

Interbull Centre Activity Report



June 2020 – February 2021

INTERBULL CENTRE

ACTIVITY REPORT JUNE 2020 - FEBRUARY 2021¹

INTERBULL CENTRE

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The Interbull Centre is the operational unit of the ICAR permanent sub-committee Interbull.



The Interbull Centre holds the status of European Union Reference Centre (EURC) for Bovine Breeding.



The Interbull Centre is ISO 9001:2015 certified.



¹ As presented on the Interbull website in April 2021 (www.interbull.org/ib/itbcreports)



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inter  **genomics**

GEN  **EX**
International Genotype Exchange Platform

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FOREWORD – Interbull Centre Director

The Interbull Centre is a section of the Department of Animal Breeding and Genetics (HGEN) of the Swedish University of Agricultural Sciences (SLU). The Interbull Centre is the operational unit for Interbull and Interbeef, a permanent subcommittee and a working group of the International Committee for Animal Recording (ICAR), respectively, and operates as the European Union Reference Centre for Zootechnics (Bovine Breeding). This Report describes the activities at the Interbull Centre between 1 June 2020 and 28 February 2021.

In January 2020, a workshop took place in Uppsala, Sweden to establish the Interbull Strategic Plan for 2020-2023. The Plan has since been shared and discussed with the Interbull Community. The goals identified in the Strategic Plan are referenced in the 2021 Interbull Operating Plan. As such, both plans will impact current and future Interbull Centre services. Little did we know at the time that this meeting was going to be one of the last once during which many of us were going to see each other face-to-face.

The Covid-19 Pandemic has left a large impact on the world since January 2020. Although Sweden is by now known to be rather ‘relaxed’ in its approach to the Covid-19 Pandemic, the Interbull Centre has also felt the impact. While members of staff were allowed to come into the office on a ‘need-to’ basis, we have worked from our home offices for most of the reporting period.

We are now used to ‘online coffee breaks’ and (too) many online meetings via video conferencing (Zoom, jitsi or Teams). SLU is providing extra support through access to software, hardware, and other resources. But the pandemic also left an impact on the composition of the Interbull Centre team. And we all miss the face-to-face interactions, coffee breaks and corridor chats.

The infrastructure for working from a distance has been in place for some time, and we are proud that, despite the current circumstances, our services have been delivered on time and ‘as usual’.

I’d like to express my sincere thanks to all Committees, Working Groups, organisations and individuals who continue to contribute to the Interbull, Interbeef, GenoEx and EU Reference Centre successes, but especially to the Interbull Centre Team.

Please take care and stay healthy,

Toine Roozen,
Interbull Centre Director



FOREWORD – Interbull Steering Committee Chair

As Toine mentioned above, 2020 was a challenging year for our whole international community. We have missed the networking opportunities and our shared learning that normally play such an important role in our industry. As have our national teams, the Interbull team have continued to deliver services to our clients throughout the year. We have also started two new services over this period, a clinical mastitis MACE evaluation and InterGenomics-Holstein. The team have worked hard through this challenging time.

I would like to thank all of Interbull's committees and working groups that are such an important component in the international genetic evaluation space. Without the time given up by these contributors, the work of Interbull would not be possible. I would also like to extend a special thanks to my fellow members of the Interbull Steering Committee. They have continued to meet regularly throughout this period and have given of freely of their time to advance the services of Interbull. Thank you.

I look forward to a return to face-to-face meetings and Interbull's continuing delivery of existing and new services.

Matthew Shaffer,
Chair, Interbull Steering Committee

1. PEOPLE

1.1. Interbull Centre Personnel

Interbull Centre staff are employed by the Department of Animal Breeding and Genetics (HGEN) of the Swedish University of Agricultural Sciences (SLU). The team currently consists of the following members of staff:

- Toine Roozen (MSc, MBA) - Director

Genetic Data Analyst (*Genetics*):

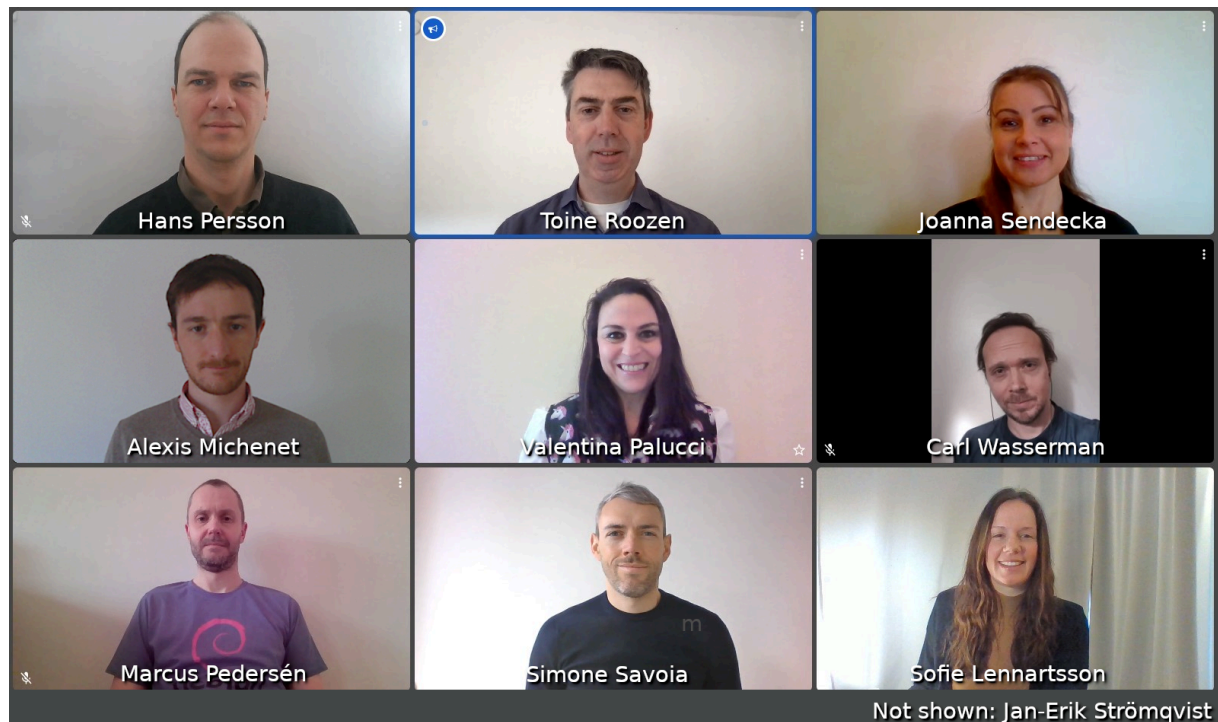
- Valentina Palucci (MSc) - Quality Manager; Service Owner MACE and GMACE
- Joanna Sendeka (PhD) - Service Owner SNP services
- Simone Savoia (PhD) - Service Owner InterGenomics and Interbeef.

Genetic Data Analyst (*IT*):

- Marcus Pedersén - Systems Administrator, IT Coordinator
- Carl Wasserman - Systems Developer
- Hans Persson - Programmer
- Jan-Erik Strömquist - Programmer

In addition, the following SLU members of staff have part-time responsibilities at Interbull Centre:

- Cano Merkan - IT Coordinator / Systems Analyst
- Sofie Lennartsson (BA) – HR, Administrator



Interbull Centre Team (February 2021)

Staff changes

Haifa Benhajali (PhD): After 5½ years, Haifa Benhajali decided to leave the Centre to focus more on big data handling and machine learning. We thank Haifa for all the good years she has spent at the Interbull Centre and for all her contributions. We wish her the best of luck in this new chapter of her career.

Alexis Michenet (PhD): After almost 2 years, Alexis Michenet has accepted another job opportunity which has taken him back to France. We are very pleased that he will continue to work in the beef genomics area. In his short time at the Interbull Centre Alexis has contributed a lot on the improvement of beef services and has been a great addition to the team. We warmly thank him for his time.

Louise Simann (BA) - Administrator: In October 2020 Louise accepted a new position as administrator in another department at SLU. We thank Louise for her help on invoices and other administrative tasks during the years she has been working with us.

Sofie Lennartsson (BA) – HR- Administrator: On December 2020 Sofie has started her new position within the HGEN’s administration group. Sofie works with personnel administration for the whole HGEN department and with 20% of her time dedicated to a range of activities assisting the Interbull Centre Director.

Mohammed Abdallah Ahmed Sallam (MSc, “Sallam”) started with the Interbull Centre as an MSc student in April 2019 on his MSc project on comparing multi-trait to single-trait International genomic evaluations with the focus on InterGenomics. Sallam subsequently joined the Interbull Centre team on a temporary basis (1 July 2020-31 December 2020) to work on EURC related activities. He started his PhD studies within SLU’s Department of Animal Breeding and Genetics on 1 January 2021.

1.2. Committee, Working Group and Task Force membership

Interbull Centre personnel is member of various Committees, Task Forces and Working groups. Details of these groups are included in Appendix 1.

