Lecture 5: Managing Weaners and Breeding Ewes for Wool Production

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Learning Objectives

On completion of this topic you should be able to:

- demonstrate a clear appreciation of the extent of the impact of age, season, pregnancy and interactions with nutrition on liveweight and fibre growth
- explain how hormonal mechanisms contribute to the effects of age, pregnancy and lactation on wool
- describe and justify management strategies that can be used to minimise the impact of age, pregnancy and lactation on wool growth and quality
- compare and contrast management choices that can be made to modulate wool production and quality in young and/or pregnant sheep

Key terms and concepts

Production efficiency; physiological status; age; pregnancy; lactation; litter size; seasonality; hormones; nutrition; fibre diameter; staple strength; fleece weight; amino acids; management strategies; stocking rate; supplementary feeding; shearing time; lambing time; supplements

Introduction to the topic

It is well documented that young sheep produce less wool, often of higher quality, than adult animals. The higher quality is associated with finer fibres but there are also other aspects of the fleece that need to be considered. In many environments around Australia young Merino sheep are also perceived to be extremely sensitive to environmental effects on fleece quantity and quality; this being particularly true in the Mediterranean environments. In these environments patterns of food availability and quality appear to impact on young animals in a way that is not so apparent in the temperate areas.

Wool growth and staple strength has also been reported to decline as a result of pregnancy and lactation and this has been associated with both the high nutritional demands of this physiological state and also with hormonal changes. The impact on farm income of this decline could be considerable particularly due to changes in wool quality associated with loss in staple strength. It has been estimated that of the 'tender' combing wool (<30 N/ktex) produced in WA, over 40% is derived from the breeding ewes; the impact being somewhat less in temperate climate zones.

5.1 Physiological effects on wool growth

a) Age

Fleece weight in sheep is maximised at around 3 – 4 years of age and this has been linked both to the maturation of wool follicles and to a decrease in the competition for nutrients required for normal body growth in young animals. There also appears to be changes in wool growth efficiency with age, younger animals being less efficient. Wool growth seems to be proportional to feed intake up until maturity (3+ years) but thereafter efficiency of wool growth appears to increase.

It has been proposed that the difference in efficiency between age groups is associated with differences in the ability of animals to partition energy/body reserves to wool growth. This may also explain the apparent susceptibility of weaners and two-tooth animals to fleece tenderness.

Weaners are said to be more responsive to changes in nutrition than older animals due to higher nutritional demands for growth and lower ability to buffer against nutritional stress. This effect is reflected in greater variation in liveweight as well as wool growth rate and changes in staple strength than is seen for older flocks. Young growing sheep are physiologically immature. They have limited reserves of body fat and protein and, because they are growing, they have an extra requirement for deposition of new body tissue in the form of protein when their liveweight is less than 30–35 kg. Consequently, they have a poor ability to respond to and buffer against seasonal variation in nutrient intake.

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MacRae *et al.* (1993) demonstrated the changes in nutrient partitioning for protein accretion as Suffolk-Finn Dorset sheep mature (Figure 5.1). Smaller sheep partition less protein to wool and more to carcass than larger sheep. Therefore wool growth rate is lower in smaller than larger sheep.

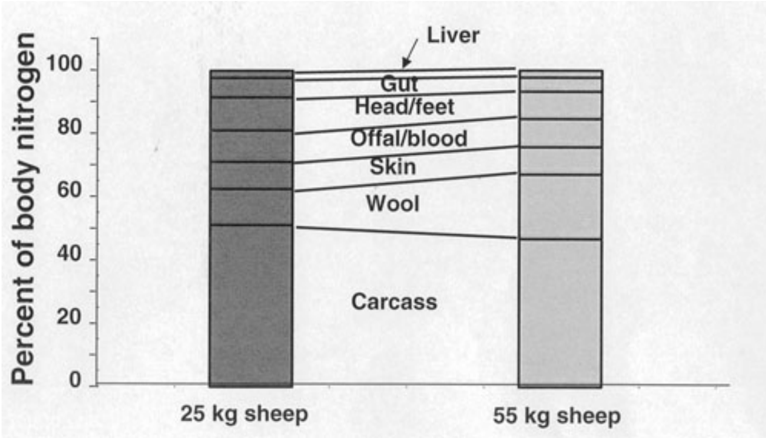

Figure 5.1: Protein accretion in young sheep (MacRae *et al.* 1993).

However, the effect of growth in young sheep on wool production depends on the feed available between weaning and maturity and this, in turn, is related to factors such as month of birth (season), geographical location (start and length of growing season, pasture type) and the amount and type of supplement fed. The nutritional implications of these interactions will become apparent as we deal with this later.

An experiment conducted at UNE on Merino x Border Leicester ewes illustrated age effects on wool growth and tenderness and also the impact of pregnancy (Hinch unpublished). There were clear differences in two-tooth ewes compared with other ewe age groups in both fleece weights and in staple strength (Figure 5.2) and there was almost a linear increase in strength with age. In this particular experiment, replicated over a 3 year period, greasy fleece weights only increased between 2 and 3 year old ewes. These data were collected over pregnancy and early lactation and the effects interact with changes in physiological state but confirm that younger animals have lower wool productivity - a pattern also reported for Merinos.

The possibility of interactions with physiological effects also raises the possibility that there may be differences in the impact of age between males and females. Fleece weights are greater in males than females of the same age and this is consistent across breeds and environments. However fibre diameter tends to be greater as well (1-3μm) and differences in the order of 12 % have been consistently reported.

