Smarter

SMAll RuminanTs breeding for Efficiency and Resilience

T2.4 Lifetime resilience

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INRAE transfert

SRUC

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Final project meeting, Toledo, 22-23 May 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°772787

TASK 2.4: Lifetime resilience

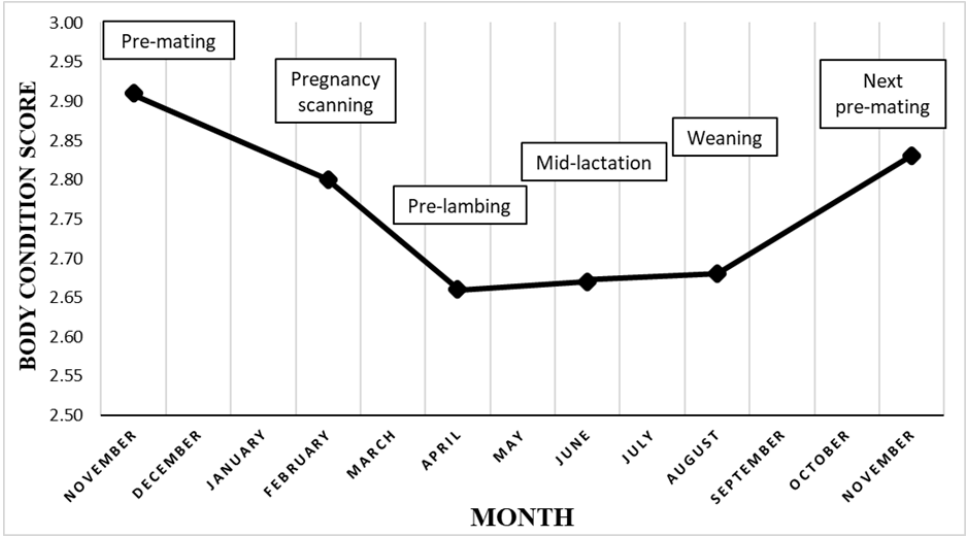
Objective To investigate new breeding goal traits for lifetime resilience for maternal sheep breeding programmes. New traits for **productive longevity, fertility and body tissue mobilisation**

Animal resources 8,335 Scottish Blackface ewes (SRUC experimental farms, data collected 1999 - 2019)

Traits investigated Body condition scores & traits relating to ewe maternal performance (as assessed by traits associated with productive longevity & fertility)

Key results

- **Traits associated with tissue mobilisation** (as assessed using body condition scores) **are mostly heritable.**
- Genetically, the **level of tissue mobilisation** between weaning and pre-mating **can affect the number of lambs reared**.
- Ewes genetically "over-fat" at pre-mating rear less lambs and experience more lamb losses.



Recommendations for EU

The results indicate **traits associated with body tissue mobilisation should be considered for future hill sheep breeding programmes**. However, they should be interpreted in the context of specific management practises, at critical times in their reproductive cycle.

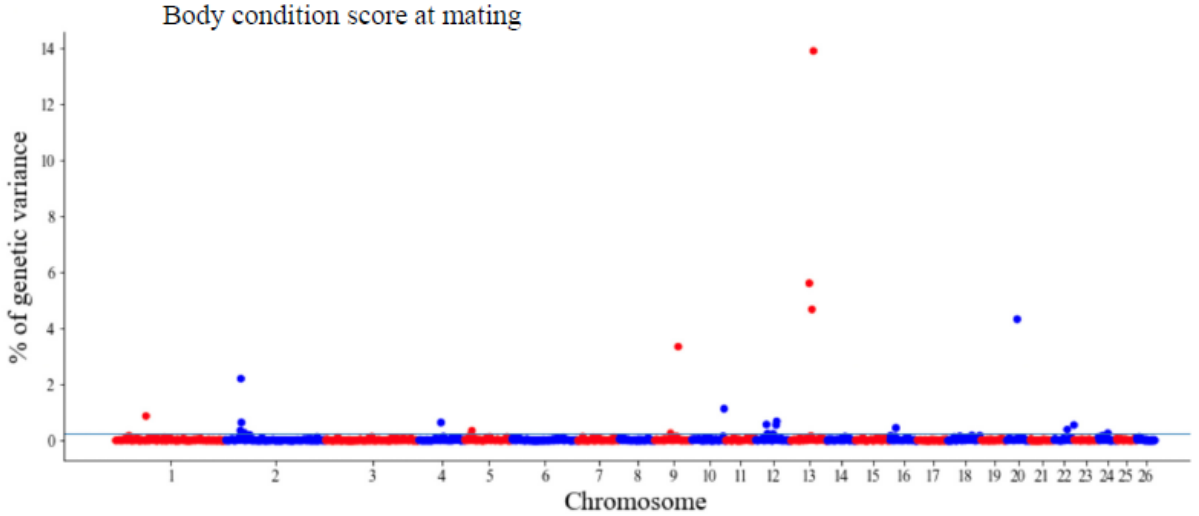
TASK 2.4: Lifetime resilience

Objective To investigate new breeding goal traits for lifetime resilience for maternal sheep breeding programmes. New traits for **production (wool & growth), reproductive performance and body tissue mobilisation**

