Effect of Deer Density on Breeding Birds in Delaware

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ABSTRACT Previous research has suggested that high deer densities negatively impact bird communities. Most of this research was conducted using a very high deer density compared to no deer. Our research investigated deer impacts across a density gradient to determine an appropriate density for deer management efforts. Using Breeding Bird Survey (BBS) data from 2005–2006 and Delaware Department of Natural Resources and Environmental Control (DNREC) deer density data for the same time period, we compared avian richness and relative abundance for BBS points to deer density in Delaware. We divided deer densities into 3 categories: low (<12 deer/km^2), medium (12–23 deer/km^2) and high (>23 deer/km^2). We placed birds into the following deer-sensitive guilds: interior obligates, forest ground nesters, shrub nesters, ground gleaners, low canopy foragers, and tropical migrants. The species richness of ground gleaners was higher in high deer densities ($F_{1,36}$ = 17.05, P = 0.0002). No other guilds' species richness was affected. The relative abundances of ground gleaners ($F_{1,36}$ = 25.60, P = <0.0001) and tropical migrants ($F_{1,36}$ = 4.11, P = 0.0501) were lowest in low deer densities. Relative abundance of wood thrush (*Hylocichla mustelina*) was also lowest in low deer densities ($F_{1,36}$ = 21.60, P = <0.0001). Richness and abundance of all guilds were positively influenced by the percent forest cover within a 50 m buffer. The effects of deer density on these bird communities were generally opposite of what past literature has suggested. In order to better understand this trend I have also conducted 618 of my own point counts and corresponding vegetation surveys throughout Delaware. This data was collected from May–August 2008 and will be repeated in the summer of 2009.

KEY WORDS breeding birds, deer, density, *Odocoileus virginianus*

White-tailed deer (*Odocoileus virginianus*) abundance in North America, particularly in the mid-Atlantic and Northeast, is well above historical levels (McCabe and McCabe 1997). Densities of up to 50 deer/km^2 were recorded in Delaware in 2005 (DNREC 2006), while historical numbers have been estimated at 3.1–4.2 deer/km^2 (McCabe and McCabe 1997). Changes in the landscape to support agriculture and silviculture have improved deer habitat and game management has protected deer from overexploitation. Because white-tailed deer are keystone herbivores (Waller and Alverson 1997), they can have an impact on populations of herbaceous and woody plants, insects, and birds (Tilghman 1989, Allombert et al. 2005, McShea and Rappole 2000). It is this impact on birds that we will be examining.

Previous research has suggested that high deer densities negatively impact bird communities (McShea and Rappole 2000, Casey and Hein 1983, DeCalesta 1994). Through over-browsing of the shrub layer, deer can reduce the available nesting and foraging habitat for certain avian species. However, most of this research was conducted using a very high deer density compared to a very low density with no moderate densities. Additionally, the use of fences to exclude deer or simulate higher deer densities was common in these studies. Our primary objective is to determine if deer are having an impact on bird abundance and richness under a natural range of densities. Our secondary objective, if deer *are* having

an effect, is to find a threshold density for management at which deer have a minimal effect on the abundance and diversity of vulnerable breeding songbirds in Delaware.

We conducted our study throughout the entire state of Delaware comparing two sources of avian abundance and richness data to deer density data. We used Breeding Bird Survey (BBS) data from 2005–2008 and our own point counts from 2008–2009. We categorized birds into the following deer-sensitive guilds: interior forest obligates, forest ground nesters, shrub nesters, ground gleaners, low canopy foragers, and tropical migrants. Species in these guilds would be expected to be greatly affected by high deer densities. Deer densities were obtained from the Delaware Division of Fish and Wildlife's Forward Looking Infrared (FLIR) survey. This survey was conducted in 2005 in each of the 17 deer management zones in Delaware, providing very specific estimates of deer density. The natural gradient of deer densities ranged from 4 to 50 deer per square kilometer of deer habitat (this estimate excludes agricultural fields), post harvest.

We also conducted vegetation surveys to measure aspects of the forest that would be expected to be affected by high deer densities. We performed both roadside and forest interior vegetation surveys. For the roadside surveys, we visually estimated the percent groundcover within a 1 m by 1 m plot and the percent midstory cover within a 1 m wide by 2 m tall plot. We visually estimated the percent of the midstory plot that was covered by invasive species. We also conducted a point sample of the surrounding vegetation using a basal area factor (BAF) 5 prism for the midstory vegetation (Avery and Burkhart 1994) and a BAF 10 prism for the canopy. Lastly, we recorded the percent conifers, the canopy height, and the average diameter at breast height (dbh) of the surrounding forest. For the forest interior surveys, we again estimated the percent groundcover and measured the basal area of the point. We counted and identified each midstory stem in a $1/100^{th}$ acre plot. We used a Nudds board to measure the vertical vegetation cover (Nudds 1977).

For analysis we divided deer densities into 3 categories: low (<12 deer/km^2), moderate (12–23 deer/km^2) and high (>23 deer/km^2). For the BBS data, the species richness of ground gleaners was greatest in high deer densities ($F_{1,129} = 5.24$, $P = 0.024$). The richness of shrub nesters ($F_{1,129} = 7.86$, $P = 0.006$), low canopy foragers ($F_{1,129} = 25.00$, $P < 0.001$), and tropical migrants ($F_{1,129} = 3.01$, $P = 0.085$) were greatest in moderate deer densities. The relative abundances of shrub nesters ($F_{1,129} = 4.62$, $P = 0.034$), ground gleaners ($F_{1,129} = 5.78$, $P = 0.018$), low canopy foragers ($F_{1,129} = 19.68$, $P < 0.001$), and tropical migrants ($F_{1,129} = 4.01$, $P = 0.047$) were also greatest in moderate deer densities. Relative abundances of Acadian flycatchers (*Empidonax virescens*; $F_{1,129} = 14.14$, $P < 0.001$) and yellow warblers (*Dendroica petechia*; $F_{1,129} = 3.15$, $P = 0.078$) were greatest in moderate deer densities as well.

We still have one more field season of our own point counts, but the preliminary results are as follows. Species richness was not significant for any guild. Relative abundances of interior forest obligates ($F_{1,201} = 2.63$, $P = 0.074$), forest ground nesters ($F_{1,201} = 3.16$, $P = 0.045$), and ground gleaners ($F_{1,201} = 3.70$, $P = 0.027$) were greatest in moderate deer densities. The relative abundance of chipping sparrows (*Spizella passerina*; $F_{1,201} = 3.34$, $P = 0.038$) was greatest in low deer densities and the relative abundance of ovenbirds (*Seiurus aurocapillus*; $F_{1,201} = 2.61$, $P = 0.076$) was greatest in moderate deer densities. We have only analyzed the forest

interior vegetation surveys to date. Vertical vegetation cover ($F_{1,153} = 4.12$, $P = 0.018$) and percent grass ($F_{1,153} = 4.41$, $P = 0.014$) were greatest in high deer densities. Percent soil was greatest in both high and low deer densities ($F_{1,153} = 2.46$, $P = 0.089$).

Most of our results were not significant, as was the case with the previous studies. Of those that were significant, the majority of guilds and species were most abundant in moderate deer densities. These results suggest that deer are not having adverse effects on the avian communities in Delaware. Deer are also not having an effect on the vegetation characteristics that we measured. We still have one more year of point counts to conduct but based on these preliminary results it seems that there is no threshold in deer density over which bird communities are adversely affected. We therefore recommend that other metrics be used to determine a threshold for deer management, such as agricultural damage or forest regeneration rates.

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