An Overview of Results and Current Status of MACE for Calving Traits

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Abstract

A study on the feasibility of an international genetic evaluation for calving traits was carried out for 10 countries with calving ease EBV and 6 countries with stillbirth EBV. Nine countries estimated both direct and maternal effects for calving ease, six of them also for stillbirth. Two countries have threshold models for genetic evaluation, one of these considers heteroskedastic residual variance. Two and three countries consider 1st parity to be a separate trait for calving ease and stillbirth respectively. Genetic correlations with two countries did not warrant international genetic evaluation due to extremely low heritabilities (<0.02) and weak genetic ties. The genetic correlations of direct calving ease estimated with the threshold model accounting for heteroskedastic residual variance with other countries increased on average by 0.11, when the minimum number of calvings was increased from 10 to 50. For the other country estimating calving ease with a threshold model and countries considering 1st parities as separate trait, this correlation increased on average by 0.03 to 0.05. Genetic correlations of calving ease in countries without stillbirth proofs with stillbirth in other countries were moderate. Relationships between national and international proofs for direct calving ease estimated by the threshold model accounting for heteroskedastic residual variance for were weaker for bulls with a low or moderate number of calvings.

Keywords: International evaluation, dairy cattle, functional traits

Introduction

International EBV for milk production and type traits are important criteria for the selection of sires by dairy farmers. However, functional traits become important for sire selection too. Recently, international genetic evaluations for somatic cells and clinical mastitis (Mark et al., 2000) were introduced. The results of the study leading to these international genetic evaluations showed that Multiple Across Country Evaluation (MACE) is possible for low heritable traits. Besides this, there are still important functional traits for which there is no international genetic evaluation. Especially the demand for international evaluations for longevity and calving traits is large. This led to studies into the feasibility international evaluations for these traits. This study on calving traits consists of a comparison of evaluations systems for calving ease (CE) and stillbirth (SB) and a comparison of EBV. A call for information about evaluation systems and a call for EBV was made in spring 2001. Thirteen countries reacted on the call for data, of which nine countries sent information and EBV, which were official at that time. USA sent EBV for CE estimated with a newly developed model early 2003.

The first objective of this project was to estimate genetic parameters for the participating countries for direct and maternal effects on calving ease and stillbirth with a MACE-system. The estimates for the genetic parameters are important for the second objective: assessing the feasibility of MACE for these traits at this moment. It will also be considered whether, and if so, which further trait harmonisations and studies are needed before an international genetic evaluation for calving traits can be introduced. A review of the present national genetic evaluation systems is therefore part of the project. In this project the breed under consideration is Holstein. Activities, data, and results of the research project on MACE for calving traits without EBV from USA obtained up to May 2002 were reported by Pasman and Reinhardt (2002). Complete results of the analysis are available in the entry MACE for calving traits of 10th May 2002 in the Interbull discussion forum on international genetic evaluation systems http://www.interbull.org/documents/MACE_calving_intermediate.pdf

In the previous stage of this project substantial dependencies of genetic correlations of direct CE in France with direct CE in other countries and of the correlation between national and international proofs for direct CE in France were apparent. The cause for these dependencies could not be identified. Especially because France was the only country evaluating CE with a threshold model, some questions arose about proofs from threshold models in MACE. In the meanwhile USA completed development of a threshold evaluation model for calving ease. With the EBV from this second threshold models some of the questions arising from the results of the previous stages of the project might be answered. In this report further activities, data, and results of MACE runs under inclusion of EBV from USA are described. Results will mainly be limited to calving ease because no additional stillbirth proofs were included. Only a parameter estimation for stillbirth under inclusion of CE-proofs from countries without a stillbirth evaluation will be studied und compared with the parameters for stillbirth obtained in run EST1 of the previous stage of the project.

Data and evaluation systems of contributing countries

Nine countries sent EBV for calving traits in 2001. Germany (DEU), Denmark (DNK), Finland (FIN), Israel (ISR), Sweden (SWE) and the Netherlands (NLD) sent proofs for direct and maternal CE and SB; Canada (CAN), France (FRA) sent proofs for direct and maternal CE; New Zealand (NZL) sent only proofs for direct CE. Proofs for direct and maternal CE from the new evaluation model of USA were received early 2003. Only proofs with evaluation breed HOL and bull breed HOL were included in the evaluation. Others were excluded from the analyses. USA delivered 39.229 proofs of which 15.622 and 14.504 were used in parameter estimation of direct and maternal CE respectively. The number of proofs delivered and the number of proofs included in analyses from the other countries are available from the previous report.

