

A joint Nordic model for type traits

Anders Fogh¹, Jan Åke Erikson², Jarmo Juga³, Minna Toivonen⁴, Jukka Pösö⁴,
Marjo Simpanen⁴, Ulrik Sander Nielsen¹, Gert Pedersen Aamand¹

¹Danish Cattle Federation, Danish Agricultural Advisory Service. Udkaersvej 15, 8200 Aarhus N, Denmark

²Swedish Dairy Association, Box 1146 SE-631 80 Eskilstuna, Sweden

³Nordic Cattle Genetic Evaluation, P.O. Box 40, Vantaa, Finland

⁴ProAgria Finnish Animal Breeding Association, P.O. Box 40 Vantaa, Finland

Introduction

An agreement was made for a joint estimation of breeding values for dairy cattle in Sweden, Denmark and Finland. The goal of this Nordic cooperation is to estimate BV's for all traits in the participating countries.

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

Material and method

In Sweden, Denmark and Finland 30 different type traits are recorded. For routine evaluation Sweden and Denmark are using 1st lactation classifications, while Finland is using classifications from all lactations.

In the common Nordic evaluation all traits are used, and the numbers of parities included are the same as nationally. A common Nordic pedigree file is used. Records are edited according to national editing rules. The records are standardized to obtain similar phenotypic standard deviation across country, year and classifier.

Table 1. Number of records for Ayrshire and Holstein for stature

| | Ayrshire | Holstein |
|---------|----------|----------|
| Sweden | 66,086 | 64,627 |
| Denmark | 57,627 | 327,101 |
| Finland | 123.433 | 46.247 |

In routine evaluations Holstein and Ayrshire are run separately in Sweden and Denmark, but in Finland they are analysed jointly. There are many small herds with both Holstein and Ayrshire cows in Finland and therefore the herd effect is more accurately estimated

when both breeds are included. Different fixed and random effects are used in different countries, and in Sweden and Finland different fixed effects are used for different traits.

The Nordic models are based on the models used nationally. In country/countries where the fixed or random effect is not used, all records are placed in the same group. Same models are used for both Holstein and Ayrshire breeds.

The effects in the Nordic models:

| | |
|---|--------|
| • Calving month (DK) | Fixed |
| • Calving year (F) | Fixed |
| • Age or age x lactation (S, DK, F) | Fixed |
| • Month of classification (S, F) | Fixed |
| • Lactation stage (S, DK, F) | Fixed |
| • Classifier x time period (DK, F) | Fixed |
| • Classifier x lactation (DK) | Fixed |
| • Herd x time period/classifier x time period (S) | Fixed |
| • Herd x time period (DK, F) | Fixed |
| • Herd x time period (F) | Random |
| • Yield classes (F) | Fixed |
| • Time at visit (S, F) | Fixed |
| • Stature classes (F) | Fixed |
| • Animal | Random |
| • Residual | |

Where S, DK and F denote the country/countries where effect is used. The DMU-program package (Madsen and Jensen, 2002) was used to estimate the BV's.

In Sweden and Finland the classification of Holstein and Ayrshire are done by the same classifiers. In Denmark classification of Holstein and Ayrshire are done by separate classifiers, but the classification work is standardized across breeds.

Classifiers in Sweden, Denmark and Finland have participated in workshops, and the classifications in the countries are therefore standardized to a large extent. Genetic correlations between countries estimated by INTERBULL are high for Holstein and moderate for Ayrshire. The moderate correlations for Ayrshire might be due to methodology and weak genetic links. On the

basis of the Holstein parameters it seems reasonable to assume that the genetic correlation between the same traits in different countries is 1. Estimation of genetic parameters was not an object within the project. The genetic parameters used are previously estimated in the Nordic countries (table 2).

Table 2. Parameters used in the joint Nordic model. Herd variation, heritabilities and repeatabilities. Same genetic parameters are used for both Holstein and Ayrshire breeds

| | Stature | Dairy form | Rump angle | Rear legs side view | Foot angle | Fore udder | Udder cleft | Udder depth | Teat length | Teat placement (front) |
|----------------------|---------|------------|------------|---------------------|------------|------------|-------------|-------------|-------------|------------------------|
| Heritability | 0.61 | 0.31 | 0.32 | 0.23 | 0.18 | 0.25 | 0.22 | 0.37 | 0.41 | 0.20 |
| Repeatability | 0.80 | 0.37 | 0.61 | 0.59 | 0.51 | 0.49 | 0.53 | 0.56 | 0.58 | 0.37 |
| Herd ratio (C^2) | 0.1 | 0.07 | 0.07 | 0.06 | 0.08 | 0.07 | 0.05 | 0.11 | 0.05 | 0.04 |

Results

Results from a common Nordic run for Holstein and Ayrshire are validated with INTERBULL III method (Boichard et al. 1995). Nordic EBV's for Holstein and Ayrshire are also correlated to results from the INTERBULL routine run in May 2004. Further genetic trends on the basis of either Nordic EBV's or INTERBULL results are shown.

