

The Australian Rangeland Goat

Management and Opportunities

A report for



By Christine Ferguson

2010 Nuffield Scholar

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Foreword

"Innovation is a dish best served by the desperate and the different, those with little to lose but a massive need to succeed." Michael Blanche, Nuffield Scholar 2010, UK.

In my family farming carries in the female gene. From a young age I was determined and some may say desperate to get my own place. Desperate enough to sell a comfortable house in Bathurst and move to the dry, isolated and just plain 'tough' northwest corner of NSW, near it's officially most isolated village of Wanaaring. We quite literally sold a house and bought a station.

My husband and I purchased Myrnong Station at the beginning of 2001, over a period of seven years we fenced our 25,000 hectare block with Total Grazing Pressure (TGP) fencing and mustered feral goats (*Capra hircus*) to stock it, in an organic, albeit tough, young farmer finance scheme.

Those first seven years were some of the driest on record, the lowest point of which saw a rolling 12 month rainfall of just 64 mm. The long dry spell was however, a great teacher, while cutting Mulga (*Acacia anuera*) to feed hungry sheep and cattle, we were mustering feral goats that were in good condition and it was these goats that were funding our grazing enterprise.

As we improved the fencing we were able to manipulate and control the grazing, using mobs of between 3,000-12,000 goats in paddocks that ranged in size from 1200-4000 hectares keeping them there while they were browsing on the thick woody plants and moving them out when they started to graze the ground cover. Paddocks were rested then for periods of up to two years. The result was an improvement in the landscape, trending gradually from woody scrub to grassland, all the time with a production output.

At the same time, the relentless goat grazing of many 'goat paddocks' in our area resulted in a degraded landscape and I was constantly hearing of the damage caused by goats, despite observing the very opposite result at Myrnong.

Trying to quantify exactly what causes such dramatically different results has led me on an interesting path over the past few years, studying post-graduate rangeland management even though I didn't finish school, and travelling the world on a Nuffield Farming Scholarship. I believe goats to be the answer, not the problem; our management of their grazing needs to be disciplined and accurate because in the bar-room brawl that is grazing mismanagement, goats are usually the last man standing.

In the course of my travels I developed an appreciation for the uniqueness of the Australian goat industry when I repeatedly had to explain to often disbelieving farmers from around the world that feral goats were there to be harvested when they grazed their way onto your land. There is no husbandry or feeding of any kind, we simply load the animals meeting market weight specifications onto a truck; simple, profitable and effective, we produce some of the best goat meat in the world without even trying.



Figure 1. A young male rangeland goat, Wanaaring, western NSW, 2010.

Acknowledgements

When my marriage ended early in my Nuffield scholarship, my then 19-year-old daughter Matilda encouraged me to keep going, telling me that the Nuffield scholarship was important for our whole family. In between contract mustering, then a full time job and studying International Business by distance education, she kept the station running while I was travelling. She was not only my support, but my sounding board and I grew to admire and respect her ever more throughout the journey. She has become my inspiration.

Thanks also to my son Will whose thoughtful and caring nature shone through the whole ordeal, and we will go on a trip one day when I don't talk about goats and grass.

My neighbours Debbie, Neill and Peter Leigo supported both myself and Matilda, repeatedly driving the 70 km round trip to feed my dogs. I could not have completed this scholarship without their generous and unfailing support.

Thank you to my sponsors Meat and Livestock Australia (MLA) and in particular Blair Brice, Manager of Goat Industry Development, his hard work and dedication will have positive ramifications for the Australian goat industry for years to come. Thanks also to the Western Catchment Management Authority (WCMA) for your financial support.

Nuffield Australia stood by me and granted extra time to complete the project; their support and understanding was greatly appreciated.

The Nuffield Global Focus Program remains one of the best things I have ever done and I am grateful to have shared the experience with such a good bunch of blokes; Hieu Ly, Don Madden, Steve Newman, Bill O'Keefe and Ian Duthie.

Gary Hannigan and Graham Finlayson, fellow Nuffielders from NSW's Western Division- you got me into this- thanks.

To all those who shared the journey with me, thank you: especially John Walker in Texas, Jane Addison in Mongolia, David Stanley in Kenya, and Greg Robertson whose company throughout southern Africa kept me laughing and whose perspective kept me grounded.

Thank you to all who welcomed me into their homes and businesses, being a Nuffield scholar is a great privilege. The 'kitchen conversations' shared with so many of you gave me an insight into another culture that I could not have achieved otherwise.

When describing my industry to others I was struck by its uniqueness. My history of buying a block of ground, fencing it, then mustering feral animals to stock it was a concept many people had difficulty comprehending. Though it may be quite unorthodox, I would like to acknowledge the working dogs who slaved through the heat and dust with me, helped me realise a dream, and taught me about loyalty, determination and persistence along the way. I literally couldn't have done it without them.

Always bear in mind that your own resolution to succeed is more important than any other one thing.

Abraham Lincoln.

Abbreviations

MLA	Meat and Livestock Australia
WCMA	Western Catchment Management Authority
TGP	Total Grazing Pressure
NIRS	Near Infrared Reflectance Spectroscopy
ILRI	International Livestock Research Institute
OTH	Over the hooks (carcass price)
GADI	Grootfontein Agricultural Development Institute

Terminology

There is some discrepancy in the use of the term ‘Feral’ to describe Australia’s goat meat for marketing purposes. In general the term ‘Rangeland Goat’ refers to goats derived from the rangelands, these are mostly feral goats but some have spent all or part of their life with their movement constricted by Total Grazing Pressure (TGP) fencing, although still managed extensively and with little to no husbandry.

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Executive Summary

Australia is the world's leading exporter of goat meat, and although rarely found on Australian dinner tables, globally goat is the most widely consumed meat (MLA, 2011a).

The Australian rangelands have through natural selection produced a goat that meets the carcass requirements of the majority of goat meat consumers across the globe, has three pregnancies every two years of 1.59 embryos per pregnancy (Parkes et al. 1996), and requires minimal to nil husbandry.

Although predominately a feral and thus free roaming animal, an increase in management through an increase in total grazing pressure (TGP) fencing has meant that the grazing pressure exerted by goats is under more intense management in the semi arid rangelands than ever before.

Management of goat grazing in the Australian rangelands is hampered by extensive scale, market fluctuations and little to no market available for goats that are under market weight specifications.

The goat industry's importance to Australia is two-fold; not only is it a growing export earner, but if goats were to have no value feral goats would further increase in numbers and cause significant natural resource damage. The harvesting of feral goats from the rangelands provides a stabilising income amid the fluctuations of an environment dominated by rainfall variability

The aim of this Nuffield study was to find simple and achievable solutions to the problems associated with changing an extensive, feral situation into intensive and managed goat grazing.

This report found that;

- Further market development would be likely to lead to better grazing management
- Australian rangeland goat meat is regarded highly in its current markets. The lean carcass and large proportion of entire male goats cater for a demand that would be difficult to meet under a farmed environment
- As the industry supply chains and infrastructure improve, opportunity for a premium branded product will develop
- Strategic, effective rest provided to grazed vegetation was crucial in maintaining and improving rangelands under goat grazing pressure.
- The range manager's knowledge of plant/animal dynamics greatly influenced the effectiveness of their management
- Directed and strategic goat grazing is capable of shaping the landscape into a state that is more conducive to livestock production.

This project was funded by Meat and Livestock Australia (MLA). Western Catchment Management Authority (WCMA) also contributed some funding towards the research.

It is hoped that pastoralists in feral goat prone areas, graziers developing goat management paddocks, land management bodies and the goat industry will benefit from this project.

Introduction

Basic Goat Physiology

The Australian rangeland goat has evolved under the accurate and implacable hand of natural selection to result in an animal able to utilise the fibrous browse endemic to the southern rangelands, travel widely to satisfy nutritional and water requirements and reproduce abundantly.

Derived from a mixture of meat, fibre and milk breeds (Jago 1999), they carry a limited amount of subcutaneous fat making them more suited to hot climates than cold.

Parkes et al., 1996, found reproduction rate to be strongly linked to body condition and cited 1.59 embryos per pregnancy and three pregnancies every two years for feral goats. This enables year round breeding and a population response to seasonal conditions. DEWHA 2008 cite herd increases in good seasons of 50% per year.

Goats are intermediate, opportunistic feeders (Jago 1999, Taylor & Fuhlendorf 2001). They are able to vary their diet according to what is available and have significantly different feeding characteristics to other livestock, as illustrated in many grazing studies including Harrington 1979, Squires 1980, Wilson & Mulham 1980, Norton, Kennedy and Hales 1990, Franco cited by Warman 2001 and Landsberg and Stol 1996. Figure 2 illustrates Franco's findings during a study conducted in the Mulga Lands near Charleville QLD in a season when feed type and availability was not limited. The goat's preference for browsing shrubs explains their population increase in areas where there has been a significant increase in this type of vegetation. (Kimball & Chuk, 2011).

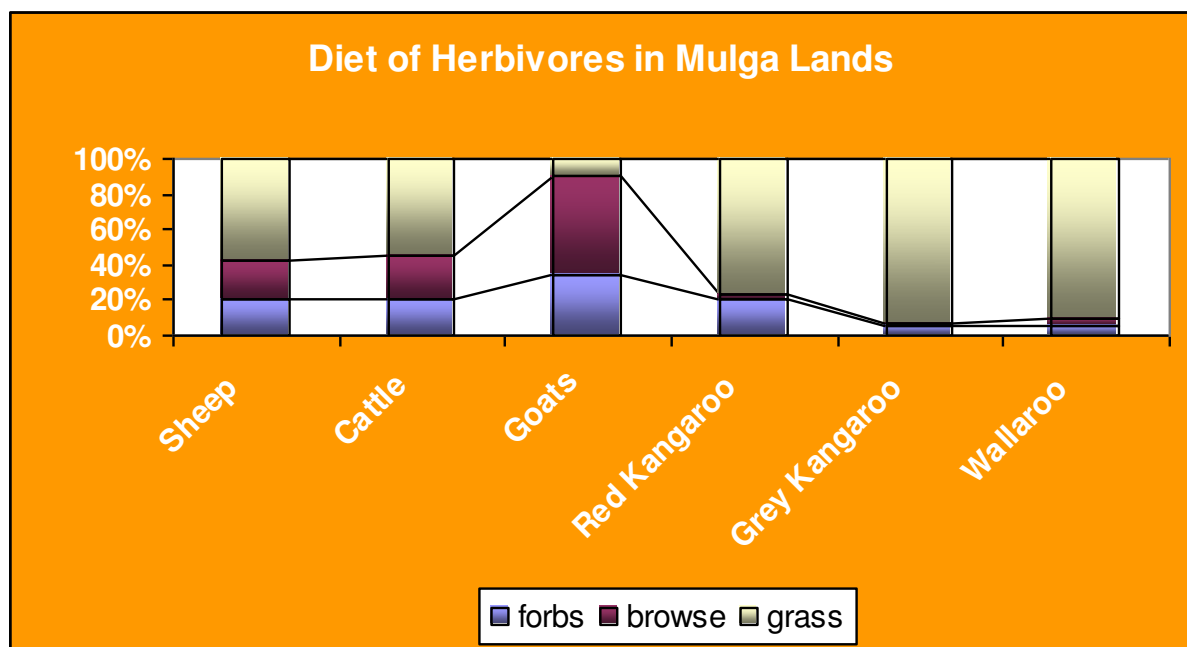


Figure 2. Dietary preference for animals grazing in the Mulga Lands during a good season when feed type was not limiting. Adapted from Ferguson, 2012 p.12.

