

**PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
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 2015 to 30 June 2016

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

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

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ABSTRACT From July 2015 – June 2016 we monitored elk (*Cervus elaphus*) abundance, demography, distribution, and mortality using individual animals marked with radio-collars. We also collected biometric data post-harvest from a mandatory elk check station during the elk hunting season. From January through February 2016 we conducted a minimum number alive survey yielding a total of 996 elk. The percentage of the population in each sex and age class remained relatively consistent across all years with an overall average of 56% adult cows, 21% calves, 16% branched-bulls and 7% spike bulls. The number of branched bulls per 100 cows for the 2016 survey was 28. The number of calves per 100 cows for the 2016 survey was 45. During the 2015 calendar year we documented 50 non-hunting related elk mortalities with vehicle collisions (13) being the leading source of known mortality. For the 2015 elk hunting season 27,592 hunters applied for 116 licenses. Ninety-five percent of antlered elk hunters harvested an elk while 68% of antlerless hunters harvested an elk. All elk tissue and blood samples tested for chronic wasting disease, tuberculosis, and brucellosis were negative.

OBJECTIVE

1. To quantify annual variation in the elk population's abundance, demographic structure, distribution, and sources of mortality.
2. To summarize annual elk harvest data.
3. To summarize annual elk-human conflicts.

METHODS

Population: Abundance and Demography

Since 1971, annual population surveys have been used to estimate elk abundance and classify individuals by sex and age. While the specific survey method has varied through time (DeBerti 2010), a minimum number alive count has been used from 2008 to the present. More specifically, in late winter (January-February) 2016, for approximately 40 days, we counted all elk observed in the Elk Management Area (EMA). We concentrated our searches in an area for several days and used radio-collared elk to locate herds and avoid double counting. We counted the same groups on several different occasions to ensure accurate results, and in some cases we utilized helicopters to verify our observations. We classified individuals by sex (bulls and cows) and age (adult cows, calves, adult bulls, and yearling bulls) and designated each group to a specific hunt zone. Hunt zones are designed and delineated to encompass a group of elk that occupy and move in the same general area over the course of a year.

For each year we calculated the percentage of adult cows, calves, adult bulls, and yearling bulls (spikes) within the population. In addition, we calculated the number of branched bulls (adult) per 100 cows by dividing the total number of bulls by the total number of cows, multiplied by 100 ($(\# \text{ bulls} / \# \text{ cows}) * 100$). Similarly, we calculated the number of calves per hundred 100 cows by dividing the total number of calves by the total number of cows, multiplied by 100 ($(\# \text{ calves} / \# \text{ cows}) * 100$).

Distribution and Mortality

To monitor the elk population's distribution and sources of mortality we captured individuals from all age classes (calves, yearlings, and adults) and fit them with radio collars. Elk >1 year old were captured by administering 1.0 cc Carfentanil citrate (Wildlife Laboratories, Inc., Fort Collins, Colorado, USA) via remote injection (Pneu-Dart Inc., Williamsport, Pennsylvania, USA) or by trapping using a modified clover trap (Thompson et al. 1989). Trapped elk were administered 0.75-3.0 cc *BAM* (Butorphanol tartrate (27.3 mg/ml), Azaperone tartrate (9.1 mg/ml), and Medetomidine HCl (10.9 mg/ml)) depending on body mass via short range dart pistol. All capture elk were sexed, aged (Quimby and Gaab 1957), and blood samples were collected for subsequent disease and pregnancy testing. After processing, an antagonist (6.0 cc Naltrexone: Wildlife Laboratories, Inc., Fort Collins, Colorado, USA) was administered and each elk monitored to ensure recovery. Newborn elk calves (≤ 7 days old) were captured without using immobilizing drugs and if needed fit with expandable-breakaway radio-collars (Telonics, Meza, Arizona). During capture calves were weighed, sexed, and aged (Johnson 1951).

Radio collared elk were regularly monitored and their locations recorded to assess the population's overall distribution. All radio collars were equipped with a mortality sensor set on an 8 hour delay. When detected, mortalities were classified by cause of death and the date, sex, age, and location of each elk was recorded. If needed, field or laboratory necropsies were performed by Pennsylvania State University Animal Diagnostics Laboratory to determine cause of death.

