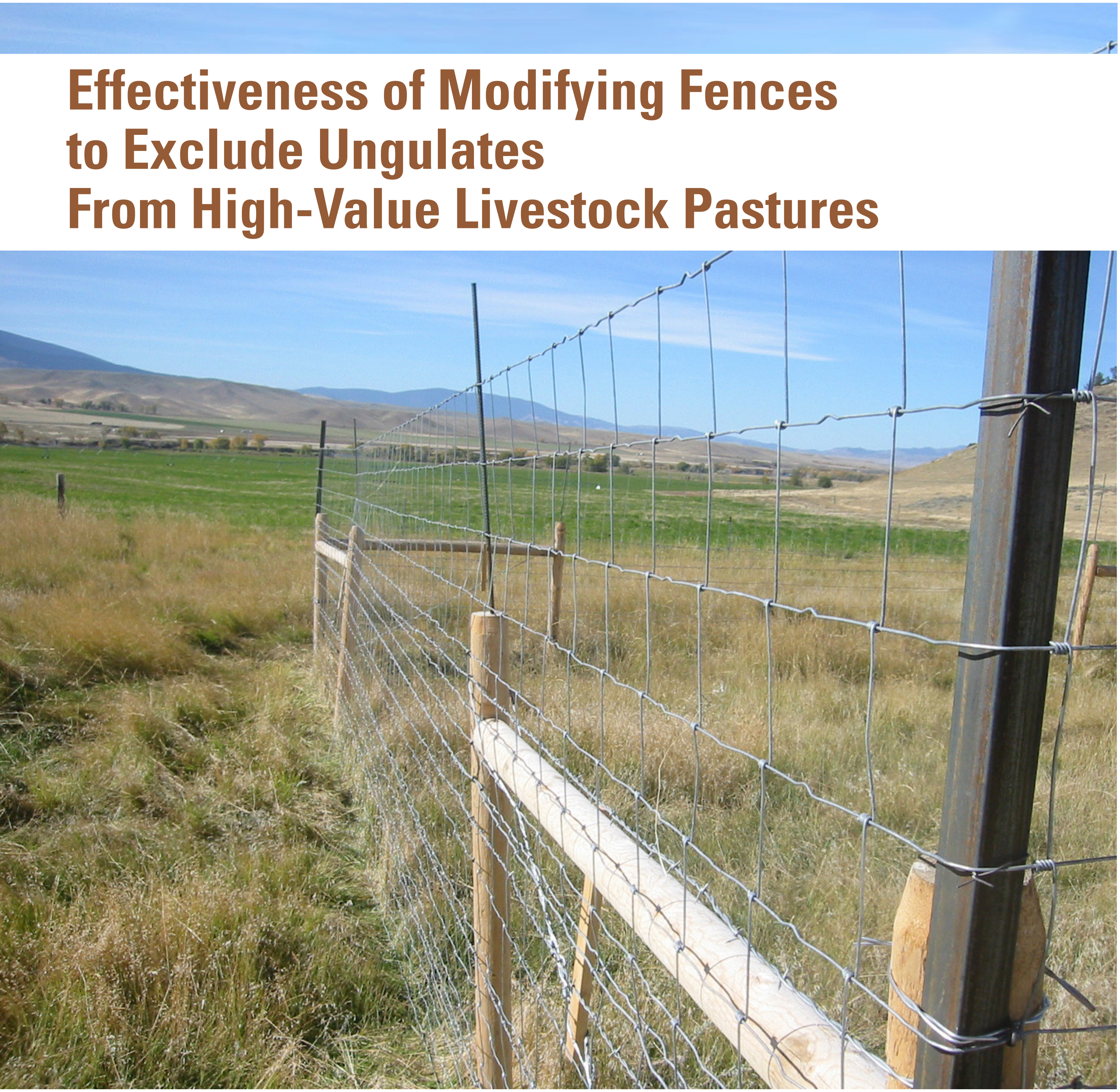
Effectiveness of Modifying Fences to Exclude Ungulates From High-Value Livestock Pastures



James E. Knight

Extension Wildlife Specialist, Animal and Range Sciences, Montana State University

MONTANA STATE UNIVERSITY EXTENSION

Research Bulletin No. 4603
April 2014

OVERVIEW

Big game animals can damage crops and compete with livestock for valuable forage. Ranchers have reported their tolerance for big game would increase if the animals could be prevented from using key areas critical for livestock use. Likewise, some farmers have high-value areas and crops that must be protected. Fences provide the most consistent long-term control compared to other deterrent methods, but are costly to erect. Traditional complete construction of game fences can cost more than $15,000 per mile for materials. Costs of erecting deer-proof fencing can be greatly reduced if an existing fence is modified instead of being replaced.

