2015 – 2030 Kentucky Elk Management Plan

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Introduction

Purpose

The mission of Kentucky Department of Fish and Wildlife Resources (KDFWR) is to conserve and enhance fish and wildlife resources and provide opportunity for hunting, fishing, trapping, boating and other wildlife-related activities. The Kentucky Elk Management Plan was developed to provide a framework for continued elk management in the commonwealth of Kentucky. As such, it highlights the history of Kentucky's elk project, current challenges and opportunities, and goals for future management.

This plan does not attempt to assign specific actions for each situation encountered by elk managers in Kentucky. Rather, this document is intended to serve as a roadmap to the long-term management goals of the Kentucky elk herd.

Development of the Kentucky Elk Management Plan

The Kentucky wildlife resource belongs to all residents of the Commonwealth. As such, the Kentucky Elk Management Plan attempts to marry science-based wildlife management principles with public input about management objectives. The plan is divided into three major sections: an introduction to the history and current status of the Kentucky elk restoration project, a discussion of KDFWR's current elk management issues, and a listing of KDFWR elk project goals and objectives. Appendices include a summary of public input used in the formation of the Kentucky Elk Management Plan, a compendium of Kentucky elk research, and the Kentucky Elk Program Five Year Plan of Work.

Public input information included in the Kentucky Elk Management Plan was gathered from a statewide survey of Kentucky citizens regarding elk management (Kentucky Resident's Awareness of and Opinion on Elk Restoration and Management), two surveys of elk hunters drawn for the Kentucky elk hunt (2013 Elk Hunter Survey and 2014 Elk Hunter Survey), and a survey of elk hunt applicants who were not drawn for the Kentucky elk hunt (2014 Elk Quota Hunt Applicant Survey). Further public input was gathered during a comment period following the completion of the Plan's first draft. All public input was combined with biological recommendations from KDFWR staff.

Plan development also included results from previous Kentucky research and management documents. This included previous KDFWR Elk Reports, information from annual biological data collection, and various findings from past academic research. A full compendium of Kentucky-specific elk research is located in Appendix B.

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Historical perspective

Elk in Kentucky's past

Prior to the European settlement, elk (*Cervus elaphus*) were the most widely spread member of the deer family in North America (Murie 1951). Accounts from Kentucky pioneers suggest that elk were abundant in many areas of the state (Walker 1888, Funkhouser 1925), a detail also supported by Kentucky's many place names that reflect the past presence of elk.

While anecdotal evidence suggests elk were an important member of Kentucky's natural ecosystem, the species began to decline following the arrival of European settlers. Habitat loss, overhunting, and persecution led to widespread de-population of elk throughout the eastern United States (O' Gara and Dundas 2002), and Kentucky was no exception. The last wild elk of Kentucky's pioneer era was reportedly killed prior to the Civil War (Barbour and Davis 1974).

Implementation of the Kentucky elk reintroduction

The late twentieth century witnessed an increasing interest in returning elk to Kentucky. Supporters of a Kentucky elk reintroduction effort noted that in addition to re-establishing a native species to the state, a successful restoration effort would also provide increased opportunities for recreation and economic development (Larkin et al. 2001). The practice of restoring populations of native wildlife species was by no means unprecedented in Kentucky: KDFWR has successfully reintroduced or augmented wildlife populations across the state including white-tailed deer (*Odocoileus virginianus*) (Doerner et al. 2005), wild turkey (*Meleagris gallapavo*) (Kentucky Department of Fish and Wildlife Resources 2011), peregrine falcon (*Falco peregrinus*) (Dzialak et al. 2007), and river otter (*Lontra canadensis*) (Beverly and Elliott 2006).

The increased interest in a Kentucky elk herd led KDFWR to conduct a habitat feasibility study and a series of public meetings in 1997 to determine the biological and sociological implications of restoring a free-ranging elk population in the state (Larkin et al. 2001). The results of those endeavors suggested that a Kentucky elk restoration project was viable. The habitat feasibility study identified a biologically appropriate area in eastern Kentucky with an adequate land base, relatively low human population density, and minimal commercial agriculture (Larkin 2001). Comments from the public meetings demonstrated widespread support for re-introducing elk to Kentucky, particularly within the proposed elk restoration zone, where 99% of comments were in favor of the project (Maehr et al. 1999).

Following the encouraging findings of the habitat feasibility study and the public meetings, KDFWR determined to pursue elk restoration. Donor herds in six western states – Arizona,

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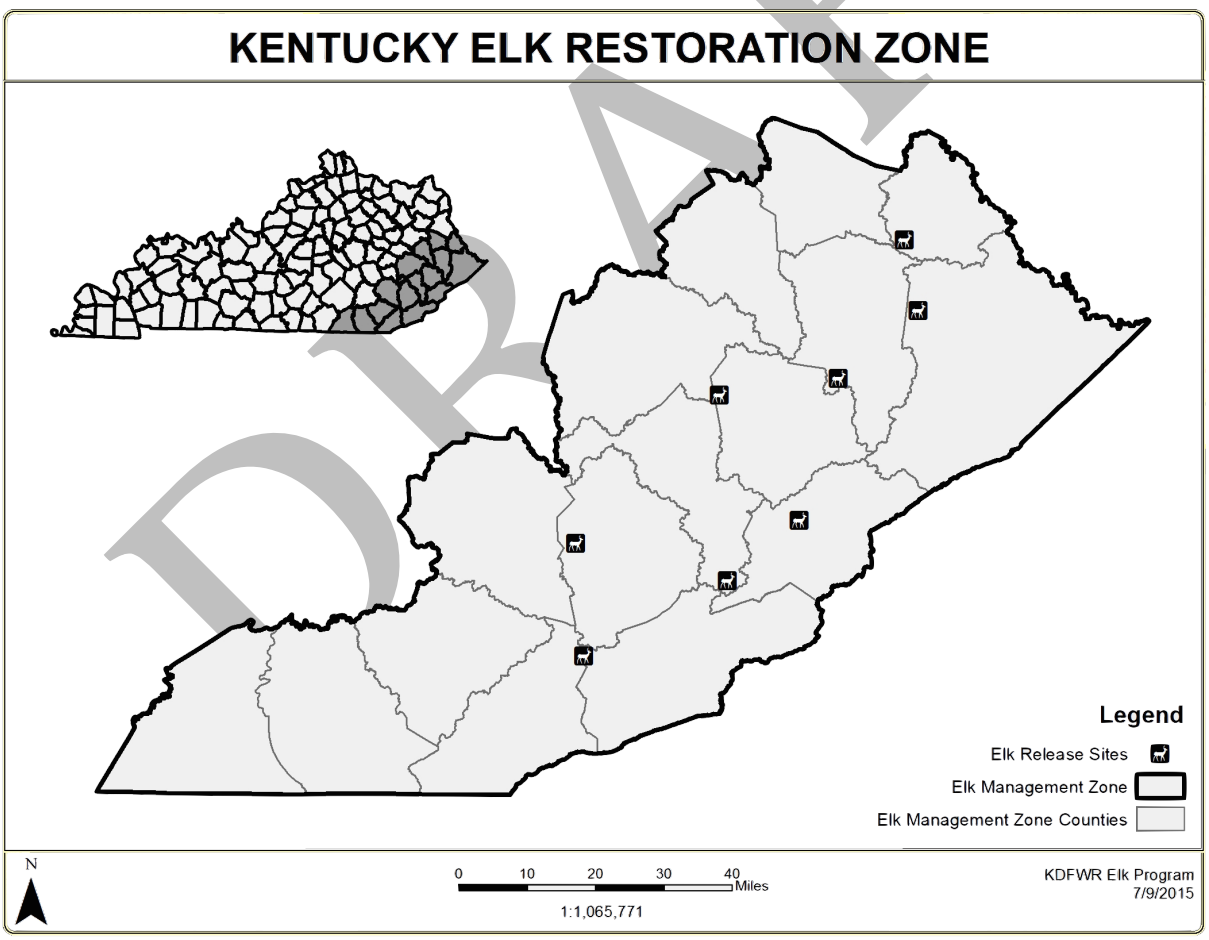
Kansas, North Dakota, New Mexico, Oregon and Utah – were located, and elk capture began in December 1997 (Larkin et al. 2001). After capture all elk underwent disease testing and were prepared for release in Kentucky. Elk translocation to Kentucky occurred from 1997 through 2002, during which time 1541 elk were released into the Kentucky elk restoration zone (Maehr et al. 1999, Seward 2003).

The Kentucky elk restoration zone encompasses 16 counties in the Cumberland Plateau physiographic region (Figure 1), an area characterized by winding ridges, deep drainages, and narrow valleys (McFarlan 1943, Overstreet 1984). Human land use within the elk restoration zone has resulted in a landscape mosaic of approximately 80% deciduous forest, 10% active and reclaimed surface mine, 9% agricultural or cleared land, and 1% urban matrix (Cox 2003). The original restoration zone included 14 counties, but Whitley and McCreary Counties were added in 2004 to provide a travel corridor between the Kentucky elk restoration zone and the Tennessee elk restoration zone.

Figure 1. Kentucky elk restoration zone and original elk release sites.



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Current status of the Kentucky elk herd

KDFWR is committed to providing conditions for a healthy elk herd throughout the 16 county elk restoration zone. The population is maintained at the desired level by hunter harvest, which is administered by KDFWR through a drawing system. Current information regarding the Kentucky elk population, herd vital rates, and hunt management can be found by visiting fw.ky.gov and searching for "Elk Report." This will provide a link to the most recent synopsis of KDFWR elk management.

Elk Management Issues

Elk habitat use

Elk habitat needs

Elk habitat is often categorized as the elements of food, cover, water, and space (Skovlin et al. 2002). Elk use of these differing components varies throughout the year and between years as a function of topography, vegetative composition, weather, hunting pressure, and other factors (Skovlin et al. 2002). Many western elk populations exhibit large seasonal movements to exploit different food sources and avoid severe weather conditions (Irwin 2002), but the Kentucky elk herd has not displayed any large-scale migratory tendencies (D. Crank, KDFWR, personal communication). Staff have recorded isolated instances in which family groups moved approximately nine miles between seasonal ranges (J. Plaxico, KDFWR, personal communication), but movements of this magnitude appear to be relatively rare in Kentucky.

