Draft Operational Plan
Elk Management in Southwestern Virginia

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Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

Since the 1990's, public interest to restore elk in Virginia has increased. In response to this public interest and neighboring states which have undertaken elk restoration programs, the Board of Game and Inland Fisheries directed the Executive Director of the Department of Game and Inland Fisheries (DGIF) to create an operational plan for elk restoration and management in Virginia. This plan addresses the potential for elk restoration and management in Virginia through consideration of biological, sociological, economic, and environmental issues.

Elk were historically found throughout eastern North America, including Virginia. However, factors such as habitat loss and unregulated hunting caused elk to become extirpated within eastern North America by the late 1800s. Attempts at elk restoration in eastern states during the early to mid-1900's often failed due to a lack of suitable habitat and knowledge of elk ecology. Of the 10 eastern states attempting elk restoration during this time, only Pennsylvania and Michigan were able to maintain elk populations. In 1916, the newly-created Virginia Game Commission authorized the importation and release of elk in 11 counties in Virginia, but most releases quickly failed. By 1926, only 2 small elk herds remained: one in the mountains of Giles and Bland counties and one in Botetourt County near Buchanan. Elk hunting seasons were held irregularly from 1922 - 1960, but by 1970, elk once again were gone from Virginia. Factors such as disease, unsustainable harvest levels, removal of crop-depredating elk, and isolation of small, unsustainable herds on limited ranges contributed to the elk's demise. Currently, an unknown number of elk occur in Virginia having moved in to the state following their release in Kentucky during the late 1990's. Initial attempts to capture and return elk to Kentucky proved impractical so an elk hunting season was approved to keep elk from becoming established in Virginia.

Restoring and maintaining elk populations provides ecological, social, and economic benefits. Hunting and wildlife viewing annually generate millions of dollars to local and state economies. In Virginia, hunting and wildlife viewing activities were estimated to have had a $1.4 billion impact on Virginia's economy during 2006. Further, elk may play a significant role in maintaining early successional habitat conditions which have been in decline over the past several decades. Elk generate some concerns due to the potential for damage, nuisance behavior, and disease transmission. Agricultural damage may be related to foraging and trampling of crops, destruction of fences, and competition for hay or pasturage. Other types of damage or nuisance activity include browsing or antler rubbing on timber resources, vehicle collisions, residential damage and habituation to humans. Important wildlife and livestock diseases may be carried and transmitted by elk including Chronic Wasting Disease, Brucellosis, and Bovine Tuberculosis, necessitating careful disease testing and monitoring during restoration efforts.

The area under consideration for possible elk restoration included Buchanan, Dickenson and Wise counties within the Cumberland Plateau (i.e., Coalfields) and Lee, Russell, Scott, and Tazewell counties in the Valley and Ridge province. While these two physiographic provinces are similar in some ways, differences in topography, geology and vegetative cover are significant. The Cumberland Plateau is rugged and the extraction of mineral resources has altered the landscape. The Valley and Ridge is characterized by long parallel ridges separated by corresponding river valleys. These wider valleys and floodplains are better suited for agriculture. According to the 2007 USDA agricultural census, the 3 Coalfield counties contain a combined 45,842 acres of farmland, much lower than the Virginia average of 82,693 acres per

county. However, the counties of Lee, Russell, Scott, and Tazewell contain an average of 144,222 acres of farmland, nearly 10 times that of the coalfield counties. The prevailing agricultural land use of the Valley and Ridge counties precludes their management for elk due to potential damage to agricultural property. The Coalfield counties of Buchanan, Dickenson, and Wise offer the best potential for elk restoration in Virginia as habitats associated with surface mining can provide suitable elk habitat while minimizing impacts to agricultural lands.

Five potential elk management options were considered for the Coalfield counties over an initial planning period of 12 years.

No Restoration

This option would maintain the current management approach in Virginia. Elk hunting would continue with no structured restoration efforts. The elk population would not be allowed to grow, but education and outreach would continue as interest in elk is not likely to wane. This option would minimize the time and expense of managing elk in Virginia, but fail to enhance any recreational or economic benefits.

Passive Restoration

This option would protect elk currently in the Coalfield counties. A population goal of 1,200 elk would be established. Elk would not be stocked, and habitat management efforts on public and private land would be used to encourage population growth. Enhanced staffing would be required to address growing elk population management needs. Passive restoration would minimize the effort required to achieve elk restoration, but would significantly delay the time frame needed to achieve recreational and economic benefits.

Active Restoration (single stocking of 75 elk)

This option would require a suitable source of elk and acceptable release sites to be identified in the Coalfield counties. Released elk would require disease testing prior to release. The population goal would be 1,200 elk. Enhanced staffing would be needed to address growing elk population management needs, and research to investigate elk population dynamics and habitat relationships would be warranted to monitor the growing elk herd. A single stocking of 75 elk would facilitate better management of the stocking and monitoring efforts. An estimated 150 elk could be harvested over the initial 12 year period. However, the population goal likely will not be reached in the initial 12 years delaying the time frame to achieve full recreational and economic benefits.

Active Restoration (incremental stocking of 200 elk)

This option would require a suitable source of elk and acceptable release sites to be identified in the Coalfield counties. Elk would require disease testing prior to release. The population goal would be 1,200 elk. Enhanced staffing would be required to address growing elk population management needs, and research to investigate elk population dynamics and habitat relationships would be warranted to monitor elk population growth. Incremental stocking of elk would facilitate easier management of stocking and monitoring efforts while enhancing population growth. An estimated 425 elk could be harvested over initial 12 year period, and the population goal can be reached in 12 years. This option provides for a faster time frame to achieve

recreational and economic benefits, but also increases the likelihood of property damage and nuisance concerns.

Active Restoration (single stocking of 200 elk)

This option would require a suitable source of elk and acceptable release sites to be identified in the Coalfield counties. Elk would require disease testing prior to release. The population goal would be 1,200 elk. Enhanced staffing would be required to address growing elk population management needs, and research to investigate elk population dynamics and habitat relationships would be warranted to monitor elk population growth. A single stocking of 200 elk would complicate management of stocking and monitoring efforts but would enhance population growth. An estimated 480 elk could be harvested over the initial 12 year period, and the population goal can be reached in 12 years. This option provides for a faster time frame to achieve recreational and economic benefits, but also increases the likelihood of property damage and nuisance concerns.

The Elk Committee recommends that VDGIF should pursue the Active Restoration Option to establish a population of 1,200 elk in the Potential Elk Restoration Area (Buchanan, Dickenson, and Wise counties). The Elk Committee further recommends that the project should set a goal of releasing 200 elk over a 3-year period in one suitable Elk Release Site within the Potential Elk Restoration Area. The Committee does not recommend establishing multiple herds over a wide area with the 200 elk.

Active restoration options offer the best alternatives to achieve recreational and economic benefits associated with elk populations. However, public awareness and support of active elk restoration management efforts are vital to a successful elk restoration program. Elk management issues such as regulation of hunting and hunter access, provisions for suitable habitat, opportunities for elk viewing, and mitigation of damage/nuisance issues will require careful attention to public attitudes and interest. Emphasis should be placed on obtaining public input and educating citizens on elk ecology and management issues. These education and outreach efforts should be sustainable in order to continually address public interest as well as emerging elk management issues.

INTRODUCTION

Since the 1990's, public interest to establish elk in Virginia has increased (McClafferty 2000), particularly in the southwestern portion of the Commonwealth. Following Kentucky's elk restoration in counties adjacent to Southwest Virginia during 1997-2002, both interest in and concerns regarding restoration of elk have intensified. Elk historically populated most of the North American continent. Recently, several states (e.g. Kentucky, Tennessee, and Wisconsin) have reestablished elk herds where populations once thrived but were extirpated for one reason or another. The Virginia Department of Game and Inland Fisheries, under the direction of a governor-appointed Board of Directors, initiated the development of this operational plan for elk restoration and management that considers the biological, sociological, economic, and environmental issues associated with elk restoration in southwestern Virginia. This plan is intended to thoroughly assess these issues and provide potential restoration alternatives.

ELK IN VIRGINIA

Pre-Colonial Occurrence

Members of the *Cervus* genus were found in North America as early as the Late Pliocene (around 2 million years ago), based on archeological evidence, including items discovered in western Maryland (O'Gara and Dundas 2002). It is not clear that these early discoveries were the ancestor of the modern North American elk (*Cervus elaphus*). *C. elaphus* remains from approximately 20,000 years ago have been documented in northwestern Virginia. The Eastern elk (*C. e. canadensis*) was found across the eastern United States but was extirpated by the late 1800s (O'Gara 2002, O'Gara and Dundas 2002). Of the 6 subspecies of elk present before European colonization of North America, 2 (Eastern and Merriam's) were driven to extinction during 1500-1900 and total elk numbers were reduced from 10 million to 100,000 (Zysik and Porter 2005).

Before European settlement, elk were found across most of Virginia – at least from the Piedmont westward (O'Gara 2002) - but were most common in the Allegheny and Blue Ridge Mountains (Wood 1943). Early colonists and explorers encountered elk. The Wood, Berkeley, and Spotswood expeditions in the late 1600s described abundant elk herds, particularly in western Virginia (e.g., in the grassy expanses of the Shenandoah Valley) (O'Gara and Dundas 2002). The Batts expedition in 1666 reported numerous elk in the New River Valley (Wood 1943). James Burke took many tanned elk, deer, and bear hides from the Burke's Garden area (Tazewell County) in 1753. American Indians were observed hunting elk and other game near salt springs in the late 1700s. Historical accounts show that elk and other game – along with Indian hunting trails - were most numerous in the larger valleys (Wood 1943). Elk were hunted for meat and hide, and later for sport (O'Gara and Dundas 2002).

Westward expansion confined elk to wilderness refuges in western Virginia (Wood 1943). Apparently, the last native elk in Virginia was killed by Col. Gos Tuley of Clarke County in 1855 and preserved at the Smithsonian Institute. Historian J. D. Hale noted that well-used trails created by elk through mountain gaps were visible in Virginia until the late 1800s, years after their extermination. Place names are a testament to the distribution and abundance of elk in Virginia and West Virginia (Wood 1943).

Early 20th Century Elk Restoration in Virginia

One of first acts of the newly-created Virginia Game Commission in 1916 was to authorize the importation of elk from Yellowstone National Park (Baldwin and Patton 1938). In 1917, approximately 150 surplus Rocky Mountain elk (*C. e. nelsonii*), of which at least 25 died in transit, were brought from Yellowstone to Virginia. These elk were released in 9 counties west of the Blue Ridge and 2 counties in the East (Wood 1943; Table 1). According to U. S. Fish and Wildlife Service files accessed by Gwynn (1977), elk also apparently were introduced in Bath County in 1913 (n = 25), Augusta and Rockingham counties in 1917 (n = 20 each), and Rockbridge County in 1922 (n = 60).

Elk were released in groups of 6-8, either immediately following transit or after a period of confinement (Baldwin and Patton 1938). Most releases quickly failed because little was known about the habitat requirements of elk, and most release sites did not possess suitable habitat (Wood 1943). One example of poor site selection was the sand dunes of Cape Henry in Princess Anne County (now Virginia Beach). Elk released there immediately conflicted with truck crop production, compelling authorities to destroy the small herd (Wood 1943).

As early as 1918, the Virginia Game Commission questioned the wisdom of encouraging elk establishment primarily because of agricultural complaints (Gwynn 1977). By 1922, the elk herd had more than doubled (O'Gara and Dundas 2002), and game wardens reported the following herd sizes by county: Bland – 50, Craig – 30, Giles – 70, Roanoke – 40, Russell – 30, Washington – 40, Warren – 30, and several in the mountains of Pulaski and Montgomery (Wood 1943). A 15-day bull elk season was instituted in 1922, as much to address conflicts as to provide sport (Baldwin and Patton 1938). Short elk seasons (2-15 days each) were held intermittently from 1922-1960, with as many as 1,500 hunters at the peak in 1958 (Gwynn 1977). Annual elk harvests ranged between 0 and 70, with most seasons reporting only single-digit harvests (Gwynn 1977). The last elk hunting season in Virginia was held during 1960 in 4 counties: Giles, Bland, Botetourt, and Bedford (O'Gara and Dundas 2002).

Table 1. Elk released in Virginia during 1917 from Yellowstone National Park (Wood 1943).

County	Release Location	No. Elk Released
Princess Anne	Cape Henry	17
Warren	Front Royal	Unknown
Botetourt	Arcadia	25
Giles	Mountain Lake and Sugar Run	16 (8 each)
Montgomery	Brush Mountain	7
Russell	Unknown	Unknown
Roanoke	Fort Lewis Mountain	8
Pulaski	Max Mountain	Unknown
Washington	Near Abingdon	25
Cumberland	Near Centerville	15-20

By 1926, only 2 elk herds remained in Virginia: one in the mountains of Giles and Bland counties west of Pearisburg and one along the Blue Ridge of Botetourt County near Buchanan (Wood 1943). Additional elk were sought to supplement these small herds as popularity of elk among Virginia sportsmen increased but harvests were disappointingly small (Baldwin and Patton 1938, Wood 1943). The U. S. Park Service and U. S. Biological Survey brought 54 more elk from Yellowstone in 1935 (Baldwin and Patton 1938). Of the 43 elk that survived transit, 37 were released in the Giles-Bland range and 6 in the Botetourt area (Wood 1943). During this time, Virginia was the only eastern state with a huntable elk population until New Hampshire opened a hunt during 1941 (Wood 1943).

The Giles-Bland herd

From the initial shipment of elk in 1917, 8 were released in the Giles-Bland area (Wood 1943). They were kept in enclosures from February until spring before being released. During 1935, a number of the 37 elk released either died or were killed within short order, leaving perhaps no more than 20 survivors from the second shipment. A short period of unlawful killing followed the 1935 shipment, apparently by farmers who resented having more elk released on their lands. Once these new elk retreated to more remote areas, the killing ceased (Wood 1943).

The 39,000-acre Giles-Bland elk range, a remote area comprising the drainages of Dismal, Mill, and Nobusiness creeks, was left relatively unscathed by timbering, although the woods had been burned regularly to keep down the underbrush (Wood 1943). Cattle were previously provided with salt and the small glades remaining when elk were restored had been made by settlers and farmers. Places where elk were found most frequently in the range included the salt grounds for cattle, old mined areas, high fields cleared and maintained by residents, bogs, ponds, and burnt-over sections. Winter range was very similar to summer range, unlike in the Western United States, except that elk were more often found on high ridges and northern slopes in summer. Although elk did come into upper agricultural fields, they rarely descended far into the farmed valleys. High fields were the most important component of this elk range, presumably because grazing areas were adjacent to thick forest cover (Wood 1943).

In the 1940s, the Giles-Bland elk herd was considered a successful anomaly among many failed attempts in the eastern United States (Wood 1943). However, the herd had grown at <10% annually from 1917-1941, which was much lower than that previously observed in the West and Midwest. Legal hunting, followed by poaching, appeared to be the main factors limiting faster population growth and expansion. Elk emigration from the range may have been another significant factor. The insufficient habitat and range size were other important issues (Wood 1943).

An estimate by Wood (1943) in 1940-41 was 75 elk on the Giles-Bland range (50 cows and 15 each of bulls and calves). In 1958, the Virginia Game Commission estimated that 125 elk were on the Giles-Bland range, and concerns were expressed about hunter difficulty in discerning between cow elk and doe deer when doe harvest became necessary to control a growing deer population (deer were restocked in the area in 1950-1956) (Gwynn 1977). The last elk was reported in the area during August 1970 (Gwynn 1977).

The Botetourt-Bedford herd

During 1917, 23 elk from Yellowstone were put in a holding enclosure in the uninhabited North Creek Valley approximately 6 miles north of the Peaks of Otter near Arcadia (Parker

1970). The elk were supposed to be held from winter until spring, but due to the death of 1 elk in the enclosure, the remaining 22 were released prematurely. Bryant Fork and Fork Mountain in the lower ridges of the Blue Ridge were the core area of the newly-released elk herd. Cleared agricultural lands in surrounding valleys bore the brunt of damage from elk soon after release. Creation of the Blue Ridge Parkway likely created a sanctuary that allowed the shift of elk toward the Peaks of Otter in the 1940s. The herd likely reached a maximum of 100 elk (Parker 1970). In 1964, University of Michigan graduate student O. J. Halladay censused 39 elk (Gwynn 1977). Only 14 elk were censused in the winter of 1969-70 at Peaks of Otter, but by summer 1970, all elk had disappeared (Parker 1970, Gwynn 1977).

By 1970, elk were gone from Virginia (Gwynn 1977). A number of factors may have contributed to their demise: disease, unsustainable harvest levels, removal of crop-depredating elk, and isolation of small, unsustainable herds on limited ranges (Gwynn 1977, McClafferty 2000). Meningeal "brain" worms (*Parelaphostrongylus tenuis*), implicated in the decline of elk herds in Virginia and other states (Gwynn 1977), were not likely a limiting factor in most populations (Wathen et al. 1997, Larkin et al. 2003).

2000 Virginia Elk Feasibility Study

Although no attempts have been made to introduce elk into Virginia since their disappearance in 1970, interest in restoring elk led to a feasibility study in the late 1990s. Funded primarily by Rocky Mountain Elk Foundation and conducted by Virginia Tech, the project examined both the biological and sociological feasibility of restoring elk in Virginia (McClafferty 2000).

Biological feasibility considered habitat suitability for elk and potential impacts of elk on other wildlife and flora in Virginia (e.g., ecosystem impacts and disease risks) (McClafferty 2000). A habitat suitability index (HSI) model measured the availability and accessibility of open foraging areas (well-interspersed, >10% of total area considered optimal), forested cover areas, permanent water sources, and fragmentation by roads. Major roads were used to delineate the potential restoration areas. Only areas within the borders of Virginia with at least 120,000 acres (i.e., 2 adjacent 60,000-ac polygons) of elk habitat were considered for further analysis (McClafferty 2000). In other words, suitable elk habitat in adjacent states was ignored.

Eight areas in Virginia were identified as potential habitat for elk: 1 in Southwest Virginia, 3 in the Southern Piedmont (Danville, Brookneal, Rehobeth), and 4 in the Shenandoah Mountains (Shenandoah, Highland, Big Meadows, Peaks of Otter) (McClafferty 2000). Highest potentials for supporting elk were found in the Highland and Big Meadows areas; medium biological feasibilities were found in the Southwest, Shenandoah, and Brookneal study areas; and low biological feasibilities were found in the Peaks of Otter, Danville, and Rehobeth study areas (McClafferty 2000).

The Southwest Virginia study area was comprised mostly of Jefferson National Forest and Clinch Mountain Wildlife Management Area lands in Russell County eastward to Pulaski County; the only portion of this study area within the Coalfields was a large part of eastern Dickenson County, the southern corner of Buchanan County, and a portion of western Russell County (McClafferty 2000). The Southwest Region as a whole was predicted to support over 900 elk, but challenges included an irregular, fragmented layout; small amounts of poorly-interspersed open land; and, a high frequency of roads (McClafferty 2000).

Socioeconomic feasibility was assessed with a statewide mail survey of Virginia residents, 4 regional stakeholder workshops, an analysis of costs and benefits associated with elk restoration, and an assessment of the likelihoods of elk-human conflicts in the 8 study areas (McClafferty 2000). Statewide, most (61%) respondents agreed that elk restoration would be good for Virginia. However, the low response rate (30%) and low confidence among respondents (49%) in their knowledge about elk indicated that most residents did not have the interest or information needed to form a definitive opinion. Residents believed the primary benefits of restoration would be value-based and indirect ecological benefits, such as returning an extirpated native species, while the greatest perceived costs were impacts to property, crops, and public safety. At the regional stakeholder workshops in Abingdon, Verona, Winchester, and Martinsville workshops increased tourism and new recreational opportunities were the most anticipated benefits (McClafferty 2000).

Primary concerns identified in the feasibility study were potential property damage by elk, impacts to local ecosystems, and costs of implementing and administering an elk program (McClafferty 2000). The suggestions for resolving cost and damage issues varied by region. Representatives from the Southwest and northern Shenandoah Mountain Regions preferred not to restore elk at all, whereas those from the southern Shenandoah Mountain and the Southern Piedmont Regions preferred to start small with monitored "experimental" populations (McClafferty 2000). Potential for landowner-elk conflict was examined by comparing human population densities and growth rates, ratios of private versus public land, and agricultural trends across each of the 8 study areas. Risks for elk conflicts with people were identified as highest in the Southern Piedmont Region and in the Shenandoah study site, moderate in the Southwest, Big Meadows, and Peaks of Otter study sites, and low in the Highland study site (McClafferty 2000).

