



Development and transfer of genomic behavioral models established in the American Holstein population to Walloon COWS

Presented by: Hugo Bérat - PhD Student
Animal Sciences Unit



Supervisors : Prof. Nicolas Gengler & Prof. Luiz Fernando Brito



Milking robots



Necklace



Electronic loop

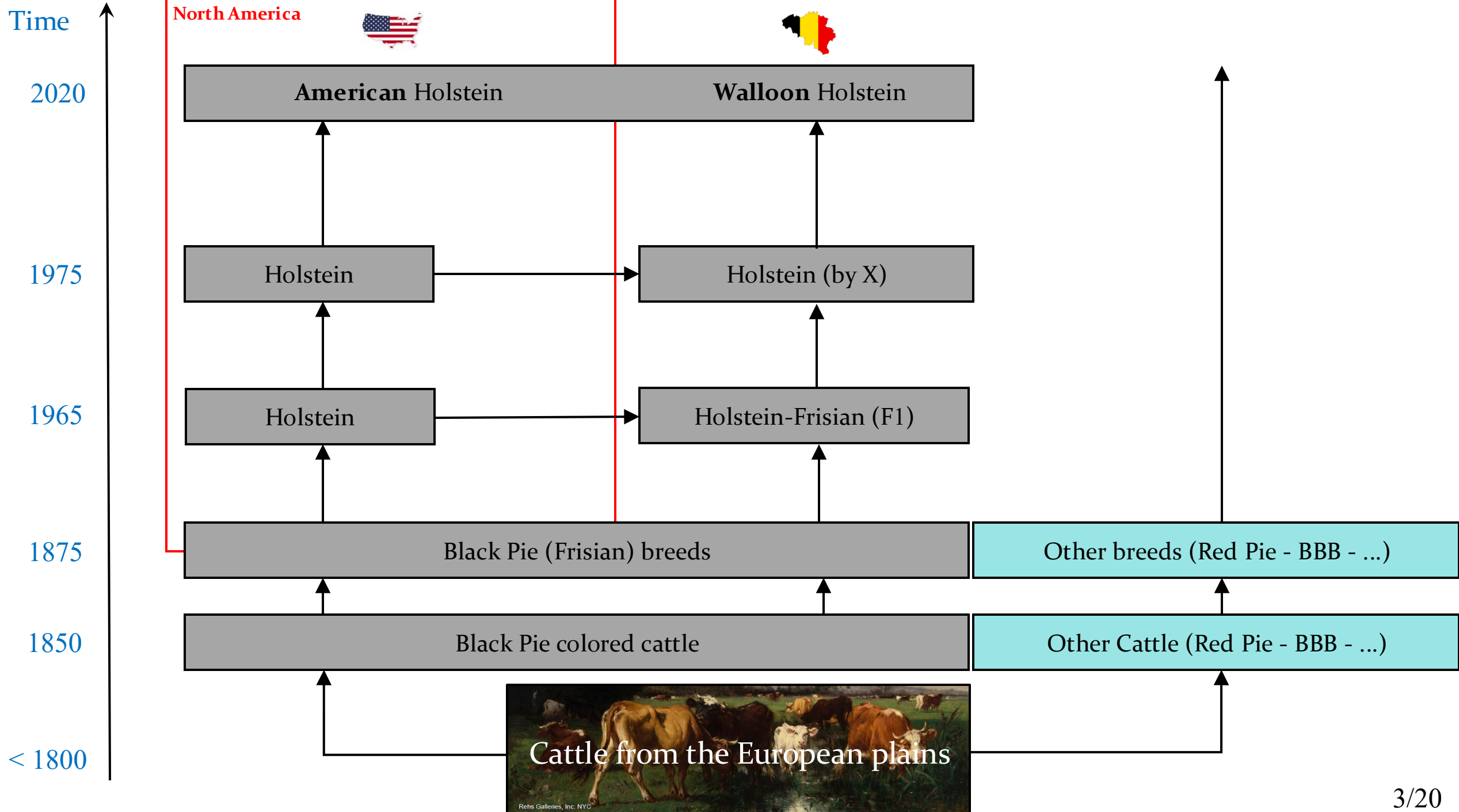


Sensor on the tail

Etc.



