

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 T5=IT	Calving interval converted to 42 days pregnancy rate Calving interval converted to 42 days pregnancy rate
BEL	T2=CY T4=C2 T5=IT	PR=Pregnancy Rate ([21/(DO-45+11)]*100, with DO=days open) PR=Pregnancy Rate ([21/(DO-45+11)]*100, with DO=days open) PR=Pregnancy Rate ([21/(DO-45+11)]*100, with DO=days open)
CAN	T1=HC T2=CY T3=C1 T4=C2 T5=IT	NR=Non Return Rate after 56 Days in heifers (NRR), % CF=Interval from Calving to First Service in cows(CF) NR=Non Return Rate after 56 Days in cows(NRR), % FC=Interval first insemination-conception in cows DO=Days open
CHE	T1=HC T2=CR T3=C1 T4=C2	CR=Heifers’ Conception rate CF=Interval from Calving to First Service (ICF), days NR=Non Return Rate after 56 Days (NRR), % 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 T5=IT	Days open expressed as Daughter Pregnancy Rate Days open expressed as Daughter Pregnancy Rate
USA	T1=HC T3=C1 T4=C2 T5=IT	CR=Conception rate (heifer) CR=Conception rate (cow) FL=Interval from first to last insemination cows (days) DP=Daughter Pregnancy Rate
ZAF	T4=IT T5=IT	CI=Calving Interval CI=Calving Interval
JPN	T1=HC T3=C1 T4=C2 T5=IT	CR=Heifers' Conception rate CR=Cows' Conception rate DO=Days open 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:

JPN (HOL)	Small changes in proofs caused by additional records and in EDCs caused by pedigree verification
FRA (ALL)	Applied new MACE coding according to Interbull recommendations. Optimized data processing. Number of daughters, herds and EDC are now calculated directly from the pipeline based on the univariate model without permanent environment effects on single-step preadjusted performances in genomic-free EBVs computation. Before they were still computed from the traditional polygenic approach. Pedigree corrections. Decrease in EDC for a proportion of bulls caused by the different weights applied in the current univariate model without permanent environment effects running on single-step preadjusted performances.
NOR (RDC)	Changes in the data extraction pipeline caused many bulls to loose from 1 to 10 daughters, depending on size of the progeny group. The National Herd Recording System is introducing new farmer reporting tools and central storage system. The data extraction pipeline is being modified to cope with this change
NLD (ALL)	Decrease in information due to data edits
CHE (ALL)	Breeding organizations have recently put more emphasis on correcting data, which contributes to some higher variation in data. This increased activity is related to the merge of two databases planned, which took place by the end of June 2026 which caused some decrease in information.
ISR (HOL)	Decrease in information due to data editings and pedigree verification
POL (HOL)	Decrease in information due to data editings and pedigree verification
DFS (ALL)	Decrease in information due to data editings
DEA (BSW)	Decrease in information due to pedigree verification
GBR (ALL)	Excluded historical data, implying that some bulls have lost daughters and herds and therefore reliability.
AUS (ALL)	Updated type of proofs according to the latest interbull recommendation. Drops in information due to pedigree verification and changes in status of bulls that are no longer qualifying for the evaluation.
USA (ALL)	Decrease in information due to pedigree validation and daughter's pregnancy rate now uses a herd-year-and-lactation-group-specific voluntary waiting period (replacing the fixed 50-day + 20-day grace assumption). Stricter data filters: records with missing calving dates, missing days open, or cases where days open was not predictive were removed. CC1 and HCO Phenotypes Insemination records are now pre-adjusted for mating type, service sire breed, and short cycles. CC1 additionally includes a days-in-milk-at-first-insemination covariable. CC2 new trait: First Service to Conception: FSC has records available from 2003 to present (22 years) rather than the previous traits definitions having 65 years of records, this cause many bulls to be missing in this submission. CC2 model is the same as CC1 including the new days-in-milk-at-first-insemination covariable. Model Structure INT, CC1, HCO, and CC2 are analyzed together in a multi-trait model however a domestic trait (Early First Calving) was moved into a separate model. Variance Components Variance components were re-estimated (heritabilities; genetic and environmental correlations). The environmental correlation between heifer (HCO) and cow traits was set to zero. Data Edits First-lactation cows must be at least 3 years old at the evaluation cutoff date to be included. DPR records were removed if the sire of a cow or heifer was unknown (aligns with other reproductive performance traits and other traits). Records belonging to contemporary groups with low observations (i.e., 3) are removed. Computation: Applied stricter convergence criteria when solving the mixed-model equations for the traditional evaluation. Extraction program efficiency improved for all traits.
DEU (ALL)	Overall base change, some drops in information due to data edits
BEL (HOL)	Drops in information due to pedigree verification, causing some bulls to no longer qualifying for inclusion.
NZL (ALL)	Decrease in information due to continuous pedigree verification and herd records being updated.
ITA (BSW)	Improvements in data editing procedures and quality control checks. In addition, the identification of the correct calving date associated with each phenotypic records has been optimized to ensure greater consistency and accuracy of the data.
IRL (ALL)	Drops in information due to pedigree correction
ITA (HOL)	Cut off of data causing drops in information and bulls missing in this submission.
CZE (HOL)	Drops in information due to herdbook updates

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.

