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Lamb Rearing Performance in
Highly Fecund Sheep

Julie Marie Everett-Hincks

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This thesis is presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Massey University, Palmerston North, New Zealand.

The Massey University Animal Ethics Committee has approved the studies involving animal manipulations.

I have prepared this thesis and it is a record of my own work.

I took the photos of the sheep, unless otherwise specified.
Abstract

This thesis investigates ewe and lamb behaviour, genetics and environmental effects to determine whether lamb rearing performance can be improved in highly fecund sheep. The studies were carried out under commercial pastoral farming conditions. High performing sheep farmers were surveyed to identify management and performance practices that differentiate farms with high and low lamb rearing success. Farmers agreed that mothering ability was the most important factor affecting lamb survival and considered lamb survival to be the most important trait affecting farm profit. The survey identified the Coopworth breed as the predominant breed of high lambing percentage flocks.

Heritability estimates were derived for lamb survival ($h^2 = 0.16$), ewe maternal behaviour score ($h^2 = 0.05$) and litter survival ($h^2 = 0.00$) in a Coopworth flock that had been selected for improved maternal ability for nearly 30 years. Maternal genetic variation in the Coopworth flock was low for lamb and maternal traits and suggests that farmers must consider the environment and management techniques to improve lamb survival. A greater proportion of the variation in triplet survival was attributed to environmental effects than it was for twins, therefore triplets require more care.

Management and environmental factors investigated in this study affected ewe and lamb attachment behaviours in larger litters. A relationship was found between pregnant ewe physiology and maternal behaviour. Ewes that maintain body condition in late pregnancy and have lower plasma $\beta$-hydroxybutyrate levels were more receptive to the demands of their litter as these ewes had higher MBS. The effect of maternal nutrition in late pregnancy and at lambing was explored further. Feeding levels did not affect the majority of maternal behaviours investigated. However triplet lamb behaviour was affected by maternal nutrition in late pregnancy and lambs born to poorly fed ewes were less likely to stand, locate their dam's udder and follow their moving dam after separation at tagging. Triplet lamb survival was similar to twin lamb survival when pasture allowance was not restricted in late pregnancy.

Ewe behaviour was affected by breed, selection line and litter size. Ewes that high bleated less and showed less flocking behaviour, in the arena test and at tagging had
greater lamb rearing performance at weaning. Ewes that were quick to contact their lambs after separation at tagging weaned greater lamb weights (weight weaned increased 10kg per ewe from MBS3 to MBS4). Lamb behaviour was not affected by breed and was not explained by birthweight. Lambs that stood and sucked from their dam within ten minutes from tagging had an improved chance of survival to weaning (survival increased 5-fold and 3-fold respectively). Lamb behaviour has a significant role in ewe-lamb attachment in large litters. In particular lamb bleating represents need and attracts the dam when separated. The lamb bleats more if its dam has a lower MBS and it will bleat more if it stands quickly. The dam will high bleat when she has lower MBS and cannot locate her lamb or litter.

Lamb rearing success for ewes with larger litters is determined by lamb behaviour and the lamb’s interaction with its dam. Triplet lambs can achieve survival rates similar to twins, providing the maternal environment and lamb genetics support appropriate ewe-lamb attachment behaviours.
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# Table of Contents

Abstract i

Acknowledgements iii

Introduction 1

CHAPTER 1 5

Literature Review 5

1.1 Introduction 6
1.2 Background 6
1.3 Behaviour 7
1.4 Selection 13
1.5 Environment and Management 15

CHAPTER 2 19

Lamb rearing success on high performing sheep farms 19

2.1 Summary 20
2.2 Introduction 20
2.3 Materials and Methods 21
2.4 Results 22
2.5 Discussion 26
2.6 Conclusions 28

CHAPTER 3 29

The effect of ewe maternal behaviour score on lamb and litter survival 29

3.1 Summary 30
3.2 Introduction 31
3.3 Materials and Methods 32
   3.3.1 Background 32
   3.3.2 Animals and Measurements 32
3.3.3 Statistical Analyses

