Introduction

The latest routine international evaluation for females fertility traits took place as scheduled at the Interbull Centre. Data from twentyone (21) countries were included in this evaluation.

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

Based on a decision made by Interbull Steering committee in August 2007, female fertility traits are classified as follows:

T1 (HC): Maiden (H)eifer's ability to (C)onceive. A measure of confirmed conception, such as conception rate (CR), will be considered for this trait group. In the absence of confirmed conception an alternative measure, such as interval first-last insemination (FL), interval first insemination-conception (FC), number of inseminations (NI), or non-return rate (NR,preferably NR56) can be submitted;

T2 (CR): Lactating (C)ow's ability to (R)ecycle after calving. The interval calving-first insemination (CF) is an example for this ability. In the abscence of such a trait, a measure of the interval calving-conception, such as says oprn (DO) or calving interval (CI) can be submitted;

T3 (C1): Lactating (C)ow's ability to conceive (1), expressed as a rate trait. Traits like conception rate (CR) and non-return rate (NR, preferably NR56) will be considered for this trait group;

T4 (C2): Lactating (C)ow's ability to conceive (2), expressed as an interval trait. The interval first insemination-conception (FC) or interval first-last insemination (FL) will be considered for this trait group. As an alternative, number of inseminations (NI) can be submitted. In the abscence of any of these traits, a measure of interval calving-conception such as days open (DO), or calving interval (CI) can be submitted. All countries are expected to submit data for this trait group, and as a last resort the trait submitted under T3 can be submitted for T4 as well.

T5 (IT): Lactating cow's measurements of (I)nterval (T)raits calving-conception, such as days open (DO) and calving interval (CI).

Based on the above trait definitions the following traits have been submitted for international genetic evaluation of female fertility traits.

Country	Traits	Submitted traits and their definitions
AUS	T4=C2	Calving interval converted to 42 days pregnancy rate
	T5=IT	Calving interval converted to 42 days pregnancy rate
BEL	T2=CY	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
	T4=C2	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
	T5=IT	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
CAN	T1=HC	NR=Non Return Rate after 56 Days in heifers (NRR), %
	T2=CY	CF=Interval from Calving to First Service in cows(CF)
	T3=C1	NR=Non Return Rate after 56 Days in cows(NRR), %
	T4=C2	FC=Interval first insemination-conception in cows
	T5=IT	DO=Days open
CHE	T1=HC	CR=Heifers' Conception rate
	T2=CR	CF=Interval from Calving to First Service (ICF), days
	T3=C1	NR=Non Return Rate after 56 Days (NRR), %
	T4=C2	FL=Interval from first to last insemination cows
CZE	T1=HC	CR=Heifers' Conception rate (pregnant or not after 3 months)

	T3=C1	CR=Cows’ Conception rate (pregnant or not after 3 months)
	T4=C2	CR=Cows’ Conception rate (pregnant or not after 3 months)
AUT/DEU	T1=HC	NR=Heifers’ Non Return Rate after 56 days
	T2=CY	CF=Interval from calving to first insemination cows (days)
	T3=C1	NR=Cows’ Non Return Rate after 56 days
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=Days open (days)
DFS	T1=HC	CR=Heifers’ Conception rate for maiden heifers
	T2=CY	CF=Interval from calving to first insemination cows (days)
	T3=C1	CR=Cows’ conception rate for cows
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=Days open (days)
ESP	T2=CY	Interval from Calving to First Service (ICF)
	T4=C2	Interval first insemination to conception
	T5=IT	Days Open
FRA	T1=HC	CR=Heifers’ Conception rate (binary trait) for maiden heifers
	T2=CY	Interval between calving and first AI
	T3=C1	CR=Cows’ Conception rate (binary trait)
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	FL=Interval from first to last insemination cows (days)
GBR	T2=CY	CI=days between 1st and 2nd calvings
	T3=C1	NR=1st lactation non return at 56 days
	T4=C2	CI=days between 1st and 2nd calvings
	T5=IT	CI=days between 1st and 2nd calvings
IRL	T2=CY	CI=Calving interval
	T4=C2	CI=Calving interval
	T5=IT	CI=Calving interval
ISR	T3=C1	CR=Inverse of the number of insemination to conception (%)
	T4=C2	CR=Inverse of the number of insemination to conception (%)
ITA	T1=HC	NR= non-return rate 56 days (heifers)
	T2=CY	CF=Days to first service
	T3=C1	CR=Conception rate at first service
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=days open (days)
ITA(BSW)	T1=HC	CR=Conception rate
	T2=CY	CF=Interval calving to first insemination
	T3=C1	CR=Conception rate
	T4=C2	DO=Days Open
	T5=IT	CI=Calving interval
NLD	T1=HC	CR=Heifers’ Conception rate
	T2=CY	CF=Interval calving to first insemination (days)
	T3=C1	CR=Cows’ Conception rate (binary trait) for cows
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	CI=Days Open
NOR	T1=HC	NI=Number of inseminations (heifers)
	T2=CY	CF=Days from calving to first insemination (days)
	T3=C1	NI=Number of inseminations (cows)
	T4=C2	NI=Number of inseminations (cows)
	T5=IT	CF=Days from calving to first insemination (days)
NZL	T2=CY	PM=Lactating cow’s ability to start cycling
	T4=C2	PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), (in days)
	T5=IT	PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), (in days)
POL	T1=HC	CR=Conception Rate (heifer)
	T2=CR	CF=Interval from calving to first insemination
	T3=C1	CR=Conception Rate (cow)
	T4=C2	FL=Interval from first to last insemination cows (days)

