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Project 1.2 Reproduction efficiency

Milestone: Progress reports accepted on analysis of reproduction efficiency data, postgraduate research and on-farm validation of within flock segmentation strategies

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Task R2.1.3.4: Complete report on establishment and progress of on-farm validation of within-flock selection to improve reproductive performance

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1. Introduction

Reproductive performance across the Australian sheep is low by world standards (Scaramuzzi 1988), with very little improvement in the last 30 years, during which an average of 76% of lambs were marked/ewe joined (ABARE 2008). As a general comment, Merinos in particular tend to have a low reproductive performance, although there are instances where selection has substantially increased the level of reproduction.

Reproductive performance is an important driver of profitability as it determines the number of surplus animals available for sale, the number of replacement ewes available and hence the potential rate of genetic improvement (for any trait or traits) through the selection differential that can be applied.

Improvements can be achieved, in both the current generation and genetically, through selection based on early reproductive performance within the selected age groups. However the performance of the whole flock is diluted by the presence of a higher proportion of unselected ewes (particularly the maidens) that are required to maintain breeding flock numbers. Increasing the number of age groups would reduce the proportion of maidens in the breeding flock. Rapid improvement requires a high selection differential, which in turn further increases the proportion of maidens.

Currently within the Merino industry, maiden ewes are joined to lamb at 2 year-old, and the entire drop cast for age after 4 or 5 annual joinings. With current trends in technology and management towards targeted management of individuals/sub-groups, identifying more productive individuals to retain in the flock has become a priority.

2. Review of age effects on reproductive performance, mortality rates, and the productivity of Merino ewes.

Reproductive performance

A number of reports on age related reproductive performances of Merino ewes are available, most of which being based on genetic resource or selection flocks on research stations, and each represent a large body of data (Turner 1962; Turner and Dolling 1965; Rose 1972; McGuirk 1973; Cloete *et al.* 2003; Safari *et al.* 2007; Lee unpublished). The data of Langlands (1984a, b) represent the performance of 283 hogget ewes (over 5 age cohorts, and split across 2 unreplicated stocking rates) followed through 8 joinings in a research station based study. Differences in net reproduction between ages appear to be lower on the “low stocking rate” plot.

The data of Moule (Mattner and Moule 1965; Moule 1966) and Mullaney and Brown (1969, 1970) were collected from commercial properties in tropical Queensland and the Western Districts of Victoria, respectively. The Queensland data in particular reflect large year effects which are confounded with age.

While there are distinct age trends in reproductive performance, other environmental influences are evident as large year effects (eg McGuirk 1973; Langlands *et al.* 1984b). In McGuirk’s (1973) analyses of each of the components of net reproduction, and net reproduction itself, age accounted for no more than 11% of the total variation.

Table 1 Values for Merino ewes' net reproduction by age relative to that of 3 year-olds and the mean net reproduction performance at 3-year-old

lm/ej = lambs marked / ewe joined, and lw/ej = lambs weaned / ewe joined

§ average effect for 7 years and older

			Age at lambing (years)									Mean net performance
Source		Trait	2	4	5	6	7	8	9	10	11	at 3yr-old
1		lw/ej	0.86	1.07	1.18	1.23	1.20	1.14	1.08	0.98		0.72
2	O group	lw/ej	0.78	1.21	1.20	1.30	1.08					0.78
2	T group	lw/ej	0.86	1.26	1.33	1.41	1.44					1.03
3		lm/ej	0.85	1.12	1.60	0.10	1.40	0.68				0.42
4		lm/ej	0.56	1.39	1.59	1.46	1.29	0.98	0.92	0.31	0.20	0.30
5	1951-1969	lw/ej	0.83	1.11	1.11	1.16	1.08	0.90	0.91	0.81		0.80
5	1962-1969	lw/ej	0.85	1.21	1.24	1.27	1.28	0.90				0.79
6	D-Flock	lw/ej	0.78	1.12	1.21	1.21						0.71
6	C-Flock	lw/ej	0.78	1.11	1.16	1.18	1.01	0.61	0.63			0.90
6	Qplu$	lw/ej	0.78	1.11	1.11	1.04	1.01					0.85
7		lw/ej	0.84	1.09	1.12	1.09	0.99§					0.90
8	low SR	lw/ej	0.72	1.04	1.03	0.97	0.89	0.93				0.89
8	high SR	lw/ej	0.87	1.21	1.21	1.25	1.19	0.85				0.52
9		lw/ej		1.07	1.09	1.04	1.01	0.95	0.75			0.51
10		lw/ej		1.20	1.28	1.30	1.28	1.24				0.75
11		lw/ej	0.76	1.13	1.14	1.05	0.86§					0.86
12		lw/ej	0.85	1.09	1.12	1.09	1.03	0.98	0.94	0.91		

