Report on 2017 Work at Willowsford Conservancy, Ashburn and Aldie, VA

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Methods

Density estimate

Deer densities in each Willowsford village were estimated through distance sampling that occurred during night surveys. Spotlighting surveys were conducted on five nights from 17 – 25 October 2017 along predetermined routes in each village. For each sighting of deer, the group size, group sex ratio, as well as distance and sighting angle to the deer were recorded. The distances were measured using rangefinders and the angles were measured using handheld compasses. The Grant and The Greens were the largest villages, with a size of 4.62 and 8.28 km^2 respectively; the two other villages, The Grove, (1.94 km^2) and The Grange (1.89 km^2), were much smaller (Table 1). The number of survey nights in each village was determined by the amount of deer encountered with at least 30 groups required before cessation (Table 2).

The deer densities were estimated using the DISTANCE program, through which we conducted a conventional distance sampling analysis (Table 2). We analyzed the four villages within Willowsford separately and each survey night was treated as a different line transect. In each analysis we ran four models, uniform, hazard-rate, negative exponential, and half-normal, with each of the three series expansions, cosine, simple polynomial, and Hermite polynomial. We chose the best model based upon the lowest AIC value. With this model, we then adjusted the distance intervals on the resulting histograms to improve the fit of a regression line to the data. To improve the confidence interval of the density estimate, in some instances we deleted the farthest sightings (right truncation) and in one village (The Grange) we removed sighting close to the road (left truncation). The Coefficient of Variability (CV) for each density estimate is a good measure of sufficient sampling and model creation; we strove to bring the CV below 0.20 and managed that for the two large villages (Table 2). The CV is affected by three factors: the fit of the regression equation to the data; the differences in number of deer sighted each night; and the variation in group size observed. We list those components to show where the model creation needs improvement (Table 2). For The Grant we used the mean of observed groups rather than size-bias regression when estimating the group size.

Relative Abundance

We estimated the distribution of deer in each village by deploying 24 camera traps and detecting deer in forest patches within each village. The Grant and The Greens (the larger villages), were each sampled at eight locations, while The Grange and The Grove (the smaller villages) were sampled at four locations each (Table 1). The camera traps were deployed at each site for 27-29 nights in August and September. The camera data were uploaded into eMammal (emammal.si.edu) where the number of deer and the sex ratios were identified in each detection. We standardized the data as deer detections per 30 nights for each camera location. We then calculated the mean number of detections per 30 nights, and the standard error of this mean, for each village.

Browse Index

At The Greens and The Grant, we conducted vegetation surveys from August through September at approximately the same locations sampled in 2016. Transects were each 30 m x 10 m, located > 30 m from the forest edge, and >100 m apart. This year all the transects were staked to insure repeatability in 2018. All saplings and trees were recorded within the transect area and all woody seedlings (woody

plants < 100 cm) were recorded within a meter of the 30 x 2 m center line. Along the center line we also counted browsed and non-browsed stems of Greenbrier (*Smilax rotundifolia*). A browse index was calculated as the % Greenbrier stems browsed and the mean browse level (with a standard error estimate) was estimated from each village.

Results

The villages do not have equal densities of deer. We estimated that The Grange and The Grant had over double the amount of deer per km^2 than either The Greens or The Grove (Table 2). The Grove had the lowest density estimate at 10 deer per km^2 [range 7-16] and The Grant had the highest with an estimate of 35 deer per km^2 (range 27 - 45] (Table 2). We do not know what is driving density in these villages. For example, despite having one of the lower density estimates, The Greens had the least amount of developed land at only 7.5% while The Grange had the highest with 30.6% (Table 1). Even though The Greens had the highest percentage of forest with 48.8%, it still had the lowest density estimate (Table 1). It could be that the current heavy construction activity at The Greens has moved deer out of the area. In the future, it will be good to consider the hunting pressure and deer harvest in our analysis. We summed the observations from all nights of spotlighting (Figure 8) and observed a clumped distribution of deer across the nights. We will be interested if this distribution shifts as development of housing units continues.

When we compared the density estimate to the camera trap data, we found that the average of detections per 30 nights was relatively constant across the villages. The Grove had a density estimate of 10 deer and an average of 77 camera detections (per 30 nights) and The Grant had a density estimate of 35 deer and an average of 118 detections (Figure 4). The Grange and The Greens had similar detection averages despite The Greens having a much lower density estimate (Figure 4). Detections is not always a good surrogate for density. Increased detections reflect increased activity and sometimes increased activity reflects density and sometimes it reflects core areas of deer activity.

