Making more from the same Ewe Base

Looking at fertility, fecundity, lamb survival and adaptability.

A report for NUFFIELD AUSTRALIA FARMING SCHOLARS

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Foreword

The Australian economic and environmental climate of the 2000's is very different to that of the last half century where most of the agricultural advancements have been enough to increase farm production and profitability. Australian farmers at the bottom of the supply chain continue to lose their percentage of retail returns compounded with very restricting production challenges such as frost and increased rainfall and temperature variability. Farmers must consider whole farm profitability and risk management to remain viable.

Australia's sheep numbers have not been this low since 1916 levels and sheep have been identified as a good risk management tool. In the past 10 years when crops have failed, particularly in the marginal cropping zones stock has been an important component in salvaging some of the inputs of cropping.

However running sheep, while a good risk management tool, must compete with cropping on a per hectare basis for net returns. Sheep generally have lower inputs but also are able to reduce numbers relatively quickly when seasons finish early. Therefore sheep numbers can be reduced quickly in times of dry, but rapid increase of numbers still appears to elude us in 2010. While it is usually 8 months from conception to weaning, sheep do have a biological capacity to produce the next crop quite quickly and certain individuals within our flocks indicate the potential yet to be harnessed across the industry.

While the numbers of sheep are quite low there is a golden opportunity to try to refocus as an industry and place selection on specific profit driving traits such as fertility. By producing more lambs from the same ewe base we have the opportunity for better utilisation of feed and capital resources and making farms more robust.

I believe that increasing fertility, fecundity, lamb survival and adaptability will start by enabling producers to improve their own genetics and profitability, but also by improving industry traits for these and marketing opportunities. It is my opinion that as an industry we need to get back to focusing on basic survival traits such as fertility and mothering and lamb survival particularly the sire influences, and I wish to see more of this when choosing to buy rams. After all no matter how good an individual sheep if it can't replace itself, then those genetics are lost with that generation. Cross breed referencing for maternal traits will also be able to give producers more options than selecting within one section of the ASBV database.

It has been shown that individual animals have genetics that increase lamb survival and it is important that these sires be identified as this has been listed as one of the highest forms of wastage in the industry. Continued selection within the ewe and sire base for increased fertility and fecundity will allow for enough animals to replace and expand current flocks and then put emphasis on wool and meat traits.

MLA the sponsors of this scholarship released a publication in March 2004 which was called Wean More Lambs, optimising sheep reproductive performance, which identified that 'reproductive efficiency is important to the profitability of all sheep flocks.'

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My brother David

My father Neville and David

To my GFP group for all their added insights and great company for our six weeks together, thank you for your support and friendship.

I would also like to thank all the people who have helped me endlessly along the way. Thank you for all the beds, information and insights, and to many who organised meetings trips and tours. There are many people who are not individually named here but whose comprehension on their industry and their own businesses have made my travelling so much richer, you are all so numerous and I hope you can gain a fraction from this report as I have gained from all of you.

When writing this report there is so much information that people have imparted with me it makes the amount of knowledge overwhelming and difficult to put into a logical format, not only about sheep, but people themselves and will be ever grateful.

There are however a few people whose efforts I shall struggle to repay and without whom my trip and understanding would not be what it is. In South Africa I would like to thank Schalk Cloete and his wife Alta for their time and for organising a very insightful trip and all of their

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Abbreviations

MARC is the Meat Animal Research station in Nebraska USA

DPI, Department of Primary Industry

INIA is the Argentinean equivalent to DPI

GADI, Grootfontein Agricultural Development Institute

Ag Research is a New Zealand research organisation

Innovis is a commercial company in the UK for sheep genetics

MLA, Meat And Livestock Australia

GFP is Global Focus Program

EBV, Estimated Breeding Value

UK is the United Kingdom

ASBV is Australian Sheep Breeding Value

DSE, Dry Sheep Equivalent

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Executive Summary

Australian sheep numbers are reportedly at 1916 levels in Australia and low worldwide. Therefore sheep fertility, fecundity, and lamb survival are very important traits to rebuild the industry and set it up for future production, however this should not be at the expense of finding better adapted and better performing animals within the current flock. There are many different types of sheep and many management systems within the different environments that give the industry a huge genetic resource, but careful selection within Australian flocks along with an emphasis on reproductive efficiency will allow producers to have more animals that are more efficient for selection to rebuild flocks while taking advantage of the currently good prices for cull animals.

There has been more emphasis in recent years on meat income with many animals being joined to terminal sires. It is important to note that the larger maintenance costs of cross bred animals coupled with lower wool incomes means that animals in meat flocks which are not achieving high reproductive rates are costing the producer. Wool income is an important risk management tool in a sheep business. This is particularly so in harsh environments and as was noted in South Africa in the 2001 wool price spike, Merinos lambing at 80% were as profitable in net terms to producers running Dorpers lambing at 170%.

If producers are going to be competitive with alternative land uses, then profitability per hectare must go up. Many areas used for sheep production are already being devoted to other enterprises such as cattle and cropping, particularly the lamb meat producing areas in South America going to soybean production and New Zealand sheep areas going to dairy.

For long-term sustainability grass-fed systems need to be more feed efficient and rely mostly on grass based systems. Different pasture types to keep the cost of production low and timing of lambing to meet this feed curve is also very important.

We are very lucky in Australia that we do not suffer some of the large predators like other parts of the world and our nutrition management and focus on the ewe condition score is very good. Multiples births of sheep are also relatively simple in sheep compared with cattle allowing room for large efficiency gains. It is difficult to obtain lambing percentages greater than 170%, many more triplets are born as percentages go above this and very high levels of management must be in place for this to be a successful venture.

Introduction

Worldwide sheep numbers are significantly low, to the point where many markets may now go unfulfilled. In Australia alone the sheep numbers are now below 77 million head (sheep CRC). Kimbal Curtis of WA Department of Agriculture and Food claims that these levels are the lowest since 1916.

The Australian flock is now comprised of far less wethers and a larger percentage of breeding ewes. (Curtis, 2009) Therefore sheep fertility, fecundity and lamb survival have never been more important, but this need not be at the expense of adaptability and finding the right animals that perform best in individual regions. More and more ewes are being joined to terminal sires which are changing the face of the industry along with the reduction in producers in the industry.

Traditionally the Australian sheep industry relied on a low input, low risk management strategy, with a greater reliance on sheep meat production over recent years, reproduction efficiency has become more important and the business is exposed to greater risk.

Higher sheep numbers start by increasing number of ewes joined, and any ewe that is not reproducing is effectively a wether and only providing income from a fleece and certainly in many meat enterprises running a dry ewe with higher DSE ratings than a merino, the profit from wool has not met the increased running costs.

