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The effect of age, fleece weight, fibre diameter and live weight on the relative value of Australian alpaca fleeces

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Abstract
The impact of commercially important alpaca fibre production and quality attributes on the relative economic value of alpaca fibre production was investigated. Fleeces from five farms in southern Australia (n = 1100) were measured using mid side samples and standard tests and were assigned a relative economic value based on an analysis of market price data. The total relative economic value increased with increasing greasy fleece weight and with increasing saddle weight up 2.5 kg. Total relative economic value declined as mean fibre diameter increased above 23µm, increasing live weight above 60 kg and with increasing age above 2 years for Huacaya and 3 years for Suri. The relative economic returns from fleece production of Huacaya and Suri breeds was similar. The main drivers of economic value for Australian alpaca fleece production are lower mean fibre diameter and increasing fleece weight. Higher economic value for fleece was associated with younger and lighter animals. This work provides a method to assign an economic value to alpaca fleeces thus enabling animal selection based on international commercial economic values.

Key Words
Fibre diameter, fleece weight, fleece value, live weight, age, measurement

Introduction
In the 1980s and 1990s, alpacas were imported into Australia and New Zealand to establish a new animal fibre industry. Their productivity has been investigated in southern Australia (Hack et al., 1999) and New Zealand (Wuliji et al., 2000). Scientific analysis of Australian data has been presented on the most appropriate fleece sampling methods (Aylan-Parker and McGregor, 2002), the comparative productivity of Huacaya alpacas compared with Merino sheep (McGregor, 2002), sources of variation in fibre diameter attributes (McGregor and Bulter, 2004a), the inheritance of Suri phenotypes resulting from different crosses (Ponzoni et al., 1997) and the inheritance of alpaca fibre attributes in young Australian alpaca (Ponzoni et al., 1999). The Australian alpaca industry is evolving from the initial breeding phase of industry development to a more commercial industry with a greater focus on financial returns from fibre production.

With other animal fibres, such as wool and mohair, the major influence on fibre value is mean fibre diameter (Anon 2006a, McGregor and Butler 2004b). Mean fibre diameter of alpaca fibre is not fixed, it varies with age, live weight, genetics and seasonal nutritional fluctuations. Thus the economic value of alpaca production changes with time. No data on the relative economic value of alpaca fibre production in Australia could be found. This paper attempts to quantify the changes in the relative economic value of alpaca production when various production and management attributes are manipulated by using real data from Australian alpacas and international fibre prices.

Methods
Fleece measurement
Data from 1100 fleeces from five farms in southern Australia (Hack et al., 1999) were collected from Huacaya and Suri alpacas. Prior to shearing all alpacas were weighed on live stock scales to the nearest 0.5 kg. At shearing, fleeces were separated into their components of saddle, neck and skirtings and weighed to the nearest 5 g. At shearing, mid side samples were taken on all animals and samples were tested for fibre diameter using the OFDA 100. For some of the animals all fleece components were also sampled and tested for fibre diameter. Full details of the test and sampling methods are found elsewhere (Aylan-Parker and McGregor 2002, McGregor 2006).

Fleece valuation
The relative economic value of each fleece has been determined using price data for white tops based on prices reported by the major international alpaca trader Alpha Tops (Figure 1, Anon 2006b). Using two complete price cycles (peak to peak) the mean relative price for each grade of alpaca fibre was calculated based on the area under each price curve over time. Data for the mean fibre diameter of each price grade has been supplied by Alpha Tops and confirmed by testing of sample tops. The relative price data has been converted into a mathematical relationship between price and mean fibre diameter using linear regression analyses to allow an average relative price for any mean fibre diameter to be estimated animal. For most of the 25 years where price data is available the maximum price of alpaca fibre was paid for fibre with a mean fibre diameter of 22µm, so this fibre has been given a relative

value of 100 units per kg

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Figure 1: Alpaca prices for the period 1981 to 2006 for different grades (BSUT suri fibre, BBAT baby alpaca, BSFT fine alpaca, BADT adult alpaca) based on Alpha Tops data (Anon 2006b)

The relative economic value for a fleece was then determined by:
1). Multiplying the weight (kg) of each component by the relative value predicted by placing the measured or determined mean fibre diameter for that component into the appropriate prediction equation; and
2). Summing the relative values for the three components together.

Given that most of the fleece skirtings measured exceeded 34µm, the relative value at 34µm has been applied to all fibre coarser than 34.0µm (17 units/kg). Colour has not been taken into account, all fibre has been assumed to be white. Suri fibre values have been increased by 10% relative to Huacaya (Vinella, 1993) which approximates the market for the period 1995 to 2002 (Figure 1). An adjustment was made to correct for differences between the mean fibre diameter measured with mid side sampling and the fibre diameter for saddles and pieces based on research carried out within the same set of alpacas (Aylan-Parker and McGregor 2002). For this analysis the mid side was taken as 1.5µm finer than the saddle.

