THE RELATIONSHIP BETWEEN BIRTH WEIGHT AND CALVING EASE IN A BEEF HERD

Y. Wang, S. P. Miller, J. W.Wilton, P. Sullivan, and L. R. Banks
CGIL, Department of Animal & Poultry Science, University of Guelph

Summary

Dystocia or calving difficulty is of tremendous importance in beef production. A difficult birth, requiring assistance can lead to increased labour and veterinarian costs. However, the further implications are decreased productivity due to mortality of calves and cows, and delayed rebreeding of cows which leads to increased culling of open cows. Like most production traits in livestock, calving difficulty can be improved or controlled by genetic selection. Selection in beef cattle to decrease calving difficulty is accomplished through EPDs (expected progeny differences) for birth weight or calving difficulty. Calving difficulty or calving ease scores are very difficult to analyze from a statistical perspective as there are only 5 categories (unassisted, easy pull, hard pull, surgical or malpresentation) where most animals (90%) are born unassisted. Birth weight on the other hand is easier to work with as it is continuous that is birth weights are measured in pounds and increase by one pound increments with a continuous range (birth weight measured in BHIP herds varies from 30 to 180 lbs). Birth weight then is more accurately measured and is moderately correlated with calving ease. Birth weight and calving ease are then analyzed together in the same statistical model to generate calving ease EPDs so the information on birth weight can add accuracy to the calving ease evaluation. Advanced models to accommodate the categorical nature of calving ease are now available and promise to improve the accuracy of calving ease EPDs. The goal of this research was to determine the relationship between birth weight and calving ease in a multi-breed population. With a better understanding of the important factors affecting calving ease and the non-linear importance of birth weight, research will continue to implement a more accurate calving ease model for more accurate multi-breed calving ease EPDs. Birth weight was found to be a major contributor to calving difficulty with a correlation of -.74 between the two traits. This correlation was calculated using a new procedure, which looks at the correlations between means of groups. A more common approach of looking at the correlation among individuals yielded a much weaker relationships with a correlation of -.19. This indicates that on average birth weight is a very good predictor of calving ease, but a poor predictor for any individual animal's record. Age of dam was an important contributor to calving difficulty, especially the difference between cows and heifers. The fundamental relationships derived here between birth weight and calving ease in a multi-breed beef herd will form the basis for future research into more accurate models to compute calving ease EPDs.

Introduction

Dystocia or calving difficulty is of tremendous importance in beef production. A difficult birth, requiring assistance can lead to increased labour and veterinarian costs. However, the further implications are decreased productivity due to mortality calves and cows, and delayed rebreeding of cows which leads to increased culling of open cows. Like most production traits in livestock, calving difficulty can be improved or controlled by genetic selection. Selection in beef cattle to decrease calving difficulty is accomplished through expected progeny differences for birth weight (BW) or calving difficulty.

Due to it's categorical nature, calving ease (CE) is recorded using a single scoring system. For example, in Beef Improvement Ontario's Beef Herd Improvement Program (BHIP), CE is recorded as: U (un-assisted), E (easy pull), H (hard pull), S (surgical) and M (Malpresentation). Factors affecting CE have been identified, such as: BW of the calf, age of dam, sex of the calf, breed, etc. Use of BW as an indicator is easier to work with as it is continuous, that is BW is measured to the nearest pound with a continuous range (BW in BHIP herds varies from 30 lbs to 180lbs. BW then is more accurately measured and is moderately correlated with calving ease. BW and calving ease are then analyzed together in the same statistical model to generate calving ease EPDs so the information on BW can add accuracy to the calving ease evaluation. Advanced models to accommodate the categorical nature of calving ease are now available and promise to improve the accuracy of calving ease EPDs.
The objective of this study is to understand the relationship between BW and CE in a multi-breed commercial beef herd via comparing the relationship between CE, Snell Score and BW.

Materials and Methods

Data used in this study came from a collection of herds registered on BHIP. A database of 133,280 records was created by retaining records with both BW and calving ease recorded for individual animals born between 1986-2000 with sire and dam identified.

Simple Pearson correlation as well as Ecological correlation, a correlation coefficient of group means, were applied to examine the relationship between CE and BW. A regression model with linear and quadratic terms was used to describe the non-linear relationship.

