A Joint Nordic Animal Model for Milk Production Traits in Holsteins and Ayrshires

Jørn Pedersen[1] and Claus Langdahl[1], Jukka Pösö[2], Kjell Johansson[3],
[1]The Danish Agricultural Advisory Centre, Udkaersvej 15, Skejby, 8200 Aarhus N, Denmark
[2]The Finnish Animal Breeding Association, P.O.Box 40, Vantaa, Finland
[3]Swedish Dairy Association, P.O.Box 7023, 75007 Uppsala, Sweden

Abstract

A joint Nordic evaluation model for milk production traits has been developed for both Holsteins and Ayrshires. Both a multi country and single country model has been analyzed. Both models are positively validated by comparison to the national evaluations. Validation by INTERBULL methods has not been completed but results obtained so far have been positive. The single country model is preferred due to further developments towards an evaluation model that will include 305-days records and test day records as well as non-Nordic information.

Introduction

For many years, the Scandinavian countries (Sweden, Denmark, Norway and Finland) have used the same bull sires in Holsteins and to some degree in Ayrshires. However, it would be more effective to select animals jointly. This will require a joint evaluation. INTERBULL has made comparisons across borders feasible for sires but a similar system for comparison of cows is not available.

On this background a project on a joint evaluation of dairy cattle in the Scandinavian countries was initiated in year 2000 in order to develop a functional evaluation system for milk production traits. It was decided to develop two models:

- "The Ayrshire model" for Finnish Ayrshire, Swedish Red and White, Red Danish and Norwegian Red Cattle.
- "The Holstein model" for Holstein cattle in the Scandinavian countries.

Material and Methods

Data

During year 2000 evaluation data for 305-days lactations was exchanged between the Scandinavian countries. Up to now, only data from Sweden, Denmark and Finland has been included. Norway is likely to submit data for the Ayrshire evaluation during 2002. The data exchanged, was data from the routine evaluations where all national editing and precorrections were included such that no further editing of data should be made. The data from Finland included both Holstein and Ayrshire as both breeds are evaluated jointly in Finland, whereas Ayrshire and Holstein are evaluated separately in Sweden and Denmark.

Two sets of data were exchanged (Table 1):

- A pedigree file with national and international identities of the animals, sire and dam. Necessary additional information on herd and birth date was included.

- A data file with variables describing fixed effects, production results, degrees of heterozygoty or dominance and recombination and other variables that are included in the national evaluation models. From Finland and Denmark results from the first three lactations were provided. From Sweden results from first lactation were supplied.

Table 1. Survey of number of records exchanged

Countries	*Number of animals*	*Number of lactations*	*Number of animals*	*Number of lactations*
	Holsteins		*Ayrshires*	
Finland (both AYS and HOL)	2,037,942	3,631,338	2,037,942	3,631,338
Sweden (1st lact. only)	1,399,387	701,282	1,894,001	914,019
Denmark	3,804,657	5,882,652	772,097	1,117,338

Phantom parent groups and genetic links

As part of editing was already made in each country, the remaining data editing included preparation of a joint pedigree file by checking and comparing pedigrees from different sources as the number of generations in the nationalevaluations varied from country to country.

An important problem was formation of common phantom parent groups. The data from each country came with the phantom parent grouping used in each country. The following common guidelines were set up for formation of phantom parent groups:

- Phantom parents of original national population remained unchanged.
- Phantom parents of animals imported from the other Scandinavian countries was traced to the original phantom parent groups.
- New phantom parent groups were formed for imports from countries outside the Scandinavian countries (Mainly a Holstein problem).

In Table 2 three different measures of the genetic similarity of the Ayrshire and Holstein populations are shown. The Swedish and Danish Holstein populations are well connected whereas the links to the Finnish Holstein are mostly due to common ancestors. The Finnish and Danish Ayrshires are relatively well connected to the Swedish Ayrshire, whereas the links between the Finnish and Danish Ayrshire populations are more sparse as sires from Finland usually have very few daughters in Denmark.

Table 2. Genetic links between The Nordic Holstein and Ayrshire populations

	Holsteins				Ayrshires			
	Sires with daughters in 2 countries			No of common sires	Sires with daughters in 2 countries			No of common sires
	% of all cows		No of sires		% of all cows		No of sires	
1st - 2nd nation	1st nation	2nd nation			1st nation	2nd nation		
SWE – DNK	10.2	20.7	257	1461	8.0	4.9	35	279
SWE – FIN	2.8	2.3	38	151	14.6	8.9	98	457
DNK – FIN	10.0	1.3	40	165	0.3	8.9	69	365

Models

The traits considered were 305-days milk, protein and fat production. Only single trait models for milk production traits have been analyzed, i.e. separate evaluation of milk, protein and fat production. Using a repeatability model accommodated for different lactations.

As Finland has already implemented a test day model, a procedure for blending of test day records and 305-days records needs to be available before a joint Nordic evaluation can be a reality. If both test day records and 305-days records should be included then in practice only a single country model would be possible. Therefore the focus has been on results from single country models (SC model) where production is considered to be the same trait in all countries. Nevertheless, also a multi country model (MC model) where genetic correlations between countries are assumed to be less than unity has been included in the analyses.

