

Introduction

The latest routine international evaluation for udder traits took place as scheduled at the Interbull Centre. Data from thirty-three (33) countries were included in this evaluation.

International genetic evaluations for udder health traits of bulls from Australia, Austria-Germany, Belgium, Canada, Croatia, Czech Republic, Denmark-Finland-Sweden, Estonia, France, Hungary, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, South Africa, Slovak Republic, Spain, Switzerland, the United Kingdom, the United States of America, Poland, Lithuania, Latvia, Croatia, Slovenia, Portugal and Uruguay were computed. Brown Swiss, Holstein, Red Dairy Cattle, Guernsey, Jersey and Simmental breed data were included in this evaluation.

Countries sending real MAS data (other countries participate to the MAS evaluation using SCS data as predictor):

HOL : DFS, NLD, FRA, CAN, ITA, CHE, USA, DEU, GBR, AUS
RDC : DFS, NLD, CAN, GBR, AUS
BSW : NLD, FRA, CHE, GBR
JER : DFS, NLD, CAN, GBR, AUS, USA
SIM : NLD, CHE, GBR
GUE : No evaluation for MAS yet

Changes in national procedures

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

AUS (ALL) Drops in information due to data clean up such as pedigree changes, status change of a bull which leads to a good number of bulls no longer qualifying. MAS: new trait, historic data are still been collected from various sources, this shows in considerable increases in number of bulls, daughters and records for the birth years 2013 through to 2017 as well as some individual older bulls. Base change for RDC

EST (HOL,RDC) Base change from cows born in years 2012-2016 to cows born in years 2014-2018.

SVN (ALL) Reduced the performance data to 2010-2022 and estimated variance components for all traits

DEA (BSW,SIM) Base change. Bug correction causing changes in the ToP declaration for young bulls being previously wrongly assigned ToP 12 and now corrected to 11

ITA (SIM) Some decrease in information due to pedigree correction

JPN (HOL) Changed iterative method from SOR to PCG and convergence criterion changed from 10-9 to 10-14 therefore older animals changed statistics. Re-estimation of heritability. Decrease in information due to pedigree correction.

DEU (HOL,RDC) Changes in the phenotypic data resulted in a minor reduction of the number of daughters for 56 bulls. Some bulls are no longer included as they go below the required threshold for numbers of herds and daughters

NZL (ALL) Continuous DNA parentage testing affecting numbers of daughters, herds and EDCs. EDCs are also affected by changes in phenotype records

CHE (ALL) Drops in information due to manual edits in database. The change of herd-year-season assignment of certain data records might also explain small changes in EDC and reliabilities for some bulls

GBR (ALL) Minor changes in data due re-extraction at each run and changes introduced by data providers

PRT (HOL) Migration of system and database to a new set of programs.

BEL (HOL) Inclusion of inbreeding effect in the model

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

Post-processing Windows:

According to the decision taken by ITC in Orlando (2015) to review the post-processing windows every 5 years, during the 2020 the relative working group has been re-activated and new windows have been identified.

As before, the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while the lower values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the

real estimated ones. Over the past five years, in fact, the previous adopted lower value (25th percentile) had been found too high causing estimated and post-processed correlations to differ significantly from each other. The new lower values have been applied to all breeds and traits.

The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more in consideration the value of the new estimated ones even when no changes are applied by the countries.

The new weights are as follows:

No changes :: 2
Small changes:: 1
Big changes :: 0

More information can be read on https://interbull.org/ib/rg_procedure

DATA AND METHOD OF ANALYSIS

Data were national genetic evaluations of AI sampled bulls with at least 10 daughters or 10 EDC (for clinical mastitis and maternal calving traits at least 50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at least 10 herds. Table 1 presents the amount of data included in this Interbull evaluation for all breeds.

National proofs were first de-regressed within country and then analysed jointly with a linear model including the effects of evaluation country, genetic group of bull and bull merit. Heritability estimates used in both the de-regression and international evaluation were as in each country's national evaluation.

Table 2 presents the date of evaluation as supplied by each country

Estimated genetic parameters and sire standard deviations are shown in APPENDIX I and the corresponding number of common bulls are listed in APPENDIX II.

