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► **To cite this version:**

Tiphaine Mace, Dominique Hazard, Sebastien Douls, Didier Foulquie, Eliel González García. Clustering and genetic analysis of body condition score and body weight variations in meat sheep. 2017, 27 p. hal-01607238

**HAL Id: hal-01607238**

**<https://hal.science/hal-01607238>**

Submitted on 5 Jun 2020

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# CLUSTERING AND GENETIC ANALYSIS OF BODY CONDITION SCORE AND BODY WEIGHT VARIATIONS IN MEAT SHEEP

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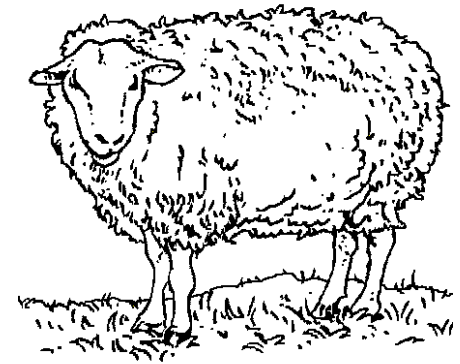
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# Plan

- Context - Robustness
- Cluster analysis
  - Materials and methods
  - Results
- Genetic analysis
  - Creation of new traits
  - Materials and methods
  - Results
- Discussion – Conclusion
- Perspective



# Robustness

- Robust animals to assure the farm sustainability in harsh condition

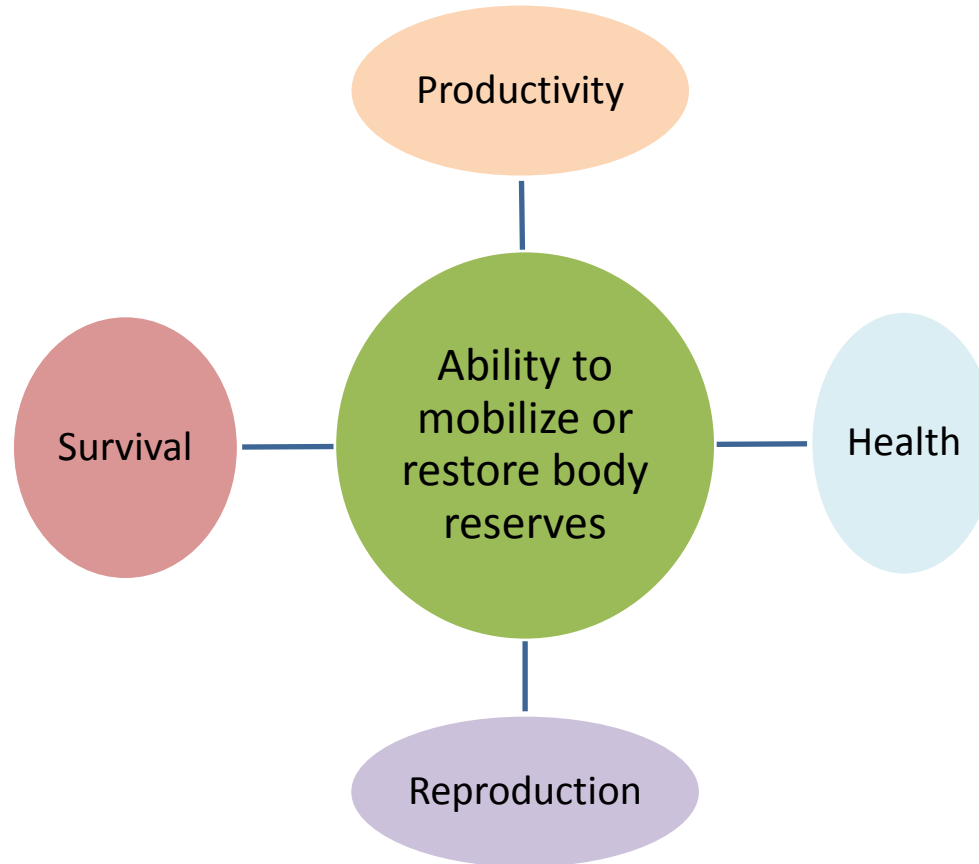


Ability to  
mobilize or  
restore body  
reserves

Russel *et al.*, 1971  
Blanc *et al.*, 2006

# Robustness

- Robust animals to assure the farm sustainability in harsh condition



Russel *et al.*, 1971  
Blanc *et al.*, 2006

# Robustness – Body Condition Score and Body Weight

- Body Condition Score (BCS) and BW to characterize robustness
  - BCS: grid from 1 to 5
  - Capacity of mobilization or accretion of body reserves (BR)
  
- Heritability
  - BCS
    - From 0.10 to 0.30 for Targhee ewes
  - Body Weight (BW)
    - From 0.30 to 0.56 for adult sheep
  
- No study on genetic for BCS and BW variations across productive cycle

Borg *et al.*, 2005  
Gizaw *et al.*, 2007  
Loker *et al.*, 2011  
Shackell *et al.*, 2011

# Robustness – Body Condition Score and Body Weight

## ➤ Objectives

- To characterize the different patterns of BCS and BW variation during productive cycle and career
- To analyze the genetic variability of BCS and BW changes throughout several productive cycles

# Materials and Methods

- La Fage: meat Romane flock (n=250 ewes) reared exclusively outdoors in harsh conditions



