News - NAV routine evaluation
7 November 2017

The latest NAV routine evaluation for yield, fertility, type, udder health, general health, calving traits, milkability, temperament, growth, longevity, youngstock survival, claw health and NTM took place as scheduled. NAV carried out three evaluations per trait group:

Holstein evaluation, including data from: Danish Holstein, Swedish Holstein, Finnish Holstein, Finnish Ayrshire and Finn Cattle.

Red Dairy Cattle evaluation, including data from: Danish Red, Swedish Red, Finnish Ayrshire, Finnish Holstein and Finn Cattle.

Jersey evaluation, including data from: Danish Jersey, Swedish Jersey and Finnish Jersey.

Extraction dates
Dates for extraction of data from national databases are given in table 1.

Table 1. Dates for extraction of data from the national databases

Trait	Denmark	Finland	Sweden
Yield	27.09.2017	17.09.2017	21.09.2017
Type, milkability and temperament	27.09.2017	17.09.2017	20.09.2017
Fertility	27.09.2017	17.09.2017	22.09.2017
Udder health and other disease	27.09.2017	17.09.2017	22.09.2017
Calving	27.09.2017	17.09.2017	22.09.2017
Longevity	27.09.2017	17.09.2017	22.09.2017
Growth	27.09.2017	17.09.2017	20.09.2017
Claw health	27.09.2017	17.09.2017	22.09.2017
Youngstock survival	02.10.2017	17.09.2017	22.09.2017

Data used in genomic prediction
Genotypes were extracted from the joint Nordic SNP data base 19 October 2017. INTERBULL information from August 2017 was included in the genomic prediction.

News in relation to NAV genetic evaluation
Herd book
Merge of herd books for Danish Red Holstein and Danish Holstein

Genomic prediction
No changes

Traditional evaluation
General health model improved

Merge of herd books for Danish Red Holstein and Danish Holstein
Seges has merged the herd books for Danish Red Holstein and Danish Holstein. All Danish Red Holstein animals which fulfil the criteria being a pure breed Holstein (minimum 87.5% Holstein genes) is still included in the Holstein evaluation. Red Holstein animals which do not fulfill the criteria being a pure breed Holstein (below 87.5% Holstein genes - mainly very old animals) are removed from the evaluation. All Holstein animals are now published on the same base meaning that the Red Holstein scale does not exist anymore and the separate scale for Danish Red Holstein is removed from the NAV bull page (https://nordic.mloy.fi/navbull)

General health

The main improvements in the General Health evaluation include changes in data, trait definitions and the change from a sire to an animal model. Details on each of these changes are given below as well as the effects on the breeding values for sires and cows.

1. Data

New editing procedures have been developed to harmonize the data used in the General Health (GH) evaluation across all three Nordic countries. For Denmark claw trimmer data were incorrectly included in the breeding value for “Feet and Leg problems” and at the same time also in Claw Health evaluation. In the new GH evaluation these data, which represented about 12% of all the Danish Feet&Leg records, have been removed. For Sweden, about 10% of lactations with incomplete reporting of veterinary treatments, have been removed. The phenotypic level (frequency of diseases) for Sweden after excluding data from these herds increased about 10% for the whole time period and the change was constant over years. Denmark and Finland had already similar editing in place.

Additionally, the GH evaluation has been upgraded to include two new traits: β-hydroxybutyrate (BHB) and Acetone as indicator traits in the GH evaluation. At present only data from Danish herds are available.

Until now, the same genetic evaluation model for GH was used for Red Dairy Cattle (RDC) and Holstein (HOL); whereas the evaluation for Jersey (JER) considered only Metabolic Disorders, and only Danish data. In the new GH evaluation all three breeds are evaluated for the same traits, and all three countries supplied JER data, however Finnish and Swedish in a much smaller degree than Denmark. A summary of the changes is in Table 2.

Table 2. Changes in data used in the General Health evaluation

Country	Changes
Denmark	Claw trimmer data removed BHB and acetone data included
Finland	Finnish Jersey data included
Sweden	Herds with incomplete reporting of veterinary treatments removed Swedish Jersey data included

2. Trait definitions

The General Health index changed from including four sub traits to include five sub traits by splitting the group of Metabolic Disorders into two traits: Ketosis and Other Metabolic Disorders (Table 3). This was done to enable utilizing the high correlations between Ketosis with BHB and Acetone of 0.68 and 0.78, respectively. Including BHB and Acetone improves the reliability of EBV for Ketosis considerably for bulls having Danish daughters with observations for those traits. However, it has very little effect on bulls having mainly progeny in Sweden and Finland, as BHB and Acetone data is not yet available in these countries (Table 4).

