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Landowner attitudes toward elk management in the Pine Ridge region of northwestern Nebraska

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Abstract: Little is known about attitudes of landowners toward elk (*Cervus elaphus*) on privately-owned land. We mailed questionnaires to agricultural landowners in the Pine Ridge region of northwestern Nebraska in both 1995 and 1997 to determine attitudes toward elk populations and management of elk. Fifty-six percent (n = 214) of respondents in 1995 and 57% (n = 461) in 1997 were in favor of free-ranging elk. 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 leased 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 landowners' property. Attitudes were affected by region and experience with damage from elk. The mean reported cost of damage was $832 and $929 in 1995 and 1997, respectively, with 75 to 80% of landowners reporting damage as minor or tolerable. Respondents who reported damage felt that the population of elk was too high, while landowners who favored elk wanted the population to increase. Most landowners (54 to 63%) were in favor of elk-hunting seasons. Fifty-five percent of respondents in 1995 reported that they would allow elk hunting on their property, compared to 75% in 1997. Management recommendations that stem from this research may apply to landscapes east of the Rocky Mountains in areas that are largely privately-owned and have been recolonized by elk.

Key words: *Cervus elaphus*, elk, human–wildlife conflicts, landowner attitudes, Nebraska, wildlife damage, wildlife management

Elk (*Cervus elaphus*) are expanding eastward and recolonizing their historic range, due in part to natural movements and translocation efforts by state wildlife agencies. Reintroductions of elk have been successful in Pennsylvania (1913), Michigan (1918), Arkansas (1981), Wisconsin (1995), Kentucky (1997), Tennessee (2000), Ontario (2000), and North Carolina (2001; Rocky Mountain Elk Foundation 2008). Unlike their western counterparts, elk in Nebraska and most eastern states spend the majority of their time on privately owned lands. Private landowners affect elk habitat through land-use patterns and determine the availability of elk for human use and interests. Wildlife managers should work with landowners to both enhance habitat and address problems that arise with elk on private lands. Problems can be addressed more efficiently if attitudes of landowners toward elk are known. Landowners can hinder the management of big game populations if there is a lack of cooperation with wildlife managers (Nielsen et al. 1986). Managers should be aware that the concept of privately-owned land and publicly-owned wildlife occasionally conflict (McKetta and Bolon 1989). The information provided on landowner attitudes in this study may be useful to wildlife managers, particularly those in states with reintroduced populations of elk that spend a considerable amount of time on privately-owned land.

Elk were native to Nebraska until market and subsistence hunting extirpated populations in the late-1880s (Jones 1962). During the late 1960s, elk were translocated from Yellowstone National Park to the Rawhide Buttes in eastern Wyoming. Some of these elk moved eastward and recolonized the Pine Ridge region of Nebraska (Fricke et al. 2008; Figure 1). Complaints from landowners about crop depredation prompted the Nebraska Game and Parks Commission (NGPC) to implement hunting seasons in 1987 and 1988 to appease landowners and to reduce the population of elk

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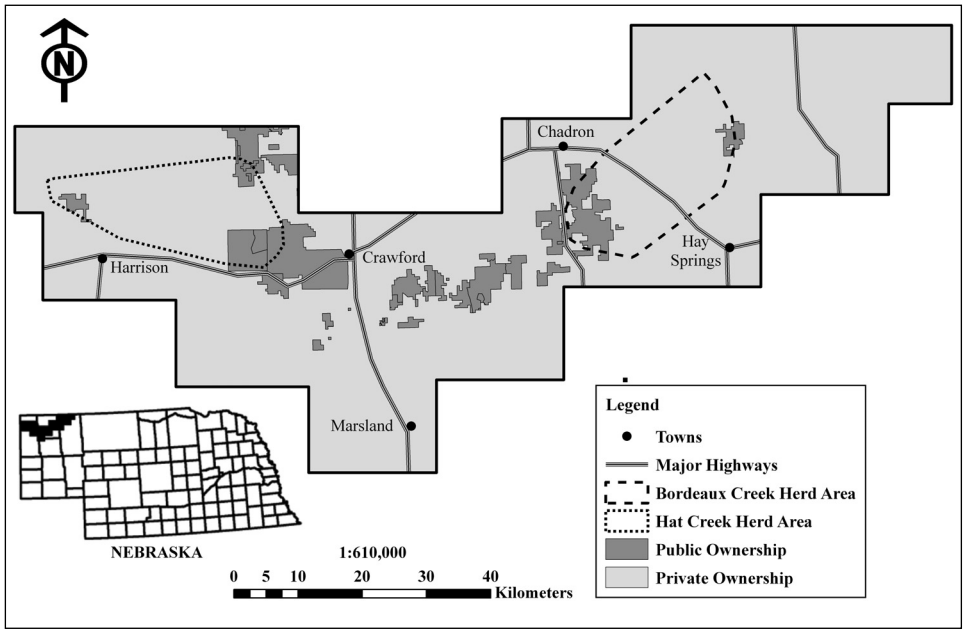

