Ewe and lamb behaviour at parturition in prolific and non-prolific sheep

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Fahmy, M. H., Robert, S. and Castonguay, F. 1997. **Ewe and lamb behaviour at parturition in prolific and non-prolific sheep.** Can. J. Anim. Sci. **77**: 9–15. This study was conducted to investigate ewe and lamb behaviour at parturition in prolific and non-prolific sheep. Observations were taken on 16 Romanov (R), 16 Finnsheep (F) and 13 Suffolk (S) ewes at their first and second parturitions. Time intervals between displaying first signs of uneasiness and first contraction, rupture of foetal membranes bag and first contraction, sighting the first lamb and expulsion of the last lamb, and contact time between ewes and their litters were assessed and correlated with litter size, and litter weight at birth and at weaning. Romanov ewes had the largest litters (3.02), took longer to deliver (120.7 min), and interacted more with their lambs (30.9 min) after lambing. F and S ewes were similar in many behavioural traits despite significant differences in number and weight of lambs delivered. Prolific R and F ewes lambing single and twin lambs delivered them faster than S ewes with similar litter sizes. Duration of lambing was significantly correlated with ewe–lamb contact but only for the two prolific breeds (r = 0.51 and 0.76 for R and F, respectively). Ewe-lamb contact was also correlated with litter size (r = 0.83), litter weight at birth (r = 0.72) and at weaning (r = 0.47) but only in F ewes. For R, F, and S ewes lambing litters of one and two lambs, the average intervals between first sight of a lamb and its expulsion were 9.2, 20.8, and 25.8 min, the intervals between expulsion and standing were 37.0, 18.6, and 19.6 min, and between standing and suckling, 24.2, 20.4, and 27.2 min per lamb, respectively. The average contact time between a ewe and each of her lambs was 13.1, 8.8, and 11.0 min, respectively. The corresponding intervals for R and F ewes lambing up to four lambs were 10.3 and 11.1, 43.3 and 21.4, 35.7 and 25.6, and 8.8 and 7.8 min (P > 0.05) per lamb, respectively. The data showed several differences between prolific and non-prolific sheep in behavioural traits at birth.

Key words: Maternal behaviour: Lamb behaviour, Romanov, Finnsheep, Prolific sheep

Fahmy, M. H., Robert, S. et Castonguay, F. 1997. **Comportement de la brebis et des agneaux à l'agnelage chez les races prolifiques et non prolifiques**. Can. J. Anim. Sci. **77**: 9–15. Nous avons observé le comportement de la brebis et des agneaux à la mise bas chez les moutons de races prolifiques et non prolifiques. Les observations étaient prises sur 16 brebis Romanov (R), 16 brebis Finnoises (F) et 13 brebis Suffolk (S) à leur premier et leur second agnelages. Nous évaluions les intervalles de temps entre l'apparition des premiers signes de douleur et la première contraction, entre la rupture des poches foetales et la première contraction, entre la sortie du premier agneau et l'expulsion du dernier, ainsi que la durée de contact entre la brebis et ses petits, en regard de la taille de la portée et du poids de la portée à la mise bas et au sevrage. Ce sont les brebis Romanov qui avaient les portées les plus grandes (3,02), qui avaient les agnelages les plus longs (120,7 min) et qui interagissaient le plus avec leurs agneaux (30,9 min) après la mise bas. Les brebis F et S avaient en commun plusieurs traits de comportement malgré des différences significatives pour le nombre et le poids des agneaux mis au monde. Les brebis des races prolifiques R et F donnant un seul agneau ou des jumeaux les mettaient au monde en moins de temps que les brebis S produisant des portées comparables. La durée de l'agnelage était significativement corrélée avec le contact brebis-agneaux, encore que seulement chez les deux races prolifiques (r = 0,51) (R) et (r = 0,76) (F). La durée de contact brebis-agneaux était également corrélée avec la taille de la portée (r = 0,83) ainsi qu'avec le poids de la portée à la mise bas (0,72) et au sevrage (r = 0,47), bien que seulement chez les brebis F. Chez les brebis R, F et S produisant un seul agneau et deux agneaux, il se passait, respectivement, 9,2, 20,8 et 25,8 min entre l'apparition de l'agneau et son expulsion; 37,0, 18,6 et 19,6 min entre l'expulsion de l'agneau et le moment où il se tenait debout et 24,2, 20,4 et 27,2 min entre le moment où il se tenait debout et celui où il commençait à têter. La durée moyenne de contact entre la brebis et chacun de ses agneaux était, toujours dans le même ordre, de 13,1, 8,8 et 11,0 min. Les intervalles correspondants pour les R et F produisant jusqu'à 4 agneaux à la fois étaient, respectivement, de 10,3 et 11,1; 43,3 et 21,4; 35,7 et 25,6 et 8,8 et 7,8 min (P > 0,05) par agneau. Nos observations ont mis au jour plusieurs différences entre races prolifiques et races non prolifiques quant au comportement à l'agnelage.

