INTRODUCTION

The latest genomic test international evaluation for conformation traits took place as scheduled at the Interbull Centre. Data from twenty-four (24) countries were included in this evaluation.

International genetic evaluations for conformation traits of bulls were computed from:
AUS BEL CAN CHE CZE DEU DFS ESP EST FRA GBR HUN IRL ITA JPN KOR NLD NZL POL PRT SVN USA ZAF LVA
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: , CAN, DEU, ESP, FRA, , , GBR, ITA, NLD, POL, HUN, CZE
bde: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
cwi: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
fan: , 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: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
fua: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
loc: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ocs: , CAN, DEU, ESP, FRA, AUS, , GBR, ITA, NLD, POL, HUN, CZE
ofl: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ous: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
ran: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rlr: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rls: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rtp: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, , CZE
ruh: , CAN, DEU, ESP, FRA, , DFS, GBR, ITA, NLD, POL, HUN, CZE
rwi: , 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: , 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:

GBR (HOL) Loss of about 300 bulls in this run compared to previous run. Due to improved QA with such that all clones are removed, removal of animals failing parentage check, removal of some invalid genotypes, some identities have been updated from Herd book numbers to eartags between the runs
HUN (HOL) Changes due to updated pedigrees for some bulls. This affects animals that have a USA or 840 sire.
CAN (HOL) ous, ofl and ocs are now calculated as composites instead of evaluated directly in line with the changes applied in MACE

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

No changes in Interbull procedures

DATA AND METHOD OF ANALYSIS

Thirteen 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 thirteen 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 2021

Country	Date
BEL	20201201
CAN	20211201
DEU	20211207
DFS	20211102
ESP	20211115
FRA	20211208
GBR	20211105
ITA	20211104
NLD	20211201
HUN	20211122
POL	20211207
CZE	20211122

Table 2.

Number of bulls in reference population for	sta
BEL	1691.0
CAN	723.0 38141.0
DEU	726.0 7535.0 42593.0
DFS	636.0 4798.0 37616.0 38595.0

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ESP   701.0  5593.0 38678.0 37822.0 39753.0
FRA   710.0  4021.0 34692.0 34182.0 34776.0 36436.0
GBR   683.0 31767.0  7788.0  4922.0  5737.0  4110.0 34011.0
ITA   705.0 31054.0  6002.0  3618.0  4155.0  3200.0 30083.0 31593.0
NLD   742.0  4105.0 36518.0 35928.0 36538.0 34236.0  4397.0  3247.0 38381.0
HUN   513.0  1991.0  7915.0  7423.0  7793.0  7227.0  2113.0  1841.0  7594.0  8467.0
POL   996.0  4449.0 32844.0 32643.0 33198.0 30332.0  4511.0  3231.0 31852.0  7456.0 34591.0
CZE   840.0  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0

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Number of bulls in reference population for        cwi
------------------------------------------------------
CAN 38137.0
DEU  7536.0 41372.0
DFS  4800.0 36406.0 37378.0
ESP  5595.0 37463.0 36611.0 38525.0
FRA  4021.0 33498.0 32995.0 33580.0 35229.0
GBR 31762.0  7789.0  4923.0  5738.0  4110.0 34006.0
ITA 31052.0  6003.0  3619.0  4156.0  3200.0 30081.0 31591.0
NLD  4106.0 35325.0 34733.0 35345.0 33068.0  4398.0  3248.0 37186.0
HUN  1991.0  7378.0  6884.0  7254.0  6716.0  2113.0  1841.0  7055.0  7927.0
POL  4449.0 31688.0 31486.0 32042.0 29202.0  4511.0  3231.0 30703.0  6916.0 33431.0
CZE  1611.0  2047.0  1690.0  1941.0  1650.0  1525.0  1312.0  1704.0  1309.0  2425.0  3445.0

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Number of bulls in reference population for        bde
------------------------------------------------------
CAN 38141.0
DEU  7535.0 42034.0
DFS  4798.0 37057.0 38032.0
ESP  5593.0 38120.0 37262.0 39193.0
FRA  4021.0 34160.0 33649.0 34244.0 35903.0
GBR 31767.0  7788.0  4922.0  5737.0  4110.0 34011.0
ITA 31054.0  6002.0  3618.0  4155.0  3200.0 30083.0 31593.0
NLD  4106.0 35960.0 35368.0 35979.0 33703.0  4398.0  3248.0 37821.0
HUN  1991.0  7403.0  6909.0  7279.0  6741.0  2113.0  1841.0  7080.0  7952.0
POL  4449.0 32331.0 32128.0 32683.0 29845.0  4511.0  3231.0 31337.0  6941.0 34075.0
CZE  1611.0  2049.0  1692.0  1943.0  1652.0  1525.0  1312.0  1705.0  1309.0  2427.0  3447.0

