

A note on the phenotypic relationship between 18-month mating mass and average lifetime reproductive performance of Merino ewes in the Tygerhoek flock

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Part of a M.Sc. thesis to be submitted to the University of Stellenbosch

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Received 6 August 1985

The relationship between 18-month mating mass and average lifetime conceptions/mating (Ec/Em), lambs born/conception (Lb/Ec), lambs born/mating (Lb/Em), pre-weaning mortalities/lamb born (Ld/Lb) and lambs weaned/mating (Lw/Em) was investigated with data from 1222 Merino ewes available for at least four lambing opportunities in the Tygerhoek flock. The regressions of average lifetime Ec/Em, Lb/Ec, Lb/Em and Lw/Em on 18-month mating mass were linear, positive and statistically significant ($P \leq 0,001$). Pre-weaning mortalities were independent of 18-month mating mass. An increase of 1 kg in 18-month mating mass was associated with respective increases of 0,007 Ec/Em, 0,018 Lb/Ec, 0,024 Lb/Em and 0,017 Lw/Em. These results were supported by subsequent analyses, where average lifetime Ec/Em, Lb/Em and Lw/Em were used as discrete independent variables, and 18-month mating mass as the dependent variable. Phenotypic correlations obtained between 18-month mating mass and average lifetime Ec/Em, Lb/Ec, Lb/Em and Lw/Em were 0,11, 0,25, 0,24 and 0,18 respectively.

Die verwantskap tussen 18-maande-paarmassa en gemiddelde leeflydsbesettings/paring (Ob/Op), lammers gebore/besetting (Lb/Ob), lammers gebore/paring (Lb/Op), voorspeense vrektes/lam gebore (Ld/Lb) en lammers gespeen/paring (Ls/Op) is ondersoek met data van 1222 Merino-ooie wat ten minste vier lamgeleenthede in die Tygerhoekkudde voltooi het. Die regressies van gemiddelde leeflyds-Ob/Op, Lb/Ob, Lb/Op en Ls/Op op 18-maande-paarmassa was lineêr, positief en statisties betekenisvol ($P \leq 0,001$). Voorspeense vrektes was onafhanklik van 18-maande-paarmassa. 'n Toename van 1 kg in 18-maande-paarmassa het gelei tot onderskeie toenames van 0,007 Ob/Op, 0,018 Lb/Ob, 0,024 Lb/Op en 0,017 Ls/Op. Hierdie resultate is ondersteun deur verdere analises, waarin gemiddelde leeflyds-Ob/Op, Lb/Op en Ls/Op as diskrete onafhanklike veranderlikes gebruik is, met 18-maande-paarmassa as die afhanklike veranderlike. Verkreef fenotipiese korrelasies tussen 18-maande-paarmassa en gemiddelde leeflyds-Ob/Op, Lb/Ob, Lb/Op, en Ls/Op was 0,11, 0,25, 0,24 en 0,18 onderskeidelik.

Keywords: 18-month mating mass, average lifetime reproduction, phenotypic correlation.

Livemass *per se*, or livemass gain are often used as criteria in selection indices for woolled and mutton sheep. Recent local

research findings do, however, indicate the possibility of a negative genetic relationship between growth rate and reproduction in beef cattle (Scholtz & Roux, 1984), that may possibly be extrapolated to other species (Roux & Scholtz, 1984). The genetic relationship of livemass with reproduction tend to be positive in sheep (Turner, 1972), but there is some evidence of a corresponding negative correlated response in reproduction rate after selection for an increased 120 days mass in Targhee sheep (Lasslo, Bradford, Torell & Kennedy, 1985).

An attempt was therefore made to gain more insight into the relationship between livemass at a relatively early age (18 months) with the average lifetime reproduction of Merino ewes in the Tygerhoek flock. The origin of this flock and the selection practices implemented therein have been well documented (Heydenrych, 1975; Heydenrych, Du Plessis & Cloete, 1984). Data from 1222 ewes, born during the period from 1969 to 1980 inclusive, and with data available for at least four lambing opportunities, were included in the analysis. Average lifetime reproductive performance of individual ewes was defined as the average number of conceptions/mating (Ec/Em), lambs born/conception or multiple births (Lb/Ec), lambs born/mating (Lb/Em), preweaning mortalities/lambs born (Ld/Lb) and lambs weaned/mating (Lw/Em) over the first four lambing opportunities. The reproduction traits were used as dependent variables in a least squares analysis, using the LSML76 computer program (Harvey, 1977). The fixed linear model for 18-month mating mass as a continuous independent variable included birth year, selection group, birth type and dam age as discrete independent variables, and the birth year \times selection group interaction. The quadratic regressions of the dependent variables on 18-month mating mass were not statistically significant, and only the linear terms were therefore retained in the final analyses. Interactions of the discrete independent variables with mating mass were simultaneously considered.

