A Joint Nordic Model for Fertility Traits

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Introduction

In 2002 an agreement was made for a joint estimation of breeding values for dairy cattle in Sweden (SE), Denmark (DK), Finland (FI) and Norway (NO). The goal of this cooperation is to estimate EBV's for all traits included in the Nordic dairy cattle breeding programs.

A part of this Nordic work is to estimate EBV's for fertility traits. The objective was to develop a model for fertility traits where EBV's for all countries are calculated simultaneously on the basis of raw data. A Nordic model will facilitate comparison of sires across borders with regard to fertility traits.

The project has focused on development of a sire model that accounts for differences in data and environment between countries. The result of the work is a model for Holstein and Ayrshire that can be used for routine evaluation of the fertility traits used in the Nordic countries.

Material and Method

On the national level a variety of traits describing fertility are used in the Nordic countries. Non Return Rate (NRR) is used in Norway and Finland. The number of inseminations per service period (AIS) and heat strength (HST) is used in Sweden. Interval from calving to first insemination (ICF) is used in Sweden and Denmark. Interval from first to last insemination (IFL) is used in Denmark and days from calving to last insemination (DOP) are used in Finland. Fertility treatments (FTR) are used in Finland and Sweden. There are also differences in how many parities that are included. Norway is using information from virgin heifers and first parity cows, Denmark and Sweden include information from heifers and later parities, while Finland use cow records only. National pedigree information was used together with information from the INTERBULL cross-reference file.

Unedited data on calving and insemination were received in the same format from all the participating countries. From Sweden, records from heifers and 1st-2nd lactation were used for Holstein, whereas for Denmark, Finland and Norway, as well as Swedish Ayrshire, data from heifers and 1st-3rd lactation were used.

The data were edited on the basis of a common set of editing rules. One part of the editing procedure is to standardize data across country, year and lactation.

Table 1. Number of records for Ayrshire and Holstein.

	Ayrshire		Holstein	
Calving number	Heifers	1.-3. lactation	Heifers	1.-3. lactation
Sweden	1,050,052	2,225,725	507,867	1,068,450[1]
Denmark	360,576	726,618	1,937,501	3,591,908
Finland	553,831	1,222,120	171,139	368,599
Norway	1,661,898	3,597,905		

[1] Only 1st and 2nd lactation

Registrations used to calculate the fertility traits and the production environment is much alike in the Nordic countries. For simplicity we therefore assume that the genetic correlations between the same traits in different countries are 1.

Estimation of genetic parameters was not an object within the project. The genetic parameters used are the ones previously found in the Nordic countries (Table 2).

Table 2. Parameters used in the joint Nordic model. Heritability on diagonal, genetic correlations above diagonal and environmental correlations below diagonal.

	1	2	3	4	5	6
1 NRR, cow	0.010	-0.70	0.15	-0.34		
2 IFL, cow	-0.38	0.020	0.41	0.87		0.65
3 ICF, cow	0.06	-0.08	0.040	0.75		0.05
4 DOP, cow			0.49	0.040		
5 NRR, heifer					0.008	-0.85
6 IFL, heifer		0.02			-0.39	0.016

The genetic models developed were based on the models used nationally. The models were modified according to the results shown by Nielsen *et al.* (2003). Different effects were used in different countries. SE, DK, FI and NO denote the country/countries where effect is used. In country/countries where an effect was not used all records were placed in the same group. In Finland a special model was used for NRR.

Model used for all traits except NRR:

- Herd x year of birth$_{DK + SE}$/ Herd x 5 year$_{FI + NO}$ — Fixed
- Calving month$_{DK}$/ Calving month$_{SE}$/ Calving month x breed$_{FI}$ — Fixed
- Insemination month$_{NO}$ (all SE, DK and FI records in one group) — Fixed
- Ended/ not ended records$_{DK}$ (all SE, FI and NO records in one group) — Fixed
- Breed of dam$_{SE}$ (all DK, FI and NO records in one group) — Fixed
- Double insemination or not$_{NO}$ (all SE, DK and FI records in one group) — Fixed
- Lactation number (cows only) — Fixed
- Herd x year of birth$_{FI + NO}$ (all DK, SE records in one group) — Random
- Sire — Random
- Residual — Random

Model used for NRR :

- Herd x year of birth$_{DK + SE}$/ Herd x 5 year$_{FI + NO}$ — Fixed
- Calving month$_{DK}$/ Calving month$_{SE}$ (all FI and NO records in one group) — Fixed
- Insemination month$_{FI + NO}$ (all SE and DK records in one group) — Fixed
- Ended/ not ended records$_{DK}$ (all SE, FI and NO records in one group) — Fixed
- Breed of dam$_{SE}$ (all DK, FI and NO records in one group) — Fixed
- Parity x timeclass of calving to first insemination$_{FI}$ (all SE, DK and NO records in one group) — Fixed
- Double insemination or not$_{NO}$ (all SE, DK and FI records in one group) — Fixed
- Lactation number (cows only) — Fixed
- Herd x year of birth$_{FI + NO}$ (all DK and SE records in one group) — Random
- Sire — Random
- Residual — Random

EBV's were calculated by mean of the DMU-program package (Madsen and Jensen, 2002).