The national models were adapted as far as possible:

- For the fixed effects an interaction with country was defined for all effects.
- For the random herd effect included in the Finnish model, one group for all Swedish cows and one for all Danish cows was defined.

In the single country model a heritability of 0.30 and a repeatability of 0.47 were used. For Finnish data the herd x year variation was assumed to be 25% of the total variation.

The model for milk, fat and protein included following effects:

	Sweden x	Denmark x	Finland x	Type
Herd	Herd x Year	Management group	Herd x Five year	Fixed
Parity	-	Parity x Five year	-	Fixed
Age	Calving age x Five year	Calving age x Parity x Five year	Calving age x Parity x Days open	Fixed
Season	Year x Season	Year x Season x Parity	Year x Season	Fixed
Calving int.	-	Previous calving interval x Five year	-	Fixed
Days open	Days open (AYS)	-	(included with age)	Fixed
Dominance	2 effects for HOL 2 effects for AYS	1 effect for HOL 3 effects for AYS	-	Fixed regression
Recombination	1 effect for AYS	-	-	Fixed regression
Other	Days open (HOL)	Current calving interval	-	Fixed regression
Herd		Herd * Year		Random
Permanent		Cow		Random
Animal		Animal		Random
Residual		Observation		Random

Results

Validation by INTERBULL I and II methods

The validation by INTERBULL methods I and II have not yet been completed. The Holstein models have been validated by INTERBULL methods I and II and the Ayrshire single country model by method I. For the joint evaluation, the results obtained so far have fulfilled the requirements of INTERBULL. For Holsteins the results of validation by method I were close to the INTERBULL limits for the Finnish part of the data, probably because the method for precorrection of variation due to age was not updated in the Finnish data. In the Ayrshire data an unsolved problem exists in Danish part of the data.

Comparisons with national results

It is important to obtain a general acceptance of the results from the joint evaluation. Differences between national results and the results from the joint evaluation should be reasonable. The following comparisons have been made:

- Comparison of genetic trends from single country model with national results.
- Correlation between estimates of breeding values from the Nordic single country model and the national model.
- Differences between estimates of breeding values from national evaluation and from the Nordic single country model.

Genetic trends

Figure 1 and 2 show the genetic trends of protein yield of cows evaluated by national and by Nordic single country model. A common base of sires born in1990 is used within each breed group (Holsteins and Ayrshire).

