EFFECT OF ENVIRONMENTAL FACTORS ON BODY WEIGHT AT DIFFERENT AGES IN THE ROMNEY MARSH SHEEP

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Summary

Data on the birth weight, 8 week body weight and ewe body weight of an unselected random mating Romney Marsh sheep flock are analyzed to study the influence of various environmental factors. The average birth weight of lambs was 5.06 kg. Sex of lamb, birth type and dam age contributed significant variation in lamb birth weight ($p < 0.05$). Males were singificantly heavier than females ($p < 0.05$) and singles were significantly heavier than multiples ($p < 0.05$) at birth. Birth weight of lamb increased with the progress of dams' age. The overall average 8 week body weight of lambs was 20.84 kg. Effect of birth weight, sex, birth type and dam age was significant on 8 week body weight of lamb. Eight week body weight increased with the increase of lamb birth weight ($b=1.285$ kg). Ewes' body weight taken before tupping was affected by ewes' age, year of performance and their weight at birth. It was concluded that performance data on lamb birth weight, 8 week body weight and ewe body weight should be corrected for the above relevantly significant environmental factors in any genetic calculation in the United Kingdom Romney March sheep.

(**Key Words**: Environmental Factors, Body Weight, Romney Marsh Sheep)

Introduction

Body weight of sheep is simple indicator of their meat production potential. Breeding programmes aimed at the increased meat production use weight of animals at certain stages as selection criterion. In undertaking such genetic improvement programmes, it is necessary to know the effect of various environmental factors on body weight traits. This helps to develop correction factors for removal of environmental trends from the phenotype of animals. This is ultimately to facilitate unbiased calculation of genetic parameters, prediction of genetic merit of individuals and estimation of genetic progress.

Romney Marsh is a dual purpose breed of sheep producing meat and wool and is originated in the low-lying areas of Kent and Sussex in England. An increase in growth rate through breeding is necessary for increased mutton production. The objective of this study was to find out effect of various environmental factors on lamb birth weight, 8 week body weight and ewe body weight.

Materials and Methods

The data used in this study were collected from a random mating flock of Ronmey Marsh sheep maintained at the Wye College, University of London, U. K. The flock was funded by Agricultural and Foor Research Council (A.F.R.C) and was established to use it as a reference population for monitoring genetic progress achieved in the Ronmey Group Breeders' (RGB) selected flock (Bhuiyan, 1989). The data covered a period from 1982 to 1989.

All sheep involved in this study were raised at Wye College sheep unit. Pedigree matings were made during the first 25 to 30 days of November in each year. Ram lambs (approximately 8-9 months of age) were used for breeding in the paddock and they were used only for one breeding season. From each lamb crop 10 ram lambs and 15 ewe lambs were randomly retained as flock replacements.

The sheep are grazed on pasture from April to December at Wye. In the early January they

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were winter-housed (when they are in-lamb) and fed with concentrates plus roughage. The roughage was hay offered *ad libitum*. The level of concentrate ranged from 600-1000 g/ewe/day depending on the stage of pregnancy. The sheep were shorn in January on being housed.

Upon lambing all lambs were individually ear-tagged using Ministry of Livestock Commission (M.L.C) metal tags and birth weights were recorded within 24 hours from birth. Within 1-2 days of lambing, ewes and their lambs were transferred to pasture. At pasture, ewes were initially supplied with concentrate at the level used indoors but this was quickly decreased as grass availability increased. Eight week body weights of lamb were taken on a single day in the fields. Similarly, ewe body weights were measured before tupping in every year. Normal health protection measures were practised for all animals throughout the year.

This study included data only on flock born (i.e. 1980 and onward) lambs and ewes. The data were analysed by the least-squares and maximum likelihood method (Harvey, 1988). Linear fixed model (Model 1) was used for all analyses. The sub-class means were compared using least significant difference (LSD). Recorded lamb 8 week body weight data were first adjusted for ages in days. Adjustment was made by linear interpolation between birth and approximate 8 week body weight using the following formula (Lasslo et al., 1985):

$$\text{Age adjusted 8 week weight} = \frac{\text{Recorded 8 week weight (kg)} - \text{birth weight (kg)}}{\text{Age at recording (in days)}} \times 56 + \text{birth weight (kg)}$$

The following linear models were best-fitted (highest R^2 value) for the following three different traits:

1) $B_{ijklmn} = \mu + G_i + S_j + T_k + D_l + Y_m + e_{ijklmn}$ ($R^2 = 0.621$)

Where,

B_{ijklmn} is the individual lamb birth weight record μ is the overall mean

G_i is the effect of ith dam generation, i = 1, 2···6

S_j is the effect of jth sex of lamb, j = 1, 2

T_k is the effect of kth birth type, k = 1, 2, 3

D_l is the effect of lth dam age, l = 1, 2···4

Y_m is the effect of mth year, m = 1, 2···6

e_{ijklmn} is the random error.

