January 2003

COYOTE-ACTIVATED FRIGHTENING DEVICES FOR REDUCING SHEEP PREDATION ON OPEN RANGE

Kurt C. VerCauteren
USDA-APHIS-Wildlife Services, kurt.c.vercauteren@aphis.usda.gov

Michael J. Lavelle
USDA/APHIS/WS National Wildlife Research Center, michael.j.lavelle@aphis.usda.gov

Steve Moyles
USDA-APHIS-Wildlife Services

COYOTE-ACTIVATED FRIGHTENING DEVICES FOR REDUCING SHEEP PREDATION ON OPEN RANGE

KURT C. VERCAUTEREN, USDA, APHIS, Wildlife Services, National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521-2154, USA
MICHAEL J. LAVELLE, USDA, APHIS, Wildlife Services, National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521-2154, USA
STEVE MOYLES, USDA, APHIS, Wildlife Services P.O. Box 58, Opal, WY 83124, USA

Abstract: Domestic sheep ranching is an important agricultural industry in the United States and coyote (*Canis latrans*) depredation on lambs and ewes continues to challenge ranchers and agencies responsible for protecting sheep. Lethal methods used in controlling coyote depredation include aerial gunning, toxicants, trapping, and calling and shooting. Nonlethal methods include frightening devices, fences, livestock protection animals, and stringent husbandry practices. Ranchers and agencies responsible for controlling coyote depredation need frightening devices that are more effective than those currently available. We describe a field evaluation of 2 animal-activated frightening devices: an acoustic device and an acoustic device with a pop-up scarecrow and strobe light. We conducted the evaluation on open range in western Wyoming during the lambing period. No coyote kills were reported during 6,087 sheepnights at 3 sites protected by the acoustic devices or during 6,598 sheepnights at 3 sites protected by the acoustic scarecrow devices. Our devices show promise for reducing predation during the lambing period and merit further evaluation.

Key words: Canis latrans, coyote, frightening device, livestock, predation, sheep, wildlife damage management

Proceedings of the 10th Wildlife Damage Management Conference. (K.A. Fagerstone, G.W. Witmer, Eds). 2003

INTRODUCTION

Sheep ranching is a large and economically important part of American agriculture. For generations, sheep ranchers have struggled with coyote predation, especially during lambing. In 1999, 60.7% of all sheep and lamb losses to predators were attributed to coyotes, with losses totaling nearly $10 million (United States Department of Agriculture 2000). In many cases, wildlife management professionals with the United States Department of Agriculture, Animal Plant and Health Inspection Service, Wildlife Services (WS) work to reduce coyote predation on sheep by employing lethal methods such as aerial gunning, calling and shooting, denning, snaring, trapping, and the use of toxicants (M-44s and Livestock Protection Collars).

Many nonlethal strategies are also used in attempts to reduce coyote depredation on sheep, but additional strategies are needed. In 1999 alone, sheep ranchers spent nearly $9 million on nonlethal methods to reduce losses to predators (United States Department of Agriculture 2000). A common husbandry practice employed to help reduce losses is to bed sheep in congregated flocks near the camp of a herder. Livestock protection dogs can also be effective in reducing sheep predation (Pfeifer and Goos 1982, Green et al. 1984, Andelt 2001). Livestock protection dogs stimulate many of a predator's senses including sight, hearing, and smell. They also pose a physical threat to coyotes attempting to prey upon protected livestock. Factors including purchase and maintenance costs, training time, liability issues, required daily attention, and mortality are drawbacks associated with dogs that not all livestock producers are willing to incur. Llamas and donkeys have also been employed to deter coyotes with some success (Andelt 2001).

