TECHNICAL PROPOSAL

FOR FREE-RANGING ELK IN KENTUCKY

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While many species have been returned to their native habitat in Kentucky, it is surprising that elk have not. Archeological and historical records abound that elk once existed in all reaches of the state. The Eastern elk (Cervus elaphus canadensis) once ranged over the entire state of Kentucky, but were extirpated by the mid-1800's (Bryant and Maser, 1982). Obviously every missing species should be given strong consideration and evaluation for restoration. The mission of the Kentucky Department of Fish and Wildlife Resources is to provide wildlife diversity and recreation for present and future generations to enjoy. The potential elk restoration fits the mission well.

The history of elk restoration has been filled with controversy. The work of several early researchers on eastern elk concluded that the brain worm (Pneumostrongylus tenuis) was responsible for many elk deaths and would doom restoration attempts to failure. Typical of these studies was one by Eveland et al. (1980) that concluded that brain worm was the major factor in controlling elk populations in Pennsylvania. This was despite the fact that they offered no numbers to back their claim. Many biologists such as this author helped support these claims by not doing more critical analysis of such studies. Studies such as these probably retarded the reintroduction of elk to the eastern United States by thirty years.

The success of elk in western states and the success of recent introductions in several eastern states has prompted the Department of Fish and Wildlife Resources (KDFWR) to investigate the potential for release in Kentucky. Three states, Pennsylvania, Michigan and Arkansas now have viable populations ranging from 450 to 1200 animals. Elk ranges in these states cover from 145,000 acres in Pennsylvania to 512,000 acres in Michigan. Elk densities vary from 363 acres/elk in Pennsylvania to 642 acres/elk in Arkansas (Wathen et.al., 1996).

The success of each is characterized by large contiguous blocks of forest land greater than 145,000 acres, relatively little row crop land and openings comprising at least 5 percent. Long (1996) recommended that 10 to 60 percent open lands was optimum and that the amount of forest could be as high as 90 percent.

One advantage of large blocks of contiguous forest is that the amount of available land and that could be damaged is minimal. Both Michigan and Pennsylvania have responded to elk depredations with aggressive programs to reduce crop damage. Michigan has targeted private lands with a special hunt to reduce damage and Pennsylvania is mitigating their damage with a program to supply fencing and provide pasture to attract elk away from crops. Kentucky currently allows any depredating animal to be shot. The state also has two programs to help alleviate crop damage. Nonetheless, any elk release in the state should be far from major row crop areas. It is ironic that the best elk habitat in Kentucky according to Long's Habitat

Suitability Index (HSI) (1996) is in Kentucky's best row crop areas.

After reviewing the literature and the results of other eastern releases KDFWR has identified five criteria to apply to a search for potential release sites. Any area should be larger than 200,000 acres. It should be isolated from large areas of row crops. It should be available to be hunted for recreation and herd control. The Pennsylvania herd is flourishing in an area with only 2 percent open land. It is clear that the percent open land can be less than suggested by Long (1996), especially where more open land is being developed by strip-mining. It should have at lease 5 percent open areas or the potential to develop open areas. It should contain some public land or have the potential to develop public land. The forest should also contain 4 vegetative layers - ground, shrub, midstory and canopy.

Methods

A land uses map of the state was developed to identify large contiguous areas of forest. 1978-1981 landsat digitized data was used to develop the map. Because of the lack of current data, identified areas were overflown with aircraft to further evaluate them. Four potential areas were identified. They are listed in order of best fitting the five criteria.

Locations

1. Southeast Kentucky - 2,666,314 acres of primarily forested land. It is bounded on the North by the city of Jackson, on the West by the city of London, on the south by Pine Mountain and on the East by the city of Pikeville. Two blocks (site A on the west and site B on the east) of 475,000 acres each comprise the center of the range. Both the blocks adjoin extensive areas of reclaimed strip-mine land and the Cypress-Amax Wildlife Management Area. Much of the land is currently under ownership of coal mining companies. Some of which might agree to memorandum of agreement to allow public excess to their lands. The area is dominated by mixed mesophytic forest with about 7 percent mine lands and 1 percent crop land. Many of these mine lands have been reclaimed, and provide forage habitat pasture for elk. Crop lands are located 30 to 50 miles from the center of the range. An additional range of approximately 460,000 acres is located to the southwest of the town of Hyden (site C). This southwestern block also contains extensive areas of reclaimed strip mines. A large portion of site C is National Forest Land comprising the Redbird unit of the Daniel Boone National Forest. USDA Forest Service personnel will be consulted about the feasibility of this site. Involved counties are Bell, Breathitt, Clay, Floyd, Harlan, Knott, Knox, Leslie, Letcher, Martin, Perry and Pike.

