Genetic correlation: a heritable parameter

Beatriz C.D. Cuyabano

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Introduction

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  - Can be used to improve inferences about less routinely measured traits,
  - Part of the information to define weights of the traits in the selection index,
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  - Can be used to improve inferences about less routinely measured traits,
  - **Part of the information to define weights of the traits in the selection index,**
  - **Very important parameter when dealing with antagonistic traits.**
- Typically genetic correlation is treated as a parameter common for all individuals.

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Genetic correlations: a parameter or a latent phenotype in genetic evaluations?

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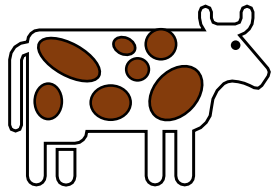
Introduction

French Montbéliarde dairy cattle



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Production x Fertility

~800k cows with records for both traits

~ 4 million animals in pedigree

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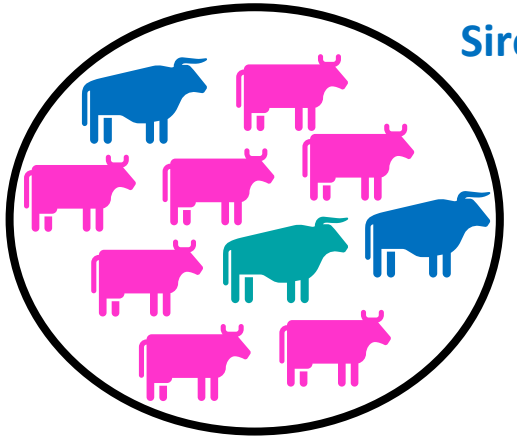

Sires with 500+ daughters

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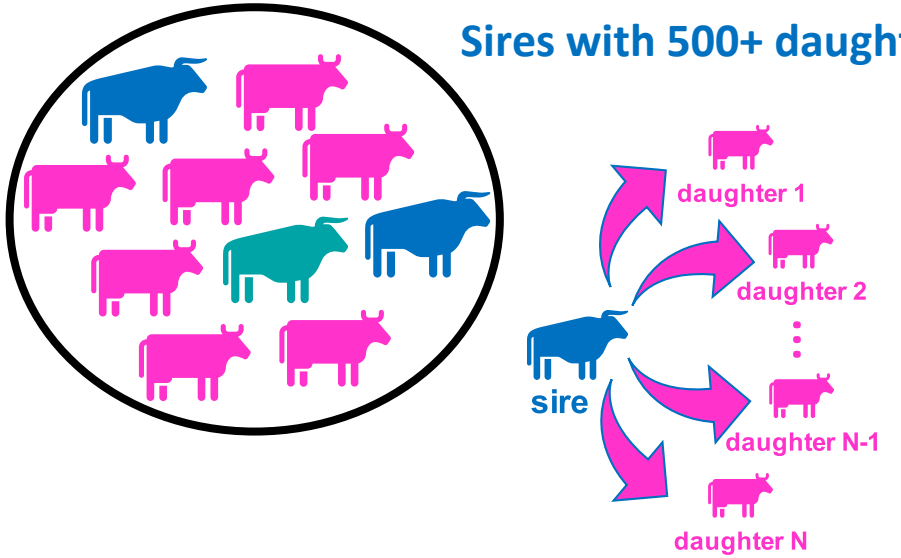

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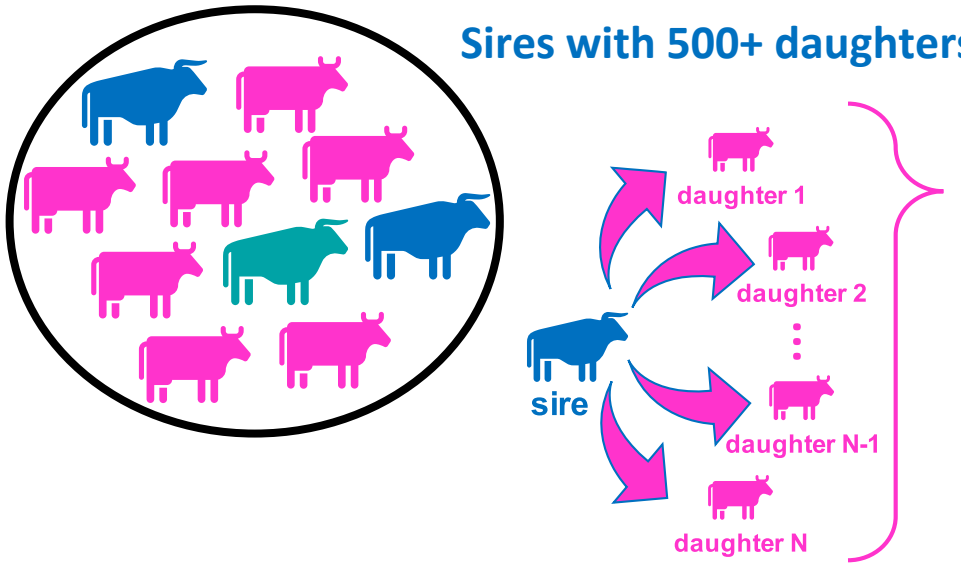

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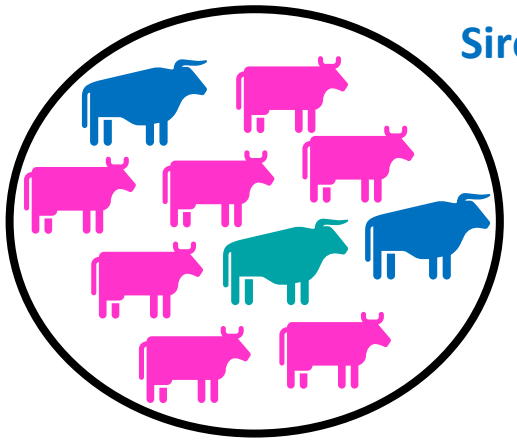

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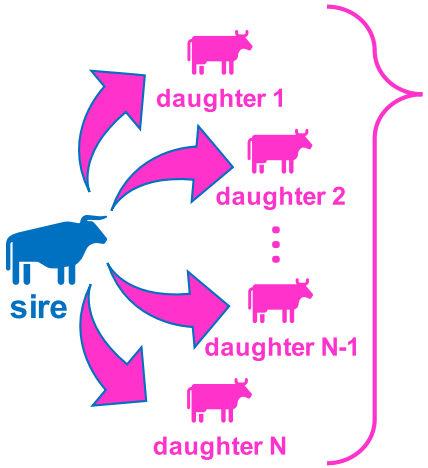

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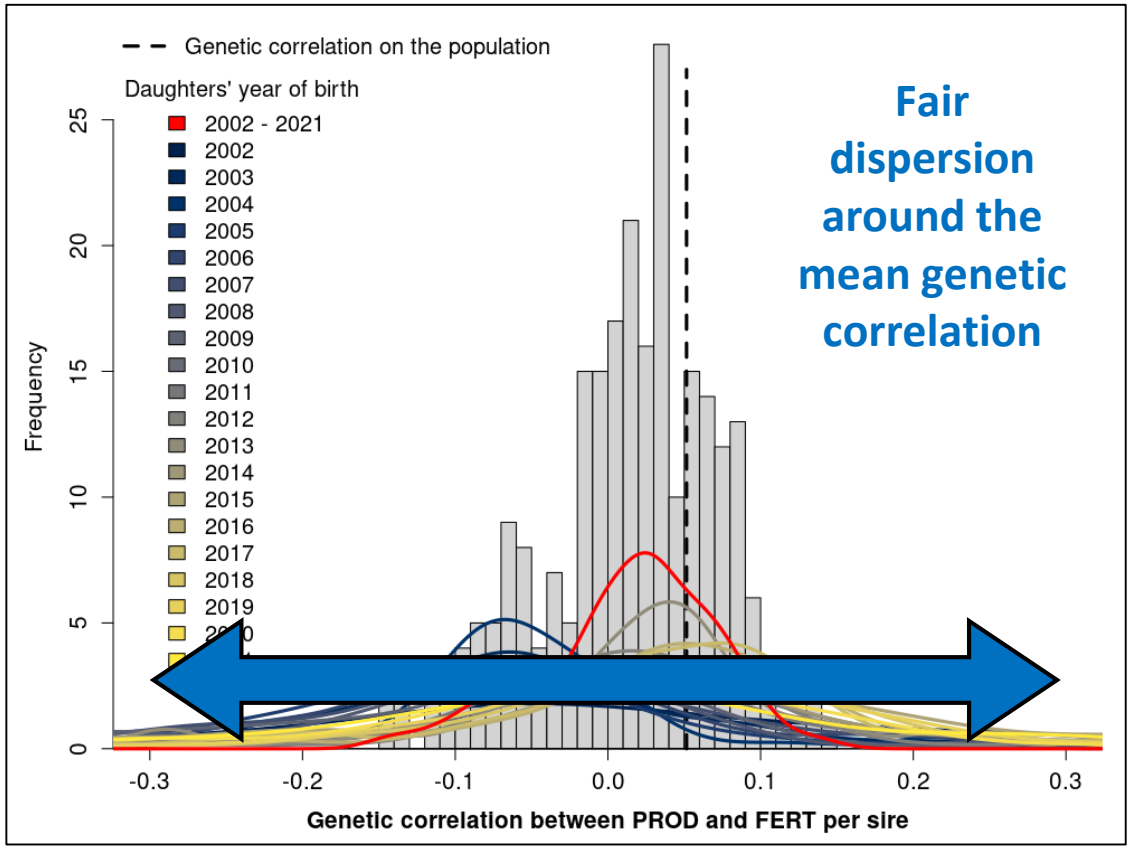

