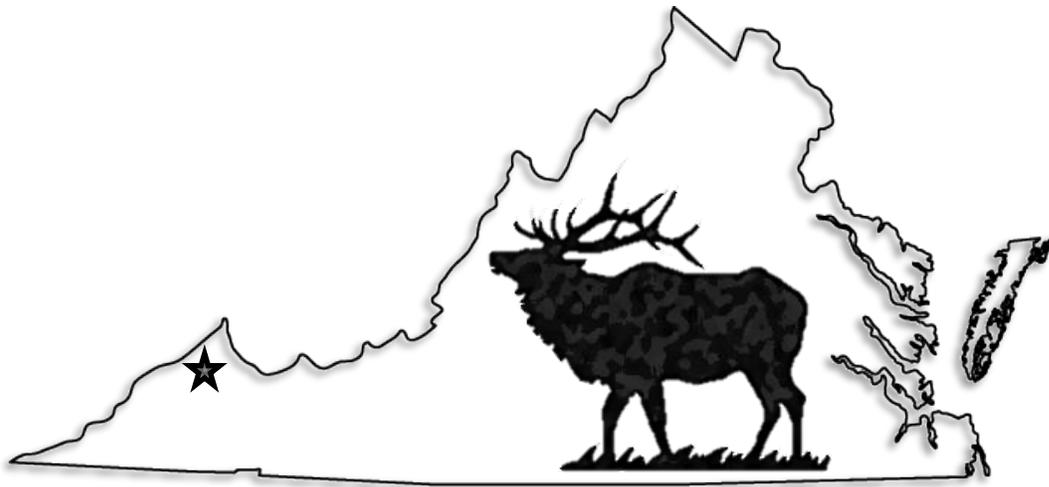


VIRGINIA ELK MANAGEMENT PLAN 2019–2028



MARCH 2019



DEPARTMENT OF
**GAME & INLAND
FISHERIES**

CONSERVE. CONNECT. PROTECT.

About the Authors

The Virginia Elk Management Plan was written by the elk program staff of the Virginia Department of Game and Inland Fisheries (DGIF), in collaboration with research partners from Virginia Polytechnic Institute and State University and the Elk Stakeholder Advisory Committee (SAC). The SAC was comprised of citizens, primarily from within southwest Virginia, chosen to represent the diverse interests of constituents with an interest in elk management issues. A description of the process used to develop this management plan is presented in the Introduction; a listing of SAC members is presented in Appendix A.

Acknowledgements

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EXECUTIVE SUMMARY

North American elk (*Cervus canadensis*) are the only species of the sub-family *Cervinae* found naturally in the New World. Taxonomically related species that dominate Europe (red deer [*Cervus elaphus*]) and having sub-species in Asia, the elk's persistence in the Western Hemisphere is a testament to its adaptability which allow it to survive in diverse habitats, in isolated populations, and to its ability to travel great distances to find needed resources. Elk arrived in North America after crossing the Bering Strait land bridge some 120,000 years ago, much later than other New World deer (*Capriolinae*) (e.g. white-tailed deer [*Odocoileus virginianus*] and mule deer [*Odocoileus hemionus*]), but prior to the arrival of humans who also used this same land bridge. Long before European settlers first arrived, evidence suggests a special connection existed between elk and native inhabitants — they depended on elk for food, worshiped them as deities, honored them in rituals, and depicted them in early cave art and on family crests.

In North America, subsistence hunting of elk has persisted for more than 16,000 years. Nearly all native cultures in North America hunted them, due in part to the wide distribution of this animal. At the peak of its establishment in North America, the elk's range stretched from the Pacific to the Atlantic Oceans, and from Canada in the north to Mexico in the south. During the period of rapid human population growth of the late 1600s and early 1700s, elk populations began to decline, especially in the East. The transition from subsistence hunting to market hunting created an unregulated, for-profit form of hunting that exploited elk populations for their meat and hides. Due primarily to this over-exploitation, elk in the eastern U.S. became extirpated by 1880. Elk in Virginia fared similarly — the last native elk in Virginia was harvested several years prior to the start of the Civil War in 1855.

Soon after the creation of Virginia Department of Game and Inland Fisheries (DGIF), restoration of elk within the Commonwealth became a priority. In the early 1900s, elk were released in 15 counties across the state, eventually creating a population of about 300 individuals by 1922. However, due to a number of factors (e.g., poor initial release site selection, poor habitat quality, poaching, over-harvest), the population withered and, by 1970, elk no longer were found in Virginia.

In 1997, Kentucky's Department of Fish and Wildlife Resources initiated a 5-year plan with the intent to restore elk in the eastern 1/3 of the state; during this period, the agency released over 1,540 elk. Given the proximity of this activity to Virginia, DGIF, in collaboration with Virginia Tech, conducted a study to assess the feasibility of restoring elk to the Commonwealth. This study, completed in 2000, examined both the biological and socioeconomic aspects of a restoration, with an intent to identify locations where successful population establishment and public support both would be high. Although habitat suitable to meet the needs of elk did exist within the Commonwealth, the potential for human-elk conflict and concerns for disease introduction ultimately forestalled any attempts to begin re-establishment in Virginia over the next decade.

However, by 2000 a number of elk had dispersed from Kentucky into adjacent Virginia counties, and attempts to capture and return them to Kentucky proved impractical. In an attempt to prevent elk from becoming established in Virginia, DGIF allowed elk of either sex to be harvested during all deer hunting seasons beginning in 2001. Despite these measures, several small herds of elk found refuge in Virginia near the Kentucky border. With growing interest in

elk - and no disease detections a decade after Kentucky's first elk reintroduction- a new paradigm in elk management developed.

A growing desire developed to receive some benefits associated with an elk herd becoming more evident in Virginia. By 2009, interest in elk prompted a new evaluation of southwest Virginia as a potential area for elk, and the DGIF Board directed the agency to develop an operational plan for the restoration of elk. Consequently, in 2011 the hunting of elk was prohibited in Buchanan, Dickenson, and Wise Counties. Starting in 2012 and continuing into 2014, DGIF released 75 elk within an Elk Restoration Area (ERA), comprised of three counties: Buchanan, Dickenson, and Wise, and imposed a prohibition on the harvest of any elk within said zone; however all elk releases were confined to reclaimed mined lands in Buchanan County only. Outside the ERA, it was and still is legal to harvest an elk under a valid deer tag. Although DGIF subsequently advertised a proposal to significantly expand the area of protection afforded to elk, the proposal was withdrawn before it could be enacted.

Since 2014, the elk population in Virginia has grown, and with this increase has come challenges and opportunities. Given the controversy associated with elk restoration in Virginia, and an expressed recognition of need for having an elk management plan similar to those already adopted by DGIF for white-tailed deer, black bear (*Ursus americanus*), and wild turkey (*Meleagris gallopavo*), DGIF contracted Virginia Tech in 2016 to initiate a facilitated public involvement process leading to the development of the Virginia Elk Management Plan.

This 10-year management plan lays out how DGIF intends to manage a sustainable population of elk for the benefit of all constituents of the Commonwealth. The agency sought professional input and the shared wisdom of wildlife managers from other eastern states where elk recently have been established to help guide management. However, the core of the plan reflects value choices expressed by a diverse array of stakeholders from across both public and private sectors who may be affected by or have interest in elk. To accomplish this, a 17-member Stakeholder Advisory Committee (SAC) was convened to represent the interests of a cross section of stakeholders, including hunters, agricultural and livestock producers, homeowners, forest landowners, animal and ecological health interests, business and tourism industries, motorists, and local, state, and federal agencies. The SAC was responsible for identifying the goals that should drive elk management in Virginia. DGIF staff with technical expertise in matters related to elk management comprised an Elk Technical Committee, which was responsible for developing the objectives and strategies to attain the goals set forth by the SAC and to assure that management is consistent with sound biological foundations and with Virginia Code and regulations. Additional public input obtained via a survey of stakeholders and through advertisement of the draft plan for broad public review has been incorporated to create the final plan. Resource managers and researchers external to DGIF provided technical feedback on the draft plan. The plan was presented to, and endorsed by, the DGIF Board of Directors on March 21st, 2019.

Following is a brief summary of the guiding principles and goals for elk management in Virginia over the next 10 years. A complete and detailed presentation of objectives and strategies is available in the "Mission, Goals, Objectives and Strategies" section of this plan.

OVERARCHING GUIDING PRINCIPLES FOR ELK MANAGEMENT

1. Elk should be managed as a wild, free-roaming public resource that meets the needs, and interests of Virginians using methods that are:

- innovative,
- fiscally responsible,
- flexible,
- adaptive,
- proactive,
- transparent,
- technically and scientifically sound,
- more natural than artificial,
- safe,
- ethical,
- humane, and
- based on continuing public input and involvement.

2. For the purposes of this plan, Buchanan, Dickenson, and Wise Counties are designated as the Elk Management Zone (EMZ) of Virginia and shall be referenced as such in all relevant documentation and regulations. Outside the EMZ, no resident elk are recommended during the tenure of this plan.

3. No more reintroductions of elk from outside Virginia are planned or recommended at this time.

4. Any deviations from the goals or guiding principles specified in this plan will require public review and involvement of both an Elk Stakeholder Advisory Committee (SAC) as well as technical guidance from the Elk Technical Committee (ETC).

GOAL STATEMENTS:

Goal statements, as presented in this plan, purposefully align with the agency's recently revised mission and vision statements. Goals for elk encompass many of the same broad values associated with all wildlife, as expressed in the agency's mission and vision, but provide additional detail as to how and when each goal is to be attained.

CONSERVE GOAL 1: *Manage elk in a manner that maintains a healthy and viable population within the EMZ.* (pg. 91 – 94)

Objectives, with associated strategies, direct DGIF to:

- determine what constitutes a minimum viable elk population and the requisite habitat needs of such a population;
- assure that a minimum viable elk population exists within the Elk Management Zone, unless an official response to a mitigating circumstance (e.g., disease outbreak) warrants reducing the population below the defined minimum threshold.

CONSERVE GOAL 2: *Manage local elk populations in ways that balance:*

- *the current desires and expectations of Virginia’s geographically and culturally diverse human populations regarding both the costs and benefits related to elk,*
- *the integrity and needs of a biologically diverse and sustainable ecosystem, and*
- *anticipated future ecological needs and societal demands.* (pg. 95 – 100)

Guiding Principles for Conserve Goal 2:

- Recreational hunting is the preferred management approach to managing elk populations.
- No more reintroductions of elk from outside Virginia or expansion of the EMZ boundaries are planned or recommended at this time.
- Growth of the elk population within the EMZ should occur primarily through natural reproduction and dispersal.

Objectives, with associated strategies, direct DGIF to:

- minimize negative impacts inflicted by elk on ecosystem functioning that adversely affect the maintenance of a biologically diverse and native ecosystem;
- reexamine and, where necessary, adjust elk population management approaches to meet Cultural Carrying Capacity (CCC);
- maintain or increase the number of hunters sufficient to accomplish stated elk population management objectives via retention, recruitment, or reactivation.

CONSERVE GOAL 3: *Consistent with the attainment of the plan’s conserve, protect, and connect goals, manage elk in ways that provide balanced benefits and enjoyment derived from elk-related activities via publicly accessible recreation opportunities for all wishing to pursue them.* (pg. 100 – 106)

Objectives, with associated strategies, direct DGIF to:

- strategically increase access to the elk resource for participants in elk-related activities;
- increase participation, as measured using metrics of participant visitation, in non-hunting recreational opportunities associated with elk within the Elk Management Zone and, when opportunities become available, for hunting;
- improve satisfaction of hunting and non-hunting-based elk recreationists;
- define, and where necessary modify, how recreational elk hunting will take place to meet hunter satisfaction and population goals throughout Virginia;
- improve adoption and sustainability of recreational elk hunting behaviors that embody fair chase and ethical harvest.

CONNECT GOAL 1: *Consistent with the plan’s other goals, improve understanding and knowledge of the options, tools, and strategies available to manage elk while promoting awareness of elk, their role in the ecosystem, and their conservation.* (pg. 107 – 109)

Objectives, with associated strategies, direct DGIF to:

- increase the public’s knowledge about and understanding of elk management, elk life history and behavior, and their role in the ecosystem.

PROTECT GOAL 1: Minimize and mitigate local and regional human-elk conflicts. Promote a shared public-agency responsibility for managing conflicts, consistent with the attainment of other stated goals. Hunting is the preferred damage management approach, wherever feasible and safe to do so. (pg. 109 – 114)

Objectives, with associated strategies, direct DGIF to:

- minimize as much as possible the risk of elk-related disease outbreaks that may threaten humans or domestic animals;
- ameliorate and/or mitigate elk damage to agricultural operations, residential properties, industries, and private landowners as measured by calls for assistance from, and damage response services provided to, the affected parties;
- minimize elk-vehicle collisions, as measured by aggregated police and insurance company incidence reports;
- minimize injuries associated with elk-related recreation, as reflected in a reduction of the number of physical encounters and injuries reported.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
Overarching Guiding Principles for Elk Management	5
Goal Statements:	5
INTRODUCTION	13
What The Virginia Elk Management Plan Is	14
How The Plan Was Developed	14
Figure 1. Area of focus in developing Virginia’s Elk Management Plan are shaded light green and gray. Counties outlined in red identify those that comprise the Elk Restoration Area, where the hunting of elk currently is prohibited. Colored areas in adjoining states signify counties where elk have been restored (pink, blue, and purple) or where restoration is proposed and ongoing (yellow).	16
Plan Format	17
Plan Flexibility	17
Acknowledgements	18
ELK HISTORY IN VIRGINIA	18
Pleistocene to Pre-colonial	18
Figure 2. Route of ancestral colonization and current consensus of pre-Colonial (c.a. 1400) distribution of North American elk (<i>Cervus canadensis</i>) and red deer (<i>Cervus elaphus</i>). This map does not depict presence of intentional introductions outside the native ranges (from Toweill and Thomas 2002).	19
1600–1900	20
Figure 3. Display of the pre-colonial range of native elk (<i>Cervus canadensis</i>) in Virginia’s different ecoregions (colored areas).	20
1900–1996	20
Figure 4. Estimated human population of Virginia (including Native Americans and all known immigrants), by year, from initial landing of European settlers at Jamestown in 1620 until the 1780 census (U.S. Census Bureau 1960).	21
Figure 5. Locations where Elk were restored to Virginia. None of the Rocky Mountain Elk obtained from Yellowstone National Park, either by private citizens (from 1913) or the Virginia Department of Game and Inland Fisheries (between 1916 and 1935) survived beyond 1970.	22
Table 1. Year, county, specific release location, and number of elk released in Virginia from Yellowstone National Park, either by private citizens (in 1913) or by the Virginia Department of Game and Inland Fisheries (from 1917 to 1935).	23
The Giles-Bland Herd	23
Table 2. Hunting season length (days), estimated number of participating hunters, and number of elk harvested primarily from the Bland-Giles herd in Virginia between 1922 and 1960. All elk in this population derive from animals obtained from Yellowstone National Park and released after 1917.	

Data for 1922-1925 include 9 counties where elk were found, whereas, after 1926, data are restricted only to the Bland-Giles Range. Estimates of total harvest do not include poached elk or elk harvested for crop damage.	24
The Botetourt-Bedford herd	25
Figure 6. Depiction of the elk restoration area and location of release sites used in the restoration of elk in Kentucky from 1997–2002 (map obtained from the Kentucky Elk Management Plan [KDFWR 2015]).	26
Table 3. Harvest of elk, recorded by sex, from 10 counties in southwest Virginia from 2000 to 2011.	27
Figure 7. Output from an analysis of biological suitability (high, medium, low) based on habitat and land use characteristics as part of a feasibility study of restoring elk in Virginia (from McClafferty 2000).	27
2009–Present	28
Table 4. Number of adult female and male elk and elk calves translocated from Kentucky to Buchanan County, Virginia, from 2012-2014.	30
ELK RESTORATIONS IN THE EASTERN UNITED STATES	31
BIOLOGY AND ECOLOGY	31
Introduction	31
Table 5. Summary data for states and provinces in eastern North America that have considered and/or enacted some activity related to the restoration of elk following its extirpation from its native range.	32
Table 6. Number (n) and percent (%) of Virginians responding to the prompt “Please tell me how well you are informed in the following areas related to elk: ...” Respondents indicated their knowledge on a 4-point Likert-type scale; the number in parentheses is the numeric value assigned to each response for coding purposes.	33
Physical Characteristics	33
Habitat Requirements	34
Food and Resource Use	35
Figure 8. Classification of North American ungulate feeders based upon their utilization of woody or herbaceous vegetation (reproduced from Hoffmann 1982).	35
Table 7. Frequency of occurrence (%) of food types found in fecal samples from elk inhabiting southwestern Kentucky from 2002-2003 (from Schneider et al. 2006).	36
Artificial Feeding	36
Home Range and Movements	37
Movements	38
Figure 9. Average seasonal home range size of bull (blue) and cow (red) elk in Virginia during 2012–2017 (* = significant difference at $p = 0.05$, ** at $p = 0.01$).	38

	Figure 10. GPS radio-collar locations for 75 elk fitted with GPS transmitters for the period 2012-2017 in and adjacent to the Buchanan County, Virginia, release site. Animal locations that left the Elk Restoration Area are enlarged and colored (blue left Virginia, yellow entered other Virginia counties. Virginia’s coal region is outlined in green, and major waterways are portrayed in blue.	39
Population Dynamics		39
Reproduction and Breeding		39
Survival and Causes of Mortality		40
	Figure 11. Source and percent (with 95% confidence) of total elk calf (0-1 years) mortality in eastern (black bars) vs. western (gray bars) North America; significant differences among regions are indicated by non-overlapping error bars (from Keller et al. 2015).	41
	Figure 12. Locations (counties, captive cervid facilities) in North America where Chronic Wasting Disease has been detected. Map by USGS, National Wildlife Health Center (http://www.nwhc.usgs.gov/disease_information/chronic_wasting_disease/).	43
Population Viability, Genetic Diversity, and Growth		43
	Figure 13. Estimated projected population size for elk in Virginia, given different potential rates of growth (λ), as derived using 2017 population status data.	45
ELK SUPPLY		46
Habitat and Land Use		46
	Figure 14. Distribution of reclaimed, abandoned, and current mine lands (green) in southwest Virginia. Navigable waterways are shown in blue.	46
	TABLE 8. Human population density (people/square mile), presented by a county’s rank in the state, and selected attributes of agricultural standing, as reflected in the county’s absolute (and quartile) rank among counties in Virginia.	47
	Figure 15. Location and spatial distribution of land classified as “farmed land” (comprised of Land Use and Land Cover types: cultivated crops, hay, or pasture [shaded yellow]) and “developed land” (shaded red) in 10 counties in southwest Virginia. Number superimposed over each county indicates the proportion of total land area (%) in that county classified as “farmed land.” The map was generated using data from the 2011 USGS land-use and land cover database.	48
	Table 9. Percent of total land area in a county in 6 classifications of land use for 10 counties in southwest Virginia. Data for mining obtained from 2010 report by the Virginia Department of Mining and Minerals. Area of developed, herbaceous, forest, and wetland are derived from the 2011 U.S. Geological Survey, National Land Cover Dataset (NLCD); farmland data obtained from a (2007) Virginia Base Mapping Program.	48
Access		49
	Figure 16. Distribution (shaded purple) and percent of total land area in a county designated as “public land” or managed as public hunting land within 10 southwest Virginia counties. Navigable waterways are shown in blue.	50
ELK-RELATED DEMANDS AND EXPECTATIONS		50
	Figure 17. Distribution of land in public ownership across the U.S. as of 2016.	51

Hunting Demand	52
Table 10. Costs (\$) associated with acquisition of elk hunting tags for residents and non-residents and whether preference points are awarded in states where elk hunting is permitted. Costs presented reflect 2016 fee structures, as reported on state agency websites.	54
Table 11. Expressed public support for the use of regulated recreational hunting to manage elk populations in Virginia among respondents (n = 3178) to a 2017 telephone survey. Respondents predominantly were residents of southwest Virginia and indicated preference using a 4-point Likert scale, to which numerical values were assigned (i.e., Strongly Support = 1, Strongly Oppose = 4).	55
Viewing Demand	56
Demand for Collecting	57
Economic Expectations	57
Table 12. Estimated economic benefits and costs per year (\$) associated with a hypothetical elk restoration in Virginia. Estimates were based on data from other elk restoration efforts in the East and calculated using 2000 dollars (McClafferty 2000).	59
Elk Conflict	60
Table 13. Reports of confirmed elk-related damage in Virginia investigated since 2000, presented by type of damage, location (county), outcome, and year in which incident occurred.	60
Agricultural damage	60
Disease	61
Figure 17. Estimated density of cattle (#/km ²) and relative rank among 95 Virginia counties for cattle production (in parentheses) for 10 counties in the area of elk management planning focus of southwest Virginia (red outline). (Data from 2012 USDA National Agricultural Statistics Service).	62
Table 14. Species of wildlife tested in Michigan between 1996 and 2001 that resulted in confirmed detection of TB. All species listed currently have wide distribution throughout Virginia (except elk). Data extracted from Schmitt et al. (2002).	63
Figure 18. Areas affected by Chronic Wasting Disease (CWD) in West Virginia, Pennsylvania, Maryland, and Virginia as of 2017. Each positive location is surrounded by 1,2,3,4 and 5-mile rings to form concentric disease management areas for each state. Reproduced from Crum, J. (WV DNR), as presented at the Interstate CWD meeting in State College, PA, June 19, 2018.	64
Fencing and property damages	65
Vehicle damages	65
Mine-land Reclamation Concerns	66
Other Damage	66
Ecosystem Impacts	66
Social Considerations	67
Public Opinions About Elk	68
Figure 19. The percent of respondents from 3 different geographic locations who indicated their agreement to the statement: “In general, you support having elk in southwest Virginia.”	69

Table 15. Respondents’ preference for the number of elk in different locations in Virginia. Respondents indicated their preference on a 5-point Likert-type scale which were assigned numerical values (1 = increase significantly, 5 = Decrease Significantly). The letter “n” represents the number of respondents.	70
Table 16. Number and percent of respondents of different stakeholder groups who supported an increase in the size of the elk population in different geographic locations within Virginia. The letter “n” represents the number of respondents.	71
Management Considerations, Expectations, and Timelines: Perspectives of Elk Managers	71
Figure 20. Phase of elk management of eastern U.S. states in 2017, including those that have decided not to proceed with a restoration (pink). Gray labelled states have not formally evaluated an elk restoration in the past 25 years, but may have had elk in the past. All colored states (with the exception of VA) are represented in the manager survey (Hurst and Parkhurst 2018b).	72
Table 17. Number and percentage of managers of eastern elk populations who indicated that a management consideration was “very important.”	73
Table 18. The phase of elk program management during which managers of elk populations in the East believed consideration of a management priority was important.	75
ELK MANAGEMENT OPTIONS	76
Introduction	76
Habitat Management	76
Regulated Hunting	77
Managing Human-elk Conflicts	78
Table 19. Recommended short- and long-term approaches to decrease human-elk conflicts in New Mexico (from Smallidge et al. 2015).	79
Education	79
Aversive Conditioning	80
Fencing	81
Trap and Relocation	81
Kill Permits	82
Financial Compensation	82
Appraisal of Management Options By Managers in Eastern States	83
Public Preferences On Conflict Management	85
ELK MANAGEMENT PLAN: MISSION, GOALS, OBJECTIVES, AND STRATEGIES	86
INTRODUCTION	86
Conceptualizing Interactions Among the Plan’s Goals	87
Figure 21. Conceptual model of the interrelationships among goals in the Elk Management Plan.	88

Figure 22. Modified conceptual model illustrating how management at a local scale may allow different desired outcomes to be achieved in parts of the region while still attaining overall CCC balance across the larger region.	89
Overarching Guiding Principles for Elk Management	90
Elk Management Plan — Conserve Goal 1	91
Elk Management Plan — Conserve Goal 2	94
Elk Management Plan — Conserve Goal 3	99
Elk Management Plan — Connect Goal 1	106
Elk Management Plan — Protect Goal 1	109
LITERATURE CITED	115
APPENDICIES	125
APPENDIX A: MEMBERS OF THE ELK STAKEHOLDER ADVISORY COMMITTEE	125
APPENDIX B: DGIF ELK TECHNICAL COMMITTEE MEMBERS	126
APPENDIX C: ELK RESTORATION IN NEIGHBORING AND OTHER STATES.	127
Eastern Kentucky	127
Great Smoky Mountains, North Carolina	128
Northeastern Tennessee	128
Southern West Virginia	129
APPENDIX D: UNANTICIPATED OUTCOMES AND UNMATERIALIZED EXPECTATIONS OF AN ELK RESTORATION.	130
APPENDIX E: COMMENTS RECEIVED FROM PUBLIC	132
APPENDIX F: RANKING GOAL OBJECTIVES	147

INTRODUCTION

North American elk are returning to the eastern United States landscape and, in the process, are drawing public attention due to the opportunities and challenges they present, whether perceived or real. Until their extirpation from the East during the 1800s, elk were a prominent component of the native eastern forest landscape. Poor management (e.g., excessive harvest) and changes to habitat associated with human population expansion drove elk to regional extinction. However, recent elk restoration programs in several states in the Cumberland Plateau have returned this species to the ecosystem. In partnership with the Rocky Mountain Elk Foundation (RMEF), Kentucky Department of Fish and Wildlife Resources, and the US Department of Agriculture, the Virginia Department of Game and Inland Fisheries (DGIF) re-established a herd of elk to Buchanan County, Virginia. The released elk, as well as individuals that dispersed naturally from Kentucky and Tennessee, are located primarily in

Virginia counties that immediately border Kentucky and now represent the core of a sustainable population. Because of their renewed presence, and the associated management challenges they bring, an elk management plan is needed to provide guidance on how best to attain desired benefits while properly addressing negative consequences associated with elk.

The DGIF, under the direction of a Governor-appointed Board of Directors, is charged specifically by the General Assembly to manage the state's wildlife resources, as expressed through legal mandates embodied in the Code of Virginia. In response to these mandates, the agency's prominent activities involve management of wildlife species (§29.1-103), public education (§29.1-109), law enforcement (§29.1-109), and establishment of regulations (§29.1-501).

To clarify the role and responsibilities of DGIF in managing Virginia's wildlife, the Board of Directors recently adopted a revised mission:

- Conserve and manage wildlife populations and habitat for the benefit of present and future generations.
- Connect people to Virginia's outdoors through boating, education, fishing, hunting, trapping, wildlife viewing, and other wildlife-related activities.
- Protect people and property by promoting safe outdoor experiences and managing human-wildlife conflicts.

WHAT THE VIRGINIA ELK MANAGEMENT PLAN IS

The Virginia Elk Management Plan is the first comprehensive document that describes the history, general biology, and current status of elk in Virginia. Through its presentation of broad goals and specific objectives, the plan also establishes the future directions or emphases DGIF intends to take in its management of the elk herd in southwest Virginia (counties of Bland, Buchanan, Dickenson, Lee, Russell, Scott, Smyth, Tazewell, Washington, and Wise [SWVA]) over the next decade. Although this plan focuses primarily on SWVA, its scope provides necessary management guidance for all areas in the commonwealth beyond the SWVA region for the next 10-year period.

A clear presentation of goals and objectives for elk ensures that Board members, DGIF staff and administration, and interested stakeholders all have a consistent understanding of what management actions are needed, how and when they will be accomplished, and why such management actions are necessary. However, the purpose of this plan is to provide strategic guidance for the management of elk rather than to establish specific and detailed directions — it is not, and never was intended to be, an operational plan. Although this plan has similarities to other management plans adopted and implemented by DGIF (e.g., for deer, black bear, wild turkey), it differs significantly from those plans in that it addresses issues relating to management of a completely extirpated species currently being restored, and reflects a framework consistent with the agency's new mission and vision statements.

HOW THE PLAN WAS DEVELOPED

In accordance with the Public Trust Doctrine, wildlife resources in each state are held in public trust and managed for residents by the state's designated wildlife agency. In Virginia, like most other states, DGIF follows the North American Model of Wildlife Conservation (Organ et al. 2012) to assure that fish and wildlife populations are available to all citizens and are managed sustainably in keeping with sound science, the expressed value choices of stakeholders, and for non-commercial purposes. To assist the agency in ensuring that this plan purposefully incorporates public input as a means to identify what those value choices may be, DGIF collaborated with the Department of Fish and Wildlife Conservation at Virginia Polytechnic Institute and State University to conduct, on the agencies behalf, a facilitated public involvement process leading to development of a draft plan. The team from the Department of Fish and Wildlife Conservation provided guidance and administrative support for the planning process, organized and facilitated all planning meetings, and assisted with administrative and logistical support (e.g., creating and maintaining an informational website, drafting meeting minutes, facilitating inter-group communication, disseminating mailings, final editing of the draft plan).

Although the focus of discussion during plan development largely was constrained to considering opportunities and challenges that exist within geographic areas of the Commonwealth that currently support or have the potential to support elk, this plan is designed to be implemented as a 10-year statewide management plan. Early in the process, DGIF decided to center attention primarily on the area where elk currently exist and where elk potentially might disperse during the plan's tenure (Figure 1). As such, most interaction with the public centered on 10 SWVA counties (Figure 1). The public involvement process consisted of multiple opportunities for individuals with interest in elk to offer input for consideration. Initially, a series of 10 focus group discussion sessions was conducted during May and June of 2016 with invited representatives of affected stakeholder groups within the 10-county region. Of the 230 invitees, 74 participated, identifying and describing a suite of opportunities and challenges perceived to exist with elk. These perceptions and comments provided useful information that helped properly frame the issues and associated values that would form the basis of later deliberations in the planning process. During the summer of 2017, a telephone survey (Hurst and Parkhurst 2018a) of approximately 3,200 individuals (of which about 2,600 individuals from within the 10-county region and another 618 individuals from outside the region responded) provided additional public input on perceptions and expectations related to elk in Virginia.

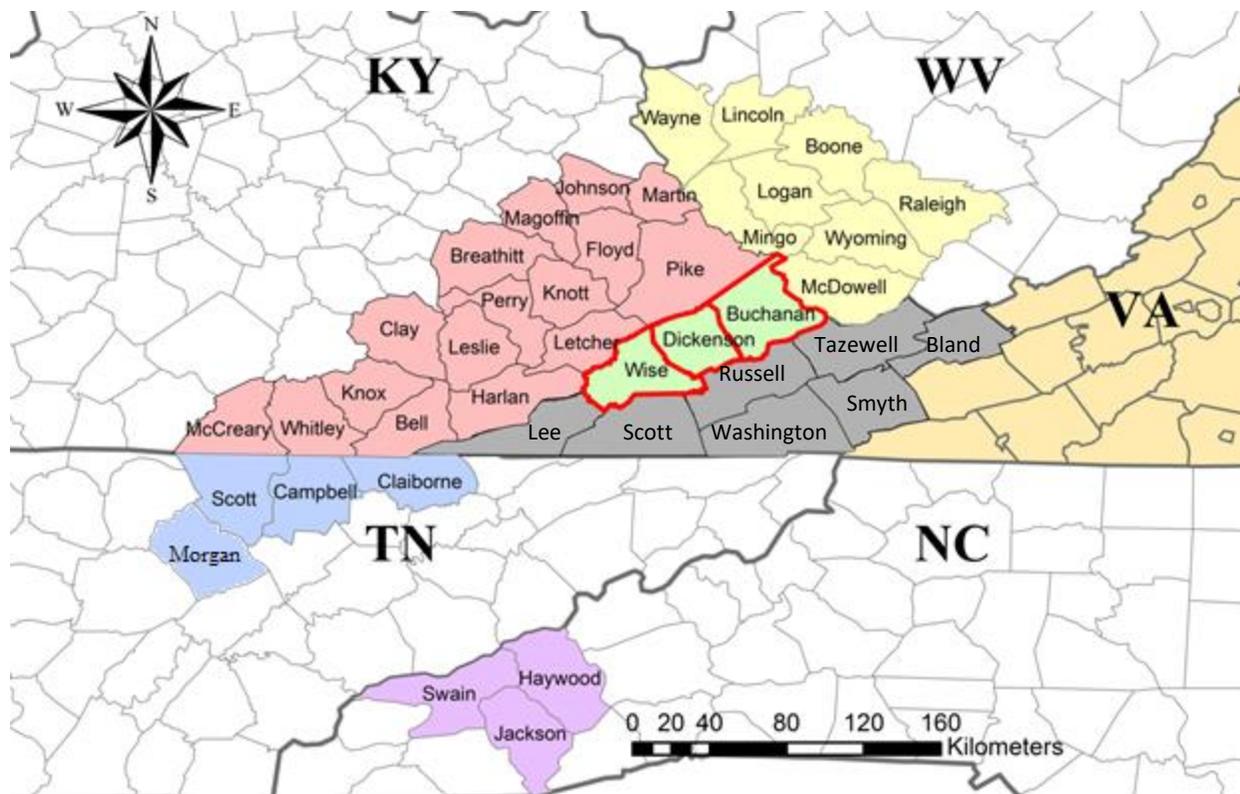


Figure 1. Area of focus in developing Virginia’s Elk Management Plan are shaded light green and gray. Counties outlined in red identify those that comprise the Elk Restoration Area, where the hunting of elk currently is prohibited. Colored areas in adjoining states signify counties where elk have been restored (pink, blue, and purple) or where restoration is proposed and ongoing (yellow).

A critical component of the planning process was the creation of a Stakeholder Advisory Committee (SAC), a group of 17 representatives from key stakeholder groups, with the possibility of being affected by elk, from across the Commonwealth, but with an emphasis on entities within SWVA (Appendix A). Individuals selected to participate on the SAC included representatives for hunters, agricultural commodity and livestock producers, homeowners, forest landowners, animal and ecological health interests, business and tourism industries, motorists, and local, state, and federal agencies. The charge given to this panel was to develop the broad management goals that would guide elk management in Virginia for the next decade while reflecting the value choices important to stakeholders. The SAC met periodically between October 2016 and March 2018 to develop the plan.

Another key element to the planning process was the involvement of an Elk Technical Committee (ETC), composed of DGIF biologists and staff members with expertise related to elk management (Appendix B). The ETC had several specific charges:

- provide, as needed, scientific information and technical feedback to the SAC during that panel’s deliberations;
- develop the historical and technical background information on elk biology and management in Virginia upon which this plan is built (as presented in subsequent chapters in this document);

- develop the specific management objectives and potential strategies to achieve the goals set forth by the SAC while reflecting the value choices expressed by the public; and
- assist in the writing of the draft final plan.

To provide additional technical guidance and insight to the ETC, a survey (Hurst and Parkhurst 2018b) was conducted of Elk Project Leaders and biologists from 12 other eastern states where elk have been restored or where restoration was considered, but not conducted. Responses from 35 biologists described their perspectives on challenges that were anticipated, actually encountered, or never materialized, as well as opportunities that came to fruition versus those that were expected but never emerged following their State's elk restoration. The comments of professionals conveyed a "real world" perspective that proved valuable to the ETC in its deliberations, with specific reference to the timing of when management outcomes could be expected.

Public review and comment on a draft Elk Management Plan occurred during the month of September 2018. To maximize public input, information instructing the public of the need for feedback was made available via news releases in and media interviews with large market and local newspapers, articles in the DGIF Outdoor Report, and information posted on the DGIF web site. At the close of the public comment period, 218 individuals submitted 202 unique comments via the DGIF web site, at the 3 public meetings held to discuss the plan, and via e-mail, or written correspondences. The SAC and ETC reviewed all comments and made revisions to the draft plan deemed appropriate based on the public feedback. A summary of the comments received, and actions taken in response, are provided in Appendix E. The Virginia Elk Management Plan 2019–2028 was presented to, and endorsed by, the DGIF Board of Directors on March 21st, 2019.

PLAN FORMAT

The Virginia Elk Management Plan 2019–2028 includes sections on the history of elk in Virginia, biology and ecology of elk, and program status (supply and demand) of elk in Virginia. Within the context of the DGIF mission statement, 5 management goals are presented to address the conservation of elk, connecting people with elk, and working with the public to protect them and their property from elk related damages. Specific objectives have been established for each goal to help guide attainment, and numerous preferred strategies suggest how each objective should be achieved.

PLAN FLEXIBILITY

This plan, as written, provides latitude to DGIF to adapt its management approaches as necessary to address specific social, environmental, technical or administrative need changes over the 10-year planning period, but any such changes will remain consistent with the plan's expressed goals. As the elk population continues to grow and potentially expands to other areas within Virginia, unanticipated management challenges or opportunities may arise that require unique responses not currently portrayed in the plan. Because goals represent the value choices the public has defined for this plan, it is unlikely that these broad guidance statements would

change within the tenure of the plan; in fact, goals, as presented in any previous management plans adopted by the agency, never have been modified during the effective period of those plans. Should a change in a defined goal be deemed necessary, the agency will initiate a new public involvement process to review the implications of the change and to re-examine the public value choices associated with the goal revision. In contrast, in other wildlife plans objectives or, more commonly, strategies have been amended to respond to changing circumstances. Although those involved in the planning effort have tried to anticipate such events and provide appropriate guidance, implementation of some suggested strategies may not occur, whereas, in particular situations, use of other strategies may be necessary to achieve the desired outcome. Prior to making any changes to an objective or set of strategies, as presented in this plan, DGIF will submit said modifications to the ETC and SAC for review and endorsement, but not initiate a larger public solicitation for comment. A summary of any changes adopted will be provided on the agency website and as an addendum to the plan.

ACKNOWLEDGEMENTS

If a plan of this type is to be successful, it must represent the values and interests of Virginians and provide opportunity for direct public involvement in its development. Members of the SAC (Appendix A) volunteered many hours of their personal time, engaged in meaningful discussions, and provided a strong voice for DGIF constituents for whom they served as representatives. In addition, many citizens throughout the state participated in group discussions, answered surveys regarding their opinions and feelings, and reviewed and provided feedback on the draft. We genuinely thank everyone who participated in this process.

We would like to acknowledge the efforts of the Virginia Tech facilitation team, Dr. Jim Parkhurst and Zach Hurst, for their guidance of the public involvement process, meeting moderation, survey design and implementation, and assistance in drafting the final plan document. We thank members of the ETC who created the technical aspects of the plan and whose review of the final draft improved its final form. We also greatly appreciate the assistance provided by our colleagues from throughout the eastern U.S. whose combined decades of experience provided us valuable advice and technical insight that helped produce the best management plan possible.

ELK HISTORY IN VIRGINIA

PLEISTOCENE TO PRE-COLONIAL

All deer species (cervids) evolved from a common ancestor somewhere in central Asia (Baker 1984). Cervids inhabiting North America today arose from two movements of animals from Asia to what now is Alaska via the Bering Strait Land Bridge. The first influx involved deer originating from Asia that eventually evolved into what are known today as white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and other South American species. Approximately 120,000 years ago, a second wave brought members of the genus *Cervus* from Asia and Europe to North America, from which the elk or Wapiti (*Cervus*

canadensis) arose. Much of the original elk lineage still resides in China and Asia, where it diverged genetically and geographically from the red deer (*Cervus elaphus*), which dominated eastern Asia and Europe (Figure 2).

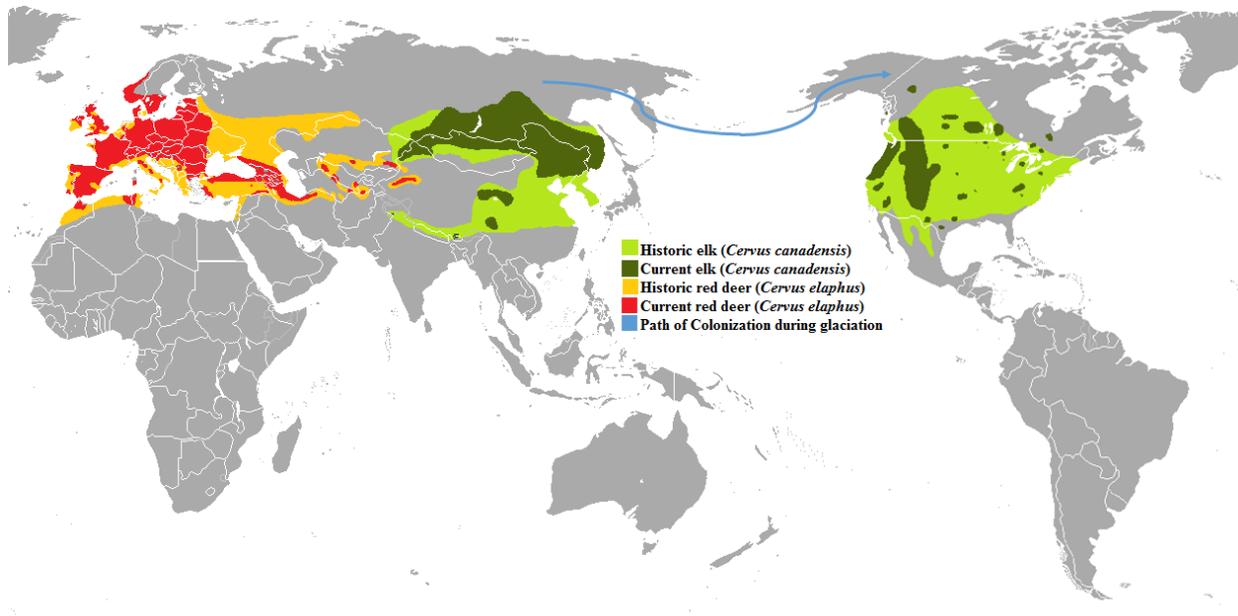


Figure 2. Route of ancestral colonization and current consensus of pre-Colonial (c.a. 1400) distribution of North American elk (*Cervus canadensis*) and red deer (*Cervus elaphus*). This map does not depict presence of intentional introductions outside the native ranges (from Toweill and Thomas 2002).

Prior to European colonization of North America, an estimated 10 million elk roamed the continent, including much of Virginia (Figure 2). Given their ability to adapt to a wide diversity of habitats, the number and distribution of elk surpassed those of white-tailed deer at that time. Elk populations appeared to be limited only by an inability to find sufficient cover for thermoregulation or quality forage.

Historically, taxonomists described 6 subspecies of elk in North America, Rocky Mountain, Tule, Roosevelt, Manitoban and two which are considered to be extinct (the Eastern elk and the Merriam’s elk). Others taxonomically placed elk together with the red deer. Today, scientists distinguish elk as a separate species from red deer and, based on genetics, recognize fewer subspecies. The number of specimens used to distinguish sub-speciation in elk are too few to provide a rigorous distinction of possible subspecies (Meredith et al. 2007, Wilson and Mittermeier 2011, Brook et al. 2016).

Prior to the early 1600s, Native Americans hunted elk for their meat and hides. They also fashioned the bones, teeth, antlers, internal organs, hooves, fat, and brain of elk into cookware, clothing, shelter, toys, tools, weapons, currency, or ornaments, or used them in religious activities.

1600–1900

Bison, deer, and elk were all abundant in Virginia when the first Europeans arrived at Jamestown. Although elk inhabited nearly all areas of the state west of the “fall line,” they were most abundant west of the Blue Ridge Mountains (Figure 3). Concurrent with the rapid growth of Virginia’s human population (Figure 4), populations of game animals, including elk, declined as a result of subsistence and market hunting for meat and hides, which eventually led to their extirpation east of the 100° Meridian (McCabe 2002). Colonel G. Tuley shot the last known native elk in Virginia (in Clarke County) in 1855 and placed the animal on display in the U.S. National Museum (O’Gara and Dundas 2002). Trails created and maintained over time by elk still were evident years after their extirpation. The names of many locations and geographical features throughout the East and here in Virginia are testament to the historical presence of, and importance afforded to, elk in the region (e.g., Elk Garden in Russell County).

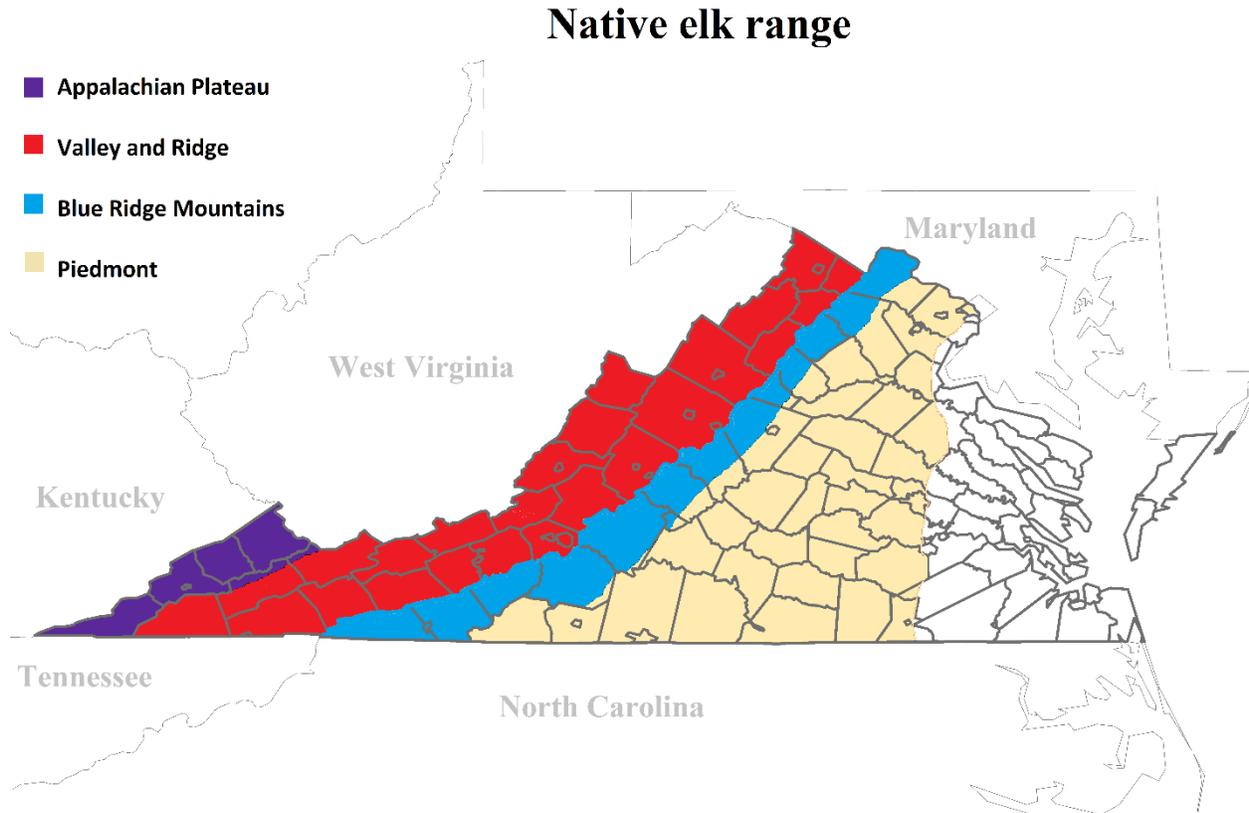


Figure 3. Display of the pre-colonial range of native elk (*Cervus canadensis*) in Virginia’s different ecoregions (colored areas).