The next step to increasing sheep numbers is to increase fecundity. By increasing ovulation rate and encouraging larger litter sizes more sheep are produced from the same numbers of ewes, which allows more selection pressure for replacements for wool and meat.

However large litter sizes require more targeted management to increase feed and shelter to ewes carrying multiples which have smaller birth weights.

Australian lamb marking percentages are less than 80% in most states (Fogarty, N.M. 1984). To increase performance of both lamb and wool enterprises there are several areas to increase productivity. These are fertility, fecundity, lamb survival, lamb growth, fat level, ewe wool production and number of lambings per lifetime (Hall, D.G. 1984; Geenty, K. 2006; Fogarty, N. 2000). Therefore increasing ewe reproductive rate will increase profits to farmers (Hall, D.G. 1984). One way many Australian and New Zealand farmers have been increasing gross margins of their sheep enterprises has been to increase not only ewe fertility but also litter size with ewe fecundity.

Increasing reliance on meat production heightens the importance of reproductive rate due to lack of wool income, which increases the risk of the operation. Reproductive rate is sensitive to climatic variations between seasons, higher rates require more tailored management expertise and as meat: wool ratio increases there is less wool income acting as a buffer against fluctuating meat prices.

Objectives

To help producers find a way to increase profitability from the same ewe base by trying to find if there are genetic resources that can improve the natural fertility and fecundity of the sheep currently in Australia.

To find out why different breeds of sheep are used in the environments which they are, what is the key feature of these sheep which makes them successful?

To find if there are any genetic or management tools which can increase lamb survival and in turn profitability.

To outline why it is so important to focus on why fertility, fecundity, adaptability and lamb survival can make producers more financially robust.

Determine some strategies that businesses use to ensure high reproductive rate for financial success and manage seasonal risk.

Chapter 1. What is a sheep and what challenges are there?

To understand the context of adaptability and why farming systems are the way they are we first must understand what different people around the world define as sheep.
In Wales sheep are defined into three category types which relate directly to the land use. There are hill types, such as the Welsh Mountain, there are upland types and lowland types such as the Beltex and Charollais, all of which have very different characteristics.

Figure 1.1 Welsh mountain sheep on mount Snowdon.

Figure 1.2. The Jacob a unique breed at RWAS.

Figure 1.3. Beltex rams at Richard Tudors.

These three are only a sample of the many breeds found in the UK alone. The Welsh Mountain is mostly a hill sheep farmed where the main constraint is usually nutrition. Often in the hills animals are lambed outdoors and have lower lambing percentages, higher fat cover and internal fat reserves to deal with the cold, and often take longer to grow to mature weights all well adapted skills for dealing with altitudes of over 1000ft or 300m. However many of these breeds are naturally fecund, and as Basil Wolfe, lecturer at Aberystwyth University explained hill breeds may only join at 60% in the hills but if brought down into the lowlands, lambing can be in excess of 150%.

In South Africa not only are the sheep very different but so is the management and the constraints. Figure 1.4 shows dormer ewes at Cape Town who are being run with donkeys to reduce predators at lambing. In figure 1.5 merinos are being run at Tygehoek experimental farm where security is an issue as people from the townships nearby steal prize stud stock for food. Figure 1.6 shows dorpers in their native environment resting on a dam bank out of Middleburg. All very different sheep and all at different performance levels with different production challenges however, the majority of sheep in South Africa were merinos.

Figure 1.4. Dormers at Cape Town

Figure 1.5. Merinos at Tygohoek experimental farm

Figure 1.6. Dorpers on the way to Middleburg.

Chapter 2. Where are we?

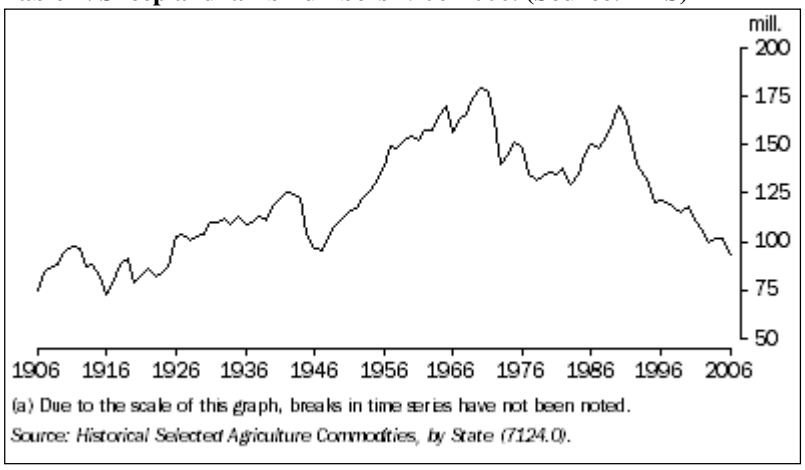
Worldwide sheep numbers are low and Australian numbers are the lowest since 1916. This is a great opportunity for Australian lamb producers to gain market share by meeting the markets we currently have and expanding into others.

Australian producers need to grow their flocks if they intend to meet the growing world demand for lamb. Lamb markets are still expanding and price isn't really restricting sales, particularly in high end markets, where lamb is not competing directly with other protein sources (James Rowe, sheep CRC, MLA Washington).

The only way producers can grow their flocks fast enough to capitalise on the current markets before they disappear due to lack of supply, is through greater efficiency from our current flocks.

This efficiency starts with higher levels of fertility, fecundity and lamb survival, followed by increased meat yields/ per mm of rain, kg of ewe run and capital invested.

Table 1. Sheep and lamb numbers 1906-2006. (Source: ABS)



Whether producers are running merinos or meat breeds higher weaning percentages give producers more options. They allow faster genetic turnover, and more replacements for higher levels of culling all increasing genetic advancement, either on wool return or meat value. Producers can also sell cull ewes to other producers or to mutton markets both of which are in short supply.

As an industry the changes we make right now can have a very large impact on the industry as we expand our sheep numbers again, so it is also a very good time to focus on the basics, such as good conformation, adaptability to your environment, more robust, low input animals that continue to produce and reproduce each year.

In regional zones around the world the merino is still king. Wool in years of little or no reproduction usually due to extreme environmental conditions still provides an income stream to the business. This was nowhere more apparent than in Patagonia in Argentina. Argentina derives 50% of its income from wool and even higher in Patagonia, but the producers live with the risk of losing their flock, or a large majority once every five years due to very cold harsh winters with heavy snowfalls. This is not just lambs lost but entire flocks, therefore animals which do survive provide wool as some sort of income for that producer (Bernard Benroth, Bariloche, Joaquin Mueller and Pacha, INIA).