Genetic selection





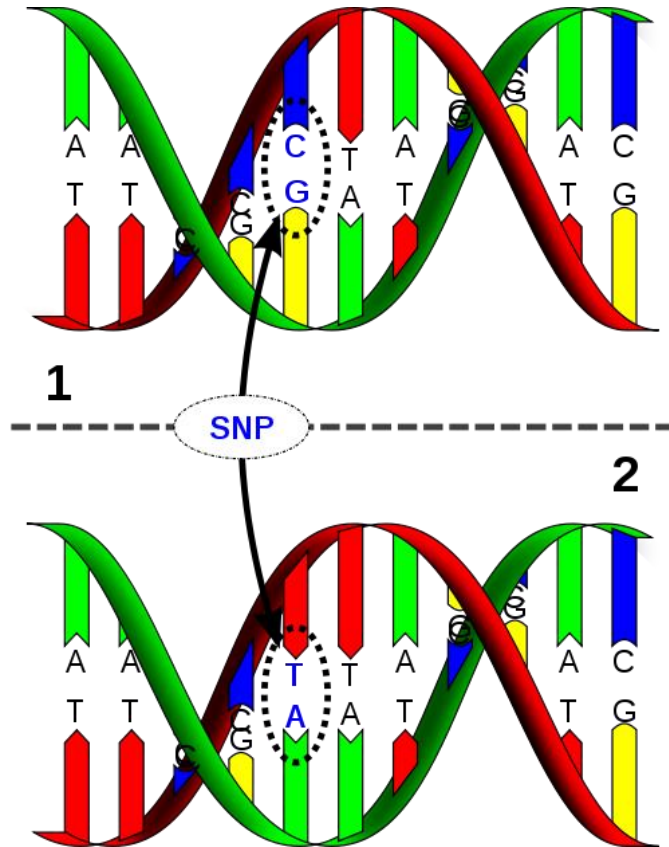
American Holsteins



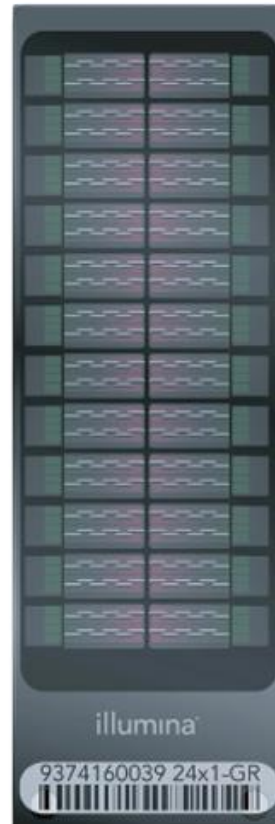
Walloon Holsteins

AVAILABLE !

SNP information for both populations

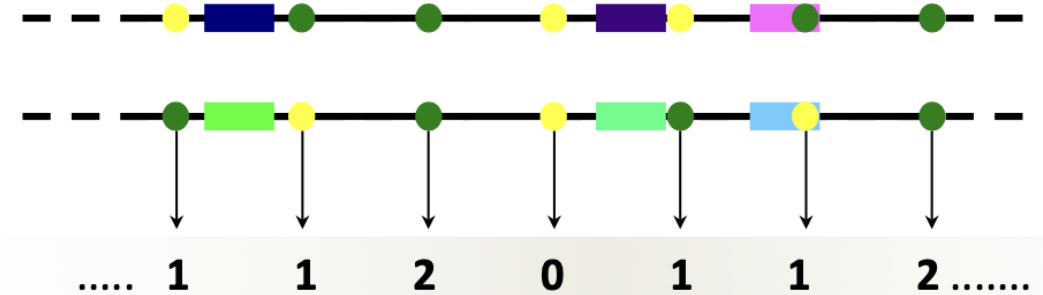


(Artigas, 2013)



(illumina®)

How to store information?



USAM000001244845 1010212201002001100110111011112200022022111222202
 011112000100002021001012202020010101101200202210111211112012120010
 1101101022202111011121110212100020122220220000010011010212211121112
 0221011100112002211111111100200010201001021220100200110011011101111
 2200022022111222202011112000100002021001012202020010101101200202210
 1112111112012120010110110102220211101112111021210002012222022000001
 001101021221112111202210111001120022111111110020001020101010212201
 002001100110111011112200022022111222202011120001000020210010122020
 20010101101200202210111211112012120010110101022202111011121110212
 100020122220220000010011010212211121112022101110011200221111111100
 200010201010102122010020011001101110111122000220221112222020111200
 010000202100101220202001010110120020221011121111201212001011011010
 2220211101112111021210002012222022000001001101021221112111202210111
 001120022111111111002000102010...



American Holsteins



Walloon Holsteins

AVAILABLE !

SNP information for both
populations

WP1

Analysis of **genetic similarity** between the two populations



American Holsteins



Walloon Holsteins

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

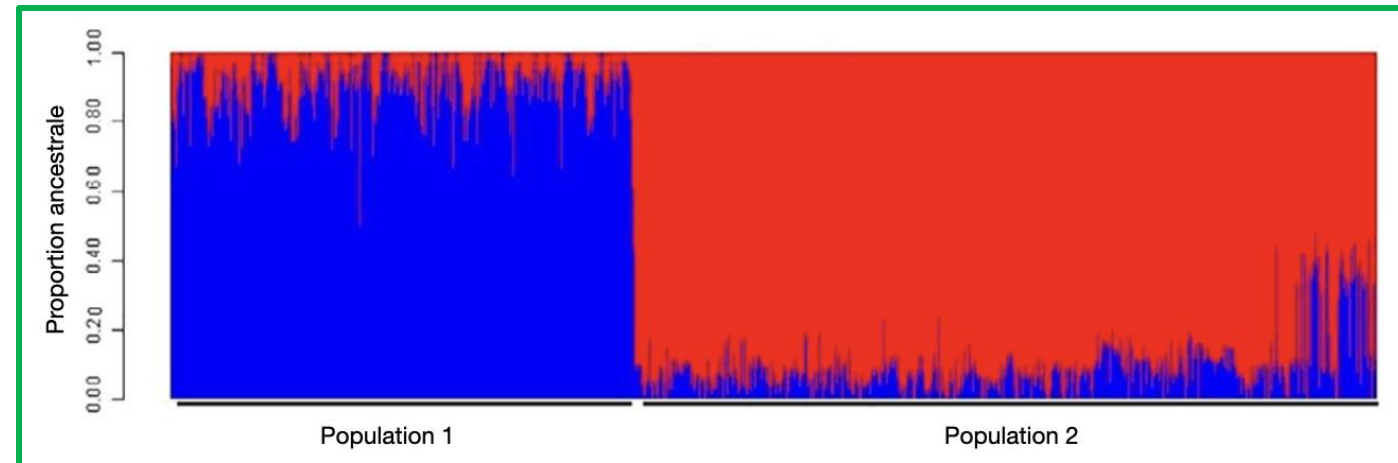
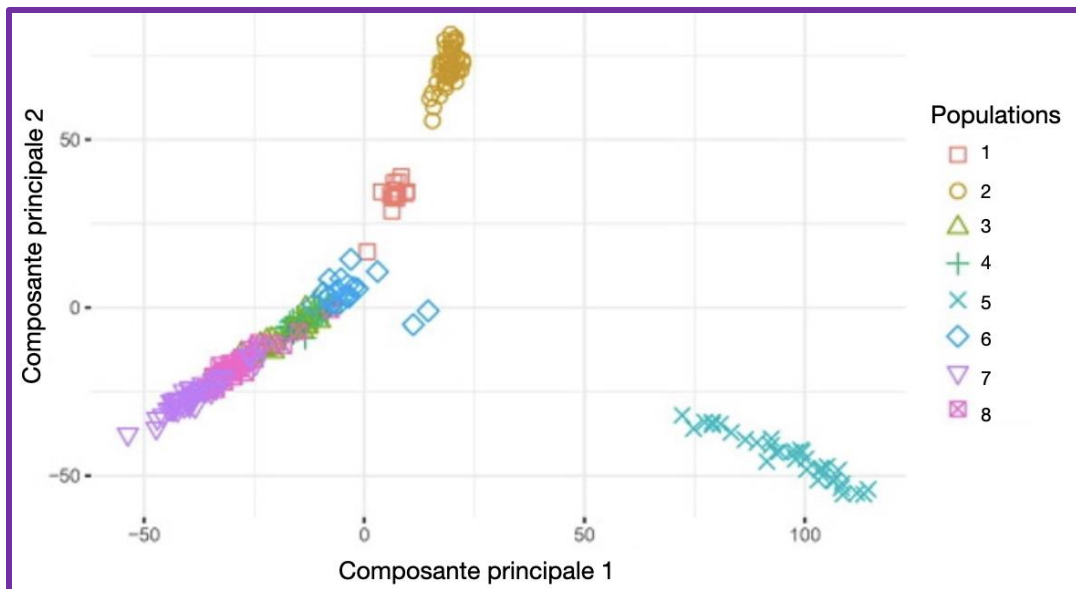
Statistical analysis methods