It is thought that testosterone is the main cause of this difference, the steroid hormone stimulating increased protein synthesis in the male with a resulting larger body size and food intake. These differences between male and female are also reflected in wool growth. The 'male advantage' is also observed in comparisons of ewes and wethers and between wethers and testosterone implanted wethers. The general consensus seems to be that wool growth differences (quantity and fibre diameter) are largely mediated via the increased feed intake of males.

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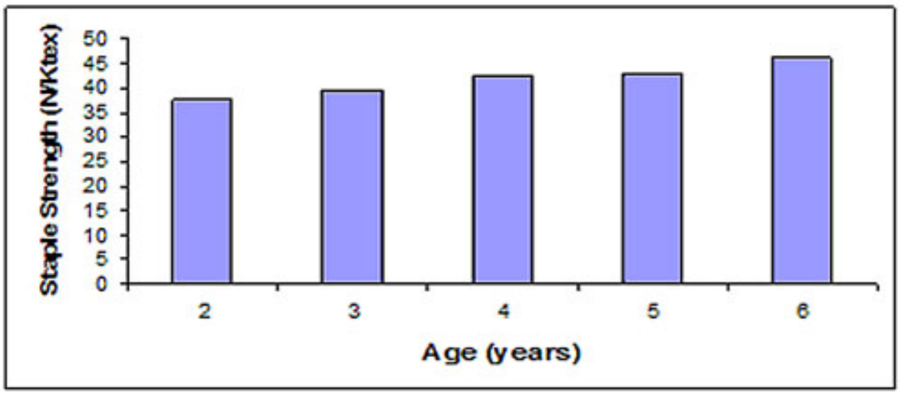

Figure 5.2: The effect of ewe age on staple strength of wool from crossbred ewes (G. Hinch Unpubl. data).

b) Pregnancy and lactation

Early studies suggested that the efficiency of fibre production by Merino ewes declines by around 40% over the period of pregnancy and lactation. The pregnancy effect appears to be greatest in the last trimester when nutrient demand is greatest and reductions in wool growth of 20-40% have been reported (this constitutes between 4 and 13% of total fleece weight).

Fibre diameter normally shows a gradual decline throughout pregnancy as demonstrated in Figure 5.3. The point of minimum fibre diameter generally occurs around the end of pregnancy, though in some instances may occur in early lactation. During lactation, there can be an increase in wool growth rate associated with an increase in fibre diameter, even though ewes may be losing weight. Minimum fibre diameter normally occurs just before parturition although the impact of nutrition interacts with pregnancy to allow maximal impact earlier than this in some cases (Kelly and Ralph 1988).

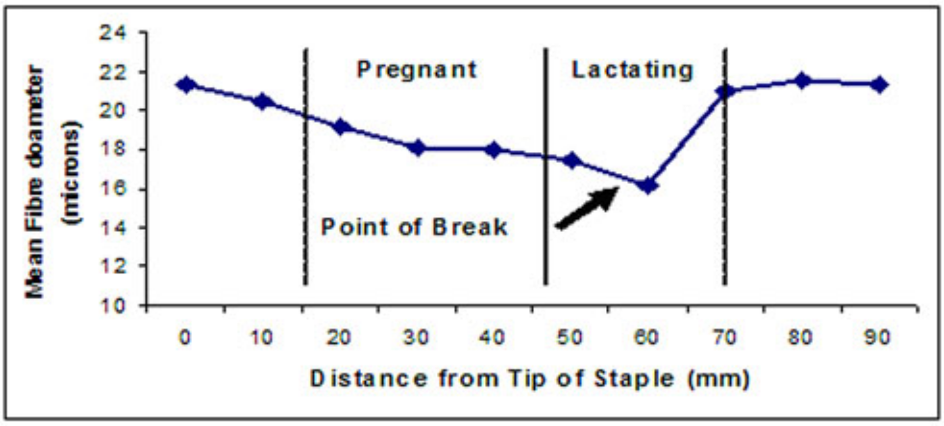

Figure 5.3: Fibre diameter profile of a Merino ewe during pregnancy and lactation (Hansford and Kennedy 1988).

The proportion of tender wool is known to increase with litter size and this is usually associated with a decrease in fleece weight (Corbett 1979, Sumner 1985). Lactation also reduces wool production, possibly to a greater extent than pregnancy and this is probably associated with the high nutritional demands of lactation. Corbett (1964) reported a reduction in wool growth of 16% due to lactation in Merino ewes and even larger effects have been noted where lactation and poor nutrition are combined.

In crossbred ewes Hinch (unpublished) showed a marked decline in staple strength over the pregnancy period. Staple strength in early pregnancy was 46 N/ktex, but by mid-pregnancy the strength had dropped to 44 N/ktex and immediately after lambing staple strength was a mean 33 N/ketx. The average difference between dry and pregnant ewes was 46.7 vs 40.4 N/ktex respectively while the averages of single, twin and triplet bearing ewes was 40, 39.8 and 40.2 respectively (Figure 5.4). The impact of advancing pregnancy on staple strength was greatest for twinning animals in this study (Figure 5.5).

