

## Utilising Maternal Trait EBVs of Beef Bulls

### SUMMARY

- **Maternal trait EBVs can identify bulls whose daughters calve successfully at 2 years of age and calve easier, have shorter calving intervals, increased longevity in the herd and wean heavier calves.**
- **A QMS funded study showed that the performance of daughters from sires selected for being either 'good' or 'bad' for individual traits did reflect the sires EBVs.**
- **MATERNAL INDICES: allow animals to be selected based on their maternal characteristics. These indices combine the EBVs for several traits weighted by their relative economic importance into a single value.**

### Introduction

Beef bulls have a major impact on the quality of the UK suckler herd as all suckler cows are sired by a beef bull. To improve the efficiency of the national herd it is therefore essential that the bulls used to breed heifer replacements, be it from the suckler herd or the dairy herd, carry the genetics to improve the maternal characteristics of their daughters.

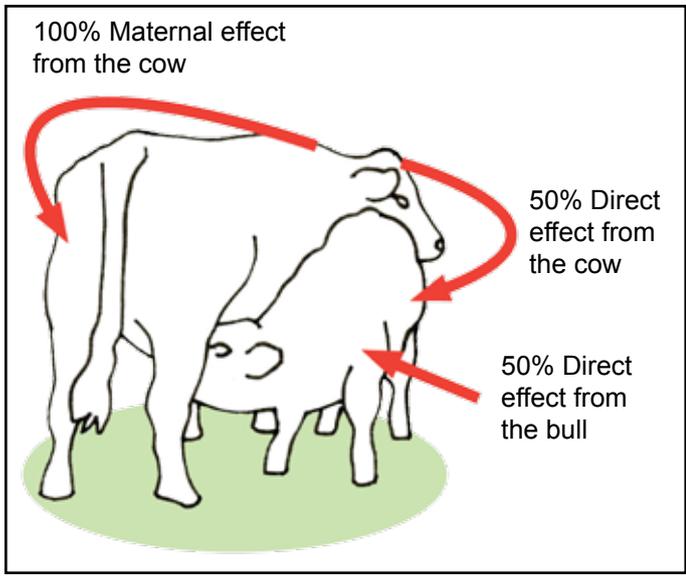
Since the 1980's Estimated Breeding Values (EBVs) have been available for an increasing proportion of the bulls bred in the UK. However, these EBVs have generally only included the growth and carcass traits which are expressed in both males and females. These EBVs include Birth Weight, 200 and 400 Day Weight/Growth, Eye Muscle Area, Carcass Back Fat, etc. There was only one EBV for a maternal trait – the 200 Day Milk EBV being a measure of how well a bull's daughters would rear their calves to weaning, the main aspect being their milking ability. Recently a range of other maternal trait EBVs have become available to UK beef breeders. They are calculated using exactly the same methodology - BLUP (Best Linear Unbiased Prediction) - which is used to calculate all the other EBVs.

### What Are Maternal Trait EBVs?

Maternal traits are characteristics only expressed by females. Examples include milk production and traits related to female fertility such as age at first calving and calving interval.

Some traits such as weaning weight and calving ease are influenced by the genetics of the calf (direct EBVs) and the cow's own genetics (maternal EBVs). For the direct EBVs each parent has an equal effect on the progenies performance. However for the traits with both a direct and maternal EBV, the dam has a greater affect on the performance of the progeny through her additional maternal effect.

This is illustrated in the following diagram. An example of such a trait would be Calving Ease. Through her direct Calving Ease EBV the cow has 50% of the genetic influence on the size and shape of the calf she produces (the other half coming from its sire). However, the cow herself has an influence on how easily her calf is born through the size and shape of her pelvis – i.e. her



maternal characteristics and it is these characteristics which are measured through her “maternal Calving Ease EBV”/“Calving Ease Daughters EBV”.

**What Maternal Trait EBVs Are Available?**

As with growth and carcase traits, the exact definition of the maternal trait EBVs varies depending on the breed of the bull and the organisation the Breed Society uses to produce their

EBVs. At present there are two different organisations producing EBVs for UK beef breeds – the UK organisation Signet and the Australian organisation BreedPlan. Both organisations use the same methodologies but produce EBVs with slightly different trait definitions. The following table lists the maternal EBVs currently produced by each system.

Using the direct and maternal EBVs of the Bull and the cows he is mated to the percent of calvings scored as easy (calving scores 1 or 2) can be predicted as shown for the example below.

	<b>Bull</b>	<b>Cow Average</b>
Direct Calving Ease EBV	+5%	+2%
Maternal Calving Ease EBV		+4%

% easy calvings = 0.5 x Bull direct calving ease EBV + 0.5 x Cow direct calving ease EBV + Cow maternal calving ease EBV  
 = (0.5 x 5) + (0.5 x 2) + 4  
 = 2.5 + 1 + 4  
 = 7.5% more easy calvings compared to the base animals

Note that although the maternal calving ease EBV of the bull does not affect the % easy calvings when he is mated it is still important to consider when selecting a bull. This is because it will affect the % easy calvings that his daughters have when they are mated.

