## INTRODUCTION

The latest genomic routine international evaluation for conformation traits took place as scheduled at the Interbull Centre. Data from twenty (22) 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, France, United Kingdom, Hungary, Ireland, Italy, Japan, Korea, The Netherlands, Norway, New Zealand, Poland, South Africa, Estonia, Slovenia, Portugal 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 submitted GEBVs.

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

## CHANGES IN NATIONAL PROCEDURES

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

ESP (HOL) Base change

NLD (HOL) Included a deregression post-processing step to keep the animals with information in the system

HUN (HOL) First participation with bcs and loc

BEL (HOL) Corrected a small bug in their routines preparing final GEBV to be submitted
Increase in the size of the reference population (mainly females)

## 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 August 2018

| Country | Date |
|---|---|
| BEL | 20180701 |
| CAN | 20180801 |
| DEU | 20180807 |
| DFS | 20180807 |
| ESP | 20180620 |
| FRA | 20180808 |
| GBR | 20180708 |

ITA 20180706
NLD 20180801
HUN 20180711
POL 20180630

Table 2.

Number of bulls in reference population for sta

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BEL | 2736.0 | | | | | | | | | |
| CAN | 1448.0 | 33770.0 | | | | | | | | |
| DEU | 1062.0 | 3322.0 | 36182.0 | | | | | | | |
| DFS | 861.0 | 2669.0 | 33592.0 | 34738.0 | | | | | | |
| ESP | 1011.0 | 3004.0 | 34086.0 | 34083.0 | 35524.0 | | | | | |
| FRA | 1081.0 | 3145.0 | 32267.0 | 32135.0 | 32973.0 | 34769.0 | | | | |
| GBR | 1011.0 | 27708.0 | 3174.0 | 2611.0 | 2947.0 | 3070.0 | 28850.0 | | | |
| ITA | 1308.0 | 28171.0 | 2761.0 | 2124.0 | 2372.0 | 2502.0 | 26871.0 | 28465.0 | | |
| NLD | 998.0 | 2908.0 | 33532.0 | 33428.0 | 33888.0 | 32198.0 | 2851.0 | 2319.0 | 35608.0 | |
| HUN | 493.0 | 1065.0 | 6217.0 | 5940.0 | 6193.0 | 6067.0 | 1035.0 | 983.0 | 6184.0 | 6733.0 |
| POL | 1526.0 | 3222.0 | 29331.0 | 29474.0 | 30175.0 | 28583.0 | 2818.0 | 2553.0 | 29388.0 | 6190.0 31789.0 |

Number of bulls in reference population for cwi

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BEL | 2736.0 | | | | | | | | | |
| CAN | 1448.0 | 33764.0 | | | | | | | | |
| DEU | 1061.0 | 3322.0 | 34968.0 | | | | | | | |
| DFS | 860.0 | 2669.0 | 32388.0 | 33526.0 | | | | | | |
| ESP | 1010.0 | 3004.0 | 32876.0 | 32876.0 | 34300.0 | | | | | |
| FRA | 1080.0 | 3145.0 | 31080.0 | 30955.0 | 31783.0 | 33569.0 | | | | |
| GBR | 1011.0 | 27702.0 | 3174.0 | 2611.0 | 2947.0 | 3070.0 | 28844.0 | | | |
| ITA | 1308.0 | 28167.0 | 2761.0 | 2124.0 | 2372.0 | 2502.0 | 26867.0 | 28461.0 | | |
| NLD | 997.0 | 2908.0 | 32345.0 | 32239.0 | 32700.0 | 31037.0 | 2851.0 | 2319.0 | 34419.0 | |
| HUN | 493.0 | 1065.0 | 5690.0 | 5411.0 | 5664.0 | 5566.0 | 1035.0 | 983.0 | 5655.0 | 6203.0 |
| POL | 1525.0 | 3222.0 | 28183.0 | 28324.0 | 29025.0 | 27461.0 | 2818.0 | 2553.0 | 28246.0 | 5660.0 30638.0 |

