



Department of
Primary Industries

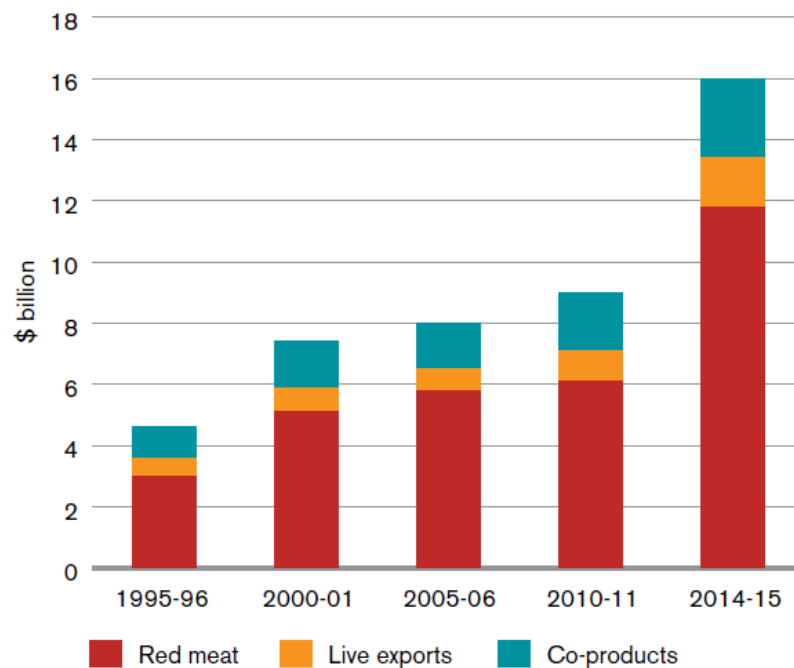
Precision Livestock Management

Dr Robin Dobos
Livestock Systems

Precision Livestock Management

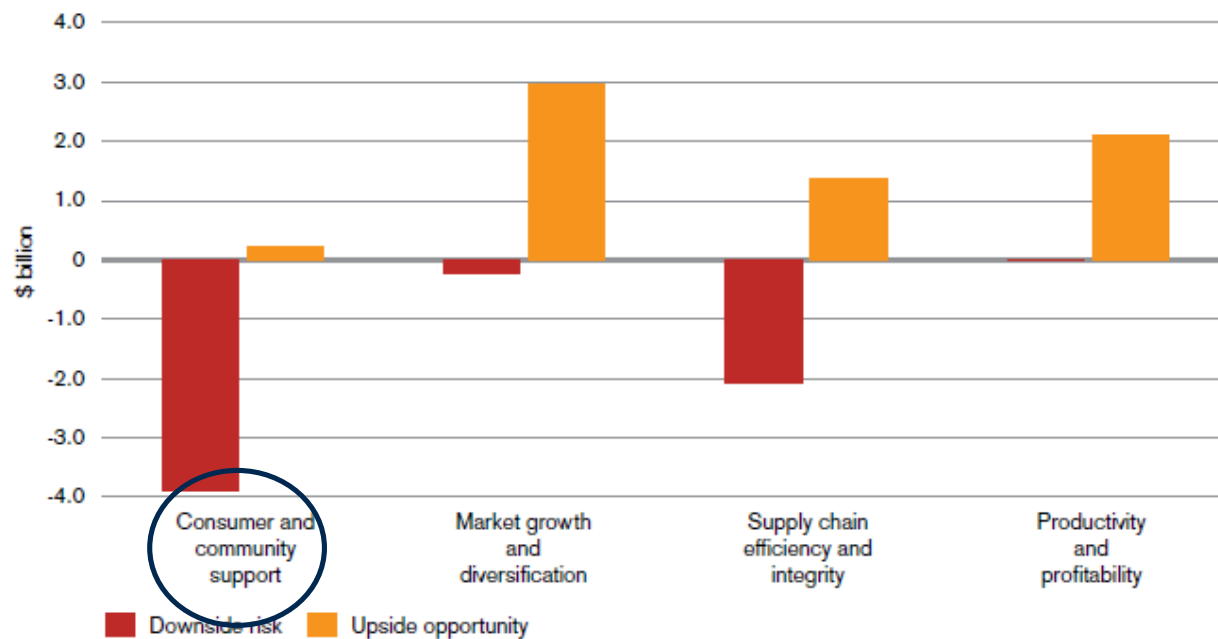
- Challenges & Opportunities - MISP 2020
- Monitoring pastures
- PLM
 - Definition
 - Introduction
 - Research
 - Applications
- Discussion

Figure 2. Value of red meat, live export and co-product exports 1995-2014



From MISP 2020

Figure 9. Forecast value of risks and opportunities (by pillar) to 2030*



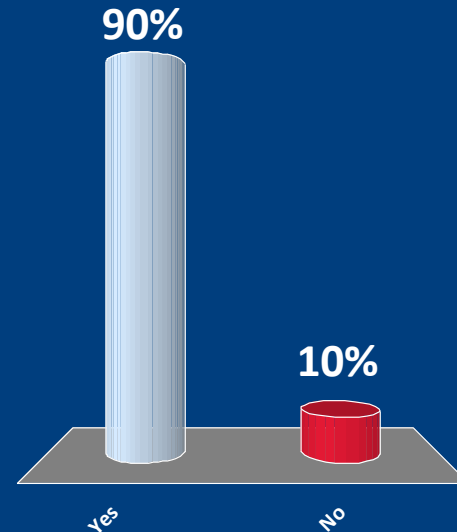
* Relative to the baseline net industry income increase of \$48,320 million by 2030 (in 2015 dollars and 5% real rate of return)

MISP 2020

Do you believe consumer perception has/or will have an impact on the way you farm?

