THE AUSTRALIAN FERAL GOAT - BASIS FOR A NEW INDUSTRY?

INTRODUCTION

B.J. RESTALL*

Goats may have been introduced into Australia by Dutch mariners in the 17th century, either from shipwrecks or as deliberate releases to aid future shipwrecked mariners, The first fleeters brought goats and almost certainly introductions were made illegally from Asia and Africa by the early traders.

Various acclimatisation societies and individuals introduced Angora, dairy and cashmere type goats, some of which ultimately found their way into the wild. Their descendants have thrived and have been described as a healthy, fecund and fit population whose size is variously estimated to be between one half and five million individuals. They present to us a gene pool possibly unique in the world.

Although these animals have been harvested for meat export since the early 1950s, serious studies of the feral population only began in the mid 1970s. These studies have shown that the feral goat has fleece, flesh and skin suitable for development for commercial exploitation.

Recent changes in the world supply pattern of cashmere fibre, has led to an intense commercial effort by a major textile processor from the U.K. to establish a cashmere industry in Australia. Other textile processors are known to be interested in the feral goat down.

These developments indicate that Australia is poised to begin a new animal industry based on the feral goat. It is timely to assess its characteristics and its potential.

CURRENT EXPLOITATION OF THE FERAL GOAT

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Little published information exists on either the biology or environmental impact of feral goats in mainland Australia. The information published (e.g. Holst and Pym 1977; Smith et al. 1973) indicates that feral goats are able to produce usable quantities of meat and/or fibre. Studies on environmental impact are being carried out in at least two environments (Henzell pers. comm.; Mahood (deceased) pers. comm.). Others, for example Harrington (1979), Kajons and Holst (1977), have provided data on environmental effects of domesticated goats of feral origin in some locations.

There is little argument that uncontrolled feral goats can damage an environment, are a risk in the event of an exotic disease outbreak and are a nuisance to pastoral area managers. Control and management of feral goats, is essential for proper environmental management, disease control and utilization of goat products.

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CURRENT USES

Feral goats have been an important resource which has supplied animals for breeding and for slaughter. Most animals that are harvested are moved into other areas rather than maintained in their original environment.

For breeding purposes, sound does have been selected from harvested ferals, subjected to a domestication process and then used as either "foundation" does in Angora grading-up programmes or for control of weeds in definable circumstances. More recently, interest in down production has emerged, for which goats of feral origin are the genetic resource. Flocks of down bearing goats have been established and animals with more or less down producing ability are being selected from within flocks.

A research project (see Paper 2) at the Agricultural Research and Advisory Station, Condobolin, has shown that goats of feral origin can be managed and bred to become efficient meat producers.

Goats have long been recognised as able to control many woody weeds and recent studies have shown that goats will control serrated tussock (*Nassella trichotoma*), (Campbell et *al.* 1979) and blackberries (*Rubus fruticosus*), (Vere and Holst 1979). Observations have been recorded by Holst *et al.* (1978) of many other weed species being consumed and/or controlled by goats. Near Orange, the N.S.W. Forestry Commission is running goats on *Pinus radiata* forest floors to control weed growth (Edwards 1981).

EXPORTS

Of all goat commodities exported from Australia, meat has been the greatest earner. Most of this produce has been derived from goats harvested from feral flocks in semi-arid pastoral areas.

Table 1 shows the numbers slaughtered in export licensed abattoirs in recent years. Western Australia has been the largest source of animals and meat. There is considerable movement of live animals for slaughter between eastern states, so that it is difficult to relate the state of origin of live animals to numbers slaughtered.

TABLE 1 Numbers of goats slaughtered at licensed abattoirs (Source: A.M.L.C.)

State	Year 1978	1979	1980	1981 (to June)
New South Wales	60,743	54,944	27,003	19,103
Victoria	-	3,552	23,786	8,009
Queensland	13,384	58,848	79,699	24,196
South Australia	32,182	62,253	125,181	47,667
West Australia	75,215	109,145	88,359	48,478
Tasmania	-	-	60	-
TOTAL	181,524	288,742	344,088	148,173

The total weight of goat meat exported from Australia and its value, have continued to increase (Table 2). If the value of exports is divided by the weight, an indication of value per tonne F.O.B. is calculated. This figure indicates that the unit value of goat meat exports has also increased.

TABLE 2 Total amount and value of goat meat (chilled and frozen) exports (Source: A.B.S.)

