

ALPACAS AND ECOSYSTEMS MANAGEMENT

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ABSTRACT

Alpacas are a species that present physiological, anatomical, morphological and behavioural distinctive characteristics compared to other species used in animal production. Empirical observation of a herd, grazing under time management controlled conditions, allowed to approximate some initial observations about the effect of alpacas in the management of ecosystems. Larger green matter availability in the paddocks grazed by alpacas, evident natural weed control, better plants distribution and increasing stocking capacity were the relevant observed issues. It is considered that the special behavioural characteristics of alpacas in terms of excretion habits, low hoof pressure, food conversion efficiency and grazing habits should be factors to be rigourously studied to explore the value of alpacas as an environmentally friendly species.

Key words: Sustainable farm management; farming systems research; alpacas

Introduction

Australian agriculture operates in one of the oldest and more fragile landscapes on the Earth. It continually strives for improvements in efficiency in technological and financial terms and to rehabilitate or maintain ecosystems. Cattle and sheep are the dominant livestock species used, across some two-thirds of the landscape, but they both have limitations and adverse impacts on agricultural ecosystems, often as a result of the declining terms-of-trade.

It is believed that alpacas as a new industry in Australia may offer the opportunity to use better management of ecosystems in a regenerative and sustainable manner because of what seems to be the ecosystem friendly advantage of the species. It is argued, that grazing behaviour, excretion habits, disease-free status, low animal hoof pressure, efficiency in conversion of low quality forage, amicable temperament and wide range of natural colours in the fibre are some of the attributes that make alpacas desirable for Australian ecosystems across the different variety of farming systems.

Research on alpacas is limited at this stage (Davis, Wuliji, Moore, Pallard & Mackintosh, 1994). However the existence of an organised national industry body is creating the conditions to ensure that alpaca farming becomes one of the better-organised future farming systems in Australia

This paper builds on empirical observation of a herd grazed under time-controlled conditions from the Sustainable Farming Systems Research Group of The Faculty of Rural Management, The University of Sydney.

The History and Ecology of Alpaca Management Systems

The historical evidence of alpaca breeding in the highlands of Los Andes Cordillera indicates that these animals are grazed in fragile ecosystems, with production systems of an extensive type, and extremely primitive, due to the cultural and socio-economic conditions of the peasantry class that are the traditional owners of alpacas in Latin America. Though this seems not to have been the main characteristic of alpaca breeding when the herds belonged to the supreme Inca chief before the Spanish conquest. Alpacas were dispersed towards the highlands of South America in the XVI century, after the Spanish invasion to the Inca territories. In five centuries the decimated herd developed amazing characteristics to ensure survival in extremely hazardous ecosystems where the nutritional supply is constraining, the ultraviolet luminosity is intense, the air is rare, the low temperatures are extreme, the supply of water is limited, and breeding and health calendars are not existent at all (Lawrie, 1995; 1999; Hicks, 1996). On the other hand, the management systems favour mixed small herds of alpacas and llamas shepherded by women and children, confined over-night in small yards around the peasantry cottage for climatic, poaching and protection from predators.

The introduction of alpacas to Australia in 1987 provided an opportunity to break down myths and discover new realities of alpaca farming. Up to now the highlighting issues are:

- alpacas are able to survive and thrive in low-land ecosystems as opposed to the generalised belief that they were not able to survive out of the highlands of Los Andes;
- alpacas are able to adapt to the multiplicity of Australian ecosystems ranging from coastal ecosystems, to highlands (i.e. 1000 metres ASL), tablelands and dry plains. In general their adaptability is similar to that of sheep, where high humidity seems to be the main constraining factor;
- alpacas are sensitive to improved management practices that affect their growing patterns, reproductive capacity, productive capacity and longevity (Davis, Moore & Bruce, 1994);
- alpacas are more efficient animals than the traditional animals farmed in Australia (i.e. cattle and sheep) in terms of forage conversion because of the special characteristics of their digestive anatomy which delays the passing of forage through the alimentary canal (Costa & Vaughan, 1998; Vaughan & Costa, 1998; Lawrie, 1995, 1999); and increasing

evidence about the lower requirements of nutrients from alpacas related to other ruminant species (Van Saun 1996; Judson 1998, 2000; Lawrie 1995, 1999); and,

- alpacas seem to be beneficial to the environment because of their particular patterns of grazing, pressure on the soil and excretion habits (Hicks, 1997; Lawrie, 1999).

