Female Inclusive MACE for Improved Genetic Evaluations in Small Populations: A Special Case for Ayrshire Dairy Herds

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About me

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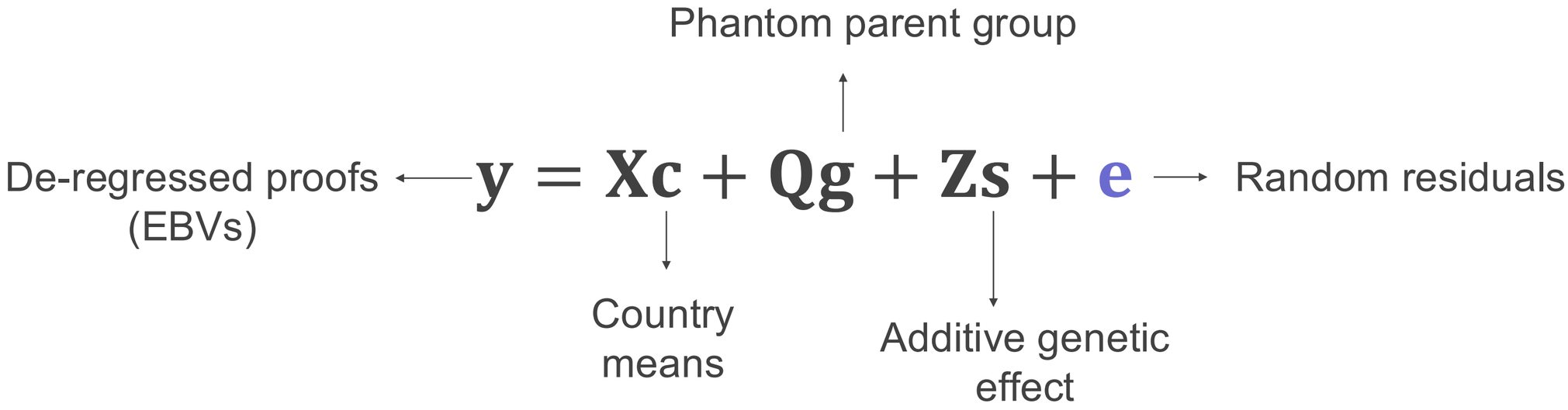
Outline

- Background on the current MACE
- Females in MACE: the case of Ayrshire
- Research objectives
- Current status
- Implementation
- Key research areas
- Overview

Current MACE Methodology

The MACE method is a **multi-trait animal model** that takes the form below



The international predicted genetic merits is formed by the sum of the solutions, the phantom parent group, and the country effects.

Schaeffer, 1994

MACE: Multiple Across Country Evaluations

BREED GROUPS

Holstein

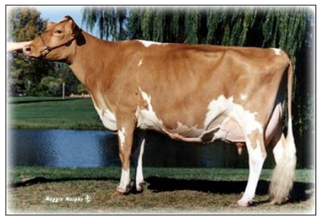
Jersey

Guernsey

Red Dairy Cattle

Brown Swiss

Simmental



TRAIT GROUPS

- Production (3 traits: milk, protein, fat)
- Conformation (38 traits)
- Udder health (2 traits)
- Longevity (1)
- Calving (5)
- Female fertility (4)
- Workability (2)

Ayrshire Dairy Herds: A Special Case

Ayrshire

Moderate-sized breed, valued for *adaptability* and *milk quality*

Why Ayrshire:

Investigate the opportunity for international collaboration to increase the accuracy of genetic evaluations for Ayrshire across multiple countries

Benefits:

