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:

FRA (HOL) Missing bulls due to routine pedigree update
DEU (HOL) Base change.
           Changes in status and publication of bulls born in 2021/2022
           For "ang":Increase in reference population due to the change in trait definition implemented last year
           Plus, for "fan", two bulls with significant GEBVs changes due to switching of genotyping
ITA (HOL) Decrease in reliability due to the changes of the information in the system
POL (HOL) Changes due to editing in pedigree and reference population
GBR (HOL) Changes due to the difference in the genetic progress between Holstein and Friesian bulls
ESP (HOL) Base change in line with MACE.
           Missing bulls due to the increase of number of daughters

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 test 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 2024

Country	Date
BEL	20201201
CAN	20240801
DEU	20240813
DFS	20240813
ESP	20240723
FRA	20240814
GBR	20240722
ITA	20240710
NLD	20240801
HUN	20240711
POL	20240712

CZE 20240729

Table 2.

Number of bulls in reference population for sta

BEL	1671.0											
CAN	726.0	40496.0										
DEU	727.0	10279.0	46400.0									
DFS	649.0	6166.0	39991.0	40956.0								
ESP	704.0	7387.0	41404.0	39985.0	42606.0							
FRA	710.0	4041.0	34734.0	34305.0	34836.0	36460.0						
GBR	683.0	34010.0	11221.0	7037.0	8293.0	4119.0	36629.0					
ITA	721.0	34158.0	9476.0	5440.0	6504.0	3310.0	33387.0	35225.0				
NLD	740.0	4119.0	36601.0	36112.0	36583.0	34237.0	4454.0	3476.0	38370.0			
HUN	549.0	2235.0	8228.0	7770.0	8065.0	7283.0	2450.0	2215.0	7806.0	9032.0		
POL	994.0	4866.0	33925.0	33717.0	34135.0	30342.0	5310.0	4364.0	31844.0	7626.0	35476.0	
CZE	844.0	1932.0	2453.0	1877.0	2261.0	1693.0	1839.0	1872.0	1725.0	1426.0	2549.0	3813.0

Number of bulls in reference population for cwi

CAN	40493.0											
DEU	10281.0	45182.0										
DFS	6167.0	38855.0	39814.0									
ESP	7389.0	40192.0	38845.0	41370.0								
FRA	4041.0	33541.0	33190.0	33640.0	35254.0							
GBR	34007.0	11224.0	7039.0	8296.0	4119.0	36627.0						
ITA	34155.0	9479.0	5442.0	6507.0	3310.0	33385.0	35223.0					
NLD	4119.0	35408.0	34988.0	35390.0	33070.0	4454.0	3476.0	37175.0				
HUN	2235.0	7691.0	7262.0	7526.0	6772.0	2450.0	2215.0	7267.0	8492.0			
POL	4866.0	32770.0	32632.0	32980.0	29213.0	5310.0	4364.0	30696.0	7086.0	34317.0		
CZE	1932.0	2450.0	1874.0	2258.0	1690.0	1839.0	1872.0	1723.0	1425.0	2546.0	3810.0	

Number of bulls in reference population for bde

CAN	40496.0											
DEU	10279.0	45841.0										
DFS	6166.0	39462.0	40423.0									
ESP	7387.0	40846.0	39453.0	42044.0								
FRA	4041.0	34202.0	33799.0	34304.0	35927.0							
GBR	34010.0	11221.0	7037.0	8293.0	4119.0	36629.0						
ITA	34158.0	9476.0	5440.0	6504.0	3310.0	33387.0	35225.0					
NLD	4119.0	36042.0	35581.0	36023.0	33704.0	4454.0	3476.0	37809.0				
HUN	2235.0	7716.0	7286.0	7551.0	6797.0	2450.0	2215.0	7292.0	8517.0			
POL	4866.0	33412.0	33232.0	33620.0	29855.0	5310.0	4364.0	31329.0	7111.0	34960.0		
CZE	1932.0	2452.0	1876.0	2260.0	1692.0	1839.0	1872.0	1724.0	1425.0	2548.0	3812.0	

