Youngstock Survival in Nordic Cattle Genetic Evaluation

E. Carlén[1], J. Pedersen[2], J. Pösö[3], J-Å. Eriksson[1], U.S. Nielsen[2] and G.P. Aamand[4]
[1] Växa Sweden, Box 288, 75105 Uppsala, Sweden
[2] SEGES Cattle, Agro Food Park 15, 8200 Aarhus N, Denmark
[3] Faba co-op, P.O. BOX 40, FIN-01301 Vantaa, Finland
[4] Nordic Cattle Genetic Evaluation; Agro Food Park 15, 8200 Aarhus N, Denmark
Corresponding author: Emma.Carlen@vxa.se

Abstract

Increased survival rates in dairy cattle is beneficial both from economical, animal welfare and consumer perspectives. The purpose of the joint breeding goal, Nordic Total Merit (NTM), for Holstein, Jersey and RDC in Denmark, Finland and Sweden is to give farmers the most profitable cows. Until May 2016, NTM included survival in calves during the first 24 hours after birth and cow longevity, but ignored the rearing period of youngstock. This paper describes the new breeding values for youngstock survival, based on young bulls and heifers, and the process for including it in NTM.

Key words: survival traits, youngstock, total merit index, genetic parameters

Introduction

The joint breeding goal Nordic Total Merit (NTM) for Red dairy cattle (RDC), Holstein and Jersey in Denmark, Finland and Sweden focus on productive and long-lasting, thus profitable cows.

Survival traits are economically important and today they are included in three different sub-indices in NTM. Firstly, calf survival that measure if calf is born alive and survive the first 24 hours after birth (stillbirth). Secondly, youngstock survival (YSS) covering the rearing period from day 2 and up to 15 and 6 months for heifers and bull calves respectively. Finally, cow longevity measuring the number of lactations that cow produces. By adding YSS in May 2016, NTM now covers survival during the whole life-time of animals.

The main reason why Nordic Cattle Genetic Evaluation (NAV) wanted to include also YSS in NTM is that losing young animals during rearing period implies economic loss. Either the farmer will lose a replacement heifer or get reduced income from beef sales. Besides this it is associated with extra health costs and work load. Moreover, survival in young animals is important in an animal welfare and consumer perspective.

The tradition in the Nordic countries of breeding for more live-born calves and increased cow longevity have most probably prevented an impaired genetic level for YSS. However, to improve this trait, direct selection is essential. This study proves that this is possible to do despite the low heritability.

The aim of this paper is to describe the genetic evaluation model for youngstock survival (including the available data, trait definitions and genetic parameters) as well as the economic values of youngstock survival and the effect of including it in NTM. In a report by Pedersen, *et al.* (2014) this is described more in detail.

Materials and Methods

Data

The national cow data bases in Denmark, Finland and Sweden contain most important information on the animals such as pedigree, production results, diseases and inseminations. Information on deaths, slaughters and movements to new herd as well as the date of these events are also available. For YSS we include calves born from 1998 and onwards that are alive after the first 24 hours from birth.

Excluded are calves from multiple births or embryo transfers, animals killed during first seven days of life, as well as malformed calves.

From this edited data set, all animals that are registered as slaughtered or sold are excluded within defined time periods (see trait definition).

Trait definition

YSS is divided on sex and rearing period to create four separate single traits. For both heifers and bulls the first period is from day two after calving to one month of age. The second period is from 2 to 15 months for heifers and from 2 to 6 months for bulls.

There are two reasons for dividing the rearing period. One reason is that many calves are moved at the age of one month of life. Heifers can be moved to specialized herds rearing heifers and bull calves to fattening herds. By dividing the trait in two periods we can better handle the different environments in the model.

The other reason is that YSS has been shown to be genetically different traits early and later in life. One possible reason for this could be because of that different parts of the immune system are involved depending on age. For young calves pneumonia and diarrhea are common reasons for death whereas this is not the case in older calves and youngstock.

The division based on sex is due to differences in survival rates, and that the longer late time period for heifers was not applicable in bull calves since many of them are slaughtered at an age of 7-12 months.

Phenotypic averages for survival rate (see Table 1) in the defined traits vary with breed and sex and has been constant over years. For all breeds survival is higher for heifers than for bulls and for RDC and HOL survival is higher in first compared to second period – note that the latter is a much longer period. For these two breeds the average survival for the full period is above 93%. Corresponding figure for JER is 86%.

Table 1. Average phenotypic survival rates.

		Average survival (%)[2]		
Trait[1]	Period	HOL	RDC	JER[3]
HP1	Day2–1 mo	97.5	97.4	92.6
HP2	1-15mo	96.3	95.4	93.4
BP1	Day2–1 mo	96.0	96.1	-
BP2	1-6mo	96.0	94.4	-

[1]Traits are divided on heifer (H) and bulls (B) and early (1) and late (2) time period.
[2]Averages are across countries (Denmark, Finland and Sweden) and for animals born 2008-2012.
[3]Averages for JER bulls not shown because of too little data available.