Year	Weight t	Value ($'000)	Value/t F.O.B. ($)
1974/75	1,124	721	641
1975/76	1,670	953	570
1976/77	2,383	1,634	685
1977/78	4,375	3,800	868
1978/79	3,980	3,873	982
1979/80	3,907	4,335	1,217
1980/81	4,066	N.A.	N.A.

Live animals for slaughter are also being exported in increasing numbers.

Unfortunately, harvested goats are not usually selectively culled, that is there is no attempt to retain sound females for breeding while others are sent to slaughter and kids returned to the wild to grow. If does are retained, it is usually in response to particular orders or that they are mustered by their future owners for that reason. Harvesters are more usually involved in catching goats for slaughter. If an animal is big enough, that is over about 10 kg dressed weight, and able to walk onto a truck, it is sent to slaughter. The product of this process must be of variable quality as the animals themselves vary from aged bucks to buck kids, from aged does to doe kids that may be in any physiological state.

The animals can be difficult to skin, old bucks have an offensive odour and condemnations of either part or whole carcases is relatively common. Feral goats have also been implicated in the incidence of Q-fever in employees in some abattoirs.

Grading of carcases from feral goats is usually done on a weight basis. Some markets,' like Singapore, prefer carcases over 18 kg; while others, like Malaysia prefer carcases below 18 kg (Anon. 1980). There is no age, sex or condition classification for the export carcase trade. There is a need to develop these classifications for the local meat trade.

Skins are a potentially valuable by-product, but are also of variable quality. Age, sex and lack of management affect scarring, bruising, external parasite infestation, and fat deposition. Skin quality is also affected by flailing and treatment once removed, No attempt is usually made to grade skins for size, quality or any other reason, These factors combine to ensure that skins from feral goats receive low prices. Trials by Holst (pers. comm.) indicate that skins from domesticated and managed feral goats are of a more consistent and higher quality, and are thus of greater value.

LEGISLATION

Attitudes and thus laws towards feral goats differ between states, although in all states there is concern about the effects of uncontrolled feral animals. In Western Australia, "wild" goats are declared noxious; in South Australia uncontrolled feral goats might be declared noxious (Henzell pers. comm.); while in New South Wales goats have recently been included within the Pastures Protection Act with managers being encouraged to control and manage feral flocks. Attitudes in Queensland and Victoria are unknown.

The West Australian Department of Agriculture have begun a down bearing goat breeding project using harvested feral goats. This project may lead to alterations to existing legislation that would allow producers to maintain husbanded flocks of goats in pastoral areas. Similarly, the legislation that is likely in South Australia may allow husbanded flocks of goats to be run in pastoral areas.

At this time, while official attitude does not agree with allowing feral animals to roam free, most agencies are becoming aware that the present uncontrolled feral goats may be a valuable source of new products and that they may also have some value in management of our pastoral areas (Mitchell 1977).

FUTURE

There is a need to assess the relative worth of our feral goat flocks. We have seen them used as foundation animals in Angora grading-up, and we know that they can produce meat and fibre in their own right. Their role in environmental management has not been studied exhaustively, but they have been shown to be of worth in the management of some weeds. An assessment of the phenotypic characters of feral goats is essential to assess their genetic worth for at least meat and down production. The need is urgent, as there is little doubt that the current rate of harvest is above the level of recruitment (Henzell pers. comm.).

SUITABILITY FOR GOAT MEAT AND SKIN PRODUCTION

P.J. HOLST*, R.A. PYM** and P.J. NICHOLLS***

GOAT MEAT AND MARKETS

The meat from goats is a preferred meat in many countries, especially in Africa and Asia where it is not only a traditional meat, but also has a particular value in that there are no known religious taboos against it (Holst and Whitelaw 1980).

Goat meat exports from Australia were initiated in 1952 and for the past three years have been approximately 3500 tonnes/year (A.M.L.C.). As a generalization, goat meat is exported to reliable traditional markets such as Malaysia, West Indies etc., to manufacturing meat markets such as the United States, and to erratic markets such as the middle east. That most of this meat was derived from feral goats might suggest that the feral goat is suitable for the export market. While this may be true, the successful export of the meat is dependent on the entrepreneural skills of the exporter, on competitive pricing (relative to mutton) and differences in the requirements of sections of the market that facilitates the utilization of a variable product (i.e. mixed sex, weight and fat cover).

