INTRODUCTION

The latest genomic routine international evaluation for **females' fertility** traits took place as scheduled at the Interbull Centre. Data from 18 countries were included in this evaluation.

International genetic evaluations for female fertility traits of bulls from Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany,
Ireland, Israel, Italy, Netherlands, New Zealand, Norway, Poland, Spain, Sweden, Switzerland, South Africa, the United Kingdom and the United States of America were computed.
Holstein data were included in this evaluation.

BEL, CAN, DEU, ESP, FRA, DFS, GBR, ITA, NLD, POL submitted GEBVs.

cc1: CAN, DEU, , FRA, DFS, GBR, ITA, NLD, POL
cc2: BEL, CAN, DEU, ESP, FRA, DFS, GBR, ITA, NLD, POL
crc: BEL, CAN, DEU, ESP, FRA, DFS, GBR, ITA, NLD, POL
hco: CAN, DEU, , FRA, DFS, , , NLD, POL
int: BEL, CAN, DEU, ESP, , DFS, GBR, ITA, NLD, POL

Based on a decision made by Interbull Steering committee in August 2007, female fertility traits are classified as follows:

T1 (HC): Maiden (H)eifer's ability to (C)onceive. A measure of confirmed conception, such as conception rate (CR), will be considered for this trait group. In the absence of confirmed conception an alternative measure, such as interval first-last insemination (FL), interval first insemination-conception (FC), number of inseminations (NI), or non-return rate (NR,preferably NR56) can be submitted;
T2 (CR): Lactating (C)ow's ability to (R)ecycle after calving. The interval calving-first insemination (CF) is an example for this ability. In the abscence of such a trait, a measure of the interval calving-conception, such as says oprn (DO) or calving interval (CI) can be submitted;
T3 (C1): Lactating (C)ow's ability to conceive (1), expressed as a rate trait. Traits like conception rate (CR) and non-return rate (NR, preferably NR56) will be considered for this trait group;
T4 (C2): Lactating (C)ow's ability to conceive (2), expressed as an interval trait. The interval first insemination-conception (FC) or interval first-last insemination (FL) will be considered for this trait group. As an alternative, number of inseminations (NI) can be submitted. In the abscence of any of these traits, a measure of interval calving-conception such as days open (DO), or calving interval (CI) can be submitted. All countries are expected to submit data for this trait group, and as a last resort the trait submitted under T3 can be submitted for T4 as well.
T5 (IT): Lactating cow's measurements of (I)nterval (T)raits calving-conception, such as days open (DO) and calving interval (CI).

Based on the above trait definitions the following traits have been submitted for international genetic evaluation of female fertility traits.

Country	Traits	Submitted traits and their definitions
AUS	T2=CY	Calving interval converted to 42 days pregnancy rate
	T4=C2	Calving interval converted to 42 days pregnancy rate
	T5=IT	Calving interval converted to 42 days pregnancy rate
BEL	T2=CY	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
	T4=C2	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
	T5=IT	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
CAN	T1=HC	NR=Non Return Rate after 56 Days in heifers (NRR), %
	T2=CY	CF=Interval from Calving to First Service in cows(CF)
	T3=C1	NR=Non Return Rate after 56 Days in cows(NRR), %
	T4=C2	FC=Interval first insemination-conception in cows
	T5=IT	DO=Days open
CHE	T1=HC	CR=Heifers' Conception rate
	T2=CR	CF=Interval from Calving to First Service (ICF), days
	T3=C1	NR=Non Return Rate after 56 Days (NRR), %
	T4=C2	NR=Non Return Rate after 56 Days (NRR), %
CZE	T1=HC	CR=Heifers' Conception rate (pregnant or not after 3 months)
	T3=C1	CR=Cows' Conception rate (pregnant or not after 3 months)
	T4=C2	CR=Cows' Conception rate (pregnant or not after 3 months)
AUT/DEU	T1=HC	NR=Heifers' Non Return Rate after 56 days
	T2=CY	CF=Interval from calving to first insemination cows (days)
	T3=C1	NR=Cows' Non Return Rate after 56 days
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=Days open (days)
DFS	T1=HC	NR=Heifers' Non Return Rate after 56 days
	T2=CY	CF=Interval from calving to first insemination cows (days)
	T3=C1	NR=Cows' Non Return Rate after 56 days
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=Days open (days)
ESP	T2=CY	DO=Days open
	T4=C2	DO=Days open
	T5=IT	DO=Days open
FRA	T1=HC	CR=Heifers' Conception rate (binary trait) for maiden heifers
	T2=CY	Interval between calving and first AI
	T3=C1	CR=Cows' Conception rate (binary trait) for cows
	T4=C2	FL=Interval from first to last insemination cows (days)
GBR	T2=CY	CI=days between 1st and 2nd calvings
	T3=C1	NR=1st lactation non return at 56 days
	T4=C2	CI=days between 1st and 2nd calvings
	T5=IT	CI=days between 1st and 2nd calvings
IRL	T2=CY	CI=Calving interval
	T4=C2	CI=Calving interval
	T5=IT	CI=Calving interval