Table 1. No. bulls from USA per birth year.

Birth-year	No. bulls	Birth-year	No. bulls	Birth-year	No. bulls
1985	612	90	1105	95	985
86	874	91	1065	96	878
87	828	92	1199	97	733
88	867	93	1043	98	337
89	1036	94	909	99	56

USA is the country with the most bull proofs for calving traits with a relatively constant no. proofs over birth years.

The number of common bulls and the number of common sire–mgs families are indications of the genetic links among the participating countries. Tables 5-8 in appendix 2 of the previous report contain these numbers for the four traits among the other countries. The information DCE and MCE between USA and the other countries is put in table 2.

Table 2. Number of common bulls and number of common sire-mgs combinations between USA and the other participating countries.

Bulls	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL
Dir.	1093	705	156	9	243	16	354	61	352
Mat.	867	636	184	13	244	17	317	98	-
Sire * MGS	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL
Dir.	1233	1132	486	19	645	17	477	493	382
Mat.	1039	1082	523	21	856	21	413	154	-

The number of bulls having proofs in USA and in FIN or ISR is low. This means that direct genetic links of FIN and ISR remain weak. The number of sire-mgs combinations, which FIN and ISR have in common with USA, is also low. The other countries all have over 100 sire-mgs combinations in common and are thus well connected despite few common bulls in the case of NLD. Previous analyses showed that the size of common sire-mgs families in FIN and ISR is small. The poor genetic links of FIN and ISR resulted in a poor estimatibility of genetic correlations of the traits in these two countries in the previous analyses.

Most countries sending data have systems for simultaneous evaluation of direct and maternal effects on calving ease and stillbirth. Exceptions are France, CAN and USA, where stillbirth is not considered, and NZL having only direct EBV for calving ease. The most common type of evaluation is a single trait linear sire-mgs model. CAN and DEU apply a Snell-transformation for calving ease and consider repeated records. A summary of the descriptions of the evaluations is presented in table 3.

Table 3. Most important characteristics of the evaluation systems in the replying countries.

Country	Type of model*	No. CE-classes	h^2_{CED}	h^2_{CEM}	h^2_{SBD}	h^2_{SBM}
CAN	Linear ST-AM Rep.	4	.11	.12		
DEU	Linear ST -AM Rep.	4/3****	.05	.05	.05	.05
DNK	Linear MT-SM**	4	.10 / .05	.07 / .03	.04 / .01	.04 / .01
FIN	Linear ST-SM	3	.01	.06	.02	.01
France	Threshold ST-SM	5/3****	.054	.031		
ISR	Linear ST-SM	2	.018	.009	.006	.006
NLD	Linear ST-SM***	4	.13	.07	.03 / .01	.05 / .01
NZL	Linear ST-SM**	2	.043 / .021			
SWE	Linear ST-SM**	2	.02	.02	.02	.02
USA	Threshold ST-SM	5	.086	.048		

* ST - separate evaluation systems for ease-of-birth and stillbirth; MT a common evaluation system; AM –animal model; SM –sire-mgs model (France also considers dam within MGS), Rep. – repeatability model

** Separate proofs for 1st parity and later parities. SWE estimates only 1st parity proofs. DNK sent 1st parity proofs for direct traits and combined proofs for maternal traits,

*** Separate proofs for 1st parity and later parities for stillbirth only

**** In DEU classes no assistance and 1 assistant combined for analysis; in France classes difficult calving, caesarean and embryotomy combined for analysis

In most countries farmers score calving ease and stillbirth, data are collected by milk recording organisations. In parts of the European Union, there is a development towards partially collecting data by obligatory identification and registration systems. Presently parts of the data from DEU, France and NLD (stillbirth) are collected in this way. Farmer's scores on calving ease of cows in NLD inseminated with test-bulls is collected through pre-printed post-cards. In FIN, data on calving ease of heifers is collected by AI-technicians at first insemination after calving.

Methods for estimation of genetic correlations

A copy of the MACE-system for routine evaluation of type traits in May 2001 was obtained from the Holstein Association (HA), USA. This system was preferred because the pedigree file and the cross-reference file of Interbull can be used for evaluation, making this more practical. Parameter estimation was carried out with the programs from HA containing EM-REML (Klei and Weigel, 1998). The programs were not changed, but the convergence criteria were 10 times as strict, except for the maximum change in $|r_g|$ (which remained 10^{-4}). The only difference with the previous analyses is that data of USA was added.

