Comparison of two methods for rapid assessment of herbivory by white-tailed deer

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Abstract

White-tailed deer help determine forest structure by browsing selectively, which can potentially decrease plant diversity and abundance at the high deer densities found in the Mid-Atlantic region. Ecological studies of forests in this region therefore need to incorporate knowledge of deer pressure. A rapid method to assess long-term deer pressure can offer a preliminary foundation for more comprehensive forest analysis or experiments. We compared two rapid methods: "forest Secchi" and "browse transects," in 11 upland hardwood forests in Mercer County, NJ having different levels of deer management. For the forest Secchi method, we used a white, 1 m^2 board divided into 16 squares, which we positioned vertically in the forest at deer height (0.5 – 1.3 m), at points 10 m in each cardinal direction from 10 random points. We recorded the percentage of grid squares obstructed partially/fully by native foliage, as viewed from the random points. For the transect method, we analyzed the closest native woody branch at deer height every 10 m along three 100 m transects, by counting the number of buds that were intact, browsed, or had other damage. Both methods separately showed significant variation among the 11 forests, ranging from 1 – 67% Secchi cover and 3 – 38% browsed buds. In some forests these results corresponded, but in others they did not, resulting in a nonsignificant correlation. Differences in the abundance and diversity of deer-palatable native species among forests may drive these conflicting results, requiring a more species-specific approach.

Introduction

The effects of deer herbivory play a significant role in shaping understory ecology. Modern anthropogenic disturbances and land fragmentation have concentrated deer populations to specific forests, further exacerbating the effects of browsing. High deer densities pose many detrimental effects to healthy forest ecosystems. Deer density is inversely related to survival of plant species, due to trampling of herbs or seedlings and herbivory on juveniles and mature plants that can inhibit growth, hinder competitive ability, and in extreme instances lead to mortality. The understory changes driven by deer herbivory furthermore can affect levels of other forest dwelling animal and plant species. Animal species relying on food and shelter provided by the understory can be forced out of areas where high deer densities have significantly changed the forest understory. Plant species resistant to deer herbivory can thrive and significantly increase in density and distribution due to lack of competition.

Ecological studies in forests with significant deer populations therefore need to take account of ambient deer browse pressure, either as part of the study question or as a covariate. A rapid assessment method would be particularly useful for studies in which the experimental effort needs to be directed primarily at questions other than ambient deer pressure, or when study sites need to be selected based partly on ambient deer pressure, as is our own goal. However, rapid methods also need to be accurate. We tested two different methods in the same sites of forests within the same season, in order to determine if they produced similar results.

Methods

Eleven forests were selected based on the following criteria: they were upland hardwood forests, they shared similar herbaceous species, and they were suspected to vary in amounts of deer browsing (i.e. some forests allowed hunting). Two methods were employed for rapid deer browse assessment .

1.The **Secchi method** consisted of placing a square meter board inscribed with a sixteen square grid ten meters from a randomly chosen point. The board was positioned at deer browse height (0.5-1.3 m). The number of squares obstructed partially or fully by native foliage was recorded in the four cardinal directions at ten different points (Fig. 1).

2. In the **transect method**, browse was observed every ten meters over three 100 m transects. The closest native tree or shrub to the point was analyzed (Fig. 2). One branch at deer height (0.5 meters to 3 meters) was systematically chosen, and the numbers of browsed, damaged, and undamaged buds at each tip on the branch were recorded (Fig. 3).

