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Does an increase in lamb birth weight though mid-pregnancy shearing necessarily mean an increase in lamb survival rates to weaning?

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ABSTRACT

Lambing percentages in New Zealand have risen over the past decade and will most likely continue to rise, while the price for lamb remains high in relation to wool. Any technique that can increase the birth weights of lightweight multiple-born lambs may increase survival rates to weaning. Mid-pregnancy shearing as a possible technique to increase lamb survival under commercial conditions was examined in the present study. Mid-pregnancy shearing was found to significantly (4.7 vs 5.1kg, $P<0.05$) increase the birth weights of twin-born lambs but had no effect on birth weight of singletons or triplet-born lambs. Both the magnitude of the response, and the fact that it did not occur in all birth ranks, are consistent with previous mid-pregnancy shearing studies. Mid-pregnancy shearing had no significant effect on lamb survival rates to weaning. To achieve an increase in survival rate to weaning through an increase in lamb birth weight alone, the lamb must be born within a birth weight survival range below optimum, and the increase in birth weight must be large enough to move a significant proportion of these lightweight lambs into a higher survival rate range.

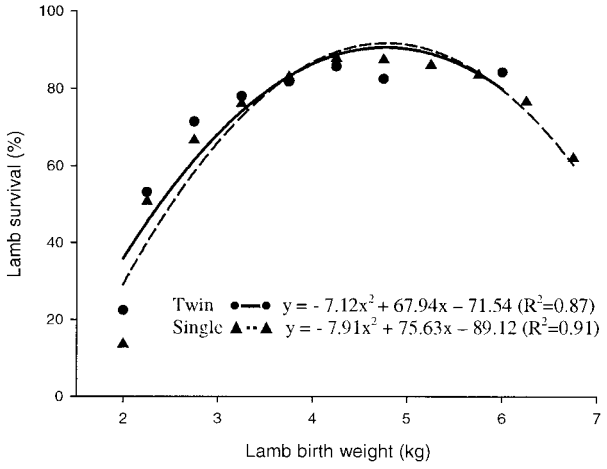
Keywords: mid-pregnancy shearing, lamb birth weight, lamb survival

INTRODUCTION

Lambing percentages in New Zealand have risen over the past decade and will most likely continue to rise, while the price for lamb remains high in relation to wool. Multiple-born lambs are lighter, have lower body reserves, and a larger surface-area-to-body-mass ratio than their singleton counterparts, all of which result in lower survival rates to weaning. It is known that lamb survival rates to weaning are highest in the 4 – 5.5 kg birth-weight range (Dalton *et al*., 1980, Figure 1). Techniques that can increase the birth weight of otherwise light-weight lambs (predominately multiple born) may increase survival rates to weaning.

Overseas, lambs born to pregnancy-shorn housed ewes have higher birth weights (Rutter *et al*., 1971; Symonds *et al*., 1986; Vipond *et al*., 1987) and improved cold resistance (Stott & Slee, 1985; Symonds *et al*., 1992) than those born to unshorn dams. Each individual effect would be expected to improve lamb survival rates under New Zealand conditions (especially in multiples), but a combined effect has the potential to substantially increase newborn lamb survival.

FIGURE 1. The relationship between singleton and twin-lamb birth weight and survival rates to weaning (adapted from Dalton *et al.*, 1980).



Within New Zealand, mid-pregnancy shearing has been shown to increase lamb birth weight (Morris & McCutcheon, 1997; Morris *et al*., 2000; Kenyon *et al*., 2002a; Kenyon *et al*., 2002b; Revell *et al*., 2002). However, mid-pregnancy shearing has been found to have inconsistent effects on the newborn lamb's thermoregulatory capability (Revell *et al*., 2002; Kenyon, 2002; Kenyon *et al*., 2002a; 2002b). This suggests that any effect of mid-pregnancy shearing on lamb survival rate is likely due to an increase in birth weight alone. Morris *et al*. (1999), in a large-scale study involving twin-bearing ewes, found that pregnancy shearing tended to increase lamb survival rates to weaning by up to 3%.

The present study was designed to determine if mid-pregnancy shearing increased lamb birth weights under commercial farming conditions, and to determine if any increase in birth weight affected lamb survival rate to weaning.

MATERIALS AND METHODS

The study was conducted at Massey University's Riverside Farm, 10km north of Masterton, New Zealand (south latitude 40° 50', east longitude175° 38') from April (mating) to December (weaning) 2000. The study was conducted on that part of the farm with flat topography. The farm is classed as 'summer-dry'. Ewes were managed under normal commercial conditions during the period of the study.