In the Buenos Aires region which is about the same latitude as Sydney, there is fierce competition for land use between farming enterprises. This is forcing cattle further out and sheep even further still (INIA). Sheep meat production cannot compete with soy production in the highly productive regions on a per hectare basis, therefore soybeans are being planted and largely expanding the cropping zone. This is reducing the total area available for sheep meat production in South America.

Chapter 3. Where can we go with fertility, fecundity, lamb survival and adaptability?

FERTILITY

It appears the most effective methods for increasing fertility are the tried and true methods. Some of these are to ensure ewes are in good condition and/or on a rising plane of nutrition for joining to minimise mating failure (Geenty, KG.1998). Check rams thoroughly and ensure they are fertile. Have smaller mob sizes and/or good ram ratio. Culling barren ewes but also genetic improvement for lamb survival can come from culling ewes that don't have the rearing ability to ensure lamb survival (Oliver, WJ. Cloete, SWP. Greyling, AC). Cull ewes with mastitis and other udder disorders (Langford, C. *et al*.2005). Check ewes at weaning and ewes which are a condition score below others may need preferential feeding to gain a condition score for the following joining (lifetime wool project, ever graze, INIA). Ewes which lose weight between weaning and mating can reduce feed conversion efficiency and can also reduce tensile strength in wool.(Geenty, KG.1998).

Joining ewe lambs is starting to be more common in Australia and was fairly common in parts of the UK that I visited. Alex Ball explained to MLA prograzier magazine summer 2007-2008 that ewe lambs that joined successfully as lambs 'went on to wean an average of 12% more lambs at two and three years of age than ewes that were dry or failed to wean a lamb.' Ewes which show oestrus as lambs (7 months) have less barrenness in successive years and can have an extra 7.7 % lambs p.a. (Geenty, KG.1998). An increase in 10% ovulation rate in New Zealand translates to 6.9% more lambs at lambing and 5.7% more lambs marked. This also highlights the huge wastage between ovulation rate and dollar returns to producers with many producers no longer selecting maternals on number of lambs born but on number of lambs weaned which translates closer to profitability.

The onset of puberty varies greatly with the age and live weight of ewe lambs. Often more fecund breeds reach puberty earlier and at lower live weights (Geenty, KG.1998). Ewes born and reared as twins usually from more fecund animals may reach puberty at a similar age to single born lambs even though they may be 3kg lighter. It has also been found that rams born as multiples usually from prolific ewes have higher serving capacity particularly if siblings were also male.

Flushing is also a management tool being promoted to increase higher ovulation rates but only appears response to a certain live weight and condition score. The Evergraze program recently found that flushing ewes for a week prior to joining increased ovulation rates in merino ewes at Wagga, and this is in line with techniques used in New Zealand and the UK.

Geenty, KG explains that old research by Hickey, in 1960 showed that ewe performance peaked at four years of age and could still be producing sufficiently at eight or nine years even though ewe losses may increase. This is very important as we try to expand the Australian flock that older ewes that are still structurally sound can still contribute to expand sheep populations even though keeping ewes to eight or nine years may not be common practice while in a flock rebuilding phase this could allow producers to retain extra breeding ewes until sufficient replacements can be bred.

FECUNDITY

Naturally fecund breeds can be a genetic trait of the breed or due to specific genes such as the booroola (Fec B) and inverdale gene (Fec X) found in New Zealand, Australia and the UK can require special management of the flock due to the larger litter sizes and lower birth weights respectively.

One way many Australian and New Zealand farmers have been increasing gross margins of their sheep enterprises has been to increase not only ewe fertility but also litter size with ewe fecundity.

The Booroola gene has been linked to some ewes with higher fecundity.

The Booroola gene has been found to significantly increase ovulation in ewes and lead to higher fertility (Hall, D.G.1984). Ewes carrying the gene can carry between 2 and 8 lambs, this leads to serious management issues and ability for greater returns for farmers and graziers. In Australian prime lamb operations 1.4 lambs appears to be the maximum per ewe per year and per 0.1 lambs between 1.0 and 1.4 can increases producers profitability by 5-15% (Hall, D.G. 1984).

Booroola ewes have been known to have 8 foetuses. Higher ovulation rates usually lead to higher overall litter sizes also (King,CF. Hopkins,DL. Williams, PM. 1998; Lindsay, DR. 1987). Many foetuses die before reaching full term and with high litter sizes of 3+ lamb survival can be low (Kleeman,D.O.1992). Ewes with triplets can take 2-3 times longer to reunite with all lambs than twins. Birth weight can vary with each copy of the gene too, with homozygous booroola (two copies of the gene) the birth weight was significantly lower than heterozygous (one copy of the gene) and non booroola ewes (Gootwine *et al,* 2005; O'Shea,

T. Hillard, M.A. 1996). Management to reduce problems with high litters can be influenced by time of joining, genotype and ewe age, nutrition and lamb survival (King, CF. Hopkins, DL. Williams, PM. 1998). Heterozygotes for the booroola gene have an increased ovulation rate of approximately 1.65 and homozygote's for the gene 3.30 (Davis *et al*, 1999).

Joining time and planning for the greatest feed availability can have a significant effect on reproductive performance (King *et al.*1998). Studies done with Booroola Leicester sheep show an anoestrus effect and therefore spring and autumn joining can vary the number of triplets and quads as well as have a significant impact on lamb survival when born in better weather conditions (Fogarty *et al, 2005*).

Figure 3.1. A Booroola composite ewe at our farm.

Another gene which has a specific influence on fecundity is the Inverdale gene. It is found commercially in flocks in New Zealand and the UK and unlike the booroola gene the effects of multiple copies of the gene are not additive. While one copy of the gene increases ovulation rate by one egg per ovulation and litter size by 0.6, two copies of the gene make the animal infertile. In the UK the gene is promoted by a company called Innovis which calls the sheep the "aberdale", where the gene has been bred into the welsh mountain. The rams are leased to producers and a management package is also provided to help producers maintain the fecundity to a manageable level. Part of this management package can also include negative flushing, where nutrition is not a limiting factor due to good pasture growth, animals can be restricted during joining to reduce the amount of multiples such as triplets and quads and try to have ewes lambing at a level where survival isn't severely compromised by low birth weights due to excessive litters (Jones D, innovis). The inverdale gene has specific application when joined to terminal sires and animals which may have two copies of the gene wouldn't be entering the breeding flock.