Direct Gestation Length (ges) has been added as the fifth trait in the calving evaluation starting from the August 2025 MACE routine evaluation, and therefore added in the calv{BRD}{RUNID}.itb and calv{BRD}{RUNID}.ipr.

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 2026).
Number of records for lactating cow’s ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		151	9079	1935	849	
BEL			2301			
CAN	195	51	11048	724	632	
CHE	3184		3534	158		
CZE			3924			
DEA	5193					
DEU			26923		343	
DFS			18342	2664	11057	
ESP			7383			
EST						
FRA	480		17858			
FRM						
GBR	122	262	8336	690	512	
HUN						
IRL			3845	289	88	
ISR			1868			
ITA	2116		7369			
JPN			7171			

KOR					
LTU					
LVA					
NLD	272		17587	317	113
NOR					3283
NZL	64	50	9287	5321	1401
POL			9613		
PRT					
SVK					
SVN					
URY			2067		
USA	887	345	28840	4076	578
ZAF			1264	768	161
CAM					
=====					
No.Records	12513	859	197639	16942	19017
Pub. Proofs	11191	1097	161772	15204	18855

					0

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

BSW	hco						
	CAN	DEA	FRA	USA	CHE	NLD	ITA
CAN	9.30						
DEA	0.84	9.87					
FRA	0.73	0.88	0.82				
USA	0.74	0.64	0.83	2.51			
CHE	0.82	0.89	0.83	0.70	13.10		
NLD	0.77	0.64	0.77	0.74	0.73	4.59	
ITA	0.72	0.64	0.80	0.82	0.71	0.69	15.65

BSW	crc							
	CAN	CHE	DEA	NLD	NZL	GBR	FRA	ITA
CAN	7.49							
CHE	0.80	11.43						
DEA	0.77	0.92	15.10					
NLD	0.81	0.81	0.83	3.78				
NZL	0.61	0.67	0.72	0.63	0.12			
GBR	0.73	0.70	0.61	0.72	0.64	3.95		
FRA	0.82	0.93	0.96	0.85	0.70	0.73	1.68	
ITA	0.82	0.83	0.86	0.80	0.64	0.71	0.85	16.67

BSW	cc1							
	CAN	CHE	DEA	NLD	USA	GBR	FRA	ITA
CAN	7.79							
CHE	0.82	11.76						
DEA	0.78	0.86	11.47					
NLD	0.72	0.69	0.67	3.69				
USA	0.73	0.69	0.67	0.74	2.80			
GBR	0.77	0.80	0.79	0.68	0.67	0.03		
FRA	0.73	0.68	0.67	0.81	0.89	0.71	0.90	
ITA	0.70	0.68	0.66	0.69	0.78	0.67	0.89	15.68

BSW	cc2								
	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	7.22								
CHE	0.76	11.12							
DEA	0.76	0.89	12.33						
NLD	0.80	0.77	0.74	3.51					
NZL	0.65	0.82	0.68	0.64	0.07				

USA	0.77	0.85	0.81	0.71	0.83	9.79			
GBR	0.72	0.81	0.82	0.73	0.70	0.67	3.95		
FRA	0.87	0.86	0.92	0.83	0.66	0.82	0.80	0.90	
ITA	0.86	0.83	0.86	0.75	0.74	0.78	0.75	0.91	18.50

BSW	int								
-----	-----	--	--	--	--	--	--	--	--

	CAN	DEA	NLD	NZL	USA	GBR	ITA	SVN	
CAN	8.16								
DEA	0.79	14.40							
NLD	0.80	0.87	3.50						
NZL	0.67	0.75	0.67	0.07					
USA	0.88	0.79	0.73	0.61	2.14				
GBR	0.83	0.74	0.80	0.70	0.80	3.95			
ITA	0.86	0.89	0.79	0.69	0.81	0.81	18.69		
SVN	0.72	0.73	0.71	0.68	0.76	0.76	0.77	19.75	

GUE	crc								
-----	-----	--	--	--	--	--	--	--	--

	CAN	GBR	NZL						
CAN	7.64								
GBR	0.75	4.74							
NZL	0.63	0.65	0.11						

GUE	cc1								
-----	-----	--	--	--	--	--	--	--	--

	CAN	GBR	USA						
CAN	7.68								
GBR	0.77	0.03							
USA	0.79	0.71	3.39						

GUE	cc2								
-----	-----	--	--	--	--	--	--	--	--

	CAN	GBR	NZL	USA	AUS				
CAN	7.26								
GBR	0.73	4.74							
NZL	0.64	0.70	0.07						
USA	0.81	0.65	0.84	11.91					
AUS	0.78	0.78	0.78	0.80	15.52				

