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Genetic correlations among fighting ability, fertility & productive traits in Valdostana cattle

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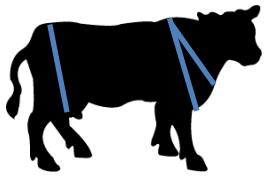


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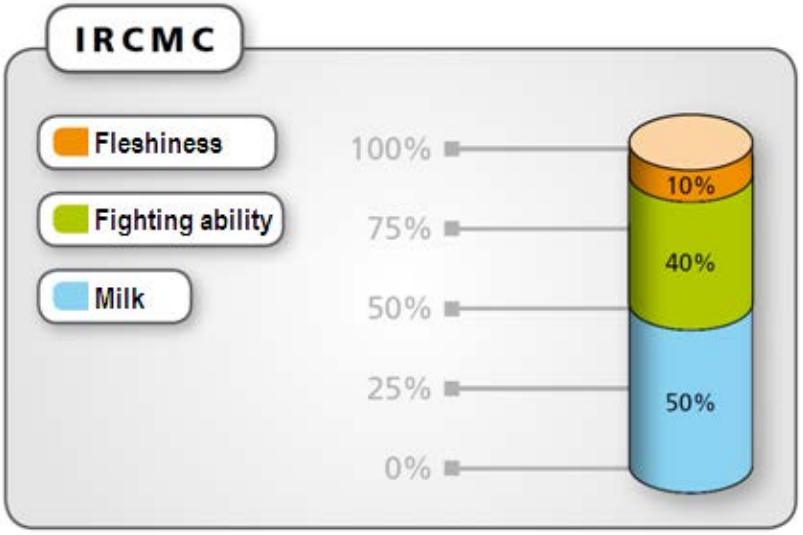
Introduction

- Aosta Chestnut & Black Pied cattle -> Autochthonous of West Alps
- Strong attitude to fight -> *"Batailles de Reines"*
- Fighting ability -> Capability to win a contest (Parker, 1974)

Batailles de Reines

- 20 heats + final fight
- Knock-out battles among pairs of cows, by weight categories
- Check for milking & pregnancy to participate

Selection in Valdostana cattle



- From 2012 fighting ability included in an aggregate selection index
- Fighting ability from “Batailles de Reines” cow performances

Best fighters are supposed to present

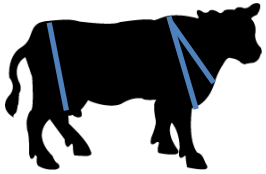
- A more “masculine” phenotype
- Lower milk production

Fighting ability & milk yield/fertility expected to be antagonistic traits

Aim of the study

Genetic correlations of fighting ability with milk yield, linear type traits & fertility

Trends of breeding values for all studied traits



Materials & Methods

Herd-book information for Aosta Chestnut and Aosta black pied breeds (Updated at November 2012)

Genetic evaluation of fighting ability, linear type traits, milk yield, fertility:

- Single trait linear models for variance components & **heritability**
- Bi-trait linear models for **genetic correlations**
- **Genetic trends** of estimated breeding values

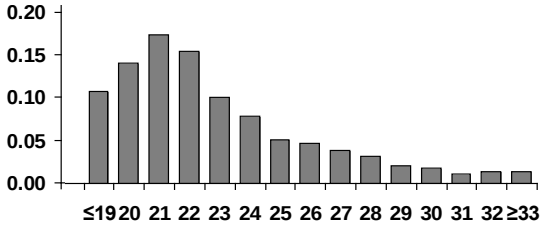
EM-REML method, REMLF90 software (Misztal, 2008)

Traits: 1. Fighting ability

Evaluation based on a Placement score obtained from results of fighting (i.e., wins achieved, no. of participant at tournament and type of tournament; Heat of final; Sartori & Mantovani, 2010)

Placement Score (PS)

$$PS_{ijkl}=20+ty_i+d_j+2w_k$$



34,190 records; 10,735 cows; 21,198 animals in pedigree

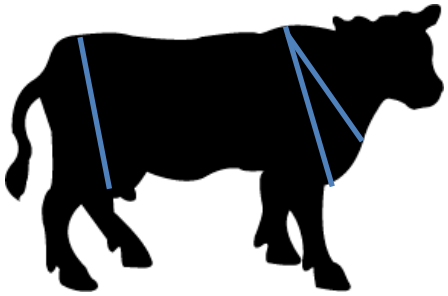
Model:

$$y_{ijklmno} = \mu + YB_i*C_j + HR_k + AC_l + bW*C_j + Pe_m + a_n + e_{ijklmno}$$

