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MEAT & LIVESTOCK AUSTRALIA PRODUCER INITIATED RESEARCH DEVELOPMENT

PIRD 2006/S05: Final report

Forward Thinking Sheep Group

Do alpacas reduce lamb predation?

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Introduction

In addition to being a major animal welfare concern, fox attacks on newborn lambs cause substantial economic losses to the sheep industry (Mahoney & Charry 2005). Australia-wide, foxes cost around $230m in livestock and biodiversity losses, and in control methods (Fleming *et al.* 2006). Lamb producers across Australia are keen to determine the effectiveness of using guard animals, such as alpacas, to reduce fox predation of lambs. Hence, the Forward Thinking Sheep Group was formed to undertake a series of on-farm trials to investigate the effects of using alpacas as lamb guardians.

Alpacas are hardy, intelligent, and gregarious animals that respect fences, bond with domestic livestock, and have strong protective instincts, especially against canines (Jenkins 2003, AAA 2006). Alpacas defend themselves and their flock by chasing predators away, or running them down and stamping on them using the forelegs, often with fatal consequences to the attacker (Mahoney & Charry 2005).

Alpacas are relatively undemanding to manage on a commercial farm, and have a range of benefits as grazing animals in terms of woody weed control, low hoof pressure, high feed conversion efficiency, and carry a low disease burden due to their excretion habits (Charry *et al.* 2003). Alpacas are an industry in their own right, with the South Americans using them as a source of fibre, meat, hide and organic fertiliser (Mahoney & Charry 2004). However, due to the current relatively low value of alpaca fleece in Australia, there is a significant market in selling castrated males as stock guards.

Guard alpacas are relatively expensive ($500-750) and so to be economically viable their effectiveness at reducing lamb losses must be significant. There is some anecdotal evidence that alpacas can effectively guard lambing ewes from foxes (and other predators) but it is not clear to what extent this occurs, and whether it is an economically sound practice (Mahoney & Charry 2004). This ambivalence is exacerbated by a range of conflicting anecdotal information provided even by the alpaca industry, with some industry leaders claiming alpacas have no guarding ability (such as Evans, 2004, quoted in Mahoney & Charry 2004), while others, such as Lawrie (2006), a large scale alpaca breeder, claims to have sold alpacas as guards to lamb producers for 12 years with no complaints from buyers regarding their lack of effectiveness. Dalgleish (2008) reports that he has sold over 500 alpacas as herd guards, with only 11 being returned to him and been replaced through his effectiveness guarantee. In the USA, where llamas are more

commonly used than alpacas as guardians of sheep against coyotes, stock losses are typically halved compared to unprotected flocks (Franklin & Powell 1994; Mahoney & Charry 2005), Dalgleish (2008) claims this level of improvement is possible with alpacas in Australia (for example, one flock with 96% lambing percentage increased to 173% with the addition of one alpaca).

The optimal ratio of sheep to alpacas is not evident from the literature or from experience within local farming networks, making alpaca purchasing decisions more difficult. Mahoney & Charry (2004) found an increase in weaning percentage of 13% when running two alpacas per flock of 1,500 ewes when compared to the control group of no alpacas. This positive effect was not as evident in smaller flocks of 300 lambing ewes where the weaning percentage was only increased by 5%.

A further study using 1500 head flocks by Mahoney & Charry (2005) found survival in the control group was 69% compared to the guarded groups' 83%. This study provided further evidence to the benefit of alpacas as guards quantifying an additional annual income of $845 per 100 lambing ewes (based on weaner values of $65 per head). Given the working life of a guard alpaca is perhaps 15 years, this study suggests alpacas are a sound investment to increase lamb survival.

However, their use of two alpacas in 1,500 sheep flocks goes against the advice of Jenkins (2003) who believes that one alpaca is required per 100 sheep or per 20ha. Franklin & Powell ran a similar study with llamas in 1994 and suggest only one llama per group, and that one llama could effectively guard 2,100 sheep.