3.4 Results

3.4.1 Environmental Effects on MBS and LIS
3.4.2 Environmental Effects on Lamb Survival
3.4.3 Genetic Parameters for MBS and LIS
3.4.4 Genetic Parameters for Lamb Survival

3.5 Discussion

3.6 Conclusions

CHAPTER 4

The effect of pregnant ewe physiology on maternal behaviour score and lamb production

4.1 Summary

4.2 Introduction

4.3 Materials and Methods

4.3.1 Background
4.3.2 Animals and Measurements
4.3.3 Statistical Analyses

4.4 Results

4.4.1 Physiological Status of the Pregnant Ewe
4.4.2 Physiological Effects on Dam MBS
4.4.3 Dam Production

4.5 Discussion

4.6 Implications

CHAPTER 5

Lambing Performance of Finns and Texels

5.0 Preamble
5.1 Summary
5.2 Introduction

5.3 Materials and Methods

5.3.1 Animals and Measurements
5.3.2 Animal Environment
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHAPTER 7</strong></td>
<td></td>
</tr>
<tr>
<td>7.3 Materials and Methods</td>
<td>111</td>
</tr>
<tr>
<td>7.3.1 Animals</td>
<td>111</td>
</tr>
<tr>
<td>7.3.2 Tagging</td>
<td>111</td>
</tr>
<tr>
<td>7.3.3 Behaviour</td>
<td>112</td>
</tr>
<tr>
<td>7.3.4 Lamb Performance</td>
<td>113</td>
</tr>
<tr>
<td>7.3.5 Statistical Analyses</td>
<td>113</td>
</tr>
<tr>
<td>7.4 Results</td>
<td>116</td>
</tr>
<tr>
<td>7.4.1 Tagging Behaviour</td>
<td>116</td>
</tr>
<tr>
<td>7.4.2 Post Tagging Behaviour and Lamb Performance</td>
<td>120</td>
</tr>
<tr>
<td>7.4.3 Post Tagging Behaviour and Lamb Survival</td>
<td>121</td>
</tr>
<tr>
<td>7.5 Discussion</td>
<td>123</td>
</tr>
<tr>
<td>7.5.1 Relationship between post-parturient and tagging behaviours</td>
<td>125</td>
</tr>
<tr>
<td>7.6 Conclusion</td>
<td>127</td>
</tr>
<tr>
<td><strong>CHAPTER 8</strong></td>
<td>129</td>
</tr>
<tr>
<td>An investigation of the relationship between ewe arena behaviour and lamb rearing performance</td>
<td>129</td>
</tr>
<tr>
<td>8.1 Summary</td>
<td>130</td>
</tr>
<tr>
<td>8.2 Introduction</td>
<td>131</td>
</tr>
<tr>
<td>8.3 Materials and Methods</td>
<td>133</td>
</tr>
<tr>
<td>8.3.1 Animals and Measurements</td>
<td>133</td>
</tr>
<tr>
<td>8.3.2 Behaviour Tests</td>
<td>134</td>
</tr>
<tr>
<td>8.3.3 Statistical Analyses</td>
<td>136</td>
</tr>
<tr>
<td>8.4 Results</td>
<td>137</td>
</tr>
<tr>
<td>8.4.1 Arena Test Behaviour</td>
<td>137</td>
</tr>
<tr>
<td>8.4.2 Maternal Behaviour</td>
<td>140</td>
</tr>
<tr>
<td>8.4.3 Lamb Rearing Performance</td>
<td>142</td>
</tr>
<tr>
<td>8.5 Discussion</td>
<td>144</td>
</tr>
<tr>
<td>8.6 Conclusion</td>
<td>148</td>
</tr>
<tr>
<td>8.7 Appendix</td>
<td>149</td>
</tr>
</tbody>
</table>
CHAPTER 9

The effect of pasture allowance during pregnancy on maternal behaviour and lamb rearing performance in highly fecund ewes