The Highland study site had the overall highest feasibility for elk restoration, and the Big Meadows and Southwest study sites both demonstrated moderate feasibility. Restoration was identified as feasible in any of these areas so long as management objectives were flexible, plans were made to address potential concerns in advance, and the public is involved in decision-making before and after elk are released (McClafferty 2000). Although sub-parts of a study area were not analyzed specifically, feasibility was clearly thought to be higher in Dickenson and Buchanan counties than in the more eastern portions of the Southwest study site. Representatives from the extreme western part of the area were invited but did not attend the regional workshop in Abingdon during this study. The risk assessments for the western counties in the Southwest were lower than for eastern counties. Human populations are relatively small, population growth is generally negative, few farms exist, and beef farming is the predominant form of agriculture. The western-most portion of the Southwest study area adjoins Kentucky's elk range, so elk are slowly colonizing this portion of Virginia on their own. "If restoration is deemed feasible for this area, separate releases in Virginia likely will not be necessary unless to speed up the process" (McClafferty 2000:85).

Current Elk Status in Virginia

As the feasibility study was being completed, elk released as part of the southeastern Kentucky restoration initiative began crossing into Virginia. The Kentucky restoration area is adjacent to Buchanan, Dickenson, Wise, and Lee Counties in Virginia, and several elk release sites were within a few miles of the Virginia border (KDFWR 2009). VDGIF has been concerned about human-elk conflicts as well as the accidental introduction of Chronic Wasting

Disease (CWD) or other diseases of deer from western states where these elk originated. Capturing and returning elk back to Kentucky did not prove to be a practical management option. In an attempt to prevent elk from becoming established in Virginia, the DGIF has allowed elk of either sex to be harvested during all deer hunting seasons (VDGIF 2006, 2009).

The elk population in Virginia is presently unknown (Wills 2007, 2009), but may number 50-100. Confirmed sightings of elk have been reported from the 4 border counties plus Russell, Scott, and Washington (Wills, unpublished data). Since 2000, 30 elk have been harvested from 5 counties (Buchanan, Russell, Scott, Washington, and Wise), including 20 males and 10 females. Of elk harvested, 19 have come from Wise County. The highest number killed in 1 year came in 2003. It appeared the harvest would continue to increase, but the harvest in recent years has ranged from 0 to 3 elk (VDGIF, unpublished data).

Increased interest in elk, along with no detections of CWD in elk in Kentucky (KDFWR 2009) or Southwest Virginia have compelled consideration of a new paradigm for elk management. At its August 2009 meeting, a proposal was made by the VDGIF Board to prohibit the killing of elk in Virginia and to develop an operational plan for elk restoration (VDGIF 2009). During August-October 2009, public input was obtained on the regulation proposal to prohibit elk harvest. Due in part to concerns expressed by agricultural interests, the VDGIF Board chose to table consideration of the hunting moratorium at its meeting on October 22, 2009. During that meeting, the Board agreed to request permissive authority from the Virginia General Assembly to establish an elk hunting license separate from the current deer-bear-turkey license. The Board also endorsed the development of an operational plan for the restoration of elk, to be developed by VDGIF staff with involvement from key stakeholders, in time for review at the June 2010 Board meeting. Elements of the operational plan were to include background information on elk, approaches for restoration, management issues, communication and education needs, monitoring and research needs, and costs and funding (VDGIF 2009).

ELK RESTORATION IN THE EASTERN UNITED STATES

Between 1892 and 1939, >5,200 elk from western states (primarily Yellowstone National Park) were transported to 36 states, the District of Columbia, Canada, and Argentina (Witmer 1990). Fortunately, the Yellowstone herd was genetically diverse for an elk population (O'Gara 2002). Genetic differences between the Rocky Mountain elk (*C. e. nelsonii*) used for restocking and the extirpated Eastern elk (*C. e. canadensis*) were no greater than normal variations found within the Rocky Mountain elk subspecies itself. The continuous historical distribution of elk from the East Coast to the Rocky Mountains resulted in clinal, rather than abrupt, genetic differences. Only West Coast populations were isolated. Some would say that the local genetic variations in elk across much of the country were not sufficient for subspecies assignments (O'Gara 2002).

In the East, 10 states attempted to establish elk herds prior to 1980 using Rocky Mountain transplants. Of these, only the herds in Pennsylvania and Michigan remain today. Early attempts in Alabama (1916, with elk gone by 1921), Florida, Indiana (1950s-1960s), Kentucky, New Hampshire (1903; gone by 1955), New York (1893-1906; gone by 1953), Virginia (1917; gone by 1970), and Wisconsin (1913; gone by 1930s) failed (Gwynn 1977, Witmer 1990, O'Gara and Dundas 2002). Primary explanations for the failure of these attempts include, in order of importance, 1) lack of appropriate habitat, 2) over-hunting and illegal harvest, 3) crop damage,

and 4) disease/parasites (Witmer 1990). The trend in failures seen in elk restoration is consistent with that of other animals in North America (Larkin et al. 2003). Feasibility studies for the restoration of elk recently were completed in New York, Illinois, Virginia, and West Virginia (McClafferty 2000, O'Gara and Dundas 2002, Enck and Brown 2005, Zysik and Porter 2005)

Experience with elk restoration in the eastern United States has provided helpful insights for states considering reintroduction. During 1996, the Tennessee Wildlife Resources Agency (TWRA) elk team visited elk ranges in 5 eastern states to evaluate habitat, management, disease issues, and positive and negative impacts of elk. This team concluded that there were 3 primary requirements for a successful, sustainable elk restoration program: (1) a large area (200,000 acres or more), (2) many open areas (15-20% of elk range best), and (3) intensive management of these open lands (Wathen et al. 1997).

A herd large enough to sustain hunting and a large enough area to support the herd, with adequate public access, are thought to be important for sustaining both elk populations and public support (Wathen et al. 1997). Areas for restoration should be sufficient to support minimum viable populations of 400 elk, although experience from other states suggests that populations of at least 700 elk are more sustainable (McClafferty 2000). Michigan was successful for decades maintaining 600-800 healthy, highly productive elk on a range of over 300,000 acres (Witmer 1990). Wood (1943), recognizing the challenges of sustaining elk on the small Giles-Bland range in Virginia, and Witmer (1990), examining a number of elk restoration successes and failures around the country, concluded that 100,000 acres is necessary for sustaining elk over the long-term. A Habitat Suitability Index model developed for Great Smoky Mountains National Park suggested that 330,000 acres should be available for a viable population (Wathen et al. 1997). Even though elk will use suboptimal quality habitats, and seek out the best relative habitat in the restoration area, the likelihood they will disperse from release sites increases if habitat quality is low (Zysik and Porter 2005).

Agricultural damage, one of the most important considerations when considering elk restoration, appears to be a manageable problem in most areas with established elk populations (Wathen et al. 1997). Avoiding reintroduction in areas where significant agricultural damage would be expected, combined with targeted hunting and technical assistance (e.g., fence installation) following reintroduction, have been important in mitigating elk damage. Pennsylvania and Michigan experienced significant agricultural damage in early years, but both states have found ways to address damage. Arkansas landowners experienced little damage from elk initially because agricultural production near elk range was limited (Wathen et al. 1997). A feasibility study conducted recently in Illinois indicated that current socioeconomic conditions, related primarily to the preeminence of agriculture, would preclude a successful restoration in Illinois (McClafferty 2000, O'Gara and Dundas 2002).

A caution commonly voiced when elk restoration is considered in the East is meningeal worms (*Parelaphostrongylus tenuis*), parasites carried by white-tailed deer that are known to cause degenerative disease in other cervids, including elk (Gwynn 1977, Walthen et al. 1997). However, even though meningeal worms are expected to kill some young elk, and mortalities should be planned for, the parasites are not expected to be a limiting factor in elk restoration, as demonstrated by several successful elk restorations in the East (e.g. AR, KY, MI, and PA) (Wathen et al. 1997, AGFC 2001, Larkin et al. 2003). Nonetheless, several unsuccessful attempts in the past were blamed on brain worm mortality. (Wathen et al 1997).

Officials in states that have restored elk generally point out that short and long term costs of restoration exceed revenue generated; however, agency goodwill and public relations have been valuable (McClafferty 2000, Enck and Brown 2005). The Rocky Mountain Elk Foundation has been instrumental to elk restoration in the East (Wathen et al. 1997), and state officials have indicated that they could not have successfully established elk populations without the organization's help (Enck and Brown 2005). Communication with the public about restoration early in the process, including education and public input, has been recognized as the most important ingredient to success (Wathen et al. 1997, Enck and Brown 2005). For more detailed discussion of elk restoration efforts in other states, see Appendix 1.

ELK ECOLOGY

Physical Characteristics

Elk (*Cervus elaphus*) are the second largest member of the deer family in North America (moose are the largest deer). However, the 4 existing subspecies of elk (Rocky Mountain elk, *C. e. nelsoni*; Manitoba elk, *C. e. manitobensis*; Roosevelt elk, *C. e. roosevelti*; Tule elk, *C. e. nannodes*) vary in size across their range (Peek 1982). Roosevelt elk are generally considered the largest subspecies (O'Gara 2002), with Tule elk being significantly smaller (Peek 1982).

Elk attain their full size and weight at 4 or 5 years of age (Hudson and Haigh 2002), but nutritional status is the ultimate determinant of size (Peek 1982). Mature bulls can weigh nearly 1,000 pounds, but may lose 20% of their body weight during the fall rut (Hudson and Haigh 2002). At about 700 pounds, adult cows are 70-80% of adult bull weight (Peek 1982, Hudson and Haigh 2002). Yearling elk (1½-year-old animals) attain 2/3 of the adult weight by their second fall (Peek 1982).

Annual antler growth in mature bulls begins during late April or early May (Peek 1982), with velvet being shed in August, and antlers dropping in late March - early April. Antler growth in yearling bulls begins later in June through July with velvet being shed in late August to mid September (Hudson and Haigh 2002).

Food Habits

Compared to white-tailed deer, elk are considered to be more of a grazing species dependent on grasses for forage. However, their diet can be highly diverse as they adapt to seasonal and annual availability of local forage items. Forage items are generally composed of grasses or shrubs during the winter with an increase in grasses during the spring. Forbes and leaves of browse species are commonly eaten during the summer with a shift back to grasses and browse in the fall (Peek 1982, Larkin et al. 2003). Depending on lactation demands, adult cows will need to consume 10 to 20 pounds of vegetation per day during the summer. Summer food intake will be about 2.5 times higher than the intake needs during winter (Cook 2002).

Home Range, Movements & Activity

To meet their social and nutritional needs throughout the year, elk are a gregarious, herding animal with relatively large home range sizes. Averaging about 12,000 acres, home range size can be highly variable (400 acres – 23,000 acres) depending on habitat quality, time of year, sex, reproductive status, and age (Mysterud et al. 2001). In 1985, radio-collared bulls and cows in Pennsylvania had average home ranges of 13,120 acres and 4,352 acres, respectively

(Cogan 1987). During 2004-2005, mean home range size for bulls was 11,200 acres and 10,432 acres for cows (PDCNR unpublished data).

Female offspring typically establish home ranges adjacent to their mother's herd. Males disperse at 2.5 years of age as a result of density-dependent factors or being driven away by harem bulls. Dispersal distances in Montana averaged 15.3 miles for bulls and only 2.2 miles for cows (Raedeke et al. 2002).

Depending on the availability of suitable habitats and snow conditions, elk populations throughout the western United States may be migratory or nonmigratory (Peek 1982). Seasonal migrations between summer and winter ranges might cover distances as long as 60 miles, but migration distances are usually much shorter (Irwin 2002).

It is believed that the original eastern elk populations did not migrate and elk introduced into eastern ranges also have not displayed migratory tendencies either (Irwin 2002). Even when elk are not migratory, populations often shift local habitat use in response to food availability and habitat needs (Peek 1982).

Habitat Requirements

Like all animals, elk need food, water, cover, and space to exist. Although elk are commonly associated with rugged mountains and canyons that are isolated from human influences, their historical range and habitat use was much more diverse. Before settlement of North America and subsequent habitat alteration by humans, elk historically were distributed across a variety of ecosystems as testimony to their adaptability. Prior to land-use changes and other interventions by man, elk were found throughout the country including the northwest rainforests, the North American prairie, and the hardwood forests of the east. Probably the only regions that elk did not inhabit were the western deserts and extreme southeast (Skovlin et al. 2002).

Although a variety of habitats are suitable, the most important components are found where different vegetation types are available to elk. The transitional areas (i.e., the ecotone) between open grassland habitats and dense early successional cover types are especially important for calving sites, access to forage, thermal needs, and escape areas (Peek 1982). Availability of succulent vegetation is an especially important feature of calving habitat (Skovlin et al. 2002). Snow depth, temperature, and other weather factors also determine habitat selection by elk as they influence energy expenditure and food availability. Snow depths in excess of 18-24 inches have been shown to change habitat use for elk (Skovlin et al. 2002).

Reproduction

As polygamous breeders, bulls gather harems of cows and calves during the early fall. Cow elk are typically bred in late September through early October during their 21-day estrus cycle. Each pregnant cow will annually produce 1 calf during late May or early June after a 247- to 265-day gestation period (average about 255 days). Twins in elk are very rare and account for <1 percent of all births (Raedeke et al. 2002). In Kentucky, calving rates apparently dropped during the year of translocation (40-66%) but were higher (89-92%) after translocation than calving rates in the western source herds (Larkin et al. 2003). It was speculated that this was caused by the stress of translocation. Newborn calves weigh from 33 – 49 lbs., with males weighing more than females (Peek 1982, Hudson and Haigh 2002).

Fecundity rates in elk generally are related to the degree of nutritional stress that results from population density changes or other factors that affect food availability. With optimal habitat conditions, newly established populations often exhibit high reproductive success, especially among yearling females (Raedeke et al. 2002).

Adult cows (those >3.5 years old) typically have annual pregnancy rates that exceed 90%. Related to condition and depending on body weight, yearling cows (1.5-year-old females) may also breed. Annual breeding by yearling cows averages 18%, but varies between 0% and 48%. There is no evidence that calves during their first fall (at 3-4 months of age) are ever bred (Raedeke et al. 2002).

Mortality

Elk in unhunted populations may live to be more than 20 years old, but average life expectancies are generally much shorter (Peek 1982). The combined impact of rutting activity and winter stress result in maximum life expectancies of bulls (13-14 years old) being less than cows, even in unhunted populations (Raedeke et al. 2002).

Hunting is the major mortality factor in most elk populations. Other losses due to large predators or malnutrition in extreme winters can also be significant in some areas or years (Peek 1982, Raedeke et al. 2002). Early in the Kentucky restoration program, 71/145 documented mortalities were due to capture-related causes (Larkin et al. 2003). Automobile collisions, meningeal worm infections, and poaching accounted for 24/145 mortalities in that 41-month time period.

Other than hunting, the biggest mortality factor for most elk populations is the predator impact on calf survival. Predation on young calves has been shown to be a limiting factor in some areas of the country (e.g., Idaho) (Thorne et al. 1976). Black bears are often the most common calf predator, but coyotes can also be a significant factor. Predation has been shown to be a limiting factor for a newly introduced elk herd in the Great Smoky Mountains National Park where 69% of calf mortalities were attributed to black bears. Another 23% of the mortalities came from coyotes or dogs (Sargeant and Oehler 2007). Because calf survival has been shown to be an important factor for elk population viability and growth, controlling predator impacts is often a population management recommendation for elk (Raedeke et al. 2002, Sargeant and Oehler 2007).

Population Dynamics

Elk populations cannot grow indefinitely. Elk population growth and density will become limited as habitat resources (primarily food supplies) become scarce (Raedeke et al. 2002). Especially as these food limitations affect recruitment and survival of calves, elk populations exhibit density-dependent growth (Raedeke et al. 2002, Skovlin et al. 2002). As elk densities increase, population growth rates generally decrease due to lowered productivity and calf survival. Natural population regulation for elk is ultimately based on food quality and quantity, with other associated factors (e.g., predation) being proximate causes (Peek 1982).

The biological carrying capacity (BCC) is the maximum number of elk an area can support over time. When the BCC is reached, the average annual population growth rate will be zero. The BCC for elk is generally unknown, but will vary widely from habitat to habitat and from year to year. One study on Tule elk at Point Reyes National Seashore in California

provided an upper limit for the BCC at 252 elk per square mile during wet years when conditions were most ideal (Howell et al. 2002).

When densities are low and resources abundant, unhunted elk populations may have a maximum growth rate of 28% per year (Eberhardt et al. 1996). Colonizing elk populations in California and Washington have exhibited annual population growth rates of 30% and 34%, respectively (Raedeke et al. 2002). Simulations have shown that the highest rates of increase would be 34-36% per year. Based on these rates of increase, elk populations under optimum conditions in excellent habitats could double their population size every 2-3 years. By comparison, white-tailed deer are more productive under excellent habitat conditions with the ability to double their population every year.

IMPACT OF ELK

Wildlife-related outdoor recreation generates considerable economic activity (U. S. Fish and Wildlife Service 2006). In several states elk play a major role in outdoor recreation planning by drawing tourists and tourism dollars to local communities (Bolon 1994, Lord et al. 1999, Fermata Inc. 2002, Southern and Eastern Kentucky Tourism Development Association 2007). Several studies have been conducted concerning both wildlife-related recreation in Virginia and specifically elk-related activities in other states.

Benefits in Other States

Studies in other states demonstrate the additional revenue possible from elk-related recreation. In Oregon, a general technical report estimated the value of elk hunter expenditures at approximately $10 million per year ($23 per hunter day) in the Blue Mountains area of Oregon and Washington (Bolon 1994). Based on studies of wildlife viewing in Oregon, it was estimated that if just 1 out of every 8 wildlife viewing trips was to view elk, that the total economic impact would be $11.5 million at a minimum. In Virginia, white-tailed deer are the most commonly watched species. It is likely that elk would be sought out for viewing opportunities as well.

Kentucky has demonstrated considerable economic impact related to their lottery elk hunts since elk hunting started in 2001. A study conducted by the Rocky Mountain Elk Foundation in 2007 demonstrated that $48,000 was spent by hunters prior to the 2006 elk hunting season scouting locations for elk hunting trips. Over $61,000 was spent by Kentucky hunters on guide and trip-related expenses during the hunting season. An additional $119,000 was spent on equipment and supplies during this same season for a total direct economic impact in the 16 southeastern elk counties of $229,703 for the 200 hunters who participated in the hunt that year. If extrapolated to the eventual goal of 1500 elk tags that the Kentucky Department of Fish and Wildlife Resources plans to issue, the total economic impact will be $1.7 million annually (Southern and Eastern Kentucky Tourism Development Association 2007).

In addition to community economic development, the Kentucky Department of Fish and Wildlife Resources collected $320,000 from lottery entrance fees and the 200 elk tags issued to lottery winners in 2007. KDFWR charges $10 to enter the lottery and $30/elk tag issued for residents. Once they reach the eventual goal of 1500 tags total economic impact to KDFWR will be approximately $700,000 annually assuming no change in the number of people entering the lottery.

Visitor surveys and counts at the Cataloochee Area of Great Smoky Mountains National Park in Tennessee demonstrated the draw that elk can have in an area (DeLozier personal communication). After the introduction of elk to this area, visitation nearly doubled and has remained above the previous level. In Pennsylvania, where the Commonwealth maintains a small elk herd of about 750 animals, a 1997 study conducted by Penn State University concluded that elk viewing had a total regional economic impact of $1.2 million (Lord et al. 1999). A follow-up study in 2002 concluded that by 2005 elk viewers would spend $3.4 million on trip-related expenses to north central Pennsylvania's elk range (Fermata Inc. 2002). For their small herd, Pennsylvania averages 20,000 applicants/year for elk hunting permits, and the elk herd draws 60-70,000 hunting and viewing visitors annually (Deberti 2006). An Elk Country Visitor Center on the Elk State Forest is slated to open in Summer 2010 as the focal point for elk-related tourism (PDCNR 2009).

Potential Benefits in Virginia

According to the U.S. Fish and Wildlife Service 2006 Survey of Fishing, Hunting and Wildlife-Associated Recreation 413,000 hunters spent 6.8 million days hunting in Virginia (U. S. Fish and Wildlife Service 2006). This activity generated $481 million in total revenue for the Commonwealth. Equipment purchases made up approximately 62% of this revenue ($297 million) and trip-related expenditures composed 26% ($125 million). Most expenditures for hunting in Virginia are related to big game hunting (U. S. Fish and Wildlife Service 2006) and the addition of elk hunting opportunity will likely stimulate additional spending.

More than 2.3 million wildlife watchers spent 5.7 million days viewing wildlife in Virginia during 2006. They produced $960 million in total expenditures with 65% ($627 million) coming from equipment and other viewing related expenditures and 26% ($248 million) coming from trip-related expenditures. Trip-related expenditures for wildlife viewing in Virginia increased 83% over data from the 2001 Survey.