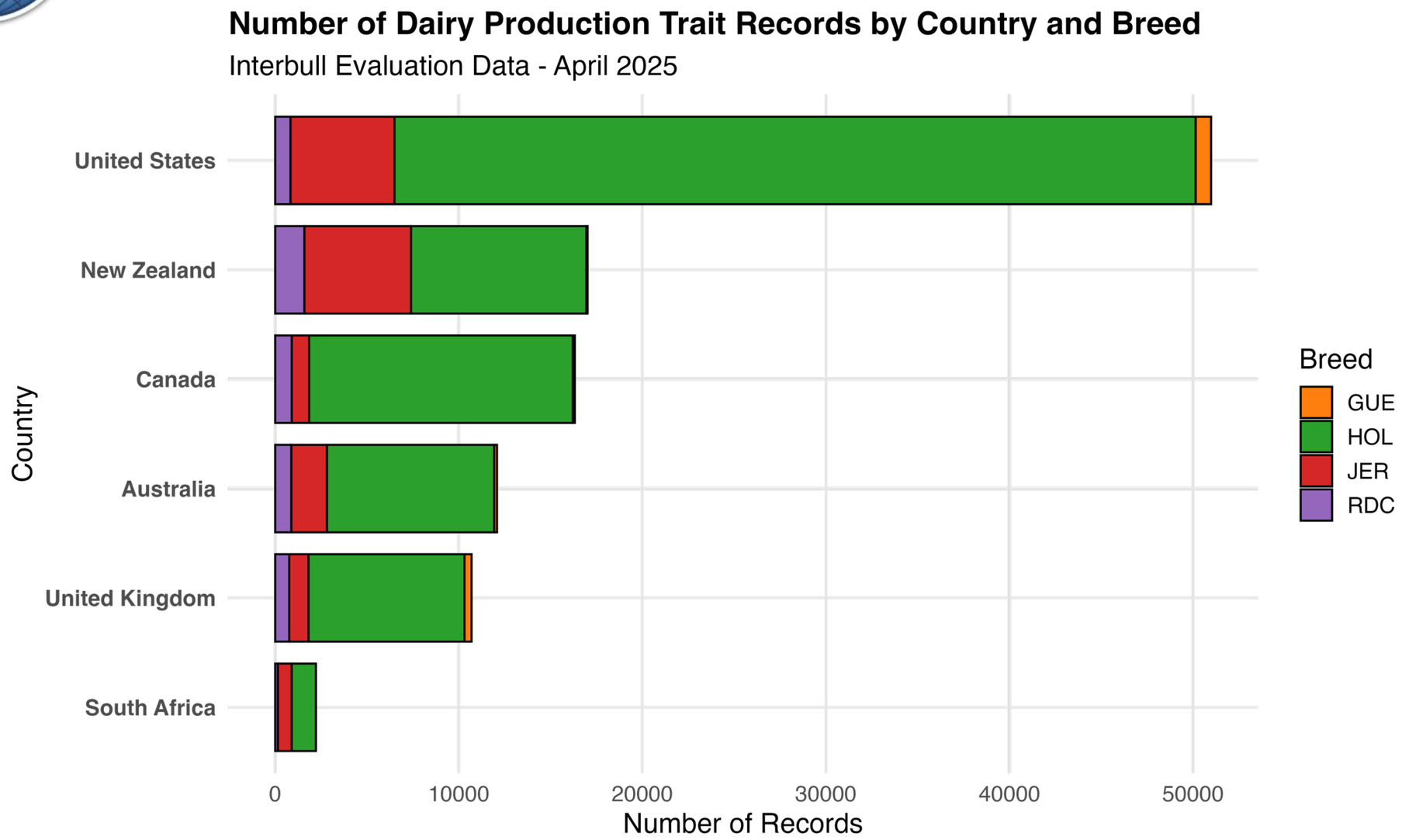
- Adding cow data would increase and allow faster growth of the current reference population
- Maximize the benefit from genotyping cows
- Reliability gains over time for both national and international genetic and genomic evaluations

Objectives

Inclusion of cows in MACE

- Modify the current MACE pipeline to allow countries to submit national EBVs including cows
- Use Interbull's platforms for sharing Ayrshire data among participating countries
- Provide both female and male MACE outputs to participating countries

Current Status



Source: Interbull centre

Current Status

Number of genotyped “Ayrshire” animals by country

Country	Female	Male	Total
Canada	8,670	1,806	10,476
United States	3,107	1,973	4,180
South Africa	2,761	19	2,780
New Zealand	2,105	41	2,146
United Kingdom	1,175	468	1,643
Australia	1,062	96	1,158
Columbia	N/A	N/A	N/A
TOTAL	**18,880**	**4,403**	**22,383**

