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Lamb Mortality

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Introduction

It has been established that net reproductive rate (lamb crops weaned) is the largest contributing factor to efficiency of lamb meat production (Large, 1970). With the present low rate of return from wool production, it is imperative that producers who will survive must produce meat more efficiently. There is also a need to increase overall numbers of lambs produced in order to justify the maintenance of the necessary infrastructure to sustain the industry. On a flock basis there are a number of components of net reproductive efficiency including age at sexual maturity, length of productive life, seasonality of reproduction, frequency of lambing, ewe fertility, ovulation rate, embryo mortality and lamb survival. Among these, it has been suggested that under some conditions, reducing lamb mortality offers the greatest opportunity to improve the efficiency of the flock (Wang and Dickerson, 1991).

The Potential

For a single or given season, the potential or upper limit for reproductive rate is represented by the ovulation rate of the ewes exposed for mating. The difference between the potential and the lamb crop raised is often referred to as reproductive wastage. Attempts have been made to estimate and partition these losses which will obviously vary with conditions. One such study reported by Willingham, Shelton, and Thompson (1986) for finewool ewes under Texas range conditions is shown in Figure 1. In this study the potential lamb crop, based on ovulation data, was estimated at approximately 151.9%, whereas the actual lamb crop raised was 100.7%. The two major areas of loss were the difference between ovulation rate and embryos present (34 lambs per 100 ewes or 22.4% of total ovulations) and the difference between lambs born and lambs weaned (15.9 lambs per 100 ewes or 13.6% of the total lambs born). In these data, few prenatal losses occurred after 24 days of gestation. These findings are consistent with other works suggesting that 20-30% of fertilized ova are lost during pregnancy (Edey, 1969) with much of this loss occurring within 19 days of conception (Michels et al., 1998). At this time there are few clues as to how to reduce the loss between ovulation and implantation, but it is thought to be, in part, a matter of chance which individual ewes fail to become pregnant or multiple ovulating ewes become pregnant with only one embryo. These data were obtained using range Rambouillet ewes, and both prenatal and postnatal losses would likely have been greater if more prolific types were used. The options to increase the number of lambs raised consist of increasing the fertility (number of ewes becoming pregnant) increasing the ovulation rate, lambing more frequently, and reducing lamb mortality. The latter is the subject of this paper.

Although postnatal losses as low as 2% (Schwulst et al., 1999) have been reported under intensively managed conditions, the writers consider 10 percent as a practical minimum under production conditions. The percent of stillborn lambs under field conditions will usually exceed the 2% figure (8.4% of total death losses - Rook 1989), but some of the reported stillbirths may be reduced if workers are present at parturition. From the suggested minimum of 10%, losses approaching 100% have been observed. Losses of this magnitude are usually associated with heavy predation or some calamitous event such as storms (heavy snows) at lambing or serious disease outbreaks.

In well managed flocks (but not barn or shed lambed), death losses tend to run from eight to 12% for singles and 16 to 20% for twins and for litter sizes above two, mortality is much higher.

Flocks with litter sizes above two tend to be those with ewes from the more prolific breeds such as the North European Short Tail group (Finnish Landrace and Romanov) or those carrying the FecB gene of Booroola origin. Mortality rates for triplets tend to approach 30% (even with intense management) and with four or more lambs the mortality tends to be 50% and above (Willingham and Shelton, 1990). The net result is that litter sizes above two may not result in an increase in the lamb weight weaned. This may not be the case for triplets if they can be intensively managed.

The above discussion suggests that: (a) lamb mortality is a serious problem to be dealt with, (b) this problem is likely to increase with efforts to increase lambing rate, (c) more intense management at lambing may contribute to improved lamb survival, and (d) the reduced flock sizes associated with the decline in ewe numbers may make it feasible to provide more intense management at lambing.

Even with intense management at lambing, and certainly in the absence of this, producers need to develop breeding and management strategies that maximize or optimize lamb survival and growth.

Factors contributing to lamb survival (or losses) may be divided into genetic and environmental components. Of these, environmental (including management) may be considered to be the most important, but there are genetic components as well.

