INTRODUCTION

The latest genomic routine international evaluation for conformation traits took place as scheduled at the Interbull Centre. Data from twenty (23) countries were included in this evaluation.

International genetic evaluations for calving traits of bulls from Australia, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark-Finland-Sweden, Spain, Estonia, France, United Kingdom, Hungary, Ireland, Italy, Japan, Korea, The Netherlands, New Zealand, Poland, Portugal, Slovenia, South Africa and the United States of America were computed. Holstein data were included in this evaluation.

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

ang: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
bcs: BEL, CAN, DEU, ESP, FRA, , , GBR, ITA, NLD, , HUN, CZE
bde: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
cwi: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
fan: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ftl: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ftp: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
fua: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
loc: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, , HUN, CZE
ocs: BEL, CAN, DEU, ESP, FRA, AUS, , GBR, ITA, NLD, POL, HUN, CZE
ofl: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ous: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ran: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rlr: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rls: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rtp: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, , CZE
ruh: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rwi: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
sta: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ude: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
usu: BEL, CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE

CHANGES IN NATIONAL PROCEDURES

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

DEU (HOL) ang re-included (blocked in 2009t)

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

No changes in Interbull procedures

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 minimising the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honour 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 December 2020

Country	Date
BEL	20190901
CAN	20201201
DEU	20201201
DFS	20201103
ESP	20201110
FRA	20201202
GBR	20201020
ITA	20201104
NLD	20201201
HUN	20201112
POL	20201031
CZE	20201112

Table 2.

Number of bulls in reference population for	sta
BEL	3180.0
CAN	1786.0 37239.0
DEU	1348.0 6331.0 40844.0
DFS	1135.0 4295.0 36702.0 37704.0
ESP	1285.0 4800.0 37482.0 36970.0 38490.0
FRA	1286.0 3971.0 34539.0 34095.0 34659.0 36340.0

GBR 1375.0 30987.0 6465.0 4432.0 4969.0 4010.0 33011.0
ITA 1669.0 31204.0 5586.0 3501.0 3956.0 3181.0 30010.0 31798.0
NLD 1234.0 4007.0 36132.0 35698.0 36259.0 34140.0 4178.0 3223.0 38059.0
HUN   803.0 1832.0 7526.0 7147.0 7420.0 7045.0 1871.0 1742.0 7315.0 8077.0
POL 1737.0 4296.0 32134.0 32032.0 32474.0 30250.0 4092.0 3418.0 31593.0 7170.0 34097.0
CZE 1393.0 1487.0 1899.0 1599.0 1801.0 1649.0 1400.0 1294.0 1682.0 1213.0 2369.0 3285.0

Number of bulls in reference population for   cwi

BEL 3180.0
CAN 1786.0 37235.0
DEU 1347.0 6333.0 39628.0
DFS 1134.0 4296.0 35495.0 36489.0
ESP 1284.0 4801.0 36269.0 35760.0 37263.0
FRA 1285.0 3971.0 33348.0 32911.0 33465.0 35136.0
GBR 1375.0 30983.0 6468.0 4433.0 4970.0 4010.0 33008.0
ITA 1669.0 31203.0 5589.0 3502.0 3957.0 3181.0 30010.0 31798.0
NLD 1233.0 4008.0 34942.0 34506.0 35068.0 32975.0 4179.0 3224.0 36867.0
HUN   803.0 1832.0 6990.0 6609.0 6882.0 6535.0 1871.0 1742.0 6777.0 7538.0
POL 1736.0 4296.0 30981.0 30878.0 31320.0 29123.0 4092.0 3418.0 30447.0 6631.0 32941.0
CZE 1392.0 1487.0 1896.0 1596.0 1798.0 1646.0 1400.0 1294.0 1680.0 1212.0 2366.0 3282.0

