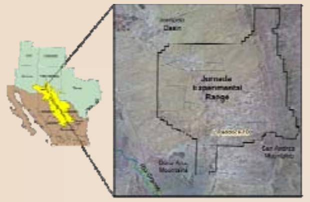

FREE-RANGING COW BEHAVIOR PRE AND POST-WEANING

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Abstract

The optimum husbandry of free-ranging cattle requires not only nutritional knowledge but also an understanding of how to manage and use behavioral information. With the advent of global positioning technology (GPS) it is now possible to monitor animal travel with relative ease over extended periods of time without the observer influencing the observation. Between March and April 2009 five cows in each of two similar large (≥ 433 ha) arid rangeland pastures were individually monitored at a 1 Hz rate before as well as following weaning. The ten cows ranged in age between three and fifteen years with six of the cows suckling male calves while the remaining four calves were female. Accelerometer and magnetometer data used to quantify foraging and non-foraging behaviors together with animal travel will be discussed in light of directional virtual fencing (DVF™) hardware and software that was used to obtain the data.

Objective

- Determine the impact of weaning on inactive and active behaviors of mature free-ranging beef cows by monitoring rate of travel.

Materials and Methods

Rangeland, cattle, weather, training

The study was conducted near Las Cruces, New Mexico, on the U.S. Department of Agriculture – Agricultural Research Service's Jornada Experimental Range (USDA-ARS-JER) in Paddock 10B and 14A (Figure 1). Daily cow behavior was monitored in brush infested Chihuahuan Semidesert Grassland paddocks between 12 March and 8 April 2009 using a single Hereford, and nine crossbred Hereford x Brangus cow-calf pairs. No precipitation was recorded throughout the trial and ambient air temperatures and wind speeds were typical of the long-term means for this season. The mature (3 to 15 year old) cattle had previously been gentled to accept wearing electronic equipment packages by feeding cottonseed cubes to each cow individually as they were instrumented.

Electronic hardware, software

Only cows were instrumented with global positioning system (GPS) ET-312 receivers manufactured by GlobalSat® Technology Corporation (Taipei Hsien, Taiwan) programmed to collect 1 Hz cow location data while AeroComm AC4790 radios (Lenexa, KS) located in the electronics equipment provided wireless communication (Schwager et al. 2008).

Data gathering, manipulation and analyses

The data came from approximately 8.7 x 10^6 1 Hz raw GPS fixes. One minute mean rate of travel (m s^{-1}) per minute for each cow was determined by calculating consecutive differences among 60 fixes. Behaviors were then categorized into ***stationary*** (< 0.057 m s^{-1}), ***foraging*** (0.057 m s^{-1} to 0.382 m s^{-1}) and ***walking*** (> 0.382 m s^{-1}) travel speeds based on observations of these behaviors recorded every minute for approximately 12 hr over 6 d in 10B and for approximately 20 hr over 7 d in 14A. All graphics and statistics were accomplished using ArcGis 9.3 and Excel 2003.

Disclaimer

Trade names used in this poster are solely for the purpose of providing specific information and do not constitute a guarantee, endorsement, or warranty of the product by the USDA-ARS and MIT over other products not mentioned.

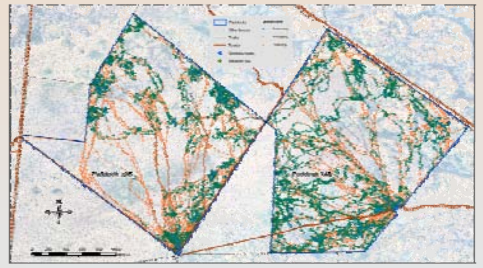

Figure 1. Locations and behaviors for five mature instrumented lactating beef cows within each of two areas on the USDA-ARS-JER from 13 to 22 March 2009 (Paddock 10B; 433 ha) and 27 March to 7 April 2009 (Paddock 14A; 433 ha). Movement was determined and plotted by calculating the horizontal displacement from 1 Hz global positioning system (GPS) data coming from battery/solar powered electronic equipment worn by each cow. Travel speeds (m s^{-1}) that delineated ***stationary*** (< 0.057 m s^{-1}), ***foraging*** (0.057 m s^{-1} to 0.382 m s^{-1}), and ***walking*** (> 0.382 m s^{-1}) were determined by observing and recording cow behaviors minute by minute for approximately 12 h over 6 d in 10B and for approximately 20 h over 7 d in 14A. Calves were weaned on 17 March (10B) and 30 March (14A). Arrows indicate the direction and rate (color) of displacement across the landscape.

