Observed Differences Among White-Tailed Deer Populations in Private and Public Land

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Introduction

White-Tailed Deer

In peer-reviewed research, white-tailed deer (Odocoileus virginaus [deer]) are considered generalists (Peebles-Spencer et al., 2017), meaning they adapt to new environments at rates much quicker than their predators and organisms at the same, or lower trophic levels. Deer are also labeled as a keystone species because they are responsible for the functioning of organisms above and below their trophic levels (Waller and Allerson, 1997). With nearly all animals coming into contact with human-altered environments, deer have been able to outcompete many organisms in these altered environments and, therefore, monopolize many resources (Rawinski, 2008). It was shown that by selectively foraging [most often in the understory], deer affect the rates of reproduction and survivability of herbs, shrubs, and trees. In published research, when their foraging is concentrated on a singular (or a few) specific species, a species can be devastated (Côté et al., 2004). As a result of the cascade effect, plant cover, biodiversity, nutrient content, and carbon content are all affected (Côté et al., 2004). As a result, deer can alter other species': eating habits; movement patterns, in an attempt to attain resources; and population sizes, reliant on the availability of resources.

In regards to the movements of the deer themselves, deer's activity patterns and habitat use have evolved to help deer avoid predators. According to peer-reviewed literature by Beier and McCullough, "Deer used closed vegetation types during daytime and open types at dusk, night, and dawn (1990)." Similarly, according to Montgomery in field-defining publishing, the time movement is as follows: "(1) feeding and movement from dawn until midmorning; (2) bedding from midmorning until midafternoon, with some individuals active for a short period in

the early afternoon; and (3) movement and feeding from midafternoon or late afternoon until dark or longer (1963).” Deer have varying degrees of response to different stimuli. To avoid predation risk, they have evolved to respond to potentially harmful stimuli. As a result, “nonlethal disturbance stimuli caused by humans are analogous to predation risk (Frid & Dill, 2002).”

According to the Virginia Deer Management Plan, published by the Virginia Department of Wildlife Resources, deer are operating at an extremely high population size, altering ecosystems throughout Virginia (2015). High population sizes don’t merely change the appearance of forests, but they also change the ecology of forests (Rawinski, 2008). Deer have used resources at a rate disadvantageous to other organisms in their local ecosystems, resulting in suboptimal reproductive levels for local flora and fauna and many species at risk of extinction (Richard and Alexander, 1998). According to a published review of literature by Taber, overabundance is relative, and its definition is only used when animals threaten human life or livelihood, are too numerous for their own good, depress the densities of economically or aesthetically important species, or cause ecosystem dysfunction (1997). Thus, by definition, the deer population has also reached a level of overabundance. Therefore, the population of deer needs to be reduced to a level optimal to the success of their own population, but more importantly a level optimal to the success of their environment. Yet the importance of deer can’t be overstated, according to the Fox Run Environmental Education Center, “At the correct population, white-tailed deer increase biodiversity and encourage new plant growth. Their feces add to the soil encouraging plants to grow and thrive. They eat brush allowing more sunlight to reach the forest floor and allowing smaller plants to grow (Fox Run Environmental Education

Center, 2021).” This leads to a delicate delicate balance of reducing their population size, but not doing so in a way that is harmful to their long-term health.

Deer Management

Deer management is the practice of maintaining a healthy deer population. It serves many purposes including developing a land ethic, preventing disease (Why We Manage Deer - Cornell BotanicGardens, 2018), and economic benefits stemming from recreation. Deer management is an umbrella policy developed by states and improvised by local counties. As a result, deer management practices vary from county to county across Virginia. Many factors are taken into account with the creation of deer management practices, including deer population goals, recreational goals, and damage prevention.

Hunting

The Virginia Deer Management Plan contends that controlling the population of deer involves the, “Use [of] hunting as the primary deer management tool.” Hunting is not only the preferred method of game management, but it is also the most effective method for managing the population of deer (Miller & Marchinton, 1995). Throughout Virginia, there are specific laws regarding: the days in which hunting can occur; more specifically the days in which does can be harvested; and seasons.