Number of bulls in reference population for bde

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BEL | 2722.0 | | | | | | | | | |
| CAN | 1448.0 | 33770.0 | | | | | | | | |
| DEU | 1062.0 | 3322.0 | 35624.0 | | | | | | | |
| DFS | 861.0 | 2669.0 | 33034.0 | 34176.0 | | | | | | |
| ESP | 1011.0 | 3004.0 | 33529.0 | 33524.0 | 34965.0 | | | | | |
| FRA | 1081.0 | 3145.0 | 31736.0 | 31603.0 | 32442.0 | 34237.0 | | | | |
| GBR | 1011.0 | 27708.0 | 3174.0 | 2611.0 | 2947.0 | 3070.0 | 28850.0 | | | |
| ITA | 1308.0 | 28171.0 | 2761.0 | 2124.0 | 2372.0 | 2502.0 | 26871.0 | 28465.0 | | |
| NLD | 998.0 | 2908.0 | 32974.0 | 32868.0 | 33329.0 | 31666.0 | 2851.0 | 2319.0 | 35048.0 | |
| HUN | 493.0 | 1065.0 | 5713.0 | 5434.0 | 5687.0 | 5589.0 | 1035.0 | 983.0 | 5678.0 | 6226.0 |
| POL | 1526.0 | 3222.0 | 28819.0 | 28960.0 | 29661.0 | 28097.0 | 2818.0 | 2553.0 | 28874.0 | 5683.0 31274.0 |

Number of bulls in reference population for ang

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BEL | 2689.0 | | | | | | | | | |
| CAN | 1446.0 | 33328.0 | | | | | | | | |
| DEU | 1051.0 | 3317.0 | 32409.0 | | | | | | | |
| DFS | 852.0 | 2664.0 | 29840.0 | 30977.0 | | | | | | |
| ESP | 1000.0 | 2999.0 | 30330.0 | 30339.0 | 31747.0 | | | | | |
| FRA | 1070.0 | 3140.0 | 28590.0 | 28475.0 | 29292.0 | 31075.0 | | | | |
| GBR | 998.0 | 27692.0 | 3167.0 | 2604.0 | 2940.0 | 3063.0 | 28333.0 | | | |
| ITA | 1306.0 | 27992.0 | 2756.0 | 2119.0 | 2367.0 | 2497.0 | 26859.0 | 28284.0 | | |
| NLD | 977.0 | 2901.0 | 29789.0 | 29694.0 | 30156.0 | 28549.0 | 2770.0 | 2313.0 | 31406.0 | |
| HUN | 483.0 | 1060.0 | 3163.0 | 2894.0 | 3143.0 | 3102.0 | 1028.0 | 978.0 | 3122.0 | 3634.0 |
| POL | 1513.0 | 3217.0 | 25629.0 | 25780.0 | 26477.0 | 24973.0 | 2810.0 | 2546.0 | 25694.0 | 3129.0 28073.0 |

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Number of bulls in reference population for        ran
-----------------------------------------------------
BEL  2737.0
CAN  1448.0 33770.0
DEU  1062.0  3322.0 36086.0
DFS   861.0  2669.0 33496.0 34642.0
ESP  1011.0  3004.0 33995.0 33992.0 35433.0
FRA  1081.0  3145.0 32172.0 32040.0 32883.0 34674.0
GBR  1011.0 27708.0  3174.0  2611.0  2947.0  3070.0 28850.0
ITA  1308.0 28171.0  2761.0  2124.0  2372.0  2502.0 26871.0 28465.0
NLD   998.0  2908.0 33437.0 33333.0 33798.0 32103.0  2851.0  2319.0 35513.0
HUN   493.0  1065.0  6217.0  5940.0  6193.0  6067.0  1035.0   983.0  6184.0  6733.0
POL  1526.0  3222.0 29328.0 29471.0 30172.0 28580.0  2818.0  2553.0 29385.0  6190.0 31786.0

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Number of bulls in reference population for        rwi
-----------------------------------------------------
BEL  2722.0
CAN  1448.0 32950.0
DEU  1062.0  3322.0 36127.0
DFS   861.0  2669.0 33537.0 34683.0
ESP  1011.0  3004.0 34032.0 34029.0 35470.0
FRA  1081.0  3145.0 32212.0 32080.0 32919.0 34714.0
GBR  1011.0 27708.0  3174.0  2611.0  2947.0  3070.0 28850.0
ITA  1308.0 28171.0  2761.0  2124.0  2372.0  2502.0 26871.0 28465.0
NLD   998.0  2908.0 33477.0 33373.0 33834.0 32143.0  2851.0  2319.0 35553.0
HUN   493.0  1065.0  6208.0  5931.0  6184.0  6058.0  1035.0   983.0  6175.0  6724.0
POL  1526.0  3222.0 29321.0 29464.0 30165.0 28573.0  2818.0  2553.0 29378.0  6181.0 31779.0