Figure 1. Map of the Pine Ridge region of northwestern Nebraska, including the Hat Creek and Bordeaux Creek herd areas, 1995–1997.

in the Pine Ridge, but complaints of elk and elk damage continued to increase in the early 1990s. The NGPC conducted a survey of all landowners in the Pine Ridge in 1995 to determine their attitudes toward elk and elk management. Later, the NGPC conducted a series of public hearings on elk throughout Nebraska to develop the Nebraska Elk Management Plan, which directed managers to: (1) maintain a minimum population of 100 elk in the Pine Ridge; (2) provide hunting opportunities for residents; and (3) reduce complaints of damage by landowners (NGPC 1995). Annual hunting seasons for elk were conducted in the Pine Ridge during 1995 to 1997, and both temporary and permanent fences were installed to protect haystacks. A multifaceted research project on elk was conducted by the University of Nebraska–Lincoln during 1995 to 2002 in the Pine Ridge (Crank 1998, Stillings 1999, Cover 2000, Fischer 2002). Researchers found that elk were distributed in 2 separate herds of 60 to 80 animals each in the Bordeaux and Hat Creek elk management units (EMU; Figure 1; Stillings 1999). The herds were healthy and growing, with little incidence of diseases (Cover 2000). Calf:cow ratios of 0.42:1 to 0.57:1 and bull:cow ratios of 0.29:1 to 0.51:1 were reported (Stillings 1999). Critical habitats (i.e., calving and wintering areas) were found almost exclusively on privately-owned land (Stillings 1999). Resource selection functions indicated that much of the unoccupied publicly-owned land in the area was suitable or highly suitable for elk (Baasch 2008). We surveyed agricultural landowners in the Pine Ridge region of northwestern Nebraska in 1995 and 1997 to determine their attitudes toward elk and elk management and to note changes in landowner attitudes toward elk in the face of an increasing elk population and NGPC's activities related to elk.

Methods

Study area

The Pine Ridge lay in the northwestern corner of Nebraska (Figure 1). It was approximately 160 km long and 1 to 8 km wide, covering 120,000 ha. The Pine Ridge was dominated by privately-owned land, interspersed with publicly-owned land managed by the U.S. Forest Service, Nebraska National Forest, and the NGPC. The study area was 94% privately-owned. The Pine Ridge was dominated by ponderosa pine (*Pinus ponderosa*) forests interspersed with grass pastures consisting of big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Kentucky bluegrass

(*Poa pratensis*), and bromegrass (*Bromus* spp.). Crops included winter wheat, alfalfa, and oats (Cover 2000). The Hat Creek area consisted of 47% ponderosa pine (14% burned in 1989), 50% pasture, and 3% cropland. The Bordeaux Creek area consisted of 51% ponderosa pine, 46% pasture, and 3% cropland (Stillings 1999). Landowners in the area were primarily farmers or ranchers who resided in predominately rural areas. The primary land-use practices included livestock grazing, forage and grain crop production, and timber harvest. The Pine Ridge area in 1995 to 1997 included 2 EMUs: the Hat Creek EMU (between Crawford and Harrison, Nebraska) and the Bordeaux Creek EMU (east of Chadron, Nebraska; Figure 1).

Survey design and methods

The questionnaire we used in 1995 contained 24 multiple-choice questions that addressed attitudes toward elk about free-range, population management, hunting, property damage, as well as local deer management. The questionnaire we used in 1997 included 17 of the 24 questions used in 1995 to allow for direct comparisons. Six questions about deer management and public meetings were removed, and 8 questions were added to address future populations of elk, hunting permits, experiences with hunters, and depredation. A cover letter was attached to explain the purpose of the study, how the information was to be used, confidentiality, and whom to contact if questions arose. The same landowners were surveyed in both years except for those who left the area and did not reestablish residence in the Pine Ridge after 1995. The survey was approved by the Nebraska Agricultural Statistics Service (NASS) and the University of Nebraska–Lincoln Institutional Review Board (UNL-IRB #97-07-388EX).