1.3. Training, Courses, Meetings and Conferences

Staff was involved with the following courses, meetings and conferences. Due to the Covid-19 Pandemic all activities meetings that were scheduled during this reporting period were attended via video conference.

Table 1.1: Provision of training during June 2020 – Feb 2021

Courses provided:	Dates	Person
ICAR-INTERBULL collaboration on animal ID	27 August 2020	Valentina Palucci
Seminar in International breeding evaluation during course in Cattle production	20 November 2020	Valentina Palucci
Seminar in International breeding evaluation during course in Animal breeding and genetics (Universita’ degli studi di Perugia, IT)	26 November 2020	Simone Savoia
Presentation of Interbull Centre quality assurance to Växa Sverige	01 December 2020	Valentina Palucci
EURC Meeting with Competent Authorities	15 December 2020 12 January 2021 13 January 2021	Joanna Sendeck, Valentina Palucci, Toine Roozen
“Genomic-free EBV for MACE”	11 February 2021	Pete Sullivan

Table 1.2: Attendance of events during June 2020 – Feb 2021

Event	Dates 2020	Attendee
2020 Interbull Online Q&A Meetings	27 August 2020 08 September 2020	Valentina Palucci, Toine Roozen, Simone Savoia, Alexis Michenet, Joanna Sendeck, Carl Wasserman, Hans Persson , Marcus Pedersen, Jan-Erik Strömquist , Haifa Benhajali
ISO 9001 External Audit	17 November 2020	Valentina Palucci, Marcus Pedersen, Toine Roozen
GenTORE meeting	18-19 November 2020	Simone Savoia
EAAP virtual meeting	1-4 December 2020	Valentina Palucci, Joanna Sendeck, Alexis Michenet, Simone Savoia
Interbeef webinar “Seminar in International breeding evaluation during course in Cattle production“	10 December 2020	Simone Savoia, Alexis Michenet, Toine Roozen
Interbull webinar “Genomic-free EBV for MACE”	11 February 2021	Valentina Palucci, Simone Savoia, Joanna Sendeck, Alexis Michenet, Toine Roozen

Table 1.3: Interbull Committee Meetings; June 2020 – Feb 2021

Committee	Dates	Attendee
Steering Committee	04 June 2020 25 August 2020 17 September 2020 12 November 2020 10 December 2020 16 February 2021	Toine Roozen, Valentina Palucci
Technical Committee	09 June 2020	Haifa Benhajali, Valentina Palucci, Simone Savoia, Alexis Michenet, Toine Roozen

Table 1.4: Working Group and Task Force Meetings by Conference call; June 2020 – Feb 2021

Group	Dates	Staff Attendees
Reporting to Steering Committee:		
IgHOL WG	10 June 2020 25 June 2020 10 September 2020 23 September 2020	Simone Savoia, Toine Roozen
Business Funding Models Task Force	18 August 2020 19 November 2020	Toine Roozen
SNPMace WG	15 June 2020 28 September 2020 9 February 2021	Haifa Benhajali, Toine Roozen Haifa Benhajali, Simone Savoia, Toine Roozen Simone Savoia, Toine Roozen
Reporting to Interbull Technical Committee:		
Validation WG	11 June 2020	Valentina Palucci
Related to Interbeef:		
Interbeef Working & Technical Groups meeting	8 July 2020 3 November 2020 28 January 2021	Alexis Michenet, Simone Savoia, Toine Roozen
Interbeef operational WG	13 February 2020 30 September 2020 14 January 2021	Alexis Michenet, Simone Savoia, Toine Roozen Alexis Michenet, Simone Savoia, Toine Roozen Alexis Michenet, Simone Savoia, Toine Roozen
Interbeef Variance Component Estimation WG	11 February 2021	Alexis Michenet, Simone Savoia
Beef PhD Advisory Committee	7 October 2020	Alexis Michenet
EU Reference Centre WG	14 September 2020 25 November 2020 14 December 2020	Joanna Sendeck, Valentina Palucci, Toine Roozen

InterGenomics:		
InterGenomics Management Group	27 October 2020	Simone Savoia
InterGenomics Technical Group	21 October 2020	Simone Savoia, Valentina Palucci
Related to ICAR Board, and WGs:		
ICAR DNA WG	24 June 2020 4 November 2020	Joanna Sendicka
ICAR ID Sub-Committee	03 September 2020	Valentina Palucci
ICAR2021 Local Organising Committee	19 November 2020 11 January 2021 05 February 2021	Valentina Palucci, Toine Roozen
ICAR2022 Local Organising Committee	31 August 2020 05 October 2020 02 November 2020 01 December 2020 08 February 2021	Valentina Palucci
ICAR Board and Chairs	10 June 2020	Toine Roozen

1.4. Consultants and Suppliers

Due to the Covid-19 pandemic Interbull Centre had no visitors during the current reporting period. Beneficial collaborations are however still in place:

- **Pete Sullivan** (Lactanet, Canada): works as a part time consultant (25%). In the current reporting period Pete’s activities were related to supporting GMACE software; main contributions to the Working Groups on “Genomic-Free EBV” (§9.4, including delivery of the related seminar), “Genomic Pre-selection and Future MACE” (§9.3), and software improvements for Interbeef reliabilities.
- **Thierry Pabiou** (ICBF, Ireland): supplies international genetic parameters for Adjusted Weaning Weight (AWW) for Interbeef evaluations to the Interbull Centre.
- **Zdenka Vezela** (CMBC, Czech Republic): supplies international genetic parameters for calving traits (birth weight, calving ease) for Interbeef evaluations to the Interbull Centre.
- **Chris Murphy** (Chris Murphy Advisory PTY Ltd, Australia): Guidance and assistance for Strategic and Operational Planning (§2.6).
- **Mike Goddard** (Agriculture Victoria Research, Australia): The Interbull Centre signed an agreement for the implementation phase of the SNP Mace project for the duration of March 2020-October 2021 (§9.1).
- **Lena Gibson**, auditor within Bureau Veritas Certification Sverige AB, has been the Interbull Centre’s external auditor for the ISO 9001 standard for the whole first re-certification period (2018-2020). Her last audit was performed on 17 November 2020 via zoom to comply with the Covid-2019 pandemic restriction (§3.2).
- **Tzayhri Osorio Gallardo** is an MSc student following the Erasmus Mundus EMABG (European Master in Animal Breeding and Genetics) program, currently attending her second year of the MSc, at SLU. She joined the Interbull Centre to conduct her MSc thesis project from 16 November 2020 until 22 March 2021. The topic of her thesis project is: "Assessing the benefits from joining the International beef cattle genetic evaluation (Interbeef) at SLU’s Interbull Centre: Estonia as a case study". As such she conducts the “Interbeef Pilot Run” for Estonia for the beef breeds Angus and Limousin, and the traits “Adjusted Weaning Weight” and “Calving Ease”. Her supervisors are Simone Savoia and Alexis Michenet (Interbull Centre) and Birgit Zumbach at Univ. of Göttingen. Her examiner is Erling Strandberg, SLU.

2. GOVERNANCE

2.1. Legal Agreement between ICAR and SLU

The Interbull Centre has been based at the Department of Animal Breeding and Genetics (HGEN) at the Swedish University of Agricultural Sciences (“SLU”) since 1995. A new agreement between ICAR and SLU regarding the operation of the Interbull Centre operations was signed on 22 December 2020.



2.2. Interbull Terms of Reference and Rules of Procedures

The “*Terms of Reference for INTERBULL Sub-Committee*”, and the “*Rules of Procedures for INTERBULL Committees*” are available on the Interbull website: [Terms of reference](https://interbull.org/ib/termsreference)²¹. The most recent updates were applied in November 2019 (inclusion of ICAR’s Conflicts of Interest Policy).

2.3. Steering Committee

During the reporting period, no changes took place to the composition of the Interbull Steering Committee. Enrico Santus’ term expired, but the SC recommended - due to the difficulties posed by the Covid-19 pandemic - that Enrico would maintain his SC membership for one additional year; until April 2021. This was endorsed by the ICAR board.

2.4. Technical Committee

Simone Savoia was endorsed by the Interbull Steering Committee as the Interbull Centre’s representative on the Interbull Technical Committee.

2.5. Scientific Advisory Committee

During the reporting period, no changes took place to the composition of Interbull’s Scientific Advisory Committee.

2.6. Interbull 2020-2023 Strategic Plan and Operating Plan

An Interbull Strategic Planning meeting was conducted in Uppsala in January 2020. The **Interbull 2020-2023 Strategic plan**³ that resulted from this meeting was ratified after seeking feedback from our stakeholders during the Interbull 2020 Online Q&A meetings of 27 August 2020 and 8 September 2020.

The Interbull 2020-2023 Strategic Plan outlines the changes Interbull envisages during the next three to five years and has four key functions:

- a) Establishes Interbull’s direction for the next three to five-year period
- b) Sets out goals and objectives in line with the vision and mission statements







² <https://interbull.org/ib/termsreference>

³ <http://www.interbull.org/ib/itbcreports>

- c) Seeks to consolidate the gains made under the previous Strategic Plans
- d) Identifies the areas for investment to strengthen capability and services.

