# HOGGET LIVEWEIGHT-OESTRUS RELATIONSHIP AMONG SHEEP BREEDS

H. H. MEYER and R. L. FRENCH

*Ruakura Animal Research Centre, Hamilton*

SUMMARY

Within the $F_1$ progeny of nine sire breeds, a positive relationship was observed between hogget liveweight and incidence of hogget oestrus. Across breeds, however, there was no relationship between mean hogget weights and either proportion of hoggets showing oestrus or number of oestruses per hogget. Finn × Romney $F_1$ hoggets showed a higher incidence of oestrus (88%), and straightbred Romneys a lower incidence (25%), than the remaining seven breeds, which ranged from 52% to 67%.

The ovulation rate was very high for Booroola × Romney (1.69) and Finn × Romney (1.42) $F_1$ ewe hoggets. Remaining breeds ranged from 1.02 to 1.11 ova per ovulating hogget. Within the two high ovulating breeds, twin ovulators averaged 6% heavier than single ovulators.

Number of hogget oestruses was positively related to subsequent ovulation rate observed at 1½ years of age. Because numerous factors (such as hogget and 1½ year liveweights) are confounded, it cannot be assumed that the observed phenotypic relationship is genetic in origin.

## INTRODUCTION

Within the sheep industry major emphasis is being placed on increased ewe fertility, particularly prolificacy, as a means of improving productivity. Unfortunately, this trait is not expressed until well after selection of breeding females normally takes place, and the low repeatability of litter size means that more than a single observation is required for accurate selection, resulting in a lengthened generation interval. It would thus be very useful to identify another attribute, preferably measured on ewes before selection of replacements is normally practised, which has a high correlation with lifetime productivity.

Many farmers cull on hogget liveweight, believing it to be highly correlated with subsequent fertility. Such culling will tend to discriminate against twin-born lambs, so the phenotypic superiority of selected ewes might be countered by genetic selection against fertility. Attention has also been focused on selection of ewe hoggets which display oestrus in their first autumn. Gen-

erally it is the larger hoggets which show oestrus, particularly in seasons of poor lamb growth, but information on its relation to liveweight and later fertility is limited.

## MATERIALS AND METHODS

In the evaluation of the so-called "exotic" sheep breeds, careful attention was paid to growth and fertility attributes. The four lamb crops, born 1974-7 to Romney dams and sired by rams of 11 breeds, were weighed at birth and thereafter at approximately monthly intervals until mating at 18 months of age. Vasectomized rams were run with the ewe hoggets from April through July each year, with fortnightly recording of the hoggets which had been marked by mating crayons on the rams. The elimination of East Friesian-derived stock in 1976 reduced to nine the number of ram breeds used in 1976 and 1977. In total, oestrous activity was observed for 2735 hoggets of the nine breed types.

In 1978, of 1408 hoggets, 495 were marked over a 3-week period in May-June and were examined by laparoscopy to determine ovulation rate (OR). Of these, 488 had observable corpora lutea. Similarly, 1½-year-old ewes from the same sire breeds were run with vasectomized rams from early January until initiation of mating in late April, with mating marks being recorded fortnightly. A sample of ewes, pre-selected at random within breed and containing a minimum of 60 ewes of each breed type, was subsequently laparoscoped following first mating to determine OR. Ewes born in 1976 thus had records on both hogget and pre-mating two-tooth mating behaviour as well as two-tooth ovulation and conception rates.

Five of the nine sire breeds were represented in all 4 years of the trial. Performance of these breeds was used as the base for estimating year effects to adjust performance of the remaining breeds and so minimize potential bias due to confounding of breeds and years.

## RESULTS

### Hogget Liveweights and Oestrous Activity

Within breeds, hogget body weight was positively correlated with number of hogget oestruses, the correlation coefficients ranging from 0.21 to 0.43 (average 0.33) for the nine breeds. This relationship, however, did not apply for mean hogget weights and oestrous activities across breeds. As shown in Table 1, the proportion showing oestrus and the mean number of mating

marks per ewe marked were closely related across the range of breeds, but neither was related to mean hogget liveweight. Both hogget liveweight and oestrous activity varied over years, but the rank among breeds for both traits remained fairly constant over years. Within breeds, both the proportion of hoggets marked and the mean number of mating marks per ewe hogget marked were highest in years with highest mean hogget liveweight. Apart from the extremes of the $F_1$ Finn × Romney and the straightbred Romney, the range of both proportion of ewes cycling and number of mating marks was fairly small. The $F_1$ Finn × Romney and Romney breeds maintained their extreme rankings for both oestrous traits over all 4 years. The proportion of hoggets cycling over the 4 years ranged from 88-97% for Finn × Romneys to 12-38% for Romneys. Similarly, the range over years for mean number of mating marks was 2.2–3.5 for Finn × Romney and 1.1–1.4 for Romney hoggets.