There is also a breed differentiation Romanov and finnsheep crossbred ewes were found to have higher survival to weaning, and higher litter sizes compared to Dorset, Texel and Montadale sheep (Leymaster, K. Freking, B. Casas, E.2004). Romanov were also found to have less anoestrus and performed well over a variety of joining seasons and had greater longevity, the impact of this breeds fertility has meant that the Meat Animal Research Center has recommended that Romanov use be extended much further in the industry, not only to increase reproductive rate, but also to extend mating season which was identified as a main constraint to the industry. Testing for meat quality has also shown that the meat quality of the Romanov while not quite as good as the finnsheep was also very good quality. The growth rates were considered slower but this also has to do with the placement of fat deposition at the 12^{th} rib and when animals are saleable weight and fat score. Some of the slower growth is also due to smaller lambs at birth due to litter size as much of the Romanov's increase in fecundity came from a higher percentage of triplets.

Finnsheep are used quite extensively not as pure breeds but in crossbreeding and composite flocks where they can have a significant increase in fertility and is balanced with other traits to be more manageable and saleable, Finns have even been used in merino operations for a short term outcross to increase fertility. Ovulation rate and reproductive performance are moderately heritable (Geenty, KG.1998) and in prolific strains in New Zealand trials 2% p.a increase was obtained. But one of the easiest ways producers can increase is to select replacements from ewe lambs as this too is quite heritable.

A standout factor was that in New Zealand, Australia, or Argentina measurements of ewe condition were taken and understood at better levels to increase number of lambs weaned. Some of this was due to increased ovulation rate as in Australia and New Zealand, but also it was increased birth weight. Multiple births lamb weights were increased which in turn increased survival rates. Some merino flocks that had small lambs also benefited from increasing lamb birth weight however in some flocks single lambs had the propensity to become too large where nutrition was less limiting and had to be managed separately.

There have been vaccinations and hormones that can also be used to increase ovulation rate. Vaccinations were used in New Zealand to produce antibodies against some of the ewes own hormones which reduced the bodies destruction of excess follicles. These can be useful tools in out of season mating or to increase lambings between 100-150% by 24% although the range is quite large and include negative effects; however a genetic solution through selection

is still the best long term approach. As mentioned out of season lambing can be a concern but there are ways to synchronise and induce cycling, methods include the ram effect and hormones. Rams may be introduced before the normal onset of season, teasers or vasectomised rams may be used to simulate a breeding program and promote the onset of cycling. Hormone treatments are often used in artificial breeding programs, but can also be used in ewe lambs to promote cycling.

While in the UK a publication by EBLEX showed that increasing ewe size has also been linked to increased fecundity provided adequate nutrition. Other factors linked with increased ewe size were lambs with superior growth rate, increased milking ability and increased cull ewe value. The disadvantages that accompanied this was the increase in feed requirements, poorer performance in harsher environments, increased cost for housing facilities, lower stocking rates and the problems with finding labour was compounded by large ewe size.
This is supported in Australia by Mark Fergusons PhD findings published in the MLAPrograzier summer 2007-2008. He also found that selection in merinos for higher muscling could also deliver higher fertility, fecundity, birthing and lamb rearing. He noted the need to also select for fatness as a management for harsher seasons, it also helped with higher birth weights and milk production and some evidence of increased lamb survival.

LAMB SURVIVAL

Wean more lamb's workshops held by NSW DPI and MLA show that more profitable producers have higher weaning percentages. Higher weaning percentages mean a larger return on investment for producers provided the costs to achieve this production can be controlled. Higher fecundity, fertility and lamb survival can be enhanced by a more precise total management regime not just extra supplementary feed produced at high cost.

Table 2. Change in profit with weaning rate in two sheep enterprises

Weaning %	1st cross $/ha	1st cross % change	Merino $/ha	Merino % change
60	-	-	83	-
70	126	-	104	24
80	152	21	124	20
90	177	16	145	17
100	202	14	166	14
110	228	13	-	-

Adapted from 'Wean More Lambs' workbook p1

As can be seen in table 2, every 10% increase in weaning percentage improves the $ /ha on both operations. Higher weaning percentages came from higher fertility and higher fecundity along with careful management to ensure maximum lamb survival.
In Australia March and April are usually the months of best semen quality and when most animals are in oestrus naturally, ovulation rates are usually highest at this time too (Ball, A. 2007). Timing of lambing to coincide with access to abundant feed, plenty of shelter with good predator control is essential for high lamb survival rates particularly for triplets.
New Zealand lamb production systems are particularly focussed on a management regime that incorporates all the above factors.

An important management tool is pregnancy scan at 75-85 days (Stephens, E. 2000; Afolayan *et al,* 1990), and feed separately, twins need 25% more feed than singles with triplets even more again. Using the spring pasture flush to meet higher feed demands is the cheapest way to increase lambing percentages, lamb survival and weaning weights (Ferguson, M., Young, J.2005).
Another factor to consider is that winter/ spring is often the worst time for trace element and mineral deficiencies, so consider vaccinating and supplementing ewes in mid pregnancy (Jolly, S. 2000).

Multiple lambs will add to energy requirements, and weight of ewe in mid pregnancy is related to lamb birth weight, and placental development (Kelly, RW. 2006; Kleeman *et al* 1990). The birth weight is also affected by sex and litter size, placental development, ewe condition, gestation length and timing. Where litter size has been encouraged such as the introduction of the booroola gene, a manager can scan to determine multiples and ensure better nutrition throughout pregnancy but particularly pay attention to increasing placental development and birth weight. Lupin supplements have been shown to be the best way to increase placental development (Kleeman *et al,* 1990) but this may be more cost efficiently achieved by more precise grazing management.
Lamb survival was identified as a problem for all producers I met, but heritability is low (Olivier, WJ. Cloete, SWP. Greyling, AC. 2009). Birth coat was said to have limited scope in merino flocks in South Africa. Increasing lamb survival via genetic gain, by adding the lambs direct heritability for lamb survival to maternal behaviour heritability and repeatability the rate of genetic gain can be improved.

Survival rates in Australia are reported to be 88% in singles, 86% twins and 45% triplets (Lindsay, DR. 1987). In New Zealand lamb survival has become more important as the flock has become more fecund, the national average lambing percentage between 2004-2006, at 25% higher than the average for the previous 15yrs at 100%. Lamb viability was lowest for triplets as expected and twins were 7% higher and singles only 5% higher than triplets.
AgResearch showed that majority of deaths occurred in the first 3 days after birth.
While weather was still the most important determining factor to lamb survival in flocks with outdoors lambing in all countries visited, it was noted that good maternal care provided by the ewe minimised the influence of poor weather conditions. Merinos in South Africa were selected directly for rearing ability as an evaluation of lamb survival. The amount of animals that survived was 88% for the first 3 days of life and from 4 days till weaning was 86%. Animals were selected into two lines, a highline of more fertile animals and the low line of lower fertility sheep. This experiment was conducted in merinos from 1986 to 2008.