Year-Battle-Category (756 levels), Herd-Round (4,771 levels), Age (7 classes), Weight within Category, Permanent environmental effect (10,735 cows) and additive Animal effect (21,198 animals in pedigree)

Traits: 2. linear type

- Yearly scores of type traits on primiparous cows (aged ~ 3 years) by trained classifiers
- Use a selection of traits from Fleshiness, Size, Thinness & Udder
- Continuous (1-5) point scale



19,292 records; 19,292 cows; 31,700 animals in pedigree

Model:

$$y_{ijklm}=\mu+HRC_i+APc_j+DIMc_k+a_l+e_{ijklm}$$

Herd-Round-Classifier (5,400 levels), Age at first parity (9 classes) Days in milk (7 classes) and additive Animal effect (31,700 animals in pedigree

Traits: 3. Milk, Fat & Protein

- Individual production of milk, fat & protein in the whole lactation
- From National official milk recording system

25,107 records; 10,509 cows; 22,505 animals in pedigree

Model:

$$y_{ijklmn}=\mu+HY_i+CalvSeas_j+CC_k+nLact_l+Pe_m+a_n+e_{ijklmn}$$

Herd-year calving (4,662 levels), Calving season (5 classes), Calving-conception interval (16 classes), number of lactation (5 levels), Permanent environmental effect (10,509 cows), and additive Animal genetic effect (22,505 animals in pedigree)

Traits: 4. Fertility

- Parity-Conception interval (PC)
- Calving interval (CI; from parity to parity)
- Italian official milk recording system

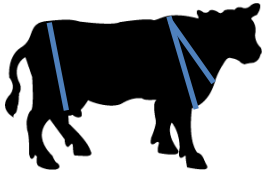
18,157 records; 6,214 cows; 15,640 animals in pedigree

Model:

$$y_{ijklmn}=\mu+HY_i+CalvSeas_j+nLact_k+Pe_l+a_m+e_{ijklmn}$$

Herd-year calving (3,486 levels), Calving season (5 classes), number of lactation (5 levels), Permanent environmental effect (6,214 cows), and additive Animal genetic effect (15,640 animals in pedigree)

Genetic correlation analysis



Rec.: 29,954
Cows: 12,686
Pedig.: 23,746

$$\text{Var}\begin{bmatrix} a_1 \\ a_2 \\ p_1 \\ p_2 \\ e_1 \\ e_2 \end{bmatrix} = \begin{bmatrix} A\sigma^2_{a1} & A\sigma_{a1a2} & 0 & 0 & 0 & 0 \\ A\sigma_{a1a2} & A\sigma^2_{a2} & 0 & 0 & 0 & 0 \\ 0 & 0 & A\sigma^2_{p1} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & I\sigma^2_{e1} & 0 \\ 0 & 0 & 0 & 0 & 0 & I\sigma^2_{e2} \end{bmatrix}$$

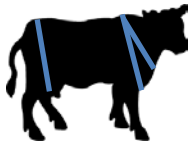
Rec.: 47,014
Cows: 7,926
Pedig.: 16,968

Rec.: 40,144
Cows: 6,380
Pedig.: 16,022

$$\text{Var}\begin{bmatrix} a_1 \\ a_2 \\ p_1 \\ p_2 \\ e_1 \\ e_2 \end{bmatrix} = \begin{bmatrix} A\sigma^2_{a1} & A\sigma_{a1a2} & 0 & 0 & 0 & 0 \\ A\sigma_{a1a2} & A\sigma^2_{a2} & 0 & 0 & 0 & 0 \\ 0 & 0 & A\sigma^2_{p1} & A\sigma_{p1p2} & 0 & 0 \\ 0 & 0 & A\sigma_{p1p2} & A\sigma^2_{p2} & 0 & 0 \\ 0 & 0 & 0 & 0 & I\sigma^2_{e1} & 0 \\ 0 & 0 & 0 & 0 & 0 & I\sigma^2_{e2} \end{bmatrix}$$

Heritability

	σ^2_{Pe}	σ^2_a	σ^2_r	h^2
Fighting ability	0.984	0.604	5.871	**0.081**
Parity-Conception (PC)	0.340	0.251	10.42	**0.022**
Calving Interval (CI)	0.357	0.256	10.49	**0.023**
Milk	0.116	0.116	0.156	**0.299**
Fat	0.014	0.015	0.025	**0.271**
Protein	0.012	0.012	0.018	**0.285**
Fleshiness	-	0.070	0.392	**0.152**
Front muscularity	-	0.058	0.456	**0.113**
Thigh and Buttocks rear view	-	0.031	0.332	**0.084**
Thorax depth	-	0.075	0.351	**0.176**
Thinness	-	0.023	0.534	**0.041**
Udder	-	0.063	0.416	**0.132**
Fore udder attach	-	0.087	0.540	**0.138**
Rear udder attach	-	0.065	0.428	**0.132**
Udder width	-	0.082	0.467	**0.150**



