Calf Watch – Developing a system to remotely monitor calving and study calf loss in extensive situations in Northern Australia

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NORTHERN TERRITORY GOVERNMENT

Calf loss is a major problem in northern Australia

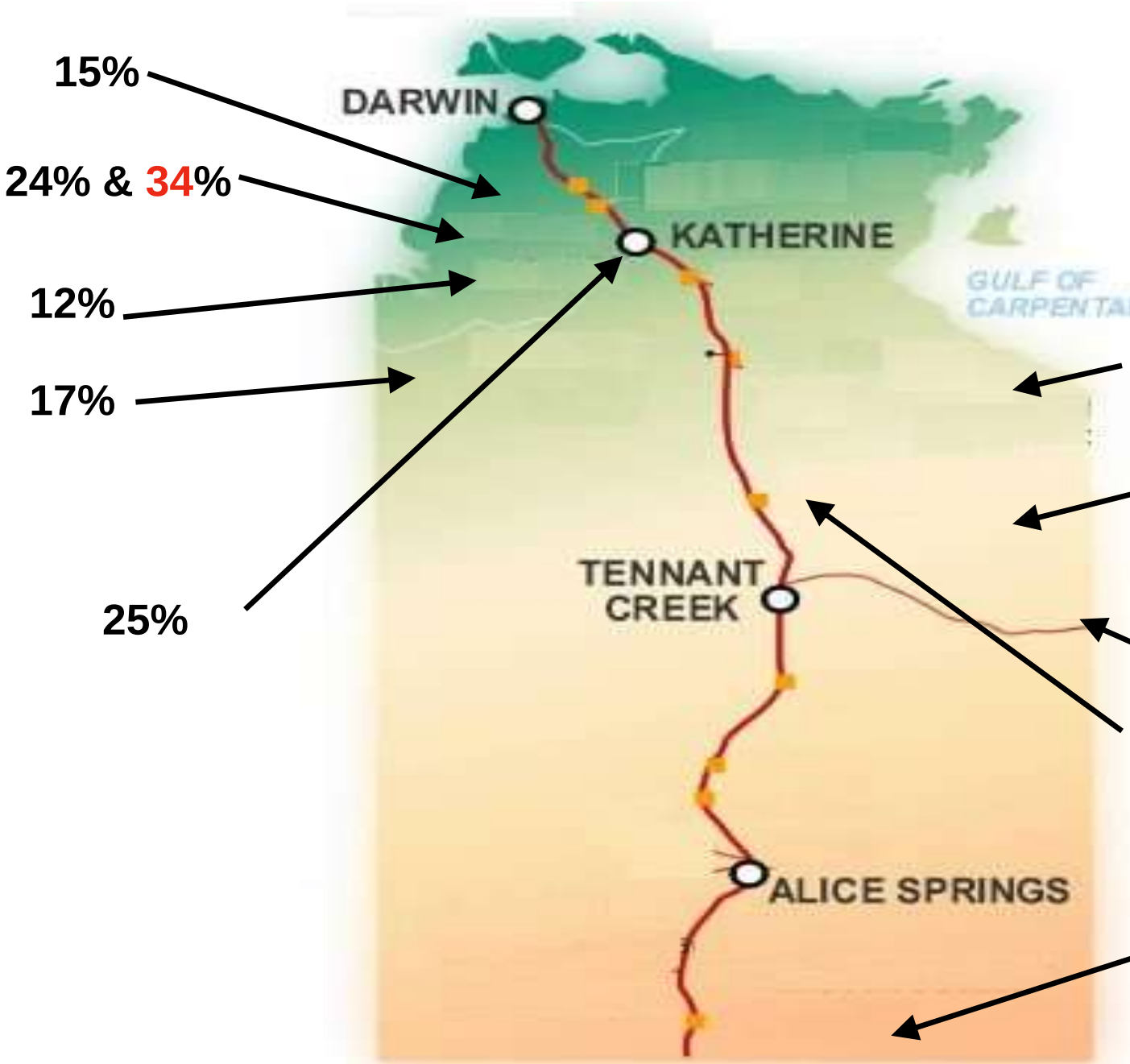
The death of calves in the first 2 weeks of life conservatively costs the northern industry $54M annually (Lane et al. 2015). Note- *This doesn't include the cost of calves that die outside this period.*

CashCow project final report (2014) figures:

Region	Median	25th percentile	75th percentile
Northern Forest	13.5%	9.4%	19.2%
Southern Forest (SE Qld)	4.6%	2.2%	8.5%

We are still are underestimating the problem as we calculate calf losses from preg testing and weaning records. So if a cow dies calving and doesn't turn up to a weaning muster "dry" then it is not included.

