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Containment of Free-Ranging Goats using Pulsed-Radio-Wave-Activated Shock Collars

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ABSTRACT

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Goats (*Capra hircus*) are useful for brush and weed control. Their usefulness would be enhanced if their distribution on grazing land could be controlled without herders or permanent fencing. The feasibility of using electric shock collars to restrict the range of grazing goats was evaluated. Electric shock collars developed for canine control were tested as an alternative method for unattended containment. Shock collars effectively contained goats within the designated test area. Goats not wearing the shock collars remained close to the collared goats due to herd instinct, and thus also remained within the test area. Preliminary results indicate that the non-visual fence may make it feasible to develop commercial weed-grazing goat herds restricted to weed infestations by electric collars.

INTRODUCTION

Goats have been used effectively for weed control in New Zealand (Gray, 1984; Radcliffe, 1985), Australia (Vere, 1979; Holmst, 1980) and Brazil (Shelton and Figueiredo, 1981). They have been used to clear brush from fire breaks in California (Green et al., 1979; Sidahmed et al., 1981) and to convert Arizona chaparral to grassland (Knipe, 1982). Goats are traditionally incorporated into multi-species grazing strategies with sheep and cattle to maximize grazing efficiency, due to the variation in forage preference of the three species (Merrill and Taylor, 1981; Squires, 1982; Urness and Jensen, 1983; Warren et al., 1984).

Leafy spurge (*Euphorbia esula* L.) is the most troublesome rangeland weed in Montana (Lacey et al., 1985). It is uneconomical to control large infestations with herbicides, so many ranchers have turned to sheep for control by grazing (Landgraf et al., 1984). Goats also graze leafy spurge, but they are not commonly used to control the weed because they are relatively more difficult

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to contain and need herders to prevent wandering (Harrington, 1982). The cost of herders limits cost-effective weed control with goats.

The Invisible Fence System (The Invisible Fence Co., Wayne, PA 19087, U.S.A.) is presently being used for containment of domestic dogs. A small radio receiver, mounted on a collar, emits a 37-Hz warning tone if a dog enters a radio field, followed in time by a mild shock pulse of 65 V at 45 mA if the collared animal fails to retreat from the radio field. The 10 Khz radio field is generated by a 12-V battery and is transmitted through a single strand of insulated 14-gauge wire. The wire can be laid out in any geometric shape and is laid on or under the ground surface.

This study was initiated to determine if an electric shock produced by the Invisible Fence System would contain untended goats grazing leafy spurge.

METHODS

Training

Shock collars were purchased and placed on 6 randomly selected Spanish meat-type goats of mixed age and sex. The goats were placed in a 30×30-m area enclosed with a 1.5-m-tall snow fence. A single strand of insulated wire was placed on the fence and energized so that the collars would receive the pulsed radio signal at a distance of 3–4 m from the wire. Training lasted 5 days before the field grazing studies were initiated.

Field grazing

Individual identification numbers 30 cm tall were painted on the rib cage of the 6 collared and 5 uncollared goats. The animals were placed in a square area 70×70 m in size, heavily infested with leafy spurge, 11 km south of Whitehall, MT. The 4900-m^2 containment area was delineated by electric wire laid on the ground. The success of goat containment was measured by recording the location of each animal as being either in or out of the containment area 6 times daily, at 10.00, 12.00, 14.00, 16.00, 18.00 and 20.00 h each day, for 12 consecutive days starting on 28 June 1987. A rectangular pen 2 m wide and 4 m long housed the goats from 20.00 until 08.00 h. The goats were free to roam. Salt and water were provided ad libitum.

Leafy spurge utilization was monitored. The percent flowering leafy spurge stems per m^2 was measured daily in 50 randomly selected areas, 25 within and 25 outside the containment area.

A second grazing study was conducted from 20 July to 3 August 1987 at a field site east of Bozeman, MT. Ten additional Spanish meat-type goats of mixed age and sex were obtained locally, and five were collar-trained as previously described. This experiment was identical to the initial experiment in

animal and plant sampling except that data on the location of the goats were recorded hourly from 08.00 until 18.00 h for 15 days. Collars were permanently removed from one goat every third day in an attempt to estimate the minimum ratio of collared to uncollared goats needed to achieve containment.

RESULTS AND DISCUSSION

Collar training

Goats were rapidly trained to the shock-collar system. Six collared goats were placed in the training pen. After several minutes the system was activated and the goats moved quickly and randomly in response to shocking. They received from 4 to 6 shocks per animal over a period of about 5 min before moving to the middle of the square pen. After approximately 20 min they began walking slowly around the pen. When the collared goats entered the transmission zone the collars emitted a beeping tone following in 2 s by a mild shock, which caused immediate retreat from the transmission wire. Within 30 min the relationship between tone and shock was apparently learned and no further shocking was observed. The intensity of the shock caused only momentary discomfort and at no time did the animals display symptoms of significant pain. During collar training the goats were fed hay and a pelleted concentrate. Twice a day the goats were hand-fed pellets. The person feeding the pellets would back up slowly into the radio field transmission zone to test the collar system. None of the goats would endure a shock to obtain the concentrate.

During the first training session several goats avoided the shocks by extending their necks upward and to the side to dislodge one or both of the electrodes which protrude through the leather collar. To remedy the situation, a small area of the neck of each collared goat corresponding to the electrode contact area was shaved and the collars were tightened to ensure firm skin contact of both electrodes.