A special transformation of CE scores has been applied to BHIP data for genetic evaluation since 1995 which change the 5 categories of CE into a nice continuous variable. For example a CE score of S (surgical) from a mature cow would be worse than an S from a first calving heifer in terms of calving ease for the calf born, and the transformed score would reflect this. These transformed scores are called Snell scores and are expressed in terms of percentage of unassisted calvings which is a continuous variable. A set of Snell score transformation tables was created by the beef research group at the University of Guelph using BHIP records collected between 1986 and 1996. Snell score accounts for factors such as: calving ease, age of dam, sex of calf and the size difference of the parents using their across breeds comparisons (ABC). It allows calculation of the "real" Pearson correlation based on individual records which is not possible with CE alone. Analysis of variance (ANOVA) using GLM (SAS, 2001) was used to evaluate calving ease based on percentage un-assisted calving (U%).

Results and Discussion

Percentage un-assisted calving (U%) were significantly affected by BW, age of the dam, sex of the calf and size difference of the parents.

The group mean correlation of –0.74 between BW and un-assisted calving percentage (U%) clearly indicates a strong negative relationship between CE and BW (**Figure 1**). The non-linearity of the relationship was verified by a group mean regression study. A regression model with linear and quadratic terms was fitted for BW on U% with a determination coefficient (R^2) of 0.81. This means that BW explained 81% of the variation in calving ease.

At a given BW group, age of dam was a larger source of variation for CE U% than sex of the calf and the size differences of the parents (**Figure 2**). For a 2-year-old dam, 90% or more calvings would be expected to be un-assisted in calves weighing 50-80 lbs. With the age of dam increased to 3 years or more, the same level of CE can be achieved with a broader range of BW (45-100 lbs). So when choosing sires for cows of 3 or more years, more emphasize can be put on production trait EPDs which will lead to more rapid genetic progress in production.

The group mean correlation was different from the correlation of individual measurements. It can be larger or smaller than individual correlations depending on the feature of the data. It can be very misleading if the group mean correlation is interpreted to be about individuals. To verify the strong negative relationship between BW and CE derived from the group mean study, a Pearson correlation between individual records was calculated. Because of the categorical nature of CE, the "real" Pearson correlation based on CE is not possible to obtain directly. However, Snell score, a transformation of CE, was the best candidate for the "real" Pearson correlation.

The fact that the Snell score has retained the nature of CE is explained by the following statistical results:
(a) The correlation between CE U% and the group mean of Snell score was 0.99.
(b) The group mean correlation between BW and Snell score was –0.76.
(c) The regression model with linear and quadratic terms was fitted for BW on group mean of Snell score had similar predictability (R^2=0.82).

Pearson correlation of -0.19 between BW and Snell score indicated group mean correlations can not be extrapolated onto individuals due to the large variation in calving ease within each BW category (**Figure 3**).

Conclusions

- BW is a major factor affecting CE with an important nonlinear relationship.
- At a given BW, age of the dam is the larger source of variance for CE. BW can be 25 pounds heavier from older cows than from heifers with no change in CE.
- Snell score retains the nature of calving ease. It provides a method or mechanism to present the result in terms of percentage of unassisted birth which is more practically implemented by producers.

Significance to the Industry

BW is the most important single factor affecting CE. The variation of CE within each BW group is rather large. The relationships derived here between BW and calving ease in a multi-breed beef herd will form the basis for future research into more accurate models to compute calving ease EPDs which will lead to more rapid genetic progress in breeding schemes.

Acknowledgements

We are grateful to Beef Improvement of Ontario (BIO) for providing the data and to BIO and Natural Sciences & Engineering Research Council of Canada for their financial support.

Figure 1. The Relationship between Group Means of Birth Weight and Calving Ease (U%)