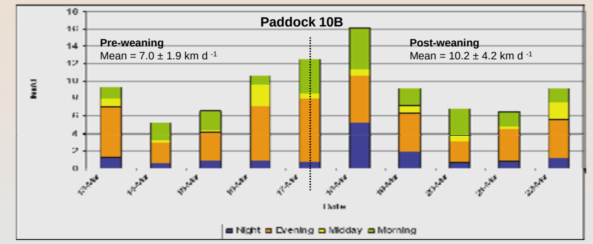

Figure 2. Mean (n ≤ 5) ± standard deviation of pre- and post-weaned mature beef cow travel (km d^{-1}) in USDA-ARS-JER Paddock 10B (415 ha) between 13 and 22 March, 2009. Times during 24 h is related to the sun's angle above the horizon: ***Morning*** (solar elevation -12º to 45º rising, ≈ 0604 to 1042 h), ***midday*** (solar elevation 45º rising to 40º setting, ≈ 1043 to 1607 h), ***evening*** (solar elevation 40º to -12º setting, ≈ 1608 to 2019 h), and ***night*** (solar elevation < -12º no sun, ≈ 2020 to 0602 h) intervals were assigned by plotting all cow travel (m s^{-1}) by minute throughout a 24 h period and then subdividing the pattern.

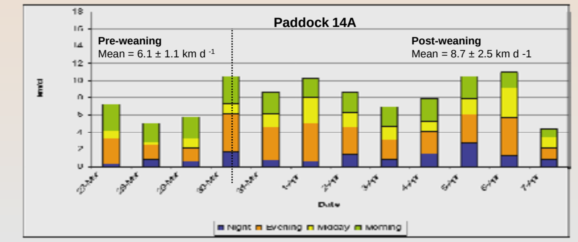

Figure 3. Mean (n ≤ 5) ± standard deviation of pre- and post-weaned mature beef cow travel (km d^{-1}) in USDA-ARS-JER Paddock 14A (433 ha) between 27 March and 7 April, 2009. ***Morning*** (solar elevation -12º to 45º rising, ≈ 0604 to 1042 h), ***midday*** (solar elevation 45º rising to 40º setting, ≈ 1043 to 1607h), ***evening*** (solar elevation 40º to -12º setting, ≈ 1608 to 2019 h), and ***night*** (solar elevation < -12º no sun, ≈ 2020 to 0602 h) intervals were assigned by plotting all cow travel (m s^{-1}) by minute throughout a 24 h period and then subdividing the pattern.

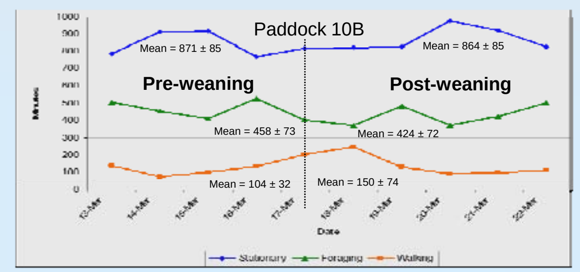

Figure 4. Mean (n ≤ 5) ± standard deviation in minutes per day pre- and post-weaning mature beef cows spent in each of three behaviors in the USDA-ARS-JER Paddock 10B (415 ha) between 13 and 22 March 2009. The range of speeds (m s^{-1}) characterizing each behavior was determined by observing the cattle over 6 d for approximately 12 h. By combining the observational data with 1 Hz global positioning system (GPS) fixes coming from instruments worn by the five cows it was possible to calculate the following relationships: ***stationary*** (< 0.057 m s^{-1}), ***foraging*** (0.057 m s^{-1} to 0.382 m s^{-1}), ***walking*** (> 0.382 m s^{-1}).