Harvest

Game Commission personnel operated an elk check station in the Quehanna Wild Area during the November season. Successful hunters were required to visit the check station within 24 hours of harvest (Pennsylvania Hunting and Trapping Digest 2015-2016). For the 2015 season all harvested elk were inspected, and a harvest report was completed. Sex, age, weight, antler measurements, harvest time and location, hunter information, and previous tagging information were recorded. A central incisor was removed for cementum annuli age analysis (Matson 1981). Blood samples were collected in the field by hunters and tested for brucellosis. Tissue samples

were collected and tested for chronic wasting disease (CWD) and tuberculosis (TB).

Elk-Human Conflicts

In late 2011 the Pennsylvania Game Commission established a computerized digital tracking system for all wildlife related incidents reported to the Game Commission. This includes phone calls from the public as well as incidents initiated by Conservation Officers. Elk related incidents are broken into 3 broad categories at the time of reporting, nuisance or damage, sick or injured, and road kills or dead. An address or location of the incident along with a written narrative is recorded at the time of reporting. These data, provided to the elk biologist on a bi-annual basis, are then linked to a latitude and longitude location and separated into finer categories. Categories are assigned according to the description of the incident or conflict.

RESULTS

Population: Abundance and Demography

During the 2016 minimum number alive survey we counted a total of 996 elk, an increase from the 821 counted in winter 2015 (Fig. 1). On several occasions during the 2016 count we used digital cameras to capture images of large groups and later examined and classified individuals. For 2 days during the count we used a helicopter to locate radio-collared animals on private land.

Despite the increase in the count between 2015 and 2016 caution should be used when interpreting these values. The minimum count is heavily influenced by the probability of detecting unmarked groups (groups with no radio-collared elk). The relatively mild winter (2016) provided easy access to remote areas and during the 2016 count we observed unmarked groups on 19 separate occasions adding 245 individuals. In contrast during the 2015 winter count heavy snowpack reduced access to remote areas and we counted only 11 unmarked groups adding just 65 elk. Despite inherent limitations the minimum count does provide a reasonable index for monitoring long term population trends, and our results to date indicate a slowly increasing population.

For 2016, demographic structure of the population remained relatively consistent within the long term averages (Fig. 2). The percentage of branched bulls (15.2%) was near the long term average of 16.1% yielding a ratio of 28 bulls per 100 cows (Table 5). The percentage of calves (24.5%) was likewise near the long term average of 21.3% yielding a ratio of 45 calves per 100 cows. Monitoring of the populations demographic structure will continue and management strategies will be adjusted as needed.

Distribution and Mortality

In 2015 we captured and marked 18 (9 males, 9 females) adult elk with a radio collar. Of the 18 collars we deployed 13 were Vectronic global positioning system (GPS) collars capable of remote download, and 5 captures were accomplished using a modified clover trap. As of August 2015, we began using GPS collars for all elk captures and will no longer deploy standard VHF collars.

In spring of 2016 we captured 16, newborn elk calves, but given their capture locations and the number of collars in the surrounding area we did not fit any with radio collars. Including data from all years (2005-2016) yields a near 50:50 male to female sex ratio and average calf weights categorized by year and sex are summarized in Table 2.

In 2015 we documented 50 non-hunting related elk mortalities (Table 1). Of these, the leading cause of known (non-hunting) mortality was elk-vehicle collisions (19 in 2015).

Harvest

For the 2015 elk hunting season 27,592 hunters (Fig. 4) applied for 116 licenses. From 2009-2013 one either-sex “special conservation tag” was auctioned by a non-profit conservation organization, with 80% of the proceeds returning to the Game Commission for elk management (Table 4). In summer 2014 legislation was passed renewing the special conservation elk tag along with the addition of a second conservation tag dedicated to the Keystone Elk Country Alliance (KECA). The KECA chose to raffle this tag selling tickets for \$25.00 a piece or 6 for \$100.00. Details on the special conservation elk tag are summarized in Table 4. During the 2015 elk hunting season, licensed antlered elk hunters were 95% successful, while antlerless hunter success was 68% (Table 3).

Results from cementum annuli age analysis for 2001-2015 are presented in Figure 5 (antlerless) and Figure 6 (antlered). The distribution of ages for antlerless elk is right skewed with a mean of 6.8 years and indicates a greater proportion of young animals are harvested on antlerless tags. Overall the distribution of ages for antlered elk appears normally distributed around a mean of 5.7 years.