A recent study conducted by the Conservation Management Institute at Virginia Tech concluded that over 640,000 visitors visit sites along the Virginia Birding and Wildlife Trail (VBWT) annually (Rosenberger and Convery 2007). Conservatively they spend about $8.6 million as part of their activities. Further, surveyed visitors recommended visiting the VBWT to 9 friends, on average, and 90% plan to visit the Trail in the future. Over 63% of all local government planners and tourism officials believe that the Trail is an economic draw for their communities, with more than 85% of local tourism officials stating that ecotourism and outdoor recreation are major draws.

Increased visitors to the Coalfield counties of Virginia to view or hunt elk would likely benefit other attractions in the region. The VBWT study mentioned earlier showed that over 50% of visitors to the Trail select sites based on the probability of seeing a particular species. Elk are very gregarious and somewhat stationary, especially during winter months. As long as they are not approached by people on foot, they tend to be very tolerant of vehicular traffic. Assuming elk exhibit the same behavior in Virginia that they have in Kentucky, this would provide elk viewing areas with a high probability of seeing elk. The same study showed that 81% of all visitors to the Trail also visit historical sites during wildlife viewing trips. Nearly half of all visitors to the VBWT visit local cultural sites and museums during their trips.

Increases in elk watching also provide opportunities for engaging Virginians and others in wildlife conservation issues. Many studies have demonstrated that people are more likely to support issues with which they are emotionally and mentally involved. Adults are 3 times more likely to learn about wildlife by seeing it versus being told about it and are much more likely to participate in volunteer programs that benefit wildlife resources. Increased wildlife viewers as a result of elk would undoubtedly raise awareness of the Department and its programs.

Other species of wildlife benefit from elk-related habitat management. Elk grazing and habitat management for elk maintain early successional habitat, particularly grasslands, which has been identified in both the Virginia Wildlife Action Plan and Quail Action Plan as one of the most imperiled habitats in Virginia. Reclaimed mine lands have proven successful at providing forage and beneficial habitat for elk in Kentucky, and individual elk now seldom disperse far from where they are born. Promotion of this habitat type would complement reforestation efforts of other rare species such as grassland plants, insects, and birds (Virginia Wildlife Action Plan, Virginia Quail Action Plan).

Concerns

In addition to the benefits of having a thriving elk population, there are also negative impacts to consider. There is a potential for elk to cause damage to agricultural fields and other property. Due to their large size, mobility, and gregarious nature, elk can be perceived as more troublesome even than white-tailed deer in certain circumstances. Various types of potential damage will be discussed in this section. Mitigation will be discussed in a later section. In addition to property damage concerns, there are concerns that elk could introduce or assist in the spread of diseases that affect deer, livestock, or humans. Disease concerns are discussed later in this document.

Excessive elk browsing on young tree seedlings could retard reforestation efforts on reclaimed mine lands. After mining operations are complete, operators are required by law to reestablish vegetative cover (depending on intended land use) before the mining permit bond money is released. Operators failing to reestablish mined lands to federal standards will not receive bond money, which is normally millions of dollars per permit. There is concern that elk browsing or antler-rubbing on tree seedlings will hinder mine reclamation.

Property damage by elk could occur in a number of ways including: foraging/trampling of small, personal-use gardens and landscaping, elk vehicle collisions, golf course damage, and cemetery disturbance.

Concerns in Other States

In nearby states with free-ranging elk herds, agricultural damage has been reported (Crank KDFWR, Bennett TWRA personal communication). In Pennsylvania, 74 elk were killed depredating crops from 2001-2009 (DeBerti PDCNR, personal communication).

Elk can damage landscaping and small gardens in residential areas. Kentucky Department of Fish and Wildlife Resources staff respond to roughly 20 elk complaints each year (Crank KDFWR, personal communication). These complaints more often involve perceived damage than actual damage resulting in monetary loss. Most callers complain about the presence of elk in their yards or minor personal garden damage. Normally 1 or 2 complaints each year result in damage valued at $500 or more. Most damage involving gardens is handled

by recommending construction of a single strand of electrified wire or polytape. In some instances, KDFWR personnel provide fencing material for garden damage complaints. Golf courses can attract elk due to an abundance of forage and water. Kentucky has had a few complaints of elk damage to golf courses, mainly during winter months. In addition to damaging turf, elk can obstruct the course disrupting golfers.

In Kentucky, KDFWR staff reported that on average, 20-25 elk/year are involved in vehicle collisions (Crank KDFWR, personal communication). No human fatalities or serious injury have occurred due to elk vehicle collisions, but there was usually a significant amount of vehicle damage. In Tennessee, 12 elk have been struck by vehicles since 2001 and 4 elk have been killed by trains (Bennett TWRA, personal communication). No reports of personal injury or fatality as a result of elk vehicle collisions have occurred in Tennessee since restoration began. In Pennsylvania, 90 elk were killed by passenger vehicles and 8 elk were killed by trains from 2001-2009 (DeBerti PDCNR, personal communication). No human injuries or fatalities were reported in Pennsylvania during this time period.

Potential Concerns in Virginia

Potential agricultural damage caused by elk could include: foraging/trampling crops directly, competition with cattle for hay and pasturage, fence damage, antler rubbing/browsing of orchard trees or trees suitable for timber harvest, and damage to other agricultural crops such as tobacco during the drying process. In Virginia, 2 incidents of agricultural damage have been reported since Kentucky began restoring elk. In Scott County, elk caused trampling damage to plastic weed barriers in a field of tomato plants. Damage to tobacco on drying sticks was reported during the fall breeding season by a farmer in Russell County. No subsequent reports came out of this area. In another part of Russell County, a small group of elk has existed since 2000 with no reports of agricultural damage despite extensive hay fields, pasturage, and croplands (VDGIF unpublished data).

Additionally, elk could hinder reforestation efforts on some mine reclamation sites. Elk near high-speed road systems pose a risk of collision with vehicles. Since 2002, at least 4 elk vehicle collisions have occurred in Virginia (VDGIF unpublished data).

Diseases of Concern in Elk Management

Elk may carry or acquire diseases that affect other ungulates such as deer and cattle (Nettles and Corn 1998). Therefore, it is important to recognize diseases that may impact Virginia's native wildlife and livestock operations and take every precaution to mitigate the risk of importing or spreading diseases through an elk restoration program. This section will address several pertinent diseases of elk, especially as they relate to cattle and deer. However, this is not meant to be an exhaustive primer on elk-related diseases. Interested readers are directed to several authoritative sources cited in this operational plan for more information.

There are no tests or procedures that can ensure a "disease free" herd for some relevant diseases, however, a rigorous screening protocol can minimize the risk of introducing potentially devastating new diseases or encouraging the spread of pre-existing diseases in local animal populations. Screening for all relevant diseases of concern must take place before elk are moved into a new location. Nettles and Corn (1998) developed a model protocol for wild elk importation to address the major disease concerns of a restoration attempt. This management plan relies heavily on recommendations set forth in their model health protocol.

Nettles et al. (2009) tested 31 elk harvested in Kentucky from 2001-2003 for various diseases. The diseases that were detected in these elk (1-6 elk previously exposed to a particular disease) included: several serovars of leptospira, EHD, bovine rhinotracheitis virus, and parainfluenza-3. None of the elk tested positive for bovine TB, brucellosis, or bovine viral diarrhea. Although sample sizes were low, it is not thought that these diseases occur in the Kentucky elk herd. CWD has not been detected in roughly 300 elk tested in Kentucky since 1997 and 30 elk tested in Virginia since 2000.

Bovine Tuberculosis

Bovine Tuberculosis (TB) is caused by the bacterium *Mycobacterium bovis* and affects many ungulates including cattle, bison, elk and deer. It usually takes years for symptoms to occur after infection. Symptoms are usually only seen in animals with advanced stages of the disease and include wasting, malaise, poor hair coat and difficulty breathing. The United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS), state departments of health, and the cattle industry have worked to eradicate bovine TB from the captive livestock population. As a result, most states are certified as TB free. In Michigan, there have been 5 free ranging elk that tested positive for bovine TB in the last 10 years out of 1,878 elk that have been tested since 1996 (Michigan Department of Natural Resources). The strain of TB found in one of these elk is identical to the strain found in infected cattle and deer in northern Michigan. The strain found in the other 4 elk is unknown. Michigan prohibits supplemental feeding or baiting of deer in the entire Lower Peninsula in order to minimize contact frequency between deer due to concerns over both TB and CWD. As is demonstrated in Michigan, bovine TB can occur in wild animal populations, but it is rare. When TB in wild cervids has occurred, diseased animals are usually found in close proximity to captive livestock herds infected with TB. VDGIF will not use sources of elk that are close to locations where TB infects wild cervid populations or domestic cattle. Therefore, introduction of this disease is not considered a high risk.

Brucellosis

Brucellosis (Bang's disease) is caused by the bacterium *Brucella abortus*. The State-Federal Brucellosis Eradication Program has reduced cattle infection to less than 1 percent nationwide since 1934. It is associated with wild elk and bison in and around Yellowstone National Park but currently is not found in wild or domestic cervids elsewhere in North America. The main effects of this disease in cattle are reduced milk production, abortion late in pregnancy and sometimes infertility. Normally, this disease does not cause temporary or permanent infertility in elk as it does in cattle. Since the only brucellosis-supporting wild ungulate population is in the Greater Yellowstone area, any elk transplanted from other areas of North America are not considered a high risk of introducing this disease to Virginia.

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is unlike other diseases in that the disease agent responsible is not a bacterium, virus, protozoan, or invertebrate parasite. CWD is a transmissible spongiform encephalopathy caused by a prion, a malformed protein found primarily in the brain, other nervous system tissues, and lymphatic tissues. This disease is characterized by sponge-like holes in the brain. Much is unknown about this disease since its discovery during the late 1960's in a captive deer facility in Colorado, but it seems to be spread by nose-to-nose contact between animals and exposure to contaminated feed, soil, or bodily fluids. It affects many cervids

including white-tailed and mule deer, elk, and moose but has only been experimentally transmitted to caribou or domestic cattle. Susceptibility of exotic cervids (e.g. fallow deer) remains unknown. Currently, there is no evidence that CWD affects humans but it is a serious concern for natural resource agencies due to the number of unknown factors involved, the potential for high mortality rates in deer and elk, and the occurrence of CWD in disjunct areas. CWD occurs in wild and captive cervid herds, but seems to spread more rapidly in high density captive situations. Samples obtained from a female white-tailed deer harvested in Frederick County, Virginia in November 2009 tested positive for CWD. This deer came from an area near West Virginia where 62 cases of CWD have been confirmed since 2005. At this time, CWD is not seen as a risk to elk restoration in Virginia if the restoration area is confined to Southwest Virginia (some 200 miles from Frederick County, Virginia) and if only sources considered at low risk for CWD are used for any elk stocking efforts. One unknown factor involves less restrictive deer and elk farming in states surrounding Southwest Virginia including Tennessee, North Carolina, and Kentucky. CWD could occur in captive cervid farms in one of these states, increasing the degree of transmission risk into wild cervid herds in Virginia.

Meningeal Worm

Meningeal worm *Parelaphostrongylus tenuis* is a parasitic worm found in white-tailed deer throughout most of eastern North America. It typically causes little mortality in white-tailed deer, but can cause illness and death in elk, moose, llamas, goats, and guinea pigs. Worms travel along the spinal cord and eventually into the brain causing trauma to the infected animal. Elk infected by meningeal worms, also referred to as "brain worms", will sometimes become severely emaciated and have various symptoms of neurological damage. Some elk die as a result but other elk can recover and even gain immunity against future infection. Even though brain worms are expected to kill some young elk, and mortalities should be planned for, the parasites are not expected to be a limiting factor in elk restoration, as demonstrated by several successful elk restorations in the East (e.g. AR, KY, MI, and PA) (Wathen et al. 1997, AGFC 2001, Larkin et al. 2003,). As noted earlier in the text, meningeal worm did infect and cause mortality of elk released in the early 1900's. In 2006, a bull elk was discovered in Wise County near the Kentucky border with a severe meningeal worm infection (SCWDS unpublished report). Elk restoration is not expected to increase the risk of transmission to domestic animals such as llamas, goats, or guinea pigs because meningeal worm is already present in Virginia.

Epizootic Hemorrhagic Disease/Bluetongue

EHD/bluetongue viruses are a group of related viruses endemic to white-tailed deer populations in much of the eastern United States, particularly in the Southeast (Davidson 2006). EHD causes fever and sometimes death for white-tailed deer, usually in late summer. This disease affects some deer populations more readily than others, but effects are usually temporary (1-3 years of lower population levels after a severe outbreak). It does not usually affect elk but they do develop antibodies after exposure. EHD is not expected to be a serious problem with elk restoration in Southwest Virginia.

Paratuberculosis

Paratuberculosis, also known as Johne's disease, is caused by the bacterium *Mycobacterium avium paratuberculosis*. This disease is different than bovine TB discussed earlier in this section. Symptoms in cattle include emaciation (and sometimes diarrhea). It normally only produces clinical signs in captive elk and deer and even then it is relatively rare

for clinical signs to manifest. Johne's disease was diagnosed in a free-ranging while-tailed deer from Fauquier County, Virginia in 2006 (Sleeman et al. 2009). This appears to be an isolated case, and deer from this region do not appear to represent a reservoir for the organism. Neither wild deer nor elk seem to be important in the overall epidemiology in the southeastern U. S. However, it is unknown whether elk will serve as a reservoir for Johne's disease and facilitate its spread.

Leptospirosis

Leptospirosis is caused by serovars of the spirochete bacterium *Leptospira interrogans*. It normally is not a concern with wild elk or white-tailed deer (Davidson 2006). Antibodies to the various serovars have been detected in elk and white-tailed deer but it is not known to cause symptoms. It mainly receives attention due to the effect it has on cattle production and is found worldwide. It can cause sudden death, depression, bloody urine, kidney disease, jaundice, and a breakdown of blood cells in cattle. Preventative treatment in cattle usually involves vaccination and administration of antibiotics for infected individuals (Merck Veterinary Manual, 9th Edition, 2008). Elk do not appear to be reservoirs of this disease (Toweill and Thomas 2002).

Bovine Rhinotracheitis

Bovine rhinotracheitis (IBR) is a relatively minor viral disease affecting the upper respiratory tract of ungulates. It is not considered a high risk disease in ungulates.

Parainfluenza

Parainfluenza-3 is a viral disease that can cause pneumonia in animals with compromised immune systems. It is sometimes detected in cattle and wild ungulates such as elk, deer, and bighorn sheep but normally does not cause mortality unless the animal has a secondary bacterial infection (Merck Veterinary Manual, 9th Edition, 2008). It is not an important elk disease but antibodies for parainfluenza-3 have been detected in 4 elk tested in Kentucky (Corn et al. 2009).

GENERAL AREA DESCRIPTION AND DEMOGRAPHICS

Area Description

The area under consideration is comprised of 7 counties all or partly in the Cumberland Plateau physiographic province, commonly called the Coalfields, in the southwest corner of the Commonwealth (Figure 1). Five of the 7 counties are also in the Valley and Ridge province, south and east of the Coalfields. The region most likely to be affected by elk includes Buchanan, Dickenson, Wise, Lee, Scott, Russell, and Tazewell counties. The latter 4 counties are primarily within the Valley and Ridge physiographic province. These two physiographic provinces are similar in some ways, but the differences in topography, geology and vegetative cover are noteworthy.

Cumberland Plateau Province

The Cumberland Plateau is rugged. Flat land is relatively scarce, found primarily on broad ridge tops and narrow floodplains. The drainages in the Cumberland Plateau are described as dendritic, meaning that the streams and valleys separate or branch out in a random pattern. Elevations rise abruptly from less than 1,000 feet where the Russell Fork and Levisa Fork Rivers enter Kentucky to more than 3,000 feet on the ridgelines.

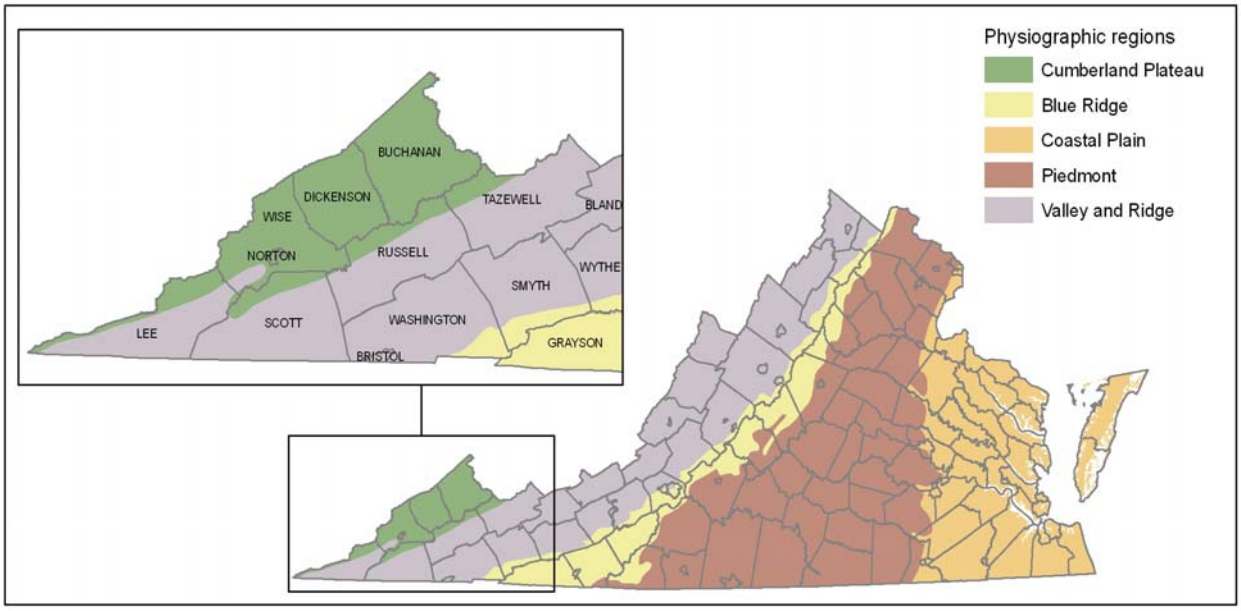

Figure 1. Physiographic regions of Virginia.

High Knob, in Wise County, is the highest peak in the area at 4,223 feet. The geology of the Cumberland Plateau is characterized by horizontal layers of sedimentary rock. These flat layers of rock are easily visible at natural outcrops and where road construction cuts through the mountains. Some of the upper rock layers in this area contain valuable mineral resources including coal, natural gas and petroleum. Extraction of these resources has altered the natural topography and vegetative cover of the landscape.

Resource extraction began to alter the landscape of the coalfields as early as the late 1800's, when railroads were constructed to move coal from loading facilities (tipples) near the underground mines to industrial centers hundreds of miles away. The local economy changed from subsistence farming to a cash economy based on the products of coal and timber. Farmland reverted to forestland and marketable timber was harvested. Widespread timber harvest removed most of the mature timber, and an introduced blight eliminated one of the dominant tree species, the American Chestnut (*Castanea dentata*) in the early 1900's. The resulting forest was a mix of oaks (*Quercus spp.*) and hickories (*Carya spp.*) on the ridges, with a greater diversity of species in the fertile valleys and coves. The early successional forests that replaced abandoned farmlands were dominated by yellow-poplar (*Liriodendron tulipifera*) and other softwoods. *Rhododendron spp*. were the most common evergreen, with only a few other native evergreen species such as the hemlock (*Tsuga canadensis*), and Virginia pine (*Pinus virginiana*). White pines (*Pinus strobus*) were planted in many open areas during the mid 1900's.

These early changes were not as conspicuous, however, as those brought on by the advent of surface mining in the 1930's. Surface mining is the process of removing the layers of soil and rock that cover a seam of coal in order to extract the coal. These layers of soil and rock are referred to as overburden. This mining technique is in contrast to underground mining, a process in which the coal is removed through tunnels or shafts without removing the overburden. Surface mining changes both the topography of the area from which the overburden was

removed and the area where the material is deposited. In a typical surface mining operation, the overburden is removed down to the layer that exposes the seam of coal. This creates a level bench across the slope of the mountain. A high wall of exposed rock layers is created between the strip bench and the original contour on the uphill slope. The overburden is often hauled and deposited on the downhill slope away from the bench. Mountaintop removal is another type of surface mining. As the name implies, in this method the layers of overburden that form the ridge or top of the mountain are completely removed down to the layer that contains the coal seam. The overburden is deposited in nearby valleys in a process called "valley fill". The combined processes (mountaintop removal and valley fill) create a plateau with level or gradually sloping contours.

Prior to the passage of the Surface Mine Control and Reclamation Act of 1977 (SMCRA), there were few regulations governing how the land would look after mining. Consequently, many surface mines were abandoned during this time without restoring the original contours, managing overburden or establishing vegetation to prevent erosion. The overburden rarely would support plant life due to the size and composition of the materials and the lack of topsoil. Since 1977, all new mining operations have been required to obtain permits, protect the environment during active mining and plan for reclamation of the affected lands for future use. As mining technology and the market price of coal have increased it was profitable to re-mine abandoned mined lands to access deeper seams or recover coal discarded in previous operations. These re-mining operations are also subject to the SMCRA regulations. Previously mined lands that are not suitable for re-mining may be reclaimed through the Abandoned Mined Lands (AML) process that was also established by the SMCRA. The AML reclamation projects are funded through a tax levied on each ton of coal that is mined.