Another index of activity is the browse index. The percent greenbrier browsed in the two surveyed villages (The Greens and The Grant) is high, and the results indicate that deer are having a higher impact on vegetation in The Grant.

In both years, The Grant had a higher percentage of browsed greenbrier than The Greens (Figure 5). Compared to the browse index from the previous year (2016), both villages had a decrease in the percentage of browsed greenbrier (Figure 5). Of the 2017 transects, the lowest percentage of greenbrier browsed in one transect for The Grant was 43% but The Greens had a minimum of 27%. In the 2016 transects, the lowest percentage of browsing was 33% in The Grant and 45% in The Greens. When we compared the camera trap detection rates to the percentage of browsed greenbrier, there was a significant correlation between the deer detections and browsing levels on nearby transects (Figure 6). So, our 2 activity indexes are in agreement (Figure 6). There is only a weak correlation between the camera estimate and the density estimates (Figure 4).

Using the camera data, we can examine the male to female ratio. We can also look at the doe to fawn ratio to gauge the level of fawn survival (Table 4). The comparison of female to male deer detections showed a larger proportion of female deer in all villages (as expected for deer populations), with The Grange having a noticeably heavy skew toward females (Table 4). The comparison of female to juvenile detections showed that the proportion was similar in all villages (Table 4).

Next Steps

We will continue all activities in 2018. We may increase the number of camera locations in the smaller village to reduce the variance on the mean detection rates. We may also shift camera locations to more closely coincide with the browse transects. We need to refine our density estimates using the spotlighting procedure. It is unclear how we should consider construction areas in the survey routes as these areas were devoid of deer and this may be skewing our results. As the two larger villages develop we assume the suitable area for each village will shift. The assistance of the volunteers during the spotlighting was immensely helpful and we hope to continue their assistance in 2018.

Table 1. Summary of surveys conducted in each village, including composition of each village, total area and area accessible by deer (combination of forest and grass).

				Area (km^2)					
Village	Camera traps deployed	# veg transects (2016)	# veg transects (2017)	Developed (%)	Forest (%)	Grass (%)	Other (%)	Suitable (F+G) (%)	Total
Grove	4	na	na	0.53 (27.6)	1.25 (64.8)	0.09 (4.7)	0.05 (2.9)	1.35 (69.5)	1.94
Grange	4	na	na	0.58 (30.6)	0.58 (30.6)	0.58 (30.7)	0.15 (8.1)	1.16 (61.3)	1.89
Grant	8	27	26	0.92 (19.9)	1.98 (42.9)	1.61 (34.8)	0.11 (2.4)	3.59 (77.7)	4.62
Greens	8	25	22	0.62 (7.5)	4.04 (48.8)	3.19 (38.5)	0.43 (5.2)	7.23 (87.3)	8.28

