Impact of Genomic Pre-selection on MACE

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WHAT ARE THE GPS EFFECTS?

Genomic pre-selection (GPS) of bulls entering AI

\[ MS \sim N(0, \frac{1}{2} \sigma_g^2) \]

If the national system does not accommodate GPS effects

GPS bias in EBV → MACE?
To study the impact of the GPS bias on MACE,
We need to simulate GPS in MACE input

The Interbull GPS WG, February, 2018

+ Modify MACE

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**STEP 1: Get DRP with no GPS**

- DRP with the desired $\Delta G$ for all countries
  - Mix99 Software
    - A special version provided by LUKE
  - MS terms
    - Randomly distributed
  - No GPS
  - First set of simulated DRP
  - CONTROL DATA
STEP 2: Simulate GPS effects

Modify the MS terms from Step 1

- Only for one country **Cou1**
- Only for bulls with birth year &ge; **2005**

Their MS terms were raised with a constant (MS+) corresponding to 10% selection intensity and 60% reliability (as in Tyrisevä et al., 2013)

On Cou1 scale: \( MS+_\text{cou1} = SD_{\text{gen\_cou1}} \times i \times \text{rel} \)

On country Cou2 scale: \( MS+_\text{cou2} = b_{\text{cou1\_cou2}} \times MS+_\text{cou1} \)

Where \( b_{\text{cou1\_cou2}} = r_{12} \times \frac{SD_{(BV_{\text{cou2})}}}{SD_{(BV_{\text{cou1})}}} \)
STEP 2: Simulate GPS effects

Modified MS terms $\rightarrow$ Mix99

With GPS

Second set of simulated DRP with GPS effects

GPS DATA

However: this not what we get If the country does not account for GPS effects
STEP 3: Simulate GPS bias at the national level

GPS DATA

From step 2

BLUP with Birth Year fixed effect

National EBV

Biased

MACE de-regression program

New de-regressed proofs Biased

GPS_biased DATA
SIMULATION: DATA

Protein, 30 countries

Simulated DRP for all countries

- CONTROL: No GPS
- GPS: GPS effects for Cou1
- GPS_biased: GPS bias for Cou1

Simulated National EBV for Cou1

- EBV_0: Before GPS
- EBV_true: GPS effects
- EBV_biased: GPS bias

Current Scenario: GPS effects exist only in Cou1
Cou1 has GPS bias
MS MEANS

MS Cou1 bulls on Cou1 scale

MS COU1 bulls on COU2 scale

MS+ on COU1 scale = 0.69
MS+ on COU2 scale = 0.66
r_G[COU1, COU2] = 0.89
National EBV cou1

ΔG COU1 bulls

GPS bias = Prediction error = EBV_biased - EBV_true
IMPACT ON MACE

Three MACE Evaluations

The three different sets of de-regressed proofs:

Control, GPS, GPS_biased

Were used as input for the current MACE system
MACE RESULTS

ON COU1 SCALE

ΔG COU1 bulls

Interbull Annual Meeting – June 22-24, 2019 – Cincinnati, Ohio, USA
Prediction error MACE vs NAT

Prediction Error averages per year

On average 92% of the GPS bias gets into MACE proofs
MACE does not accommodate the GPS bias

Therefore,

MACE needs to be modified