Although some mined lands persist in the condition in which they were abandoned, many areas have been reclaimed. Some have been restored to original contours, but other mined lands have been reconstructed to provide flat land that is at a premium in this area. These reclaimed mined lands provide enhanced opportunities for residential, agricultural, industrial and retail development. Schools, colleges and medical facilities have also been constructed on previously mined lands. Vegetation has been established on all reclaimed mine sites both to prevent erosion and to benefit wildlife. Reclaimed surface mines now provide a substantial amount of important wildlife habitats including grasslands, shrublands and early successional forests.

Natural gas well development has also changed the landscape of the Cumberland Plateau. Nearly 6,000 gas wells have been established in recent years. Each gas well installation requires road construction and site preparation (clearing and grading the site). These small clearings are typically planted in grass and maintained as open land. The well sites diversify wildlife habitat by providing openings in the forest, and the associated infrastructure of access roads and transportation pipelines provide both habitat diversity and travel corridors for many species.

Valley and Ridge Province

The topography of the Valley and Ridge is characterized by long parallel ridges that run from southwest to northeast. The ridges are separated by correspondingly long valleys and rivers. This type of parallel drainage pattern is known as a trellis pattern. Elevations range from just over 1,000 feet on the valley floor to over 4,000 feet at the ridgelines. Beartown Mountain, in Tazewell County, is the highest peak in the area at 4,700 feet. This mountain forms part of the rim of one of the area's most unique topographical features, a bowl-shaped valley known as

Burke's Garden. Burke's Garden is one of the highest valleys in Virginia, with an elevation of 3,000 feet.

Whereas the extraction of mineral resources greatly influenced the types of vegetation present in the area, the vegetation of the Valley and Ridge province is determined more by the minerals that remain in the ground. The geology of the Valley and Ridge is also comprised of sedimentary rock. However, the layers of rock are folded and faulted rather than flat. These formations contain little or no coal. The ridges are formed primarily of sandstone, and the valleys have deposits of more easily weathered shale and carbonates. The floodplains and valleys of this province are much wider than in the Cumberland Plateau. The forested ridges of the Valley and Ridge province are also dominated by oaks and hickories with greater species diversity in fertile coves and valleys. The wider valleys and floodplains, some of which have limestone soils, are better suited for agriculture. Consequently, croplands and grasslands are more common. Grasslands that are no longer maintained by grazing or hay production often revert to stands of eastern red cedar (*Juniperus virginiana*) before advancing to intermediate and advanced stages of forest succession.

The area (Buchanan, Dickenson, and Wise counties as well as surrounding counties) includes lands owned by private individuals, corporations and various public entities. The largest corporate landholdings are owned by companies engaged in the mineral resource, timber and agricultural industries. Public lands are owned and managed by local, state and federal agencies, as well as by non-governmental organizations (NGO's) (Figure 2). Local governments include the 7 counties mentioned previously, as well as several cities and towns.

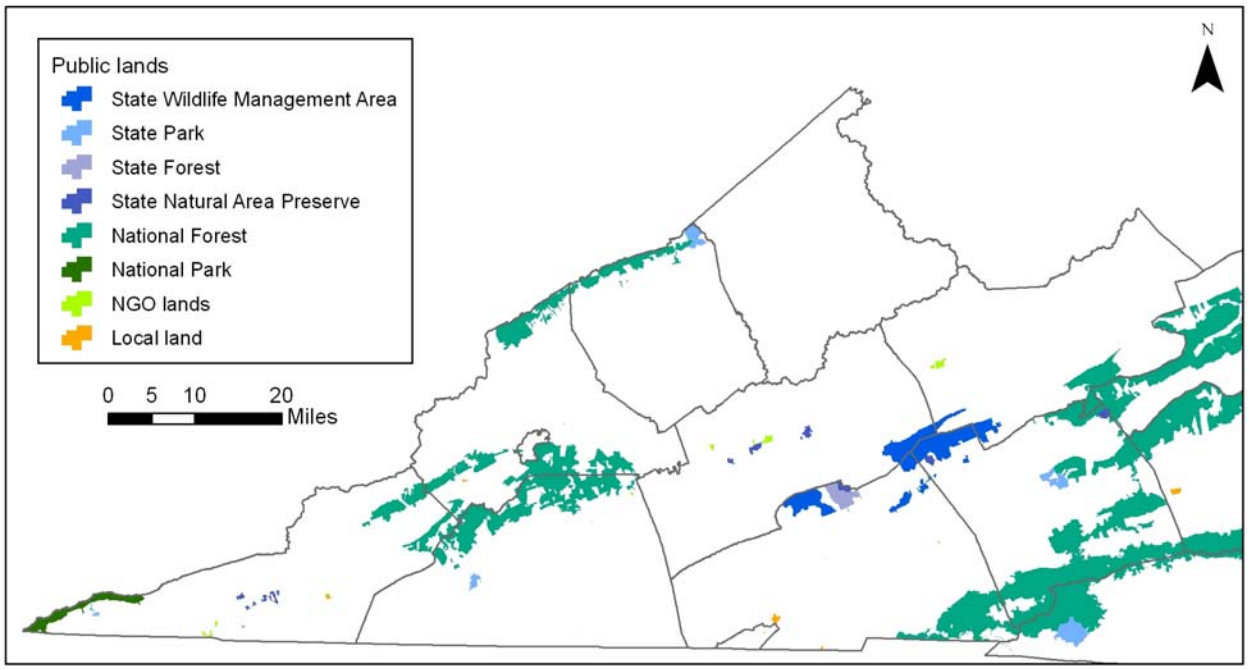

Figure 2. Public lands displayed according to owner type. Data provided by the Virginia Department of Conservation and Recreation, Division of Natural Heritage.

Table 2. Agricultural land use in the area.

County	Acres of Farmland
Buchanan	9,331
Dickenson	14,342
Wise	22,169
Lee	117,776
Russell	151,564
Scott	153,881
Tazewell	153,677
Statewide County Average	82,693

Notable state-owned lands include: the Pinnacles Natural Area, Wilderness Road and Natural Tunnel State Parks (Virginia Department of Conservation and Recreation); Keen Mountain Correction Center, Red Onion and Wallens Ridge State Prisons (Virginia Department of Corrections); the Channels State Forest (Virginia Department of Forestry) and the Clinch Mountain Wildlife Management Area (VDGIF). The Breaks Interstate Park is an interstate holding on the Virginia-Kentucky border in Dickenson County. Federally-owned lands include portions of the Jefferson National Forest (U.S. Forest Service), the Cumberland Gap National Historic Park (National Park Service), the John W. Flannagan Reservoir Project (U.S. Army Corps of Engineers) and some riparian habitats owned by the Tennessee Valley Authority. The Nature Conservancy is 1 NGO that owns several parcels of land in the Clinch, Holston and Powell River drainages.

Land Use Characteristics

Land use characteristics differ between the Cumberland Plateau and Valley and Ridge counties (Table 2). Buchanan, Dickenson, and Wise are located on the Cumberland Plateau and are the largest producers of coal in the state. Total area of these 3 counties is 1,242 square miles. According to the 2007 USDA agricultural census, Wise County had 22,169 acres of farmland, Dickenson had 14,342 acres of farmland, and there were 9,331 farm acres in Buchanan County.

These 3 counties contain much less farmland than the Virginia county average of 82,693 acres (the average for Buchanan, Dickenson, and Wise is 15,281 agricultural acres). However, the 4 adjacent counties that are also likely to be influenced by elk contain much larger agricultural acreages than the Cumberland Plateau counties. Lee, Russell, Scott, and Tazewell counties all contain an average of 144,222 acres of agricultural land, nearly 10 times the average of the coalfield counties.

Similar to land use, there is much variation among land cover in the 7 counties in southwest Virginia. Dickenson and Buchanan are mostly forested, while there are significant portions of the other 5 counties in open areas (Figure 3). Lee, Tazewell, Russell and Scott have a high percentage of farm area which accounts for much of their open areas. The open areas on the Cumberland Plateau represent mostly reclaimed surface mines, particularly those where grasslands were established. While there are surface mining activities in all these counties, the majority of the surface mining occurs in Wise County, followed by Buchanan and Dickenson (Table 2.).

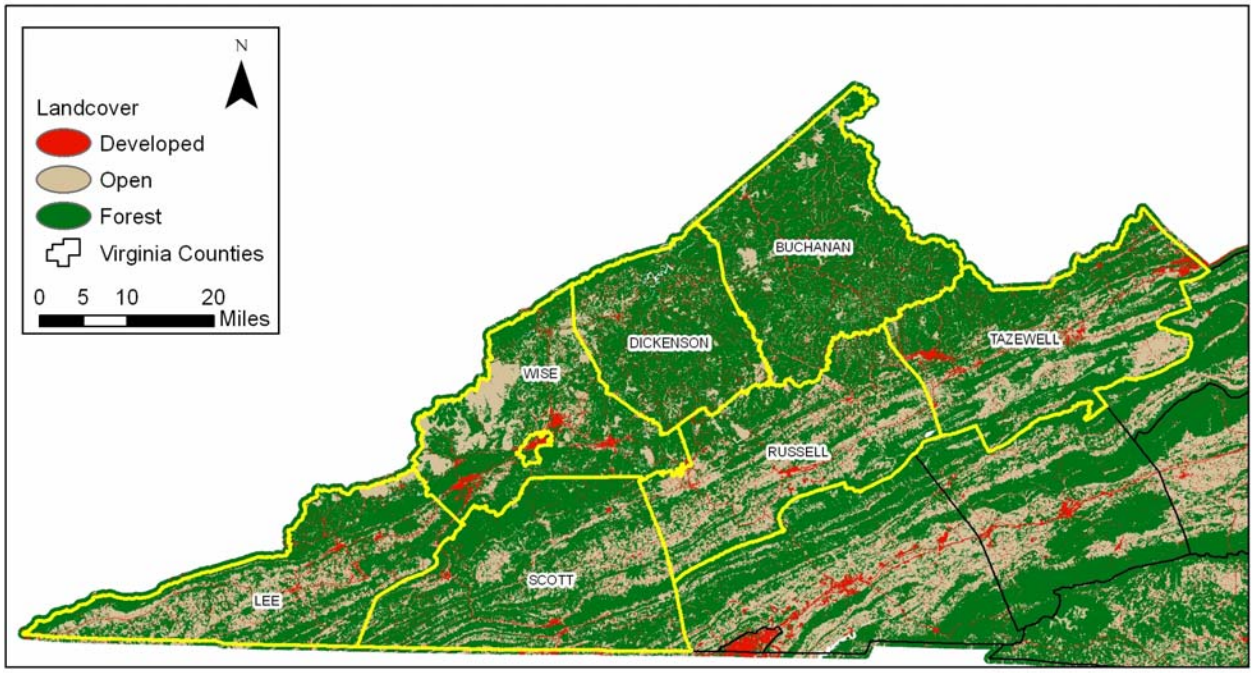

Figure 3. Landcover map of southwest Virginia. The map is based on the 2007 United States Geological Survey (USGS), National Landcover dataset (NLCD) with updates from the 2007 aerial imagery from the Virginia Geographic Information Network's Virginia Base Mapping Program (VBMP). The open areas category includes agricultural, barren, scrub-shrub and grassland categories.

The surface mined areas are more dispersed in Buchanan and Dickenson Counties, whereas in Wise County there is a larger and more focused center of activity along the western border (Figure 4.). This more contiguous area is shown below on the map (Figure 3), as the prominent and primarily open area.

Table 3. Land area of permitted surface mines, developed land, open land, forested land and total land area per county. Areas of developed, open and forested land are calculated from the 2007 USGS NLCD with updates from 2007 VBMP. The area of mines is based on permit data from the DMME.

County	Acres of Developed	Acres of Mines	Acres of Open	Acres of Forest	Total Acres
Buchanan	20,589	19,234	37,224	264,440	322,317
Dickenson	15,246	8,077	30,114	166,787	213,352
Wise	19,040	29,843	74,005	165,782	259,254
Lee	19,768	5,845	83,679	176,274	280,058
Russell	20,910	3,460	112,096	171,268	304,962
Scott	18,148	96	82,736	242,846	344,614
Tazewell	25,932	2,929	92,136	214,427	332,548

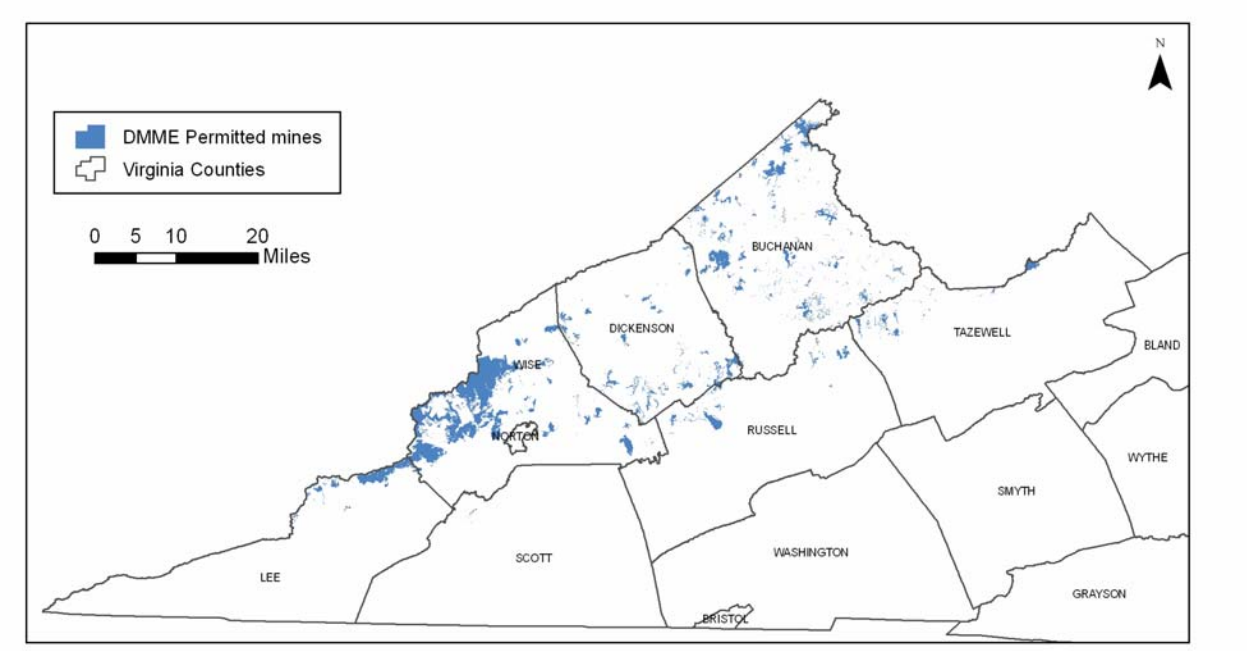

Figure 4. Areas of coal surface mine permits in Lee, Wise, Dickenson, Buchanan, Scott, Russell and Tazewell counties. Data provided by Virginia Department of Mines, Minerals and Energy, Division of Mined Land Reclamation.

ELK MANAGEMENT OPTIONS

During Kentucky's elk restoration efforts, some elk released in Kentucky moved into Virginia and established small herds in a few scattered locations. As a result of elk moving into Virginia, a number of Virginia citizens have expressed interest in restoring elk to the Commonwealth. Some citizens view elk restoration as a positive endeavor, but others have concerns over damage and disease introduction. In order to assess the potential for restoring elk in Virginia, the Elk Committee has identified several possible elk management options: maintaining current management, passive restoration, and active restoration. The following sections describe these elk management options during a 12-year period. The 12-year planning horizon begins immediately in the case of the No Restoration Option or the Passive Restoration Option and begins the first year elk are released for the Active Restoration Option.

Option 1: No Restoration Option (Current Management)

This option for managing elk will maintain the current management strategy with no structured restoration effort. Both sexes of elk are currently subject to harvest on any day of the legal deer season and this hunting regulation would remain in effect. VDGIF staff has used this liberal harvest strategy to retard the establishment of a reproducing elk population. The No Restoration Option assumes that the elk population in Virginia will not grow, or will increase only slightly during the 12-year planning period. The population goal is no elk, although it is likely that there will always be a few immigrant elk in Virginia.

The elk management plan would guide state response to elk-related issues that arise, even without a restoration program. A few elk emigrating from Kentucky could cause nuisance problems, requiring an effective set of elk control guidelines and agency responses to elk incidents. VDGIF's education and outreach program would continue because public interest in elk is unlikely to wane. Hunters and wildlife watchers will continue to seek information regarding recreational opportunities, harvest statistics, and areas in which to hunt elk. Mandatory check-in of elk would continue under the No Restoration Option in order to collect harvest data including age, location of kill, other pertinent information, and tissues for disease testing.

Advantages of this option

- Minimal property damage
- Low management costs to VDGIF

Disadvantages of this option

- Unfulfilled recreational opportunity
- Unfulfilled economic benefits to communities

Cost estimate

- 12-Year Net Cost - $97,364

Restoration Options

The prevailing land use of the Valley and Ridge counties (Lee, Scott, Russell, and Tazewell) complicates their management for elk due to potential damage to agricultural property. However, the Cumberland Plateau counties of Buchanan, Dickenson, and Wise have suitable elk habitat and a more limited potential for damage to property, including agricultural property. Kentucky, Tennessee and Pennsylvania serve as models for elk restoration in the eastern United States and a comparison to the area considered in this plan is useful. Buchanan, Dickenson, and Wise counties appear to offer the best potential for elk restoration when land use and land cover types are considered. There are fewer acres of crops in these counties than in elk management areas in Kentucky, Pennsylvania or Tennessee (Table 4). Another indicator of habitat quality is road density, which is related to remoteness of habitat areas. The road density in Buchanan, Dickenson, and Wise counties is higher than in elk management areas of Pennsylvania and Tennessee, but less than in Kentucky (Table 4). Buchanan, Dickenson, and Wise counties might be managed for elk successfully and are hereinafter referred to as the "Potential Elk Restoration Area".

Table 4. Comparison of road density (miles of roads per square mile of land) and density of agricultural land (acres of crops per square mile of land) in the Potential Elk Restoration Area and elk restoration areas within 3 states. Agriculture data was downloaded from the 2007 USDA agriculture census. Road density was calculated using ESRI's Tele Atlas of North America dataset.

State	Miles of Roads/Mi^2	Acres of Crops/Mi^2
Kentucky	0.38	14.54
Pennsylvania	0.17	39.15
Tennessee	0.22	63.20
Virginia	0.35	10.59

Elk could be restored to Virginia in one of two ways, a passive approach or an active approach. Passive restoration would rely upon elk currently in Virginia, as well as immigration of more elk from Kentucky. Active restoration would rely upon translocation of elk from outside the state. In either case, the Potential Elk Restoration Area could provide the manageable space to support a herd of 1,200 animals, or 1 elk per square mile.

Identifying landowners within the restoration area willing to provide elk habitat on their lands and gaining their support would be vital to a successful restoration effort. Establishing a buffer around the Potential Elk Restoration Area would help define the way elk are managed inside versus outside the area. The current option of harvesting an elk of either-sex during deer hunting seasons would have to be suspended within the Potential Elk Restoration Area while the elk population increases to a level that would sustain hunting. However, this elk hunting regulation should remain in effect in Virginia outside the Potential Elk Restoration Area.