Results and discussion

Relative economic value of alpaca fibre

The relative value of alpaca fibre related to the MFD is shown in Figure 2. The data indicate an average decline in price of 11% per 1µm increase in fibre diameter up to 26µm. Above 26µm the average decline in price was 5% per 1µm increase in fibre diameter. Fibre of 32µm was valued at only 27% of the value obtained for the finest fibre. Given the limited number of data points the best regression fit between mid side fibre diameter (MSMFD) and relative economic value (RELVAL) was provided by two linear regression equations as follows:

1.For MSMFD values 22.0 to 26.0µm; RELVAL = - 10.9 x (MSMFD + 1.5) + 339.8;

2. For MSMFD values 26.1 to 34.0µm; RELVAL = - 4.933 x (MSMFD + 1.5) + 184.8; and

3.For MSMFD values greater than 34.0µm; RELVAL = 17.

Note that if saddle grid samples or bale core samples are used for fibre diameter measurements, then these values would substitute for the term within the bracket.

Figure 2: The effect of alpaca fibre diameter on the relative price of white alpaca tops over the 10 year period 1985 to 1995 (l) and during the price cycle troughs in 1986, 1991 and 1992 (¡).

The shape of the price/fibre diameter curve is generally similar to that seen with wool and mohair. This is not surprising as the physical properties of alpaca, wool and mohair that affect textile performance are identical. For example, Swinburn et al. (1995) found that increasing alpaca fibre diameter significantly increased the prickliness and reduced the softness of alpaca blend knitwear.

Relative economic value of Australian alpaca fleeces

The total relative economic value increased with increasing fleece weight (Figure 3a) and with increasing weight of the saddle up to a saddle weight of about 2.5 kg (Figure 3b). Note the large error bars for the data for saddle weight from 2.5 to 4.5 kg. These error bars indicate the large variability of the economic value at these heavier saddle weights. There are heavy fleeces with high economic value as a result of having a fine fibre diameter and other heavy fleeces with low economic values as they have coarse fibre diameters.

Total relative economic value declined as mean fibre diameter increased above 23µm closely reflecting the price discount curve (Figure 3c). Total relative economic value declined with increasing live weight above 60 kg (Figure 3d) and with increasing age above 2 years for Huacaya and 3 years for Suri (Figure 3e).

Generally Huacaya and Suri showed the same economic responses to changes in fibre diameter, fleece weight and age. However if the price premium of 10% for Suri fibre was eliminated (as appears to be the case under current international market conditions (Figure 1) then Huacaya would produce fleeces of higher relative economic value (in other words the Suri relative value line would move down 10%).

Clearly the greater the weight of the saddle, the greater the economic return. However, given that the mean fleece weight did not change with changes in mean fibre diameter (see Hack et al. 1999, McGregor 2006), the greatest driver for increased economic value was reducing mean fibre diameter.

Figure 3: The relationship between the total relative economic value of fibre grown by Australian Huacaya (l) and Suri (¡) alpacas and a) total fleece weight, b) saddle weight, c) mean fibre diameter, d) live weight at shearing, and e) age at shearing.

Using the economic values in selection programs

The relative economic values determined in this work can be used to evaluate the economic value of individual animals in breeding programs such as the AGE program. As Figure 3e shows, the economic value from fibre production of alpacas aged six years and older was about half or less of that of alpacas aged one to three years. This reduction in economic value will be minimised or eliminated if breeders can substantially reduce fibre diameter blowout (McGregor and Butler 2004a).

Fibre diameter "blowout"

The term "micron blowout" is commonly used in the wool industry to describe the increase in mean fibre diameter with age that is not due to short lived environmental influences. Depending on the property, the average increase in mean fibre diameter between ages 0.5 and 7.5 (7.5 being the approximate age before the response plateaus) is around 7.5 ± 7.5µm (McGregor and Butler 2004a). Thus it has been estimated that 95% of the repeatable increases in mean fibre diameter from 0.5 to 7.5 years of age will be between 0 and 15µm. This implies that repeatable animal to animal variation is such that some alpacas will not increase their fibre diameter at all from a young to an old age, while some other alpacas will increase their fibre diameters about 15µm.

Furthermore, the increase in fibre diameter with age is only weakly correlated with the inherent animal fibre diameter at a young age, as indicated by the repeatable animal correlation of 0.5 years of age and slope being only 0.363. It would appear that the issue of finding the cause of differences in "micron blowout", whether genetic or environmental, is crucial in being able to control fibre diameter of Australian alpacas through their lifetime. The existence of huge differences in "micron blowout" is confirmed, beyond any reasonable doubt, by this research with Australian alpacas. This is clearly one of the most important issues that needs addressing within the Australian alpaca industry.

Conclusion

The main drivers of economic value for Australian alpaca fleece production are lower mean fibre diameter and increasing fleece weight. Higher economic value for fleece was associated with younger and lighter animals. This work provides a method to assign an economic value to alpaca fleeces thus enabling animal selection based on international commercial economic values.

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