The Utilization and Evaluation of Different Techniques for the Calculation of the *Odocoileus virginianus* Population at Brookhaven National Laboratory

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Abstract

The Utilization and Evaluation of Different Techniques for the Calculation of the *Odocoileus virginianus* Population at Brookhaven National Laboratory. MEGAN DYER (Community College of Rhode Island, Warwick, RI 02886) T. GREEN (Brookhaven National Laboratory, Upton, NY 11973).

At Brookhaven National Laboratory (BNL), there have been numerous problems with the white-tailed deer population including increased car/deer accidents, foraging on ornamentals, and spread of Lyme disease. BNL decided to take surveys of the deer populations in order to get a more accurate estimate of how overpopulated the deer actually were. They divided all of the roads on-site into three transects: green, blue, and yellow. The surveys were taken from a car using a Bushnell Yardage Pro Sport distance meter, and a pair of binoculars was used to tell the number of deer per cluster and to distinguish the bucks from the does. An NK Kestrel 3000 was also used at the beginning of each survey to take weather conditions like dew point, temperature and wind speed. Using four different techniques, the data was evaluated and compared in order to get an accurate population estimate. The numbers calculated were very different and varied from 537 to 1,866 deer total, the latter being believed to be more accurate. This data will be used in the future in order to design and implement a deer management plan at Brookhaven National Laboratory.

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Introduction

White-tailed deer can be found all over the United States and are starting to become a problem species. Overpopulation and loss of habitat is forcing deer out into the open where they browse on landscaping and are often hit by cars. At Brookhaven National Laboratory (BNL), you can see white-tailed deer *(Odocoileus virginianus)* at most times of the day feeding along the sides of the roads and in the open fields. BNL sits on 5265 acres of land, most of which is composed of Pine Barrens, but still the deer are having trouble. White-tailed deer are selective eaters and only forage on certain species and parts of plants, usually the ones that contain the most nutritional value (Halls, 1984). The trouble is that there are too many deer and not enough of the plants that are in their diet, so many of the deer are extremely malnourished even though they are surrounded by greenery.

The overpopulation of white-tailed deer leads to many other problems such as a greater number of car/deer accidents, increased foraging on ornamentals, and a greater potential for disease transmittal. Due to increased foraging along roadsides, deer have become accustomed to being in close proximity with people and cars. This has resulted in many accidents where the deer run into the road or jump over the median into oncoming traffic. In the past three years, there have been forty-six accidents resulting in the death of the deer (1999 SER, 200 SER, 2001 SER) and thousands of dollars in damage to the vehicles that hit them. Another growing problem is the deer are no longer feeding exclusively on the indigenous species of plants at the Lab, but have been browsing instead on the newly planted ornamental white cedars and others being planted

around the buildings. This has caused incredible damage to the landscape, as well as cost the lab thousands of dollars in having to replace the dead trees with new ones.

Also with overpopulation, comes disease transmittal. Deer aren't getting enough food, so their immune systems aren't as strong and can't fight off disease as well. Plus, there are more deer, so they come in contact with one another more frequently than they would if they were at or below carrying capacity, making it possible for parasites like meningeal worms, muscle worms, cattle worms, and large stomach worms, and diseases such as skin tumors and theileriasis (Halls, 1984), which depend on the host animals' coming into contact with others in order to spread, which could destroy a population.

Deer are also carriers of black-legged ticks (*Ixodes scapularis*); commonly known as deer ticks, which carry *Borrelia burgdorferi*, the bacterium that causes Lyme disease. Infected ticks, which in their larval and nymphal stages are no larger than a pinhead, transmit the bacteria to humans by inserting their mouths into the skin to take in blood. In 1999 alone, 16,273 cases of Lyme disease were reported to the Centers for Disease Control and Prevention (CDC), the majority of them coming from Northeastern states including New York, Rhode Island, Connecticut and Massachusetts.

BNL has set up a survey method in order to estimate the population of white-tailed deer at the Lab. Using this analysis, they will be able to design and implement a management plan, which will ultimately decrease the number of deer on site making more food available to those remaining, resulting in improved health, reduced car/deer accidents, and possibly reduction in deer tick densities.

Materials and Methods

In order to take surveys of the deer population, Brookhaven National Laboratory has divided the roads into three line transects, the green route which covers most of the constructed area, the blue route which covers the undeveloped outer area and the RHIC ring, and the yellow route which covers most of the area not accounted for by the other two. Before beginning each survey, weather conditions including general conditions, dew point, relative humidity, temperature, percent cloud cover, and wind speed and direction were recorded using a compass and an NK Kestrel 3000. The surveys were taken from a vehicle driving <10 mph to minimize deer disturbance. When a deer was sighted, location as well as angular and perpendicular distances was recorded using a Bushnell Yardage Pro Sport distance meter. Binoculars were also used to tell the age and sex of deer at greater distances and to search the open fields for ones that might otherwise be missed. Each route was surveyed three times for a total of nine surveys, in a period of six weeks.