Rangeland Goat Habitat

Approximately 95% (MLA, 2011a) of Australia's goats are found in the southern rangelands where the majority of goats are feral and an increasing number are kept in a loosely domesticated way.

Recent estimates suggest that western NSW is home to approximately 70% of Australia's goats (Ballard et. al, 2011). There has been a significant increase in the area fenced with TGP management fencing, often under natural resource management grants, specifically for the management of feral goats. At times these fences aim to keep goats out, but often they are used to control goats in a managed way, to hold the underweight portion of harvested animals until they reach market specifications.

The most dominant climatic characteristic of the western NSW rangelands is rainfall variability as seen in Figure 3, dry seasons are more common than wet ones, and the land manager adjusts livestock numbers to match this variability.

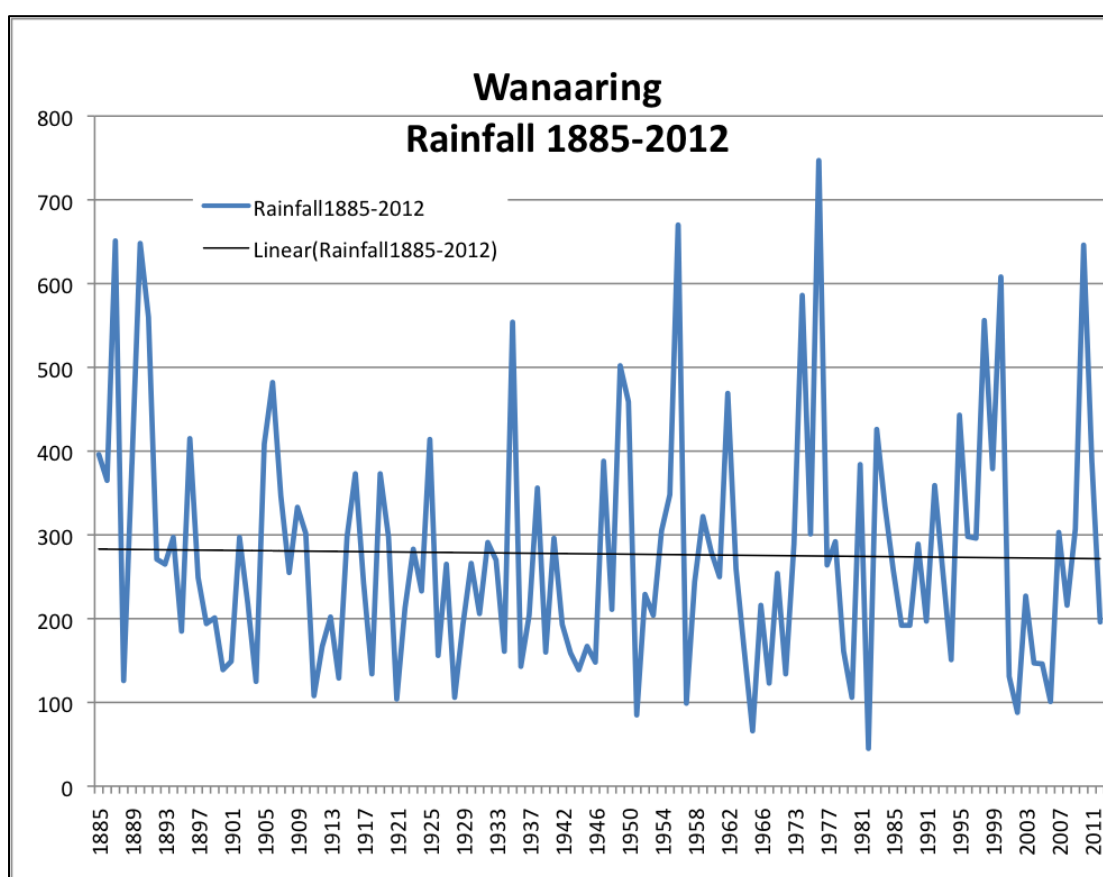


Figure 3. Annual rainfall recorded in Wanaaring district 1885-2012. Source author's own farm records.

Across the arid and semi-arid grasslands and savannahs of the world, the vegetation composition has been changing in the last few decades (Eldridge et al., 2011). There has been a very noticeable increase in woody plants and a reduction in grasses. This has affected the productivity of the landscape and is said to have directly affected the lives of more than 2 billion people (Eldridge et al., 2011). It is thought that a combination of altered grazing regime, the removal of fire from the landscape and an increase in carbon dioxide have driven the change (Taylor & Fuhlendorf, 2001).

Interestingly, it is thought that the increase in the Australian feral goat population occurred following the increase in woody plants (Kimball & Chuk, 2011).

Often the woody plants have mechanisms to prevent grazing such as thorns or chemical compounds that make vegetation less palatable to livestock. Goats have the greatest prehensile ability of all livestock making them more able to derive nutritious leaf matter off thorny plants. They are observed to have less sensitivity to chemicals such as turpenoids, that make plants un-palatable than other livestock (Taylor & Fuhlendorf, 2001).

There is conjecture amongst scientist as to whether this vegetative change has led to increases or decreases in biodiversity and whether a woody weed encroached landscape is necessarily a degraded landscape. However, from a production point of view, an increase in woody plants and a decrease in palatable grasses in almost all cases lead to a reduction in production.

The Australian Rangeland Goat Industry

The population of Australia's feral goats continues to rise despite constant increases in the number harvested for slaughter. In 2010 the population was estimated to be over 3 million (Bastin, 2012), and 1.7 million head were slaughtered (MLA, 2011a).

Last year, 2012, marked sixty years since the Australian feral goat began its life as a commercial product (Standing Committee on Agriculture, 1982). The fledgling industry began to gain strength through the 1990's when the US became a major importer, now accounting for 53% of Australia's goat meat exports (MLA, 2012a). The industry has continued to grow as indicated in Figure 4, the 2010-2011 value of goat meat exports was A\$125 million (MLA, 2011a), and while not a large export earner by Australian agricultural standards, it is a success story in that it has provided a stabilising income in the marginal rangelands so affected by extremely variable rainfall and turned a pest into a significant resource.

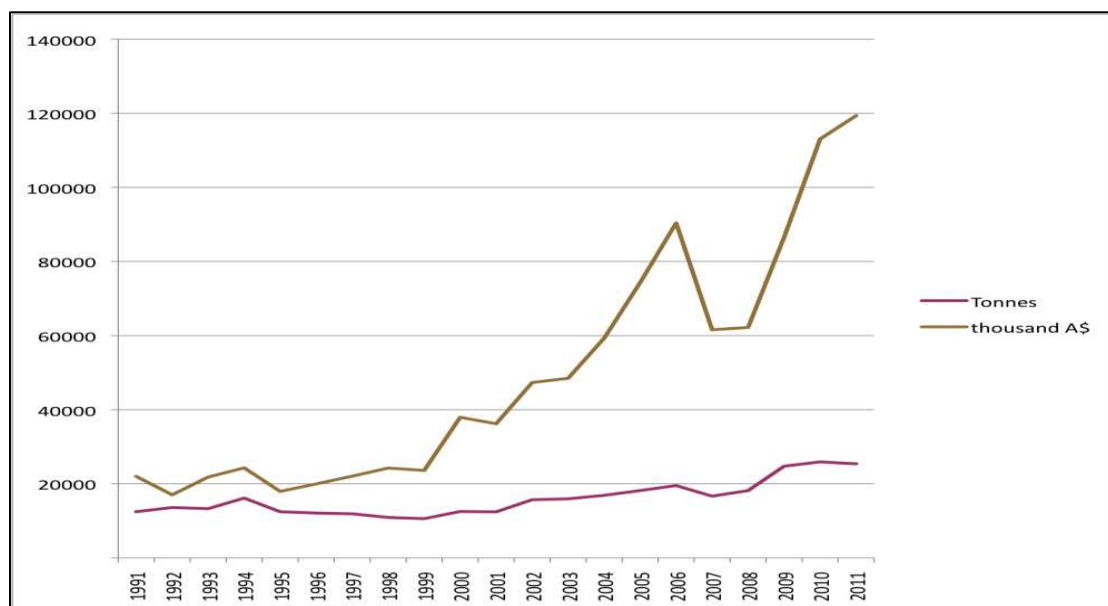


Figure 4. Red (lower) line indicates tonnes of goat meat exported from Australia, green (higher) line indicates total value in thousand A\$ of goat meat exports. Source data provided by Meat and Livestock Australia, January 2013.

Estimates of the feral goat population have ranged widely, but recent studies using aerial survey data indicate a national population of 3.3 million, an increase from an estimated 1.4 million in 1997 (Pople & Froese, 2012). There is, at this stage, no accurate way to differentiate between true feral goats and rangeland goats kept in extensive conditions using TGP fencing, although indications are that numbers of these extensively domesticated goats are increasing (Ballard et al., 2011). The western rangelands of NSW have the highest density of feral goats as shown in Figure 5, and comprised 70% of the 2010 count. In 2011, it was estimated that there were 2.95 million goats in western NSW (Basten, 2012). Given that this area has a significant amount of TGP fencing and a solid industry structure, it can be presumed that a good proportion of the 2.95 million goats estimated for that area are held behind wire rather than being feral.

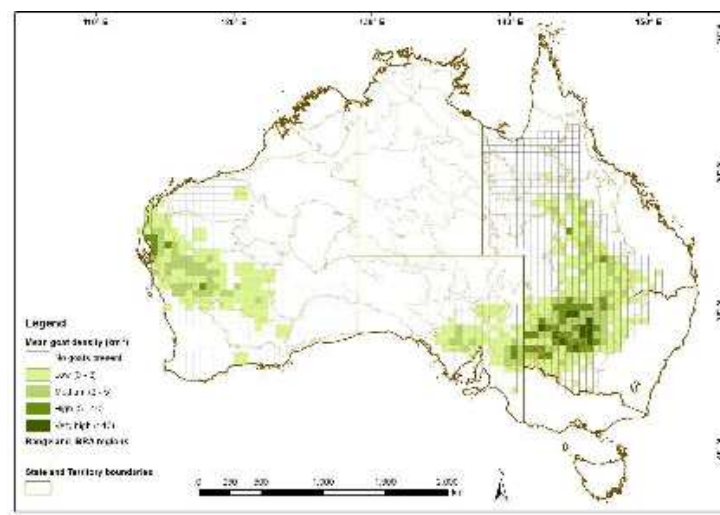


Figure 5. Average densities (km⁻²) of feral goats in Australia 2011 (adapted from Pople & Froese, 2012, p. 29).

Although the world's leading exporter, Australian goat meat accounts for less than 0.4% of global consumption (MLA, 2011a), and ranks 31st on the FAO goat production database (MLA 2012a). The world's largest producers, China and India, are also the world's largest consumers.

The factors affecting the number of goats harvested are price and density. Price is affected by supply, mutton price and currency fluctuations. Density is affected by competition and seasonal conditions. Figure 6 shows how important market price is in influencing the number of goats slaughtered.