A list of agricultural landowners (n = 903) in the Pine Ridge area was compiled by NASS for the 1995 survey. The list included only those individuals who had >$1,000 in agricultural sales. All questionnaires were individually numbered for identification. The initial mailing was completed in June 1995. A postcard reminder was sent to nonrespondents in July 1995. In 1997, we obtained through NASS a list of agricultural landowners (n = 1,009) who owned or operated ≥32 ha of land using the same criteria as the 1995 survey. We used additional selection criterion to avoid selection of landlords, city homeowners, or owners of housing developments as these could lead to lowered response rate. The list of landowners and their corresponding identification numbers was maintained by NASS to ensure confidentiality. We numbered all questionnaires in the first mailing to enable identification of nonrespondents. We made the initial mailing for this questionnaire in September 1997, and we sent a postcard reminder to nonrespondents in October 1997. We sent a second copy of the questionnaire to nonrespondents in October 1997, 2 weeks after the postcard reminder. We were unable to conduct nonrespondent surveys because of NASS policies on confidentiality and because of time constraints.

Data analysis

The 1995 survey data were entered into a Statistical Analysis System (SAS) database (SAS Institute, Cary, N.C., 1990) and verified by cross-referencing it with the original questionnaires. We produced descriptive statistics and cross-tabulations using SAS. The 1997 survey data were entered into an Excel 5.0 spreadsheet (Microsoft Corporation, Redmond, Calif., 1994) and verified by cross-referencing it with the original questionnaires. We used the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Ill., 1997) to produce descriptive statistics and cross-tabulations. We used log-linear analysis (PROC CATMOD, SAS Institute, Cary, N.C., 1990) to determine if interactions existed among the independent variables of operation type and property location (inside or outside EMUs).

Results

Demographics

Of the 903 questionnaires sent in 1995, 242 (27%) were returned in usable form. Landowners who lived within EMUs responded at a higher rate (30%) than those who lived outside EMUs (18%). Of the 1,009 questionnaires sent during 1997, 503 (50%) were returned in usable form.

Seventy percent of all respondents were full-time farmers or ranchers, 17% were part-time farmers or ranchers, and 7% leased all their land to others. Six percent of the responses were from the Hat Creek EMU (n = 28), 14%

from the Bordeaux Creek EMU (n = 60), and 80% (n = 383) from outside either EMU. Thirty-three percent of respondents outside EMU boundaries reported having elk on their property, whereas 88% of those within EMUs reported having elk on their property.

Attitudes toward and damage by elk

Most respondents (56%) were in favor of free-ranging elk in the Pine Ridge. The reasons for favoring elk included, opportunity to view elk (83%), return of a native species (48%), opportunity to hunt elk (46%), potential financial benefit from increased tourism (26%), and the possibility of leasing land for hunting (12%). Twenty-six percent of respondents disapproved of elk because of damage to crops and property (95%), grazing competition between elk and cattle (75%), possible transmission of diseases to cattle (75%), and problems in dealing with hunters (50%). The remaining 17% of respondents had no opinion on free-ranging elk.

Attitudes toward free-ranging elk did not change between 1995 and 1997 (χ^2 = 0.36, P = 0.54). Although we found no differences in attitudes toward elk for respondents inside versus outside EMUs (χ^2 = 0.18, P = 0.66), more respondents in the Bordeaux Creek EMU were in favor of elk than those in the Hat Creek EMU (χ^2 = 10.11, P = 0.001). We found no differences in attitudes toward elk between respondents who reported elk on their property and those who did not in either year (χ^2 = 0.03, P = 0.84). A higher proportion of respondents (65%) reporting no damage from elk were in favor of free-ranging elk, compared to those who experienced damage (χ^2 = 6.37, P = 0.01).