All elk tissue and blood samples tested for CWD, tuberculosis, and brucellosis were not detected or negative.

Elk-Human Conflicts

In 2015, the Game Commission received 91 elk related incidents an increase from the 81 received in 2014 (Table 6). The majority of these were related to elk-vehicle collisions (~31%) and reports of elk mortalities (~27%). We intend to use these values as indicators of social tolerance, and hope to drive them down through public hunting and continual public land habitat improvement.

RECOMMENDATIONS

1. Continue to monitor movements, dispersal, distribution, and survival of radio-collared elk using radio telemetry via vehicle and aircraft.
2. Maintain the elk check station to collect biological data and continue disease testing of harvested elk.
3. Develop a structured process for determining the number of licenses issued based on population trends and management objectives for each Elk Hunt Zone (EHZ).
4. Evaluate the boundaries of the current hunt zone in relation to elk telemetry data.
5. Evaluate the validity of assumptions and population monitoring procedures through internal and external peer review. Prioritize research needs based on internal and external reviews.

LITERATURE CITED

- DeBerti, J. M. 2010. Elk population survey and harvest management. Pennsylvania Game Commission, Harrisburg, USA.
- Johnson, D. E. 1951. Biology of the elk calf, *Cervus canadensis Nelson*. Journal of Wildlife Management 15:396-410.
- Matson, G. M. 1981. Workbook for cementum analysis. Milltown, Montana, USA.
- Quimby, D. C. and Gaab J. E. 1957. Mandibular dentition as an age indicator in Rocky Mountain Elk. Journal of Wildlife Management 21:435-451.
- Thompson, M. J., R. E. Henderson, T. O. Lemke, and B. A. Sterling. 1989. Evaluation of a Collapsible Clover Trap for Elk. Journal of Wildlife Management 17:287-290.

Table 1. Causes and number of known Pennsylvania elk mortalities by year, 2011-2015.

Cause of Death	2011	2012	2013	2014	2015	Total
Highway	14	19	20	13	19	85
Undetermined	15	5	9	32	12	73
Crop Damage	6	5	3	4	0	18
Other	8	0	2	5	6	21
Accidental	3	5	1	5	1	15
Illegal	2	0	4	5	6	17
Meningeal Worm	4	0	2	0	6	12
Trains	1	0	0	1	0	2
Total	53	34	41	65	50	243

Table 2. Mean newborn elk calf weights and number of individuals captured by sex and year, 2005-2016.

Year	Female		Male	
	Mean Weight (lbs)	# of calves	Mean Weight (lbs)	# of calves
2005	40.2	11	41.6	10
2006	37.5	7	43.5	6
2007	40.5	15	45.9	12
2008	35.5	14	39.4	10
2009	39.8	13	43.0	9
2010	37.4	9	43.3	11
2011	28.7	4	41.1	3
2012	41.2	4	-	0
2013	32.5	3	38.3	2
2014	38.3	6	47.1	5
2015	40.2	5	45.5	6
2016	37.5	10	44.1	6
Means	37.4	8.4	43.0	6.7

Table 3. Annual number of Pennsylvania elk hunting licenses issued and hunter success, 2001-2015.

Year	Licenses Issued			Hunter Harvest			Harvest Success (%)		
	Antlered	Antlerless	Total	Antlered	Antlerless	Total	Antlered	Antlerless	Overall
2001	15	15	30	14	13	27	93%	87%	90%
2002	36	34	70	32	29	61	89%	85%	87%
2003	20	80	100	19	49	68	95%	61%	68%
2004	12	28	40	12	22	34	100%	79%	85%
2005	10	30	40	10	25	35	100%	83%	88%
2006 [†]	15	25	40	14	19	33	93%	76%	83%
2007 [†]	15	25	40	14	19	33	93%	76%	83%
2008 [†]	17	28	45	17	23	40	100%	82%	89%
2009*	20	39	59	20	24	44	100%	62%	75%
2010*	17	33	50	17	23	40	100%	70%	80%
2011*	18	38	56	18	34	52	100%	89%	93%
2012*	19	46	65	19	33	52	100%	72%	80%
2013*	26	60	86	25	47	72	96%	78%	84%
2014**	27	81	108	25	63	88	93%	78%	81%
2015**	21	95	116	20	65	85	95%	68%	73%
Overall	288	657	945	276	488	764	97%	76%	82%

[†] Does not include September season.

