final report

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Maternal Sire Genotype Evaluation (MCPT)

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ABSTRACT

Progeny testing 91 high performance sires, entered by industry, has demonstrated considerable scope for selection and genetic improvement within maternal breeds. There are very large ranges in 1stX EBVs, such that choosing extreme sires would result in 1stX lambs differing by 10kg post weaning and their carcass fat by 8mm GR or 1.5 fat scores at the same carcass weight. Results from the subsequent 2ndX lambs have shown the differences in growth and fat levels are passed on to the second generation, with a range of 6kg for post weaning weight and 5mm GR or 1.0 fat score in carcasses. There is a dramatic effect of the maternal sire on lambing %, growth and carcass of lambs and wool, which all affect $ returns from the 1stX ewe. The major driver for $ returns is number of lambs slaughtered and the groups of 1stX ewes have ranged from 81 to 167% for lamb weaning percentage from adult ewes. The total returns varied by $35/ewe/year, which represents a difference of $13,125 in lifetime returns from 1stX ewe progeny per maternal sire.

The leading sires for each of the various traits are different, which highlights the need for breeders at all levels to carefully consider the traits that contribute to their enterprise and select sires accordingly. 1stX breeders can make considerable improvement by using sires with high EBVs for growth and leanness. In contrast, 2ndX breeders make the greatest gains from improvement in lambing rate with significant contributions from growth, leanness to match specifications, muscling and wool. Alternative breeding and alliance structures need to be facilitated, including contract matings, to encourage the use of superior sires and provide better information on the genetic merit of crossbred ewes.

EXECUTIVE SUMMARY

Background and Industry Context

Productivity of the ewe flock, through lamb carcasses (number produced, weight and fat level) and wool (weight and fibre diameter), has a major impact on the profitability of lamb enterprises. However genetic improvement in the maternal sector of the industry is lagging behind that in terminal sires, where the benefits of using high EBV LAMBPLAN tested sires have been clearly demonstrated and there has been a dramatic uptake of genetic technology and improvement. There are even greater potential increases in productivity and profitability of lamb enterprises from wide use of superior maternal sires than the increases being achieved with superior terminal sires.

Objective

To increase the average genetic merit of prime lamb maternal sires by 1% pa through increasing the use of LAMBPLAN by maternal and dual purpose seedstock breeders.

The specific objective of the project is to evaluate approximately 90 high performance maternal and dual purpose sires by progeny test for both growth and carcass (1stX and 2ndX progeny) and maternal phase production of 1stX ewes.

Methodology

Border Leicester and other breeds of rams (n=91) with LAMBPLAN information and nominated by industry, have been individually mated to Merino ewes using artificial insemination. Matings occurred at three sites over three years (Cowra and Hamilton 1997 to 1999 and Struan 1998 to 2000). Three common sires were used at all sites in each year as genetic links to allow combined analysis of data and estimation of across-site EBVs.

First cross wether progeny were grown out to slaughter with assessment of growth and carcass traits (weight, fat, muscle). First cross ewe progeny were grown out and retained for breeding to terminal sires over three (3) years to obtain an estimate of lifetime lambing performance. The 2ndX lambs are grown out to slaughter with carcass data collected. Varying production systems eg. spring, summer and autumn joining, are used for the crossbred ewe evaluations at the various sites to conform with general practice in each area. At Cowra the 1stX ewes were split to autumn or spring joining to assess any GxE interaction . The 1stX ewes bred at Struan are evaluated at Rutherglen.

Results and Achievements

- The project is clearly demonstrating the differences in performance between ewes by different sires, which can mean $35/ewe greater returns annually. The number of lambs slaughtered per ewe joined is the major $ driver, with other traits, growth, fat and wool also contributing. Groups of 1stX ewes have ranged from 81 to 167% for lamb weaning percentage from adult ewes at Cowra. Early results from other sites are showing similar ranges among the 1stX ewe groups.
- There is a very large range in EBVs for weight and carcass fat in particular (about twice that for terminal sires), as well as muscling, wool weight and fibre diameter. The range in fat represents a difference of 1.5 fat scores in 1stX and almost 1 fat score in 2ndX lambs at the same carcass weight.

These differences are largely between sires rather than breeds and producers need to tailor their sire selections carefully to best match their production system.

- Early results indicate there may be important GxE interactions, due to at least some sires, for reproduction in autumn and spring production systems. Further analyses are required to evaluate the feasibility and consistency of 1stX reproduction and 2ndX growth and carcass EBVs in relation to industry LAMBPLAN EBVs and in light of these GxE interactions.

The project has generated considerable interest from industry with the results extended widely to the various target groups. The extensive communication from the project has been very effective and has included:

- *Dynamic Dams Newsletter* – 13 issues (3/year), distributed to 300 seedstock breeders, lamb producers, consultants, advisors and selected media.
- *Field days* – 17 field days and targeted meetings at the project sites.
- *Presentations and displays* – at other field days and target groups (50).
- *Industry journal articles* – such as The Muster, Aust. Farm J., etc (23).
- *Media* – numerous articles on MCPT and maternal improvement in the rural press and radio and TV. The Newsletters and other information are also on the LAMBPLAN website.

- The genetic trend for LAMBPLAN tested maternal flocks is increasing at >1% pa., with increased use of LAMBPLAN by the maternal sector. Results from the project are used by breed societies and breeders in their advertising and promotion. There is a high rate of inquiry from breeders and producers about maternal improvement, with no less than 10 related PIRDS initiated. Breeding alliances and contract matings are starting to be established. This reflects the considerable change that is occurring in producer's interest in and attitude towards maternal improvement.

Industry Implications

The large ranges in 1stX EBVs provide considerable scope for selection and genetic improvement within maternal breeds. Choosing sires from the extremes would result in 1stX lambs differing by 10kg post weaning and their carcass fat by 8mm GR or 1.5 fat scores at the same carcass weight. Other results have shown these differences in growth and fat levels persist in 2ndX lambs with a range of up to 6kg post weaning and 5mm GR or 1.0 fat score.

There is a dramatic effect of the maternal sire on $ returns from the 1stX ewe, with the major driver being the number of lambs slaughtered. Total returns have varied by $35/ewe/year, which represents a difference in lifetime returns of $13,125 from 1stX ewe progeny per maternal sire.

The leading sires for each of the various traits are different. This highlights the need for breeders at all levels to carefully consider the traits that contribute to their enterprise and select sires accordingly. 1stX, 2ndX and maternal seedstock breeders all have different objectives. 1stX breeders can make considerable improvement by using sires with high EBVs for growth and leanness. In contrast, 2ndX breeders make the greatest gains from improvement in lambing rate with significant contributions from growth, leanness to match specifications, muscling and wool. The tiered crossbreeding structure in the industry leads to *market failure* in the sale of 1stX ewes, because of a lack of information on their real value or genetic merit at the point of sale. The structure also fails to provide incentives for selection and use of superior genetic merit maternal sires. Alternative structures need to be developed to facilitate a more transparent market with better information flow that gives 2ndX lamb producers greater control over the genetic merit of their crossbred ewe flock and 1stX breeders the opportunity to obtain the *true* value of their 1stX ewes.

Take Home Messages

- The sire of the 1stX ewe has a major impact on 1stX lamb production by affecting:
  - lamb growth ***(carcass weight and 1stX ewe breeders)***
  - carcass fat and muscling ***(number meeting specs)***

- The sire of the 1stX ewe has a major impact on total $ returns to the 2ndX lamb enterprise by affecting:
  - lambing rate, including lamb survival ***(number slaughtered)***
  - lamb growth ***(carcass weight)***
  - fat level ***(number meeting specs)***
  - ewe wool production and value

- The top sires are from several breeds.

- Choice of the best sire for 1stX ewes may depend on the management and marketing system in the lamb enterprise.

Recommendations

1. Funding be extended to December 2004 to allow completion of the MCPT as designed.

The long-term design of the project was acknowledged by MRC. The first phase involving 1stX growth and carcass performance is complete. The second phase involving 1stX ewe performance is 60% completed and funding to 2004 will complete evaluation for all 91 maternal sires. This was the commitment to breeders who entered the sires and will allow the momentum achieved to be continued and the industry outcomes realised.

2. Development of LAMBPLAN Across-breed EBVs for growth, carcass and wool traits may be feasible with further analysis, but considerable caution would be prudent for reproduction traits.

MCPT gives direct comparisons for a limited number of selected sires across several breeds. Reliable LAMBPLAN across-breed EBVs depend on linkage and estimates of breed variances and mean differences. MCPT results indicate important differences between breed means and apparent discrepancies in rankings for some sires. Further joint analysis may resolve these issues for growth, carcass and wool. However reproduction is more difficult to evaluate accurately because of large environmental variation, component traits and GxE interactions, which are likely to preclude across-breed EBVs.

3. A targeted extension program be further planned and implemented.

MCPT has shown superior sires result in major improvements in performance. New industry structures and breeding alliances need to be facilitated and developed to exploit these opportunities. Simple messages showing how producers can put the results into practice need to be put together for the various target groups and implemented using existing personnel such as PDOs and state Department advisors.

4. The plan for analysis of MCPT data be adequately resourced and implemented.

A plan has been developed for analysis of the extensive data, comprising 91 sires and approx 15,500 progeny and base animals for 64 traits (survival, growth, carcass, meat quality, reproduction, milk, wool and FEC). It will enhance the LAMBPLAN genetic parameter matrix for maternal breeds and provide more appropriate indexes as well as model lamb production systems to quantify the major profit drivers.

5. The variation in feed requirements and efficiency of the 1stX ewes and the level of genetic variation be determined.

The maintenance feed cost for the ewe flock accounts for over 65% of total feed required for carcass production. Measurement of grazing intake would quantify the likely large differences in biological efficiency of the 1stX ewe groups. It would also provide estimates of heritability and genetic correlations with the traits already available in the MCPT data set and allow EBVs for efficiency to be included in breeding programs.

6. The MCPT project be used to validate the usefulness of markers and QTLs to assist selection in lamb breeding programs.

The MCPT project provides an invaluable data set for screening and validation of markers and QTLs that may assist selection, especially for meat quality, worm resistance and reproduction. DNA has been collected from 1stX and 2ndX progeny and profiling selected diverse sire groups could be used for screening and validation of markers. A small input of additional funds for a post graduate studentship would add greatly to the outputs from the MCPT as the bulk of the costs have already been incurred.

CONTENTS

1. BACKGROUND AND INDUSTRY CONTEXT

1.1 Introduction

Productivity of the ewe flock has a major impact on the profitability of lamb enterprises. Lamb carcasses (number produced, weight and fat level) and wool (weight and fibre diameter) are the major contributors to income. The potential productivity of the ewes for these traits is determined by their genetic merit. The task is to achieve higher genetic merit among the commercial flocks of crossbred ewes that predominate in the specialist sector of the Australian lamb industry. Crossbreeding has been used very effectively for many years to maximise heterosis. However a wider range of genotypes and genetic technology is now available to achieve more rapid genetic improvement.

There has been a dramatic uptake of genetic technology, such as LAMBPLAN, in recent years. This has largely occurred within the terminal sire sector of the lamb industry. With the developments in across flock procedures the increase in genetic trend for growth, leanness and muscling in industry terminal sire flocks is becoming apparent. Terminal sire flock ram buyers are paying significantly higher prices for high EBV rams (Ferguson and Fogarty 1997). While these same procedures are available within LAMBPLAN for maternal traits this sector is lagging behind in terms of use and uptake of the technology. Many lamb producers who have made considerable improvements in terminal sire genetics and their production and marketing operations are looking to make similar improvements on the maternal breeding side of their lamb enterprise.

There is considerable variation among sires for growth and carcass traits. The benefits of using high EBV LAMBPLAN tested sires has been clearly demonstrated (Hall et al 1992, 1995, 2001). Other research at Cowra has shown that BLxM carcasses were fatter with smaller eye muscle area than Dorset and Texel 1stX carcasses (Fogarty et al 2000b). However there was considerable variation between the individual BL sires for these carcass traits as well as growth rate (Fogarty et al 2000a) (see Fig. 1.1 and Fig. 1.2). There are also dramatic differences in lambing rate between BLxM ewes from different sources which reflect, at least in part, genetic differences for reproduction amongst BL sires. Other maternal genotypes (eg Coopworth, Booroola Leicester, Finn, East Friesian) are being increasingly used in industry and sires from these breeds need to be evaluated.

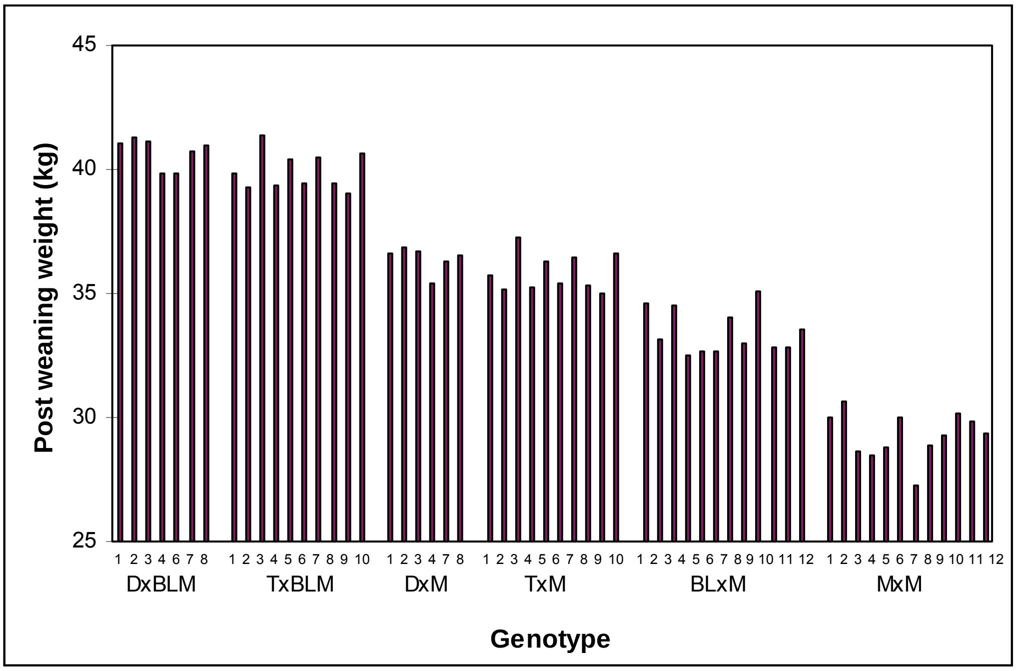


Fig. 1.1. Sire progeny means for post weaning weight
(adjusted to cryptorchids at 156 days, twin born and reared)

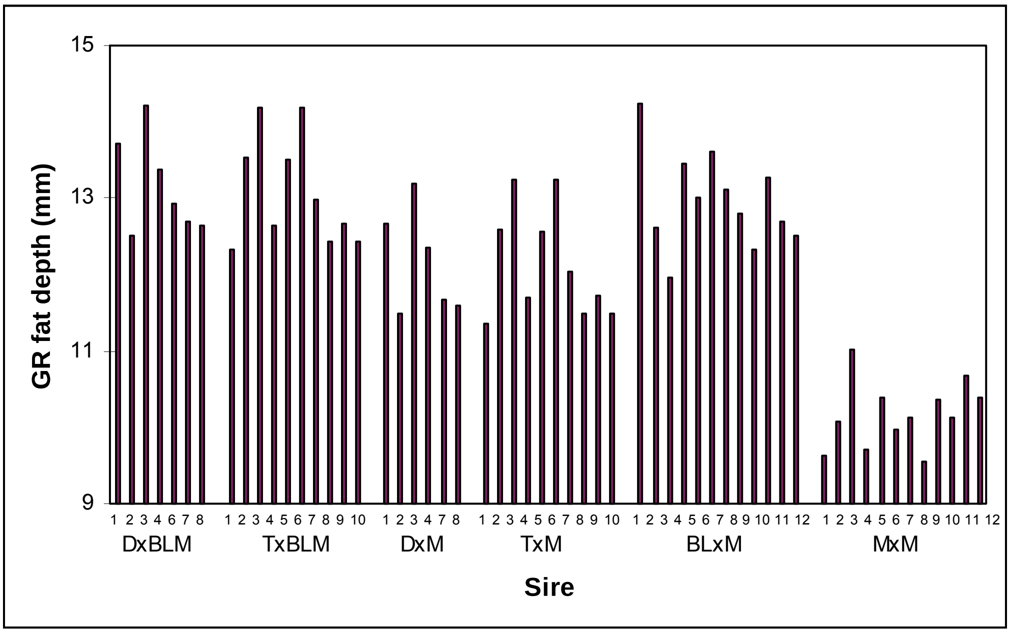


Fig. 1.2. Sire progeny means for GR fat depth
(adjusted to cryptorchids at 24 kg carcass weight)

Superior maternal sires need to be identified and effectively demonstrated to the industry. Progeny testing of maternal and crossing sires provides a powerful tool to:

- identify superior sires for breeding
- demonstrate and quantify variation between sires for all traits effecting profitability
- demonstrate LAMBPLAN is an effective means of identifying superior genetics
- increase the value of superior sires relative to *average* sires

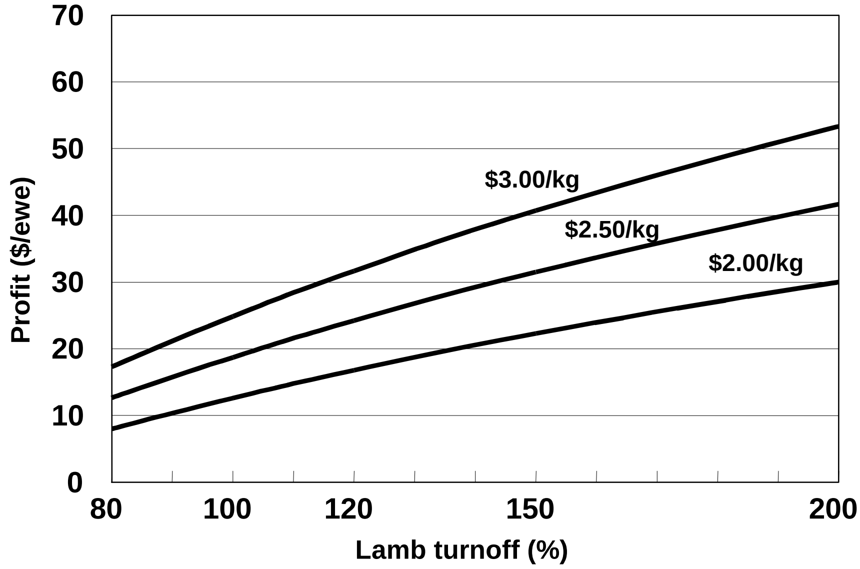
The terminal sire central progeny tests (Banks et al. 1995) have demonstrated their success in providing a focus and reaching a wide section of the lamb breeding industry by identifying superior sires and demonstrating the variation that exists amongst terminal sires for growth, leanness and muscling. There are even greater potential increases in productivity and profitability of lamb enterprises from wide use of superior maternal sires than those increases achieved with superior terminal sires.

1.2 Ewe Productivity and Profitability

Many specialist lamb producers are questioning their lamb production systems and the genetic merit of the dam and its contribution to lamb quality, consistent supply, productivity and profitability. To look at overall efficiency of production the yearly feed intake to produce lean lamb meat can be partitioned into that required for growing ewe replacements and ewe maintenance, gestation/lactation and that for lamb maintenance and growth (Dickerson 1978, see Fig. 3). The major portion of the feed is consumed in maintaining the breeding flock (typically >70%) and this feed cost is fixed regardless of lamb turnoff rate. Using a lamb profit equation (see Appendix 1 - modified from Fogarty and Gilmour 1993) profitability per unit feed almost doubles as lamb turnoff increases from 100% to 150%, even after accounting for the reduced number of ewes that can be run (Fig. 4).

Fig4. Gross Profit ($/feed unit) - 2nd Cross Lambs

50%



18kg lamb ($/kg including skin), accounts for extra feed costs

The Border Leicester x Merino ewe (BLM) has been the major dam used for lamb production in Australia for most of the last century. The BLM has generally had higher lambing rates than other ewes when joined in the autumn, but lambing rates are variable and generally low from spring joinings (see review Fogarty 1978). Lamb weaning rates are rarely above 130% from autumn joinings and in the range of 60-85% from spring joinings for BLM ewes. Higher annual lambing rates (211% lambs born and 160% lambs weaned) have been obtained under 8-monthly joining systems with various crossbred ewes (Fogarty et al. 1992d). Realised selection response of about 1% per year has been achieved in weight of lamb weaned per ewe per year (Fogarty 1994).

Often when experimental data has been analysed the source of ewes has been significant for ewe and lamb productivity traits (eg Hall et al. 1994, Fogarty and Mulholland – unpublished data). Significant variation amongst Border Leicester sires in lamb growth and carcass traits (Fig. 1.1 and Fig 1.2) has been found in the diverse genotype trial at Cowra (Fogarty et al. 2000a,b). This variation amongst maternal sires needs to be better documented and demonstrated to the industry for the full range of traits ie direct and maternal lamb growth and carcass quality, ewe reproduction, lamb survival and wool production.

2. OBJECTIVES

To increase the average genetic merit in prime lamb maternal sires by at least 1% pa through,

- increasing the number of maternal and dual purpose seedstock breeders using LAMBPLAN by 100, and
- increasing the number of lambs tested in maternal and dual purpose breeds from 11,000 in 1997 to 30,000 by June 2001.

Specific objectives:

a) To evaluate by progeny test approximately 90 high performance maternal and dual purpose sires for both growth and carcass phase and maternal phase production,

- growth and carcass phase of 1st and 2nd generation crossbred progeny.
- maternal phase of 1st generation crossbred female progeny.

The growth and carcass phase of the 1st generation was completed by June 2001 and the growth and carcass phase of the 2nd generation and maternal phase evaluation is 60% completed. The remainder of the progeny testing evaluation will be completed by 2004.

b) To progressively release to industry across-breed EBVs from the progeny tests and evaluate the scope for and value of converting all LAMBPLAN maternal EBVs to an across-breed basis using the progeny test data to contribute to between breed links, with an interim recommendation by June 2001.

c) To demonstrate the range in genetic merit in those components of lamb enterprise profitability deriving from the maternal genotype, and support improved industry performance in these areas by a targeted extension program by 2001.

d) To enhance, in association with LAMBPLAN, industry understanding of maternal EBVs by an additional 100 maternal and dual purpose seedstock breeders using LAMBPLAN testing and maternal ram buyers paying higher prices for rams with high EBVs by 2001.

3. EXPECTED OUTCOMES AND BENEFIT TO INDUSTRY

a) Identification of and more widespread use of maternal and crossing sires with high genetic merit for:

- growth, leanness and muscling
- net lambing rate
- wool production and quality

b) Demonstration of the sire variation that exists among crossbred progeny for growth, carcass traits, wool production and ewe lambing rate at different seasons of lambing.

c) Greater uptake of LAMBPLAN by maternal and crossing seedstock breeders.

d) Greater demand for LAMBPLAN information on potential sires and crossbred progeny by ram buyers and purchasers of crossbred dams

e) Greater genetic trends for maternal traits in industry flocks.

f) Improved efficiency of production of lambs through higher lambing rates by matching sires used to the genetic requirements of the lamb production system being used.

The value of these outcomes to the industry is difficult to quantify because they depend on the uptake by commercial breeders. However a modest increase of 5% in lamb turnoff amongst the top 30% of lamb production represents an increase of over $9m pa to these producers and $18m to the industry as a whole.

4. METHODOLOGY

4.1 Design

Border Leicester and other breeds of rams used as maternal sires with LAMBPLAN information and nominated by industry, were individually mated to Merino ewes using thawed frozen semen and laparoscopic artificial insemination. The Merino ewes were randomised and joined to the nominated sires at three sites over three years at each site (Cowra and Hamilton 1997 to 1999 and Struan 1998 to 2000). At Hamilton half the ewes were Merino and the other half were Corriedale. Three common sires were used at all sites in each year to provide genetic links to allow combined analysis of data and estimation of across site and year EBVs.

First cross wether progeny were grown out and slaughtered at average 22kg carcass weight. Assessment of growth rate and standard carcass traits (weight, fat, muscle), was recorded. First cross ewe progeny were retained and grown out for breeding. These crossbred ewes are bred for at least three (3) years to obtain an estimate of lifetime lambing performance. Additional information on variation of out-of-season reproductive activity, fleece weight and fibre diameter is also being collected as well as worm resistance. The 1stX ewes are joined to high index LAMBPLAN tested terminal sires. The 2ndX lambs are grown out to heavy weights and slaughtered with standard carcass information collected. Varying production systems eg. spring, summer and autumn joining, are used for the crossbred ewe evaluations at the various sites to conform with general practice in each area. At Cowra the 1stX ewes are split at random prior to their first joining with one group joined in the autumn and the other joined in the spring to assess any GxE interaction or change in ranking of sires when joined out of season in the spring. The 1stX ewes generated at Struan are transferred to Rutherglen at 10-12 months of age for evaluation.

Approximately 25 1stX ewes/sire, assessed over three years in each lambing system, are required to detect a 10% difference in lambing rate. Approximately 33 1stX ewes/sire are required for similar precision for evaluation in two lambing systems. The Merino ewes were randomised on origin, age and liveweight and mated using laparoscopic AI to the nominated sires, aiming to generate the above number of 1stX ewe progeny per sire.