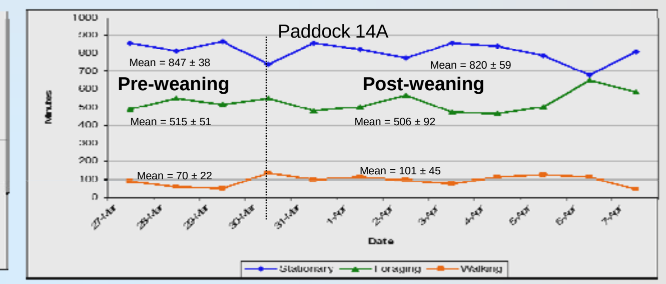

Figure 5. Mean (n ≤ 5) ± standard deviation in minutes per day pre- and post-weaning mature beef cows spent in each of three behaviors in the USDA-ARS-JER Paddock 14A (433 ha) between 27 March and 7 April 2009. The range of speeds (m s^{-1}) characterizing each behavior was determined by observing the cattle over 7 d for approximately 20 h. By combining the observational data with 1 Hz global positioning system (GPS) fixes coming from instruments worn by the five cows it was possible to calculate the following relationships: ***stationary*** (< 0.057 m s^{-1}), ***foraging*** (0.057 m s^{-1} to 0.382 m s^{-1}), ***walking*** (> 0.382 m s^{-1}).

Cow wearing battery/solar powered electronics equipment.

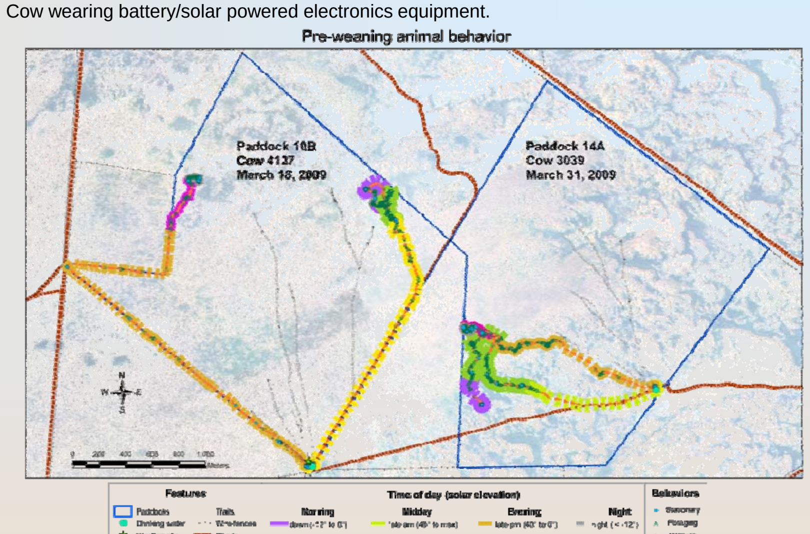

Figure 6. The spatial location, temporal rate of displacement (behavior) and direction of movement of two cows the day before weaning in USDA-ARS-JER Paddocks 10B and 14A determined from 1 Hz global positioning system (GPS) data obtained from battery/solar powered electronics equipment worn by each animal. Travel speeds (m s^{-1}) that delineated ***stationary*** (< 0.057 m s^{-1}), ***foraging*** (0.057 m s^{-1} to 0.382 m s^{-1}), and ***walking*** (> 0.382 m s^{-1}) were determined by observing and recording the behavior of these two cows and eight others minute by minute for approximately 32 h across 13 days. The observational data were used to characterize the displacement rate of consecutive 1 Hz global positioning system (GPS) fixes. The three behaviors were further characterized as occurring during specific times during 24 h related to the sun's angle above the horizon: ***Morning*** (solar elevation -12º to 45º rising, ≈ 0604 to 1042 h), ***midday*** (solar elevation 45º rising to 40º setting, ≈ 1043 to 1607 h), ***evening*** (solar elevation 40º to -12º setting, ≈ 1608 to 2019 h), and ***night*** (solar elevation < -12º no sun, ≈ 2020 to 0602 h).