Mots clés: Comportement maternel, comportement des agneaux, Romanov, Finnoises, races ovines prolifiques

Maternal behaviour in sheep has been intensively investigated and reviewed (Wallace 1949; Hulet et al. 1975; Alexander 1988). However, most of the research has dealt with non-prolific breeds. Shelley (1970) showed that up to 21% of total lamb deaths in a flock of Merino sheep could be attributed to aspects of maternal behaviour of ewes. In prolofic breeds, preweaning lamb mortality can be as high as 38% (Greeff et al. 1992). Maternal behaviour of ewes producing large litters may be an important factor contributing to high lamb mortality both at birth and thereafter (Vince 1993). However, the survival of lambs is influenced by several factors related to birth itself and the ability of the

newborn to stand, find the udder and feed as soon as possible (Arnold and Morgan 1975). Little is known about maternal behaviour of prolific sheep and comparative studies of prolific and non-prolific breeds are rare (Poindron et al. 1984, Owens et al. 1985; Slee and Springbett 1986; Poindron et al. 1996). The objective of this study was to investigate ewe and lamb behaviour at parturition in Romanov (R) and Finnsheep (F) representing two prolific breeds and compare it with Suffolk (S) representing a non-prolific breed.

MATERIALS AND METHODS

The animals used in this study were 16 R, 16 F and 13 S ewes born in the spring of 1991, and their progeny born in 1992 and 1993 at the La Pocatière Experimental Farm in Québec. The ewes were divided into three groups of equal size and genotypes at about 8 mo of age. Oestrus was synchronised in ewes of the three groups 1 wk apart in October 1991 (first parity), and again in December 1992 (second parity) using vaginal sponges (Véramix, Upjohn, Orangeville, ON). To stimulate follicular development, ewes were injected with 350 IU PMSG (Equinex, Ayrest, St. Laurent, PQ) at sponge removal. Ewes were hand-mated to sires of their respective breeds. Fourteen days after the first mating, ewes were grouped by breed and placed with fertile rams fitted with marking harnesses for 15 d. At about 60 d of gestation, the number of embryos present was determined by using an ultrasound equipment. Ewes were housed indoors in large pens in groups of approximately 10 animals. The temperature and humidity inside the sheep barn were kept within the 10–15°C and 70–75% levels, respectively. The animals were exposed to normal daylight; however, to video tape at night, the lambing area was illuminated with weak red lights (40 W), sufficient for the cameras to record clear pictures.

During the experiment a high-moisture grass silage was fed (approximately 25% DM and 16% protein) ad libitum. During the breeding period, no supplementation was given. During the last 6 wk of gestation, ewes were offered increasing amounts (200 to 700 g d^{-1}) of a commercial concentrate (15% CP). During lactation, ewes nursing single lambs received 500 g d^{-1} whereas those nursing a multiple litter received 700 g d^{-1} of the same commercial concentrate. Fresh water and minerals were continuously available.

One week before the expected date of lambing, ewes were penned individually in 1.9×2.8 m lambing pens, with concrete floors covered with deep bedding. The temperature and humidity inside the lambing quarters were maintained at 15°C and 50–60%, respectively. Two video cameras (Panasonic model WV-1460), one on each side of the lambing pens, were installed to continuously monitor maternal behaviour. Behavioural data were collected from the moment ewes started displaying the first signs of uneasiness until the last lamb had suckled. Whenever possible, direct but discrete observations by herdsmen were also taken to corroborate the observations recorded on videos. Because the objective of the study was to evaluate maternal behaviour without unduly exposing the ewes to peril during parturition, necessary help during lambing was rendered only if in the judgement of the attendant the life of the ewe was at risk. Assistance was provided to ewes in only two cases, and none to lambs.

The following data were collected on the ewes: 1) number of lambs born, 2) time interval between first display of uneasiness and first contraction. 3) time interval between rupture of the foetal membranes and first contraction, 4) duration of lambing, calculated between appearance of the first lamb and complete expulsion of the last lamb, 5) total time of contact between ewes and their lambs; this included drying, grooming, licking, caressing (but not nursing), and 6) litter weight at birth and at 50 d.