The Genetic Component

Genetics or breeding systems are contributing factors to lamb mortality or survival in many ways. Genetics is a major contributing factor to litter size which, as outlined above, affects lamb mortality or survival. Litter sizes above two are not frequent enough to present a serious problem, except for the more prolific types. Those (prolific breeds) available in this country include the Finnish Landrace, the Romanov and those carrying the FecB gene of Booroola origin. In commercial lamb production, none of these should be used as purebreds or in the homozygous state with respect to the FecB gene. In the case of the short tail types, the percentage can be diluted to that desired, but the Booroola type can be employed only as homozygote (two copies of the gene) or heterozygote (one copy of the gene). Some data on ovulation and lambing rate for the half Finnish and the heterozygote (one copy of the gene) Booroola gene is shown in Table 1.

These data show that both types have approximately the desired ovulation and lambing rate, but that the Booroola (FecB) carrier has a greater tendency to have litter sizes above two. Experience with the original Booroola genotype has shown that they do a poor job of rearing this number of lambs (Bindon, 1984). There is work in progress to transfer the FecB gene into other genotypes such as the Rambouillet, but it is not known at this time if these will do a better job of rearing multiple births. It is expected that the Rambouillet genotype will provide heavier weaning weights or faster growth rates. For the present discussion, it is suggested that the Romanov would perform similarly to the Finn in this respect (Fahmy, 1996).

In addition to the influence of litter size, it is expected that mating system (heterosis in either the dam or the lamb), when corrected for litter size, will tend to improve lamb survival by two to 5 percent (Wiener et al 1973), but this may vary with the breeds involved.

One of the major factors contributing to lamb mortality is cold stress. It has been shown that a single gene trait results in a hairy birth coat which improves lamb survival of those exposed to cold stress (Slee, 1978). It may be significant to note that none of the prolific breeds currently employed possess this gene.

It has been shown that there is a heritable component to the ability of the dam to raise the lambs born to her (Shelton and Menzies, 1970). The heritability of this trait (.16 in this study) is of a similar to or of greater magnitude to that of the other reproductive traits. Such an effect might be mediated through temperament or mothering ability of the ewe, udder shape, milking ability, etc. It should also be pointed out that in the case of lamb mortality, selection for survival is automatic and may equal the magnitude warranted. However, the ability to rear lambs may be a more important component of selection for lifetime ewe productivity or total lamb weight weaned over a period of years. In addition, lamb survival may well play a part in the choice of cross breeding system and breeds employed for commercial lamb production.

Environmental Factors Contributing to Lamb Survival

As mentioned earlier, serious losses of lambs may occur as a result of predation or disease, although the latter tend to be associated more with prenatal as opposed to postnatal losses. For reasons of time and space these items will not be dealt with in the present discussion, but are issues that the producer will need to address.

Perhaps the greatest single predisposing factor contributing to lamb loss is birth weight; whereas in fact, the major direct causes of losses are starvation and hypothermia. The literature relating to these points is rather extensive and no attempt will be made to review all of this at this time. One such study (Shelton, 1964) based on finewool ewes (mostly Rambouillet) with the moderate level of management necessary to collect experimental data indicated death losses more than 65% for lambs weighing less than 4 pounds at birth. Minimum losses (6.4 to 8.1 percent) occurred for lambs weighing nine to 12 lbs. Losses increased for lambs weighing above 12 lbs., and some ewe losses will be encountered with these heavy weight lambs, especially if ewes are lambed unattended on the pasture or range. However, death losses due to overweight lambs represent a very small part of the problem (0.32% of the number in the above study) involving mostly fall born lambs. The problem of heavy weight lambs will be greater for single lambs born in the spring of the year. At the same time it will be less with increased use of more prolific types of ewes. The only precaution the author would suggest in respect to heavy weight lambs would be to use caution in breeding large sire breeds (such as Suffolk or Hampshire) to first lambing ewes (ewe lambs or yearling ewes) which are bred for spring lambs. Some increased losses of both lambs and ewes have been reported under these conditions (Willingham et al., 1994). Several factors were involved in this instance such as large sire breed rams, and small or underdeveloped females producing mostly single lambs born in the spring of the year.

Since low birth weight is a major predisposing factor to lamb mortality it seems logical to look at factors affecting birth weight.