National EBV were weighted according to no. born calves/no. calving daughters instead of no. effective daughter contributions (EDC). The new weighting procedure is ignored for two reasons. Firstly, weighting according to EDC instead of no. daughters would in case of linear models not have a major influence on results and no influence on the conclusions of this study. This is despite weighting to EDC may significantly improve international EBV of individual sires and will be necessary in a routine MACE-system. Besides this, most evaluation centres do not have EDC for calving traits available.

Genetic correlations among countries for direct calving ease, maternal calving ease, direct stillbirth and maternal stillbirth were estimated with the EBV as sent in by the participating countries. Genetic correlations of pre-corrected maternal proofs („pure maternal“ and „pure MGS“ effects) obtained in the previous stage of this project were for some country combinations lower and never substantially higher than without pre-correction. This and unresolved questions about weighting factors and parameters give further analyses with pre-corrected maternal proofs little use. The estimation under standard Interbull conditions is referred to as EST10.

Use of calving ease as information source for stillbirth

Calving ease and stillbirth are genetically closely related traits. CAN, France, NZL and USA do not estimate breeding values for stillbirth. Stillbirth EBV of sires evaluated in these countries may be of interest in countries with a stillbirth evaluation. Therefore parameter estimation ESTSB for stillbirth was carried out under inclusion of calving ease EBV from CAN, France, NZL and USA. Results will be compared with those of EST1 for stillbirth in the previous report.

Increase of minimum number of herds

The increase of the minimum number of herds results in the exclusion of EBV with low reliabilities from the parameter estimation. Thus there may be fewer disturbing effects in the parameter estimation and estimates of genetic correlations may become higher.

Genetic parameters for calving ease and stillbirth with CE proofs of CAN, France, NZL and USA were re-estimated for bulls with calvings in at least 50 herds in estimation EST50. This means that there are fewer EBV available for parameter estimation and that there will be fewer but possibly more accurate genetic links. The genetic links of USA in the parameter estimation for CE under the increased data restrictions are presented in table 4.

Table 4. Number of common bulls and number of common sire-mgs combinations between USA and the other participating countries (min. 50 calvings).

Bulls	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL
Dir.	525	510	121	1	101	16	252	39	207
Mat.	442	436	139	7	83	9	257	39	-
Comb.	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL
Dir.	851	973	281	8	472	15	369	453	274
Mat.	637	812	451	14	536	12	336	79	-

The number of common bulls with calvings in at least 50 herds in some countries is considerably less than the number of common bulls with calvings in at least 10 herds (compare table 4 with table 2). The number of genetic links of USA trough common sire-mgs families, however, remained more than sufficient except with ISR, FIN and possibly for maternal CE with NLD.

Genetic evaluation with genetic correlations from estimation EST10

The purpose of the evaluation is to check for systematic problems that do not appear in parameter estimation. EBV of sires born from 1984 onwards from all nine countries, included in the parameter estimation, was used for evaluation.

Information of foreign sires was only used when they had at least 75 daughters in at least 50 herds. Genetic correlations from estimation EST10 were used as input parameters. The number of used records per country is presented in table 5.

Table 5. No. records used for genetic evaluation per country (DCE=dir. calving ease, MCE=mat. calving ease, DSB=dir. stillbirth, MSB=mat. stillbirth).

Country	No. Records for DCE-est.	No. Records for MCE-est.	No. Records for DSB-est.	No. Records for MSB-est.
CAN	3251	2655	-	-
DEU	6998	7041	6944	6985
DNK	4040	4272	4033	4263
FIN	481	464	589	599
France	2575	4441	-	-
ISR	82	494	82	494
SWE	2005	1734	1972	1706
NLD	3831	3429	1993	3573
NZL	1629	-	-	-
USA	17139	13191	-	-
Total	42031	37721	15613	17620

Very surprising is the low number of EBV from NLD included in the genetic evaluation, compared to the number of EBV from NLD used for parameter estimation. There are no additional stillbirth proofs to those used previously. Therefore stillbirth proofs will not be discussed

Results and Discussion

Estimation of genetic parameters among EBV delivered by the participating countries

The results of parameter estimation EST10 for calving ease are described in this section. Convergence was reached for all traits. The number of rounds is put in table 6.

