Interbull Business Meeting

Item 8: Interbull Technical Updates
Valentina Palucci

- Update on work from Working Groups:

  - GREL WG

  - Validation tests WG

  - Genomic pre-selection & future MACE WG (*Pete Sullivan, item 8a*)

  - New trait pipeline WG (*Ezequiel Nicolazzi, item 8b*)

- Update from Interbull Centre

  - Harmonisation of traits

GREL WG update

- Interbull Methodology:

  ✓ Harmonize calculation of genomic reliabilities

  ✓ Make values comparable across countries

- Difficult to reduce computational time required for largest populations:

  ➢ Small variation within birth year in candidate bulls

  ➢ Possible approach: use Interbull methodology at fixed interval of time or when major changes in the model, keep GEDC constant in between for routine evaluations

WG Members
Zengting Liu (Chair)
Katrine Haugaard
Ismo Strandén
Paul VanRaden
Martin Lidauer
Jérémie Vandenplas
Herwin Eding

- Focus on improving genomic validations in order to better account for GPS

- Interbull Technical Workshop, Rome February 2023:
  - Presented an enhanced version of the GEBV-test
  - Overall positive feedback from testing countries

WG Members
Paul VanRaden (Chair)
Zengting Liu
Valentina Palucci
Pete Sullivan
Raphael Mrode
Andres Legarra

- After the Workshop:

  - GEBV-test Software further enhanced to better handle small populations (*countries feedback from technical workshop*)

  - Included information on power of the test to better understand inconclusive results

  - Additional information to allow further analysis at national level ($_{i.e}$ R^2 of base adjustment regression, validation test regression, mean difference …)

- Aim:

  - New GEBV-test software available January 2024

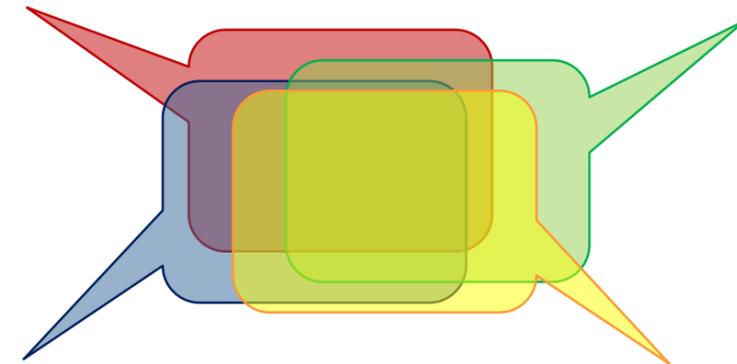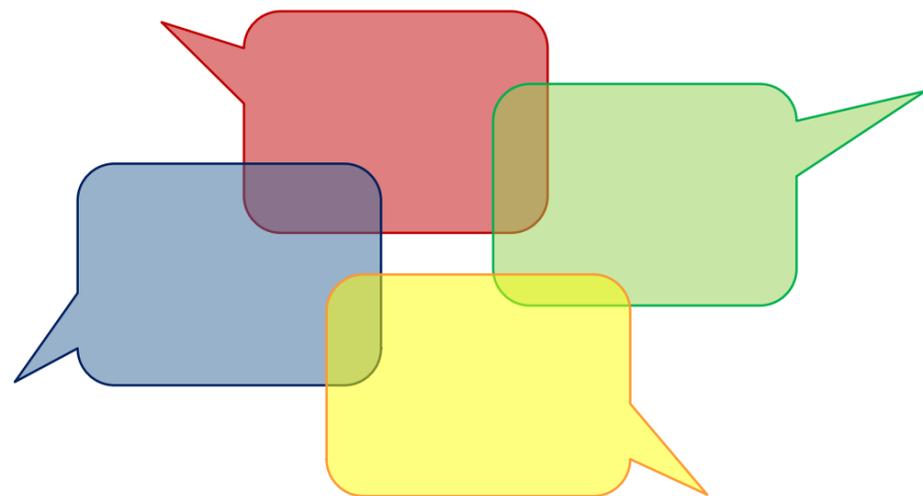 - Roll out plan will be communicated before end of 2023

- Interbull test I, II, III and IV give usable results

  - Test III looses power due to fewer bulls available
      -> needs refinements

- WG will continue looking at possibilities to improve Test III

  - Possibly expanding GEBVtest software to account for it

Harmonisation of traits

- In the context of across country evaluations, trait correlations play an important role in the quality of the estimations.