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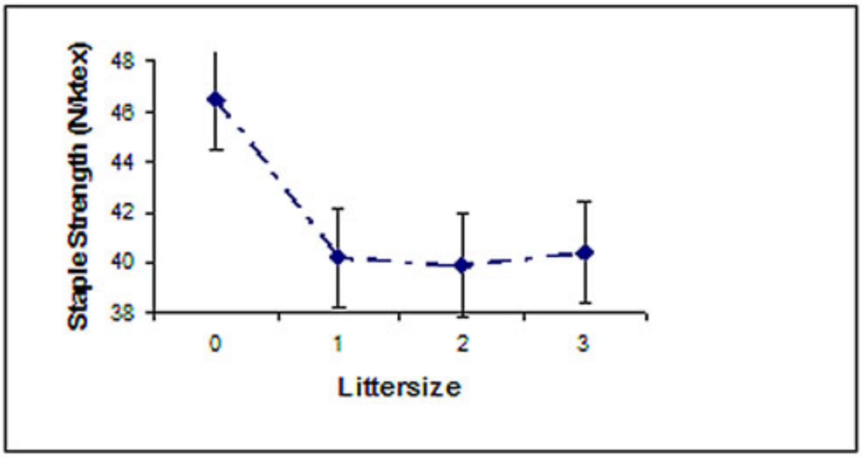

Figure 5.4: The impact of littersize on staple strength in crossbred ewes (G. Hinch Unpubl. data).

As indicated above reproductive state can alter wool production and quality considerably and these effects are closely correlated with liveweight and body condition changes of ewes. It would seem that such effects may impact, not only in the current year but may 'carry over' to subsequent years. Data for Merino ewes grazing pastures in Central Western NSW (Waters *et al.* 2000) has confirmed that carry-over effects of lamb bearing/rearing can be seen both in liveweight and body condition for up to 10 months. However in this study, which used a diverse range of Merino bloodlines of low fecundity, there were no clear carry-over effects on fleece weights or fibre diameter into the following year.

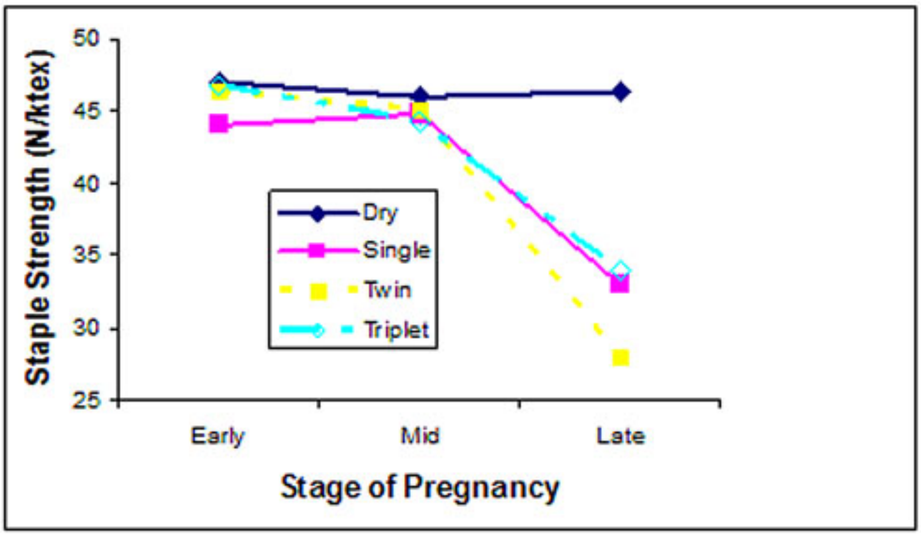

Figure 5.5: Staple strength changes during pregnancy in ewes carrying different littersizes (G. Hinch Unpubl. data).

Various studies have shown that annual fleece weights of breeding Merino ewes are reduced by 150-650 grams relative to non-breeding ewes (very dependent on the strain of Merino). For instance in the study by Waters *et al.* (2000), dry ewes grew 430g more clean wool and had 0.5 μm greater fibre diameter than lambing ewes. The impact of rearing a twin rather than a single lamb was 80g clean fleece and a 0.1μm in fibre diameter in favor of the single bearing ewe.

As indicated the decline in fleece weight due to pregnancy and lactation is usually accompanied by a reduction (0.2 – 1.5 microns) in average fibre diameter for the annual fleece. This is potentially a wool quality benefit associated with breeding ewes, but the change in diameter often results in greater diameter variation along the staple. This in turn can have implications for staple strength and in most studies using 'strong wool' Merinos, staple strength of the annual fleece is decreased by about 6 N/ktex as a result of pregnancy and lactation. This is a similar figure to that noted earlier for well-fed crossbred ewes.

It has been reported that ewes that produce a lamb but fail to rear that lamb are also likely to produce wool with a low staple strength, sometimes even lower than ewes in the flock that do rear a lamb. This

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probably results because fibre diameter is reduced during pregnancy, creating a weak point, but then rapidly rises after the loss of the lamb. This means that the fibre diameter is more variable and consequently the staple weaker.

The decline in wool production associated with physiological state is also associated with a considerably lower efficiency of production because of the much higher feed intake of pregnant and particularly lactating ewes. Oddy, (1985) calculated that for each kilogram of feed consumed by a dry Merino ewe, 14.5 grams of wool was produced compared to only 8.8 grams of wool per kg feed consumed by a ewe rearing a lamb. In this study the medium-Peppin dry ewes grew a total of 3633 grams of wool during the experimental period compared to 2940 grams by the breeding ewes. If the 1.6 kg of feed per head per day consumed by the pregnant ewes had been fed to the dry ewes it is estimated that they would have produced 4872 grams of wool.

Changes in the efficiency of wool growth associated with pregnancy and lactation could also be due to a lack of nutrients such as specific amino acids and/or to hormonal changes that determine the partitioning of nutrients. Efficiency of energy utilisation seems to be reduced in lactating ewes, for example non–lactating ewes produce 60% more wool per unit intake than lactating ewes (Oddy and Annison 1979). They suggested that the most likely mechanism determining the depression in wool growth during lactation is a limited availability of key nutrients, particularly amino acids.

