Using Commercial Data and Genomics to Improve Female Fertility and Calf Survival of Limousin beef cattle in the UK

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Leading the way in Agriculture and Rural Research, Education and Consulting

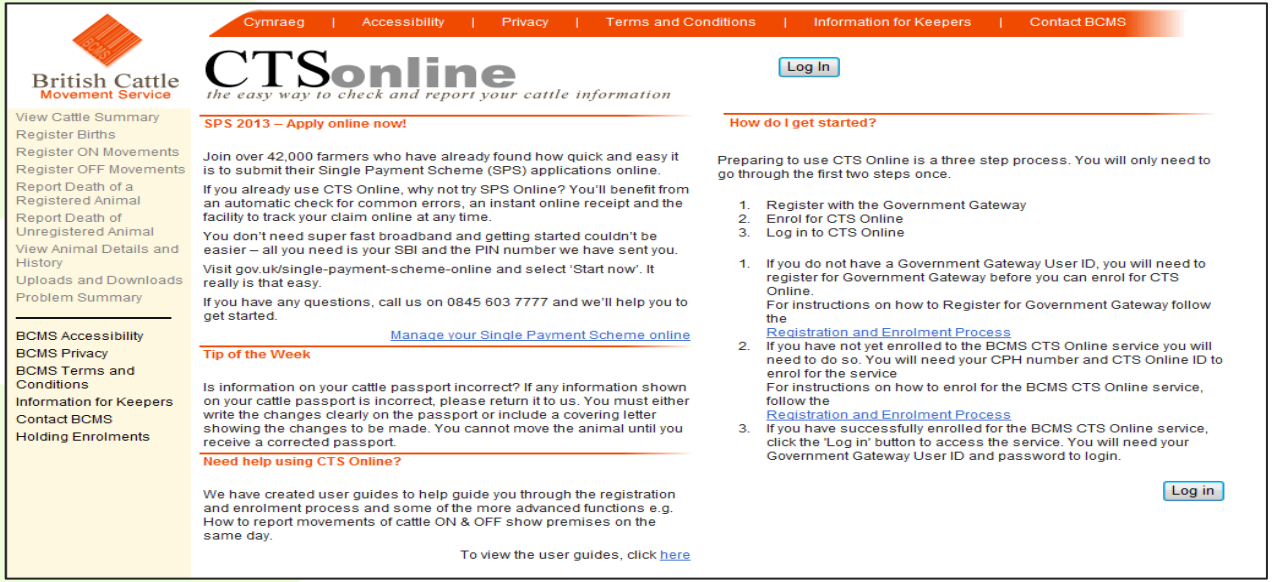
Introduction

- Fertility evaluations using pedigree data
- General low uptake of EBVs
  - Low accuracy as late in life, sex limited
  - Terminal V maternal conflict
- Fertility evaluations changed in 2017
  - National BCMS database
    - Pedigree + commercial + cross bred
  - Genomic selection

⇨ Increased accuracy

British Cattle Movement Service

COMMERCIAL animals



- Information:
  - Dam
  - Breed
  - Date of birth
  - Date of death
  - Movement

- Not compulsory:
  - Sire

Fertility and Survival GEBVs

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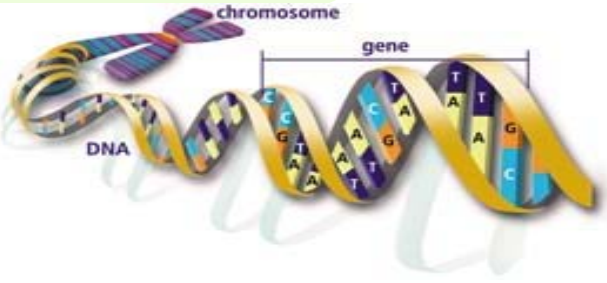
- 1 year project (2016-2017)
- Limousin genomic breeding values for female fertility and calf survival traits
- GEBVs implemented July 2017



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VIA carcase traits GEBVs

- 4 year project (2012-2015)
- Limousin genomic breeding values for abattoir VIA carcase traits
- First UK GEBVs March 2016

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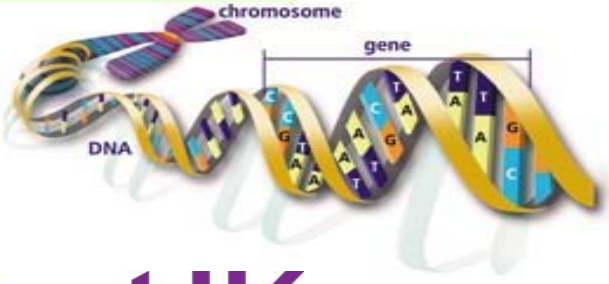
abp Food Group