Number of bulls in reference population for   bde

BEL 3165.0
CAN 1786.0 37240.0
DEU 1348.0 6332.0 40286.0
DFS 1135.0 4296.0 36144.0 37142.0
ESP 1285.0 4801.0 36925.0 36411.0 37931.0
FRA 1286.0 3971.0 34007.0 33562.0 34127.0 35807.0
GBR 1375.0 30988.0 6466.0 4433.0 4970.0 4010.0 33012.0
ITA 1669.0 31205.0 5587.0 3502.0 3957.0 3181.0 30011.0 31799.0
NLD 1234.0 4008.0 35574.0 35138.0 35700.0 33607.0 4179.0 3224.0 37499.0
HUN   803.0 1832.0 7015.0 6634.0 6907.0 6560.0 1871.0 1742.0 6802.0 7563.0
POL 1737.0 4296.0 31621.0 31517.0 31959.0 29763.0 4092.0 3418.0 31078.0 6656.0 33581.0
CZE 1393.0 1487.0 1898.0 1598.0 1800.0 1648.0 1400.0 1294.0 1681.0 1212.0 2368.0 3284.0

Number of bulls in reference population for   ang

BEL 3111.0
CAN 1783.0 36795.0
DEU 1338.0 6327.0 37075.0
DFS 1127.0 4291.0 32966.0 33958.0
ESP 1275.0 4796.0 33719.0 33229.0 34705.0
FRA 1276.0 3966.0 30855.0 30438.0 30970.0 32639.0
GBR 1354.0 30970.0 6460.0 4427.0 4964.0 4004.0 32244.0
ITA 1667.0 31012.0 5581.0 3496.0 3951.0 3175.0 29999.0 31600.0
NLD 1201.0 4000.0 32394.0 31979.0 32519.0 30484.0 4091.0 3217.0 33852.0
HUN   794.0 1827.0 4460.0 4099.0 4346.0 4058.0 1865.0 1736.0 4241.0 4966.0
POL 1726.0 4291.0 28434.0 28350.0 28767.0 26632.0 4085.0 3410.0 27901.0 4097.0 30384.0
CZE 1384.0 1484.0 1859.0 1565.0 1761.0 1611.0 1399.0 1288.0 1643.0 1175.0 2326.0 3235.0

Number of bulls in reference population for   ran

BEL 3181.0
CAN 1786.0 37238.0
DEU 1348.0 6330.0 40747.0
DFS 1135.0 4294.0 36605.0 37607.0
ESP 1285.0 4799.0 37390.0 36878.0 38398.0
FRA 1286.0 3971.0 34444.0 34000.0 34569.0 36245.0
GBR 1375.0 30986.0 6464.0 4431.0 4968.0 4010.0 33010.0
ITA 1669.0 31203.0 5585.0 3500.0 3955.0 3181.0 30009.0 31797.0
NLD 1234.0 4007.0 36037.0 35603.0 36169.0 34045.0 4178.0 3223.0 37964.0
HUN   803.0 1832.0 7526.0 7147.0 7420.0 7045.0 1871.0 1742.0 7315.0 8077.0
POL 1737.0 4296.0 32131.0 32029.0 32471.0 30247.0 4092.0 3418.0 31590.0 7170.0 34094.0

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CZE  1393.0  1487.0  1899.0  1599.0  1801.0  1649.0  1400.0  1294.0  1682.0  1213.0  2369.0  3285.0

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Number of bulls in reference population for        rwi
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BEL  3165.0
CAN  1786.0 36417.0
DEU  1348.0  6331.0 40789.0
DFS  1135.0  4295.0 36647.0 37649.0
ESP  1285.0  4800.0 37428.0 36916.0 38436.0
FRA  1286.0  3971.0 34484.0 34040.0 34605.0 36285.0
GBR  1375.0 30987.0  6465.0  4432.0  4969.0  4010.0 33011.0
ITA  1669.0 31204.0  5586.0  3501.0  3956.0  3181.0 30010.0 31798.0
NLD  1234.0  4007.0 36077.0 35643.0 36205.0 34085.0  4178.0  3223.0 38004.0
HUN   803.0  1832.0  7517.0  7138.0  7411.0  7036.0  1871.0  1742.0  7306.0  8068.0
POL  1737.0  4296.0 32124.0 32022.0 32464.0 30240.0  4092.0  3418.0 31583.0  7161.0 34087.0
CZE  1393.0  1487.0  1899.0  1599.0  1801.0  1649.0  1400.0  1294.0  1682.0  1213.0  2369.0  3285.0