SCIENTIFIC LITERATURE

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

International genetic evaluation computation:
Schaeffer. 1994. J. Dairy Sci. 77:2671-2678
Klei, 1998. Interbull Bulletin 17:3-7

Verification and Genetic trend validation:
Klei et al., 2002. Interbull Bulletin 29:178-182.
Boichard et al., 1995. J. Dairy Sci. 78:431-437

Weighting factors:
Fikse and Banos, 2001. J. Dairy Sci. 84:1759-1767

De-regression:
Sigurdsson and G. Banos. 1995. Acta Agric. Scand. 45:207-219
Jairath et al. 1998. J. Dairy Sci. Vol. 81:550-562

Genetic parameter estimation:
Klei and Weigel, 1998, Interbull Bulletin 17:8-14
Sullivan, 1999. Interbull Bulletin 22:146-148

Post-processing of estimated genetic correlations:
Mark et al., 2003, Interbull Bulletin 30:126-135
Jorjani et al., 2003. J. Dairy Sci. 86:677-679
<https://wiki.interbull.org/public/rG%20procedure?action=print>

Time edits
Weigel and Banos. 1997. J. Dairy Sci. 80:3425-3430

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for the next routine evaluation can be found on
<http://www.interbull.org/ib/servicecalendar>.

NEXT TEST INTERNATIONAL EVALUATION

Dates for the 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 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.

PUBLICATION OF INTERBULL TEST RUN

Test evaluation results are meant for review purposes only and should not be published.

^LTable 1. National evaluation data considered in the Interbull evaluation for udder health (December Routine Evaluation 2022).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		146	8741	1743	812	
BEL			2256			
CAN	270	107	13687	861	870	
CHE	3159		3328	98		3545
CZE			4677			
DEA	5979					24476
DEU			23890		295	
DFS			14251	2314	8123	
ESP			4484			
EST			1337		480	
FRA	485		18416			470
FRM						4703
GBR	149	310	7452	760	578	85
HUN			3163			190
IRL			2943			
ISR			1669			
ITA	2124		9652	73		1770
JPN			6835			
KOR			1628			
LTU			1341		436	
LVA			1328		667	
NLD	225		16925	245	100	503
NOR					4314	

CHE	0.88	0.86	0.85	0.89	0.82	0.74	0.82	0.69	13.07	
ITA	0.87	0.91	0.86	0.87	0.85	0.71	0.83	0.65	0.85	7.13

 JER mas

	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	7.29									
DFS	0.92	12.07								
GBR	0.80	0.85	1.89							
NLD	0.83	0.83	0.78	4.25						
USA	0.77	0.76	0.74	0.74	2.47					
AUS	0.67	0.67	0.66	0.68	0.66	0.11				
ZAF	0.73	0.71	0.72	0.81	0.70	0.69	20.96			
NZL	0.63	0.63	0.63	0.65	0.63	0.63	0.77	0.39		
CHE	0.84	0.81	0.74	0.76	0.75	0.70	0.80	0.73	13.00	
ITA	0.76	0.73	0.73	0.80	0.67	0.67	0.80	0.70	0.82	7.13

 RDC scs

	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	5.95													
DFS	0.94	12.93												
GBR	0.94	0.91	11.64											
NOR	0.86	0.90	0.81	13.69										
USA	0.92	0.86	0.88	0.80	0.23									
DEU	0.94	0.96	0.95	0.89	0.89	14.24								
AUS	0.81	0.84	0.87	0.81	0.73	0.84	0.27							
EST	0.88	0.89	0.89	0.84	0.85	0.93	0.81	18.97						
ZAF	0.83	0.85	0.85	0.88	0.86	0.92	0.76	0.87	25.29					
NZL	0.77	0.79	0.81	0.79	0.72	0.80	0.90	0.79	0.79	0.44				
LTU	0.85	0.89	0.87	0.89	0.81	0.90	0.79	0.91	0.87	0.77	0.34			
LVA	0.86	0.87	0.90	0.84	0.84	0.92	0.82	0.91	0.88	0.80	0.88	436.42		
NLD	0.91	0.95	0.95	0.88	0.86	0.96	0.85	0.90	0.88	0.82	0.86	0.88	4.16	
CAM	0.89	0.89	0.89	0.88	0.82	0.89	0.88	0.89	0.88	0.86	0.88	0.88	0.90	6.18