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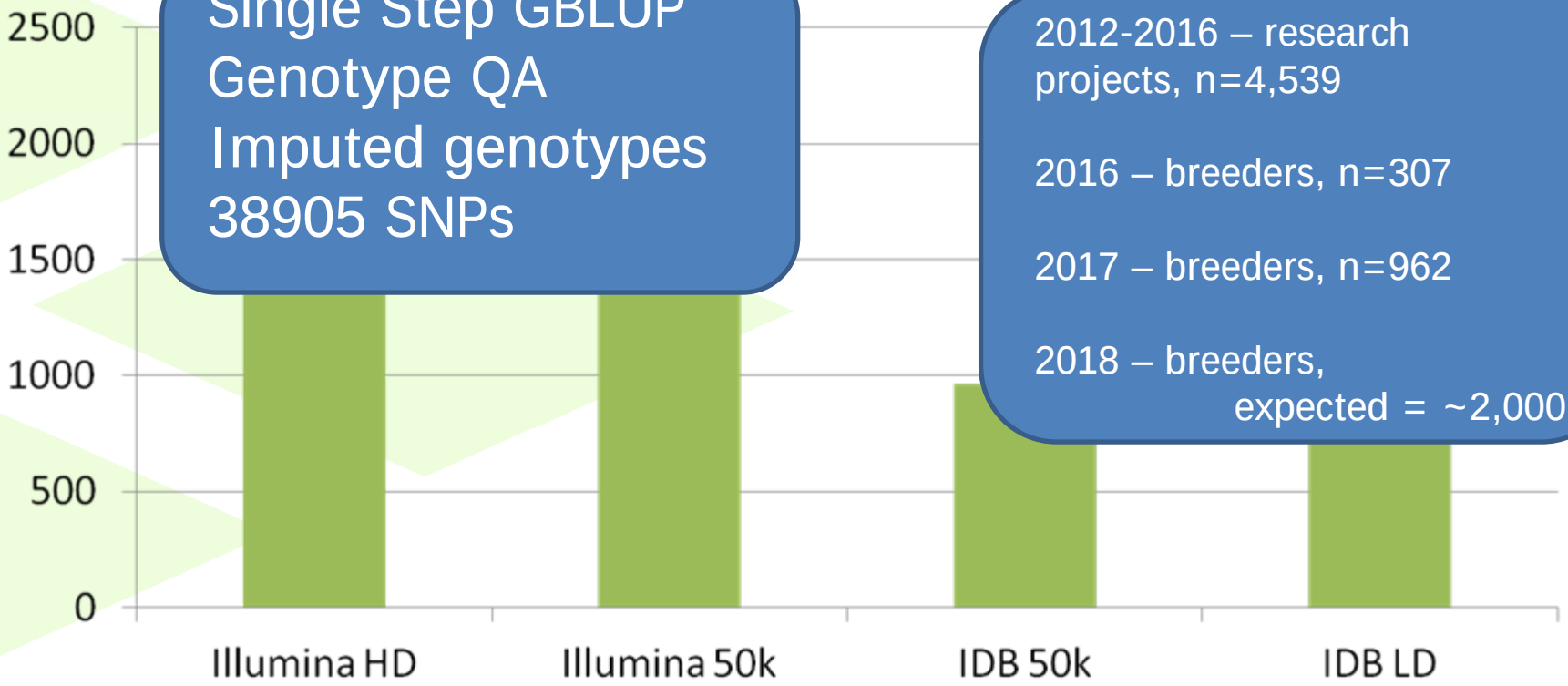
Genotypes (n=5,808)

