BROWSE PREFERENCE OF WHITE-TAILED DEER (*Odocoileus virginiana*) AT UNDERC,

Vilas/Gogebic Counties, Wisconsin/Michigan

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ABSTRACT

As an initial step in determining the effects of browsing on trees by white-tailed deer at the University of Notre Dame Environmental Research Center, we conducted this baseline study of browse preference. During the summer of 2002 we made several field observations of deer eating habits by recording the number of bites per plant species in a given plot or transect sample area. This enabled us to determine the relative browsing preference of deer for each species. We found that *Populus tremuloides*, *Prunus serotina*, and *Amelanchier spp.* were significantly preferred species ($p<0.01$). *Abies balsema* and *Rubus strigosus* were significantly avoided ($p<0.01$). This preliminary study allows us to predict the change in forest composition when deer are excluded from the sample sites in future studies.

INTRODUCTION

It has been shown that the browsing pressure exerted by white-tailed deer (*Odocoileus virginiana*) can alter the composition and structure of forest communities (Webster et al. 2001, Aldredge and Wall 2001, Augustine and Jordan 1998, and Augustine et al. 1998). As selective herbivores, high population levels of deer inhibit growth of specific tree species due to preferential grazing (Webster et al. 2001; Augustine et al. 1998). The relevance of these studies to forest management issues (i.e. loss of native species and native forest compositions due to increased browsing pressure) reinforces their importance. Scientists are currently working to create models that predict change/damage to forest communities according to the number of deer present and the availability of alternative food sources (Augustine, Frelich and Jordan 1998; Augustine and Jordan 1998).

White-tailed deer are herbaceous browsers with selective nutritional needs and eating habits. Deer do not like large blocks of any one species or any one type of cover. They are most abundant along the margins of forests where the greatest amount of desirable food is available in the form of low growing shrubs and bushes (Taylor 1956). During the spring and summer, nursing females may eat more frequently and in larger quantities due to the heavy nutritional stress of the energy demands of nursing young (Porter 1991). Because of the lower nutrient value of winter foods, it is important for does to increase their nutrient intake in spring to prepare for fawning. Improved nutrition promotes healthier fawns and better antler growth. Summer foods include leaves of select trees and shrubs such as aspen, red maple, white ash, blackberries, dogwoods and sassafras.

Although there are regional differences in the daily browse requirements of deer, these have been adequately determined. In Michigan, it was found that an average of 5 pounds of browse-was required per day by yarded deer (Taylor 1956). Wisconsin studies showed that a mature deer required 5 to 7 pounds of first-class browse per hundredweight of deer (Taylor 1956). In another study, it was found that deer apparently were able to recognize the most nutritious food, but they discriminate only in choosing the best available (Taylor 1956). This suggests that deer can choose the best food based on nutrition value and palatability.

The goal of this study is to describe the food preferences of white-tailed deer at the University of Notre Dame Environmental Research Center (UNDERC) in Vilas/Gogebic County (Wisconsin/Upper Peninsula Michigan). We began a baseline study to determine deer feeding preferences on the property. Since browsers are selective in their diet and all plants are not equally preferred, those species not eaten by deer may have a distinct advantage in the competition to survive. Thus, understanding which plant species are preferred by deer may help predict the vegetative landscape and forest composition outside and inside of exclosures proposed by Dr. Gary Belovosky and Dr. Joe Caudell to be built the summer following this study.

STUDY AREA AND METHODS

Our project was conducted on the UNDERC property in the Vilas and Gogebic Counties (Wisconsin and Upper Peninsula Michigan) in Summer 2002 as part of Notre Dame's Practicum in Field Environmental Biology (BIOS 569). This approximately 7500-acre property straddles the Wisconsin-Michigan state line, and is centered at 46' 13' North by 89' 32' West. It is an extremely wet area, with over 16% of its area covered by open water. 30 lakes and bogs lie within property lines. (UNDERC website).