	T5=IT	DO=Days open
URY	T4=C2	Days open expressed as Daughter Pregnancy Rate
	T5=IT	Days open expressed as Daughter Pregnancy Rate
USA	T1=HC	CR=Conception rate (heifer)
	T3=C1	CR=Conception rate (cow)
	T4=C2	DP=Daughter Pregnancy Rate
	T5=IT	DP=Daughter Pregnancy Rate
ZAF	T4=IT	CI=Calving Interval
	T5=IT	CI=Calving Interval
JPN	T1=HC	CR=Heifers'Conception rate
	T3=C1	CR=Cows'Conception rate
	T4=C2	DO=Days open
	T5=IT	DO=Days open
SVN	T5=IT	CI=Calving interval (days)

CHANGES IN NATIONAL PROCEDURES

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

POL (HOL)	Decrease in information due to pedigree verification
JPN (HOL)	Slight reduction in information due to pedigree verification
DEA (BSW)	Decrease in information due to some data corrections in one of the databases of the joint German-Austrian evaluation
FRA (HOL)	Decrease in information due to pedigree verification
CHE (ALL)	Decrease in information due to database edits and change of herd-year-season assignment of certain data records
ITA (HOL)	Decrease in information and missing bulls due to a four months cut-off of data
AUS (ALL)	Decrease in information due to pedigree verification
ISR (HOL)	Decrease in information due to parentage verification and closing or combining of herds.
ESP (HOL)	Base change. Slight drops in information due to changes in the database, in some cases there is even a change to non official proof.
ZAF (ALL)	Base change
USA (ALL)	Decrease in information due to pedigree verification and herd-year minimum edits.
NLD (ALL)	Some changes in Type of Proofs due to harmonisation of this record
NZL (ALL)	Base change, drops in information due to continuous parenting testing and herds records being updated
DEU (ALL)	overall base change: cowbase previous routine run 2504r: 201901 - 202112, cowbase current routine run 2508r: 201905 - 202204

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

A new document called confdoc_DEFINITION{runid}.itb has been introduced reporting all the trait definitions applied by countries as reported in the PREP.

During 2023-2024, Interbull Centre and the Interbull Technical Committee (ITC) have worked on developing a new procedures for adjusting of the international correlations after a given test run in case countries would decide NOT TO implement the changes tested in the next routine run.
Until now, the relative difference between the previous routineâ\200\231s and test runâ\200\231s correlations, for each pair of countries, was assessed and the average value of the two was used whenever such difference did exceed a threshold of 0.01. Otherwise, correlations from the latest test run were used.
However, in some cases, the difference in correlations between routine/test runs were way above a 1% difference so that by using the average value the newly derived correlations would still be greatly affected by the changes tested but not implemented. This remark has been made in few occasions by some participating countries.
A new approach proposed by Peter Sullivan, was developed and extensively tested. The new approach is based on first identifying the relative impact of the changes tested by a country during the test run (but not implemented in a routine run) and then correcting the whole correlation matrix detracting such estimated impact.
This new approach would assure that the new correlations would be free from any effect from any changes tested but not implemented.
The new procedure has been fully developed during 2023 and extensively tested during 2024 and introduced officially in the April 2025 routine evaluation.

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
https://interbull.org/ib/servicecalendar

NEXT TEST INTERNATIONAL EVALUATION

Dates for the next test run can be found on
https://interbull.org/ib/servicecalendar

From 2025 an extra MACE test run has been scheduled in May, data submissions' deadline and target for distribution of results are all reported in the above link.

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 fertility (August Routine Evaluation 2025).
Number of records for lactating cow's ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		152	8997	1909	834	
BEL			2246			
CAN	191	50	10793	694	622	
CHE	3131		3449	153		
CZE			3529			
DEA	5098					
DEU			26487		335	
DFS			18001	2578	10911	
ESP			7191			
EST						
FRA	460		17647			
FRM						
GBR	117	261	8036	675	504	
HUN						
IRL			3484	260	79	
ISR			1785			
ITA	2078		7480			
JPN			6985			
KOR						
LTU						
LVA						
NLD	257		17257	291	108	
NOR					3222	
NZL	58	50	9023	5186	1375	
POL			8963			
PRT						
SVK						
SVN						
URY			2104			
USA	1244	814	43694	5655	827	
ZAF			1278	765	160	
HRV						
CAM						
No.Records	12634	1327	208429	18166	18977	
Pub. Proofs	11005	1093	160812	14864	18596	0

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

BSW hco

	CAN	DEA	FRA	USA	CHE	NLD	ITA
CAN	9.28						
DEA	0.86	9.89					
FRA	0.73	0.88	0.75				
USA	0.79	0.78	0.85	2.55			
CHE	0.89	0.95	0.86	0.80	13.15		
NLD	0.80	0.67	0.76	0.77	0.74	4.59	
ITA	0.74	0.68	0.83	0.84	0.73	0.73	15.67

BSW crc

	CAN	CHE	DEA	NLD	NZL	GBR	FRA	ITA
CAN	7.46							
CHE	0.81	11.40						
DEA	0.77	0.95	15.05					
NLD	0.81	0.82	0.82	3.75				
NZL	0.61	0.63	0.70	0.63	0.12			
GBR	0.71	0.69	0.62	0.73	0.65	3.91		
FRA	0.82	0.97	0.96	0.85	0.66	0.74	1.69	
ITA	0.82	0.84	0.87	0.80	0.62	0.72	0.87	16.89

BSW cc1

	CAN	CHE	DEA	NLD	USA	GBR	FRA	ITA
CAN	7.52							
CHE	0.83	11.72						
DEA	0.80	0.95	11.44					
NLD	0.72	0.69	0.67	3.67				
USA	0.75	0.67	0.67	0.76	2.90			
GBR	0.77	0.79	0.79	0.68	0.68	0.03		
FRA	0.73	0.69	0.67	0.81	0.85	0.71	0.88	
ITA	0.69	0.66	0.66	0.69	0.78	0.67	0.88	16.05

