European Association for Animal Production

Identification of QTL for behavioural reactivity in sheep using the ovineSNP50 beadchip

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Context

Context

Global overview

Evolution of sheep extensive farming systems includes :

- increased size of flock
- reduced support provided by human
- use of harsh environments

1

Animals are required to have a higher level of behavioural autonomy

2

Increase the adaptability of animals

3

Adaptation involves:

- a strength sociability (for flock movements and social support)
- a good maternal behaviour (for the lamb's survival and growth)
- few reactivity to human
- high spatial cognitive abilities

Context

Genetic for behavioral traits (Previous work)

- behavioral responses to challenges vary markedly within breeds in sheep (Boissy et al., 2005)
- medium to high heritability depending upon behavioral trait
  - reactivity toward human : $h^2 = 0.2$
  - vocal reactivity: $h^2 = 0.5$

Genetic selection for behavioral traits should offer opportunities for improving the robustness of the animals

Purpose of this study

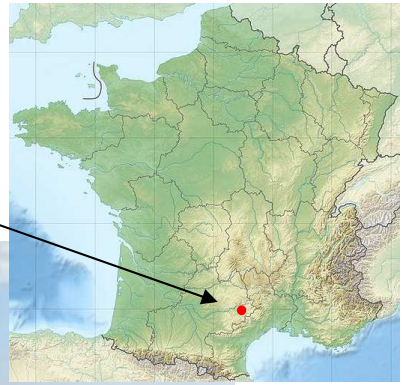
To map QTL for behavioral traits in an half-sibs population using Single Nucleotide Polymorphisms (SNP) genotypes

Materials & Methods

Materials & Methods

Animal material:

- Romane breed (Berrichon x Romanov)
- flock raised outdoors all along the year
  fed on rangelands (1 ewe/ha)
  at the experimental farm La Fage (Roquefort)



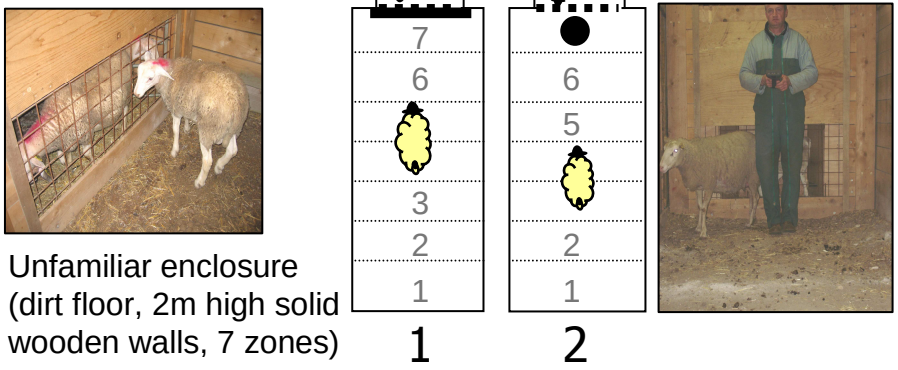
- Genetic design :
  - 9 half-sib families (103 lambs per family)
  - n=933 along 5 years
- Individual behavioural measurement :
  - age = 85 ± 6 days (10 days after weaning)

Materials & Methods

Two experimental devices for Behavioural measurement :