Forty percent of respondents in 1995 thought the number of elk was acceptable, and 56% favored free-ranging elk. Sixty-two percent of respondents who favored elk in 1997 thought the population of elk was too low, and 71% of those wanted the population to increase. Sixty percent of those not in favor of elk thought the population was too high. Respondents who reported damage in 1997 thought the overall population of elk was too high (χ^2 = 18.64, P = 0.0002) and wanted elk populations decreased (χ^2 = 17.00, P = 0.0004). Twice as many respondents who reported having elk on their land thought the local population of elk was too high, compared to those who did not have elk on their land. Seventy-nine percent of respondents living outside EMUs thought that the local elk population was too low, and 73% wanted it increased. Eighty-eight percent of landowners in the Hat Creek EMU thought the local elk population was too high, and 74% wanted it reduced in the future. Seventy-three percent of Bordeaux Creek EMU respondents thought the local elk population was too low, and 74% wanted it increased in the future. In 1997, 27% more respondents than in 1995 thought that the elk population in their local area was too high.

Sixteen percent of the respondents in 1995 and 11% in 1997 reported damage to crops or property due to elk. In 1995, 78% of respondents that reported damage thought the population of elk in their local area was too high. Forty-five percent of respondents reported elk present on their property and of these, 52% reported elk on their property in the 12 months prior to the survey. The mean estimate of annual damage from elk was $832 (range: $100 to $4,000, n = 8) in 1995. The mean damage estimate in 1997 was $929 (range: $50 to $6,000, n = 17), which was similar to the estimate in 1995 (t = 1.21, P = 0.87). Damage to fences made up 60% of all damage reported by surveyed landowners in the Pine Ridge in 1997. Seventy-four percent of respondents in 1995 and 80% in 1997 described damage from elk as minor or tolerable. As damage estimates approached $1,000, respondents described damage as intolerable. We found no difference in tolerance levels toward damage between full- and part-time farmers or ranchers (χ^2 = 0.04, P = 0.83). Seven respondents (21%) in 1995 and eight (15%) in 1997 notified the NGPC of damage to property caused by elk. More (76%) respondents in the Hat Creek EMU notified the NGPC than did respondents in the Bordeaux Creek EMU. The NGPC's response was described as good or very good by 9 (60%) respondents and poor or very poor by six (40%). Only 37% of Pine Ridge landowners who were aware of the availability of free fencing materials in 1997 requested them. Seventy-seven percent of respondents who requested fencing materials said they received them in a timely manner. Thirty-nine percent of respondents in 1995 and 33% of respondents in 1997 thought the NGPC should

spend more time and money managing damage caused by elk, whereas 15% and 19%, in those years, respectively, said that the NGPC should not. The remaining 44% in 1995 and 48% in 1997 either had no opinion or were undecided. A higher proportion (75%) of landowners who had sustained property damage thought the NGPC should spend more time and money on damage management (χ^2 = 3.28, P = 0.06).

Attitudes toward hunting

Fifty-four percent of landowners in 1995 and 63% in 1997 were in favor of hunting seasons for elk. Fifty-two percent and 60% in those years, respectively, believed that the population should be controlled primarily through hunting. Thirty-four percent of landowners in 1997 thought that the number of permits was about right, and 21% thought it was too low. Seventy-one percent of landowners in the Hat Creek EMU and 52% of those who reported elk damage thought that the number of permits was too low. Fifty-five percent of respondents in 1995 reported that they would allow elk hunting on their property, compared to 75% in 1997. Landowners in favor of elk reported that they would allow hunting (χ^2 = 17.74, P = 0.00003). No difference was found between the number of respondents inside versus outside EMUs who would allow hunting (P = 0.74). Of those not allowing hunting, 19% in 1997 reported damage from elk. Forty-six percent of respondents in 1995 reported that they would allow some or all persons who asked permission to hunt compared to 43% in 1997. Thirty-eight percent of landowners in 1995 would allow only a family member, friend, or neighbor to hunt elk on their property compared to 44% in 1997.

Relatively few respondents (30% in 1995, 15% in 1997) reported that they would charge a fee to hunt elk on their property. The average fee charged for elk-hunter access in the Pine Ridge in 1997 was $505 (range: $10 to $2,500, n = 21). More landowners in the Hat Creek EMU (22%) indicated they would charge fees to hunters (χ^2 = 4.84, P = 0.03) compared to those in the Bordeaux Creek EMU (10%). More landowners who reported elk damage (18%) also indicated that they would charge a fee (χ^2 = 6.65, P = 0.01) when compared to those reporting no damage. Overall, 94% of the respondents in 1997 had positive experiences with elk hunters. Very few (6%) respondents had only minor problems with elk hunters, and 1 respondent had a substantial problem with elk hunters.

