Traits and Tools for Retention and Replacement of Females

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State Beef Extension Specialist

Overview

• Traits for replacement female selection
  – Breeding Objectives
  – Optimization of performance
  – Fit to environment
  – Genetic Selection Tools
What Does the Ideal Cow Look Like?

Different for Everyone!

The Ideal Cow

• Early Sexual Maturity
• High Reproductive Rate
• Low Rate of Dystocia
• Longevity
  – Genetics/crossbreeding and management
• Minimum Maintenance Requirements
  – Size!
• Ability to convert forage to lbs. of calf
  – Fit to Environment!

Dickerson, 1970
There are How Many?

- Some breeds have up to 25 EPDs/Indexes on each animal!
- Not to mention ratios, adj. weights and ultrasound data

This is why we need breeding objectives!

Breeding Objectives

- Allows easy identification of areas to place selection intensity
  - Mission statement
  - Defines a direction!
- Most important things to ascertain
  - What do we do well?
  - What needs improvement?
  - Where can I increase profit?
  - Terminal or keeping replacements?
  - What inputs are available (labor, forage, grain, etc.)
    - Fit to the environment (What traits/inputs are limiting)
Fit the Environment

- Optimize for environment and resources
  - Milk Production
  - Mature Weight
  - Calving Ease

Considerations

This extra energy has to come from somewhere!
Where’s the Beef?

Increased Size!

- Lower Inventory
- Increased lbs. of beef
  - Some from technology
  - The rest from increased growth
    - Increased carcass weights
    - Increased Cow Mature Size!
  - Good for the packers-is it good for the cowman?
    - More size, more growth, more feed, more money
    - Can we figure out how to do more with less?
Optimal Characteristics

Table 4. Matching genetic potential for different traits to production environments.¹

<table>
<thead>
<tr>
<th>Production Environment</th>
<th>Feed Availability</th>
<th>Stress²</th>
<th>Milk Production</th>
<th>Mature Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
<td>M to H</td>
<td>M to H</td>
<td>L to M</td>
</tr>
<tr>
<td>Medium</td>
<td>Low</td>
<td>M to H</td>
<td>M</td>
<td>L to M</td>
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<td>High</td>
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<td>L to M</td>
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<tr>
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<tr>
<td></td>
<td>High</td>
<td>L to M</td>
<td>L to M</td>
<td>M</td>
</tr>
</tbody>
</table>

L = Low; M = Medium; H = High.
1 Adapted from Bullock et al., 2002.
2 Heat, cold, parasites, disease, mud, altitude, etc.
3 Ability to store fat and regulate energy requirements with changing (seasonal) availability of feed.
4 Physiological tolerance to heat, cold, internal and external parasites, disease, mud, and other factors.

Why Mature Size?

• Why is mature size low-hanging fruit?
  – Easy to select for size!
  – Highly heritable (0.44-0.69; Arango et al. 2002)

https://www.msu.edu/~ritchieh/historical/cattletype.html
Mature Size

- Bigger cows have higher maintenance energy requirements

  Intake increases ~1.5 lbs./day for each 100 lbs. increase in BW

### Daily DM intake for cows of varying weights

<table>
<thead>
<tr>
<th>Cow’s Weight</th>
<th>Percentage of Body Weight</th>
<th>Daily DM Intake (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>2.33%</td>
<td>21.0</td>
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<tr>
<td>1000</td>
<td>2.56%</td>
<td>22.6</td>
</tr>
<tr>
<td>1100</td>
<td>2.19%</td>
<td>24.1</td>
</tr>
<tr>
<td>1200</td>
<td>2.13%</td>
<td>25.6</td>
</tr>
<tr>
<td>1300</td>
<td>2.08%</td>
<td>27.0</td>
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<tr>
<td>1400</td>
<td>2.04%</td>
<td>28.6</td>
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<tr>
<td>1500</td>
<td>2.00%</td>
<td>30.0</td>
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<tr>
<td>1600</td>
<td>1.97%</td>
<td>31.5</td>
</tr>
<tr>
<td>1700</td>
<td>1.94%</td>
<td>33.0</td>
</tr>
</tbody>
</table>

MRC 2000

- Bigger cows eat less as a % of body weight-if calves are a lot bigger, this may be the most efficient system!

