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Modelling fertility traits under natural mating conditions in beef cattle

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Introduction

- In Spain there are many local breeds (>35)
- Their selection programs are focused on increasing productivity (kg of weaned calf per cow) through growth traits
- Official report (MAGRAMA) of fertility warned about low fertility in beef breeds
- Context:
  - Absence of systematic control
  - Difficult to measure in extensive production
  - Natural mating (scarce use of AI)
  - Farmers assume high fertility of their cows
  - One of the most **economically important traits**

  (Phocas et al., 1998; Urioste et al., 1998; Cammack et al., 2009; Fortes. et al., 2013)

OBJECTIVE

Incorporation of fertility traits in beef cattle selection programs using easy to record data

First approach:

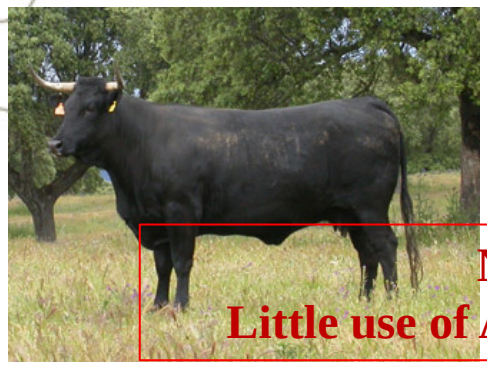
Calving interval 1-2

Material

- Data from 2 breeds

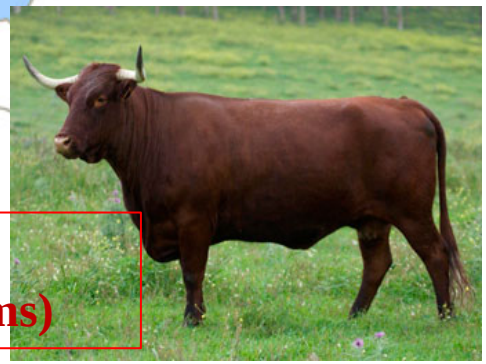
-Avileña-Negra Ibérica

Highland
+
Grassland
70 cows/herd



-Retinta

Grassland
100 cows/herd



Natural mating
Little use of AI (management problems)

Material

Edits

Herd in breeding program & ≥2 sires

Cows: Age at first calving **AF** (448-1619 days)

Calving interval from first to second calving $\mathbf{CI_{1\text{-}2}}$ (289-600 days)

Avileña-Negra Ibérica (ANI)

9383 cows with $\boldsymbol{CI_{1\text{-}2}}$

$\boldsymbol{CI_{1\text{-}2}}$

409 ± 73 days

Retinta (RT)

5230 cows with $\boldsymbol{CI_{1\text{-}2}}$

$\boldsymbol{CI_{1\text{-}2}}$

453 ± 102 days

Statistical Models

Fertility	=	C.G.	+	Cow	+	Bull (Second mating)	+	e	
~~Fertility~~ CI $_{1\text{-}2}$	=	Herd-Year-Season		Age at first calving		Age at mating			**Both models**
				Inbreeding coefficient		Inbreeding coefficient			
				Additive genetic effect		Permanent effect			**Model 1**
				Additive genetic effect		Permanent effect			**Model 2**
						Additive genetic effect			

- **Age Dam** at first calving (3 levels : <2.5years. 2.5≥years≤3. >3years)
- **Age Sire at second mating (6 levels: 1** <2 years . **2** ≥2years - <3 years . **3** ≥3years - <4 years . **4** ≥4years - <5 years . **5** ≥5years - <6 years. **6** ≥6years)
- **Inbreeding coefficients of cows and bulls** (tabular method . Thier, 1990)

Another trait

Conception rate at 21 d cycles (max. 7 cycles)

- 1 success / 0 no success
- Product model & Additive model
- Convergence problems

Phenotype difficult to identify

Three management systems: Continuous , two season and one season matings

Methods

- Bayesian inference with Markov chain Monte Carlo algorithm
  - 1.000.000 iterations
  - 500.000 burn-in
  - 10 thin
- Software TM (Legarra et al., 2008)

Results and discussion

- Difference in days between the best and the worst solutions for each effect

Effect	N levels		Solutions Best-Worst (days)			
			Model 1		Model 2	
	ANI	RT	ANI	RT	ANI	RT
HYS	1969	1323	379.82	537.06	390.13	545.54
Cow Age	3	3	19.96	18.73	19.98	18.81
Bull Age	6	6	29.31	76.33	30.52	77.66
Inbreeding coefficient's Dams (days/% inbreeding)			0.16 ± 0.13	0.07 ± 0.23	0.16 ± 0.13	0.06 ± 0.24
Inbreeding coefficient's Sires (days/% inbreeding)			0.76 ± 0.34	0.85 ± 0.54	0.79 ± 0.35	0.83 ± 0.56
Bull permanent effect	879	743	149.38	284.44	121.49	229.66
Cow additive genetic effect	16795	11445	45.67	53.51	42.78	45.15
Bull additive genetic effect	16795	11445	-	-	49.22	74.30

Results and discussion

- Genetic parameters

		MODEL 1		MODEL2	
		ANI	RT	ANI	RT
Genetic parameters	$\sigma_{a♀}^2$	252.07 ± 83.52	616.96 ± 271.20	233.94 ± 92.45	525.06 ± 281.17
	$\sigma_{p♂}^2$	1249.97 ± 218.66	4566.72 ± 621.03	1026.28 ± 241.61	3775.11 ± 749.51
	σ_e^2	3365.04 ± 87.91	6396.85 ± 265.92	3371.85 ± 91.86	6459.04 ± 274.08
	$h_♀^2$	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.02	0.04 ± 0.02
	$c_♂^2$	0.26 ±0.03	0.39 ± 0.03	0.20 ± 0.04	0.31 ± 0.06
	$\sigma_{a♂}^2$			401.19 ± 219.90	1225.14 ± 700.77
	$h_♂^2$			0.08 ± 0.04	0.10 ± 0.06
	$r_{g♀♂}$			0.24 ± 0.36	0.18 ± 0.50

≠ 0???

Conclusions

- The male component is more relevant than in other studies with AI (Mackinnon et al. 1989)
- Fertility in these populations can be improved through bulls screening
- There could be bull pathologies and low quality semen which influence reproduction parameteres
- Inbreeding depression: higher in bulls than in cows

Future

- More studies

BULLS
-Screening

-Pathologies

COWS
-Pathologies

-Nutrition (BCS)

-More traits
Age at First Calving
Conception Rate

Thanks for your attention