Table 3. Trait definition (indicators traits in italics) in the old and new evaluation for General Health.

Old GH evaluation - Jersey (Danish national model)	Old GH evaluation - RDC and Holstein (NAV model)	New NAV GH evaluation - all breeds
	Early Reproductive Disorders	Early Reproductive Disorders
	Late Reproductive Disorders	Late Reproductive Disorders
	Feet&Leg problems	Feet&Leg problems
Metabolic Disorders	Metabolic Disorders	Ketosis
		Other Metabolic Disorders
	Clinical Mastitis	*Clinical Mastitis*
		Acetone[1]
		β-hydroxybutyrate (BHB)[1]

[1] BHB and Acetone data is based on milk recording from day 10-60 in the first three lactations (only weighted EBV across lactations will be published).

Table 4. Availability of BHB and acetone data by country and breed

	Holstein	RDC	Jersey
Denmark	2013-	2013-	2013-
Sweden	Not yet collected on a regular basis		
Finland	Not yet collected on a regular basis		
% of population	60%	15%	95%

3. Genetic model and genetic parameters

The main improvement in the genetic model for GH traits is the change from a sire model to an animal model. This has some impact on EBVs for bulls. However it has a larger effect on EBVs for individual cows. The change to an animal model means that cows in the future can be included in the reference population used to calculate genomic breeding values for GH traits. As a consequence of the new division of metabolic disorders into two traits and the inclusion of BHB and Acetone, some genetic parameters have also been re-estimated for HOL and RDC (Table 5).

In the new NAV model for Jersey all the genetic parameters for all traits have been estimated. A further improvement in the genetic model, which has much less impact on bulls EBVs, is the change of the herd-year effect from random to fixed and the deletion of the herd-period (5 year) effect from the model.

Table 5. Genetic correlations and heritabilities (on the diagonal) in first lactation for Early Reproductive Disorders (ERP), Late Reproductive Disorders (LRP), Other Metabolic Disorders (OMB), Ketosis (KET), Feet&Legs (FLP), β-hydroxybutyrate (BHB) and Acetone (ACE) for HOL, RDC and JER.

Traits	ERP	LRP	OMB	KET	FLP	BHB	ACE
HOL							
Early Reproductive Disorders	0.020						
Late Reproductive Disorders	0.40	0.010					
Other Metabolic Disorders	0.40	0.29	0.006				
Ketosis	0.29	0.21	0.74	0.012			
Feet&Leg problems	0.35	0.36	0.38	0.19	0.010		
β-hydroxybutyrate	0.05	-0.02	0.48	0.65	0.01	0.149	
Acetone	0.03	0.03	0.65	0.76	0.04	0.89	0.053
RDC							
Early Reproductive Disorders	0.010						
Late Reproductive Disorders	0.24	0.010					
Other Metabolic Disorders	0.30	0.09	0.003				
Ketosis	0.26	-0.08	0.64	0.007			
Feet&Leg	0.00	-0.01	0.39	-0.06	0.010		
BHB	0.04	-0.02	0.46	0.63	0.01	0.149	
Acetone	0.04	-0.09	0.62	0.74	0.10	0.89	0.053
JER							
Early Reproductive Disorders	0.009						
Late Reproductive Disorders	0.32	0.003					
Other Metabolic Disorders	0.47	-0.05	0.005				
Ketosis	0.39	0.10	0.55	0.015			
Feet&Leg	0.28	0.04	0.22	0.34	0.011		
BHB	0.04	0.00	0.33	0.60	0.08	0.052	
Acetone	0.05	-0.04	0.40	0.72	0.04	0.92	0.017

4. Summary of changes and effects on breeding values

The upgrade of the GH evaluation includes new data editing procedures, new trait definitions, new genetic parameters, and changes in the model used for the evaluation. All together, these changes will have significant impact on bull's EBVs. However, the largest change is that individual cow EBVs for GH include own phenotypes from November 2017. A summary of the changes is in Table 6 and summaries of the effects on sire EBVs are in Tables 7, 8 and 9.