The following data were recorded for each lamb: 1) individual birth weight, 2) time interval between when the lamb was first seen until it was completely expelled, 3) time interval between expulsion and standing, 4) time interval between standing and first suckling, 5) time interval between expulsion and first suckling, 6) the contact between the ewe and each lamb, 7) lamb survival, and 8) lamb 50-d weight. The time interval between the expulsion of successive lambs was also calculated. Autopsy to determine the cause of death was performed on lambs that were born dead or died within the period of observation.

Two ewes took 1007 (R) and 549 (F) min to lamb. These lambings were considered abnormal and were excluded from the analyses. The data were analysed for dam and lamb traits separately using different statistical models. Because most of the traits related to time deviated from normality, the data from ewes and lambs for these traits were transformed to logarithms before applying the statistical models. The preliminary model for ewe traits indicated that breed-by-parity interaction was not significant for any of the traits studied, so this effect was excluded from further analyses. The final model included breed, ewe-within-breed (error term for breed), and parity effects (GLM, SAS Institute, Inc. 1985). Since the traits investigated were influenced by the number of lambs born, a second analysis including this effect was applied to data of the two prolific breeds combined, and those of S, separately. Pearson's coefficient of correlation was calculated for the performance of the two parities, for each breed separately and for the three breeds combined. Correlations between the different traits for each breed were also calculated.

The lamb traits were analysed using two models. The first included the effects of breed, ewe/breed, sex, breed × sex, order of birth of the lamb, order of birth × both sex and breed, and the three-way interaction, breed × sex × order of birth was applied on only the ewes that produced single and twin lambs to compare the three breeds on an equal basis. The second model was applied only on data of the R and F breeds and included all the factors of the previous model except the three-way interaction. Significant differences among breeds was detected using the PDIFF option (SAS Institute, Inc. 1985).

RESULTS

About 57% of R, 47% of F and 27% of S ewes lambed between 16:00 and 24:00 h and 29, 47, and 60% of the ewes lambed between 08:00 and 16:00 h, respectively. The lowest percentage of lambing in the three breeds 14.2, 5.3, and

Table 1. Least squares means for some maternal traits of R, F, and S ewes at first and second parities

	Breed of ewe			Parity		SEM[z]
	Romanov	Finnsheep	Suffolk	First	Second	
Number of litters	30	27	20	40	37	
Number of lambs born	3.02*a*	2.09*b*	1.63*c*	2.08	2.42	0.17
Interval discomfort–contraction (min)	87.8	79.3	107.5	72.4	110.6	44
Interval rupture–contradiction (min)	65.1	48.8	68.7	2.6*a*	119.1*b*	32
Duration of lambing (min)	120.7*b*	57.1*a*	57.4*a*	61.7	95.1	20
Ewe–lamb contact time (min)	30.9*a*	19.7*b*	22.7*b*	23.2	25.7	3.1
Litter birth weight (kg)	7.05*a*	5.30*b*	8.31*a*	5.47*a*	8.30*b*	0.41
Litter weaning weight (kg)	27.1*b*	23.4*b*	35.4*a*	23.5*a*	33.7*b*	2.2

[z]SEM associated with the classification with the least number of observations.
a–c Means followed by different letters (within breed and within parity) were significantly different ($P < 0.05$).

Table 2. Least squares means[z] for the traits studied according to number of lambs born

	Romanov and Finnsheep				Suffolk		SEM[y]
	Single	Twin	Triplet	Quad	Single	Twin	Second
Number of litters	10	15	9	5	8	12	
Interval discomfort–contraction (min)	40.5	57.0	94.1	123.0	35.5	91.0	35.2–76.0
Interval rupture–contraction (min)	12.5	6.2	61.2	94.0	74.5	73.3	28.3–65.8
Duration of lambing (min)	20.3	42.5	111.0	166.0	38.2	69.0	15.6–23.4
Ewe–lamb contact time (min)	9.3*a*	25.0*b*	29.0*bc*	36.1*c*	16.5	26.0	2.3–5.7
Litter birth weight (kg)	3.3*a*	5.2*b*	6.9*c*	8.2*d*	5.54*a*	9.43*b*	0.25–0.43
Litter weaning weight (kg)	16.4*a*	23.2*ab*	28.4*b*	26.9*b*	24.6*a*	39.4*b*	1.8–2.8

[z]Means for prolific and Suffolk were obtained from separate analyses.
[y]Smallest and largest SEM.
a–c Means followed by different letters (within breed) were significantly different ($P < 0.05$).