The potential for a domestic market for carcase goat meat has not been identified. Without a reliable supply of quality carcases, it is a difficult exercise but the table, restaurant and providoring outlets would suggest that it is significant. The current (since 1981) supply of carcase meat to the Sydney and Canberra markets meets a steady demand for the limited number of carcases available. Carcases of 10-12 kg with some fat cover are in particular demand.

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EFFICIENT MEAT PRODUCTION

Factors that have to be considered in meat production are reproductive efficiency, growth rates and the potential for genetic improvement, Reports on fertility (Holst and Pym 1977; Holst 1981; Harrington 1982) and growth rates (Holst and Pym 1977; Hancock, Phillips and Sabine 1979) for the feral and domesticated goat suggest that the feral goat has an outstanding potential to produce meat efficiently.

Potential for genetic improvement

There are two main genetic avenues for improving meat production in the feral goat. The first method is to select within existing stock for improved growth rate to slaughter age and the second is to upgrade by crossbreeding with a breed showing superior performance.

There is a dearth of information on genetic parameters associated with growth in the goat and to provide this much needed information on the Australian feral goat a selection experiment was initiated by the N.S.W. Department of Agriculture at Condobolin in 1974. Selection was for increased liveweight at 5 months of age adjusted for birth and rearing types and age of dam. The realised heritability of 5 month liveweight calculated in the 1976 drop kids was 0.35 ± 0.15. This agrees with the few published heritability estimates of liveweight at about this age in goats and with the majority of estimates in sheep. Thus selection for improved liveweight at slaughter should yield reasonable response. The main problem limiting gains in this area is the necessity for accurate correction factors for age, birth and rearing types and dam age (Pym, Holst and Nicholls 1982).

As an indication of the performance of the goats in the feral breeding programme, average liveweights of 1977 drop twin progeny from non-maiden does are shown in the table below. Selection commenced in 1975 and was only exercised in the males. Weaning and 5 month weight were corrected for age. Weaning was at about 13 weeks.

TABLE 3 Average liveweights of 1977 drop twin progeny from non-maiden does in the selected and control lines

Liveweight (kg)	Males		Females	
	Selected	Control	Selected	Control
Birth	3.3	3.1	3.0	2.9
Weaning	20.2	18.7	16.6	16.4
5 months	26.5	24.3	21.3	20.6

Perhaps the simplest and quickest means of making genetic improvement in livestock is to cross with a superior breed. One major problem in Australia is that breeds possibly superior to the feral goat in growth and meat characteristics are few and those that are present have a very narrow genetic base and are highly inbred. An evaluation of the Anglo Nubian breed as a means of upgrading the growth and carcase characteristics of feral goats was commenced at Condobolin in 1975. Preliminary results indicated that the Anglo Nubian x feral first cross animals were some 3 kg heavier at 5 months of age than their feral parents and the F1 x Anglo Nubian parent backcross were about 4 kg heavier than the ferals. The main problem in this evaluation was the impossibility of obtaining objective data on the performance of the Anglo Nubian parent breed and the small number of males of that breed that could be used in the study.

Notwithstanding these limitations, the results to date indicate that there may be considerable potential in the industry for the male progeny produced by backcrossing the F1 crossbred doe to Anglo Nubian bucks. It should be possible to generate reasonably large numbers of these 3/4 Anglo Nubian bucks and the performance of the commercial progeny produced from mating these animals to feral does would in all probability be fairly similar to that of first cross animals. One possible implication of such a move may be to have an undesirable influence upon the fleece characteristics of the feral goat.

Work is in progress to obtain more comprehensive genetic parameter estimates from the feral selection experiment and to more precisely evaluate the potential of the Anglo Nubian in upgrading programmes.

LEATHER

Australia exports 300 tonnes of goat skins annually and this represents essentially all the feral goats slaughtered in the country. Demand for these skins has not been great and in the absence of a domestic goat skin industry, returns to the producer have been minimal. Most of the skins would not have been graded prior to sale/export.

Factors affecting the quality of a skin include the following:

pre slaughter – damage from ectoparasites, fences, transport
slaughter – careless flaying
preservation – no trimming, often air dried
grading – not graded nor sorted into single lines based on sex, age, hair, etc.

It is not unusual for all of the above factors to be operating and thus even a potential1y good quality skin will be damaged. Yet, all of the above factors can be solved by adopting known management techniques and because the skins are usually structurely sound, with care, they could have been valuable. Top quality, finely grained leather is used for shoe uppers, gloves, etc. Other poorly grained but sound leather is in demand for luggage, shoe linings, book covers, etc.

