Monitoring Animal Travel with Digital Pedometers

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Travel is an important endergonic physiological function. Blaxter (1967) suggested that cattle expend about 15% more energy out-of-doors than indoors. The maintenance energy requirement of grazing animals may be 25 to 50% greater than for animals in confinement, with the cost of travel contributing substantially to this increase (Osuji 1974).

Animal travel may be influenced by location of water and minerals, weather, topography, forage availability and quality, and innate characteristics of the animal. As forage availability decreases, cattle spend more time grazing (Lofgreen et al. 1957; Arnold 1960). Also, *Bos indicus* cattle apparently travel more than do cattle of *Bos taurus* breeding (Herbel and Nelson 1966).

Early travel data were obtained by following an animal and counting the number of steps of known length, taken by an observer (Cory 1927). Several researchers have obtained travel data by observing animals and mapping their movements (Dwyer 1961; Durham 1975; Malechek and Smith 1976). However, animal travel data obtained by observation may be more subjective than that obtained with mechanical techniques. Cresswell (1957) described the rangemeter as a satisfactory tool to monitor sheep travel. Powell (1968) reported on the use of a pedometer to monitor sheep travel. He evaluated the Suprex Pedometer[1] and concluded the disadvantages outweighed the advantages for measuring distances walked by sheep. Kiddy (1976) reported dairy cows' activity measured with pedometers during estrus was approximately four times that of animals in anestrus. The objective of this research was to evaluate one type of digital pedometer[2] for monitoring travel of beef cattle on brushy rangeland.

Materials and Methods

The pedometers tested in this study measured 2 by 4 by 4 cm. A digital readout located on top of the instrument was encased beneath a clear cover. The digital mechanism was activated by an up-and-down motion of the pedometer maintained in an upright position. The digital readout allowed accumulation of approximately 160.8 km (99.9 miles). By depressing a button on top of the instrument the pedometers were reset to zero. A flat-head screw in the pedometer base, when rotated, adjusted for the pace-length of animals within a range of 0.3 to 0.9 m (1 to 3 ft). The resultant pace-length setting was indicated by the position of a red line indicator along a scale behind the clear cover on the front of the pedometer. Since the red line indicator did not stay in adjustment, an alternative approach was used to set the instrument's pace-length. The flat-head screw in the pedometer's base was turned in

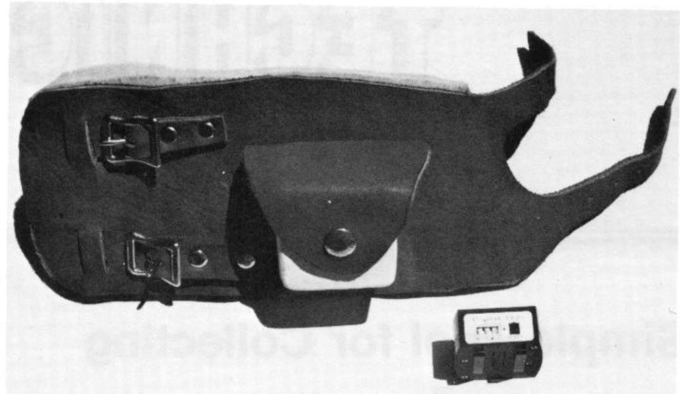

Fig. 1. *Digital pedometer and instrument package used to monitor cattle travel on brushy rangeland.*

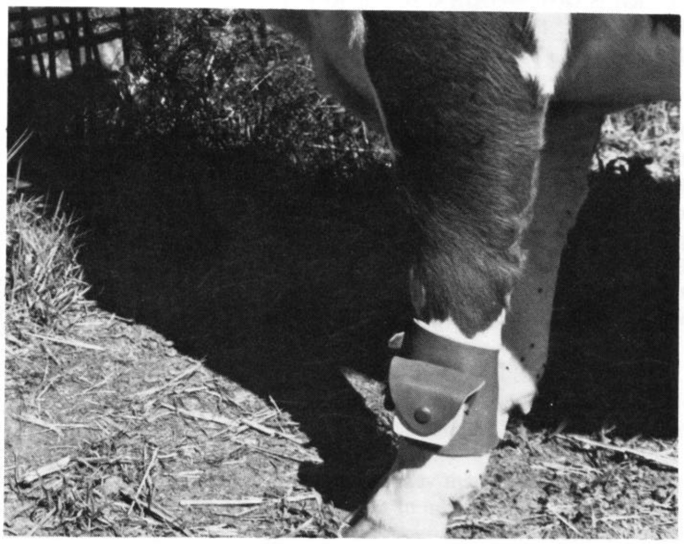

Fig. 2. *Pedometer instrument package buckled to the metacarpus of the heifer's left foreleg.*

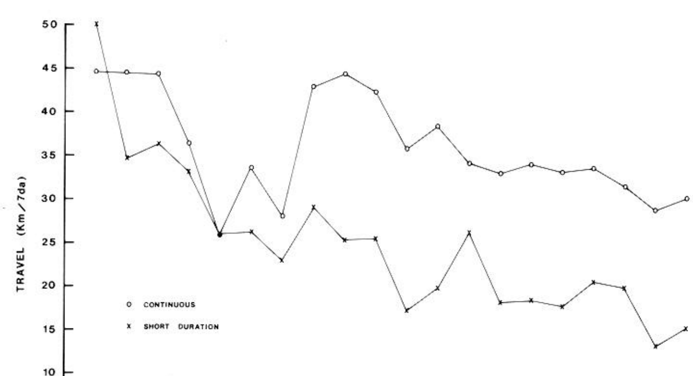

Fig. 3. *Hereford heifer travel on native rangeland managed under continuous and short-duration grazing over 140 consecutive days. Each point represents the mean travel of two animals.*

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[1] Manufactured by Brian R. Morris & Co. Ltd., 118b London Road, St. Albans.

