Small Ruminant Research 145 (2016) 94–102

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

The effect of ewe nutrition and body condition during late-pregnancy on the behaviour of twin-bearing ewes and their lambs

G.V. Gronqvist, R.E. Hickson*, R.A. Corner-Thomas, P.R. Kenyon, K.J. Stafford, S.T. Morris

International Sheep Research Centre, Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11-222, Palmerston North, 4442, New Zealand

ARTICLE INFO

Article history:
Received 17 May 2016
Received in revised form 20 October 2016
Accepted 31 October 2016
Available online 2 November 2016

Keywords:
Ewe and lamb behaviour
Vocalisation
Late pregnancy nutrition

ABSTRACT

This study describes the effect of maternal nutrition and body condition score (BCS) during pregnancy on the behaviour of twin-bearing ewes and their lambs as assessed 3 h to 18 h after birth. Ewes (n = 274) of BCS 2.0, 2.5 or 3.0 were offered either pregnancy maintenance requirements (fed to allow for foetal but not maternal weight gain; 'medium') or ad libitum feeding from day 112 until day 136 of pregnancy for experiment 1 and from day 128 until day 141 of pregnancy for experiment 2. Lamb vigour behaviours (time to stand, suck, make contact with and follow their dam) and bleating behaviour of ewes and lambs were recorded for 5 min, following handling at 3–18 h. A subgroup of lambs in experiment 1 was tested in a maternal-recognition test. A lesser percentage of ewes in the ad libitum treatment than in the medium treatment high-pitched bleated (86.9% [95% CI 77.4–92.8%] versus 80.0% [69.2–87.7%], and 95.4% [86.5–98.5%] versus 86.9% [70.0–90.5%], in experiments 1 and 2 respectively, $P < 0.05$). Number of low pitched bleats per ewe was generally greater for ewes in the ad libitum than the medium treatment, although this effect was mediated by mid-pregnancy body condition in a different way for each experiment. Effects of maternal body condition and nutrition treatment on bleating behaviour of lambs were not repeatable across experiments, and the ewe nutrition treatments did not affect lamb vigour behaviours ($P > 0.05$) in the 5-min observation period immediately following handling at 3–18 h after birth. Behaviour of twin-bearing ewes of BCS2-3 in mid pregnancy, and their twin-born lambs, showed very few changes 3–18 h after birth in response to ad libitum versus pregnancy-maintenance feeding during mid to late pregnancy.

1. Introduction

The average lambing percentage in New Zealand has increased from 98% in 1987 to 121% in 2013 (Morris and Hickson, 2016). This increase is associated with a greater percentage of twin- and triplet-litters (Amer et al., 1999). Twin-born lambs have greater mortality rates than single-born lambs (Hight and Jury 1970; Dalton et al., 1980; Hinch et al., 1983). In addition, twin-bearing ewes require greater levels of feeding to enable their lambs to achieve adequate growth rates (Kenyon and Webby, 2007; Nicol and Brookes, 2007).

In New Zealand's pastoral sheep system, late pregnancy coincides with winter and feed is often in short supply during this period (Matthews et al., 2000). The aim of feeding regimens during this period is frequently to achieve "pregnancy maintenance" – that is, for ewes to gain conceptus weight whilst maintaining their own body weight (Rattray et al., 1974). By restricting feeding level to pregnancy maintenance at this time, pasture can be saved for lactation. This allows increased feeding during lactation, which can increase growth rates of lambs (Morris and Kenyon, 2004).

Behaviours such as grooming, standing, sucking and bleating are important in the first few hours after birth for the successful establishment of the ewe-lamb bond (Dwyer and Lawrence, 2005). Lambs that were slow to stand or whose mothers were less attentive, indicated by less time spent grooming, were more likely to be mismothered and less likely to survive (Owens et al., 1985; Dwyer and Lawrence, 1999). Observing ewe and lamb behaviour in the minutes immediately post-birth is not practical in an extensive grazing situation, where ewes may flee on approach of the observer prior to formation of a bond or cause disruption to a forming bond. Therefore, observation of behaviour is frequently made in the first 24-h of life, but after the immediate post-birth bonding has occurred, in these situations (Everett-Hincks et al., 2005; Corner et al., 2010).

* Corresponding author.
E-mail address: r.hickson@massey.ac.nz (R.E. Hickson).

http://dx.doi.org/10.1016/j.smallrumres.2016.10.029
0921-4488/

A major factor limiting production in highly fecund ewe flocks is lamb mortality (Morris and Hickson, 2016), and neonatal behaviour of ewes and lambs is likely to affect lamb survival (Atroshi and Österberg, 1979; O'Connor et al., 1985; Nowak, 1996). Previous studies examining the effect of undernutrition (below pregnancy maintenance) have shown a negative impact on maternal behaviours including lamb cleaning (Dwyer et al., 2003), making and maintaining contact with the lamb (Putu et al., 1988; Everett-Hincks et al., 2005) and maternal behaviour score (Corner et al., 2006). In addition, lamb neonatal behaviours such as the time to stand after birth, time to follow dam (Everett-Hincks et al., 2005) and udder seeking (Muñoz et al., 2009) can be negatively affected by maternal undernutrition. In contrast, there is a lack of information on whether this relationship extends above pregnancy-maintenance feeding level, such that ad libitum compared with pregnancy-maintenance feeding in pregnancy would have a positive impact on ewe and lamb behaviour.

Body condition score is a subjective measure of body reserves (Kenyon et al., 2014). Ewes in greater body condition have an increased ability to buffer against poor nutrition. Therefore, behavioural responses to ewe nutrition may be influenced by ewe body condition. The aim of these experiments was to determine whether mid-pregnancy BCS and ad libitum versus pregnancy-maintenance feeding in mid to late pregnancy influenced behaviour soon after birth of twin-born lambs and their dam.