Losses are even greater in heifers calving for the first time



15%

24% & 34%

12%

17%

25%

NT Commercial station
Avg. loss = 22%

(Schatz and Hearnden 2008)

32%

10% Composite Stud herd.

30% Comp.

39% Santa

35% Santa

Big losses seen in big mobs in large paddocks

12% Angus

Calf loss has been difficult to investigate using traditional methods as calving females are difficult to find in large paddocks and close observation during calving alters behaviour and can even cause mismothering.

Also calf carcases are difficult to find under extensive conditions and so it is often not possible to conduct necropsies to determine the cause of death.

If calving could be monitored remotely it would enable collection of data that was not previously possible. This would greatly increase knowledge about calf loss and help identify solutions to reduce it.

CalfWatch aim: to develop a method to remotely monitor calving and find dead calves, and then to use it to find ways to reduce calf loss .

ie. find out where and when calves are born and then when, where and why they die.

Researchers at the University of Florida developed a system of using birth sensors to remotely monitor calving. Calf Watch adapted this system for use in northern Australia and uses it to investigate the causes of calf loss.

The UF system uses birth sensors that are inserted into the vagina of pregnant cows up to 4 months before calving. When sensors are expelled at birth, the rapid change in temperature causes them to start emitting a UHF signal that is received by antennas mounted on towers in a low-power wireless-area network (LPWAN). Signals are transferred by a gateway, via the internet to servers owned by the sensor manufacturer (JMB). A calving alert is then sent and is also immediately viewable on a website.

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The equipment was initially set up for a pilot study at Katherine Research Station over the 2018/19 calving season.

Acknowledge the great work of Jack Wheeler and KRS staff in designing and constructing the towers.

A fantastic piece of bush engineering.

Each tower has a read range radius of about 1.75 -1.9 km in 360 degrees from the tower

Towers are equipped with:

- **Power supply = 3 x 100W 12 V solar panels, 2 x 100 amp hour gel filled batteries, and a solar regulator**
- **An ethernet gateway attached to a UHF antenna to receive signals from expelled sensors and send them to JMB.**
- **An industrial quality rugged modem and a yagi antenna to send signals to JMB servers via the internet (due to poor mobile phone signal strength).**
- **Birthing sensors cost USD $177 each and a fully equipped tower cost about $9,500.**

After sorting out some teething problems it was found to work successfully (eg. one type of antenna caused gateways to fail).

Theoretically birthing sensors have enough battery life to be used two or three times …….. If you can find them.

However the pilot study found that expelled sensors and newborn calves are much harder to find in north Australia where paddocks are larger, have more trees and longer grass than the research sites in Florida.

This reinforced the need for additional ways of finding birth sites, especially for larger paddocks. Options:

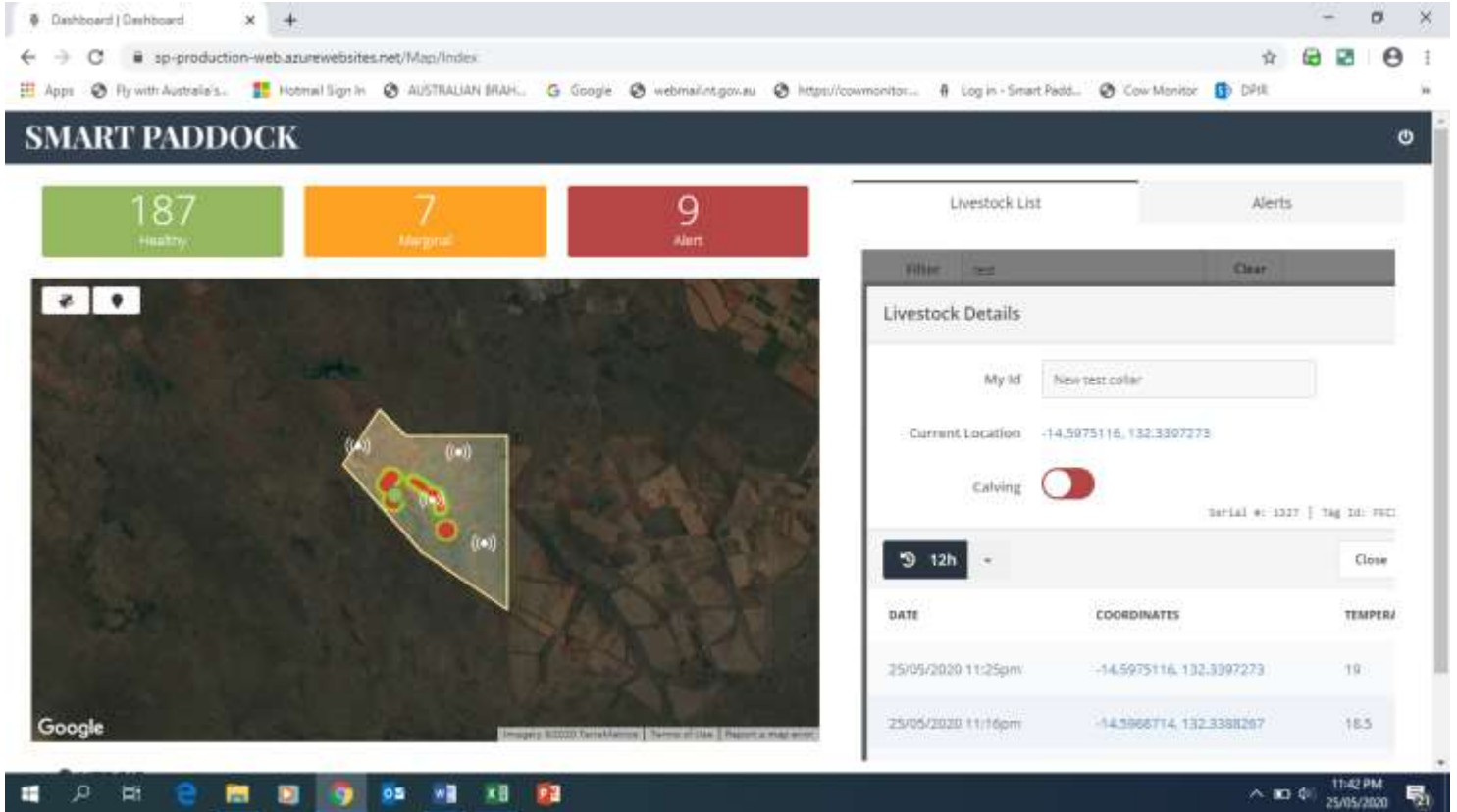
- **put GPS chips in birthing sensors (original plan, but manufacturer changed their mind).**
- **locate cows with additional GPS tracking tags once sensor alerts have been received.**

Find a GPS tracking collar that could do the following:

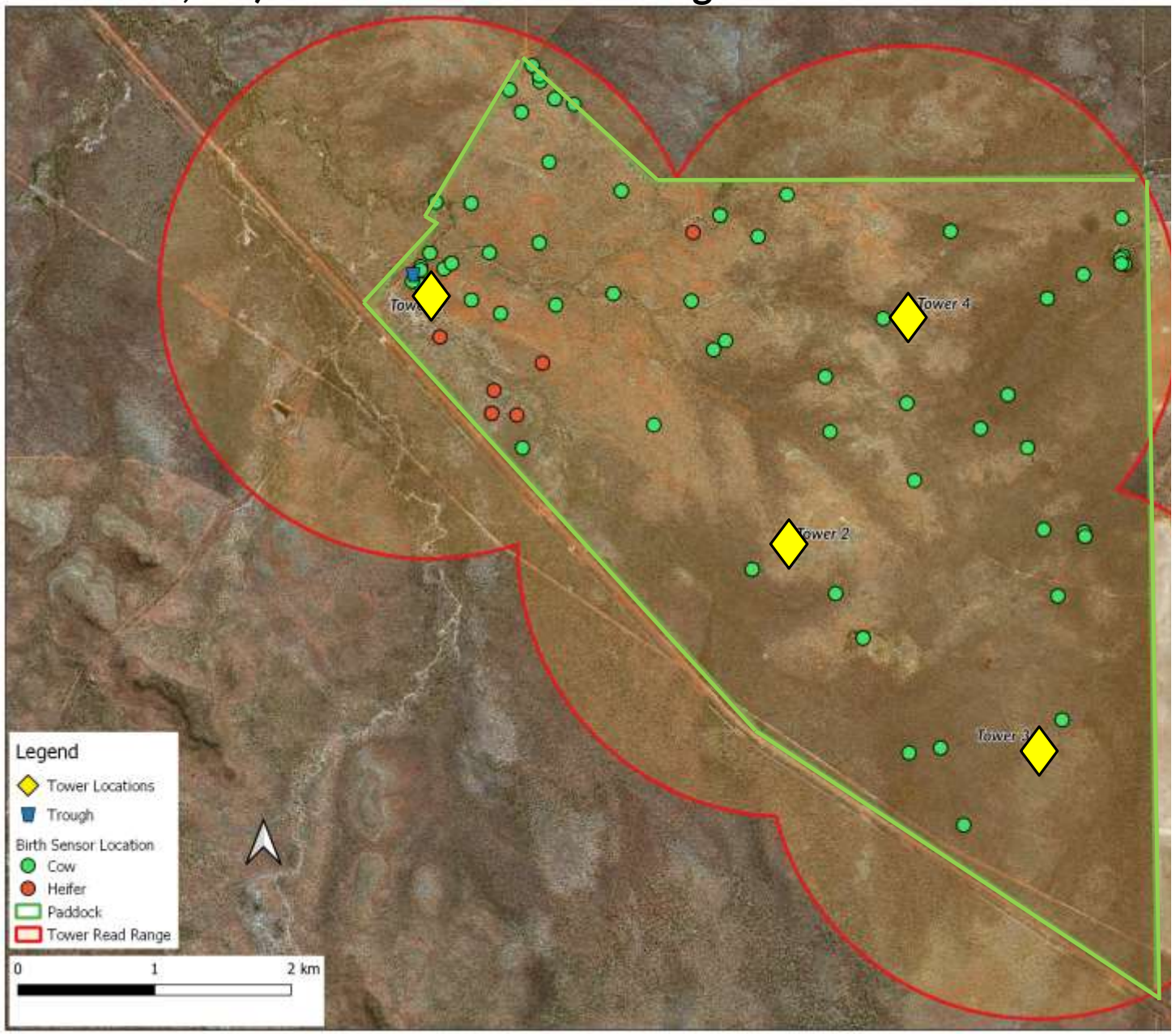
- **Ping each collar at least every 15 minutes**
- **Batteries last at least 4 months**
- **Provide GPS location of animals in real time (so that we can find out where they are when we get an alert). ie don't store data on board or communicate it hours later when animals walk past an antenna.**
- **Supply 200 collars by August 2019 at a cost of around $300 per collar.**

At the time the only company that could meet our requirements was Smart Paddock (an Australian company based in Victoria).

The total cost of a collar and the support to monitor it (monitoring equipment, website, site visit etc.) was $300.



Used the GPS collars in conjunction with the birthing sensor system in an expanded study at Manbulloo station (near Katherine, NT) over the 2019/20 calving season.



6 km

4 towers gave satisfactory coverage of the 2,215 ha trial paddock (un-cleared native pasture).

On 14/8/19 - 200 cows (due to calve Sep-Dec 2019) were fitted with birthing sensors and GPS collars….. World first for GPS collars on cattle on this scale.

Aim: get an alert when a cow calves ….. find her location from the GPS collars which transmit the location of each cow every 15 minutes…. find her in the paddock and record observations.

Alerts were successfully received from 85% of birth sensors, and if the GPS collar was working we were able to locate cows for observation at calving. This allowed us to observe more cows calving in a big paddock that would be possible without this technology, and with minimum disturbance.

However - there were some issues with GPS tracker reliability. It was almost impossible to find cows if the alert was received when the collar was not working…… wait until they come in to the water trough to get observations.