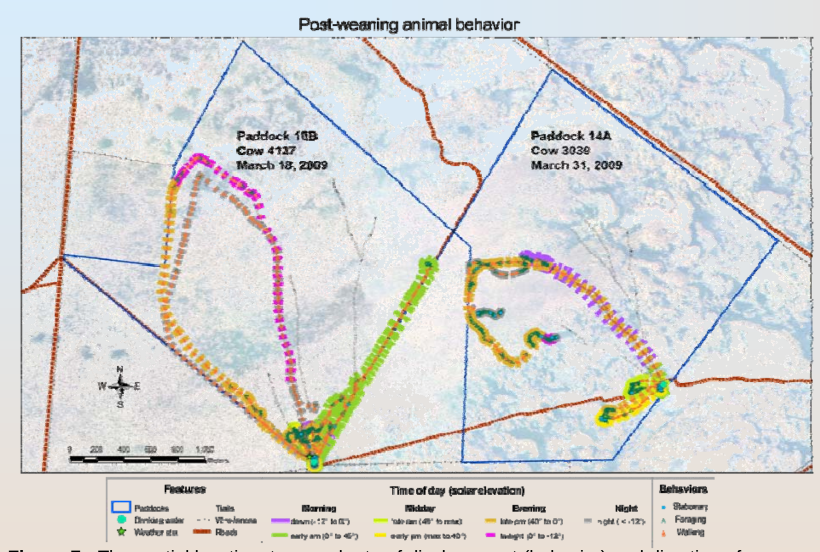

Figure 7. The spatial location, temporal rate of displacement (behavior) and direction of movement of two cows the day after weaning in USDA-ARS-JER Paddocks 10B and 14A determined from 1 Hz global positioning system (GPS) data obtained from battery/solar powered electronics equipment worn by each animal. Travel speeds (m s^{-1}) that delineated ***stationary*** (< 0.057 m s^{-1}), ***foraging*** (0.057 m s^{-1} to 0.382 m s^{-1}), and ***walking*** (> 0.382 m s^{-1}) were determined by observing and recording the behavior of these two cows and eight others minute by minute for approximately 32 h across 13 days. The observational data were used to characterize the displacement of consecutive 1 Hz global positioning system (GPS) fixes. The three behaviors were further characterized as occurring during specific times during 24 h related to the sun's angle above the horizon: ***Morning*** (solar elevation -12º to 45º rising, ≈ 0604 to 1042 h), ***midday*** (solar elevation 45º rising to 40º setting, ≈ 1043 to 1607 h), ***evening*** (solar elevation 40º to -12º setting, ≈ 1608 to 2019 h), and ***night*** (solar elevation < -12º no sun, ≈ 2020 to 0602 h).

Results and Discussion

Free-ranging cow travel formed a reticulate spatial and temporal pattern appearing much like a branching shrub with its basal area located at the drinking water and areas of intensive use located along routes of travel much as vegetative or fruiting bodies appear along a stem (Figure 1). This pattern persisted during pre- as well as post-weaning, though daily travel increased approximately 3 km/d following weaning (Figures 2 and 3). Daily travel increased in 10B immediately on either side of weaning, yet this pattern was not observed in 14A. Furthermore, the mean increase in travel observed 24 hours post-weaning in 10B was also seen in 14A. Total cow numbers and cow ages were not similar in 10B and 14A due to husbandry constraints; therefore, it would not be prudent to speculate on specific causes for these differences. Overall cow travel and its variability among cows increased post-weaning while foraging time decrease (Figures 4 and 5). Simply reporting means reduce the individual behavior patterns that cows exhibit immediately before and following weaning (Figures 6 and 7). It appears possible to discriminate among several free-ranging animal behaviors involving activity and inactivity based solely on rate of travel (m s^{-1}) when the interval between GPS fixes is 1 Hz and the rates of travel calculated can be verified through observational data. Such information may have useful husbandry implications.

Conclusions

Free-ranging cattle:

- Do not utilize paddocks uniformly.
- Travel throughout 24 h with the majority occurring during daylight; however, daily patterns vary.
- Traveled more following weaning with increased variability among cows.

Electronics:

- 1 Hz GPS fix rates allow cow travel rate (m s^{-1}) to autonomously be characterized into periods of inactivity and activity involving foraging and walking.
- Flawless wireless communication and continuous power are two challenges yet to be solved in electronics equipment worn by free-ranging cows.

Data presentation and analysis:

- With ArcGIS 9.3 and Excel 2003 it was possible using 1 Hz GPS data only to produce figures that simultaneously depict a cows location on the landscape, its temporal activity, and direction of movement.
- As data from other sensor hardware, time-stamped to GPS data, is obtained free-ranging cattle behaviors should be more accurately autonomously characterized.

Literature Cited

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