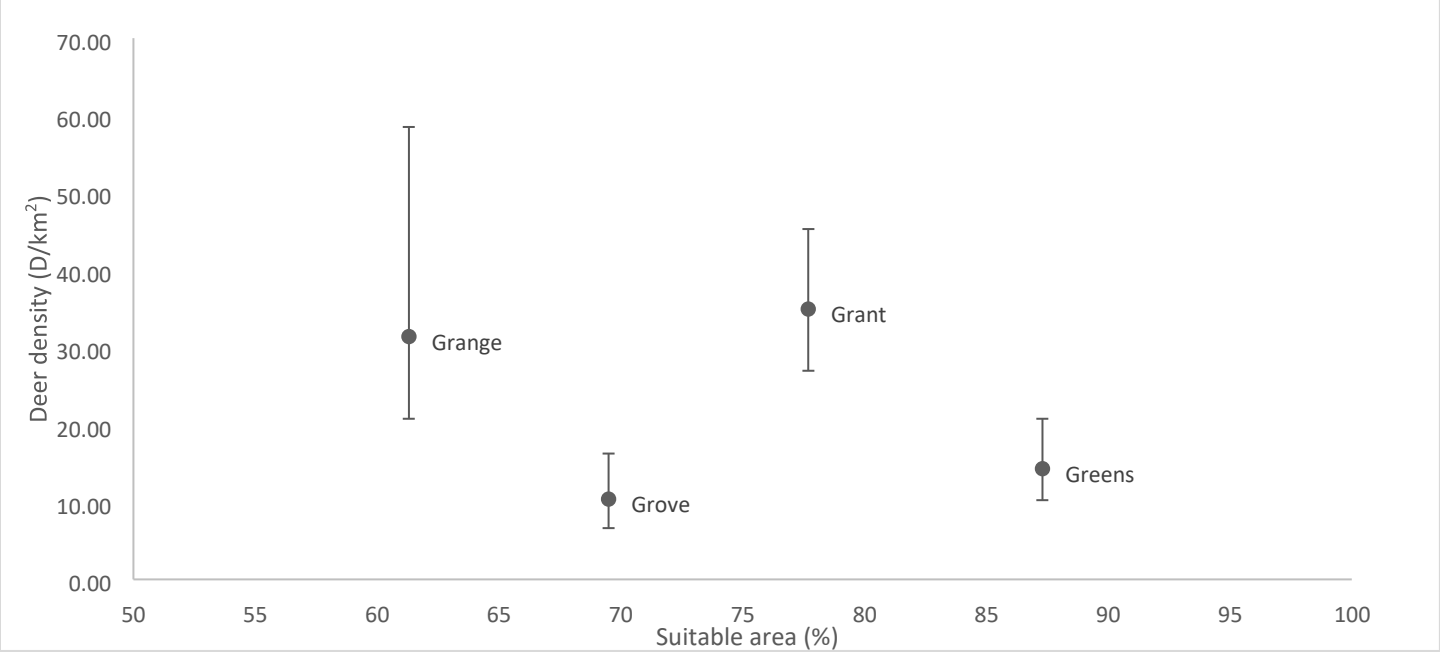

Figure 1. Deer density estimates (± 95% CI) compared with percent suitable habitat in each village (See Table 1 for number of survey nights). Suitable habitat was a combination of forest and grassland habitat.

Table 2. Conventional distance sampling analysis parameters and results for each village.

Village	Grove	Grange	Grant	Greens
Estimate (D/km^2)	10.4	34.9	35.0	14.6
Density survey nights	5	5	3	4
Regression curve	Uniform	Half-normal	Hazard	Uniform
Confidence interval	6.6 - 16.3	20.8 - 58.5	26.9 - 45.3	10.2 - 20.8
Degrees of freedom	12	19	15	106
Left Truncation	None	5	None	None
Right Truncation	160	160	250	180
Coefficient of variance (CV)	0.21	0.25	0.12	0.18
CV due to: Regression model	0.04	0.09	0.04	0.07
CV due to: transect variability	0.12	0.11	0.04	0.08
CV due to: group size	0.05	0.05	0.03	0.02