1900–1996

At the turn of the century, attitudes and values associated with wildlife began to change. Congress effectively ended market hunting with the passage of the Lacey Act in 1900, which

established regulations on the harvest and transport of wildlife. A growing conservation movement led to the establishment of agencies at both the state and national level tasked with protecting natural resources. At the same time, private organizations and foundations began to promote adoption of values and a conservation ethic associated with hunting and fishing that encouraged fair-chase and discouraged waste (many of which became guiding principles of the North American Model of Wildlife Conservation). In Virginia, the DGIF was established by General Assembly in 1916 and became the agency with primary responsibility for management of the state’s wildlife resources.

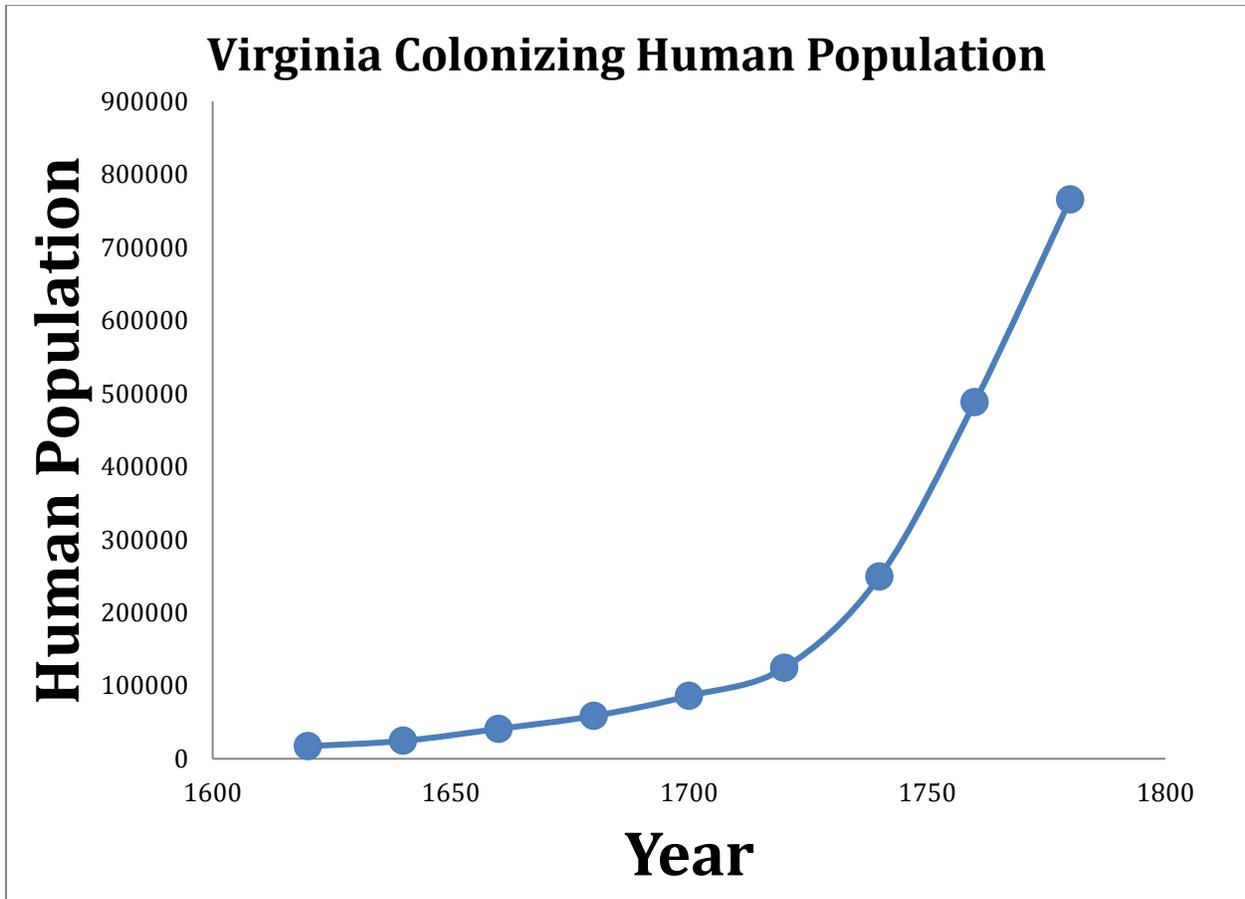


Figure 4. Estimated human population of Virginia (including Native Americans and all known immigrants), by year, from initial landing of European settlers at Jamestown in 1620 until the 1780 census (U.S. Census Bureau 1960).

One of first activities initiated and authorized by DGIF was the importation of elk from Yellowstone National Park (Baldwin and Patton 1938). However, according to Gwynn (1977), private citizens already had released a small number of elk in Virginia by 1913, but little information exists about the number or location of these early releases. Beginning in 1917, 140-150 elk transported from Yellowstone were released in Virginia (Figure 5); at least 25 of these animals died in transit. Elk initially were released in 9 counties west of the Blue Ridge and in 2 counties in eastern Virginia (Wood 1943). Then, in 1922, DGIF released an additional 43 translocated elk, split between sites in Botetourt (6) and Giles (37) Counties (Table 1; Wood

1943). Typically, elk were released in groups of 6-8 immediately after transit or after a short period of confinement (Baldwin and Patton 1938). Because biologists knew little about the habitat requirements of elk, restoration often was unsuccessful as the sites selected for release did not provide suitable habitat (Wood 1943). An example of poor site selection was the placement of elk outside their historic range in the sand dunes of Cape Henry in Princess Anne County (now Virginia Beach; Figure 5). Given the lack of suitable habitat, elk released there immediately depredated truck crops, compelling authorities to destroy the small herd (Wood 1943).

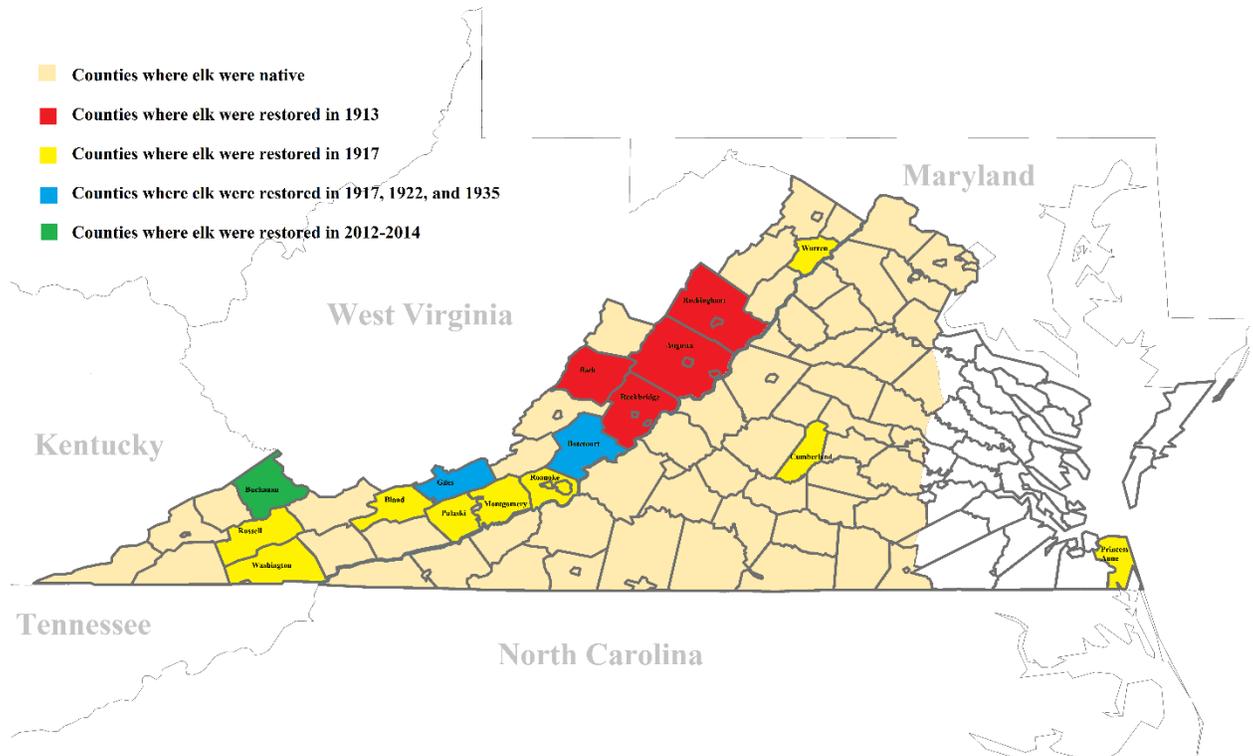


Figure 5. Locations where Elk were restored to Virginia. None of the Rocky Mountain Elk obtained from Yellowstone National Park, either by private citizens (from 1913) or the Virginia Department of Game and Inland Fisheries (between 1916 and 1935) survived beyond 1970.

As early as 1918, questions began to arise about the wisdom of re-establishing elk, primarily because of agricultural complaints (Gwynn 1977). By 1922, the state’s elk herd had more than doubled (O’Gara and Dundas 2002). At that time, game wardens reported herd sizes, by county, as follows: Bland - 50, Craig - 30, Giles - 70, Roanoke - 40, Russell - 30, Washington - 40, Warren - 30, and, in the mountains of Pulaski and Montgomery - “several” (Wood 1943). A 15-day bull elk season opened in 1922, as much to address conflicts as to provide sport (Baldwin and Patton 1938). However, by 1926, only two elk herds remained in Virginia, both of which were located west of the Blue Ridge Mountains: one in the mountains of Giles and Bland Counties west of Pearisburg and one along the Blue Ridge of Botetourt County near the town of Buchanan (Wood 1943). Short elk seasons (of 2-15 days each) intermittently arose from 1922-1960, hunting activity peaked in 1958 with 1,500 hunters participating (Table 2; Gwynn 1977).

Discussions about supplemental feeding these small herds grew as popularity of hunting increased, despite the small number of elk harvested (Baldwin and Patton 1938, Wood 1943). In response, the U.S. Park Service and U.S. Biological Survey (now the U.S. Fish and Wildlife Service) transported 56 additional elk from Yellowstone in 1935, six of which died in transit (McKenna 1962). Annual elk harvests thereafter ranged between 0 and 70 animals, with tallies in many seasons reaching only single-digits (Table 2; Gwynn 1977). Virginia was the only eastern state that had a regulated elk hunt during this period, until New Hampshire offered a hunt in 1941 (Wood 1943). The last official recreational hunting season for elk in Virginia occurred in 1960 in 4 counties: Giles, Bland, Botetourt, and Bedford (O’Gara and Dundas 2002).

Table 1. Year, county, specific release location, and number of elk released in Virginia from Yellowstone National Park, either by private citizens (in 1913) or by the Virginia Department of Game and Inland Fisheries (from 1917 to 1935).

Year	County	Release Location	Number
1913	Augusta	Unknown	20
	Bath	Unknown	25
	Rockbridge	Unknown	60
	Rockingham	Unknown	20
1917	Botetourt	Arcadia	25
	Cumberland	Near Centerville	15-20
	Giles	Mountain Lake and Sugar Run	16 (8 each)
	Montgomery	Brush Mountain	7
	Princess Anne	Cape Henry	17
	Pulaski	Max Mountain	Unknown
	Roanoke	Fort Lewis Mountain	8
	Russell	Unknown	Unknown
	Warren	Front Royal	Unknown
Washington	Near Abingdon	25	
1922	Botetourt and Giles	Unknown	43 (6 and 37, respectively)
1935	Botetourt and Giles	Unknown	50 (5 and 45, respectively)

THE GILES-BLAND HERD

From the initial 1917 translocation, 8 elk initially were placed in the Giles-Bland area and kept in enclosures from February until later that spring before being released (Wood 1943). From the 1922 shipment, fewer than 20 of the 37 elk placed in Giles survived due to natural or human-caused mortality. After the 1935 release, farmers who resented having more elk occupy their land participated in a period of unlawful killings. Once these elk retreated to more remote areas, the killing ceased (Wood 1943).

The 39,000-acre Giles-Bland elk range, a remote area encompassing the Dismal, Mill, and Nobusiness Creek drainages, had been left relatively unscathed by timbering, but the forests were burned regularly to manage the underbrush (Wood 1943). Elk regularly occupied small remnant glades created by early settlers and farmers, sites where producers had placed salt for cattle, old mined areas, high elevation pastures and fields, bog and pond edges, and burned-over tracts. Winter and summer ranges were similar, except that elk often moved higher on the ridges

and occupied northern slopes more frequently in summer. Although elk occasionally foraged in agricultural fields located on these higher slopes, they rarely descended into the more heavily farmed valleys. High elevation fields were an important component of the elk range, presumably because grazing areas were adjacent to thick forest cover (Wood 1943).

Biologists of that time considered the Giles-Bland elk herd a successful anomaly, given the large number of failed restoration attempts elsewhere in the East (Wood 1943). However, despite that optimism, this herd displayed <10% annual growth over the period from 1917-1941, a rate lower than that observed in the West and Midwest. Hunting, both legal and illegal, appeared to be limiting population growth and expansion. Marginal habitat quality and small range size caused elk to emigrate from the area, another significant limiting factor to population growth (Wood 1943). Wood (1943) estimated that 75 elk occupied the Giles-Bland range (50 cows, 15 bulls, 15 calves) in the early 1940s; the herd grew to approximately 125 elk by the late 1950s (Virginia Game Commission 1958). Gwynn (1977) reported the last elk sighting in this area occurred in August 1970.

Table 2. Hunting season length (days), estimated number of participating hunters, and number of elk harvested primarily from the Bland-Giles herd in Virginia between 1922 and 1960. All elk in this population derive from animals obtained from Yellowstone National Park and released after 1917. Data for 1922-1925 include 9 counties where elk were found, whereas, after 1926, data are restricted only to the Bland-Giles Range. Estimates of total harvest do not include poached elk or elk harvested for crop damage.

Year	Length (days)	Estimated # of Hunters	Total Harvest
1922-29	15	Unknown	
1930	3	Unknown	
1931	3	Unknown	~34 (all years 1922 - 1933 combined)
1932	3	Unknown	
1933	3	Unknown	
1934	3	Unknown	
1935	3	Unknown	2
1936	3	350 - 425	2
1937	3	350 - 425	4
1938	3	350 - 425	2
1939	3	350 - 425	7
1940	3	350 - 425	5
1941	3	350 - 425	4
1942	3	350 - 425	7
1943	4	Unknown	46 - 70
1944-45	3	Unknown	?
1946-55	0	Closed Season	0
1956	6	Unknown	0
1957	0	Closed Season	0
1958	2	1000-1500	12
1959	3	1000-1500	5
1960	3	Unknown	3

THE BOTETOURT-BEDFORD HERD

In 1917, 25 elk obtained from Yellowstone National Park were placed in an enclosure within North Creek Valley, approximately 6 miles north of the Peaks of Otter near Arcadia (Parker 1970). Elk originally were to be held over-winter until spring; however, because an elk died while in captivity, the 22 animals remaining in the pen were released prematurely. Following that release, low ridges within the Bryant Fork and Fork Mountain sections of the Blue Ridge Mountains became the core range of the herd. Agricultural lands in the immediate surrounding valleys incurred damage from elk soon thereafter. Construction of the Blue Ridge Parkway and establishment of Shenandoah National Park created a sanctuary that allowed elk to shift their range south during the 1940s toward the Peaks of Otter. The herd reached a maximum population size of about 100 elk during the mid-1940s (Parker 1970), but a persistent decline soon began. A 1964 census revealed only 39 elk (Halladay 1964, in Gwynn 1977). By the winter of 1969-70, 14 elk remained on the Peaks of Otter range and, by summer 1970, all elk had disappeared (Parker 1970, Gwynn 1977). Disease, unsustainable levels of harvest, purposeful removal of crop-depredating elk, and isolation on small, unsuitable patches of habitat all contributed to the herd's demise (Gwynn 1977, McClafferty 2000). Although some people believed that meningeal brain worm (*Parelaphostrongylus tenuis*), an infectious parasite hosted by white-tailed deer that often is fatal to elk, partially was responsible for the decline of elk herds in Virginia and other states (Gwynn 1977), others believed it was not a limiting factor in most populations (Wathen et al. 1997, Larkin et al. 2003). Brain worm infections certainly contributed to some mortality in elk, but the ultimate causes of the decline and eventual reason for elk's second extirpation were the lack of quality habitat and implications of human-elk conflicts.

As elk numbers were declining, extraction of mineral resources along the Cumberland Plateau during the late 1900s increased dramatically. Extraction of coal and other resources, followed by mandated land reclamation, substantially altered the Plateau's landscape and, in the process, created an ecological type that would be ideal for grazing species like elk, which require large areas of open grasslands adjacent to or interspersed with forest.

1997–2009

Over a 5-year period (1997–2002), the Kentucky Department of Fish and Wildlife Resources (KDFWR) released 1,541 elk onto 8 reclaimed mine sites located within a 16-county restoration area in easternmost Kentucky (Figures 1, 6). Given the close proximity of recently restored populations of elk to Virginia's western border (see Figure 1) and the expressed concern about property damage, impacts to agriculture, and the potential for introducing disease, DGIF initiated actions to prevent the establishment of elk populations in Virginia. Although elk already were present in northcentral Tennessee, concern was especially high given the size and scope of activities in Kentucky. As anticipated, some of Kentucky's elk began dispersing into SWVA. With assistance from KDFWR biologists, DGIF initially attempted to capture any elk that immigrated and return them back to Kentucky, but this proved to be both difficult and costly. To help suppress elk establishment, DGIF began to allow the harvest of elk during the

regulated deer season, so long as harvest was in accordance with existing deer hunting regulations. Then, in 2001, the Board of Game and Inland Fisheries (the Board) liberalized hunting regulations to allow the take of either-sex elk during any open deer season throughout the state. Elk harvests varied by county and sex annually through 2011, reaching a high of 10 animals statewide in 2003 (Table 3).

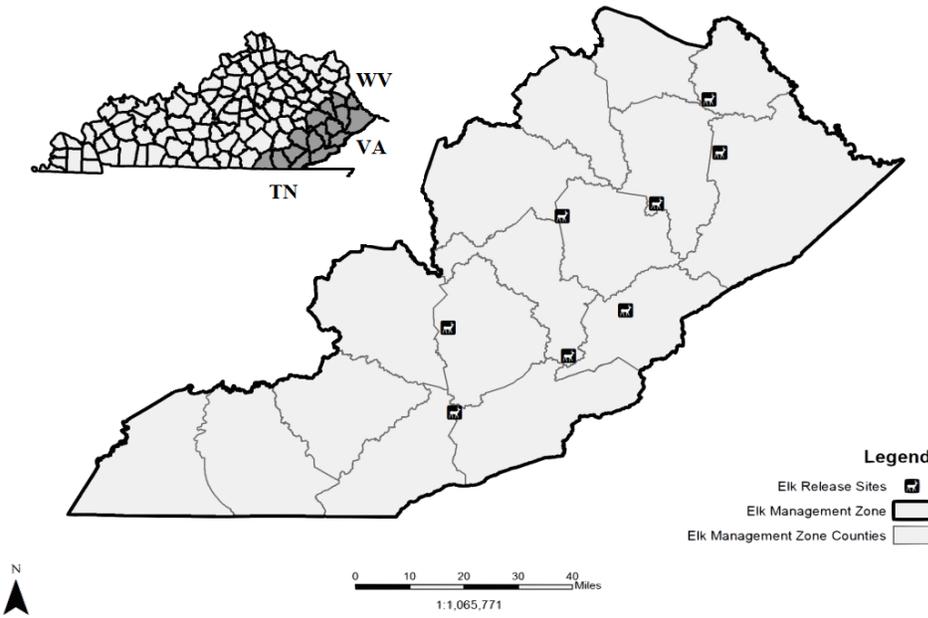


Figure 6. Depiction of the elk restoration area and location of release sites used in the restoration of elk in Kentucky from 1997–2002 (map obtained from the Kentucky Elk Management Plan [KDFWR 2015]).

The DGIF’s initial attempts to keep Kentucky elk from becoming established in Virginia resulted in some stakeholders voicing dissatisfaction with that policy and instead expressing a strong interest in restoring elk. In response to growing demands to follow Kentucky’s lead, DGIF collaborated with Virginia Polytechnic Institute and State University (VT) to conduct a statewide elk restoration feasibility study, funded in part by the Rocky Mountain Elk Foundation, to evaluate habitat suitability, social acceptability, costs, and benefits of establishing elk in Virginia (McClafferty 2000). This study identified 3 regions within the Commonwealth that demonstrated potential biological suitability, based on habitat and land use qualities (Figure 7). Portions of SWVA appeared to provide suitable biological habitat (rated as medium), but social considerations within the region raised concern, especially the potential for elk-human conflicts (McClafferty 2000). Although the review identified potential benefits to the region from elk-related tourism, the lack of significant public land and restrictions on recreational access were likely to impose major limitations on attaining desired benefits associated with restoration of elk in SWVA (McClafferty 2000).

Table 3. Harvest of elk, recorded by sex, from 10 counties in southwest Virginia from 2000 to 2011.

COUNTY	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
BLAND																								1	
BUCHANAN	1				1										1										
DICKENSON																									
LEE																								1	
RUSSELL				1	1	1							1												
SCOTT							3																		
SMYTH																									
TAZEWELL																								1	
WASHINGTON						1																			
WISE			2		2		8	2				1	2		1		1					1	3	1	1
M/F TOTAL	1	0	2	1	4	5	8	2	0	0	0	1	3	0	1	1	1	0	0	0	2	4	2	1	
HARVEST	1		3		9		10		0		1	3		2		1		0		6		3			

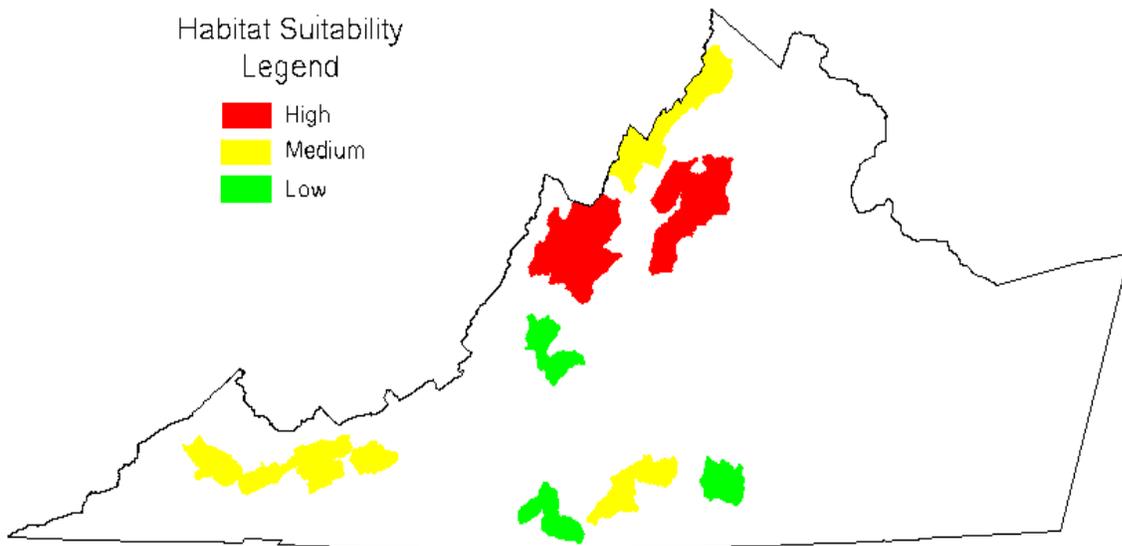


Figure 7. Output from an analysis of biological suitability (high, medium, low) based on habitat and land use characteristics as part of a feasibility study of restoring elk in Virginia (from McClafferty 2000).

2009–PRESENT

Given a growing public interest in elk restoration and ongoing programs in neighboring states, the Board directed DGIF's Executive Director to explore options for elk restoration and management in the Coalfield Counties (Buchanan Dickenson, and Wise) of Virginia due to the success that Kentucky was having with elk on old mining lands. The Department established an Elk Plan Committee in the fall of 2009 to develop an elk management plan. After considering the biological, sociological, economic, and environmental implications associated with elk restoration, DGIF staff in June 2010 presented the Board with 5 potential restoration options. Without public input, staff initially recommended Option 4; an incremental stocking of 200 elk over a 3-year period:

- Option 1: *No Restoration* – do not allow the elk population to grow.
- Option 2: *Passive Restoration* – do not stock elk purposefully, but instead manage any existing and future immigrated elk to attain a population of 1,200 animals.
- Option 3: *Active Restoration via a single stocking of 75 elk* – transport, introduce, and manage elk to attain a population of 1,200 animals.
- Option 4: *Active Restoration via incremental stocking of 200 elk* – periodically transport and introduce, then manage elk to attain a population of 1,200 animals.
- Option 5: *Active Restoration via a single stocking of 200 elk* – transport, introduce, and manage elk to attain a population of 1,200 animals.

Immediately following the June board meeting, the draft elk plan was made available on the DGIF website and a comment period was opened until August 1, 2010. A news release was sent out on June 15th listing five public meetings that would be held in SWVA. Staff also met with Buchanan, Dickenson, Wise, Scott, and Lee county officials prior to the meetings to discuss the plan, the process and to receive input and comments. All counties except Buchanan County and Scott County had concerns and indicated opposition to the restoration of elk in their county (Virginia DGIF 2010). The majority (78%) of comments received from the public favored some form of restoration, but positions on elk restoration were highly polarized. Entities voicing support for restoration came from the Buchanan County Board of Supervisors, the Scott County Board of Supervisors, the Rocky Mountain Elk Foundation, the Virginia Bowhunter's Association, the Cumberland Mountain Sportsman's Association, and the U.S. Forest Service. However, strong opposition was expressed by: the County Boards of Supervisors in Dickenson, Wise, Tazewell, and Russell Counties, the Russell County Chamber of Commerce, the Virginia Farm Bureau (and its affiliates in Russell, Scott, Franklin, and Wythe Counties), the Virginia Cattlemen's Association (and its affiliates in Smyth, Washington, and Russell Counties), the Virginia Agribusiness Council, the Coalfield Beef Cattle & Land Use Association, the Southwest Virginia Agricultural Association, the Abingdon Feeder Cattle Association, the Virginia Academy for Food Animal Practitioners, and the Virginia Department of Agriculture and Consumer Services (the State Veterinarian's Office).

However, as indicated in the draft restoration plan, to have a successful elk management and restoration program in Buchanan, Dickenson and Wise Counties, community support was essential. Given that only the Buchanan County Board of Supervisors supported elk restoration it was the DGIF staff's opinion that a conservative approach should be taken initially to further a dialogue, understanding, and acceptance of elk and their management in the three counties.

Therefore, staff changed its recommendation and recommended that the department should pursue Option 2 - Passive Restoration in an elk restoration area comprised of Buchanan, Dickenson, and Wise counties.

At its August 17, 2010, meeting, the Board acknowledged the staff's recommendation, but instead voted to pursue a derivation of Option 3, directing the agency to begin restoring 75 elk incrementally to a suitable release site in Buchanan County. From the minutes of the meeting, the Board's specific directive was:

“The Elk restoration option shall be a modification of Option 3 where DGIF would establish a pilot program for the reintroduction of elk by stocking not more than 75 elk in Buchanan County only. The goal would be to have an elk herd not to exceed 400 animals. The elk management area would include Buchanan, Dickenson and Wise counties where elk hunting would be prohibited.”

Concerns about elk restoration came before the 2011 Session of the Virginia General Assembly, ultimately resulting in passage of legislation that imposed new limits on the Board. The Code of Virginia (§ 29.1-103) was modified to require *“the authorization and cooperation of the local government for the locality where the introduction occurs”* before the Board can *“introduce any new species of game birds, game animals, or fish.”*

Despite these legislative actions, elk restoration proceeded, even though the Boards of Supervisors in Dickenson and Wise County continued to express their opposition. DGIF had received support from the Buchanan County Board of Supervisors and the owners of privately-held reclaimed mine land on which elk were to be released. This site offered quality habitat with ample forage and was situated in an area with low potential for negative human interactions.

Given the biological success of KDFWR's elk restoration program, the consistent absence of disease in elk detectable via laboratory testing of sampled individuals, their proximity to Virginia, and cooperation from KDFWR, DGIF elected to use elk from Kentucky's herd as the source population for its restoration effort. On May 23, 2012, 11 elk captured in Kentucky were released into a holding and acclimatization pen at the Buchanan County release site after a 90-day quarantine period in Kentucky for disease surveillance and health testing. The Virginia Department of Agriculture and Consumer Services (VDACS) and the United States Department of Agriculture Veterinary Services (USDA-VS) assisted in testing each animal for bovine tuberculosis, brucellosis, blue tongue, epizootic hemorrhagic disease, Johne's disease, vesicular stomatitis, anaplasmosis, infectious bovine Rhinotracheitis, leptospirosis, and bovine viral diarrhea virus. If an animal was found dead at any point during the restoration, a full necropsy was performed and the animal was tested for CWD, brucellosis, and bovine tuberculosis. Additional releases of translocated elk from Kentucky onto the Buchanan County site occurred during 2013 and 2014, until the restoration goal of 75 elk was achieved (Table 4). The time in quarantine for captured elk was 90 days in 2012 and 2013 but was reduced to 45 days in 2014 with the permission of VDACS and USDA-VS. All adult animals released onto the Buchanan site were fitted with GPS radio transmitter collars to track movements, dispersal, survival, and habitat use.

Table 4. Number of adult female and male elk and elk calves translocated from Kentucky to Buchanan County, Virginia, from 2012-2014.

Year	Females ^a	Males	Calves	Total
2012	11(3)	5	4 ^b	20
2013	2(2)	8	0	10
2014	32(21)	13	0	45
Total	45	26	4	75

^a Number in parentheses represents the number of cows in that group that were pregnant at time of release.

^b Calf count in 2012 represents 4 pregnant cows that were captured in Kentucky, but gave birth while in captivity (these cows are *not* listed in the pregnant count).

Effective for the 2011 deer season, in 2010 the Board enacted a prohibition on the hunting of all elk within Buchanan, Dickenson, and Wise Counties, which comprised the newly designated Elk Restoration Area (ERA). The Board also prohibited the baiting and feeding of wildlife year-round within these counties. To help limit the establishment of elk populations outside the 3-county ERA, legal hunting of either-sex elk during any open deer season continued throughout the rest of the state.

Virginia’s founding elk herd grew slowly the first few years, and concerns arose about whether elk that temporarily migrated out of Buchanan County received sufficient protection to assure herd growth and stability. In 2013, DGIF proposed expanding the counties where elk harvest was prohibited from the original 3 to also include Lee, Russell, Scott, and Tazewell. Public opposition to this proposal arose quickly, preventing its adoption.

In January 2012, legislation to amend and reenact §§ 29.1-100 and 29.1-529 of the Code of Virginia (relating to use of non-lethal control measures against elk) emerged from the General Assembly, granting the Director of DGIF the option to authorize non-lethal control measures against elk found to be responsible for damage. This change added all species within the Cervidae (elk and deer) to regulations and laws that pertain to deer; elk and deer essentially now would be treated the same in the Code.

The Board advertised a proposal in March 2015 to close all hunting of elk in 31 counties west of the Blue Ridge Mountains as means to enhance population growth of the Virginia elk herd. As with previous elk restoration matters, this proposal proved contentious and stimulated divergent public comments. Of the written comments received, 134 (58%) supported and 98 (42%) opposed the proposal; these comments reflected the strongly polarized positions stakeholders held regarding elk. Entities supporting the proposal included Virginia Department of Conservation and Recreation (via its Breaks Interstate Park), Lonesome Pine Chapter of Rocky Mountain Elk Foundation, Blue and Grey Chapter of Rocky Mountain Elk Foundation, and the Rocky Mountain Elk Foundation. Entities expressing opposition included the U.S. Forest Service, Virginia Department of Agriculture and Consumer Services, County Boards of Supervisors from Tazewell, Lee, Scott, Wise, Washington, and Bedford Counties, Virginia Forest Products Association, Virginia Vineyards Association, Virginia Cattlemen’s Association, Virginia State Dairymen’s Association, Virginia Academy of Food Animal Practitioners, and the Virginia Farm Bureau (and affiliates in Botetourt, Washington, Rockingham, and Augusta Counties). Given the concerns expressed by opponents, the Board withdrew the proposal and took no action. Instead, at their June 2015 meeting, the Board directed DGIF to develop an elk

management plan, with input from a stakeholder advisory group, to clarify elk management goals and needs in SWVA that reflect the different perspectives of the public.

ELK RESTORATIONS IN THE EASTERN UNITED STATES

Kentucky and Virginia are not the only eastern states to have undertaken restorations. Since elk were extirpated from the area east of the 100° meridian, various states (Table 5) have attempted, with varying success, to restore elk (Witmer 1990, Enck et al. 1998, Griffin 2000, O’Gara and Dundas 2002, Popp et al. 2014). Between 1892 and 1939, entities in 36 states, the District of Columbia, Canada, and Argentina translocated over 5,200 elk obtained from the western U.S. (primarily Yellowstone National Park; Witmer 1990). Currently, 11 states and 1 Canadian province, all in eastern North America, successfully have re-established elk herds (Popp et al. 2014). Not all attempts to restore elk were conducted by an agency of a state, but instead were undertaken by private citizens or organization (Gwynn 1977, Witmer 1990, Enck et al. 1998, Griffin 2000, O’Gara and Dundas 2002, Popp et al. 2014). In recent decades, elk released in these restorations came from Canada or the states of Arizona, Idaho, Kansas, Kentucky, New Mexico, North Dakota, Oregon, South Dakota, Utah, and Wyoming (DeBerti 2006, Bowling et al. 2015). Of the existing eastern elk restoration programs, 4 are within 150 miles (240 km) of Virginia’s ERA (see Figure 1). DGIF has confirmed that elk from Tennessee and Kentucky have entered Virginia and an initiated restoration in West Virginia likely will produce additional immigrants in the near future. Elk inhabiting Kentucky, Tennessee, Virginia, and West Virginia have the potential to form a metapopulation of interbreeding animals, creating a common genetic lineage in the future.

BIOLOGY AND ECOLOGY

INTRODUCTION

Many Virginians have limited knowledge of elk, given that these animals were not widespread across Virginia for over 150 years and reintroduced elk existed primarily in isolated and rural areas (Wood 1943). Consequently, a general lack of knowledge regarding elk and their management persists. As part of a feasibility study related to restoring elk to Virginia, McClafferty (2000) found that half (50%, n = 298) of responding Virginia residents admitted being uncertain in their knowledge of elk and about their ability to form an opinion on elk restoration (certain vs uncertain). Respondents who frequently participated in outdoor recreation were more confident in their knowledge than those who did not recreate outdoors. Since renewed consideration of restoration of elk in Virginia first began, Virginians’ knowledge of elk is roughly the same. Most respondents to a 2017 survey of Virginians indicated that they were not informed (from: very informed, well informed, somewhat informed, not informed, don’t know) about elk biology and behavior (53%, n = 1,698), options and strategies used to manage elk populations (64%, n = 2,044), and the laws and regulations that affect elk (63%; n = 2,021;

Table 6). When asked a series of 5 questions to test their level of knowledge about elk and elk management, respondents provided, on average, only 2.8 (median = 3) correct answers to the questions (Hurst and Parkhurst 2018a). Respondents also were unsure of the number of elk in the state; although biologists estimate that 150-200 elk were present in Virginia at the time of the survey, the median number of elk believed to be in Virginia by respondents was 300 (Hurst and Parkhurst 2018a).

Table 5. Summary data for states and provinces in eastern North America that have considered and/or enacted some activity related to the restoration of elk following its extirpation from its native range.

State/Province	Year of Extirpation (Estimated)	Date of Attempted Restoration	Number of Elk Translocated	Current Population Size (Estimated)
Alabama	early 1800s	1916	55	0
Arkansas	1840s	1981–1985 ^a	112	500
Florida	NA	1968	6	0
Illinois	1850	Feasibility study conducted; decided not to pursue restoration		
Indiana	1930	1950s	Unknown	0
Kentucky	1850	1997–2002	1,541	11,000+
Louisiana	1842	1916	20	0
Maryland	late 1700s	Feasibility study conducted; decided not to pursue restoration		
Michigan	1877	1914–1918	23	500–900
Minnesota	NA	1914–1935	27	200 ^b
Missouri	1865	2011–2013 ^a	108	130
New Hampshire	1867	1903	12	0
New York ^c	1847	1893-1906	332	0
North Carolina	late 1700s	2001–2002	52	150
Ohio	1875	Feasibility study conducted; restoration pending		
Ontario, Canada	late 1700s	1998–2001 ^a	460	900 ^b
Pennsylvania	1867	1913–1926	177	1,000
Tennessee	1865	2000–2008	201	450
Virginia	1855	2012-2014 ^a	75	200
West Virginia	1875	2016-Present	24 ^d	Goal: 150
Wisconsin	late 1800s	1995–2016	100	250 ^b

^a Earlier restoration attempt(s) failed prior to the listed success

^b Population spread across several locations

^c New York re-evaluated restoration in mid-2000s; decided not to pursue another restoration

^d Currently in a multi-year active restoration effort

Table 6. Number (n) and percent (%) of Virginians responding to the prompt “Please tell me how well you are informed in the following areas related to elk: ...” Respondents indicated their knowledge on a 4-point Likert-type scale; the number in parentheses is the numeric value assigned to each response for coding purposes.

Question	Very Well Informed (1)		Well Informed (2)		Somewhat Informed (3)		Not Informed (4)		Don't Know / Didn't Answer		Mean Score
	n	%	n	%	n	%	n	%	n	%	
Elk biology and behavior	144	4.5	339	10.5	1,031	32	1,698	52.7	9	0.3	3.3
Options and strategies used to manage elk populations	119	3.7	255	7.9	743	23.1	2,044	63.5	60	1.9	3.5
Laws and regulations that affect elk	203	6.3	308	9.6	653	20.3	2,021	62.7	36	1.1	3.4

PHYSICAL CHARACTERISTICS

Elk display a number of physical features that allow them to adapt to diverse habitats, diets, and climatic conditions across regions. Body size and antler configurations can vary substantially depending upon an animal’s inherited genetics, quality of nutritional intake, and the environmental conditions within which it resides. Despite amassing considerable knowledge about elk, especially of elk in the West, there is a significant need to learn more about ecological interactions of populations of restored elk and their physiological adaptations to climates and habitats in the East.

Elk are the second largest member of the deer family (Cervidae). A female (cow) elk can attain a weight in excess of 600 lbs. (272 kg.) (range: 375-660 lbs. [170-300 kg.]), whereas male (bull) elk occasionally top 1,000 lbs. (454 kg.) (range: 550-1300 lbs. [250-591 kg.]) (Hudson and Haigh 2002). Elk reach their full adult size and weight at 4 to 5 years of age (Hudson and Haigh 2002), but nutritional status ultimately determines size (Peek 1982). Weight in elk fluctuates throughout the year; a male may lose 20% of its body weight during the rut, whereas a female may shed 10% or more of her weight during lactation (Hudson and Haigh 2002). An adult bull elk may stand 5 ft. (150 cm.) tall at the shoulder; an adult cow will be slightly shorter, at 4 ft., 8 in. (135 cm.). Elk exhibit disproportionately long legs that enable them to move with ease over

rough terrain and through deep snow, which helps them access food resources that are not available to other wildlife (Hudson and Haigh 2002).

Elk maintain 2 distinct seasonal coats: the short reddish summer coat that is displayed between May and August is replaced by a heavier tawny-colored winter coat composed of coarse under-hairs that emerges fully in September and is shed the following May. Coat growth and shedding is triggered by hormonal response to photoperiod (day length) rather than temperature (Hudson and Haigh 2002). As is true with other deer, elk calves are born with and maintain a spotted coat throughout their first summer to help camouflage them until their first winter coat grows in.

Depending on the animal's state of maturity, males begin growing new antlers as soon as they shed the previous year's antlers, typically in March and into April. Mature bulls shed antlers earlier in the spring than do their younger cohorts. Male calves begin growing antlers when they reach 10 months old and often will display a single spike on either side in their second fall. Antler size reaches a maximum at 10 to 12 years of age, but will vary based on genetics, physical condition, and diet. The antlers of a healthy, mature bull will average about 28 lbs. (13 kg.), but can reach as much as 40 lbs. (18 kg.), and represent 6–8% of its body weight (Hudson and Haigh 2002).

Although elk have rather poor depth perception, they successfully detect motion and accommodate for visual shortcomings by using other well-developed senses. Their hearing is acute, they have an exceptional sense of smell, and their sense of taste is discriminating (especially in chemoreception) (Hudson and Haigh 2002).

HABITAT REQUIREMENTS

Because of their absence from the East for over 100 years, most people view the North American elk as a “species of the West.” Elk in the West typically are associated with large expanses of open public land shared with deer, cattle, horses, and other range species. Now that elk have returned to the East, this characterization of elk habitat is changing.

Elk require open areas, such as grasslands or fallow fields, where they congregate and forage by grazing. Forage quality and productivity in these habitats typically will be higher in years with abundant rainfall. The amount of open area required depends on the quality of forage available; higher quality forage reduces the percentage of open area needed. Generally, no less than 15% of an elk's home range should be open, either in one large patch or in several smaller areas (Larkin et al. 2004). Elk will also use very small areas (<1 acre [0.4 ha]) of open and/or mown grass if they can find desired forage. Openings that are partially forested or <40 acres (16 ha) in size are preferred because these sized areas allow elk to quickly escape into cover (Lyon and Christenson 2002). However, as canopy closure increases, herbaceous plant growth rates and forage quality decreases, thereby reducing suitability to elk.

Elk in Kentucky appear to be using forested lands more than expected, possibly due to increasing herd size, limitations on available acreage of suitable habitat (reclaimed mine lands), and/or because it provides cover to avoid increasing hunting pressure (Bowling et al. 2015). Elk also use forest stands to escape heat. Elk can tolerate temperatures as low as -4° F (-20° C) for extended periods and elk are well-adapted to cope with snow, but snow depth >18-24 inches (46-61 cm.) will influence habitat selection (Skovlin et al. 2002). Elk are not adapted to withstand prolonged heat (Hudson and Haigh 2002) and mature forests with a dense canopy provide shelter

for thermoregulation during the warmest parts of the day. Even with its summer coat, an elk generally will avoid being out in an open area when the temperature rises above 70° F (21° C). Elk cows, in particular, require areas where they can escape heat and birth their calf in isolation. Mature forests with a dense canopy provide this shelter, but cows will seek transitional areas between open grassland habitats and dense early successional cover as important calving sites (Peek 1982). Abundant succulent herbaceous vegetation must be available nearby to calving sites (Skovlin et al. 2002).

The quality of an elk’s winter range can be a limiting factor on population growth, especially if elk do not migrate. Recent studies suggest that summer habitats and dietary quality also can be limiting (Christianson and Creel 2007). A lack of quality foods during spring and summer, a time during which resource requirements are high (e.g., lactation, antler development), can limit individual and herd conditions (Merrill 1994). Summer elk range should contain a sufficient number of large areas of diverse, high-quality forages to minimize overgrazing and allow natural plant growth and regeneration, while also providing forest cover nearby for shelter.

FOOD AND RESOURCE USE

Elk have a 4-chambered stomach and therefore are true ruminants. They regurgitate and re-chew a cud (partially digested previously consumed forage) multiple times, extracting additional nutrients from this reprocessed food. Ruminants fall along a gradient from specialized browsers (e.g., deer) to mixed feeders (e.g., elk) to exclusive grazers (e.g., cattle; Figure 8). Being among the mixed feeders, elk can utilize a diversity of vegetative food resources as encountered on their home range.