From the ratio of the genetic variances, it appears that international EBV for bulls with daughters in FIN or ISR will have a much larger standard deviation than national EBV. It should be checked by an evaluation, if this is due to additional bulls or due to large deviations for bulls with national EBV. Genetic correlations from estimation EST10 are presented in Table 7. The absolute genetic correlations of FIN and ISR are generally low and instable due to low heritable traits and weak genetic links with the other countries. Inclusion of extremely low heritable traits in populations without very strong genetic links with other populations, where the situation is different, may not be useful. Therefore discussion about $|r_g|$ of FIN and ISR is limited.

Table 6. No. rounds up to convergence and ratio of genetic variances after and before iteration (s_g^2 estimated / s_g^2 input).

Trait:	No. rounds	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL	USA
CE dir.	255	1.00	1.01	.93	84.2	.97	2.42	1.27	.98	1.13	1.03
CE mat.	232	1.00	.96	1.03	303	1.04	2.76	1.28	.99	-	1.01

Table 7. Genetic correlations for calving ease from estimation EST10 (direct above diagonal; maternal below diagonal).

	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL	USA
CAN	-	.77	.86	.38	.40	-.89	.85	-.74	-.67	-.75
DEU	.86	-	.91	.61	.71	-.78	.85	-.64	-.53	-.71
DNK	.81	.82	-	.50	.65	-.92	.97	-.81	-.72	-.91
FIN	-.48	-.83	-.56	-	.26	-.36	.44	-.21	-.36	-.45
France	.99	.83	.81	-.42	-	-.56	.68	-.69	-.23	-.64
ISR	-.33	-.26	-.31	.03	-.33	-	-.94	.91	.82	.88
SWE	.92	.70	.87	-.29	.92	-.36	-	-.89	-.73	-.95
NLD	-.90	-.74	-.77	.27	-.93	.44	-.88	-	.66	.89
NZL	-	-	-	-	-	-	-	-	-	.69
USA	-.86	-.63	-.76	.16	-.88	.62	-.90	.94	-	-
Average $\|r_g\|$ with other countries										
Dir.	.70	.72	.81	.40	.54	.78	.81	.72	.60	.76
Mat.	.77	.71	.71	.38	.76	.34	.73	.73	-	.72
Average $\|r_g\|$ with other countries outside FIN & ISR										
Dir.	.72	.73	.83		.57		.85	.76	.60	.79
Mat.	.89	.76	.81		.89		.87	.86	-	.83

The $|r_g|$'s among countries for CE are generally lower than in the previous analyses without USA. In some cases differences for direct calving ease are large. For maternal calving ease, with one country less, differences in $|r_g|$'s were only up to –.03. The cause of correlations being closer to zero due to inclusion of USA may be the increase in size of the genetic covariance matrix, which may have detrimental effects on the estimatibility of genetic relationships. Estimation of r_g from subsets may result in better estimates for r_g (Jorjani, 1999). As in the previous analyses, estimates of correlations of both CE traits in FIN and maternal calving ease in ISR with other countries remained extremely low.

Genetic relationships among maternal CE are on average stronger than those among direct CE. The difference in average $|r_g|$ is .10 or greater in CAN, France and NLD. Only for DNK the average $|r_g|$ is higher for direct CE than for mat. CE. This coincides with DNK being the only country estimating CE and SB simultaneously. Average $|r_g|$ for direct CE is low in France and NZL. This may for NZL be due to the model without maternal effects or due to different farming conditions. Results on this for France may not be due application of a threshold model (compare with results for USA) and require closer attention.

Genetic relationships of direct calving ease in USA were strong with SWE (r_g=-.95), DNK (r_g=-.91), NLD (r_g=.89) and ISR (r_g=-.88). With all other countries except FIN genetic correlations were moderate ($|r_g|$ from .64 to .75). Genetic relationships of maternal calving ease in USA were strong with NLD (r_g=.94), SWE (r_g=-.90), France (r_g=-.88) and CAN (r_g=-.86). With all other countries except FIN genetic correlations were moderate ($|r_g|$ from .62 to .74).

So far there were few published attempts of international evaluations. Only Mark et al. (2001) estimated genetic correlations among FIN, SWE and DNK. Besides that NRS convert EBV for direct CE from USA. The estimated correlation of the EBV used for this conversion is .72, which is lower than the correlation estimated in this study. The estimates of r_g between SWE and DNK in this study for direct CE were comparable to those estimated by Mark et al. Those for maternal CE were higher in this study. Absolute genetic correlations of SWE or DNK with FIN are much lower in this study. Especially, correlations for the maternal traits are close to zero.