Crop land in all the areas consists primarily of gardens and small hay fields. Mitigation of garden and fence damage may have to be considered by the Department or its partners.

2. Land Between the Lakes. This area is a 170,000 acre federal recreational area located between the Tennessee and Cumberland rivers in western Kentucky and Tennessee. It is primarily oak/hickory forest. Ten percent of the area is maintained in openings. Since the area is a peninsula, the potential for human-elk conflict is minimized. The Tennessee portion of the area is under consideration for elk restoration by TWRA. The Department supports this TN effort as long as Kentucky citizens do.

3. Big South Fork Recreation Area and Daniel Boone National Forest. This area is located in McCreary County Kentucky. McCreary County is 60 percent federal ownership which would reduce the amount of private conflicts with elk. The potential elk range is 211,000 acres extending from the Tennessee border to the North Fork of the Cumberland River. The area is 95 percent forested. Although the area meets all criteria, deer herds in the area have done poorly because of nutritional problems and poaching. An attempt should be made to restore elk on the area after restoration is complete in the first and second choice areas. National Park Service Personnel will be contacted about the feasibility of restoration.

4. Mammoth Cave National Park. The park is 99 percent forested and lacks enough openings to support elk. It is 110,000 acres, which is smaller than criteria. Federal law restricting hunting on National Parks eliminates it as a restoration site. The lack of openings and large amounts of surrounding private crop lands is a sure formula for intolerable landowner conflicts. The site isn't being considered.

5. Western, Central and Northeastern Kentucky was eliminated as sites because of the prevalence of cropland and the potential for serious landowner conflicts.

Eastern Elk population growth rates are relatively low, 12-15 percent, when compared to deer which have a rate of 25-30 percent. Because of this slow growth, the KDFWR should not expect rapid results. A table of growth rates developed by TWRA estimates a population of 500 elk can be developed by releasing 100 elk per year over a three year period (Wathen, et. al 1996). Each of the areas in Southeastern Kentucky can support 1300 elk. The total potential for the Southeast site is in excess of 7,388 elk. For any one of the three areas in Southeast Kentucky to reach potential will take 17 years if restoration releases is limited to 100 per year for three years. The Big South Fork site has the potential for 500 elk based on its size.

If each of the 3 sites (A, B,, and C) receive 200 elk in each of 3 consecutive years, they will reach target capacity after 7 years. Site A would receive elk in years 1 through 3, site B year 4-6, and site C in year 7-9. Site A would reach capacity at year 7, site B at year 10, and site C at year 13. The Big South Fork site, because of its small size, will only require four years of restoration and will reach potential 14 years after the stocking is initiated in year 10.

Because of the time involved, multiple stocking sources should be sought. If multiple stocking sources can be located then the time factor of growth should be ignored and the goal should be 600 animals at sites A, B, and C. The Big South Fork should receive four to five hundred animals if Federal authorities are in agreement. Block stocking at each of the major sites should be accomplished by having three subrelease areas separated by 15 to 17 miles. Two hundred animals should be released at each of the three release areas. Complete fill of the entire range should require 21 years. The maximum possible number of elk is 7,389.

Genetics

The various sub species of elk are very similar genetically. Whitaker (1970) recommended that "subspecies be recognized only when effective long-term primary isolating mechanisms can be demonstrated; these would be mainly geographic." Since North American

elk were a continuum, his suggestion is that elk subspecies not be recognized. Thomas and Toweill (1982: 17) state "From a management point of view, however, it makes no difference how the various individual populations of North American elk are categorized, so long as their habitat requirements are understood and the animals are managed within stated objectives for particular areas." Tule and Roosevelt elk are the most removed from the norm in this respect and should not be considered for restoration in Kentucky. Any restoration, however, would probably benefit from receiving elk from multiple sources of the Rocky Mountain or Manitoba subspecies. The probability of genetic isolation will be reduced and the chances of having alleles that best match the habitat are increased. Most the genetic material that once existed in the Eastern elk also exists in the Rocky Mountain and Manitoban subspecies. The genetic divergence that occurred in the eastern elk would again have the opportunity to occur. However, due to an altered landscape, the changes would be somewhat different than those that occurred prior to settlement. Kentucky would, in fact, have a totally different elk in time. It would resemble what the eastern elk might have become.

Would we recognize this new elk as a new subspecies? Than would be doubtful. It is time that we recognize that there is one North American elk just as there is one white-tailed deer. When we say we are going deer hunting in Kentucky, we do not say we are going boreal deer hunting.