BSW cc2

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	6.83								
CHE	0.77	11.15							
DEA	0.74	0.94	12.35						
NLD	0.80	0.78	0.76	3.42					
NZL	0.65	0.81	0.73	0.66	0.07				
USA	0.80	0.80	0.81	0.75	0.68	2.57			
GBR	0.69	0.78	0.78	0.71	0.70	0.80	3.91		
FRA	0.87	0.90	0.90	0.85	0.68	0.83	0.78	0.88	
ITA	0.84	0.87	0.86	0.75	0.76	0.77	0.74	0.91	19.17

BSW int

	CAN	DEA	NLD	NZL	USA	GBR	ITA	SVN
CAN	7.79							
DEA	0.79	14.42						
NLD	0.81	0.86	3.41					
NZL	0.69	0.77	0.68	0.07				
USA	0.89	0.77	0.74	0.65	2.57			
GBR	0.82	0.69	0.80	0.70	0.81	3.91		
ITA	0.86	0.89	0.79	0.73	0.74	0.80	19.25	
SVN	0.72	0.68	0.71	0.70	0.69	0.75	0.72	20.02

GUE crc

	CAN	GBR	NZL
CAN	7.64		

GBR	0.74	4.52	
NZL	0.62	0.64	0.11

GUE cc1

	CAN	GBR	USA
CAN	7.57		
GBR	0.77	0.03	
USA	0.80	0.73	3.49

GUE cc2

	CAN	GBR	NZL	USA	AUS
CAN	7.27				
GBR	0.69	4.52			
NZL	0.64	0.70	0.07		
USA	0.84	0.80	0.70	2.89	
AUS	0.68	0.67	0.72	0.72	10.22

GUE int

	CAN	GBR	NZL	USA	AUS
CAN	7.81				
GBR	0.82	4.52			
NZL	0.68	0.70	0.07		
USA	0.89	0.80	0.68	2.89	
AUS	0.71	0.68	0.73	0.72	10.22

HOL hco

	CAN	CZE	DEU	DFS	FRA	USA	POL	CHE	NLD	ITA	JPN
CAN	7.73										
CZE	0.76	17.56									
DEU	0.89	0.78	15.13								
DFS	0.77	0.84	0.84	13.51							
FRA	0.75	0.77	0.80	0.88	0.70						
USA	0.83	0.83	0.84	0.86	0.84	2.38					
POL	0.62	0.55	0.66	0.70	0.61	0.66	14.09				
CHE	0.95	0.78	0.92	0.78	0.78	0.85	0.55	13.57			
NLD	0.80	0.77	0.84	0.86	0.82	0.82	0.64	0.80	5.34		
ITA	0.82	0.85	0.87	0.90	0.91	0.93	0.73	0.86	0.85	1.93	
JPN	0.85	0.70	0.85	0.71	0.69	0.82	0.62	0.84	0.75	0.82	6.21

HOL crc

	BEL	CAN	CHE	DEU	DFS	ESP	GBR	IRL	ITA	NLD	NZL	POL	FRA
BEL	4.62												
CAN	0.77	7.53											
CHE	0.79	0.83	12.32										
DEU	0.72	0.83	0.88	10.90									
DFS	0.80	0.87	0.94	0.91	11.58								
ESP	0.85	0.78	0.79	0.78	0.78	10.93							
GBR	0.89	0.74	0.77	0.71	0.78	0.87	4.57						
IRL	0.85	0.59	0.66	0.59	0.61	0.82	0.81	3.58					
ITA	0.81	0.88	0.89	0.89	0.90	0.82	0.79	0.65	1.40				
NLD	0.77	0.82	0.88	0.84	0.92	0.77	0.75	0.58	0.85	4.69			
NZL	0.63	0.61	0.63	0.59	0.65	0.66	0.65	0.59	0.66	0.56	0.09		
POL	0.75	0.87	0.87	0.82	0.85	0.76	0.74	0.59	0.88	0.76	0.68	15.28	
FRA	0.78	0.86	0.94	0.93	0.94	0.79	0.79	0.65	0.91	0.89	0.65	0.87	1.12

HOL cc1

	CAN	CHE	CZE	DEU	DFS	FRA	GBR	ISR	ITA	NLD	USA	POL	JPN

CAN	6.74																		
CHE	0.92	10.81																	
CZE	0.82	0.71	17.42																
DEU	0.91	0.91	0.80	14.63															
DFS	0.74	0.68	0.86	0.79	13.09														
FRA	0.77	0.73	0.90	0.76	0.87	0.96													
GBR	0.77	0.77	0.68	0.79	0.66	0.72	0.03												
ISR	0.79	0.69	0.93	0.79	0.88	0.89	0.76	3.27											
ITA	0.71	0.66	0.90	0.69	0.81	0.89	0.66	0.90	1.19										
NLD	0.73	0.71	0.85	0.78	0.88	0.90	0.68	0.86	0.79	4.56									
USA	0.79	0.71	0.95	0.75	0.82	0.85	0.68	0.91	0.87	0.79	2.83								
POL	0.77	0.66	0.87	0.78	0.74	0.77	0.66	0.83	0.80	0.71	0.79	19.08							
JPN	0.78	0.77	0.90	0.77	0.82	0.83	0.77	0.85	0.83	0.77	0.91	0.75	7.57						

