

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, USA
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)	Decrease in information due to pedigree updates, and status changes of some bulls which then leads to no longer being qualified for the >10 threshold.
USA (BSW)	Participating with real MAS data. Drops in information are due to pedigree corrections and herd-year minimum edits
FRA (ALL)	Base change
EST (HOL, RDC)	Decrease in number of daughters/EDC-s of some bulls is due to the pedigree correction and deleted incorrect first lactation information of some cows.
SVN (ALL)	Base change. Decrease in information due to changes in pedigree completeness as well as phenotypic data improvement.
JPN (HOL)	Some decrease in information due to pedigree changes
ITA (HOL)	One year cut-off of data causing drops in information, base change
ITA (BSW)	Base change
ITA (SIM)	Base change
ISR (HOL)	Correction of a minor mistake in the calculation of the reliabilities causing 4 bulls to show lower reliabilities now
CAN (ALL)	Base change
DEU (ALL)	Base change
NLD (ALL)	Base change
POL (HOL)	Changes in the recording software by the national organisation of milk recording system. Most of the changes were caused by small revisions of herd registration numbers
NZL (ALL)	Changed pedigree extract so that Holstein and Friesian breed proportions re-balanced for all animals based on a more realistic assumption of Holstein and Friesian ancestry. Specifically, any HF animals from NZ, Australia or the UK in the pedigree which have one or both parents missing, instead of merely assuming the missing parent(s) to have no Holstein genetics, now assumes a mixture of Holstein and Friesian genetics equal to the average of their herd contemporaries. These changes are also carried down to all progeny in the pedigree. Updated days-in-milk to include all data collected up to 305 days of lactation. Excluded any records where a cow has not calved within 365 days of her last parturition.
CHE (ALL)	Improvements in recording of pedigree validity and handling of animals with uncertain parentage on the database as well as the recomputation of breed percentages for all animals born after 01.01.1990 led to (great) changes in all pedigrees and in consequences in all genetic evaluation results.
LTU (HOL,RDC)	New database, moved database selection limit of test day date to remove very old info from 1990 to 2000. Base change
NOR (RDC)	Changes in the data extraction pipeline that affects bulls with daughter phenotypes prior to 2004.
PRT (HOL)	Pedigree updates and corrections in database extraction are causing some drops in information

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

International reliability estimation

Harris and Johnson. 1998. Interbull Bulletin 17:31-36

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 (April Routine Evaluation 2023).
Number of records for milk somatic cells by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		147	8778	1748	816	
BEL			2281			
CAN	274	108	13796	871	874	
CHE	3193		3360	97		3613
CZE			4722			
DEA	6028					24673
DEU			24057		299	
DFS			14334	2320	8138	
ESP			4484			
EST			1365		482	
FRA	491		18487			479
FRM						4750
GBR	151	311	7514	768	581	84
HUN			3164			190
IRL			2962			
ISR			1694			

ITA	2149		9297	66		1806
JPN			6895			
KOR			1670			
LTU			898		362	
LVA			1346		670	
NLD	229		17015	250	102	512
NOR					4322	
NZL	75	57	8874	5083	1442	
POL			12499			
PRT			2964			
SVK			1183			
SVN	333		668			664
URY			2087			
USA	1176	740	41821	5193	763	103
ZAF			1205	612	125	
HRV			971			1056
CAM					48	

No. Records	14099	1363	220391	17008	19024	37930
Pub. Proofs	11253	1055	158790	13808	17911	34051

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

BSW scs

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.48									
FRA	0.91	1.02								
NLD	0.89	0.92	3.67							
USA	0.89	0.90	0.85	0.21						
CHE	0.90	0.93	0.94	0.81	10.49					
DEA	0.88	0.96	0.92	0.85	0.97	11.93				
NZL	0.71	0.77	0.79	0.67	0.74	0.67	0.37			
ITA	0.88	0.89	0.89	0.83	0.96	0.91	0.68	15.59		
GBR	0.93	0.96	0.95	0.91	0.93	0.95	0.81	0.89	11.59	
SVN	0.80	0.80	0.79	0.79	0.80	0.78	0.68	0.82	0.82	10.95