Unquestionably, litter size has the greatest influence on birth weight, but in any effort to improve efficiency of meat production from sheep, it is not feasible to suggest a reduction in prolificacy as a means of improving birth weight. Perhaps the ideal situation would be for first lambing ewes to produce single lambs and to produce twins at each subsequent lambing. Although this is not likely to be completely realized, efforts should be made to approach this by discriminating against single births (except for young ewes) and litters in excess of two or possibly three. This is the basis in which many producers have used ewes carrying a percentage of one of the more prolific breeds which will often approach this theoretical ideal.

Aside from litter size, the other factors affecting birth weight are nutrition and temperature. The latter also contributes to lamb mortality (or survival) aside from its contribution to birth weight.

Nutrition is not a major factor in birth weight of single lambs from ewes in medium to good flesh which are receiving at least a maintenance ration. If there is a nutritional problem for single bearing ewes it is more likely to be protein, but the average producer is so oriented to providing protein that this practice may be overdone. A single bearing ewe may require only on the order of 180 grams (0.4 lbs.) of protein even in the last trimester of pregnancy, and assuming at least half of this is provided by the pasture forage, as little as 90 grams or 0.4 lbs. of a protein supplement may be required. A good pasture may well provide for all their needs. There may be other reasons for feeding or not feeding during lambing. Ewes which are hungry may be busy feeding and pay less attention to mothering the lamb. Also, if hand feeding is practiced (such as feeding pellets on the ground), the disruption of feeding may cause ewes to abandon newborn lambs.

Feeding during late pregnancy and early postpartum is more critical for litter bearing ewes. The increased demands for the two or more fetuses may place the ewe in a negative energy or protein balance. Fleshy ewes may breakdown body fat to meet their own needs, but there are two problems with relying on this to meet the ewes' energy needs for fetal development. Catabolism of body fats can be used to meet the ewe's direct energy needs, but it cannot be or is a very inefficient source of glucose (the primary nutrient required by the fetus). Thus even with the breakdown of body fat the embryo may be undernourished, and the incomplete breakdown of the body fat may trigger pregnancy toxemia which is fatal to the ewes. Also ewes carrying multiple fetus may have reduced body space as a result of the uterine contents and thus be unable to consume sufficient low quality forage or feedstuffs to meet their needs. Producers may choose to pregnancy test their ewes (ultrasound) in order to sort single from multiple ewes. On the other hand, they may choose to make this distinction based on breeding or their knowledge of the flock. For instance, range raised finewool ewes usually have a relatively low level of twins and seldom have more than two and thus are often treated as single bearing ewes. On the other hand, more prolific types of ewes may be assumed to have a high frequency of multiple births and be treated as such.

A second important environmental factor affecting birth weight and thus lamb mortality is environmental temperature during (late) gestation (Shelton, 1964). High environmental temperatures during late gestation (last 30 to 45 days) will result in fetal dwarfing. The physiological explanation for this is that if the ewes are suffering from heat stress (increased respiratory rate) their (finite) blood supply will be shunted to the lungs and superficial tissue to accommodate heat loss, with a reduced blood supply available to the internal organs (especially the uterus). The result is an undernourished (one or more) fetus, and the degree of this effect is dependent on the amount of heat stress and how long (hours of the day or number of days) it is experienced. This effect is not prevented by feeding or condition or fleshing of the ewe. In fact both of these can have a further negative impact.

Fortunately this problem does have partial or reasonable solutions. The problem is obviously more serious in the more southern climates and among late summer or early fall born lambs. However, some degree of fetal dwarfing can be documented throughout much of the country. In general, fall born lambs weigh approximately one to 2 lbs. less than spring born lambs of similar genotype. This may go largely unnoticed by producers, but it may influence lamb survival in both negative and positive ways (e.g., there may be fewer problems of dystocia). On the other hand, there is a serious interaction between litter size and birth weight of late summer and fall born lambs. It appears that under these conditions there is a finite amount of nutrients available to the uterus and that twin born lambs may weigh only on the order of 1/2 what a single would weigh. The problem is much worse for litter sizes of more than two. The author is aware of reported instances of 50 to 70 percent mortalities of late summer or early fall born lamb crops from the more prolific types of ewes. A reasonably effective solution to these problems is to avoid lambing ewes under these conditions (avoid August and September lambings). In Texas, it is preferable to delay lambing until October 15. Ewes subjected to heat stress in late gestation may be benefitted by providing good shade during the day (possibly open barns) and allowing them to feed at night. For producers operating under extensive conditions or with limited labor, this type of management is often not an option.