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Number of bulls in reference population for        ang
------------------------------------------------------
BEL  1623.0
CAN   720.0 37697.0
DEU   716.0  7529.0 38801.0
DFS   629.0  4793.0 33858.0 34827.0
ESP   691.0  5589.0 34893.0 34060.0 35947.0
FRA   700.0  4014.0 31003.0 30521.0 31083.0 32730.0
GBR   662.0 31749.0  7780.0  4914.0  5730.0  4101.0 33240.0
ITA   703.0 30860.0  5995.0  3611.0  4149.0  3192.0 30068.0 31393.0
NLD   709.0  4096.0 32775.0 32205.0 32794.0 30575.0  4307.0  3239.0 34169.0
HUN   504.0  1984.0  4846.0  4373.0  4716.0  4237.0  2102.0  1833.0  4515.0  5351.0
POL   985.0  4442.0 29140.0 28958.0 29488.0 26709.0  4501.0  3221.0 28156.0  4380.0 30873.0
CZE   831.0  1607.0  2009.0  1658.0  1903.0  1614.0  1521.0  1305.0  1666.0  1271.0  2384.0  3397.0

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Number of bulls in reference population for        ran
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CAN 38140.0
DEU  7534.0 42496.0
DFS  4797.0 37519.0 38498.0
ESP  5592.0 38586.0 37730.0 39661.0
FRA  4021.0 34597.0 34087.0 34686.0 36341.0
GBR 31766.0  7787.0  4921.0  5736.0  4110.0 34010.0
ITA 31053.0  6001.0  3617.0  4154.0  3200.0 30082.0 31592.0
NLD  4105.0 36423.0 35833.0 36448.0 34141.0  4397.0  3247.0 38286.0
HUN  1991.0  7915.0  7423.0  7793.0  7227.0  2113.0  1841.0  7594.0  8467.0
POL  4449.0 32841.0 32640.0 33195.0 30329.0  4511.0  3231.0 31849.0  7456.0 34588.0
CZE  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0
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Number of bulls in reference population for rwi

CAN 37318.0
DEU 7534.0 42537.0
DFS 4797.0 37560.0 38539.0
ESP 5592.0 38623.0 37767.0 39698.0
FRA 4021.0 34637.0 34127.0 34722.0 36381.0
GBR 31766.0 7787.0 4921.0 5736.0 4110.0 34010.0
ITA 31053.0 6001.0 3617.0 4154.0 3200.0 30082.0 31592.0
NLD 4105.0 36463.0 35873.0 36484.0 34181.0 4397.0 3247.0 38326.0
HUN 1991.0 7906.0 7414.0 7784.0 7218.0 2113.0 1841.0 7585.0 8458.0
POL 4449.0 32834.0 32633.0 33188.0 30322.0 4511.0 3231.0 31842.0 7447.0 34581.0
CZE 1611.0 2050.0 1693.0 1944.0 1653.0 1525.0 1312.0 1706.0 1310.0 2428.0 3448.0

Number of bulls in reference population for rls

CAN 38141.0
DEU 7535.0 42594.0
DFS 4798.0 37617.0 38596.0
ESP 5593.0 38679.0 37823.0 39754.0
FRA 4021.0 34693.0 34183.0 34777.0 36437.0
GBR 31767.0 7788.0 4922.0 5737.0 4110.0 34011.0
ITA 31054.0 6002.0 3618.0 4155.0 3200.0 30083.0 31593.0
NLD 4106.0 36520.0 35930.0 36540.0 34237.0 4398.0 3248.0 38383.0
HUN 1991.0 7915.0 7423.0 7793.0 7227.0 2113.0 1841.0 7594.0 8467.0
POL 4449.0 32844.0 32643.0 33198.0 30332.0 4511.0 3231.0 31852.0 7456.0 34591.0
CZE 1611.0 2050.0 1693.0 1944.0 1653.0 1525.0 1312.0 1706.0 1310.0 2428.0 3448.0

