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The Life-Functions Ratio: a new indicator trait of trade-offs to go beyond genetic correlations

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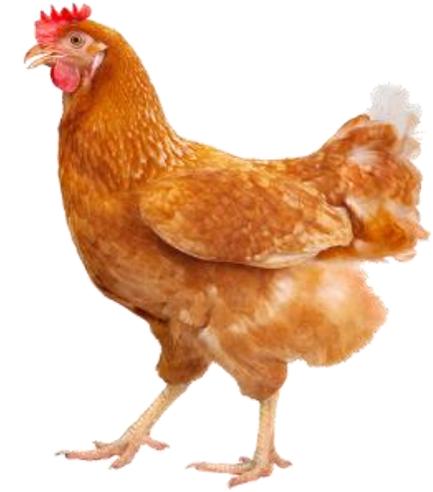
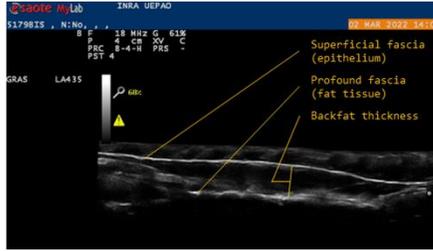
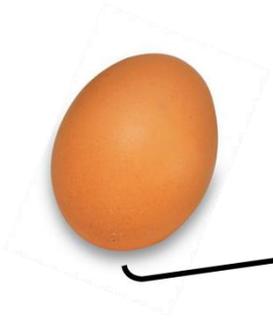
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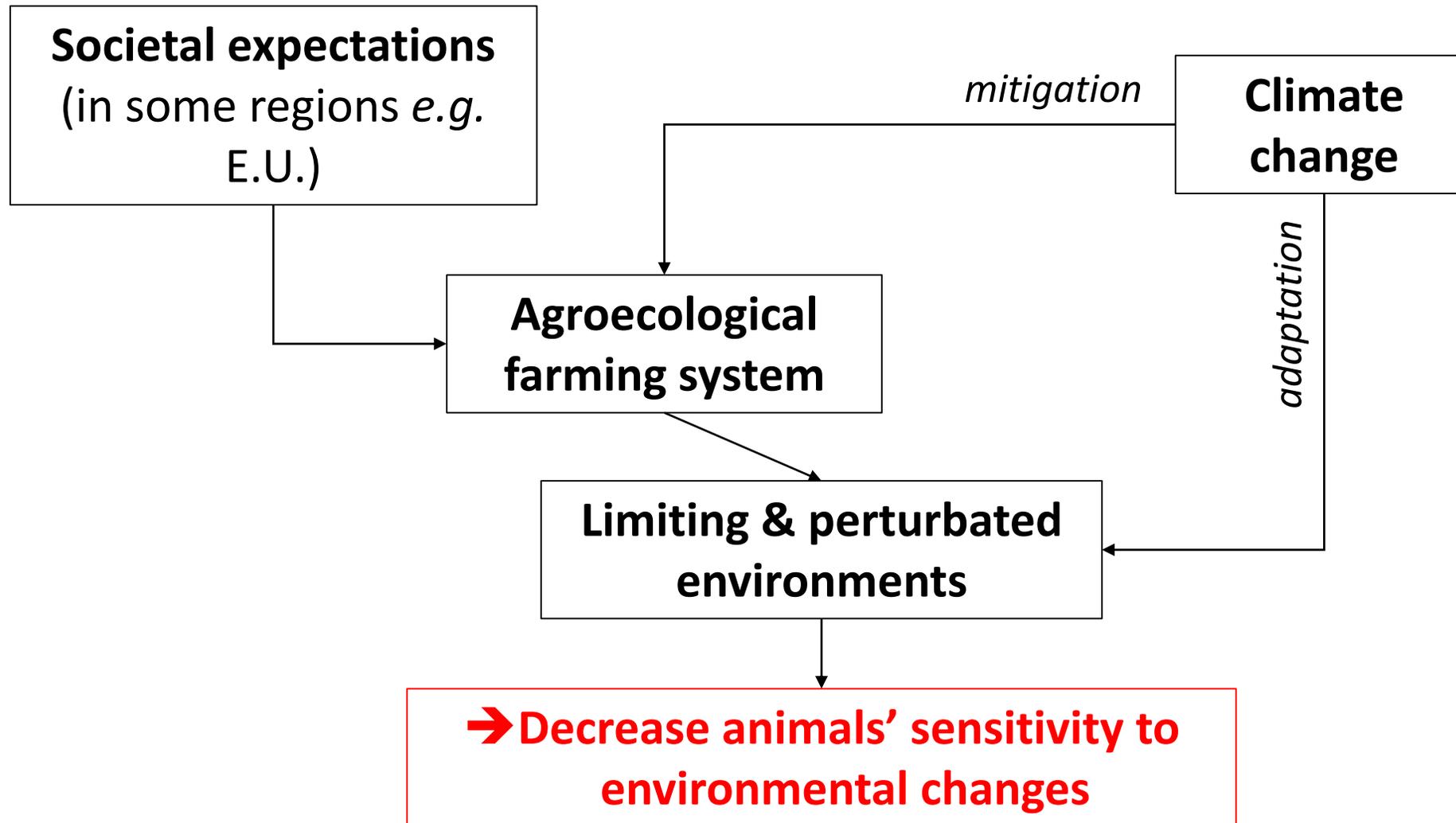


