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Estimating the Economic Value of Australian Stock Herding Dogs

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KEYWORDS

animal welfare, canine value, farm economics, owner survey, stock herding, working dog

ABSTRACT

This study aimed to estimate the value of the typical Australian herding dog in terms of predicted return on investment. This required an assessment of the costs associated with owning herding dogs and estimation of the work they typically perform. Data on a total of 4,027 dogs were acquired through The Farm Dog Survey which gathered information from 812 herding dog owners around Australia. The median cost involved in owning a herding dog was estimated to be a total of AU$7,763 over the period of its working life. The work performed by the dog throughout this time was estimated to have a median value of AU$40,000. So, herding dogs typically provided their owners with a 5.2-fold return on investment. When respondents were asked to nominate the maximal, one-off, veterinary expenditure they would consider to remedy an illness or injury for an especially valued dog, the median response was AU$1,001–2,000 which is not concordant with the dogs' calculated median lifetime value. The current findings equip working dog owners with useful information to make financially appropriate expenditure decisions related to their working dogs. This is expected to increase farm profitability and improve welfare for farm dogs.

Introduction

Australia has approximately 91,000 livestock producers (Australian Bureau of Statistics 2012b) each of whom employs an average of three working dogs to assist with their stock handling requirements (McNair Ingenuity Research Pty Ltd 2012). The contribution of these dogs, according to Australian lore, is considerable (Parsons 2010). However, a quantification of the value of the stock herding dog to the livestock industries has not previously been achieved.

To maximise profitability, producers must be cognisant of the cost of production and make investment decisions based on the expected financial returns (Kumbhakar & Bokusheva 2009; Hall *et al* 2012). Herding dog ownership represents an investment into farm labour efficiency. Therefore, expenditure decisions associated with the care and upkeep of working dogs should be informed by knowledge of the value of these animals. In this way, the welfare of the farm working dog is intimately linked with their

perceived value. Although some producers have affection and respect for their working dogs (Savalois *et al* 2013), these emotional factors may not be sufficient to justify expenditure on these animals. A recent exploration of the attitudes of dairy farmers revealed that, although many of the study participants recognised their cows as having an intrinsic value beyond production, the cost-effectiveness of treatment intervention was the factor most likely to influence the farmers' intention to take action on the health of their herd (Bruijnis *et al* 2013). Similarly, 39% of livestock producers surveyed by Jensen *et al* (2009) cited the cost of veterinary care, relative to the value of the animal requiring treatment, as an obstacle to using these services. Therefore, an exploration of working dog value may have implications for farm dog welfare. As a potentially valuable resource, dogs may merit a level of care reflective of their economic value to the farm enterprise, regardless of the emotional attachment of the dog owner.

The goal of the present study was to estimate the net economic worth of the Australian stock herding dog. Additionally, we hoped to gain some insight into the way farmers currently perceive the worth of their stock dogs by assessing financial decisions that directly affect their dogs. A questionnaire was constructed for Australian stock herding dog users to collect the necessary data for these estimations.

Materials and methods

The Farm Dog Survey was designed to investigate many areas of farm dog usage and management and the characteristics and views of their owners. However, for the purposes of estimating the economic value of herding dogs, respondents were asked approximately 20 questions associated with the cost of acquiring and maintaining their dogs, the time invested in training them and the dogs' workload and longevity.

The questionnaire

The online version of the Farm Dog Survey was administered for a three-month period from 10 March to 10 June 2013. All promotional materials indicated that a hard copy of the survey could be provided to participants with a reply-paid envelope if they requested one by telephone. Approval for this study was granted from the University of Sydney Human Research Ethics Committee (Approval number 15474).

The target population for the survey was all stock herding dog users in Australia. Participation was encouraged with an incentive in the form of the opportunity to win commercial working dog food in a prize draw at the end of the survey period. An introductory message gave participants the option to respond anonymously and the assurance of confidentiality if they chose to leave their details to enter the prize draw.

A link to the online questionnaire was posted on the websites of the University of Sydney, Meat and Livestock Australia and the Working Kelpie Council of Australia (WKCA). It was advertised through stories in multiple, rural newspapers, on two television programmes and in two agricultural magazines with Australia-wide distributions. The committee of the 2013 Casterton Kelpie Auction (CKA, one of Australia's leading working dog auction events) promoted the survey in a mail-out to past and present vendors and purchasers. The researchers also recruited survey participants, in person, at herding dog trials during the study period.

