Genetic improvement strategies and successes by Australian Angus breeders

Peter Parnell
Chief Executive Officer
Angus Australia
Outline

1. Angus Australia, background
2. Angus Breedplan, breed trends
3. Selection indexes, breed & herd trends
4. Sources of genetic trend
5. Management of recessive genes
6. Future needs
Angus Australia

Our Vision:

Leadership in the delivery of innovative programs that enhance and promote the value of Angus cattle and Angus beef products.
What we do .......

• Breed registration & recording
• Breed development (R&D)
• Marketing
• Education
• Youth development
There are over 2.5 million cows in Australia joined to Angus bulls.
Over 50% of Australia’s feedlot cattle for export are Angus or Angus crossbred
Female Inventory:

- 2005: Spring 63%, Autumn 37%
- 2006: Spring 62%, Autumn 38%
- 2007: Spring 62%, Autumn 38%
- 2008: Spring 60%, Autumn 40%
- 2009: Spring 62%, Autumn 38%
- 2010: Spring 65%, Autumn 35%
- 2011: Spring 68%, Autumn 32%
Calf registrations:

- **ACR**: 12%, 8%, 6%, 8%, 6%, 6%, 6%, 8%
- **MBR**: 32%, 32%, 24%, 29%, 29%, 27%, 28%
- **APR**: 55%, 58%, 47%, 59%, 58%, 65%, 59%
- **HBR & RAR**: 6%, 6%, 6%, 6%, 6%, 6%, 6%, 6%
Calf registrations:

Compiled by Australian Registered Cattle Breeders Association (ARCBA)
Performance Recording:

>50% of all beef performance recording in Australia
Performance Recording:

>60% of all carcase scan records collected in Australia
## Estimated Breeding Values (EBVs)

### Growth
- Birth Wt.
- 200-day Growth
- 400-day Wt.
- 600-Day Wt.

### Reproduction
- Days to Calving
- Gestation Length
- Calving Ease (Dir)
- Calving Ease (Dtrs)
- Scrotal Size

### Carcase
- Carcase Wt
- EMA
- Rib Fat
- Rump Fat
- RBY %
- IMF%

### Efficiency
- Net Feed Intake

### Maternal
- Milk
- Mature Cow Wt.

### Other (trial)
- Structural scores
- Temperament
ARDROSSAN ADMIRAL A2 (AI) (ET)

Birth Date: 16/02/2005
Register: HBR

Sire: ARDROSSAN DIRECTION W109 (AI) (ET) NAQQW109
Dam: KENNY’S CREEK ROSEBUD W171 (AI) (ET) NDIVW171

<table>
<thead>
<tr>
<th>April 2012 Angus Australia BREEDPLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving Ease Dir (%)</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>EBV</td>
</tr>
<tr>
<td>-4.6</td>
</tr>
<tr>
<td>99%</td>
</tr>
</tbody>
</table>

Breed Avg. EBVs for 2010 Born Calves: +0.0, +0.3, -2.9, +4.5, +38, +71, +90, +83, +12, +1.4, -3.0, +50, +3.5, -0.1, +0.0, +0.3, +1.0, +0

Traits Observed: BWT, 400WT, SS, FAT, EMA, IMF
Statistics: Number of Herds: 238, Progeny Analysed: 4278, Scan Progeny: 2424, Carcase Progeny: 16, Number of Dtrs: 646
Genetic trend:

![Graph showing genetic trend over time](image)

- Birth Wt
- 5 yr trend Birth Wt.

- Average EBV trend previous 5 years
- EBV

- 1990
- 1995
- 2000
- 2005
- 2010

- +0.19 kg/yr
- +0.05 kg/yr
Genetic trend:

- **200 Day Wt**
- **5 yr trend 200 Day Wt**

- +1.5 kg/yr
- +1.1 kg/yr
Genetic trend:

[Graph showing the trend of 600 Day Wt and 5 yr trend 600 Day Wt from 1990 to 2010. The graph indicates an average EBV trend of +2.5 kg/yr.]
Genetic trend:

Graph showing the trend in EBV (Expected Breeding Value) for Mature Cow Weight from 1990 to 2010. The solid line represents the Mature Cow Weight, and the dashed line represents the 5-year trend in Mature Cow Weight. The average EBV trend over the previous 5 years is +2.2 kg/yr.
Genetic trend:

The graph shows the EBV trend over time from 1990 to 2010. The solid line represents the EMA trend, while the dashed line represents the 5-year trend EMA. The average EBV trend over the previous 5 years is indicated by the dashed line.

- From 1990 to 1995, the EBV trend is relatively flat, followed by a gradual increase.
- From 2000 to 2005, there is a noticeable increase in the EBV trend.
- From 2005 to 2010, the EBV trend continues to rise, with a notable acceleration after 2005.