➤ The Life-Functions Ratio: a new indicator trait of trade-offs to go beyond genetic correlations

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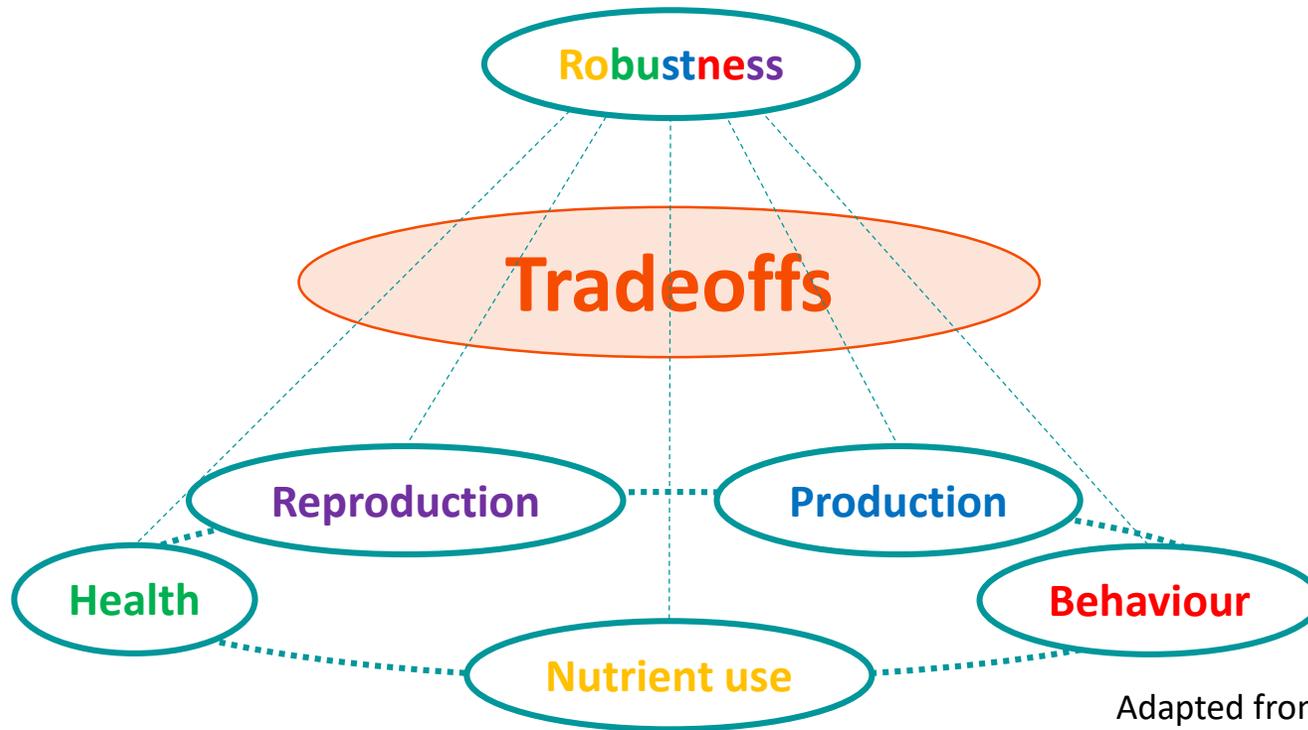
➤ Animals need to cope with environmental perturbations



