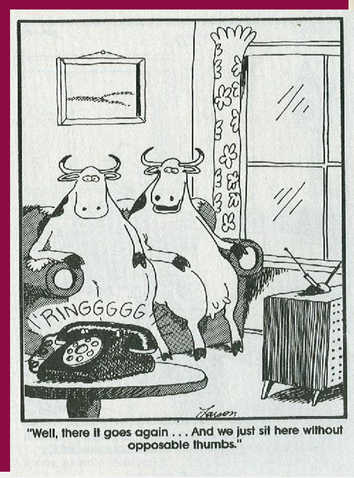
The Potential for the Cow App



GPS vs Accelerometers: The Battle Between Technology to Monitor Cattle Behavior and Welfare

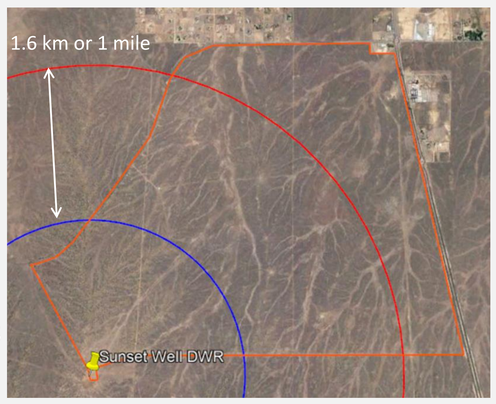
Colin Tobin, Derek Bailey
Email: cttobin@nmsu.edu; dwbailey@nmsu.edu

Introduction

- Locating and monitoring livestock on rangelands can be difficult
- Animal welfare can become an issue when
  - Watering systems fail
  - Livestock become ill
  - Defoliation levels increase to a level that limits livestock intake
- What if we had a sensor that could tell us when something is wrong?
- We believe that both GPS tracking and accelerometers can help determine if livestock become deprived of water

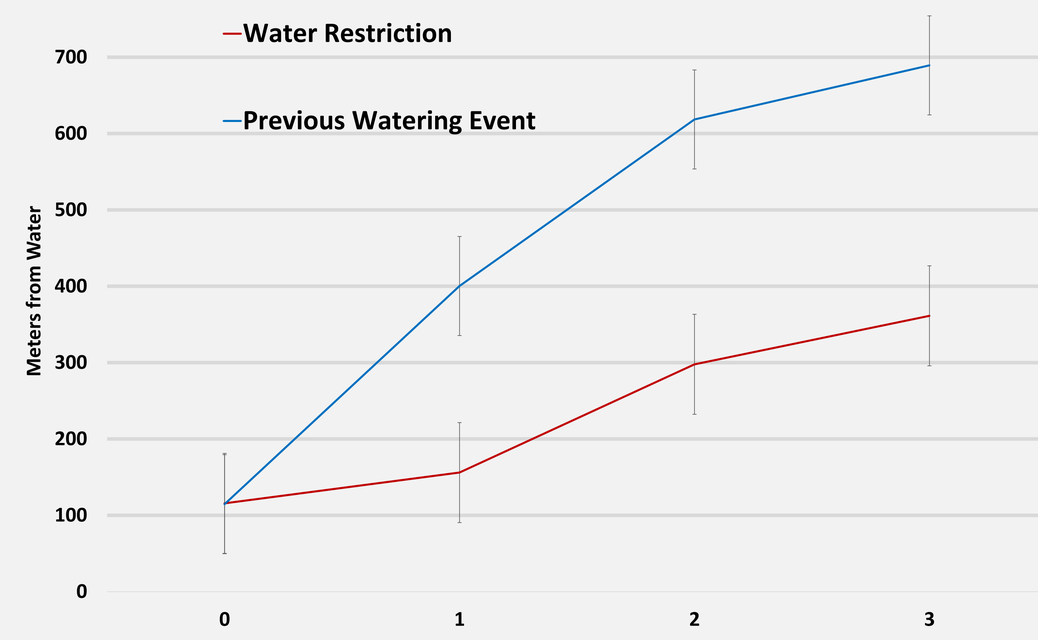
Methods

- Deep Well Ranch, Prescott, Arizona
  - North pasture, 1600 ha, one water source
- 20 cattle were fitted with IgotU GPS
  - GPS fix rate of 2 and 10 minute intervals
- 10 cattle with Axivity accelerometers
  - Accelerometer measurement rate of 12.5 Hz
- Access to water removed for 4 hours (8 am to 12 pm) during 5 trials
  - 2018-June 6, 12, 18
  - 2019-July 17, 19
- Accelerometer data were aggregated to 1 minute epochs
  - Predicted activity using random forest procedures
    - Metrics evaluated: X, Y, Z axis, Movement Intensity (MI)
- Data were analyzed using repeated measures of Proc Mixed
- Protocol approved by NMSU IACUC



Results

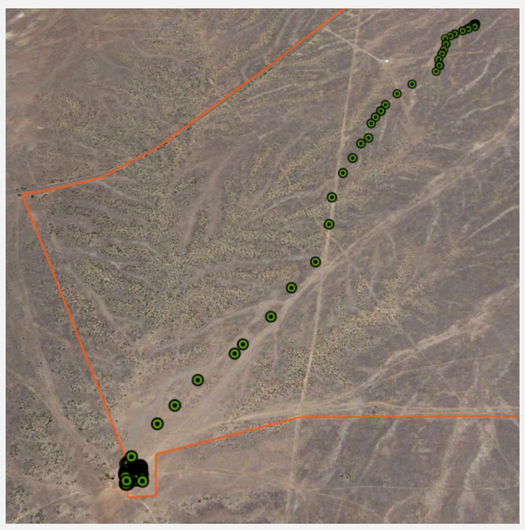
- Minimum animal distance to water was lower using GPS data
- (P <0.0001)
  - When water was withheld compared to the previous watering event
- Accelerometer data suggests that y-axis, z-axis, and MI are more informative for random forest procedures
- Accelerometer data vary greatly across individual animals
  - Separate models may be needed for each individual
- GPS tracking appears to be more informative of simulated water failure than accelerometer data



Hourly deviation of animal movement intensity when deprived of water for up to 4 hours from the previous watering event

Hourly deviation of animal distance when deprived of water for up to 4 hours from the previous watering event

Cow 063 June 5, 2018 watering event , the white points indicate entry path to water, blue points indicate exit



Cow 063 June 6, 2018 watering event , green points indicate entry path to water with no exit due to simulated water failure

Future

- Real-time GPS software has the potential to detect welfare issues such as water deprivation
  - Cellphone app could alert caretaker of potential water system failure

Moovement Real-Time GPS tag

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