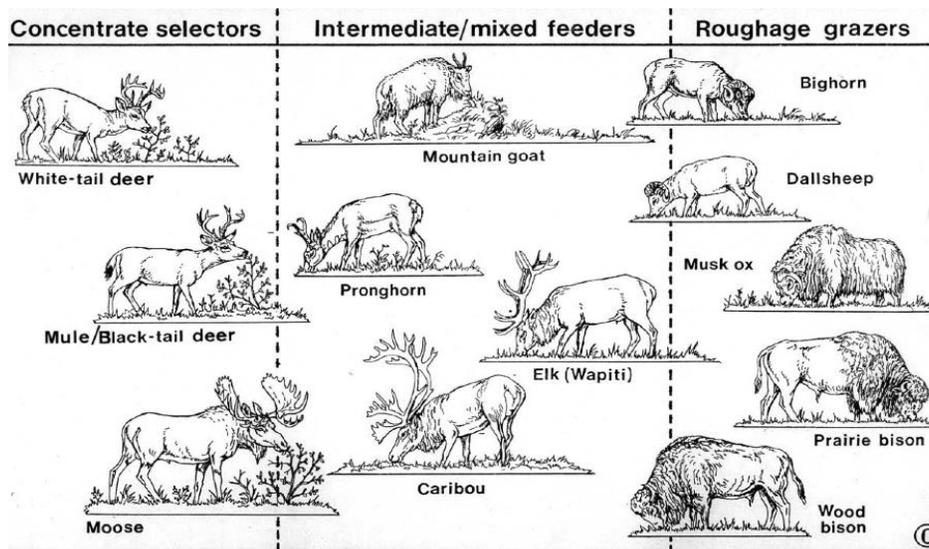


Figure 8. Classification of North American ungulate feeders based upon their utilization of woody or herbaceous vegetation (reproduced from Hoffmann 1982).

Evolutionary adaptations have allowed elk to utilize hundreds of species of plants and diverse habitats throughout their continental distribution, but their diet nearly always includes a mix of woody browse and grasses (Walters et al. 2010). From spring into early summer, elk select the most nutritious and digestible plants encountered. As grasses dry later in the summer, elk transition to forbs and legumes. In fall, woody browse material predominates their diet, but elk then shift to whichever foods are available during winter (Table 7). Relatively few studies of the diet of elk in the East have been conducted. Schneider et al. (2006) found elk in eastern Kentucky on reclaimed mine sites (similar to reclaimed mine lands in Virginia) use >40 different plant species. In areas where agriculture is prevalent, elk will consume crops opportunistically due to the high nutrition provided and ease of digestibility; corn (*Zea mays*), soybeans (*Glycine max*), winter wheat (*Triticum aestivum*), alfalfa (*Medicago sativa*), and fruit trees are foraged when accessible (DeCalesta and Witmer 1994, Schneider et al. 2006).

As noted earlier, food selection and quality can influence the movements, home range use, reproductive success (and thus population growth), and antler growth of elk (Hudson and Haigh 2002). Elk feeding on low-quality forage display lower individual weight gains, low fecundity, reduced pregnancy rates (including number of yearling cows breeding), decreased calf weight, increases in gestation times, and decreased calf survival, all of which can alter sex ratios (Cook 2002). In the eastern U.S., rainfall and the availability of water generally are not limiting and abundant quality and quantity of forage is available to elk populations. An adult elk typically requires about 10–20 lbs. (dry weight) of forage daily. Pregnant or lactating cows have greater nutritional demands and can consume 2 to 3 times more than this average, depending on the quality and availability of forage (Cook 2002).

Table 7. Frequency of occurrence (%) of food types found in fecal samples from elk inhabiting southwestern Kentucky from 2002-2003 (from Schneider et al. 2006).

Category	Summer	Fall	Winter	Spring	Annual
Grass	27	17.7	40	9.7	23.6
Forbs	34.4	21.8	23.7	26.9	26.7
Browse	23.2	41.9	17.8	46.1	32.2
Unknown	15.3	18.6	18.5	17.3	17.4

ARTIFICIAL FEEDING

Providing elk additional resources beyond what naturally is available may cause problems for an elk population. The digestive system of a ruminant relies on a symbiotic, or mutually beneficial, relationship between particular food items and certain microorganisms (bacteria, protozoa, yeasts, and fungi) that exist in the chambers of their stomach and aid in the breakdown and digestion of certain foods. The composition of this gastric microbe community changes gradually through the seasons, depending upon the availability of forage on the landscape (Hudson and Haigh 2002). When ruminants encounter forage to which they are not accustomed to at that time of the year, they cannot digest it properly due to the absence of microbes needed to help process that food type (Hattel et al. 2007). As a result, ruminants may develop acidosis (grain overload) and may die acutely or enterotoxemia (overeating disease) and may die of starvation despite having a stomach full of undigested material.

Providing supplemental feed during winter often will encourage elk to concentrate in high numbers in areas that cannot provide nutritionally adequate natural forage for the animals (Forrestal et al. 2012). Concentrating elk increases the chance of spreading disease via direct

physical contact among individuals (Schmitt et al. 2002, Rhyan and Spraker 2010) or via indirect means from exposure to infectious bodily fluids (i.e., saliva, urine, feces, etc.) and/or may expose them to higher predation risk in regions where large predators are present (Milner et al. 2014). Supplemental feeding of elk also can lead to or promote human-elk conflicts as herd size and density temporarily increase in response to the artificial resources being provided. A population sustained on supplemental resources will exceed what the habitat is able to support (i.e., the population exceeds biological carrying capacity); once this artificial support ends, the abnormally high concentration of elk often will negatively affect the native plant communities upon which the herd normally would depend, showing signs of overutilization and trampling. Furthermore, as the number of elk at a supplemental feeding site increases, the probability of elk-vehicle collisions and other human-elk conflicts increases as additional animals are drawn in from great distance to find and acquire needed resources (Inslerman et al. 2006). These ramifications explain why feeding wildlife is not recommended, and why feeding elk in Virginia is illegal.

HOME RANGE AND MOVEMENTS

The size of an animal's home range (the area where an animal finds the food water and shelter it needs on a day to day basis and the core area(s) include places where the animal is found >50% of the time) is defined by the availability and location of its required resources, such as food, water, and shelter. Home range size also varies depending on season and the sex, age, and body condition of an animal. For elk, an average home range is about 12,000 acres (4,860 ha), but may span anywhere from 400-23,000 acres (162-9,315 ha) (Myserud et al. 2001). Bull elk typically maintain larger home ranges than cow elk. Mature bulls in Pennsylvania displayed an average home range size of 13,120 acres (5,314 ha), whereas the range size of cows averaged 4,352 acres (1,763 ha) (Cogan 1987). Range size also can vary substantially between years. During 2004-2005 in Pennsylvania, mean home range size for bulls was 11,200 acres (4,536 ha) and 10,432 acres (4,225 ha) for cows (DeBerti 2006). Range size data for other recently restored elk populations in the East varied substantially. In Ontario, individuals of both sexes remained within an 8-sq. mile (5,120 ac; 2,074 ha) area surrounding their release site (Ryckman et al. 2010). Elk in Tennessee predominantly utilized small core areas that averaged 1,950 acres (790 ha) in size, but maintained a large home range (17,540 acres [7,104 ha]; Lupardus 2005). In Kentucky, cows used 3,954 acres (1,601 ha) annually, whereas range sizes among bulls were highly variable, spanning between 988-29,652 acres (400-12,009 ha) (Zyzik and Porter 2005, KDFWR 2008).

Between 2012 and 2017 in Virginia, elk have displayed a different home range pattern from those observed elsewhere. The average home range among males (3,710 acres [1,503 ha]) was smaller than that observed in females (5,894 acres [2,387 ha]), a condition that has remained consistent across all years (Figure 9). Home range size was smallest during the winter for both sexes (Figure 9). Home range among females was largest just prior to calving season when they travelled away from the herd to give birth, but became quite small post calving season. When young calves are sedentary (a few weeks), cows must return to feed them several times a day and will not travel far from their bedded calf, thereby reducing their range size.

MOVEMENTS

Given the widespread and ready availability of resources within habitats of the East, most biologists believe that the elk originally occupying this part of the historic range did not migrate. Similarly, elk reintroduced into eastern ranges have not displayed migratory tendencies (Irwin 2002), despite having come from populations in the West where seasonal migration is the norm. Elk in the western U.S. typically move 10-125 miles (16-201 km) seasonally, from their high-elevation summer ranges down to lower elevations that are characterized by less snow and greater available forage during winter (Berger 2004, Smith 2007, White et al. 2010). Although elk in the East exhibit small seasonal range shifts, their core areas generally remain stable.

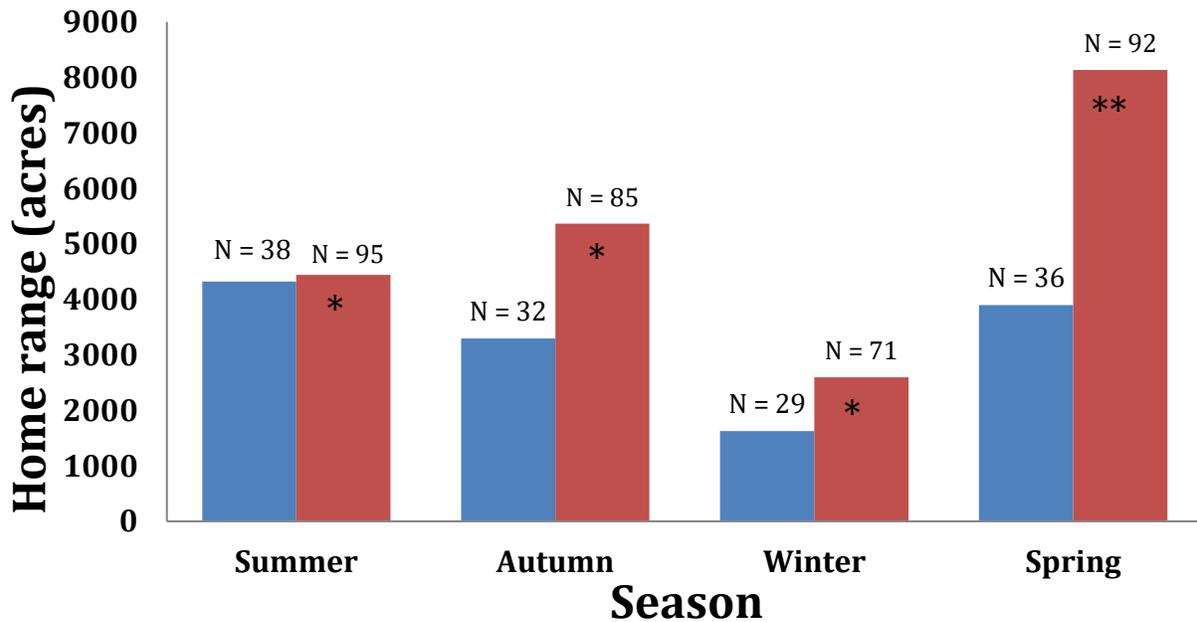


Figure 9. Average seasonal home range size of bull (blue) and cow (red) elk in Virginia during 2012–2017 (* = significant difference at $p = 0.05$, ** at $p = 0.01$).

Both male and female elk will make occasional temporary excursions of up to 25 miles (40 km) from their normal home range, but nearly all will return to the same area of activity. Here in the East, long-distance movements often are associated with breeding activities rather than purposeful migrations, but young elk (1.5–2.5 years old), particularly bulls, commonly disperse considerable distances from their natal range; among elk populations in the East, dispersals typically range from 2-15 miles (3-24 km) (Ryckman et al. 2010). Most of the elk translocated from Kentucky and released in Virginia have remained in the general vicinity of the Buchanan County release site. Of the 75 animals released, 54 remained close to the release site; 21 elk travelled >5 miles (8 km) (the minimum distance needed to exit Buchanan County) and 7 elk moved >12 miles (19 km) (the minimum distance needed to exit Virginia) (Figure 10). However, because total distance travelled is not always a straight-line movement, many of these long-distance movements remained completely within Buchanan County. Only 5 animals actually left the ERA; 2 went back to Kentucky (1 of which immediately returned to Virginia), 1

went north into West Virginia, and 2 went south into Russell County but stayed to the north-west of the Clinch River and returned to the Virginia coal fields region (Figure 10).

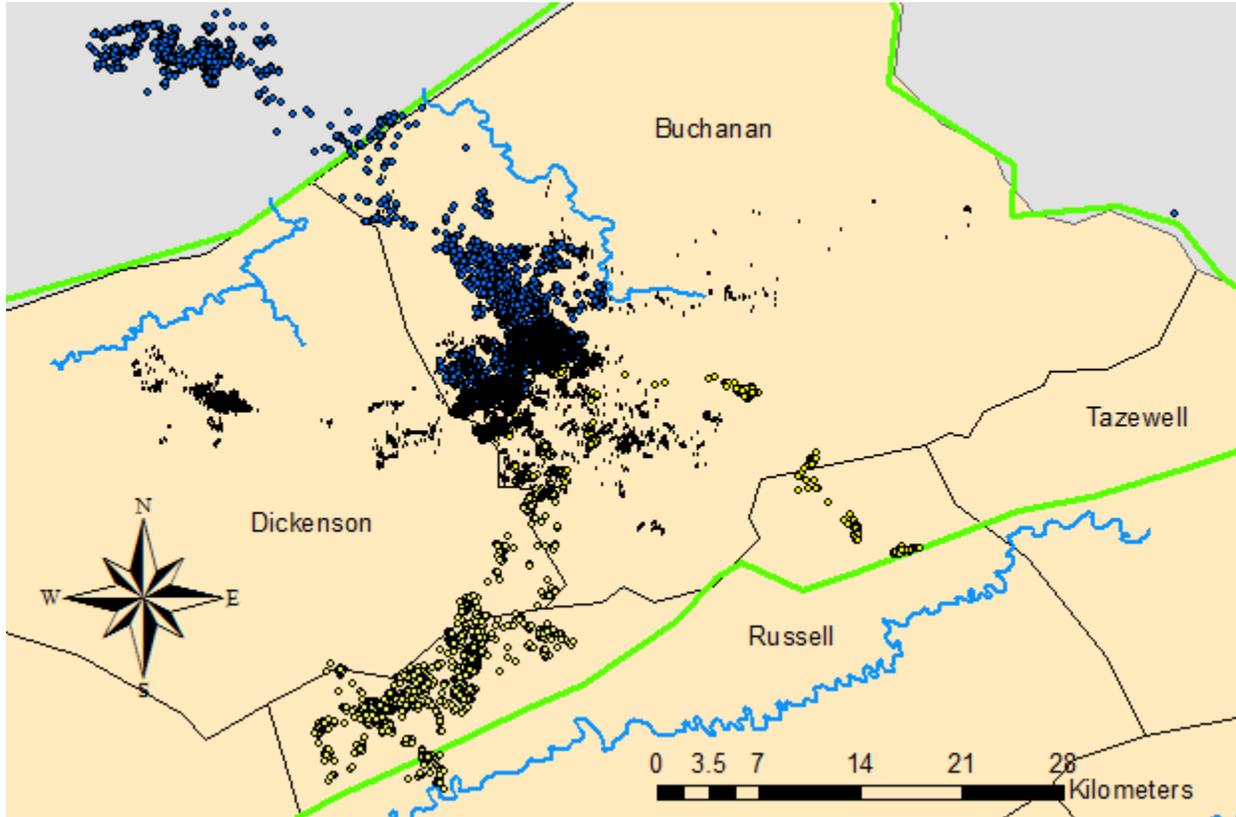


Figure 10. GPS radio-collar locations for 75 elk fitted with GPS transmitters for the period 2012-2017 in and adjacent to the Buchanan County, Virginia, release site. Animal locations that left the Elk Restoration Area are enlarged and colored (blue left Virginia, yellow entered other Virginia counties). Virginia's coal region is outlined in green, and major waterways are portrayed in blue.

POPULATION DYNAMICS

REPRODUCTION AND BREEDING

Unlike white-tailed deer, reproduction in elk is more prolonged, starts at an older age (i.e., 2½ rather than 1½ years of age), and rarely produces more than a single calf; twins in elk are very rare and account for <1% of all births (Raedeke et al. 2002). As polygamous breeders, bulls begin to gather groups (harems) of cows and calves during early fall and breed from late September through early October. During the 21-day estrus cycle exhibited by cows, they are receptive for only a few hours (Hudson and Haigh 2002). In contrast to other comparably sized mammals, elk exhibit relatively short periods of gestation and lactation. Cows give birth during late May or early June after an average 247-day gestation period (range: 243 to 258 days); calving within a herd typically peaks around June 1st (Hudson and Haigh 2002).

Newborn calves weigh between 33-49 lbs. (15-22 kg.); males typically weigh more than females at this stage (Peek 1982, Hudson and Haigh 2002). Calves generally are weaned by 110 days, but often begin eating forage soon after birth to stimulate the development of the microflora in their rumen. By the time a calf is one year old, its average weight will be about 300 lbs. (140 kg.). At the time of birth, the sex ratio of calves favors males, even within populations that are not hunted, whereas adult populations typically display a larger female component (Raedeke et al. 2002). A typical adult sex ratio for elk ranges from 30-70 bulls per 100 cows, with fewer males in hunted populations (Geist 2002).

Food quality and availability, as well as nutritional stress brought on by changes in population density, can influence fertility rates in elk. When located on optimal habitat, newly established elk populations often exhibit high reproductive success, and breeding among yearling (1.5 years old) females is common (Raedeke et al. 2002). Adult cows (>3.5 years old) typically display annual pregnancy rates >90%, whereas the percentage of bred yearling cows averages 18%, but can vary between 0-48%. It is very rare for calves in their first fall (3-4 months of age) to breed (Raedeke et al. 2002). In Kentucky, calving rates initially were lower than anticipated (40-66%), but now have stabilized at a rate (89-92%) higher than that observed in the source herd in the West (Larkin et al. 2003). Biologists with KDFWR attribute this temporary reduction in calving rate to the stress of translocation.

In late August and after the velvet is shed from their antlers, males begin to spar and compete for dominance within the herd. Dominant bulls attract females by bugling, disseminating pheromones produced in several glands and in their urine, and wallowing in shallow mud pools (Geist 2002). Bulls undergo extreme changes in body condition prior to and during the rut, including an increase in neck size and mane length (pre-rut) and a loss of body weight of up to 20% as the rut progresses (Hudson and Haigh 2002). Male competition usually occurs without direct physical altercation, relying instead upon threats and intimidation. Mature bulls will chase subdominant bulls to restrict access to their assembled harem of cows. However, when two bulls are of equal stature, the battle for dominance often becomes a physical wrestling match using their antlers as tools of engagement. Although wounds about the neck and face are common, death rarely occurs (Geist 2002).

SURVIVAL AND CAUSES OF MORTALITY

In the absence of hunting, elk may live >20 years, but average life expectancy generally is lower (Peek 1982). Life expectancy in bulls (13-14 years) typically is lower than that observed in cows (may reach >21 years), due primarily to the stress, weight loss, and other physical effects of rutting activity prior to the onset of winter (Raedeke et al. 2002). The principle source of mortality in most elk populations is loss associated with hunting and wounding loss (Brodie et al. 2013). Other mortality factors include predation by large carnivores and malnutrition, especially in severe winters (Peek 1982, Raedeke et al. 2002). For elk that persist in low-quality habitat, malnutrition can be a significant factor in mortalities (Cook 2002). Early in Kentucky's restoration effort, 49% (n [the number of respondents] = 71) of the documented mortalities were due to capture-related causes, whereas auto collisions, meningeal worm infections, and poaching accounted for most non-capture related mortalities (Larkin et al. 2003).

Unlike western states where wolves (*Canis lupus*) and cougars (*Puma concolor*) are present and capable of taking down an adult elk, here in the Appalachian Region, large predators capable of pursuing an adult elk, are not present, so humans represent the primary mortality

factor for healthy adult animals. Other than hunting, the biggest natural mortality factor for most elk populations is predation on calves (Keller et al. 2015). Because the predator community in the East is limited primarily to black bears (*Ursus Americana*) and coyotes (*Canis latrans*), calf mortality due to predation is substantially lower than that observed in western North America (Figure 11; Thorne et al. 1976, Yarkovich et al. 2011, Keller et al. 2015). Among restored elk populations in the East, calf survival varied among states from 60% in North Carolina to 77% in Kentucky to a high of 82% in Pennsylvania (Keller et al. 2015). Because calf survival has strong implications on elk population viability and growth, managers often seek ways to limit calf predations (Raedeke et al. 2002, Sargeant and Oehler 2007).

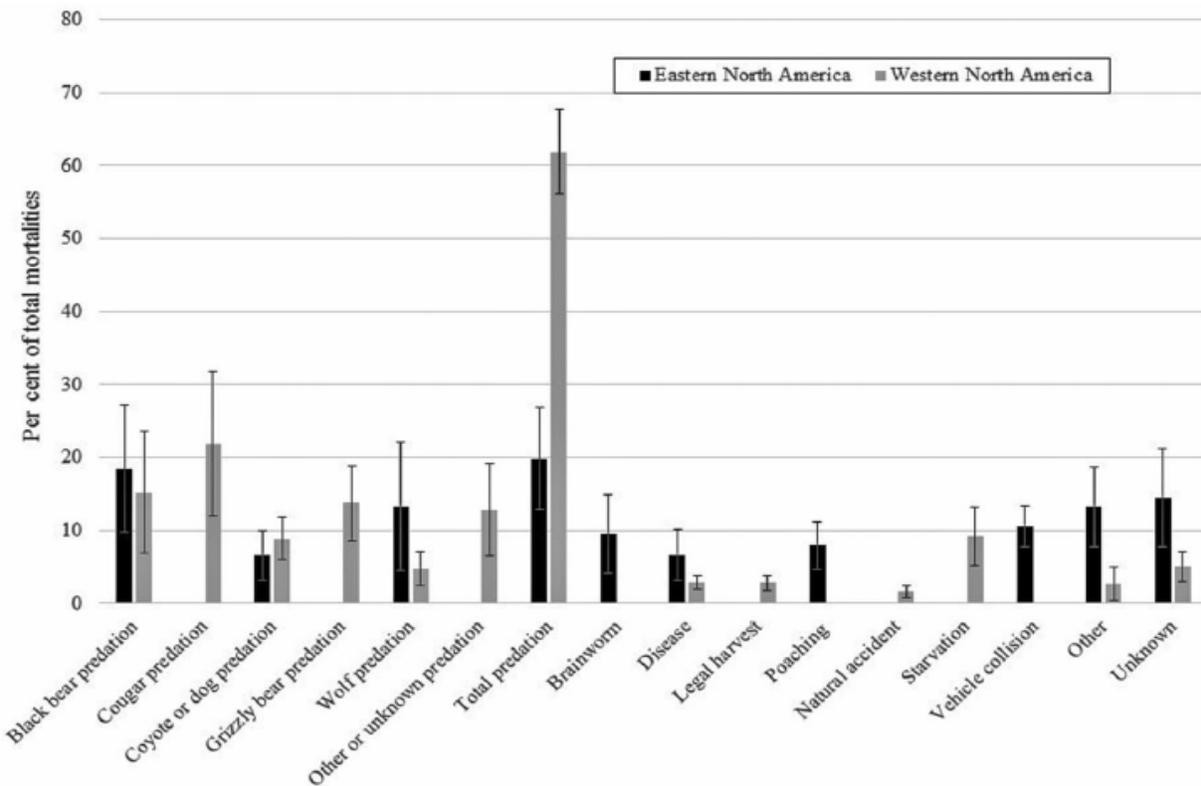


Figure 11. Source and percent (with 95% confidence) of total elk calf (0-1 years) mortality in eastern (black bars) vs. western (gray bars) North America; significant differences among regions are indicated by non-overlapping error bars (from Keller et al. 2015).

Given the lower risk of predation among adults, harvest by hunting has become an essential means to attain and maintain desired herd quality (e.g., density, sex ratio, physical condition) and optimal population size. However, elk often will change behavior following exposure to a predator-related threat, including recreational hunting (Proffitt et al. 2009). Where elk are exposed to hunting pressure, they often become more nocturnal, begin using habitats with fewer openings, increase their rates of movement, or congregate in smaller groups, all of which can affect public viewing negatively (Proffitt et al. 2009).

Disease and parasites also represent potential mortality factors for elk. Prominent among the diseases of concern with elk is Chronic Wasting Disease (CWD), an infectious, progressive, and fatal disease affecting the brain and nervous system of cervids. The infectious agent that causes CWD is a protein called a prion, which can be transmitted directly from infected to healthy animals or transmitted indirectly via either contact with infectious bodily fluids excreted by infected individuals or soil contaminated with prions deposited by infected individuals (Plummer et al. 2018). In Virginia, surveillance for CWD began in 2002 when the disease was first detected in deer east of the Mississippi River. CWD was confirmed in northwestern Virginia in 2009 (Figure 12), approximately 350 miles from the ERA, and disease management protocols have been enacted to limit its spread throughout the remainder of Virginia. In response to the presence of CWD in Virginia, DGIF instituted specific management actions, including:

- restricting movement of captive cervids (2002);
- revising CWD surveillance and response plans to address risks imposed from adjacent states (2005, 2012, 2014);
- prohibiting feeding of wildlife within the ERA and within the CWD containment area;
- restricting import of certain portions of hunter-killed cervids from areas with CWD (2005) or from enclosures intended to confine deer or elk (2013); and
- prohibiting the possession or use of deer scents and lures that contain natural deer urine or other bodily fluids used for the purposes of taking, attempting to take, attracting, or scouting wildlife (2015).

Beginning prior to the restoration, in 2001, all elk harvested via recreational hunters, dispatched, or found dead must be screened for CWD; to date, none of those examined have tested positive for CWD.

Elk used in the Kentucky restoration (and thus the source for Virginia's program) came from donor herds in Arizona, Kansas, North Dakota, New Mexico, Oregon and Utah. Prior to release, all involved elk underwent some disease testing (Bowling et al. 2015).

Meningeal worm is a native parasitic nematode for which gastropods (snails, slugs) and cervids serve as hosts. During a part of its life cycle, larvae infect cervids when a deer or elk incidentally consumes an infected gastropod. The larval parasite then is shed in their feces, exposing gastropods to infection, thus completing the life cycle. Although very common in many populations of white-tailed deer (albeit in different densities), infection with these larvae has little to no ill effects on deer, due to the larvae's different behavior in white-tailed deer compared to the behavior of the worm in elk. Thus, when elk incidentally consume affected gastropods, aberrant migration of *P. tenuis* larvae in brain tissue can result in neurological ataxia, mentation changes, emaciation, and eventual death.

Although rates of brain worm infection vary greatly, this parasite represents a known mortality risk for elk in Virginia, and therefore its effects need description and consideration in population modeling and growth expectations. Early in Kentucky's restoration program, managers attributed 23% of known non-capture related mortalities to meningeal worm and observed higher rates of prevalence in younger age classes (Larkin et al. 2003). In Michigan, brain worm accounted for only a minor portion (3%) of overall mortalities in elk, but, like Kentucky, managers reported higher mortality among young animals (Bender et al. 2005). Biologists in Missouri attributed 33% of mortalities from 2011-2013 within their restored elk herd to *P. tenuis* (Chitwood et al. 2018).

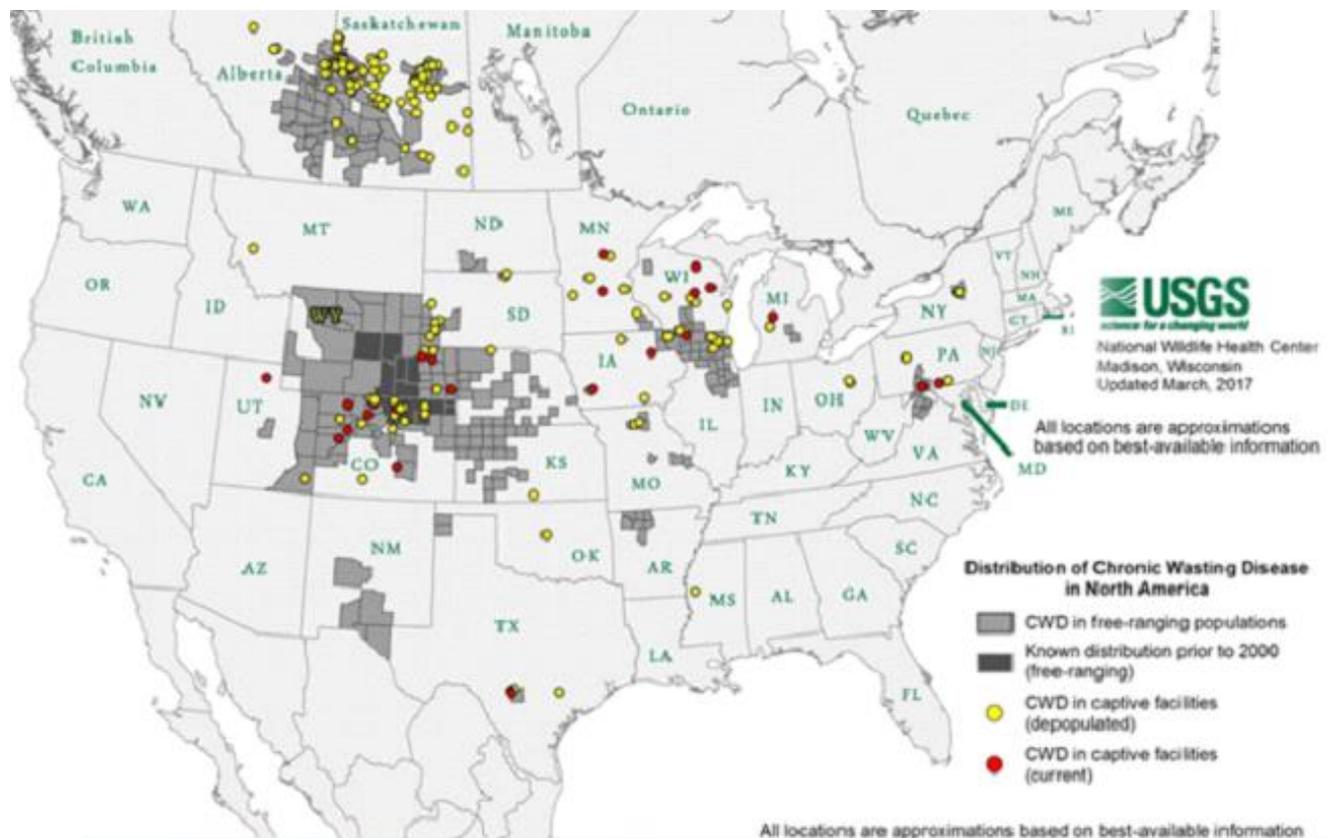


Figure 12. Locations (counties, captive cervid facilities) in North America where Chronic Wasting Disease has been detected. Map by USGS, National Wildlife Health Center (http://www.nwhc.usgs.gov/disease_information/chronic_wasting_disease/).

POPULATION VIABILITY, GENETIC DIVERSITY, AND GROWTH

If a population is to persist, without negative effects associated with inbreeding, the population must attain and maintain a minimum number of individuals. Estimates of what constitutes a “minimum viable population” (MVP) — the minimum number of animals necessary to constitute a genetically and biologically diverse population that is self-sustaining — vary widely. Estimating MVP often is difficult due to factors that contribute to faulty modeling, including identifying the proper size of area over which estimation should be made and its relation to typical range size, especially in large animals (Reed et al. 2003). For elk, estimates for MVP range from a low of 50 individuals to as many as 1,000 (McCullough et al. 1993). McClafferty (2000) suggested that MVP for a restored elk population likely falls between 90 to 500 individuals (± 360). However, Kalb and Bowman (2017) postulated that, because cervids are highly adaptable, as few as 5-10 individuals may be sufficient to sustain a healthy population. Such low MVP numbers certainly are not desirable, but they suggest that when founding elk used in restoration efforts are genetically diverse, they likely display sufficient diversity to avert most concerns about long-term population survival. Although the exact genetic composition of Virginia’s current elk population has not been determined, adequate diversity likely exists given that Kentucky (the source of animals used in Virginia’s restoration) obtained animals from multiple source populations during its 5-year restoration effort. Anticipated movement between, and breeding activity among, different elk populations across Kentucky, Tennessee, Great

Smoky Mountain National Park, Virginia, and West Virginia have the potential to enhance genetic diversity, ultimately representing a meta-population within the greater Appalachian Region.

Although Virginia's founding elk population continues to grow, it cannot do so indefinitely if confined to a particular area. Elk are a density-dependent species — growth of the population will slow as the availability of essential habitat resources (primarily food) decreases in response to an increase in population size (Raedeke et al. 2002). *Biological carrying capacity* (BCC) is a metric used to describe the number of individuals of a species that a habitat can support where both the condition and health of the habitat and the animals inhabiting that area remain favorable. If the number of individuals exceeds this threshold, qualities of the habitat begin to decline (e.g., creation of a browse line from the foraging of overabundant deer), individual or herd condition begins to decline (e.g., evidence of malnutrition appears, fewer offspring produced), or both may arise. Although useful to managers as a conceptual means to estimate the maximum number of animals that management activities could allow on an area, it rarely forms the basis for establishing population management goals today. (Hui 2006). The BCC for elk in the East generally remains unknown, yet it varies considerably from habitat to habitat and from year to year. In general, as the quality of habitat increases, so does the number of elk it can support.

In theory, once a population reaches BCC, the average annual rate of population growth (λ) will fall to zero. For elk, food quality and availability affect recruitment and survival of calves, resulting in a low rate of population growth when food is limited (Raedeke et al. 2002, Skovlin et al. 2002). When population density is low and resources are abundant, elk populations that are not hunted may achieve a maximum growth rate of 28% per year (Eberhardt et al. 1996). Colonizing populations of elk in California and Washington exhibited annual population growth rates of 1.30 and 1.34, respectively (Raedeke et al. 2002). Based on such rates of increase, an elk population under optimum conditions in excellent habitats could double in size every 2-3 years (Figure 13). However, ideal conditions are not the norm and elk populations typically are prone to a variety of mortality factors, which reduce population growth to between 1.10 and 1.18. Unlike white-tailed deer, which can double their population every year when inhabiting excellent habitat conditions, elk populations frequently require >4 years to double in size (Popp et al. 2014). Among restored eastern elk populations, mortalities stemming from brain worm, vehicle collisions, legal harvest, and poaching have kept λ below 1.15 (i.e., for every 100 animals alive at the end of a year, 115 would be expected the following year).

Examples exist where annual growth rates reach as high as 1.30, but these rates typically are not uniform across an entire state and are not sustainable, thus they reflect no more than a single year or short-term estimate (Raedeke et al. 2002). Most populations do not experience continual or consistent growth either, as rates fluctuate year to year depending on weather, habitat condition, or incidence of predation. The long-term average rate of growth of restored elk populations in the East (of those exhibiting growth) has been $\lambda \approx 1.07$ (Figure 13). Currently Virginia biologists estimate that there are 200 – 250 elk in the state. Elk in areas not exposed to hunting and where natural mortality is low should display higher growth rates than exploited populations (Popp et al. 2014).

Population size and growth substantially will influence when potential benefits associated with elk (e.g., viewing, hunting) can be achieved; in general terms, benefits likely will not become viable until the population reaches a critical minimum threshold. Among programs in the East that have restored elk during the last 35 years, an average of nearly 11 years (range: 6

[KY] to 17 [AR]) passed, post- re-introduction, before the population had grown to ≥ 300 animals and could sustain hunting (Kentucky Department of Fish and Wildlife Resources 2018, Arkansas Game and Fish Commission 2018). Even after reaching this threshold, many of these programs restricted harvest to the take of a select number of bulls during the first few years of implementing a hunting program (Popp et al. 2014). In response to a question about unanticipated outcomes related to restoration of elk populations, managers shared their sentiment that it took longer than anticipated for them to achieve hunting goals and that, once a hunting program had been implemented, other desired goals also were delayed or affected negatively (e.g., viewing opportunities; Hurst and Parkhurst 2018b). As noted earlier, elk alter behavior in response to hunting pressure and will seek out parts of the range that provide better cover or protection against detection, which can reduce viewers' ability to find and observe elk where hunting is allowed.

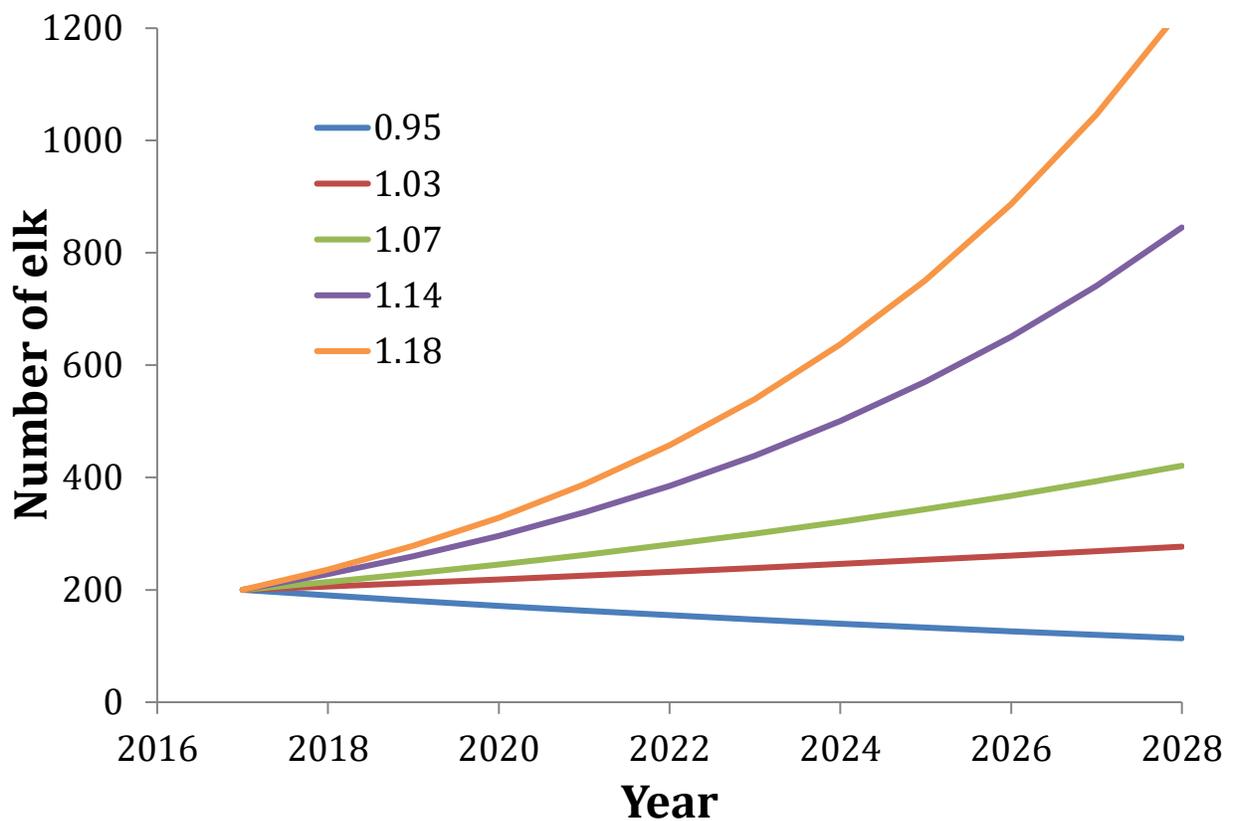


Figure 13. Estimated projected population size for elk in Virginia, given different potential rates of growth (λ), as derived using 2017 population status data.

ELK SUPPLY

HABITAT AND LAND USE

The value of habitat for elk throughout SWVA depends on its current use and physical features. Because elk prefer to forage in open non-forested areas, the abandoned or reclaimed mine lands, natural gas well pads, old-field meadows, mowed grassy pastures, and agricultural lands found in this region all would be attractive to elk. Agricultural lands certainly provide an abundance of high quality forage, but use of such parcels as foraging sites by elk can lead to conflicts with producers.

A dramatic increase in the surface extraction of coal during the late 1990s and early 2000s across the Appalachians, and the subsequent land reclamation of previously mined lands, created ideal elk habitat (Figure 14). As a result, these reclaimed lands became sites where elk restoration efforts in Kentucky, Tennessee, and Pennsylvania occurred. Given the successes witnessed in these states, similar areas in SWVA and now in West Virginia are being used and are expected to perform equally well as elk habitat. Buchanan, Dickenson, and Wise Counties in Virginia possess an abundance of historic, current, and/or proposed mining sites, which should provide quality elk habitat, if properly managed. It also represents largest contiguous acreage of potentially suitable elk habitat with a low probability for human conflict.

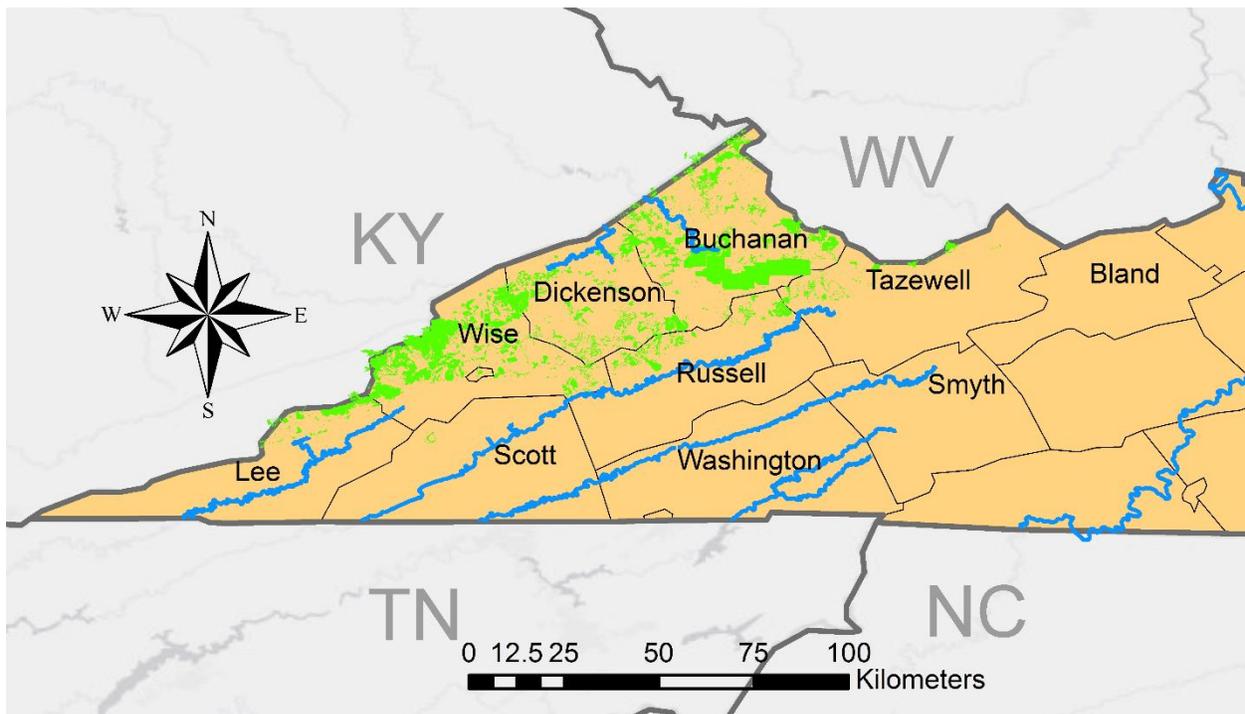


Figure 14. Distribution of reclaimed, abandoned, and current mine lands (green) in southwest Virginia. Navigable waterways are shown in blue.

Theoretically, the potential for human-elk conflict will be lowest in areas with low human population density and designated lands for the needs of elk. In comparison to other regions of the Commonwealth, SWVA exhibits some of the lowest human densities (Table 8) and

proportionally less developed land per county in the state (Table 9). Existing land use in SWVA varies considerably among counties. Within the ERA acres farmed and cattle produced both are low when compared to other counties in the region (Table 8). In contrast, lands dedicated to agriculture (corn, wheat, soybean, Christmas tree, and fruit production) and cattle farming in neighboring Tazewell, Russell, Scott, Smyth, and Washington Counties all are significantly higher (Figure 15, Table 8). In addition some growers and producers have entered small markets on small acreages where conflict could pose a greater individual impact on the owner's finances.

TABLE 8. Human population density (people/square mile), presented by a county's rank in the state, and selected attributes of agricultural standing, as reflected in the county's absolute (and quartile) rank among counties in Virginia.

County/ City	Density (people/mile ²)	State Rank ^a	Head of Cattle	State Rank ^b	Acres in Forage Crops*	State Rank ^b	Acres Under Cultivation*	State Rank ^b
Bland	19	130 (4 th)	15,662	35 (2 nd)	11,176	45 (2 nd)	**	86 (4 th)
Buchanan	49	104 (4 th)	651	86 (4 th)	817	85 (4 th)	**	94 (4 th)
Dickenson	48	105 (4 th)	1,488	72 (3 rd)	1,790	71 (3 rd)	14	92 (4 th)
Lee	60	96 (3 rd)	28,376	20 (1 st)	20,957	25 (2 nd)	828	57 (3 rd)
Russell	64	94 (3 rd)	55,987	7 (1 st)	26,305	19 (1 st)	386	72 (3 rd)
Scott	43	110 (4 th)	28,259	21 (1 st)	24,599	21 (1 st)	225	79 (4 th)
Smyth	73	85 (3 rd)	65,365	4 (1 st)	28,169	15 (1 st)	660	63 (3 rd)
Tazewell	89	75 (3 rd)	37,199	15 (1 st)	21,437	23 (1 st)	DD	78 (4 th)
Washington	99	70 (3 rd)	67,259	3 (1 st)	40,325	5 (1 st)	381	74 (4 th)
Wise	104	68 (3 rd)	2,587	68 (3 rd)	2,587	68 (3 rd)	35	90 (4 th)
City of Norton	538	44 (2 nd)	NA	NA	NA	NA	NA	NA
City of Bristol	1,348	29 (1 st)	NA	NA	NA	NA	NA	NA

^a Out of 133 counties and independent cities

^b Out of 98 counties

* Corn used as an index for acres under cultivation. Other commodities vary in scale by region.