4.2 Sites and Production Systems

Cowra Agricultural Research & Advisory Station
Base ewes: Merino medium wool –12 sires each year X approx 66 base ewes, March 1997, February 1998, 1999
1stX ewe progeny evaluation: ewes split to either autumn or spring joining systems and mated to Poll Dorset sires for 3 lambings.
Autumn - first joining at 7 months (autumn 1998)
Spring - first joining at 14 months (spring 1998)
Final drop of 2ndX lambs slaughtered October 2003

Hamilton Pastoral & Veterinary Institute
Base ewes: Merino fine wool and Corriedale – 12 sires each year X approx 70 base ewes, April 1997, March 1998, 1999
1stX ewe progeny evaluation: ewes joined in autumn to terminal sires for 3 lambings, with first joining occurring at 7 months (autumn 1998).
Final drop of 2ndX lambs slaughtered May 2003

Struan Agricultural Centre / Rutherglen Research Institute
Base ewes: Merino broad wool SA type – 14 sires each year X approx 70 base ewes, January 1998, 1999, 2000
The AI matings and base ewe lambings with 1stX wether progeny grown out to slaughter at Struan. The 1stX ewe progeny grown out at Struan to 10-12 months and transferred to Rutherglen for maternal evaluation.
1stX ewe progeny evaluation: ewes joined in spring/summer to White Suffolk sires, with first joining at 18 months (spring 1999).

Final drop of 2ndX lambs slaughtered November 2004

General Design of Maternal Sire Central Progeny Test

Maternal Sires X Merino Ewes

Matings of maternal sires at Cowra, Hamilton (1997,1998,1999) and Struan (1998, 1999, 2000)

eg. Border Leicester, Booroola Leicester, Coopworth, Corriedale, East Friesian, Finnsheep

1stX ewes - *grown out*	**1stX wethers - *slaughtered***
- survival	- survival
- growth	- growth
- breeding season	- carcass wt, fat, ema,
- wool wt, yield, fibre diam	- pH, colour
- faecal egg count	

Terminal sires X 1stX ewes (x 3 years)
Matings of first cross ewes Cowra, Hamilton, Rutherglen
- breeding season
- lambing rate
- wool wt
- milk production

2ndX lambs - *slaughtered*
- survival
- growth
- carcass wt, fat, ema,
- pH, colour

4.3 Measurements and Protocols

Minimum data and measurements recorded at each site will include:

Maternal Sire Mating Phase
Ewe liveweight - around mating
Pregnancy diagnosis, Foetal number scan (optional)
Lambing data: id, dam id, sire id, date, type of birth, sex, weight, assistance, pms (optional)
Marking - castrate males
****Weaning weight*** (about 11 weeks)
****Liveweight*** + Fat score (GR mm manual) - fasted liveweight
- wethers @ slaughter, ewes @ same age
****Hot carcass weight***
****GR knife*** (hot in chiller)
****Eye muscle area***, calculated (d x w x0.008) from depth and width measurements
C fat, Muscle pH and Colour (L, a, b) - to be negotiated with local works
Pelts - wool length; hairy, kemp & pigment scores - live preslaughter
Pelts - pinhole in fellmongered pelts - collected @Cowra 1997

Reproduction - 1stX ewes
Onset of puberty
Ewes ovulating & ovulation rate (optional)
****Ewe and lambing*** data - similar to Maternal Sire Phase above
****2ndX carcass*** data - similar to Maternal Sire Phase above

Wool Data
1stX ewe hoggets
Greasy Fleece Weight
****Clean fleece weight, *fibre diameter***, yield%
Fleece bin line (main, 2nd, tender) - grab sample for additional measurements
1stX ewe adults - greasy fleece weight, bin line
****major production traits*** *for reporting LAMBPLAN EBVs*

Joinings of 1stX ewes: Ewes to be joined to syndicate of terminal sire rams at about 2%. Rams at each site should be one breed. Rams blue dot ie high index and balanced EBVs for growth, fat and muscle.

Culling Policy: Generally there will be no culling, except for a very few lambs that may not be growing due to injury or disease eg arthritis. A level that could be adopted would be <3σ below the mean weight for the sire group. No intervention to remove any 1stX or 2ndX lambs from higher order births.

Additional Data Collected
Milk production: Subsequently milk production data have been collected from samples of 1stX ewes from each sire group, on their first lactation. These have involved measurement of milk production in early and late lactation using the 4 hour oxytocin technique. Individual ewe samples have been analysed for composition at commercial laboratories.
Faecal egg count (FEC): Data has been collected from all 1stX ewes at an appropriate time during their first year at Cowra and Hamilton.
DNA samples: DNA samples from most 1stX and 2ndX progeny have also been collected from blood and stored for subsequent studies.

4.4 Reporting Procedures

Performance and EBVs

i) 1stX growth and carcass - wt, fat, ema
ii) 1stX wool - cfw, fd
iii) 1stX reproduction - nlb, nlw, wt weaned, wt weaned/ewe wt$^{0.75}$
iv) 2ndX growth and carcass - wt, fat, ema, $index

The time scale of when results will be available is as follows:

	i)	ii)	iii)	iv)	
May '98	C1, H1				
Jan '99			C1a, H1		
May '99	C2, H2, S1	C1, H1			C1a, H1
Sept '99			C1s		
Jan '00			C12a, H12	C1s	
May '00	C3, H3, S2	C2, H2, R1			C12a, H12
Sept '00			C12s, R1		
Jan '01			C123a, H123	C12s, R1	
May '01	S3	C3, H3, R2			C123a, H123
Sept '01			C123s, R12		
Jan '02			C23a, H23	C123s, R12	
May '02		R3			C23a, H23
Sept '02			C23s, R123		
Jan '03			C3a, H3	C23s, R123	
May '03					C3a, H3
Sept '03			C3s, R23		
Jan '04					C3s, R23
Sept '04			R3		
Jan '05					R3

(C=Cowra, H=Hamilton, S=Struan, R=Rutherglen, 1,2,3=sire intake, a,s=aut/spr join)

A major LAMBPLAN EBV report is produced annually (July/Aug as data becomes available). As more complete reproduction data becomes available this may need to be revised. The limited frequency of EBV reports is to avoid confusion amongst breeders and rationalise the time and cost involved in analysis and preparation of reports.

Other Reporting of Results:

Appropriate reports and results other than EBVs, eg pregnancy and foetal scanning data, lambing results, are provided on a regular and timely basis by each site manager through the *Dynamic Dams Newsletter*. Data presented are generally on a comparative basis eg. LSM adjusted etc.

4.5 Link Sires

Three link sires have been used at each site in each year. The links include a Border Leicester (Kelso, BL12), Coopworth (Oaklea, Cp5) and Finnsheep (Warrayure, Fi7) as a broad representation of the genotypes being tested in the project. The owners of the rams paid one entry fee and provided one batch of semen as a normal sire entry and agreed to provide the additional semen for links at a discounted price. In 1998 at Struan the BL link sire was not used due to confusion at AI which resulted in another BL sire being tested.

Following discussions with Dr Arthur Gilmour, the use of the same link sires across all sites and years provides the most accurate EBVs for sires and hence rankings for the various traits. This applies particularly if there are Genotype X Environment interactions present, which we expect could be important for some of the reproduction traits. The downside of using the same links throughout are; a greater disparity in accuracy of EBVs between links and other sires, possibly flak from other breeders about seen to be favouring some, not necessarily having the best sires being used as links and improving over time, the risk that the breeds and sires used as links will not be representative of the range of sires being tested. *[With hindsight to date these possible downsides do not appear to have eventuated. There is obviously a greater accuracy of the link sire EBVs, but they have generally performed fairly well and have covered a range in performance for different traits.]*

There is a long time scale involved before the reproduction and 2ndX lamb data are available, eg. we will only have the first lambing results from the first autumn joined group at Cowra and Hamilton before the final sire matings occur at these sites. Any selection of other link sires could only be based on 1stX growth and carcass data (only for the final matings in any case).

4.6 Maternal Sire Selection

Despite the extremely short notice for the start of the project in 1997 (for breeders to nominate sires and have semen collected, frozen and delivered), there was an outstanding response. There were 33 sires nominated in the first year, with capacity for only 21 sires at Cowra and Hamilton. A selected and reserve list of sires was established by Neal Fogarty, Leo Cummins and Rob Banks, LAMBPLAN Coordinator. LAMBPLAN information was used and sires were selected to provide a reasonable representation of breeds at each site. Some reserve sires were used at each site because adequate quality semen was not available at AI in March and April 1997.

Subsequent matings were: Struan - January 1998, 1999, 2000
Cowra - February 1998, 1999
Hamilton - March 1998, 1999

All nominations were called in September to allow greatest flexibility in selections and assignment of sires to locations as well as sufficient time for breeders to collect and supply semen.

Procedures for Selecting Sires All site managers and Rob Banks (LAMBPLAN) made final selections for sires to be used across all 3 sites. The following broad criteria was used:

- representation of breeds used in the industry in proportion to their impact
- LAMBPLAN EBVs
- young rams preferred
- regional representation

5. PROJECT MANAGEMENT

5.1 Project Team

Principal Investigators

The project is conducted by a national project team, which currently comprises:

Dr Neal Fogarty, (Leader) Principal Research Scientist, NSW Agriculture, Orange Agricultural Institute, Orange NSW 2800

Dr Leo Cummins, Senior Research Scientist, Department of Natural Resources and Environment, Pastoral & Veterinary Institute, Hamilton Vic. 3300

Gervaise Gaunt, Research Scientist, Department of Natural Resources and Environment, Rutherglen Research Institute, Rutherglen Vic 3685

Drs Janelle Hocking Edwards and Nick Edwards, Research Scientists, South Australian Research & Development Institute (SARDI), Struan Research Centre, Naracoorte, SA 5271

In addition, Dr Arthur Gilmour, Principal Research Scientist, Orange and Dr David Hopkins, Senior Research Scientist, Cowra were involved in the design and development of carcass evaluation protocols and Dr Hopkins has assisted in carcass evaluations at Cowra along with Dr Alex Safari, Livestock Research Officer, Cowra.

Jayce Morgan is undertaking M.Rur.Sc. studies on ewe milk production at Cowra through the University of New England under the supervision of Assoc. Professor Geoff Hinch, Department of Animal Science and Dr Fogarty.

The Struan site was managed by John Stafford, Senior Livestock Officer, Primary Industries South Australia, until his retirement in August 2000. Elke Stephens, Lamb Product Development Officer, PIRSA, Struan, has assisted greatly in carcass evaluations.

Philip Kenney, Research Officer, Sheep Products, Department of Natural Resources and Environment, Rutherglen Research Institute, was involved in early planning of the project prior to his retirement in 1997.

Technical Support

Considerable technical support has been provided at each site over the years by:

Cowra

Jayce Morgan, Technical Officer
Kelly Lees, Technical Officer
Tony Markham, Technical Assistant
Ashley Radburn, Technical Assistant
Manager and other staff at Cowra AR&AS and Orange AI

Hamilton

Kerrie Groves,Technical Assistant
Murray Arnold, Senior Technical Officer
Roger Thompson, Senior Technical Officer
Alison Behrend, Technical Assistant
Victoria Condon, Technical Assistant

Michelle Carter, Technical Assistant
Manager, Brian Clark and Stockmen Brian Hurley and Phil Forsyth

Struan

Jack Rowe, Technical Officer
Tamara Starbuck, Research Officer
Liz Abraham, Technical Assistant
John Cooper, Farm Manager and Farm Staff Colin Windebank and Shane Walker

Rutherglen

Greg Seymour, Technical Officer
Taffy Phillips, Technical Officer
Paul Curran, Technical Officer

Project Coordination

Laurie Thatcher was the Project Co-ordinator for MRC/MLA until the end of 2000. This role has now been taken over by Dr Rob Banks.

Dr Rob Banks has been closely involved with the design and management of the project throughout in his role as Manager LAMBPLAN. Dr Alex Ball has recently been involved since he became Manager LAMBPLAN.

5.2 Technical Transfer Advisory Group (TTAG)

The TTAG reviewed the proposal and strongly supported the establishment of the project in February 1997. They further agreed to aid in dissemination of information about the project and provide ongoing advice. This has been an important aspect of the success of the project and widespread interest and implementation of results by industry. The TTAG has representation of maternal seedstock breeders and commercial lamb producers from a wide area of SE Australia. The TTAG members are:

Don Peglar, Mt Gambier, SA – Coopworth breeder and lamb producer
Lynton Arney, Strathalbyn, SA – Border Leicester breeder
John Keiller, Portland, Vic – Composite breeder and lamb producer
Charlie Prell, Crookwell, NSW – Corriedale breeder and lamb producer
Robert Mortimer, Tullamore, NSW – Merino breeder

Sandy Cameron, Meredith, Vic – Milk sheep and lamb producer

TTAG meetings are convened by the MLA Coordinator and are funded separately from the project. Formal TTAG meetings have been held as follows:

February 1997 – Rutherglen

October 1997 – Cowra

September 1998 – Rutherglen

December 1999 – Struan

November 2000 – Cowra

The November 2000 meeting reviewed and strongly endorsed the continuation of the project to completion in December 2004.

6. MARKETING PLAN

6.1 Background

- Genetic improvement of maternal/dual-purpose breeds (Border Leicester, Coopworth, Corriedale, Merino) using LAMBPLAN is occurring, but lags considerably behind that in terminal sire breeds.
- Genetic improvement of maternal traits will have a major impact on profitability of lamb producers, primarily through increased lamb turnoff, or lower cost of production per kg.
- Awareness of the importance of maternal traits on gross margins appears to be only moderate.
- Breed mixing has already begun in maternal/dual-purpose breeds, similar to the trend in terminal sires, and across breed evaluations are a sensible target. These will require improved definition of objectives for different production system x target market niches, and better understanding of breed additive effects (breed means) and interactions (hybrid vigour) than we have currently.
- The MCPT project can address some, but not all of these issues because of inadequate scale.
- Marketing of MCPT results will be closely coordinated with LAMBPLAN marketing.
- There is no marketing budget allocated to the MCPT project.

6.2 Information Generated from MCPT

Products to be marketed from the project include:

**** Higher profitability for 1stX carcasses***

- higher growth rates
- meeting specs (weight, fat, muscle)

**** Higher profitability for 2ndX lamb producers***

- higher lambing and weaning rates
- higher growth rates
- meeting specs (weight, fat, muscle)
- higher wool profits

**** Higher prices for genetically superior maternal rams***

Additional value of a high EBV Border Leicester flock ram

BL sire X 50 Merino ewes X 100% lambs X 3 yrs = 75 wether + 75 ewe progeny
75 BLM ewes X 120% lambs X 5 years = 450 slaughter lambs

Weight: ***+ 1kg EBVwt***
75 BLM wethers = 75 lambs X 0.5 (genetic contrib.) X 0.4 kg c/c wt X \$2.00 =\$ 30.00
75 BLM ewes = 450 lambs X 0.25 (genetic contrib.)X 0.4 kg c/c wt X \$2.50 =\$112.50
=\$142.50
[cf Term. sire X 50 BLM ewes X 120% lambs X 3 yrs X 0.5 X 0.4 kg X \$2.50 =\$ 90.00]

Lambing rate: ***+ 0.01 EBVnlw***
75 BLM ewes =75 X 0.5(genetic contrib.) X 120%X 5 yrs X 0.01 EBV X \$45 =\$101.25

Wool production: ***+ 0.1 kg EBV gfw***
75 BLM ewes =75 X 0.5(genetic contrib.) X 5 yrs X 0.1 kg gfw X \$3.50 =\$ 65.63

The 1stX producer only gains \$30 compared to \$112.50 for the 2ndX cross producer from the use of a ram with +1kg EBVwt, although the former might expect to receive a higher price for the sale of heavier 1stX ewes. All of the gains from lambing rate (and generally all wool) are accrued by the 2ndX producer. This has implications for extension and development of the marketing plan.

Some of the specific information generated from MCPT includes:

- estimates of the genetic range in component traits and in \$/ha for a range of production systems. This range will be across breeds (although they are not definitively sampled).
- assessment of the usefulness of LAMBPLAN EBVs and Indexes for predicting performance of crossbred daughters.
- key benefits and problems of particular breeds.
- in conjunction with LAMBPLAN, prototype Maternal Across-Flock evaluations.

6.3 Objective

To increase the average genetic merit of sires used in the maternal sector of the lamb industry. This will be achieved by strategies to:

- increase the use of LAMBPLAN in maternal breeds
- increase rate of genetic gain in maternal studs
- increase demand for superior sires at stud and commercial levels
- demonstrate the contribution of maternal genetics to lamb profitability
- encourage and facilitate contract matings for the supply of lamb dams

6.4 Target Audiences

- ***Maternal Seedstock Breeders*** - about 500 total flocks
- ***Maternal Ram Buyers*** - 30,000 - 40,000 rams purchased p.a., by 5-10,000 flocks
- ***1stX Ewe Buyers*** - 1.5 - 2.5 million ewes purchased p.a. by 16,000 flocks
-

Specific groups within these audiences are identified to target with particular information as the project progresses through its various stages:

A. Participants in MCPT

B. Commercial lamb producers, producer groups, lamb alliances (through PDOs), PIRDs

C. Breed Societies, existing and potential LAMBPLAN users

D. Partners in lamb production value chains, such as Merino producers who source Border Leicester rams

The PDOs and Departmental advisors are major avenues for promoting change amongst commercial lamb producer groups and alliances, which are already a receptive target for LAMBPLAN and MCPT. The PDOs are the "on the ground" agents whose role should be expanded to include options for genetic improvement.
Stages of the MCPT project include:

Stage 1

- results accumulating for individual traits in each environment by sire
- scale of trait and $/ha differences in sire groups
- outline of models for estimating $/ha, impact of improvement for individual and alliance operations and how to improve it
- relationship of this to LAMBPLAN Maternal Indexes

Stage 2

- combined analysis for EBVs (July/Aug annually)
- initial relationships with LAMBPLAN within-breed results
- prototype Across-Breed results

Stage 3

- refined LAMBPLAN Across-Breed evaluations standard, including EBVs and Indexes for crossbred daughters performance for a range of production system x target market.

7. RESULTS

Detailed results from each site have been published progressively in the *Dynamic Dams Newsletter*. An overall summary is provided here with examples from particular sites, rather than repeating results from all sites where they show similar trends.

7.1 Progress to Date

A total of 91 maternal sires have been mated using frozen semen and AI over three years at each of three sites (Cowra and Hamilton 1997 to 1999 and Struan 1998 to 2000). Three sires were used at all sites in each year to provide genetic links to allow combined analysis. All 1stX wether progeny have been slaughtered by June 2001 (see Table 1). The 1stX ewes are being joined to high index terminal sires for three lambings, with 2ndX lambs grown out and slaughtered with carcass measurements collected as per schedule. At Cowra half the first group of the ewes have completed their three lambings (1997 drop – autumn joined) with their final 2ndX lambs slaughtered in February 2001 The last of the 1stX ewes generated at Struan (2000 AI mating) have been transferred to Rutherglen for evaluation. The schedule of progress to date for the various groups at each site is shown in Table 1.

Table 7.1. Progress of Maternal sire AI matings and progeny evaluation – July 2001

Sire intake	Evaluation of 1stX lambs		Evaluation of 1stX ewes and 2ndX lambs									
				Year 1			Year 2			Year 3		
	Lambs born	Wethers carcass	Season joined	Ewes joined	Lambs born	Carcass	Ewes joined	Lambs born	Carcass	Ewes joined	Lambs born	Carcass
Cowra												
1997	✔	✔	Aut[a]	✔	✔	✔	✔	✔	✔	✔	✔	✔
			Spring[b]	✔	✔	✔	✔	✔	✔	✔	✔	Oct'01
1998	✔	✔	Aut[a]	✔	✔	✔	✔	✔	✔	✔	Jul'01	
			Spring[b]	✔	✔	✔	✔	✔	Oct'01			
1999	✔	✔	Aut[a]	✔	✔	✔	✔	Jul'01				
			Spring[b]	✔	✔	Oct'01						
Hamilton												
1997	✔	✔	Aut[a]	✔	✔	✔	✔	✔?	✔	✔	Aug'01	
1998	✔	✔	Aut[a]	✔	✔?	✔	✔	Aug'01				
1999	✔	✔	Aut[a]	✔	✔	✔	✔	Aug'01				
Struan/Rutherglen												
1998	✔	✔	Spring[c]	✔	✔	✔	✔	✔	Oct'01			
1999	✔	✔	Spring[c]	✔	✔	Oct'01						
2000	✔	✔	Spring[c]	Nov'01								

First joining to terminal sires at: [a] 7 months of age [b] 14 months of age [c] 17 months of age

✔? lambing affected by vibriosis at Hamilton in 1999, additional lambing undertaken

The breeds with the highest number of sires being tested are: Border Leicester (18), East Friesian and crosses (12), Finnsheep and crosses (12) Coopworth (10), White Suffolk (7), Corriedale (6) and Booroola Leicester (6). A range of other breeds is also represented amongst the other sires being tested. These include Merino, South African Meat Merino (SAMM), Hyfer, Romney, English Leicester, Gromark, Cheviot, Perendale, Wiltshire Horn, Poll Dorset, Texel, South Hampshire Down and White Dorper. The full list of sires and details of entrants is given in Appendix 2.

In each year there were more nominations for sires than places available. In 1997 there were 21 sires selected from 33 nominations, which were made at very short notice. In 1998 and 1999 there were 29 sires selected each year for the 3 sites from 32 and 36 nominations respectively. There were 11 sires selected for the 2000 matings at Struan from 16 nominations. Selection of sires was made by site managers and Rob Banks (LAMBPLAN) using the criteria outlined in Section **4.6**.

7.2 Base AI Matings

Results were variable for the base ewe matings that used thawed frozen semen and laparoscopic AI undertaken by commercial operators (Table 7.2). The results achieved at Cowra were very good (average 85% pregnant and 111% lambs marked) and consistent with those achieved in another experiment in the previous 3 years with the same operator. Different Merino ewes were bought in 1999, which may have contributed to the slightly lower results than in the earlier years.

Table 7.2. Scanning and lambing results from AI matings

Site/yr	Ewes AI	Sires	Pregnant %	Foetal Number[a]	Lambs born %[b]	Lambs marked %[b]	1stX ewes/sire
Cowra							
1997	800	12	87	1.88	163	120	33
1998	820	12	87	1.88	160	117	36
1999	800	12	80	1.75	134	97	32
Hamilton							
1997	835	12	73	1.57	116	82	26
1998	821	12	47	1.31	59	48	14
1999	835	12	54	1.46	82	58	19
Struan							
1998	1077	14	62	1.44	88	69	22
1999	1059	14	71	1.54	100	45	22
2000	1076	14	64	1.39	85	60	23

[a] per pregnant ewe, [b] % of ewes AIed

The very good results at Cowra are attributed to: use of an experienced and good operator; use of mature (5-6 yo) ewes in good condition and on a rising plane of nutrition; meticulous attention to detail eg timing of hormone treatments, use of teasers and AI as ewes cycle, low stress (workers and sheep) environment; good quality semen; good technical support and pre and post AI sheep management.
Results at the other sites were variable with a low pregnancy rate (47%) and foetal number at Hamilton in 1998 and severe weather conditions at lambing causing high losses at Struan in 1999. There were no obvious reasons for the results and several factors probably contributed to the variability from the AI matings.

The matings were designed to generate an average of 33 1stX ewes per sire at Cowra (to allow the autumn and spring joining split) and 25 1stX ewes per sire at

Hamilton and Struan. Overall at Cowra there was an average of 34 ewes per sire, although individual sire groups range from 25 to 43. Some groups had a disproportionately high ratio of male to female 1stX progeny which also contributed to some of the smaller sized ewe groups. At Hamilton in 1997 there was an average of 26 1stX ewes per sire with a range of 16 to 39. The poor AI results in 1998 gave a range of 7 to 20 and in 1999 the range was 8 to 29 1stX ewes per sire. The two smallest groups, EF47 (7) and BL61 (8), are marginal for reproduction information and the owners of the sires are to be given the option of having reproduction results and EBVs published. At Struan the average number of 1stX ewes per sire was slightly below the design and individual groups ranged from 15 to 31. There will be a reduction in accuracy of EBVs for reproduction traits for some of the groups with very low numbers, but there will be little effect on other traits which have higher heritability and where measurements from both wethers and ewes contribute to results eg. weight.

7.3 stX Lambs

For most sites and years there was a range of over 0.5 kg in birth weight of 1stX lambs between the sire groups. There was a trend for East Friesian, Coopworth and White Suffolk sires to have higher birth weight lambs, with Finn sires low and Border Leicester sires intermediate, although there was considerable variation between sires within breeds. The following figures from Cowra in 1998 are an example of these results (Fig. 7.1). While the number of Merino ewes assisted at birth was generally low and less than 5%, some sire groups had over 15% of ewes requiring assistance (Fig. 7.2). Lamb survival varied considerably between sire groups (Fig. 7.3) and for the various types of birth. The relationship between lamb survival and birth weight for the different type of birth categories is shown in Fig. 7.4.

