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Associations of body condition score and change in body condition score with lamb production in New Zealand Romney ewes

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Abstract

Body condition score (BCS) is an on-farm subjective measurement used to inform feed management decisions in sheep. This study determined the associations of BCS and changes in BCS on production. Ewe BCS was recorded four times annually in a flock of 2534 Romney ewes aged one-five, first bred at eight-months of age. Production was measured as the number of fetuses scanned (NLS), number of lambs weaned (NLW), average weight of lambs weaned (WWT) and total weight of lamb weaned (TLW). Ewe BCS was greatest at lambing and lowest at weaning. At pregnancy scanning (at an average of 75 days of pregnancy), two weeks prior to lambing, and at weaning, BCS ≥4.5 was associated with the lowest NLS and NLW, but the greatest WWT. Ewes with a BCS ≤2.5 at weaning were associated with the greatest TLW, suggesting these ewes had utilised their stored body fat to achieve high milk yields. Ewes that decreased BCS between lambing and weaning produced greater ($P<0.05$) TLW compared with ewes which maintained or gained BCS indicating their body reserves were acting as a buffer for milk production. The results of the current study showed that there was an effect of BCS on NLS, NLW, WWT and TLW. The change in BCS from scanning to weaning is an important determinate of NLW, WWT and TLW. A further study with more focus on the change in BCS is, therefore, warranted.

Keywords: BCS; lamb production; weaning weight; BCS change; total weight of lamb weaned

Introduction

The New Zealand sheep flock was 27.6 million in 2016 distributed evenly between the North and South Islands. In 2016, the average lambing percentage was 130% and average lamb carcass weight was 18.6 kg (Beef+Lamb New Zealand 2017). For the majority of sheep farmers, lamb sales are the main source of income (Beef+Lamb New Zealand 2018). The amount of saleable lamb produced is driven by both the total number and weight of lambs weaned (Morel 2006; Young et al. 2010). Sheep production is influenced by the body reserves of the ewe by allowing for energy to be stored as fat to be used during pregnancy and lactation to grow the lambs. Body reserves are estimated using body condition score (BCS) which is a subjective estimate of both fat and muscle on the ewe (Van Burgel et al. 2011; Kenyon et al. 2014). Ewe BCS is a better indicator of body reserves than is live weight (Russel et al. 1969; West et al. 1990; Dunn & Moss 1992). It has been suggested that feed management decisions should be based on BCS, rather than on live weight (Dechow et al. 2001).

A strong relationship has been reported between ewe BCS at a given time and her reproductive performance. (Kenyon et al. 2014). The measurement of BCS allows for intervention in nutritional management to increase productivity. There is limited information however, on the effect of BCS on the weight of the lamb at weaning. To these authors knowledge there is no published data on the effect of change of BCS during the year on production traits such as number of lambs scanned at pregnancy diagnosis, number of lambs born, number of lambs weaned and weaning weight. The present study examined the effect of both BCS and BCS change between mating and weaning on number of lambs scanned (NLS), number of lambs weaned (NLW), lamb weaning weight (WWT) and total weight of lamb weaned (TLW).

Materials and methods

Animals

The study included 2534 Romney and Highlander ewes first bred at eight-months of age. Ewe data were obtained from Freestone, a Focus Genetics flock that was commercially managed. Birthyear ranged from 2008-2016, ewe age ranged from one to five years. Ewes had both sire and dam data recorded and DNA was collected from the ewes and their lambs to determine parentage. The NLS was based on the number of lambs recorded at pregnancy diagnosis using ultrasound scanning (as per SIL database procedure) and ranged from one to six. Rearing rank or NLW was recorded as number of lambs present at weaning and ranged from one to six.

Measurements

Ewe BCS measures were recorded four times per year between 2009-2017, on a 1-5 scale (Jefferies 1961) with 0.5 increments. The four time points were; prior to mating in March (mating), at pregnancy diagnosis in July (scanning), prior to lambing in August (lambing) and at weaning in December (weaning). Ewe live weight was also recorded at mating and lambs were weighed at weaning (WWT). Pregnancy scanning was recorded at approximately 75 days of pregnancy and was recorded as NLS from zero through to six. Number of lambs born was not recorded. The number of lambs present at weaning (NLW) combined with the lamb weaning weight was used to determine TLW.