Number of bulls in reference population for rlr

CAN 37214.0
DEU 7528.0 40482.0
DFS 4791.0 35535.0 36504.0
ESP 5586.0 36583.0 35737.0 37640.0
FRA 4013.0 32620.0 32134.0 32709.0 34298.0
GBR 30931.0 7779.0 4913.0 5728.0 4100.0 32423.0
ITA 30225.0 5995.0 3611.0 4148.0 3192.0 29253.0 30762.0
NLD 4095.0 34463.0 33872.0 34482.0 32218.0 4306.0 3239.0 35866.0
HUN 1989.0 7022.0 6529.0 6898.0 6370.0 2108.0 1839.0 6697.0 7567.0
POL 4440.0 30824.0 30621.0 31175.0 28347.0 4500.0 3222.0 29843.0 6560.0 32514.0
CZE 1610.0 2037.0 1680.0 1931.0 1641.0 1523.0 1311.0 1694.0 1302.0 2366.0 3357.0

Number of bulls in reference population for fan

CAN 38120.0
DEU 7535.0 40440.0
DFS 4799.0 35730.0 36692.0
ESP 5594.0 36791.0 35939.0 37861.0
FRA 4021.0 32871.0 32362.0 32954.0 34609.0
GBR 31748.0 7788.0 4922.0 5737.0 4110.0 33248.0
ITA 31037.0 6002.0 3618.0 4155.0 3200.0 30067.0 31576.0
NLD 4103.0 34641.0 34053.0 34663.0 32424.0 4316.0 3247.0 36042.0
HUN 1991.0 7226.0 6734.0 7103.0 6574.0 2111.0 1841.0 6901.0 7772.0
POL 4449.0 31018.0 30817.0 31370.0 28571.0 4511.0 3231.0 30032.0 6766.0 32759.0
CZE 1610.0 2048.0 1691.0 1942.0 1651.0 1525.0 1311.0 1704.0 1308.0 2426.0 3445.0