Fair dispersion around the mean genetic correlation

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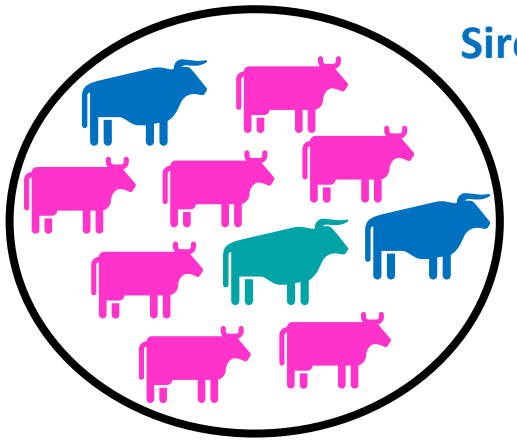

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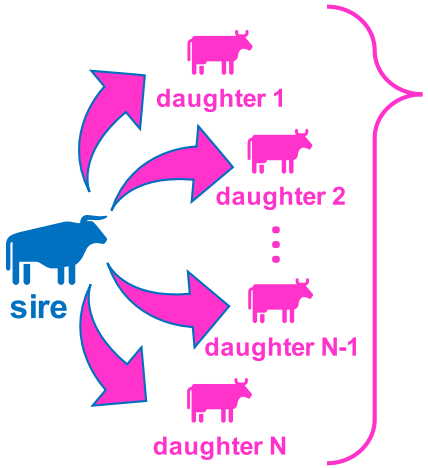

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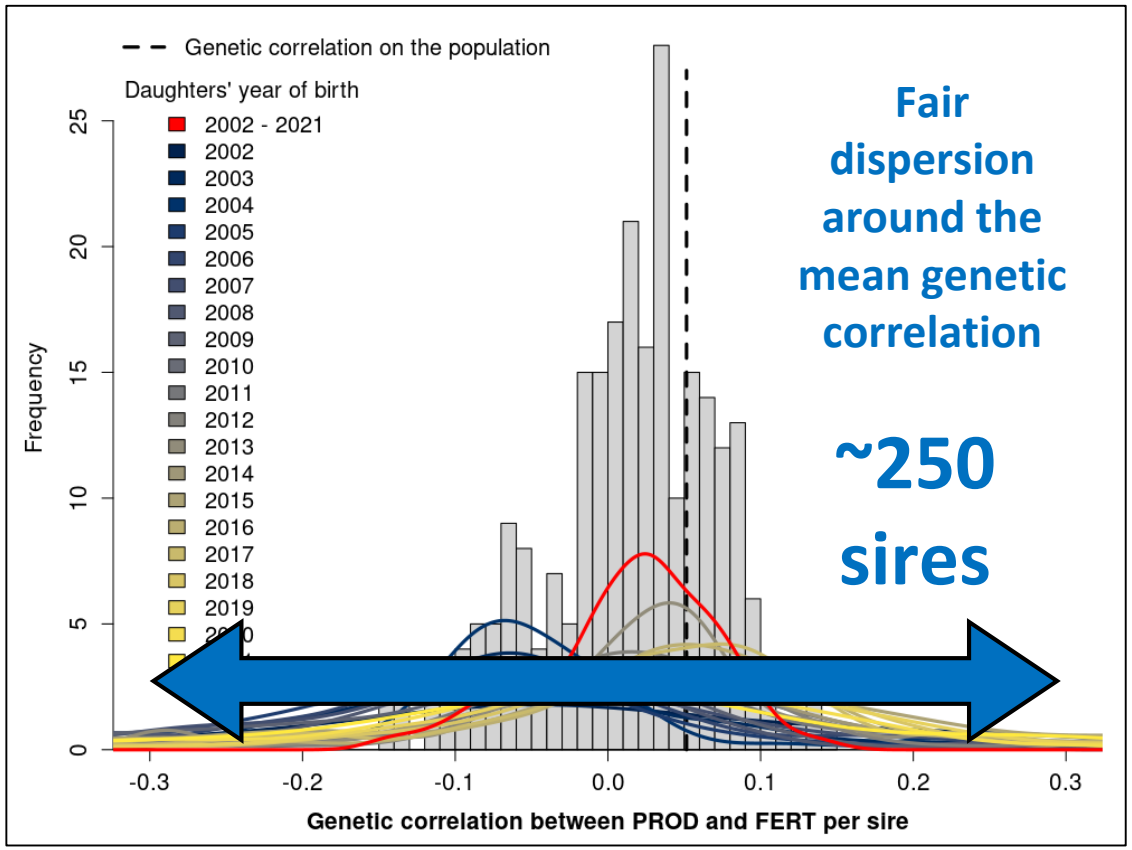
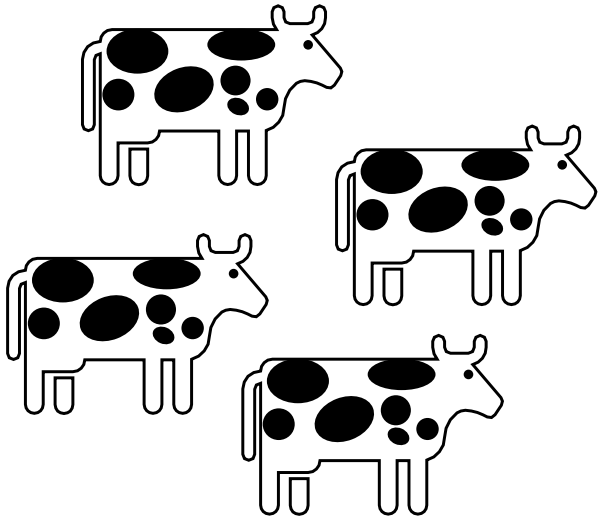


Fair dispersion around the mean genetic correlation

~250 sires

Up-scaling the study

Study on French Holstein dairy cattle



Study on French Holstein dairy cattle

- Phenotypes in the form of yield deviations:
  - Milk (MY) and protein yield (PY)
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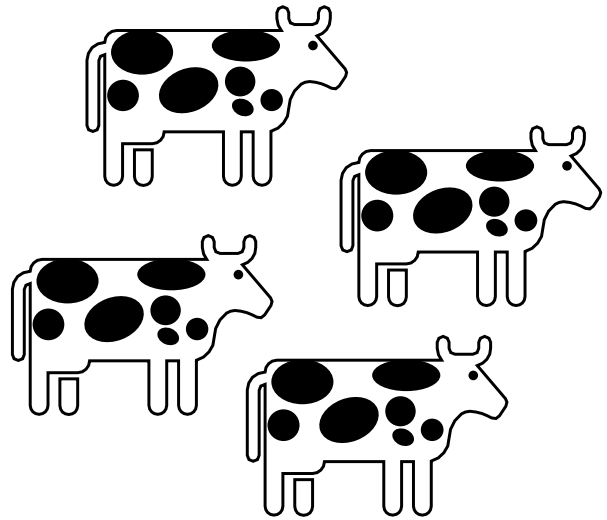

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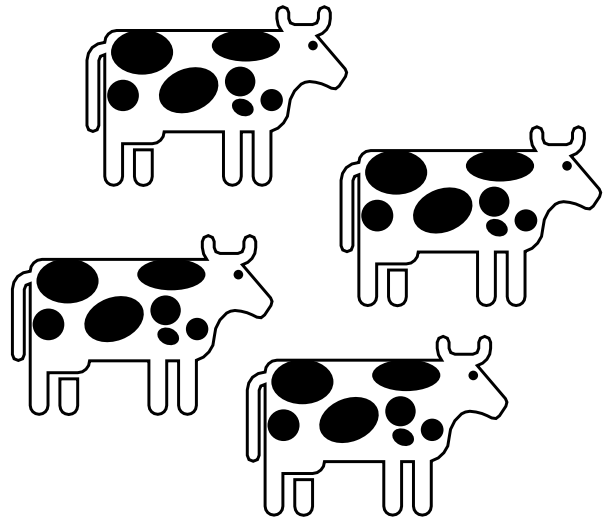

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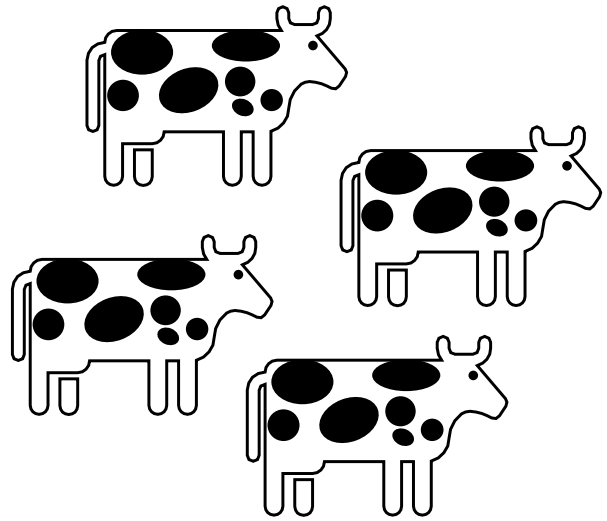