➤ Acting on tradeoffs to improve robustness

A way to look at environmental sensitivity = Robustness:

multi-performance in multiple environments



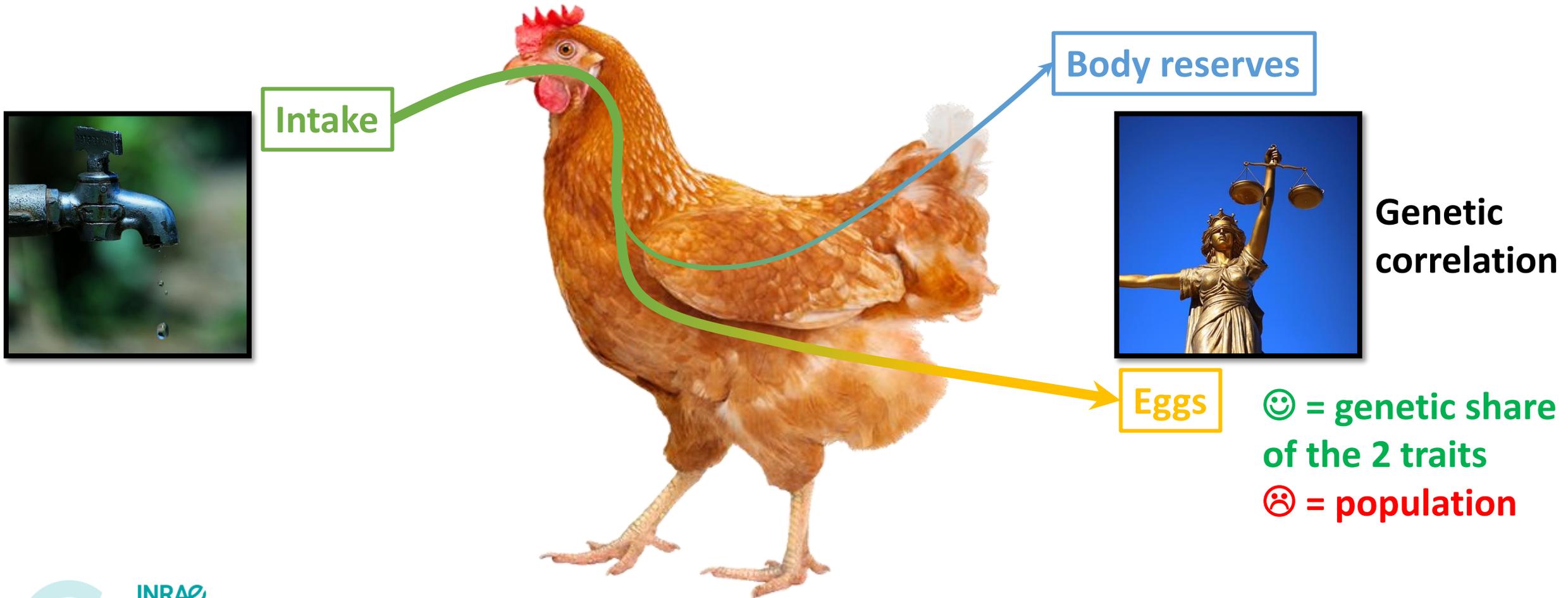
Adapted from [Friggens et al. \(2017\)](#)