13.3% occurred between 00:00 and 08:00 h, respectively. Time of the day had no significant effect on the behavioural traits studied.

The number of lambs born was significantly higher in R (3.02) than in F (2.09) and S (1.63) ewes (Table 1). No significant differences were observed between breeds in the interval between first display of uneasiness and first contraction and time interval between rupture of foetal membranes and first contraction. Romanov ewes took significantly longer to lamb than F or S ewes, which took a similar time, despite the significant difference in number of lambs born. The time R ewes spent interacting with their lambs was significantly longer than that spent by F and S ewes (Table 1). Placentaphagie was more frequent in prolific ewes (46 and 65% in R and F, respectively) compared with S ewes (12%) and primiparous (56%) compared with multiparous ewes (30%). About 32% of R and 35% of S lambing was considered difficult (visual appraisal by experienced herdsmen assessed as follows: at least 2 h of labour but no sign of the lamb at the vulva, or presence of the lamb at the vulva but failure to expulsion for 2 h despite strong contractions) compared with 17% for F ewes. Difficulty of lambing increased in the second parity. Suffolk and R litters were heavier than F litters at birth, and S litters were significantly heavier than those of the two prolific breeds at 50 d.

The effect of parity was significant on interval between rupture of foetal membranes and first contraction, litter birth weight, and litter weaning weight. The total ewe-lamb contact time was similar in primiparous (23.2 min) and multiparous (25.7 min) ewes (Table 1). The interval between rupture of foetal membranes and first contraction was extremely short in first as compared to second parity. The arithmetic means were 20 (< 1 to 129 min) and 112 min (3 to 395 min) for first and second parities, respectively. Least squares analysis exaggerated these differences.

The interval between first display of uneasiness and first contraction and duration of lambing became increasingly longer in litters of triplets or larger (Table 2). The interval between the rupture of water bag and first contraction was

Table 3. Selected correlation coefficients between the traits studied

	Lambing duration	Ewe–lamb contract time	Litter weight at birth	Litter weight at weaning
Litter size				
R	0.59**	0.29	0.68**	0.32
F	0.69**	0.83**	0.88**	0.62**
S	0.50*	0.20	0.86**	0.80**
Lambing duration				
R		0.51**	0.49**	0.20
F		0.76**	0.72**	0.43
S		0.04	0.64**	0.48
Ewe–lamb contact time				
R			0.28	0.23
F			0.72**	0.47*
S			–0.05	0.40

Other significant correlation were found between interval rupture-contraction and each of litter size (0.46*) and litter weight at birth (0.57*), and between interval discomfort–contraction and duration of lambing (0.41*), all for the R breed.
*, ** P, < 0.05 and $P < 0.01$, respectively.

Table 4. Weights and behavioural traits (least squares means ± SEM) of litters of single and twin lambing in three breeds

	Romanov		Finnsheep		Suffolk	
	1st	2nd	1st	2nd	1st	2nd
No of lambs	8	7	16	6	20	12
Seen–expelled (min)	16.9 ± 9.9	1.4 ± 11.2	22.3 ± 6.6	19.4 ± 15.1	32.4 ± 5.5	19.1 ± 7.6
	9.2 ± 13.2*a*		20.8 ± 13.9*a*		25.8 ± 7.9*a*	
Expelled–stand (min)	27.8 ± 9.8	46.1 ± 14.4	13.6 ± 5.7	23.7 ± 14.2	16.8 ± 5.5	22.3 ± 6.8
	37.0 ± 8.4*a*		18.6 ± 8.0*a*		19.6 ± 4.6*a*	
Stand–suckle (min)	16.5 ± 16.3	31.8 ± 23.9	19.0 ± 9.5	21.8 ± 23.6	33.6 ± 9.2	20.8 ± 11.3
	24.2 ± 12.6*a*		20.4 ± 12.0*a*		27.2 ± 6.9*a*	
Birth–suckle (min)	44.7 ± 22.6	77.4 ± 33.1	32.4 ± 13.1	45.6 ± 32.5	50.4 ± 12.7	43.4 ± 15.7
	61.0 ± 17.1*a*		39.0 ± 16.3*a*		46.9 ± 9.4*a*	
Ewe–lamb contact (min)	17.4 ± 4.2	8.6 ± 4.4	11.0 ± 2.5	6.6± 6.1	17.4 ± 2.3	6.5 ± 3.0
	13.1 ± 3.4*a*		8.8 ± 3.7*a*		11.9 ± 2.1*a*	
Interval between 1st and 2nd lamb	36.0[z] ± 12.2*ab*		21.3 ± 13.2*a*		50.9 ± 9.3*b*	
Birth wt (kg)	2.76 ± 0.43	2.18 ± 0.45	2.95 ± 0.25	2.12 ± 0.63	5.20 ± 0.23	5.01 ± 0.30
	2.47 ± 0.26*b*		2.54 ± 0.24*b*		5.15 ± 0.16*a*	
Weaning wt (kg)	13.0 ± 1.8	17.4 ± 2.7	14.9 ± 1.1	11..42.5	21.81.0	20.0 ± 0.7
	15.2 ± 1.7*b*		13.2 ± 1.6*b*		20.9 ± 0.9*a*	