- Phenotypes in the form of yield deviations:
  - Milk (MY) and protein yield (PY)
  - Cow conception rate (CR)
- ~4.5 million cows born between 1991-2020 with complete records,
- ~8.5 million animals in pedigree. (~3,400 bulls 1991-2015)

Genetic parameters

	MY	PY	CR
MY	0.223 (0.001)	0.78 (0.05)	-0.15 (0.03)
PY		0.378 (0.001)	-0.20 (0.04)
CR			0.006 (0.002)

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Genetic correlations at the individual level

Individual-Specific Genetic Correlation

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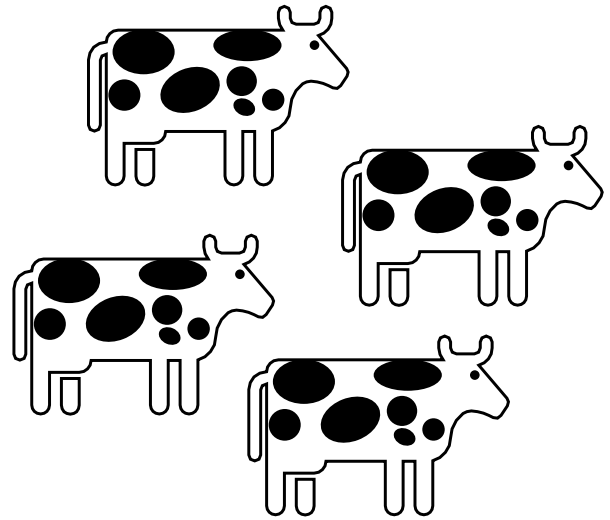

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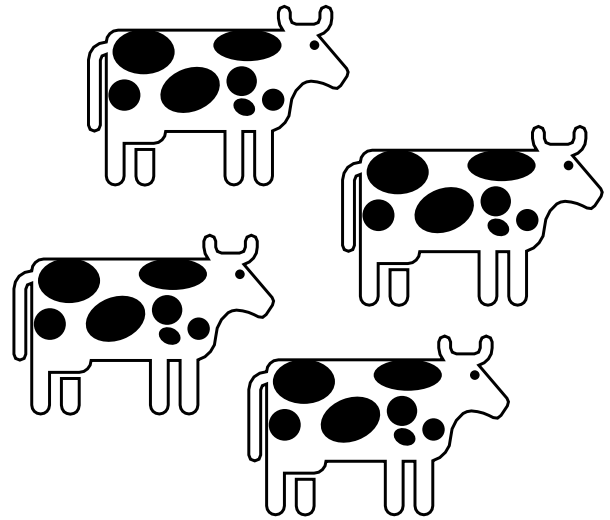
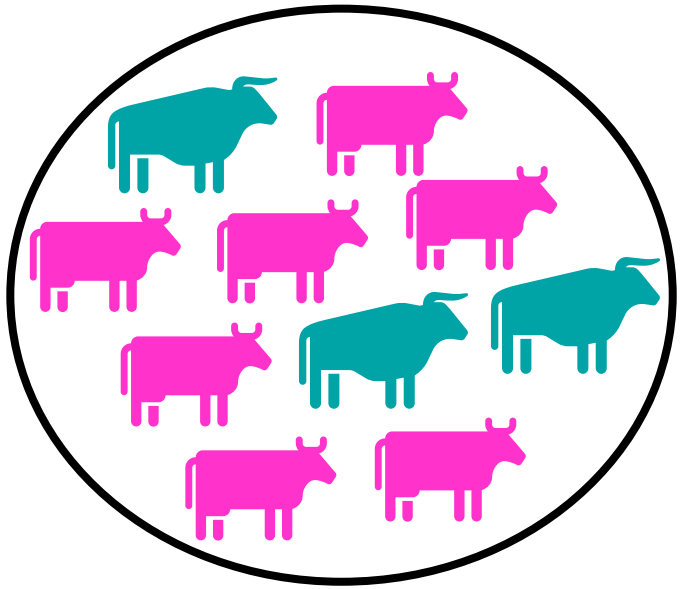


Individualized Sire Genetic Correlation

iSGC

Individual-Specific Genetic Correlation



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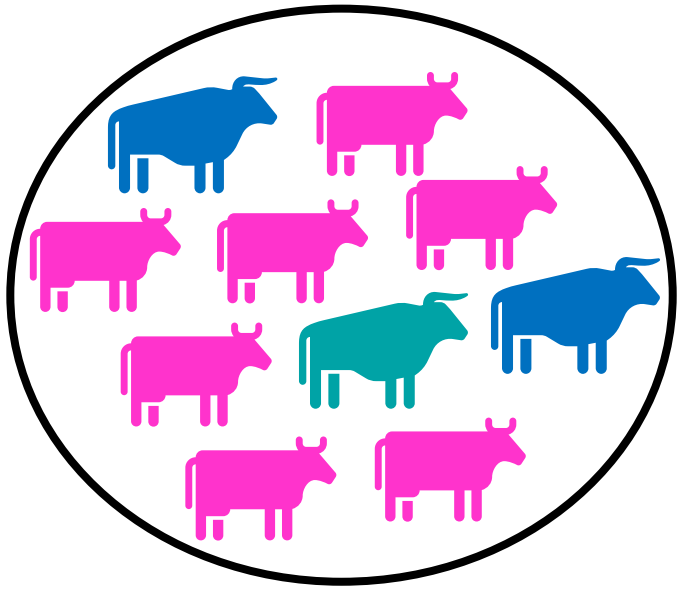
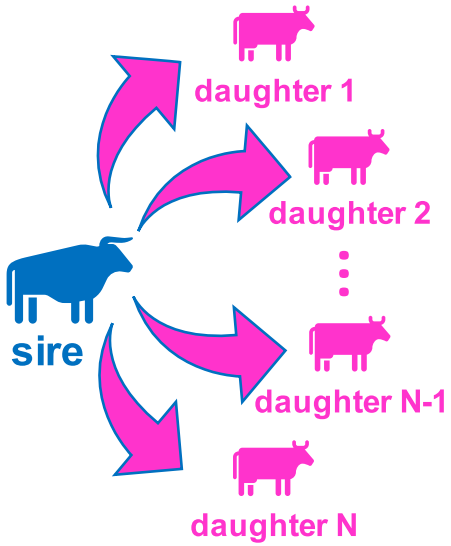


Sires with 500+ daughters



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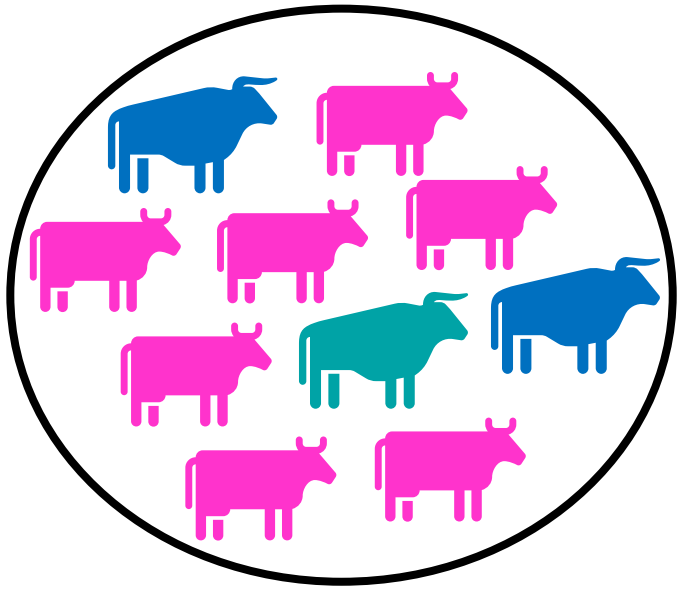

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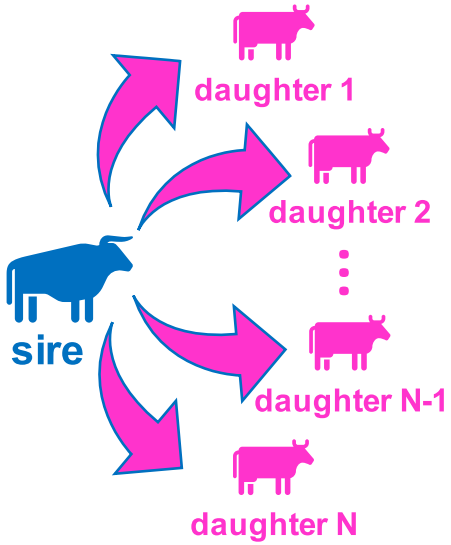

The expected daughter's breeding value is the parent-average

1. $g_{\text{trait 1}} = \frac{1}{2} g_{\text{dam,trait 1}} + \frac{1}{2} g_{\text{sire,trait 1}}$