- Harmonising traits helps to **improve correlations** and thus to achieve **better international evaluations**.

- ITC has approved recommendations to improve the across country compatibility of **Female Fertility**

Future MACE contributions

- Interbull Staff Acknowledgements:
  - Haifa Benhajali (2017-2018)
    - ➤ Initial R&D and programming for GPS simulation and modeling
  - Simone Savoia and Marcus Pederson (2019-2021)
    - ➤ Transfer and access to Haifa's data and programs, ITBC computing resources, etc.
  - Valentina Palucci (2021-ongoing)
    - ➤ Collaboration on routine implementation of GPS-MACE at Interbull Centre
- New working group member in 2023
  - Ismo Strandén, Luke (replaces Esa)

Role of the Working Group

Objectives:

1. Develop a **GPS-MACE** international model that accounts for **G**enomic **P**re-**S**election effects without requiring genotypes

2. Reduce bias in future MACE proofs that can still be used as phenotypic input data for national genomic evaluation systems

Background: "Genomic-free EBV webinar" (2021):

https://Interbull.org (Publications & Events)

Key Reports and Activities

- JDS: National EBV are biased w/o genotypes used for GPS (Patry and Ducrocq, 2011)

- JDS: MACE proofs include the national EBV bias (Patry et al, 2013)

- Interbull workshop: Adapting MACE for GPS (Slovenia, 2017 Feb)

Interbull Technical Committee and Working Groups: tasked to quantify GPS effects and simulate GPS data to test future MACE approaches (Estonia, 2017 Aug)

- Interbull meeting: Modifying MACE for GPS (USA, 2019 Jun) ⟵ Literature Review: IB 55

- Interbull webinar: Genomic-free input for MACE (2021 Feb) ⟵ https://Interbull.org

- Interbull meeting: Genetic regressions for GPS in MACE (Canada, 2022 May)

- Interbull workshop: Implementing GPS-MACE (Italy, 2023 Feb) ⟵ Model Application: IB 58

- GPS effects alter the distributions of GEBV, with effects on both the PA (between-family) and MS (within-family) portions of an AI sire's GEBV

    - BLUP handles the PA selection effects, but not the MS pre-selection effects

    - GPS effects on MS distributions can be added to the MACE model:

        ➢ Read how this is done with GPS-MACE in Interbull bulletin 58

- GPS-MACE programs have been developed for use by Interbull

    - Programs were tested on Interbull data and computing systems

    - Solve-time is longer than with MACE, but still feasible

Current Status of Future MACE

- Accounting for GPS effects on MS means:

  ➢ Encouraging results from sensitivity studies with alternative shrinkage parameters

  ➢ Parameters should be estimated for optimal MS mean adjustments

- Accounting for GPS effects on MS variances:

  ➢ Methods are available but testing is in early stages

- Using GPS-MACE results within the GMACE evaluation:

  ➢ Impacts on GMACE results should be checked with the final GPS-MACE model

  ➢ GMACE results should be more accurate with improved PA from GPS-MACE

  ➢ Biggest impacts are expected for the scales of non-genomic countries

GPS-MACE model

- Current MACE: $y = \mu + Q_1 g + \mathbf{a} + e$

$y = \mu + (Q_1 g + \mathbf{PA}) + (\mathbf{MS}) + e$

GPS effects

- **GPS-MACE:** $y = \mu + (Q_1 g + \mathbf{PA}) + (\mathbf{Q_2 s + m}) + e$

GPS effects

$$\overline{\mathbf{MS}} = \mathbf{Q_2 s}, \qquad \overline{\mathbf{m}} = \mathbf{0}$$

$$\begin{bmatrix} X'DX & X'DZ & X'DZQ_2 \\ Z'DX & Z'DZ + W \otimes G_t^{-1} & Z'DZQ_2 \\ Q_2'Z'DX & Q_2'ZDZ & Q_2'Z'DZQ_2 + cI \end{bmatrix} \begin{bmatrix} \mu \\ Q_1g + a \\ s \end{bmatrix} = \begin{bmatrix} X'Dy \\ Z'Dy \\ Q_2'Z'Dy \end{bmatrix}$$