The North American elk would be considered an extirpated endangered species in Kentucky if we had a list of threatened and endangered species. The North American elk is on the Kentucky Nature Preserves list of endangered species in the state (1996). As much consideration should be given it as is given any other threatened or endangered species.

Poaching

Poaching was found to be the primary non-hunting limiting factor in Michigan, Pennsylvania and Arkansas. This is not surprising as the same is true of white-tailed deer. Active information and education programs and stiff fines and penalties have successfully reduced poaching loss in Michigan (Parker, 1990).

Kentucky should give serious consideration to increasing elk poaching fines above those for deer. Elk poaching fines in western states range from $1,500.00 to $1,700.00. A statute change will be required to do this.

The Division of Information and Education should develop an education campaign that focuses on the potential value of elk to the local economy and tourism. Consideration should also be given to focus law enforcement attention on the restoration project. Deer hunting will be occurring in the restoration area during the restoration phase. There is the potential for illegal and accidental kill of elk by deer hunters. Educational brochures about the difference between elk and deer should be developed. Educational signs should also be placed in the release areas and at local locations.

Disease

Diseases in wild animal populations tend to be less of a problem than in domestic livestock. Wild populations tend to be less concentrated and the exchange of organisms is more difficult. Nonetheless, several diseases that have economic or public health impacts have

appeared in elk. In all of these cases, artificial feeding has been a contributing cause to the spread of the diseases. KDFWR should seek the advice of the State Veterinarian in developing a protocol for ensuring that translocated elk will be disease free. The Southeastern Cooperative Wildlife Disease Study is currently proposing to draft a model importation protocol to address health issues associated with the restoration of elk in the eastern United States. This protocol if approved by Ky's Department of Agricultural vet, will be followed by KDFWR. Briefly listed below are the important diseases found in elk and current recommendations for preventing the spread of the diseases.

Brucellosis - A disease that is caused by bacteria of the genus Brucella. It is known to cause abortion in cattle and wild ruminants. This disease is also pathogenic to man. Brucellosis is only endemic in elk in the Greater Yellowstone area and in Wood Buffalo National Park in Canada. The disease can be avoided by not obtaining elk from these areas. Although the incidence of brucellosis is negligible in other areas, it is strongly recommended that any translocated elk be tested with the rapid card test. If brucellosis is found in any elk while testing for transport, all transport should be halted until the trap location is further evaluated for the presence of brucellosis.

Chronic Wasting Disease - A disease caused by infectious proteins called prions. The disease is found in elk and mule deer only in Colorado and Wyoming. It causes emaciation and salivation. Animals stricken with this disease eventually become stupefied and die. The disease has a long incubation of at least 1.5 years. There is no test for the disease but it can easily be avoided by not transporting elk from areas of Colorado or Wyoming where these diseases exist.

Bovine Tuberculosis (BTB) - This disease is caused by the Tuberculin bacteria. It is similar to tuberculosis in humans and offers the same threat. Fortunately the disease is only found in elk in Wood Buffalo National Park. It is also found in deer in Michigan. Elk should only be translocated from areas free of BTB. All translocated elk should be skin tested for BTB before shipment. If an animal reacts to the BTB test, an Avian TB test should be given. If the animal does not react to the Avian TB test, a more extensive battery of tests should be performed to confirm the presence of BTB. To avoid multiple testing the new dual cervid test should be used. If BTB is confirmed at a trap location then trapping and shipping should be halted immediately.

Paratuberculosis or "Joneys" disease- This disease is found only in Colorado and California. It causes emaciation and diarrhea. It can be easily avoided by not transporting elk from those areas of Colorado and California where the disease exists.

Below are also listed diseases that may impact elk if they are translocated to Kentucky.

Brain Worm or Meningeal Worm - This disease is caused by the parasite Parelaphostrongylus tenuis. The disease has no public health implications. Stupification in elk is caused by the worm entering the brain and spinal column. The parasite exists in native white-tailed deer populations

without causing complications in them. However, other states report a one to 2 percent annual losses of elk to the disease (Cartwright 1996, Cougan 1996). The disease can cause concern among persons who witness it because of the erratic behavior of the infected elk. KDFWR should make it clear to everyone involved that brain worm problems will occur. Brain worm problems may appear to intensify as population sizes increase, but the total number will probably be only one to 2 percent of the population. Capture and removal of brain worm damaged elk will be required. Equipment will be purchased to handle elk showing symptoms of brain worm.