Use of calving ease as information source for stillbirth

The parameter estimation ESTSB under inclusion of calving ease EBV from CAN, France, NZL and USA gave plausible results for stillbirth. Genetic correlations for direct stillbirth and maternal stillbirth under inclusion of calving ease EBV from CAN, France, NZL and USA were estimated with a minimum of 10. The correlations among countries with direct stillbirth and sufficient genetic links are generally by 0.02 to 0.03 closer to zero due to inclusion of CE from countries without stillbirth evaluation. The correlation between DNK and SWE decreases even by .05 to .76. For maternal stillbirth changes in correlations among countries are when present considerably smaller.

The absolute genetic correlations of calving ease from CAN, France, NZL and USA with stillbirth are on average lower than absolute genetic correlations among stillbirth in the participating countries. Absolute genetic correlations of calving ease for the direct trait in USA and for the maternal trait in CAN with stillbirth in other specific countries are of a magnitude similar to some correlations among stillbirth.

Table 8. Genetic correlations for stillbirth* from estimation ESTSB (direct above diagonal; maternal below diagonal, correlations among countries with stillbirth evaluation from previous analyses (EST1, Pasman et al. (2002) between parentheses).

	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL	USA
CAN	-	.56	.64	-.13	.36	-.82	.64	.46	-.65	-.73
DEU	.79	-	.92 (.93)	.67 (.41)	.42	-.44 (-.36)	.83 (.85)	.73 (.75)	-.32	-.54
DNK	.64	.89 (.90)	-	.58 (.10)	.42	-.68 (-.64)	.89 (.92)	.76 (.81)	-.51	-.74
FIN	-.12	.18 (.10)	.13 (.33)	-	-.08	.09 (.62)	.39 (.09)	.47 (.29)	.21	.05
France	.96	.63	.50	-.18	-	-.35	.51	.40	-.24	-.61
ISR	-.01	.01 (.20)	-.28 (.01)	-.34 (-.23)	-.12	-	-.61 (-.58)	-.47 (-.32)	.84	.79
SWE	.76	.74 (.76)	.88 (.90)	-.13 (.02)	.67	-.25 (.05)	-	.82 (-.85)	-.45	-.75
NLD	.41	.58 (.58)	.70 (.70)	.34 (.43)	.40	-.58 (-.62)	.56 (.53)	-	-.42	-.52
NZL	-	-	-	-	-	-	-	-	-	.69
USA	-.87	-.55	-.50	-.09	-.90	.34	-.68	-.36	-	-
Average $\lvert r_g \rvert$ with other countries with stillbirth evaluation										
Dir.	.54	.72	.77	.44	.36	.46	.71	.65	.46	.57
Mat.	.46	.48	.58	.22	.42	.29	.51	.55	-	.42
Average $\lvert r_g \rvert$ with other countries with stillbirth evaluation outside FIN & ISR										
Dir.	.58	.83	.86		.44		.85	.77	.43	.64
Mat.	.65	.74	.82		.55		.73	.61	-	.52

*calving ease for CAN, France, NZL &USA.

Increase of minimum number of herds

Convergence for parameter estimation EST50 was reached for all traits. The number of rounds is put in table 9.

The ratio of genetic variances before and after iteration is not substantially affected by an increased restriction on number of herds, except for FIN and ISR where results so far were instable. Genetic correlations among calving ease estimated from EBV with at least 50 herds (estimation EST5) are shown in table 10. For stillbirth under inclusion of CE-proofs from CAN, France, NZL and USA the correlations can be found in table 11.

Table 9. No. rounds up to convergence and ratio of genetic variances after and before iteration (s_g^2 estimated / s_g^2 input) for evaluation with at least 50 herds.

Trait:	No. rounds	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL	USA
CE dir.	180	1.00	1.01	.97	123	.99	3.18	1.22	.98	1.12	1.04
CE mat.	244	.98	.96	1.05	9.88	1.04	2.66	1.25	.99	-	1.01
SB* dir.	133	1.01	.98	1.02	93.6	.99	3.91	1.15	1.08	1.12	1.03
SB* mat.	212	.98	1.00	1.12	171	1.04	2.76	1.45	1.03	-	1.00

*CE-proofs of CAN, France, NZL & USA in stillbirth evaluation.

Table 10. Genetic correlations for calving ease from estimation EST50 (direct above diagonal; maternal below diagonal).

