Livestock Control with Electrical and Audio Stimulation

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Conflicts between livestock and other users of rangelands in riparian areas are forcing resource managers and ranchers to find better ways to control livestock distribution. Current control techniques involve extensive fence construction, including corridor fences along riparian areas.

Radio-activated electrical stimulus is an alternative to traditional fencing to control cattle distribution. Our hypothesis was that cattle could be trained to respond to electrical stimulus to avoid an area (aversion area) that would be defined by a signal from a radio transmitter. In practice, the animals to be controlled would wear a collar containing a radio receiver and an electrical stimulator with contacts touching the animal's skin. When a collared animal moves into the aversion area, the transmitter signal activates the receiver in the collar, and an electrical stimulus is applied to the animal. If the animal remains in the aversion area, the stimulus is repeated at periodic intervals until the animal leaves the aversion area. As a safety factor, the receiver would be designed to stop the electrical stimulus if it exceeded a predetermined length of time.

An abundance of literature focuses on the behavior of domestic livestock (Arnold and Dudzinski 1978, Fraser 1985, Hafez 1975) but little on learning by cattle in the range environment (Kiley-Worthington and Savage 1978). Albright et al. (1966) demonstrated that dairy cattle respond to and can be herded with auditory stimulus. Karn and Lorenz (1984) successfully used electrical stimulation to separate range cattle into groups for supplemental feeding. Aversive training with audio and electrical stimuli is an accepted and successful technique for training dogs (Tortora 1982) and has recently been used to train cutting horses (personal communication Chad James, Tri-tronics Inc., Tucson, Arizona).

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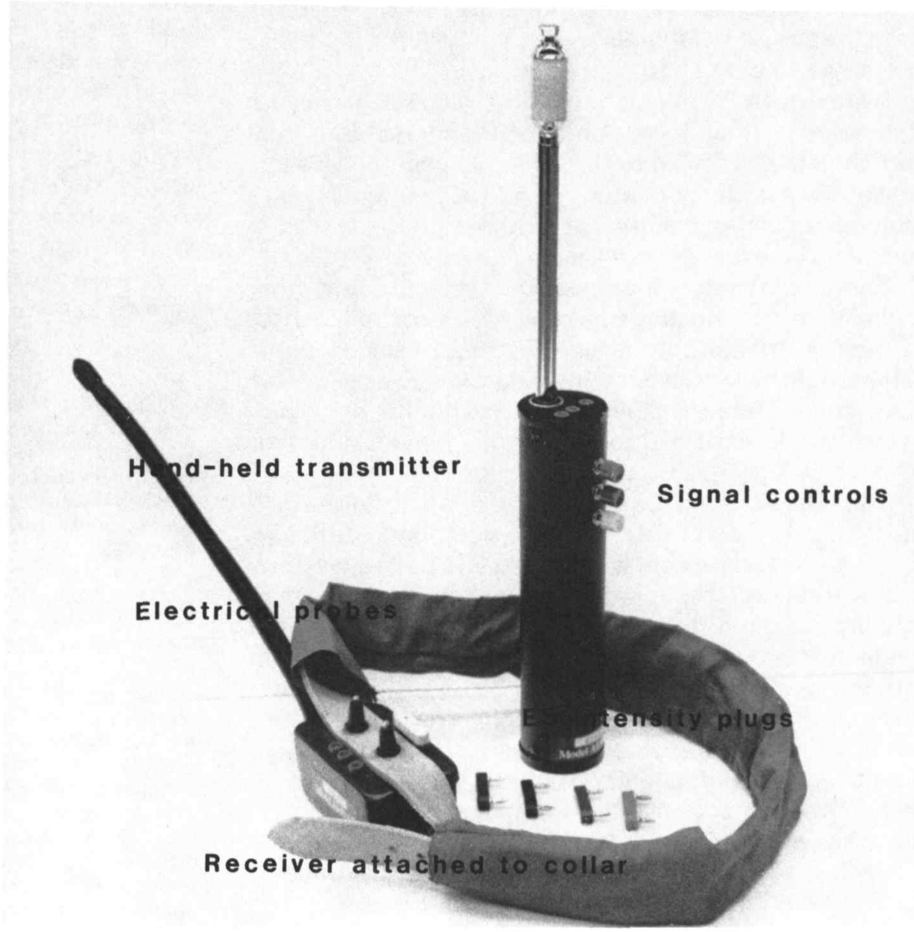

Fig. 1. *Radio transmitter and receiver used to apply audio-electrical and audio stimulation.*

Methods

Four yearling Hereford steers weighing about 650 pounds each were used in all experiments. These animals had been grazing with other yearlings in pastures bounded by electric fences. The study area was at the Oregon State University, Eastern Oregon Agricultural Research Center at Union, Oregon.