1 Turner and Dolling (1965); 2 Turner (1962); 3 Mattner and Moule (1965) and Moule (1966); 4 Rose (1972); 5 McGuirk (1973); 6 Lee *et al.* unpublished; 7 Safari *et al.* (2007); 8 Langlands *et al.* (1984a,b); 9 Mullaney and Brown (1969); 10 Mullaney and Brown (1970); 11 Cloete *et al.* (2006); 12 Assumed values used by Richards and Atkins (see section 3 below)

Fleece weight and quality

A summary of age related changes in clean fleece weight are shown in Table 2. All but the data of Mullaney *et al.* (1969) are derived from research flocks. As a general statement clean fleece weights tend to decline from a peak at 2- year-old. Although the "low SR" plot of the Langlands *et al*. (1984a) fits with this trend, the lower "high SR" fleece weights showed little effect of age until 8- and 9-year-old. Most of the estimates indicate a decline in clean fleece weight of up to 10% at 7-year-old.

It has been long established that fibre diameter is finest in young sheep and increases with age, with the largest increases occurring in the early years of production (Table 2). However, at data shown in Table 2 suggest that at 7-year-old fibre diameter will be similar of up to 5% broader than the fibre diameter at 3-year-old.

Other age related changes in fleece quality with age include a reduction in staple length (Brown *et al.* 1966; Mullaney *et al.* 1969). Relative to the 3-year-old value, staple length declined from 1.05 at hogget shearing to 0.91 at 7-year-old (Brown *et al.* 1966), and data from a survey of commercial properties in Victoria showed at decline in staple length of 12% between 3- and 7-year-old (Mullaney *et al.* 1969).

A significant reason for culling older Merino ewe age groups is the age related decline in fleece weight and wool quality as outlined above. Two earlier reports on the optimum age structure are available based on whole drop performances.

Included in the report of Turner *et al*. (1968) was an examination in a self-replacing Merino ewe flock (under selection for fleece weight) of the effect the number of ewe age groups had on surplus animal numbers and relative return from wool. Combining these two outcomes was achieved using relative weights for each. Their conclusion was that either 5 or 6 breeding ewe age groups (2-6 or 2-7 year-old) were optimal, depending on the level of reproduction.

Studies by Egan *et al.* (1972), and later extended by Jardine *et al.* (1975), aimed to study the effects of the main biological factors of age, sex (ewe/wether) and reproductive performance on flock structure of Corriedale ewe/wether self-replacing flocks using relative values for wool and meat The reports of Egan *et al.* (1972) and Jardine *et al.* (1975) indicated that the optimal age structure would shift to younger structures where reproductive performance was low and meat prices relative to wool were low. If reproductive performance is low, increasing the proportion of maidens will have little effect.

The optimal solution obviously changes with relative prices. Differential management and selection based on performance gives more flexibility in terms of flock structure, and these need further examination.

Mortality rate

Within the Australian Merino industry, ewes are commonly cast for age at either 5 or 6 years old as an entire age group. Research flocks in general have followed a similar practice. Thus, because entire age groups have been removed from the flock, longevity data is very limited (Table 3). The few large studies of mortality rates as related to age have been based on "roll-calls" of adult animals at particular musters. These studies will tend to be overestimates as "mortalities" include actual deaths (whether a carcass is located or otherwise), animals that elude mustering (through the fence?), animals that lose their ear tag (Turner *et al.* 1959) or where older ewes, in earlier years have been culled on condition, mouth etc and the individual not recorded (McGuirk 1973). The reports of Turner *et al.* (1959), Rose (1972) and McGuirk (1973) are from research flocks. Moule reports (Mattner and Moule, 1965; Moule 1966) are based on a large scale study of 25 commercial flocks mainly in tropical Queensland, while that of Granger (1944) is from data collected from a stud in NSW.