The results concerning the effects of birth years, selection groups, birth type and dam age were in general correspondence with previous results (Cloete & Heydenrych, 1986), and have been omitted in further discussions. The interactions of the discrete independent variables with mating mass were statistically nonsignificant, and have also been omitted.

The regressions of average lifetime Ec/Em, Lb/Ec, Lb/Em and Lw/Em on 18-month mating mass are presented in Figure 1. The regression of Ld/Lb on mating mass was not significant and is excluded. An increase of 1 kg in mating mass was associated with respective increases of 0,007 Ec/Em, 0,018 Lb/Ec, 0,024 Lb/Em and 0,017 Lw/Em. All these regression coefficients were positive and statistically significant ($P \leq 0,001$). Corresponding regression coefficients for Lb/Em and Lw/Em reported by Shelton & Menzies (1968) were 0,012 and 0,011 respectively. The present regressions are in general agreement, but tend to be higher than those obtained by the authors cited.

In his discussion of Coop's (1962) results, Cockrem (1965) pointed out that, if the relationship between livemass and reproduction is real, differences in livemass should be obtained between groups of ewes classified according to their reproductive performance. This aspect was investigated in three additional runs with average lifetime Ec/Em, Lb/Em and Lw/Em as discrete independent variables, and 18-month mating mass as the dependent variable. Reproduction classes represented by an inadequate number of observations were pooled with adjacent classes where applicable. With the exception of mating mass, the other fixed effects were the

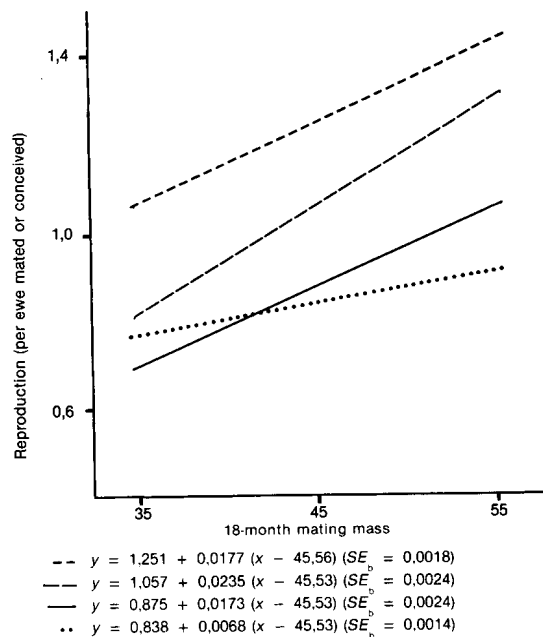


Figure 1 The regressions of average lifetime Ec/Em (.....), Lb/Em (---), Lb/Em (—) and Lw/Em (—) on 18-month mating mass

same as those considered previously. The degrees of freedom for average lifetime Ec/Em, Lb/Em and Lw/Em were partitioned into single-degree orthogonal polynomials. The proportion of variance in 18-month mating mass associated with reproductive performance varied between 1,2% for Ec/Em and 6,2% for Lb/Em, with the effects of reproduction significant ($P \leq 0,001$) in all three analyses. The average 18-month mating mass of ewes classified according to their average reproduction over four lambing seasons are presented in Figure 2. The variance in 18-month mating mass associated with Ec/Em could almost entirely be attributed to the linear regression of 18-month mating mass on Ec/Em. Both the linear and quadratic terms were significant ($P \leq 0,01$) in the analysis involving Lb/Em, contributing 91,2 and 5,4% to the sum of squares for Lb/Em respectively. The linear effect of Lw/Em similarly accounted for 91,4% of the variance in the analysis incorporating Lw/Em as a discrete independent