Alpacas are highly social, especially with other camelids. Mahoney & Charry (2004) mention the importance of keeping flocks with alpaca guards well separated – perhaps two hectares apart – to prevent alpacas spending significant time socialising with neighbouring alpacas. These authors claim that no more than two alpacas should be used together in single flock. On the other hand, single alpacas are known to fret if left on their own with a group of sheep, which may pose an animal welfare concern. Anecdotal evidence suggests that using three or more alpacas per paddock as guards carries the risk of alpacas forming a species mob and ignoring sheep. This is supported by Jenkins (2003) and Mahoney & Charry (2004). On the other hand, some alpaca studs who also run sheep claim that running larger groups of female alpacas (over six or so) with sheep is particularly effective at keeping out all animal trespassers, including kangaroos and

birds of prey, and this is also supported by Jenkins (2003). This is in agreement with Lawrie (2006), who believes that the most aggressive guards are older females.

Protective instincts in alpacas are not fully developed until about two years of age (Jenkins 2003) when they begin to develop territorial instincts (Franklin & Powell 1994). Entire males should not be used as guards as they are likely to attempt to mate unjoined ewes, with potentially fatal consequences for the sheep.

Both Jenkins (2003) and Mahoney & Charry (2005) mention the importance of alpaca health to optimise guarding ability. They particularly mention keeping the eyes of the alpacas exposed by clipping excess fleece away (if necessary), as wool-blind alpacas are significantly handicapped in their ability to observe small objects in the distance, such as an approaching fox.

Unfortunately, few studies attempt to determine the proportion of lamb deaths that are directly caused by fox attack, relative to deaths due to cold, starvation, dystocia or abandonment (Franklin & Powell 1994; Mahoney & Charry 2005). Further, the carcasses of lambs that have died from natural causes may be desecrated by foxes (and birds of prey), meaning that while many dead lambs may carry evidence of predator attack it is not clear whether the predator was the cause of death (Holst 2004). In Iowa and Texas, intensive studies have found that around 40% of lamb losses are caused directly by predators (Franklin & Powell 1994); and it is likely that similar rates occur in Australia. Hence, the importance of *post mortem* examination is evident, a key component of this study. Some producers report that the presence of alpacas increases the number of dead lambs found (Dalgleish 2008), but this is most likely to be largely due to foxes not being able to enter the paddock to remove lambs that have died of natural causes.

The producers involved were all forward-thinking commercial sheep producers who have integrated alpacas into their lambing systems. All have experienced significant lamb and ewe losses from predators, particularly foxes, and have turned to alpacas as an additional tool to baiting and shooting foxes in the belief that losses will be reduced.

The objectives of this project were:

- Identify the number of lamb deaths to predators (versus natural death) and identify the economic cost of these losses

- Measure weaning weights and percentages and compare between groups and averages

- to determine if the use of alpacas affects the number of losses of lambs

- Determine the effectiveness of single-alpaca guards versus paired or multiple guards

- Determine the increased value in lamb production (kg/ha) from the different scenarios and compare with district averages

- Estimate return on investment of purchasing alpacas as guardians at today's prices

- Commence systems to record weaning weights and percentages for group members to use as benchmarking tools so that progress can be reviewed from season to season

- To improve animal welfare standards in line with community expectations

This project aimed to provide participants with a replicated study to determine the most effective systems for using alpacas as guards against predator attacks, including foxes and crows. The results have not been influenced by any vested interests (for example, alpaca industry groups) by ensuring that no alpaca breeders were involved in the project.

In addition, this project empowered producers to take greater control of their lamb production systems through improved record keeping, greater monitoring of day-to-day events during lambing, and provided an opportunity to learn basic *post mortem* examination skills to determine common causes of death among lambs. This study may also have highlighted other areas of sheep management system that need refinement to minimise losses of lambs between birth and weaning.

Methodology

Potential participants for the study were contacted by telephone during the summer of 2006. Participants were located largely by word-of-mouth, and some by contacting alpaca studs and receiving details of animal sales. A survey ("Current use of alpacas survey", Appendix 1) was sent to all participants to gauge current opinion of the effectiveness of alpacas as stock guards, and to record predation history and control strategies.

The initial workshop for those undertaking the on-farm trial was conducted at Woodside in May, 2007, where producers reviewed and refined the methodology, procedures and recording system requirements previously circulated. It also provided the opportunity to share ideas and experiences, and for Productive Nutrition to explain autopsy procedures, using the *Lamb Autopsy* manual (Holst 2004). Training for one participant, who commenced lambing in May, was completed on a one-on-one basis in late April to 'road test' the methods.