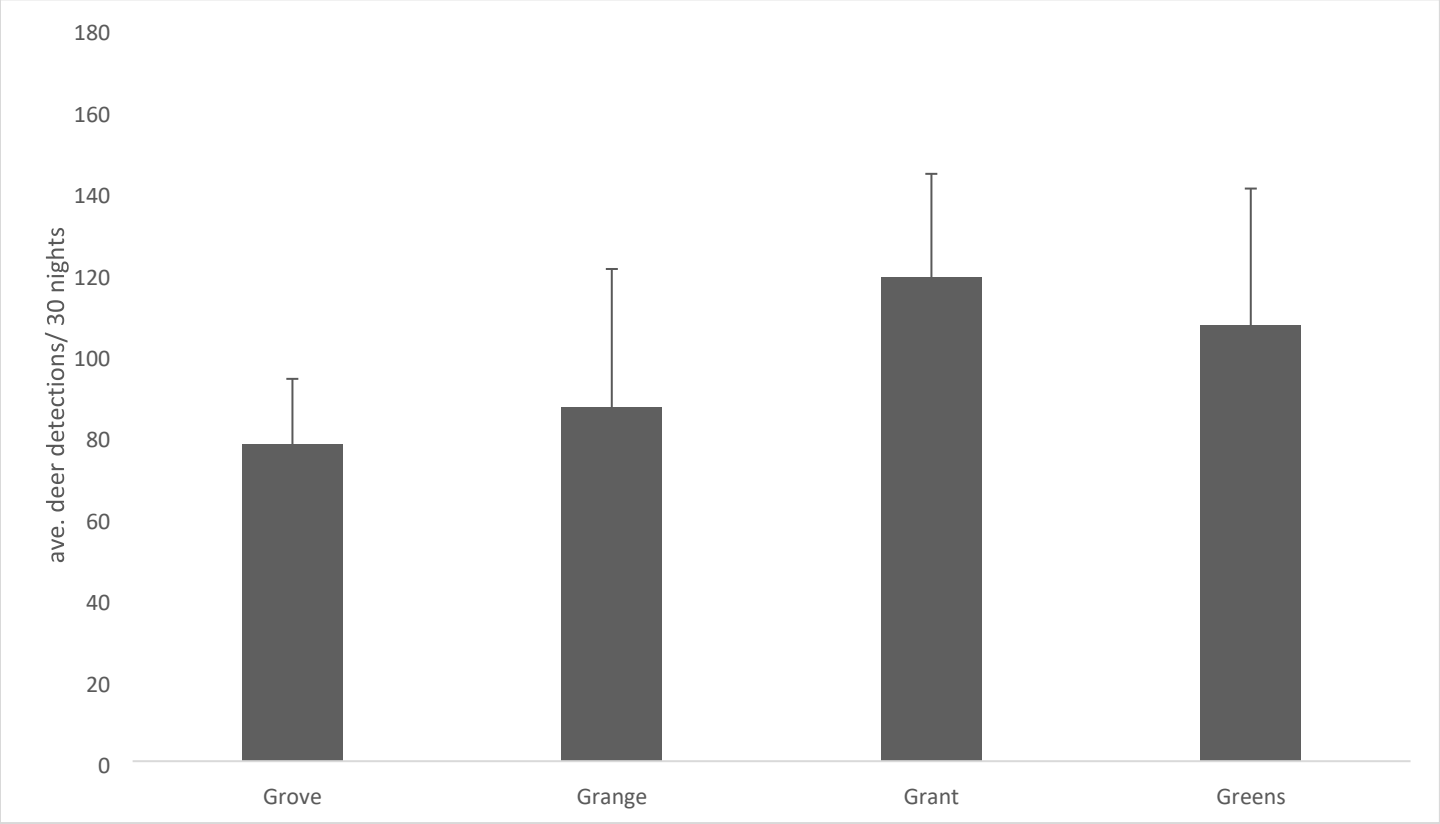

Figure 2. Average number of camera trap deer detections per 30 camera nights (SE) at each village. Data was collected from 24 camera traps (See Table 1). The villages are listed in order of size.

Table 3. Average number of deer detected /30 camera nights for each village.

Village	Average	# Camera nights	Standard Error	Confidence interval
Grove	77.9	109	16.1	46.4 -109.4
Grange	86.9	108	34.1	20.1 - 153.6
Grant	118.9	216	25.4	69.01 - 168.8
Greens	107.1	218	33.7	41.1 - 173.1

Table 4. Number of deer detected by camera trap per village. We list the proportion of adult female to male adult deer detected and proportion of adult female to juvenile deer detected using camera traps per village. The sex or age of some deer could not be determined and are listed as unknown.

Village	Female	Male	Juvenile	Unknown	Total	Female: Male	Female: Juvenile
Grove	194	13	50	25	282	15:1	4:1
Grange	204	4	75	39	322	51:1	3:1
Grant	510	85	142	81	818	6:1	4:1
Greens	399	146	66	165	776	3:1	6:1