The estimated population of the white-tailed deer was calculated using the data from the nine surveys. Four calculations were done for each route and the average of the three was taken. The first (1) calculation was taken using the DISTANCE program. The second (2) calculation was done using the following calculation:

$$\frac{\text{(average \# of deer)}}{\text{(square feet of line transect)}} \times \frac{\text{(43, 559.83 square feet)}}{\text{(1 acre)}} \times \frac{\text{(5265 acres)}}{(1)} \times (1.33) = \text{total \# deer}$$

where the square footage of the transect was the length driven in feet, multiplied by two hundred because it is assumed that you can see one hundred feet into the woods along either side of the transect. Also, the area of the open fields is added to the area of the line transect. The third (3) equation is the same as the second; only the area of the open fields is neglected. In the fourth (4) equation, the sum of all of the distances were taken from the three routes and divided by the total number of deer to get an average transect width. This was then multiplied by the transect length in order to get the area, and then put into the above equation. All population estimates were multiplied by 1.33 in order to indicate a 75% confidence level.

Results

Using the four different techniques to estimate the deer population, the DISTANCE software produced an estimate of 537 deer total at Brookhaven National Laboratory. Using the second (2) equation, the population was estimated at 1,606 deer total, and 1,866 deer was calculated with the open fields being neglected in the third (3) equation. In the fourth (4) equation, the population estimate was 981 deer, with the average transect being 369.03 feet wide.

Discussion and Conclusions

The third (3) equation worked the best because it produced results that were closest to those stated in the 2000 Site Environmental Report (SER). The SER stated that in November/December 2000, the deer population was at an estimated 1,942, and the estimate from equation three (3) was 1,866.

Peter Kelly of the U.S. Fish and Wildlife Service has taken deer surveys regularly at BNL since November 2000. In comparing the data of the nine surveys above, with his past surveys, it has been found that there is a 16.5% difference between the two groups of data. This difference could be accounted for by a number of things. First, the data taken for this project is an average of nine surveys, three for each transect, while Kelly's is an average of 21 surveys. Second, the surveys evaluated above were taken in a span of six weeks, while Kelly's were taken year round over a span of a year and a half, so seasonal fluctuations were taken into account with his. And lastly, I could only compare two of the four equations because Peter Kelly did not take distance measurements on his surveys.

The data taken above may include a slight error due to the methods used while taking the surveys. Distances were often taken of deer clusters instead of individual animals. The data was entered into the DISTANCE program as individual distances so more reasonable numbers could be reached, and so this may incur a slight error. Also, the nine surveys taken above were from June 21, 2002 to August 1, 2002, which is the time of year that deer give birth to fawns. Because of the timing, the numbers may be inflated a bit because there hasn't been a winter-die off to re-balance the population yet. And lastly, a two hundred foot width was assumed for some of the equations but never measured, so that may make the numbers slightly erred as well.

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References

BNL. 2000. Site Environmental Report for Calendar Year 1999. BNL-52585. Brookhaven National Laboratory, Upton, New York. August 2000.

BNL. 2001. Site Environmental Report for Calendar Year 2000. BNL- 52626. Brookhaven National Laboratory, Upton, New York. September 2001.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., & Thomas, L. (2001). Introduction to Distance Sampling: Estimating Abundance of Biological Populations. New York: Oxford University Press.

Halls, Lowell K. (1984). White-tailed Deer: Ecology and Management. Washington D.C.: Stackpole Books.

Koenen, Kiana K. G., DeStefano, Stephen, & Krausman, Paul R. (2002). Using distance sampling to estimate seasonal densities of desert mule deer in a semidesert grassland. Wildlife Society Bulletin, 30(1), 53-63.

McShea, William J., Underwood, H. Brain, & Rappole, John H. (1997). The Science of Overabundance: Deer Ecology and Population Management. Washington: Smithsonian.

Rabe, Michael J., Rosenstock, Steven S., & deVos, Jr., James C. (2002). Review of big-game survey methods used by wildlife agencies of the western United States. Wildlife Society Bulletin, 30(1):46-52.

(2001, September 21). CDC Lyme Disease Home Page. Centers for Disease Control and Prevention: Division of Vector-Borne Infectious Diseases (4), Retrieved July 15, 2002 from http://www.cdc.gv/ncidod/dvbid/lyme/index.htm