HOL cc2

	BEL	CAN	CHE	CZE	DEU	DFS	ESP	FRA	GBR	IRL	ISR	ITA	NLD	NZL	USA	POL	ZAF	AUS	URY	JPN
BEL	4.62																			
CAN	0.73	6.48																		
CHE	0.81	0.90	10.91																	
CZE	0.66	0.86	0.88	17.42																
DEU	0.78	0.93	0.92	0.91	13.46															
DFS	0.79	0.84	0.87	0.82	0.94	12.84														
ESP	0.83	0.75	0.85	0.85	0.81	0.77	10.93													
FRA	0.80	0.90	0.93	0.86	0.95	0.88	0.81	0.91												
GBR	0.88	0.69	0.74	0.66	0.76	0.79	0.85	0.75	4.57											
IRL	0.83	0.74	0.84	0.70	0.78	0.75	0.83	0.82	0.81	3.58										
ISR	0.61	0.73	0.73	0.89	0.81	0.78	0.78	0.75	0.66	0.64	3.27									
ITA	0.78	0.85	0.89	0.91	0.90	0.86	0.87	0.88	0.75	0.78	0.83	1.32								
NLD	0.77	0.82	0.86	0.81	0.92	0.88	0.75	0.90	0.71	0.77	0.79	0.82	4.68							
NZL	0.72	0.64	0.77	0.77	0.66	0.63	0.83	0.66	0.69	0.74	0.73	0.79	0.63	0.06						
USA	0.78	0.85	0.83	0.88	0.90	0.85	0.85	0.84	0.81	0.79	0.79	0.89	0.78	0.67	2.37					
POL	0.81	0.87	0.90	0.89	0.92	0.86	0.86	0.87	0.80	0.74	0.81	0.92	0.80	0.79	0.89	14.65				
ZAF	0.77	0.76	0.81	0.73	0.81	0.74	0.82	0.80	0.78	0.85	0.59	0.77	0.71	0.71	0.85	0.81	15.61			
AUS	0.70	0.67	0.73	0.63	0.70	0.63	0.70	0.73	0.68	0.82	0.59	0.68	0.63	0.68	0.71	0.67	0.78	8.51		
URY	0.71	0.68	0.66	0.64	0.67	0.67	0.66	0.66	0.69	0.69	0.58	0.64	0.68	0.77	0.68	0.64	0.75	0.66	1.40	
JPN	0.84	0.82	0.86	0.79	0.85	0.84	0.87	0.84	0.86	0.84	0.71	0.86	0.77	0.69	0.92	0.86	0.87	0.70	0.68	18.22

HOL int

	BEL	CAN	DEU	DFS	ESP	GBR	IRL	ITA	NLD	NZL	USA	POL	ZAF	AUS	URY	FRA	JPN	SVN
BEL	4.62																	
CAN	0.88	7.03																
DEU	0.86	0.91	12.31															
DFS	0.89	0.90	0.95	12.76														
ESP	0.87	0.84	0.86	0.85	10.93													
GBR	0.89	0.83	0.85	0.89	0.88	4.57												
IRL	0.83	0.81	0.82	0.79	0.87	0.82	3.58											
ITA	0.89	0.90	0.90	0.92	0.90	0.86	0.79	2.51										
NLD	0.88	0.84	0.87	0.92	0.82	0.83	0.79	0.86	4.71									
NZL	0.73	0.68	0.67	0.64	0.76	0.70	0.75	0.71	0.64	0.06								
USA	0.79	0.92	0.91	0.85	0.85	0.81	0.79	0.87	0.77	0.64	2.37							
POL	0.84	0.83	0.82	0.85	0.86	0.83	0.70	0.91	0.77	0.72	0.75	13.72						
ZAF	0.79	0.82	0.85	0.79	0.87	0.80	0.87	0.81	0.77	0.71	0.86	0.77	15.61					
AUS	0.71	0.71	0.69	0.66	0.72	0.68	0.83	0.66	0.66	0.68	0.72	0.66	0.80	8.51				
URY	0.73	0.67	0.67	0.67	0.68	0.67	0.70	0.69	0.66	0.82	0.66	0.70	0.77	0.68	1.40			
FRA	0.81	0.89	0.84	0.83	0.80	0.75	0.81	0.81	0.79	0.61	0.82	0.69	0.81	0.74	0.66	0.91		
JPN	0.85	0.93	0.89	0.89	0.90	0.87	0.83	0.91	0.83	0.67	0.92	0.86	0.88	0.71	0.69	0.82	18.22	
SVN	0.87	0.74	0.76	0.82	0.77	0.77	0.72	0.85	0.78	0.70	0.68	0.73	0.67	0.67	0.71	0.75	0.76	18.91

JER hco

	CAN	DFS	USA	NLD
CAN	7.93			
DFS	0.71	17.44		
USA	0.72	0.81	2.72	

NLD	0.81	0.83	0.72	5.07

JER crc

	CAN	DFS	GBR	NLD	NZL	IRL	CHE
CAN	7.03						
DFS	0.81	13.32					
GBR	0.65	0.82	3.79				
NLD	0.81	0.83	0.68	3.65			
NZL	0.57	0.64	0.62	0.55	0.07		
IRL	0.61	0.61	0.79	0.60	0.57	2.42	
CHE	0.81	0.83	0.70	0.84	0.57	0.65	9.09

JER cc1

	CAN	DFS	GBR	NLD	USA	CHE
CAN	6.95					
DFS	0.70	15.58				
GBR	0.78	0.67	0.03			
NLD	0.72	0.75	0.67	3.74		
USA	0.75	0.75	0.67	0.69	2.91	
CHE	0.90	0.70	0.78	0.72	0.68	11.56

