

ESTIMATES OF PRE- AND PERINATAL MORTALITY IN THE NEW ZEALAND ROMNEY MARSH EWE

II. PRE- AND PERINATAL LOSS IN THOSE EWES THAT CONCEIVED TO SECOND SERVICE AND THOSE THAT RETURNED TO SECOND SERVICE AND WERE MATED A THIRD TIME

T. D. QUINLIVAN,* C. A. MARTIN,* W. B. TAYLOR†
AND I. M. CAIRNEY†

**New Zealand Romney Marsh Survey, Feilding, and*

†New Zealand Sheep and Beef Cattle Survey, Wellington, New Zealand

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Summary. Estimates of pre- and perinatal loss in parous and non-parous 2½-year-old ewes which conceived to a second or third mating are described. This paper is a continuation of the study on losses in New Zealand Romney Marsh ewes that conceived to one service (Quinlivan, Martin, Taylor & Cairney, 1966).

The data presented show the estimated mean prenatal loss (excluding non-fertilization) for parous and non-parous ewes, that conceived to second service, to be 25·7%. From a consideration of lambs born dead the total estimated pre- and perinatal loss amounts to 47·9%.

The percentage of ewes exhibiting genital tract abnormalities is considered and shows that 1% and 6·6% of the parous ewes in the 1963 and 1964 observations respectively, and 6% and 15% of the non-parous ewes in the two observations revealed some abnormality at autopsy.

INTRODUCTION

Estimates of pre- and perinatal mortality in the New Zealand Romney Marsh ewes that conceived to one mating have already been outlined (Quinlivan, Martin, Taylor & Cairney, 1966). This second paper completes the estimates of pre- and perinatal mortality obtained from a series of slaughter observations that involved 993 2½-year-old Romney Marsh ewes during 1963 and 1964.

MATERIALS AND METHODS

The design and implementation already outlined in the first paper on these observations applies similarly to this recorded estimate.

Because of the small number of ewes in the 1963 observation all ewes that returned to one service were slaughtered 2 days after being mated a second time. The 1963 observation thus provided data on ovulation and fertilization rates only.

The ewes in the 1964 observation from the original 18-, 30- and 140-day slaughter groups that returned to one service were alternately allocated to two slaughter groups:

(1) Slaughtered 2 days after being mated a second time.

(2) Slaughtered 30 days after being mated a second time. Of the ewes allocated to this group that returned to service prior to their due slaughter date all were slaughtered 2 days after they were mated a third time.

Those ewes in the original full-term group that returned to service either a second or third time were re-mated and allowed to lamb. Data were therefore available on ovulation and fertilization rates, embryonic mortality to 30 days and foetal and lamb loss from 30 days to lambing from those ewes which conceived to second service; and ovulation and fertilization rates and lamb production from those ewes that returned to second service and were mated a third time.

TABLE 1
OVULATION RATE OF THOSE EWES THAT WERE MATED AND
CONCEIVED TO SECOND SERVICE

	1963	1964		
	2-day	2-day	30-day	Total
No. of ewes	29	55	53*	108
No. of ewes examined	29	55	30	85
No. of corpora lutea	33	80	50	130
Ovulation rate (%)	114	145	167	153

* Denotes total ewes that were allocated into a 30-day slaughter group. A proportion (33.3% for the parous and 51.7% for the non-parous) subsequently returned to the ram.

RESULTS

DATA FROM EWES MATED AND CONCEIVED TO SECOND SERVICE

The data provided information on the performance both of ewes that had lambed the previous year as 2-year-olds (parous) and those that had no lamb as 2-year-olds (non-parous).

Ovulation rate

Table 1 presents the data from the 1963 and 1964 observations from those ewes that were mated a second time. As no significant difference existed between the parous and non-parous animals the results are combined ($\chi^2 = 0.493$, $P = 0.48$).

Fertilization rate

Table 2 presents the data for the fertilization rate of recovered ova. The data from the parous and non-parous ewes are combined as no significant differences existed ($\chi^2 = 0.922$, $P = 0.33$). The lower recovery rate in both observations

in comparison to ewes slaughtered 2 days after first service (Quinlivan *et al.*, 1966) could be accounted for by the higher incidence of occluded Fallopian tubes.

