Simple ways to use genetics to improve reproduction in beef cattle

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Presentation to Gyranda Open Day 2016
Overview

• defining reproduction
• what is latest research
• how does days to calving work
• putting it together – practical approach
• questions

...out to the yards
Profit drivers in northern Australia

- Relative trait importance for northern beef breeding

![Bar chart showing the relative trait importance for northern beef breeding. The chart highlights Cow Weaning Rate as the most important trait with 39%, followed by Sale Liveweight Dir. (19%), Dressing % (9%), Saleable Meat % (11%), and Cow Survival Rate (15%). Other traits like Fat Depth (rump), Marbling Score, Cow Weight, Calving Ease - dir., and Calving Ease - mat. have lower importance with 0% each.]}
What is beef cattle reproduction?

complex trait, different female & males

puberty
cycling
ovulation
conception
pregnancy
calving
weaning

pubertal
semen volume
viable sperm
morphology
libido
dominance
serving ability

= net reproduction rate
Controllers of reproduction

Nutrition big factor (+ health, disease)

BUT latest research

- underlying genetic control
  - especially components (not just calf or not)

- differences between bulls in reprod. rate of daughters
- can improve weaning rate by selection
Latest research findings

1) Early in life component traits of female reproduction heritable

- **heifer**
  - *age at puberty*
  - highly heritable

- **1st calf-cow**
  - *time to re-cycle*
  - mod–highly heritable

**big differences between sires daughter’s performance**

- both traits highly related lifetime female reproduction
- select these 2 traits to improve lifetime performance
2) DNA adding accuracy to predictions
   – Need large reference populations

3) Male traits highly heritable (passed on!)
   – scrotal + other physical (e.g. preputial eversion)
   – BBSE measures (crush side, lab morphology)
Ovarian scanning

Corpus Luteum (CL)

First observed CL

- 2,200 cows BRAH & TCOMP
- 4-8 wks from 14 months to 9 yrs

AGE AT PUBERTY & Post calving recycle
Key FEMALE trait heritabilities

- age at puberty genetic control
- related to lifetime reproduction
Brahman sires

<table>
<thead>
<tr>
<th>Heifer Age</th>
<th>EBV (months)</th>
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<tbody>
<tr>
<td>BELMONT 510/97</td>
<td>-6.1</td>
</tr>
<tr>
<td>LANCEFIELD 4999M</td>
<td>-4.9</td>
</tr>
<tr>
<td>BELMONT 268/97</td>
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<tr>
<td>BELMONT 79/96</td>
<td>-4.7</td>
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<tr>
<td>LANCEFIELD DESTINY</td>
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<tr>
<td>TARTRUS ABEL MANSO</td>
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<tr>
<td>ALLAWAH M119</td>
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</tr>
<tr>
<td>ALLAWAH M90</td>
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<tr>
<td>CONA CREEK EQ773</td>
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<tr>
<td>ALLAWAH M137</td>
<td>+4.8</td>
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<tr>
<td>CONA CREEK 3062</td>
<td>+5.1</td>
</tr>
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</table>

Heifer age at puberty affects EBVs (months). The impact on maiden calving rate is significant; many heifers are not pubertal at first mating.
48% wet 1st calf BRAH cows only resumed cycling after calf weaned

Calving rate: wets 41% (dries 81%)

Wet 1st calf cow resumption of cycling
Key FEMALE trait heritabilities

- re-cycling lactating cows genetic control
- highly related to lifetime reproduction
### Lactation anoestrous interval EBV