PCA

Structure

Genetic distance

...





American Holsteins



Walloon Holsteins

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best**
American **individuals**

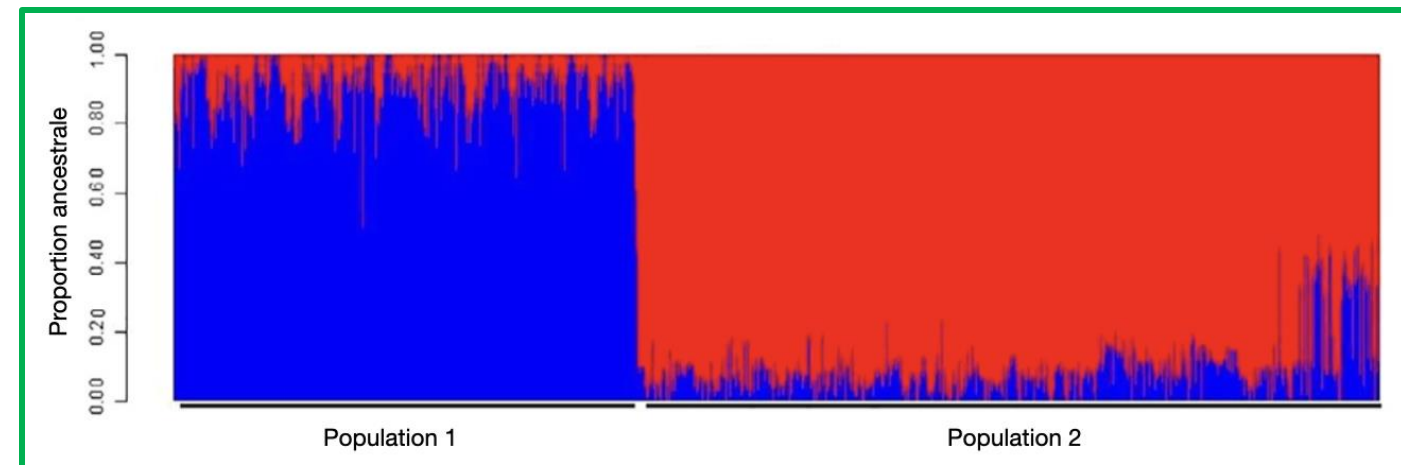
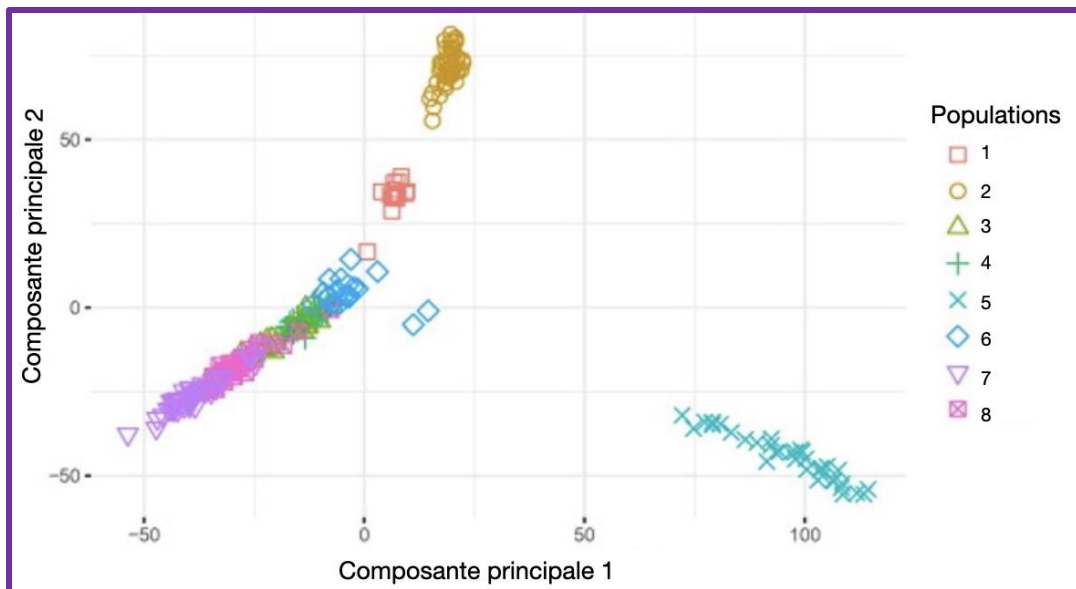
Statistical analysis methods

PCA

Genetic distance

...