Prior to publication of the questionnaire, advice was sought from members of the Working Kelpie Council of Australia (WKCA) to ensure that the question terminology was appropriate for the target audience. A pilot distribution of the survey to 125 solicited participants led to some minor modifications prior to widespread distribution.

The online version of the Farm Dog Survey was constructed using the survey system Qsmart (Torque Management Systems Limited, Auckland, New Zealand). The entire questionnaire had a maximum of 143 items divided into ten sections. However, participants had fewer questions to answer if they responded in the negative to questions about certain activities, such as breeding or trialling of dogs. Furthermore, the participants had the option in three sections of the questionnaire to give details on *up to* three of their dogs. Choosing to answer these questions for one or two dogs reduced the number of questions to be answered by 28 or 56, respectively. The logic system of the online survey allowed for the routing of participants to questions of relevance. Eighteen questions were relevant to the economic value of the dogs. These are described below. For the complete questionnaire, see the supplementary material to papers published in *Animal Welfare* section at the UFAW website, www.ufaw.org.uk.

Respondents were asked to indicate the number of each type of livestock on the property. The answer options included six continuous categories for cattle from 'nil' to 'more than 8,000' and seven categories for sheep from 'nil' to 'more than 25,000'. There was the option to describe 'other' livestock using free text.

The questionnaire required participants to report the number of dogs they currently have in work. Respondents were then asked to give details on one to three of the dogs they currently work with most often. They were asked what type of work they mostly use each dog for. The options were 'yard (forcing)', 'mustering', 'both (all-rounder)' and 'trial only'. When asked where each dog was acquired, respondents could select from the options 'own breeding programme', 'external breeder' or 'other'. In addition, if they had not bred the dog, they were asked to state how much they paid for each dog. The options were six categories from AU$0 to over AU$5,000. Respondents were requested to report, for each dog discussed, what level of training it had when acquired; from 'unstarted', 'started' or 'fully trained'. They were asked to declare the 'approximate non-routine veterinary costs for each dog in the past five years'. The four option categories ranged from AU$0 to more than AU$2,000. The respondents were also asked if their dogs were insured.

The workload of the dogs was investigated by asking their owners, 'at peak times, how much time does your top dog spend working on average, each day and each week?' They could select 'less than two hours', 'two to four hours', 'four to six hours' or 'more than six hours' per day and from one to seven days per week.

Respondents were asked to report what percentage of the dogs they acquire or retain for work become successful working dogs. The options were 'less than 50%', '50–64%', '65–79%', '80–99%' and '100%'. For the 'dishonourable discharges (dogs dismissed before old age or injury)', survey respondents were asked to focus on the last dog they had had in training that they did not retain as a working dog. They were then able to choose one of four options to indicate at what age the dog was dismissed from 'less than 3 months' to 'more than twelve months'. Respondents were also asked to report the retirement age for the last successful working dog(s) ('honourable discharges') they had to retire or that ceased work prematurely.

To investigate the training of working dogs, respondents were asked how long, in general, it takes them to train both started and unstarted dogs to a competent working standard. In addition, they were asked 'how much time is spent with the dog during an average training session?' The options were: 'I don't have formal training sessions', 'less than 15 minutes', '15–30 minutes', '30–60 minutes' and 'greater than 1 hour'. They were also asked to select how many training sessions they have per month from the options: 'I don't have formal training sessions', 'less than eight', 'eight to 15', '16–30' and 'more than 30'.

Respondents were asked to 'estimate the average yearly cost per dog of feeding and routine healthcare'. The options were 'less than AU$400', 'AU$400–800', 'AU$801–1,500' and 'more than AU$1,500'. In addition, they were asked to state the maximum amount they would consider spending on their best working dog to treat it for a serious illness or injury to allow it to return to work. They could choose a response from one of six categories ranging from 'AU$200 or less' to 'more than AU$5,000'.

Calculations and analysis

All data were exported into Microsoft Excel® (Microsoft Corporation, Ryde, NSW, Australia) and descriptive statistics were generated using this software programme.

To estimate the typical economic contribution of the dogs, the median values for the major costs associated with dog ownership were summated and compared to the median number of hours worked over a lifetime by the sample of dogs reported in the Farm Dog Survey. Where median values were ranges, the mid-point of the range was used for calculations.

