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The effect of mid-pregnancy shearing on lamb birthweight and survival to weaning

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requirements of the degree of Doctor of
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Abstract

Mid-pregnancy shearing has been promoted in New Zealand as a technique to improve both lamb birthweights and survival. In the literature mid-pregnancy shearing has resulted in an increase lamb birthweight. However, the results have been inconsistent in magnitude and birthrank specificity. Additionally the mechanism responsible for the birthweight response has not been identified. The objectives of this study were to: ascertain the causes of the variation in the birthweight response to mid-pregnancy shearing, identify a possible metabolic mechanism for the birthweight response and lastly, to examine the effect of mid-pregnancy shearing on the newborn lamb's thermoregulatory capability and survival rate to weaning.

The first study was designed to determine whether dam nutrition during the mid- to late- pregnancy period influenced the birthweight response to mid-pregnancy shearing. Mid-pregnancy shearing was found to significantly ($P < 0.05$) increase lamb birthweight without differently affecting the birthweights single- or twin-born lambs. Dam feeding level post-shearing had no effect on the birthweight response. The newborn lamb's thermoregulatory capability was not affected by dam shearing treatment. When the results of this study were compiled with those of previous pregnancy shearing studies it was concluded that the birthweight response is greatest under conditions in which the unshorn ewe gives birth to a lamb(s) of low birthweight.

The second study was designed to examine the birthweight response to mid-pregnancy shearing under two differing maternal treatments (one designed to restrict foetal growth (low group), the other designed not to limit foetal growth (maintenance group)) allowing the conclusion made in Chapter 2 to be tested. Mid-pregnancy shearing was found to increase the birthweights of singletons ($P < 0.05$) but not twins, and of lambs born to maintenance ($P < 0.05$) but not low group ewes. Additionally, mid-pregnancy shearing had no effect on the thermoregulatory capacity of twin-born lambs. When the results of this study were considered with previous studies it became apparent that there are two criteria (not one) that must be met to achieve a birthweight response to mid-pregnancy shearing. First, the dam must have the potential to respond (i.e. give birth to an otherwise lightweight lamb(s)) and, second, she must have the means to respond (i.e. an adequate level of maternal reserves and/or level of nutrition to partition towards additional foetal growth).

The large-scale study was designed to investigate the effect of a mid-pregnancy shearing on lamb birthweights and survival rates to weaning under commercial conditions on two different farms. Mid-pregnancy shearing was found to significantly increase ($P < 0.05$) the birthweights of twin-born lambs at each site and this tended to increase survival rates. However, at Tuapaka singletons born to shorn dams had significantly ($P < 0.05$) lower survival rates than their counterparts born to unshorn dams. These findings indicate that under commercial conditions mid-pregnancy has the potential to increase the birthweight of at least twin born lambs. However, for this increase in birthweight to have any effect on survival rates to weaning, birthweights must otherwise be destined to be low and within a birthweight range in which survival rates to weaning are not optimal.

The final study examined a possible metabolic mechanism for the birthweight response to mid-pregnancy shearing. Twin bearing ewes were either; left unshorn or shorn during mid-pregnancy, and either had T3/T4 concentrations similar to that observed in the pregnant unshorn ewe or were subjected to elevated T3/T4 concentrations in the short to medium term post mid-pregnancy shearing (as previously reported in mid-pregnancy shorn ewes). Neither shearing nor T3/T4 treatment affected lamb birthweight or summit metabolism. Lamb birthweights in all groups were relatively high and as such a birthweight response to mid-pregnancy shearing was not expected. To successfully determine if elevated maternal thyroid hormones are the mechanism responsible for the birthweight effect, conditions must be present that would otherwise result in a birthweight response to mid-pregnancy shearing.