Animal resources 2,000 ewes with 6,442 records, 5,700 lambs with yearling records, Australian Merino breed (INIA experimental farms, data collected 1999 - 2020)

Traits investigated Body condition score at mating, pre-lambing and weaning, wool quantity and quality, reproductive performance: pregnancy rate, lambing potential, ewe rearing ability, and number of lambs weaned per ewe, lifetime reproductive performance

Key results
- **Unfavourable genetic correlations between wool traits with BCS, backfat and reproduction**.
- **Genetically heavier yearling ewes display greater reproductive performance**.
- **Selecting for finer fleeces will yield little to no change in reproduction traits but decrease BCS and backfat**



Recommendations for EU

When selecting animals for wool's quality and quantity, it is advisable to **carefully consider the potential trade-offs with reproduction and body condition**, especially in environments with restrictions.

TASK 2.4: Lifetime resilience

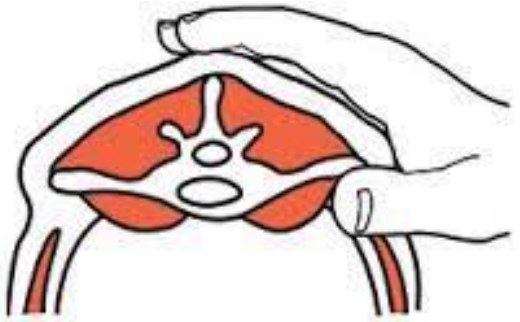
Objective To investigate the potential inclusion of new breeding goal traits for lifetime resilience for maternal sheep traits

Animal resources 27,969 records from multi-breed ewe population

Traits investigated Barren Rate, Embryo loss, Pregnancy scan, BCS and live-weight

Key results

- Average pregnancy scan litter size 1.67; Barren rate 8.21%; Embryo loss 0.06 lamb
- **Heritability**: Pregnancy scan **15%**, Barren rate **11%**; Embryo loss **3%**
- **Correlations**: Genetic correlation between barren rate in nulli and multi-parous ewes **0.63**
- **Moderate genetic correlation between barren rate and ewe BCS**



- **Barren rate included as a breeding goal trait in the national genetic evaluations**

Recommendations for EU Genetic selection for lifetime resilience traits is possible and should be considered for inclusion in sheep breeding programmes

TASK 2.4: Lifetime resilience

Objective Investigate genomic selection for elements of fertility in tandem with performance records: estimate genetic parameters and perform GWAS for (a) **functional longevity** in Chios dairy sheep breed in Greece and (b) **resilience of milk performance** (persistency, Somatic Cell Count - SCC, Body Condition Score - BCS) in Frizarta ewes

Animal resources (a) 11,147 Chios animals with available pedigree (87 farms) and 211 genomic data -50k genotypes (3 farms)
(b) 7,060 Frizarta sheep with pedigree - 315 with available genomic (50k genotypes) & phenotypic data

Key results

- **Functional longevity was significantly heritable** (h2=0.11) and a slightly negative phenotypic correlation was estimated with lifetime milk production (r=-0.13)
- **Five chromosome-wise significant SNPs** were associated with functional longevity
- **SCC and BCS were significantly heritable** (h2=0.09 and 0.10, respectively) - repeatability estimates were 0.25 and 0.32, respectively; GWAS analyses in preparation

Novelty

- First genome-wide study on the genetic architecture of lifetime resilience in Chios sheep
- Novel SNP markers detected associated with animal resilience
- First genome-wide study to explore the genetic basis of milk persistency and BCS fluctuation during lactation in Greek dairy ewes

Recommendations for EU **Genomic selection could be implemented into multi-traits indexes to improve lifetime resilience in commercial dairy sheep**

TASK 2.4: Lifetime resilience

Objective Investigate genomic selection for elements of fertility in tandem with performance records: To estimate genetic parameters and perform GWAS for **total prolificacy, age at first lambing** and **maternal lamb survival** and identify candidate genes involved in molecular pathways underlying **reproduction** in Chios dairy sheep breed in Greece

Animal resources 11,147 Chios animals with available pedigree (87 farms) and 538 genomic data - 50k genotypes (from 3 farms)

Key results

- **All reproductive traits were significantly heritable** (h2 = 0.07–0.21), with no evident genetic antagonism (including production and climate resilience). **Four significant SNPs and 13 candidate genes associated with first lambing age**