We randomly selected six points on the property for our study, discarding any coordinates that fell in lakes or bogs. The six 20m x 20m plots were centered at each random coordinate; transects were marked from the plot's edge to the nearest road (ranging in length from 16-371 meters). See Table 1 in the appendix for details of plot and transect size and length. By sampling deer herbivory in both plots and along transects we obtained a broader picture of browsing pressure on UNDERC property. Most plots were situated in a single type of forest composition, whereas transects traveled through a number of different habitats.

Within the plots we recorded species name, height, and deer browse on all woody species within 6 randomly chosen 2m x 2m subplots. We used subplots rather than sampling each entire 20m x 20m plot due to thick groundcover vegetation. Along the transects we recorded species name and signs of deer browse of all woody species between 30 and 150 cm in the 2-m wide strip. Samples of leaves that appeared to have been eaten were collected and taken back to the laboratory for identification.

We used SYSTAT Version 10 to test the significance of our findings through chi-squared tests.

RESULTS

Plant composition:

Table 1 includes raw data of the number of total plants of each species in plots (a) and transects (b), and the number and percentage browsed upon by deer. There were 39 recorded browse markings in the plots, and 102 plants browsed in the transects. We found considerable differences in forest composition between our six sample sites. Table 2 summarizes the dominant species in each plot. Sugar maple forests dominated the upland hardwood forest at UNDERC although this was only representative of three of the sample plots.

We also found significant differences in species composition between plots and transects. When the percentage of each species found in the plots and transects was calculated, we found that the two sampling methods did not give similar results (See Figure 1). The plots' dominant species is *Ledum groenlandicum* (54.34% of the plots total recorded plants). The transects have a greater species diversity, with a variety of abundantly recorded species: *Populus tremuloides* (27.11%), *Corylus americana* (16.33%), *Alnus rugosa* (13.47%), and *Abies balsemea* (11.05%) are the four most common.

The majority of the plots' *Ledum groenlandicum* is a result of the random placement of Tenderfoot Bog site in a bog area that is not representative of the larger area as measured by the transect. To correct for this, we reevaluated our data excluding Tenderfoot Bog site. We find that the plot and transects still differ, but the plots' dominant species are now more diverse: *Rubus strigosus* (27.31%), *Acer rubrum* (23.67%), and *Acer saccharum* (18.91%).

Preference:

Using a browsing preference index, we can rate deer partiality for individual plant species. By dividing the percentage of a certain species that are eaten out of total eaten plants by the percentage that the species makes up of all observed plants, we ranked the observed species as avoided (preference index value < 1), no preference (value = 1), or preferred (value > 1). See Table 3 for a summary of the browsing preferences of deer in the transects and plots, and Figure 2 for a graphical display of these results. In the transects we see that *Cornus stolonifera, Tilia Americana, Prunus serotina, Acer rubrum, Populus tremuloides, Acer saccharum,* and *Amelanchier huronensis* are significantly preferred. *Corylus Americana, Alnus rugosa, Abies balsemea, Betula alleghaniensis, Chamaedaphne calyculata, Ledum groenlandicum,* and *Rubus strigosus* are significantly avoided. For the plots, we see that *P.serotina, P. tremuloides, A. rubrum, Amelanchier medic,* and *C. americana* are all preferred significantly (p<0.01). *A. saccharum* and *Fraxinus nigra* were avoided in the plots despite being preferred in the transects.

DISCUSSION

The purpose of this study was to determine the browse preferences of white-tailed deer at UNDERC. Our results identify several species of preference, including *P. tremuloides, A. rubrum,* and *P. serotina*. The availability and use of these species was significant enough to determine a high preference among these plants. We predict that over time, with similar deer densities and environmental conditions, the abundance of these species will decrease if regularly exposed to deer browsing habits. Conversely, we predict an increase in abundance over time of the preferred plant species if deer are excluded from the area, as in an exclosure study site. We also found several species of woody plants avoided by deer during the summer months, such as *R. strigosus* and *A. balsema*. It would be expected that these species would show similar relative abundance if deer are excluded because of the low browse pressure. Over time, the upland hardwood forest composition will directionally select for these avoided species, if deer browsing is a critical selective force.