 RDC mas

	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	7.82												
DFS	0.89	13.56											
GBR	0.86	0.85	2.10										
NOR	0.82	0.71	0.73	13.69									
USA	0.79	0.74	0.78	0.79	0.22								
AUS	0.68	0.67	0.68	0.72	0.69	0.12							
EST	0.81	0.73	0.79	0.82	0.80	0.72	18.97						
ZAF	0.84	0.82	0.82	0.88	0.79	0.71	0.84	25.33					
NZL	0.65	0.63	0.67	0.76	0.70	0.67	0.82	0.77	0.44				
LTU	0.79	0.74	0.80	0.87	0.79	0.73	0.91	0.86	0.79	0.34			
LVA	0.78	0.72	0.80	0.87	0.75	0.71	0.94	0.87	0.84	0.91	435.86		
NLD	0.84	0.79	0.84	0.86	0.84	0.69	0.86	0.85	0.72	0.82	0.86	4.44	
CAM	0.84	0.84	0.85	0.88	0.81	0.82	0.89	0.88	0.88	0.89	0.88	0.86	6.18

 SIM scs

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.09										
FRA	0.89	1.01									
ITA	0.88	0.87	12.57								
NLD	0.91	0.93	0.84	4.35							
CHE	0.93	0.93	0.88	0.93	10.38						
DEA	0.92	0.93	0.85	0.91	0.89	12.27					
HUN	0.89	0.90	0.92	0.88	0.89	0.89	16.37				
SVN	0.84	0.82	0.82	0.81	0.83	0.80	0.82	9.38			
GBR	0.91	0.95	0.87	0.95	0.90	0.93	0.89	0.83	11.67		
HRV	0.87	0.79	0.80	0.79	0.80	0.79	0.83	0.78	0.80	9.74	

USA 0.84 0.90 0.87 0.87 0.85 0.81 0.91 0.78 0.90 0.80 0.20

SIM mas

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	1.08										
FRA	0.87	1.00									
ITA	0.90	0.82	12.54								
NLD	0.86	0.86	0.78	4.04							
CHE	0.83	0.89	0.87	0.84	9.87						
DEA	0.92	0.92	0.85	0.87	0.75	12.27					
HUN	0.87	0.82	0.88	0.86	0.84	0.88	16.37				
SVN	0.83	0.81	0.82	0.77	0.80	0.80	0.82	9.38			
GBR	0.75	0.88	0.76	0.81	0.89	0.78	0.82	0.77	2.78		
HRV	0.84	0.78	0.79	0.71	0.78	0.78	0.83	0.78	0.75	9.74	
USA	0.81	0.87	0.72	0.84	0.81	0.80	0.75	0.69	0.80	0.72	0.20

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0	97	57	185	145	155	31	140	68	32
FRA	89	0	91	135	195	260	29	230	65	51
NLD	52	77	0	89	107	163	30	139	43	46
USA	182	99	80	0	328	339	35	236	95	40
CHE	124	152	99	305	0	629	34	492	78	76
DEA	140	210	154	304	524	0	48	700	82	100
NZL	31	23	23	32	27	43	0	39	23	11
ITA	124	192	115	166	435	601	32	0	83	93
GBR	69	58	37	94	62	58	21	63	0	20
SVN	29	50	46	32	71	92	10	91	16	0

BSW

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	0	87	53	185	71	155	31	140	31	32
FRA	80	0	71	112	79	224	23	200	31	50
NLD	47	60	0	80	49	146	30	127	21	44
USA	182	80	70	0	97	338	35	236	41	40
CHE	65	63	47	74	0	241	17	203	19	59
DEA	140	174	136	303	208	0	48	700	39	100
NZL	31	20	23	32	15	43	0	39	10	11
ITA	124	164	104	166	175	601	32	0	42	93
GBR	30	28	18	41	16	28	8	33	0	14
SVN	29	48	45	32	56	92	10	91	12	0

GUE

common bulls below diagonal
 common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL
CAN	0	32	76	52	14
GBR	27	0	90	41	13
USA	68	93	0	70	29
AUS	50	35	68	0	26
NZL	11	11	29	26	0