**CRC Brahman sires**

<table>
<thead>
<tr>
<th>Sire</th>
<th>EBV</th>
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<tr>
<td>LANCEFIELD 4999M</td>
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<tr>
<td>MR V8 797/3</td>
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</tr>
<tr>
<td>TARTRUS 3886</td>
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<tr>
<td>CONA CREEK 2722</td>
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<tr>
<td>NEWCASTLE WATERS TOBY</td>
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<tr>
<td>LANCEFIELD 4461</td>
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<tr>
<td>McKELLAR RICARDO</td>
<td>-1.9</td>
</tr>
<tr>
<td>TARTRUS ABEL MANSO</td>
<td>-1.8</td>
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<tr>
<td>TARTRUS 2415</td>
<td>+1.9</td>
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<tr>
<td>TARTRUS 3292</td>
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<tr>
<td>JDH DENVER DE MANSO</td>
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<tr>
<td>LANCEFIELD AMBITION</td>
<td>+2.1</td>
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<tr>
<td>LYNDHURST 1660/7</td>
<td>+2.4</td>
</tr>
<tr>
<td>WAVERLEY SUPREME DE MANSO</td>
<td>+2.6</td>
</tr>
<tr>
<td>TARTRUS MR MANSO 025</td>
<td>+3.8</td>
</tr>
<tr>
<td>BELMONT 79/96</td>
<td>+5.6</td>
</tr>
</tbody>
</table>

**Sources:**

- shorter
- longer

**Notes:**

- 4.4 month difference
- 1st calf daughters to resume cycling

**EBV**

- EBV: Expected Breeding Value
- CRC Brahman sires
- Anoestrous interval
- Lactation
- 1st calf daughters
3.7 month difference resume cycling

1st calf wet cows

40% difference in calving rate
In wet first calvers

BEL 79/96

MK3/840

DC EBV +11

DC EBV -6
How do you get more of these?

13 yr old

13 yr old

11/11

11/11
GROUP 1

3/6

RECORD

REPRODUCTION

GROUP 2

6/6
4) *Days to calving* EBV
   - extremely useful field trait (captures AP + 1<sup>st</sup> calf recycle)

5) Correlated **male** traits *(indirect selection for female)*
   - sperm morphology useful
   - SC predictive if measured early (mainly puberty)
   ** Needs to be turned into EBV **

• **New genetic project** *(includes Gyranda genetics)*
  - recording lots more female phenotypes
  - driving future DNA prediction

  ➢ increased accuracy DC EBV (young sale bulls)
Days to calving calculation

Cow A: days to calving = 285 days

Cow B: days to calving = 375 days

Cow C: days to calving = 420 days
How to collect days to calving records

- natural mating only
- repeat records (up to 6 per cow)
- records on all cows in mating group
- record culled not-pregnant
- requires accurate birth dates

- Current 30,800 records in Santa BREEDPLAN
  - raw data into an estimated breeding value (EBV)
  - more data the greater the accuracy of prediction
## July 2016 Santa Gertrudis GROUP BREEDPLAN

