Results of Deer Population Studies in River Vale Township in 2019

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Objectives: We conducted infrared drone (sUAS) surveys to census white-tailed deer (*Odocoileus virginianus*) populations in River Vale Township including an approximate 300m buffer around the township boundary in April 2019.

Methods: Staff from the Center for Environmental Studies from Raritan Valley Community College conducted thermal imaging drone-based (sUAS) surveys using a Zenmuse XT thermal imaging camera mounted on a DJI Inspire drone from April 23 to April 26, 2019. Surveys were conducted on four nights between the hours of 9 pm – 7 am, only during clear conditions with no/low wind. Individual survey extents and areas can be seen in Figure 1. Surveys were conducted at night to allow for adequate thermal contrast between the landscape and deer. All flights were conducted with an FAA certified pilot and the aid of a visual observer. Missions were flown below 400 feet above ground level in class G airspace, and under a night waiver as required by FAA regulations. All observations of deer and search limits were mapped in real time using ArcCollector software. The total number of deer found was then divided by the total search area to calculate overall deer density (deer/mi^2) for each night and the Township as a whole.

**Figure 1. Locations, dates and areas covered during sUAS surveys in River Vale Township in 2019**
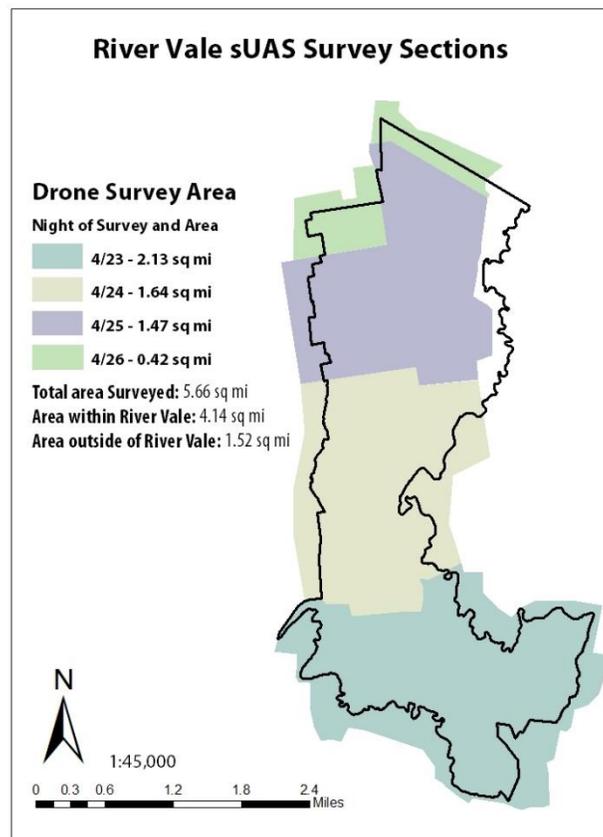
Table 1. Number of deer, area surveyed, and density found by date in River Vale Township

River Vale Township			
Night of Survey	Deer Count	Survey Area (mi^2)	Density (deer/mi^2)
4/26/2019	42	0.43	99
4/25/2019	161	1.47	110
4/24/2019	163	1.64	96
4/23/2019	180	2.13	85
Total	546	5.66	96

Results: Surveys covered a total of 5.66 mi^2 with 4.14 mi^2 occurring within the Township and 1.52 mi^2 in adjacent areas buffering the town, within an average distance of approximately 300m. A total of 546 deer were counted, for a total density of 96 deer/mi^2 within the Township. The results of individual surveys were highly consistent with the town-wide numbers, having an average of 97±10.3 deer/mi^2. While it is possible that deer may have moved between survey sections and been double or undercounted between nights, the close correspondence between individual and town-wide densities suggests that this factor had minimal to no effect in biasing the overall density calculations. The number of deer observed, the area, and densities within each section is reported in Table 1. Figure 2 shows a map of where deer were found throughout the entire survey area. Deer densities seem to be evenly dispersed throughout the entire Township (Figure 2). Density areas were calculated in ArcMap using the Kernel Density function with a search radius of 1495.4', based on the effective home range size of 0.24 mi^2 for white-tailed deer in a suburban environment (Bowman 2011). Note that this does not necessarily correspond to the home ranges of deer in River Vale, but is meant to give a visual representation of where deer were distributed at the time of the surveys.

