

**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 2006 to 30 June 2007

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; Indiana State University of Pennsylvania, Indiana, Pennsylvania.

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

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DATE: 5 July 2007

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 2006 ground based elk survey. The population estimates resulting from fall 2006 was 638 (95% confidence interval 453-900). Known elk mortalities (46) were recorded January 2005 through January 2006. Elk-vehicle collisions (17) and crop-damage kills (8) were the leading causes of known elk mortality. Two elk were harvested in the September elk season. Forty hunters participated in the 6-day elk season from 6-11 November 2006. Thirty-three elk (14 antlered and 19 antlerless) were harvested during the sixth elk season in 70 years resulting in a harvest rate of 83%. 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 continuing the 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 ≥ 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 2.0 cc of Naltrexone (50 mg/cc) intravenously and 4.0 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. Additionally, this year we used global positioning collars (Advanced Telemetry Systems, Isanti, Minnesota, USA).

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 2006 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) ≤ 7 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 15 October 2005 to 15 October 2006. Mortalities were recorded by cause, date of death, sex, age, and location for each elk. The time frame of yearly mortalities has changed to reflect the current survey. Mortalities are recorded from survey to survey. 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 6-11 November 2006; 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. For the early season from 18-22 September and 21-28 October 2006, the same information was collected at the check station; however, the check station was located at Elk Power in St. Marys, Pennsylvania. Hunters were to call the NCRO and would be met by PGC personnel at the check station.

RESULTS

Population Surveys

This fall (11 September to 13 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.

Sixty-six survey routes were completed in 2006 (70 in 2005). In addition, 162 (144 in 2005) opportunistic sightings were included. A total of

1848 sightings were observed, of those 106 were marked (1112 and 62 marked, in 2005). There were 44 (48 in 2005) marked and numbered elk available.

The population estimate resulting from the fall 2006 survey was 638 (714 in 2005) (95% confidence interval 453-900). Average number of sightings per marked elk was 2.47 (1.291 in 2005).

Overall, We are pleased with the performance of the survey this year. Unlike last year, we did not see the negative impact of an early abundant acorn crop and feel that this years results are more representative of the population than last years estimate.

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; however, with elk dispersed over 800 mi² it is still labor intensive.

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 during the first year of life. One calf was legally harvested, 1 illegally, and another died of unknown causes. In 2006, 15 calves were captured with one mortality occurring from pneumonia. In 2007, we have captured 28 newborn calves. We have had 3 calf mortalities to date. Results of necropsies are pending. Kaplan-Meier survival estimation results are pending. Average calf weight from 2005-2007 was 42 lbs at capture (n=58). Seventy-one percent (22 of 31) of radio-collared cows calved during the 2006 season.

Mortality

Records were compiled on 46 known elk mortalities (excluding legal harvest) from 15 October 2005 to 15 October 2006 (Table 1); this is an increase from the 30 known mortalities in 2005. Elk-vehicle collisions (17), crop damage kills (8), illegal harvests (4), brainworm (6), and accidental (3) were the leading causes of known elk mortality.

Harvest

Ten hunters participated in the 2-week September-October elk season. Two hunters successfully harvested antlerless elk. Forty hunters participated in the 6-day elk season from 6-11 November 2006. Thirty-three hunters successfully harvested an elk. Nineteen antlerless and 14 antlered elk were harvested in Elk, Cameron, and Clearfield counties. Cementum aging analysis showed cows averaged 9 (6.7 in 2005) years old and 6.6 (5.6 in 2005) 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 2008 calving season.

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.

Cause	Male			Female			Unknown			Total
	<1 yr	1-2 yrs	>2 yrs	<1 yr	1-2 yrs	>2 yrs	<1 yr	1-2 yrs	>2 yrs	
Unknown	1	1	1			2				5
Highway	1	4	5	1	1	3	2			17
Illegal Harvest			2			2				4
Crop Damage		1	5		1	1				8
Brainworm ^a			5			1				6
Accidental		1	2							3
Train										0
Other	1		1	1						3
Total	3	7	21	2	2	9	2	0	0	46