JER cc2

	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL	CHE
CAN	6.68									
DFS	0.81	15.67								
GBR	0.70	0.73	3.78							
NLD	0.80	0.78	0.71	3.64						
NZL	0.64	0.64	0.67	0.64	0.05					
USA	0.80	0.76	0.77	0.75	0.70	2.67				
ZAF	0.67	0.65	0.74	0.66	0.77	0.83	11.22			
AUS	0.64	0.64	0.64	0.63	0.65	0.64	0.70	6.52		
IRL	0.74	0.73	0.76	0.75	0.66	0.75	0.78	0.72	2.42	
CHE	0.81	0.86	0.68	0.77	0.84	0.72	0.69	0.66	0.75	11.13

JER int

	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL
CAN	6.65								
DFS	0.84	15.37							
GBR	0.74	0.81	3.78						
NLD	0.80	0.82	0.76	3.58					
NZL	0.65	0.64	0.67	0.62	0.05				
USA	0.83	0.79	0.77	0.73	0.70	2.67			
ZAF	0.70	0.70	0.74	0.70	0.77	0.83	11.22		
AUS	0.68	0.67	0.67	0.67	0.66	0.67	0.71	6.52	
IRL	0.78	0.73	0.74	0.75	0.63	0.75	0.80	0.74	2.42

RDC hco

	CAN	DEU	DFS	NOR	USA	NLD
CAN	8.28					
DEU	0.89	14.32				
DFS	0.71	0.82	12.20			
NOR	0.84	0.88	0.88	16.69		
USA	0.82	0.82	0.79	0.73	2.80	
NLD	0.79	0.84	0.79	0.65	0.74	5.89

RDC crc

	CAN	DEU	DFS	GBR	NOR	NZL	NLD	IRL

CAN	6.71							
DEU	0.83	10.03						
DFS	0.83	0.90	12.73					
GBR	0.79	0.71	0.68	4.15				
NOR	0.83	0.80	0.83	0.61	14.30			
NZL	0.66	0.59	0.56	0.66	0.59	0.11		
NLD	0.82	0.83	0.87	0.72	0.78	0.57	3.50	
IRL	0.60	0.60	0.62	0.80	0.61	0.60	0.60	2.90

RDC cc1

	CAN	DEU	DFS	GBR	NOR	NLD	USA
CAN	7.49						
DEU	0.90	13.71					
DFS	0.70	0.81	12.97				
GBR	0.77	0.79	0.67	0.03			
NOR	0.81	0.88	0.94	0.78	14.10		
NLD	0.73	0.77	0.82	0.68	0.69	3.85	
USA	0.80	0.75	0.75	0.68	0.72	0.79	2.88

RDC cc2

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	7.09										
DEU	0.91	11.55									
DFS	0.80	0.93	12.85								
GBR	0.70	0.75	0.74	4.15							
NOR	0.77	0.80	0.88	0.71	14.10						
NZL	0.67	0.67	0.66	0.69	0.66	0.07					
USA	0.85	0.88	0.76	0.78	0.71	0.68	2.65				
ZAF	0.68	0.80	0.73	0.70	0.77	0.65	0.78	17.03			
NLD	0.82	0.91	0.84	0.71	0.72	0.68	0.77	0.72	3.69		
AUS	0.66	0.68	0.63	0.67	0.64	0.67	0.67	0.63	0.64	7.69	
IRL	0.74	0.79	0.75	0.79	0.71	0.72	0.77	0.82	0.76	0.78	2.90

RDC int

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	6.81										
DEU	0.90	11.32									
DFS	0.86	0.95	13.20								
GBR	0.82	0.84	0.78	4.15							
NOR	0.76	0.72	0.67	0.68	14.30						
NZL	0.73	0.67	0.65	0.70	0.62	0.07					
USA	0.88	0.88	0.74	0.79	0.68	0.66	2.65				
ZAF	0.74	0.84	0.74	0.73	0.81	0.67	0.80	17.03			
NLD	0.84	0.87	0.90	0.80	0.69	0.65	0.76	0.77	3.49		
AUS	0.70	0.69	0.67	0.68	0.68	0.67	0.69	0.72	0.67	7.69	
IRL	0.80	0.81	0.77	0.79	0.68	0.72	0.76	0.85	0.77	0.79	2.90