We used four Tri-tronics A1-90[1] remote trainers designed for dogs (Fig. 1). A training unit consisted of a hand-held transmitter and receiver mounted on a collar with two probes that emitted electrical stimuli. Each training unit operated on a separate frequency to individually control each receiver. This model training unit

[1]The use of trade name does not imply endorsement or approval of any provided product by the USDA Forest Service to the exclusion of others that may be suitable.

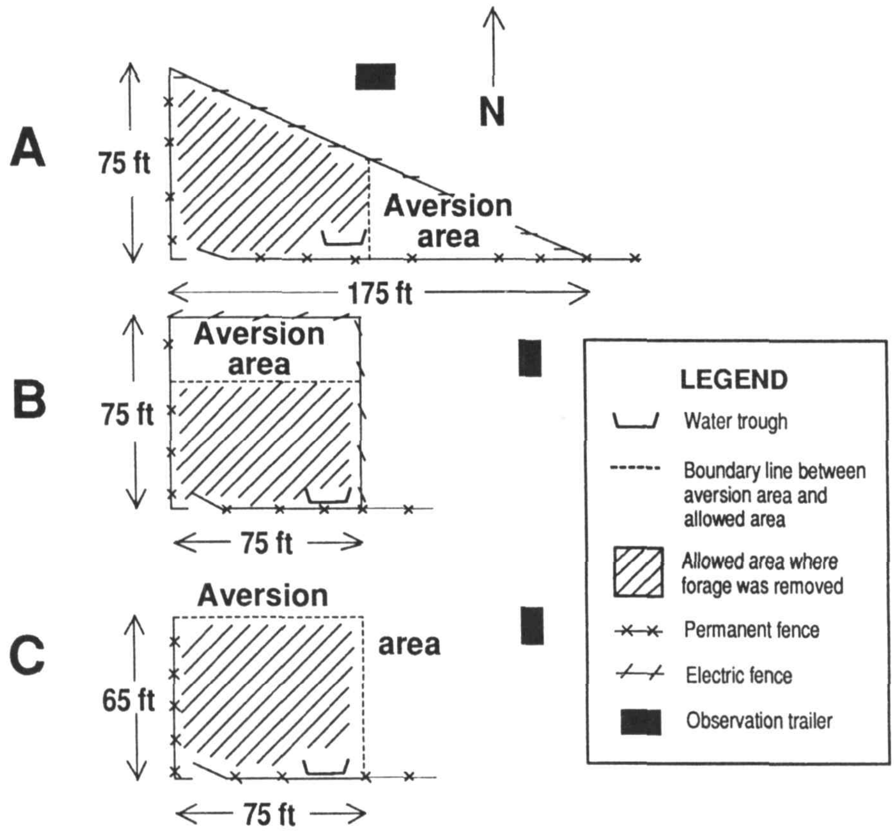

Fig. 2. *Pasture configurations used in training and testing steer response to audio-electrical stimulation: A. Training area. B. Trial pasture. C. Fenceless trial pasture.*

provided two audio signals and one level of electrical stimulation. The electrical stimulation was provided by rapid discharge of a capacitor across two probes on the inside of the collar.

Receivers were designed to provide a warning audio stimulation, an audible buzz tone, when one button was pushed on the remote transmitter. A short-buzz audio stimulation was followed by an electrical stimulation when the second button was pushed. The electrical stimulation could not be executed independently. The equipment thereby provided an audio-electrical stimulation.The audio stimulation had a constant tone and volume, but the electrical stimulation intensity could be varied through five levels—with level one the least intense and level five the most intense. Each receiver had a safety mechanism to terminate electrical stimulation after 10 seconds, a feature designed to prevent injury.

The first step was to determine the animal's response to the equipment and to determine the appropriate electrical stimulus level. The second step was to determine the response of the test animals to aversion training. The third step was to determine the results of the aversion training in a simulated real-pasture setting. Visual observations of animal behavior were documented with a video camera.