ISR	T3=C1	CR=Inverse of the number of insemination to conception (%)
	T4=C2	CR=Inverse of the number of insemination to conception (%)
ITA	T2=CY	CF=Days to first service
	T3=C1	NR=Non-return rate at 56 days (%)
	T4=C2	CI=Calving Interval (days)
	T5=IT	CI=Calving interval (days)
ITA(BSW)	T2=CY	CF=Interval calving to first insemination
	T4=C2	Days Open
	T5=IT	CI=Calving interval
NLD	T1=HC	CR=Heifers' Conception rate
	T2=CY	CF=Interval calving to first insemination (days)
	T3=C1	CR=Cows' Conception rate (binary trait) for cows
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	CI=Calving Interval (days)
NOR	T1=HC	NR=NR=Non-return rate 56 days (heifers)
	T2=CY	CF=Interval calving to first insemination (days)
	T3=C1	NR=NR=Non-return rate 56 days (cows)
	T4=C2	CI=Calving Interval (days)
	T5=IT	CI=Calving Interval (days)
NZL	T2=CY	PM=Lactating cow's ability to start cycling
	T4=C2	PC=Lactating cow's ability to conceive (CR42)
	T5=IT	PC=Lactating cow's ability to conceive (CR42)
POL	T1=HC	Non return rate at 56 days for heifer
	T2=CR	Interval from calving to first insemination
	T3=C1	Non return rate at 56 days for cows
	T4=IT	Days open
	T5=IT	Days open
USA	T1=HC	CR=Conception rate (heifer)
	T2=CY	CF=Interval from calving to first insemination
	T3=C1	CR=Conception rate (cow)
	T4=C2	DP=Daughter Pregnancy Rate
	T5=IT	DP=Daughter Pregnancy Rate
ZAF	T4=IT	CI=Calving Interval
	T5=IT	CI=Calving Interval

CHANGES IN NATIONAL PROCEDURES

Changes in the national genetic evaluation of fertility traits are as follows:

FRA (HOL) New base for all traits. Participating for the first time with HCO

NLD (HOL) Participating for the first time with HCO

DEU (HOL) New base.

POL (HOL) Data editing

ITA (HOL) Data editing

BEL (HOL) MACE breeding values are now integrated as external information in the genomic evaluation
Small modifications in data editing

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

The Parameter-space approach (Sullivan, 2016) was used for this GMACE run:

- New residual correlations were derived to account for different heritability among country-traits
- Parameter space restrictions were used to bound GMACE results on the scale of each country
- The use of Predicted National Reliabilities (the MP.5 approach) is no longer used for the GMACE genetic evaluations. For reliability approximations, MP.5 is no longer used for reliabilities that have a defined parameter space, but MP.5 continues to be used to improve reliability predictions in countries where a bull does not have a national GEBV (i.e. where a parameter space is not defined)
- Information about bull controlling country (file 734) and genotyped animals (file 733) is now extracted directly from IDEA

Sullivan, P.G. 2016. Defining a Parameter Space for GMACE. Interbull Bulletin 50, p 85-93.

DATA AND METHOD OF ANALYSIS

Eleven Holstein populations sent GEBV data for up to 38 traits, while classical EBVs for the same traits were used in the analyses. Young bull GEBVs from the GEBV providers have been converted to the scales of all countries participating in classical MACE. A bull will get a MACE EBV or a GMACE EBV but not both.
From those eleven countries, National GEBVs of bulls less than seven years of age and with no classical MACE proofs were included for the breeding value prediction with a further requirement of either a MACE-PA or a GMACE-PA (for young genomic bulls with young genomic sires) being available.

The parameter-space approach is used for the GMACE genetic evaluations (Sullivan, 2016)

SCIENTIFIC LITERATURE

The international genetic evaluation procedure is based on international work described in the following scientific publications:

Sullivan, P.G. 2016. Defining a Parameter Space for GMACE. Interbull Bulletin 50, p 85-93.

VanRaden, P.M. and Sullivan, P.G. 2010. International genomic evaluation methods for dairy cattle. Gen. Sel. Evol. 42:7

Sullivan, P.G. and Jakobsen, J.H. 2012. Robust GMACE for young bulls methodology. Interbull Bulletin 45, Article 1.