Arena test

Both tests aim to evaluate social motivation and reactivity toward human



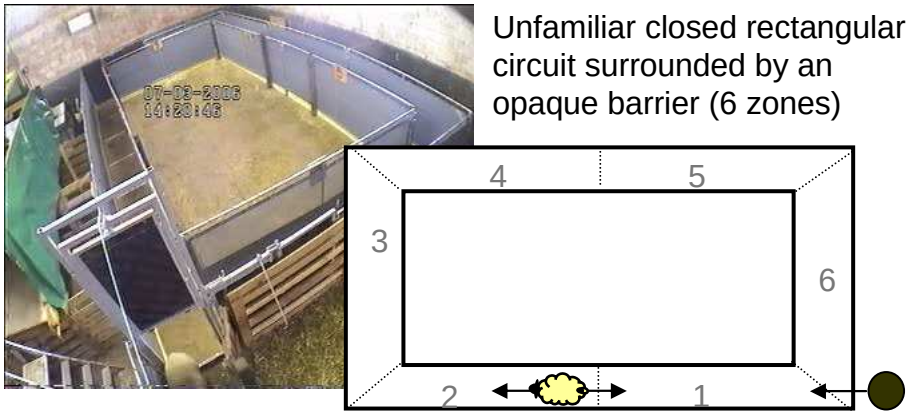
Unfamiliar enclosure (dirt floor, 2m high solid wooden walls, 7 zones)

0: familiar flock-mates behind a grid-barrier
tested animal introduced, 15 sec for joining

1: opaque panel pulled down
↳Reactivity to social isolation (60s)

2: panel pulled up and a human enters
↳Conflict between attraction for flock-mates and human presence (60s)

Corridor test



Unfamiliar closed rectangular circuit surrounded by an opaque barrier (6 zones)

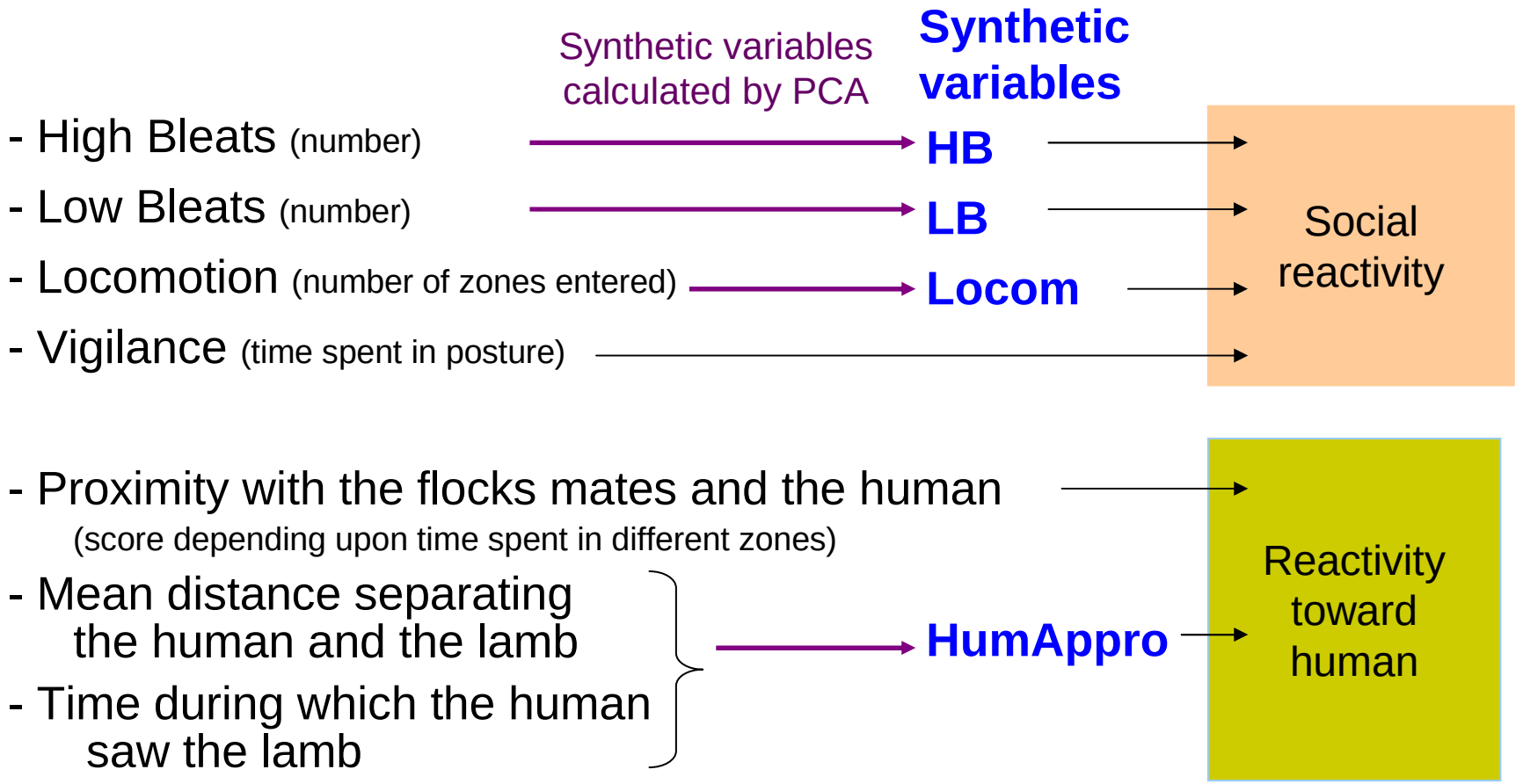
1: animal enters, moves through the corridor
↳Reactivity to social isolation (60s)