The present series of studies demonstrate that mid-pregnancy shearing is a technique that can be used commercially to increase lamb birthweights, but appears to have no effect on the newborn lamb's thermoregulatory capability. It is hypothesised that an elevation in maternal thyroid hormone concentration post-shearing is the mechanism responsible for the birthweight response but this requires further study. It has been shown that to achieve a birthweight response to mid-pregnancy shearing the ewe must meet two criteria, first; she must have the potential to respond (i.e. be destined to give birth to an otherwise lightweight lamb(s)) and second; she must have the means to respond (i.e. an adequate level of condition and/or nutrition). To increase lamb survival rates to weaning via an increase in birthweight alone, lambs must otherwise be destined to be born of a birthweight in which survival rates to weaning are below optimum.

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Contents

CHAPTER ONE - LITERATURE REVIEW **16**

Preamble	16
Pregnancy shearing of the housed ewe	19
<i>Body temperature and respiration rates</i>	19
<i>Ewe liveweight change and intake</i>	20
<i>Gestation length and birthweight</i>	21
<i>Brown Adipose Tissue (BAT) formation and heat production</i>	22
<i>Survival of lambs</i>	23
<i>Lamb growth rates</i>	23
<i>Factors affecting the birthweight response</i>	24
<i>Stage of gestation when shorn</i>	24
<i>Intake response to shearing</i>	25
<i>Effect of ewe allowance following pregnancy shearing</i>	25
<i>Conclusion</i>	26
Pregnancy shearing under pastoral conditions	26
<i>Ewe body temperature</i>	26
<i>Ewe body condition and liveweight</i>	27
<i>Lamb birthweights</i>	28
<i>Heat production of lambs</i>	30
<i>Lamb survival and growth</i>	30
<i>Factors affecting the productive responses</i>	31
<i>Stage of gestation when shorn under New Zealand conditions</i>	31
<i>Intake response to shearing</i>	32
<i>Effect of ewe herbage allowance following pregnancy shearing</i>	32
<i>Conclusion</i>	33
The effect of pregnancy shearing on wool quality and quantity	33
Metabolic responses to pregnancy shearing	35
<i>Blood metabolites</i>	35
<i>Glucose</i>	35
<i>Fatty acids</i>	36
<i>Hydroxybutyrate</i>	37
<i>Maternal hormones</i>	38
<i>Cortisol</i>	38
<i>Insulin</i>	38
<i>Thyroid hormones</i>	39
<i>Growth hormone</i>	41
<i>Summary of shearing effect on maternal hormones</i>	41
Purpose and scope of the investigation	42

CHAPTER TWO - THE EFFECT OF EWE NUTRITION DURING MID- AND LATE-PREGNANCY ON THE BIRTHWEIGHT RESPONSE FROM MID-PREGNANCY SHEARING **43**

Abstract	43
Introduction	44
Methods	45
<i>Experimental design and animals</i>	45

<i>Treatments</i>	46
<i>Pasture</i>	47
<i>Climatic data</i>	48
<i>Animal measurements</i>	48
<i>Ewes</i>	48
<i>Lambs</i>	50
<i>Data analysis</i>	52
Results	54
<i>Pasture conditions</i>	54
<i>Animal Measurements</i>	54
<i>Ewe liveweight</i>	54
<i>Ewe intake</i>	58
<i>Ewe condition score</i>	61
<i>Ewe fleece weight</i>	62
<i>Ewe rectal temperatures</i>	62
<i>Gestation length</i>	65
<i>Lamb liveweights</i>	65
<i>Lamb crown-rump length, girth and wool depth</i>	67
<i>Lamb rectal temperature</i>	68
<i>Calorimetry</i>	69
Discussion	71
Conclusion	75

CHAPTER THREE - MATERNAL CONSTRAINT AND THE BIRTHWEIGHT RESPONSE TO MID-PREGNANCY SHEARING

	77
Abstract	77
Introduction	78
Methods	79
<i>Experimental design and animals</i>	79
<i>Pasture</i>	80
<i>Animal measurements</i>	81
<i>Ewes</i>	81
<i>Lambs</i>	82
<i>Climatic Data</i>	83
<i>Data analysis</i>	83
Results	84
<i>Ewe liveweight and condition score</i>	84
<i>Ewe intake</i>	85
<i>Ewe rectal temperatures</i>	86
<i>Gestation length and lamb liveweights</i>	88
<i>Girth, crown rump length, dry and wet wool depth</i>	91
<i>Summit metabolism</i>	91
Discussion	93
Conclusion	97

