoon-berry (*Amelanchier alnifolia*) and Canada buffalo-berry (*Sheperdia canadensis*). Most of the V3 bur oak sites surveyed were located on the eastern slope of Riding Mountain National Park.

## **Methods:**

### **1. Site Choice:**

Coverage of the study area could not be exhaustive, therefore, it was decided to concentrate on hardwood dominated (mainly aspen) forest along an age gradient from young (<40 yrs) through mature (40-80 yrs) to old (>80 yrs). Study sites were chosen on the basis of stand type, determined from forest cover maps and information from local biologists. We searched for golden-winged warblers along roads, trails and openings (cutovers, old fields, and elk habitat improvement plots) in the north, south, east, west and central parts of the Duck Mountains (Figure 2). Areas were accessed by mountain bike or by hiking and were surveyed for golden-winged warblers using tape-recorded playback of their song. In this manner, over 200 km of backcountry trails were surveyed.

### **2. Bird Observations:**

When a golden-winged warbler was located, a 12 metre long mistnet was erected and a tape recorder was left playing to lure the bird into the net. The mistnets used had a mesh diameter of 30 mm and were 2.5 m tall when expanded. When a bird was captured, a numbered aluminum U.S. Fish and Wildlife Service band was attached to its leg and wing length and weight measurements were recorded. Birds were handled following protocol approved by the Canadian Council for Animal Care. Birds were not harmed by any of these procedures, as several individuals were recaptured 3 or 4 days later and appeared to be in good health. In addition,

several banded individuals were observed still on their territories 4 or more weeks after being captured.

### **3. Vegetation Measurements:**

To describe the habitat that golden-winged warblers were using, vegetation was measured using a modified James and Shugart method (1970). Vegetation was measured in two, 0.04ha circles (22 m in diameter), one centred on the bird's territory and the other in a random direction 50 metres from the outside edge of the first circle. Canopy, subcanopy and shrub densities were estimated, while their heights were measured with a clinometer. Tree and shrub species diversity was also recorded. Within each circle, ground cover was estimated within broad categories; herb, low shrub, moss, grass, leaf litter, down woody material and bare ground, in 4 random 1 m<sup>2</sup> quadrats. Vegetation was also measured using the same method, in the areas where we searched for golden-winged warblers, but found none.

### **4. Statistical Analysis:**

Statistical tests were conducted on vegetation data to compare vegetative parameters between sites having golden-winged warblers to those without. For multivariate tests, data were standardized to control for different measurement units and to account for rare species (McCune and Mefford 1997). Standardized data were then run through a Pearson Correlation in PC-ORD (McCune and Mefford 1997) to remove highly correlated variables. Variables were then run through a Principle Component Analysis (PCA), to establish factors related to vegetation measurements. These Factors were then used in a TWINSPAN analysis in PC-ORD.

TWINSPAN simultaneously classifies species and samples in a two-way ordered table based on similarity of occurrence (Hill, 1979). A Logistic Regression using SPSS was then conducted on sites within the TWINSPAN groups to detect those variables associated with the presence or absence of golden-winged warblers within a habitat type (TWINSPAN group).

## **Results:**

### **1. Bird results:**

We collected habitat information and GPS locations for 45 golden-winged warblers; 7 in Riding Mountain, 1 in the Porcupine Hills and 37 in the Duck Mountains (Figures 2,3,4,5). On two occasions, female golden-winged warblers were also captured. On two further occasions, female birds were seen in association with a captured male, but not captured. Although we did

Figure 2: Location of study sites in Duck Mountain

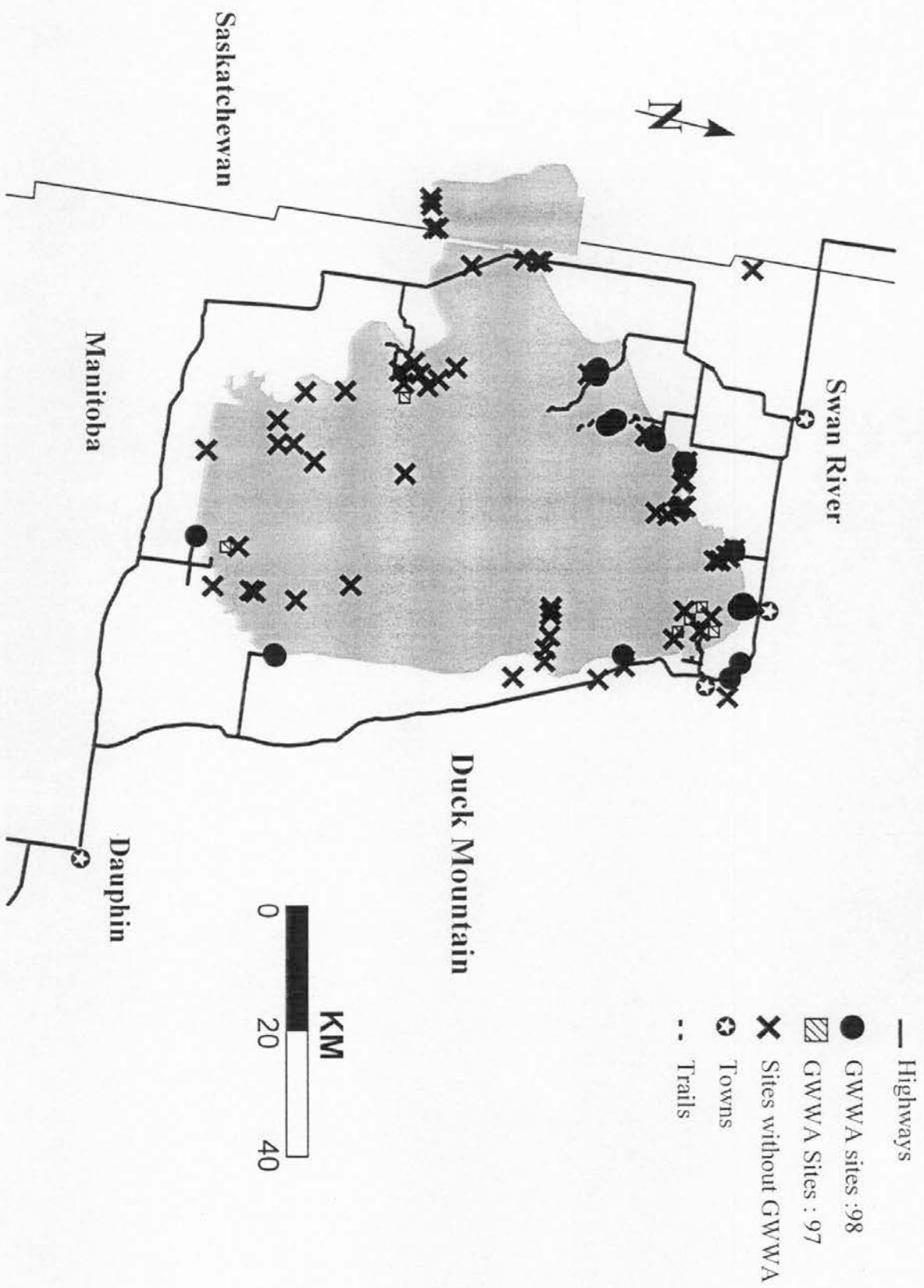


Figure 4: Location of study sites in Riding Mountain

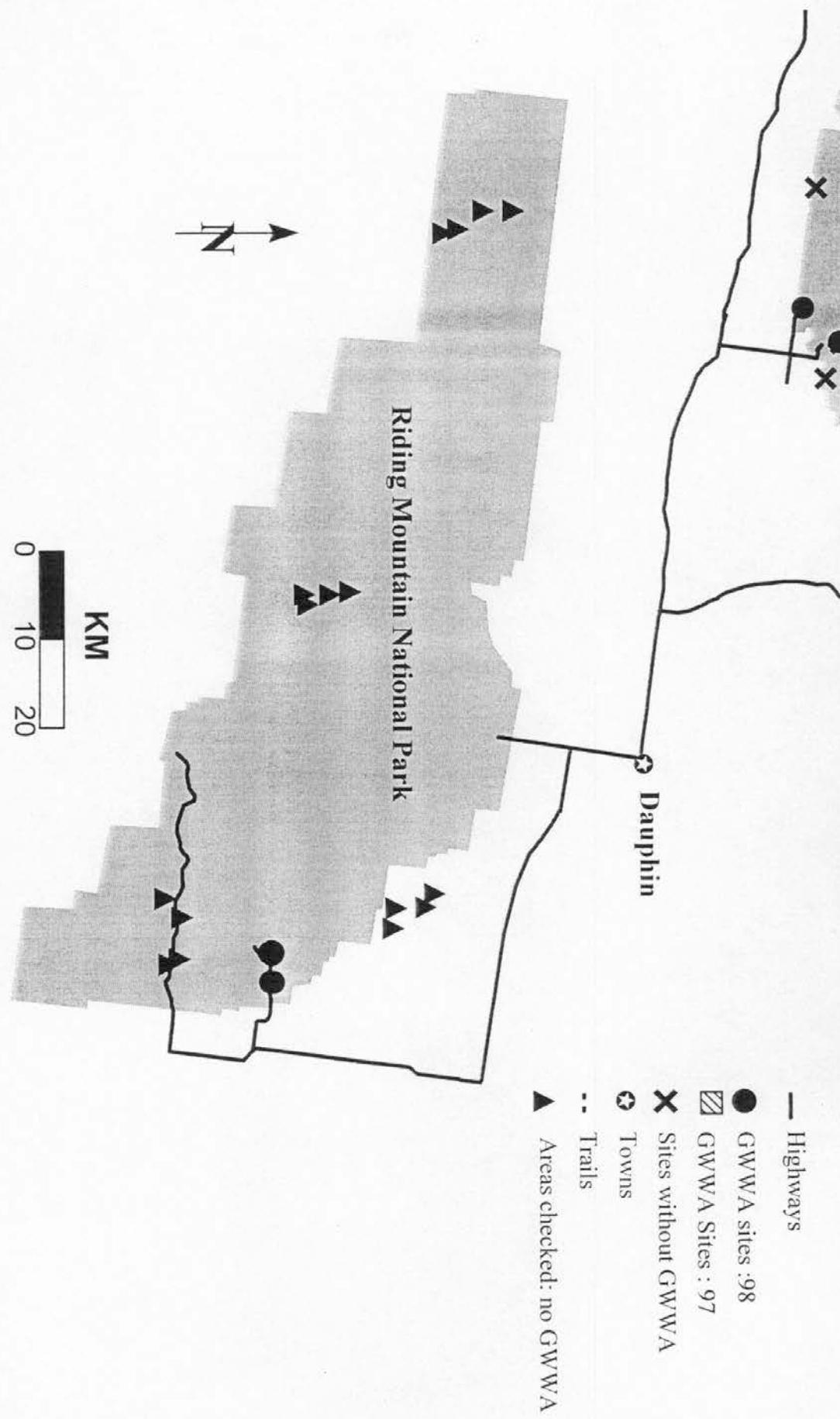


Figure 3: Location of study sites on the north side of the Duck Mountains.

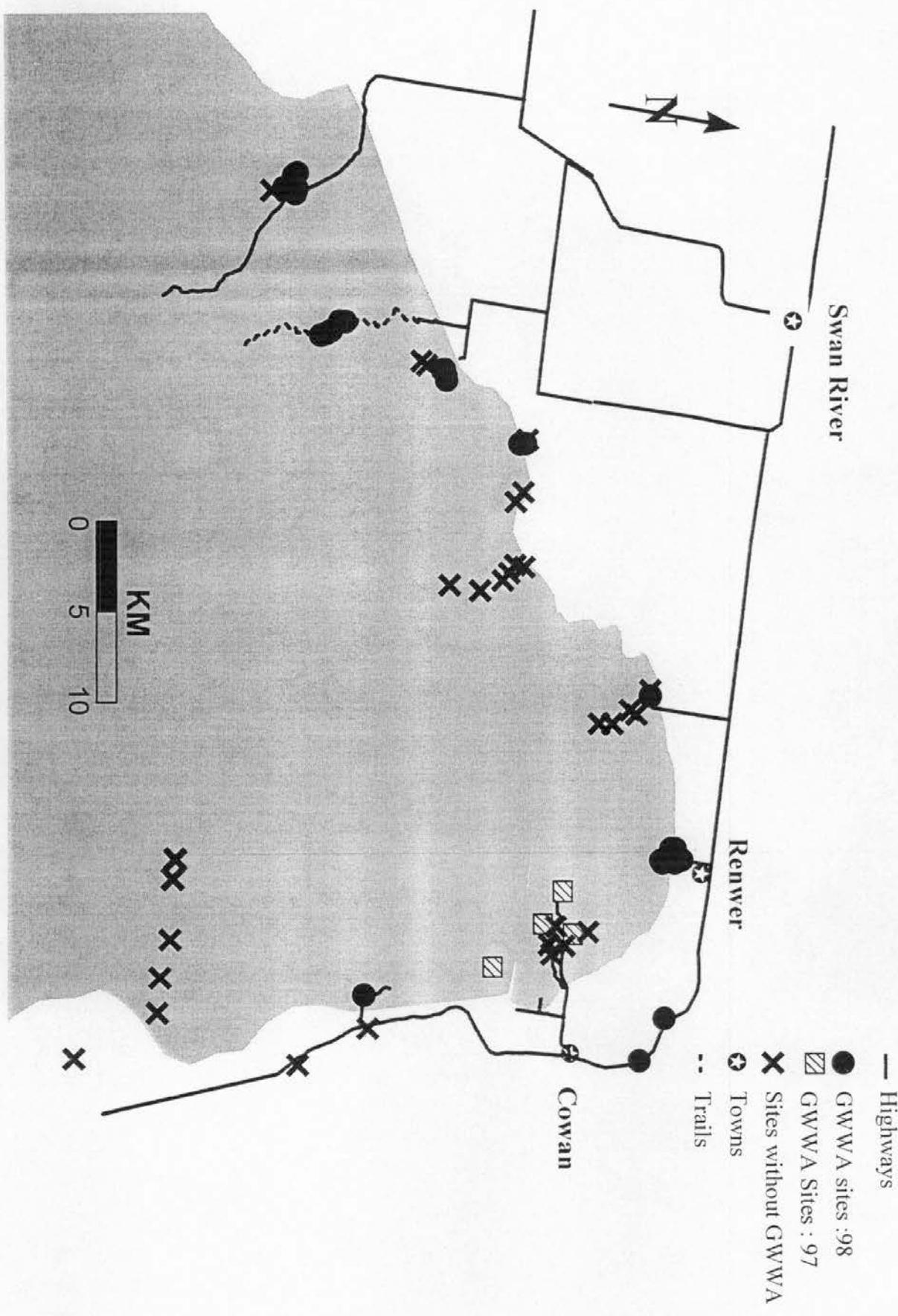
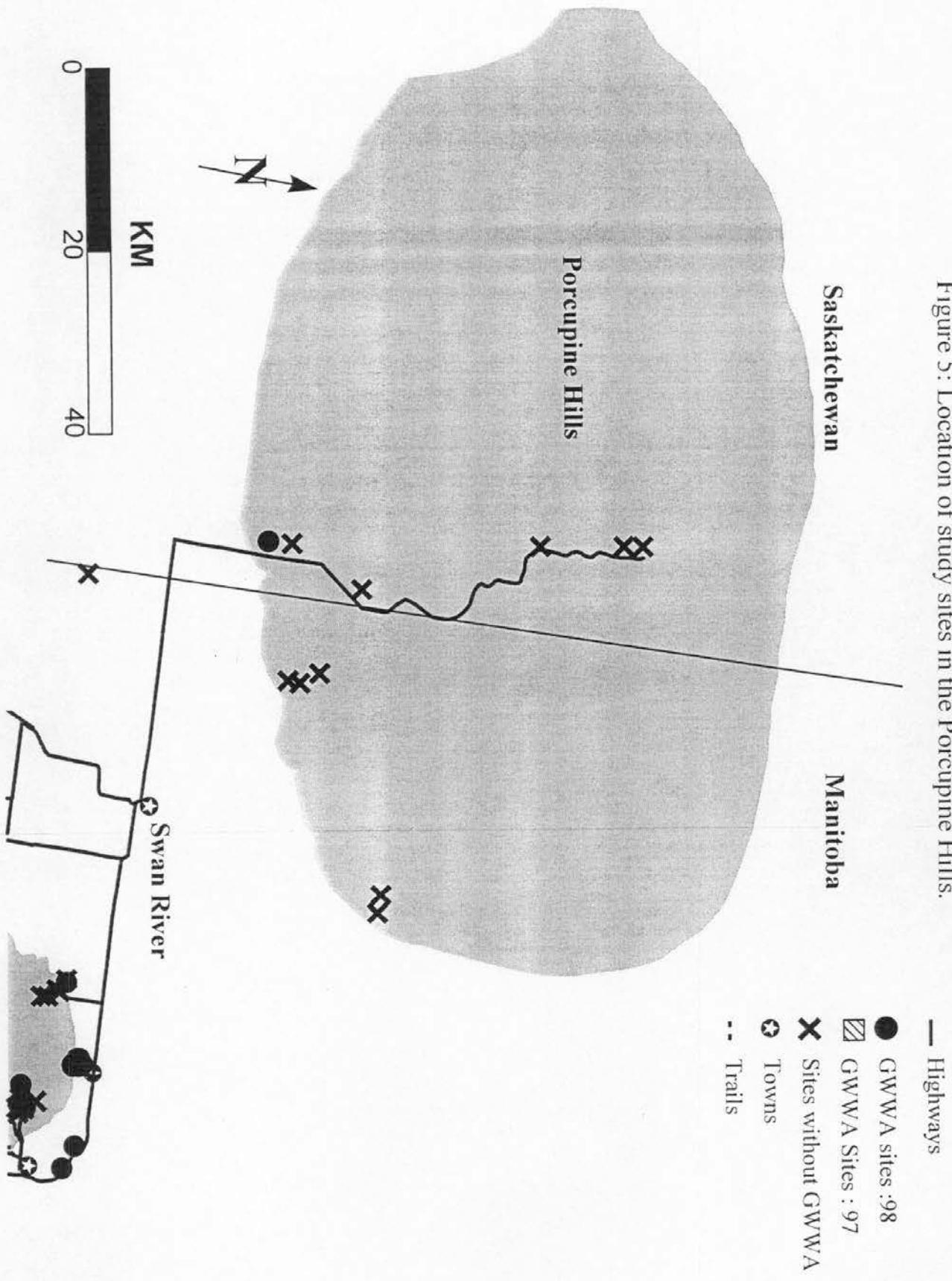


Figure 5: Location of study sites in the Porcupine Hills.



not find any nests, or see any young birds, it appears that many of the male golden-winged warblers were paired and that the birds are almost certainly breeding in this area.