Each participating property split their lambing ewes into two to four flocks depending on their property size and infrastructure, with each flock considered one treatment. Flocks, each of similar size and breed of ewe, were allocated to similar sized paddocks with similar aspect and predator cover. Alpacas were introduced to the flock at least four weeks before lambing to bond, as advised by Jenkins (2003) and Lawrie (2006). Participants continued baiting foxes during the experimental period as per normal farm practice.

During the lambing period, flocks were regularly monitored (daily where possible) to count numbers of lambs and to determine the levels of predation on lambs and ewes. The cause of death of animals (eg fox attack, crow attack, natural causes) and any post-death predator damage were recorded, with *post mortem* examination of lambs using Holst (2004) where possible.

Data recording sheets were prepared by Productive Nutrition and distributed to all participants – see Appendix to this report. The completed sheets were collected after lambs were weaned.

Results

Of approximately 30 producers that were contacted over summer 2007, 16 committed to undertaking the "current use of alpacas survey" (either written or over-the-phone) with six formally committed to the on-farm study component of the project. The main reasons for the decline in number of participants included:

- excessive workload required by the project
- cessation of running sheep in favour of cropping
- decision to not lamb in 2007 due to drought
- inability to run multiple mobs of sheep

- not willing to have a control group, that is, without alpacas as guardians
- "already knew the answers"
- suspicious of participating in an activity that seemed an invasion of privacy

Several group members unable to participate in the on-farm trial provided input to the study where possible and were keen to take part in the reporting, learning and evaluation processes.

The "current use of alpacas survey" was returned by 15 participants. The following results emerged:

- a mean of 1140 sheep per surveyed property
- producers had used alpacas for 3.7 lambings
- all but two properties baited foxes, and half of surveyed farms used shooting as a control measure
- marking percentages were 92% before using alpacas, and 101% lambing after
- all but one producer were happy with their alpacas' performance, but some thought that efficacy would be improved with smaller paddocks
- producers were divided in their opinions between running one or two alpacas, although two producers with large flock sizes ran up to four per flock
- only one producer would not recommend alpacas to others
- purchase price for castrated male alpaca was in the range $200-750, averaging $472
- half of the producers believed that alpacas should be cheaper; the average suggested value was $300, but opinion ranged between $50-600

Improvements in lambing success varied between properties; the two Yorke Peninsula properties observed no change but were sure that alpacas did reduce predation, while one producer in the Mount Lofty Ranges observed weaning rates increasing from 99% to a consistent (over five years) rate of 120%.

Another producer had purchased alpacas to guard commercial, free-range poultry, and was extremely satisfied with the results, especially the reduction in losses to birds of prey. This producer said they would recommend alpacas to other poultry producers.

In determining numbers of alpacas per group, the survey participants were divided. About half believed that two alpacas were required, both for their own welfare and to increase the effectiveness of fox deterrence. Producers used various methods to decide on how many alpacas per group – some studied the literature, others asked for advice, some compared alpaca behaviour over the years, and some went on 'gut-feeling'. Others were limited in the number of alpacas they owned simply because they felt they could not afford to buy any more. One producer had an alpaca die of snake bite just before the lambing season, so only had one left to use. Snake bite is a not an uncommon cause of death in guardian alpacas or llamas (Franklin & Powell 1994).

None of the properties in the study undertook pregnancy scanning, although one normally did. For the others, pregnancy scanning was not part of normal farm practice and would have required considerable expense and additional handling.

Four producers participated in the on-farm study and collected the required amount of data, but this reduced number significantly reduced the statistical power of the project. However, it was decided to continue with the remaining producers as one had already started and the others were keen to undertake the study. For confidentiality reasons, the four properties that undertook the on-farm study are identified as properties 1, 2, 3 and 4.

Across the four properties, 2635 ewes produced a total of 2,687 lambs, of which 392 lambs died before marking. Properties reported an overall weaning rate of 102.3%, with 14.5% fatality rate. The four groups with the highest lambing percentage were all guarded by a single alpaca. Lambing success per treatment group across all properties are displayed in Table 1.