In the initial years of the elk restoration project, elk in Kentucky were highly associated with herbaceous openings that result from surface mine reclamation (Dahl 2008). Olsson et al. (2007) suggested that elk primarily used reclaimed surface mines for feeding, and used the surrounding intact timberlands for thermal and escape cover. Despite these early findings, evidence suggests that this yearlong attraction to reclaimed surface mine habitat could be shifting in some areas. GPS collar data demonstrate that some Kentucky elk have begun spending a significant portion of time in forested habitat (J. Hast, KDFWR, personal communication). This is congruent with increased KDFWR staff observations of heavy elk use in forested environments and elk hunter reports.

Shifts in contemporary Kentucky elk habitat use

Increased elk utilization of forested habitats appears to have been increasing for several years, but this shift had become especially evident to elk managers by 2012-2013 (G. Jenkins, KDFWR, personal communication). Increased elk utilization of timberlands was somewhat unanticipated, but this transition makes ecological sense when external factors

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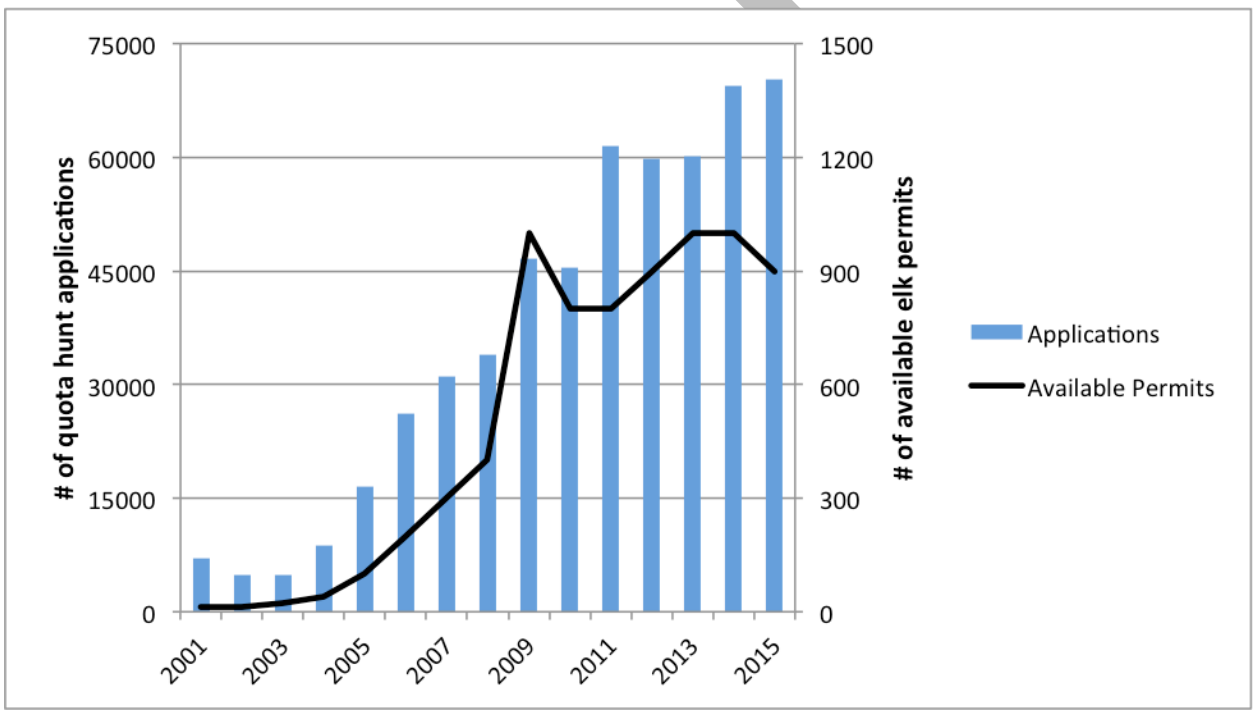
are considered. Factors of particular significance include increased hunting pressure, hunter distribution on the landscape, and de facto changes in habitat management.

Increased hunting pressure

KDFWR's intent has been to use hunting as the primary elk population management tool. To establish this precedent, Kentucky has offered limited elk hunting opportunities since 2001. These early hunts offered relatively few permits, however, since KDFWR was still focusing on growing the elk population. After KDFWR determined that population targets were within reach around 2008, the agency began increasing annual elk permit allocations. In fact, from 2007 to 2009 KDFWR increased annual permit allocations by 233%; interest in the Kentucky elk hunt (as measured by permit applications) also increased significantly during this period (Figure 4). While these additional permit allocations were well within the biological bounds of the population, it did lead to a substantial increase of hunters on the landscape. This increase in permit allocations meant that Kentucky elk were being hunted by more people in more places.

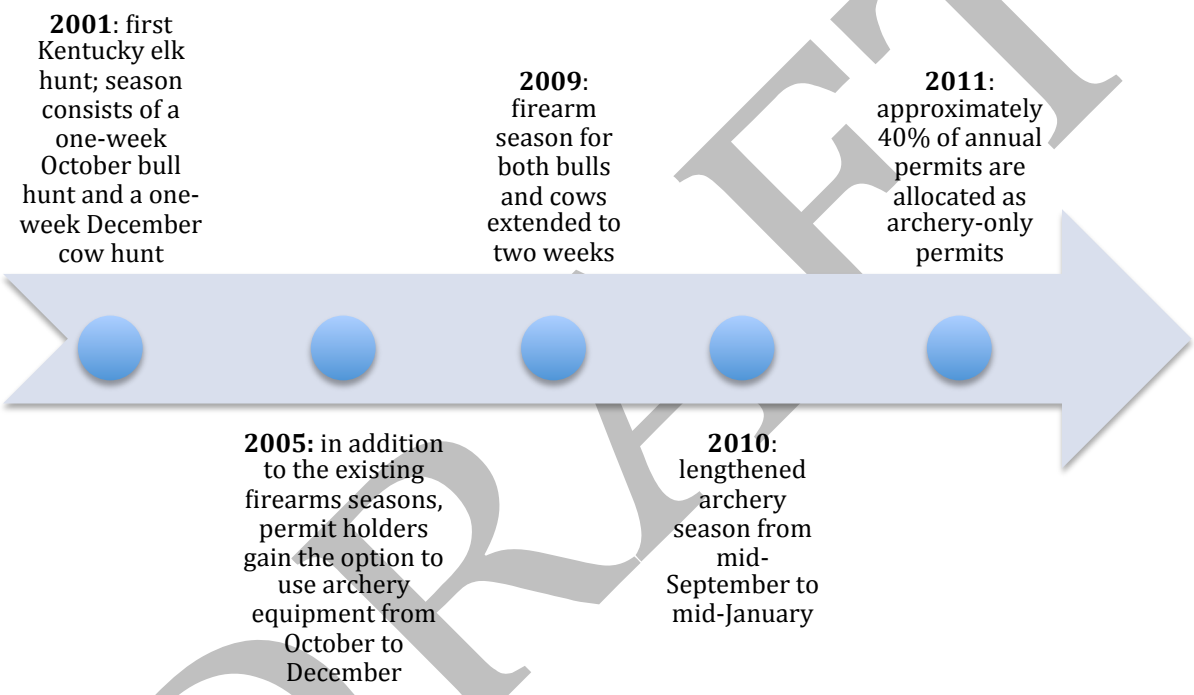
Figure 4. The relationship between Kentucky elk permits and permit applications.



While the overall increase in permit allocation has certainly increased elk hunting pressure, a temporal component is also involved. As KDFWR increased permit allocations, elk season was lengthened to maintain hunter satisfaction, to increase opportunity for hunting with archery equipment, and to reduce safety concerns. As a result of these regulatory changes, the elk season evolved from a relatively

concentrated event (a one-week bull season, two months of no elk hunting, followed by a two-week cow season) to a much more intensive structure (elk season opens in mid-September and continues through mid-January) (Figure 5). While Kentucky elk season is divided into discrete seasons based on sex of the animal and weapon type, the current structure still results in four months of continuous hunting pressure on elk herds. Stalling et al. (2002) suggest that such an intensive season structure can result in elk selecting more remote habitats with greater levels of escape cover. The rugged, forested terrain that characterizes most eastern Kentucky timberland habitat matches both of these requirements.

Figure 5. Timeline of Kentucky elk season duration and intensity.



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Hunter distribution on the landscape

Hunting pressure itself is a function of hunter numbers and season length, but the spatial distribution of hunters on the landscape can also play a vital role in elk response. A large body of research suggests that elk in hunted populations generally avoid roads, and that these negative effects grow as hunting pressure and road densities increase (McCorquodale 2013). This should not come as a surprise, given that previous studies have demonstrated that elk hunters seldom venture more than 300 meters from roads or trails, even when hunting on foot (Lyon and Burcham 1998). Most reclaimed surface mines in Kentucky have extensive road networks accessible to hunters, and hunters during the 2014 season spent the majority (58%) of their time in open minelands. In

fact, over 40% of Kentucky hunters listed "spot and stalk from a vehicle" as their primary elk hunting technique (Kentucky Department of Fish and Wildlife Resources 2014, Kentucky Department of Fish and Wildlife Resources 2015*a*). The increased vulnerability of elk that used heavily-roaded surface mines likely led to selection for more remote areas with less vehicle access.