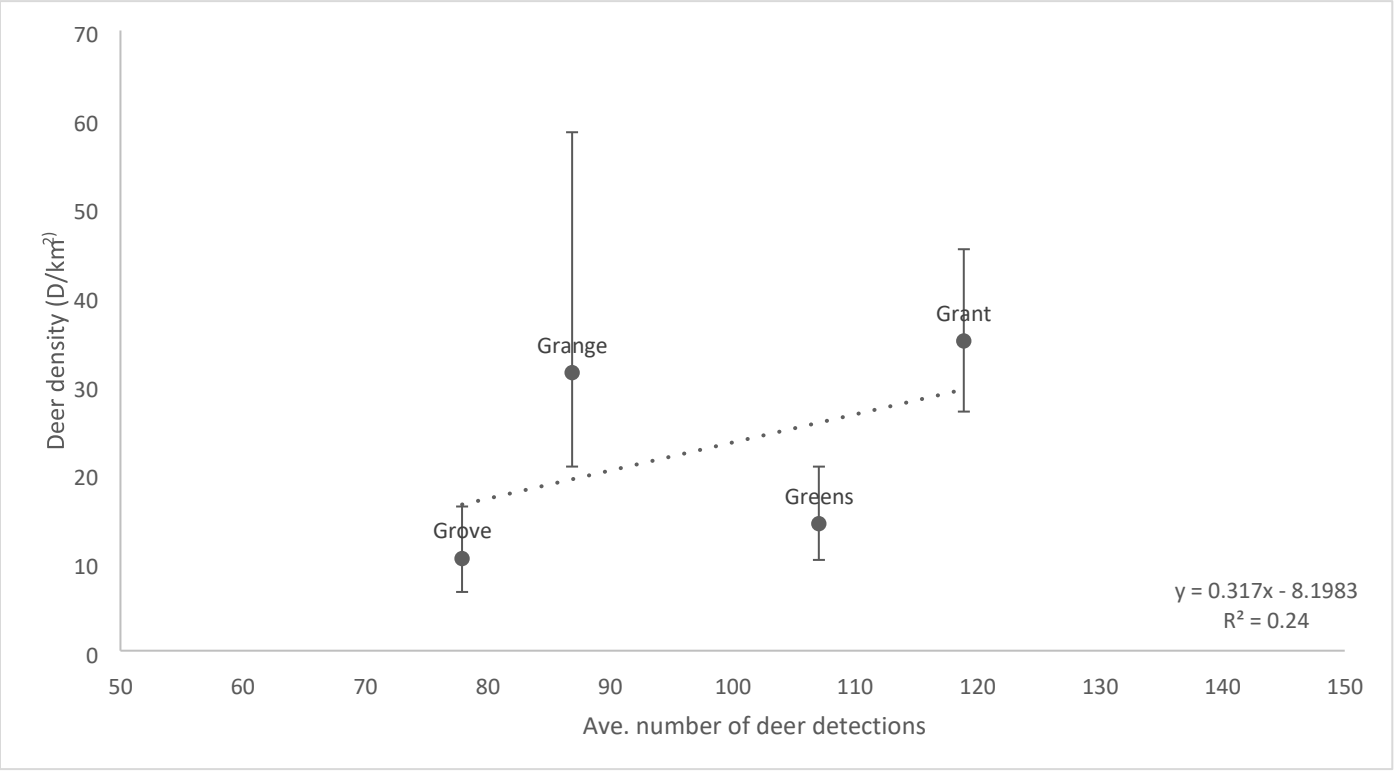

Figure 4. Average number of deer detections per 30 camera nights compared with the deer density (± 95% CI) for each of the villages.