TABLE 2
FERTILIZATION RATE OF RECOVERED OVA
IN THOSE EWES SLAUGHTERED 2 DAYS *post*
coitum

	1963	1964
No. of ova shed*	33	80
No. of ova recovered	25	59
No. of ova fertilized	24	47
No. of ova not fertilized	1	10
No. of abnormal ova	0	2

* Estimated from corpora lutea counted.

Embryonic viability at 30 days

Table 3 presents data, from the 1964 observation only, of the viability of embryonic material recovered from ewes that conceived to a second mating and were slaughtered 30 days later. The following classification was employed.

A, Embryos alive on recovery.

B, Membranes only present.

C, Corpus luteum present. No embryonic material recovered.

TABLE 3
VIABILITY OF EMBRYOS RECOVERED
FROM EWES THAT CONCEIVED TO A
SECOND MATING AND WERE SLAUGHTERED
30 DAYS *post coitum*

Total ewes examined	30
Total corpora lutea	50
Viable embryos (A)	37
Non-viable embryos	
B	2
C	11
Total	13

The data obtained from the parous and non-parous ewes are combined as no significant difference existed ($\chi^2 = 0.01$, $P = 0.92$). Of the fifty corpora lutea counted thirteen (26%) could not be accounted for as live embryos at 30 days. In no case was a cystic corpus luteum observed. The loss to a comparable stage in those ewes conceived to one service was, by comparison, 22% for the parous ewes and 16.6% for the non-parous ewes.

Lambing data for full-term group

Table 4 presents the data from those ewes that conceived to a second mating and were allowed to lamb. The following classification was used:

- F₁, Alive at birth.
 F₂, Not alive at birth but showing full body development.
 F₃, Mummified.
 C, No lamb.

As no significant differences existed between the parous and non-parous ewes the data are combined ($\chi^2 = 0.18$, $P = 0.67$).

TABLE 4
 LAMBING DATA FROM FULL-TERM GROUP

No. of ewes conceived to second service	31*
No. of ewes aborted	0
No. of ewes lambed	17
No. of viable lambs (F ₁)	14
No. of non-viable lambs	
F ₂	6
F ₃	0
No. of no-lamb ewes (C)	13

* One ewe died in this group. On post-mortem she was shown to be pregnant with one foetus *in utero*.

Excluding one ewe that died, of the thirty ewes that conceived to second service seventeen (56.7%) subsequently lambed, the remaining thirteen (43.3%), although apparently conceived to second service, failed to produce a lamb. Of these thirteen ewes, nine were non-parous and four were parous. Seven of the nine non-parous ewes, on post-mortem, revealed some abnormality of the genital tract, the remaining two being normal. Of the four parous ewes one showed an abnormality, the other three were normal.

The higher proportion of barren ewes and lambs born dead in comparison to the data from those ewes conceived to one service should be noted.

Summary of estimates of pre- and perinatal loss in those ewes that were mated and conceived to a second service

Table 5 summarizes the degree of pre- and perinatal survival that occurred from coitus to lambing. Data from the 2-day group on ovulation and fertilization rates are presented but are not included in the calculation of embryonic loss. This is ascertained from the estimated ovulation rate of the 30-day slaughter group, the viability of embryos recovered at 30 days after mating and the lambing performance of those ewes allowed to lamb. All estimated losses are assessed on corpora lutea counts.

The ovulation rate of the 2-day slaughter group may be considered as the ovulation rate of those ewes that returned to one service and were mated a second time. The non-fertilization rate of the twenty-nine ewes examined in 1963 showed no difference from those ewes that had conceived to one service in that year. With the larger number of ewes involved in the 1964 observation (fifty-five) the mean fertilization rate for the parous and non-parous ewes was 82.5%, this being comparable to those ewes that conceived to a single service in that year (87.2%).