Single Step GBLUP
Genotype QA
Imputed genotypes
38905 SNPs



2012-2016 – research projects, n=4,539

2016 – breeders, n=307

2017 – breeders, n=962

2018 – breeders, expected = ~2,000

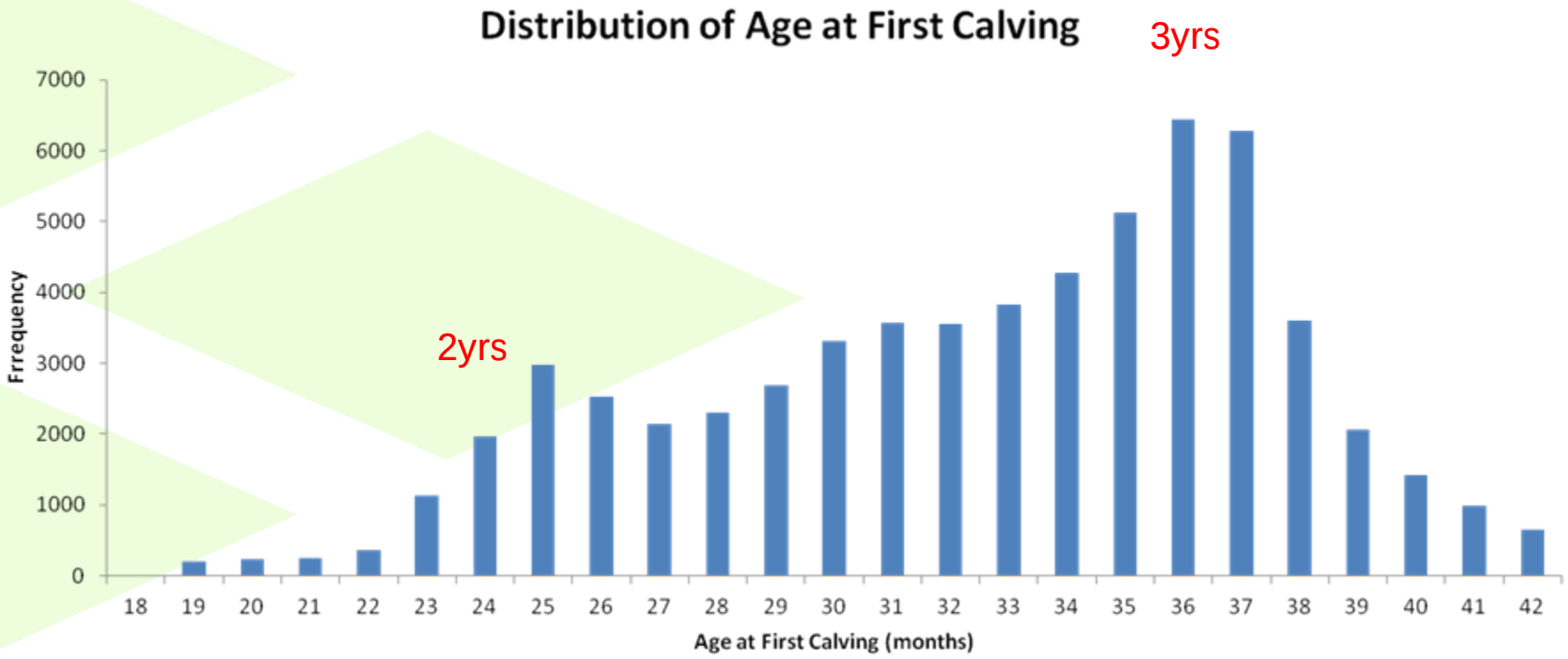
Female Fertility and Calf Survival

- Using national records (BCMS)
- ~12 million animal records (45%+Limousin)
- Restricted to 2003+ and applied some basic data edits
  - ~8 million records
  - ~ ½ million cows with fertility records

Female Fertility and Calf Survival

- Age at first calf
  - 548 & 1460 days (18-48m)
- Lifespan
  - number of parities when aged 6.5 years
- Calving interval
  - days between 1st and 2nd calf
- Calf survival
  - to 10 months, 1=died, 2=survived