Holst (1982) concluded that the skins were basically sound and that considerable scope existed for improving leather quality by altering management and processing procedures. He noted the acceptable grain fineness of some skins was related to density of primary follicles (Np) and skin surface area. He proposed selection criteria and methods for the genetic improvement/maintenance of the skin quality for leather purposes of these goats. Factors included density of primary follicles, guard hair length, diameter and follicle depth,

Rendel and May (1978) showed that it was possible to achieve these objectives in sheep. In view of similarity in other traits between sheep and goats (Turner 1982) it is reasonable to expect that these selection objectives could be achieved in goats as well. The meat/skin goat could then be a well grown, fertile goat with dense fine, short guard hair with shallow follicles.

GENETIC IMPROVEMENT FOR DOWN PRODUCTION

B.J. RESTALL

Since the first recognition that at least some of the Australian feral goats grew a fine down similar to cashmere (Smith, Clarke and Turner 1973), a small number of breeders have been attempting to improve down production from selected feral animals.

In 1981, a large cashmere processor issued a buying schedule that gave a premium for white down of 15/16 μ diameter, with coarser and colored fibres being discounted. The 1982 price schedules have increased these differentials giving breeders clear production goals.

Further impetus to this infant industry has come from commercial promotions that indicate that 1000 tonne of down is required by one UK processor alone (Dawson International 1981). These developments have led to a demand for information on breeding for increased down production.

Breeding for improved production implies that there are clearly defined breeding goals, and breeding plans based on a knowledge of the production parameters of the goat. Unfortunately, we lack any systematic study of the genetics of down production in our goats, and indeed have only fragmentary data on the fleece characteristics and their variation in the feral population, Nevertheless, provisional breeding plans are required now, and these must be necessarily based on extrapolation from other sources until we have completed our own systematic studies.

Down production in our goats will be a function of the down bearing surface area, the density of down fibres per unit area, the diameter of the fibre (related to cross-sectional area), the length of the fibre and its specific gravity. The successful manipulation of these components to improve down quantity and maintain quality requires a knowledge of the relative importance of the components, their variability, heritability, and the genetic and phenotypic correlations between them.

The situation with the goat is complicated because it has two coats. The biological and genetical relationships between the two are unknown, but may be of practical importance if, for example, the hair coat protects the downy undercoat from damage.

GENETIC STUDIES WITH DOWN BEARING GOATS

For some 50 years selection and crossbreeding studies with goats have been carried out in the USSR. Reports of this work appearing in Animal Breeding Abstracts have been reviewed (Restall, in preparation) and indicate that the components of down production are highly heritable. Increases in down weight due to selection have been substantial but generally are at the expense of fibre diameter. The use of the Angora to improve yields of white down have also resulted in an increase in fibre diameter. While genetic correlations are not reported it seems as if density and diameter may be negatively correlated as in the sheep. The current Soviet breeding policy appears to be selection for fine white down within the various indigenous strains.

FLEECE CHARACTERISTICS OF THE AUSTRALIAN FERAL GOAT

Smith e-6 *al.* (1973) suggested that 10 to 15 per cent of feral goats grew down with a mean diameter of 15.5 μ and a mean length of 3.5 cm, i.e. within the

limits for cashmere processing. Measurements on a number of groups of goats have extended these observations (Table 4).

TABLE 4 Fleece characteristics of male feral goats originating in western N.S.W. Mean values and standard deviations (SD)

Parameter	Flock A	Flock B	Flock C	
			White	Coloured
n	9	22	59	24
Total fleece weight g	327.1 (94.8)	314.3 (132.8)	160.9 (52.3)	179.2 (56.7)
Down weight g	101.3 (66.0)	113.2 (52.9)	50.2 (32.1)	71.3 (30.7)
Yield %	29.2 (3.3)	37.4 (13.4)	30.3 (14.1)	39.4 (9.6)
Diam. down	16.5 (0.3)	16.1 (1.57)	16.9 (1.58)	16.8 (1.32)
Length down	4.1 (0.35)	3.75 (0.57)	-	-

The data show variability in total fleece weight, down weight and down diameter such that there is considerable scope for selection.

Only limited data is available for female goats; in a group of 125 unselected feral does from western N.S.W., 90 (72%) were assessed as having commercially recoverable down. Samples of their fleeces showed a mean yield of 22.3 per cent (sd 7.7), a mean diameter of 15.8 μ (sd 1.18) and a mean length of 3.38 cm (sd 0.84).