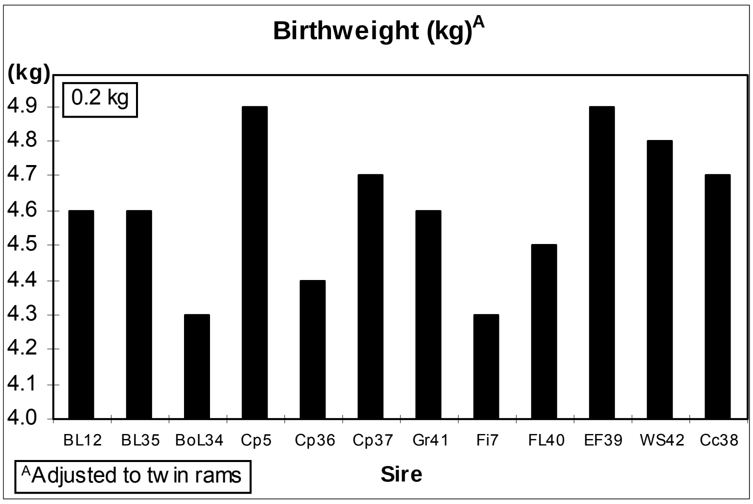


Fig. 7.1. 1stX lambs – Cowra 1998

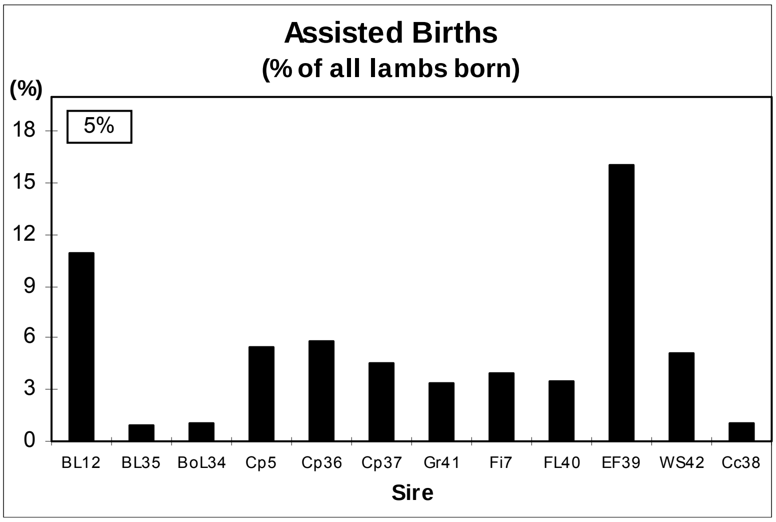


Fig. 7.2. 1stX lambs – Cowra 1998

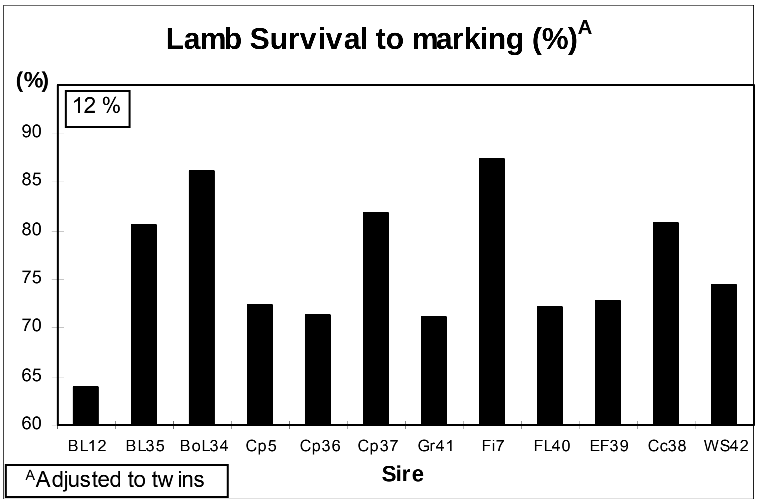


Fig. 7.3. 1stX lambs – Cowra 1998

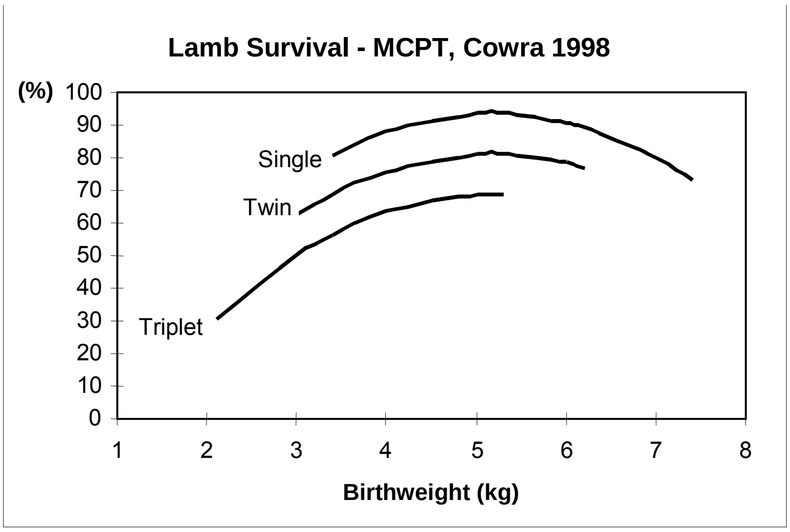


Fig. 7.4. 1stX lambs – Cowra 1998

There was also considerable variation between the sire groups for gestation length (Fig. 7.5). Coopworth and White Suffolk sires were generally close to 150 days gestation, Finn sires 146-147 days, with Border Leicester sires 148-149 days on average.

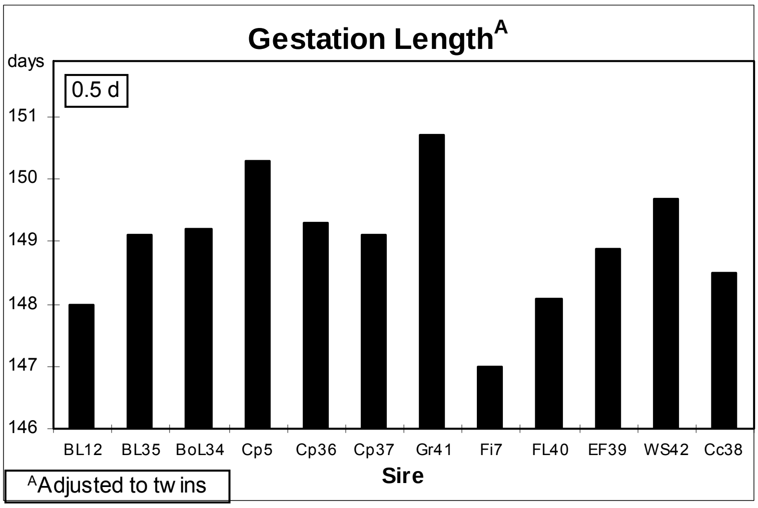


Fig. 7.5. 1stX lambs – Cowra 1998

7.4 stX EBVs

1stX EBVs have been calculated and published annually in the Dynamic Dams Newsletter. EBVs for weight (post weaning, ewes and wethers), fat (carcass GR, wethers) and muscle (carcass ema, wethers) were published for 21 sires in July 1998, 51 sires in August 1999 and 80 sires in August 2000. EBVs for wool weight (clean, hogget ewes), fibre diameter (hogget ewes) for 21 sires were published in August 1999 and 51 sires in August 2000. EBVs for faecal egg count (FEC) of 1stX ewes were also published in August 2000. The final group of 1stX wethers from Struan (2000 drop) were slaughtered in June 2001 to provide the remaining data for the 1stX meat EBVs on all 91 sires to be published shortly, along with 1stX wool EBVs for the sires mated in 1999.

The EBVs for the maternal sires are based solely on the performance of their 1stX progeny in the MCPT. No other information is used such as data from the LAMBPLAN database. Hence the MCPT EBVs are not comparable with LAMBPLAN EBVs. MCPT EBVs for the sires have been calculated to date using BVEST procedures (Gilmour 1993). OVIS, the new software developed for LAMBPLAN (Brown et al. 2000) will be available and used for future EBV calculation.

1stX EBVs 2000 for meat traits (80 sires) and wool traits (51 sires) are shown in Table 7.3, with the trait leaders in Table 7.4 (see Appendix 2 for sire codes).

Table 7.3. 1stX EBVs 2000 for meat, wool and worm resistance (FEC)

Sirecod	EBV Weight (kg)	EBV Fat (mm)	EBV Ema (cm^2)	EBV Clean (kg)	EBV diameter (*um*)	EBV FEC
BoL1	1.2	4.2	-0.6	0.24	2.6	-0.5
BL2	2.9	-0.7	-0.3	-0.05	2.4	-0.1
Fi3	-1.1	-1.3	0.0	-0.64	-2.9	-0.3
Cr4	-7.1	-4.4	1.8	0.38	-2.5	-0.5
Cp5	-0.1	1.2	-0.2	1.14	0.6	-0.9
EF6	-1.0	-6.7	0.5	0.0	0.9	-0.1
Fi7	1.6	0.8	0.0	-0.95	-5.9	0.3
BL8	1.2	6.1	-1.0	0.27	2.8	0.2
Fi9	-2.1	0.7	-0.7	-0.74	-2.9	0.8
WS10	2.5	-0.7	1.8	-0.74	0.0	-0.2
Cr11	-8.1	0.1	-0.1	0.24	-5.4	-0.1
BL12	3.8	2.1	-0.3	0.62	3.3	0.3
BL13	0.7	6.9	-0.4	-0.34	-0.6	0.2
Ro14	-1.5	-1.9	-0.1	0.84	1.3	-1.2
BoL15	0.3	4.8	0.0	-0.56	0.0	-0.7
Cp16	-0.7	1.4	0.6	0.24	3.3	0.6
Fi17	1.2	0.9	0.3	-0.30	-1.5	-0.4
Cp18	-4.5	0.5	0.3	0.68	2.5	0.6
EF19	3.6	-6.8	-0.9	0.02	2.0	-0.6
Cr20	-6.2	-1.4	0.0	0.41	-3.4	1.6
Fi21	-0.3	-0.9	-0.6	-0.40	-2.7	0.1
Fi22	-0.8	-0.1	-1.9	-0.48	-4.7	
Fi23	-2.0	-1.2	0.0	-0.41	-4.0	
BL24	2.2	3.2	-0.5	0.16	2.7	
BL25	-0.8	1.8	-0.4	0.23	4.4	
Cp26	1.6	0.7	0.9	0.65	0.4	
Cr27	-5.7	-1.8	0.4	0.40	-3.6	
EF28	8.3	-5.6	-1.8	0.14	1.6	
Hv29	-5.3	1.1	0.5	-0.51	-1.1	
Hv30	-6.0	-1.3	0.8	-0.29	-1.3	
PD31	6.4	0.0	1.2	-0.29	0.0	
BL32	0.6	1.1	-0.4	0.38	2.8	
WS33	4.8	-1.7	0.6	-0.52	1.8	
BoL34	-6.3	8.2	0.9	-0.30	0.7	0.7
BL35	-2.2	1.6	-0.9	0.33	1.2	-0.6
Cp36	1.4	1.3	-0.4	0.76	0.6	0.2
Cp37	-3.9	0.9	-0.1	0.47	4.8	-0.2
Cc38	-1.9	-2.1	1.3	-0.16	1.7	-1.0
EF39	3.4	-6.7	-0.8	-0.18	1.6	0.8
FL40	2.8	0.1	-0.2	-0.13	-3.2	0.7
Gr41	-4.0	0.9	-0.8	-0.07	-2.1	0.2
WS42	4.6	0.1	0.4	-0.82	2.1	-1.1
BoL43	-0.2	6.0	-0.4	-0.49	-0.6	0.0
EF44	-0.4	-5.6	-0.9	-0.14	0.3	0.6
EF45	2.6	-6.3	0.1	0.09	-0.6	0.3
Cr46	-4.7	0.00	-0.1	0.32	-4.1	-0.1
EF47	0.9	-4.3	0.0	0.10	1.5	0.3
FiF48	1.3	-1.0	-0.3	-0.38	-2.5	-0.4
Ro49	0.0	0.0	-0.3	0.44	0.6	0.1
Tx50	1.8	-0.5	1.9	0.09	1.7	-1.0
WS51	4.3	0.1	0.5	-0.02	2.1	-0.7
BL52	-1.3	0.9	0.1			-0.8
BL53	-1.6	2.7	0.2			0.4
BL54	3.8	2.2	-1.6			-0.7
BoL55	-0.5	3.5	0.0			-0.5
M56	-10.9	-3.6	-0.2			1.7
EL57	-2.0	3.7	-0.5			0.1
WH58	3.1	3.0	1.3			-1.0
EF59	8.9	-8.2	-0.6			0.1
WS60	0.1	-1.4	1.7			-0.3
BL61	-1.3	-0.4	0.4			1.4
BL62	2.7	3.9	-1.0			0.7
BoL63	-5.1	6.4	-0.4			1.1
Cr64	-5.7	-1.5	-0.2			1.3
Cp65	1.0	1.0	1.1			-1.7
Ch66	-2.4	-0.9	0.6			-2.5
Fi67	3.0	0.3	0.0			1.5
EFP68	2.1	-3.4	0.2			1.2
EFR69	-0.7	-1.2	0.6			-0.5
BL70	5.1	1.8	-0.5			
BL71	3.3	3.2	0.4			

M72	-5.0	-2.3	-0.9
EL73	2.4	-0.2	-0.8
Cp74	-1.7	-0.6	0.0
Hy75	-3.4	2.2	1.4
FiF76	1.1	-1.6	-0.9
EF77	2.6	-4.6	-1.1
SHD78	4.0	1.6	0.1
PD79	5.0	1.0	0.7
WS80	3.9	-0.7	0.3

Table 7.4. 1stX EBVs 2000 – Trait leaders

Sire	**Weight (kg)**	**Sire**	**Fat (mm)**	**Sire**	**Ema (cm^2)**	**Sire**	**Clean wool (kg)**	**Sire**	**Fibre Diam. (μm)**
EF59	8.9	**EF59**	-8.2	**Tx50**	1.9	**Cp5**	1.14	**Fi7**	-5.9
EF28	8.3	**EF19**	-6.8	**WS10**	1.8	**Ro14**	0.84	**Cr11**	-5.4
PD31	6.4	**EF39**	-6.7	**Cr4**	1.8	**Cp36**	0.76	**Fi22**	-4.7
BL70	5.1	**EF6**	-6.7	**WS60**	1.7	**Cp18**	0.68	**Cr46**	-4.1
PD79	5.0	**EF45**	-6.3	**Hy75**	1.4	**Cp26**	0.65	**Fi23**	-4.0
WS33	4.8	**EF28**	-5.6	**WH58**	1.3	**BL12**	0.62	**Cr27**	-3.6
WS42	4.6	**EF44**	-5.6	**Cc38**	1.3	**Cp37**	0.47	**Cr20**	-3.4
WS51	4.3	**EF77**	-4.6	**PD31**	1.2	**Ro49**	0.44	**FL40**	-3.2
SHD78	4.0	**Cr4**	-4.4	**Cp65**	1.1	**Cr20**	0.41	**Fi3**	-2.9
WS80	3.9	**EF47**	-4.3	**Cp26**	0.9	**Cr27**	0.40	**Fi9**	-2.9
BL12	3.8	**M56**	-3.6	**BoL34**	0.9	**BL32**	0.38	**Fi21**	-2.7
BL54	3.8	**EFP68**	-3.4	**Hy30**	0.8	**Cr4**	0.38	**FiF48**	-2.5
EF19	3.6	**M72**	-2.3	**PD79**	0.7	**BL35**	0.33	**Cr4**	-2.5
EF39	3.4	**Cc38**	-2.1	**WS33**	0.6	**Cr46**	0.32	**Gr41**	-2.1
BL71	3.3	**Ro14**	-1.9	**Cp16**	0.6	**BL8**	0.27	**Fi17**	-1.5
WH58	3.1	**Cr27**	-1.8	**EFR69**	0.6	**BoL1**	0.24	**Hy30**	-1.3
Fi67	3.0	**WS33**	-1.7	**Ch66**	0.6	**Cp16**	0.24	**Hy29**	-1.1
BL2	2.9	**FiF76**	-1.6	**WS51**	0.5	**Cr11**	0.24	**EF45**	-0.6
FL40	2.8	**Cr64**	-1.5	**EF6**	0.5	**BL25**	0.23	**BL13**	-0.6
BL62	2.7	**Cr20**	-1.4	**Hy29**	0.5	**BL24**	0.16	**BoL43**	-0.6
		WS60	-1.4						

Understanding the EBVs

The 1stX EBVs are based on measurements on the 1stX progeny of sires mated in 1997, 1998 and 1999 at Cowra, Hamilton and Struan. The 1stX wether progeny were slaughtered at heavy weights (22 to 25 kg carcass weight, depending on the site). The 1stX ewe progeny were shorn as hoggets and individual mid-side samples tested for yield and fibre diameter. Three common sires (BL12, Cp5, Fi7) are used across all sites in each year to provide genetic links to allow EBVs to be calculated across all data.

Sire EBV for Weight (kg)

Data include 1stX ewe and wether weaning weight and post weaning weight (ewes about 7 months, wethers prior to slaughter) data, with adjustment for age and type of birth and rearing. *The EBVweight describes the sires' genes for fast growth to heavy weights.*

Sire EBV for Fat (GR mm at constant weight)

Data include carcass GR and C fat depth measurements on 1stX wether progeny independent of carcass weight. *The EBVfat describes the sires' genes for producing fat (+) or lean (-) carcasses, independent of the carcass weight.*

Sire EBV for Eye Muscle Area (cm2 at constant carcass weight)

Date include carcass eye muscle area and depth measurements on wether progeny independent of carcass weight. *The EBVema describes the sires' genes for producing large (+) or small (-) eye muscles, independent of the carcass weight.*

This allows a comparison of the relative eye muscle area and fat levels for sires with progeny of different average carcass weights.

Sire EBV for Clean Wool Weight (kg)

1stX ewe progeny were shorn as hoggets and mid-side samples tested for yield to determine clean fleece weight. *The EBVwool weight describes the sires' genes for producing high (+) or low (-) clean wool weights.*

Sire EBV for Fibre Diameter (μm)

1stX ewe progeny were shorn as hoggets and mid-side samples tested for average fibre diameter. *The EBVfibre diameter describes the sires' genes for producing wool of high (+) or low (-) fibre diameter.*

Sire EBV for Faecal Egg Count (FEC)

Based on a faecal egg count in 1stX ewes, generally at less than 12 months of age. The units for the EBVs are $\sqrt[3]{}$ (eggs/g). Samples could not be collected from any of the 1stX ewes at Struan. *The EBVfec describes the sires' genes for resistance to worms, with negative values having lower egg counts and showing more resistance than sires with positive values.*

These EBVs have been calculated using LAMBPLAN analysis procedures, solely from data generated within the MCPT sites. This means they are independent of LAMBPLAN Across-Flock EBVs and are not comparable.

The 2000 data set contains 5439 1stX progeny (ewes and wethers with weights) from 80 sires. There are 400-500 1stX progeny from each of the link sires and an average of 53 1stX progeny from the other sires tested. The EBVs for carcass, wool and FEC traits are based on approximately half these records as measurements are only made in one sex.

Range in 1stX EBVs

Some interesting trends are starting to show up in the results. In particular, there are considerable ranges in sire EBVs for 1stX meat traits (80 sires) and 1stX wool traits (51 sires) (Table 7.5). The ranges in EBVs represent very large differences in growth and fat levels in 1stX progeny of these sires and are about twice the range found for terminal sire progeny tests (Banks et al. 1995). Several sires and breeds were represented among the trait leaders (Table 7.4) and there was considerable variation between individual sires within the breeds. The leading sires are generally different for the various traits, although EF59 is the trait leader for weight (+8.9kg) and fat (-8.2mm). The East Friesian sires (9 sires tested) were all very lean with an average EBV of –6.1mm GR fat.

Table 7.5. 1stX estimated breeding values (EBVs)

Trait	Sires	Range of EBVs	
Weight (kg)	80	+8.9	-10.9
Fat (mm GR)	80	-8.2	+8.2
Muscle (cm^2)	80	+1.9	-1.9
Wool wt. (kg)	51	+1.1	-1.0
Fibre diam. (μm)	51	+4.8	-5.9

A 1stX Meat$ index was included with the 1998 1stX EBVs, based on growth to 22.5 kg carcass weight, with economic weightings for fat and muscle, based on those used in the terminal sire CPT. The economic values used were: fat $-0.05/mmGR/kg carcass weight, which equates to the differential paid by processors for 3 and 4 score lambs, and muscle $0.10/cm^2 ema/ kg carcass weight. However in this project the range of sire progeny fat depth is more than twice the range for terminal sires. This has the effect of fat driving the index to a much greater degree than weight and muscle. Realistically in the lamb market there is little differential for fat at the extremes (fat and lean). The value of $0.05 used in the index does a reasonable job with most sires, but it gives too high a premium to those that are extremely lean and too large a discount to those that are extremely fat. The TTAG highlighted the problem and recommended that the index not be used in future. With this extreme range in fat the normal linear indexes are not appropriate. Development of the more appropriate indexes will continue within the project and becomes more complex and critical as 1stX lambing performance is incorporated.

7.5 Evaluation of 1stX Ewes

Joining at 7 months

The 1stX ewe progeny were grown out and cycling activity monitored with harnessed teasers through their first autumn. The 1stX ewes at Hamilton and half the ewes from each sire at Cowra were joined at 7 months of age to terminal sire rams. The percentage of ewes pregnant (Fig. 7.6) and average foetal number (Fig. 7.7) for the 1997 drop 1stX ewes ultrasound scanned at the end of May 1998 at Cowra illustrate the variation found among groups of 1stX ewes by different sires.

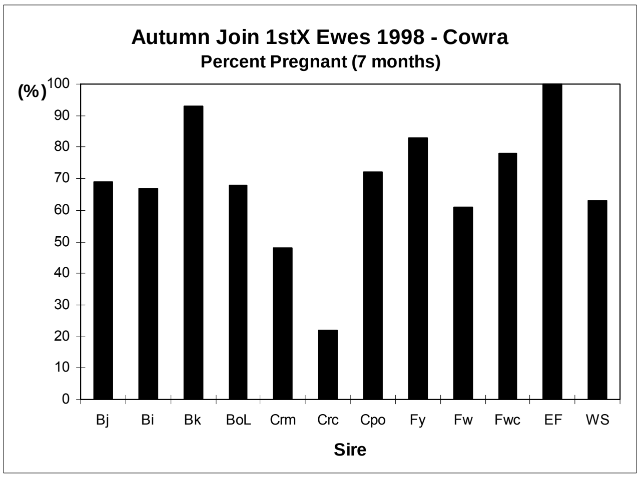


Fig 7.6. 1stX ewes joined at 7 months

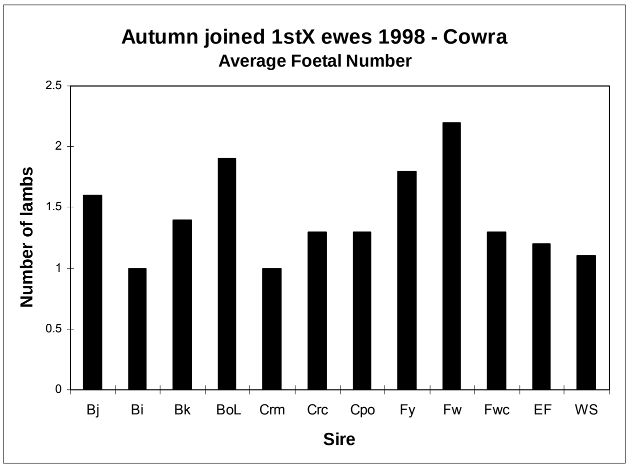


Fig. 7.7. 1stX ewes joined at 7 months

The percentage of ewes becoming pregnant at this young age of 7 months is effected to some extent by their liveweight (see Fig. 7.8). Generally, heavier ewes cycle and become pregnant more readily, but there were differences in the proportions pregnant for sires with similar progeny weights.

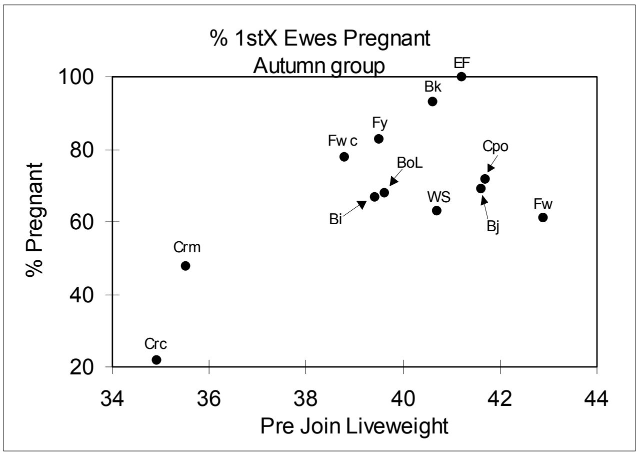


Fig. 7.8. Relationship of pregnancy and ewe liveweight

The data over three years of joining at 7 months, involving 57 sire groups at Hamilton and Cowra has been examined by Cummins and Fogarty (2000). The results shown in Table 7.6 are based on real time ultrasound pregnancy diagnosis carried out in mid pregnancy. At each site and for each year, the sires have been ranked in order of conception rate in their seven-month-old ewe progeny from highest to lowest, and for further descriptive purposes classified into thirds.

