**Fundamentals of Beef Production Profit**

Profit = Revenue – Costs

Revenue – easy to measure
Costs – hard to measure

---

**Increased Accuracy-Benefits**

- Mitigation of risk
- Faster genetic progress

\[
BV / t = r_{BV,EBV} i \frac{BV}{L}
\]

---

**What Role Does Genetics Play?**

<table>
<thead>
<tr>
<th>Trait</th>
<th>ADG</th>
<th>DMI</th>
<th>RFI</th>
<th>G:F</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG</td>
<td>0.26</td>
<td>0.58</td>
<td>-0.15</td>
<td>0.31</td>
</tr>
<tr>
<td>DMI</td>
<td>0.40</td>
<td>0.66</td>
<td>-0.60</td>
<td>-0.60</td>
</tr>
<tr>
<td>RFI</td>
<td>0.52</td>
<td>-0.92</td>
<td>0.27</td>
<td></td>
</tr>
</tbody>
</table>

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**Weight Trait Project**

The WTP is an organized effort to facilitate DNA technology transfer and while at the same time providing a national focus for integration of molecular information into beef genetic evaluation and selection.

www.BeefEfficiency.org
Field demonstration project will demonstrate utility of molecular EPDs for FE and component traits and “test drive” the technology.

<table>
<thead>
<tr>
<th>Location of producer collaborators</th>
<th>EPDs for FE and component traits and “test drive” the technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Map showing states and locations of producer collaborators.</td>
</tr>
</tbody>
</table>

**Economically Relevant Traits**

- Traits that are directly associated with a revenue stream or a cost
  - Examples
    - BWT vs CE
    - REA vs YG
    - YWT vs CWT
    - MWT vs DMI
    - RFI vs FI

**Indicator Traits**

- Traits that are genetically correlated to an ERT
- Why use indicator traits?
  - Measured earlier in life
  - Cheaper/easier to measure
  - Measured on both sexes

**What Is a Selection Index?**

- Selection on ‘aggregate merit’ (Hazel, 1943)
- List of traits that influence “satisfaction”
- Relative Economic Value (REV) of each trait
  - Increase in satisfaction with one unit change in a trait, all others held constant
- List of characteristics to be measured on animal

**Formula for Selection Index:**

\[ H_i = a_1 BV_{i1} + a_2 BV_{i2} + K + a_n BV_{in} \]
Why Do We Need Selection Indexes?

“There is no easily accessible, objective way for breeders, particularly breeders in the beef and sheep industries where ownership is diverse and production environments vary a great deal, to use these predictions intelligently.”

-- R. M. Bourdon, 1998

Most Desirable Index?

- Phenotypic RFI
- Genetic RFI
- Economic index of DMI and GAIN
- Economic index of RFI and Gain

Simulation Framework

- Stochastic Model
- Allows for random variation in multiple traits
- Variation based on fluctuation in historical data
- Simulate base herd then perturb traits one at a time

\[ \mathbf{b} = \mathbf{P}^{-1} \mathbf{Gv} \]

Index Based Selection Rolfe et al. (2011)

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Direction</th>
<th>DMI</th>
<th>GAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI</td>
<td>Down</td>
<td>-36.7</td>
<td>-3.4</td>
</tr>
<tr>
<td>GAIN</td>
<td>Up</td>
<td>-20.3</td>
<td>-7.5</td>
</tr>
<tr>
<td>G:F</td>
<td>Up</td>
<td>-27.5</td>
<td>-2.4</td>
</tr>
<tr>
<td>( b_1 )</td>
<td>Down</td>
<td>-44.6</td>
<td>-1.9</td>
</tr>
<tr>
<td>( b_2 )</td>
<td>Down</td>
<td>-38.5</td>
<td>0</td>
</tr>
<tr>
<td>( b_3 )</td>
<td>Down</td>
<td>-12.4</td>
<td>5.4</td>
</tr>
<tr>
<td>( b_4 )</td>
<td>Down</td>
<td>0</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Terminal or Maternal?

Terminal

- $B$, $F$, $G$ (Angus)
- TI (Simmental)
- CHBS (Hereford)
- MTI (Limousin)
- EPI and FPI (Gelbvieh)
- Charolais
- GridMaster (Red Angus)

Maternal

- $S$, $EN$ (Angus)
- API (Simmental)
- BMIS, BIII, CEZS (Hereford)
- HerdBuilder (Red Angus)
- $Cow$ (Gelbvieh)
How much impact does DMI have?

- HCW = 59.5%
- DMI = 19.3%
- MS = 11.1%
- REA = 5.5%
- FAF = 4.6%

Occhiner et al. (2016)

### Heritabilities

<table>
<thead>
<tr>
<th>Breed</th>
<th>DMI (lb)</th>
<th>MWWT (lb(^{0.75}))</th>
<th>ADG (lb)</th>
<th>RFI (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereford</td>
<td>3.2</td>
<td>4.6</td>
<td>1.6</td>
<td>0.6</td>
</tr>
<tr>
<td>USMARC</td>
<td>1.9</td>
<td>3.4</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Simmental x</td>
<td>1.4</td>
<td>1.7</td>
<td>1.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Angus x</td>
<td>1.1</td>
<td>1.5</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>USMARC</td>
<td>1.9</td>
<td>3.4</td>
<td>1.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

GWAS of DMI and RFI in Angus and Hereford

Impact on Accuracy – %GV = 10%

Impact on Accuracy – %GV = 40%

Field Demonstration

AI Sires

AI to Herd Bulls from 24 WTP Producers

AI to commercial cattle

Rex Ranch (2011) & USMARC (2011 and 2012)

FE (2013)

FE (2013 & 2014)
SUMMARY OF DEMONSTRATION CATTLE

<table>
<thead>
<tr>
<th>Sire Breed</th>
<th>Heifer</th>
<th>Steer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>14</td>
<td>53</td>
<td>67</td>
</tr>
<tr>
<td>COM</td>
<td>5</td>
<td>54</td>
<td>59</td>
</tr>
<tr>
<td>HH</td>
<td>12</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>AN</td>
<td>72</td>
<td>132</td>
<td>204</td>
</tr>
<tr>
<td>GV</td>
<td>69</td>
<td>80</td>
<td>149</td>
</tr>
<tr>
<td>CH</td>
<td>32</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>LM</td>
<td>34</td>
<td>39</td>
<td>73</td>
</tr>
<tr>
<td>SM</td>
<td>17</td>
<td>98</td>
<td>115</td>
</tr>
</tbody>
</table>

Genomic Prediction Equations

- Starting point
  - Requires continuous phenotyping and genotyping
  - In a strategic fashion
- Current methods have limitations
  - Across-breed is still problematic
  - Multi-trait models will be needed to account for sequential culling bias

Next steps

- Sequenced all sires
- Re-genotyping with GGP250
- Also genotyping ~2,500 purebreds

Helpful Resources

- http://beef.unl.edu
- www.nbcec.org
- www.beefefficiency.org
- www.eBEEF.org