The implications of these data for breeding plans are that it may be of value to spend considerable effort to locate males with superior down weights within the desired diameter range in order to obtain large selection differentials.

Phenotypic correlations for some parameters in flocks B and C are given in Table 5.

TABLE 5 Phenotypic correlations for some fleece parameters in male goats from two flocks

	Down wgt X						Total flce wgt X		
	Total flce	Diam. down	Yield %	Body wgt	Lngth down	Lngth hair	Body wgt	Lngth hair	Yield %
Flock B	0.51	0.62	0.65	0.49	0.52	0.13 ns	0.81	0.87	-0.25
Flock C									
White	0.65	0.31	0.84	0.04 ns	-	-	-	-	-
Colrd	0.77	0.47	0.71	-	-	-	-	-	-

The positive correlations between down weight, diameter and yield suggest that selection for down weight within a flock will result in an increase in the mean diameter of the selected animals. These correlations also suggest that the hair and down components of the fleece may be considered independently for the purpose of selection, and that selections will have to be based on the more expensive measures of down weight and diameter.

Data are lacking for density of down fibres, the other important fleece component. Holst (pers. comm.) has recorded a primary plus secondary density of 22.9 per sq mm; data from the USSR gives a density range of 21 to 30 follicles per sq mm. There is an urgent need for data on the genetic correlations between the fleece components, particularly that between density and down diameter.

Provisional breeding plans for the improvement of down production should aim at producing white down with a mean diameter of 15.5 μ. As heritabilities are likely to be moderate to high, selection based on independent culling levels for down weight and diameter should result in improvement of weight of down of the desired quality. It would be advisable to avoid the temptation to rapidly increase weights by allowing diameter to broaden, as it may be difficult to recover the fibre fineness without loss in weight in the future. A far better strategy is to hold diameter at the desired level and allow weight to increase through changes in density, length and body weight.

To improve the probability of obtaining superior individuals, herd sizes should be as large as possible, and employ an open nucleus breeding system. Co-operative breeding schemes between breeders with agreed production goals could achieve such herd sizes.

THE NUTRITION OF THE FERAL GOAT

B.W. NORTON*

The establishment of a goat industry producing meat and fibre in Australia will require basic information on the nutrient requirements of goats and on management practices necessary to optimise the selected form of production. Reliable information on the energy requirements of goats for maintenance and growth comes from the studies of Devendra (1967a and b) with indigenous Malaysian goats (mature weight 25 kg), and the N-balance studies of Majumdar (1960a and b) with Jamnapari goats (31–44 kg) provide the only information on maintenance protein requirements. Little is known about the specific requirements for fibre growth or the mineral nutrition of the goat.

Although any future goat industry in Australia will be based on grazing systems, a critical assessment of nutrient requirements must involve studies with pen-fed goats where feed intake and quality are varied and related to production characteristics. The broad genetic base of the Australian feral goat population may provide ample scope for selection, but this variability may also cause difficulty in the precise description of the nutritional requirements of these animals.

Table 6 shows mean values, range and coefficient of variation for some measurements of feed intake and utilization of a randomly selected population of feral goats offered a concentrate diet (17.9% crude protein, 38.6% NDF).

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TABLE 6 Mean values, range and coefficients of variation for live-weight, feed intake, digestibility, live weight gain and fleece growth of male feral goats (n = 25) offered a concentrate diet

	Mean	Range	Coefficient of variation (%)
Organic matter intake			
g/kg 0.75/d	71	41-109	28.5
as % live weight	3.3	2.1-4.8	30.2
Digestibility (%)			
Organic matter	65	60-79	5.7
Nitrogen	72	65-80	4.7
Live weight (kg)	21.3	13.8-27.8	14.6
Live weight gain (g/d)	79	19-139	37.8
Fleece growth (mg/cm^2/d)	0.23	0.11-0.40	30.4

These results demonstrate the likely variability associated with nutritional trials with feral goats, and in addition to this, approximately 20% of the goats used were excluded from these figures because of a persistent non parasitic diarrhoea. In this study, digestible organic matter (DOM) intake was significantly ($P < 0.05$) correlated with live weight gain ($r = 0.84$), and described by the following equation

$$D = 0.321\ (\pm\ 0.043)G - 8.3 \quad RSD = \pm\ 2.7$$

where D = DOM intake (g/kg 0.75/d)
G = Live weight gain (g/kg 0.75/d).