## **2. Statistical Analysis:**

A Principle Component Analysis (PCA), reduced 37 measured vegetation variables into 13 different factors. When these factors were used in a Logistic Regression to predict the presence of golden-winged warblers, only Factors 2, 5, 11 & 12 were significant (see Appendix A). The regression found golden-winged warblers were positively associated with bur oak, both in the canopy and shrub layers, and with shrub aspen and shrub Manitoba maple (*Acer negundo*). They were negatively associated with bare ground (see Appendix A). In addition to differences in bur oak and maple composition, a Mann-Whitney U-test ( $P<.05$ ), conducted on the means between sites with and without golden-winged warblers, found that sites with golden-winged warblers also had more open canopies, denser shrub cover and less rose (*Rosa sp.*) than sites without golden-winged warblers (Table 1).

The 115 study sites were located in a variety of different habitats, from mature forest to cutovers. To obtain information on golden-winged warbler use of sites within habitat classes a TWINSPAN analysis was used. TWINSPAN divided the 115 study sites into 4 main groups based on similarities of vegetational structure and species composition: Group 1: mature aspen forest ( $n=18$ ); Group 2: young regenerating sites ( $n=24$ ); Group 3: older regenerating sites ( $n=49$ ), and Group 4: open savannah ( $n=24$ ) (Figure 6). A Logistic Regression was run on each group separately to compare sites with golden-winged warblers to those without; significant factors are shown in Appendix B. In Group 1 (mature forest), no significant difference was found between sites having golden-winged warblers and those not. In Group 2 (young regeneration), sites with golden-winged warblers had a denser shrub layer, more aspen saplings and denser grass cover than sites without (Table 2). In Group 3 (older regeneration), sites with golden-winged warblers had more open canopies with taller trees than sites without, while in Group 4 (open savannah), sites with golden-winged warblers had more bur oak (both in the canopy and shrub layer) than sites without (Table 2).

Figure 6: TwinSpan groups. Numbers in bold indicate sites with golden-winged warblers.

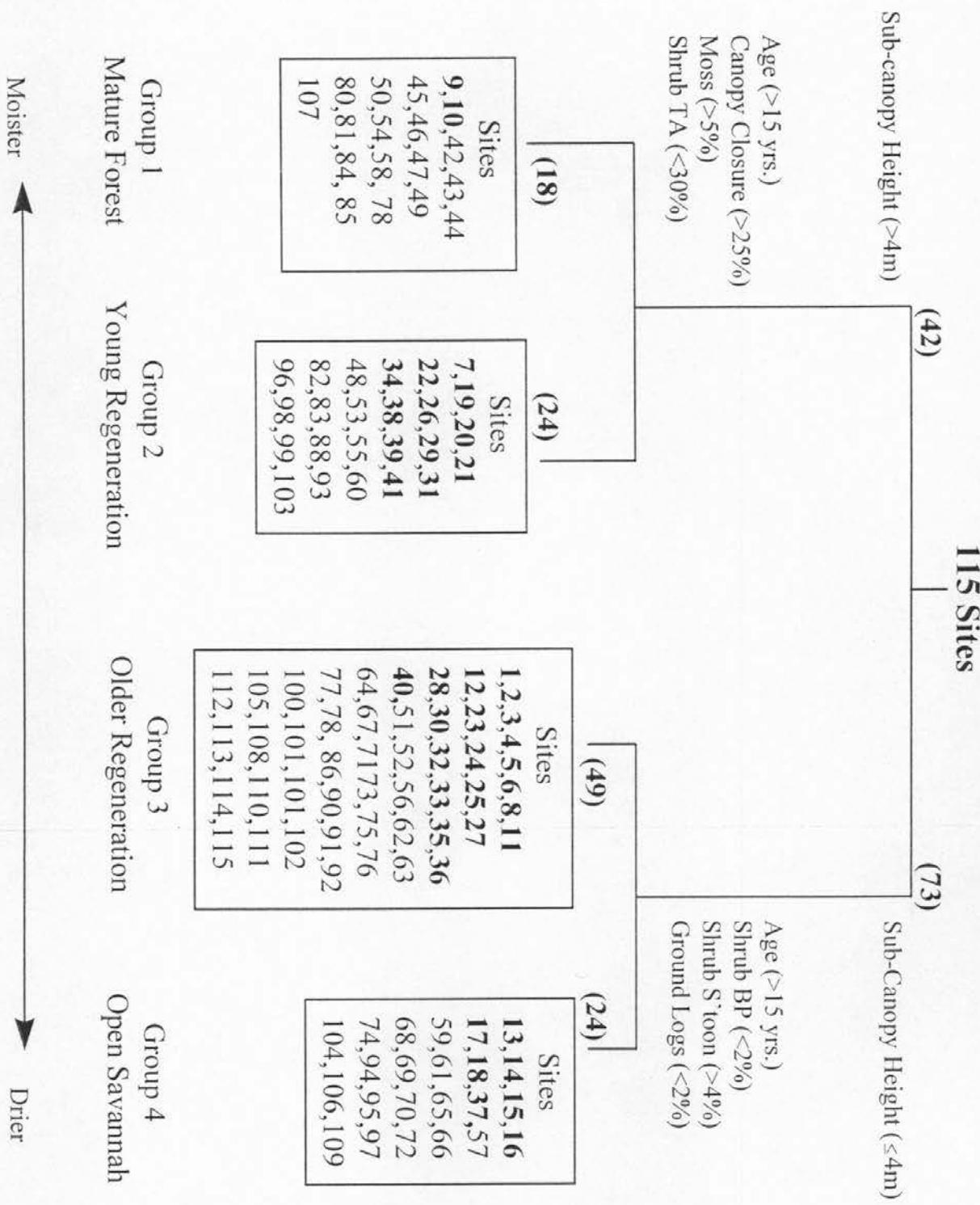


Table 1: Mean ( $\pm$  SD) of vegetative characteristics associated with sites that had Golden-winged warblers vs. sites without Golden-winged warblers.

Vegetation	Canopy		Sub-Canopy		Shrub	
	With	Without	With	Without	With	Without
Stand Age	18.0 $\pm$ 21.4	26.2 $\pm$ 22.8	-	-	-	-
% Cover	6.4 $\pm$ 7.0*	24.1 $\pm$ 24.4*	1.6 $\pm$ 2.8	4.4 $\pm$ 10.8	58.0 $\pm$ 17.5*	43.6 $\pm$ 20.4*
Average Height	16.3 $\pm$ 6.8	14.7 $\pm$ 7.2	3.1 $\pm$ 3.9	3.8 $\pm$ 4.7	1.9 $\pm$ 0.7	1.9 $\pm$ 0.9
% <i>Populus tremuloides</i>	51.5 $\pm$ 39.4	58.7 $\pm$ 32.6	9.6 $\pm$ 21.0	17.9 $\pm$ 27.4	33.5 $\pm$ 26.8	25.9 $\pm$ 25.9
% <i>P. balsamifera</i>	14.6 $\pm$ 18.3	14.6 $\pm$ 25.0	3.4 $\pm$ 10.4	3.4 $\pm$ 10.1	12.4 $\pm$ 14.6	5.1 $\pm$ 11.2
% <i>Betula papyrifera</i>	4.7 $\pm$ 12.6	9.7 $\pm$ 18.4	2.4 $\pm$ 9.0	7.3 $\pm$ 15.9	2.3 $\pm$ 11.3	2.1 $\pm$ 6.7
% <i>Quercus macrocarpus</i>	12.6 $\pm$ 31.6*	1.4 $\pm$ 11.1*	-	-	3.9 $\pm$ 11.4*	0.1 $\pm$ 0.9*
% <i>Picea glauca</i>	4.5 $\pm$ 12.8	7.2 $\pm$ 11.1	3.1 $\pm$ 10.2	4.8 $\pm$ 13.2	0.7 $\pm$ 1.7	3.8 $\pm$ 11.0
% <i>Pinus banksiana</i>	0.0 $\pm$ 0.0	3.1 $\pm$ 14.2	-	-	0.4 $\pm$ 2.0	0.4 $\pm$ 2.2
% <i>Acer negundo</i>	-	-	-	-	0.9 $\pm$ 1.9*	0.1 $\pm$ 0.4*
% <i>A. spicatum</i>	-	-	-	-	2.6 $\pm$ 5.7	7.7 $\pm$ 20.0
% <i>Salix spp.</i>	-	-	-	-	5.7 $\pm$ 15.4	8.3 $\pm$ 12.8
% <i>Corylus cornuta</i>	-	-	-	-	11.5 $\pm$ 18.1	15.7 $\pm$ 20.3
% <i>Alnus spp.</i>	-	-	-	-	5.3 $\pm$ 11.4	2.9 $\pm$ 6.9
% <i>Amelanchier alnifolia</i>	-	-	-	-	3.7 $\pm$ 7.6	4.7 $\pm$ 7.8
% <i>Prunus virginiana</i>	-	-	-	-	3.6 $\pm$ 7.0	4.9 $\pm$ 7.8
% <i>Coronilla stolonifera</i>	-	-	-	-	2.1 $\pm$ 2.9	1.9 $\pm$ 3.5
% <i>Rosa spp.</i>	-	-	-	-	4.4 $\pm$ 4.9*	8.0 $\pm$ 9.9*

\* Indicates means that are significantly different P<0.05, Mann-Whitney U-test

**Table 2:** Differences between sites with and without golden-winged warblers (Logistic Regression).

TwinSpan Group	Group Discription	G	P	Factor	Golden-winged warbler Association
1	Mature Forest	-	n.s.		-
2	Young Regeneration	4.10	0.04	1	a) GWWA's in areas with denser aspen shrub
		4.08	0.04	11	b) GWWA's in areas with more grass cover
3	Older Regeneration	3.99	0.05	3	a) GWWA's in younger areas with less canopy cover
		4.16	0.05	7	b) GWWA's in areas with taller canopy trees
4	Open Savannah	4.96	0.02	1	a) GWWA's in areas with more Bur Oak

**Discussion:**

This study has shown that the population of golden-winged warblers in western Manitoba is larger and more important than previously thought. If this population is breeding successfully, it may be important for the genetic integrity of golden-winged warblers in North America. Gill (1997) found that hybridization between blue-winged and golden-winged warblers may be causing genetic assimilation of the golden-winged warbler in the eastern United States. In Pennsylvania, up to 70% of golden-winged warblers tested, carried blue-winged warbler DNA (Gill, 1997). Although there have been records of blue-winged warblers in Manitoba and Saskatchewan, they appear to have been accidental, rather than breeding individuals (Herriot 1988, Hobson 1988).

In mature forest sites (Group 1), no significant difference was found between sites with golden-winged warblers and sites without. This may be due to insufficient sample size, as only 2 of the 18 sites in this category had golden-wings. From personal observation, however, I found that in forested areas, golden-winged warblers occurred in sites that were older, drier and more open than sites in which they did not. The two sites in Group 1 (#9 & 10), where the golden-winged warblers did occur were both along the Roaring River, in forest that was overmature and starting to open up due to natural treefall gaps.

In young regeneration sites (Group 2), golden-winged warblers occurred in areas with a denser shrub layer of young aspen, less bare ground and more grass than in areas where they did not. Golden-winged warblers were also not observed in recent cutovers less than 4 years old. In the older regeneration sites (Group 3), golden-winged warblers occurred in sites that had tall, open canopies, with many standing residual trees and young regenerating aspen. In contrast, sites without golden-wings had older, denser regeneration, but had very few or no standing residual trees. The results indicate that cutovers where some residual trees were left had golden-winged warblers, while those that had been completely cut did not. Group 3 sites with golden-winged warblers also tended to have more regenerating trembling aspen than sites without. Open savannas (Group 4), were comprised of habitats which shared the traits of being very open and dry, with stunted trees and significant grass cover. Golden-winged warblers used bur oak savannas significantly more than trembling aspen-white spruce savannas or jack pine-bur oak savannas.

**Management Recommendations:**

Populations of golden-winged warblers breeding in western Manitoba are larger, and hence, more important than previously thought. Although associated with regenerating forest, much remains to be learned about microhabitat requirements of golden-winged warblers as they do not occur in all areas and appear to be patchy in their distribution. Maintaining residual trees and leave patches in cut areas and maintaining older forest with gaps seems to be the best approach for sustaining diversity in this area.

a) Standing Residuals: Logged areas having overstory trees left as residuals scattered throughout the cut block will likely result in regenerating stands that favour golden-winged warblers and other species.

b) Fires: Evidence from the study suggests that golden-winged warblers are associated with structural diversity in fires disturbed areas (ie. fire skips, green patches and standing snags). There needs to be further research on the structural attributes associated with fire disturbed sites. Practices such as salvage logging of fire damaged and green timber in burned areas may reduce the suitability of this habitat for golden-winged warblers and other wildlife.

c) Further Research: This was only a preliminary survey. There are undoubtedly more golden-winged warblers in the Porcupine Hills and in other areas of the Duck Mt.'s that were not surveyed. We need to find out the effect of different harvesting and disturbance regimes on the distribution and reproductive success of golden-winged warblers and other neotropical migrants using these forests.

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**Appendix A:** Eigenvalues for the Logistic Regression for all 115 study sites.

The four Factors presented explain the most variance for presence of golden-winged warblers.

(Factors can have either positive or negative values; two negative values will mean a positive score for that factor).

		Factor 2 (-)	Factor 5 (+)	Factor 11 (-)	Factor 12 (+)
Canopy	Age	-0.10	0.11	<b>0.77</b>	0.12
	Cover	0.11	0.14	<b>0.71</b>	-0.22
	Height	0.24	0.25	-0.08	0.12
	Trembling Aspen	0.48	0.27	-0.01	-0.05
	Balsam Poplar	0.11	0.03	0.13	0.00
	White Birch	0.06	-0.01	-0.02	-0.10
SubCanopy	Bur Oak	<b>-0.93</b>	0.01	0.08	0.01
	White Spruce	0.00	-0.14	0.02	0.13
	Cover	0.02	0.02	0.14	-0.08
	Height	0.09	0.01	0.09	0.08
	Trembling Aspen	0.09	0.04	0.25	-0.10
	Balsam Poplar	0.10	-0.03	0.23	0.17
Shrub	White Birch	0.06	0.10	-0.01	-0.10
	White Spruce	0.02	0.02	-0.39	-0.04
	Cover	-0.06	0.53	-0.11	0.25
	Height	0.11	0.23	0.12	0.09
	Trembling Aspen	0.23	0.20	<b>-0.80</b>	-0.02
	Balsam Poplar	0.12	-0.01	-0.26	0.09
Ground	White Birch	0.10	-0.04	0.02	-0.01
	Manitoba Maple	0.03	-0.02	-0.06	<b>0.80</b>
	Mountain Maple	0.04	-0.16	0.23	-0.09
	Willow	0.15	0.05	0.08	0.04
	Hazle	0.16	-0.17	0.42	0.08
	Alder	-0.03	-0.13	0.09	0.48
	Saskatoon Berry	-0.61	0.00	0.26	-0.14
	Chokecherry	-0.33	-0.13	0.21	-0.16
	Dogwood	0.20	0.27	0.39	0.29
	Rose	0.13	0.08	0.38	-0.30
	White Spruce	0.05	0.03	0.03	-0.14
	Bur Oak	<b>-0.85</b>	0.06	0.02	0.02
	Herb	0.12	0.27	-0.01	0.01
	Low Shrub	-0.13	0.20	-0.01	0.19
	Moss	0.09	0.19	0.03	-0.22
	Grass	-0.12	0.16	0.01	0.00
	Litter	-0.04	0.38	0.45	-0.15
	Log	0.19	-0.20	-0.63	0.09
	Bare	0.03	<b>-0.90</b>	-0.08	0.07
Explained Variation		2.71	1.92	3.41	1.50
Percent Total		0.07	0.05	0.09	0.04

(Marked loadings are > .7000)

**Appendix B:** Eigenvalues for the Logistic Regression for the TwinSpan Groups.  
 Factors presented explain the most variance for the presence fo golden-winged warblers.