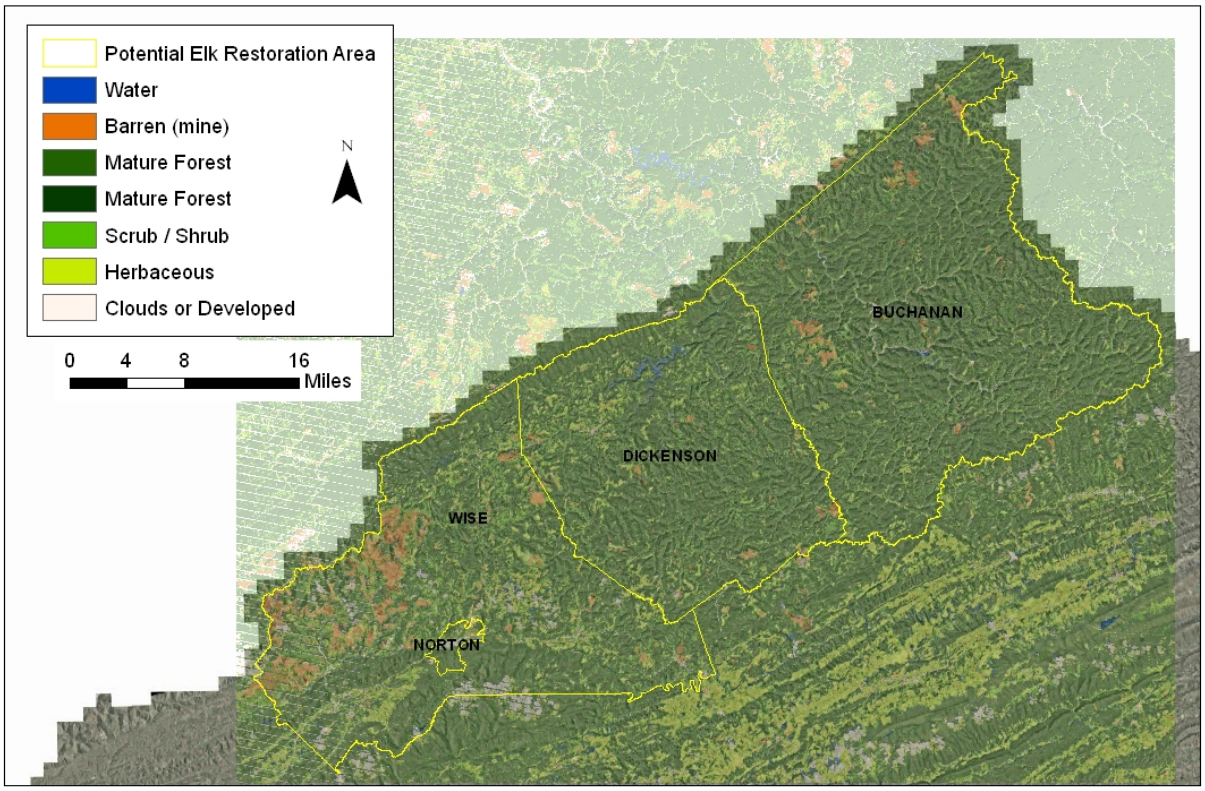

Figure 5. Potential Elk Restoration Area. Landcover classification developed by DGIF, based on 2009 Landsat 7 Satellite Imagery. Aerial imagery from 2006-2007 provided by Virginia Geographic Information Network.

Population and harvest management goals must be established to identify when hunting could resume and whether certain sex or age categories of elk would be protected. Generally, population growth would not be seriously impeded with conservative bull harvests at a relatively low population size (at least 100 adult bulls in the population). However, conservative harvests of cows should not begin before the total elk population has exceeded 400 animals with 150 adult cows in the population.

Option 2: Passive Restoration Option

Passive restoration would not include transplanting elk into Virginia. A passive approach would protect existing elk from harvest and allow herds to grow where they have currently established. Assuming that there are about 50 elk now in Wise County, a population model predicts that Virginia could have an elk herd of about 500 animals in the Potential Elk Restoration Area within 12-years (Appendix 4). While population models suggest what might be achieved in the way of population growth, they can not take into account chance events that could greatly influence herd growth. This is particularly important to keep in mind when considering this option. For example, immigrant elk may be so widely dispersed that population growth is much slower than possible in well-established herds. Also, events in Kentucky may strongly influence elk emigration to Virginia. There may not now be 50 elk in Virginia, and it could be many years before a herd of sufficient size to produce steady population growth takes up residence.

Estimated costs of the Passive Restoration Option are presented in Appendix 5. It is recommended that VDGIF conduct helicopter flights every 3 years in order to identify areas that continue to hold elk, as well as to count elk. Once a small herd establishes itself in Virginia, habitat management could help to concentrate elk and encourage herd growth.

With an increasing elk herd, VDGIF would take mitigating actions to ameliorate issues caused by elk. Elk population growth would prompt VDGIF to hire elk project staff, including and Elk Project Leader, 2 Conservation Police Officers, and 2 Wildlife Technicians to manage the increasing elk herd. VDGIF would work with cooperating landowners to improve elk habitat in an attempt to concentrate and hold elk on suitable lands. VDGIF staff would assist property owners experiencing damage from elk by supporting activation of a judicious mechanism to compensate property owners for elk damage, by providing technical advice to landowners, and by acting directly to remove or harass offending elk. VDGIF staff would increase education and outreach activities to improve citizen, local government, and local business knowledge about elk and elk management.

<u>Advantages of this option</u>

- Least controversial of the restoration options
- Harvest of 40 elk (over 12 years)
- Minimum effort to accomplish elk restoration
- Slower population growth allows region and DGIF to slowly adapt
- Cheapest of the restoration options, with the lowest initial investment

Disadvantages of this option

- Longer period of time needed to establish an elk herd to provide hunting or viewing opportunities
- Least certainty for success (unknown and low initial population size)
- Population goal not reached in 12 years
- Some property damage
- Less funding management from hunting revenue

Cost Estimate

- 12-Year Net Cost - $1,662,466

Active Restoration Options

Active restoration would involve obtaining elk from one or more sources to be transplanted into a specific area. This method is commonly used to restore a wildlife population in a relatively short time. The population goal would be to establish an elk herd of 1,200 animals in the Potential Elk Restoration Area within 12 years following an initial release of elk. VDGIF would need to find one or more cooperating landowners willing to provide an appropriate Elk Release Site. A suitable Elk Release Site would be cooperatively-managed properties of sufficient size to provide for the food and other needs of released elk throughout the year. The area must also allow controlled access for protection of the elk from disturbance and for public enjoyment of the elk resource.

Potential source herds of elk would have to be identified and a stocking timeline established, including the number of elk to be released in each sex and age class by year. In most elk restoration programs, stocking occurs over several years regardless of scale. Capture, quarantine, and release usually occur during winter months, after the breeding season ends, and well before calving season in late spring. Elk are normally captured using a baited corral trap. All elk would be quarantined in the area where they are captured and tested for pertinent diseases before movement. Quarantining elk typically involves holding them in an escape-proof corral until appropriate disease testing is completed as specified by the State Veterinarian. The quarantine period would likely be a period of 90 days, the time necessary to perform two tests for bovine brucellosis and TB. Quarantining elk would require providing food, water, and security from harassment for the animals, as well as observing them for signs of disease. After the disease testing and quarantine period, elk would be loaded into cattle trailers and driven to a suitable release site within the Potential Elk Restoration Area.

VDGIF would not move elk into the state from sources that are likely to bring bovine tuberculosis, bovine brucellosis, CWD, or other high-risk diseases into Virginia. However, there are several potential source herds currently in North America. Wild elk in Kentucky are one of the safest sources for elk available. Furthermore, the most logistically simple and cost effective source is located in Kentucky. Some of these elk have already crossed over the state boundary and become established in scattered localities in southwestern Virginia. Natural migration will likely continue, but is not expected to occur rapidly. Overall, elk in Kentucky have not moved far away from release sites because of mild winters and abundant but disjunct forage areas. Release site fidelity has persisted despite rapid population growth and close proximity to

unoccupied suitable habitat, both in Kentucky and Virginia (Logsdon KDFWR, personal communication). Depending on where elk would be obtained in the Kentucky, transport by cattle trailer to Virginia release sites would likely be less than 75 miles. The greatest expenditure of time, effort, and money during the transplant phase would be in capturing and quarantining elk.

Another potential source herd is located in Alberta, Canada at Elk Island National Park (EINP). This park has been a source herd for various elk restocking programs in North America. Park personnel typically make surplus elk available to various government agencies intending to establish self-sustaining, free-ranging elk populations. As discussed in Appendix 1, there is a cervid importation restriction between Canada and the United States, making the EINP herd a nonviable option at this point. Also, at least two other states (Wisconsin and Tennessee) have expressed interest in obtaining elk from this herd to augment their elk populations, meaning that Virginia would have to wait for these states to fill their transplant needs before receiving elk from EINP after any import restrictions are lifted. USDA APHIS recently completed a risk assessment for introducing bovine TB or brucellosis into the United States from animals brought in from Elk Island National Park and concluded that the risk was very low. This finding suggests that this herd may become a viable source herd soon. However, CWD was discovered in deer near EINP recently and the viability of this source for elk remains in doubt.

A third method of acquiring elk for release into Virginia would be similar to that used by Kentucky to stock elk in the eastern part of their state. Kentucky acquired elk from six western states, including Arizona, Kansas, New Mexico, North Dakota, Oregon, and Utah. One serious concern with acquiring elk from multiple sources in the western part of the U.S. is the risk of importing a disease such as CWD. Furthermore, this method would likely be the most expensive source given the distance from Virginia and the likelihood of having to obtain elk from more than one state. A mixed source of elk could involve obtaining some animals from a more economic source such as Kentucky and obtaining others from more distant, western sources if Kentucky were unable to provide a satisfactory number of elk.

Active restoration could involve multiple stocking scenarios with varying herd growth rates, transplant costs, research and monitoring costs, as well as the number of elk that could be harvested during the 12-year planning period. To provide examples of projected costs, hunter-related income, and hunting schedules, the Elk Committee has made estimates of population growth and expenses for each of 3 active restoration scenarios (Appendix 5).

These population growth and project cost estimates are sensitive to many external factors, including the availability of elk, the demand for elk hunting, and other factors. Costs and revenues presented are estimates only, as many factors could influence actual annual costs, income, and population growth over the 12-year planning period. Consultation with several states recently involved in elk restoration revealed an average cost of $1,000 per animal to capture, quarantine, test for diseases, and transport. This cost estimate does not include other expenses such as radio collaring, population monitoring, habitat monitoring, research, or increased staffing needs (see Monitoring and Research Needs section below). Increased fuel costs or other unforeseen circumstances could increase the cost per animal.

It is certain that should VDGIF choose an active restoration option for managing elk, the implemented project would not follow one of these scenarios exactly. However for planning

purposes, the Elk Committee has designed these scenarios to represent conservative, moderate, and more aggressive approaches to active restoration.

Option 3: 75 Elk Stocked in Initial Year

This scenario schedules a one time stocking of 75 elk. The approach is basically a go-slow one that involves moving a minimum number of elk into the state to form a nucleus herd for future population growth. Based on a population growth model, the elk herd could reach about 500 animals in a 12-year period. Hunting of bulls could begin 9 years following release of elk. By year 10, tags could be issued for cows as well.

This scenario also funds aerial helicopter surveys the first year of the project and then every third year afterwards. Additionally, the Committee recommends hiring an elk management staff (as outlined in the Passive Restoration Option) in the first year of the project. Communication and outreach activities would intensify to maintain close contact with communities in the Potential Elk Restoration Area.

Advantages of this option

- Easier to monitor and manage elk stocking
- Intermediate population growth allows region and DGIF to adapt
- Costs are more evenly distributed over the years (less front-end loaded)
- 150 elk harvested (over 12 years)

Disadvantages of this option

- Some property damage
- Population goal not reached in 12 years
- Longer time to realize recreational and economic benefits to communities
- Higher elk management cost to VDGIF

Cost Estimate

- 12-Year Net Cost - $2,829,462

Option 4: 200 Elk Stocked Over a 3-Year Period

This scenario schedules the stocking of 75 elk in year one, 75 elk in year 2, and 50 elk in year 3 (200 animals total). Based on population growth modeling, the population would grow to over 1,200 during the 12-year planning period. Herd growth would support harvesting at least 10 bulls each year beginning in year 4 (first year after transplanting ends). By year 7, tags could be issued for cows as well.

This scenario also funds a 4-year research project starting the first year that elk are released (see Monitoring and Research Needs section). Aerial surveys would occur each year for the first 4 years and then every third year afterwards. Additionally, the Committee recommends hiring an elk management staff (as outlined in the Passive Restoration Option) in the first year of

the project. Communication and outreach activities would intensify to maintain close contact with communities in the Potential Elk Restoration Area.

Advantages of this option

- Higher recreational and economic benefit to communities
- 425 elk harvested over 12 years

Disadvantages of this option

- Increased property damage
- Higher elk management cost to VDGIF
- Harder to monitor and manage elk herd
- Costs are very front-end loaded

Cost Estimate

- 12-Year Net Cost - $2,994,338

Option 5: 200 Elk Stocked in Initial Year Only

This scenario schedules a one time stocking of 200 elk. Based on a population model, the elk herd would grow to over 1,300 animals during the 12-year planning period. Herd growth would support hunting bulls in year 4 and cows in year 5 following the initial stocking.

This scenario also funds a 4-year research project starting the first year that elk are released (see Monitoring and Research Needs section). Aerial surveys would occur each year for the first 4 years and then every third year afterwards. Additionally, the Committee recommends hiring an elk management staff (as outlined in the Passive Restoration Option) in the first year of the project. Communication and outreach activities would intensify to maintain close contact with communities in the Potential Elk Restoration Area.

Advantages of this option:

- Higher recreational and economic benefit to communities
- 480 elk harvested over 12 years

Disadvantages of this option:

- Difficulty in obtaining 200 elk in one year
- Increased property damage
- Higher elk management cost to VDGIF
- Harder to monitor and manage elk herd
- Costs are very front-end loaded

Cost of this option

- 12-Year cost - $2,910,938

Post-Release Actions

Under any Active Restoration scenario, VDGIF would take mitigating actions to ameliorate negative results of the Active Restoration approach. Sufficient numbers of elk would be outfitted with radio telemetry so that elk movements could be monitored. An effort would be made to locate elk that have died to determine the cause of death and to obtain tissues for disease testing.

VDGIF would work with cooperating landowners to improve elk habitat in an attempt to concentrate elk on suitable lands. VDGIF staff would assist property owners experiencing damage from elk by supporting activation of a judicious mechanism to compensate property owners for damage by elk, by providing technical advice, and by acting directly to remove or harass offending elk. VDGIF staff would increase education and outreach activities to improve citizen, local government, and local business knowledge about elk and elk management.

RECOMMENDATION

The Elk Committee recommends that VDGIF should pursue the Active Restoration Option to establish a population of 1,200 elk in the Potential Elk Restoration Area (Buchanan, Dickenson, and Wise counties). The Elk Committee further recommends that the project should set a goal of releasing 200 elk over a 3-year period in one suitable Elk Release Site within the Potential Elk Restoration Area. The Committee does not recommend establishing multiple herds over a wide area with the 200 elk.

MANAGEMENT CONSIDERATIONS

If VDGIF is successful in establishing an elk herd in the Potential Restoration Area, staff will spend a considerable amount of time and resources managing elk. The following sections present pertinent information on several aspects of the management of elk.

Recreation Management

Demand for Hunting

Demand for elk hunting today is high, both nationally and in Virginia. Elk hunting demand has increased throughout the U.S., despite declining participation in hunting generally. The number of hunters who pursued elk in North America rose from 552,773 in 1975 to 834,402 in 1995, a 51% increase (Toweill and Thomas 2002). Hunters today have a keen interest in elk as evidenced by the requests to VDGIF for information about hunting elk in Virginia. Kentucky has also received much interest from hunters interested in hunting elk. In 2008, almost 34,000 people purchased a $10 chance to win one of 400 tags that were drawn to hunt elk in Kentucky. People applied from 49 states. Virginia hunters bought 427 lottery tickets for Kentucky's 2008-2009 elk hunt (KDFWR).

Regulation of Hunting

With the high demand for elk hunting opportunities, it has become necessary for elk managers throughout the nation to carefully regulate hunting pressure, as well as elk populations. Western state wildlife agencies are heavily dependent on revenues from elk licenses and have expended considerable effort to improve management of elk. The challenge for wildlife

managers is to protect and maintain healthy age class and sex ratios while sustaining elk hunting opportunity (Toweill and Thomas 2002). Mature bulls are earnestly sought by both hunter and non-hunter alike. In western states, increased access to elk habitats through construction of logging and mining roads coupled with high hunting pressure has reduced the number of mature bulls in populations. Furthermore, their decline as a segment of the population has resulted in undesirable conditions including disrupted breeding seasons and reduced calf production. Most states and provinces have an antlered-only elk season, followed or preceded by a controlled hunt during which a limited number of licenses are issued for antlerless elk (Toweill and Thomas 2002). Control of access to elk, whether on public or private lands, is an important component of a successful elk management program.

Wildlife Viewing/Tourism

Under the Code of Virginia §29.1-509 (Appendix 2) landowners who provide access to their land at no charge have limited liability for damages to hunters, anglers, sightseers or others on their property. Although liability is limited, some landowners continue to restrict access to their properties because of liability concerns. However, some open access to private lands would be feasible. Outfitters who charge to lead trips would, under the Code of Virginia, need to carry their own liability insurance.

The U.S. Forest Service currently manages over 90,000 acres of land in the coal region of Virginia as part of the Clinch Ranger District. The U.S. Army Corps of Engineers holds roughly 7,000 acres of land around Flannagan Reservoir. Breaks Interstate Park is roughly 4,000 acres in size. Although these lands are accessible to the public, little open habitat is available in these areas to facilitate elk viewing opportunities. Beyond these lands however, energy extraction companies and other large industrial landowners would have to grant access to view elk, especially on elk-favored mine reclamation parcels. In Kentucky, almost all of the elk viewing areas are on privately held mine reclamation parcels requiring landowner permission for outfitters to bring in groups.

Beyond this, one other possible means of developing elk viewing areas on private lands is possible under Section E of the same section of code mentioned above. This section does provide the means for the Department or other state agencies or local governments to enter into land access agreements for the express purpose of providing elk-related recreational opportunities to the public.

In the event that traffic becomes an issue in elk viewing areas, as it did in Pennsylvania, VDGIF staff and local governments would need to work with the Virginia Department of Transportation to develop safe roadside pull-offs and other viewing sites on public transportation routes. In Pennsylvania, the safety of elk viewers became a problem when crowds began to stop on small rural roads. Any long-term plans for elk viewing in Virginia would need to be closely coordinated with local governments, VDOT, Virginia State Parks, local chambers of commerce, and local and state tourism officials to address the need for infrastructure related to increased visitation to areas not currently developed for heavy traffic.

Habitat Management

Elk Habitat Needs

Elk are highly adaptable large herbivores that once inhabited a variety of ecosystems found across North America, including many types of prairies and forests (Toweill and Thomas

2002). The restriction of elk to remote and rugged terrain was the result of European settlement and subsequent extirpation of elk in settled areas. Elk, like other species, need food, water, cover, and space. These resources are influenced by many topographic, climatic, and biological factors. However, elk habitat quality is fundamentally a function of cover and forage. Suitable elk range is found in areas where habitats, often forests, providing escape cover and protection from the elements are located near areas of forage. In mountainous portions of the western United States, elk may make seasonal shifts in habitat use in response to climatic and biological factors. For example, elk may move onto southern mountain slopes in winter to feed, particularly when snow depths exceed 18 inches. Also, hot weather may have a pronounced effect on elk activity and habitat selection, with cooler microhabitats and activity periods selected to reduce energy expenditures. Escape cover is an important elk habitat component, and may be provided either by topography or thick vegetation that limits sight distance (Toweill and Thomas 2002). Elk managers and researchers in the eastern United States have frequently emphasized the importance of openings for elk populations in a predominantly forested matrix (Wathen et al. 1997, Zysik and Porter 2005).

Elk Habitat in Virginia

Suitable food and cover resources in Virginia's Coalfields can be found by elk on active and reclaimed coal mine and gas well sites. These industrial activities, when followed by mined land reclamation, produce substantial areas of early successional vegetation near steep slopes. Dense forest with rhododendron and hardwood sapling understories occur on and adjacent to reclaimed mine areas and provides both thermal and escape cover. Openings associated with small farms and residential development in the coalfields also provide limited foraging habitat. Water is abundant throughout the region due to relatively high rainfall and the dendritic drainage pattern of the plateau. The Valley and Ridge portion of the study area also provides elk habitat. Ridges running though the area provide travel corridors and cover. Farm fields provide foraging habitat. Dense red cedar thickets growing on limestone outcrops in abandoned pastures provide cover and forage resources. However, elk that inhabit the Valley and Ridge habitats are more likely to create damage to agricultural property. Valley and Ridge habitats could not support a viable elk population without landowner cooperation.

Mining Practices

In the Cumberland Plateau of southwestern Virginia, mining activity may have negative short-term but positive long-term effects on elk habitat quality. The mining technique of mountaintop removal and valley fill creates disturbance that may displace elk temporarily until mining activity ceases and mine reclamation occurs. However where re-mining is occurring on previously reclaimed lands, elk attracted to forage may become somewhat habituated to mining activity. Reclaimed lands undergo succession slowly and elk may find suitable forage on these lands for many years. Underground mine development and gas well development do not disturb as much land as surface mining, but gas wells can provide smaller openings over a dispersed area. Reclamation practices have an important influence on the quality of elk habitat. Virginia mine operators must file a mine site reclamation plan and post a sizeable performance bond that is released once reclamation objectives are realized. Two general types of reclamation are possible, one resulting in grassland and one in forest. Reclamation projects to create forests will not provide elk habitat for as many years as those creating grasslands. Many mine operators opt for forest reclamation because performance bonds are recovered more quickly, thereby lowering mining costs. Reclamation practices to reestablish forests are changing. Previous reclamation

rules required soil compaction that could inhibit tree root growth. New rules allow more loosely compacted soils conducive to tree root growth. However, areas reclaimed in this fashion are often so rough and rocky that they discourage use by elk (Logsdon KDFWR, personal communication).