The major costs were considered to be the dog's purchase price, the time invested in training the dog to competency, feed, routine healthcare and veterinary costs over the typical working lifetime. Additionally, these same costs were included for the resources lost on dogs culled during the process of recruiting a successful dog.

Some assumptions were required for the purposes of the calculations. To create a financial representation of time investments and returns, an hourly rate of AU$20 was used. This represents the median Australian farm-hand wage (Payscale 2013). In addition, because specific details of each respondent's stock management calendar were not requested in the Farm Dog Survey, the typical annual frequency and duration of stock handling periods had to be estimated from a secondary source. The estimated frequency of these work periods was calculated using a sheep husbandry calendar template tool which lists eight major husbandry tasks required on sheep-producing properties throughout the year (Australian Wool Innovation 2008). The duration of the tasks was estimated using the typical flock size reported by the respondents and, as an indicative figure, the number of sheep able to be crutched in a single day employing a crutching cradle (Hall *et al* 2012). Crutching was chosen as a representative husbandry task as the time taken to perform this activity would be expected to be longer than drenching, jetting and vaccinating but shorter than the major task of shearing (Scobie *et al* 2005).

Results

The sample

Eight hundred and twelve responses were received, of which 98.6% were online submissions. The respondents' demographic information is shown in Table 1 with that of the Australian livestock-producing population for comparison (where available). The respondents submitted details for 1,806 of the dogs currently working, 864 dogs they had most recently dismissed and 1,357 dogs they had most recently retired. Table 2 summarises the characteristics of the dogs currently used by the survey participants.

The mean number of dogs currently in work was four per respondent (median of three, mode of two, minimum of one, maximum of 30). The median retirement age for the last one to three dogs retired by the respondents was ten years. Thirty-one per cent of these dogs finished their working lives due to death, 21% were euthanised on retirement, 5% were re-homed and the remaining 43% of retired dogs were retained as companion or breeding animals.

Table 1 Demographic information for the respondents of the Farm Dog Survey (n = 812) and corresponding information (where available) for the Australian farming population.

Demographic characteristic	Farm Dog Survey sample relative frequency (%)	Australian farming population relative frequency (%)
Gender		
Male	69	72†
Female	31	28†
Age (years)		
18-29	11	
30-39	15	
40-49	20	
50-59	26	
60-70	22	
> 70	5	
Median	50-59 years	53 years†
Location		
NSW	42	32‡
VIC	17	25‡
QLD	19	31‡
SA	9	10‡
WA	6	9‡
TAS	5	3‡
NT	0.6	0.4‡
ACT	0.3	0.04‡
Property size (ha)		
< 500	32	
500-1,000	17	
1,001-3,000	23	
3,001-7,000	11	
7,001-15,000	8	
15,001-30,000	5	
> 30,000	5	
Production		
Cattle	76	87†§
Sheep	75	48‡§
Cattle & sheep	51	
Goats	6	0.2†§
Cattle herd size		
Nil	24	
< 100	20	
100-500	31	
501-1,500	15	
1,501-3,000	7	
3,001-8,000	3	
> 8,000	1	
Median herd size	100-500 head	
Sheep flock size		
Nil	25	
< 500	21	
501-2,000	17	
2,001-5,000	18	
5,001-10,000	11	
10,001-25,000	7	
> 25,000	1	
Median flock size	2,001-5,000 head	

†Australian Bureau of Statistics (2012b)
‡Australian Bureau of Statistics (2012c)
§Australian Bureau of Statistics (2012ba)

Investment (input)

Purchase costs

Costs at acquisition applied to 73% of the dogs currently working as only 27% were bred by their current owner. For those dogs acquired externally (not home-bred), the median purchase price range was ‘less than AU$500’ with 69% of dogs purchased for this amount. Table 3 details the range of purchase prices reported by the respondents.

Maintenance costs

The median annual cost per dog of feeding and routine healthcare was estimated by survey participants to be AU$400–800, with 77% reporting these maintenance costs to be AU$800 or less.

Veterinary costs

For dogs the respondents currently have in work, the median estimate of the veterinary expense per dog in the last five years was ‘less than AU$500’. Table 4 indicates that this category applied to 80% of the 1,806 dogs described.

Training costs

Training costs applied to 93% of the 1,806 dogs currently in work as only 7% were purchased fully trained. The median time for the respondents’ working dogs to attain competency was 12 months. During this period of training the duration and frequency of training sessions ranged from less than 15 minutes, less than twice a week to over one hour, more than once a day. However, approximately 35% of respondents reported that they did not set aside specific training sessions. Accounting for this ‘on-the-job-training’, the median training session duration and frequency was 15 minutes, less than eight times per month. Table 5 provides a calculation to estimate the financial cost associated with the dedication of this time to dog training.