9.1 Summary
9.2 Introduction
9.3 Materials and Methods
  9.3.1 Animals and Measurements
  9.3.2 Arena Test Behaviour
  9.3.3 Maternal Behaviour
  9.3.4 Lamb Behaviour
  9.3.5 Statistical Analyses
9.4 Results
  9.4.1 Arena Test Behaviour
  9.4.2 Maternal Behaviour
  9.4.3 Dam Performance
  9.4.4 Lamb Behaviour
  9.4.5 Lamb Performance
9.5 Discussion
9.6 Implications for Industry

CHAPTER 10

General Discussion

References
List of Tables

Table 2.1 Summary description of farms surveyed .................................................. 23
Table 2.2 The importance of factors affecting lamb survival according to respondents
from High and Low farm groups. ................................................................. 24
Table 3.1 The maternal behaviour scores at tagging and the number of animals used in
this study. .................................................................................................... 32
Table 3.2 The effect of age of dam on maternal behaviour score and litter survival (least
squares mean ± standard error). ................................................................. 35
Table 3.3 The effect of litter size at birth on maternal behaviour score and litter survival
(least squares mean ± standard error). ........................................................ 35
Table 3.4 The effect of age of dam, sex of lamb and birth year of lamb on lamb survival
from birth to weaning (least squares mean ± standard error) ......................... 37
Table 3.5 Estimated variance components for maternal behaviour score (MBS) and litter
survival (LIS) (standard error included). ..................................................... 38
Table 3.6 Estimated variance components for lamb survival from birth to weaning
(standard error included). ................................................................. 39
Table 4.1 The maternal behaviour scores at tagging and the number of dams with
recorded MBS in this study ........................................................................ 52
Table 4.2 Pregnancy measurements by breed group (Coopworth and EF-Coop ewes)
(least squares mean ± standard error). ........................................................ 54
Table 4.3 The effect of MBS on Coopworth and EF-Coop ewes with twin and triplet
litters (least squares mean ± standard error). ............................................ 55
Table 4.4 The effect of ewe breed and litter size on litter survival (least squares mean ±
standard error). ........................................................................ 56
Table 4.5 The effect of maternal behaviour score on dam litter survival from tagging to
weaning (least squares mean ± standard error) ......................................... 56
Table 4.6 The effect of maternal behaviour score on weight of lamb weaned (kg) (least
squares mean ± standard error). ............................................................... 57
Table 5.1 The effect of ewe breed on pre-lambing performance (least squares mean ±
standard error). .................................................................................. 70
Table 5.2 The effect of ewe breed on lamb rearing performance (least squares mean ±
standard error). .................................................................................. 71
Table 5.3 The effect of lamb breed on performance to weaning (least squares mean ±
standard error). .................................................................................. 72
Table 6.1 Number of animals included in analyses................................................. 80
Table 6.2 Definitions of ewe and lamb behaviours recorded after birth.................. 82
Table 6.3 Description of the maternal behaviour score used in this study after parturition......................................................................................................................... 82
Table 6.4 Lambing day according to litter size, time between the birth of first and second born lambs for twinning ewes and observation period for Finn and Texel ewes included in this study (least squares mean ± standard error).................... 85
Table 6.5 The effect of breed on ewe and lamb behaviour after birth (Wilcoxon mean ± standard error)........................................................................................................... 87
Table 6.6 Lamb and ewe bleating behaviour after birth (least squares mean ± standard error)......................................................................................................................... 90
Table 6.7 The effect of ewe breed and litter size on maternal behaviour score after birth (least squares mean ± standard error).............................................................. 90
Table 6.8 The effect of behaviour after parturition on twin lamb survival to weaning (Wilcoxon mean ± standard error). ...................................................................................... 91
Table 6.9 The effect of ewe grooming time on lamb survival to weaning (least squares mean ± standard error)........................................................................................................... 93
Table 6.10 The effect of lamb bleating frequency on lamb survival to weaning (least squares mean ± standard error). ...................................................................................... 93
Table 6.11 The effect of ewe MBS on lamb survival to weaning (least squares mean ± standard error). ..................................................................................................................... 93
Table 6.7.1 Ewe behaviour following parturition (least squares mean ± standard error). ................................................................................................................................. 99
Table 6.8.1 Performance of Finn and Texel lambs observed after birth (least squares mean ± standard error). ...................................................................................... 100
Table 6.8.2 The effect of behaviour after parturition on single lamb survival to weaning (Wilcoxon mean ± standard error). .............................................................. 101
Table 6.9.1 Ewe liveweight and liveweight change from mating through to lambing (least squares mean ± standard error). ...................................................................................... 102
Table 6.9.2 Performance of lambs born naturally and to assisted ewes (least squares mean ± standard error). ...................................................................................... 103
Table 6.9.3 Proportion of ewes and lambs that did the following behaviour within 30 minutes from birth.............................................................................................. 103