Structure





American Holsteins

Walloon Holsteins

AVAILABLE !
SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best American individuals**

AVAILABLE !

Use of **PLF data** for these animals

WP2

Creation of traits of interest



Statistical analysis methods

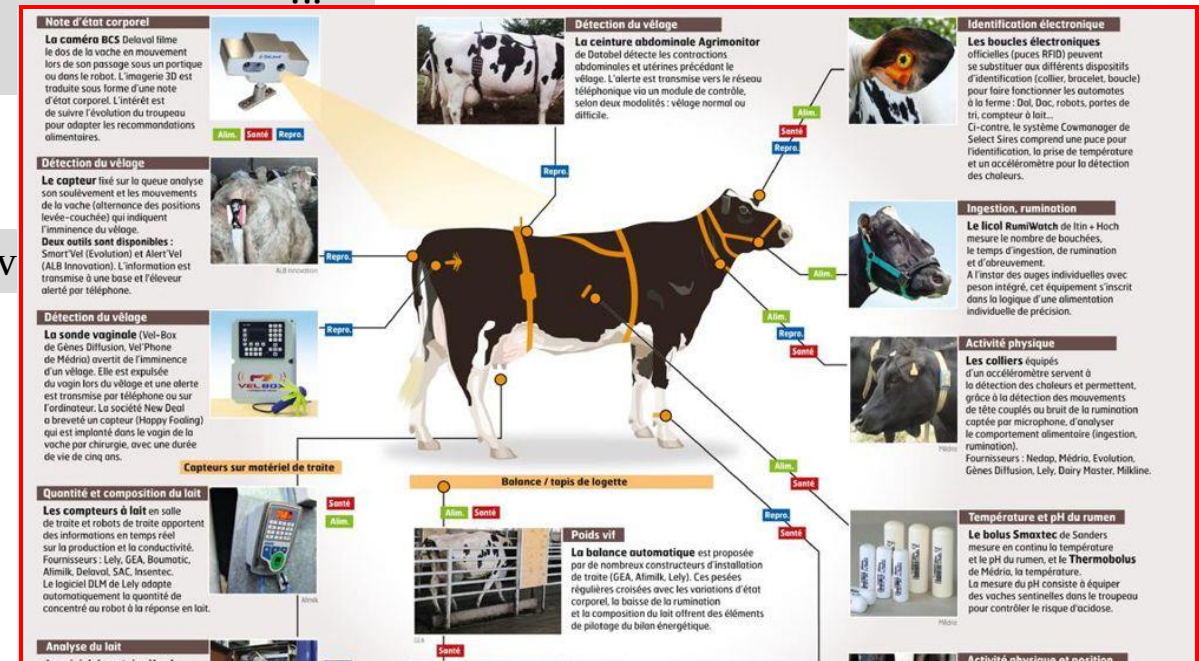
PCA

Structure

Genetic distance

...

Comprehensiv





American Holsteins

Walloon Holsteins

AVAILABLE !
SNP information for both
populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best**
American **individuals**

AVAILABLE !

Use of **PLF data** for these
animals

Statistical analysis methods

PCA

Genetic distance

Structure

...

Comprehensive **literature review**

WP2
Creation of traits of interest

Estimation of **genetic parameters**

Use of **quantitative genetics models**



American Holsteins

Walloon Holsteins

AVAILABLE !

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best American individuals**

AVAILABLE !

Use of **PLF data** for these animals

Statistical analysis methods

PCA

Genetic distance

Structure

...

WP2

Creation of traits of interest

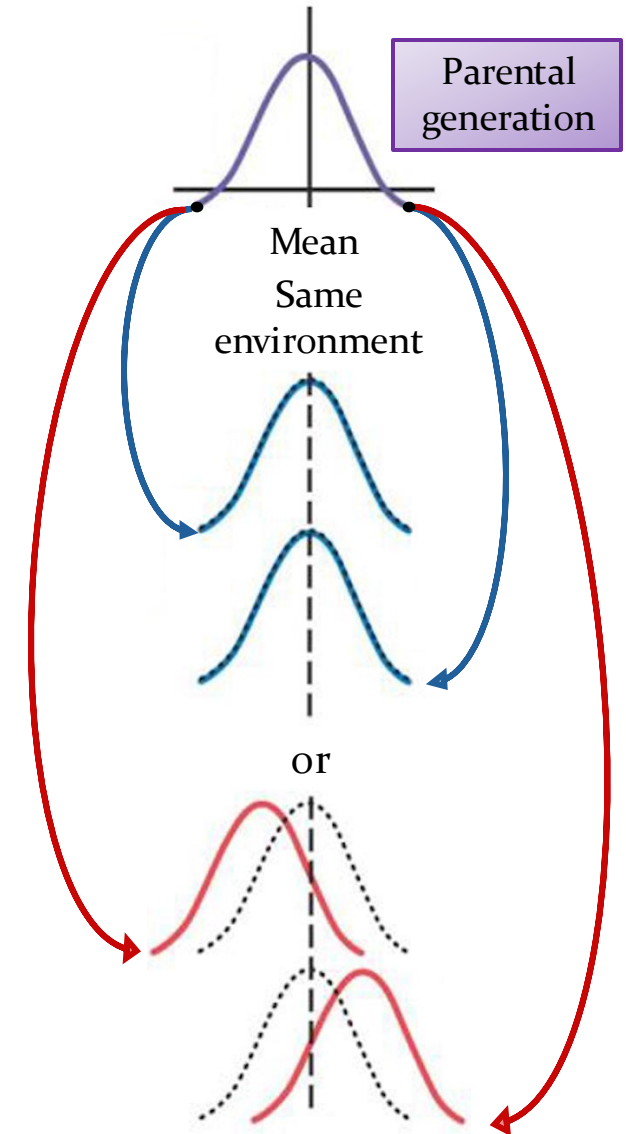
Comprehensive **literature review**

Estimation of **genetic parameters**

Elimination of **non-heritable** traits

Preservation of **heritable** traits

Use of **quantitative genetics models**





Investigating the genetic background of novel behavioral indicators of robotic milking efficiency in North American Holstein cattle