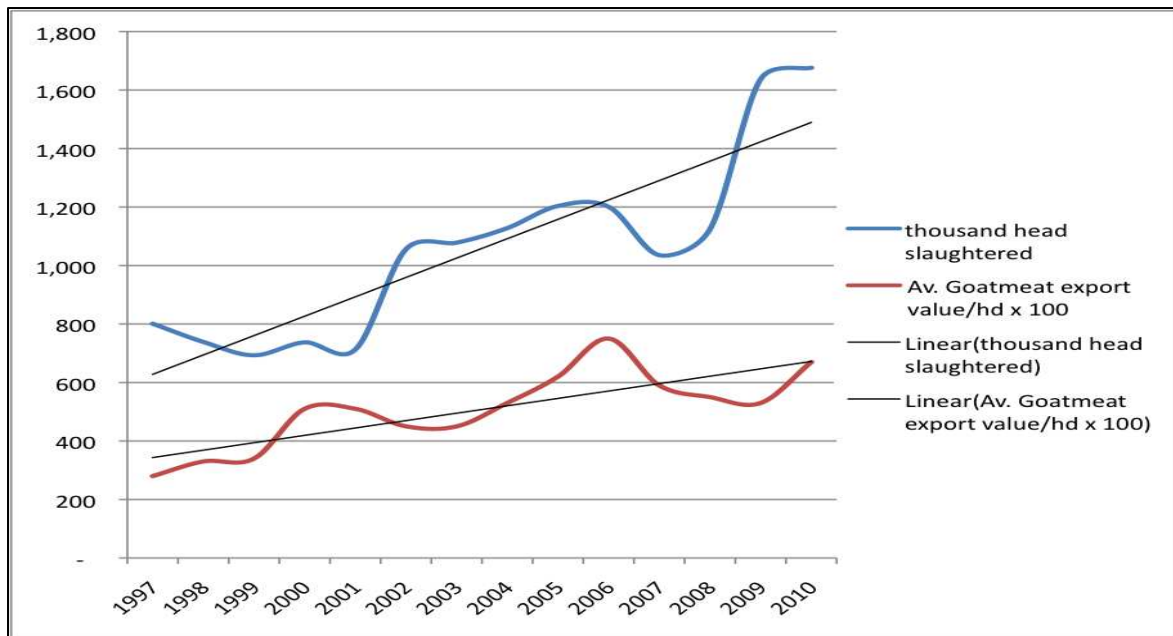


Figure 6. Price/harvest relationship from 1997-2010 (adapted from Ferguson 2012, p. 16).

Harvesting of feral goats is usually carried out by landholders and at times by contract musters engaged on a profit-share basis. Ownership of the goat is transient; being tied to the land on which they are found, which does contribute to competition and sometimes conflict between neighbours. Generally rangeland goats are mustered using motorbikes with the aid of light aircraft and working dogs. Goats are also trapped on water points during hot dry weather.

The rangeland goat industry remains the wild card in the Australian meat game. Built on a history of ‘running’ feral goats it has struggled to become a professional player providing a consistent supply of quality animals. Rangeland goats have evolved to suit Australian conditions since white settlement from domestic goats gone wild. They are livestock’s answer to the rabbit, but with a market. They run in National Parks, on private pastoral land and in vast tracts of virtually uninhabited country. Their ability to reproduce prolifically is an asset to a producer and a problem for a natural resource manager. They persist through their sheer suitability to this country.

The humble goat seems to be just what this world of impending climate change and food shortages needs. It is an animal that can produce low fat, high protein meat for the masses with no religious or cultural taboos, using low value forage in hot and arid environments. Australia is well placed to further develop this organically evolving industry.

Study Objectives

The key objectives of this Nuffield study were to find simple aids to goat grazing management in the arid rangelands, identifying the principles of grazing systems that worked and that were achievable in extensive pastoral situations. It became apparent that a more stable and profitable industry would facilitate good goat grazing management, particularly the building of a market for goats under market weight specifications and a dollar reward for producing a quality product.

Methods

Over a period of 2 ½ years (possibly the longest Nuffield scholarship ever,) I spent 29 weeks overseas and visited 19 countries as well as visiting three goat processors here in Australia and some leading Australian goat meat producers. Globally, commercial goat farming is a small business, most goats are kept in a subsistence manner, so in order to learn more about managing their grazing I had to look at the bigger picture of rangeland management and not just confine myself to goats. I visited farmers, researchers, marketers, market outlets and other industry related bodies, as well as looking at ancient nomadic pastoral practices still in use today.

Effective Goat Grazing Management

Background information

It is widely accepted that the major cause of rangeland degradation is the failure to manage grazing pressure (McKeon et al., 2004). In western NSW managing grazing pressure is fraught with difficulties caused by distance to market, poor road infrastructure and labour shortages. The large scale of properties and thick woody vegetation make it difficult to ensure all animals are bought in during a muster and straggler stock left behind continue to exert grazing pressure after the majority of livestock have been removed. Managing the grazing pressure of domestic stock is difficult enough, but added to this mix is the grazing pressure exerted by wild grazers such as goats, rabbits and kangaroos. Management of feral goat grazing pressure is limited to mustering or trapping at water points during dry weather. If feral goat density or goat meat price is low, it can be unprofitable to muster goats for removal.

Land degradation by feral goats is listed as a key threatening process under the Environment Protection and Biodiversity Conservation Act of 1999 (Department of Environment, Climate Change and Water 2011).

The Goat Grazing Management Issue in Western NSW

The grazing pressure exerted by feral goats can be managed through the control of land with TGP fencing and the control of water, as well as the removal of goats by mustering and water trapping. Reduced feral goat control occurs with absentee land ownership, difficult terrain or when landholders are unaware of the density of feral goats on their property due to the extensive nature of land holdings. A reduction in the value of goat meat also contributes to a reduction in feral goat management as can be seen in Figure 6.

The grazing pressure exerted by goats in a TGP fenced area is another matter and a key factor in this study. When their movements are constrained by fencing, goats utilise their capacity to consume a wide spectrum of the vegetation on offer and unless adequate and effective rest from grazing is provided, land degradation will occur as illustrated in Figure 7. In the words of Riaan Dames, *"Fencing + Poor Management = Disaster."*

Added to their ability to utilise almost all vegetation on offer is their capacity for reproduction as outlined earlier in this report. In a TGP fenced situation, a captured feral female goat may enter the paddock in good condition and so have a multiple pregnancy, as the nutrition available diminishes, the number of animals in the paddock increases with births conceived outside the paddock, however, the female's body weight will often be too low to meet market requirements so she continues to be held in the TGP fenced paddock, unable to put on weight, with progeny that are slow to reach market weight due to the limited feed available, and vegetation that is unable to recover due to the relentless grazing of an increasing goat population.

The goat population will stabilise to a degree once reproduction slows, but by then the grazing pressure is too great for the vegetation, in other words, the constant stocking rate has diminished the carrying capacity.

It is vital that landholders restricting the movements of goats through TGP fencing have strategies to ensure there is not relentless goat grazing occurring within these TGP fenced areas. Currently the removal of goats under market weight is restricted due to a very small market for these animals. Providing country with rest through a rotational graze system is restricted by difficulty in removing all the goats from a paddock, and a reproduction rate that

requires a landholder to be one step ahead of the goats by fencing a new paddock. It has also been difficult to understand just how long the vegetation needed resting for and dynamic factors such as an erratic climate and large variation in the type of vegetation make calculating necessary rest periods even more difficult.



Figure 7. “Fencing + Poor Management = Disaster,” Riaan Dames, 2012. Overgrazing by goats in a TGP fenced paddock in the Mulga Lands of Western NSW. Source author.

Landscape Shaping With Targeted Goat Grazing

Weed control using goats is not a new concept, however, in the US it is being brought to a new level with the aid of technology and innovative business concepts.

Businesses such as Livestock for Landscapes (Voth, 2010) and Rent-A-Ruminant LLC (Rent-A-Ruminant, 2013) have been established that provide goats to clear firebreaks and control woody weeds in urban and semi-rural situations. The owners of these herds of goats are paid to graze them in weed encroached areas with the aid of electric fencing and herding dogs.

Professor John Walker, Director of the Texas Agrilife Research & Extension Centre in San Angelo has led the “Super Juniper Eating Goat” project that has proved goats can be selectively bred to consume a larger proportion of the troublesome woody weed Juniper or Cedar (*Juniperus ashei*).

Juniper is an invasive woody shrub that is described as the major ecological and economical problem on the Edwards Plateau in Texas (Taylor & Fuhlendorf, 2001). It has a negative effect on livestock production, water yield and quality and wildlife habitat. A lack of frequent fires and changes in grazing regimes following white settlement are blamed for its encroachment.

Near infrared reflectance spectroscopy (NIRS), pioneered at Texas A & M University, was used to analysis faecal samples of goats grazing together in order to determine the composition of their diet (J. Walker pers. Comm.. March 2010). Two herds were created using this technology, low and high consumers of Juniper. These were then selectively bred, high consumers to high consumers, low consumers to low consumers. Further NIRS testing

on the progeny of these goats proved that selective breeding for dietary selection was effective.

Professor Walker believes that by changing an animal's genetics, we can change its grazing habits and produce "designer livestock." The project has now split the high consuming goats from the low consumers and vegetation monitoring is being conducted to determine if there is a measurable difference in rangeland condition caused by the different grazing habits of the two mobs of goats. Work is also being conducted to identify genetic markers.

At the Texas A & M Agrilife Research Station near Sonora, combinations of fire and grazing are used to reduce Juniper infestations and improve land productivity. There is a six month window following burning when the turpenoids in Juniper are low enough to allow goats to graze them back very heavily and regain control of a bush encroached pasture (Taylor & Fuhlendorf, 2001). The fenceline effect was stark, comparing these managed pastures with land locked up behind game fencing for hunting purposes only as seen in Figure 8.



Figure 8. Fenceline difference on a goat producing farm in Texas; goat grazing on left, hunting reserve for white tailed deer on right, San Angelo, Texas, March 2010.

Texas A & M University conducted a 20-year grazing study on pastures using goats at light (1 goat/2.7 hectares), moderate (1 goat/1.3 hectares) and heavy densities (1 goat/0.9 hectares). After 20 years, all stocked pastures regardless of density improved in range condition and grass productivity. Compared to pastures where livestock had been excluded, these goated pastures had lower woody plant cover and higher plant species diversity as shown in Figure 9 (Taylor & Fuhlendorf, 2001).



Figure 9. Range in good condition following prescribed burning and goat grazing at Sonora, Texas, March 2010.

Across the border in New Mexico, Associate Professor Andrés Cibils from New Mexico State University has been conducting research at the Corona Range and Livestock Research Centre. This research focuses on targeted grazing of small ruminants to control Juniper encroachment using different densities and different animal species. When comparing the results from targeted grazing with areas of herbicide application the end result appeared similar (see figures 10,11 & 12), however one was achieved with a production output and one with an overhead input.



Figure 10 Range two years after herbicide application to control Juniper, New Mexico, March 2010.



Figure 11. Juniper plant following heavy grazing by goats at Corona Research Station, New Mexico, March 2010.



Figure 12. Plot grazed with heavy stocking rate of goats, followed by cattle in foreground, compared to lighter densities in background, New Mexico, March 2010.

In the Republic of South Africa and Namibia changes to grazing and fire regimes have led to an increase in Acacia Karoo (Van den Berg, 2011), as shown in Figure 13. Although providing high value forage, impenetrable thickets are often formed. Goats are well able to make use of the high protein leaf and turn the thicket into a canopied forest that protected grasses growing underneath from sun and frosts and enabled other livestock to graze the area. However, farmers indicated that the use of goats to perform this function was becoming unprofitable due to the high incidence of stock theft. Repeatedly farmers stated that it was more profitable to run cattle due to the increased difficulty posed to stock thieves of stealing a larger animal.