De facto changes in habitat management

Habitat structure across the elk restoration zone has been changing as a result of disturbances in the coal industry. Much of the early Kentucky research (Larkin 2001, Wichrowski et al. 2005, Schneider et al. 2006, Olsson et al. 2007,) demonstrated that elk highly favored the food resources available on reclaimed surface mines. Elk did not use all parts of the mined landscape equally, however. The grassland reclamation process favored by most mining companies results in very nutritious forage in the initial years after establishment; however, forage quality generally degrades over time as the vegetative composition transitions from wheat, rye, and clovers to more competitive species such as serecia lespedeza and tall fescue. As a result, elk tend to highly favor forages on recently reclaimed sites over areas with older vegetation (W. Bowling, KDFWR, personal communication). This meant that the standard business practices of the coal companies resulted in de facto landscape-scale habitat management that benefitted elk. However, the number of new reclamation projects have drastically decreased from previous levels due to changing market forces that have led to a multiyear, regional downturn in the Central Appalachian coal industry (Estep 2015*b*). The absence of new reclamation projects would not necessarily force elk to use forested habitat, but new reclamation projects previously represented a substantial nutritional reward that held elk on surface mine habitat.

Any of these three external factors alone – increased hunting pressure, high hunter use of roads, and a loss of de facto habitat management –may not have proven adequate to prompt a widespread shift in habitat utilization, but their cumulative effects have likely prompted a change in how elk view the landscape. In effect, each of these factors provides a different stimulus to local elk herds that have resulted in greater use of forested habitat. Increased hunter pressure and high hunter use of roads "pushes" elk off of surface mines, and the decrease of new reclamation projects means that elk are no longer "pulled" onto surface mines to the extent that they were previously. This simultaneous push-and-pull is effectively conditioning elk herds to avoid open habitats, especially during hunting season.

Despite the large differences in floral community composition between reclaimed surface mines and forested areas, research suggests that dietary preferences should not be a constraint to elk utilization of timbered habitat. Elk are intermediate feeders, selecting a wide variety of forages to meet their dietary needs (Cook 2002). Elk in Kentucky consume approximately equal amounts of grasses, forbs, and browse on an annual basis, but the

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relative abundance of these forage types varies seasonally (Schneider et al. 2006). Elk throughout the Cumberland Plateau consume primarily grasses and browse during the spring and winter, forbs during the summer, and equal portions of grasses, forbs, and browse during the fall (Schneider et al. 2006, Lupardus et al. 2011). These findings led authors of a Tennessee dietary study to suggest that oak savannas maintained through a combination of silvicultural practices and prescribed fire could prove the ideal habitat for elk in the Cumberland Plateau (Lupardus et al. 2011). The oak savanna habitat type is largely absent from the Kentucky elk restoration zone as of 2015, but proactive management could begin transitioning portions of the landscape to this habitat type, which could provide ample food resources while maintaining cover.

Adequate nutritional resources are certainly a consideration for elk in a changing landscape, but it is not the only element that should be considered. The same factors that have likely led to the different patterns of habitat utilization may also be changing herd dynamics. Prior to the advent of season-long hunting pressure, Kentucky elk often grouped into a few large herds that contained a large proportion of local elk population (W. Bowling, KDFWR, personal communication). However, a recent behavioral study conducted in the same areas has suggested that elk have transitioned to more groups consisting of smaller herd sizes (B. Slabach, University of Kentucky, personal communication). Larkin et al. (2004) suggested that a reduction in local elk herd densities could potentially threaten the long-term viability of Kentucky elk restoration efforts by reducing reproductive efficiency. There is no indication that a shift in habitat utilization has led to a decrease in elk vital rates, but KDFWR staff should nevertheless remain cognizant of this possibility.

Finally, increased use of forested habitats means that elk will likely be less visible, which could potentially impact the satisfaction levels of humans involved in elk-related recreation. In fact, many Kentucky hunters have recently noted that they had difficulty locating elk in the animal's "usual" (i.e., open) habitat, and expressed lower hunting satisfaction as a result (Kentucky Department of Fish and Wildlife Resources 2014, Kentucky Department of Fish and Wildlife Resources 2015*a*). It is likely that non-consumptive elk recreationists would experience similar frustrations when faced with a lack of watchable wildlife.

Population monitoring

Quantifying landscape-level population trends is one of the most challenging tasks confronting wildlife managers. The ability to dependably identify population trends is especially important when issuing annual hunting permits for relatively small populations. Fortunately, past research provides various survey methodologies and population models that provide guidance when managing free-ranging wildlife populations.

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KDFWR Elk Program staff have identified several key demographic metrics that are combined with site-specific variables (such as hunter access) to inform sound management decisions. It is important to note, however, that KDFWR staff do not view these metrics in a vacuum; rather, each piece of information is analyzed alongside the others as components of a whole. This approach entails additional complexity, but it provides a more comprehensive view of the elk population than might be otherwise obtained.

Reproduction

Adult female reproduction and yearling female reproduction represent different components within the KDFWR elk model due to differential pregnancy rates between age classes. KDFWR collects two independent metrics for reproduction input into the model.

Fetus collection

KDFWR personnel collect fetuses from the cow elk hunt. This metric quantifies the breeding success rate during early gestation. Pregnancy rate is not a perfect proxy for successful reproduction due to potential termination of the pregnancy prior to birth, but it does provide information about reproductive trends over time.

Blood tests

Development of a reliable blood test for pregnancy-specific protein B has allowed KDFWR to receive antemortem pregnancy data since 2012. These data have been collected as part of a cow elk research project and for cows captured for translocation to Missouri, Virginia, and Wisconsin. As with fetus collection, this pregnancy rate provides a quantifiable point of reference at a given period in gestation. While these elk were part of a translocation project, we have no reason to expect their pregnancy rates would differ from the general population that remained on the Kentucky landscape.

Annual ratio counts

Annual Ratio Counts are conducted each fall to quantify bull:cow ratios and calf:cow ratios. These numbers are used in two contexts. First, they constitute important trend data that can illuminate changes in local herd compositions. Secondly, these data are compared to the expected output from the KDFWR elk population model as a form of ground-truthing.

Survival

Survival inputs are collected from a combination of past research and current observations. Various past studies have quantified annual survival and cause-specific mortality factors among discrete age and sex classes of Kentucky elk. These findings are used as a baseline for all modeling purposes. These past research results are also compared with trend data from Annual Ratio Counts to ensure that these past results still seem valid in response to emerging information.

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Mark-resight surveys

Mark-resight surveys have been described as the "golden standard" of population estimation techniques (Pierce et al. 2012). This technique uses multiple sampling frames to compare the proportion of marked animals with unmarked animals. The utility of mark-resight surveys are well recognized in the wildlife literature, but successful implementation requires significant numbers of marked animals on the landscape. The Hazard Limited Entry Area has a significant number of marked animals due to previous research projects; as a result, this method has been used exclusively in the Hazard Limited Entry Area.

Aerial counts

Aerial counts are conducted from either helicopters or fixed wing aircraft to survey blocks of landscape inaccessible from the ground. Survey teams consist of a pilot and two KDFWR employees proficient in aerial survey methods. Flight paths are constructed in a manner that allows the survey team to cover as much land as possible. Upon spotting an elk herd, the aircraft circles the group until KDFWR staff have counted and categorized all available animals based on sex and age. Aerial counts are most advantageous for their ability to cover large blocks of landscape in a much more timely fashion than ground-based counts and because they allow staff to survey otherwise inaccessible terrain. The method is not without fault, however. While aerial counts provide a means of quickly surveying inaccessible areas, elk located within the timber cannot be readily identified, even during leaf-off conditions. As a result, aerial count data should be viewed as a minimum count on a specific property as opposed to a population estimation technique.

Elk recreation

Hunting

Background

Kentucky offered its first elk hunt in 2001, and annual hunts have occurred each year since. Permit numbers have fluctuated over the years, but have generally exhibited an upward trend. While elk hunting is now firmly ingrained in the Kentucky sporting tradition, the regulations that govern the hunt have undergone a substantial evolution during this time. These changes were incorporated to meet the changing needs of an increasing elk population and mounting hunter interest. At the time of the first Kentucky elk hunt there were very few elk hunting opportunities in the eastern United States, and none in Appalachia (O' Gara and Dundas 2002). As a result, there were very few relevant models on which KDFWR elk managers could pattern the Kentucky hunt. In this absence of applicable models, KDFWR staff instead relied on Kentucky elk research to create state-specific regulations that maintained a robust elk population while maintaining a high level of user satisfaction (Duda et al. 2011, Kentucky Department of Fish and Wildlife Resources 2014, Kentucky Department of Fish and

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Wildlife Resources 2015a, Kentucky Department of Fish and Wildlife Resources 2015b). The results of this science-driven management have been adequate to maintain a robust elk population, but this paradigm has required a flexible approach to elk hunting regulations.

Hunting management zones

Elk are a herd animal with large home ranges, but eastern Kentucky has relatively little public land. The combination of these factors means that clusters of elk populations on public property could be subjected to overharvest if appropriate harvest controls are not in place. To address this issue, KDFWR created Limited Entry Areas (LEAs) to protect large pieces of public property with historically high elk densities. KDFWR restricts elk permit numbers within these LEAs to prevent potential overharvest.

All portions of the elk restoration zone that are not within an LEA are designated as the At-large Area. All general drawing quota permit holders automatically receive a permit for the At-large Area. To receive an LEA permit, a hunter with a general drawing quota permit must apply for a secondary drawing.

Elk management units

Elk Management Units (EMUs) were developed to address localized areas of recurring negative elk-human interactions. There have been relatively few areas in the Kentucky elk restoration zone where elk caused persistent problems, but EMUs have been instrumental in helping address this challenge in the locations where these problems have occurred. After delineating an EMU, KDFWR staff have the ability to place additional hunters into the EMU during a special late season hunt (see following section for full details). These hunts occur only on private property during midwinter – the season most negative elk-human interactions are documented on private lands. As a result, hunters pressure (and potentially harvest) only potential nuisance elk.

Current elk permit types

As of Spring 2015, there were five different avenues by which Kentucky elk permits were distributed: general drawing quota permits, landowner-cooperator permits, commission permits, voucher-cooperator permits, and late season permits.

General drawing quota permits

General drawing quota permits are available by applying to the Kentucky elk drawing online; KRS 150.025 (1) provides statutory authority for this permit. Permits are offered for bull firearm, bull archery, cow firearm, and cow archery; individuals may apply separately for each permit type, for a total of 4 possible applications per year. However, individuals can only apply once for each permit type. A secondary drawing to determine hunting area occurs after the initial

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drawing; details of this secondary drawing are covered below in the "Hunting management zone" section. General drawing quota permits cannot be bought or sold, and hunters have to follow the season requirements for the permit for which they were drawn. The annual allocation of general drawing quota permits are determined by the KDFWR Commission, and reflect elk population estimates, estimated harvest success, and available hunting access.