Table 3. Regressions of individual predicted breeding values on year of birth for first 3 days and 4 day to weaning of 3548 highline and 1664 lowline lambs.

Trait Line	First 3 days Highline	First 3 days Lowline	4 day to wean Highline	4 day to wean lowline
Direct	0.0114 +/- 0.0005	0.0049 +/- 0.0011	0.0131+/-0.0006	-0.0049+/-0.0011
Maternal	0.0087+/-0.0006	-0.0281+/-0.0012	0.0031+/-0.0005	-0.0048+/-0.0009

Adapted from Cloete, SWP. Misztal, I. Olivier, JJ. 2009.

As can be seen in table 3 there is a distinct difference in the breeding values of the two different lines as seen over the 18 years of this experiment. The genetic trends showed that the lambs had an increase of 0.61% per annum in the high line and 0.26% in the lowline for survival to 3 days after birth; the maternal trend was 0.46% and -0.96% p.a. for the two lines. The trends for 4 days after birth to weaning showed a direct influence in the lambs of 0.70% in the highline and -0.26% in the lowline of the total phenotypic average. The maternal characteristics for the same trait showed 0.16% and -0.26% p.a. respectively (Cloete, SWP. Misztal, I. Olivier, JJ. 2009.). Therefore while the effects are small they are additive and can make an important contribution to ewe efficiency and improve animal welfare at the same time.

Meantime ewe nutritional management and picking suitable lambing sites is the more practical and advantageous gains to lamb survival. Other methods include identifying early and late lamber's and managing the nutrition to suit. This means restricted feeding for late single lambs to reduce incidence of distocia and increased feeding or best paddock to early

multiples to allow for higher birth weight and extra nutrient for lactation, and allow the ewe to hold better condition to have a better chance of rejoining next season. (Geenty, KG.1998).

Main losses at lambing are birth injury/stillborn, distocia, mismothering, predation, and exposure/hypothermia/hyperthermia (Langford *et al*. 2004). When planning for multiple births any reduction in risk of these should be taken into consideration. These were noted to be the main causes of lambing loss in all countries sometimes in slightly different order. And there were many approaches to managing this.

Many of these countries also suffer from major predators. In South Africa it is the black backed jackal (*Canis mesomelas)* a medium sized dog that can be a problem with taking lambs, the other main predator is in the cat family, and is called a caracal. The caracal *(Caracal caracal)* is a small member of the large cats; it is heavier than the jackal and is capable of taking adult animals. South American producers in Patagonia were complaining of rouge puma which were training young cubs and having a devastating effect on their flocks. There was also the large red fox in Patagonia which can be problematic however; the smaller grey fox is usually no trouble. This means that particularly with small predators mothering ability where the ewe protects her lamb and also a short interval between birth and the first drink of colostrum, lambs will be able to follow mothers to away from danger quicker.

European countries, New Zealand and Australia are fortunately to have only foxes to contend with for the most part unless its stray dogs or dingoes in northern Australia.

Figure 3.2. A lambing pen in Wales, with weaned lambs for shearing

In many areas in the UK, housing of ewes for lambing is a common practice. Once ewes have lambed and mothered lambs they are put into a pen with more ewes for a day or two and then turned outside to fend for themselves. Some sheep also require a lot of assistance to lamb

including caesarean sections and these can be monitored closely in the lambing shed. However there are problems with this approach also as there is a large overhead expenditure and risk of infections at the birthing site, and in some cases reliance on higher levels of intervention.

Lambing losses appear to be at about 20% for outdoor systems in New Zealand, Australia and the UK. Shed systems may be able to reduce losses by up to 8% but under usual conditions 2-5% at great expense in infrastructure and labour. While weather is a significant contribution to lamb losses, there are still many other contributing factors such as abortions. In the New Zealand and also in the UK there are vaccination programs to reduce the amount of abortions. A health management program is usually part of business in UK systems, part of which include clostridial, pasturella, toxoplasmosis and enzootic abortion vaccines. Shed flocks are usually fed silage and sometimes trace minerals such as cobalt, copper and selenium. Sometimes prior to lambing vitamin B12 is given in the feed as it is believed to help with lamb vigour. As many of the sheep which are indoors, are usually of breeds and nutrition where 160-200% lambing would be expected, lambs would be expected to have lower birth weights and reduced survival.

Figure 3.3 Shed pens of ewes in Scotland

Figure 3.4 Mule ewes in Scotland

In Australia the approach is varied, there are different lambing dates, tree and shrub shelter belts, residual crop stubbles and tall grasses sown in strips or paddocks of tall feed conserved for shelter but all outdoors. In South Africa in the Karoo the vegetation is known as ‘veld’ and is made up of small shrubs and grass for shelter from bad weather events. In Patagonia there were many rock shelves which provide shelter from bad weather not only for lambs but also for adult ewes which are also lost in bad conditions.

To increase lamb survival there is a lot of need for information about the breeding system and the genetics and performance of the animals being measured. The maternal central progeny test (MCPT) between 1998 and 2003 in Australia showed that there is a genetic link between individual sires and increased lamb survival with some rams exceeding 90% lambs weaned. Some rams which have been linked to higher lamb survival rates have been found to have higher rectal temperatures after birth, while there has been no reasons for this anomaly, I believe that this is due to higher metabolism and utilisation of brown adipose fat.

There was also a link not only with individual sires but researchers at MARC in the USA showed that Romanov cross sheep have higher levels of lamb survival despite high litter size indicating that breed selection can also be a useful tool for extreme cases. But until breeds and indeed sires within breeds are fully evaluated here, most of the genetic gain will come from the repeatable behaviour of good mothering ewes contributing to time spent with the lamb at birth site, ease of lambing, colostrum and milk production, and the ability of a ewe to 'count' and not leave some lambs behind.

In New Zealand a comment was made that ewes have to be good mothers as often particularly in the steeper hill country when lambs are born it is customary that some lambs will roll/slide down the hill away from the birth site and if the ewe cannot 'count' and look for the lost lamb, exposure will set in quite quickly.

Figure 3.5. Rams at 'Wairere Rams' New Zealand show the hills they live in.

Pregnancy management to ensure singles do not get too big and are exposed to risk of distocia and twins are fed sufficiently to allow evident increase in birth weight reduce the threat of poor lamb persistence.