GUE	int								
-----	-----	--	--	--	--	--	--	--	--

	CAN	GBR	NZL	USA	AUS				
CAN	7.78								
GBR	0.83	4.74							
NZL	0.67	0.70	0.07						
USA	0.88	0.76	0.64	2.40					
AUS	0.83	0.77	0.77	0.87	15.52				

HOL	hco										
-----	-----	--	--	--	--	--	--	--	--	--	--

	CAN	CZE	DEU	DFS	FRA	USA	POL	CHE	NLD	ITA	JPN
CAN	7.66										
CZE	0.76	17.58									
DEU	0.87	0.78	15.15								
DFS	0.76	0.83	0.85	13.50							
FRA	0.78	0.82	0.84	0.90	0.79						
USA	0.80	0.82	0.83	0.86	0.89	2.45					
POL	0.62	0.57	0.66	0.70	0.68	0.69	13.89				
CHE	0.91	0.76	0.89	0.74	0.74	0.77	0.53	13.60			
NLD	0.79	0.77	0.84	0.86	0.85	0.81	0.66	0.77	5.33		
ITA	0.82	0.85	0.87	0.90	0.94	0.94	0.74	0.83	0.84	1.86	
JPN	0.85	0.71	0.85	0.71	0.74	0.83	0.62	0.82	0.75	0.83	6.21

HOL	cfc																				
	BEL	CAN	CHE	DEU	DFS	ESP	GBR	IRL	ITA	NLD	NZL	POL	FRA								
BEL	4.62																				
CAN	0.77	7.69																			
CHE	0.78	0.82	12.29																		
DEU	0.73	0.83	0.85	10.86																	
DFS	0.80	0.87	0.92	0.91	11.59																
ESP	0.88	0.76	0.79	0.76	0.76	10.88															
GBR	0.89	0.75	0.74	0.72	0.78	0.91	4.57														
IRL	0.85	0.59	0.68	0.59	0.62	0.88	0.82	3.57													
ITA	0.80	0.88	0.87	0.90	0.90	0.79	0.79	0.66	1.38												
NLD	0.77	0.81	0.85	0.84	0.92	0.76	0.75	0.58	0.84	4.68											
NZL	0.65	0.62	0.65	0.60	0.66	0.68	0.65	0.61	0.67	0.57	0.09										
POL	0.74	0.86	0.85	0.82	0.84	0.76	0.75	0.59	0.88	0.76	0.69	15.72									
FRA	0.79	0.87	0.92	0.93	0.95	0.78	0.80	0.66	0.92	0.89	0.67	0.88	1.13								
HOL	cc1																				
	CAN	CHE	CZE	DEU	DFS	FRA	GBR	ISR	ITA	NLD	USA	POL	JPN								
CAN	6.84																				
CHE	0.89	10.80																			
CZE	0.82	0.69	17.59																		
DEU	0.90	0.88	0.81	14.61																	
DFS	0.74	0.67	0.85	0.80	13.08																
FRA	0.77	0.68	0.91	0.77	0.89	0.99															
GBR	0.77	0.77	0.69	0.79	0.66	0.73	0.03														
ISR	0.80	0.69	0.93	0.80	0.88	0.88	0.77	3.27													
ITA	0.72	0.66	0.90	0.70	0.83	0.91	0.67	0.90	1.17												
NLD	0.73	0.68	0.84	0.78	0.88	0.91	0.68	0.84	0.80	4.56											
USA	0.77	0.66	0.95	0.76	0.83	0.88	0.67	0.94	0.88	0.78	2.82										
POL	0.78	0.66	0.86	0.78	0.75	0.79	0.66	0.84	0.81	0.72	0.79	19.47									
JPN	0.79	0.77	0.92	0.77	0.83	0.84	0.77	0.86	0.84	0.78	0.88	0.77	7.53								
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	0.75	6.67																			
CHE	0.78	0.86	10.93																		
CZE	0.68	0.89	0.86	17.59																	
DEU	0.79	0.94	0.88	0.91	13.43																
DFS	0.79	0.85	0.83	0.84	0.94	12.83															
ESP	0.87	0.78	0.85	0.83	0.81	0.79	10.86														
FRA	0.81	0.91	0.89	0.87	0.95	0.89	0.81	0.91													
GBR	0.89	0.71	0.74	0.68	0.76	0.80	0.91	0.77	4.57												
IRL	0.83	0.73	0.82	0.70	0.78	0.76	0.87	0.81	0.83	3.57											
ISR	0.63	0.76	0.72	0.87	0.80	0.79	0.78	0.78	0.67	0.64	3.27										
ITA	0.79	0.87	0.86	0.92	0.91	0.87	0.85	0.90	0.76	0.77	0.81	1.29									
NLD	0.78	0.82	0.82	0.81	0.91	0.89	0.74	0.90	0.73	0.76	0.79	0.83	4.68								
NZL	0.71	0.64	0.79	0.78	0.65	0.63	0.85	0.65	0.69	0.73	0.73	0.79	0.63	0.06							
USA	0.69	0.82	0.84	0.91	0.81	0.79	0.85	0.82	0.66	0.66	0.87	0.86	0.74	0.83	9.60						
POL	0.82	0.88	0.87	0.91	0.92	0.87	0.88	0.88	0.82	0.75	0.80	0.93	0.81	0.79	0.86	14.97					
ZAF	0.77	0.78	0.81	0.76	0.82	0.76	0.86	0.81	0.81	0.84	0.58	0.78	0.73	0.70	0.71	0.82	15.62				
AUS	0.82	0.81	0.84	0.78	0.82	0.75	0.86	0.89	0.78	0.89	0.68	0.80	0.75	0.75	0.77	0.81	0.87	12.28			
URY	0.70	0.67	0.69	0.63	0.67	0.67	0.68	0.66	0.69	0.69	0.55	0.65	0.67	0.75	0.63	0.65	0.74	0.77	1.40		
JPN	0.85	0.84	0.83	0.82	0.86	0.85	0.93	0.86	0.87	0.84	0.73	0.86	0.79	0.70	0.81	0.88	0.87	0.82	0.67	18.10	
HOL	int																				
	BEL	CAN	DEU	DFS	ESP	GBR	IRL	ITA	NLD	NZL	USA	POL	ZAF	AUS	URY	FRA	JPN	SVN			
BEL	4.62																				
CAN	0.89	7.22																			
DEU	0.86	0.91	12.28																		