Table 6. Summary of the major differences between November 2017 evaluation and old GH evaluation

Old evaluation	November 2017 Evaluation	Comments	Effect
Danish Feet&Leg problems included claw trimmer data	Claw trimmer data is removed	Claw trimmer data are also in the Claw Health evaluation and including it in the GH evaluation was double counting of information	Large changes in EBV for Danish bulls. Very small changes in EBV for Finnish and Swedish bulls
Swedish herds with incomplete reporting of veterinarians treatments included	Swedish herds with incomplete reporting of veterinarians treatments removed	Some Swedish veterinarians do not systematically report treatments, creating incomplete data for some herds. This needed to be treated in the upgrade of GH evaluation. The problem from other countries was already handled	Small changes in EBV for Swedish bulls which had been used in the herds that have been removed
Jersey evaluation done for metabolic disorders only. No Swedish and Finnish data included	GH NAV evaluation for Jersey – data from all three Nordic countries	The Danish national model for metabolic disorders is now replaced with a NAV model including new genetic parameters and breeding values for all the traits in the GH evaluation for Danish, Swedish and Finnish Jersey cows	Large changes in EBV for Jersey bulls
No use of BHB and acetone data as indicator traits in the GH evaluation	Use of Danish BHB and Acetone data as indicator traits in the GH evaluation	BHB and Acetone data is up to now only available from Denmark. There are genetic correlations between BHB and acetone with all traits in GH evaluation. However the highest correlations are between Ketosis with BHB and Acetone	Effects on bulls with daughters having BHB/Acetone information and cows with own information. Some changes in EBV for Danish bulls and to a lesser extend Swedish and Finnish bulls. Increases the EBV reliability especially for Ketosis
Metabolic Disorders as sub-trait for GH	Metabolic Disorders is split into Ketosis and Other Metabolic Disorders	The trait definition between the old and the new model has changed. Comparisons are made between the old ”metabolic disorders” and the new “other metabolic disorders”	Effects the publication of EBVs and the weighing of traits into NTM
Sire model	Animal model	Cows get breeding values that are based on own information. Cows can be used in the reference population for genomic prediction.	Changes in EBV for bulls and cows
Herd-year effect as random	Herd-year effect as fixed		Minor effect
Herd-year(5years)	Effect has been removed		Minor effect
In-house program for reliability estimation	Reliability estimation using Apax		New reliabilities are on average lower than old reliabilities

The upgrade of the GH evaluation introduced changes, for bulls and cows, for all breeds, traits and countries. Breeding value changes for the GH index on AI bulls born after 2009 and with a reliability for GH index > 0.35 are substantial. Across country correlations for the GH index between the old and the new EBVs, are of 0.89 for RDC and 0.92 for HOL (Table 7). The proportion of bulls that changed less than four units of EBVs for the GH index is of 76% for HOL (Table 8) and 75% for RDC (Table 9).

Across country correlations between EBVs from new and old evaluation for sub-traits ranged from 0.76 to 0.96 and from 0.76 to 0.92 for HOL and RDC, respectively, for AI bulls born after 2009 and with a reliability for GH index > 0.35 (Table 7). In accordance with the new data editing of Feet&Leg data from Denmark, the lowest correlations are found for Feet&Leg problems in Danish Holstein bulls. The next largest effect on EBVs is illustrated by the correlation of Ketosis and Other Metabolic Disorders from the new evaluation with Metabolic Disorders from the old evaluation. In this case the effect is the result of a re-definition of the trait, where Metabolic Disorders has been split into Ketosis and Other Metabolic Disorders, thus the correlation is between two slightly different traits.

The correlations for RDC in Sweden are on average lower than for Finland (Table 7), which can be related to the editing of herds in Sweden. From an exercise where the effect of editing of herds was studied in isolation, the differences in EBV were largest for Swedish bulls were some of the herds have been removed, whereas for Finnish bulls the changes were very small.
For Jersey, the old evaluation considered only Metabolic Disorders, and only Danish data. Correlations between the old Metabolic Disorders with the new Other Metabolic Disorders and Ketosis were of 0.70 and 0.51, respectively (not shown).