GUE

HOL

common bulls below diagonal																													
common three quarter sib group above diagonal																													
	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	0	926	2595	1689	307	1684	1788	1790	3910	156	1943	1594	1121	899	1480	1428	505	834	561	1256	457	1699	350	553	1086	774	218	337	880
CHE	847	0	1180	769	186	770	735	982	1057	70	783	671	452	650	502	602	258	441	394	550	246	753	195	266	510	292	138	214	342
DEU	2036	1116	0	2894	482	2697	2165	3642	3754	184	2726	1781	1320	1320	1518	1656	549	1056	829	1988	709	2911	685	785	1264	688	346	694	878
DFS	1504	725	2205	0	358	1880	1672	2418	2384	170	1715	1420	994	957	1078	1151	505	924	723	1403	433	1916	410	523	979	547	261	463	727
EST	195	107	353	235	0	311	289	427	405	55	322	245	227	223	234	237	113	156	137	304	128	398	134	188	213	136	95	143	162
FRA	1240	711	1648	1166	171	0	1679	2267	2714	143	1788	1417	1031	1090	1317	1364	501	886	712	1395	467	2030	348	477	1034	592	222	376	684
GBR	2022	702	1672	1308	174	1153	0	1919	2384	162	1632	1514	929	931	1114	1154	507	977	918	1138	392	1543	356	462	976	542	205	364	748
NLD	1745	979	3463	2186	314	1602	1696	0	2817	183	1910	1609	1060	1396	1185	1272	514	1166	861	1679	575	2216	461	560	1103	549	278	498	775
USA	4437	990	2812	1923	289	1594	2164	2541	0	230	2817	2129	1428	1053	2107	1697	633	1188	777	1822	572	2507	469	744	1358	940	250	426	1268
ISR	111	40	139	124	33	88	111	137	218	0	155	128	123	88	122	120	65	129	99	142	55	170	61	83	114	72	48	72	101
ITA	1677	727	1965	1413	194	1121	1311	1663	2194	108	0	1261	1085	858	1229	1373	443	748	583	1353	408	1925	383	564	1015	651	257	427	751
AUS	1627	596	1362	1053	130	1013	1327	1422	2192	82	978	0	800	813	985	968	481	1293	711	935	327	1200	293	426	829	498	170	320	750
HUN	1062	381	1070	822	137	772	809	918	1417	84	959	609	0	589	781	852	395	544	429	1002	332	1084	259	392	743	501	162	287	563
BEL	897	662	1360	903	141	1122	916	1615	944	56	867	718	516	0	599	741	337	558	496	715	312	923	231	308	694	333	172	297	391
JPN	827	352	726	630	90	545	605	677	1041	53	645	585	462	401	0	984	428	617	427	922	331	1119	250	399	751	613	168	254	645
ESP	975	501	1103	900	118	1138	922	1155	1155	71	1043	708	693	732	503	0	448	592	481	950	335	1237	265	413	876	533	194	320	584
ZAF	465	216	428	389	56	397	444	437	618	42	357	419	320	287	299	399	0	367	294	406	180	418	118	165	438	266	72	156	326
NZL	826	372	810	664	81	576	844	1066	1138	103	564	1301	422	453	346	453	298	0	720	679	269	755	209	276	595	336	124	243	589
IRL	495	378	671	570	73	556	872	760	657	73	476	588	345	457	267	435	246	589	0	506	208	614	161	208	451	218	95	186	368
CZE	961	422	1577	994	193	955	832	1535	1486	109	1025	639	927	580	457	706	286	507	368	0	523	1536	357	454	826	526	225	400	630
SVK	323	127	530	230	54	269	226	407	384	22	255	162	233	191	127	172	97	163	97	446	0	483	143	166	326	215	75	154	252
POL	1528	644	2697	1629	292	1488	1336	2115	2492	130	1608	943	998	857	636	920	316	581	478	1314	340	0	510	666	1069	644	285	531	757
LTU	197	90	633	246	69	156	190	301	327	29	210	133	158	124	90	116	47	100	77	244	73	404	0	232	251	164	82	183	194
LVA	347	137	629	324	106	251	265	374	643	52	365	216	281	179	179	225	96	154	113	299	77	531	155	0	407	267	122	268	290
PRT	1120	464	1149	875	141	925	892	1100	1415	77	950	663	736	698	472	839	389	482	377	686	223	1065	157	307	0	494	152	335	576
KOR	761	210	483	413	67	377	398	407	1076	38	541	369	404	250	389	382	197	245	144	378	130	545	71	160	413	0	112	161	428
SVN	164	101	338	209	56	166	146	243	200	34	217	117	120	133	93	142	51	84	72	163	35	255	41	69	119	69	0	119	103
HRV	203	141	721	371	103	272	263	459	326	50	337	203	213	242	120	247	107	145	126	301	78	482	130	206	273	74	97	0	198
URY	847	274	655	530	91	464	626	635	1565	57	569	601	460	312	393	475	292	490	282	457	153	635	112	164	503	346	57	121	0