* Does not include 1 either sex special conservation tag that resulted in the harvest of 1 antlered elk each year.

** Does not include 2 either sex special conservation tags that resulted in the harvest of 2 antlered elk each year.

Table 4. Summary of Pennsylvania's annual special conservation elk licenses including cost, participating organization and funding method from 2009-2016.

Year	Conservation Organization Contracted	Cost	Fund Raising Method
2009	National Wild Turkey Federation	\$28,000.00	Auction
2010	Rocky Mountain Elk Foundation	\$35,000.00	Auction
2011	Safari Club International	\$29,000.00	Auction
2012	Eastern Chapter of the Wild Sheep Foundation	\$37,500.00	Auction
2013	Rocky Mountain Elk Foundation	\$40,000.00	Auction
2014	Rocky Mountain Elk Foundation	\$41,000.00	Auction
2014	Keystone Elk Country Alliance	\$163,175.00	Raffle
2015	Rocky Mountain Elk Foundation	\$52,500.00	Auction
2015	Keystone Elk Country Alliance	\$157,150.00	Raffle
2016	Rocky Mountain Elk Foundation	\$85,000.00	Auction
2016	Keystone Elk Country Alliance	\$190,325.00	Raffle

Table 5. Ratio of branched bulls (excludes spikes) and calves per 100 cows by year for the Pennsylvania elk population, 2008-2016.

Year	Bull:100Cow:Calf
2008	28:100:32
2009	28:100:44
2010	31:100:36
2011	31:100:37
2012	30:100:31
2013	32:100:37
2014	32:100:37
2015	20:100:46
2016	28:100:45
Mean	29:100:38

Table 6. Summary of elk-related conflicts reported to the Pennsylvania Game Commission, 2012-2015. Note that specific categories may not match corresponding categories in Table 1 as they may have been reported by agency personnel.

Incident Nature		Description	2012	2013	2014	2015	Totals
	Entangled	The elk had no physical injuries, but was entangled in some debris or carrying some debris (typically antlered elk).	2	3	2	7	14
Elk Injured or Distressed	Found but Not Euthanized	Includes injuries where the probability of survival was high.	5	5	11	3	24
	Found and Euthanized	Includes injuries/behavior that prompted euthanasia.	1	2	10	4	17
	Not Found	The animal was never found/located.	10	10	14	3	37
	Unknown	The animal was injured but no additional information was available.	3	2	1	1	7
Elk Related Nuisance	Aggression	Includes aggressive behavior toward people, pets, or vehicles.	3	3	1	7	14
	General Discontent	Generally related to the unwanted presence of elk, or the potential for some form of damage to occur.	6	10	2	4	22
Elk Related Damage	Personal Property	Personal property including but not limited to, fences, vehicles, yards, gardens, shrubs or other landscaping, and houses or buildings.	15	5	6	5	31
	Crop / Agriculture	Damage to commercial agriculture.	2	5	3	1	11
	Damage - Other	Damage claims falling outside all other categories.	0	0	0	1	1
	Combat Related Mortality	Mortal injuries determined to originate from elk-to-elk combat (typically bulls).	1	3	0	1	5
Elk Mortalities	Poaching*	Elk killed illegally out-of-season or by unlicensed individuals.	0	1	0	2	3
	Crop Kills	Includes elk killed for crop depredation.	5	3	4	0	12
	Carcass Reported	Includes elk carcasses falling outside all other categories.	8	8	12	22	50

Table 6. cont.

Incident Nature	Description	2012	2013	2014	2015	Totals	Incident Nature
Elk-Vehicle Collisions	Died from Impact	The elk carcass was located nearby and injuries were related to a vehicle collision.	14	16	10	16	56
	Elk Euthanized	The elk was located and euthanized due to injuries.	6	4	4	4	18
	Elk Not Killed/Found	The elk was witnessed running away or was never located.	4	3	1	8	16
Unknown	Insufficient Information	Includes reports that did not include enough information to evaluate/summarize.	3	2	0	2	7
Totals			88	85	81	91	345

* Includes animals reported to the Pennsylvania Game Commission but does not include animals discovered by Agency personnel. See Table 1 for complete figures.