Considering these observations and assumptions this paper extends observations on some of the above mentioned issues from a farming systems perspective.

The Distinctive Characteristic of Alpacas

It is considered that there are anatomical, physiological, morphological and behavioural issues of the alpaca species (i.e. *Llama pacos*) that are worthy to be highlighted, being the purpose to rise research interest in those issues that may help in the evaluation of alpacas as one important option in the implementation of sustainable integrative production systems in rural Australia.

(a) Grazing behaviour: alpacas have a particular way to graze the paddock. There are several factors to consider: a *grazing time*, a *grazing method*, and a *grazing pattern*. The observed grazing time is early in the morning and early in the afternoon, with extension of the afternoon grazing time to longer hours, depending the sunlight availability and season. It seems that animals graze for longer time within the Autumn and Winter seasons than what they use to graze in the Spring and Summer seasons. The grazing method is a combination of browsing and traditional grazing where the browsing is more common than the traditional grazing. The grazing pattern goes from trees, shrubs and weeds to grasses &/or legumes in a gradually selective manner, excepting for the thistles species. It is important to highlight that if this is a common pattern of the species, this gradual selectivity has a positive effect in threatened species, and traditionally more palatable species, encouraging their robustness and re-establishment. This type of grazing pattern seems to favour native grasses, perennial grasses and highly palatable weeds. On the other hand, with this pattern of grazing the improvement of paddocks should not be solely confined to grasses and legumes.

(b) Excretion habits: alpacas deposit urine and faeces in a common place in the paddock through a uniform pattern of pile allocation. What the implications of the geographical allocation of dung piles are, is an unknown factor at this stage. However it can be said that because urine and faeces are deposited in the same pile, the biochemical decomposition and incorporation to the soil of these organic materials is highly efficient; the microfauna activity around the dung piles is remarkable. The response of the plant species around the piles in terms of vigour and productivity is evident. Within 12 to 14 months the paddocks grazed by alpacas offered a meaningful visual difference within 1 metre around the dung pile places. It was observed that the holistic management principle of high animal density and short

occupation periods (Savory & Butterfield, 1999), eventually produced a full animal fertilisation of the paddocks after 7 to 10 rotations since the animals moved the dung piles, within a specific pattern of allocation, in a regular manner within the paddocks.

(c) Low hoof pressure: alpacas have a static low weight of 39 kilo-Pascals (kPa). Sheep reports 82-kPa, cattle 185-kPa, man 85-kPa and kangaroos 46-kPa. (i.e. 1 kPa = 1 Newton = 1 kg metre /s²), (Lawrie, 1995, pers. com.). On the other hand, the soft padded foot of the alpaca does not represent a threat to the soil structure as the clawed foot of other grazing species (Hicks, 1996). Sheep drag their hooves along the ground as they walk, thus pulverising the surface structure and causing surface crust to develop.

(d) Conversion efficiency: alpacas are reported to have a longer digestive system (i.e. longer intestine) therefore delaying the excretion of the forage and increasing the absorption rate of nutrients (Vaughan & Costa, 1998) or alternatively requiring less nutrients by unit of metabolic weight (Lawrie, 1995, 1999 & Judson, 1998). Therefore, due to their most efficient conversion rate, alpacas do well on a variety of high-fibre, low-protein grasses, including native species. These native species do not require nitrogen and phosphorus fertilisers for establishment &/or survival but use most efficiently the natural fertilising conditions derived from the alpaca dung piles, extracting more N from the urine.

Observations on Alpaca Grazing

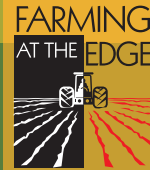
Observation of the alpaca herd within the period 1997-2001 provided the opportunity to highlight the following issues as relevant to the particular characteristics of alpaca grazing:

1 Changes in plant composition in paddocks grazed by alpacas

The pastures of two (2) hectares of experimental paddocks (i.e. 20 paddocks) were allocated to alpacas in Spring 1997 after a prior vacancy of six (6) months from sheep grazing. An initial and final monitoring of plant population, i.e. introduced and native grasses and legumes and weed varieties, was conducted at the beginning of 1998 and 2001 using "dry-weight-rank" (Mannetje & Haydock, 1963) as a component of BOTANAL method, and considering elements for the biodiversity theme protocol (Kemp, 1998). BOTANAL is a comprehensive sampling and computing procedure for visual estimation of botanical composition and herbage mass of pastures developed by Tothill, Hargraves & Jones (1992). Species were ranked first (1), second (2) and third(3) according to their estimated contribution to pasture herbage mass, where 1 is the higher value as an indication of dominance/abundance. Table 1, "Plant Species Monitoring" indicates the prevalent species at the monitoring times and the level of domain for each plant.