Table 7.6. Effects of sire of 1stX ewes on pregnancy rates(%) when joined at 7- months of age

Hamilton			**Cowra**		
1997	**1998**	**1999**	**1997**	**1998**	**1999**
EF 19 (94)	EF 47 (100)	BL 62 (79)	EF 6 (100)	EF 39 (100)	BoL 55 (88)
Fi 21 (84)	BL 12 (80)	Fi 7 (75)	BL 12 (93)	BoL 34 (80)	BL 53 (79)
Fi 17 (80)	BoL 43 (75)	EFR 69 (72)	Fi 3 (83)	Fi 7 (80)	BL 54 (76)
BL 13 (71)	Tx 50 (72)	Fi 67 (64)	Fi 9 (78)	WS 42 (76)	BL 52 (74)
Fi 7 (62)	*FiF 48 (72)*	*EFP 68 (59)*	*Cp 5 (72)*	*BL 12 (75)*	*BL 12 (69)*
Cp 16 (50)	*Cp 5 (63)*	*BoL 63 (41)*	*BL 2 (69)*	*FL 40 (71)*	*EF 59 (58)*
BoL 15 (46)	*EF 44 (61)*	*Ch 66 (41)*	*BoL 1 (68)*	*Cp 36 (68)*	*Cp 5 (50)*
BL 12 (42)	*EF 45 (54)*	*Cp 65 (38)*	*BL 8 (67)*	*Cp 5 (58)*	*Fi 7 (47)*
Cp 5 (38)	Fi 7 (50)	BL 61 (38)	WS 10 (63)	Gr 41 (44)	WH 58 (42)
Ro 14 (27)	Ro 49 (43)	BL 12 (33)	Fi 7 (61)	Cp 37 (41)	M 56 (41)
Cp 18 (26)	WS 51 (31)	Cp 5 (33)	Cr 4 (48)	BL 35 (41)	EL 57 (38)
Cr 20 (24)	Cr 46 (21)	Cr 64 (9)	Cr 11 (22)	Cc 38 (31)	WS 60 (21)

link sires are shown in bold and sire codes are in Appendix 2

The best third had a pregnancy rate of 79% at Hamilton and 84% at Cowra, while the worst third had 31% at Hamilton and 41% at Cowra. The better performance at Cowra was probably due to slightly better nutrition at this site. The link sires showed considerable variability between sites and years, suggesting that the genetic accuracy achieved with these numbers of progeny for this trait is relatively low.

Dyrmundsson (1973) in a review on puberty and early reproduction in ewe lambs reported that only 32 percent of 44 groups of lambs had a mean age of puberty of less than 220 days. Puberty in ewe lambs was affected by both genetic and environmental (both nutrition and day length) factors. The range in pregnancy rates that we are reporting here are similar to those in his review.

The sire groups were classified into thirds and then looked for breed effects for those breeds represented by multiple sires. The fact that sires were nominated by their owners and not sampled randomly from the breeds, means that the breed effects shown below must be interpreted with caution. However this classification indicated that 64% of Finn groups, 57% of East Friesian groups, 50% of Booroola Leicester groups, 47% of Border Leicester groups and 18% of the other groups had pregnancy rates in the highest category. Pregnancy rates at these levels would justify joining as lambs. Conversely, 100% of the Corriedale groups, 36% of the Coopworth groups, 20% of the Border Leicester groups, 18% of the Finn groups and 59% of the other groups had pregnancy rates in the lowest third, which would seem to preclude a successful joining as ewe lambs at 7 months of age.

Mating ewe lambs at 7 months of age in Australian prime lamb production systems has been quite unusual, but in some instances the asynchrony between the breeding seasons of the Merino and prime lamb flocks has allowed successful mating at 9 to 10 months of age. The data presented here indicates that there are many Finn, East Friesian and Border Leicester sires whose F1 female progeny can exhibit high pregnancy rates when mated at 7 months of age. There are, however, a few sires of these breeds and a relatively high proportion of sires from other breeds that would be disappointing when mating their ewe progeny at this age. The challenge is to develop genetic information systems which will allow producers to recognise these differences. The development of new composite breeds or crossbreeding systems that include genes enhancing early puberty could allow the more complete separation of the Australian wool and lamb industries. Such new composites would have a range of other breeding objectives as well, which would allow them to meet specific production system and marketing needs.

Ovulation Rate

The 1stX ewes at Struan have had ovulation rate recorded in May at about 11 months of age. There is a considerable range in ovulation rate among sire groups at this early age which indicates potential differences in lambing rate. The 1999 drop 1stX ewes were 45.1 kg (fasted weight) in May 2000 and the range for ovulation rate is shown in Fig 7.9.

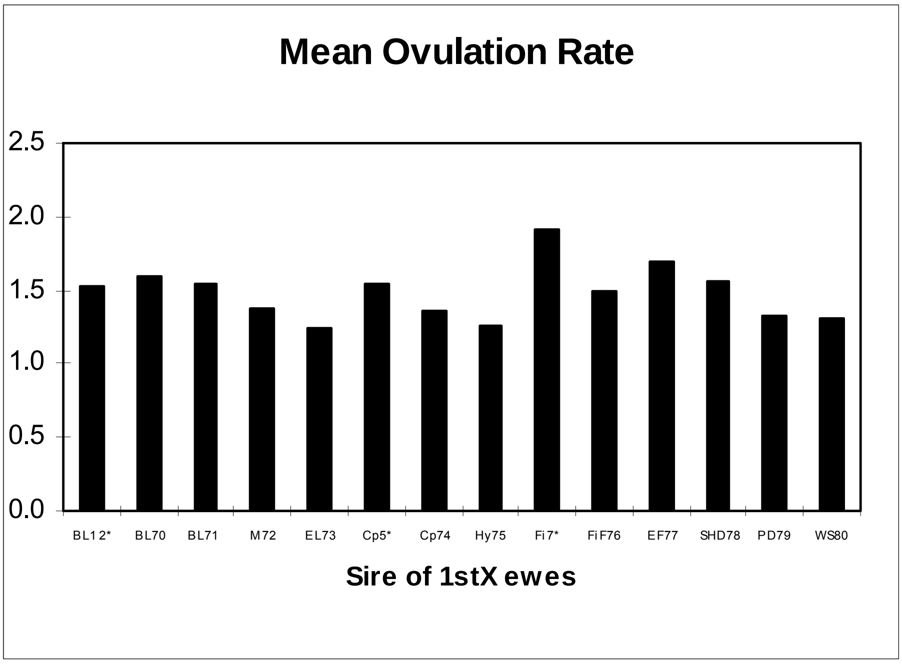


Fig. 7.9. 1stX ewes – 1999 drop Struan

Lambing Rate

At Cowra the autumn joined 1stX ewes born in 1997 (average 16 progeny of 12 sires) were the first group to complete evaluation. They were mated naturally to Poll Dorset rams in Feb/March 1998, 1999 and 2000 to lamb at 1, 2 and 3 years of age. In each year the 2ndX lambs were slaughtered as a group (about 7 months of age) when they reached a target average carcass weight of 22kg.

At the 2000 lambing from the 1997 and 1998 drop 1stX ewes (autumn joined at Cowra) there was an average of 135% of lambs weaned (per ewe joined). Over 88% of the ewes lambed from the 5-week joining and the ewes that lambed averaged almost twins born. However there was again a very large range in lambing performance from the groups of 1stX ewes by different maternal sires (Fig. 7.10 and Fig. 7.11). The top of the bar gives the % lambs born and the top of the solid bar gives the % lambs weaned. Among the 1997 drop ewes (Fig. 7.10) the BL2 and Fi9 groups weaned 167% of lambs, with 3 other groups weaning 150%.

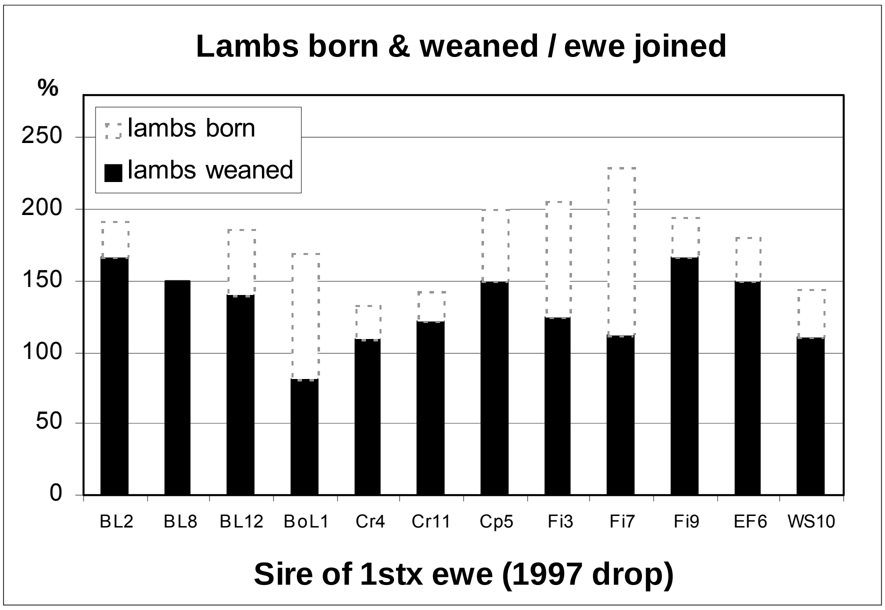


Fig. 7.10. Autumn joining 2000 - Cowra

Among the 1998 drop ewes (Fig. 7.11) the Cp5 group weaned 183% and WS42 169% of lambs, with 3 other groups weaning 150% or more. For both drops some other groups had more lambs born, partly due to a high proportion of triplets but had lower lamb survival that resulted in fewer lambs weaned.

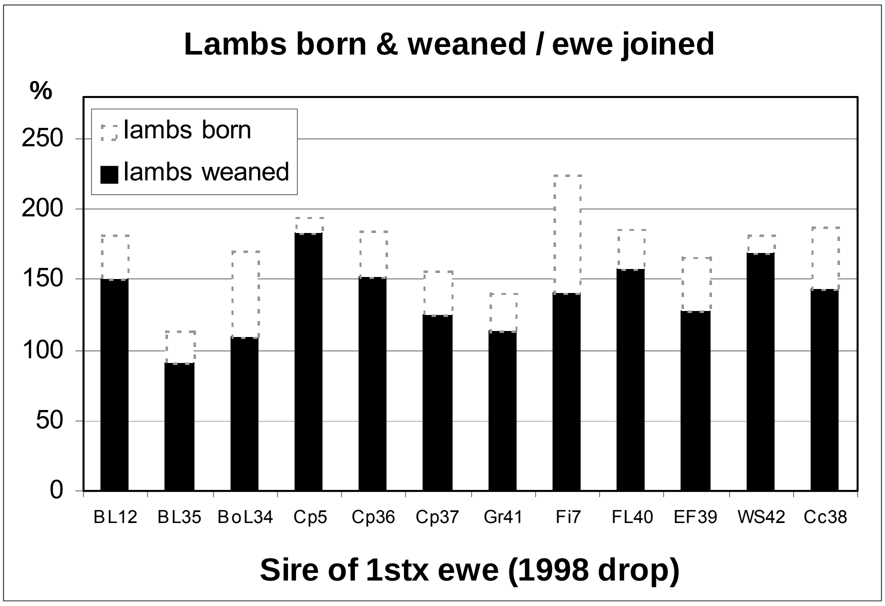


Fig. 7.11. Autumn joining 2000 - Cowra

The total lambs weaned per ewe joined (Cowra 1997 drop) over three lambings varied considerably (Fig. 7.12) and ranged from 81 to 167% lambs weaned per ewe joined in 2000. While some other groups had higher percentages of lambs born, due to higher average litter size, lower lamb survival reduced their lamb weaning percentage. Lambing rates were low in 1998 when the ewes were joined at 7 months of age, although one group achieved 100% lambs weaned (Fi3) and others were over 90%. There was reasonable consistency of performance of the ewe groups over the three years.

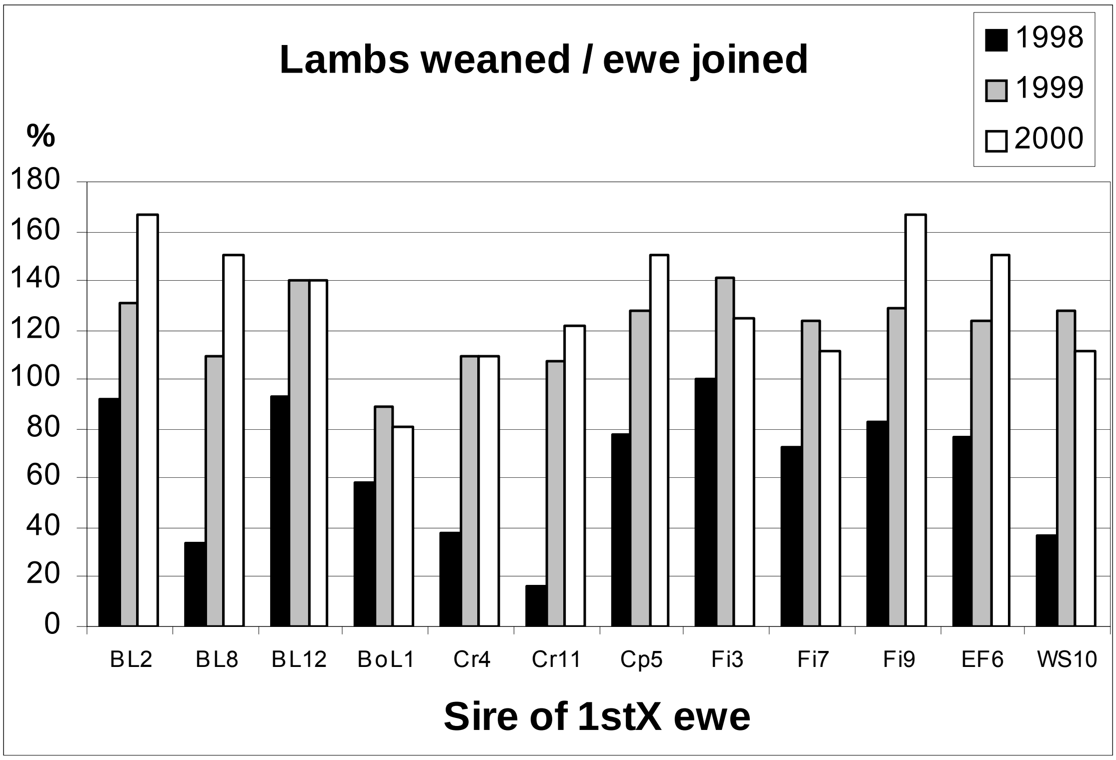


Fig. 7.12. 1997 drop 1stX ewes mated in autumn 1998, 1999 and 2000 at Cowra.

2ndX Lamb Production

The sire is generally relied on to produce the right lamb carcass for the market. While the contribution of the ewe is often overlooked. The results show different ewe types can have a large effect on the carcass traits of their lambs. These differences in fat levels, muscling and conformation can have a dramatic impact on the success in meeting particular market specifications.

There was a large range between the groups of 2ndX carcasses for fat levels, muscling and conformation as well as growth and dressing percentage. There was a range of 5mm GR between the groups (Fig. 7.13) for carcasses of the same weight. This represents a difference of a full fat score due to different 1stX ewes alone. Lambs from East Friesian (EF6) 1stX ewes were very lean, but there was a range of over half a fat score between other maternal sires within the Border Leicester and Finn breeds. The range in eye muscle area between the 1stX ewe sire groups is also shown in Fig 7.14.

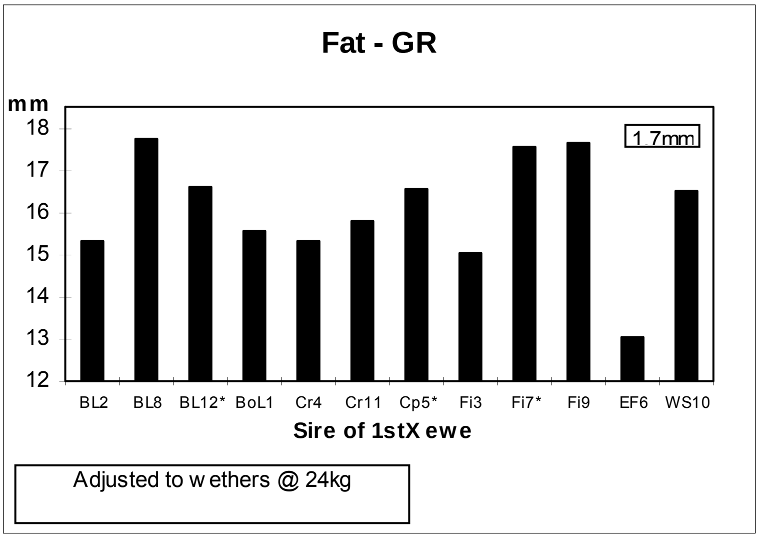


Fig. 7.13. 2ndX carcasses – 1999 Cowra

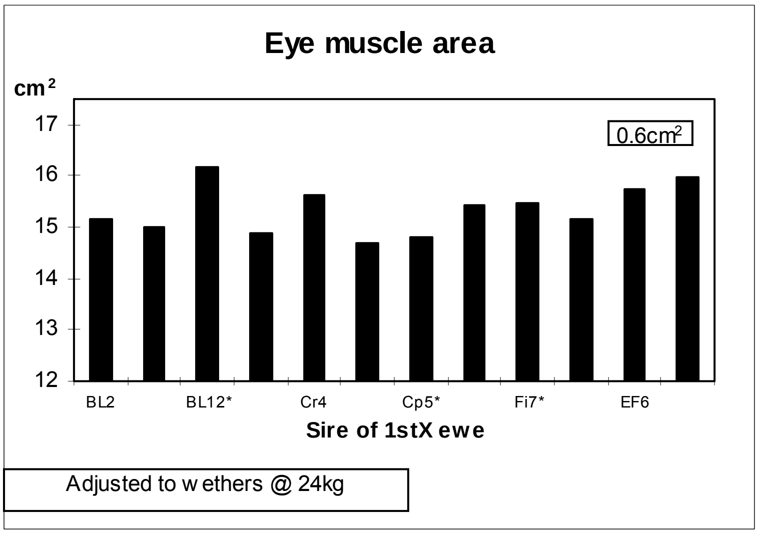


Fig. 7.14. 2ndX carcasses – 1999 Cowra

The sire of the 1stX ewe also had a dramatic effect on the growth of the 2ndX lambs. Post weaning weight of lambs prior to slaughter is shown in Fig. 7.15. The weights have been adjusted to remove the environmental effects of age, sex and birth and rearing type. Hence the differences are due to a combination of the direct genes passed on for growth and the maternal environment, including milk production, provided by the 1stX ewe. This has resulted in a range of almost 6 kg across the groups.

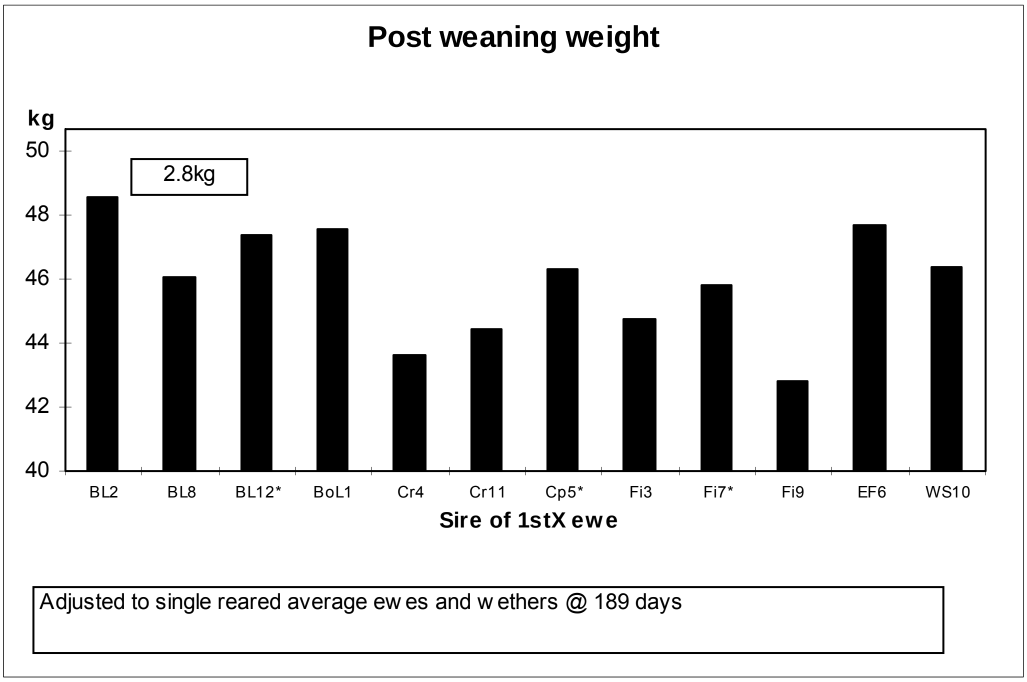


Fig. 7.15. 2ndX carcasses – 1999 Cowra

Wool Production

In contrast to other traits, there tends to be major breed characteristics for wool weight and fibre diameter, although there is still significant sire variation within breeds. The range in EBVs (51 sires) for clean wool weight was +1.1 to – 1.0 kg (Table 7.5) based on hogget shearing performance. The trait leader sires were generally Coopworth, Border Leicester and Corriedale (Table 7.4), with Finn and White Suffolk sires at the lower end (Table 7.3). However the range among Border Leicester sires was –0.34 to + 0.62. The large range in wool weight has persisted at later adult shearings. For example the average greasy fleece weights for the 1997 drop 1stX ewes at their third shearing at Cowra ranged from 4.3 to 6.2 kg (Fig 7.16). The range among the Border Leicester sire groups was 4.8 to 5.3 kg.

There was a very large range in EBVs for hogget fibre diameter from –5.9 to +4.8 microns (Table 7.3). The sires with the lowest EBVs were Finn and Corriedale, with all EBVs less than –2.5 microns being from sires of these breeds. The Border Leicester and Coopworth sires tended to be at the higher end, although the range was –0.6 to +4.4 microns for Border Leicester sires and +0.6 to +4.8 microns for Coopworth sires. The range in EBVs is likely to be greater when 1999 and 2000 sires are included as Merino sire groups, which were tested in these years, have lower fibre diameter than the Finn sires (Fig 7.17).

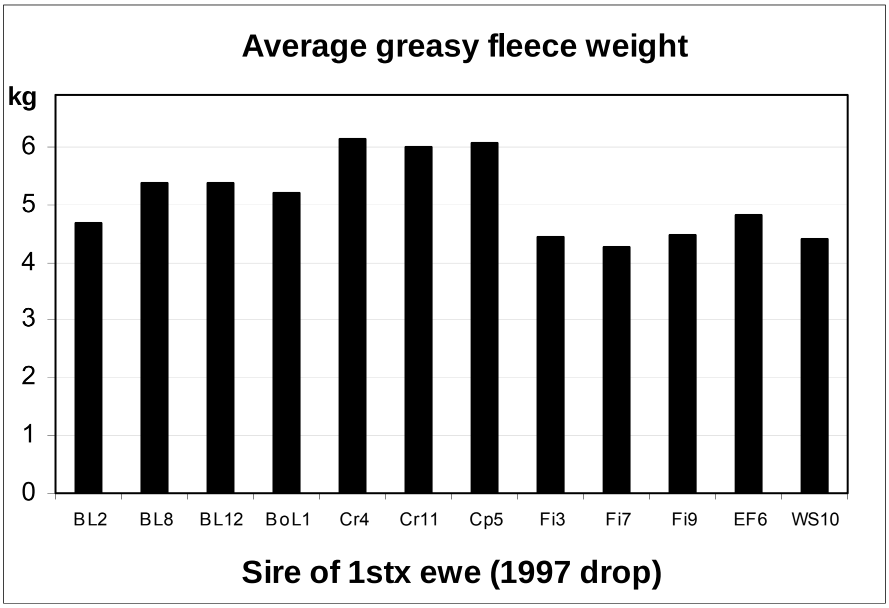


Fig. 7.16. 2000 shearing - Cowra

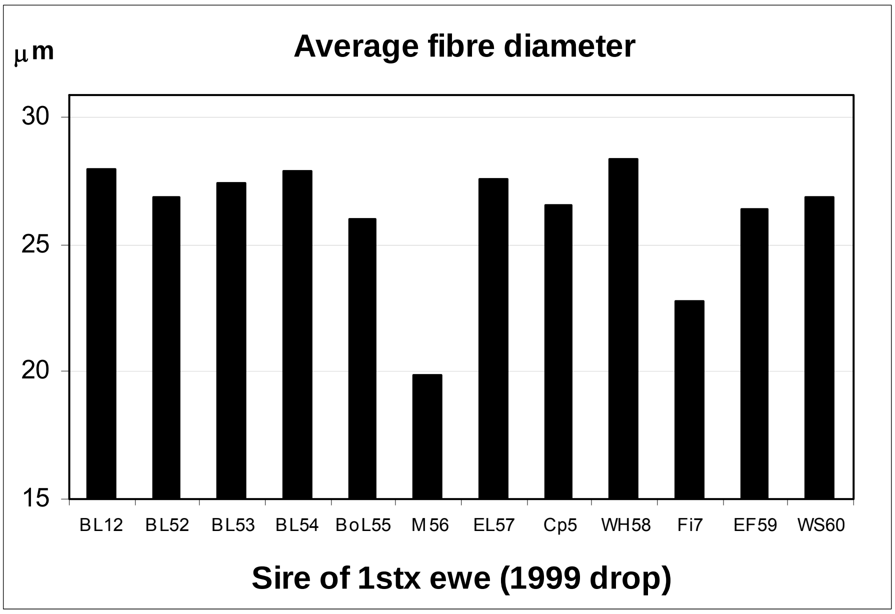


Fig. 7.17. 2000 shearing - Cowra

Wool production from 1stX ewes contributes significantly to returns from the lamb enterprise. Over the first three years of production at Cowra (when ewes were first joined at 7 months of age) wool averaged 26% of total $ returns. This ranged from 19% for a BL sire group with high lamb production to 37% for a Corriedale sire group with heavy and fine fleeces and relatively low lamb production (see Fig 7.24 in Section 7.5 $ returns).