The Interbull 2020-2023 Strategic Plan identified 6 Key Goals (Figure 2.1), all considered equally important at the Strategic Planning Meeting. These six goals have been leading in the development of the **2021 Interbull Operating plan**⁵. The 2021 Operating Plan includes the Interbull Centre's activities related to Services and Research & Development for Interbull, Interbeef, EU Reference Centre, and ICAR.

Figure 2.1: Key Goals in Interbull 2020-2023 Strategic Plan.

	Meeting future data service needs
	Defining a new traits pipeline
	Providing international evaluations in the genomic era
	Continuously improve core services
	Strengthening governance
	Driving branding and marketing

2.7. Business Funding Models Task Force

The Business Funding Models Task Force (BFMTF) was appointed by the Interbull Steering Committee in 2019 to review the current fee structure being applied to services offered by the Interbull Centre with the goal of assessing options and making recommendations for the future. This group will continue to offer advice to the Steering Committee as new services are added.

Current Fee structure

Despite increased (salary) costs at the Interbull Centre and the decreasing number of milk-recorded cows (on which the service fee is based), the Interbull service fee structure and level have not changed since 2013.

To address this, the Steering Committee also approved a new policy: The fees for services offered by the Interbull Centre will be increased annually. The exact level will be decided by the Interbull Steering Committee on an annual basis. For 2021, the increase has been set at 2% for all Interbull Dairy services with the exception of IgHOL, which commenced as recent as December 2020.

Service Fee structure for novel traits

The BFMTF shared during the 2020 Online Q&A meeting its recommendation that funding models should recognize the contribution made to the global system from countries with extensive data collection and/or a longer history of data recording at the national level. Such funding model was introduced with the introduction of MACE for Clinical Mastitis as a tool for SNP training for countries with a national genomic evaluation for clinical mastitis already in place ([§8.1](#)).

2.8. New Traits Pipeline Working Group

The Interbull Steering Committee appointed the New Traits Pipeline Working Group (NTP WG) during the SC meeting of 10 December 2020. The NTP WG Terms of Reference were approved during the SC meeting of 16 February 2021. The creation of this WG, as well as its objectives and activities are in line with Key Goal 2 of the Interbull 2020-2023 Strategic Plan.

2.9. Codes of Practice

Together with the relevant communities, Interbull Centre staff have developed and maintained 'Codes of Practice' which guide the Interbull Centre and its Service Users in an efficient implementation and delivery of services.

Interbull Code of Practice

The [Interbull Code of Practice](#)⁴ has been updated, on the basis of decisions by the Steering Committee, notably:

- **Chapter 6, Traits and Breeds:** Adding specific information pertaining to the new SNP Training for clinical mastitis (cma) evaluation.
- **Chapter 10: Service fees:** Including information on how fee for novel traits, such as cma, will be calculated
- **Appendix I:** addition of the Letter of Understanding for the SNP Training for cma evaluation.

Interbeef Code of Practice

The Interbeef Code of Practice has not been updated since its last formal adoption by the Interbeef WG in November 2019. The Interbeef Code of Practice is available through the [Interbull website](#)⁵ and the [ICAR website](#)⁶.

GenoEx-PSE Code of Practice

The original [GenoEx-PSE Code of Practice](#) is still in place. An updated version will be made available with the release of the next version of GenoEx-PSE.

⁴ <http://www.interbull.org/ib/codeofpractice>

⁵ https://wiki.interbull.org/public/wholeBCoP_toPrint?action=print&rev=2

⁶ <https://www.icar.org/index.php/technical-bodies/working-groups/interbeef-working-group/>

3. SERVICES & OPERATIONS – Interbull Centre

Since the start of international evaluations in 1995, the service portfolio and output at the Interbull Centre has increased significantly; both through expansion of the international genetic evaluations to include new populations and new traits, and through the addition of new services.

During the current period the first official test evaluation for SNP Training for clinical mastitis has been performed. The first official routine evaluation for SNP Training trait is scheduled for April 2021. GenoEx-GDE, for genotype data exchange, has been officially tested for exchange of genotypes related to the InterGenomics BSW evaluation, its introduction in the official routine evaluation is scheduled for April 2021 as well.

3.1. Global Reach

The Interbull Centre provides international genetic evaluation services for dairy and beef cattle in 34 countries from 5 continents; Europe: 26 countries; America's: 3; Oceania and Asia 2 each; Africa: 1. As a result of the Covid-19 pandemic, Mexico has taken the difficult decision to suspend its participation to the Interbull evaluations at the end of 2020. Due to organisational restructuring, Croatia will participate in Interbull evaluations through a new organisation: The Centre for Livestock Breeding. After participation in the Interbeef April 2020 test evaluation, the national genetic evaluation centres from Slovenia and Latvia joined the Interbeef services during the current reporting period for their first Interbeef routine evaluation in October 2020. Both evaluations centres are also involved in Interbull (dairy) evaluations.

The Interbull Centre performed Interbeef pilot evaluations for Italy and Estonia: We anticipate their participation in 2021.

Figure 3.1: Interbull's Global Reach (February 2021)



Beef Evaluations:

- Africa:** South Africa
- Europe:** Czech Republic, Denmark, Finland, France, Germany, Ireland, Latvia, Slovenia, Sweden, Switzerland, United Kingdom
- Oceania:** Australia

GenoEx-PSE:

- Europe:** Germany, Italy, Slovenia, Ireland, Denmark, Norway, Poland
- Asia:** Japan

3.2. Quality Management

Interbull Centre has just finished its second 3-year certification period. All external audits to date have been concluded with total absence of non-conformities found. We are keen to keep these excellent results also for the next certification period by periodical review of our procedures and by keeping high focus towards our customers' satisfaction. During the internal audits in May 2020, Management, IT and ICAR services were reviewed.

No additional services have been included in our Quality Management System since last year's inclusion of GenoEx-PSE and ICAR's DNA Data Interpretations Accreditation.

The surveillance audit on 17 November 2020 by Lena Gibson (Bureau Veritas) went successfully with total absence of non-conformities found and a praise from Lena about the strength and maturity of our Quality Management System considering the relative few years since it has been implemented. The 2020 external audit marked the end of the first re-certification period. The 2021 audit will be the beginning of the second re-certification period. According to the Bureau Veritas regulation, a new auditor will be reviewing our Quality Management System. The 2020 Audit was therefore likely the last audit by Lena. We wish to thank Lena for her precious inputs and feedback over this 3-year period and her very positive and friendly attitude.



4. SERVICE and OPERATIONS – International Dairy Breed Evaluations (Interbull)

4.1. Validation of National EBVs and GEBVs

Validation of national EBVs and GEBVs remains one of the top priorities towards reliable National/International genetic/genomic evaluations. The work of the Interbull WG on defining new validation procedures in the genomic area continues with the aim to provide new validation approaches for countries with national genomic evaluations in place. Such new methodologies will expand the portfolio of validation methods offered by Interbull currently consisting of five (5) different validation methods: four methods aimed at assessing the quality of conventional national evaluations, namely Method I, II, III and Mendelian Sampling Variance test and one assessing the quality of genomic national evaluations, GEBV test.

4.2. Truncated MACE (“TMACE”)

National genomic evaluations are increasingly dependent on Interbull MACE results due to the inclusion of foreign genotypes without national phenotypic information in the reference population. The only source of phenotypic information available for such animals are de-regressed MACE EBVs on the scale of interest. The latest MACE EBVs are used for regular estimation of SNP effects, but obtaining appropriate MACE de-regressed values for validation purposes is not a straightforward task.

In order to assist countries with improving the national genomic prediction and validation, Interbull introduced Truncated MACE as an additional service. Truncated MACE is performed annually in October. The second Truncated MACE run was held in October 2020, the following populations/organizations provided Truncated MACE data: Germany-Austria/LFL, ZuchtData (Brown Swiss), Japan/NLBC (Holstein).

4.3. MACE Evaluations

Interbull Centre test evaluation runs were performed in September-October 2020 and January-February 2021. Many changes in national and international evaluations have been introduced during this period, and are all described in the service reports published on the Interbull Centre website at [MACE service reports](#)⁷ after each subsequent routine evaluation. Tables 4.1 and 4.2 show statistics on Interbull MACE evaluations.

The following changes in participation occurred:

- Udder traits: SVK SIM is now participating in a joined evaluation with DEA and CZE
- Longevity traits: JPN joined the evaluation for the first time with HOL data in December 2020
- Calving traits: POL joined the evaluation for the first time with HOL data in December 2020
- Workability traits: ESP joined the evaluation for the first time with HOL data in August; POL joined the evaluation for the first time with HOL data in December 2020.

