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Technical Note: Automatic sorting of free-ranging cattle

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Abstract

An automated system to weigh and sort free-ranging cattle was adapted to administer cottonseed pellets (41% crude protein) to free-ranging cattle. The frequency with which animals drank water determined the interval between supplemental feedings. The automatic spacing of individual animals was the weakest link in the chain of events leading to the sorting of cattle into groups to administer treatments. Periodically during the study, free-standing water was available due to above-average precipitation. This resulted in an inconsistent supplementation schedule because animals did not have to return through the maze to drink water. Single herd management eliminated potential pasture-treatment confounding but accentuated individual animal behavior, which resulted in a range of supplement intakes and drinking water patterns.

Key Words: drinking water behavior, supplementation, live-weight

With the advent of single animal electronic identification, individual animal management became a reality during the late 1960's (Street 1979). Electronic automation made it possible to reduce labor, improve data accuracy, and optimize the production potential of individual animals. During the 1980's electronics and information processing were integrated into production agriculture systems on livestock farms (Spahr 1984).

Karn and Lorenz (1984) used electric shock to train cattle to avoid entering an alley which led into a pen containing feed. Rose (1991) has proposed a nose/lip implant, which when interrogated with a radio signal produces an electric shock, to control the ingress and egress of free-ranging livestock in lieu of conventional wire fencing. Martin et al. (1989) used electric shock to train sheep not to eat from a trough containing supplement.

The drinking water behavior of cattle has been used to draw animals through automated systems designed to administer water and obtain individual animal live-weights (Adams et al. 1987, Anderson and Weeks 1989). Supplements have been administered automatically to individual animals using electronic systems (Karn and Clanton 1974, Morris and Delmas 1982).

With behavior modification and automatic sorting, single herd management of free-ranging livestock is possible. Automation can overcome the bias of pasture differences resulting from separate supplement groups, in addition to facilitating individual animal record keeping. The objective of this paper is to describe an automated procedure for individually weighing and sorting free-ranging adult cattle into groups.

Materials and Methods

Single herd management was facilitated through individual electronic identification from an external transponder worn around the animal's neck (Universal Identification Systems, Corp., Cookeville, Tenn.). Cows were individually and automatically weighed, before drinking water, as they walked through a one-directional maze to obtain water to drink (Fig. 1). When interrogated the external transponders controlled pneumatically operated gates that automatically moved to sort animals into one of 3 locations.

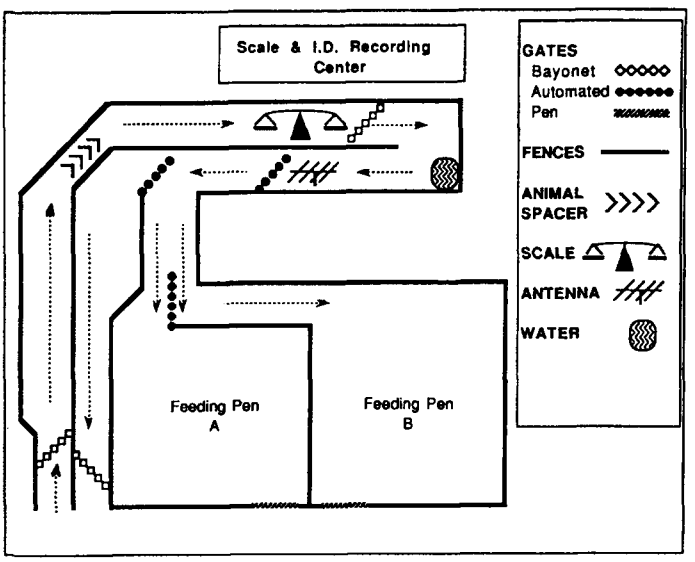

Fig. 1. Block diagram of a 1-directional maze designed for weighing and sorting cattle.

One-way gates, some of the bayonet-type (Anderson and Smith 1980), ensured 1 directional movement through the system, which included a 6m-long single-animal electronic scale (L-8 Agri Products, formally of Solana Beach, Calif.). Once adult cattle had passed the spacer, (Anderson and Mertz 1983) their movement was monitored as a series of photocell beams were sequentially broken. If more than 1 photo beam was simultaneously broken more than 1 animal was in the maze. The pneumatic gates would default to a setting in which all animals would be returned to the pasture regardless of the animals preselected treatment (pen or pasture).

