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The effect of Finnish Landrace and Texel ewe and lamb behaviour after tagging on lamb survival to weaning

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ABSTRACT

The study was carried out on a commercial New Zealand sheep farm with performance recorded straightbred Finnish Landrace and Texel primiparous ewes. The objective of the study was to determine the strength of ewe-lamb attachment at tagging by investigating the behaviour of Finn and Texel ewes and their lambs and relate those behaviours to survival to weaning. Lamb and ewe behaviour was observed for ten minutes after the lambs were ear tagged. Finn ewes took at least twice as long to contact their lambs than Texel ewes ($P<0.01$). There were no breed differences for time of lamb to stand and suck after tagging. Finn twin lambs took longer to follow their dam than Texel twin lambs ($P<0.01$). Ewes with higher Maternal Behaviour Score (high MBS favourable) contact their lambs quicker and the lamb stood, sucked and followed its moving dam more quickly than lambs of ewes with low MBS ($P<0.05$). Texel ewes with twins had higher low-pitch bleating frequencies than Texel ewes with a single lamb ($P<0.01$). MBS had a significant and positive effect on low-pitch bleating frequency ($\beta=19.3 \pm 3.51$ bleats/MBS, $P<0.0001$). Ewes with lower MBS at tagging high-pitch bleated significantly more if their lamb took longer to stand ($\beta=5.25 \pm 0.65$ bleats/minute, $P<0.0001$). Lamb survival improved 3-fold for lambs that sucked their dam ($P<0.01$) and improved nearly 5-fold for lambs that stand, within ten minutes after tagging ($P<0.05$). Lamb behaviour at tagging better explained the variation in lamb survival than the ewe behaviours analysed.

Keywords: ewe behaviour, lamb behaviour, survival.

INTRODUCTION

The periparturient behaviour of the ewe has an impact on lamb survival (Nowak *et al*., 2000) and failure of the lamb and ewe to interact properly can result in lamb deaths (O'Connor & Lawrence, 1992; Everett-Hincks *et al*., 2004a). The development of a strong maternal bond is important for lamb survival and it is influenced strongly by continuous association between the ewe and her lamb after birth (Murphy *et al*., 1994). Lamb desertion may occur when the ewe is disturbed (Smith, 1965) for example at ear tagging (tagging). Tagging involves a shepherd catching the lambs and separating them from their dam. Lamb desertion by the ewe may result from the conflict between the normal flocking behaviour of sheep and the isolation associated with lambing (Kilgour & Szantar-Coddington, 1995). Ewe-lamb separation is detrimental to lamb survival (Nowak & Lindsay, 1992; Alexander *et al*., 1983; Stevens *et al*., 1982) and lamb performance (Napolitano *et al*., 1995). Orgeur *et al*. (1998) reported that when ewes and lambs are separated from each other there is an increase in bleating and locomotor activity.

Maternal Behaviour Score (MBS) observed at tagging has been shown to affect lamb and litter survival across a number breeds (O'Connor *et al*., 1985; Everett-Hincks *et al*., 2002; 2005). MBS is a good indicator of lamb growth and the strength of the pre-weaning ewe-lamb relationship (O'Connor, 1996; Everett-Hincks *et al*., 2004b). Lambs of ewes with MBS 4 or 5 located their dam's udder in a third of the time taken by lambs of MBS 3 ewes (Parker & Nicol, 1993). The variation of mothering ability within and between breeds gives promise of scope for genetic improvement of this important characteristic (Manktelow, 1996). The aim of this study was to determine the strength of ewe-lamb attachment at tagging by investigating the behaviour of Finn and Texel ewes and their lambs and to relate these behaviours to lamb survival to weaning.

MATERIALS AND METHODS

Animals and measurements

Behaviours of 2 year old Texel and Finnish Landrace ewes with single and twin lambs were monitored at tagging in 2001; numbers of ewes and lambs are shown in Table 1. Two shepherds observed the ewes closely between 7 am and 6 pm daily from two weeks prior to and throughout lambing. Ewes were individually identified by large ear tags.

Table 1: Number of animals included in analyses and percentage lamb mortality from tagging to weaning.