1. Yes

2. No



Challenges

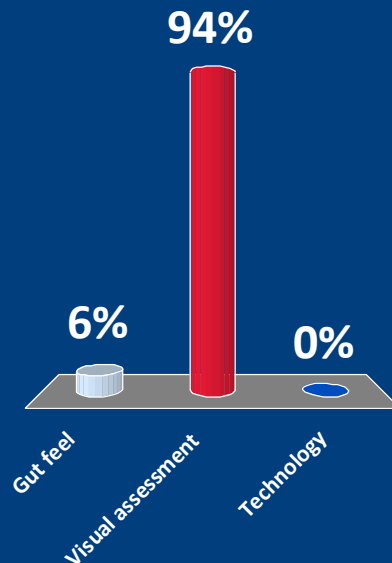
- Off-farm costs greater than our competitors
- On-farm productivity performance is now below productivity improvements being secured by our major competitors
- The onus on the production sectors is to find new pathways to productivity
- This is an on-going challenge for our industry.

The opportunities

- Opportunities exist for *new technologies* to keep the Australian red meat industry internationally competitive
 - Reducing cost of production
 - Increasing efficiency of production from pasture
- Is there a role for Precision Livestock Management?

How do you determine how much pasture is in a paddock?

1. Gut feel
2. Visual assessment
3. Technology

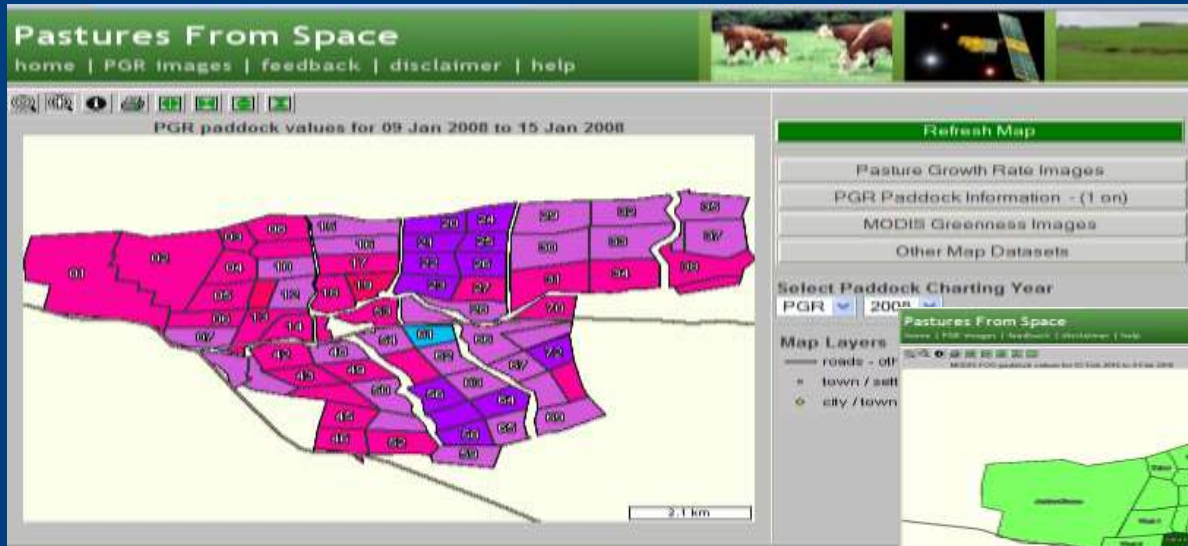


Monitoring pastures

- Many methods
 - Visual
 - Rising plate meter
 - Capacitance meter
 - Active optical sensors (eg GreenSeeker)
- Calibration
- Diverse species

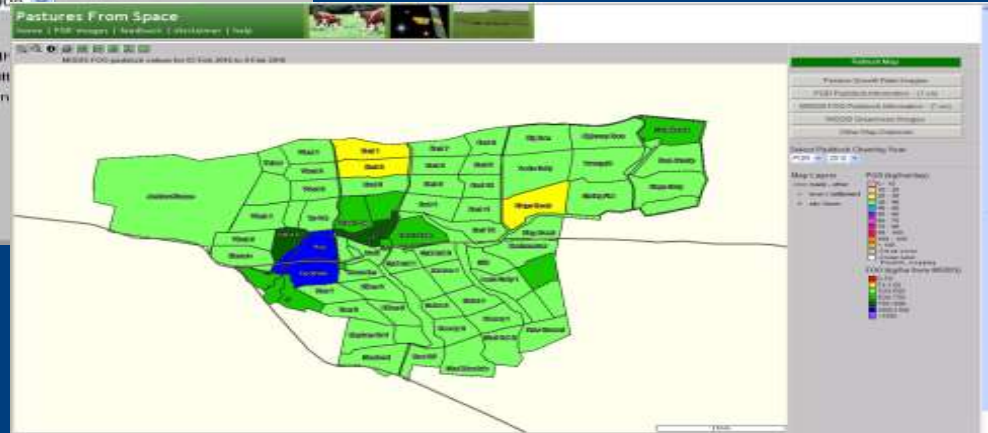


Pastures from Space



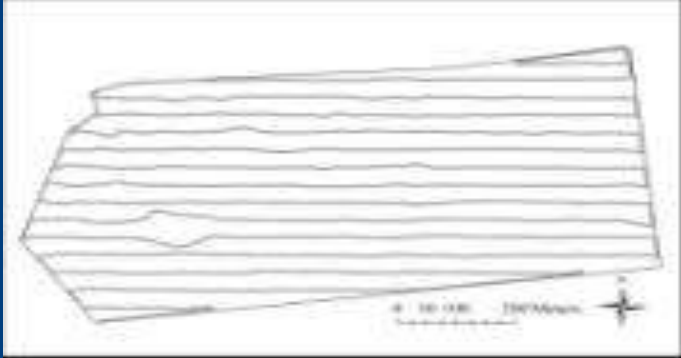
Pasture Growth Rate
(PGR)

Food-on-Offer (FOO)