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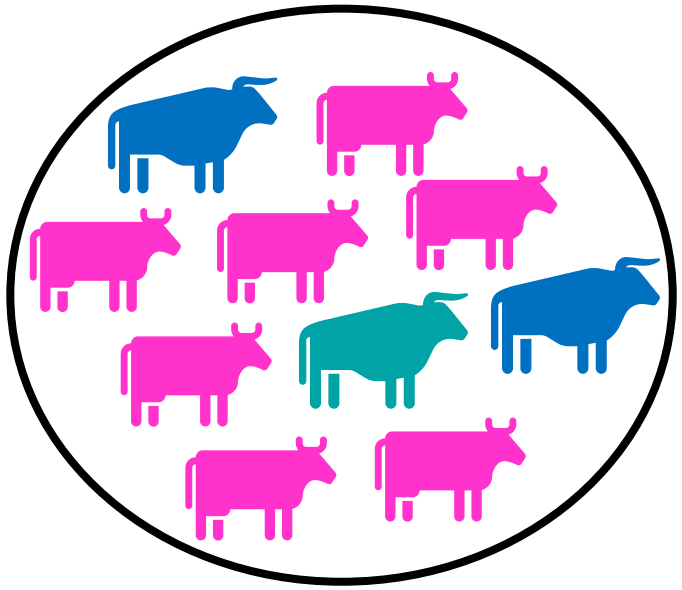

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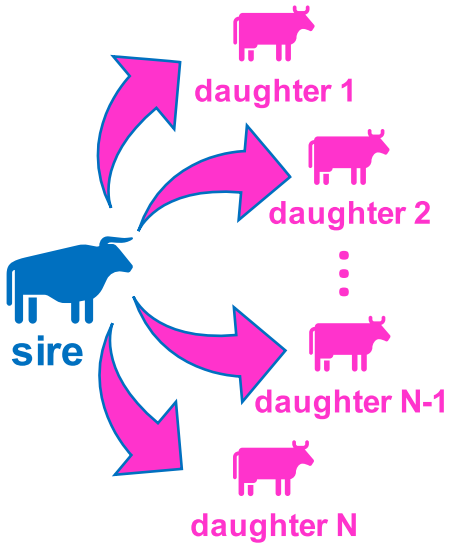

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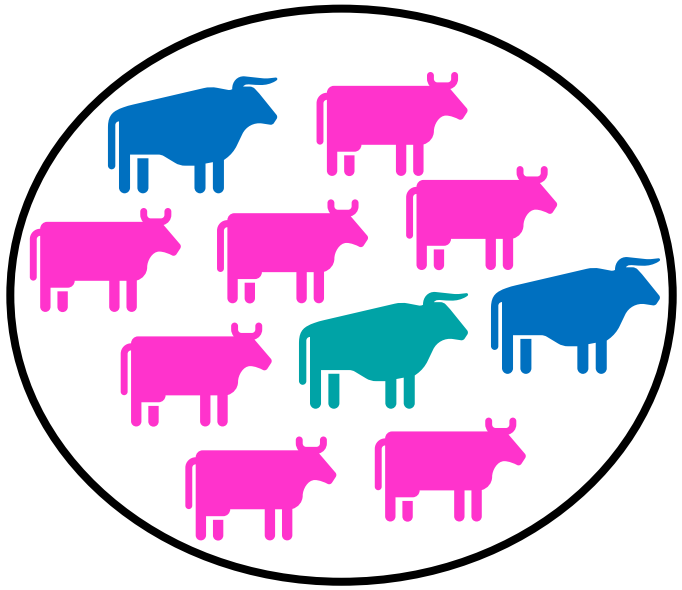
Remove maternal information from the daughters' breeding values

Individual-Specific Genetic Correlation



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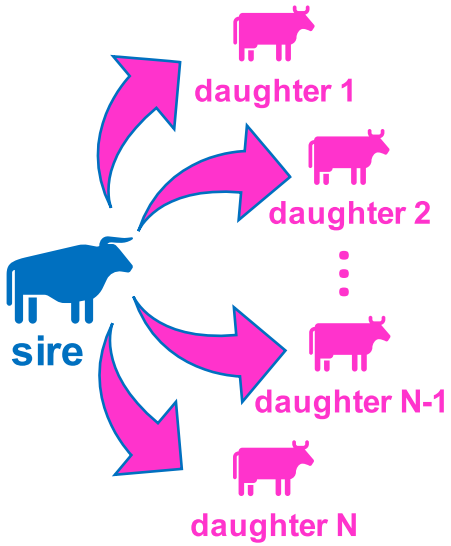

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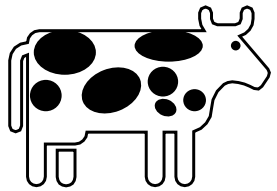
Remove maternal information from the daughters' breeding values

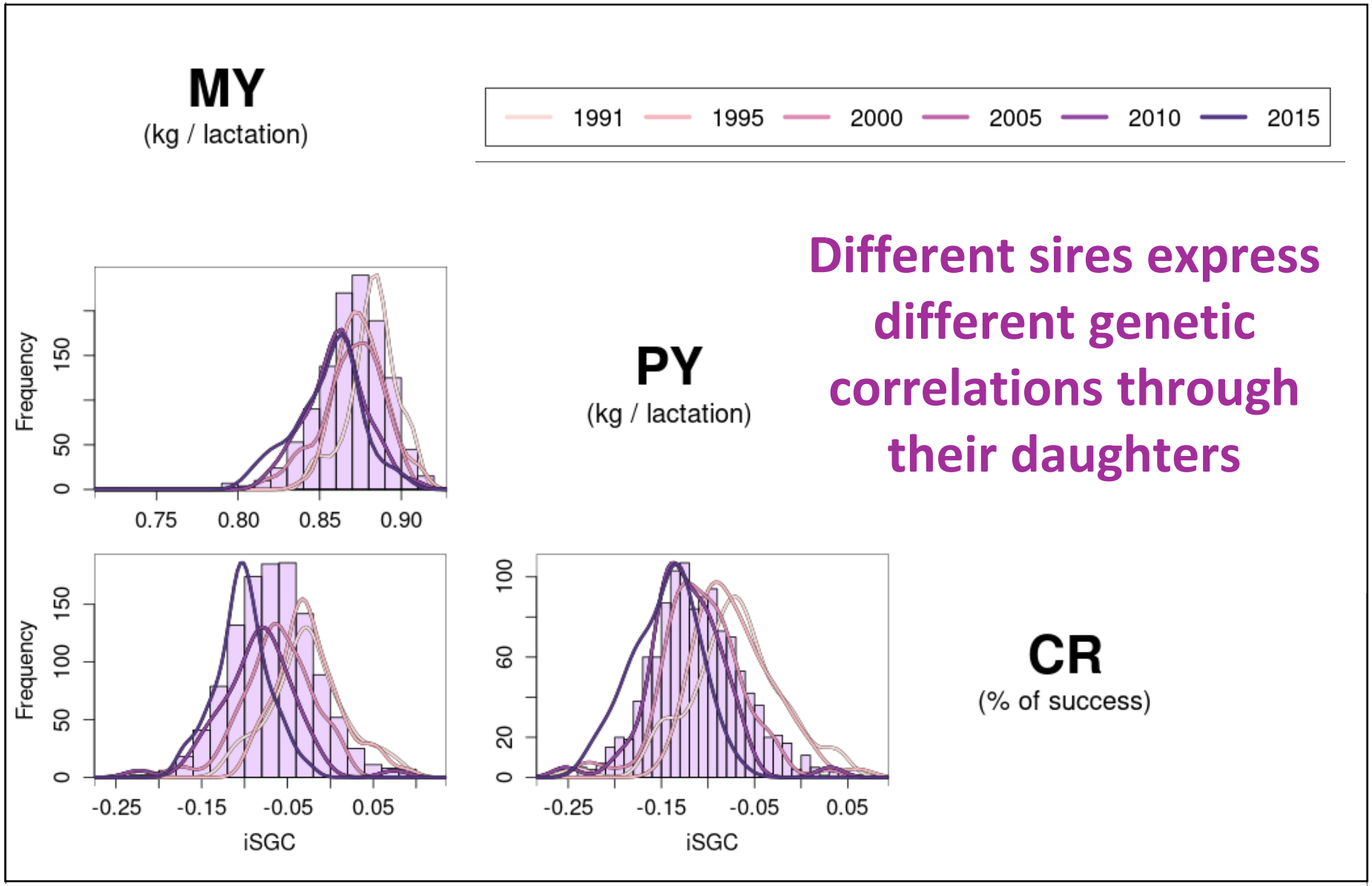
$$\text{iSGC} = \text{cor}\left(g_{\text{trait 1}} - \frac{1}{2} g_{\text{dam,trait 1}}, g_{\text{trait 2}} - \frac{1}{2} g_{\text{dam,trait 2}} \right)$$

Daughters' BV corrected for their dams expresses only the sire information

Individual-Specific Genetic Correlation

1161 sires with 500+ daughters





Different sires express different genetic correlations through their daughters

Individual-Specific Genetic Correlation

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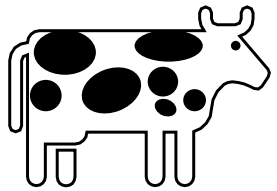