➔ Genetic improvement of multi-performance:

- selection index
- global criterion (e.g. functional longevity)
- **tradeoff**

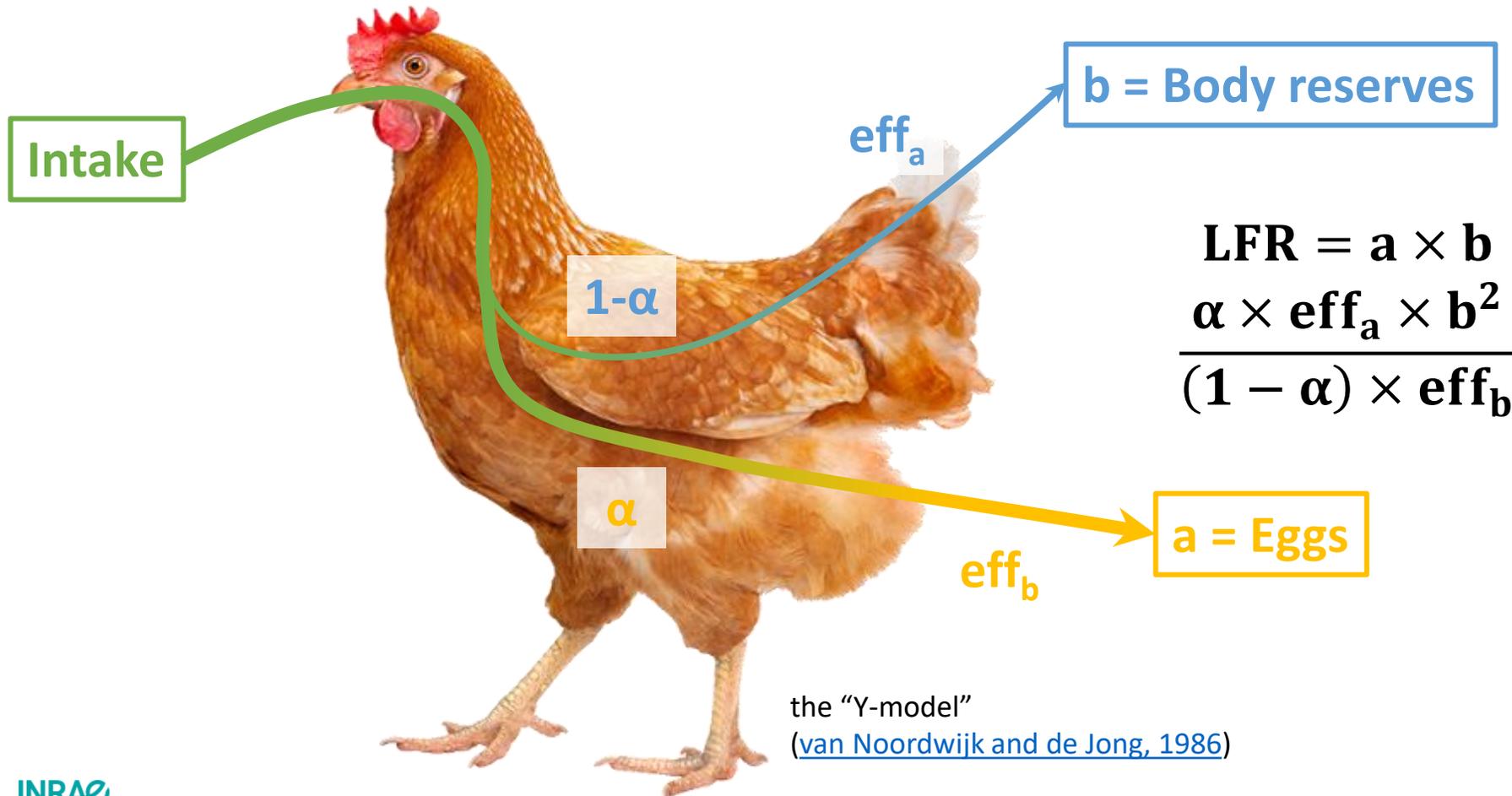
➤ What is a tradeoff?

