The breeding programme for the Angora goat in Australia

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The principal product of the Angora goat is mohair which is a long, lustrous speciality fibre. The fibre is white with a mean diameter of about 25μm for kids and 30-36μm for commercial adult grades. The fibres grow continuously and the coat from superior Angoras is mostly free of medullation and kemp (Wildman, 1954).

The goat resource in Australia

Angora goats originated in Turkey and were introduced to South Africa in 1838, USA in 1849 and Australia in 1853. The first European settlers brought dairy goats to Australia in 1778 and importations continued thereafter. In 1853 acclimatisation societies and pastoralists (farmers) imported Angora and Cashmere goats so that by the late 1880s there were a few Angora flocks of several thousand animals. However, severe drought over many years led to these animals being released (or escaped) into public lands where they joined many other escaped dairy goats to form what is now known as the Australian feral goat.

Today the feral goat is essentially a low-milking dairy goat type with an undercoat of down (Holst, 1981). In 1950 only one recognised Angora flock existed in Southern Australia. By 1975 the genetic resource was about 2 500 Angoras and perhaps 1 million non-domesticated feral goats.

Lessons

Early attempts to develop a mohair industry failed because:

- there was no source of quality genetic material;
- breeding aims were not defined;
- there was no industry organization;
- poor nutrition (especially droughts);
- shepherding/fencing was inadequate.

Breeding programm. Stage 1. (1970-1984)

In the 1970s sheep farming in Australia was a large industry suffering a wool price collapse and it was natural that several farmers sought to diversify by including mohair production. Their small ruminant management skills were good, they understood animal fibre and they had shearing (fibre clipping) facilities. Fencing was adequate. Individual identification of goats was by eartags with, in bucks, ear tattoos (Holst, 1998).

There was a comprehensive Government infrastructure (research, advisory services and veterinary) servicing the sheep industry (mostly at no cost to farmers) and specialised laboratories for wool fibre measurement (fee charged). In 1971, an Angora / mohair industry association was established together with a research committee; the latter due to the efforts of a single enthusiastic luxury-fibre entrepreneur. Funding was limited.

At this time there was an assumption, that range (or pastoral country) and browse was good for Angora goats and mohair production. This was based on the Edward's Plateau in the USA and range in South Africa. Unfortunately, the rainfall variability and quality of range in Australia is not comparable to either of these countries.

With this background the first planned mohair industry in Australia was initiated. It consisted of a small number of studs established to produce sires for a larger number of commercial mohair producers who would use cross-breeding to generate larger flocks (Table 1).

Table 1. Description of the breeding aims for Stage 1 of the Angora/mohair industry.

Section	Breeding aim	Breeding objective	Selection criteria	Breeding plan
Commercial mohair producers*	Profit through diversification	Fleece weight Fibre diameter	Visual / greasy fleece weight Visual	Cross-breeding (Angora x feral)
Breeders of Angora goats **	Profit through breeding sires	Fleece weight Fibre diameter Style Kemp	Visual / greasy fleece weight Visual / limited lab Visual Visual	Straight-breeding from existing Angoras

* Located in range and agricultural areas.

** Located in agricultural areas only.

Breeding aims

Overseas estimates of heritability for economically important traits were moderate (Table 2). However, estimates of phenotypic and genetic correlations were scarce and there were no genetic parameter estimates for Australian Angora goats.

The setting of breeding objectives was influenced by overseas experience which was based on the relative economic value of each trait affecting their mohair quality and quantity. In most cases commercial mohair producers simply want to produce large quantities of the most profitable fibre and it is assumed that the price signals they receive are reliable. In Australia, at that time, mohair was sold in bales on description and not on measured data and Clark (1990) described differences in the relative values for quality attributes between buyers and processors. Since cross-breeding was the major activity, the breeding objectives were fleece weight and fibre diameter.

The cross-breeding programme (Table 3) for the commercial producers of mohair was a slow process. While fifth generation animals could be considered pure-bred they retained an unacceptable level of medullated fibre and kemp (Patel, 1982; Shelton, 1986). Indeed the reduction of percent kemp fibre in the flock was a practical problem at that time. Kemp was expensive to measure in the laboratory, the sampling site was poorly defined and it was thought to have a low heritability. Yet Texan and African breeders had successfully reduced it to negligible amounts.

Table 2. Estimates of the heritabilities of some selection traits for Australian and overseas Angora goats before and after 1972 (from RA Clark, 1990).