Covariables in s have Incidence Matrix: ZQ_2

We can add a Ridge-regression factor: c

$$EBV = \hat{\mu} + Q_1\hat{g} + \hat{a} + Q_2\hat{s}$$
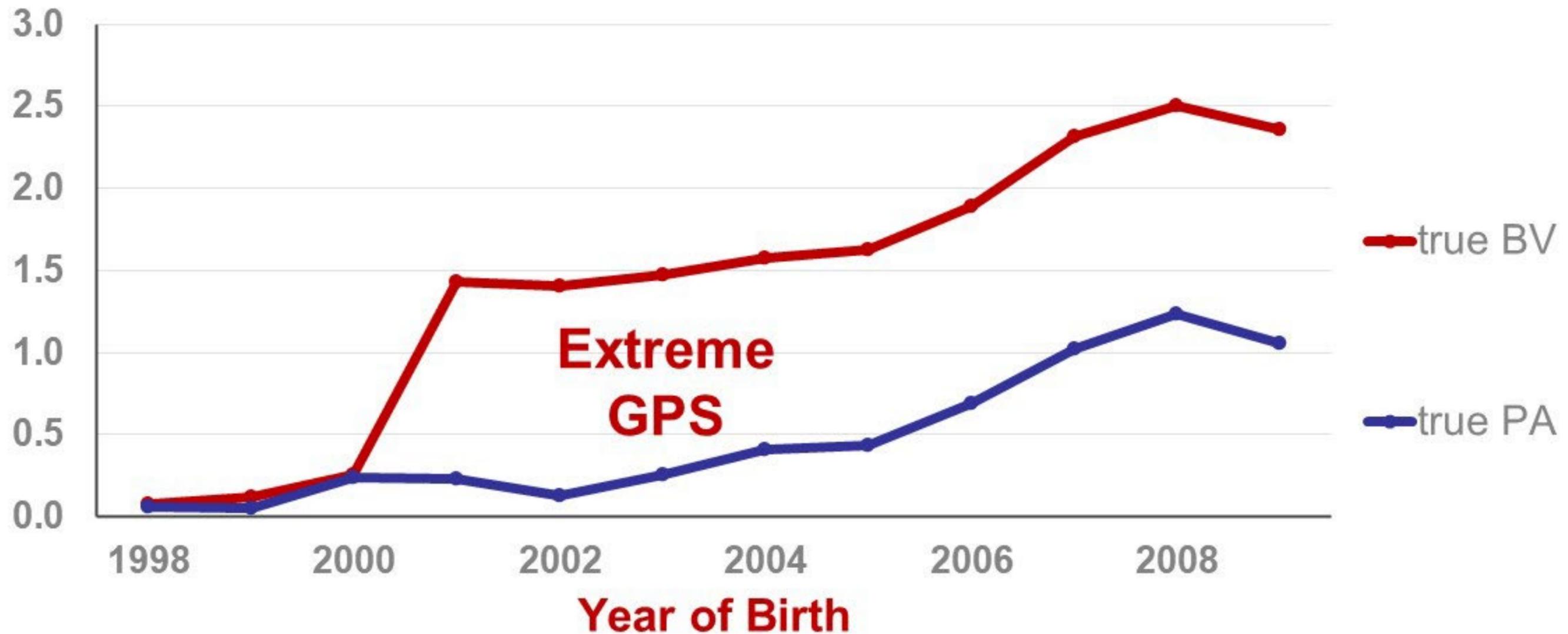
1. **Simulation study**: *unbiased national EBV* input for MACE

   1. A simple design with GPS practiced in only one country

   2. Expectation of MACE output that is unbiased, which is easily tested

2. **Official data study**: *biased national EBV* input used in MACE, after years of GPS in many countries, but with GPS effects not properly included in the national EBV computed without genotypes