		Group 2		Group 3		Group 4	
		F1 (+)	F11 (+)	F3 (-)	F7 (-)	F1 (-)	
Canopy	Age	0.056	0.118	<b>0.790</b>	0.027	-0.266	
	Cover	0.112	0.160	<b>0.761</b>	0.056	0.224	
	Height	0.496	-0.019	0.008	<b>-0.903</b>	0.311	
	Trembling Aspen	0.341	0.057	0.161	-0.300	0.149	
	Balsam Poplar	0.068	0.150	0.297	-0.078	0.059	
SubCanop	White Birch	-0.038	-0.285	-0.092	-0.128	0.231	
	Bur Oak	-	-	-	-	-	<b>-0.848</b>
	White Spruce	0.036	0.276	0.086	0.116	0.159	
	Cover	0.264	-0.006	0.014	0.002	-0.016	
	Height	0.104	0.069	-0.061	-0.097	-0.051	
Shrub	Trembling Aspen	-0.031	0.034	0.017	0.042	0.197	
	Balsam Poplar	-0.144	-0.056	-0.101	0.018	-	
	White Birch	0.155	-0.032	0.043	0.039	-	
	White Spruce	0.167	-0.031	-0.042	-0.060	0.114	
	Cover	<b>0.854</b>	0.349	0.232	-0.192	-0.426	
Ground	Height	0.235	-0.259	0.350	-0.024	-0.157	
	Trembling Aspen	<b>0.705</b>	0.158	-0.605	-0.117	0.523	
	Balsam Poplar	0.132	0.220	-0.191	0.028	0.041	
	White Birch	0.008	0.143	0.054	0.203	0.095	
	Manitoba Maple	-0.069	-0.162	-0.044	-0.076	-0.006	
	Mountain Maple	0.315	-0.114	-0.034	0.024	0.012	
	Willow	-0.490	0.434	0.379	-0.274	0.316	
	Hazle	-0.181	-0.146	0.206	0.205	0.157	
	Alder	-0.459	0.273	0.400	-0.125	-0.023	
	Saskatoon Berry	-0.027	0.001	0.003	0.017	-0.319	
	Chokecherry	0.013	0.229	0.038	-0.098	0.068	
	Dogwood	0.034	0.319	0.108	0.052	0.136	
	Rose	0.105	-0.081	0.260	-0.207	0.124	
	White Spruce	-0.086	0.011	0.076	0.118	0.074	
	Bur Oak	-0.045	0.072	0.066	0.556	<b>-0.873</b>	
Explained Variation	Herb	0.025	0.561	0.068	0.230	-0.011	
	Low Shrub	0.480	0.005	-0.178	-0.077	-0.090	
	Moss	0.367	-0.101	-0.112	0.159	0.068	
	Grass	0.077	<b>0.806</b>	-0.031	0.054	0.222	
	Litter	0.044	0.094	0.693	-0.212	-0.297	
	Log	0.398	-0.838	-0.578	-0.093	-0.247	
Percent Total	Bare	0.005	-0.287	-0.173	0.017	0.034	
	Explained Variation	<b>3.611</b>	<b>2.774</b>	<b>3.274</b>	<b>1.712</b>	<b>2.837</b>	
Percent Total	Percent Total	0.098	0.075	0.088	0.046	0.079	

(Marked loadings are > .7000)

**Appendix C:** Location of all Golden-winged Warblers discovered in 1998.

Bird #	Band #	Sex	Wing L. (mm)	Weight (g)	Latitude			Longitude			Location
					deg	in	sec	deg.	min	sec	
1	3500-30001	M*	62	9.0	52	4	58	100	49	18	1
2	3500-30002	M	62	9.1	52	4	46	100	49	27	1
3	3500-30003	F*	58	8.7	52	5	2	100	49	17	1
4	3500-30005	M	63	8.7	52	4	47	100	49	5	1
5	3500-30006	M	63	8.7	52	4	46	100	49	14	1
6	3500-30007	M	61	9.0	52	4	19	100	49	7	1
7	3500-30010	M	61	n/a	52	4	24	100	39	9	2
8	3500-30011	M	59	9.0	52	4	23	100	49	0	1
9	3500-30012	M	64	8.8	52	5	5	100	41	26	2
10	3500-30013	M	65	8.6	51	50	53	101	12	8	3
11	3500-30014	M*	63	8.9	51	50	42	101	11	56	3
12	3500-30015	M	64	9.3	51	54	46	100	40	17	4
13	3500-30016	M*	64	9.3	51	57	56	101	8	13	5
14	3500-30017	M	62	9.6	50	46	50	99	36	31	6
15	3500-30018	M	64	9.2	50	47	1	99	36	33	6
16	3500-30019	M	64	9.0	50	46	1	99	39	19	6
17	3500-30020	M*	63	9.1	50	46	31	99	39	19	6
18	3500-30021	M	60	8.9	50	46	43	99	39	7	6
19	3500-30022	M	61	8.9	50	46	48	99	39	21	6
20	3500-30023	M	59	9.0	50	46	41	99	39	30	6
21	3500-30024	M	63	9.0	51	57	44	101	8	9	5
22	3500-30027	M	62	9.3	52	4	43	100	49	36	1
23	3500-30028	M	64	9.9	52	4	37	100	49	38	1
24	3500-30029	M	62	9.6	52	4	36	100	49	46	1
25	3500-30030	M*	62	8.1	52	4	46	100	49	48	1
26	3500-30031	F*	58	8.9	52	4	46	100	49	48	1
27	3500-30032	M	64	9.0	51	51	7	101	12	39	3
28	3500-30033	M	62	9.6	51	49	6	101	18	43	7
29	3500-30034	M	n/a	n/a	51	54	51	101	11	8	8
30	3500-30035	M	60	8.5	51	54	51	101	11	8	8
31	3500-30036	M	64	9.0	51	54	53	101	10	57	8
32	3500-30037	M	64	9.0	51	54	47	101	11	5	8
33	3500-30038	M	63	9.1	51	54	56	101	10	49	8
34	3500-30039	M	63	9.0	51	49	4	101	18	29	7
35	3500-30040	M	63	10.2	51	15	48	100	48	26	9
36	3500-30041	M*	62	9.8	51	48	57	101	19	18	7
37	3500-30042	M*	61	8.5	51	49	3	101	19	27	7
38	3500-30043	M	63	9.8	51	48	40	101	18	39	7
39*	3500-30044	M	62	9.0	52	13	16	101	42	34	10
40	U1	M	-	-	52	3	15	100	56	59	11
41	U2	M	-	-	51	51	18	101	12	41	3
42	U3	M*	-	-	51	50	32	101	11	51	3
43	U4	M	-	-	51	54	59	101	10	38	8
44	U5	M	-	-	51	24	7	100	33	31	9
45	U6	M	-	-	51	23	58	100	33	42	9

**Locations**

39\*= bird caught in Sask.

M\*= paired bird

U= uncaptured bird

Renwer=1 Hwy Burn=2 Roaring River=3

Old field=4 Fernland=5 Riding Mt.=6

Sarah Lk=7 Island Lk=8 South duck=9

Porcupine=10 Kriderman pit=11

Appendix D: Mean ( $\pm$ SD) of TWINSPLAN habitat groups.

Group	No. GWWA	Habitat	Age (yrs)	% Cover	Canopy						
					Height (m)	% TA	% BP	% WB	% BO	% WS	% JP
1 2 of 18	Mature Aspen & Mt. Maple	53 ± 16.6	51.5 ± 21.1	19.4 ± 4.2	61.1 ± 16.8	13.6 ± 13.6	11.4 ± 13.1	0 ± 0	6.7 ± 13.5	1.7 ± 3.5	
	Mature Aspen - little Subcanopy	58 ± 18.7	49.8 ± 22.4	22.0 ± 10.5	73.3 ± 27.8	4.2 ± 7.7	19.7 ± 27.7	0 ± 0	2.2 ± 4.4	0.6 ± 1.7	
	Young Regen - moderate Shrub	4 ± 1.9	6.1 ± 6.6	22.0 ± 2.9	66.5 ± 42.0	8.5 ± 14.1	13.0 ± 21.7	0 ± 0	12.0 ± 17.9	0 ± 0	
	Young Regen - dense Shrub	5 ± 0.5	3.1 ± 2.6	18.8 ± 5.1	56.0 ± 29.2	34.0 ± 24.0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	
2 17 of 24	Young Regen - dense Hazel	12 ± 18.2	8.9 ± 7.6	20.4 ± 3.5	73.9 ± 24.5	20.6 ± 24.6	1.1 ± 3.3	0 ± 0	7.8 ± 12.0	0 ± 0	
	Recent clearcuts - little Residual	3 ± 2.9	3.1 ± 2.1	15.3 ± 4.6	55.0 ± 21.8	6.0 ± 8.2	15.0 ± 16.6	0 ± 0	4.0 ± 8.9	0 ± 0	
3 20 of 49	Older Regen with Birch	15 ± 3.8	14.8 ± 10.1	7.9 ± 3.8	23.1 ± 35.6	16.3 ± 23.6	31.3 ± 31.5	0 ± 0	6.3 ± 12.5	10.6 ± 21.3	
	Older Regen with Aspen	10 ± 5.9	8.1 ± 17.0	10.9 ± 7.5	51.3 ± 37.7	13.1 ± 18.2	2.5 ± 7.1	0 ± 0	0.0 ± 0.0	0 ± 0	
	Young Regen - little Aspen	5 ± 2.1	2.6 ± 0.9	20.3 ± 2.7	21.7 ± 16.4	17.1 ± 24.1	44.6 ± 19.0	0 ± 0	16.7 ± 20.4	0 ± 0	
	Older Regen - dense Shrub	31 ± 36.1	19.7 ± 28.3	17.7 ± 5.5	57.2 ± 35.4	28.4 ± 31.1	1.3 ± 3.5	0 ± 0	0.0 ± 0.0	0 ± 0	
	Recent cuts with Aspen	5 ± 4.4	8.1 ± 15.2	16.4 ± 7.9	83.3 ± 31.2	2.3 ± 4.5	0.8 ± 1.9	0 ± 0	1.0 ± 3.6	0 ± 0	
	Older Regen with BP	27 ± 14.9	22.5 ± 19.9	9.6 ± 3.6	43.2 ± 30.0	54.3 ± 31.0	2.1 ± 3.9	0 ± 0	0 ± 0	0.4 ± 0.9	
	Open areas with willow	29 ± 15.5	11.5 ± 9.4	9.8 ± 1.9	53.1 ± 48.5	34.4 ± 40.3	0 ± 0	0 ± 0	0 ± 0	0 ± 0	
	Aspen-Spruce savannah	28 ± 10.6	14.7 ± 8.3	10.1 ± 2.4	56.0 ± 34.9	4.5 ± 6.7	0 ± 0	0 ± 0	34.5 ± 30.0	0 ± 0	
4 7 of 24	Aspen-Pine savannah	28 ± 12.2	22.7 ± 17.4	10.8 ± 3.1	57.8 ± 44.3	0 ± 0	3.9 ± 5.5	20.0 ± 38.5	0 ± 0	18.3 ± 36.1	
	Bur Oak savannah	38 ± 13.7	10.6 ± 5.8	8.8 ± 2.5	2.5 ± 2.7	0 ± 0	0 ± 0	97.5 ± 23.6	0 ± 2.2	0 ± 0	

Appendix D: Mean ( $\pm$ SD) of TWINSPAN habitat groups.

No.	SubCanopy								
		Group GWWA	Habitat	% Cover	Height (m)	% TA	% BP	% WB	% WS
1	2 of 18	Mature Aspen & Mt. Maple	23.6 $\pm$ 22.2	11.9 $\pm$ 1.9	71.0 $\pm$ 14.6	16.7 $\pm$ 15.2	10.6 $\pm$ 14.0	0.6 $\pm$ 1.7	
		Mature Aspen - little Subcanopy	7.6 $\pm$ 4.4	7.7 $\pm$ 3.1	38.6 $\pm$ 29.3	10.6 $\pm$ 19.4	18.1 $\pm$ 16.3	1.9 $\pm$ 4.3	
2	17 of 24	Young Regen - moderate Shrub	4.6 $\pm$ 2.7	9.7 $\pm$ 1.6	31.5 $\pm$ 22.7	10.0 $\pm$ 13.7	4.0 $\pm$ 4.2	40.0 $\pm$ 14.6	
		Young Regen - dense Shrub	1.4 $\pm$ 0.8	7.3 $\pm$ 2.7	20.0 $\pm$ 11.2	0 $\pm$ 0	15.0 $\pm$ 22.4	0 $\pm$ 0	
		Young Regen - dense Hazle	2.8 $\pm$ 2.2	7.9 $\pm$ 3.0	19.4 $\pm$ 32.5	5.0 $\pm$ 10.0	26.1 $\pm$ 30.6	10.6 $\pm$ 18.4	
		Recent clearcuts - little Residual	1.8 $\pm$ 1.9	6.4 $\pm$ 1.1	8.5 $\pm$ 13.2	10.0 $\pm$ 22.4	4.0 $\pm$ 8.9	10.0 $\pm$ 22.4	
3	20 of 49	Older Regen with Birch	1.3 $\pm$ 2.5	1.0 $\pm$ 2.0	5.0 $\pm$ 10.0	0 $\pm$ 0	7.5 $\pm$ 15.0	0 $\pm$ 0	
		Older Regen with Aspen	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	
		Young Regen - little Aspen	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	
		Older Regen - dense Shrub	0.1 $\pm$ 0.4	0.5 $\pm$ 1.4	0.6 $\pm$ 1.8	1 $\pm$ 1.8	0 $\pm$ 0	0 $\pm$ 0	
		Recent cuts with Aspen	0.1 $\pm$ 0.3	0.7 $\pm$ 1.7	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	4.2 $\pm$ 14.4	
		Older Regen with BP	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	
		Open areas with willow	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	
4	7 of 24	Aspen-Spruce savannah	2.3 $\pm$ 4.8	1.4 $\pm$ 1.9	11.0 $\pm$ 19.4	0 $\pm$ 0	0 $\pm$ 0	6.0 $\pm$ 10.3	
		Aspen-Pine savannah	1.1 $\pm$ 1.8	0.9 $\pm$ 1.4	13.3 $\pm$ 21.8	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	
		Bur Oak savannah	2.3 $\pm$ 4.0	1.5 $\pm$ 2.7	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	

Appendix D: Mean ( $\pm$  SD) of TWINSPAN habitat groups.

No.	Shrub										
	Group	GWVA	Habitat	% Cover	Height	% TA	% BP	% WB	% JP	% Man Mp	% Mt. Mp
1	2 of 18	Mature Aspen & Mt. Maple		44.2 $\pm$ 16.8	2.4 $\pm$ 0.9	3.9 $\pm$ 4.0	0.3 $\pm$ 0.8	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	37.5 $\pm$ 29.5
		Mature Aspen - little Subcanopy		48.1 $\pm$ 16.5	1.8 $\pm$ 0.6	10.8 $\pm$ 7.8	2.8 $\pm$ 6.1	2.5 $\pm$ 5.0	0 $\pm$ 0	0 $\pm$ 0	0.8 $\pm$ 1.8
2	17 of 24	Young Regen - moderate Shrub		36.5 $\pm$ 11.3	1.5 $\pm$ 0.4	39.5 $\pm$ 22.4	12.8 $\pm$ 17.3	2.8 $\pm$ 0.6	4.0 $\pm$ 6.5	0 $\pm$ 0	0 $\pm$ 0
		Young Regen - dense Shrub		70.5 $\pm$ 14.9	2.0 $\pm$ 0.2	41.8 $\pm$ 26.2	17.5 $\pm$ 8.5	0.5 $\pm$ 1.1	0 $\pm$ 0	3.0 $\pm$ 3.3	9.5 $\pm$ 6.2
		Young Regen - dense Hazel		62.8 $\pm$ 16.2	1.8 $\pm$ 0.4	44.2 $\pm$ 25.6	2.5 $\pm$ 3.1	0.8 $\pm$ 1.3	0 $\pm$ 0	0 $\pm$ 0	4.2 $\pm$ 8.0
		Recent clearcuts - little Residual		39.0 $\pm$ 29.3	1.4 $\pm$ 0.3	24.5 $\pm$ 28.0	5.0 $\pm$ 7.1	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	14.5 $\pm$ 23.9
3	20 of 49	Older Regen with Birch		39.4 $\pm$ 10.9	2.0 $\pm$ 0.4	8.8 $\pm$ 10.3	13.1 $\pm$ 24.6	41.9 $\pm$ 22.0	2.5 $\pm$ 5.0	0 $\pm$ 0	0 $\pm$ 0
		Older Regen with Aspen		56.3 $\pm$ 9.9	2.7 $\pm$ 1.0	46.4 $\pm$ 16.3	26.3 $\pm$ 19.7	0.9 $\pm$ 2.7	1.9 $\pm$ 4.4	0.1 $\pm$ 0.4	0.9 $\pm$ 1.3
		Young Regen - little Aspen		48.8 $\pm$ 19.9	1.8 $\pm$ 0.9	66.5 $\pm$ 21.5	12.7 $\pm$ 10.5	0.4 $\pm$ 1.0	0 $\pm$ 0	0 $\pm$ 0	1.3 $\pm$ 3.1
		Older Regen - dense Shrub		73.8 $\pm$ 11.5	3.0 $\pm$ 1.3	30.3 $\pm$ 24.1	7.5 $\pm$ 8.9	1.9 $\pm$ 3.5	0 $\pm$ 0	1.9 $\pm$ 2.2	18.8 $\pm$ 33.5
		Recent cuts with Aspen		51.9 $\pm$ 23.6	1.9 $\pm$ 0.8	58.5 $\pm$ 21.9	5.0 $\pm$ 8.3	0.8 $\pm$ 1.6	0 $\pm$ 0	0 $\pm$ 0	0.6 $\pm$ 1.6
		Older Regen with BP		40.7 $\pm$ 19.2	1.7 $\pm$ 0.3	8.2 $\pm$ 6.1	18.2 $\pm$ 18.7	0 $\pm$ 0	0 $\pm$ 0	0.4 $\pm$ 0.9	0 $\pm$ 0
		Open areas with willow		36.9 $\pm$ 9.7	1.4 $\pm$ 1.2	20.6 $\pm$ 26.3	14.4 $\pm$ 22.3	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0
4	7 of 24	Aspen-Spruce savannah		22.8 $\pm$ 8.7	1.6 $\pm$ 0.3	21.5 $\pm$ 18.9	1.8 $\pm$ 1.7	0 $\pm$ 0	0 $\pm$ 0	0.5 $\pm$ 1.7	0 $\pm$ 0
		Aspen-Pine savannah		52.2 $\pm$ 18.9	1.6 $\pm$ 0.4	14.2 $\pm$ 10.0	0 $\pm$ 0.0	0.3 $\pm$ 0.8	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0
		Bur Oak savannah		47.5 $\pm$ 17.8	1.5 $\pm$ 0.3	0 $\pm$ 0	0 $\pm$ 0.0	0.5 $\pm$ 1.1	0 $\pm$ 0	0.5 $\pm$ 1.1	0 $\pm$ 0

Appendix D: Mean ( $\pm$ SD) of TWINSPAN habitat groups.

