Using cow carcass weight to select efficient cows

Getinet M. Tarekegn, Harriet Bunning, Marco Winters, Raphael Mrode, Mike Coffey
Breeding for Efficiency

Breeding Goal: Maximise Production
Breeding for Efficiency

Breeding Goal: Maximise Production

Breeding Goal: Maximise Efficiency
Breeding for Efficiency

Breeding Goal: Maximise Production

Breeding Goal: Maximise Efficiency

£ \rightarrow CO_2 \rightarrow \text{Cow} \rightarrow \text{Meat} \rightarrow \frac{\text{e.g.}}{CO_2}
Breeding for Efficiency

How much does it cost (£ or CO₂) to keep a cow?

Ideal phenotype: Dry Matter Intake or Methane
Breeding for Efficiency

How much does it cost (£ or CO₂) to keep a cow?

Ideal phenotype: Dry Matter Intake or Methane

Potential proxy: Cow Weight
Breeding for Efficiency

How much does it cost (£ or CO₂) to keep a cow?

Ideal phenotype: Dry Matter Intake or Methane

Potential proxy: Cow Weight

BUT No national liveweight data
Cull Cow Carcase Data

- UK Carcase Database: 14.5 million animals
  - Carcase Weight
  - EUROP Conformation
  - EUROP Fat
  - Date of Slaughter
- >1.8 million cull cows
  - Must have had > 0 calves
Cull Cow Carcase Data: Breeds

- 220 different breed codes
- Inc. crossbred
- Most common:
  - Holstein
  - Lim X
  - Friesian
  - Angus X
  - Simmental X

883,744, 52%
775,399, 45%
55,708, 3%
Aim: Calculate genetic parameters for cull cow carcase traits to check viability for use as proxy traits
Materials & Methods

• Cows 1095 – 7811 days old
• Carcase weight 275 – 500kg
• 4991 cows born 1998 – 2010 included
• 5 generations, pedigree including 32,917 animals
• 12 breed groups included, with Limousin most common

• Phenotypes:
  • Carcase Weight (kg)
  • EUROP Conformation (45 points)
  • EUROP Fat Class (45 points)
Materials & Methods

\[ Y_{ijklmno} = Sr_i + S_j + A_k + CYBSB_l + BYBSB_m + a_n + e_{ijklmno} \]

Where:

- \( Sr_i = source \ of \ the \ cows \)
- \( S_j = Season \ of \ birth \)
- \( A_k = Age \ of \ the \ cows \) fitted as covariate
- \( CYBSB_l = \) combination of cow-year of birth-season
- \( BYBSB_m = \) breed-year of birth-season
- \( a_n = Animal \ as \ Random \)
- \( e_{ijklmno} = Residual \)

The heritability estimates were generated using REMLF90 program of the BLUPF90 family.
### Results

<table>
<thead>
<tr>
<th>Traits</th>
<th>$h^2$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>0.79</td>
<td>0.003</td>
</tr>
<tr>
<td>EUROP Fat Class</td>
<td>0.36</td>
<td>0.095</td>
</tr>
<tr>
<td>EUROP Conformation</td>
<td>0.32</td>
<td>0.081</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Traits</th>
<th>$h^2$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>0.79</td>
<td>0.003</td>
</tr>
<tr>
<td>EUROP Fat Class</td>
<td>0.36</td>
<td>0.095</td>
</tr>
<tr>
<td>EUROP Conformation</td>
<td>0.32</td>
<td>0.081</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prime Traits</th>
<th>$h^2$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>0.42</td>
<td>0.022</td>
</tr>
<tr>
<td>EUROP Fat Class</td>
<td>0.45</td>
<td>0.023</td>
</tr>
<tr>
<td>EUROP Conformation</td>
<td>0.42</td>
<td>0.022</td>
</tr>
</tbody>
</table>

## Results

<table>
<thead>
<tr>
<th>Traits</th>
<th>$h^2$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>0.79</td>
<td>0.003</td>
</tr>
<tr>
<td>EUROP Fat Class</td>
<td>0.36</td>
<td>0.095</td>
</tr>
<tr>
<td>EUROP Conformation</td>
<td>0.32</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prime Traits</th>
<th>$h^2$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>0.42</td>
<td>0.022</td>
</tr>
<tr>
<td>EUROP Fat Class</td>
<td>0.45</td>
<td>0.023</td>
</tr>
<tr>
<td>EUROP Conformation</td>
<td>0.42</td>
<td>0.022</td>
</tr>
</tbody>
</table>

Higher heritability due to less environmental variation?

### Conclusion

- Preliminary results show moderate to high heritability for cull cow carcase traits
- Good potential target traits for selective breeding

<table>
<thead>
<tr>
<th>Traits</th>
<th>$h^2$</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>0.79</td>
<td>0.003</td>
</tr>
<tr>
<td>EUROP Fat Class</td>
<td>0.36</td>
<td>0.095</td>
</tr>
<tr>
<td>EUROP Conformation</td>
<td>0.32</td>
<td>0.081</td>
</tr>
</tbody>
</table>
What Next?

Use these phenotypes to predict liveweight

Options:

1. Use constant killing out percentage (only carcase weight)
2. Use EUROP corrected killing out percentage (carcase weight, conformation & fat)
3. Also use other data (age & days since last calving)
Option 1: Carcase weight alone

Liveweights for Stabiliser cows provided by Stabiliser Cattle Company

Liveweight = 286 + 1.1 * Carcase Weight

R$^2 = 0.32$

Mean KO% = 52%
Liveweights for Stabiliser cows provided by Stabiliser Cattle Company

Option 2: Include other carcase traits

- Preliminary results suggest that both EUROP Conformation and Fat have effects on killing out percentage
- Suggests using more variables to predict liveweight may be better
Option 3: Include other variables

Liveweights for Stabiliser cows provided by Stabiliser Cattle Company

- Preliminary results suggest days since last calving also has an important effect on killing out percentage
- Opportunity for QA e.g. remove animals > 400 days since last calving
What Next?

Use these phenotypes to predict liveweight

Options:

1. Use constant killing out percentage (only carcase weight)
2. Use EUROP corrected killing out percentage (carcase weight, conformation & fat)
3. Also use other data (age & days since last calving)

Next: Test prediction model using other breeds

Calculate genetic parameters for predicted liveweight
Summary

- Cull cow carcase data is an untapped source of useful phenotypes
- Cull cow carcase weight is highly heritable
- There is potential to predict cow liveweight using carcase weight
- Other factors (such as EUROP grade, and calving data) may improve this prediction

Cull cow carcase weight could be used as a proxy to select low input cows
Thank you for listening

For more info on UK National Beef Evaluations:
ahdb.org.uk/knowledge-library/national-beef-evaluations