According to LaFon, the Forest wildlife program manager of the Department of Wildlife Resources, “Virginia is controlled by the number of days does can be shot.” He also said that Virginia was “conservative on public lands” with fewer days hunters can harvest does, as the

"killing of does regulate the population, bucks not as much (personal communication, December 12, 2022)."

Throughout Virginia, there are three distinct seasons - archery, muzzleloader, and rifle. Each season spans a particular timeline and has its own regulations. Throughout Virginia, hunting started on October 1st, 2022, with the end date being subject to change throughout each county. In Giles County, the last day of hunting was January 7th, 2023. According to the Virginia Department of Wildlife Resources, the hunting season and its gender parameters can be defined for Giles below (Virginia Department of Wildlife Resources, 2022):

Season:	**Start (Private):**	**Start (Public):**	**End (Private):**	**End (Public):**	**Either Sex Hunting Days (Private):**	**Either Sex Hunting Days (Public):**
Archery (Early Season)	October 1st	October 1st	November 18th	November 18th	Everyday	Everyday
Archery (Late Season)	December 4th	December 4th	January 7th (2023)	January 7th (2023)	Everyday	Everyday
Muzzleloader (Early Season)	November 5th	November 5th	November 18th	November 18th	November 12th only	None
Muzzleloader	January	None	January	None	None	None

(Late Season)	2nd (2023)		7th (2023)			
Rifle	November 19th	November 26th	December 3rd	December 3rd	November 26th, December 2nd and 3rd	November 26th, December 2nd and 3rd

There are distinct differences in the duration of hunting seasons on private and public land, as well as distinct differences in the ability to hunt either sex on particular days. Antlerless deer are fawns without antlers, does, or bucks without antlers, however, based on the size of most antlerless deer their gender can usually be determined, and are primarily does. Either sex hunting days allow antlerless deer and bucks to be harvested, with the remainder of the season only allowing the harvesting of bucks. According to the annual Deer Kill Summary, throughout the 2021-2022 season in Giles (the most recently reported season) 1798 total deer were taken, 1021 were antlered males, 94 were male fawns, and the remainder (683) were females, this was a 37% ratio of females (Virginia Department of Wildlife Resources, 2022). There is no reason to believe that 2022-2023 didn't follow a similar pattern under the same hunter-vigor and the same season duration.

Methods

To gather data about observed differences among deer populations in private and public land, photographs of deer were gathered through the placement of four game cameras across similar ecological areas. The ecological areas were all within Giles County, Virginia, placed across hardwood forests. Two game cameras were placed on privately owned land, with the permission of the owners, in locations near frequent deer usage. The two addresses of the land plots were Tax Map #42 52 and 407 Kerr Lane [1]. The two cameras placed on publicly owned land were both placed in the Eastern Divide jurisdiction of the Jefferson National Forest, with no permission being necessary for the placement of cameras [2]. The deer were characterized by their herd size, their gender, their activity, their time of activity, and their activity duration. These particular characteristics were gathered because of their relationship to "open" environments. As previously stated, deer behave differently in open environments, according to Beieir and McCullough in a peer-reviewed article. Unusual times of movement would be a result of skewed behaviors of deer, as a result of hunting efforts concerning private or public land.

The gender makeup of deer populations is heavily related to hunting patterns, as most hunting jurisdictions limit the days in which particular deer sexes can be taken. Additionally, there are personal preferences in the harvesting of deer, with many people prioritizing the taking of bucks because of their racks, many people also have preferences in the type of meat obtained from particular deer. A typical deer herd ranges from 5:1 to 3:1 does to bucks (Adams, 2023). A distinct difference in this ratio suggests differences in hunting patterns across public and private land because of the access (and subsequent personal preferences), as well as the opportunity (being regulated by the days in which specific deer genders can be taken). All of the cameras' photographs represent a plot of land 100 acres, or less. This was in reference to a study by Jacobson, in a leading study of camera placement, in which he recommends a plot of 100 acres

as the upper bound for accurate game observations (1997). Additionally, according to LaFon, the placement of cameras has a direct impact on the results of the study (personal communication, December 12, 2022), with better placements leading to more accurate results.