Source: Brian Van Doormaal, 2024

Current Status

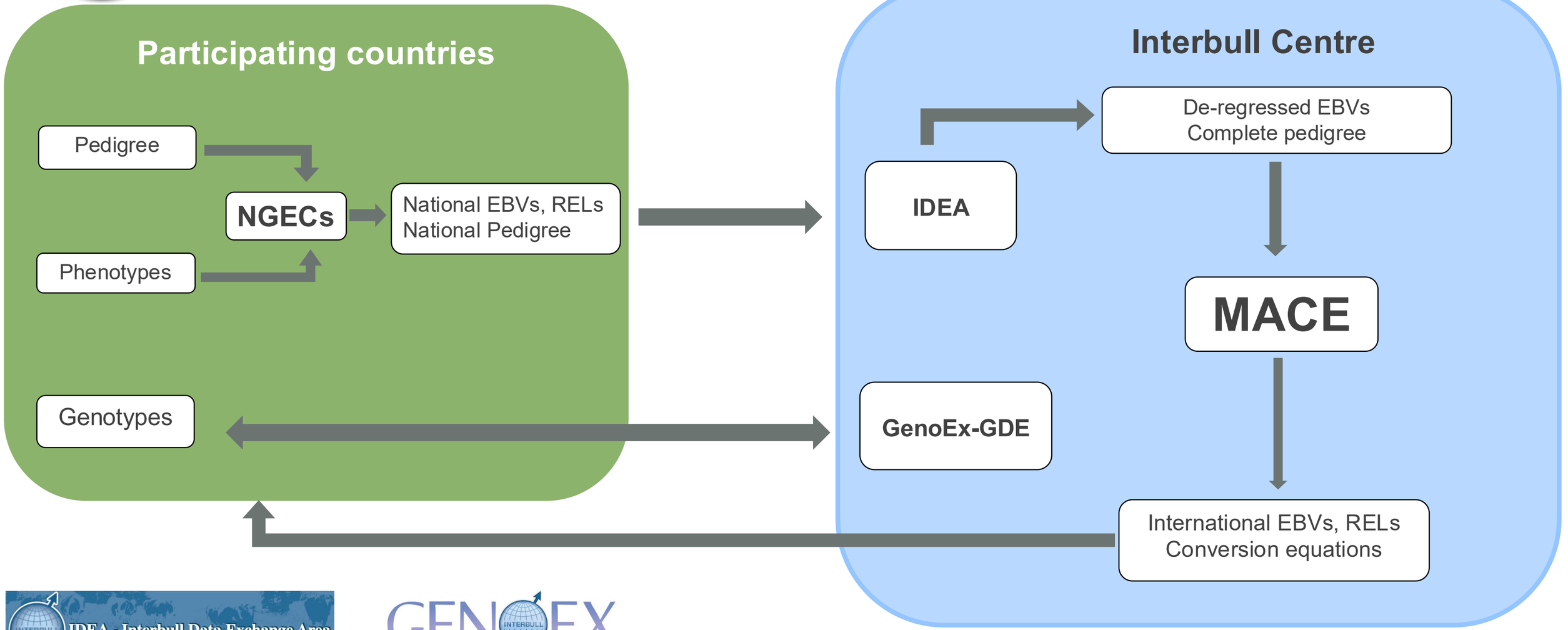
International Ayrshire genotypes by year of birth and sex as of 2024

Birth Year	Male		Female		Total
	No	Group	No	Group	
2023	94	Young 1,228	628	Young 2,759	722
2022	308		2,131		2,439
2021	270		2,493	Reference 18,830	2,763
2020	310		2,555		2,865
2019	246		2,094		2,340
2018	204	Reference 2,980	1,740		1,944
2017	242		1,329		1,571
2016	229		1,388		1,617
2015	241		1,425		1,666
2014	233		1,232		1,465
2013	216		1,007		1,223
2012	233		880		1,113
2011	116		618		734
2010	90		428		518
<2010	1,104		1,641		2,745