Number of bulls in reference population for ang

BEL	1579.0											
CAN	720.0	39556.0										
DEU	684.0	9819.0	32660.0									
DFS	614.0	5720.0	27283.0	28211.0								
ESP	668.0	6937.0	28562.0	27275.0	29700.0							
FRA	677.0	3620.0	23057.0	22778.0	23151.0	24762.0						
GBR	659.0	33574.0	10648.0	6475.0	7728.0	3582.0	35693.0					
ITA	715.0	33641.0	9162.0	5135.0	6196.0	3024.0	33031.0	34668.0				
NLD	680.0	3671.0	23849.0	23529.0	23848.0	22631.0	3824.0	3173.0	25152.0			
HUN	512.0	2208.0	5029.0	4635.0	4862.0	4179.0	2343.0	2194.0	4463.0	5521.0		
POL	957.0	4420.0	21133.0	21105.0	21388.0	18744.0	4749.0	4059.0	19160.0	4425.0	22664.0	
CZE	824.0	1917.0	2375.0	1808.0	2190.0	1627.0	1828.0	1858.0	1655.0	1382.0	2475.0	3718.0

Number of bulls in reference population for ran

CAN 40495.0
DEU 10278.0 46303.0
DFS 6165.0 39894.0 40859.0
ESP 7386.0 41312.0 39893.0 42514.0
FRA 4041.0 34639.0 34210.0 34746.0 36365.0
GBR 34009.0 11220.0 7036.0 8292.0 4119.0 36628.0
ITA 34157.0 9475.0 5439.0 6503.0 3310.0 33386.0 35224.0
NLD 4118.0 36505.0 36016.0 36492.0 34142.0 4453.0 3475.0 38274.0
HUN 2235.0 8228.0 7770.0 8065.0 7283.0 2450.0 2215.0 7806.0 9032.0
POL 4866.0 33922.0 33714.0 34132.0 30339.0 5310.0 4364.0 31841.0 7626.0 35473.0
CZE 1932.0 2453.0 1877.0 2261.0 1693.0 1839.0 1872.0 1725.0 1426.0 2549.0 3813.0

Number of bulls in reference population for   rwi

CAN 39673.0
DEU 10278.0 46344.0
DFS 6165.0 39938.0 40903.0
ESP 7386.0 41349.0 39933.0 42551.0
FRA 4041.0 34679.0 34253.0 34782.0 36405.0
GBR 34009.0 11220.0 7036.0 8292.0 4119.0 36628.0
ITA 34157.0 9475.0 5439.0 6503.0 3310.0 33386.0 35224.0
NLD 4118.0 36545.0 36059.0 36528.0 34182.0 4453.0 3475.0 38314.0
HUN 2235.0 8219.0 7764.0 8056.0 7274.0 2450.0 2215.0 7797.0 9023.0
POL 4866.0 33915.0 33710.0 34125.0 30332.0 5310.0 4364.0 31834.0 7617.0 35466.0
CZE 1932.0 2453.0 1877.0 2261.0 1693.0 1839.0 1872.0 1725.0 1426.0 2549.0 3813.0

Number of bulls in reference population for   rls

CAN 40497.0
DEU 10280.0 46402.0
DFS 6166.0 39992.0 40957.0
ESP 7388.0 41406.0 39986.0 42608.0
FRA 4041.0 34735.0 34306.0 34837.0 36461.0
GBR 34011.0 11222.0 7037.0 8294.0 4119.0 36630.0
ITA 34159.0 9477.0 5440.0 6505.0 3310.0 33388.0 35226.0
NLD 4119.0 36602.0 36113.0 36584.0 34238.0 4454.0 3476.0 38371.0
HUN 2235.0 8228.0 7770.0 8065.0 7283.0 2450.0 2215.0 7806.0 9032.0
POL 4866.0 33925.0 33717.0 34135.0 30342.0 5310.0 4364.0 31844.0 7626.0 35476.0
CZE 1932.0 2453.0 1877.0 2261.0 1693.0 1839.0 1872.0 1725.0 1426.0 2549.0 3813.0

Number of bulls in reference population for   rlr

CAN 39570.0
DEU 10275.0 44292.0
DFS 6159.0 37998.0 38956.0
ESP 7381.0 39310.0 37987.0 40480.0
FRA 4033.0 32662.0 32343.0 32766.0 34322.0
GBR 33178.0 11215.0 7028.0 8285.0 4109.0 35481.0
ITA 33327.0 9472.0 5433.0 6498.0 3302.0 32558.0 34393.0
NLD 4109.0 34546.0 34143.0 34525.0 32219.0 4365.0 3468.0 35867.0
HUN 2230.0 7334.0 6911.0 7169.0 6426.0 2369.0 2212.0 6771.0 7866.0
POL 4857.0 31906.0 31784.0 32113.0 28358.0 5300.0 4355.0 29836.0 6730.0 33400.0
CZE 1931.0 2440.0 1864.0 2248.0 1681.0 1838.0 1871.0 1713.0 1418.0 2487.0 3722.0