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Number of bulls in reference population for        rls
--------------------------------------------------------
BEL  3181.0
CAN  1786.0 37240.0
DEU  1348.0  6332.0 40846.0
DFS  1135.0  4296.0 36704.0 37706.0
ESP  1285.0  4801.0 37484.0 36972.0 38492.0
FRA  1286.0  3971.0 34540.0 34096.0 34660.0 36341.0
GBR  1375.0 30988.0  6466.0  4433.0  4970.0  4010.0 33012.0
ITA  1669.0 31205.0  5587.0  3502.0  3957.0  3181.0 30011.0 31799.0
NLD  1234.0  4008.0 36134.0 35700.0 36261.0 34141.0  4179.0  3224.0 38061.0
HUN   803.0  1832.0  7526.0  7147.0  7420.0  7045.0  1871.0  1742.0  7315.0  8077.0
POL  1737.0  4296.0 32134.0 32032.0 32474.0 30250.0  4092.0  3418.0 31593.0  7170.0 34097.0
CZE  1393.0  1487.0  1899.0  1599.0  1801.0  1649.0  1400.0  1294.0  1682.0  1213.0  2369.0  3285.0

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Number of bulls in reference population for        rlr
--------------------------------------------------------
BEL  3129.0
CAN  1782.0 36315.0
DEU  1342.0  6327.0 38739.0
DFS  1129.0  4288.0 34623.0 35615.0
ESP  1279.0  4794.0 35389.0 34886.0 36379.0
FRA  1280.0  3963.0 32469.0 32049.0 32593.0 34204.0
GBR  1352.0 30154.0  6460.0  4423.0  4961.0  4000.0 31428.0
ITA  1667.0 30379.0  5583.0  3494.0  3950.0  3173.0 29185.0 30972.0
NLD  1205.0  3997.0 34079.0 33644.0 34204.0 32124.0  4087.0  3215.0 35546.0
HUN   800.0  1830.0  6634.0  6254.0  6526.0  6189.0  1868.0  1740.0  6421.0  7180.0
POL  1731.0  4287.0 30115.0 30011.0 30451.0 28267.0  4081.0  3409.0 29585.0  6275.0 32022.0
CZE  1386.0  1486.0  1886.0  1586.0  1788.0  1637.0  1398.0  1293.0  1670.0  1205.0  2307.0  3194.0

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Number of bulls in reference population for        fan
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BEL  3142.0
CAN  1783.0 37221.0
DEU  1348.0  6332.0 38693.0
DFS  1135.0  4296.0 34815.0 35799.0
ESP  1285.0  4801.0 35594.0 35085.0 36596.0
FRA  1286.0  3971.0 32716.0 32273.0 32835.0 34511.0
GBR  1355.0 30972.0  6466.0  4433.0  4970.0  4010.0 32253.0
ITA  1668.0 31192.0  5587.0  3502.0  3957.0  3181.0 29999.0 31786.0
NLD  1211.0  4005.0 34253.0 33821.0 34382.0 32326.0  4097.0  3223.0 35718.0
HUN   803.0  1832.0  6838.0  6459.0  6731.0  6393.0  1871.0  1742.0  6625.0  7385.0
POL  1737.0  4296.0 30305.0 30203.0 30643.0 28487.0  4092.0  3418.0 29770.0  6481.0 32262.0
CZE  1393.0  1486.0  1897.0  1597.0  1799.0  1647.0  1400.0  1293.0  1680.0  1211.0  2367.0  3282.0

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Number of bulls in reference population for        hde
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Number of bulls in reference population for fua

BEL 3181.0
CAN 1786.0 37239.0
DEU 1348.0 6332.0 40026.0
DFS 1135.0 4296.0 35891.0 36887.0
ESP 1285.0 4801.0 36667.0 36156.0 37667.0
FRA 1286.0 3971.0 33748.0 33308.0 33866.0 35544.0
GBR 1375.0 30987.0 6466.0 4433.0 4970.0 4010.0 33011.0
ITA 1669.0 31204.0 5587.0 3502.0 3957.0 3181.0 30010.0 31798.0
NLD 1234.0 4008.0 35333.0 34897.0 35458.0 33366.0 4179.0 3224.0 37258.0
HUN 803.0 1832.0 6992.0 6611.0 6884.0 6537.0 1871.0 1742.0 6779.0 7540.0
POL 1737.0 4296.0 31330.0 31226.0 31668.0 29472.0 4092.0 3418.0 30792.0 6633.0 33290.0
CZE 1393.0 1487.0 1898.0 1598.0 1800.0 1648.0 1400.0 1294.0 1681.0 1212.0 2368.0 3284.0