Milk Production

Milk production of ewes affects the growth of their lambs. Production and composition of milk from the 1stX ewes is being measured. Several ewes from each sire are being milked at 3, 4 and 12 weeks during their first lactation. Milk production peaks at 3 to 4 weeks and then declines. Fig. 7.18 and Fig. 7.19 show average daily milk production over the 3 milkings for the 1997 and 1998 drop 1stX ewes respectively at Cowra. Production is higher from ewes suckling twins than singles and the values have been adjusted to a single reared basis so the groups can be compared.

1997 1stX ewes. (Fig. 7.18) Results are for the autumn and spring joined groups (lambed at 12 and 19 months resp.) with an average of 16.4 ewes/sire. There was a large range of 1.11 to 1.75 l/d for the ewe groups. Ewes rearing twin lambs had higher production than those rearing singles (1.84 v 1.49 l/d). There was also a difference between the seasons (1.34 *v* 1.65 l/d for autumn and spring joined). This difference reflects both the effects of season and the older age of the spring joined ewes.

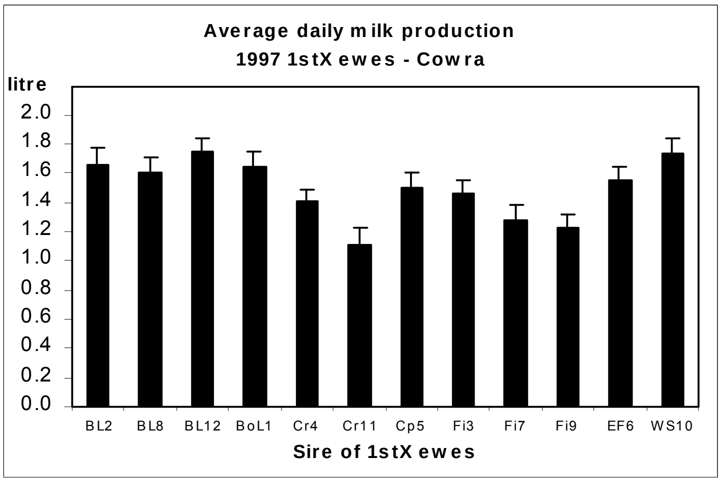


Fig. 7.18. First lactation – Cowra

1998 1stX ewes. (Fig. 7.19) There was also a large range in average milk production (1.18 to 1.87 l/d) among these ewe groups (autumn joined, lambing at 12 months - average 5.6 ewes/sire). Differences in milk composition were small and total solids reflected differences in production (Fig. 7.20).

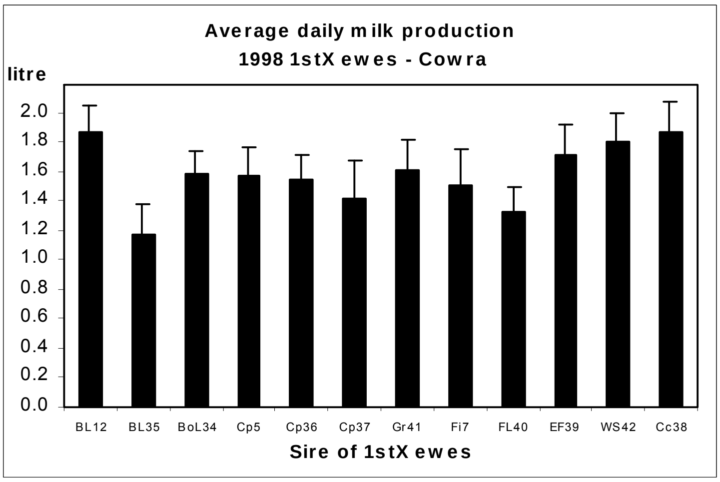


Fig. 7.19. First lactation – Cowra

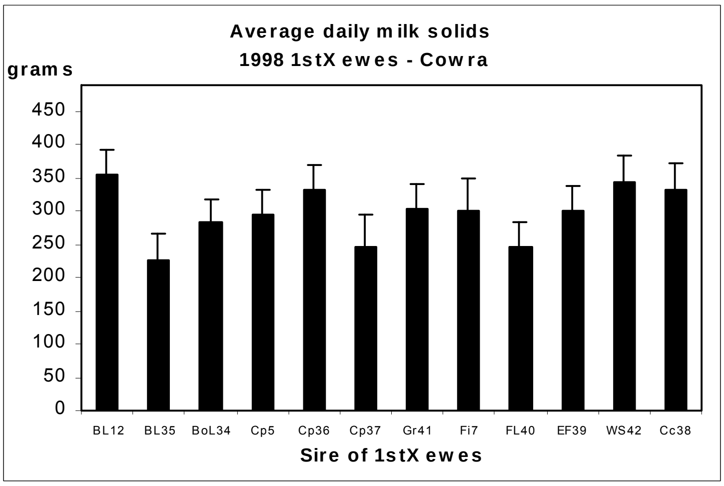


Fig. 7.19. First lactation – Cowra

Age of ewe effect

A further experiment has been undertaken by Jayce Morgan as part of her Masters studies to compare milk production, composition and lamb growth rates of the 1stX ewes of three ages or parities in both autumn and spring lambing systems. Samples of ewes by the three link sires from each of the 1997, 1998 and 1999 drops have been milked at 3, 4 and 12 weeks of lactation following the 2000 autumn and spring joinings at Cowra. The results are currently being analysed.

Milking procedure

Milk production is measured at approximately 3, 4 and 12 weeks of lactation. Ewes are injected with oxytocin to bring on *milk let-down*. They are then milked by machine and hand stripped to remove all milk. Their lambs are weighed and kept isolated from the ewes. Approximately 4 hours later each ewe is milked again (machine and hand stripped) and production measured. A milk sample is analysed for fat %, protein % and lactose % at a commercial laboratory. The time in minutes between the milkings is recorded and production adjusted to 24 hours.

As part of the development of the procedures an initial experiment was undertaken to examine the effects of different levels of oxytocin on milk production and composition and the need for hand stripping in association with machine milking to reduce variation (Morgan et al. 2000). Thirty primiparous 1stX ewes were divided into 3 treatment groups and milked on 3 occasions at 2 day intervals using the 4 hour milk test. The 3 oxytocin treatments were 1 iu, 5 iu and 10 iu with the same level of oxytocin used at the initial milking and at 4 hours. Milk was harvested by machine and hand stripping and these milk fractions were kept separate and measured for yield and composition. Percentage fat was significantly lower for 1 iu oxytocin than for 5 iu and 10 iu at the initial milking, but was significantly higher at 4 hours for 1 iu than for 5 iu and 10 iu. It appears that 1 iu oxytocin is insufficient to get full release of milk and fat from the alveoli at the initial milking resulting in higher fat at the test milking. The milk yield fraction harvested by hand stripping was 18.9% of the total yield in these non dairy sheep.

Worm Resistance

Faecal egg count (FEC) can provide a good indicator of the resistance of animals to worms. Several studies in Merinos and overseas flocks have shown FEC is moderately heritable and worm resistance can be improved by selection. In the MCPT, FEC is recorded for all young 1stX ewes at Cowra and Hamilton. This provides an estimate of the genes for worm resistance among the maternal sires.

The FEC involves collecting faecal samples from the young 1stX ewes when they have had some natural exposure to worms and built up a moderate burden prior to drenching. The main species present at Cowra have been black scour (*Trichostrongylus*), small brown stomach (*Ostertagia*) and large intestinal (*Oesophagostomum*).

The average FEC for the 1stX progeny of the sires tested in 1998 are shown in Fig. 7.21. The overall average FEC for each year has been moderate with considerable variation between sire groups. Link sire Cp5 has been consistently low over the years. Where several sires have been tested from the same breed in the same year there have generally been large differences in FEC among them. The data has been combined across sites to provide EBVs for FEC (see Table 7.3).

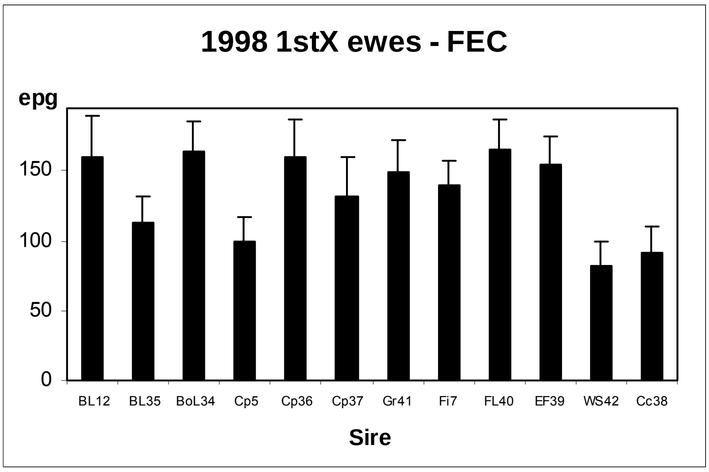


Fig. 7.21. FEC Cowra

Autumn v Spring joining – GxE?

Ewes are joined at varying times throughout the year because of different management and seasonal conditions and a market requirement for the year-round supply of lambs. Sheep tend to be seasonal breeders with the highest oestrous activity being expressed in the autumn. However there is considerable variation between and within breeds in the length of the breeding season and their out-of-season activity. The existence of significant genotype x environment (GxE) interactions pose problems for evaluation, selection and genetic improvement for both seedstock breeders and lamb producers. At Cowra the ewe progeny from each sire are split and joined in either autumn or spring. Early results have been analysed to test the null hypothesis that the GxE for lambing performance from autumn and spring joined ewes is not significant (Fogarty et al. 2001b).

The analyses involved two joinings (1998 and 1999) for 1997 drop 1stX ewes (n=425) and one joining (1999) for the 1998 drop ewes (n=440). The first joining for the 1stX ewes occurred at 7 and 14 months of age for the autumn and spring joining groups respectively. The total weight of lamb weaned and carcass for each ewe was calculated. No adjustments were made to the lamb weights (except for sex, with 5% added to ewe lambs), so the differences in total weight reflect differences in ewe lambing rate, lamb survival, earliness of lambing (age at weaning and slaughter) and pre and post weaning growth rate. The ewe traits analysed included the component traits: fertility (ewes lambing or not), litter size and ewe rearing ability (ratio of lambs weaned to lambs born for lambing ewes); and the composite traits: lambs born, lambs weaned, weight weaned and carcass weight, all expressed as per ewe joined. The analyses used maximum likelihood procedures in ASREML (Gilmour *et al.* 1999). The model included sire group, season (autumn, spring join) and the interaction. Year of joining and interactions were also fitted for the 1997 drop data set.

1997 drop 1stX ewes. Sire group was significant (P<0.01) for all the 1stX ewe reproduction and lamb traits with the very large range among the 12 sire groups shown in Table 7.7. In terms of lamb weaning rate the range was 73% to 137% and for total weight of carcass per ewe joined it was 16.5kg to 30.7kg. It is also noted that the leading sires for these traits were different. Sire group BL2 ranked second for weaning rate (126%) behind Fi3, but had heavier lambs at weaning and carcasses to be leader for these traits.

There were significant sire x season interactions for fertility (P<0.01), weight weaned (P<0.05) and weight of carcass (P<0.05). These interactions were largely due to three sire groups, BL12, Cp5 and EF6, which had considerably lower performance from spring than autumn joinings. The other sire groups generally had similar or slightly higher performance from the spring joinings.

The season x year interactions were significant for most traits, except litter size, with the predicted means shown in Table 7.7. Values are low for the 1998 autumn joining as the ewes were joined at 7 months of age to lamb at 1 year of age. The average fertility at this time was 62% although there was considerable variation among the groups because of the range in liveweight and onset of puberty at this young age. There was little difference in fertility between autumn and spring joinings in 1999. Ewe rearing ability was lower from the autumn joining when weather conditions at lambing (late July/August) were not as favourable as from the spring joining (lambing in late March/April). The season x year interaction was caused by ewe rearing being relatively lower for the ewes lambing at 1-year of age in 1998 than at 2- years of age in 1999. The season x year interactions for the other composite traits were similarly due in the main to the relatively lower performance from the ewes joined in autumn at 7 months of age.

1998 drop 1stX ewes. Sire group was significant for all the 1stX ewe reproduction and lamb traits (P<0.01, except for ewe rearing P<0.05), with the very large range among sire groups shown in Table 7.8. In terms of lamb weaning rate the range was 38% to 115% and for total weight of carcass per ewe joined it was 8.6kg to 31.4kg. The leading sire group for these traits was EF39, although it ranked below Fi7 for lambs born (144% *v* 147%). The sire x season interaction was not significant for any trait.

Table 7.7. Range of predicted sire means, significance of effects and predicted means for season x year for reproduction of 1997 drop 1stX ewes at Cowra in 1998 and 1999

	Fertility (%)	Litter size (n)	Ewe rearing (%)	Lambs born[a] (%)	Lambs weaned[a] (%)	Weight weaned[b] (kg)	Weight carcass[b] (kg)
Range - sires	57 ± 4	1.21 ± 0.10	66 ± 4	87 ± 10	73 ± 9	22.8 ± 2.5	16.5 ± 1.9
	87 ± 6	2.05 ± 0.08	92 ± 4	169 ± 9	137 ± 8	39.8 ± 2.8	30.7 ± 2.1
Sire group	**	**	**	**	**	**	**
Season	*	NS	**	*	**	NS	**
Year	**	**	*	**	**	**	**
Sire x Season	**	NS	NS	NS	NS	*	*
Sire x Year	**	NS	NS	NS	NS	NS	NS
Season x Year	**	NS	*	P<0.1	*	**	*
1998 joining							
Autumn	62 ± 3	1.38 ± 0.05	71 ± 3	92 ± 5	65 ± 5	20.2 ± 1.4	14.0 ± 1.1
Spring	75 ± 3	1.46 ± 0.05	89 ± 2	112 ± 5	96 ± 5	26.6 ± 1.4	20.7 ± 1.1
1999 joining							
Autumn	90 ± 4	1.69 ± 0.04	82 ± 2	153 ± 6	119 ± 5	42.2 ± 1.4	28.6 ± 1.1
Spring	88 ± 4	1.73 ± 0.04	89 ± 2	153 ± 5	130 ± 5	34.7 ± 1.4	30.5 ± 1.1

a per 100 ewes joined   b per ewe joined   * P<0.05   ** P<0.01

Table 7.8. Range of predicted sire means, significance of effects and predicted means for seasons for reproduction traits of 1998 drop 1stX ewes at Cowra joined in 1999

	Fertility (%)	Litter size (n)	Ewe rearing (%)	Lambs born[a] (%)	Lambs weaned[a] (%)	Weight weaned[b] (kg)	Weight carcass[b] (kg)
Range - sires	37 ± 6	1.10 ± 0.16	62 ± 6	41 ± 14	38 ± 13	10.5 ± 3.4	8.6 ± 3.2
	94 ± 14	1.87 ± 0.11	94 ± 10	147 ± 12	115 ± 12	35.2 ± 3.2	31.4 ± 3.1
Sire group	**	**	*	**	**	**	**
Season	NS	NS	*	*	**	**	**
Sire x Season	NS	NS	NS	NS	NS	NS	NS
Autumn	58 ± 3	1.37 ± 0.05	79 ± 3	87 ± 5	63 ± 5	18.2 ± 1.3	16.0 ± 1.2
Spring	66 ± 4	1.46 ± 0.05	89 ± 3	102 ± 5	86 ± 5	24.0 ± 1.3	21.9 ± 1.2

[a] per 100 ewes joined   [b] per ewe joined   * P<0.05   ** P<0.01

Performance for all traits was lower from the autumn than spring joining, although the differences for fertility and litter size were not significant. Season was confounded with age of ewes and the lower performance from the autumn joining reflected the younger age of the ewes at this joining and lambing.

Discussion. The significant sire x season interaction indicates that daughters from some sire groups at least, may be high performing when joined in the autumn but relatively lower performing from spring joinings. This appeared to occur with three of the 12 sire groups from the 1997 drop ewes. These sires were from different breeds (BL, Cp and EF) and the two other BL sire groups did not contribute to the interaction. There is considerable variation between breeds in the length of the breeding season and out-of-season breeding ability. Within breed selection has also been shown to improve out-of-season lambing performance (Notter *et al.*1998), indicating that there is some genetic control of the trait.

The sire x season interaction reported here is confounded with age at joining. In their first year, ewes were joined at 7 months of age in autumn and 14 months of age in spring. Measures of reproduction at these young ages, especially 7 months, may be different traits to adult performance. Fertility and the composite traits certainly have a component of puberty and attainment of sexual maturity as shown by the very large range in fertility at this time among the groups. Analyses of more data in subsequent years will clarify this.

Implications. Estimated breeding values (EBVs) for the number of lambs born and weaned (per ewe joined) are provided by LAMBPLAN, but take no account of any GxE. Evaluation of sires is generally in seedstock flocks where variation for out-of-season breeding ability may not be expressed. For example, BL ewes do not cycle from late spring to early autumn (Hall and Killeen 1989), although there are large differences in spring joining performance among crossbred ewes by different BL sires. Lamb breeders with a spring joining system need to take this into account in selection of sires of their 1stX ewes.

Metabolic Size of 1stX ewes

Breeders often raise the question of differences in the size and body weight of the 1stX ewes and the relative carrying capacity of the ewes from the different sires. While it is not possible to get direct measurements of carrying capacity within the current project, we can estimate the maintenance requirements of the ewes from their metabolic size ($\text{weight}^{0.75}$). The effect on $ returns of ewes adjusted to the same weight using metabolic size is illustrated below. Fig. 7.22 shows $ returns from lamb carcasses (in and out of specs) and wool for the 1997 drop 1stX ewes at Cowra lambing in spring 1999. Fig. 7.23 shows the total $ returns for the same ewes when they were adjusted to a ewe weight of 60kg (post joining weight)

The average liveweight of the 1stX ewe groups ranged from 57.4kg for Fi9 to 66.9kg for BL2. As can be seen from Fig. 7.23 comparing the 1stX ewes at an average of 60kg only made small differences to the rankings of the groups. For example Fi3 replaced BL12 as the top group, but those in the top 5 remained the same.

This statistical adjustment takes no account of feed requirements for lambs nor any inherent differences between the 1stX ewe groups that may exist for intake or net feed efficiency. Discussions are being held with other researchers to address these issues through development of associated projects.

Fig. 7.22. Autumn joined – 1999 Cowra

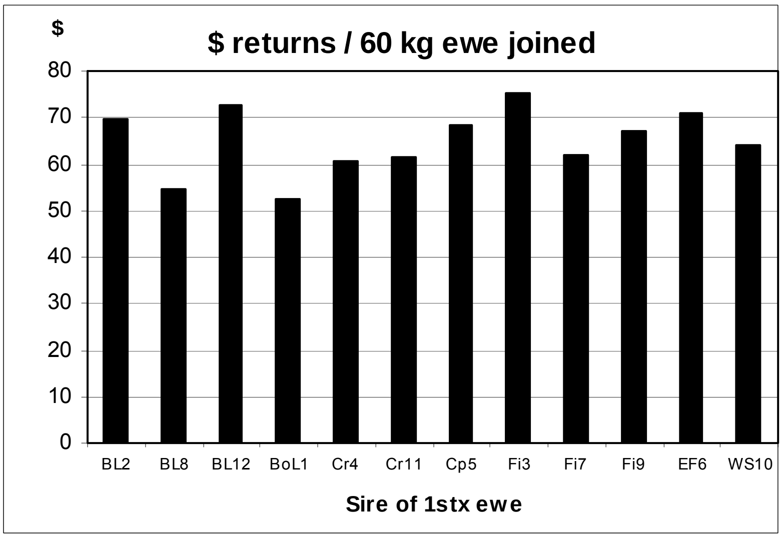


Fig. 7.23. Adjusted ewe weight - autumn joined – 1999 Cowra

7.6 $ Returns

At Cowra the autumn joined 1stX ewes born in 1997 (average 16 progeny of 12 sires) were the first group to complete evaluation. They were mated naturally to Poll Dorset rams in Feb/March 1998, 1999 and 2000 to lamb at 1, 2 and 3 years of age. In each year the 2ndX lambs were slaughtered as a group (about 7 months of age) when they reached a target average carcass weight of 22kg. The 1stX ewes were shorn in October of 1998, 1999 and 2000, with greasy fleece weight and classing bin line recorded. In 1998 mid-side samples were also taken for measurement of yield and fibre diameter.

Australian five-year average prices for 2ndX lamb carcasses and skins and 1stX wool were used to calculate $ returns. The base carcass price used was $1.95/kg, with discounts for low weight (-1.0 $/kg, <16kg) and fat score (–0.5 $/kg, score 1; -0.4 $/kg, score 5). Trade weight carcasses (16-20kg) were only given a small discount (-0.10 $/kg) because they would normally be sold in the trade market or kept longer to reach heavier weights. Average skin prices were $6.36, $7.67 and $8.42 for 16, 16-20 and >20 kg carcasses respectively.

The five-year average (1995/96 to 1999/00) wool prices for the various micron categories were used to estimate wool returns. For the 1998 hogget shearing the average fibre diameter for each 1stX ewe group was used to determine the average price (c/kg clean) for the group by interpolation, which was then multiplied by the individual clean fleece weight. For the 1999 and 2000 adult shearings each bin line was measured for fibre diameter and yield and the price for the micron category was determined as in 1998. Individual greasy fleece weight was then multiplied by the bin line yield and price. In all years the individual ewe wool return was multiplied by 0.9 to account for the lower price of the non fleece portion.

The total $ returns from the 1stX ewe groups for their lamb carcasses (in and out of specifications), skins and their wool over three years are shown in Figure 7.24. The top sire group (BL2) returned $263/ewe over three years, which was $105/ewe more than the lowest group or 23% greater than the average. Overall, lamb carcasses contributed 62% of returns, with lamb skins 12% and ewe wool 26%. Lamb value was a higher proportion of returns for those groups with higher lamb production eg. BL2 (81% for carcasses and skins), whereas more valuable fleeces from the Cr11 sire group contributed 37%. There were also large differences in the proportion of carcasses that met specifications to achieve the highest price. The EF6 and BL2 sire groups had a high proportion of carcasses meeting the weight and fat specifications.

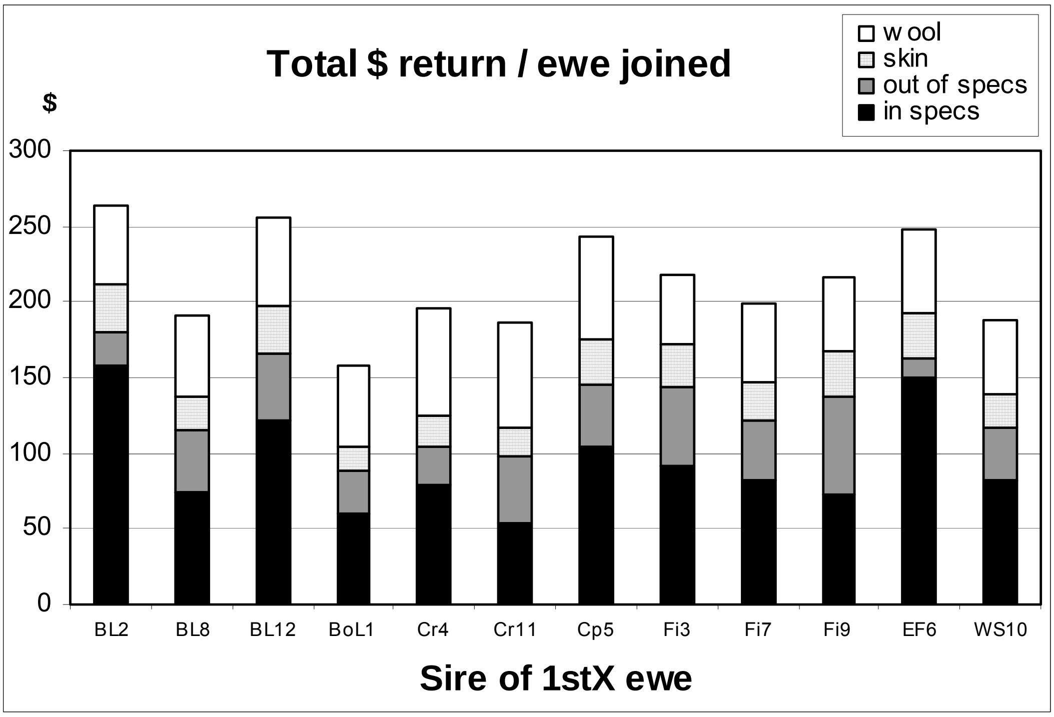


Fig. 7.24. $ returns from three lambings – autumn joining 1997 drop ewes Cowra

7.7 Management – Site Reports

Cowra

A range of seasonal conditions have been encountered over the four years of the project to date at Cowra. The project commenced with the first AI mating in March 1997, which was a dry autumn and winter, requiring the Merino ewes to be supplemented with grain and hay through late pregnancy and lambing. There was good grass/clover and dry land lucerne for lambs in early spring but the season cut out late in November, necessitating supplementation of lambs over the summer. After a very dry summer and autumn, good rain in late April and winter of 1998 saw the first lambing for 5 years without supplementary feed being required. A good spring provided lucerne for lambs until January 1999, a very hot and dry summer meant they had to be finished to slaughter on grain through February. Some supplement was required for ewes in late pregnancy and during lambing in 1999. A good spring and summer followed with good lucerne pasture into February. The year 2000 had above average rainfall with an excellent spring and no supplementary feeding required. The dry autumn in 2001 necessitated some grain and silage supplementation of ewes in late pregnancy.

