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Why Namibian Farmers Are Satisfied With the Performance of Their Livestock Guarding Dogs

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The success of livestock guarding dogs (LGDs) in mitigating farmer–predator conflict relies on the perceptions of farmers that use them. Purebred LGDs are provided to Namibian farmers by the Cheetah Conservation Fund as a farmer–predator conflict mitigation measure. We examined the perceptions of farmers using 164 of these LGDs by analyzing data collected during face-to-face interviews from 2000–2010. Although most respondents reported reduced livestock losses since LGD introduction, satisfaction with LGD performance was more strongly linked to their observations of LGD behavior. The most commonly reported negative behaviors were staying home (29 LGDs, 18%) and chasing wildlife (25 LGDs, 15%). On subsistence farms, care provided was negatively correlated with LGD age ($r = -.34$, $n = 35$, $p = .04$) *and LGDs reportedly staying home were provided with less care than other LGDs. Overall, LGDs performed satisfactorily on commercial and subsistence farms, and thus contributed to farmer–predator conflict mitigation.*

Keywords livestock losses, farmer perceptions, human–wildlife conflict, Namibia

Introduction

Livestock depredation is one of the main sources of conflict between people and predators worldwide (Graham, Beckerman, & Thirgood, 2005; Inskip & Zimmermann, 2009; Sillero-Zubiri & Laurenson, 2001; Thirgood, Woodroffe, & Rabinowitz, 2005). This conflict

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directly impacts farming communities, which bear the costs of coexisting with predators (Bagchi & Mishra, 2006; Butler, 2000; Distefano, 2005; Rabinowitz, 2005). Consequently, techniques have been developed to reduce the costs of predation (Jackson & Wangchuk, 2004; Linnell, Smith, Odden, Kaczensky, & Swenson, 1996; Shivik, 2004). Key to the success or failure of these techniques is the perceptions of the farming community that are expected to use them (Breitenmoser et al., 2005; Shivik, 2006).

One method that has gained popularity among farmers and conservationists is the use of livestock guarding dogs (LGDs) to protect livestock from predators (Rigg, 2001). Dogs have been used and informally bred to protect livestock from predators for thousands of years in eastern Europe, the Middle East, and Asia; this tradition has produced the LGD breeds known today (Coppinger & Coppinger, 2001; Rigg, 2001). Thus, carnivore conservationists worldwide have recommended the use of LGDs as a farmer–predator conflict mitigation method (Andelt & Hopper, 2000; Gehring, verCauteren, & Landry, 2010; Marker, Dickman, & Macdonald, 2005; Smith, Linnell, Odden, & Swenson, 2000; van Bommel & Johnson, 2012).

In Namibia, the Cheetah Conservation Fund (CCF) imported Turkish livestock guarding dogs (Anatolian Shepherds and Kangal dogs) since 1994, with the proximate aim of reducing predation on goats and sheep (small stock) on Namibian farmlands (Marker et al., 2005). The ultimate aim of this program is to assist livestock farmers to coexist with cheetahs (*Acinonyx jubatus*) and other predators on their farms, without resorting to killing these predators (Marker et al., 2005).

Surveys in the USA and Namibia revealed that livestock farmers perceive LGDs as a useful, practical, and economically feasible means of reducing livestock losses (Andelt, 2004; Coppinger, Coppinger, Langeloh, Gettler, & Lorenz, 1988; Green & Woodruff, 1990; Marker et al., 2005). However, these perceptions cannot always be explained by the number of livestock lost (Marker, Mills, & Macdonald, 2003; Selebatso, Moe, & Swenson, 2008). Particularly, farmer perceptions of their LGDs' effectiveness may be driven by their witnessing desirable LGD behavior and perceived absence of undesirable behavior.

The use of LGDs has been promoted as a means of reducing livestock depredation on both commercial and subsistence farms in Africa (Marker et al., 2005; Ogada, Woodroffe, Oguge, & Frank, 2003; Woodroffe, Frank, Lindsey, ole Ranah, & Romañach, 2007). Nonetheless, the utility of LGDs on these two farm types has not been previously compared. The CCF LGD program in Namibia provides purebred LGDs to both commercial and subsistence farmers at discounted prices. Farmers in the program receive ongoing support from CCF in the form of information on LGD training and discounted dog food (see Marker et al., 2005). Nonetheless, subsistence farmers with little or no stable form of income may struggle to provide sufficient food for the large-breed LGDs (weight range 55–100 lb. or 25–45 kg) considered here.