CHAPTER FOUR - THE EFFECT OF MID-PREGNANCY SHEARING ON LAMB BIRTHWEIGHT AND SURVIVAL RATES TO WEANING UNDER COMMERCIAL CONDITIONS

99

Abstract	99
Introduction	101
Methods	102
<i>Riverside</i>	102
<i>Experimental design and animals</i>	102
<i>Treatments</i>	102
<i>Pasture</i>	103
<i>Animal measurements</i>	104
<i>Ewes</i>	104
<i>Lambs</i>	105
<i>Tuapaka</i>	105
<i>Experimental design and animals</i>	105
<i>Treatments</i>	105
<i>Animal measurements</i>	106
<i>Ewes</i>	106
<i>Lambs</i>	106
<i>Data Analysis</i>	107
Results	107
<i>Ewe liveweight</i>	107
<i>Riverside</i>	107
<i>Tuapaka</i>	108
<i>Ewe condition score</i>	111
<i>Riverside</i>	111
<i>Tuapaka</i>	111
<i>Annual ewe fleece weight</i>	114
<i>Riverside and Tuapaka</i>	114
<i>Lamb birthweights and liveweights</i>	114
<i>Riverside</i>	114
<i>Tuapaka</i>	115
<i>The relationship between ewe liveweight and condition score during mid-pregnancy and mid-pregnancy shearing treatment in twin-born lambs</i>	115
<i>Lamb survival</i>	119
<i>Cause of death at Tuapaka</i>	120
Discussion	122
Conclusion	127

CHAPTER FIVE - ARE ELEVATED MATERNAL THYROID HORMONE CONCENTRATIONS RESPONSIBLE FOR THE LAMB BIRTHWEIGHT EFFECT?

Abstract	129
Introduction	130
Methods	131
<i>Experimental design and animals</i>	131
<i>Treatments</i>	131
<i>Surgery and thyroxine implants</i>	132
<i>Thyroxine injections</i>	132
<i>Ewe management</i>	133
<i>Pasture conditions</i>	133
<i>Animal measurements</i>	134
<i>Ewes</i>	134

<i>Lambs</i>	134
<i>Data analysis</i>	135
Results	135
<i>Ewe liveweight and Condition Score</i>	135
<i>Dam blood T3/T4 concentrations</i>	137
<i>Gestation length and lamb size</i>	138
<i>Summit metabolism</i>	141
Discussion	142
Conclusion	145
CHAPTER SIX - GENERAL DISCUSSION	147
<hr/>	
Introduction	147
Achievement of ewe liveweight targets	148
Evaluation of measurement techniques	148
<i>Ewe intake</i>	148
<i>Ewe rectal temperatures</i>	149
<i>Condition scores</i>	151
<i>Measurement of newborn lamb thermoregulatory capability</i>	151
<i>Large scale commercial field studies</i>	152
<i>Maternal T3/ T4 manipulation</i>	153
<i>Statistical analysis</i>	154
The effect of mid-pregnancy shearing on lamb birthweight	154
Does a birthweight response always mean an increase in lamb survival rates to weaning?	156
The possible impact of using the mid-pregnancy shearing on New Zealand sheep farms	162
What is the financial effect?	163
Should New Zealand farmers routinely use mid-pregnancy shearing?	165
How should the mid-pregnancy shearing technique be managed on New Zealand sheep farms?	166
Areas requiring further study	167
Conclusion	168
REFERENCES	169
<hr/>	
APPENDIX	179
<hr/>	
Appendix 1: Artificial control of thyroid levels	179
<i>Introduction</i>	179
<i>Study 1 - Development of a technique to control maternal thyroid hormone concentrations at a level seen in the unshorn ewe</i>	180
<i>Aim</i>	180
<i>Method</i>	180
<i>Data analysis</i>	181
<i>Results</i>	181
<i>Discussion/Conclusion</i>	182