Table 1: Lambing statistics across all properties ('Death %' is calculated as the proportion of dead lambs per number of lambs born).

Alpacas	Mobs	Ewes	Lambs	Lambing %	Deaths	Death %	Weaning %
0	2	890	791	89%	185	23%	89%
1	9	1372	1440	105%	136	9%	115%
2	3	373	456	122%	71	16%	103%
TOTAL	**14**	**2635**	**2687**	**102%**	**392**	**14.5%**	**102%**

However, these data are confounded as Property 4, which had two control groups, had overall lower lambing percentages than the other farms. In fact, this property had lower

lambing percentages in the guarded group, just 67%, compared to the unguarded groups of 89%. Detailed results for each property are described below.

Property 1

Lambing commenced in early May at this Mount Lofty Ranges property, running Merino-cross ewes. There was not a strong link on this property between losses and weather conditions. However, there was a tendency for greater numbers of fox baits to be taken on days when more lambs were attacked, suggesting a link between fox activity and bait taking. Table 2 shows the summary of lambing data.

Table 2: Lambing success at Property 1

Alpacas	Ewes	Lambs	Lambing %	Deaths	Death %	Weaning %
1	172	205	119%	32	16%	119%
1	165	219	133%	30	14%	133%
2	183	210	115%	19	9%	115%

The group with the highest weaning percentage was guarded by one inexperienced alpaca. Greater numbers of ewes died in the treatment group with two alpacas (nine, compared to five in the other groups), but there was no clear link other than the group with more ewes deaths contained the oldest ewes (up to ten years old).

Approximately half the lambs on this property that were examined *post mortem* showed evidence of predatory damage, however predation (fox and/or eagle) was the primary cause of death in only about one-quarter of the cases, with eagles associated solely with about 10% of deaths.

Expected financial returns for each lambing group appear in Table 3. The lambs on this property were sold at a carcass weight of approximately 24kg for about $3.10/kg several months after the trial was completed. There was no loss of lambs after weaning.

Table 3: Approximate financial returns per hectare at Property 1. The average financial return for the groups with a single alpaca was $789/ha.

Alpacas	Paddock area (ha)	Live lambs	Return/ha ($)
1	20	205	$763
1	20	219	$815
2	20	210	$781

These financial data suggest that using a single alpaca was most cost effective on this property. This property had no neighbours with sheep and no neighbours controlling foxes. However, a large abattoir is located across the road from the group that was guarded by two alpacas, and it is not clear whether this had a significant effect on fox movements and subsequent lamb survival and financial return.

Property 2

Lambing of crossbred ewes commenced on this Mount Lofty Ranges property in early August. The property had six lamb deaths from a mating of 46 ewes (13% deaths). None of the dead lambs had been attacked by predators, except for one which had an eye attacked by crows several days after death. The results of three autopsies were returned, with causes of death being primary exposure, misadventure and one lamb being born with no backbone. These sheep were kept as a single group so a comparison could not be made between treatments. However, the neighbouring property that lambed at a similar time had lamb losses of over 30%.

Property 3

This Mid North property commenced lambing of crossbred ewes in early August. There was no measured effect of the presence of alpacas on weaning weight, with mean weight of 36kg. This property achieved 154% lambing in two groups guarded by a single alpaca, with overall lambing percentage of 140% for three groups each guarded by one alpaca, and 151 % for the group guarded by two (Table 3). The lamb mortality rate per ewe (35%) was highest in the group guarded by 2 alpacas. This group lost 21 lambs in one night and it is suspected that stray dogs may have been responsible, and may have confounded the result from the group guarded by 2 alpacas. This is accounted for in the revised "2-dog" figures in Table 4, which shows that regardless of the impact of the stray dogs, the two alpacas were less effective than any of the single-guard groups.

Table 4: Lambing success at Property 3 (2-dog accounts for the suspected dog attack)

Alpacas	Ewes	Lambs	Lambing %	Deaths	Deaths %	Weaning %
1	26	40	154%	6	15%	130%
1	72	87	121%	3	3%	116%
1	82	126	154%	7	6%	145%
2	95	143	151%	40	28%	92%
2-dog	*95*	*143*	*151%*	*19*	*13%*	*107%*

The closest neighbour to this property lambed in autumn with some level of fox control, which may have mean that local fox numbers were slightly lower at lambing time.

