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Ewe body condition score and the effect on lamb growth rate

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Abstract

Data were analysed to investigate the association between ewe body condition score (BCS) and lamb growth rate (LGR). Ewe BCS was assessed on a scale of 1 to 5 pre-lambing (BCSL) and at weaning (BCSW). Change in BCS throughout lamb rearing (BCSChange) was calculated as the difference between BCS at weaning and pre-lamb. The three way interaction between birth rank, BCSL and BCSChange was significant ($P < 0.05$). When the interaction was examined for birth rank, it was significant between BCSL and BCSChange in singles ($P < 0.05$) and twins ($P < 0.01$), but not in triplets. In singles and twins, lambs with the highest LGR were from dams that had high BSCL and negative BCSChange or those with low BCSL and positive BCSChange. Triplets had a similar trend whereby lambs with the highest LGR were from dams with a high BCSL and a negative BCSChange. This study suggests that if farmers manage their ewes to achieve a high BCS at lambing time this is likely to improve lamb growth to weaning. In addition, identifying ewes with a low BCS at lambing and preferentially feeding them to increase BCS during rearing may increase single and twin lamb growth rates.

Keywords: body condition score; ewe; growth rate; lamb

Introduction

Lamb growth rate is an important driver of farm profit. Faster growing lambs achieve target weights earlier and can be weaned for slaughter earlier to take advantage of meat schedule premiums. Continued improvement in the average lambing percentage has led to many ewes now having multiple births. Lactation performance has become more important than when the lamb crop included more single lambs. As a consequence, routine assessment and monitoring of the condition of ewes during the breeding season, along with understanding when and how this information should be used is becoming more important. Body condition scoring is a useful management tool to collect this information (van Burgel et al. 2011; Sanson et al. 1993) and using it to manage ewes to condition score targets has been shown by Trompf et al. (2011) to increase ewe productivity.

There have been several studies which examined the relationship between ewe body condition score (BCS) and lamb growth rate. In some studies there was a positive relationship between lamb growth rate and ewe BCS (Kenyon et al. 2004; Gibb & Treacher 1980), while others reported no association (Litherland et al. 1999). More recently, studies by Thompson et al. (2011) investigating liveweight change of the ewe during pregnancy have shown that this was related to lamb growth in Merinos. A previous study from a subset of the same flocks as the current study, but with fewer data, found a negative association with BCS at weaning and total weight of lamb weaned. Total weight of lamb weaned is a trait which incorporates lamb survival, birth weight and lamb growth rate (Mathias-Davis et al. 2011).

The objective of the current work was to examine, in four intensively recorded high performance flocks, the relationship between ewe BCS pre-lambing, ewe BCS change over rearing and lamb growth rate for single, twin and triplet-born lambs.

Materials and methods

Animals

Performance records in the Sheep Improvement Ltd. (SIL) national sheep recording database were used (Table 1). Data from ewes in four Southland flocks comprising 2,516 ewes lambing in three consecutive years were used. The data set was limited to ewes having up to three lambs with records available for their lambs which survived to weaning. Ewes that had been part of an embryo transfer programme, had required intervention at birth, or had all or some of their lambs fostered were excluded from the analysis. All lambs surviving to weaning and for which growth rate data could be calculated were included. Thus lambs with growth rates available were included regardless of the survival of their siblings. This resulted in 3,615 ewe records and 6,413 lamb records (Table 1).

Ewe data

Ewe data were recorded and entered into the SIL database. Date of birth, birth weight (BWT), lamb birth rank (BR), lamb sex (SEX), weaning date, number of lambs weaned (NLW) and weaning weight were recorded. Day of birth year (DOY) was calculated as the number of days from 1 January in that year to the date of birth. Lamb growth rate (LGR) was calculated as the difference between weaning weight and BWT divided by the number of days between weaning and birth, reported in g/day. Ewe age, flock, DOY, birth year, BR, mob, NLW, SEX, ewe live weight at mating (LWMATE) and pedigree were analysed for association with LGR. Ewe age was

Table 1 Number of lamb records by ewe age, birth rank and birth year.

Ewe age	Birth rank	Lamb count		
		2009	2010	2011
2	1	78	42	96
	2	248	192	464
	3	53	29	167
3	1	68	56	62
	2	438	370	399
	3	226	138	221
4	1	69	47	75
	2	380	199	332
	3	202	82	166
5+	1	56	46	67
	2	340	223	347
	3	164	104	167

Table 2 Incremental F and P values for fixed effects in the ASREML animal model for lamb growth rate. LWMATE = Ewe weight at Mating; BWT = Lamb birth weight; DOY= Day of birth year NLW = Number of lambs weaned; BR = Birth rank; BCSL = Body condition score at lambing; BCSChange = Body condition score change. Bold text indicates significance at P <0.05.