### Annual DM intake for cows of varying weights

<table>
<thead>
<tr>
<th>Cow’s Weight</th>
<th>Annual DM Intake (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>7,694</td>
</tr>
<tr>
<td>1000</td>
<td>8,249</td>
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<tr>
<td>1100</td>
<td>8,792</td>
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<tr>
<td>1200</td>
<td>9,329</td>
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<td>1300</td>
<td>9,870</td>
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<td>1400</td>
<td>10,424</td>
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<tr>
<td>1500</td>
<td>10,960</td>
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<tr>
<td>1600</td>
<td>11,505</td>
</tr>
<tr>
<td>1700</td>
<td>12,038</td>
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</tbody>
</table>

Calculated from NRC 2000

Mature Size

- Bigger cows have higher maintenance energy requirements

  - Marginal increases in weaning weight

\[ y = 0.0607x + 459 \]

+6 lbs. WW/100 lbs. cow weight

- Urick et al., 1971 = 0.042
- Mourer et al., 2010 = 0.064
- Dobbs, 2011 = 0.060

1111 spring-calving records on Brangus cows from ‘02–’09, crossbred calves, El Reno, OK

C.D. Dobbs, M.A. Brown, D.L. Lalman
Breakevens

- Cost of additional 100 lbs. cow body weight/year is ~$42
  - Doye and Lalman 2011

\[ \text{Breakeven Weight per 100 lbs.} = \left( \text{Additional Calf WW} \cdot \text{Market Value} \right) - \text{Additional Cow Cost} \]

\[ \text{Breakeven weight per 100 lbs.} = (X \text{ lbs.} \cdot 1.45 \text{ per lb.}) - 42 \]

Breakeven Weight of ~29 lbs. WW per 100 lbs. additional body weight!

\[ \text{Breakeven $ per 100 lbs.} = \left( \text{Additional Calf WW} \cdot \text{Market Value} \right) - \text{Additional Cow Cost} \]

\[ \text{Breakeven $ per 100 lbs.} = (6 \text{ lbs.} \cdot X \text{ per lb.}) - 42 \]

Breakeven of ~$7/lb. of additional WW per 100 lbs. additional body weight!

~550 lb. steer and heifer average from OKC sale on 8/27/2012

Mature Size

- Smaller cows can be an asset!

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>&lt;1300</td>
<td>37</td>
<td>1242</td>
<td>617</td>
<td>49.7%</td>
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<tr>
<td>1300-1400</td>
<td>39</td>
<td>1357</td>
<td>611</td>
<td>45.0%</td>
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<tr>
<td>1400-1500</td>
<td>38</td>
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<tr>
<td>1500-1600</td>
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<td>1549</td>
<td>598</td>
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<tr>
<td>&gt;1600</td>
<td>22</td>
<td>1698</td>
<td>572</td>
<td>33.7%</td>
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</tbody>
</table>

Ringwall, 2008  [Link](http://www.beeftalk.com/images/fullsizecolor/bt408color.jpg), 5-9 yr old cows at Dickinson Research Extension Center in Dickinson, ND
Cowboy Math

• 5,000 lbs. DM/acre
  – Use ¼ (1,250 lbs.)
• 1000 lb. cow needs 6.5 acres/yr.
• 1600 lb. cow needs 9 acres/yr.

• 160 acres:
  – 17 cows @ 1600 lb.
    • Baseline 600 lb. calf = 8,400*$1.40 = $11,760
  – 24 cows @ 1000 lb.
    • 564 lb. calves = 13,536*$1.42 = $19,221

Income Difference=$7,461

Fit the Environment

• Optimize for environment and resources
  – Labor
  – Time
  – Forage
  – Grain

• Methods:
  – Breed Type
  – Decision Support software
  – EPDs
  – Crossbreeding
  – Genomics

OPTIMIZE PRODUCTION TRAITS
Breed Type

<table>
<thead>
<tr>
<th>Breed Group</th>
<th>Growth Rate and Mature Size</th>
<th>Percent Retail Product</th>
<th>Age at Puberty</th>
<th>Milk Production</th>
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<td>Limousin</td>
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<tr>
<td>Angus</td>
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<tr>
<td>Hereford</td>
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<td>XX</td>
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<tr>
<td>Brahman</td>
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<td>Gelbvieh</td>
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<td>Brangus</td>
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<td>XX</td>
</tr>
<tr>
<td>Santa Gertrudis</td>
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<td>XX</td>
<td>XX</td>
<td>XX</td>
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</tbody>
</table>

Two Easy Ways to Contain Costs and Inputs:
1. Optimize Growth and Mature Size
2. Optimize Milk Production

These are guidelines-Animals can usually be found in any breed that fit these characteristics

Decision Support Software

- User-defined inputs are more customized
- Charolais Terminal sire profitability index
  - [http://index.charolaisusa.com/profitindexall.aspx](http://index.charolaisusa.com/profitindexall.aspx)
- ERT Tool
  - [http://ert.agsci.colostate.edu/](http://ert.agsci.colostate.edu/)
- Angus Optimal Milk Module
  - [http://www.angus.org/Performance/OptimalMilk/OptimalMilkMain.aspx](http://www.angus.org/Performance/OptimalMilk/OptimalMilkMain.aspx)
Expected Progeny Differences

“Correct” for environmental differences and genetic merit of the dam

Know that EPDs and Economic Index values are more valuable than actual records or ratios
- EPD 7-9 times more effective in generating response to selection than actual measurements

Relative performance, not absolute values

What does it mean?