2) $W8_{ijklmno} = \mu + G_i + S_j + Y_k + T_l + R_m + B_n + e_{ijklmno}$ ($R^2 = 0.644$)

Where,

$W8_{ijklmno}$ is the individual age adjusted 8 week body weight μ is the overall mean

G_i is the effect of ith dam generation, i = 1, 2···6

S_j is the effect of jth sex of lamb, j = 1, 2, 3

Y_k is the effect of kth year, k = 1, 2···6

T_l is the effect of lth birth type, l = 1, 2, 3

R_m is the effect of mth dam age, m = 1, 2 ···4

B_n is the effect of nth birth weight

$e_{ijklmno}$ is the random error.

3) $E_{ijklmn} = \mu + G_i + A_j + D_k + Y_l + B_m + e_{ijklmn}$ ($R^2 = 0.845$)

Where,

E_{ijklmn} is the individual ewe body weight μ is the overall mean

G_i is the effect of ith generation, i = 1, 2···6

A_j is the effect of jth age of ewe, j = 1, 2 ···4

D_k is the effect of kth dam age, k = 1, 2···6

Y_l is the effect of lth year, l = 1,2···6

B_m is the effect of mth birth weight

e_{ijklmn} is the random error.

Results and Discussion

Lamb Birth Weight

Least-squares means and standard errors for lamb birth weight are shown in table 1. Sex of lamb, birth type and dam age had significant effect on lamb birth weight ($p < 0.001$). Males were heavier than females ($p < 0.001$) and singles were significantly heavier than multiples at birth ($p < 0.05$). Birth weight of lamb increased with the progress of dams' age. It could be due to development of mothers' uterine system with their age. This could be further explained as the result of systematic environmental changes in ewes with time (Falconer, 1989). Dam generation and year had no effect ($p > 0.05$) on lamb birth weight. The insignificance of dam generation could be

TABLE 1. LEAST-SQUARE EFFECTS OF DAM GENERATION, SEX, BIRTH TYPE, DAM AGE AND YEAR FOR LAMB BIRTH WEIGHT (kg)

Classification	No. of observations	Least-squares Mean	Least-squares S.E.
Overall	245	5.056	0.237
Dam generation			
1	26	4.243	0.237
2	75	5.003	0.132
3	57	5.149	0.202
4	55	5.278	0.338
5	19	5.240	0.490
6	13	5.420	0.649
Sex			
Male	131	5.234^{a}	0.235
Female	114	4.877^{b}	0.247
Birth type			
Single	66	6.205^{a}	0.238
Twin	163	5.173^{b}	0.233
Triplet	16	3.789^{c}	0.314
Dam age			
2	85	4.332^{a}	0.127
3	68	5.130^{b}	0.167
4	55	5.231^{bc}	0.291
over 4	37	5.529^{c}	0.529
Year			
1983	9	5.366	0.609
1984	25	5.218	0.480
1985	36	5.091	0.337
1986	64	5.084	0.202
1987	56	4.823	0.144
1988	54	4.751	0.173

Means not followed by the same letter in each column differ significantly ($p < 0.05$).

due to random selection of replacement generations in the flock. These results are in agreement with Bhuiyan (1989) and Ch'ang and Rae (1961) respectively in the U. K. and New Zealand Romney Marsh sheep.

Lamb 8 week weight

Least-squares means and standard errors for 8 week body weight are shown in table 2. Sex, year, birth type, dam age and birth weight contributed significant variation ($p < 0.05$). Males were heavier than females and castrated males were lighter than uncastrated ones ($p < 0.05$).

TABLE 2. LEAST SQUARE EFFECTS OF DAM GENERATION, SEX, YEAR, BIRTH TYPE AND DAM AGE FOR LAMB AGE ADJUSTED 8 WEEK WEIGHT (kg)

Classification	No. of observations	Least-squares Mean	Least-squares S.E.
Overall	228	20.842	0.993
Dam generation			
1	24	22.342	1.174
2	69	21.038	0.552
3	54	21.113	0.851
4	50	20.394	1.405
5	18	20.510	2.034
6	13	19.653	2.649
Sex			
Male	99	21.530^{a}	0.969
Female	109	20.094^{b}	1.018
Castrated male	20	20.901^{b}	1.212
Year			
1983	8	17.485	2.541
1984	23	22.749	2.013
1985	33	20.728	1.380
1986	57	22.490	0.875
1987	55	20.199	0.624
1988	52	21.401	0.709
Birth type			
Single	63	23.112^{a}	1.041
Twin	150	21.018^{b}	0.991
Triplet	15	18.395^{c}	1.349
Dam age			
2	79	20.315^{a}	0.573
3	62	21.466^{b}	0.721
4	51	21.603^{b}	1.225
Over 4	36	19.983^{a}	2.185
Birth weight	$b = 1.285 + 0.280$ ($p < 0.001$)		

Means not followed by the same letter in each column differ significantly ($p < 0.05$).