	Finn			Texel		
	All	**Litter size 1**	**Litter size 2**	**All**	**Litter size 1**	**Litter size 2**
Number of Ewes	64	24	40	56	38	18
No. of lambs reared to Tagging	99	24	75	72	38	34
No. of lambs reared to Weaning	68	16	52	55	28	27
No of lambs that died (% mortality)	31 (31%)	8 (33%)	23 (31%)	17 (24%)	10 (26%)	7 (21%)

Table 2: Definitions of ewe and lamb behaviours recorded after tagging.

Behaviour	Description
Ewe behaviours	
High-pitched ewe bleats	Made with the mouth open by ewes when they are separated from their lambs.
Low-pitched ewe bleats	Made with the mouth closed and emitted when the ewe is in close proximity to the lamb.
Maternal Behaviour Score	
MBS 1	Dam flees at the approach of the shepherd, shows no interest in the lambs and does not
MBS 2	Dam retreats further than 10 metres but comes back to her lambs as the shepherd leaves
MBS 3	Dam retreats to such a distance that tag identification is difficult (5-10 metres)
MBS 4	Dam retreats but stays within 5 metres
MBS 5	Dam stays close to the shepherd during handling of her lambs
MBS 6	Dam makes contact with her lambs while they are being handled by the shepherd
Lamb contact	Time to make physical contact with lamb (nose the lamb).
Lamb behaviours	
Stands	Lamb supports itself on all four feet for at least five seconds
Successful suck	Lamb standing and has teat in mouth, appears to be sucking for at least 5 seconds.
Follows moving ewe	Ewe moves away and lamb follows.
Bleats	The number of bleats was recorded for each lamb.

Birth time was recorded for ewes and lambs were tagged about 8 hours after birth. During tagging, a brass ear tag was fitted and a rubber ring placed on the lamb's tail. The lamb was vaccinated against scabby mouth. The lamb weight, sex, dam identity, tagging date and time was noted at tagging. Lambs were tagged where they were found in the paddock. If twin lambs had separated prior to tagging, they were brought together for tagging. Following tagging the two shepherds moved a distance of 10-20 m and recorded lamb and ewe behaviours for the following ten minutes on prepared recording sheets.

The maternal behaviour score (MBS) of each ewe was based on its response to the shepherd tagging its lambs (score modified by O'Connor, 1996). The ewe behaviours and lamb behaviours that were recorded are shown in Table 2. Lamb survival in this study was recorded from parturition to weaning. Lambs that survived to weaning were given a score of '1' and lambs that died were given a score of '0'.

Statistical analyses

The numbers of ewes and lambs used in the final dataset are shown in Table 1. Differences between breeds within litter size for continuous behaviour traits, such as bleating frequencies were tested using PROC MIXED which uses the restricted maximum likelihood (REML) method to estimate fixed and random effects (SAS, 2002). Results are given as least square means and the standard error of the difference between means for the contrasts of Finns and Texels, single and twin litters, and the interaction between the main factors.

The LIFETEST procedure (SAS, 2002) was used to compute and plot the distribution estimate of ewe and lamb time-related behaviours after tagging, such as ewe-lamb contact time, time for lamb to stand, suck and follow the moving ewe. These behaviour observations are skewed and right-censored due to the termination of the experiment (*i.e.* ten minutes after tagging) but LIFETEST correctly uses the censored observations as well as the non-censored. The survival distribution function (SDF) evaluated at time (t) (*i.e.* 10 minutes) is the probability that a lamb of a particular breed and litter size will have a 'behaviour' time exceeding t, that is: $S(t) = Pr(T>t)$, where $S(t)$ denotes the survival distribution function and T is the behaviour time of a randomly selected lamb. The cumulative distributive functions for each of the behaviour traits are graphically plotted and are defined as 1-S(*t*), that is the probability that a behaviour time does not exceed time (*t*) (*i.e.* 10 minutes). To determine whether the curves plotted are homogenous across breeds or litter sizes (P>0.05), PROC LIFETEST provides two rank tests (log-rank and Wilcoxon). The Wilcoxon test places more weight on early times and the log-rank test places more weight on larger times. The association between covariates and the behaviour time variable were investigated using the Wilcoxon Test and reported if significant at P<0.05. The covariate tests are pooled across treatments and it is not possible to calculate the directional effect the covariate is having on the dependent variable.