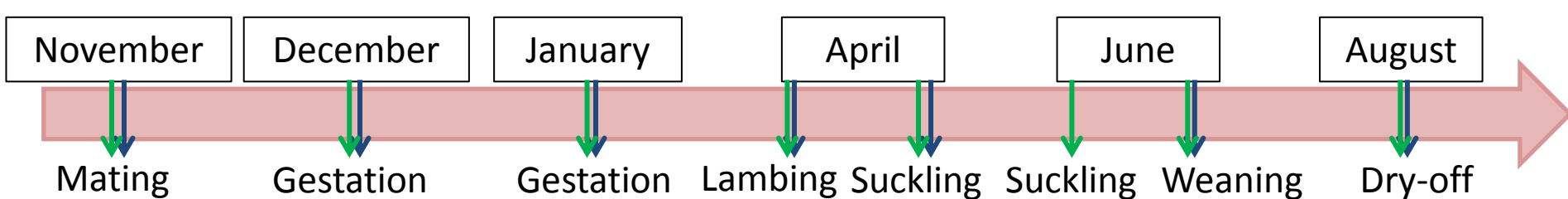


# Materials and Methods

- La Fage: meat Romane flock (n=250 ewes) reared exclusively outdoors in harsh conditions
- BCS and BW measured on 1448 ewes from 78 sires (2002-2015)
  - Cycle 1: 1448
  - Cycle 2: 1170
  - Cycle 3 and more: 665

# Materials and Methods

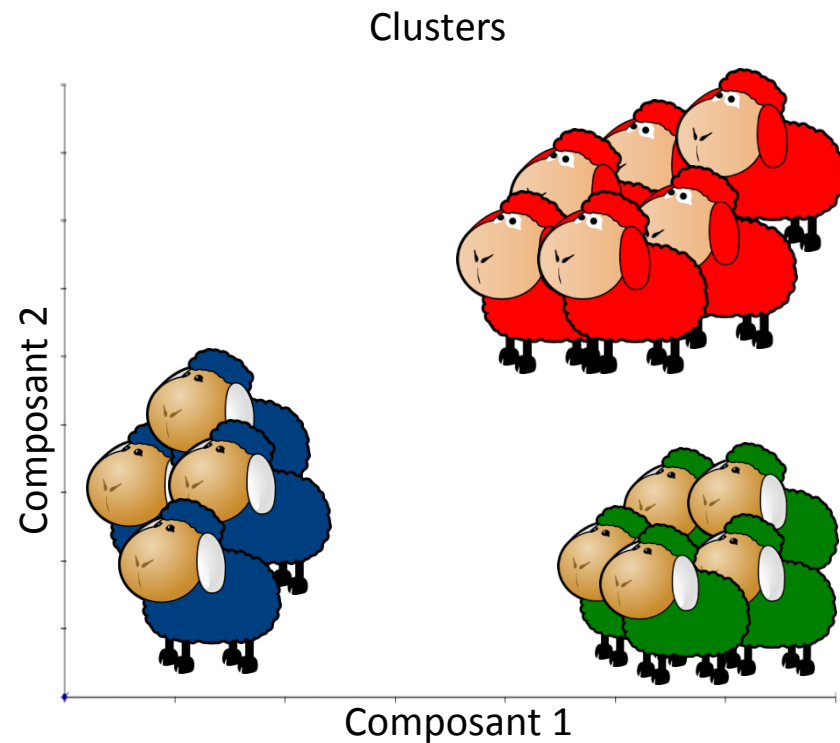
- La Fage: meat Romane flock (n=250 ewes) reared exclusively outdoors in harsh conditions
- BCS and BW measured on 1448 ewes from 78 sires (2002-2015)
  - Cycle 1: 1448
  - Cycle 2: 1170
  - Cycle 3 and more: 665
- **8 BCS** and **7 BW** measurements per production cycle



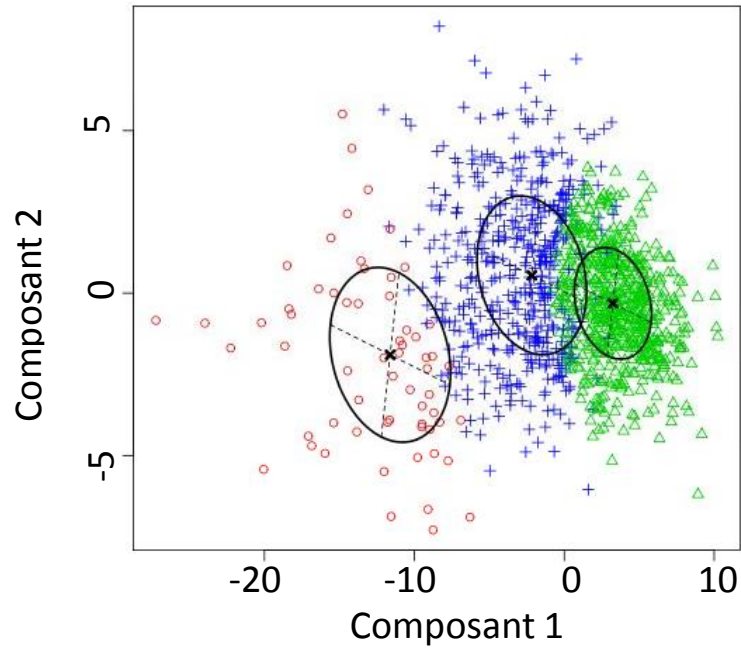
# Materials and Methods – Cluster analysis

## ➤ Clustering

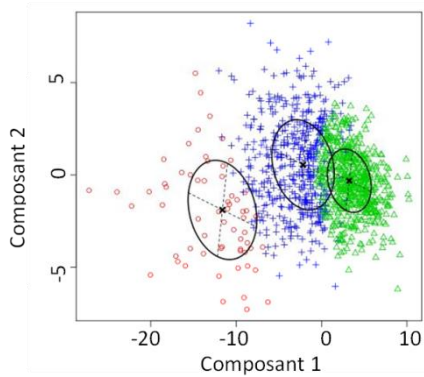
- To describe profiles
- Smoothing
- PCA
- Clusters construction
  - Expectation-Maximization Algorithm