	<b>Signet (UK)</b>	<b>BreedPlan (Australia)</b>
Calving Ease	✓ (Maternal Calving Ease)	✓ (Calving Ease Daughters)
200 Day Milk	✓	✓
Age At First Calving	✓	
Scrotal Size	✓	✓
Fertility	✓ (Calving Interval)	✓ (Days To Calving)
Size		✓ (Mature Cow Weight)
Longevity	✓	

**Definition of Current Maternal trait EBVs**

<b>Maternal Calving Ease (Signet) or Calving Ease Daughter (BreedPlan)</b>	Identifies females which due to their own characteristics e.g. pelvic area etc will calve easily. (This should not be confused with Calving Ease Direct which predicts calf factors e.g. size).
Measurement	%
Interpretation	Positive values mean more unassisted calvings.
Typical range (good to poor)	+4% to -10%

<b>200 Day Milk</b>	Identifies how well heifers will perform when they become mothers e.g. the potential milk yield of the cow.
Measurement	Kg of calf weight at 200 days of age.
Interpretation	Positive values identify females which will rear heavier calves at weaning.
Typical range (good to poor)	+10kg to -2kg
<b>Age At First Calving</b> (Signet only)	Identifies heifers which are more likely to calve at a younger age given the mating opportunity.
Measurement	Proportion calving earlier given the opportunity (e.g. 0.1 = 10%)
Interpretation	Negative values mean heifers will potentially get pregnant at a younger age when given the opportunity.
Typical range (good to poor)	-0.2 to +0.2 (-20% to +20%)
<b>Scrotal Size</b>	An indicator of male fertility with regards to semen quality and quantity. There is also a small favourable correlation with Age Of Puberty in female progeny.
Measurement	cms.
Interpretation	Positive values indicate higher fertility in males and earlier puberty in females.
Typical range (good to poor)	+2cm to -2cm
<b>Cow/Heifer Fertility</b> <b>Calving Interval</b> (Signet) <b>Days To Calving</b> (BreedPlan)	Both EBVs measure the cow's ability to get back in calf again quickly post calving.
Measurement	Days.
Interpretation	Negative values indicate heifers/cows that get back in calf more quickly (i.e. are more fertile).
Typical range (good to poor)	-8 days to +12 days
<b>Mature Cow Weight</b> (BreedPlan only)	An estimate of the genetic difference in cow size/liveweight at 5 years of age.
Measurement	Kg of cow weight when the calf is weaned (200 days of age).
Interpretation	Positive values indicate cows that are heavier when their calves are weaned.
Typical range (good to poor)	+90 kg to -10 kg
<b>Longevity</b> (Signet only)	Predicts the length of an animals breeding life in the herd.
Measurement	Parities
Interpretation	Positive values indicate a longer breeding life.
Typical range (good to poor)	+1 parity to -0.5 parity

## Maternal Indices

Both organisations produce indices for maternal characteristics. An index combines EBVs for several traits weighted by their relative economic importance into a single value to enable

selection for a defined breeding objective. The maternal indices currently produced by the two organisations are shown in the following table.

Signet (UK)	BreedPlan (Australia)
Maternal Value	-
Maternal Production Value	Self Replacing Index

### Definition of Current Maternal indices

<p><b>Maternal Value</b> (Signet only)</p> <p>Measurement</p> <p>Interpretation</p> <p>Typical range (good to poor)</p>	<p>This is an economic value of an animal's genetic ability to produce breeding females. The individual EBVs included in calculating this index are –</p> <p>Maternal Calving Ease 200 Day Milk Age At First Calving Longevity Calving Interval</p> <p>£</p> <p>Positive values indicate more productive, fertile and longer living cows.</p> <p>+£29 to -£23</p>
<p><b>Maternal Production Value</b> (Signet) <b>Self Replacing Index</b> (BreedPlan)</p> <p>Measurement</p> <p>Interpretation</p> <p>Caution</p> <p>Typical range (good to poor)</p>	<p>Although slightly different between the 2 organisations and for each breed within each organisation, both indexes are similar in that they value an animal's ability to both produce breeding females and high quality carcasses from the male offspring. Terminal and maternal traits have approximately the same emphasis.</p> <p>£</p> <p>Positive values indicate animals which will produce productive heifers and quality carcasses from slaughtered progeny</p> <p>Where there is little or no information available for maternal traits it is likely that terminal sire traits will dominate the index produced.</p> <p>+£28 to -£28</p>

### Maternal Trait EBVs Do Work

SAC, as part of a QMS project used industry data to test whether maternal trait EBVs of bulls were reflective of their daughter's performance. This work clearly showed that daughters from the high accuracy bulls with favourable EBVs were better than daughters from high accuracy bulls with unfavourable maternal trait EBVs. The differences show that daughters from the high accuracy bulls with favourable maternal trait EBVs performed

better when compared with their contemporaries i.e. heifers which were reared/managed in the same group but sired by bulls with average or unfavourable maternal trait EBVs. For example, the daughters from bulls identified as being favourable for longevity were found to produce on average 0.4 more parities in the suckler herd compared to their contemporaries.