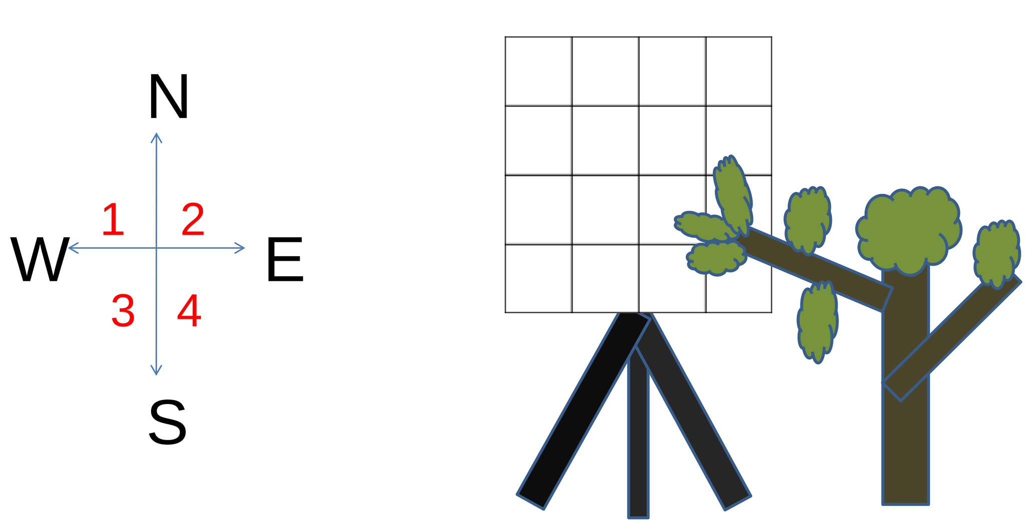

Figure 1. The Secchi method with leaf coverage of 5 squares. At each forest, ten random points were chosen. At each point, the Secchi method was applied in each of four quadrants, as delineated by the cardinal directions.

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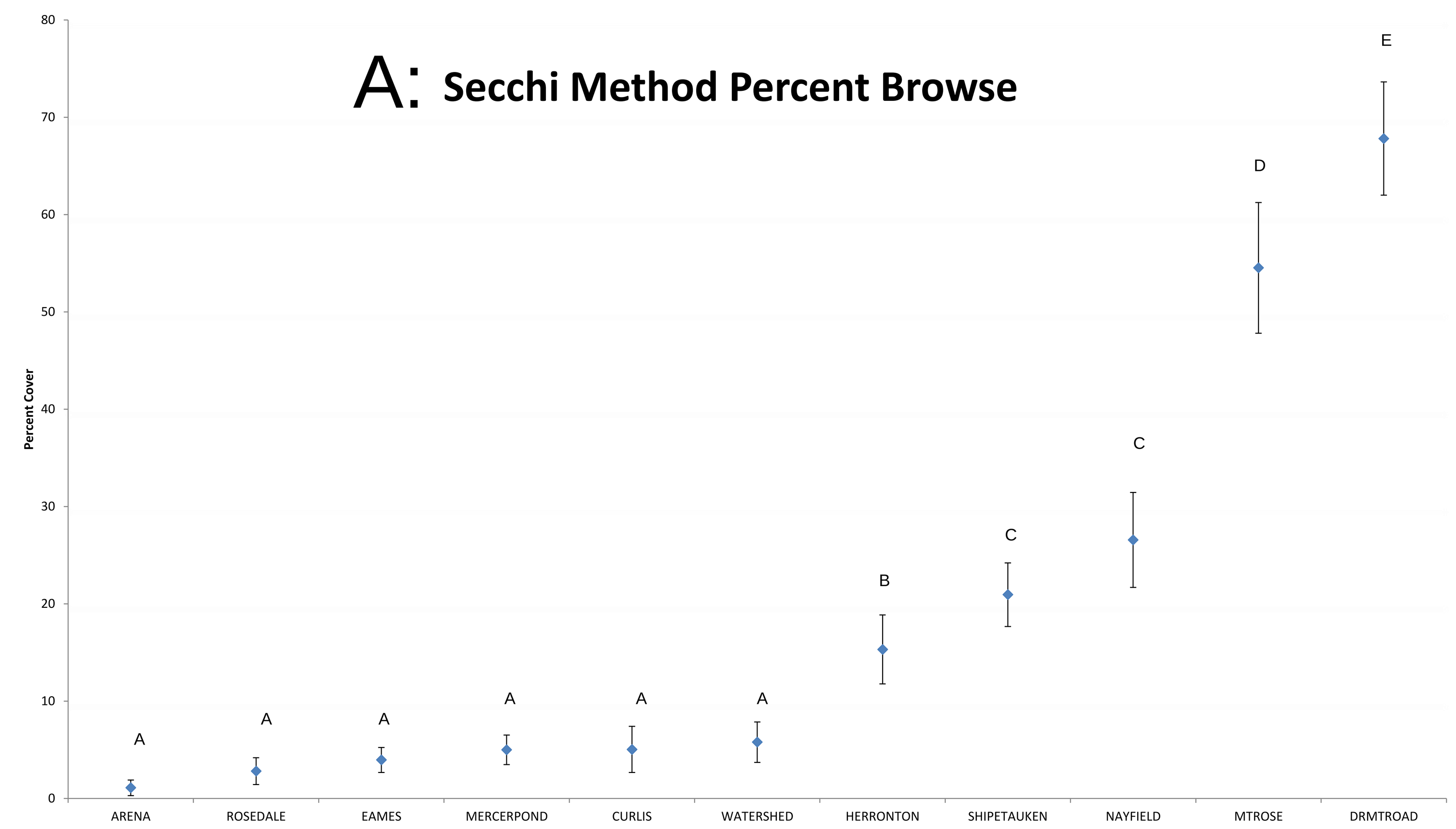
Results