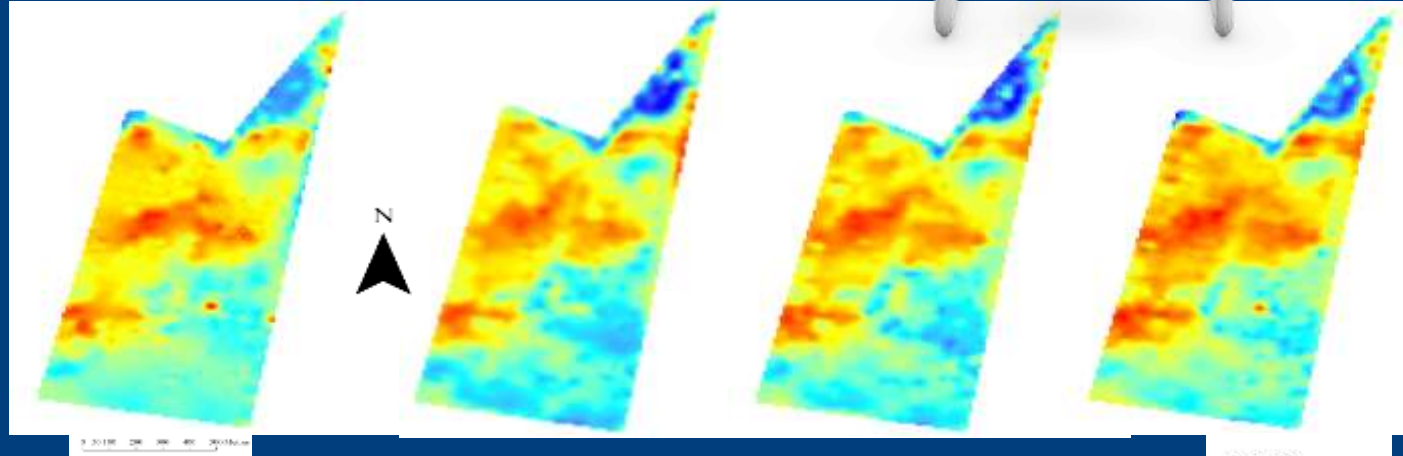
Donald GE, Trotter MG, Lamb DW (2010) Precision livestock management: an example of pasture monitoring in Eastern Australian pastures using proximal and remote sensing tools. In '10th International Conference of Precision Agriculture'. Denver, Colorado, USA. (Ed. R Kholsa). (Colorado State University).

Mapping

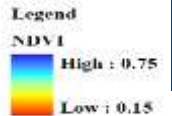


UAV deployment?

On-ground
CropCircle
(ACS-210)



80 ha Wheat (early flag leaf)



Precision Livestock Management (PLM)

Definition

- Ability to identify critical-control points in the production system early enough to implement corrective measures to ensure animal health, welfare and sustainability are not compromised

Precision Livestock Management

- The ability to monitor *individual* livestock and provide producers to enhance decision making in the livestock production system
- Has the potential to facilitate more rapid, frequent and objective monitoring of animal performance

What do we already know about our livestock system?

- Species, sex, age, class
- Environmental information (temp, rainfall, wind etc)
- Pasture/feed availability

But what are the animals doing?

What are your animals doing?

- Behaviour
 - fast and direct reaction to environmental changes
 - direct interaction with other animals
 - indicator of animal wellbeing or stress
 - Lameness, infected (internal parasites etc)

How can you use this important information?!

Sensors used in PLM

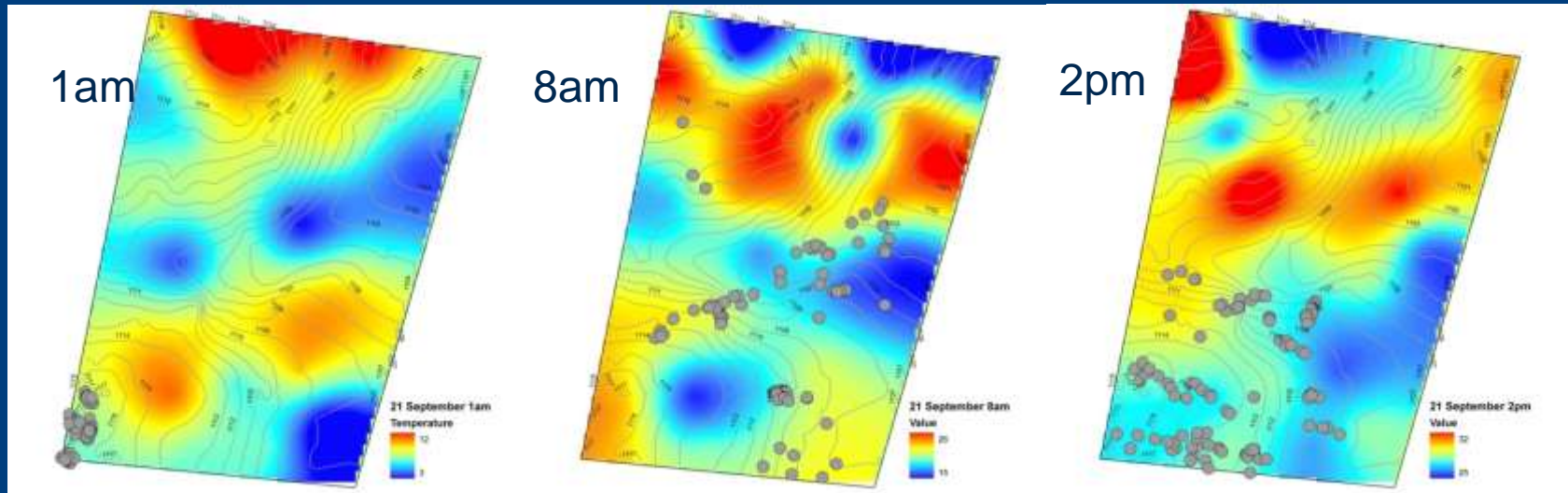
- Many sensors exist
 - Measure motion (accelerometers, gyroscopes)
 - Location (GPS/GNSS)
 - Direction (magnetometers)
 - Height & density of pasture (Active Optical Sensors)
 - Temperature, soil moisture etc
- Currently used in:
 - Intensive animal industries eg dairy (motion sensors)
 - Lameness, oestrus detection
- Can they be used to help producers improve management?