---

^LAPPENDIX II. Number of common bulls

BSW hco

---

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEA	FRA	USA	CHE	NLD	ITA
CAN	0	112	56	116	114	37	105
DEA	98	0	210	208	649	162	552
FRA	48	161	0	77	177	86	188
USA	105	166	58	0	217	63	150
CHE	96	550	136	181	0	117	476
NLD	33	151	73	59	111	0	133
ITA	91	437	147	109	418	107	0

```
 ------------------------------------------------------------------------------
BSW crc
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  NZL  GBR  FRA  ITA
 ------------------------------------------------------------------------------
  CAN    0  130  128   42   21   56   74  125
  CHE  111    0  653  123   31   77  177  507
  DEA  114  544    0  174   47   75  219  676
  NLD   37  113  160    0   30   48   91  145
  NZL   20   25   41   23    0   20   23   39
  GBR   51   61   58   45   16    0   60   83
  FRA   64  135  167   76   18   52    0  199
  ITA  110  445  555  122   33   63  155    0
 ------------------------------------------------------------------------------
BSW cc1
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  USA  GBR  FRA  ITA
 ------------------------------------------------------------------------------
  CAN    0  133  129   42  148   56   79  126
  CHE  112    0  650  124  284   83  185  508
  DEA  114  540    0  177  256   83  231  675
  NLD   37  113  160    0   74   53   95  147
  USA  144  249  206   68    0   78  105  190
  GBR   51   67   65   50   77    0   65   91
  FRA   68  142  178   80   75   59    0  210
  ITA  110  447  552  121  138   69  166    0
 ------------------------------------------------------------------------------
BSW cc2
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
 ------------------------------------------------------------------------------
  CAN    0  117  112   38   17  140   52   73  107
  CHE   95    0  641  124   28  341   77  185  484
  DEA   98  536    0  177   39  330   75  228  628
  NLD   34  113  160    0   25   97   48   95  145
  NZL   16   23   36   20    0   27   17   20   30
  USA  131  316  286   85   24    0   84  125  235
  GBR   46   61   58   45   13   83    0   63   81
  FRA   63  142  177   80   16   89   56    0  209
  ITA   92  416  497  118   26  163   61  162    0
 ------------------------------------------------------------------------------
BSW int
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  DEA  NLD  NZL  USA  GBR  ITA  SVN
 ------------------------------------------------------------------------------
  CAN    0  118   40   17  146   55  118   28
  DEA  103    0  176   39  329   75  741   89
  NLD   36  160    0   25   97   48  153   44
  NZL   16   36   20    0   27   17   33   10
  USA  137  286   85   24    0   84  258   34
  GBR   49   58   45   13   83    0   86   23
  ITA  101  655  127   29  185   67    0   87
  SVN   26   83   44   10   30   21   83    0
 ------------------------------------------------------------------------------
GUE hco
--------
GUE crc
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  NZL
```

```
 ------------------------------------------------------------------------------
  CAN    0   19    3
  GBR   16    0   14
  NZL    2   12    0
 ------------------------------------------------------------------------------
GUE cc1
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  USA
 ------------------------------------------------------------------------------
  CAN    0   21   45
  GBR   17    0   63
  USA   44   59    0
 ------------------------------------------------------------------------------
GUE cc2
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  NZL  USA  AUS
 ------------------------------------------------------------------------------
  CAN    0   14    1   41   25
  GBR   11    0   12   90   39
  NZL    1   10    0   24   22
  USA   39   91   23    0   72
  AUS   21   32   21   69    0
 ------------------------------------------------------------------------------
GUE int
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  GBR  NZL  USA  AUS
 ------------------------------------------------------------------------------
  CAN    0   14    1   41   25
  GBR   11    0   12   90   39
  NZL    1   10    0   24   22
  USA   39   91   23    0   72
  AUS   21   32   21   69    0
 ------------------------------------------------------------------------------
HOL hco
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CZE  DEU  DFS  FRA  USA  POL  CHE  NLD  ITA  JPN
 ------------------------------------------------------------------------------
  CAN    0 1192 2494 1604 1390 3342 1710  922 1629 1813 1253
  CZE  903    0 1983 1371 1270 1636 1535  518 1627 1299  882
  DEU 2109 1550    0 2977 2509 3288 2962 1248 3475 2520 1424
  DFS 1545  955 2389    0 1799 2027 1917  815 2496 1585 1075
  FRA 1084  798 1501 1111    0 1766 1872  768 2071 1533 1173
  USA 3871 1379 2747 1918 1113    0 2551  973 2175 2481 1602
  POL 1623 1320 2792 1680 1376 2774    0  712 2113 1872 1049
  CHE  845  359 1175  770  712  902  598    0  981  669  501
  NLD 1629 1423 3169 2242 1430 2010 2009  976    0 1658 1160
  ITA 1472  911 1619 1200  816 1981 1575  572 1260    0 1105
  JPN  749  419  693  602  457  919  612  329  633  543    0
 ------------------------------------------------------------------------------
HOL crc
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       BEL  CAN  CHE  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  POL  FRA
 ------------------------------------------------------------------------------
  BEL    0  853  662 1361  986 1006  963  563  677 1391  555  791 1052
  CAN  865    0  949 2624 1653 1797 1845  621 1670 1768  771 1550 1487
  CHE  672  881    0 1273  819  799  837  469  635 1035  457  670  780
  DEU 1406 2196 1220    0 3115 2589 2508 1015 2211 3997 1111 2640 2741
  DFS  937 1620  782 2450    0 1758 1807  838 1362 2536  941 1712 1809
  ESP 1084 1649  757 2349 1619    0 1684  778 1496 2030  790 1689 1963
```

```
  GBR  955 1956  802 2010 1491 1568    0 1117 1415 2126 1064 1530 1723
  IRL  556  621  479  903  717  799 1170    0  473 1022  834  603  803
  ITA  677 1454  566 1566 1168 1291 1163  417    0 1507  489 1572 1303
  NLD 1583 1811 1041 3810 2355 2151 1937  976 1321    0 1214 1982 2210
  NZL  458  721  384  884  701  674  939  734  416 1123    0  619  847
  POL  726 1490  563 2428 1500 1552 1385  501 1377 1890  494    0 1725
  FRA 1049 1176  718 1643 1112 1915 1175  662  824 1512  534 1245    0
 ------------------------------------------------------------------------
HOL cc1
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       CAN  CHE  CZE  DEU  DFS  FRA  GBR  ISR  ITA  NLD  USA  POL  JPN
 ------------------------------------------------------------------------
  CAN    0  957 1081 2668 1696 1502 1906  157 1692 1796 3604 1700 1401
  CHE  889    0  436 1279  826  787  851   65  636 1038 1041  711  533
  CZE  859  308    0 1617 1128  990  956  129 1117 1383 1505 1408  746
  DEU 2212 1218 1329    0 3145 2767 2560  192 2224 3995 3563 2906 1626
  DFS 1640  785  896 2465    0 1822 1868  171 1385 2556 2198 1865 1134
  FRA 1193  726  650 1661 1121    0 1754  133 1311 2225 1985 1831 1310
  GBR 2021  819  705 2054 1536 1198    0  176 1438 2173 2460 1632 1203