Figure 2. The number of deer observed within the entire survey area (left) and heat map showing the density of deer (right).
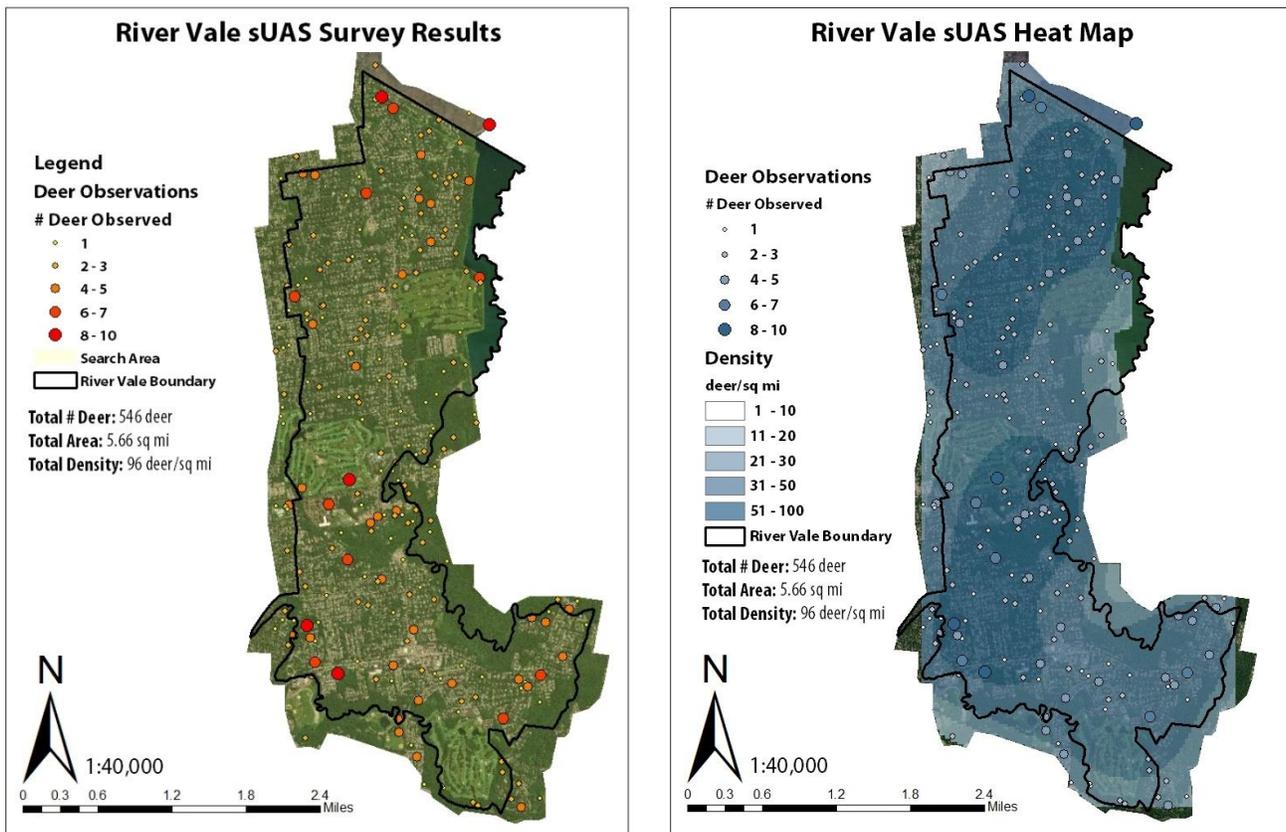

Discussion: The results from River Vale Township in 2019 show deer densities (96 deer/mile^2) to be far higher than historical levels, statewide averages, and densities needed to maintain ecosystem health. The most recent regional estimates of deer densities available from the New Jersey Department of Environmental Protection indicated minimum average densities to be as high as 78/mi^2 (NJ Division of Fish and Wildlife 1999). However, these estimates are based off of harvest statistics from hunting and may not be accurate in areas where hunting access is limited; e.g., as in many suburban or urban environments, which characterize much of central and northeastern NJ (NJ Division of Fish and Wildlife 1999). Other survey methods such as road-based spotlight surveys or infrared aerial surveys are therefore needed in these circumstances to obtain more accurate population estimates. Indeed, local surveys using these direct measurement techniques have found local deer densities to be in excess of 150-200 deer/mi^2 in some areas of New Jersey (NJDFW 1999, McWilliams et al. 2013). It is also important to note that the number and densities of deer observed in this study were

recorded at the most conservative time of year; i.e., after the period of peak mortality from hunting and cold temperatures in the fall and winter months and before the birth of fawns in late spring. With females in this area regularly giving birth to 2-3 fawns per year, it is likely that the actual deer population size for the majority of the year is much higher than the survey results indicate.