The trial design was a 3 x 2 factorial involving pregnancy status (single- versus twin- versus triplet-bearing) and shearing treatment (shorn on average day 70 of pregnancy (P70) versus unshorn (with approximately 6 month's wool growth)).

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Romney ewes (5 years of age, n = 1030) mated to Suffolk rams were used during the trial period. All ewes conceived in a 17-day (1 oestrous cycle) mating period and were selected on this basis from a commercial flock of 1402. Average day 0 (P0) of pregnancy was defined as 9 days after ram introduction. Pregnancy diagnosis (ultrasound) was conducted at both P50 and P86 (to accurately assess pregnancy status). Approximately half of the single-, twin-, and triplet-bearing ewes were shorn using a cover comb (Sunbeam New Zealand Ltd, maximum stubble depth 9mm) at P70, the remainder being left unshorn.

From mating until set stocking, all ewes were managed as one group (rotationally grazed) except for a short period (10 days, P70-80) post mid-pregnancy shearing in which shorn and unshorn ewes were grazed in adjacent paddocks (shorn ewes were grazed in a more sheltered paddock). Both groups were offered similar allowances (average herbage masses of 1111 kgDM/ha). At P133 single, twin, and triplet-bearing ewes were set stocked (11.2, 9.5 and 7.7 ewes/ha respectively) with equal numbers of shorn and unshorn ewes within each paddock.

MEASUREMENTS

All ewes were weighed prior to set stocking (P133) (shearing treatment had no effect on dam liveweight, data not shown). The mid-point of lambing (L1) was 12 September 2000. All lambs were identified to the dam, sexed, recorded for birth-rank, weighed, and tagged within 12 h of birth regardless of category (dead vs alive). Each lamb's status (present vs absent) at weaning (L 86/87) was established as a measure of lamb survival rate to weaning. Birth rank did not change if a lamb(s) within a multiple set were not present at weaning.

Data analysis

Lamb birth weight was subjected to analysis of variance using the Generalised Linear Model procedure of the statistical package 'Minitab' (Minitab, 1998). Sex of lamb was used as a fixed effect, with ewe live weight at set stocking, and date of birth, used as covariates in the model to partition variation in lamb birth weight.

The proportion of lambs surviving to weaning was analysed as a binomial trait using the statistical package 'SAS' (SAS, 1985) procedure for categorical data modelling (CATMOD).

RESULTS

Lamb birth weight

There was a significant interaction between ewe shearing treatment and birth rank on lamb birth weight, such that shearing the ewe significantly ($P<0.05$) increased the birth weights of twin-born lambs (by 0.4 kg) but had no significant effect on the birth weights of either singletons or triplets (Table 1).

Lamb survival

There was a significant ($P<0.05$) interaction between the effects of ewe shearing treatment and birthrank on lamb survival rates (Table 1), such that twins ($P=0.16$) and triplets ($P=0.11$) born to shorn ewes tended to have higher survival rates (but not significantly so within rank) than their counterparts born to unshorn dams, while the opposite relationship (also not significant) was observed in singletons ($P=0.18$). Relatively low numbers in the singletons and triplets may have limited the ability of this study to determine a difference in survival rate to weaning.

TABLE 1: The effect of birth-rank and ewe shearing treatment on lamb birth weight (kg) and survival rates to weaning (%) (Mean ±SEM). Means within treatments having differing superscripts are different ($P<0.05$).

	(n)	Birth weight	Survival rate to weaning
Birth rank			
1	311	6.1^{c} ±0.05	1.56^{1} ±0.15 $(82.6)^{b\,2}$
2	1342	4.9^{b} ±0.02	1.40 ±0.07 $(80.3)^{b}$
3	144	4.0^{a} ±0.07	0.38 ±0.17 $(59.3)^{a}$
Shearing treatment			
Unshorn	932	4.9^{a} ±0.04	1.26 ±0.08 (77.9)
Shorn	865	5.2^{b} ±0.04	1.40 ±0.09 (80.2)
Birth rank x Shearing			
1 x Unshorn	181	6.0^{d} ±0.07	1.74 ±0.20 $(85.1)^{b}$
1 x Shorn	130	6.2^{d} ±0.06	1.34 ±0.21 $(79.2)^{b}$
2 x Unshorn	676	4.7^{c} ±0.03	1.31 ±0.10 $(78.8)^{b}$
2 x Shorn	666	5.1^{b} ±0.03	1.50 ±0.10 $(81.8)^{b}$
3 x Unshorn	75	3.9^{a} ±0.09	0.13 ±0.22 $(53.2)^{a}$
3 x Shorn	69	4.2^{a} ±0.10	0.67 ±0.25 $(66.2)^{a}$