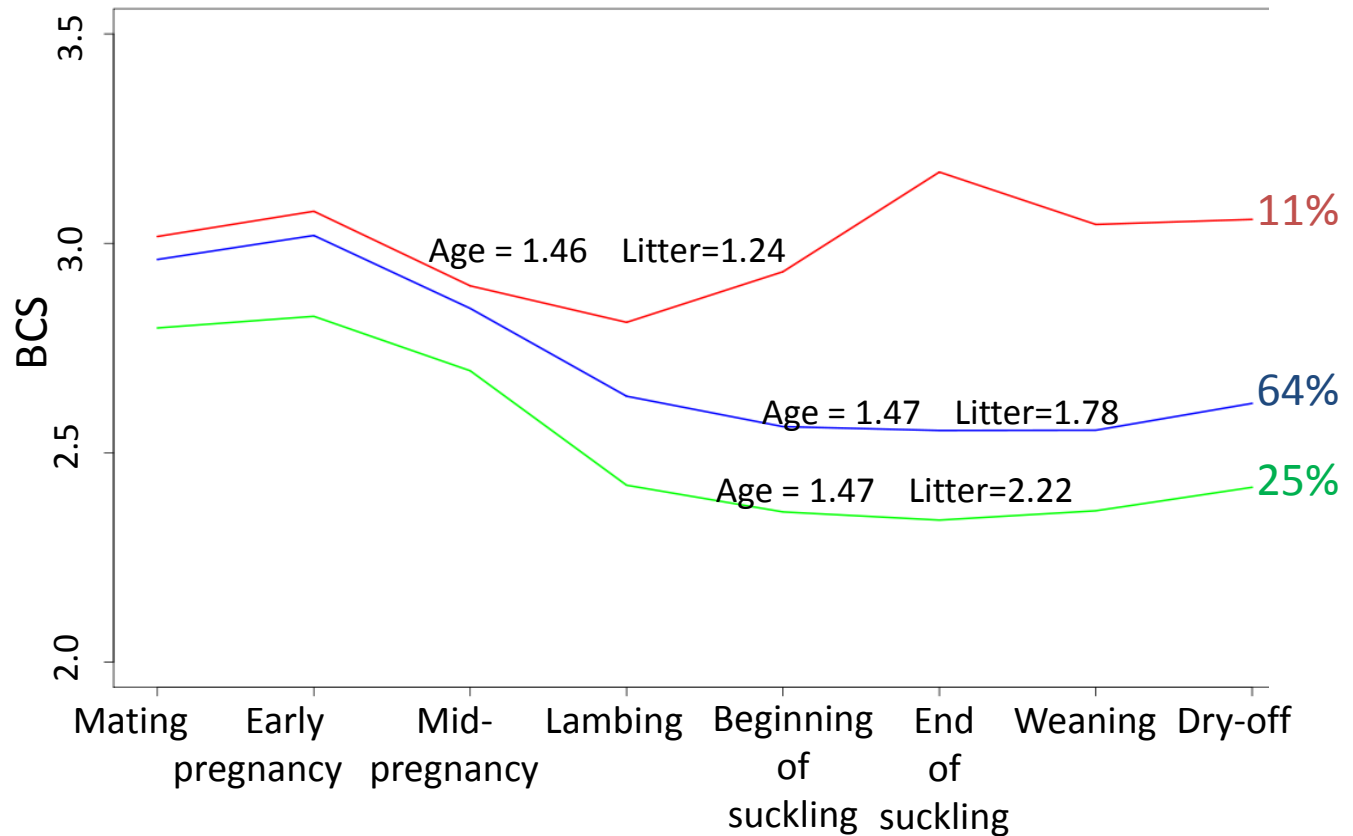
# Results for BCS Clusters



# Results for BCS Clusters

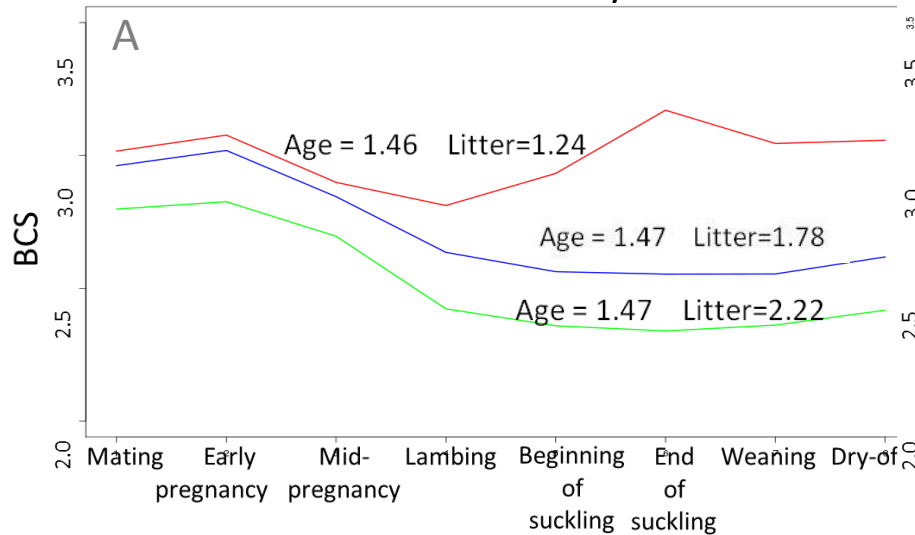


BCS clusters for cycle 1

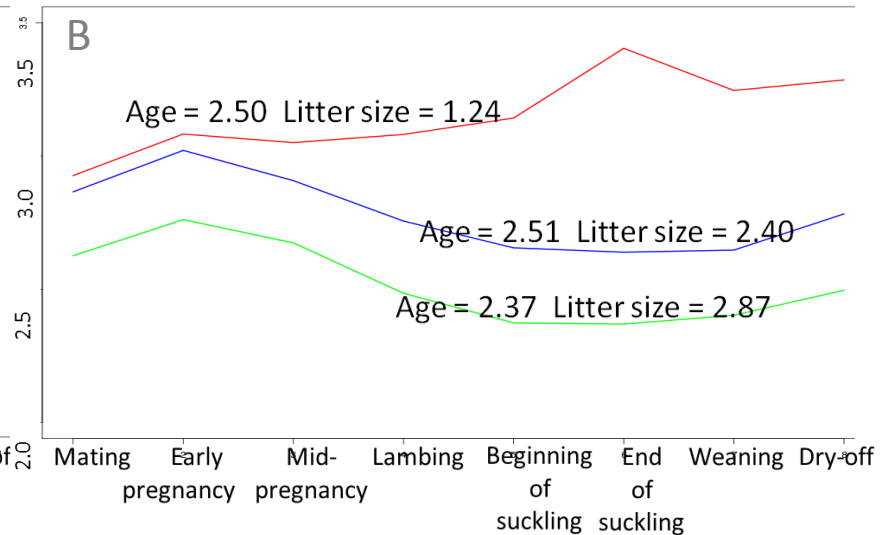


# Results for BCS Clusters

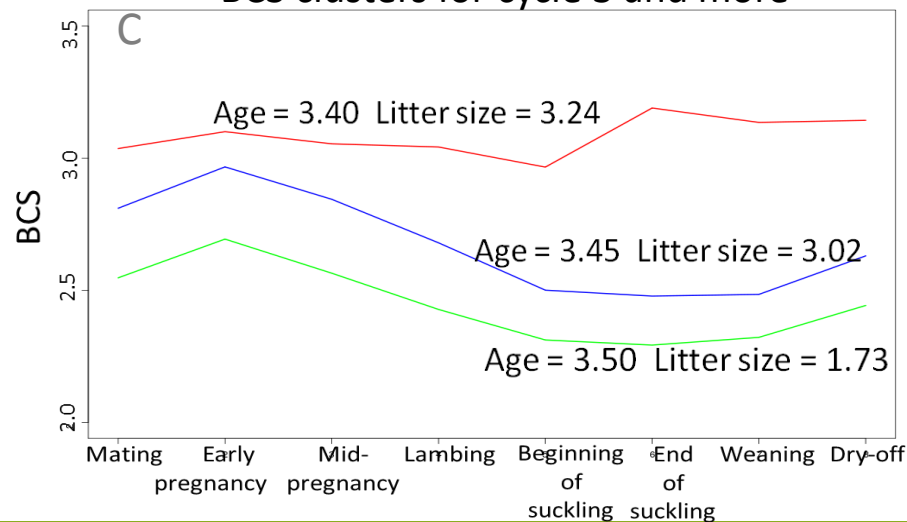
BCS clusters for cycle 1



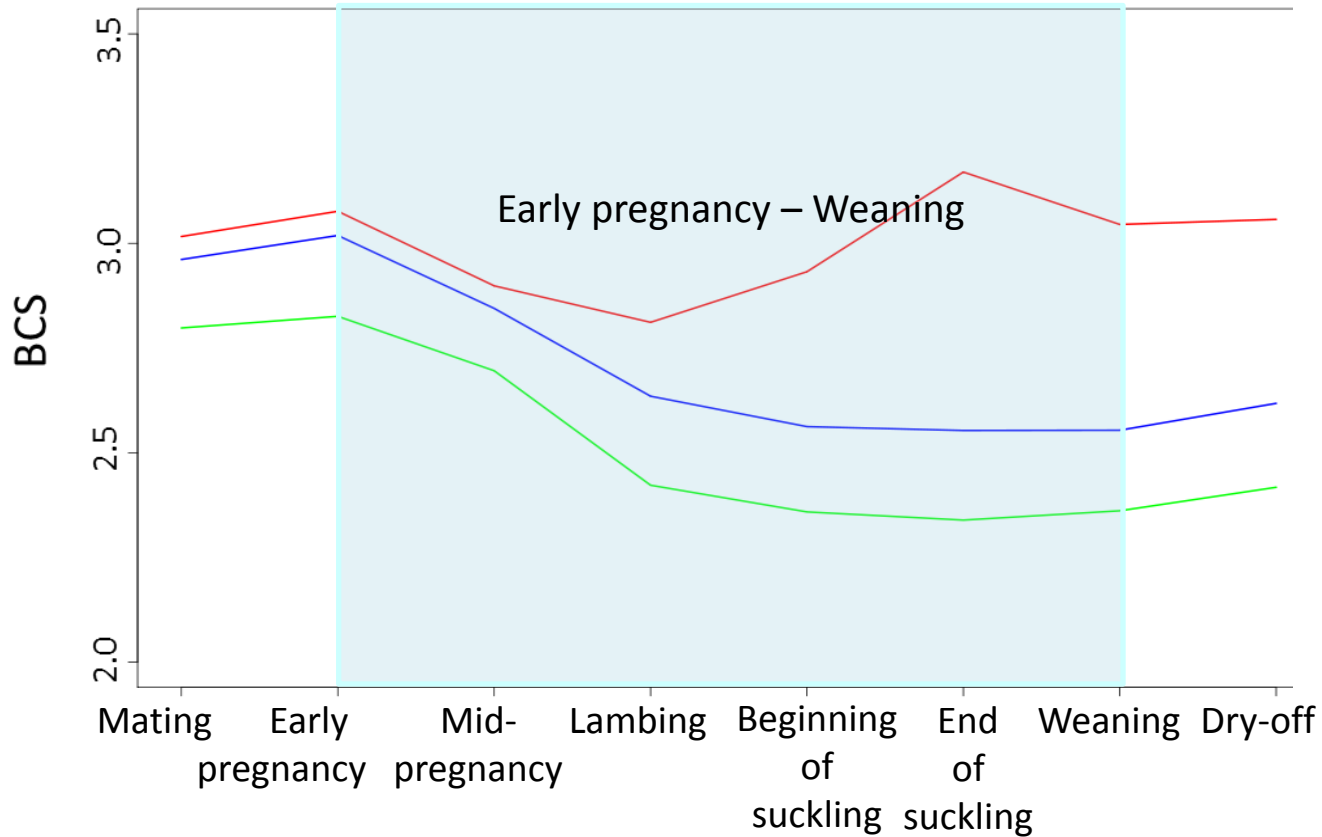