Attitudes toward elk management

Twelve percent of respondents in 1995 rated the NGPC's performance in managing elk dur-ing the 2 years prior to the survey as good or very good. Twenty-seven percent gave an adequate rating, and 27% rated their performance as poor or very poor. Landowners who reported elk on their property were more likely to give the NGPC a poor or very poor rating (22%) than landowners who did not have elk (4%) on their property. Thirty-one percent of respondents in 1997 thought that NGPC was doing a good or very good job of managing elk, and 17% described it as fair. Respondents providing a good or very good rating nearly tripled between 1995 and 1997, and the number of respondents giving a poor or very poor rating to the NGPC decreased by 50%. Fifty-six percent of respondents who reported damage gave the NGPC a poor or very poor rating, whereas 79% of respondents who reported no damage gave it a good or very good rating. Landowners in the Hat Creek EMU were twice as likely to give the NGPC a poor or very poor job rating compared to those in the Bordeaux Creek EMU (χ^2 = 2.98, P = 0.08). Landowners outside the EMUs were nearly 4 times as likely to give the NGPC a good or very good rating when compared to those within the EMUs (P = 0.0001). The largest proportion of respondents (30% in 1995, 39% in 1997) had no opinion about the NGPC Elk Management Plan (NGPC 1995). Eleven percent of landowners in 1995 and 34% in 1997 believed that the NGPC should pay for elk management; 30% of them in 1995 and 21% in 1997 believed elk hunters only should pay; 29% in 1995 and 13% in 1997 believed all hunters should pay for elk management; and 21% of landowners in 1995 and 10% in 1997 believed that all taxpayers should pay for elk management.

Discussion

The survey response rate was considerably lower in 1995 (27%) than in 1997 (50%), possibly due to negative attitudes of landowners toward the NGPC prior to 1995. In addition,

activities related to elk in the area increased considerably from 1995 to 1997, which likely increased landowner interest and awareness. Activities included public hearings, hunting seasons, increased responsiveness to damage complaints, radio-telemetry research projects, and a local chapter of the Rocky Mountain Elk Foundation being formed. We conducted the survey in 1997 because of the changes in activities that occurred since 1995. The lack of nonrespondent surveys causes some concern in our conclusions due to the possibility of nonresponse bias, especially in 1995. Another possible reason for low response rate in 1995 was that surveys were mailed to nontarget groups. We added additional criteria in 1997 to resolve the problem. We did, however, have a relatively large sample size in both years (~1,000).

Landowners in northwestern Nebraska were in favor of free-ranging elk. In northern Arizona, 35% of ranchers favored elk for esthetic reasons; 32% favored elk for hunting reasons; and 16% favored them for the revenues derived from tourism and hunters who would help to support the local economy (Heydlauff et al. 2006). Applegate (1981) also reported that landowners associated observation of wildlife as one of the noneconomic benefits of elk. We observed significant differences between the 2 EMUs in landowner attitudes toward elk, although these areas were only 30 km apart. Regional variation in management preference may be more related to perceived damage levels and tolerance than to any differences between geographic areas (Pomerantz 1986). Differences in attitudes toward free-ranging elk in the Pine Ridge may be attributed to negative perceptions of wildlife due to potential damage to agricultural crops and personal property. Negative attitudes toward wildlife often develop when wildlife causes economic losses to agricultural producers (Conover 1998). Pomerantz et al. (1986) found that most people favored the status quo population level until damage from wildlife reached levels that were perceived as intolerable; then, population reductions were favored. Managers should be sensitive to subtle differences in damage levels, economic conditions, and social pressures when establishing EMU boundaries and herd management strategies.

The relatively low number of landowners who reported damage may have attributed to the similarity in damage estimates between years despite increased efforts by the NGPC to control damage. Although the reported incidence of damage was higher in 1995, the estimated cost was similar to what it was in 1997. The mean estimate of annual damage by elk was much lower than that reported for big game in Montana ($6,353; Lacey et al. 1993). Sixty-two percent of ranchers in Arizona reported elk damage of <$5,000, and 30% reported losses of >$5,000 (Heydlauff et al. 2006). Estimates may be inflated due to landowner bias, but there is no reliable or efficient method to measure this bias or the economic impact to private lands of damage by big game (Nielsen et al. 1986).