Results and Discussion

Genetic trends for heifers and cows are shown in tables 3-4. The trends are shown for the Holstein and Ayrshire breed group across countries.

Holstein

For heifers IFL has increased with 3 days during the period. For cows IFL has increased with 12 days and ICF has increased with 8-9 days from 1980-1996. NRR for cows has decreased with 3-4% during the period. The results observed in the Nordic countries are in accordance with a genetic increase of 17 days DOP from 1960-1998 found in USA (Van Raden, 2003). In the Nordic countries a large part of the Holstein sires of sons is of a North American origin.

Table 3. Genetic trend in NRR, ICF and IFL for Holstein from 1980-1996.

	Heifers	Cows		
Birth year of sire	IFL	NRR	ICF	IFL
1980	-2.9	3.4	-6.3	-9.9
1981	-2.3	3.0	-5.6	-8.7
1982	-2.4	2.9	-4.9	-8.1
1983	-2.7	3.0	-4.9	-8.3
1984	-2.2	2.0	-4.4	-6.8
1985	-1.8	1.5	-3.6	-5.1
1986	-2.2	1.2	-3.3	-4.4
1987	-2.1	0.8	-3.8	-4.1
1988	-1.2	1.2	-1.8	-2.8
1989	0.0	1.0	-1.1	-2.1
1990	-0.3	0.6	-0.1	-1.0
1991	-0.4	0.4	-0.5	-0.6
1992	0.0	0.0	0.0	0.0
1993	-0.5	0.1	0.7	0.2
1994	-0.1	0.2	2.3	1.1
1995	0.6	-0.1	3.2	2.5
1996	0.1	-0.3	2.2	2.1

Table 4. Genetic trend in NRR, ICF and IFL for Ayrshire from 1980-1996.

	Heifers	Cows		
Birth year of sire	IFL	NRR	ICF	IFL
1980	-0.6	0.2	-1.6	-2.2
1981	-1.3	0.3	-0.8	-1.2
1982	-0.2	-0.1	-0.4	-0.8
1983	-0.4	0.0	-0.8	-1.5
1984	-1.1	0.4	-0.3	-2.0
1985	-1.2	0.7	-0.5	-2.0
1986	-0.9	0.9	0.1	-1.5
1987	-1.4	-0.1	0.0	-1.0
1988	-1.4	0.4	1.4	0.1
1989	-1.1	-0.2	0.7	0.0
1990	-0.8	-0.7	0.0	0.1
1991	-0.3	0.0	0.5	-0.5
1992	0.0	0.0	0.0	0.0
1993	-0.3	-1.1	0.4	0.8
1994	-1.0	-0.5	1.4	0.5
1995	-0.9	0.0	0.9	-0.5
1996	0.1	-0.9	0.3	-0.2

Ayrshire

For heifers IFL there has not been any genetic trend from 1980-1996, and for cows the genetic level of NRR, IFL and ICF has also been almost constant across the period.

In general the fertility of Holstein has decreased during the period, whereas the fertility of the Ayrshire breeds has been constant. The genetic trend for Holstein has been quite similar across the Nordic countries. However, differences in national breeding goals with different proportion of crossing with North American Holstein meant that there are differences in the genetic trend from 1980-1996 and in the genetic level at present. In table 5 the percentage of all sires are shown together with the percentage of sires in top 50 from each country for IFL. Finland has the largest proportion of sires compared to the proportion of sires tested. The proportion of HF genes is lowest for the Finnish sires.

Table 5. Percentage of Holstein sires from different countries among the top 50 and all sires for IFL.

	All sires	Top 50
Sweden	24 %	18 %
Denmark	59 %	46 %
Finland	8 %	32 %
Other	9 %	4 %

Results shown so far are from a model where heterozygosity is not included. However, results from models including heterosis show that different populations have different genetic level of the fertility traits and that there are heterosis between the populations in the Nordic countries. It is therefore important to include heterosis in the model before it is used in practice.

To validate the model an INTERBULL III test was performed for cow traits for Holstein. The results showed that the standard deviation was within 0.02 times the genetic standard deviation for NRR, AIS, IFL and DOP, while it was slightly above the limits for ICF.

Conclusions

The deteriorating genetic trend for Holstein is showing the importance of including fertility in a total merit index so the genetic trend can be at least hold constant.

Initially all fertility traits used in the Nordic countries today will be evaluated and can be published in the participating countries. On the national level the traits are combined with different weightings into an overall fertility index, which cannot be compared across countries. To facilitate comparison of bulls across borders a Nordic fertility index will be developed.

Further it is important that the possibility for including fertility traits in MACE procedures are investigated to facilitate comparison of sires not only across Nordic countries.

References

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