The objective of this study was to investigate the possibility of modifying existing fencing to prohibit deer *(Odocoileus* spp.) and elk *(Cervus elaphus)* crossings. Forty exclosures were constructed to test four different fence modifications across southwest Montana. Exclosures were baited and monitored for two winters to determine how well they deterred ungulate crossings. Results indicate effective modifications can be made to existing fences for $500 - $1,350 per mile for materials. Different designs proved to have varying levels of effectiveness, with six-foot woven wire being 100 percent effective. These fences are a cost-effective way to fence out wildlife in many high-value areas where traditional game fences are not practical. If farmers and ranchers can keep big game animals out of important foraging areas, resulting in reduced depredation losses, their tolerance for these animals may increase on the rest of their property.

INTRODUCTION

Wildlife damage is a major concern for many farmers, ranchers, and wildlife professionals throughout the United States. In the western U.S., much of this concern is centered upon deer (white-tailed deer, *Odocoileus virginianus* and mule deer, *O. hemionus*) and elk *(Cervus elaphus)* consuming forage intended for livestock. Deer and elk cause considerable monetary loss as perceived by some farmers and ranchers (Conover 1994; Wywialowski 1994; Irby et al. 1997). Big game animals caused an average monetary loss of $5,616 in forage consumption per landowner in southwestern Montana in 1993 (Lacey et al. 1993). Financial losses due to wildlife depredation lower landowner tolerance of wildlife on their property (Conover 1998). Compensation programs exist in some areas to replenish losses accrued by ranchers due to wildlife forage consumption, but these programs are costly and do not satisfy all producers (Van Tassel et al. 1999; Wagner et al. 1997).

Although many methods of deterring ungulates to prevent depredation have been used, fencing is the most reliable long-term method (Craven 1983; deCalesta 1983). Many designs of woven wire and electric fences are currently used to deter ungulates, with varying levels of efficacy (VerCauteren et al. 2006b). Unfortunately, fence is expensive to build and is sometimes more costly than the commodity being protected.

By reducing costs of fence construction, more high-value crops and pastures can be protected from ungulates in a cost-effective manner. Modifying existing fences instead of constructing new fences would greatly reduce materials cost. Having the ability to use cost-effective fencing to reduce ungulate depredation in key areas will allow farmers and ranchers to reduce forage losses without relying on state reimbursement programs or other retroactive solutions. Tolerance for wildlife on private land can be increased if damage caused by wildlife is reduced or wildlife can be directed to less critical areas. By fencing only key areas subjected to high economic losses from ungulates, wildlife migrations and daily movements will not be interrupted, and crucial habitat is provided by the rest of the ranch at a reduced overall cost to the producer. Increased tolerance for deer and elk on private land is an important consideration today and in the future of wildlife management, as more historical range for these animals is consumed by human development.

Many pastures and crops in Montana are already fenced to contain or exclude cattle and sheep. This study investigated the possibility of modifying existing livestock fences to prohibit deer and elk entry. Previously, there were no formal evaluations on the effectiveness of such fences at deterring deer and elk.

Four modification designs using combinations of woven and smooth wire were tested across southwestern Montana over two winters. All designs were developed to cost as little as possible, while still being potentially effective at stopping deer and elk. The goal was to create a barrier that an animal would not be willing to cross to reach a food source, although the capability of a deer or elk to penetrate even the most expensive design tested certainly exists.

METHODS

Formal testing of four configurations of high-tensile and net-wire designs took place on private ranches in central and southwestern Montana. Specific designs were selected to minimize cost of material to increase cost-effectiveness potential.

