PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
RESEARCH DIVISION
PROJECT ANNUAL JOB REPORT

PROJECT CODE NO.: 06210

TITLE: White-tailed Deer Research/Management

PROJECT JOB NO.: 21013

TITLE: Survival, mortality causes, and antlered harvest rates of white-tailed deer in Pennsylvania

PERIOD COVERED: 1 July 2006 through 30 June 2007

COOPERATING AGENCIES: Pennsylvania Cooperative Fish and Wildlife Research Unit, The Pennsylvania State University, Department of Conservation and Natural Resources

WORK LOCATION(S): Wildlife Management Units (WMUs) 2G and 4B

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DATE: 21 June 2007

Abstract: Survival, mortality causes, and antlered harvest rates are vital parameters to improving reliability of deer population trends. Using radio-collared white-tailed deer, we will estimate and model survival and antlered harvest rates for application to Pennsylvania's deer population monitoring techniques. From January to April 2007, we captured 368 individual deer in Wildlife Management Units (WMUs) 2G and 4B. With deer from previous years and new captures, we were monitoring 300 deer following the capture period. This is the beginning of a multi-year study.

OBJECTIVES

1. Estimate survival and mortality causes of white-tailed deer.

2. Quantify effect of variables on survival.

3. Estimate harvest rates of antlered white-tailed deer.

4. Quantify effects of variables on harvest rates of antlered white-tailed deer.

METHODS

Northern and southern study areas were located in (WMUs) 2G and 4B. These WMUs represented 2 of 5 physiographic units within the WMU system Pennsylvania. Based on deer, habitat, and human-related characteristics, the study area WMUs were selected to represent larger groups of WMUs across Pennsylvania. Field activities occur across a broad area within each WMU to increase variability of survival and harvest covariates, thus improving biological inference of the relationship between survival and harvests and covariates (Steury et al. 2002).

We used drop nets (Conner et al. 1987), rocket nets, and modified Clover traps (Clover 1954, McCullough 1975) baited with corn to capture deer. Deer captured using drop-nets and rocket nets were sedated with a light, intramuscular

(IM) dose of xylazine hydrochloride (XYL), and face-masked. XYL was delivered via hand syringe at about 0.6 mg/kg body weight, or about 20 mg for a fawn, 30 mg for a yearling, and 40 mg for an adult. These dosages were well below the dosage recommended by Bubenik (1982) for immobilization of white-tailed deer using xylazine alone; complete sedation was not required to facilitate handling deer tangled in the nets. Deer captured with Clover traps were manually restrained and face-masked.

When captured, all deer were fitted with an ear tag in each ear. All suitable male and female deer were fitted with standard VHF radiocollars that use microchip technology to indicate time of mortality, and released at the capture site. A subset of deer was fitted with GPS radiocollars that will obtain detailed movement (e.g., bi-hourly locations) information. Handling protocols were approved by the Pennsylvania State University (PSU) Institutional Animal Care and Use Committee.

Deer manually restrained by personnel were immediately released after individual markers were applied. Chemical immobilizations were antagonized with IM injections of tolazoline hydrochloride (TOL; 4.0 mg/kg) because it provides a more consistent antagonism of xylazine than yohimbine hydrochloride (Kreeger 1996).

Survival and locations of radio-collared deer were monitored at varying intervals throughout the year. During capture periods, deer survival was monitored at least once per week. Following capture periods, we collected at least 2 locations per deer per week. Telemetry effort depended on availability of personnel.

Mortalities were investigated within a day or 2 of detection. Field examinations to determine cause of death were performed when possible; however, if cause of death was uncertain and the carcass was in suitable condition, animals were taken to the Animal Diagnostics Laboratory at Penn State University for a complete necropsy. Annual survival was estimated using Kaplan-Meier staggered entry design (Pollock et al. 1989).

Radio-collared deer will provide information on survival and mortality causes. Survival estimates will be calculated using Kaplan-Meier staggered entry design (Pollock et al. 1989) because animals will be added as they are captured, they can be censored when contact is lost, and there is no assumption of constant survival over a time interval. Since mortality may increase due to weather events during winter (White et al. 1987), making an assumption of constant daily survival over a period of months (Heisey and Fuller 1985) during winter appears unrealistic. Sample sizes of 40-50 deer will be required on the air at all times to achieve good precision of survival estimates (Pollock et al. 1989). Consequently, our objective for radio-collared deer is 70 animals per study site to allow for mortalities and loss of radio contact.

Estimating antlered harvest rates will be completed using the same methods as described above for survival.

Numerous covariates such as winter severity, condition of deer, age of deer, predation, and human-related factors such as road density can influence non-hunting survival. To assess effect of these covariates on non-hunting survival of white-tailed deer, measurements of these variables for home ranges of individual deer will be modeled in relation to the deer's survival using logistic regression (Hosmer and Lemeshow 1989). Home ranges will be estimated using Kernal methods. Recommended sample sizes of locations of at least 30 locations per animal (Seaman et al. 1999) may not be logistically possible with personnel funding available. As a result, a subset of radio-collared deer will be located at least twice a week throughout the non-capture period. For radio-collared deer without sufficient home range sample sizes, including deer that die prior to accumulation of at least 30 locations, we will create circular buffers within which habitat characteristics will be assessed. These buffers will be based on the median home range sizes of the subset of radio-collared deer for each study area (Vreeland et al. 2004). A series of candidate models containing likely combination of covariates will be developed with the best model(s) chosen using AIC methods (Burnham and Anderson 1998).

Effect of variables, such as forest cover and public lands, on antlered harvest rates will be estimated using the same methods as described above for survival.

RESULTS

From January to April 2007, we captured 368 white-tailed deer (Table 1).

In WMU 2G, 153 deer were captured on State Forests, State Game Lands, and private lands. Thirty-three males and 115 females were being monitored following the capture period.

In WMU 4B, 215 deer were captured on State Forests, State Game Lands, and private lands. Forty-six males and 106 females were being monitored following the capture period.

From January to June 2007, 19 mortalities were recorded (Table 2).

RECOMMENDATIONS

1. Continue telemetry monitoring of survival and movements of male and female deer.

2. Continue telemetry monitoring of harvest rates of antlered deer.

3. Continue winter capture activities to replenish study animal sample sizes.

4. Conduct analyses of survival, movements, and antlered harvest rates.

5. Incorporate results of analyses into population monitoring methods.

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Table 1. White-tailed deer captures including recaptures reported in parentheses by sex and age class from January - April 2007 in WMUs 2G and 4B, Pennsylvania. An adult is classified as an animal 1.5 years old or older.

	WMU		
Sex/age class	2G	4B	All captures
Male adults	16 (5)	18 (2)	41
Male fawns	32 (6)	50 (24)	112
Female adults	56 (8)	47 (7)	118
Female fawns	24 (6)	55 (12)	97
Total	128 (25)	170 (45)	368

Table 2. Mortality causes for female white-tailed deer in Pennsylvania, January - April 2007.

	WMU		
Mortality Cause	2G	4B	Total
Capture-related	6	6	12
Roadkill	0	1	1
Natural Causes	0	1	1
Unknown	0	5	5
Total	6	13	19