Table 2 Age effects on clean fleece weight and fibre diameter of Merino ewes relative to their performance at 3 year-old, and the mean 3 year-old fleece weight and fibre diameter

§ average effect for 7 years and older

		Ewe age									3-yo
Source		1	2	4	5	6	7	8	9	10	mean
		Clean Fleece weight									
1		0.90	0.95	0.99	0.96	0.94	0.89	0.83	0.77	0.70	2.61
2				0.92	0.91	0.87	0.79	0.76			2.40
3	High SR-Dry			0.96	1.01	1.01	0.97	0.82	0.85		2.20
3	High SR-Wet			1.04	1.06	1.04	1.03	0.93	0.90		1.93
3	Low SR-Dry			0.95	1.00	0.95	0.91	0.82	0.77		2.88
3	Low SR-Wet			0.99	1.00	0.97	0.93	0.87	0.81		2.72
4	D-Flock		0.97	0.99	0.96	0.92					3.84
4	C-Flock		1.02	0.98	0.96	0.93	0.89	0.85	0.79		3.95
4	Qplu$		0.97	1.00	0.97	0.94	0.90				4.96
5			0.95	1.02	1.01	0.99	0.97§				3.54
6		0.85	0.95	1.01	0.98	0.91	0.80§				3.38
7		0.87	0.94	1.01	0.98	0.91	0.85	0.81	0.77	0.74	
		Fibre diameter									
1		0.99	0.99	1.00	1.01	1.01	1.00		0.98	0.94	20.88
2				0.99	1.00	1.00	1.00	0.98			20.29
3	High SR-Dry			0.98	0.99	1.00	1.01	1.03	1.01		19.00
3	High SR-Wet			0.99	1.03	1.05	1.04	1.05	1.01		18.20
3	low SR-Dry			0.99	1.03	1.02	1.02	1.03	0.97		19.80
3	low SR-Wet			0.99	1.00	1.01	1.00	1.01	0.98		20.10
4	D-Flock		0.98	1.02	1.03	1.04					21.72
4	C-Flock		0.98	1.01	1.02	1.03	1.04	1.04	1.03		21.77
4	Qplu$		0.97	1.01	1.03	1.04	1.05				21.86
5			0.97	1.02	1.05	1.06	1.08§				22.00
6		0.95	0.98	1.02	1.03	1.03	1.02§				21.88
7		0.95	0.98	1.01	1.02	1.03	1.03	1.02	1.01	1.00	

1 Brown *et al.* (1966); 2 Mullaney *et al.* (1969); 3 Langlands *et al.* (1984); 4 Lee *et al.* Unpublished; 5 Cloete *et al.* (2003); 6 Safari *et al.* (2007); 7 Assumed values used by Richards and Atkins (see section 3 below)

The implication from some of these reports is the importance of nutrition/ body condition on mortality rates, particularly in older age cohorts. The annual records presented by Turner *et al.* (1959) indicate the increase in mortality associated with a drought year across the range of age groups, although ages 7+ year-old were more severely affected. Both Rose (1972) and McGuirk (1973) report mortalities before and after changing joining dates, although in both cases these were confounded with year effects. Losses of 3-10 year-old ewes at Julia Creek (Qld) appeared to be reduced following a change from autumn to spring joining, but weaner losses appeared to increase (Rose 1972). A change for a March to April joining at Trangie (NSW) was associated with a small decline in ewe mortalities, although data were only available for ages 2-5 under an April joining (McGuirk 1973).

The report of Langlands *et al.* (1984c), while likely to represent more accurate counts of actual deaths, is based on relatively few animals across a range of years (up to 9 year-old for each of 5 age cohorts, across two plots – less than 30 animals per age cohort in a given year/plot). While the impression (and likelihood?) is that deaths were higher at a high stocking rate, in fact there were no statistically significant differences between the (unreplicated) plots at individual ages (Figure 1). The cumulative mortalities did differ between the plots at 8 and 9 years of age, although we cannot be sure of the reasons for those differences (including chance plot effects) because the treatments were not replicated. However, when taken together with the data from the more extensive studies above, it is likely that nutrition to support ewe condition will be important in the management and production from older ewes.

