New Prediction of Direct Herd Life Proofs
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Introduction
Published Herd Life proofs are a combination of Direct Herd Life (DHL) and Indirect Herd Life (IHL). DHL reflects true daughter survival while IHL is an indirect measure of longevity based on proofs for non-production traits. The current prediction of IHL was implemented in November 2004. The final equation to predict DHL had an adjusted R-Square of 0.50 and included EBV (relative emphasis) for body capacity (-6%), feet and legs (3%), overall udder (16%), rump angle (11%), SCS (-14%), milking speed (12%), 56-day non return rate for cows (13%), and interval from calving to first service (-22%). Body capacity was replaced by dairy strength in August 2005 with the same emphasis and sign.

In 2006, a revised genetic evaluation for DHL was released by CDN (Sewalem et al., 2007), where DHL is measured using 5 traits, namely survival from 1st calving to 120 days in milk (DIM), from 120 DIM to 240 DIM, from 240 DIM to 2nd calving, from 2nd calving to 3rd calving, and from 3rd calving to 4th calving. Additionally, new genetic evaluations for reproductive performance traits will soon be released, which includes new female fertility and calving performance traits.

Thus, the objective of this investigation was to update the prediction formula for DHL, using the most recent Herd Life and reproduction performance evaluations.

Data and Analysis
In order to obtain accurate prediction of DHL, only Holstein bulls with at least 70 daughters that completed the third lactation were included. This strong editing criterion resulted in a small sample of bulls with high reliability for DHL EBV. The bulls also needed to have at least 50 daughters for NRRc. In total, 301 bulls born after 1986 were used. A regression analysis that maximized the adjusted R-square value was first completed. As a second step the level of significance of each factor included in the analysis was performed, in order to obtain the best prediction in terms of the highest level of adjusted R-square and the removal of nuisance variables.

Results and Discussion
Figure 1 shows the traits that are significantly correlated with DHL (EBV correlations). The three traits with the highest correlation were all female fertility traits: a) interval between first service to conception in cows (FSTCc, -0.46); b) number of services per conception in cows (NSc, -0.44); and c) the interval from calving to first service (CTFS, -0.40). This figure shows how each trait is related to DHL by itself. However, as some traits are highly related among each other, analysis by multiple regression may show different results than the correlation analysis and it is more appropriate for determining the optimal prediction formula for DHL.
Figure 1. EBV correlations between DHL and various traits ($P \leq 0.05$)

ANGU= Angularity; BD= Body depth; BONE= Bone quality; CONF= Conformation; CTFSc= Calving to first service in cows; CZh= Calf size at first calving; DCEc= Direct calving ease at later calvings; DCEh= Direct calving ease at first calving; DCSh= Direct calf survival at first calving; FL= Feet and legs; FSTCc= First service to conception in cows; FSTCh= First service to conception in heifers; FTP= Fore teat placement; FUA= Fore udder attachment; LPI= Lifetime Profit Index; MCEc= Maternal calving ease at later calvings; MCEh= Maternal calving ease at first calving; MCSc= Maternal calf survival at later calvings; MCSh= Maternal calf survival at first calving; MS= Mammary system; MSp= Milking speed; NRRc= Non return rate in cows; NRRh= Non return rate in heifers; NSc= Number of services in cows; NSh= Number of services in heifers; PERS= Lactation persistency; RA= Rump angle; RAH= Rear udder height; Texture= Udder texture; TL= Teat length; UD= Udder depth.
A model with traits included in the current official prediction was tested and the resulting R-square was 0.48, thus two percentage points less than what was found two years ago. The difference may be due to a larger group of bulls included in this analysis. Various combinations of traits were tested, and the final equation to predict DHL had an adjusted R-Square of 0.57 (Figure 2). Non return rate was excluded as a new trait, first service to conception, had a more significant impact on R-square. Both traits could not be included simultaneously as they were highly related. Dairy strength was excluded as some of the individual traits (stature, angularity and chest width) that are part of dairy strength had more significant impact in R-square. As calf survival and calving ease were quite correlated within first calving or within later calvings, maternal calving ease at first calving and maternal calf survival at later calvings were added to the equation. Rump angle was excluded, as the major scorecard trait Rump had a more significant impact on R-square. Finally, milking temperament and lactation persistency were added to the prediction equation. Three groups of traits were part of the prediction: Type (40.2%), Reproduction (30.6%), and Functional (29.2%). The trait with the largest emphasis was SCS (-14.1%), followed by FSTCc (-13.3) and Mammary System (10.6%).

Figure 2. Relative emphasis of each trait in the proposed new prediction for DHL.

**Recommendation**

It is recommended that the current prediction formula for direct herd life be replaced by the proposed formula for all breeds, as soon as the reproduction performance evaluation becomes official.

**Reference**