<i>Study 2 - Development of a technique to elevate thyroid hormone concentrations in the short to medium time period</i>	184
<i>Aim</i>	184
<i>Method</i>	184
<i>Data analysis</i>	184
<i>Results</i>	184
<i>Discussion/Conclusion</i>	185
Appendix 2: Autopsies of dead lambs at Tuapaka	187
<i>Introduction</i>	187
<i>Diagnosing cause of death</i>	187
<i>Autopsy sheet used at Tuapaka</i>	188

List of Tables

Table	Page
<i>Table 1.1. Summary of studies examining birthweight responses to pregnancy shearing under New Zealand conditions.</i>	29
<i>Table 2.1. The effect of pregnancy rank, shearing treatment and feeding regimen on ewe liveweights (kg) at P101, P139, L38 and L76 (Mean ±SE). Means within treatments having different superscripts are different (P<0.05).</i>	55
<i>Table 2.2. The effect of pregnancy rank, shearing treatment and ewe feeding regimen on ewe Digestible Organic Matter Intakes (DOMI) (kg DOMI ewe⁻¹ day⁻¹) (Mean ±SE). Means within treatments having different superscripts are different (P<0.05).</i>	60
<i>Table 2.3. The effect of pregnancy rank, shearing treatment and feeding regimen on ewe condition scores at P101 and P139 (Mean ±SE). Means within treatments having different superscripts are different (P<0.05).</i>	61
<i>Table 2.4. The effect of pregnancy rank, shearing treatment and feeding regimen on annual fleece weights (kg) for all ewes and the effect of pregnancy rank and feeding regime on second shear fleece weights (July – November) of pregnancy-shorn ewes (P70 – L56) (Mean ±SE). Means within treatments having different superscripts are different (P<0.05).</i>	62
<i>Table 2.5. The effect of pregnancy rank, shearing treatment and feeding regimen on ewe rectal temperatures (°C)(Mean ±SE) at different times from mid-pregnancy until parturition. The maximum and minimum air temperature (°C) for each day of measurement is shown. Means within treatments having different superscripts are different (P<0.05).</i>	64
<i>Table 2.6. The effect of pregnancy rank, dam shearing treatment and feeding regimen on gestation length (days) (Mean ±SE). Means within treatments having different superscripts are different (P<0.05).</i>	65
<i>Table 2.7. The effect of birth-rank, dam shearing treatment and feeding regimen on lamb liveweight (kg) at birth, L38 and L76 (Mean ±SE). Means within treatments having differing superscripts are different (P<0.05).</i>	66
<i>Table 2.8. The effect of birth-rank, dam shearing treatment and feeding regimen on crown-rump length (CRL) (mm), girth (mm), and dry and wet wool depth (mm) measurements of new-born lambs (Mean ±SE). Means within treatments having differing superscripts are different (P<0.05).</i>	67
<i>Table 2.9. The effect of birth-rank, dam shearing treatment and feeding regimen on average lamb rectal temperatures (°C) (Mean ±SE) at 1, 3, 6 and 9 hours after birth. Means within treatment having differing superscripts are different (P<0.05).</i>	68
<i>Table 2.10. The effect of birth-rank, dam shearing treatment and feeding regimen on the proportion (%) of lambs (<36hrs of age) that failed to reach summit metabolism. Means with different superscripts are different (P<0.05).</i>	69
<i>Table 2.11. The effect of birth-rank, dam shearing treatment and feeding regimen on the rate of increase in heat production (W/kg/min) and the effect of shearing treatment and dam feeding regimen on summit metabolic rate</i>	