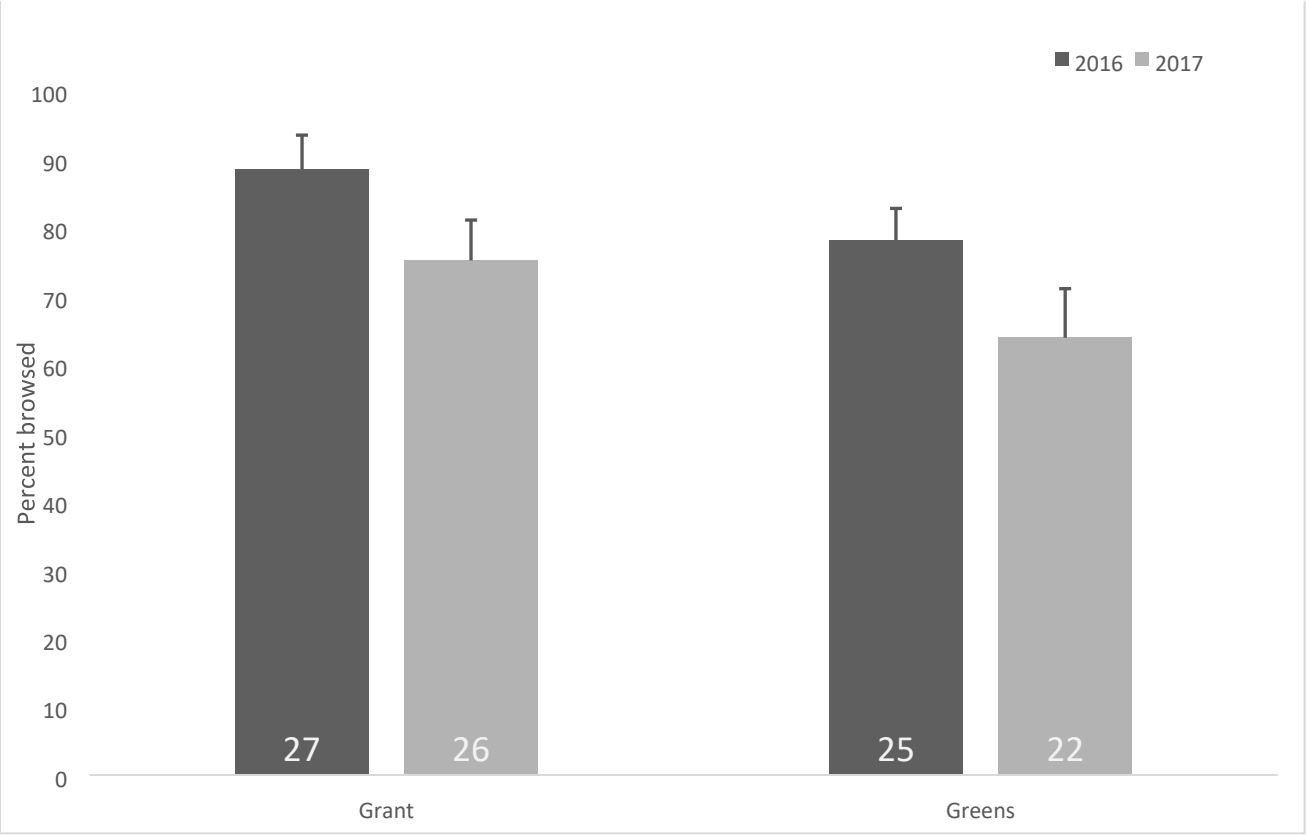

Figure 5. Percent of browsed greenbrier (± SE) from the vegetation surveys in 2016 and 2017 at The Grant and The Greens, including the number of transects had greenbrier each year. Although 30 transects were surveyed at each site, transects with no greenbrier present were removed from analysis.

