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ELK IN NEBRASKA: OPPORTUNITY OR ANOTHER PRIVATE-PUBLIC LAND CONUNDRUM

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Abstract: We conducted a comprehensive research project on elk in the Pine Ridge region of northwestern Nebraska from 1995 to 2002 to determine ecological factors that could be used to improve management and reduce damage. The population ranged from 120 to 150 animals, with an average calf:cow ratio of 0.5:1 and bull:cow ratio of 0.4:1. We located 21 radio-collared female elk 6,311 times during 1995 to 1997. Seasonal home ranges of 2 herds were 10 and 44 km^2, while average annual home ranges of the herds were much larger (483 and 440 km^2, respectively). All wintering areas (n = 21) and 80% of the calving areas (n = 22) were located on privately-owned land. Active timber harvest temporarily displaced elk, most notably during the calving season. Elk shifted home ranges in association with the seasonal availability of agricultural crops, in particular, alfalfa, oats, and winter wheat. Population models indicated that static levels of hunting mortality would lead to a stable population of about 130 elk over 10 years. Most landowners in the Pine Ridge (57%) favored free-ranging elk, but 26% were concerned about damage to agricultural crops and competition with livestock. Habitat suitability models and estimates of social carrying capacity indicate that up to 600 elk could be sustained in the Pine Ridge without significant impacts to landowners. We recommended an integrated management program used to enhance elk habitat on publicly-owned land and redistribute elk from privately-owned land.

Key words: *Cervus elaphus*, elk, home range, management, Nebraska, radio-telemetry, re-introduced species

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INTRODUCTION

Elk (*Cervus elaphus*) are native to Nebraska and roamed the Great Plains in the early 1800s. Jones (1962) reviewed records of 19th Century sightings of elk in Nebraska and reported the first documented elk sightings by Lewis and Clark in 1803 and reports of sightings as late as the 1880s. Elk and bison (*Bison bison*) were nearly eliminated during the 1830s through 1860s

by market hunters. Swenk (1908) reported that elk were extirpated from Nebraska about the same time as the Plains bison (B. b. bison) in the early 1880s.

In the 1960s, Rocky Mountain elk were transplanted from Yellowstone National Park to the Rawhide Buttes, near Lusk, Wyoming. Two tagged elk from the translocated herd were observed in the Pine Ridge in 1967 and 1969. The number of elk in Nebraska continued to increase through the 1970s and 1980s, to a level in which complaints from landowners in the Pine Ridge led to the implementation of relatively liberal hunting seasons in the late 1980s. Elk numbers continued to increase through the 1990s to the present.

Elk provide benefits to the people of Nebraska, but also provide a management challenge to natural resource agencies. Elk in Nebraska, unlike the western states, spend the majority of their time on privately-owned land. Elk damage field crops, fences, and hay stacks. The Nebraska Game and Parks Commission (NGPC) held a series of public meetings to address the future of elk and elk management in the Pine Ridge in 1995. After reviewing the comments at each meeting, the NGPC developed an elk management plan (Nebraska Game and Parks Commission, 1995) that identified the following objectives: 1) determine the status of the elk population and maintain a minimum population of 100 elk, with at least 6 mature (6+ point) bulls, 2) respond to all depredation complaints, 3) implement prescribed hunting seasons, starting in 1995, 4) monitor the overall health of the elk population and prevent contamination of domestic livestock through removal or treatment of infected elk, and 5) provide informational and educational materials to the public, that promote free-ranging elk as a valuable component of Nebraska's native fauna.

Research on elk in the Pine Ridge was needed to support evaluation and continuation of the NGPC management plan. Information on the number of elk, sex/age structure, distribution, critical calving and wintering areas, effects of human disturbance, health of the elk population, and public attitudes was needed to enable the NGPC to conduct an ecologically sound elk management program. We conducted a comprehensive research project on elk in the Pine Ridge from 1995 to 2002, in accordance with NGPC objectives, to determine ecological factors that could be used to improve management and reduce damage.

STUDY AREA

The study was conducted in the Pine Ridge region of northwestern Nebraska, which is 160 km long, 1 to 8 km wide, and covers 120,000 ha (Stillings 1999). Two distinct study areas were used for this project; the Hat Creek area, located between Crawford and Harrison, Nebraska, and the Bordeaux Creek area, located east of Chadron, Nebraska. The Hat Creek area encompasses 44,035 ha, consisting of 47% ponderosa pine (*Pinus ponderosa*) forest (of which 14% was burned in 1989), 50% grassland, and 3% agricultural crops. The Bordeaux Creek area encompasses 48,398 ha, consisting of 51% ponderosa pine forest, 46% grassland, and 3% agricultural crops. Agricultural crops, including alfalfa, oats, millet, and winter wheat are available seasonally to elk, with baled hay being available throughout the year. The 2 study areas consist of privately-owned (94%) and publicly-owned (6%) land with a limited road system that provides access to ranches. The public land is owned by the NGPC and United States Forest Service (USFS) (Stillings 1999).