2: human enters, walks of regular steps
↳Flight reaction to human (60s)

Materials & Methods

Behavioural traits

All phases were video-recorded,



Materials & Methods

Genotyping :

- Illumina OvineSNP50 beadchip
- SNP quality control (call rate, HW disequilibrium, MAF.
- 43820 SNPs for analysis

ANR APIS-GENE

SheepSNPQTL
Utilisation d'une puce 60 000 SNP pour cartographier finement des QTL affectant des caractères de production, de résistance aux maladies et de comportement chez les ovins

Statistical analysis

➢ Phenotypes

- corrected for fixed effects (sex, number of lambs burned and suckled, age of dam)
- some behavioral traits were applied a transformation (2^{th}-square root, log) to reach quasi-normal distribution

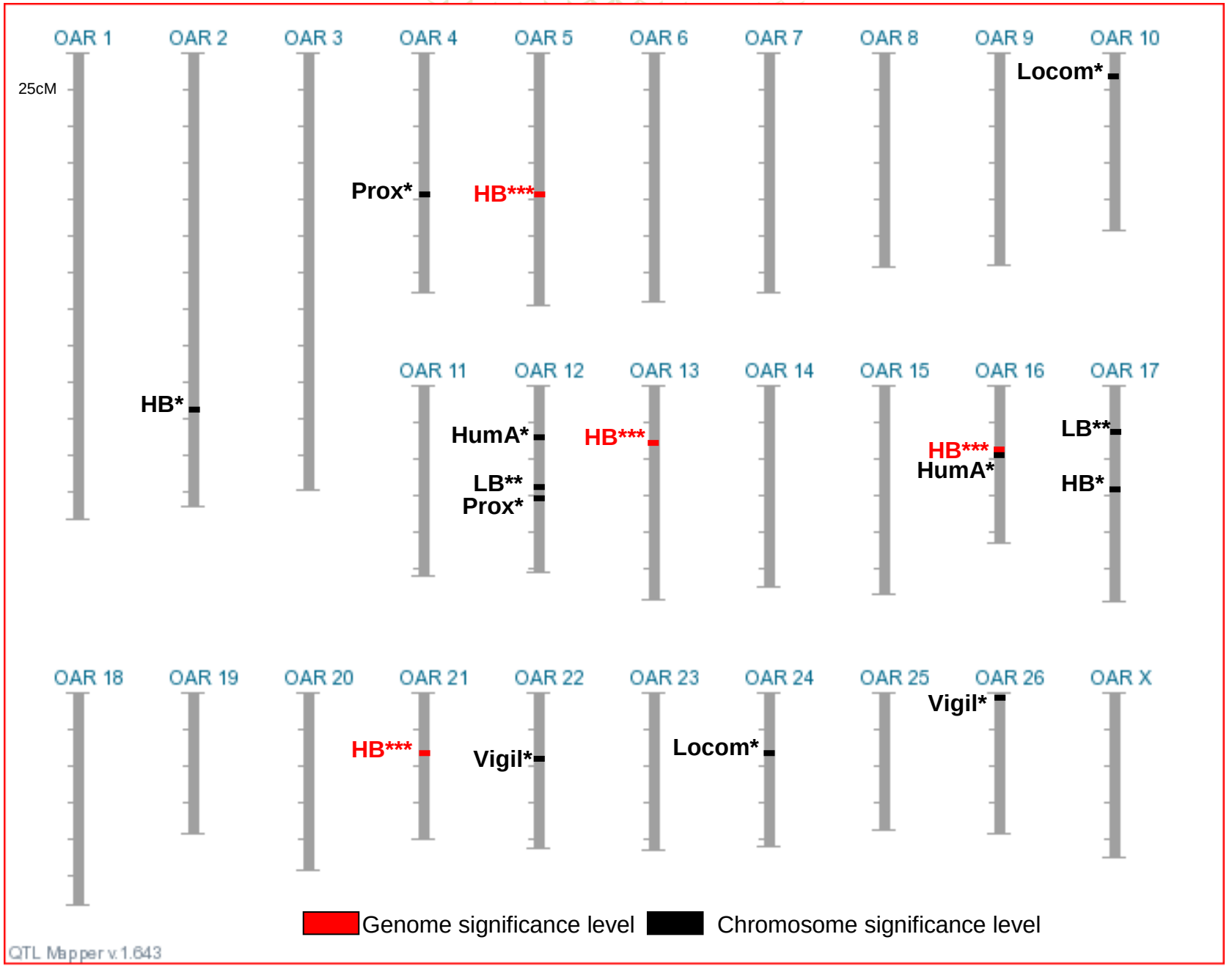
➢ QTLMAP software (Elsen *& al.*, 1999) :