DFS	0.89	0.90	0.94	12.77														
ESP	0.88	0.86	0.88	0.85	10.86													
GBR	0.90	0.84	0.86	0.89	0.92	4.56												
IRL	0.84	0.81	0.81	0.80	0.88	0.84	3.57											
ITA	0.90	0.90	0.90	0.92	0.91	0.86	0.79	2.46										
NLD	0.88	0.83	0.86	0.92	0.82	0.83	0.78	0.85	4.71									
NZL	0.72	0.67	0.65	0.63	0.75	0.70	0.75	0.68	0.62	0.06								
USA	0.81	0.89	0.84	0.86	0.84	0.80	0.77	0.88	0.76	0.59	2.25							
POL	0.84	0.82	0.82	0.85	0.86	0.84	0.71	0.91	0.77	0.67	0.74	14.13						
ZAF	0.77	0.83	0.85	0.79	0.89	0.82	0.86	0.80	0.76	0.70	0.81	0.75	15.62					
AUS	0.84	0.85	0.80	0.77	0.86	0.79	0.90	0.78	0.73	0.75	0.85	0.72	0.88	12.28				
URY	0.72	0.66	0.66	0.66	0.67	0.68	0.69	0.69	0.66	0.80	0.66	0.67	0.75	0.77	1.40			
FRA	0.83	0.90	0.85	0.84	0.80	0.78	0.82	0.83	0.79	0.59	0.88	0.71	0.80	0.89	0.66	0.91		
JPN	0.85	0.93	0.90	0.89	0.94	0.87	0.82	0.92	0.82	0.65	0.89	0.86	0.89	0.82	0.67	0.83	18.10	
SVN	0.87	0.76	0.76	0.82	0.75	0.78	0.76	0.85	0.78	0.67	0.75	0.71	0.67	0.76	0.67	0.81	0.73	18.54

JER	hco
-----	-----

	CAN	DFS	USA	NLD
CAN	7.99			
DFS	0.71	17.48		
USA	0.72	0.83	2.72	
NLD	0.80	0.84	0.75	5.05

JER	crc
-----	-----

	CAN	DFS	GBR	NLD	NZL	IRL	CHE
CAN	7.17						
DFS	0.81	13.23					
GBR	0.66	0.83	3.75				
NLD	0.80	0.83	0.70	3.52			
NZL	0.56	0.63	0.62	0.55	0.07		
IRL	0.61	0.61	0.79	0.59	0.57	2.57	
CHE	0.80	0.84	0.70	0.82	0.58	0.65	8.85

JER	cc1
-----	-----

	CAN	DFS	GBR	NLD	USA	CHE
CAN	6.85					
DFS	0.70	15.58				
GBR	0.79	0.66	0.03			
NLD	0.72	0.74	0.68	3.66		
USA	0.74	0.80	0.67	0.68	2.99	
CHE	0.87	0.68	0.78	0.69	0.68	11.52

JER	cc2
-----	-----

	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL	CHE
CAN	6.73									
DFS	0.85	15.68								
GBR	0.70	0.73	3.75							
NLD	0.79	0.78	0.72	3.56						
NZL	0.64	0.64	0.67	0.64	0.05					
USA	0.79	0.78	0.65	0.70	0.84	10.04				
ZAF	0.71	0.70	0.76	0.67	0.77	0.76	11.20			
AUS	0.77	0.78	0.74	0.71	0.78	0.67	0.85	9.34		
IRL	0.74	0.73	0.77	0.74	0.66	0.71	0.83	0.79	2.57	
CHE	0.81	0.81	0.68	0.76	0.83	0.84	0.80	0.80	0.79	11.28