Novelty

- First genome-wide study to explore the genetic mechanisms underlying the reproduction of the highly prolific Chios dairy sheep
- Novel SNP markers were detected for age at first lambing that may enhance the list of causal variants and genomic regions related to sheep reproduction

Recommendations for EU

GWAS can be effectively used to detect genomic markers associated with polygenic reproductive traits to reduce economic losses for sheep production systems

Genomic selection to improve reproductive efficiency without compromising milk production and climate resilience

TASK 2.4: Lifetime resilience

Objective Investigate genomic selection for elements of fertility in tandem with performance records: To search for QTL associated with the ability to **mobilize and replenish energy body reserves**

Animal resources 1,000 Romane ewes (INRAE experimental farm), background data

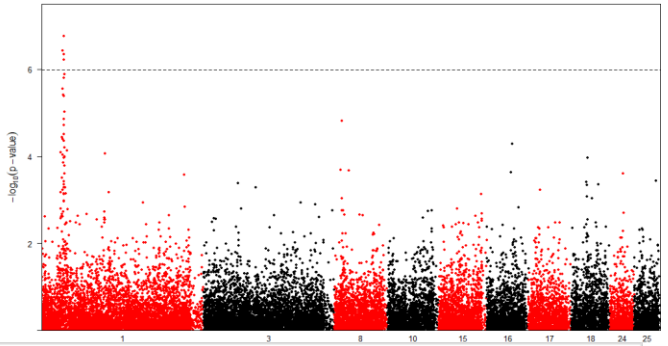
Key results

- **A highly significant QTL on OAR1 associated with body reserve (BR) levels during mobilization period** (from mid-pregnancy to weaning in our conditions)
- **Few QTL associated with BR changes**

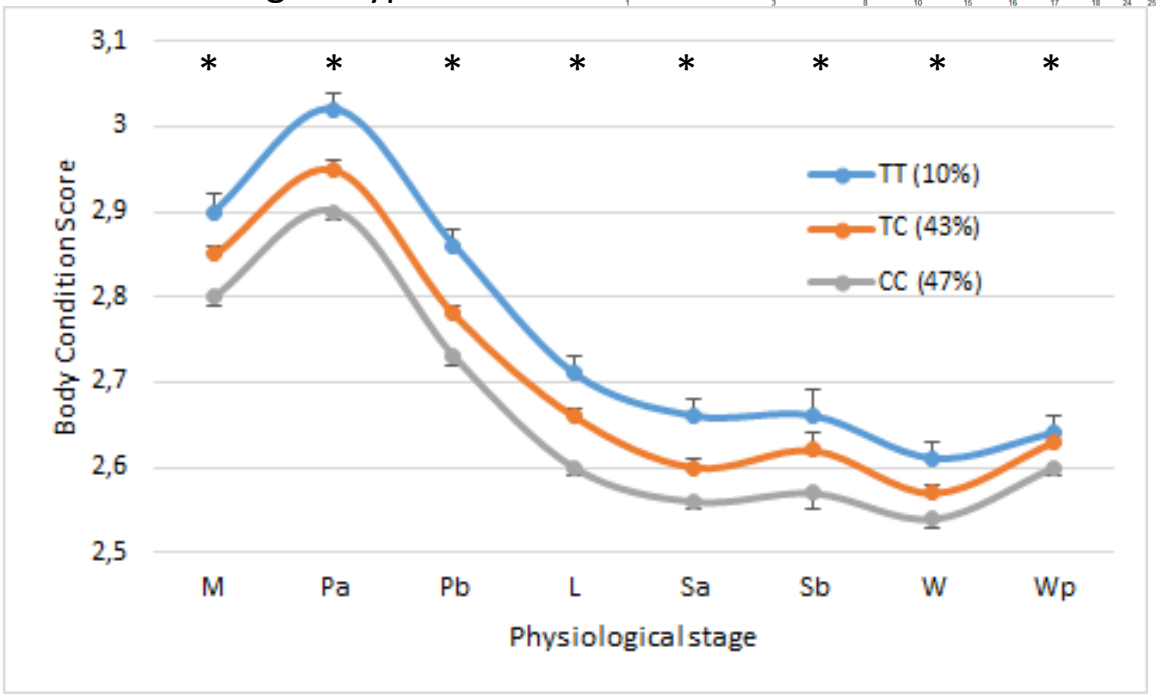
Novelty

- One candidate mutation in the leptin receptor gene (LEPR): → ewes carrying the mutation showed higher fat deposition (at all physiological stages)

Chromosome plot for BCS at lambing



Effect of LEPR genotype



Recommendations for EU

Genetic variants in LEPR gene could be used to select ewes able to increase BR during periods of fat accretion

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Thank you for your attention

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