BCS clusters for cycle 2



BCS clusters for cycle 3 and more

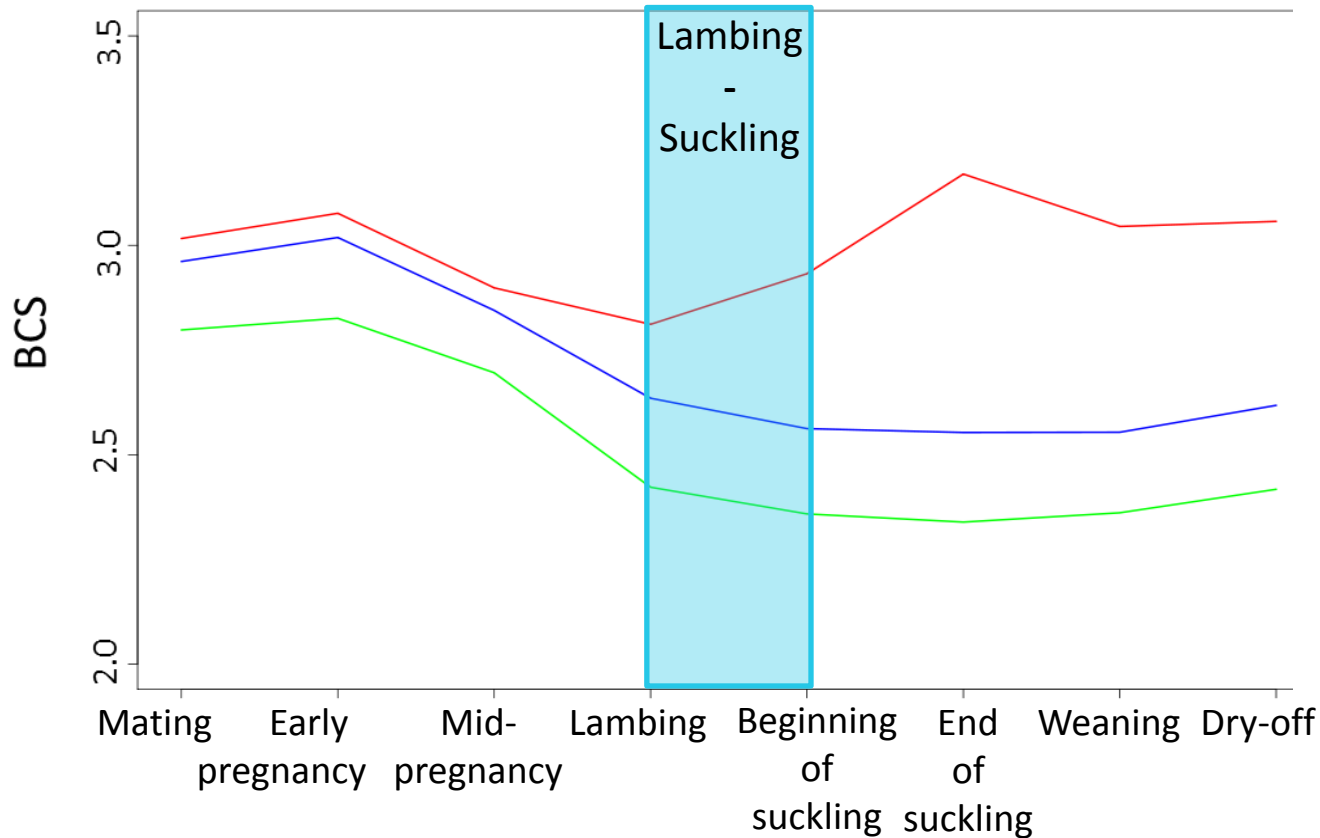


# Creation of new traits



$$Y = BCS_{\text{Weaning}} - BCS_{\text{Early Pregnancy}}$$

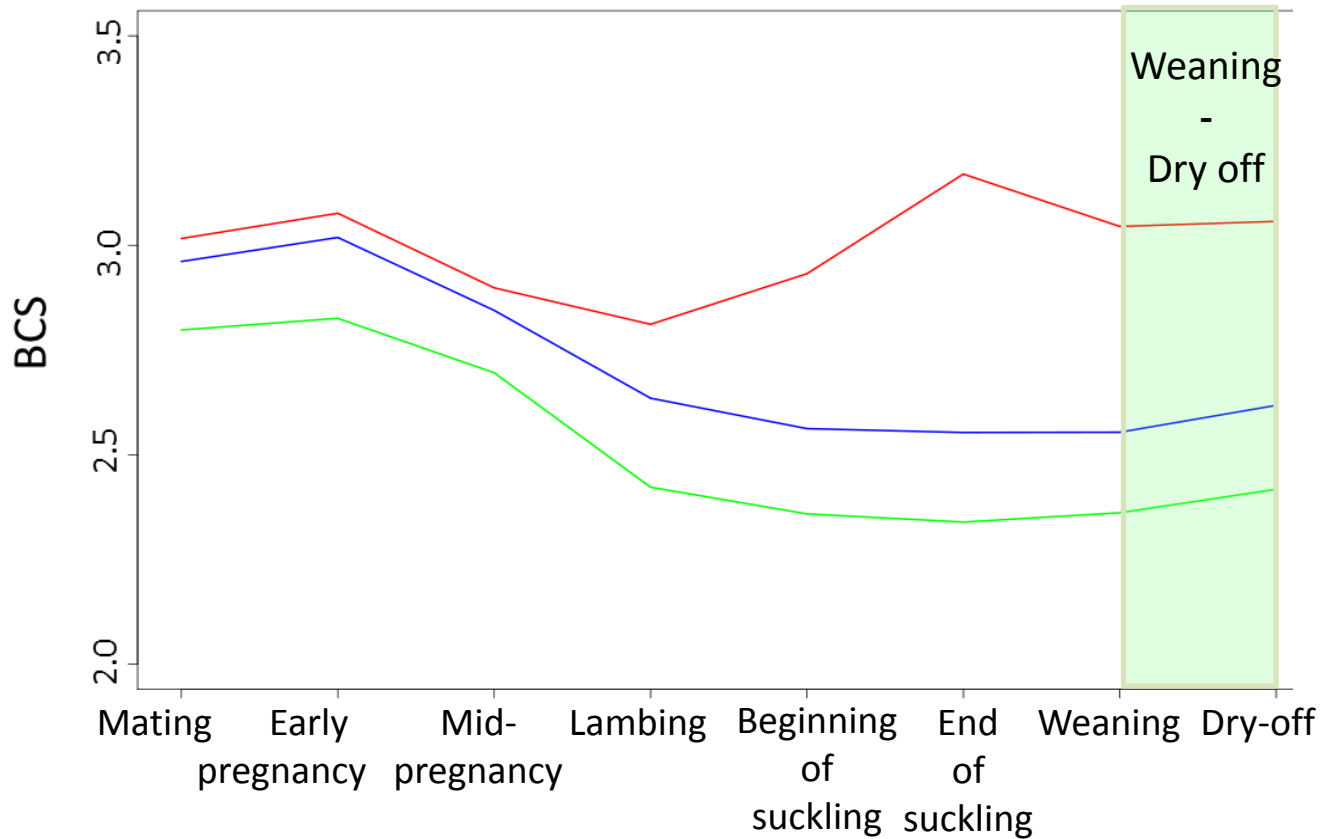
# Creation of new traits



$$Y = BCS_{\text{Suckling}} - BCS_{\text{Lambing}}$$