Correlations of fertility vs. milk

	PC	CI	Milk	Fat	Protein
PC	0.022	**0.999**	-0.297	-0.301	-0.321
CI	0.999	0.023	-0.325	-0.355	-0.357
Milk	0.640	0.532	0.299	**0.872**	**0.949**
Fat	0.666	0.586	0.954	0.271	**0.903**
Protein	0.632	0.571	0.979	0.965	0.285

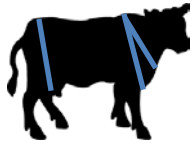
Genetic correlations

Phenotypic correlations

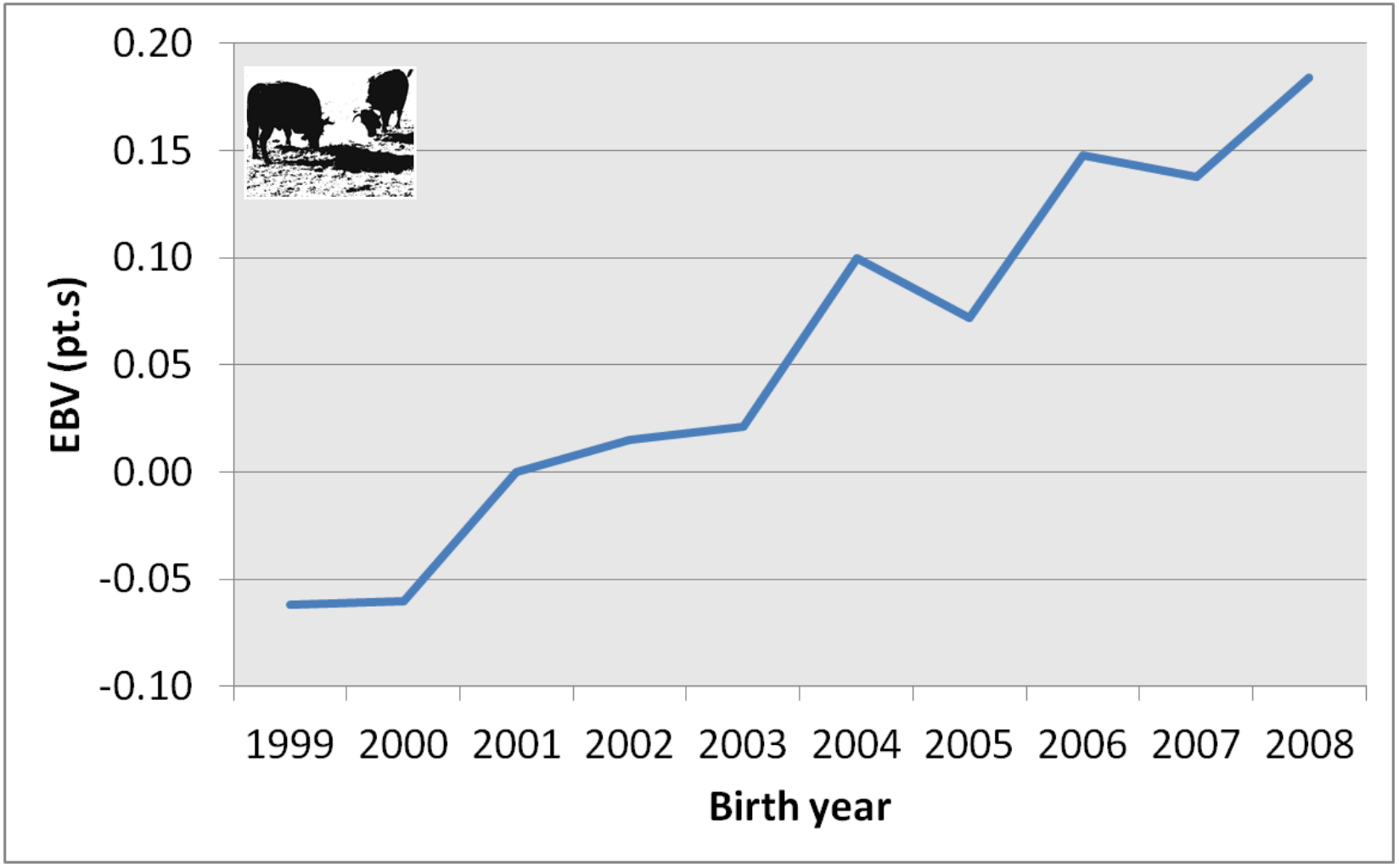
PC = Parity-conception interval; CI = Calving interval; Milk, Fat & Protein = Whole lactation, kg