DPI/PARG Research are addressing five areas

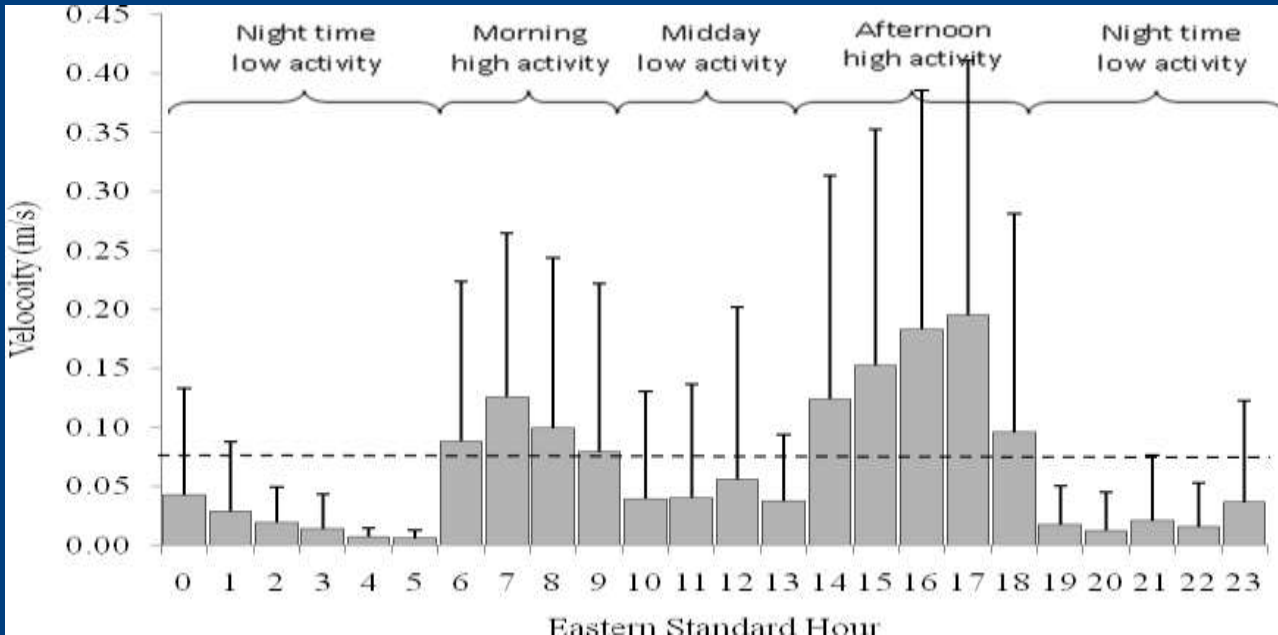
1. Determination of the key indicators that can be identified using sensors;
2. Field testing of a few technologies currently available;
3. Data analysis
 - integrated solutions that improve producer decision making;
4. Define the value created by the use of PLM;
5. Collaborate with commercial partners for on-farm use

Which parts of the farm are the livestock using?

- Where you expect your cattle to go isn't always where they do go!



Understanding livestock behavioural patterns



Trotter MG, Lamb DW, Hinch GN, Guppy CN (2010) Global Navigation Satellite Systems (GNSS) livestock tracking: system development and data interpretation. *Animal Production Science* 50, 616–623.

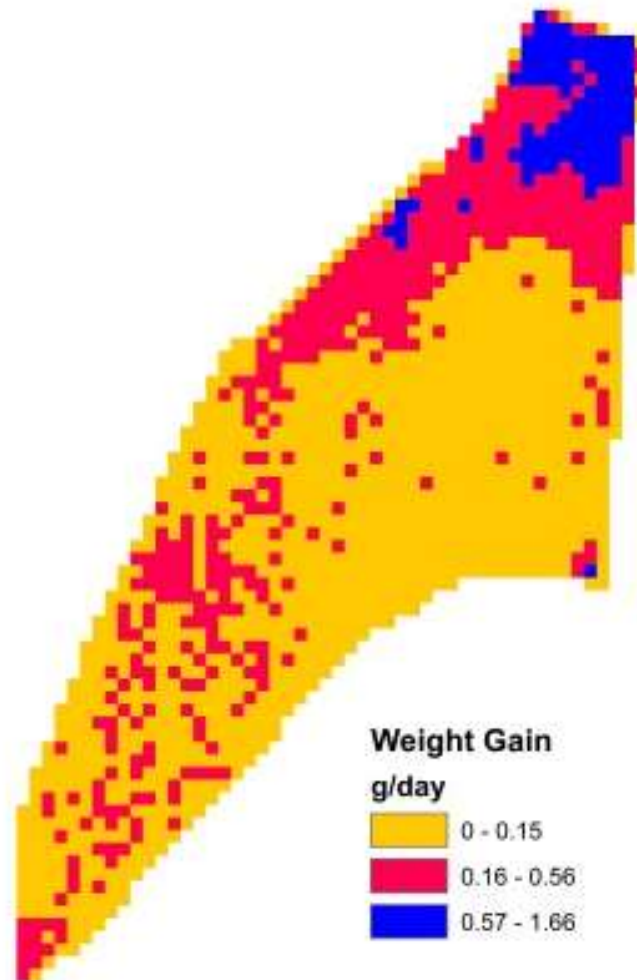


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Combining pasture and animal

- Animal Product Yield Maps (APYM)

An APYM reveals the spatial variability and productivity expressed in terms relevant to producers (e.g. kilograms of red meat grown per day).