⁷ http://www.interbull.org/ib/maceev_archive

Table 4.1: Size of the Interbull Centre operations for MACE

Multiple Across Country Evaluation (MACE)	Dec 2018	Dec 2019	Dec 2020
Countries	33	33	33
Evaluation breeds	6	6	6
Country-breed-trait combinations	1 937	1 930	1961
Breed-trait evaluations	181	181	181
Animals in the pedigree database	34 643 754	36 094 659	38 286 074
Submitted national estimated breeding values	13 048 518	13 420 740	13 907 511
Qualified national estimated breeding values	7 171 732	7 332 267	7 518 415
Calculated international estimated breeding values	300 525 105	305 068 667	312 433 664
Distributed international estimated breeding values	111 976 925	112 896 290	114 804 143

Multiple Across Country Evaluation (MACE)	Sept 2018	Sept 2019	Sept 2020
Estimated across country genetic correlations	12 926	13 085	13 234
Validation tests (subject to natural fluctuations)	99	233	252

Table 4.2: Degree of Participation to MACE evaluations

	Prod (3)	Conf (up to 33)	Udder (2)	Long (1)	Calv (4)	Fert (5)	Work (2)	Tot (50)	2004r vs. 2012r
BSW	11	9	10	10	6	9	7	62	0
GUE	5	4	5	5	-	5	-	24	0
HOL	30	23	29	21	18	20	15	156	+5*
JER	12	10	9	9	-	9	6	55	0
RDC	15	10	14	12	7	11	7	76	0
SIM	12	-	11	5	-	-	-	28	-1*
Tot	85	56	78	62	31	54	35	401	
Change	0	0	-1	+1	+1	0	+3		+4

* Routine international genetic evaluations for Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental were computed as scheduled in August and December 2020.

4.4. International Genomic Evaluation of Young Bulls (GMACE)

International genomic evaluation of young bulls (GMACE) is to date conducted for the Holstein breed only, with 12 countries submitting national genomic breeding value estimates (GEBV) for up to 38 traits. Statistics on GMACE evaluations are presented in table 4.3.

GMACE test runs were performed as scheduled in September-October 2020 and January-February 2021. GMACE routine runs were performed in August and December 2020.

Table 4.3 - Size of the Interbull Centre operations for GMACE

Genomic Multiple Across Country Evaluation (GMACE)	Dec 2018	Dec 2019	Dec 2020
Countries	33	33	33
Evaluation breeds	1	1	1
Country-breed-trait combinations	374	376	399
Breed-trait evaluations	38	38	38
Animals in the pedigree database	34 643 754	36 094 659	38 286 074
Submitted national estimated breeding values	26 811 378	29 266 198	32 020 628
Qualified national estimated breeding values	19 234 402	19 527 768	20 240 812
Calculated international estimated breeding values	182 673 348	175 338 148	185 107 347
Distributed international estimated breeding values	458 789	427 365	410 872

4.5. InterGenomics: Interbull genomic evaluation of the BSW and Holstein populations

Interbull Centre conducts genomic evaluation of the BSW population on behalf of the countries with Brown Swiss dairy cattle (“InterGenomics”), and small Holstein populations (InterGenomics-Holstein). Statistics on these evaluations are presented in tables 4.4 and 4.5.

The InterGenomics (BSW) process has been further streamlined by implementing the version 3 of Findhap imputation software distributed by USDA (Findhap⁸). The work on streamlining the process continued resulting in a better handling and checking of incoming data, introduction of a dedicated repository making easier and more accurate traceability of changes made to the programs.



Table 4.4: Size of the Interbull Centre operations for InterGenomics (Brown Swiss)

InterGenomics (Genomic evaluation of BSW populations)	Dec 2018	Dec 2019	Dec 2020
Countries	8	8	8
Country-trait combinations	280	280	280
Unique submitted genotypes	37 913	44 625	52 352
Genotypes entering imputation & genomic evaluation	32 557	36 791	41 665
Distributed international genomic estimated breeding values	8 579 480	10 301 760	11 666 480

InterGenomics countries: Canada, France, Germany, Austria, Italy, Slovenia, Switzerland, USA.

During the current period, official InterGenomics evaluations were performed for the first time for Holstein populations - in December 2020. Details on the development of this service can be found in §8.3. The size of the Interbull Centre operations for the InterGenomics-Holstein December 2020 routine run is reported in table 4.5.

Table 4.5: Size of the Interbull Centre operations for InterGenomics-Holstein

InterGenomics-Holstein (Genomic evaluation of small Holstein populations)	Dec 2020
Countries	4
Country-trait combinations	89
Contributors	3
Unique submitted genotypes	34 911
Genotypes entering imputation & genomic evaluation	12 280
Distributed international genomic estimated breeding values	776 346

InterGenomics-Holstein countries: Ireland, Israel, Slovenia, South Korea.

⁸ <https://aipl.arsusda.gov/software/findhap/>

5. SERVICES and OPERATIONS – International Beef Evaluations (Interbeef)

Interbeef routine evaluations are performed two times per year, in January and October. During the current reporting period, two routine runs were conducted in October 2020 and January 2021. In the October 2020 routine run 2 new countries joined the Interbeef Service:



- Slovenia (SVN), with adjusted weaning weight (aww) and calving traits (birth weight (bwt) and calving ease (cae)) for Charolais and Limousin breeds;
- Latvia (LVA), with aww trait for Charolais and Limousin breeds.

Results of the calving test run for Aberdeen Angus and Hereford breeds were delivered in October 2020 to the 3 participating countries (CZE, DFS and IRL). The organisations involved expressed their preference to go through an additional test run (April 2021) in order to test the new models that will be implemented at national level in the first months of 2021.

Results of the Interbeef Pilot run for ITA on aww trait for Limousin breed were delivered to AIA in April 2020 and presented during the Interbeef Technical and Working Group meeting in July 2020. The Organisation expressed their interest in joining the April 2021 test run.

Results of the Interbeef Pilot run for EST on aww trait for Limousin and Aberdeen Angus breeds and calving ease trait for Limousin breed were delivered to the Eesti Põllumajandusloomade Jõudluskontrolli AS Organisation in January 2021. The distribution of Interbeef evaluations results across breeds, traits and countries is reported in table 5.1.

Table 5.1: Distribution of evaluation across breeds, traits and countries

	AAN		HER			SIM		CHA			LIM			TOTAL
	aww	aww	Aww	bwt	cae	aww	bwt	cae	aww	bwt	cae			
AUS						✓			✓				2	
CZE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11	
DEU	✓	✓	✓			✓			✓				5	
DFS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11	
FRA						✓	✓	✓	✓	✓	✓	✓	6	
IRL	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11	
ZAF						✓	✓						2	
CHE	✓	✓	✓			✓			✓				5	
GBR									✓	✓	✓	✓	3	
SVN						✓	✓	✓	✓	✓	✓	✓	6	
LVA						✓			✓				2	
TOTAL	5	5	5	3	3	10	6	5	10	6	6		64	

Interbeef breeding values are estimated using MiX99 Software. Reliabilities are calculated using the MTEDC5 package. Variance components for aww are estimated by ICBF using the DMU package, variance components for calving traits (bwt and cae) are estimated by CMBC using the BLUPF90 package.

Statistics on the Interbeef evaluations of the beef breeds Charolais, Limousin, Simmental, Hereford and Aberdeen Angus are presented in table 5.2.

Table 5.2: Size of the Interbull Centre operations for Interbeef

Interbeef	Jan 2019	Jan 2020	Jan 2021
Countries	9	9	11
Evaluation breeds	5	5	5
Country-breed-trait combinations	55	57	65
Animals in the pedigree database	35 109 302	36 502 945	40 843 119
Submitted phenotype records	40 734 117	42 548 308	43 646 793
International estimated breeding values*	257 156 657	266 458 024	354 191 720
Publishable international estimated breeding values *	6 805 936	7 429 550	5 175 455

* Direct + maternal EBVs are counted as one.

6. DATA EXCHANGE SERVICES – Interbull Centre

6.1. GenoEx-PSE

GenoEx-PSE (Parentage SNP Exchange) is the first service on Interbull Centre's International Genotype Exchange Platform. The main purpose of GenoEx-PSE is to provide a service for exchanging standardised sets of SNPs for genotyped



animals to facilitate and streamline parentage analysis activities carried out by organisations that are responsible and/or active in parentage integrity. One of the key benefits of joining GenoEx-PSE is that AI bull owners will have more accurate identity of daughters in countries importing semen. GenoEx-PSE is also expected to assist with the transition from the use of microsatellites to the use of SNP for parentage verification.

Table 6.1: GenoEx-PSE Users (February 2021)

Country	Organisation
Denmark	SEGES Danish Agriculture & Food Council F.m.b.A
Germany	VIT w. V. IT-Solutions for Animal Production
Ireland	ICBF Irish Cattle Breeding Federation
Italy	ANAPRI Associazione Nazionale Allevatori Razza Pezzata Rossa Italiana ANAFIJ Associazione Nazionale Allevatori della Razza Frisona e Jersey Italiana
Japan	LIA Livestock Improvement Association of Japan, Inc.
Norway	GENO Geno Global Ltd
Poland	NRIAP National Research Institute of Animal Production
Slovenia	AIS Agricultural Institute of Slovenia

GenoEx-PSE is available for any cattle breed, both beef and dairy. Currently the exchange of genotypes for Parentage Verification is enabled. Interbull Centre has developed the exchange of genotypes for Parentage Discovery in GenoEx-PSE, as well as additional Service User management and this will be launched once the ICAR accreditation for DNA data interpretation for Parentage Discovery is available - since the valid accreditation for each type of data is an important prerequisite for participation in this service. Further details, including User Manual, Code of Practice and Service User Agreement are available on the [GenoEx website](https://genoex.org/)⁹.