Sixty percent of landowners surveyed during our study reported damage to fences by elk, but, surprisingly, none of our graduate students who were in the field from 1995 to 1997 ever observed damage to fences or received a request from a landowner to repair a fence. Similarly, 64% of Montana landowners reported damage to fences caused by big game (Lacey et al. 1993). Fifty-one percent of landowners in Montana reported damage to pastures by all free-ranging ungulates; 30% reported damage to hay fields; 34% reported damage to crops; and 32% reported damage to hay stacks. Damage caused by elk was reported least frequently (20%), after white-tailed deer (*Odocoileus virginianus*; 67%), mule deer (*O. hemionus*; 62%), and pronghorn (*Antilocapra americana*; 46%; Irby et al. 1997). All 3 species are present along with elk in the Pine Ridge of Nebraska. Farmers in Utah and Wyoming also reported that deer (*Odocoileus* spp.) were responsible for the most damage (McIvor and Conover 1994). Ranchers in Arizona reported competition between elk and cattle (100%) as the top concern, followed by damage to fences (96%), pasture (51%), and crops (47%; Heydlauff et al. 2006). Wywialowski (1994) concluded that farmers were aware of measurable losses and that producer-derived estimates of wildlife-caused losses were likely conservative.

Surveyed landowners in the Pine Ridge rarely reported significant damage (>$1,000) caused by elk. Ranchers in Montana reported that damage from free-ranging ungulates was seldom serious (67%; Irby et al. 1997). We found no difference in tolerance for damage caused

by elk between full- and part-time farmers or ranchers, which is contrary to the findings of Brown et al. (1980), Tanner and Dimmick (1984), and Purdy and Decker (1985), in which full-time farmers had less tolerance for wildlife damage than did part-time farmers. Studies have indicated that landowners are willing to tolerate some degree of damage because they enjoyed the presence of white-tailed deer on their property (Brown et al. 1979, Tanner and Dimmick 1984, Decker and Gavin 1985, Conover 1998). Other studies have shown that landowners who hunted were more tolerant of wildlife damage and higher population levels (Brown et al. 1979, 1980, Decker et al. 1985) than those who did not hunt. More respondents in the Hat Creek EMU (72%) described damage from elk as intolerable than respondents in the Bordeaux Creek EMU. Landowners in the Hat Creek EMU reported that the elk population was too high and wanted decreases in numbers; thus, theirs was a more negative attitude toward elk. Similarly, in Montana, 44% of landowners with elk on their property who experienced damage thought elk numbers were too high (Irby et al. 1997). Attitudes of landowners in the Pine Ridge toward the NGPC's response to elk damage were related to occurrence of damage. Twenty-eight percent of ranchers who reported damage rated the Arizona Game and Fish Department's response to damage from elk as good to fair, and 59% of them rated the department's response as poor (Heydlauff et al. 2006).

We found that 44% of the landowners in the Pine Ridge allowed family or friends to hunt elk on their property, possibly because of either increasing elk populations or positive relationships between landowners and hunters. Fifty-six percent of Texas landowners allowed only family and friends to hunt on their property (Butler and Workman 1993). Lacey et al. (1993) and Irby et al. (1997) found that most landowners in Montana (77% and 84%, respectively) allowed hunters access to their land. Forty-six percent of Nebraska landowners reported that they were in favor of elk because they had the opportunity to hunt them, which is higher than ranchers surveyed in Arizona (37%; Heydlauff et al. 2006). In 1995, 30% more landowners reported charging for hunting access than in 1997. In 1995 and 1997, 22% more landowners charged fees for hunting access in the Hat Creek EMU than in the Bordeaux EMU. However, we were uncertain about the causes of these discrepancies. The NGPC has never been supportive of fee-access hunting, and some concerns linger regarding liability and insurance. Fewer than 0.5% of Idaho landowners (McKetta and Bolon 1989), and 8% of Montana landowners charged fees for big-game hunting (Irby et al. 1997).