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

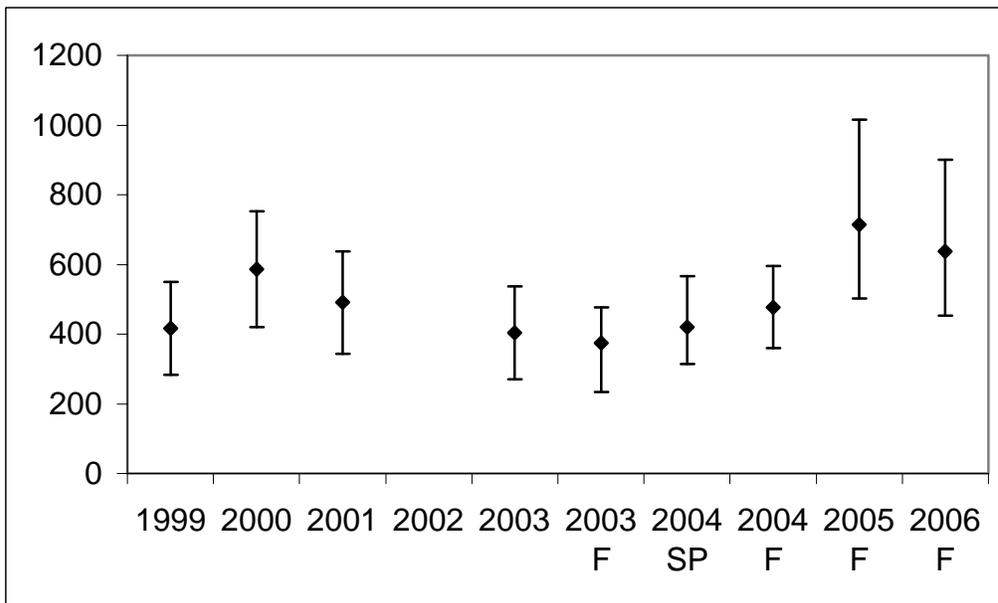


Figure 1. Elk population estimates and 95% confidence intervals from aerial and ground surveys, Pennsylvania, 1998-2006. (F = Fall, SP = Spring; other years were conducted in winter).

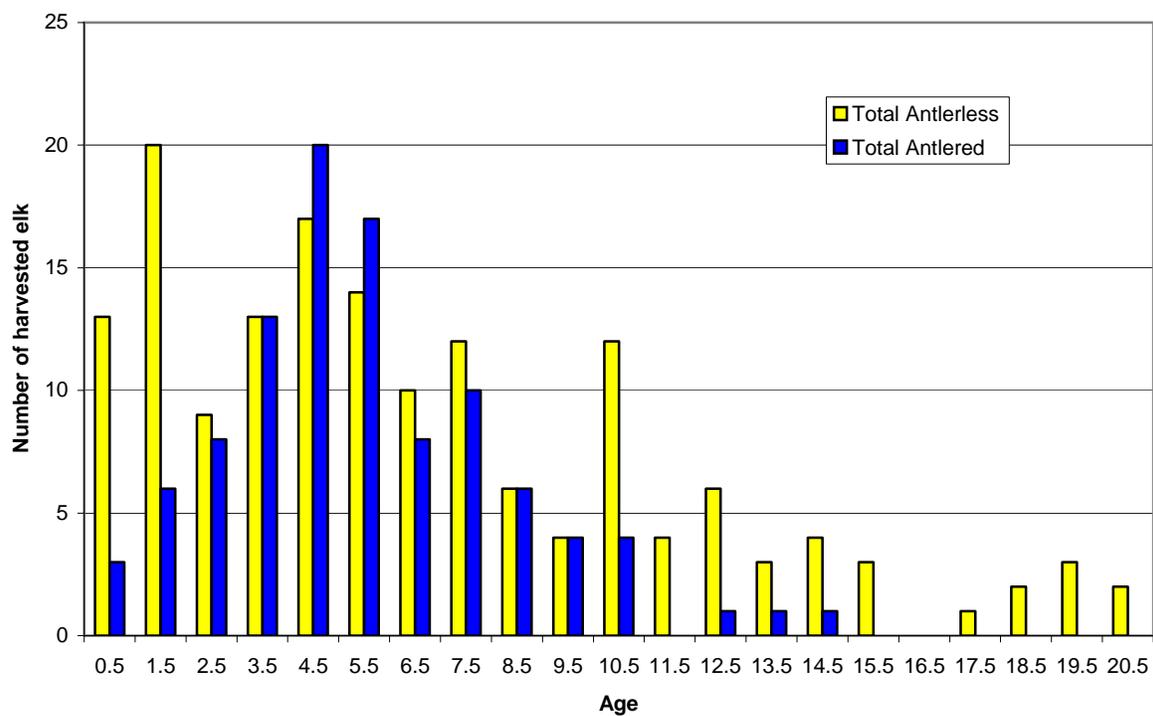


Figure 2. Age of harvested elk in Pennsylvania determined by cementum analysis from 2001-2006 (n=260).