After Trotter et al (2014)

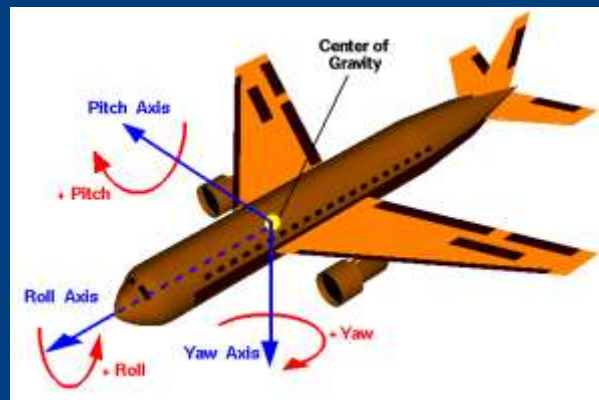
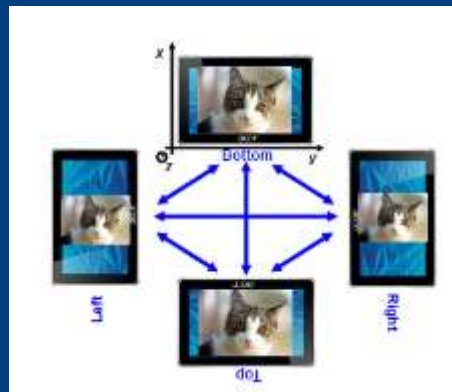
Measuring animal activity

Accelerometers

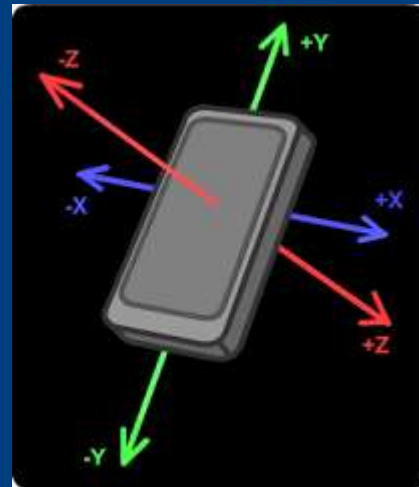
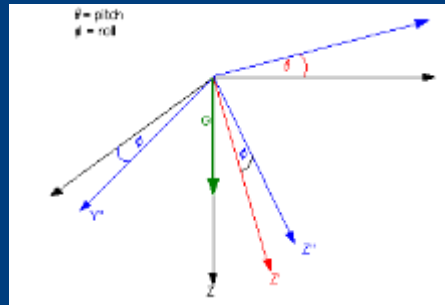
They are every where:

Air bags, phones, computers, watches, TVs, etc etc

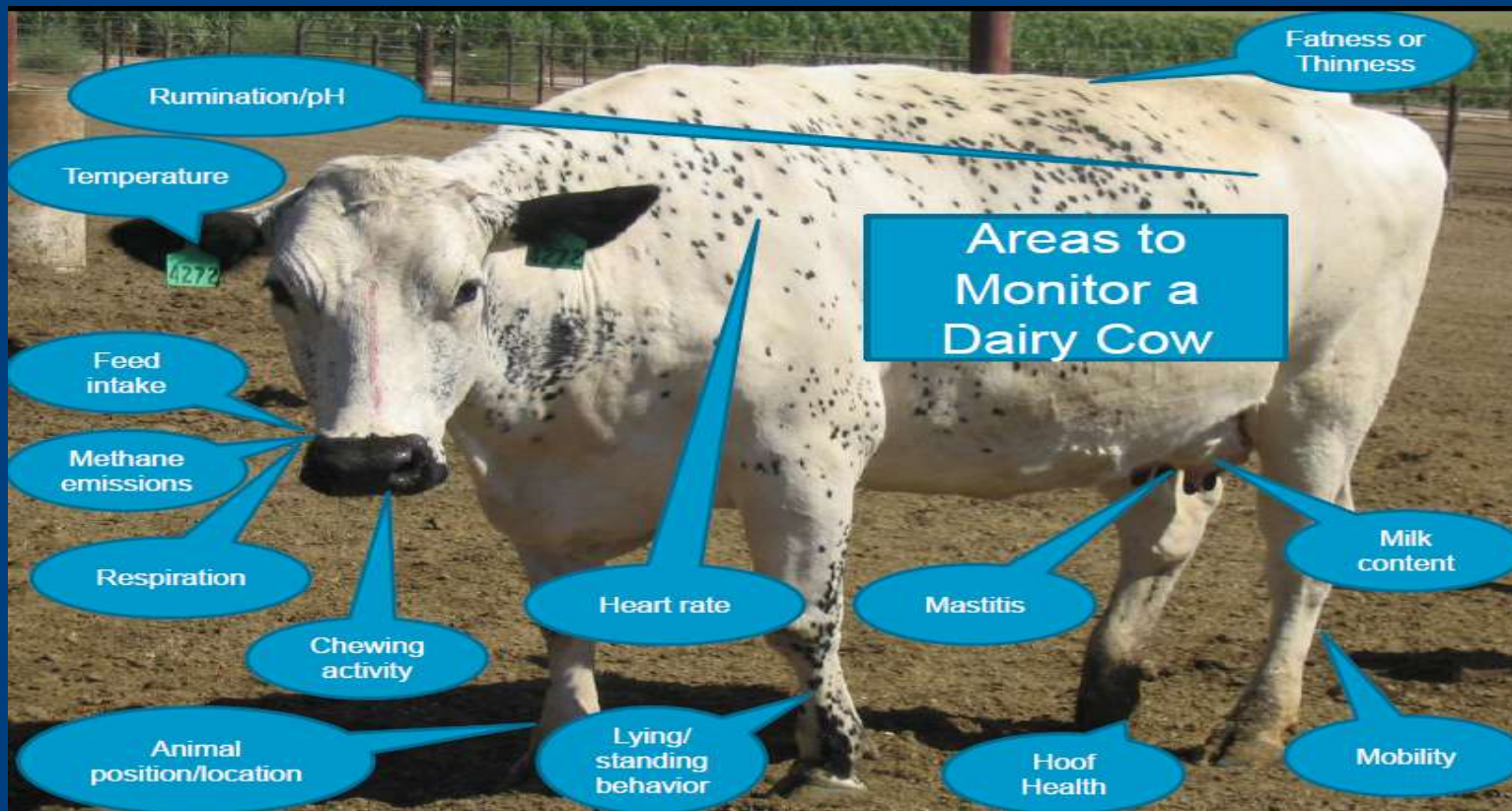
Ability to monitor individual animals



$(|G_{px}| < 0.5g)$ AND $(G_{px} > 0.5g)$ AND $(|G_{py}| < 0.4g)$: Change orientation to Top
 $(|G_{px}| < 0.5g)$ AND $(G_{px} < -0.5g)$ AND $(|G_{py}| < 0.4g)$: Change orientation to Bottom
 $(|G_{px}| < 0.5g)$ AND $(G_{py} > 0.5g)$ AND $(|G_{px}| < 0.4g)$: Change orientation to Right
 $(|G_{px}| < 0.5g)$ AND $(G_{py} < -0.5g)$ AND $(|G_{px}| < 0.4g)$: Change orientation to Left.

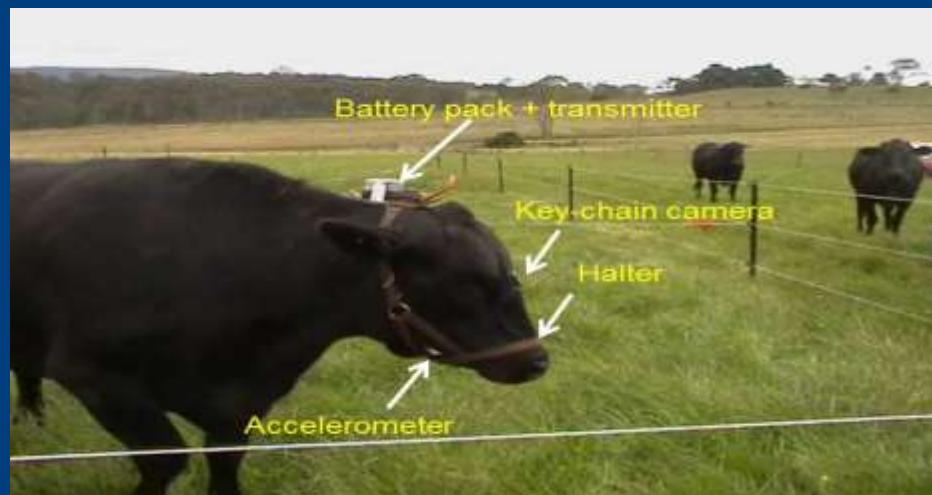


What do we measure on the animal?