Figure 1. Genetic trends for protein yield of Holstein cows

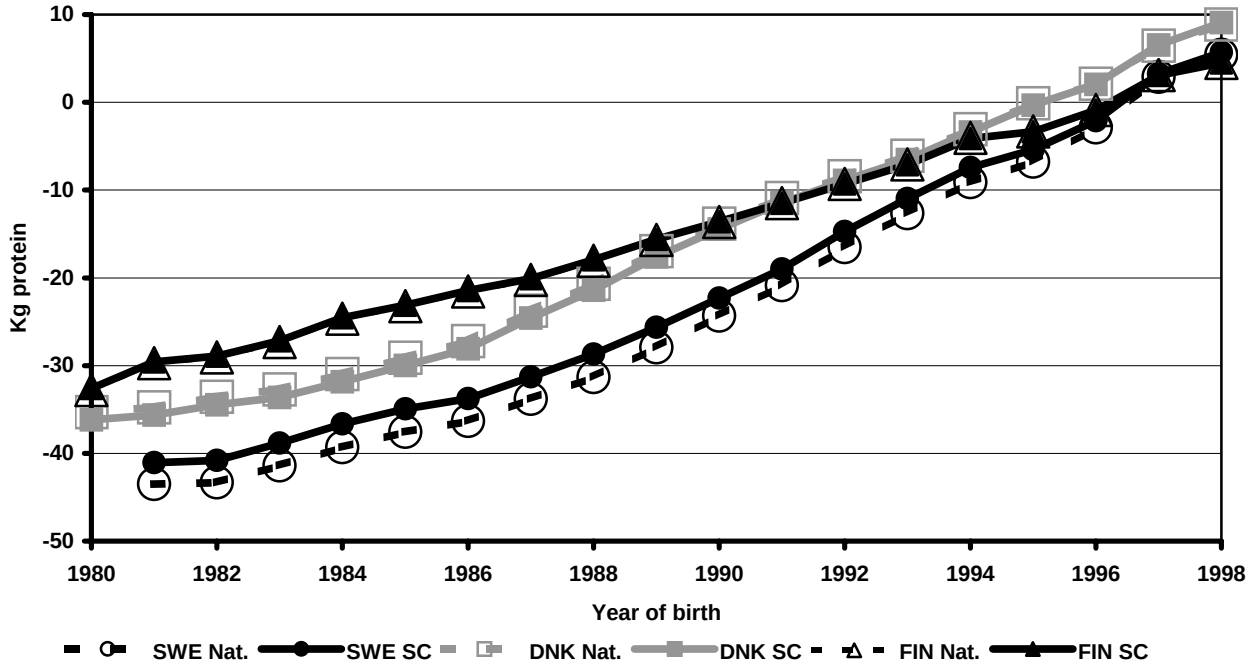
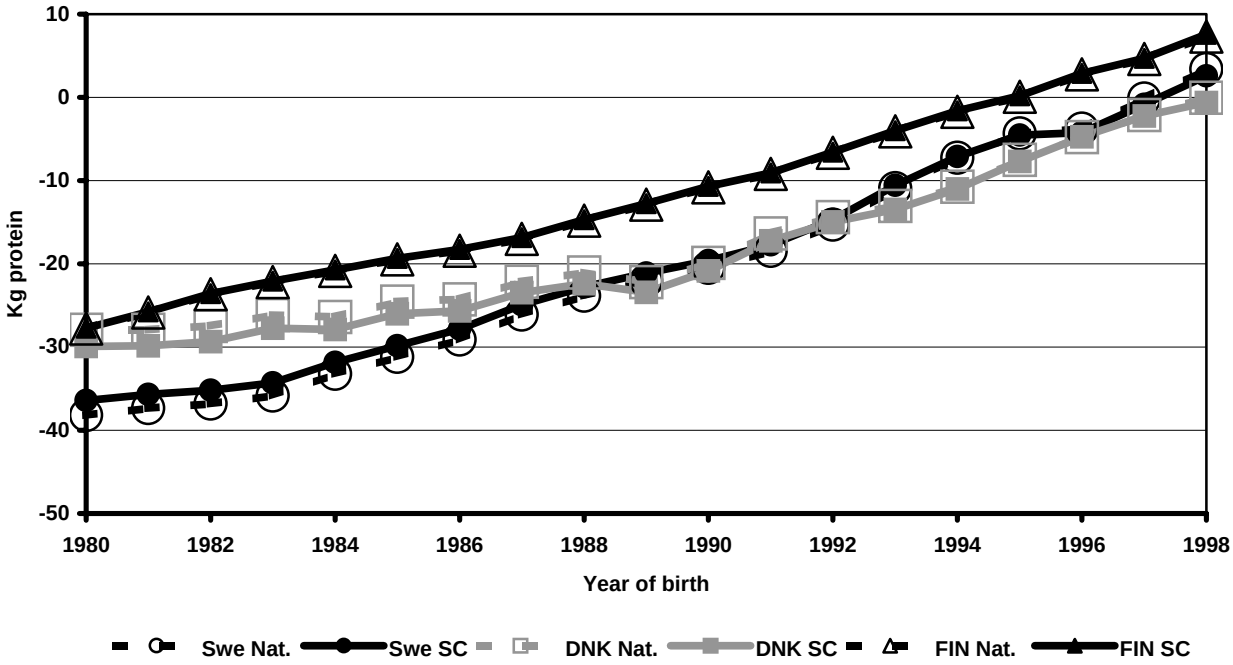


Figure 2. Genetic trends of protein yield of Ayrshire cows



For Holstein cows the genetic trends obtained by the national and the single country (SC) model were nearly identical in Denmark and Finland. Also, for Finnish Ayrshire cows the national and the SC model gave very similar trends. For the other populations (Swedish Ayrshire and Holsteins and Danish Ayrshire) the differences in genetic trends from 1980 to 1998 was 1 - 2 kg protein. The genetic level of the three Holstein populations has become nearly identical during the 90'ies, whereas the current genetic level of the Finnish Ayrshire population is slightly higher than in the other two Ayrshire populations.

As expected, results from the multi country model (not shown) were slightly more similar to those from the national evaluations.

Correlations and deviation from national breeding values

For both Holsteins and Ayrshires the correlations between national and SC model EBVs were high (generally above 0.99). As expected the differences were very close to zero for most cows. For cows born in 1990 and later 98% had their protein EBV changed less than 1 kg. For sires the differences were larger but analyses showed that large differences between EBV's in the two systems were closely related to sires that had the majority of daughters in another Nordic country.

Conclusion

At this point a Nordic Animal Model for milk production traits has been developed. Some additional "fine tuning" is still needed before implementation. The single country model is preferred due to:

- The need to blend foreign information (INTERBULL results)
- The further development towards a Nordic evaluation model for milk production traits.

The main practical obstacle to implementation one of the models is that Finland has already implemented a test day model. In Denmark it is decided to change to test day model in approximately one year. Sweden and Norway have currently no decision with respect to test day models. Therefore a procedure for blending of test day records and 305-days record should be available before joint Nordic evaluation could be a reality.

The development of a procedure for blending of test day records and 305-days records is made in a joint project of MTT Agrifood Research at Jokioinen, Finland and Danish Institute of Agricultural Sciences at Foulum, Denmark.

In another joint Nordic project, models for sire evaluation of some functional traits are currently under development. Initially, this project has concentrated on traits that are not included in INTERBULL's evaluation program. The traits are: Other diseases than mastitis, fertility and calving performance. The objective of these projects is a comprehensive joint Nordic evaluation covering all traits of economic importance.