Number of bulls in reference population for   fan

CAN 40461.0
DEU 10280.0 44243.0
DFS 6165.0 38158.0 39105.0
ESP 7387.0 39509.0 38136.0 40685.0
FRA 4039.0 32905.0 32532.0 33004.0 34625.0
GBR 33983.0 11223.0 7037.0 8294.0 4117.0 36294.0
ITA 34128.0 9478.0 5440.0 6505.0 3308.0 33362.0 35195.0
NLD 4115.0 34716.0 34286.0 34697.0 32417.0 4373.0 3474.0 36035.0
HUN 2232.0 7539.0 7115.0 7375.0 6631.0 2372.0 2214.0 6976.0 8072.0

POL 4864.0 32091.0 31941.0 32296.0 28573.0 5308.0 4362.0 30016.0 6937.0 33636.0
CZE 1931.0 2451.0 1875.0 2259.0 1691.0 1839.0 1871.0 1723.0 1424.0 2547.0 3810.0

Number of bulls in reference population for   hde

Number of bulls in reference population for   fua

CAN 40497.0
DEU 10280.0 45580.0
DFS 6166.0 39242.0 40201.0
ESP 7389.0 40591.0 39232.0 41780.0
FRA 4041.0 33944.0 33578.0 34043.0 35665.0
GBR 34011.0 11220.0 7038.0 8295.0 4119.0 36627.0
ITA 34159.0 9477.0 5441.0 6506.0 3310.0 33388.0 35226.0
NLD 4119.0 35802.0 35371.0 35782.0 33464.0 4454.0 3476.0 37569.0
HUN 2235.0 7693.0 7264.0 7528.0 6774.0 2450.0 2215.0 7269.0 8494.0
POL 4866.0 33121.0 32972.0 33329.0 29565.0 5309.0 4363.0 31044.0 7088.0 34669.0
CZE 1932.0 2452.0 1876.0 2260.0 1692.0 1839.0 1872.0 1724.0 1425.0 2548.0 3812.0

Number of bulls in reference population for   ruh

CAN 40495.0
DEU 10279.0 45265.0
DFS 6165.0 38927.0 39863.0
ESP 7388.0 40275.0 38896.0 41439.0
FRA 4041.0 33637.0 33271.0 33737.0 35359.0
GBR 34009.0 11218.0 7036.0 8293.0 4119.0 36622.0
ITA 34157.0 9475.0 5439.0 6504.0 3310.0 33385.0 35223.0
NLD 4119.0 35479.0 35053.0 35460.0 33147.0 4454.0 3476.0 37245.0
HUN 2235.0 7705.0 7275.0 7540.0 6786.0 2450.0 2215.0 7281.0 8506.0
POL 4866.0 33257.0 33100.0 33465.0 29701.0 5309.0 4363.0 31179.0 7103.0 34805.0
CZE 1932.0 2452.0 1876.0 2260.0 1692.0 1839.0 1872.0 1724.0 1425.0 2548.0 3812.0

Number of bulls in reference population for   ruw

Number of bulls in reference population for   usu

BEL 1671.0
CAN   726.0 40499.0
DEU   727.0 10281.0 46400.0
DFS   649.0 6167.0 39994.0 40958.0
ESP   704.0 7390.0 41408.0 39989.0 42610.0
FRA   710.0 4041.0 34735.0 34306.0 34837.0 36461.0
GBR   683.0 34013.0 11221.0 7039.0 8296.0 4119.0 36629.0
ITA   721.0 34161.0 9478.0 5442.0 6507.0 3310.0 33390.0 35228.0
NLD   740.0 4119.0 36602.0 36113.0 36584.0 34238.0 4454.0 3476.0 38371.0
HUN   549.0 2235.0 8228.0 7770.0 8065.0 7283.0 2450.0 2215.0 7806.0 9032.0
POL   994.0 4866.0 33924.0 33717.0 34134.0 30342.0 5309.0 4363.0 31844.0 7626.0 35475.0
CZE   844.0 1932.0 2453.0 1877.0 2261.0 1693.0 1839.0 1872.0 1725.0 1426.0 2549.0 3813.0