Wastage costs

The mean proportion of dogs acquired for work that are retained as successful was reported by the respondents to be 80%. This equates to a cull rate of one dog in five. For 95% of the dismissed dogs described in the survey, the decision to cull the dog was made when the dog was six months or older. However, the median age category for dismissal was ‘over 12 months’ of age. Table 6 shows the calculation of costs associated with the culled herding dog over a 12-month period, prior to it being dismissed.

An estimation of the typical lifetime investment into a herding dog was made by summating the median per dog expenditure reported by survey respondents for the purchase price, the training costs, the maintenance costs and veterinary expenditure over the median working lifespan of ten years and the costs related to failed dogs occurring at a ratio to success of 1:4. See Table 7 for a summary of this calculation.

Table 2 Characteristics of the 1,806 dogs currently engaged in stock work as reported by the Farm Dog Survey respondents.

Canine characteristic	Dogs in work (%)
Gender	
Female	41
Female neutered	10
Male	44
Male neutered	5
Age	
Mean	5 years
Breed	
Kelpie	60
Kelpie cross	8
Border collie	16
Border collie cross	7
Australian cattle dog	1
Australian cattle dog cross	1
Coolie	1
Coolie cross	1
Other	4
Main work	
All rounder (utility)	63
Mustering	27
Yard (forcing)	8
Trialling only	2
Trial participation	
No	84
Yes	16
Insurance status	
Insured	9
Not insured	91

Table 3 The purchase price range of 1,312 dogs acquired externally (not home-bred) and currently engaged in stock work for respondents of the Farm Dog Survey.

Purchase price (AU$)	Relative frequency (%)
0	35
< 500	34
500-1,000	21
1,001-2,000	6
2,001-5,000	3
> 5,000	0.7

Table 4 Farm Dog Survey respondents' estimates of the non-routine veterinary expenses per dog over the past five years for the dogs they currently have in work.

Veterinary expense per dog in the last five years (AU$)	Relative frequency (%)
0	31
< 500	49
500-2,000	17
> 2,000	3

Return on investment (output/input)

The typical stock herding dog's value can be estimated by calculating the return the owner receives on their investment. The efficiency of the investment is derived by dividing the output of the resource by the input or costs: AU$40,000/AU$7,763 = 5.2.

Expenditure decisions

Return (output)

Annual workload

Respondents reported a peak workload for their dogs from less than two hours, one day a week to more than six hours, seven days a week. The frequency distribution of reported canine workloads can be viewed in Table 8.

The median number of days respondents' dogs worked per week during peak periods of stock work was five. The median number of hours worked during these periods was four to six hours per day.

A calculation estimating the median value of the herding dog's working lifetime is shown in Table 9.

The Farm Dog Survey respondents were asked to predict how much they would spend to treat their best working dog for an illness or injury to allow it to return to work. The median response range was AU$1,001–2,000. Forty percent of respondents would spend over AU$2,000 to save their best dog, while 12% nominated that they would spend over AU$5,000 to ensure their best dog returns to work. Table 10 displays a summary of these results.

Discussion

This study represents the first attempt to estimate the value of the typical Australian stock herding dog in terms of its economic efficiency. This process has provided an insight into what Australian stock dog owners spend to acquire and keep herding dogs and the work performed by these dogs. It is important to acknowledge some of the limitations of the current study. The method of recruiting survey participants could not ensure a random sample of the stock dog-owning population. There was the potential for involvement in the survey to be greatest among people with a particular interest in working dogs and, therefore, a particular interest in the research. An attempt was made to mitigate this by offering an incentive for participation that would be of some value to all working dog owners. Nevertheless, our respondents do own more dogs, on average, than a previously surveyed group of farmers. The Quantitative Agricultural Readership Survey (QARS) 2009 (McNair Ingenuity Research Pty Ltd 2012) surveyed 1,720 randomly selected broad-acre property owners or managers (including some crop-only enterprises). Their target population owned properties with annual estimated agricultural operations that were valued at greater than or equal to AU$40,000. Of the properties employing working dogs (the total number was not reported), the mean number of dogs was three per property. The Farm Dog Survey target population was not limited to a particular operational size or turnover. Therefore, our survey sample includes more owners of properties of smaller size when compared to that of QARS. As a result, the present study may include farmers who do not have farming operations requiring large numbers of dogs but could also include individuals who professionally breed working dogs or use them in large numbers in saleyards rather than on broad-acre properties. Although the Farm Dog Survey respondents had a *median* of three dogs each, a mean of four emerged from right-skewed data created by the participation of small numbers of people with unusually large numbers of dogs. This supports the assertion that people with a particular dog

affiliation may have responded to our survey.