Number of bulls in reference population for hde

Number of bulls in reference population for fua

CAN 38142.0

```
DEU  7536.0 41775.0
DFS  4800.0 36805.0 37779.0
ESP  5595.0 37863.0 37009.0 38931.0
FRA  4021.0 33901.0 33395.0 33983.0 35640.0
GBR 31767.0  7789.0  4923.0  5738.0  4110.0 34011.0
ITA 31054.0  6003.0  3619.0  4156.0  3200.0 30083.0 31593.0
NLD  4106.0 35719.0 35127.0 35737.0 33462.0  4398.0  3248.0 37580.0
HUN  1991.0  7380.0  6886.0  7256.0  6718.0  2113.0  1841.0  7057.0  7929.0
POL  4449.0 32040.0 31837.0 32392.0 29554.0  4511.0  3231.0 31051.0  6918.0 33784.0
CZE  1611.0  2049.0  1692.0  1943.0  1652.0  1525.0  1312.0  1705.0  1309.0  2427.0  3447.0

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Number of bulls in reference population for        ruh
-------------------------------------------------------
CAN 38141.0
DEU  7536.0 41463.0
DFS  4799.0 36487.0 37433.0
ESP  5594.0 37550.0 36664.0 38591.0
FRA  4021.0 33595.0 33084.0 33678.0 35335.0
GBR 31767.0  7789.0  4923.0  5738.0  4110.0 34009.0
ITA 31054.0  6003.0  3619.0  4156.0  3200.0 30083.0 31593.0
NLD  4106.0 35397.0 34804.0 35416.0 33146.0  4398.0  3248.0 37257.0
HUN  1991.0  7393.0  6899.0  7269.0  6731.0  2113.0  1841.0  7070.0  7942.0
POL  4449.0 32177.0 31974.0 32529.0 29691.0  4511.0  3231.0 31187.0  6933.0 33921.0
CZE  1611.0  2049.0  1692.0  1943.0  1652.0  1525.0  1312.0  1705.0  1309.0  2427.0  3447.0

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Number of bulls in reference population for        ruw
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Number of bulls in reference population for        usu
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BEL  1692.0
CAN   723.0 38143.0
DEU   726.0  7535.0 42592.0
DFS   636.0  4799.0 37615.0 38595.0
ESP   701.0  5595.0 38677.0 37822.0 39754.0
FRA   710.0  4021.0 34691.0 34181.0 34775.0 36435.0
GBR   683.0 31768.0  7788.0  4922.0  5738.0  4110.0 34012.0
ITA   705.0 31055.0  6002.0  3618.0  4156.0  3200.0 30084.0 31594.0
NLD   742.0  4106.0 36518.0 35928.0 36538.0 34235.0  4398.0  3248.0 38381.0
HUN   513.0  1991.0  7914.0  7422.0  7792.0  7226.0  2113.0  1841.0  7593.0  8466.0
POL   996.0  4449.0 32842.0 32641.0 33196.0 30330.0  4511.0  3231.0 31850.0  7455.0 34589.0
CZE   840.0  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0

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Number of bulls in reference population for        ude
-------------------------------------------------------
CAN 38135.0
DEU  7535.0 42591.0
DFS  4798.0 37614.0 38593.0
ESP  5593.0 38676.0 37820.0 39751.0
FRA  4021.0 34691.0 34181.0 34775.0 36435.0
GBR 31763.0  7788.0  4922.0  5737.0  4110.0 33263.0
ITA 31053.0  6002.0  3618.0  4155.0  3200.0 30082.0 31592.0
NLD  4102.0 36516.0 35926.0 36536.0 34235.0  4315.0  3246.0 37924.0
HUN  1991.0  7915.0  7423.0  7793.0  7227.0  2111.0  1841.0  7592.0  8465.0
POL  4449.0 32843.0 32642.0 33197.0 30331.0  4511.0  3231.0 31851.0  7456.0 34590.0
CZE  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0

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Number of bulls in reference population for        ftp
-------------------------------------------------------
CAN 38142.0
DEU  7536.0 42547.0
DFS  4799.0 37570.0 38549.0
ESP  5594.0 38633.0 37777.0 39708.0
FRA  4021.0 34645.0 34135.0 34730.0 36389.0
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GBR 31768.0  7789.0  4923.0  5738.0  4110.0 34012.0
ITA 31055.0  6003.0  3619.0  4156.0  3200.0 30084.0 31594.0
NLD  4106.0 36472.0 35882.0 36493.0 34189.0  4398.0  3248.0 38335.0
HUN  1991.0  7914.0  7422.0  7792.0  7226.0  2113.0  1841.0  7593.0  8466.0
POL  4449.0 32842.0 32641.0 33196.0 30330.0  4511.0  3231.0 31850.0  7455.0 34589.0
CZE  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0

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Number of bulls in reference population for        ftl
----------------------------------------------------------
BEL  1663.0
CAN   721.0 38125.0
DEU   726.0  7535.0 42591.0
DFS   636.0  4798.0 37614.0 38593.0
ESP   701.0  5593.0 38676.0 37820.0 39751.0
FRA   710.0  4021.0 34691.0 34181.0 34775.0 36435.0
GBR   668.0 31763.0  7788.0  4922.0  5737.0  4110.0 33568.0
ITA   704.0 31053.0  6002.0  3618.0  4155.0  3200.0 30082.0 31592.0
NLD   722.0  4103.0 36516.0 35926.0 36536.0 34235.0  4322.0  3246.0 37955.0
HUN   513.0  1991.0  7915.0  7423.0  7793.0  7227.0  2111.0  1841.0  7592.0  8465.0