Landowner-cooperator permits

Landowner-cooperator permits are provided to landowners who open their property to public hunting; KRS 150.178 provides statutory authority for this permit. For each 5,000 acres enrolled in a public hunting agreement with KDFWR, the landowner receives one either sex elk permit each year. Landowners may give away or sell these permits. A hunter with the landowner-cooperator permit may hunt during any season. However, that person may only hunt on the public land enrolled in the program. As of 2015, this program has opened approximately 130,000 acres for public hunting opportunity in the Kentucky elk zone.

Special commission permits

Special commission permits are available to registered non-profit groups whose focus is on wildlife conservation; KRS 150.177 provides statutory authority for this permit. A hunter with this permit can hunt during any elk season anywhere they have permission to do so. The Kentucky Department of Fish and Wildlife Commission issues 10 of these either sex elk permits per year. Non-profits can sell a permit outright or auction it, but all proceeds must be used for a conservation project in Kentucky. Special commission permits have limited transferability, contingent on the conservation group who sold the tag.

Voucher-cooperator permits

Voucher-cooperator permits are provided to landowners who enroll their property into the Voucher-cooperator Program; KRS 150.178 provides statutory authority for this permit. Landowners with at least 100 acres of property can enroll in the Voucher-cooperator Program. Landowners receive points for animals that are harvested from their enrolled property (1 point for each cow, 2 points for each bull). When the landowner accumulates 20 points, they will receive one fully transferrable, either sex elk permit for the next season. There is no limit to how long it takes a landowner to accumulate 20 points. Whoever holds the voucher-cooperator permit must hunt on property owned by the landowner enrolled in the program, but they can hunt during whichever elk season is currently open.

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Late season permits

Late season permits were created to curb elk nuisance in areas of localized elk-human conflict; KRS 350.190 provides statutory authority for this permit. Late season permits are drawn from the residents of an Elk Management Unit county who unsuccessfully applied to the general drawing quota. Late season permit holders must hunt only on private lands within the EMU boundaries, and may harvest only the sex of animal designated by their permit. KDFWR has authority to issue either antlerless or spike elk permits for the late season hunt.

Hunting guides

There has been a substantial increase in the number of Kentucky hunting guide services as permit numbers have increased. In fact, a survey from the 2006 elk season demonstrated that only 18% of elk hunters used a guide, and paid $40-600 for the service (We Make Things Happen Corporation 2007). In the 2013 and 2014 seasons, however, 39% of hunters used a guide, and paid a mean of $665 for the service (Kentucky Department of Fish and Wildlife Resources 2014, Kentucky Department of Fish and Wildlife Resources 2015*a*). KDWFR requires licensed hunting guides to submit an application along with proof of Hunter Education certification, a Kentucky State Police background check, and affidavits attesting to current CPR and First Aid training. As of 2015, there were 23 guides licensed for elk hunting in Kentucky.

Non-consumptive recreational opportunities

Despite Kentucky's large and accessible elk population, eastern Kentucky's free-ranging elk herd offers relatively few structured elk viewing opportunities. Two Kentucky State Resort Parks (Jenny Wiley and Buckhorn Lake) and a limited number of private companies offer elk tours, and in early 2015 the Appalachian Wildlife Foundation expressed its intent to open a wildlife education center that will have elk as its focal piece (Estep 2015*a*). There are also two elk viewing areas – one developed by Breathitt County Fiscal Court and the other by a partnership between University of Kentucky and the Rocky Mountain Elk Foundation – that were established on properties accessible to the public. The previously mentioned opportunities notwithstanding, there has been relatively little growth in Kentucky's non-consumptive elk tourism sector when compared to other eastern elk herds. An area of the Great Smoky Mountains National Park witnessed a 100% increase in visitor attendance following the establishment of an elk herd (Keepfer 2014), and the Elk Country Visitor Center in Benezette, Pennsylvania welcomed approximately 411,000 elk enthusiasts in 2014 (R. Cogan, Keystone Elk Country Alliance, personal communication). These numbers are especially impressive given that both of the previously mentioned locations are relatively remote, with relatively small elk herds in comparison to the Kentucky population.

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Despite the lack of growth, there is interest in creating an elk-centered tourism industry in Kentucky. Various local governments have branded themselves in this regard (Clay County declared itself Gateway to Elk Country, Knott County declared itself Elk Capital of Kentucky), and several local towns have also introduced elk murals, statues, and other elk related artwork into their downtown areas. A recent report estimated that 47 million people live within a half-day drive of the Kentucky elk restoration zone, with approximately 163 million people within a days drive (We Make Things Happen Corporation 2007). While not all of these individuals would be interested in wildlife viewing, they nevertheless represent a large potential market.

Access to property with elk

The Kentucky elk restoration covers approximately 4.1 million acres, but relatively little (13%) of this acreage is open for elk-related recreational activities (Figure 6; J. Hast, KDFWR, personal communication). While the lack of public access is due to the large amount of privately owned property in the elk restoration zone, the issue is also exacerbated by the relatively small tract sizes of the average landholding. KDFWR has found that this large number of small landowners can increase the difficulty of securing access agreements on landholdings of a meaningful size. This relative lack of public land poses several management issues.

Due to the high percentage of private property, KDFWR lacks the ability to perform habitat improvements on most of the landscape within the elk restoration zone. A lack of public access also poses obstacles for population management through hunting, as many of the individuals drawn for the general quota permit do not have ready access to private lands within the elk restoration zone. As a result, public lands support a disproportionate amount of Kentucky elk hunting. This can prove challenging to KDFWR staff when seeking to manage overall population levels while preventing localized overharvest.

However, there is a wide range of management authority across the public property within the elk management zone (Figure 7). Of the 560,000 acres of public land in the elk restoration zone, federal land (United States Forest Service and United States Army Corp of Engineers) constitutes the largest component (56%), followed by lands under KDFWR management authority (38%), other Kentucky state agencies (3%), the University of Kentucky (2%), and other public-private partnerships (2%). There are a wide variety of management paradigms across these properties, both within and between agencies. For example, KDFWR has increased the amount of public land available for elk recreation through the landowner-cooperator permit and voucher-cooperator permit programs, but the agency has often been unable to manage habitat on these properties. In fact, the voucher-cooperator permit program does not provide KDFWR with any management authority, and while the landowner-cooperator permit program does provide KDFWR with management authority, either party can end the agreement with a 30-day notice. As a

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result, KDFWR staff have been hesitant to invest in major habitat improvement projects on many of these properties. This is unfortunate, since a substantial portion (53%) of the public lands under KDFWR management authority within the elk zone are held in these short-term agreements (Figure 8).

This situation is further complicated because many of the elk herds found on public land exist at relatively low densities. Staff on the Daniel Boone National Forest receive many requests from individuals interested in elk viewing each year (S. Meadows, Daniel Boone National Forest, personal communication), but very few locations on the Daniel Boone National Forest currently offer readily available viewing opportunities. This issue is not relegated to National Forest lands, however, as similar situations occur on several other public properties within the elk restoration zone (W. Bowling, KDFWR, personal communication). Targeted habitat improvement projects could likely increase elk utilization of these properties, especially if implemented near areas with existing elk populations or in conjunction with active elk translocation projects.

Figure 6. A comparison of public and private land management in the Kentucky elk restoration zone.

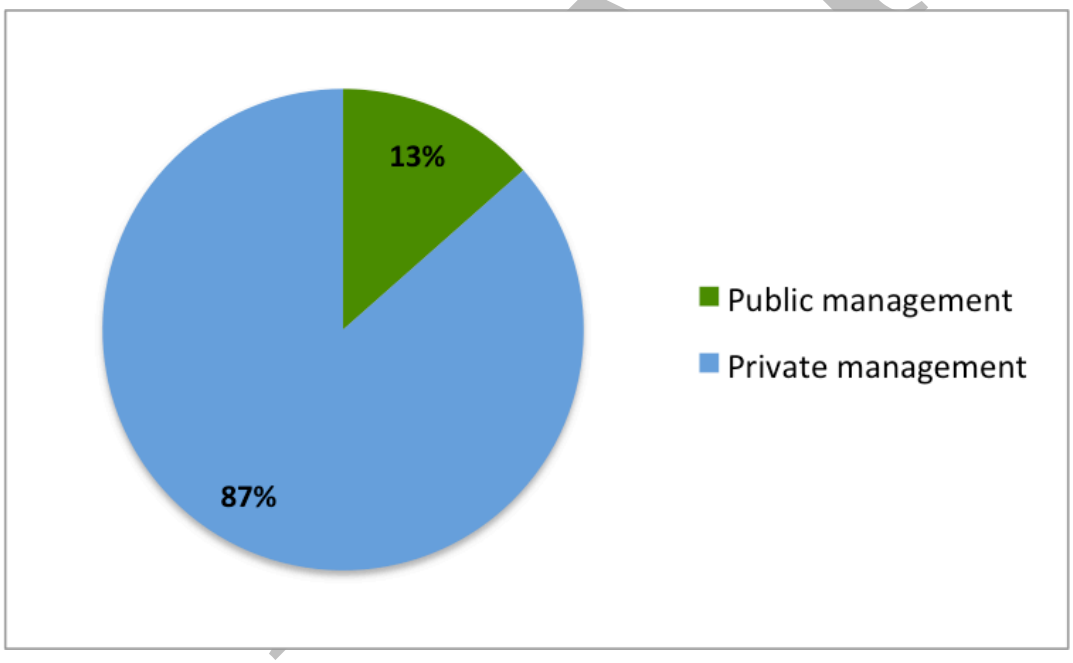


Figure 7. A comparison of entities with management authority on public land in the Kentucky elk restoration zone.