Following this baseline study on deer browse preferences, exclosures will be placed in each of the sample plots and observed over a period of time to determine if there is any change in forest composition when deer are excluded. Exclosures have been used in many studies to determine the effects of browsing on plants, and to further determine plant preference (Harlow 1984; Webster, Jenkins and Parker 2001; Fletcher, McShea, Shipley and Shumway 2001). It will be especially interesting to observe the effect on seedling and sapling growth of the preferred species, as the young plants are browsed upon early in the spring when they are tender, denuding the understory of saplings.

Other possible projects for the future may include a nutritional value analysis of the preferred species to determine if there is an inherently higher nutritional value in these species compared to the avoided species. Chemical analyses of food indicate their content of protein, ash, ether extract, crude fiber, nitrogen-free extract, total carbohydrates, calcium, phosphorus, and magnesium gave inconclusive results. The only element occurring fairly consistently in larger amounts in preferred foods was calcium (Taylor 1956). Also, clipping and plant biomass studies may more quantitatively determine availability and consumption, and therefore preference, of plant species.

This was a time consuming study, and perhaps more sample areas or other experiments could have been done given more time to complete the project. The thick vegetation in several of the sample plots caused us to sample smaller subplots, so results may not have been representative of the larger area. The large differences in forest composition between the plots and transects at the same site can be explained by the large size of the property and the topographical and hydrological effects on the landscape. There are many different forest communities on the property, and so deer browse may differ between these locations. We suggest omitting the Tenderfoot Bog site from the exclosure experiment because the plant composition is not representative of the surrounding forest.

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APPENDIX A
Tables:

Table 1a: Plant species and Deer Browse in Plots			
species	number	browsed	%browsed
Abies balsema	31	0	0
Acer rubrum	169	14	35.89744
Acer saccharum	135	1	2.564103
Amelanchier medic	24	3	7.692308
Betula alleghaniensis	3	0	0
Betula papyrifera	3	0	0
Corylus americana	40	3	7.692308
Fraxinus nigra	16	0	0
Lonicera hirsuta	30	1	2.564103
Picea glauca	4	0	0
Populus tremuloides	45	14	35.89744
Prunus serotina	3	1	2.564103
Prunus virginiana	5	1	2.564103
Rubus strigosus	195	1	2.564103
Thuja occidentalis	2	0	0
Tsuga canadensis	9	0	0

Table 1: Plant Species and Deer Browse Recorded In Transects

Species	Number	Number Browsed	% Browsed
Abies balsamea	251	0	0.00
Acer rubrum	71	8	11.27
Acer saccharum	64	6	9.38
Amelanchier spp.	22	2	9.09
Alnus rugosa	306	1	0.33
Betula alleghaniensis	10	0	0.00
Betula papyrifera	3	0	0.00
Chamaedaphne calyculat	5	0	0.00
Cornus stolonifera	9	7	77.78
Corylus americana	371	11	2.96
Dirca palustris	3	0	0.00
Fraxinus nigra	130	2	1.54
Ilex verticillata	8	0	0.00
Larix laricina	1	0	0.00
Ledum groenlandicum	126	0	0.00
Lonicera canadensis	12	0	0.00
Ostrya virginiana	1	0	0.00
Picea glauca	2	0	0.00
Picea mariana	31	0	0.00
Populus tremuloides	619	59	9.53
Prunus serotina	40	5	12.50
Rhamnus alnifolia	6	0	0.00
Rubus strigosus	102	0	0.00
Salix spp.	27	0	0.00
Tilia americana	2	1	50.00
Vaccinium myrtilloides	17	0	0.00

Table 1: All deer browse data from plots (a) and transects(b). Includes plants species, number observed, number browsed, and percent browsed of those observed.