Number of bulls in reference population for ruh

BEL 3181.0
CAN 1786.0 37239.0
DEU 1348.0 6332.0 39715.0
DFS 1135.0 4296.0 35574.0 36543.0
ESP 1285.0 4801.0 36355.0 35813.0 37329.0
FRA 1286.0 3971.0 33443.0 32998.0 33562.0 35240.0
GBR 1375.0 30987.0 6466.0 4433.0 4970.0 4010.0 33009.0
ITA 1669.0 31204.0 5587.0 3502.0 3957.0 3181.0 30010.0 31798.0
NLD 1234.0 4008.0 35012.0 34575.0 35138.0 33051.0 4179.0 3224.0 36936.0
HUN 803.0 1832.0 7005.0 6624.0 6897.0 6550.0 1871.0 1742.0 6792.0 7553.0
POL 1737.0 4296.0 31467.0 31363.0 31805.0 29609.0 4092.0 3418.0 30928.0 6648.0 33427.0
CZE 1393.0 1487.0 1898.0 1598.0 1800.0 1648.0 1400.0 1294.0 1681.0 1212.0 2368.0 3284.0

Number of bulls in reference population for ruw

Number of bulls in reference population for usu

BEL 3181.0
CAN 1786.0 37241.0
DEU 1348.0 6332.0 40844.0
DFS 1135.0 4296.0 36702.0 37704.0
ESP 1285.0 4801.0 37482.0 36970.0 38490.0
FRA 1286.0 3971.0 34538.0 34094.0 34658.0 36339.0
GBR 1375.0 30989.0 6466.0 4433.0 4970.0 4010.0 33013.0
ITA 1669.0 31206.0 5587.0 3502.0 3957.0 3181.0 30012.0 31800.0
NLD 1234.0 4008.0 36132.0 35698.0 36259.0 34139.0 4179.0 3224.0 38059.0
HUN 803.0 1832.0 7525.0 7146.0 7419.0 7044.0 1871.0 1742.0 7314.0 8076.0
POL 1737.0 4296.0 32132.0 32030.0 32472.0 30248.0 4092.0 3418.0 31591.0 7169.0 34095.0
CZE 1393.0 1487.0 1899.0 1599.0 1801.0 1649.0 1400.0 1294.0 1682.0 1213.0 2369.0 3285.0

Number of bulls in reference population for ude

BEL 3144.0
CAN 1783.0 37232.0
DEU 1348.0 6331.0 40842.0
DFS 1135.0 4295.0 36700.0 37702.0
ESP 1285.0 4800.0 37480.0 36968.0 38488.0
FRA 1286.0 3971.0 34538.0 34094.0 34658.0 36339.0
GBR 1355.0 30982.0 6465.0 4432.0 4969.0 4010.0 32263.0
ITA 1668.0 31203.0 5586.0 3501.0 3956.0 3181.0 30009.0 31797.0
NLD 1211.0 4004.0 36130.0 35696.0 36257.0 34139.0 4096.0 3222.0 37602.0
HUN 803.0 1832.0 7526.0 7147.0 7420.0 7045.0 1871.0 1742.0 7315.0 8077.0
POL 1737.0 4296.0 32132.0 32030.0 32472.0 30249.0 4092.0 3418.0 31591.0 7170.0 34095.0
CZE 1393.0 1487.0 1899.0 1599.0 1801.0 1649.0 1400.0 1294.0 1682.0 1213.0 2369.0 3285.0