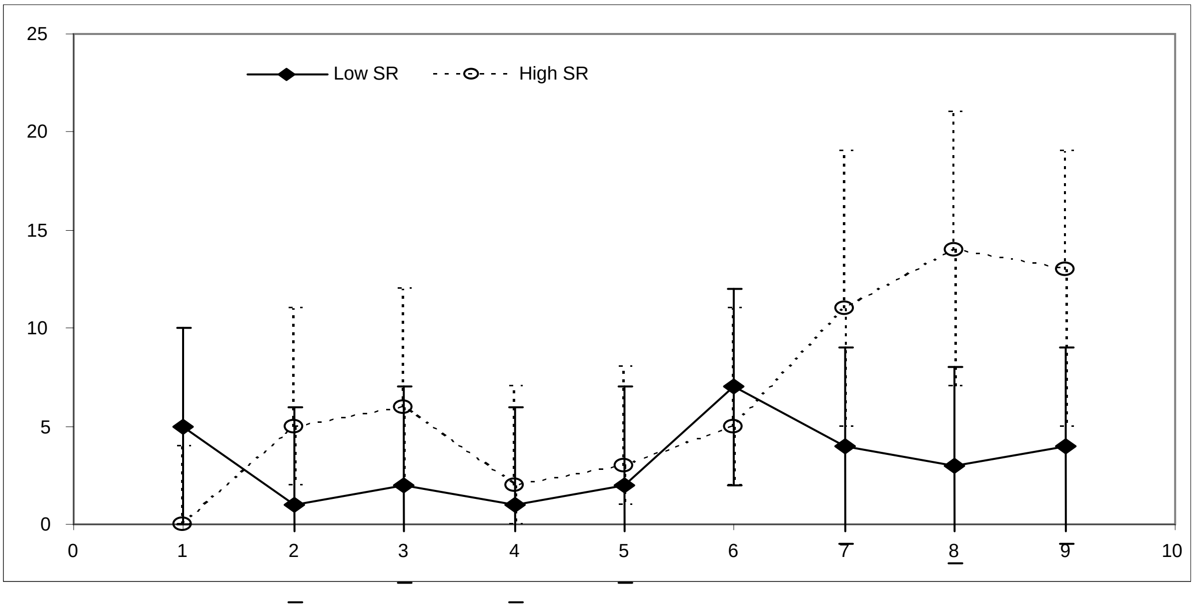

Figure 1 Deaths at each age of ewes grazing plots at a high or low stocking rate.

Recently, genetic influences on longevity of sheep have been reported (Hatcher *et al.* 2009, Mekkawy *et al.* 2009). The extent to which there are genotype x environment interactions influence longevity have not been elucidated to date but are likely to be important. Genetic differences between the studies are likely to be reflecting both differences in the environment and the genetics of the flocks studied.

Table 3 Annual ewe mortality rates (%) by ewe age

		Ewe age (yrs)												
Source:		0.75	2	3	4	5	6	7	8	9	10	11	12	13
1	Non-drought years		2.4	2.6	1.5	2.1	2.6	2.6	7.3	7.3	1.7			
1	Drought year		5.8	2.7	4.5	0.7	4.7	11.1	18.6	21.2	45.6			
2				4.2	4.8	5.7	8.5	13.9	25.6					
3	"Low SR"	3.2	0.7	1.4	0.7	1.4	4.9	2.9	2.3	3.1				
3	"High SR"	0.0	3.7	4.7	1.6	2.5	4.2	9.7	13.7	14.8				
4		38.6	7.6	2.9	3.8	12.7	8.1	9.4	5.4					
5	Autumn joined	38.0	5.0	9.0	8.0	13.0	11.0	15.0	16.0	24.0	30.0	46.0	73.0	100.0
5	Spring joined	48.0	6.0	4.0	1.0	4.0	1.0	9.0	10.0	17.0	27.0	63.0	64.0	65.0
6				3.0	4.0	2.0	4.0	7.0	5.0	21.0	31.0	38.0	62.0	
7				2.5	2.6	4.1	5.5	5.8	6.8	19.1	31.8	33.3	60.0	
8			2.5	2.2	2.2	2.7	3.6	5.1	6.9	9.2	11.8			

1 Turner and Dolling (1965); 2 McGuirk (1973); 3 Langlands *et al.* (1984c); 4 Mattner and Moule (1965) and Moule (1966); 5 Rose (1972); 6 Granger (1944); 7 Kelley (1939); 8 Assumed values used by Richards and Atkins

Conclusions

- Other than the effects of annual reproductive performance, there is no information on the wool production of different segments of the breeding flock based on cumulative reproductive performance.
- Nutrition/body condition is likely to be important in the performance of older ewes, particularly those older than 7-8 years of age. However, there has been no direct study relating nutrition/condition to age effects on mortality, production and reproduction.
- The data relating mortality and reproduction to age were collected prior to the recognition of the importance of condition targets. The diversity in the estimates of age effects can be attributed to the range seasons and environments from which the data were sourced.