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Number of bulls in reference population for        rls
-----------------------------------------------------
BEL  2737.0
CAN  1448.0 33770.0
DEU  1062.0  3322.0 36183.0
DFS   861.0  2669.0 33593.0 34739.0
ESP  1011.0  3004.0 34087.0 34084.0 35525.0
FRA  1081.0  3145.0 32268.0 32136.0 32974.0 34770.0
GBR  1011.0 27708.0  3174.0  2611.0  2947.0  3070.0 28850.0
ITA  1308.0 28171.0  2761.0  2124.0  2372.0  2502.0 26871.0 28465.0
NLD   998.0  2908.0 33533.0 33429.0 33889.0 32199.0  2851.0  2319.0 35609.0
HUN   493.0  1065.0  6217.0  5940.0  6193.0  6067.0  1035.0   983.0  6184.0  6733.0
POL  1526.0  3222.0 29331.0 29474.0 30175.0 28583.0  2818.0  2553.0 29388.0  6190.0 31789.0

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Number of bulls in reference population for        rlr
-----------------------------------------------------
BEL  2709.0
CAN  1446.0 32835.0
DEU  1056.0  3314.0 34080.0
DFS   855.0  2661.0 31517.0 32652.0
ESP  1005.0  2996.0 31998.0 32002.0 33418.0
FRA  1075.0  3137.0 30203.0 30092.0 30912.0 32638.0
GBR   997.0 26874.0  3164.0  2601.0  2937.0  3060.0 27514.0
ITA  1307.0 27331.0  2753.0  2116.0  2364.0  2494.0 26043.0 27623.0
NLD   982.0  2898.0 31484.0 31377.0 31838.0 30186.0  2767.0  2310.0 33109.0
HUN   492.0  1065.0  5344.0  5065.0  5318.0  5229.0  1034.0   983.0  5309.0  5856.0
POL  1520.0  3213.0 27319.0 27457.0 28158.0 26605.0  2807.0  2544.0 27386.0  5314.0 29722.0

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Number of bulls in reference population for        fan
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BEL  2719.0
CAN  1446.0 33760.0
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DEU  1061.0  3322.0 33991.0
DFS   860.0  2669.0 31669.0 32797.0
ESP  1010.0  3004.0 32161.0 32163.0 33593.0
FRA  1080.0  3145.0 30411.0 30282.0 31116.0 32907.0
GBR   999.0 27699.0  3174.0  2611.0  2947.0  3070.0 28347.0
ITA  1307.0 28164.0  2761.0  2124.0  2372.0  2502.0 26865.0 28458.0
NLD   987.0  2906.0 31618.0 31516.0 31975.0 30352.0  2777.0  2318.0 33241.0
HUN   492.0  1065.0  5554.0  5276.0  5528.0  5436.0  1035.0   983.0  5520.0  6066.0
POL  1525.0  3222.0 27468.0 27610.0 28311.0 26788.0  2818.0  2553.0 27530.0  5525.0 29921.0

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Number of bulls in reference population for        hde
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Number of bulls in reference population for        fua
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BEL  2737.0
CAN  1448.0 33769.0
DEU  1062.0  3322.0 35365.0
DFS   861.0  2669.0 32781.0 33921.0
ESP  1011.0  3004.0 33271.0 33269.0 34701.0
FRA  1081.0  3145.0 31477.0 31349.0 32181.0 33974.0
GBR  1011.0 27707.0  3174.0  2611.0  2947.0  3070.0 28849.0
ITA  1308.0 28170.0  2761.0  2124.0  2372.0  2502.0 26870.0 28464.0
NLD   998.0  2908.0 32733.0 32627.0 33087.0 31425.0  2851.0  2319.0 34807.0
HUN   493.0  1065.0  5692.0  5413.0  5666.0  5568.0  1035.0   983.0  5657.0  6205.0
POL  1526.0  3222.0 28528.0 28669.0 29370.0 27806.0  2818.0  2553.0 28588.0  5662.0 30983.0

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Number of bulls in reference population for        ruh
-----------------------------------------------------
BEL  2737.0
CAN  1448.0 33769.0
DEU  1062.0  3322.0 35053.0
DFS   861.0  2669.0 32464.0 33577.0
ESP  1011.0  3004.0 32959.0 32926.0 34363.0
FRA  1081.0  3145.0 31172.0 31039.0 31877.0 33670.0
GBR  1011.0 27707.0  3174.0  2611.0  2947.0  3070.0 28849.0
ITA  1308.0 28170.0  2761.0  2124.0  2372.0  2502.0 26870.0 28464.0
NLD   998.0  2908.0 32421.0 32314.0 32776.0 31119.0  2851.0  2319.0 34494.0
HUN   493.0  1065.0  5706.0  5427.0  5680.0  5582.0  1035.0   983.0  5671.0  6219.0
POL  1526.0  3222.0 28665.0 28806.0 29507.0 27943.0  2818.0  2553.0 28724.0  5676.0 31120.0