Number of bulls in reference population for ftp

BEL	3181.0												
CAN	1786.0	37243.0											
DEU	1348.0	6335.0	40802.0										
DFS	1135.0	4296.0	36656.0	37658.0									
ESP	1285.0	4802.0	37438.0	36925.0	38446.0								
FRA	1286.0	3971.0	34492.0	34048.0	34613.0	36293.0							
GBR	1375.0	30991.0	6470.0	4433.0	4971.0	4010.0	33016.0						
ITA	1669.0	31208.0	5591.0	3502.0	3958.0	3181.0	30015.0	31803.0					
NLD	1234.0	4008.0	36086.0	35652.0	36214.0	34093.0	4179.0	3224.0	38013.0				
HUN	803.0	1832.0	7525.0	7146.0	7419.0	7044.0	1871.0	1742.0	7314.0	8076.0			
POL	1737.0	4296.0	32132.0	32030.0	32472.0	30248.0	4092.0	3418.0	31591.0	7169.0	34095.0		
CZE	1393.0	1487.0	1899.0	1599.0	1801.0	1649.0	1400.0	1294.0	1682.0	1213.0	2369.0	3285.0	

Number of bulls in reference population for ftl

BEL	3144.0												
CAN	1783.0	37223.0											
DEU	1348.0	6334.0	40846.0										
DFS	1135.0	4295.0	36700.0	37702.0									
ESP	1285.0	4801.0	37481.0	36968.0	38489.0								
FRA	1286.0	3971.0	34538.0	34094.0	34658.0	36339.0							
GBR	1355.0	30985.0	6469.0	4432.0	4970.0	4010.0	32267.0						
ITA	1668.0	31206.0	5590.0	3501.0	3957.0	3181.0	30013.0	31801.0					
NLD	1211.0	4004.0	36130.0	35696.0	36257.0	34139.0	4096.0	3222.0	37602.0				
HUN	803.0	1832.0	7526.0	7147.0	7420.0	7045.0	1871.0	1742.0	7315.0	8077.0			
POL	1737.0	4296.0	32132.0	32030.0	32472.0	30249.0	4092.0	3418.0	31591.0	7170.0	34095.0		
CZE	1393.0	1487.0	1899.0	1599.0	1801.0	1649.0	1400.0	1294.0	1682.0	1213.0	2369.0	3285.0	

Number of bulls in reference population for rtp

BEL	3163.0												
CAN	1786.0	34139.0											
DEU	1346.0	6329.0	38538.0										
DFS	1133.0	4290.0	34397.0	35306.0									
ESP	1283.0	4796.0	35175.0	34582.0	36098.0								
FRA	1284.0	3965.0	32311.0	31817.0	32378.0	34057.0							
GBR	1373.0	29153.0	6464.0	4427.0	4965.0	4004.0	31171.0						
ITA	1669.0	29361.0	5586.0	3497.0	3953.0	3176.0	28346.0	29952.0					
NLD	1232.0	3984.0	33827.0	33342.0	33900.0	31863.0	4155.0	3200.0	35550.0				
POL	1734.0	4289.0	30644.0	30484.0	30929.0	28758.0	4085.0	3412.0	30052.0	32478.0			
CZE	1391.0	1482.0	1883.0	1584.0	1785.0	1634.0	1396.0	1289.0	1666.0	2294.0	3200.0		

Number of bulls in reference population for ocs

AUS	2900.0												
BEL	438.0	3164.0											
CAN	1074.0	1786.0	37208.0										
DEU	781.0	1347.0	6328.0	40183.0									
ESP	727.0	1284.0	4798.0	36824.0	37819.0								
FRA	713.0	1285.0	3969.0	33878.0	33995.0	35664.0							
GBR	1214.0	1375.0	30960.0	6464.0	4968.0	4009.0	32985.0						
ITA	865.0	1669.0	31181.0	5585.0	3955.0	3180.0	29988.0	31776.0					
NLD	767.0	1233.0	4007.0	35503.0	35629.0	33510.0	4178.0	3223.0	37425.0				
HUN	597.0	803.0	1832.0	7526.0	7420.0	7045.0	1871.0	1742.0	7315.0	8077.0			
POL	659.0	1736.0	4293.0	31493.0	31833.0	29610.0	4090.0	3416.0	30964.0	7170.0	33455.0		
CZE	374.0	1392.0	1487.0	1897.0	1799.0	1647.0	1400.0	1294.0	1681.0	1213.0	2367.0	3283.0	