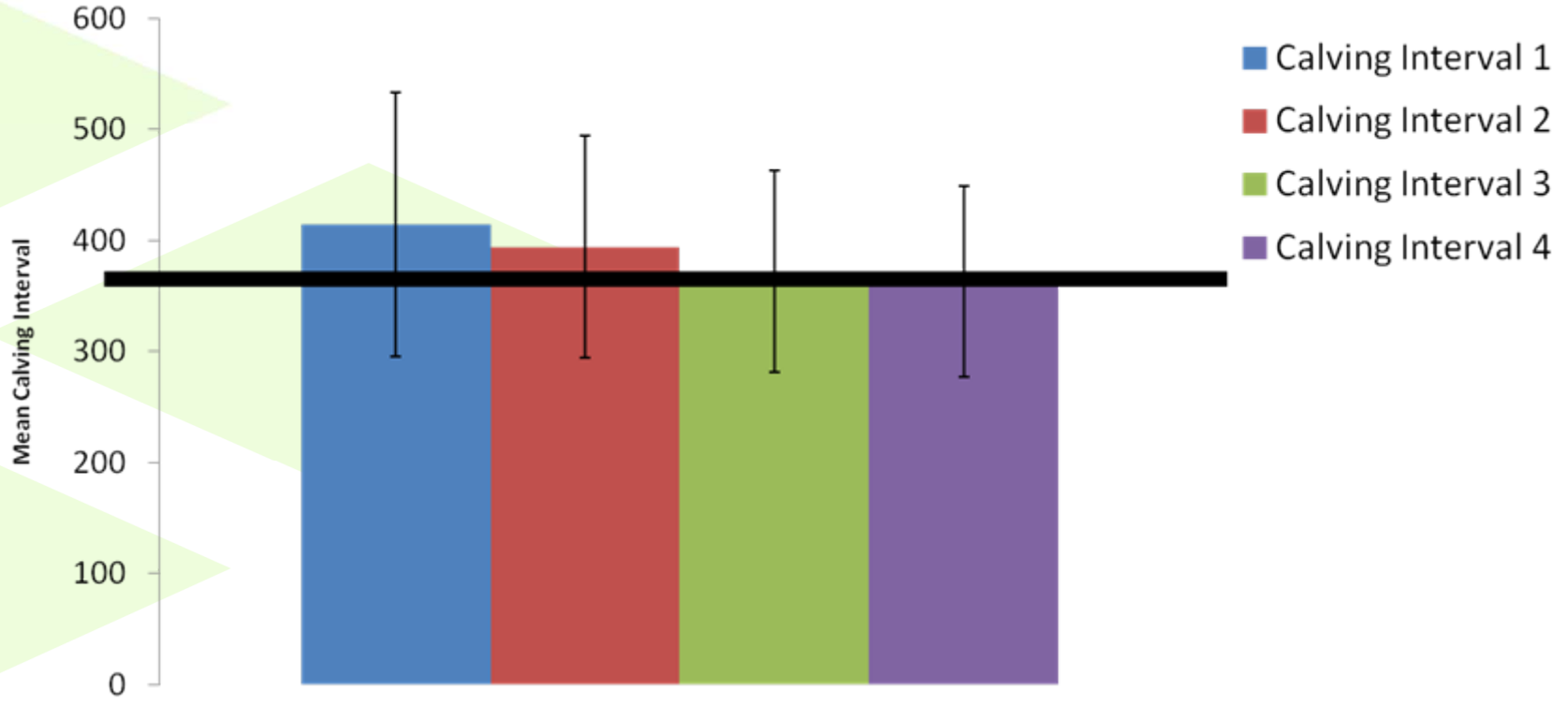
Age at First Calf



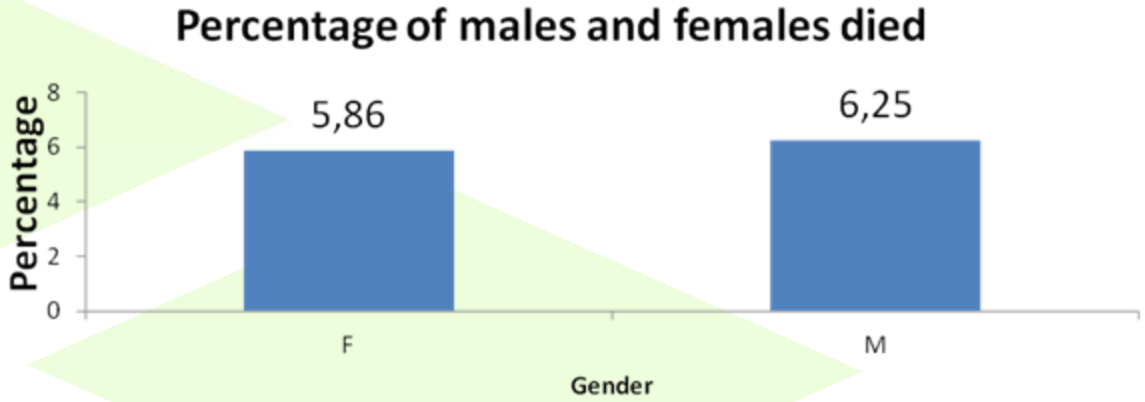
Lifespan

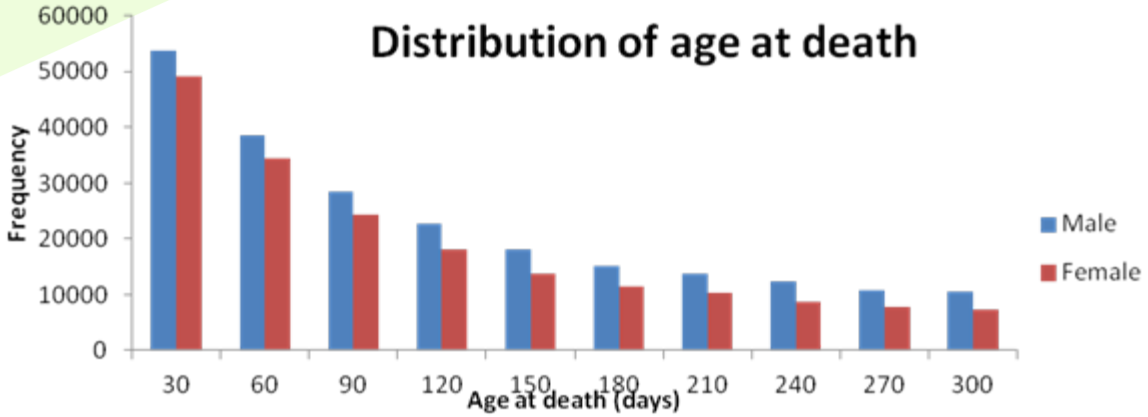
Number parities	Number cows	Average dam age (years)	Percentage of all dams	Percent of dams from previous parity
1	559,832	2.6	100.0	-
2	435,001	3.8	77.7	77.7
3	341,358	4.9	61.0	78.5
4	263,169	6.0	47.0	77.1
5	196,876	7.0	35.2	74.8