Pneumonia - Bacterial infections in translocated elk occur frequently if the animals are exposed to a large amount of stress. Although elk are fairly easy animals to handle, each exposure to humans increases the output of adrenalin. The continued output of adrenalin causes a suppression of the immune system. If the immune response is suppressed enough, pneumonia will occur, and the animal will die within two weeks to a month after transport. It is vital that visitors to translocated animals be kept to a minimum. Elk seem to have an extremely negative response to flash bulbs.

Hemorrhagic Disease- Elk are susceptible to hemorrhagic disease (HD), a viral disease of white-tailed deer that is passed between animals by biting midges. HD has occurred in deer in the release area. Outbreaks of the disease are rare (once every six to 10 years) in the state. When outbreaks occur they are expected to cause the loss of five to 10 percent of the animals in the outbreak area. Such an outbreak, if it occurs, could delay the program schedule by one year.

Wild elk herds are essentially disease free, while captive herds are more likely to harbor disease. Kentucky will only obtain stock from disease free wild herds.

Competition With Other Species

The introduction of a missing species cannot be accomplished without some negative or positive impacts on other species. The conclusion of eastern elk studies indicates no significant impact to other species. One question comes to mind when considering the impact of elk on plant and animal communities in the east. Will the presence of elk make plant and animal communities more natural? These communities developed under the influence of both deer and elk. These systems may have been different before the removal of elk and deer. Even today, in southeastern Kentucky, white-tail deer numbers are just approaching the level that existed before 1700.

The major species of concern are plants, threatened and endangered species, neotropical migrant birds, white-tailed deer and wild turkey. There are a few elk food habit studies for elk, and in the east many of their preferences are known from western elk studies. Depending on the time of year elk diets are 56 to 75 percent grasses. Browsing peaks in March April and May in western states at 33 percent. Forbes make up 20 percent of the diet in the summer and fall (Harper et al. 1967).

The grass species most expected to be used are Orchard Grass, Sedges, Bluegrass, and Kentucky 31 Fescue. It is difficult to determine what forb species will most be utilized in

Kentucky habitat. Comparisons with western forb species are difficult because they are so dissimilar with eastern species. Legumes such as lespedizia, clovers and vetches are expected to be utilized by elk.

Preferred browse plant species in Kentucky are expected to be Red Maple, Willow, Box Elder, Japanese Honeysuckle, and Blackberry. Although Fir and Spruce are mentioned in the literature, it is interesting to note that pine species are not preferred by elk (Thomas and Toweill 1982). Browsing by elk occurs from 6 inches in the forest strata to 6 feet. The higher reach of elk allows them to utilize browse that is not available to deer. The impact of elk on browse species will not be totally additive for this reason. Hunter et al. (1980) indicated that browsing by elk occurred heavily in open areas but elk did little feeding in areas of high stand density (> 1,000 stems/acre). They found that in open cover types red maple and fire cherry decreased due to browsing by elk and deer. This is consistent with other literature indicating that elk prefer open feeding areas. They stated that despite use by deer and elk most of the woody plant species remained viable and potentially productive. Another conclusion found by Hunter (1980) was that the browse species preferred by elk helped buffer, or reduce the impact of, the utilization of commercial timber species. Some minor damage of these buffering plants was also found to be due to bark stripping by elk.

Concerns about over grazing of pre-bond strip mines would be valid if elk densities were maintained at high levels. TVA's Land Between the Lakes has had trouble establishing new grass in an elk viewing pasture that they created (Blomer, 1996). Elk and bison densities combined on the area total one animal per 12.5 acres. However, elk densities in the east Kentucky restoration area will only be one-animal per 360 acres at peak numbers. At these levels, elk grazing will hardly be noticeable.

Competition with game species is not expected to be a problem. Hunter et al. (1979) indicated that there is considerable food overlap between elk, deer and turkey. These overlaps would be critical if both deer and elk were allowed to increase to carrying capacity. Population goals for elk and deer in Kentucky are well below carrying capacity. With this being the case, competition pressures will be too small to measure. Michigan, Pennsylvania and Arkansas have not seen a decline in deer where the elk are located (Cartwright 1996, Langanau 1997, Cougan 1997). Coincidentally, deer populations have actually increased where those states' elk populations are located. In Michigan, the district which included their entire elk range also had one of the states most successful turkey flocks (Wathen, et. al 1996). Elk in the east are known to consume acorns, however, acorns do not appear to be as critical food source for elk as they are for deer and turkey (Wathen, et. al 1996).