Instruments

The only instruments used in this study were game cameras (Tasco 8MP Megapixel Tan Game Trail Camera Low Glow). The cameras were equipped with SD cards (Secure Digital cards) and they were motion triggered to take photographs following any distinct movements. They were also able to take infrared photographs at night, to allow continuous observation.

Procedure

The cameras were placed on January 26th, 2023, and they were retrieved exactly 8 days later, on February 3rd, 2023. The placement of the cameras was done two-and-a-half weeks following the end of hunting season in order to allow the habituation of deer to return to normal following high human involvement which would trigger their fight-or-flight instinct, according to Frid and Dill (2002). The cameras were all placed in open environments to allow for a specific quantifiable activity expectation, as per Beier & McCullough (1990). The cameras were all placed facing toward the open environments. All of the plots were open environments, but the degree varied slightly due to the conservation differences between private and public land. Additionally, the cameras were within .5 miles of roadways because they weren't equipped with GPSs, and this would allow for quicker recovery, while not having the movement of vehicles factoring into the behavioral changes of the deer. Finally, the cameras were placed to avoid detection, otherwise, theft could occur. At the time of placement, it was unknown how many deer would be captured, but it was established 30 deer were needed to provide a statistically

significant result. The numerical value of 30 constitutes the minimum number of samples for a population to be statistically significant.

Conditions

The cameras were operating in locations where other external factors did not change. Apart from placing the camera, the environment stayed entirely the same. No vegetation was altered, and no food was left behind to avoid human stimuli in their environments (Frid & Dill, 2002).

Results Private

Tax Map #42 52

For private land in Giles County, Virginia, there were two separate plots. The first plot was located at Tax Map #42 52 [3]. I was permitted by the owner to place my cameras on the land. I chose this particular plot because of its size (as it was less than 100 acres) and its open nature, as well as its accessibility by road. On this plot of land, there were 21 distinct deer with a ratio of 21:1 does to bucks [4]. The largest herd size was five deer and that only occurred once, and there were five herds with a single deer. The average herd size was 2.1 deer per herd. The most frequent time of activity was nighttime (8:12 PM - 6:37 AM) with eight deer being observed, followed by dusk (6:11 PM-8:12 PM) with seven deer being observed, and morning (8:13 AM- 12 PM) with six deer being observed. The most frequent activity was foraging, with 17 of the 21 deer being observed foraging for a mix of field grasses (ryegrass, clover grass, etc.), the remaining 4 out of 21 deer were traveling. Of the deer foraging, there were eight distinct

herds, and a total of 38 minutes of footage of foraging, showing that on average the herds were grazing for 4.75 minutes each. Of the deer traveling, there were two distinct herds, and a total of 6 minutes of traveling, showing that on average the herds were traveling across the plot of land for two minutes each.

407 Kerr Lane

The other plot of land that was a part of the private land plots, was located at 407 Kerr Lane, Eggleston, in Giles County, Virginia [5]. There were a total of 11 distinct deer with a ratio of six does, 2 bucks, and 3 unknown deer, leading to a range of 9:2 to 6:5 does to bucks [6]. The largest herd size was composed of two deer, and that was also the most common herd size with four separate instances. The smallest herd size was composed of one deer, and that size had four separate instances. The average herd size was 1.57 deer per herd. The most frequent time of activity was dusk with six out of the 11 deer being observed at dusk, daytime was the second most observed time with three out of the 11 deer being observed during the daytime (12 PM-6:10 PM), and finally, two deer were observed at nighttime. The most frequent activity was grazing with six out of the 11 deer being observed foraging, the remaining activity was traveling with five out of the 11 deer being observed traveling. Of the deer foraging, there were four distinct herds and a total of 42 minutes, showing that on average each herd was foraging for 10.5 minutes. Of the deer traveling, there were three distinct herds and a total of three minutes, breaking down to a minute of traveling per herd on this particular plot.

Private Land

The plots of land had a very similar ecology, they contained grasses native to Virginia alongside hardwood forests. The plots of land were also maintained similarly, primarily used for hunting and for recreational purposes, according to the owners. Therefore, the data from the two plots of land can be interpreted as one singular data collection representative of privately hunted land. The data of the whole private data collection represents a statistically significant sample size greater than 30 (the generally agreed upon number of samples in a population to qualify as being statistically significant) to represent the private land of Giles County, Virginia.