HOL

common bulls below diagonal																													
common three quarter sib group above diagonal																													
	CAN	CHE	DEU	DFS	EST	FRA	GBR	NLD	USA	ISR	ITA	AUS	HUN	BEL	JPN	ESP	ZAF	NZL	IRL	CZE	SVK	POL	LTU	LVA	PRT	KOR	SVN	HRV	URY
CAN	0	263	722	878	191	957	983	380	1290	98	1272	915	732	578	888	934	251	459	343	779	251	1142	230	365	669	546	174	232	517
CHE	230	0	249	243	67	251	243	157	239	26	262	238	126	215	174	204	64	152	128	164	68	265	71	83	141	113	69	66	104
DEU	555	221	0	955	235	854	767	552	697	86	966	647	555	569	535	681	198	395	320	709	225	1276	304	419	488	303	251	401	336
DFS	893	219	832	0	323	1411	1394	779	1041	158	1340	1291	916	851	1001	1070	487	860	686	1285	355	1699	362	462	906	496	240	422	609
EST	122	34	169	214	0	264	265	182	240	54	280	236	219	213	228	232	110	151	131	298	111	379	124	179	203	132	93	140	149
FRA	758	222	625	885	149	0	1274	566	937	121	1380	1126	907	920	1046	1158	414	703	585	1207	350	1751	284	403	875	499	198	317	524
GBR	1005	222	618	1113	168	918	0	583	1158	160	1361	1369	882	857	1015	1087	465	893	841	1088	340	1446	313	413	901	499	200	338	648
NLD	360	146	491	790	127	460	567	0	388	90	546	512	395	549	371	458	207	468	352	694	175	894	204	247	439	204	148	280	277
USA	1483	210	565	1068	184	751	1263	351	0	159	1419	1046	870	576	1027	903	349	578	439	961	271	1422	267	497	775	649	185	229	731
ISR	66	11	59	111	33	74	109	69	156	0	143	126	120	88	120	120	63	127	97	142	52	166	56	76	114	72	47	69	94
ITA	1069	229	729	1121	173	881	1140	494	1461	95	0	1079	985	751	1103	1224	369	618	489	1191	335	1685	329	479	890	594	235	350	618
AUS	991	206	506	931	129	836	1214	442	1167	81	877	0	783	783	981	965	464	1262	692	927	297	1168	266	393	803	475	168	302	682
HUN	706	98	429	760	137	665	787	333	930	82	888	604	0	569	772	842	383	537	413	998	308	1061	243	373	721	481	160	274	504
BEL	608	204	574	803	139	933	872	570	557	56	771	711	512	0	577	724	330	542	482	698	282	887	213	294	671	323	170	286	363
JPN	620	133	326	570	90	479	591	270	808	53	611	584	462	401	0	984	425	609	429	922	306	1105	234	383	727	587	165	240	573
ESP	642	159	474	834	118	942	899	433	739	71	896	702	693	732	503	0	442	590	475	950	305	1219	247	398	860	520	190	308	535
ZAF	236	51	154	372	56	326	429	183	390	42	311	413	319	287	299	399	0	362	283	400	169	409	110	162	426	253	71	146	305
NZL	414	132	313	609	80	481	751	426	550	103	500	1265	421	450	346	453	296	0	708	677	255	733	195	264	579	324	124	232	545
IRL	337	126	281	521	71	474	819	334	420	70	415	568	339	455	270	433	234	582	0	498	189	600	156	200	427	216	96	175	348

HRV	149	41	389	338	103	233	261	253	185	50	269	198	213	239	120	246	107	145	122	301	78	475	130	206	270	73	95	0	182
URY	500	80	250	469	91	378	591	219	815	56	526	599	450	310	393	475	289	487	286	457	152	617	112	159	494	337	57	119	0

JER

common bulls below diagonal

common three quarter sib group above diagonal	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	0	132	175	47	487	281	159	197	42	36
DFS	125	0	187	165	221	173	160	172	61	40
GBR	178	182	0	101	256	240	173	238	76	46
NLD	42	167	94	0	106	83	79	92	41	29
USA	514	202	280	113	0	529	298	400	72	46
AUS	287	142	244	74	575	0	241	458	60	44
ZAF	155	143	174	75	314	231	0	207	58	43
NZL	205	148	243	87	471	507	216	0	57	37
CHE	36	60	73	35	73	51	51	48	0	32
ITA	31	40	47	24	45	38	38	35	32	0