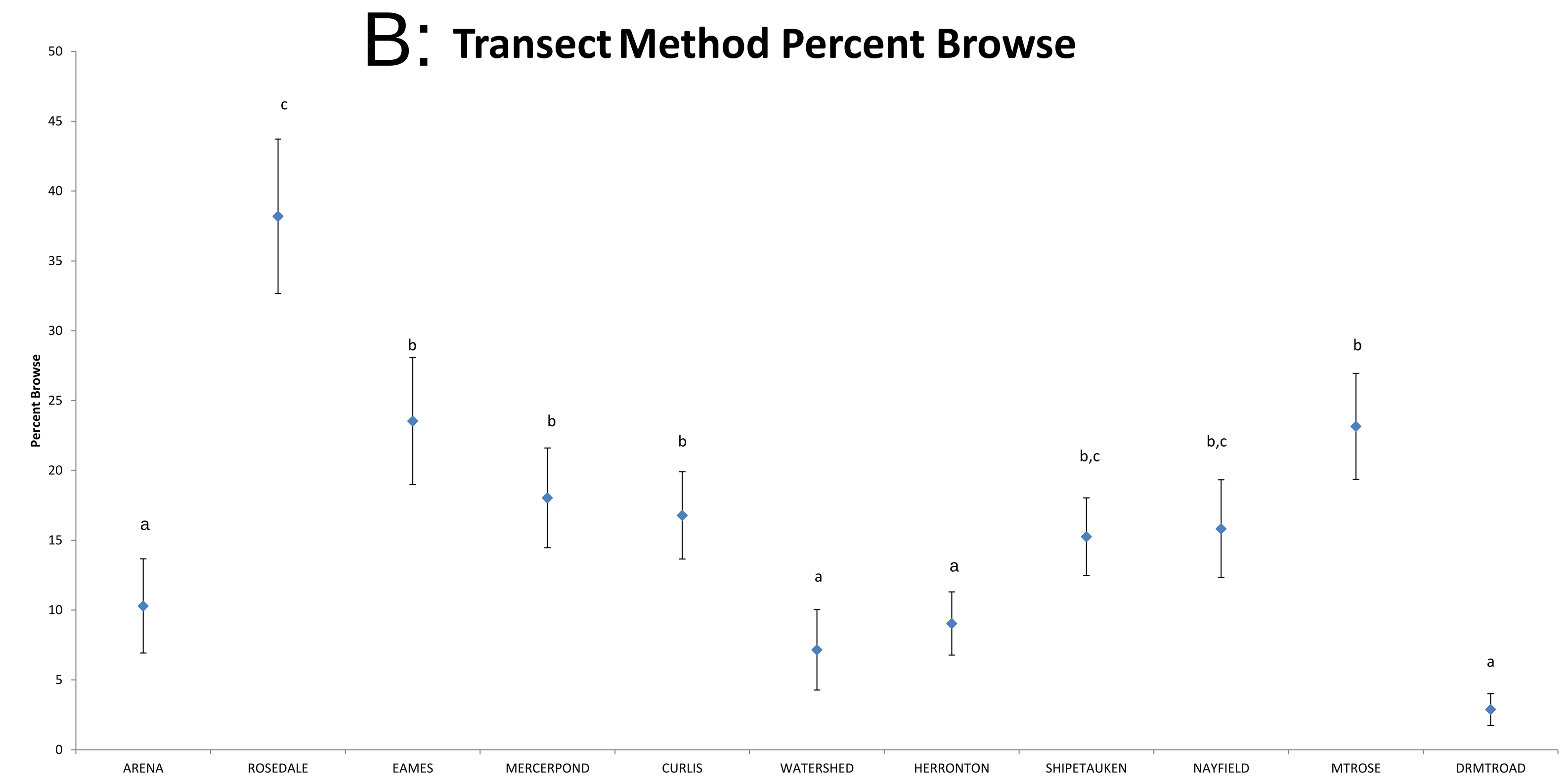


Figure 4: Comparison of Secchi and browse methods among forests. Graph A shows the percent of the Secchi board covered by native foliage, arranged in order of increasing cover. Graph B illustrates the observed level of deer browse on native woody species indicated by percent of ends browsed. Comparison of both graphs suggests a weak relationship between percent cover and percent deer browse at each individual site. In both graphs, error bars indicate SE.