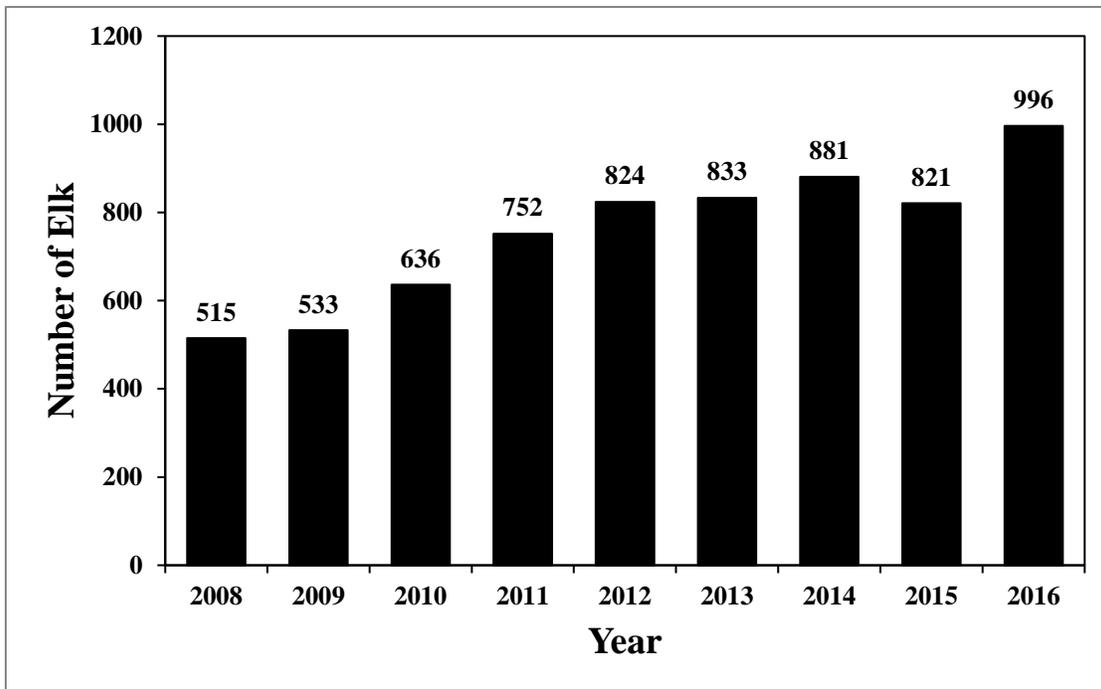


Figure 1. Annual minimum number alive count for Pennsylvania elk by year, 2008-2016.