Source: Brian Van Doormaal, 2024

Females in MACE

Implementation



IDEA - Interbull Data Exchange Area
Start page | Help

GENOEX
International Genotype Exchange Platform

Research Areas

☑ Research agreement and data call

Required changes

✓ Modification of IDEA's Fortran program

Research Areas

Technical Issues to Investigate

- ✓ Minimum cow requirements;
  - Number of progeny
  - Reliability of cow EBV.
  - Number of herds
  - Status of the cow
- ✓ Best method to de-regress cow EBVs for MACE
- ✓ Possible bias, double counting
- ✓ Changes in reliability

$$\mathbf{y} = \mathbf{Xc} + \mathbf{Qg} + \mathbf{Z}(\mathbf{d} + \mathbf{s}) + \mathbf{e}$$

cows + bulls

Current Progress

BASIC STATISTICS FOR THE EVALUATIONS

Year	Observations		Minimum		Maximum		Mean		Stand. Dev.	
	PRV	CUR	PRV	CUR	PRV	CUR	PRV	CUR	PRV	CUR
2015	1	1	91.112	********	91.112	********	91.112	********	0.000	0.000
2016	1	1	-127.425	-0.000	-127.425	-0.000	-127.425	0.000	0.000	0.000
2017	2	2	704.847	358.000	992.740	424.000	848.794	391.000	203.571	46.669

BASIC STATISTICS FOR THE PROVIDED COW RELIABILITIES

Year	Observations		Minimum		Maximum		Mean		Stand. Dev.	
	PRV	CUR	PRV	CUR	PRV	CUR	PRV	CUR	PRV	CUR
2015	1	1	0.758	0.758	0.758	0.758	0.758	0.758	0.000	0.000
2016	1	1	0.693	0.000	0.693	0.000	0.693	0.000	0.000	0.000
2017	2	2	0.716	0.736	0.772	0.777	0.744	0.756	0.040	0.029