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Table 1. Example: Live-weights, protein supplementation (41% cottonseed pellet) and drinking water data for cattle grazing arid rangeland between 16 April and 16 July 1986.

	Live-weight			Supplement							Drinking		
							Feedings						
					Daily Intake Over 91 d Trail[1]		Interval Between		Number			Interval Between[2]	
	No. Animals	Mean	Range	Total Consumed	Mean	Range	Mean	Range	Mean	Range	No. Animals	Mean	Range
	(n)	(kg)	(kg)	(kg)	(kg/hd/d)	(kg/hd/d)	(d)	(d)	(n)	(n)	(n)	(d)	(d)
Bulls	5	477	393–514	709	1.6	1.1–1.8	3.4	2.7–4.8	28.2	19–34	5	2.3	1.7–2.8
Supplemented Cows													
High Frequency													
Lactating	12	340	205–457	1449	1.3	0.9–1.8	3.9	2.9–4.6	24.3	20–31	12	3.4	2.1–5.7
Non-Lactating	5	384	305–485	663	1.5	1.0–1.9	3.5	2.7–4.3	26.4	21–34	5	2.9	1.6–4.3
Low Frequency													
Lactating	9	301	210–432	664	0.8	0.6–0.9	6.1	5.1–9.1	15.3	10–18	8	4.5	2.8–8.5
Non-Lactating	6	303	202–375	355	0.6	0.5–0.9	7.5	4.8–9.1	12.7	10–19	4	4.1	3.1–5.7
Non-supplemented Cows													
Lactating	17	375	150–523								7	4.2	2.6–6.8
Non-Lactating	20	390	200–687								9	4.1	3.1–5.7

[1]Animals were given 5 kg of supplement each time they were fed; orts were weighed back to accurately determine individual intake.
[2]Only 34 days of data were collected. Free-standing water in the pasture from 5–29 through 6–3 (2.41 mm) and 6–23 through 6–26 (6.78 mm) eliminated the animal's need to return to Headquarters to drink water.

If only 1 animal at a time was in the system it was restrained from walking forward for about 11 sec following the drinking of water. While the animal was stopped, its transponder was interrogated and its identification number along with date, time, and live-weight were recorded. In addition, the automated gates in the system moved into position to sort the animal either into pen A or B or back into the pasture. After this brief restraint the spring loaded gate, which had remained closed in front of the animal, automatically opened. As the animal walked through the gate opening, a solenoid lock attached to the cattle spacer was electronically released. Once the locking mechanism on the spacer was released another animal was free to enter the alley leading to the scale platform. This process repeated itself until all animals had passed through the weighing/sorting system.

The system was evaluated in a 91-day study at the Jornada Experimental Range Headquarters (32° 37′ N, 106° 40′ W) in Dona Ana County, New Mexico, between 16 April and 16 July, 1986. Two, 2,300-ha pastures were sequentially stocked with a single herd of 69 Hereford and F1 crossbred Hereford cows 4 years of age or older and 5 Simmental bulls. Calves were not weighed automatically and did not have to negotiate the maze to drink water.

The automated system was evaluated as a tool to aid in administering a 41% crude protein cottonseed pellet supplement. Cows were initially allotted to a nonsupplemented control and 2 protein supplement levels: 1.8 kg/hd/d (high) and 0.9 kg/hd/d (low), on the basis of breed, lactation status, and age. All bulls were to be fed at the high supplement level. Five kilograms of cottonseed was fed to each supplemented animal during a 24-hour period. This amount was fed during the initial visit regardless of the number of additional times the animal came through the system that day. Supplement was administered manually between 0700 and 1800 hours, Mountain Standard Time, in wooden boxes distributed around the perimeter of pens A and B (Fig. 1). When an animal finished eating, the orts were weighed and the animal was immediately released back into the pasture.