Calving interval



Calf Survival





Genetic Parameter Estimation

- Further data edits
  - Ensure reproductive life complete
  - Known sire or maternal grandsire
  - Trait specific edits

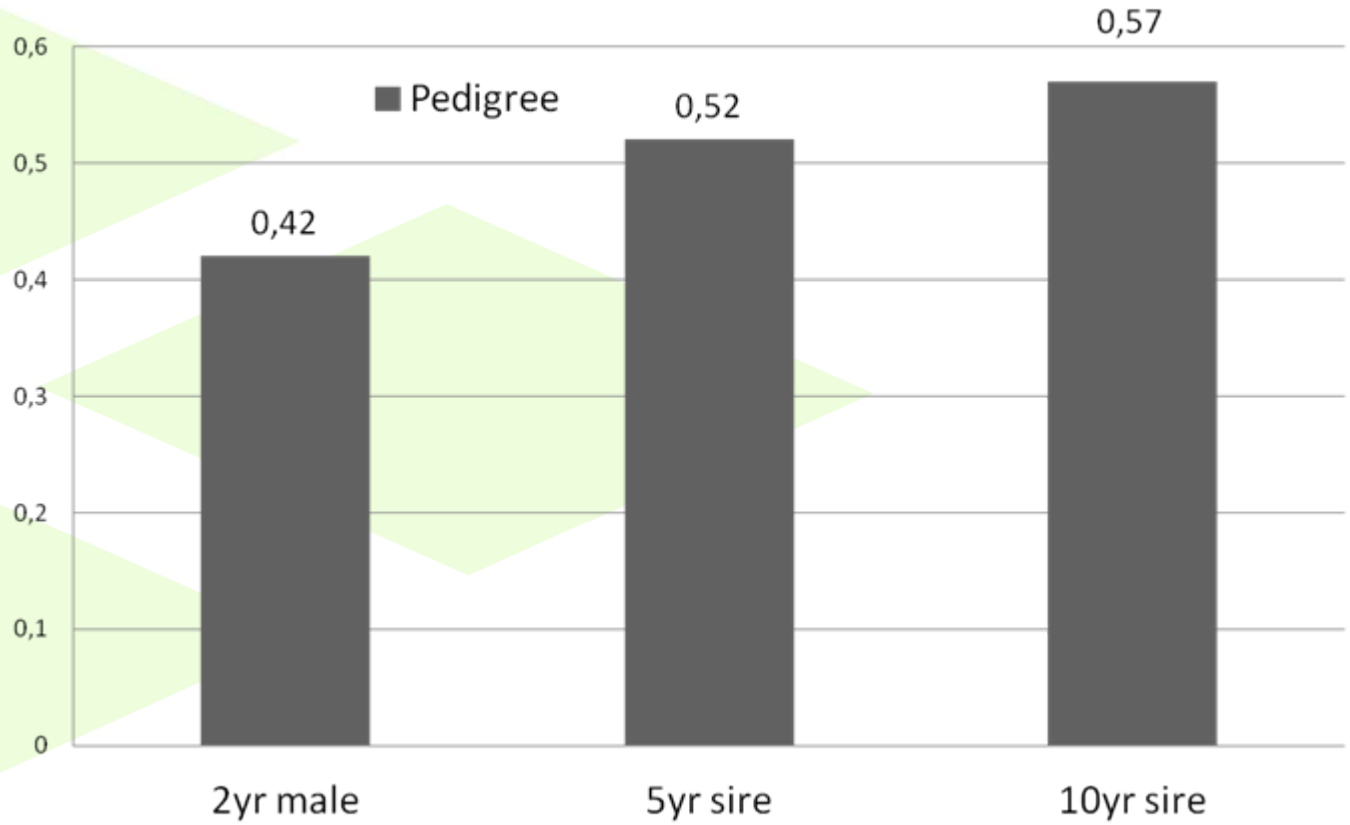
	CG	DAM PARITY	CALVING MONTH	SEX	HET/REC	AFC (l & q)	DAM AGE	ANIMAL
AFC	X	X			X			X
CI	X		X		X	X		X
LS	X				X	X		X
CS	X	X		X	X		X	X