The GPS collar problems have been identified…… failures were due to high temperatures affecting the LoRaWAN antenna circuitry design causing the outbound signal to scramble.
Also moisture got inside some enclosures – due to heating and cooling causing a high pressure differential and air leakage into the enclosures even though they were IP (ingress protection) rated.

A new improved model has been developed and will be used over the 2020/21 calving season.

The collars also contain accelerometers – may be able to identify time of calving from characteristic change in movement patterns

If proven to be a reliable method…….. No longer need for birth sensors.

Despite GPS collar issues, it was possible to get observations on most cows within 2 days of calving due to hot dry weather which meant that most cows congregated around the single water point during the day before grazing away at night.

Mean maximum temperatures : Oct = 39.8°C, Nov = 40.4°C, Dec = 40.8°C. No rain until 2/12/19.

Allowed daily visual checks of most cows. If GPS data was not available for calving cows then observations were recorded when they came for water in the days after calving.

Alerts were received from 85% of birth sensors soon before calving.

Of the sensors that did not give an alert correctly;

- **4 sensors were expelled early (more than one month before calving)**
- **2 alerts were received after cows had been observed to have calved**
- **No alert was received from 21 sensors. Failure of these 21 sensors is difficult to assess, 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).**

Sufficient data/observations were collected to be able to determine the outcome of 208 pregnancies.

The calf loss rate in mature cows (16.8%) was at the high end of the normal range for mature cows (CashCow 25th - 75th percentiles for the Northern Forest zone = 9.4% - 19.2%).

The foetal and calf loss rate in first calf heifers in this study (36%) was very high and was well above the CashCow 75th percentile reported for first calf heifers in the Northern Forest zone. *(They had been trucked to a harsher location while pregnant).*

The calf loss in mature cows (16.8%) was higher than the average at this site in the previous 4 years (10.7%).
It is difficult to determine the reason for this increase, and is likely due to the cumulative effect of several different factors:

- **The late start to the wet season and very poor wet season (worst in 50 years).**
- **The extra activity of people in the paddock taking observations of cows at calving (although care was taken to disturb cows as little as possible).**
- **Wild dogs were present in the paddock (trail camera photos), but actual evidence of dog attack was quite low - 2.5% of calves with bite marks at weaning – compared to NT average = 6.2% (McCosker and Dobbie).**

Dogs were seen chasing 1 calf but it had previously been noted to be sick, weak and wobbly….. which is probably why they were chasing it.

Also we set up a portable yard in the paddock and mustered a group of cows and calves to tag 50 calves with VHF tracking tags with accelerometers.

Tested the technology but may have contributed to calf loss (mismothering) - although they were only in the yard for a couple of hours.

(It was not possible to catch and tag calves at birth safely).

Causes of calf loss in mature cows - CalfWatch Manbulloo 2019/20

Birth – 2 days

6% in first calf heifers

Less unknown cases with better GPS tracking

	Calf loss
Dystocia loss	1%
Peri-natal loss - unknown cause	4%
Post-natal loss - unknown cause	4%
Post-natal loss - bottle teats	6%
Post-natal loss – Neonatal septicaemia via umbilical cord	0.6%
Post-natal loss – infection of the umbilical cord	0.6%
Total loss	17%

resulted in low grade bacteraemia causing nephritis (infection of the kidney), hepatitis (infection of the liver), interstitial pneumonia (infection of the lung) and septic arthritis (infection of joints) – the calf chased by dogs