-----------------------------------------------------
Number of bulls in reference population for        ruw
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-----------------------------------------------------
Number of bulls in reference population for        usu
-----------------------------------------------------
BEL  2737.0
CAN  1448.0 33770.0
DEU  1062.0  3322.0 36181.0
DFS   861.0  2669.0 33591.0 34737.0
ESP  1011.0  3004.0 34085.0 34082.0 35523.0
FRA  1081.0  3145.0 32266.0 32134.0 32972.0 34768.0
GBR  1011.0 27708.0  3174.0  2611.0  2947.0  3070.0 28850.0
ITA  1308.0 28171.0  2761.0  2124.0  2372.0  2502.0 26871.0 28465.0
NLD   998.0  2908.0 33531.0 33427.0 33887.0 32197.0  2851.0  2319.0 35607.0
HUN   493.0  1065.0  6216.0  5939.0  6192.0  6066.0  1035.0   983.0  6183.0  6732.0
POL  1526.0  3222.0 29329.0 29472.0 30173.0 28581.0  2818.0  2553.0 29386.0  6189.0 31787.0

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Number of bulls in reference population for        ude
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BEL  2722.0
CAN  1446.0 33766.0
DEU  1062.0  3322.0 36180.0
DFS   861.0  2669.0 33590.0 34736.0
ESP  1011.0  3004.0 34084.0 34081.0 35522.0
FRA  1081.0  3145.0 32266.0 32134.0 32972.0 34768.0
GBR   999.0 27704.0  3174.0  2611.0  2947.0  3070.0 28352.0
ITA  1307.0 28170.0  2761.0  2124.0  2372.0  2502.0 26870.0 28464.0
NLD   988.0  2906.0 33530.0 33426.0 33886.0 32197.0  2777.0  2318.0 35160.0
HUN   493.0  1065.0  6217.0  5940.0  6193.0  6067.0  1035.0   983.0  6184.0  6733.0
POL  1526.0  3222.0 29329.0 29472.0 30173.0 28582.0  2818.0  2553.0 29386.0  6190.0 31787.0

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Number of bulls in reference population for        ftp
-------------------------------------------------------
BEL  2737.0
CAN  1448.0 33770.0
DEU  1062.0  3322.0 36135.0
DFS   861.0  2669.0 33545.0 34691.0
ESP  1011.0  3004.0 34040.0 34037.0 35478.0
FRA  1081.0  3145.0 32220.0 32088.0 32927.0 34722.0
GBR  1011.0 27708.0  3174.0  2611.0  2947.0  3070.0 28850.0
ITA  1308.0 28171.0  2761.0  2124.0  2372.0  2502.0 26871.0 28465.0
NLD   998.0  2908.0 33485.0 33381.0 33842.0 32151.0  2851.0  2319.0 35561.0
HUN   493.0  1065.0  6216.0  5939.0  6192.0  6066.0  1035.0   983.0  6183.0  6732.0
POL  1526.0  3222.0 29329.0 29472.0 30173.0 28581.0  2818.0  2553.0 29386.0  6189.0 31787.0

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Number of bulls in reference population for        ftl
-------------------------------------------------------
BEL  2722.0
CAN  1446.0 33754.0
DEU  1062.0  3322.0 36180.0
DFS   861.0  2669.0 33590.0 34736.0
ESP  1011.0  3004.0 34084.0 34081.0 35522.0
FRA  1081.0  3145.0 32266.0 32134.0 32972.0 34768.0
GBR   999.0 27704.0  3174.0  2611.0  2947.0  3070.0 28353.0
ITA  1307.0 28170.0  2761.0  2124.0  2372.0  2502.0 26871.0 28465.0
NLD   988.0  2906.0 33530.0 33426.0 33886.0 32197.0  2777.0  2318.0 35160.0
HUN   493.0  1065.0  6217.0  5940.0  6193.0  6067.0  1035.0   983.0  6184.0  6733.0
POL  1526.0  3222.0 29329.0 29472.0 30173.0 28582.0  2818.0  2553.0 29386.0  6190.0 31787.0

-------------------------------------------------------
Number of bulls in reference population for        rtp
-------------------------------------------------------
BEL  2717.0
CAN  1448.0 30646.0
DEU  1060.0  3315.0 33846.0
DFS   859.0  2662.0 31260.0 32312.0
ESP  1009.0  2997.0 31758.0 31671.0 33110.0
FRA  1079.0  3138.0 30024.0 29838.0 30676.0 32470.0
GBR  1009.0 25849.0  3167.0  2604.0  2940.0  3063.0 26986.0
ITA  1308.0 26254.0  2755.0  2118.0  2366.0  2496.0 25119.0 26549.0
NLD   996.0  2882.0 31224.0 31066.0 31529.0 29925.0  2825.0  2294.0 33092.0
POL  1523.0  3214.0 27817.0 27900.0 28609.0 27074.0  2810.0  2546.0 27822.0 30145.0