Neotropical migrant birds (NTMB's) may be impacted both negatively and positively. Browsing by elk would increase the impacts on the intercanopy nesting neotropical migratory which are most impacted by deer. Potential negative impacts may be experienced by interior forest nesting birds that nest in the lower portions of the midstory such as the rose-breasted grosbeak and wood thrush. The impacts on these species should be minor because such a small percent of elk diet is browse. Pre and post transplant studies on the rose-breasted grosbeak in the Cumberland mountains (Pine, Black, Cumberland, Log and Stone Mountains) would help quantify this impact. It should be in year six of the project before elk populations are established in these mountains.

Direct disturbance on most neotropical migrant birds would be limited because browsing by elk is at a low level at the time that these birds are nesting. The restoration proposal also calls for low numbers of elk to be maintained (one per 360 acres). This low density of elk should have a minor impact on nesting habitat for these species.

Wathen (et al. 1996) raises concerns that elk habitat management will benefit brown-headed cowbirds which are known to parasitize the nests of NTMB's. Miles (1995) found that larger forest openings and lower average vegetation height are potential cowbird foraging sites. This proposal plans on maintaining and enhancing elk habitat on reclaimed strip-mine sites. These sites are most likely cowbird habitat at the present time. Management strategies will maintain this habitat in this successional stage which will be beneficial to cowbirds. However, the restoration effort will not create more cowbird habitat. Additional cowbird and elk habitat is expected to be created by new strip-mining in the area. The feeding activity of elk may improve feeding opportunities for cowbirds by disturbing insects and making them more available to cowbirds.

Theoreticians are faced with a dilemma when they ponder the question of elk restoration in Kentucky and threatened and endangered species. On a state status elk is an endangered extirpated species. Should they be favored over another state endangered species or vice versa. When the question expands to a nationally endangered species, answers become more clear. Nationally endangered species probably take precedent over a state endangered species. Especially since elk are not threatened in the western states. Fortunately, eastern elk restoration is not expected to have significant impacts on nationally endangered or threatened species. The Federal threatened and endangered animal species in the proposed restoration area are the blackside dace (Phoxinus cumberlandensis), Indiana bat (Myotis sodalis), peregrine falcon (Falco peregrinus), red-cockaded woodpecker (Picoides borealis), and gray bat (Myotis grisescens) (Beam 1997).

Other species that are on the state threatened, endangered or of special concern in the area are the Johnny darter, cumberland Johnny darter, arrow darter, long-tail salamander, Wherle's salamander, milk snake, scarlet kingsnake, sharp-shined hawk, common barn-owl, common raven, golden winged warbler, Cereulean warbler, masked shrew, long-tailed shrew, pigmy shrew, Rafinesque's big-eared bat, eastern woodrat, southern red-backed vole, Kentucky red-backed vole, black bear, least weasel, slender glass lizard, coal skink, northern coal skink, southeastern five-lined skink, hooded merganser, least flycatcher, Canada warbler, rose-breasted grosbeak, Bachman's sparrow, eastern small-footed bat, eastern spotted skunk, American lamprey, mountain brook lamprey, northern brook lamprey, northern madtom, eastern sand darter, Tippecanoe darter, gilt darter, trout-perch, northern harrier, bobolink, evening bat, salamander mussel, spectaclecase mussel, snuffbox mussel, little spectacle case mussel, long-solid mussel, gray tree frog, northern leopard frog, northern pine snake, least flycatcher, Blackburnian warbler, dark-eyed junco, New England cottontail rabbit, cotton mouse, hellbender, and great blue heron (Beam 1997). North American elk are not expected to impact the status of these 48 species of state concern.

An examination of a list of state threatened and endangered plants (Kentucky State Nature Preserves Commission 1996) produced one plant found in the literature of eastern elk food preferences. Sweet fern (Comptonia peregrina) was listed as state endangered and was

found to be as much as 59 percent browsed in some habitats by deer or elk (Hunter et al. 1980). The Hunter study did not have a means to differentiate between deer and elk browsing. The study also took place in areas with much higher deer density than that in the proposed release area. Pre impact studies of sweet fern are recommended.

There were no federally endangered plants found to be utilized by elk. It is interesting to note here that elk are on the list of plants and animals extinct or extirpated from Kentucky (Kentucky State Nature Preserves Commission 1996).