  ISR  110   38  101  149  132   73  134    0  130  182  233  168  128
  ITA 1467  566  876 1556 1171  829 1196   88    0 1518 2343 1705 1017
  NLD 1827 1041 1308 3795 2362 1534 1993  144 1323    0 2460 2160 1238
  USA 4243  973 1295 2889 2036 1239 2479  230 1951 2296    0 2497 1812
  POL 1599  606 1249 2731 1643 1327 1476  132 1474 2069 2622    0 1071
  JPN  869  366  424  786  671  526  668   63  581  726 1067  642    0
 ------------------------------------------------------------------------
HOL cc2
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       BEL  CAN  CHE  CZE  DEU  DFS  ESP  FRA  GBR  IRL  ISR  ITA  NLD  NZL  USA  POL  ZAF  AUS  URY  JPN
 ------------------------------------------------------------------------
  BEL    0  849  663  551 1357  989 1011 1048  969  566   90  680 1395  542 1084  800  335  810  380  567
  CAN  854    0  943 1064 2589 1654 1813 1462 1836  614  154 1665 1748  740 3706 1606  449 1464  835 1298
  CHE  673  865    0  436 1267  827  801  773  841  469   66  636 1038  447 1136  677  264  706  345  497
  CZE  445  830  308    0 1610 1128 1103  982  945  401  129 1116 1383  462 1532 1330  255  689  484  711
  DEU 1398 2119 1204 1317    0 3133 2624 2728 2515 1016  191 2209 3966 1089 4109 2706  562 1893  918 1535
  DFS  937 1584  786  896 2448    0 1804 1809 1833  843  173 1385 2562  919 2592 1769  515 1450  728 1063
  ESP 1087 1629  758  926 2354 1651    0 1980 1705  782  156 1515 2051  794 2515 1751  521 1332  748 1222
  FRA 1039 1137  708  642 1606 1095 1904    0 1722  810  136 1297 2197  846 2669 1748  484 1390  642 1248
  GBR  955 1925  802  697 1990 1498 1571 1163    0 1120  177 1419 2136 1039 2768 1563  508 1631  792 1145
  IRL  556  602  479  318  896  717  799  659 1171    0  120  474 1028  828  931  615  339  822  424  492
  ISR   55  107   38  101  147  132  118   72  133   94    0  130  184  126  258  163   61  130   98  127
  ITA  677 1433  566  876 1540 1171 1294  816 1163  418   88    0 1517  487 2367 1620  264  960  558  962
  NLD 1586 1769 1041 1308 3739 2364 2159 1492 1943  978  144 1323    0 1184 3030 2011  506 1652  777 1167
  NZL  438  665  371  356  838  666  654  514  900  726  101  396 1070    0 1215  634  355 1301  587  600
  USA  978 4277 1066 1313 3150 2177 2306 1509 2643  862  247 1973 2751 1168    0 2448  640 2221 1313 2104
  POL  721 1478  558 1140 2420 1519 1583 1230 1381  503  121 1373 1874  492 2489    0  323 1104  665  985
  ZAF  281  412  222  185  431  381  478  337  447  297   39  205  422  284  615  250    0  480  319  414
  AUS  707 1506  629  503 1467 1097 1115  966 1451  717   85  777 1454 1291 2293  877  421    0  750  965
  URY  271  778  255  324  658  505  641  373  634  327   55  397  610  477 1581  533  267  584    0  622
  JPN  370  737  319  377  679  585  618  459  587  310   55  512  631  298  930  542  260  524  319    0
 ------------------------------------------------------------------------
HOL int
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
       BEL  CAN  DEU  DFS  ESP  GBR  IRL  ITA  NLD  NZL  USA  POL  ZAF  AUS  URY  FRA  JPN  SVN
 ------------------------------------------------------------------------
  BEL    0  852 1355  989 1011  969  566  679 1395  542 1084  803  335  810  380 1048  567  169
  CAN  859    0 2595 1663 1819 1845  621 1668 1758  746 3720 1622  453 1472  841 1470 1303  221
  DEU 1397 2129    0 3130 2623 2515 1016 2210 3963 1088 4104 2722  562 1892  918 2727 1535  368
  DFS  937 1595 2444    0 1804 1833  843 1386 2560  919 2591 1782  515 1450  728 1809 1063  269
  ESP 1087 1645 2354 1651    0 1705  782 1515 2049  794 2512 1767  521 1331  748 1979 1220  257
  GBR  955 1938 1990 1498 1571    0 1120 1420 2136 1039 2768 1576  508 1631  791 1722 1145  215
  IRL  556  611  896  717  799 1170    0  474 1027  828  931  620  339  822  424  810  492  119
  ITA  677 1439 1541 1171 1294 1163  418    0 1518  487 2368 1634  264  960  558 1299  962  241
```

```
  NLD 1586 1783 3737 2363 2159 1943  978 1323    0 1184 3029 2032  506 1652  777 2196 1166  289
  NZL  438  670  838  666  654  899  725  396 1070    0 1215  637  355 1301  586  846  600  123
  USA  978 4307 3150 2177 2306 2643  862 1973 2751 1168    0 2473  640 2221 1313 2669 2104  257
  POL  731 1502 2454 1538 1601 1396  508 1396 1907  495 2526    0  324 1111  671 1758  990  292
  ZAF  281  419  431  381  478  447  297  205  422  284  615  251    0  480  319  484  414   70
  AUS  707 1511 1467 1097 1115 1451  717  777 1454 1291 2293  885  421    0  750 1390  965  169
  URY  271  784  658  505  641  634  327  397  610  477 1581  540  267  584    0  642  622  100
  FRA 1039 1145 1606 1095 1904 1163  659  816 1492  514 1509 1245  337  966  373    0 1248  207
  JPN  370  740  679  585  618  587  310  512  631  298  930  550  260  524  319  459    0  161
  SVN  133  173  362  215  224  158   91  202  250   82  210  245   50  116   51  151   85    0
 ------------------------------------------------------------------------------
JER hco
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  USA  NLD
 ------------------------------------------------------------------------------
  CAN    0  123  376   42
  DFS  119    0  178  118
  USA  369  170    0   86
  NLD   35  116   85    0
 ------------------------------------------------------------------------------
JER crc
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  IRL  CHE
 ------------------------------------------------------------------------------
  CAN    0  125  168   51  189   15   52
  DFS  121    0  205  181  188   61   83
  GBR  170  200    0  112  256   94   92
  NLD   44  181  109    0  108   42   51
  NZL  192  164  263  100    0  158   78
  IRL   14   57   98   41  179    0   33
  CHE   48   82   90   44   71   29    0
 ------------------------------------------------------------------------------
JER cc1
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  USA  CHE
 ------------------------------------------------------------------------------
  CAN    0  131  178   53  445   54
  DFS  126    0  209  185  199   85
  GBR  173  202    0  115  252   93
  NLD   47  185  110    0  115   55
  USA  451  192  268  117    0  111
  CHE   48   83   88   47  111    0
 ------------------------------------------------------------------------------
JER cc2
--------
 common bulls below diagonal
 common three quarter sib group above diagonal
      CAN  DFS  GBR  NLD  NZL  USA  ZAF  AUS  IRL  CHE
 ------------------------------------------------------------------------------
  CAN    0  123  170   49  176  439  141  246   15   52
  DFS  118    0  208  186  181  251  166  183   61   85
  GBR  167  201    0  115  252  279  184  248   94   94
  NLD   42  186  109    0  103  130   83   88   42   56
  NZL  176  157  255   95    0  423  224  481  155   82
  USA  445  231  305  135  496    0  339  544   56  113
  ZAF  140  148  186   79  231  351    0  262   44   71
  AUS  243  156  254   81  524  592  248    0   72   79
  IRL   14   57   98   41  175   59   45   69    0   33
  CHE   46   83   90   47   71  114   61   67   29    0
 ------------------------------------------------------------------------------
JER int
--------
 common bulls below diagonal
```