JER	int
-----	-----

	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL
CAN	6.74								
DFS	0.85	15.34							

GBR	0.75	0.83	3.75						
NLD	0.79	0.82	0.76	3.49					
NZL	0.63	0.63	0.67	0.61	0.05				
USA	0.83	0.85	0.74	0.72	0.62	2.36			
ZAF	0.70	0.71	0.77	0.70	0.77	0.77	11.19		
AUS	0.79	0.76	0.74	0.72	0.78	0.80	0.85	9.34	
IRL	0.77	0.73	0.75	0.74	0.63	0.77	0.83	0.79	2.57

RDC hco

	CAN	DEU	DFS	NOR	USA	NLD			
CAN	8.31								
DEU	0.87	14.47							
DFS	0.71	0.84	12.21						
NOR	0.86	0.90	0.88	16.52					
USA	0.82	0.81	0.80	0.77	2.64				
NLD	0.79	0.83	0.78	0.65	0.75	5.74			

RDC crc

	CAN	DEU	DFS	GBR	NOR	NZL	NLD	IRL	
CAN	6.63								
DEU	0.83	10.18							
DFS	0.82	0.90	12.72						
GBR	0.80	0.71	0.68	4.17					
NOR	0.83	0.80	0.84	0.61	14.47				
NZL	0.64	0.60	0.56	0.64	0.58	0.11			
NLD	0.81	0.83	0.87	0.72	0.78	0.57	3.43		
IRL	0.61	0.60	0.62	0.80	0.61	0.61	0.60	2.94	

RDC cc1

	CAN	DEU	DFS	GBR	NOR	NLD	USA		
CAN	7.37								
DEU	0.90	13.83							
DFS	0.70	0.82	12.95						
GBR	0.77	0.80	0.69	0.03					
NOR	0.80	0.88	0.94	0.78	14.11				
NLD	0.73	0.77	0.83	0.68	0.69	3.95			
USA	0.76	0.77	0.76	0.67	0.72	0.77	2.97		

RDC cc2

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	7.05										
DEU	0.92	11.71									
DFS	0.80	0.93	12.86								
GBR	0.71	0.76	0.75	4.17							
NOR	0.75	0.80	0.88	0.70	14.11						
NZL	0.65	0.67	0.64	0.68	0.66	0.07					
USA	0.77	0.80	0.75	0.65	0.74	0.85	10.04				
ZAF	0.70	0.81	0.74	0.73	0.76	0.64	0.62	16.98			
NLD	0.82	0.91	0.86	0.73	0.72	0.67	0.75	0.73	3.76		
AUS	0.75	0.78	0.67	0.78	0.64	0.76	0.72	0.72	0.73	10.62	
IRL	0.73	0.78	0.74	0.80	0.71	0.71	0.66	0.81	0.75	0.83	2.94

RDC int

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	6.80										
DEU	0.90	11.47									
DFS	0.85	0.94	13.21								
GBR	0.84	0.85	0.80	4.17							
NOR	0.76	0.72	0.67	0.68	14.47						

NZL	0.68	0.66	0.62	0.68	0.62	0.07						
USA	0.83	0.83	0.78	0.75	0.68	0.64	2.34					
ZAF	0.75	0.85	0.73	0.74	0.81	0.65	0.79	16.96				
NLD	0.82	0.86	0.91	0.81	0.69	0.63	0.75	0.77	3.49			
AUS	0.81	0.76	0.69	0.79	0.68	0.76	0.79	0.78	0.72	10.61		
IRL	0.79	0.81	0.76	0.80	0.68	0.72	0.74	0.84	0.77	0.85	2.94	

^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	120	61	125	121	37	111
DEA	106	0	215	213	676	165	580
FRA	52	163	0	75	181	87	191
USA	115	172	55	0	221	65	158
CHE	104	576	140	185	0	120	496
NLD	33	153	72	61	113	0	140
ITA	98	466	150	118	438	114	0

BSW crc

common bulls below diagonal
common three quarter sib group above diagonal
CAN CHE DEA NLD NZL GBR FRA ITA

CAN	0	132	134	46	25	59	80	127
CHE	113	0	678	129	35	79	192	529
DEA	118	570	0	182	54	77	234	706
NLD	41	118	168	0	33	51	98	157
NZL	24	26	45	26	0	21	28	44
GBR	54	64	61	49	18	0	63	86
FRA	69	148	179	82	21	56	0	214
ITA	112	467	587	132	35	66	169	0

BSW ccl

common bulls below diagonal
common three quarter sib group above diagonal
CAN CHE DEA NLD USA GBR FRA ITA

CAN	0	136	136	46	157	59	84	129
CHE	115	0	676	130	300	83	198	526
DEA	119	566	0	185	273	84	244	704
NLD	41	118	168	0	79	55	102	159
USA	153	264	221	73	0	84	112	205
GBR	53	67	65	52	81	0	68	91
FRA	73	154	189	86	83	63	0	224
ITA	113	464	580	132	148	69	179	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	119	118	40	18	137	53	77	111
CHE	99	0	664	130	29	300	79	198	497
DEA	103	559	0	184	43	266	77	242	647
NLD	36	118	167	0	30	79	51	102	154
NZL	17	23	40	24	0	22	17	23	34
USA	129	264	217	73	18	0	80	112	195
GBR	47	64	61	49	14	78	0	66	83
FRA	67	154	188	86	18	83	61	0	222
ITA	96	430	517	127	29	138	63	174	0