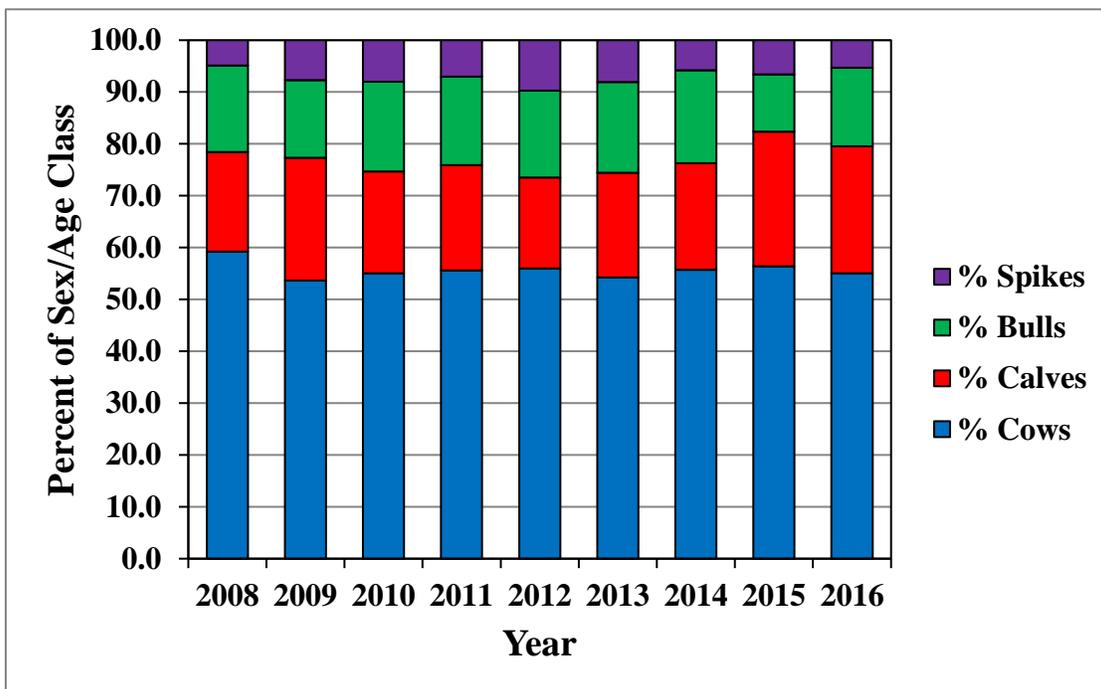


Figure 2. Percentage of sex and age classes for the Pennsylvania elk population by year, 2008-2016.

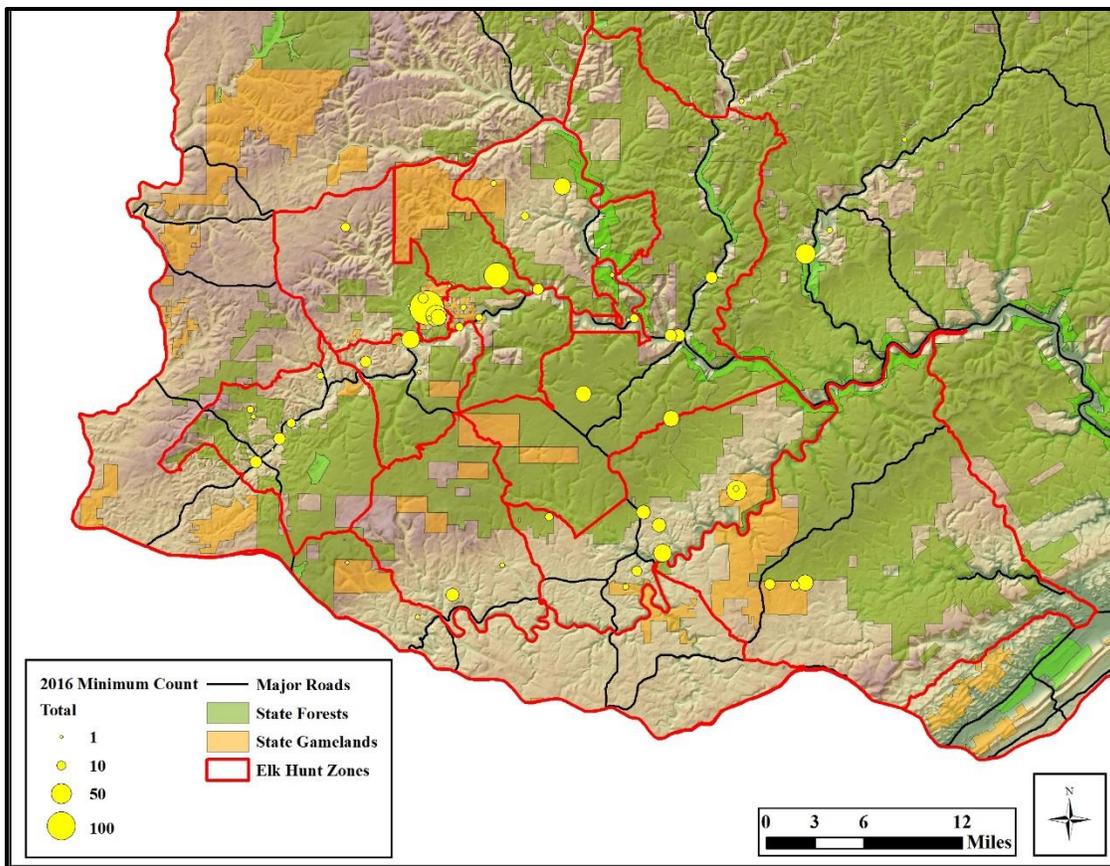


Figure 3. Distribution of elk observed during Pennsylvania’s 2016 minimum number alive count.