6.2. GenoEx-GDE

GenoEx-GDE (Genomic Data Exchange) builds on the International Genotype Exchange Platform ("GenoEx"): a platform for exchanging genotypes in a standardised way and within a user's group that defined by the genotypes' owner.

GenoEx-GDE provides an easy way for exchanging large genotypes datasets, facilitating building reference populations, decreasing costs by avoiding re-genotyping the same individuals and encouraging development of genomic evaluation.

⁹ <https://genoex.org/>

The beta version of GenoEx-GDE was released for testing in August 2020 to Brown Swiss Organisations participating in the InterGenomics Service. Interbull Centre distributed also the support program “gxprep.py” aimed at converting the genotypes files in a compatible format to be uploaded on GenoEx-GDE.

Based on the positive feedback from the Brown Swiss community, GenoEx-GDE was officially introduced ahead of the January 2021 InterGenomics test run.

The Brown Swiss Organisations, with support from Interbull Centre, uploaded on GenoEx-GDE all their historical genotypes previously submitted for the InterGenomics Service using the 705 file format. Interbull Centre verified the consistency of the submitted genotypes and scheduled the full implementation of GenoEx-GDE for the genotypes exchange starting from the InterGenomics April 2021 routine run.

Interbull Centre is working towards enhancing both the GenoEx-GDE user experience (by developing/implementing high-priority web interface features) and the technical quality of the Service (i.e. cross-referencing ICAR DNA WG recommendations on genotypes quality control or connecting GenoEx-GDE to IDEA, by developing/implementing database features).

Following the official implementation of GenoEx-GDE in the InterGenomics Service, Interbull Centre will work towards extending the use of the GenoEx-GDE database to other Service Users.

6.3. Exchange of information on Genetic recessive traits

Exchange of information on genetic recessive traits via the IDEA AnimInfo module continues. Information on genetic recessive traits so far shared is based on the WHFF official list ([Genetic traits¹⁰](#)) and only used for Holstein populations. The Interbull Centre works with the ICAR Breed Associations WG and Interbeef WG in establishing a similar service for beef cattle. Interbull Centre’s AnimInfo has been set up to easily expand the current service to other breeds.

Countries that have signed up to this service are Australia, The Netherlands, Germany, Belgium, Switzerland, Canada and United Kingdom. The shared data includes information on the following traits: Cholesterol Deficiency (76,939 records); Polled (19,200); Brachyspina (28,213); Bovine Leukocyte Adhesion Deficiency (BLAD, 122,666); Mule Foot (2,055); Deficiency of Uridine Monophosphate Synthase (DUMPS, 25,223); Complex Vertebral Malformation (CVM, 53,456); Citrullinemia (2,457); blood clotting disorder “Factor X1” (7).

As stated in the Interbull Code of Practice, Appendix X, handling of possible conflicting information is the responsibility of the national Genetic Evaluation Centres (NGECs) and, when applicable, of the third party providing such information. During the period covered by this report, participating NGECs have actively collaborated in resolving as many data conflicts as possible.

¹⁰ <http://www.whff.info/documentation/genetictraits.php#go1>

7. EUROPEAN UNION REFERENCE CENTRE (EURC)

As the European Union reference centre (EURC Zootechnics - Bovine Breeding), the Interbull Centre is responsible for the scientific and technical contribution to the harmonisation and improvement of the methods of performance testing and genetic evaluation of purebred breeding animals of the bovine species in the European Union.



7.1. EURC Performance Recording, Evaluation and Publication (PREP) Database

Interbull Service Users and National Genetic Evaluations Centres are acquainted with Forms “GE”, “GENO” and “BEEF” to describe their national systems for performance recording and genetic & genomic evaluation. In its function as the EU Reference Centre, and in order to harmonise and standardise performance recording and evaluations, the Interbull Centre is expanding its service to collect and provide information from breeds, populations and evaluation system. The Interbull Centre’s current information system for performance testing and genetic evaluations will be updated in order to make it scalable and efficient in dealing with and sharing of information from an increased number of organisations. It has therefore developed a database that enables the collection of additional information, and harmonisation of the information in order to make it comparable between organisations: EURC Performance Recording, Evaluation and Publication (“PREP”) Database.

While development of the PREP DB continues, to date information for dairy (milk, fat and protein) and beef (adjusted weaning weight) for Interbull Service Users and their breeds, has already been assimilated, specifically for the trait definition, data processing and statistical procedures. Once the PREP DB has been completed, breed societies and third parties designated by breed societies (NGEC’s) can give information in a standardised way (rather than ‘free text’). Although this may initially be a time-intensive activity, it is expected to be most valuable in an effort to better compare and ultimately harmonise performance testing and genetic evaluation methodologies. The type of information collected includes:

- Meta information on breeding “chain” (countries, organisations and populations)
- trait definition used (specifications, or e.g. ICAR standards)
- time periods for data collection and analysis
- processing and statistical procedures (levels for details).

7.2. EURC Validation service

Conventional Validation tests provide reassurance to the National Genetic Evaluation Centres, cattle organizations and farmers that the bias in their statistical models applied for a given breed/trait are within a tolerated threshold of 2%. This is an assurance that their statistical models applied are sound and fit well their data avoiding any under/over estimation of their animals’ genetic worth.

Validation tests have been available for breeds and countries involved in Interbull’s international evaluations for many years. In 2020, the Interbull Centre performed 252 of such validation tests to National Genetic Evaluation Centres.

Now, in its function of EURC, the Interbull Centre is making validation test I and III (Interbull CoP Appendix III¹¹), available to all national genetic evaluations:

- a) For all **dairy breeds** that have been registered with their national competent authorities in line with EU Regulation 2016/1012, commonly known as the “EU Animal Breeding Regulation” (Zootechnics¹²);
- b) Whether or not they participate in Interbull international evaluations;
- c) Applicants will be required to complete the **Performance Recording, Evaluation, and Publication Forms** (“PREP” Form) for the traits they wish to get validated;
- d) The EURC validation test is currently limited to Production Traits (Milk, Fat and Protein), and will be expanded to additional traits as soon as the PREP form for such traits will be available;
- e) Both applicants and relevant Competent Authorities will be notified of the outcome of the validation;
- f) Such results will also be made available on the EURC section on the Interbull Centre’s website.

¹¹ https://interbull.org/ib/cop_appendix2

¹² https://ec.europa.eu/food/animals/zootechnics/member_states_en

8. OTHER, NEW and IMPROVED SERVICES – Interbull Centre

8.1. New *cma* MACE evaluation: SNP Training for Clinical Mastitis

The mastitis (*mas*) evaluations that have been performed in recent years, combining SCS and (sub-) clinical mastitis information, had lately brought up two main arguments towards the possibility to have a dedicated clinical mastitis (*cma*) evaluation. The two main arguments were the low correlations for national bulls between national and MACE proofs and the need, in the genomic era, to have a foreign reference population for clinical mastitis not affected by the presence of SCS data.

Several pilot investigations have been conducted during 2020 which have led to the following identified criteria for data inclusion:

- Number of daughters and herds shall be based ONLY on clinical mastitis records
- When genetic reliabilities are estimated with a multiple trait model the corresponding EDC calculation shall not be based on a single trait model.
- A bull would require having a minimum of 10 daughters in 10 herds for inclusion in the MACE evaluation (both for correlations and EBV estimation).

The new *cma* evaluation will serve as a SNP training tool for mastitis for countries with national genomic evaluation while the current *mas* evaluation will remain the official international evaluation for publication purposes. Results from the *cma* evaluation, therefore, may not be used for publication purposes.

The first official test run for *cma* has taken place during the January 2021 test evaluation, table 8.1 presents the list of countries/breeds which have submitted specific *cma* data. We welcome further participation from countries with *mas* evaluations.

Table 8.1: Countries per evaluated breed providing data for the new *cma* January 20201 test evaluation.

Country	Breed					Total
	HOL	JER	RDC	BSW	SIM	
CHE	✓			✓	✓	3
CAN	✓	✓	✓			3
DEU	✓					1
DFS	✓	✓	✓			3
FRA	✓			✓		2
GBR	✓	✓	✓	✓	✓	5
NLD	✓					1
USA	✓	✓				2
Total	8	4	3	3	2	20

8.2. Review of MACE Post Processing Windows

According to the current procedure, estimated correlations are required to fall within certain windows' values. For milk production traits, for example, separate windows are maintained depending on the climate and whether or not countries predominantly have grazing system. Two countries with a similar climate and production system (grazing vs. non-grazing) are expected to be more correlated with each other than two countries with different climate or production system. If estimates are lower than the minimum window's value, they are set equal to the minimum window's value specified for that given group. In addition, estimates are regressed towards a mean correlation within groups, the regression depending on the number of common bulls.