Embryonic loss (excluding non-fertilization) was calculated from the ovulation rate of the 30-day slaughter group. By deducting the percentage of non-viable embryos from the ovulation rate percentage the estimated number of embryos alive/100 ewes at 30 days was calculated. Examination of the data from the full-term group showed no mortality between 30 days and full term through either abortion or mummification. Total lambs alive at full term was calculated on total number of lambs (alive and dead) from the full-term group. The total estimated prenatal loss in those ewes that returned to one service and conceived to a second mating thus became 25.7% (24.3% for the parous sheep and 28.7% for the non-parous).

TABLE 5

ESTIMATED PROGRESSIVE PRE- AND PERINATAL SURVIVAL PER 100 EWES THAT CONCEIVED TO A SECOND MATING

	1963	1964
Ovulation rate (%) (2-day group only)	114	145
Less loss through non-fertilization	109	120
Ovulation rate (%) (30-day group)	-	167
Less embryos not viable at 30 days	-	124
Less losses between 30 days and full term	-	124
Lambing		
Less dead lambs at lambing	-	87
Actual lambing % obtained	-	82

Of the twenty lambs born to the seventeen ewes that lambed, six (30%) were dead at birth. Thus, of the lambs alive immediately prior to lambing, 70% survived the birth process. Of the thirteen ewes that produced no lambs in the full-term group eight showed some genital tract abnormality that could have affected fertilization. Whether or not these ewes should be included in any calculation of lambing percentage (based on ewes to the ram—lambs born alive) is debatable. The remaining five ewes that on post-mortem showed normal genitalia evidently experienced total embryonic loss at a stage too late for them to return to service during the breeding season.

It has thus been estimated that of the total of 167 corpora lutea counted/100 ewes, in the 30-day slaughter group, eighty-seven foetuses/100 ewes survived to be born as live lambs. The total mean estimated pre- and perinatal loss was thus 47.9% for these ewes (44.8% for parous and 52.7% for non-parous). By comparison the estimated loss in those ewes that conceived to one service was 26.9% for those 2½-year-old ewes that had previously had a lamb and 41.7% for those ewes that had previously had no lambs as 2-year-olds.

DATA FROM EWES THAT HAD RETURNED TO SERVICE TWICE AND WERE
MATED A THIRD TIME

These estimates pertain only to the 1964 observation. Although the number of ewes involved was small, as is inevitable in any observation of this kind, they are included to complete the data obtained from these observations.

Ovulation rate

The data for the parous and non-parous ewes are combined as no significant difference in ovulation rates existed ($\chi^2 = 0.493$, $P = 0.48$). Thirty-seven corpora lutea were counted in the twenty-three ewes examined, giving an ovulation rate of 161%.

TABLE 6
FERTILIZATION RATE OF OVA RECOVERED FROM EWES THAT RETURNED TO SECOND SERVICE AND WERE MATED A THIRD TIME

No. of ova shed*	37
No. of ova recovered	28
No. of ova fertilized	13
No. of ova not fertilized	14
No. of abnormal ova	1

* Estimated from corpora lutea counted.

Fertilization rate

Table 6 presents the fertilization rate of recovered ova. As no significant differences existed between the parous and non-parous ewes ($\chi^2 = 0.922$, $P = 0.33$) both data are combined.

TABLE 7
LAMB PRODUCTION FROM THOSE EWES MATED A THIRD TIME

	<i>Parous ewes</i>	<i>Non-parous ewes</i>
Total ewes mated a third time	1	7
No. of ewes aborted	0	0
No. of ewes that lambed	0	1
No. of viable lambs (A_1)	0	1
No. of non-viable lambs		
A_2	0	0
A_3	0	0
No. of no-lamb ewes (C)	1	6

The lower recovery rate (75.7%) particularly in the non-parous ewes and the lower fertilization rate in both groups were partly attributed to the presence of genital tract abnormalities in four of the eight parous and eight of the fifteen non-parous ewes.

Lambing data

Table 7 presents data available on those ewes that returned to second service, were remated and retained in the lambing group. Both parous and non-parous components are presented.

Of the seven ewes that failed to produce a lamb four of the non-parous ewes showed normal genital tracts on autopsy, the remaining two showing occlusion of the Fallopian tubes. The parous ewe that failed to produce a lamb was normal on post-mortem.

