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Short communication

The influences of live weight and body condition score of ewe lambs from breeding to lambing on the live weight of their singleton lambs to weaning

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ABSTRACT

One of the limiting factors to the adoption of breeding 7-month-old ewes is that their lambs are lighter at birth and weaning than lambs born to mature ewes. The present study tested the hypothesis that the live weight and body condition score of 7-month-old ewes at breeding and during pregnancy would influence the live weight of their singleton-born lambs to weaning. Data was collected on one commercial sheep farm from 591 ewes across two years. In 2011 and 2012, during pregnancy the ewes gained 14.6 and 10.1 kg of total live weight, respectively. Multiple regression analysis indicated that live weight of ewes at breeding had a positive effect ($P < 0.05$, 0.03 ± 0.02 kg of birth weight per kg of ewe live weight) on lamb birth weight while ewe live weight in late pregnancy had a negative effect ($P < 0.05$, -0.03 ± 0.01 kg of birth weight per kg of ewe live weight). Overall the *R*-square of the model for lamb birth weight was small ($R^2 = 0.01$) indicating, that live weight of the ewe was not a major contributor to the live weight of lambs at birth. The live weight of ewes in late pregnancy had a positive impact on both the live weight of lambs at approximately 18 days of age and at weaning ($P < 0.05$, 0.05 ± 0.02 and 0.08 ± 0.03 kg of lamb live weight per kg of ewe live weight, respectively) but again the R^2 value for the multiple regression was small (0.01). Body condition score of the ewe at breeding and in mid-pregnancy had no effect ($P > 0.05$) on lamb birth weight. In contrast ewes with body conditions scores of 3.5 and 4.0 or greater in late pregnancy gave birth to lighter lambs (4.9 ± 0.1 and 4.7 ± 0.2 kg, respectively) than ewes with body condition scores of 2.5 or less (5.3 ± 0.1 kg) or 3.0 (5.2 ± 0.1 kg, $P < 0.05$). There was no effect ($P > 0.05$) of ewe body condition score on lamb live weight at approximately 18 days of age or at weaning. Therefore, under the conditions of this study ewe live weight and condition score during pregnancy had a minimal effect of lamb live weight from birth to weaning.

1. Introduction

Breeding ewes to lamb at one year of age is a potential means of improving farm profitability and ewe lifetime performance (Kenyon et al., 2011c; Young et al., 2010). However, less than 40% of 7-month-old ewes are bred each year in Australia and New Zealand, indicating that ewe lamb breeding can be a difficult practise for farmers to utilise (Anonymous, 2013; Curtis and Croker, 2005). The aims of a ewe breeding program utilising breeding of 7-month-old ewes should include the successful weaning of a lamb that is as heavy as possible.

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Live weights and survival rates of lambs born to ewes bred at 7-month of age are often lower than those born to mature ewes (Corner et al., 2013). The birth weight of a lamb can affect its survival chances, with lower survival rates observed at the birth weight extremes (Hatcher et al., 2009; Knight et al., 1988; Thompson et al., 2004). In addition, the weight of the lamb at birth influences its weaning weight (Kenyon et al., 2004a) and low weaning weights of lambs born were identified by farmers as a limiting factor for breeding 7-month-old ewes (Kenyon et al., 2004b). It has been established that the live weight and body condition of the mature ewe can affect both lamb birth and weaning live weight (Hickson et al., 2012; Kenyon et al., 2004a; Oldham et al., 2011). Using a meta-analytic approach of data from many studies, Schreurs et al. (2010b) reported that, when breeding 7-month-old ewes, increased live weight at breeding and during pregnancy had a positive effect on the live weight of their offspring. However, in that analysis no attempt was made to correct for the potential influence of the conceptus mass on total live weight of the ewe in pregnancy. Currently the impact of body condition of 7-month-old ewes on the live weight of their lamb is unknown. As a result there are no guidelines which farmers can use to determine the optimum live weight and body condition score that ewe lambs should achieve prior to breeding. Therefore, the aim of the present study was to test the hypothesis that the conceptus-free live weight and body condition score of ewes 7-month-old at breeding would have a positive influence on the live weight of her offspring to weaning.

2. Materials and methods

2.1. Animals

Over two years, two cohorts of singleton bearing 7-month-old Highlander® composite (½ Romney, ¼ New Zealand Texel and ¼ Finn) ewes were monitored from the beginning of breeding through to the end of their first lactation. The animals were grazed under commercial conditions on a farm located in the lower North Island of New Zealand (40°56′ S, 175°42′ E). Breeding began on the 29th April in 2011 and on the 1st May in 2012. In both years, only ewes that achieved the minimum live weight of 38 kg were bred. Ewes were bred with composite hogget rams (¼ Suffolk, ¼ Texel and ½ Dorper) at a ratio of 1:65 for a 34-day period. At the end of the breeding period, rams were removed and each cohort of ewes was managed as a single flock under commercial farming conditions until weaning of their lambs. Throughout pregnancy and lactation ewes were offered ryegrass pastures of between 1100 and 1500 kg DM/ha.