## Shrub cont'd.

Group	% Willow	% Hazle	% Alder	% S'toon	% Ch. Cherry	% Dogwd	% Rose	% WS	% BO
1	0.3 $\pm$ 0.8	20.0 $\pm$ 10.7	11.7 $\pm$ 13.0	1.7 $\pm$ 2.2	0.6 $\pm$ 1.7	6.1 $\pm$ 4.9	5.3 $\pm$ 5.1	0.6 $\pm$ 1.1	0 $\pm$ 0
	3.9 $\pm$ 6.5	36.4 $\pm$ 22.3	2.2 $\pm$ 6.7	6.1 $\pm$ 6.4	4.2 $\pm$ 4.7	4.7 $\pm$ 4.9	15.0 $\pm$ 7.3	0.8 $\pm$ 2.5	0 $\pm$ 0
2	9.5 $\pm$ 8.2	0 $\pm$ 0	10.8 $\pm$ 14.0	0.3 $\pm$ 0.6	0 $\pm$ 0	0 $\pm$ 0	2.3 $\pm$ 2.6	13.5 $\pm$ 18.5	0 $\pm$ 0
	5.0 $\pm$ 11.2	4.0 $\pm$ 5.5	5.0 $\pm$ 4.0	0 $\pm$ 0	3.0 $\pm$ 3.3	4.5 $\pm$ 3.3	2.0 $\pm$ 2.1	0 $\pm$ 0	0 $\pm$ 0
	4.7 $\pm$ 7.4	22.2 $\pm$ 12.5	5.3 $\pm$ 13.1	1.8 $\pm$ 2.7	3.3 $\pm$ 3.3	1.4 $\pm$ 1.8	5.6 $\pm$ 4.6	0 $\pm$ 0	0 $\pm$ 0
	0.5 $\pm$ 1.1	42.5 $\pm$ 31.0	0.0 $\pm$ 0.0	2.5 $\pm$ 3.1	3.0 $\pm$ 2.1	0 $\pm$ 0	5.0 $\pm$ 5.3	0 $\pm$ 0	0.5 $\pm$ 1.1
3	10.6 $\pm$ 11.6	0 $\pm$ 0	6.3 $\pm$ 12.5	0 $\pm$ 0	0.6 $\pm$ 1.3	0 $\pm$ 0	2.5 $\pm$ 3.5	4.4 $\pm$ 1.3	0 $\pm$ 0
	2.9 $\pm$ 5.2	0.3 $\pm$ 0.9	6.8 $\pm$ 5.2	0 $\pm$ 0	0 $\pm$ 0	0.6 $\pm$ 1.3	4.1 $\pm$ 4.5	3.4 $\pm$ 6.3	0 $\pm$ 0
	0.4 $\pm$ 1.0	8.8 $\pm$ 19.1	1.7 $\pm$ 3.0	0 $\pm$ 0	0 $\pm$ 0	2.5 $\pm$ 3.9	3.1 $\pm$ 2.7	0.4 $\pm$ 1.0	0 $\pm$ 0
	0.9 $\pm$ 1.9	18.4 $\pm$ 24.3	0.9 $\pm$ 1.9	0.3 $\pm$ 0.9	2.8 $\pm$ 4.1	5.3 $\pm$ 3.8	2.8 $\pm$ 2.1	0 $\pm$ 0.0	0 $\pm$ 0
	2.4 $\pm$ 2.4	14.6 $\pm$ 16.7	0.2 $\pm$ 0.7	2.5 $\pm$ 3.4	5.4 $\pm$ 7.6	0.5 $\pm$ 1.0	7.2 $\pm$ 6.2	1.3 $\pm$ 2.5	0 $\pm$ 0
	10.4 $\pm$ 7.6	16.8 $\pm$ 24.7	0.0 $\pm$ 0.0	1.4 $\pm$ 1.3	6.1 $\pm$ 5.9	0 $\pm$ 0	25.7 $\pm$ 19.8	3.6 $\pm$ 8.4	0 $\pm$ 0
	46.9 $\pm$ 22.0	0.0 $\pm$ 0.0	0.6 $\pm$ 1.3	2.5 $\pm$ 5.0	0 $\pm$ 0	3.8 $\pm$ 3.2	1.9 $\pm$ 2.4	0.6 $\pm$ 1.3	0 $\pm$ 0
	4	31.6 $\pm$ 17.6	0.0 $\pm$ 0.0	3.5 $\pm$ 11.7	8.0 $\pm$ 11.8	7.3 $\pm$ 12.7	0.3 $\pm$ 0	4.0 $\pm$ 6.0	12.5 $\pm$ 24.7
	1.4 $\pm$ 4.2	21.9 $\pm$ 19.1	0.0 $\pm$ 0.0	17.8 $\pm$ 8.4	14.6 $\pm$ 9.8	0.6 $\pm$ 1.7	7.9 $\pm$ 5.5	0.9 $\pm$ 1.9	1.6 $\pm$ 2.5
	0.0 $\pm$ 0.0	0.5 $\pm$ 1.1	8.5 $\pm$ 19.0	21.0 $\pm$ 8.8	14.5 $\pm$ 14.1	0 $\pm$ 0	5.5 $\pm$ 4.5	0.5 $\pm$ 1.1	26.0 $\pm$ 18.2

Appendix D: Mean ( $\pm$  SD) of TWINSPAN habitat groups.

No.	Group	GWWA	Habitat	Ground Cover						
				% Herb	% Lw Shrub	% Moss	% Grass	% Liter	% Log	% Bare
1	2 of 18	Mature Aspen & Mt. Maple	22.2 $\pm$ 9.6	12.3 $\pm$ 7	2.75 $\pm$ 2.1	1.32 $\pm$ 1.2	50 $\pm$ 7.1	4.94 $\pm$ 2.8	0 $\pm$ 0	
		Mature Aspen - little Subcanopy	20 $\pm$ 8.7	10.7 $\pm$ 6.8	2.47 $\pm$ 3	10.3 $\pm$ 15	47.8 $\pm$ 11	7.85 $\pm$ 3.6	0 $\pm$ 0	
2	17 of 24	Young Regen - moderate Shrub	23.3 $\pm$ 11	9.63 $\pm$ 3	1.5 $\pm$ 2.1	15.1 $\pm$ 9.9	29.4 $\pm$ 14	17.5 $\pm$ 17	4.75 $\pm$ 6.9	
		Young Regen - dense Shrub	21.9 $\pm$ 5.3	13.5 $\pm$ 8.2	0.5 $\pm$ 1.1	14.4 $\pm$ 13	34.5 $\pm$ 9.8	13.4 $\pm$ 7.9	1.63 $\pm$ 3.6	
		Young Regen - dense Hazel	22.7 $\pm$ 6.7	15.4 $\pm$ 4.9	0.07 $\pm$ 0.2	15.6 $\pm$ 12	30.1 $\pm$ 7.5	15.1 $\pm$ 12	0 $\pm$ 0	
3	20 of 49	Recent clearcuts - little Residual	7.3 $\pm$ 4.6	6.55 $\pm$ 6.3	0.25 $\pm$ 0.6	2.75 $\pm$ 4	28 $\pm$ 29	23.9 $\pm$ 16	34 $\pm$ 30	
		Older Regen with Birch	21.3 $\pm$ 4.3	13 $\pm$ 14	0.94 $\pm$ 1.5	18.8 $\pm$ 11	23.8 $\pm$ 15	6.25 $\pm$ 5.3	14.5 $\pm$ 29	
		Older Regen with Aspen	24.1 $\pm$ 12	7.92 $\pm$ 4.3	4.97 $\pm$ 7.5	24.6 $\pm$ 31	22.7 $\pm$ 13	16 $\pm$ 13	0.16 $\pm$ 0.4	
		Young Regen - little Aspen	23.4 $\pm$ 13	11.3 $\pm$ 5.3	0.42 $\pm$ 1	10.4 $\pm$ 13	28.4 $\pm$ 7.5	20.7 $\pm$ 6.8	4.9 $\pm$ 11	
		Older Regen - dense Shrub	25.3 $\pm$ 8.7	10.1 $\pm$ 6.2	0.78 $\pm$ 1.4	8.28 $\pm$ 11	41.9 $\pm$ 18	12.9 $\pm$ 7.3	0.08 $\pm$ 0.2	
4	7 of 24	Recent cuts with Aspen	23.7 $\pm$ 10	12.3 $\pm$ 6	0.22 $\pm$ 0.6	6.35 $\pm$ 5.1	28.5 $\pm$ 14	17.1 $\pm$ 11	8.97 $\pm$ 17	
		Older Regen with BP	22 $\pm$ 6.1	11.4 $\pm$ 4.4	0 $\pm$ 0	25 $\pm$ 15	38.1 $\pm$ 11	0.71 $\pm$ 1.4	1.7 $\pm$ 3.5	
		Open areas with willow	21.4 $\pm$ 3.2	4.06 $\pm$ 3.7	0 $\pm$ 0	41.4 $\pm$ 19	28.9 $\pm$ 20	5 $\pm$ 7.6	0 $\pm$ 0	
4	7 of 24	Aspen-Spruce savannah	23.2 $\pm$ 8.6	8.53 $\pm$ 5.5	0.44 $\pm$ 0.4	46.6 $\pm$ 27	17 $\pm$ 15	0 $\pm$ 0	5.09 $\pm$ 13	
		Aspen-Pine savannah	16.7 $\pm$ 11	16 $\pm$ 6.3	1.46 $\pm$ 2.6	22.7 $\pm$ 15	37.7 $\pm$ 11	1.18 $\pm$ 2.2	3.06 $\pm$ 5.6	
		Bur Oak savannah	18.3 $\pm$ 8.1	16.4 $\pm$ 4.5	0 $\pm$ 0.6	30.3 $\pm$ 9.9	34.1 $\pm$ 13	1.41 $\pm$ 2.5	0.31 $\pm$ 14	

**Appendix E: Canopy data for all vegetative plots in 1998 study.**

Site#	GWWA	Map	UTM	Age	% Closure	Avg Ht.	% TA	% BP	% WB	% BO	% WS	% JP
1	Y	63 C/2	751E 716N	8	5.0 ± 0.0	15.0 ± 1.4	35.0 ± 7.1	45.0 ± 35.4	20.0 ± 28.3	0 ± 0	0 ± 0	0 ± 0
2	Y	63 C/2	750E 714N	7	3.5 ± 2.1	14.0 ± 0.0	52.5 ± 10.6	32.5 ± 10.6	10.0 ± 14.1	0 ± 0	0 ± 0	0 ± 0
3	Y	63 C/2	754E 713N	7	5.0 ± 1.4	23.5 ± 2.1	95.0 ± 7.1	0.0 ± 0.0	5.0 ± 7.1	0 ± 0	0 ± 0	0 ± 0
4	Y	63 C/2	753E 713N	7	3.0 ± 2.8	23.5 ± 2.1	15.0 ± 21.2	30.0 ± 42.4	55.0 ± 63.6	0 ± 0	0 ± 0	0 ± 0
5	Y	63 C/2	754E 704N	6	3.5 ± 2.1	21.5 ± 2.1	10.0 ± 14.1	60.0 ± 56.6	30.0 ± 42.4	0 ± 0	0 ± 0	0 ± 0
6	Y	63 C/2	667 E 704 N	10	3.5 ± 2.1	20.0 ± 1.4	90.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
7	Y	63 C/2	755E 705N	6	1.0 ± 1.4	10.0 ± 14.1	25.0 ± 35.4	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
8	Y	63 C/2	841E 717N	10	0.5 ± 0.7	4.5 ± 6.4	50.0 ± 70.7	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
9	Y	62 N/14	483E 462N	75	32.5 ± 10.6	25.0 ± 1.4	90.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
10	Y	62 N/14	483E 462N	80	6.0 ± 5.7	23.5 ± 2.1	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
11	Y	62N/15	850E 527N	15	7.5 ± 3.5	9.0 ± 1.4	90.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
12	Y	62 N/14	531E 593N	8	2.0 ± 0.0	26.0 ± 0.0	70.0 ± 14.1	30.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
13	Y	62 J/13	572E 254N	50	2.5 ± 3.5	4.0 ± 5.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	45 ± 64	5 ± 7	0 ± 0
14	Y	62 J/13	571E 258N	25	25.0 ± 21.2	10.8 ± 0.4	20.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	80 ± 14	0 ± 0	0 ± 0
15	Y	62 J/13	537E 249N	50	10.0 ± 0.0	10.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	95 ± 7	0 ± 0	0 ± 0
16	Y	62 J/13	539E 252N	25	5.0 ± 0.0	8.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	95 ± 7	0 ± 0	0 ± 0
17	Y	62 J/13	537E 253N	25	10.0 ± 0.0	7.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	100 ± 0	0 ± 0	0 ± 0
18	Y	62 J/13	537E 253N	50	17.5 ± 17.7	10.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	100 ± 0	0 ± 0	0 ± 0
19	Y	62 N/14	533E 588N	10	10.0 ± 7.1	13.5 ± 2.1	80.0 ± 28.3	20.0 ± 28.3	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
20	Y	63 C/2	748E 715N	5	2.5 ± 0.7	19.5 ± 0.7	67.5 ± 10.6	32.5 ± 10.6	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
21	Y	63 C/2	748E 714N	5	3.0 ± 2.8	20.5 ± 2.1	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
22	Y	63 C/2	748E 713N	5	1.5 ± 0.7	23.0 ± 2.8	50.0 ± 70.7	50.0 ± 70.7	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
23	Y	63 C/2	748E 714N	5	2.5 ± 3.5	11.0 ± 15.6	50.0 ± 70.7	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
24	Y	62 N/14	479E 488N	50	10.0 ± 14.1	10.5 ± 14.8	12.5 ± 17.7	37.5 ± 53.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
25	Y	62 N/14	408E 432N	5	12.5 ± 10.6	23.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
26	Y	62 N/14	496E 537N	6	4.5 ± 0.7	24.0 ± 0.0	75.0 ± 35.4	25.0 ± 35.4	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
27	Y	62 N/14	408E 432N	6	3.0 ± 2.8	21.5 ± 0.7	62.5 ± 53.0	37.5 ± 53.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
28	Y	62 N/14	497E 534N	5	2.5 ± 0.7	27.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
29	Y	62 N/14	500E 537N	5	3.5 ± 2.1	24.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
30	Y	62 N/14	410E 431N	6	5.0 ± 0.0	20.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
31	Y	62 N/7	739E 803N	6	7.5 ± 3.5	19.0 ± 0.0	80.0 ± 28.3	0.0 ± 0.0	0.0 ± 0.0	20 ± 28	0 ± 0	0 ± 0
32	Y	62 N/14	401E 429N	4	1.5 ± 0.7	17.0 ± 1.4	0.0 ± 0.0	0.0 ± 0.0	50.0 ± 70.7	0 ± 0	50 ± 71	0 ± 0
33	Y	62 N/14	399E 431N	4	1.5 ± 0.7	8.5 ± 0.7	0.0 ± 0.0	12.5 ± 17.7	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0