Studies suggest that precolonial deer densities were likely to be approximately 5-11 deer/mi^2 (McCabe and McCabe 1997), and impacts to preferred browse species have been observed at densities above 10 deer/mi^2 (Horsley et al., 2003; deCalesta and Stout, 1997; Alverson et al., 1988; Frelich and Lorimer, 1985; Behrend et al., 1970). Impacts to forest regeneration, bird communities, invertebrates, and a host of other ecosystem variables tend to occur above deer densities of 15-20/mi^2 (McWilliams et al. 2018, Russell et al. 2017, Nuttle et al. 2011, Horsley et al. 2003, Drake et al. 2002, de Calesta 1994).

The effects of overabundant deer are not limited to natural areas, moreover, but to human populations as well, costing millions of dollars a year from deer-vehicle collisions, damage to agricultural crops and landscaping, and impacts of Lyme's disease and other tick-borne diseases (Patton et al. 2018, Sherman 2018, Conover 2011). Spatial analysis of deer vehicle collision data provided by River Vale Township for 2016-2017, showed a positive relationship between deer-vehicle collisions and areas with higher densities of deer (Figure 3). Deer management practices that successfully reduce deer populations may result in significant reductions of these damages; e.g., with 60% reductions of deer populations in Princeton resulting in proportionate decreases in deer-vehicle collisions in the same year (Williams et al. 2013). To best maintain the greatest benefits for ecosystem health and integrity and minimization of economic and social costs, it is therefore advisable that targets for deer management be set at approximately 10 deer/mi^2 (Kelly 2019).

Figure 3. Spatial relationships of deer vehicle collisions with deer densities in River Vale Township, NJ
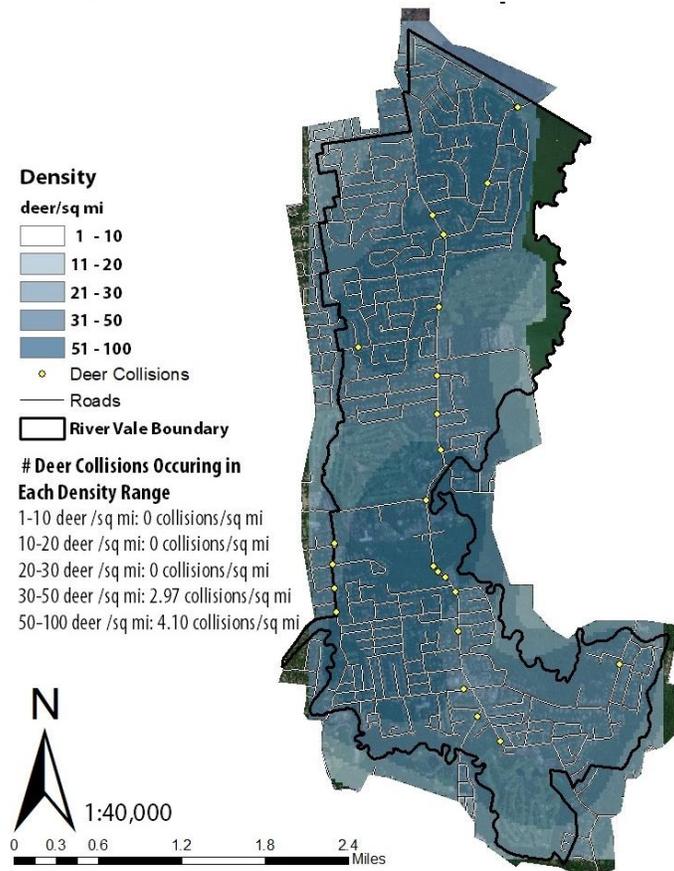
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