In the rest of this paper results from only 10 traits are shown.

Results for Holstein

An INTERBULL III test is performed for Nordic Holstein sires born between 1990 and 1994 with more than 20 classified daughters in the reduced dataset (table 3). Results show, that EBV's are within limits for all traits, except dairy form.

Table 3. INTERBULL III test for Nordic Holstein sires born between 1990 and 1994 with more than 20 classified daughters in the reduced dataset

| INTERBULL III | Stature | Dairy form | Rump angle | Rear legs side view | Foot angle | Fore udder | Udder cleft | Udder depth | Teat length | Teat placement (front) |
|---------------|---------|------------|------------|---------------------|------------|------------|-------------|-------------|-------------|------------------------|
| IB-limits | 0.058 | 0.011 | 0.016 | 0.014 | 0.011 | 0.014 | 0.010 | 0.019 | 0.011 | 0.015 |
| Number | 1499 | 1439 | 1439 | 1499 | 1499 | 1498 | 1498 | 1498 | 1497 | 1439 |
| Results | 0.031 | -0.022 | 0.003 | 0.002 | -0.001 | 0.004 | -0.003 | -0.006 | -0.007 | 0.009 |

To compare Nordic EBV's with INTERBULL EBV's correlations are made for sires from each country. In table 4 correlations between Nordic EBV's and INTERBULL EBV's on

Swedish, Danish and Finnish scale are calculated for Swedish, Danish and Finnish sires born in 1997-1998.

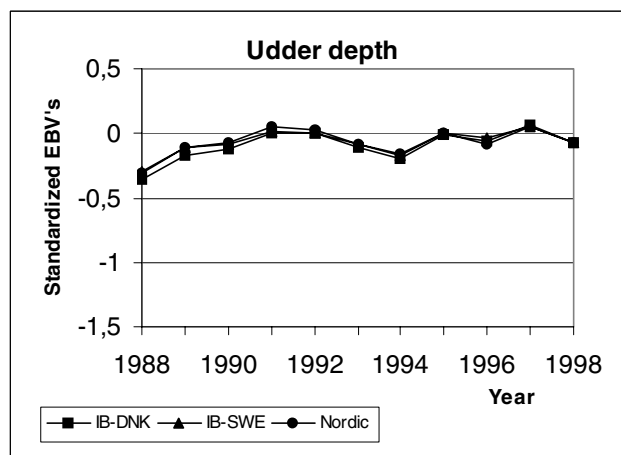
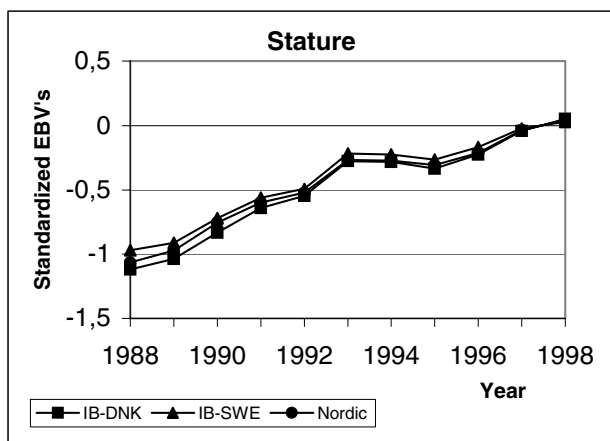
Table 4. Correlation between Nordic EBV's and INTERBULL EBV's for Swedish, Danish and Finnish Holstein sires born in 1997-1998. Sires with more than 20 classified daughters