Trait	Country	Heritability	Reference
Greasy fleece weight	Turkey	0.26 - 0.15	1
	USA	0.40	2
	USA	0.13 - 0.83	5
	Australia	0.42 - 0.45	6
Fibre diameter	USA	0.12	2
	Turkey	0.19	4
	USA	0.11 - 0.24	5
	Australia	0.08 - 0.14	6
Kemp score	USA	0.43	2
	USA	0.05 - 0.19	5
	Australia	0.36 - 0.42	6
Medullation	Australia	0.0 - 0.39	6

References 1.Sincer (1963); 2. Shelton and Bassett (1970); 3. Yalcin (1972); 4. Yalcin *et al.* (1979); 5. Shelton and Snowder (1983); 6. Gifford *et al.* (1991).

Conduct

The industry association provided a focus for farmers in the Angora industry and to those who may be interested in joining. It conducted rural livestock competitions, provided a register for breeding stock and generally provided education material, either written or through group meetings. It had a national responsibility and was the spokesperson on issues concerning the mohair industry.

Initially the mohair was sold to independent buyers for domestic and export (mostly UK) markets. Members of the association quickly realised that prices could be improved if the individual farm lots were classed and pooled. This also provided another educational opportunity.

Table 3. The cross-breeding programme as used by commercial mohair producers.

Generation	Breed of doe	Breed of buck	Breed of progeny
1	unregistered feral B	angora A	½ A ½ B
2	½ A ½ B	A	¾ A ¼ B
3	¾ A ¼ B	A	$^{7}/_{8}$ A $^{1}/_{8}$ B
4	$^{7}/_{8}$ A $^{1}/_{8}$ B	A	$^{15}/_{16}$ A $^{1}/_{16}$ B
5*	$^{15}/_{16}$ A $^{1}/_{16}$ B	A	$^{31}/_{32}$ A $^{1}/_{32}$ B

* does mated < 12 months of age – nine years from 100 feral does to 100 angora does.

Role of the Government and related agencies

The services provided by the Government and related agencies to the new mohair industry were invaluable and essential to its development. They included research on genetics, products, management, fibre measurement and diagnostic techniques for disease; changes to legislation and facilitating the registration of chemicals for goats. Education of farmers and the service industry was a major activity.

Outcome of the first breeding Programme

In describing the results, Stapleton (1985) and Gifford et al. (1985) indicated that Australian mohair had a yield of about 91 percent, mean fibre diameter ranging from 24µm at the first shearing, 26µm at the second, 30µm at the third and fourth shearing and 33µm in later fleeces. This differs little from the limited data published between 1975-1977 (Evans, 1980). Kemp was two percent down from three to five percent in 1978, but still unacceptably high. Indicative clean fleece weight at the third shearing was 1.12 kg (six months fleece).

In 1985 mohair fibre production would not have been profitable for farmers.

Lessons

Several problems were identified and lessons learned:

- the range environment was not suitable because of variable nutrition, kid predation, vegetable matter fibre contamination;
- animal production was inferior to that reported overseas, with the assumption that genetic material was inferior;
- marketing - demand for fibre and returns were variable between years - kemp and gare were a significant deterrent to buyers.

Breeding programme. Stage 2. (1984-...)

A depressed mohair market and the realisation by breeders (angora goat numbers dropped from 275 000 to 150 000) that Australian mohair had unacceptable levels of kemp and gave low fleece weights, relative to that available from the main producing countries of South Africa and USA, led to a demand to import genetic material.

In 1984 local breeders purchased several Texan goats, rather than South African, believing that the disease risk would be lower. Australia's strict protocol (National Government) to ensure that such importations were free of scrapie disease meant that the imported goats were bred in quarantine for over seven years. This resulted in over 1 000 animals being available to the industry in 1992 and available to research prior to that event (Table 4).

A performance recording Programme for Texan goats in quarantine (Lollback, 1995) demonstrated that Texan goats had:

- greasy fleece weights almost double that of selected Australian Angoras and clean fleece weights at least 50 percent higher;
- very low (< 1 percent) incidence of kemp;
- considerable variation in performance between the imported animals.

Table 4. Description of the breeding aims for Stage 2 of the Angora/mohair industry.

Section	Breeding aim	Breeding objective	Selection criteria	Breeding plan
Commercial	Profit through diversification	Fleece weight Fibre diameter Kemp	Visual/greasy weight Visual Visual	Purchase superior bucks, heavy culling of progeny
Breeders	Profit through breeding sires	Fleece weight Fibre diameter Kemp, gare Style	Greasy wt./clean on selected Visual/some laboratory Visual/some laboratory Visual	Use selected imports on large proportion of does. Use MOPLAN

Such was the acceptance and demand for imported genetics that it was estimated that 50 percent of the local Angora does were bred to Texan bucks in 1992, the first year of their release.