Table 6.9.4 Time taken for the ewe to make lamb contact, the lamb to stand, locate and suck from its ewe’s udder (least squares mean ± standard error) ................................................... 103
Table 6.9.5 Ewe and lamb bleating frequency (least squares mean ± standard error) ................................................... 104
Table 6.9.6 Ewe behaviour after parturition (least squares mean ± standard error) ................................................... 105
Table 7.1 Number of animals included in analyses ........................................................................................................... 111
Table 7.2 Tagging dates and times according to breed (least squares mean ± standard error) .................................................................................................................. 112
Table 7.3 Description of the maternal behaviour scoring system at tagging ......................................................... 113
Table 7.4 Definitions of ewe and lamb behaviours recorded after tagging .......................................................... 113
Table 7.5 The effect of breed on ewe MBS after tagging (least squares mean ± standard error) .................................................... 116
Table 7.6 The effect of breed on ewe and lamb behaviour after birth (Wilcoxon mean ± standard error) .................................................................................................................. 116
Table 7.7 The effect of breed and litter size on ewe and lamb bleating behaviour after tagging (least squares mean ± standard error) .................................................................................. 119
Table 7.8 Regression coefficient estimates, odds ratios and 95% confidence intervals for the odds ratios and probability levels from logistic regression analysis of all lambs and their chance of survival to weaning .......................................................................................................................................................... 122
Table 7.9 Phenotypic correlations between post-parturient and post-tagging behaviours observed in this study (phenotypic correlation ± standard error) ......................................................... 125
Table 8.1 The maternal behaviour scores at tagging and the number of animals used in this study (proportion of animals in dam selection line with MBS). .......................................................................................... 134
Table 8.2 The effect of dam selection line on movement within the arena (least squares mean ± standard error). Means within dam selection line having different superscripts are different (P<0.05) ........................................................................ 138
Table 8.3 The effect of dam selection line on social behaviour within the arena (least squares mean ± standard error). Means within dam selection line having different superscripts are different (P<0.05) ........................................................................ 140
Table 8.4 The effect of dam selection line on lamb rearing performance (least squares mean ± standard error). Means within dam selection line having different superscripts are different (P<0.05) ........................................................................ 143
Table 8.5 The effect of litter size at birth and whether a ewe does or does not enter Zone 2 in the arena behaviour test, on litter survival at tagging (least squares mean ± standard error) .................................................................................................................. 143
Table 8.7. Correlation coefficients between measures of arena and maternal behaviour and lamb production traits for dam selection lines. .............................................. 149
Table 9.1 Number of ewes included in statistical analysis according to post-grazing pasture sward height, block and litter size at birth. ..................................................... 155
Table 9.2 Description of the maternal behaviour score (MBS) used in this study. .... 159
Table 9.3 The effect of pasture allowance and foetal number on movement within the arena (least squares mean ± standard error). Means within pasture sward height and within litter size having different letter superscripts are different (P<0.10) .......................................................... 164
Table 9.4 The effect of pasture allowance and foetal number on social behaviour within the arena (least squares mean ± standard error). Means across pasture sward heights and across litter size having different letter superscripts are different (P<0.10) ......................................................................................... 165
Table 9.5 The effect of pasture allowance and litter size on MBS and ewe tagging behaviour (least squares mean ± standard error). Means across pasture sward height and across litter size having different letter superscripts are different (P<0.10) ........................................................................................................ 167
Table 9.6 The effect of pasture allowance and litter size at birth on ewe liveweight and growth (least squares mean ± standard error). Means within pasture sward height and within litter size having different letter superscripts are different (P<0.10) ............................................................ 168
Table 9.7 The effect of pasture allowance and litter size on ewe lamb rearing performance (least squares mean ± standard error). Means across pasture sward height and across litter size having different letter superscripts are different (P<0.10) ........................................................................................................ 170
Table 9.8 Correlations between ewe behaviour and performance traits across all sheep regardless of litter size at birth. ........................................................................... 171
Table 9.9 The effect of pasture allowance and litter size on lamb behaviour in the five-minute observation period immediately following tagging (weighted least squares mean ± standard error). Proportions across pasture sward height having different letter superscripts are different (P<0.10) .............................................................................. 172
Table 9.10 The effect of pasture allowance (sward height) on lamb behaviour times after tagging for twins and triplets (Wilcoxon mean ± standard error). Times are presented as minutes. ....................................................................................... 178
Table 9.11 The effect of pasture allowance and litter size on individual lamb performance (least squares mean ± standard error). Means across pasture sward height having different letter superscripts are different (P<0.10)..........................179