[z]Excluding one ewe with intervals between lamb births of 118 and 82 min, in the two parities reduced that mean to 10.4 min.
Survival of single and twin lambs of the three breeds was 100%.
a,b Breed means followed by different litters were significantly different ($P < 0.05$).

Table 5. Lambs traits according to the order of lamb at parturition in prolific sheep

	Romanov				Finnsheep				Means	
Order of lamb at birth	1st	2nd	3rd	4th	1st	2nd	3th	4th	Romanov	Finnsheep
No of lambs	30–24	28–23	22–15	9	26–24	15	9–8	2	89–77	51–47
Interval seen–expelled (min)	21.3	11.3	2.3	6.4	12.8	16.3	8.0	7.5	10.3±4.2	11.1 ± 8.3
Interval expelled–stand (min)	27.1	32.1	54.0	60.2	14.0	20.8	28.3	22.4	43.3 ± 7.4	21.4 ± 13.7
Interval stand–suck (min)	46.9	26.9	36.6	32.4	21.2	21.0	29.4	30.6	35.7 ± 6.0	25.6 ± 10.6
Interval birth–suck (min)	73.4	58.7	90.1	70.6	35.1	41.7	57.9	73.6	73.2 ± 10.9	52.1 ± 19.2
Ewe–lamb contact (min)	15.0	9.3	6.4	4.4	13.2	6.5	3.9	7.7	8.8 ± 0.9	7.8 ± 2.0
Interval between lambings (min)	47.2	52.5	45.4		44.5	10.4	36.6		48.4 ± 9.2	30.5 ± 19.0
Lamb survival (%)	89.8	93.4	79.9	66.6	96.4	100	100	100	82.4a ± 4.3	>100b ± 9.3
Birth wt (kg)	2.30	2.28	2.23	2.13	2.70	2.47	2.32	2.09	2.23 ± 0.10	2.39 ± 0.21
Weaning wt (kg)	13.5	14.0	11.0	10.3	14.0	11.9	8.9	–	12.8 ± 0.4	11.6 ± 0.6

a,b Significantly different ($P < 0.05$).

much longer in S than in prolific sheep lambing singles and twins. In single litters, prolific sheep took 20 min to deliver their lambs compared with 38 min for S. In twin litters, the lambing period for the two types was 42 and 69 min, respectively. The time of contact between a ewe and her lamb was longer in S than in prolific ewes lambing singles and was similar in those lambing twins. The average contact time per individual lamb born was longer in twin litters (12.5 min) than in singles (9.3 min) or multiple litters (9.0-9.7 min).

The correlation between duration of lambing in first and second lambings was 0.30 for R, 0.67 for F and –0.78 for S. The overall estimate for the three breeds was 0.44 ($P < 0.55$). The correlation between the ewe–lamb contact time at first and second parities was 0 for the two prolific breeds and 0.57 for S.

As expected, number of lambs born had significant correlations with lambing time and litter birth weight in the three breeds, the strongest correlations were those of F (Table 3). Number of lambs born was also highly correlated with the ewe–lamb contact time but only in F. Duration of lambing was highly correlated with the ewe–lamb contact time (only in the two prolific breeds), and litter weight at birth.

Table 4 presents the individual lamb traits for single and twin litters of the three breeds by order of birth of the lambs. The time interval between first sight of a lamb and its expulsion was shorter in R than in F and S ewes (9.2 vs. 20.8 and 25.8 min, respectively), while the opposite was observed in the time between expulsion and standing, which was longest in R (37.0 vs. 18.6 and 19.6 min, respectively). Lambs of the three breeds took between 16.5 and 33.6 min to suck their dams for the first time. As a result of high variation between animals, none of the differences between breeds in these three characters was significant. Expulsion of the second lambs in R litters was extremely fast lasting for only 1.4 min on average; however, it took these lambs 46.1 min. to stand, and further 31.8 min before they had their first meal. On average, the first two R lambs took about 1 h from birth to first sucking compared with 47 min for S, and 39 min for F lambs. The time interval between lambing the first and second lamb was longest in S (51 min), shortest in F (21 min, difference $P < 0.05$), and intermediate in R (36 min).