Correlations Fighting vs. others

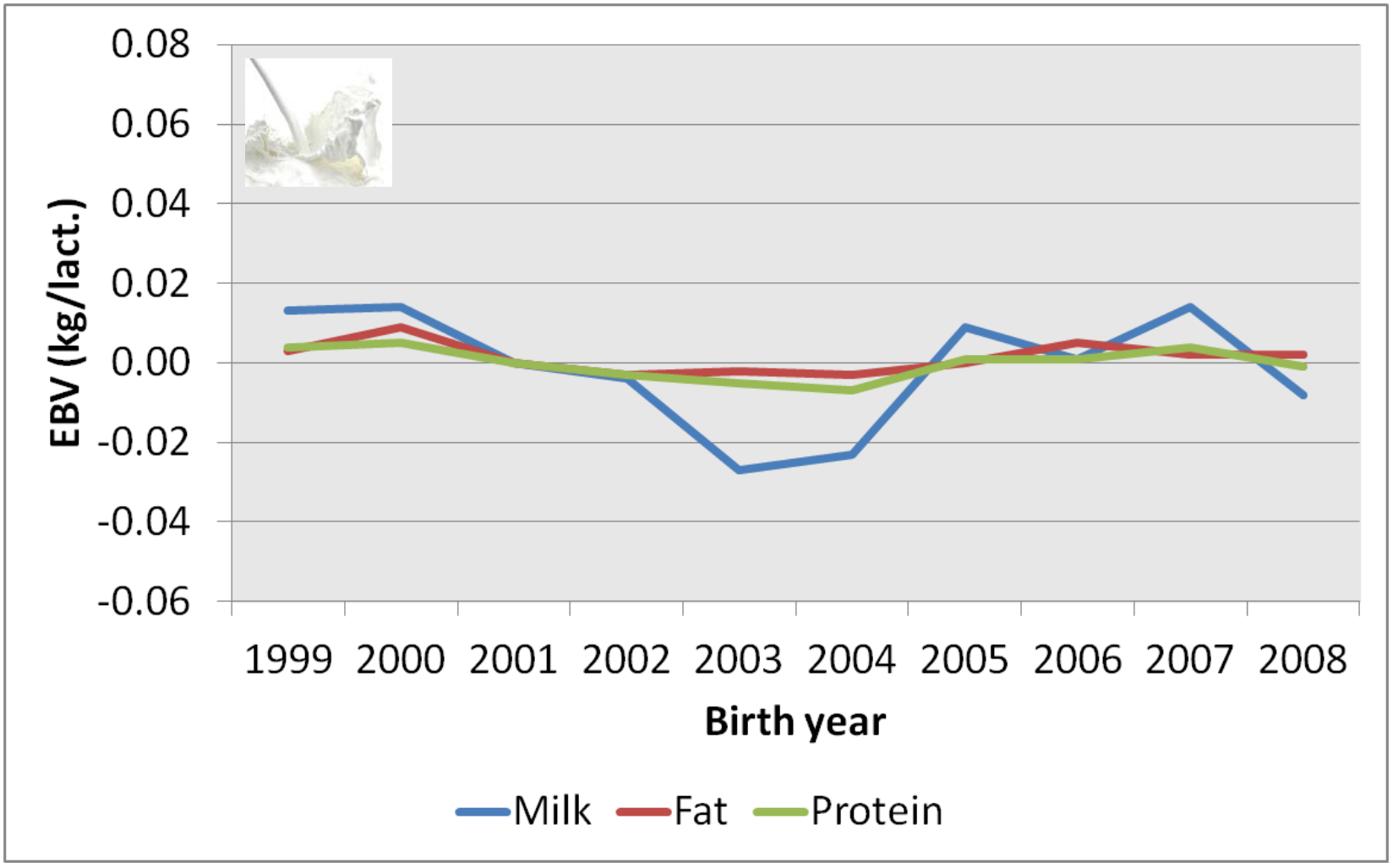
Fighting ability	σ_{Pe1Pe2}	r_{Pe}	σ_{g1g2}	r_g
Parity-Conception (months)	0.236	**0.378**	0.129	**0.361**
Calving Interval (months)	0.251	**0.393**	0.109	**0.304**
Milk yield (Kg)	0.139	**0.037**	-0.599	**-0.221**
Fat yield (Kg)	0.077	**0.058**	-0.267	**-0.284**
Protein yield (Kg)	0.128	**0.104**	-0.284	**-0.333**
Fleshiness	-	-	-0.007	**-0.030**
Front muscularity	-	-	0.020	**0.092**
Thigh and Buttocks rear view	-	-	-0.020	**-0.084**
Thorax depth	-	-	0.033	**0.149**
Thinness	-	-	-0.022	**-0.128**
Udder	-	-	-0.032	**-0.146**
Fore udder attach	-	-	0.017	**0.062**
Rear udder attach	-	-	-0.056	**-0.250**
Udder width	-	-	-0.065	**-0.265**