Two separate goat herds of mixed age, sex and origin were assembled for the experiments. In both groups animals were randomly selected for collar training. During collar training one goat in each group did not avoid the shocks so the collar was removed and an additional animal was selected for training. The untrainable goats would remain motionless during shocking and appeared to be unable to retreat. It appears, then, that some goats cannot be successfully trained to the collar system with this method.

Goat containment

None of the six collared goats left the containment area during the initial study, which consisted of a 12-day grazing period (Fig. 1). The uncollared goats were not constrained by the wire, and spent 15% of the time grazing

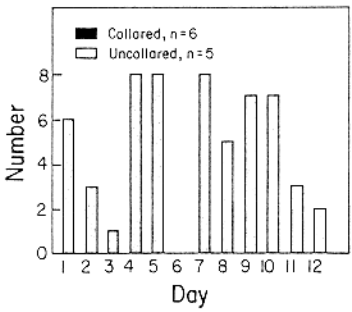

Fig. 1. Number of escapes per day of 6 collared and 5 uncollared goats from an area delineated by a pulsed radio signal.

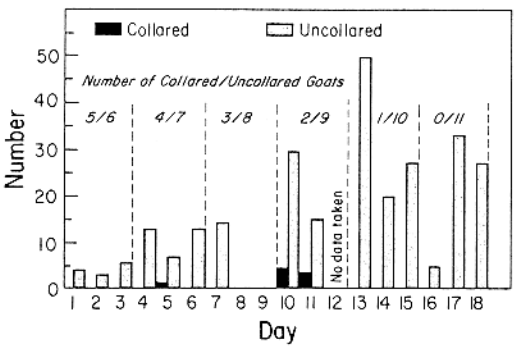

Fig. 2. Number of escapes per day based on changing the ratio of collared and uncollared goats every third day.

outside of the containment area. However, they never wandered more than 50 m from the confined animals. Both the collared and uncollared goats displayed anxiety when separated by more than 20 m, with the result that the uncollared goats would return to the collared goats in the containment area.

On the fifth day of the second study, collared goat No. 2 left the containment area for several minutes (Fig. 2). The same goat, which was one of only two goats still collared, endured the shocks and left the containment area for 4 h on the 10th and 3 h on the 11th day. On the 13th, 14th and 15th days, when goat No. 1 was the only collared goat, it would not endure shocks to join the rest of the herd. When the rest of the herd left the containment area, goat No. 1 would display obvious anxiety and move down a hill to an area where she was unable to see the uncollared goats.

Leafy spurge consumption

Leafy spurge flowers were heavily grazed by the goats (Fig. 3). The number of flowering stems per m^2 decrease more than 50% during both studies. It is

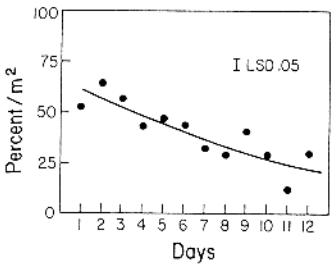

Fig. 3. Reduction in flowering leafy spurge stems per m^2 between 20 July and 3 August 1987 from goat grazing at Whitehall, MT.

possible that consumption of leafy spurge would have been greater if the grazing studies had been initiated earlier during the vegetative stage, or if the availability of other forbs and brush species was less. The goats would typically graze leafy spurge rapidly for about 10 min, stripping leaves and flowers from the stems, and then seek other forage for several minutes. This behaviour was repeated between 10 and 15 times each day.

The goats, unlike sheep grazing leafy spurge (Landgraf et al., 1984), were observed to eat a wide variety of plant species, especially houndstongue (*Cynoglossum officianale* L.), choke cherry (*Prunus virginiana* L.), western wild rose (*Rosa woodsii* Lind.) and cottonwood (*Populus deltoides* Marsh.). If desirable plant species are found in association with leafy spurge, careful grazing management will be necessary to prevent overgrazing by goats (Malechek and Leinweber, 1972).

No attempt was made in this experiment to collar goats displaying dominant behaviour, as the separation of goats into collared and uncollared groups was done randomly. Collar-training the most dominant goats in a herd might permit herd containment with a minimum of collars. While it was beyond the scope and design of this trial to determine the ratio of collared to uncollared goats needed for effective containment, the number of escapes of uncollared goats increased as the number of collared goats declined (Fig. 2). The only goat which endured shocking to join the uncollared herd in two field trials was the submissive, non-dominant goat No. 2 (Fig. 2). Goat No. 2 was a small female who received constant physical abuse from the rest of the goats. Despite the physical abuse her herd instinct was strong and she became extremely distraught when separated from the goat herd. It appears that the shock collars are effective for goat containment, but some culling of deviant animals would be necessary.

These grazing studies indicate that pulsed radio waves which stimulate electric shock collars have potential for containing goats. It is possible that goat herds could be released in large weed-infested areas encircled with a strand of wire and left to graze weeds for a predetermined interval.

Shock collars may also be useful for containing other classes of livestock. The cost of the electronic components of the commercial collar system tested in this research does not bear any direct relationship to the unit's present retail price. Therefore, significant cost-reduction is possible, and electric shock collars might be practical for the livestock industry if further testing substantiates the results of this preliminary study.

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