The desired behavior was to have the test animals change their direction of travel away from the aversion area. The level of electrical stimulation was to be sufficient to create this response and no greater.

Animal Response

Each animal was fitted with a collar of a different color to identify individuals and an electrical stimulation intensity of either two, three, four, or five. The collars were snugly fitted to the animals' necks. The collars fit the narrowest portion of the neck with no apparent effect on eating, drinking, or breathing. Each collar was adjusted so that the electrodes remained in contact with the skin below the animal's jaw on the lower side of the neck.

After the steers were collared, they were herded into a small corral. The steers appeared to adjust to the collars within five minutes. We began with the level two electrical stimulation. This level caused the steer to lower its head, bawl, jump forward, and run. This was a more dramatic response than anticipated, indicating that level two was too high. Two steers were refitted with level one electrical stimulation plugs and two with level two plugs. The animals showed only mild responses to level one and level two electrical stimulation, such as laying their ears back and not moving. We have no explanation for the first steer's initial reaction to level two electrical stimulation, but it was obvious that level two was inadequate. We changed the plug levels to three and four with two steers in each level. At level three the steers shook their heads and laid

Table 1. Animal response to audio-electrical stimulation.

Category	Day 1	Day 2	Day 3	Day 4	Total	% correct
	Correct response/incorrect response[1]					
Steer 1	1/1	2/0	15/1	8/0	28/2	93
Steer 2	1/0	2/0	27/0	17/0	47/0	100
Steer 3	2/0	4/0	16/0	4/0	26/0	100
Steer 4	1/0	5/1	13/1	12/0	33/2	94
Total	5/1	13/1	71/2	41/0	134/4	
% correct	83	93	97	100	97	
Hours steers were in pasture	4	6	7	3	20	
Hours of recorded observations	4	5	6	3	18	

[1]Correct response = animal left the aversion area and returned to the allowed grazing area. Incorrect response = animal remained in the aversion area after receiving AES.

their ears back. Level four electrical stimulation consistently caused the animals to turn about 90 degrees and jump. All electrical stimulation levels were changed to level four, and tested twice more. All steers responded in the same manner, and level four electrical stimulation was selected for the grazing trials.

During these trials, the steers seemed to associate the audio stimulation buzz with an electrical stimulation that followed. The audio stimulation caused them to lay their ears back. This observation indicated that audio stimulation alone might be used to control cattle distribution.

Training

A 0.1-acre triangular training area was established in a pasture where two sides were permanent fences joined at a 90 degree angle and the third side was an electric fence (Fig. 2a). Forage was uniformly distributed and water was available. About one-third of the pasture, including the narrowest end, was designated as the aversion area. The aversion area was defined by an imaginary line identified by landmarks outside the training area. Because the aversion area narrowed to a point, it was speculated the animals would recognize that moving further into the aversion area would reduce their options for escape.

Feed was taken away from the test steers about 12 hours before the trials to encourage feeding activities during our observations. The steers entered the training area in the "allowed" access portion of the pasture and explored and grazed at will. As soon as a steer moved into the aversion area, the observer administered an audio electrical stimulus. If an animal continued further into or did not leave the aversion zone, it was given additional stimulation at about 5- to 10-second intervals. Each audio electrical stimulus provided an electrical stimulation of five seconds or less.

The first steer entered the aversion area within two minutes of entering the training area and was subjected to audio electrical stimulation. The steer jumped forward and ran further into the aversion area. A second signal was applied, and the steer ran into the narrow neck of the aversion area. A third signal was given, and the animal turned quickly and ran out of the aversion area. A second steer entered the aversion area before the first steer exited and was also given an audio electrical stimulation signal; the second steer spun and ran out just ahead of the first steer. Both of these animals were again grazing with 10 seconds after the last audio electrical stimulation. The steers were observed and received audio electrical stimulation signals as necessary for the next 4 hours. During the first afternoon of training, two steers received stimulations twice and two steers once (Table 1). Following the initial audio electrical stimulations to the first steer, only one signal was administered for each entry in the aversion area because the steers immediately returned to the allowed area. After 4 hours of training, the steers were returned to the holding corral and provided a bale of hay.

There was an abundance of forage in the allowed area and the steers had no incentive to go into the aversion area. To accelerate training, most of the forage was removed from about two-thirds of the allowed area.