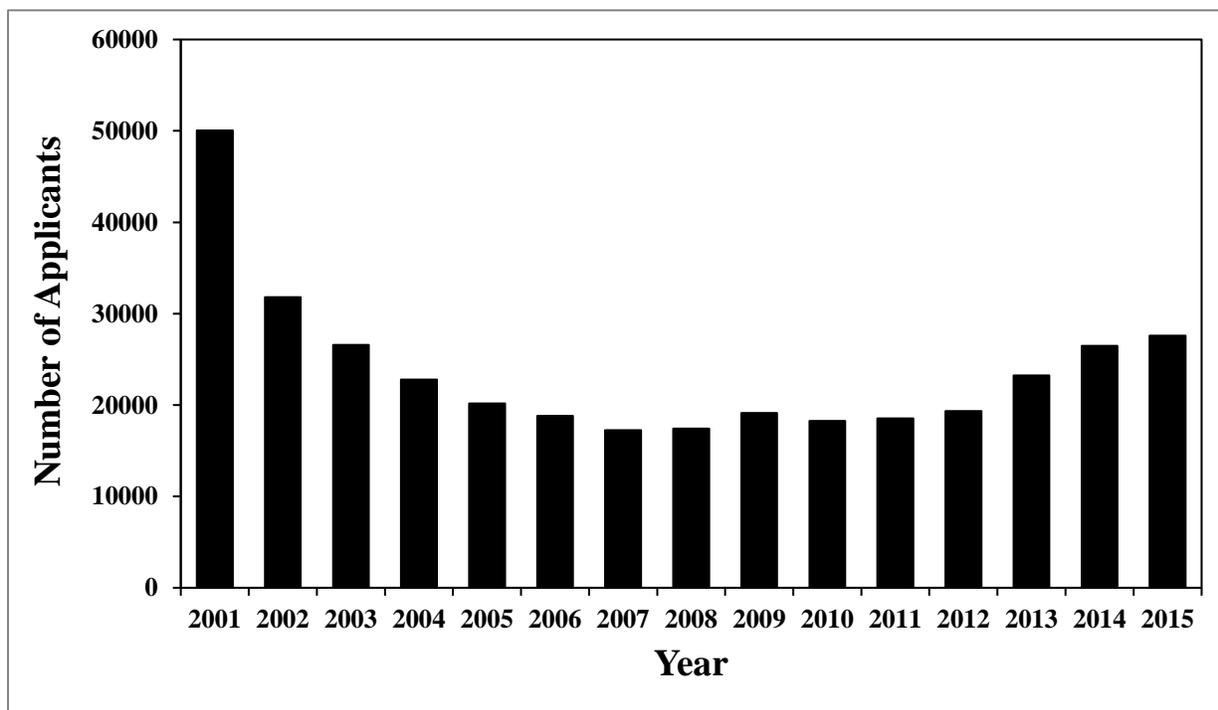


Figure 4. The number of hunters annually applying for an elk license by year, 2001-2015.