Data editing

Records with a scanning and rearing rank of four or above were removed from the dataset because the number were small (n=79). Only ewes and lambs with a valid NLS and NLW were included. Ewes were classified according to the following combinations of NLS and NLW; scanned and weaned single (1_1), scanned and weaned a twin (2_2), scanned a twin and weaned a single (2_1), scanned and weaned a triplet (3_3), scanned a triplet and weaned a twin (3_2) or single (3_1). Age at first lambing was determined based on whether the ewe had a first lambing date at one-year or two-years of age. For each ewe, WWT and TLW was calculated from individual weaning weight data.

Ewes at each measurement period were classified into the following BCS groups ≤2.5, 3.0, 3.5, 4.0 and ≥4.5. Change in BCS were classed in terms of gain in BCS, loss in BCS or maintained BCS between consecutive measurement periods. The change between measurements was a gain or loss that ranged from 0.5 to 2.0 BCS.

Statistical analysis

Statistical analyses were undertaken using SAS 9.4 (SAS Institute Inc, Cary NC, USA). The descriptive statistics were obtained using the MEANS procedure. Analysis of variance for NLS, NLW, WWT and TLW were performed at each measurement period of BCS using the SAS GLM procedure with a model that included the effects of BCS class, season, age, age at first lambing, scan-rearing rank of the ewe. Least-squares means of NLS, NLW, WWT and TLW for each BCS class within each measurement period were obtained and used for multiple mean comparison using the Fisher's least-significant-difference test as implemented in the LSMEANS option of the GLM procedure. Effects of change in BCS from mating to weaning on NLS, NLW, WWT and TLW were evaluated using the GLM procedure with a model that included the effects of season, age at first lambing and scan-rearing rank of the ewe.

Results

Descriptive statistics for BCS, live weight at mating and production traits are presented in Table 1. Ewe BCS was highest at lambing and the lowest at weaning.

Table 1 Summary statistics for BCS at mating, pregnancy scanning, prior to lambing and weaning, mating live weight, number of lambs scanned (NLS), number of lambs weaned (NLW), average lamb WWT and total weight of lamb weaned (TLW).

Trait	n	Records	Mean	SD	Min	Max
Mating BCS	2324	4553	3.48	0.46	1.5	5
Scanning BCS	2268	6578	3.45	0.47	1.5	5
Lambing BCS	1514	2908	3.58	0.46	1.5	5
Weaning BCS	2534	5465	3.05	0.62	1	5
Mating live weight (kg)	2040	4554	72.85	8.85	44.8	108.5
NLS	2533	7543	1.97	0.88	0	3
NLW	2010	6164	1.53	0.84	0	3
WWT (kg)	1450	5020	33.21	6.92	10	58
TLW (kg)	1462	5053	54.77	21.24	13.2	157

Ewes of BCS ≥4.0 at mating had a greater (P<0.05) NLS compared with ewes with a BCS of 3.0 (Table 2). However, BCS at mating had no effect on NLW, WWT or TLW. Ewe BCS at scanning influenced all production traits (P<0.05). Ewe BCS at scanning of ≥4.5 had lower NLS, NLW and TLW but a greater lamb WWT. Ewe BCS at lambing and weaning was associated with NLW, lamb WWT and TLW (P<0.05). Ewes with a BCS ≤4.0 at lambing had a greater TLW than ewes with BCS ≥4.5. There was a negative association between BCS and NLW and ewes with BCS ≥4 had a lower TLW than those with BCS <4, however ≥3.5 BCS weaned the heaviest (P<0.05) lambs (Table 2). There was no effect of BCS at the previous weaning on production traits (results not shown).

A change in BCS from the previous weaning to mating was associated with all production traits (Table 3). Ewe BCS change from mating to scanning was associated with NLS but not NLW, WWT or TLW. A gain in BCS in this period was associated with a lower NLS (P<0.05). Ewe BCS change between scanning and lambing was associated with all production traits. A gain in BCS between scanning and lambing was associated with a lower NLW and TLW (P<0.05), but a greater (P<0.05) WWT. Ewe BCS change from lambing to weaning also affected all production traits. A loss in BCS in this period was associated with a greater (P<0.05) NLW and TLW but a lower WWT (P<0.05).