Figure 13. Acacia Karoo in South Africa, July 2012.

Identifying the Principles of Grazing Systems that Work

The management of rangelands is usually limited to the control of grazing and fire. Maximising production and going beyond limiting land degradation to improving land state are sometimes seen as conflicting short-term goals but complimentary long-term aspirations.

Extensive scale, limited labour availability, distance from markets and the lack of a reliable rainy season limit the range manager's tool kit in western NSW. Finding simple solutions to fit within the confines of these limitations led to investigations of calculated strategic grazing systems, ancient methods as well as natural grazing systems.

Holistic Management

At the African Centre for Holistic Management on Dimbangombe Ranch in Zimbabwe, I met Alan Savory, Jody Butterfield, and their farm manager as well as director and veterinarian Astrid Huelin. I also spent two half days out with the herders with a mixed herd of cattle, sheep and goats.

High pasture utilisation with aid of high density grazing followed by effective pasture rest constitutes the basics of Alan Savory's grazing management strategy.

Holistic Management plans grazing with a focus on land regeneration. Dr. Savory believes that the greater portion of most farmers' money is invested in land, so it is in their financial interest to ensure that land is in the best condition possible. This philosophy highlights the importance of security of tenure.

He advocates a planning process for grazing management and argues that a 'system' is for something predictable, there are so many unknowns in grazing that a planning process is necessary to facilitate management. The merits of planned grazing in an area with no fixed rainy season seem great. Calculating how much pasture is available and how long that it will sustain the livestock and other grazers on a property must facilitate better land and livestock management. Dr. Savory has developed a "Grazing Plan and Control Chart" that is based on historical and current observations and is developed as an "open" season plan, when pasture is still growing, changing to a "closed" season plan when growth has stopped and feed budgeting is paramount. While the theory of calculating grazing with the aid of a control chart is sound, the actual implementation may be too time-consuming and complicated for western division land managers already under severe time limitations.

Dimbangombe Ranch had been grazed communally until about nine years ago when the property came under Holistic Management with a start up herd of just 70 cattle. Since then the herd had built up to 150 cows and followers, a total of 480 cattle, plus about 30 sheep and a handful of goats. The herd had consisted of 700 head of goats at one stage but internal parasite problems had resulted in a high mortality rate and the further incorporation of goats into the grazing system was minimised.

The pasture across Dimbangombe formed a thick ground cover but was largely moribund grasses, indicating under-utilisation. Dr. Savory commented on the difficulty of maintaining livestock numbers where cattle trading was hampered by a lack of industry infrastructure and limited commercial grazing operations.

The livestock on Dimbangombe were in fair to poor condition. They were grazed in two herds; about 100 weaner cattle were herded separate to the remaining stock. A total of 12 herders were employed on the ranch, working in two shifts they herded the livestock across the ranch according to a carefully considered grazing plan. Each night the livestock were

yarded for protection from predators in an enclosure made of heavy vinyl. The enclosure, known as a “kraal,” was designed to be easily relocated and sites were selected as regeneration areas. The dunging and urinating of the nightly confined livestock created a dense manure cover about five cm deep that led to nutrient-rich pasture growth.



Figure 14. Sheep and cattle in poor condition at Dimbangombe Ranch, Zimbabwe, August 2012.



Figure 15. Cattle returning to the kraal in the evening, Dimbangombe Ranch, Zimbabwe, August 2012.

Although the density of pasture on Dimbangombe was impressive, particularly when compared to the surrounding communally grazed lands in Zimbabwe, questions have to be asked about the state of the livestock and their poor reproduction rate. Dr. Savory maintains that there is more profitability in increasing the productiveness of your land than your livestock, but is the trade off too great? Dimbangombe is not a commercially viable farm but a training facility funded by US Aid. The real proof of Holistic Management is in the commercial producers that are improving their land and making a profit from their livestock at the same time.

Best Farmer Course- Riaan Dames

South African Rangeland scientist, founder and managing director of 'Best Farmer,' Riaan Dames promotes "Controlled Fodder Flow Grazing Management," a strategy for managing grazing that essentially leaves half of the grazing area resting for 12 months (Dames 2012).

He aims to increase farm profitability by improving the quality of fodder produced. Increases in the turnover of root matter through the use of a graze and rest procedure improve soil condition by increasing microbial life, increasing the mineral cycle and improving water-holding capacity.

In an extensive rangeland situation it requires considerable investment in infrastructure or labour to increase mob density to a level where animal trampling is able to incorporate organic matter on top of the soil such as old rank grass into the soil profile. The idea of using high utilisation over a 12 month time frame, followed by a long rest such as Dames is promoting is more achievable in an extensive rangeland situation than cell grazing.

More effective utilisation is achieved by grazing all of the livestock on half of the grazing land for 12 months while the other half of the property is receiving full rest. Most rangeland vegetation has a period when it is more palatable and beneficial to livestock, by aiming for a 70-80% utilisation rate livestock can more readily make use of vegetation at the optimum time. Long rest periods and high utilisation favour the more productive plants.

He developed this system in South Africa and Namibia after finding that many rotational grazing systems were effective at improving range condition but that, in general, animal production under continuous grazing was 30% better than under any form of rotational grazing (Dames personal comm. 16 July. 2012).

Since founding the strategy in 1996, Dames claims that his clients have averaged an improvement in carrying capacity of 30% and an improvement in profitability of 50% within a five-year period. He has also been working to implement the system in communal grazing areas that are suffering severe degradation from overgrazing.

Dames says, "*manage for animal performance but make sure pasture rest is an integral and uncompromised part of the management strategy*" (personal comm. 16 July, 2012).

Dr Ibo Zimmerman from Polytechnic in Windhoek, Namibia has focused his research over many years on production-based rangeland science. He believes that essentially, good rangeland management was as simple as providing the pasture with adequate rest and adequate grazing to allow plants to produce at their optimum for the rainfall received. He believed that the Controlled Fodder Flow strategy promoted by Riaan Dames had considerable merit for arid rangelands.

Meiki Rust is a beef producer at Okahandja, central Namibia. For many years Meiki had not just been running his farm on Holistic Management principles, but had been an educator, promoting and teaching Holistic Management. His land has improved in cover and condition but he was frustrated by low animal performance and poor profitability. When I met him he was in the process of removing intensive fencing for cell grazing and converting his management strategy to Riaan Dames 50% rest, 50% graze plan. He believed that by giving his cattle better access to a variety of vegetation, animal performance and thus farm profitability would improve.

Grootfontein Agricultural Development Institute (GADI)

Middleburg in the Eastern Upper Karoo of the Republic of South Africa is the site of reputedly the oldest continuous grazing trial in the world (Van den Burg, 2011). In 1946 the Bergkamp grazing trial was established to determine the effect of continuous grazing, continuous rest and seasonal grazing on the species composition of mountainous vegetation.

The continuous grazed paddock of 10.4 hectares was stocked with eight sheep from 1946 to 1974, when the number of sheep was reduced to four. The result of continuous grazing in this trial have been an increase in the density of woody plants, compared to the continuously rested plot as demonstrated in figure 16.



Figure 16. Continuous grazing on the left and continuous rest on the right, Middleberg, RSA, July 2012.

Figure 17 illustrates the importance of seasonal timing in providing plants with effective rest. The plot on the left has been grazed by sheep for four months during winter, while the plot on the right has been grazed by sheep for four months during summer. The vegetative outcomes

are starkly different and yet each plot has had exactly the same grazing density, grazing time and period of rest from grazing.



Figure 17. Winter graze plot on the left and summer graze plot on the right, Middleberg RSA, July 2012.

This particular trial highlights the difference between providing a pasture with rest, and providing a pasture with rest designed to promote productive pastures. Knowledge of what comprises effective rest for desirable plant species is an integral part of good rangeland management. It is with this knowledge that we can then ensure pastures are maintained and improved in production capacity.

Nomadic Herding in Mongolia

In August 2010 I travelled with Jane Addison, Australian PhD student with The University of Queensland, CSIRO, throughout the Gobi Desert in Mongolia. Jane was interviewing nomadic herders for her doctoral research investigating the links between land tenure, rangeland condition and herder livelihoods.

Mongolia is a land-locked country with 1.5 million km² of unfenced, un-owned land, where nomadic herders have grazed their livestock in a mobile pastoral system for well over one thousand years (Addison, Friedel, Brown, Davies, & Waldron, 2012).

On the desert steppe of the Gobi Desert the grazing regime centres on herders strategically moving their herds during the summer months in an effort to maximise the livestock condition in preparation for the winter when temperatures can get to 30°C below freezing. During the coldest months, livestock are held in winter camps and fed fodder collected by hand throughout the warmer months. The average rainfall in the areas we visited was between 67 and 132 mm/year (Addison et al., 2012). Livestock herds in the Gobi are typically comprised of a mixture of camels, horses, goats and sheep and occasionally some cattle.

We interviewed over 30 herders following the incredibly hard winter of 2009-10 that resulted in losses of around 30% of all livestock. Many of the herders interviewed were desperate and nearly destitute.

An increase in global cashmere prices had driven a greater than 150% increase in the goat component of most herder's flocks since 1960 (Addison et al., 2012). Goats were the first animals to die in winter; their inability to carry substantial amounts of subcutaneous fat resulted in them literally freezing to death. The recent financial demands placed on herders of providing tertiary education to their children were resulting in what appeared to be inappropriate agricultural practices of grazing an animal unsuited for their environment.



Figure 18. Goat carcasses near a winter camp in the Gobi Desert, August 2010. The 2009-10 winter was exceptionally hard and resulted in livestock losses of 30%.

This increase in goat numbers is often blamed for an increase in land degradation but herders we interviewed didn't identify goats as causing more landscape degradation than any other livestock. This study also did not identify the increase in goat numbers as being responsible for rangeland degradation. A decline in summer rainfall although not in overall precipitation was noted as causing a reduction in pasture biomass. A transition to a market-based economy is also thought to have had an impact on rangeland condition.

What was surprising was a comparative lack of unpalatable plant species in a landscape that had been used for grazing for such a long period of time. Competition for pasture was high during the summer growing period, limiting the opportunity for plant rest.



Figure 19. A mixed herd of sheep and goats grazing in the Gobi Desert, August 2010.

Natural Grazing System with Human Overlay in Kenya

The annual migration of 1½ million wildebeest (Homewood et al., 2001) from the Serengeti in Tanzania to the Mara in Kenya, together with numerous other wild ungulates and the domestic livestock of the Masai people, is a spectacle in grazing, as seen in Figure 20.



Figure 20. Wildebeest as far as the eye can see in the Mara, Kenya, August 2012.

Management of grazing is restricted to the zoning of land for nil to limited to unrestricted pastoral use (Homewood et al. 2001) and the management of domestic grazers including cattle, sheep and goats (Nelson, 2012).

For protection from predators and stock theft, livestock are held each night in enclosures called “bomas” constructed of either the cut branches of Thorny Acacia trees or steel and wire mesh panels. Radial degradation of the land surrounding the more permanent bomas was apparent as seen in Figure 21. The advantages of easily portable boma materials in encouraging mobile pastoralism and reducing the loss of vegetation caused through the use of Acacia branches to construct enclosures was illustrated by four operators, who provide portable boma materials to pastoralists (G. Church pers. comm. Aug 2012).