3 Modelling the potential benefits of within-flock selection

There are three opportunities for commercial flocks to improve reproductive performance using within-flock selection.

Ewe lifetime selection:

Two strategies can be employed, culling poor performers early and keeping productive animals for longer in the flock.

1. Culling ewes that are dry (at scanning) on 2 occasions can result in a 5-10% culling rate but achieve a moderate increase in flock reproduction rate. Culling on a single record is less accurate but involves a higher culling rate and will increase the proportion of less productive maidens in the breeding flock.
2. Lifetime ewe selection is based on keeping productive animals for 1 to 2 years beyond their normal cast age. Up to 50% of the oldest age group are kept in the flock longer based on their lifetime reproduction rate, increasing flock reproduction rate.

Genetic improvement:

3. Select rams at stud source on production including an ASBV for reproduction rate (NLW). In flocks recording some traits related to reproduction rate (such as body weight, testis size), it is possible to find rams that are +5% EBV (nlw) which make up about 10% or more of the flock ram population. (Note that +10% EBV (nlw) rams would only be 1% of the available rams).

   Using these +5% rams, benefits arise relatively slowly in the medium to long term. About 50%+ of the EBV is accumulated in the flock by year 7 and about 70% by year 10 – eventually all the EBV is realised.

To evaluate the potential gains from these strategies available to commercial Merino breeders, data from the Trangie resource flocks was used to estimate responses in reproduction and Smart Merino software used to estimate:

- Economic response
- Impact on production level and surplus animals
- Capacity for further within-flock selection

This example started with a flock of 2000 breeding ewes in 4 age groups, having 75% net reproduction (lambs weaned per ewe joined), and adult ewes producing a fleece of 6 kg greasy wool annually 20.5µm fibre diameter. Surplus animals available for sale before implementing the three within-flock selection strategies listed above were 908 hoggets and 458 adult ewes annually.

Reproduction responses: Flock reproduction rate increased from 75% to 82% in 5 years (almost entirely due to ewe selection), further to 90% in 10 years (from both ewe and ram selection). The improvements in reproductive rate and the components contributing to that improvement are shown in Figure 2.

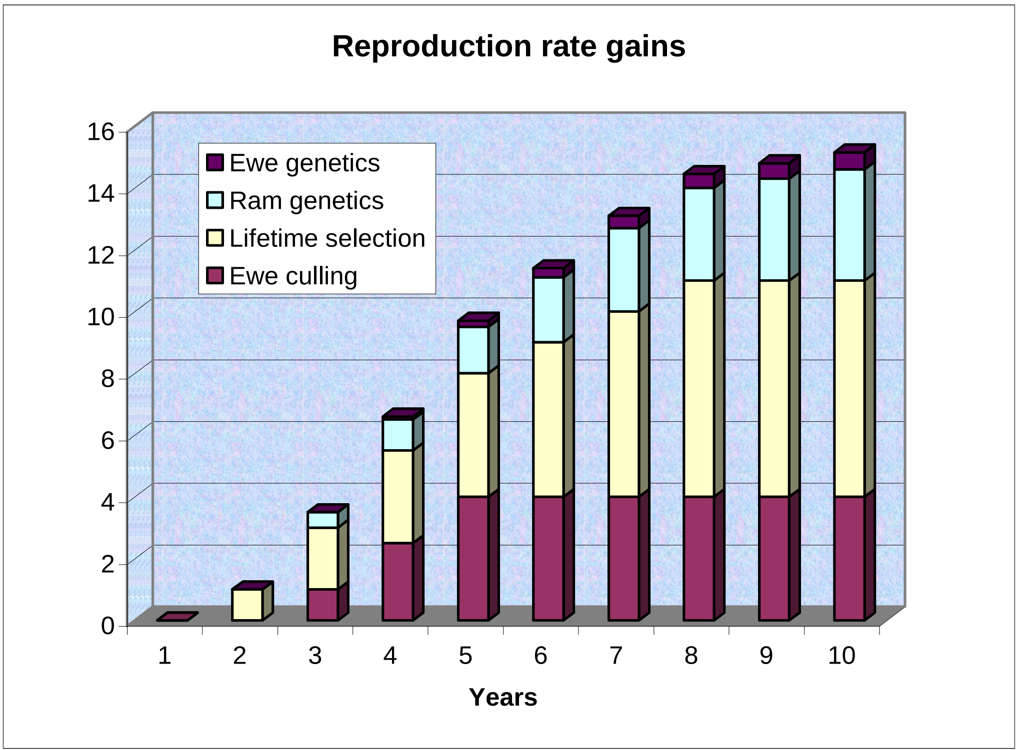

Figure 2 Potential responses in reproduction rate over 10 years

The retention of older ewes was responsible for about a 4% increase in reproduction rate after 5 years (7% after 10 years), while culling twice dry had approached its maximal response of 4% at 5 years. Ram's genetics will not be evident for 2 years after the first daughters are born, but after 10 years could produce gains of *circa* 4%.

