# MATCH BIRTHWEIGHT ASBVS TO FLOCK FECUNDITY FOR LAMB SURVIVAL

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## SUMMARY

Selection of sires with high growth rates may unintentionally reduce lamb survival via dystocia due to the genetic relationships between high growth rates and birthweight. A range of Australian Sheep Breeding Values (ASBVs), including birthweight, lambing ease and gestation length, can be used as selection criteria to genetically increase lamb survival. However, their impact on lamb survival is likely to vary between birth types. Relationships between lambing ease scores, birth weights, gestation length and lamb survival of crossbred lambs born to Merino ewes from the MLA Resource Flock were quantified. Across all birth types, lamb survival was greatest for unassisted lambs; assisted lambs were of low incidence and above average birthweight. Increased lambing ease scores (i.e. more lambing difficulty) were associated with longer gestation length, higher birthweight and poorer lamb survival. Higher birthweight ASBVs were associated with increased lamb survival, but this was dependent on litter size and the lamb surviving parturition. Less fecund commercial flocks that experience dystocia related issues should place an upper limit on birthweight ASBVs and include lambing ease and gestation length ASBVs in their ram selection decisions. These flocks will also need to management ewe nutrition during late pregnancy, to ensure their single bearing ewes do not produce heavy lambs.

## INTRODUCTION

Lamb survival is a key component of reproductive efficiency in sheep flocks (Hinch and Brien 2014) particularly in enterprises where the incidence of multiple births (twins and triplets) is relatively high. In extensively managed flocks, lamb mortality is highly variable between farms and years, but averages 10% for single born lambs and 30% for twins with the cause of death affected by the fecundity of the flock (Hinch and Brien 2014) as well as ewe nutrition during pregnancy, maternal behaviour and enviromental conditions at lambing. Dystocia has been implicated in up to 67% of lamb mortality and up to 41% of ewe mortality (Jacobson *et al.* 2020) with the risk of dystocia increasing at both high or low lamb birthweights (Horton *et al.* 2018). Variation in birthweight explains a large proportion of variation in lamb survival. The optimum birthweight for survival ranges between 4.5 and 5.5 kg (Hatcher *et al.* 2009), although birth type, breed and ewe age can shift the optimum range. Lambing ease scores have been genetically associated with all causes of lamb death (Brown *et al.* 2014).

Direct selection for lamb survival is problematic as both sires and dams must have survived as lambs and lamb mortality can occur more than 7 days post-partum (Hatcher *et al.* 2009). Birthweight and lambing ease scores have been identified as potential selection criteria to improve lamb survival (Brien *et al.* 2014) and Australian Sheep Breeding Values (ASBVs) for both traits are available through Sheep Genetics. Genetic gain in lamb survival can be slow due to it's low heritabilility, however the availability of ASBVs for a range of reproduction traits provide key tools for producers to utilise in their breeding flocks. Robertson *et al.* (2022) noted that high ASBVs for post-weaning

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weight and birthweight can lead to unacceptably high levels of dystocia in single-bearing Merino ewes mated to Composite or Poll Dorset rams, which reduced lamb marking rates. This preliminary paper explores the relationships between Australian Sheep Breeding Values (ASBVs) for birthweight (BWT), lambing ease (LE) and gestation length (GL) with lamb survival amongst lambs born to Terminal sires over Merino ewes, when lambed in a common environment.

## MATERIALS AND METHODS

Data were extracted from the MLA Resource Flock Katanning (van der Werf *et al.* 2010). LE scores were measured at birth, scoring each lamb on a 5-point scale consisting of: 1 for no assistance, 2 for some assistance, 3 for hard assistance, 4 for abnormal presentation and 5 for other (such as veterinary assistance). Individual lambs could be unobserved and receive no LE score. In this study, animals with LE scores greater than 3 were discarded, as these scores reflect problems which were at low incidence and considered non-genetic in origin (Sheep Genetics 2014). BWTs and GL were also extracted from the database for all animals. All the ewes were joined via artificial insemination, so the gestation length was known. Lamb survival to weaning was calculated using the rearing type records in the database. Least squares means were estimated in R (R Core Team 2022) with year of birth and lamb sex fitted as fixed effects. The predictability of BWT ASBVs was examined by regressing the (un)adjusted BWTs from this study on breeding values obtained from an independent analysis with the data from the resource flocks excluded.

## RESULTS AND DISCUSSION

**Birthweight and lamb survival.** A curvilinear relationship between lamb survival and birth weight (Figure 1) was evident for all birth types. The 'optimal' birthweight for survival was similar for single and twin born lambs, but lower for triplets. The slope of the curve around the optimum was relatively flat for singles but steeper for both twins and triplets, although the latter do not typically extend across the same range of BWTs as single born lambs.

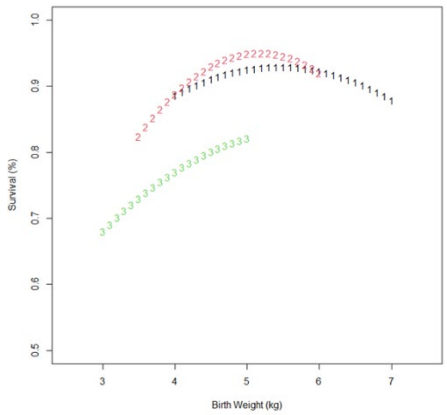


**Figure 1. The relationship with BWT (kg) and lamb survival to weaning for single (1), twins (2) and triplet (3) born lambs in the MLA Resource Flock Katanning**

Mean survival was highest for lambs born without assistance and, these lambs tended to have lower BWT than those requiring assistance – lambs requiring assistance were typically well above average BWT (Table 1). It is worth noting that most of the lambs that were assisted were close to death when they were assisted (i.e. no dead-at-birth lambs were recorded in the data) and our results are consistent with this observation. In many commercial sheep flocks, ewes typically lamb

unassisted and would be expected to have higher rates of lamb mortality than this resource flock.