| Country of sires | INTERBULL national scale | Stature | Dairy form | Rump angle | Rear legs side view | Foot angle | Fore udder | Udder cleft | Udder depth | Teat length | Teat placement (front) |
|---------------------|--------------------------|---------|------------|------------|---------------------|------------|------------|-------------|-------------|-------------|------------------------|
| Swedish sires (139) | IB Swedish scale | 0.98 | 0.95 | 0.97 | 0.95 | 0.95 | 0.97 | 0.96 | 0.97 | 0.97 | 0.97 |
| | IB Danish Scale | 0.97 | 0.92 | 0.96 | 0.94 | 0.92 | 0.95 | 0.93 | 0.97 | 0.97 | 0.97 |
| | IB Finnish scale | 0.96 | 0.85 | 0.97 | 0.94 | 0.86 | 0.95 | 0.93 | 0.95 | 0.97 | 0.94 |
| Danish sires (703) | IB Swedish scale | 0.99 | 0.95 | 0.99 | 0.97 | 0.96 | 0.96 | 0.95 | 0.99 | 0.99 | 0.98 |
| | IB Danish Scale | 0.99 | 0.99 | 0.99 | 0.99 | 0.98 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| | IB Finnish scale | 0.98 | 0.92 | 0.99 | 0.97 | 0.91 | 0.92 | 0.97 | 0.97 | 0.98 | 0.97 |
| Finnish sires (64) | IB Swedish scale | 0.97 | 0.88 | 0.97 | 0.95 | - | 0.94 | 0.91 | 0.96 | 0.98 | 0.94 |
| | IB Danish Scale | 0.97 | 0.85 | 0.97 | 0.95 | - | 0.92 | 0.89 | 0.96 | 0.98 | 0.95 |
| | IB Finnish scale | 0.97 | 0.95 | 0.97 | 0.96 | - | 0.95 | 0.94 | 0.97 | 0.99 | 0.96 |

Correlations between Nordic EBV's and INTERBULL EBV's on national scale are high for Swedish (0.95-0.98), Danish (0.98-0.99) and Finnish sires (0.94-0.99) for all traits.

As shown, correlations between Nordic EBV's and INTERBULL EBV's are high for the newly proven sires. In figures 1 and 2 the genetic trends for stature and udder depth are shown. In the

figures the EBV's are expressed in Nordic EBV's, INTERBULL EBV's in Danish scale and INTERBULL EBV's in Swedish scale for all Nordic sires. EBV's are standardized to an average of zero and standard deviation of one for all Nordic sire born in 1997-1998 with more than 20 classified daughters. The genetic trends for stature and udder depth are alike.



Figures 1 and 2. Genetic trend for stature and udder depth on the basis of Nordic EBV's or INTERBULL EBV's on Swedish and Danish scale - Holstein

Results for Ayrshire

An INTERBULL III test is performed for Nordic Ayrshire sires born between 1990 and 1994 with more than 20 classified daughters

in the reduced dataset (table 5). Results show, that EBV's are within limits for all traits, except dairy form and fore udder attachment.

Table 5. INTERBULL III test for Nordic Ayrshire sires born between 1990 and 1994 with more than 20 classified daughters in the reduced dataset

| INTERBULL III | Stature | Dairy form | Rump angle | Rear legs side view | Foot angle | Fore udder | Udder cleft | Udder depth | Teat length | Teat placement (front) |
|------------------|---------|---------------|---------------|------------------------|---------------|---------------|----------------|----------------|----------------|---------------------------|
| IB-limits | 0.073 | 0.011 | 0.014 | 0.011 | 0.009 | 0.011 | 0.011 | 0.018 | 0.019 | 0.013 |
| Number | 516 | 327 | 327 | 516 | 515 | 512 | 512 | 512 | 506 | 326 |
| Results | 0.001 | -0.019 | -0.010 | 0.012 | 0.001 | 0.014 | 0.009 | -0.013 | -0.001 | -0.007 |

To compare Nordic EBV's with INTERBULL EBV's correlations are made for sires from each country. In table 6 correlations between Nordic EBV's and INTERBULL EBV's on

Swedish, Danish and Finnish scale are calculated for Swedish, Danish and Finnish sires born in 1997-1998.

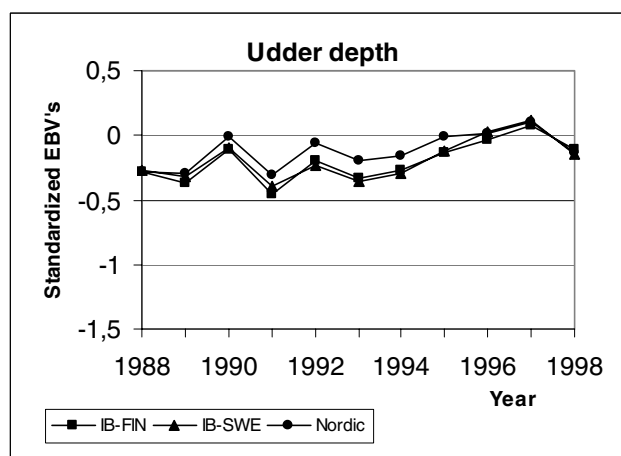
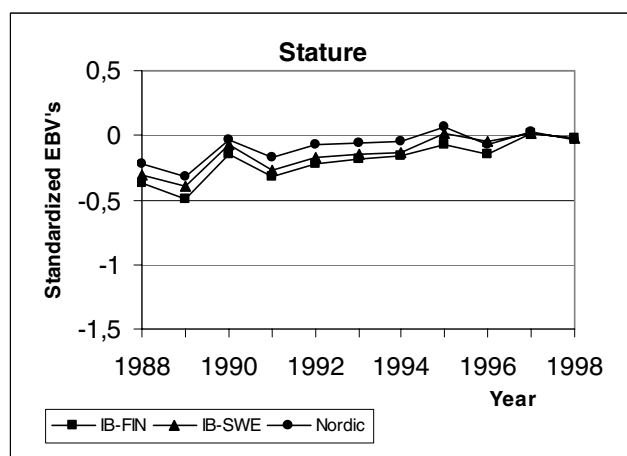
Table 6. Correlation between Nordic EBV's and INTERBULL EBV's for Swedish, Danish and Finnish Ayrshire sires born in 1997-1998. Sires with more than 20 classified daughters