TABLE 1: BREED MEANS FOR HOGGET LIVEWEIGHT AND OESTROUS ACTIVITY[1]

| *Sire Breed* | *Number* | *LW (kg)* | *% Marked* | *NM/HM*[2] | *NM/H*[3] | $b_{NM:LW}$[4] |
|---|---|---|---|---|---|---|
| Oxford | 255 | 31.9 | 62 | 1.9 | 1.24 | 0.072 |
| Dorset | 305 | 30.1 | 66 | 1.9 | 1.15 | 0.054 |
| Border L. | 325 | 29.5 | 52 | 1.7 | 0.99 | 0.083 |
| German | 286 | 29.4 | 53 | 1.8 | 0.83 | 0.097 |
| Finn | 356 | 29.3 | 92 | 2.8 | 2.79 | 0.108 |
| Cheviot | 297 | 27.6 | 67 | 2.0 | 1.44 | 0.121 |
| Finn × R. | 239 | 27.4 | 66 | 2.0 | 1.60 | 0.135 |
| Booroola | 212 | 26.0 | 53 | 2.0 | 1.18 | 0.171 |
| Romney | 460 | 24.2 | 25 | 1.3 | 0.34 | 0.059 |

[1] Pooled over years (1975-8).
[2] Number of marks (oestrous cycles) per hogget marked.
[3] Number of oestrous cycles expressed as number of marks per hogget joined with teasers.
[4] Regression of number of mating marks on hogget liveweight.

The intrabreed regressions (pooled over years and birth rank) for the number of mating marks on hogget liveweights are shown in Table 1. All regressions were positive and siginficantly larger than zero, with the Booroola cross showing the greatest change in number of hogget cycles per unit increase in liveweight, and the Dorset cross and straightbred Romney having the lowest regression coefficients. Apart from the heaviest and lightest breeds (Oxford and Romney), there was a trend for the regression coefficient to increase as breed means decreased; *i.e.*, additional liveweight had a greater effect on hogget oestrus in lighter breeds.

## Hogget Ovulation Rate

The mean ovulation rates and liveweights for hoggets laparoscoped are shown in Table 2. Apart from the Finn- and Booroola-sired hoggets, OR ranged from 1.02 to 1.11. The numbers of ewes laparoscoped varied considerably over breeds because of differences in proportions of ewes cycling at the time. Of 488 ewe hoggets observed to have produced one or more ova, only two hoggets (one Oxford and one Booroola) had more than two ova. Across breeds there was no positive relationship between mean hogget liveweight and mean hogget OR. Within the only two breeds with appreciable numbers of twin ovulators, such ewes were 6% heavier than their contemporary single ovulators in the case of Finns, and 5% heavier for Booroola crosses.

TABLE 2: MEAN OVULATION RATES AND MARCH LIVEWEIGHTS FOR HOGGETS OBSERVED (WINTER 1978)

| *Sire Breed* | *Observed/Total* | *OR* | *Weight (kg)* |
|---|---|---|---|
| Oxford | 55/154 | 1.05 | 32.7 |
| Dorset | 53/174 | 1.06 | 30.2 |
| Border Leicester | 61/157 | 1.11 | 31.3 |
| German | 33/150 | 1.03 | 30.7 |
| Finn | 110/171 | 1.42 | 29.1 |
| Cheviot | 52/133 | 1.02 | 30.2 |
| Finn × Romney | 65/141 | 1.05 | 28.5 |
| Booroola Merino | 29/117 | 1.69 | 27.1 |
| Romney | 30/211 | 1.10 | 27.0 |

## Hogget Oestrus vs. Two-tooth Ovulation Rate

In an attempt to assess the impact of selection for hogget oestrus on subsequent fertility, oestrous activity in 1976-born hoggets was related to their OR at first mating (at 1½ years). The number of animals laparoscoped was too small to obtain an accurate assessment of the effect of number of hogget oestrous cycles on later ovulation rate within any one breed; hence the within-breed results were pooled across breeds (Table 3). Romneys were excluded because few ewes had more than one mark, and $F_1$ Finn × Romneys because few ewes had less than three marks. The increase in number of hogget marks from 0 to 1 was associated with a 0.11 increase in OR at 1½ years. Additional incremental increases in number of marks showed further increases of 0.14 and 0.09 in OR at first mating at 1½ years.

TABLE 3: CHANGE IN OVULATION RATE AT 1½ YEARS OF AGE WITH INCREASING NUMBER OF HOGGET OESTROUS CYCLES

| *Sire Breed* | *1–0*[1] | *2–1* | *3–2* |
|---|---|---|---|
| Oxford | + 0.19 | + 0.22 | — 0.02 |
| Dorset | + 0.03 | + 0.42 | — 0.10 |
| Border Leicester | + 0.07 | — 0.11 | + 0.31 |
| German | + 0.07 | + 0.08 | + 0.21 |
| Cheviot | + 0.03 | + 0.01 | + 0.15 |
| Finn × Romney | + 0.14 | + 0.18 | + 0.18 |
| Booroola Merino | + 0.25 | + 0.16 | — 0.09 |
| Mean | + 0.11 | + 0.14 | + 0.09 |

[1] (OR of ewes with NM = 1) — (OR of ewes with NM = 0).