The reported presence of negative LGD behaviors was expected to reduce farmer satisfaction and subsequently reduce perceived LGD effectiveness. The most commonly reported LGD behavioral problems in the CCF program were chasing wildlife and staying at home rather than accompanying the livestock (Marker et al., 2005). As wildlife utilization is an important source of income for most Namibian farmers (Naidoo et al., 2010; Richardson, 1998), the potential for LGDs to harass wildlife is viewed negatively (Schumann, 2009). Furthermore, a dog that chases wildlife is less attentive to its livestock, which may be preyed upon in the dog's absence. Similarly, LGDs that occasionally stay at home rather than accompany the livestock would be less effective in deterring predators than consistently attentive LGDs (Coppinger, Lorenz, Glendinning, & Pinardi, 1983).

We examined whether the care provided by the farmer influenced wildlife chasing and staying home behaviors. Malnourished dogs could be expected to hunt wildlife to obtain

food more frequently than properly fed dogs. Alternatively, malnourished dogs may be less likely to chase wildlife than other dogs, due to a lack of energy. Similarly, we predicted that LGDs that are provided less care would be more likely to stay home, as they would lack the energy required to accompany their livestock.

To address the current gaps in information on the relationship between farmers and LGDs, we outlined the following research objectives: (a) to investigate whether livestock losses and/or LGD behavior influence farmer satisfaction with their LGDs; (b) to test whether LGDs were provided the same level of care on subsistence and commercial farms and, if so, how this affected perceived LGD performance; (c) to test whether commonly reported LGD behavioral problems are linked to the care provided for LGDs by farmers.

Methods

The CCF LGD Program

CCF sells purebred LGD puppies to commercial and subsistence farmers for N$700 (approximately US$80) at 8 weeks of age. All dogs are sterilized before placement and provided routine veterinary care by CCF during farm visits. When they receive their LGDs, the farmers attend a two to three hour-long training session at CCF where the raising and training of LGDs is covered in detail (Marker et al., 2005). CCF supplies educational material to each farmer regarding the correct care of the LGD and predator-friendly farming practices (Schumann, 2003).

Routine farm visits to evaluate the LGDs' progress are conducted by CCF three times during the dog's first year on the farm, and annually thereafter. Thus, each dog is evaluated multiple times during the course of its working life. During these farm visits, relevant people at the farm are interviewed regarding the LGD. The interviewees were either the farmer, the herder of the livestock that the LGD guarded, or the person entrusted to look after the dog (not all dogs were accompanied by herders and not all farmers live permanently at their farms). Where possible, the farmer or dog caretaker and the herder answered the questions together. In cases where the people at the farms during the routine visits did not understand the questions or did not have sufficient knowledge about the LGDs, the interviews were not conducted.

Study Area and Farming Practices

LGDs bred by CCF are widely distributed on farms in Namibia (Figure 1), with particular emphasis on the north-central parts of the country, which harbors the highest density of cheetahs (Marker-Kraus, Kraus, Barnett, & Hurlbut, 1996). Other predatory species in the region include leopard (*Panthera pardus*), black-backed jackal (*Canis mesomelas*) and caracal (*Caracal caracal*) (Stein, Fuller, Damery, Sievert, & Marker, 2010). The small stock (sheep and goats) with which LGDs in the CCF program are placed are generally farmed on a small scale, and the animals are enclosed at night (this is one of the criteria used to select farms for LGD placement) (Marker-Kraus et al., 1996). Furthermore, 73% of the LGDs in this study worked with a herder at the time of the survey. Our results are thus applicable to the use of LGDs with small stock farmed on a small, semi-intensive scale, where medium- to large-sized felid and medium-sized canid species are the main predators.

Data Collection and Manipulation

We used data on 164 LGDs older than 6 months of age collected from the routine CCF interviews conducted during 2000–2010. Data collected on 85 LGDs during 2000–2008 were

