The consequences of white-tailed deer (*Odocoileus virginianus*) overabundance on forest vegetation

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Introduction

Historically the white-tailed deer (*Odocoileus virginianus*) has not been as abundant as we see today despite inhabiting the same wide home range (Smith 1991). Population density of this species correlates to the number and distribution of forest openings which allows them to have a home range of 59-250 hectares (Smith 1991). White-tailed deer can be found in southern Canada, most of the United States, and northern South America (Smith 1991). North-temperate, subtropical and semi-arid environments are habitats in North America for the white-tailed deer. South American populations may be found in rainforests and other equatorial locations.

As a medium-sized ungulate, white-tailed deer males weigh between 90-135 kg, and females range from 54-81 kg to 72-108 kg, differing seasonally. Females are able to breed at 6-7 months but the average breeding age is 1.5 years old. Males do not attain sexual maturity until 1.5 years old. Once copulation and fertilization are successful, gestation lasts about 202 days. White-tailed deer life expectancy is capable of reaching 20 years old, however, a majority do not live past 10 years of age. Regardless of habitat conditions, white-tailed deer are capable of rapid population growth even with low population densities (Smith 1991). It has been shown that even in managed populations, densities outpace pre-European settlement populations (Rooney and Waller 2003).

Population numbers increased with the clearing of land and exploitation of forests. White-tailed deer benefit from the openings, second-growth forests and farmlands that logging, clearing and agriculture create (Smith 1991). Browsing by white-tailed deer has led to altered vegetation populations and increased the presence of browse-resistant and less palatable vegetation species

(Russell et al. 2017). The purpose of this paper is to review the literature on the effects of white-tailed deer overabundance on forest vegetation.

Methods

I searched for relevant peer review journal articles using the databases Web of Science, Google Scholar and Wildlife and Ecology Worldwide. Criteria for searches included combining two or more key words, filtering dates to the last twenty years (preference given to the last decade) and if applicable, peer reviewed only. Keyword combinations were repeated on all three databases. I chose papers based on the reputation of the journal and author(s). I obtained the mammalian species account (Smith 1991) via directions of the course instructor. Source information is combined based on relevance to the section topic. Data is combined by region, if applicable.

Results and Discussion

The cougar (*Felis concolor*) and wolf (*Canis lupus*) are noted predators of the white-tailed deer throughout history (Smith 1991). As European settlers colonized the United States, both the cougar and wolf populations drastically declined. Locations suchs as the Great Lakes have seen the annihilation of native predators aid in the increase in white-tailed deer populations (Rooney and Waller 2003). With the reduction of predators, there is a decrease in natural population control of the white-tailed deer. Four or more deer per square kilometer have the potential to provide unfavorable impacts to browse-sensitive tree seedlings, among other vegetation. It is estimated that less than 40% of United States forests have white-tailed deer densities below this level (Russell et al. 2017). Reduction of natural population control and a majority of the species time being allocated to browsing (Smith 1991) causes harmful impacts to forest vegetation.

Regeneration of forest vegetation has been found to correspond with white-tailed deer browsing. Palatable species of trees have less seedling recruitment in areas with high levels of browsing (Russell et al. 2017). Regrowth of favored and susceptible woody plants are confined while for herbaceous plants, eliminated, due to continus browsing of white-tailed deer. These effects consequently bring about trophic cascades and habitat modification (Rooney and Waller 2003).

A 2014 study conducted by Shelton et al. demonstrates regrowth in exclosures versus control plots, giving white-tailed deer access only to the latter. Existing seedlings had greater growth rates within the exclosure, twice that of the controls. In spring plants, height, abundance and diversity saw an increase and summer plants experienced denser vegetation. No new populations of hardwood trees were observed in control plots however, in the exclosure fifty-one seedlings of six species were discovered. This data was surprising as control plots did not have white-tailed deer browsing them for two to three years in over 86% of the plots (Shelton et al. 2014). There is an assumption that expulsion from the control plots for extended time periods would allow for regeneration of vegetation but this data shows otherwise. Two species, *Lindera benzoin* (spicebush) and *Asimina triloba* (pawpaw) abundance in the exclosure was 3 to 4 times greater compared to the control plots (Shelton et al. 2014).

In Ohio, Wisconsin and the general Northern United States there have been disastrous consequences of white-tailed deer overabundance. As discussed earlier, >4 deer per square kilometer produce negative effects on vegetation (Russell et al. 2017). Sharon Woods Metro Park, Ohio had unmanage white-tailed deer densities that hit over 110 individuals per square kilometer. As a result, 150 vascular plant species became locally extinct (Rooney and Waller 2003). Across the Northern United States, research found that tree seedling quantities declined as deer population densities increased to >5.8 individuals per square kilometer. This pattern presented in all forest types except majority oak forests (Russel et al. 2017). Before European colonization, deer densities in Wisconsin were around 4 individuals per square kilometer. Through the 1930s and 1940s, densities increased to 9 to 14 deer per square kilometer. Subsequently, in connection with the increased densities, there was major damage to agriculture and forests in the region (Rooney and Waller 2003).

Indirect impacts occur due to overabundance of white-tailed deer in forest ecosystems. Forest herbs are lost through deer browsing which has the potential to diminish insect species diversity due to losing their food source. Combined, insects and vascular plants comprise 70% of currently described species. The insect-plant relationships endangerment means a threat for all of biodiversity (Rooney and Waller 2003). Specialized herbivores and pollinators could be indirectly affected by white-tailed deer through the cascade effect. This leads to competition and habitat modification. Upsetting the plant-pollinator relationship may alter flower abundance. Additionally, high levels of browsing remove vegetation cover, curtailing available habitat for other species (Côté et al. 2004). Cascade effects can influence various aspects of an ecosystem such as soil nutrients, species populations and mycorhizae (Lesser et al. 2019)

After the decline of predators with the arrival of Europeans to the United States, white-tailed deer populations began to flourish. More than 60% of United States forests have over 4 deer per square mile, the number where impacts begin to be observed. Seedlings struggle to create new populations in high browsing areas and regrowth of various flora types are confined or eliminated in these areas. Exclosures that block deer activity have seen increased size, diversity and abundance in vegetation. Overabundance of white-tailed deer have even led to local extinctions of vascular plants. Indirectly, deer cause a cascade effect that is detrimental to other species relationships and the ecosystem as a whole. Future research is needed to better comprehend the full ecosystem effects of high white-tailed deer densities. Data shows that this species clearly has negative impacts on forest vegetation through direct and indirect means.

Literature Cited

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