Sheep ranchers, herders, and wildlife managers have employed a variety of frightening devices situated near flocks in attempts to frighten coyotes. The novel sights and sounds of frightening devices may reduce predation, though usually only for short periods of time. Devices employed include blaring radios, tarps blowing in the wind, scarecrows, old automobiles, propane exploders, and Electronic Guards. Of these, only Electronic Guards have been scientifically evaluated. Electronic Guards are frightening devices that are activated approximately every 8 min during hours of darkness and emit a shrill siren and strobe light for about 30 sec (United States Department of Agriculture 1992). They are designed to be hung from posts or trees near or within sheep bedding areas and reduce predation on ewes and lambs. At an average density of one device/10 acres, Electronic Guards are effective for an average of 91 nights before coyotes habituate to them and resume killing sheep (Linhart 1984).

Researchers recommend intermittent and varied audible signals (Linhart et al. 1984) and several types of stimuli (Kohler et al. 1990) to slow coyote habituation. Devices that activate only in the presence of offending animals have the potential to be effective for longer periods of time (Gilsdorf 2002, Beringer et al. 2003). Our goal was to evaluate the effectiveness of 2 animal-activated frightening devices (1 acoustic and 1 acoustic with a strobe light, and pop-up scarecrow) for reducing predation on ewes and lambs on open range during the lambing period. Both devices had been evaluated previously on white-tailed deer (Odocoileus virginianus) in agricultural settings (Gilsdorf 2002, Beringer et al. 2003). We hypothesized that predation rates would be lower on sheep protected with these devices than on unprotected sheep. Our animal use methods were approved by the WS, National Wildlife Research Center's Institutional Animal Care and Use Committee. Reference to trade names does not imply United States government endorsement of commercial products or exclusion of a similar product with equal or better effectiveness.

STUDY AREA

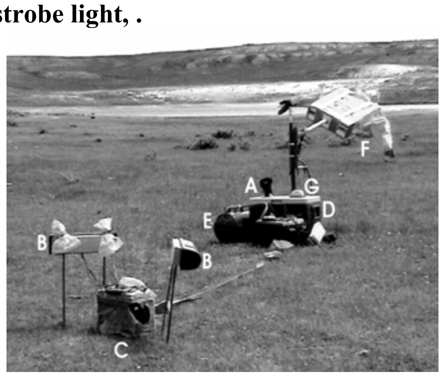
We conducted the evaluation on United States Department of Interior, Bureau of Land Management (BLM) property in northeast Lincoln County, WY, USA. The area was arid and predominately a sagebrush (*Artemesia* spp.) community interspersed with small stands of aspen (*Populus tremuloides*). The area was leased by a private rancher for grazing livestock.

MATERIALS AND METHODS

We evaluated 2 animal-activated frightening devices: an acoustic device (AD) (Figure 1), and an acoustic scarecrow device (ASD) (Figure 2). Both devices included a compact disk (CD) player (Aiwa CDC-X217, Aiwa Co. Ltd., Tokyo, Japan or Pioneer DEH-23, Pioneer Corporation, Muar, Johor, Malaysia) and an all-weather speaker (Lohman, Outland Sports, Neosha, MO). They were triggered by infrared-beam sensors (HF-50 and HF-200, PULNiX America, Inc., Sunnyvale, CA). Power was supplied by 12-volt deep-cycle marine batteries, 3 for AD systems and 4 for ASD systems. The ASD device included additional visual stimuli consisting of a pop-up scarecrow illuminated during nighttime hours by a strobe light. The pop-up scarecrow operated on compressed air released by a valve from a high-pressure storage tank (65–100 p.s.i.). The scarecrow, clad in a bright-yellow rain jacket, reclined until the device was triggered, then instantly rose to a height of 1.5 m while the CD played and the strobe light flashed for 30 sec.

Figure 1. Animal-activated acoustic frightening device evaluated in protecting domestic sheep from coyote predation, Wyoming, 2002. A. All-weather speaker, B. infrared sensors, C. 12-V battery, and D. CD player in protective case.