Table 1: Plant species monitoring

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SPECIES Common Name	SPECIES Scientific name	TYPES (P: perennial) (A: Annual)	MONITORING LEVEL 1	MONITORIN G LEVEL 2
Monocotyledonous				
Wallaby grass	<i>Danthonia spp</i>	Grass (P)	Identified (3)	Identified (3)
Wheat grass	<i>Elymus scabrum</i>	Grass (A)?	Identified (3)	Identified (3)
Bent grass	<i>Agrostis spp</i>	Grass (A)	Identified (3)	Identified (3)
Prairie grass	<i>Bromus unioloides</i>	Grass (A)	Identified (1)	Identified (2)
Cocksfoot	<i>Dactylis glomerata</i>	Grass (P)	Identified (2)	Identified (1)
Couch grass	<i>Cynodon dactylon</i>	Grass (P)	Identified (3)	Identified (3)
Paspalum	<i>Paspalum dilatatum</i>	Grass (P)	Identified (2)	Identified (2)
Phalaris	<i>Phalaris tuberosa</i>	Grass (P)	Identified (1)	Identified (2)
Red grass	<i>Bothriochloa macra</i>	Grass (P)	Identified (3)	Identified (3)
Ryegrass	<i>Lolium spp.</i>	Grass (P/A)	Identified (2)	Identified (1)
Silver grass	<i>Vulpia spp</i>	Grass (A)	Identified (2)	Identified (3)
Spear grass	<i>Stipa spp.</i>	Grass (P)	Identified (3)	Identified (3)
Barley grass	<i>Hordeum leporinum</i>	Grass (A)	Identified (3)	Non- identified
Wire grass	<i>Aristida spp</i>	Grass (A)	Identified (3)	Identified (3)
Yorkshire fog	<i>Honchus lanatus</i>	Grass (P)	Identified (2)	Identified (1)
Ripgut	<i>Bromus diandrus</i>	Grass (A)	Non-identified	Abundant (2)
Finger Rush	<i>Juncus subsecundus</i>	Rush (P)	Identified (3)	Identified (3)
Dicotyledonous				
Blackberry	<i>Rubus fruticosius</i>	Weed (P)	Identified (2)	Minimal (3)
Black thistle	<i>Cirsium vulgare</i>	Weed (A)	Identified (3)	Identified (3)
Burr medic	<i>Medicago polymorpha</i>	Weed (A)	Identified (1)	Identified (3)
Cut-leaf medic	<i>Medicago laniniata</i>	Weed (A)	Non-identified	Abundant (2)
Cotton fireweed	<i>Senecio quadridentatis</i>	Weed (A)	Identified (3)	Identified (3)

Crowsfoot	<i>Erodium spp</i>	Herb (A)	Identified (3)	Identified (2)
Curly dock	<i>Rumex crispus</i>	Weed (A)	Identified (3)	Identified (3)
Flaxleaf leebane	<i>Conzya bonariensis</i>	Weed (A)	Identified (3)	Identified (3)
Horthorne		Weed (P)	Identified (2)	Identified (3)
Indiansedgemustard	<i>Sisymbrium officinale</i>	Weed (A)	Identified (3)	Identified (3)
Joyweed	<i>Alternanthera nana</i>	Weed (A)	Identified (2)	Identified (3)
Plantago	<i>Plantago spp</i>	Weed (A)	Identified (3)	Identified (3)
Marshmellow	<i>Malvia parvifolia</i>	Weed (A)	Identified (2)	Identified (3)
Paterson curse	<i>Echium plantagineum</i>	Weed (A)	Identified (3)	Decreased (2)
Skeleton weed	<i>Chondrilla juncea</i>	Weed (A/P)	Identified (3)	Identified (3)
Slender dock	<i>Rumex brownii</i>	Weed (P)	Identified (1)	Minimal (3)
Sowthistle	<i>Sonchus oleraceus</i>	Weed (A)	Identified (3)	Non-existent
Vetch	<i>Vicia spp</i>	Legume	Non-identified	Identified (3)
White clover	<i>Trifolium repens</i>	Legume	Identified (3)	Identified (3)

A benchmark with neighbouring paddocks (of similar characteristics in terms of soil and pastures) grazing cattle, under a cell grazing, holistic management approach, at a density of 4 DSE/acre showed at the time of the final monitoring in the alpaca paddocks an increase in perennial grasses, specially the highly nutritious cocksfoot, at the expense of annual grasses, the resurgence of depleted native grasses, and the abundance of other palatable herbs like crowfoot, as well as the decline in weeds, i.e. joy weed and burr medic, and undesirable annual grasses i.e., barley grass and silver grass. Also there was a meaningful reduction in the population of Paterson curse, blackberries and horthorne. The different varieties of thistles seem to be a particular species to which alpacas do not show interest (after the second year of the trial these weeds were manually controlled).