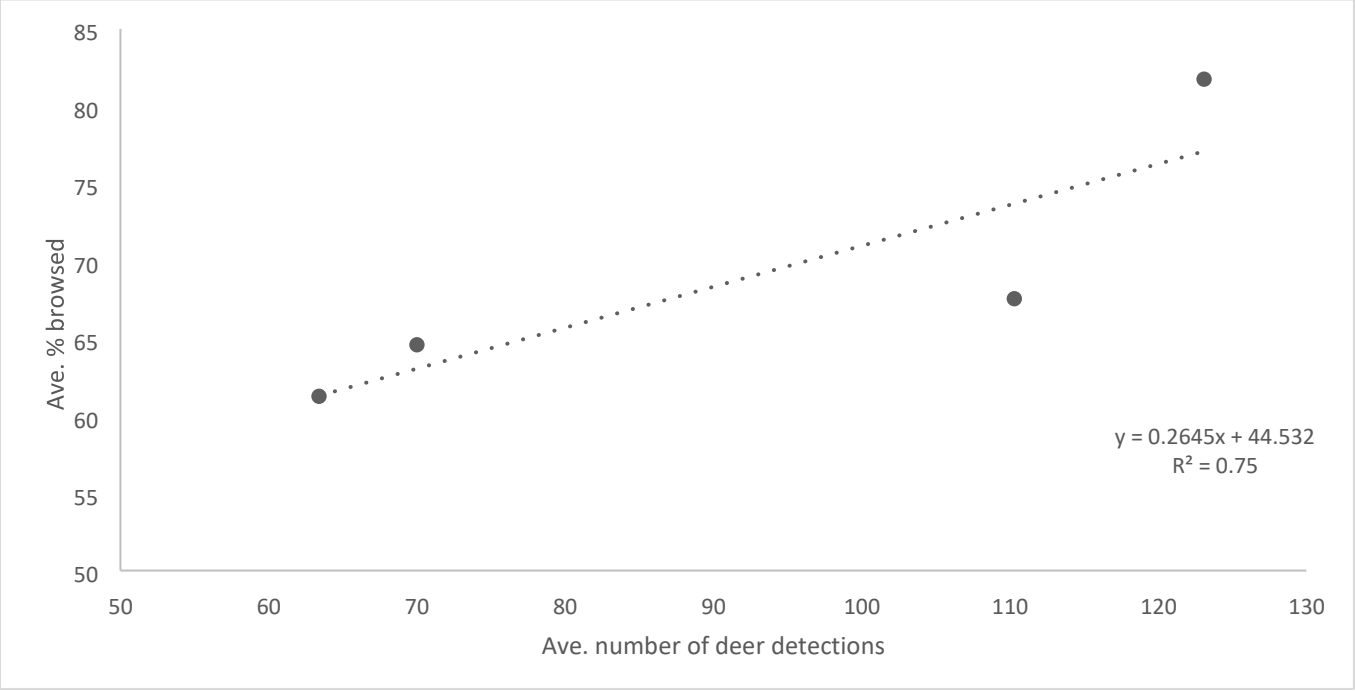

Figure 6. Average number of deer detections per 30 camera nights compared with the average % browsed greenbrier for four clusters of camera traps and vegetation transects (2 clusters in The Grant, 2 cluster in The Greens).

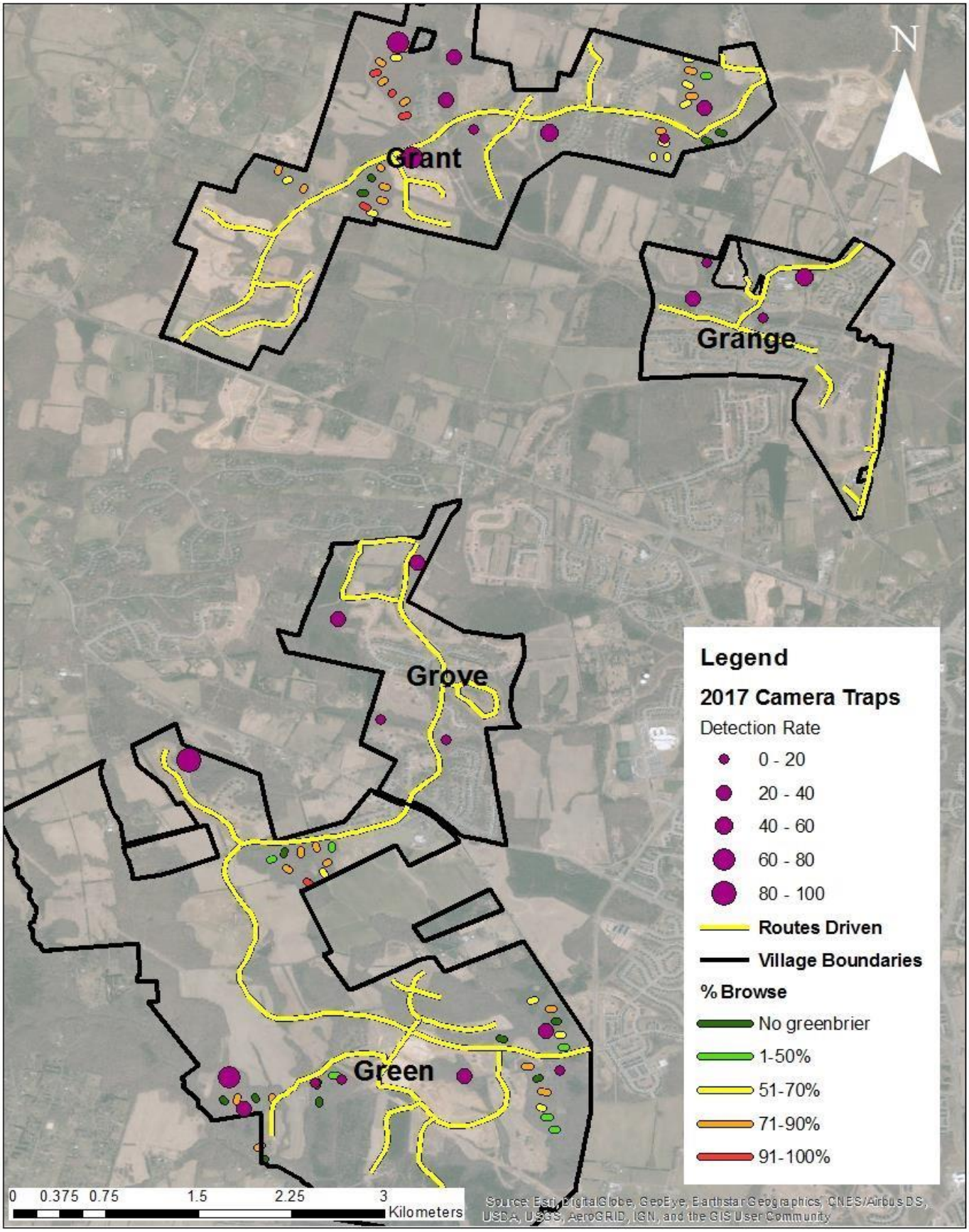

Figure 7. Map of all four villages. Includes the location of vegetation transects, distance survey transects and the camera trap locations sized according to detection rate (Deer/10 camera nights).