Longer gestation length was associated with increased assistance at lambing, higher BWT and poorer lamb survival (Table 2). However, gestation length is rarely known in commercial flocks with natural joining. Across all birth types, lambing ease score increased (i.e. increased birthing difficulty) when birthweight approached 5.5 kg (Figure 2). Bunter *et al*. (2023) reported that birthweight and lambing ease are antagonistic traits especially for single born lambs. Lambing ease scores are infrequently measured in commercial or stud flocks unless dystocia is a significant issue, so the lambing ease data available may be represented by the flocks with higher birthweight lambs.

**Table 1. Least squares means (standard error) for survival (%) and birthweight (kg) for single, twin and triplet born lambs whose dams were either not assisted or assisted during parturition**

| Birth type | Assistance | Survival | Birthweight | n |
|---|---|---|---|---|
| Single | No assistance | 0.91 (0.01) | 5.30 (0.03) | 894 |
| Single | Assisted | 0.60 (0.05) | 5.74 (0.13) | 25 |
| Twin | No assistance | 0.91 (0.01) | 4.49 (0.02) | 1,789 |
| Twin | Assisted | 0.59 (0.05) | 4.93 (0.13) | 18 |
| Triplet | No assistance | 0.78 (0.02) | 3.83 (0.06) | 245 |
| Triplet | Assisted | 0.46 (0.05) | 4.27 (0.04) | 8 |

**Table 2. Least squares means for lambing ease scores, lamb survival (%) and birthweight (kg) by gestation length group (standard errors in brackets)**

| Gestation length | Lambing ease score | Survival | BWT | n |
|---|---|---|---|---|
| < 144 | 1.01 (0.03) | 0.79 (0.06) | 3.50 (0.17) | 26 |
| 145 – 150 | 1.03 (0.01) | 0.87 (0.01) | 4.28 (0.04) | 1,011 |
| >150 | 1.15 (0.02) | 0.79 (0.04) | 4.83 (0.11) | 62 |

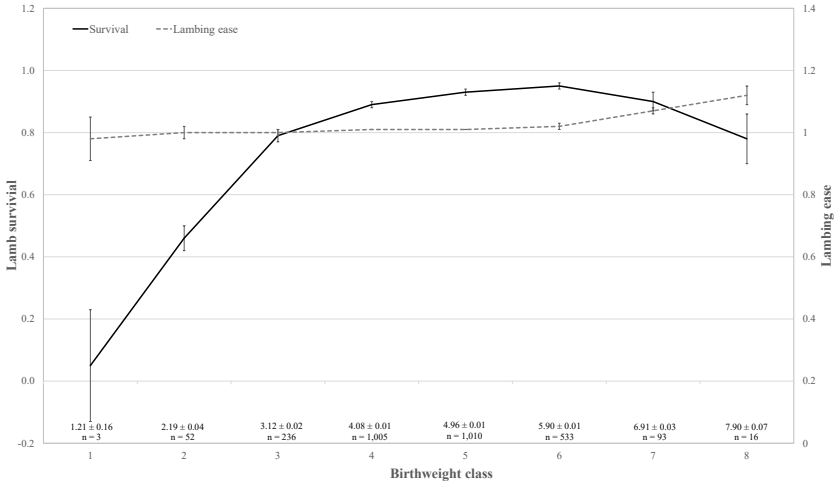


**Figure 2. Across all birth types, lambing difficulty increased as birthweight approached 5.5 kg, at which point lamb survival decreases. Data are least squares means by birthweight class (± standard error) along with the number of lambs in that class**

**BWT ASBV predictive ability.** The regression coefficients for BWT of progeny on their sire ASBVs were 0.955 for single-born lambs, 0.790 for twins and 0.478 for triplets. Higher ASBVs for BWT increased lamb survival, but this was contingent on litter size (affecting BWT) and the lamb surviving parturition (LE). Higher sire ASBVs for BWT were also associated with longer gestation length and higher LE scores, but this did not always translate into lower lamb survival. LE ASBVs were also significant predictors ($P<0.001$) of progeny LE outcomes.

## CONCLUSIONS

Genetic improvement of lamb survival is complicated due to the direct genetic effects of the dam and lamb (i.e. half sire genes) and the mediating impacts of flock management and the lambing environment. Therefore, the current reproductive rate of a flock will have an impact. Commercial producers with a high proportion of single born lambs and evidence of lambing ease problems should consider placing an upper limit on BWT ASBVs, include some emphasis on both LE-dir and GL when choosing their rams and carefully manage the nutrition of their single-bearing ewes during late pregnancy. This is especially true for those flocks that place a high emphasis on post weaning growth rates as this trait is genetically associated with higher BWT.

Producers with more fecund flocks can afford to select rams with higher BWT ASBVs, because average lamb birth weight is lower in twin litters, and there is a positive relationship between birth weight and lamb survival overall.

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