The flow on from the reproductive improvement and alteration to the age structure after only 5 years was:

- 228 more ***high-value*** surplus hoggets (66 wethers and 162 ewes) and fewer surplus old animals (101) available for sale.
- Fewer maidens (of lower reproduction) required as replacements
- Higher selection intensities are possible on wool traits

Table 4 Responses after 5 years in greasy fleece weight and fibre diameter associated with within-flock selection strategies to improve reproductive performance and with hogget selection for wool

	75% reproduction	82% reproduction
No selection for wool - greasy fleece weight - fibre diameter	 6 kg 20.5 µm	 -0.1 kg +0.1 µm
Hogget selection on wool - greasy fleece weight - fibre diameter	 +0.2 kg -0.3 µm	 +0.2 kg -0.4 µm

Wool responses: With no attempt to improve reproductive performance, after 5 years of hogget selection for wool improvements of 0.2 kg in greasy fleece weight and a reduction of -0.3 µm in fibre diameter could be achieved (

Table 4). Without any selection for wool, keeping older ewes resulted in small detrimental changes to both fleece weight and fibre diameter (-0.1 kg and +0.1 µm, respectively after 5 years). Combining both selection on wool and within-flock selection strategies to improve reproductive rate would enable further improvement in the fleece through the increase in selection intensity possible from the higher reproductive rate and reduction in the number of replacement ewes required. These improvements more than overcome the costs associated with the retention of productive older ewes.

The improvements to the gross margin/ ewe are illustrated in Table 5 which shows that selection and reproduction responses can increase profit separately. However, improving the reproduction rate will complement the selection response by providing greater selection intensities in the selection of replacement ewes.

Table 5 Changes in gross margin/ewe from improvements in reproductive rate and from selection for wool traits

	75% reproduction	82% reproduction	90% reproduction
No selection for wool	$59.00	+$3.00 5% increase from reproduction alone	+$8.20 14% increase from reproduction alone
Selection on fibre diameter + fleece weight	+$2.40 4% increase from selection alone	+$6.80 12% increase from reproduction + selection	+$12.60 21% increase from reproduction + selection

Conclusion

There is no single strategy that can deliver a large outcome by itself, but, collectively, breeding and selection is a worthwhile investment (Figure 2).

Retaining more productive ewes for longer has the following benefits:

- Reduce the proportion of maidens in the flock
- Fewer replacement ewes needed
- Increase whole flock reproductive rate
- Increase the potential selection differential
- Increase the number of surplus young animals
- Reduce the number of cast for age ewes

4 Selection demonstration flocks

Although the theoretical potential benefits of retaining older, more productive ewes from known information in the literature have been established, a number of assumptions were needed. It is well known that reproductive performance and production traits, such as clean fleece weight, are negatively correlated (Lee and Atkins 1995). However, there is no known rigorous study of possible effects of an interaction between reproductive performance and age on production traits.

As indicated by Lee *et al.* (2009), further information on the implications for other production traits of retaining ewes with a high reproductive performance for longer, and their capacity to continue reproducing (at levels higher than likely replacement ewes) at older ages will be required. Evidence from other (undomesticated/semidomesticated) ungulate species suggests that females with a high lifetime reproductive performance have greater longevity and lower reproductive costs than their less productive cohorts (Clutton-Brock *et al.* 1996; Hamel *et al.* 2009; Weladji *et al.* 2008).

Lifetime net reproductive performance has a strong genetic relationship with each of the component traits, and has a relatively high realisable heritability (compared with annual measures of net reproduction or the component traits). To use that trait both the birth and rearing status of lambs is required. It is technically possible to record reproductive performance of individual ewes (by both scanning and the use of Pedigree Matchmaker), but there is need to demonstrate the on-farm feasibility of the collection of all these data and the best way of utilising it to improve reproductive performance of the breeding flock.

Objectives

To determine the relative productivity (wool production and quality) of older ewes that have a high net reproductive performance over a number of years.