Sullivan, P.G. 2012a. GMACE reliability approximation. Report to the GMACE working group of Interbull. GMACE_rels 2013

Sullivan, P.G. 2012b. GMACE variance estimation. Report to the GMACE working group of Interbull. GMACE_vce 2013

Sullivan, P.G. 2012c. GMACE Weighting Factors. Report to the GMACE working group of Interbull. GMACE_gedcs 2013

Jakobsen, J.H. and Sullivan, P.G. 2013. Trait specific computation of shared reference population. Reference sharing Nov 2013

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for next routine run can be found on http://www.interbull.org/ib/servicecalendar

NEXT TEST INTERNATIONAL EVALUATION

Dates for next routine run can be found on http://www.interbull.org/ib/servicecalendar

PUBLICATION OF INTERBULL ROUTINE RUN

Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honor the agreed code of practice, decided by the Interbull Steering Committee, and only publish international evaluations on their own country scale. Evaluations expressed on another country scale are confidential and may only be used internally for research and review purposes.

Table 1. National evaluation dates in GMACE run April 2017

Country	Date
BEL	20170401
CAN	20170401
DEU	20170404
DFS	20170306
ESP	20170307
GBR	20170304
ITA	20170306
NLD	20170401
POL	20170215
FRA	20170405

Table 2.

Number of bulls in reference population for hco

CAN	21045.0					
DEU	2288.0	31874.0				
DFS	2121.0	29754.0	30820.0			
FRA	2411.0	28762.0	28658.0	30829.0		
POL	2533.0	25446.0	25481.0	24801.0	27478.0	
NLD	2403.0	30298.0	30095.0	29174.0	25937.0	31580.0

Number of bulls in reference population for crc

BEL	2093.0								
CAN	1171.0	27825.0							
DEU	940.0	2394.0	33677.0						
DFS	857.0	2180.0	31484.0	32586.0					
ESP	912.0	2215.0	31798.0	31849.0	32807.0				
GBR	800.0	24358.0	2180.0	1938.0	1979.0	24720.0			
ITA	1086.0	25051.0	1817.0	1522.0	1551.0	23627.0	25509.0		
NLD	957.0	2487.0	32082.0	31920.0	32362.0	2226.0	1797.0	33919.0	
POL	1075.0	2454.0	27256.0	27316.0	27687.0	1961.0	1813.0	27836.0	28687.0
FRA	968.0	2528.0	30311.0	30226.0	30669.0	2239.0	1817.0	30793.0	26411.0	32439.0

Number of bulls in reference population for cc1

CAN	27845.0							
DEU	2392.0	32056.0						
DFS	2162.0	29869.0	30876.0					
FRA	2529.0	28908.0	28747.0	30900.0				
GBR	24206.0	2180.0	1935.0	2243.0	24604.0			
ITA	25060.0	1817.0	1519.0	1823.0	23597.0	25517.0		
NLD	2485.0	30449.0	30212.0	29304.0	2224.0	1795.0	31826.0	
POL	2598.0	25630.0	25631.0	24973.0	1991.0	1858.0	26149.0	27616.0

Number of bulls in reference population for cc2

BEL	2516.0								
CAN	1311.0	29959.0							
DEU	958.0	2393.0	33693.0						
DFS	858.0	2139.0	31492.0	32409.0					
ESP	913.0	2173.0	31811.0	31670.0	32632.0				
GBR	844.0	26425.0	2178.0	1925.0	1966.0	26780.0			
ITA	1138.0	26676.0	1804.0	1500.0	1528.0	25278.0	27002.0		
NLD	974.0	2455.0	32092.0	31747.0	32195.0	2215.0	1783.0	33934.0	
POL	1434.0	2556.0	27265.0	27159.0	27534.0	1966.0	1838.0	27706.0	29162.0

Number of bulls in reference population for int

BEL	1694.0								
CAN	811.0	27863.0							
DEU	898.0	2003.0	27710.0						
DFS	815.0	1720.0	25663.0	26411.0					
ESP	865.0	1752.0	25934.0	25700.0	26588.0				
GBR	785.0	25979.0	1887.0	1602.0	1643.0	26328.0			
ITA	742.0	25376.0	1663.0	1377.0	1402.0	25100.0	25698.0		
NLD	911.0	2008.0	26246.0	25807.0	26197.0	1881.0	1650.0	27872.0	
POL	949.0	1708.0	21454.0	21227.0	21589.0	1612.0	1397.0	21760.0	22277.0