

Biology

The Effect of Chinese Privet (*Ligustrum sinense*) Density on Species Richness and Diversity of a Small Mammal Community in West Central Georgia

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Introduction

Invasive species have had enormous, sometimes irreversible, effects on biodiversity, human property, and economic activities throughout the world (Wang and Grant 2013). Since the 1700s, at least nine species of privet have been introduced into the United States; it is probable that all were introduced as ornamentals (Maddox, Byrd and Serviss 2012). Chinese privet (*Ligustrum sinense*) is a nonnative invasive plant species that was introduced into the United States in 1852. It grows as a perennial shrub or small tree to a height of 9 m (29.5ft), developing multiple stems, and was planted throughout much of the southern region (Wang and Grant 2013). The foliage is evergreen and seeds are widely dispersed by birds and other wildlife. Privet can grow in low nutrient soils and tolerates low light levels allowing for invasion under dense forest canopies (Hart and Holms 2013). Forest invasion by shade-tolerant alien plants (Chinese privet) has the potential to drastically modify species composition, stand structure, and ecosystem function (Hart and Holms 2013). Invasion by this species has been shown to have a negative relationship with herb and shrub layer diversity and native tree seedling density in some forests of the region (Hart and Holms 2013). Invasive plant species have been known to cause mass extinctions and habitat destruction, as well as to cost billions of dollars annually in control measures (Wilcox and Beck 2007). This study investigated the impact of the density of Chinese privet on native small mammal species diversity in an upland Southern forest.

Materials and Methods

The study sites selected for the small mammal trapping grids were on opposite sides of a logging road. One side of the road had an understory dominated by privet (privet site) and the other had little privet in the understory (non-privet site). Small mammals on each site were sampled using 3" X 3.5" X 9" Sherman live traps placed in a 5X 5 grid with 10m between each trap. Traps were baited with a mixture of rolled oats and peanut butter. Cotton balls were placed in the traps

when the temperature was below 45 degrees F.

The traps were pre-baited and left closed for three days at the beginning of the study to provide an acclimation period for the rodents on study sites to become accustomed to traps. The traps were opened and baited on the fourth day. Traps were checked daily while open. If the trap contained a mouse it was brought to the front of the trapping grid. Once all traps in the grid were checked, the trap number was logged. Data collected from each mouse included species, sex, weight, reproductive status, and capture status. Uniquely numbered ear tag was placed on each individual when first captured to allow identification of the individual if captured again. The traps were then reset, baited, and cotton balls added if needed. Three trapping sessions of 5 days each were completed to determine the characteristics of the rodent community on each site.

Habitat characteristics for both sites were characterized using 3m radius vegetation plots centered on each trap location to determine privet stem densities and plant community diversity. All woody stems greater than 1 foot and less than 10 feet in height were counted and identified to species. Stems were considered separate if stems were not connected to common source above ground.

A Shannon diversity index value was calculated for each sample point to describe the diversity of small mammal communities between the two study sites.

$$H' = - \sum_{i=1}^R p_i \ln p_i$$

Woody vegetation characteristics of the two study sites were compared to determine the difference in small mammal habitat quality. The mean Shannon diversity index values for the high density privet site and the low density privet site were compared. The mean number of privet stems per 3m sample point was compared between the high density privet site and the low density privet site. In addition, the total number of all woody stems per 3m sample point was compared between the high density privet site and the low density privet site. A T-test ($p=0.05$; $df=48$) was used to determine if differences between means being compared were significant.

Results

Woody vegetation:

The mean number of total woody and privet stems per 3m vegetation plot between the two sites were significantly different ($p<0.001$). The low privet site had a mean of 28.96 stems per vegetation plot and the high privet area had a mean of 85.76 stems per vegetation plot (Fig 1). The density of privet stems in the

privet site was significantly greater than the density of privet in the low privet site ($p < 0.001$). The low privet site had a mean of 3.72 stems of Chinese privet per vegetation plot and the high privet area had a mean of 72.8 stems of Chinese privet per vegetation plot (Fig 2). A trend was found between the density of privet stems in a vegetation plot and the diversity of woody understory stems found in the same vegetation plot (Fig 3). When comparing the diversity of understory woody vegetation between study sites, the low privet site was significantly more diverse than the privet site ($p < 0.001$). The low privet site had a mean Shannon diversity index of 1.65 and the high privet area had a mean Shannon diversity index of 0.63 (Fig 4). A Shannon diversity index for 3m sample points was used to calculate the mean diversity of privet stems for the Chinese privet dominated site and a lower privet density area. (Fig 4)