Economic Impact

That an established elk herd can have impacts on local economies is well-documented. A significant portion of citizens in the rural Rocky Mountains make a living by providing services to elk hunters. Idaho nonresident elk hunters paid license fees of $1.2 million in 1979, while Montana and Colorado nonresidents contributed $3.8 and $6.2 million, respectively to hunt elk in those states (Thomas and Toweill 1982). Elk hunting leases to outfitters are a major component of the economy. Providing food, lodging, gas and incidentals provide economic impact. Elk viewing is also having an impact in the eastern areas where they exist. Current information is lacking regarding the impact of elk viewing. It is likely that, following an elk reintroduction, tourism would increase in the communities near the elk range (Long 1996). The cities of Hazard, Hindman, Pikeville, and Whitesburg would benefit greatly from tourism created by elk viewers. Both Michigan and Pennsylvania have established viewing programs and it is typical to see hundreds of cars in those areas in the fall of the year (Parker 1990, Cougan 1997). Pennsylvania reports that the average elk viewer spends $11.85 per visit to their elk herd (Shafer and Wang 1989). They reported 7,200 recreational visits to their 400 animal herd in 1989. Pennsylvania also reports that viewing has increased dramatically since 1989 (Cougan 1997). Figures developed in this report are probably too conservative for this reason. Given a conservative 3 percent inflation rate and an expected 7,300 animal herd, Kentucky could expect 36,000 recreational viewer days (RVD) with each viewer spending $15.01. Pennsylvania went on to report that their viewers were willing to spend an additional $20.43 per visit.

Using these figures Kentucky could expect $540,036.00 in undeveloped tourism income. Improvements in infrastructure could allow full development of tourism to the extent that viewers were able to spend the maximum they could spend. If tourism was fully developed, in this manner, to offer services to elk viewers, the potential income would be $1,275,840.00. Michigan and Arkansas report more expansive development of their viewing tourism is starting to occur and increase viewer spending. Often tourism occurs in unexpected ways. A canoe operator in Ponca, Arkansas reports a large jump in business during elk viewing time (Wolfe 1996). A small town in Michigan has recently started an elk festival in the fall. The town is filled with tourists for the festival and parking is reported difficult to find (Langanau 1997).

Pennsylvania also reports that 40 percent of their viewers travel 100 miles to see elk and an additional 40 percent travel 200 miles. The following cities are within 200 miles of the potential elk range and could expect to have tourist travel to view elk. Cincinnati, Ohio; Huntington-Charleston, West Virginia; Louisville, Kentucky; Lexington, Kentucky; Owensboro, Kentucky; Bowling Green, Kentucky; Nashville, Tennessee; Chattanooga, Tennessee; Knoxville,

Tennessee; Greenville, South Carolina and Asheville, North Carolina. The combined populations of these cities and their associated metropolitan areas is 6,142,005. This figure does not include small cities and rural areas located in between.

The impact of elk hunting would also increase tourism. Michigan reports that 50 percent of all elk hunts are guided (Langenau 1997). They also report that the minimum charge for a guided hunt is $500.00. Given the size of eventual hunts in Kentucky, the estimated guide income would be $205,250.00. Deer hunters in Kentucky report spending $494.00 per hunt (U.S. Fish and Wildlife Service 1991). Elk hunters are expected to spend at least that much. The tourism income from elk hunters would be expected to be $272,572.00.

Early economic impacts from hunting will be small but should increase as the additional sites become available for hunting. Michigan charges $4.00 per application and receives 50,000 applications for 235 licenses. Applications generate $200,000.00 per year and licenses generate $23,000.00. These monies are enough to pay for the program except that it does not cover habitat management costs (Parker 1990). KDFWR could make the project and habitat management self sufficient by charging a $10.00 application fee and $250.00 for each non-resident license issued and $25.00 to $40.00 for resident licenses. Kentucky's range if filled to capacity could produce an annual harvest of 240 bulls. A 75 percent success rate would imply that KDFWR could issue 320 licenses for bulls alone. An additional 418 cow permits would be required to maintain a stable population. Income from licenses would be from $62,000.00 to $184,000.00. Application funds at $10.00 each would generate an additional $500,000.00. Total program income is estimated at $684,000.00. The size of the Kentucky range and potential number of elk may generate much more than the 50,000 applications generated in Michigan.

The overall income from viewing, hunting expenditures, guide income, and department income is expected to be $2,437,662.00 annually.* Using various models as standard multipliers for jobs added to the economy, tourism could expect to provide from $5,240,973.00 to $24,376,620.00 to the economy.