Table 9.12 Correlations between lamb behaviour and performance traits across all litter sizes at birth. ...........................................................................................................................................180
List of Figures

Figure 1 Some factors influencing lamb survival and ewe lamb rearing ability. ............ 3
Figure 2.1 Major sheep breeds on respondents farms.................................................. 23
Figure 2.2 Percentage of post parturient lamb losses by litter size and High, Low farm
(standard error included). ............................................................................................. 24
Figure 2.3 Mean feeding levels for different ewe groups at different stages of pregnancy
for all the farms surveyed (Feeding level: 1=below maintenance; 2=maintenance
and 3=above maintenance). .......................................................................................... 25
Figure 2.4 Mean shepherding frequency for sheep raising singles, twins and triplets on
High and Low farms (standard error included). ............................................................ 26
Figure 3.1 The effect of maternal behaviour score (MBS) on litter survival (LIS) (least
square means and standard errors). ............................................................................. 36
Figure 3.2 The effect of maternal behaviour score (MBS) on lamb survival from birth to
weaning (least squares mean ± standard error). ......................................................... 37
Figure 3.3 The genetic pathways for maternal behaviour score (MBS), litter survival
(LIS) and lamb survival to weaning (LAS). ................................................................. 40
Figure 5.1 Post mortem results for Finn and Texel lambs ............................................. 72
Figure 6.1 The effect of breed of ewe on the time between twin lamb births. ............... 86
Figure 6.2 The effect of breed on the proportion of single and twin lambs to have ewe
contact within ten minutes from birth. ........................................................................ 87
Figure 6.3 The effect of breed on the proportion of single and twin lambs to stand
within thirty minutes from birth .................................................................................. 88
Figure 6.4 The effect of breed on the proportion of single and twin lambs to locate their
ewe’s udder thirty minutes after birth. ....................................................................... 88
Figure 6.5 The effect of breed on the proportion of single and twin lambs to suck from
their ewe’s udder thirty minutes after birth ............................................................... 88
Figure 6.6 The effect of ewe breed on time spent grooming twin lambs. ....................... 89
Figure 6.7 The effect of ewe-lamb contact time on twin lamb survival to weaning ....... 92
Figure 6.8 The effect of twin lamb stand time on lamb survival to weaning ................. 92
Figure 6.9. The effect of time to locate ewe’s udder on twin lamb survival to weaning.
....................................................................................................................................... 92
Figure 7.1 The effect of breed on the proportion of single and twin lambs to have ewe
contact after tagging .................................................................................................... 118
Figure 7.2 The effect of breed on the proportion of single and twin lambs to stand .... 118
Figure 7.3 The effect of breed on the proportion of single and twin lambs to suck ..... 118
Figure 7.4 The effect of breed on the proportion of single and twin lambs to follow their moving dam within ten minutes after tagging. ............................................................... 119
Figure 7.5. The effect of MBS within litter size on weight of lamb weaned per ewe
(least squares mean ± standard error). ........................................................................ 121
Figure 7.6. Behaviour conflicts for the dam when her litter is being ear-tagged (where
D= Dam, L1 and L2 = Dam’s Litter, L= Flock Lamb, E= Flock Ewe). ....................... 123
Figure 8.1. Arena configuration for arena behaviour test ........................................... 135