Our recruitment method enlisted the help of two Kelpie-affiliated societies (CKA committee and the WKCA) to promote the survey to their members. So, it is possible that Kelpies are over-represented in the current data. Similarly, promotion of the survey at dog trials may have resulted in an over-representation in the survey sample of working dog trial participants. Despite this, dogs not competing in dog trials were well represented at 84% of the sample.

Table 5 Calculation of the median cost of the time invested in training a stock herding dog to the point of competency, as reported by the Farm Dog Survey respondents.

Median session frequency per month	Median session duration (h)	Median training time to competency (months)	Hourly expense (AU$)‡	Total
4†	0.25	12	20	AU$240

† Mid-point of median training frequency of 0 to 8 sessions per month;
‡ Median farm hand wage (Payscale 2013).

Table 6 Calculation of the median cost incurred for each dog that was ultimately culled by the respondents.

Expense	Cost over 12 months (AU$)
Purchase	250†
Maintenance	600‡
Training	240§
Total	1,090

† Mid-point of median purchase price range AU$0–500 (see Table 3);
‡ Mid-point of median maintenance cost range AU$400–800;
§ See Table 5.

Table 7 Estimation of the median lifetime investment into a herding dog.

Expense	Calculation	Total (AU$)
Purchase	AU$250	250
Maintenance	AU$600 × 10 years†	6,000
Veterinary	AU$100 × 10 years†	1,000
Training	AU$20 per h a month × 12 months‡	240
Wastage	AU$1,090§ × 0.25#	273
Total		7,763

†Median retirement age;
‡See Table 5;
§See Table 6;
#Cull: success ratio of 1:4.

Despite these weaknesses, the survey sample is similar to the Australian farming population when considering several demographic characteristics, such as gender, age and geographic location (Australian Bureau of Statistics 2012a,b,c).

To calculate the financial contribution of a typical dog over its lifetime, some assumptions were made. The amount of work performed annually was derived from the survey data detailing the days and hours worked during peak periods. However, there were no survey data to indicate how often these dogs performed this work throughout the year and what other work they were required to do at less strenuous times. As 75% of respondents produced sheep with a median flock size of 2,001–5,000, this group of farmers and their dogs was used to estimate the stock work performed annually. A standard

sheep husbandry calendar template (Australian Wool Innovation 2008) suggests eight separate husbandry events that are required to maintain ewes, rams and lambs including drenching, shearing, jetting, weaning, marking, crutching and vaccinating in addition to sending stock for sale. Hall *et al* (2012) recommend combining these tasks to four episodes for efficiency. The same document suggests that crutching ewes can be performed at an approximate rate of 500 per day with the employment of a crutching cradle. With this as an indicative figure, one week per husbandry task was estimated for the median flock size of 2001–5,000. There is clearly the potential for significant variation in the stock work required of herding dogs annually according to the nature of the enterprise and the practices employed. Furthermore, in calculating the dogs' financial contribution, no value was attributed to work performed by dogs outside the allotted eight-week peak period each year. Omitting these undefined, yet probably significant, duties would result in an underestimation of the canine contribution.

Table 8 The number of days worked per week and hours worked per day by respondents' dogs during times of peak stock work. Table of relative frequencies of peak workload of dogs currently working for the Farm Dog survey respondents (%).

		Peak hours worked per day				
		< 2	**2 to 4**	**4 to 6**	**> 6**	**Total (%)**
Peak days worked per week	One	3	0.5	0.3	0.1	3.9
	Two	4	3	2	0.1	9.1
	Three	3	8	4	2	17
	Four	2	5	6	2	15
	Five	5	5	10	7	27
	Six	1	2	5	6	14
	Seven	2	4	3	5	14
	Total	20	27.5	30.3	22.2	100

Table 9 Calculation of the median value of a herding dog's working lifetime (AU$).