Iolo Owens in Wales has developed a shedding breed known as the easy care sheep. He believes that by removing the wool from his sheep the energy that would be partitioned to wool growth goes to milk production and as a fat buffer on his animals. Other research has also shown that hair breeds often milk better however, faster growth before weaning leads to faster turnoff times and higher weaning weights but it is still unproven if the economic return for the extra growth due to better milk production is more profitable than the wool income and is certainly more risky to capture the gain consistently.

ADAPTABILITY

At first glance, adaptability of sheep is a term that is interpreted differently around the world but on further examination most producers and scientists came up with a similar explanation even though their climates and management systems were quite different. Adaptability means animals which 'perform well in a given environment for a profitable outcome or the environment that you create for them' (USDA, MARC pig researchers). Perform mean to convert kilograms of feed into kilograms of sheep meat efficiently. Lambing percentages varied in different environments depending on feed, management and other limiting factors.

In New Zealand reproductive rate is the focus of the industry which is mostly a meat based industry. Hamish Bielski, sheep genetic manager of Mount Linton station New Zealand explained that the number of lambs weaned is a key profit driver, a sentiment that was echoed through most New Zealand producers and researchers. This naturally started at scanning, with highly fecund flocks and followed by good lambing conditions, good mothering and lamb survival and then followed by good growth. In New Zealand the season was very tightly matched with pasture growth and seasonality.

While New Zealand's profitability is determined by number of lambs weaned and kilograms of lamb per ewe run, even to the point of kg of lamb per kg of Dry Matter, South Africa's approach was very different.

South Africa in a much drier environment has very different determination of profit with a largely merino base flock. Willem Olivier of Grootfontein agricultural development institute (GADI) explained that **'in 2001 when the small wool spike was on, merinos lambing at 80% was equal to dorpers lambing at 170% in end dollar terms.'** This enlightening statement shows the need for risk management, particularly in less reliable areas. To focus on meat alone with Dorpers in South Africa, very intense selection and management needs to be in place to remain competitive with merinos for long term profitability, assuming these performance levels in the same environment.

In Patagonia to stop sheep losses in severe storms sheds are being installed to some degree with government help, but importing fodder into housed facilities is not a viable option for extended periods as local fodder reserves don't exist and must come from the pampas region adding significantly to cost of imported feed. Sometimes also in severe storms, some producers I spoke to evacuate their families and staff and therefore there is no one left to feed the animals.

The approach to the management of this dilemma has varied across the sheep world. In the UK animals with sufficient nutrition and natural fecundity to reach high lambing rates such as 170% are often lambed indoors particularly in the lowland areas where many of these animals may have high meat values, there is also a significant push from producers and consumers alike in many areas to address animal welfare concerns to a point where subsidy money can be used to house and tend to animals at the expense of commercial viability. Huw Davies, a welsh producer stated that animal welfare was his number one priority.

New Zealand producers, however, while they are constantly aware of the issues of lamb survival, with no subsidy base line their number one goal is profit. The way in which they approach this is through high ovulation rates and high lambing percentages. The lamb losses between scanning and weaning were very similar worldwide and in a range between 15-25% with individual flocks and regions varying within this depending on environment and climatic conditions at lambing time.
The New Zealanders main objective was to increase ovulation rate, get them lambed and get them to live. As with most meat breed producers that I spoke to the ideal is 200% lambing where every ewe has and rears twins. There were some in New Zealand that were really striving for triplets but only if the mothering ability was good enough to rear them.

There appears to be a natural link between increased ewe sizes being positively correlated with increased lambing percentages however, producers have shown that with time and careful monitoring, selection for lower adult ewe weights while maintaining high levels of fertility. At MARC in Nebraska there are also trials being done this year in cattle on grass fed feed conversions as opposed to grain. This is very important for our grass based industry to be able to not only reduce ewe maintenance through reducing ewe size but also the efficiency at which the ewes will convert one kilogram of dry matter into growing either a kilogram of wool or kilograms of foetus', it may also mean that ewes can be identified which produce

high wool incomes, with high reproductive performances on less dry matter which would mean significant increases for producers by having animals that are better adapted to perform in these environments. With governments potential to bring in climate change initiatives which could tax producers for methane outputs this has potential to become a key profit driver. It is also important to note that different pasture types have a very large impact on nutrition accessible to animals in the rumen and can also have a large effect on methane output, milk production, lamb growth rates, levels of fat deposition all of which also have a large impact on ewe and lamb efficiency, water utilisation and farm profitability.

The selection of 7 month old ewes joined to enter the flock shows many signs of selecting for more adapted animals. Much of the growth of a ewe lamb at this point has been a function of maternal environment, therefore very likely that the adult ewe had longer seasonality and was able to join at the beginning of the joining period. The lamb has survived birth without injury and received sufficient milk. There is a direct correlation between high weaning weights and post weaning weights. These ewe lambs are most likely to be sufficient weights to join at 7 months with their mothers. Care must be taken however to ensure that you are not just selecting for singles, and that multiples are allowed the chance to grow out also and join. This allows an extra lambing per year which lowers running lifetime running costs of the ewes and ewe lambs which do join at 7 months have been shown to have higher lifetime performance (Geenty, KG.1998).

As sheep producers we are also inherently lucky that multiple births in sheep do not occur the same biological dilemmas as found in twinning cattle. Twinning cattle can have higher levels of placental crossover and therefore higher abortions and sterility in female calves with male siblings. There also does not appear to be the issue with lower survival rate of foetuses in the same uterine horn (Echternkamp, SE. Cushman, RA. Allan, MF. Thallman, RM. Gregory, KE. 2007).

Recommendations

The numbers of sheep are low worldwide and as some areas normally dedicated to sheep production are undergoing a change in land use, sheep enterprises need to become more efficient and competitive by improved reproduction. After many dry tough years in Australia, producers have realised the benefit of lower risk operations such as sheep compared to cropping. This coincided with lamb consumption increasing by 1% along with a 9% increase in price in the year of the global financial crisis, (James Rowe, sheep crc) which is a fairly good acid test for where the industry stands.

In pastoral zones where climate is more risky, wool production is still a very good risk management tool. However, ventures into increasing reproductive performance and muscling are also still beneficial. It has been shown that increasing fertility and fecundity allows more selection on replacements and unproductive older sheep. Willem Olivier's statement that in the 2001 wool spike showed in south Africa that merinos producing at 80% was equal to dorpers at 170% in net terms has stuck with me as an important lesson that small changes in market prices can have a huge impact on returns for producers, and while the meat industry appears fairly stable in the next few years, wool is still a product which has a significant impact on farm risk management and is a natural accompaniment with running most breeds of sheep.