Table 5 presents lamb traits for the entire R and F litters. The difference between the figures for the first two lambs in Tables 4 and 5 resulted from the extra litters of triplets and

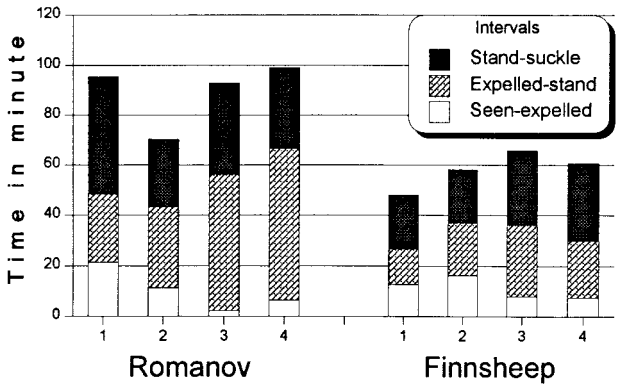

Fig. 1. Time interval between the first sight of a lamb at the vulva and the first nursing of R and F lambs according to order of birth.

quadruplets. The average time from first sight of a lamb to its expulsion was similar in the two prolific breeds and declined with increase in number of lambs born. In general, R lambs born took longer to stand and suck than did F lambs. However, because of the large variation that existed between individual observations, the differences did not reach significance level. Figure 1 combines the time interval between the first sight of a lamb and its first meal, for first- to fourth-born lambs. It shows clearly that F lambs were faster than their R counterparts to stand and feed. This may have resulted in the significant higher ($P < 0.05$) survival rate of F than R lambs in this study. Most of the lambs lost were born dead (9) – two died from pneumonia, two from dystocia, and the others from various causes. The interval betwen lambs births was shorter in F than in R especially between second and third births (10.4 vs. 52.5 min).

Table 6 presents correlation coefficients between the various lamb traits studied. In R, a significant positive correlation was calculated between the interval expelled–stand and stand–suck. Negative correlation was found for the three breeds between lamb birth and weaning weights and interval expelled–stand, but only those for the S were statistically significant. Both prolific breeds showed a significant negative correlation between birth weight and the interval stand–suckle. The contact time between a ewe and its lamb was significantly correlated to birth weight in R and weaning weight in both R and F sheep. That relation was negative for S but not significant statistically.

DISCUSSION

This study involved a small sample of the three breeds, and only for two parities, hence there were great variations among and within animals for the different traits studied. For example some ewes took 1 min to lamb a single lamb. The other extreme was one R ewe that took 4 min in first and 1007 min in second parity to lamb twins in both cases. It is logical that ewes lambing large litters take more absolute time to deliver than ewes lambing single or twin litters. Dividing the duration of lambing by the number of lambs born gave 40, 35, and 27 min per lamb for R, S, and F, respectively. This may indicate that F ewes deliver their litters easier than R. Atroshi and Österberg (1979) showed that the first lamb of F ewes of different ages was expelled in between 13.1 and 19.2 min, on average, and the time became longer as the number of lambs born increased. Finnsheep and S ewes took similar time to lamb despite the difference observed in litter size. Breed differences were observed by Alexander et al. (1990) who reported that the proportion of Border Leicester ewes lambing singles or twins, in more than 2 h was more than those of Merino and Glen Vale breeds.

Prolific sheep exhibited a shorter time interval between first display of uneasiness and first contraction, as well as duration of lambing than S, but again their lambs were significantly smaller than those of the S. When lambing duration was divided by kilograms of lambs born, R, F, and S ewes took 17, 10, and 7 min to deliver 1 kg of born lambs. Considering that average birth weight of S lambs was almost double that of F and R lambs, this may indicate that S ewes are well-developed to cope with delivering large lambs. The present findings of increased time interval between first display of uneasiness and first contraction, and the increase of duration of lambing with increased litter size agree with those of Owens et al. (1985) on prolific Booroola Merino. However, the duration of grooming averages reported by Alexander et al. (1990) for different breeds and different litter sizes (82–180 min) were much higher than those found in the present study. It must be mentioned that the lambing conditions in the two experiments were different. In the study of Alexander et al. (1990), the ewes lambed in large paddocks whereas in the present study they lambed indoors in small lambing pens.