Figure 5.6 compares wool growth rates in dry and pregnant (or lactating) ewes that were fed to maintain equal conceptus-free liveweights. Even though the pregnant/lactating ewes were fed more, wool growth was depressed by around 50% at the time of parturition. Although sheep were losing weight in lactation, wool growth increased at this time, which suggests that the low efficiency for wool growth during late pregnancy is associated with the preferential use of nutrients for foetal growth and accumulation of maternal body stores. During lactation, wool growth appears to benefit from the mobilisation of stored maternal body stores.

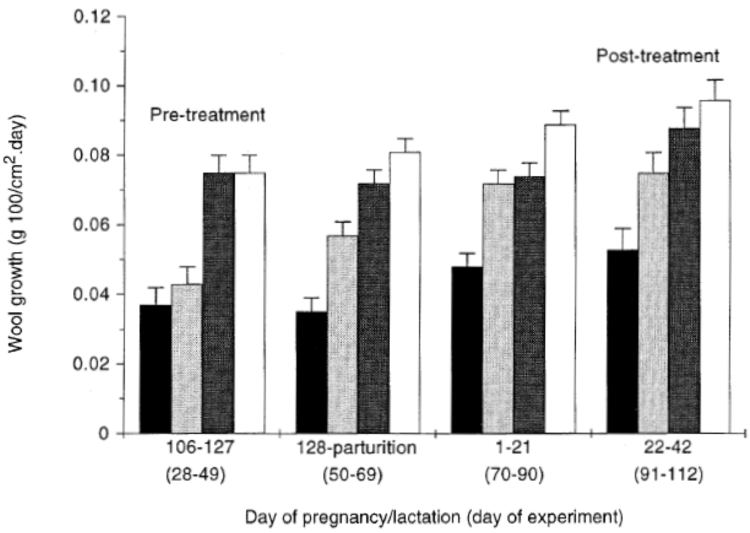

Figure 5.6: Comparison of wool growth of dry Merino ewes or pregnant and lactating animals (black and grey bars are pregnant and lactating ewes, dark grey and white bars are dry ewes) (Masters and Mata 1996).

c) Seasonality

Superimposed on other physiological effects is a seasonal pattern of wool growth that is closely linked to changes in the light cycle. The effects are most apparent in so called 'long wool' breeds such as Border Leicester and Romney (Bigham *et al.* 1978) and not so marked in the less seasonal breeds such as the Merino. However studies have shown that Merinos also have a clear seasonal change in wool growth and in fibre diameter that is repeatable over years. It is notable that, for all breeds, the impact of season on wool growth is less pronounced in younger (growing) sheep.

Sumner *et al.* (1994) were able to demonstrate a difference in wool growth ranging from 8 to 15 g/d in Merino ewes and wethers; maximum growth rate occurring in late Spring (about a month earlier than for the long wool breeds) and minimum growth at the beginning of Winter (Figure 5.7). Sumner *et al.* (1994) suggested that differences in the timing of the decline in wool growth maybe associated with a greater

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sensitivity of the Merino to feed quality. The seasonal pattern for fibre diameter was similar to that observed for wool growth rate (Figure 5.7).

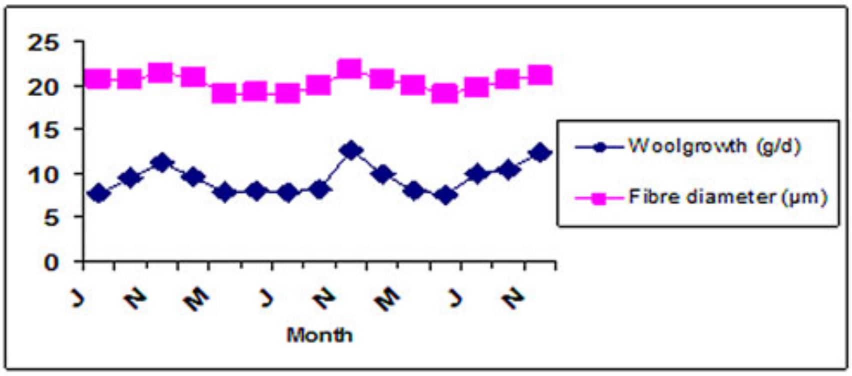

Figure 5.7: Mean clean wool growth rate and mean fibre diameter of Merino ewes and wethers recorded over two years (Sumner *et al.* 1994).

d) Mechanisms potentially contributing to changes in wool production

Hormones

There are a large number and variety of hormones that have a potential role in influencing wool production, in particular the hormones that change during pregnancy and lactation and with age. The hormones involved are primarily those involved in protein and energy metabolism and include:

Insulin. Insulin is a metabolic hormone associated with regulation of energy metabolism. Sheep tend to become insulin resistant during pregnancy with a resultant decrease in the uptake of nutrients by maternal tissues. This allows the foetus to have a competitive advantage, nutrients being partitioned away from tissue deposition. However, such a mechanism could be expected to increase wool growth and therefore is unlikely to be linked to fibre growth reductions.

Cortisol. When sheep are stressed cortisol levels are elevated and, at high concentrations, have been shown to depress wool growth. However, cortisol levels in pregnant and lactating ewes are usually low except at parturition and the changes in levels are not sufficient to explain depressions in wool growth prior to parturition.