Genetic parameter estimates (SE)

Heritability on diagonal, genetic correlation above, phenotypic below

Trait	Number	Vp	Age at 1st calf	Calving interval	lifespan	Calf survival
AFC	58,148	15057 (99.40)	0.13 (0.01)	-0.04 (0.18)	-0.03 (0.14)	-
CI	27,861	10448 (96.05)	-0.03 (0.01)	0.05 (0.02)	-0.46 (0.19)	-
LS	34,307	1.19 (0.01)	0.01 (0.01)	-0.30 (0.01)	0.05 (0.01)	-
CS	55,149	0.075 (0.001)	-	-	-	0.04 (0.01)

Average accuracy for Age at first calf



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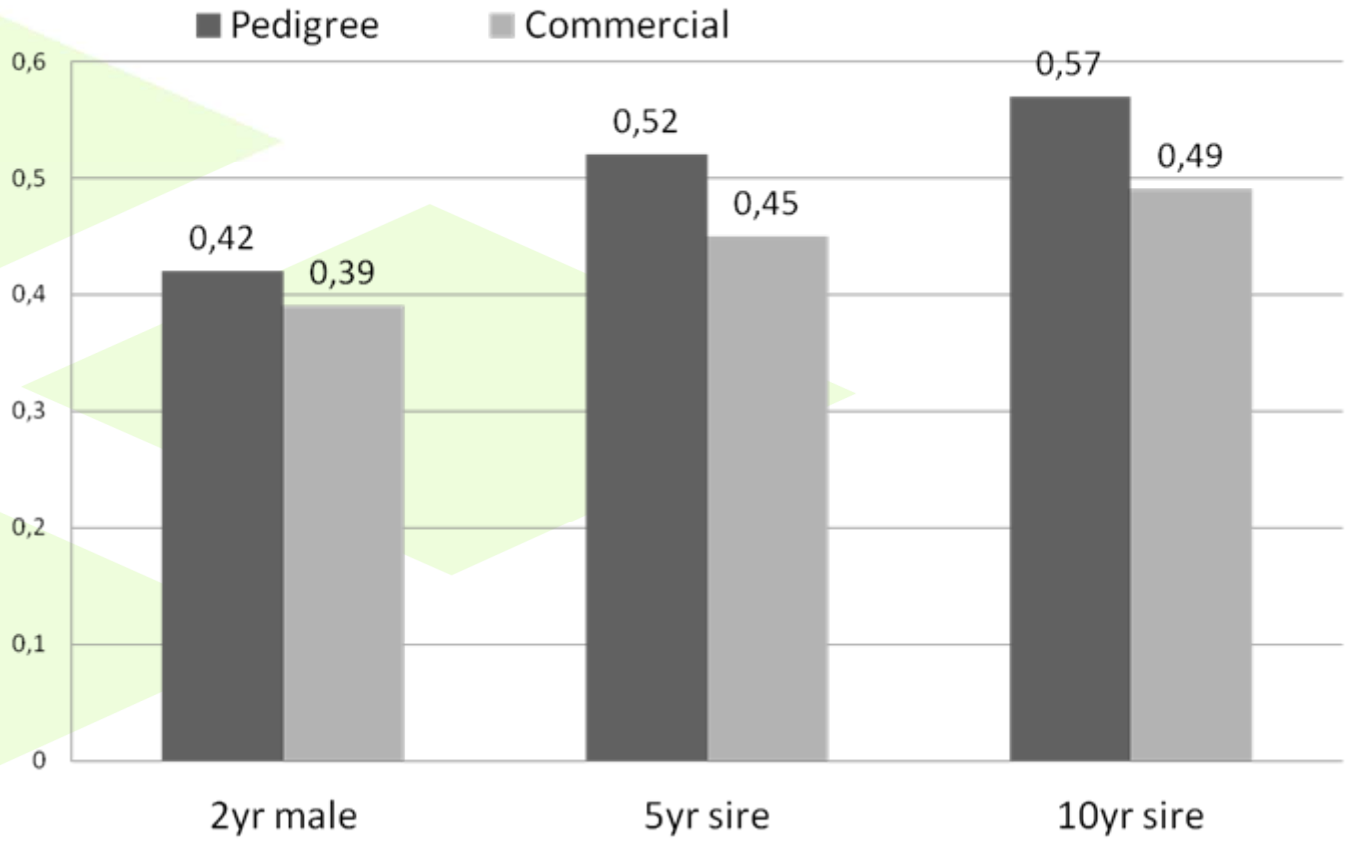