The AI matings to Merino ewes in March 1997 and February 1998 and 1999 were carried out by David Kennett, Genstock, Jerilderie, with excellent results each year (see Section 7.2). Approximately 800 mature Merino ewes were mated using laparoscopic AI over three days each year. The 1stX ewe progeny were mulesed at marking. The 1997 drop 1stX ewes were grown out at Orange Agricultural Institute.

The management system for evaluation of 1stX ewes at Cowra involved a random split of ewes, within sire group, to autumn (mid Feb) and spring (mid Oct) joining, with first joining at 7 and 14 months respectively. 1stX ewes are shorn in October each year. Harnessed teasers were used to monitor oestrus and age of puberty from mid January in their first year. Teasers are also used for two weeks prior to the spring joinings to utilise the ram effect. Each age group of 1stX ewes is joined to a group of Poll Dorset rams purchased from LAMBPLAN tested flocks. Selected rams are high index (blue dot) with EBVs matched as far as possible for high weight and muscle and low fat.

An outbreak of virulent footrot occurred amongst the base Merino ewes in early September 1998 when seasonal conditions were perfect for rapid spread. An eradication program was immediately put in place. The 1stX lambs were weaned (2 weeks early at about 10 weeks of age) and the Merino ewes slaughtered. Unfortunately the dry Merino ewes were running with the dry 1997 drop 1stX ewes and there was some infection of these ewes. Weekly foot bathing was undertaken during the spring to successfully prevent spread. There was no apparent infection following autumn rain and a wet spring in 1999 with ideal conditions for spread. The final clearance was given following feet inspections of all sheep in January 2000, when the station was released from quarantine after 16 months.

It is a credit to the Manager and field staff at Cowra that this major outbreak of a virulent strain of footrot was eradicated so quickly without compromising the project. The outbreak created additional workload and management problems for staff, but there was little impact on meeting the objectives of the project. Stocking pressure was increased at Cowra because the 1stX ewe weaners could not be transferred to Orange for growing out. The Merino base ewes were replaced for the final mating which occurred on schedule in mid-February 1999.

Hamilton

The project has been carried out during a prolonged spell of dry years in SW Victoria.
First cross production. The first AI matings were carried out in March and April 1997. The ewes were in reasonable condition and we achieved a satisfactory pregnancy rate of 73%. Supplementary feeding of the ewes was required in early pregnancy but a relatively dry winter actually meant that the ewes did well in late pregnancy. Spring rainfall was relatively low but adequate but we only got a mediocre summer fodder crop. Weaning was carried out in late November with weaning weights of 26.5kg from Corriedale ewes and 23.8kg from Merinos. The male lambs were grazed on this crop until slaughter in April and May 1998. We had some losses due to Brassica poisoning which we attempted to control by feeding a hay supplement. The second batch of lambs spent the last month of finishing in a feedlot on a proprietary pellet. The ewe lambs grazed on stubbles with a lupin grain supplement in the summer/autumn of 1998.

The second AI matings were carried out in March 1998. As indicated above, this was another dry summer but the ewes were considered in reasonable condition at mating, but the AI conception rate was a disappointing 46%. Following a break in the season in late April we had quite good conditions for the rest of the year. The Merino ewes required more assistance at lambing time and birth weights were increased slightly compared to the previous year. The lambs were weaned in late November with lambs from Corriedale ewes averaging 29.7kg and from Merino ewes averaging 28kg. The slaughter lambs grazed on a turnip crop from weaning until slaughter in May. They only achieved modest growth rates on this crop, probably at least partly due to the lack of summer rain.

The third round of AI matings was carried out in March 1999. Again the season was relatively dry but the ewes were in good condition and were being supplemented with a small amount of lupins. The AI conception rate was only 54%. The ewes which were AI'ed lambed earlier than other ewes on PVI and were unaffected by the *campylobacter* abortions which affected other flocks on the Institute. Again we had a dry spring, with pasture growth barely adequate. The lambs were weaned in early December, with lambs from Corriedale ewes averaging 33.2kg and those from Merinos 30.7 kg. The brassica crop sown to finish the slaughter lambs was again very poor and was supplemented with cereal grain. There were again a few deaths due to brassica poisoning during this period, confirming that relatively poor crops grown in droughty conditions can be a problem. These lambs had to go into a feedlot for a final 2 month finishing phase and were slaughtered in mid June.

Second cross production. The first batch of second cross matings were made when the 1997 drop ewe lambs were mated to a team of Composite terminal sires at the end of March 1998 under quite poor seasonal conditions. They achieved an average pregnancy rate of 53%, with most conceptions at the end of the joining period. Seasonal conditions later in the year improved, but the lamb survival figure was only 71%. The lambs themselves grew out quite well with a mean preweaning growth rate of 295g/day. After weaning they were managed until slaughter with the first cross lambs.

In late March 1999 these young ewes (1997-drop) were rejoined and the next batch of ewe lambs (1998 drop) were also joined. The young ewes achieved a scanned pregnancy rate of 97% with a 54%multiple pregnancy rate. The ewe lambs achieved a pregnancy rate of 59% with most conceptions late in the joining season. Both these flocks were seriously affected by an *Ovine Campylobacteriosis* (Vibriosis) abortion problem. This resulted in a lambs marked to lambs scanned ratio of 51% for the older ewes and 60% for the ewe lambs. We propose to join these two groups of ewes one extra time to help compensate for these losses. The lambs from the 1997-drop ewes had a preweaning growth rate of 290 g/day, while those from the ewe lambs had a growth rate of 275 g/day.

The matings in 2000 commenced in mid March under near drought conditions with all ewes being heavily supplemented with cereal grain. The 1997-drop group were in satisfactory condition but the 1998-drop and the 1999-drop (ewe lambs) were in lighter condition than would be desirable. The 1997-drop ewes achieved a scanned pregnancy rate of 97% with 49% multiples. The 1998-drop ewes achieved a scanned pregnancy rate of 98% with 41% multiples, however 56% of these conceptions were later in the joining season. The ewe lambs achieved a pregnancy rate of 49% with most of these at the end of the joining period. Seasonal conditions were good during late winter and early spring, but they dried off very quickly and severely in late spring. The lambs from all 3 groups were weaned in early December with mean weaning weights of 32.4kg for the lambs from the 1997-drop ewes, 30.7kg from the 1998 ewes and 22.2 for the 1999-drop ewes. This suggests a 10 to 20% reduction in lamb growth rate compared to previous years, probably due to the reduction in feed quality at the end of this lactation. Because of the poor spring and summer conditions all these lambs went into a feedlot finishing system based on oats and lucerne hay where they gained 180 g/day. This feedlot-finishing phase had a few problems with prolapsed rectum and *Clostridium sordelli* infections.

The matings for 2001 commenced on 27 February for the 1997- and 1998-drop ewes and 15 March for the 1999-drop ewes. The ewes were in quite good condition at mating and we had a good early autumn break and a reasonable season has continued. The 1997-drop ewes had a scanned pregnancy rate of 97% with 45% multiples. The 1998-drop ewes also had a pregnancy rate of 97% with 53% multiples, while the 1999-drop ewes had a 99% pregnancy rate with 45% multiples. The 1997- and 1998- ewes mostly lambed under reasonable weather conditions but the 1999 ewes have lambed under quite severe conditions.

Struan

This project coincided with a series of uncharacteristically dry seasons, featuring late breaks, generally dry but not always mild winters and short dry springs. This resulted in generally poorer and shorter growing seasons than experienced in the Southeast Region

1998. The ewes came into mating in January in good condition and we achieved a pregnancy rate to the AI of 62%. The ewes were supplemented with clover hay from AI until just prior to lambing and maintained their body weight quite well following a good break to the season in late April which saw the ewes lambing on green grass. One bad spell of weather occurred during lambing resulting in more losses at lambing than would usually be expected. The winter was generally mild with good pasture growth and the lambs grew out well to weaning with an average growth rate of 190g/day. The lambs were drenched at weaning and run together until early November on pastures of phalaris and strawberry clover which rapidly dried off during late October and early November due to an early finish to the season. In early November the wether lambs were split off, given an Ivomec drench capsule and run on the flood irrigation (perennial ryegrass and white clover) at Struan until slaughter in late May where they had an average hot carcass weight of 24.1 kg. The ewe lamb portion was supplemented with clover hay at pasture over summer and sent to Rutherglen in early August

1999. The ewes were in good condition at AI and this resulted in a good conception rate of 71%. However, due to a late break which necessitated a lot of supplementary feeding the ewes were in poorer condition than 1998 at lambing. Once again we were unlucky to have bad weather during lambing which resulted in reduced lamb survival which was very disappointing after the good conception rates. Winter feed conditions were generally poor resulting in lower growth rates than 1998. The lambs were weaned in mid September and received an Ivomec drench at that time, grazing on phalaris and strawberry clover pastures until early December. At that time they were drenched with Cydectin before going onto Struan's irrigation where they maintained growth rates of 190 g/day. The wether lambs were slaughtered mid May with an average hot carcass weight of 21.9 kg. The ewe lambs were transferred to Rutherglen in early June with a liveweight of 45 kg.

2000. As a result of poor seasonal conditions in 1999 the Merino ewes were generally in poorer condition at mating in January than previous years, but we still achieved a conception rate of 63%. There was a good break to the season in mid May which meant the ewes all lambed on sufficient paddock feed with the lambs growing at 200 g/day from birth to weaning as a result of good pasture growing conditions during a very mild winter. The lambs were weaned in mid September onto ryegrass and white clover pastures after receiving a Cydectin drench. The lambs were drenched again with Cydectin in early December and put onto the irrigation averaging growth rates of 140 g/day due to particularly hot and dry conditions during December , January and February. This meant the irrigation had to work particularly hard to keep pasture growth up to the animals. The wether lambs were slaughtered in late May with a carcass weight of 24 kg and the ewe lambs were sent to Rutherglen with a liveweight of 48 kg in early June

Rutherglen

A total of 900 1stX ewes which were bred at Struan, SA were delivered to Agriculture Victoria – Rutherglen (AV-R) in 1999, 2000 and 2001. To date there has been two seasons of lambings and one slaughter. Ewes are joined to high performance White Suffolk rams for six weeks in November-December with lambing in mid-April.

There were higher conception rates of the maiden ewes in 1999 (85% 1998 drop) compared to maiden ewes in 2000 (69% 1999 drop) which is difficult to explain. The 1999 drop maiden ewes were actually 3kg heavier at joining than the 1998 drop when they were joined as maidens. All ewes are joined under similar circumstances. It should be noted that although the overall average of the 1999 drop is 69%, the range was 26% to 100%. The 1998 drop achieved 94% from their second joining which occurred at the same time as the 1999 drop maiden mating.

Seasonal conditions in late 1999 and early 2000 were good and the ewes needed only a small amount of hay supplementary feeding to keep them in peak condition for lambing in autumn 2000. It was not necessary to supplementary feed the ewes (and lambs) post-lambing and weaning as the remainder of the 2000 season until the lamb slaughter in November was excellent, although declining rapidly.
Seasonal conditions in 2001 have been poor with minimal feed available in summer and autumn. Below average rainfall in December 2000 and January 2001 restricted growth rates of lucerne. Ewes were heavily supplementarily fed grain and hay in early autumn and throughout lambing. Supplementary feeding continued until weaning and lambs were fed a small quantity of grain for one month following weaning. Pasture growth post-weaning has improved but only marginally which is reflected in the lower lamb growth rates in 2001 compared to 2000.

At the AV- R Annual Field Day in September 1999 and October 2000, the ewes (and lambs in 2000) were displayed in their sire groups with EBV information provided. The large liveweight variation between sires groups was clearly obvious.

8. INDUSTRY IMPLICATIONS

Progeny testing maternal sires involves two phases corresponding to the 1stX and 2ndX breeding sectors in the lamb industry; firstly the growth and carcass performance of 1stX lambs and secondly the 2ndX lamb performance and wool production of 1stX ewes. The first phase of the MCPT will be completed shortly with the publication of the 1stX EBVs for weight, fat and muscle for all 91 maternal sires entered, following slaughter of the final group of 1stX wethers from Struan in June 2001. The second phase, evaluation of 1stX ewes over three lambings, will be completed in 2004.

The MCPT is testing 91 sires from several maternal breeds including Border Leicester, Coopworth, East Friesian and Finnsheep. Results to date demonstrate considerable variation among sires in performance of their crossbred progeny. The considerable ranges in 1stX EBVs, especially for weight and fat, are approximately twice those for terminal sires (Banks *et al.* 1995) and provide considerable scope for selection and genetic improvement within maternal breeds. Choosing sires from the extremes would result in 1stX lambs differing by 10kg post weaning and their carcass fat by 8mm GR or 1.5 fat scores at the same carcass weight. Subsequent results have shown the differences in growth and fat levels persist in 2ndX lambs with a range of up to 6kg post weaning and 5mm GR or 1.0 fat score.

There is a dramatic effect of the maternal sire on returns from the 1stX ewe. The major driver is number of lambs slaughtered with wool contributing about 26% of returns. Results from early groups of 1stX ewes at Cowra have shown lamb weaning percentage ranging from 81 to 167% from adult ewes and total returns varying by $35/ewe/year. Early results from other sites are showing similar ranges among the 1stX ewe groups. A range of this magnitude represents a difference in lifetime returns of $13,125 from 1stX ewe progeny per maternal sire. It should also be remembered that the maternal sires were entered by seedstock breeders as their top genetic material and there is likely to be a much greater range in performance if all sires being used across the industry were sampled. Opportunities exist to exploit this variation to improve commercial flocks.

It is also apparent that the leading sires for each of the various traits are different. This highlights the need for breeders at all levels to carefully consider the traits that contribute to their enterprise and select sires accordingly. 1stX, 2ndX and maternal seedstock breeders all have different objectives. The majority of the increased returns from genetic improvement of maternal sires are reaped by the 2ndX breeder, yet they are the farthest removed from the selection decisions because of the tiered crossbreeding structure that exists in the industry.

1stX breeders can make considerable improvement by using sires with high EBVs for growth and leanness. The sires selected by the 1stX breeder can have a large effect on the returns and profit generated directly from the 1stX wethers slaughtered and 1stX ewes sold. In contrast, 2ndX breeders make the greatest gains from improvement in lambing rate with significant contributions from growth, leanness to match specifications, muscling and wool. The tiered crossbreeding structure in the industry leads to *market failure* in the sale of 1stX ewes, because of a lack of information on their real value at the point of sale. The structure also fails to provide incentives for selection and use of superior genetic merit maternal sires. Alternative structures need to be developed to facilitate a more transparent market with better information flow. This would give 2ndX lamb producers greater control over the genetic merit of their crossbred ewe flock and give 1stX breeders the opportunity to obtain the *true* value of their 1stX ewes.

Ensuring the genetic merit of prime lamb dams

Prime lamb producers are realising the importance of the genetics of the dam to the profitability of their enterprise. They are increasingly looking to ensure the high genetic merit and health status of their crossbred ewes. There are several approaches to this:

Breed your own

Maintain a self-replacing flock, such as Coopworth, to breed replacements as well as use for commercial lamb production. This has the advantage of controlling the breeding program and health status of your enterprise, but incurs the extra expense and management of growing out replacements and running a selection program. Some breeders are also developing composites to exploit some of the imported breeds. The feasibility of self-replacing flocks is enhanced considerably if young ewes can be bred successfully in their first year.

Purchasing 1stX ewes

Certify that the 1stX ewes are sired by high performance LAMBPLAN tested rams. Determine that the LAMBPLAN selection criteria used for the sires is suitable for the buyer's own production and marketing system. Ensure the 1stX ewes come from a high performing base flock (Merino or otherwise).

Contract matings

Producers contract to purchase 1stX ewes, that are sired by rams they have selected or fully or partially purchased. This allows the producer to choose a high performing base flock and control the genetic merit of the sires used. Several producers are looking to some form of contract matings to provide assured genetic merit and health status for their flock. The desire to use some of the new genotypes that have recently become available is likely to further promulgate the use of contract matings. Contract matings are also likely to be attractive to Merino breeders and groups who are interested in getting more directly involved in the lamb industry.

Take Home Messages

- The sire of the 1stX ewe has a major impact on 1stX lamb production by affecting:
    - lamb growth ***(carcass weight and 1stX ewe breeders)***
    - carcass fat and muscling ***(number meeting specs)***
- The sire of the 1stX ewe has a major impact on total $ returns to the 2ndX lamb enterprise by affecting:
    - lambing rate, including lamb survival ***(number slaughtered)***
    - lamb growth ***(carcass weight)***
    - fat level ***(number meeting specs)***
    - ewe wool production and value
- The top sires are from several breeds.
- Choice of the best sire for 1stX ewes will depend on the management and marketing system in the lamb enterprise.

Management and Marketing Issues

Some of the choices faced by breeders at the various levels in the industry are illustrated by *Staffo's flock* for selection of the best crossbred ewes.

Staffo is a lamb producer who uses crossbred ewes, which he buys from his friend Leo. Staffo wants Leo to produce him the most profitable ewes for his flock and he has the choice of rams from the MCPT.
Overall profitability depends mainly on:

- how many ewes and wethers the ram produces in Leo's flock
- how many lambs the crossbred ewes produce in Staffo's flock
- how heavy the sale lambs are
- do they get a discount for fatness or premium for muscling

Some rams will be better than others in different situations. So Staffo has to define a few things first to be able to choose the best sire for his crossbred ewes.

Production system. Leo mates 50 Merino ewes to each ram for 4 years which produces 100 crossbred ewes and 100 crossbred wethers. Leo sells his wethers at 22.5 kg carcass weight.
Staffo buys crossbred ewes from Leo, mates them to lamb at 2yrs of age and keeps them for 5 lambings. Staffo averages 100% lambing from adult ewes (ie 100 lambs sold per 100 ewes mated) and 80% from maidens. He sells 2ndX lambs at 22.5 kg carcass weight.

Markets. Both Leo and Staffo sell their market lambs over the hooks. They estimate the following prices are expected.
Weight - Leo's first cross lambs: $2.00/kg carcass weight; Staffo's second cross: $2.20 per kg carcass weight.
Fat - Both sell in a system that penalises fat score 5 lambs by 20 c/kg. Leo rarely produces fat score 5 lambs, so lean is not of value to him. However, Staffo produces about 20% fat score 5 lambs and is discounted on these. This is the equivalent of a penalty of 4c/kg overall.
Muscling - Neither Staffo nor Leo get a direct premium for muscle. However both know that they will be able to negotiate a higher price ie about $1-00 per lamb if they develop a reputation for well muscled sheep. This is equivalent to about 4c/kg for an extra cm^2 of muscle.

Leo can use any of the rams in the MCPT to produce Staffo's ewes. His question is:

- which ram will make him the most money from his crossbred wethers, and
- persuade Staffo to pay more for the crossbred ewes.

Staffo, being a mercenary producer, is only interested in making the most money out of his ewes. Both Staffo and Leo will make money out of fast growth, muscling and leanness. Staffo will also make money from the fertility of the ewes, their ability to impart growth to the lambs (often called mothering ability) and their fleece value. However for the present Staffo will only consider lamb weight, fat and muscling.

Staffo has a computer program that predicts the value of using different rams in Leo's flock. It calculates the extra value of carcasses from using a particular ram, over the average ram, in Leo's flock. The extra value is in Leo's flock and also in Staffo's flock through the crossbred ewes. The EBVs used in these calculations were presented in *Dynamic Dams No 8 August 1999*. (NB Staffo's computer program was developed to use LAMBPLAN EBVs which are based on yearling weight, rather than postweaning weight.)

Table 8.1. Extra $ returns from slaughter lambs in Leo's and Staffo's flocks from using EF28 and PD31 over the average MCPT rams

Sire	**EF28**		**PD31**	
Slaughter lambs	**Leo's 1stX wethers**	**Staffo's 2ndX lambs**	**Leo's 1stX wethers**	**Staffo's 2ndX lambs**
Weight ($)	2.54	1.4	2.08	1.14
Fat ($)	0	1.12	0	-0.02
Muscle ($)	-0.68	-0.34	0.47	0.23
Total $/lamb	**1.86**	**2.18**	**2.55**	**1.36**
No. lambs	100	480	100	480
Total $/sire	**186**	**1046**	**255**	**652**

Table 8.1 shows the ram of most value to Staffo is EF28 (EBVs: weight 8.2kg, fat -5.6mm, eye muscle area -1.7cm^2). Staffo gains on average an extra $2.18 per lamb. This comes from higher carcass weight (+$1.40), leanness or fewer FS5 lambs (+$1.12), and a loss on muscling (-$0.34). The extra value to Leo from using EF28 is $1.86 per lamb. However Leo would gain more from his wethers if he used PD 31 (EBVs: weight 6.7kg, fat 0.1mm, eye muscle area 1.2cm^2) – an extra $2.55 per lamb over the average ram. This is because Leo does not need to reduce fat, and much of EF28's extra value to Staffo comes from leanness.

The other point to note from Table 8.1 is that there are a lot more lambs slaughtered from Staffo's flock than wethers from Leo's flock. The ram Leo uses produces 100 wethers, but his 100 daughters produce 480 lambs in Staffo's flock. This means that the ram used by Leo has a much greater impact in terms of total extra $ in Staffo's than in Leo's flock.

Take home messages

- the best ram will vary with different production and marketing systems ie the best ram for Leo is not the best for Staffo
- define what characters are important in gaining extra $ in your flock
- crossbred ewes produce a lot more lambs than the sire produces wethers
- if Staffo wants Leo to produce the best ewes for him, he may have to:
    - contract Leo to mate particular rams
    - pay Leo a bit more to share the advantage he gets

This example only takes account of the differences in weight, fat and muscle. The total picture also includes differences in crossbred ewe lambing rate and wool production, considered below.

Leo was considering what rams to buy. The choice was between EF28 and PD31. Based on the EBVs for growth, fat and eye muscle, Leo was best to buy PD31 unless Staffo was willing to pay extra for his ewe lambs sired by EF28. Ewes sired by EF28 gave the best return to Staffo.

Now, as it was explained, Staffo is tight, and wants to make sure that any money he spends is returned, at least two fold. He is also aware that as well as growth, fat and muscle, there are three other traits that affect this profit. These are wool cut, number of lambs weaned and the improvement to growth made by mothering ability of which milk supply is the major part.

Staffo assumes the EBVs for these traits for the two rams are as follows:

Ram	EF28	PD31
Wool weight	- 0.2kg	- 0.6 kg
NLW	0.4	0.2
Mothering	+4kg	+2kg

These assumed EBVs suggest that ewes by EF28 will cut more wool, produce more lambs and have better mothering ability than those by PD31. The NLW here of +0.4 and + 0.2 means that the EBV for EF28 is 140% of lambs and that for PD31 is 120% of lambs in a base flock where the average is 100%. *These EBVs are assumed and have not been calculated from the progeny test results.*

So how much more is Staffo willing to pay for the ewes to be produced by EF28? Once again Staffo uses his computer program and came up with the results shown in Table 8.2.

The values at the top of Table 8.2 are from Table 8.1. Assuming that the first full shearing of the ewes is by Staffo, he is the only one who benefits from these three traits of the crossbred ewe (wool, number of lambs and their additional weight from better mothering).

Now the extra value to Staffo of PD31 above average is $2242, whereas that of EF28 is $5210, a difference of $2968. So, if Staffo wants a return of $2 for every $1 he puts in, he can afford to pay Leo $1484 more to use EF28, or $14.84 per ewe.

Table 8.2. Value of different traits and their aggregate total for Staffo and Leo

Sire	EF28		PD31	
Slaughter lambs	**Leo's 1stX wethers**	**Staffo's 2ndX lambs**	**Leo's 1stX wethers**	**Staffo's 2ndX lambs**
Weight ($)	*2.54*	*1.4*	*2.08*	*1.14*
Fat ($)	*0*	*1.12*	*0*	*-0.02*
Muscle ($)	*-0.68*	*-0.34*	*0.47*	*0.23*
Total $/lamb	***1.86***	***2.18***	***2.55***	***1.36***
No. lambs	100	576	100	528
Total $/sire	**186**	**1255.68**	**255**	**717**
Wool		-0.35		-1.05
NLW		6.5		3.25
Mothering		1.76		0.88
Total		7.91		3.08
No lambings		500		500
Total value ($)		**3955**		**1525**
Grand Total ($)		**5210**		**2242**

Take home messages

- NLW is a very important trait.
- High reproduction improves returns from weight and carcase traits.
- The value of a ram's offspring can be very wrong if all traits of value are not accounted for.