In both sites, the number of stems of water oak was similar. The low privet site had a mean of 1.04 stems/ sample point and the high privet site had a mean of 1.84 stems/sample point. The number of stems of honeysuckle was similar. The low privet site had a mean of 1.36 stems/ sample point and the high privet area had a mean of 1.92 stems/ sample point. Greenbrier was also found in both but stem count was not conducted.

Small mammals:

A Shannon diversity index was calculated for individuals captured in Chinese privet dominated area and a lower privet density site. The low privet site had a mean of 0.69/ sample point and the high privet site had a mean of 0.52/sample point (Fig 5). The total number of small mammals captured in the Chinese privet dominated site and a lower privet density site was similar but varied in species diversity. The low privet area had a total of 6 white footed mice and 5 golden mice and the high privet site had a total of 3 white footed mice and 9 golden mice (Fig 6).

Discussion

This study examined the diversity of small mammal species in Chinese privet dominated site and a lower privet density site. We hypothesized that the high privet density would have an effect on the small mammal population but our data indicated privet density did not influence small mammal diversity (Fig 5). Possible reasons that no significant difference was found are: ample food in both plots; acceptable cover in both plots; plot size; number of trapping days; and two different mice species that each preferred one plot over the other. The white footed mouse (*Peromyscus leucopus*) and the golden mouse (*Ochrotomys nuttalli*) were the primary mammals studied. The white footed and golden mouse were captured in both the Chinese privet dominated plot and a lower privet density sites.

The white-footed mouse is considered a habitat generalist compared to the golden mouse which prefers very dense mixed evergreen and deciduous canopies including ample climbing structures such as honeysuckle and greenbrier. (Christopher and Barrett 2006). The data show greater abundance of golden mouse in the privet site. The white-footed mouse was found in greater abundance in the non-privet site where it had several different, more diverse habitat types available (Fig 6). A Shannon diversity index showed the amount of diversity between each site for the total number of stems. The data showed that the privet was the dominant species and overpowered the native species in the privet dominant site. While the low privet density site showed a large diversity in understory woody plants (Fig 3 and 4).

Chinese privet, honeysuckle, greenbrier, and water oak are readily used as food resources by both the golden mouse and white-footed mouse (Christopher and Barrett 2006). Chinese privet was found in both sites but was most dense in the privet plot (Fig 2). Water oak, honeysuckle, and green brier were found in both sites in similar amounts. Equal amounts of food sources lead to the mice being able to get nutrition in both sites. Chinese privet provides not only protection from predators but also increased food and nest resources (Christopher and Barrett 2006). While the food resources are equal in both plots the amount of cover and protection for the mice varied greatly. The privet plot provided more cover than the non-privet site in the amount of total stems counted (Fig 1).

The trapping grid was small due to the number of traps available. This led to a relatively low number of individuals captured in each study site. Expanding the trapping grids or increasing the number of study sites included may provide greater insight into the effect of privet on small mammal communities. Trapping only consisted of three weeks in which new captures were caught at every trapping day. A longer trapping time could allow for more individuals to be caught. A future study to be conducted would be choosing only one species of mouse and rerunning this experiment, or have a much larger trapping grid in both sites for a longer amount of time.

In summary, this study investigated the diversity of small mammal species in Chinese privet dominated site and a lower privet density site. The data indicated the density of privet did not affect the density of small mammal (rodent) populations. The data did show a trend of greater abundance of golden mouse in the privet and white-footed mouse in the non-privet sites. Many factors lead to the lack of a significant difference between the two plots and future studies are needed to further understand more subtle habitat preferences among small mammal species. Future studies should include a larger number of traps and expanding the study to include multiple study plots with high privet density and low privet density.