## Appendix E: Canopy data for all vegetative plots in 1998 study.

Site#	GWVA	Map	UTM	Age	% Closure	Avg. Ht.	% TA	% BP	% WB	% BO	% WS	% JP
34	Y	62 N/14	408E 424N	4	5.0 ± 0.0	20.5 ± 2.1	12.5 ± 17.7	32.5 ± 10.6	15.0 ± 21.2	0 ± 0	40 ± 14	0 ± 0
35	Y	63 C	153E 884N	5	3.5 ± 2.1	19.0 ± 1.4	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
36	Y	63 C/2	682E 656N	4	2.5 ± 2.1	15.5 ± 3.5	10.0 ± 14.1	40.0 ± 56.6	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
37	Y	62 N/14	4779E 470N	50	1.0 ± 1.4	9.5 ± 13.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	50 ± 71	0 ± 0
38	Y	62 N/14	487E 456N	60	5.0 ± 0.0	19.0 ± 4.2	80.0 ± 28.3	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	20 ± 28	0 ± 0
39	Y	62 N/14	503E 538N	5	25.0 ± 21.2	21.0 ± 0.0	90.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
40	Y	62 N/7	917E 955N	10	2.5 ± 3.5	3.0 ± 4.2	0.0 ± 0.0	50.0 ± 70.7	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
41	Y	62 N/7	914E 952N	7	5.0 ± 0.0	14.5 ± 0.7	90.0 ± 14.1	0.0 ± 0.0	10.0 ± 14.1	0 ± 0	0 ± 0	0 ± 0
42	N	63 C/2	799E 661N	60	70.0 ± 0.0	20.5 ± 0.7	72.5 ± 3.5	0.0 ± 0.0	27.5 ± 3.5	0 ± 0	0 ± 0	0 ± 0
43	N	62 N/14	601E 598N	50	72.5 ± 3.5	18.0 ± 1.4	87.5 ± 3.5	12.5 ± 3.5	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
44	N	62 N/14	601E 593N	70	55.0 ± 21.2	17.0 ± 5.7	30.0 ± 14.1	15.0 ± 21.2	15.0 ± 7.1	0 ± 0	40 ± 0	0 ± 0
45	N	62 N/14	606E 589N	70	42.5 ± 17.7	24.5 ± 2.1	60.0 ± 14.1	0.0 ± 0.0	30.0 ± 28.3	0 ± 0	0 ± 0	10 ± 14
46	N	62 N/14	610E 586N	40	50.0 ± 14.1	19.5 ± 0.7	75.0 ± 7.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	15 ± 21	0 ± 0
47	N	62 N/14	617E 578N	70	52.5 ± 17.7	21.5 ± 2.1	50.0 ± 28.3	35.0 ± 35.4	5.0 ± 7.1	0 ± 0	5 ± 7	5 ± 7
48	N	62 N/14	616E 551N	1	1.5 ± 0.7	27.0 ± 1.4	30.0 ± 42.4	0.0 ± 0.0	50.0 ± 70.7	0 ± 0	20 ± 28	0 ± 0
49	N	62 N/14	565E 590N	50	60.0 ± 14.1	21.5 ± 0.7	65.0 ± 21.2	35.0 ± 21.2	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
50	N	62 N/14	559E 594N	50	60.0 ± 7.1	22.0 ± 0.0	60.0 ± 28.3	15.0 ± 21.2	25.0 ± 7.1	0 ± 0	0 ± 0	0 ± 0
51	N	62 N/14	531E 595N	70	67.5 ± 3.5	23.0 ± 0.0	5.0 ± 7.1	95.0 ± 7.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
52	N	63 C/2	661E 689N	2	1.5 ± 0.7	11.5 ± 0.7	72.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
53	N	63 C/2	674E 679N	0	0.8 ± 0.4	16.5 ± 6.4	50.0 ± 70.7	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
54	N	63 C/2	682E 657N	20	1.0 ± 1.4	10.0 ± 14.1	50.0 ± 70.7	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
55	N	63 C/2	681E 665N	0	1.0 ± 1.4	8.0 ± 11.3	50.0 ± 70.7	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
56	N*	63 C/2	808E 646N	20	15.0 ± 7.1	10.0 ± 0.0	10.0 ± 14.1	87.5 ± 17.7	0.0 ± 0.0	0 ± 0	0 ± 0	3 ± 4
57	N	63 C/2	814E 640N	25	6.0 ± 5.7	10.0 ± 1.4	2.5 ± 3.5	0.0 ± 0.0	5.0 ± 7.1	0 ± 0	0 ± 0	93 ± 11
58	N	63 C/2	799E 640N	40	40.0 ± 14.1	15.0 ± 0.0	32.5 ± 3.5	0.0 ± 0.0	62.5 ± 3.5	0 ± 0	0 ± 0	5 ± 7
59	N	63 C/2	810E 636N	25	7.5 ± 3.5	10.0 ± 0.0	20.0 ± 14.1	0.0 ± 0.0	10.0 ± 14.1	0 ± 0	0 ± 0	70 ± 0
60	N	62 N/15	848E 522N	3	3.5 ± 2.1	17.0 ± 0.0	55.0 ± 63.6	15.0 ± 21.2	30.0 ± 42.4	0 ± 0	0 ± 0	0 ± 0
61	N	62 N/15	893E 487N	25	14.0 ± 8.5	7.0 ± 1.4	5.0 ± 7.1	0.0 ± 0.0	95 ± 7	0 ± 0	0 ± 0	0 ± 0
62	N	62 N/14	494E 520N	2	2.5 ± 2.1	21.5 ± 2.1	25.0 ± 35.4	0.0 ± 0.0	75.0 ± 35.4	0 ± 0	0 ± 0	0 ± 0
63	N	62 N/14	498E 528N	2	0.5 ± 0.7	9.0 ± 12.7	40.0 ± 56.6	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
64	N	62 N/14	410E 444N	3	1.5 ± 0.7	17.0 ± 7.1	37.5 ± 53.0	12.5 ± 17.7	25.0 ± 35.4	0 ± 0	25 ± 35	0 ± 0
65	N	62 N/11	438E 104N	20	6.5 ± 2.1	9.5 ± 3.5	70.0 ± 42.4	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	30 ± 42	0 ± 0
66	N*	62 N/11	458E 114N	20	5.5 ± 0.7	9.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0

## Appendix E: Canopy data for all vegetative plots in 1998 study.

Site#	GWWA	Map	UTM	Age	% Closure	Avg. Ht.	% TA	% RP	% WB	% BO	% WS	% MP
67	N	62 N/11	425E 127N	25	7.5 ± 3.5	12.0 ± 0.0	62.5 ± 53.0	37.5 ± 53.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
68	N	62 N/11	459E 157N	20	1.5 ± 0.7	5.3 ± 1.1	25.0 ± 35.4	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	75 ± 35	0 ± 0
69	N	62 N/11	441E 140N	25	20.0 ± 14.1	9.5 ± 0.7	65.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	35 ± 21	0 ± 0
70	N	62 N/11	422E 197N	20	15.0 ± 7.1	12.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
71	N	62 N/12	158E 131N	25	5.0 ± 0.0	6.0 ± 2.8	50.0 ± 70.7	50.0 ± 70.7	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
72	N	62 N/12	169E 135N	25	14.0 ± 8.5	8.5 ± 0.7	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
73	N	62 N/12	205E 145N	20	12.5 ± 10.6	5.8 ± 1.8	10.0 ± 14.1	90.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
74	N	62 N/5	197E 145N	20	22.5 ± 10.6	12.5 ± 0.7	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
75	N	62 N/12	203E 152N	100	15.0 ± 7.1	22.0 ± 0.0	95.0 ± 7.1	5.0 ± 7.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
76	N	62 N/7	772E 852N	60	62.5 ± 3.5	16.0 ± 0.0	35.0 ± 21.2	65.0 ± 21.2	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
77	N	62 N/7	815E 841N	4	3.5 ± 2.1	15.5 ± 0.7	87.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	13 ± 18	0 ± 0
78	N	62 N/7	823E 978E	5	7.5 ± 3.5	21.0 ± 0.0	90.0 ± 14.1	5.0 ± 7.1	5.0 ± 7.1	0 ± 0	0 ± 0	0 ± 0
79	N	62 N/7	816E 904N	80	62.5 ± 3.5	19.0 ± 0.0	67.5 ± 31.8	22.5 ± 17.7	0.0 ± 0.0	0 ± 0	10 ± 14	0 ± 0
80	N	62 N/7	819E 911N	60	37.5 ± 3.5	20.5 ± 0.7	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
81	N	62 N/7	789E 066N	50	60.0 ± 14.1	18.0 ± 0.0	40.0 ± 56.6	0.0 ± 0.0	60.0 ± 56.6	0 ± 0	0 ± 0	0 ± 0
82	N	62 N/11	602E 133N	5	4.5 ± 3.5	21.5 ± 0.7	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
83	N	62 N/11	624E 134N	5	17.5 ± 10.6	21.0 ± 0.0	90.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
84	N	62 N/7	480E 020N	50	70.0 ± 0.0	15.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
85	N	62N/6	491E 955N	60	65.0 ± 7.1	48.0 ± 35.4	85.0 ± 7.1	5.0 ± 7.1	10.0 ± 14.1	0 ± 0	0 ± 0	0 ± 0
86	N	62N/6	541E 915N	7	3.5 ± 2.1	21.0 ± 1.4	42.5 ± 24.7	0.0 ± 0.0	32.5 ± 10.6	0 ± 0	25 ± 35	0 ± 0
87	N	62 N/6	579E 921N	30	3.5 ± 2.1	12.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
88	N	62 N/6	600E 984N	2	2.0 ± 1.4	20.0 ± 0.0	50.0 ± 70.7	50.0 ± 14.1	0.0 ± 0.0	0 ± 0	30 ± 42	0 ± 0
89	N	62 N/6	575E 946N	40	11.5 ± 4.9	12.0 ± 0.0	25.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	75 ± 21	0 ± 0
90	N	62 N/6	602E 805N	40	62.5 ± 3.5	12.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
91	N	62 N/12	236E 317N	0	1.0 ± 0.0	20.0 ± 0.0	87.5 ± 17.7	12.5 ± 17.7	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
92	N	62 N/12	238E 311N	3	1.0 ± 0.0	12.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
93	N	62 N/12	237E 287N	5	5.0 ± 0.0	24.5 ± 0.7	90.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
94	N	62 N/12	265E 198N	30	25.0 ± 0.0	13.5 ± 6.4	80.0 ± 28.3	20.0 ± 28.3	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
95	N	62 N/12	291E 190N	30	6.0 ± 5.7	9.0 ± 0.0	55.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	45 ± 7	0 ± 0
96	N	62 N/12	287E 195N	4	5.0 ± 0.0	20.5 ± 0.7	30.0 ± 14.1	15.0 ± 21.2	35.0 ± 35.4	0 ± 0	20 ± 28	0 ± 0
97	N	63 C/2	3000E 57660	30	40.0 ± 14.1	11.0 ± 0.0	90.0 ± 14.1	0.0 ± 0.0	5.0 ± 7.1	5 ± 7	0 ± 0	0 ± 0
98	N	63C	308E 938N	6	17.5 ± 17.7	19.0 ± 4.2	20.0 ± 28.3	70.0 ± 42.4	10.0 ± 14.1	0 ± 0	0 ± 0	0 ± 0
99	N	63 C	305E 938N	6	7.5 ± 3.5	21.0 ± 1.4	37.5 ± 53.0	62.5 ± 53.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0

## Appendix E: Canopy data for all vegetative plots in 1998 study.

Site#	GWWA	Map	UTM	Age	% Closure	Avg. Ht.	% TA	% BP	% WB	% BO	% WS	% JP
100	N	63 C	292E 950N	18	22.5 ± 24.7	8.0 ± 0.0	95.0 ± 7.1	0.0 ± 0.0	5.0 ± 7.1	0 ± 0	0 ± 0	0 ± 0
101	N	63 C3	260E 002N	18	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
102	N	63C	196E 011N	18	55.0 ± 7.1	7.0 ± 1.4	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
103	N	63 C	151E 913N	6	2.0 ± 0.0	20.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
104	N	63 C/6	367E 931N	20	15.0 ± 7.1	9.0 ± 0.0	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
105	N	63 C/6	534E 069N	3	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
106	N	62 N/10	915E 249N	60	60.0 ± 14.1	18.0 ± 0.0	82.5 ± 24.7	0.0 ± 0.0	15.0 ± 21.2	0 ± 0	0 ± 0	3 ± 4
107	N	62 N/15	788E 398N	25	75.0 ± 0.0	14.0 ± 0.0	45.0 ± 7.1	0.0 ± 0.0	45.0 ± 21.2	0 ± 0	10 ± 14	0 ± 0
108	N	62 N/15	799E 397N	20	32.5 ± 10.6	9.5 ± 0.7	40.0 ± 14.1	50.0 ± 28.3	10.0 ± 14.1	0 ± 0	0 ± 0	0 ± 0
109	N	62 N/15	833E 399N	20	55.0 ± 7.1	11.5 ± 0.7	40.0 ± 28.3	25.0 ± 35.4	0.0 ± 0.0	0 ± 0	35 ± 7	0 ± 0
110	N	62 N/15	855E 394N	15	2.0 ± 0.0	18.0 ± 0.0	75.0 ± 35.4	25.0 ± 35.4	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
111	N	62 N/15	874E 394N	15	20.0 ± 14.1	7.0 ± 0.0	17.5 ± 10.6	15.0 ± 21.2	25.0 ± 35.4	0 ± 0	0 ± 0	43 ± 25
112	N	62 N/15	906E 345N	20	25.0 ± 7.1	7.5 ± 0.7	10.0 ± 14.1	90.0 ± 14.1	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0
113	N*	63 C	105E 360N	18	25.5 ± 34.6	10.0 ± 11.3	75.0 ± 21.2	0.0 ± 0.0	25.0 ± 21.2	0 ± 0	0 ± 0	0 ± 0
114	N	63C	105E 366N	18	11.0 ± 12.7	11.5 ± 2.1	0.0 ± 0.0	75.0 ± 35.4	0 ± 0	25 ± 35	0 ± 0	0 ± 0
115	N	63C	2000E 58240	18	50.0 ± 14.1	6.5 ± 0.7	100.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0 ± 0	0 ± 0	0 ± 0

## Appendix F: Subcanopy data for all vegetative plots in 1998 study.

## Appendix F: Subcanopy data for all vegetative plots in 1998 study.

## Appendix F: Subcanopy data for all vegetative plots in 1998 study.

SITE#	GWWA	%Closure	Average Ht.	%TLA	%BP	%WB	%WS
65	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
66	N*	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
67	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
68	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
69	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
70	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
71	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
72	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
73	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
74	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
75	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
76	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
77	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
78	N	0.5 ± 0.7	4.0 ± 5.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	50.0 ± 70.7
79	N	2.5 ± 3.5	5.5 ± 7.8	0.0 ± 0.0	30.0 ± 42.4	20.0 ± 28.3	0.0 ± 0.0
80	N	5.0 ± 7.1	7.0 ± 9.9	37.5 ± 53.0	0.0 ± 0.0	0.0 ± 0.0	12.5 ± 17.7
81	N	5.0 ± 7.1	6.0 ± 8.5	30.0 ± 42.4	0.0 ± 0.0	20.0 ± 28.3	0.0 ± 0.0
82	N	7.5 ± 3.5	10.5 ± 2.1	22.5 ± 24.7	25.0 ± 35.4	0.0 ± 0.0	30.0 ± 42.4
83	N	6.0 ± 5.7	8.5 ± 2.1	60.0 ± 14.1	0.0 ± 0.0	5.0 ± 7.1	35.0 ± 21.2
84	N	12.5 ± 10.6	9.0 ± 2.8	85.0 ± 21.2	0.0 ± 0.0	15.0 ± 21.2	0.0 ± 0.0
85	N	15.0 ± 7.1	12.5 ± 3.5	55.0 ± 7.1	0.0 ± 0.0	45.0 ± 7.1	0.0 ± 0.0
86	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
87	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
88	N	3.5 ± 2.1	13.5 ± 2.1	0.0 ± 0.0	0.0 ± 0.0	87.5 ± 17.7	12.5 ± 17.7
89	N	2.5 ± 3.5	3.5 ± 4.9	35.0 ± 49.5	0.0 ± 0.0	0.0 ± 0.0	15.0 ± 21.2
90	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
91	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
92	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
93	N	2.5 ± 3.5	7.0 ± 9.9	25.0 ± 35.4	0.0 ± 0.0	25.0 ± 35.4	0.0 ± 0.0
94	N	15.0 ± 21.2	4.0 ± 5.7	50.0 ± 70.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
95	N	2.5 ± 3.5	2.5 ± 3.5	25.0 ± 35.4	0.0 ± 0.0	0.0 ± 0.0	25.0 ± 35.4
96	N	1.0 ± 1.4	6.0 ± 8.5	0.0 ± 0.0	0.0 ± 0.0	50.0 ± 70.7	