2 Changes in stocking density in the alpaca paddocks

Figure 1, *Stocking densities in alpaca grazing*, indicates the changes in stocking density within the three years of the experiment. These data were recorded in a per-semester basis using a holistic management-grazing chart.

The initial stocking density was estimated at 3 DSE/acre (or 7.5 DSE/ha). A DSE equivalent was considered to be a 40 kg live-weight dry sheep equivalent animal. The stocking density at the end of the experiment was 9 DSE/acre (or 13.5 DSE/ha). The used average weight per alpaca was 60 kg (Charry 2001, pers. com.).

A holistic management approach to grazing management similar to that described by Savory & Butterfield (1999) and TCF (1999_{a,b,c} & 2000) was implemented for paddock utilisation. The occupancy of the paddocks in the non-growing season was 8 to 10 days with an average resting time of 152 days. The occupancy of the paddocks in the growing season was 3 to 5 days with an average resting period of 60 days. The decision criteria to move animals between paddocks were length of plants and/or biomass presence.

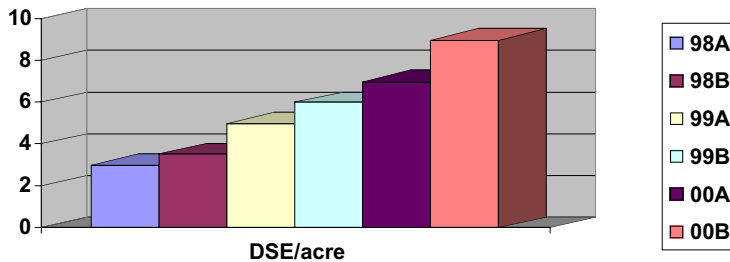


Figure 1: Stocking densities in alpaca grazing (1998-2000)

3 The beneficial effect of alpacas in ecosystems management and biodiversity enhancement

Definitely there was an observed positive effect in the paddocks grazed by the alpacas. A sustained effect in plant composition and soil conditions can not be argued since agronomic parameters were not strictly considered at the beginning of the experiment. However from the perspective of farming systems, it may be argued that there is a strong evidence to confirm that alpacas are an environmentally friendly species. The observed modifications in the overall ecosystem, with the positive advantage of an increased stocking density over time, take us to consider that there are four issues, amongst those that have been scientifically (Costa & Vaughan, 1998; Davis et al. 1995; Vaughan & Costa 1998, and Judson 1998, 2000; Van Saun 1996) and empirically (Lawrie 1995 & 1999, and Hicks 1996) argued about alpacas

as beneficial to ecosystems management, and considered relevant to have a positive effect in the viability and enhancement of ecosystems and biodiversity.

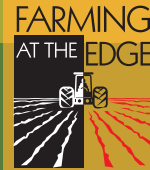
Conclusions

No conclusions may be advanced in agronomical terms about pastures and soil since the purpose of the herd management was not agronomic but systemic. However, within this framework relevant characteristics of the alpaca species are highlighted with the purpose to encourage further exploration to improve hypotheses that alpacas are environmentally friendly, and that they affect the viability of the ecosystems under their grazing in a positive manner. The appearance of new plant species, not identified in the initial paddock inventory, and decline in undesirable weed species, seems to indicate that grazing behaviour of alpacas does lead to a more uniform grazing pattern across a range of species *i.e.* reduced selectivity. This reduced selectivity allows the utilisation by the alpaca species of plants that are not used by other species. It is probable that the excretion habits of alpacas create new patterns of biodiversity within the paddock with increased productivity of the area and improvement of the overall microfauna of the ecosystem. It remains as a worthwhile issue to explore, the particular pattern of excretion, and the setting of dung piles within the paddock. The increased stocking density over time in the alpaca paddocks seems to be an early indicator of the beneficial effect of the alpacas on the biodiversity and ecosystem enhancement in the paddock.

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