9. CONCLUSIONS AND RECOMMENDATIONS

The project is clearly demonstrating differences in performance between ewes by different sires which can mean $35/ewe/year higher returns. These differences are largely between sires rather than breed differences and producers need to tailor their sire selections carefully to best match their production system. The project is also providing information for LAMBPLAN to be able to provide across-breed evaluation for maternal breeds.

Achievements

Relative to Objectives (see Section 2)
Overall: Definitive figures are required from LAMBPLAN, but it would appear:

- genetic trend for maternal tested flocks is increasing at >1% pa (A. Ball pers. comm.)
- the LAMBPLAN database increased substantially in the year to June 2000 for most maternal breeds (Border Leicester 30%, Coopworth 23%, East Friesian 40%, Merino 15%, Corriedale 9%) (Feedback, Aug 2000)

Specific:

a) 91 sires being tested as per schedule

b) 1stX EBVs have been released as data becomes available. Further analyses are required to evaluate the feasibility and consistency of 1stX reproduction and 2ndX growth and carcass EBVs in relation to industry LAMBPLAN EBVs and in light of possible large GxE interactions, especially for reproduction in autumn v spring production systems. This needs to be done jointly with LAMBPLAN.

c) There is a very large range in EBVs for weight and carcass fat in particular (about twice that for terminal sires), as well as muscling, wool weight and fibre diameter. The range in fat represents differences of 1.5 fat scores in 1stX and almost 1 fat score in 2ndX lambs at the same carcass weight. A range in returns from 1stX ewes $35 per ewe per year has been demonstrated (ie $35x5yrx75ewes = $13,125 difference in lifetime returns from 1stX ewe progeny per maternal sire). The number of lambs slaughtered per ewe joined is the major $ driver, with other traits, growth, fat and wool also contributing. The results have been extended widely to the various target groups, although the time is now right to put in place a more coordinated and structured extension program.

d) See *Overall* above. I am not aware of any definitive data on the prices paid for maternal rams relative to their EBVs. However at the last TTAG meeting Lynton Arney stated there was a 25-30% premium for $uperBorder$ rams over their other rams and Don Peglar said there was a very good indication that producers were paying a premium for high performance rams at the last Coopworth sale in SE South Australia.

Outcomes

1. Increased use of LAMBPLAN testing by the maternal sector.
2. A high rate of inquiry from breeders and producers about maternal improvement.
3. Results used by breed societies and breeders in their advertising and promotion.
4. No less than 10 PIRDs with a maternal improvement component have been initiated.
5. In addition to MCPT, articles are now frequently being published in the press on related PIRDs and improvement of lambing percentage and maternal genetics, often acknowledging stimulus from MCPT. This reflects the considerable change that is occurring in producer's interest in and attitude towards maternal improvement.
6. Breeding alliances and contract matings are starting to be established.

Recommendations

1. Funding be extended to December 2004 to allow completion of the MCPT as designed.
The long-term design of the MCPT project, requiring 1stX ewes to be bred and evaluated over three lambings to obtain a realistic progeny test for the maternal sires, was acknowledged by MRC in the contract. The first phase involving evaluation of 1stX growth and carcass performance is complete. The second phase involving evaluation of 1stX ewe performance is approximately 60% completed. Further funding to December 2004 will complete evaluation of 2ndX carcasses from the 1stX ewes by all 91 maternal sires, which was the commitment to breeders who entered the sires.

The project has already generated wide interest among seedstock breeders, lamb producers and advisors. The project has contributed to changing attitudes towards maternal genetic improvement and increasing lambing rate which is apparent across the industry. Examples of these changes include the formation of the $uperborder$ group, the number of related PIRDs, the increased interest from the rural press and the high level of direct inquiries from lamb producers and breeders. Extension of funding to complete the project will allow this momentum to be continued and the industry outcomes to be realised.

2. Development of LAMBPLAN Across-breed EBVs for growth, carcass and wool traits may be feasible with further analysis, but considerable caution would be prudent for reproduction traits.
The MCPT provides direct comparisons of sires across several maternal (and other) breeds. EBVs for growth, fat, muscle, wool weight, fibre diameter, and FEC based on 1stX progeny have been published within the project. The number of sires tested from each breed is limited (Border Leicester 18, East Friesian 12, Finnsheep 12, Coopworth 10, White Suffolk 7, Corriedale 6, Booroola Leicester 6) and they are selected rather than random representatives of the breeds. The feasibility of calculating reliable LAMBPLAN across-breed EBVs depends on the degree of linkage across the breeds and estimates of breed variances and mean differences. Inclusion of MCPT data in the LAMBPLAN data base would contribute in a limited way to these linkages. There is an increasing level of crossing and linkage between the Border Leicester, Finn, East Friesian and Coopworth breeds in flocks that LAMBPLAN test. However apparent discrepancies between rankings of some sires and the magnitude of differences in EBVs based on MCPT performance and LAMBPLAN data are cause for caution and needs to be further investigated jointly with LAMBPLAN. While there is considerable overlap in performance among the breeds in MCPT and several are represented among the leading sires for most traits (see Table 7.4), breed trends are apparent (eg leanness of East Friesian, high fat of Border Leicester, low fibre diameter of Finnsheep and Corriedale sires) which indicates there are important

differences between breed means for these traits. Further analysis of MCPT and LAMBPLAN data should be undertaken to estimate the likely magnitude of the differences between breed means.

Reproduction is more difficult to evaluate accurately than other production traits as it generally has a low heritability and is more subject to environmental variation that cannot be accounted for. The traits used in LAMBPLAN (nlb and nlw) are ratios of the cumulative number of lambs (born and weaned) and the number of lambing opportunities for the ewe. These are composite traits which are the multiplicative outcome of the components, fertility, litter size (ovulation rate and embryo survival) and lamb survival. Under commercial production systems the component traits tend to compensate (eg high litter size results in poorer lamb survival). Breed means are likely to be significantly different for the various component traits eg. progeny of Finnsheep sires appear to have higher litter size on average than Border Leicester sires tested in MCPT to date. In addition there appear to be important GxE interactions for some sires at least when their progeny are evaluated in different seasons (see Section 7.5). These factors are likely to preclude the development of useful LAMBPLAN across-breed EBVs for reproduction traits at this stage.

3. A targeted extension program be further planned and implemented.
The MCPT has clearly demonstrated the use of superior genetic merit maternal sires results in major improvements in performance. New industry structures and breeding alliances need to be facilitated and developed to foster the uptake of genetic technology by the maternal breeding sector and by commercial producers to exploit these opportunities. The project marketing plan has identified the various target groups, such as seedstock breeders, lamb producer and marketing groups and alliances, which operate at different levels in the industry. Simple messages showing how producers can put the results into practice need to be put together for the various target groups and implemented using existing personnel such as PDOs and state Department advisors. The use of contract matings needs to be further highlighted as a means of lamb producers achieving greater control over the genetic composition of their ewe flock.

The extensive use of the *Dynamic Dams Newsletter*, industry journals and targeted field days that has proved successful to date should also be continued.

4. The plan for analysis of MCPT data be adequately resourced and implemented.
An extensive data base is being generated within the MCPT project, comprising 91 sires and approximately 2,500 base ewes (Merino and Corriedale), 2,500 1stX wethers, 2,500 1stX ewes and 8,000 2ndX lambs covering 64 production trait combinations (trait x animal group) for survival, growth, carcass, meat quality, reproduction, milk, wool and worm resistance performance. A preliminary plan for the in-depth genetic analysis of this data set has been discussed. It will provide estimates of genetic parameters, including heritabilities and genetic correlations, for a wide range of production traits and measures of overall performance. The relationship between MCPT progeny performance and LAMBPLAN EBVs for the sires will be evaluated and effects of crossbreeding assessed. A range of possible composite traits and indexes, including economic weights and total earnings per lifetime need to be systematically examined. The results of these analyses will enhance the LAMBPLAN genetic parameter matrix to improve the accuracy of EBVs for maternal breeds and provide more appropriate indexes. It is estimated that this large and valuable program of analysis will require a full-time post-doctoral scholar for three years, with some analyses being undertaken by PhD student(s), in addition to the inputs of the principal investigators. The means to adequately resource these analyses need to be pursued as it is additional to the extension of funding of the MCPT outlined above (Recommendation 1). It would be desirable for the post-doc to be in place by early 2002, given the time scale for collection and availability of the data. The milking data from Cowra

is currently being analysed by Ms Jayce Morgan as part of her MRurSc studies through the University of New England under the supervision of Assoc Professor Geoff Hinch and Dr Neal Fogarty. It has recently been agreed some genetic analyses of the 1stX growth and carcass data will be undertaken by a PhD student from Melbourne University under the supervision of Drs Mike Goddard and Leo Cummins.

There is also a need for modelling of lamb production systems to quantify the major profit drivers and to examine their sensitivity under different production systems. The increasing interest from breeders in use of *new* genotypes, development of composites and self-replacing flocks also highlights the need for modelling studies to be undertaken to examine the feasibility of various scenarios for long term sustainable breeding programs. For example, the high performance (>100% lambs weaned) of some 1stX ewe sire groups from matings at 7 months of age considerably reduces the cost of replacement ewes and makes the development of composite self-replacing flocks more economically feasible.

5. The variation in feed requirements and efficiency of the 1stX ewes and the level of genetic variation be determined.
The feed cost for maintenance of the ewe flock and replacements accounts for over 65% of the feed required for production of lamb carcass weight. Measurement of the grazing intake would quantify the likely large differences in biological efficiency of the 1stX ewe groups, over and above that due to the range of over 10 kg in average mature weight. It would also provide estimates of heritability for intake and importantly, genetic correlations with the complete range of production traits already available in the MCPT data set. This would reduce the feed required per kg of carcass produced through genetic improvement of feed efficiency in lamb flocks, by inclusion of parameters in the LAMBPLAN genetic parameter matrix to allow breeders to include efficiency EBVs in their breeding programs. It would also allow MCPT genotypes to be evaluated on the basis of total feed requirements throughout the year rather than simply performance per ewe to allow better evaluation of alternate genotypes and lamb production systems.

6. The MCPT project be used to validate the usefulness of markers and QTLs to assist selection in lamb breeding programs.
The MCPT project provides an invaluable data set for screening and validation of markers and quantitative trait loci (QTL) that may be useful for assisting in selection, especially for meat quality, worm resistance, feed intake and reproduction traits. DNA samples have been collected from most 1stX and 2ndX progeny in the project to date and will continue in future years. There is a very diverse range of sire genotypes being tested in MCPT and results have shown considerable ranges in performance for most traits. This provides the opportunity to DNA profile selected diverse sire groups for screening and validation of particular markers or QTLs of interest. For the 91 maternal sires being tested, each of the three link sires (Border Leicester, Coopworth, Finn) have over 500 1stX progeny and the remainder an average of approximately 50 1stX progeny. In addition each sire has approximately twice this number of 2ndX progeny. A relatively small input of additional funds for a post graduate studentship would add greatly to the outputs from the MCPT as the bulk of the costs have already been incurred within the project.

10. FUNDING

Meat and Livestock Australia

The level of funding from MRC (now MLA) was budgeted to provide salary for a half time Technical Officer and operating expenses associated with the AI matings, foetal scanning, hogget wool testing, data collection and operating costs at each site. The funding at each site over the period of the contract is shown in Table 10.1.

Table 10.1. MLA funding for the project

	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02*	Total
NSW Ag	16,828	40,364	43,696	41,000	38,036	8,928	188,852
DNRE - Hamilton	23,000	39,000	40,000	32,000	30,500	8,300	172,800
Rutherglen	-	-	2,000	15,000	36,000	9,000	62,000
PISA/SARDI	-	29,000	36,000	32,000	5,500	5,000	107,500
Total	39,828	108,364	121,696	120,000	110,036	31,228	531,152

* on receipt and acceptance of Final Report

NSW Agriculture, Department of Natural Resources and Environment (NRE, Vic) and South Australian Research and Development Institute (SARDI)

The various state Departments (NSW Agriculture, NRE Victoria, PIRSA/SARDI) provided the research station resources, including the sheep, management, supplements, overheads and facilities to run the project at each site, the salaries of the Principal Investigators and other staff input (other than the half time Technical Officer by funded by MLA above). These inputs from the state Departments accounted for approximately 80% of the total costs of the project to date.

Breeders

Breeders paid an entry fee of $400 per sire accepted for the progeny testing and supplied approximately 70 doses of frozen semen from the ram to the appropriate site. Of these total funds of $36,400, some $18,000 have been used to purchase and store semen required for the link sire matings, produce display materials used at all sites, extension and costs associated with production and mailing of the *Dynamic Dams Newsletter*. The remaining funds will continue to be used to produce and distribute the *Dynamic Dams Newsletter* and for extension materials and other costs associated with the whole project. Any of these funds remaining on completion of the project in December 2004 will be distributed among the sites on a pro rata basis.

The owners of the three link sires agreed to supply the additional frozen semen required for the subsequent matings (approximately 560 doses per sire) at a discount rate. These owners were GB Starritt & Son (BL12), DW & IA Peglar (Cp5) and GM & MA Wake (Fi7) and their generous support for the project is appreciated.

11. COMMUNICATION

Dynamic Dams Newsletter

Some 13 issues of the *Dynamic Dams Newsletter* (3 per year) have been produced and distributed. There is a steady increase in requests from producers to receive the Newsletter with the mailing list close to 300, including entrants, seedstock breeders, lamb producers, consultants, advisors and selected media. There has been very favourable feedback from producers, consultants and media sources. *Dynamic Dams* has been very effective in getting results and other information to the various target audiences.

Field Days at MCPT Sites

- Rutherglen, Field Day - September 1997
- Orange, Official Opening of the Sheep Industry Development Centre, by Minister - February 1998 - 1stX ewe progeny display and poster featured - radio and TV coverage of project.
- Cowra Lamb Forum - March 1998 - theme for the forum, featured talks and display of 1stX progeny, Minister for Agriculture (R Amery) opened day (>200 producers)
- Hamilton South West Farmers Day - 5 May 1998 - 1stX ewe lambs displayed (90 producers)
- Hamilton Lamb Field Day - June 1998 - Marketing Alliances, Maternal CPT, Intensive Grazing Management (80 producers)
- Struan Dynamic Dams Field Day, 25 March 1999
- Cowra Lamb Field Day, 28 April 1999(>100)
- Hamilton Field Day, May 1999
- Struan Crossbred Ewe Breeders Night, 16 August 1999. This meeting will incorporate the launch of the $uperborder$ PIRD in South Australia, and the formation of a crossbred ewe producers group.
- Rutherglen Field Day, Sept 1999 (display)
- Hamilton, South West Farmers Day – April 2000
- Cowra Field Day, 3 May 2000 – MCPT was the focus with Ian Ross speaking on Eating Quality, two producers – Andy Roberts and Robert Mortimer on breeding operations at the maternal level as well as Neal Fogarty on what the results mean. There were other talks from staff on specific MCPT results and inspection of the sheep.
- Cowra, $uperBorder$ group AGM, 23 June 2000 - Neal Fogarty, Bernie Munro and a lamb producer spoke and inspection of sheep in MCPT.
- Rutherglen Field Day, October 2000 – MCPT featured and project sheep on display
- Kybybolite Field Day, November 2000 – L. Cummins speaker and MCPT sheep displayed
- Cowra MCPT Day – regional Lamb Groups – June 2001 – presentations and sheep displayed
- Rutherglen Field Day, September 2001 – MCPT featured and project sheep on display

Other Field Days and Displays

- Beef & Sheep Technology - AAABG/Trangie April 1997 (display)
- addressed combined lamb groups central Vic, July (LC)
- presented and manned a poster display at Sheepvention, Hamilton in August 1997
- presentation at Border Leicester stud sale in Horsham in November 1997 (LC)
- poster presentation for Beef Expo in Hamilton in February 1998.
- Guyra, Australian Society of Animal Production - Conference Lamb Field Day - April 1998 - Poster display
- 13th Annual NSW Grasslands Society Conference, Orange - Tour - July 1998 - talk and display of 1stX ewes (70 producer delegates)
- Australian Border Leicester Assoc. AGM & Workshop, Echuca - October 1998 – talk
- Australian National Field Days, Orange - 5-7 November 1998 - display as part of NSW Agriculture Lamb Feature
- Field Day, Tullamore - 4 September 1998 - Spoke on MCPT results and their implications (~100 breeders/producers)
- East Friesian Field Day, Derrinallum - December 1998 - Spoke on MCPT results
- *DD Newsletter* and material/posters provided for several field days/worksops at Cootamundra (7/98), Cowra (7/98), Armidale (8/98), Yeoval (8/98), Tumut (9/98) and Tenterfield (12/98)
- Royal Melbourne Show - Lamb Day - 1998 - Poster display
- Open Day, Orange Agricultural Institute, 20 March 1999
- Annual Kangaroo Island Lamb Field Day 1999
- Australian Finnsheep Association AGM 1999
- Maternal genetics was also a part of meetings at Cowra (26 August), Temora (28 August) and Deniliquin (28 September) organised through the Aust. BL Assoc. (1999)
- Lucindale Field Day, SA – March 2000
- Trangie Field Day, 14 June 2000- *Merinos for the New Millennium* Neal Fogarty was a keynote speaker and a static display was mounted.
- Harden Grains Expo, 27 July 2000 - MCPT display
- Calimo Station Field Day, Deniliquin, August 2000 – Leo Cummins spoke
- Riverina Merino Field Days, Conago, September 2000 - Neal Fogarty keynote speaker
- Centre Plus Field Day, Tullamore, October 2000 - Neal Fogarty a keynote speaker
- Condobolin Field Day, October 2000 – Ashley White presented MCPT results as part of the launch of a package for Merino breeders - *A fine future for wool* - by the NSW Minister for Agriculture Richard Amery
- Guyra Field Day, 29 January 2001 – presentation
- Meat Profit Day, Adelaide February 2001 – Static display
- Koorawatha Lamb Group – March 2001 – presentation
- Sheep Farmer Conferences – in association with AAABG – *New Breeding Technologies for Sheep Farmers* - Lincoln, Telford, Palmerston North, New Zealand July/August 2001 (Neal Fogarty invited to present)

Technical Conferences and Seminars

- Sheep & Wool Conference - Orange, October 1997 (NF Poster/Talk)
- Sheep & Wool Conference, Yanco 20-22 October 1998 - paper on MCPT in Lamb Contract (~80 advisors, researchers and consultants)
- PDO Workshop, Sydney - 2 Sept 1998 - Maternal CPT and contract matings
- Seminar, Orange Agricultural Institute, 28 May 1999
- Wool & Sheepmeat Services Annual Conference (NSW Agriculture), Armidale, November 1999, paper presented
- Agriculture Victoria, Animal Institute Research Conference – Attwood, May 2000 - paper presented
- Rutherglen Research Institute Seminar – The value of improving Prime Lamb Dams. June 2001.

Scientific Conferences

- 13th Conference of the Association for the Advancement of Animal Breeding and Genetics (AAABG), Mandurah WA, July 1999, paper presented (N. Fogarty)
- Combined Conference of the Australian Society of Animal Production (ASAP) and the Asia-Australasian Association of Animal Production (AAAP) in Sydney in July 2000. Neal Fogarty presented two papers. In addition Posters on milk production (Jayce Morgan) and wool production of the 1stX ewes (Leo Cummins) presented.
- European Association of Animal Production, The Hague, August 2000, paper presented (F. Brien)
- 5th International Sheep Veterinary Congress, South Africa January 2001 - Paper and poster presented (Leo Cummins)
- Autralian Veterinary Association Conference, Melbourne, May 2001 - Paper presented (Leo Cummins)
- 14th Conference of the Association for the Advancement of Animal Breeding and Genetics (AAABG), Queenstown NZ, July 2001, 2 papers presented (N. Fogarty)

Industry Journal Articles

The Muster *of Australian Breeders of Stud Sheep*

- *Maternal Sire Progeny Test.* January 1997
- *Maternal Sire Progeny Test – up and running.* June 1997
- *1998 MCPT Matings* - May 1998
- *Maternal Sire Progeny Test - 1stX Meat EBVs* - August 1998
- *Lamb industry profitability* - December 1998
- *Improving lambing rate* - December 1998
- *What is the best first cross ewe?*- May 1999
- *The sire of crossbred ewes makes a $ difference*. May 2000
- *Mum affects lamb carcasses too!* December 2000
- *What are first cross ewes worth?* December 2000
- *Top crossbred ewes returned $105 more per ewe*. May 2001
- *Breeding from ewe lambs*. May 2001

Border Leicester Sheep Breeders Directory - 2000

- *Selecting the best Border Leicester rams for crossing*

LAMBPLAN Newsletter

- *Maternal Sire Central Progeny Test (MCPT).* December 1997

Australian Farm Journal

- *Making the most of Mum's genes* – May 1999
- *Controlling maternal genetics* (L Thatcher)

FEEDBACK

- *Testing Maternal Sires where it counts* – July 1999
- *Prime lamb dams in the spotlight* – August 2000

Poll Dorset Journal

- *Sire makes big difference in 1st cross ewe performance* – September 1999

Ovine Observer

- *More money from crossbred ewes* – June 2000

Marksman News

- *Better Mums – More Lambs – More Money* – Spring 2000
- *What are first cross ewes worth*? Summer 2001
- *Dynamic Dams for targeted markets* Winter 2001

Sheepmeat Beat Newsletter has also been used extensively for extending information from MCPT.

Rural Press / Media

Some 9 Press Releases have been issued and distributed to the major rural newspapers : Land, Weekly Times, Stock & Land, Agriculture TODAY, Qld Country Life, Farm Journal, Farming Ahead, Stock Journal, NSW Farmers', Farmer & Stockowner, as well as local papers and regional magazines, radio and TV stations throughout inland NSW & Vic. Numerous articles on the MCPT project have appeared in these papers.

In addition to the articles directly on the MCPT, there have been numerous articles in the past two years relating to the improvement of lambing percentage and maternal genetics, particularly in the Land, Weekly Times, Stock and Land and Western Magazine. These articles have been on associated PIRDS, such as the Centre Plus Lamb Plus trial in NSW and evaluation of maternal breeds for production of heavier weight sucker lambs in WA, together with stories based around lamb producers relating to the improvement of lambing percentage and maternal genetics. These articles often acknowledge stimulus from the MCPT project and indicate a strong shift in producer awareness and attitudes towards improving maternal genetics. There have also been several articles in recent months in the Weekly Times on genetically improving lambing percentage and contract mating to supply dams.

Seedstock breeders are also using MCPT results in their breed newsletters and in stud advertisements in breed and industry journals.

Articles have been written for NSW Agriculture Today and published in March, 1998, May 1998, August 1998, February 1999 and MCPT has been highlighted in their Prime Lamb Feature in September 2000 and September 2001.

Other:

- Radio interviews - ABC 2CR Rural Report - (May 1997, Feb, July, July 1998)
- Video, Prime TV News 13.8.97, also distributed to WIN
- F@rming Online - “Prime lamb dam traits study” 2 April 1998
- F@rming Online - “Prime lamb producers urged to embrace maternal sires program” 18.1.99
- Radio interviews - ABC 2CR Rural Report - (July 1998, July 1998, January 1999) and Statewide Country Hour
- Radio interview - 2GZ Rural Report - (January 1999)
- MCPT information has been included on the Prime Notes CD-ROM (QDPI)
- WIN TV News – Cowra Field Day featured – May 2000
- ABC Regional Rural Report – Interview – May 2000

Website

The MCPT project is included on the LAMBPLAN website with all issues of the *Dynamic Dams Newsletters* available as well as other information.
(http://lambplan.une.edu.au/mcpt)

12. PUBLICATIONS

12.1 Scientific

Fogarty, N.M., Cummins, L., Stafford, J., Gaunt, G. and Banks, R. (1999). Benchmarking maternal genetics in the lamb industry. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* **13**: 78-81.

Fogarty, N.M., Cummins, L., Stafford, J., Gaunt, G. and Banks, R. (2000). Opportunities for improvement of maternal performance in the lamb industry. *Asian-Australian Journal of Animal Science* **13** Supp July A:309-311.

Cummins, L. and Behrendt, R. (2000). Wool quality attributes of young crossbred ewes. *Asian-Australian Journal of Animal Science* **13** Supp July C: 119.

Morgan, J., Fogarty, N. and Nicol, H. (2000). Oxytocin administration and its effect on ewe milk composition. *Asian-Australian Journal of Animal Science* **13** Supp July C:206-208.

Fogarty, N.M. (2000). Responding to the challenge - production systems. *In* D.G. Hall. Opportunities for Meat from Lambs and Goats in Australia. *Asian-Australian Journal of Animal Science* **13** Supp July B:91-101.

Fogarty, N.M., Cummins, L.J., Gaunt, G., Hocking-Edwards, J., Edwards, N., Lees, K. and Morgan, J. (2001a). Opportunities to exploit genetic variation among maternal sires in the lamb industry. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* **14**: 123-126.

Fogarty, N.M., Morgan, J.E. and Lees, K. (2001b). Sire x season interactions for lambing performance of crossbred ewes. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* **14**: 127-130.

12.2 Technical Conference

Fogarty, N. (1997). Maternal Sire Central Progeny Test (MCPT). *Proceedings Wool and Sheepmeat Services Annual Conference*, October, Orange. Pp. 34-5.

Fogarty, N. (1998). LAMB.325 Maternal Sire Central Progeny Test - improving lamb maternal genetics. Field Trip Booklet, *13th Annual Grasslands Society Conference*. July, Orange pp 11-15.