This equation indicates that the maintenance requirement of these goats (25.9 g DOM/kg 0.75/d) was similar to that reported by Devendra (1967a) for Malaysian goats (25.2 g DOM/kg 0.75/d) and not greatly different from sheep of similar weight (A.R.C. 1965). The requirement for liveweight gain (3.1 g DOM/g gain) was also similar to that for growing lambs (Walker and Norton 1971a) suggesting that some similarities do exist between sheep and goats in dietary requirements. However, these preliminary observations need further confirmation because goats differ from sheep by having lower fleece growth rates at equivalent N intakes (Reis and Schinckel 1964; Walker and Norton 1971b), leaner carcases, seasonal patterns of fleece growth and probably higher requirements during pregnancy for the growth of multiple foetuses. The following areas of nutrition research require high priority if producer interests in the goat industry are to be met with factual information.

Pregnancy and lactation

The goat is a prolific breeder under feral conditions and reproductive activity may be related to prevailing nutritional conditions. Singh (1968) has demonstrated very poor reproductive performance in does restricted in energy intake, and does carrying multiple foetuses have high nutritive requirements in late pregnancy (Kalaissakis 1959). The effects of nutrition in this period on lactation performance also need careful study. The selection of goats for high growth rate from birth to weaning is essentially a selection of goats from dams with high milk yields. The relationship between pre- and post-natal nutrition of the doe on milk yield, composition and persistence will have a major effect on kid growth to weaning and hence on all aspects of productivity from goats in a commercial enterprise,

Post weaning growth

Yearly management systems for goats are yet to be determined, and specific information is required on optimum weaning times, and on the management of the post weaning kids. It is at this time that greatest nutritional stress applies to the growing kids, and from our experience growth rates during this period under a range of pasture conditions have been disappointingly low. Table 7 shows some mean values, range and coefficient of variation for the liveweight gain of feral kids we have recorded from goats grazing tropical pastures in the post weaning period.

TABLE 7 Mean values, range and coefficient of variation (CV) for mean live weight (kg), live weight gain (g/d) of female feral goats in post-weaning period grazing different pastures

Pasture	Season	Grazing period (d)	Mean Live weight (kg)	Live weight gain (g/d) Mean	Range	CV (%)
Pangola grass	Summer	74	13.7 (61)*	74	43-116	20.6
	Autumn	85	17.0 (63)	17	0- 38	51.6
	Winter	101	17.0 (82)	-15	-48- 28	86.8
Oats	Winter	52	19.9 (84)	139	15-223	27.1

* Figures in parentheses are number of goats

When compared with pre-weaning growth rates, there has been a significant decrease despite treatment for intestinal parasites and supplementation with cobalt. However, growth rates markedly improved when goats grazed oats indicating firstly that compensatory weight gain occurs in these animals and secondly that a nutritional, rather than genetic factor was probably responsible for poor growth prior to this period. There is a need to raise kids to 25 kg by at least 18 months of age for both the maintenance of breeding flock numbers and for the turn off of animals suitable for slaughter. There is an urgent need to define the protein, energy and mineral requirements of goats in the post weaning period so that management practices may be developed to optimise the growth and productivity of goats during this time of maximum stress,

Fibre production and nutrition

There is presently no information on the relationship between fibre (cashmere) production and nutrition that can be reliably applied to the Australian feral goat. However, a number of areas of research can be readily identified from the extensive literature on wool growth in sheep. The initiation and development of secondary and primary follicles *in utero* needs intensive study, with particular attention to the relationship between maternal nutrition throughout follicle development and the effect that multiple foetuses has on this process. These studies must be extended into the post-natal period to determine the effects of nutrition on fibre production and on the development and ultimate maturity of secondary follicles during this time, The relationship between nutrition, live weight growth and fleece production also needs clarification. Does the selection of goats for high live weight gain during post-natal growth select against goats with high potential for fleece production? Alternatively, what penalty is paid in terms of fibre diameter (quality) when goats are liberally fed to maximise fleece growth? Cashmere production is seasonal, commencing in January in our flock and being shed in August. The physiological factors affecting the

initiation of growth and the stimulus to shedding, the effects of pregnancy and seasonal feed availability on cashmere growth must be determined before management strategies can be developed to optimise fleece production.

IS THERE AN ECONOMIC FUTURE FOR FERAL GOAT EXPLOITATION?

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I have chosen to use the term bush goat to refer to a domesticated feral goat, and the term feral goat to goats in an unmanaged state.