	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL	USA
CAN	-	.80	.90	.44	.46	-.81	.89	-.69	-.55	-.83
DEU	.82	-	.88	.56	.72	-.69	.85	-.62	-.56	-.70
DNK	.82	.82	-	.39	.75	-.93	.99	-.86	-.76	-.94
FIN	-.07	-.47	-.25	-	.19	-.17	.35	.00	-.15	-.34
France	.98	.76	.81	.03	-	-.72	.76	-.79	-.54	-.71
ISR	-.61	-.76	-.63	.57	-.54	-	-.95	.95	.75	.95
SWE	.94	.68	.87	-.02	.94	-.54	-	-.88	-.75	-.95
NLD	-.90	-.72	-.76	-.02	-.95	.58	-.88	-	.65	.88
NZL	-	-	-	-	-	-	-	-	-	.73
USA	-.88	-.60	-.74	-.16	-.90	.59	-.90	.93	-	-
Average $\|r_g\|$ with other countries										
Dir.	.71	.71	.82	.29	.63	.77	.82	.70	.60	.78
Mat.	.75	.70	.71	.20	.74	.60	.72	.72	-	.71
Average $\|r_g\|$ with other countries outside FIN & ISR										
Dir.	.73	.73	.87		.68		.87	.77	.65	.82
Mat.	.89	.73	.80		.89		.87	.86	-	.83

Average $|r_g|$'s of direct CE increased in France (by .11), NZL (by .05), DNK (by .04) and USA (by .03). Cause of increases for DNK and NZL may be first parities being evaluated as a separate trait. The increases for France and USA may be due to differences in EBV for bulls with few progeny being different due to the threshold model. Surprising is the large increase of absolute genetic correlations of France with other countries for calving ease. After previous analyses without USA it was thought that this increase may be due to smaller differences between EBV of linear and threshold models when they are based on more data. Thus substantially higher absolute genetic correlations of USA for direct CE would be expected after EST50 than after EST10. The cause of this not to occur may be presence in the model of FRA and the absence in the model of USA of adjustment for heteroskedastic error variance.

Besides this large increases of $|r_g|$ with other countries of maternal calving ease in ISR were observed. There were also large changes in r_g of FIN for both traits Therefore results for FIN and ISR should be interpreted with care. The results for FIN may be explained by the fact that stillbirth in Finland is recorded at first milk recording and calving ease and first AI-service. Therefore recording inaccuracies for calving ease may be larger in FIN. Changes in correlations among maternal calving ease in other countries generally were small.

The effects of increasing minimum no. herds result on average in slightly lower correlations for direct SB among countries with stillbirth evaluation (see also table 8). Correlations of direct calving ease with stillbirth increase on average slightly for USA and NZL, but considerably for

France and CAN. For maternal effects average $|r_g|$ increase consistently for all countries except France, where $|r_g|$ decreases from .55 to .52. Effects of including calving ease proofs from countries without stillbirth evaluation are not different due to the increase of the minimum no. herds.

Table 11. Genetic correlations for stillbirth[*] from estimation ESTSB with a minimum number of 50 calvings or daughters (direct above diagonal; maternal below diagonal, correlations among countries with stillbirth evaluation from previous analyses (EST5 Pasman et al. (2002) between parentheses).

	CAN	DEU	DNK	FIN	France	ISR	SWE	NLD	NZL	USA
CAN	-	.59	.76	.14	.31	-.69	.72	.50	-.56	-.82
DEU	.77	-	.86 (.90)	.49 (-.70)	.53	-.23 (.36)	.76 (.80)	.75 (.76)	-.36	-.54
DNK	.65	.89 (.89)	-	.59 (-0.59)	.49	-.60 (-.03)	.90 (.94)	.81 (.86)	-.53	-.78
FIN	-.06	-.40 (-.70)	-.40 (-.83)	-	-.11	.01 (-.50)	.37 (-.30)	.48 (-.47)	.05	-.06
France	.95	.55	.46	.12	-	-.50	.57	.47	-.55	-.66
ISR	-.38	-.49 (-.04)	-.68 (-.24)	.42 (.56)	-.32	-	-.64 (-.19)	-.44 (-.04)	.75	.90
SWE	.77	.81 (.81)	.93 (.95)	-.16 (-.84)	.65	-.59 (-.17)	-	.83 (.86)	-.48	-.77
NLD	.46	.61 (.62)	.71 (.72)	-.25 (-.77)	.40	-.67 (-.64)	.59 (.56)	-	-.45	-.55
NZL	-	-	-	-	-	-	-	-	-	.75
USA	-.87	-.53	-.50	-.13	-.91	.51	-.67	-.36	-	-
Average $\|r_g\|$ with other countries with stillbirth evaluation										
Dir.	.57	.62	.75	.39	.44	.38	.70	.66	.44	.60
Mat.	.52	.64	.72	.32	.42	.57	.61	.57	-	.45
Average $\|r_g\|$ with other countries with stillbirth evaluation outside FIN & ISR										
Dir.	.64	.79	.86		.51		.83	.80	.46	.66
Mat.	.66	.77	.84		.52		.77	.64	-	.51

[*]calving ease for CAN, France, NZL &USA.