[1]Logit-transformed
[2]Back-transformed (%)

DISCUSSION

The aims of this study were to investigate the effect of mid-pregnancy shearing on lamb birth weight and survival rates to weaning under commercial conditions. Mid-pregnancy shearing increased the birth weight of twin-born lambs, but had no significant effect on the birth weight of either single- or triplet-born lambs. This birthrank specific response has been observed in previous mid-pregnancy shearing studies (Morris & McCutcheon (1997) in twins, and by Morris *et al*. (2000), Kenyon *et al*. (2002b) and Revel *et al*. (2002) in singletons). The magnitude of the birth weight response observed in twins in the present study is consistent with that observed in other mid-pregnancy studies (Kenyon *et al*., 2002a; 2002b).

Although a relatively large increase in twin lamb birth weight was observed (0.4 kg, $P<0.05$) mid-pregnancy shearing failed to significantly increase twin lamb survival rates to weaning. Therefore, the question to be asked is 'why did such an increase in birth weight of twins fail to improve survival rates to weaning'? Dalton *et al*. (1980) showed that lamb survival rates are highest in the 4.0 to 5.5 kg birth-weight range (Figure 1). From the birth weights of twin-lambs born to unshorn dams in the present study, using the survival results of Dalton *et al*. (1980) (Figure 1), we can calculate predicted survival rates for either a 4.7 or a 5.1 kg twin lamb (90.6 and 89.8% respectively). However, examining the survival rate in this manner fails to take into account the variation within birth rank. Predicted survival rates to weaning of all twin lambs born in the present study can be calculated by multiplying the numbers of lambs born within each of the 0.5 kg birth-weight ranges by the survival rates

TABLE 2: The effect of dam shearing treatment on predicted twin-born-lamb survival rates (based on survival data presented by Dalton *et al*. (1980)) to weaning at Riverside farm.

		Dam shearing treatment			
		Unshorn		Shorn	
Birth weight range	**Dalton's survival %**	**Actual numbers born**	**Predicted number survived**	**Actual numbers born**	**Predicted number survived**
< 2.0	22.4	2	0	0	0
2.0 - 2.5	53.1	2	1	2	1
2.5 - 3.0	71.4	8	5.3	1	0.6
3.0 - 3.5	78.0	24	18.2	8	6.1
3.5 - 4.0	81.8	73	60.5	25	20.7
4.0 - 4.5	85.7	121	106.1	71	62.3
4.5 - 5.0	82.5	184	160.8	149	130.2
5.0 >	84.2	262	220.6	410	345.2
Total		**676**	**572.5**	**666**	**566.1**
Predicted survival rate (%)			84.7		85.0
Actual survival rate (%)			78.8		81.8

reported by Dalton *et al*. (1980) (Table 2). Based on this calculation, there is no difference in the predicted survival rates for twin lambs born to either unshorn or shorn dams (84.7 and 85.0% respectively), supporting the lack of a mid-pregnancy-shearing effect found on lamb survival in the present study.

The actual increase in the twin lamb survival rate observed by mid-pregnancy shearing (though not significant) in the present study is greater than that calculated (3.0 vs 0.3%, Table 2). Similarly, Morris *et al*. (1999) reported an up to 3% increase in twin lamb survival rates by increasing lamb birth weight from 4.5 to 4.8 kg. An increase in survival rate of this magnitude (3%) is also not expected in that study based on the increase in birth weights observed (using the survival data of Dalton *et al*., 1980). These findings in addition to the present study may indicate that there is some other factor(s), which may act independently of birth weight to improve the survival rates of lambs born to shorn ewes.