BSW mas

	CAN	FRA	NLD	USA	CHE	DEA	NZL	ITA	GBR	SVN
CAN	6.38									
FRA	0.81	1.03								
NLD	0.79	0.73	4.02							
USA	0.81	0.83	0.76	2.53						
CHE	0.88	0.83	0.85	0.76	11.43					
DEA	0.90	0.70	0.87	0.71	0.90	11.93				
NZL	0.69	0.64	0.66	0.64	0.70	0.74	0.37			
ITA	0.85	0.73	0.80	0.68	0.88	0.92	0.70	15.59		
GBR	0.84	0.84	0.83	0.79	0.84	0.74	0.64	0.76	2.28	
SVN	0.79	0.72	0.73	0.72	0.71	0.83	0.76	0.84	0.76	10.96

GUE scs

	CAN	GBR	USA	AUS	NZL
CAN	6.02				
GBR	0.93	13.60			
USA	0.93	0.90	0.25		
AUS	0.81	0.87	0.77	0.24	
NZL	0.76	0.81	0.70	0.89	0.62

HOL scs

	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
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NLD	0.92	0.93	0.84	3.97							
CHE	0.93	0.93	0.87	0.93	10.37						
DEA	0.92	0.93	0.85	0.91	0.89	12.24					
HUN	0.88	0.90	0.92	0.88	0.89	0.89	16.37				
SVN	0.84	0.82	0.82	0.81	0.84	0.80	0.82	9.34			
GBR	0.91	0.95	0.87	0.95	0.90	0.93	0.89	0.83	11.77		
HRV	0.86	0.79	0.79	0.79	0.80	0.78	0.83	0.78	0.80	9.67	
USA	0.84	0.90	0.87	0.87	0.85	0.81	0.91	0.78	0.90	0.79	0.20

SIM mas

FRM	FRM	FRA	ITA	NLD	CHE	DEA	HUN	SVN	GBR	HRV	USA
	1.08										
FRA	0.86	1.00									
ITA	0.90	0.82	12.56								
NLD	0.87	0.86	0.78	4.20							
CHE	0.82	0.88	0.86	0.83	9.88						
DEA	0.92	0.91	0.85	0.88	0.74	12.24					
HUN	0.86	0.82	0.88	0.86	0.84	0.87	16.37				
SVN	0.82	0.80	0.82	0.77	0.80	0.80	0.82	9.34			
GBR	0.74	0.88	0.75	0.81	0.89	0.76	0.82	0.76	2.79		
HRV	0.83	0.77	0.79	0.71	0.77	0.78	0.83	0.78	0.75	9.67	
USA	0.81	0.87	0.71	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	59	186	150	159	32	142	68	32
FRA	89	0	93	135	197	262	29	232	65	52
NLD	54	79	0	91	111	165	30	143	43	47
USA	182	99	82	0	331	342	37	240	95	40
CHE	128	154	103	308	0	645	36	503	78	77
DEA	143	211	156	307	537	0	50	714	82	102
NZL	32	23	23	33	29	45	0	42	23	11
ITA	126	194	118	168	446	613	35	0	83	94
GBR	69	58	37	94	62	58	21	63	0	20
SVN	29	51	47	32	72	94	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	86	54	56	75	157	32	140	31	32
FRA	79	0	71	26	79	225	23	201	31	51
NLD	48	60	0	19	51	149	30	131	21	44
USA	57	25	17	0	29	50	15	44	18	12
CHE	68	63	49	25	0	253	17	211	19	60
DEA	143	174	140	45	218	0	50	713	39	101
NZL	32	20	23	14	15	45	0	42	10	11
ITA	125	165	107	35	185	613	35	0	42	94
GBR	30	28	18	17	16	28	8	33	0	14
SVN	29	49	45	11	57	94	10	91	12	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	GBR	USA	AUS	NZL
CAN	0	33	77	53	14