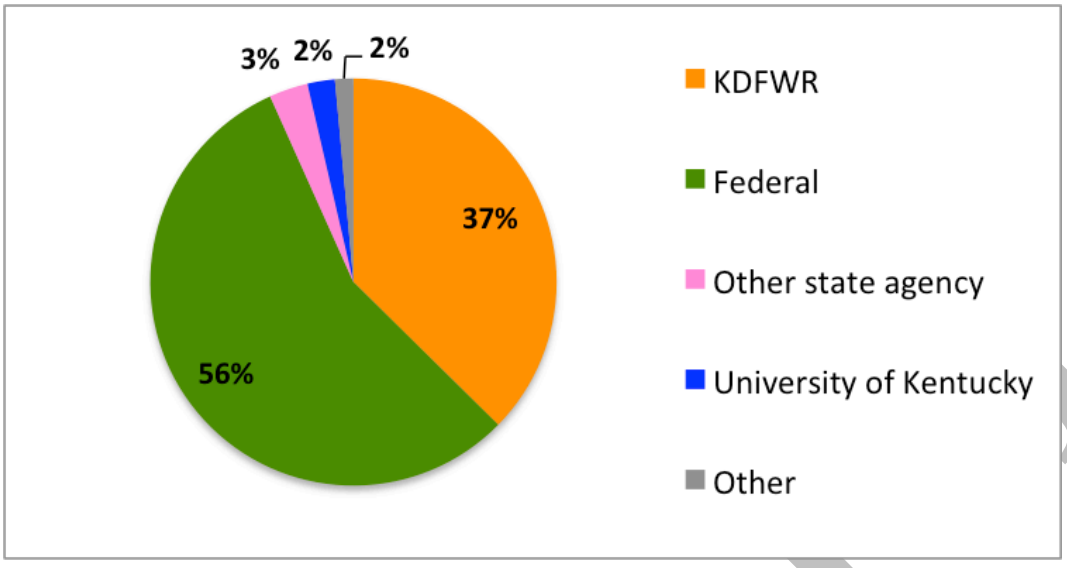
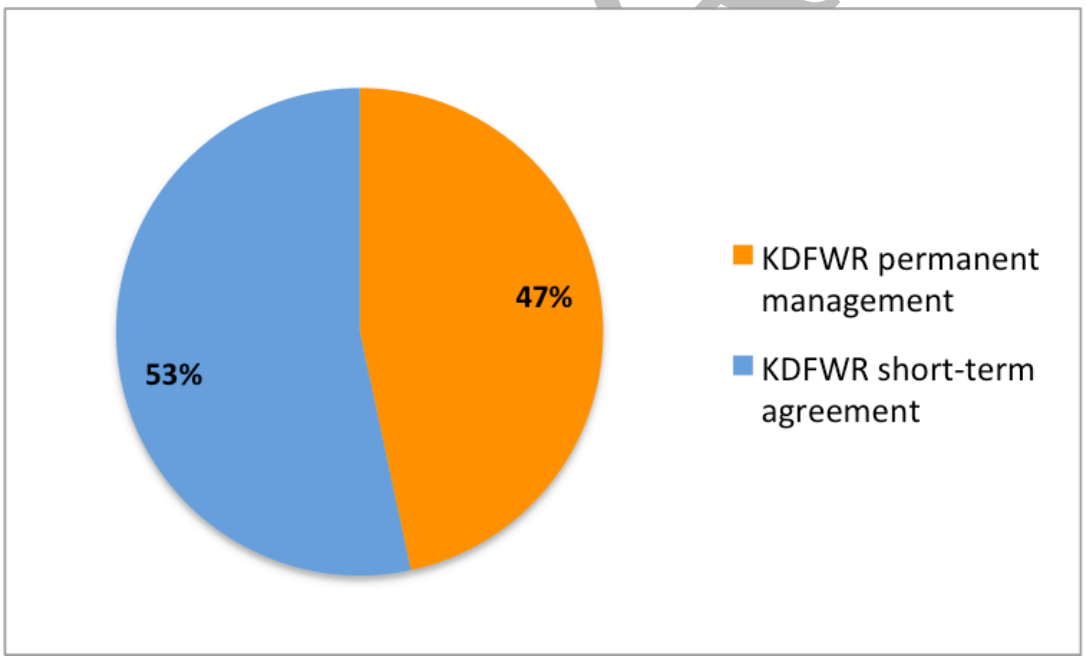


Figure 8. A comparison of management agreement types on properties to which KDFWR has management authority.



Elk – human conflict

Sources of conflict on private property

Elk nuisance on private property has not occurred on a widespread basis, but KDFWR personnel have documented isolated instances (D. Crank, personal communication). Despite relatively few annual instances of documented property damage, many Kentucky citizens have indicated a low tolerance of elk damage to private property. Examples of past damage and property types are provided in Table 1.

Table 1. Property types and commonly associated elk nuisance issues

Property Type	Damage Commonly Associated with Property Type
Livestock pasture	Fences torn down, forage crops eaten
Yard	Turf damage, ornamental plants browsed or rubbed with antlers
Cemetery	Turf damage, tombstones overturned
Home garden	Produce eaten, plants trampled
Golf course	Turf damage

KDFWR response to elk-human conflict

Upon receiving a report of elk nuisance on private property, KDFWR staff visit the landowner to assess and document the damage. The staff on hand then fill out a wildlife damage form detailing the kind and amount of damage occurring, and submit the form to the KDFWR nuisance wildlife database. KDFWR may take further action if deemed necessary. Past actions have included, but are not limited to: provide technical guidance to the landowner that enabled them to successfully address the situation, haze the offending animals with noisemakers and/or nonlethal projectiles, loan the landowner KDFWR-owned temporary electric fencing, relocate the offending animals, implement special hunts to remove the offending animals, provide the landowner with a depredation permit, and lethal control.

Elk presence near highways

Due to the rugged topography of the Cumberland Plateau, many highways in the Kentucky elk restoration zone lie along valley bottoms. Elk occasionally forage in the valleys, especially during the winter months (D. Crank, personal communication). While elk-vehicle collisions are relatively rare in Kentucky (approximately 20 annual reported elk-vehicle collisions, vs. approximately 3,000 annual reported white-tailed deer-vehicle collisions)(Kentucky State Police 2012), the presence of elk in proximity to highways is inherently unsafe.

KDFWR has used several strategies to address elk proximity to highways. Sections of roadways with a past history of elk-vehicle collisions and/or high elk concentrations have

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been outfitted with signs warning motorists of potential elk crossings. No quantitative data are available to determine the effectiveness of these signs, but anecdotal evidence suggests they increase motorist attentiveness to elk in the roadway (W. Bowling, personal communication). Other KDFWR management tools to address elk around roadways have included hazing with noisemakers and/or nonlethal projectiles, relocation, lethal control, increased harvest pressure, and working with Kentucky Department of Transportation (KDOT) to increase highway corridor visibility; furthermore, KDFWR could coordinate with KDOT to locally reduce speed limits in areas of high collision risk.

Current realized economic impact of elk in Kentucky

Two broad avenues currently exist for elk-related economic development in Kentucky: hunting and wildlife viewing. Survey data suggest that hunters have greater individual mean expenditures than wildlife viewers ($3,921 vs. $353) (Duda et al. 2011, Kentucky Department of Fish and Wildlife Resources 2014, Kentucky Department of Fish and Wildlife Resources 2015*a*). It should be noted that results from wildlife viewers measured individual trips, whereas hunter data combined expenses from all scouting and hunting trips, and included data for the entire hunting party. While this is a sizeable difference, several possible explanations exist for this disparity.

First, wildlife viewers likely do not need as much specialized equipment, especially if outings are relatively casual. While hunters and non-consumptive users will likely have some of the same equipment (binoculars), hunters may have additional expenditures for weapons, camouflage, guide fees, etc., that will not necessarily be incurred by wildlife viewers. The large number of elk zone residents who engage in this elk viewing also served to skew the average expenditure by all elk viewers downward. Duda et al. (2011) found that when stratified by residence, many more elk zone residents (12%) had taken elk viewing trips in the previous year compared to non-zone residents (4%). While visitors who lived inside the restoration zone were much more prevalent, their mean expenditure per trip ($67) was much less than the mean expenditure ($480) of non-consumptive users who lived outside the restoration zone (Duda et al. 2011).

KDFWR currently lacks information for the overall financial impact of non-consumptive elk activities, but KDFWR conducted hunter surveys following the completion of the 2013 and 2014 elk hunting seasons to determine the extent of the financial impacts. These surveys indicated that elk hunting provided a total direct economic impact of $3.21 million and $2.79 million, respectively (Table 2). Using the standard hunting expenditure multiplier variable calculated for Kentucky by the International Association of Fish and Wildlife Agencies (2002), the total impact of elk hunting expenditures in Kentucky during 2013 and 2014 were $6.54 million and $5.68 million.

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Table 2. Estimated financial impact of the 2013 and 2014 Kentucky elk hunting seasons.

	2013		2014	
	Within the elk zone	**Total**	**Within the elk zone**	**Total**
Direct expenditures	$1,607,959	$3,205,147	$1,738,892	$2,786,099
Total economic impact after multiplier effect	$3,280,236	$6,538,500	$3,547,340	$5,683,642

Elk Project Goals and Objectives

The following goals and objectives are not intended as a day-to-day schedule of KDFWR Elk Program projects; rather, they are intended as a visioning framework for the next 15 years. As a result, not all objectives have a clear metric of measurement. It should also be noted that these Goals, Objectives, and Strategies are not necessarily listed in order of priority or importance.

I. BIOLOGICAL AND SOCIAL CARRYING CAPACITY

Goal Manage the elk population at biologically and socially acceptable levels using scientifically sound management practices.

Objective I.1 Maintain the elk population at a level that respects biological and social carrying capacities.

Strategy I.1a Monitor statewide population status through modeling.

Strategy 1.1b Identify at least one method of acquiring localized elk population estimates in areas of management interest.

Strategy I.1c Collect data from staff surveys and harvested animals to monitor potential changes in herd demographics and vital rates.

Strategy I.1d Use a variety of public involvement techniques (e.g., focus groups, surveys, task forces, public meetings, local government coordination) to determine social carrying capacity in all areas of the elk zone based on social, economic, political, and biological perspectives.