| Name/ID | Gestation Length (DAYS) | Birth WT (kg) | 200 Day WT (kg) | 400 Day WT (kg) | 600 Day WT (kg) | Mat Cow WT (kg) | Scrotal Size (cm) | Days to Calving | Carcass Val (kg) | Eye Muscle Area (cm²) | Rib Fat (mm) | Rump Fat (mm) | Retail Yield (%) | IMF (%) | Flight Time (sec) | Domestic Index (%) | Export Index (%) |
|---------|------------------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|---------------|-------------------|---------|----------------|------------------|-----------------|
| ROSEVALE BEAUMON X334 | -1.1  | 0.0  | +1  | +9  | +16  | +33  | +4  | +1.7  | -21.2  | +6  | +0.6  | +0.8  | +0.8  | +1.3  | +0.3  | +0.30  | 91  | $+31  | $+56  |
| STRATHMORE WARDEN (P) | 55%  | 87%  | +1  | -6  | +2  | -17  | +5  | +0.3  | -18.7  | +5  | +1.5  | +1.5  | 0  | +1.4  | +1.0  | $+22  | 97  | $+20  | $+39  |
| GYRANDA COSMIC C476 | -  | +0.5  | 91%  | +8  | +21  | +16  | +1  | +1.7  | -18.6  | +1.8  | 0  | +0.0  | +1.4  | +0.1  | +1.0  | +0.13  | 94%  | $+29  | $+53  |
| MULCHANIA E45 | -  | -0.5  | 91%  | +73%  | 86%  | +6%  | -2  | -0.4  | -17.5  | 0  | -3.1  | +2.3  | +3.1  | +0.7  | +0.2  | -0.02  | 69%  | $+21  | $+37  |
| GYRANDA EXPECTATION E472 | -  | -0.8  | 91%  | 86%  | 86%  | 80%  | 50%  | +3.5  | -17.0  | +7  | +1.3  | +1.1  | -1.0  | +1.0  | +0.3  | -0.06  | 67%  | $+27  | $+46  |
| GYRANDA S11M | -  | -  | -4  | +1  | +11  | +17  | -2  | -0.1  | -15.4  | -  | +1.5  | +1.0  | +1.2  | +0.6  | +0.1  | -  | $+18  | $+39  |
| WAICO LANDLORD (P) | +2.9  | 53%  | 59%  | 91%  | 91%  | 89%  | 88%  | +4  | +19.9  | +19  | +3.5  | -1.0  | +0.5  | -1.0  | -0.9  | -0.7  | -0.17  | 71%  | $+1  | $-12  |
| ROSEVALE AMBASSADOR A26 (P) | -  | +1.1  | 75%  | 55%  | 55%  | 95%  | 95%  | +3  | +20.4  | +27  | 0  | +1.3  | +1.4  | +1.0  | +1.0  | +1.0  | +26  | 75%  | $+5  | $-4  |
| ROSEVALE ZINZAN 7B (AI) | -1.8  | 89%  | 95%  | 85%  | 85%  | 85%  | 85%  | +0  | +20.8  | +37  | +5.5  | +1.7  | -1.6  | -1.0  | -1.6  | -1.0  | -1.6  | 58%  | $+26  | $+13  |
| ROSEVALE PALOROYE LAWMAN | -  | +2.7  | 65%  | 84%  | 81%  | 81%  | 81%  | -8  | +20.9  | +32  | +6.5  | -4.3  | -3.3  | +2.3  | +0.2  | -0.7  | +1.0  | 80%  | $+16  | $+9  |
| TYNDALE NODDY (AI)(P) | -1.8  | 50%  | 90%  | 98%  | 98%  | 98%  | 98%  | -1  | +20.9  | +28  | +5.5  | +3.3  | -0.1  | +1.1  | +1.0  | +1.0  | +1.0  | 58%  | $+13  | $-2  |
| ROSEVALE COOLIBAH C10 (P) | -1.2  | 95%  | 98%  | 99%  | 99%  | 99%  | 99%  | 0  | +20.9  | +28  | +5.5  | +3.3  | -0.1  | +1.1  | +1.0  | +1.0  | +1.0  | 90%  | $+14  | $-2  |
| Breed Avg. EBVs for 2014 Born Calves | -0.4  | +1.2  | +10  | +16  | +22  | +25  | +0  | -0.7  | +10  | +2.2  | +0.1  | -0.2  | +0.7  | +0.0  | +0.04  | +1  | $+14  | $-16  |
How the days to calving EBV works

DC EBV = -19d

DC EBV = +17d

Predicted difference
\[ \frac{1}{2}(-19 + 17) = 18d \]

Sire A daughters 18 days earlier days to calving every year compared to Sire B daughters

~ 18% higher daughter weaning rate per yr

➢ EBVs predict expected progeny differences
Days to calving EBV – proven sire

**GYRANDA ALCATRAZ**

- **EBV top 1% of Santa breed**
- **EBV accuracy – amt of info**: 85%
- **Breed average EBV (2014 drop)**: +0.3
- **Gyranda average EBV (2014 drop)**: -2.0
Days to calving EBV – young sale bull

**GYRANDA LICORICE**

**EBV** top 5% of Santa breed

**EBV accuracy** – amt of info

Breed average EBV (2014 drop)

Gyranda average EBV (2014 drop)

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### July 2016 Santa Gertrudis GROUP BREED PLAN

