

# Experiences in Combining MACE Fertility Proofs to the New German Daughter Fertility Index RZR

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## Abstract

Germany (DEU) is one of only three countries currently (April 2008) participating in all 5 MACE trait runs for fertility and providing all traits according to the Interbull definitions. On national base 5 fertility traits are combined to the daughter fertility index RZR. These include 4 of the 5 Interbull traits (except the combined trait Days Open) and the non-IB trait Non-Return-Rate heifers. Because most other countries don't participate in all IB trait runs for fertility on DEU base foreign bulls often miss MACE proofs for some traits. Especially if one of the two major cow traits in the index T2 (Calving to 1<sup>st</sup> Service) or T3 (Non-Return-Rate cows) is missing the index calculation has to be done with missing traits. As a consequence the reliability of RZR for foreign bulls is often very low.

All countries having phenotypic insemination data should expand the national evaluation so that all IB traits can be provided. During the development of the new German multi-trait-model for daughter fertility the Interbull traits have been proven to be useful and necessary for precise description of complex daughter fertility.

From the German point of view sending/using an original proof just once in MACE and not parallel in more than one trait run would avoid possible double counting of information. Users of MACE proofs would get a more realistic picture on the amount of original information.

Proofs based on exclusively 2<sup>nd</sup> crop daughters from imported semen should be included in official MACE proofs as long as the country of origin participates in MACE fertility and the bull has at least one trait proof published in the country of origin. In the current situation bulls can only get official MACE proofs for traits the country of origin participates. As consequence e.g. all French bulls don't get MACE proofs for Calving to 1<sup>st</sup> Insemination or all USA bulls don't get MACE proofs for Non-Return-Rate cows even though reliable 2<sup>nd</sup> crop proofs based on thousands of daughters from other countries are available.

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## Introduction

For dairy breeds a new multi-trait-animal-BLUP evaluation model for daughter fertility was introduced by **vit** in January 2008. The new model includes 5 daughter fertility traits (re-cycling ability; two conception traits, each for heifers and cows):

- **NRh / NRc** = Non-Return-Rate-56 heifers (h)/cows (c)
- **FLh / FLc** = First-to-Last-Insemination heifers (h)/cows (c)
- **CF** = Calving-to-1<sup>st</sup>-Insemination.

The 5 evaluated breeding values (**EBVs**) are combined to a daughter fertility index RZR (relative breeding value reproduction),

according to the relative economic weights. Since April 2008 RZR is with a relative weight of 10%.part of the total merit index RZG

For foreign bulls without daughter information in the national model correct calculation of RZR causes problems. Interbull (**IB**) provides MACE EBVs for 4 out of the 5 nationally used traits (missing FLh) and not all countries participate in all MACE runs. Current MACE results in single trait EBVs. Furthermore MACE EBVs for different traits include the same original information because some countries send the same EBV into more than one trait run. Therefore the calculation of RZR based on MACE proofs needs different approaches for foreign bulls.

### Genetic parameters used in the multi-trait-model

Table 1 shows the genetic parameters used in the multi-trait-model (details see *Liu et al., 2007*). The low genetic correlations of -0,05 to +0,37 between CF and the conception traits

show that the ability to re-cycle and the ability to conceive are genetically almost independent aspects of daughter fertility. The two components of Days Open (**DO**) i.e. CF and FLc cause each about one half of the total variance.

**Table 1.** Genetic parameters for daughter fertility traits.

Genetic parameters h <sup>2</sup> (diagonal) correlations (off-diagonal)	CFc (T2)	NRh (T1)	NRc (T3)	FLh (-)	FLc (T4)	genetic standard deviation
calving to 1st ins. (CFc)	3.9%	0.02	-0.05	0.14	0.37	6.9 days
Non-Return-56 heifers (NRh)		1.2%	0.63	0.53	0.15	4.8 %
Non-Return-56 cows (NRc)			1.5%	0.25	0.39	6.0 %
1st to last ins. heifers (FLh)				1.4%	0.48	7.4 days
1st to last ins. cows (FLc)					1.0%	4.9 days

### Combining national proofs to daughter fertility index RZR

EBVs are standardised for publication to relative breeding values with an average of 100 and a genetic standard deviation of 12 within the yearly rolling base (currently A.I. bulls born 1998 to 2000).

For all bulls with at least national daughter information for one traits the multi-trait-animal-BLUP-model gives EBVs for all 5 traits based on pedigree information and the genetic correlations between the traits. The 5 standardized EBVs are combined to RZR using the relative economic weights shown in figure 1.

**Figure 1.** Relative weight of traits within daughter fertility index RZR.

Re-Cycle	Calving - 1st Ins. (CF)		Cow	25%	Relative-EBV Reproduction <b>RZR</b>
	Conception	Non-Return 56 (NR)	Heifer	12.5 %	
Cow			25 %		
1st - Last Ins. (FL)		Heifer	12.5 %		
		Cow	25 %		

### MACE proofs in daughter fertility index RZR

Four out of the five national traits are in consensus with the corresponding IB traits. Because IB converts just one heifer conception

trait (T1) NRh is send into the MACE run T1 and FLh is not send for MACE. For the MACE trait T5 (Calving Interval, **CI**) EBVs derived from combining CF and FLc proofs are send. Besides **vit** (DEU) only Canada and the joint Scandinavian evaluation (DFS) provides all

MACE traits according to the IB definitions (see [http://www.interbull.org/Female\\_fert/framesid a-fert.htm](http://www.interbull.org/Female_fert/framesid a-fert.htm)).