Lamb survival to weaning was analysed with the LOGISTIC procedure of SAS (2002). Estimates of the regression coefficients and their 95% confidence intervals and odds ratios were calculated by specifying the appropriate options in the model statement.

RESULTS

The mean lambing date differed significantly for Finns and Texels (1st September and 5th September 2001, P<0.01) and was due to a difference in mating date. The majority of lambs were tagged around midday and the time from birth to tagging differed significantly for Finns and Texels (7.7 ± 0.68 and 5.8 ± 0.59 hours respectively, P<0.05).

Post-Tagging Behaviour

Ewe breed had a significant effect on MBS (P<0.0001) where Finn ewes had significantly lower MBS than Texel ewes (Table 3). The effect of litter size and the interaction between litter size and breed were not significant for MBS (P>0.05). Ewes with lower MBS high-pitch bleated more frequently (β=-0.02±0.004 high bleats/MBS, P<0.0001).

Ewes with twins gave significantly (P<0.05) more low-pitch bleats (48 ± 4.44) than ewes with a single lamb (33 ± 5.46). This difference was seen within Texel but not Finn ewes (Table 3). Ewes with higher MBS low-pitch bleated significantly more than ewes with lower MBS (β=19.3 ± 3.51 bleats/MBS; P<0.0001). The hours from birth at time of tagging also had a significant effect on ewe low-pitch bleating frequency (β=-1.22 ± 0.58 bleats/hour, P<0.05).

Finn ewes with twin lambs high-pitch bleated significantly more than Texel ewes with twin lambs (Table 3). Ewes high-pitch bleated more if their lambs took longer to stand (β=5.25 ± 0.65 bleats/minute, P<0.0001) and they had lower MBS at tagging (β=-4.93 ± 1.08 bleats/MBS, P<0.0001). The time for ewes to contact their single and twin lambs differed significantly between breeds, with Finn ewes taking longer to make contact (Table 3). One minute after tagging 84% of single Texel lambs had ewe contact compared to 54% of Finns (Figure 1). The LIFETEST procedure was used for

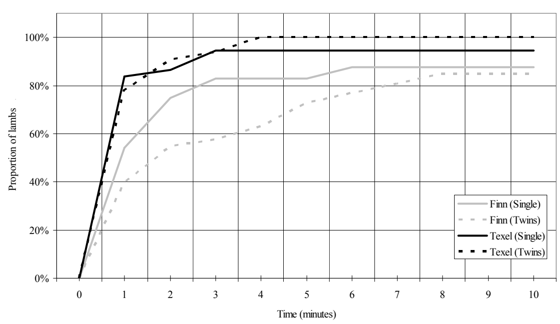
Table 3: The effect of breed on ewe and lamb behaviour after tagging (least squares mean ± standard error).

Behaviour	Litter size	Finn	Texel	P
Ewe behaviours				
Ewe low-pitch bleating frequency	Single	43 ± 8.77	23 ± 6.93	ns
	Twin	49 ± 5.4	47 ± 8.12	ns
	P (Litter size)	ns	**	
Ewe high-pitch bleating frequency	Single	11 ± 3.78	10 ± 1.64	ns
	Twin	17 ± 2.5	10 ± 1.82	*
	P (Litter size)	ns	ns	
Maternal Behaviour Score (MBS)	All	2.8 ± 0.097	3.7 ± 0.115	****
	Single	2.7 ± 0.165	3.5 ± 0.157	**
	Twin	2.8 ± 0.100	3.9 ± 0. 166	****
	P (Litter size)	ns	ns	
Time to contact (minutes; Figure 1)	Single	1.10 ± 0.259	0.49 ± 0.099	**
	Twin	2.16 ± 0.289	0.71 ± 0.154	****
Lamb behaviours				
Time to stand (minutes; Figure 2)	Single	0.86 ± 0.266	0.91 ± 0.323	ns
	Twin	0.81 ± 0.178	0.77 ± 0.252	ns
Time to follow (minutes; Figure 3)	Single	2.06 ± 0.478	2.42 ± 0.449	ns
	Twin	2.60 ± 0.298	1.22 ± 0.294	**
Time to suck (minutes; Figure 4)	Single	3.08 ± 0.874	3.83 ± 0.633	ns
	Twin	3.86 ± 0.466	3.44 ± 0.596	ns
Lamb bleating frequency	Single	29 ± 9.04	18 ± 3.38	ns
	Twin	29 ± 5.52	23 ± 4.07	ns
	P (Litter size)	ns	ns	