## Appendix F: Subcanopy data for all vegetative plots in 1998 study.

## Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWVA	% Cover	Avg. Ht.	% TA	% BP	% WR	% JP	% Ma. Mp	% Mt. Mp
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	Y	62.5 ± 3.5		2.5 ± 0.7	25.0 ± 21.2	42.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
2	Y	70.0 ± 0.0		3.0 ± 0.0	40.0 ± 0.0	25.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 0.0
3	Y	62.5 ± 17.7		2.0 ± 0.0	52.5 ± 3.5	5.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
4	Y	65.0 ± 21.2		3.5 ± 0.7	70.0 ± 14.1	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
5	Y	40.0 ± 14.1		1.0 ± 0.0	50.0 ± 14.1	30.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 3.5
6	Y	37.5 ± 3.5		2.0 ± 0.0	40.0 ± 14.1	37.5 ± 17.7	0.0 ± 0.0	12.5 ± 17.7	0.0 ± 0.0
7	Y	65.0 ± 35.4		2.0 ± 0.0	82.5 ± 17.7	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1
8	Y	52.5 ± 3.5		3.5 ± 2.1	44.0 ± 19.8	32.5 ± 3.5	7.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0
9	Y	42.5 ± 31.8		1.0 ± 0.0	20.0 ± 28.3	17.5 ± 24.7	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
10	Y	32.5 ± 24.7		1.5 ± 0.0	7.5 ± 3.5	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
11	Y	27.5 ± 10.6		0.0 ± 0.0	5.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
12	Y	80.0 ± 0.0		2.5 ± 0.0	32.5 ± 10.6	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	25.0 ± 7.1
13	Y	20.0 ± 0.0		1.3 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
14	Y	65.0 ± 0.0		1.3 ± 0.4	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
15	Y	45.0 ± 21.2		1.8 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
16	Y	47.5 ± 24.7		1.8 ± 1.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
17	Y	57.5 ± 10.6		1.3 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
18	Y	67.5 ± 24.7		1.3 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
19	Y	32.5 ± 10.6		1.8 ± 0.4	32.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	25.0 ± 7.1
20	Y	82.5 ± 10.6		2.0 ± 0.0	32.5 ± 10.6	22.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 3.5
21	Y	87.5 ± 10.6		2.3 ± 0.4	49.0 ± 1.4	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 0.0
22	Y	67.5 ± 10.6		2.0 ± 0.7	32.5 ± 3.5	30.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
23	Y	85.0 ± 7.1		2.3 ± 0.4	55.0 ± 28.3	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1
24	Y	37.5 ± 3.5		2.8 ± 0.4	7.5 ± 3.5	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
25	Y	67.5 ± 10.6		2.0 ± 0.7	60.0 ± 14.1	25.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
26	Y	67.5 ± 3.5		2.0 ± 0.0	45.0 ± 7.1	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
27	Y	70.0 ± 0.0		2.3 ± 0.4	45.0 ± 7.1	20.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
28	Y	75.0 ± 7.1		2.5 ± 0.7	55.0 ± 7.1	17.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
29	Y	80.0 ± 7.1		2.3 ± 0.4	75.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
30	Y	77.5 ± 3.5		2.3 ± 0.4	77.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
31	Y	50.0 ± 0.0		1.5 ± 0.0	22.5 ± 24.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
32	Y	65.0 ± 7.1		1.8 ± 0.4	91.5 ± 9.2	3.5 ± 2.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

## Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWWA	% Cover	Avg. Ht.	% TA	% IP	% WR	% HP	% MP	% Man. Mp	% Mt. Mp
		Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD
33	Y	55.0 ± 7.1	1.8 ± 0.4	27.5 ± 31.8	57.5 ± 38.9	0.0 ± 0.0	0.0 ± 0.0	1.0 ± 1.4	0.0 ± 0.0	
34	Y	27.5 ± 17.7	2.0 ± 1.4	15.0 ± 21.2	40.0 ± 28.3	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
35	Y	65.0 ± 21.2	1.8 ± 0.4	35.0 ± 0.0	0.0 ± 0.0	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
36	Y	57.5 ± 10.6	2.0 ± 0.0	67.5 ± 24.7	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	
37	Y	32.5 ± 3.5	2.5 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	
38	Y	55.0 ± 35.4	1.5 ± 0.0	7.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	
39	Y	72.5 ± 3.5	2.0 ± 0.0	60.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	
40	Y	55.0 ± 7.1	1.5 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	72.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
41	Y	72.5 ± 17.7	1.5 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
42	N	65.0 ± 7.1	4.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	95.0 ± 7.1	
43	N	60.0 ± 0.0	2.3 ± 1.1	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	40.0 ± 35.4	
44	N	45.0 ± 7.1	3.3 ± 1.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	55.0 ± 21.2	
45	N	30.0 ± 0.0	2.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	45.0 ± 7.1	
46	N	27.5 ± 3.5	1.3 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	
47	N	55.0 ± 35.4	2.0 ± 0.0	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
48	N	22.5 ± 10.6	0.9 ± 0.2	67.5 ± 31.8	20.0 ± 21.2	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
49	N	55.0 ± 7.1	3.0 ± 1.4	2.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	50.0 ± 42.4	
50	N	45.0 ± 21.2	2.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	35.0 ± 7.1	
51	N	67.5 ± 24.7	4.5 ± 0.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	97.5 ± 3.5	
52	N	52.5 ± 31.8	1.5 ± 0.7	72.5 ± 10.6	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	
53	N	7.5 ± 3.5	1.8 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	55.0 ± 7.1	
54	N	15.0 ± 7.1	1.5 ± 0.7	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	15.0 ± 21.2	
55	N	10.0 ± 0.0	1.5 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
56	N*	40.0 ± 28.3	1.5 ± 0.7	5.0 ± 7.1	20.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
57	N*	55.0 ± 7.1	1.5 ± 0.7	22.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
58	N	42.5 ± 24.7	1.8 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
59	N	45.0 ± 21.2	1.3 ± 0.4	17.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
60	N	45.0 ± 21.2	1.0 ± 0.0	55.0 ± 28.3	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	17.5 ± 10.6	
61	N	85.0 ± 7.1	2.3 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
62	N	20.0 ± 0.0	1.0 ± 0.0	75.0 ± 7.1	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
63	N	15.0 ± 0.0	0.8 ± 0.0	65.0 ± 21.2	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	
64	N	35.0 ± 7.1	1.3 ± 0.4	80.0 ± 0.0	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	

## Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWWA	% Cover	Avg. Ht.	% TA	% RP	% WB	% JP	% Man. Mp	% Mt. Mp
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
33	Y	55.0 ± 7.1	1.8 ± 0.4	27.5 ± 31.8	57.5 ± 38.9	0.0 ± 0.0	0.0 ± 0.0	1.0 ± 1.4	0.0 ± 0.0
34	Y	27.5 ± 17.7	2.0 ± 1.4	15.0 ± 21.2	40.0 ± 28.3	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
35	Y	65.0 ± 21.2	1.8 ± 0.4	35.0 ± 0.0	0.0 ± 0.0	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
36	Y	57.5 ± 10.6	2.0 ± 0.0	67.5 ± 24.7	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0
37	Y	32.5 ± 3.5	2.5 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0
38	Y	55.0 ± 35.4	1.5 ± 0.0	7.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
39	Y	72.5 ± 3.5	2.0 ± 0.0	60.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0
40	Y	55.0 ± 7.1	1.5 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	72.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
41	Y	72.5 ± 17.7	1.5 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
42	N	65.0 ± 7.1	4.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	95.0 ± 7.1
43	N	60.0 ± 0.0	2.3 ± 1.1	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	40.0 ± 35.4	0.0 ± 0.0
44	N	45.0 ± 7.1	3.3 ± 1.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	55.0 ± 21.2
45	N	30.0 ± 0.0	2.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	45.0 ± 7.1
46	N	27.5 ± 3.5	1.3 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
47	N	55.0 ± 35.4	2.0 ± 0.0	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
48	N	22.5 ± 10.6	0.9 ± 0.2	67.5 ± 31.8	20.0 ± 21.2	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
49	N	55.0 ± 7.1	3.0 ± 1.4	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	50.0 ± 42.4	0.0 ± 0.0
50	N	45.0 ± 21.2	2.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	35.0 ± 7.1	0.0 ± 0.0
51	N	67.5 ± 24.7	4.5 ± 0.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	97.5 ± 3.5
52	N	52.5 ± 31.8	1.5 ± 0.7	72.5 ± 10.6	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
53	N*	7.5 ± 3.5	1.8 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	55.0 ± 7.1	0.0 ± 0.0
54	N	15.0 ± 7.1	1.5 ± 0.7	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	15.0 ± 21.2
55	N	10.0 ± 0.0	1.5 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
56	N*	40.0 ± 28.3	1.5 ± 0.7	5.0 ± 7.1	20.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
57	N*	55.0 ± 7.1	1.5 ± 0.7	22.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
58	N	42.5 ± 24.7	1.8 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
59	N	45.0 ± 21.2	1.3 ± 0.4	17.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
60	N	45.0 ± 21.2	1.0 ± 0.0	55.0 ± 28.3	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	17.5 ± 10.6
61	N	85.0 ± 7.1	2.3 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
62	N	20.0 ± 0.0	1.0 ± 0.0	75.0 ± 7.1	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
63	N	15.0 ± 0.0	0.8 ± 0.0	65.0 ± 21.2	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
64	N	35.0 ± 7.1	1.3 ± 0.4	80.0 ± 0.0	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

## Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWWA	% Cover	Avg. Ht.	% TA	% BP	% WB	% JP	% Man. Mp	% Mt. Mp
		Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD
65	N	10.0 ± 0.0	1.3 ± 0.4	35.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
66	N*	20.0 ± 7.1	1.5 ± 0.0	50.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
67	N	42.5 ± 24.7	1.5 ± 0.0	2.5 ± 3.5	20.0 ± 28.3	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
68	N	25.0 ± 7.1	1.8 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
69	N	32.5 ± 10.6	1.8 ± 1.1	17.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
70	N	25.0 ± 7.1	1.8 ± 0.4	17.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
71	N	25.0 ± 0.0	1.8 ± 0.4	2.5 ± 3.5	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0
72	N	30.0 ± 0.0	1.0 ± 0.0	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
73	N	17.5 ± 10.6	1.5 ± 0.7	5.0 ± 7.1	57.5 ± 24.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
74	N	30.0 ± 14.1	2.0 ± 0.0	25.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
75	N	60.0 ± 28.3	2.3 ± 0.4	10.0 ± 7.1	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0
76	N	47.5 ± 31.8	2.3 ± 0.4	17.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
77	N	47.5 ± 10.6	1.8 ± 0.4	7.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
78	N	67.5 ± 31.8	1.8 ± 0.4	50.0 ± 14.1	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
79	N	55.0 ± 7.1	1.8 ± 1.1	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
80	N	65.0 ± 21.2	2.5 ± 0.7	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1
81	N	50.0 ± 0.0	2.3 ± 0.4	15.0 ± 7.1	0.0 ± 0.0	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
82	N	42.5 ± 24.7	1.5 ± 0.0	20.0 ± 0.0	3.8 ± 1.8	3.8 ± 1.8	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
83	N	40.0 ± 14.1	1.8 ± 0.4	40.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
84	N	45.0 ± 21.2	1.3 ± 0.4	15.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
85	N	77.5 ± 24.7	2.8 ± 0.4	22.5 ± 24.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
86	N	67.5 ± 10.6	2.0 ± 0.0	32.5 ± 10.6	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
87	N	32.5 ± 3.5	1.0 ± 0.0	60.0 ± 42.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
88	N	80.0 ± 7.1	1.0 ± 0.0	77.5 ± 24.7	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
89	N	17.5 ± 10.6	1.5 ± 0.7	35.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
90	N	85.0 ± 7.1	2.3 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
91	N	3.0 ± 2.8	1.3 ± 0.4	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0
92	N	32.5 ± 46.0	1.5 ± 2.1	85.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
93	N	75.0 ± 0.0	2.0 ± 0.0	60.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
94	N	35.0 ± 7.1	1.8 ± 0.4	7.5 ± 3.5	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
95	N	15.0 ± 7.1	1.5 ± 0.0	45.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
96	N	60.0 ± 14.1	1.3 ± 0.4	55.0 ± 0.0	15.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

**Appendix G:** Shrub data for all vegetative plots in 1998 study.

SITE #	GWWA	% Cover	Avg. Ht.	% TA	% RP	% WB	% JP	% Man. Mp	% Mt. Mp
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
97	N	72.5 ± 31.8	2.0 ± 1.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
98	N	52.5 ± 31.8	2.0 ± 0.0	17.5 ± 10.6	7.5 ± 10.6	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
99	N	50.0 ± 28.3	1.8 ± 0.4	12.5 ± 17.7	10.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	20.0 ± 28.3
100	N	77.5 ± 17.7	1.8 ± 0.4	15.0 ± 14.1	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
101	N	65.0 ± 7.1	4.5 ± 0.7	60.0 ± 14.1	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
102	N	55.0 ± 7.1	4.0 ± 1.4	70.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
103	N	50.0 ± 14.1	1.3 ± 1.8	55.0 ± 7.1	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
104	N	45.0 ± 7.1	1.3 ± 0.4	27.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
105	N	55.0 ± 7.1	1.5 ± 0.0	77.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1
106	N	42.5 ± 24.7	1.8 ± 0.4	15.0 ± 7.1	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
107	N	22.5 ± 17.7	1.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
108	N	35.0 ± 7.1	1.5 ± 0.7	10.0 ± 14.1	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
109	N	15.0 ± 21.2	1.0 ± 1.4	7.5 ± 3.5	12.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5
110	N	85.0 ± 7.1	5.5 ± 0.7	32.5 ± 10.6	7.5 ± 3.5	10.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	22.5 ± 17.7
111	N	37.5 ± 3.5	2.0 ± 0.0	15.0 ± 21.2	50.0 ± 14.1	20.0 ± 14.1	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0
112	N	50.0 ± 14.1	2.0 ± 0.0	10.0 ± 0.0	47.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
113	N*	35.0 ± 7.1	2.5 ± 0.7	20.0 ± 14.1	0.0 ± 0.0	37.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
114	N	30.0 ± 0.0	2.0 ± 0.0	0.0 ± 0.0	37.5 ± 31.8	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
115	N	55.0 ± 7.1	3.3 ± 1.1	57.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWWA	% Willow		% Hazle		% Alder		% S'toon		% Choke		% Dogw.		% Rose		% WS		% Bur Oak	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	Y	15.0	± 14.1	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	3.8	± 1.8	1.0	± 1.4	0.0	± 0.0	0.0	± 0.0
2	Y	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	8.8	± 8.8	2.3	± 0.4	0.0	± 0.0	0.0	± 0.0
3	Y	7.5	± 10.6	20.0	± 14.1	0.0	± 0.0	6.5	± 4.9	0.0	± 0.0	1.0	± 1.4	5.0	± 0.0	0.0	± 0.0	0.0	± 0.0
4	Y	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	7.5	± 3.5	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0
5	Y	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	7.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
6	Y	0.0	± 0.0	0.0	± 0.0	10.0	± 14.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
7	Y	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
8	Y	3.0	± 2.8	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.0	± 1.4	7.5	± 10.6	0.0	± 0.0	0.0	± 0.0
9	Y	2.5	± 3.5	20.0	± 14.1	0.0	± 0.0	0.0	± 0.0	10.0	± 14.1	20.0	± 14.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
10	Y	2.5	± 3.5	67.5	± 10.6	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	10.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
11	Y	77.5	± 3.5	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	7.5	± 3.5	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0
12	Y	0.0	± 0.0	7.5	± 10.6	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0
13	Y	0.0	± 0.0	0.0	± 0.0	42.5	± 60.1	25.0	± 35.4	0.0	± 0.0	0.0	± 0.0	12.5	± 17.7	2.5	± 3.5	12.5	± 17.7
14	Y	0.0	± 0.0	35.0	± 7.1	0.0	± 0.0	10.0	± 7.1	17.5	± 3.5	0.0	± 0.0	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0
15	Y	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	7.5	± 3.5	7.5	± 3.5	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	37.5	± 17.7
16	Y	0.0	± 0.0	0.0	± 0.0	25.0	± 14.1	7.5	± 10.6	0.0	± 0.0	7.5	± 3.5	0.0	± 0.0	52.5	± 10.6	0.0	± 0.0
17	Y	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	17.5	± 17.7	35.0	± 35.4	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	12.5	± 10.6
18	Y	0.0	± 0.0	0.0	± 0.0	30.0	± 0.0	22.5	± 10.6	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	15.0	± 21.2	0.0	± 0.0
19	Y	2.5	± 3.5	12.5	± 17.7	2.5	± 3.5	0.0	± 0.0	2.5	± 3.5	2.5	± 3.5	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0
20	Y	0.0	± 0.0	10.0	± 14.1	2.5	± 3.5	0.0	± 0.0	7.5	± 3.5	2.5	± 3.5	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0
21	Y	0.0	± 0.0	10.0	± 0.0	10.0	± 0.0	0.0	± 0.0	2.5	± 3.5	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
22	Y	0.0	± 0.0	7.5	± 10.6	0.0	± 0.0	0.0	± 0.0	7.5	± 3.5	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
23	Y	0.0	± 0.0	25.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
24	Y	47.5	± 31.8	0.0	± 0.0	0.0	± 0.0	10.0	± 14.1	0.0	± 0.0	2.5	± 3.5	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0
25	Y	2.5	± 3.5	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	0.0	± 0.0
26	Y	0.0	± 0.0	32.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	12.5	± 10.6	0.0	± 0.0	0.0	± 0.0
27	Y	0.0	± 0.0	2.5	± 3.5	10.0	± 0.0	0.0	± 0.0	0.0	± 0.0	1.3	± 1.8	12.5	± 17.7	0.0	± 0.0	0.0	± 0.0
28	Y	1.3	± 1.8	17.5	± 3.5	0.0	± 0.0	0.0	± 0.0	7.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
29	Y	2.5	± 3.5	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	7.5	± 10.6	2.5	± 3.5	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0
30	Y	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	2.5	± 3.5	10.0	± 0.0	0.0	± 0.0	0.0	± 0.0
31	Y	10.0	± 7.1	45.0	± 7.1	0.0	± 0.0	7.5	± 3.5	10.0	± 14.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
32	Y	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	1.3	± 1.8	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0