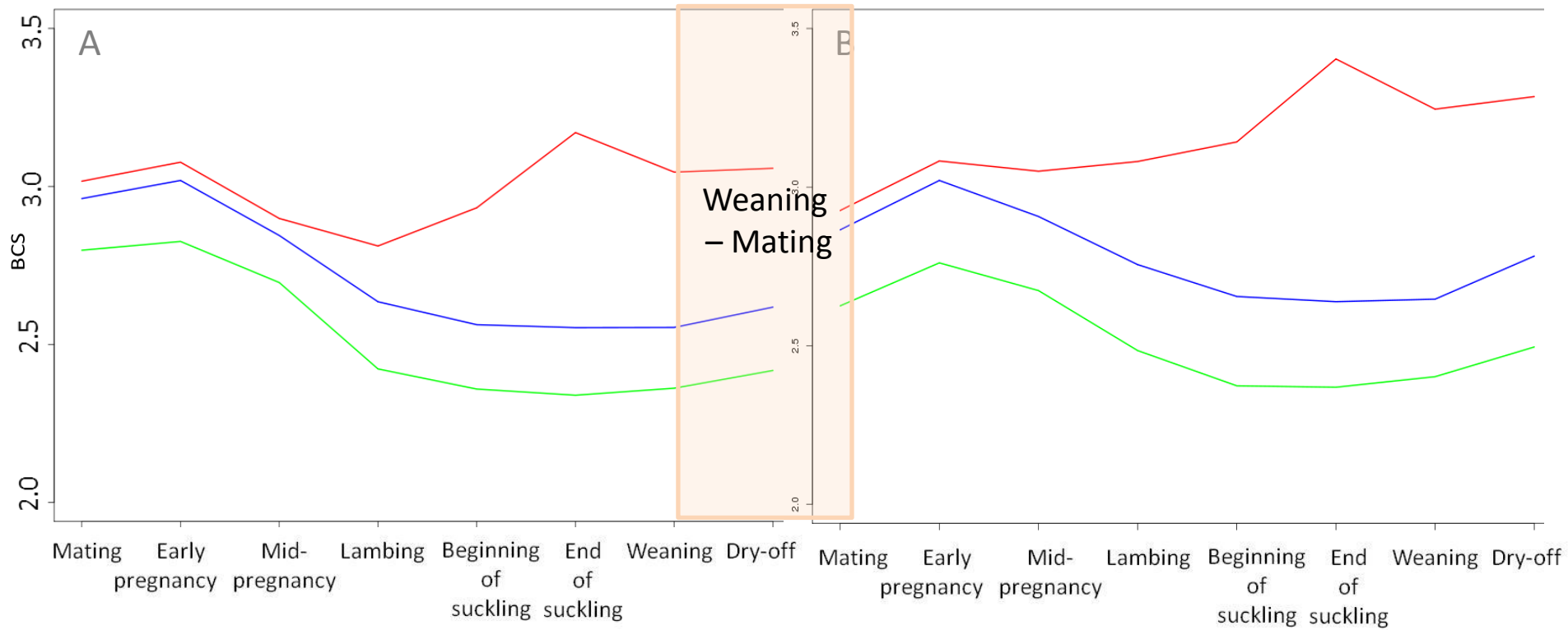


# Creation of new traits



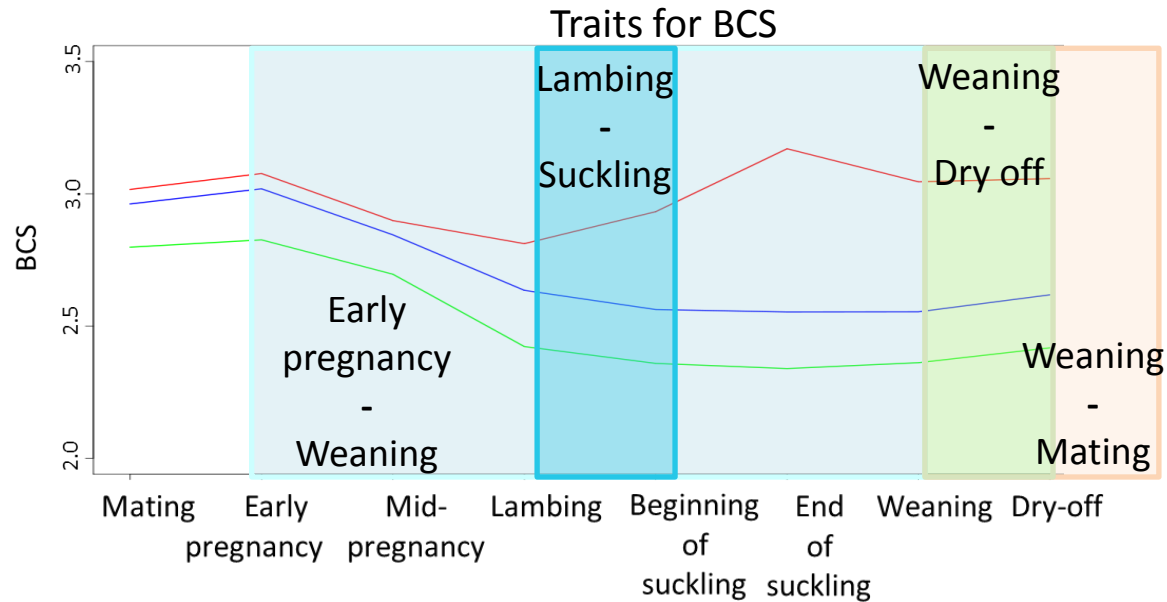
$$Y = BCS_{\text{Dry off}} - BCS_{\text{Weaning}}$$

# Creation of new traits



$$Y = BCS_{\text{Mating}} - BCS_{\text{Weaning}}$$

# Materials and Methods – Genetic Analysis



- Univariate and multivariate analysis (animal model): Heritabilities and