Such windows values have been last reviewed during the 2015 Interbull Meeting with the ITC recommendation to periodically reviewing them with a period of 5 years. Following such recommendation, Interbull Centre has in January 2020 re-activated the original WG, with the addition of few new members which we thank for their availability, and new windows have been identified. As before, the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while the minimum window's values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the real estimated ones. Over the past five years, the minimum window's values adopted (based on the 25th percentile) had been found too high causing estimated and post-processed correlations to differ significantly from each other.

Moreover, the weight assigned to the magnitude of changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more in consideration the value of the new estimated ones even when no changes are applied by the countries. The new weights are shown in table 8.2. The revised post-processing procedure (new minimum window's values and weights for countries changes) have been introduced during the January 2021 test run and applied to all breeds and traits. More information can be found on [Interbull procedure](#)¹³.

Table 8.2: Post processing weights

Type of Change	Weight
No changes between Country _{1,2}	2
Small changes between Country _{1,2}	1
Big changes between Country _{1,2}	0

8.3. Interbull genomic evaluation of small Holstein populations (InterGenomics-Holstein)

Interbull Centre and the InterGenomics-Holstein WG established by Interbull Steering Committee worked together toward the implementation of InterGenomics-Holstein as a new Interbull Centre Service.

In April 2020 a research run using genotypes submitted by InterGenomics-Holstein Organisations and Contributors (Organisations willing to provide nationally progeny proven bulls' genotypes to the InterGenomics-Holstein genotypes pool) highlighted the benefit of the increased reference population's size thanks to Contributors' genotypes.

In May 2020 the Interbull method for approximation of genomic reliabilities was applied and the results were approved by the Interbull Technical Committee in June 2020.

The first official InterGenomics-Holstein test run was performed at the Interbull Centre in September 2020 in parallel with the InterGenomics (Brown Swiss) September 2020 test run. The results were delivered to both InterGenomics-Holstein Organisations and Contributors.

The InterGenomics-Holstein WG finalised the [Agreement](#)¹⁴ and shared the final versions with InterGenomics-Holstein Organisations and Contributors in October 2020. The agreements have been

¹³ https://interbull.org/ib/rg_procedure

¹⁴ https://interbull.org/ib/ig_hol_letter_agreement

signed by November 2020, before the start of the first InterGenomics-Holstein routine run, performed in December 2020.

Four InterGenomics-Holstein Organisations and three Contributors joined the InterGenomics-Holstein December 2020 routine run:

- ❖ InterGenomics-Holstein Organisations:
 - Irish Cattle Breeding Federation (ICBF) – Ireland
 - Israel Cattle Breeders Association (ICBA) – Israel
 - Slovenian Holstein Association (HOL-SLO) – Slovenia
 - National Institute of Animal Science (NIAS) - South Korea
- ❖ Contributors:
 - GenEval – France
 - Nordic Cattle Genetic Evaluations (NAV) – Denmark, Finland and Sweden
 - Vereinigte Informationssysteme Tierhaltung (vit) – Germany

The size of the Interbull Centre operations for the first InterGenomics-Holstein routine run in December 2020 is reported in Table 4.5. We welcome further participants into InterGenomics-Holstein. Please contact the Interbull Centre to discuss this at any time.

8.4. Support Services to ICAR

In addition to the genetic and genomic evaluations for dairy and beef, the Interbull Centre provides technical support to ICAR.

ICAR Accreditation of DNA Data Interpretation Centres

Early 2018 ICAR released the Accreditation service for DNA Data Interpretation Centres. The Interbull Centre handles the technical component for the accreditation by distributing the test files and checking the results. The test files are created by a programme, 'Cuckoo', that has been developed by Lactanet, Canada.

As of 28 February 2021, twenty-three organisations have completed the test and are now recognised as ICAR Accredited DNA Data Interpretation Centres (see [ICAR DNA list](#)¹⁵ for the full list). Several of these organisations have been re-accredited, after the original, two-year term of their accreditation came to an end. Visit the [ICAR website](#)¹⁶ for further info.



ICAR Certificate of Quality

The Interbull Centre supports ICAR with the provision of the ICAR Certificate of Quality. During the current reporting period were however no ICAR audits performed due to Covid-19 pandemic-related travel restrictions.

¹⁵ <http://tiny.cc/ICARDNAlist>

¹⁶ http://tiny.cc/ICARDNA_ACCR

9. RESEARCH & DEVELOPMENT – Dairy

The following is a summary of research and development activities conducted at the Interbull Centre or with the involvement of the Interbull Centre staff since June 2020.

9.1. SNPmace WG; International SNP Evaluations

SNPmace Feasibility phase

The SNPmace Project officially started May 2018 and ended November 2019. The aim from this project was to assess the feasibility of an international genomic evaluation without exchange of raw data. The study was conducted using Brown Swiss data from InterGenomics; breeding values estimated using the SNPmace methodology were compared to those obtained from a multi-trait international genomic evaluation based on genotypes. Final results showed that combining the SNP solutions from several Brown Swiss populations gave the same result as combining the raw data. This means that more accurate SNP solutions, and hence more accurate genomic EBVs¹⁷, can be achieved by 1) first analysing training population within a country and then 2) combining the SNP solutions from a range of countries – without the exchange of genotypes!

Following a review of these results at the end of 2019, the Interbull SC decided to build on the positive results of this first phase of the SNPmace project and develop a service to calculate international SNP solutions using data from multiple countries.

SNPmace Implementation phase

The aim for this phase of the project was mainly to fine-tune both the model and the MetaGS software by addressing all the issues that were raised but not planned for in the feasibility phase and to cover the gap between the research analysis and the service implementation by testing the software in a service-like context. Interbull Centre, together with Victoria Agriculture staff based in Melbourne, Australia, investigated successfully the following issues raised by the SNPmace WG and applied the necessary changes to the MetaGS software:

- The inclusion of a mean term in the equations for the SNP solutions
- Impact of the inclusion of a polygenic effect
- An improved method of monitoring convergence of the solver
- Testing of the re-scaling option
- Test accuracy of imputing effects for missing SNPs
- Run the SNPmace analysis for a fertility trait.

In February 2021 ANARB (ITA) tested successfully the software to be run by national genetic evaluation centres. Interbull Centre and the SNPmace WG, in agreement with the Interbull SC, issued a data call in February 2021. The data call is open to BSW and HOL Organisations interested in participating in a pilot run and a validation study. These will be the final steps needed to assess the possibility of a service implementation.

9.2. Genomic Reliabilities (“GREL”) WG

Prior to the current reporting period one single formula has been introduced to calculate the DGV reliabilities (GREL) for all reference animals, taking into consideration the data contribution of both

¹⁷ (Jighly et al., 2019).

bulls and cows. However, the effect of the change of cow reliabilities calculation on candidates remained to be investigated. During the current reporting period, the WG:

- Tested the Interbull GREL method for single-step genomic evaluation and is currently checking the effect of the change in the formulae on candidate genomic reliability values.
- Provided guidance for the implementation of the Interbull GREL methodology in the IgHOL genomic evaluations.

9.3. Genomic Pre-selection (GPS) and Future MACE WG

Following the development of simulation methods for Genomic Pre-selection (GPS) scenarios relevant to MACE¹⁸, and a review of the potential approaches to increase MACE robustness to GPS bias¹⁹, the WG has started in the current reporting period developing new MACE software, which will account for GPS effects on the distributions of breeding values over time. This work will continue during 2021.

9.4. Genomic-free EBV WG

Many National Genetic Evaluation Centres (NGECs) within the Interbull Community have implemented or are working toward implementing a single step procedure in their routine evaluations. One issue that these NGECs are or will be facing is that the EBV produced by a single step evaluation includes genomic information and thus cannot be submitted as input for MACE. Some of these NGECs have requested Interbull to give some recommendations on how to produce genomic-free output that can be used in MACE without having to run the evaluation twice. The Interbull Technical Committee (ITC) created a dedicated WG in order to elaborate recommendations to the NGECs on this matter. Members of this WG were Gert Pedersen Aamand, Gerben de Jong, Zengting Liu, Mike Goddard, Paul VanRaden, Esa Mäntysaari, Pete Sullivan and Haifa Benhajali.

The WG held two conference calls to discuss different proposals that were suggested by its members. Final recommendations were elaborated and submitted to ITC, and subsequently SC, for approval. After approval from ITC and SC, a dedicated webinar “**Genomic-free EBV for MACE**” was organised by Interbull Centre and held on 11 February 2021, with over 100 registrants, to share the final recommendations with the Interbull Community.

During the webinar, chaired by Gert Pedersen Aamand (Genomic-Free EBV WG chair) it was explained that the activity of the “Genomic-free EBV” WG was aimed at identifying new solutions to produce genomic-free EBVs that could be used as input for the MACE evaluation. Pete Sullivan presented the Genomic-Free EBV WG recommendations. After an interesting discussion all participants agreed on the solutions identified by the WG and no objections were raised. With this webinar, the task of the Genomic-Free EBV WG has been completed.