Number of bulls in reference population for   ude

CAN 40493.0
DEU 10282.0 46413.0
DFS 6166.0 39995.0 40959.0
ESP 7388.0 41410.0 39988.0 42610.0
FRA 4041.0 34734.0 34304.0 34836.0 36460.0
GBR 34011.0 11229.0 7040.0 8298.0 4119.0 36327.0
ITA 34160.0 9485.0 5443.0 6509.0 3310.0 33395.0 35233.0
NLD 4117.0 36608.0 36115.0 36587.0 34237.0 4381.0 3482.0 37936.0
HUN 2234.0 8231.0 7771.0 8066.0 7283.0 2376.0 2218.0 7668.0 8768.0

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POL  4867.0 33927.0 33718.0 34137.0 30342.0  5312.0  4366.0 31847.0  7628.0 35478.0
CZE  1933.0  2453.0  1877.0  2261.0  1693.0  1840.0  1873.0  1725.0  1426.0  2549.0  3814.0

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Number of bulls in reference population for        ftp
----------------------------------------------------------
CAN 40503.0
DEU 10284.0 46370.0
DFS  6166.0 39950.0 40914.0
ESP  7389.0 41367.0 39944.0 42569.0
FRA  4041.0 34688.0 34258.0 34791.0 36414.0
GBR 34016.0 11231.0  7040.0  8299.0  4119.0 36641.0
ITA 34165.0  9487.0  5443.0  6510.0  3310.0 33399.0 35238.0
NLD  4120.0 36563.0 36070.0 36544.0 34191.0  4461.0  3483.0 38334.0
HUN  2237.0  8231.0  7771.0  8066.0  7282.0  2454.0  2219.0  7807.0  9035.0
POL  4867.0 33926.0 33717.0 34136.0 30341.0  5312.0  4366.0 31846.0  7627.0 35477.0
CZE  1933.0  2453.0  1877.0  2261.0  1693.0  1840.0  1873.0  1725.0  1426.0  2549.0  3814.0

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Number of bulls in reference population for        ftl
----------------------------------------------------------
BEL  1642.0
CAN   724.0 40480.0
DEU   727.0 10279.0 46394.0
DFS   649.0  6165.0 39988.0 40952.0
ESP   704.0  7387.0 41401.0 39983.0 42601.0
FRA   710.0  4041.0 34733.0 34304.0 34835.0 36459.0
GBR   668.0 34007.0 11218.0  7036.0  8292.0  4119.0 36384.0
ITA   720.0 34155.0  9475.0  5439.0  6503.0  3310.0 33384.0 35221.0
NLD   720.0  4117.0 36599.0 36110.0 36580.0 34236.0  4379.0  3475.0 37951.0
HUN   531.0  2233.0  8227.0  7769.0  8064.0  7283.0  2396.0  2214.0  7679.0  8828.0
POL   994.0  4866.0 33923.0 33716.0 34133.0 30341.0  5309.0  4363.0 31843.0  7626.0 35474.0
CZE   844.0  1932.0  2453.0  1877.0  2261.0  1693.0  1839.0  1872.0  1725.0  1426.0  2549.0  3813.0

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Number of bulls in reference population for        rtp
----------------------------------------------------------
CAN 37403.0
DEU 10278.0 44107.0
DFS  6160.0 37772.0 38649.0
ESP  7383.0 39105.0 37679.0 40213.0
FRA  4035.0 32508.0 32100.0 32557.0 34179.0
GBR 32182.0 11225.0  7034.0  8293.0  4113.0 34799.0
ITA 32160.0  9482.0  5438.0  6505.0  3305.0 31573.0 33229.0
NLD  4096.0 34305.0 33840.0 34231.0 31962.0  4437.0  3459.0 35873.0
POL  4860.0 32439.0 32238.0 32588.0 28852.0  5306.0  4360.0 30308.0 33861.0
CZE  1928.0  2437.0  1862.0  2245.0  1678.0  1836.0  1868.0  1709.0  2474.0  3729.0