Discussion

The results showed that BCS at mating and scanning are positively associated with NLS at pregnancy diagnosis. It has previously been reported that BCS at mating had a positive effect of BCS on NLS up to a BCS of 2.0-3.0 (Kenyon et al. 2004; Kleemann & Walker 2005). Molina et al. (1994) reported a positive linear relationship up to BCS 2.0-3.0. In the current study, the lowest BCS group was 2.5, so it is possible that the effect of the lower BCS ewes was not apparent. In contrast, Aliyari et al. (2012) reported a lower fertility rate in ewes with a BCS of >3.5 compared with those with BCS of 3.0 in which fertility was greatest.

Ewe BCS at mating was not associated with WWT. This finding is in agreement with previous studies which found there was no effect of BCS at mating on WWT (Al-Sabbagh et al. 1995; Aliyari et al. 2012; Verbeek et al. 2012). It is not surprising that mating BCS does not impact on WWT as there are numerous environmental pressures between mating and weaning that influence WWT including, but not limited to, feed availability, weather and stocking rate. Lambing BCS was positively associated with WWT. The results of the current study were similar Molina et al. (1991), however, Karakuş and Atmaca (2016) (2.5-3.5) reported in Norduz ewes and Corner-Thomas et al. (2015) (1.5-2.5) in Romney crossbred ewes, that there was no effect of BCS at lambing on WWT.

The most important trait for farm income is TLW, which is a measure that combines both lamb survival and live weight. The TLW was not influenced by BCS at mating, but a greater BCS at scanning, lambing and weaning

Table 2 Least-squares means and SEM for number of lambs scanned (NLS), number of lambs weaned (NLW), individual lamb weaning weight (WWT) and total weight of lamb weaned (TLW) in New Zealand Romney and Highlander ewes of different classes of body condition score (BCS) at mating, scanning, lambing and weaning.

Period	BCS class	n	NLS	NLW	WWT (kg)	TLW (kg)
Mating	≤2.5	214	2.40±0.06^{ab}	1.76±0.07	35.9±0.6	64.0±2.1
	3	1191	2.38±0.03^{b}	1.76±0.04	35.9±0.4	63.2±1.2
	3.5	2192	2.42±0.03^{ab}	1.76±0.04	36.1±0.3	63.5±1.1
	4	934	2.47±0.03^{a}	1.72±0.04	36.5±0.4	63.2±1.2
	≥4.5	224	2.49±0.05^{a}	1.73±0.08	36.8±0.7	65.2±2.2
Scanning	≤2.5	150	2.42±0.06^{ab}	1.84±0.07^{a}	32.8±0.6^{c}	56.7±1.7^{ab}
	3	901	2.42±0.05^{a}	1.83±0.06^{a}	33.6±0.5^{b}	58.0±1.5^{a}
	3.5	2491	2.36±0.05^{bc}	1.82±0.06^{a}	33.9±0.5^{ab}	58.0±1.4^{a}
	4	1175	2.41±0.05^{ab}	1.80±0.06^{a}	34.5±0.5^{b}	57.5±1.5^{ab}
	≥4.5	250	2.29±0.07^{c}	1.64±0.09^{b}	34.9±0.7^{a}	54.2±2.2^{b}
Lambing	≤2.5	45		1.76±0.10^{a}	30.5±0.8^{d}	56.2±2.4^{ab}
	3	317		1.81±0.06^{a}	31.8±0.5^{cd}	58.2±1.7^{a}
	3.5	1134		1.74±0.05^{a}	32.1±0.5^{c}	56.2±1.4^{ab}
	4	693		1.56±0.06^{b}	33.3±0.5^{b}	53.5±1.5^{b}
	≥4.5	105		1.36±0.08^{c}	35.7±0.7^{a}	47.7±2.2^{c}
Weaning	≤2.5	1032		2.15±0.05^{a}	32.7±0.5^{c}	64.7±1.3^{a}
	3	1330		1.89±0.05^{b}	34.4±0.5^{b}	59.3±1.3^{b}
	3.5	1099		1.63±0.05^{c}	35.5±0.5^{a}	53.6±1.3^{c}
	4	358		1.25±0.06^{d}	36.0±0.5^{a}	45.2±1.6^{d}
	≥4.5	101		0.88±0.07^{e}	37.0±0.9^{a}	42.4±2.5^{d}

[a, b, c] Means with different superscript within column at each measurement time are significantly different (P<0.05).