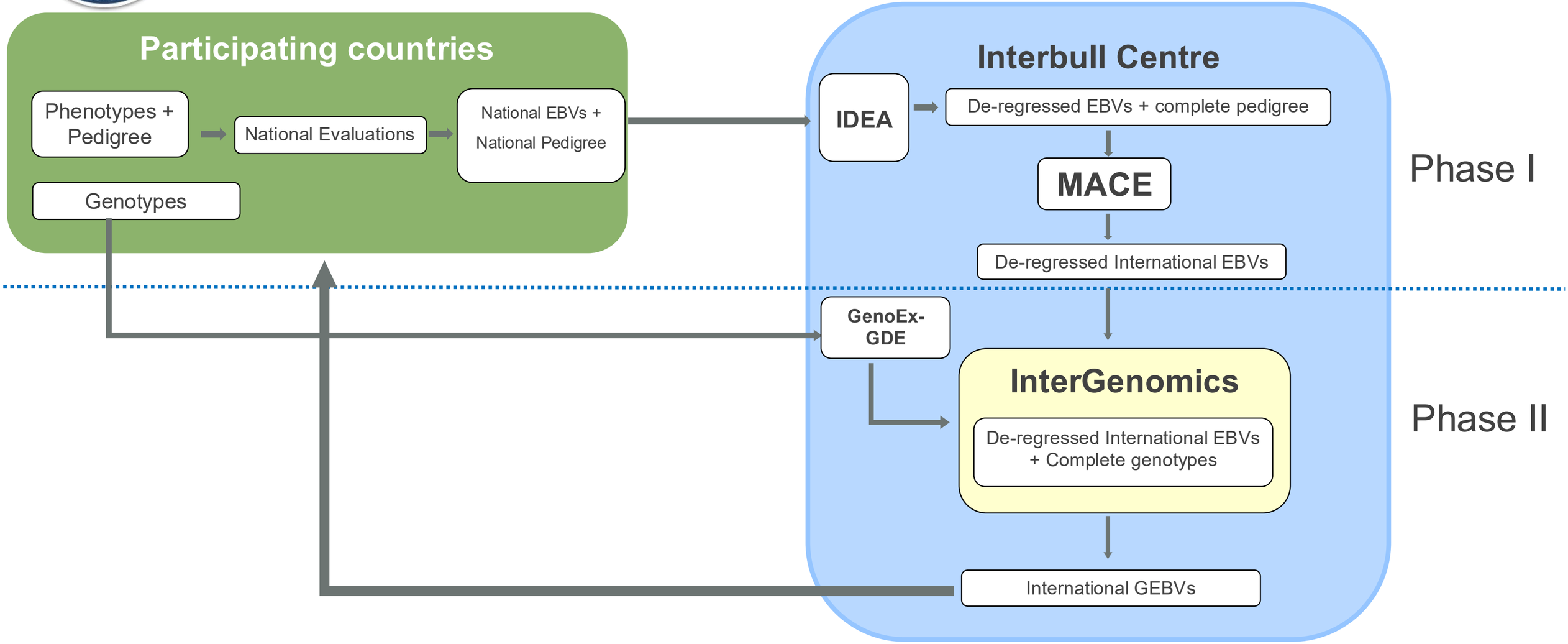
End of cow statistics

Overview

- Assessing the feasibility of including females in MACE
- Investigate level of bias in MACE results
- Assess the gain in reliability
- Obtain unbiased MACE (both cows and bulls) proofs to be distributed to participating countries
- Verify and adjust the current conversion equations

Females in MACE

Opportunity: InterGenomics



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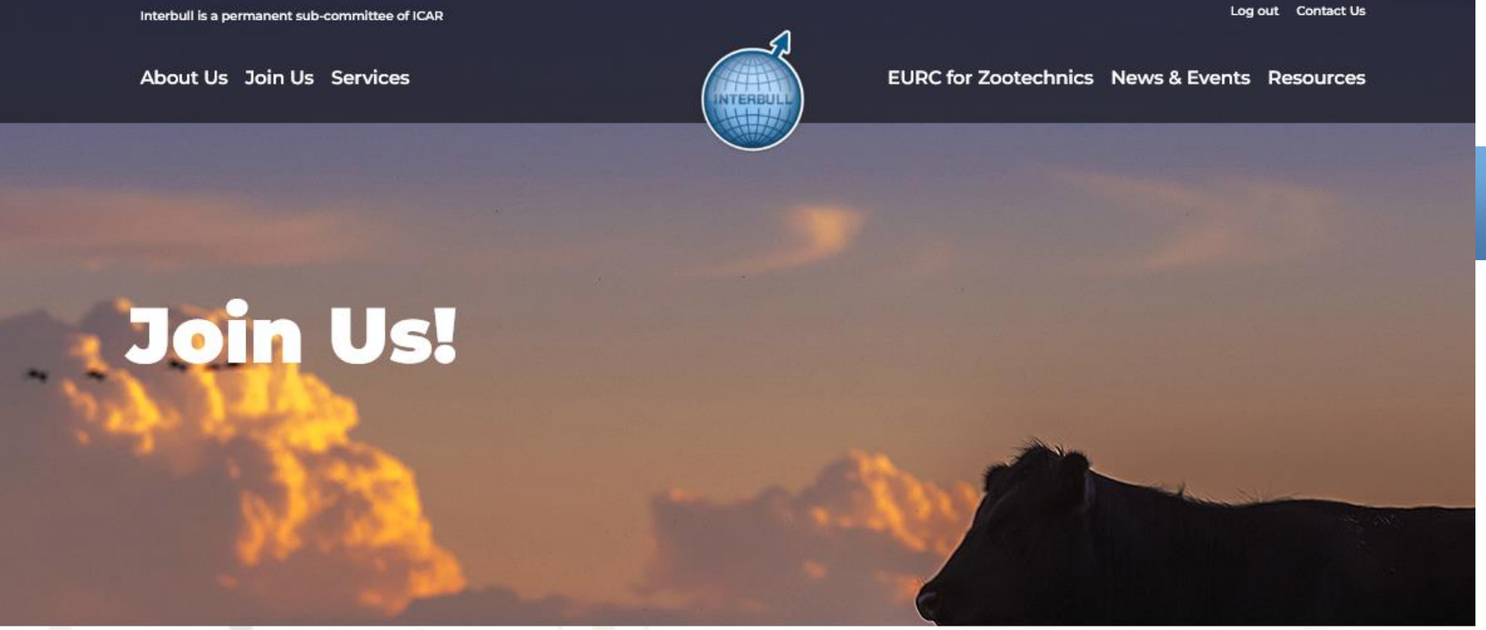

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