caused by bacterial invasion via the umbilicus

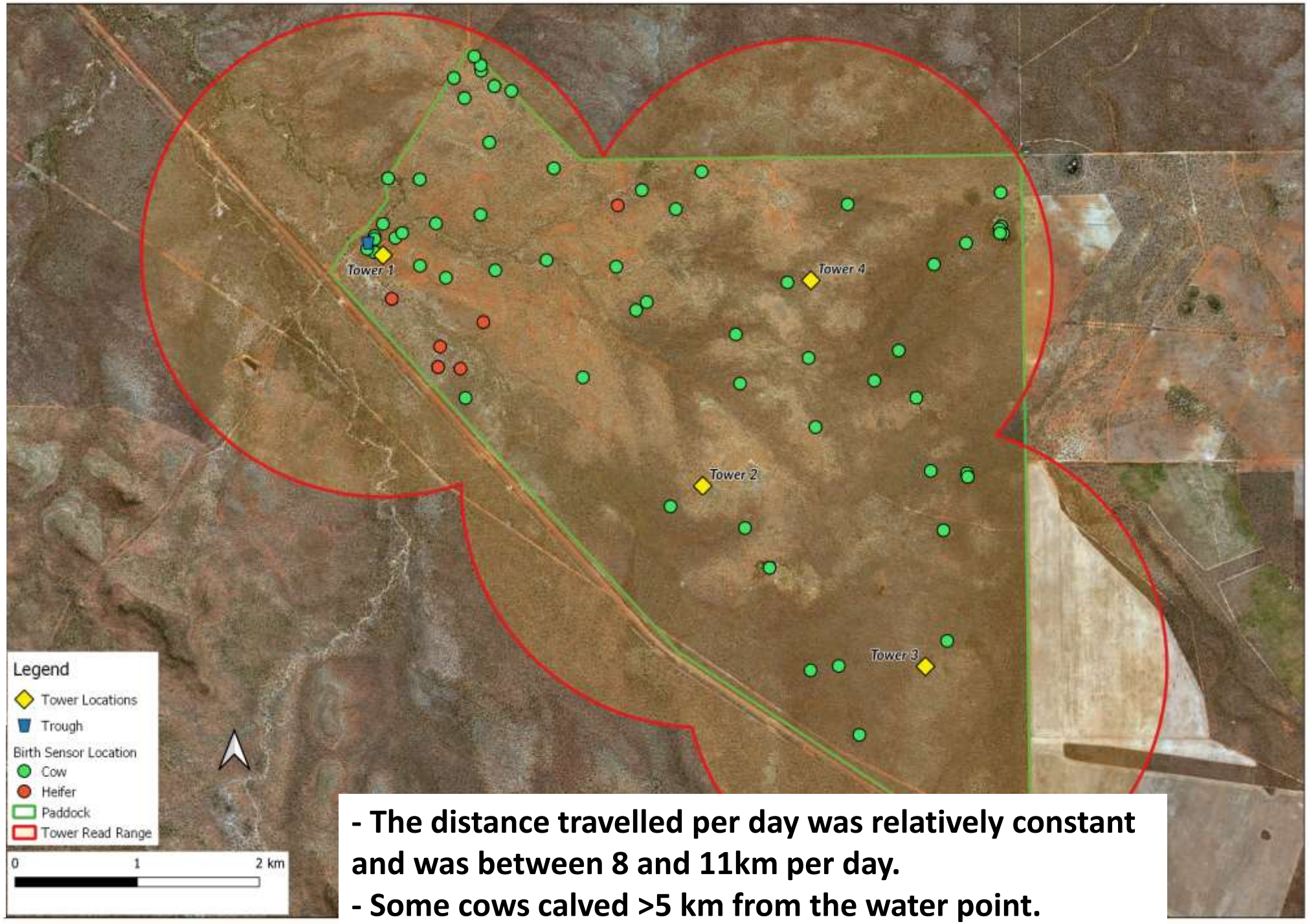
Bottle teats are a bigger problem than previously thought. The calving alerts allowed a greater number of cows to be observed shortly after birth than normally happens in extensive situations in northern Australia.

A number of cows that lost their calves were observed to have bottle teats shortly after calving, but several weeks later their udders looked normal and so they would not be identified as having bottle teats at a muster several months later. Therefor it is likely that cows with bottle teats are remaining in herds and losing multiple calves.

As with previous studies there were still a number of calves lost to unknown causes – extending the project for another year with better GPS tracking should reduce the number of losses where the cause cannot be identified.

Despite most cows congregating around the water during the day, it seems that the majority either walked away to calve in more private locations or did not come in to the water point on the day that they calved.
Birth sites were distributed quite evenly throughout the paddock although there were some calving “hot spots”.

Heifers calving for the first time tended to calve closer to water than older cows (1.19 vs 2.78 km).