Figure 8.2. The effect of litter size at birth and dam selection line on maximum distance from the person (standard errors included). ........................................................................ 139
Figure 8.3 Proportion of time spent High IGF, Control and Low IGF ewes in arena zone. .................................................................................................................................. 141
Figure 8.4 Proportion of High IGF, Control and Low IGF ewes with MBS ................ 141
Figure 9.1 Pasture sward height treatments and brief trial plan ................................. 156
Figure 9.2 Arena configuration for arena behaviour test ............................................. 158
Figure 9.3 The effect of pasture allowance on MBS (least squares mean ± standard error) ............................................................................................................................................. 166
Figure 9.4 The effect of pasture allowance on proportion of ewes that stayed at the
tagging site after tagging (least squares mean ± standard error) ............................... 166
Figure 9.5 The effect of litter size at birth and pasture allowance late pregnancy on ewe litter survival from birth to tagging (least squares mean ± standard error) .......... 169
Figure 9.6 The effect of pasture allowance on proportion of lambs to bleat before ewe contact after tagging (standard errors included) ............................................................ 172
Figure 9.7 The effect of pasture allowance on proportion of ewes to make lamb contact after tagging (standard errors included) ................................................................. 173
Figure 9.8 The effect of pasture allowance on proportion of lambs to stand in the five-minute observation period immediately after tagging (standard errors included). 174
Figure 9.9 The effect of pasture allowance on the proportion of lambs to locate their dam’s udder in the five-minute observation period immediately after tagging (standard errors included) ................................................................................... 174
Figure 9.10 The effect of pasture allowance on the proportion of lambs to follow their moving dam after tagging (standard errors included) .................................................... 175
Figure 9.7a and 9.7b. The effect of pasture allowance on the proportion of lambs to have ewe contact within five minutes from tagging. Graphs of estimated ‘behaviour’ functions for twin lambs (Figure 9.7a) and for triplets (Figure 9.7b) ......... 176
Figure 9.8a and 9.8b. The effect of pasture allowance on the proportion of lambs to stand within five minutes from tagging. Graphs of estimated 'behaviour' functions for twins (Figure 9.8a) and for triplets (Figure 9.8b). .............................................................. 177

Figure 9.9a and 9.9b. The effect of pasture allowance on the proportion of lambs to locate their dam’s udder within five minutes from tagging. Graphs of estimated ‘behaviour’ functions for twin lambs (Figure 9.9a) and for triplets (Figure 9.9b).
........................................................................................................................................ 177

Figure 9.10a and 9.10b. The effect of pasture allowance on the proportion of lambs to follow their moving dam within five minutes from tagging. Graphs of estimated ‘behaviour’ functions for twin lambs (Figure 9.10a) and for triplets (Figure 9.10b).
........................................................................................................................................ 177

Figure 9.11a and 9.11b. The effect of pasture allowance on the proportion of lambs to suckle within five minutes from tagging. Graphs of estimated behaviour functions for twin lambs (Figure 9.11a) and for triplets (Figure 9.11b). .............................................................. 177

Figure 9.12 The effect of pasture allowance and litter size at birth on lamb survival at tagging (standard errors included). ................................................................. 179

Figure 9.13 Behaviour conflicts for the dam when her litter is being ear-tagged (where D= Dam, L1, L2 and L3 =Dam’s Litter, L= Flock Lamb, E=Flock Ewe). ......... 183