As a whole, there were 32 distinct deer across these two private plots. The gender range was from 29:3 does to bucks to 26:6 does to bucks, with the legitimate number of both being 26 observed does and 3 observed bucks [7]. The most frequent time of activity was dusk with 13/32 deer being observed at dusk. The second most frequent time of activity was nighttime with 10/32 deer being observed at nighttime. The third most frequent time of observed activity was the morning with 6/32 deer being observed then. And, the least frequently observed time was daytime with only 3/32 deer being observed then [8]. The most frequent activities were foraging, with 23/32 deer being observed foraging in some capacity. Traveling was the second most observed activity, with 9/32 deer being observed traveling [9]. For the herds foraging, there were 12 distinct herds and a total of 80 minutes of observation, leading to an average of 6.67 minutes of foraging per herd. For the herds traveling, there were five herds and observations lasting 9 minutes, leading to an average of 1.8 minutes per herd. Although according to the unpaired t-test, the results of the duration of activities were statistically insignificant (p-value of .6542).

Results Public

There were no observations of any deer across the two public plots of land, alongside the Cascades Trail [10] and Bird Mountain Lane [11], both of which were located under the Eastern Divide jurisdiction of the Jefferson National Forest. Because of the lack of observations, no assumptions can be made about the effects of public access hunting on observed deer. There were likely unforeseen confounding variables affecting the observations of the deer.

Discussion

As shown by peer-reviewed research from Frid and Dill, deer tend to behave to human stimuli in the same manner as they would a natural predator, such as a coyote (2002). This involves them avoiding the areas, or being triggered by fight or flight responses. The two cameras placed in publicly accessible forests, allowed human stimuli to enter into the environments and the pressure likely resulted in an alteration of behaviors and avoidance of those particular plots. This would explain the absence of any data in regard to the public lands cameras. Additionally, the public plots of land in which the cameras were placed were all open, but the degree may have varied slightly from the private plots. This was due to security reasons, as cameras too obviously placed were at risk of being taken, and all results would have been lost. For future experimentation, the cameras would be equipped with GPS, which would aid in the placement of the cameras further away from human stimuli, and this would likely minimize the behavioral changes as a result of human stimuli. Additionally, with more money, more cameras could be purchased and placed more frequently around private and public plots to provide more data from more herds.

Conclusion

For the privately owned land plots in the study, there were a total of 32 unique deer. The characteristics of the herd size, the gender makeup of the herds, the herd activities, and the time of activities were all observed. The average herd size was 2.1 deer per herd, with 26 does and 3 bucks being observed and a range of 29 does to 3 bucks or 26 does to 6 bucks (since the gender of some deer could not be made out through the cameras, although they were definitively deer). Assuming the real ratio fell somewhere between 29:3 and 26:6, the post-rut herd would be a typical one, following the 3:1-5:1 ratio of does to bucks that was suggested by Adams, published on the National Deer Association, following the recruitment of deer as a method of herd self-correction (2022). The deer's most frequent activity was foraging, and they were most active during dusk (6:00 PM-8:15 PM), these were both in line with the study conducted by Montgomery (1963). For the publicly owned land plots, there were no visible deer, therefore, no observations could be made. As a result of this study, it can be determined that privatization as a method of deer management has very little effect on the behavior of deer compared to a typical herd. This is derived from the following points; deer are typically the most active in open environments at dusk or nighttime (Beier & McCullough, 1990), the most common types of activities at nighttime and dusk are foraging or movement (Montgomery, 1963), and according to Adams, the typical deer herd in the post-rut season (during the period when the research was taking place) falls somewhere between 3:1 and 5:1 does to bucks following recruitment.

No comparison could be made between the private and public plots because of the statistical insignificance of the public plots. But, the Virginia Deer Management plan ends in 2024, this plan guides all deer management programs throughout Virginia, including Giles County. As a result of this research, the results can serve as evidence for legislators to maintain

the current privatized hunting model of a longer season, as it reduces the deer population towards a more suitable level while maintaining the same behaviors of the herds. This could also influence geographically or ecologically similar counties to prioritize privatized hunting in order to attain similar behavioral results as Giles County while following the harvesting numbers indicated previously.