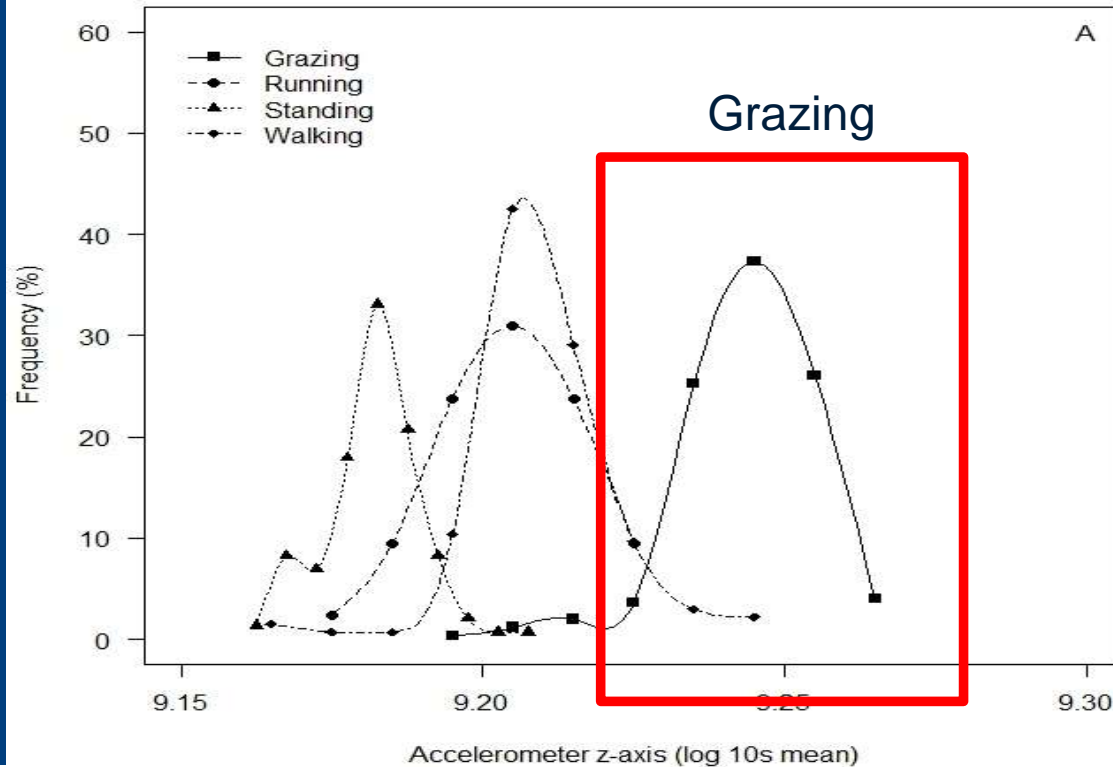


NSW DPI & UNE PARG studies

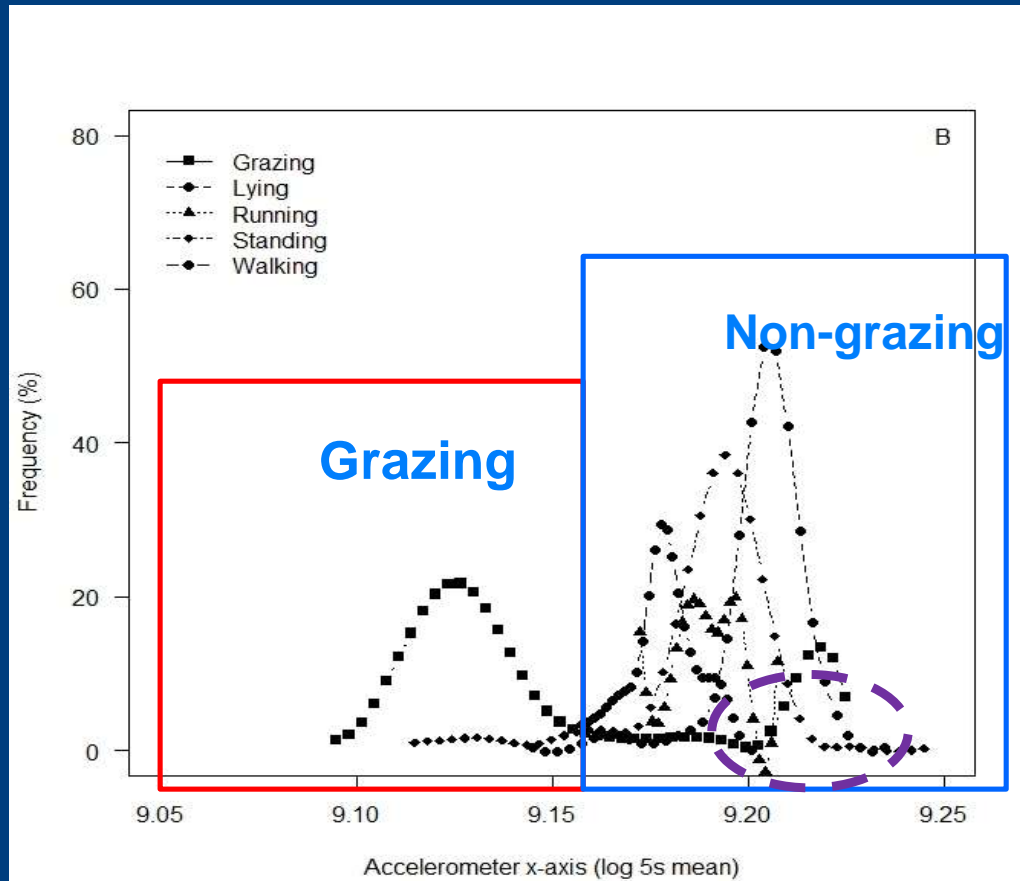
- Cattle and sheep activity at pasture
 - What are they doing
 - Head movement (grazing)
 - Jaw movement (biting, chewing)
 - Searching (walking)
 - Resting (lying/standing)
- Behaviour classification
- Monitoring health
- Estimate intake
- Energy expenditure
- **Annotation**