Crop damage should not be a major economic impact of the release. However, some individuals will experience damage. Some local crop damage to gardens may occur. Isolated corn fields will also be subject to damage. Predominant crop lands in the state are located 40 to 50 miles from the release sites. Extending Kentucky's policies regarding deer depredation to elk should alleviate conflicts. The only exception to this is antlerless permits for in season harvest. A policy of harassment of depredating elk should be developed. Screamer pistols and cracker shells should be provided to people experiencing depredation at cost. Also local wildlife officials should use harassment techniques in instances where elk can be effectively discouraged. Trapping and movement of elk straying from the boundaries of the elk should be considered. If trapping and movement are not an option, the KDFWR should allow the removal of the elk by the local landowner through its current disposal tag system. Success in reducing elk damage has been shown in several states by providing high quality, well-fertilized pastures to attract elk away from crops (Brown and Mandery 1962:35). An aggressive program of habitat improvement on strip-mine lands will accomplish much the same thing. Open seasons on elk in conflict areas could be an option of last resort if public sentiment advises.

Pennsylvania reported the total cost of crop damage in 1982 as $13,600 or $45.33 per animal unit and $0.07 per acre range (Whitmer and Cogan 1986). Corn, hay, oats, and fences

were the most reported types of damage (Long 1996). The elk range in Pennsylvania is lacking openings on public lands. Only 2 percent of the public lands are suitable foraging habitat while 15 to 20 percent of private lands within the elk range are foraging habitat. This tends to aggravate crop damage problems in the area. On the other hand, Arkansas reported "To date, no serious depredation or nuisance problems have been documented." (Cartwright 1997).

Automobile damage is another potential impact of elk. Elk have a natural tendency to stay away from human activity and therefore, the eastern states with elk populations report few car - elk accidents. Arkansas reports that only seven have been hit since 1981 (Cartwright 1996). Michigan reports an average of 5.3 per year since 1990 (Bezotte 1997). This may appear surprising since Interstate 75 and two other major highways pass through the Michigan elk range. However, other researchers have pointed out that as road densities increase, elk tend to move away from these disturbances (Wyoming Forest Study Team 1971:48) A maximum of 3 auto collisions per year could be expected for each 200,000 acres of elk range based on these figures. This figure may be high because there are relatively few high-speed highways in the proposed release area. This is not to diminish the impact on the individual that hits an elk. Auto damage can amount to several thousand dollars when this occurs.

Shipment and Sources

Commercial shipment should be considered because of the large numbers of elk required for the restoration. Contract haulers with semi-trailers should be able to deliver elk at a lower cost. We expect commercial shipment costs to be about $250.00 per animal. Moving elk using department personnel would strain the resources of the department and, from experience, probably cost about $1000.00 per elk just for shipment. Stress on the animals may be higher with contract haulers but not enough to warrant the higher cost.

Soft or Hard Release

In a soft release, animals are penned and fed at the release site to accustom them to the area before release. In a hard release, animals are immediately turned out into the wild when they arrive at the release site. The advantages of a soft release are twofold. The loss of new animals can be monitored to determine shipping mortalities. Soft release animals are thought more likely to remain in the immediate area of release. The disadvantages are high cost and an increased chance of spreading disease. Also, unless the soft release site is kept absolutely secure from visitors, the animals may be subject to more stress resulting in higher mortality than with a hard release.

The potential project will require multiple release sites. If release number goals are obtained, a soft release will not be required to keep animals in the area. Six hundred animals per site should assure that animals will be found in the area. Intensive monitoring of the initial and subsequent stockings should occur to determine post release mortality. Hard releases are recommended because it will not be necessary to keep all released animals in the vicinity of the release site. Some dispersal of animals is desired to populate the vast amount of the habitat.

Costs

Below is a summation of the estimated first year cost of the project.

Animal cost per unit:

Shipping:	$250.00	
Handling:	$250.00	
Total:	$500.00 X 200 =	$100,000.00
Research Cost:		$134,000.00
Sightability survey:		$4,500.00
FLIR Camera:		$115,000.00
Information and Education:		$8,000.00
Equipment:		$7,100.00
Law Enforcement:		$30,000.00
Biologist		$30,000.00
Grand Total:		$428,000.00

Subsequent year cost will not have the research cost added. They will have manpower added for law enforcement and district biologists' field time. With these modifications the annual cost will be $178,100 per year for the 14-year period. Final total cost will be: $2,954,400.00. Significant income will first be generated in year seven. The expected income will increase as additional units come on line for hunting, beginning with $117,500.00 in year seven. Income will expand to $223,500.00 in year 10. By year 14 income should be $342,000.00 per year. The program should generate $1,683,000.00 by year 14. Final annual income after year 21 should be $684,000.00. The program break-even point will occur in year 16 if no unforseen events interrupt the program. Some supplemental income for the program can be generated in the second year of the program by offering limited permits (3 to 6) in lotteries, auctions and raffles.