Testing was conducted to show effectiveness of each fence design at deterring deer and elk separately for clear results. The main criterion for site selection was a history of relatively high winter use by deer or elk, but not both species concurrently. Four ranches were chosen for the study where ungulate numbers were relatively high. On each ranch, two individual study areas were selected, giving a total of four study sites for deer and four for elk. Test sites for elk were approximately 25 miles south of Cameron, Montana, and approximately 10 miles west of White Sulphur Springs, Montana. Test sites for deer were located approximately 18 miles northeast of Melville, Montana, and approximately 10 miles east of Livingston, Montana. Three of the specific locations tested for deer were visited predominantly by white-tailed deer, with the fourth location visited predominantly by mule deer.

Sites on each ranch were separated to eliminate the likelihood that the same animals would visit both sites during any given week. Site separation at testing locations for deer was approximately six miles, and for elk, sites were separated by approximately eight miles and 37 miles on each ranch. Specific site selection criteria included relatively level ground, as little rock as possible, and a history of ungulate use during winter in the specific location. The study period was from October through March during 2004 - 2005, and repeated in 2005 - 2006.

Fence Designs

All four fence designs were modifications of an existing four-strand barbed wire fence. In all designs, half-inch steel rebar was used to extend the height of wooden posts to six feet (Figure1). A half-inch hole was drilled into the center of the post to a depth of six inches, and a 30-inch section of rebar was driven into the hole with a hammer. Corner posts were extended to a height of six feet using a four-foot-long piece of 1.5-inch by 1.5-inch angle iron, which was wired to the post in two locations. All additional wires were attached to wood posts using one inch barbed fencing staples, and attached to steel extensions using 16.5-gauge tie wire.

Design 1 (Figure 2) consisted of adding a single strand of 12-gauge smooth wire between each existing barbed wire and between the bottom barbed wire and the ground. Three strands of 12-gauge smooth wire were added above the existing barbed wire to bring the fence height to a total of six feet. Vertical fence stays were placed on the wires between posts to hold the bottom eight wires at a consistent spacing. Wire spacing was six inches for the bottom eight wires, and eight inches for the top three wires. Rebar extensions were bent at a 45-degree angle toward the outside of the fence.

Design 2 (Figure 3) was identical in wire configuration to the first; the only difference was four strands of additional smooth wire were electrified with a portable charger producing a minimum of four Kv of electricity. The lowest additional strand of smooth wire was not electrified so vegetation would not ground the fence. The next four additional wires were electrified, leaving the top two additional wires non-electric. All barbed wires and the bottom strand of smooth wire were connected to a ground rod driven twelve inches into the soil. Tube insulators were used on electrified wires on wooden posts, and corner insulators were used in each corner. Rebar extensions were bent outward at a 45-degree angle.

FIGURE 1.

FIGURE 2.

FIGURE 3.

Design 3 (Figure 4) had four-foot-high woven wire (6-inch x 6-inch squares) placed over the barbed wire, with the bottom at ground level. Three strands of 12-gauge smooth wire were strung above the barbed wires to bring the total height to six feet. Wire spacing for the three smooth wires was eight inches. Once again, rebar extensions were bent at a 45-degree angle toward the outside of the fence.

Design 4 (Figure 5) had three foot woven wire placed over the barbed wire, with the bottom at ground level. Then, three foot woven wire was strung above existing barbed wire to bring the total height to six feet. Woven wires were tied together using 16.5-gauge tie wire. Due to the stiffness of the woven wire, rebar extensions were left straight in this modification.

Study Design

At each of the eight study sites, five individual, standard four-strand barbed wire fence exclosures were constructed (Figure 6). Each square exclosure was 32 feet x 32 feet. Wooden posts with a four-to-six inch diameter were driven into the ground using a tractor-mounted hydraulic post driver. Above-ground height of each post was 4.5 feet. Corner H braces were assembled, with 16-feet spacing between each. Four strands of 12.5-gauge twisted barbed wire were attached to the posts, with equal spacing of 12 inches between each wire, to bring the total height of the top wire to four feet. Fence stays were used to ensure equal wire spacing between corner assemblies.

Exclosures were constructed in a line parallel to nearest available cover with 10 yards between each exclosure. Four exclosures were then randomly selected to receive one of the four selected fence designs, with the fifth left as a control. Since the study compared modifications to a four-strand barbed wire fence, a non-modified four-strand barbed wire fence was used as the control. Six small square bales (approximately 440 pounds total) of high quality alfalfa hay were then stacked on edge inside each exclosure in a two-wide by three-high pattern as bait.