Figure 2. Animal-activated acoustic frightening device with added pop-up scarecrow and a strobe light evaluated in the protection of domestic sheep from coyote predation, Wyoming, 2002. A. All-weather speaker, B. infrared sensors, C. 12-V batteries, D. CD electronics in protective case, E. high-pressure air storage tank, F. scarecrow, and G. strobe light, .



We installed the AD or ASD at the apex of 2 infrared beam systems. We set the dual, parallel infrared-triggering beams at coyote chest height (45 cm). The systems were positioned to protect 50–100 m of 2 borders of a flock (Figure 3). When both beams were broken simultaneously, the CD player randomly selected and played 1 of 32 audio tracks. The tracks consisted of sounds likely to elicit fear in coyotes (e.g., aggressively barking dogs, shotgun barrages with human shouts, trumpet revelry, helicopter gunships, etc.) (Beringer et al. 2003). We monitored and maintained the devices at least every other day to be sure they were functioning properly. Maintenance included replacing batteries when voltage was low (<12V), refilling air tanks when <65 p.s.i., and testing device function.

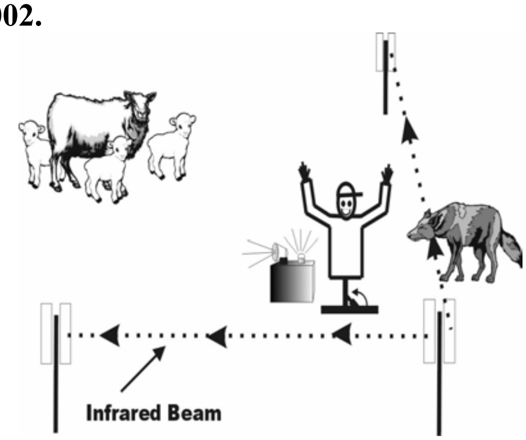
We initiated the evaluation at the beginning of the lambing period (29 May 2002) and continued until docking (9 July 2002), when lambing rates and mortalities were assessed. Approximately 4,500 ewes were divided among 8 flocks, each with a herder. The number of ewes/flock ranged from 490–571 and increased to 1,052–1,425 sheep (ewes and lambs) by the end of the lambing period. We randomly assigned 3 of the flocks AD systems, 3 ASD systems, and the other 2 flocks served as controls. For flocks assigned a frightening device system, sheep in sub-flocks bedded within 50 m of a system were considered protected and sub-flocks bedded farther away were considered unprotected. All sheep in the control flocks were also considered unprotected.

We used "sheepnights" as our unit of measure, defined as: the number of sheep available to be predated each night. Thus, if 20 sheep were available for 5 nights, it represented 100 sheepnights. We knew the number of pregnant ewes in each of the 8 flocks when they were put on the lambing grounds (29 May 2002). We also knew the total in each flock (ewes and lambs) at the time of docking (9 July 2002). The number of ewes in each flock initially was then subtracted from the final total in each flock, leaving a change in animals over the evaluation period. To establish a population growth rate for each flock, this value was divided by 39, the total number of nights during the evaluation period. The population growth rate was used to calculate the approximate sheep population within each flock for each night. For flocks with frightening devices, we subtracted the known number of sheep the herder bedded near the frightening device from the flock estimate to determine how many were unprotected. We tallied sheepnights by summing the number of protected and unprotected sheep over the course of the evaluation.

We calculated predation rates based on the number of sheep killed and our sheepnight totals. We also quantified the economic benefit of the frightening devices by applying the predation rate we calculated for unprotected sheep to number of protected sheep to estimate the number of sheep "saved" (Linhart et al. 1992). We then used sheep values from the United States Department of Agriculture – Colorado, Mountain area and western United States sheep market report for 20 September 2002 at $81.50/animal to calculate the value of the sheep saved.

