Beef Genomics 101

Jared Decker
Associate Professor and Beef Genetics Specialist
decherje@missouri.edu
573-882-2504
Twitter: @pop_gen_JED
Blog and Facebook: A Steak in Genomics™
Tradition
Legacy
How?
How?
SUSTAINABILITY: STEWARDSHIP RESPONSIBILITY PROFITABILITY
EPDs Work!
Selection Decisions
Phenotypic Selection

Does NOT account for environmental differences!

Less accurate
EPDs Defined

• Expected
  • Prediction of the Future
  • Average or Mean

• Progeny
  • Calves

• Difference
  • Compare two animals
  • Compare animal to breed average
Relatedness is KEY
EPDs in Practice

**Black Bull**
- Weaning Weight EPD = 2
- Average Weaning Weight of Calf Crop = 495

**Gold Bull**
- Weaning Weight EPD = 22
- Average Weaning Weight of Calf Crop = 515

---

**University of Missouri**
Do EPDs Work?
Thompson Research Center

• 781 calves from 231 cows with GeneMax Advantage Scores
## GeneMax

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Std. Error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW GMX</td>
<td>0.435 lbs</td>
<td>0.204 lbs</td>
</tr>
</tbody>
</table>

![Calf Carcass Weight vs Dam CW GMX Score](image)
<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>WW GMX</td>
<td>0.435</td>
<td>0.088</td>
<td>1.0e-06</td>
</tr>
<tr>
<td>MM GMX</td>
<td>0.336</td>
<td>0.080</td>
<td>3.0e-05</td>
</tr>
</tbody>
</table>

![Scatter plot showing calf weaning weight kg vs. dam WW GMX score.](image)
Black Bull
Weaning Weight EPD = 2
Average Weaning Weight of Calf Crop = 495

Gold Bull
Weaning Weight EPD = 22
Average Weaning Weight of Calf Crop = 515

EPDs in Practice
University of Missouri
Calf Performance
Weaning Weight is increasing 1.5 pounds per year
Birth Weight is decreasing 0.27 pounds per year
Marbling is increasing 0.47 units per year
Carcass Weight is increasing 4.3 pounds per year
EPDs Work!
Traditional EPDs

- Own Performance
- Progeny Performance
- Contemporary Group
- Pedigree
- EPD
Two-Step Genomic-Enhanced EPDs

- Own Performance
- Progeny Performance
- Pedigree
- Contemporary Group
- Contemporary Group
- Genomic Test Result

GE-EPD
Single-Step Genomic-Enhanced EPDs

- Own Performance
- Contemporary Group
- Pedigree + Genomic
- GE-EPD

- Progeny Performance
- Contemporary Group

University of Missouri
The Dance Steps of Genomics Part I: Understanding Genomic Prediction
The Dance Steps of Genomics Part II: Using Genomics in Your Herd
<table>
<thead>
<tr>
<th>Pedigree Relationship Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Paternal Grandsire</strong></td>
</tr>
<tr>
<td>Paternal Grandsire</td>
</tr>
<tr>
<td>Paternal Granddam</td>
</tr>
<tr>
<td>Maternal Grandsire</td>
</tr>
<tr>
<td>Maternal Granddam</td>
</tr>
<tr>
<td>Sire</td>
</tr>
<tr>
<td>Dam</td>
</tr>
<tr>
<td>Animal</td>
</tr>
</tbody>
</table>
## Genomic Relationship Matrix

<table>
<thead>
<tr>
<th></th>
<th>Paternal Grandsire</th>
<th>Paternal Granddam</th>
<th>Maternal Grandsire</th>
<th>Maternal Granddam</th>
<th>Sire</th>
<th>Dam</th>
<th>Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paternal Grandsire</td>
<td>1</td>
<td>0</td>
<td>0.17</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.20</td>
</tr>
<tr>
<td>Paternal Granddam</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.30</td>
</tr>
<tr>
<td>Maternal Grandsire</td>
<td>0.17</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.33</td>
</tr>
<tr>
<td>Maternal Granddam</td>
<td>0</td>
<td>0</td>
<td>0.17</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.17</td>
</tr>
<tr>
<td>Sire</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.11</td>
<td>0.5</td>
</tr>
<tr>
<td>Dam</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Animal</td>
<td>0.20</td>
<td>0.30</td>
<td>0.33</td>
<td>0.17</td>
<td>0.5</td>
<td>0.5</td>
<td>1.07</td>
</tr>
</tbody>
</table>
Use Genomic Predictions

- **BUY BULLS WITH GE-EPDs**
  - Increases EPD precision/reliability
  - Identify genetic differences between flush mates
  - Equivalent to 10 to 20 progeny
  - Reduces risk
Heifer Genomic Predictions

- Have to use the information to see return on investment!
- Test many more heifers than you plan to keep
  - Genomics provides additional information for ranking
  - Increased precision of genomics re-ranks heifers
Pick the right test!