BSW int											

common bulls below diagonal											
common	three	quarter	sib	group	above	diagonal					
	CAN	DEA	NLD	NZL	USA	GBR	ITA	SVN			

CAN	0	124	42	18	148	56	121	30			
DEA	108	0	183	43	336	77	772	96			
NLD	38	167	0	30	100	51	162	46			
NZL	17	40	24	0	28	17	37	12			
USA	140	292	88	25	0	88	262	38			
GBR	50	61	49	14	86	0	87	24			
ITA	105	685	136	32	189	68	0	93			
SVN	27	88	45	11	32	22	88	0			

GUE hco											

GUE crc											

common bulls below diagonal											
common	three	quarter	sib	group	above	diagonal					
	CAN	GBR	NZL								

CAN	0	21	3								
GBR	17	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	46								
GBR	17	0	63								
USA	45	59	0								

GUE cc2											

common bulls below diagonal											
common	three	quarter	sib	group	above	diagonal					
	CAN	GBR	NZL	USA	AUS						

CAN	0	15	1	35	26						
GBR	11	0	12	62	41						
NZL	1	10	0	7	22						
USA	35	58	5	0	44						
AUS	22	34	21	42	0						

GUE int											

common bulls below diagonal											
common	three	quarter	sib	group	above	diagonal					
	CAN	GBR	NZL	USA	AUS						

CAN	0	15	1	42	26						
GBR	11	0	12	91	41						
NZL	1	10	0	24	22						
USA	40	92	23	0	73						
AUS	22	34	21	70	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	1221	2589	1694	1415	3469	1841	964	1700	1877	1289

CZE	928	0	2036	1421	1282	1699	1617	533	1660	1337	906								
DEU	2207	1599	0	3122	2539	3406	3210	1295	3612	2608	1470								
DFS	1631	1003	2535	0	1825	2134	2118	856	2610	1664	1121								
FRA	1093	804	1508	1125	0	1792	1956	785	2082	1545	1181								
USA	4020	1442	2872	2024	1129	0	2777	1012	2258	2598	1661								
POL	1737	1393	3064	1895	1460	3007	0	755	2247	2026	1097								
CHE	886	376	1224	806	720	935	638	0	1015	693	519								
NLD	1706	1459	3308	2362	1423	2105	2155	1013	0	1714	1200								
ITA	1533	951	1691	1273	827	2105	1715	595	1321	0	1145								
JPN	779	438	734	640	460	980	647	343	663	577	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	880	677	1413	1025	1033	988	591	692	1440	566	849	1087
CAN	891	0	994	2729	1742	1877	1924	663	1720	1855	811	1671	1531
CHE	683	927	0	1322	851	826	871	495	651	1073	475	714	808
DEU	1455	2305	1271	0	3277	2680	2595	1076	2218	4178	1149	2859	2813
DFS	973	1707	815	2604	0	1842	1866	894	1404	2670	985	1907	1871
ESP	1114	1728	786	2445	1706	0	1743	807	1547	2110	815	1852	2039
GBR	981	2034	835	2099	1540	1628	0	1271	1441	2206	1108	1634	1761
IRL	579	664	506	964	774	827	1335	0	493	1090	891	654	831
ITA	692	1520	586	1629	1241	1368	1214	442	0	1537	509	1676	1285
NLD	1634	1896	1080	3997	2492	2238	2019	1046	1385	0	1260	2133	2273
NZL	465	755	397	917	736	695	976	793	434	1160	0	659	862
POL	788	1601	597	2688	1702	1747	1496	550	1512	2061	521	0	1835
FRA	1083	1222	745	1714	1172	1992	1217	689	854	1581	545	1355	0