It is possible that the inhibitory influences of cortisol may be mediated by activating local paracrine/autocrine factors within the follicle which act as inhibitors of cell division or wool protein synthesis. Epidermal growth factor (EGF), which transiently inhibits the growth of the fibre when administered to sheep, is one potential candidate to fill this role but further studies are needed to clarify the role of "growth factors" in wool growth changes and particularly in young animals.

Growth hormone. This hormone is actively involved in protein accretion in muscle but has been reported to suppress wool growth at high concentrations. Physiological levels during the reproductive phase are normally lower than the levels required in experimental protocols to depress fibre growth but this hormone is high in growing or undernourished animals and may play a role in wool growth changes in these situations.

Placental lactogen. This hormone is very similar to growth hormone and increases rapidly in late pregnancy and early lactation. However to date information on its effect on wool growth are equivocal.

None of the major hormones that alter dramatically during pregnancy and lactation can directly explain changes in wool growth. It is possible that a reduction in blood flow to the skin during pregnancy and lactation could decrease the substrate supply to the wool follicle but such an effect has still not been documented.

Amino acid supply

Animal house experiments indicate that wool growth in late pregnancy and early lactation or in young animals can be substantially increased by the provision of high quality protein supplements protected from degradation in the rumen. For example, substitution of lupin seed protein with partially protected canola meal has been shown to increase wool growth in late pregnancy and early lactation by up to

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50%. Lupin seed contains 30% protein but this protein is highly digestible in the rumen and lupins provide little by-pass protein, even though they are an excellent source of energy. Therefore it may be possible to use specific supplements to manipulate wool growth in pregnancy.

Other supplements that are a good source of protected protein include high protein meals such as cottonseed and sunflower meals. These meals can be treated with formaldehyde or prepared by heating the protein slightly (expeller process) which gives a measure of protection from microbial breakdown in the rumen. Lupin seed, even if treated to decrease solubility in the rumen, may still be of limited benefit because of its poor balance in amino acids relative to other possible sources of protein.

In a study using pregnant crossbred ewes (Hinch unpublished), cottonseed meal provided at a number of levels had minimal effects on staple strength and fleece weights. However in studies reported by Masters and Mata (1998) canola meal supplements were shown to significantly improve wool characteristics, particularly for early (March) lambing ewes.

Clearly the manipulation of nutrition is a key issue in the management of wool quantity and quality and is the point of discussion in the next section of this topic.

5.2 Nutrition

The impact of nutrition on wool growth and quality is probably the key factor to consider for management, and an understanding of the impact of changes in pasture availability and quality throughout the year, and in different regions, is central to understanding how to manage wool production in a flock of any particular genetic background.

Mediterranean environments of Australia, where seasonal changes in nutritional conditions are very pronounced, are the areas where the impact of age and physiological state on fleece characteristics is most obvious. In these environments there is a 'normal ' pattern of weight change associated with changes in nutritional quality and quantity. This pattern is summarised in Table 5.1 along with an indication of the changes occurring in nutrition, in particular the large contrast of the Autumn ‘break'.

In practice, these pasture availability patterns do not fall neatly into the four seasons due to large between year variation in the timing of the start and finish of the growing season. This large seasonal variation in the quantity and quality of feed is accompanied by large changes in liveweight, wool growth and fibre diameter which are particularly notable in young stock. The latter is partially a result of the timing of the Autumn break with the poorest pasture conditions usually occurring at the time when young stock (12-15 months old) have the largest nutritional demands for growth.

Table 5.1: Summary of seasonal changes in nutritional characteristics of average Mediterranean pastures and associated weight changes of grazing animals (Hinch 2005).

Season	Feed	Quality	Weight change
Summer	Dry feed, adequate amounts	Poor	Weight maintenance
Autumn	Dry feed, limited quantity	Poor	Weight loss
Winter	Green feed, limited quantity	High	Weight gain
Spring	Green feed, adequate amounts	High	Weight gain slowing

Figure 5.9 illustrates the liveweight changes that occurred in autumn-born Merino lambs during 1993. Weight losses occurred into late-Summer/early-Autumn until the seasonal ‘break’. Such changes in liveweight are also reflected in wool growth rate and fibre diameter. For example in a trial conducted in south western WA (S. Gherardi pers. comm.) it was noted that throughout the wool growing period for Autumn-born, Spring-shorn weaners, fibre diameter ranged from 22.1 μm in October to 15.0 μm in February and increased again to 23.5 μm by the following September. This change in fibre diameter was associated with a 'tender' fleece with a staple strength of 22.4 N/ktex.

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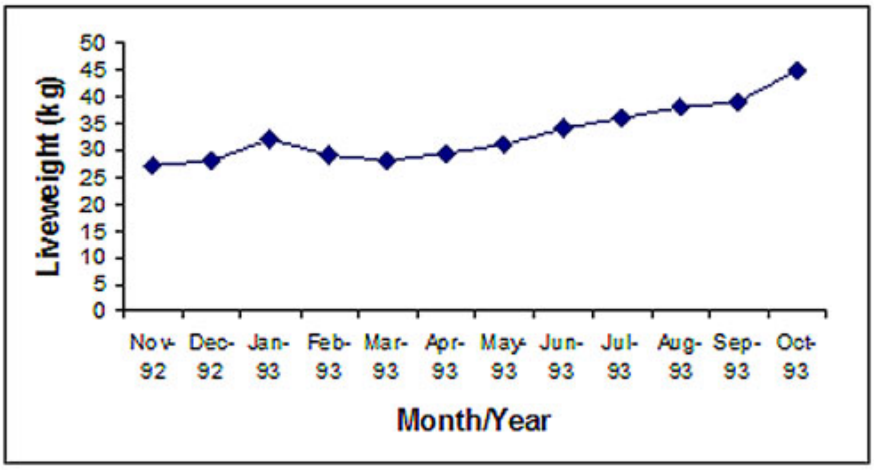

Figure 5.9: Annual variation in liveweight of young Merino sheep in Western Australia (S. Gherardi *et al.* Unpubl. data).