POL   996.0  4449.0 32843.0 32642.0 33197.0 30331.0  4511.0  3231.0 31851.0  7456.0 34590.0
CZE   840.0  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0

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Number of bulls in reference population for        rtp
----------------------------------------------------------
CAN 35042.0
DEU  7530.0 40283.0
DFS  4792.0 35310.0 36196.0
ESP  5587.0 36369.0 35433.0 37359.0
FRA  4015.0 32464.0 31904.0 32495.0 34153.0
GBR 29934.0  7783.0  4916.0  5731.0  4104.0 32168.0
ITA 29211.0  5997.0  3613.0  4150.0  3195.0 28417.0 29746.0
NLD  4082.0 34213.0 33572.0 34179.0 31959.0  4374.0  3224.0 35873.0
POL  4442.0 31354.0 31095.0 31653.0 28840.0  4504.0  3225.0 30311.0 32972.0
CZE  1606.0  2034.0  1678.0  1928.0  1638.0  1520.0  1307.0  1690.0  2353.0  3363.0

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Number of bulls in reference population for        ocs
----------------------------------------------------------
AUS  2901.0
CAN  1074.0 38080.0
DEU   785.0  7508.0 41860.0
ESP   740.0  5582.0 37997.0 39053.0
FRA   716.0  4017.0 34017.0 34096.0 35743.0
GBR  1215.0 31717.0  7758.0  5726.0  4108.0 33950.0
ITA   865.0 31014.0  5983.0  4148.0  3198.0 30040.0 31550.0
NLD   767.0  4101.0 35870.0 35892.0 33591.0  4390.0  3242.0 37723.0
HUN   616.0  1988.0  7913.0  7792.0  7227.0  2109.0  1839.0  7594.0  8463.0
POL   657.0  4444.0 32190.0 32543.0 29678.0  4508.0  3228.0 31209.0  7456.0 33932.0
CZE   374.0  1611.0  2048.0  1942.0  1651.0  1525.0  1312.0  1705.0  1310.0  2426.0  3446.0

----------------------------------------------------------
Number of bulls in reference population for        ous
----------------------------------------------------------
CAN 38113.0
DEU  7513.0 42525.0
DFS  4793.0 37606.0 38579.0
ESP  5585.0 38656.0 37814.0 39725.0
FRA  4019.0 34679.0 34176.0 34760.0 36417.0
GBR 31746.0  7762.0  4918.0  5728.0  4109.0 33974.0
ITA 31039.0  5987.0  3616.0  4150.0  3199.0 30065.0 31575.0
NLD  4102.0 36504.0 35928.0 36526.0 34225.0  4391.0  3243.0 38361.0
HUN  1988.0  7913.0  7422.0  7792.0  7227.0  2109.0  1839.0  7594.0  8463.0
POL  4447.0 32832.0 32640.0 33184.0 30319.0  4510.0  3230.0 31841.0  7456.0 34576.0
CZE  1611.0  2050.0  1693.0  1944.0  1653.0  1525.0  1312.0  1706.0  1310.0  2428.0  3448.0

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Number of bulls in reference population for        ofl
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---------------------------------------------------------
CAN 37961.0
DEU  7512.0 41881.0
DFS  4793.0 36973.0 37944.0
ESP  5585.0 38017.0 37181.0 39075.0
FRA  4019.0 34038.0 33543.0 34117.0 35764.0
GBR 31615.0  7761.0  4917.0  5727.0  4109.0 33099.0
ITA 30944.0  5986.0  3615.0  4149.0  3199.0 29970.0 31480.0
NLD  4099.0 35889.0 35313.0 35912.0 33611.0  4309.0  3242.0 37268.0
HUN  1988.0  7912.0  7421.0  7791.0  7226.0  2107.0  1839.0  7591.0  8460.0
POL  4447.0 32212.0 32021.0 32566.0 29699.0  4510.0  3230.0 31230.0  7455.0 33955.0
CZE  1611.0  2048.0  1691.0  1942.0  1651.0  1525.0  1312.0  1705.0  1310.0  2426.0  3446.0

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Number of bulls in reference population for        loc
---------------------------------------------------------
CAN 32459.0
DEU  7457.0 37780.0
DFS  4741.0 33113.0 33948.0
ESP  5533.0 34181.0 33262.0 35123.0
FRA  3972.0 30360.0 29794.0 30395.0 31979.0
GBR 29491.0  7707.0  4876.0  5685.0  4069.0 30941.0
ITA 28854.0  5950.0  3585.0  4118.0  3171.0 28058.0 29306.0
NLD  4058.0 32212.0 31562.0 32188.0 29988.0  4274.0  3213.0 33481.0
CZE  1601.0  2014.0  1660.0  1910.0  1620.0  1517.0  1301.0  1673.0  3320.0
HUN  1981.0  6196.0  5713.0  6071.0  5572.0  2098.0  1834.0  5874.0  1281.0  6735.0
POL  4401.0 28392.0 28100.0 28689.0 25988.0  4474.0  3199.0 27514.0  2314.0  5735.0 29899.0

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Number of bulls in reference population for        bcs
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DEU 34459.0
FRA 27211.0 28671.0
GBR  7641.0  4038.0 30118.0
ITA  5927.0  3159.0 26530.0 27965.0
NLD 28853.0 26753.0  4315.0  3196.0 30583.0
CZE  2010.0  1617.0  1507.0  1293.0  1671.0  3195.0
CAN  7361.0  3927.0 27969.0 27519.0  4001.0  1592.0 32633.0
ESP 30872.0 27240.0  5620.0  4097.0 28804.0  1906.0  5432.0 31764.0
HUN  6990.0  6350.0  2098.0  1828.0  6669.0  1296.0  1978.0  6869.0  7532.0
POL 27191.0 24780.0  4420.0  3178.0 26189.0  2243.0  4311.0 27433.0  6538.0 28623.0
```