We consulted with herders on placement of the systems and installed them in locations that were convenient for bedding sheep. We relocated the systems whenever herders needed to move their sheep to new grazing areas. We instructed herders to bed as many of their sheep within the beams of the system as possible each night (Figure 3), and record the number of sheep bedded near each system. Each herder camped at the center of their assigned grazing area and tended their flocks daily throughout the lambing period. They located any dead sheep and we determined the cause of death to predatory species for predated sheep. On open range situations, locating carcasses is difficult (Lindzey and Wilbert 1989) and it is estimated that only 50% of all kills are found. We doubled all sheep kill totals in order to incorporate kills not located.

Figure 3. Frightening devices were set up to protect 2 sides of a flock of domestic sheep from coyote predation, Wyoming, 2002.

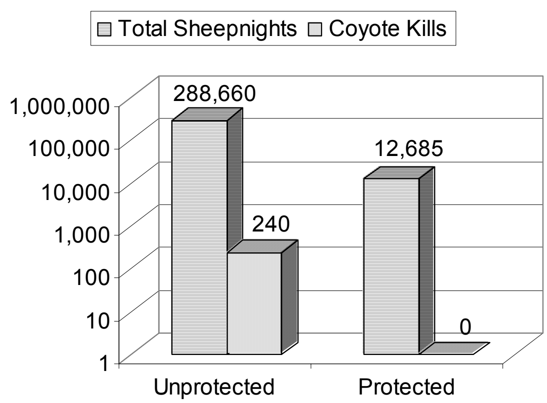


RESULTS

On nights that systems were used, an average of 130 (n = 97, SE = 9.55) sheep were bedded by a system, representing 17% of a herder's flock. A total of 12,685 protected sheepnights (6,087 with the AD device and 6,598 with the ASD device) and 288,660 unprotected sheepnights were recorded.

Herders found a total of 354 sheep killed by predators during the evaluation. We doubled this total (708) to take into account the kills not found. We identified 120 (240) of these to be coyote kills on unprotected sheep and 0 on protected sheep (Figure 4). The remaining kills were attributed to other species including common raven (Corvus corax) (60.7%), golden eagle (Aquila chrysaetos) (36.8%), and red fox (Vulpes vulpes) (2.6%); none of these kills occurred near our systems. The 240 coyote-killed sheep represented a loss of 2% of the entire flock of 11,242 sheep. The overall loss of sheep to predation by all species equated to 6% of the entire flock. The coyote predation rate for unprotected sheep was 0.08% (240 kills during 288,660 sheepnights). No sheep were killed within the protected areas; therefore, the predation rate for protected sheep was 0.00%. We achieved this 0.00% predation rate for 22 nights during the peak of the lambing period. Based on the predation rate for unprotected sheep, our devices saved 11 sheep, worth a total of $896.50.

Figure 4. Number of sheepnights and coyote kills for unprotected and protected sheep, Wyoming, 2002.



DISCUSSION

Variability among levels of cooperation with different herders could influence perceived efficacy of the devices. Increased diligence by herders to consistently use the systems, more portable and easier to use systems, an increased number of systems, and increasing the size of the area protected by each system would all serve to increase the percentage of flocks protected. Likely, this would serve to further decrease coyote predation. Once bedded, sheep usually stayed near the systems until morning. The sheep exhibited little or no response to the systems, even when they triggered them (Figure 5).

Figure 5. Sheep exhibited no response after triggering animal-activated acoustic frightening devices, which were designed to reduce coyote depredation, Wyoming, 2002.

In their current experimental form, our systems would likely be most practical for use where sheep are kept in fenced pastures and bedded in the same locations each night. The devices are not quickly installed and bulky to move, partially because they require three or four 12-V deep-cycle batteries, each weighing 27 kg. Daily attention was required to ensure adequate air pressure, because > 65 p.s.i. was needed to erect the pop-up scarecrow.