Results and Discussion

Between 16 April and 16 July, 10.22 cm of precipitation was recorded at ranch Headquarters. Ninety percent of the precipitation received during the study (9.19 cm) was received between 29 May and 3 June (2.41 cm; 6 days) and 23 June and 26 June (6.78 cm; 4 days) while the 5 remaining events occurred on isolated days and ranged between 0.05 and 0.3 cm. The January through July precipitation was 68% above the long-term average of 9.7 cm. There was 7.4 cm of rainfall recorded in June; this exceeded the long-term average for June by 6.2 cm (U.S. Commerce Department 1986). The 6 days of rain in late May and early June and the rainy period later in June for 4 days left free-standing water in the pasture and eliminated the need for animals to return to Headquarters to drink water. Overall, data were collected on 64 out of 91 days. Of the 27 days data were not collected, the longest consecutive period was for 13 days during which time the 6.78 cm of precipitation was received. Measurable precipitation was recorded on 10 days, leaving only 17 days (21%) in which data were not collected for unexplained reasons.

The mechanical and automatic spacing of individual animals was the weakest link in the automated chain of events. If cows closely followed each other in single file, the cattle spacer was frequently unable to separate them. Therefore, with 2 or more animals within the maze, no data were obtained because the gate default settings immediately returned these animals to pasture following their drinking water. Once in the pasture the animals did not re-enter the maze again until they again were thirsty. Possible modifications to the holding pen and or cattle spacer might alleviate this problem but will require further experimentation.

Training cattle to accurately negotiate the maze required about 3 months. However, not all animals were successfully trained and some had to be dropped from the experiment. Currie et al. (1989) reported culling $< 5\%$ of a group of steers because of disposition or lack of adapting to a procedure in which they had to enter a scale platform in order to drink water. In our experience individual temperament was the key factor responsible for an animal's adaptability to this type of management. Animals that were docile when in the presence of humans adapted most quickly to the automated management. Animals with horns adapted to the system; however, polled animals were preferred since they were less likely to destroy equipment and were able to move through narrow alleys and chutes easier than horned animals.

Each animal's frequency to drink water varied. Therefore, the actual daily intake of supplement the treated animals received ranged between 0.5 and 1.9 kg/hd/da (Table 1).

Conclusions

A free-ranging herd of beef cattle can be trained to negotiate a one-directional maze in order to obtain drinking water and receive a supplement. Docile animals and precipitation events which do not produce free-standing water are essential if water drinking behavior is to be used to bring animals to a specific location. Electronic identification made possible long-term individual liveweight records, automated sorting, and single herd management. The automated system eliminated pasture-treatment confounding; but individual animal behavior was accentuated, resulting in a range of supplement intakes and drinking water patterns.

Literature Cited

Adams, D.C., P.O. Currie, B.W. Knapp, T. Mauney, and D. Richardson. 1987. An automated range-animal data acquisition system. J. Range Manage. 40:256–258.

Anderson, D.M., and D.L. Mertz. 1983. A mechanical animal powered cow spacer. J. Range Manage. 36:542–543.

Anderson, D.M., and J.N. Smith. 1980. A single bayonet gate for trapping range cattle. J. Range Manage. 33:316–317.

Anderson, D.M., and D.L. Weeks. 1989. Cattle liveweight sampled on a continuous versus intermittent basis. Livestock Prod. Sci. 23:117–135.

Currie, P.O., J.D. Volesky, D.C. Adams, and B.W. Knapp. 1989. Growth patterns of yearling steers determined from daily weights. J. Range Manage. 42:393–396.

Karn, J.F., and D.C. Clanton. 1974. Electronically controlled individual cattle feeding. J. Anim. Sci. (Abstract) 39:136.

Karn, J.F., and R.J. Lorenz. 1984. Technique to separate grazing cattle into groups for feeding. J. Range Manage. 37:565-566.

Martin, M.J.D., D.A. Pritchard, and R.G.A. Stephenson. 1989. Electric shock conditioning of sheep to avoid feed supplement troughs in field investigations of diet supplementation. Aust. Rangel. J. 11:44–46.

Rose, A.F. 1991. An alternative to fences. Rangelands 13:144–145.

Spahr, S.L. 1984. Extending the capability of the livestock manager through electronics, p. 583–591. *In:* Agriculture electronics—1983 and beyond. Vol. II. Amer. Soc. Agr. Eng.

Street, M.J. 1979. A pulse-code modulation system for automatic animal identification. J. Agr. Eng. Res. 24:249–258.

U.S. Department of Commerce. 1986. National Oceanic and Atmospheric Administration. Climatology data annual summary: New Mexico. 90(13). Asheville, N.C.