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

PROJECT CODE NO.: 06250

TITLE: Elk Research/Management

JOB CODE NO.: 25001

TITLE: Elk Population Survey/Elk Harvest Management

PERIOD COVERED: 1 July 2005 to 30 June 2006

COOPERATING AGENCIES: Pennsylvania Department of Conservation & Natural Resources, Bureau of Forestry (BOF) and Bureau of State Parks; Penn State Animal Diagnostics Laboratory, Pennsylvania State University, University Park, Pennsylvania.

WORK LOCATION(S): Cameron, Clearfield, Clinton, Elk, and Potter Counties

PREPARED BY: Jon M. DeBerti

DATE: 5 July 2006

Abstract: Elk (*Cervus elaphus*) marked with radio-collars were used to calculate a mark-resighting population estimator and to monitor elk movements, reproduction, and habitat use. Personnel from the Pennsylvania Game Commission (PGC) and Department of Conservation and Natural Resources' Bureaus of Forestry and State Parks and volunteers conducted a fall 2005 ground based elk survey. The population estimates resulting from fall 2005 was 714 (95% confidence interval 502-1016). Known elk mortalities (37) were recorded January 2005 through January 2006. Elk-vehicle collisions (13) and crop-damage kills (7) were the leading causes of known elk mortality. Forty-one hunters participated in the 6-day elk season from 7-12 November 2005. Thirty-five elk (10 antlered and 25 antlerless) were harvested during the fifth elk season in 70 years. All elk tissue and blood samples tested for chronic wasting disease (CWD), tuberculosis, and brucellosis were negative. I recommend that we continue evaluating the new elk survey for the entire elk range and continue the elk check station to collect biological data and monitor herd health. I recommend continuing monitoring cow reproduction and calf survival. Additionally, I recommend beginning a habitat use/ food habits study to evaluate the effectiveness of our habitat management practice and to better quantify important features of the landscape for elk in winter.

OBJECTIVE

To measure annual changes in demographic characteristics of the elk population, monitor herd distribution, calf survival and document elk harvest.

METHODS

As in previous years, elk $\geq$1 year old were captured and fitted with radiocollars (Advanced Telemetry Systems, Isanti, Minnesota, USA). Free-

ranging elk were captured using a Pneu-Dart Cartridge (Pneu-Dart Inc., Williamsport, Pennsylvania, USA) dartgun and 1 cc Pneu-Darts. Carfentanil citrate (Wildlife Laboratories, Inc., Fort Collins, Colorado, USA) was used as the immobilizing drug and the antagonist was Naltrexone (Wildlife Laboratories, Inc., Fort Collins, Colorado, USA). Elk were captured using 1 cc doses of Carfentanil citrate (3 mg/cc). Following processing, each elk received 1.25 cc of Naltrexone (50 mg/cc) intravenously and 3.75 cc subcutaneously.

Each captured adult elk was equipped with a numbered yellow radiotransmitter collar. Transmitters were at 150-151 MHz frequencies and powered by lithium batteries.

Population Survey

Since 1971, annual elk surveys have been used to monitor elk populations. Recent surveys provided 100% aerial coverage of the "Traditional" elk range permitting a population estimate based on Chapman's mark-recapture method (Chapman 1951). However, these annual surveys only provided a minimum number of elk residing in the "Expanded" range, not a population estimate. Elk residing in the expanded range were only counted if associated with radio-collared elk or if their location is known prior to the survey. Thus, the lack of a random sample in the "Expanded" range prevents calculation of population estimates.

To resolve this problem we focused on ground-based capture-recapture methods when identifying potential alternatives. After considering a number of alternatives, we identified Bowden's estimator (Bowden and Kufeld 1995) as a possible alternative (Rosenberry and DeBerti 2003).

Bowden's estimator is a unique variation of traditional capture-recapture methodology. In its basic form, the Bowden estimator divides the total number of animals sighted during a survey by the average number of sightings of marked animals to estimate the population. A favorable quality of Bowden's estimator is that animal sightings can occur within a less structured survey.