Year to year fluctuations of lamb 8 week weight were noticed but these were statistically not significant ($p > 0.05$). Single born lambs were always heavier than twin and triplet at 8 week of age. Similar marked effect of type of birth and live weights measured at different times from weaning to the breeding stage was observed in Romney sheep (Ch'ang and Rae, 1970). Age of lambs' mother had significant ($p < 0.05$) effect on 8 week body weight of progenies. It progressively increased from 2 to 4 years of their mothers' age but decreased in later ages. It indicated that difference in early perinatal growth (until 8 week of age) should be caused to a considerable extent by maternal factors such as the availability of milk, the number of individuals suckling and their vitality and aggressiveness (Elliot et al., 1979). It also indicated that maternal effect is important in ewes aging 2-4 years. Regression of birth weight on 8 week weight was significant ($p < 0.001$). With 1 kg increase in birth weight there was an increase of 1.285 kg 8 week body weight. Similar results also arose from those of Elliot et al. (1979) for lamb in Parendale sheep.

TABLE 3. LEAST-SQUARE EFFECTS OF GENERATION, AGE, DAM AGE AND YEAR FOR EWE BODY WEIGHT (kg)

Classification	No. of observations	Least-squares Mean	S.E.
Overall	242	80.475	3.859
Generation			
1	58	74.867	2.355
2	53	76.628	1.231
3	50	75.585	2.745
4	36	84.852	5.240
5	30	87.387	7.525
6	15	83.928	10.066
Age			
2	84	61.671[a]	0.845
3	69	77.322[b]	2.634
4	44	88.577[c]	4.960
over 4	45	94.329[d]	8.121
Dam age			
2	53	81.228	3.976
3	43	81.294	3.974
4	44	78.957	4.014
5	33	78.505	4.118
6	41	79.802	4.037
7	28	83.057	4.144
Year			
1984	14	87.771[a]	10.036
1985	28	86.859[a]	7.516
1986	39	80.900[b]	5.201
1987	45	81.702[b]	2.747
1988	57	75.430[c]	1.128
1989	59	70.186[d]	2.346
Birth weight	$b = 2.912 + 0.614$ ($p < 0.001$)		

Means not followed by the same letter within each column differ significantly ($p < 0.05$).

Ewe body weight

Least-squares means and standard errors for ewe body weight before tupping are shown in table 3. Age of ewe, year and their birth weight were found to have significant effect on ewes' pre-tupping body weight. From 2 to 4 years of ewes' age an increase in body weight was noticed. Two year old ewes were significantly lighter than ewes of 3 and over 4 years of age. Similar results were observed among ewes of other ages. It could be attributed to systematic environmental changes with time (Falconer, 1989). Dams' age had no effect on ewes' pre-tupping body weight ($p > 0.05$). Year to year contributed significant variation in ewe body weight ($p < 0.05$). Year to year differences in ewe body weight before tupping probably attributed to variation in climatic conditions and natural vegetation rather than indoor feeding, since indoor feeding conditions were almost similar throughout the year studied. Birth weight of ewe has shown to have significant effect on pre-tupping ewe body weight ($p < 0.05$).

Similar effect of age of ewe, year of performance and their birth weight was observed in New Zealand Romney sheep (Ch'ang and Rae, 1970; Hight and Jury, 1971 and Baker et al., 1974).

Literature Cited

Bhuiyan, A. K. F. H. 1989. Estimation of direct and correlated responses in sheep selected for prolificacy in a group breeding scheme. Ph. D. Thesis, University of London. pp. 224.

Baker, R. L., J. N. Clarke and A. H. Carter. 1974 Sources of variation for wool, body weight and oestrous characters in Romney hoggets. Proc. N. Z. Soc. Anim. Prodn. 34:19-22.

Ch'ang, T. S. and A. L. Rae. 1961. Sources of variation in the weaning weight of Romney Marsh lambs. N. Z. J. Agril Res. 4:578-582.

Ch'ang, T. S. and A. L. Rae. 1970. The genetic basis of growth, reproduction and maternal environment in Romney ewes. 1. Genetic variation in hogget characters and fertility of the ewe. Austr. J. Agril. Res. 21:115-129.

Elliot, Z. H., A. L. Rae and G. A. Wickham. 1979. Analysis of records of a Parendale flock. II. Genetic and phenotypic parameters for immature body weights and yearling fleece characteristics. N. Z. J. Agril. Res. 22:267-272.

Falconer, D. S. 1989. Introduction to Quantitative Genetics. Third edition. Longman, London. pp. 438.

Harvey, W. R. 1988. User's guide for LSMLMW, mixed model least-squares and maximum likelihood computer program-PC-1 Version, Mimeograph, Ohio State University, Ohio, USA.

Hight, G. H. and K. E. Jury. 1971. Hill country sheep production III. Sources of variation in Romney and Border Leicester × Romney lambs and hoggets. N. Z. J. Agril. Res. 14:669-686.

Lasslo, L. L., G. E. Bradford, D. T. Torrell and B. W. Kennedy. 1985. Selection for weaning weight in Targhee sheep. Direct responses. J. Anim. Sci. 61(2):376-386.