2. Materials and methods

Two experiments were conducted during consecutive years on Massey University's Keeble Farm, 5 km south of Palmerston North, New Zealand (40°S, 175°E), with the approval of the Massey University Animal Ethics Committee.

2.1. Experiment one (2010)

The experiment included 154 twin-bearing, multiparous Romney ewes (3 to 5 years of age) and their lambs (n = 308). Only ewes that had both twin-born lambs alive at the time of observation were included in the study. No ewes were assisted at parturition.

Ewes in the experiment had a BCS of either 2, 2.5 or 3 (scale of one to five, one = emaciated, five = obese; Jefferies, 1961; Kenyon et al., 2014) at the start of the experiment (which began 89 days after the start of the breeding period, D89).

2.1.1. Treatments

From D89 to D111, ewes were grazed in a single group and the pre- and post-grazing covers were 1273 ± 27 and 885 ± 26 kg DM/ha, respectively (Kenyon et al., 2012). At D112, ewes were randomly allocated within BCS group to either a 'medium' or ad libitum nutrition treatment until D136. The aim of the medium nutrition treatment was to restrict ewe intake to approximately pregnancy maintenance, which was achieved by offering pre-grazing herbage masses below 1200 kg DM/ha and post-grazing masses less than 1000 kg DM/ha. Previous studies have shown that pregnancy maintenance occurs when pasture covers are within these ranges (Kenyon et al., 2009). The ad libitum nutrition treatment required post-grazing herbage mass above 1200 kg DM/ha to ensure unrestricted intakes (Morris and Kenyon, 2004). Pre and post-grazing pasture masses were 1272 ± 68 kg DM/ha and 855 ± 81 kg DM/ha, respectively for the medium treatment and 2005 ± 71 kg DM/ha and 1424 ± 76 kg DM/ha, respectively for the ad libitum treatment (Kenyon et al., 2012).

From D136 to D142, all ewes were grazed in a single mob with mean pre- and post-grazing herbage masses of 1913 ± 141 kg and 1434 ± 141 kg DM/ha, respectively. At D142, ewes were randomly allocated to paddocks for lambing, where the mean pre-grazing pasture mass was 1885 ± 80 kg DM/ha (Kenyon et al., 2012). Ewes lambed over a 20-day period and the experiment was completed 24 hours after birth of the final lambs.

After exclusion of ewes that did not have two lambs alive at the time observation, each sub-group contained the following number of ewes: ad libitum BCS2.0 n = 21, ad libitum BCS2.5 n = 28, ad libitum BCS3.0 n = 25, medium BCS2.0 n = 27, medium BCS2.5 n = 25 and medium BCS3.0 n = 26.

2.1.2. Measurements

Live weight and BCS of ewes were recorded at D89, D112, D136 and D142. During the lambing period ewes were inspected twice daily at 8am and 4pm. Lambs were handled once their coat was dry and the lamb was mobile (at approximately 3–18 h of age). During handling, lambs were identified to their dam, ear-tagged and had their weight, birth-rank and sex recorded. Immediately following handling, the two lambs were placed together, lying on the ground while three observers moved approximately 10 metres away. The moment the lambs were released was considered to be 'time zero'. The observers recorded the individual behaviours of the lamb and ewe during the next five minutes.

The behaviours recorded included the time at which the lamb stood (defined as fully supporting itself on all four legs for at least five seconds), the time at which the lamb and ewe made contact (defined as being within 0.5 m of each other (Corner et al., 2005; Everett-Hincks et al., 2005)), the time at which the lamb followed the ewe at least 5 m from their first point of contact (Everett-Hincks et al., 2005), and the time at which the lamb successfully sucked from its dam's teat (lamb held teat in its mouth and appeared to be sucking with for at least five seconds). These variables were recorded as the number of seconds from the start of observation until the behaviour was observed. Lambs that did not display the behaviour were given a value of 301 s.

The observers also counted the total number of low-pitched bleats (bleats involving little mouth movement) and high-pitched bleats (bleats involving full mouth movement) emitted by each lamb and by the ewe (Everett-Hincks et al., 2005). Maternal behaviour score (MBS) was assessed on a five-point scale (O'Connor et al., 1985) for each ewe based on the distance the ewe moved away from her lambs while the lambs were being handled (one = at the approach of the shepherd ewe flees and does not return, five = ewe stays within one metre and makes contact with the shepherd and lamb).

2.1.3. Maternal-recognition test

A random subset of lambs (n = 190; 95 sets of twins) were subjected to a maternal-recognition test, similar to that described by Nowak et al., (1987, 1989). The lamb's ability to discriminate its dam has been used as an indicator of ewe-lamb bond strength (Nowak et al., 1987, 1989), an aspect of ewe and lamb behaviour that could not be measured through paddock observations. The testing arena was of a triangular shape fenced by one metre high solid walls (3.7 × 6.1 m, Fig. 1). Adjacent to the vertex of the triangle pen was a lamb holding pen. At the base end of the triangle arena were two pens (1.85 × 1.1 m) side by side, separated from the testing arena by wire-mesh gates. The arena itself was divided into three zones separated by lines drawn on the ground; a neutral zone (the area of the triangle that was more than one metre from either ewe pen), and two ewe contact zones adjacent to the ewe pens (Fig. 1).

Testing occurred between 1pm and 3pm daily. As a result, lambs were tested at approximately 12 (n = 130) or 24 (n = 60) h of age depending on when they were born and handled. The dam of the lamb being tested was placed randomly in one of the two ewe pens, with an 'alien' ewe which had lambed at a similar time placed in the other pen. Each lamb was tested individually and was placed, standing, in the waiting pen facing the two ewes. Once the lamb was