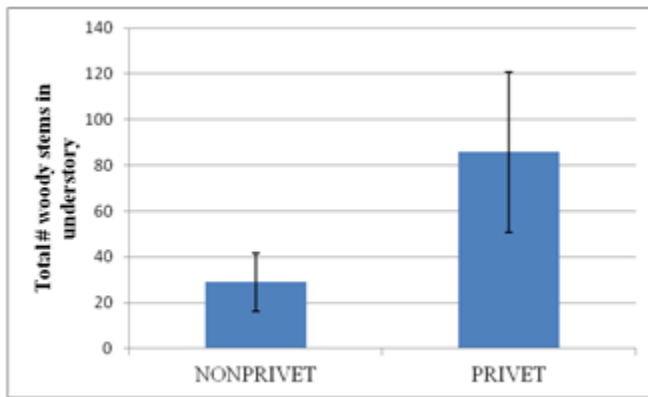


Fig 1: Mean total number of woody stems at a sample point in two forest sites with varying densities of Chinese privet. Error bars represents 1 standard deviation.

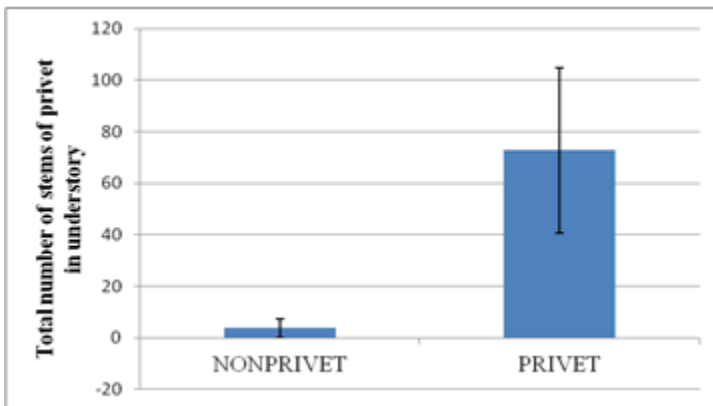


Fig 2: Mean total number of Chinese privet stems at a sample point in two forest sites with varying densities of Chinese privet. Error bars represents 1 standard deviation.

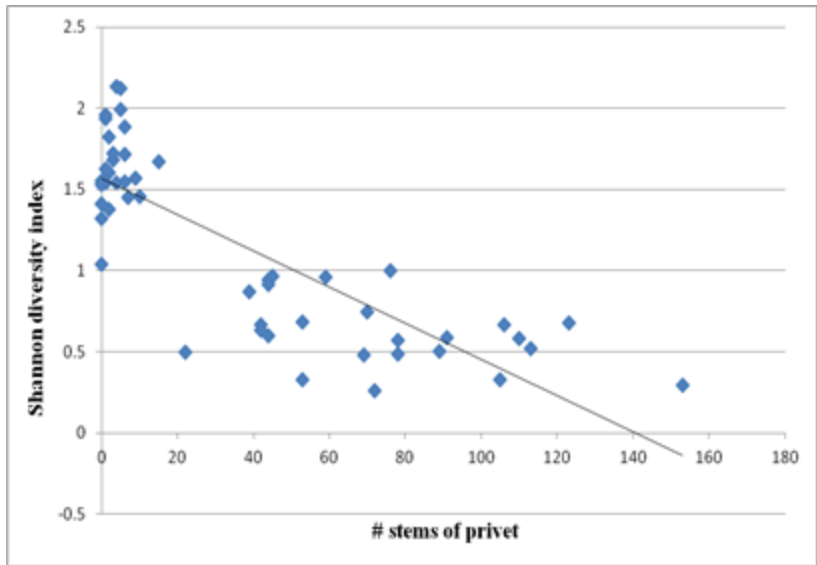


Fig 3: Shannon diversity index of woody understory vegetation in sample points with varying density of Chinese privet. Greater Shannon diversity index value indicates sample points with greater woody understory diversity.