The second major effect of temperature on lamb mortality is that of cold stress during lambing (Falck, Carstens and Waldron, 2001). It must be realized that unless protection can be provided for ewes lambing during the cold seasons, hypothermia is a major cause of lamb mortality. It will be recalled that Rook (1989) reported starvation as the major cause of death; however, much of this starvation was predisposed by low birth weights and cold stress at lambing. The degree to which cold stress is a problem would obviously depend on location (latitude). At the more southern locations (e.g., Texas) many producers avoid lambing in late December, January and possibly early February. Other producers in the Northwest may avoid lambing prior to May.

The degree of this problem (cold stress) is also related to litter size (Willingham and Shelton, 1986) in that lamb losses to cold stress are much higher among multiple births than for singles (see Figure 2). In the referenced study, death losses among multiple births were higher for litters born in the winter than for spring or fall, whereas, single born lambs were not similarly affected. Thus, there is an interaction with respect to death losses between lambing rate (litter size) and lambing date. This interaction is no doubt partially explained by the effect of cold stress on low birth weight lambs, but it is also impacted by the fact that with ewes giving birth to two or more lambs, the time the ewe spends with an individual lamb is both reduced and delayed. The end result of this may well show up as a lamb which starved, but in reality the explanation may be more complex. Thus, for producers who are unable to provide intense management at lambing, the breeding or lambing season should be delayed to avoid lambing during the cold season, and this is especially true for the more prolific types of ewes.

No attempt is being made to discuss details of intensive management during lambing in the belief that producers have their own skills. With larger flocks, the industry is likely moving away from lambing in confinement due to the facilities and labor required. However, if flock sizes are reduced along with the use of more prolific types, more intense management during lambing may become both more important and more feasible. In this connection, it should be pointed out that with appropriate management during breeding, the lambing period may be reduced to as little as three weeks per lambing season. The economics of intense management at lambing would be greatly dependent on overall facilities and labor supply.

Literature Cited

Edey, T.N. 1969. Prenatal mortality in sheep: A review. Anim. Breeding Abst. 37:173-190.

Fahmy, M.H. 1996. Growth, fertility, prolificacy and fleece weight of Romanov, Finnsheep, and Booroola purebreds and their first cross and backcross with the DLS breed. Anim. Sci. 62:479-487.

Falck, S.J., G.E. Carstens and D.F. Waldron. 2001. Effects of prenatal shearing of ewes on birth weight and neonatal survivability of lambs. Sheep and Goat Res. J. 17:14.

Large, R.J. 1970. The biological efficiency of meat production in sheep. Anim. Prod. 12:393-401.

Michels, H., D. Vanmontfort, E. Dewil, and E. Deuypere. 1998. Genetic variation in prenatal survival in relation to ovulation rate in sheep: A review. Small Ruminant Res. 29:129-142.

NRC. 1985. Nutrient requirements for sheep. National Academy of Science Press.

Rook, J.S. 1989. Reducing lamb mortality. Proc. Sheep Reproduction Symposium. Denver, CO. pp 95-111.

Schwulst, F.J., D.G. Ely, D.G. Morrical, and K.C. Aaron. 1999. Effects of hemoglobulin treatment and genetic type on survival and preweaning growth performance of lambs. Sheep and Goat Res. J. 15:15-23.

Shelton, M. 1964. Relation of birth weight to death losses and to certain productive characters of fall-born lambs. J. Anim. Sci. 23:355-359.

Shelton, M. and J.W. Menzies. 1970. Repeatability and heritability of components of reproductive efficiency in fine-wool sheep. J. Anim. Sci. 30:1.

Shelton, M. 1998. Reproductive performance of sheep exposed to hot environments. In: Proceedings of Symposium on Development of Sheep Production Systems in Hot Arid Zones. April 20-22. Kuwait Institute for Agric. Res. Kuwait.

Wang, C.T. and G.E. Dickerson. 1991. Simulation of life-cycle efficiency of lamb and wool production for genetic levels of component traits and alternative management options. J. Anim. Sci. 69:4324-4337.

Wiener, G., F.K. Deeble, J.S. Broadbent and M. Talbot. 1973. Breed variation in lambing performance and lamb mortality in commercial sheep flocks. Anim. Prod. 17:229-243.