Number of bulls in reference population for ous

BEL	3159.0		
CAN	1786.0	37239.0	
DEU	1348.0	6332.0	40843.0

DFS 1135.0 4296.0 36701.0 37703.0
ESP 1285.0 4801.0 37481.0 36969.0 38489.0
FRA 1286.0 3971.0 34537.0 34093.0 34657.0 36335.0
GBR 1374.0 30987.0 6466.0 4433.0 4970.0 4010.0 33006.0
ITA 1669.0 31204.0 5587.0 3502.0 3957.0 3181.0 30010.0 31798.0
NLD 1234.0 4008.0 36134.0 35700.0 36261.0 34141.0 4179.0 3224.0 38060.0
HUN   803.0 1832.0 7526.0 7147.0 7420.0 7045.0 1871.0 1742.0 7315.0 8077.0
POL 1737.0 4296.0 32132.0 32030.0 32472.0 30248.0 4092.0 3418.0 31593.0 7170.0 34095.0
CZE 1393.0 1487.0 1899.0 1599.0 1801.0 1649.0 1400.0 1294.0 1682.0 1213.0 2369.0 3285.0

Number of bulls in reference population for   ofl

BEL 3122.0
CAN 1783.0 37084.0
DEU 1347.0 6331.0 40202.0
DFS 1134.0 4296.0 36072.0 37071.0
ESP 1284.0 4801.0 36845.0 36338.0 37841.0
FRA 1285.0 3971.0 33899.0 33463.0 34016.0 35685.0
GBR 1354.0 30856.0 6465.0 4433.0 4970.0 4010.0 32133.0
ITA 1668.0 31108.0 5586.0 3502.0 3957.0 3181.0 29914.0 31702.0
NLD 1210.0 4005.0 35522.0 35088.0 35649.0 33530.0 4097.0 3223.0 36969.0
HUN   803.0 1832.0 7525.0 7146.0 7419.0 7044.0 1871.0 1742.0 7314.0 8076.0
POL 1736.0 4296.0 31514.0 31413.0 31855.0 29631.0 4092.0 3418.0 30984.0 7169.0 33477.0
CZE 1392.0 1487.0 1897.0 1597.0 1799.0 1647.0 1400.0 1294.0 1681.0 1213.0 2367.0 3283.0

Number of bulls in reference population for   loc

BEL 3099.0
CAN 1775.0 31317.0
DEU 1342.0 6285.0 36136.0
DFS 1129.0 4251.0 32243.0 33101.0
ESP 1279.0 4754.0 33038.0 32446.0 33911.0
FRA 1280.0 3925.0 30229.0 29714.0 30292.0 31899.0
GBR 1349.0 28611.0 6420.0 4397.0 4930.0 3973.0 29860.0
ITA 1659.0 28764.0 5553.0 3475.0 3926.0 3154.0 27886.0 29284.0
NLD 1204.0 3966.0 31846.0 31334.0 31922.0 29900.0 4064.0 3195.0 33180.0
CZE 1388.0 1477.0 1863.0 1566.0 1767.0 1616.0 1393.0 1283.0 1649.0 3157.0
HUN   799.0 1825.0 5812.0 5439.0 5701.0 5391.0 1862.0 1736.0 5599.0 1184.0 6354.0

Number of bulls in reference population for   bcs

BEL 3016.0
DEU 1329.0 32856.0
FRA 1269.0 27070.0 28586.0
GBR 1356.0 6376.0 3942.0 29046.0
ITA 1658.0 5536.0 3141.0 26357.0 28010.0
NLD 1215.0 28490.0 26670.0 4109.0 3179.0 30282.0
CZE 1378.0 1859.0 1614.0 1383.0 1276.0 1648.0 3034.0
CAN 1775.0 6219.0 3877.0 27100.0 27501.0 3908.0 1469.0 31592.0
ESP 1266.0 29770.0 27137.0 4873.0 3901.0 28545.0 1765.0 4669.0 30589.0
HUN   796.0 6605.0 6168.0 1860.0 1731.0 6393.0 1199.0 1821.0 6499.0 7148.0