Assumptions of Bowden's estimator include: 1) each animal has an equal chance of being marked, 2) the number of times a marked animal is seen is recorded without error (i.e., marks are not lost), 3) sighting effort must be adequate enough to produce ≥1 sighting per marked animal and preferably many sightings of marked animals would occur, 4) sightings of unmarked animals are determined without error, 5) likelihood of sighting is independent of marked status, and 6) the population is closed to additions and removals.

There are 3 options for sighting effort. First, predetermined routes could be surveyed by assigned individuals. Second, personnel from the PGC and Bureau of Forestry personnel could be asked to record elk sightings during the course of everyday activities for a predetermined period of time. And finally, a combination of fixed routes and workday sightings could be used.

This survey will be conducted in phases until we find the best methodology that will provide the most repeatable and reliable results. In the fall of 2003, we conducted our first survey using this technique, using limited personnel from Wildlife Management, local WCOs, and LMOs. We used a combination of survey routes and opportunistic sightings. In the spring and fall of 2004 we expanded this effort to include PGC Food and Cover and

Department of Conservation and Natural Resources (DCNR) Forestry and Parks personnel and increased the number of routes conducted.

Recruitment

Radio-collared cows were monitored from May to August 2005 to determine calf production. Radio-collared cows were frequently located to determine if they had calved. Date, age, location, and radio frequency were recorded for all initial sightings of radio-collared cows with a calf. To verify if a radio-collared cow produced a calf, the calf had to be observed nursing the cow or separated from other elk with a single calf. To determine elk calf survival, newborn calves were captured (without immobilization drugs) $\leq$5 days old and fitted with an expandable-breakaway radio-collar equipped with a mortality sensor (Advanced Telemetry Systems, Isanti, Minnesota). Observations of radio-collared cows and calves will continue throughout the next year to verify initial observations and monitor calf survival.

Mortalities

Known elk deaths were recorded from 31 January 2005 to 31 January 2006. Mortalities were recorded by cause, date of death, sex, age, and location for each elk. Field or laboratory necropsies were performed by Pennsylvania State University Animal diagnostics laboratory to determine cause of death, when appropriate.

Harvest

Commission personnel manned a check station in Quehanna Wild Area during the 6-day elk season from 7-12 November 2005; successful hunters were required to visit the check station within 24 hours of harvest. All elk were inspected, and a harvest report was completed. Sex, age, weight, antler and body measurements, harvest time and location, hunter information, and previous tagging information were recorded. A central incisor was removed for cementum age analysis. Blood samples were collected in the field by hunters for brucellosis testing. Tissue samples were collected for CWD and tuberculosis.

RESULTS

Population Surveys

This fall (12 September to 14 October), personnel from the PGC Bureau of Wildlife Management, PGC northcentral region, and DCNR conducted the elk population survey. A total of 28 survey routes were designated across the entire elk range. Opportunistic sightings were also included in calculations.

Seventy survey routes were completed in 2005. In addition, 144 opportunistic sightings were included. A total of 1112 (62 marked, 1050 unmarked) were observed. There were 48 (40 in 2004) marked and numbered elk available.

The population estimate resulting from the fall 2005 survey was 714 (477 in 2004) (95% confidence interval 502-1016). Average number of sightings per marked elk was 1.291 (1.975 in 2004).

Overall, We are pleased with the performance of the new survey; however, we experienced a new but expected problem with the survey this year.

An abundant acorn crop this year lead to decreased sightablity of marked elk as well as unmarked elk overall. We did not see 18 of the 48 marked elk during the survey. This was caused by the heavy use of the abundant acorn crop this past fall. Furthermore, this influenced the confidence we have in the survey results. We also ran 25 survey routes without seeing a single elk. In the future we may not run surveys when acorn crops will be heavy.

Based on this result and its comparison with previous years (Figure 1), we are encouraged that Bowden's estimator will provide an effective alternative to the former aerial survey.