ns=not significant at P<0.05; * P<0.05; ** P<0.01; *** P<0.001; **** P<0.0001. Time traits (Wilcoxon Test; Wilcoxon mean ± standard error) also presented in Figures 1 through to 4.

the time related behaviours after tagging and was unable to calculate the directional effect the covariate was having on the dependent variable. However the analysis did show that ewe contact time with single lambs was significantly affected by MBS and high-pitch bleating frequency (P<0.0001), lamb sex and sire of lamb (P<0.05). Nearly 80% of Texel twin lambs had ewe contact one minute after tagging compared to 40% of Finn twin lambs (Figure 1). Twin lamb contact was significantly affected by ewe MBS (P<0.0001), ewe high-pitch bleating frequency (P<0.0001), ewe low-pitch bleating frequency (P<0.05) and lamb bleating frequency (P<0.01). Ewe-lamb contact time was quicker if the ewe had higher MBS, high bleated fewer times and low bleated more. Ewe-lamb contact time was also quicker if twin lambs bleated.

Figure 1: The effect of ewe-lamb contact time after tagging and the proportion of Finn and Texel single and twin born lambs to make contact ten minutes from tagging.



Lamb breed did not significantly affect time to stand and time to suck for single and twin lambs (Table 3). Within one minute after tagging between 70% and 80% of all lambs had stood (Figure 2). Single and twin lambs were quicker to stand after tagging if their dam high-pitch bleated fewer times (P<0.01) and had higher MBS (P<0.10). Lamb sex influenced the single lambs time to stand (P<0.05), whereas ewe weight prior to lambing (P<0.05) had a significant effect on time to stand for twin lambs (P<0.05). (The directional effect of lamb sex and ewe weight prior to lambing on time for lamb to stand could not be calculated). Lamb birth weight significantly affected time for lamb to stand (β=-0.08 ± 0.034 minutes per kg, P<0.05).

Twin Finn lambs took longer to follow their moving dam than twin Texel lambs (Table 3). Nearly 30% of twin Texel lambs followed their moving dam within one minute of tagging, compared to only 2% of Finns, but only 55% of twin Texel lambs had followed ten minutes after tagging compared to 70% of Finns (Figure 3). Lambs were quicker to follow their moving dam if she had a higher MBS at tagging (P<0.01). Lambs that bleated took longer to follow their dam than lambs that did not bleat (P<0.01). About half of all lambs had sucked from their dam ten minutes after tagging (Figure 4). Lambs were quicker to suck from their dam with higher MBS (P<0.05).

Figure 2: The effect of lamb time to stand after tagging and the proportion of Finn and Texel single and twin born lambs to stand ten minutes from tagging.

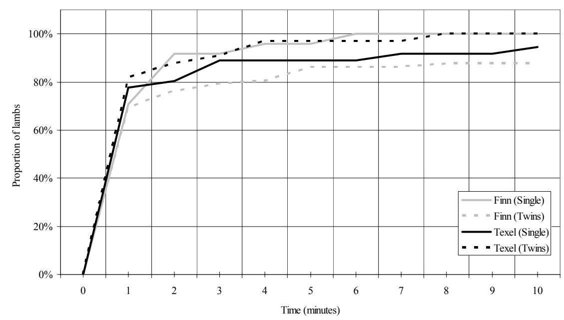


Figure 3: The effect of lamb time to follow their moving dam after tagging and the proportion of Finn and Texel single and twin born lambs to follow ten minutes from tagging.