HOL ccl

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	1000	1167	2758	1785	1549	1990	175	1739	1878	3758	1833	1449
CHE	931	0	475	1328	857	815	883	70	652	1076	1083	758	553
CZE	929	338	0	1789	1243	1096	1047	151	1173	1523	1667	1576	817
DEU	2309	1270	1477	0	3313	2837	2657	209	2228	4174	3729	3212	1666
DFS	1725	817	979	2621	0	1885	1939	188	1429	2693	2329	2136	1186
FRA	1249	754	710	1738	1188	0	1791	138	1299	2290	2076	1967	1336
GBR	2105	850	769	2150	1593	1249	0	191	1469	2259	2602	1771	1240
ISR	122	39	117	161	141	75	144	0	145	202	277	194	141
ITA	1535	586	944	1626	1244	864	1245	99	0	1548	2386	1821	1032
NLD	1910	1080	1412	3981	2500	1616	2077	160	1387	0	2585	2367	1284
USA	4445	1020	1444	3082	2168	1331	2616	275	2053	2429	0	2726	1894
POL	1714	647	1430	3122	1939	1466	1614	155	1625	2322	2879	0	1149
JPN	907	383	460	823	712	544	698	71	620	768	1136	696	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	875	678	608	1409	1027	1037	1086	994	593	94	695	1443	557	973	854	335	824	389	585	
CAN	880	0	984	1148	2693	1743	1893	1508	1908	654	171	1707	1830	776	3639	1707	448	1513	851	1338	
CHE	684	910	0	475	1322	857	829	806	875	495	70	652	1076	463	1083	719	264	726	352	516	
CZE	489	899	338	0	1785	1243	1210	1087	1042	463	151	1173	1523	520	1667	1479	276	743	520	782	
DEU	1446	2225	1261	1468	0	3299	2716	2796	2598	1073	208	2220	4145	1133	3711	2927	562	1931	920	1575	
DFS	973	1674	817	979	2607	0	1883	1873	1893	898	188	1428	2696	960	2328	1956	514	1486	736	1112	
ESP	1116	1705	787	1020	2451	1730	0	2054	1765	810	171	1569	2131	821	2338	1906	522	1359	749	1263	
FRA	1077	1188	740	701	1678	1159	1989	0	1765	835	137	1280	2269	860	2054	1856	485	1419	634	1269	
GBR	981	1998	835	765	2083	1547	1631	1211	0	1274	190	1444	2215	1082	2545	1670	508	1680	810	1169	
IRL	579	642	506	357	952	774	827	687	1336	0	129	494	1095	876	839	666	339	861	432	509	
ISR	56	117	39	117	160	141	130	73	142	103	0	145	202	130	277	187	61	134	100	135	
ITA	692	1493	586	944	1617	1244	1371	847	1214	443	99	0	1547	501	2384	1725	259	966	569	972	

NLD	1636	1856	1080	1412	3930	2501	2242	1572	2024	1048	160	1387	0	1224	2586	2165	505	1693	792	1206
NZL	454	698	386	391	877	700	676	530	939	776	106	415	1110	0	1020	676	355	1335	595	618
USA	938	4258	1020	1444	3045	2168	2196	1291	2547	845	275	2053	2430	963	0	2577	525	1886	1244	1778
POL	782	1572	594	1285	2690	1717	1763	1343	1497	554	142	1519	2050	528	2703	0	327	1164	700	1047
ZAF	281	411	222	199	431	381	478	340	446	297	39	204	423	284	527	260	0	478	312	414
AUS	723	1550	645	531	1506	1129	1139	994	1496	750	87	793	1490	1324	1994	928	418	0	761	988
URY	285	804	265	352	685	522	649	387	668	340	58	414	638	497	1440	568	267	608	0	616
JPN	383	771	336	414	718	625	658	472	611	326	61	548	669	316	960	596	260	547	334	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	878	1407	1028	1037	994	594	694	1444	557	1112	860	335	824	395	1086	585	146	
CAN	884	0	2701	1754	1900	1919	661	1710	1840	781	3852	1727	453	1523	871	1518	1344	194	
DEU	1445	2234	0	3300	2720	2602	1073	2223	4144	1133	4210	2954	562	1931	945	2800	1576	339	
DFS	973	1684	2607	0	1887	1895	898	1430	2696	961	2680	1976	515	1488	758	1875	1112	241	
ESP	1116	1721	2452	1734	0	1766	811	1569	2131	821	2616	1926	522	1360	767	2058	1264	234	
GBR	981	2012	2083	1547	1631	0	1274	1446	2217	1083	2878	1682	508	1681	828	1766	1171	188	
IRL	579	650	952	774	827	1335	0	494	1095	876	984	671	339	861	442	836	509	111	
ITA	692	1499	1617	1244	1371	1214	443	0	1548	501	2400	1743	259	967	572	1283	972	213	
NLD	1637	1870	3928	2501	2244	2025	1048	1387	0	1225	3107	2189	506	1693	810	2268	1205	260	
NZL	454	702	877	701	678	938	775	415	1111	0	1270	681	355	1335	609	863	619	107	
USA	1007	4457	3269	2272	2424	2756	927	2061	2842	1226	0	2657	640	2271	1374	2724	2150	224	
POL	795	1597	2736	1743	1787	1511	557	1540	2087	533	2752	0	328	1172	712	1868	1057	277	
ZAF	281	419	431	381	479	447	297	204	423	285	615	261	0	480	321	485	414	48	
AUS	723	1557	1506	1129	1143	1496	750	793	1493	1328	2349	937	421	0	779	1419	988	144	
URY	285	813	688	525	660	669	340	414	641	498	1654	577	269	610	0	661	637	88	
FRA	1077	1196	1678	1159	1989	1211	687	847	1572	530	1572	1357	340	994	387	0	1269	181	
JPN	383	774	718	625	658	611	326	548	669	316	984	603	260	547	334	472	0	144	
SVN	116	153	336	196	203	137	88	178	228	73	185	236	34	102	43	137	80	0	