Hugo Bérat,^{1,2} , Nicolas Gengler,² , Jacob M. Maskal,¹ , Jacquelyn P. Boerman,¹ and Luiz F. Brito^{1*}

¹Department of Animal Sciences, Purdue University, West Lafayette, IN 47907

²TERRA Teaching and Research Center, Gembloux Agro-Bio Tech, University of Liège, 5030 Gembloux, Belgium

Traits*	Parity	σ_a^2	σ_{pe}^2	σ_{pe2}^2	σ_e^2	t
AMT	1 - 6	1.75	0.72	0.34	1.02	0.74 ± 0.01
TMT	1 - 6	11.25	5.67	5.17	20.24	0.52 ± 0.01
INT	1 - 6	0.002	0.002	0.005	0.02	0.34 ± 0.01
NoV	1 - 6	0.33	0.31	0.37	2.42	0.29 ± 0.01
NSE	1 - 6	0.070	0.074	0.12	0.47	0.29 ± 0.01
PSM	1 - 6	26.83	33.21	41.38	402.47	0.20 ± 0.01
PCS	1 - 6	0.004	0.008	0.015	0.022	0.55 ± 0.01

Permanent
environmental variance
between parities

Permanent
environmental variance
within parities

Heritability



h^2

0.46 ± 0.02

0.27 ± 0.01

0.08 ± 0.01

0.10 ± 0.01

0.10 ± 0.01

0.05 ± 0.01

0.09 ± 0.01



American Holsteins



Walloon Holsteins

AVAILABLE !

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best American individuals**

AVAILABLE !

Use of **PLF data** for these animals

Statistical analysis methods

PCA

Genetic distance

Structure

...

WP2

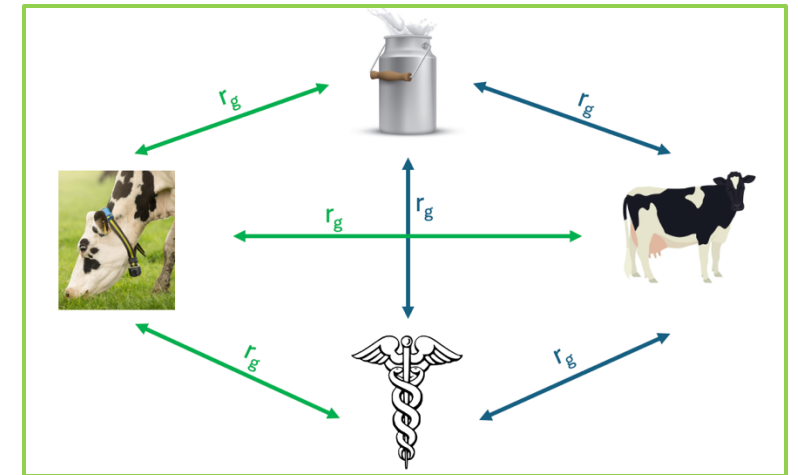
Creation of **traits of interest**

Estimation of **genetic parameters**

Comprehensive **literature review**

Elimination of non-heritable traits

Preservation of heritable traits



Analysis of **genetic correlations** with selected traits

WP2

Use of **quantitative genetics models**



American Holsteins

Walloon Holsteins

AVAILABLE !

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best American individuals**

AVAILABLE !

Use of **PLF data** for these animals

Statistical analysis methods

PCA

Genetic distance

Structure

...

147. Learning behaviour of dairy cows in automated milking systems: genetic parameters and suggested candidate genes

R. Schafberg, F. Rosner, D. Oelschlägel and H.H. Swalve*

Institute of Agricultural and Nutritional Sciences, Martin-Luther University Halle-Wittenberg, 06099 Halle (Saale), Germany; hermann.swalve@landw.uni-halle.de

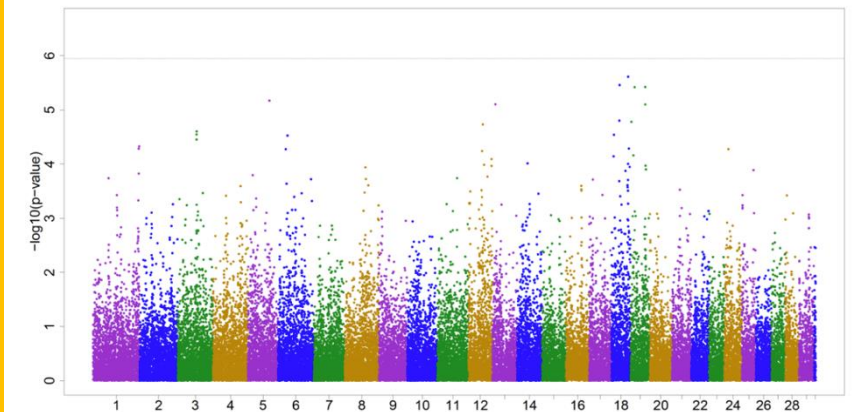


Figure 1. Manhattan plot of GWAS ($-\log_{10} P$ -value) for trait **refusals per day (RPD)**

(Schafberg, 2023)

WP2

Creation of traits of interest

Comprehensive literature review

Estimation of **genetic parameters**

Elimination of **non-heritable** traits

Preservation of **heritable** traits

GWAS analysis to identify SNPs and **chromosomal regions** of interest

WP3

Analysis of **genetic correlations** with selected traits

WP2

Use of **quantitative genetics models**



American Holsteins

Walloon Holsteins

AVAILABLE !

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations

WP1

Selection of the **best American individuals**

AVAILABLE !

Use of **PLF data** for these animals

WP2

Creation of **traits of interest**

Estimation of **genetic parameters**

Use of **quantitative genetics models**

Statistical analysis methods

PCA

Structure

Genetic distance

...