likelihood computation every 0.1 cM :
3 methods: - linkage analysis (LA)
- association analysis (GWAS)
- linkage and association joint analysis (LDLA)

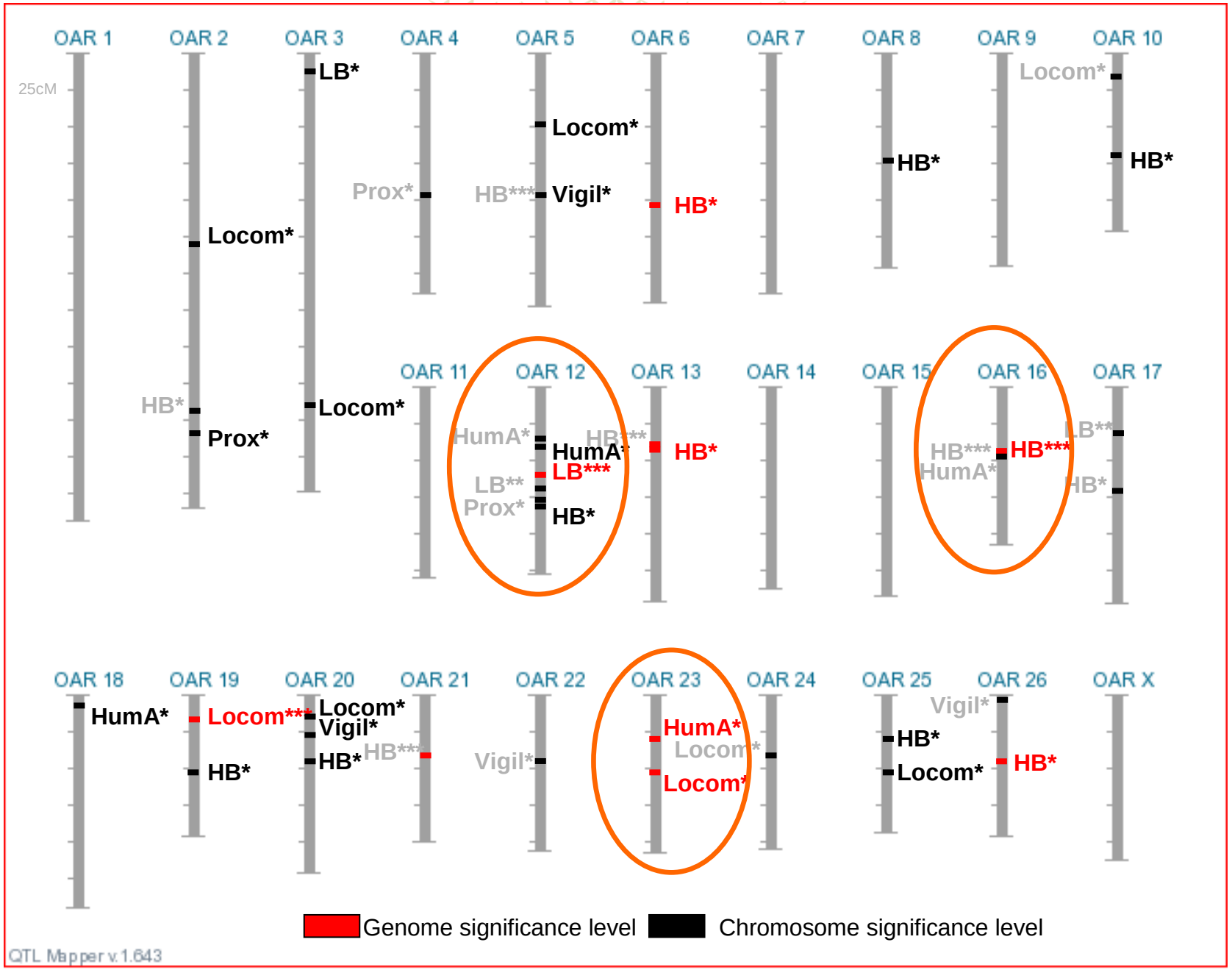
➢ Thresholds computed with a 10000 permutations