** = insufficient data available

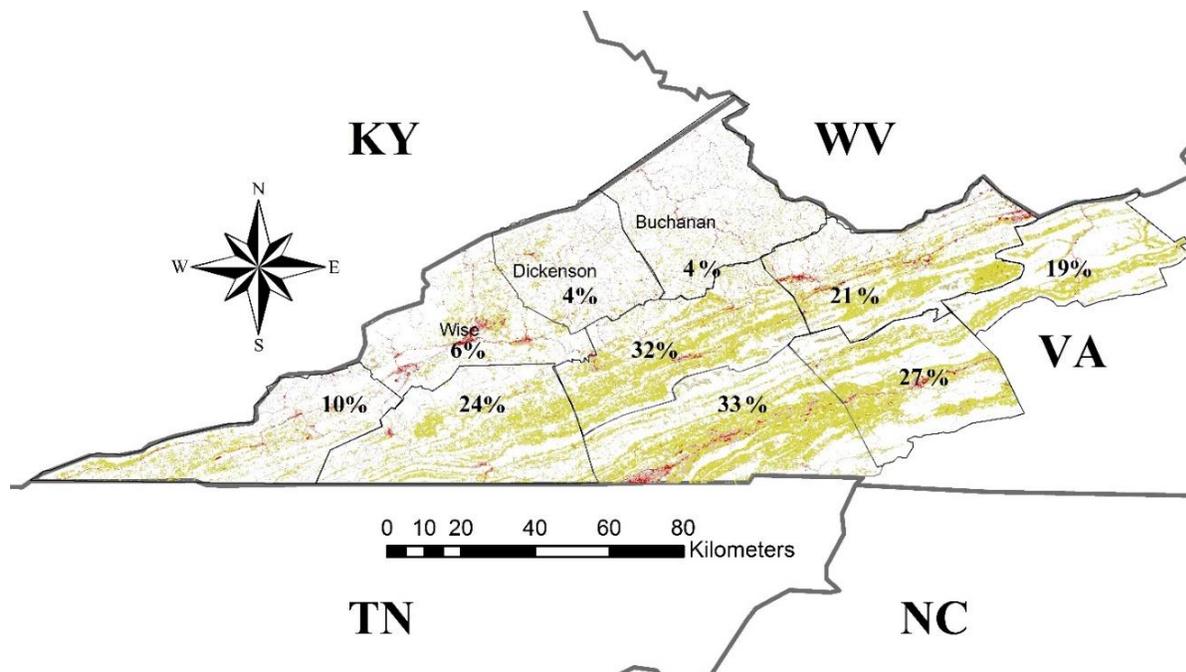


Figure 15. Location and spatial distribution of land classified as “farmed land” (comprised of Land Use and Land Cover types: cultivated crops, hay, or pasture [shaded yellow]) and “developed land” (shaded red) in 10 counties in southwest Virginia. Number superimposed over each county indicates the proportion of total land area (%) in that county classified as “farmed land.” The map was generated using data from the 2011 USGS land-use and land cover database.

Table 9. Percent of total land area in a county in 6 classifications of land use for 10 counties in southwest Virginia. Data for mining obtained from 2010 report by the Virginia Department of Mining and Minerals. Area of developed, herbaceous, forest, and wetland are derived from the 2011 U.S. Geological Survey, National Land Cover Dataset (NLCD); farmland data obtained from a (2007) Virginia Base Mapping Program.

County	Farmlands	Developed	Forests	Herbaceous	Mine Land	Wetlands & Water
Bland	19%	3%	76%	2%	0%	0%
Buchanan	4%	9%	79%	6%	2%	0%
Dickenson	4%	7%	80%	7%	1%	1%
Lee	10%	7%	62%	20%	1%	0%
Russell	32%	7%	56%	4%	0%	0%
Scott	24%	8%	61%	7%	0%	0%
Smyth	27%	5%	66%	2%	0%	0%
Tazewell	21%	8%	64%	6%	0%	0%
Washington	33%	8%	57%	2%	0%	0%
Wise	6%	8%	68%	11%	6%	0%

ACCESS

When land is in private ownership, habitat management is at the discretion of the owner (or designated manager). Across the 3-county ERA, the majority of land is in private ownership (Figure 16). Although habitat quality frequently reflects the level of investment made by owners, ownership also has significant implications on access. Having access to areas where elk reside will be a critical determinant of whether Virginians are going to realize certain benefits associated with elk restoration. As a part of the study conducted to produce this management plan, a recently completed telephone survey of landowners who owned >10 acres in SWVA found that 33% (n = 413) of landowners currently granted non-family individuals access to their land for wildlife viewing. Of those who allowed access, 2% (n = 7) charged a fee to do so. The survey also found that 48% (n = 605) of these landowners currently allowed hunters access to their land for hunting; only 4% (n = 23) charged hunters a fee for this access (Hurst and Parkhurst 2018a).

Now that an elk herd is becoming established in SWVA, many (58%, n = 727) of these same respondents expressed a likelihood (“somewhat likely” to “very likely”) that they would allow access to their land in the future for wildlife viewing purposes. Although most landowners (82%, n = 598) indicated they probably would not charge potential viewers a fee, the mean assessment among those who expressed an intent to require payment was \$23.95 (median = \$12.50) per user per visit (Hurst and Parkhurst 2018a).

A different trend emerged when questioning landowners who held >10 acres in SWVA regarding whether they would provide access to elk hunters; many (47%, n = 582) indicated they likely would not allow access to their land for hunting. However, of those likely to provide access, most (74%, n = 383) indicated little likelihood of charging hunters an access fee to hunt elk; in fact, 67% (n = 348) of respondents stated no intent at all to charge an access fee. Of those likely to charge a fee to hunt elk, the mean fee charged per visit would be \$217.78 (median = \$100) (Hurst and Parkhurst 2018a).

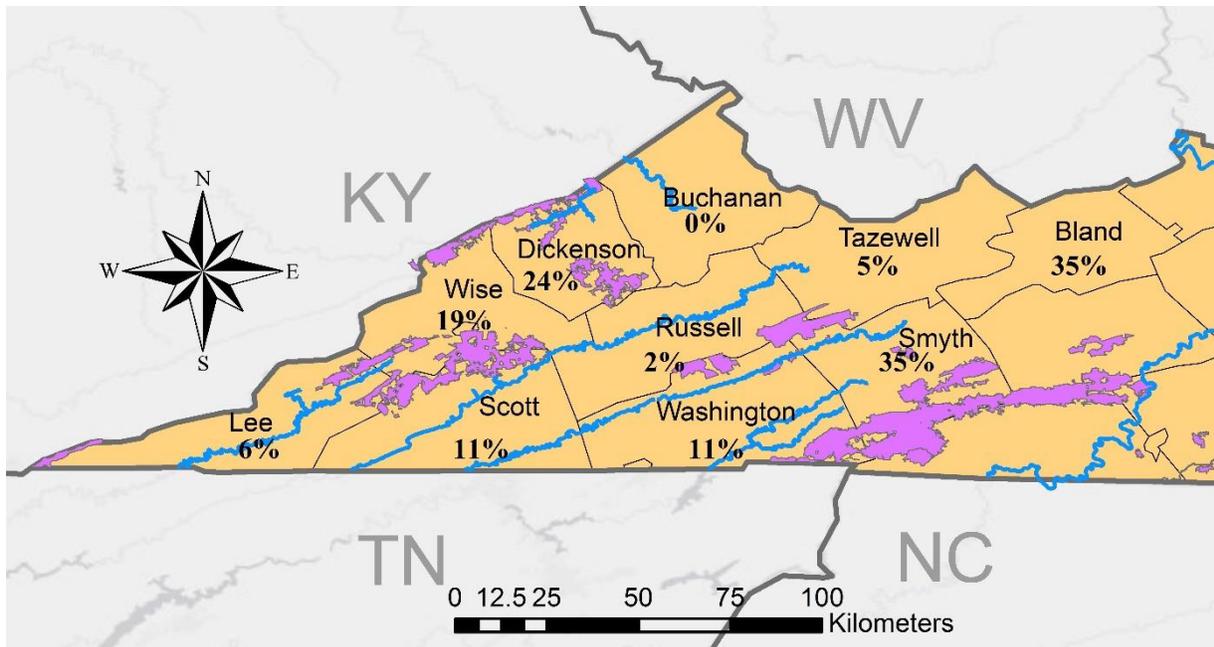
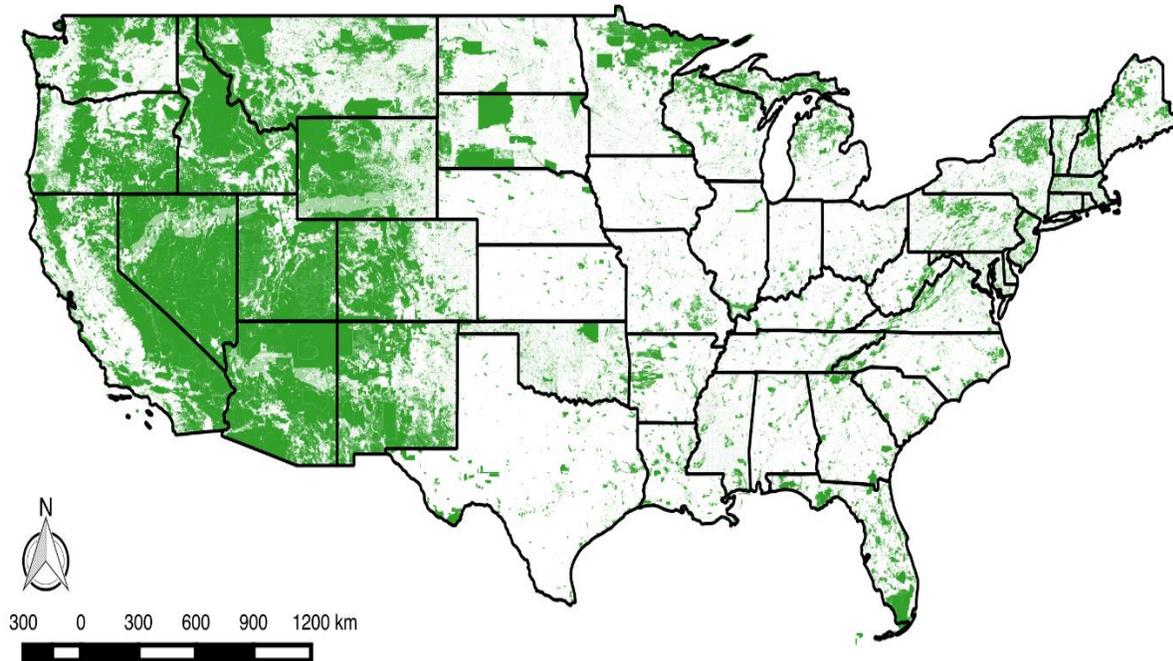


Figure 16. Distribution (shaded purple) and percent of total land area in a county designated as “public land” or managed as public hunting land within 10 southwest Virginia counties. Navigable waterways are shown in blue.

ELK-RELATED DEMANDS AND EXPECTATIONS

As managers restore elk populations in the East, they are confronting an array of realities that can create significant management challenges, some of which have the potential to influence whether certain desired benefits can be attained and by whom. Unlike their counterparts in the West, one of the more serious issues managers face is ownership of lands on which elk herds exist. In western states, where elk predominantly are dispersed across vast tracts of public land (Figure 17), managers work primarily with a relatively small number of governing entities or agencies to formulate management strategies, and involvement with private individuals occurs mostly with owners of large tracts. Given this ownership pattern, recreationists typically have easy access to the elk resource. In contrast, land ownership patterns in the East are very different. The amount of land in public ownership is much less in the East (Figure 17), so a considerable proportion of the suitable elk habitat likely lies in private hands. Working with private owners to develop meaningful management strategies is made more difficult when other attributes of private ownership are examined — a trend toward smaller parcel size (and hence a need to work with many owners), high turnover in land ownership, significant disparity among owners in management goals and objectives, few parcels receiving any form of land management, and far greater population densities. The ability to reach consensus on desired management goals and outcomes is far more complicated as the number of parties involved increases.



Source: U.S. Geological Survey, Gap Analysis Program (GAP). May 2016. Protected Areas Database of the United States (PAD-US), version 1.4 Combined Feature Class.

Figure 17. Distribution of land in public ownership across the U.S. as of 2016.

Similar disparities exist when contrasting the likelihood of human-elk interactions between the West and East. Given the strong migratory behavior western elk display (i.e., occupying high elevation publicly-owned ranges in late spring, summer, and early fall, and returning to the more urbanized valleys primarily during winter), the likelihood of direct human-elk interaction is low throughout portions of the year. The incidence of human-elk interactions is more related to migration routes and seasonality overall. Given the suite of eastern land ownership attributes discussed above, together with the reality that easterners are generally less familiar with elk, the likelihood for human-elk interaction is greater. Although this may afford certain advantage relative to tourism interests (close proximity to population centers, associated infrastructure, and facilitated mobility), the potential for conflict is also greater.

Therefore, decisions on how best to manage the elk resource must be based on an evaluation that identifies benefits that might be attained (and by whom) from having elk, as well as an assessment of the potential risks and/or costs borne by those who live in close proximity with elk. In many cases, decision-making requires some form of prioritization or weighting potential costs and benefits in ways that accurately reflect the values and desires expressed by Virginia's various stakeholders.

As part of the recently completed telephone survey (Hurst and Parkhurst 2018a), Virginians were asked to identify how important they viewed various considerations when making decisions about managing elk. This list of potential considerations was ranked by the percent of respondents who indicated each was important (either "very important" or "somewhat important" in guiding management decision-making (number in parentheses = % indicating "important")):

- 1) private property rights and access issues (64%);

- 2) opportunities to use elk for education (62%);
- 3) the right of elk to exist as part of ecosystem (58%);
- 4) the desires of residents (57%);
- 5) impacts and costs of damage from elk (51%);
- 6) opportunities to view elk (49%);
- 7) impact elk may have on changing residents' way of life (43%);
- 8) opportunities to hunt elk (40%);
- 9) economic profitability (33%).

Interestingly, residents from within the 3-county ERA placed greater importance on all considerations (except “opportunities to hunt elk” and “impacts and costs of damage from elk”) than did residents from other parts of Virginia — local residents placed similar importance on the 2 exception considerations. All respondents, regardless of location, viewed “the right of elk to exist as a part of the ecosystem” as important (Hurst and Parkhurst 2018a).

Only minor differences in ranked importance of considerations emerged when distinctions among stakeholder groups were examined. The most prominent difference in one's view of what constituted an important management consideration occurred between people who identified themselves as a hunter or conservationist and those who identified themselves as a home gardener, forester, or agricultural producer. Hunters and conservationists viewed “opportunities to view elk” as more important than (91% vs. 76%) did home gardeners, foresters, or agricultural producers. Hunters and conservationists also considered “opportunities to hunt elk” (92% vs. 71%) as more important than did home gardeners, foresters, or agricultural producers. Apart from this attitudinal departure, respondents in all stakeholder groups revealed similar ratings of importance for the listed considerations.

HUNTING DEMAND

In spite of the decline in the number of licensed deer hunters nationally, state agencies do not have concerns about having sufficient hunting effort to manage elk properly. In fact, the demand for opportunities to hunt elk, including in the East and in Virginia specifically, has increased dramatically. The number of hunters across North America who pursued elk increased from 552,773 in 1975 to 834,402 in 1995, a 51% increase (Toweill and Thomas 2002). Elk hunters throughout the U.S. are willing to pay a fee to enter lotteries in the hope of drawing an elk tag, knowing that additional fees will come if a tag is drawn (Table 10). States that manage elk populations in the East cannot satisfy the existing demand for elk hunting, given the relatively small number of elk on the landscape. Kentucky, a state that has become attractive among elk hunters due to the size of its herd, now receives about 70,000 tag applications (@ \$10.00 each) every year, but, to assure population viability, can provide only 900–1,000 tags to hunters (Kentucky Department of Fish and Wildlife Resources 2018). In Tennessee's first elk hunt (2009), nearly 10,000 individuals applied (@ \$10.00 each) to secure 1 of 6 available tags; now in the 9th year of Tennessee's program, elk hunters will be competing (@ \$12.00 each) for 14 available tags (Tennessee Wildlife Resources Agency 2018). Similar demand exists in Pennsylvania, where 25–30,000 hunters annually apply (@ \$10.70 each) for about 100 elk tags (Pennsylvania Game Commission 2018). In Wisconsin's first elk hunt after their restoration, the state drew 38,500 in-state applications for an elk tag.

DGIF anticipates that the demand for elk hunting in Virginia, from both residents and non-residents, would be similar to that witnessed in other eastern states and that demand will exceed the availability of elk tags. In a recent survey of licensed Virginia hunters, many respondents indicated that, if given the opportunity, they would travel to SWVA to hunt elk during an open season (54% [n = 471] during firearms, 44% [n = 358] during muzzleloader, 35% [n = 278] during archery) (DGIF Hunter Survey 2016). A telephone survey of Virginians conducted as a part of the development of this management plan found that 75% (n = 917) of hunters who predominantly reside in SWVA were likely to travel to Buchanan County expressly to hunt wild elk (Hurst and Parkhurst 2018a). A higher percentage (76%, n = 784) of respondents from SWVA were likely to travel within the region to hunt elk than were respondents (69%, n = 131) from outside of the 10-county area likely to come to SWVA.

Reasons to explain why the demand to hunt elk in Virginia remains high are numerous and diverse. People like to hunt elk for the recreational value it affords, the challenge presented, to experience nature while hunting, the opportunity to tag a trophy-quality animal, the opportunity to use different hunting methods (e.g., archery, various firearms), and for sustenance (Peterson 2004). The fact that elk meat, like that of most other wild cervids, is low in fat and high in protein contributes to its value among hunters. Additionally, given the size of an elk when compared to white-tailed deer, the return per effort in terms of volume of meat obtained is substantially greater for each elk harvested (on average, an elk will yield ~40% of the live weight of the animal in deboned meat [Field et al. 2003]). Thus, especially for hunters who have limited time available to hunt, successfully taking an elk “fills the freezer” quicker than pursuing deer.

Recent national polling found that 74% of Americans surveyed expressed support for recreational hunting, and 95% believed people should be allowed to hunt if they do so legally (Responsive Management 2011). Results from our recent telephone survey of Virginians mirrored this national trend, where most Virginians (83%, n = 2843) indicated they supported the use of recreational hunting to manage elk populations (Table 11; Hurst and Parkhurst 2018a). However, support varied depending on whether the respondent hunted. In our recent telephone survey, 76% (n = 1496) of all respondents believed preserving the tradition and heritage of hunting elk in Virginia was important (“Very Important” or “Somewhat Important”), whereas 91% (n = 1108) of hunters indicated this was important. Most respondents (89%, n = 2841) also supported (“Very Important” [59%] or “Somewhat Important” [30%]) the opportunity to hunt elk for food. In contrast, the opportunity to take a trophy animal was less acceptable to the public, as only 57% (n = 1816) believed this was an important reason to hunt elk (28% “Very Important,” 29% “Somewhat Important”); because one-third of all respondents (33%, n = 1069) responded “Not at All Important,” trophy hunting is likely to be a divisive issue.

Table 10. Costs (\$) associated with acquisition of elk hunting tags for residents and non-residents and whether preference points are awarded in states where elk hunting is permitted. Costs presented reflect 2016 fee structures, as reported on state agency websites.

State	Resident Lottery Entry	Resident Tag	Non-resident Lottery Entry	Non-resident Tag	Preference Points? ^a
Alaska	None	In tag ^b	None	300.00	NA
Arizona	13.00	148.00	15.00	665.00	Yes
Arkansas	35.00	In tag	NA	NA	No
California	8.13	445.35	8.13	1361.20	Yes
Colorado	30.00*	49.00	40.00*	629.00	Yes
Idaho	None	30.75	None	416.75	NA
Kansas	12.81	302.50	NA	NA	Yes
Kentucky	10.00	30.00	10.00	400.00	No
Michigan	5.00	100.00	NA	NA	Yes
Minnesota	4.00	287.00	NA	NA	No
Montana	2.00*	20.00	20.00*	851.00	Yes
Nebraska	8.50	160.00	8.50	459.00 ⁺⁺	Yes
Nevada	10.00	138.00	10.00	1218.00	Yes
New Mexico	None	69.00	None	787.00	No
North Dakota	5.00	30.00	NA	NA	Yes
Oklahoma	5.00	51.00	5.00	306.00	Yes
Oregon	8.00	46.00	8.00	549.00	Yes
Pennsylvania	10.70	25.00	10.70	250.00	Yes
South Dakota	10.00	185.00	NA	NA	Yes
Tennessee	10.00	27.00	10.00	300.00	Yes
Utah	10.00*	285.00	10.00*	800.00	Yes
Washington	None	50.40	None	497.00	Yes
Wyoming	5.00	52.00	14.00	577.00	Yes
MEAN	10.64	120.52	13.03	609.76	

^a Preference points are given to lottery entrants who do not draw a tag, as means to increase the applicant's odds of drawing a tag in the future

^b "In tag" indicates there are no additional fees associated with an elk tag apart from the state hunting license

* Application applies only to high target/ high demand areas

⁺⁺ requires guided access to private lands, no public hunting for out-of-state residents.

Table 11. Expressed public support for the use of regulated recreational hunting to manage elk populations in Virginia among respondents (n = 3178) to a 2017 telephone survey. Respondents predominantly were residents of southwest Virginia and indicated preference using a 4-point Likert scale, to which numerical values were assigned (i.e., Strongly Support = 1, Strongly Oppose = 4).

Strongly Support (1)		Somewhat Support (2)		Somewhat Oppose (3)		Strongly Oppose (4)		Don't Know / Refuse		Mean Value
n	%	n	%	n	%	n	%	n	%	
1734	54%	929	29%	269	8%	247	8%	41	1%	1.7

In addition to the limitation that small population size (and hence a limited number of tags) may impose on an agency’s ability to meet existing hunting demand, securing adequate access to elk also is likely to be a constraint. If elk hunters are to be successful, they must have access to the areas that elk inhabit. In western states, hunters traditionally have had access to large tracts of public land, such as those managed by the U.S. Forest Service and the Bureau of Land Management, or on state-owned or state managed lands (some lands are leased, and enhanced for public hunter access). Additionally, hunters may choose to pay a fee to gain entry to private lands where elk reside. Knight (2016) recently found such access fees paid to private landowners can reach as high as \$7,000 per participating individual and thus can represent significant revenue for landowners who provide quality habitat.

As noted earlier, land ownership patterns in the East present unique and sometimes contentious challenges. Unlike in the West, where large contiguous tracts of public land provide millions of acres of land for public use, less public land is available to hunters in the East, (Figure 17), parcel sizes are smaller, and tracts often are not as contiguous. Consequently, access to the elk resource represents a potentially serious issue that may affect an agency’s ability to manage elk.

Restoration efforts that occur on or in close proximity to private land present both opportunities and challenges. Income driven opportunities exist for landowners who assess some form of access fee on individuals seeking an opportunity to hunt elk. The challenge lies in a hunter’s ability to pay such fees to gain access to the private properties where elk may exist. In areas where the demand for access outpaces the supply of publicly accessible lands or where nominal fees exist, concern arises that elk hunting, in effect, may become restricted or available only to those who can afford paying the high fees landowners might charge for access.

However, not all believe access, or the lack thereof, is a significant impediment to elk management in the East. In a survey of elk managers from the East, most (86% [weighted average], n = 21.5) strongly (59%) or somewhat (27%) agreed with the statement “In general, individuals wishing to gain access to elk in my state currently can do so via public lands and/or private lands with landowner permission.” Additionally, many (46% [weighted average], n =

11.1) managers strongly (21%) or somewhat (25%) disagreed with the statement “Hunters being denied access to private lands where elk exist inhibits our ability to meet our state's elk population management goals.” Many of these states started elk programs with large parcels of public lands dedicated in-part to their elk restoration efforts. Up to 50% or more of some states “elk areas” are comprised of publicly held or managed lands (D.M. Kalb, unpublished data). When asked if their agency had implemented any efforts or programs to help facilitate access to private lands for elk hunting, 60% (n = 6) of responding managers in the East indicated their agency had no special programs.

Nevertheless, many state agencies have tried to increase access to private lands through a variety of options, including issuing elk tags to owners who allow access, and imposing special registration fees or surcharges on license sales devoted to establish access via a lease or rental agreement with private landowners. Some agencies have sponsored or organized programs that connect hunters with private landowners to improve harvest. Examples of such state programs include:

- Idaho- E-PLUS program
- Michigan- HAP (hunter access program)
- Washington- “feel free to hunt” and “register to hunt” programs
- Wyoming- Access Yes
- Oregon- Access and Habitat Program
- Kentucky- Voucher Cooperator Elk Permit Program

VIEWING DEMAND

Ecotourism is the fastest growing segment of the tourist industry and, within 5 years, is projected to constitute 25% of all global travel (Williams 2014). The United States Fish and Wildlife Service (USFWS) (2017) reported that 1 in 3 Americans enjoys watching wildlife, and over 86 million Americans (~26%) claim to participate in wildlife watching. Many of those who participate in wildlife watching, and drive this ecotourism demand, want to view unique, rare, and threatened animals in natural and sustainable habitats (Fiorello and Bo 2012). An estimated 23.7 million people reported making specific travel plans to participate in wildlife watching, an increase of over 25% in the last 5 years (USFWS 2017). People who traveled to see wildlife averaged 14 days per year away from home and spent an average of \$87 per day while away from home (USFWS 2017). As a result, wildlife watching in the U.S. currently supports a \$75.9 billion industry that generates about 500,000 jobs (USFWS 2017).

Given that most restored elk herds in the East are within approximately 1-2 hours of an urban center, they have the potential to draw wildlife viewers who want to experience a species that has not existed in some areas for over 100 years. The tourism draw in the East increases when elk reside in scenic landscapes, affording viewing experiences similar to those traditionally available only via travel to western states. Tourism officials in Tennessee reported that visitors came from 12 different states in 2007 to view their elk herd (SEKTDA 2007). Representatives of the Great Smoky Mountains National Park observed that visitations nearly doubled following the release of elk in NC (from 65,000 to a high of 124,000 visits), which they partially attributed to the presence of elk (SEKTDA 2007). Officials in the Town of Benezette, PA, (year-round human population of 350) reported tallying 1,300 visitors a day during the height of the fall bugling season in 1997 (Lord et al. 1999, SEKTDA 2007).

In a 2016 survey of licensed hunters in Virginia, 35% (n = 277) expressed a likelihood that they would travel to Buchanan County in SWVA specifically to view elk (VDGIF Hunter Survey 2016). Among the general public, though, interest in potentially viewing elk is stronger; 63% (n = 2039) of participants in our telephone survey and who reside within the 10-county SWVA region indicated they were likely to travel to Buchanan County for the express purpose of viewing wild elk (Hurst and Parkhurst 2018a). Residents of Buchanan, Dickenson, and Wise Counties were more likely (71%, n = 566) to travel to view elk than were respondents (60%, n = 369) from outside the 10-county area.

Although there appears to be demand for, and support of, elk viewing, potential impediments exist that will need to be addressed if this potential is to be realized. As is true regarding hunting, viewers also must have access to sites where elk can be viewed. Some of the same resolutions used to improve hunting access may be applicable for wildlife viewers. However, apart from the issue of access, additional challenges exist in providing the basic hospitality and related infrastructural development required to meet the needs of visitors coming to SWVA to see or hear elk. Recent improvements in the availability of restaurants, lodging, and other hospitality needs within the region contributed to an increase in tourism bookings (e.g., at cabins at Adventure Outdoors Wildlife Viewing Center). Additional investment may be required in the types of infrastructure needed to maximize the viewing industry potential. However, as Fiorello and Bo (2012) acknowledge, investment in infrastructure development to promote ecotourism can create other issues for a community; they advise that ecotourism must be well planned, purposeful, and reliant on sound environmental decisions that assure protection of the very resource that draws tourists. Additionally, as ecotourism grows, the character of community that residents are accustomed to may change; therefore, decision-making must be community-based to empower local residents an opportunity to determine how the community will respond to the impacts imposed by tourists (Fiorello and Bo 2012).

DEMAND FOR COLLECTING

Hunting for and collecting the shed antlers of elk have become important ways people interact with elk and experience the outdoors in the early spring. Shed antlers of any size are a prized find for most collectors. Elk sheds sell for about \$12 per pound, more if collected as a matching set, and are prized by artists, craftsmen, and gift shops who offer retail products made from these antlers (Steele 2015). The opportunity to collect elk sheds potentially extends the amount of time people will visit the region and interact with the elk resource.

ECONOMIC EXPECTATIONS

Elk have the potential to provide economic benefits to areas where elk populations are established (Walters et al. 2010, Cox 2011). Revenue flowing into communities where elk exist comes from direct and indirect (value-added) sources typically not available prior to the re-establishment of elk. Walters et al. (2010) observed that communities also can realize considerable revenue growth from restaurants, bed and breakfasts, guiding services, hotels, and other tourism-based facilities where the elk resource is marketed appropriately. Economic

potential often is measured as value per elk or value per acre of habitat used by elk. By applying a standardized multiplier, the indirect economic impact derived from hunters and viewers can more than double these estimates (to as much as \$600–800 per elk). For example, estimates of value derived from hunting elk vary regionally; managers in Kentucky (2014) calculated a value of \$291 of direct expenditure per elk pursued for harvest and \$595 value-added expenditures per elk, whereas in Montana (2016), estimated value was \$411 per elk and \$839 in value-added expenditures per elk. Obviously, the value attributed to elk within a region depends upon the health and size of the herd as well as the amount of support of and importance placed on that resource by the local community. Approximately 2.3% (nearly \$900 million) of Montana’s economy is associated with hunting, fishing, and wildlife watching (MDFWP, 2004). The Montana Department of Fish, Wildlife, and Parks derives about 53% of its annual budget from the sale of elk licenses alone, not including fees associated with drawing a tag or entering a lottery or funding associated with Pittman-Robertson federal funds (MDFWP 2004). Montana’s elk herd is significantly larger than the size Virginia’s will reach. In an attempt to estimate potential value in Virginia, McClafferty (2000) examined both costs and benefits associated with elk and determined a value-added economic potential from hunting alone of approximately \$300 per elk (Table 12). Virginia hunters telephone survey revealed that hunters who expressed a likelihood to make a trip to hunt elk in SWVA indicated a willingness to pay on average \$332 (median = \$150) to gain access to private lands on which to hunt elk (Hurst and Parkhurst 2018a).

Similar economic potential theoretically exists regarding revenues attributed to wildlife viewing. As noted earlier, officials in the Town of Benezette, PA, reported tallying 1,300 visitors a day during the height of the bugling season, each of whom spent an average of \$10–20 per person per day; in 1997, the economic influx for the community was >\$1 million per year (Lord et al. 1999, SEKTDA 2007). Recent efforts have been undertaken to capture more income from tourists via the strategic development of elk-related products and activities (FERMATA 2002). Donovan and Champ (2009) estimated that viewing associated with the winter feeding grounds for the ~250 elk on the Jewell Meadows Wildlife Area in Oregon netted \$6.5 million annually. Among the estimated 20,000 visitors to this site each year, the average distance traveled was 135 miles (round trip) and participants spent an average of \$369 per trip. McClafferty (2000) estimated potential value-added expenditures associated with viewing elk in Virginia would be \$284 per elk (Table 12). Viewers also may experience access-related expenditures not accounted for in these estimates, but, as revealed in recent survey work, Virginians who expressed a desire to travel to view elk were willing to pay on average \$28 (median = \$10) to gain access to private lands to view elk (Hurst and Parkhurst 2018a).

Table 12. Estimated economic benefits and costs per year (\$) associated with a hypothetical elk restoration in Virginia. Estimates were based on data from other elk restoration efforts in the East and calculated using 2000 dollars (McClafferty 2000).

	Value/ Animal	Value/ Hectare ^f	Total Value ^g
Economic Benefits/year			
Hunting ^a	\$299.79	\$1.50	\$149,895
Tourism ^b	\$284.40	\$1.42	\$142,200
Total Benefits	\$584.19	\$2.92	\$292,095
Economic Costs/year			
Crop Damage ^c	\$45.33	\$0.23	\$22,665
Elk-vehicle Collisions ^d	\$26.54	\$0.13	\$13,274
Management Costs ^e	\$266.67	\$1.33	\$133,333
Total Costs	\$345.33	\$2.21	\$169,272
Overall Value of Elk/year	\$238.86	\$0.71	\$122,823

^a Hunting income (per animal in the population) includes primary expenditures for license and application fees, guide services, and service fees for lodging and food, based on experiences in Michigan (SEAFWA 1997).

^b Tourism includes all primary expenditures paid by visitors traveling to view elk in Pennsylvania (SEAFWA 1997).

^c Crop damage is based on PA's worst reported year (1982) (SEAFWA 1997).

^d Elk/vehicle collision costs are based on Michigan's estimated \$3,000 of property damage/ collision and 3 collisions/81,000 ha/year (SEAFWA 1997)

^e Management costs are estimated from Michigan's annual budget, and include habitat improvement, hunt season administration, and personnel needs (Parker 1990)

^f Value/ha is based on 1 elk/200 ha of habitat.

^g Total value is based on 100,000 ha of elk range and a density of 1 elk/200 ha.

Other economic impacts might accrue to a community in a region that supports elk. In Montana, landowners reported changes in assessed property value related to the presence of elk; 21% of landowners realized an increase in property value, 2% reported a decrease, and 77% saw or expected no change in property values (Lacey et al. 1993). In addition, fees paid to access private lands for elk hunting and viewing can provide significant revenue for landowners who maintain quality habitat. Although only 4% of property owners in Montana allowed big game hunting on their property, those who did averaged between \$1,000–\$5,000 annually from leases or fees paid by hunters to gain access (Lacey et al. 1993). Organized elk hunts in Montana on private lands currently range from \$2,950–\$11,000 per individual per hunt (D.M. Kalb, unpublished data). In Kentucky, 39% of hunters reported using a guide service as means to gain access to productive elk habitat, and 4 of every 5 hunters paid some form of a fee to access private lands (Bowling et al. 2015). Because the majority of property in SWVA is in private ownership, as an elk herd becomes established, a considerable opportunity may exist for landowners to acquire income from access fees or other funds available through cost-share programs to improve elk habitat on their property to benefit hunting and wildlife viewing.

ELK CONFLICT

In addition to the potential economic benefits that elk may provide, some level of negative impact also should be anticipated. As Virginia’s elk population grows, conflicts inevitably will arise. Therefore, the challenge DGIF faces is to reduce or eliminate elk conflicts prior to, and as they occur. Beginning in 2000, when elk first dispersed into Virginia from Kentucky, DGIF began to record all elk-related conflicts, including damage to agricultural crops, fences, gardens and landscaping, and golf courses as well as vehicle collisions, disease detections, and ecological changes. Of prime concern to residents of SWVA is the potential of damage to agriculture, specifically the cattle industry, which is an important economic driver for the region. Damage reports for crops or agricultural-related industries and elk-vehicle collisions have been minimal (Table 13). Additionally, among the elk tested for CWD, bovine tuberculosis, and brucellosis since surveillance began in 2012, all test results to date have been negative.

Table 13. Reports of confirmed elk-related damage in Virginia investigated since 2000, presented by type of damage, location (county), outcome, and year in which incident occurred.

Damage Type	Location	Resolution	Year
Vehicle strikes (5)	Wise (3) Rus (1) Buch (1)	All elk killed, no personal injuries	2001-2017
Farm tobacco sticks	Russell	Technical assistance	2000
Plastic weed barrier	Scott	Technical assistance	2005
Family garden (3)	Buchanan	Electric Fence install (DGIF & RMEF staffs)	2014, 16, 18
Dwarf apple trees (2)	Buchanan	Snow fencing installed	2015- 2016
Elk tangled in swing set	Buchanan	Elk humanely dispatched	2016
Sport field pugging	Buchanan	Technical assistance provided	2016, 17
Elk blocking access to house	Buchanan	Elk was hazed off of property to acceptable location	2017
Fence damage (2)	Buchanan	Education about fence styles and repairs	2017, 18
Planted tree browse	Wise	Kill permit for deer (primary contributor)	2019

AGRICULTURAL DAMAGE

Damage to agriculture occurs when elk consume or trample crops or plots of forage plants (e.g., alfalfa). Elk are attracted to agricultural crops for their high nutritional quality and ease of digestion, especially during periods when natural forage is not readily available (Walters et al. 2010). Crop damage is more likely to occur in fields close to forest edges. However, population density of elk within the local area typically influences the likelihood for crop damage (Lacey et al. 1993, Hegel et al. 2009). Elk are more likely to forage on larger farms, that display significant acreage in readily accessible crops, and especially farms that irrigate.

Elk are attracted to stored hay used to provide winter forage to cattle, especially as naturally available winter food resources become limited. When stored hay bales are not fenced or otherwise protected, elk can consume, damage, and/or unroll entire bales while foraging. If elk repeatedly gain access to unprotected stored food sources, large numbers of elk may begin to congregate near these reserves, becoming habituated to human activity and increasing the potential interaction between elk and cattle.

Another form of damage to agriculture inflicted by elk is “horning,” where, in the late summer or early fall, bull elk rub their antlers against small trees and shrubs to remove the antlers’ velvet coating or to leave a scent mark. Nurseries, fruit orchards, and tree farms can incur significant damage from antler rubbing, which may kill affected plants if completely girdled. The incidence of horning activity is greater in populations that exhibit a higher bull ratio in the elk population (Miller et al. 1987). Rubbing damage also may have negative impacts on forest succession, plant composition, and age class structure due to the preferences bulls demonstrate when selecting plants to rub (Maas-Hebner et al. 2005). Elk prefer conifers, especially spruce (*Picea sp.*), when rubbing and scraping velvet from antlers (Maas-Hebner et al. 2005).

Many states track damages associated with elk. In Utah, elk ranked 7th in terms of the total number of complaints received for damage to alfalfa crops behind gopher, deer, hare, squirrel, prairie dog, and waterfowl (Messmer and Schroeder 1996). Approximately 12% of all wildlife damage claims submitted in Colorado involved elk, which then constituted 17% of the state’s overall annual financial payout on damage claims (Colorado Parks and Wildlife 2016). Among Eastern states with restored elk populations, Pennsylvania and Wisconsin estimated costs for total annual damage attributed to elk at <\$2,000 and <\$1,000, respectively (Witmer and Cogan 1989, Koele and Balgooyen 2015). Damage from elk in Wisconsin comprised <1% of all wildlife complaints (Koele and Balgooyen 2015).

DISEASE

Concern about disease in elk encompasses three major areas: 1) disease within the elk population and its potential transmission to other wildlife, 2) transmission of disease from elk to domestic animals, most notably livestock, and 3) transmission of disease from elk to humans. The DGIF works cooperatively with other agencies (e.g., VDACS, U. S. Department of Agriculture [USDA]) to conduct surveillance for the presence of pathogens of concern in wildlife populations, monitor the geographic and inter-species spread of disease among wildlife populations, and to mitigate as much as possible the transmission of pathogens from wildlife to humans and/or domestic animals.

With elk, several prominent diseases are of greatest concern, given the potential they have to inflict significant economic and ecologic impacts on wildlife and domestic livestock. This is especially true given the economic importance of the cattle industry in SWVA (Table 8; Figure 17). In addition to the direct economic losses an individual producer might incur from treating or culling affected animals exposed in a disease outbreak, a key concern of Virginia’s cattle industry focuses on the potential loss of the state’s various “disease-free” statuses. The loss of any of these disease-free status labels directly affects market value for all cattle producers in that region or the state as a whole. Such was the case following an outbreak of bovine tuberculosis (*Mycobacterium bovis*; TB) in Michigan (Brook and McLachlan 2006), where the

total economic impact from loss of status was estimated in the millions of dollars per year (Miller et al. 2013). USDA protocol mandates continuous follow-up testing within the infected area, and subsequent euthanasia of infected livestock, until the region is declared “disease-free” for TB again, a process that may take years. Despite the concerns about potential disease outbreaks associated with elk, Brook (2009) observed that Manitoban farmers maintained a positive attitude toward elk based on their realization that other potential economic benefits could be reaped, such as hunting related income, from having a well-managed elk population.

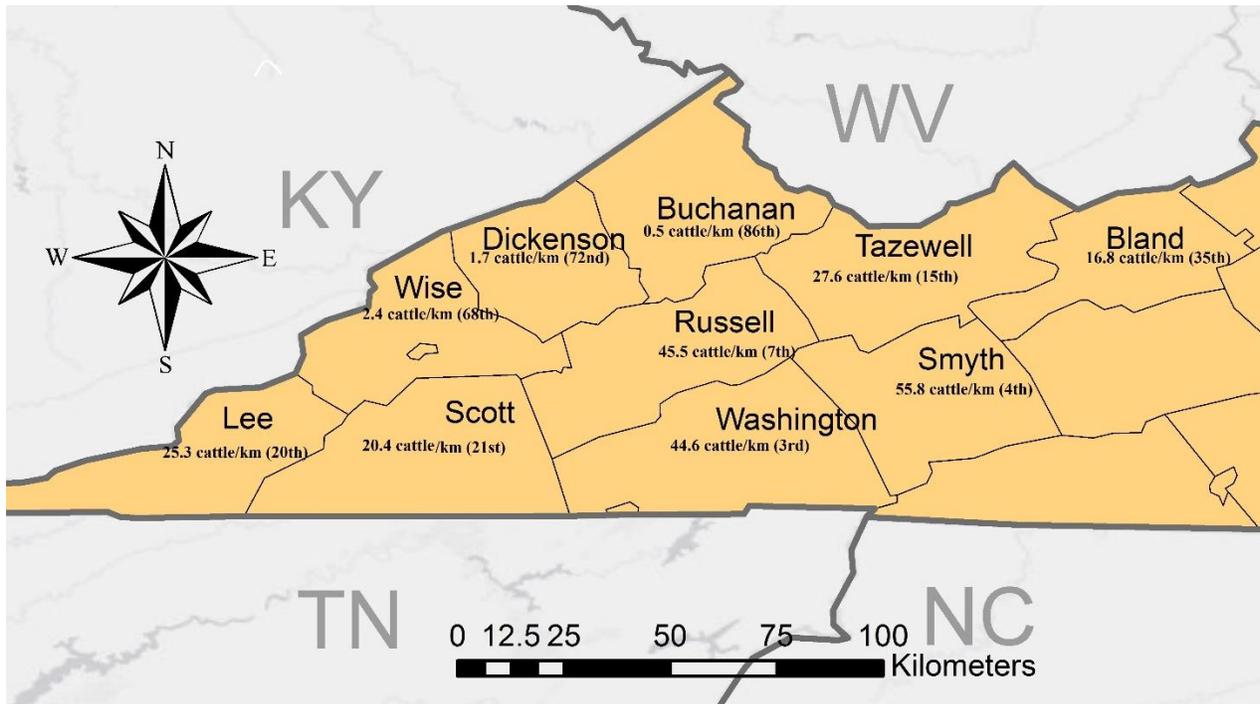


Figure 17. Estimated density of cattle ($\#/km^2$) and relative rank among 95 Virginia counties for cattle production (in parentheses) for 10 counties in the area of elk management planning focus of southwest Virginia (red outline). (Data from 2012 USDA National Agricultural Statistics Service).

TB is a disease that can have serious negative effects on a cattle industry. Elk and a variety of other native wildlife species (e.g., deer, raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), bobcats (*Felus rufus*), coyotes (*Canis latrans*), foxes (*Vulpes vulpes*), bears)), as well as domestic animals (e.g., goats, pigs, dogs, cats), are known to harbor or potentially be a vector of TB (Schmitt et al. 2002), thus, accurate detection and tracking of responsible hosts can be difficult. TB has been confirmed in at least two North American wild elk populations: the Riding Mountain area of Manitoba, Canada, and central Michigan. Bovine TB has been diagnosed in a variety of species in Michigan since 1994 (Schmitt et al. 2002: Table 14).

Another disease of potential consequence to the cattle industry is brucellosis (*Brucella abortus*), which causes cows (both elk and bovine) to spontaneously abort fetuses. Brucellosis is currently circulating within some elk populations in western states (Thorne et al. 2002), but has not been detected in any restored elk populations in the East. Brucellosis has become a prominent issue in populations of free-ranging elk and bison in the Greater Yellowstone Area (GYA) of Wyoming, Montana, and Idaho, and, as is frequently the case, the bacterium initially spilled over from domestic cattle to wildlife where it is now established (Thorne et al. 2002). It

has since spilled back from wildlife to cattle. Brucellosis transmission generally occurs via contact with an aborted fetus or expelled placental tissue (Thorne et al. 2002). Several behavioral traits exhibited by most female elk to reduce detection by predators also reduce the probability of transmission of brucellosis from elk to domestic livestock. Examples include breaking away from the herd to give birth in isolation, intensively cleaning the calf soon after birth, and consumption of any remnant tissues associated with the birthing process (Rhyan and Spraker 2010). Transmission becomes amplified when the normal behavior of female elk is disrupted by the unnatural concentration of elk on or near the winter feeding grounds during the calving season (Cross et al. 2015). Although a vaccine exists to minimize brucellosis infections in cattle, attempts to vaccinate elk against the disease have not yet proven effective (Olsen et al. 2006). (Olsen et al. 2006). The milder winters inherent to Virginia (when compared to western elk ranges), and the ban on feeding within the EMZ, minimizes the likelihood of transmission.

