Evaluation of a birthing sensor system to remotely identify calving.

T. Schatz[A,C], *E. Fordyce*[A], *M. Wooderson*[A], *K. McCosker*[A] , *and R. Boughton*[B]

[A] Department of Primary Industry and Resources, GPO Box 3000, Darwin, N.T. 0801, Australia.
[B] University of Florida – IFAS Center, 3401 Experiment Station, Ona, Florida 33865, USA
[C]Email: tim.schatz@nt.gov.au

Investigating calf loss in northern Australia has been difficult using traditional methods as calving females and calf carcases are difficult to find in large paddocks, and close observation during calving alters behaviour. The ability to remotely monitor calving would enable collection of data that previously was not possible. A new system using intra-vaginal birthing sensors was evaluated at Manbulloo station near Katherine, Northern Territory (NT).

Researchers at the University of Florida modified an existing "barn" system of birthing sensors (Cowmonitor 2020) to increase the footprint area and enable remote monitoring of calving. This system was further modified to cover a larger area and adapted for use in the NT where mobile phone coverage is limited. The system uses intra-vaginal birthing sensors that start emitting a UHF signal when a rapid temperature change is detected, such as when they are expelled during calving. The signals are received by antennas in a low-power wireless-area network (LPWAN) and are transferred by a gateway, via the internet to servers owned by the sensor manufacturer (JMB North America). A calving alert is then sent and is also immediately viewable on a website. The birthing sensors also contain a Bluetooth beacon which is activated on expulsion and assists with locating expelled sensors, although the range is only about 50 m. The cows are also fitted with GPS tracking collars that record location every 15 minutes enabling cows to be located at the time of an expulsion alert. The location data is viewable in real time on a website maintained by the company that produces the GPS collars (Smart Paddock Pty Ltd).

Four gateways with external antennas were mounted on 12 m high towers to give adequate coverage of the 2,215 ha uncleared paddock of native pasture (which was approximately 7.7 km long and 6 km wide at the widest point). Each tower had a read range of about 1.8-2 km in 360 degrees from the tower. On 14 August 2019 birthing sensors were inserted into 189 pregnant cows and they were fitted with GPS tracking collars. Another 10 cows were fitted with GPS collars but not birthing sensors. The cows calved 36 to 141 (mean = 90) days after birthing sensor insertion. When an expulsion alert was received a person would attempt to locate the cow to record observations of the cow and calf. It was very hot and dry during most of this time with mean maximum temperatures of 39.8ºC, 40.4ºC and 40.8ºC in October, November and December respectively (BOM 2020), and cows congregated around the single water point for most of the day before leaving in the late afternoon to graze. This allowed daily visual checks to be made on most cows, and if calving cows could not be located using GPS data (eg. if the GPS collar was not working at the time of calving) then observations were recorded when they came for water in the days after calving. All calving alerts were verified by visual observation and calving outcomes were determined for 185 cows by observation regardless of whether an alert had been received. Rain fell in December, after which the cows no longer congregated near the water point for most of the day and this made it difficult to locate cows if they did not have a working GPS collar. As a result 4 cows that calved in late December were excluded from the study as they had not yet been found for observation.

Expulsion alerts were received from 71% of sensors soon before calving. A different type of alert was received from a further 27 sensors which evaluation of calving observations found could be interpreted as an expulsion alert as they were received just before calving. If these are included in the total number of sensors that recorded an alert before calving then 85% (158 of 185) of sensors were successful in remotely identifying calving. Of the sensors that did not give an alert correctly; 4 sensors were expelled early (>1 month before calving), 2 alerts were received after cows had been observed to have calved, and no alert was received from 21 sensors. Failure of these 21 sensors was difficult to assess as they were not found, but could be due to internal malfunction (equipment failure), or inability of a base station to receive a signal due to the location where they landed on the ground (environmental interference).

This study found that the birthing sensor system was quite successful in remotely identifying time of calving even though the high temperatures during the study would have often been similar to the body temperature of cows and so there would not have been a large change in temperature to trigger activation to beacon mode. Theoretically the birthing sensors have enough battery life to be used 2 or 3 times but locating expelled sensors in a large paddock with many trees and tall grass is virtually impossible without GPS tracking. Most of the expelled sensors were found if the cow had a working GPS collar at the time of expulsion, but few were found if it did not. The birthing sensors would be improved if they had GPS capability and sent the location of expulsion with the alert.

References

BOM (2020) *http://www.bom.gov.au/climate/dwo/201912/html/IDCJDW8048.201912.shtml.* [Accessed 15 January 2020].
Cowmonitor (2020) *http://cowmonitor.com/technology/.* [Accessed 15 January 2020].