Chapter 5 General Discussion

A thorough understanding of the genetic and non-genetic factors that impact sheep survival has clear economic implications. Improved lamb survival adds value directly to the lamb crop by increasing the number of lambs marketed. Increased numbers of lambings by a ewe over her lifetime also affects income through reduced ewe replacement rates, increased selection intensity in the ewe lamb crop, and an increase in the number of lambs marketed. However, relationships between performance and survival are complex and the appropriate strategies for achieving genetic progress in sheep survival are unclear.

Our genetic evaluation of lamb survival in Polypay sheep in this dissertation revealed nearly no genetic variance for survival to 3 d of age. Obviously, without genetic variation in survival, no response to selection on correlated traits can be anticipated. From the survival analysis, both large litter sizes and low birth weights were major factors influencing lamb mortality, and birth weight accounted for most of the litter size effects on survival in triplets and quadruplets.

One strategy would be to select for a higher twining rate within the flock. After accounting for the anticipated effects of ewe age, the highest proportion of twin lambings that can be expected on a whole-flock basis ranges from 60 to 65%, after which the proportion of triplets increases and twinning decreases. Selection for both direct and maternal birth weight is possible. However, the effectiveness of a correlated response to selection on birth weight to change lamb survival is questionable due to the lack of genetic variation in lamb survival. Selection to measure additive direct effects on birth weight may be associated with an increase in frame size while high additive maternal genetic birth weight effects may reflect the many underlying genetic

components involved with lamb development *in utero*. Increasing birth weight through selection may slightly improve survival of triplets and quadruplets but the effect on singles and twins is not clear, given the nonlinear phenotypic relationship between birth weight and lamb survival. Results from this dissertation indicated that the high prolificacy Polypay breed was at relatively low risk of increasing mortality associated with an increase in birth weights. As a recommendation to producers, selection for increased birth weight may be tempting, especially in relatively prolific sheep, however, the relationships are not clear and as environmental effects on litter size change from year to year, and place to place, the influence of genetically heavier birth weights may be detrimental in some flocks and/or in some years. Producers are better advised to implement management practices that provide special treatment to those lambs that are at greatest risk.

Ewe survival is more complex than lamb survival because of the countless number of environmental effects that contribute to the removal of a ewe from the flock. Ewes are culled based on their phenotypic performance for traits that correspond to economic and health factors, such as fertility, body weight and condition, structural soundness, and, to a lesser extent, prolificacy. Therefore, the length of time a ewe stays in the flock can be thought of as a function of observed performance and underlying survival traits associated with health and fitness. The genetic and non-genetic relationships between the different performance and survival traits all influence the length of productive life in different ways. Environmental relationships between stayability and adult body size reflect the typical culling procedures for a western range flock, where light weight, low conditioned ewes are preferentially removed prior to breeding; however, a genetically antagonistic relationship appears to also exist between stayability and body size.

The relationships that exist between stayability and ewe production traits are not easy to interpret for producers given the small observed phenotypic correlations. Intuitively, producers may correlate a heavier body weight with a more productive ewe, however, genetically smaller ewes appear to have longer productive lives.

The relationships between ewe stayability and lamb traits indicated a slight antagonistic relationship between lamb growth and future stayability. This relationship reflects the genetic correlation between adult weight and stayability. In contrast, maternal lamb traits were positively associated with stayability. This relationship may reflect a pleotropic effect between all the underlying traits that influence maternal lamb growth and ewe survival. For example, ewes that have a higher genetic value for stayability may be better adapted for extensive range conditions and therefore express a higher level of milk production compared to ewes with lower stayability.

Producers tend to focus their selection decisions on traits that directly influence lamb performance. Multiple-trait selection indexes are a useful means of selection based on an economic breeding objective and properly include the genetic and environmental relationships between survival and other production traits. The inclusion of fitness traits in a selection index would promote genetic change that is optimal for the system, accounting for antagonistic relationships between fitness and performance.

The survival evaluations in this dissertation were performed on data collected from sheep in a commercial range environment. In the text, reference was made to the potential impact of

selection and management practices on variance and covariance estimation of survival traits. Biases in genetic evaluations using commercial livestock data are difficult to identify when non-linear relationships that may exist cannot be addressed. Clarification of nonlinear relationships requires random selection of replacement females within the flock. However, this restriction is not economically practical for most flocks. The need to extensively manage large numbers of ewes over many years of production would decrease the value of the flock.

To further evaluate genetic and non-genetic fitness relationships in sheep, a randomly selected sub-group within a flock could be managed to stratify the environmental factors that potentially impact current evaluations. For example, allocating a group of ewes to be extensively managed at lambing, requiring them to nurse their litter through to weaning, and randomly selected ewes from the lamb crop would help clarify relationships between lamb and ewe performance by including more phenotypically small ewe lambs in the evaluations. The potential downside of a randomly selected, extensively managed sub-group of sheep would be a possible increase in mortality of lambs along with the unknown impact of including more light-weight ewes in the breeding flock. However, this strategy would allow the underlying relationships between performance and fitness to be evaluated without the unknown effects of selection bias that may exist in commercially managed flocks.