Table 14. Species of wildlife tested in Michigan between 1996 and 2001 that resulted in confirmed detection of TB. All species listed currently have wide distribution throughout Virginia (except elk). Data extracted from Schmitt et al. (2002).

Species	Tested	Positive	Percentage
Black bear (<i>Ursus americanus</i>)	153	4	2.61%
Bobcat (<i>Felis rufus</i>)	53	4	7.55%
Coyote (<i>Canis latrans</i>)	291	13	4.47%
Opossum (<i>Didelphis virginiana</i>)	261	2	0.77%
Raccoon (<i>Procyon lotor</i>)	220	2	0.91%
Red fox (<i>Vulpes vulpes</i>)	18	2	11.11%
Elk (<i>Cervus canadensis</i>)	3500	1	0.03%
White-tailed deer (<i>Odocoileus virginianus</i>)	64,423	370	0.57%

Chronic Wasting Disease (CWD) also poses a potential threat to species in the deer family, including elk but most notably white-tailed deer. Virginia currently is 1 of 25 CWD confirmed states (and 2 Canadian Provinces, Figure 12); the disease has been detected thus far only in white-tailed deer in Shenandoah and Fredrick counties in the Commonwealth (Figure 18). In response, DGIF has established a CWD containment area (which also includes Warren and Clark counties), implemented an enhanced monitoring and sampling program, minimize the chance of infected carcasses and high-risk carcass parts from leaving the CA, and enacted liberal harvest opportunities to reduce populations of deer in the affected region. A widespread CWD outbreak among free-roaming cervids could have negative consequences on DGIF’s ability to sustainably manage deer and/or change management tactics. These impacts may be less pronounced for elk than for deer, given that the current distribution of elk is restricted and the population size and density is much smaller.

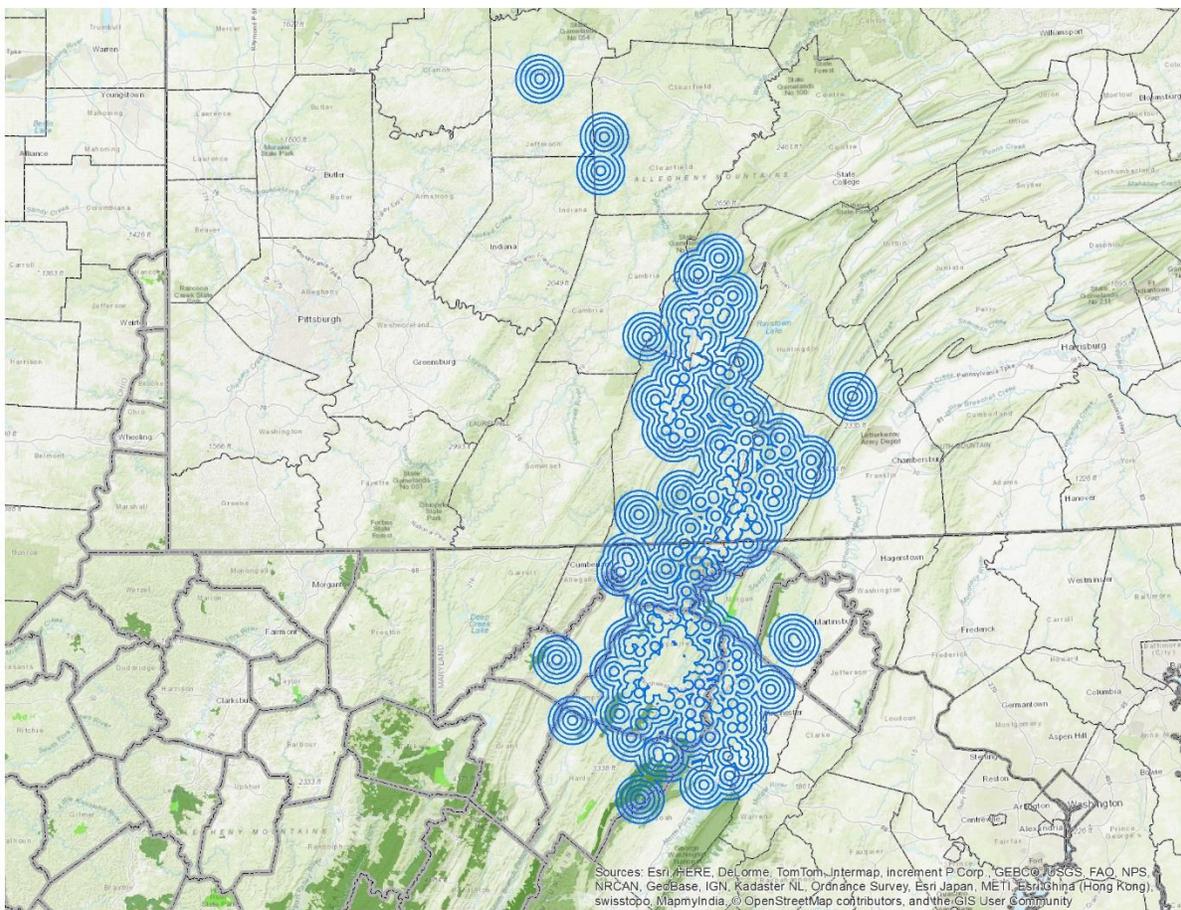


Figure 18. Areas affected by Chronic Wasting Disease (CWD) in West Virginia, Pennsylvania, Maryland, and Virginia as of 2017. Each positive location is surrounded by 1,2,3,4 and 5-mile rings to form concentric disease management areas for each state. Reproduced from Crum, J. (WV DNR), as presented at the Interstate CWD meeting in State College, PA, June 19, 2018.

Elk also may serve as a host for a number of diseases of concern for transmission to humans, including a suite of tick-borne ailments (e.g., Lyme disease, ehrlichiosis, babesiosis) as well as

rabies, brucellosis, and TB. TB has not been detected in Virginia since the mid-1990s. Rabies is rare in deer and elk, but caution still is warranted for anyone handling a suspect animal. Brucellosis occasionally is confirmed in humans in Virginia, but the affliction likely comes from consumption of unpasteurized dairy products (Virginia Department of Health 2018).

Although Meningeal Worm can infect livestock, the incidence of infection is low and preventative treatments exist. Given the current size and dispersal of SWVA deer population, deer serve as the more likely vector and host of the parasite than do elk, thus elk are not yet viewed as a significant contributing factor in enhancing the risk of transmission.

FENCING AND PROPERTY DAMAGES

Like most wild cervids, elk are capable of jumping considerable heights, even from a standstill. Despite this leaping ability, elk usually prefer to stay in contact with the ground and sometimes find themselves entangled in fencing. The highest incidence of fence entanglement occurs during periods of increased travel, such as times of reduced food availability and when young disperse (Harrington and Conover 2006). Although entanglement of bull elk by their antlers does occur, it more often is a result of their greater propensity to disperse, and thus encounter fencing more frequently, than an issue with having large antlers per se. Further, juvenile bulls are 8 times more likely to become entangled than an adult animal (Harrington and Conover 2006). The potential of ensnaring an elk decreases when fence height is <39 inches (99 cm) or when there is >1 wire strand placed above the fence (Harrington and Conover 2006). If an elk believes it cannot clear a fence, it is more likely than a deer to use its large body size to push through fencing, resulting in damage to the fence (Harrington and Conover 2006). Despite this forceful tendency exhibited by elk, various fence designs exist that can be used to reduce elk-human conflicts, including electrification and construction with more robust materials. A properly designed and installed fence can reduce access of elk to stored feed, reduce competition with livestock for grazing, prevent elk from damaging recreational or sports fields, and minimize damage to home gardens and ornamental plants.

VEHICLE DAMAGES

Although reports of deer-vehicle collisions throughout many parts of Virginia are high, authorities believe 9 out of every 10 collisions still are not reported (State Farm Insurance; unpublished data, VA Dept. of Motor Vehicles). In contrast, an elk-vehicle collision (EVC) likely would not go unreported as the probability of property damage or human injury is greater in a collision with a larger animal. Dodd et al. (2007) observed that EVCs are highly correlated with the presence of open fields, pastures, or early succession habitats in close proximity to a highway that elk use for foraging. Nearly half of all collisions occur during the fall breeding season or rut (September through November), and most happen in the evening within 1 hour of sunset (Dodd et al. 2007). In addition, vehicles traveling at high speeds are at greater risk of hitting an elk than those travelling slower (Bertwistle 1999). According to the U.S. Department of Transportation (2008), costs associated with an EVC average about \$3,000 (\$3,650 converted to 2018 USD) in repair costs, and nearly 100% of all EVCs result in some degree of damage.

Biggs et al. (2004) estimated personal property damages associated with EVCs in New Mexico at \$3,448 (\$4,600 converted to 2018 USD) per collision. Data on the exact number of EVCs per year are scant, but managers in Kentucky estimate they experience 20–25 EVCs per year (given an elk population of >11,000), whereas biologists in Pennsylvania report about 10 EVCs per year (with approximately 1,000 elk). Near the Great Smoky Mountains National Park, the primary factor contributing to EVCs in that region is habituation of elk to humans resulting from supplemental feeding. Dodd et al. (2007) found that strategically placed fencing reduced elk-vehicle collisions. Other methods to reduce EVCs include providing crossing structures (e.g., over/underpasses) and warning signs actuated by the presence of elk.

MINE-LAND RECLAMATION CONCERNS

Required land reclamation of previously mined lands in Appalachia has created an abundance of open, early successional habitats that are ideal for elk. However, as mining companies strive to fulfill obligations spelled out in reclamation plans governing the reclamation of these tracts, the presence of elk (and other wildlife) on these sites can impede attaining the final restoration condition (G. Jenkins, Kentucky Deer and Elk Project Leader, personal communication). In cases where elk damage or inhibit successful establishment of the required type or extent of vegetated cover through their browsing and “horning” of woody vegetation, companies may fail to receive reimbursement of bonds to lease holders due to the inability to meet the specified criteria of a complete restoration.

OTHER DAMAGE

Walters et al. (2010) described a variety of other potential conflicts acknowledged by managers of restored elk populations, including damage to golf courses, cemeteries, and home gardens. As elk populations continue to increase, the types and extent of damage associated with elk may also increase.

ECOSYSTEM IMPACTS

Although not well documented, the historic presence of native elk undoubtedly affected the Virginia landscape in multiple ways. Elk like all wildlife populations can change the dynamics of extant plant communities, including forest composition and regeneration, due to their foraging activities (Schneider et al. 2006, Cox 2011). Elk have an ability to create and maintain early succession habitats and alter forest succession and plant community structure due to the preferences they exhibit for certain species and age classes of plants (Maas-Hebner et al. 2005). An initial analysis of the Great Smoky Mountains National Park in 2007 speculated that the presence of elk likely would have minimal impact on rare plants and that grazing by elk would have little effect on other flora and fauna species in the park. A subsequent investigation confirmed these speculations, but also found that elk had a beneficial impact on certain vegetation communities (GSMNP 2010). Today, patches of open early succession habitats

within the forest matrix are limited in both abundance and distribution throughout the Appalachian Mountain region. As a result, wildlife species dependent upon these habitats, such as the golden-winged warbler (*Vermivora chrysoptera*), eastern meadowlark (*Sturnella magna*), and northern bobwhite (*Colinus virginianus*), currently are in decline as these habitats have transitioned into forestland. Such species would likely benefit from the additional early succession habitat created or sustained by elk.

However, not all interactions between elk and other wildlife species are likely to be mutually beneficial. As a large herbivore, elk have the potential to compete with other wildlife species for available food resources, especially during times when particular forage types are limited (such as hard mast). If the density of elk were to reach unnaturally high levels, large-scale negative ecological impacts could arise. As an example, lack of natural predators and insufficient hunting pressure allowed elk numbers in the Jackson Hole, Wyoming, and the Greater Yellowstone Area to exceed normal capacity, which resulted in considerable damage to willow, cottonwood, and aspen tree stands and impeded their regeneration. The impact of this damage cascaded through the ecological community, altering species compositions and densities of other wildlife populations associated with these habitats (USDOI et al. 2007).

An emerging ecological concern relates to the role elk (as well as frugivorous, and herbivorous wildlife) theoretically may play in the dissemination and spread of non-native and/or invasive plants. Reclaimed mine lands are areas known to be affected by exotic plants, given these plants success as pioneer-type plants in degraded soils. As a result, exotic species have become a priority for control efforts in the Appalachian region due to their potential detrimental impact on biodiversity (Cox 2011). Because elk frequent these sites and are capable of moving long distances, they may help spread non-native and invasive plants over the landscape by carrying seeds on their pelts or disseminate seeds in their feces. Elk also could favor the growth of non-native plants by preferentially grazing native plants. Now that elk are returning, a recalibration of system dynamics appears to be underway; the ecological implications of having this large herbivore back on the landscape once again warrants careful reexamination and consideration.

Native elk once represented a prey source for large predators (mountain lions, wolves, bears) common to the Appalachian region of that time; today, in terms of large predators, only the black bear remains. For the region's current carnivores, elk calving season potentially brings additional prey. Coyotes, bobcats, and bears, have adapted to the seasonal availability of deer fawns (which overlaps with elk calving), now may also prey on elk calves. Throughout the year, a weakened, injured, or older elk provides opportunity to secure a large quantity of meat to any carnivore able to bring down that infirmed animal. For carnivores incapable of killing an adult elk on their own, opportunities to scavenge meat from a carcass undoubtedly will exist.

SOCIAL CONSIDERATIONS

Carrying capacity can be defined several ways, depending upon its intended application. In theoretical ecology, BCC is defined as the number of individuals of a species that a habitat can support. However BCC is rarely used to formulate management objectives. Instead, population management goals today are shaped more often on a social construct for carrying capacity, that being *cultural carrying capacity* (CCC), which is defined as the number of individuals of a species in an area that society, as a whole, is willing to tolerate (Ellingwood and Spignesi 1986). CCC typically will be much lower than the BCC of an area. Attributes of CCC, typically a suite

of social, economic, political, and perhaps biotic parameters, are relatively easy to identify, but often difficult to quantify. CCC will differ depending upon the species of concern, the stakeholders involved, the location, and the period of time within which discussion about that species occurs. Therefore, CCC often can be subjective and dynamic.

Why CCC is important to managers is that it represents a population target at which the demands for benefits derived from the species (such as viewing them, having them in the natural landscape, or hunting them) are in balance with concerns about the negative consequences associated with that species (such as different forms of damage or animal-vehicle collisions). CCC will be exceeded when the negative consequences outweigh the benefits being derived. Managers set populations goals that attempt to achieve this balance of allowing attainment of as many of the positive values while minimizing the likelihood of negative ramifications. To do this successfully, managers periodically must “take the pulse” of society to assess peoples’ tolerance for different species of wildlife. Very often, they accomplish this by conducting surveys or engaging in other forms of public involvement.

PUBLIC OPINIONS ABOUT ELK

McClafferty (2000) was the first to evaluate CCC for elk by investigating public attitudes about elk and their management in Virginia. This study examined both the potential negative impacts of elk as well as the potential economic benefits associated with an elk population. A cost/benefit analysis utilized actual costs identified in states that already had restored elk populations and monetary values and expenditures associated with the pursuit of elk-related activities (McClafferty 2000). Although a majority (61%) of Virginians responded positively with the statement, “Reintroducing elk into Virginia is a good idea,” they also expressed concern about potential negative consequences, most notably issues related to disease and damage to agriculture.

A more recent telephone survey of Virginia residents (Hurst and Parkhurst 2018a) found 86% (n = 2,755) of respondents supported having elk in SWVA and 89% (n = 2,858) of respondents appreciated knowing elk have been restored in SWVA (Figure 19). Although most members of the group still expressed support and appreciation of elk, a higher proportion of respondents who identified themselves as home gardeners and forestry or agricultural producers did not support or appreciate elk (26% and 21%, respectively) when compared to other stakeholder groups (Hurst and Parkhurst 2018a).

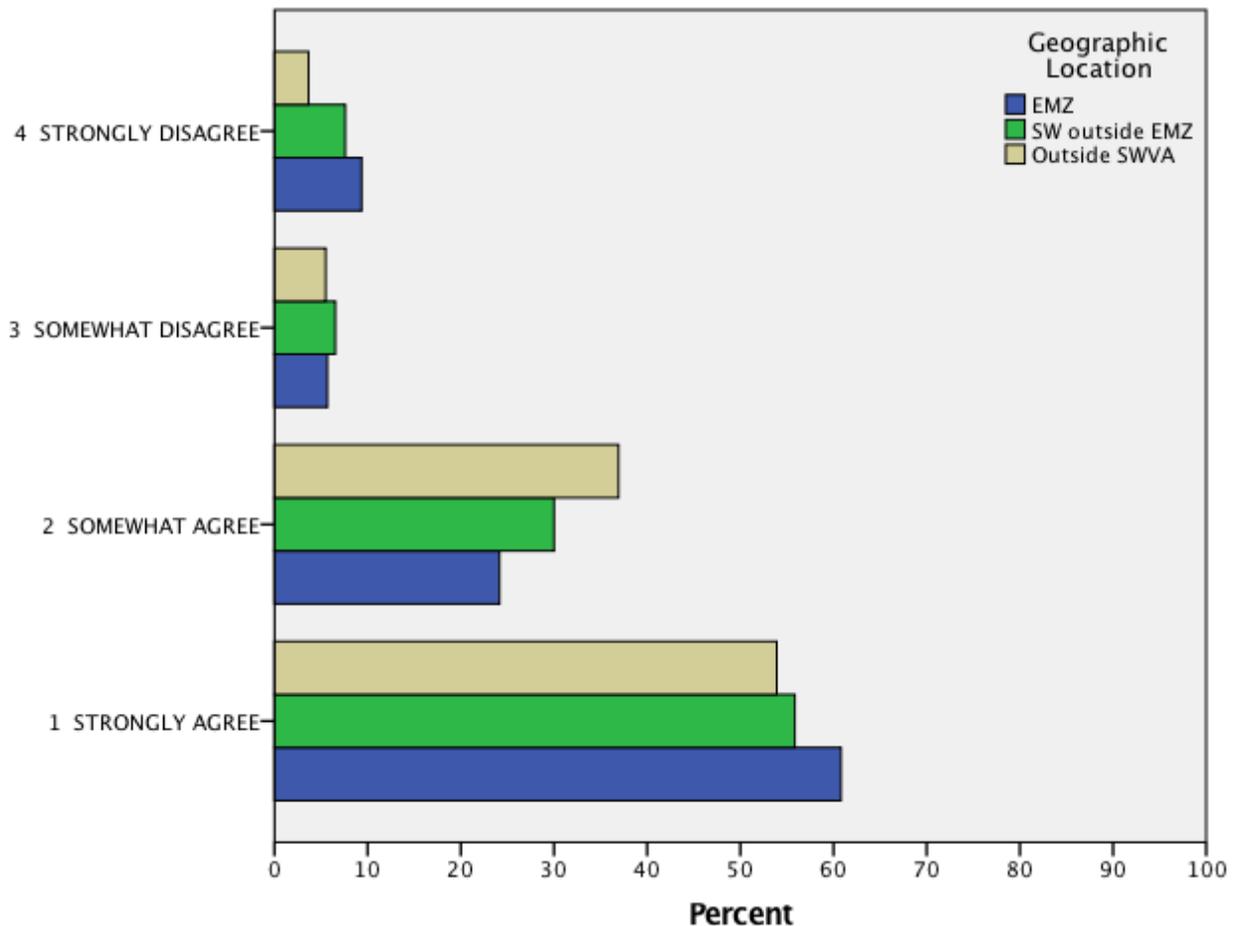


Figure 19. The percent of respondents from 3 different geographic locations who indicated their agreement to the statement: **“In general, you support having elk in southwest Virginia.”**

When asked about the population status of elk, a majority of respondents to a recent telephone survey (Hurst and Parkhurst 2018a) indicated the number of elk should increase within the SWVA region (68%, n = 2191), in the county where they live (64%, n = 2063), and in their immediate neighborhood (55%, n = 1770; Table 15). Respondents who reside within the ERA expressed mixed attitudes about population status. Although most respondents from this geographic area (72%, n = 551) favored a population increase within SWVA (in fact, 37% [n = 283] desired a “significant increase”), a higher proportion of respondents (7%, n = 54) indicated they wanted a “significant decrease” when compared to other SWVA residents (4%, n = 68) and Virginians at-large (3%, n = 17). Attitude about population status varied noticeably among different stakeholder groups. Hunters favored an increase (“significant increase” and “somewhat increase”) of the elk population within SWVA (87%, n = 78), their county of residence (81%, n = 74), and their neighborhood (76%, n = 65). In contrast, home gardeners, members of the forest industry, and agricultural producers were less favorable of a population increase; among these groups, only 49% (n = 115) preferred an increase within SWVA, their county of residence (45%, n = 105), or their neighborhood (36%, n = 82; Table 16).

Table 15. Respondents' preference for the number of elk in different locations in Virginia. Respondents indicated their preference on a 5-point Likert-type scale which were assigned numerical values (1 = increase significantly, 5 = Decrease Significantly). The letter "n" represents the number of respondents.

Do you think the number of elk [...] should increase significantly, increase somewhat, stay the same, decrease somewhat, or decrease significantly?

	Increase Significantly (1)		Increase Somewhat (2)		Stay the Same (3)		Decrease Somewhat (4)		Decrease Significantly (5)		Don't Know / Refuse	
	n	%	n	%	n	%	n	%	n	%	n	%
...in southwest Virginia...	931	28.9%	1,260	39.1%	648	20%	91	2.8%	142	4.4%	149	4.6%
...in the county where you live....	992	30.8%	1,071	33.3%	805	25.0%	99	3.1%	149	4.6%	105	3.3%
...near your neighborhood ...	844	26.2%	926	28.7%	1023	31.8%	106	3.3%	169	5.2%	153	4.8%

Table 16. Number and percent of respondents of different stakeholder groups who supported an increase in the size of the elk population in different geographic locations within Virginia. The letter “n” represents the number of respondents.

Stakeholder Group	Number of Stakeholders		Elk in southwest Virginia	Elk in the county where you live	Elk near your neighborhood
None of These Groups	237	n	123	103	81
		%	52	42	34.
Hunter or Conservationist	86	n	78	74	65
		%	87	81	76
Viewer, Environmentalist, or Animal Rights Supporter	367	n	256	225	171
		%	70	60	46
Home Gardener, Forestry, or Agricultural Producer	229	n	115	105	82
		%	49	45	36
More Than One Group	2141	n	1,618	1,554	1,369
		%	76	72	64
Total	3067	n	2,190	2,061	1,768
		%	71	66	58

MANAGEMENT CONSIDERATIONS, EXPECTATIONS, AND TIMELINES: PERSPECTIVES OF ELK MANAGERS

In 2017, managers of restored elk populations in the East (Figure 20) were asked to categorize prevailing attitudes of stakeholders in their state about elk and elk management. Overall, managers believed attitudes among residents who resided within a county where elk now existed, those who resided in a non-elk county, and representatives of local government all were positive. However, perceptions of attitudes varied most noticeably depending upon the phase of maturity the respondent’s elk management program had reached (i.e., how far along the program was from just interest/evaluation in having elk, founding of an elk herd, to establishment/growth of an elk population, to management). Managers’ perceptions suggested attitudes were less positive for residents of an elk county (-15%) and representatives of local government (-17%) for states in the management phase than they were during the establishment

must consider all of these areas of consideration during management planning. However, managers did distinguish differences in the relative importance of these categories, when ranked in descending order of importance (expressed as average % of responding participants indicating an item as “Very Important”), they ranked as follows: technical or population-based (65%, n = 16), social (44%, n = 12), and recreational/educational (43%, n = 12). Within these categories, managers identified certain areas of consideration as being more important. Among technical or population-based concerns, managers ranked (% of respondents indicating an items being “Very Important”) habitat (93%, n = 26), disease transmission (85%, n = 24), and herd demographics (81%, n = 22) highly. Among social issues, damage (63%, n = 18) was a key concern. Finally, within the recreational/educational arena, public access (61%, n = 17) ranked high as a planning concern (Table 17).

Table 17. Number and percentage of managers of eastern elk populations who indicated that a management consideration was “very important.”

Management Consideration	Type	%	n
Habitat	Technical	93	26
Disease transmission	Technical	86	24
Herd demographics	Technical	79	22
Damage	Social	64	18
Public access	Recreation/Education	61	17
Way of life impacts	Social	50	14
Viewing and tourism	Recreation/Education	50	14
Ecological role	Technical	39	11
Vehicle collisions	Social	32	9
Hunter satisfaction	Recreation/Education	32	9
Income and Economics	Social	32	9
Educational opportunities	Recreation/Education	32	9
Herd genetics	Technical	29	8

Managers’ views on the importance of certain considerations changed depending upon the phase of management being examined (Table 18). When discussing technical and population-based considerations, managers believed these matters were important through all phases, but took on greater significance during the management phase. Of particular concern, managers focused on herd demographics and an elk’s role in the ecosystem, with somewhat less,

but continued attention to genetic diversity in the herd, habitat quality, and disease transmission. Managers viewed social issues as needing consistent attention in all phases, but, like the previous category, attention became more focused after a herd became established. Under the social category, managers identified vehicle collisions, agricultural damage, and impacts on one's way of life as items of greatest concern. Income and/or economic development considerations did not seem to play a significant role in the eyes of managers, although, if consideration did occur, emphasis occurred more often during the founding and establishment/growth phases. Within the recreational/educational arena, several patterns emerged. Managers believed issues related to public access became most critical during the management phase (perhaps suggesting this issue should have received greater attention earlier in the process), considerations related to hunting required more attention during the management phase, and educational opportunities and issues related to viewing and tourism remained concerns in all phases.

Despite careful planning, it can be difficult to anticipate or account for all possible outcomes that might arise as an elk restoration program evolves. The collective experiences of others who already implemented a restoration program can highlight potential issues and events that an agency should anticipate. Managers were asked to provide information about unanticipated outcomes from their states restorations (Appendix D). These Managers were also asked to provide any anticipated outcomes from an elk restoration that did not come to fruition (Appendix D).

Table 18. The phase of elk program management during which managers of elk populations in the East believed consideration of a management priority was important.

Management Consideration	Type	Program Phase								Total %
		Interest / Evaluation		Founding		Establishment / Growth		Management		
		%	n	%	n	%	n	%	n	
Herd genetic variability/diversity	Technical	38%	15	26%	10	15%	6	21%	8	39
Herd demographics (births, deaths, age/sex ratios, etc.)	Technical	10%	6	26%	16	31%	19	33%	20	61
Ecological role restored elk will play	Technical	51%	20	10%	4	15%	6	23%	9	39
What constitutes sufficient habitat to support a viable elk population	Technical	37%	23	19%	12	23%	14	21%	13	62
Transmission of disease and parasites	Technical	34%	24	23%	16	21%	15	21%	15	70
Elk-vehicle collisions	Social	30%	16	17%	9	26%	14	28%	15	54
Damage to agricultural operations or other private properties	Social	34%	22	19%	12	22%	14	25%	16	64
Educational opportunities	Recreation / Education	26%	14	24%	13	24%	13	26%	14	54
Income, economic diversification and / or economic development opportunities	Social	32%	14	20%	9	20%	9	27%	12	44
Elk viewing and tourism opportunities	Recreation / Education	28%	19	22%	15	26%	18	24%	16	68
Hunter satisfaction	Recreation / Education	19%	5	7%	2	7%	2	67%	18	27
Public access	Recreation / Education	21%	14	22%	15	28%	19	28%	19	67
Effects of elk presence on residents' way of life	Social	36%	16	16%	7	22%	10	27%	12	45

ELK MANAGEMENT OPTIONS

INTRODUCTION

Although a number of states (e.g., Kentucky, Wisconsin) opted to continue stocking additional elk to augment their restorations in order to more quickly attain some of the benefits associated with elk, DGIF is proposing to move slowly and allow the current elk herd to grow via natural means and immigration. DGIF does not plan to import additional elk to bolster the existing elk herd in Virginia. Conversely, DGIF has no plans to remove elk from SWVA (unless a disease outbreak would necessitate such action). A significant amount of time, resources, and financial contributions have been invested to return this species to its historical range and provide opportunities for residents of and visitors to Virginia to receive benefits associated with a restored elk population.

Successful management of Virginia's elk population will mean DGIF has achieved a balance between meeting the elk-related demands of users and reducing conflicts of affected stakeholders, all while guaranteeing public safety. Many strategies and methods are available to the agency to accomplish this task, and DGIF will continue to use the best scientific knowledge to guide its management decisions regarding wildlife populations, including elk. As is true with other game species, the regulated harvest of elk is a critical management tool to achieve desired population goals and prevent or mitigate human-elk conflicts. However, use of regulated hunting can complicate the agency's attempts to achieve the desired balance among stakeholders' needs and demands due to elk behavioral responses to hunting pressure. As mentioned earlier, elk alter their activity to become less visible and avoid humans, which has implications on elk viewing and other elk-tourism opportunities. Yet, conflicts with any wildlife, including elk, are inevitable and timely response and implementation of mitigation actions are required to prevent or minimize such occurrences. The challenge DGIF faces in finding and maintaining an appropriate balance is significant.

The section that follows is a brief discussion of the pros and cons or advantages and disadvantages associated with the suite of management options available to the agency as it strives to achieve this balance. Even though a particular strategy or technique is described in this section **does not mean that the agency necessarily intends to or ever will adopt the practice**; rather, this review attempts to present the current state of our knowledge about techniques available when managing elk.

HABITAT MANAGEMENT

Creating and maintaining the types of habitat elk prefer is an effective way to manage elk herds and potentially avoid some elk-human conflicts. When provided with high quality forage in close proximity to areas that also satisfy thermal and protective cover needs, elk are less likely to wander into other areas. Meeting the needs of elk requires careful planning to assure sufficient and diverse food resources are available year-round, with consideration of seasonal patterns of growth and the effects of climatic variation on resource quality. As elk consume available high-quality forage resources or environmental conditions (e.g., drought) make vegetation less palatable, alternative native food resources must be available to compensate for

the diminishing supply of food items, especially if managers hope to hold the herd in a particular area. Successful integration of both cool- and warm-season forage plots can provide effective means to allow elk to rotate into different sectors of a managed area without having to wander in search of forage (Harper et al. 2004; 2015). Properly managed stands of native warm-season grasses carry additional benefits, animals grazing on native warm-season grasses during summer months gain body mass faster (by as much as a pound per day) than when feeding on cool-season grasses (Harper et al. 2004). Additionally, native warm-season grasses help fortify highly erodible, rocky, and drought-prone soils due to their deep and prolific rooting (Harper et al. 2004; 2015).

Vegetation can be used to manage or alter the movements of elk in other ways. Vegetated barriers dominated by plants elk find undesirable or impenetrable, such as dense pine groves, often serve as effective deterrents to keep elk from areas where they may cause conflicts (deCalesta and Witmer 2005). These dense vegetated strips also may help insulate elk from human-caused disturbances (e.g., excessive noise, vehicle contact, encounters with pets) and serve as a barrier to limit intrusion of people into their habitat. However, trade-offs and/or disadvantages associated with vegetation management exist and need serious consideration about potential negative effects on other desired management goals prior to any implementation. Where benefits derived from tourism and elk viewing opportunities represent high-priority objectives, managers should assess how the creation of vegetated barriers or enhanced protective cover for elk might influence line-of-sight and visibility. Special provisions (e.g., raised observation platforms, strategically located overlooks) may be necessary to afford viewing opportunities while also realizing the intended values derived from conducting the vegetation management effort in the first place.

Management strategies can either encourage or discourage the presence of elk. The DGIF should be able to, and will, promote elk habitat within the EMZ that effectively provides nutrition to elk, while also being strategically located to reduce potential conflicts. Outside the EMZ management in response to, or for elk will not be actively implemented by DGIF.

REGULATED HUNTING

As noted earlier, DGIF considers regulated hunting as its most effective method to manage population growth and thus achieve its desired population goals. Currently, the existing demand for opportunities to hunt elk far exceeds the agency's capacity to satisfy this demand. In a recent survey of Virginian hunters, 45% of respondents stated they were likely to take a trip to SWVA to hunt elk if they had the opportunity (Hurst and Parkhurst 2018a). Until the founding elk population grows sufficiently to be able to accommodate a sustainable harvest, restrictions must be imposed to limit hunting pressure being placed on the population. Ample evidence exists in Virginia's past elk history to illustrate how harvest programs prevented a population from reaching and maintaining a minimum viable population. Yet, finding the proper balance in what constitutes an appropriate level of harvest is complex. Applying too little hunting pressure may allow the population to expand above CCC and increases the potential for economic and environmental damage or other human-elk conflicts (e.g., see Smith et al. 2003, Lister and McDaniel 2006). Too much hunting, or pressure exerted prematurely can reduce genetic diversity, stunt population growth or, because of behavioral changes in elk in response to this pressure, impede or prevent viewing opportunities. Therefore, deciding when to initiate

recreational hunting of elk and how to allocate the opportunities that may become available represent difficult, but essential decisions the agency must make. This allocation is especially difficult early in the elk program when fewer hunting opportunities exist.

Currently, elk can legally be harvested outside the EMZ during any of the regulated deer hunting seasons; hunting of elk within these three counties now is prohibited. However, once the population is large and stable enough to tolerate a sustainable harvest, DGIF will use regulated hunting to manage population growth within the elk management zone. The primary method of managing cervid populations is via the harvest of females, as they drive herd growth, stability, or decline, and can influence group movements, social structure, and family group fidelity (Hegel et al. 2009).

The focus of DGIF will be to continue to allow hunting opportunities outside of the EMZ for control of elk that may disperse out of the region. Additionally when a stable population is reached within the EMZ to provide hunting, regulations will be focused on the EMZ and equitable opportunities for those who wish to participate. Hunting will remain the best means and the primary tool used to control elk population growth and dispersal.

MANAGING HUMAN-ELK CONFLICTS

The likelihood for conflict is often (but not always) related to both the density of the human population and the elk population in an area — if both increase, risk for conflict rises concurrently (the current human population in the EMZ is declining). Effective strategies available to resolve human-elk conflicts vary and the selection of options a manager chooses to implement will be influenced by the needs and circumstances of each conflict situation. Smallidge et al. (2015) provided examples of time-based conflict resolution options suitable for consideration in New Mexico that may help shape decision-making here in Virginia (Table 16). As noted earlier, several strategies listed as long-term involve mitigation measures rely directly on creating, modifying, or improving elk habitat.

Table 19. Recommended short- and long-term approaches to decrease human-elk conflicts in New Mexico (from Smallidge et al. 2015).

Short-Term Approaches	Long-Term Management
Harass depredating elk	Develop community-based advisory boards
Repair damaged fences	Implement landscape-scale timber thinning
Encourage all stakeholders to contribute to fence repairs	Halt and reverse woody encroachment in meadows
Stakeholders pay for riders*	Utilize prescribed fire to improve range
Adjust grazing management (e.g., season-long continuous instead of a rotation)	Adjust hunting strategies to alter herd structure
Conduct educational workshops	Herbicide application
Adjust elk hunting tag issuance	Replace & install new fences
	Develop supplemental water sources

*Riders are employees with specific skills at distributing animals and keeping them out of specific areas where fencing is impractical.

EDUCATION

Increasing General Public Understanding — Given that many human-elk conflicts arise from peoples’ unfamiliarity with this animal, education to increase awareness and understanding about elk, its behaviors (i.e., what’s normal, what’s not), and options available to avoid or minimize conflicts will be important. Such a task often requires covering a large number of topics, particularly basic biology and ecology, but also must draw connections between that knowledge and appropriate situational applications to help avoid potential conflicts before they arise. Additionally, improving constituents’ familiarity with regulations and laws related to elk (e.g. not feeding elk) helps reduce unintended violations and clarifies personal responsibilities. Therefore, proactive engagement with communities affected by the presence of elk and with targeted stakeholder groups accurately can define reasonable expectations and prepare members of the public for both the positive opportunities associated with elk, but also identify likely challenges (and what can or should be done to minimize those aspects).

Preparing Affected Parties with Technical Assistance — It is important to conduct periodic and targeted training workshops to enhance knowledge, understanding, and effective application of conflict management techniques to reducing negative interactions with elk. Use of hands-on, site-specific demonstrations of physical devices or other means to reduce human-elk interactions have been effective in improving the readiness of likely affected parties, especially members of the agricultural community. To be most effective, such demonstrations also need to provide

meaningful comparisons about the pros and cons of various techniques and the economic trade-offs associated with different options.

Developing and Disseminating Readily Available Educational Resources — Access to current, science-based information is important to promoting improved awareness and knowledge. Educational materials, developed to deliver consistent and accurate information to diverse audiences on a variety of topics, need to be prepared and targeted to the specific needs of users. Efforts of the Pennsylvania Game Commission and its partners provide good examples of effective strategies that integrate multiple interests (e.g., hunting, tourism, safety) across various delivery platforms for diverse audiences (<https://www.youtube.com/watch?v=cmjZWg39QCA>; <https://www.elkexpo.com/>).

AVERSIVE CONDITIONING

Aversive conditioning is an effort to modify behaviors exhibited by an animal, typically those deemed undesirable to humans, as means to reduce or eliminate problematic human-wildlife interactions. In essence, actions are taken to “teach” the animal that its presence in a particular location or a behavior it is demonstrating is “unacceptable.” Methods of aversive conditioning are numerous and categorized by the type of method (visual, auditory, chemical, or physical deterrent) or the length of time necessary (short-term, long-term) to achieve the desired outcome.

Hazing often is used to provide a quick, short-term option to alter an undesirable behavior or immediately move an animal out of an area, thus mitigating a conflict situation. Hazing is best suited to small-scale, individual animal or small group situations, especially when an undesired situation first arises. Examples of hazing techniques include projecting loud and/or unpleasant noises (yelling, banging pots and pans, blowing whistles, sounding an air horn, lighting fire crackers), employing visual stimuli (bright lights, strobes, effigies), or delivering a physical incentive that causes temporary discomfort to encourage departure and/or discontinuation of the undesired behavior (projecting bean bags, paint balls, rubber bullets) (deCalesta and Witmer 2005).

In circumstances where undesirable behaviors have been allowed to persist or where large groups of elk are involved, achieving a successful remedy typically is more difficult and likely will require greater investment of effort and use of long-term options. Although potential long-term options fall within the same type categories, those considered suitable for use in simple hazing cases typically are not as effective with animals displaying well-established or habituated behaviors, especially if only a single technique is implemented. Combinations of multiple hazing techniques used concurrently or in rotation sometimes increase the level of stimulation provided and increase the overall efficacy of the conditioning effort. More often, in these tougher situations, other, more significant techniques are needed to modify the behavior of persistent animals. Use of propane exploders (e.g. zon guns), registered chemical repellents, remote controlled aircraft or drones, and guard animals (dogs) are examples of longer-term approaches to behavior modification (deCalesta and Witmer 2005). However, reliance upon aversive conditioning methods alone often leads only to temporary relief. When behavior patterns are deeply entrenched or during periods of resource stress (e.g., limited natural food

availability), hazing methods typically fail and more robust approaches are needed to deter persistent elk.

FENCING

To Reduce or Prevent Access by Elk — Wherever elk have unrestricted access to abundant and nutritional food resources, they will make full use of the opportunity provided. Examples of resources that are seasonally attractive to elk include stored/baled hay or alfalfa, well-maintained rotational pasture or grazing land, standing silage, row crops, and other agricultural commodities. In suburban or residential areas, attractants may include home landscaping, small vegetable or flower gardens, and large open areas dominated by grass. The level of vulnerability of these resources rises when the resource is located in close proximity to the core range of elk and/or as the quality or richness of the food resource increases. With continued access to an area elk may attempt to defend the food from other wildlife and cattle, especially during periods of stress or reduced availability of naturally occurring foods.

Properly designed and installed fencing can reduce or eliminate depredation of stored feed and stacked hay and vulnerable commodity production fields (Hegel et al. 2009). Electric fencing is more effective than other non-electric styles at reducing agricultural damage by elk (Johnson et al. 2014). Single-strand, electrified polytape fencing offers a high level of success in keeping elk out of personal gardens, cemeteries, and other locations that are small enough to economically protect with fencing (Justin McVey, NC Wildlife Resources Commission; personal communication). Fencing also can be used to direct natural elk movements or dispersals through safer wildlife corridors and away from areas where they pose an increased risk of causing conflict (such as roadways).

Minimizing Damage to Fences — Fence design strongly influences the probability of entangling an elk or promoting an elk's attempt to push through a fence. When the height of a fence remains below 39 inches and wire strands at the top are clearly visible to the elk, damage to the structure by elk is reduced (Harrington and Conover 2006). Additionally, elk demonstrate an ability to find and use purposefully created openings or crossings that provide a less dangerous path to necessary resources (like water sources), thereby reducing the incidence of entanglement (Harrington and Conover 2006). Temporarily removing the top strand of a fence prior to and during the rut, when elk are highly active, may reduce entanglements and damage inflicted on fences. Because newborn calves do not yet have the jumping ability of adults, they are 8 times more likely to get caught in a fence than are adults (Harrington and Conover 2006). Temporarily removing the bottom strand of a fence for a short period in summer allows calves to pass beneath, thereby reducing the capture of calves that cannot clear the obstruction.

TRAP AND RELOCATION

Trap and relocate operations are time consuming, expensive, and pose potential dangers to both the animal being captured and the people performing the operation. Therefore, moving elk is not a preferred option for resolving conflict. However, as means to avert an emerging threat from becoming a larger or long-term risk, trap and relocate efforts may offer biologists an

alternative option to consider instead of lethal removal. The benefits potentially derived from relocating an elk from a conflict situation need to be weighed, on a case-by-case basis, against the costs incurred in capturing and moving the animal to a new area. To enhance the success of relocation efforts, the site of release becomes an important consideration — due to their inability to find or meet minimum required needs, elk placed on inferior habitat are likely to disperse soon after release, creating a new problem instead of resolving one. The CCC of the release areas should be such that the elk will be tolerated by people in the vicinity.

KILL PERMITS

As allowed under provisions of Virginia Code (§ 29.1-529), DGIF personnel have the authority to issue to affected parties a kill permit allowing for the “take” of elk that are causing damage to personal property, including that inflicted upon “... fruit trees, crops, livestock, or personal property utilized for commercial agricultural production.” Upon confirmation that an elk has caused damage, a representative of DGIF will discuss with the affected party options available to resolve the problem. However, agents of DGIF “... have the option of authorizing nonlethal control measures rather than authorizing the killing of elk [or bear], provided that such measures occur within a reasonable period of time” (§ 29.1-529.A). These provisions allow representatives of DGIF the ability to determine what measures, if any, are most effective and necessary before issuing a kill permit. A request to implement alternative nonlethal measures does not preclude subsequent issuance of a kill permit if damage persists.

FINANCIAL COMPENSATION

Courts have ruled that, although wildlife resources are “owned” collectively by the public, but managed in the public’s interest by a state and/or federal agency, these agencies are not liable for any costs associated with wildlife damage (Musgrave 1993). Although some states (n = 18) in the past provided or currently provide farmers compensation for damage to agricultural commodities inflicted by wildlife, most do not (Wagner et al. 1997). Among the states and Canadian provinces that once implemented wildlife compensation programs, many later abandoned them when funding was no longer available to support the program (Wagner et al. 1997). From 1942-2005, Virginia administered a limited compensation program for damages caused by deer, that was funded by the purchase of county-specific damage stamps. This program was discontinued due to rapidly escalating administrative costs that outweighed any benefits returned. Additionally, problems in consistently applying criteria or equitably distributing compensation contributed to the program’s demise. At the peak of program utilization, only 18 counties in Virginia participated in the program (DGIF 2005).

Reasons to justify implementation of a compensation program vary, but examples offered include instances where the causative species is new to an area (via range expansion), resulted from an action of the government, or possesses high political, social, or economic value (Wagner et al. 1997). Although most compensation programs provide monetary relief, not all involve financial distributions. Some states and provinces provided “temporary coverage” for a set period of time, after which farmers were required to establish their own damage prevention mechanisms (e.g., Wisconsin, Quebec, and Nova Scotia). Other agencies provided assistance in

the form of damage prevention techniques (e.g., Colorado, Alberta). In many cases, compensation for damages would be limited or withdrawn altogether if previous offers of assistance were declined or resources provided to an affected party were not used (Hegel et al. 2009, Colorado Parks and Wildlife 2015).

Research suggests that monetary compensation reduces the likelihood that those affected by damage will take recommended actions to prevent future damage (Hegel et al. 2009). Compensation often provides temporary economic relief for those suffering damage, but history has shown that, unless the true cause of damage is identified and addressed, those receiving benefits become dependent upon and expect to continue receiving such payments in the future with little desire to fix the situation. Without enforced provisions to make recipients fix a problem, program administrators find compensation requests come from, and payments often go to, the same individuals year after year (Hegel et al. 2009).

APPRAISAL OF MANAGEMENT OPTIONS BY MANAGERS IN EASTERN STATES

As part of the survey of managers of elk programs in eastern states (Hurst and Parkhurst 2018b), participants were asked about their experience with and opinions regarding methods to resolve human-elk conflicts. The intent of the survey was to gather evidence that could inform decision making about management approaches. Additionally, the hope was that differences between or among strategies might emerge relative to their effectiveness at different phases of management that would enable Virginia's elk program to more effectively address conflict. Managers ranked a suite of commonly used conflict management strategies in terms of frequency of use, effectiveness, and scenario under which use was considered appropriate. Regarding the proportion of states where various management techniques are used (% of states using the item) in conflict resolution, managers provided the following:

- technical assistance (100%, n = 9)
- exclusion/fencing (89%, n = 8)
- hazing/audio-visual deterrents (89%, n = 8)
- recreational hunting (78%, n = 7)
- cost share for preventative measures (56%, n = 5)
- agency lethal control (44%, n = 4)
- landowner kill permits (44%, n = 3)
- relocation (33%, n = 3)
- monetary compensation (22%, n = 2)
- contracted lethal control (11%, n = 1), and
- insurance assistance (11%, n = 1).