[2] Digi-Meter #14-828 manufactured by Edge Mark in Japan.

a counterclockwise direction until it could no longer be easily turned. This position was considered "flush" and represented the minimum pace length setting for the instrument. At this point, a permanent mark was made on the pedometer case to correspond to the groove in the screw head.

Each pedometer was housed upright in a 4 by 5-cm case made of 16-gauge steel with a leather lid that was closed with a snap. In the event water might enter the metal case, drainage holes were provided in the bottom. The metal case was riveted to a leather band shaped from 11 by 34-cm chap-leather stock (Fig. 1). Foam rubber padding 2 cm thick was glued to the back of the leather bands to protect the animal. The pedometer was wrapped with 1-cm thick foam rubber before being placed into the metal case. This instrument package was then buckled, in a manner which allowed it to rotate freely, around the metacarpus of the heifer's left foreleg (Fig. 2).

The pedometer technique was evaluated in conjunction with a grazing study on the Texas Experimental Ranch in the eastern Rolling Plains. Five, 4-ha pastures were grazed in a short duration system [5-1; 28:112 day][3]; and one 20-ha pasture was grazed continuously. Both treatments were grazed at a stocking rate approximately one animal unit per 5.6 ha throughout the duration of the study. The pastures were located on a Clay Loam range site with slope gradients less than 4%.

Travel of two Hereford heifers, averaging 307 kg, was monitored continuously within each grazing treatment from July 31 to December 7, 1975. Animals were brought to a pen within their respective pastures on a weekly basis. Pedometers were inspected; readings and time of readings were recorded from each of the four animals. When the animals were returned to the pasture, the pedometers were reset to zero and the time recorded. The pedometer readings were adjusted to a 7-day (168-hour) basis.

Pedometer precision was evaluated by walking the four animals over distances of 0.48, 0.80, and 1.6 km at a pace-length setting of "flush" and three turns clockwise from "flush." In the analysis of this data pedometer and animals were confounded since every instrument-animal combination was not evaluated. Therefore, it was not possible to separate animal variability from that of the pedometers.

In the 140-day trial one pedometer was adjusted for pace-length by walking a heifer with the instrument package in place along a known distance. This procedure was repeated with screw adjustments in a clockwise direction until the distance recorded by the pedometer corresponded to the distance traveled. The adjusted setting of the screw in the instrument's base was identified by a second mark on the instrument case corresponding to the position of the groove. The number of clockwise turns from the "flush" setting to the second setting was recorded. This allowed checking during the trial. The remaining three instruments were not calibrated to the animals, rather the pace-length settings on the instruments were maintained at the minimum pace-length setting, i.e., "flush." If these animals had been walked a known distance before the trial began a factor could have been derived to correct the pedometer readings for accuracy. However, this was not possible due to lack of available labor.

Results and Discussion

The leather bands were not removed from the four animals during the 140-day trial. Periodic visual observations indicated that the instrument package did not influence the bearer's movements, cause discomfort, or produce leg abrasions. The foam rubber padding surrounding the instrument presumably reduced the chance for damage and maintained the pedometer in an upright position within the case. The snap holding the leather lid over the metal case inadvertently released while the animals were at pasture. However, the pedometers were never lost from their metal case. Considering the brushy pastures in which the trial was conducted the instrument packages were found to perform very satisfactorily.

The positioning of the flat-head screw in the pedometer's base provided a satisfactory alternative approach to overcome the defective red line scale. Slippage of the pace-length set screws on the four pedometers never exceeded three clockwise turns from the "flush" position.

In a separate 1-day trial, pace-length settings of "flush" and three turns clockwise from "flush" were used to evaluate pedometer precision. There were significant differences between the mean travel of the four animal-pedometer combinations over distances of 0.48, 0.80, and 1.61 km. Differences resulting from adjustment of the pace-length set screw were not significant. Thus, it was concluded that with distances not exceeding 1.61 km there was no statistical difference between pedometer readings at either pace-length setting. In order to establish the accuracy of the instruments over longer distances further investigations will be required.

Analysis of the pedometer data collected over the 140-day trial indicated distance traveled by individual animals within a grazing treatment did not differ significantly (10% level), but significant differences were observed between treatments. Heifers grazing the 20-ha pasture traveled an average of 36.1 kg/7 day as compared to 25.0 km/7 day for those grazing on the 4-ha pastures. Figure 3 shows animal travel in km/7 day plotted against time intervals at which pedometer readings were taken. It appears that weather and vegetation parameters were correlated with the travel observed. These data are presently being analyzed.

It is concluded that digital pedometers of the type employed are sturdy and hold their pace-length calibration well when used as described in this paper. The value of this technique lies in the precise and inexpensive method for monitoring animal travel on a continuous basis. The technique allows numbers of animals to be monitored with minimal labor input. If animals are of a gentle disposition, they can be approached while at pasture to obtain daily pedometer readings.

The degree of accuracy obtainable by this technique will require further investigation. Animal travel can be divided into at least three categories: foraging, walking, and running. The pace-length of each of these differs; therefore, the accuracy of the pedometer readings depends upon the pace-length category to which the pedometer was adjusted or the correction factor used to adjust the readings. Foraging probably accounts for the largest percent of an animal's movement (Moorefield and Hopkins 1951). Therefore, obtaining a correction factor or setting the pace-length for foraging should provide travel data more accurate than mapping animal movements.

[3] Kothmann, M. M., ed. 1974. A glossary of terms used in range management. 2nd ed. Society for Range Management, Denver, Colorado. 36 p.

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