Comprehensive **literature review**

Elimination of non-heritable traits

Preservation of heritable traits

Observed **Phenotype** **P**
↑
Extended prediction model **to**
↑
Genotype **G**

Development of **genomic prediction equations**

WP4

GWAS analysis to identify SNPs and chromosomal regions of interest

WP3

Analysis of **genetic correlations** with selected traits

WP2



American Holsteins

Walloon Holsteins

AVAILABLE !

SNP information for both populations

WP1

Analysis of **genetic similarity** between the two populations



WALLeSmart



WP1

Selection of the **best American individuals**

AVAILABLE !

Use of **PLF data** for these animals

WP2

Creation of **traits of interest**

Estimation of **genetic parameters**

Use of **quantitative genetics models**

Statistical analysis methods

PCA

Genetic distance

Structure

...

Comprehensive **literature review**

Elimination of non-heritable traits

Preservation of heritable traits

Implementation of prediction equations in **WALLeSmart's GenoWall OAD**

External validation of equations based on **Walloon data**

Development of **genomic prediction equations**

WP4

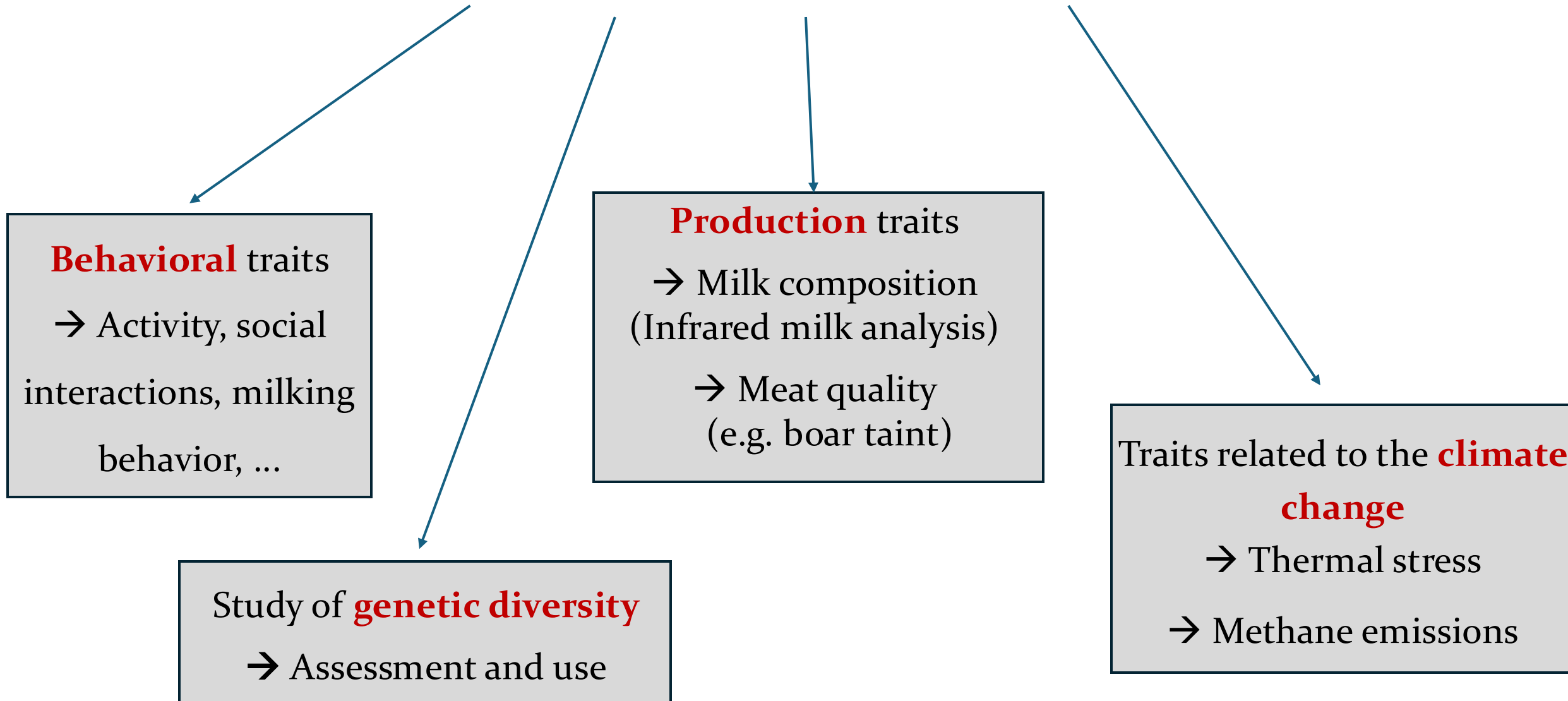
GWAS analysis to identify SNPs and **chromosomal regions** of interest