Managers who had used these techniques then provided opinion on which they rated the most important strategies (in descending order, based upon weighted % of those indicating the strategy was "Very Important"):

- technical assistance (93%, n = 13)
- recreational hunting (87%, n = 6)

- compensation (81%, n = 5)
- preventive measures cost share (64%, n = 4)
- exclusion/fencing (62%, n = 8)
- hazing (50%, n = 6),

However, simply because an agency may use a particular technique does not mean that all practices are appropriate for use or carry the same level of importance for resolving human-elk conflicts in all settings. Managers suggested that conflicts involving agriculture, home gardens, and residential landscaping may need different approaches. When deciding on appropriate methods to implement, managers must consider the consequences of using a technique, such as does the technique resolve a conflict and at reasonable cost to the affected party. The phase of a program's maturity influenced managers' opinions about selection and effectiveness of conflict resolution methods. For programs earlier in their development (i.e., establishment/growth), managers rated (as weighted % of states ranking item as "most important") the strategies below as more effectively balancing resolution of elk-damage conflicts to agriculture and in home gardens and residential landscaping with agency expenditures:

- exclusion/fencing (~60%)
- technical assistance (~30%)
- relocation of problematic elk (8% [for agricultural damage only]), and
- recreational hunting (~5%).

In contrast, techniques that managers of well-established elk populations (i.e., management phase) relied on most often and believed most effective were:

- recreational hunting (50% overall; 100% for cases of agricultural damage)
- cost share for preventive measures (~29%), and
- technical assistance (21%).

Information about conflict management strategies that agencies considered or implemented, but later abandoned due to ineffectiveness, could help other managers avoid inappropriate approaches they might otherwise adopt. In response to this inquiry, managers found their approach to conflict resolution (i.e., the strategies selected) needed to change as elk became conditioned or habituated (Hurst and Parkhurst 2018b). This was true especially with hazing techniques, such as noisemakers (e.g., propane cannons [Zon guns]), projectiles (rubber bullets, paintballs), and verbal hazing, all of which become less effective with repeated use.

Managers stressed a need to be flexible and adaptive when selecting damage resolution strategies. As one manager stated, "*Not all of these tools are appropriate for all scenarios, but they each will work to some extent. Of course, as habituation increases, the effectiveness of abatement strategies will decrease.*" Thus, conflict resolution methods realistically should be viewed as "tools in a toolbox." Furthermore, engagement with landowners about abatement options is important. As one respondent stated, "*...just going it alone without the involvement of these folks is a dead end and will not work.*" Landowners can help with maintenance (e.g., fences) and provide useful information to help evaluate which "tool" is most appropriate in different instances.

PUBLIC PREFERENCES ON CONFLICT MANAGEMENT

The telephone survey of Virginians (Hurst and Parkhurst 2018a) revealed distinct preferences among respondents in what they considered suitable methods to resolve elk damage situations. Overall, the public reacted unfavorably to killing elk that cause damage. When ranked by percent response for most highly preferred strategy, respondents' expressed preferences were:

- scare away elk that cause damage (53%, n = 1,705)
- fencing to exclude elk that may cause damage (52%, n = 1,688)
- recreational hunting to reduce elk populations in areas where damage occurs (52%, n = 1,676), and
- kill elk that cause damage (15%, n = 490).

Although “scare away elk that cause damage” was most preferred among all respondents, subsequent preferences differed among stakeholders, particularly between respondents who did and did not derive their income primarily from agriculture. Respondents whose income was not dependent upon agriculture expressed preference for the use of “fencing to exclude elk” (54%, n = 1,532) next, whereas “recreational hunting to reduce elk populations” (67%, n = 88) was next most important among those whose primary income came from agriculture. Noting that “kill elk that cause damage” was least preferred by all respondents, respondents who did not depend on agricultural income preferred it less (15%, n = 428) than did those who depend on agricultural income (33%, n = 43). The least preferred approach to resolve agricultural damage among all groups was “killing elk.”

When asked about approaches to use to protect farmers and producers who experience elk damage, respondents ranked the following as highly preferred methods (in descending order by % of respondents):

- provide technical information on ways to prevent damage (69%, n = 2,205)
- financial help or cost-sharing to reduce the cost of materials to prevent damage (55%, n = 1,755)
- provide financial help to reduce the cost of insurance (46%, n = 1,480), and
- direct payment for loss (compensation; 44%, n = 1,423).

Preference differed by the geographic region within which the respondent resided. Among residents of SWVA, and those residing within the ERA specifically, “financial help to reduce the cost of insurance” (50%, n = 390) and “provide direct payment for loss” (47%, n = 367) were highly preferred more frequently than was true for Virginians at-large (37%, n = 228; 35%, n = 212, respectively). Among respondents who did not depend on agricultural income, “provide technical information” (70%, n = 2,016) was most preferred, whereas respondents who derived most of their income from agriculture preferred “financial help or cost-sharing” (67%, n = 88).

Although not a highly preferred strategy by the public or DGIF, there will be instances where humanely dispatching an elk is necessary, especially in situations where other damage resolution strategies were ineffective. Opinion from the public about who would be preferred as the responsible agent for killing elk offers guidance as the agency mulls options. When asked

who should be responsible for killing problematic elk, respondents ranked the following as highly preferred (in descending order by % of respondents):

- Staff of the Department of Game and Inland Fisheries (56%, n = 1,794)
- Hunters who are selected to participate in a special controlled hunt (53%, n = 1,721)
- Affected landowners who are issued a kill permit (52%, n = 1,687)
- Sharpshooters (hired professionals to reduce populations) approved by the Department of Game and Inland Fisheries (39%, n = 1,263)

ELK MANAGEMENT PLAN: MISSION, GOALS, OBJECTIVES, AND STRATEGIES

INTRODUCTION

This section of the Elk Management Plan establishes policies that will guide the agency's management of the elk population in Virginia through 2028. It also outlines and describes what DGIF hopes to accomplish, and the methods and approaches it considers feasible to use in its management of elk.

Goals for this plan were developed by a 17-member Stakeholder Advisory Committee (SAC) comprised of representatives from key affected stakeholder groups from across the Commonwealth, but with an emphasis on interests within SWVA. Individuals serving on the SAC included representatives for hunters, agricultural commodity and livestock producers, homeowners, forest landowners, animal and ecological health interests, business and tourism industries, motorists, and local, state, and federal agencies (Appendix A). Technical support and feedback was provided by an ETC composed of personnel of DGIF (Appendix B) with expertise relevant to the management of elk.

As presented, goals are broad visionary statements of desired outcomes, they reflect the values held and expressed by the diverse public DGIF serves, provide a clear statement of *what* DGIF should strive to accomplish with its elk management program, and project *why* the issue being addressed in a goal is important. In distilling these expressed value statements, a number of overarching guiding principles emerged, which provide additional direction and valuable guidance on important management issues on which the agency should focus its management over the next decade.

Following the presentation of each goal statement are a number of objectives. Unlike the visionary nature of a goal, objectives reduce these broad and aspirational statements of desired outcome into manageable pieces and describe, with specific indicators, *what* needs to be done and *when* it will be completed. To be effective, objectives must be quantifiable, have established deadlines for achievement, and reflect the technical realities of science. Potential strategies, listed under each objective, establish the suite of possible methods that outline *how* the agency

could fulfill that objective. Members of the TAC formulated all objectives and strategies, with input from the SAC on prioritization.

Because goals (and the underlying values upon which they emerged) remain relatively constant over time, it is unlikely that significant changes to these directional statements would be necessary over the 10-year life of the plan. In contrast, one might anticipate a greater need to amend an objective or set of strategies given changing social, environmental, technical, or administrative/political conditions. To remain relevant, a plan needs to be flexible, adaptive, and responsive to changing conditions and new information. Recognizing this need, the SAC endorsed allowing the agency necessary flexibility to update objectives and strategies between major plan revisions so long as DGIF consults with the SAC and provides opportunity for feedback, but additional public review would not be required. Any adopted modifications to objectives or strategies are to be documented and presented as addenda to this plan on the agency's web site. In the rare and unanticipated event that DGIF would seek to change a plan goal or guiding principle, a new effort to solicit public input and review would be needed.

The Elk Management Plan differs from previous Virginia wildlife species management plans in that it incorporates and follows the structure of DGIF's new Mission and Vision statements, as adopted in 2016. With this new mission, DGIF clearly defines its three priorities: **Conserve, Connect, and Protect**. To facilitate the transition of management in accordance with this revised mission, components of the plan have been integrated within the framework of the new mission and are presented in ways to highlight that relationship. As with other species management plans in the past DGIF asked members of both the SAC and the TC to rank the priority of all the objectives within each goal for future guidance to staff regarding areas of focus within the plan. While each member agreed that all the objectives were important and needed, each felt differently about individual objectives overall importance to the future of the elk program (APPENDIX F).

CONCEPTUALIZING INTERACTIONS AMONG THE PLAN'S GOALS

As managers make decisions about management relative to one goal area, those decisions often will have repercussions in another goal area, potentially influencing whether stated objectives in the latter area actually remain attainable. For this reason, it is important to examine and consider the connections and feedback between and among all goals collectively (Figure 21). Anticipating or visualizing all possible scenarios that might emerge, it is difficult to accurately predict what impact a management decision might have on other desired outcomes. Nevertheless, if DGIF hopes to achieve balance between realizing opportunities afforded by elk while minimizing the negative effects elk can bring, this is a critically important and necessary step.

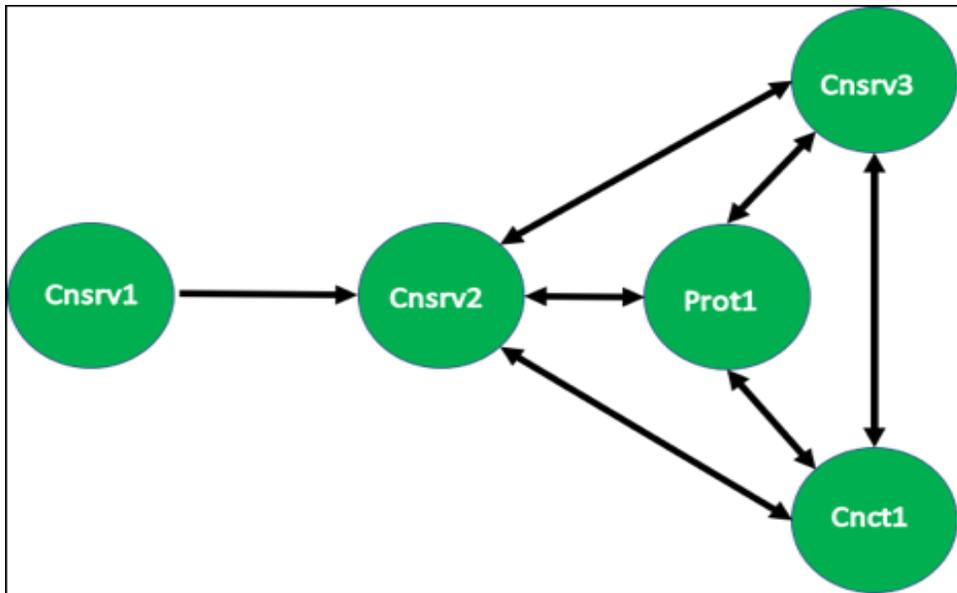


Figure 21. Conceptual model of the interrelationships among goals in the Elk Management Plan.

To illustrate this point, consider the effect the status of the elk population might have on goal attainment. Although the plan does not specify or discuss a particular number of elk associated with each goal, issues related to population size certainly permeate all goals, each in different and potentially significant ways. For example, Conserve Goals 1 and 2 directly address matters of elk population size and management, where some level of population size becomes the central outcome. Alternatively, Conserve Goal 3 and Protect Goal 1 focus on desired outcomes associated with elk, but the objectives and strategies employed to attain those outcomes will differ depending upon the size of the existing elk population at that time and where it has to be to secure a particular desired outcome. Connect Goal 1 is not affected directly by population status, but the messages delivered under this goal must describe realistically the outcomes and consequences anticipated at differing population levels.

A closer examination of these interactions among goals begins to reveal the true complexity of management needs and the inherent difficulties encountered when trying to achieve proper balance between benefits and risks. For example, Conserve Goals 1 and 2 both directly discuss population status of elk, but in distinctly different ways. Conserve Goal 1 examines the minimum population level and habitat conditions required to establish and maintain a viable and healthy presence of elk in SWVA, but without any consideration of other attributes of CCC (other than expressing the desire to sustain an elk population). A component of Conserve Goal 1 is to determine the smallest baseline population of elk necessary to sustain the species, in pure biological terms, and establish the conditions needed to maintain a population at that minimum level. Although biologists believe this level already may have been reached, the need to verify this viewpoint remains a plan objective if the agency's effort to expand knowledge about basic ecology of elk in Virginia is to be met — which is a key premise of Connect Goal 1. In contrast, Conserve Goal 2 examines anticipated opportunities/benefits and challenges/risks that arise as the elk population is allowed to expand (beyond the base minimum number of animals defined in Conserve Goal 1). However, because the major thrust of Conserve Goal 2 is to find the proper balance among all desired outcomes (both benefits and risks simultaneously),

it must consider the implications incurred from imposing limitations on how large a population might become or where a population might be allowed to expand if undesirable impacts are to be avoided.

All of the remaining goals interact with each other, but more importantly, each one potentially poses unique consequences on what materializes under Conserve Goal 2 (i.e., adjustments made to accommodate CCC). Broadly speaking, Conserve Goal 3 provides guidance on how best to realize the suite of potential recreational and economic benefits derived from elk that stakeholders deem desirable and feasible to pursue. Because having more elk on the ground typically enhances the likelihood that benefits will materialize, efforts under this goal seek to promote population expansion. Connect Goal 1 recognizes the need for outreach and education about the opportunities and challenges associated with having elk on the landscape and establishes mechanisms through which that happens, paying close attention to implications related to population size. Protect Goal 1 specifically focuses on needs associated with minimizing risk and addressing damage caused by elk. In many cases, outcomes sought under this goal directly counter the needs and/or desires expressed in Conserve Goal 3; because the risk of damage or other threats often increases proportionally as population size increases, this goal likely seeks to reduce risk via population management (i.e., reduction). Although each of these goals influences the others, their greater influence is on Conserve Goal 2, which attempts to mitigate opposing influences and find appropriate balance and remain below the CCC threshold.

Because CCC can, and often does, vary regionally, the plan provides sufficient flexibility allowing DGIF to potentially “micro-manage” elk within its range, considering the particular local desires and constraints exhibited or expressed by constituents (Figure 22). Where the expressed desires of constituents of a particular area are to allow herd expansion as means to receive greater benefit, regardless of the inherent risks associated with a larger population, management could be tailored to favor such interests. In other areas, where the potential for increased risk is not acceptable, the agency may seek to implement measures to reduce local population expansion or herd dispersal. As a result, the scale at which management is applied becomes more detailed and complex and the agency will face hard choices as it implements objectives under Conserve Goal 2 and attempts to achieve a state of conditions that meet CCC both locally and regionally.

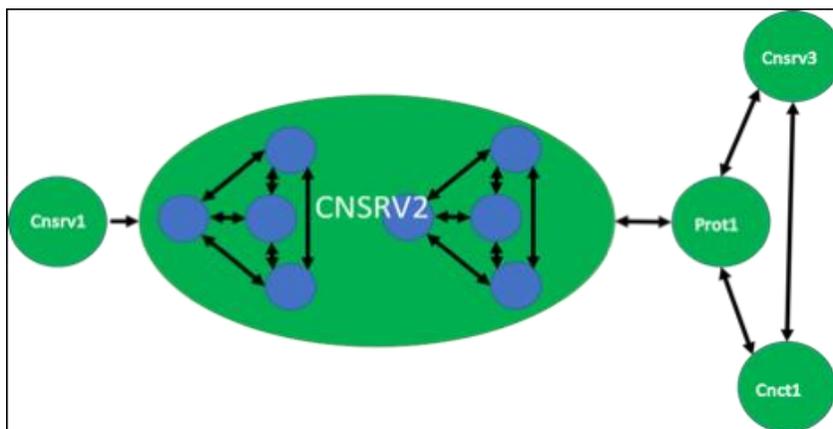


Figure 22. Modified conceptual model illustrating how management at a local scale may allow different desired outcomes to be achieved in parts of the region while still attaining overall CCC balance across the larger region.

DGIF VISION STATEMENT

Leading wildlife conservation and **inspiring** people to value the outdoors and their role in nature.

OVERARCHING GUIDING PRINCIPLES FOR ELK MANAGEMENT

1. Elk should be managed as a wild, free-roaming public resource that meets the needs and interests of Virginians using methods that are:

- innovative,
- fiscally responsible,
- flexible,
- adaptive,
- proactive,
- transparent,
- technically and scientifically sound,
- more natural than artificial,
- safe,
- ethical,
- humane, and
- based on continuing public input and involvement.

2. For the purposes of this plan, Buchanan, Dickenson, and Wise Counties are designated as the Elk Management Zone (EMZ) of Virginia and shall be referenced as such in all relevant documentation and regulations. Outside the EMZ, no resident elk are recommended during the tenure of this plan.

3. No more reintroductions of elk from outside Virginia are planned or recommended at this time.

4. Any deviations from the goals or guiding principles specified in this plan will require public review and involvement of an Elk Stakeholder Advisory Committee (SAC) as well as technical guidance from the Elk Technical Committee (ETC).

The Plan's overarching guiding principles establish, at the most basic level, how and why DGIF can be expected to manage elk in Virginia. DGIF has a legislative mandate (§29.1-103) to manage Virginia's elk resource, and the agency does so in accordance with the core principles of the North American Model of Wildlife Conservation. The elk management goals and objectives that follow reflect DGIF's observance of and adherence to these principles, among which include that elk are viewed as a public resource that should never be privately owned and, like other native wildlife, elk are managed sustainably in trust by DGIF for the non-commercial use

of all citizens. As such, successful elk management depends not only on the best scientific information and techniques, but also the support and engagement of a diverse citizenry.

DGIF “CONSERVE” MISSION STATEMENT

Conserve and manage wildlife populations and habitat for the benefit of present and future generations.

DGIF “CONSERVE” GOAL STATEMENT 1

Conserve sustainable and diverse native wildlife populations and ecosystems.

ELK MANAGEMENT PLAN — CONSERVE GOAL 1

Goal Statement: Manage elk in a manner that maintains a healthy and viable population within the Elk Management Zone.

Although elk historically were a component of Virginia’s native ecosystems they were extirpated due primarily to human activities that include overharvesting and habitat loss. Today, elk once again occupy a niche in Virginia’s ecosystem and enhance the local native biodiversity of southwest Virginia and should be conserved in perpetuity along with the region’s other native wildlife.

Objective 1: During the tenure of the plan, determine what constitutes a minimum viable elk population and the requisite habitat needs of such a population.

Biologists currently do not know what constitutes a minimum viable population for elk in Virginia and their use of, and needs for, habitat are not yet well understood. Population-based considerations when evaluating minimum viable population include demographic factors, population growth rates, and impacts of environmental variability and population genetics in growth. Another consideration contributing to viability is an analysis of whether the elk population in Virginia will become a part of a metapopulation with elk in adjoining states or if they will remain an isolated population.

Potential Strategies:

- a. Quantify the demographic characteristics of Virginia’s elk population (i.e., birth rate, death rate, immigration, emigration).

- b. Identify and evaluate factors (e.g., predation, disease, elk-vehicle collisions, and genetics) that affect the health and viability of Virginia’s elk population.
- c. Identify and evaluate habitat attributes that affect the health and viability of Virginia’s elk population.
- d. Investigate, select, and test parameters that will allow development of a population model for elk in Virginia.

Objective 2: By 2027, assure that a minimum viable elk population exists within the Elk Management Zone, unless an official response to a mitigating circumstance (e.g., disease outbreak) warrants reducing the population below the defined minimum threshold.

Once DGIF develops a better understanding of what constitutes a minimum viable elk population in Virginia, the agency then can manage the resource in ways to assure that additional augmentation of the population is unnecessary. Other uses of the elk resource (e.g., hunting) must not impede the attainment of this objective — population viability supersedes all other considerations, apart from those needed to properly respond to disease. If this should occur, efforts to reestablish population viability should begin after the outbreak is resolved.

Potential Strategies:

- a. Examine available methods to estimate populations, evaluate their utility for use in Virginia, and apply appropriate metrics of population status to monitor achievement of population goals.
- b. Conduct periodic surveillance to locate and identify new sub-populations of elk; when detected, incorporate these units into the agency’s overall elk management planning and response.
- c. Assess and, where necessary, mitigate factors that may limit or impose negative consequences on elk population viability, including, but not limited to, the direct and indirect effects of regulated hunting (lack of or insufficient vs. excessive hunting effort, bag limits, season length, either-sex restrictions, weapon limitations, etc.), and population demographics (poaching, predation, recruitment, immigration, emigration).
- d. Assess and evaluate the status, condition, and suitability of current and future habitat available to elk within the Elk Management Zone.
 - i. Develop and apply standards and criteria that provide an effective rating of the quality of habitat for elk in Virginia. Ensure that any data used in assessments provide support to justify and implement proactive management activities, when necessary or warranted.

- ii. Use the most recent landscape inventory data (e.g., National Land Cover Database, GAP data, historical distribution data, published literature, or other appropriately-scaled data), including such attributes as forest age, cover type, tree stocking rate (i.e., density), habitat interspersion, etc., to inventory the location, amount, and juxtaposition of existing and future suitable habitat.
- e. Determine when and the processes through which changes in habitat (e.g., direct loss or conversion, natural succession, insect outbreak, timber harvest, mine lands reclamation, wildfire, climate change) may affect the quantity and quality of elk habitat.
- f. Through periodic re-examination of landscape inventory data and field surveillance, monitor for changes in habitat status/condition within the Elk Management Zone as means to detect proactively situations where herd sustainability may be jeopardized.
- g. Promote appropriate habitat management for elk on lands within the Elk Management Zone, including lands of interested parties that DGIF does not own or manage, to help maintain minimum population viability and diversity.
 - i. Assess the feasibility of managing reclaimed mine lands as elk habitat by investigating, evaluating, and, where appropriate, incorporating data available from the Department of Mines, Minerals, and Energy (DMME).
 - ii. Examine the effects of land ownership (private vs. public) on how and where habitat for elk currently is being provided.
 - iii. Provide technical assistance to landowners on managing wildlife habitat.
 - iv. Collaborate with and support other agencies, non-governmental organizations, and private entities and individuals (with special emphasis on owners of large tracts of land) to meet established elk population objectives and achieve shared habitat management goals.
 - v. Engage proactively with local governments, developers, and communities to ensure that the needs of and impacts to elk and other wildlife are considered and, where feasible, mitigated prior to initiating development activities.
 - vi. Work with DMME to investigate the possibility of modifying existing regulatory requirements pertaining to the restoration of mined lands and the release of bonds as means to promote creation of early successional habitats.
- h. Conduct active disease surveillance, minimize risk of introducing new disease-causing agents into the elk population, and manage elk to minimize disease transmission between elk and other susceptible species.
 - i. Remove and test, where appropriate, illegally-held captive cervids for Chronic Wasting Disease (CWD), bovine tuberculosis, brucellosis, and other diseases.

- ii. Prevent introduction of infectious disease-causing agents using regulations and policies.
- iii. Wherever possible, manage endemic diseases to prevent negative effects on elk populations.
- iv. Re-examine, update as necessary, and implement provisions of the agency's disease surveillance and response plans and protocols.
- v. Evaluate the impact of *Parelaphostrongylus tenuis* (meningeal worm) on elk in southwest Virginia.
- vi. Maintain and enforce a prohibition on the supplemental feeding of elk and any other activities that unnaturally concentrate elk and deer.
- vii. Regulate captive elk and other cervids to minimize the risk for disease transmission to wild elk populations.
- viii. Maintain or enhance collection of biological samples from dead and harvested elk.

DGIF “CONSERVE” GOAL STATEMENT 2

Manage populations and habitats to meet the balanced needs among diverse human communities.

ELK MANAGEMENT PLAN — CONSERVE GOAL 2

Goal Statement: Manage local elk populations in ways that balance:

- **the current desires and expectations of Virginia’s geographically and culturally diverse human populations regarding both the costs and benefits related to elk**
- **the integrity and needs of a biologically diverse and sustainable ecosystem, and**
- **anticipated future ecological needs and societal demands.**

DGIF’s strategic plan states that Virginia’s wildlife populations are to be managed to maintain optimum populations to serve the needs of the Commonwealth. Cultural carrying capacity (CCC) for elk is the maximum number of elk in an area that coexists compatibly with humans. CCC for elk inevitably is lower than the biological carrying capacity (BCC) - the maximum

number of elk that a habitat can sustain over time. CCC varies widely within and among communities. At CCC, demands for benefits from elk (i.e., recreation) will be mediated by the need to moderate elk numbers in ways that reduce negative consequences (i.e., damage). Because elk sometimes congregate in high-density groups, significant impacts to natural ecosystems and property or crops can occur. Proactive population management therefore entails anticipating future changes in CCC as well as ecosystem sustainability needs. Thus, managers must find ways to manage the population to meet the desires of constituents, but also protect ecosystem integrity and native biodiversity. However, meaningful attainment of benefits (e.g., tourism) often cannot be met until a certain minimum elk population size is attained. Management activities that delay this attainment may substantially affect what benefits are realized within a given time period. As a result, management objectives for elk often appear subjective, but reflect incorporation of a combination of social, economic, political, and biological perspectives of the community in the effort to attain CCC. As the agency works to find and maintain that balance, the Stakeholder Advisory Committee (SAC) recommends the agency take a precautionary approach to minimize adverse impacts and, as such, let the elk population expand primarily via passive natural processes only within the EMZ. The Department's management actions and regulations should not promote resident elk populations outside of the EMZ over the 10 year period of this plan.

Goal Guiding Principles:

- 1. Recreational hunting is the preferred management approach to managing elk populations.**
- 2. No more reintroductions of elk from outside Virginia or expansion of the EMZ boundaries are planned or recommended at this time.**
- 3. Growth of the elk population within the EMZ should occur primarily through natural reproduction and dispersal.**

Objective 1: Throughout the tenure of this management plan, minimize negative impacts inflicted by elk on ecosystem functioning that adversely affect the maintenance of a biologically diverse and native ecosystem.

In Virginia, elk have the potential to affect ecosystems both positively and negatively as their population increases. Elk foraging and trampling can open and maintain early successional habitat that currently is lacking in southwest Virginia. However, elk can modify habitats to the detriment of other wildlife species, inhibit regeneration of forests, and potentially damage certain unique or sensitive plant communities. Even at low population levels, elk may cause measurable impact to certain natural systems. However, their absence reduces animal diversity and rids the ecosystem of a key herbivore. The management challenge under this objective is to manage elk impacts within limits that permit functioning of a biologically diverse ecosystem.

Potential Strategies:

- a. Identify and evaluate the effects elk can have on Virginia's ecosystems.

- i. Place special emphasis on assessing impacts to early successional habitats.
- ii. Develop and use efficient methods to assess and monitor the impacts of elk on ecosystem structure, functions, and diversity at appropriate scales for management within the Elk Management Zone (e.g., consider potential use of citizen science, cervid exclosures, expert opinion surveys, browse surveys).
- b. Where elk are determined to be affecting ecosystem management goals adversely, implement appropriate practices/techniques to mediate said impacts (e.g., elk population management, elk exclusions, harassment).
- c. Promote habitat management practices that provide long-term benefits to a diversity of wildlife species.
 - i. Use prescribed burning, disking, and/or timber management practices that improve the inherent qualities of natural systems rather than relying on artificial, resource-intensive methods (e.g., establishment of food plots).
 - ii. Restore, regenerate, or re-establish native plant species important to wildlife, emphasizing early successional habitats.

Objective 2: On a biennial basis, reexamine and, where necessary, adjust elk population management approaches to meet Cultural Carrying Capacity (CCC).

Knowledge about the past, current, and likely future status of the elk population is essential to successful elk management. Information on population size and trends is important to monitor herd status properly relative to population objectives. Mandatory reporting of elk harvest provides much of the data needed to assess status, but additional information from other sources (e.g., hunter surveys, damage reports) often is needed to complement harvest data. Elk population objectives also must integrate social, economic, political, administrative, biological, and ecological perspectives. The challenge in establishing population objectives is balancing social and ecosystem demands while being mindful of future trends in each. Methods used to determine local CCC should consider all stakeholders. Ideally, stakeholders help the agency define a desired elk population level and an appropriate population objective (increase, stabilize, or decrease).

Potential Strategies:

- a. Identify geographic areas (1) that are most likely to experience elk-human conflicts or where tolerance of elk most likely would be exceeded, and (2) where elk-derived benefits are most likely to accrue.
 - i. Utilize information gathered from elk habitat assessments (Conserve Goal 1) to inform estimation of social impacts associated with elk and their use of different land use types (e.g., agricultural lands, reclamation sites, recreation areas).

- ii. Using scientific literature, case studies, and insights from other states, identify factors and conditions under which elk-human conflicts and elk-related benefits would likely arise and use that information to predict future social and ecosystem trends.
- b. Employ surveys and other public involvement methods to gather information to estimate CCC.
 - i. Develop metrics of stakeholder support and tolerance for elk (i.e., estimate CCC) that will help guide elk population management.
 - ii. Assess public satisfaction with (or acceptance of) the agency's elk damage management.
- c. Use harvest data, hunter surveys, field sampling, and other appropriate assessment methods to regularly monitor elk population status (i.e., size, trends, condition) within and outside the Elk Management Zone.
 - i. Incorporate measures of hunter effort in monitoring elk population trends.
 - ii. Consider web-based and smartphone applications and technology to create GIS-enabled databases to enter hunt logs, landowner sightings, trail cameras, transect-based fecal counts, drone footage, etc. to supplement traditional population status assessment techniques.
 - iii. Improve the quality of elk population data by developing and refining monitoring procedures, especially where elk hunting and harvest data are not available or not representative.
- d. Develop, implement, evaluate, and, where necessary, modify hunting regulations to meet stated elk population objectives.
 - i. Identify and initiate action to remove impediments (e.g., laws, ordinances, etc.) that restrict the use of recreational hunting as a population control tool.
 - ii. Implement and evaluate the effectiveness of different harvest approaches in meeting elk population goals (e.g., traditional hunting seasons, special hunts, alteration of season length and/or bag limits, etc.).
 - iii. Incorporate information on elk population status and factors that affect herd health and viability (including genetics, disease, causes of mortality) when setting seasons, bag limits, and allocation strategies.
- e. Implement management methods in areas outside the Elk Management Zone that reduce elk population expansion.

- i. See Conserve Goal 3 for details on use of hunting to manage elk populations.
 - ii. Where hunting is not allowed, is deemed unsafe, inappropriate, or likely to prove ineffective, use other population management practices to reduce population expansion.
- f. Continue and/or improve existing programs that manage local elk populations within the Elk Management Zone.
 - i. Provide site-specific programs and/or options to manage elk within the Elk Management Zone (e.g., technical assistance to communities and landowners, out-of-season kill permits).
 - ii. Investigate and evaluate potential non-hunting options to manage elk populations and develop guidelines that clearly state the conditions of how or when these options would be used.
 - iii. At the time when implementation of a recreational elk hunting program within the Elk Management Zone may occur, re-examine and prioritize strategies used to achieve local elk population goals under this new population management paradigm.
- g. Prevent or reduce conflicts between elk recreationists and other citizens.
 - i. Examine the suite of elk-related recreational activities to assess the likelihood for conflict or potential violations of law by participants (e.g., trespass/confrontational interactions with landowners; causing congestion/impeding traffic flow while viewing elk; illegal parking, etc.).
 - ii. Evaluate methods to avoid or reduce conflicts identified in (i) above, including education/outreach, policy/regulation, and targeted enforcement.
- h. Clarify use of the term “elk” in Code and regulations to facilitate enforcement and management.
 - i. Thoroughly search the Code of Virginia, the Virginia Administrative Code, and all DGIF regulation documentation to identify how and where the terms “elk,” “white-tailed deer,” and “cervid” currently exist, the context in which their use occurs, and whether such use restricts or impedes meaningful enforcement action related to elk.
 - ii. Correct incompatible or inappropriate terminology and clarify the unique distinctions among these terms.
- i. Reduce illegal elk mortality using law enforcement, educational programming, public incentives, and other deterrent strategies.

- j. Develop collaboration with wildlife agencies in other states and/or conduct contract-based research to improve understanding of elk population dynamics and refine population estimation techniques.
- k. Ensure continued alignment and compatibility of elk population objectives with goals established in other plans adopted by the DGIF Board.
 - i. Examine population and habitat management objectives contained in other species management plans (e.g., White-tailed Deer, Black Bear, and Wild Turkey Management Plans) and evaluate the impact of elk population objectives on stated objectives to assure consistency.

Objective 3: Throughout the tenure of this plan, maintain or increase the number of hunters sufficient to accomplish stated elk population management objectives via retention, recruitment, or reactivation.

Because of its effectiveness as a population management tool, preserving or, where necessary, increasing the use of regulated recreational hunting is important. Recognized challenges that need to be addressed include the declining number of hunters, lack of hunter access, and restrictive laws or local ordinances that impede hunting. A growing public awareness and demand for local, natural food sources, an increasing desire to pursue elk as a game animal, and the continued public support hunting receives as a means to address community and ecological objectives present DGIF with opportunities to foster greater participation in hunting.

Potential Strategies:

- a. Evaluate hunter recruitment programs for their effectiveness with elk hunters and, if necessary, develop and enhance these programs to support elk hunter recruitment, retention, and reactivation
- b. Provide support to programs that promote a positive image for hunters who provide voluntary service and help DGIF meet habitat and other management objectives.
- c. Assure American Disability Act (ADA) compliant hunting access.

ELK MANAGEMENT PLAN — CONSERVE GOAL 3

Goal Statement: Consistent with the attainment of the plan’s conserve, protect, and connect goals, manage elk in ways that provide balanced benefits and enjoyment derived from elk-related activities via publicly accessible recreation opportunities for all wishing to pursue them.

Elk are popular among wildlife watchers, hunters, and the public in areas where elk exist. However, in Virginia, elk are not present statewide, but instead are concentrated in southwest Virginia within the Elk Management Zone. The restricted distribution of elk affects those who live in proximity to the population more so than that experienced by those outside the current range. The Department's management actions and regulations should not promote resident elk populations outside of the EMZ over the 10 year period of this plan. Given that fact, allocation of the benefits from elk must consider this distribution and its resulting impacts in terms of those who bear the burdens of living with elk. One way of addressing the disparity between those who shoulder a burden of impact is via preferential or hierarchical allocation of elk viewing and hunting opportunities, perhaps as follows: youth (for viewing and educational uses), residents of the Elk Management Zone, and landowners in southwest Virginia who grant access to the public (for hunting). Given the tradition of hunting elk (using archery, muzzleloader, and firearms), the recreational elk hunting program should strive to improve hunter satisfaction while meeting population management objectives. Hunters need to recognize the role hunting plays in successful elk management, but also recognize the need to practice their sport in ways that respect landowners and other outdoor recreationists. For the purposes of this plan, hunting refers to the legal pursuit and/or taking of wild animals under fair chase conditions for recreational and/or management purposes; sharpshooting is not hunting.

Objective 1: Throughout the tenure of this plan, strategically increase access to the elk resource for participants in elk-related activities.

Elk are a public resource. As such, where reasonable and feasible, management decisions should strive to ensure that elk are available and accessible in sufficient numbers for all members of the public who want to engage in elk-related recreation. Access to elk should not benefit one particular entity over other interests. Currently, access to the elk resource is constrained due to their presence primarily on private lands. Emphasis on acquiring lands or gaining public access for elk recreation should consider broad uses and have a focus on assembling contiguous tracts. Through well-planned, collaborative, and strategic actions with other partners, a multitude of regional benefits can be attained while reducing the potential for adverse impacts associated with elk.

Potential Strategies:

- a. Use data obtained from multiple sources (e.g., focus groups, public survey, expert input, literature, etc.) to determine the types of human-elk interactions stakeholders desire, and evaluate the role that access may play in their occurrence.
- b. Within the Elk Management Zone, assess and evaluate the type, location, suitability, and amount of land available for different forms of desired human-elk interactions.
 - i. Identify lands that currently exhibit constraints on allowing recreational uses or those where certain uses are excluded (e.g., open recreational hunting on Department of Conservation and Recreation lands).

- c. Examine and pursue creating realistic opportunities to attain benefits derived from access to the elk resource.
 - i. Establish a likelihood of occurrence for challenges and opportunities associated with different desired elk-related benefits, given expectations regarding the location and status of the elk population, habitat conditions, and social considerations.
 - ii. Evaluate the optimum size of sub-units (e.g., smaller than the Elk Management Zone) necessary to realistically manage for and attain different elk-related benefits.
 - iii. Examine the feasibility of partitioning users (seasonally, temporally, geographically) to reduce potential conflicts associated with different stakeholder desires (e.g., viewing vs. hunting).
 - iv. Solicit guidance from, and collaborations with, relevant organizations and stakeholders to facilitate complementary efforts to attain or forgo identified outcomes.
- d. Strategically increase the amount of land available for elk-related recreation and habitat management within the Elk Management Zone.
 - i. Evaluate the strategic and economic feasibility of different options (leasing, incentives, and/or partnerships) to acquire land or obtain access to enhance opportunities for elk-related recreation and habitat management.
 - ii. Increase DGIF's ability to acquire land or improve access for elk-related recreation and habitat management by streamlining the agency's land acquisition process and promoting access as an agency priority.
- e. In conjunction with other goals (Conserve Goal 2) and objectives (Conserve Goal 3: Objective 3) related to hunting, improve hunter access on private and public lands near the EMZ and within the EMZ, if hunting is adopted.
 - i. Foster better cooperation and connections between hunters and landowners.
 - ii. Implement cooperative agreements (e.g., Public Access Lands for Sportsmen program) between DGIF and appropriate landowners who allow hunting on private lands.
- f. Identify and seek to remove impediments (e.g., confusing laws, costs) that limit the recreational hunting of elk. Ensure that laws and ordinances do not restrict unnecessarily the hunting of elk.

Objective 2: Throughout the tenure of this management plan, and where feasible, increase participation, as measured using metrics of participant visitation, in non-hunting recreational opportunities associated with elk within the Elk Management Zone and, when opportunities become available, for hunting.

Traditionally, recreationist numbers and days spent afield provide a common measure of demand for game management programs. Although recreation demand for elk currently is unknown, if the elk population is managed properly, DGIF should anticipate seeing an increase in recreationists coincident with an increase in the number of elk. An increase in participation will enable economic benefits to accrue. According to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, over 2.5 million people participated in non-consumptive wildlife activities (e.g., observing and photographing wildlife) in Virginia and contributed an additional \$959 million dollars to the state economy.

Potential Strategies:

- a. Identify and evaluate non-hunting recreational opportunities associated with elk that exist in and near the Elk Management Zone and assess the management and regulatory conditions necessary to realize these uses.
 - i. Examine and evaluate existing and potential supply and demand issues related to non-hunting recreational opportunities, including, but not limited to: shed hunting, viewing, and photography.
 - ii. Monitor public recreational visitations to the region to determine if and how users interact with elk and engage in other elk-related activities.
 - iii. Conduct surveys of residents and visitors to assess recreational interactions and desires associated with elk.
 - iv. Investigate and seek ways to remove constraints and impediments to participation in elk-related recreation (e.g., restrictions on recreational access, impositions via local ordinance or confusing laws, cost, etc.), and monitor to avoid establishment of future impediments.
- b. In cooperation with partners, including private landowners and other agencies, provide accessible viewing opportunities in appropriate, safe, and acceptable locations.
- c. Use appropriate metrics to monitor changes in the supply and demand for non-hunting elk-related recreational opportunities.
- d. Ensure that participation in elk-related recreational opportunities, with special reference to elk viewing and photography, do not facilitate human-elk conflicts and/or lead to habituation of elk. Maintain prohibition of all supplemental feeding of elk.

- e. Collaborate and cooperate with appropriate entities (e.g., tourism agencies) to manage elk populations in ways that may enable tourism and economic benefits without compromising the attainment of other goals established in this plan.
 - i. Provide technical assistance, consultations, and referrals to assist the efforts of local communities in developing tourism opportunities or deriving elk-related economic benefits.
 - ii. Use agency resources to educate and inform constituents about elk-viewing opportunities and locations, and safe and ethical behavior while viewing.
- f. Create infrastructure (e.g., viewing platforms, parking lots, kiosks, etc.) to facilitate use of lands acquired for elk-related recreation, but with consideration toward minimizing the costs of future maintenance such facilities may require.

Objective 3: Throughout the tenure of this plan, improve satisfaction of hunting and non-hunting-based elk recreationists.

Although the number of elk recreationists and recreation days spent afield provide some measure of recreational demand, recreational satisfaction is more complex and is influenced by other elements of the recreational experience, including, but not limited to, seeing elk and elk sign, hearing elk, being close to nature, being safe, and seeing trophy-sized elk. Managing for specific components of recreational satisfaction can enhance the overall recreational experience. Favorable recreational satisfaction will help retain elk hunting as an important and viable population management tool and foster opportunities for elk-based tourism.

Potential Strategies:

- a. Until determined to be biologically sustainable for a viable population and until hunting options are defined and thoroughly evaluated, recreational elk hunting within the Elk Management Zone will be prohibited.
- b. Ensure that hunters registered their take of an elk outside the Elk Management Zone on their big game license at the time of harvest and record the harvest with the DGIF game harvest reporting system officially as an elk.
- c. Investigate the feasibility of, need for, and/or implications arising from instituting a separate elk tag and season for the recreational hunting of elk in Virginia.
 - i. Investigate and evaluate different tagging and pricing strategies and examine the regulatory/legislative implications, if any, necessary to implement each tag type. Examples to study may include: an additional notch tag on the existing Big Game License, with or without a change in price, and a stand-alone elk tag (created via legislation).

- ii. Evaluate the influence of tag structure and allocation options (e.g., silent auction, lottery) on (a) hunting as a management tool, (b) hunter opportunity (including equitable and fair access to a tag), and (c) the number of hunters likely to secure and possess an elk tag.
 - iii. Examine and assess the impacts of season and bag limits for elk under various tag strategies on attaining stated population management goals.
 - iv. Investigate the implications on the agency's ability to track the harvest of elk under an elk tag vs. when elk are taken as "deer."
- d. Before an elk season within the Elk Management Zone is adopted, investigate and evaluate appropriate means to equitably manage the allocation of opportunities among hunters (e.g., by weapon, by residency type [inside vs. outside EMZ; state vs. out-of-state]).
 - i. Investigate and evaluate implications from implementing a hierarchical prioritization scheme for allocating elk tags, as expressed by public values, on DGIF's ability to achieve elk management goals. Examine ramifications and/or consequences of sequentially favoring private landowners within southwest Virginia who provide meaningful public access for elk-related recreation first, then individuals who reside within the Elk Management Zone, then individuals who reside in counties west of and including Bland, Smyth and Washington counties, all other residents of Virginia and finally out-of-state residents.
 - ii. Identify/quantify recreational demand (including access) for different types of elk hunting (i.e., archery, muzzleloader, general firearms) using hunter surveys and other data collection methods (e.g., during mandatory harvest checking).
 - iii. Devise means to promote elk hunting among non-traditional constituent groups.
- e. Secure sufficient public access within the Elk Management Zone, prior to implementing any hunting activity, to ensure that lack of access does not constrain attainment of hunting goals.

Objective 4: By 2021, define and, where necessary, modify how recreational elk hunting will take place to meet hunter satisfaction and population goals throughout Virginia.

Hunting is the preferred technique to manage the elk population and, as the elk population grows, it will become the important tool to manage elk herds within, and outside, the Elk Management Zone. To use hunting to meet population management goals, an effective, yet equitable, hunting program will need to be developed. This program should consider hunter demand and satisfaction to ensure that adequate numbers of elk hunters are available when needed to achieve goals.

Potential Strategies:

- a. Identify attributes of desirable and undesirable hunting and non-hunting-based elk recreational experiences (e.g., recreationist density, specific characteristics of elk quality being sought, access needs, etc.).
- b. Biennially evaluate and improve satisfaction among elk hunters and non-hunting-based recreationists through appropriate mechanisms, including modification to existing regulations.
 - i. Determine the relative importance and sensitivity of measures of satisfaction and dissatisfaction as they relate to hunting and non-hunting elk recreational experiences.
 - ii. Assess and quantify elk hunter satisfaction, among particular hunting types (archery, muzzleloader, general firearms), and of the overall recreational hunting experience.
 - iii. Assess and quantify non-hunting recreationist satisfaction, among particular activities, and the overall recreational experience.
 - iv. Evaluate satisfaction affecting elk herd and recreational site characteristics throughout the Elk Management Zone and enact management actions where deficiencies exist.
- c. Investigate and implement population management methods that provide diverse elk recreation experiences and opportunities.
 - i. Alter herd management strategies and/or herd demographic characteristics to maximize satisfaction, where appropriate.
 - ii. Regulate and provide diverse hunting opportunity, harvest, and effort (e.g., either-sex opportunities, season length, access, season timing, bag limits, hunter densities, harvest allocation/ opportunities) among user groups to satisfy demand and maximize overall satisfaction of elk hunters and attain desirable herd characteristics for non-hunting-based recreationists.
 - iii. Examine the need to develop and enact special regulations to govern or restrict elk hunting in select areas as means to promote other desired benefits.