	(W/kg) of twin-born lambs (Means \pm SE). Means within treatment having differing superscripts are different ($P<0.05$). _____	70
Table 3.1.	The effect of pregnancy rank, ewe group and shearing treatment on ewe liveweights (kg) at P69, P105, P140, L36 and L84 (Mean \pm SE). Means within treatments having different superscripts are different ($P<0.05$). _____	84
Table 3.2.	The effect of pregnancy rank, ewe group and shearing treatment on ewe condition score at P69, P105, P140, L36 and L84 (Mean \pm SE). Means within treatments having different superscripts are significantly different ($P<0.05$). _____	85
Table 3.3.	The effect of ewe group and shearing treatment on ewe digestible organic matter intakes (DOMI) of twin-bearing ewes in late pregnancy (kg DOMI ewe ⁻¹ day ⁻¹) (Mean \pm SE). Means within treatments having different superscripts are significantly different ($P<0.05$). _____	86
Table 3.4.	The effect of pregnancy rank, ewe group and shearing treatment on ewe rectal temperatures ($^{\circ}$ C) (Mean \pm SE) at P124, P130, P135 and P137. Maximum and minimum air temperatures ($^{\circ}$ C) for the day of rectal temperature measurement are shown. Means within treatments having different superscripts are significantly different ($P<0.05$). _____	87
Table 3.5.	The effect of pregnancy rank, ewe group and shearing treatment on gestation length (days) (Means \pm SE). Means within treatments having different superscripts are significantly different ($P<0.05$). _____	88
Table 3.6.	The effect of birth rank, ewe group and ewe shearing treatment and their interactions on lamb liveweight (kg) at birth, L36 and L86 (Means \pm SE). Means within treatments having different superscripts are significantly different ($P<0.05$). _____	90
Table 3.7.	The effect of ewe group and shearing treatment on girth (cm), crown rump length (CRL) (cm), dry (Dry) and wet (Wet) wool depth measurements (mm) of new-born twin lambs (Mean \pm SE). Means within treatments having different superscripts are significantly different ($P<0.05$). _____	91
Table 3.8.	The effect of sex of the lamb, ewe group and ewe shearing treatment on the proportion (%) of twin-born lambs (less than 36hrs of age) that did not reach summit metabolism (Mean \pm SE). _____	92
Table 3.9.	The effect of ewe group and shearing treatment on summit metabolism (W/kg) of twin-born lambs less than 36 hrs of age (Mean \pm SE). Means within treatments having different superscripts are significantly different ($P<0.05$). _____	92
Table 4.1.	Average herbage masses (kgDM/ha) during pregnancy (P-11 to P133), prior to set stocking (P133) and during lactation (P133 to L87) and average sward heights (cm) prior to set stocking (P133) and during lactation (P133 – L87) at Riverside. _____	104
Table 4.2	Average herbage masses (kg DM/ha) during pregnancy (P-13 to P130), at set stocking (P130) and during lactation (P130 to L91) and average sward heights (cm) at set stocking (P130) and during lactation (P130 – L91) at Tuapaka. _____	106
Table 4.3.	The effect of pregnancy rank and shearing treatment on ewe liveweights (kg) at P67, P101, P133, L34/35 and L86/87 at Riverside (Mean \pm SE). Means within treatment having different superscripts are different ($P<0.05$). _____	109