<table>
<thead>
<tr>
<th></th>
<th>Gestation Length (days)</th>
<th>Birth Wt (kg)</th>
<th>200 Day Wt (kg)</th>
<th>400 Day Wt (kg)</th>
<th>600 Day Wt (kg)</th>
<th>Mat Cow Wt (kg)</th>
<th>Milk (kg)</th>
<th>Scrotal Size (cm)</th>
<th>Days to Calving (days)</th>
<th>Carcase Wt (kg)</th>
<th>Carcase Muscle Area (sq cm)</th>
<th>Rib Fat (mm)</th>
<th>Rump Fat (mm)</th>
<th>Retail Beef Yield (%)</th>
<th>IMF (%)</th>
<th>Flight Time (secs)</th>
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<tbody>
<tr>
<td>EBV</td>
<td>-</td>
<td>-</td>
<td>+12</td>
<td>+20</td>
<td>+29</td>
<td>+33</td>
<td>+5</td>
<td>-</td>
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<td>+0.9</td>
<td>+0.5</td>
<td>+0.7</td>
<td>-</td>
<td>-0.16</td>
<td>-</td>
</tr>
<tr>
<td>Acc</td>
<td>-</td>
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<td>64%</td>
<td>63%</td>
<td>66%</td>
<td>60%</td>
<td>38%</td>
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<td>44%</td>
<td>-</td>
<td>49%</td>
<td>54%</td>
<td>54%</td>
<td>40%</td>
<td>-</td>
<td>64%</td>
</tr>
</tbody>
</table>

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**Days to Calving (days)**

-8.6

44%

+0.3

-2.0
Days to calving EBV – top cow

**GYRANDA 98K**

**Sire:** GYRANDA 38G  
**Dam:** GYRANDA K13  
**Breeder:** GYRANDA PASTORAL CC.  
**Current Owner:** GYRANDA PASTORAL CC.  
**PR Form No.:** 37050  
**Progeny:** [12 - View]  
**Pedigree:** [View]

### July 2016 Santa Gertrude 3 Group Breedplan

<table>
<thead>
<tr>
<th>Trait</th>
<th>200 Day Wt (kg)</th>
<th>400 Day Wt (kg)</th>
<th>Mat Wt (kg)</th>
<th>Scrotal Size (cm)</th>
<th>Days to Calving (days)</th>
<th>Carcass Wt (kg)</th>
<th>Eye Muscle Area (sq cm)</th>
<th>Rib Fat (mm)</th>
<th>Rump Fat (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Condition</td>
<td>-7</td>
<td>-14</td>
<td>-16</td>
<td>+4</td>
<td>-1.1</td>
<td>-22.5</td>
<td>-8</td>
<td>-0.4</td>
<td>+1.5</td>
</tr>
<tr>
<td>-10</td>
<td>-11</td>
<td>-15</td>
<td>-17</td>
<td>+5</td>
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<td>-24.5</td>
<td>-10</td>
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<td>+1.7</td>
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</tbody>
</table>

Breed Avg. EBVs for 2014 Bear Calves: Click for Percentiles

<table>
<thead>
<tr>
<th>Trait</th>
<th>200W, 500W, FAT, EMA, DC</th>
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<tbody>
<tr>
<td>Observed Traits</td>
<td>200W, 500W, FAT, EMA, DC</td>
</tr>
</tbody>
</table>
Days to calving EBV – bottom cow

Santa Animal Details
GYRANADA 50K

<table>
<thead>
<tr>
<th>Sire:</th>
<th>GYRANADA MAGNUM</th>
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<tbody>
<tr>
<td>Dam:</td>
<td>GYRANADA QUINTET</td>
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<td>Breeder:</td>
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<tr>
<td>Current Owner:</td>
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<td>Progeny:</td>
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<td>Pedigree:</td>
<td>[View]</td>
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July 2016 Santa Gertrudis GROUP BREEPLAN

