Innovation: Improving beef efficiency
Step change in genetic (and genomic) improvement in Scottish beef industry.
What is the value of genetic selection? (US dairy cows)

In 2015: 1957 base was 44% of total fat, management was 28% of gains, and genetics was 28% of gains.

From John Cole, AIPL
Current information in breeding values

Performance data

EBV

Progeny

Pedigree
Tracing genes through pedigree
Tracing genes through pedigree vs genome

This lab estimates your genome-wide percentage of Neanderthal ancestry

Got Neanderthal DNA?

An estimated 2.9% of your DNA is from Neanderthals.

Eileen Wall (you)  2.9%  87th percentile
Average European user  2.7%

MODERN HUMANS
- Higher brow
- Narrower shoulders
- Slightly taller

NEANDERTHALS
- Heavy eyebrow ridge
- Long, low, bigger skull
- Prominent nose with developed nasal chambers for cold-air protection
Current information in breeding values - DNA add genomic prediction

- Performance data
- Genomic result
- gEBV
- Pedigree
- Progeny
Genomic selection impacts genetic gain

\[ \Delta G_{\text{year}} = \sqrt{\text{reliability} \times \text{selection intensity} \times \sqrt{\text{genetic variance}}} \times \text{generation interval} \]

- \( \Delta G = \) genetic gain each year
- reliability = how certain we are about our estimate of an animal’s genetic merit (genomics ↑)
- selection intensity = how selective we are when making mating decisions (management can ↑)
- genetic variance = variation in the population due to genetics
- generation interval = time between generations (genomics ↓)
Beef Genomics
Genetic trends in Charolais

YEAR

EBW

200 Day milk
200 Day Growth
400-Day Growth
.... And over in Ireland

- Genetic progress focused on terminal traits, with little progress attained in maternal traits.
Why maternal and calf traits?

- Most cows are 36 months when they have their first calf
- Huge potential to reduce to 24 months (where appropriate)

Distribution of age at first calving (months)

- 31 months in BES
- Calv Int = 398 days
Why maternal and calf traits?

- Most cows are 36 months when they have their first calf
- Huge potential to reduce to 24 months (where appropriate)

1 Davies I. (2016, 03), Late-calving heifers costs beef farmers £4,000/year, http://www.fwi.co.uk/business/late-calving-heifers-costs-beef-farmers-4-000-year.htm
Improving Maternal Beef traits

• Selection focused on beef growth and carcass traits has neglected many maternal traits

• Initiatives to improve maternal beef herds through increased use of improved maternal genotypes and genomic selection
  – Scotland Beef Efficiency Scheme (BES)
    ➢ Improve herd profitability
    ➢ Reduce greenhouse gas (GHG) emissions
BES impact prediction

- Predict effects of farmer sourcing elite maternal genotypes to breed herd replacements

Maternal Dual Purpose Index

Maternal Sub-index
- Mature weight (heifer, cow, cull cow)
- Calving interval
- Age at first calving
- Longevity
- Gestation length
- Calving ease

Terminal Sub-index
- Beef value
Genetic effect of Elite Maternal sires

Elite maternal +£30 sires used for 20y

Current trend = -£0.722/y

↑ Weight
↑ Calving interval
↓ Calving ease
Expressed GHG with Elite Maternal sires

+$30$ Elite maternal sires mated to herd for 20 years

Current Total maternal GHG trend

Replacement heifers

Breeding cows

Total maternal GHG
BES – potential benefits

- Genetic improvement value
  - £3.50/cow/year maternal traits
  - £4.11/cow/year efficiency/terminal traits
  - Permanent and cumulative

- 10 years = 270,000 t of CO2e and ~ £22m
BES – Data benefits

• Better data, and using it (!), help farmers make the best breeding and management choices.
  – better rates of calving
• A more sustainable Scottish beef sector – environmentally and economically

350,000 calvings
55,000 animals selected for genotyping
Highlights

- Sub-clustered by breed but linkages
Highlights

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• 85% self calved
  – 2.2% vet assistances
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• 85% self calved
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• 73% of dams docile/quiet
  – 2.5% aggressive

• 3.5% of calves lazy/weak
  – 5X more likely to die early
Highlights

- Sub-clustered by breed but linkages
- 85% self calved
  - 2.2% vet assistances
- 73% of dams docile/quiet
  - 2.5% aggressive
- 3.5% of calves lazy/weak
  - 5X more likely to die early
- Traits from historic data
  - $h^2$ age @ slghtr = 17%
  - $h^2$ age @ 1\textsuperscript{st} calf = 39%

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<th>CalvInt (days)</th>
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Summary

- Beef behind dairy in terms of genetic improvement
  - Lots of low hanging fruit
- Step changes in the coming years
- Genetic evaluations developed for novel traits, e.g.,
  - Feed efficiency – industry trait collection ongoing
  - Disease resistance if large enough populations can be amassed and data shared - top 5 disposal reasons where old age, infertility, born dead, pneumonia and general health
- Integration of data across farm types and industry for gEBVs for all
- Good baseline data helps implement and realise potential of innovations – genomics and wider
THANK YOU!