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Number of bulls in reference population for        ocs
----------------------------------------------------------
AUS  3076.0
CAN  1235.0 40404.0
DEU   919.0 10227.0 45637.0
ESP   842.0  7365.0 40711.0 41885.0
FRA   747.0  4037.0 34061.0 34157.0 35769.0
GBR  1270.0 33936.0 11164.0  8271.0  4117.0 36541.0
ITA  1173.0 34085.0  9420.0  6484.0  3307.0 33303.0 35138.0
NLD   808.0  4111.0 35950.0 35937.0 33594.0  4443.0  3464.0 37710.0
HUN   764.0  2231.0  8226.0  8065.0  7284.0  2445.0  2210.0  7807.0  9028.0
POL   692.0  4859.0 33272.0 33480.0 29690.0  5306.0  4360.0 31202.0  7627.0 34817.0
CZE   414.0  1932.0  2451.0  2259.0  1691.0  1839.0  1872.0  1724.0  1426.0  2547.0  3811.0

----------------------------------------------------------
Number of bulls in reference population for        ous
----------------------------------------------------------
CAN 40443.0
DEU 10236.0 46302.0
DFS  6153.0 39969.0 40927.0
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ESP  7368.0 41369.0 39971.0 42563.0
FRA  4039.0 34723.0 34301.0 34822.0 36443.0
GBR 33969.0 11169.0  7023.0  8272.0  4118.0 36566.0
ITA 34118.0  9427.0  5427.0  6485.0  3308.0 33336.0 35171.0
NLD  4113.0 36585.0 36112.0 36571.0 34228.0  4445.0  3466.0 38349.0
HUN  2231.0  8226.0  7771.0  8065.0  7284.0  2445.0  2210.0  7807.0  9028.0
POL  4861.0 33912.0 33714.0 34119.0 30331.0  5306.0  4360.0 31834.0  7627.0 35459.0
CZE  1932.0  2453.0  1877.0  2261.0  1693.0  1839.0  1872.0  1725.0  1426.0  2549.0  3813.0

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Number of bulls in reference population for        ofl
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CAN 40291.0
DEU 10238.0 45665.0
DFS  6154.0 39379.0 40337.0
ESP  7368.0 40732.0 39380.0 41905.0
FRA  4039.0 34082.0 33711.0 34178.0 35790.0
GBR 33842.0 11174.0  7024.0  8273.0  4118.0 36134.0
ITA 33992.0  9430.0  5428.0  6486.0  3308.0 33212.0 35046.0
NLD  4111.0 35971.0 35537.0 35956.0 33614.0  4366.0  3466.0 37269.0
HUN  2228.0  8224.0  7769.0  8063.0  7283.0  2367.0  2209.0  7666.0  8759.0
POL  4861.0 33293.0 33135.0 33502.0 29711.0  5307.0  4361.0 31223.0  7626.0 34839.0
CZE  1932.0  2451.0  1875.0  2259.0  1691.0  1839.0  1872.0  1724.0  1426.0  2547.0  3811.0

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Number of bulls in reference population for        loc
----------------------------------------------------------
CAN 35276.0
DEU 10179.0 41540.0
DFS  6105.0 35590.0 36418.0
ESP  7317.0 36880.0 35508.0 37913.0
FRA  3997.0 30418.0 30057.0 30471.0 32022.0
GBR 32313.0 11119.0  6981.0  8229.0  4087.0 34580.0
ITA 32214.0  9376.0  5390.0  6448.0  3278.0 31691.0 33245.0
NLD  4076.0 32306.0 31885.0 32248.0 30003.0  4336.0  3440.0 33499.0
CZE  1923.0  2417.0  1843.0  2227.0  1660.0  1834.0  1862.0  1692.0  3686.0
HUN  2222.0  6511.0  6108.0  6345.0  5631.0  2358.0  2204.0  5948.0  1397.0  7030.0
POL  4817.0 29474.0 29311.0 29610.0 26015.0  5270.0  4323.0 27520.0  2435.0  5908.0 30791.0

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Number of bulls in reference population for        bcs
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DEU 38059.0
FRA 27258.0 28701.0
GBR 10923.0  4053.0 33174.0
ITA  9302.0  3267.0 30149.0 31876.0
NLD 28939.0 26760.0  4373.0  3422.0 30578.0
CZE  2409.0  1655.0  1823.0  1854.0  1689.0  3560.0
CAN 10068.0  3949.0 30774.0 30895.0  4015.0  1913.0 35440.0
ESP 33416.0 27301.0  8034.0  6381.0 28854.0  2220.0  7214.0 34401.0
HUN  7303.0  6406.0  2436.0  2201.0  6877.0  1412.0  2222.0  7142.0  8088.0
POL 28143.0 24796.0  5138.0  4269.0 26187.0  2363.0  4717.0 28246.0  6711.0 29406.0
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