References

Adams, K. (2022, November 4). *The Reality of Doe:Buck Ratios | National Deer Association*. National Deer Association |. https://deerassociation.com/reality-doebuck-ratios/

Beier, P., & McCullough, D. R. (1990). Factors Influencing White-Tailed Deer Activity Patterns and Habitat Use. *Wildlife Monographs*, *109*, 3–51. http://www.jstor.org/stable/3830629

Côté, S. D., Rooney, T. P., Tremblay, J.-P., Dussault, C., & Waller, D. M. (2004). Ecological Impacts of Deer Overabundance. *Annual Review of Ecology, Evolution, and Systematics*, *35*, 113–147. http://www.jstor.org/stable/30034112

Vanorio, A. (2022, July 22). *Everything you want to know about white-tailed deer*. Fox Run Environmental Education Center. Retrieved February 16, 2023, from https://www.foxrunenvironmentaleducationcenter.org/new-blog/2019/8/12/everything-you-want-to-know-about-white-tailed-deer

Frid, A., & Dill, L. (2002). Human-caused Disturbance Stimuli as a Form of Predation Risk. *Conservation Ecology*, *6*(1). http://www.jstor.org/stable/26271862

Jacobson, Harry A. et al. 1997. "Infrared-triggered cameras for censusing white-tailed deer." *Wildlife Society Bulletin* 25:547–56.

Taber, R. (1997). [Review of *The Science of Overabundance: Deer Ecology and Population Management*, by W. J. McShea, H. B. Underwood, & J. H. Rappole]. *Wildlife Society Bulletin (1973-2006)*, *25*(2), 578–580. http://www.jstor.org/stable/3783495

Miller, K., & Marchinton, R. L. (1995). *Quality Whitetails: The why and how of Quality Deer Management* [E-book]. Stackpole Books. https://books.google.com/books?hl=en&lr=&id=zY_c2ccyCtYC&oi=fnd&pg=PR11&dq=deer+management+strategies&ots=zhb3T2Sgwt&sig=7EJIY82BEL4-2K1TruGGtSKEZb4#v=onepage&q&f=false

Montgomery, G. G. (1963). Nocturnal Movements and Activity Rhythms of White-Tailed Deer. *The Journal of Wildlife Management*, *27*(3), 422–427. https://doi.org/10.2307/3798516

Peebles-Spencer, J. R., Gorchov, D. L., & Crist, T. O. (2017, October 15). *Effects of an invasive shrub, Lonicera maackii, and a generalist herbivore, white-tailed deer, on forest floor plant community composition*. ScienceDirect. https://www.sciencedirect.com/science/article/abs/pii/S0378112717304619

Rawinski, T. J. (2008, June). *Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview*. Forest Service, U.S. Department of Agriculture. Retrieved October 1, 2022, from https://mountainlion.org/wp-content/uploads/2021/07/PA-A-FS-Rawinski-Impacts-of-Wh

ite-Tailed-Deer-Overabundance-in-Forest-Ecosystems.pdf

Richard T. T. Forman, & Alexander, L. E. (1998). Roads and Their Major Ecological Effects. *Annual Review of Ecology and Systematics*, *29*, 207-C2. http://www.jstor.org/stable/221707

Virginia Department of Wildlife Resources. (2015). *Virginia Deer Management Plan, 2015-2024*. Virginia DWR. Retrieved September 27, 2022, from https://dwr.virginia.gov/wildlife/deer/management-plan/

Virginia Department of Wildlife Resources. (2021). *2021–2022 Deer Kill Summary*. Virginia DWR. https://dwr.virginia.gov/wildlife/deer/harvestsummary/

Why We Manage Deer – CornellBotanicGardens. (2018, November 20). https://cornellbotanicgardens.org/conserve/deer/why-we-manage-deer/

Waller, D. M., & Alverson, W. S. (1997). The White-Tailed Deer: A Keystone Herbivore. *Wildlife Society Bulletin (1973-2006)*, *25*(2), 217–226. http://www.jstor.org/stable/3783435

Appendix

[1]



[2]



[3]



[4]