<table>
<thead>
<tr>
<th>Estation Length (days)</th>
<th>Birth Wt (kg)</th>
<th>400 Wt (kg)</th>
<th>600 Wt (kg)</th>
<th>Mat Wt (kg)</th>
<th>Day Cow Wt (kg)</th>
<th>Milk (kg)</th>
<th>Scrub Size (cm)</th>
<th>Carcase Wt (kg)</th>
<th>Carcase Area (sq cm)</th>
<th>Rib Fat (mm)</th>
<th>Eye Muscle Area (mm)</th>
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<tr>
<td>Days to Calving (days)</td>
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<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>+33</td>
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<td>+14</td>
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<td>67%</td>
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Breed Avg. EBVs for 2014 Born Calves [Click for Percentiles]

-0.4 +1.2 +10 +16 +22 +25 +0 +0.7 +0.3 +10 +2.2 +0.1

Traits Observed: 200W, 600W, FAT, EMA, DC

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Stud Book No.</th>
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<tbody>
<tr>
<td>GYRANADA K90</td>
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<tr>
<td>GYRANADA APACHE</td>
<td>Male</td>
<td>203707</td>
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<td>14/03/1997</td>
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</table>
Selection can change traits

➢ selection is a key tool
NT Brahman selection experiment

EBV - days to calving (days)

SEL herd
Society Avg.

DC EBV available
NT Brahman selection experiment

On average SEL +35%

- 2004: +24%
- 2005: +36%
- 2006: +45%

Year group

Pregnancy rate

SEL
COM

NT Brahman s election experiment
1) Maiden heifers

- Manage to target into mating weight
  - avoid boxing older cows ...can’t look after
  - appropriate health etc

- Mate early & short (decide Y vs 2)
  - late calvers ...problems with re-breed

- Mate all/most & cull on preg test
  - exception if poor yearling preg rate
2) First-calf cows

- Manage ....most vulnerable
  - body condition coming into calving

- Control mate
  - prevent out of season if post wean cycling

- Cull all non-calvers
  - keeping multiplies problem
  - if just have to, don’t keep future replacements
3) Older cows

- Control mate (3 months)
  - Late calve usually not worth it

- Cull non-pregs
  - exception need numbers

- Cull bottle teat (bad structure)
  - reduce calf losses
  - poor weaning weight

- Monitor cow body condition
  - calving every year may run-down
  - may need to adjust bull selection
4) Buying replacement bulls

A) Physical

- adequate scrotal size (watch age and wt)
- breeding soundness exam (including morphology)
- sheath, temperament + structure
- Health vaccinations, over fed etc
- Control mate – 3 mth
  - 2-3% plenty (if BBSE tested)
  - re-test prior to mating each year
4) Buying replacement bulls

B) Genetics

➢ **Source of improvement in commercial cow herd**

• Use reproduction EBVs
  – *days to calving* essential (sets fertility of your future cow herd)
    • *scrotal size* EBV if no DC EBV
    • check dams first rebreed

• Other trait EBVs
  – growth + finish + cow size/condition + bwt (1yr mating) + more ($EBV)
  – match traits to your environment/mgt/system
  – benchmark EBVs your production system

• Need EBV, comparing bulls across groups, years, herds, ages
What is Gyranda’s role?

- lots and lots of recording
- pedigree ...DNA most accurate
- selecting (and culling) sires & dam
  - DC and PNS EBVs (improve future sons)
  - balancing growth, carcase EBVs
  - structural, type, polled, etc

- prepare bulls for sale
  - feed, BBSE, etc

- produce EBVs
  - product description (when you buy)
  - selection to continually improve (better bulls next year)
Simple “recipe” for reproduction

1) add fertile bull to well managed maiden heifers

2) ensure bull is carrying reproduction genetics + other econ traits

3) subtract failed preg

4) take care with first calvers and remate

5) again, remove non-preg

6) repeat steps 1-5 every year

7) Bake in a run of good seasons

8) Add a pinch of good luck & enjoy the fruits of your labour