Under pastoral conditions, mid-pregnancy shearing has failed to consistently affect the summit metabolic rate of newborn lambs. Revell *et al.* (2002) observed that mid-pregnancy shearing increased twin-born lamb summit metabolic rates but, that it had the opposite effect in singletons. Others have reported no effect of mid-pregnancy shearing on the newborn lamb's thermoregulatory capability (Kenyon, 2002; Kenyon *et al*. 2002a; 2002b). Other possible mechanisms reported that may increase survival include; changes in lamb fleece characteristics (e.g., a greater wet-fleece depth of lambs born to shorn dams in comparison to their counterparts born to unshorn dams, a change in dam behaviour (e.g., the seeking of shelter), easier lambing, increased ease for lamb finding the teat, increased dam awareness of the lamb, and fewer ewes being lost to casting with consequent loss of their lambs (Wodzicka-Tomaszewska, 1963; Frengley, 1964; Rutter *et al*., 1971; Alexander & Lynch, 1976; Lynch & Alexander, 1976; Black & Chestnutt, 1990; Kenyon, 2002).

The lamb survival data of Dalton *et al*. (1980) explains the difficulty of manipulating lamb survival though a change in birth weight alone, when most lambs are destined to be born in the 4.0 to 5.5 kg birth-weight range. To successfully achieve a survival response through an increase in birth-weight, the lamb(s) must first be born within a birth weight range below optimum, and second, any increase in birth weight must be large enough to move a significant proportion of these low birth weight lambs into a higher survival rate range. Morris *et al*. (1999) demonstrated (Table 3) that a 0.5 kg increase in birth weight within a flock with an average birth-weight of approximately 3.7 kg will increase survival rates by 4 % (77.4 to 81.5 %). On many New Zealand farms twin lamb birth weights are often less than 4.0 kg, indicating that mid-pregnancy shearing has the potential to increase survival rates, independently of any other factor. Additionally, Kenyon *et al*. (2002a; 2002b) illustrated that the mid-pregnancy effect on birth weight is generally greater in conditions in which lamb birth weights are destined to be relatively low (with birth-weight responses of up to 0.8 kg being observed). This would suggest that the mid-pregnancy shearing of the ewe has the potential to increase multiple born lamb survival rates on many New Zealand farms. However, Kenyon *et al*. (2002b) showed that in conditions in which foetal growth is severely restricted (though poor dam condition and/or nutrition), a birth-weight response to mid-pregnancy shearing was not observed.

It should also be remembered that increasing the birth weights of an otherwise high-birth weight lamb(s) may result in a reduction in survival rates. Mid-pregnancy shearing has been shown to either not increase, or to only slightly increase lamb birth weight, when lambs are otherwise destined to be born of relatively high birth weight (Kenyon *et al*., 2002a). However, even a small increase in birth weight of lambs destined to be born heavier than 5.5 kg can significantly reduce survival rates (Kenyon, 2002). This would suggest that the mid-pregnancy shearing technique is best suited for high fecundity flocks or for multiple-bearing ewes only. Even if a birth-weight response is not observed in singletons, and, therefore, there is not a negative effect on singleton lamb survival rates, there is the additional cost of shearing single-bearing ewes twice yearly to incorporate the mid-

TABLE 3: Actual survival of multiple-born lambs by birth weight range and predicted survival if birth weights increased by 0.5 kg due to pregnancy shearing (adapted from Morris *et al*., 1999).

Actual BW range (kg)	No. born	Survival (%)	Actual survival	New distribution	Predicted survival
<2.0	49	22.4	11	-	-
20-2.5	162	53.1	86	49	26
2.5-3.0	325	71.4	232	162	116
3.0-3.5	674	78.0	526	325	253
3.5-4.0	709	81.8	580	674	551
4.0-4.5	460	85.7	394	709	608
4.5-5.0	194	82.5	160	460	379
>5.0	57	84.2	48	251	211
Totals	**2630**		**2037**	**2630**	**2144**
Survival (%)		77.4			81.5

pregnancy shearing policy in many New Zealand crossbred flocks. However, shearing twice yearly can increase both wool quality and quantity (which should increase wool returns) and relieves the need for pre-lamb crutching (Kenyon, 2002). Additionally, under those environmental conditions in which a once-yearly mid-pregnancy shearing policy can be incorporated, failure to achieve a survival response will not increase costs (Kenyon, 2002).

CONCLUSION

This study indicates that mid-pregnancy shearing can increase twin lamb birth-weights under commercial conditions. However, the increase observed did not result in an increase in lamb survival rates to weaning. To achieve an increase in survival rate to weaning through an increase in lamb birthweight alone, the lamb must be born within a birth weight survival range below optimum, and the increase in birth weight must be large enough to move a significant proportion of these lightweight lambs into a higher survival rate range.

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