To demonstrate the **feasibility** of collecting reproduction data on-farm, and

To demonstrate the best use of this data to identify opportunities at critical stages of the reproduction cycle where improvements are likely to generate the greatest benefit

Design and methodology

Across 3 states there have been four sites established on commercial wool producing properties.

- South-West slopes of NSW (commenced 2009)
- Central West plains NSW (commenced 2009)
- South west Victoria, Glenthompson (commenced March 2010)
- Cunnamulla Qld (commenced February 2010)

At each property, 3 ewe age groups (3-5 yr) will be measured in the initial year, and measurements continued in each of 3 yrs. In the 2nd and 3rd years 6 year-old ewes will be retained in the breeding flock. Liveweights and condition/fat scores are being monitored over the annual reproductive cycle. Pregnancy rates are being determined using commercial scanners, and lamb survival and dam/offspring associations recorded using Pedigree Matchmaker (Richards and Atkins 2007). At shearing, individual fleece weights are recorded and midside samples collected for measurement of yield, fibre diameter, staple strength (ATLAS) and staple length by the Australian Wool Testing Authority.

Progress and results

Both sites in NSW (Industry & Investment NSW) were established in 2009, while the Victorian (Victorian Department of Primary Industries) and Queensland (Agri-Science Queensland) sites commenced in March and February 2010, respectively. Thus, only the 2 sites in NSW have completed one reproductive cycle.

NSW sites

Reproductive performances

Conception rates at both sites were similar, on the South-West Slopes being 132 lambs / 100 ewes joined, and on the Central West Plains 133 lambs / 100 ewes joined (Table 6), with the latter having lower fertility but higher fecundity. While the South-West Slopes property realized there was a lamb survival problem, the use of Scanning and Pedigree Matchmaker clearly identified the problem of twin survival. Plans were established to specifically address the management of twin-bearing ewes in future years.

Table 6 Lambs scanned and survival rates to weaning of flocks on the South-West Slopes and Central West Plains of NSW

	No. lambs		
	Dry	1	2
Pregnancy scanning			
South-West Slopes	11%	49%	41%
Central West Plains	14%	39%	47%
Lamb survival			
South-West Slopes		66%	38%
Central West Plains		80%	67%

The pregnancy status of ewes within each of the age groups of both the South-West Slopes and the Central West Plains flocks is shown in Table 7.

Table 7 Fat score and pregnancy status at scanning of each age group from flocks on the South-West Slopes and Central West Plains of NSW

		South-west slopes			Central-west Plains		
Age		Dry	Single	Twins	Dry	Single	Twins
3	Fat Score	3.30	3.07	3.08	3.31	3.36	3.41
	sd	*0.77*	*0.57*	*0.55*	*0.81*	*0.67*	*0.56*
	%	12.6	34.3	53.1	31.8	39.2	27.6
4	Fat Score.	3.33	3.32	3.22	3.35	3.31	3.58
	sd	*0.77*	*0.67*	*0.65*	*0.89*	*0.77*	*0.70*
	%	10.1	39.9	50.0	36.4	32.6	32.0
5	Fat Score	3.82	3.09	3.80	2.98	3.25	3.19
	sd	*0.42*	*0.61*	*0.58*	*0.66*	*0.72*	*0.65*
	%	9.5	48.3	42.2	31.8	28.2	40.4

Fleece traits

Raw means for the fleece traits measured in each of the scanning and rearing categories are shown for the South-west Slopes property in Table 8. In the one year measured it appears there may be an interaction of age and the number of lambs borne/reared within the South-west Slopes flock for clean fleece weight and possibly fibre diameter. However, any such effects on staple strength or staple length are less obvious.

Table 8 Effects of scanning performance and rearing performance on the fleece characteristics of Merino ewes at 3-, 4- and 5-years of age at the South-West Slopes site

		Scanning			Lambs weaned		
	Age	Dry	1	2	Dry	1	2
Clean fleece wt (kg)							
	3	3.67	3.16	3.13	3.60	3.09	3.10
	4	3.33	3.09	3.16	3.33	3.14	2.74
	5	3.42	3.01	2.84	3.50	2.95	2.58
Fibre diameter (µm)							
	3	17.43	17.10	17.18	17.37	16.99	17.53
	4	17.68	17.51	17.58	17.68	17.50	16.97
	5	17.90	17.37	17.35	18.01	17.37	16.94
Staple strength (N/ktex)							
	3	44.81	44.52	42.77	44.89	44.04	48.31
	4	38.93	45.06	43.96	38.93	45.99	46.81
	5	42.45	44.41	43.72	42.90	44.93	41.25
Staple length (mm)							
	3	93.95	88.48	87.81	93.21	88.29	88.92
	4	91.13	84.68	86.72	91.13	86.03	83.38
	5	90.09	83.71	82.98	91.00	83.54	81.92