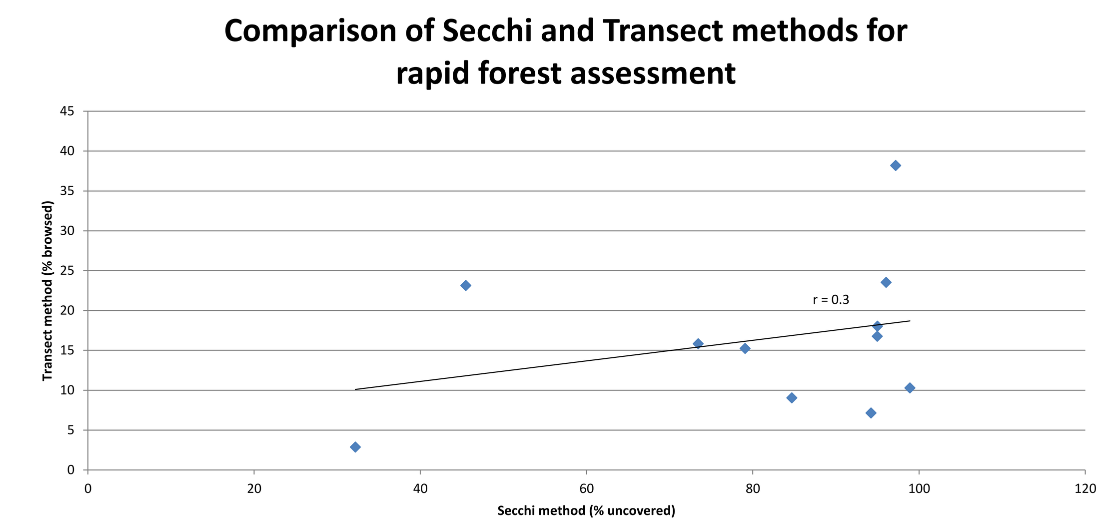


Figure 5. Correlation of deer browse between the two methods of rapid forest assessment, Secchi and transect. A significant correlation was not observed (r = 0.3)

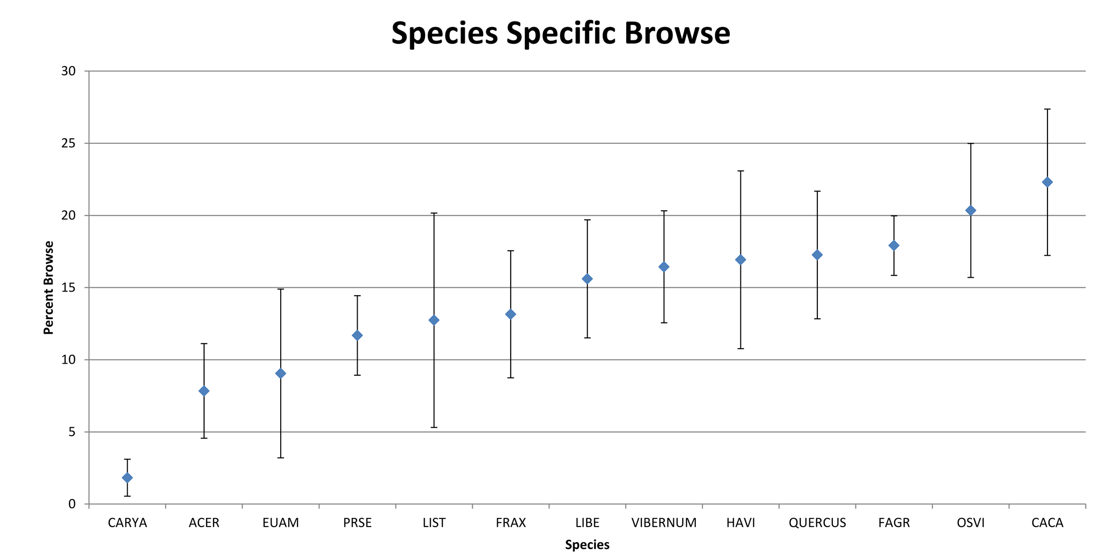


Figure 6. Percent browse on the most common species among 11 forest study sites: *Carya* sp., *Acer* sp., *Euonymus americana*, *Prunus serotina*, *Liquidambar styraciflua*, *Fraxinus* sp., *Vibernum* sp., *Hamamelis virginiana*, *Quercus* sp., *Fagus grandifolia*, *Ostrya virginiana*, and *Carpinus caroliniana*. Error bars indicate standard error, n>4.