Two years after the Texan purchase, Angora embryos from South Africa were imported into New Zealand quarantine. In 1999 a further importation of South African Angoras was made available to local breeders.

Nongenetic gains

After 25 years of Angora breeding there were demonstrable improvements in the goat fibre industry. These included an improved level of technical knowledge by farmers, improved metrological services, an increased variety of marketing options, the breeding and rearing of Angora goats in more suitable environments and increased acceptance of goat production by the other livestock sectors.

Relative to sheep and wool production, the level of input by commercial mohair producers was medium whereas the Angora breeding sector maintained a high level of input. Breeders were technically well informed and possessed skills and services derived from the traditional sheep industry.

All breeders were members of an industry association and received regular information by newsletter and by attending shows and conferences. Government livestock advisers and researchers were active and made an important contribution to knowledge and confidence.

Not surprisingly, when the mohair market signalled low prices for the Australian product, it was the breeders who initiated and invested in the importation of genetic material and set the breeding objectives for Stage 2.

Genetic gains

Stapleton (1985) outlined the requirements and need for a performance recording service and central register for Australian Angora goats. However, this was largely ignored in the industry until the importation of Texan goats. MOPLAN, the performance recording and genetic evaluation service, was developed to collect production data on the imported goats and their progeny, whilst they were in quarantine. It involved a standard system of data collection and the genetic evaluation of economically important traits. It was a collaboration between owners, the Departments of Agriculture, the Animal Business Research Institute, Armidale (data register and genetic evaluation) with funding from the Government and the mohair industry. MOPLAN uses BLUP technology to enable it to use information from relatives in calculating Estimated Breeding Values and index values for performance based on the first two shearings (Table 5). However, the index values may be limited in that an animals' lifetime performance is difficult to predict and the base population is not homogenous (Stapleton 1997).

Table 5. Example of index values and returns for Texan cross goats (Stapleton 1995,96).

% Texan	MOPLAN index	Fleece weight (mean 5 fleeces)	Fleece relative value
0 Aust	97.9	1.63	100
37	96.8	1.99	119
50	99.3	2.32	135
75	105.0	2.44	155
87	106.3	2.62	165
100 Texan	108.5	2.84	174

Lessons

With practical breeding objectives and quality genetic material it is possible to breed a robust animal producing quality fibre. However, difficulties remain:

- Poor domestic markets (tradition) for meat and skins results in low values;
- Predation (usually fox *Vulpes vulpes* and bird) affects kid survival figures;
- Mohair values fluctuate regardless of fibre quality but in periods of low world demand, kempy mohair is overlooked;
- MOPLAN has not been widely adopted because there is no clear incentive at this time to change from subjective assessment and limited objective measurement. Breeders are experiencing a low demand for high merit bucks and incur additional costs associated with fibre metrology and central register services;
- In Australia, goats are still socially not acceptable to the average sheep and cattle farmer. An estimate of the current number of Angora goats is 60 000. Nevertheless, there is an anticipated medium term demand for non-fibre meat goats for the maintenance of range and pasture (weed control).

The future

Producers agree that the Texan and South African genetic material has contributed significantly to the Australian Angora/mohair industry. Qualitative evaluation of the impact will take some years but the outcome appears to be a more robust Angora producing a quality fibre. The unstable profitability and social non-acceptance of goats (diminishing) continues to hinder the size of the Australian industry.

Summary

1. The principle product of an Angora goat is mohair fibre. It must aim to produce high quality fibre to obtain premium prices and to avoid zero demand for inferior products in many years.

2. Central to fibre quality is the genetic resource and the environment.

3. It is possible to upgrade a large resident goat population by cross-breeding with high merit Angora bucks, though it is slow.

4. Regional breeding success depends on education (animal management, fibre), services (education, metrology, marketing, breeding, performance recording) and prices (reflects world supply).

5. Access to superior Angora bucks, at an acceptable cost, is essential. Role for stud breeder, Government agencies, etc.

6. Production and marketing of quality mohair fibre is not possible under a 'laissez faire' system. Some degree of centralisation is warranted for education, breeding progress and marketing.

7. Breeding plans, such as MOPLAN, need a significant economic incentive before they are adopted yet the outcome (superior animals) is accepted.

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