Means for the fleece traits measured in each of the scanning and rearing categories are shown for the Central West Plains property in Table 9. Although it appears there maybe age effects on a number of fleece traits, particularly 3- and 4-year-old *v.* 5-year-old, differences in genetics prevents this comparison with the true determination of age effects requiring comparisons at the within-ewe level (i.e. measurements over a number of years.

Table 9 Effects of scanning performance and rearing performance on the fleece characteristics of Merino ewes at 3-, 4- and 5-years of age at the Central West Plains site

		Scanning			Lambs weaned		
	Age	Dry	1	2	Dry	1	2
Clean fleece wt (kg)							
	3	5.39	4.98	4.70	5.39	4.90	4.56
	4	5.06	3.96	4.02	5.06	3.98	3.97
	5	4.11	3.64	3.54	4.11	3.61	3.36
Fibre diameter (µm)							
	3	23.95	22.53	22.12	23.95	22.25	22.05
	4	22.80	22.60	22.42	22.80	22.41	22.11
	5	22.12	21.84	21.62	22.12	21.71	21.62
Staple strength (N/ktex)							
	3	43.60	38.70	28.31	43.60	36.15	27.55
	4	39.83	36.96	28.42	39.83	34.61	27.96
	5	33.24	34.93	26.67	33.24	31.98	25.62
Staple length (mm)							
	3	111.50	107.84	108.62	111.50	108.40	107.45
	4	95.92	95.53	97.85	95.92	96.10	96.68
	5	95.62	92.20	93.12	95.62	92.70	92.58

Cunnamulla, Queensland

This site commenced in February 2010. At scanning (April 2010), 16.2% of the ewes were dry (63.7 kg liveweight, condition score 3.65), 52.4% carried a single lamb (62.0 kg liveweight, condition score 3.87) and 31.4% carried multiple lambs (63.8 kg liveweight, condition score 3.94). Data by age group are shown in Table 10.

Table 10 Liveweight, condition score and pregnancy status at scanning of Merino ewes age 3-, 4- and 5-year old from the site at Cunnamulla, Queensland

Age		Dry	Single	Twins
3	Liveweight	60.60	61.57	63.32
	sd	*7.45*	*5.69*	*6.74*
	Condition. Score	3.83	3.98	4.14
	sd	*0.64*	*0.62*	*0.67*
	%	20.2%	42.9%	37.0%
4	Liveweight	65.04	64.33	67.69
	sd	*7.00*	*5.42*	*6.38*
	Condition. Score	3.69	3.81	4.00
	sd	*0.79*	*0.75*	*0.77*
	%	22.2%	50.4%	27.4%
5	Liveweight	66.00	61.88	63.31
	sd	*5.23*	*4.67*	*5.09*
	Condition. Score	3.33	3.75	3.74
	sd	*0.91*	*0.67*	*0.82*
	%	11.4%	58.9%	29.7%

Glenthompson, Victoria

This site commenced in March 2010 (pre-joining), when the mean liveweight was 48.2 kg and condition score was 2.61. Scanning would be due in June.

Adoption strategy

The following draft strategy was developed for use at these sites if activity were continued.

Aim

- Demonstrate the ease of collecting reproduction data on-farm
- Demonstrate the use of this data to identify opportunities likely to generate the greatest benefit.

Outcome

- Each producer to develop a reproduction action plan for their flock.
- Highlight improvements and/or modifications to current management practices during the reproduction cycle to improve their flock's reproduction rate

Outline

- Information on the current performance of each of the four sites (reproduction, stocking rate, wool production & quality) will be collated.
- Establish groups (7 to 10 growers) associated with each of the sites.
- Each group would meet 4 times per year at critical times of the reproductive calendar to discuss issues and consider ewe and pasture performance.
- Each of the four sites linked with local extension officer

Conclusions

All four sites have now been established, with data available from two sites for a full year (ewes aged 3-5 years). However, the gaps in knowledge cannot be filled until data for additional years are available to establish a reproductive history and allow age effects to be determined. Differences in ewe genetics and initial ages involved in the first year preclude estimating reproductive effects on the productivity of older ewes as set out in the aims of the project.

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