## DISCUSSION

Hogget oestrous activity is of practical interest to commercial sheep breeders only if they wish to breed ewe hoggets or if hogget oestrus is indicative of future reproductive performance and can thus serve as a selection criterion for flock improvement. The variation among breeds in this trial in the proportion of hoggets marked was quite small apart from $F_1$ Finn cross and straightbred Romney hoggets. Likewise, ovulation rate was quite uniform among breeds apart from $F_1$ Finn and Booroola crosses. The positive association observed within breeds between mean hogget liveweight and proportion of ewes marked indicates that good management is important in a hogget mating programme. However, the mean ORs for the breeds involved are not likely to rise much above the levels observed in 1978 (Table 2), when both liveweights and oestrous activity levels were above average for all breeds.

The comparison of the two high-fertility breeds (Booroola and Finn) relative to the rest of the breeds suggests that Booroola crosses excel only in the ovulation rate of cycling hoggets and show no propensity for early sexual maturity at light liveweights.

The high level of sexual activity in $F_1$ Finn ewe hoggets parallels the precocity of Finn cross males The absence of early seasonal onset of hogget oestrus among any of the breeds observed is probably due to lack of sexual maturity, although, if this were the only factor, Finn cross females should have shown earlier onset of hogget oestrus relative to other breeds.

If the aim is to breed ewe hoggets, some breeds hold much more prospect for success than others, but none of the breed

crosses observed in this study will allow for high proportions of hoggets conceiving at the normal time of mating mixed-age ewes.

The value of either hogget liveweight or oestrous behaviour as a selection criterion is dependent on the phenotypic and genetic correlations of these traits with subsequent reproductive performance. Overseas reports have indicated small but positive phenotypic correlations of adult reproductive performance with hogget liveweight (*e.g.,* Purser and Roberts, 1959, for Scottish Blackface; Young *et al.,* 1965, Merino; Shelton and Menzies, 1968, Rambouillet) and with hogget oestrus (Hulet *et al.,* 1969, 3 U.S. breeds). Corresponding genetic correlations have likewise been small but positive, suggesting that selection on these hogget characters would result in genetic improvement for adult reproductive performance.

Initial estimates for New Zealand Romneys (Ch'ang and Rae, 1972) were larger than most overseas estimates, with genetic correlations averaging 0.5 for both body weight and number of hogget oestrous cycles with fertility. R. L. Baker *et al.* (unpublished), from a larger trial, have since obtained much smaller estimates for these genetic correlations, averaging 0.1 with many estimates being negative. As a compromise of New Zealand and overseas data, the New Zealand national performance recording scheme for sheep (Sheeplan) uses the value of 0.2 for the genetic correlation between lambs born and hogget liveweight in calculating breeding values.

Despite the apparently large positive relationship between number of hogget oestrous cycles and OR at 1½ years (Table 3), the commercial breeder has few hoggets with more than two hogget marks. About 60% of available hoggets are needed as

TABLE 4: OVULATION RATE AT 1½ YEARS OF AGE IN RELATION TO NUMBER OF HOGGET OESTRUSES

| *Sire Breed* | *No. Ewes* | *Mean OR*[1] | *No. Hogget Marks* | | |
|---|---|---|---|---|---|
| | | | *0* | *≥1* | *≥2* |
| Oxford | 60 | 1.38 | 1.11 | 1.43 | 1.46 |
| German | 59 | 1.17 | 1.07 | 1.20 | 1.23 |
| Border Leicester | 71 | 1.40 | 1.33 | 1.42 | 1.43 |
| Cheviot | 73 | 1.29 | 1.25 | 1.30 | 1.33 |
| Dorset | 94 | 1.44 | 1.20 | 1.49 | 1.66 |
| Finn × Romney | 70 | 1.30 | 1.00 | 1.33 | 1.39 |
| Booroola Merino | 89 | 2.06 | 1.81 | 2.14 | 2.18 |
| Romney | 64 | 1.07 | — | — | — |
| Finn | 63 | 2.03 | — | — | — |

[1] Mean ovulation rate for all ewes laparoscoped.

replacements, and this corresponds to all of the hoggets showing oestrus for most of the breeds examined. As shown in Table 4, selection of only hoggets which cycle (relative to random selection) would produce a correlated increase in ovulation at 1½ years of only 0.04 ova. If only those hoggets with multiple marks were kept, the increase in OR would be 0.08 ova. In terms of the animals selected, selection on hogget oestrus differs little from selection on hogget liveweight.

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