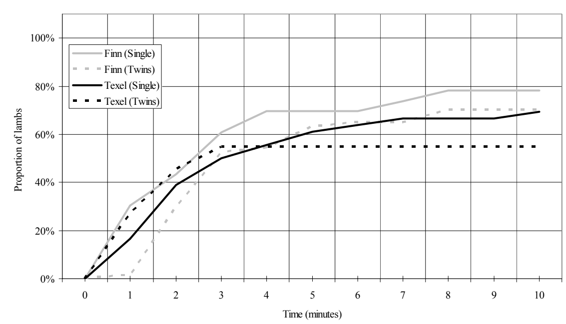
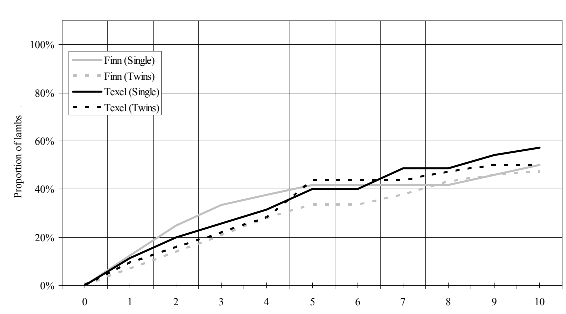


Figure 4: The effect of lamb time to suck after tagging and the proportion of Finn and Texel single and twin born lambs to suck ten minutes from tagging.



Finn and Texel lambs had similar bleating frequencies recorded within ten minutes after tagging (Table 3). The effect of litter size at birth and the interaction between breed and litter size were not significant ($P>0.05$) factors affecting lamb bleating frequency. However MBS did have a significant effect on lamb bleating frequency where higher MBS was associated with lower lamb bleating frequencies ($\beta=-5.03 \pm 2.14$ bleats/MBS, $P<0.05$).

Post Tagging Behaviour and Lamb Survival

The results of the multiple logistic regression for Finn and Texel lambs are summarised in Table 4 and describe how the odds of survival to weaning changes as behaviour changes after tagging from '0' (*e.g.* did not stand) to '1'(*e.g.* did stand) and as litter size and breed changes. The chance of survival to weaning was higher for Texel lambs but not significantly different from Finns. Lambs that did not suck within ten minutes after tagging had a 30% chance of survival to weaning compared to those that did ($P<0.05$). The odds for lamb survival was lowest for lambs that did not stand within ten minutes from tagging (OR=0.22), that is the chance for a lamb to survive to weaning was only 22% for those that did not stand after tagging compared to those that did ($P=0.11$).

Stepwise logistic regression procedure only fitted statistically significant variables into the model ($P<0.05$) and identified lamb sucking and standing behaviour as the behaviour responses most likely to affect lamb survival. A lamb that did not suck from its dam within ten minutes from tagging had a 27% chance of survival compared to a lamb that did (OR=0.27; CI=0.11-0.68; $P<0.01$). A lamb that did not stand within ten minutes from tagging had a 17% chance of survival to weaning compared to a lamb that did (OR=0.17; CI=0.03-0.87; $P<0.05$).

DISCUSSION

In this study lambs were tagged between five and eight hours from birth and generally sooner than under commercial conditions (12-24 hours from birth). According to Murphy *et al*. (1994) bonding and consequently survival of twins can be considerably improved if the ewe remains together with her lambs for a minimum of 6 hours after birth, therefore lamb survival was probably not affected by the practice of tagging. Depending on the strength of the bond formed with her lamb, the fear for the shepherd, the visibility of her lambs versus other lambs, the proximity of the flock and the dam's 'drive' to be with the flock, the dam will stay close to her litter or desert them in preference to be with the flock.

Table 4: Regression coefficient estimates, odds ratios and 95% confidence intervals for the odds ratios and probability levels from logistic regression analysis of all lambs and their chance of survival to weaning.