Table 3 The effect of losing, maintaining or gaining BCS from previous weaning to mating, mating to scanning, scanning to lambing and lambing to weaning on number of lambs scanned (NLS), number of lamb weaned (NLW), average litter weaning weight (WWT), total weight of lamb weaned (TLW) (Mean±SEM).

Time period	BCS change	n	NLS	NLW	WWT	TLW
Weaning to mating	loss	273	2.20±0.05^{c}	1.27±0.06^{c}	38.1±0.6^{a}	52.6±1.8^{c}
	maintain	880	2.37±0.04^{b}	1.66±0.05^{b}	36.7±0.4^{b}	61.6±1.3^{b}
	gain	1273	2.48±0.04^{a}	1.88±0.05^{a}	36.5±0.4^{b}	67.0±1.2^{a}
Mating to scanning	loss	875	2.54±0.03^{a}	1.77±0.05	36.0±0.4	64.1±1.3
	maintain	2310	2.44±0.03^{b}	1.75±0.04	36.1±0.3	63.4±1.1
	gain	1466	2.38±0.03^{c}	1.74±0.04	36.4±0.4	62.9±1.2
Scanning to lambing	loss	409		1.93±0.09^{a}	33.1±0.8^{b}	64.5±2.4^{a}
	maintain	882		1.88±0.07^{a}	33.9±0.7^{b}	64.7±2.0^{a}
	gain	686		1.65±0.08^{b}	35.2±0.7^{a}	59.2±2.1^{b}
Lambing to weaning	loss	1173		1.94±0.07^{a}	34.2±0.7^{b}	65.0±2.0^{a}
	maintain	461		1.59±0.08^{b}	35.5±0.7^{a}	57.3±2.2^{b}
	gain	177		1.10±0.09^{c}	36.3±0.8^{a}	48.7±2.6^{c}

[a, b, c] Means with different superscript within column at each measurement period are significantly different (P<0.05).

was generally associated with a lower TLW. The TLW was heavily influenced by NLW therefore tends to show the same patterns as NLW. This effect has been reported previously by Mathias-Davis et al. (2011). The review by Kenyon et al. (2014) suggested that although there has been a general positive relationship between BCS and WWT, there is a plateau above which no further increase in production is seen. This means that ewes with a lower BCS at weaning appear to have used body reserves to feed their multiple lambs, and due to rearing multiple lambs, the TLW is greater.

An increase in BCS from the previous weaning to mating resulted in greater NLS, NLW and TLW but lower WWT, indicating that it is important for the ewe to be fed to increase BCS across this time. The change in BCS between mating and scanning was associated with NLS but not with NLW, WWT or TLW. Ewes that gained BCS between scanning to lambing and lambing to weaning generally had lower NLW and TLW, but greater WWT. The increased WWT was not great enough to compensate for NLW when TLW was calculated. The amount of loss in condition from scanning to weaning is possibly a reflection in the number of lambs the ewe carried and reared. A ewe with more lambs will use more BCS to ensure adequate milk for the lambs.

Combined, these results suggest that it is important for the farmer to monitor BCS at scanning, lambing and weaning, and to ensure the ewes do not exceed BCS 4.0 and to aim for a BCS of 3.0 for greater TLW. Limitations of the study are that the feeding management is unknown, therefore, it is hard to determine if the loss in BCS is from the feeding levels or from milk production (Peterson et al. 2006). A single BCS measurement does provide evidence for the potential production of the ewe, however, the profile of BCS change over a season may be a better indicator of production. The current study ewes had above average live weight, therefore it would be interesting to see if the same relationships existed in a flock of lighter ewes.

The results of the current study show that for this breed type and location there is an effect of BCS on NLS, NLW, WWT and TLW. It is recommended that farmers aim for a BCS of 3.0 at mating through to scanning and to not exceed BCS 3.5 at lambing, however, it is key that the ewe has enough condition to be able to drop to a BCS of 2.5 at weaning. The change in BCS from both previous weaning to mating and scanning to weaning are important determinates of NLW, WWT and TLW. A further study with more focus on the change in BCS is, therefore, suggested.

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