WP3

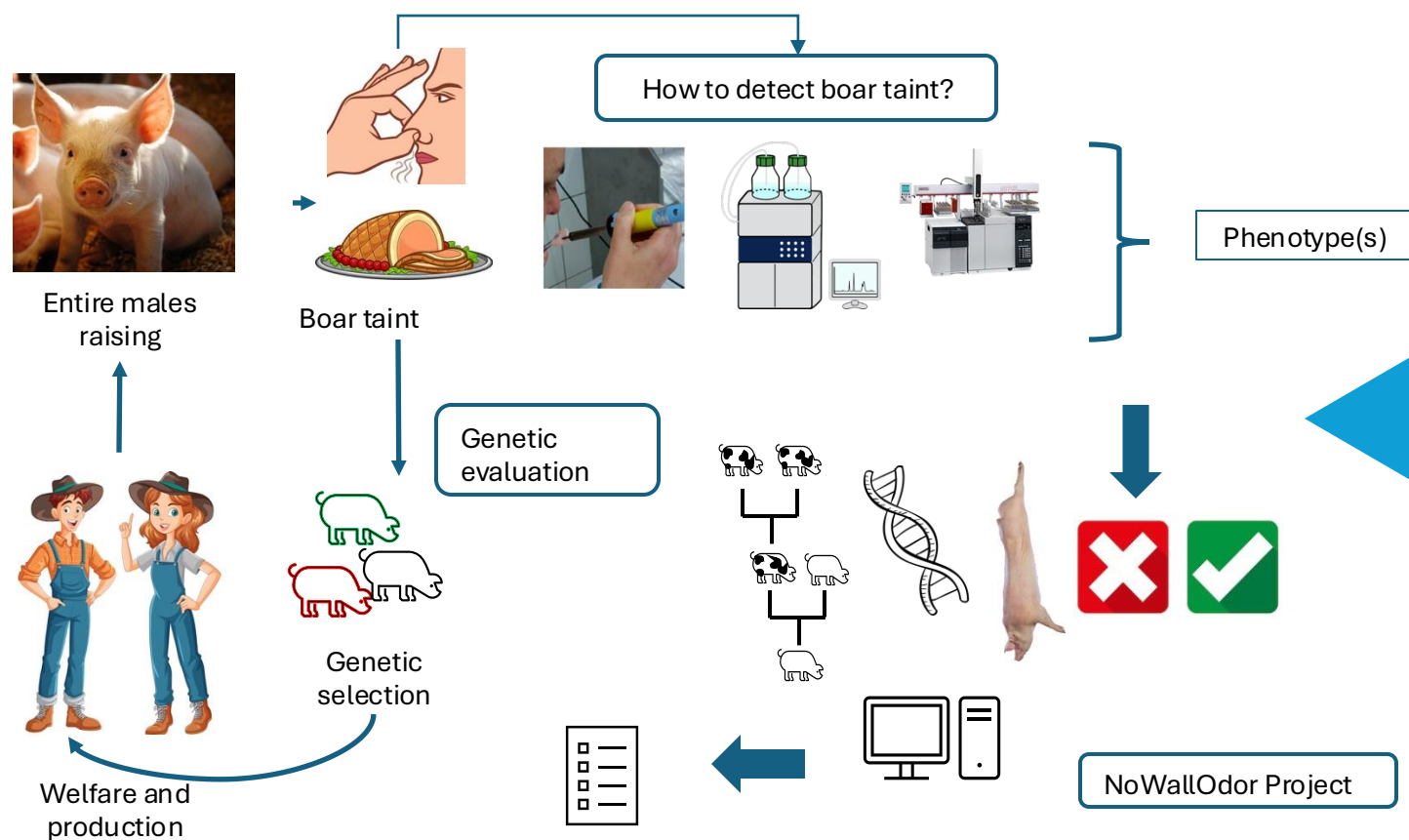
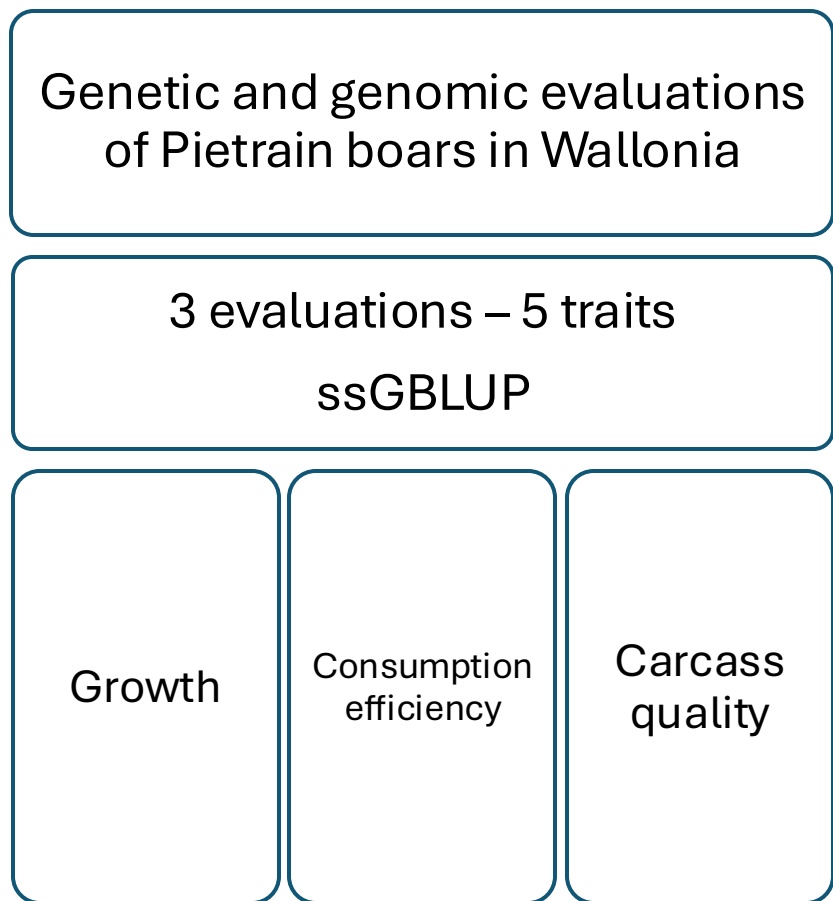
Analysis of **genetic correlations** with selected traits

WP2

Examples of relevant studies done in our laboratory



Pigs genetic evaluations and NoWallOdor



Heat stress in dairy cows and HTwoTHI



Production $\searrow$ Fertility $\searrow$ Health $\searrow$ Welfare $\searrow$

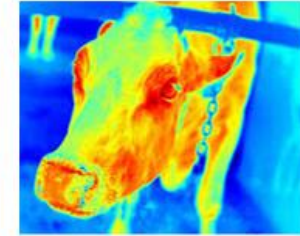
How to detect heat stress?