The importance of high utilisation and effective (though not total) rest of pasture is a major component of this natural grazing system. Providing effective rest can be hampered by communal and thus competitive grazing, minimising opportunities to allow adequate rest for pasture species (Figure 23). Security of tenure is vital to any rangeland improvement scheme, a lack of security will undermine the best intentions of natural resource managers.



Figure 22. An overgrazed area resulting in soil erosion near a permanent boma in the Mara, Kenya, August 2012.



Figure 23. Goats doing very well on a commercial farm in Laikipia, Kenya, August 2012, where effective pasture rest and planned grazing were facilitated by security of land tenure.

Fencing Alternatives to Control grazing pressure

Virtual Fencing

Dean Anderson US Department of Agriculture animal research scientist has conducted some interesting research into directional virtual fencing using multi species bonding. His research has involved using animal psychology to bond sheep to a small mob of cattle. The cattle are trained to voice cues, which are delivered via speakers attached to collars. The cattle movements are controlled and the sheep don't move far from the cattle.

It is early days in this research, however the use of animal psychology combined with technical innovation could prove an aid to grazing pressure control in extensive rangeland situations in the future.

Bud Williams Stockmanship

“Confidence is key. Go out and try, be happy with what you get even if it isn’t what you wanted because you’ll learn how to get what you got. Everyday I went out there and I failed, but I learnt so I succeeded.” Bud Williams, March 2010.

Bud Williams is renowned throughout the world for his stockmanship skills. He has taught stock handling for many years and is famous for some impressive gathering of caribou and wild cattle. I went to see Bud and his wife Eunice in Bowie Texas to see if it was possible to train livestock to stay in a mob and make mustering and hence grazing management easier. We attended the Waurika cattle sale in Oklahoma where they bought a few trade cattle. Bud then age 78, said of their cattle trading, “We got no business doing this, but it gets us out of the house.”

According to Bud, herding is what all livestock want to do, we just mess it up for them. He stressed the importance of timing and applying pressure in the right place to make the livestock feel comfortable. Importantly we also need to ensure there is adequate access to nutrition and water for them to be comfortable staying in a large herd; this is often the limiting factor in the western NSW rangelands.



Figure 24. *“Better fix us some supper Eunice, the girl still don’t get it.”* Bud Williams to his wife Eunice after 12 hours of trying to teach me March 2010, Texas.

Sadly Bud passed away during the writing of this report and will be remembered for his tremendous contributions to the livestock industry, his inability to suffer fools, and his willingness to pass on his knowledge to anyone who wanted to learn.

A Summary of Goat Grazing Management Solutions

Time and again, in a huge variety of environments, the importance of high utilisation and effective pasture rest has been highlighted. From Texas to Kenya, from Mongolia to Wanaaring, graziers are altering the vegetation species composition of native grazing country by a failure to effectively manage grazing pressure.

It is impossible to determine what constitutes effective rest for rangelands without a thorough understanding of the desired pasture species' physiological and morphological traits (Taylor & Fuhlendorf, 2001). Combining this understanding with knowledge of different livestock species' feeding habits places the range manager in a situation where good decisions can be made. Without comprehensive knowledge, management becomes guesswork. In the cropping industry there are many tools available that enable a manager to make objective rather than subjective decisions, and the use of technology to assist rangeland management decisions is likely to increase in the future.

In managing extensive rangelands, the only real tools available to the land manager are grazing and fire, but climatic variability, seasonal growth, market conditions and financial restrictions are ever changing. It is vital that the rangeland manager is able to use careful planning and imagination in order to adapt and make good land management decisions.

Goat grazing is a tool to aid land rehabilitation and management, however the opportunistic feeding habits of goats require management to be diligent and observant in order to effectively manipulate grazing pressure. Rest from grazing for desirable pasture species must be an uncompromised component of rangeland grazing strategies, and may at times be provided by altering the livestock species under management.

"...every situation requires management that must be an original product of human imagination, and even that must evolve as the situation changes." (Savory & Butterfield, 1999, p. 178).

Goat Meat Market Opportunities

Background Information

For the past two decades the Australian goat meat industry has largely been driven by the demand from the US Hispanic population. Typically, goat meat is marketed by processors to importers as a frozen six-way cut carcass although the goat meat processing company; Western Exporters in Queensland have had success exporting diced bone in and bone out product in 1kg pre-packed bags (N. Duncan 2011 pers. comm. 11 May).

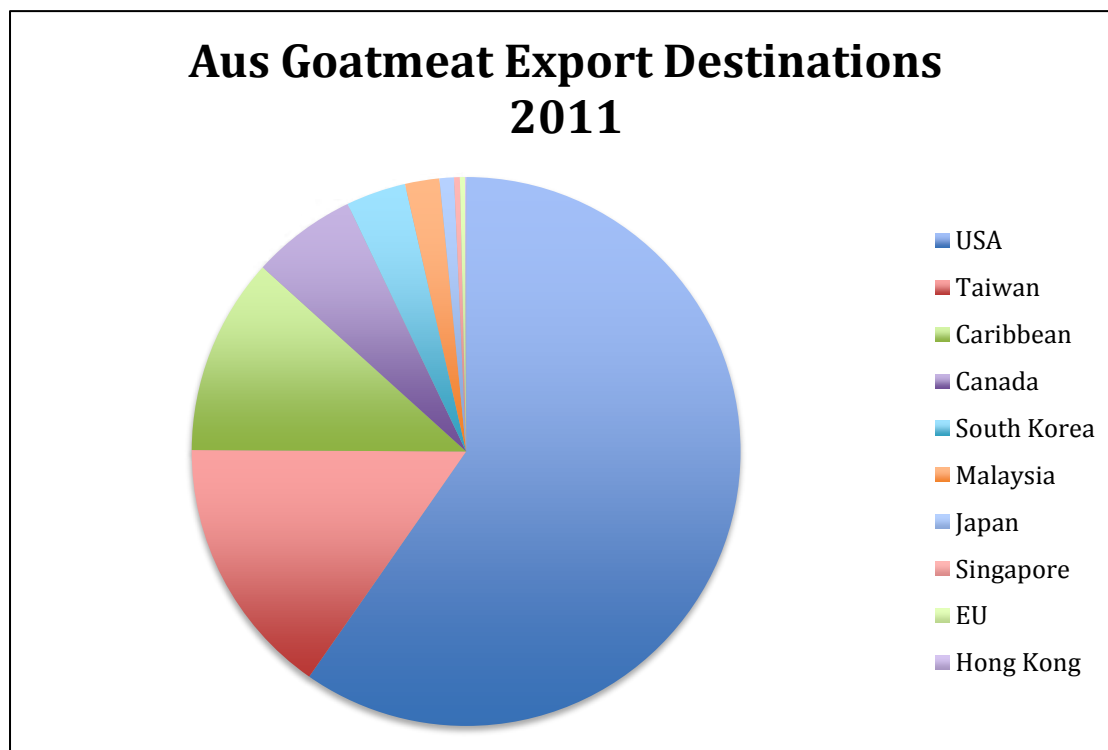


Figure 25. 2011 Australian goat meat export destinations, the USA accounted for 60% of all product exported. Source data provided by Meat and Livestock Australia, January 2013.

The main drivers of goat meat price are supply, mutton price and foreign exchange rate.

Supply is affected not just by seasonally variable reproduction rates and thus goat population, but also harvesting. Wet weather can stop harvesting and also hamper the supply chains that are mostly reliant on dry weather roads.

The sheep shortages experienced during the past few years strengthened the goat meat market as processors looked to fill sheep meat supply shortfalls by processing goat meat. These two commodity products are at times interchangeable: both provide low cost protein and so the price for both mutton and goat are strongly linked as demonstrated in Figure 26 (Stokes, 2009).

With over 95% of Australian goat meat exported the price is extremely susceptible to fluctuations in the value of the Australian dollar (Schuster, 2006).

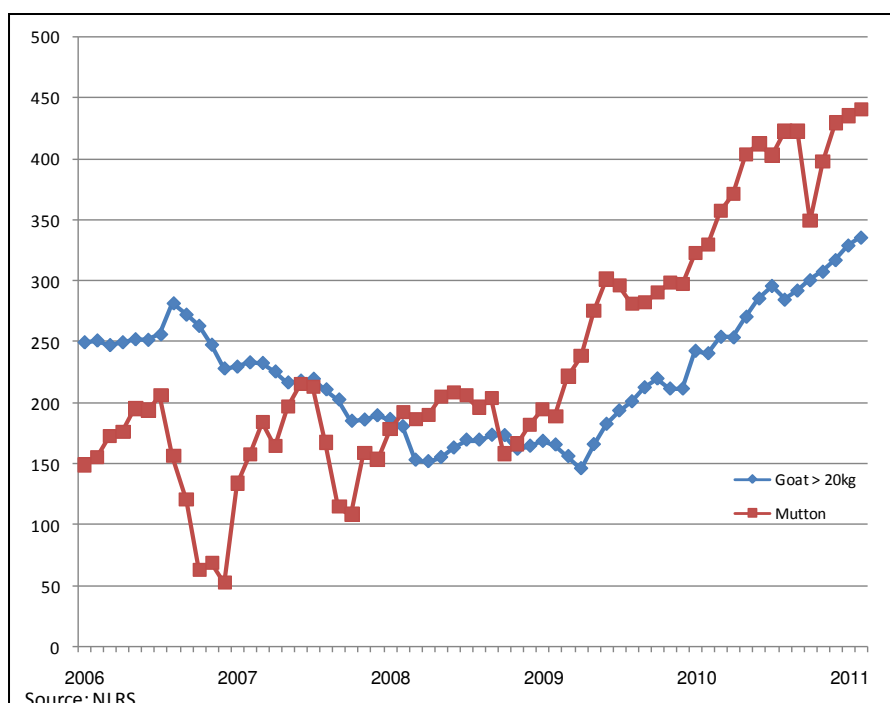


Figure 26. Mutton (red) and goat meat (blue) Over-the-Hook (OTH) price 2006-2011, (MLA, 2011b, page 12).

A strong increase in goat slaughter numbers since 2009, culminating in a record slaughter number of over two million goats for 2012 has led to a fall in the price paid by processors since mid 2011, as shown in Figure 27. Supply of goats has been maintained throughout the price decline as deteriorating seasonal conditions necessitate a reduction in livestock numbers. The run of good seasons prior to 2012 led to an increase in the feral goat population due to the ready availability of nutrition increasing reproduction and wet weather restricting opportunities for goat harvesting.