JER

common bulls below diagonal

common three quarter sib group above diagonal	CAN	DFS	GBR	NLD	USA	AUS	ZAF	NZL	CHE	ITA
CAN	0	49	85	20	92	133	72	91	25	23
DFS	44	0	123	131	68	139	137	144	59	37
GBR	81	116	0	73	92	177	133	169	68	42
NLD	13	126	69	0	40	76	75	82	37	29
USA	83	57	90	39	0	170	124	126	38	26
AUS	120	105	179	69	180	0	236	453	57	43
ZAF	65	116	134	72	135	231	0	202	55	43
NZL	83	118	171	77	127	500	213	0	53	37
CHE	23	56	64	32	32	51	50	47	0	31
ITA	19	35	41	24	25	37	38	35	32	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal	CAN	DFS	GBR	NOR	USA	DEU	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	0	189	86	7	220	14	106	3	70	93	17	10	7	0
DFS	194	0	117	138	216	63	207	130	51	188	110	129	61	0
GBR	87	112	0	66	123	15	94	13	39	92	27	16	42	0
NOR	6	112	69	0	84	15	75	27	0	48	25	19	49	0
USA	206	213	118	85	0	24	148	24	59	131	34	25	48	26
DEU	13	54	15	14	22	0	43	30	1	22	29	36	15	0
AUS	107	181	90	64	150	42	0	40	34	162	45	39	41	12
EST	2	119	11	27	23	30	37	0	0	19	26	50	19	0
ZAF	72	48	35	0	53	1	34	0	0	35	5	2	3	0
NZL	91	185	88	48	133	22	163	18	30	0	28	18	25	12
LTU	16	98	25	22	29	28	42	25	5	25	0	53	15	0
LVA	10	88	16	17	22	30	35	43	2	15	47	0	16	0
NLD	7	59	41	48	47	14	39	18	3	25	14	15	0	0
CAM	0	0	0	0	26	0	12	0	0	12	0	0	0	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal	CAN	DFS	GBR	NOR	USA	AUS	EST	ZAF	NZL	LTU	LVA	NLD	CAM
CAN	0	82	31	3	79	34	0	35	37	13	7	3	0
DFS	80	0	82	140	206	221	130	46	186	109	126	59	0
GBR	30	77	0	56	88	59	7	27	63	21	14	32	0
NOR	3	113	59	0	84	75	27	0	48	25	19	45	0
USA	79	203	86	85	0	136	24	54	128	34	25	46	26

AUS	34	198	57	64	139	0	40	31	153	42	38	39	10
EST	0	119	7	27	23	37	0	0	19	26	49	19	0
ZAF	36	46	26	0	52	33	0	0	33	5	2	2	0
NZL	37	181	62	48	133	155	18	30	0	28	18	23	12
LTU	12	97	19	22	29	40	25	5	25	0	53	14	0
LVA	7	84	14	17	22	35	42	2	15	47	0	14	0
NLD	3	57	32	44	46	37	18	2	23	13	13	0	0
CAM	0	0	0	0	26	10	0	0	12	0	0	0	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	0	2	180	131	234	271	2	11	67	2	74
FRA	1	0	141	78	10	255	4	48	0	100	3
ITA	206	126	0	250	98	988	18	141	46	324	33
NLD	156	74	246	0	92	383	8	75	49	161	28
CHE	286	8	101	96	0	359	2	2	53	2	32
DEA	315	212	904	404	324	0	37	244	49	706	36
HUN	0	3	15	8	1	24	0	10	0	19	0
SVN	10	46	134	70	2	231	9	0	0	121	1
GBR	84	0	50	49	60	52	0	0	0	0	19
HRV	1	90	311	158	2	740	17	112	0	0	4
USA	89	3	40	30	31	42	0	1	26	4	0

SIM

common bulls below diagonal
common three quarter sib group above diagonal

	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
FRM	0	2	157	104	5	228	2	11	25	2	36
FRA	1	0	85	31	1	161	3	25	0	59	1
ITA	183	74	0	238	8	987	18	141	18	324	33
NLD	127	30	235	0	7	350	8	71	18	153	28
CHE	5	1	8	7	0	90	0	0	1	0	5
DEA	276	124	904	370	81	0	37	244	20	706	36
HUN	0	2	15	8	0	24	0	10	0	19	0
SVN	10	22	134	67	0	231	9	0	0	121	1
GBR	34	0	23	20	1	25	0	0	0	0	16
HRV	1	51	311	151	0	740	17	112	0	0	4
USA	51	1	40	30	5	42	0	1	22	4	0