Strategy I.1e Use recreational hunting as the primary elk population management strategy.

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Strategy I.1f Where hunting is inappropriate, identify other management options to control elk populations.

Strategy I.1g Use public education to foster an understanding of how to coexist with elk and foster acceptance of growing elk populations.

Strategy I.1h Use research and monitoring activities to determine the efficacy of management programs to achieve area-specific biological and social carrying capacity objectives.

Strategy I.1i Investigate the potential for using active, in-state translocation to establish elk herds in areas of the restoration zone that currently lack populations; in evaluating new areas for relocation, account for both biological and social factors.

Objective I.2 Conduct and support practical research to help achieve elk management goals.

Strategy I.2a Have annual meetings with staff representatives from Regional Programs, Wildlife Research Program, Wildlife Health Program, and the Law Enforcement Division to identify research needs.

Strategy I.2b Maintain a prioritized list of elk research needs, potential funding sources, and implementation strategies.

Strategy I.2c Stay abreast of current research to identify new findings in elk ecology and management, as well as to identify potential collaborators for future Kentucky elk research.

Objective I.3 Determine and address the most important risk factors that may prevent attainment and/or maintenance of the long-term viability of elk populations.

Strategy I.3a Evaluate risk factors that might prevent the attainment and/or maintenance of population viability, including population demographics (e.g., changes in births, deaths, and population growth), genetics (e.g., inbreeding concerns), environmental influences (e.g., disease, competitors, pollutants, natural catastrophes), human impacts (e.g., roads, urbanization, poaching, illegal trade), and habitat concerns (e.g., corridors, forest composition, roadless areas).

Strategy I.3b Develop ecologically-relevant elk management units in which the previously mentioned risk factors can be analyzed.

Strategy I.3c Develop plans to counteract risk factors that pose a threat to long-term population viability in any elk management unit.

Strategy I.3d As needed, develop research projects to measure the impact of management activities on risk factors within individual management units.

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Objective I.4 Maintain herd health and prevent the introduction of disease into Kentucky.

Strategy I.4a Coordinate with the Wildlife Health Program, Regional Programs, and the Law Enforcement Division to establish standardized disease-testing protocols for sick elk.

Strategy I.4b Continue to collect chronic wasting disease samples from neurologically compromised animals.

Strategy I.4c Coordinate with the Wildlife Health Program to determine the number and location of CWD samples acquired from non-target animals each year.

Strategy I.4d Coordinate with the Wildlife Health Program to monitor the implications of meningeal worm infection.

Strategy I.4e Continue cooperation with USDA/APHIS and SCWDS for disease surveillance.

Strategy I.4f Maintain regulatory authority that allows the destruction of confiscated, illegally held cervids.

II. Habitat

Goal Conserve elk habitat in Kentucky in a manner consistent with elk population objectives and with emphasis on areas of special significance (e.g., areas with source populations and habitat linkages). Conservation may consist of habitat enhancement or protection.

Objective II.1 Ensure habitat requirements meet objectives for biological and social carrying capacity.

Strategy II.1a Monitor changes in the quantity and quality of elk habitats. Monitoring habitat changes may include use of Landsat imagery, aerial photography, existing GIS information, Continuous Forest Inventory data, forest stand information, and specific field data.

Strategy II.1b Actively promote and implement habitat management practices on lands– both public and private – within the elk restoration zone to maintain consistency with population viability and social carrying capacity objectives.

Strategy II.1c Work with large public landholders (United States Forest Service, United States Park Service, United States Army Corp of Engineers, Kentucky Division of Forestry, etc.) to identify and implement landscape-scale habitat management projects.

Strategy II.1d Investigate novel habitat improvement methods from both public and private sector sources.

Objective II.2 Refine specific elk habitat quality and associated habitat needs (e.g., amount, composition, linkages, diversity) needed to meet biological and social carrying capacity objectives for elk populations.

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Strategy II.2a Periodically analyze current habitat use to determine if elk utilization of the landscape is changing over time.

Strategy II.2b Determine impact of habitat changes (e.g., decline of surface mines, expanding human population, changes in forest composition) on elk populations.

Strategy II.2c Conduct further investigations into the efficacy of prescribed fire for elk habitat improvement on reclaimed surface mines.

Strategy II.2d Conduct further investigations into the efficacy of different silvicultural and prescribed fire treatments in forested habitats.

Strategy II.2e Monitor elk populations in areas where habitat improvement practices have been implemented to ensure that management practices are positively affecting resident elk herds.

Objective II. 3 Determine the relationships between population dynamics of elk in Kentucky and the dynamics of suitable habitat across the entire restoration zone.

Strategy II.3a Determine the importance of source populations (in particular the public land habitats in National Forests, National Parks, Wildlife Management Areas, Nature Preserves, and State Parks) to viable elk populations and social carrying capacity objectives.

Strategy II.3b Determine if habitat found within large public land ownerships provides adequate resources to support viable elk populations.

Strategy II.3c Determine corridor characteristics (e.g., cover types, length, width) that facilitate elk movements between populations.

Strategy II.3d Evaluate impact of barriers (e.g., roads, rivers, poor habitat) to elk movements and habitat utilization.

Strategy II.3e Collaborate with partners to identify and establish corridors that will promote connectivity with elk herds in Tennessee, Virginia, and West Virginia.

Objective II.4 Incentivize elk habitat improvements on private lands.

Strategy II.4a Develop at least one program through which landowners can benefit by improving habitat on their property.

Strategy II.4b Work with KDFWR design staff to create and circulate a landowner-friendly document describing elk habitat improvements.

Strategy II.4c Collaborate with the Natural Resources Conservation Service (NRCS) and Private Lands Biologists to provide private landowners inside the elk restoration zone with technical assistance for elk habitat improvements.

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Strategy II.4d Develop a process for forming elk management cooperatives on private land.

Strategy II.4e Work with large private landholders to identify and implement landscape-scale habitat management projects.

Strategy II.4f Investigate the creation of new public-private partnership programs that can result in elk habitat improvements across the restoration zone.

Objective II.5 Seek opportunities to perform habitat management that will positively affect multiple wildlife species.

Strategy II.5a Coordinate habitat management with other KDFWR staff and partners to structure habitat projects that will provide positive outcomes for multiple wildlife species.

Strategy II.5b Coordinate with other KDFWR conservation initiatives to best leverage agency resources.

III. NEGATIVE ELK-HUMAN INTERACTIONS

Goal Minimize the occurrence of agricultural, urban, ecosystem, and vehicular elk damage.

Objective III.1 Quantify negative elk-human interactions.

Strategy III.1a Conduct periodic surveys to monitor, quantify, and categorize elk damage levels.

Strategy III.1b Develop a program in conjunction with Kentucky Department of Transportation and Kentucky State Police to accurately monitor and index annual elk-vehicle collisions.

Strategy III.1c Conduct research to assess the effects of non-hunted lands on the incidence of elk damage.

Objective III.2 Eliminate repeat nuisance activity.

Strategy III.2a Identify best management practices for field staff that will adequately address elk nuisance interactions.

Strategy III.2b Develop and adopt official Elk Damage Standard Operating Procedures.

Strategy III.2c Ensure that all Wildlife and Law Enforcement Division field staff in the elk restoration zone are familiar with and follow the Elk Damage Standard Operating Procedures (SOP).

IV. RECREATION

Goal Maximize the opportunities for citizens to safely enjoy elk hunting and other elk related experiences (i.e. elk viewing).

Objective IV.1 Maximize elk-related recreational opportunities on public and private lands.

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Strategy IV.1a Actively pursue programs that will open additional lands to elk recreation.

Strategy IV.1b Identify and support partners who may undertake the creation of non-consumptive elk recreation activities and businesses.

Strategy IV.1c Develop a landowner incentive program for allowing hunters to access private property.

Strategy IV.1d Investigate projects and/or regulations that will provide ample recreation opportunities to both hunters and non-consumptive elk enthusiasts.

Strategy IV.1e Investigate the development of elk "sanctuaries" whose primary purpose will be providing viewing opportunities for non-consumptive recreation.

Strategy IV.1f Investigate a program that would reward landowners for providing KDFWR with trapping access for future elk translocation projects.

Objective IV.2 Manage elk hunts in a manner that maintains a high level of satisfaction among Kentucky elk hunters and elk hunt applicants.

Strategy IV.2a Conduct periodic surveys of elk quota hunt applicants to identify changes that could provide unsuccessful applicants with a more fulfilling experience.

Strategy IV.2b Conduct periodic surveys of drawn elk hunters to monitor hunter satisfaction and identify changes that could provide future hunters with a more satisfying experience.

Strategy IV.2c Maintain an open line of communication with elk hunting guides as a means of identifying hunter needs that were not revealed in the hunter surveys.

Strategy IV.2d Investigate ways to assure potential applicants that the application process is unbiased and equitable.

Objective IV.3 Increase public recognition of the benefits provided by elk recreation activities in Kentucky.

Strategy IV.3a Periodically measure and publicize the economic impacts of the Kentucky elk hunt and non-consumptive elk recreation.

Strategy IV.3b. Provide support to partners (Kentucky Department of Travel and Tourism, TOUR Southern and Eastern Kentucky, Rocky Mountain Elk Foundation, United States Forest Service, Kentucky State Parks, local governments and chambers of commerce, etc.) seeking to increase the impact of elk-related recreation.

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V. Public education

Goal Educate Kentucky's citizens regarding elk ecology, management, and behavior, with emphasis on the wise use of the resource, elk-related conflicts, and the importance of hunting, all within the context of elk management objectives.

Objective V.1 Develop public information educational materials and programs related to Kentucky's elk management program.

Strategy V.1a Publish annual elk reports.

Strategy V.1b Produce at least one popular article for Kentucky Afield Magazine each year.

Strategy V.1c Work in conjunction with KDFWR design staff to produce TV, radio, and newspaper spots in anticipation of seasonal items of interest to the general public.

Strategy V.1d Maintain up-to-date website information.