Monitoring

Each animal should be well identified as a release-year animal. Colored and numbered neck collars will help future survey efforts. If individually marked, collars are available, they should be used. Colored or marked collars should also help deter poaching. Local reproduction will be easier to determine if the translocated population has colored collars. Collars should change color in each subsequent year of the restoration. Lincoln's marked-recapture index will be a possible survey tool in the second year of restoration if collar colors vary with stocking years. A Sightability index should be developed in the first winter after release. This can be done by locating radioed animals and then determining the ability to see them from the air. This technique was used successfully in Pennsylvania (Cougan 1992).

Sixty elk from the first release should be radio-telemetered with two year mortality signal collars. Satellite plotting may be desirable if it is not cost prohibitive. The 30 bulls and 30 cows should be followed to determine, mortality, home range and relationship to the habitat. Other radiotelemetry in addition to feeding studies will be possible in subsequent years.

Survey methods should be threefold. Direct helicopter surveys should be the primary monitoring devices. Snow counts may not be possible in some years, for that reason, FLIR (Forward Looking Infrared Radar) surveys should be used if at all possible. The cost of FLIR

may preclude its use. Individual sightings may also be a useful survey tool if animals can be marked individually. The use of individually numbered or marked collars will give an opportunity for the local community to become involved in monitoring elk populations. Local involvement to such an extent may help deter poaching by increasing public support of the project via ownership.

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Time Line

A schedule of target dates, needs and responsibilities is found in table 2. This will be updated as needed.

Information and Education

News releases should be started as soon as possible. A Kentucky Afield show should be done about the project. Shows and articles about the project should be done constantly during the comment period. Copies of this show should be sent to field biologists and conservation officers for display to local civic groups and hunting clubs. The Program Coordinator should schedule several informational meetings for May-July 1997 in the major towns within the range.

Public Comments

Public comments should be gathered for a two or more month period following release of information about the project. These comments should be reviewed by KDFWR. The project should be suspended if it is determined there is a majority of public opinion opposed to it. Concerns of opposition parties should be addressed if the project is supported by a majority. Comments should be sent to Elk Project, KDFWR, #1 Game Farm Rd., Frankfort, KY 40601.

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Table 1. Stocking rates and estimated growth of elk at the possible restoration sites in Kentucky.

YEAR	Stocking Site A		Stocking Site B		Stocking Site C		Big South Fork ?		
	number	pop.	number	pop.	number	pop.	number	pop.	income
1	200	220							
2	200	462							
3	200	728.2							
4		801.02	200	220					
5		881.12	200	462					
6		969.23	200	728.2					
7		1066.2		801.02	200	220			111750
8	COMMENCE			881.12	200	462			111750
9	LIMITED			969.23	200	728.2			111750
10	HUNTING			1066.2		801.02	200	220	223500
11			COMMENCE			881.12	200	462	223500
12			LIMITED			969.23		508.2	223500
13			HUNTING			1066.2		559.02	335250
14					COMMENCE			614.92	342000
					LIMITED		COMMENCE		1683000
Total stocked			2200		HUNTING		LIMITED		
Minimum total elk			3813.4				HUNTING		
EVENTUAL FILL OF TOTAL RANGE									
NUMBERS OF ELK AT END OF GROWTH ==						7388.9			
TIME TO FILL ==				21 YEARS					

Table 2. Needs, Times , and Responsibilities Required to Carry Out the Restoration.

Date	NEED	Responsibility	Order
Mar. 97	News Releases	I & E	1
Mar. 3	Comment period	I & E	2
Apr. 97	TV presentation	Ky. Afield	3
May 97	Informational Meetings	Cervid Program	4
June 97	End Comment	I & E	5
June 97	Review Comments	I & E	6
June 97	Commission vote	Department	7
July 1, 97	Stocking source	Cervid Program	8
July 97	Budget	Cervid Program	9
Sept., 97	Research project	Cervid Program-University	10
Sept. 97	Order Collars, radios, etc.	Cervid Program	11
Sept 97	Shippers	Cervid Program	12
Sept 97	Personnel Needs	Law Enforcement	13
Dec., 97	Dart Gun Supplies	Cervid Program	14
Dec., 97	Field Equipment	NE & SE District Biologists	15
Dec., 97	Bill to increase elk fines	Commissioners office	16
Dec. 97	Schedule sightability surve	Cervid Program	17
Jan., 98	Signs	I & E	18
Jan., 98	Information Brochures	I & E	19
Jan., 98	First Release	Combined effort	20
Feb., 98	Sightability survey	Cervid Program	21
Feb. 98	First Helicopter surveys	Cervid Program	22