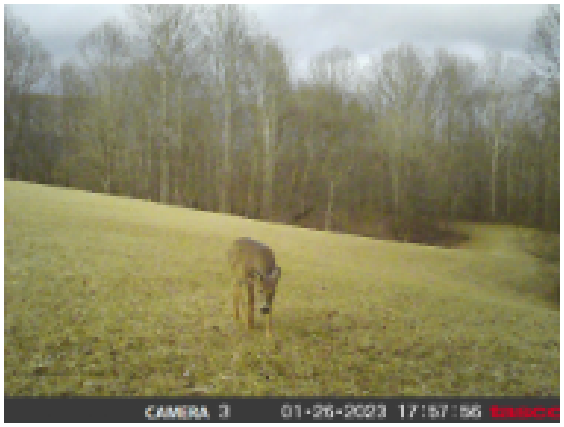




[5]



[6]




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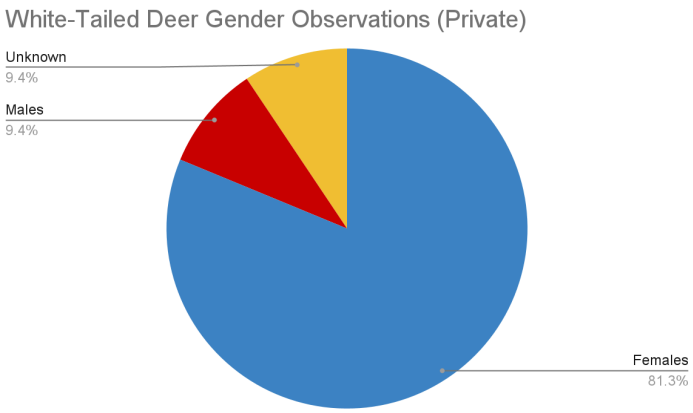

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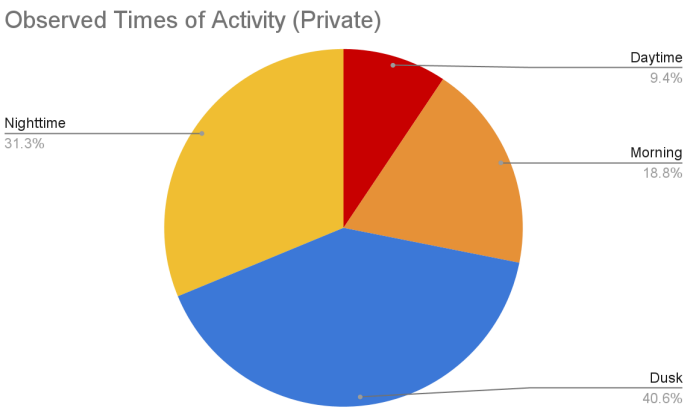

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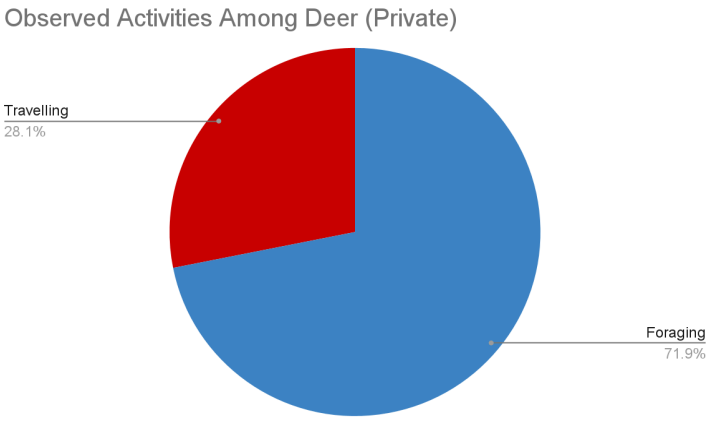
[7]


White-Tailed Deer Gender Observations (Private)
Unknown
9.4%
Males
9.4%
Females
81.3%

[8]


Observed Times of Activity (Private)
Daytime
9.4%
Morning
18.8%
Dusk
40.6%
Nighttime
31.3%

[9]


Observed Activities Among Deer (Private)
Travelling
28.1%
Foraging
71.9%

[10]



[11]