Genetic parameters

Genetic parameters used in the genetic evaluation were estimated in a Danish calf survival project (Buch, 2012). Heritabilities on observed scale for the four YSS traits are low, around 1-3%. The low heritability is mainly due to low frequencies of dead animals and large environmental variation. However, genetic variation exists so genetic improvement in YSS is possible. Genetic correlations between single traits are presented in Table 2.

Table 2. Genetic correlations between youngstock survival traits[1] across breeds.

	Genetic correlations		
	BP1	HP2	BP2
HP1	0.9-0.95	0.4-0.75	0.3-0.6
BP1		0.4-0.8	0.4-0.6
HP2			0.9-0.99

[1]Traits are divided on heifer (H) and bulls (B) and early (1) and late (2) time period.

Genetic correlations are fairly high within period and across sex, above 0.9. They are lower and of moderate size (0.4-0.75) between periods within sex.

Genetic evaluation model

The genetic evaluation model is a multiple-trait linear animal model for the four YSS traits.

Fixed effects
- Herd x 5-year birth period
- Country x year x birth month
- Country x transfer to a new herd (0/1) x month of transfer (only for HP2 and BP2)
- Heterozygosity (breed combinations included as fixed regressions)

Random effects
- Phantom parent groups defined by birth year and original breed group
- Herd x year of birth
- Genetic effect of animal

Comment on model effects

The fixed effect of transfer to new herd is only included for late period and if transfer occurs within 60 days from onset of that period. The reason why the effect is excluded for other time periods is that transfer is common for both heifers and bulls in early period as well as for heifers in end of late period and transferred calves have a higher survival rate than non-transferred animals since an animal has to be alive to be transferred.

The reason why we have herd-year as both a fixed effect (grouped in 5-year periods) and random is to reduce the problem with non-informative herds that can be common in small herds if all animals survive and we have no variation for the trait.

Results & Discussion

Implementation in routine

In November 2014 NAV implemented YSS in routine evaluation and started to publish estimated breeding values (EBV) and a sub-index for YSS. This is created by weighing together EBVs for the four single traits with economic weights (EW) for each of the traits ($EBV_{HP1}*EW_{HP1}+...+EBV_{BP2}*EW_{BP2}$). EW are based on economic values of 1 survival unit and standard deviation of survival rate for each trait.

In February 2016 GEBV for YSS was published for the first time and in May 2016 YSS was included with economic weight in NTM.

Brief overview of economic model with YSS

To get economic values for YSS some additional biological and economic assumptions were needed in the original economic model used to create values for NTM when it was introduced 2008 (Pedersen *et al.*, 2008).

Additional biological assumptions concerned survival rates and average age of death of youngstock. The latter have an effect of the feed costs.

There were some differences in both factors between genders, countries and breeds. As mentioned above survival rates were for example lower in bulls than in heifers and lowest for Jersey breed. The range for survival in the different traits varied from 98.5% (HP2, Finnish Holstein) to around 90% (BP1, Jersey).

Additional economic assumptions are costs for destruction of dead animal, extra cost to prevent death and extra work cost.

For a calf that dies within the first month of life (P1) the costs are similar to the estimated cost for still birth (destruction €21 plus extra work 0.25 hours) but adding an extra cost of €5 as a cost for effort to prevent death in calf plus feed cost up to death of animal.

For a calf that dies after the first month (P2) there is a similar cost of destruction as in first period plus extra work 0.5h, extra cost €10 as an effort to prevent death and feed cost up to death.

Animal value, slaughter price and costs associated to feeding, housing and labour are associated to economic value of YSS and were already included in the model. The same values were kept since the relation between income and cost, e.g. milk price and feed costs, has been relatively constant over time. For example the economic value of a heifer was set to around €1200 for RDC and Holstein and €700 for Jersey.

By adding YSS in economic model to get economic values for this trait, the economic values for some other traits were somewhat reduced (for example still birth) since part of the value for YSS was earlier included in those traits. It can be mentioned that a revision process of NTM and all its economic values will be initiated during 2017.

Economic values

The economic values for the single YSS traits can be seen in Table 3.

Table 3. Economic values of youngstock survival traits in different breeds (across countries) expressed as value in Euro of improving survival rate with 1%-unit per cow and year.

Trait	HOL	RDC	JER
HP1	3.45	3.55	2.00
HP2	4.05	4.15	2.41
BP1	1.29	1.43	0.27
BP2	1.79	2.02	0.79

Multiplying the values in Table 3 with 100 gives a rough estimate of the value of one lost animal in each of the periods.

Looking within the Holstein breed, the highest value is for HP2 and the lowest for BP1– it cost about €405 losing a Holstein heifer in late rearing period compared to €129 of losing a Holstein bull calf during the first month of life.

In Table 4 the economic value in Euro of 1 index unit for YSS as well as for other breeding goal traits. The figures represent economic weights in NTM.

For YSS the values are €2.03, €1.40 and €0.92 for RDC, Holstein and Jersey respectively. That the value is highest for RDC is because of higher genetic variation in survival rate and a higher value for beef in this breed. Lowest value for Jersey is due to lower beef value.