In the Mediterranean environment generally wool growth and fibre diameter in sheep decline from about the time of seed set in spring, with a major decline following pasture senescence.

The major constraints for the nutrition of grazing sheep in Mediterranean environments are low digestibility of organic matter consumed during Summer/Autumn and low pasture availability during Autumn/Winter. This has major ramifications for the quantity and quality of wool produced as energy and/ or protein intake can be below maintenance for a period of 1 – 5 months until the start of the growing season.

In contrast, in temperate regions of Eastern Australia, where rainfall patterns and temperatures dictate a winter feed deficit (both quantity and quality), the impact of seasonal changes in nutrition on fibre diameter are not as apparent. In these environments Spring lambing is normal and therefore the impact of poor nutrition occurs during Winter, often at lower weights and ages and just prior to shearing time.

It is worth noting that most specialist wool producers in Mediterranean areas budget to hand feed autumn-lambing ewes and young sheep at pasture for 3 – 4 months over late summer/autumn. In the past, the primary objective of this feeding has been to keep animals alive rather than to manage wool quality and the economics of feeding for improved wool quality warrants further consideration. Figure 5.10 shows the relationship between liveweight loss and staple strength in young Merinos indicating that any weight loss at all is likely to compromise staple strength and therefore wool value.

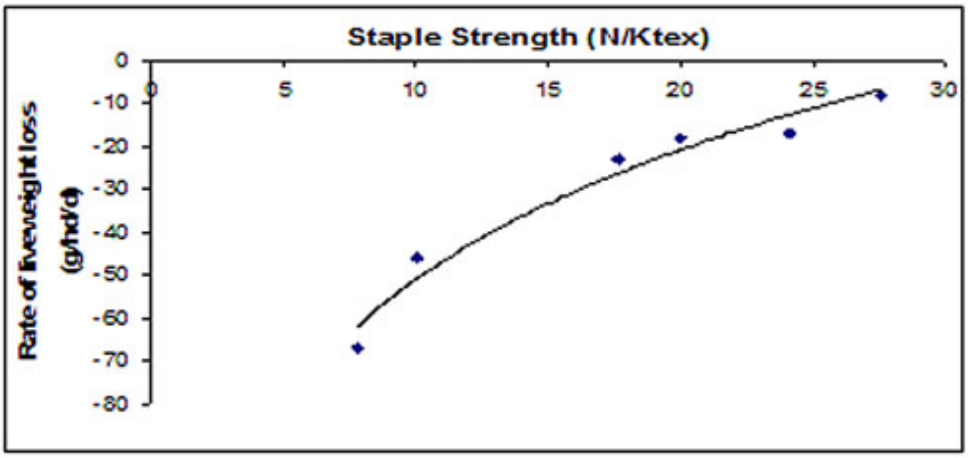

Figure 5.10: The relationship between liveweight loss and staple strength in young Merinos (S.Gherardi Unpubl. data).

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Young vs adult

The greater variation in fibre diameter across seasons for young compared with adult sheep was demonstrated in a study by Peterson, (1999) (Figure 5.11) using Spring-shorn Merino wethers, set-stocked at 10 sheep per hectare, at Mt Barker, South Australia.

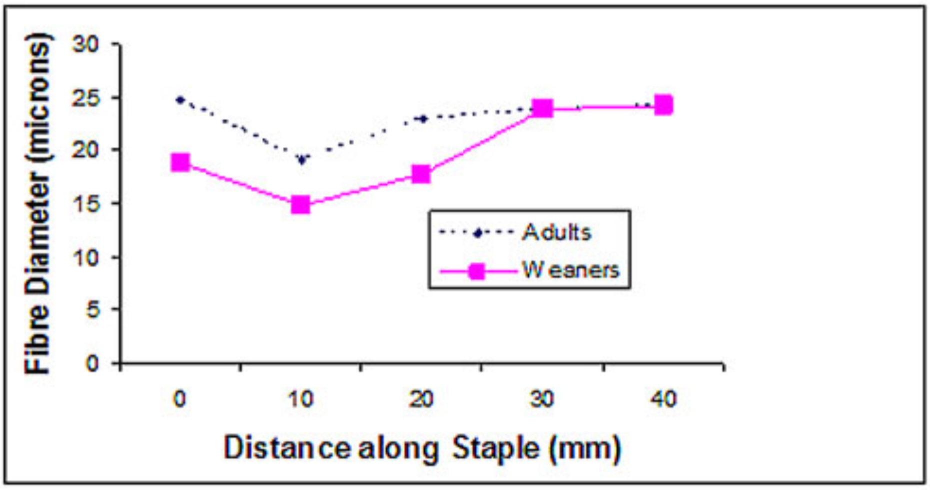

Figure 5.11: Fibre diameter variation in adult and weaner Merinos grazing Mediterranean pastures (A. Peterson Unpubl. data).

By considering fibre diameter profiles, it becomes clear why weaners produce wool of a lower staple strength than dry adult sheep. Both profiles show a decline in diameter associated with summer and autumn. However, most importantly, weaners begin with a lower fibre diameter, yet finish with a similar diameter, compared to the dry adult sheep. The result is a more variable diameter profile for weaners, with a lower minimum diameter and a **greater difference** between minimum and maximum diameters. As the latter attributes of the diameter profile have been linked to reduced staple-strength, young sheep would be predicted to produce wool of lower strength than dry adult sheep.