Exclosures were monitored once weekly from October through March to determine if deer or elk had entered them. All exclosures were monitored for 22 weeks during 2004-2005, and for 24 weeks during 2005-2006. The study was conducted during winter so that animals could be baited into exclosures with a food source. Each exclosure was considered to be breached if there was evidence of any deer or elk entering, including tracks, scat, or consumed hay. Necessary repairs were made to all fences on a weekly basis, restoring them to original condition. Alfalfa hay was replenished as needed every week. By repairing each study site to original condition every week, independence among treatments was maintained. If an exclosure was breached, it was counted as a failure for that period of one week, and unbreached fences were counted as a success. Any exclosure that was breached and had all hay consumed for three consecutive weeks was determined to be a failure for that site for the remainder of the winter, and was no longer repaired or replenished with fresh hay. Controls were baited continuously throughout the study season.

RESULTS

Deer

Pooled data for sites testing efficacy with deer yielded a total of 184 weeks where fences were baited and actively monitored. Of these, the control was breached a total of 126 times. All designs were significantly different from the control. Design 4, with six foot woven wire, was the most consistently effective design for deterring deer throughout the study, with zero failures.

FIGURE 4.

FIGURE 5.

Elk

Pooled data for sites testing efficacy with elk yielded a total of 150 weeks when sites were baited and monitored. Snow drifts greater than three feet deep caused three sites to be temporarily removed from the study during year two. Since the effective height of the fence was less than three feet, and not a valid test of the designs under normal conditions, these weeks were not included in the analysis, resulting in a difference between total number of weeks tested for deer and elk. The control for elk sites was breached a total of 61 times. All designs were significantly different from the control. Design 4, with six foot woven wire, was the most consistently effective design for deterring elk throughout the study, with zero failures. Comparing between designs, differences of Design 1 and Design 3 were not considered to be statistically different. All other designs were statistically different from each other.

DISCUSSION

Cost of materials for Design 1 was approximately $504/mile. Design 2 cost $582/mile, using a portable, battery-operated fence charger. Design 3 cost $1,010/mile, and Design 4 cost $1,359/mile. Cost for all designs exclude the initial four-strand barbed wire fence. All prices are for materials only, and were calculated from retailers in the Bozeman, Montana, area at the time of construction in August 2004. Costs of fencing have traditionally been broken down into materials and labor for installation (Halls et al. 1965; Bryant et al. 1993; Seamans and VerCauteren, 2006; VerCauteren et al. 2006b). In this study, labor was not included in determining cost of fence construction. Labor expenses for fencing are highly variable depending on location, landscape features, type of fencing, and contractors involved. Therefore, only material cost has been calculated for these designs, and should be compared to other fences accordingly.

All tested designs were more effective than controls. There were differences among designs, with some being more effective than others. The six foot woven wire design was the most effective for both deer and elk, but other designs showed some ability to deter ungulates.

The effectiveness of using a six-foot fence height is an important finding from this study. Previously, the most commonly accepted fences for deterring ungulate crossings have been constructed with eight foot woven wire (VerCauteren et al. 2006b). Deer and elk have the ability to jump over fences higher than six feet. (Craven 1983). However, this did not occur during this study using a food resource as bait during winter conditions. This indicates that a desire for food is not enough motivation for an ungulate to jump over a fence of this height. It is a reasonable assumption that the drive to obtain food inside an exclosure will be less if food resources are sufficient outside the exclosure. The results of this study indicate that a fence higher than six feet is not necessary to protect a food source from ungulates, even during harsh winter conditions. The six-foot height is necessary for modifying an existing fence as opposed to construction with all new materials.

Many pastures and crops in Montana and other areas of the west are currently fenced with four-strand barbed wire or woven wire fences to control domestic livestock, particularly cattle and sheep. Few of these fences are higher than four feet, which allow for passage by deer and elk. Typical construction of eight-foot fencing uses 11-foot long wooden posts, set into the ground to a depth of 36 inches. To construct this high fence around a field already fenced to control livestock, the existing fence posts must be replaced with the longer posts. The cost of material and labor to do this is very high.