Maintaining lower adult ewe weights, particularly in meat breeds allows more animals to be run and better annual condition score with less energy going to maintenance. By using careful selection to do this, fecundity can still remain high and the number of kilograms weaned per ewe run is higher. I feel this is important in better management of our resources such as land, water and capital. It is also important to remember with meat breeds that the wool portion of income is very low so therefore animals with low reproductive efficiency are far more costly.
It is also important to remember when selecting animals for reproductive performance animals which retain fat cover and have better fat reserves are far more likely to be more fertile and have higher litter sizes.

While ewe lambs are expected to have lower numbers of lamb's weaned and lower weights, joining ewe lambs increases overall farm efficiency and the ability to identify ewes which join early and have higher lifetime performance. Older ewes which are still conformationally

sound and still reproductive can be used to contribute to number of lambs produced while rebuilding flocks. MLA wean more lambs program showed that to increase lambing percentage from 80% to 90% in first cross ewes made a 21% increase to $/ha at $2.80 dressed weight, and $60 per head which is very different to recent sales of $4.70 -$5.00 dwt.

It is also important to remember that there are many different types of sheep run in different environments around the world and all have different adaptations which is a great genetic resource, and different managements which may also apply here. There are individuals in current flocks which outperform other animals, particularly in survival, mothering and fertility. However, fertility, fecundity, mothering and lamb survival can all be selected for, and improving reproductive efficiency doesn't have to be difficult, it just takes focus.

References

Afolayan, RA., Fogarty, NM., Gilmour, AR., Ingham, VM., Gaunt, GM., Cummins, LJ. (1990). Reproductive performance and genetic parameters in first cross ewes from different maternal genotypes. *Journal of animal science.* Online journal 21 12 2007

Ball, A. (2007). Mating crossbred ewe lambs. *Mla prograzier, summer 2007-2008.*[1]

Broad, TE., Montgomery, GW., Crawford, AM., Hill, DF. (1995). Current state of the New Zealand sheep genome programme. *Proc. Aust. anim. Breed. Genet. Vol. 11.pp458-464.* (AgResearch, NZ)

Clarke, JN., Banks, RG. (1995). The potential of new genotypes in the Australian and New Zealand lamb industries. *Proc. Aust. Assoc. Anim. Breed. Genet.* Vol.11. (livestock library)

Davis, G.H (1999). Combined effect of the inverdale and booroola prolificacy genes on ovulation rate in sheep. *Proc. Assoc. Anim. Breed. Genet.* Vol 13, pp74-77.(AgResearch, NZ)

Dodds, KG. (2008). The activin receptor-like kinase 6 booroola mutation enhances suppressive effects on bone morphogenic protein 2 (BMP2), BMP4, BMP6, and growth and differentiation factor-9 on FSH release from ovine pituitary cell cultures. *J Endocrinology* vol 196(2). P251-61.(bioinfobank library).

Everett-Hincks, JM., Dodds, KG. (2007). Management of maternal offspring behavior to improve lamb survival in easy care sheep systems. *J AnimSci.*, Vol. Oct 26.(bioinfobank library).

Ferguson, M., Young, J. (2005). Monitor ewes carefully for effective management. Vol 167, December 2005. *Farming Ahead with Kondinin group.* (Kondinin magazine).

Fogarty, N. (2000). More money from crossbred ewes. *Ovine observer.* Number 11. (WA DPI)

Fogarty, N., Ingham, V., McLeod, L., Morgan, J., Gaunt, G. (2005). Dynamic Dams for lamb production: More $$$s from crossbred ewes with the right genetics. *Technical bulletin 50.*(NSW DPI)

Geenty, K. (2006). High performance lamb production systems. Presentation at Holbrook.

Gootwine, E., Rozov, A., Bor,A., Reicher, S.(2006). Carrying the FecB (Booroola) mutation is associated with lower birth weight and slower post-weaning growth rate for lambs, as well

as a lighter mature bodyweight for ewes. R*eproduction, Fertility and Development.* Vol.18(4). P 433-437. (CSIRO)

Jolly, S. (2000). Sheep nutrition in winter.*SA Lamb*. Vol 15 (livestock library)

Kelly, RW. (2006). Care for mum- foetal programming, lamb survival and lifetime performance. (livestock library).
King,CF. Hopkins,DL. Williams,PM. (1998). Reproductive performance of Border Leicester x Polwarth ewes with and without the Booroola gene (FecB). *Animal production in Australia.Vol22,* pp225-228. (DPI, Tasmania)

Kleeman, DO., Walker, SK., Smith, DH., Grimson, RJ., Grosser, TI., Seamark, RF. (1990). The effect of short-term nutrition during mid pregnancy on placental and foetal growth in triplet-bearing booroola x south Australian merino ewes. *Proc. Aust. Soc. Anim. Prod. V*ol 18. P505. (SA DPI)

Kleemann, DO., Walker, SK., Grimson, RJ., Grosser,TI., Smith,DH., Seamark,RF. (1992). The effect of increasing the time spent at the birthsite on lamb survival in a flock of high fecundity (FecB) south Australian merino ewes. *Proc. Aust. Soc. Anim. Prod.* Vol.19. p204.(SA DPI.)

Langford, C., Alcock, D., Holst, P., Shands, C., Casburn, G. (2004). Wean more lambs, optimising sheep reproductive performance.(MLA publication).

Lindsay, DR. (1987). Physiology, management, and genetics of reproductive performance in sheep. *Proc. Aust. Assoc. Anim. Breed. Genet.* Vol 6. (livestock library)
Montgomery, GW.,Scott, IC., Littlejohn, RP., Davis, GH., Peterson, AJ.(1989). Concentrations of FSH are elevated in new born ewe lambs carrying the booroola gene but not in lambs from a prolific Romney strain. *Reproduction, fertility and Development,* vol 1,no 4,p 299-307. (www.livestocklibrary.com.au)

O'Shea, T., Hillard, MA. (1996). Oestradiol; implant reduces litter size in the booroola merino. *Proc. Aust. Soc. Anim. Prod.* Vol.21. p200-203.(UNE,CSIRO, Armidale)

People and livestock(2004). Booroola gene of sheep patented. People and livestock issue 1. (www.lifeinitiative.net/docs/pa101.html)

Souza, CJ., MacDougall, C., Campbell, BK., McNeilly, AS., Baird,DT. (2001). The booroola (FecB0 phenotype is associated with a mutation in the bone morphogenic receptor type 1 B (BMPR 1B) gene. *J of endocrinology.* Vol 169. Issue 2

Stephens, E. (2000). Pregnancy scanning of ewes. *SA Lamb*. Vol 15 (livestock library).