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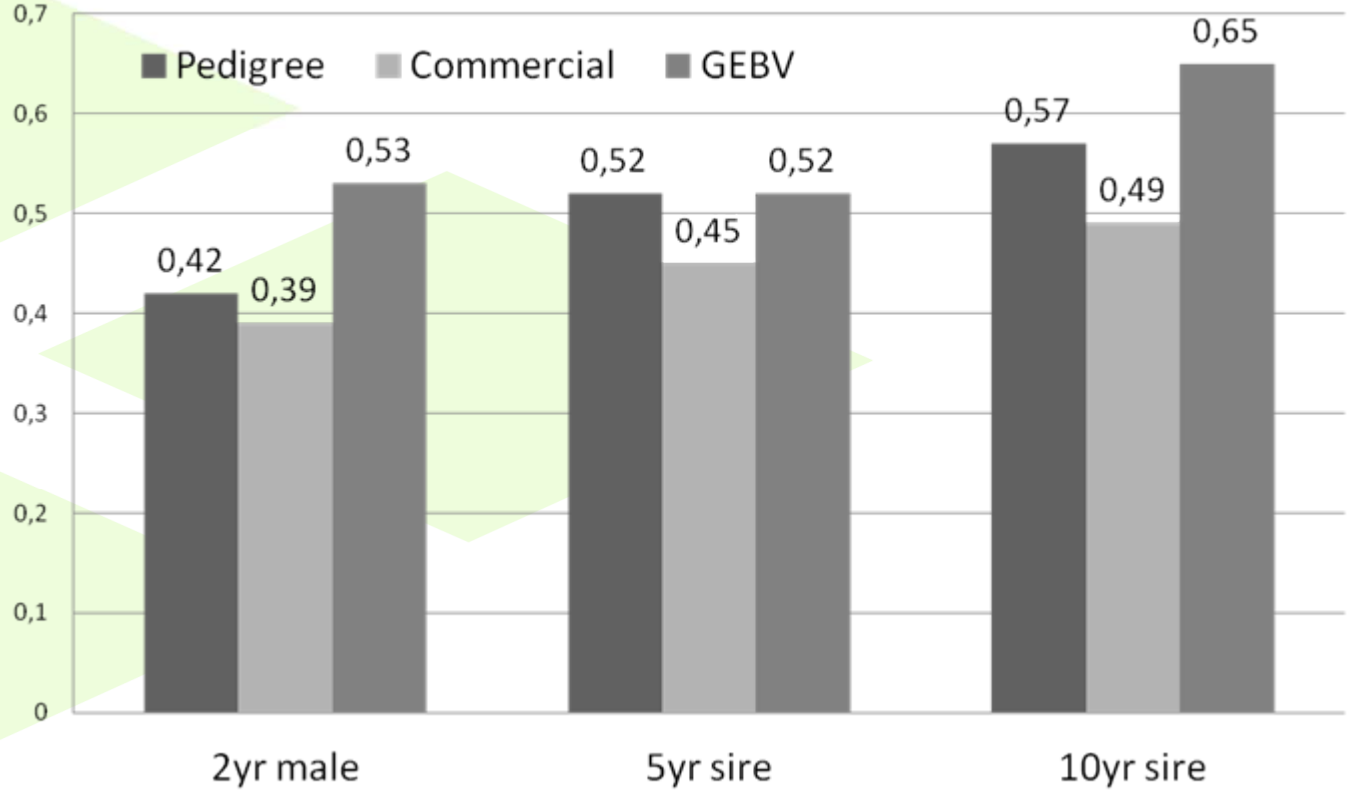
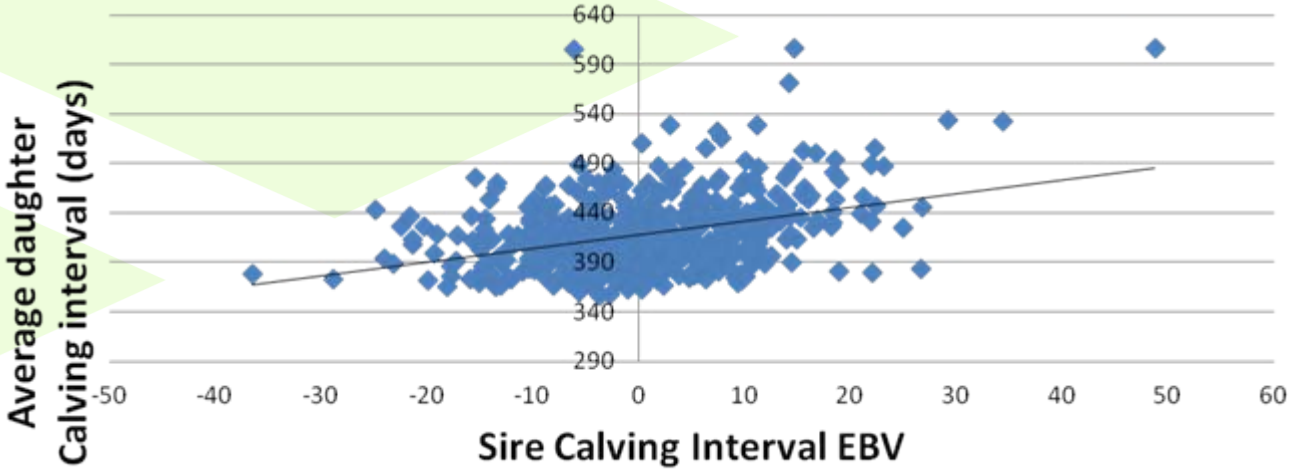