The positive correlations of duration of lambing in prolific sheep suggested that ewes tend to maintain similar rankings in first and second lambings, that was not the case with S ewes where the correlation was negative.

The duration of lambing was longer in second that in first parity, with lambs being born in 39 vs. 30 min, respectively. However, in both parities it took 11 min to deliver 1 kg of lamb. The time intervals between first display of uneasiness and first contraction, and rupture of foetal membranes to first contraction were shorter in first than in second parities. The non-significant effect of parity on the behavioural traits studied may have resulted from the high variation between animals and the fact that lambing in both parities was individually in small pens; hence the ewes were more relaxed than lambing in large pens with other ewes around.

In the present study on prolofic and non-prolific sheep, the duration of expulsion of each lamb became progressively shorter after the first lamb was born, which agrees with the findings of Holmes (1976) and Owens et al. (1985). In R ewes lambing twins, the second lamb was expelled very rapidly, whereas in F and S ewes, despite the large different in size of the lambs born, the second lamb took similar time to be delivered.

Several studies including those of Arnold and Morgan (1975), Atroshi and Österberg (1979), Poindron (1981), and Owens et al. (1985) reported that most newborn lambs stand within an hour of birth and appear to suckle for the first time within this time. This was the case for F and S born lambs;

Table 6. Correlation coefficient for lamb weights and behavioural traits in R, F and S sheep

		Interval expelled–stand	Interval stand–suck	Ewe–lambs contact	Lamb birth wt.	Lamb weaning wt.
Interval seen–expelled	R	0.012	0.080	0.184	0.159	0.194
	F	–0.121	–0.020	–0.054	0.300*	0.011
	S	0.172	0.065	0.097	0.357	0.278
Interval expelled–stand	R		0.483**	–0.142	–0.230	–0.021
	F		0.066	–0.062	–0.231	–0.150
	S		0.042	0.171	–0.532**	–0.376*
Interval stand–suck	R			0.106	–0.332**	–0.216
	F			–0.024	–0.354*	–0.028
	S			0.142	0.113	0.332
Ewe–lambs contact time	R				0.280**	0.272*
	F				0.055	0.320*
	S				–0.239	–0.137

*, ** $P < 0.05$ and $P < 0.01$, respectively.

however, in R in most cases it took more than an hour for lambs to stand and find the udder. The longer time it took R lambs to stand and suck compared with the non-prolific S in this study agrees with the findings of Slee and Springbett (1986) who reported that most F failed to stand for at least 3 min during the first hour after birth compared with lambs from nine other non-prolific breeds. Both studies contradict the findings of Poindron (1981) who reported that R and Ile-de-France lambs stood after 26 and 28 min, respectively and that half the R lambs took less than 40 min to reach the udder. The present findings do not support the observations frequently made by Romanov breeders on the vigour and speed for standing and suckling of R lambs after birth. Slee and Springbett (1986) suggested that failure of F lambs to stand and reach the udder was associated with a higher incidence of hypothermia.

It is believed that in prolific sheep birth weight influences behaviour traits, but litter size does not, except indirectly through its effect on birth weight — the smaller the lamb the less active it is (Atroshi and Österberg 1979; Owens et al. 1985; Slee and Springbett 1986). The present results with F and S contradict these beliefs, S lambs, weighing almost the double of F lambs, took about 7 min more to reach the udder than did F lambs. This may indicate more viability of F lambs compared with S lambs.

Triplet- and quadruplet-born lambs in R and F litters reached the udder more slowly than first- and second-born lambs. Poindron et al. (1996) suggested that the slowness of triplets and quadruplets to reach the udder could be due to poor thermoregulatory performance of small lambs.

In R, F and S litters, the ewe gave more attention to the first-born than to the second-born lambs. In triplet and quadruplet R and F litters, the third and fourth lambs received less attention than the first two lambs. Holmes (1976) and Atroshi and Österberg (1979) studying F ewes reported that the duration of maternal licking of each lamb decreased with birth order. On the other hand, Owens et al. (1985) reported that Booroola Merino ewes appear to devote equal attention to each of their lambs.

In S ewes, the interval between lambing first and second lambs was much longer than in the two prolific breeds. An analysis of the variables obtained by dividing the time interval traits studied on R and F by birth weight of lambs, indicated similar results to those reported in Table 5.

