

Breeding Values

FOR BEEFMASTER FERTILITY

Fertility is a critically important trait in beef cattle herds. However, fertility is generally influenced by many environmental and managerial factors that overshadow the genetic component and complicate the estimation of breeding values. Fertility is generally defined by indicator traits when estimating breeding values. For instance, age at first calving serves as a measurement of Heifer Fertility, while inter-calving period represents Cow Fertility.

GENETICS

Ability relative to group average determines genetic ability, rather than phenotypic measurement: In principle, in a group of heifers that were born together and calve on average at 30 months of age, the heifer calving at 28 months for example will exhibit above-average genetic potential, while the one calving at 32 months will be below average. However, a heifer calving at 32 months in another group with an average calving age of 34 months, will be genetically superior.

HEIFER FERTILITY: HOW SOON DOES SHE START CALVING?

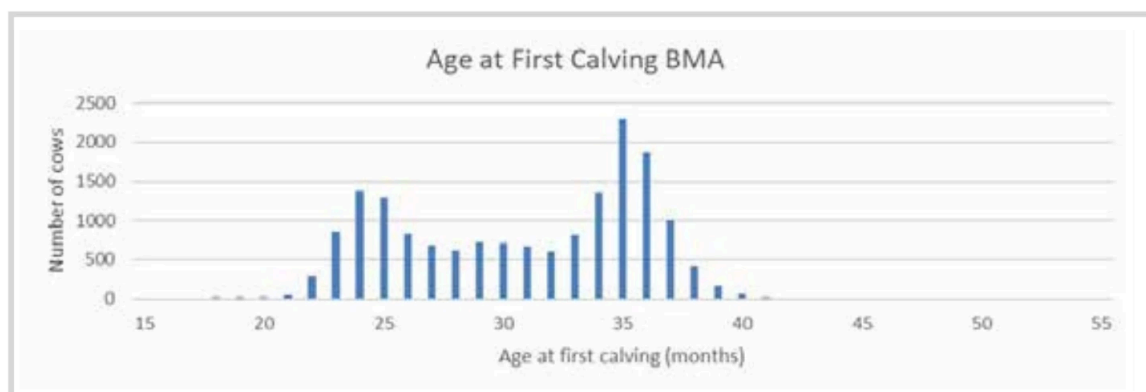


Figure 1: Age at first calving of currently active Beefmaster cows.

From the histogram of age at first calving of currently active Beefmaster cows (Figure 1), most cows calved at 35 to 36 months for the first time. However, there is also a peak at 24 months and a small peak at 30 months. Management determines the phenotypic age at first calving of the herd. Weaning weight breeding values are estimated regardless of the favourable or unfavourable environment in which the calf was weaned. Fertility breeding values are therefore also estimated irrespective of the breeder's management practices. The crucial

factor is the contemporary group: if all animals within the same contemporary group (heifers born in the same group) are treated equally, those calving earlier within the group are considered genetically more fertile, while those calving later or not at all are considered less fertile or infertile. The definition of the contemporary group for Heifer Fertility accommodates significant management differences between herds, e.g. whether the heifers calve at 2 years or 3 years.

When phenotypic herd averages for Age at First Calving (AFC) are plotted against the herd average for the breeding value index for Heifer Fertility, it can be seen that earlier calving herds do not have the higher EBVs, showing that the herd management effect of calving age has effectively been removed from the breeding values.

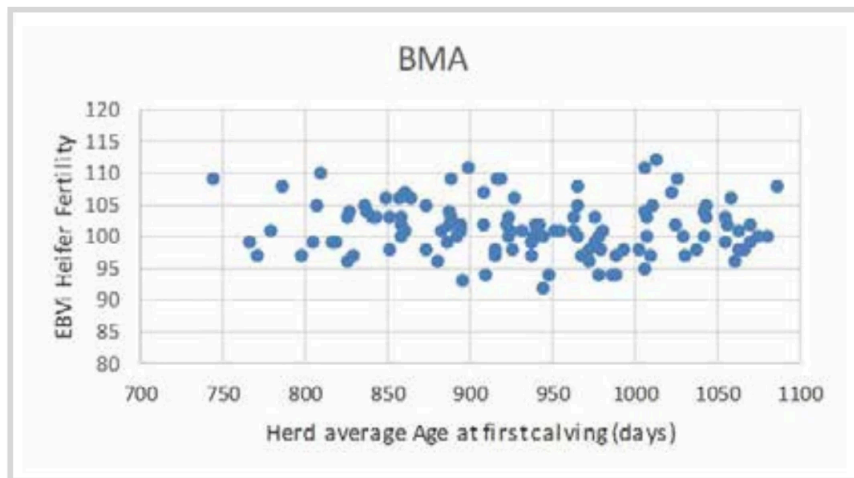


Figure 2: The relationship between phenotypic herd average for age at first calving and the herd average breeding value for Heifer Fertility.

To compare heifers fairly and to accommodate different ages when the heifers are put to the bull, calving in a contemporary group starts at day 0 when the first heifer calves, with a standard age. The number of days that each heifer calves is added to the standard age of the contemporary group. The variances between different contemporary groups are also standardized. These adapted values then become the measurement for Heifer Fertility. When estimating breeding values, it is also important to include less fertile and infertile heifers, i.e. those who skipped a calving, or never calved, otherwise breeding values will be biased. It is also important to include the data of infertile daughters in the estimation of breeding values for sires. Following

international practices, females still alive in the herd at a late stage, without having calved, is penalized by allocating an extreme age at first calving value. It is accepted that a heifer is infertile if a breeder canceled her at 3 years of age or older without a calving being recorded, or if she was included on a mating list but did not produce a calf. An Age of First Calving of more than 4.5 years is then allocated to her, which makes it possible to compare her with heifers that did calve. Additional adjustments to level the playing ground between heifers and to take care of environmental aspects also include standardizing the variances of the contemporary groups. Genomic information also increases the accuracy of prediction.