Objective 5: Throughout the tenure of this management plan, improve adoption and sustainability of recreational elk hunting behaviors that embody fair chase and ethical harvest.

Public perception of elk hunters and elk hunting activities has the potential to shape the future of hunting. Therefore, guidelines, regulations, and education pertaining to elk hunting should address concerns for safety, ethics, and fair chase.

Potential Strategies:

- a. Use surveys or other methods to assess the current state of elk hunting activities in relation to fair chase and ethical harvest implement programs to correct (eliminate; regulate) undesirable behaviors and promote desirable ones.
 - i. Develop and implement educational programs, guidelines, and recognition programs that promote acceptable hunter ethics and legal participation in hunting.
 - ii. Manage illegal activities to deter unsportsmanlike and unethical behavior through law enforcement, incentives, and other strategies.
 - iii. Maintain and enforce existing prohibitions on use of bait, feed, and natural scents (made of deer or elk tissues, excreta, or fluids) during the hunting of elk.
 - iv. Discourage wanton waste of elk meat by hunters using law enforcement, incentives, education, and other deterrent strategies.
- b. Examine and, where necessary, update DGIF’s hunter education program to improve hunters’ understanding regarding sportsmanship and the ethical pursuit of game, public perceptions of hunting, and how hunters’ behaviors affect public perception and attitude.

DGIF “CONNECT” MISSION STATEMENT

Connect people to Virginia’s outdoors through boating, education, fishing, hunting, trapping, wildlife viewing, and other wildlife-related activities

DGIF “CONNECT” GOAL STATEMENT 1

Promote people’s awareness and appreciation of their role in wildlife conservation

ELK MANAGEMENT PLAN — CONNECT GOAL 1

Goal Statement: Consistent with the plan’s other goals, improve understanding and knowledge of the options, tools, and strategies available to manage elk while promoting awareness of elk, their role in the ecosystem, and their conservation.

Successful elk management depends not only on the best scientific information and techniques, but also on the support and engagement of a diverse citizenry. Public attitudes and perceptions often determine the success or failure of elk management actions, therefore, a knowledgeable and informed public needs a scientific foundation upon which to base their viewpoints. An informed public is less likely to experience long-term or consistent elk conflicts. An enhanced emphasis on public education is necessary to achieve elk management objectives.

Objective 1: Throughout the tenure of this management plan, increase the public’s knowledge about and understanding of elk management, elk life history and behavior, and their role in the ecosystem.

Potential Strategies:

- a. Promote DGIF as the primary source for elk-related information in Virginia.
 - i. Improve the public’s perception and use of DGIF as a credible, trustworthy, and timely source of scientific information about elk and their management for all stakeholders.
 - ii. Provide timely, up-to-date, and readily accessible information about elk, elk management, and the elk program to users through the DGIF website and other media.
 - iii. Make an “Elk 101” educational curriculum and tutorial available for educator use.
 - iv. Ensure that all operational documents and protocols for the elk program are readily available to members of the public.
 - v. Annually tabulate and produce an annual elk status report that:
 1. Summarizes all forms of elk damage, including that inflicted upon agricultural commodities and property, residential homeowners, ecosystem functioning, vehicular collisions, forestry operations, animal health, human safety, mining reclamation, estimated economic impacts, tourism figures, or any other impacts to the public.
 2. Describes key parameters of the elk program in Virginia, including population estimates, herd demographics, elk locations.
 3. Assesses, documents, and interprets trends and/or changes in parameters.
- b. Using available public assessment methods, evaluate the current knowledge and perceptions of Virginians regarding elk, including basic life history, behavior, and management of elk, differences between elk and white-tailed deer, issues of liability and trespass, and regulations pertaining to elk.

- c. Investigate and evaluate outreach methods (e.g., brochures, public service announcements, social media, smart phone and browser apps, GIS-enabled databases and maps) as to their ability to disseminate information about elk effectively to targeted stakeholder audiences.
- d. Develop instructional and outreach programs and materials that address the following:
 - i. Identified shortcomings in knowledge and understanding or inaccurate perceptions of elk as identified in “Strategy b” above.
 - ii. Ecological impacts associated with elk.
 - iii. Basic life history and behavior of elk.
 - iv. Recreational and economic opportunities that elk may provide (i.e., hunting, viewing, tourism).
 - v. Elk-related conflicts (e.g., damage, disease) and the methods available to manage conflicts.
 - vi. Complexities of managing elk populations (e.g., CCC, ecological impacts, legal constraints, differences among land types and ownerships, balancing potential conflicts and opportunities) and the true costs/benefits of various elk management strategies.
 - vii. Laws, regulations, and responsibilities parties/individuals bear in preventing conflicts (e.g., trespass, firearms restrictions, road hunting, need for landowner permission, etc.).
 - viii. Liability protection for landowners who allow hunting (re: Code of Virginia §29.1-509)
 - ix. Roles and responsibilities of DGIF as they relate to wildlife disease issues.
 - x. Utilize collaborators (i.e., recognized experts, representatives from other government agencies, non-governmental organizations, universities) to assist with the development, dissemination, and delivery of scientifically accurate information about elk.
 - xi. Solicit and involve Virginia Farm Bureau Federation, Virginia Cooperative Extension, and other entities with established outreach networks to deliver educational programming to stakeholder groups with which those partners have close ties, and use instructional methods suited to the targeted audience (e.g., on-site demonstrations, field days, workshops, and other hands-on techniques).

- xii. Collaborate with the State Veterinarian to evaluate and disseminate relevant information about elk health and disease.
- e. Foster and engage in continuing facilitated public discussion with stakeholders about elk, their management, and resolving conflicts.
- f. Ensure that all DGIF employees aspire to and deliver a consistent message that clearly reflects the agency’s position on management of Virginia’s elk population.
 - i. Increase the knowledge and awareness among all DGIF staff about the life history and behavior of elk, their management, and the availability of information on these topics.

DGIF “PROTECT” MISSION STATEMENT

Protect people and property by promoting safe outdoor experiences and managing human-wildlife conflicts

DGIF “PROTECT” GOAL STATEMENT 1

Minimize wildlife-related conflicts while balancing conservation goals and human benefits

DGIF “PROTECT” GOAL STATEMENT 2

Promote public safety for all people enjoying Virginia’s wildlife and waterways

ELK MANAGEMENT PLAN — PROTECT GOAL 1

Goal Statement: Minimize and mitigate local and regional human-elk conflicts. Promote a shared public-agency responsibility for managing conflicts, consistent with the attainment of other stated goals. Hunting is the preferred damage management approach, wherever feasible and safe to do so.

Most of the public resistance against establishing and expanding the elk herd in southwest Virginia stems from concerns about elk damage or other negative attributes associated with elk. Examples of damage commonly associated with elk in Virginia include crop depredation, elk-vehicle collisions, and ecosystem and land reclamation impacts. Citizens, communities, DGIF,

and other agencies all share some responsibility in managing elk damage. Although DGIF has responsibility for providing opportunities and programs to control elk populations, the decisions and actions of landowners and community leaders directly influence the incidence of local elk damage and the effectiveness of programs developed to address damage. Citizens' decisions about planting gardens or ornamental plants, feeding elk or other wildlife, hunting elk or allowing elk to be hunted, erecting barriers to exclude elk, and participating in community planning processes all have impact on local elk movements and abundance, leading to consequences for themselves and their neighbors. Community leaders can influence human-elk conflicts depending upon decisions they make regarding whether to use elk control programs, enact ordinances, and/or involve and educate citizens. Elk hunting is a viable, cost-efficient management tool that not only maintains a healthy elk resource, but also diminishes crop depredation, elk-vehicle collision rates, and elk-ecosystem and land reclamation impacts.

Objective 1: Throughout the tenure of this plan, minimize as much as possible the risk of elk-related disease outbreaks that may threaten humans or domestic animals.

Human diseases associated with elk include ehrlichiosis, babesiosis, rabies, brucellosis, and bovine tuberculosis (TB). Bovine tuberculosis, which also affects cattle, has not occurred in Virginia since isolated cases were detected in captive fallow deer at two Tidewater facilities in the early 1990s. Rabies is very rare in elk, but caution is warranted for anyone handling a suspect animal. Brucellosis is a reportable livestock disease that can infect elk and may be transmitted by elk, but has not yet been found in Virginia's elk or livestock. Ehrlichiosis and babesiosis are tick-borne human illnesses. Risks for a number of elk-related diseases can be minimized by curtailing human activities that concentrate deer (e.g., feeding deer, moving deer).

Potential Strategies:

- a. Maintain and enforce a ban on the supplemental feeding of elk and discourage any other activities that unnaturally concentrate elk.
- b. Remove and test illegally-held captive elk or deer for CWD, bovine tuberculosis, brucellosis, and other diseases.
- c. Continue the existing testing procedures (as outlined in operational plans and protocols) on all elk that have been harvested, killed, or died of natural causes whenever and wherever such biological samples can be collected in a cost-efficient manner, and in coordination with hunters and other agencies and local officials.
 - i. Maintain and disseminate contact information about the Elk Harvest Line as means to enhance collection of biological samples from dead and harvested elk.
- d. Enforce regulations on the possession of captive cervids (elk and deer) to minimize the risk of disease transmission to wild elk.
- e. In compliance with the disease response plans, immediately respond to any detected cases of suspected disease in elk.

- f. Develop, update, and follow disease surveillance and response plans and protocols as needed.

Objective 2: Throughout the tenure of this management plan, ameliorate and/or mitigate elk damage to agricultural operations, residential properties, industries, and private landowners as measured by calls for assistance from, and damage response services provided to, the affected parties.

Elk damage to agricultural crops represents one of the important public concerns related to elk management in Virginia. DGIF should use data on use of kill permits and from the Virginia Wildlife Conflict Helpline to obtain important information on elk crop damage. Resolution of wildlife damage incidents should be in accordance with best management practices, sound science-based decisions, and with public safety at the forefront of all decisions. Resolution strategies require periodic reexamination and updating to make sure management approaches reflect state-of-the-art practice.

Potential Strategies:

- a. Annually review and update operational plans to ensure that response strategies represent the state of current knowledge and represent the most appropriate and cost-effective methods appropriate for Virginia.
 - i. Using appropriate assessment methodology, monitor and track the effectiveness of existing responses to and mitigation of elk damage complaints both within and outside the Elk Management Zone.
- b. Use hunting as the primary strategy to manage elk populations in areas of documented damage inflicted by elk.
 - i. Foster cooperation between hunters and those experiencing elk damage.
- c. Where necessary and appropriate, implement site-specific techniques to manage verified damage situations (e.g., kill permits).
 - i. Evaluate implications related to ethics, safety, and public perception when considering use of lethal damage-management methods (e.g., kill permits).
- d. Provide technical assistance to communities and landowners in the proper implementation of damage management strategies and tools for elk.
- e. Investigate the feasibility, effectiveness, and ramifications of expanding special hunting programs to meet unaddressed conflict resolution needs in residential areas.

- f. As appropriate, investigate the need and/or feasibility of implementing strategies designed for specific commodities or areas to respond in a timely fashion to unique situations.
- g. Investigate and evaluate alternatives for managing site-specific elk damage where use of hunting is determined to be ineffective, unacceptable, or not feasible (e.g., due to safety concerns) or where hunting of elk has not yet been implemented.
 - i. Determine the circumstances and/or conditions under which alternative damage management strategies would be deemed acceptable and/or effective.
 - ii. Evaluate the suitability of culling, fencing, and harassment as techniques to manage elk conflicts.
 - iii. Wherever alternative damage management strategies for elk are implemented, assess and monitor their effectiveness and public satisfaction with said alternatives.
- h. Investigate, evaluate, and where appropriate, implement programs designed to raise tolerance of damage (e.g., technical assistance on fencing, hunter access).
- i. Collaborate with other agencies, especially those with land holdings in or near the Elk Management Zone, to achieve elk damage objectives.
- j. Evaluate the effects of other conservation/environmental programs on elk conflicts (e.g., Conservation Reserve Program field borders).
- k. Develop better, cost-efficient, and meaningful metrics to assess and quantify damage inflicted by elk.
- l. Investigate and evaluate the potential benefits derived from, feasibility of, and implications that arise from implementation of a wildlife damage reimbursement plan, such as might be provided through financial cost share incentives, direct compensatory payment, or increased harvest allocation opportunities.
- m. Locally manage the negative effects of elk on successful reclamation, with an emphasis placed on reestablishing ecosystem structure, function, and diversity via use of elk population control, elk exclusion, or other appropriate techniques.
- n. Work with regulatory agencies (e.g., DMME) to examine the feasibility of modifying existing bond release reclamation requirements to provide greater flexibility in establishing early successional habitats.

Objective 3: Throughout the tenure of the management plan, minimize elk-vehicle collisions, as measured by aggregated police and insurance company incidence reports.

As the population of elk in Virginia continues to expand, the potential for elk-vehicle collisions increases concurrently. Elk exhibit behaviors similar to deer that makes them susceptible to collisions, namely crepuscular and nocturnal activity. Although controlling elk populations through hunting will be a primary means to reduce collisions, DGIF should continue collaboration with VDOT and other partners to investigate highway mitigations options (e.g., fencing, underpasses, signage). Currently, data maintained by the Highway Loss Data Institute and State Farm Insurance, supplemented by police reports and data of the Virginia Department of Motor Vehicles, provide the best metric for tracking elk-vehicle collisions in Virginia.

Potential Strategies:

- a. Use hunting as the primary strategy to manage elk populations in areas of documented higher incidence of elk-vehicle collisions.
- b. Coordinate annually with the Virginia Department of Transportation (VDOT), the Virginia Department of Motor Vehicles, the Virginia State Police, and representatives of the insurance industry to monitor elk-vehicle collisions within and outside the Elk Management Zone.
- c. Coordinate with other agencies, organizations, and entities, including private landowners, to develop habitat corridors within which elk can travel safely and to direct elk movements away from high traffic thoroughfares.
 - i. Investigate the installation of fencing to prevent elk from entering busy roadways.
 - ii. Investigate the installation of over/underpasses to provide safe passage for elk across busy roadways.
- d. Collaborate with representatives of local government planning departments to ensure that proposed development, rights-of-way management, and road construction projects consider impacts related to elk movement and to seek ways to reduce the potential for elk-vehicle collisions.
- e. Identify areas within and outside the Elk Management Zone of high elk crossing activity and promote greater driver awareness of the potential for elk-vehicle collisions in these areas.
 - i. Use land use data and models to identify potential areas near roadways that may display or promote high elk movement activity.
- f. Support research that improve knowledge about elk-vehicle incidents and develop new and/or improved methods to reduce or prevent elk-vehicle collisions in Virginia.

Objective 4: Throughout the tenure of this management plan, minimize injuries associated with elk-related recreation, as reflected in a reduction of the number of physical encounters and injuries reported.

As the population of elk in southwest Virginia continues to expand and more people engage in elk-related recreation, the potential for a rise in injuries among different users also increases. Elk have caused injuries to wildlife viewers when people approach too close, especially during the rut and when elk believe offspring are threatened. Because elk currently are concentrated in a relatively small geographic area, risk exists for conflicts among hunters and between hunters and non-hunting recreationists. Although data on hunting-related injury for elk do not yet exist, Virginia hunters consistently have ranked feeling safe in the field as their most important hunting satisfaction component. Education and recreation management can help ameliorate some of the potential risks. Existing education and outreach programs should be examined, evaluated, and, where necessary, enhanced as means to reduce risk and maintain hunters' and other recreationists' safety.

Potential Strategies:

- a. Uphold and monitor compliance with mandatory hunter safety certification for all elk hunters.
- b. Evaluate current education programs for their effectiveness in conveying information regarding safe hunting and viewing practices.
- c. Cooperate with other agencies and organizations to conduct programs and deliver hunter and recreationist safety information.
- d. Continue to enforce laws and regulations that address safety concerns.

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APPENDICIES

APPENDIX A: MEMBERS OF THE ELK STAKEHOLDER ADVISORY COMMITTEE

Stakeholder Category	First	Last_Name	Organization / Background
Hunters/ Consumptive users	Kathy	Funk	State Chair, RMEF
	John	Taylor	Southwest Virginia Coalfields Chapter Member, RMEF
	Mike	Giles	Past President (2008-13) Appalachian Highlands Chapter of The Ruffed Grouse Society
Agriculture/ Farming	Andy	Smith	President Elect, VA Cattlemen's Association
	Wilmer	Stoneman	Associate Director of Governmental Relations, Virginia Farm Bureau
	Emily	Edmondson	Virginia Farm Bureau local member
	David	Lawson	Vineyard owner, (past Wise-Dickenson VA Farm Bureau President)
Large-parcel Landowners	Barry	Garten*	USFS District Ranger, Clinch Ranger District
	Chris	Stanley	Director of Engineering and Permitting, Cambrian Coal Group, Clintwood Elkhorn Mining LLC
	James	Walters	Director of Forestland Operations, Fountain Forestry
	Lynda	Stuart	CEO and President of Stuart Land and Cattle Co.
Conservation Values	Brad	Kreps	Clinch Valley Program Director, The Nature Conservancy
	Sharon	Ewing	Manager of Virginia State Parks District 6, Department of Conservation and Recreation
Tourism/ Economic Development	Randy	Rose*	Heart of Appalachia Tourism Authority-Virginia Tourism Corporation
	Mary	Belcher*	Executive Director, Buchanan County Chamber of Commerce
Residents	Tom	Gilliam	Member of Virginia Master Gardeners and Master Naturalists
	John	Puckett	Scott County Sheriff

*These representatives were not able to attend each SAC meeting, but sent a representative from their agency to provide input in their absence (substitute members are not listed).

APPENDIX B: DGIF ELK TECHNICAL COMMITTEE MEMBERS

Name	Title
Al Bourgeois	Region 4 District Biologist
Shannon Bowling	Region 3 Terrestrial Manager
Jamie Davis	Region 3 Conservation Police Captain
Tom Hampton	Region 3 Lands and Facilities Manager
Jay Jeffreys	Terrestrial Science Team Coordinator
David Kalb	Elk Project Leader
Megan Kirchgessner	Wildlife Veterinarian
Matt Knox	Deer Project Coordinator
Nelson Lafon	Deer Project Coordinator
Brian Moyer	Recreation Program Manager
David Steffen	Terrestrial Science Team Coordinator
Betsy Stinson	Region 3 District Biologist
Seth Thompson	Region 3 District Biologist
Mark VanDyke	Region 3 Conservation Police Officer

APPENDIX C: ELK RESTORATION IN NEIGHBORING AND OTHER STATES.

EASTERN KENTUCKY

Elk were presumably found across Kentucky before European settlement (O’Gara and Dundas 2002). The Walker expedition from Virginia in 1769 observed an abundance of elk, but the species was extirpated from Kentucky by the mid-1800s (O’Gara and Dundas 2002).

Two reintroductions of elk have taken place in Kentucky. In February 1996, managers of the Land Between the Lakes National Recreation Area (LBL) released 29 elk from Elk Island National Park (EINP), Alberta, Canada into a 670-ac fenced wildlife viewing area (McClafferty 2000). Of more consequence to Virginia, between December 1997 and March 2002, Kentucky Department of Fish and Wildlife Resources (KDFWR) translocated 1,541 elk from 6 states (AZ, KS, ND, NM, OR, and UT) and released them at 8 different sites in the Cumberland Plateau of southeastern Kentucky (KDFWR 2005).

Objectives of the second effort were to restore a sustainable population of 8,000 elk to 16 counties (4.1 million acres) in southeastern Kentucky (bordering Tennessee, Virginia, and West Virginia) and restrict elk from becoming established outside of this ERA (KDFWR 2005). The original zone was 14 counties with a 10-county buffer zone on the northern and western edges. In 2004, buffer counties were removed and 2 counties adjacent to the Tennessee ERA were added to the zone (KDFWR 2005). A feasibility study (Phillips 1997, in McClafferty 2000) had suggested that free-ranging elk could survive on >2,400,000 acres of forested lands in southeastern Kentucky. Southeastern Kentucky was chosen for restoration because of low human population density, limited row crops and urban centers, and 12,000 acres of surface-mined topography with reclaimed vegetation (Larkin et al. 2003).

Translocated elk were kept in holding facilities at capture locations and tested for a number of diseases, including brucellosis, tuberculosis, Johne’s disease, vesticular stomatitis, anaplasmosis, and blue tongue (Larkin et al. 2003). Each elk was fitted with radio-transmitters and mortality switches. Complete necropsies were performed on all dead elk that could be found, and 49% of all known mortalities were capture-related (Larkin et al. 2003). Annual survival and reproductive output observed during the first 3 years of the restoration program were high but typical for a colonizing ungulate population with good nutrition and little or no predation (Larkin et al. 2003). During 2005, 43 elk died from meningeal worms (*Parelaphostrongylus tenuis*), 11 from vehicle strikes, 12 from poaching; *P. tenuis* was most prevalent in calves and yearlings (KDFWR 2005). No other diseases were linked to elk deaths.

Regulated hunting accounts for most elk mortality in Kentucky, but increasing harvests suggest that hunting is not yet limiting the growth of the population (KDFWR 2009). Elk are harvested primarily by hunters who draw tags, although a number of elk have been killed since 2004 by deer hunters outside of the ERA, where population control is desired. In 2004, 41 tags were made available to the general public (KDFWR 2005). Of 60 elk taken that year, 23 were outside of the ERA. In 2005, 100 elk tags were issued (50 bulls and 50 cows). In 2008, 400 tags were issued and 347 elk were harvested (Wills 2009). In 2009, the 1000 elk tags issued included 250 bull tags and 750 cow tags (KDFWR 2009). Overall, 96% and 89% of bull and cow hunters, respectively, have been successful (KDFWR 2009).

Elk have not moved far from their release sites despite strong population growth (Wills 2009). The estimated elk population in southeastern Kentucky has grown from 5,700 in 2007 to 9,000 in 2009 (Wills 2007, 2009). In 2017, with an estimated 10,000 – 15,000 elk, Kentucky is again setting goals to increase the distribution of the herd through decrease in cow tags and movement of animals within their own elk zone. The successful establishment of this elk herd

may relate to starting out with a high population, which has much less demographic variation than a small herd, like that in the Great Smoky Mountains National Park in North Carolina (Murrow et al. 2009).

GREAT SMOKY MOUNTAINS, NORTH CAROLINA

Elk were historically numerous in the Carolinas but declined in the 1700s due to habitat loss, overhunting, and competition with livestock. Eastern elk were extirpated in the region surrounding the present-day Great Smoky Mountains National Park (GSMNP) by the mid 1800's, with exceptions reported in the Black Mountains of North Carolina (Murrow et al. 2009).

An experimental release of elk was made in 2001-2002 into the Cataloochee area of the GSMNP, per the National Park Service policy to restore extirpated native species (Murrow et al. 2009). Elk were obtained from EINP (n = 27) and LBL (n = 25; LBL received elk from EINP in 1996). The elk were acclimated in a pen next to the Cataloochee release site for 60 days (Murrow et al. 2009).

Poor calf recruitment, partly due to black bear predation, has caused low population levels and low population growth in models (Murrow et al. 2009). Only 61 elk were estimated in Cataloochee in 2006. Model projections suggest that demographic variation imperil this small population in the future. The largest source of mortality for adults and subadults has been meningeal worms; black bears have been the largest source of calf mortality. Some cows have started to calve in densely vegetated habitat to avoid detection by bears, a learned behavior seen in the Western US. Removal of some bears until this behavior is learned, along with prescribed burning to create more hiding cover is recommended to increase calf survival (Murrow et al. 2009). GSMNP staff has noted success after moving black bears before and during calving seasons in recent years (K. Delozier, GSMNP, personal communication). In addition, augmenting the herd when disease restrictions allow would be helpful (Murrow et al. 2009).

NORTHEASTERN TENNESSEE

The last Eastern elk was killed in Tennessee in the mid-1800s (Wathen et al. 1997, TWRA 2005). Since then, restoration has been contemplated in western and eastern Tennessee, but only accomplished in the latter (TWRA 2005).

The Tennessee Wildlife Resources Agency (TWRA), recognizing that elk restoration across Tennessee was unrealistic, conducted a process in the 1990s to identify areas of greatest potential should the decision be made to reintroduce elk (Wathen et al. 1997). The TWRA elk team identified 3 areas in TN with the most potential: Land Between the Lakes (LBL) in western Tennessee (near the Kentucky LBL herd), the northern Cumberland Plateau, and the northern Cherokee National Forest (Wathen et al. 1997). TWRA proposed elk introduction at LBL, but retracted the proposal due to strong local opposition (TWRA 2005). In 1999, in response to citizen interest in elk in eastern Tennessee, public meetings were held and a formal request to TWRA was made in August 2000 to reintroduce elk into the Cumberland Plateau region (TWRA 2005). This area is adjacent to Kentucky's elk restoration area, so interstate coordination was considered necessary (Wathen et al. 1997). However, it was noted by Wathen et al (1997) that this region includes large acreage of TWRA lands as well as timber and coal company lands where openings and access for elk hunting and viewing could be managed.

The Tennessee restoration area comprises 670,000 acres in Scott, Morgan, Campbell, Anderson and Claiborne counties (TWRA 2005). In December 2000, 50 elk were obtained from EINP in Alberta with subsequent releases from EINP in 2001 and 2002. In 2003, 30 elk from LBL, Kentucky were released (TWRA 2005). Tennessee moved another 34 elk from LBL in winter 2008

(Wills 2009). A number of the elk have been radio-collared and all have been tagged (TWRA 2005). The elk population has grown from an estimated 160-200 in 2007 to over 300 in 2009 (Wills 2007, 2009). The plan is a population of 1400-2000 elk (TWRA 2005). It was predicted in 1997 that a huntable population of 500 elk could be achieved in 7-17 years (Wathen et al. 1997). In fact, the first hunt (for bulls only) was held during October 2009 (TWRA 2009, Wills 2009) and 5 bulls were harvested (Bennett, TWRA, personal communication). Hunts have been conducted annually through 2017, but are still limited in number with few cow tags.

SOUTHERN WEST VIRGINIA

Eastern elk were common throughout West Virginia prior to European settlement, particularly in the higher mountains (Zysik and Porter 2005). The last killing of native elk was probably in 1843 in Canaan Valley, but perhaps a small herd remained near the headwaters of the Tygart and Greenbrier Rivers as late as 1875 (O’Gara and Dundas 2002, Enck and Brown 2005).

West Virginia began considering elk restoration in 1999 (Zysik and Porter 2005). An elk habitat suitability model was developed for West Virginia and identified three regions with the best habitat potential for elk restoration (Zysik and Porter 2005). The Monongahela area in northeastern West Virginia has the most suitable habitat in aggregate and is adjacent to the Shenandoah region identified in Virginia’s feasibility study (McClafferty 2000). The Ohio Hills region, with the highest quality habitat, has less aggregate habitat and is less preferable due to roads. The Southern Coal Fields has the lowest habitat quality due to relatively less total open area, which has been primarily created by surface-mined sites that are larger than optimal for elk. However, the latter area is adjacent to both the Kentucky elk restoration area and the Southwest region identified in Virginia’s feasibility study (McClafferty 2000, Zysik and Porter 2005).

Cornell University conducted a social feasibility assessment, based on general population surveys, for the Monongahela (eastern) and Southern Coal Fields (southern) regions (Enck and Brown 2005). The Ohio Hills region was excluded because it was not considered a realistic prospect for elk restoration. Majorities of survey respondents in both areas (~75% in the southern region and 66% in the eastern region) supported elk restoration in their county. Survey respondents apparently based their expectations about the likely benefits and problems with elk on their real experiences with deer; however, they apparently believed elk were slightly less likely to be beneficial and slightly more likely to be problematic than deer (Enck and Brown 2005). Of 10 possible impacts from a restored elk population, few respondents in the southern area evaluated any impacts as negative; however, 2 impacts of concern in the eastern area were vehicle collisions and crop damage. Three positive impacts expected in both areas were tourism, preservation of a species, and “return of a missing component of wilderness” (Enck and Brown 2005).

The WVDNR finished an elk management plan for the southwestern portion of West Virginia in 2016. In addition to “passive restoration” of elk colonizing from Kentucky, the plan also includes active restoration efforts.

During Kentucky’s restoration efforts, 394 elk were released in Martin and Pike counties, Kentucky, which border West Virginia. The Southern Coal Fields area was finally determined as the best potential for WV elk success and WVDNR released the first 24 elk of a restoration effort in 2017. An agreement with AZ was reached to allow 60 additional animals to be captured and released in 2018. The West Virginia elk restoration zone, as of 2017, includes all or parts of 7 Southwestern counties (bordering KY and VA): Logan, Mingo, Lincoln, Wayne, Boone, McDowell and Wyoming (WVDNR 2016).

APPENDIX D: UNANTICIPATED OUTCOMES AND UNMATERIALIZED EXPECTATIONS OF AN ELK RESTORATION.

To gauge the potential for unanticipated outcomes, managers in the East were asked to share thoughts and experiences on events or issues that clearly were not anticipated or expected in hopes of raising awareness and to identify when, during program implementation, these issues arose. Response varied most noticeably depending on whether the agency still was establishing their elk herd or whether implementation had been completed. For those still establishing a herd, qualitative responses of managers regarding the unexpected focused mostly on their surprise about the public's acceptance and interest in the restoration effort:

- “A majority of the public accepts elk locally within our management zone”
- “Huge spike in local tourism, drawn in just to 'see the elk”
- “Overall, we have had a positive response from the public both locally and statewide”
- “There have been some groups that have been reluctant to the concept of elk in [State], but overall the experience I feel has been positive”).

Other unanticipated issues managers identified arose relative to their surprise over the herd's expected growth in population size and distribution:

- “Brain worm”
- “Lack of population growth”
- “The slow growth of population ...”
- “That cow elk do not disperse”
- “If you want to expand elk distribution, you must move elk on the landscape”
- “The elk staying extremely local to the original release site as well as the way the local public have adopted the elk.”

Once an elk population became established, unanticipated outcomes focused on difficulties encountered as politics influenced management:

- “Political involvement in management”
- “The politicization of elk management...our elk program has rocketed into the most politicized species across the agency, by far”
- “Excessive opposition to any increase in elk numbers from the producers and associated organizations”
- “A strong polarization between non-consumptive users (elk viewers) and consumptive users (hunters). I expected a more stable balance between the two groups.”

Other areas of unanticipated concern arose over disease, access, and the public's interest in population status:

- “The threat of disease is opening access to hunting on private land”
- “Discovery of CWD in the deer and elk herd within elk range. The [agency] has tested for CWD since 1997. None of the elk tested positive until 2015.”
- “Providing population estimates.”

Although attention to unanticipated outcomes is important, recognizing issues and/or outcomes that previously were expected to arise, but did not, is equally valuable to an agency. Consideration of unmaterialized outcomes may help agency staff direct management efforts and resources to real issues of importance rather than to outcomes that the collective experience of others suggest are not likely to occur. As was true in the case of unanticipated issues, the timing of where a restoration program is in its evolution often predicts whether the expectations an agency has about its program are accurate and proper. In many cases, managers' comments suggest that restoration takes longer than expected and sufficient time for the expected outcome(s) to arise simply has not past. A good example of this was managers' comments relative to their expectations about elk-landowner conflicts, where a much-anticipated need for attention on resolving damage or other conflict problems had not yet occurred:

- "Landowner-elk conflicts are at a minimum right now and could materialize as the herd gets bigger"
- "To date nearly no landowner complaints related to elk"
- "Pasture and agricultural damage has been minimal (knock wood), but our population is still small and new; as it matures, we still anticipate mitigating some problems."

Similar surprise was expressed by some managers regarding the lack of dispersal exhibited by elk, when the expectation had been an anticipated challenge of keeping elk within a management area:

- "Initially there was concern that elk would not stay in the elk range. With [state's] elk on the [location] elk range, this has not been a problem. For [another state's] elk on the [another location] area, this has been a problem initially. Time will tell if this problem persists, and whether it will be a problem on the [location] elk range."

Even among states with mature restoration programs and well-established elk populations, unmaterialized expectations continued to surprise managers. For restoration programs early in their maturation, the following comments may serve as useful examples of areas an agency may wish to give closer consideration:

- "Negative human-elk interactions (including vehicle collisions) have not increased in proportion to the herd's observed population growth"
- "Ag damage and vehicle collisions not as bad as expected"
- "No CWD on the feed grounds"
- "Private land utilization — allowing landowners the opportunity to hunt elk will help with private landowner issues"
- "If a continued emphasis is placed on elk viewing, habituation will continue to worsen and likely result in dangers to human safety and/or vilification of elk hunting"
- "Elk tourism is yet to take off to any degree."

APPENDIX E: COMMENTS RECEIVED FROM PUBLIC

Public Comment Period

Open public comments for the draft of the Virginia Elk Management Plan 2019–2018 were accepted from November 5th, 2018 through December 5th, 2018. The open comment period was announced via news reports, newspaper article, social media as well as being distributed through information sources provided through Stakeholder Advisory Committee members. A total of 202 unique comments were received from 218 commenter individuals or organizations. All but 3 comments came in through the online comment form available on the DGIF website.

Distribution of Plan Comments

We received comments regarding the Virginia Elk Management Plan 2019–2018 from 75 Virginia Counties or Independent Cities as well as comments that originated in 5 other States (7 total non-Virginia comments). Comments came from Counties highlighted orange or Independent Cities within the County.



Figure 23. Comments regarding the Virginia Elk Management Plan 2019 – 2028 came from the public during the November 5th through December 5th 2018 open public comment period came from areas in Virginia highlighted in orange.

The following table shows summaries of each unique comment sent in regarding the Elk Management Plan, what section of the plan each comment addresses, and the response to these comments including if any changes were made to the plan as a result of the comment(s). Full comments are available upon request.

County/City	Value Summary	Goal: Objective	Changes to Plan/ Response
Prince William	Support for current EMZ, support for no more introductions, support for minimization of negative environmental/ ecosystem impacts, support for habitat evaluations, desire for additional stakes to be represented on the SAC	OGP 2; OGP 3; Cnsv 2-obj 1; Cnsv 1-obj 1; OGP 4	For the tenure of this plan the EMZ will remain three counties. Through the tenure of this plan there will be no additional reintroductions or introductions into new areas. Current objectives address elk related ecosystem impacts including on other species. Current objectives address evaluating habitat availability on both public and private lands to ensure a healthy elk herd within the EMZ. Stakes will continually be evaluated, and stakeholders were from a multitude of stakes which will continue to be involved in future plans.
Giles	desire for expansion of elk protections, desire for additional animal movements throughout Virginia, separate elk from deer tag, remove elk from kill permit, support for limited elk hunting, operational hunting suggestions, desire for safe wildlife crossing of highways	OGP 2; OGP 3; Cnsv 2-obj 2; Ptct 1-obj 2; Csnv 3-obj 4; Ptct 1-obj 3	For the tenure of this plan the EMZ will remain three counties. Through the tenure of this plan there will be no additional reintroductions or introductions into new areas. Clarification of elk in code will provide opportunity to create an elk tag. Current objectives address evaluation methods for local conflict resolution including evaluation of the current kill permit code. Current objectives address institution of a harvest regime when the population is stable. Current objectives address minimizing elk-vehicle collisions.
Virginia Beach	Support for the plan as written	All	No changes to plan required.
Tazewell	Concerns about EMP advertisement, concerns regarding elk related agriculture conflicts, concerns regarding elk-vehicle collisions, opposed to elk in Virginia	Introduction; Ptct 1-obj 2; Ptct 1-obj 3; Cnsv 1	Notice and information regarding the comment period were provided on every form of public and DGIF media accessible. Current objectives address damage to agricultural property and potential mitigation strategies. Current objectives address minimizing elk-vehicle collisions. Elk are a native part of VA ecosystem and will be supported at a viable level into the future.
NC- Macon	Support for expanded elk protection, support for separation of deer and elk tag, support for long-term management, question if elk are currently at a sustainable level, concerns about habitat restoration abilities, concerns regarding how CCC will be identified and balanced, desire to have land purchased within the EMZ, clarification of (Cnsv 3-obj 3,d,i) regarding out of state opportunities,	OGP 2; Cnsv 2-obj 2; Cnsv 1; Goals intro; Cnsv 1-obj 1; Cnsv 2-obj 2; Cnsv 1,2,3; Csnv 3-obj 3	For the tenure of this plan the EMZ will remain three counties. Clarification of elk in code will provide opportunity to create an elk tag. Elk are a native part of VA ecosystem and will be supported at a viable level into the future. An elk population at MVP does not necessarily correlate to a sustainable population for harvest. Current objectives address evaluating habitat availability on both public and private lands to ensure a healthy elk herd within the EMZ. Clarification of elk in code will provide the opportunity to create an elk tag. Acquisition of property for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies. Correction made to address possibilities for out-of-state residents.
Wise	Continue to harvest elk on a deer tag, CWD concerns for cattle and related disease concerns, does not want Wise in the EMZ	Cnsv 3-obj 4; Ptct 1-obj 1; OGP 2	Current objectives address evaluating harvest strategies when sustainable. The most recent science suggests that CWD is not transmissible to cattle. Current objectives address strategies to mitigate potential disease risks associated with elk. For the tenure of this plan the EMZ will remain three counties.

Buchanan	Support for elk in Virginia, support for increased tourism in SWVA	Cnsv 1; Cnsv 3-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level into the future. Current objectives address increasing participation in elk related activities and visitation to the EMZ.
Buchanan	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
MT- Missoula	Support for N.A. Model of Conservation efforts use of sound science, support for habitat assessment for MVP, support for increase access and opportunities, support for long-term management at CCC, support for expansion of elk protections, support for property acquisition for elk management, support continued cooperation with other states, support continued monitoring for elk related diseases, support for elk hunting	OGP 1; Cnsv 1-obj 1; Cnsv 3-obj 2; Cnsv 2; OGP 2; Cnsv 1,2,3; Cnsv 3-obj 1; Ptct 1-obj 1; Csnv 3-obj 4	Elk will be managed in accordance with the best known practices available including adherence to the N.A. Model. Current objectives address evaluating habitat availability on both public and private lands to ensure a healthy elk herd within the EMZ. Current objectives address increasing participation in elk related activities and visitation to the EMZ. Current objectives address connecting people to the outdoors through elk. Current objectives address evaluating and balancing CCC on a regular basis. For the tenure of this plan the EMZ will remain three counties. Acquisition of property for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies. Current objectives address collaboration with other agencies and entities for the benefit of the elk population. Current objectives address minimizing the risks associated with elk related diseases. Current objectives address evaluating elk harvest strategies and opportunities when the herd is stable.
Botetourt & Washington	Concerns about disease risks associated with elk, desire to maintain a designated EMZ, support for a healthy herd and no more restorations, support for habitat investigations especially as it relates to public vs private lands, support for no DGIF management outside the EMZ, support for community sponsored solutions to potential elk damages, does not want property acquired for elk recreation, continue elk hunting on a deer tag, opposes elk restoration to Virginia, concerns regarding funding for agency support in mitigating elk conflicts	Ptct 1-obj 1; OGP 2; Cnsv 1; OGP 3; Cnsv 1-obj 1; Ptct 1-obj 2; Cnsv 3-obj 4; Cnsv 2-obj 3	Current objectives address minimizing the risks associated with elk related diseases. Through the tenure of this plan the EMZ will remain three counties. Elk are a native part of VA ecosystem and will be supported at a viable level into the future. Through the tenure of this plan there will be no additional reintroductions. Current objectives address evaluating habitat availability on both public and private lands to ensure a healthy elk herd within the EMZ. Current objectives address damage to agricultural property and potential mitigation strategies. Current objectives address evaluating elk harvest strategies and opportunities when the herd is stable. Current objectives recognize the need for hunter recruitment for both successful management of the elk, but also as part of additional revenue for supporting a successful elk project.
Chesterfield	Desire to have updates on the elk plan, desire to expand protection for elk	Cnct 1-obj 1; OGP 2	Current objectives address creating and annually updating a report on the elk program and providing public access to this information. For the tenure of this plan the EMZ will remain three counties.
Greene	Support for elk in Virginia, support for tourism, support for elk as a connection to the outdoors, support for fair chase hunting, desire for expansion of elk protection	Cnsv 1; Cnsv 3-obj 2; Cnct 1; Cnsv 3-obj 5; OGP 2	Elk are a native part of VA ecosystem and will be supported at a viable level into the future. Current objectives address increasing participation in elk related activities and visitation to the EMZ. Current objectives address connecting people to the outdoors through elk. Current objectives address promoting fair chase sports. For the tenure of this plan the EMZ will remain three counties.
Fauquier	Desire to hunt elk in Virginia	Cnsv 3-obj 4	Current objectives address evaluating harvest strategies when sustainable.
Pulaski	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level into the future.

Caroline	Support for elk harvest on a deer tag, concerns about elk damage to agriculture	Cnsv 3-obj 4; Ptct 1-obj 2	Current objectives address evaluating harvest strategies when sustainable, and using hunters to ameliorate wildlife damages to agriculture. Current objectives address damage to agricultural property and potential mitigation strategies.
Roanoke City	Support for elk hunting, operational hunting suggestions, concerns about diseases, expansion of elk protection	Cnsv 3-obj 4; Ptct 1-obj 1; OGP 2	Current objectives address evaluating harvest strategies when sustainable. Current objectives address strategies to mitigate potential disease risks associated with elk. For the tenure of this plan the EMZ will remain three counties.
Fairfax County	Support elk in Virginia, desire for long-term management, desire for federal cooperation, expansion of elk protection	Cnsv 1; Cnsv 3-obj 1; OGP 2	Elk are a native part of VA ecosystem and will be supported at a viable level into the future. Current objectives address collaboration with other agencies and entities for the benefit of the elk population. For the tenure of this plan the EMZ will remain three counties.
Louisa	The new style under the new mission statement requires additional clarity, desire for self-sustaining elk population, support for elk hunting and viewing, operational hunting suggestions, desire to have operational components especially habitat related included in the plan, desire for partnership development that lead to habitat creation and improvement, desire for public land acquisition or improved access, desire for creation of refuge habitat, P. 21: Revise graph to indicate humans in Virginia before Europeans, P. 99 also on page 85 clarify sharpshooting	All; Cnsv 1; Cnsv 3; Introduction; Cnsv 1-obj 1; Cnsv 3-obj 1; Cnsv 1,2,3; individual statement/ideas.	Current objectives address reaching a minimum viable population within Virginia. Current objectives address elk related viewing and photography. Current objectives address evaluating harvest strategies when sustainable. Currently the plan is not, and never was intended to be operational or contain operational components. Current objectives address evaluating and improving habitat for elk within the EMZ. Current objectives address cooperative partnerships for the benefit of elk. Access for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies. Current factors that affect elk population growth are not well understood, including habitat requirements within Virginia. Current objectives address evaluating and quantifying these factors which may include current sanctuary areas. Graph revised to include a more appropriate estimate of Native American populations. Sharpshooting defined for clarity (pg 85).
Washington	Should give Wise and Dickenson the option to not be in the EMZ, elk cause concern the agricultural community	OGP 2; Ptct 1-obj 2	For the tenure of this plan the EMZ will remain three counties. Current objectives address damage to agricultural property and potential mitigation strategies.
Prince William	Expansion of elk protection, separation of deer and elk tag	OGP 2; Cnsv 2-obj 2	For the tenure of this plan the EMZ will remain three counties. Clarification of elk in code will provide opportunity to create an elk tag.
Roanoke City	Support for elk in Virginia, desire to hunt in VA, expansion of elk protections	Cnsv 1; Cnsv 3-obj 4; OGP 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable. For the tenure of this plan the EMZ will be three counties.
Wise	Desire for increased elk population, desire to achieve CCC, expansion of elk protection, separation of deer and elk tag	Cnsv 1-obj 1; Cnsv 2; OGP 2; Cnsv 2	Current objectives address evaluating viable population size and achieving that at a minimum. Current objectives address evaluating and balancing CCC for elk. For the tenure of this plan the EMZ will be three counties. Current objectives address evaluating and balancing CCC for elk. Clarification of elk in code will provide opportunity to create an elk tag.
Bland	desire for increased elk habitat, expand elk protections, balancing CCC, desire for improved access to the elk resource	Cnsv 1-obj 1; OGP 2; Cnsv 2; Cnsv 3-obj 1	Current objectives address evaluating elk habitat requirements. For the tenure of this plan the EMZ will be three counties. Current objectives address evaluating and balancing CCC for elk. Current objectives address increasing access to the elk for all types of activities.

