Expression of Conformation Genetic Evaluations in Canada

This is the final article in a four part series focusing on the Canadian type classification system and genetic evaluations for conformation traits.

In February, May, August and November of each year, Canadian Dairy Network releases new official genetic evaluations for all dairy breeds. Included in each release are bull proofs and cow indexes for close to 30 conformation traits. These genetic evaluations assist producers in genetic selection and mating decisions, which requires an thorough understanding of what "the numbers" mean. Previous articles have dealt with the type classification data used for conformation genetic evaluations as well as details of the calculation procedures, while the interpretation and use of the published ratings will be addressed in this article.

What is Average?

Once the genetic evaluations are computed at CDN, a group of animals must be used to establish the point of reference to which the breed average is set. This group is generally referred to as the "genetic base". For type evaluations in Canada, the genetic base is defined as all proven bulls which were born in the most recent 10-year period. This group is updated in the February run of each year. For example, in February 2000, the genetic group included all officially proven bulls born between 1985 and 1994 which will remain relatively stable for the entire year. At each release, the average proof of these bulls is set to zero for each trait. In this way, as the proven bull population improves genetically over time, the average proof of zero follows along. For proper interpretation, cow indexes are expressed on the same scale as bull proofs but that means that the average index of the current cow population is not necessarily zero. Currently, cows born in 1991 have an average index close to zero whereas the cows born in 1996 average approximately +2.

What is the Range?

In order to allow for an easy comparison of strengths and weaknesses across type traits, the range in proofs for each trait is standardized based on the same bull population as for the genetic base described above. In statistical terms, the proofs are forced to have a standard deviation of 5 points which measures the degree of variation across bulls. The published values do not have any units of measurement associated with them but are referred to as Estimated Breeding Values (EBVs). Table 1 shows the percentage of the bull population which is expected to be at various EBV levels on the scale used for all type traits. For example, close to seven percent of the proven bulls are expected to be rated between +7 and +9 while less than three percent are expected to have a proof above +9 with the top bull being between +15 and +20.

In order to compare the relative superiority of bulls and cows across traits, a Percentile Rank is also published for overall Conformation and the major type traits. A Percentile Rank of 94% means that the animal is better than 94% of the population or, in other words, is among the top 6% of the breed. Table 1 includes the expected range in Percentile Rank for bulls according to various levels of proof.

Table 1: Expected Distribution of Bull Proofs for Conformation Traits		
Range in Proof	**Percentage of Bulls**	**Range in Percentile Rank**
+12 or better	1.1 %	99 %
+10 to +12	1.8 %	97 to 98 %
+7 to +9	6.8 %	90 to 96 %
+4 to +6	14.5 %	76 to 89 %
+1 to +3	21.8 %	54 to 75 %
0	8.0 %	47 to 53 %
-1 to -3	21.8 %	25 to 46 %
-4 to -6	14.5 %	11 to 24 %
-7 to -9	6.8 %	4 to 10 %
-10 to -12	1.8 %	2 to 3 %
-12 or lower	1.1 %	1 %

Published Letter Codes

Most type traits have genetic evaluations expressed simply on a numeric scale ranging from approximately -15 to +15. The published bull proofs and cow indexes identify genetic differences within the population with the highest values generally considered the most desirable or at least the direction of selection for making improvement. On the other hand, there are four descriptive type traits which are published as a combination of a numerical rating and a letter code, namely Rump Angle, Rear Legs Side View, Udder Depth and Teat Length. For these traits the most desirable rating is not at either extreme (ie: score of 1 or 9) so the genetic evaluations are expressed on a very descriptive basis using letter codes. Letters used include H=high or L=low for Rump Angle, S=straight or C=curved for Rear Legs Side View, D=deep or S=shallow for Udder Depth and S=short or L=long for Teat Length. The letter indicates the tendency towards one extreme or the other while the numerical value reflects how significant the tendency is away from breed average, which is set to zero. For example, an Udder Depth proof of 6D indicates the daughters have a tendency towards deep udders and the degree of that tendency is relatively significant as indicated by the numerical rating of 6.

Pin Setting and Set of Rear Legs

Canadian classifiers evaluate these traits on a 9-point linear scale using a rating of 5 as ideal. As for any other descriptive type trait, the classification scores for these traits are used to calculate the published genetic evaluations for the traits Rump Angle and Rear Legs Side View described above. Recall that the letter code indicates the daughter tendency while the numerical rating represents the daughter average. Canadian researchers have found, however, that for these two traits there are some bulls who have groups of daughters at both extremes with relatively few which are desirable yet, on average, they are considered to be ideal bulls with a proof close to zero. To correct for this problem, the classification data for Pin Setting and Set of Rear Legs are also analyzed treating the score of 5 as the most desired. For this reason the bull proofs and cow indexes for these traits reflect the “likelihood” that the progeny will have ideal Pin Setting or Set of Rear Legs with the highest rating being the most desirable and zero equalling breed average. For these traits, if the bull proof is relatively low, a look at the proof for the associated trait, either Rump Angle or Rear Legs Side View, will indicate the expected tendency of his daughters.

Role of Type Traits

Genetic evaluations for type traits, especially those related to Mammary System and Feet & Legs, play a key role in breed improvement. They are used directly in ranking bulls and cows for the Lifetime Profit Index (LPI) and indirectly as a predictor of Herd Life used in the Total Economic Value (TEV) published for bulls. MACE evaluations for Holstein bulls proven outside of Canada are calculated by Interbull and published by CDN for a list of 20 type traits. Significant genetic gains have been realized in Canada for major type traits with approximately one-half point EBV progress each year. For sake of comparison, this equates to half of the rate of genetic progress realized for Protein Yield, in terms of standardized units, reflecting the success of Canada's breeding philosophy of high production and improved conformation required to sustain high production over several lactations.