Wheaton, JE., Thomas, DL., Kusina, NT., Gottfredson, RG., Meyer, RL.(1996). Effects of passive immunisation against inhibin-peptide on secretion of follicle stimulating hormone and ovulation rate in ewes carrying the Booroola fecundity gene. *J Biology of Reproduction.* Vol.55. p1351-1355.

Wilson, T., Xi-Yang,W., Juengel, JL., Ross,IK., Lumsden, JM., Lord, EA., Dodds, KG., walling, GA., McEwan, JC., O'Connell, AR., McNatty, KP., Montgomery, GW. (2001). Highly prolific booroola sheep have a mutation in the intracellular kinase domain of bone

morphogenic protein IB receptor (ALK6) that is expresses in both oocytes and granulosa cells. *J Biology of Reproduction.* Vol.64. p1225-35.(AgResearch, NZ)

Xia, Y., O'Shea, T., Murison, R., McFarlane, JR. (2003). Concentrations of progesterone, Follistatin, and follicle stimulating hormone in peripheral plasma across the oestrous cycle and pregnancy in merino ewes that are homozygous or non carriers of the booroola gene. *J Biology of Reproduction.* Vol.69. p1079-1084.

Curtis, K, (2009). Australias declining sheep flock. www.sheepcrc.org.au

Geenty, KG.(1998). A guide to improved lambing percentage. *Wools of new Zealand and meat new Zealand.* In association with *agreasearch, Lincoln university, Massey university, New Zealand sheep council*

Stuart, C & T. (2007). Field guide to mammals of South Africa. *Struik publishers*

Everett-Hincks, J., Dodds, KG. (2008). Management of maternal-offspring behaviour to improve lamb survival is easy care sheep systems. *J Animal Science.* Vol. 86. pE259-270

Cloete, SWP. Misztal, I. Olivier, JJ.(2009). The improvement of lamb survival of merino sheep as a correlated response to direct selection for rearing ability

EBLEX (2009). English performance recorded flocks directory 2009. *EBLEX and signet breeding services.*

Behrendt, R., Curnow, M. (2008). Ewe management handbook. *Lifetime wool*.

Leymaster, K. Freking, B.(2004). Evaluation of Dorset, finnsheep, Romanov, Texel, and Montadale breeds of sheep: IV. Survival, growth, and carcase traits of F1 lambs. *J Animal science. 2004* Vol.82. pp3144-3153

Leymaster, K. Freking, B., Casas, E.(2005). Evaluation of Dorset, finnsheep, Romanov, Texel, and Montadale breeds of sheep: V. Reproduction of F1 ewes in spring mating seasons. *J Animal scienceI.2005.* Vol.83. pp 2743-2751

Leymaster, K. Freking, B., Casas, E.(2004). Evaluation of Dorset, finnsheep, Romanov, Texel, and Montadale breeds of sheep: II. Reproduction of F1 ewes in fall mating seasons. *J Animal Science.* 2004. Vol.82. pp1280-1289

Lupton, CJ. Freking, B., Leymaster, KA.(2005). Evaluation of Dorset, finnsheep, Romanov, Texel, and Montadale breeds of sheep: III. Wool characteristics of F1 ewes. *J Animal science.* 2004. Vol.82. pp 2293-2300

Shackelford, SD. Leymaster, KA. Wheeler, TL. Koohmaraie, M. Lamb meat quality progress report number 3. Preliminary results of an evaluation of effects of breed of sire carcass composition and sensory traits of lamb. *USDA*

Olivier, WJ. Cloete, SWP. Greyling, AC. (2009). The genetic relationship among lamb survival, birth coat type, birth weight and 42 day body weight in a South African fine wool merino stud. *Grootfontein agric*Vol 9. No 1 2009

Willem Olivier of Grootfontein agricultural development institute (GADI) pers comm.

(Echternkamp, SE. Cushman, RA. Allan, MF. Thallman, RM. Gregory, KE. 2007). Effects of ovulation rate and foetal number on fertility in twin producing cattle. *J Animal science 2007.* Vol. 85. Pp3228-3238.

USDA, MARC genetics team. Pers comm..
Hamish Bielski, sheep genetic manager of Mount Linton, pers comm..
Huw Davies , Wales, pers comm.
Basil Wolfe, lecturer at Aberystwyth, pers comm.
James Rowe, sheep CRC conference
Bernard benroth, Bariloche, pers comm.
Joaquin Mueller and pacha, inia, bariloche pers comm.
Dewi Jones, innovis pers comm.
Sam Boon, signet. Per comm..
Chris Lloyd, pers comm..
Schalk Cloete, pers comm..
Mark Fergusons PhD findings published in the mlaPrograzier summer 2007-2008.

Plain English Compendium Summary

Project Title:	Making more from the same ewe base
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Objectives	• To help producers to increase profitability from the same ewe base through genetic resources in fertility and fecundity in the Australian sheep flock. • Show what are the key features of very successful breeds • See what management tools can we adopt or focus on. Show why it is so important to focus on fertility, fecundity, adaptability and lamb survival and what are the risks
Background	Sheep numbers are low worldwide while lamb markets are still growing. However competing enterprises and rising costs of production, mean that lamb production must make more profitable returns per hectare and one of the main ways to do this is through reproduction. Reproduction is made up of fertility, fecundity and lamb survival, but need to be balanced with the best adapted animals. It is also important that as reproductive rate increases so does financial risks and management.
Research	A Global Focus Program of 6 weeks which consisted of visits to Canberra, Philippines, China, Mississippi, Canada, Washington, France and Ireland. The next ten weeks of travel consisted of visits to large sheep producing countries with a range of breeds and climates. Wales, New Zealand, South Africa, Argentina and Peru research stations and producers were visited.
Outcomes	Making more from the same ewe base can be done through targeted fertility management. It is not one specific genetic trait or management strategy but steps. • Focus on fertile animals which rear lambs • Increase ovulation rate or fecundity within the ewe base • Start breeding from capable animals at a young age and keep very productive animals longer. • Maintain wool clip in meat flocks as a risk management tool. • Higher reproductive rates can lead to higher risk. • Genetic improvement can be made to reproduction although slow. • Some animals show very good survival and mothering traits which can be selected for.
Implications	Australian producers with the assistance of researchers can identify animals in their own flock and industry that have better fertility and survival traits. This allows producers to run fewer adults at higher costs and higher feed consumption and run more lambs, for meat or wool. Higher fertility within flocks allows producers faster flock rebuilding, more meat to sell and more lamb's wool.