Animal-activated frightening devices that stimulate several senses in a non-routine manner have more potential than single-stimuli, routinely-activated devices. In previous research, a variation of the ASD system proved effective in providing protection to soybean fields from white-tailed deer in Missouri (Beringer et al. 2003) while a variation of the AD system was ineffective for protecting corn from white-tailed deer (Gilsdorf 2002). In our evaluation, the devices were equally effective: no sheep were killed when bedded by either system.

When protecting ewes and lambs on open range during the lambing period, the goal is to utilize a system that will provide protection throughout this most vulnerable time. The lambing period lasts from 30–40 days (Bill Taliaferro, Personal Communication), and based on our results and those of Linhart (1984) and Linhart et al. (1984, 1992) with Electronic Guards, we believe that the AD and ASD systems are effective. It is likely that our devices would be more effective than Electronic Guards. The AD and ASD are activated only in the presence of animals, they broadcast a variety of alarming sounds, and the ASD incorporates visual stimuli along with acoustic stimuli. No kills were reported near our systems during the evaluation period (22 nights); therefore, we saw no evidence of habituation to either system. Animal-activated frightening devices have the potential to play a role in minimizing sheep predation. These devices could be a component of an integrated coyote damage management strategy that includes lethal control in its various forms. Additional evaluation of these systems during the lambing period and on enclosed pastures, as well as summer, high-country range, is merited.

ACKNOWLEDGMENTS

We thank Megan McLachlan for helping in the field. We are also indebted to the rancher and sheepherders for their cooperation and participation.

LITERATURE CITED

ANDELT, W.F. 2001. Effectiveness of livestock guarding animals for reducing predation on livestock. Endangered Species UPDATE 18:182-185.

BERINGER, J., K.C. VERCAUTEREN, AND J. MILSPAUGH. 2003. Evaluation of an animal-activated scarecrow and a monofilament fence for reducing deer use of soybean fields. Wildlife Society Bulletin 32:in press.

GILSDORF, J.M. 2002. Effectiveness of frightening devices for reducing deer damage to corn fields. MS Thesis, University of Nebraska, Lincoln, NE, USA.

GREEN, J.S., R.A. WOODRUFF, AND T.T. TUELLER. 1984. Livestock-guarding dogs for predator control: costs, benefits, and practicality. Wildlife Society Bulletin 12:44-50.

KOHLER, A.E., R.E. MARSH, AND T.P. SALMON. 1990. Frightening methods and devices/stimuli to prevent mammal damage-a review. Proceedings of the Vertebrate Pest Conference 14:168-173.

LINDZEY, F.G., AND C. WILBERT. 1989. Estimating domestic sheep losses to mountain lions. Great Plains Wildlife Damage Control Workshop 9:27-31.

LINHART, S.B. 1984. Strobe light and siren devices for protecting fenced-pasture and range sheep from coyote predation. Proceedings of the Vertebrate Pest Conference 11:154-156.

_____, R.T. STERNER, AND J.W. THEADE. 1984. Efficacy of light and sound stimuli for reducing coyote predation upon pastured sheep. Protection Ecology 6:75-84.

_____, G.J. DASCH, R.R. JOHNSON, J.D. ROBERTS, AND C.J. PACKHAM. 1992. Electronic frightening devices for reducing coyote predation on domestic seep: efficacy under range conditions and operational use. Proceedings of the Vertebrate Pest Conference 15:386-392.

PFEIFER, W.K., AND M.W. GOOS. 1982. Guard dogs and gas exploders as coyote depredation control tools in North Dakota. Proceedings of the Vertebrate Pest Conference 10-55-61.

UNITED STATES DEPARTMENT OF AGRICULTURE. 1992. Directions for using the "electronic guard" ("EG") to scare coyotes from sheep pastures and bed grounds. USDA Pocatello Supply Depot, Pocatello, ID, USA.

UNITED STATES DEPARTMENT OF AGRICULTURE. 2000. Sheep and goats predator loss. National Agricultural Statistics Service, Washington D.C., USA http://usda.mannlib.cornell.edu/, (24 September, 2002).