1. Simulated Data with strong GPS
(MACE with unbiased EBV input)

(GPS-MACE with unbiased EBV input)

PREDICTED Genetic Values

- true BV
- EBV
- PA
- true PA

NO EBV Bias

MS includes GPS

Year of Birth
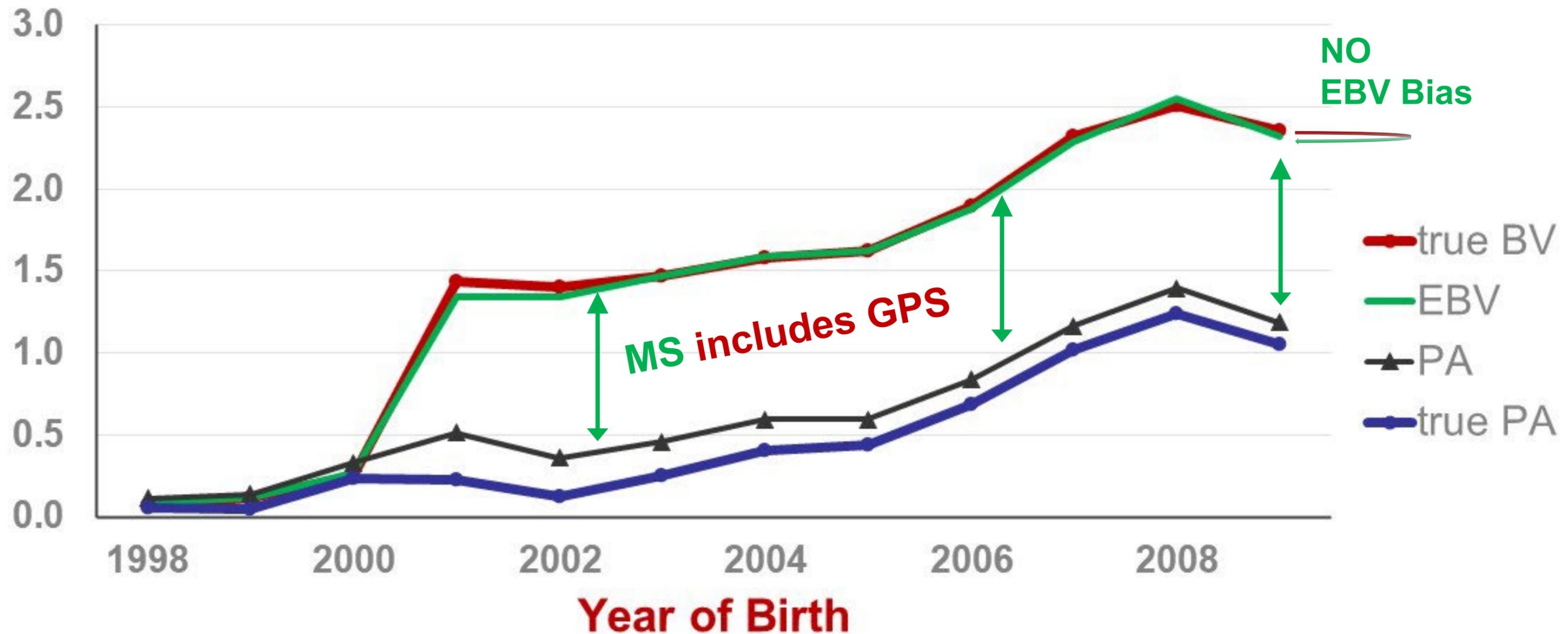
- Official input data used for MACE in April 2022 for:

  ➢ Eight traits: pro, fat, ocs, ous, scs, cc1, int, msp

  ➢ Three "genomic" breeds: Holstein, Jersey, Brown Swiss

- Proven bulls were born as recently as 2017, with approximately 8 completed years of progeny-proven GPS bulls (2009-2016)

- National EBV are biased (i.e. with estimated MS effects that are too small) due to the requirement of ignoring genotypes