Source of variation	Degrees of freedom	F value	P value
Mean	1	48687.8	**<0.001**
Lamb sex	1	806.2	**<0.001**
LWMATE	1	99.7	**<0.001**
BWT	1	1307.8	**<0.001**
Flock & Birth year	7	53.6	**<0.001**
Mobs nested in flock & Birth year	62	8.9	**<0.001**
DOY	1	2.4	0.12
NLW	2	480.1	**<0.001**
BR	2	5.4	**0.005**
Ewe age	3	18.1	**<0.001**
BCSL	1	12.2	**<0.001**
BCSChange	1	11.2	**<0.001**
BR x Ewe age	6	2.6	**0.01**
BR x BCSL	2	2.3	0.10
BR x BCSChange	2	1.5	0.22
NLW x BCSL	2	3.1	**0.05**
NLW x BCSChange	2	3.8	**0.02**
BCSL x BCSChange	1	9.4	**0.002**
BR x BCSL x BCSChange	2	3.6	**0.03**

grouped as 2, 3, 4, and 5+ years. Body condition scores were recorded within two weeks prior to lambing (BCSL) and again at weaning, approximately 85 days from birth (BCSW). Body condition scores were recorded on a scale of 1 to 5 as described by Jeffries (1961) with 1 being extremely emaciated and 5 being obese. The scale was modified to include half scores (Mathias-Davis et al. 2011), Change in BCS during lamb rearing (BCSChange) was calculated as the difference between BCSW and BCSL. The association of ewe BCSL and BCSChange with LGR were analysed.

In accordance with the Code of Welfare, ewes with a body condition score of <1.5 were immediately offered preferential feeding to improve their condition. As the study progressed and farmers introduced regular body condition scoring as a routine management tool, the number of ewes in this category was reduced each year.

Statistical analyses

The data were analysed as an animal model in ASREML (Gilmour 2009). The interest was in determining the association between the LGR and BR and the covariates BCSL, BCSChange. Other fixed effects fitted in the model were NLW; ewe age; SEX; LWMATE; flock and year of birth combined as a factor (FlockYear); pregnancy scan mob, birthing mob and weaning mob combined into one variable (Mobgrp) and nested within FlockYear; and the covariates BWT and DOY.

The random effects were genetic and maternal effects calculated using the relationship matrix, permanent environment and environmental litter effects represented by dam/year.

Starting with the full model including all interactions up to four ways of the fixed effects terms of interest, terms were removed in a stepwise process using a threshold of P <0.05. The remaining interactions were BR by ewe age, BR by BCSL, BR by BCSChange, NLW by BCSL, NLW by BCSChange, BCSL by BCSChange and BR by BCSL by BCSChange.

Results

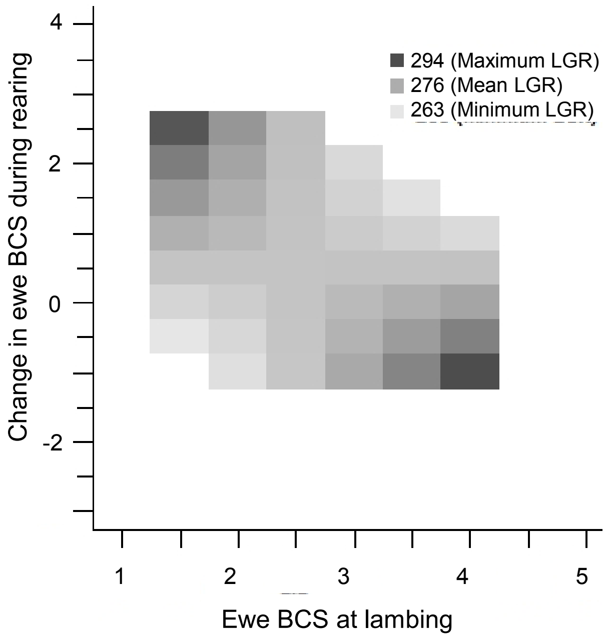
Lamb growth rate was significantly affected by all fixed effects and their interactions except BR by BCSL and BR by BCSChange, which were nested in higher order interactions, and DOY (Table 2).

The proportion of variation ± standard error in lamb growth rate in the population studied attributable to maternal heritability, expressed when the ewe lamb produces progeny of her own; direct heritability, directly transmitted genetic component of the offspring; maternal permanent environment, such as milking and maternal ability, and litter effect arising from animals within a litter having a more similar environment than other contemporaries, were 0.11 ± 0.03, 0.19 ± 0.04, 0.08 ± 0.03 and 0.10 ± 0.02 respectively.