Attitudes toward the NGPC Elk Management Plan (NGPC 1995) are mostly positive. Maintaining this positive attitude is a primary concern for Nebraska wildlife managers. The use of limited landowner hunting permits should be maintained to provide recreational opportunities for landowners and to maintain positive relations with landowners. Overall, population control through hunting and damage management options should be maintained to ensure positive landowner attitudes toward elk in the future. Landowner attitudes toward the NGPC and their management of elk improved considerably from 1995 to 1997, which was likely due to the implementation of annual hunting seasons, increased responsiveness to damage complaints, and better communication regarding elk in the Pine Ridge. The negative perception held by some landowners may have been due to a lack of communication, as several respondents expressed that they were unaware that the NGPC was doing anything to manage elk. Attitudes toward free-ranging elk became increasingly positive between 1995 and 1997. The change is likely due both to increased use of depredation control measures and to providing hunting opportunities to landowners.

Management implications

Private landowners in the Pine Ridge region of northwestern Nebraska were largely receptive to having elk in the area, and most of them were in favor of an increased elk population. To maintain this level of acceptance, wildlife managers should consistently encourage landowners to provide opportunities for viewing and hunting elk, citing the advantage of increased revenue for them. Wildlife mangers also should provide information about grazing, timber management, and other habitat management options on private land that are beneficial to elk, especially in calving

and wintering areas. Landowners perceive the opportunity to hunt as a benefit of having a local elk population. Benefits may be accrued by personal involvement or economic gain through charging fees for public access. Wildlife managers can help landowners realize these benefits by providing both landowner permits or transferable permits that help reduce damage caused by elk and providing information on fee-hunting operations. In addition, managers can use hunter education and law enforcement to minimize potential hunter–landowner conflicts.

A public information program also should be used to increase public awareness of elk and management options. Perhaps, more importantly, managers must work to minimize negative impacts of the presence of elk (i.e., crop damage, impacts on livestock, and detrimental hunter behavior) and be aware that differences in attitudes may occur in EMUs. Information and assistance on managing elk damage (i.e., fencing, hazing, lure crops, and selective removal) should be readily available and easily implemented at minimal cost to landowners. As of 2007, the elk population in Nebraska was approximately 1,400 animals, with roughly 900 elk populating 3 EMUs in the Pine Ridge region and annual herd growth estimated at 15 to 20% (NGPC 2007). Significant increases in future elk herds are possible, leading to higher incidence of human–elk conflicts. Currently, 7 EMUs cover the western two-thirds of Nebraska (NGPC 2009).

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Literature cited

Applegate, J. E. 1981. Landowner's behavior in dealing with wildlife values. *In* R. T. Dumke, G. V. Burger, and J. R. March, editors. Wildlife management on private lands. Wisconsin Department of Natural Resources, Madison, Wisconsin, USA.

Baasch, D. M. 2008. Resource selection by white-tailed deer, mule deer, and elk in Nebraska. Dissertation, University of Nebraska, Lincoln, Nebraska, USA.

Brown, T. L, D. J. Decker, and D. L. Hustin. 1979. Public attitudes toward black bear in the Catskills. Outdoor Recreation Resources Unit, Department of Natural Resources, Cornell University, Ithaca, New York, USA.

Brown, T. L., D. J. Decker, and D. L. Hustin. 1980. Farmers' tolerance of white-tailed deer in central and western New York. Cornell University Agricultural Experiment Station, Agriculture Publication 7, Ithaca, New York, USA.

Butler, L. D., and J. P. Workman. 1993. Fee hunting in the Texas Trans-Pecos area: a descriptive and economic analysis. Journal of Range Management 46:38–42.

Conover, M. R. 1998. Perceptions of American agricultural producers about wildlife on their farms and ranches. Wildlife Society Bulletin 3:597–604.

Cover, M. A. 2000. Ecology of elk in the Pine Ridge region of northwestern Nebraska: seasonal distribution, characteristics of wintering sites, and herd health. Thesis, University of Nebraska, Lincoln, Nebraska, USA.

Crank, R. D. 1998. Landowner and tourist attitudes toward elk management in the Pine Ridge region of northwestern Nebraska. Thesis, University of Nebraska, Lincoln, Nebraska, USA.

Decker, D. J., and T. A. Gavin. 1985. Human dimensions of managing a suburban deer herd: situation analysis for decision making by the Seatuck National Wildlife Refuge, Islip, NY. Human Dimensions Research Unit, Serial 85–93, Department of Natural Resources, Cornell University, Ithaca, New York, USA.