Willingham, T., M. Shelton, and P. Thompson. 1986. An assessment of reproductive wastage in sheep. Theriogenology 26:179-188.

Willingham, T.D., M. Shelton, and C. Lupton. 1988. The influence of introducing the Booroola Merino genotype to Rambouillet flocks on reproduction and fleece traits in comparison with other selected breeds and crosses. SID Research Digest 4(2):1-9.

Willingham, T.D. and M. Shelton. 1990. Reducing lamb mortality. Texas Agric. Expt. Sta. PR 4771 (7 pp).

Willingham, T.D., D.F. Waldron, M. Shelton, P.V. Thompson, and G.D. Snowder. 1994. Reproductive performance of Rambouillet and Australian Merino cross ewes. Texas Agric. Expt. Station PR 5217.

Table 1. Distribution of ovulation and lambing rate of the prolific types.

	Ovulation rate (%)					Lambing rate (%)					
Type*	1	2	3	4	avg.	0	1	2	3	4	avg.
Booroola (carrier)	7.8	46.7	37.7	7.8	2.64	5.5	23.6	47.3	20.0	3.6	2.05
1/2 Finn.	16.4	65.9	15.9	1.6	2.11	7.0	25.7	52.6	12.3	2.3	1.85

* Adapted from Willingham, Shelton, and Lupton (1988)

Figure 1. Areas of Reproductive Wastage

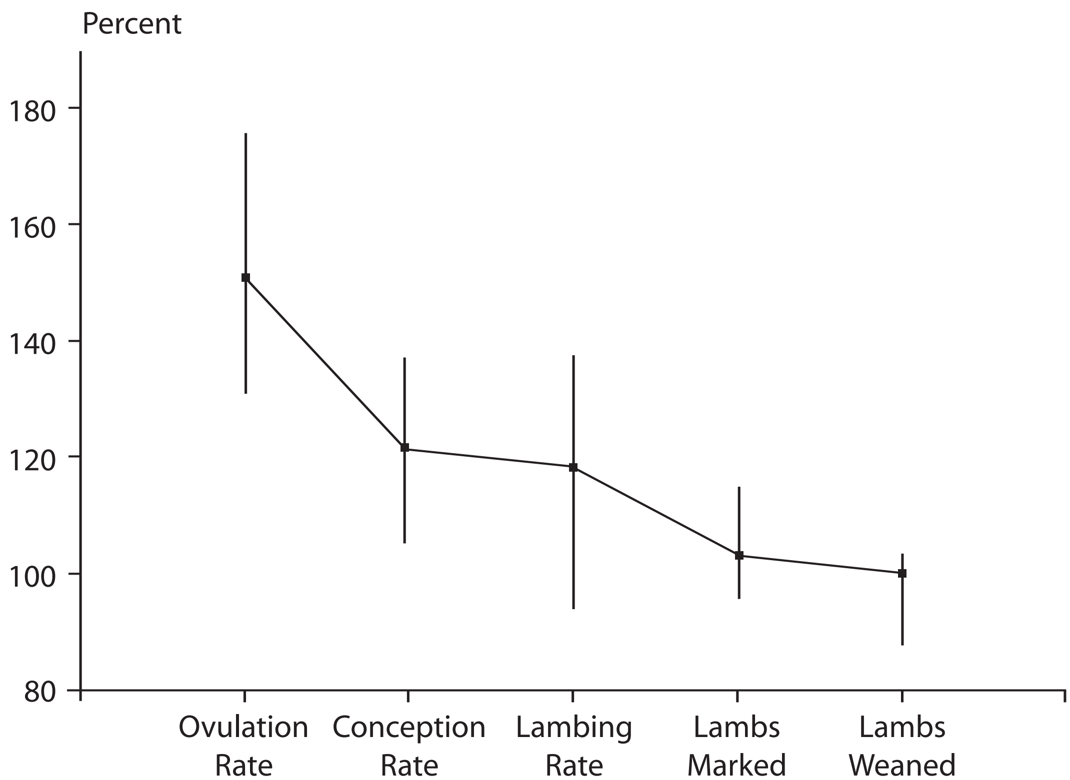

Figure 2. The Influence of Lambing Season and Birth Type on Lamb Mortality