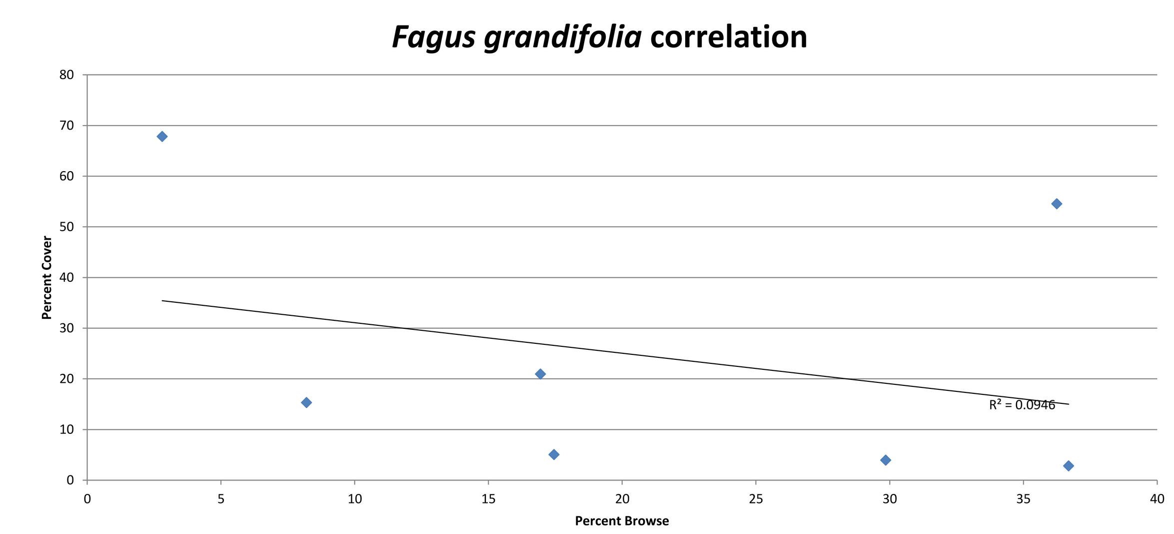


Figure 7. Correlation between percent cover of Secchi board with percent browse by deer on *Fagus grandifolia* trees and seedlings in 7 study forests containing the species (r = 0.31, P = 0.50).