Key points:
- Average EBV trend: +0.28 cm²/yr
- Average EBV trend (5 years): +0.19 cm²/yr
Genetic trend:

- Average EBV trend previous 5 years
  - 1990: +0.07%/yr
  - 2010: +0.12%/yr
# ARDROSSAN ADMIRAL A2 (AI) (ET)

- **Birth Date:** 16/02/2005
- **Register:** HBR

## Sire: ARDROSSAN DIRECTION W109 (AI) (ET) NAQW109
- **G A R PRECISION 1680 USA1680**
- **C A FUTURE DIRECTION 5321 USA5321**
- **C A MISS POWER FIX 308 USA12054694**
- **G T MAXIMUM USA88**
- **ARDROSSAN WILCOOLA Q71 (AI) (ET) NAQQ71**
- **ARDROSSAN WILCOOLA K31 (AI) (ET) NAQK31**

## Dam: KENNY’S CREEK ROSEBUD W171 (AI) (ET) NDW171
- **V D A R NEW TREND 315 USA315**
- **B/R NEW DESIGN 036 USA036**
- **B/R BLACKCAP EMPRESS 76 USA76**
- **PAPA EQUATOR 2928 USA2928**
- **IMRON ROSEBUD U17 (AI) (ET) WFRU17**
- **SOUTH CROSS L11 (AI) (ET) NSCL11**

## April 2012 Angus Australia BREEDPLAN

<table>
<thead>
<tr>
<th>Trait</th>
<th>EBV</th>
<th>Acc</th>
<th>Calving Ease Dir (%)</th>
<th>Calving Ease Dhrs (%)</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>Carcass Wt. (kg)</th>
<th>Eye Muscle Area (sq.cm)</th>
<th>Rib Fat (mm)</th>
<th>Rump Fat (mm)</th>
<th>Retail Beef Yield (%)</th>
<th>IMF (%)</th>
<th>Docility (Trial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBV</td>
<td>-4.6</td>
<td>95%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>+58</td>
<td>+103</td>
<td>+133</td>
<td>+128</td>
<td>+17</td>
<td>+1.2</td>
<td>-4.5</td>
<td>+77</td>
<td>+10.2</td>
<td>-1.8</td>
<td>-1.7</td>
<td>+1.7</td>
<td>+2.8</td>
<td>+35</td>
</tr>
<tr>
<td>Acc</td>
<td>95%</td>
<td>91%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>98%</td>
<td>97%</td>
<td>99%</td>
<td>99%</td>
<td>99%</td>
<td>96%</td>
<td>92%</td>
<td>95%</td>
<td>95%</td>
<td>92%</td>
<td>91%</td>
<td>91%</td>
</tr>
</tbody>
</table>

**Breed Avg. EBVs for 2010 Born Calves** [Click for Percentiles]

| EBV | -0.0 | +0.3 | +2.9 | +4.5 | +38 | +71 | +83 | +12 | +1.4 | -3.0 | +50 | +3.5 | -0.1 | +0.0 | +0.3 | +1.0 | +0 |

## SELECTION INDEX VALUES

<table>
<thead>
<tr>
<th>Market Target</th>
<th>Index Value</th>
<th>Breed Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Fed/CAAB Index</td>
<td>+$ 145</td>
<td>+$ 94</td>
</tr>
<tr>
<td>Heavy Grass Fed Steer Index</td>
<td>+$ 110</td>
<td>+$ 77</td>
</tr>
<tr>
<td>Short Fed Domestic Index</td>
<td>+$ 94</td>
<td>+$ 68</td>
</tr>
<tr>
<td>Terminal Index</td>
<td>+$ 107</td>
<td>+$ 68</td>
</tr>
</tbody>
</table>
Relative emphases in profit driver traits for different indexes published by Angus Australia (*Weighted Average includes 30% Long Fed/CAAB, 30% Heavy Grass Fed Steer, Steer, 30% Short Fed and 10% Terminal Index).
Genetic trend:

Annual trend and rolling 5yr trend in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index).
Genetic trend:

Annual trends and rolling 5yr trends in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index).
Genetic trend:

Annual trends and rolling 5yr trends in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index)
Annual trends and rolling 5yr trends in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index)
Genetic trend:

Annual trends and rolling 5yr trends in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index)
Genetic trend:

Annual trends and rolling 5yr trends in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index)
Genetic trend:

Annual trends and rolling 5yr trends in "weighted" $Index Value (30% Long Fed / CAAB Index, 30% Heavy Grass Fed Steer Index, 30% Short Fed Index and 10% Terminal Index)
Contributions to genetic trend in the Australian Angus population

Amer, 2012 (unpublished)
Gene contribution of key ancestors of the Australian Angus population:
Estimated Breeding Values (EBV)