Sire A EPD=30
Sire A WW EPD=30
Sire B WW EPD=40

NOTHING!

We expect calves out of sire B to average ~10 lbs. heavier at weaning than the average of calves out of sire A (bred to same cows)

Top 25% of his breed
Expect only 1 of 4 bulls to sire calves with heavier weaning weights (bred to same cows)
## EPDs for Some Limiting Traits

### Table from NBCEC Sire Selection Manual

<table>
<thead>
<tr>
<th>Breed</th>
<th>Growth</th>
<th>Reproduction</th>
<th>Carcass</th>
<th>Ultrasound</th>
<th>Other</th>
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<tbody>
<tr>
<td></td>
<td>Birth Weight</td>
<td>Weaning Weight</td>
<td>Sired Lb</td>
<td>Yarding Lb</td>
<td>Mature Weight</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Blonde d'Aquitaine</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
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<td>Brahman</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
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<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Independent Culling Levels**

EPDs aren’t just useful to select for more!

- **Output Traits**
- **Limiting Traits**
## AB-EPDs

### Angus

<table>
<thead>
<tr>
<th>Trait</th>
<th>BW</th>
<th>WW</th>
<th>MA</th>
<th>REA</th>
<th>MARB</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPD</td>
<td>-1.3</td>
<td>54</td>
<td>26</td>
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<td>Conversion</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>AB-EPD</td>
<td>-1.3</td>
<td>54</td>
<td>26</td>
<td>-0.09</td>
<td>0.71</td>
</tr>
<tr>
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<td>1/2</td>
<td>1/1</td>
<td>3/3</td>
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</tr>
</tbody>
</table>

### Charolais

<table>
<thead>
<tr>
<th>Trait</th>
<th>BW</th>
<th>WW</th>
<th>MA</th>
<th>REA</th>
<th>MARB</th>
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### Limousin

<table>
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<th>REA</th>
<th>MARB</th>
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<td>AB-EPD</td>
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<tr>
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<td>2/3</td>
<td>2/3</td>
<td>1/1</td>
<td>3/3</td>
</tr>
</tbody>
</table>

Calculator is posted on the [www.beefextension.com](http://www.beefextension.com) website!

## EPD Accuracy

- EPDs are not static—they change over time
  - Accuracy!
- Increases with more data
  - Individual performance or relatives
  - Also with genomic data (marker panels)
- Risk management tool!

Figure from charolaisusa.com
Effect of Genomic Testing on EPDs

- Accuracy increases according to:
  - Predictive ability of the test
  - Original accuracy of the animal
- Seedstock: How much value do I gain vs cost of test
- Commercial: What premium can I pay for increased accuracy from genomic testing?
GE-EPD Accuracy Increase

Selection Indices

- Easy multiple trait selection
- One of easiest ways to select for PROFIT
- Generally, only use 1 index at a time

1. ID your production and marketing system
   - Market end point (when and how they are marketed)
   - Current performance and genetic level
   - Terminal or keeping replacements?

2. ID index appropriate to the production system
   - What traits are included?
   - Current performance and genetic level
Use of Selection Indexes

- Select for the highest index values
  - Limit use of additional EPDs
    - Muddy the waters, decrease intensity
    - Set limits on those that are important
      - Mature Size
      - Milk Production
      - Calving Ease
  - Don’t duplicate what’s already in the index
    - Use one index at a time

Crossbreeding

- Recently under fire
  - Relatively easy way to increase cowherd efficiency
  - Easy management of genetic defects
  - Avoid inbreeding
  - Breed Complementarity
    - Combine “best” traits from each breed
  - Heterosis
    - Crossbred advantage in performance over purebred lines
Crossbred Advantage

- Breed Complementarity
- Heterosis

Crossbred Cow Advantage

- If you only take advantage of heterosis in one place, do it in the cows!

Heterosis largely impacts fertility and longevity—these gains are not at the expense of much larger cows and higher feed costs!
Mating Management

- Use crossbred cows to increase fertility and longevity
- Use AI with high accuracy bulls to manage risk
- Use EPDs, indexes, and performance data to optimize cowherd to environment
  - We don’t always have to select for more
- Utilize terminal matings to produce calves with high-output genetics while maintaining a moderate cowherd!
  - Address fit to market and consumer preferences

Questions?