Pregnancy diagnosis was determined (non-pregnant, single or twin-bearing) using trans-abdominal ultrasound in mid-pregnancy (approximately 88 days after start of breeding in 2011 and 85 days in 2012). In both years, a second pregnancy diagnosis was conducted using the same technique in late-pregnancy (139 and 135 days after the start of breeding in 2011 and 2012, respectively). The present study considered only singleton-bearing ewes which were confirmed as pregnant at both pregnancy diagnoses. Therefore, the study presented here includes 295 and 294 ewe-lamb pairs from 2011 and 2012, respectively. In 2011, lambing began on the 17th September and finished on the 27th October. In 2012, lambing began on the 23rd September and finished on the 26th October. Lambs were weaned as per standard farm practice on the 12th January 2011 and 14 January 2012 (97 days after the mid-point of the lambing period, L97).

2.2. Measurements taken

In 2011 and 2012, all ewes were weighed un-fasted on the day of ram introduction (start of breeding), at the removal of the ram (end of breeding), 88 and 85 days after the start of breeding in 2011 and 2012, respectively (mid-pregnancy), and 139 and 135 days after the start of breeding in 2011 and 2012, respectively (late pregnancy). In addition, ewe body condition scores (BCS, Jefferies, 1961, scale 1–5, 1 = emaciated, 5 = obese) were recorded at the start of breeding, and in mid- and late-pregnancy. At the start of the breeding period in 2011, ewe live weights ranged from 38.0 to 56.6 kg (mean = 44.7 kg) and BCS ranged from 2.0 to 4.5. In 2012, live weights at breeding ranged from 38.0 to 53.5 kg (mean = 43.1 kg) and BCS from 2.0 to 4.0.

During the lambing period, ewes were observed twice daily. Lambs, regardless of whether they were born alive or dead, were tagged with a uniquely numbered ear tag and were identified to their dam. At the time of ear tagging, the sex of the lamb and its birth weight were recorded. Live lambs less than 4 h of age were left untagged until the next observation period to allow the ewe and lamb to bond. During the lactation period, additional lamb live weights were recorded at an average age of 18 days in 2011 and 17 days in 2012 and at an average age of 97 days in both years (weaning). Lambs were recorded as dead if they were not present at weaning.

2.3. Statistical analyses

All statistical analyses were conducted using SAS (SAS Institute Inc., Cary, NC, USA).

2.3.1. Conceptus-free live weights

In order to eliminate the influence of conceptus weight on ewe live weight in pregnancy, predicted conceptus-free live weights of ewes were used in the analyses. Ewe conceptus-free live weights at the end of breeding and in mid- and late-pregnancy were adjusted by subtracting the estimated weight of the conceptus. The weight of the conceptus was estimated based on lamb birth weight using the equations from the GRAZPLAN model (Freer et al., 1997). To estimate 'days pregnant' it was assumed that all pregnancies were 146 days in length and therefore 146 days minus the difference between the date of weighing and the date of lambing was the total number of days pregnant. This method of estimating the weight of the conceptus has previously been used in studies of mature ewes by John et al. (2011) and Paganoni et al. (in press). Failure to remove the weight of the conceptus can have a confounding effect as a heavier lamb at birth would be likely to have a greater foetal weight at a given point in time and therefore result in a heavier total ewe live weight.

$$\text{Conceptus weight} = \text{lamb's birth weight} \times 1.43e^{3.38(1-e^{0.91(1-(\text{days pregnant}/146))})}$$

2.3.2. Comparison of years

The effect of year on ewe live weight and lamb live weight was analysed using a general linear model. The models of ewe live weight contained the fixed effect of year (2011 and 2012). Models of lamb live weight contained the fixed effects of year and sex of the lamb and also contained day of birth relative to the mid-point of the lambing period as a covariate. The effect of year on ewe body condition scores was analysed using a generalised model based on a Poisson distribution and a logit transformation. The effect of year on lamb survival to weaning was analysed using a generalised model using a binomial distribution and a logit transformation. The model of lamb survival contained the fixed effects of year and the sex of the lamb.

2.3.3. Effect of ewe live weight on lamb live weight

The effect of ewe live weight on lamb live weight (at birth, ~18 days of age, weaning) was determined using a step-wise multiple regression analysis. Step-wise regressions were conducted using the residual of lamb live weights generated from the general linear model used in the comparison of years. In order to calculate the solution to the multiple regression models the overall mean, which was determined from the general linear model, was added to the residual of the lamb live weights.

2.3.4. Effect of ewe BCS on lamb live weight

The effect of ewe BCS on lamb live weight at each time point (birth, ~18 days of age, weaning) was determined using general linear models. Due to low numbers of ewes with a BCS of 2, these ewes were combined with ewes with a BCS of 2.5 to create a group BCS ≤ 2.5. Grouping also