Categorization of behaviour - cattle



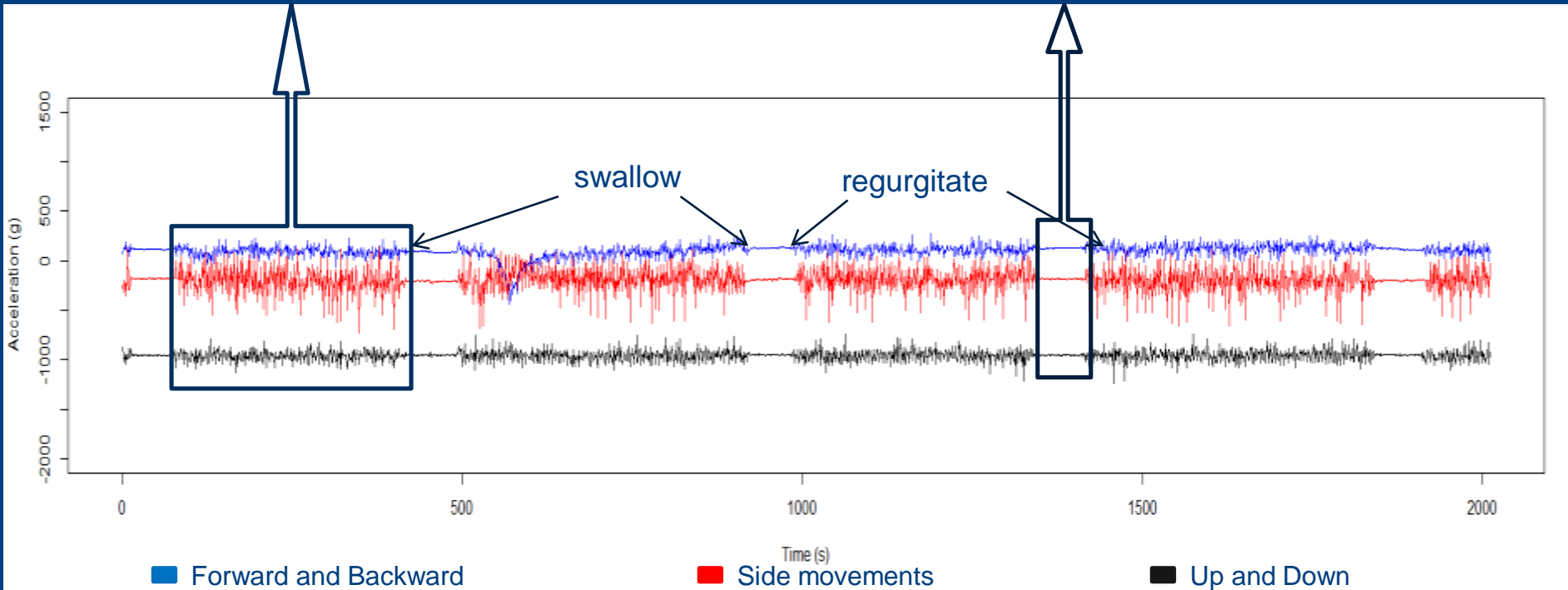
Categorization of behaviour - sheep

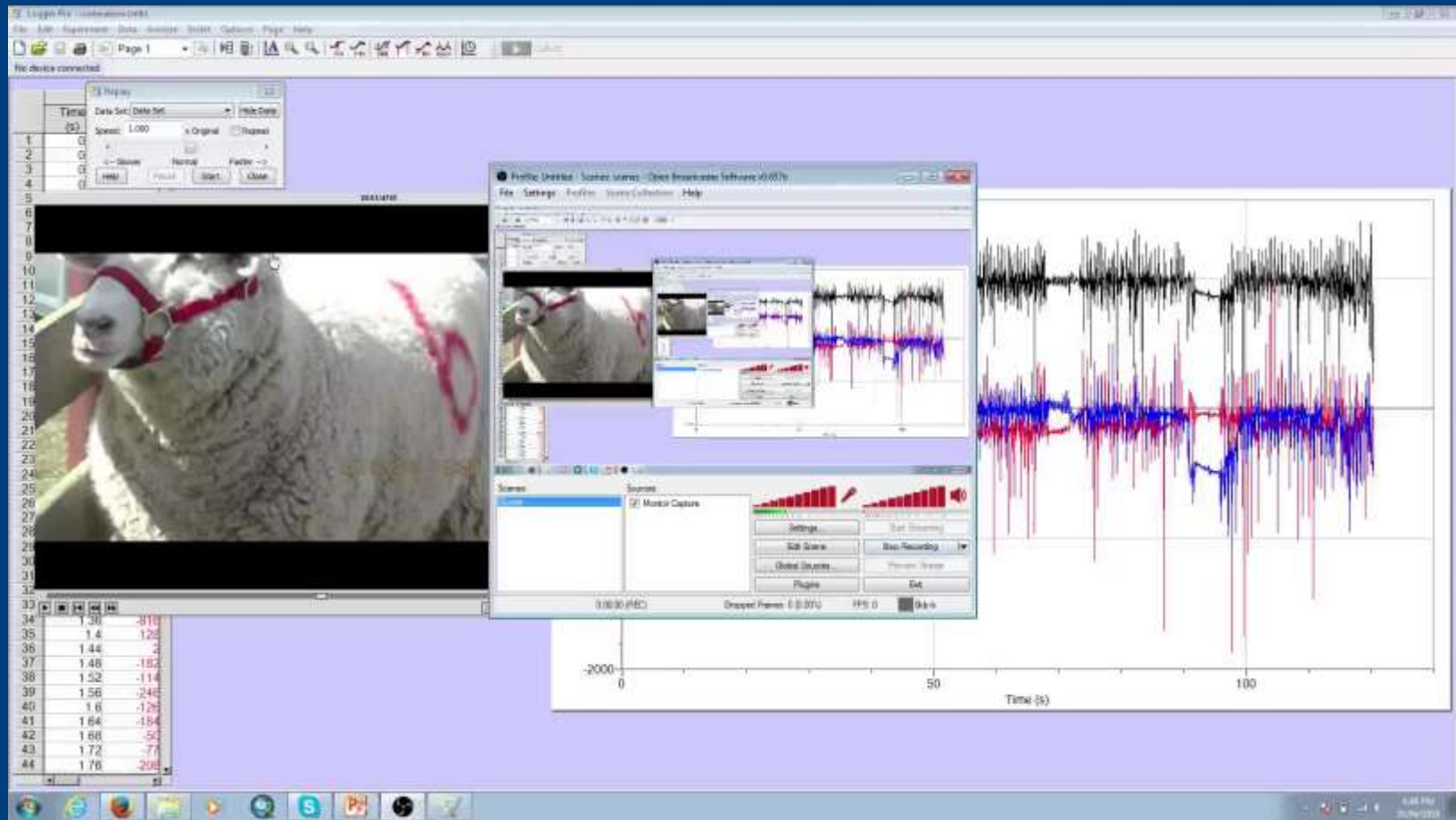


Rumination Behaviour - sheep

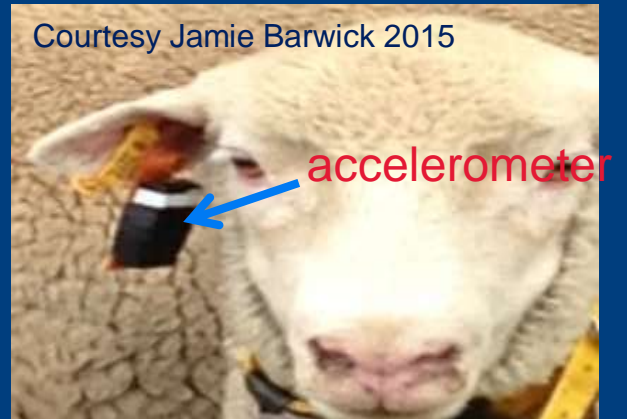
“Chewing”

“Nothing”





Courtesy CSIRO





Courtesy Sam Platts 2016

Past, present & future research

- GPS
 - Location
 - Activity (poor predictor)
 - In combination with climate sensors
- Activity sensors
 - Grazing, walking, standing, lying, ruminating, etc (high accuracy)
 - Eating (jaw movements) – intake
- Location + activity (real-time)
 - Personal navigation system for livestock
 - Identify **individual** animals
 - What are they doing, where are they?
- Virtual fencing
 - legislation

Given all the components we can measure, what do you think is the most important to your livestock business?

Challenges - PLM

- “Making sense of sensor data”
 - Algorithms
 - Between animal variation
 - Sensor location (ear tag)
 - Annotation of behaviour + signals
- Valuing PLM?
- Commercialisation
 - Partners
- PLM – red meat industry’s international competitiveness
 - Investment at the R&D phase by RDC etc

Acknowledgements

- NSW DPI collaborators
 - Dr Paul Greenwood, Dr Hutton Oddy, Soils, Pasture & Climate groups within Livestock Systems
- University of New England, Precision Agriculture Research Group
 - Dr Mark Trotter, Prof David Lamb, Mr Derek Schneider, students
- CSIRO – “Chiswick”, Armidale
- Commercial companies
- CRCs
 - Spatial Information
 - Sheep
- Funding bodies (MLA, DA, private)

Thank you

Discussion/Questions