Own records
- weights
- scans
- scores

Pedigree
- parents (sibs etc)
- progeny
  - carcass
  - daughters

Correlated traits
- other weights
- other scans
- other traits

Genomic values
- Pfizer Molecular Value Predictions
Inclusion of Pfizer 50K SNP data into Angus Breedplan

Step 1. Discovery (Pfizer, Angus Australia)
1,031 sires genotyped with Illumina SNP50 to develop “prediction equations” to estimate Molecular Value Predictions (MVPs) based on correlations with EBVs

Step 2. Calibration (AGBU)
Correlations of MVPs with grand-progeny phenotypes

3) IMPLEMENTATION
Calibration of Pfizer 50K SNP panel

- Birth weight: 0.40
- Weaning weight - direct: 0.35
- Weaning weight – maternal: 0.38
- Yearling weight: 0.41
- Mature Cow Weight: 0.29
- Scrotal size: 0.44
- Carcass weight: 0.36
- Carcass rib fat: 0.44
- Carcass eye muscle area: 0.45
- Carcass intramuscular fat %: 0.20

➢ explain 4 - 20% genetic variation
Inclusion of Pfizer 50k SNP panel into Angus Breedplan

Step 1. Discovery (Pfizer, Angus Australia)
1,031 sires genotyped with Illumina SNP50 to develop “prediction equations” to estimate Molecular Value Predictions (MVPs) based on correlations with EBVs

Step 2. Calibration (AGBU)
Correlations of MVPs with grand-progeny phenotypes

Step 3. Implementation (AGBU, ABRI, Angus Australia)
“Blending” of MVP results with EBVs
Animal has genomic information included in EBVs
Accuracy (%) for 2,241 Angus animals with MVPs blended (April, 2012)

<table>
<thead>
<tr>
<th>Trait</th>
<th>CED</th>
<th>BW</th>
<th>WW</th>
<th>YW</th>
<th>MCW</th>
<th>CEM</th>
<th>MILK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>52.4</td>
<td>79.8</td>
<td>75.2</td>
<td>75.2</td>
<td>69.2</td>
<td>45.3</td>
<td>61.5</td>
</tr>
<tr>
<td>After</td>
<td>57.2</td>
<td>80.8</td>
<td>76.9</td>
<td>77.3</td>
<td>70.5</td>
<td>50.1</td>
<td>66.6</td>
</tr>
<tr>
<td>Change</td>
<td>+4.8</td>
<td>+1.0</td>
<td>+1.7</td>
<td>+2.1</td>
<td>+1.3</td>
<td>+4.8</td>
<td>+5.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trait</th>
<th>SCROTAL</th>
<th>CARC-WT</th>
<th>CARC-EMA</th>
<th>CARC-RUMPFAT</th>
<th>CARC-RIBFAT</th>
<th>CARC-IMF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>64.4</td>
<td>67.9</td>
<td>59.9</td>
<td>67.0</td>
<td>66.1</td>
<td>57.9</td>
</tr>
<tr>
<td>After</td>
<td>69.2</td>
<td>70.5</td>
<td>64.3</td>
<td>69.2</td>
<td>70.4</td>
<td>59.0</td>
</tr>
<tr>
<td>Change</td>
<td>+4.8</td>
<td>+2.6</td>
<td>+4.5</td>
<td>+2.1</td>
<td>+4.3</td>
<td>+1.1</td>
</tr>
</tbody>
</table>

Overall impact on $Index accuracy: 1 - 3%
2010: 35 bulls joined by AI to 1,640 cows to produce 906 calves
2011: 47 bulls joined by AI to 2,325 cows
2012: Target > 50 bulls
Cohort 1:
NFI testing: Aug – Dec, 2012
Carcase data: Jun-Sept, 2013

Cohort 2:
NFI testing: Aug – Dec, 2013
Carcase data: Jun-Sept, 2014

Cohort 3:
NFI testing: Aug – Dec, 2014
Carcase data: Jun-Sept, 2015
Recessive genetic conditions:

Impact of DNA tests on frequency of Arthrogryposis Multiplex (AM) and Neuropathic Hydrocephalus (NH) and Contractural Arachnodactyly (CA) in registered Australian Angus
Recessive gene status of key ancestors of the Australian Angus population
Key messages:
Key messages:

1. Angus breeders in Australia have achieved excellent genetic progress
2. Much of the genetic progress has been due to introductions from USA
3. Rates of genetic progress have declined in recent years
4. Recessive genetic conditions need to be rapidly identified and managed
Key messages:

5. Need for strategic investment in collecting phenotypes necessary to exploit genomics opportunities

6. Greater global co-operation in genetic evaluation may enable better utilisation of breed genetic diversity