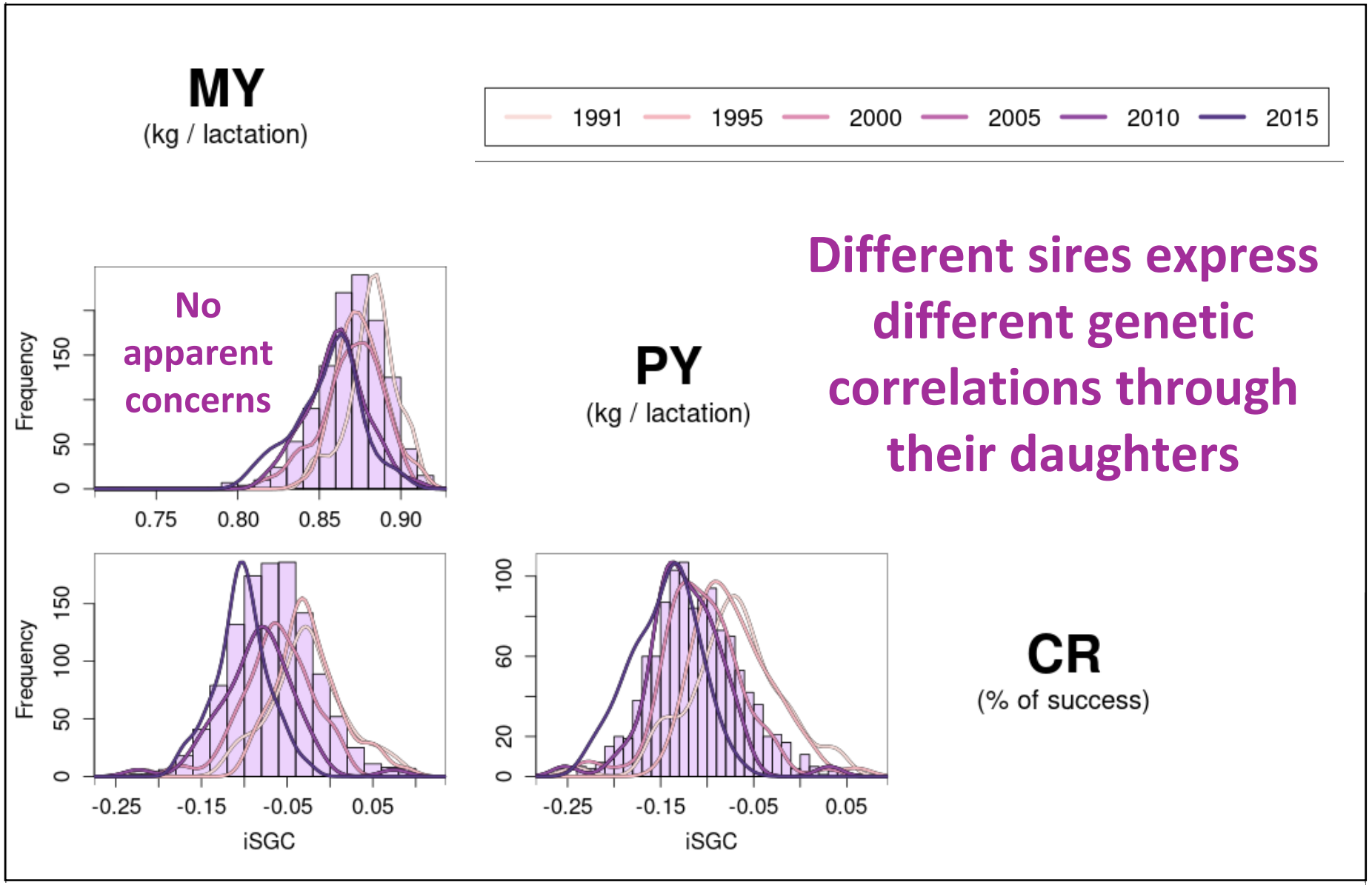

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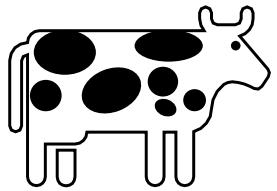

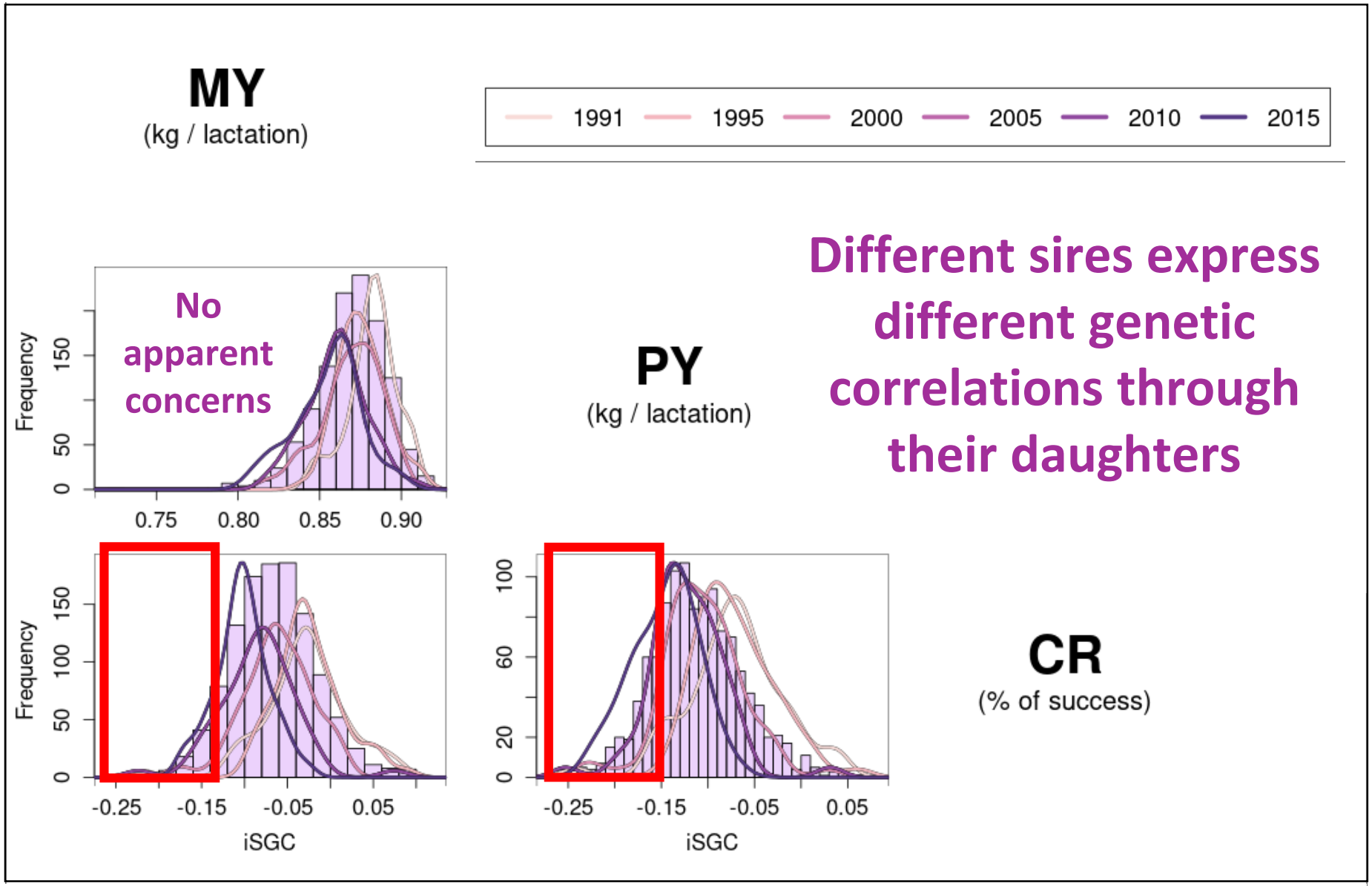

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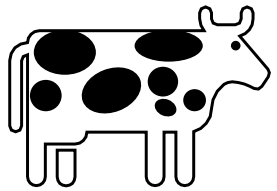