The average weight of lambs on this property at weaning was 36kg. Table 5 shows the estimated financial returns per hectare for each mob, assuming a carcass weight of 20kg worth $3/kg.

Table 5: Approximate financial returns per hectare at Property 3 The average financial return for the groups with a single alpaca was $414/ha

Alpacas	Paddock area (ha)	Live lambs	Return/ha ($)
1	5	40	$480
1	20	84	$252
1	14	119	$510
2	17	103	$364

These returns largely reflect the different stocking rates between mobs, which varied between 3.6 and 5.9 ewes/ha. Given the lower lambing percentage in the group guarded by two alpacas, it is evident that on this property, a single guard is more cost effective. However, this may be associated with the very small mob sizes on this property, where the largest group was 95 ewes.

Property 4

This Mount Lofty Ranges property, grazing all Merinos, began lambing in the middle of July. The lambing statistics appear in Table 6.

Table 6: Lambing success at Property 4

Alpacas	Ewes	Lambs	Lambing %	Deaths	Deaths %	Weaning %
0	560	497	89%	110	22%	88.8
0	330	294	89%	75	26%	89.1
1	560	377	67%	58	15%	67.3

There was some relationship apparent between weather conditions and the incidence of lamb deaths. On days of higher rainfall (>5mm) and windy conditions there tended to be more lamb fatalities due to exposure (based on *post mortem* examination), and greater numbers of deaths tended to occur in less sheltered paddocks. About half the lambs that were dead appeared to have been attacked by foxes or eagles after death, rather than predators being the primary cause of death. The neighbouring properties lambed about

two months later, meaning that fox numbers were likely to be high at this property especially given baiting was not practiced.

Estimating a useful financial return on this property is difficult given the greatly varied stocking rates (8-19 ewes/ha). Being a self-replacing Merino flock, for the sake of illustrating financial returns (Table 7) it was assumed the value of a lamb as $50 (that is, a mid-point between sale price of wethers and cost of buying in ewes) and also assumed no loss of lambs post weaning, which is usual for this farm.

Table 7: Approximate financial returns per hectare at Property 4; the average financial return for the groups with two control groups was $659/ha or $44 per ewe

Alpacas	Paddock area (ha)	Ewes	Live lambs	Potential return/ha
1	70	560	377	$269
0	30	560	497	$828
0	30	330	294	$490

While feed supply was not limited, lamb production per hectare was less in the treatment group due to significantly lower numbers of ewes. However, the return per hectare is also lower in the guarded group, which more reflects the lack of lambing success among the ewes than a higher rate of predation.

Discussion

Guard animals are one part of a holistic approach to reducing the effects of fox attacks, and must be used in conjunction with other methods such as shooting and poisoning (Fleming *et al.* 2006). Given lamb prices of $65 per head a producer only needs to market 10 additional lambs to cover the current cost of one alpaca.

The majority of the findings of the survey were similar to the results of Franklin & Powell (1994) in the USA with llamas. This suggests that research conducted using llamas may be appropriate for Australian farmers using alpacas, and may also suggest that llamas may be more suitable as guards than alpacas. Several producers commented in the surveys that they observed alpacas sticking to fencelines and not keeping close to the sheep; Franklin & Powell (1994) however believe this is an important part of defence through situational awareness, and that should a predator or trespasser approach, most llamas or alpacas will immediately turn to defend their flock. Dalgleish (2008) believes

that producers should consider swapping alpacas between their paddock mates until an effective team is established; of course, this requires additional observations and work on the part of the producer.

Overall, it is clear that there is insufficient information available for the average Australian sheep producer to identify the best methods of protecting lambs from predator attack. Unfortunately, this study has not added a great body of information to this small pool of knowledge due to the ultimately small sample size, and numerous confounding factors across and between properties.

The lack of pregnancy scanning on these properties was unfortunate in terms of preventing an accurate understanding of lambing potential being established. Several of the producers who were initially interested in the project but did not participate in the on-farm trial did plan to undertake scanning. However, given the thorough monitoring and recording of lambing, lamb fatalities and presence of lamb body parts, it is reasonable to assume that few lambs died or vanished unaccounted for.