At present, bush and feral goats are utilised in four main ways:

(1) For the production of meat and skins.
(2) For use in Angora upgrading programmes.
(3) Using selected bush or feral goats for a cashmere enterprise.
(4) For use as a method of weed control.

The long term use of bush goats in upgrading programmes (both Angora and cashmere) is unlikely. In an example Angora goat grading up programme (Mitchell 1978) no further bush goats were brought into the programme after year one. It is doubtful that there will be further demand for bush goats in Angora upgrading as new enteries into the industry are most likely to buy 1st or 2nd cross Angora does that have been culled from other flocks.

There will be a short term demand for bush goats showing cashmere characteristics if a cashmere industry develops. The prospects for a developing cashmere industry are beyond the scope of this paper but Buffier and Gellatly (1981) and a recent publicity document by Dawson International indicated that returns should be comparable to sheep enterprises. However, demand for bush goats will only be short term and dependent on the ultimate size of the cashmere industry. In addition, demand for feral stock will be restricted to those showing cashmere characteristics and this could vary from 15 per cent of the herd to 60 per cent of the herd (Mitchell 1981 pers. comm.).

WEED CONTROL

Goats are most likely to be considered for weed control in areas where cultivation and cropping are not established practices. Two distinct areas where there appears potential for weed control by goats are:

(1) In pastoral areas where control of shrubs is desired. Harrington (1979) concluded that goats had very little potential for controlling scrub species in western New South Wales and south-west Queensland but there may be potential in other areas that have different shrub species.

(2) Tablelands and coastal areas. Goats have been shown to help control blackberry (*Rubus fruticosus*), briar (*Rosa rubiginosa*), poa tussock (*Poa labillardieri*), and serrated tussock (*Nasella trichotoma*) (Holst 1980).

Goats can be productive when used in control of some weed species. Vere and Holst (1980) demonstrated that with an 86 per cent kid weaning rate per annum, the costs of control of blackberries equalled the returns from goats. This compares with a control cost of conventional spraying methods of $88.37 per

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hectare. The result is heavily dependent on surplus goatprices ($9.00) and could be further improvedi f higher sale prices were achieved.

The final costs of control with goats compared with conventional practices are dependent on:

- the additional costs of the fencing and yards capable of handling goats
- the reproductive rate
- the price received for surplus stock
- the cost of conventional control methods
- the growth rate of the goats. In many situations, stocking rates required may be sufficiently heavy to reduce reproduction and growth rates.

There is room for an integrated control plan that includes goats as part of the initial campaign to reduce a number of weed species. Once weed populations are reduced to manageable levels, another decision of whether to eradicate by other methods or maintain a reduced number of goats run in conjunction with sheep or cattle so that the weeds are kept under control need to be considered.

The attractiveness of goats as a method of weed control would be enhanced if fibre production could be obtained as well.

GOATS FOR MEAT PRODUCTION

To arrive at a gross margin for meat production the following assumptions have been made:

- breeding does rated at 1.5 d.s.e.
- does mated annually, first mated at 8 months, retained for 4 years; 2% bucks, retained for 2 years; 100% kids weaned.
- net selling: wether kids $12, cull doe weaners $11, cull for age does $8.

In a 500 head breeding herd producing 500 kids, 133 doe weaners and 5 male weaners would be retained for replacements, leaving 105 does and 245 wethers to be sold at 8 and 5 months of age respectively.

The gross returns from this enterprise are:

105 doe weaners at $11	$1,155
116 cull for age does at $8	928
245 wethers at $12	2,940
	$5,023

or $10.05 per breeding doe.

The variable costs include drenching adults twice per year at 10 cents, and kids once at 7 cents; vaccinating adults and kids twice at 10 cents, and dipping adults at 5 cents. Total variable costs are $0.89 per doe.

These estimates give a gross margin per doe of $9.16 or $6.11 per d.s.e.