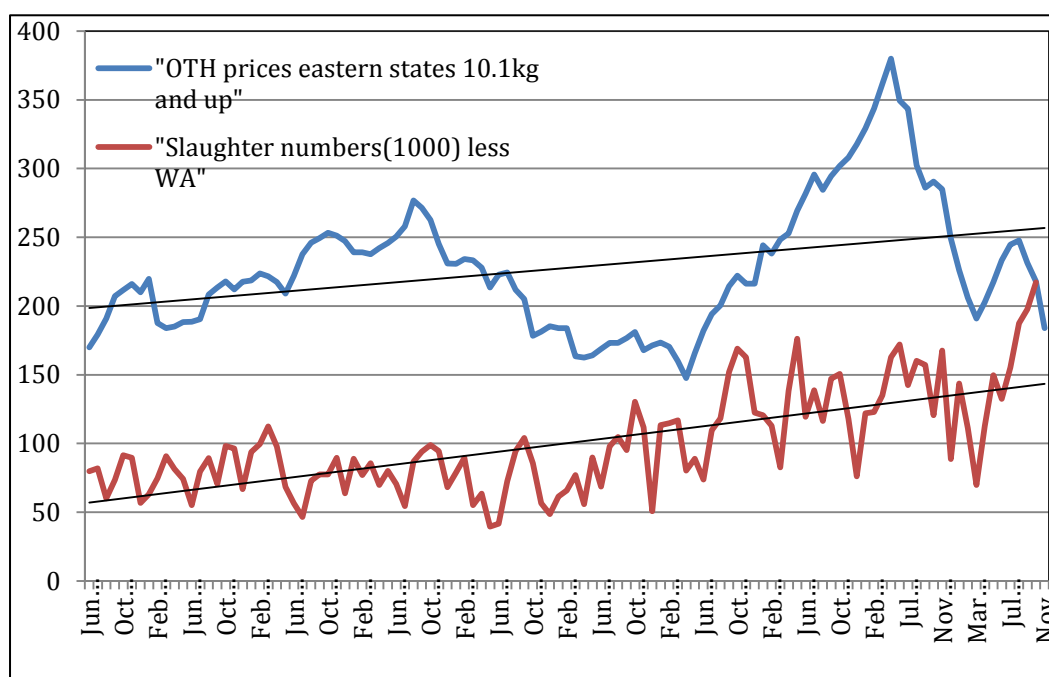


Figure 27. The lower red line indicates slaughter numbers (1000) for the eastern states, the higher blue line indicates OTH eastern states price for 10.1kg carcass and heavier. An unprecedented strong supply has led to a fall in prices received by producers. Source data provided by Meat and Livestock Australia January 2013.

Market expansion has historically been hampered by low and inconsistent supply. The rapid increase in goat slaughter numbers during the past four years increases opportunity to expand into emerging markets.

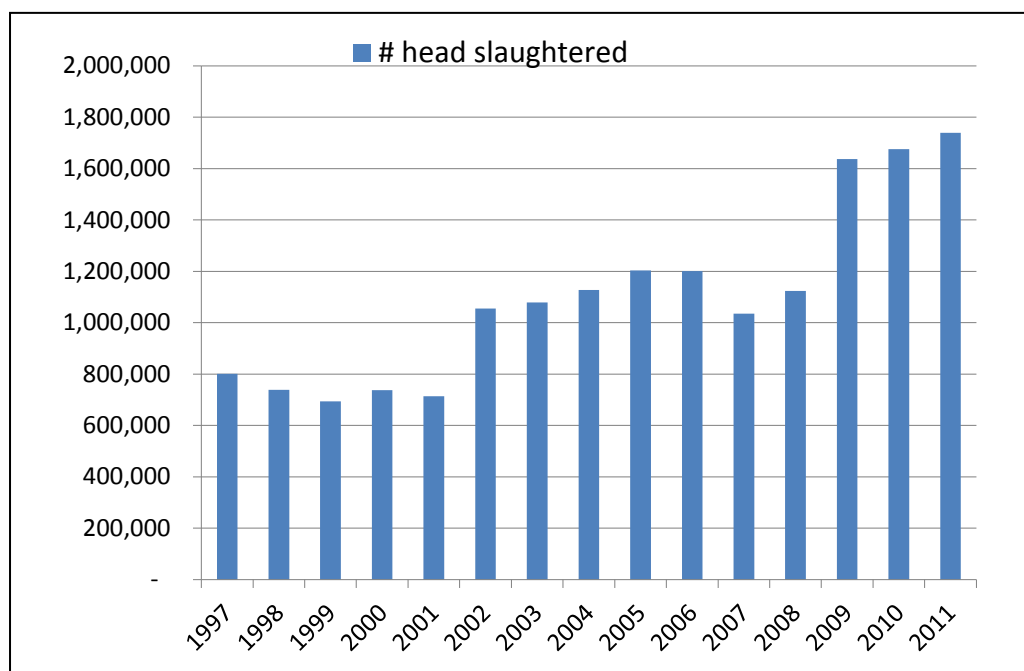


Figure 28. Goats slaughtered in Australia; 1997-2011.
Source data provided by Meat and Livestock Australia, January 2013.

Emerging Markets, Further Trade Developments and Big Ideas

If we consider the big picture of goat meat market potential, opportunities seem many and varied. The world's two largest goat meat consumers, China and India, have undergone social and economic change, becoming more urbanised and affluent. The western world is continually seeking healthy dietary alternatives and environmental concerns are leading consumers down the path of considering the environmental impact of the food that sustains them.

Australia's rangeland goat meat has the potential to satisfy many markets created by these situations, but the reality is that our 25,000 tonnes of export product (MLA, 2012a) can't be spread too thinly or inconsistency of supply will inhibit market growth. Investigating market potential must be done through the lens of the reality of supply limitations.

Marketing a Healthy, Green Alternative

A recent nutritional analysis of both rangeland and Boer goat meat commissioned by MLA has produced findings that align with goat meat nutritional analysis conducted in other countries (MLA, 2012b). Goat meat is high in iron, zinc and vitamin B12. Characteristically low in fat, goat meat can be marketed for its health benefits, and rangeland goat carcasses carry less fat than Boer goats.

The fact that Australian goat meat is typically harvested from feral goats provides an opportunity to appeal to the environmentally conscious consumer, and market the meat as a means of environmental management with no chemical inputs.

Distinguishing Flavours

Within Australian goat meat there are two distinct flavours. The meat from mature male goats has an extremely strong “goat” flavour and is generally unpalatable to most westerners. It does appeal though to certain cultures and the rangeland goat industry supplies this market, which would be difficult under a farmed goat situation.

The meat from female goats and castrated males has a subtle flavour and is easily substituted for mutton and at times lamb, but noticeably contains less fat.

A Premium Branded Rangeland Goat Product

Essentially Australian rangeland goat meat is a commodity low cost protein product, the minimal production inputs and inconsistency of supply aligning the product with this market.

However, given continued industry growth and an increase in supply, potential to produce a premium branded product into the high end US, European, Domestic and even Indian and Chinese markets among others, may develop. Quality control and separating the goat meat flavours will play a critical role in the success of this venture, enabling consumers to confidently purchase a premium priced product. The development of solid supply mechanisms to facilitate this market will be essential to market development.

The US Market-From Strength to Strength

Importing 53% (MLA, 2012a) of Australian goat meat, the US market underpins the Australian goat industry. The growth in volume has been strong but the increase in value has been more so as indicated in figure 29.

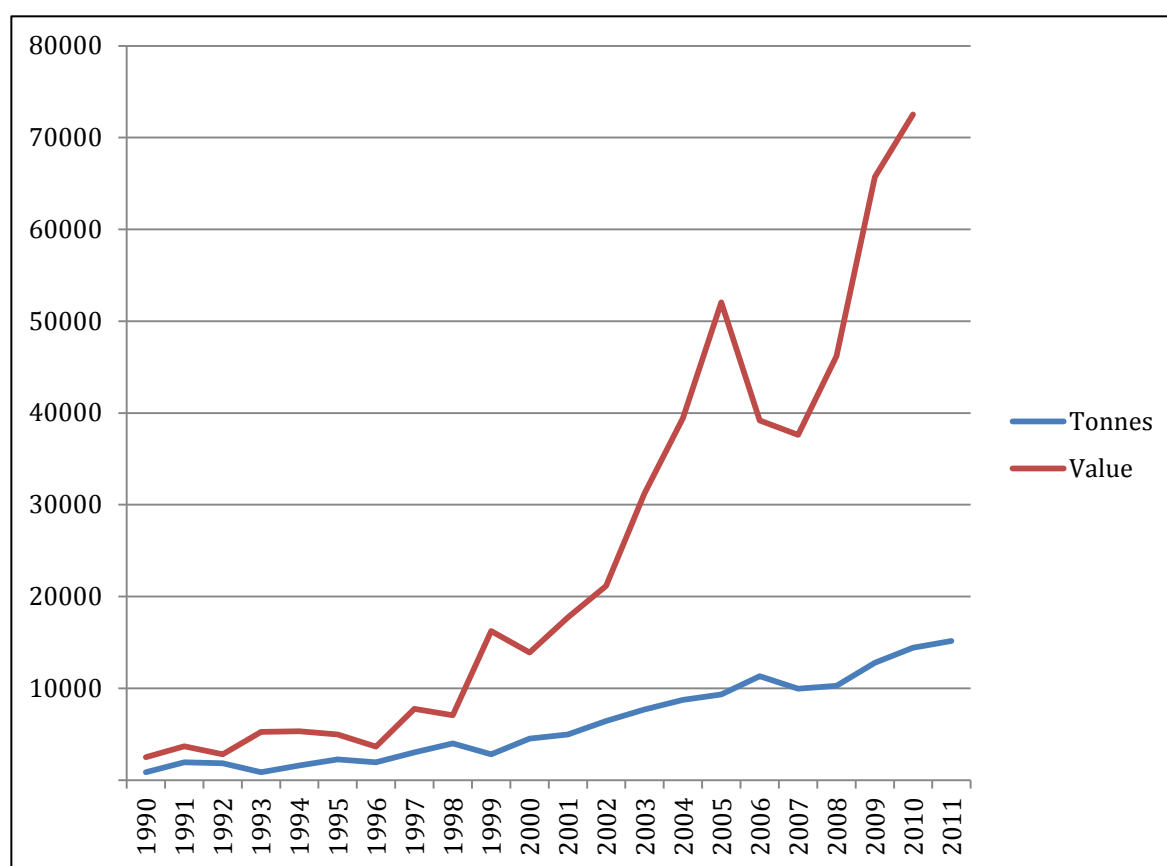


Figure 29. US goat meat imports of Australian goat meat in tonnage (blue bottom line) and value in 1000 AU\$ (red line top). Source data provided by Meat and Livestock Australia, January 2013.

At the Tennessee State University animal physiologist Dr Richard Browning Jr. is conducting research to determine goat breeds suited to the cold and wet conditions of northeast USA, (Figure 30). He was enthusiastic about the market potential for goat meat and pointed to strong growth in the goat population of 627% from 1990 to 2010 and a corresponding growth in the volume of imported goat meat.



Figure 30. Kiko and Spanish Blood goats undergoing the ultimate stress test at Tennessee State University, March 2010.

Speaking with consumers and retailers of goat meat in Tennessee, it was indicated that Australian goat meat was preferred to home grown domestic product as it was more flavoursome. Reluctant sampling by the author indicated that the flavour that was desired by these consumers was that of mature male goats.

This strong demand in the US is unlikely to be met by domestic production. The preferential environment for goats to thrive is a hot and dry one, even in Texas and New Mexico, the largest goat producing states in the US. Winters are not as conducive to goat production as it is in the Australian rangelands.

Potential competitors for the US market are relatively few. Brazil has a goat population of 10 million (FAOSTAT 2013), with a correspondingly high domestic population of goat meat consumers. Imports from India or African countries are unlikely to meet food safety standards in the near future or supply the same quality and type of goat meat as the Australian industry. China, as the world's third largest goat meat exporter (MLA 2012a), could emerge as a competitor in the US market with increased commercialisation; however their large domestic population of goat meat consumers limits expansion of their exported product.

Further market development in the US may include catering for the high-end Hispanic and Muslim consumer.

China- potential market or competitor?