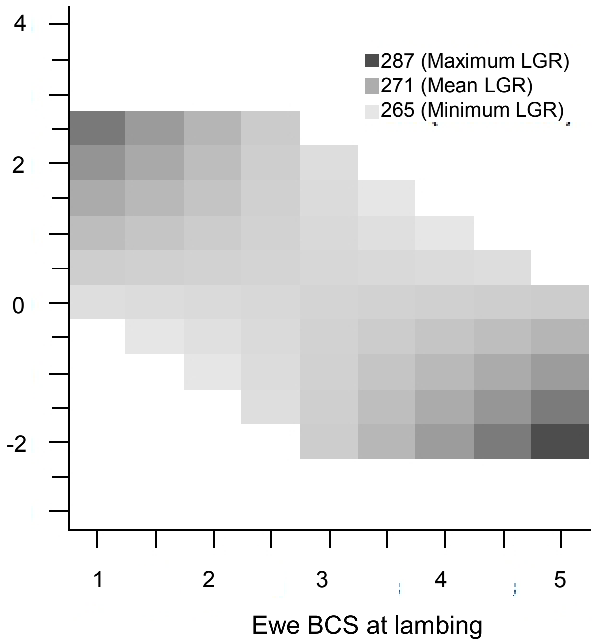
The three way interaction between BR, BCSL and BCSChange was significant (P <0.05). When the interaction was investigated by birth rank, there was significant interaction between Ewe BCSL and BCSChange in singles (P <0.05) and twins (P <0.01), but no interaction in the triplets (P >0.05). In singles and twins the lambs with the highest LGR were those whose dams had a high BSCL and negative

Figure 1 Lamb growth rates in g/day (LGR) scaled within birth rank, by ewe body condition score (BCS) at lambing and change in ewe BCS during rearing. Darker shade = Higher average LGR; Lighter shade = Lower average LGR. Graphs are cropped to the range of data with at least five lamb records available.

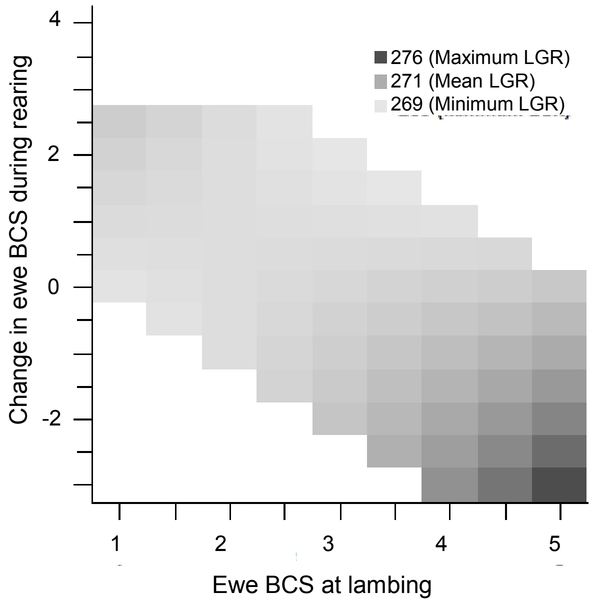
(a) Singles



(b) Twins



(c) Triplets



BCSChange, that is they lost body condition during rearing, or those with low BCSL and then a positive BCSChange that gained body condition during rearing. Within triplets there was a similar trend where lambs with the highest LGR were from dams with a high BCSL and a negative BCSChange. It can be seen that the average LGR distribution became less variable and lower as birth rank increased (Figure 1). The lamb record distribution across BCSL and BCSChange by birth rank is shown in Table 3.

Discussion

The purpose of this study was to investigate the effect of ewe BCS pre-lambing and the subsequent change in ewe BCS during rearing, on lamb growth rate. Lamb growth rate was significantly affected by an interaction between pre-lambing BCS and the change in BCS to lamb weaning.