  ➢ Expecting GPS effects to be "underestimated" from these data
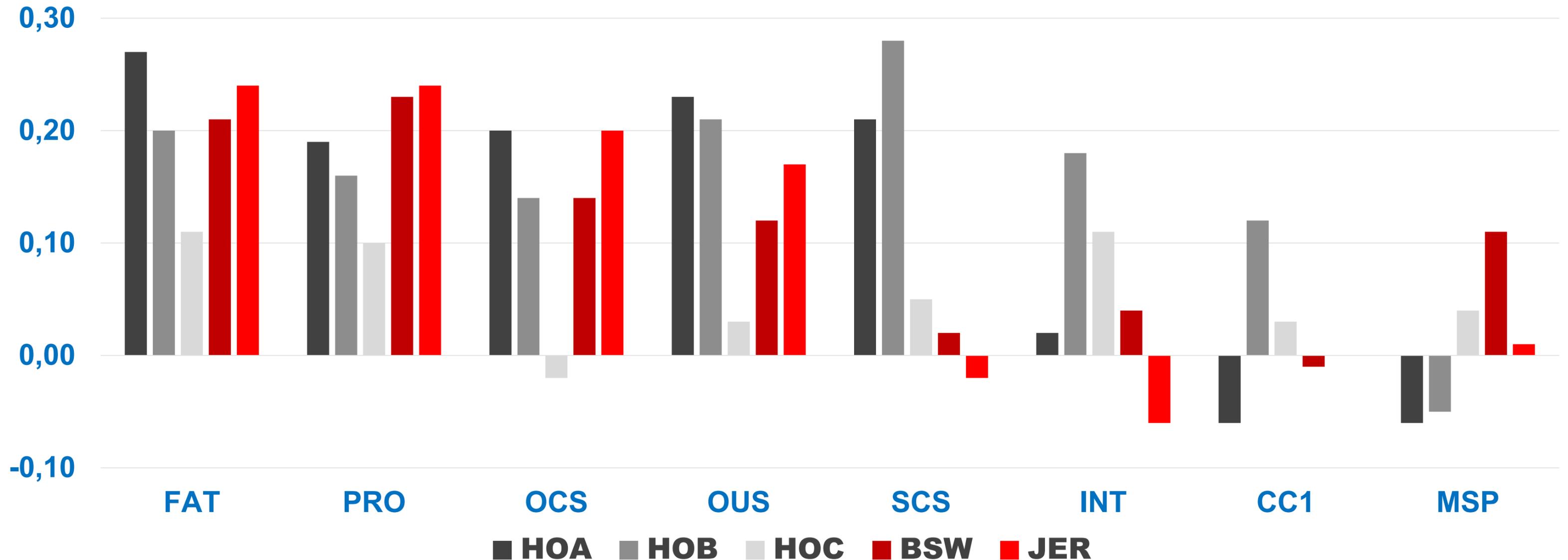
Impact of GPS on MACE proofs (std. scale)

Distributions of Averages by Country of Registration, for the Holstein trait Protein in Canada

