# International evaluations for the Ayrshire and Guernsey breeds<sup>1</sup>

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#### Introduction

#### Ayrshire

This study is part of a project undertaken by the INTERBULL Centre in collaboration with the Nordic Farmers Advisory Committee aiming at a joint genetic evaluation of bulls from the Nordic countries. This project was initiated in 1992 with a study on genetic links and comparisons among Holstein-Friesian bulls from Denmark, Finland, and Sweden. That study concluded that joint genetic evaluations of Nordic Holstein-Friesian bulls was possible when data from common exporting countries, especially the USA, were included in the analysis (Banos et al, 1994).

In the present study, the objective was to assess the feasibility of genetic comparisons of Ayrshire bulls from Finland (FIN), Norway (NOR), and Sweden (SWE) and perform a test joint evaluation for protein yield. Data from Canada (CAN) and the USA were also included to investigate the connections between Nordic and North American bull populations.

This study can be also considered a first step towards a more comprehensive genetic evaluation of the Ayrshire breed, which will include all countries with an active Ayrshire breeding programme. The foundation of such a project was set at the 7<sup>th</sup> World Ayrshire Conference, October 1992, Sweden (Philipsson et al, 1992).

#### Guernsey

This project is a follow-up on decisions made at the 7<sup>th</sup> World Guernsey Conference, July 1992, Guernsey Island, and has been undertaken in co-ordination with the World Guernsey Federation who also provided partial funding. The goal has been to establish a sire evaluation scheme for the Guernsey breed starting with an assessment of the feasibility of such global evaluation.

# Data description and methods of analysis

#### Ayrshire

Data were Ayrshire bull pedigree and national evaluation records from Agriculture Canada, the Finnish Animal Breeding Association, the Norwegian Red-and-White Association, the Swedish Association for Livestock Breeding and Production, and the United States Department of Agriculture.

#### Measuring genetic links

Numbers of pedigree records received from each country are shown in Table 1. Bull pedigree records included the identification of the sire, the dam, the maternal-grand-sire (MGS), and

<sup>&</sup>lt;sup>1</sup> INTERBULL Open Meeting, August 5-6, 1994, Ottawa, Canada

the maternal-grand-dam (MGD). This information was used to determine the national origin (NO) of each bull according to Model 1:

NO-bull=1/2 NO-sire + 1/4 NO-MGS + 1/4 NO-MGD [1] Thus, a bull with CAN sire and NOR MGS from the base generation, and FIN MGD would be 50% CAN, 25% NOR, and 25% FIN. Sons and maternal-grand-sons of this example bull would subsequently inherit 1/2 or 1/4 of his national origin. If some ancestors were missing, the coefficients in Model 1 were re-arranged so that they always summed to unity.

National origins were used to group bulls and evaluate the degree of genetic exchange among the participating bull populations, as in Banos et al (1994).

In addition, the numerator relationship matrix among all bulls, regardless of national origin, was set up and the average genetic relationships within and across country were estimated. These values were also used to assess the increase in accuracy of comparisons between all country pairs due to genetic connections (Kennedy and Trus, 1993).

## Genetic evaluation across country

Artificial Insemination (AI) bulls first sampled in the participating countries with national evaluations for protein yield based on at least 20 daughters were considered in the international evaluation. Numbers of bulls by country of evaluation, dates of national evaluations, and description of national protein proofs are given in Table 1.

TABLE 1:Numbers of Avrshire bull pedigree records (PED) and national protein proofs considered in the international evaluation (FSP), dates of national evaluations whose data were used (YYMM), estimated sire standard deviation for protein yield (STD), and units of measurement (UNIT) by country of evaluation.

Country of evaluation	PED	FSP	YYMM	STD	UNIT
CAN	8585	379	9401	6.02	BCA
FIN	6264	2931	9304	5.08	kgs
NOR	2792	2736	9306	5.57	kgs
SWE	10521	2783	9302	6.00	kgs
USA	2160	199	9307	-14.47	pounds

National proofs were de-regressed within country to provide approximate adjusted daughter averages which were then standardized by the standard deviation estimates shown in Table 1 and analyzed using the following model (Schaeffer, 1985):

$$y = Xc + ZQg + Zs + e$$
 [2]

Where

- y: Daughter averages for protein yield from national evaluations
- c: Country of evaluation effect
- g: Genetic group effect
- s: Bull effect (including genetic relationships among bulls)
- e: Residual effect
- X, Z, Q: Incidence matrices

Genetic groups were defined to account for the differential origin of the bulls. Fifty nine (59) such groups were defined by the national origin and the birth year of each bull.