5.3 Grazing and feeding strategies

Young sheep

In general we can say that fibre diameter and thus staple strength in young sheep can be manipulated by:

- Improving weaner weight at the start of Summer or Winter depending on the environment - thus attaining a high liveweight in young sheep before the period of nutritional stress which in turn increases the minimum fibre diameter and reduces the need for additional feed
- Minimising liveweight loss (feed intake) in the period of poorest nutritional conditions - prevention of weight loss will increase the minimum diameter and staple strength and, provided feeding is restricted to the period of slow wool growth, will have only a small effect on average fibre diameter
- Restricting feed intake and rate of growth in the period of best feed conditions - high stocking rates during periods of adequate feed supply may reduce the potential for 'blow out' in fibre diameter and therefore increase returns per hectare.

Stocking rate

The use of stocking rate changes to manipulate seasonal effects is an important component of management of young sheep in Mediterranean environments, less so in temperate regions. A study conducted by Peterson (pers comm.), working in South Australia examined the effects of stocking rate during Winter-Spring on the productivity of weaners born in the Autumn of the previous year. All sheep were grazed at similar stocking rate until the break of season at which time, each group was split into two management groups, one having non-restricted access to pasture (set-stocked) and the other having restricted access (strip-grazed). The goal was to limit the increase in liveweight and wool growth rate associated with the green feed in Winter and Spring.

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For both heavy and light weaners, the unrestricted treatment showed a rapid increase in liveweight during Winter-Spring compared to the restricted treatment. The failure for liveweights to decline over the Summer was due to the presence of clover burr, sustaining weaner growth. Heavier animals showed an initial decline in fibre diameter compared to lighter animals while the unrestricted group showed a rapid increase in diameter in Winter-Spring compared to the restricted group. The heavy unrestricted group showed the highest clean fleece weight, being approx. 1 kg heavier than fleeces produced by the light restricted group. The heavy unrestricted group also showed the highest average fibre diameter, being approx. 1.5 microns greater than that achieved by the light restricted group. This is a reflection of the high wool growth rates achieved by this group during the spring.

Restricting access to feed during the winter and spring gave less variation in fibre diameter and increased staple strength. And it is clear that management of stocking rate of weaners during their second Spring can have large effects on gross returns per hectare.

Supplementary feeding

Supplementary feeding strategies can be used to minimise the effects of seasonal changes in nutrition on the productivity of young sheep. There have been many studies on this aspect of Merino management comparing the relative merits of a range of feeding strategies. However it seems that feeding of young stock is most common in the Mediterranean environments and the response is more easily generalised in this environment.

Supplements are normally fed to sheep to prevent large liveweight losses but it is known that excessive delays (survival strategy) in commencing supplementation may result in 'tender' wool (< 20 N/ktex). In contrast commencing supplementary feeding to ensure maintenance of liveweight (the 'maintenance' strategy) will maintain staple strengths of >30 N/ktex.

For example one study by Gherardi *et al.* (1996) examined the impact of supplementation on staple strength from two strains of Merino (Merryville - 17.3 µm at hogget shearing) and (Wallinar/Purpareena - 19.4 µm) at three sites ranging between 200-800 mm annual rainfall. They chose four lupin-feeding strategies that differed in the timing of the commencement of supplements. These were:

- **Survival** – sheep were fed as necessary for survival (generally late February). They would be allowed to lose weight slowly over summer from around 33 kg to 27 kg (i.e. 18% peak liveweight)
- **Traditional** – sheep were fed for liveweight maintenance from mid-February, which is when pasture quality generally falls below 50% digestibility
- **Recommended** – sheep were fed for liveweight maintenance from pasture senescence (possibly late November)
- **Tactical** – sheep were fed as for the recommended treatment, but received extra hay or lupins following rainfall events and the break of the season.

Over the two years of the study it was observed that there was a decrease in staple strength with increasing rainfall, probably reflecting the earlier decline in feed quality in the higher rainfall area, but only a small difference in staple strength between the supplementary feeding treatments. The tactical treatment gave significantly higher staple strength values compared to the traditional and recommended treatments at the lower rainfall site.

The biggest differences in staple strength were between the genotypes, the fine wool sheep producing wool of 8 N/ktex stronger than the medium wool sheep. The genotype effect was consistent across all years. This effect is confounded with the age of the animals as the fine wool sheep were born in April/May and were consequently more mature than the medium wool sheep born in July/August when they entered the restricted feed period of Summer/Autumn.

A later experiment (Peterson *et al.* 2000) examined the effect on weaners (37 or 27 kg at the commencement of Summer) of lupin or canola meal supplementation compared with restricted or unrestricted access to green feed in the Autumn. The only change in staple strength was an increase associated with restricting green feed available at the break of the season (Table 5.2). This treatment also had a reduced fibre diameter (about one micron).

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It seems that supplementary feeding during Summer–Autumn can increase wool growth of young sheep but the benefits to annual wool production and the effect on mean fibre diameter may be small as a higher proportion of wool is grown during the 'green feed' period. For weaners it seems that some restriction of feed availability during the 'green feed' period may be advantageous in Mediterranean environments but unnecessary in the Temperate areas where lambing occurs in the Spring.

Table 5.2: Wool and liveweight measurements of young Merino sheep as influenced by Autumn feeding regime (Peterson *et al.* 2000).