correlations estimation with (ASReml), use of all cycles

$$Y = \mu + \text{animal} + \text{perm} + \text{age} + \text{parity} + \text{litter} + \text{year} + e$$

Y: trait

$\mu$ : mean of the trait

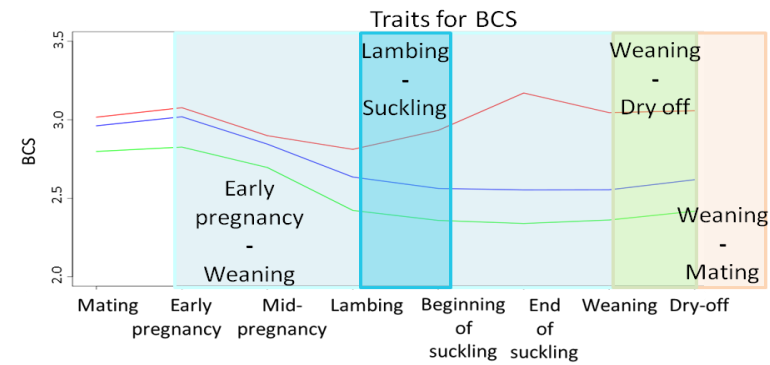
animal: additive genetic effect of the ewe

perm: environmental permanent effect of the ewe