Forestry Practices

Forest management, like mining, can have both negative and positive effects on elk habitat quality. Disturbance during logging operations can displace elk. However, elk may return to logged areas if the resulting habitat structure meets their needs. Small clearcuts and selective harvests may increase elk habitat quality if logging slash or post-logging human activities do not discourage elk use of the area. However, increased human access on old logging roads can result in substantial year-round disturbance of elk and higher elk mortality from hunting (Toweill and Thomas 2002). Both private landowners and corporations conduct forest management activities in the study area. In the coalfields, logging often occurs immediately before mining activities commence. In the Valley and Ridge province adjacent to the study area, landowners sell timber on generally smaller acreages when stumpage values are optimal.

Prescribed Burning Practices

Prescribed burning is a commonly used elk habitat improvement practice in western states. Benefits from prescribed burning include increased palatability and availability of forage plants, maintain forest openings, and provide hiding cover for calves (Murrow et al. 2009). Research has documented improvement of elk foraging habitat through use of prescribed burning (Toweill and Thomas 2002). Prescribed burning is not widely practiced in the study area. The U.S. Forest Service regularly conducts prescribed burns on national forest lands in Scott, Lee, Wise, and Dickenson counties, and plans to increase use of this management practice (Adams USFS, personal communication). Private landowners in southwestern Virginia infrequently use prescribed burning extensively as a land management practice.

Livestock Grazing Practices

The extent and intensity of cattle ranching varies tremendously in the study area. In the Valley and Ridge counties, cattle ranching is the primary agricultural activity. Within the Cumberland Plateau counties comprising the study area, cattle ranching is much less prominent, and most available ranges are on reclaimed mine lands attractive to elk. Competition between elk and cattle for forage has been a long-standing issue in the western United States. Of major concern is competition in winter where elk may crowd onto limited and ever-shrinking ranges (Toweill and Thomas 2002). Collaborative problem solving for range competition issues in western states has resulted in demonstration projects that protect range resources, support cattle ranching, and maintain huntable elk populations. Recent research has shown that rotational grazing by cattle may be used to improve elk spring and winter ranges.

Management of Disturbance

Several factors influence the degree of disturbance experienced by elk. Among these are ruggedness of terrain, thickness of vegetation, and intensity of habitat use by humans or other predators. Human activity in elk habitats is highly dependent on land ownership and density of roads open to vehicles. Weather can also cause elk to seek shelter in settled areas, thereby increasing their vulnerability to disturbance.

Management of elk is not possible without cooperation between those who control hunters and those who control land (Toweill and Thomas 2002). While wildlife agencies can put into place appropriate regulations to control hunter numbers and elk harvests, landowners ultimately decide who has access to elk. Research in Idaho has shown that managing vehicular access on public lands improved survival rates of bulls and improved bull/cow ratios (Toweill and Thomas 2002). It is vital that VDGIF forge the needed partnerships with landowners to effectively manage elk. VDGIF partnerships with corporate landowners providing elk habitat potentially could address owner liability concerns, improve behavior of public visitors to corporate lands, and provide secure habitats for elk.

Management of Elk Damage in Virginia

Although elk have caused little damage to property in Virginia to date, reports of property damage from elk would likely increase if the elk population in the state increased. VDGIF will need to help citizens that sustain property damage from elk regardless of the management direction chosen. Damage control techniques employed should be compatible with elk population goals. For example, special hunts or relocation could address damage by elk outside a restoration zone, should restoration become a goal. Providing fencing to exclude elk or use of damage stamp funds to compensate damage by elk could prove useful in areas where elk are desired.

Nuisance/Damage Management

VDGIF must be ready to address complaints from citizens about elk damage. The Commonwealth has existing programs to help citizens experiencing damage from white-tailed deer and black bear. These programs include county damage stamps, kill permits, authorization of special hunts, technical advice to ameliorate damage, and hazing or trapping by VDGIF staff.

County Damage Stamps

The Commonwealth has a long-standing law that requires hunters to buy a special stamp to hunt deer, bear, or elk in counties that elect to participate in the damage stamp program (See Appendix 3). Counties collect damage stamp funds and use them to pay landowners for damages caused by deer, elk, bear, or big game hunters. County damage stamps were once required in a number of counties. However, only Smyth and Scott counties have participated in this program recently. Limitations of the county damage stamp system may require creation of an alternative, judicious mechanism to compensate property owners for damage by elk.

Kill Permits

Another long-standing law requires VDGIF to issue kill permits for deer and bear damaging fruit trees, crops, livestock, or personal property used for commercial agricultural production (See Appendix 3). VDGIF is also required to issue a kill permit when deer cause a hazard to the operation of aircraft at airports. A kill permit may be issued when deer cause a hazard to the operation of motor vehicles within the corporate limits of any city or when deer damage residential plants, whether ornamental, noncommercial agricultural, or of other types. Because elk are members of the deer family, references to deer in this law are applicable to elk.

Special Permits

The Director of VDGIF may authorize special hunts to address wildlife-related threats to public health and safety or significant economic loss (See Appendix 3). The special permit may authorize licensed hunters to take game or fur-bearing species in excess of established bag limits and seasons. VDGIF regularly issues these special permits to local governments and others to control deer populations. For example, VDGIF authorizes a public deer hunt at Claytor Lake State Park in mid-January after the normal deer season. This permit helps the park manage its deer herd at a time when public use of the park is not high. VDGIF also issues a similar permit to the City of Radford to allow deer herd management in areas where public hunting is not practical.

Technical Advice

VDGIF staff frequently provides technical advice to citizens that want to reduce wildlife-related damage to property. Requests for help from VDGIF often concern deer or bear. Staff provides advice on damage control techniques such as elimination of attractants, exclusion, frightening or hazing, repellents, and population reduction. These techniques can substantially reduce property damage from elk when properly prescribed and applied.

Direct Action

Addressing public concerns about elk has resulted in direct action by wildlife agency staff in other states. VDGIF staff sometimes conducts aversive conditioning and removal of black bear or deer causing property damage or public safety concerns. DGIF staff has the capability to conduct aversive conditioning or removal of elk to ameliorate property damage or public safety concerns.

COMMUNICATION AND OUTREACH

Background

Management of elk is of intense public interest. The public routinely inquires about the management of elk already in the Commonwealth, and also has many questions about elk in general. Clearly, public support is critical to the successful restoration and management of elk in eastern states. Communication with the public about restoration early in the process, including education and public input, has been recognized as the most important ingredient to success (Wathen et al. 1997, Enck and Brown 2005). This plan presents a brief outline of the communication and education needs for elk management in Virginia.

Communication Goals

Successful communication will deliver significant participation in public input opportunities for the Elk Management Plan, and will engage the community in a dialogue about the plan. VDGIF must address 2 communication and education needs. First, VDGIF must help the public learn about elk. Virginia citizens need more information about elk ecology and management so that they may provide effective input to the elk plan. Second, VDGIF must obtain public input to effectively manage elk.

Issues Related to Learning about Elk

Overall, people in Virginia do not know a lot about elk. Some may equate elk behavior and reproduction with white-tailed deer. However, there are significant differences between the 2 species. Some may not be aware that elk were native to the Commonwealth or that a small herd from Kentucky has been established in several southwestern counties. Most have no personal knowledge of elk from the earlier restoration attempts in Virginia. Those that do are often not familiar with modern elk management techniques that can address property damage issues. Communities now experiencing immigration by Kentucky elk have unrealistic expectations of the benefits and losses that elk may bring (Enck and Brown 2005). This elk management planning effort will provide needed information to citizens interested in elk management.

Issues Related to Public Input on Elk

DGIF must have a thorough understanding of citizen opinions (through public input) to gain community support for its elk management decisions. The local farming community has deep roots with a tremendous love of the land and personal relationships with the wildlife found there. Many may have a prejudice against elk because of perceptions that their presence will pose a threat to livestock by possibly introducing diseases. Another concern is potential damage to habitat having a negative impact on native wildlife. People often hold opposing views on the advisability of managing for elk in Virginia. Although a recent study of social attitudes towards elk restoration in southern West Virginia found a majority (~75%) of survey respondents supportive (Enck and Brown 2005), experience in Kentucky suggests that introduction of elk may polarize community attitudes (C. Logsdon, personal communication).

The elk management plan was drafted with input from potential management cooperators and, once reviewed by the Board, will receive public input from a broad audience. Input will be sought through various means, including town hall meetings, the agency's web site, personal meetings and mail from constituents, and meetings with local government organizations and trade associations. Input received will be summarized and documented in the final plan. Regardless of the management option selected, VDGIF must work with local stakeholders to make elk management decisions that affect local communities. Such a collaborative approach will foster critical community support. This job will continue for as long as there is an elk herd in Virginia to manage and thus requires a long-term and substantial commitment of resources from VDGIF. The communication and education jobs discussed in the following section all have the goal of creating a well-informed and interested local public capable of helping VDGIF make good elk management decisions.

Communication and Outreach Jobs

VDGIF should accomplish a number of communication and outreach jobs related to elk and elk management in the planning area. These jobs vary by management option and are discussed separately. All should commence following VDGIF's decision on the direction of elk management in Virginia. Jobs discussed under the No Restoration Option would be conducted regardless of the management option selected.

No Restoration Option

VDGIF will provide basic elk ecology and management information to diverse audiences, including hunters, farmers, motorists, local governments, large landowners, and public schools. Communication tools useful for this job include town hall meetings, articles in local papers and trade publications, the regional hunting and fishing expo, and the VDGIF website.

VDGIF will provide detailed information to interested parties about elk diseases and disease risk management. Hunters, farmers, and large landowners will have an interest in this topic. Communication tools useful for this job include meetings with trade associations, articles in trade publications and local newspapers, and the VDGIF website.

Restoration Options

VDGIF will provide information about the elk restoration project to diverse audiences, including hunters, farmers, motorists, local governments, landowners, and public schools. This job will be ongoing during restoration actions. Communication tools useful for this job include town hall meetings, fact sheets, DVDs, articles in local papers and trade publications, the regional hunting and fishing expo, and the VDGIF website.

VDGIF will provide information about benefits and liabilities that may result from elk populations to diverse audiences, including hunters, farmers, motorists, local governments, landowners, and public schools. Particular emphasis should fall upon techniques to realize benefits and to mitigate liabilities. Communication tools useful for this job include town hall meetings, fact sheets, DVDs, articles in local papers and trade publications, the regional hunting and fishing expo, and the VDGIF website.

VDGIF will provide information about how the restoration of elk will affect hunting opportunities, not only for elk but also for other species, particularly white-tailed deer. Hunters and all landowners will have an interest in this topic. Useful communication tools include town hall meetings, trade association meetings, fact sheets, articles in local papers and trade publications, and the regional hunting and fishing expo.

VDGIF will provide information about control of public access to elk herds and liability issues to large landowners and trade associations. Useful communication tools include meetings with trade associations and individual landowners, as well as fact sheets, and articles in trade publications.

ADMINISTRATIVE CONSIDERATIONS

A significant increase in administrative responsibilities is expected to occur as elk numbers increase in Virginia, requiring a substantial investment in VDGIF staff time and funds. VDGIF will require additional staff to properly oversee and direct an elk management project. A full-time Elk Project Coordinator will be needed to respond to requests for information, plan the management of elk herds, develop public access to the elk resource, and respond to problems that may occur. A larger elk herd will result in more illegal killing of elk and more complaints of property damage by elk. Law enforcement staff will need to be increased to meet these demands. Habitat management needs will require the addition of technical staff and purchase of farming equipment.

Laws and regulations must be reviewed and amended to meet elk management needs. The current definition of deer, or the separation of elk from deer, will need to be addressed in the Code of Virginia and Virginia Administrative Code. Current regulations that include elk as "deer" and that allow for the legal hunting of elk during open deer seasons would need to be modified to prohibit elk harvest, at least in the restoration area. Upon the elk herd reaching a predetermined number or herd density, the legal hunting of elk in the restoration area would resume. At that time, the legal requirements for the harvesting of elk in the restoration area would need to be established. An application fee of $15.00 is recommended to apply for elk tags. The portion allocated for administrative costs is $7.50. VDGIF will need to work with the General Assembly to establish an elk tag (these elk tag revenues are not shown in Appendix 5).

Staff will need to develop guidelines to facilitate the acceptable issuance of DCAP and kill permits and to determine appropriate VDGIF responses to any confirmed elk damage. Replacement costs for elk will need to be reviewed and may be adjusted appropriately to correspond to the cost of the animal, effort to transport and restock elk, and to help deter the illegal killing of any released animals. As seen in some western states, the replacement cost could be scaled so that more desirable animals (i.e. trophy bulls) would require a higher replacement value.

Captive cervid farming is stringently controlled in Virginia. If active restoration is employed, captive deer facility operators will likely have questions about the potential for acquiring elk for their facilities. Additional staff effort would be required to address these potential requests.

MONITORING AND RESEARCH NEEDS

To protect VDGIF's investment in elk restoration, determine the fate of the released elk, and to address the significant concerns regarding elk stocking already identified within local county governments, agricultural, and mining interests, 3 separate elk monitoring and research projects would be important for an active elk restoration effort. These research projects would address elk population dynamics, habitat use and impacts, and human dimensions. Cost estimates for elk research and monitoring are presented in Appendix 5. Graduate student costs include a $30,000 stipend, vehicle, gas, office, travel, supplies, materials, etc.

Elk Population Dynamics Monitoring and Research

An elk population dynamics research project will be a Master Level Graduate Student project that evaluates overall annual population abundance, natality, survival and mortality, age and sex composition, home range and movements, including dispersal, of the restocked elk. It is important to note that this research project would only be necessary if active restoration is pursued. The Committee recommends that at least 25 of the released animals (20-25% males and 75-80% females) be fitted with GPS collars each year for the first 3 years of stocking efforts and be monitored for at least the first 4 years. Additionally, the Committee recommends that annual aerial censuses be conducted every 1-3 years to determine overall elk population abundance, age and sex composition, and geographical distribution/range.

Elk/Human Dimensions Research Project

Elk restoration in southwest Virginia will likely be controversial. In late 2009, in response to a solicitation from the Chairman of the Board of VDGIF, local county boards of supervisors in 4 counties (Dickenson, Lee, Russell, Wise counties) voted to oppose restoration of elk within their jurisdictions. Additionally during 2009-2010, the Virginia Farm Bureau, the State Veterinarian, and the Board of the Virginia Department of Agriculture and Consumer Services officially opposed elk reintroduction in Virginia.

The Elk Committee recommends that the VDGIF initiate a human dimensions research project in conjunction with any elk stocking efforts. Formal data regarding public opinions on elk restoration are over 10 years old (McClafferty 2000). Further, political opposition identified in the past 6 months clearly indicates that public opinion and information issues must be addressed as a part of any elk restoration program. This project should be conducted whether active or passive restoration is pursued.

Elk Habitat Use and Impact Research Project

The Elk Habitat and Impact Research Project will be a Master Level Graduate Student project that evaluates habitat use, home range and dispersal, and property damage monitoring.

Nuisance Elk Monitoring

Whether passive or active elk restoration is pursued, the Elk Committee recommends that the Department develop and adopt a standard protocol where all nuisance elk calls are ultimately routed through the elk staff by developing a computer based nuisance elk report form, similar to the nuisance bear reporting form.

Elk Vehicle Collision Monitoring

Whether passive or active elk restoration is pursued, VDGIF will need to work cooperatively with the Virginia Department of Transportation, Virginia State Police, and local county law enforcement agencies to develop a mandatory system where all elk/vehicle collisions are reported to the Department's elk staff within 48 hours. Similar to the nuisance elk protocol mentioned above, an elk vehicle collision computer report form should be developed. When feasible, CWD tests will be conducted on all elk killed by vehicles.

Elk Disease Monitoring

Whether passive or active elk restoration is pursued, the Elk Committee recommends that the Department develop and adopt a standard protocol for elk disease testing. Elk with clinical signs of *Parelaphostrongylus tenuis* infection will be a management issue. Alexy et al. (2004) reported the occurrence of elk exhibiting clinical signs of meningeal worm infection as a cause for nuisance complaints in Kentucky. Infected animals were often reported in yards and around private residences for extended periods; and because of their emaciated condition and abnormal behavior, Kentucky biologists spend many hours responding to calls from the public concerning these animals. When feasible, CWD tests should be conducted on all documented elk mortalities.

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APPENDIX 1. ELK RESTORATION IN NEIGHBORING AND OTHER STATES.

Southeastern 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 Manitoba elk (*C. e. manitobensis*) 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 1,554 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 Elk Restoration Zone (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 elk restoration area 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-minded 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 roadkills, 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 restoration zone, 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 restoration zone. 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). 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 1800s, 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 *C. e. manitobensis* and considered to be the subspecies most genetically similar to Eastern elk. 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).

Notwithstanding USDA movement restriction on cervids (see below under Tennessee), elk have not been transported into Cataloochee primarily because of the North Carolina Wildlife Resource Commission's (NCWRC) opposition, which is related to a state ban on cervid importation (E. Stanford, NCWRC, personal communication, 2009). NCWRC is concerned that allowing live elk importation for restoration purposes would be politically problematic while the state maintains its ban on the movement of cervids into captive facilities. The National Park Service could technically move elk into GSMNP if they kept transport vehicles wholly within their boundaries, but thus far, the agency has chosen to cooperate with NCWRC (E. Stanford, NCWRC, personal communication, 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 2205).

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 zone, 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).

Restrictions on cervid movements related to disease concerns have complicated elk restoration efforts in Tennessee in recent years. TWRA has expressed interest in getting more elk from EINP, a request that thus far has been denied by the U. S. Department of Agriculture (Wills 2007, 2009). The United States and Canada apparently have an agreement on movement of live cervids (D. Ratajczak, TWRA, personal communication, 2009). The EINP population is considered wild, but since the captive industry has challenged any movements from EINP into the United States, apparently these elk are held to the same standards as captive elk (e.g., tagging, documentation, testing). The US and Canada are working on details to allow movement of elk from EINP. In the meantime, TWRA cleared obstacles with USDA and Tennessee Department of Agriculture for moving elk from LBL in KY (D. Ratajczak, TWRA, personal communication, 2009). Presumably, LBL is considered "enclosed" and monitored from USDA's perspective, and therefore, authorized to move cervids under captive provisions (K. Delozier, GSMNP, personal communication, 2009).

Southwestern 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). No efforts have yet been attempted, but a number of elk have crossed from Kentucky (Enck and Brown 2005). During Kentucky's restoration efforts, 394 elk were released in Martin and Pike counties, Kentucky, which border West Virginia. Based on elk movements and release site fidelity in these 2 Kentucky counties, a population of 50-250 elk could establish in the West Virginia border counties by 2025. Southwestern West Virginia has similar land use patterns as the Kentucky restoration area in terms of timbering and surface mining. If this elk colonization does occur in West Virginia, it would probably expand beyond the border counties into more of the state (Enck and Brown 2005).

An elk habitat suitability model was developed for West Virginia by comparing habitat assessments to habitat use in Kentucky (Zysik and Porter 2005). Previous HSI models for elk (e.g., NY, VA) were based in science but not ground-truthed with actual elk behavior in the eastern US. The fine filter New York model had to be significantly modified to account for actual habitat use observed in Kentucky 3 years post-release (Zysik and Porter 2005). The model is most sensitive to open areas, even more so than roads (Zysik and Porter 2005).

Three regions were identified by Zysik and Porter (2005) with the best habitat potential for elk restoration in West Virginia. The Monongohela 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 Monongohela (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).

With regards to tourism, the expectation in the eastern area may be more realistic than in the southern area (Enck and Brown 2005). The southern area had a lower social feasibility index (SFI) or "potential community capacity" than the eastern area. SFI is combination of social and economic variables. Most counties in the southern area have worsening SFIs, and the lack of infrastructure will make it difficult to realize tourism benefits and mitigate problems from elk. Eastern residents generally thought problems with elk were more likely, and benefits less likely, to occur than southern residents, even though the eastern area has more capacity to deal with problems and realize benefits. Although social feasibility is higher in the eastern area, Enck and Brown (2005) suggested that both areas were sufficient for the West Virginia Division of Natural Resources (WVDNR) to consider elk restoration (Enck and Brown 2005).

The WVDNR has been developing an elk management plan for the southwestern portion of West Virginia since summer 2009 (J. Crum, WVDNR, 2009). The plan will likely direct WVDNR to permit "passive restoration" of elk colonizing from Kentucky. Boundaries of the restoration area are likely be that portion of the state south and west of Interstates 64 and 77, including the counties of Mingo, Wayne, Logan, McDowell, Wyoming, and parts of Raleigh, Kanawha, and Lincoln. The plan will not likely include the active reintroduction of elk. The passive approach will likely entail a prohibition on killing elk west and south of the restoration boundary for some period while simultaneously continuing to kill elk (using a deer tag) outsize of the zone (J. Crum, WVDNR, 2009).