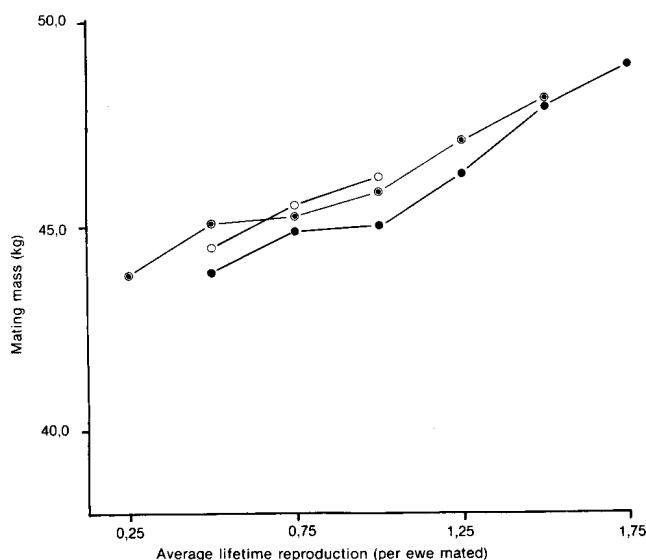


Figure 2 Mean values of 18-month mating mass for ewes classified according to lifetime Ec/Em (○), Lb/Em (●) and Lw/Em (○) averaged over the first four lambing opportunities

variable. When only the linear regressions were considered, an increase of one unit in Ec/Em, Lb/Em and Lw/Em was associated with respective increases of 3,2; 3,9 and 2,9 kg in 18-month mating mass. These results correspond to those obtained by Hight & Jury (1976), but the regressions of body mass on Lb/Em and Lw/Em in the present investigation were somewhat higher after transformation to a common basis.

The obtained phenotypic relationship between average lifetime reproduction and 18-month mating mass can therefore be considered to be real and positive. Phenotypic correlations of the respective reproduction traits with 18-month mating mass are presented in Table 1. The correlation between 18-month mating mass and lifetime Ec/Em was favourable, but not particularly high. Shelton & Menzies (1968) correspondingly reported a low negative correlation of $-0,04$ between yearling mass and barrenness in Rambouillet ewes. Stronger relationships existed between 18-month mating mass and average lifetime Lb/Em and Lb/Em (Table 1). These results are in agreement with existing reports (Young, Turner & Dolling, 1963; Nichols & Whiteman, 1966; Shelton & Menzies, 1968; Ch'ang & Rae, 1972; Basuthakur, Burfening, Van Horn & Blackwell, 1973; Hight & Jury, 1976; Napier, Jones & Ward, 1980). Ten comparable correlations between early livemass (yearling, hogget or 18-month livemass) and lambing rate reported by the authors cited ranged between 0,09 and 0,23. Pre-weaning mortalities were virtually independent of 18-month mating mass (Table 1). The phenotypic correlation between average lifetime Lw/Em and mating mass was favourable and amounted to 0,18. Ten comparable correlation coefficients in the literature ranged from 0,05 to 0,19 (Young, *et al.*, 1963; Nichols & Whiteman, 1966; Shelton & Menzies, 1968; Basuthakur, *et al.*, 1973; Hight & Jury, 1976; Elliot, Rae & Wickham, 1979; Napier, *et al.*, 1980). Although being in general agreement with results in the literature, it is evident that the present phenotypic correlations between 18-month mating mass and average lifetime lambing and weaning rate tended to be equal to the highest comparable estimates in the literature.

Table 1 The phenotypic correlations of 18-month mating mass with the average lifetime reproduction of Merino ewes

Reproduction trait	Phenotypic correlation
Conceptions/mating	0,110
Lambs born/conception	0,247
Lambs born/mating	0,241
Preweaning mortalities/lamb born	0,024
Lambs weaned/mating	0,175

It should be noted that the relationship obtained between early livemass and average lifetime reproduction is purely phenotypic. Further research will be directed towards the determination of the genetic correlation between these characteristics. Based on results reviewed by Turner (1972), a negative genetic relationship between livemass and reproduction is unlikely in sheep. It appears that a reduced reproductive performance as a correlated response to selection for livemass is not likely to occur in most flocks. In most cases selection for livemass should be associated with small genetic gains in reproductive performance (Turner, 1972). There may, however, be exceptions in this respect as indicated by Lasslo, *et al.* (1985).

Acknowledgement

The authors wish to thank the late Mr D.J.B. Meissenheimer, Mr J.J. du Plessis and Miss E. du Toit for the maintenance of the experimental flock, and Mr A. van Rooyen and Mrs C. Thiart for assistance in the statistical analysis of the data.

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