**Appendix G:** Shrub data for all vegetative plots in 1998 study.

SITE #	GWVA	% Willow		% Hazle		% Alder		% S'toon		% Choke		% Dogw.		% Rose		% WS		% Bur Oak	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
33	Y	0.0	± 0.0	0.0	± 0.0	9.0	± 8.5	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
34	Y	0.0	± 0.0	0.0	± 0.0	35.0	± 49.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
35	Y	2.5	± 3.5	35.0	± 14.1	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	15.0	± 7.1	2.5	± 3.5	0.0	± 0.0
36	Y	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	5.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0
37	Y	45.0	± 21.2	0.0	± 0.0	35.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0
38	Y	5.0	± 7.1	17.5	± 17.7	40.0	± 42.4	1.3	± 1.8	2.5	± 3.5	0.0	± 0.0	12.5	± 17.7	0.0	± 0.0	0.0	± 0.0
39	Y	0.0	± 0.0	25.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0
40	Y	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	2.5	± 3.5	5.0	± 0.0	0.0	± 0.0
41	Y	0.0	± 0.0	72.5	± 3.5	0.0	± 0.0	7.5	± 3.5	5.0	± 0.0	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	2.5	± 3.5
42	N	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
43	N	2.5	± 3.5	27.5	± 10.6	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	10.0	± 14.1	5.0	± 0.0	2.5	± 3.5	0.0	± 0.0
44	N	0.0	± 0.0	20.0	± 28.3	10.0	± 14.1	0.0	± 0.0	0.0	± 0.0	10.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0
45	N	0.0	± 0.0	20.0	± 28.3	15.0	± 21.2	0.0	± 0.0	0.0	± 0.0	15.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
46	N	0.0	± 0.0	40.0	± 56.6	30.0	± 42.4	2.5	± 3.5	0.0	± 0.0	5.0	± 7.1	7.5	± 3.5	2.5	± 3.5	0.0	± 0.0
47	N	0.0	± 0.0	25.0	± 35.4	35.0	± 49.5	0.0	± 0.0	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
48	N	2.5	± 3.5	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	0.0	± 0.0
49	N	0.0	± 0.0	10.0	± 14.1	5.0	± 7.1	2.5	± 3.5	5.0	± 7.1	5.0	± 7.1	10.0	± 14.1	0.0	± 0.0	0.0	± 0.0
50	N	0.0	± 0.0	22.5	± 3.5	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	5.0	± 7.1	15.0	± 7.1	0.0	± 0.0	0.0	± 0.0
51	N	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
52	N	0.0	± 0.0	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0
53	N	0.0	± 0.0	35.0	± 21.2	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
54	N	0.0	± 0.0	10.0	± 14.1	10.0	± 14.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
55	N	0.0	± 0.0	77.5	± 10.6	0.0	± 0.0	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	12.5	± 10.6	0.0	± 0.0	0.0	± 0.0
56	N*	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	5.0	± 7.1	0.0	± 0.0	57.5	± 3.5	0.0	± 0.0	0.0	± 0.0
57	N*	0.0	± 0.0	10.0	± 14.1	0.0	± 0.0	15.0	± 21.2	12.5	± 10.6	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0
58	N	0.0	± 0.0	37.5	± 3.5	0.0	± 0.0	0.0	± 0.0	10.0	± 14.1	12.5	± 17.7	22.5	± 17.7	0.0	± 0.0	0.0	± 0.0
59	N	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	15.0	± 21.2	7.5	± 10.6	0.0	± 0.0	10.0	± 0.0	0.0	± 0.0	0.0	± 0.0
60	N	0.0	± 0.0	12.5	± 10.6	0.0	± 0.0	2.5	± 3.5	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
61	N	0.0	± 0.0	37.5	± 17.7	0.0	± 0.0	35.0	± 21.2	6.3	± 5.3	0.0	± 0.0	5.0	± 0.0	0.0	± 0.0	7.5	± 3.5
62	N	0.0	± 0.0	0.0	± 0.0	7.5	± 3.5	0.0	± 0.0	0.0	± 0.0	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
63	N	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	25.0	± 35.4	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
64	N	2.5	± 3.5	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	5.0	± 7.1	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0

## Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWVA	% Willow	% Hazle	% Alder	% Sttoon	% Choke	% Dogw.	% Rose	% WS	% Bur Oak
		Mean SD	Mean SD	Mean SD	Mean SD	Mean SD				
65	N	30.0 ± 28.3	0.0 ± 0.0	0.0 ± 0.0	35.0 ± 49.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
66	N*	45.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
67	N	20.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	25.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0
68	N	18.8 ± 15.9	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	70.0 ± 14.1	0.0 ± 0.0
69	N	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	15.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	17.5 ± 24.7	40.0 ± 56.6	0.0 ± 0.0
70	N	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	35.0 ± 7.1	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
71	N	2.5 ± 3.5	55.0 ± 7.1	0.0 ± 0.0	2.5 ± 3.5	10.0 ± 7.1	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
72	N	0.0 ± 0.0	45.0 ± 35.4	0.0 ± 0.0	10.0 ± 0.0	25.0 ± 21.2	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
73	N	15.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	5.0 ± 7.1	0.0 ± 0.0	12.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0
74	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	20.0 ± 28.3	5.0 ± 7.1	0.0 ± 0.0	17.5 ± 24.7	0.0 ± 0.0	0.0 ± 0.0
75	N	5.0 ± 0.0	40.0 ± 28.3	0.0 ± 0.0	2.5 ± 3.5	10.0 ± 14.1	10.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
76	N	10.0 ± 14.1	50.0 ± 28.3	0.0 ± 0.0	0.0 ± 0.0	17.5 ± 17.7	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
77	N	5.0 ± 7.1	5.0 ± 7.1	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	10.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0
78	N	2.5 ± 3.5	32.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	5.0 ± 7.1	0.0 ± 0.0
79	N	7.5 ± 3.5	65.0 ± 7.1	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	5.0 ± 7.1	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0
80	N	0.0 ± 0.0	47.5 ± 31.8	0.0 ± 0.0	15.0 ± 14.1	5.0 ± 7.1	0.0 ± 0.0	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
81	N	20.0 ± 28.3	20.0 ± 14.1	20.0 ± 28.3	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
82	N	17.5 ± 10.6	0.0 ± 0.0	1.3 ± 1.8	1.3 ± 1.8	0.0 ± 0.0	0.0 ± 0.0	1.3 ± 1.8	35.0 ± 21.2	0.0 ± 0.0
83	N	10.0 ± 14.1	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	32.5 ± 3.5	0.0 ± 0.0
84	N	2.5 ± 3.5	25.0 ± 7.1	0.0 ± 0.0	15.0 ± 7.1	10.0 ± 14.1	2.5 ± 3.5	22.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0
85	N	0.0 ± 0.0	45.0 ± 63.6	0.0 ± 0.0	7.5 ± 10.6	2.5 ± 3.5	2.5 ± 3.5	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0
86	N	0.0 ± 0.0	47.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0
87	N	27.5 ± 24.7	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
88	N	0.0 ± 0.0	15.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
89	N	50.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0
90	N	2.5 ± 3.5	67.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 10.6	10.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
91	N	0.0 ± 0.0	50.0 ± 42.4	0.0 ± 0.0	10.0 ± 14.1	15.0 ± 21.2	2.5 ± 3.5	10.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
92	N	2.5 ± 3.5	5.0 ± 7.1	0.0 ± 0.0	1.3 ± 1.8	0.0 ± 0.0	0.0 ± 0.0	6.3 ± 5.3	0.0 ± 0.0	0.0 ± 0.0
93	N	0.0 ± 0.0	20.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
94	N	40.0 ± 42.4	0.0 ± 0.0	0.0 ± 0.0	15.0 ± 21.2	20.0 ± 21.2	0.0 ± 0.0	5.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0
95	N	47.5 ± 10.6	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
96	N	2.5 ± 3.5	15.0 ± 21.2	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

## Appendix G: Shrub data for all vegetative plots in 1998 study.

SITE #	GWVA	% Willow	% Hazel	% Alder	% S'toon	% Choke	% Dogw.	% Rose	% WS	% Bur Oak
		Mean SD	Mean SD							
97	N	0.0 ± 0.0	30.0 ± 28.3	0.0 ± 0.0	15.0 ± 7.1	10.0 ± 0.0	5.0 ± 7.1	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
98	N	22.5 ± 24.7	30.0 ± 42.4	5.0 ± 7.1	2.5 ± 3.5	2.5 ± 3.5	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
99	N	25.0 ± 21.2	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	5.0 ± 7.1	7.5 ± 3.5	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
100	N	7.5 ± 3.5	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	35.0 ± 21.2	22.5 ± 10.6	0.0 ± 0.0
101	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	10.0 ± 0.0	17.5 ± 10.6	0.0 ± 0.0
102	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	5.0 ± 7.1	0.0 ± 0.0	20.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0
103	N	17.5 ± 10.6	0.0 ± 0.0	10.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0
104	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	27.5 ± 3.5	35.0 ± 7.1	0.0 ± 0.0	7.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
105	N	0.0 ± 0.0	10.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
106	N	12.5 ± 17.7	40.0 ± 28.3	0.0 ± 0.0	12.5 ± 3.5	12.5 ± 3.5	0.0 ± 0.0	4.0 ± 1.4	3.5 ± 2.1	0.0 ± 0.0
107	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	10.0 ± 14.1	10.0 ± 14.1	10.0 ± 14.1	22.5 ± 24.7	7.5 ± 3.5	0.0 ± 0.0
108	N	17.5 ± 24.7	2.5 ± 3.5	0.0 ± 0.0	2.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0	40.0 ± 14.1	2.5 ± 3.5	0.0 ± 0.0
109	N	27.5 ± 17.7	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 10.6	17.5 ± 24.7	2.5 ± 3.5	10.0 ± 7.1	2.5 ± 3.5	0.0 ± 0.0
110	N	0.0 ± 0.0	2.5 ± 3.5	5.0 ± 7.1	0.0 ± 0.0	5.0 ± 7.1	3.8 ± 1.8	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
111	N	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0
112	N	35.0 ± 14.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
113	N*	25.0 ± 21.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
114	N	15.0 ± 14.1	0.0 ± 0.0	25.0 ± 35.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 10.6	5.0 ± 0.0	0.0 ± 0.0
115	N	5.0 ± 7.1	0.0 ± 0.0	15.0 ± 7.1	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 3.5	2.5 ± 3.5	0.0 ± 0.0	0.0 ± 0.0

## Appendix H: Ground cover data for all vegetative plots in 1998 study.

Site #	GWWA	Age	% Herb	% Low Shrub	% Moss	% Grass	% Litter	% Log	% Bare
1	Y	8	35.6 ± 16.6	5.6 ± 5.0	0.6 ± 1.2	25.0 ± 28.7	19.3 ± 11.7	13.8 ± 15.3	0.0 ± 0.0
2	Y	7	34.4 ± 19.9	13.1 ± 8.0	0.0 ± 0.0	6.9 ± 6.5	20.0 ± 11.6	21.3 ± 16.9	0.0 ± 0.0
3	Y	7	30.6 ± 9.4	6.3 ± 2.3	2.0 ± 2.1	7.5 ± 2.7	43.6 ± 12.8	10.0 ± 10.4	0.0 ± 0.0
4	Y	7	20.6 ± 13.2	18.8 ± 19.4	0.0 ± 0.0	4.4 ± 6.8	32.5 ± 19.1	23.1 ± 21.9	0.0 ± 0.0
5	Y	6	22.5 ± 7.6	9.4 ± 5.0	0.0 ± 0.0	10.3 ± 9.0	23.8 ± 23.7	29.1 ± 25.6	0.0 ± 0.0
6	Y	10	0.3 ± 0.7	1.5 ± 3.5	0.0 ± 0.0	96.4 ± 8.7	0.0 ± 0.0	1.9 ± 5.3	0.0 ± 0.0
7	Y	6	21.9 ± 16.0	1.3 ± 3.5	2.5 ± 7.1	11.9 ± 8.0	40.6 ± 26.2	13.8 ± 5.8	8.1 ± 15.6
8	Y	10	17.1 ± 15.3	8.1 ± 8.4	19.1 ± 25.6	33.1 ± 38.3	10.0 ± 9.3	12.5 ± 16.7	0.0 ± 0.0
9	Y	75	13.8 ± 10.6	2.5 ± 3.8	0.6 ± 1.8	13.8 ± 11.6	56.3 ± 20.0	11.9 ± 11.0	0.0 ± 0.0
10	Y	80	6.5 ± 3.1	2.1 ± 2.5	1.6 ± 3.5	47.9 ± 38.8	34.4 ± 35.9	7.5 ± 7.6	0.0 ± 0.0
11	Y	15	23.8 ± 11.6	0.6 ± 1.8	0.0 ± 0.0	63.8 ± 23.7	11.3 ± 13.8	16.3 ± 16.6	0.0 ± 0.0
12	Y	8	36.9 ± 21.7	15.0 ± 9.3	0.0 ± 0.0	1.3 ± 3.5	31.9 ± 7.0	16.3 ± 16.6	0.0 ± 0.0
13	Y	50	4.0 ± 4.2	8.8 ± 8.8	1.3 ± 3.5	47.9 ± 45.7	5.0 ± 6.0	0.6 ± 1.8	32.5 ± 35.4
14	Y	25	18.1 ± 11.6	11.9 ± 8.4	0.0 ± 0.0	11.9 ± 7.0	42.5 ± 25.5	1.3 ± 3.5	11.3 ± 31.8
15	Y	50	21.3 ± 12.5	13.8 ± 5.8	0.0 ± 0.0	35.0 ± 23.1	28.1 ± 11.3	5.6 ± 12.4	0.0 ± 0.0
16	Y	25	13.8 ± 7.4	13.8 ± 6.4	0.0 ± 0.0	35.6 ± 25.6	36.9 ± 26.2	0.0 ± 0.0	0.0 ± 0.0
17	Y	25	13.1 ± 10.0	20.6 ± 12.9	0.0 ± 0.0	30.0 ± 28.4	34.4 ± 19.5	0.0 ± 0.0	1.3 ± 3.5
18	Y	50	25.0 ± 13.4	17.5 ± 9.3	0.0 ± 0.0	20.6 ± 8.2	36.9 ± 23.9	0.0 ± 0.0	0.0 ± 0.0
19	Y	10	16.9 ± 12.5	14.4 ± 24.1	0.0 ± 0.0	36.3 ± 23.9	26.9 ± 23.0	5.6 ± 6.2	0.0 ± 0.0
20	Y	5	20.0 ± 7.1	13.1 ± 9.2	0.0 ± 0.0	3.1 ± 3.7	44.4 ± 14.3	18.8 ± 12.2	0.0 ± 0.0
21	Y	5	16.3 ± 15.5	21.3 ± 13.3	0.0 ± 0.0	3.8 ± 4.4	35.6 ± 18.2	23.1 ± 14.1	0.0 ± 0.0
22	Y	5	20.6 ± 14.5	20.6 ± 24.7	0.0 ± 0.0	34.4 ± 31.3	18.8 ± 17.1	3.8 ± 5.8	0.0 ± 0.0
23	Y	5	15.0 ± 9.3	20.6 ± 26.5	0.0 ± 0.0	0.0 ± 0.0	41.9 ± 23.4	21.9 ± 21.7	0.0 ± 0.0
24	Y	50	16.9 ± 24.2	9.4 ± 8.2	0.0 ± 0.0	40.0 ± 29.4	18.8 ± 15.5	2.5 ± 4.6	0.0 ± 0.0
25	Y	5	20.6 ± 12.7	22.5 ± 14.4	0.0 ± 0.0	1.9 ± 2.6	35.0 ± 25.6	2.5 ± 7.1	17.5 ± 21.9
26	Y	6	25.6 ± 16.4	18.8 ± 10.3	0.0 ± 0.0	2.5 ± 3.8	35.0 ± 19.1	20.6 ± 21.9	0.0 ± 0.0
27	Y	6	21.9 ± 28.5	11.3 ± 8.3	14.4 ± 26.1	13.1 ± 31.3	37.5 ± 23.5	13.8 ± 12.7	0.0 ± 0.0
28	Y	5	16.3 ± 9.5	12.5 ± 11.6	0.0 ± 0.0	6.3 ± 13.8	48.1 ± 20.3	9.4 ± 9.4	0.0 ± 0.0
29	Y	5	30.6 ± 33.1	8.8 ± 6.9	0.0 ± 0.0	23.8 ± 26.2	21.3 ± 26.4	15.6 ± 12.4	0.0 ± 0.0
30	Y	6	19.4 ± 17.0	23.1 ± 25.5	0.0 ± 0.0	3.1 ± 4.6	24.4 ± 20.4	30.0 ± 15.1	0.0 ± 0.0
31	Y	6	23.8 ± 16.6	17.5 ± 12.2	0.0 ± 0.0	18.8 ± 12.2	35.0 ± 21.7	5.0 ± 14.1	0.0 ± 0.0
32	Y	4	25.6 ± 21.3	7.5 ± 8.5	0.0 ± 0.0	41.9 ± 19.3	24.4 ± 18.8	0.0 ± 0.0	