GBR	28	0	91	42	13
USA	69	93	0	71	29
AUS	51	35	69	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	935	2630	1720	316	1692	1813	1812	3966	160	1933	1609	1121	911	1491	1429	505	841	570	1272	464	1753	300	561	1260	795	225	348	881
CHE	860	0	1201	780	189	779	743	990	1066	70	773	680	455	658	506	604	257	451	401	555	248	768	145	268	565	298	143	221	341
DEU	2078	1139	0	2936	497	2720	2190	3690	3792	188	2686	1796	1321	1337	1526	1659	549	1066	839	2004	713	2998	554	795	1446	702	361	721	879
DFS	1539	737	2247	0	374	1897	1688	2450	2422	174	1687	1434	998	974	1087	1162	505	933	733	1419	436	1968	359	532	1121	565	269	486	734
EST	203	111	365	249	0	313	300	439	416	57	330	246	228	228	235	239	113	158	139	312	130	415	101	190	234	140	97	148	166
FRA	1250	719	1671	1183	171	0	1685	2289	2725	145	1739	1425	1037	1098	1322	1373	503	892	722	1406	470	2061	289	479	1140	601	224	387	687
GBR	2050	712	1694	1327	181	1158	0	1946	2415	166	1597	1526	931	940	1120	1159	507	984	927	1150	395	1579	320	468	1079	551	212	378	756
NLD	1775	993	3523	2216	324	1626	1725	0	2841	185	1859	1620	1060	1414	1194	1275	514	1180	874	1696	578	2275	368	568	1270	561	284	522	782
USA	4513	1002	2858	1972	299	1605	2201	2570	0	240	2768	2147	1428	1069	2122	1698	633	1197	791	1844	581	2602	401	758	1588	966	260	441	1279
ISR	115	41	142	130	34	90	117	141	230	0	155	132	124	92	124	121	66	130	102	149	56	180	56	85	124	74	50	77	106
ITA	1680	715	1935	1398	202	1108	1286	1625	2192	108	0	1220	1056	839	1205	1343	418	706	556	1332	407	1956	338	567	1149	653	265	433	732
AUS	1648	607	1376	1062	130	1020	1339	1431	2213	83	956	0	799	820	988	971	481	1302	721	940	330	1225	264	431	938	510	174	330	758
HUN	1064	383	1073	828	138	774	814	918	1418	86	936	609	0	593	783	853	395	544	430	1006	333	1091	250	393	833	509	163	296	562
BEL	912	675	1380	921	146	1129	926	1637	961	58	846	727	517	0	602	747	337	565	500	720	315	938	185	309	754	337	173	306	394
JPN	838	357	730	634	91	549	609	685	1051	55	642	587	462	403	0	989	428	618	432	926	332	1135	228	401	822	624	169	264	648
ESP	976	504	1108	909	120	1144	927	1157	1156	73	1000	711	694	735	507	0	448	595	485	956	337	1261	243	416	971	543	196	329	582
ZAF	465	216	428	389	56	399	444	438	618	42	336	419	320	287	299	399	0	367	294	406	180	418	106	165	443	266	72	158	326
NZL	835	380	819	672	82	581	849	1079	1147	103	545	1309	422	459	347	455	298	0	722	681	270	770	190	278	650	339	126	249	602
IRL	505	385	682	577	74	562	883	771	671	75	459	597	345	463	270	437	246	591	0	510	210	627	146	210	481	225	100	192	368
CZE	979	426	1595	1011	202	967	846	1556	1512	117	1009	646	931	585	461	712	286	510	370	0	526	1568	296	459	916	534	227	419	633
SVK	329	127	532	231	54	271	226	409	392	23	252	163	233	191	127	172	97	163	97	447	0	489	106	167	348	217	78	158	253
POL	1587	666	2795	1684	307	1525	1378	2180	2620	142	1652	967	1005	872	646	941	316	598	487	1350	345	0	416	680	1252	663	299	557	767
LTU	171	59	513	215	46	120	170	229	281	25	181	121	152	90	77	98	40	90	69	192	48	322	0	206	245	158	71	165	179