Results

LINKAGE ANALYSIS

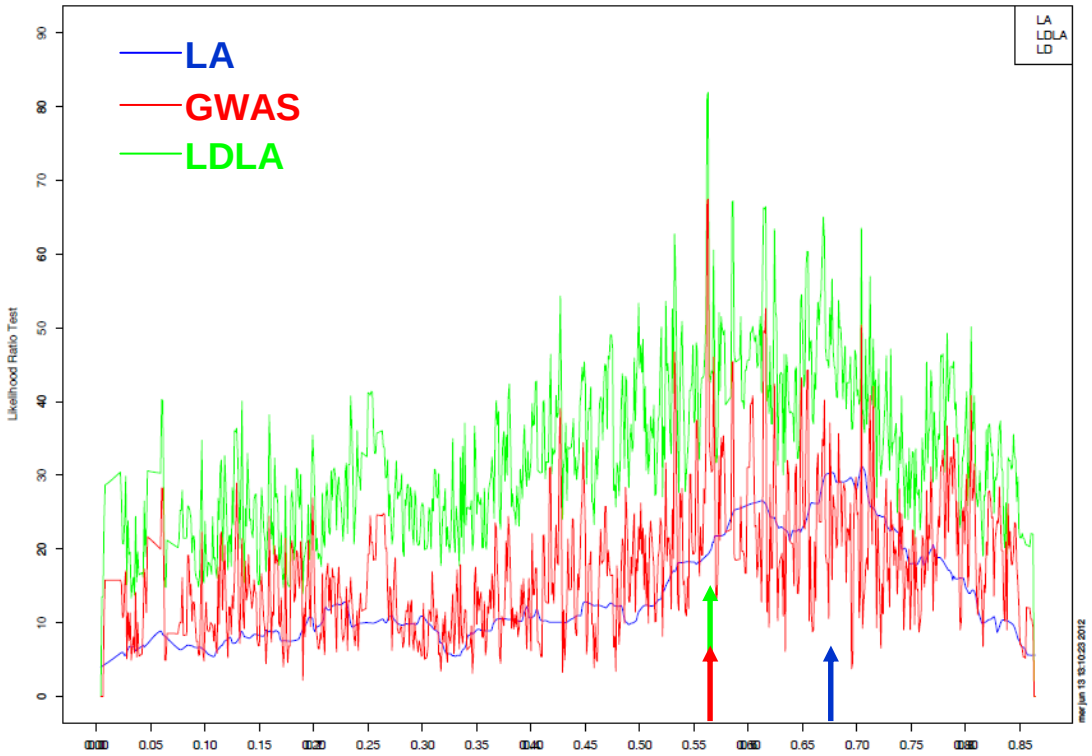


LINKAGE ANALYSIS



ASSOCIATION ANALYSIS

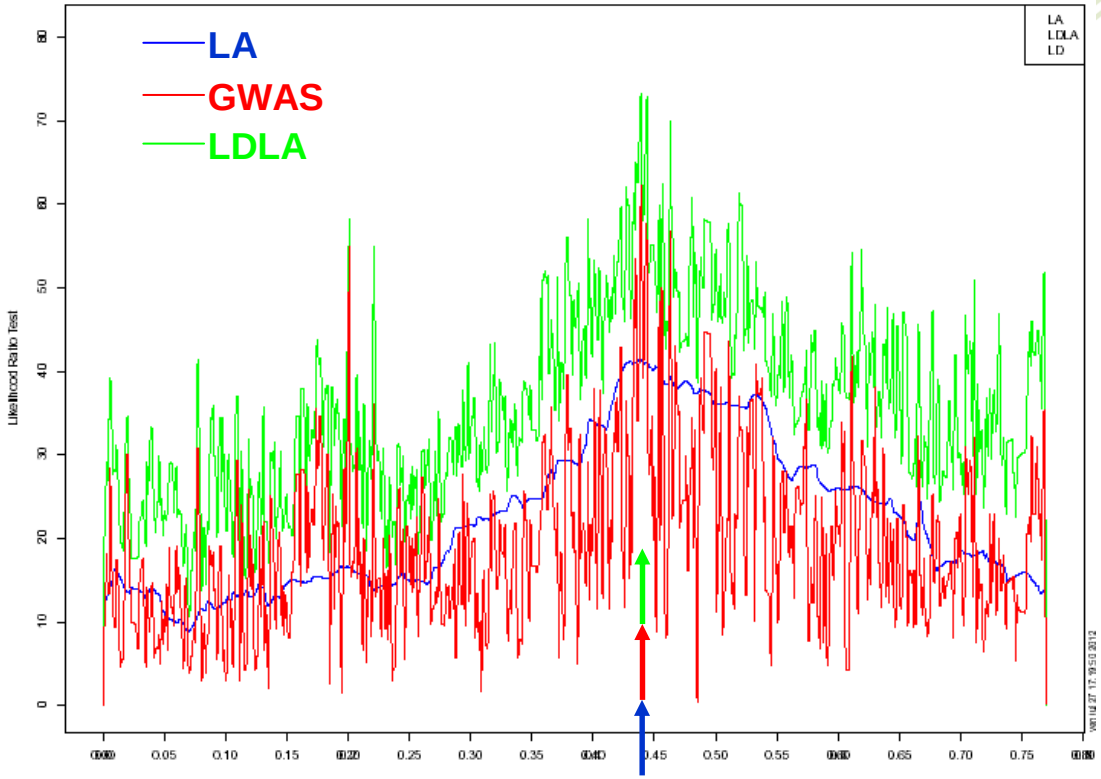
Example of profiles on OAR12 for Low Bleat



An interesting QTL on OAR12 for Low Bleat

	LA	LDLA	GWAS
Significance levels	1% chr.	0.1% gen.	5% gen.
Position (cM)	67.8	56.3	56.3
Effect (max) (phenotypic SD)	0.8	2.8	2.8
Confidence interval	13.7	0.3	0.3
		Haplotypes with highest effect carried by dams	