Farm



Environmental changes :
Temperature $\nearrow$
Humidity $\nearrow$



Physiological changes :
Body temperature $\nearrow$

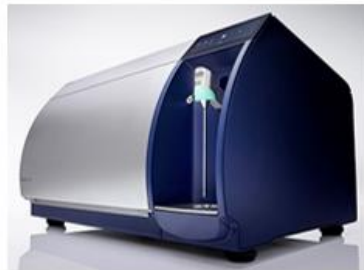


Production changes :
Milk quantity $\searrow$
Changes in milk composition



Behavioural changes

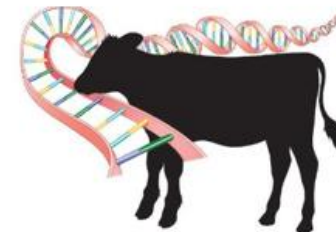
How to detect heat stress at large scale?



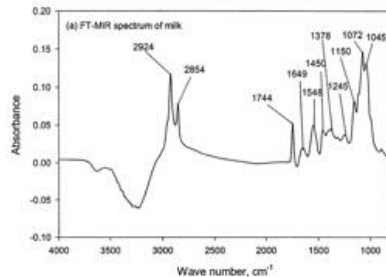
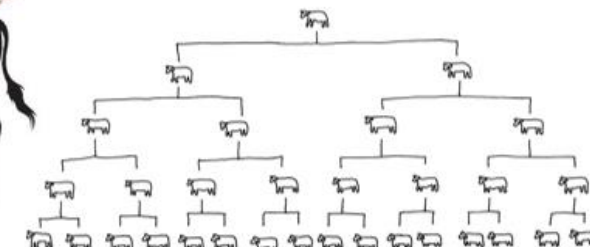
OU



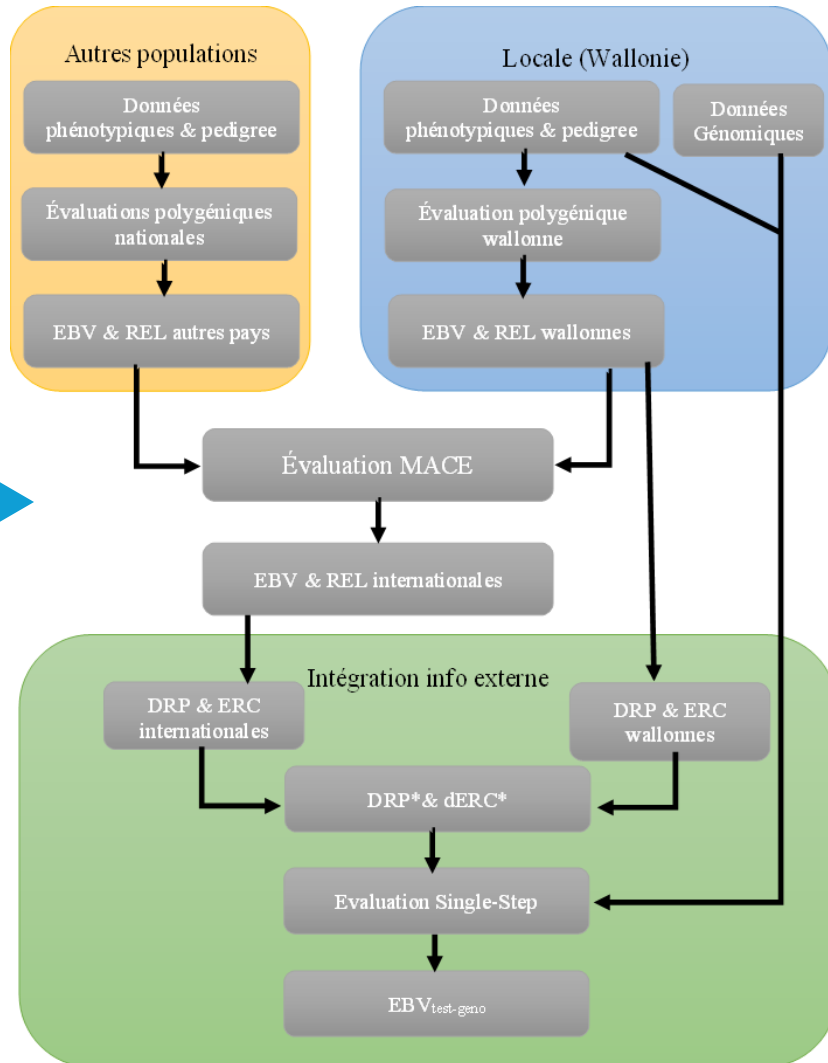
How to improve resistance to heat stress?



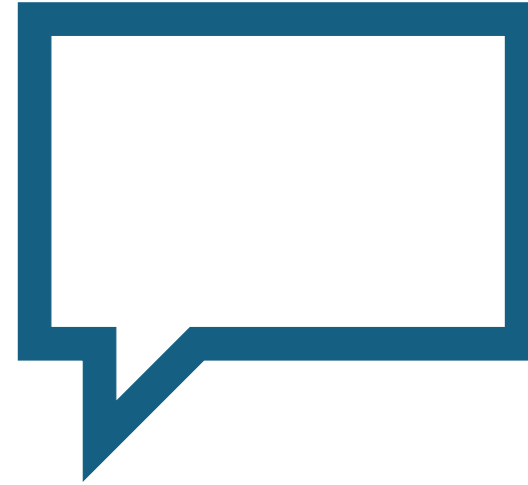
Selection



Dairy and Dual-Purpose cattle genetic evaluation



- 3x year: Routine Run: polygenic + genomic eval DP/HOL
 - (DP genomic: 1x year)
- Participation in MACE evaluation INTERBULL
- When needed: participation INTERBULL Test-Run
- Breed assignment tests for DP and red cattle (EBRW + PRO)
- Transition towards full Single-Step evaluation
- Base change (2015 vs 2020)
- Pedigree db (with our informatician)
- Holicow project: administrative assistance + follow-up in some meetings
- Following other projects (ScorWelCow, WES)
- Where needed: helping with project applications



Thank you for listening