FIGURE 6.

Extensions to wooden fence posts with an above ground height of four feet were successful in this study at supporting wires in a durable fashion for an additional two feet of height. Modifications can be made to posts with considerably less equipment and effort than setting a new post. By using fence posts already in the ground (instead of replacement posts), cost of the fence modification was reduced greatly. Posts described by Bryant et al. (1993) in the construction of the fence around the Starkey Experimental Forest and Range in Oregon currently cost $23.10 each in Bozeman, Montana. The half-inch steel rebar extensions used in this study cost $0.41 each. Approximately 90 posts are necessary to construct one mile of fence, yielding a savings of $2044 per mile on posts alone to modify a fence. If steel T-posts are in place instead of wood posts, they can also be extended by welding on the rebar or using modifications described by Onstad and Knight (2001).

Another benefit of using an existing fence is that some of the wires already in place can be used in the modification design. Although this study focused on modifying four-strand barbed wire fences, fences for controlling domestic sheep are often constructed using 2.5-foot to four-foot woven wire. This woven wire can be used as part of the modified design, reducing purchase cost of wire.

Not all designs tested in this study should be considered adequate at providing relief from ungulate depredation in all situations. A fence must be cost-effective to produce a desired savings over time, and each individual producer should make decisions based on their unique situation. The results of this study show that Design 4, a six-foot woven wire fence, will be sufficient in most situations for protection of high-value crops and pasturelands. Although it was the most expensive design tested, the cost is low enough compared to potential loss to be cost effective in many situations. Individual landowners may find, however, that a lower-cost design would be more beneficial in their particular situation, despite the lower expected efficacy. Areas where pressure on crops is limited by abundant nearby resources may not require expensive fencing to deter ungulates. Particular pastures that have been set aside for spring livestock forage, for example, may not require expensive fencing to keep elk from foraging if similar resources are available nearby.

Cost of fencing is, perhaps, the most important factor for a landowner to consider when deciding whether or not to implement fencing as an ungulate depredation control method. In order to be cost-effective, the cost of the fence cannot exceed damage losses expected over the lifespan of the fence. Cost-benefit ratios should be calculated considering the expected lifetime of the fence used. By reducing initial cost with designs tested in this study, fencing will become an efficient mechanism for certain producers to lessen depredation losses on forage and cropland. Producers must also calculate maintenance cost when considering whether or not a fence will be cost effective. Maintenance will vary depending on terrain, weather conditions, and vegetation in the area, and should be considered on a case-by-case basis. Additionally, future conditions must be anticipated, and changing ungulate populations or patterns, different crops and changing commodity prices will all need to be considered before choosing to fence an area to prevent wildlife depredation. Computer models and other tools should be used by landowners to help decide whether or not to implement fencing to prevent ungulate depredation (VerCauteren et al. 2006a).

IMPLICATIONS

Modified fencing for deer and elk should be considered for areas that receive a loss in production that justifies the expense of fence construction. Fencing should be limited to specific portions of ranches that receive high economic losses, and not be applied to large expanses of land. Examples of areas that may be beneficial to protect if they are heavily used by deer or elk include grain crops, hay crops, and irrigated, fertilized, or otherwise improved pastures. Landscape-scale application will likely reduce the economic benefit to a point that makes the control economically impractical. The fence designs tested in this study should not be applied to all situations where deer or elk need to be excluded. These designs were developed to maintain low material cost, so they could be economically-practical for agricultural producers. Although no animals penetrated the six-foot woven wire design in this study, it is certainly possible for deer and elk to jump over fences six feet high. In cases where few animals could cause large losses in a short time, more expensive fencing may be justified. Higher-value interests increase the amount of money that can be spent cost-effectively on ungulate control. Where zero tolerance for deer crossings is demanded under all circumstances (such as airports), woven wire fences eight feet high may be justified. Adjacent habitat, other available food sources, the commodity being protected, level of control desired, and cost should all be considered when choosing whether or not to use fencing to deter ungulates, as well as what style of fencing will best attain desired results.