<i>Table 4.4. The effect of pregnancy rank and shearing treatment on ewe liveweights (kg) at P69, P101, P130, L28/29 and L90/91 at Tuapaka (Mean \pmSE). Means within treatment having different superscripts are different ($P<0.05$). _____</i>	110
<i>Table 4.5. The effect of pregnancy rank and shearing treatment on ewe condition score at P67, P101, P133, L34/35 and L86/87 at Riverside (Mean \pmSE). Means within treatment having different superscripts are different ($P<0.05$). _____</i>	112
<i>Table 4.6. The effect of pregnancy rank and shearing treatment on ewe condition score at P69, P101, P130, L28/29 and L90/91 at Tuapaka (Mean \pmSE). Means within treatment having different superscripts are different ($P<0.05$). _____</i>	113
<i>Table 4.7. The effect of pregnancy rank and ewe shearing treatment on ewe annual fleece weight (kg) at Riverside and Tuapaka (Mean \pmSE). Means within treatments having differing superscripts are different ($P<0.05$). _____</i>	114
<i>Table 4.8. The effect of birth-rank and ewe shearing treatment on lamb liveweight (kg) at birth, docking (L34/35) and weaning (L86/87) at Riverside and at birth, docking (L28/29) and weaning (L90/91) at Tuapaka (Mean \pmSE). Means within treatments having differing superscripts are different ($P<0.05$). _____</i>	117
<i>Table 4.9. The effect of ewe liveweight (kg) group at mid-pregnancy (P67 and P69 at Riverside and Tuapaka respectively) and shearing treatment on twin lamb birthweight (kg) (Mean \pmSE). Means within farms with different superscripts are different ($P<0.05$). _____</i>	118
<i>Table 4.10. The effect of ewe condition score group (scale 1 – 5) at mid-pregnancy (P67 and P69 at Riverside and Tuapaka respectively) and shearing treatment on twin lamb birthweight (kg) (Mean \pmSE). Means within farms with different superscripts are different ($P<0.05$). _____</i>	118
<i>Table 4.11. The effect of birth-rank and ewe shearing treatment on proportion (%) of lambs surviving to weaning at both Riverside and Tuapaka (Mean \pmSE). Means within treatments having differing superscripts are different ($P<0.05$). _____</i>	120
<i>Table 4.12. The effect of birth-rank and ewe shearing treatment on cause of lamb mortality (%) in autopsied lambs at Tuapaka (Mean, \pmSE). Means within treatments having differing superscripts are different ($P<0.05$). _</i>	121
<i>Table 5.1. The effect of dam treatment on the liveweight (kg) of twin-bearing ewes at P69, P106, P140, L47 and L122 (Mean \pmSE). _____</i>	136
<i>Table 5.2. The effect of dam treatment on the condition score of twin-bearing ewes at P69, P130 and L122 (Mean \pmSE). _____</i>	137
<i>Table 5.3. The effect of dam treatment on annual fleece weight (kg) (Mean \pmSE).</i>	137
<i>Table 5.4. The effect of dam treatment on the gestation length (days) and liveweights (kg) at birth (L1), L47 and L122 of twin lambs (Mean \pmSE). Means within columns having different superscripts are different ($P<0.05$). _____</i>	140
<i>Table 5.5. The effect of dam treatment on the crown rump length (CRL) (cm) and Girth (cm) of twin lambs (Mean \pmSE). Means within columns having different superscripts are different ($P<0.05$). _____</i>	141

<i>Table 5.6. The effect of dam treatment on the proportion of lambs (%) that reached summit metabolism and the summit metabolic rate (W/kg) of twin lambs (Mean \pmSE).</i>	141
<i>Table 6.1. The effect of dam shearing treatment on predicted twin lamb survival rates (based on survival data presented by Dalton et al. (1980)) to weaning at Tuapaka.</i>	157
<i>Table 6.2. The effect of dam shearing treatment on predicted singleton lamb survival rates (based on survival data presented by Dalton et al. (1980)) to weaning at Tuapaka.</i>	158
<i>Table 6.3. The effect of dam shearing treatment on predicted twin born lamb survival rates (based on survival data presented by Dalton et al. (1980)) to weaning at Riverside.</i>	159
<i>Table 6.4. The effect of dam shearing treatment on predicted singleton lamb survival rates (based on survival data presented by Dalton et al. (1980)) to weaning at Riverside.</i>	160
<i>Table 6.5. Actual survival of multiple-born lambs by birthweight range and predicted survival rate if birthweights are increased by 0.5 kg due to pregnancy shearing (adapted from Morris et al. 1999).</i>	161
<i>Appendix Table 1. Ewe treatment groups.</i>	181
<i>Appendix Table 2. Ewe treatment groups.</i>	184