Decker, D. J., R. A. Smolka Jr., J. O'Pezio, and T. L. Brown. 1985. Social determinants of black bear management for the northern Catskill Mountains. Pages 239–247 *in* S. L. Beasom and S. F. Robertson, editors. Game harvest management. Caesar Kleberg Wildlife Institute, College of Agriculture, Texas A and M University, Kingsville, Texas, USA.

Fischer, J. W. 2002. A regional GIS-based analysis of elk habitat suitability in northwestern

Nebraska. Thesis, University of Nebraska, Lincoln, Nebraska, USA.

Fricke, K. A., M. A. Cover, S. E. Hygnstrom, S. R. Groepper, H. H. Genoways, K. M. Hams, and K. C. VerCauteren. 2008. Historic and recent distributions of elk in Nebraska. Great Plains Research 18:189–204.

Heydlauff, A. L., P. R. Krausman, W. W. Shaw, and S. E. Marsh. 2006. Perceptions regarding elk in northern Arizona. Wildlife Society Bulletin 34:27–33.

Irby, L. R., J. Saltiel, W. E. Zidack, and J. B. Johnson. 1997. Wild ungulate damage: perceptions of farmers and ranchers in Montana. Wildlife Society Bulletin 25:320–329.

Jones, J. K. 1962. Early records of some mammals of Nebraska. University of Nebraska Bulletin 4:89–100.

Lacey, J. R., K. Jamtgaard, L. Riggle, and T. Hayes. 1993. Impact of big game on private land in southwestern Montana: landowner perspectives. Journal of Range Management 46:31–37.

McIvor, D. E., and M. R. Conover. 1994. Perceptions of farmers and non-farmers toward management of problem wildlife. Wildlife Society Bulletin 22:212–219.

McKetta, C., and N. Bolon. 1989. Idaho landowner attitudes on hunting and hunters. Focus on Renewable Natural Resources 15:3–4.

NGPC. 1995. Nebraska elk management plan. Nebraska Game and Parks Commission, Lincoln, Nebraska, USA.

NGPC. 2007. Big game hunting guide: elk. Nebraska Game and Parks Commission, <http://www.ngpc.state.ne.us/hunting/guides/biggame/BGelk.asp>. Accessed July 24, 2009.

NGPC. 2009. Big game hunting guide: elk unit maps. Nebraska Game and Parks Commission, <http://www.ngpc.state.ne.us/hunting/guides/biggame/BGelkunitmaps.asp.> Accessed July 24, 2009.

Nielson, D. B., F. J. Wagstaff, and D. Lytle. 1986. Big-game animals on private range. Rangelands 8:36–38.

Pomerantz, G. A., C. Ng, and D. J. Decker. 1986. Summary of research on human tolerance of wildlife damage, Natural Resource Research and Extension Series 25. Department of Natural Resources, Cornell University, Ithaca, New York, USA.

Purdy, K. G., and D. J. Decker. 1985. Central New York beaver damage tolerance study, Human Dimensions Research Unit Serial 85–5. Department of Natural Resources, Cornell University, Ithaca, New York, USA.

Rocky Mountain Elk Foundation. 2008. Elk restoration, <http://www.rmef.org/Conservation/HowWeConserve/Restoration. Accessed September 14, 2009.

Stillings, B. A. 1999. Ecology of elk in northwestern Nebraska: demographics, effects of human disturbance, and characteristics of calving habitat. Thesis, University of Nebraska, Lincoln, Nebraska, USA.

Tanner, G. P., and R. W. Dimmick. 1984. An assessment of farmers' attitudes toward deer and deer damage in west Tennessee. Proceedings of the Eastern Wildlife Damage Control Conference 1:195–199.

Wywialowski, A. P. 1994. Agricultural producers' perceptions of wildlife-caused losses. Wildlife Society Bulletin 22:370–382.

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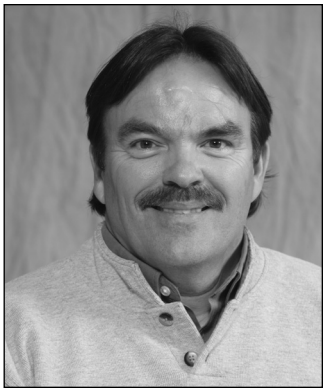

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