Recruitment

To measure calf survival, project personnel (with assistance from Food and Cover personnel, local LMO and WCO, DCNR personnel, and deer project personnel) captured 22 newborn calves and equipped them with expandable-breakaway collars with mortality sensors during the 2005 calving season. Three collars were shed and we have had 3 mortalities. One calf was legally harvested, 1 illegally, and another died of unknown causes. Kaplan-Meier survival estimation results are pending. Eighty percent (24 of 31) of the radio-collared cows calved during the 2005 season. Average weight was 42 lbs and average age at capture was 3 days.

Mortality

Records were compiled on 37 known elk mortalities (excluding legal harvest) from 31 January 2005 to 31 January 2006 (Table 1); this is an increase from the 30 known mortalities in 2004. Elk-vehicle collisions (13), crop damage kills (7), illegal harvests (5), brainworm (5), and accidental (2) were the leading causes of known elk mortality.

Harvest

Forty-one hunters participated in the 6-day elk season from 7-12 November 2005. Thirty-five hunters successfully harvested an elk. Twenty-five antlerless and 10 antlered elk were harvested in Elk, Cameron, and Clearfield counties. Average dressed weight of cows was 329 lbs and 565 lbs for bulls. Cementum aging analysis showed cows averaged 6.7 (7.5 in 2004) years old and 5.6 (5.7 in 2004) for bulls (Figure 2). All elk tissue and blood samples tested for CWD, tuberculosis, and brucellosis were negative.

RECOMMENDATIONS

1. Continue to evaluate Bowden's estimator for conducting a ground based elk survey.

2. Begin habitat use and food habits study using radio-collared elk.

3. Monitor movements, dispersal and survival of radio-collared elk using radio telemetry via vehicle and aircraft.

4. Maintain the elk check station to collect biological data and continue disease testing of harvested elk.

5. Monitor radio-collared newborn calves for survival and capture 20 calves and equip with expandable-breakaway collars equipped with mortality sensors during the 2007 calving season.

6. Recollar calves from the 2005 calving season with radio collars to monitor survival until death.

Table 1. Causes and number of known elk mortalities by sex and age in Cameron, Clearfield, Clinton, and Elk counties, Pennsylvania, 31 January 2005 to 31 January 2006.

	Male			Female			
Cause	<1 yr	1 – 2 yrs	>2 yrs	<1 yr	1 – 2 yrs	>2 yrs	Total
Crop Damage		1	6				7
Highway	1	3	2	2		5	13
Illegal			3			2	5
Unknown						3	3
Rumen Acidosis					1		1
Accidental	1					1	2
Brainworm[a]			1		3	1	5
Other				1			1
Total	2	4	12	3	4	12	37

[a] Confirmed by necropsy at Penn State University Animal Diagnostics Lab.