Table 7. Across country and within-country correlations between EBVs from the new (November 2017) evaluation and the old (August 2017) evaluation for the GH index and included traits for AI bulls with a reliability for the GH index above 35% born after 2009

Birth country of the bull	Across countries		Denmark		Finland		Sweden	
Breed	HOL	RDC	HOL	RDC	HOL	RDC	HOL	RDC
General health index	0.92	0.89	0.92	0.83	0.88	0.92	0.93	0.88
Early Reproductive Disorders	0.96	0.92	0.97	0.96	0.89	0.91	0.93	0.89
Late Reproductive Disorders	0.92	0.90	0.92	0.89	0.96	0.91	0.93	0.88
Ketosis[a]	0.78	0.76	0.78	0.71	0.65	0.80	0.81	0.72
Other Metabolic Disorders[a]	0.82	0.80	0.82	0.62	0.75	0.80	0.87	0.83
Feet&Leg	0.78	0.90	0.78	0.84	0.77	0.90	0.84	0.92

[a] Correlated with Metabolic Disorders from old (August 2017) evaluation

The frequency of EBV changes for all breeds is also largest for those traits (Feet&Leg/Other Metabolic Disorders) where the input data have been modified or the trait has been re-defined (Tables 8, 9 and 10).

Table 8. Frequency (%) of changes in EBVs between the new evaluation and the old evaluation for HOL bulls born after year 2000 (and with reliability for GH index > 35%) split into bulls that change 3 or less than 3 units (≤ 3), from 4 to 8 (4-8) units and more than 8 (>8) unit changes.

Birth country of the bull	Across countries			Denmark			Finland			Sweden		
Change in EBV index units	≤3	4-8	>8	≤3	4-8	>8	≤3	4-8	>8	≤3	4-8	>8
General health index	76	21	2	61	37	2	63	35	1	66	31	2
Early Reproductive Disorders	86	13	1	77	22	1	62	36	2	73	26	1
Late Reproductive Disorders	77	20	3	64	33	3	61	34	5	61	35	4
Ketosis[a]	49	30	21	38	43	19	37	37	26	33	43	24
Other Metabolic Disorders[a]	57	31	12	44	44	12	50	38	11	50	40	10
Feet&Leg	55	29	15	40	42	18	54	40	6	54	36	10

[a] Compared with Metabolic Disorders from old (August 2017) evaluation

Table 9. Frequency (%) of changes in EBVs between the new evaluation and the old evaluation for RDC bulls born after year 2000 (and with reliability for GH index > 35%) split into bulls that change 3 or less than 3 units (≤3), from 4 to 8 (4-8) units and more than 8 (>8) unit changes.

Birth country of the bull	Across countries			Denmark			Finland			Sweden		
Change in EBV index units	≤3	4-8	>8	≤3	4-8	>8	≤3	4-8	>8	≤3	4-8	>8
General health index	75	23	2	74	25	1	74	25	1	76	22	2
Early Reproductive Disorders	72	24	4	72	25	3	69	28	2	74	24	2
Late Reproductive Disorders	65	28	7	73	22	5	62	34	4	65	30	5
Ketosis[a]	56	29	15	57	32	11	57	32	11	54	33	13
Other Metabolic Disorders[a]	63	28	8	63	30	8	59	35	6	69	29	2
Feet&Leg	70	25	5	60	36	4	74	24	2	71	27	2

[a] Compared with Metabolic Disorders from old (August 2017) evaluation

Table 10. Frequency (%) of changes in EBVs between the new evaluation and the old evaluation for JER bulls born after year 2000 (and with reliability for GH index > 35%) split into bulls that change 3 or less than 3 units (≤3), from 4 to 8 (4-8) units and more than 8 (>8) unit changes.

Birth country of the bull	Across countries		
Change in EBV index units	≤3	4-8	>8
Ketosis[a]	30	29	41
Other Metabolic Disorders[a]	25	24	52

[a] Compared with Metabolic Disorders from old (August 2017) evaluation

Cow EBV correlation for Finish and Danish RDC and HOL cows are at the same level as illustrated in Table 11 for Swedish cows. For Jersey the correlations are lower (about 0.50) due to the significant changes in traits involved in the evaluation for Jersey.

Table 11. Cow EBV correlations, average and standard deviation of the difference in the GH index between the new and the old evaluation for RDC, and HOL cows from Sweden born between 1995 and 2015.