JER hco

common bulls below diagonal				
common three quarter sib group above diagonal				
	CAN	DFS	USA	NLD
CAN	0	136	391	46
DFS	132	0	198	126
USA	382	189	0	96
NLD	38	124	94	0

JER crc

common bulls below diagonal							
common three quarter sib group above diagonal							
	CAN	DFS	GBR	NLD	NZL	IRL	CHE
CAN	0	140	175	61	199	20	54
DFS	135	0	210	197	200	70	86
GBR	176	204	0	118	262	103	95
NLD	53	197	115	0	117	51	52
NZL	201	176	269	109	0	171	81
IRL	18	66	106	50	197	0	37
CHE	50	85	93	45	73	33	0

JER cc1

common bulls below diagonal						
common three quarter sib group above diagonal						
	CAN	DFS	GBR	NLD	USA	CHE
CAN	0	143	184	62	470	56
DFS	137	0	214	200	223	88
GBR	179	206	0	120	266	96
NLD	55	200	115	0	132	56

	USA	480	215	283	135	0	115			
	CHE	50	86	90	48	116	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	135	175	57	185	441	144	251	19	55
DFS	129	0	214	201	192	224	171	190	70	88
GBR	170	206	0	121	260	265	187	255	103	98
NLD	49	201	115	0	114	133	89	91	51	57
NZL	184	167	264	105	0	355	225	494	170	85
USA	446	215	282	135	376	0	292	461	57	115
ZAF	144	153	190	85	233	306	0	265	46	72
AUS	247	163	260	84	537	488	253	0	78	82
IRL	17	66	106	50	195	59	47	74	0	37
CHE	49	86	93	48	73	116	63	70	33	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	137	176	57	187	462	146	253	19	
DFS	131	0	214	201	192	267	171	190	70	
GBR	172	206	0	121	261	287	188	256	103	
NLD	50	201	115	0	114	146	89	91	51	
NZL	187	167	264	105	0	441	226	494	170	
USA	472	246	311	151	511	0	344	563	59	
ZAF	146	153	190	85	234	358	0	266	46	
AUS	250	163	260	84	537	610	253	0	78	
IRL	17	66	106	50	195	62	47	74	0	

RDC hco										

common bulls below diagonal										
common three quarter sib group above diagonal										
	CAN	DEU	DFS	NOR	USA	NLD				

CAN	0	10	203	7	113	6				
DEU	10	0	75	21	26	15				
DFS	213	67	0	153	189	67				
NOR	6	20	134	0	78	52				
USA	108	24	182	78	0	44				
NLD	6	15	65	52	42	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	204	89	8	73	7	7		
DEU	12	0	81	16	21	26	22	10		
DFS	214	70	0	136	169	208	69	30		
GBR	90	15	133	0	83	91	46	33		
NOR	7	20	144	87	0	61	56	69		
NZL	74	25	203	90	60	0	31	23		
NLD	7	22	67	45	56	30	0	17		
IRL	7	9	26	32	68	21	17	0		

RDC cc1										

common bulls below diagonal										
common three quarter sib group above diagonal										
	CAN	DEU	DFS	GBR	NOR	NLD	USA			

CAN	0	13	204	90	8	7	161				
DEU	12	0	80	16	22	22	32				
DFS	214	68	0	140	159	69	227				
GBR	91	15	137	0	88	48	122				
NOR	7	20	138	92	0	54	92				
NLD	7	22	67	47	54	0	52				
USA	156	30	221	117	92	50	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	203	84	8	70	156	78	7	82	7
DEU	12	0	78	16	22	24	32	3	22	51	10
DFS	213	67	0	137	159	196	227	62	69	251	30
GBR	85	15	134	0	82	88	121	49	46	102	33
NOR	7	20	138	86	0	55	92	0	54	83	69
NZL	70	23	191	85	54	0	109	41	29	168	23
USA	152	30	221	118	92	110	0	61	52	138	36
ZAF	83	3	59	46	0	39	56	0	3	45	4
NLD	7	22	67	45	54	28	50	3	0	47	17
AUS	84	49	228	101	72	168	138	47	45	0	30
IRL	7	9	26	32	68	21	36	4	17	28	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	203	86	8	70	181	79	7	83	7
DEU	12	0	78	16	22	24	32	3	22	51	10
DFS	213	67	0	137	169	196	240	63	69	252	30
GBR	87	15	134	0	83	88	132	49	46	104	33
NOR	7	20	144	87	0	56	92	0	56	87	69
NZL	70	23	191	85	55	0	123	41	29	168	23
USA	183	30	237	131	92	125	0	78	53	158	36
ZAF	84	3	60	46	0	39	73	0	3	46	4
NLD	7	22	67	45	56	28	51	3	0	47	17
AUS	85	49	229	103	76	168	161	48	45	0	30
IRL	7	9	26	32	68	21	36	4	17	28	0

SIM hco

SIM crc

SIM cc1

SIM cc2

SIM int