age of the ewe, parity, litter, year of measurements as fixed effects

e: residual

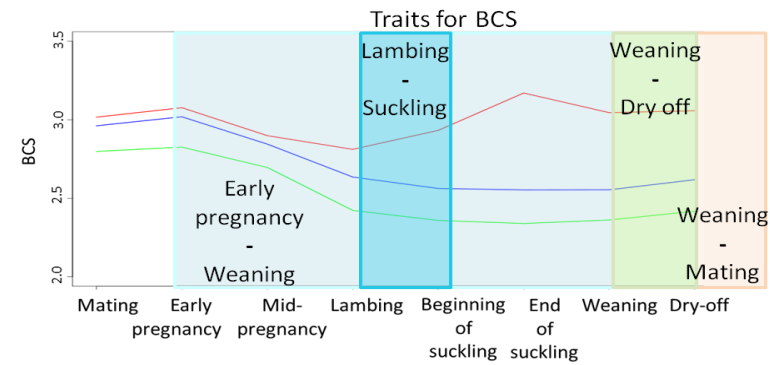
# Results



- Low to medium heritabilities ( $0.06 \pm 0.01$  to  $0.15 \pm 0.01$ )
- Positive correlations between periods characterizing BR mobilization

Variables BCS	Lambing - Suckling
Early pregnancy - Weaning	0.49 (0.12)