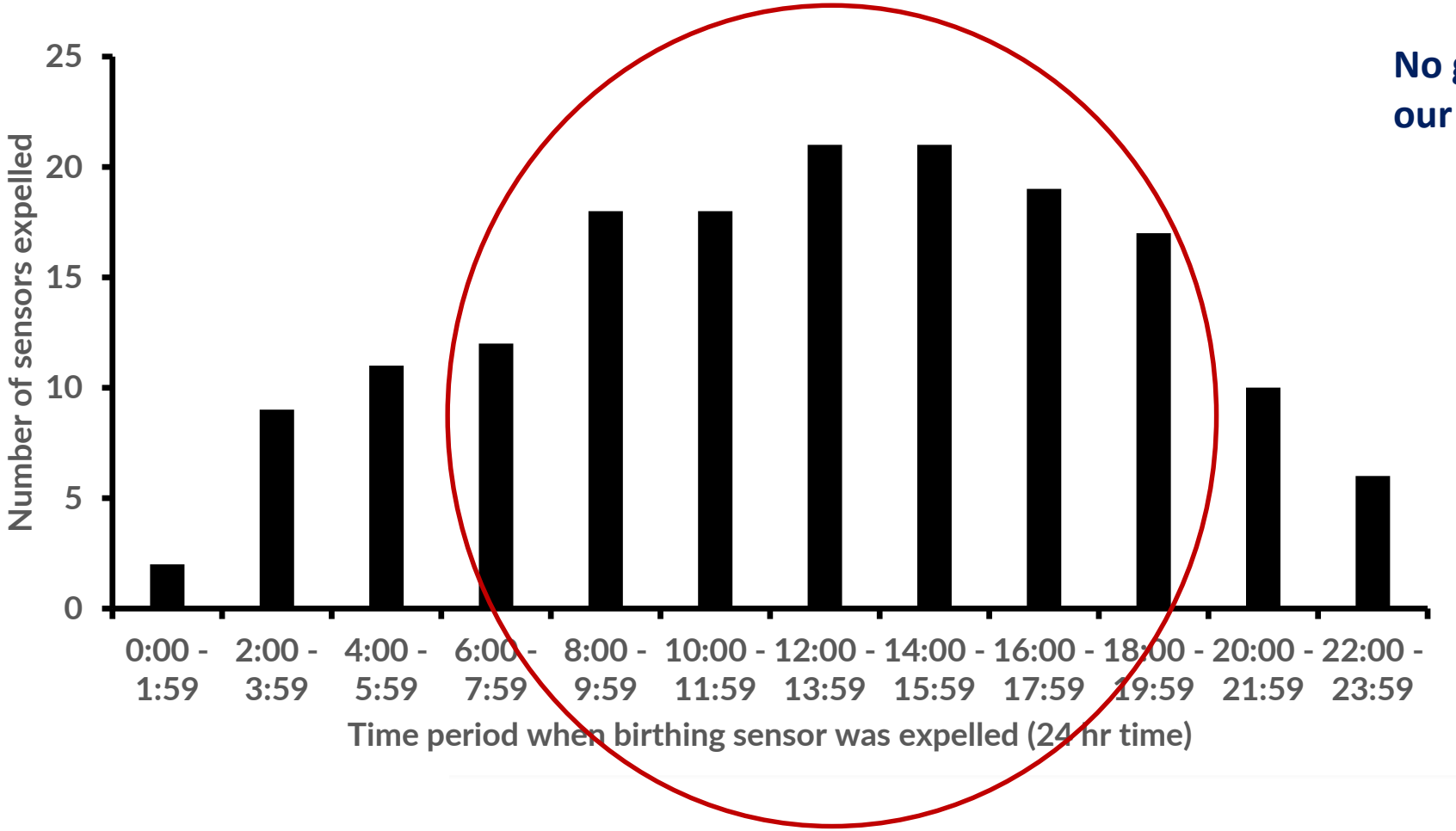


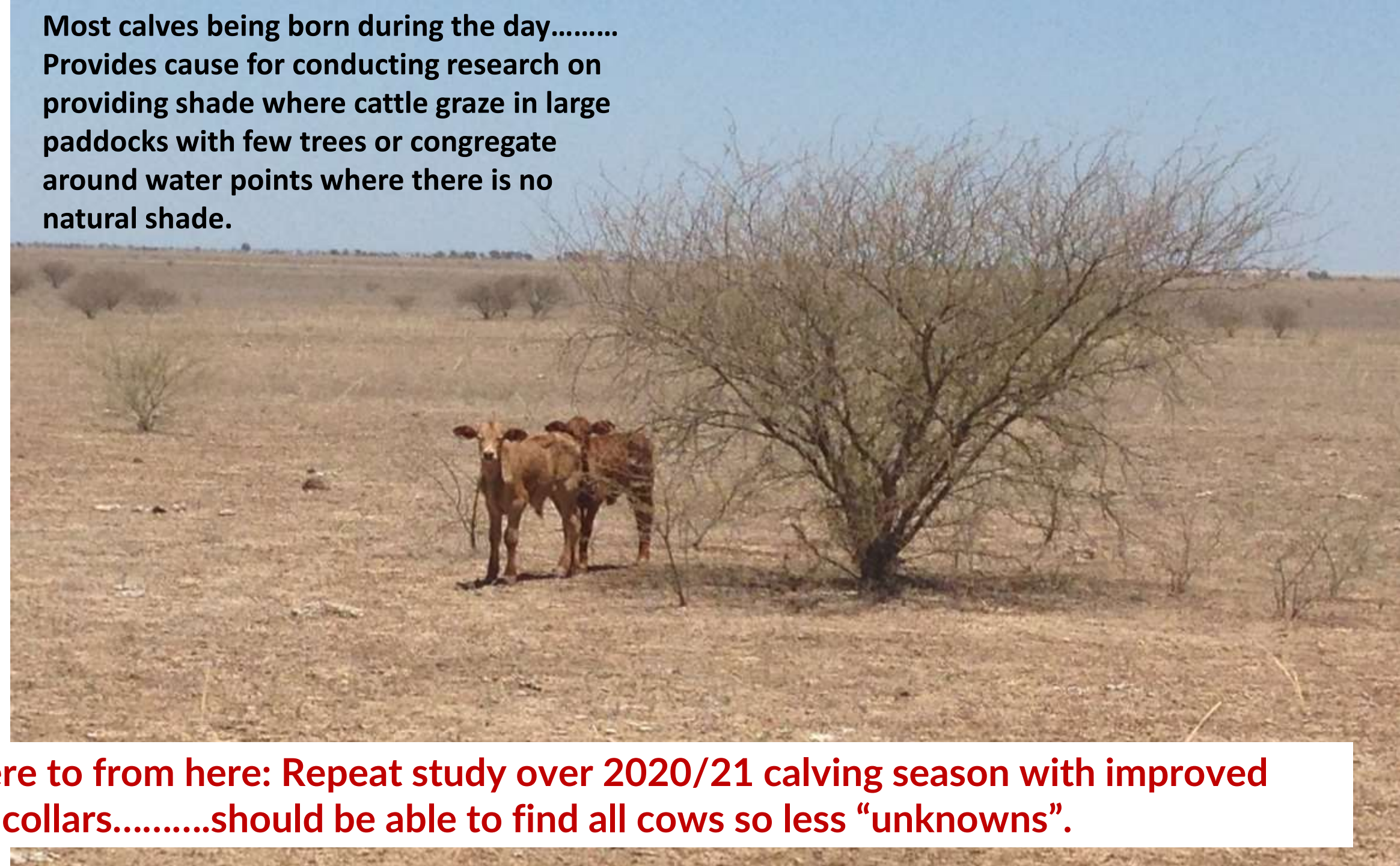
- The distance travelled per day was relatively constant and was between 8 and 11km per day.
- Some cows calved >5 km from the water point.

71% of birth sensors were expelled during daylight hours (6:00 to 19:00) with the peak period being between 12:00 and 15:00.

Studies in the USA have found that night feeding results in a high proportion of calves being born during the day.

No grass around the water point meant our cows were feeding at night.





- **Where to from here: Repeat study over 2020/21 calving season with improved GPS collars……should be able to find all cows so less "unknowns".**

Acknowledge the help of the following people:

- Jack Wheeler and his crew for designing and building the towers, and cattle work.
- Staff who did calf checks and responded to calf alerts especially: Elle Fordyce, Mel Wooderson, Jane Douglas, Gretel Bailey-Preston, and Gabriel Ribeiro and Hugo Mello (Brazillian students).
- Raoul Boughton (University of Florida)- technical expertise, help with many aspects.
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- Comcat Katherine– supplying and help installing equipment.
- MLA – Project funding

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