As a result of high lamb survival rate especially in single and twin litters in the three breeds, the behavioural traits studied could not be related to lamb losses. It is worth mentioning that most lamb mortality occurred in large R litters which showed the longest period between birth and sucking. Poindron et al. (1996) stated that teat-seeking activity declines rapidly if sucking is delayed due to decline in strength of the lamb from lack of food. Lambs of low birth weight such as those of prolific breeds, are likely to be the most affected by delayed successful sucking. The lower vigour of the neonate may therefore affect lamb survival in large litters. However, because the ewes lambed individually in small lambing pens, they recognized and accepted all their lambs easily, accordingly no case of rejecting a newly born lamb was recorded in this study. A recent study by Murphy et al. (1994) indicated that close contact after birth is an important factor that ensures a strong bond and high rate of survival of multiple-born lambs.

Only a few correlations between the various traits studied were statistically significant. They confirmed several conclusions stated earlier, such as the longer expulsion time and shorter birth to sucking time with increased birth weight, and the positive effect of the initial contact time between the ewe and her lambs on lamb weight at weaning.

In conclusion, the present findings confirm the few studies reported earlier on differences between prolific and non-prolific sheep in many aspects of maternal behaviour at parturition even when the two types were compared using ewes that gave comparable litter sizes. Many of the behavioural traits studied differed between the two prolific breeds investigated. The behaviour of the newborn is also different in prolific and non-prolific sheep.

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Alexander, G. 1988. What makes a good mother? Components and comparative aspects of maternal behaviour in ungulates. Proc. Aust. Soc. Anim. Prod. **17**: 24–41.

Alexander, G., Stevens, D., Bradley, L. R. and Barwick, S. A. 1990. Maternal behaviour in Border Leicester, Glen Vale (Border Leicester derived) and Merino sheep. Aust. J. Exp. Agric. **30**: 27–38.

Arnold, G. W. and Morgan, P. D. 1975. Behaviour of the ewe and lamb at lambing and its relationship to lamb mortality. Appl. Anim. Ethol. **2**: 25–46.

Atroshi, F. and Österberg, S. 1979. The behaviour of the Finnsheep during and shortly after lambing. Acta Agric. Scand. **29**: 258–262.

Greeff, C. J., Hofmeyr, J. H., Lourens, D. J., Wyma, G. A. and Maijale, K. 1992. Performance of Finnsheep in South Africa. Agric. Sci. Finl. **1**: 195–202.

Holmes, R. J. 1976. Relationship of parturient behaviour to reproductive efficiency of Finnsheep. Proc. N. Z. Soc. Anim. Prod. 36: 253–257.

Hulet, C. V., Alexander, G. and Hafez, E. S. E. 1975. The behaviour of sheep. Pages 246–294 *in* E.S.E. Hafez, ed. The behaviour of domestic animals. Baillière Tindall, London, UK.

Murphy, P. M., Lindsay, D. R. and Purvis, I. W. 1994. The importance of the birthsite on the survival of Merino lambs. Proc. Aust. Soc. Anim. Prod. **20**: 251–254.

Owens, J. L., Bindon, B. M., Edey, T. N. and Piper, L. R. 1985. Behaviour at parturition and lamb survival of Booroola Merino sheep. Livest. Prod. Sci. **13**: 359–372.

Poindron, P. 1981. Contribution à l'étude des mécanismes de régulation du comportement maternel chez la brebis (*Ovis aries* L.). Thèse de Doctorat, Université de Provence, Provence, France.

Poindron, P., Raksanyi, L. Ogeur, P. and Le Neindre, P. 1984. Comparaison du comportement maternel en bergerie à la parturition chez des brebis primipares ou multipares de race Romanov, Préalpes de Sud et Ile-de-France. Génét. Sél. Evol. **16**: 503–522.

Poindron, P., Nowak, R., Oldham, C. M. and Lindsay, D. R. 1995. The reproductive behaviour of prolific sheep. Pages 471–483 *in* M. H. Fahmy, ed. Prolific sheep. CAB International, Oxford, UK.

SAS Institute Inc. 1985. User's guide; Statistics, 5th ed. SAS Institute, Inc., Cary, NC.

Shelley, L. 1970. Interrelationships between the duration of parturition, post-natal behaviour of ewes and lambs and the incidence of neonatal mortality. Proc. Aust. Soc. Anim. Prod. **8**: 348–352.

Slee, J. and Springbett, A. 1986. Early post-natal behaviour in lambs of ten breeds. Appl. Anim. Behav. Sci. **15**: 229–240.

Vince, M. A. 1993. Newborn lambs and their dams: the interactions that lead to suckling. Adv. Stud. Beh. **22**: 239–268.

Wallace, L. R. 1949. Observations of lambing behaviour in ewes. Proc. N.Z. Soc. Anim. Prod. **9**: 85–96.