LVA	352	138	637	332	107	253	270	383	657	54	366	218	282	180	181	228	96	156	114	304	77	547	133	0	451	271	122	275	293
PRT	1320	515	1352	1037	160	1039	1002	1283	1697	81	1112	787	835	768	526	941	396	529	401	772	233	1288	153	351	0	541	176	361	632
KOR	782	213	492	426	69	382	405	417	1106	39	546	377	408	253	396	390	197	248	149	383	130	562	71	162	465	0	114	168	433
SVN	173	104	354	218	57	168	153	249	209	36	223	120	121	133	95	143	51	85	76	164	36	266	31	71	139	71	0	126	101
HRV	213	147	746	393	107	279	270	482	339	53	335	209	218	248	125	252	108	149	131	316	79	508	113	213	298	81	101	0	206
URY	857	275	665	536	93	469	640	647	1582	62	557	611	463	314	393	474	292	502	283	464	153	655	103	167	549	349	57	124	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	270	737	892	199	965	997	388	1328	102	1285	925	731	584	896	935	251	466	342	790	253	1170	216	366	798	559	177	243	520
CHE	236	0	257	251	70	262	249	163	253	26	269	240	128	220	179	207	64	157	129	165	69	274	58	85	180	118	72	68	103
DEU	566	224	0	985	244	880	784	567	719	88	981	656	556	579	537	687	198	400	322	721	229	1320	255	420	583	309	262	421	340
DFS	913	228	859	0	337	1426	1408	791	1073	162	1299	1295	917	863	1011	1079	487	866	686	1295	357	1737	324	463	1027	512	249	443	612
EST	131	37	176	226	0	265	275	186	251	56	286	237	220	218	229	234	110	153	132	306	113	397	96	180	223	136	95	145	153
FRA	769	232	645	898	150	0	1289	574	950	123	1334	1134	909	931	1051	1172	414	710	591	1214	351	1783	241	404	967	507	203	326	526
GBR	1024	230	630	1131	174	931	0	592	1199	164	1340	1379	885	869	1019	1092	465	899	846	1098	342	1486	285	415	998	510	207	352	656
NLD	366	153	504	802	131	468	579	0	401	92	551	519	397	558	374	462	207	479	354	699	175	919	162	248	503	210	150	296	282
USA	1532	220	587	1103	196	764	1311	360	0	172	1478	1065	872	591	1043	908	349	590	440	989	282	1523	242	501	956	675	194	244	746
ISR	69	12	59	115	34	74	116	70	169	0	141	128	121	92	122	121	64	128	97	149	53	177	52	77	124	74	49	74	99
ITA	1085	233	742	1105	181	882	1131	500	1525	96	0	1043	954	736	1068	1200	346	588	471	1166	336	1711	291	468	1017	593	238	357	605
AUS	1001	209	510	934	129	842	1225	448	1185	82	863	0	782	791	984	967	464	1269	693	930	300	1191	243	393	910	487	171	312	690
HUN	707	99	431	761	138	666	792	334	934	84	860	604	0	573	774	842	383	537	413	1002	309	1069	235	373	811	491	161	283	505
BEL	615	212	583	815	144	942	885	580	571	58	760	720	513	0	581	730	330	550	484	704	285	902	171	294	730	328	172	295	366
JPN	625	134	327	575	91	483	595	273	819	55	603	585	462	403	0	989	425	610	429	926	306	1121	213	384	797	599	167	251	577
ESP	644	160	477	838	120	948	905	437	742	73	876	704	693	735	507	0	442	593	475	955	306	1245	226	398	952	531	192	317	534
ZAF	236	51	153	372	56	326	429	183	390	42	288	413	319	287	299	399	0	362	283	400	169	409	99	162	431	253	72	148	305
NZL	422	136	317	615	81	485	755	437	561	103	485	1272	421	456	347	455	296	0	709	679	256								