Genetic evaluation with genetic correlations from estimation EST10

International genetic evaluation for calving traits was carried out under the usual Interbull conditions regarding birth years and no. observations with EBV as delivered by the national evaluation centres links. Tables 12 and 13 contain results of a comparison of national and international proofs for direct and maternal CE.

Table 12. Comparison of international (I.prf) and national dir. CE proofs (N.prf) for Bulls with min. 50 herds in N.prf with correlations from estimation EST10.

	I.prf – N.prf		St. deviation						
Country	Mean	Max.	N.prf	I.prf	R	#Bulls	$Rel._{dom}$	$Rel._{for}$	std_{for}/std_{dom}
Direct calving ease									
CAN	.000	1.65	2.139	2.139	.998	3308	84.2	49.3	.762
DEU	.000	.073	.042	.042	.998	6807	82.9	47.1	.737
DNK	-.017	8.82	5.208	5.368	.992	1122	73.1	61.5	.997
FIN	.012	1.99	1.440	1.373	.956	371	33.5	26.4	.761
France	-.041	1.34	.636	.667	.947	878	73.1	44.4	.836
ISR	-.255	4.73	3.201	3.014	.945	94	77.3	59.4	.859
SWE	-.012	13.53	5.073	5.223	.946	1449	59.8	63.6	1.105
NLD	-.001	1.07	1.508	1.508	.999	3813	87.7	53.6	.808
NZL	.013	5.12	4.067	4.069	.989	1615	67.3	41.1	.699
USA	.000	.12	1.049	1.048	.999	16565	78.1	52.5	.815

Table 13. Comparison of international (I.prf) and national mat. CE proofs (N.prf) for Bulls with min. 50 herds in N.prf with correlations from estimation EST10.

	I.prf – N.prf		St. deviation						
Country	Mean	Max.	N.prf	I.prf	R	#Bulls	$Rel._{dom}$	$Rel._{for}$	std_{for}/std_{dom}
Maternal calving ease									
CAN	-.001	2.36	1.986	1.991	.993	1815	74.8	48.5	.848
DEU	.000	.100	.045	.045	.994	6151	67.8	4.6	.724
DNK	.007	7.79	5.057	5.036	.997	4257	65.8	43.2	.777
FIN	.001	3.22	3.800	3.769	.996	369	65.8	3.5	.463
France	.000	1.17	.775	.784	.987	2172	55.2	49.6	.901
ISR	-.044	2.06	1.985	2.078	.968	497	41.2	24.0	.790
SWE	.001	1.20	5.220	5.297	.964	1259	59.6	47.9	.872
NLD	-.017	1.31	.903	.920	.988	996	64.0	48.9	.884
USA	.000	.109	.080	.080	.998	10294	63.8	44.4	.847

Agreement between national and international proofs was not very good for FIN, ISR, SWE and France. For FIN and ISR genetic evaluation may be unstable due too unclear genetic relationships caused by weak genetic links, extremely low heritabilities in some cases, and therefore badly estimated genetic correlations with other countries. The amount of disagreement between national and international proofs of bulls with offspring in SWE was similar for all traits and considerably larger than in the previous analyses without data from USA. The cause for disagreement may be due to good genetic relationships of calving traits in SWE with those in other countries whilst reliabilities of national EBV are relatively low. A similar situation exists for maternal calving ease in France.

There was a general tendency of increase of disagreements between national and international proofs. On the one hand this is a logical result of adding USA to the analyses. For direct calving ease an additional cause may be the poorer estimatibility of all genetic correlations among 10 countries at once.

Pasman and Reinhardt (2002) concluded that the disagreement between national and international proofs of bulls with offspring in France for direct calving ease may be caused by proofs from France being estimated with a threshold model. This is not true because agreement between national (estimated with a threshold model, see table 3) and international proofs of USA was already very good with a minimum of 50 calvings. There is although a major difference between the two threshold models. The model of France considers heteroskedastic residual variances (Ducrocq, 2000) and the model of USA does not (Wiggans et al., 2002). Heteroskedasticy of residual variances may be the cause the disagreement between national and international proofs of bulls with offspring in France for direct calving ease. This is in line with the results of Prins et al. (2003), who found negligible differences between EBV from a linear model and EBV from a threshold model with homogeneous residual variance and considerably different EBV from a threshold model with heterogeneous residual variance.