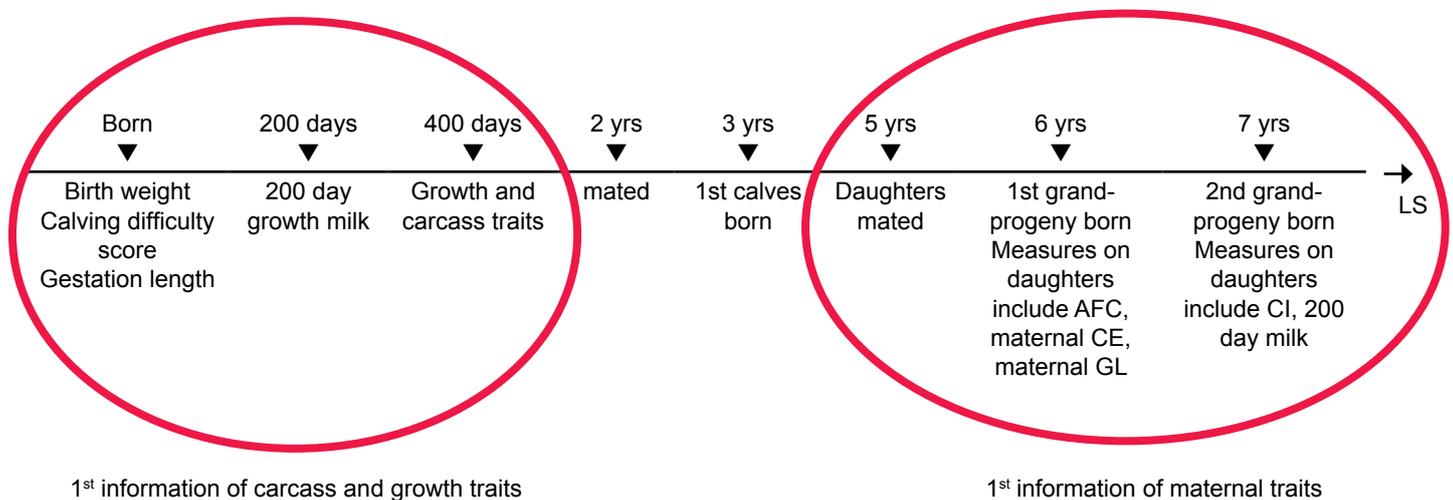
## Actual Performance Of Daughters

Trait / Phenotype	Sires favourable EBVs	Sires unfavourable EBVs
Age At First Calving (days)	-21	+17
Maternal Calving Ease (linear transformed calving difficulty score*)	-0.07	0.12
Calving Interval (days)	-7	+9
200 Day Milk (kg calf 200 day weight)	+5.3	-5.1
Longevity (parities)	+0.4	-0.5

\* The more negative the phenotype value the easier the calving (note this is in the opposite direction of the calving ease EBVs)

This study highlighted that it was the older bulls that had maternal trait EBVs with high accuracy. The reason for this is that performance information is only available from daughters who themselves have had progeny (as illustrated below), making the bull older when information is available compared to when terminal trait information becomes available. A retrospective genetic evaluation was undertaken based on data available

10 years previously and the EBVs as a younger less accurate bull were compared with EBVs of the same bulls when they were older and more accurate. This comparison showed that the rankings were very similar. For example, bulls that were identified as having favourable EBVs when they were older generally also had favourable EBVs when they were young bulls.



AFC: Age at First Calf, CE: calving ease, GL: gestation length, CI: calving interval

### How to Use Maternal Trait EBVs

Maternal trait EBVs are only useful where the daughters of a bull or cow are going to be used as breeding replacements. If all the progeny are going to be slaughtered then maternal trait EBVs can be ignored and animals selected on their growth and carcass EBVs.

Where the bull's daughters are going to be used as replacements the best starting point to screen a reasonably large number of bulls would be the Maternal Production Value (Signet) or Self Replacing Index (BreedPlan) which takes into account both the performance of a bull's male offspring as slaughter animals and his daughters as replacements. An alternative approach

with breeds recorded under the Signet scheme would be to initially select bulls based on their Maternal Value Index with evaluates bulls solely in terms of their daughter's performance as breeding females. Then having produced a list of possible purchases, individual bulls can be assessed on their Beef Value or other terminal sire characteristics.

Where there is sufficient selection it will be sensible to then examine individual maternal trait EBVs. The exact priority will differ between farms but the following table gives a general guide as to the order of importance e.g. Ease of Calving is placed first as a dead calf is of no value however well it might grow or however well it might milk.

Priority		
1	Calving Ease Direct Calving Ease Maternal	Always select for high positive values
2	Fertility Calving Interval (Signet) Days To Calving (BreedPlan)	Always select for high positive values
3	Puberty Age At First Calving	Select for big negative values
4	Check terminal sire values	E.g. 400 Day Weight
5	Longevity	Select for high positive values
6	Milk	Select average or just above average
7	Mature Weight	Select for average or below average values

Priorities will vary between breeds depending on the breeding goals. For example, selection for milk will be more important in the less milky breeds.

### Acknowledgements

This work was funded by QMS



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