In comparison with sheep, the following gross margin figures have been calculated (Davies 1981):

Sheep enterprise	Return per d.s.e.
	$
Wethers	9.79
Merino ewes	11.34
Merino ewe x Border Leicester ram	11.32
Crossbred ewe and Dorset ram	11.22

At present relative prices the returns from meat goats is low in comparison to alternative sheep enterprises. Goats could become competitive in the following situations:

(1) A change in the relative prices for goat and sheep products, This will depend largely on the export market for goat products. The domestic market can be developed further but it is doubted if goat meat prices would ever significantly exceed lamb prices. A significant margin would be necessary to cover the extra killing charges that apply to goat products as compared with lamb. Excluding purchase price of the live animal, a cost of 63 cents/kg was quoted for goat meat delivered to the wharf compared with 27 cents/kg for 15 kg prime lamb carcases (Holst pers. comm.). This margin may be reduced if an improvement in goat skin prices can be achieved.
(2) Goat meat production in conjunction with fibre production.
(3) Goat meat production as a by-product of using goats for weed control.
(4) Areas may exist where goats can better utilize the existing herbage and can therefore be stocked at a higher d.s.e. rating than other animals.
(5) Areas may exist where goat nutritional requirements can more closely fit seasonal production patterns.
(6) Areas may exist where there is a degree of complementarity between goats and cattle or sheep. Stocking of a certain number of goats on an area may not reduce the sheep or cattle numbers running on the area. Thus returns may be improved from that area.

The long term future for bush goats selected solely as a meat producing animal appears limited. However, in the short term bush and feral goats will be required as a basic genetic pool for establishing a cashmere industry.

Providing there is no inverse relationship between cashmere production and meat production, selection of feral animals should be made for both characteristics. The budgets presented show that fibre production in conjunction with meat production is a necessary prerequisite for financial competitiveness with sheep. Likewise, Buffier and Gellatly (1981) stress the dependence that cashmere budgets have on the meat prices received for culls.

Bush goats have a use in weed control in selected situations but again the use of a dual purpose animal would be desirable.

In the long term the future of the domesticated feral is largely dependent on the fortunes of the cashmere industry and on its ability to be part of a management strategy to control weeds.

CONCLUSIONS

Even with our limited knowledge of the feral goat we are able to say that it is capable of producing a readily saleable meat on the export market, a meat that is preferred by two thirds of the world's population, a down that weaves into one of the most luxurious and expensive clothing materials in the world, and may produce a high grade leather. With at least one of these products, meat, we know that we can make productive gains by selective breeding and it is highly likely

that the same is true for the down and skin. Fortunes have been made from humbler beginnings.

Our current exploitation of this resource, indiscriminate harvesting for the export meat trade, is clearly wasting these valuable animals. We have no assessment of the true worth of the feral population, and even with those we harvest only a crude product grading is attempted. This noble beast deserves better.

Some idea of the potential for an industry based on the feral goat, can be had if we consider that meat aside, one textile processor alone wants 1000 tonne of Australian goat down. This sort of production would require some 6 to 10 million goats, who would produce in excess of $100m worth of meat and down.

Whether or not we build an industry to attain this potential will be decided in the next 5 to 10 years. We are told that the current rate of harvesting feral goats exceeds the replacement rate, so we may be gradually eliminating the potential. There is little doubt that in the marginal environments where the majority of the feral goats run uncontrolled over extensive areas, they are detrimental to those environments. If we value our land resource we will have to remove those goats in the not too distant future. We would be well advised to survey the feral goat stocks and select those suitable for controlled exploitation before we advertently or inadvertently remove them altogether.

The challenge that the development of a new animal industry presents to us all is exciting and demanding. The opportunity does not present itself often. A crucial initial step is the motivation of potential producers, and it is likely that the valuable role of the goat as a land management tool will be a powerful motivator to graziers. Once it is realised that goats can be productive on otherwise waste plant materials, and effect cost savings in weed control simultaneously, serious consideration of them as a productive animal may gain impetus.

There is somewhere in the vicinity of 15 to 20 thousand feral goats currently run under controlled husbandry and already there is a demand for information on management, breeding and feeding. It is important at this early stage that our research and extension are sound and practically oriented. We should be aware of the economic analyses that indicate that a successful industry will be based on an animal producing both meat and down, and the consequent implications for research. The enormous gaps in our knowledge of the biology of the feral goat cry out for basic studies, and we will have to be selective to ensure that such studies truly compliment the applied work. Some important research priorities with respect to breeding, feeding and managing goats under our wide range of environments have been highlighted by the contributors to this contract.

This opportunity to initiate a new animal industry comes at a time when the technology of animal production of other species has reached a sophisticated level, and much of value can be readily transposed to hasten development. It also comes at a time when the traditional suspicions between producer, researcher and advisory officer are disappearing and it is to be hoped that all sections of the agricultural community can work together to ensure that we make the most of the exciting challenge presented by the Australian Feral Goat.

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