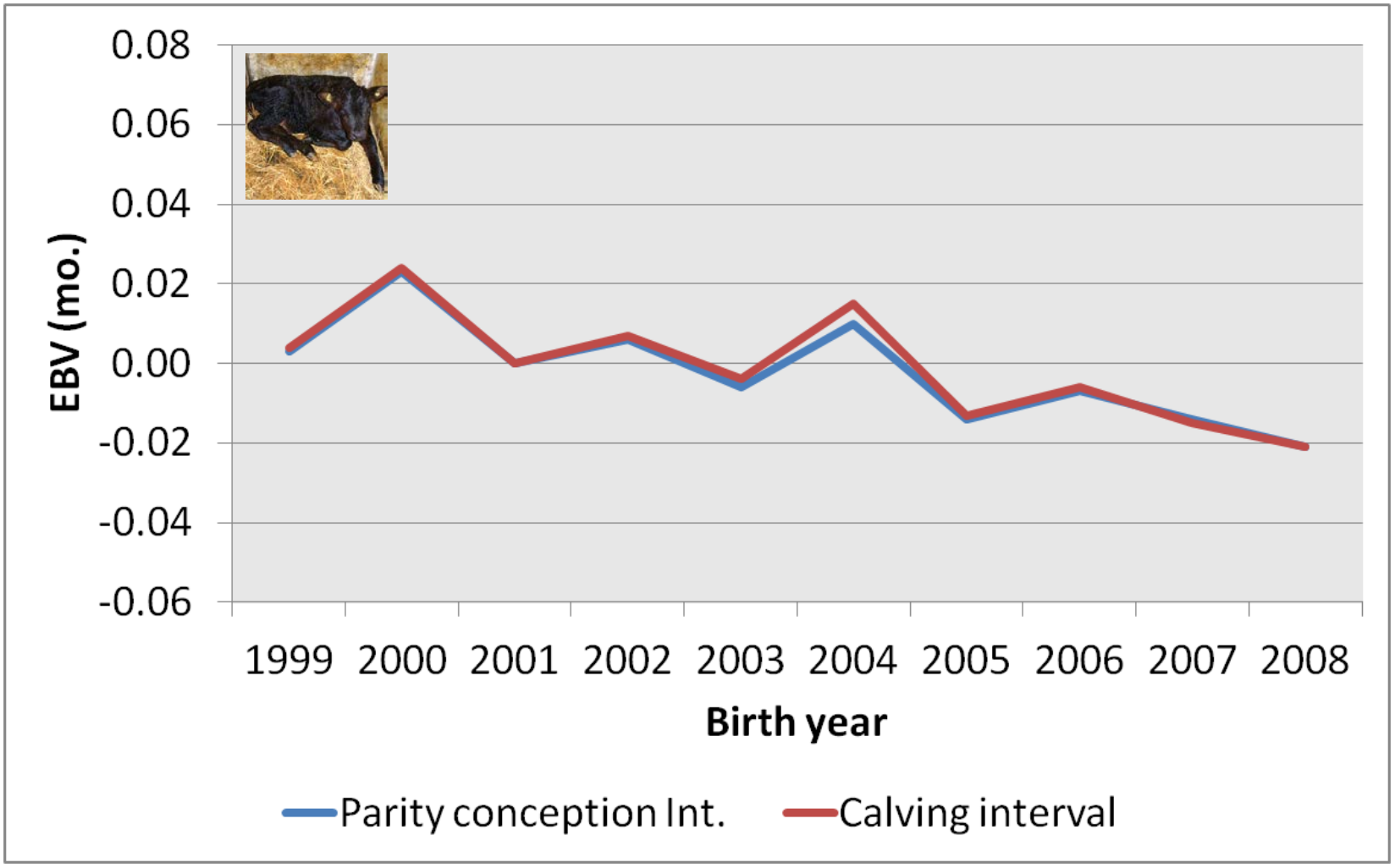
Genetic trend for fighting ability



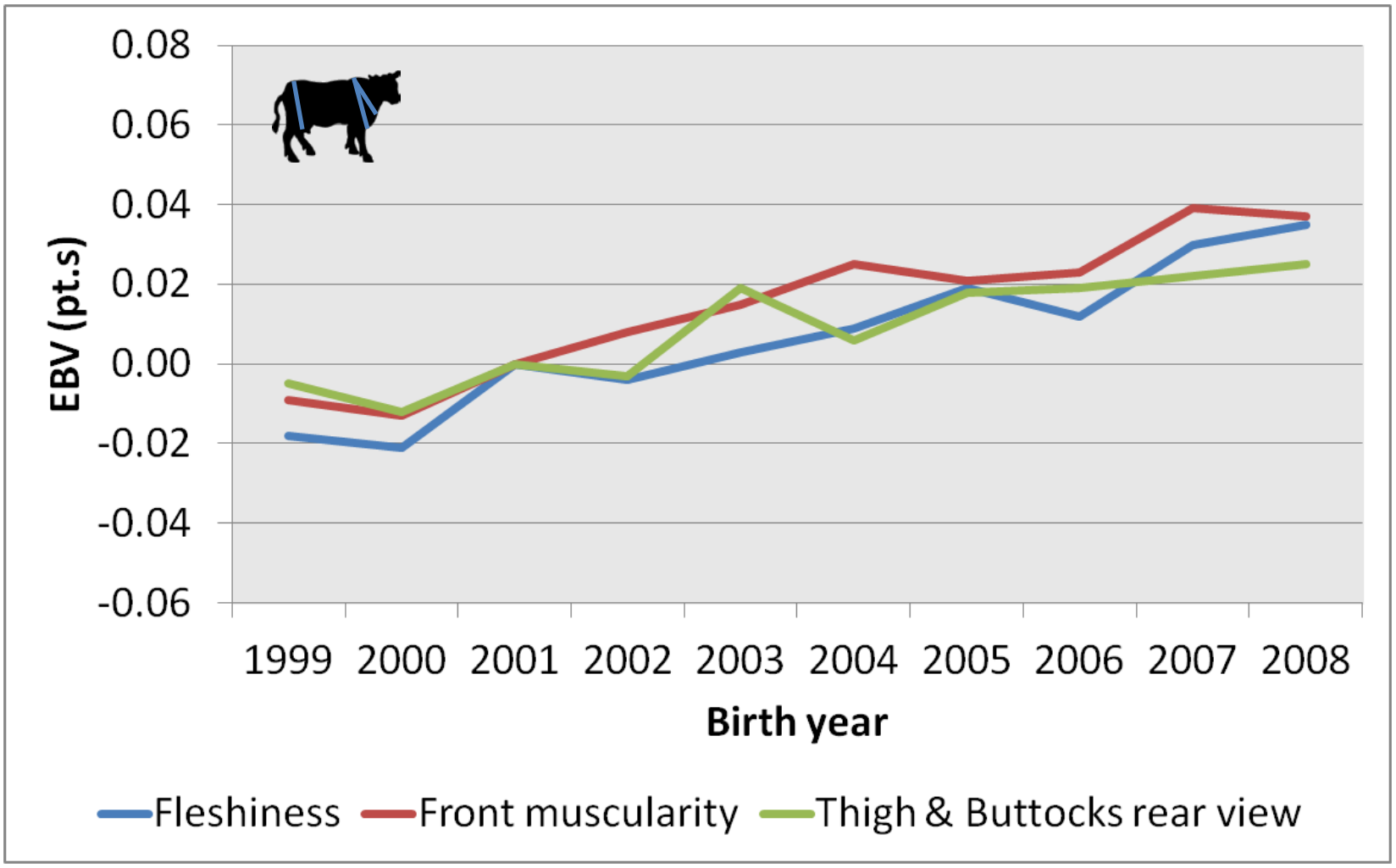
Genetic trend for milk yield



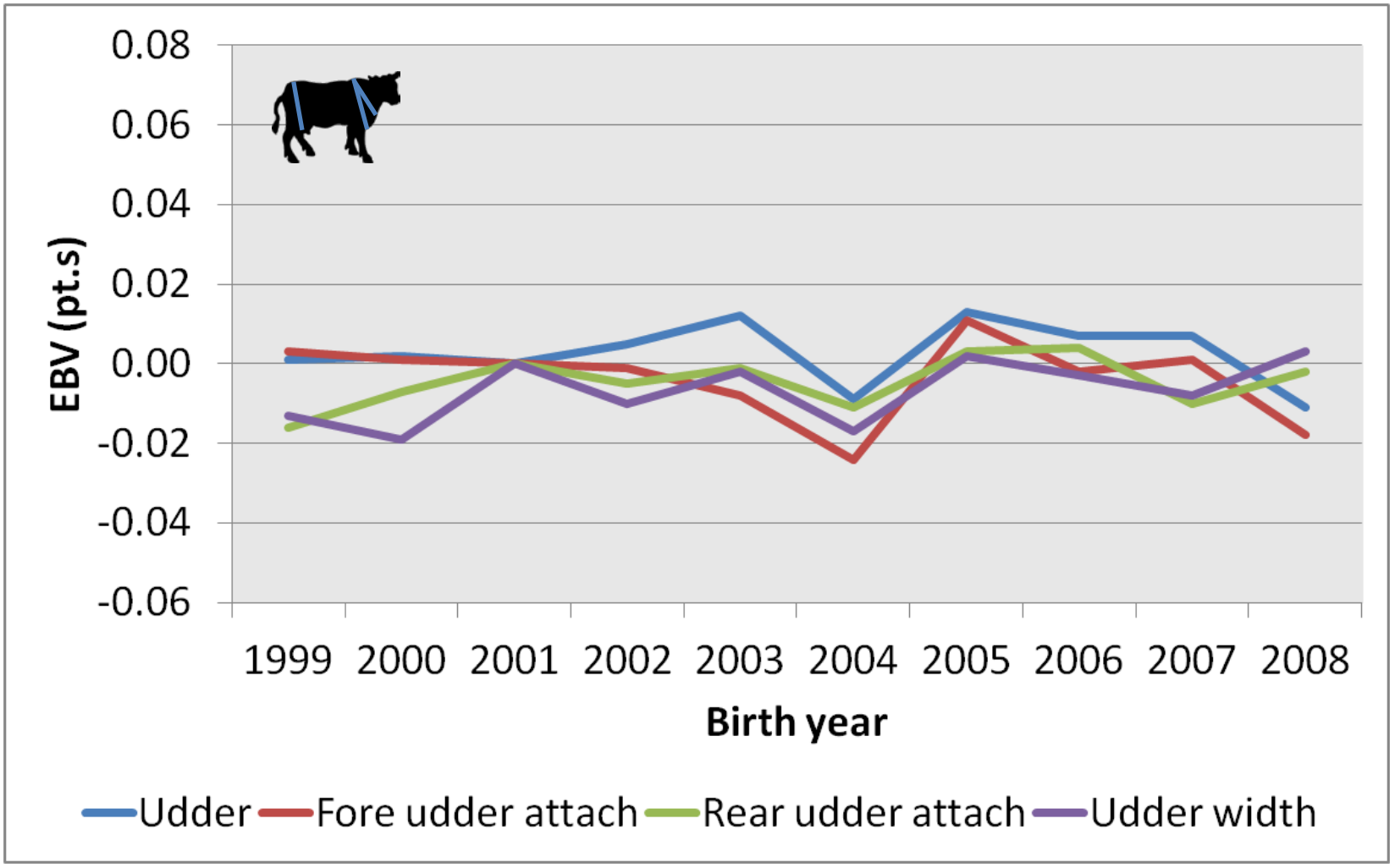
Genetic trend for fertility traits



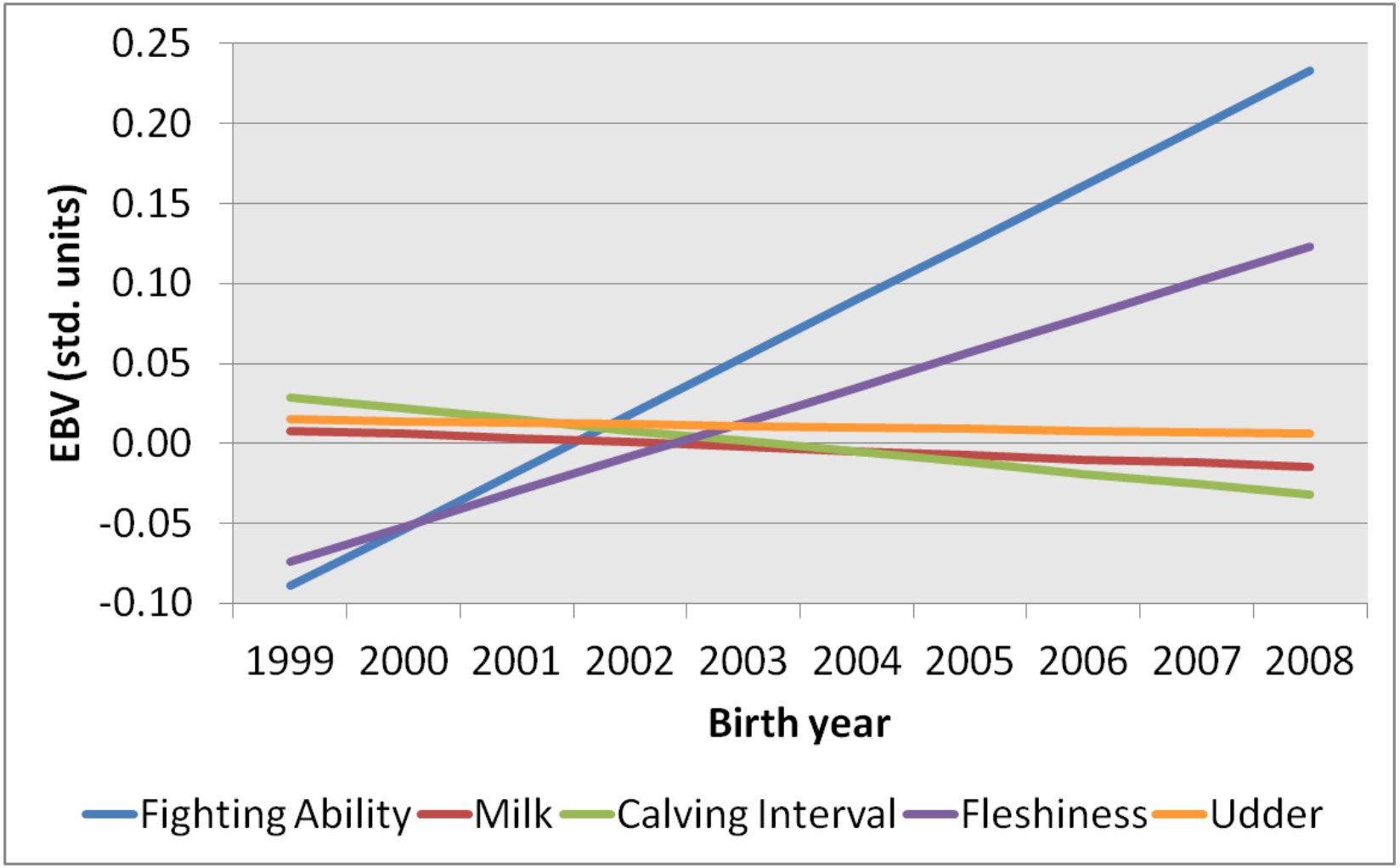
Genetic trend for fleshiness traits



Genetic trend for udder traits



Genetic trend for main traits



Conclusions

- **Genetic correlations** of fighting ability:
  - **Moderate and negative** (r_g = -0.28±0.06) with **milk traits**