Trait	General Health index	
Breed	RDC	HOL
Correlation – old vs. new evaluation	0.89	0.88
EBV average difference[a]	-0.05	0.37
Standard deviation difference[a]	2.46	2.84

[a] Difference = New evaluation – Old evaluation (August 2017)

Regarding reliability estimation of EBVs the change includes the use of Apax software instead of the in-house program for estimation of reliabilities. The new reliabilities for bulls are on average a bit lower than old reliabilities. Following the expectations, EBV reliabilities for cows with BHB and Acetone observations were higher for the GH index for HOL and in general were higher for most of the sub-traits in all breeds compared to cows without BHB and Acetone observations (Table 12).

Table 12. Approximate reliabilities for seven sub-traits and the GH index, for cows with observations but without own progeny, separate for cows with or without BHB and Acetone (Ace) observations. (N = number of cows in that group)

Breed	BHB&Ace observations	ERP[a]	LRP[b]	OMB[c]	KET[d]	FLP[e]	GH[f]	BHB[g]	ACE[h]	N
HOL	Yes	0.30	0.28	0.34	0.36	0.28	0.32	0.44	0.41	329,277
	No	0.29	0.28	0.29	0.29	0.28	0.30	0.25	0.27	2,842,827
RDC	Yes	0.28	0.27	0.32	0.34	0.26	0.30	0.43	0.41	31,382
	No	0.27	0.27	0.27	0.27	0.26	0.28	0.23	0.25	1,850,730
JER	Yes	0.28	0.25	0.28	0.31	0.27	0.29	0.35	0.33	56,705
	No	0.27	0.25	0.26	0.27	0.27	0.28	0.24	0.25	202,454

[a]Early Reproductive Disorders (ERP), [b]Late Reproductive Disorders (LRP), [c]Other Metabolic Disorders (OMB), [d]Ketosis (KET), [e]Feet&Legs (FLP), General Health index, [g]β-hydroxybutyrate (BHB) and [h]Acetone (ACE).

The changes in GEBVs for General health follow the changes observed in EBVs meaning that correlations between the GEBVs from the new and the old model are on same level as observed for EBVs for all breeds (Table 7).

Genetic base

EBVs for bulls and females are expressed on the same cow base. This genetic evaluation included cows born from 07.11.2012 to 07.11.2014 in the genetic base (average 100).

Publication of NTM for Nordic and foreign bulls

NTM is published if the bull has official EBVs (NAV (G)EBV or international EBV) for Yield, Mastitis and Type. By official means for NAV EBVs that the NAV thresholds are met, and for international EBVs (IB EBVs) that Interbull EBVs for the single bull exist. For traits without a NAV (G)EBV or an IB (G)EBV a NAV pedigree index is calculated.

For bulls with a Nordic herd book number the pedigree index follows the principles described in the October 2008 routine information. For foreign bulls without a Nordic herd book number the pedigree index is calculated in as ½(EBVsire-100) +1/4(EBVmgs-100) +100. If EBVsire or EBVmgs is not official NAV EBVs then 100 is used.

Publication of EBVs/GEBVs
Official EBVs/GEBVs for bulls used for AI in Denmark, Finland or Sweden are published at the NAV bull search page NAV Bull Search.

Official NAV GEBVs for foreign AI bulls not used for AI in Denmark, Finland and Sweden are published at NAV homepage. The excel sheets also include GEBVs for bulls used for AI in Denmark, Finland and Sweden. The excel sheets include AI bulls that are 10 month to 5 years old at the date of publication, and is mainly useful for foreign AI-companies.

Interbull EBVs/GEBVs are published at the NAV Interbull Search.

NAV – frequency and timing of routine runs
NAV has 4 large evaluations per year, which include updated phenotypic and genomic data, and additional eight small runs including updated genotypes. In table 12 the NAV and INTERBULL release dates for 2017 are shown.

Table 12. NAV and INTERBULL release dates in 2017/18. EBVs released at NAV dates in bold will be delivered to international genetic evaluation.

Month	NAV Small run[1)]	NAV Large runs[2)]	INTERBULL
October 2017	3		
November 2017		7	
December 2017	5		5
January 2018	4		
February 2018		**6**	
March 2018	6		
April 2018	3		3
May 2018		2	
June 2018	6		
July 2018	3		
August 2018		**7**	7
September 2018	4		
October 2018	2		
November 2018		**6**	
December 2018	4		4

[1)] Genotypes updated; [2)] Genotypes and phenotypes updated

You can get more information about the joint Nordic evaluation:
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