Another consideration for producers using fencing is wildlife passage through their property. Fences should not be constructed in such a manner to interrupt seasonal wildlife migrations or daily movements. Areas less than 640 acres would be appropriate. The length of the fence on any side of a square exclosure this size would be one mile, leaving a deer or elk with a maximum distance of half-mile to travel to circumvent the excluded area around the nearest side of the fence. Both deer and elk are very capable of traveling this distance in a day (Craighead et al. 1973, Nelson et al. 2004). Limiting sizes of fenced areas will allow deer and elk access to necessary habitat throughout the property, while still protecting the landowner's valuable interests. The objective of using these modified fence designs is to reduce monetary damages caused by wildlife, not reduce wildlife numbers on private lands. Landowners have expressed that wildlife damages below $1,000 annually are tolerable, but above that is unacceptable (Brown et al. 1978). In a more recent survey by Conover (1998), 80 percent of farmers indicated that annual losses less than $500 from wildlife were acceptable. By reducing damage done by deer or elk in areas of high value, levels of damage may be reduced to the acceptance threshold. This should increase tolerance for deer and elk on the rest of the farm or ranch.

ACKNOWLEDGEMENTS

This publication is based on the MS thesis of Roy Fenster, 2006, Animal and Range Sciences Department, Montana State University, Bozeman, MT. Research was funded in part by the Jack H. Berryman Institute, the Montana Grazing Lands Conservation Initiative, and the United States Dept. of Agriculture Cooperative State Research, Education, and Extension Service.

LITERATURE CITED

Brown, T. L., D. J. Decker, and C. P. Dawson. 1978. *Willingness of New York farmers to incur white-tailed deer damage.* Wildlife Society Bulletin. 6:235-239.

Bryant, L. D., J. W. Thomas, and M. M. Rowland. 1993. *Techniques to construct New Zealand elk-proof fence.* Gen. Tech. Rep. PNW-GTR-313. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 17 p.

Conover, M. R. 1994. *Perceptions of grass-roots leaders of the agricultural community about wildlife damage on their farms and ranches.* Wildlife Society Bulletin 22:94-100.

Conover, M. R. 1998. *Perceptions of American agricultural producers about wildlife on their farms and ranches.* Wildlife Society Bulletin 26:597-604.

Craighead, J. J., F. C. Craighead, Jr., R. L. Ruff, and B. W. O'Gara. 1973. *Home ranges and activity patterns of nonmigratory elk of the Madison drainage herd as determined by biotelemetry.* Wildlife Monographs 33. 50pp.

Craven, S. R. 1983. Deer. Pages D-23 – D-33 in R. M. Timm, editor. *Prevention and control of wildlife damage.* University of Nebraska Cooperative Extension.

deCalesta, D. S. 1983. Elk. Pages D35 – D-44 in R. M. Timm, editor. *Prevention and control of wildlife damage.* University of Nebraska Cooperative Extension.

Halls, L. K., C. E. Boyd, D. W. Lay, and P. D. Goodrum. 1965. *Deer fence construction and cost.* Journal of Wildlife Management 29:885-888.

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.

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

Nelson, M. E., L. D. Mech, and P. F. Frame. 2004. *Trackingof white-tailed deer migration by global positioning system.* Journal of Mammalogy 85:505-510.

Onstad, C. and J. Knight. 2001. *Fencing to protect stored hay form deer and elk.* Montana State University Extension Service MT200108AG.

Seamans, T. W. and K. C. VerCauteren. 2006. *Evaluation of ElectroBraid fencing as a white-tailed deer barrier.* Wildlife Society Bulletin 34:8-15.

Van Tassel, L. W., C. Phillips, and B. Yang. 1999. *Depredation claim settlements in Wyoming.* Wildlife Society Bulletin 27:479-487.

VerCauteren, K. C., M. J. Lavelle, and S. Hygnstrom (a). 2006. *A simulation model for determining cost-effectiveness of fences for reducing deer damage.* Wildlife Society Bulletin 34:16-22.

VerCauteren, K. C., M. J. Lavelle, and S. Hygnstrom (b). 2006. *Fences and deer-damage management: a review of designs and efficacy.* Wildlife Society Bulletin 34:191-200.

Wagner, K. K., R. H. Schmidt, and M. R. Conover. 1997. *Compensation programs for wildlife damage in North America.* Wildlife Society Bulletin 25:312-319.

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