Richmond City	Support for the guiding principles as written, concerns about agricultural damages, concerns regarding elk related diseases, desire to have continued elk harvest on a deer tag, desire for enhanced outreach and education regarding elk through cooperation	OGP-All, Ptct 1-obj 2; Ptct 1-obj 1; Cnct 1	Current objectives address elk related damages and how best to address those. Current objectives address mitigation of elk related disease risks. Current objectives address hunter recruitment and management to ensure population control and reduce conflicts. Current objectives address cooperation with multiple entities to provide factual information to all who are interested.
Fairfax County	Support for Goals and strategies, desire to have public access to elk, concerns regarding equitable distribution of hunting opportunities	All; Cnsv 1, 2, 3; Cnsv 3-obj 3	Access for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies. Current objectives address creating and maintaining equitability for hunting opportunities.
Covington	desire for increased elk habitat	Cnsv 1-obj 1	Current objectives address creating the quality and quantity of habitat needed for a stable elk population.
Covington	Support for elk in Virginia, wants more emphasis placed on hunting, support for healthy native and sustainable herd	Cnsv 1; Cnsv 3; Cnsv 1-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address promoting and recruiting hunters when a sustainable regime can be implemented. Current Goals address maintaining a healthy and viable elk herd.
Wise	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Orange	Desire for democracy in hunting when available, operational hunting suggestions, suggestions for hunter education,	Cnsv 3-obj 3; Cnsv 3-obj 4; Cnsv 3-obj 5	Current objectives address evaluation of equitability in hunting opportunities. Current objectives address evaluating harvest strategies when sustainable. Current objectives address evaluating and updating the hunter education programing.
Wise	Rather have native elk on Mt. Rogers than non-native ponies, support for elk tourism, support for elk hunting	OGP 2; Cnsv 3-obj 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain 3 counties. Current objectives address increasing participation in elk related activities and visitation to the EMZ. Current objectives address evaluating harvest strategies when sustainable.
Giles	Do not want elk in Virginia, does not think Virginia has elk habitat, believe it is a waste of money to buy elk, concerned about elk damage to private landowners, concerned about damages to agriculture	Cnsv 1; Cnsv 1-obj 1; History; Ptct 1-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale. Current objectives address evaluating elk habitat requirements. Elk restored to Virginia were not purchased from Kentucky. Current objectives address risks to landowners and agriculture with strategies regarding how to address them.
Pittsylvania	Continue elk harvest on deer tag, no more elk reintroductions	Cnsv 3-obj 4; Ptct 1-obj 2; OGP 3	Current objectives address evaluating harvest strategies when sustainable, and using hunters to ameliorate wildlife damages to agriculture. For the tenure of this plan no more elk introductions are planned.
Pittsylvania	No more elk reintroductions, support for elk harvest on deer tag	OGP 3; Cnsv 3-obj 4; Ptct 1-obj 2	For the tenure of this plan no more elk introductions are planned. Current objectives address evaluating harvest strategies when sustainable, and using hunters to ameliorate wildlife damages to agriculture.
Dinwiddie	Support for three county restoration zone as dictated, support for elk harvest on deer tag	OGP 2; Cnsv 3-obj 4; Ptct 1-obj 2	For the tenure of this plan the EMZ will remain 3 counties. Current objectives address evaluating harvest strategies when sustainable, and using hunters to ameliorate wildlife damages to agriculture.
Bland	Concern regarding hunter participation for management, Concerns about damage to fencing and crops from elk	Cnsv 3-obj 2; Ptct 1-obj 2	Current objectives address increasing hunter participation and satisfaction. Current objectives address damage to property and mitigation strategies.

Augusta	Concerns regarding long-term success of populations, concerns about elk protections, separation of deer and elk tag,	Cnsv 1; Cnsv 1-obj 2; Cnsv 2-obj 2	Current objectives address ensuring a minimum viable population within Virginia. Current objectives address evaluating, mitigating and enforcing wildlife laws and regulations. Clarification of elk in code will provide the opportunity to create an elk tag.
Montgomery	Concerns regarding elk-vehicle collisions, Concerns about agricultural damages, Concerns regarding kill permits	Ptct 1-obj 3; Ptct 1-obj 2;	Current objectives address minimizing elk-vehicle collisions. Current objectives address elk related damages and evaluating how best to address those including the use of kill permits.
Lee	Opposition to elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Lee	Concerns about an elk transmissible disease, opposition to elk reintroduction in Virginia	Ptct 1-obj 1; OGP 3; Cnsv 1	Current objectives address minimizing the risks associated with elk related diseases. Through the tenure of this plan there will be no additional reintroductions. Elk are a native part of VA ecosystem and will be supported at a viable level.
Henrico	Support for elk as a native species, expand elk protection, support for elk hunting	Cnsv 1; OGP 2; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. For the tenure of this plan the elk management zone will remain three counties. Current objectives address a harvest regime when sustainable.
Fairfax County	support for elk in Virginia, support for elk hunting, support for elk tourism, expand elk protection, support for elk hunting	Cnsv 1; Cnsv 3-obj 2; OGP 2; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address increasing participation in elk related activities and visitation to the EMZ. For the tenure of this plan the elk management zone will remain three counties. Current objectives address a harvest regime when sustainable.
Scott	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
Tazewell	support for elk in Virginia, expand elk protection, support for elk hunting	Cnsv 1; OGP 2; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. For the tenure of this plan the elk management zone will remain three counties. Current objectives address a harvest regime when sustainable.
Wythe	Support for elk in Virginia, support for elk hunting	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable.
Chesapeake	Support for elk in Virginia, encouragement for interstate cooperation	Cnsv 1; Cnsv 3-obj 1	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address collaboration with other agencies and entities for the benefit of the elk population.
Wythe	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
Bland	Expand elk protection	OGP 2	For the tenure of this plan the EMZ will remain three counties.
Buchanan	Separation of deer and elk tag, expansion of elk protection	Cnsv 2-obj 2; OGP 2	Clarification of elk in code will provide opportunity to create an elk tag. For the tenure of this plan the EMZ will remain three counties.
Smyth	Expansion of elk protection, operational hunting suggestions	OGP 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain three counties. Current objectives address institution of a harvest regime when sustainable.
Bedford County	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Grayson	Concerns regarding genetic health	Cnsv 1-obj 1	Current objectives address evaluating a healthy herd including population genetics.
Smyth	Separate deer and elk tag, support for elk hunting when suitable with common sense approach	Cnsv 2-obj 2; Cnsv 3-obj 4; OGP 1	Clarification of elk in code will provide opportunity to create an elk tag. Current objectives address institution of a harvest regime when sustainable. Elk will be managed in accordance with the best known practices available.
Roanoke City	Support for elk in Virginia, support for elk hunting	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable.

Greene	Support for elk as a native species, concerns regarding harming wildlife, concerns regarding hunter safety, support for elk viewing	Cnsv 1; Cnsv 1-obj 2; Ptct 1-obj 4; Cnsv 3-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address potential ways to reduce illegal harvest. Current objectives address promoting human safety around elk. Current objectives address elk related viewing and photography.
Dickenson	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Warren	Expand elk protection	OGP 2	For the tenure of this plan the EMZ will remain three counties.
Gloucester	Requests for specific operational information to be included in Goals, expansion of elk protection, operational hunting suggestions, suggestions for agricultural damages	OGP 1; OGP 2; Cnsv 3-obj 4; Ptct 1-obj 2	Elk will be managed in accordance with the best known practices available but this is not an operational plan and was not intended to be one. For the tenure of this plan the EMZ will remain three counties. Current objectives address institution of a harvest regime when sustainable. Current objectives address elk related damages and evaluating how best to address those.
Rockingham	Separation of elk and deer tags	Cnsv 2- obj 2	Clarification of elk in code will provide opportunity to create an elk tag.
Bedford County	Support for elk as a native species, support for elk hunting, support for elk viewing	Cnsv 1; Cnsv 3-obj 4; Cnsv 3-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable. Current objectives address elk related viewing and photography.
Martinsville	Operational harvest suggestions, support for elk as a native species, concerns regarding relationship with other species	Cnsv 3-obj 4; Cnsv 2-obj 1	Current objectives address institution of a harvest regime when sustainable. Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address elk related ecosystem impacts including on other species.
York	Support for elk in Virginia, support for elk hunting, operational hunting suggestions	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable.
Smyth	Separation of deer and elk tag, operational hunting suggestions, expansion of elk protection	Cnsv 2-obj 2; Cnsv 3-obj 4; OGP 2	Clarification of elk in code will provide opportunity to create an elk tag. Current objectives address a harvest regime when sustainable. For the tenure of this plan the EMZ will remain three counties.
Buchanan	Opposition to elk in Virginia, concerns about damage to private property, concerns about elk-vehicle strikes	OGP 2; Ptct 1-obj 2; Ptct 1-obj 3	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale. Current objectives address minimizing elk-vehicle collisions and property damages.
Floyd	Support for elk in VA.	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
WV- Summers	Comments unrelated to the plan.	NA	No changes to plan required.
Rockingham	Support for elk in VA.	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Virginia Beach	Comments unrelated to the plan.	NA	No changes to plan required.
Chesterfield	Continue use of deer tags, private property should have management control	OGP 2; Ptct 1-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale. Current objectives address private property as a focus for mitigation of elk related issues.
Washington	Suggest working with landowners for hunting access, operational hunting suggestions	Cnsv 3-obj 1; Cnsv 3-obj 4;	Current objectives address collaboration with other agencies and entities (including private land owners) for the benefit of the elk population and increased access. Current objectives address a harvest regime when sustainable.
Campbell	Support for elk photography	Cnsv 3-obj 2	Current objectives address elk related viewing and photography.

Norfolk	Expansion of elk protection, separation of deer and elk tag	OGP 2; Cnsv 2-obj 2	For the tenure of this plan the EMZ will remain three counties. Clarification of elk in code will provide opportunity to create an elk tag.
Hanover	Form cooperation between regional states, support for creating elk habitat, support for elk in Virginia, support for elk hunting	Cnsv 3-obj 1; Cnsv 1-obj 2; Cnsv 1; Cnsv 3-obj 4	Current objectives address collaboration with other agencies and entities for the benefit of the elk population. Current objectives address evaluating and creating elk habitat. Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable.
Grayson	Support for elk in VA. Operational hunting suggestions	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable.
Radford	Support for continued restoration	OGP 3	During the tenure of this plan, no more elk reintroductions are planned.
Middlesex	Support for elk in VA.	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Grayson	Do not want elk in area, concerns about damage to private property and agriculture, concerns about disease, concerns about population control, concerns about personal safety and human safety, disagree with elk in Virginia	OGP 2; Ptct 1-obj 2; Ptct 1-obj 1; Cnsv 3-obj 3; Ptct 1-obj 4; Cnsv 1	For the tenure of this plan the EMZ will remain three counties. Current objectives address elk related damages and how best to address them. Current objectives address mitigation of elk related disease risks. Current objectives address hunter recruitment to ensure population control. Current objectives address promoting human safety around elk. Elk are a native part of VA ecosystem and will be supported at a viable level.
Mecklenburg	Support for elk in Virginia, operational hunting comments, desire for increased poaching fines	Cnsv 1; Cnsv 3-obj 4; Cnsv 1-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable. Current objectives address evaluating, mitigating and enforcing wildlife laws and regulations. Virginia currently has among the highest fines for elk poaching.
Tazewell	expansion of elk protections, operational hunting suggestions, continued introductions eastward	OGP 2; Cnsv 3-obj 4; OGP 3	For the tenure of this plan the EMZ will remain three counties. Current objectives address a harvest regime when sustainable. There will be no additional introductions during the tenure of this plan.
Caroline	Comments unrelated to the plan.	NA	No changes to plan required.
Fairfax County	Support for the plan as written	All	No changes to plan required.
Bland	Concerns about disease transmission	Ptct 1-obj 1	Current objectives address disease transmission.
Lee	Support for elk in Virginia, emphasis on public education	Cnsv 1; Cnct 1	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address increasing public awareness and knowledge about elk.
Dickenson	Support elk In Virginia, desire for increased tourism	Cnsv 1; Cnsv 3-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address increasing participation in elk related activities and visitation to the EMZ.
Fairfax City	Comments unrelated to the plan.	NA	No changes to plan required.
Tazewell	Comments unrelated to the plan.	NA	No changes to plan required.
Franklin County	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Nottoway	Elk restoration of native range, operational hunting suggestions, support for increased tourism, concerns regarding benefits to those inside the EMZ	OGP 2; Cnsv 3obj- 4; Cnsv 3-obj 2	For the tenure of this plan the EMZ will remain three counties. Current objectives address a harvest regime when sustainable. Current objectives will guide evaluation of balancing the benefits associated with elk
Radford	Expansion of elk protection	OGP 2	For the tenure of this plan the EMZ will remain three counties.

Hampton	Support for elk in Virginia, desire for increased active education regarding elk	Cnsv 1; Cnct 1	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale. Current objectives address increasing public awareness and knowledge about elk in a variety of ways.
NC-Buncombe	Concerns regarding a balanced CCC, concerns about harvest outside the EMZ, Support for elk in Virginia	Cnsv 2; OGP 2; Cnsv 1	Current Goals and objectives address balanced needs of human and elk populations. For the tenure of this plan the EMZ will remain three counties. Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale.
Buchanan	Support for elk tourism, Increase public access	Cnsv 3-obj 2; Cnsv 3-obj 1	Current objectives address increasing participation in elk related activities and visitation to the EMZ. Current objectives address elk related tourism and access to the elk as a public resource.
Tazewell	Expansion of elk protection, separation of deer and elk tag	OGP 2; Cnsv 2-obj 2;	For the tenure of this plan the EMZ will remain three counties. Clarification of elk in code will provide opportunity to create an elk tag.
Giles	concerns about population control	Cnsv 3-obj 2	Current objectives address increasing hunter recruitment and satisfaction.
Floyd	Concerns about agricultural production, concerns about elk-vehicle strikes, concerns about further introductions	Ptct 1-obj 2; ptct 1-obj 3; OGP 3	Current objectives address damage to agricultural property and potential mitigation strategies. Current objectives address minimizing elk-vehicle collisions. During the tenure of this plan no additional introductions are planned.
Fairfax County	Operational hunting suggestions, support for elk as a native species	Cnsv 3-obj 4; Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable.
Russell	Support for expanded elk protection, support for delayed elk harvest, support for elk related tourism	OGP 2; Cnsv 3-obj 4; Cnsv 3-obj 2	For the tenure of this plan the EMZ will remain three counties. Current objectives address a harvest regime when sustainable. Current objectives address increasing participation in elk related activities and visitation to the EMZ.
Wythe	Support for the plan as written	All	No changes to plan required.
Fairfax County	Support for elk in Virginia, expansion of elk protection, support for elk hunting, desire to see less poaching	Cnsv 1; OGP 2; Cnsv 3-obj 4; Cnsv 1-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. For the tenure of this plan the EMZ will remain three counties. Current objectives address institution of a harvest regime when sustainable. Current objectives address evaluating, mitigating and enforcing wildlife laws and regulations.
Amherst	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
Henry	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
Buchanan	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
Virginia Beach	Support for elk in Virginia, expansion of elk protection, separation of deer and elk tag	Cnsv 1; OGP 2; Cnsv 2-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. For the tenure of this plan the EMZ will remain three counties. Clarification of elk in code will provide opportunity to create an elk tag.
Washington	Operational hunting suggestions	Cnsv 3-obj 4	Current objectives address a harvest regime when sustainable.
Albemarle	Support for the plan as written	All	No changes to plan required.
Giles	Desire for an introduction into Giles, support for elk hunting, concerns about elk-vehicle collisions	Cnsv 1; Cnsv 3-obj 4; Ptct 1-obj 3	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable. Current objectives address minimizing elk-vehicle collisions.
Bland	Support for elk in Virginia, support for elk hunting	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable.
Hanover	Concern for farmers, Concerns for other wildlife, concerns regarding habitat availability	Ptct 1; Cnsv 1, 2	Current Goals address agricultural related conflicts. Current Goals address ecological implications and habitat management.

WV- Summers	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Bland	Support for elk in Virginia, desire for increased education regarding elk, expansion of elk protection, support for elk harvest on a deer tag	Cnsv 1; Cnct 1; OGP 2; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale. Current objectives address increasing public awareness and knowledge about elk. Current objectives address a harvest regime when sustainable.
Wise	Question regarding Stakeholder involvement, Concerns about habitat changes leading to shifts in elk, Does not want to be within the EMZ, concerns regarding costs to private citizens, wants compensation for damages, wants DGIF to build fencing	OGP 4; Cnsv 1-obj 2; OGP 2; Ptct 1-obj 2	Stakeholders were from a multitude of stakes and will continue to be involved in future plans. Current objectives address evaluating habitat needs and availability within the EMZ. Three counties for the EMZ were strongly supported by the SAC, the TC and Virginia's public at large. Current objectives address potential options for addressing damage concerns.
Wise	Opposition to additional introductions, concerns about agricultural damages, concerns about property damage, concerns regarding elk-vehicle collisions, concerns regarding costs to private citizens, Concerns about disease transmission, questioning elk as native.	OGP 3; Ptct 2; Ptct 3; Ptct 2-obj 2; Cnsv 1	During the tenure of this plan no additional introductions are planned. Current objectives address damage to private property and agricultural conflicts. Current objectives address minimizing elk-vehicle collisions. Current objectives address potential options for addressing damage concerns. Current objectives address disease risks. Elk are a native part of VA ecosystem and will be supported at a viable level.
Tazewell	Expansion of elk protection, support for elk hunting, operational harvest suggestions, separation of deer and elk tag	OGP 2; Cnsv 3obj- 4; Cnsv 2-obj 2;	For the tenure of this plan the EMZ will remain three counties. Current objectives address a harvest regime when sustainable. Clarification of elk in code will provide opportunity to create an elk tag.
Fauquier	Desire for flexibility in the EMZ boundary, desire for increase property acquisition	OGP 2; Cnsv 1,2,3	For the tenure of this plan the EMZ will remain three counties. Acquisition of property for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies.
Charlottesville	Support for biological based management of elk, support for elk viewing	OGP 1; Cnsv 3-obj 2	Elk will be managed in accordance with the best known practices available. Current objectives address elk related viewing and photography.
Nelson	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Charlottesville	Concerns about disease, Concerns about public education regarding elk	Ptct 1-obj 1;Cnct 1-obj 1	Current objectives address diseases. Current objectives address open communication and engaging the public
Rockbridge	Concerns regarding long-term management, Concerns regarding elk-vehicle collisions, concerns about declining hunter numbers, concerns about private property damage, concerns about ecological impacts.	Cnsv 1; OGP 2; Ptct 1-obj 2; Cnsv 2-obj 3; Ptct 1-obj 3; Cnsv 2-obj 1	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale. Current objectives address damage to agricultural property and potential mitigation strategies. Current objectives address hunter recruitment to achieve management objectives. Current objectives address minimizing elk-vehicle collisions. Current objectives address ecological impacts.
Albemarle	Concerns regarding long-term management	Cnsv 1; OGP 2	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale.
NC- Onslow	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Roanoke City	Support for the plan as written, support for elk related tourism	All; Cnsv 3-obj 2	No changes to plan required. Current objectives address increasing participation in elk related activities and visitation to the EMZ.

Charlottesville	Support for elk In Virginia, support for elk harvest	Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a harvest regime when sustainable.
Dickenson	Oppose elk in Dickenson, Concerns about property damage	OGP 2; Ptct 1-obj 2	For the tenure of this plan the EMZ will remain three counties. Current objectives address damages to personal property.
Washington	Expansion of elk protection, separation of elk and deer tags, operational harvest suggestions, increase public access.	OGP 2; Cnsv 2-obj 2; Cnsv 3obj-4; Cnsv 1,2,3	For the tenure of this plan the EMZ will remain three counties. Clarification of elk in code will provide opportunity to create an elk tag. Current objectives address a harvest regime when sustainable. Access for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies.
Grayson	Support for elk in Virginia, operational hunting comments.	Cnsv 1; Cnsv 3-obj 3	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address unique harvest opportunities.
Dickenson	Expansion of elk protection, operational hunting suggestions	OGP 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain three counties. Current objectives address institution of a harvest regime when sustainable.
Fredericksburg	Support for elk hunting, operational hunting suggestions	Cnsv 3-obj 4;	Current objectives address a harvest regime when sustainable.
Dickenson	Support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Chesapeake	Support for elk as a native species, support for elk photography	Cnsv 1; Cnsv 3obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address elk related viewing and photography.
Shenandoah	Operational hunting suggestions, expansion of elk protection	Cnsv 3-obj 4; OGP 2	Current objectives address a harvest regime when sustainable. For the tenure of this plan the EMZ will remain three counties.
Chesterfield	Support for elk in Virginia, concerns about overharvest, desire for suitable habitat, desire for program updates	Cnsv 1; Cnsv 3-obj 4; Cnsv 1-obj 2; Ptct 1-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable. Current objectives address evaluation of elk habitat. Current objectives address creation of informational updates on the elk program for public dissemination.
Washington	Expansion of elk protection, support for increased tourism, support for elk hunting	OGP 2; Cnsv 3-obj 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain three counties. Current objectives address increasing participation in elk related activities and visitation to the EMZ. Current objectives address a harvest regime when sustainable.
Spotsylvania	Expansion of elk range, support for a healthy herd	OGP 2; Cnsv 1	For the tenure of this plan the elk management zone will remain three counties. Elk are a native part of VA ecosystem and will be supported at a viable level.
Richmond City	Support for elk as a native species, desire to see restricted, ethical harvest	Cnsv 1; Cnsv 3-obj 3; Cnsv 3-obj 5	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address unique harvest opportunities. Current objectives address promoting fair chase sports.
MD- Harford	Support for elk viewing	Cnsv 3-obj 1,2	Current objectives address elk viewing and photographing
Goochland	Support for the plan as written	All	No changes to plan required.
Fluvanna	Support for elk hunting, operational harvest suggestions.	Cnsv 3-obj 4;	Current objectives address a harvest regime when sustainable.
Russell	Support for the plan as written	All	No changes to plan required.
Fredericksburg	Concerns about elk-vehicle collisions, concerns about property damage, concerns about elk-human interactions and safety, concerns about harvest limitations and management.	Ptct 1-obj 2; Ptct 1-obj 3; Ptct 1-obj 4; Cnsv 2-obj 2	Current objectives address damage to agricultural property and potential mitigation strategies. Current objectives address minimizing elk-vehicle collisions. Current objectives address human safety around elk. Current objectives address careful examination of CCC and management strategies to achieve that level.

Winchester	Support for elk hunting, expansion of elk protection, separation of deer and elk tags.	Cnsv 3-obj 4; OGP 2, Cnsv 2-obj 2	Current objectives address a harvest regime when sustainable. For the tenure of this plan the EMZ will remain three counties, clarification of elk in code will provide opportunity to create an elk tag.
Rockingham	Support for elk in Virginia, expansion of elk protection, desire for disabled hunting opportunities	Cnsv 1; OGP 2; Cnsv 3	For the tenure of this plan the elk management zone will remain three counties. Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address diversity of hunting opportunities.
Goochland	Support elk in Virginia, concerns about proper management and vehicle collisions and crop damage, support for expanded elk protection	Cnsv 1; Ptct 1-obj 2; Ptct 1-obj 3; OGP 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address damage to agricultural property and potential mitigation strategies. Current objectives address minimizing elk-vehicle collisions. Elk are a native part of VA ecosystem and will be supported at a viable level.
Albemarle	support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
NJ- Ocean	Restoration of predators, do not hunt	Cnsv 1; Cnsv 2-GP	Current Goals address a healthy and viable elk herd. Hunting is the most effective population management strategies.
Chesapeake	Concerns regarding a balanced CCC	Cnsv 2	Current Goals and objectives address balanced needs of human and elk populations.
Rockbridge	Concerns about crop damage, does not want elk in Rockbridge, concerns about lack of hunters.	Ptct 1-obj 2; OGP 2; Cnsv 2-obj 3	Current objectives address damage to agricultural property and potential mitigation strategies. For the tenure of this plan the elk management zone will remain three counties. Current objectives address hunter recruitment to achieve management objectives.
Orange	Support for elk in Virginia, support for elk related tourism, operational hunting suggestions	Cnsv 1; Cnsv 3-obj 2; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address increasing participation in elk related activities and visitation to the EMZ. Current objectives address institution of a harvest regime when sustainable.
Mecklenburg	Operational harvest suggestions	Cnsv 3-obj 4	current objectives address implementing a harvest regime when sustainable
Page	Operational harvest suggestions, concerns regarding illegal take	Cnsv 3-obj 4; Cnsv 1-obj 2	Current objectives address implementing a harvest regime when sustainable. Current objectives address evaluating, mitigating and enforcing wildlife laws and regulations.
Dickenson	Support for elk related tourism	Cnsv 3-obj 2	Current objectives address increasing participation in elk related activities and visitation to the EMZ.
Nelson	support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Chesterfield	Support for elk as a native species, support for elk related tourism	Cnsv 1; Cnsv 3-obj 2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address increasing participation in elk related activities and visitation to the EMZ.
Chesapeake	Support for elk hunting, expansion of elk protection, desire for equitability in hunting opportunities, operational harvest suggestions, suggestion for collaboration	Cnsv 3-obj 4; OGP 2; Cnsv 3-obj 3; Cnsv 3-obj 1	Current objectives address a harvest regime when sustainable. For the tenure of this plan the EMZ will remain three counties, clarification of elk in code will provide opportunity to create an elk tag. Current objectives address collaboration with other agencies and entities for the benefit of the elk population.
Hanover	Support for elk in Virginia, expansion of elk protection, support for a balanced ecosystem	Cnsv 1; OGP 2; Cnsv 2-obj 1	For the tenure of this plan the elk management zone will remain three counties. Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address elk related ecosystem impacts including on other species.
Stafford	Support for elk as native species	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Gloucester	support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Fairfax County	Support for elk hunting, operational harvest suggestions	Cnsv 3-obj 4	Current objectives address institution of a harvest regime when sustainable.

Rockingham	Concerns about long-term management of elk	Cnsv 1; OGP 2	Elk are a native part of VA ecosystem and will be supported at a viable level within a three county region to ensure management is successful on a small scale.
Augusta	Operational harvest suggestions	Cnsv 3-obj 4	Current objectives address institution of a harvest regime when sustainable.
Surry	Separation of elk and deer tags, operational harvest suggestions, expansion of elk protection	Cnsv 2- obj 2; Cnsv 3-obj 4; OGP 2	Clarification of elk in code will provide opportunity to create an elk tag. For the tenure of this plan the EMZ will remain three counties. Current objectives address institution of a harvest regime when sustainable.
Buckingham	Expansion of elk protection, support for elk as a native species.	OGP 2; Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level. For the tenure of this plan the elk management zone will remain three counties.
Buchanan	Support for elk in Virginia, operational hunting comments.	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable.
Amherst	support for scientific management of elk	OGP 1	Scientifically sound management is key to this plan.
Louisa	Support for elk in Virginia; support for elk hunting	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable.
Madison	Support for elk in Virginia; support for elk hunting	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable.
Louisa	Support for elk hunting; suggestion for management collaboration	Cnsv 3-obj 4; Cnsv 3-obj 1	Current objectives address institution of a harvest regime when sustainable. Current objectives address collaboration with other agencies and entities for the benefit of the elk population.
Rappahannock	Expansion of the EMZ, support for elk as a native species, support for elk hunting.	OGP 2; Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. For the tenure of this plan the elk management zone will remain three counties. Current objectives address institution of a harvest regime when sustainable.
Richmond City	Wants diagrams removed from introduction of goals, desire for a cliff-notes version of the plan, General support for the plan,	Goals Intoduction; All	Diagrams are a secondary means to convey a message to diversify the options constituents have to understand the plans message(s). The executive summary in the entire document provides a few page synopsis of the plans entirety.
Fluvanna	Comments unrelated to the plan.	NA	No changes to plan required.
Waynesboro	Support for elk, support for additional elk	Cnsv 1; OGP 3	Elk are a native part of VA ecosystem and will be supported at a viable level. During the tenure of this plan no additional introductions are planned.
Botetourt	support for elk in Virginia, support for Virginia based tourism, expansion of elk protection	Cnsv 1; Cnsv 3-obj 2; OGP2	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address increasing participation in elk related activities and visitation to the EMZ. For the tenure of this plan the elk management zone will remain three counties.
Prince William	General support for plan, support for elk photography	All; Cnsv 3-obj 2	Current objectives address elk viewing and photographing
Augusta	Questions the need for elk, concerns about agricultural damage, concerns about elk movement throughout state, concerns about vehicle collisions.	Cnsv 1; Ptct 1-obj 2; OGP 2;Ptct 1-obj 3	Elk were a native part of VA ecosystem and will be found here due to surrounding state activities. Current objectives address damage to agricultural property and potential mitigation strategies. For the tenure of this plan the elk management zone will remain 3 counties, Current objectives address minimizing elk-vehicle collisions.
Fairfax County	Support for elk in VA, support for delayed elk hunting.	Cnsv 1; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address institution of a harvest regime when sustainable.

Staunton	Lack of detail regarding reintroductions and size of EMZ. Desire to have additional restorations on public lands in other areas.	OGP 2; OGP 3	For the tenure of this plan the EMZ will remain three counties. The guidance provided for this statement comes from publicly engaged SAC that represented diverse stakeholders and desired a slow approach to elk management through the tenure of this plan. During the tenure of this plan no additional introductions are planned.
Suffolk	Questioning delay in harvest, separation of elk and deer tags	Cnsv 3-obj 4; Cnsv 2-obj 2	Harvest plan will be no later than 5 years and will be implemented when the herd is sustainably viable. Clarification of elk in code will provide opportunity to create an elk tag.
Dinwiddie	Expansion of elk protection, support for elk hunting.	OGP 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain three counties. Current objectives address institution of a harvest regime.
Cumberland	Support for elk hunting, increase public access.	Cnsv 3-obj 4; Cnsv 1,2,3	Elk are a native part of VA ecosystem and will be supported at a viable level. Acquisition of property for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies.
Charlottesville	Support for elk as native species	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Wythe	expand elk range to entire native area	OGP 2	For the tenure of this plan the EMZ will remain three counties.
Roanoke County	desire to view elk, restrict hunting, enforce poaching regulations, support for elk as a native species	Cnsv 3-obj 1; Cnsv 3-obj 4; Cnsv 1-obj 2; Cnsv 1;	Current objectives address increasing viewing opportunities. Current objectives address institution of a harvest regime when sustainable. Current objectives address evaluating, mitigating and enforcing wildlife laws and regulations. Elk are a native part of VA ecosystem and will be supported at a viable level.
Hanover	hunting is unethical tool, suggests contraception	Cnsv 2-GP	Hunting is the most effective population management strategy and provides recreational opportunities.
Loudoun	Desire for healthy elk, do not over hunt	Cnsv 1; Cnsv 3-obj 4	Current Goals address a healthy and viable elk herd. Current objectives address institution of a harvest regime when sustainable.
Virginia Beach	Active expansion of elk herd	OGP 2,OGP 3	For the tenure of this plan the EMZ will remain three counties. During the tenure of this plan no additional introductions are planned.
Albemarle	Comments support plan.	All	No changes to plan required.
Alleghany	support for elk hunting, concerns about crop damage and fences	Cnsv 3-obj 4; Ptct 1-obj 2	Current objectives address institution of a harvest regime when sustainable. Current objectives address protection of agricultural operations.
Charlottesville	Support for elk as native species, support for balancing CCC, use hunting as a last resort	Cnsv 1; Cnsv 2; Cnsv 2-GP	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address evaluating and striving for a balanced CCC. Hunting is the most effective population management strategies.
Montgomery	Support for elk hunting, do not allow public access to GIS habitat database, separate elk tag, increase public access, concerns regarding hunter access	Cnsv 3-obj 4; Cnsv 1; Cnsv 2-obj 2; Cnsv 3-obj 1	Current objectives address institution of a harvest regime when sustainable. Habitat data created for analysis will be used for internal investigations. Clarification of elk in code will provide opportunity to create an elk tag. Acquisition of property and increased access for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies. Current objectives address increasing access to elk for all.
Botetourt	support for elk in Virginia	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Surry	Support for elk as native species, support for increased biodiversity, support for hunting as a management tool	Cnsv 1; Cnsv 2; Cnsv 3-obj 4	Elk are a native part of VA ecosystem and will be supported at a viable level. Current objectives address a balanced and diverse ecosystem. Current objectives address institution of a harvest regime.
Greene	Support for a healthy elk herd, expansion of elk protection	Cnsv 1; OGP 2	The first Goal of the plan is to ensure a healthy herd in Virginia. For the tenure of this plan the EMZ will remain three counties.
Loudoun	Hunting is unethical tool, suggests contraception	Cnsv 2-GP	Hunting is the most effective population management strategy and current objectives address consideration of other options when hunting is not feasible.

Loudoun	Support for hunting as a management tool	cnsv 3-obj 4	Current objectives address institution of a harvest regime when sustainable.
Buchanan	Expansion of elk protection, operational hunting suggestions.	OGP 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain three counties. Elk harvest regulations will be defined by the technical committee.
Nelson	support for elk	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Spotsylvania	Support for elk as native species	Cnsv 1	Elk are a native part of VA ecosystem and will be supported at a viable level.
Washington	Questions elk restoration to private lands, restoration should be public	Cnsv 1,2,3	Acquisition of property for elk management is a top priority as included in 4 goals, 7 objectives and 10 strategies.
Bedford County	Question any restoration; Prevent expansion of current elk; Elk vehicle collision concerns.	Cnsv 1; OGP 2; Ptct 1-obj 3	Elk were a native part of VA ecosystem and will be found here due to surrounding state activities. Management strategies are available to keep the EMZ three counties for the tenure of this plan. Current objectives address minimizing Elk-vehicle collisions and will be tracked through the tenure of this plan.
Shenandoah	First desire is a healthy herd. Expansion of elk protection, operational harvest suggestions, separation of elk and deer tags.	Cnsv 1; OGP 2; Cnsv 3-obj 4; Cnsv 2-obj 2	The first Goal of the plan is to ensure a healthy herd in Virginia. For the tenure of this plan the EMZ will remain three counties. Elk harvest regulations will be defined by the technical committee. Clarification of elk in code will provide opportunity to create an elk tag.
Buchanan	Support for elk hunting, Increase recreation opportunities, add to hunter education class, additional introductions, and operational hunting suggestions.	Cnsv 3; Cnsv 3-obj 5; OGP 3; Cnsv 3-obj 4;	When possible and appropriate the agency will promote additional recreation associated with elk. As necessary, information will be addressed in the hunter education class. During the tenure of this plan no additional introductions are planned. Elk harvest regulations will be defined by the technical committee.
Wise	Support for elk related tourism, expansion of elk protection, operational harvest suggestions.	Cnsv 3-obj 2; OGP 2; Cnsv 3-obj 4	Current objectives address increasing participation in elk related activities and visitation to the EMZ. For the tenure of this plan the EMZ will remain three counties, Elk harvest regulations will be defined by the technical committee.
Buchanan	Expansion of elk protection.	OGP 2	For the tenure of this plan the EMZ will remain three counties,
Buchanan & Wise	Expansion of elk protection, separation of elk and deer tags, operational harvest suggestions.	OGP 2, Cnsv 2-obj 2; Cnsv 3-obj 4	For the tenure of this plan the EMZ will remain three counties, clarification of elk in code will provide opportunity to create an elk tag. Elk harvest regulations will be defined by the technical committee.

APPENDIX F: RANKING GOAL OBJECTIVES

During the finalization of the Virginia Elk Management Plan 2019 – 2018 the Stakeholder Advisory Committee (SAC) members, and the Technical Committee (TC) members were asked to rank the 15 objectives within the plan independently. Ranked objectives help to provide guidance on the focus for limited staff time, resources, and funding that needs to be allocated over time. The average rank by each committee is listed (number of participants of each committee). A rank of 15 was the most important, a rank of 1 was considered the least important.

Objective statements	SAC (10)	TC (8)
<u>Cnsv 1: Objective 1:</u> During the tenure of the plan, determine what constitutes a minimum viable elk population and the requisite habitat needs of such a population.	9.6	13.9
<u>Cnsv 1: Objective 2:</u> By 2027, assure that a minimum viable elk population exists within the Elk Management Zone, unless an official response to a mitigating circumstance (e.g., disease outbreak) warrants reducing the population below the defined minimum threshold.	9.5	11.8
<u>Cnsv 2: Objective 1:</u> Throughout the tenure of this management plan, minimize negative impacts inflicted by elk on ecosystem functioning that adversely affect the maintenance of a biologically diverse and native ecosystem.	7.9	5.6
<u>Cnsv 2: Objective 2:</u> On a biennial basis, reexamine and, where necessary, adjust elk population management approaches to meet Cultural Carrying Capacity (CCC).	8.9	7.5
<u>Cnsv 2: Objective 3:</u> Throughout the tenure of this plan, maintain or increase the number of hunters sufficient to accomplish stated elk population management objectives via retention, recruitment, or reactivation.	9.1	3.4
<u>Cnsv 3: Objective 1:</u> Throughout the tenure of this plan, strategically increase access to the elk resource for participants in elk-related activities.	9.2	12.9
<u>Cnsv 3: Objective 2:</u> Throughout the tenure of this management plan, and where feasible, increase participation, as measured using metrics of participant visitation, in non-hunting recreational opportunities associated with elk within the Elk Management Zone and, when opportunities become available, for hunting.	7.5	8.1
<u>Cnsv 3: Objective 3:</u> Throughout the tenure of this plan, improve satisfaction of hunting and non-hunting-based elk recreationists.	9.3	5.6
<u>Cnsv 3: Objective 4:</u> By 2021, define and, where necessary, modify how recreational elk hunting will take place to meet hunter satisfaction and population goals throughout Virginia.	9.2	9.5
<u>Cnsv 3: Objective 5:</u> Throughout the tenure of this management plan, improve adoption and sustainability of recreational elk hunting behaviors that embody fair chase and ethical harvest.	10.0	7.8
<u>Cnct 1: Objective 1:</u> Throughout the tenure of this management plan, increase the public’s knowledge about and understanding of elk	7.6	10.1

management, elk life history and behavior, and their role in the ecosystem.

<u>Ptct 1: Objective 1:</u> Throughout the tenure of this plan, minimize as much as possible the risk of elk-related disease outbreaks that may threaten humans or domestic animals.	7.1	8.9
<u>Ptct 1: Objective 2:</u> Throughout the tenure of this management plan, ameliorate and/or mitigate elk damage to agricultural operations, residential properties, industries, and private landowners as measured by calls for assistance from, and damage response services provided to, the affected parties.	5.9	8.4
<u>Ptct 1: Objective 3:</u> Throughout the tenure of the management plan, minimize elk-vehicle collisions, as measured by aggregated police and insurance company incidence reports.	6.0	4.4
<u>Ptct 1: Objective 4:</u> Throughout the tenure of this management plan, minimize injuries associated with elk-related recreation, as reflected in a reduction of the number of physical encounters and injuries reported.	4.6	2.3

APPENDIX G: 2020 ANNUAL ELK PROGRAM UPDATE

ELK MANAGEMENT PROGRAM ANNUAL UPDATE MARCH 19TH, 2020

In 2000, a multifaceted study by Virginia Polytechnic Institute and State University (Virginia Tech) assessed the biological and cultural feasibility of elk restoration in Virginia. This study was the initial step in planning for elk in Virginia in modern times. In 2010, following public input on a draft elk restoration plan, DGIF staff was directed by the Virginia Board of Game and Inland Fisheries (Board) to translocate up to 75 elk to a suitable release site in Buchanan County. In cooperation with the Kentucky Department of Fish and Wildlife Resources and other partners, DGIF staff trapped and relocated 71 adult animals to a reclaimed mined area in Buchanan County between May 2012 and April 2014. Rigorous disease testing was conducted on all animals before they were brought into Virginia.

Elk Management Planning

The public has shown a passionate interest in elk and elk management. The DGIF began convening elk stakeholders in 2016 to provide a forum to exchange ideas and information with interested stakeholders in southwest Virginia. In response to stakeholder input, DGIF has updated and expanded elk content on the agency website to include information addressing disease testing of translocated elk, damage management, viewing guidance, and other topics. Information regarding elk disease testing protocols and results was provided to partners in southwest Virginia.

In March 2019, a 10-year management plan for elk in Virginia was adopted by the Board of DGIF. The goals of this plan were developed through public input that was facilitated and quantified in collaboration with Virginia Tech. Public values associated with elk were collected by Virginia Tech in three ways. First, representatives from various stakeholder groups met with Virginia Tech investigators in 10 interest (stake)-based focal groups throughout the region to discuss the values, opportunities, challenges, and solutions associated with elk challenges in southwest Virginia. DGIF staff were available to provide technical expertise as necessary. Second, data was collected from a Stakeholder Advisory Committee (SAC) that helped assess and describe the public values to be included in the management plan. Finally, Virginia Tech conducted 3,200 surveys (roughly 300 from each of the southwest counties, and 600 more from around Virginia), to evaluate the range of public opinions regarding elk.

The management plan directs DGIF on how to manage elk for the next ten years, including addressing unanswered questions about elk biology and behavior in Virginia. The plan specifically challenges DGIF staff to have a harvest management strategy in place by 2024, the only five-year goal within the tenure of the plan. Additionally, DGIF staff have drafted a staff guidance document on managing conflicts between elk and humans.

Elk Population Estimation

Most elk released during the three-year restoration period that ended April 2014 continue to remain within 9 km–12 km of the original release site in Buchanan County. Staff estimate that there are currently about 250 elk in southwest Virginia. This estimate is based upon known released animals that can still be identified, estimated elk immigration from Kentucky, estimated births, as well as

known and estimated deaths (mortalities). With this year's recruitment of calves, DGIF estimates there are approximately 200 elk in Buchanan County, 20–40 elk in Wise and a few elk in Dickenson. There are some small isolated populations of 3–20 individuals in Lee, Russell, and Tazewell counties. There are also unconfirmed reports of elk in Washington, Scott, and Bland counties. The DGIF knows of a minimum of 30 calves that were born in spring 2019. Staff documented nine mortalities during calendar year 2019; two mortalities were from vehicle strikes with no human injuries; three were dispatched due to suspected brain worm, and four died from unknown causes. Of these nine animals, six were disease tested for Chronic Wasting Disease, Tuberculosis and brucellosis; no test results indicated disease presence. The remaining three carcasses were too decomposed for sample collection.

Staff are evaluating multiple techniques to assess population status through trail cameras and the use of radio-collared animals. The department has also contracted with Virginia Tech to develop mark-recapture population estimates by making use of individual elk's uniquely identifiable characteristics, including ear-tags, antler characteristics, and any other uniquely identifiable qualities.

Elk Movement and Resource Use – Monitoring Efforts

DGIF staff and volunteers use trail cameras and visual observations of elk to monitor herd health, activity, and reproduction. Local volunteers continue to expand elk habitat on public and private lands around the release site. These efforts have improved habitat quality and created some excellent viewing opportunities. DGIF recently radio-collared an additional 12 cow elk to monitor herd movement, evaluate calving areas, and assess other biological factors associated with the herd.

Elk Movement and Resource Use – Elk Habitat and Diet

The elk spend much of their time in forested areas, primarily as a refuge from heat, and likely, to avoid human disturbance. They use wooded areas to feed on a variety of understory plants and leaves of browse species; however, the majority of their diet consists of grasses and forbs, which they find in field openings on private lands and reclaimed strip mines. In summer, the elk rarely feed in openings during the heat of the day. Instead, they bed down under cover and begin to feed shortly before dusk and continue through the night. During the cooler months, they feed in open areas throughout the day. Many of the open areas that elk use for foraging are in high quality habitat maintained through plantings, fertilizing, and mechanical removal of woody vegetation. These habitat modifications are aided by the processes that are undertaken during and after coal-mined land reclamation, which has encouraged Virginia's elk herd to remain stable in small home ranges of less than 9,000 acres.

Since April 2018, staff have been collecting elk fecal samples to determine dietary resource use across seasons. These samples are being stored to evaluate at a later date.

Elk Damage Management

There were three reported instances of elk damage to property in calendar year 2019. One incident attributed to elk involved damage to tree growth on mine land restoration sites. However, a DGIF biologist visit to the site determined that deer, rather than elk, were primarily responsible for damaging the trees. Kill permits were issued for deer, with the understanding that harvest pressure in the area would also deter elk from damaging regrowth. No kill permits for elk were requested or issued in this instance. The second elk damage incident involved elk knocking over headstones

in a family grave yard. In this case, information about elk behavior and effective hazing techniques was provided, and the managing family was offered assistance to right the stones. The third incident involved elk damaging a golf course. Information and hazing materials were provided to the course managers and DGIF staff visited several times to aid in hazing the animals.

Additional Virginia Elk Program Accomplishments

The Virginia elk cam was launched and logged over 160,000 viewers from 40 states and 40 different countries. The elk cam will run annually through the rut (August through October) and showcase DGIF's elk restoration accomplishment and successes. The live feed for the elk cam is available 24 hours a day thanks to the addition of infra-red lights allowing for night viewing of the elk. There are also several viewing options to optimize visitors' chances of seeing elk when they log in. A final addition this year will allow elk cam viewers to directly connect to DGIF's Restore the Wild website to encourage membership and support.

This year, three groups of undergraduates from Virginia Tech analyzed elk data and used it in senior capstone research projects. The groups analyzed female elk movements and estimated calving dates, bull movements and habitat use, and also compiled hours of elk camera data into short highlight films that focus on educating viewers about specific elk behaviors. One such highlight reel will hopefully be added to the current year's live elk cam display.

A cooperative grant application between Southwest Virginia Sportsmen, The Nature Conservancy and DGIF was initially approved for \$2.25 million to restore elk habitat in the Elk Management Zone (EMZ). These funds will be used to improve habitat and create public access to over 2,500 acres within the EMZ. All properties associated with the grant have abandoned coal-mined land features that will be improved for the betterment of the environment and the economy of the region.

The Elk Technical Committee convened (August 2019) to discuss elk hunt lottery systems, application processes, and harvest considerations surrounding the potential for a future hunting season within the EMZ.

A Look at the 2020 Elk Project Plans

A federal grant in the amount of \$2.9 million was awarded to DGIF to improve public access to lands in southwest Virginia. This grant will partner private landowners with DGIF to allow public access for hunting, fishing, trapping, and wildlife viewing opportunities in the region. This grant will likely have major implications for the future of elk hunting and viewing.

The Virginia Legislature approved a bill (HB388) authorizing DGIF to create a separate elk hunting license within the EMZ. The bill passed both Houses (97-0, and 38-0) and was approved by the Governor on 3/12/2020. The bill will become effective July 1, 2020.