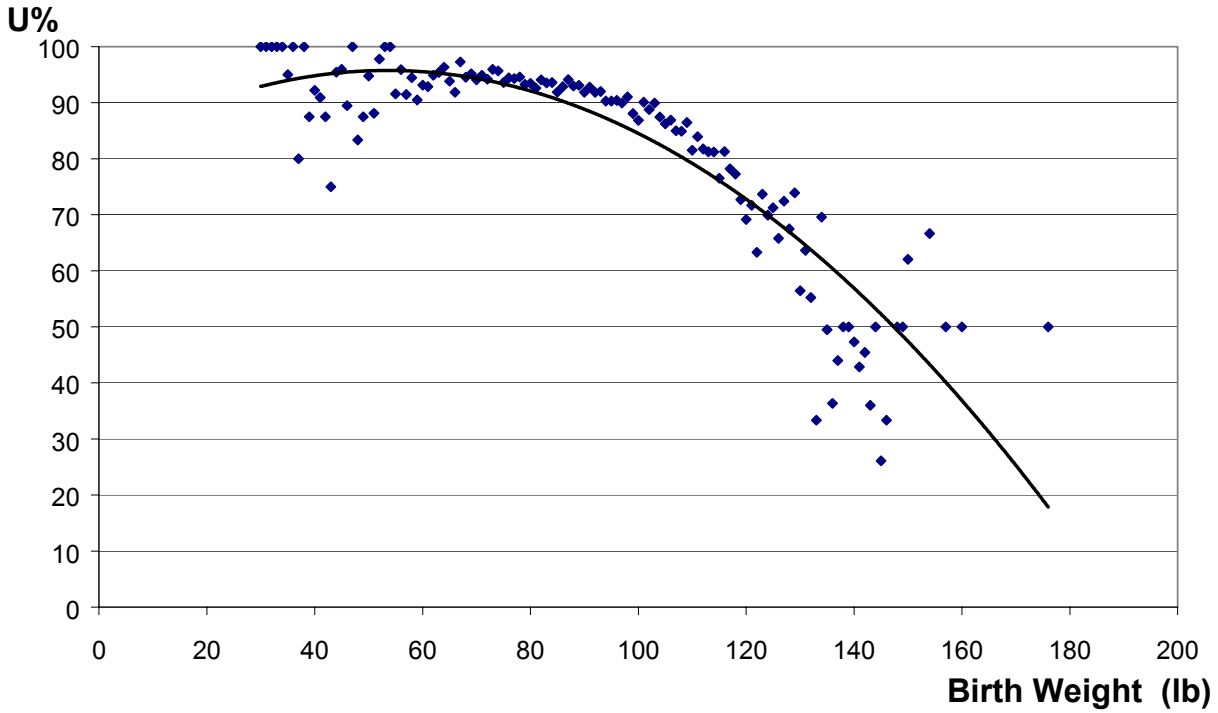

Figure 2. The Relationship between Birth Weight and Calving Ease (U%) for Different Ages of the Dam

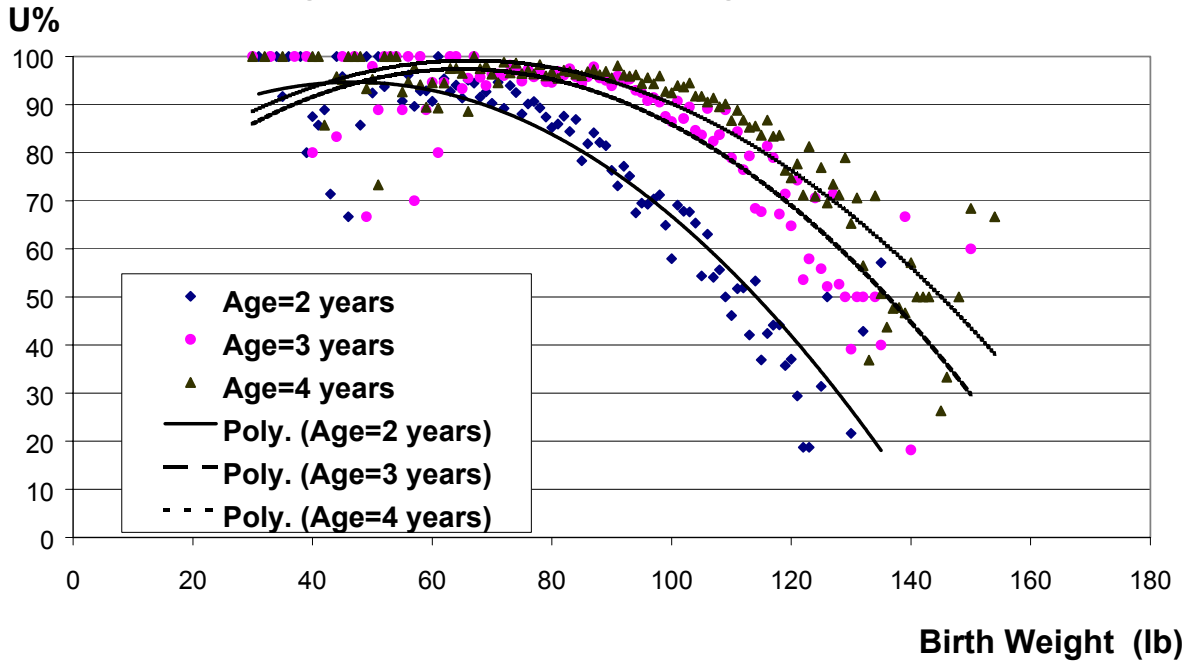

Figure 3. The Relationship between Individual Birth Weight and Snell Score