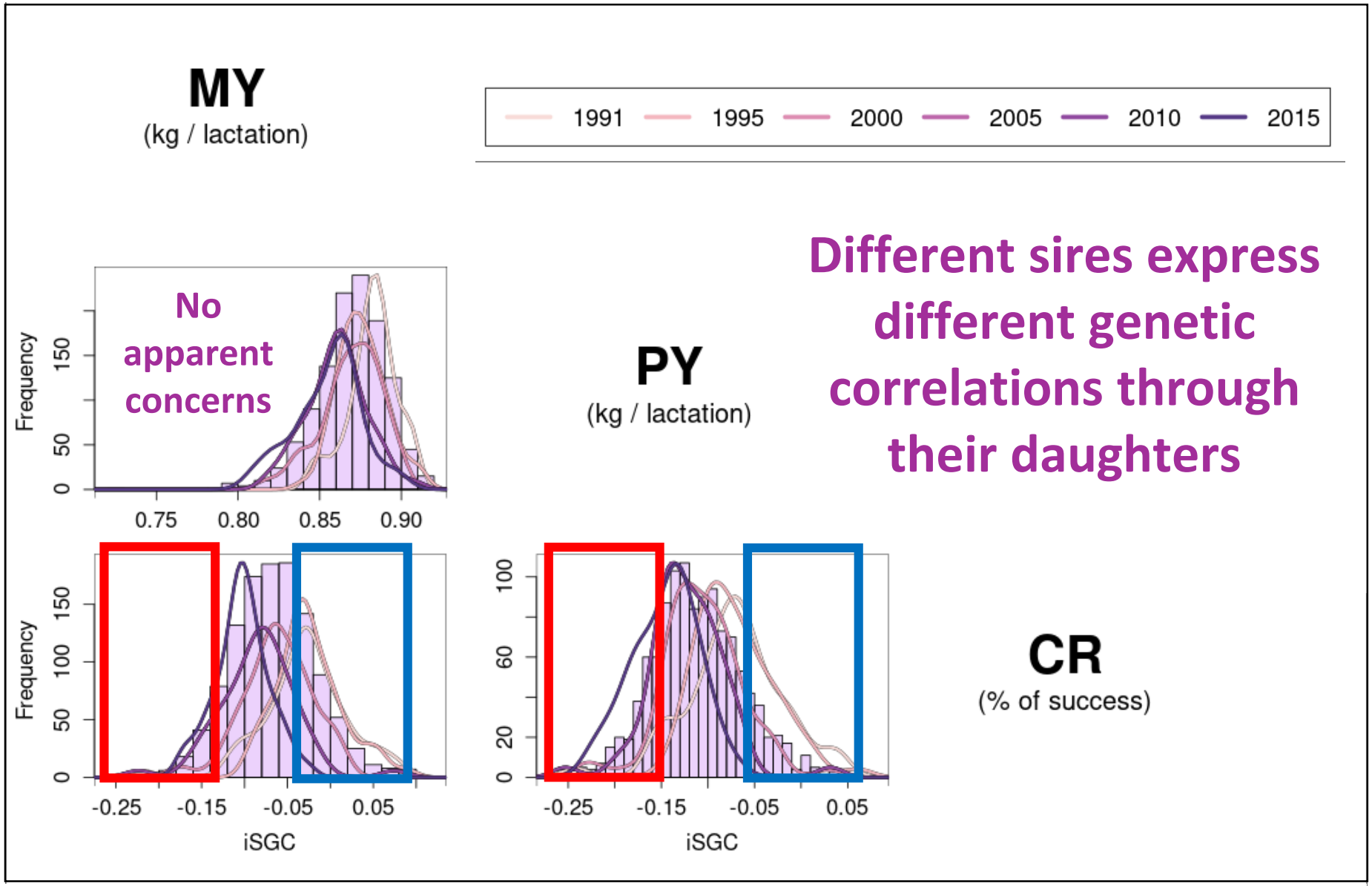

Individual-Specific Genetic Correlation

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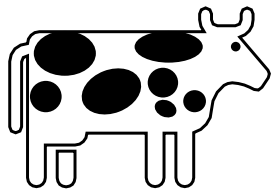

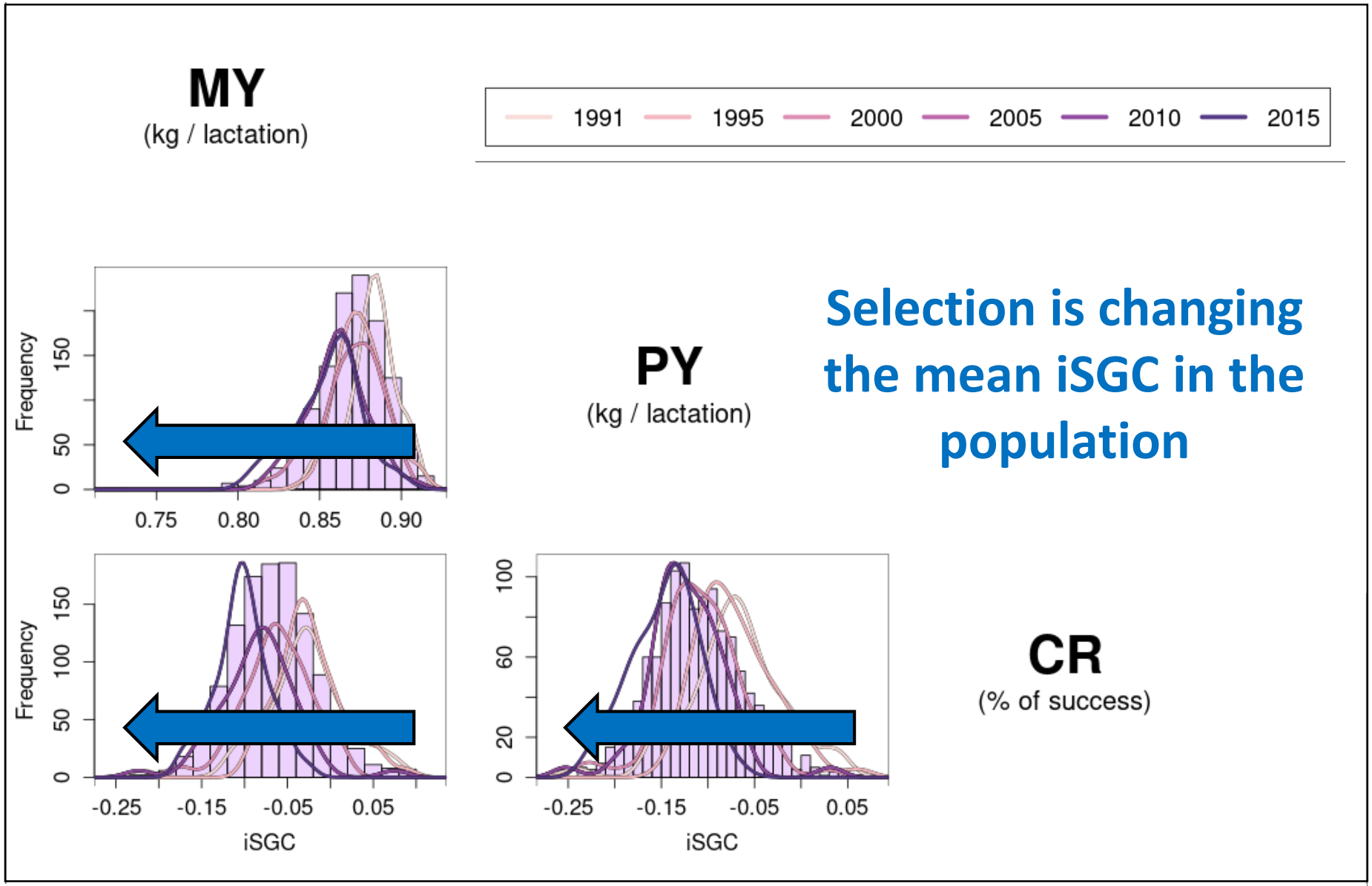

Selection is changing the mean iSGC in the population

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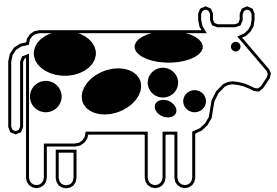
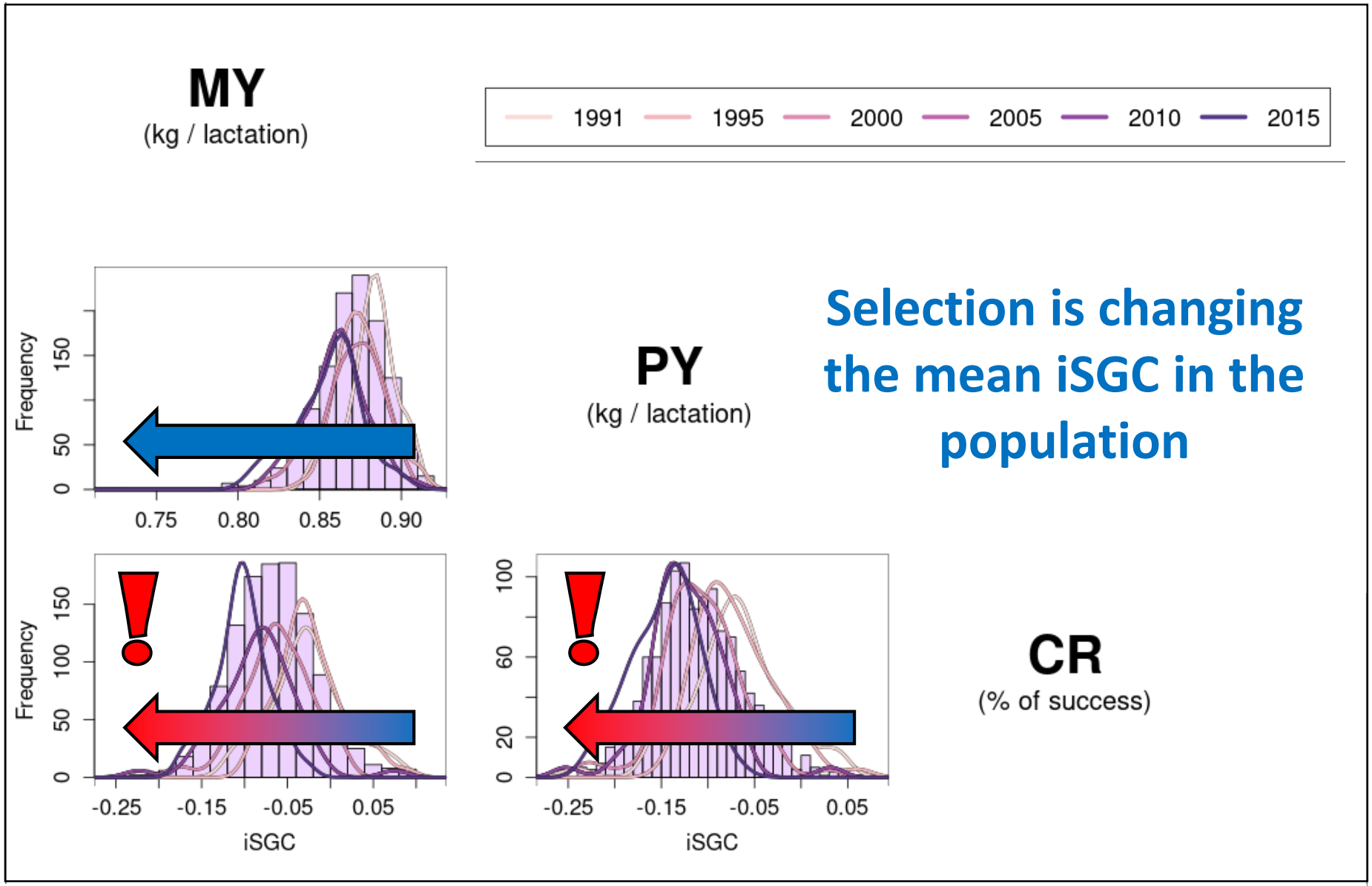