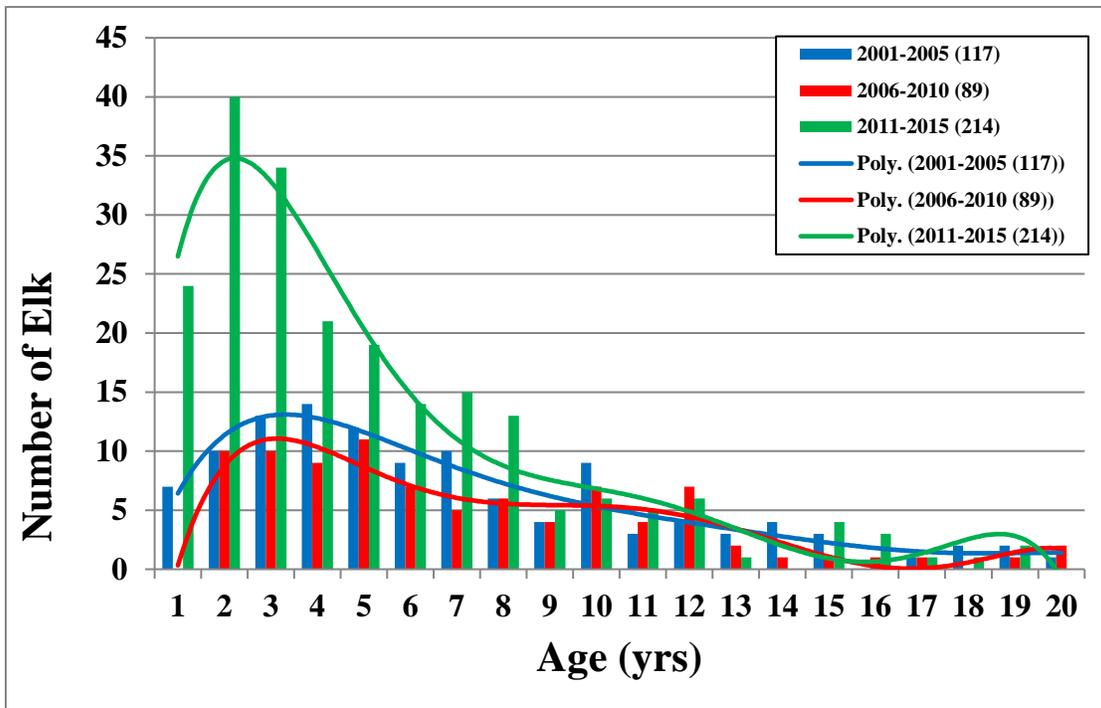


Figure 5. Age distribution of antlerless elk harvested in Pennsylvania between 2001-2015, determined by cementum analysis. Lines represent sixth order polynomial functions and () in the legend indicate sample sizes.

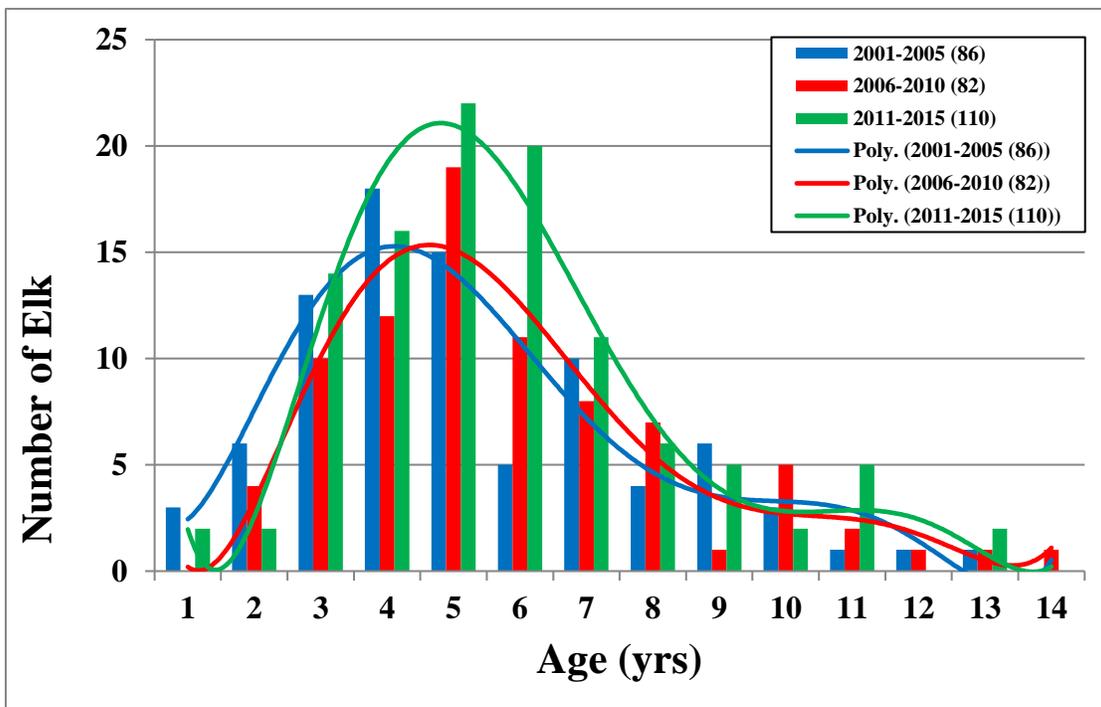


Figure 6. Age distribution of antlered elk harvested in Pennsylvania between 2001-2015, determined by cementum analysis. Lines represent sixth order polynomial functions and () in the legend indicate sample sizes.