common three quarter sib group above diagonal

	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL
CAN	0	126	171	49	178	444	143	248	15
DFS	121	0	208	186	181	251	166	183	61
GBR	169	201	0	115	252	279	184	248	94
NLD	43	186	109	0	103	130	83	88	42
NZL	179	157	255	95	0	423	224	481	155
USA	452	231	305	135	496	0	339	544	56
ZAF	142	148	186	79	231	351	0	262	44
AUS	246	156	254	81	524	592	248	0	72
IRL	14	57	98	41	175	59	45	69	0

RDC hco

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	NOR	USA	NLD
CAN	0	10	197	7	111	6
DEU	10	0	69	20	24	14
DFS	207	60	0	147	183	64
NOR	6	19	127	0	77	48
USA	106	22	176	77	0	43
NLD	6	14	61	48	41	0

RDC crc

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	GBR	NOR	NZL	NLD	IRL
CAN	0	13	196	87	8	73	7	6
DEU	12	0	77	16	18	25	20	7
DFS	206	65	0	131	159	199	67	24
GBR	88	15	127	0	79	88	46	29
NOR	7	17	132	83	0	57	53	63
NZL	74	24	194	87	56	0	29	18
NLD	7	20	64	45	53	28	0	14
IRL	6	7	19	28	62	17	14	0

RDC cc1

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	GBR	NOR	NLD	USA
CAN	0	13	196	87	8	7	157
DEU	12	0	76	16	18	20	28
DFS	206	64	0	134	149	67	213
GBR	88	15	130	0	81	46	114
NOR	7	17	126	85	0	51	85
NLD	7	20	64	45	51	0	47
USA	153	26	209	109	85	45	0

RDC cc2

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	0	13	194	82	8	69	180	78	7	79	6
DEU	12	0	75	16	18	21	29	3	20	51	7
DFS	203	64	0	132	149	188	233	63	67	244	24
GBR	83	15	128	0	78	85	129	48	46	100	29
NOR	7	17	126	82	0	48	89	0	51	79	63
NZL	69	21	183	82	47	0	122	41	26	164	17
USA	184	27	232	127	89	123	0	77	50	150	33
ZAF	83	3	60	45	0	39	72	0	3	46	4

NLD	7	20	64	45	51	25	48	3	0	44	14
AUS	81	49	221	99	68	165	153	48	42	0	24
IRL	6	7	19	28	62	17	33	4	14	23	0

RDC int

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	0	13	194	84	8	69	181	78	7	80	6
DEU	12	0	75	16	18	21	29	3	20	51	7
DFS	203	64	0	132	159	188	233	63	67	244	24
GBR	85	15	128	0	79	85	129	48	46	100	29
NOR	7	17	132	83	0	49	89	0	53	83	63
NZL	69	21	183	82	48	0	122	41	26	164	17
USA	185	27	232	127	89	123	0	77	50	150	33
ZAF	83	3	60	45	0	39	72	0	3	46	4
NLD	7	20	64	45	53	25	48	3	0	44	14
AUS	82	49	221	99	72	165	153	48	42	0	24
IRL	6	7	19	28	62	17	33	4	14	23	0

SIM hco

SIM crc

SIM cc1

SIM cc2

SIM int