Sire EBV v Progeny performance

- Sires 50%+ accuracy & 10+ daughters
- Correlations ranged 0.19 (AFC) to 0.43 (CS)
- Regressions ranged 0.96 (AFC) to 1.38 (CI)



Relationship with existing fertility EBVs

- One set of (G)EBVs published
- Large amounts of new data, new trait definitions, genomic element
- Animals with accuracy 50%+ in both evaluations
  - AFC, r=0.33
  - CI, r=0.33
  - LS, r=0.43

1 extra calf?

- 1.6 million beef cows
  - 31% sired by Limousin
- 496,000 extra calves
  - 300 kg carcase and 84% weaning rate
  - 125,000 tonnes of beef
    - 15% of current production
  - Same size national herd
    - Reduction of greenhouse gas emissions
      - 537 – 578, 000 tonnes of CO_2e (Navajas *et al.,* 2008)

Thank you

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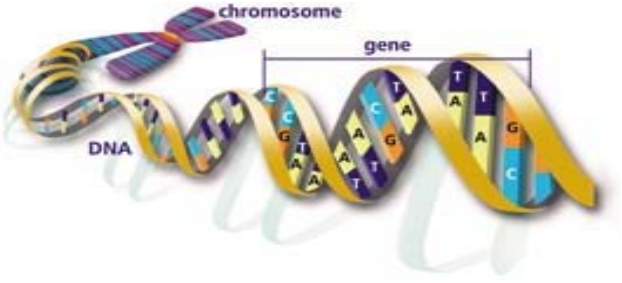

Genetic parameter estimation

- CG – herd and season (6 month slice)
- AFC and CS CG
  - Animals
- CI and LS CG
  - 1st calf
- Further edits
  - Reproductive life completed
  - Sire or maternal grand sire known
- 3 generation pedigree
- ASReml for parameter estimation

- Trait specific edits
  - Age at First Calf (AFC)
    - 548 and 1,460 days
    - Calf not the result of ET
    - AFC within 3 SD of CG mean
    - Not a single sire or small (<5) CG
  - Calving interval (CI)
    - Valid AFC, 270 – 913 days, penalty applied if greater than 913days
    - CI within 3 SD of CG mean
    - Not a single sire or small (<5) CG
  - Lifespan (LS)
    - Valid AFC
    - Not a single sire or small (<5) CG
  - Calf Survival (CS)
    - Multiple births
    - Death rate < 2% within a CG
    - CS within 3 SD of population mean for each sex
    - Not a single sire or small (<5) CG
    - 2007-2009 born animals

Relationship with VIA carcase GEBVs

N=4,025	AFC	CI	LS	CS
Carcase Wt	-0.002	-0.03	0.03	-0.05
Slaughter Age	0.03	0.01	0.02	-0.03
Fillet	0.11	0.16	-0.22	-0.10
Conformation	0.19	0.04	-0.08	-0.04
Fat	-0.09	-0.23	0.18	-0.06