## Appendix H: Ground cover data for all vegetative plots in 1998 study.

Site #	GWVA	Age	% Herb	% Low Shrub	% Moss	% Grass	% Litter	% Log	% Bare
33	Y	4	23.8 ± 14.3	2.5 ± 3.8	0.0 ± 0.0	1.3 ± 2.3	30.0 ± 19.6	42.5 ± 32.4	1.3 ± 3.5
34	Y	4	23.8 ± 15.8	10.0 ± 13.9	0.0 ± 0.0	24.4 ± 25.0	25.6 ± 16.8	1.3 ± 3.5	15.0 ± 29.8
35	Y	5	25.6 ± 18.8	16.9 ± 9.6	0.0 ± 0.0	15.0 ± 11.6	40.0 ± 23.1	5.0 ± 7.6	0.0 ± 0.0
36	Y	4	22.5 ± 30.6	3.1 ± 3.7	0.0 ± 0.0	31.3 ± 34.5	20.0 ± 19.3	14.4 ± 10.5	0.0 ± 0.0
37	Y	50	33.8 ± 35.2	14.7 ± 14.2	0.0 ± 0.0	12.5 ± 12.2	0.0 ± 0.0	0.0 ± 0.0	39.1 ± 29.5
38	Y	60	21.9 ± 26.9	17.5 ± 6.5	0.0 ± 0.0	26.3 ± 27.5	22.5 ± 19.5	11.9 ± 10.7	0.0 ± 0.0
39	Y	5	35.0 ± 28.4	7.5 ± 6.5	0.6 ± 1.8	8.8 ± 17.1	33.1 ± 24.2	8.1 ± 8.4	0.0 ± 0.0
40	Y	10	18.8 ± 11.3	33.1 ± 24.8	3.1 ± 8.8	23.1 ± 20.2	5.6 ± 8.6	10.0 ± 9.6	0.0 ± 0.0
41	Y	7	8.8 ± 2.3	4.4 ± 4.2	1.3 ± 3.5	9.4 ± 12.9	72.5 ± 11.3	3.8 ± 7.4	0.0 ± 0.0
42	N	60	1.3 ± 1.4	0.3 ± 0.7	0.6 ± 0.7	0.0 ± 0.0	45.5 ± 48.7	2.3 ± 3.7	0.0 ± 0.0
43	N	50	31.3 ± 19.0	3.8 ± 4.4	2.9 ± 2.4	1.9 ± 3.7	54.3 ± 23.0	6.0 ± 6.5	0.0 ± 0.0
44	N	70	14.4 ± 6.2	11.3 ± 13.6	7.5 ± 10.0	0.6 ± 1.8	61.9 ± 9.6	5.6 ± 8.6	0.0 ± 0.0
45	N	70	23.1 ± 18.3	21.3 ± 12.2	3.8 ± 4.4	0.0 ± 0.0	41.9 ± 15.1	6.3 ± 8.8	0.0 ± 0.0
46	N	40	23.1 ± 12.2	11.9 ± 8.0	2.5 ± 3.8	2.5 ± 3.8	53.8 ± 9.5	0.0 ± 0.0	0.0 ± 0.0
47	N	70	21.3 ± 9.5	15.6 ± 7.3	1.9 ± 3.7	3.8 ± 4.4	47.5 ± 11.6	10.0 ± 12.5	0.0 ± 0.0
48	N	1	24.4 ± 29.6	11.9 ± 12.2	0.6 ± 1.8	6.3 ± 13.8	16.9 ± 13.6	40.0 ± 34.2	0.0 ± 0.0
49	N	50	31.3 ± 23.1	21.3 ± 31.8	3.1 ± 3.7	1.3 ± 2.3	39.4 ± 26.1	3.1 ± 4.6	0.0 ± 0.0
50	N	50	30.0 ± 13.9	11.3 ± 4.4	0.0 ± 0.0	1.3 ± 2.3	51.9 ± 16.0	5.6 ± 4.2	0.0 ± 0.0
51	N	70	28.1 ± 21.0	7.5 ± 6.5	1.9 ± 3.7	0.0 ± 0.0	55.0 ± 16.0	7.5 ± 11.6	0.0 ± 0.0
52	N	2	40.0 ± 20.0	10.0 ± 6.0	0.0 ± 0.0	8.8 ± 5.8	21.3 ± 14.6	21.3 ± 24.7	0.0 ± 0.0
53	N	0	2.1 ± 2.5	2.1 ± 2.5	0.0 ± 0.0	0.0 ± 0.0	3.1 ± 8.8	38.8 ± 24.7	62.9 ± 19.1
54	N	20	24.4 ± 27.6	13.8 ± 9.9	2.5 ± 3.8	0.6 ± 1.8	54.4 ± 25.4	5.6 ± 7.3	0.0 ± 0.0
55	N	0	6.3 ± 2.3	3.1 ± 3.7	0.0 ± 0.0	0.0 ± 0.0	8.1 ± 13.6	17.5 ± 16.0	65.0 ± 18.5
56	N*	20	25.0 ± 27.1	11.9 ± 10.0	0.0 ± 0.0	23.1 ± 26.2	38.8 ± 31.0	1.3 ± 3.5	0.0 ± 0.0
57	N*	25	9.4 ± 5.6	18.8 ± 5.8	6.9 ± 10.3	32.5 ± 21.4	31.9 ± 12.8	0.6 ± 1.8	0.0 ± 0.0
58	N	40	12.5 ± 19.5	15.6 ± 9.4	1.3 ± 3.5	1.3 ± 2.3	61.9 ± 15.1	6.3 ± 6.9	0.0 ± 0.0
59	N	25	6.3 ± 4.4	22.5 ± 14.9	5.0 ± 14.1	18.1 ± 23.0	26.3 ± 20.5	0.0 ± 0.0	14.4 ± 28.5
60	N	3	5.0 ± 2.3	3.6 ± 4.2	0.0 ± 0.0	0.6 ± 1.2	15.0 ± 24.6	42.5 ± 31.4	31.9 ± 34.4
61	N	25	22.5 ± 23.9	6.9 ± 8.0	0.6 ± 1.8	3.8 ± 4.4	64.4 ± 21.6	1.9 ± 2.6	0.0 ± 0.0
62	N	2	14.4 ± 22.6	5.6 ± 5.6	2.5 ± 5.3	34.4 ± 23.5	25.0 ± 24.8	15.6 ± 26.9	2.5 ± 5.3
63	N	2	20.6 ± 27.0	10.6 ± 14.5	0.0 ± 0.0	2.5 ± 4.6	0.6 ± 1.8	36.3 ± 37.4	30.6 ± 31.6
64	N	3	9.4 ± 5.0	9.4 ± 8.2	0.0 ± 0.0	12.5 ± 23.5	22.5 ± 34.4	21.9 ± 27.0	26.9 ± 28.9

## Appendix H: Ground cover data for all vegetative plots in 1998 study.

Site #	GWWA	Age	% Herb	% Low Shrub	% Moss	% Grass	% Litter	% Log	% Bare
65	N	20	16.3 ± 14.3	4.4 ± 3.2	0.0 ± 0.0	74.4 ± 15.2	5.0 ± 3.8	0.0 ± 0.0	0.0 ± 0.0
66	N*	20	11.3 ± 5.2	6.3 ± 13.8	0.0 ± 0.0	80.0 ± 12.5	2.5 ± 2.7	0.0 ± 0.0	0.0 ± 0.0
67	N	25	18.8 ± 11.3	13.1 ± 10.7	0.0 ± 0.0	39.4 ± 26.4	28.8 ± 25.5	0.0 ± 0.0	0.0 ± 0.0
68	N	20	15.6 ± 6.2	2.5 ± 3.8	0.0 ± 0.0	79.4 ± 3.2	3.8 ± 3.5	0.0 ± 0.0	0.0 ± 0.0
69	N	25	25.0 ± 8.9	5.6 ± 5.0	0.0 ± 0.0	63.1 ± 15.1	6.3 ± 6.9	0.0 ± 0.0	0.0 ± 0.0
70	N	20	20.0 ± 13.4	6.9 ± 8.0	0.0 ± 0.0	61.9 ± 21.7	11.3 ± 13.3	0.0 ± 0.0	0.0 ± 0.0
71	N	25	14.4 ± 6.2	9.4 ± 9.0	0.0 ± 0.0	48.8 ± 28.3	25.0 ± 34.2	0.0 ± 0.0	2.5 ± 4.6
72	N	25	10.6 ± 5.6	15.6 ± 11.8	0.0 ± 0.0	38.8 ± 28.3	33.1 ± 23.1	0.0 ± 0.0	1.9 ± 3.7
73	N	20	16.3 ± 6.9	3.8 ± 4.4	0.0 ± 0.0	21.3 ± 11.6	49.4 ± 16.6	0.0 ± 0.0	9.4 ± 7.3
74	N	20	10.6 ± 3.2	16.9 ± 9.6	0.0 ± 0.0	35.6 ± 10.5	36.9 ± 13.1	0.0 ± 0.0	0.0 ± 0.0
75	N	100	15.6 ± 13.2	6.3 ± 4.4	0.0 ± 0.0	18.8 ± 31.8	49.4 ± 25.8	14.4 ± 13.5	0.6 ± 1.8
76	N	60	23.8 ± 17.5	9.4 ± 8.2	0.0 ± 0.0	9.4 ± 9.0	53.8 ± 18.5	3.8 ± 8.8	0.0 ± 0.0
77	N	4	19.4 ± 16.6	5.6 ± 4.2	0.0 ± 0.0	11.3 ± 8.8	13.1 ± 16.7	20.0 ± 25.6	0.0 ± 0.0
78	N	5	31.3 ± 20.8	9.4 ± 7.8	0.6 ± 1.8	15.0 ± 20.5	28.1 ± 20.9	9.4 ± 15.2	0.0 ± 0.0
79	N	80	34.4 ± 12.4	16.3 ± 8.8	3.1 ± 3.7	6.3 ± 7.9	30.6 ± 15.2	3.1 ± 4.6	0.0 ± 0.0
80	N	60	23.8 ± 10.3	16.3 ± 9.9	1.3 ± 3.5	11.3 ± 8.3	42.5 ± 13.6	5.0 ± 14.1	0.0 ± 0.0
81	N	50	26.3 ± 29.1	8.8 ± 7.9	10.0 ± 17.1	1.3 ± 2.3	46.9 ± 20.0	6.9 ± 10.3	0.0 ± 0.0
82	N	5	17.5 ± 11.0	6.3 ± 3.5	1.9 ± 2.6	26.9 ± 10.3	38.8 ± 23.0	0.0 ± 0.0	8.8 ± 16.4
83	N	5	10.6 ± 13.2	6.9 ± 4.6	5.0 ± 6.5	6.3 ± 9.2	49.4 ± 20.3	27.5 ± 26.0	0.0 ± 0.0
84	N	50	26.9 ± 10.3	20.0 ± 8.9	1.3 ± 2.3	6.3 ± 6.4	41.9 ± 12.2	5.0 ± 6.0	0.0 ± 0.0
85	N	60	15.6 ± 13.7	11.3 ± 7.4	0.0 ± 0.0	2.5 ± 2.7	56.3 ± 21.2	13.1 ± 9.2	0.0 ± 0.0
86	N	7	48.1 ± 27.0	16.9 ± 12.2	0.0 ± 0.0	0.6 ± 1.8	25.0 ± 12.8	10.0 ± 10.7	0.0 ± 0.0
87	N	30	23.8 ± 25.5	3.1 ± 3.7	0.0 ± 0.0	44.4 ± 30.5	28.8 ± 28.6	1.3 ± 3.5	0.0 ± 0.0
88	N	2	15.6 ± 10.2	19.4 ± 13.5	0.0 ± 0.0	3.8 ± 4.4	20.0 ± 16.7	37.5 ± 37.3	0.0 ± 0.0
89	N	40	35.6 ± 19.5	13.1 ± 8.8	1.3 ± 3.5	21.3 ± 16.6	28.8 ± 11.6	0.0 ± 0.0	0.0 ± 0.0
90	N	40	18.1 ± 10.7	3.1 ± 3.7	0.6 ± 1.8	3.8 ± 3.5	73.1 ± 8.4	1.3 ± 3.5	0.0 ± 0.0
91	N	0	3.6 ± 2.0	5.6 ± 2.9	0.0 ± 0.0	0.0 ± 0.0	16.9 ± 27.6	21.3 ± 25.0	52.6 ± 29.4
92	N	3	18.8 ± 11.3	13.1 ± 10.3	0.0 ± 0.0	3.8 ± 4.4	35.6 ± 22.4	30.0 ± 28.3	0.0 ± 0.0
93	N	5	18.1 ± 16.0	13.1 ± 10.3	0.0 ± 0.0	1.9 ± 2.6	36.9 ± 11.6	30.0 ± 16.7	0.0 ± 0.0
94	N	30	15.0 ± 11.0	18.1 ± 8.8	0.0 ± 0.0	23.1 ± 9.6	39.4 ± 14.5	0.0 ± 0.0	11.9 ± 26.4
95	N	30	17.5 ± 12.5	4.4 ± 5.6	0.0 ± 0.0	43.1 ± 28.4	35.0 ± 21.5	0.0 ± 0.0	0.0 ± 0.0
96	N	4	14.4 ± 10.2	17.5 ± 7.6	0.0 ± 0.0	3.8 ± 4.4	41.3 ± 25.9	16.9 ± 10.7	10.0 ± 24.5

Appendix H: Ground cover data for all vegetative plots in 1998 study.

Site #	GWWA	Age	% Herb	% Low Shrub	% Moss	% Grass	% Litter	% Log	% Bare
97	N	30	18.1 ± 8.8	27.5 ± 14.6	0.0 ± 0.0	15.0 ± 14.1	39.4 ± 21.9	0.0 ± 0.0	0.0 ± 0.0
98	N	6	16.9 ± 9.2	21.9 ± 23.6	0.0 ± 0.0	18.8 ± 14.6	40.0 ± 20.9	1.3 ± 3.5	0.0 ± 0.0
99	N	6	30.6 ± 19.4	11.3 ± 10.6	0.0 ± 0.0	18.8 ± 16.2	33.1 ± 20.7	7.5 ± 13.9	0.0 ± 0.0
100	N	18	23.1 ± 18.3	15.6 ± 9.4	0.0 ± 0.0	8.8 ± 3.5	43.8 ± 21.7	0.0 ± 0.0	0.0 ± 0.0
101	N	18	32.5 ± 25.4	13.1 ± 12.2	4.4 ± 10.5	13.8 ± 15.3	27.5 ± 21.9	3.8 ± 7.4	0.0 ± 0.0
102	N	18	34.4 ± 9.0	13.8 ± 7.4	0.0 ± 0.0	7.5 ± 6.5	35.0 ± 12.0	14.4 ± 12.4	0.0 ± 0.0
103	N	6	40.0 ± 24.1	13.1 ± 12.2	0.0 ± 0.0	11.9 ± 16.9	16.3 ± 14.3	18.8 ± 17.1	0.0 ± 0.0
104	N	20	13.1 ± 11.3	13.8 ± 10.3	0.0 ± 0.0	43.1 ± 18.3	30.0 ± 11.0	0.0 ± 0.0	0.0 ± 0.0
105	N	3	44.4 ± 23.4	8.8 ± 9.9	0.0 ± 0.0	2.5 ± 3.8	21.9 ± 12.8	16.9 ± 12.8	6.9 ± 15.8
106	N	60	41.3 ± 17.9	10.6 ± 10.2	0.6 ± 1.8	5.6 ± 6.8	35.0 ± 10.4	6.9 ± 8.8	0.0 ± 0.0
107	N	25	20.0 ± 10.4	3.1 ± 3.7	3.1 ± 3.7	2.5 ± 3.8	59.4 ± 12.4	11.9 ± 10.0	0.0 ± 0.0
108	N	20	32.5 ± 17.7	16.9 ± 17.1	0.0 ± 0.0	24.4 ± 24.3	27.5 ± 15.4	0.0 ± 0.0	0.0 ± 0.0
109	N	20	41.9 ± 21.7	9.4 ± 10.8	3.1 ± 3.7	7.5 ± 8.5	38.1 ± 23.1	0.0 ± 0.0	0.0 ± 0.0
110	N	15	31.9 ± 17.3	12.4 ± 13.4	3.8 ± 10.6	4.4 ± 5.6	43.8 ± 16.2	6.3 ± 10.3	0.0 ± 0.0
111	N	15	18.1 ± 17.3	3.8 ± 5.2	0.0 ± 0.0	1.9 ± 2.6	18.1 ± 21.0	0.0 ± 0.0	58.1 ± 30.6
112	N	20	21.3 ± 5.8	3.1 ± 4.6	0.0 ± 0.0	17.5 ± 12.2	56.9 ± 13.6	0.0 ± 0.0	0.0 ± 0.0
113	N*	18	20.6 ± 11.2	8.8 ± 13.3	0.6 ± 1.8	22.5 ± 9.3	36.3 ± 9.5	11.3 ± 13.6	0.0 ± 0.0
114	N	18	27.5 ± 10.0	6.3 ± 7.9	0.0 ± 0.0	27.5 ± 14.1	35.0 ± 20.0	3.8 ± 10.6	0.0 ± 0.0
115	N	18	21.9 ± 15.3	11.3 ± 13.3	1.3 ± 2.3	5.6 ± 7.3	36.3 ± 22.8	18.8 ± 19.4	0.0 ± 0.0