Difficult question! Depends a lot on the scale (cell to regions) and on the field (genetics to economics).
A collective expertise in INRAE (Network Compromis, Metaprogram SANBA) confirmed.



➤ Tradeoff and resource acquisition and allocation

Difficult question! Depends a lot on the scale (cell to regions) and on the field (genetics to economics).
A collective expertise in INRAE (Network Compromis, Metaprogram SANBA) confirmed.



➤ Questions !

AND

Answers ?

What is the genetic architecture of tradeoff between eggs and body reserves?

- Genetic parameters

$$h^2 = 0.31$$

- QTL detection

We identified 3 QTLs

What is the genetic relationship between tradeoff, allocation, and the original traits?

LFR was highly correlated with original traits ($r_g > 0.60$)

LFR was little correlated with α ($r_g = 0.02$)

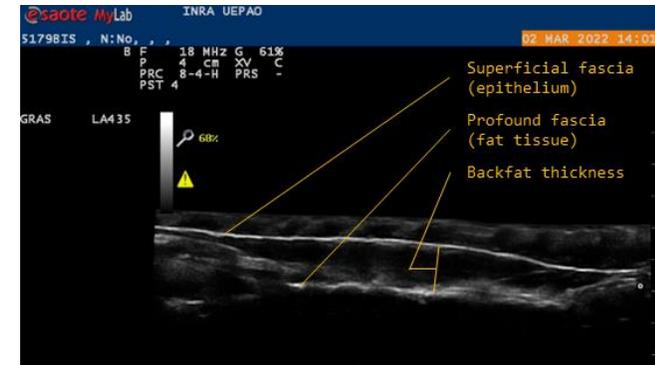


➤ Materials



Rhode Island line of Novogen (Nucleus + experimental supplement):

- 3 related batches from 2020 to 2022 (n=2,016 hens)
- Genotyped with a 60k SNP bedchip
- Phenotypes recorded (80 wks of age):
 - Egg Number
 - Backfat thickness (ultrasonography)
- Phenotype calculated : LFR



LFR

➤ Methods

Variance components estimation with ASREML 4.2:

- Fixed effect of the batch
- Random effects: additive genetic effect (pedigree relationship matrix) and residuals

GWAS with Muller:

Same model with:

- BLUP (fixed additive genetic variance)
- Additional fixed effect: SNP (regression)



➤ Genetic parameters

	α	LFR	Backfat	Eggs
α	0.18 (0.05)			
LFR	-0.02 (0.20)	0.31 (0.07)		
Backfat	-0.63 (0.13)	0.78 (0.07)	0.44 (0.07)	
Eggs	0.59 (0.13)	0.62 (0.11)	0.12 (0.18)	0.13 (0.04)

LFR displayed:

- Moderate heritability → room for genetic improvement
- Highly correlated with backfat and eggs → good tradeoff trait
- Not correlated with allocation coefficient → LFR and α relate to different aspects of tradeoff