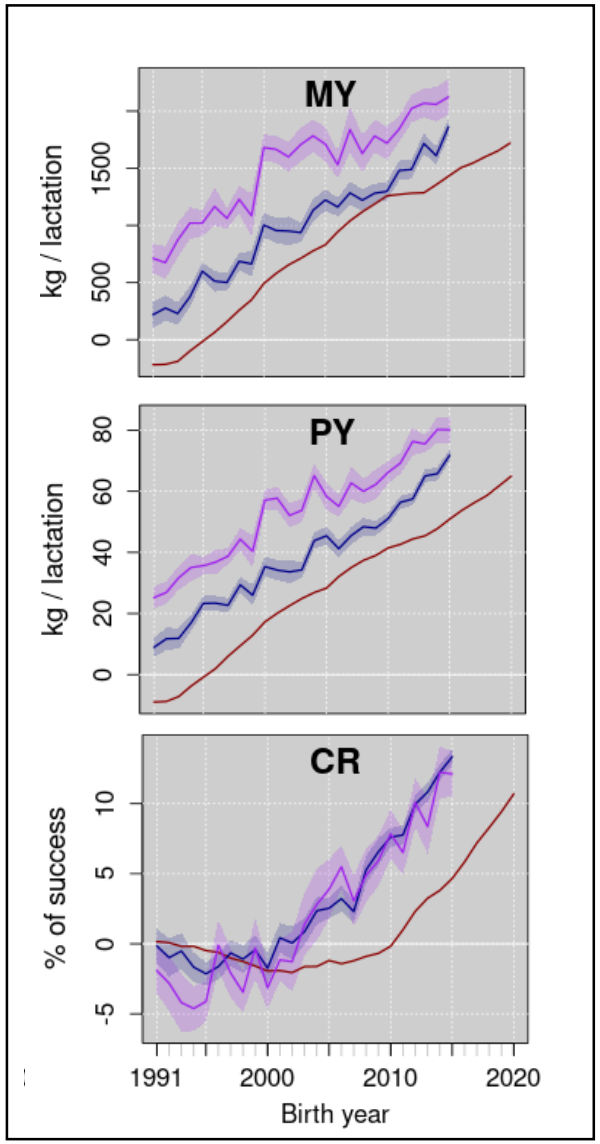
Genetic progress

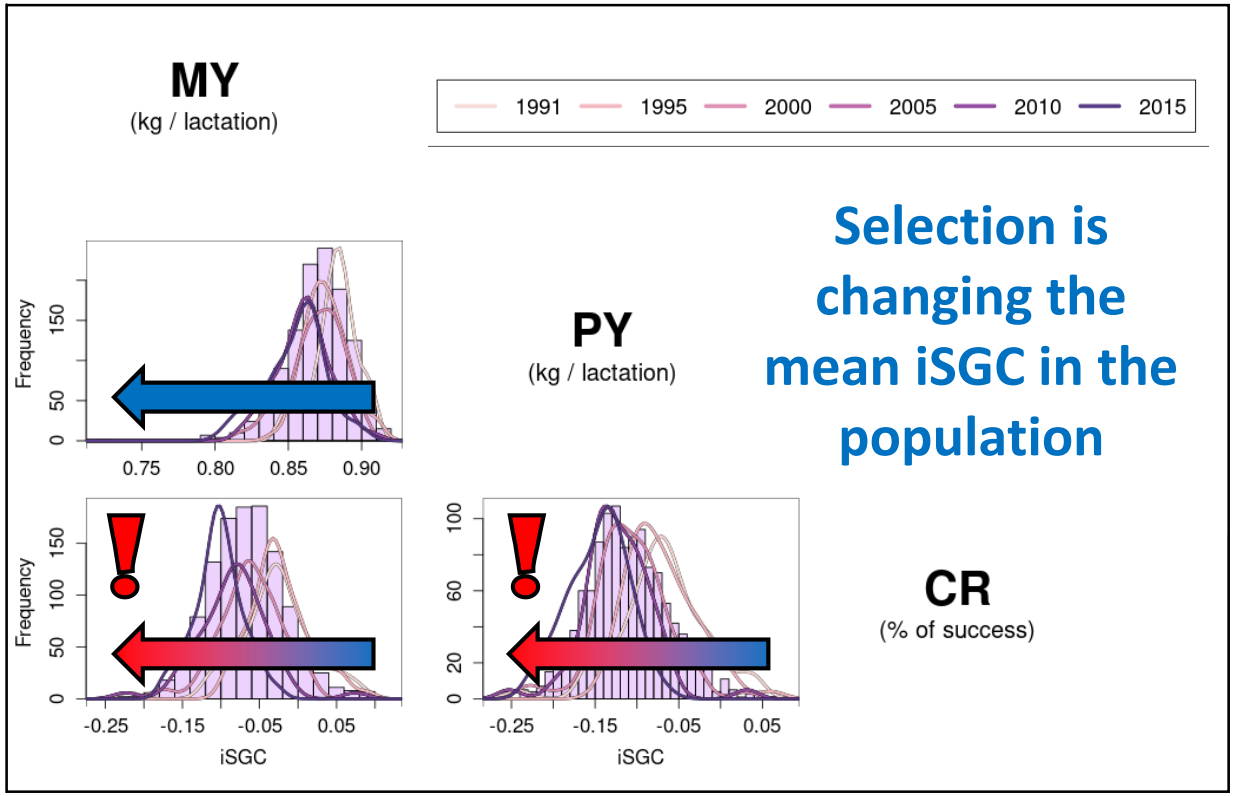
Genetic progress

Bulls

Cows

Sires with 500+ daughters





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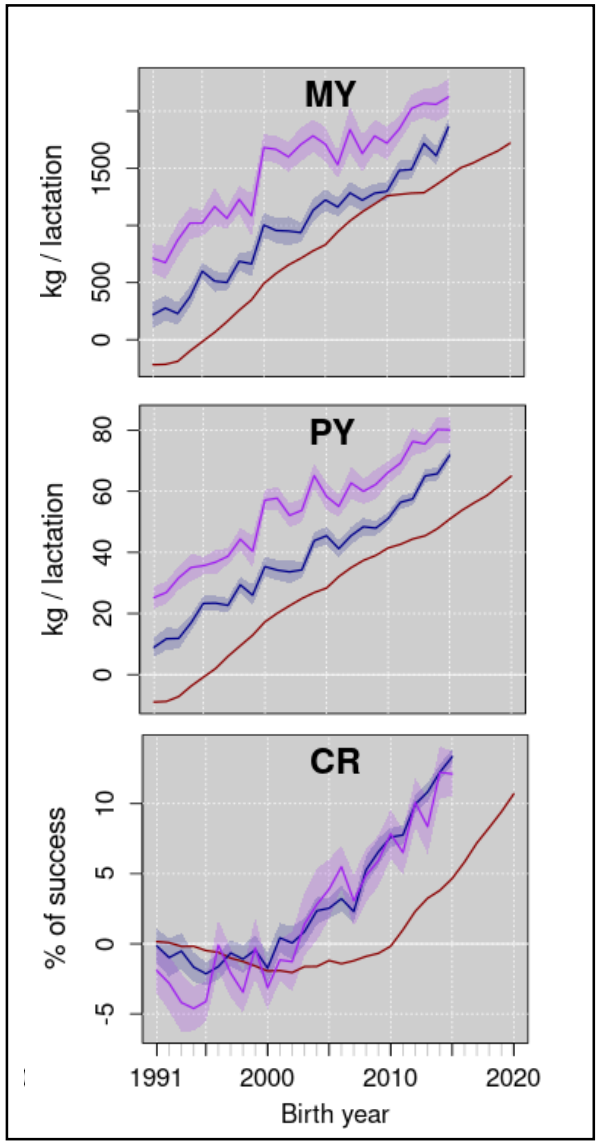