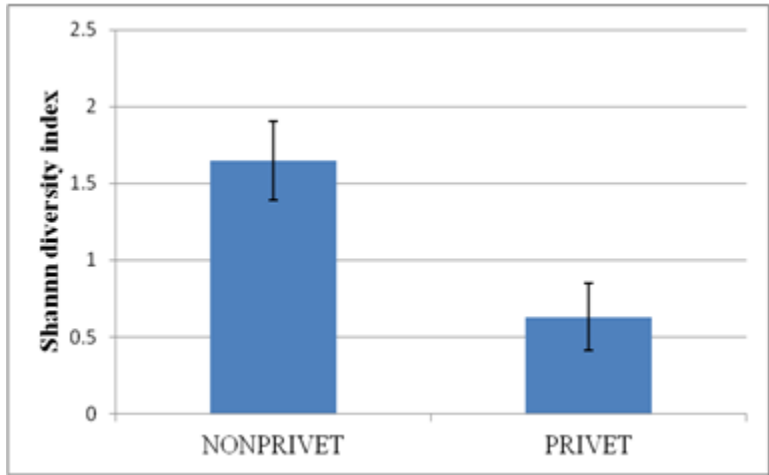


Fig 4: Mean Shannon diversity index at a sample point in two forest sites with varying densities of Chinese privet. Error bars represent 1 standard deviation.

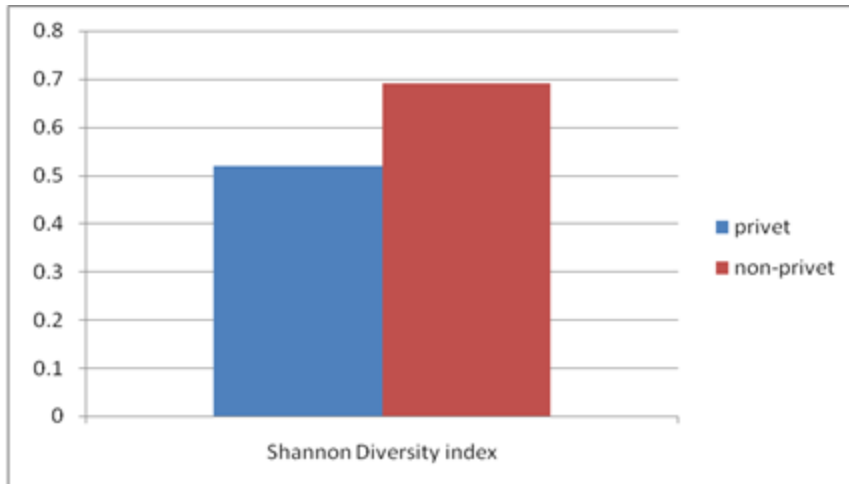


Fig 5: Mean total number of total mice (white-footed and golden) at a sample point in two forest plots with varying densities of Chinese privet.

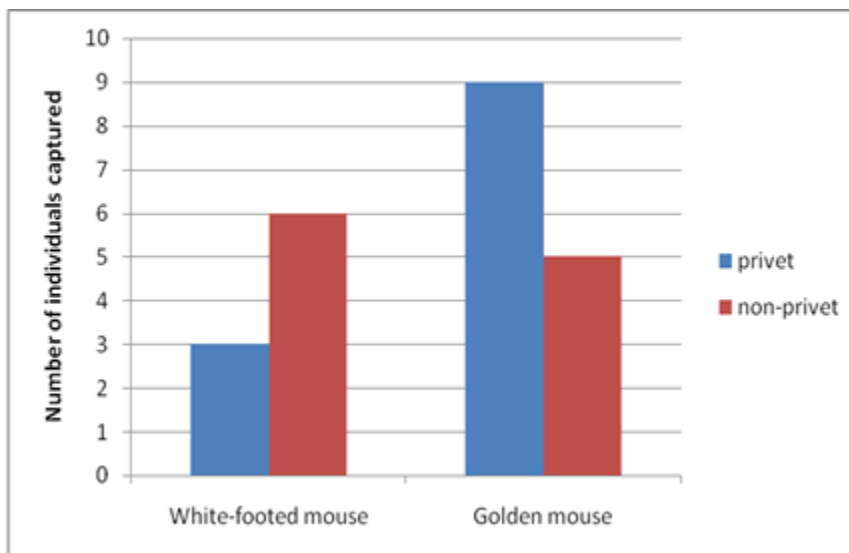


Fig 6: Total number of individual mice (white-footed and golden) at a sample point in two forest plots with varying densities of Chinese privet.

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