COW FERTILITY: HOW REGULARLY DOES SHE CALF?

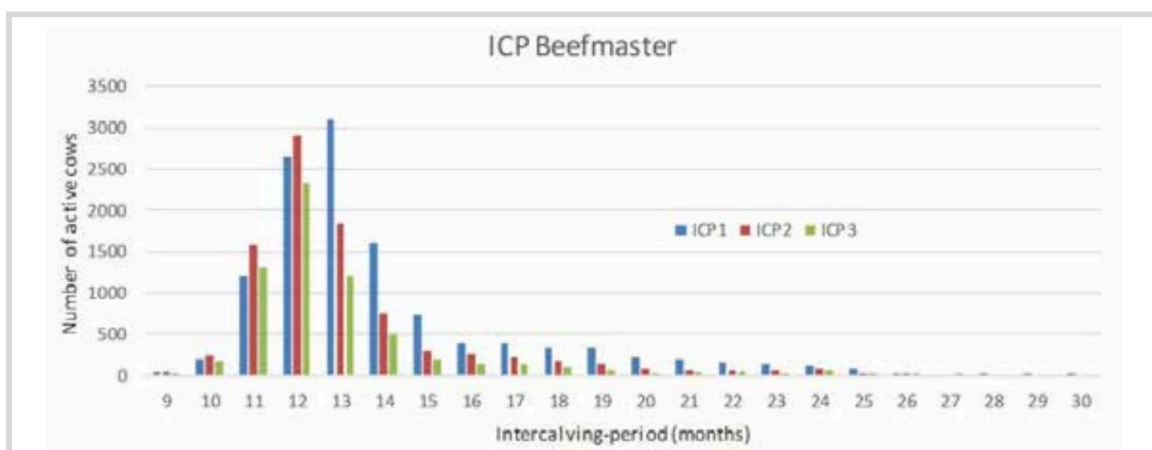


Figure 3: The inter-calving period of currently active Beefmaster cows.

Continues on p. 74

The phenotypic histogram in Figure 3 show that once the cows start calving, only a few cows are allowed to skip or calve in the next calving season, indicating a combination of high fertility and good management in the breed in general.

Inter-calving period (ICP) is the measure of cow fertility used by SA Stud Book for estimating breeding values. ICP1 (between the first and second calf), ICP2 (between the second and third calf), and ICP3 (between the third and fourth calf) are included in breeding value estimation. Contemporary groups become too small after the 4th calf, and only the most fertile cows are left, so there is much less variation making it difficult to pick up genetic differences. A cow with three short inter-calving periods (ICPs), will be considered highly fertile compared to cows with only one or two short ICPs, as measured within their respective contemporary groups. Genetic correlations between the different ICPs and genomic information are also included to increase the accuracy of breeding value estimation.

The contemporary group for Cow Fertility follows a similar approach to Heifer Fertility. It consists of at least three cows that have calved together on the same farm, in the same year-season, and calve their next calf on the same farm, even if some calve in the following breeding season. Cows that have an ICP of more than 900 days, or did not wean their previous calf, are penalized in the estimation of breeding values. Measurements of animals that gave birth to embryo calves, and their subsequent calvings are excluded. Breeding values are released once 60% of cows in a contemporary group have calved. Bulls and animals without measurements receive breeding values based on pedigree information. The breeding value for Cow Fertility is, therefore, a weighted measure of the breeding values based on the first three ICPs, namely ICP1 (between first and second calf), ICP2 (between second and third calf) and ICP3 (third and fourth calf). These 3 breeding values are weighted equally and combined into one Cow Fertility breeding value.

LONGEVITY: ARE HER CALVES RETAINED IN THE STUD HERD?

Initially, the selection of young animals is based on various factors, including performance, likability, and even the price paid for the sire. However, over time, high fertility will ensure the retention of cows in the herd. Longevity is measured by marking each calf within a birth contemporary group as present or absent at specific milestones, such as weaning age and one to 10 years of age. This information is used in breeding value estimation. A cow that has reached old age, but none of her calves were retained, will have a lower longevity breeding value than a cow of the same age of which several of her calves were retained and produced calves themselves. Since Longevity is a breeding value, the performance of family members is also taken into account through the pedigree. This breeding value measures fertility, as well as retention of calves for stud breeding.

FERTILITY VALUE

The Fertility Value is a selection value that measures Calf Quantity and Calf Quality:

1. Calf Quantity: How soon do heifers in the family start calving (GEBV Heifer Fertility) and how regular do cows calve (GEBV Cow Fertility)?
2. Calf Quality: Do cows and calves in the family tend to remain as stud animals (EBV Longevity)?

SUMMARY

Fertility is generally regarded as lowly heritable and therefore not worth the effort of selecting for it. However fertility has a genetic base, and some animals are genetically more fertile than others. Successful selection for fertility in a beef herd is achievable by using the Selection Value for Fertility, which combines breeding values for Heifer Fertility, Cow Fertility, and Longevity.

Dr Helena Theron,