9.5. Validation WG

Following a decision from the Interbull Technical Committee during the Dubrovnik meeting, the Validation WG was created to address the various validation issues both NGECs and ITBC are facing due to the new developments at the national level (genomic pre-selection, single step methods, etc.). Members of the group are Esa Mäntysaari (Chair), Paul Van Raden, Zengting Liu, Pete Sullivan, Raphael Mrode and Valentina Palucci. The investigation of the WG is ongoing and currently focuses on gathering experience on new validation techniques available from scientific literature.

¹⁸ (Benhajali et al., 2019)

¹⁹ (Sullivan et al., 2019)

10. RESEARCH & DEVELOPMENT – Beef

For Interbeef research projects that are not performed by Interbull Centre, data - including genotypes where appropriate - from participating organisations are sent to ITBC for renumbering of animal identification number, extraction of pedigree from IDEA and creation of the pedigree file needed in the project. All files are then sent to the research partner.



10.1. Carcass project

A pilot evaluation for carcass traits was performed by ICBF (Ireland) and the results distributed to the participating countries by ITBC. The evaluation involved:

- 3 traits: Carcass weight (cwe), Carcass conformation (cco) and Carcass fat (cfa)
- 4 countries: DFS, GBR, IRL and CHE;
- 3 breeds: CHA, LIM and SIM.

During the January 2021 Interbeef Technical and Working Group meeting, the participants agreed on a new data call (using IDEA database) aimed at collecting data for the Interbeef April 2021 test run.

10.2. Fertility project

Romain Saintilan (GenEval, FRA) and Wolfgang Ruten (vit, DEU) worked on an agreement for trait definition and data consistency among countries.

During the January 2021 Interbeef Technical and Working Group meeting, the participants agreed on a data call aimed at collecting data in concomitance with the Interbeef April 2021 test run. Pedigree information will be uploaded to the IDEA database while for performance data, flat files will be used. The data call will be focused on 2 traits: number of calving (nca) and calving interval (cai)

10.3. Validation of national and international models WG

A first meeting among the “Interbeef Validation WG” members and the three Interbeef scientific advisors (Dorian Garrick (Massey University, NZL), Roel Veerkamp (WUR, NLD), Esa Mäntysaari (LUKE, FIN)) was held on 4 June 2020.

Terms of Reference were agreed within the WG, and a survey was sent out to Interbeef members to 1) assess the degree of validation performed at country level and 2) define the specific needs of the Interbeef countries.

10.4. Variance Component WG

In relation with the increasing number of breed-trait-country combinations, exchanges of VCE parameters require to be more and more automated. As the Interbeef workflow will be updated (in particular to cope with carcass traits), a set of files to define Interbeef model and the associated parameter has been discussed within the WG.

11. INTERBULL CENTRE INFRASTRUCTURE & DATA EXCHANGE

The Interbull Centre has an efficient, effective, versatile, scalable, and powerful computing infrastructure. It consists of customer facing software services and databases for data exchange: Interbull **Data Exchange Area** (“IDEA”) and International **Genotype Exchange Platform** (“GenoEx”), as well as a cluster system with attached clustered file storage that is used for high-performance data analysis and tools for system monitoring, operational system management, backups, communication and project management. Software costs are kept low by use of many well-vetted Open Source components, while the performance and ease of maintenance of the system has been honed by years of experience doing large-scale data analysis at the Interbull Centre.

The Interbull Centre continues to invest in infrastructure improvement in order to continue to provide an increasing number of services efficiently.

11.1. System Maintenance and Development

During this reporting period, system administration focused particularly on the following areas:

- Updating of systems and operating systems and other maintenance tasks has been improved and new routines has been implemented.
- Hosting of Virtual Machines has been restructured. Dedicated servers to host Virtual Machines have been setup. Redundancy has been setup to minimize down time in case of hardware failure, and synchronization has been setup to minimize data loss.
- Warm-standby server for PostgreSQL has been implemented to minimize the risk of data loss and downtime.
- A new calculating cluster, “Urd”, has been taken into production. The new system has enhanced security and improved functionality. These are resources that Interbull have full control and mandate to coordinate and use as required. Calculating nodes are server grid hardware with fast CPU's and sufficient amount of RAM-memory. File storage has been restructured and divided into smaller parts for better maintainability. File servers have been set up with RAID and replication to minimize downtime and data loss in case of hardware failure. There is also a synchronization to off-site file servers. A web has been designed that contains information for users on how to connect to and use the system. It also contains other useful information from and about the system, with status and summary information from the system.
- Migrating from operating system CentOS to Debian on the majority of our servers, including testing, evaluating, and rewriting of installation scripts. This was initiated due to the uncertainty of the future for CentOS after supporting organisation RedHat was purchased by IBM, and that -at a later stage- support for different versions of CentOS was dropped.

12. RESEARCH & DEVELOPMENT – External funding

In addition to funds raised from service fees, research and development activities at the Interbull Centre are financed by grants from the Swedish University of Agricultural Sciences (SLU) and the European Union.

Contributions of the above organisations to the development of Interbull Centre services are gratefully acknowledged. Contributions made to R&D activities from participating organisations leading to improved or expanded Interbull Centre services are also much appreciated and welcomed.

Interbull Centre's involvement in the following international consortia is focused on providing services to the project (enabling international exchange of data; quality control), and on developing services to the Interbull Community (several of whom are involved in the projects), in line with the Interbull 2020-2023 Strategic Plan.

12.1. “GenTORE”

Project title: *Genomic management tools to optimise resilience and efficiency*

Project Period: 1 June 2017 – 31 May 2022 (60 months);

Funding source: European Commission; Horizon2020, Research and Innovation action;

Website: GenTORE²⁰ or interbull/gentore²¹

Twitter: [@GenTORE_2020](https://twitter.com/GenTORE_2020)



GenTORE WP4 aims to develop new evaluations for traits related to

efficiency and resilience. “Age at Slaughter” has been identified as a proxy for resilience.

Organisations involved in Interbeef have relevant data available. Interbeef partners have started with analysis of age at slaughter and carcass data in order to develop international breeding value estimations through Interbeef for such traits. Interbull Centre will collect and store performance data from Interbeef members on “Age at slaughter” for the GenTORE project in the Performance Database.

Interbull Centre will, as part of GenTORE activity, rewrite the Interbeef workflow to enable the incorporation of traits such as “Age at Slaughter” in its Interbeef Workflow and deliver this new trait.

12.2. “International Genetic and Genomic Evaluations of Beef Cattle”

Project Period: 1 May 2018 – 1 May 2022 (48 months);

Funding source: ICBF, ICAR, Interbull

PhD Project carried out by PhD Candidate Renzo Bonifazi. The aim of this research is to investigate some of the upcoming challenges in beef international evaluations. The research question can be further divided into four objectives:

1. How to improve genetic parameter estimation across Interbeef populations and provide reliable estimates when few genetic links exist among populations?
2. Which is the most appropriate genomic model for beef cattle international evaluations and how much gain in term of genomic reliability can be achieved through international cooperation?
3. Which is the most efficient way to integrate beef international genetic and genomic proofs at the national level?
4. How to include difficult-to-measure traits in international beef evaluations?

In 2020, Interbull Centre supported Renzo in data interpretation for Objective 2, which was Renzo's main focus of activity during this reporting period.

²⁰ www.GenTORE.eu

²¹ www.interbull.org/ib/gentore

13. SERVICE CALENDARS

Schedules for International dairy and beef evaluations at the Interbull Centre are released upon approval by the Interbull Steering Committee and the Interbeef WG respectively. The Service Calendars are scheduled well in advance so that national genetic evaluation centres and the Interbull Centre can plan their activities accordingly.

The latest service calendars are available online:

- [Interbull service calendar](http://www.interbull.org/ib/servicecalendar)²²
- [Interbeef service calendar](http://www.icar.org/index.php/technical-bodies/working-groups/interbeef-working-group)²³

14. MEETINGS

14.1. 2020 Interbull Annual Meeting: Q&A

The 2020 Interbull Annual meeting was cancelled due to the risks posed by the COVID-19 pandemic. As disappointing as this might have been, this decision was made to protect the health of everyone involved.

Considering the truly international character of the Interbull Community spread over 5 continents and therefore operating in a wide range of time zones:

1. Videos were created as a substitute for the Business Meeting presentations. The videos could be viewed where and when convenient for our stakeholders;
2. Two “Interbull 2020 Question & Answer Meetings” were organised at two different times on two different days in two different weeks.

The Meetings focussed on business topics, rather than technical ones. As in previous years, the Interbull Centre Activity and Finance Reports were made available online. The Interbull Centre’s and Interbull Committee’s activities were presented, as well as the recommendations from the Business Funding Models Task Force and the Draft Interbull 2020-2023 Strategic Plan, resulting from the January 2020 Interbull strategic planning meeting in Uppsala. The videos and reports can be accessed through the Interbull website: [Interbull meeting](https://interbull.org/ib/2020_interbull_meeting)²⁴.

The topics that were identified for the 2020 Interbull Open Meeting were moved forward to the 2021 Interbull Open Meetings, which are now scheduled on 26 and 30 April 2021.