## Guernsey

Bull pedigree records were collected from six countries with active Guernsey populations. The following organizations provided data: the Australian Dairy Herd Improvement Scheme-Australia (AUS), Agriculture Canada, the Canadian Guernsey Association, and the Canadian Livestock Records Corporation-Canada (CAN), the English Guernsey Cattle Society and the Animal Data Centre-Great Britain (GBR), the Agricultural and Milk Marketing Board-Guernsey Island (GBG), Livestock Improvement-New Zealand (NZL), and the United States Department of Agriculture (USA). Records included all Guernsey bulls ever found in these countries, either progeny tested there or imported. No national evaluation proofs were received at this stage.

To better assess data connectedness with regards to the artificial insemination (AI) bull populations, each country was also asked to identify bulls that were first AI sampled there. Such screening would also exclude proofs based on imported semen.

TABLE 2. Numbers of <u>Guernsey</u> bull pedigree records (PED) and bulls first AI sampled (FSP) by country of evaluation					
Country of evaluation	PED	FSP			
AUS	172	66			
CAN	5650	172			
GBG	1435	96			
GBR	860				
NZL	130	0			
USA	7911	602			

All data that were made available from each country are described in Table 2.

Unfortunately, explicit identification of AI progeny tested bulls was missing from the GBG and GBR files. In the GBG file, bulls coded as "proven" were considered as such. This arbitrary decision might have excluded foreign bulls progeny tested in GBG, thereby weakening potential genetic links between GBG and other countries. Also, all 130 bulls in the NZL file were imports and, therefore, excluded from the FSP data set.

Birth years of these bulls ranged from the early 50s to early 90s in all countries. All bull records in Table 2 were used to compute the genetic constitution of every single animal based on the national origin of its ancestors, as shown with Model 1. Genetic relationships among countries were also computed. Estimability of various effects in Model 2 were then assessed by examining the rank of the coefficient matrix.

# Results and discussion

# Genetic links

# Ayrshire

The genetic constitution of the five Ayrshire bull populations considered in this study is shown in Table 3. Values in this Table represent the average of the 10 most recent birth years of bulls (1978-1988). For example, in the SWE AI bull population these 10 years .89% of the genes originated in CAN, 16.98% in FIN, 10.05% in NOR, 71.82% in SWE, and .26% in the USA. Similarly, SWE contributed .50% of the genes in the FIN AI bull population and 23.65% in NOR.

 TABLE 3: Percent genetic constitution of <u>Ayrshire</u> bull populations evaluated in five countries (AI bulls born 1978-1988 were considered).

Country of evaluation	Population of origin					
	CAN	FIN	NOR	SWE	USA	
CAN	63.54	0	0	0	36.46	
FIN	1.25	86.41	11.34	.50	.50	
NOR	0	3.01	73.34	23.65	0	
SWE	.89	16.98	10.05	71.82	.26	
USA	43.77	0	0	0	56.23	

Table 3 suggests that direct genetic links have been established between Canada and the USA and, to various degrees, among the Nordic countries but not as much between the Nordic and the North American countries. Thus, in a joint analysis of all five countries information from one geographic group of countries would not contribute substantially to the other.

Genetic relationships among Ayrshire bulls within and between countries were computed and are shown in Table 4. The reduction in genetic drift variance between countries due to pairwise genetic relationships is also shown in Table 4. The latter is associated with the accuracy of comparisons between countries.

TABLE 4: Average genetic relationships (x10 <sup>-3</sup> ) within (diagonal) and between (above diagonal) <u>Ayrshire</u> bull populations in various countries and percent reduction in genetic drift variance due to genetic relationships between countries (below diagonal).							
Country	CAN FIN NOR SWE USA						
CAN	29.40	1.47	0	.22	28.07		
FIN	6.14	18.49	2.76	1.77	1.84		
NOR	0	18.45	11.42	2.10	0		
SWE	1.25	14.25	23.66	6.29	.36		
USA	75.79	5.84	0	1.41	44.68		

Results shown in Table 4 indicate that the two countries benefitting the most from a joint evaluation are Canada and the USA. Strong genetic links have been developed there, resulting in a reduction of the genetic drift variance among the two countries of about 75%. The genetic links among the three Nordic countries were equally strong to each other but weaker than between Canada and the USA.