LAMBING PERFORMANCE OF THOSE EWES ALLOWED TO LAMB IRRESPECTIVE
OF NUMBER OF TIMES SERVED

Table 8 presents the data for those parous and non-parous ewes that were allowed to lamb, irrespective of the number of times they were served and is a summation of the lambing data presented in the first and second papers on these observations.

TABLE 8
LAMBING PERFORMANCE OF THOSE EWES ALLOWED
TO LAMB

	<i>Parous ewes</i>	<i>Non-parous ewes</i>
Total No. of ewes	79	77
No. of ewes that aborted	0	1
No. and percentage of ewes that lambed	72 (91.1)	57 (74.0)
No. and percentage of total lambs born	95 (120.3)	67 (87.0)
No. and percentage of lambs born alive	85 (89.5)	48 (71.6)
No. and percentage of lambs born dead	10 (10.5)	19 (28.4)
No. and percentage of no-lamb ewes	7 (8.9)	20 (26.0)

Total lamb production was based on ewes mated and total lambs born (alive and dead). Twenty-three of the parous ewes had twins and nine of the non-parous ewes had twins.

Although analysis of the total lambs born between the two groups of ewes revealed no significant difference ($\chi^2 = 1.767$, $P = 0.18$) it is apparent that the proportions of total lambs born, lambs born dead and barren ewes differ and would, in practice, be of importance in any consideration of the relative performance of parous versus non-parous ewes.

DISCUSSION

The data revealed that eight ewes (3.8%) and fourteen ewes (1.8%) were not served by the ram in the 1963 and 1964 observations respectively. Two of the ewes were parous, the remaining twenty being non-parous. The two parous

ewes showed apparently normal genitalia and of the twenty non-parous ewes eighteen (90%) showed some genital tract abnormality.

The incidence of genital abnormalities in those ewes that were mated by the ram and that were subsequently slaughtered in their respective groups showed that 1% and 6.6% of the parous ewes and 7% and 15% of the non-parous ewes for the 1963 and 1964 observations, respectively, were affected. Comparisons made of the occurrence of abnormalities in ewes conceived either to one, two or three services showed that 3.7% and 7.3% of the ewes mated once, 13% and 13.3% of those mated twice and 25% and 60% of those mated a third time, of the parous and non-parous ewes, respectively, were affected.

The discrepancy between the lambing performance of the parous and non-parous ewes is marked particularly in relation to total lambs born, lambs born dead and barren ewes. The repeat-breeder ewe tends to constitute a similar problem as it does in the bovine. Casida (1961) states the problem to be one of fertilization failure and embryonic loss in the cow and it would seem that a similar circumstance exists in the ewe, with a comparatively high incidence of genital tract abnormalities plus infertility of a functional type, although the actual mechanisms involved in embryonic loss are not understood. Following routine bacteriological sampling during these observations it may be assumed that low grade infection is not a major cause of embryonic mortality in the ewe.

It is possible that some degree of prenatal mortality is involved in normal biological processes and may be regarded as unavoidable. However, it seems desirable to examine both the extent and the aetiology of these losses as it may be possible to reduce them and thus obtain greater reproductive efficiency in domestic animals.

The aim of these observations was to establish basic data for ovulation and fertilization rates, embryonic mortality and perinatal death in a large sample of 2½-year-old Romney Marsh ewes, at the same time making a comparison between those ewes that had experienced a full-term pregnancy as 2-year-olds the previous year and those who had not. It would seem desirable, by the application of the above principles, to examine the situation in other age groups.

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REFERENCES

- CASIDA, L. E. (1961) Present status of the repeat breeder cow problem. *J. Dairy Sci.* **12**, 2323.
QUINLIVAN, T. D., MARTIN, C. A., TAYLOR, W. B. & CAIRNEY, I. M. (1966) Estimates of pre- and perinatal mortality in the New Zealand Romney Marsh ewe. I. Pre- and perinatal mortality in those ewes that conceived to one service. *J. Reprod. Fert.* **11**, 379.