Legend:
- MS
- EBV
- PA

Birth Year of HOLSTEIN bulls EBV-proven in any country
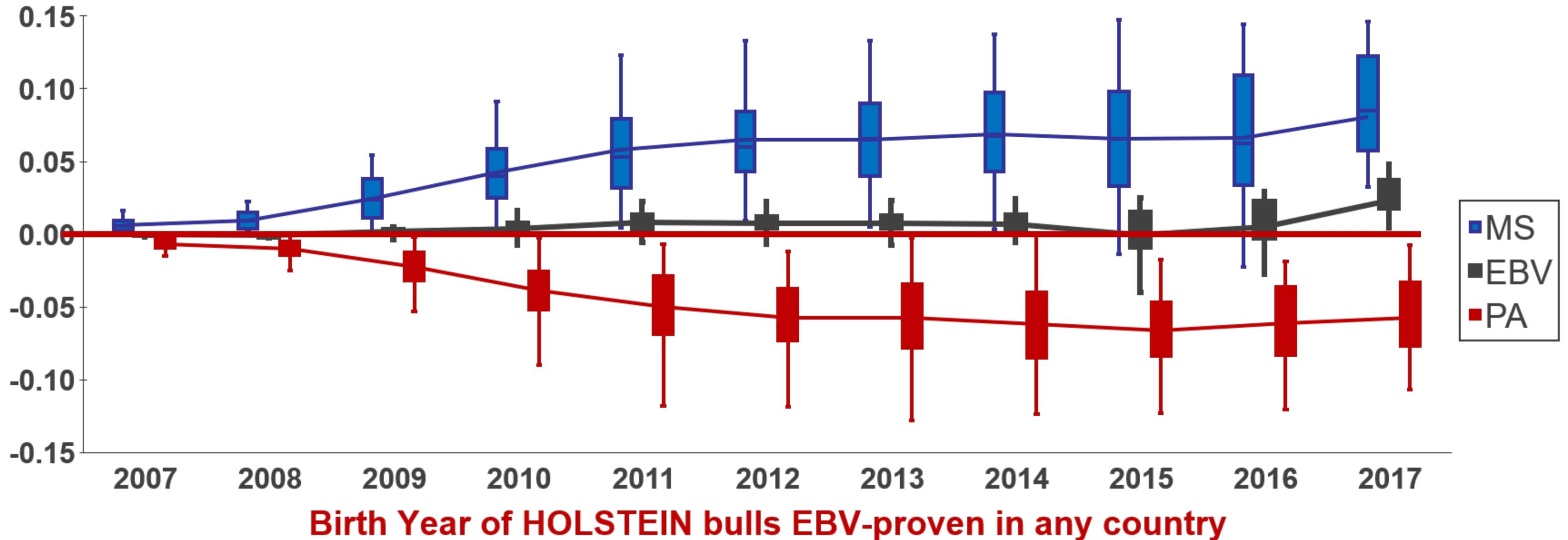
- GPS-MACE works now, but it will be even better with new national EBV

    - National EBV without genotypes do not include GPS effects

        ➢ True GPS effects are underestimated (but not zero) from the current national EBV

        ➢ The underestimates are better than assuming no GPS effects at all

- Better inclusion of GPS effects in national EBV will increase the magnitudes of GPS effects estimated in GPS-MACE, but how do we do it?

        ➢ Can a GPS-EBV model that is like GPS-MACE be used at the national level?

        ➢ Can ssGEBV be partitioned to remove individual genotype effects but keep GPS?

        ➢ Can a de-regressed ssGEBV be used instead of a de-regressed EBV?

Interbull Business Meeting

Item 8b: New Traits Pipeline

E Nicolazzi, G. de Jong, V. Palucci, T. Roozen

THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Network. Guidelines. Certification.

- 2021: WG defined to establish a clear pipeline to:
  - ✓ Identify key decision factors for implementing any traits