Arkansas

Native elk were found across much of Arkansas but were most abundant near the Oklahoma border (O'Gara and Dundas 2002). Elk were extirpated from Arkansas by the 1840s, likely due to over-hunting, habitat destruction, and competition with livestock (AGFC 2001, White et al. 2008).

Arkansas' first elk restoration was attempted in 1933, when the U. S. Fish and Wildlife Service translocated 3 bulls and 5 cows from the Wichita Mountains Wildlife Refuge, OK to the Black Mountain Refuge in Franklin County, AR (O'Gara and Dundas 2002). In 1943, an estimated 75 elk were found in the county. By 1948, the herd had grown to 125. After reaching a maximum of approximately 200 elk in the 1950s, the herd disappeared for uncertain reasons, among which were presumably poaching, natural mortality, and range shrinkage due to natural succession (AGFC 2001, O'Gara and Dundas 2002).

Arkansas' second restoration has been much more successful thus far. During 1981-1985, 112 Rocky Mountain elk (105 from CO, 7 from NB) were stocked on 5 release sites near Buffalo National River in the Ozarks of Newton County (AGFC 2001, O'Gara and Dundas 2002). Some of the elk were tagged and tested for tuberculosis and leptospirosis prior to release (AGFC 2001). Volunteers in Newton County helped move elk, so the cost of establishment was greatly reduced (D. Goad, AGFC, personal communication, 2009)

Elk were restored to Arkansas for 2 main reasons: to return a native species with ecological function and to provide recreation (White et al. 2008). The TWRA team who visited with Arkansas staff in 1996 reported that there had also been political pressure to stock elk in the 1980s, and that biologists at the time believed the effort would fail due to brain worm infection (Wathen et al. 1997). Because failure was expected, little effort was made in monitoring or habitat work during the early years following elk reintroduction (Wathen et al. 1997).

The elk herd ranges over 315,000 acres in 6 counties in Arkansas: Boone, Carroll, Madison, Marion, Newton, and Searcy (AGFC 2001, White et al. 2008). Approximately half of the elk are on federal (NPS) and state (WMA) land, and the other half are on private land (AGFC 2001). The public land herd is confined to Newton and Searcy counties (White et al. 2008). The elk that moved onto private land in Boone and Carroll Counties do not appear to interact with the main Buffalo River herd (AGFC 2001). Elk have been reported from 14 counties but are thought to be transient, with no reproduction, outside of the 6 core counties (AGFC 2001, White et al. 2008).

There is some capacity for elk herd expansion on NPS land, but expansion is limited on the adjacent Ozark National Forest lands because of forest management practices which result in few large openings or herbaceous cover (AGFC 2001). Private lands offer little room for expansion due to the potential for conflicts. Intensive management of elk populations and habitat, as well as human elk-conflicts, is necessary given the small herd of limited distribution (AGFC 2001).

Officials in Arkansas held their first elk hunt in the fall of 1998; 18 resident licenses were issued in a lottery, and 2 licenses (1 resident, 1 nonresident) were auctioned off by the Rocky Mountain Elk Foundation (McClafferty 2000). Since 1998, 254 elk (118 bulls and 136 cows) have been legally harvested in Arkansas (D. Goad, AGFC, personal communication, 2009). In addition to legal harvest, poaching and disease have been other forms of mortality, with meningeal worms affecting mostly young elk (White et al. 2008).

The goal of maintaining an elk population in Arkansas of 450-500 with a 40:100 bull/cow and calf/cow ratio has been achieved for some time (AGFC 2001,Wills 2007, 2009). There are no plans to restore elk to other areas of the state, and a thorough feasibility study would be necessary before embarking on such an effort (AGFC 2001). Arkansas has one full-time elk biologist and an interagency elk committee (D. Goad, AR Game and Fish Commission, personal communication, 2009).

Michigan

Elk, found historically only on Michigan's Lower Peninsula, disappeared by the 1870s (O'Gara and Dundas 2002). In 1915, 23 Rocky Mountain elk were placed in an enclosure in the north-central portion of the Lower Peninsula near Wolverine (McClafferty 2000, MDNR 2009). In 1918, 7-9 of these elk were released along the Sturgeon River in Cheboygan County and ultimately founded the herd that thrives there today (McClafferty 2000, O'Gara and Dundas 2002). Free-ranging elk exist on a 512,000 mi^2 range in the northern Lower Peninsula in Cheyboygan, Otsego, Presque Isle, and Montmorency counties (Wathen et al 1997).

The herd grew quickly, from an estimated 200 animals in 1925, 300-400 in 1939, 900-1,000 in 1958, and 1,200-1,500 in 1961. Crop and reforestation damage rose in the 1960s, and the elk population was large enough in the 1970s to provide for a tourist industry (McClafferty 2000, O'Gara and Dundas 2002). The first hunts held in 1964 helped stabilize the population and address human-elk conflicts (O'Gara and Dundas 2002).

Unfortunately, reduced habitat quality and poaching decreased the elk population to only about 200 by the winter of 1975. In the late 1970s, interest in elk was renewed in the Pigeon River area during the time oil exploration was ongoing. Reduced poaching, habitat

improvement, and managed oil development allowed elk to increase to 850 by 1984 (MDNR 2009).

Elk hunting resumed in 1984 to control agricultural and forest damage (MDNR 2009). In addition to hunting, Michigan Department of Natural Resources (MDNR) has employed high tensile electric fences for landowners and food plots on state-owned wildlife openings. Farm and forestry damage has been reduced significantly since these strategies were implemented (McClafferty 2000).

From 1984-1995, harvest ranged from 49-306 (Wathen et a. 1997). In 1996, the TWRA team visiting several states with elk hunting programs considered Michigan's the most successful, with 400 permits issued annually and a 70% hunter success (Wathen et al. 1997). The goal of 800-900 wintering elk has been achieved (O'Gara and Dundas 2002, MDNR 2009).

Minnesota

Following failed attempts in 1914 and 1929, a release of elk in 1935 into northwestern Minnesota resulted in a herd of 250 in the 1940s (O'Gara and Dundas 2002). The herd was reduced to only 15 in the 1970s due to crop damage. In 1985, a court injunction barred landowners' requests for removal of the few remaining elk. An agreement was reached to fund damage compensation and to hold a hunting season whenever 20 calves were produced. Hunting seasons have been held sporadically since 1987. The small herd is found along the Minnesota-Manitoba border. Lack of large areas of suitable habitat that is not also adjacent to agricultural lands prevents further expansion (O'Gara and Dundas 2002). The Minnesota elk population is estimated at around 100 (Wills 2007, 2009).

Oklahoma

The last native elk in Oklahoma was likely taken in 1881 (O'Gara and Dundas 2002). During 1911-1912, 20 elk from Jackson Hole, WY were moved to Wichita Mountain National Wildlife Refuge (WMNWR) in western Oklahoma. The herd stagnated until the 1930s, when it began growing to its peak of 600 animals in 1967. During 1969-1971, 405 elk were translocated from WMNWR to eastern Oklahoma. In most of the 9 release sites, this reintroduction was unsuccessful, allegedly due to poaching and meningeal worms (Wathen et al. 1997, O'Gara and Dundas 2002).

Four eastern WMAs in Oklahoma have continued to support small elk herds, and the WMNWR herd is maintained at around 500 elk via a draw hunt (O'Gara and Dundas 2002). The eastern restoration program has been a challenge on separate elk ranges of only 12-64,000 acres each (Wathen et al. 1997). Even on small ranges, however, managers have noted a positive relationship between maintaining adequate openings and elk population growth (Wathen et al. 1997). The combined eastern Oklahoma elk population was estimated at 290 in 2007 (Wills 2007).

Pennsylvania

Eastern elk, found across Pennsylvania before European settlement, were most common in the Allegheny Mountains; the last hold-out was reportedly killed in Elk County around 1870 (O'Gara and Dundas 2002). Between 1913 and 1926, the Pennsylvania Game Commission (PGC) obtained and released a total of 177 Rocky Mountain elk from Yellowstone National

Park, a game preserve in South Dakota, and a private preserve in Monroe County, PA into 10 counties in central Pennsylvania (Deberti 2006). The current herd is descended from 24 elk released in Cameron County in 1915; 10 more bulls were released in neighboring Elk County between 1924 and 1926 to reinforce the founding population (McClafferty 2000). Some elk moved 40 miles within a week of release (O'Gara and Dundas 2002). The 22 elk obtained from a private herd in Monroe County, PA suffered less mortality and traveled shorter distances than the western elk, leading to speculation that these private elk may have been remnants of the Eastern subspecies (O'Gara and Dundas 2002).

During the 1920s, crop damage led to elk being trapped and moved or killed (Deberti 2006). A hunting season was established in 1923 for bulls with 4 or more points per antler, but hunting was stopped in 1931 due to declining herds (Deberti 2006). During 1923-1931, 98 elk were harvested by hunters and 78 were killed due to crop damage or poaching (O'Gara and Dundas 2002). Little is known about the few elk that remained in Pennsylvania from 1931-1971 (Deberti 2006). The herd increased from 38 in 1974 to 117 in 1980 (Deberti 2006).

During the 1980s, the Pennsylvania elk herd remained relatively stable (Deberti 2006), but crop damage complaints threatened the future of the herd; by 1990s, redistribution of elk and management had mitigated a lot of the concerns (McClafferty 2000). The herd increased and expanded south and east until 2002 when it stabilized at around 500-600 (Deberti 2006). Trapping and transferring 68 elk (most of which were problem animals) and releasing them at 3 sites in Clinton County hastened expansion. In the most successful transfer, habitat was optimal and the elk remained wild and out of conflict with people (Deberti 2006). The herd was estimated at 600-650 in 2000 and 750 in 2009 (Wills 2007, 2009).

The current Pennsylvania elk herd is located in 6 counties (Elk, Cameron, Centre, Clearfield, Clinton, and Potter) on an Elk Management Area that was expanded from 835 mi^2 to 3,750 mi^2, as called for in the 2006 elk plan revision (Deberti 2006, PGC 2009). Several conservation organizations have purchased sizable tracts of land for the elk range. In 2006, 74% of the Elk Management Area was on public land (Deberti 2006).

The PGC's current elk management program includes hunting and viewing, habitat enhancement, land acquisitions, aerial surveys, fencing, trapping and translocating, and research and education (McClafferty 2000, Deberti 2006). The first modern elk hunt in Pennsylvania was conducted in 2001, targeting areas where human-elk conflicts were most prevalent (Deberti 2006). Hunters in Pennsylvania harvested 27 elk in 2001, and 33-61 each season since (PGC 2009). The Elk Habitat Challenge, initiated in 2001, has raised funds (over $800K by 2006), mostly for food plot development and maintenance. Also, multiple agencies have cooperated in improving habitats on abandoned mine lands. A PGC Food and Cover crew has been established to work within the management area (Deberti 2006). Herbaceous vegetation complexes have been managed to facilitate elk movement and population growth where desired (Deberti 2006).

Wisconsin

Elk occurred over a majority of Wisconsin before European settlement, mostly in the southern and western portions of the state (O'Gara and Dundas 2002). The last native elk was probably killed in 1868. In 1913 and 1917, elk from Yellowstone National Park were released into an enclosure, but the population dwindled by the 1930s and the program was terminated (O'Gara and Dundas 2002). Following a feasibility study and recommendation to attempt a

second restoration, 25 elk were translocated in 1995 from Michigan and released near Clam Lake, WI as an experimental free-ranging herd (McClafferty 2000, O'Gara and Dundas 2002). The elk had been quarantined for 90 days in Michigan and were moved into a 3-ac enclosure in Wisconsin before being released into the wild (Wathen et al. 1997).

Restoration was initially managed outside of Wisconsin Department of Natural Resources (L. Stowell, WDNR, personal communication, 2009). Procurement, acclimation, and releases during the first 4 years (1995-99) were accomplished as part of a research project by the University of Wisconsin-Stevens Point. The Wisconsin legislature funded the project at $25,000 per year and the Rocky Mountain Elk Foundation (RMEF) gave $100,000 per year. RMEF also purchased 1,500 acres of elk range that was subsequently acquired by the U. S. Forest Service. There are currently around 150 elk on 1,112 square miles of the Clam Lake Elk Range, which is mostly on the Chequamegon National Forest. There has been little agricultural damage. Plans are underway for a limited bull elk season once the population reaches 200 (L. Stowell, WDNR, personal communication, 2009). In recent years, Wisconsin has expressed interest in getting more elk from Elk Island National Park, a request that thus far has been denied by U. S. Department of Agriculture due to cervid movement restrictions (Wills 2007; see Tennessee section above for discussion of these restrictions).

APPENDIX 2. DUTY OF CARE AND LIABILITY FOR DAMAGES OF LANDOWNERS TO HUNTERS, FISHERMEN, SIGHTSEERS, ETC. (CODE OF VIRGINIA §29.1-509)

A. For the purpose of this section:

"Fee" means any payment or payments of money to a landowner for use of the premises or in order to engage in any activity described in subsections B and C of this section, but does not include rentals or similar fees received by a landowner from governmental sources or payments received by a landowner from incidental sales of forest products to an individual for his personal use, or any action taken by another to improve the land or access to the land for the purposes set forth in subsections B and C of this section or remedying damage caused by such uses.

"Land" or "premises" means real property, whether rural or urban, waters, boats, private ways, natural growth, trees and any building or structure which might be located on such real property, waters, boats, private ways and natural growth.

"Landowner" means the legal title holder, lessee, occupant or any other person in control of land or premises.

"Low-head dam" means a dam that is built across a river or stream for the purpose of impounding water where the impoundment, at normal flow levels, is completely within the banks, and all flow passes directly over the entire dam structure within the banks, excluding abutments, to a natural channel downstream.

B. A landowner shall owe no duty of care to keep land or premises safe for entry or use by others for hunting, fishing, trapping, camping, participation in water sports, boating, hiking, rock climbing, sightseeing, hang gliding, skydiving, horseback riding, foxhunting, racing, bicycle riding or collecting, gathering, cutting or removing firewood, for any other recreational use, or for use of an easement granted to the Commonwealth or any agency thereof to permit public passage across such land for access to a public park, historic site, or other public recreational area. No landowner shall be required to give any warning of hazardous conditions or uses of, structures on, or activities on such land or premises to any person entering on the land or premises for such purposes, except as provided in subsection D. C. Any landowner who gives permission, express or implied, to another person to hunt, fish, launch and retrieve boats, swim, ride, foxhunt, trap, camp, hike, rock climb, hang glide, skydive, sightsee, engage in races, to collect, gather, cut or remove forest products upon land or premises for the personal use of such person, or for the use of an easement as set forth in subsection B does not thereby:

1. Impliedly or expressly represent that the premises are safe for such purposes; or

2. Constitute the person to whom such permission has been granted an invitee to whom a duty of care is owed; or

3. Assume responsibility for or incur liability for any intentional or negligent acts of such person or any other person, except as provided in subsection D.

D. Nothing contained in this section, except as provided in subsection E, shall limit the liability of a landowner which may otherwise arise or exist by reason of his gross negligence or

willful or malicious failure to guard or warn against a dangerous condition, use, structure, or activity. The provisions of this section shall not limit the liability of a landowner which may otherwise arise or exist when the landowner receives a fee for use of the premises or to engage in any activity described in subsections B and C of this section.

E. For purposes of this section, whenever any person enters into an agreement with, or grants an easement to, the Commonwealth or any agency thereof, any county, city, or town, or with any local or regional authority created by law for public park, historic site or recreational purposes, concerning the use of, or access over, his land by the public for any of the purposes enumerated in subsections B and C of this section, the government, agency, county, city, town, or authority with which the agreement is made shall hold a person harmless from all liability and be responsible for providing, or for paying the cost of, all reasonable legal services required by any person entitled to the benefit of this section as the result of a claim or suit attempting to impose liability. Any action against the Commonwealth, or any agency, thereof, for negligence arising out of a use of land covered by this section shall be subject to the provisions of the Virginia Tort Claims Act (§ 8.01-195.1 et seq.). Any provisions in a lease or other agreement which purports to waive the benefits of this section shall be invalid, and any action against any county, city, town, or local or regional authority shall be subject to the provisions of § 15.2-1809, where applicable.

APPENDIX 3. STATUTES PERTINENT TO ELK DAMAGE MANAGEMENT.

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§ 29.1-352. Damage stamp program established; purpose; intent.

There is hereby established a damage stamp program to provide for an available source of funds to be used to compensate damage to crops, fruit trees, commercially grown Christmas trees, nursery stock, livestock, colonies of bees, bee equipment and appliances, as defined in §3.1-610.1, or farm equipment that is caused by deer, elk, or bear, or by big game hunters. It is the intent of the General Assembly that persons suffering loss or damage as the result of these activities should be realistically compensated for damages that occurred to their property as the result of the activity. A local governing body shall encourage to the maximum extent possible the utilization of the damage stamp fund for payment of claims in keeping with the purposes of this article.

(1981, c. 16, § 29-92.1; 1983, c. 198; 1987, c. 488; 2003, c. 137; 2004, cc. 87, 463.)

§ 29.1-353. Local governing body to adopt ordinance.

A. Any local governing body may adopt an ordinance consistent with the provisions of this article for the purpose of establishing a damage stamp program. No such ordinance shall be in force between May 1 of any year and the following April 30 whenever the amount of money in this special fund is more than twice the average annual disbursement made from the fund for the payment of damage claims in the locality during the immediately preceding 3 years. However, such estoppel shall not apply to any locality during the first 3 years immediately following the effective date of the first such ordinance adopted by the governing body of that locality pursuant to this or any earlier similar enabling act.

B. Any locality which has adopted an ordinance prior to July 1, 1981, will not be required to adopt a new ordinance; however, any prior ordinance shall be administered pursuant to the provisions of this article.

(1981, c. 16, § 29-92.2; 1987, c. 488.)

§ 29.1-354. Stamps required; issuance; fee; affixing stamps; cancellation.

It shall be unlawful for any person to hunt bear, deer or elk in any locality adopting a damage stamp ordinance within the Commonwealth without having first obtained the special stamp. A violation of this provision shall be punishable as a Class 3 misdemeanor.

The annual fee for such a stamp shall be $1. The local governing body may prescribe any fee, not to exceed $5 for these special stamps, when issued to nonresidents of the Commonwealth.

The special stamps shall be obtained from a locally designated official or from any agent designated by the Board pursuant to §29.1-327. The agent shall be paid a fee of $.10 from the special fund for each stamp issued.

The stamp shall be affixed to the reverse side of a current hunting license of each person required to obtain the stamp, and that person shall cancel the stamp with his initials.

(1981, c. 16, § 29-92.3; 1987, c. 488; 1989, c. 421; 2003, c. 137.)

§ 29.1-355. Disposition of funds.

All moneys received from the sale of the special stamps shall be paid into the local treasury to the credit of a special damage stamp fund and identified by the year in which the moneys were collected. The special fund shall be used for the following purposes:

1. Payment for damages to crops, fruit trees, commercially grown Christmas trees, nursery stock, livestock, colonies of bees, bee equipment and appliances, as defined in §3.1-610.1, or farm equipment that is caused by deer, elk, or bear at any time, or by big game hunters during hunting season; and

2. Payment of the actual and necessary costs of the administration of the provisions of this article, including the printing and distribution of the required stamps and the payment of reasonable fees to persons designated by a local governing body to inspect, evaluate, and confirm reported claims and adjust such claims; and

3. In the discretion of the local governing body, payment of the costs of law enforcement directly related to and incidental to carrying out the provisions of this article and the general game laws of the Commonwealth; any person compensated to engage in such law-enforcement activities shall be approved for such employment by the director and appointed to be a special game warden in accordance with the Board's standards and policies governing such appointment; and

4. In the discretion of the local governing body, administrative expenses related to the special stamps, support of a county volunteer fire prevention and suppression program when the program includes fire fighting on big game hunting lands open to the public, and support of local volunteer rescue squads whose services are available to hunters in distress. However, the money appropriated from the special damage stamp fund for these purposes shall not exceed, in the aggregate, in any calendar year, an amount equal to 25 percent of the amount paid into the special damage stamp fund during the fiscal year or previous calendar year. Once selecting the fiscal year or previous calendar year, the local governing body must continue to use that selected period of time in determining the amount of money to be appropriated from the special damage stamp fund.

(1981, c. 16, § 29-92.4; 1983, c. 198; 1985, c. 284; 1986, c. 361; 1987, c. 488; 2003, c. 137; 2004, cc. 87, 463.)

§ 29.1-356. Reporting damages; filing and adjudicating claims.

Any person suffering damage pursuant to the provisions of this article shall report the damage to a locally designated official whose duty it shall be to have the damage investigated. The claim for damage shall be filed under oath and in a manner and form as may be prescribed by the local governing body.