Group	Variable	Regression Coefficient	Odds Ratio (OR)	95% (CI) Confidence Interval	P
Breed	Finn	-0.14 ± 0.317	0.76	0.22 – 2.65	ns
	Texel	0	1		
Litter size	One	-0.26 ± 0.252	0.60	0.22 – 1.61	ns
	Two	0	1		
Dam Behaviour	MBS 2	-0.12 ± 0.40	1.08	0.26 – 4.54	ns
	MBS 3	0.31 ± 0.35	1.66	0.46 – 5.98	ns
	MBS 4	0	1		
	Made contact	0	1		
	Did not contact	-0.06 ± 0.413	0.89	0.18 – 4.49	ns
Lamb Behaviour	Did stand	0	1		
	Did not stand	-0.76 ± 0.483	0.22	0.03 – 1.44	ns
	Did follow Dam	0	1		
	Did not follow	-0.28 ± 0.276	0.57	0.19 – 1.69	ns
	Did suck Dam	0	1		
	Did not suck	-0.60 ± 0.243	0.30	0.12 – 0.78	*

ns = not significant; * P<0.05; ** P<0.01; *** P<0.001; **** P<0.0001.

In this study Finn ewes had lower MBS and took longer to contact their twin lambs. MBS gives an indication of a ewe's degree of attachment to her lambs following parturition when challenged with human presence. MBS had a significant effect on ewe-lamb contact time, time for the lamb to stand, suck and follow its moving dam. Ewes that were closer to their lamb at tagging, as determined by higher MBS, were quicker to contact their lamb after tagging, their lambs stood sooner, sucked and were quicker to follow their moving dam. According to Alexander (1988), mother-young acceptance is more likely if the newborn lamb stands soon after birth, sucks soon after standing, follows their mother closely and moves to the mother if separated. There were no breed differences for time of lamb to stand and suck after tagging but Finn twin lambs took longer to follow their dam possibly as a result of delayed ewe contact. Astroshi & Osterberg (1979) observed that an increase in birth weight shortened the time from birth to standing. This study showed a similar relationship between birth weight and time to stand after tagging.

In this study, ewes with lower MBS at tagging high-pitch bleated significantly more as also found by Dwyer *et al*. (1998). They suggested that high-pitched bleating is affected by ewe breed and may reflect the likelihood of separation of the ewe from the lamb. The ewes in this study high-pitch bleated significantly more if their lamb took longer to stand, suggesting that ewes high-pitch bleated more in stressful situations. Lindsay *et al*. (1990) suggested that the best mothers were those that were less active in stressful situations and those that bleated more often. However Lindsay *et al.* (1990) did not specify whether the ewe bleats were high or low pitched. Our results support those of Lindsay *et al*. (1990) if they were referring to low-pitch bleats.

Texel ewes with twins low-pitch bleated more frequently than Texel ewes with a single lamb. MBS had a significant and positive effect on low-pitch bleating frequency. Ewes with younger lambs at tagging also low-pitch bleated significantly more. Dwyer *et al*. (1998) suggested that the low-pitched bleat rate of ewes may be a reflection of her intrinsic physiology and the higher rate in primiparous ewes may reflect her inexperience, immaturity and therefore slower bond formation. Nowak (1996) suggests that vocal communication between the ewe and the lamb is central to adequate bond formation and has demonstrated that lamb bleating behaviour is involved in the attachment process.

Lindsay *et al*. (1990) observed that increased vocal behaviour of lambs was strongly associated with earlier recognition of their mother and better bonding. Lamb bleating behaviour after tagging was similar between breeds and lambs of different litter sizes in this study. However lamb bleating frequency was significantly higher when the ewe had a lower MBS, therefore inferring that the lamb is aware of its separation from its dam and is trying to locate her. Lamb vocalisations are modified by their rearing experience and appear to represent a signal of need (Dwyer *et al*., 1998).

Cloete *et al.* (2002) showed that time to stand from birth and time to suck from standing has a genetic component which differs between breeds. Therefore, it is likely that lamb survival to weaning can be improved by incorporating these lamb behaviours in animal breeding programmes. Behaviour observed and recorded after tagging requires less effort and supervision than after parturition and better fits with current farm management practices in performance recorded flocks.

This study showed that a lamb that stands and sucks shortly after tagging has significantly improved chance of survival to weaning; lamb survival was improved 3-fold for lambs that suck from their dam and improved nearly 5-fold for lambs that stand within ten minutes after tagging. A lambs and dam's response to stress induced by the shepherd at tagging is a good predictor of lamb survival to weaning.

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