	Heavy Unrestricted	Light Unrestricted	Heavy Restricted	Light Restricted
Fibre Diameter (μm)	20.1	19.3	19.0	18.4
Clean Fleece Wt (kg)	3.6	3.1	3.0	2.6
Staple Strength (N/ktex)	35.6	33.9	41.9	40.6
Staple Length (mm)	105	98	98	92
Mid Breaks (%)	22	12	56	30
Liveweight (Sept) - (kg)	58.6	55.3	47.2	44.4
DSE/ha	8	13	15	20
Wool Prod (kg/winter ha)	29	40	45	52

Pregnant ewes

Supplementary feeding, lambing time and shearing time are three strategies available to woolgrowers to manage the wool quality changes that are likely to occur in breeding ewes.

Shearing time

The impact of pregnancy and lactation on staple strength depends on the management system, in particular the timing of shearing and lambing. Essentially the closer to lambing ewes are shorn the closer to the end of the fibre the staple 'break' will occur and the lower the impact on wool value. Consequently the relative timing of these events should theoretically be close to minimise the impact of pregnancy and lactation on wool strength.

Shearing near the point of break results in longer fibres in the processed top because it reduces the number of mid-staple breaks thus increasing the processing quality of wool from breeding ewes. In the Winter rainfall areas, when lambing is often in Autumn, shearing needs to be in Summer or Autumn to coincide with the point of break. Of course shearing at this time may cause problems later in the year with an increase in seed penetration and vegetable matter contamination in the wool. In addition, the possibility of flystrike in sheep carrying 6 – 8 months wool in Spring is increased and this may require additional use of chemical treatments. Such problems can be overcome but they need to be accompanied by improved management to take advantage of the benefits of shearing near the point of break. The choice is not a simple one because there are other factors such as sale of sheep, cold stress and availability of labour that also need to be considered in the selection of shearing time.

Lambing time

In an Autumn lambing system in Mediterranean environments such as in WA, clean fleece weight, fibre diameter and staple strength all decline in those ewes carrying a lamb relative to dry ewes. In contrast in a Spring lambing system, such as that commonly found in Victoria, clean fleece weight and fibre diameter decline but without a decline in staple strength. This difference in staple strength between the two systems is reflected in a much greater variability in the diameter profile of the ewes from the Autumn lambing system.

The seasonality of pasture production, means that the time of lambing will have a major influence on the balance between the food that is needed and the food that is available. The traditional time to lamb in the Mediterranean environments of southern Australia has been in Autumn and surveys in Victoria, South Australia and Western Australia in the early 1990's indicated that well over 60% wool producers planned lambing to occur at this time. This means that in late pregnancy and early to mid lactation, when nutritional demands are high, pasture quality and quantity are at their worst. Under such conditions both wool growth and fibre diameter are dramatically reduced. Worse still, from the point of

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view of wool quality, the reduction in fibre diameter for a short period produces a weak point in the wool and therefore reduces staple strength.

By shifting lambing to late Winter or Spring, nutrient requirements more closely match the availability of pasture resulting in a bimodal fibre diameter profile reducing the variation in fibre diameter and the minimum fibre diameter. In contrast to its variability, the average fibre diameter of the fleece is not greatly influenced by time of lambing, although there are some reports that lambing in Spring results in a slightly lower diameter (0.5 micron) than lambing in Autumn (Foot and Vizard 1992).

In general in Mediterranean environments there is an economic advantage (GM/ha) to Spring lambing over an Autumn lambing across a range of stocking rates because of the additional cost of the supplementary feed required in the Autumn lambing system There is also the potential bonus of improved staple strength.

Further consideration of the Spring lambing system also reveals that carrying capacity of a farm, in say Victoria, is increased over the full year by lambing in Spring and the requirement for supplementary feeding is decreased. On the negative side, later-born lambs will be smaller going into the late Summer period of the following year, with the potential negative effects on staple strength discussed in the previous lecture. Therefore, in the large proportion of Australia where the growth of pastures fluctuates widely throughout the year great care must be taken to choose lambing or shearing times which can minimise the impact of these feed changes on wool quality. In environments where changes in pasture growth and quality are less or where they are synchronised with shearing the importance of time of lambing is much lower.

Supplements
Although feed supplements (eg canola meal) have been shown to increase wool growth rate of Merino ewes during late pregnancy, the value of these supplements depends on pasture availability and quality. In a study in a Mediterranean environment (Masters and Mata 1998), the closer to the break of season canola supplement was used the less the benefit was seen. This effect could be seen within 2 weeks of rain falling. Therefore, in Autumn lambing ewes, the strategic use of high quality protein supplements for a short period around the time of parturition is recommended as it will increase wool growth and fibre diameter for a short period and is likely to improve staple strength and, provided this period of supplementation is short, is unlikely to produce any increase in the average diameter of the fleece. In Spring lambing ewes where pasture is usually non-limiting the provision of supplement is likely to increased wool growth and fibre diameter possibly accentuating the weakness resulting from the low fibre diameter in Autumn.

However, there will be circumstances where the depression in wool growth in late pregnancy or lactation will be greater than the seasonal depression caused by a lack of feed during Autumn. In such situations there is a biological benefit in using supplements with the intention of improving wool quality. The relative price of supplements relative to wool price differentials will determine if such management options are economic.

Irrespective of the time of lambing, it is important to consider that the point of slowest wool growth and therefore weakest point in the staple is often during pregnancy rather than lactation. For this reason, feeding during late pregnancy to improve wool growth or earlier in pregnancy to increase body condition and nutrient reserves is likely to have a positive effect on staple strength.

Readings

The following readings are available on web learning management systems

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