The region is dominated by rugged ponderosa pine forest, interspersed with

relatively flat grassland pastures and agricultural fields. Predominant hardwood species associated with riparian areas include green ash (*Fraxinus pennsylvanica*) and cottonwood (*Populus deltoides*). Predominant grass species include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Kentucky bluegrass (*Poa pratensis*) (Stillings 1999).

METHODS

We captured 21 female Rocky Mountain elk by helicopter net-gunning in the Pine Ridge region of Nebraska in April 1995. Radio-collars were placed on 10 female elk in the Bordeaux Creek area and 11 female elk in the Hat Creek area. We located these elk by radio-telemetry and visual observation 6,311 times between April 1995 and August 1997. We used 522 visual observations of elk to generate calf:cow and bull:cow ratios in the Bordeaux Creek and Hat Creek areas. We developed a population model using STELLA for each herd from demographic rates determined from field observations.

We located 22 elk calving sites and 42 random locations and measured 10 micro- and 9 macro-habitat variables at each area between mid-June and July 1996 and 1997 to determine factors that affect habitat selection during calving seasons. We identified 21 winter elk-use sites and 44 random locations and measured 10 micro- and 9 macro- habitat variables at each area between January and March of 1996 and 1997 to determine factors that affect habitat selection during winter. We generated 72 logistic regression models and used Akaike's Information Criterion (AIC) to determine relative probabilities of individual elk selecting use sites over randomly-located sites.

We calculated the relative proportions of habitat use by elk in the Pine Ridge from 5,787 locations of radio-collared elk. Habitat variables (landcover type, aspect, slope, distance to road, road density, and distance from the ponderosa pine edge) were measured for each location using a Geographic Information System (GIS). The habitat variables were also measured for a random point coverage (n = 5,787) to compare and contrast the differences, if any, between elk-use and non-use areas. We developed a logistic regression model to describe elk habitat selection for 2 discrete, non-migratory herds of elk. We used GIS to apply the model to the entire Pine Ridge study area and to create a map of potentially suitable elk habitat.

Blood samples were collected from 21 captured elk and 65 harvested elk from 3 study areas in Boyd, Dawes, and Sioux counties of Nebraska during 1995 to 1997, to monitor the health of the elk population.

We mailed questionnaires to all Pine Ridge landowners in 1995 and 1997 to determine their attitudes toward elk and elk management.

RESULTS AND DISCUSSION

The estimated number of elk in the Bordeaux Creek herd ranged from 59 to 77, with calf:cow ratios of 0.42-0.57:1 and bull:cow ratios of 0.29-0.42:1. The estimated number of elk in the Hat Creek herd ranged from 61 to 72, with calf:cow ratios of 0.43-0.51:1 and bull:cow ratios of 0.44-0.51:1 (Stillings 1999).

We identified 2 distinct, nonmigratory elk herds with annual home ranges that averaged 19,359 ha and 17,614 ha for the Bordeaux and Hat Creek study areas, respectively. Seasonal home ranges varied from 1,821 ha to 4,258 ha in winter, 2,887 ha to 4,165 ha in spring, 982 ha to 2,077 ha during calving, 1,574 ha to 4,408 ha in summer, and 1,976 ha to 4,408 ha during the breeding season (Cover 2000). Cropland areas within winter range sites

were used 3 times more than expected, considering their availability in both study areas. Spring home range areas shifted to forested habitat. Ponderosa pine habitat was used nearly 2 times more than expected, considering the availability in calving areas. Elk used agricultural fields 5 times more than expected, considering the availability during the breeding season. They avoided pasture areas with cattle present (Stillings 1999).

Eighty percent of all calving areas (n = 22) were located on privately-owned land. Seventy-three percent (n = 16) of elk calving areas were located in ponderosa pine forest. The logistic regression model that best described elk use and fit the independent variables using a manual selection procedure, included: presence of cattle, average slope, habitat type, and distance from a road (AIC = 49.57) (Stillings 1999).