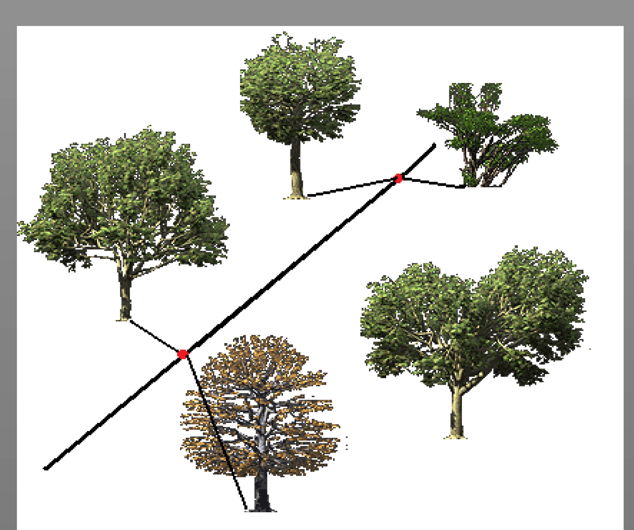


Figure 2. Schematic diagram of the transect method's tree selection process

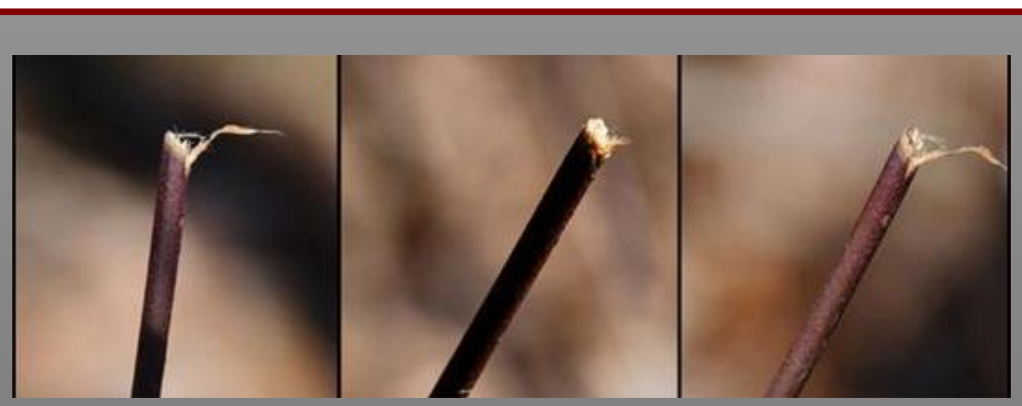
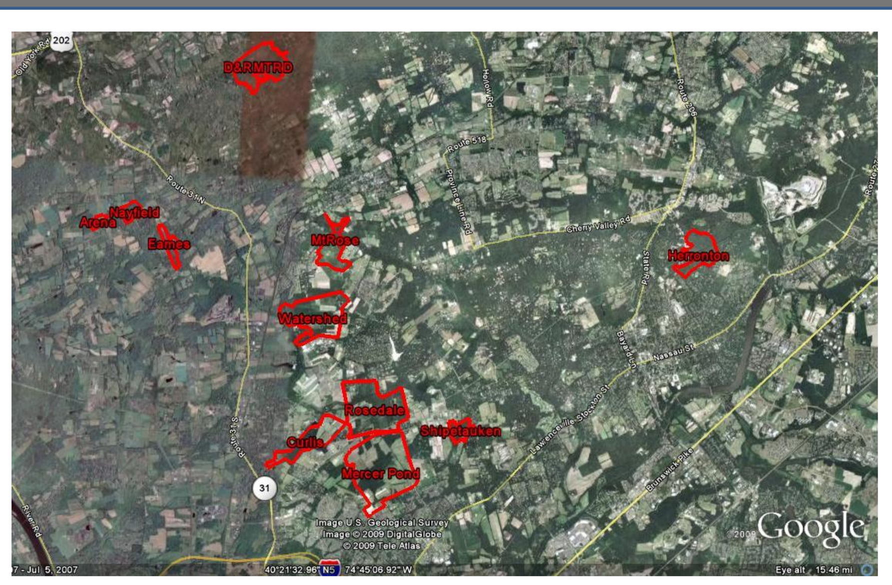


Figure 3. "Shreddy ends" indicating browse by white-tailed deer. This characteristic frayed end is due to a deer's crushing of the stem between the lower incisors and canines against the pad and results in striping of the woody stems and twigs.

Forested area with severe deer browse as evident by the lack of understory and clear browse line. This forest would possess a low Secchi cover score.



Locations and property boundaries of the 11 chosen study forests. Specific sites within each forest were chosen for similar characteristics as well as a variety in deer management practices. All methods were performed on upland, hardwood forested areas within each site.

Discussion

The transect and Secchi methods for rapid assessment of deer browse pressure both demonstrated significant differences in browse among forests; however, the pattern of variation among forests was completely different for the two methods. This suggests either that one method is more accurate than the other or that they measure different phenomena. Three related factors should strongly influence the results in a manner than will influence the relationship between these two methods: 1) the past history of deer browse at a site, 2) the species composition of the understory, and 3) the understory density. For example, if a forest has been very severely browsed in the past, then the Secchi measurement will show very low cover, but the browse transects may in fact show little current browse because the deer have moved on (such low plant density there is little left to eat) and/or only less preferred species remain. However, we observed the three lowest browse estimates in the forest with the lowest Secchi cover, the highest Secchi cover, and the most intermediate Secchi cover (Fig. 4). To standardize the comparison, it may be advisable to measure browse on just one species that is present in all forests; we chose *Fagus grandifolia*, which was present and common in most forests and had relatively high preference by deer (Fig. 6). Still, we observed no significant relationship between the two methods (Fig. 7). We conclude that the Secchi cover method is useful to rapidly assess past deer pressure but does not predict current deer browse rates. Direct browse observations are required to assess current deer browse, and these need to be standardized by measuring the same species among all forests.