Fogarty, N.M. (1998). Lamb industry profitability: getting the most from genetics. PDO Workshop, MLA, Sydney, September pp6.

Fogarty, Neal. (1998). Opportunities for maternal sector improvement. *Proceedings Wool and Sheepmeat Services Annual Conference*, October, Yanco. Pp 135-139.

Fogarty, N. M., Morgan, J. and Lees, K. (1999). Which maternal sire makes the $ difference? *Proceedings Wool and Sheepmeat Services Annual Conference*, November, Armidale. Pp. 121-124.

Brien, F.D., Graham, J.F., Cummins, L.J., Clarke, A.J. and Fogarty, N.M. (2000). Improving genetic evaluation in the beef and lamb industries in southern Australia. *Proceedings of the European Association of Animal Production,* The Hague, August (Abstract) p 36.

Cummins, L (2000). Valuing first cross ewes. *Poster 1-2 at AV Animal Industries Group Conference,* May

Cummins, L. J. and Fogarty, N. M. (2001). Breed and Sire Effects on the Fertility of Seven-Month-Old Crossbred Ewes. *Proceedings of the 5th International Sheep Veterinary Congress,* South Africa, January (Abstract)

Cummins, L. J., Fogarty, N. M., Stafford, J. and Gaunt, G. (2001). Improved lamb production from better crossbred ewes. *Proceedings of the Australian Veterinary Association Conference* Melbourne, May

Hocking-Edwards, J., Edwards, N., Stafford, J. and Gaunt, G. (2001). Prime lamb producers – which maternal breed is best?. *Proceedings of the 42nd Annual Conference of the Grassland Society of Victoria* **42**: 169-170.

12.3 12.3 Advisory

Fogarty, N.M. (1997). Maternal sire progeny test. *Muster* No. **38** p.24. January.
Fogarty, N.M. (1997). MRC supports new lamb Maternal Sire Project. *Sheepmeat Beat* **4**(9) 21 February 1997.
Fogarty, N.M. (1997). Editor: *LAMB - MATERNAL Newsletter.* No. **1**. May.
Fogarty, N.M. (1997). Maternal genetic improvement. *LAMB - MATERNAL Newsletter*. May No. **1**. pp.5-6.
Fogarty, N.M. (1997). Maternal Sire Progeny Tests - up and running. *Sheepmeat Beat*. **4**(15) 16 May. p.2.
Fogarty, N.M. (1997). Maternal sire progeny test - up and running. *Muster* No.**39**, June 8-11.
Fogarty, N.M. (1997). Maternal sire evaluation - foetal scanning of ewes. *Sheepmeat Beat* **4**(17) 13 June. p.2.
Fogarty, N.M. (1997). Maternal Sire progeny tests. *AAABG News,* July p5.
Fogarty, N.M. and Lees, K. (1997). Eds. *Dynamic Dams - Ewe genetics for the future - Newsletter* No.**2**. Sept.
Fogarty, N. (1997). Mother knows best - maternal reproduction and genetics. In "Performance Pays - Dynamic Dams & Superior Sires" Rutherglen Sept. pp.21-25.
Fogarty, N.M. (1997) Maternal sire CPT - Weaning report. *Sheepmeat Beat* **5**(3), 28th Nov.
Fogarty, N.M. (1997). Maternal sire central progeny test (MCPT). *LAMBPLAN Newsletter*, December **6,**4.
Fogarty, N.M. and Lees, K. (1998). Eds. *Dynamic Dams - Ewe genetics for the future - Newsletter* No.**3**. March. Pp 10.
Fogarty, N.M. (1998). Maternal sire progeny testing - improving maternal genetics. *Cowra Lamb Forum Notes.* March, NSW Agriculture pp4.
Fogarty, N. (1998). What is MCPT?. *Sheepmeat Beat* **5**(11), 20th March.pp 1-3.
Fogarty, N. (1998). LAMB.325 Maternal Sire Central Progeny Test, Cowra Report May. *Sheepmeat Beat* **5**(17), 12th June.pp 7-8.
Fogarty, N.M. and Lees, K. (1998).1998 MCPT matings. *The Muster* No. **42** May, pp 4-7.
Fogarty, N. (1998). Maternal Sire Central Progeny Test. *Sheepmeat Beat* **5**(18), 26th June.pp 2-4.
Fogarty, N.M. and Lees, K. (1998). Eds. *Dynamic Dams - Ewe genetics for the future - Newsletter* No.**4**. July. Pp 14.
Fogarty, N.M. (1998).1stX meat EBVs - 1997 MCPT Sires. *Dynamic Dams* July **4,**1-3.
Fogarty, N.M. (1998). Contract mating - control your genetics. *Dynamic Dams* July **4,**10.
Fogarty, N. (1998). Maternal Sire Central Progeny Test - 1stX Meat EBVs. *The Muster* No. **43** August, pp 12-13.
Fogarty, N.M. and Lees, K. (1998). Eds. *Dynamic Dams - Ewe genetics for the future - Newsletter* No.**5**. September. Pp 9.
Fogarty, N. (1998). MCPT Update: Cowra. *Dynamic Dams* September **5,**4-5.

Fogarty, N.M. (1998). Breeding options to make the most of your lamb enterprise. Field Day Notes *Meat from Finewool Sheep* Tullamore, September.

Fogarty, N. (1998). Maternal Sire Central Progeny Test (MCPT): What does it offer Border Leicester breeders? Australian Border Leicester Association, AGM & Workshop. Echuca, October pp5.

Fogarty, N.M. (1998). Opportunities for maternal sector improvement in the lamb industry. *Sheepmeat Beat* **6**(1), 30th October pp 4-5.

Fogarty, N.M. (1998). Lamb industry profitability: getting the most from genetics. *The Muster* No. **44** December, pp 8-9.

Casburn, G. and Fogarty, N.M. (1998). Improving lambing rate with good management. *The Muster* No. **44** December, pp 10-11.

Fogarty, N.M. and Lees, K. (1998). Eds. *Dynamic Dams - Ewe genetics for the future* **-** *Newsletter* No.**6**. December. Pp 8.

Fogarty, N. (1999). Dynamic Dams: are you getting the lamb advantage? Manildra Agricultural Bureau, February pp5.

Fogarty, N.M. and Lees, K. (1999). Eds. *Dynamic Dams - Ewe genetics for the future* **-** *Newsletter* No.**7**.March. Pp 6.

Thatcher, Laurie (1999). Place of maternal sire testing in lamb consistency program. In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp1-5.

Stafford, John (1999). The valuation of maternal sires. In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp 6-14.

Hancock, Bruce (1999). Defining the problems in marketing for crossbred ewes. In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp 15-17.

Keiller, John (1999). Buying first cross ewes - the problem from the ewe buyer perspective. In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp18-19.

Stafford, John. (1999). The progeny test - what will it show? In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp20-21, 25-33.

Cummins, Leo. (1999). Maternal central progeny testing. In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp 22-24.

Joseph, Kate. (1999). Developing an alliance for sourcing better crossbred ewes. In "Capitalising on the best genetics in prime lamb dams" *Dynamic Dams Field Day,* Struan, March, pp 36-38.

Fogarty, N. (1999). Which sire produces the best first cross ewes? *Cowra Lamb Field Day Notes.* April pp. 1-5.

Morgan, J. (1999). Milk production studies. *Cowra Lamb Field Day Notes.* April p 6.

Lees, K. (1999). Worm resistance and DNA studies. *Cowra Lamb Field Day Notes.* April pp. 7-8.

White, A. (1999). How to breed better prime lamb dams. *Cowra Lamb Field Day Notes.* April p 11.

Fogarty, N. (1999). What is the best first cross ewe? *The Muster* No. **45** May, pp 6-7.

Fogarty, N. (1999). Making the most of Mum's genes. *Australian Farm Journal Wool.* May pp. 18-19.

Anon. (1999). Testing maternal sires where it counts. *Feedback* July p.6.

Fogarty, N.M. and Lees, K. (1999). Eds. *Dynamic Dams - Ewe genetics for the future* **-** *Newsletter* No.**8**.August. Pp 12.

Fogarty, N. (1999). Sire makes big difference in 1st-cross ewe performance. *Poll Dorset Journal* **29** (2): 63. September.

Fogarty, N.M. and Lees, K. (1999). Eds. *Dynamic Dams - Ewe genetics for the future - Newsletter* No.**9**. December. Pp 12.

Fogarty, N.M. and Lees, K. (2000). Eds. *Dynamic Dams - Ewe genetics for the future - Newsletter* No.**10**. April. Pp 10.

Fogarty, Neal. (2000). How much $ difference does the sire of crossbred ewes make? *Cowra Lamb Forum 2000: Notes.* May pp. 2-6.

Fogarty, Neal. (2000). The sire of crossbred ewes makes a $ difference. *The Muster* No. **48** May, pp 14-15.

Morgan, Jayce. (2000). Milk production of 1stX ewes. *Cowra Lamb Forum 2000: Notes.* May p.7.

Lees, Kelly. (2000). Worm resistance of 1stX ewes. *Cowra Lamb Forum 2000: Notes.* May p.8.

Fogarty, N.M. (2000). Increasing returns from meat in Merino breeding enterprises. In *Merinos for the New Millennium*, Trangie, June, pp32-5.

Fogarty, N.M. (2000). More money from crossbred ewes. *Ovine Observer* No **11** June pp1-3.

Fogarty, N.M. (2000). The Border Leicester and MCPT results. *Proceedings $uperBorder$ Conference*, Temora, June pp3.

Fogarty, N.M. (2000). Selecting the best Border Leicester rams for crossing. In *2000 Border Leicester Sheep Breeders Directory,* Australian Border Leicester Association Inc.

Fogarty, N.M. (2000). Meat from Merinos. *Riverina Merino Field Days Booklet*. September

Thatcher, Laurie. (2000). Controlling Maternal Genetics. *Australian Farm Journal,* August pp 67-70.

Fogarty, N.M. (2000). Making more $ from crossbred ewes. *Agriculture Today*, Sept.

Fogarty, N.M. and Lees, K. (2000). Eds. Dynamic Dams - Ewe genetics for the future - Newsletter No.**11**. August. Pp 14.

Fogarty, N.M. (2000). More $ from crossbred ewes. *Dynamic Dams No.* **11** pp. 4-5.

Fogarty, N.M. (2000). Meat Options for Merino Breeders. *Centre Plus Field Day Notes*, Tullamore, October

Fogarty, N.M. (2000). Prime lamb dams in the spotlight. *FEEDBACK* August pp25-26.

Fogarty, N.M. (2000). Selecting the best Finnsheep rams for crossing. *Australian Finnsheep Association Newsletter*

White, A. and Fogarty, N.M. (2000). Merinos for meat production. Condobolin Field Day Notes. October.

Fogarty, N.M. (2000). Mum affects lamb carcasses too! *The Muster* No. **50** December, p 18.

Gaunt, G.M (2000). Better Mums – More Lambs – More Money! *Marksman News,* Spring 2000

Gaunt, G.M (2000). Value of Improving Prime Lamb Dams: Maternal Central Progeny Testing (MCPT), Agriculture Victoria – Rutherglen Annual Spring Field Day notes, October.

Gaunt, G.M (2000). Maternal Central Progeny Testing. Annual Report 1999-2000. Agriculture Victoria, Rutherglen Research Institute pp. 19-20.

Fogarty, N.M. and Lees, K. (2000). Eds. Dynamic Dams - Ewe genetics for the future - Newsletter No.**12**. December. Pp 10.

Cummins, L. (2000). What are first cross ewes worth? *The Muster* No. **50** December, p 6-7.

Cummins, L. (2001). Breeding from ewe lambs. *Marksman News,* Summer 2001 **10**(4)

Fogarty, N.M. and Lees, K. (2001). Eds. Dynamic Dams - Ewe genetics for the future - Newsletter No.**13**. April. Pp 10.

Fogarty, N.M. (2001). Top crossbred ewes returned $105 more per ewe. *Dynamic Dams No.* **13** pp. 1-2.

Hocking-Edwards, J., Edwards, N., Stafford, J. and Gaunt, G. (2001). Maternal Central Progeny Test – which maternal breed is best?. *Proceedings of the Prime Lamb Expo (Growing profit through quality)* April, Mt Gambier. pp. 36-37.

Fogarty, N.M. (2001). Top crossbred ewes returned $105 more per ewe. *The Muster* No. **51** May, p 6-7.

Cummins, L. (2001). Breeding from ewe lambs. *The Muster* No. **51** May, p 12.

Fogarty, N.M. (2001). Making more dollars from maternal genetics. In *New Breeding Technologies for Sheep Farmers - Proceedings of Sheep Farmer Conferences in assoc with AAABG.* July/Aug, Lincoln, Telford, Palmerston North: New Zealand, pp 24-27.

Gaunt, G.M. (2001) Dynamic Dams for Targeted Markets. *Marksman News*, Winter 2001

Gaunt, G.M (2001) Maternal Central Progeny Testing, 2001 Results. *Lamb and Goat Field Day,* Agriculture Victoria- Rutherglen, September

Fogarty, N.M. (2001) Maternal genetics: More, heavier lambs from good mothers. *Agriculture Today*, Sept. p 15.

Gaunt, G.M (2001). Maternal Central Progeny Testing: 2001 Results, Agriculture Victoria – Rutherglen Sheep and Goat Field Day notes, September.

12.4 Electronic

Prime Notes CD-ROM. “Maternal Sires Central Progeny Test” QDPI
Internet site: http://lambplan.une.edu.au/mcpt

13. REFERENCES

Banks, R. G., Shands, C., Stafford, J. and Kenney, P. (1995) "LAMBPLAN Superior Sires" Meat Research Corporation, Sydney.

Brown, D.J., Tier, B., Reverter, A., Banks, R. and Graser, H.U. (2000). *Wool Technol. Sheep Breed.* **48,** 285.

Dickerson, G. E. (1978). *Anim. Prod.* **27**, 367.

Dyrmundsson, O.R. (1973) *Anim. Breed. Abstr.* **41**, 273

Ferguson, B. D. and Fogarty, N. M. (1997). *Proc. Assoc. Adv. Anim. Breed. Genet.* **12**, 360.

Fogarty, N.M. (1978). *Wool Technol. Sheep Breed.* **26**(2), 31.

Fogarty, N.M. (1994). *Proc. 5th Wld. Congr. Genet. Appld. Livest. Prod.*, Guelph, Canada. **18**: 79.

Fogarty, N.M. (1995). *Anim. Breed. Abstr.* **63**, 101.

Fogarty, N.M. and Gilmour, A.R. (1993). *Aust. J. Expt. Agric.* **33,** 259.

Fogarty, N.M., Hall, D.G. and Atkinson, W. (1992). *Aust. J. Agric. Res.* **43,** 1819.

Fogarty, N.M., Hopkins, D.L. and van de Ven, R. (2000a). *Anim. Sc.* **70:** 135.

Fogarty, N.M., Hopkins, D.L. and van de Ven, R. (2000b). *Anim. Sc.* **70:** 147.

Gilmour, A.R. (1993). BVEST: A Multiple Trait Animal Model Best Linear Unbiased Predictor Breeding Value Estimation Program. NSW Agriculture, Orange.

Gilmour, A. R., Cullis, B. R., Wellham, S. J. and Thompson, R. (1999) ASREML Reference Manual. NSW Agriculture Biometric Bulletin No. 3. Orange Agric. Inst., Orange, NSW.

Hall, D.G. and Killeen, I.D. (1989). *Theriogenology* **31:** 721.

Hall, D.G., Fogarty, N.M., Holst, P.J., Gilmour, A.R., Banks, R. and Luff, A.F. (1992). *Proc. Aust. Assoc. Anim. Breed. Genet.* **10,** 316.

Hall, D.G., Gilmour, A.R. and Fogarty, N.M. (1994). *Aust. J. Agric.Res.* **45**, 415.

Hall, D.G., Luff, A.F., Fogarty, N.M. and Holst, P.J. (1995). *Proc. Aust. Assoc. Anim. Breed. Genet.* **11,** 185.

Hall, D.G., Gilmour, A.R., Fogarty, N.M., Holst, P.J. and Hopkins, D.L. (2001). *Aust. J. Agric.Res.* **52**, 859.

Notter, D.R., Al-Shorepy, S.A., Vincent, J.N. and McQuown, E.C. (1998). *Proc. 6th Wld. Congr. Genet. Appld. Livest. Prod.* **27:** 43.

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15. APPENDICES

15.1 APPENDIX 1: Lamb Profit Equation

Box 1 shows the calculations for 100% lamb turnoff of 18kg carcass weight lambs at a price of $2/kg (including skin value).

Box 1 Second Cross Lamb Production - Profit Equation

Product	Price	Costs	$Profit
Income			
Sale lambs (n x 18kg c/c wt)	$2.00/kg (incl skin)	5%+$2+175kgDM	$25.20
Wool (3.5kg clean, 28um)	400 c/kg	12%	$12.32
Old ewes (0.23 @ 22kg)	$1.00/kg (incl skin)	5%	$4.81
Expenses			
Ewe feed intake (500 kg DM)		$0.04/kg DM	($20.00)
Ewe replacements (0.27)		lamb sale $	($9.72)
		***Profit / Ewe** (@ 100%)*	***$12.61***

Maternal sire entries - details

** Link sires used at each site each year*

Year	Site	Sire Code	Tag	Stud	Breed	Entrant	Phone No.
1997	**Cowra**	**BoL1**	922047	Struan	Booroola Leicester	PIRSA	08 8762 9100
		BL2	950137	Johnos	Border Leicester	NW & JI Johnson	08 8756 6053
		Fi3	940001	Yamba	Finnsheep	M & L Burns	03 5798 1583
		Cr4	940364	Maluka	Corriedale	P Secker	02 4848 1244
		Cp5*	940449	Oaklea	Coopworth	DW & IA Peglar	08 8738 9291
		EF6	940B21	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		Fi7*	930057	Warrayure	Finnsheep	GM & MA Wake	03 5574 1254
		BL8	950181	Inverbrackie	Border Leicester	CE & LJ Arney	08 8536 0031
		Fi9	935010	Warrayure	Finnsheep	Knight & Bottcher	03 5578 7250
		WS10	910058	Leahcim	White Suffolk	AWSA/Michael	08 8865 2085
		Cr11	930097	Coora	Corriedale	Coora Partnership	02 4848 1244
		BL12*	94S291	Kelso	Border Leicester	GB Starritt & Son	03 5829 0144
1997	**Hamilton**	**BL13**	950246	Inverbrackie	Border Leicester	CE & LJ Arney	08 8536 0031
		Ro14	930146	Claymour	Romney	Rouch & Gillman	03 5727 1552
		BoL15	924287	Struan	Booroola Leicester	PIRSA	08 8762 9100
		Cp16	930069	Narrambla	Coopworth	D Wigan	03 5577 2321
		Fi17	950054	Gippfinn	Finnsheep	S & D Jones	03 5122 3328
		Cp18	942297	Oaklea	Coopworth	J Keiller	03 5526 5248
		EF19	940B26	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		Cr20	880491	Stanbury	Corriedale	Cole & Risbey	03 5593 9278
		Fi21	960002	UNSW	Finnsheep	S & D Jones	03 5122 3328
1998	**Struan**	**Fi22**	890049	ATC	Finnsheep	Jaydee Stud	08 8764 2065
		Fi23	930049	Tambaroora	Finnsheep	Jaydee Stud	08 8764 2065
		BL24	960346	Gleneith	Border Leicester	CE & LJ Arney	08 8536 0031
		BL25	960188	Johnos	Border Leicester	NW & JI Johnson	08 8756 6053
		Cp26	960210	Oaklea	Coopworth	DW & IA Peglar	08 8738 9291
		Cr27	921586	Coora	Corriedale	Coora Partnership	03 5578 6267
		EF28	960133	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		Hy29	960028	Cowra	Hyfer	NSW Agriculture	02 6391 3813
		Hy30	960128	Cowra	Hyfer	NSW Agriculture	02 6391 3813
		PD31	960110	Wyndamah	Poll Dorset	GJ & BJ Oxley	03 5037 2355
		BL32	95T138	Kelso	Border Leicester	GB Starritt & Son	03 5829 0144
		WS33	951470	Galaxy Park	White Suffolk	AWSA/Gale	08 8210 5230
1998	**Cowra**	**BoL34**	0029	Caveton Park	Booroola Leicester	PIRSA	08 8762 9100
		BL35	940765	Retallack	Border Leicester	BLA(NSW)/Grinter	02 6974 1153
		Cp36	960067	Narrambla	Coopworth	RJ & PH Lane	02 6362 7115
		Cp37	940274	Narrambla	Coopworth	RJ & PH Lane	02 6362 7115
		Cc38	960621	Coronga	Coronga Composite	Premier Breed. Tech	02 6365 8207
		EF39	B40	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		FL40	940016	Wycombe	Finn x Leicester	R & L Coddington	02 6775 5225
		Gr41	955551	Yangoora	Gromark	Yangoora Gromarks	02 6383 3254
		WS42	940069	Leahcim	White Suffolk	AWSA/Michael	08 8865 2085
1998	**Hamilton**	**BoL43**	96P6322	Struan	Booroola Leicester	PIRSA	08 8762 9100
		EF44	960026	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		EF45	0019	Glenspean	East Friesian	S & J Cameron	03 5286 1455
		Cr46	950161	Gundowringa	Corriedale	HJ & CJ Prell	02 4848 1244
		EF47	950509	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		FiF48	960086	Gippfinn	Finn x Friesian	S & D Jones	03 5122 3328
		Ro49	9200089	Evergreen	Romney	C Duncombe	03 5264 5170
		Tx50	949002	Coolana	Texel	Coolana Rural	03 5350 5531
		WS51	900429	Galaxy Park	White Suffolk	AWSA/Gale	08 8210 5230
1999	**Cowra**	**BL52**	920070	Kegra	Border Leicester	BLA(NSW)/Golder	02 6977 1339
		BL53	960102	Inverbrackie	Border Leicester	CE & LJ Arney	08 8536 0031
		BL54	970030	Johnos	Border Leicester	NW & JI Johnson	08 8756 6053
		BoL55	955203	Struan	Booroola Leicester	PIRSA	08 8762 9100
		M56	900183	Centre Plus	Merino	L Mortimer & Sons	02 6892 8259
		EL57	960043	Ostlers Hill	English Leicester	ELAssoc/Stephenson	03 5764 1298
		WH58	960505	Clifton Hills	Wiltshire Horn	AWHSBA/Ballantyne	03 5145 8225
		EF59	970100	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		WS60	970842	Linden Genetics	PLG White Suffolk	Linden Genetics	02 6386 2020
1999	**Hamilton**	**BL61**	970188	Wongajong	Border Leicester	AD & CM Wilson	02 5882 3338
		BL62	980050	Kelso	Border Leicester	GB Starrttt & Son	03 5829 0144
		BoL63	955160	Struan	Booroola Leicester	PIRSA	08 8762 9100
		Cr64	910415	Coolana	Corriedale	PG Munro	
		Cp65	978431	Cashmore Park	Coopworth	J Keiller	03 5526 5248
		Ch66	920L91	Grand Ridge	Cheviot	RN Waddell	03 5629 4300
		Fi67	960085	Gippfinn	Finnsheep	S & D Jones	03 5122 3328
		EFP68	981019	Yollom	East Friesian x Perendale	MF & ML Molloy	03 5596 2077
		EFR69	970175	Price	East Friesian x Romney	EJ & KJ Price	03 5527 1110
1999	**Struan**	**BL70**	970310	Johnos	Border Leicester	NW & JI Johnson	08 8756 6053
		BL71	970290	Kelso	Border Leicester	GB Starritt & Son	03 5829 0144
		M72	933051	Merinotech Mid	Merino	Merinotech Mid North	08 8665 4019
		EL73	950T82	Koenarl	English Leicester	CR Taylor	03 5595 0272
		Cp74	970101	Oaklea	Coopworth	DW & IA Peglar	08 8738 9291
		Hy75	960215	Cowra	Hyfer	NSW Agriculture	02 6391 3813
		FiF76	960132	Gippfinn	Finn Friesian	S & D Jones	03 5122 3328
		EF77	960136	Silverstream	East Friesian	Silverstream Ltd.	0011 643 477 6375
		SHD78	970155	Tauranga	South Hampshire Down	S & M Macmillan	03 5596 2251
		PD79	970101	Wyndamah	Poll Dorset	GJ & BJ Oxley	03 5037 2355
		WS80	970172	Koonawarra	White Suffolk	AWSA	08 8210 5211
2000	**Struan**	**BL81**	960327	Morton	Border Leicester	JD & CM Corbin	08 8765 8058
		BL82	980260	Johnos	Border Leicester	NW & JI Johnson	08 8756 6053
		BL83	980085	Johnos	Border Leicester	NW & JI Johnson	08 8756 6053
		SAM84	980046	Jeancourt	S Af. Merino	W & M Heddle	08 8271 7080
		Cp85	980091	Oaklea	Coopworth	DW & IA Peglar	08 8738 9291
		Gr86	980144	Yangoora	Gromark	Yangoora Gromarks	02 6383 3254
		Hy87	940278	Cowra	Hyfer	NSW Agriculture	02 6391 3813
		Fi88	538	Gippfinn	Finn	S & D Jones	03 5122 3328
		EFP89	981071	Yollom	East Friesian	Karioi Seed Stock/Udy	03 5597 6621
		WS90	960513	Langley Heights	White Suffolk	AWSA	08 8210 5211
		WD91	990906	Axis	White Dorper	B & L Mawson	08 8537 0615