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Number of bulls in reference population for        ocs
-------------------------------------------------------
AUS  2917.0
BEL   364.0  2720.0
CAN  1062.0  1448.0 33744.0
DEU   718.0  1061.0  3321.0 35548.0
ESP   681.0  1010.0  3003.0 33455.0 34881.0
FRA   696.0  1080.0  3144.0 31633.0 32336.0 34119.0
GBR  1190.0  1011.0 27684.0  3174.0  2947.0  3070.0 28826.0
```

```
ITA   846.0  1308.0 28151.0  2761.0  2372.0  2502.0 26851.0 28445.0
NLD   733.0   997.0  2908.0 32928.0 33284.0 31594.0  2851.0  2319.0 35000.0
HUN   453.0   493.0  1065.0  6217.0  6193.0  6067.0  1035.0   983.0  6184.0  6733.0
POL   641.0  1525.0  3221.0 28718.0 29562.0 27970.0  2818.0  2553.0 28786.0  6190.0 31176.0

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Number of bulls in reference population for        ous
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BEL  2716.0
CAN  1448.0 33769.0
DEU  1062.0  3322.0 36181.0
DFS   861.0  2669.0 33591.0 34737.0
ESP  1011.0  3004.0 34085.0 34082.0 35523.0
FRA  1081.0  3145.0 32266.0 32134.0 32972.0 34764.0
GBR  1010.0 27707.0  3174.0  2611.0  2947.0  3070.0 28846.0
ITA  1308.0 28170.0  2761.0  2124.0  2372.0  2502.0 26870.0 28464.0
NLD   998.0  2908.0 33533.0 33429.0 33889.0 32199.0  2851.0  2319.0 35608.0
HUN   493.0  1065.0  6217.0  5940.0  6193.0  6067.0  1035.0   983.0  6184.0  6733.0
POL  1526.0  3222.0 29329.0 29472.0 30173.0 28581.0  2818.0  2553.0 29388.0  6190.0 31787.0

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Number of bulls in reference population for        ofl
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BEL  2701.0
CAN  1446.0 33618.0
DEU  1061.0  3322.0 35545.0
DFS   860.0  2669.0 32965.0 34108.0
ESP  1010.0  3004.0 33452.0 33454.0 34878.0
FRA  1080.0  3145.0 31631.0 31507.0 32334.0 34117.0
GBR   998.0 27576.0  3174.0  2611.0  2947.0  3070.0 28221.0
ITA  1307.0 28064.0  2761.0  2124.0  2372.0  2502.0 26764.0 28358.0
NLD   987.0  2906.0 32924.0 32820.0 33280.0 31591.0  2777.0  2318.0 34529.0
HUN   493.0  1065.0  6216.0  5939.0  6192.0  6066.0  1035.0   983.0  6183.0  6732.0
POL  1525.0  3222.0 28715.0 28858.0 29559.0 27968.0  2818.0  2553.0 28782.0  6189.0 31173.0

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Number of bulls in reference population for        loc
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BEL  2678.0
CAN  1439.0 27698.0
DEU  1056.0  3270.0 29593.0
DFS   855.0  2621.0 27289.0 28168.0
ESP  1005.0  2949.0 27895.0 27752.0 29049.0
FRA  1075.0  3089.0 26185.0 25927.0 26855.0 28337.0
GBR   994.0 25184.0  3123.0  2562.0  2895.0  3018.0 25801.0
ITA  1299.0 25578.0  2721.0  2087.0  2334.0  2464.0 24594.0 25805.0
NLD   981.0  2864.0 27483.0 27257.0 27868.0 26154.0  2733.0  2282.0 28914.0
HUN   489.0  1062.0  4548.0  4273.0  4525.0  4457.0  1030.0   980.0  4513.0  5055.0

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Number of bulls in reference population for        bcs
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BEL  2564.0
DEU  1049.0 26201.0
FRA  1068.0 22921.0 24809.0
GBR   986.0  3112.0  3006.0 24299.0
ITA  1300.0  2709.0  2451.0 23088.0 24538.0
NLD   972.0 24198.0 22930.0  2714.0  2263.0 25578.0
CAN  1440.0  3252.0  3068.0 23704.0 24323.0  2836.0 28038.0
HUN   490.0  5351.0  5241.0  1034.0   982.0  5318.0  1064.0  5863.0
```