Table 2: Site Descriptions and Sampling Methods			
Site	Forest Composition (major species present)	Plot Sampling Method	Transect Length
Maple Ridge/S. Gate	Sugar Maple	6 2X2m^2 subplots	218 m
Balsam Fortress	Balsam Fir, Black Ash	6 2X2m^2 subplots	104 m
Northgate	Aspen, Balsam Fir, Red Raspberry	6 2X2m^2 subplots	16 m
Tenderfoot Bog	Speckled Alder, *Ledum groenlandicum*	6 2X2m^2 subplots	371 m
Vernal Pond West	Red Maple, Sugar Maple	6 2X2m^2 subplots	165 m
Hummingbird	Sugar Maple, Red Maple	6 2X2m^2 subplots	218 m

Table 2: Site descriptions of dominant species and sampling methods used at each site.

Table 3: Relative Preference for Plant Species (Tenderfoot Bog site excluded)				
Species	Transect Preference Index		Plot preference index	
Cornus stolonifera	10.1825397	Preferred **	NA	NA
Tilia americana	6.54591837	Preferred **	NA	NA
Prunus serotina	3.74052478	Preferred **	6.1025641	Preferred**
Fraxinus nigra	2.72746599	Preferred **	0	Avoided*
Populus tremuloides	1.90622898	Preferred **	5.6957265	Preferred**
Acer rubrum	1.71696219	Preferred *	1.51661356	Preferred**
Amelanchier huronensis	1.37808808	Preferred **	2.28846154	Preferred**
Acer saccharum	1.26695194	Preferred	0.13561254	Avoided**
Prunus virginiana	NA	NA	3.66153846	Preferred**
Corylus americana	0.53535392	Avoided **	1.37307692	Preferred**
Alnus rugosa	0.17002385	Avoided **	NA	NA
Abies balsemea	0	Avoided **	0	Avoided**
Betula alleghaniensis	0	Avoided **	0	Avoided**
Betula papyrifera	0	Avoided	0	Avoided**
Lonicera canadensis	0	Avoided	0.61025641	Avoided*
Picea glauca	0	Avoided	0	Avoided
Rubus strigosus	0	Avoided **	0.0938856	Avoided**

* = statistically significant ($P<0.05$)

** = highly statistically significant ($P<0.01$)

Table 3: Relative preference Indices for plant species in plots and transects. Species are considered preferred if %eaten/%observed is greater than 1, and avoided if the index is less than 1.

APPENDIX B
Figures:

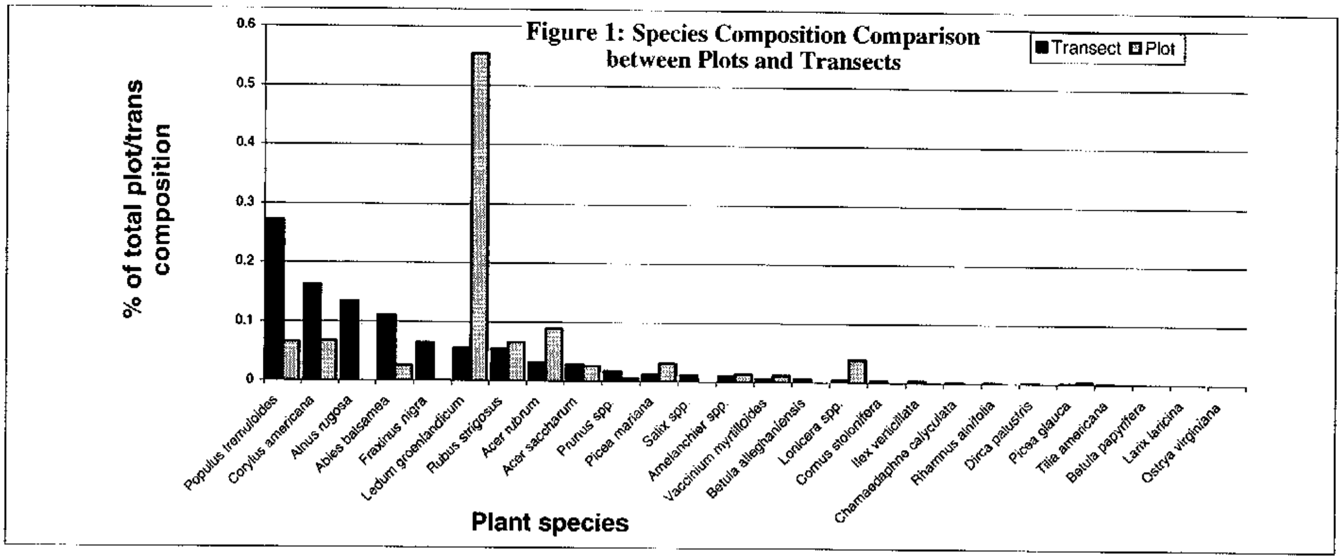

Figure 1: Species composition comparison between the plots and transects for all the sample sites. The percentages reflect the total number of plants of each species/total number of plants observed in either the plots or transects. (Includdes Tenderfoot Bog site)

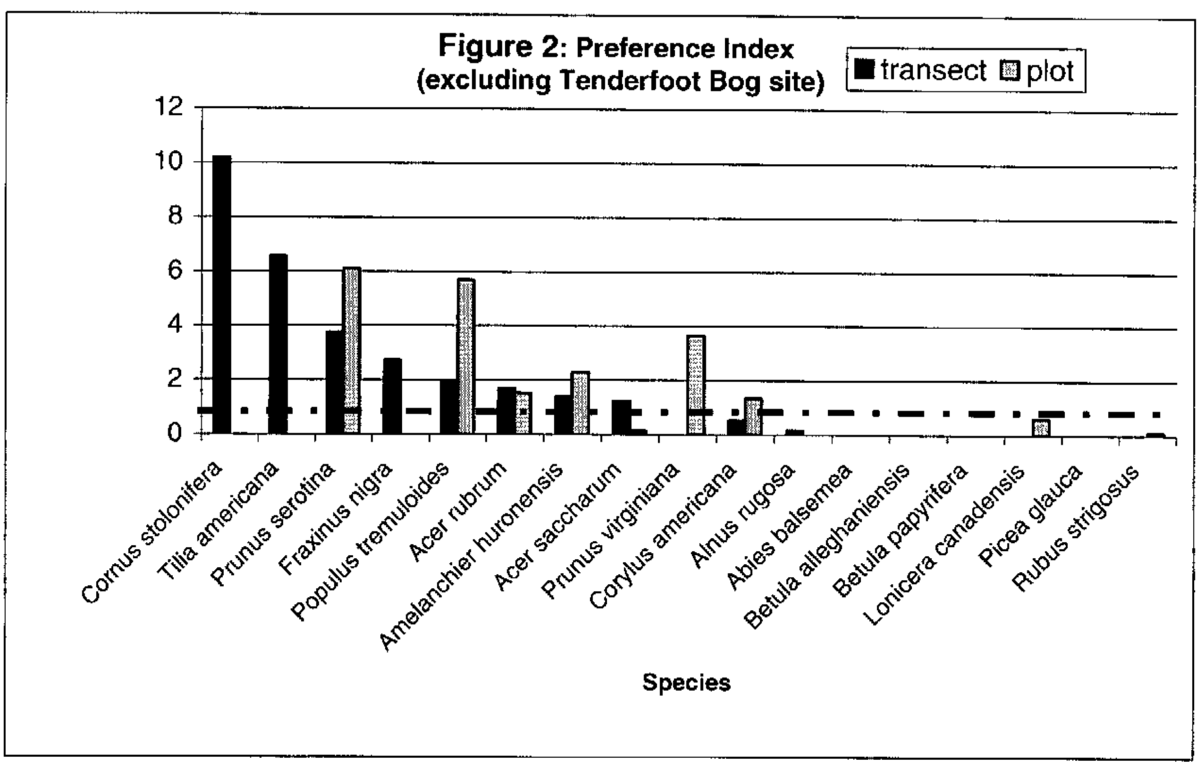

Figure 2: The preference index for each plant species. An index value above the dotted line (at y=1) represents preference, and indice values below the line indicate species that are avoided.