While the data, when averaged across all properties, suggested a benefit in using two alpacas per group, this was largely due to one farm (Property 4) running large numbers of Merinos and experiencing comparatively poor lambing results. Weaning percentage was highest in the single guarded groups, and the death rate was just 9%, two and a half times lower than that of the unguarded groups. This suggests that factors such as ewe age played a greater part in the lower lambing percentage, and that the single alpaca did a sterling job of significantly reducing predation by foxes and eagles, but not sufficiently so to produce highest financial returns. This property highlighted the risks associated with calculating benefits based entirely on gross margins per hectare, as the low lambing rate played a much greater role in financial returns, given the very low loss of lambs to predators.

Property 1 had a similar result, with a death rate of 9% in the group with two guards, and 14% in the mobs with single alpacas. Given in each case that about half the fatalities were due primarily to predation, it is quite sensible to conclude that two alpacas are better than one in terms of limiting predation, and one is certainly better than none.

However, on Property 3, the group guarded (or maybe not guarded in this case) by two alpacas had the worst rate of lamb deaths, even after the effects of a probable dog

attack are allowed for. While alpacas and llamas are effective at preventing fox attacks, they are far less able to defend against dogs, due to the less nervous and more aggressive nature of domesticated dogs (Franklin & Powell 1994; Jenkins 2003), and the likelihood that they attack in numbers. Therefore it is vital that farmers planning to use alpacas as guards are aware that they are fox guards, rather than defenders against canines in general.

One participant believes that alpaca do not so much "protect" the sheep, rather that they have an intense dislike of canines. While this is debated by the literature, where it is generally argued that a guard alpaca sees the sheep as part of their territory, the exact *modus operandi* of guardian alpacas is not clear, and perhaps needs to be better understood to allow better selection of potential guard animals.

The difference in performance of individual alpacas as sheep guards may also be due to inherent differences between animals such as with sheep dogs; some animals may not be suitable as sheep guards due to temperament or other as yet unidentified factors. This study did not take account of or investigate these differences, but these authors and Dalgleish (2008) believe that research is needed to develop a simple 'screening' system to identify potentially reliable guard alpacas.

Based on the finding of Mahoney & Charry (2005) that alpacas as guards result in additional income of $845 per 100 ewes, purchasing wethered alpacas for $400-550 appears to be a sensible investment given they live for 20 or more years, and can be expected to have a working life as a guardian of 15 years (AAA 2006). This study, however, would add that ensuring other methods of fox control are maintained is vital, and the cost of these (1080 bait, ammunition, licences for fire-arms, fuel cost for spot-lighting) needs to be considered.

To confirm the benefits of using alpacas as guards, a much larger and more intense study needs to be established, replicated across several properties and over at least three seasons. While this on-farm study has produced useful results, and no doubt assisted the participants in understanding their system, a larger study is required to produce reliable results. The use of alternative methods for reducing predator attack on livestock is growing internationally, but in many cases with little scientific evidence. As the welfare of animals becomes a greater issue with various groups expressing concern over high loss

of lambs, high-quality research is needed to prove or disprove the many different perspectives on how to reduce predation of livestock.

Conclusion

Producers appear reluctant to commit to projects that require additional work, as evidenced by the progressive dropout rate from this project, although they are keen to find answers to practical questions. This poses some difficulty under the current outline of the PIRD program. It is clear from this study that a larger and more complex study is required to answer what might seem to be a simple question.

Based on lambing percentages, and the experiences reported in the surveys, it is reasonably evident that using alpacas as guardians reduces predation of lambs, and are indeed cost effective. It remains unclear how many alpacas are needed to guard a mob of ewes and lambs, although one per group appears highly effective in the small flocks (<600 ewes) that participated in this trial. Further research is required, under more controlled conditions, to better understand the use of sheep guards in Australian conditions.

Due to the complexity of managing such an experiment, and the gradually increasing amount of research supporting the use of alpacas, we believe that MLA should consider alpacas to be a useful tool in predation control, and encourage producers to consider using them as part of multi-faceted, holistic approach to improving weaning rates across Australia's sheep flock.

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