When data from all five countries were simultaneously considered in Model 2, genetic links among countries were found sufficient to allow for estimable differences among all genetic group levels, thereby meeting the prerequisite for computing unbiased international proofs.

# Guernsey

The genetic constitution of the AI Guernsey bull populations considered in this study is shown in Table 5. Values in this Table represent the average of the 10 most recent bull birth years (1978-1988).

TABLE 5: Percent genetic constitution of <u>Guernsey</u> bull populations evaluated in five countries (AI bulls born 1978-1988 were considered).

Country of evaluation	Population of origin					
	AUS	CAN	GBR	GBG	USA	
AUS	5.71	15.62	0	2.86	75.80	
CAN	0	7.40	0	.27	92.32	
GBG	0	6.03	14.22	73.28	6.47	
USA	0	.07	0	0	99.93	

Clearly USA genetics have dominated the picture in AUS and CAN. In GBG (Table 5) there may be additional genes from abroad. However, since we chose to be conservative, some recent foreign contributions might have been missed.

Genetic relationships among Guernsey bulls within and between countries were computed and are shown in Table 6. The reduction in genetic drift variance between countries due to pairwise genetic relationships is also shown in Table 6.

TABLE 6: Average genetic relationships (x10 <sup>-3</sup> ) within (diagonal) and between (above diagonal) <u>Guernsey</u> bull populations in various countries and percent reduction in genetic drift variance due to genetic relationships between countries (below diagonal).					
Country	AUS	CAN	GBG	USA	
AUS	21.81	3.92	.64	5.38	
CAN	19.11	18.60	.21	14.32	
GBG	2.48	.89	25.23	.01	
USA	18.82	52.25	.02	35.59	

As was also the case in Ayrshire, the strongest links have been developed between USA and CAN. These two countries would benefit the most from a joint evaluation. The links of GBG with the other countries appear being quite weak but they may be slightly under-estimated, as explained earlier.

In general, genetic links among these Guernsey bull populations were weaker than links among Holstein-Friesian populations assessed in previous studies, yet sufficiently strong to render estimable comparisons among levels of effects in the international model (Model 2).

# Across country evaluation

International evaluations were only computed for the Ayrshire breed. Correlations between national and international proofs within country were always higher than .99.

Figure 1 shows comparative genetic progress and genetic levels for protein yield of the AI bull populations in the three Nordic countries. Values are on a standardized scale, but the genetic progress can be translated to 1.94 kgs/year in SWE, 1.06 kgs/year in FIN, and 1.03 kgs/year in NOR. The genetic level of the most recent batch of bulls is about the same in these countries, indicating equal competitiveness status at the international scene.

Results shown in Figure 1 depend on the national evaluation models used at the time of this joint evaluation (pertinent release dates are in Table 1). Since that time, FIN has modified the evaluation model and obtained a higher (more accurate) estimate of genetic progress. Such change would affect the relative position and slope of the FIN curve in Figure 1.

A repeat run including national proofs based on imported semen revealed biases in the estimated genetic merit of those bulls by about 6 kgs in Sweden and Finland. Similar biases were observed in the study of Holstein-Friesian bulls (Banos et al, 1994). Presence of these national proofs in the joint analysis affected considerably the international ranking of imported bulls; therefore such proofs should be excluded from an official international evaluation.

#### Conclusions

Official INTERBULL international evaluations for Ayrshire bulls from SWE, FIN, and NOR, for dairy-production traits, are scheduled for August 1994, under the umbrella of the international genetic evaluation service. Test evaluations will be computed for Ayrshire bulls from additional countries as well as Guernsey bulls from any country wishing to participate in the service, prior to releasing official proofs. Data and genetic trend validation will take place prior to any international evaluation.

#### References

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FIGURE 1: Average within birth year of bull standardized international proof (STDPROOF) for protein of Ayrshire bulls progeny tested in Finland, Norway, and Sweden.

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# INTERNATIONAL PROOF PROTEIN

