Distinguishing Cattle Foraging Activities Using an Accelerometry-Based Activity Monitor

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Technical Note

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Abstract

Various sensors and analytic tools have been developed to assist with the collection and analysis of data regarding the activities of animals at pasture. We tested an accelerometry-based activity monitor, the Kenz Lifecorder EX (LCEX; Suzuken Co Ltd, Nagoya, Japan), to differentiate between foraging and other activities of beef cows in a steeply sloping pasture. Logistic regression (LR) and linear discriminant analysis (LDA), two of the most widely used techniques for distinguishing animal activities based on sensing device information, were employed in the analysis. An LCEX device was worn on a collar by each of four cattle over the course of 4 d, during which time the activity (foraging, resting, ruminating, walking, and grooming) of each cow was recorded by trained observers at 1-min intervals for a total of 15 h. LR and LDA were applied to the LCEX and observer data to distinguish between foraging and other activities. Overall, a more accurate measure was obtained by LDA (90.6% to 94.6% correct discrimination among cows) than by LR (80.8% to 91.8% correct discrimination). The threshold LCEX value for distinguishing between foraging and other activities varied among cows, and the correct discrimination rate for the pooled data set was 92.4% for LDA and 85.6% for LR. Based on individual cow LDA, the time spent foraging averaged between 443 and 475 min $\cdot$ d^{-1}. Our results indicated that LCEX can be used to identify the foraging activity of cattle.

Key Words: activity monitor, cow, grazing behavior, grazing management, linear discriminant analysis, logistic regression

INTRODUCTION

The development of simple, cost-effective tools for the temporal monitoring of cattle on pasture or rangeland could benefit both producers and researchers. Global positioning systems (GPSs) have increasingly been used to monitor spatial distribution and track routes (Ganskopp et al. 2000; Ganskopp 2001; Barbari et al. 2006) and are often combined with sensing devices to monitor animal activities, especially grazing behavior. Information on grazing behavior can be acquired from these devices by measuring the electrical resistance of jaw opening (Penning 1983; Matsui and Okubo 1991; Rutter 2000) or by pendulum pedometers fitted around the neck (Phillips and Denne 1988; Umemura et al. 2009); tilt sensors attached to a commercial GPS tracking collar (Ganskopp 2001); devices that record the sounds of bites and chewing in grazing (Ungar and Rutter 2006); and accelerometers fitted on the jaw or neck (Wark et al. 2007; Watanabe et al. 2008; Moreau et al. 2009). However, most of these devices cannot be used by farmers because they are only capable of taking measurements for a few days, due to their high energy consumption, or because they are expensive and require extensive experience to correctly attach them to animals (Ungar and Rutter 2006). Moreover, the data obtained by such sensing devices are complex, and the classification of grazing behavior requires custom software, such as the "Graze" program (Rutter 2000).

Recently, simple accelerometry-based activity monitors have been developed for studies of human health (Kumahara et al. 2004; Ayabe et al. 2006; McClain et al. 2007). Although these devices convert raw accelerometer data into activity levels using proprietary criteria, that data can be accessed and analyzed independently for animal activity studies. Ueda et al. (2011) developed a simple method for identifying the foraging activity of dairy cows in flatland pasture using the Kenz Lifecorder EX (LCEX; Suzuken Co Ltd, Nagoya, Japan) and a manually identified threshold value. The LCEX has recently been developed into a commercially available tool for human health management and research at a relatively low price (approximately 430 US dollars per unit). However, to further develop cow activity monitoring using the device, we tested the ability of the LCEX system to monitor activity of beef cattle in a steeply sloping pasture, because most of the grazed pasture in Japan is located in mountainous or hilly terrain. The analytic methods used to distinguish foraging activity were logistic regression (LR) and linear discriminant

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