The next morning (day 2), the steers were returned to the training area after the excess forage was removed. The animals grazed slowly toward the aversion area and received an audio electrical stimulation when they entered the forbidden area. After each audio electrical stimulation they generally turned about 90 degrees and continued to graze outside the aversion area. In some instances they took one step backwards, turned, and continued to graze. It appeared they were treating the aversion boundary as a barrier. The animals behaved in a predictable manner, and only one steer responded incorrectly and received a second audio electrical stimulation before he exited the aversion area (Table 1).

Trial Pasture

On day 3, the training area was reconfigured into a 0.1-acre rectangle with permanent wire fences on two sides and electric fences on the other two sides (Fig. 2b). The allowed grazing area of the training pasture was retained as the allowed grazing area for the newly configured trial pasture. The aversion area was the north one-third of the trial pasture. The intent was to remove the narrowing feature of the training area and provide a new aversion area to determine if the steers had learned to respond correctly to the audio electrical stimulation or if they had only learned the location of the aversion boundary.

Steer response was essentially the same as observed in the training area. Two steers each responded once to one stimulation signal by moving forward further into the aversion zone—an incorrect response; but when given a second signal, they responded correctly by turning and exiting the aversion area. During the 6 hours of observations recorded on day 3, 97 percent of the responses to audio electrical stimulation signals were correct (Table 1).

Fenceless Trials

Advanced trials were conducted on the afternoon of day 3 and the morning of day 4. We removed the electric fences from two sides of the trial pasture and left the permanent fences on the other two sides (Figure 2c). The allowed grazing area remained about the same size, and the aversion area was the rest of the pasture—about 50 acres. As the cattle grazed into the aversion area, they received an audio electrical stimulation signal. The four steers were kept in the allowed grazing area with only an occasional signal. The animals appeared to accept the invisible barrier and responded in the desired manner whenever audio electric stimulation was applied (Table 1). When a steer moved into the aversion area it received a signal and turned away from the line of travel, took a step backward or sideways, and continued grazing within 10 seconds. There was no apparent deterrent to the animal's grazing behavior, only the location of the grazing.

After we completed our observations on day 4, we examined the steers' reactions to only audio stimulation for a 1-hour observation period. The audio stimulation alone was applied as the animals crossed into the aversion area. In all instances the animals responded as though they had received audio electrical stimulation. Their reaction was to turn, step away from the aversion area, and continue grazing. Occasionally, when two steers were grazing together and only one steer received audio stimulation, both animals would respond by changing direction and moving away from the aversion area. This same behavior was also observed during audio electrical stimulation trials.

Conclusions

Cattle can be trained to avoid an area without a fence-defined boundary by using a remotely controlled audio electrical stimulation. After less than 2 days of training, the four steers responded to the signals in the desired way. Although the steers responded to audio stimulation in the same way, we did not determine the length of time the steers retained their learned response to audio stimulation. We observed no adverse affects because the steers resumed grazing soon after receiving either audio electrical or audio alone.

Electrical stimulation may have the potential to control livestock distribution and to reduce the costs of fencing and herding if cattle respond in the same manner under range grazing conditions. Audio-electric stimulation may be an economical alternative for controlling livestock in riparian areas (where corridor fencing is the standard practice), forest regeneration sites, and other areas sensitive to grazing. Fenceless livestock control also has aesthetic appeal as an alternative to barbed wire or other fences. Such a method could be made essentially invisible by camouflaging the transmitter. Further research is needed on equipment development, effective training methods, and retention of audio stimulation training.

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President's Notes (cont'd)

second annual meeting this fall. It will happen about the first of November and Rich Duesterhaus will take the lead in arranging and hosting this year's event. Good things are growing out of the rather loose alliance so far. Not only are we sharing in ways to enhance our professionalism, but we also have generated a much broader based support for range management funding.

Boost for Range Research

Another opportunity I had in D.C. was to participate in a day's activities sponsored by the National Research Council's Board of Agriculture. The Board invited about 20 professional societies to participate in discussions on the National Research Initiative. I used that opportunity to get up to date on well-orchestrated efforts to promote research funding. Range Research is an integral part. I also took the opportunity to visit with four Congressmen and Senators to specifically promote Range Research funding. From a global perspective Range Research is critical to mankind and I am proud to be working to this end. I was graciously received.— **Rex Cleary,** President, SRM