• If testing a registered animal, use the breed association’s genomic prediction to produce GE-EPDs!

• If testing commercial straightbred cattle, if a breed specific test is available, USE IT!

• Breed-specific test is going to outperform multiple-breed test
Under appreciated traits

- Stayability/Sustained Cow Fertility
- Heifer Pregnancy
- Mature Cow Weight
- Milk (push towards average or lower)
Multiple Trait Selection

• Which trait is most important?
Multiple Trait Selection

• Which trait is most important?

PROFIT!

• Select for it using an economic selection index
What is an economic index?

- Combination of EPDs weighted according to their economic importance
- Expressed as a dollar value
- Breeds have different indexes
- Different indexes for different marketing endpoints
Field-Testing $BEEF

• Used embryos from flushes to produce:
  • 25 Low $B calves
  • (average $47.40 $B)
  • 18 High $B calves
  • (average $141.12 $B)
Field-Testing $BEEF$

<table>
<thead>
<tr>
<th>Comparison</th>
<th>GMX Feeder Advantage Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low $B$</td>
<td>27</td>
</tr>
<tr>
<td>High $B$</td>
<td>94</td>
</tr>
</tbody>
</table>

[Bar chart showing comparison between Low $B$ and High $B$ in GeneMax Feeder Advantage Index.]

University of Missouri
Field-Testing $BEEF

• Breeding values (twice the progeny difference) predicted profit differences of $187.38 between average of the two groups
Field-Testing $BEEF$

- Breeding values (twice the progeny difference) predicted profit differences of $187.38 between average of the two groups

- Actual difference was $215.47
Reaping the Value of Genomics
### Premiums for heifers with various classifications

Predicted premiums for heifers with various classifications, based on mixed model analysis of 2008 to 2017 sale reports.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Effect</th>
<th>Standard Deviation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show-Me-Plus</td>
<td>$153.13</td>
<td>29.59</td>
<td>2.75e-07</td>
</tr>
<tr>
<td>Tier II</td>
<td>$66.27</td>
<td>11.07</td>
<td>2.36e-09</td>
</tr>
<tr>
<td>Artificial inseminated pregnancy</td>
<td>$106.23</td>
<td>7.12</td>
<td>&lt;2.2e-16</td>
</tr>
<tr>
<td>Number of heifers per lot</td>
<td>$17.29</td>
<td>2.35</td>
<td>2.27e-13</td>
</tr>
<tr>
<td>Sale Weight</td>
<td>$0.79/pound</td>
<td>0.03</td>
<td>&lt;2.2e-16</td>
</tr>
</tbody>
</table>

**ROI ranges from 255%-545% for Show-Me-Plus heifers**

Genomic ROI: Early Returns Suggest Premium for Show-Me-Plus Heifers

http://blog.steakgenomics.org/2016/02/genomic-roi-early-returns-suggest.html

See http://agebb.missouri.edu/select/prgmreq.htm for more information.
Get Paid For What They Are Worth

Average of
heifer crop

=  

Average of
steer crop

University of Missouri
Value Added Genetic Based Marketing Programs
Research Highlights
## Reproductive Tract Scores

**Applied Reproductive Strategies in Beef Cattle**  
Ruidoso, NM 2018  

### Pregnancy Rates by Reproductive Tract Score

<table>
<thead>
<tr>
<th>Subspecies</th>
<th>RTS 2</th>
<th>RTS 3</th>
<th>RTS 4</th>
<th>RTS 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bos indicus</em> influenced</td>
<td>35%</td>
<td>39%</td>
<td>52%</td>
<td>55%</td>
</tr>
<tr>
<td><em>Bos taurus</em></td>
<td>32%</td>
<td>46%</td>
<td>50%</td>
<td>52%</td>
</tr>
</tbody>
</table>
National Center for Applied Reproduction & Genomics

University of Missouri

Training in reproductive and genetic technologies for veterinarians, veterinary students, producers and other industry professionals

University of Missouri
Genomics of Puberty and Fertility

- ~6,000 Angus samples
- Proposal under review for ~2,500 Hereford and ~2,500 Red Angus
- 1,500 *Bos indicus* influenced females available
  - Seeking funding
Identifying Local Adaptation and Creating Region-Specific Genomic Predictions in Beef Cattle

http://blog.steakgenomics.org/2016/05/local-genetic-adaptation-grant.html
Hair Shedding

• 1 to 5 subjective score
• “Hair shedding scores: A tool to select heat tolerant cattle”

http://articles.extension.org/pages/74069/hair-shedding-scores:-a-tool-to-select-heat-tolerant-cattle
Hair Shedding and Weaning Weight

- Comparing adjusting calf weaning weight with adjusting hair shedding score of the dam,
- Decreasing hair score by 1 unit results in an increased weaning weight of 12.6 pounds ($p = 0.056$).
EPDs Work!

deckerje@missouri.edu
573-882-2504
Twitter: @pop_gen_JED
Blog: A Steak in Genomics™