Strategy V.1e Make Elk Program staff available for speaking engagements at conservation organization meetings and banquets, county government meetings, etc.

Objective V.2 Reframe the KDFWR elk population goal away from a discrete number and toward a healthy elk herd.

Strategy V.2a Actively move conversations regarding the Kentucky elk population away from a discussion of an overall population number to a context of biological and social carrying capacity.

Strategy V.2b Emphasize herd health metrics instead of growth metrics

Objective V.3 Distribute information about successful implementation of Goals, Objectives, and Strategies from the Elk Management Plan.

Strategy V.3a Develop a Kentucky elk-specific outreach platform (Facebook, Twitter, website, etc.) that allows KDFWR to better inform the public.

Strategy V.3b Work in conjunction with KDFWR design staff to produce television, radio, newspaper, and internet spots regarding implementation of successful Elk Program projects.

VI. Administrative Goals

Goal Provide administrative funding support and leverage partner dollars for elk management programs.

Objective VI.1 Maintain or increase elk program funding, accounting for inflation.

Strategy VI.1a Influence budget priorities to carry out goals and objectives of the Elk Management Plan.

Strategy VI.1b Use the elk management plan as the basis of budget formulations.

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Goal Use the Elk Management Plan as the guiding document for Kentucky elk management and research.

Objective VI.2 Develop a framework through which the Elk Management Plan informs the creation of concrete projects that, when implemented, will help fulfill the vision of the Management Plan.

Strategy VI.2a Create a supporting Plan of Work that provides a timeline for specific projects and regulatory goals on a rolling five-year basis.

Strategy VI.2b In each five-year Plan of Work, provide an assessment of the accomplishments and failures of the previous Plan of Work projects in regard to the Elk Management Plan's Goals, Objectives, and Strategies.

Kentucky elk management has undergone substantial changes from the inception of restoration efforts in 1997 until today. This evolution in management occurred in response to increasing elk populations, the growing opportunities for elk-related recreation, and the development of new collaborations with a wide range of partners. Now, nearly 20 years after the first "restoration elk" were released in Kentucky, the KDFWR focus has progressed from herd restoration to herd management. The Goals, Strategies, and Objectives presented in this section will define the path forward for management of the Kentucky elk herd in this next phase of development.

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Appendix A. Public Input Used in Plan Development

Public input from the four surveys that were used for this Plan – Kentucky Resident's Awareness of and Opinion on Elk Restoration and Management (Duda et al. 2011), 2013 Elk Hunter Survey (Kentucky Department of Fish and Wildlife Resources 2014), 2014 Elk Hunter Survey (Kentucky Department of Fish and Wildlife Resources 2015*a*), and 2014 Elk Quota Hunt Applicant Survey (2015*b*) – were instrumental in developing a comprehensive document that accounted for Kentucky elk enthusiast's opinions. Each of these surveys contained a substantial amount of information that helped inform KDFWR's management goals. While all survey questions and public responses were taken into account, only the most pertinent findings in this Plan have been highlighted for the sake of brevity.

Kentucky resident's awareness of and opinion on elk restoration and management

Survey design and methods

This survey was commissioned by KDFWR, and conducted by Responsive Management (Duda et al. 2011). The telephone survey was given to 1,273 Kentucky residents, and the responses were stratified by whether the residents lived inside or outside the 16 county elk restoration zone. Responsive Management analyzed all data, and calculated sampling error to be no higher than plus or minus 2.75 percentage points.

Results

Despite the fact that Kentucky boasts the largest elk herd east of the Rocky Mountains, a significant portion of Kentucky residents do not realize that a free-ranging elk population exists in Kentucky. As would be expected, elk zone residents and hunters have a higher recognition of the eastern Kentucky elk herd. Nevertheless, even substantial numbers of individuals from these two demographics are not aware of the Kentucky elk herd. Despite these findings, most Kentucky citizens supported the existence of a free-ranging elk herd in Kentucky. Support for the herd was greater among elk zone residents than out-of-zone residents. The most commonly stated reasons for opposition to the herd were potential elk-vehicle collisions and potential crop damage.

Most Kentucky residents felt that KDFWR managed the elk herd satisfactorily, and a majority of Kentucky residents supported elk hunting. While there was widespread support across the state for hunting free-range elk, an even larger margin of Kentucky residents thought that elk management decisions should explicitly account for economic development opportunities. A majority of Kentucky residents were of the opinion that hunting and non-consumptive uses could co-exist.

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Elk hunter surveys from the 2013 and 2014 seasons

Survey design and methods

These surveys were developed and carried out by staff from KDFWR's Elk Program and Public Affairs Program. Survey requests were delivered to all individuals who drew elk permits in the general quota hunt in the 2013 and 2014 hunting seasons, for a total of 1,010 hunters from the 2013 season and 1,015 hunters from the 2014 season. Hunters from each year received the survey request soon after the completion of their respective hunting season. Survey response rates totaled 68% (2013 season) and 58% (2014 season). To enhance readability, results from the 2013 and 2014 surveys were combined except in cases where the results differed substantially. Full synopses of each survey can be found in the summary documents from each season (Kentucky Department of Fish and Wildlife Resources 2014, Kentucky Department of Fish and Wildlife Resources 2015*a*).

Results

The majority (83%) of drawn hunters thought that KDFWR's overall management of the elk herd was good, whereas only 7% thought overall herd management was bad. A smaller majority (78%) of hunters thought that KDFWR's management of the elk hunt was good, whereas 12% thought that elk hunt management was bad. Overall, most respondents (79%) were satisfied with their elk hunting experience, while only 16% of respondents were not satisfied with their hunt. Most hunters (88%) indicated that they planned to apply for future Kentucky elk hunts. Hunters from both seasons indicated that their primary reasons for applying to the Kentucky elk hunt was the opportunity to harvest any elk in Kentucky, the opportunity to bring home a substantial portion of meat, and the opportunity to create special memories with friends or family. While a large majority (93%) of respondents stated a desire to harvest a bull in the future, they did not necessarily favor "trophy" elk management. Drawn elk hunters from the 2013 and 2014 seasons were generally opposed to mandatory sit-out periods after drawing a permit, although they expressed the most tolerance for KDFWR's current three year sit-out period after drawing a bull elk permit (Figure 2).

Several reoccurring themes also emerged in the open response sections. Many hunters expressed frustration with access and property issues. Items of particular concern were the lack of public land with accessible herds, a perception that elk guides had preempted public land, a perception that KDFWR was catering to the guide services through special regulations, too much competition from other hunters (both elk and other game), inadequate maps, a lack of clearly marked boundaries on public land, and excessive road hunting. Many people also noted that elk were not as visible as they had been led to believe, and questioned the wisdom of providing elk for other state's restoration projects.

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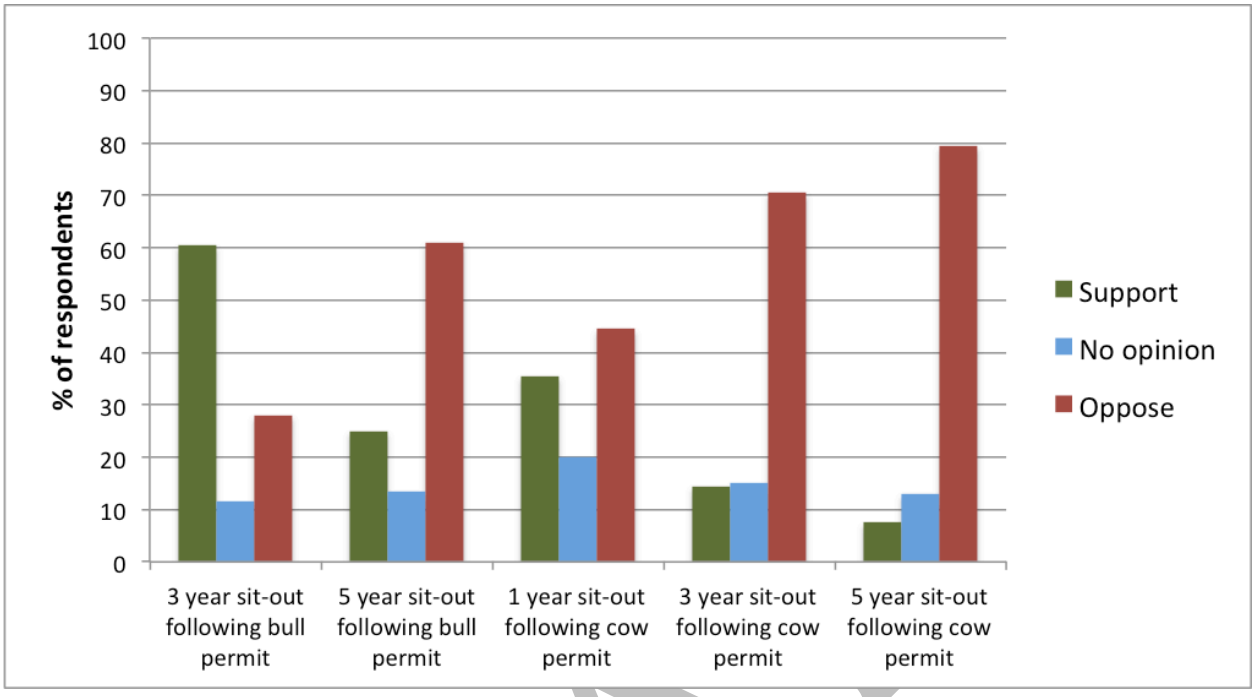
Figure 2. Elk hunter opinions regarding mandatory sit-out periods in the years after drawing an elk permit.



2014 elk quota hunt applicant survey

Survey design and methods

This survey was developed and implemented by staff from KDFWR's Elk Program and Public Affairs Program. In winter 2015, survey requests were delivered to 2,000 randomly selected individuals who unsuccessfully applied for 2014 season elk permits. Responses were initially sought through an online survey tool; all individuals who did not reply to the online survey request were mailed a paper survey form. The survey response rate was 48%. A full synopsis can be found in the survey's summary document (Kentucky Department of Fish and Wildlife 2015*b*).