Conclusions

Estimates of genetic correlations of calving traits among countries show the possibility of international genetic evaluation for all participating countries except FIN and ISR, especially as EBV for calving traits are mostly used to exclude "bad" bulls from the breeding program. Causes for the poor results for FIN and ISR may be the poor genetic links with other countries and low heritabilities, but there may be an influence of the different environment as well especially in ISR.

Model influences on average $|r_g|$ are not clear at first sight. Consistent effects of evaluating 1st parity CE as a separate trait or of threshold models could be found. Average $|r_g|$ is low for direct calving ease in France, but not in USA though both countries evaluate calving ease with a threshold model. The two countries evaluating 1st parity CE as a separate trait have substantially different average $|r_g|$ for direct CE, with that of NZL being low. In case of NZL this may be confounded with different environmental conditions for the population or with the absence of maternal effects in the model. Differences among countries for maternal CE were considerably smaller and cannot be related to model differences.

The addition of a 10th country to the estimation of genetic correlations for direct calving ease resulted in a general decrease of $|r_g|$ among countries. Similar tendencies were also found after adding CE proofs of countries without SB evaluation to MACE for SB. The underlying cause for this may be the covariance matrix may become too large to be estimated at once. Estimation of r_g from subsets may result in better estimates for r_g and should be carried out in routine estimation of r_g.

Some additional information for a stillbirth EBV may be obtained from calving ease when there is no stillbirth EBV available, as done for estimation ESTSB. However some correlations of CE with stillbirth in another country were well below .5. The effects on estimates of genetic correlations among the countries with recorded stillbirth are such that relationships were weakened in some extent, especially for direct stillbirth. It is questionable if calving ease of these countries should be included in MACE for stillbirth.

The effects of further restrictions on number of calvings and calving daughters are mostly negligible (compare the results of estimations EST50 and EST10) for mat. CE. For dir. CE large increases in $|r_g|$'s were found between France and the other countries. The latter may be due to differences in EBV for sires with few progeny due to France being the only country with a heteroskedastic model for genetic evaluation. However, substantial differences for genetic correlations among other countries were also observed. An increase of the minimum no. calvings will reduce effects of differences in modelling on estimates of r_g for direct CE and SB.

After genetic evaluation substantial differences between national and international proofs for direct calving ease in France were found, especially for bulls with a national proof based on few calvings. In previous stages of the project, this was considered to be due to France being the only country estimating EBV for calving traits with a threshold model. For the recently added proofs from the threshold model of USA differences between national and international proofs for direct calving ease were small. The difference between the two threshold models is the handling of the residuals variance. This may be the cause of the differences between national and international proofs for direct calving ease in France.

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References

Ducrocq, V. 2000. Calving ease evaluation of French dairy bulls with a heteroskedastic threshold model with direct and maternal effects. *Interbull Bulletin 25,* 123-130.

Jorjani, H. 1999. Connectedness in dairy cattle populations. *Interbull Bulletin 22,* 21-24.

Klei, L. & Weigel, K. 1998. A method to estimate correlations among traits in different countries using data on all bulls. *Interbull Bulletin 17,* 8-14.

Mark, T., Fikse, W.F., Sigurdsson, A. & Philipsson, J. 2000. Feasibility of international genetic evaluations of dairy sires for somatic cell count and clinical mastitis. *Interbull Bulletin 25,* 154-162.

Mark, T., Nielsen, U.S., Pösö, J., Gundel, M. & Svendsen, M. 2001. Genetic relationships among functional traits in the Nordic Holstein populations. *Interbull Bulletin 27,* 64-67.

Pasman, E. & Reinhardt, F. 2002. Feasibility of international genetic evaluations for calving ease and stillbirth in Holstein. *Interbull Bulletin 29,* 49-54.

Prins, D., Bijma, P., Harbers, A. & de Jong, G. 2003. Linear vs. threshold models; Possible advantages of using a threshold method for breeding value estimation of calving ease. .pdf File under Publications - *MSc theses* at http://www.zod.wau.nl/abg/

Wiggans, G.R, Van Tassel, C.P., Philpot, J.C. & Misztal, I. 2002. Comparison of dystocia evaluations from sire and sire-maternal grandsire threshold models. *Proc. 7WCGALP,* Communication no. 20-1.