Hours per day	Days per week	Weeks per year	Years	Pay rate (AU$ per hour)	Total (AU$)
5†	5	8‡	10§	20#	40,000

† Mid-point of median range of hours worked per day;

‡ Assumption of eight stock handling tasks per year (Australian Wool Innovation 2008), typically taking one week per task (Hall *et al* 2012);

§ Median retirement age;
# Median farm hand wage (Payscale 2013).

Table 10 Farm Dog Survey respondents' hypothetical, maximum, one-off expenditure to treat their best dog for illness or injury to allow it to return to work.

Predicted expenditure (AU$)	Relative frequency (%)
200 or less	2
201-500	6
501-1,000	21
1,001-2,000	31
2,001-5,000	28
> 5,000	12

To represent the time worked by the dogs as a financial contribution, the work was valued at AU$20 per hour as this is the median rate paid to farm hands in Australia (Payscale 2013). However, this equation

does not account for the other costs related to human employment such as a vehicle or horse for the farm hand and the associated fuel and insurance costs. Furthermore, the assertion that the dog could be replaced by a human worker at any pay rate does not account for the ability of the dog to negotiate farmland inaccessible by vehicle, move over and through stock in yards and the stock sense that is hypothesised to be partly genetically programmed in these dogs (Kelley 1942; Arvelius *et al* 2013). These factors, along with companionship, are part of the intangible value of the working dog which is not represented in the calculations.

The reported age of working dogs at their retirement could have been affected by recall bias as the respondents were required to remember the last one to three dogs that had reached the end of their working life. However, a median age of retirement of ten years is consistent with the median age of death reported for companion dogs in several studies. A cross-sectional study of over 15,000 deceased companion dogs of 169 United Kingdom (UK) Kennel Club recognized breeds revealed a median age at death of eleven years and three months (Adams *et al* 2010). This figure is not dissimilar to an earlier UK study reporting 12 years as the median age of death (Michell 1999) and a Danish study which reported ten years as the median age at death among a group of mixed and purebred dogs (Proschowsky *et al* 2003). Clearly, there is a distinction between age at retirement and age at death. However, for approximately half of the retired dogs described by the Farm Dog Survey respondents, retirement and death were synonymous as 52% ended their working lives due to death or were euthanased.

The age of working dog retirement reported in the current study is probably elevated in comparison to the aforementioned longevity studies as the populations being represented are different. The companion dog longevity studies represent the age at death of all the dogs the respondents had owned in the defined period. In contrast, the retirees reported in the current study represent the successful dogs owned by the respondents and consequently excludes those dogs culled at a young age for health and behavioural reasons.

Despite this, if the median companion dog lifespan is 10–12 years (Michell 1999; Proschowsky *et al* 2003; Adams *et al* 2010), ten years represents a lengthy working career when the physical and demanding nature of the work is considered (Hampson & McGowan 2007). Recent breed-specific longevity data may provide some insight into the resilience of the Australian working dogs sampled in our study. An analysis of patient records of deceased dogs from primary veterinary practices in the UK revealed that the longevity of cross-bred dogs exceeded that of pure-bred dogs by 1.1 years (O'Neill *et al* 2013). Furthermore, of the breeds, the Border collie was one of the longest lived. Approximately one-third of the dogs the Farm Dog Survey respondents currently have in work were described as purebred Border collies or crossbreds.

While longevity may be under genetic influence it is also worth considering possible environmental influences. Although data to support this assertion have not been collected in this study, the apparently impressive length of the Australian farm dog's career may reflect some health benefits of the working environment. Their work involves being extremely physically active and, unlike pets (Courcier *et al* 2010), they are unlikely to be fed to excess as feed contributes to farming costs. This is supported by Singh *et al* (2011) who reported the average bodyweight among a sample of New Zealand stock herding dogs to be approximately 23 kg. Therefore, a lean body mass and low body-fat mass is expected in these dogs. Such a regime has been associated with health and longevity (Huck *et al* 2009). Indeed, Huck *et al* (2009) reported an increase in median lifespan of 1.8 years in dogs that had been food-restricted throughout their lives compared to non-restricted control dogs. The health status of the farm dogs may go some way to explaining the low veterinary costs reported by the survey respondents. A median figure of AU$500 per dog over five years may reflect low rates of illness but must also equate to low rates of injury. This is unexpected considering the physically challenging nature of stock work and the inherent risk of

trauma. Alternatively, the reports of low veterinary costs could indicate an unwillingness of these working dog owners to invest in extensive and expensive veterinary care for their dogs. In contrast, owners of companion dogs were estimated to have spent an annual average of AU$380 per dog on veterinary services (excluding routine vaccination and neutering) in 2009 (Australian Companion Animal Council Inc 2010).