If the claimant and the designated local official agree as to the amount of damage, the local governing body may approve the amount and order payment thereof from the special damage stamp fund established by this article. No claim for damages shall be paid to any person who does not permit the hunting of big game or elk by licensed hunters on his property. However, the fact that a landowner places reasonable restrictions on the number of licensed hunters who are permitted to hunt big game or elk on his property shall not disqualify him from filing a claim for damages pursuant to this section. In the event that no agreement as to the amount of damages can

be reached, the claimant may initiate an action in the general district court of the county in which the damage occurred.

(1981, c. 16, § 29-92.5; 1987, c. 488; 1988, cc. 375, 385; 2003, c. 137.)

§ 29.1-357. Civil action required.

In any instance in which compensable damage is alleged to have been caused by an individual hunter whose whereabouts are known and when it is reasonable and practicable to do so, the claimant shall first proceed against such hunter in a civil action before any payment is made pursuant to the provisions of this article.

Upon payment of any claim pursuant to the provisions of this article, the county shall be subrogated to the rights of the claimant against such individual hunter.

(1981, c. 16, § 29-92.6; 1987, c. 488.)

§ 29.1-358. Localities to report claims and reimbursements.

Any locality establishing a damage stamp program pursuant to the provisions of this article, including those localities previously authorized to adopt such an ordinance prior to July 1, 1981, shall ensure that annual reports of all damage claims made and the amount of reimbursement therefore are made to the Department of Game and Inland Fisheries.

(1981, c. 16, § 29-92.7; 1987, c. 488.)

§ 29.1-529. Killing of deer or bear damaging fruit trees, crops, livestock, or personal property or creating a hazard to aircraft or motor vehicles.

A. Whenever deer or bear are damaging fruit trees, crops, livestock or personal property utilized for commercial agricultural production in the Commonwealth, the owner or lessee of the lands on which such damage is done shall immediately report the damage to the Director or his designee for investigation. If after investigation the Director or his designee finds that deer or bear are responsible for the damage, he shall authorize in writing the owner, lessee or any other person designated by the Director or his designee to kill such deer or bear when they are found upon the land upon which the damages occurred. However, the Director or his designee shall have the option of authorizing the capture and relocation of such bear rather than authorizing the killing of the bear, provided that the relocation occurs within a reasonable period of time; and whenever deer cause damage on parcels of land of 5 acres or less, except when such acreage is used for commercial agricultural production, the Director or his designee shall have discretion as to whether to issue a written authorization to kill the deer. The Director or his designee may limit such authorization by specifying in writing the number of animals to be killed and duration for which the authorization is effective and may in proximity to residential areas and under other appropriate circumstances limit or prohibit the authorization between 11:00 p.m. and one-half hour before sunrise of the following day. The Director or his designees issuing these authorizations shall specify in writing that only antlerless deer shall be killed, unless the Director or his designee determines that there is clear and convincing evidence that the damage was done by deer with antlers. Deer or bear killed pursuant to such authorization shall be utilized or disposed of within 24 hours of being killed. Any owner or lessee of land who has been issued a written authorization shall not be issued an authorization in subsequent years unless he can demonstrate to the satisfaction of the Director or his designee that during the period following the prior authorization, the owner or his designee has hunted bear or deer on the land for which he received a previous authorization.

B. Subject to the provisions of subsection A, the Director or his designee may issue a written authorization to kill deer causing damage to residential plants, whether ornamental, noncommercial agricultural, or other types of residential plants. The Director may charge a fee not to exceed actual costs. The holder of this written authorization shall be subject to local ordinances, including those regulating the discharge of firearms.

C. Whenever deer are creating a hazard to the operation of any aircraft or to the facilities connected with the operation of aircraft, the person or persons responsible for the safe operation of the aircraft or facilities shall report such fact to the Director or his designee for investigation. If after investigation the Director or his designee finds that deer are creating a hazard, he shall authorize such person or persons or their representatives to kill the deer when they are found to be creating such a hazard.

D. Whenever deer are creating a hazard to the operation of motor vehicle traffic within the corporate limits of any city, the operator of a motor vehicle may report such fact to the Director or his designee for investigation. If after investigation the Director or his designee finds that deer are creating a hazard within such city, he may authorize responsible persons, or their representatives, to kill the deer when they are found to be creating such a hazard. The carcass of every deer or bear so killed may be awarded to the owner or lessee by the Director or his designee, who shall give such person a certificate to that effect on forms furnished by the

Department. Any person awarded a deer or bear under this section may use the carcass as if he had killed the animal during the hunting season for deer or bear.

E. Whenever deer are damaging property in a locality in which deer herd population reduction has been recommended in the current Deer Management Plan adopted by the Board, the owner or lessee of the lands on which such damage is being done may report such damage to the Director or his designee for investigation. If after investigation the Director or his designee finds that deer are responsible for the damage, he may authorize in writing the owner, lessee or any other person designated by the Director or his designee to kill such deer when they are found upon the land upon which the damages occurred. The Director or his designee also may limit such authorization by specifying in writing the number of animals to be killed and the period of time for which the authorization is effective. The carcass of every deer so killed may be awarded to the owner or lessee by the Director or his designee, who shall give such person a certificate to that effect on forms furnished by the Department. Any person awarded a deer under this section may use the carcass as if he had killed the animal during the hunting season for deer. The requirement in subsection A of this section, that an owner or lessee of land demonstrate that during the period following the prior authorization deer or bear have been hunted on his land, shall not apply to any locality that conducts a deer population control program authorized by the Department.

F. The Director or his designee may revoke or refuse to reissue any authorization granted under this section when it has been shown by a preponderance of the evidence that an abuse of the authorization has occurred. Such evidence may include a complaint filed by any person with the Department alleging that an abuse of the written authorization has occurred. Any person aggrieved by the issuance, denial or revocation of a written authorization can appeal the decision to the Department of Game and Inland Fisheries. Any person convicted of violating any provision of the hunting and trapping laws and regulations shall be entitled to receive written authorization to kill deer or bear. However, such person shall not (i) be designated as a shooter nor (ii) carry out the authorized activity for a person who has received such written authorization for a period of at least 2 years and up to 5 years following his most recent conviction for violating any provision of the hunting and trapping laws and regulations. In determining the appropriate length of this restriction, the Director shall take into account the nature and severity of the most recent violation and of any past violations of the hunting and trapping laws and regulations by the applicant. No person shall be designated as a shooter under this section during a period when such person's hunting license or privileges to hunt have been suspended or revoked.

G. The Director or his designee may authorize, subject to the provisions of this section, the killing of deer over bait within the political boundaries of any city or town in the Commonwealth when requested by a certified letter from the governing body of such locality.

(Code 1950, § 29-145.1; 1954, c. 686; 1956, c. 684; 1958, cc. 315, 609; 1960, c. 129; 1962, c. 229; 1970, c. 79; 1980, c. 271; 1987, cc. 48, 488; 1991, c. 99; 1993, cc. 204, 273; 1994, c. 571; 1996, c. 314; 1998, c. 179; 1999, c. 563; 2000, c. 6; 2002, c. 174; 2003, cc. 123, 135; 2004, c. 447.)

4VAC15-40-240. Animal population control.

Whenever biological evidence suggests that populations of game animals or fur-bearing animals may exceed or threaten to exceed the carrying capacity of a specified range, or whenever population reduction of a species is necessary to manage for another wildlife species, or whenever the health or general condition of a species indicates the need for population reduction, or whenever the threat of human public health and safety or significant economic loss indicates the need for population reduction, the director is authorized to issue special permits to obtain the desired reduction by licensed hunters or licensed trappers on areas prescribed by department wildlife biologists. Designated game species or fur-bearing species may be taken in excess of the general bag limits on special permits issued under this section under such conditions as may be prescribed by the director.

Statutory Authority

§§ 29.1-501 and 29.1-502 of the Code of Virginia.

Historical Notes

Derived from VR325-02-1 § 23, eff. September 15, 1988; amended, Virginia Register Volume 10, Issue 23, eff. September 8, 1994; Volume 11, Issue 9, eff. February 22, 1995; Volume 13, Issue 18, eff. July 1, 1997; Volume 15, Issue 19, eff. July 7, 1999.

APPENDIX 4. POPULATION GROWTH AND COST ESTIMATE FOR THE PASSIVE RESTORATION OPTION.

Population Growth and Revenue Model for the Passive Restoration Option

Year	*Elk Released* [a]	*Bulls* [b]	*Cows*	*Calves*	*Total Elk*	*Bull Tags*	*Cow Tags*	*Total Tags*	*Applications* [c]	*Revenue*
1	0	19	24	10	53	0	0	0	0	$ -
2	0	22	27	15	64	0	0	0	0	-
3	0	32	32	18	82	0	0	0	0	-
4	0	41	38	21	100	0	0	0	0	-
5	0	48	45	24	117	0	0	0	0	-
6	0	60	67	36	163	0	0	0	0	-
7	0	76	78	43	197	0	0	0	0	-
8	0	93	102	54	249	0	0	0	0	-
9	0	115	120	65	300	10	0	10	14,809	111,068
10	0	141	142	77	360	10	0	10	14,809	111,068
11	0	170	168	91	429	10	0	10	14,809	111,068
12	0	198	199	107	504	10	0	10	14,809	111,068
Total	0					40	0	40	59,236	$ 444,270

[a]Elk released before calving

[b]Post-hunting season population (bulls, cows, calves, total elk)

[c]$7.50 ($15.00 application fee minus $7.50 administrative cost)

Restoration Cost Estimate for the Passive Restoration Option

Year	*Relocation Cost* [a]	*Equipment Costs* [b]	*Staff Costs* [c]	*Research/Survey Costs* [d]	*Outreach Costs* [e]	*Tag Revenues* [f]	*Revenues - Costs*
1	$ -	$ -	$ 3,358	$ 9,000	$ 3,358	$ -	$ (15,716)
2	-	-	3,358	-	3,358	-	(6,716)
3	-	-	3,358	-	3,358	-	(6,716)
4	-	-	3,358	9,000	3,358	-	(15,716)
5	-	-	3,358	-	3,358	-	(6,716)
6	-	306,000	231,450	-	3,358	-	(540,808)
7	-	12,500	231,450	9,000	3,358	-	(256,308)
8	-	12,500	231,450	-	3,358	-	(247,308)
9	-	12,500	231,450	-	15,858	111,068	(148,741)
10	-	12,500	231,450	9,000	3,358	111,068	(145,241)
11	-	12,500	231,450	-	3,358	111,068	(136,241)
12	-	12,500	231,450	-	3,358	111,068	(136,241)
Total	$ -	$ 381,000	$ 1,636,940	$ 36,000	$ 52,796	$ 444,270	$ (1,662,466)

[a] No relocation

[b] Vehicles, communication equipment, elk handling equipment, farm equipment

[c] Current effort years 1-5, elk population growth warrants new positions in year 6 (1 WB, 2 CPOs, 2 WBAs)

[d] Aerial survey of coalfield counties

[e] 100 hours per year for publications, talks, school programs and production of outreach materials

[f] No tag revenues

APPENDIX 5. POPULATION GROWTH AND COST ESTIMATES FOR THE ACTIVE RESTORATION OPTIONS

Population Growth Model for the Active Restoration Option (with 1 stocking of 75)

Year	Elk Released [a]	Bulls [b]	Cows	Calves	Total Elk	Bull Tags	Cow Tags	Total Tags	Applications [c]		Revenue
1	75	23	46	21	90	0	0	0	0	$	-
2		31	53	30	114	0	0	0	0		-
3		43	63	35	141	0	0	0	0		-
4		56	75	40	171	0	0	0	0		-
5		71	88	48	207	0	0	0	0		-
6		88	105	57	250	0	0	0	0		-
7		109	124	67	300	0	0	0	0		-
8		132	146	79	357	0	0	0	0		-
9		149	172	93	414	10	0	10	14,809		111,068
10		172	174	110	456	10	30	40	20,770		155,775
11		197	183	114	494	15	30	45	21,376		160,320
12		221	183	115	519	15	40	55	22,449		168,368
Total	75					50	100	150	79,404	$	595,530

[a] Elk released before calving

[b] Post-hunting season population (bulls, cows, calves, total elk)

[c] $7.50 ($15.00 application fee minus $7.50 administrative cost)

Restoration Cost Estimate for the Active Restoration Option (with 1 stocking of 75)

Year	*Relocation Cost* [a]	*Equipment Costs* [b]	*Staff Costs* [c]	*Research/Survey Costs* [d]	*Outreach Costs* [e]	*Tag Revenues* [f]	*Revenues - Costs*
1	$ 75,000	$ 306,000	$ 231,450	$ 9,000	$ 6,716	$ -	$ (628,166)
2	-	12,500	231,450	-	6,716	-	(250,666)
3	-	12,500	231,450	-	6,716	-	(250,666)
4	-	12,500	231,450	9,000	6,716	-	(259,666)
5	-	12,500	231,450	-	6,716	-	(250,666)
6	-	12,500	231,450	-	6,716	-	(250,666)
7	-	12,500	231,450	9,000	6,716	-	(259,666)
8	-	12,500	231,450	-	6,716	-	(250,666)
9	-	12,500	231,450	-	19,216	111,068	(152,099)
10	-	12,500	231,450	9,000	6,716	155,775	(103,891)
11	-	12,500	231,450	-	6,716	160,320	(90,346)
12	-	12,500	231,450	-	6,716	168,368	(82,299)
Total	$ 75,000	$ 443,500	$ 2,777,400	$ 36,000	$ 93,092	$ 595,530	$ (2,829,462)

[a] 75 elk stocked the first year

[b] Vehicles, communication equipment, elk handling equipment, farm equipment

[c] Elk population growth warrants new positions in year 1 (1 WB, 2 CPOs, 2 WBAs)

[d] Aerial survey of coalfield counties

[e] 200 hours per year for publications, talks, school programs and production of outreach materials

[f] From population growth and hunting opportunity model (Appendix 4)

Population Growth Model for the Active Restoration Option (with 3 stockings totaling 200)

Year	Elk Released [a]	Bulls [b]	Cows	Calves	Total Elk	Bull Tags	Cow Tags	Total Tags	Applications [c]		Revenue
1	75	18	52	30	100	0	0	0	0	$	-
2	75	50	113	65	228	0	0	0	0		-
3	50	93	166	90	349	0	0	0	0		-
4		118	196	106	420	10	0	10	14,809		111,068
5		149	231	125	505	10	0	10	14,809		111,068
6		187	273	148	608	10	0	10	14,809		111,068
7		227	313	175	715	15	10	25	18,520		138,900
8		273	342	202	817	20	30	50	21,933		164,498
9		323	382	220	925	25	30	55	22,449		168,368
10		377	418	243	1038	25	40	65	23,383		175,373
11		439	426	268	1133	25	75	100	25,974		194,805
12		508	446	275	1229	25	75	100	25,974		194,805
Total	200					165	260	425	182,660	$	1,369,950

[a]Elk released before calving

[b]Post-hunting season population (bulls, cows, calves, total elk)

[c]$7.50 ($15.00 application fee minus $7.50 administrative cost)

Restoration Cost Estimate for the Active Restoration Option (with 3 stockings totaling 200)

Year	*Relocation Cost* [a]	*Equipment Costs* [b]	*Staff Costs* [c]	*Research/Survey Costs* [d]	*Outreach Costs* [e]	*Tag Revenues* [f]	*Revenues - Costs*
1	$ 75,000	$ 306,000	$ 231,450	$ 248,300	$ 10,074	$ -	$ (870,824)
2	75,000	12,500	231,450	248,300	$ 10,074	-	$ (577,324)
3	50,000	12,500	231,450	210,200	$ 10,074	-	$ (514,224)
4	-	12,500	231,450	85,200	$ 22,574	111,068	$ (240,657)
5	-	12,500	231,450	-	$ 10,074	111,068	$ (142,957)
6	-	12,500	231,450	-	$ 10,074	111,068	$ (142,957)
7	-	12,500	231,450	9,000	$ 10,074	138,900	$ (124,124)
8	-	12,500	231,450	-	$ 10,074	164,498	$ (89,527)
9	-	12,500	231,450	-	$ 10,074	168,368	$ (85,657)
10	-	12,500	231,450	9,000	$ 10,074	175,373	$ (87,652)
11	-	12,500	231,450	-	$ 10,074	194,805	$ (59,219)
12	-	12,500	231,450	-	$ 10,074	194,805	$ (59,219)
Total	$ 200,000	$ 443,500	$ 2,777,400	$ 810,000	$ 133,388	$ 1,369,950	$ (2,994,338)

[a] 200 elk stocked the first three years

[b] Vehicles, communication equipment, elk handling equipment, farm equipment

[c] Elk population growth warrants new positions in year 1 (1 WB, 2 CPOs, 2 WBAs)

[d] From Research and Monitoring Cost Table

[e] 300 hours per year for publications, talks, school programs and production of outreach materials

[f] From population growth and hunting opportunity model (Appendix 4)

Population Growth Model for the Active Restoration Option (with 1 stocking of 200)

Year	Elk Released [a]	Bulls [b]	Cows	Calves	Total Elk	Bull Tags	Cow Tags	Total Tags	Applications [c]		Revenue
1	200	46	140	77	263	0	0	0	0	$	-
2		79	166	93	338	0	0	0	0		-
3		117	198	105	420	0	0	0	0		-
4		148	233	125	506	10	0	10	14,809		111,068
5		186	260	149	595	10	15	25	18,520		138,900
6		227	296	168	691	15	15	30	19,362		145,215
7		274	323	188	785	15	30	45	21,376		160,320
8		323	358	207	888	20	30	50	21,933		164,498
9		371	399	228	998	25	30	55	22,449		168,368
10		426	438	254	1118	25	40	65	23,383		175,373
11		490	450	281	1221	25	75	100	25,974		194,805
12		561	474	289	1324	25	75	100	25,974		194,805
Total	200					170	310	480	193,780	$	1,453,350

[a]Elk released before calving

[b]Post-hunting season population (bulls, cows, calves, total elk)

[c]$7.50 ($15.00 application fee minus $7.50 administrative cost)

Restoration Cost Estimate for the Active Restoration Option (with 1 stocking of 200)

Year	*Relocation Cost* [a]	*Equipment Costs* [b]	*Staff Costs* [c]	*Research/Survey Costs* [d]	*Outreach Costs* [e]	*Tag Revenues* [f]	*Revenues - Costs*
1	$ 200,000	$ 306,000	$ 231,450	$ 498,300	$ 10,074	$ -	$ (1,245,824)
2	-	12,500	231,450	123,300	$ 10,074	-	(377,324)
3	-	12,500	231,450	85,200	$ 10,074	-	(339,224)
4	-	12,500	231,450	85,200	$ 22,574	111,068	(240,657)
5	-	12,500	231,450	-	$ 10,074	138,900	(115,124)
6	-	12,500	231,450	-	$ 10,074	145,215	(108,809)
7	-	12,500	231,450	9,000	$ 10,074	160,320	(102,704)
8	-	12,500	231,450	-	$ 10,074	164,498	(89,527)
9	-	12,500	231,450	-	$ 10,074	168,368	(85,657)
10	-	12,500	231,450	9,000	$ 10,074	175,373	(87,652)
11	-	12,500	231,450	-	$ 10,074	194,805	(59,219)
12	-	12,500	231,450	-	$ 10,074	194,805	(59,219)
Total	$ 200,000	$ 443,500	$ 2,777,400	$ 810,000	$ 133,388	$ 1,453,350	$ (2,910,938)

[a] 200 elk stocked the first year

[b] Vehicles, communication equipment, elk handling equipment, farm equipment

[c] Elk population growth warrants new positions in year 1 (1 WB, 2 CPOs, 2 WBAs)

[d] From Research and Monitoring Cost Table

[e] 300 hours per year for publications, talks, school programs and production of outreach materials

[f] From population growth and hunting opportunity model (Appendix 4)

Research and Monitoring Cost Estimate for the Active Restoration Option

Year	Annual Cost	*Habitat Use*	*Human Dimensions*	*Elk Population Dynamics*	*Staff*[a]	*Equipment*[b]	*Services*[c]
1	$ 248,300	$ 38,100	$ 38,100	$ 172,100	$ 38,100	$ 125,000	$ 9,000
2	248,300	38,100	38,100	172,100	38,100	125,000	9,000
3	210,200	38,100		172,100	38,100	125,000	9,000
4	85,200	38,100		47,100	38,100		9,000
5	-			-			
6	-			-			
7	9,000			9,000			9,000
8	-			-			
9	-			-			
10	9,000			9,000			9,000
11	-			-			
12	-			-			
Total	$ 810,000	$ 152,400	$ 76,200	$ 581,400	$ 152,400	$ 375,000	$ 54,000

[a]Graduate student costs include $30,000 salary and $8,100 for equipment and supplies

[b]25 GPS collars