The present data set is larger than the one used in previous studies. It includes a greater range of body condition scores that were included in the analysis as a covariate rather than grouped. Mob was included as a fixed effect in the analysis of the current study to correct for the possibility of differential feeding as happened for ewes with a BCS <1.5. Single, twin or triplets lambs were reported according to litter size at birth and pedigree has been included in the analysis to correct for the genetic effect of lamb growth rate and the maternal genetic and permanent environment provided by the dam. The inclusion of body condition score change to the analysis has demonstrated that there is not a simple association between BCS at lambing and lamb growth rate. A subsequent change in ewe BCS between lambing and weaning also has an effect on lamb growth rate. Given these differences, a direct comparison to previous research is not possible. However, these results are consistent with the findings by Gibb and Treacher (1980), where the growth rate for twin lambs was found to be higher for ewes with an average BCS of 3.2 than for ewes with an average BCS of 2.4 and the study by Litherland et al. (1999) who found no difference in lamb growth rate between

Table 3 The distribution of lamb records within birth rank, by ewe body condition score at lambing (BCSL) and ewe body condition score change over rearing (BCSChange).

Birth rank	BCSL	BCS Change															Total
		-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
1	1								1			1					2
	1.5							1	2	5	4				1		13
	2					5	2	27	36	38	7	8		3			126
	2.5					1	5	39	67	35	34		9				190
	3				1	26	14	104	30	73	2	27					277
	3.5				1		13	16	17	2	7						56
	4					13	9	42	3	30							97
	4.5						1										1
	5																
	Total				2	45	44	229	156	183	54	36	9	3	1		762
2	1							13			2					2	17
	1.5							2	16	8	2	2					30
	2					50	29	140	161	77	7	12		1			477
	2.5					6	131	432	283	61	47	3	8				971
	3			47	9	444	257	559	102	132		45					1,595
	3.5				8	73	116	76	51	1	3						328
	4		1	30	59	159	86	118	9	27							489
	4.5				2			4	2								8
	5			4		6		7									17
	Total		1	81	78	738	619	1,351	624	306	61	62	8	1		2	3,932
3	1							7								2	9
	1.5						3	1	2								6
	2					14	8	85	48	12		6		2			175
	2.5					7	82	144	93	14	7		8				355
	3			33		213	56	153	19	29	3	16					522
	3.5			2	3	34	38	5	9		2						93
	4	10		77	80	202	15	70		36							490
	4.5			3	4												7
	5		10	14	6	20		12									62
	Total	10	10	129	93	490	202	477	171	91	12	22	8	2		2	1,719
Grand total		10	11	210	173	1,273	865	2,057	951	580	127	120	25	6	1	4	6,413

twinning ewes of BCS 2.5 and BCS 1.5. The current findings are also in keeping with a study in 2011 that showed ewes with a high BCS at weaning had a lower average total lamb weaned (Mathias-Davis et al. 2011).

The current study has identified single and twin lamb growth rate increases in two groups of ewes.

The first group were high BCS ewes that subsequently lost condition whilst rearing their lambs, indicating that the energy reserves they had acquired pre-lambing were utilised to feed their lambs. The interaction found here may be partly due to a genetic effect. The heritability of ewe body condition score at lambing has previously been reported as 0.18 (Everett-Hincks & Cullen 2009) to 0.21 (Shackell et al. 2011). To investigate this, further research into the heritability of body condition score change may be interesting. However, regardless of the genetic predisposition of the ewe, adequate feeding is required to achieve a high BCS at lambing. Monitoring BCS in ewes from year to year may help identify the ewes in the flock which more easily utilise their energy reserves.

The second group with higher lamb growth rates, were ewes with low BCS pre-lambing who gained condition whilst rearing their lambs. It should be noted that it would be a high risk strategy to manage ewes to a low BCS target during gestation as under-nutrition in mid to late pregnancy can reduce fetal growth and birth weight (Kenyon et al. 2007). However, using body condition scoring as a tool to identify ewes with low body condition scores at lambing time and preferentially feeding them during lamb rearing is likely to be beneficial and increase their lambs' growth rates.

The lack of variation in lamb growth rate and generally low averages observed in triplet lambs in this study, compared to singles and twins, suggests there is a limiting factor controlling triplet lamb growth rate. Studies by Dwyer et al. (2005) indicated that triplet lambs had some placental insufficiency in comparison to other litter sizes which correlated with lamb neonatal vigour. It is possible that it this may be influencing the subsequent growth rates of triplet lambs. It is also possible that the increased energy demands on ewes having triplet lambs means ewe intake during gestation and rearing is not sufficient to enable their lambs to reach their growth potential such that they would benefit from increased feed allocations. Kenyon et al. (2007) suggest that there is a ceiling to ewe intake during gestation which may lead to a negative energy balance in late pregnancy for triplet-bearing ewes and that there may be an advantage in offering these ewes a concentrate supplement in late pregnancy.

Further research investigating body condition score changes throughout the breeding season, the association with lamb birth weight and survival rate, and further knowledge of the basis of the genetic and environmental effects may lead to a better understanding of these relationships, and provide improved tools for managing ewes to increase lamb production.

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