  - **Moderate and positive** (r_g = 0.33±0.04) with **fertility traits**
  - **Low positive with "masculine traits"** (front muscularity, r_g = 0.09; thorax depth, r_g=0.15) and **low/moderate negative with "feminine traits"** (udder, r_g= -0.15; rear udder attack, r_g=-0.25; udder width, r_g=-0.27)
- **Positive trends for fighting and muscularity, slightly positive for fertility traits and steady for milk and udder traits**:

Aosta Chestnut and Aosta Black Pied are becoming more and more "good fighters", and less "milk producers"

Thank you for your attention!!!

Acknowledgements

AnaBoRaVa

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Regione Autonoma Valle d'Aosta

AREV

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Correlations among linear type traits

	Fl	FrM	T&B	Td	Th	Ud	FU	RU	UW
Fleshiness (Fl)	0.15	0.93	0.96	0.62	-0.08	-0.35	-0.34	-0.28	-0.33
Front Muscul. (FrM)	0.72	0.11	0.88	0.76	0.01	-0.39	-0.37	-0.33	-0.37
Thigh and Buttocks (T&B)	0.74	0.56	0.08	0.50	-0.07	-0.26	-0.26	-0.24	-0.29
Thorax depth (Td)	0.43	0.43	0.37	0.18	0.11	-0.01	-0.20	-0.02	-0.12
Thinness (Th)	0.01	0.01	-0.01	0.01	0.04	0.11	0.40	0.39	0.42
Udder (Ud)	-0.09	-0.07	-0.05	-0.17	0.48	0.13	0.87	0.86	0.89
Fore udder attach (FU)	-0.03	-0.02	-0.01	0.01	0.10	0.58	0.14	0.65	0.69
Rear udder attach (RU)	-0.08	-0.06	-0.04	0.01	0.10	0.59	0.4	0.13	0.96
Udder width (UW)	-0.07	-0.05	-0.03	0.01	0.10	0.57	0.37	0.59	0.15

Genetic correlations

Phenotypic correlations