SVK	182	26	133	200	53	213	219	99	198	23	221	158	229	185	127	172	96	160	96	447	0	436	92	156	324	203	73	146	226
POL	1112	225	1317	1464	302	1316	1337	912	1728	141	1510	956	995	858	646	939	315	592	479	1350	328	0	389	620	1199	636	292	531	691
LTU	135	20	203	203	45	109	166	101	176	25	160	122	150	89	77	98	40	88	66	192	46	312	0	189	226	140	68	154	160
LVA	224	32	324	280	103	200	249	152	420	49	288	195	272	174	174	218	94	147	107	290	77	498	127	0	423	256	116	264	268
PRT	830	157	509	947	159	888	969	501	1065	81	1023	777	827	766	526	940	395	526	393	772	226	1258	151	332	0	523	174	340	578
KOR	553	92	221	388	69	338	390	150	743	39	515	367	404	253	396	390	196	244	155	383	128	550	68	155	462	0	113	155	391
SVN	135	53	252	197	57	157	152	121	157	35	207	118	121	133	95	143	51	85	73	164	36	265	31	68	139	71	0	123	98
HRV	155	42	410	358	107	240	267	267	196	53	275	203	218	245	125	251	108	149	126	316	79	501	112	212	295	80	99	0	190
URY	510	80	255	472	93	382	607	224	833	61	515	608	453	312	393	474	289	499	287	464	152	636	103	160	540	340	57	122	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	133	177	47	493	283	159	200	42	33
DFS	126	0	191	166	225	176	160	174	60	36
GBR	182	187	0	101	259	243	173	238	74	41
NLD	42	168	94	0	110	84	79	93	41	27
USA	521	206	286	117	0	532	298	404	71	42
AUS	291	146	249	75	580	0	242	466	60	41
ZAF	155	143	176	75	314	232	0	210	57	38
NZL	209	151	246	88	478	519	219	0	56	34
CHE	36	59	72	35	72	50	50	48	0	28
ITA	28	35	41	22	41	35	33	32	28	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	50	87	21	95	135	74	95	26	22
DFS	45	0	124	139	69	140	137	146	58	33
GBR	85	118	0	75	92	179	134	171	66	38
NLD	14	134	71	0	43	79	76	86	38	27
USA	86	58	93	42	0	175	124	132	38	26
AUS	123	106	183	72	185	0	236	461	57	40
ZAF	67	116	136	73	135	231	0	205	54	38
NZL	88	120	175	81	133	512	216	0	52	34
CHE	24	55	64	33	32	50	49	47	0	27
ITA	18	31	36	22	25	34	33	32	28	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	190	88	7	221	14	107	3	70	93	21	10	7	0
DFS	195	0	119	138	217	64	210	132	51	188	102	131	63	0
GBR	89	114	0	67	125	15	96	13	40	92	26	16	43	0
NOR	6	112	70	0	85	15	75	27	0	48	19	19	49	0
USA	208	215	120	86	0	24	149	25	59	132	37	25	48	30
DEU	13	55	15	14	22	0	44	30	1	22	28	36	16	0
AUS	108	184	91	64	151	43	0	41	34	165	44	40	42	12
EST	2	121	11	27	24	30	38	0	0	19	22	52	21	0
ZAF	72	48	35	0	53	1	34	0	0	35	5	2	3	0
NZL	91	186	88	48	134	22	166	18	30	0	22	19	26	12
LTU	19	88	24	18	32	27	41	22	5	22	0	44	15	0
LVA	10	90	16	17	22	30	36	45	2	16	40	0	17	0
NLD	7	61	42	48	47	15	40	20	3	26	14	16	0	0
CAM	0	0	0	0	30	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	84	32	3	81	34	0	35	37	18	7	3	0
DFS	83	0	84	140	207	223	132	46	186	101	126	63	0
GBR	30	79	0	58	90	60	7	27	63	20	14	33	0
NOR	3	113	61	0	85	75	27	0	48	19	19	45	0
USA	80	205	88	86	0	136	25	54	129	37	25	46	30
AUS	34	200	58	64	139	0	41	31	155	40	38	41	10
EST	0	121	7	27	24	38	0	0	19	22	49	21	0
ZAF	36	46	26	0	52	33	0	0	33	5	2	2	0
NZL	37	182	62	48	134	157	18	30	0	22	18	24	12
LTU	17	87	18	18	32	38	22	5	22	0	44	14	0
LVA	7	84	14	17	22	35	42	2	15	40	0	14	0
NLD	3	61	33	44	46	39	20	2	24	13	13	0	0
CAM	0	0	0	0	30	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	183	132	238	273	2	11	66	2	82
FRA	1	0	142	79	14	257	4	49	0	101	3
ITA	209	127	0	255	99	1007	18	148	45	333	33
NLD	157	75	249	0	93	390	8	80	48	165	31
CHE	290	11	102	97	0	364	2	2	53	2	33
DEA	314	214	926	411	330	0	37	255	48	726	38
HUN	0	3	15	8	1	24	0	10	0	19	0
SVN	10	47	140	75	2	240	9	0	0	130	1
GBR	83	0	49	48	60	51	0	0	0	0	20
HRV	1	91	321	161	2	760	17	119	0	0	4
USA	97	3	40	32	32	42	0	1	27	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	227	2	11	25	2	37
FRA	1	0	85	31	2	161	3	25	0	58	1
ITA	183	74	0	240	9	1006	18	148	18	333	33
NLD	127	30	236	0	8	354	8	74	18	155	29
CHE	5	2	9	8	0	96	0	0	1	0	5
DEA	275	124	926	373	89	0	37	255	20	726	38
HUN	0	2	15	8	0	24	0	10	0	19	0
SVN	10	22	140	69	0	240	9	0	0	130	1
GBR	34	0	23	20	1	25	0	0	0	0	17
HRV	1	51	321	153	0	760	17	119	0	0	4
USA	52	1	40	30	5	42	0	1	23	4	0