➤ Genome Wide Association Study

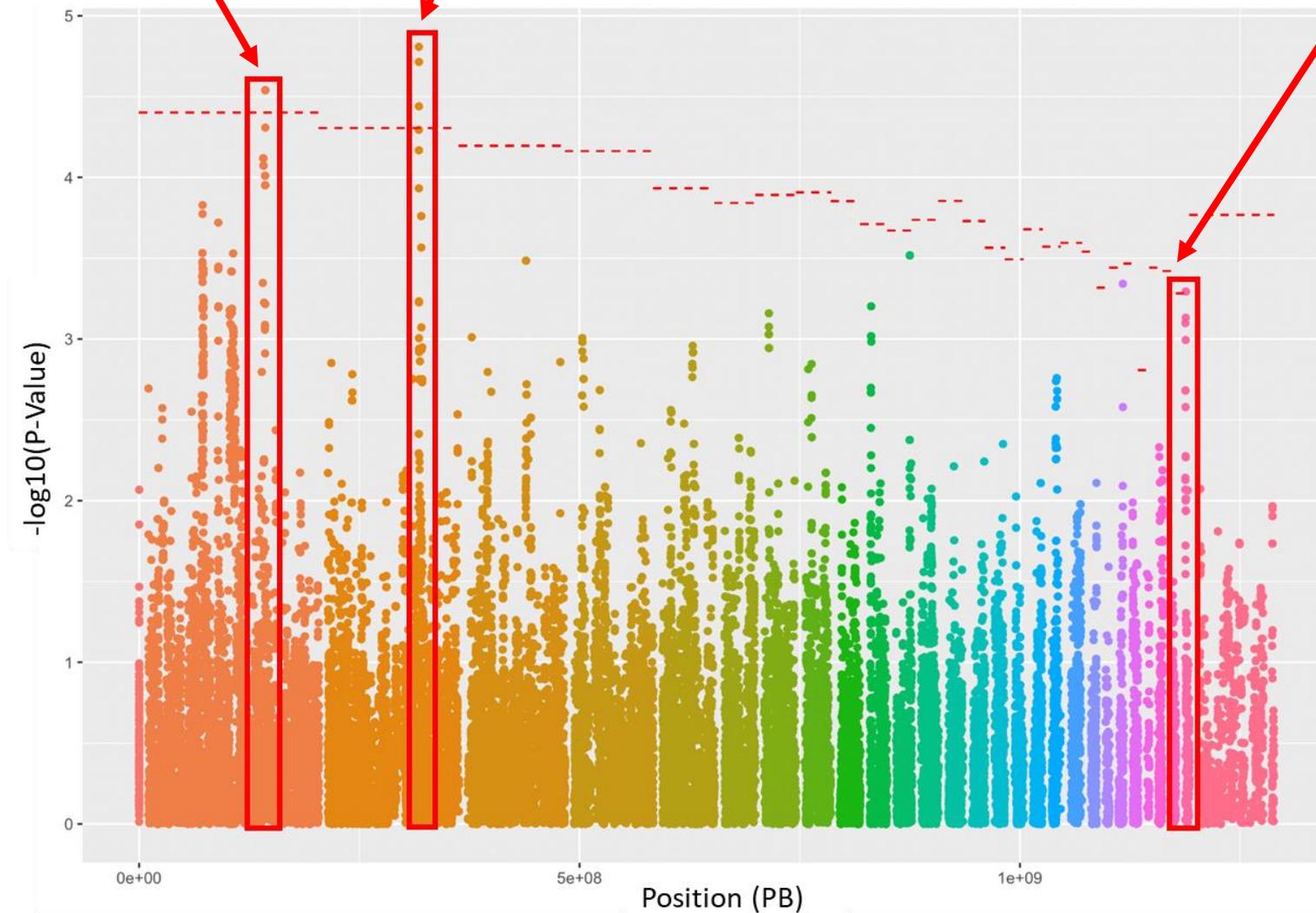
Carbohydrate sulfotransferase 10

energy metabolism
oestrogens

Long non coding RNA

RAN bind protein 3

energy metabolism



INRAE

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➤ Thanks for your attention



What is the genetic architecture of tradeoff between eggs and body reserves?

- Moderate heritability (0.31) ➔ room for genetic improvement
- Highly correlated with backfat and eggs ➔ good tradeoff trait

What is the genetic relationship between tradeoff, allocation, and the original traits?

- Not correlated with allocation coefficient ➔ LFR and α relate to different aspects of tradeoff