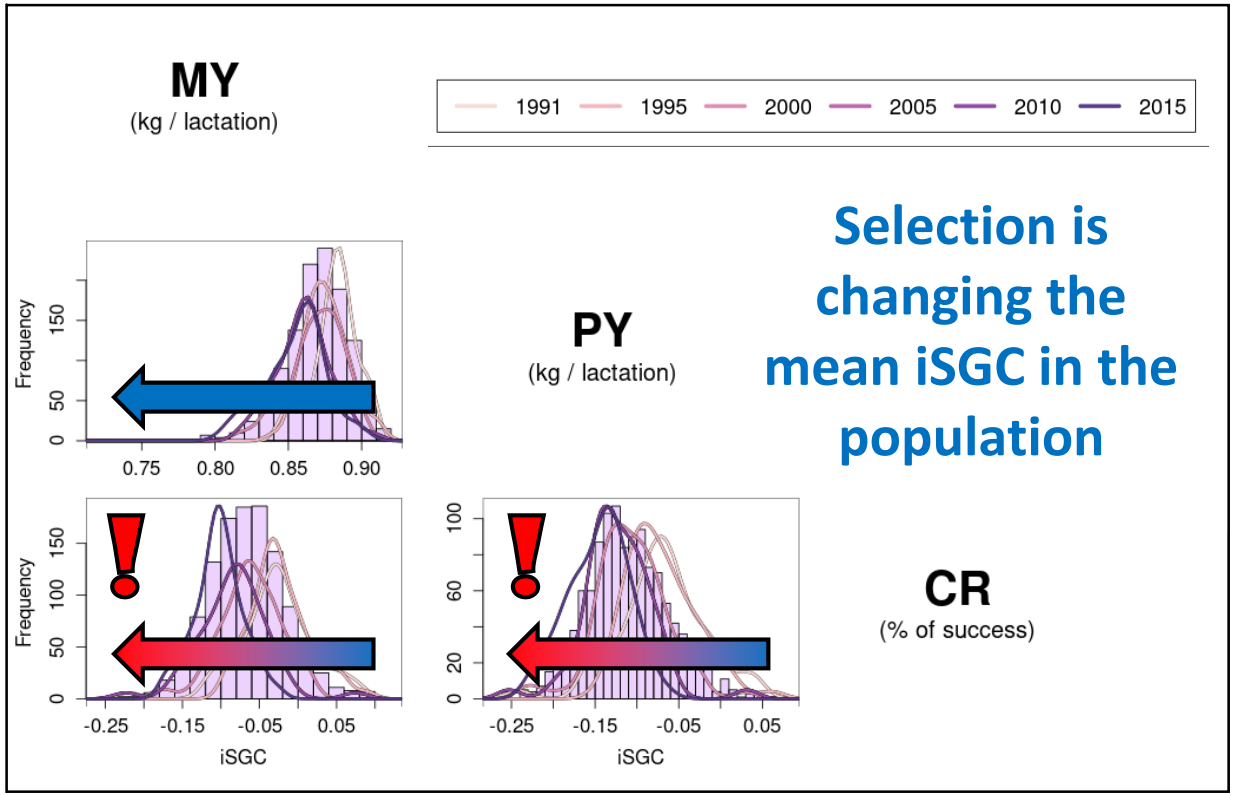

Positive genetic progress does not imply that we are breaking the genetic correlation between traits

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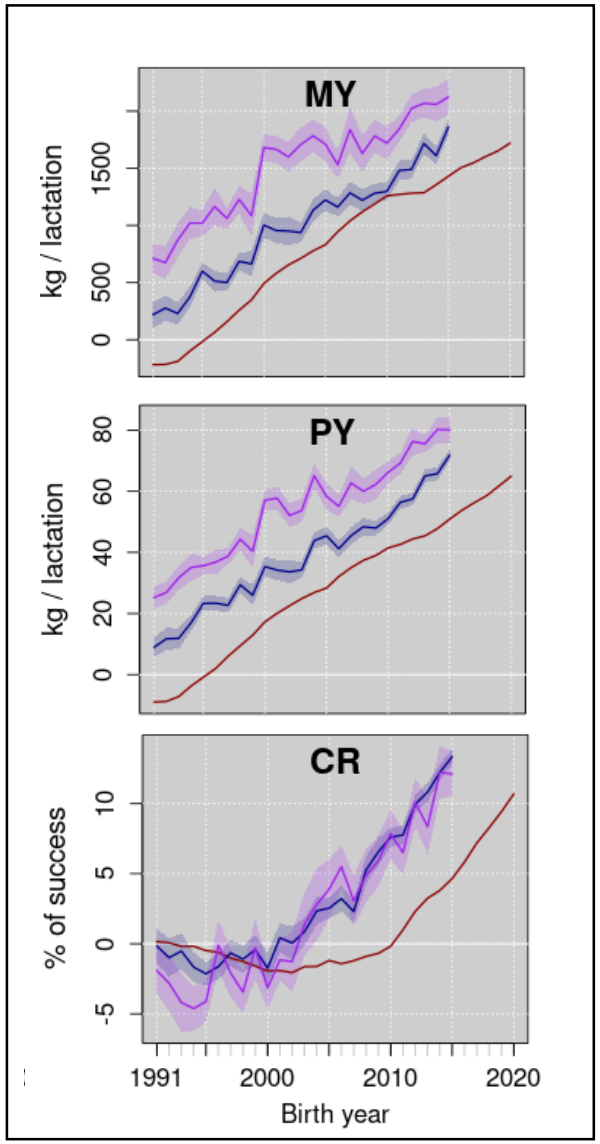

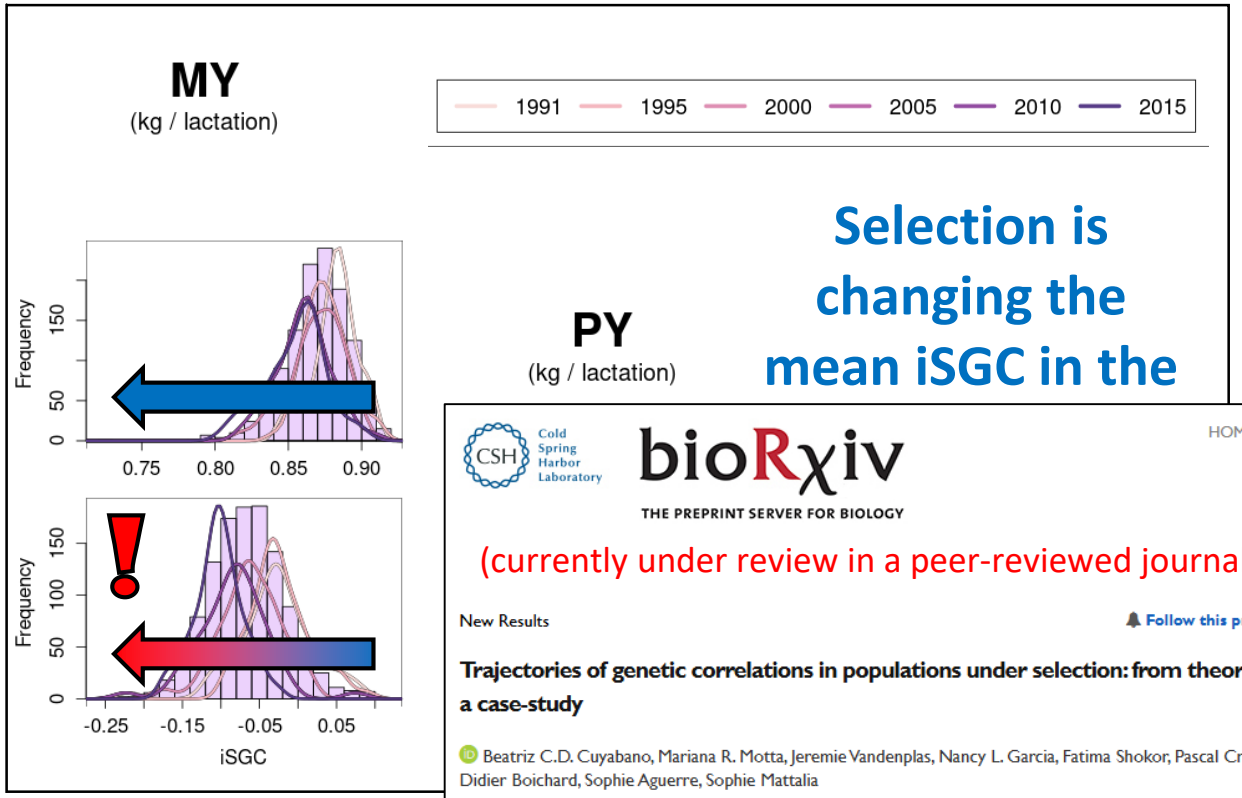

Selection is changing the mean iSGC in the

Genetic correlations in populations under selection:

\+ ↘ always

\- ↘ ↗ → depending on the weights in the selection index

Could we select for less negative genetic correlations?

A heritable parameter

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- Variance component estimation on the iSGCs:
  - iSGC treated as the trait of interest,
  - 1161 sires with 500+ daughters, to whom iSGC were calculated,
  - Pedigree tracing back four generations for each one of the sires: 5,811 animals.

A heritable parameter

	MY	PY	CR
MY	0.223 (0.001)	0.78 (0.05)	-0.15 (0.03)
PY		0.378 (0.001)	-0.20 (0.04)
CR			0.006 (0.002)

Genetic parameters

A heritable parameter

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Genetic parameters

$$h^2_{iSGC}$$

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Genetic parameters

h^2_{iSGC}

iSGCs are heritable!

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Thank you for your attention!


OXBOW

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