The model that best described winter elk habitat selection (AIC = 70.7) included the variables: road type, slope, and distance to edge (Cover 2000). The second best fitting model (AIC = 72.5) included road type, slope, distance to edge, and hiding cover. Odds ratios for both models suggest that elk prefer winter areas that provide increasing slope ($\bar{x}$ = 16%, odds ratio = 1.225), distance to edge ($\bar{x}$ = 286 m, odds ratio = 1.004), and the avoidance of areas with gravel or paved roads compared to two-track roads ($\bar{x}$ = 74%, odds ratio = 0.016). Areas with higher percentages of hiding cover ($\bar{x}$ = 59%, odds ratio = 1.009) also were preferred. All wintering areas (n = 21) were located on privately-owned land. Application of these models may assist wildlife managers in identifying areas that could serve as potential winter-use sites.

Habitat selection by elk in the Pine Ridge is largely determined by human disturbance factors and land-use patterns. Active timber harvest was found to temporarily displace elk. The distance between home range centers of elk exposed to logging ($\bar{x}$ = 5554 m) was larger than the distance moved by elk not exposed to logging ($\bar{x}$ = 3337 m) (Stillings 1999). Elk responded to summer agricultural crops by shifting home ranges approximately 2.5 km toward crops after the second cutting of alfalfa and maturation of oats and millet during the late dough-stage. The distribution of elk in the Bordeaux area during winter was driven by the initiation of supplemental feeding. The elk calving season occurred at the same time as the initial stocking of cattle. Elk responded to cattle by moving out of recently stocked pastures and reducing the size of their home ranges. Road density and the amount of travel were the 2 most important variables quantifying differences between elk-use and non-use areas. Areas with greater than 0.51 km of road/km^2 and a road use index greater than 1650 will likely be avoided by elk (Stillings 1999).

We characterized the suitability of habitat for elk in the Pine Ridge as low (34%), medium (38%), high (21%), and optimal (8%). We estimate that the Pine Ridge region provides 140,000 ha (540 mi^2) of highly to optimally suitable elk habitat (Fischer 2002). Habitat suitability models can be used to direct management efforts to ensure that the number and distribution of elk in the Pine Ridge region is ecologically sound and socially acceptable.

No titers were observed for anaplasmosis, bluetongue, or brucellosis. Detectable antibodies for *Leptosira interrogans bratislava* (8 of 86, 9%) and *L. i. hardjo* (7 of 86, 8%) were observed in all 3 study areas (Cover 2000). Positive sera results were found for epizootic hemorrhagic disease (2 of 86, 2%) and bovine viral disease (3 of 86, 3%) in Dawes and Sioux counties. The low percentage of exposed elk in our sample and the low antibody titer ratios (1:100 to 1:400) suggest

that previous exposure to infectious organisms may have occurred, but none of the 3 populations have active infections.

Fifty-six percent (n = 214) of the landowners that responded to our survey in 1995 and 57% (n = 461) in 1997 were in favor of free-ranging elk (Crank 1998). Motivation for those in favor of elk was utilitarian (opportunity to view and hunt elk), ecological (return of a native species), and economic (benefits from increased tourism and leasing land for elk hunting). Reasons for opposition to elk were largely economic (damage to crops, competition with livestock, transmission of diseases to livestock) and convenience (dealing with elk hunters). Attitudes toward free-ranging elk were not affected by year or presence of elk on a landowner's property. Landowner attitudes were influenced by region and experience with elk damage. The mean reported cost of damage in 1997 was $929 (range = $50 to $6000) and 80% of the landowners described their damage as minor or tolerable. Respondents who reported damage felt the population was too high, while 71% of the landowners who were in favor of elk wanted the population of elk to increase. Most landowners (54 to 63%) were in favor of hunting seasons for elk. Seventy-five percent of respondents in 1997 reported that they would allow elk hunting on their property, compared to 55% in 1995 (Crank 1998).

MANAGEMENT IMPLICATIONS

While exclusion of stored hay is widely practiced, hunting is the primary management technique used to control damage caused by elk. Population models indicate that static levels of hunting mortality would lead to a stable population of about 130 elk over 10 years. The population could increase 4-fold in 10 years, however, if mortality by hunting were eliminated. Most landowners in the Pine Ridge favored free-ranging elk, but 26% were concerned about damage to agricultural crops and competition with livestock. Habitat suitability models and estimates of social carrying capacity indicate that up to 600 elk could be sustained in the Pine Ridge without significant impacts to landowners. Increases in the level of the elk population and associated opportunities for elk hunting could be achieved by modifying the harvest structure and permitting system. In addition, an integrated management program used to enhance elk habitat on publicly-owned land and redistribute elk from privately-owned land is warranted.

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