Animal welfare implications

At a median of less than AU$500, the purchase price of the majority of the dogs in this study contributes relatively little to the lifetime cost associated with them. These unexceptional prices are despite approximately 80% of the dogs being described as purebred which would often result in an inflation of price in the companion dog industry. Thirty-five per cent of dogs were given to the respondents free of charge, which could suggest an oversupply of working dogs. This can result from indiscriminate breeding practices. The implications of this are several. Indiscriminate breeding does not allow for an optimisation of health and behaviour traits. Branson *et al* (2009) indicated that the reasons working dogs in the private sector (security, hunting and farming) failed their training were described as behavioural in nature 90% of the time. A scientific and planned approach to breeding leads to an increase in the number of dogs which display favourable behavioural characteristics (Arvelius & Klemetsdal 2013) and sound health (Lewis *et al* 2010). Conversely, if a significant proportion of herding dogs are bred without an informed strategy, the result will be unnecessarily high cull rates for both health and behavioural reasons. As demonstrated in this paper, beyond the welfare concerns associated with wastage, there is a financial consequence linked to culling.

The low purchase price of working dogs may have a further welfare implication. Paying very little for an object or item influences the perceived value of that item (Kanagal 2013). If owners perceive a dog as having little value, they may be disinclined to direct time, effort and expense towards its care, comfort and training. Reducing this financial and time investment could jeopardise the dog's welfare and its level of success as a working dog. It is for this reason that the findings of the present study have the potential to enhance the welfare of Australian farm dogs. A demonstrated fivefold return on the typical investment in a working dog gives an objective figure on which to judge the potential contribution and value of a dog. Expenditure on the care or treatment of a dog, which may have been considered extravagant in light of the dog's purchase price alone, can be more easily justified on a cost-benefit basis when the dog's worth is more completely understood. An example of this disparity is evident in the survey participants' response to how much they would pay to save their best dog from illness or injury to allow it to return to work. It would be interesting to repeat the question to survey participants after providing them with the current working dog economic value calculations to see if the extent to which they are willing to invest in their dogs increased. It would appear to be a false economy to incur the costs of buying, training and maintaining a new dog of unknown potential instead of investing in a successful dog to ensure its ongoing performance. The decision of the majority (91%) of survey respondents not to insure their working dogs further suggests their value is being underestimated.

The results of this study also give an indication of the cost of investing in dogs which fail to become successful working dogs. As a mid-point estimation, over AU$1,000 worth of time and resources are wasted on each culled dog. This information could influence working dog owners in various ways. Culling a dog early in its training and assessment period will reduce the maintenance and training costs associated with the individual dog in favour of accruing the cost of a replacement dog. However, experienced stock dog handlers have expressed the belief that some accomplished dogs may only demonstrate their ability and potential at 12–18 months of age (McConnell & Baylis 1985; Parsons 2010). This observation is consistent with the finding that the assessment of potential guide dogs was more accurate at predicting success when performed at fourteen months rather than at six months of age (Batt

et al 2008). Therefore, it would instead be prudent for dog users to take an active approach to minimising the number of unsuitable and failing dogs. This should involve a multi-faceted approach addressing breeding practices and goals in addition to husbandry and training practices that maximise the dogs' performance. Further research is required to identify the optimal breeding and management strategies for Australian herding dogs.

Conclusion

Livestock enterprises tend not to tolerate high costs. Minimising variable input and operating costs, such as casual labour and fuel will maximise profitability. Stock herding dogs provide a means of achieving these savings. While the costs associated with acquiring and keeping these dogs are minimal, such modest costs should not be considered a reflection of their worth. Estimates of the financial contribution of the typical working dog to the farmer indicate at least a five-fold return on investment. Labour efficiency of this magnitude can only be considered extremely valuable. The expenditure decisions of working dog owners in the survey do not reflect recognition of the value of these dogs. Therefore, these findings may serve to equip working dog owners with useful information to make financially appropriate expenditure decisions when it comes to their working dogs. This could lead to increased profitability for farmers and improved welfare for their dogs. Furthermore, it is anticipated that the current data will, by revealing the costs associated with unsuccessful dogs, motivate further research into optimising breeding and training outcomes for the Australian stock herding dog.

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