| Ayrshire | | Stature | Dairy form | Rump angle | Rear legs side view | Foot angle | Fore udder | Udder cleft | Udder depth | Teat length | Teat placement (front) |
|------------------------|------------------|---------|---------------|---------------|------------------------|---------------|---------------|----------------|----------------|----------------|---------------------------|
| Swedish sires (166) | IB Swedish scale | 0.99 | 0.96 | 0.98 | 0.97 | 0.95 | 0.96 | 0.96 | 0.98 | 0.98 | 0.98 |
| | IB Danish Scale | 0.99 | 0.94 | 0.98 | 0.97 | 0.92 | 0.91 | 0.96 | 0.98 | 0.98 | 0.97 |
| | IB Finnish scale | 0.98 | 0.91 | 0.98 | 0.97 | 0.84 | 0.95 | 0.91 | 0.97 | 0.97 | 0.96 |
| Danish sires (111) | IB Swedish scale | 0.98 | 0.98 | 0.99 | 0.98 | 0.97 | 0.96 | 0.98 | 0.98 | 0.98 | 0.97 |
| | IB Danish Scale | 0.99 | 0.99 | 0.99 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.99 | 0.99 |
| | IB Finnish scale | 0.97 | 0.99 | 0.99 | 0.97 | 0.81 | 0.96 | 0.95 | 0.98 | 0.99 | 0.97 |
| Finnish sires (199) | IB Swedish scale | 0.97 | 0.85 | 0.96 | 0.97 | - | 0.94 | 0.89 | 0.97 | 0.97 | 0.93 |
| | IB Danish Scale | 0.97 | 0.90 | 0.97 | 0.96 | - | 0.97 | 0.89 | 0.97 | 0.98 | 0.94 |
| | IB Finnish scale | 0.98 | 0.93 | 0.97 | 0.98 | - | 0.97 | 0.95 | 0.98 | 0.98 | 0.96 |

Correlations between Nordic EBV's and INTERBULL EBV's on national scale are high for Swedish (0.95-0.99), Danish (0.98-0.99) and Finnish sires (0.93-0.98) for all traits.

As shown, correlations between Nordic EBV's and INTERBULL EBV's are high for the newly proven sires. In figures 3 and 4 are genetic trends for stature and udder depth shown. In

the figures are the EBV's expressed in Nordic EBV's, INTERBULL EBV's in Finnish scale and INTERBULL EBV's in Swedish scale for all Nordic sires. EBV's are standardized to an average of zero and standard deviation of one for all Nordic sire born in 1997-1998 with more than 20 classified daughters. Genetic trends are fairly alike.



Figures 3 and 4. Genetic trend for stature and udder depth on the basis of Nordic EBV's or INTERBULL EBV's on Swedish and Finnish scale - Ayrshire

Conclusions

The results show, that it is possible to estimate BV's for type traits across borders, in a way where INTERBULL validations are fulfilled.

Results also show that there are high correlations between Nordic EBV's and EBV's calculated by INTERBULL. The genetic trends on the basis of either Nordic EBV's or INTERBULL EBV's are also alike.

Genetic correlations between the Nordic countries estimated by INTERBULL are high for Holstein and more moderate for Ayrshire. The harmonization of the classification work in the Nordic countries indicates that the estimated genetic correlations used in INTERBULL evaluations for Ayrshire might be underestimated. Presumably the reasons for the moderate correlation are the method used to estimate correlations between countries and the weak genetic links between countries

The harmonization of the scoring between countries and the results shown in this paper justifies the use of a genetic correlation of 1 for both Holstein and Ayrshire. This also has an important practical meaning, as it enables the same ranking of sires and cows in the Nordic countries and support corporation among AI-societies in the tree countries.

References

- Boichard, D. Bonaiti, B., Barbat, A. and Mattalia S. 1995.** Three methods to validate the estimation of genetic trend for dairy cattle. Journal of Dairy Science 78, 431-437.
- Madsen, P., and Jensen, J. 2002.** A user's guide to DMU. A package for analysing multivariate mixed models. Version 6, release 4.3. 19 pp.