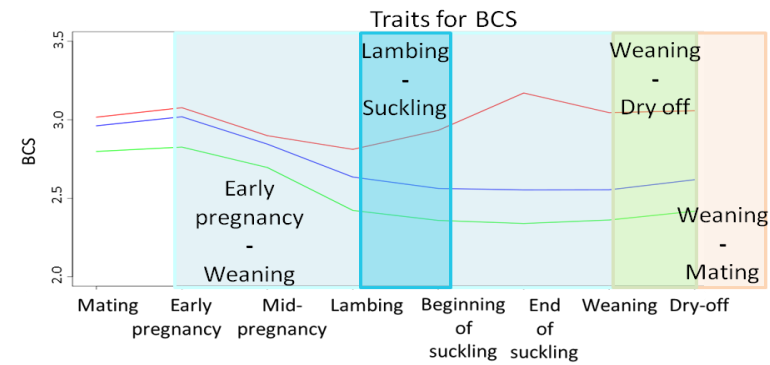
# Results



- Low to medium heritabilities ( $0.06 \pm 0.01$  to  $0.15 \pm 0.01$ )
- Positive correlations between periods characterizing BR mobilization
- Positive correlations between periods characterizing BR accretion

Variables BCS	Weaning - Mating
Weaning – Dry off	0.75 (0.10)

# Results



- Low to medium heritabilities ( $0.06 \pm 0.01$  to  $0.15 \pm 0.01$ )
- Positive correlations between periods characterizing BR mobilization
- Positive correlations between periods characterizing BR accretion
- Negative correlations between periods characterizing BR accretion and mobilization

Variables BCS	Weaning – Dry off
Early pregnancy - Weaning	-0.71 (0.08)
Lambing - Suckling	-0.46 (0.12)

# Discussion - Conclusion

- BCS: three similar profiles across productive cycles
- BCS and BW variations heritable: first demonstration
- Increase in weight during dry-off correlated to heavier lambs
- Accretion and mobilization of BR linked at the genetic level
  - Common genes?

# Discussion - Conclusion

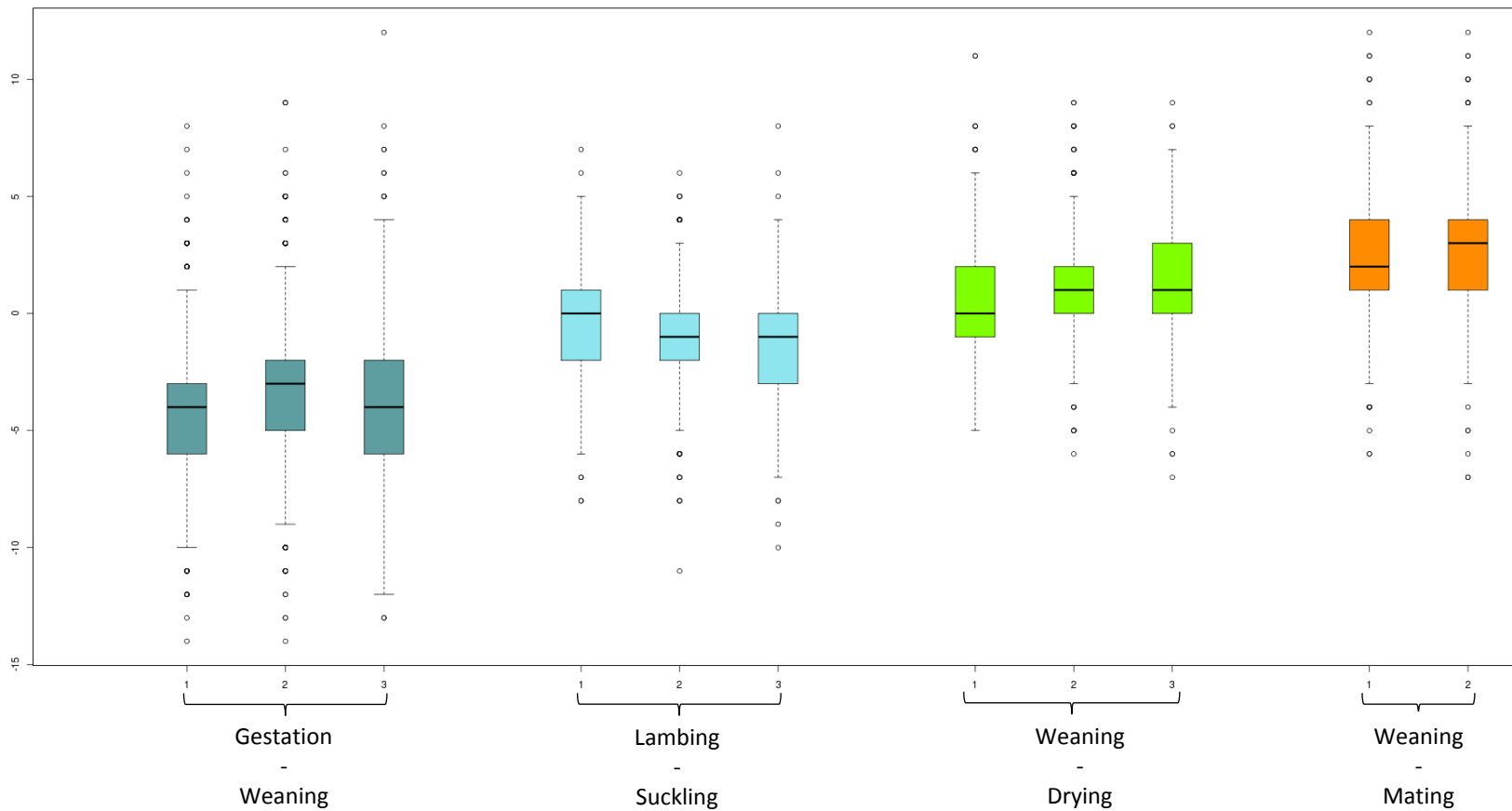
## ➤ Perspectives

- Modelisation of the variations profiles (BCS and BW)
- Longitudinal genetic analysis with reaction norm model
- Joint analysis with climatic data (reaction norm model)
- Better phenotyping for BR variations (key metabolites /hormones /ultra sound...)



Thanks for your attention







# Results