Table 4. Economic value (euro) of an index unit for traits included in Nordic Total Merit index (NTM).

Sub-index	HOL	RDC	JER
Yield	7.61	8.33	6.80
Growth	0.61	-	-
Fertility	3.15	2.26	1.56
Birth	1.52	1.21	0.47
Calving	1.72	1.04	0.47
Udder health	3.55	2.78	3.44
Other diseases	1.12	1.04	0.31
Feet & legs	1.22	0.78	0.31
Udder	2.54	2.78	2.03
Milkability	0.81	0.87	0.78
Temperament	0.30	0.26	0.23
Longevity	1.12	0.61	0.63
Claw health	0.81	0.43	0.39
Youngstock survival	1.40	2.03	0.92

If we consider the economic value of YSS in relation to other traits in NTM, YSS has a relatively high economic value. For RDC and Jersey only four other traits have higher value. For Holstein, the value of YSS is comparable with the value for birth index (which mainly includes the economic value of a stillborn calf (direct effect). That they are so equal although it costs more losing an older animal than a newborn calf, is because the rate of stillborn calves in Holstein is fairly high.

Effect of including YSS in NTM

To be able to understand the effect we get by including YSS in NTM we looked at correlations of sire EBVs.

Firstly, correlations between YSS index and NTM (without YSS included=old NTM) and its included indices were studied. To summarize these results, it was found that correlations for YSS to NTM and to some other functional traits (birth traits, health and longevity) and to NTM were generally low but favourable.

Secondly, we looked at correlations between NTM and its included traits without (old NTM) or with YSS included (new NTM).

For all breeds, the biggest change was as expected an increase in progress for YSS. This change was largest for RDC (+0.25) and therefore it caused lower correlation (0.97) between old NTM and new NTM for this breed. For Holstein and Jersey, the increase in correlation for YSS was +0.14 and here the correlation between old and new NTM was as high as 0.99. In Figure 1, the pattern of change in correlations for YSS and NTM is shown.

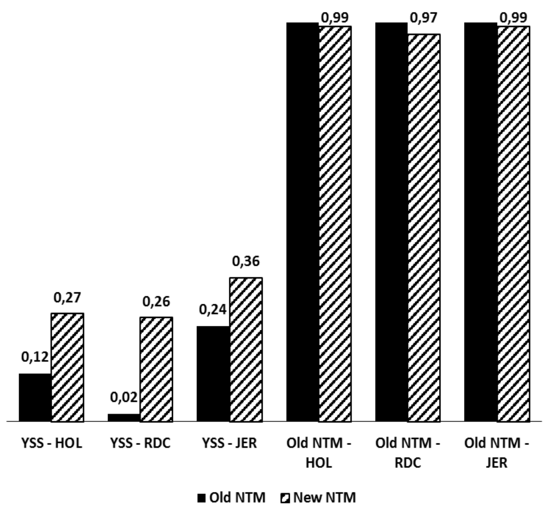

Figure 1. Correlations in sire EBVs for youngstock survival and NTM for Holstein, RDC and Jersey between old NTM (without YSS) and new NTM (with YSS).

Thus, in general including YSS in NTM was expected to have a small effect on NTM rankings for bulls and as expected a favourable effect for YSS. Effect on other sub-indices in NTM were small but there was a slight reduction in genetic progress for yield in all breeds and a small increased progress in health traits, especially for Holstein (results not shown).

Frame (size of cow) is not included in NTM for any of the breeds but for all breeds YSS was unfavourable correlated to this sub-index (bigger cows associated with lower youngstock survival).

Conclusions

Including youngstock survival in Nordic Total Merit caused only small re-ranking of bulls based on NTM. However, it had some effect on the pattern of progress on included sub-indices, especially it increased to total progress on non-production traits in Holstein.

Even if more or less same bulls are selected, the economic value of NTM was improved by including YSS since the standard deviation increased with about 1-3%.

Compared to earlier improvements of NTM, the gain of adding YSS was larger because of low correlations to other traits in NTM.

So to conclude, with YSS in NTM we have a more economically optimal breeding goal.

References

Buch, L.H. 2012. Genetiske muligheder for at nedbringe ungdyrdødeligheden (In Danish). Report from project 2143, Knowledge Centre for Agriculture, Agro Food Park 15, Skejby, 8200 DK-Aarhus. *http://projektfinansiering.vfl.dk/Promilleafgiftsfonden/2011/Genmulighederforatsaenkedoedelighed/Sider/default.aspx*

Pedersen, J., Sørensen, M.K., Toivonen, M., Eriksson, J-Å. & Aamand, G.P. 2008. Report on Economic Basis for a Nordic Total Merit Index. *http://www.nordicebv.info/wp-content/uploads/2015/05/Report-on-Economic-Basis-for-a-Nordic-Total-Merit-Index.pdf*

Pedersen, J., Pösö, J., Eriksson, J-Å., Nielsen, U.S. & Aamand, G.P. 2014. NAV evaluation for calf survival. *http://www.nordicebv.info/wp-content/uploads/2015/04/CalfSurvivalFinalReport.pdf*