  - ✓ Define infrastructure needed and programs/methodology

  - ✓ Develop business model, business plan and appropriate fee structure
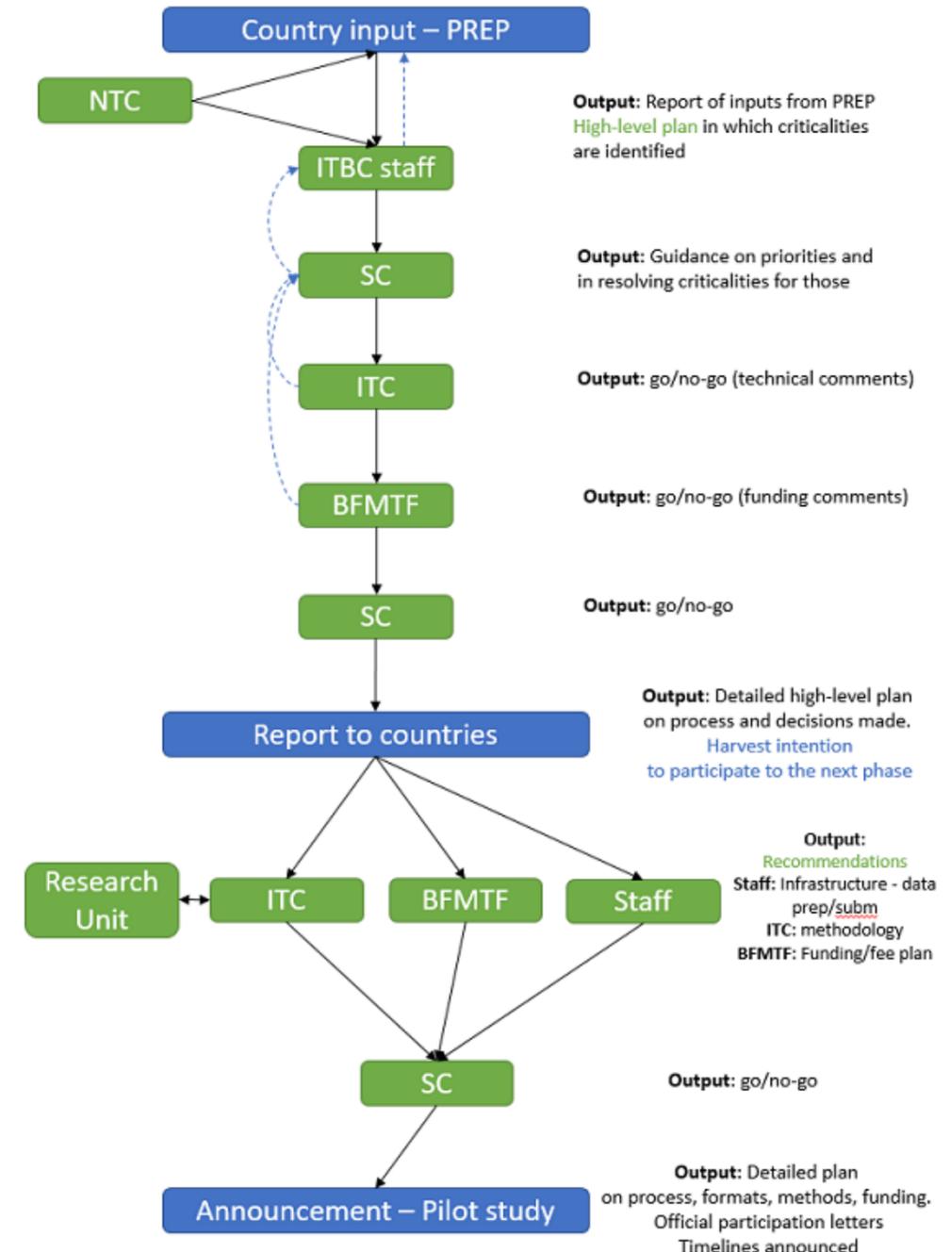
- PREP-DB chosen as platform

  - Continuous flow of information

  - Transparent

  - Accessible worldwide

- Active inputs from member countries on their needs for new int'l evaluations

  - Which traits have enough data available?

  - Which traits have a national evaluation (conventional/genomic) in place?

  - Is there a need to combine information (data/EBV) across countries?

  - What service is requested?

    - One of the current available

    - New service

Most Promising Next Traits

Feed efficiency

Claw-health related traits

	Retained placenta	Hypocalca-emia/Milk fever	Gestation length	Feed efficiency	Residual feed intake	Methane emission	Sub-clinical ketosis	Clinical Ketosis	Calf Survival	Lactation Persistency	Anestrus	Metritis	Endo-metritis	Cystic ovaries	Digital dermatitis	Interdigital dermatitis	Interdigital hyperplasia	Sole hemorrhage	Sole ulcer	White line disease	Body weight
ANABLE																					
ANAFI			I	I																	
ANAPRI																					
CDCB	I	I	I	I				I				I									
CONAFE	D											D									
CRV	I	I	I				I	I			I	D	I	I	I	I	I	I	I	I	I
DATAGENE																					
GENO	I	I	I					I			I	I		I	I				I	I	
ICBF			I																		
LACTANET																					
NAV																					
NIAP																					
NLBC																					
PLEMDAT																					
QUALITAS			I						I												
VIT	I	I						I	I	I		I		I		I			I		

Next steps:
- Fill in PREP in relation to new traits identified by 15 Sep
- Review of information
- Decision on how to proceed

Legend:
- = High interest
- = Medium Interest
- = No information provided
- = Low Interest
- I = Evaluation implemented
- D = Evaluation under development
- { = New potential traits identified