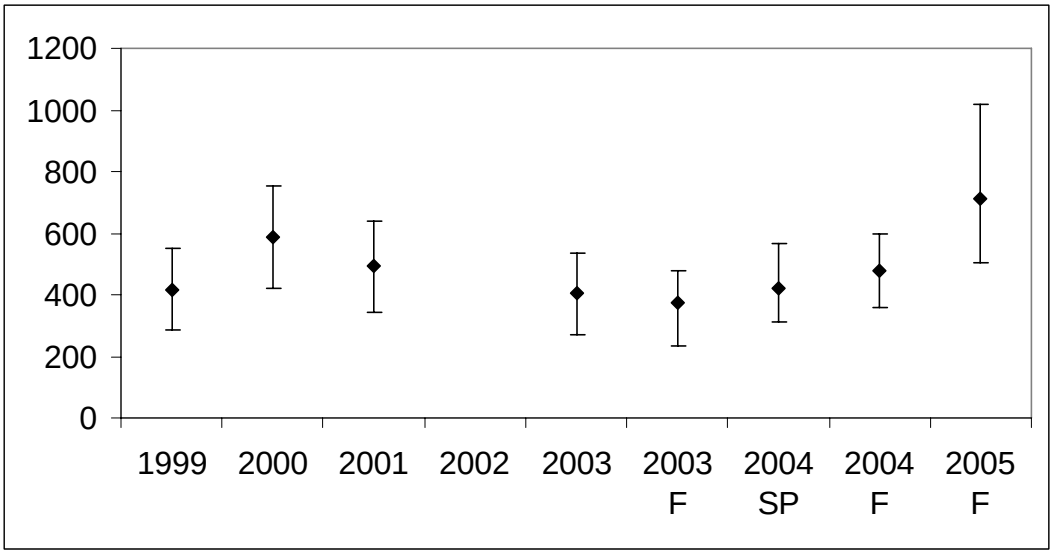

Figure 1. Elk population estimates and 95% confidence intervals from aerial and ground surveys, Pennsylvania, 1998-2005. (F = Fall, SP = Spring; other years were conducted in winter).

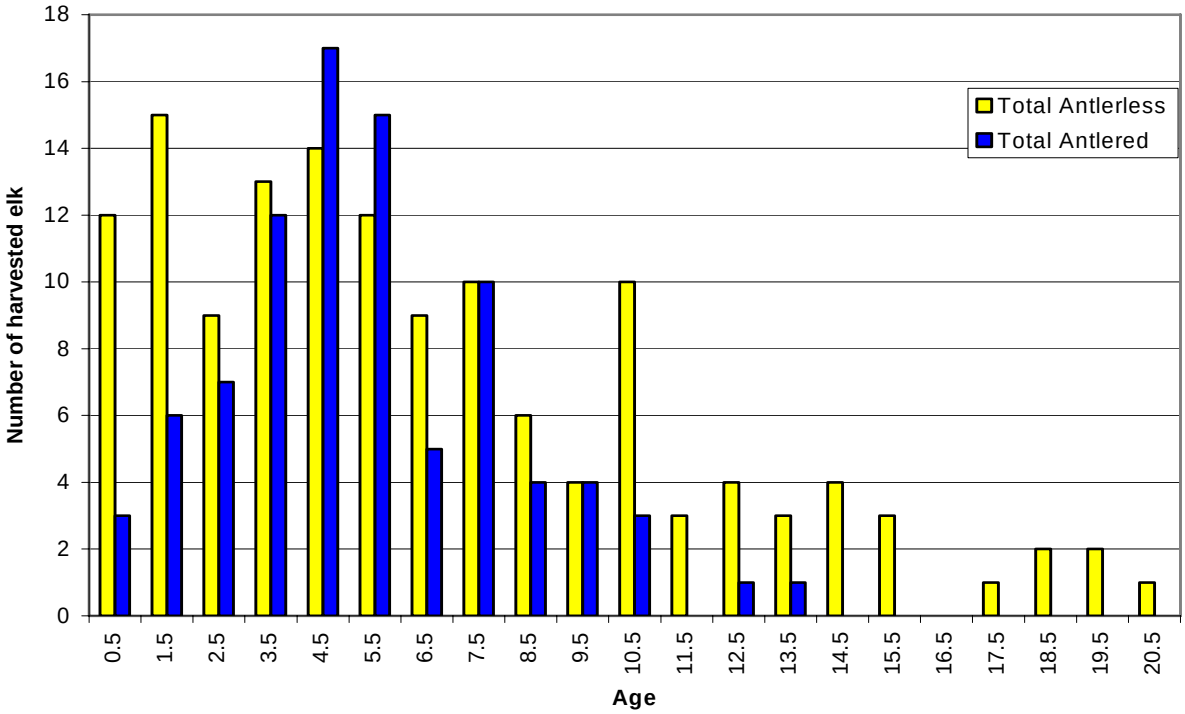

Figure 2. Age of harvested elk in Pennsylvania determined by cementum analysis from 2001-2005 (n=225).