All other countries provide less traits. Many countries do not evaluate heifer conception (T1 missing) and/or have just one cow conception trait (see table 2). Therefore one to three MACE traits are missing (see table 2). Together with FLh that isn't converted by IB up to 50% of information needed for calculation of RZR is missing even for main Holstein countries like USA.

**Table 2.** Participation in MACE daughter fertility (country \* trait) and indication of submitted traits as “primary EBV” or “same EBV as in other MACE run”.

Country	T2	T1	T3	T4	T5
	CF	NRh	NRc	FLc	CI
<b>Countries participating with all 5 traits</b>					
DEU	x	x	x	x	x
CAN	x	x	x	x	x
DFS	x	x	x	x	x
<b>Countries participating with 4 traits</b>					
GBR	x		x	x	x
ITA	x		x	x	x
NLD	x		x	x	x
<b>Countries participating with 3 traits</b>					
BEL	x			x	x
ESP	x			x	x
IRL	x			x	x
NZL	x			x	x
USA	x			x	x
CHE	x		x	x	
CHR	x		x	x	
FRA		x	x	x	
CZE		x	x	x	
<b>Countries participating with 2 traits</b>					
ISR			x	x	

The current MACE gives single-trait proofs. To achieve a RZR based on single-trait MACE proofs that is comparable to a RZR based on **vit** proofs from the multi-trait-model the index should take the genetic correlations between

the traits into account. The original proof may come from a single-trait (e.g. USA) or multi-trait model (e.g. CAN). In second case the MACE proof includes already correlated information from other (national) traits. In cases a bull has daughters in more than one country and these countries have single- and multi-trait national models the situation is even more complicated. So a correct solution is almost impossible. Finally **vit** calculates the RZR without taking into account genetic correlations between proofs. Only in case of missing proofs these are derived from the correlated traits and pedigree index.

On basis of original proofs even more proofs are missing. Several countries participate with one national proof in different MACE runs. Table 2 indicates which of the country\*trait proofs is ‘primary’ information and where the same national proof is included in another MACE run, too. For country\*trait with very different trait definition from IB (e.g. New Zealand with ‘Percentage of cows re-calving in the first 42 days of herds calving period’) the allocation of primary and re-used information may be difficult. But at least one of the two is re-used. On German basis e.g. the three MACE proofs for a USA bull for T5/DO, T4/FLc and T2/CF include the same original EBV ‘daughter pregnancy rate’ that is basically a linear function of DO. The genetic correlation between DO and NRc is just -0.18 i.e. the traits are genetically almost independent. Nevertheless the MACE correlation for T4 between DEU and USA is quite high (0.85). In comparison the MACE correlation between CAN and DEU both providing “true” T4 as NRc from a very similar model is at the same level (0.85). Comparing the MACE correlations between countries having the “true” traits to those sending the same trait in more than one run (i.e. one is not the “true” trait) raises the question whether the (one) original information is really correctly converted to the German base. The impression is that at least partly there is some double counting when one national EBVs is converted to two MACE proofs and these are used in calculating RZR. Another aspect is the confusion of for users of MACE proofs. The MACE proofs indicate more original information on daughter fertility than is in reality.

On the one hand original information is multiple used in MACE. Otherwise available information is not used in routine MACE. As a general rule second crop proofs (from importing countries) are only included in routine MACE if at least one country (country of origin) sends a first crop proof. So bulls can't get official MACE proofs based on only second crop proofs from importing countries. Influential FRA bulls like Jocko Besne don't have MACE proofs for T2/CF even though at least 7 other countries participating in T2 provide EBVs including each more than 1,000 Jocko Besne daughters. The same is for USA bulls and T3/NRc. Important sires of sons like Norriela Cleitus Luke or Maizefield Bellwood have NRc proofs with thousands of 2<sup>nd</sup> crop daughters from several countries but don't get MACE proofs for T3 because USA doesn't participate at T3.

### **Possible improvements**

Several countries not (yet) participating in all MACE runs have the necessary phenotypic data to evaluate all IB traits; i.e. all countries having a primary true conception trait. In these cases the national evaluation systems should be enhanced to all IB traits. This would lead to improved MACE proofs for daughter fertility and improved national proofs, too. The intensive research at **vit** during the development of a new multi-trait model has shown that daughter fertility is complex and needs different traits to describe it realistically for every bull. The ability to re-cycle represented by CF and the ability to conceive are genetically almost independent aspects of daughter fertility and cause each about 50% of the variation in DO/CI. Conception traits were proven to be genetically (partly) different for heifers and cows. NR56 is currently the most

used conception trait. It is available for all mated animals and therefore also for not successful animals. But NR56 is not fully describing the ability to conceive. Many cows get pregnant from re-inseminations after 56 days and the genetic correlation of NR56 and approved conception (e.g. FL) is just moderate.

The current practice to accept a national proof for more than one MACE trait run can create problems. Including one EBV only once in the MACE trait run with the trait definition most similar (or average correlation is highest) would avoid double counting across all conversions. Furthermore this would give users of MACE proofs a more correct impression on the amount of original data for daughter fertility.

MACE for fertility is a new IB service and number of traits and trait definitions differs between participating countries. In April 2008 16 countries/populations participated but just 3 in all 5 trait runs. In this specific situation the necessity of a proof from country of origin for including a bulls proof in official MACE should be changed from a within trait requirement to an across trait requirement. If a bull gets a proof from country of origin in at least one MACE trait (i.e. the country participates in MACE fertility) all fertility proofs from all countries should be included in official MACE for this bull.

### **References**

Liu, Z., Jaitner, J., Pasman, E., Rensing, S., Reinhardt, F. & Reents, R. 2007. Genetic Evaluation of Fertility Traits of Dairy Cattle Using a Multiple Trait Model. *Interbull Bulletin* 37, 134-139.