List of Figures

<u>Figure</u>	<u>Page</u>
<i>Figure 2.1. Ewe-group feeding regimens.</i>	47
<i>Figure 2.2. Stylised graph of an increase in heat production observed in lambs when subjected to the standard stimuli (an increase in heat production to the standardised stimuli is measured as the difference in heat production between point B and line A divided by the time elapsed between line B and point C). Vertical bars represent the standard deviation of the first four points, not of each point.</i>	52
<i>Figure 3.1. Birthweight responses to mid- to late-pregnancy shearing (single-closed symbols, twins- open symbols) as a function of the birthweights of control lambs (each point represents a separate trial or treatment [shearing date] within a trial (Morris and McCutcheon 1997, Morris et al. 2000, Revell et al. 2000, Revell et al. 2002 and Chapter 2)). Shearing responses for each of the feeding regimes in this study are indicated by their subscripts (single maintenance (SM), single low (SL), twin maintenance (TM), twin low (TL)).</i>	98
<i>Figure 4.1. Birthweight responses to mid- to late-pregnancy shearing (single-closed symbols, twins- open symbols) as a function of the birthweights of control lambs (each point represents a separate trial or treatment [shearing date] within a trial ((Morris and McCutcheon 1997, Morris et al. 2000, Revell et al. 2000, Revell et al. 2002 and Chapter 2 and 3)). Shearing responses for each the two farms (within each birth rank) in the present study are indicated by Tuapaka (Ta) and Riverside (Rv).</i>	128

- Figure 5.1.** Effect of dam treatment on maternal T3 (ng/dL) (upper graph) and T4 (•g/dL) (lower graph) concentrations during mid- to late-pregnancy. In the T3 graph 'Morris' indicates T3 elevation reported by Morris et al. (2000). The vertical bars indicate standard errors of the means. _____ 139
- Figure 5.2.** Birthweight responses to mid- to late-pregnancy shearing (singles-closed symbols, twins- open symbols) as a function of the birthweights of control lambs born to unshorn dams (each point represents a separate trial or treatment [shearing date] within a trial (Morris and McCutcheon 1997, Morris et al. 2000, Revell et al. 2000, Revell et al. 2002 and Chapter 2 and 3)). The present study is indicated by '2000'. The results of Morris et al. (2000) within each birthrank for each of the shearing dates are indicated by 'Morris'. _____ 146
- Appendix Figure 1.** From Morris et al. (2000). Effects of time of shearing (P50, triangles; P70, diamonds; P100 squares; and unshorn, circles) and pregnancy rank (single-bearing ewes, closed symbols; twin-bearing ewes, open symbols) on plasma triiodothyronine (T3) concentration. __ 179
- Appendix Figure 3.** The effect of differing T4 injection regimens on maternal T4 (µg/dL) (upper graph) and T3 (ng/dL) (lower graph) concentrations. The results reported by Morris et al. (2000) are indicated by "Morris et al. 2000). _____ 186

List of Abbreviations

BAT	brown adipose tissue
CIDR	controlled internal drug release
Cr ₂ O ₃	chromic sesquioxide
CRL	crown-rump length
CS	condition score
CT	computer topography
d	day(s)
DM	dry matter
DMD	dry matter digestibility
DOMD	organic matter digestibility of dry matter
DOMI	digestible organic matter intake
g	gram(s)
ha	hectare(s)
h	hour(s)
IU	international unit(s)
kg	kilogram(s)
L	day of lactation (e.g. L34 = day 34 of lactation)
LCT	lower critical temperature
MJ	megajoules
ME	metabolisable energy
m	metre(s)
mm	millimetre
mg	milligrams
µg/dL	micrograms per deci-litre
min	minute(s)
NEFA	non-esterified fatty acids
ng/dL	nanograms per deci-litre
NPRQ	non-protein respiratory quotient
NST	non-shivering thermogenesis
OF	oesophageal fistulated
OM	organic matter
OMI	organic matter intake
OMD	organic matter digestibility
P	day of pregnancy (e.g. P70 = day 70 of pregnancy)
PMSG	pregnant mare serum gonadotropin
SMR	summit metabolic rate
s.u.	stock unit
T3	tri-iodothyronine
T4	thyroxine
vs	versus
W	watts
°C	degree(s) celsius