14.2. Interbeef Meetings

Interbull Centre staff (Alexis Michenet, Simone Savoia, Toine Roozen) co-organised and attended the following Interbeef meetings during the reporting period.

- Interbeef Working & Technical Groups meeting:
 - 8 July 2020
 - 3 November 2020
 - 28 January 2021
- Interbeef webinar “Seminar in International breeding evaluation during course in Cattle production “, 10 December 2020

²² <http://www.interbull.org/ib/servicecalendar>

²³ www.icar.org/index.php/technical-bodies/working-groups/interbeef-working-group

²⁴ https://interbull.org/ib/2020_interbull_meeting

14.3. Interbull Annual Meetings

The SC agreed to organise the Interbull Annual Meetings jointly with ICAR in even years (2020, 2022, etc.), while alternating the odd years between EAAP (2021, 2025 etc.) and ADSA (2019, 2023, etc.). Due to the COVID-19 Pandemic, this schedule has required adjustments and will need to be reviewed further. This has resulted in joint Interbull-ICAR meetings in two consecutive years.

26 – 30 April 2021: The Interbull-ICAR meeting that was originally scheduled for June 2020, has been rescheduled to 26-30 April 2021. This will be a virtual meeting: icar2021.nl.

28 May – 3 June 2022: The Joint ICAR-Interbull Meeting will be held in Montreal, Canada.



15. COMMUNICATIONS and PUBLICATIONS

15.1. Interbull Bulletin and Website

The **Interbull Bulletin** contains the state-of-the-art in genetic evaluation methods, as well as the most recent information on national and international implementations. As no Open Meeting was organised in 2020, no new issue of the Interbull Bulletin has been published. All issues can however still be accessed through [Interbull journal](http://interbulljournal.org)²⁵

The websites for [Interbull](http://interbull.org)²⁶ and the [Genotype](http://GenoEx.org)²⁷ Exchange Platform have been updated with the latest information, including Interbull Centre Activity and Finance Report, as well as the 2020-2023 Strategic Plan and 2021 Operating Plan: [Reports](http://interbull.org/reports)²⁸

Pictures of Interbull events remain available in the 'Hall of Fame': [Photos](http://interbull.org/photos)²⁹

15.2. Publications of Interbull Centre staff and consultants

Pete Sullivan wrote a Chapter summarising past, present and future genetic and genomic evaluation services offered by Interbull in "International genomic evaluation methods for dairy cattle" for the ebook: van der Werf, J. and Pryce, J. (ed.), *Advances in breeding of dairy cattle*, Burleigh Dodds Science Publishing, Cambridge, UK, 2019, (ISBN: 978 1 78676 296 2; www.bdspublishing.com) <http://dx.doi.org/10.19103/AS.2019.0058.23>.

The following paper is under review (submitted to Journal of Advanced Research (IF: 6.99)):
Jighly A, **Benhajali H**, Liu Z, Goddard M (2021) MetaGS: An accurate method to impute and combine SNP effects across populations using summary statistics.

²⁵ <https://journal.interbull.org/>

²⁶ www.interbull.org

²⁷ <https://GenoEx.org>

²⁸ <http://interbull.org/ib/itbcreports>

²⁹ <http://interbull30years.blogspot.se/>

Appendix 1: Interbull and Interbeef WG and TF compositions.

Interbull Centre personnel is represented in various Committees, Task Forces and Working Groups. Full membership for these groups is provided below. Within brackets are members of the Interbull Centre team who regularly attend the meetings of the group, even if not official group member.

ICAR's Sub-Committees and Working Groups:

- **Interbull Steering Committee:**

Matthew Shaffer (Chair), Brian Van Doormaal (Vice-Chair), Gerben de Jong, Marija Klopčič, Sophie Mattalia, Gert Pedersen Aamand, Enrico Santus, Gordon Doak, Urs Schnyder (**Toine Roozen, Valentina Palucci**).

- **ICAR ID Subcommittee:**

Jo Quigley (Chair), Kaivo Ilves, Folkert Vonken, **Valentina Palucci**, Othon Reynoso Campos.

- **ICAR DNA WG:**

Brian Van Doormaal (Chair), André Eggen, Suzanne Harding, Dariusz Kamola, Michael Keane, Sandra Kipp, Raffaele Mazza, Matthew McClure, Romy Morrin-O'Donnell, Nilesh Nayee, Ezequiel Nicolazzi, **Joanna Sendeck**a, Wim van Haeringen, Jiansheng Qiu.

- **Interbeef WG:**

Andrew Cromie (Chair), Robert Banks, Emma Carlén, Mike Coffey, Mauro Fioretti, Laurent Griffon, Svenja Strasser, Japie van der Westhuizen (**Toine Roozen, Simone Savoia, Alexis Michenet**).

- **Beef Genetic Traits WG**

Suzanne Harding (chair), Jennifer McClure, matthew McClure, Catalin Rotar, Steven Skinner, Alena Svitakova, Kevin Byskov, Pauline Michot, Brian Wickam, Alexis Michenet, Valentina Palucci

Steering Committee's Working Groups and Task Forces:

- **Interbull Technical Committee:**

Gert Pedersen Aamand (Chair), Gerrit Kistemaker, Tom Lawlor, Paul VanRaden, Zengting Liu, Raphael Mrode, Esa Mäntysaari, Gerben de Jong, Peter Sullivan, **Simone Savoia (Toine Roozen, Valentina Palucci, Joanna Sendeck**a, **Alexis Michenet**)

- **Interbull Scientific Advisory Committee:**

Mike Goddard, Daniel Gianola and Ignacy Misztal.

- **SNPMace WG:**

Enrico Santus (Chair), **Toine Roozen** (Secretary), Mike Goddard, Vincent Ducrocq, Esa Mäntysaari, Zengting Liu and **Simone Savoia**.

Work is carried out by Abdulqader Jighly (Victoria Agriculture), **Haifa Benhajali** and **Simone Savoia** (Interbull Centre).

- **EU Reference Centre WG:**

Toine Roozen, Marija Klopčič, Sophie Mattalia (Chair), **Joanna Sendeck**a and **Valentina Palucci**.

Work is carried out by **Joanna Sendeck**a and **Valentina Palucci**.

- **Business Funding Models Task Force:**

Brian Van Doormaal (Chair), Matthew Shaffer, Sophie Mattalia, **Toine Roozen**.

- **InterGenomic-Holstein (IgHOL) WG:**

Maria Klopčič (Chair), Sophie Mattalia, Brian Van Doormaal, **Toine Roozen, Simone Savoia**

Work is carried out by **Simone Savoia**.

- **New traits Pipeline WG:**
Gerben de Jong, Gordon Doak, **Toine Roozen, Valentina Palucci.**

Technical Committee's Working Groups:

- **Genomic free EBV WG (dissolved February 2021):**
Gert Pedersen Aamand (Chair), Gerben de Jong, **Pete Sullivan**, Paul Van Raden, Mike Goddard, Esa Mäntysaari, Zengting Liu, **Haifa Benhajali.**
- **Genomic Reliability (GREL) WG:**
Zengting Liu (Chair), Mario Calus, Martin Lidauer, Vincent Ducrocq, Paul VanRaden, **Haifa Benhajali.**
- **Genomic Pre-selection (GPS) & Future MACE WG:**
Pete Sullivan (Chair), Esa Mäntysaari, Gerben de Jong, **Haifa Benhajali.**
- **Validation WG:**
Esa Mantyssary (Chair), Zengting Liu, Paul VanRaden, Pete Sullivan, Raphael Mrode and **Valentina Palucci.**
Work is carried out by Pete Sullivan and Esa Mantyssary.
- **Post processing of MACE correlations WG:**
Raphael Mrode (Chair), Zengting Liu, Paul VanRaden, Tom Lawlor and **Valentina Palucci.**
Work is carried out by **Valentina Palucci.**

Interbeef Working Groups:

- **Interbeef Technical Group:**
Romain Saintilan (Chair), Andrew Cromie, Thierry Pabiou, Ross Evans, Wolfgang Ruten, Laurent Griffon, Brad Crook, Sophie Kunz, **Simone Savoia and Alexis Michenet (Toine Roozen).**
- **Interbeef Validation WG:**
Ross Evans (Chair), Thierry Pabiou, Romain Saintilan, Dorian Garrick, Roel Veerkamp, Esa Mäntysaari, **Alexis Michenet.**
Work is carried out by **Alexis Michenet and Simone Savovia**
- **Interbeef VCE WG:**
Thierry Pabiou (Chair), Wolfgang Ruten, Zdenka Vesela, Sophie Kunz, **Simone Savoia, Alexis Michenet.**
Work is carried out by **Alexis Michenet and Simone Savoia**
- **Advisory Committee for the PhD Project "International Genetic and Genomic Evaluations of Beef Cattle" by Renzo Bonifazi:**
Roel Veerkamp (Promotor), Mario Calus, Jeremie Vandenplas, Jan ten Napel, Ross Evans, Martino Cassandro, Emiliano Lasagna, **Simone Savoia (Alexis Michenet (Toine Roozen).**