Results

The majority (92%) of quota hunt applicants thought that KDFWR's overall management of the elk herd was good, whereas only 1% thought overall herd management was bad. A smaller majority (82%) of hunters thought that KDFWR's management of the elk hunt was good, whereas 7% thought that elk hunt management was bad. A majority of respondents (93%) indicated that they planned to apply for future Kentucky elk hunts. Hunters from both seasons indicated that their primary reasons for applying to the Kentucky elk hunt was the opportunity to harvest any elk in Kentucky, the opportunity to bring home a

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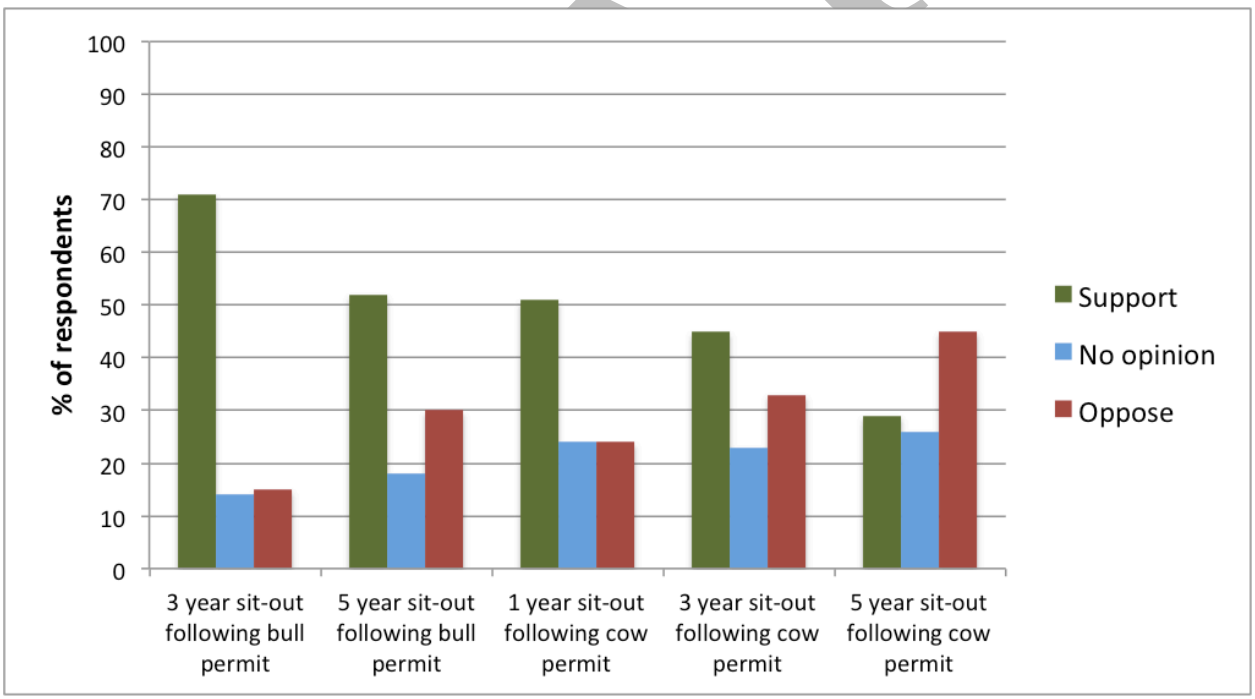
substantial portion of meat, and the opportunity to create special memories with friends or family. While a large majority (98%) of respondents stated a desire to harvest a bull in the future, they did not necessarily favor "trophy" elk management. Compared to elk hunters surveyed in the 2013 and 2014 seasons, applicants who had not been drawn for a permit generally expressed a higher level of support for mandatory sit-out periods after drawing a permit (Figure 3).

Several reoccurring themes emerged in the open response sections. While many hunters expressed support for the KDFWR elk program and gratitude at the recreational opportunity provided by elk, substantial numbers of hunters charged that the drawing system was designed to provide an unfair advantage to various different groups (KDFWR employees, wealthy individuals, politicians, etc.). Other hunters did not contend that the system was unfair, but complained that the drawing process lacked transparency. Finally, many hunters suggested that KDFWR develop a preference point system to reward unsuccessful (but loyal) applicants.

Figure 3. Elk quota hunt applicant opinions regarding mandatory sit-out periods in the years after drawing an elk permit.



Appendix B. Compendium of Kentucky Elk Research

Compendium of journal and technical articles, graduate theses and dissertations, and book chapters focusing on Kentucky elk research.

Journal articles and book chapters

Corn, J. L, M. E. Cartwright, K. J. Alexy, T. E. Cornish, E. J. B. Manning, A. N. Cartoceti, and J. R. Fischer. 2010. Surveys for disease agents in introduced elk in Arkansas and Kentucky. Journal of Wildlife Diseases 46: 186-194.

Cox, J. J. 2011. Tales of a repatriated megaherbivore: challenges and opportunities in the management of reintroduced elk in Appalachia. Proceedings of the 17th Central Hardwood Forest Conference.

Larkin, J. L., K. J. Alexy, D. C. Bolin, D. S. Maehr, J. J. Cox, M. W. Wichrowski, N. W. Seward. 2003. Meningeal worm in a reintroduced elk population in Kentucky. Journal of Wildlife Diseases 39: 588-592.

Larkin, J. L., J. J. Cox, M. W. Wichrowski, M. R. Dzialak, and D. S. Maehr. 2004. Influences on release-site fidelity of translocated elk. Restoration Ecology 12:97-105.

Larkin, J. L., R. Grimes, L. Cornicelli, J. J. Cox, and D. S. Maehr. 2001. Returning elk to Kentucky: foiling Murphy's Law. Pages 101-107 *in* D. S. Maehr, R. Noss and J. L. Larkin, editors. Large mammal restoration: ecological and sociological challenges in the 21st century. Island Press, Washington D.C., USA.

Larkin, J. L., D. S. Maehr, J. J. Cox, D. C. Bolin, M. W. Wichrowski. 2003. Demographic characteristics of a reintroduced elk population in Kentucky. The Journal of Wildlife Management 67: 467-476.

Larkin, J. L., D. S. Maehr, J. J. Cox, C. Logsdon. 2002*a*. Yearling males successfully breed in a reintroduced elk (*Cervus elaphus nelsoni*) population in Kentucky. Southeastern Naturalist 1: 279-286.

Larkin, J. L., D. S. Maehr, J. J. Cox, M. W. Wichrowski, and R. D. Crank. 2002*b*. Factors affecting reproduction and population growth in a restored elk population. Wildlife Biology 8: 9-14.

Maehr, D. S., R. Grimes, and J. L. Larkin. 1999. Initiating elk restoration in the east: the Kentucky case study. Proceedings of the annual conference of Southeastern Fish and Wildlife Agencies 53: 350-363.

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Olsson, P. M. O., J. J. Cox, J. L. Larkin, D. S. Maehr, P. Widen, M. W. Wichrowski. 2007. Movement and activity patterns of translocated elk (*Cervus elaphus nelsoni*) on an active coal mine in Kentucky. Wildlife Biology in Practice 3:1-8.

Philips, J. 1997. Technical proposal for free-ranging elk in Kentucky. Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, 15 pp.

Schneider, J., D. S. Maehr, K. J. Alexy, J. J. Cox, J. L. Larkin, B. C. Reeder. 2006. Food habits of reintroduced elk in southeastern Kentucky. Southeastern Naturalist 5: 535-546.

Secrist, D. E., D. S. Maehr, J. L. Larkin, M. J. Lacki. 2004. Potential impacts of reintroduced elk on amphibian distribution and abundance in eastern Kentucky, USA. Natural Areas Journal 24.

Seward, N. W., D. S. Maehr, J. W. Gassett, J. J. Cox, J. L. Larkin. 2005. Field searches versus vaginal implant transmitters for locating elk calves. Wildlife Society Bulletin 33: 751-755.

Wichrowski, M. W., D. S. Maehr, J. L. Larkin, J. J. Cox, M. P. O. Olsson. 2005. Activity and movements of reintroduced elk in southeastern Kentucky. Southeastern Naturalist 4: 365-374.

Graduate theses and dissertations

Alexy, K. J. 2004. Meningeal worm (*Parelaphostrongylus tenuis*) and ectoparasite issues associated with elk restoration in southeastern Kentucky. Ph.D. Dissertation, Clemson University, Clemson, South Carolina, USA.

Bowling, W. E. 2009. Maternal antibody transfer and meningeal worm infection rates in Kentucky elk. M.S. Thesis, University of Kentucky, Lexington, USA.

Cox, J. J. 2003. Community dynamics among reintroduced elk, white-tailed deer, and coyote in southeastern Kentucky. Ph.D. Dissertation, University of Kentucky, Lexington, USA.

Ciuzio, E. A. 2002. Do restored elk affect bird communities in eastern Kentucky? M.S. Thesis, University of Kentucky, Lexington, USA.

Dahl. L. M. 2008. Using forward-looking infrared radiography to estimate elk density and distribution in eastern Kentucky. M.S. Thesis, University of Kentucky, Lexington, USA.

Larkin, J. L. 2001. Demographic and spatial characteristics of a reintroduced elk population. Ph.D. Dissertation, University of Kentucky, Lexington, Kentucky.

Olsson, M. 2000. Activity and movement patterns of reintroduced North American elk in eastern Kentucky. M.S. Thesis. Karlstad University, Karlstad, Sweden.

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Secrist, D. E. 2000. Impacts of reintroduced elk on amphibian distribution and abundance in an eastern Kentucky forest. M.S. Thesis, University of Kentucky, Lexington, USA.

Seward, N. W. 2003. Elk calf survival, mortality and neonatal habitat use in eastern Kentucky. M.S. Thesis, University of Kentucky, Lexington, USA.

Ter Beest, J. M. 2005. Effects of a restored elk population on soils, vegetation, and water quality in eastern Kentucky. M. S. Thesis. University of Kentucky, Lexington, USA.

Wichrowski, M. W. 2001. Activity, movement, and habitat use of a reintroduced elk population in Appalachia. M.S. Thesis, University of Kentucky, Lexington, USA.

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