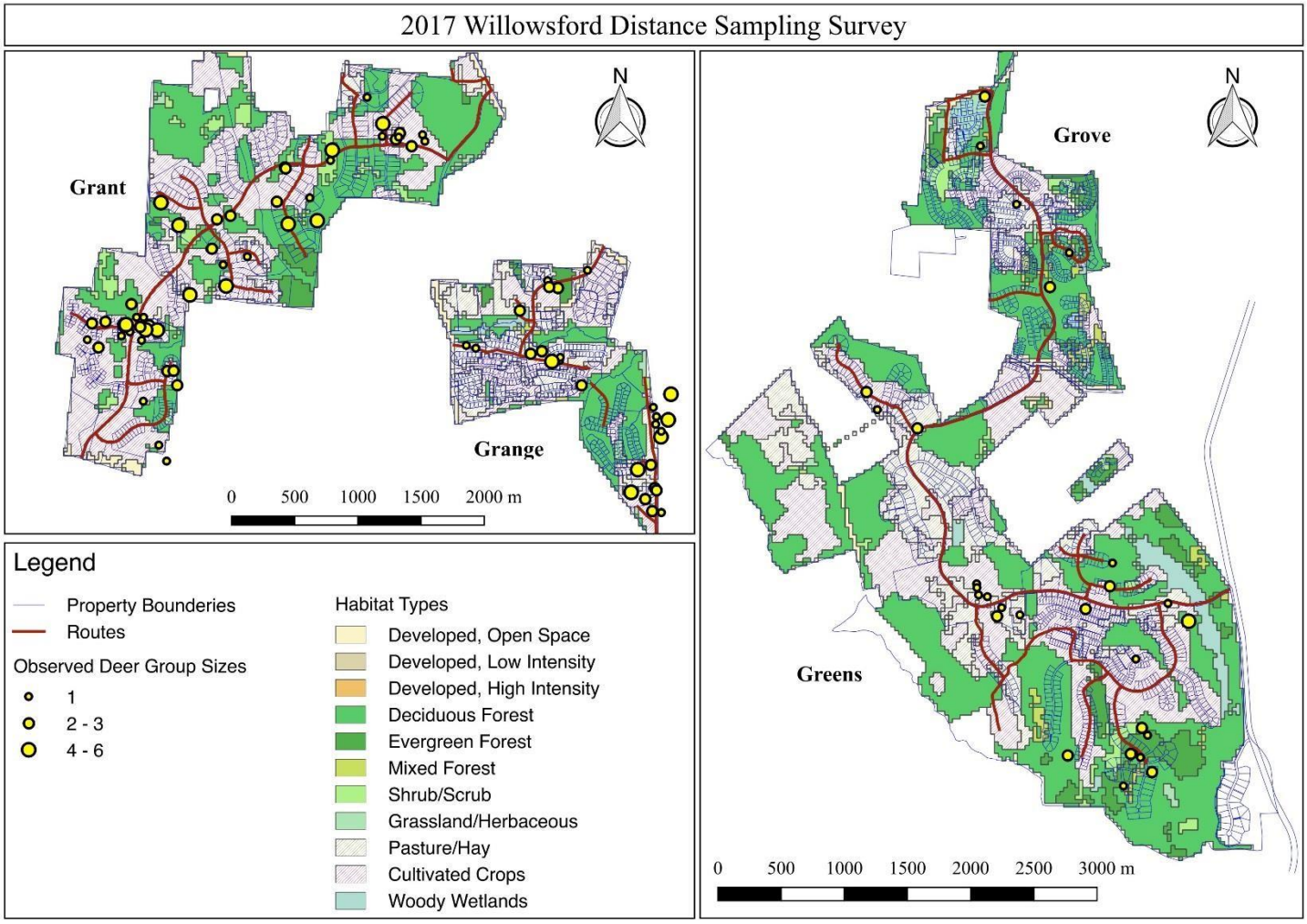

Figure 8. The location of deer located during the spotlighting surveys. These observations represent the sum of multiple nights so not an indication of density but rather relative distribution of deer.