China is the world's largest consumer and producer of goat meat with an estimated herd size of approximately 140 million head (MLA, 2012a) it produces almost 20 million tonnes of goat meat, about 800 times more than Australia.

In-depth information on the Chinese goat industry has been difficult to acquire. During a meeting with a representative of the Chinese Animal Agriculture Association, Mr Liu Quangde , the author was assured that the domestic demand for goat meat would remain strong as it was the preferred meat. Government policies aimed at reducing land degradation in arid regions had limited livestock grazing in regions that were typically goat-producing areas. Farmers were keeping their goats in sheds and collecting fodder by hand, with the increase in labour requirements resulting in less livestock being kept by farmers.

Chinese goat slaughter numbers have increased by 70% from 2001 to 2010 to reach 135 million head in 2010 (FAOSTAT 2013). The value of their exported product has also substantially increased as shown in Figure 31. In 2010 they were the third largest exporter of goat meat, exporting approximately 7,000 tonnes and importing 4,000 tonnes (MLA 2012a).

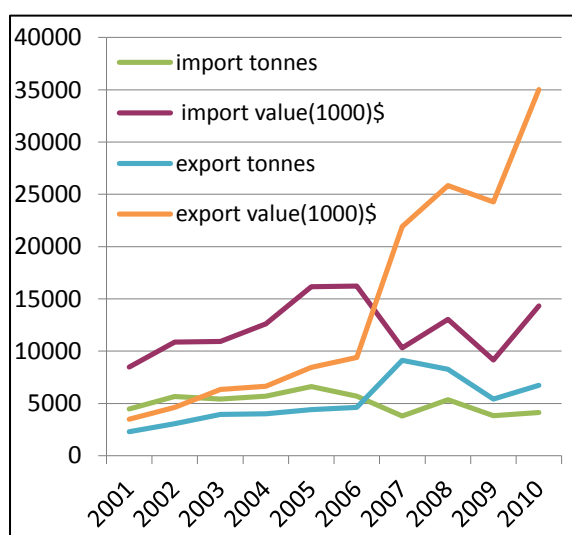


Figure 31. Chinese goat meat import tonnage and value and export tonnage and value, FAOSTAT 2013.

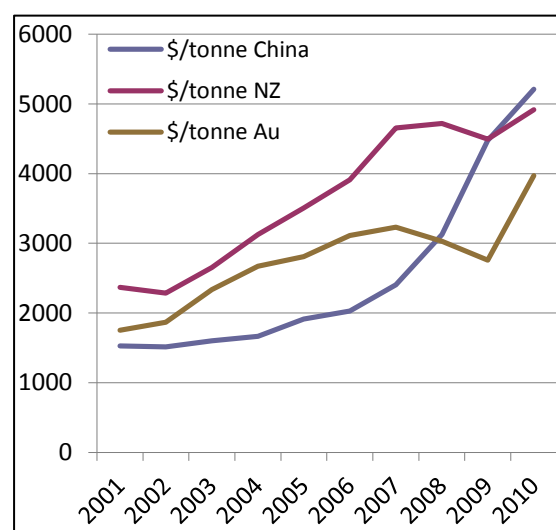


Figure 32. \$/tonne realised by New Zealand, Australia and China, 2001-2010, FAOSTAT 2013.

China is the world's third largest goat meat exporter and according to FAOSTAT 2013, is realising a better end-price for its product as shown in Figure 32.

Although in the past we have exported small quantities goat meat to China, the lack of a free trade agreement limits our trade potential through the imposition of prohibitive tariffs, which totaled 27% at August 2010, (Yana Gao, Trade Development Officer MLA Beijing 2010, pers. comm., 9 August). New Zealand is currently the leading exporter of goat meat into China (FAOSTAT 2013).

India- Potential

Goat meat is an intrinsic part of Indian culture and has no cultural or religious taboos. With a goat herd size of over 150 million in 2010 (MLA 2012a), India has the largest goat herd in the world, approximately 50 million times larger than Australia's, mainly kept in a subsistence state with no commercial goat processing.

At a meeting with representatives of the Livestock Sector of the Planning Commission, Government of India, it was noted that the estimated 2.6 million tonnes of meat produced was insufficient as 70-80% of the population were non-vegetarian (Dr KS Ramachandra pers. Comm..October 20, 2010). Goat meat dealers operating within wet markets were attempting to increase supply by giving loans to landless people to purchase 10 female goats and a breeding buck, browsing them on communal areas then selling back to the dealer. Changes to social infrastructure, consumer shopping habits and affluence are likely to lead to the formation of a commercial goat processing industry.

The growing number of middle class Indians increasing their meat consumption provides an attractive market to the Australian goat meat industry, however, trade restrictions imposed through prohibitive tariffs (37% in 2010, MLA) hamper Australia's entry into this market. With 70% of the Indian population involved in agriculture, government policies are often short-sighted, however, there appeared to be some recognition of the need to address malnourishment issues through increased food trade.

Opportunity for the Australian goat industry may eventuate in the sale of breeding animal genetics and the export of carcasses for processing and selling as a branded Australian product through high-end food services, however, trade impediments and supply restrictions limit this opportunity.



Figure 33. Goat carcasses selling for AU\$6/kg in a wet market in Mysore, Southern India, October 2010.

South East Asia

In Malaysia, Australian goat meat is recognised because of the live export trade of male rangeland goats, typically for sacrificial purposes as seen in Figure 34. These goats are air freighted, (see Figure 35), along with Boer goats imported for breeding purposes.



Figure 34. Australian rangeland goats at a purchasing depot in Malaysia, December 2011.



Figure 35. Three tiered goat crates unloaded at Kuala Lumpur airport, Malaysia, December 2011.

Malaysia is home to large ethnic populations from goat meat eating cultures, particularly Indians, Africans and Chinese. In an effort to become self sufficient in goat meat production the Malaysian government has assisted farmers to build their goat herds, often through importing Boer goat breeding stock from Australia. The high incidence of internal parasites and foot problems caused by the humid environment mean that goats are typically kept in an intensive manner, housed in raised sheds and fed by hand.

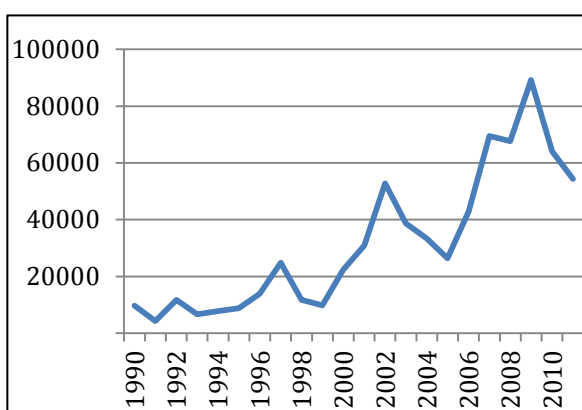


Figure 36. Live export of Australian goats to Malaysia 1990-2010. Source data provided by Meat and Livestock Australia, January 2013.

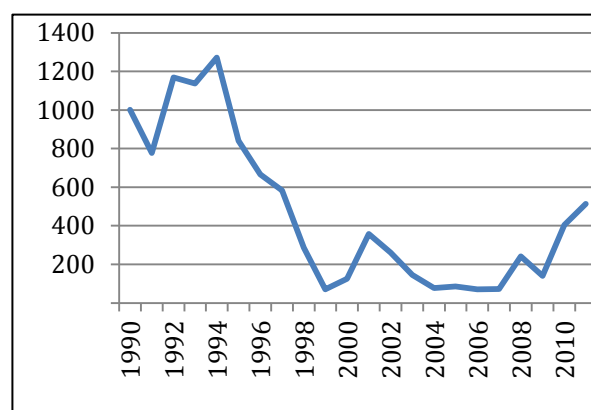


Figure 37. Tonnes of Australian goat meat exported to Malaysia 1990-2010. Source data provided by Meat and Livestock Australia, January 2013.

Goat meat imported frozen from Australia is typically sold through wet markets, sometimes as 'fresh' meat.



Figure 38. The wet market in Kuala Lumpur, where Australian goat meat is sold to Indian, African and Chinese customers, among others. December 2011.

The Middle Eastern Market

Historically Australia exported live goats via sea to the Middle East; this was disbanded due to the high mortality rate of these primarily feral animals. Goat meat is popular meat in the area and often receives a higher price than mutton, particularly for home grown product. A large proportion of the Middle Eastern work force comes from India and Bangladesh, both high consumers of goat meat. Primarily the market seems to be met with Pakistani, Indian and Ethiopian goat meat. On a landed price/kg basis, Australia is unable to compete with these producers.

Supermarkets are increasing in popularity throughout the area, and this may facilitate the marketing of a premium Australian product into the market. However, the preference for fresh meat rather than frozen limits market potential and increases the cost to the consumer, restricting market access.



Figure 39. Pakistani goat meat being sold for the equivalent of AU\$6/kg in a supermarket in Bahrain, October 2010.

The Domestic Market- where have we gone wrong?

Marketing of goat meat within Australia has been focused on selling a Boer goat carcass into the food service trade as a means of market creation providing an alternative red meat to traditional beef and lamb consumers. This market has been hampered by two major factors. Firstly, there is limited ability to supply this type of carcass, and secondly, converting consumers to a new food is a lengthy process. Currently, the domestic market accounts for less than 5% of Australia's goat meat production (Schuster, 2006).

The potential exists, and is being realised, to supply small rangeland goat carcasses to traditional goat meat eating populations distributed through specialist butchers. KJ Halal Meats operates an abattoir at Nyngan, on the eastern edge of the NSW rangelands and provides a model for potential industry development. Processing 1,000 small rangeland goats each week, it sells directly to Muslim butcher shops, mostly located in the Sydney region. Aiming for a 10kg lean carcass weight minimises competition with other processors who are focused on the export market and provides producers with a market for smaller animals. KJ Halal Meats, in line with other processors, indicated that a Boer goat carcass carried too much fat for market requirements.

The cost of processing a small goat is the same as that of a large one but the yield is lower so either the end price must be greater or the costs associated with meeting the market must be lower. By selling these small animals on the domestic market costs are minimised and exposure to currency fluctuations are nil.

Future development of this market would further advance the industry through the expansion of a market for smaller stock and reduce negative environmental impacts by minimising the length of time goats need to be held to meet market requirements.

Is There an Opportunity to sell Rangeland Goat Genetics?

The Australian rangeland goat carcass meets a wide segment of the market and is held in high regard by consumers, and yet there has never been a serious attempt to market the genetics refined by natural selection.

In New Zealand the Kiko goat has been selectively bred from feral herds and marketed into the US market with marked success. Inherited suitability to a cold and wet climate gives them an advantage in that market that the Australian goat could not match, but the Australian rangeland goat's size, reproductive ability and hardiness are traits that would be welcomed into the breeding plan of many goat producing environments.

With the increase in TGP fencing and industry infrastructure in western NSW, opportunity exists to develop a marketable gene pool.

Recommendations

Grazing Management

Australia's rangeland manager has a difficult task. The management of an extensive, complex, living system, governed by a variable market and an erratic environment with minimal management tools available is not for those who lack imagination, resourcefulness or for the faint hearted.

The land management tools available on extensive operations are the control of grazing and the control of fire.

In the case of grazing control, manipulation of grazing time and thus rest time, density and type of grazing through selection of animal species is paramount to not just a productive and profitable operation, but importantly one that aligns with the surrounding ecology and produces positive environmental outcomes.

The primary aim of this study was to isolate and simplify the principles of good goat grazing management in arid areas.