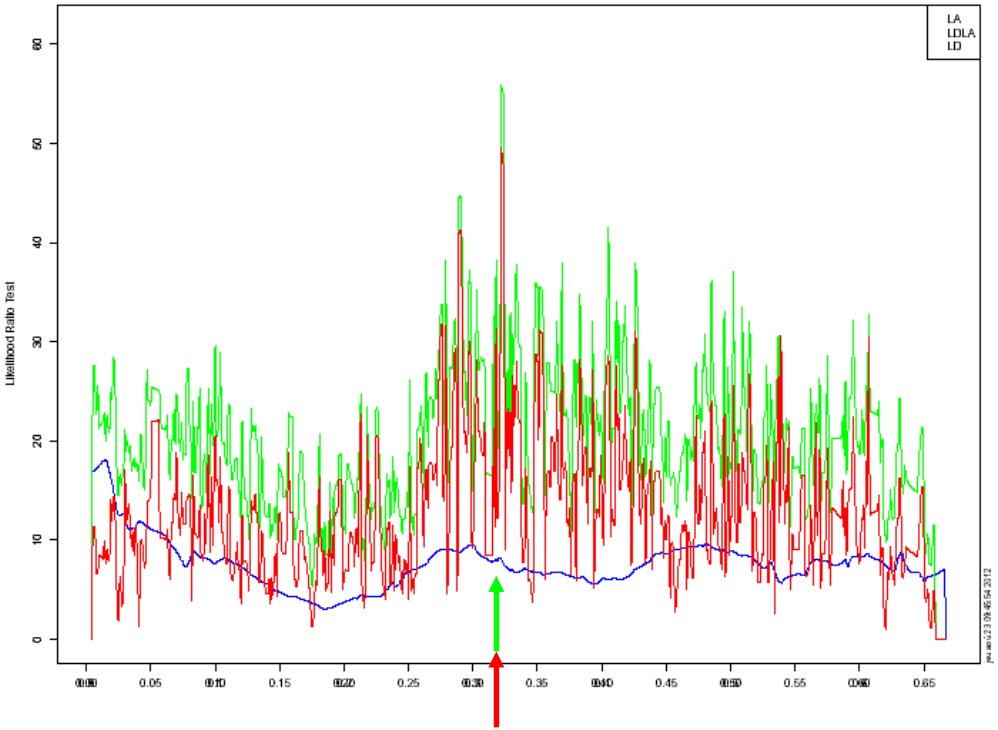
Example of profiles on OAR 16 for High Bleat



An interesting QTL on OAR16 for High Bleat

	LA	LDLA	GWAS
Significance levels	0.1% gen.	0.1% gen.	0.1% gen.
Position (cM)	43.8	43.9	43.9
Effect (max) (phenotypic SD)	0.4	1.3	1.5
Confidence interval	13	0.3	0.2
		Haplotypes with highest effects carried by sires and dams	

Example of profiles on OAR23



An interesting QTL on OAR23 for Human Approach behaviour.

	LA	LDLA	GWAS
Significance levels	-	0.1% gen.	5% gen.
Position (cM)		32.2	32.2
Effect (max) (phenotypic SD)		4.0	2.3
Confidence interval		0.4	0.4
		Haplotypes with highest effect carried by dams	

Conclusion

Conclusion

Analytical issue:

- Several highly significant QTL associated with social behaviour and reactivity toward human in sheep
- Some regions appeared quite small (thanks to complementarity of methods)

These results will:

- lead to a better knowledge of genetic variability of behavioural traits in sheep
- help to understand the physiological bases of behavioural traits

Applied issue: This work offers a relevant approach to facilitate the adaptation of the animals to their environment and can be considered as a fundamental issue for the success of livestock farming

Perspectives:

- Further work required to dissect underlying genetic mechanisms (validated QTL effect, refined localisation, identified candidate genes...)

- To be integrated the impact on health and production performances in order to ensure the robustness

Acknowledgements

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Thank you for your attention !