Fortunately, the principles are simple:

1. Effective rest and recovery for vegetation must be a planned and uncompromised component of goat grazing management
2. Planned grazing is paramount in a variable environment, where reactive and imaginative management are also important
3. In order to manage the grazing of vegetation towards a desirable outcome, the manager must have a thorough understanding of the physiological and morphological traits of the vegetation and how they relate to the foraging behaviour of the livestock (Taylor and Fuhlendorf, 2001).

Industry bodies and government agencies can assist grazing management through goat market creation and strengthening, and importantly an increase in industry infrastructure to process small goats for the domestic market.

There is opportunity for industry and researchers to replicate Texas A & M's "Super Juniper Eating Goat" experiment to create designer livestock for landscape shaping. The use of NIRS technology to selectively breed goats to control particular problem plants would have positive environmental and economical results.

Market Opportunities

Marketing Australian goat meat has always been restricted by limited and seasonal supply; and while supply is still affected by seasonality, slaughter numbers have doubled in the past ten years and industry infrastructure and organisation has seen marked improvements. Also contributing to a more stable industry has been the increase in rangeland goats under management, reducing the opportunistic and thus erratic nature of the industry.

Within this context, it is timely to investigate the expansion of the industry. Potential opportunities identified in this study included:

1. The creation of a premium, branded Australian product. Selling the health benefits of goat meat as well as the positive environmental message of controlling a potentially environmentally damaging animal, in essence, it is the story of the Australian feral

goat that could be sold. This product would need to separate and distinguish the two distinct flavours in goat meat, that of mature males from that of immature and female goats

2. Investigation into the potential domestic market for small rangeland goats should be a primary focus for industry bodies. A limited market for these animals reduces producer confidence in the industry, and thus volume of supply
3. Industry and government bodies would serve the industry well by striving to improve trade arrangements and restrictions, particularly with India and China
4. The possibility of the sale of Australian rangeland goat genetics should be investigated but care must be taken to maintain the robustness created by natural selection.



Figure 40. Feral goats near White Cliffs, western NSW. Source, Matilda Ferguson 2011.

References

- Addison, J., Friedel, M., Brown, C., Davies, J., & Waldron, S. (2012). A critical review of degradation assumptions applied to Mongolia's Gobi Desert. *The Australian Rangeland Journal*, 34(2), 125-137.
- Ballard, G., Fleming, P., Melville, G., West, P., Pradhan, U., Payne, N., Russell, B., & Theakston, P. (2011) Feral goat population trends in Western New South Wales rangelands. Unpublished final report to the Western Catchment Management Authority, May 2011. Orange: NSW Department of Primary Industries.
- Bastin, G. (2012). ACRIS Total grazing pressure update; trends in the abundance and distribution of feral goats in the rangelands. Alice Springs, Australian Government Department of Sustainability, Environment, Water, Population and Communities. Retrieved October 10, 2012, from <http://www.environment.gov.au/land/publications/acris/pubs/acris-grazing-pressure-update.pdf>
- Browning, R. Jr., & Leite-Browning, M., (2009), Breed evaluation for health, reproductive, and carcass traits in meat goats: observations from the southeastern US. Proceedings from the 4th International Goat Symposium, Brasil.
- Dammes, R., (2012). Workshop-Best Farmer; profitable conservation farming, the controlled fodder flow grazing management strategy, a proven strategy for sustainable increased profitability from natural rangelands. 16 July 2012, GSSA Congress, Langebaan, South Africa.
- Department of Environment, Water, Heritage and the Arts (DEWHA). (2008). Threat abatement plan for competition and land degradation by unmanaged goats. Retrieved May 5, 2011, from <http://www.environment.gov.au/biodiversity/threatened/publications/tap/goats08.html>
- Eldridge, D.J., Bowker, M.A., Maestre, F.T., Roger, E., Reynolds, J.F., & Whitford, W.G. (2011). Impacts of Shrub encroachment on ecosystem structure and functioning: towards a global synthesis. *Ecology Letters*, 14(7), 709-722. <http://onlinelibrary.wiley.com/doi/10.1111/j.1461-0248.2011.01630.x/full>
- FAOSTAT, (2013). Food and Agriculture Organization of the United Nations. Retrieved January, 2013, from <http://faostat.fao.org/site/569/DesktopDefault.aspx?PageID=569>
- Ferguson, C. (2012). The feral goat industry and implications for groundcover. Report to Western Catchment Management Authority, June 2012.
- Harrington, G. (1979). The effects of feral goats and sheep on the shrub population in a semi-arid woodland. *The Australian Rangeland Journal*, 1(4), 334-45.
- Homewood, K., Lambin, E., Coast, E., Kariuki, A., Kikula, I., Kivelia, J., Said, M., & Serneels, S. (2001). Long-term changes in Serengeti-Mara wildebeest and land cover: pastoralism, population, or policies? *Proceedings of the National Academy of Sciences of the United States of America*, 98(22), 12544-12549 doi:10.1073/pnas.221053998

- Jago, B. (1999). Feral goat (*Capra hircus*) in Queensland; pest status review series-land protection. Queensland Government Natural Resources and Mines, Queensland. Retrieved April 28, 2011, from http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-FeralGoat-PSA.pdf
- Kimball, N.P., & Chuk, M. (2011). Feral Goat Ecology and Management in the Western NSW Rangelands: A review, Western Catchment Management Authority.
- Landsberg, J., & Stol, J. (1996). Spatial distribution of sheep, feral goats and kangaroos in woody rangeland paddocks. *Rangelands Journal*, 18(2), 270-291.
- McKeon, G., Hall, W., Henry, B., Stone, G., & Watson, I., (Ed.) (2004). Pasture degradation and recovery in *Australia's rangelands: learning from history*. Queensland: Department of Natural Resources, Mines and Energy.
- Meat & Livestock Australia (MLA). (2011a). *Fast facts 2011; Australia's goat meat industry*. Sydney: Author.
- Meat and Livestock Australia (MLA). (2011b). Australian goatmeat supply profile. Sydney: Author.
- Meat & Livestock Australia (MLA). (2012a). *Fast facts 2012; Australia's goat meat industry*. Sydney: Author.
- Meat & Livestock Australia (MLA). (2012b). Australian goat nutrient composition data, 2012. Sydney: Author.
- Nelson, F. (2012). Natural conservationists? evaluating the impact of pastoralist land use practices on Tanzania's wildlife economy. *Pastoralism Journal* 2012 2:15.
- Norton, B.W., Kennedy, P.J., & Hales, J.W. (1990). Grazing management studies with Australian cashmere goats, 3, effect of season on the selection of diet by cattle, sheep and goats from two tropical grass-legume pastures. *Australian Journal of Experimental Agriculture*, 30, 783-8.
- Parkes, J., Henzell, R., & Pickles, G. (1996). Managing vertebrate pests: feral goats. Canberra: Australian Government Publishing Service: Retrieved March 21, 2011, from http://adl.brs.gov.au/data/warehouse/mvpfgr9abr_001/mvpfgr9abr_0010111a/ggchap1_6.pdf.
- Pople, T., & Froese, J. (2012) Distribution, abundance and harvesting of feral goats in the Australian rangelands 1984-2011. Queensland Government. Retrieved October 10, 2012, from <http://www.environment.gov.au/land/publications/acris/pubs/acris-goats-report.pdf>
- Rent-A-Ruminant. (2013). Rent a ruminant LLC. Retrieved March 28, 2013, from <http://www.rentaruminant.com/index.html>
- Savory, A., & Butterfield, J. (1999). *Holistic management; a new framework for decision making* (2nd ed.). Washington DC, Island Press.

- Schuster, P. (2006). Supply profile of the Australian goat meat industry. Sydney: Meat and Livestock Australia (MLA).
- Squires, V.R. (1980). Chemical and botanical composition of the diets of oesophageally fistulated sheep, cattle and goats in semi- arid *Eucalyptus populnea* woodland community. Australian rangeland journal, 2 (1), 94-103.
- Standing Committee on Agriculture. (1982). Goats for meat and fibre in Australia. Report to the Expert Panel, Technical Report Series No. 11. Canberra: Author.
- Stokes, T. (2009). Is it feasible to increase the supply of goat meat in Australia given the nature, variability and risks in the market? Unpublished degree dissertation, University of New England, Armidale, NSW.
- Taylor, C.A., & Fuhlendorf, S.D. (2001). Contribution of goats to the sustainability of Edwards Plateau rangelands; an overview of goat foraging research conducted by the Texas Agricultural Experiment Station. Technical report 03-1, Texas, USA: Agricultural Research Station.
- Van den Berg, L. (2011). Visual landscape changes after 43 years of fixed seasonal grazing in the Eastern Upper Karoo. Grootfontein Agricultural Development Institute (GADI). Volume 11, No 1, 2011. Retrieved November 8, 2012, from http://gadi.agric.za/Agric/Vol11No1_2011/bergkamp.php
- Voth, K,. (2010). Livestock for landscapes. Retrieved November 8, 2012, from <http://www.livestockforlandscapes.com/>
- Warman, K. (2001). Dietary study of herbivores in Mulga lands. The Mulga Line, 08/2001. Qld: Department of Primary Industries.
- Wilson, A.D., & Mulham, W.E. (1980). Vegetation changes and animal productivity under sheep and goat grazing on an arid Belah (*Casuarina cristata*) - Rosewood (*Heterodendrum oleifolium*) woodland in western New South Wales. Australian Rangelands Journal, 2, 183-188.

Plain English Compendium Summary

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Objectives	<ul style="list-style-type: none"> • To isolate and simplify the principles of good goat grazing management in arid areas. • To identify opportunities for the Australian rangeland goat industry
Background	<p>The Australian rangeland goat industry is based on a feral goat herd of approximately 3 million that continues to grow despite continued increased harvesting for slaughter. Increasingly, goats are kept in a loosely domesticated way on extensive pastoral properties and their grazing is being managed.</p> <p>Goats eat a wider variety of vegetation than other livestock and so have the ability to denude a landscape if confined. Their preference for browsing woody plants rather than grazing on grass also gives them the ability under good management to improve the state of rangelands suffering from woody weed encroachment.</p> <p>There is a limited market for small goats that are outside market specifications; this can lead to overgrazing in goat paddocks.</p>
Research	29 weeks of overseas travel to 19 countries, interviewing farmers, researchers and practitioners of ancient grazing systems. Observations of landscapes under different forms of management and natural grazing systems. Visits to 3 Australian goat processing plants and leading goat producers in Australia. Reviews of relevant literature and research.
Outcomes	<p>Good goat grazing management is founded on a thorough understanding of the physiology of the vegetation being managed and the foraging behaviour of the livestock.</p> <p>Plant rest and recovery must be an integral and uncompromised part of a grazing plan.</p> <p>In an extremely variable climate, planned grazing facilitates good management, imagination and creativity are equally important.</p> <p>Increased market stability will aid management.</p> <p>Development of a domestic market for small rangeland goats would aid both the industry and have positive environmental outcomes.</p> <p>Opportunity exists to develop a premium branded product for sale to high end consumers.</p> <p>Opportunity exists to develop and sell Australia's rangeland goat genetics.</p>
Implications	<p>Goat grazing can be positively managed in arid areas.</p> <p>The rangeland goat industry is ready for further expansion.</p>
Publications	<p>Nuffield Australia</p> <p>Western Catchment Management Authority- The feral goat industry and implications for ground cover, 2012.</p>