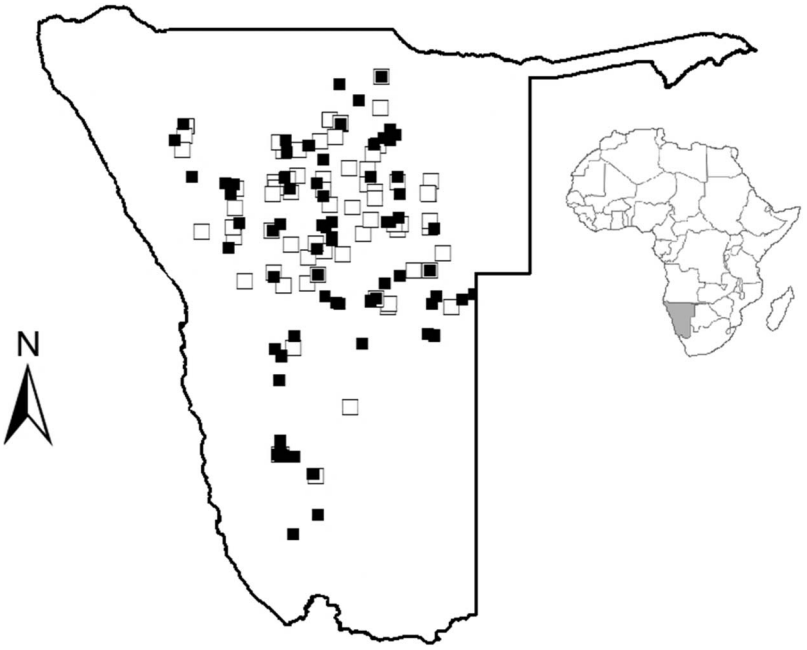

Figure 1. Locations of the LGDs evaluated in this study in Namibia (highlighted on the map of Africa). Open squares represent LGDs evaluated in the 2000–2008 survey, and closed squares represent LGDs evaluated in the 2009–2010 survey.

included in our analysis. Data on an additional 15 LGDs collected in this period were discarded, as these LGDs were re-evaluated in the 2009–2010 survey. In 2009, we revised the questionnaire and used this version during 2009–2010; 79 LGDs were evaluated during this period.

In both the 2000–2008 and 2009–2010 surveys, most questions asked were closed (i.e., the interviewee selected from a list of potential answers). Some open-ended questions were included to provide insight into why particular answer options were chosen and to describe the kind of dog food provided. The answer options were coded such that positive numbers were given for positive responses and negative numbers were given for negative responses (Tables 1 and 2). Uncertain answers were excluded, and answers such as "sometimes yes, but sometimes no" were scored as 0, as this is mid-way between positive and negative.

Scores measuring farmer satisfaction, the care provided for the LGD (farmer care score), and the three primary LGD behaviors witnessed by respondents were calculated from the answer codes as follows. The code numbers generated from all of the answers informing a particular score (see Tables 1 and 2) were averaged, then converted into values between 0 (all answers scored -2) and 1 (all answers scored $+2$), following Marker et al. (2005).

The primary LGD behaviors, as identified by Coppinger and Coppinger (1980), are: attentiveness (the tendency of the dog to stay with the flock), trustworthiness (the lack of predatory behavior towards the flock and the lack of other behavioral problems), and protectiveness (the tendency of the dog to display protective behavior towards the flock). The questions used to inform each LGD behavior score (Table 1) were designed to simplify these LGD behavior categories into behaviors that could be easily observed by the interviewees.

Table 1
The questions and answer choices used to calculate the scores for each of the three major dog behaviors: attentiveness, trustworthiness, and protectiveness

Total attentiveness	Total trustworthiness	Total protectiveness
Q: Is the dog with the livestock all the time? A: Yes = +2; No = −2	Q: Is the dog submissive to the livestock? A: Yes = +2; No = −2	Q: How would you rate your dog's protectiveness? A: Excellent = +2; Good = +1; Fair = −1; Poor = −2
Q: Where is the dog at night? A: With livestock = +2; Anywhere else = −2	Q: Does the dog have any behavioural problems? A: Yes = +2; No = −2	Q: Have you had livestock losses in the last year since the dog? A: Yes = −2; No = +2
Q: Does the dog appear to be part of the flock? A: Yes = +2; No = −2		
Q: Are the dog and stock bonded together? A: Yes = +2; No = −2		

Table 2
The questions and answer choices used to calculate the scores for farmer care and satisfaction

Total farmer care score	Total satisfaction score
Q: Describe what food you give to your dog. A: Open-ended	Q: How is your dog working? A: Excellent = +2; Good = +1; Fair = −1; Poor = −2
Q: How would you describe the owner's involvement with the dog? A: Daily = +2; At least once per week = +1; At least once per month = −1; Only herder = −2	Q: Is the dog doing what you thought it would do? A: Yes = +2; No = −2 Q: Has there been an economic benefit to having the dog? A: Yes = +2; No = −2

The satisfaction score was informed by answers to the three questions listed in Table 2, with their accompanying answer choices. Questions about the dogs' diet and the regularity of the farmers' involvement informed the farmer care score. This was thus based on more objective measures (the interviewer requested to see the dog food described) than the other scores. Answers to the dog food question were coded as follows. If the diet contained dog pellets, it was coded +2; if dog pellets were substituted with meat scraps, it was coded +1; if no animal protein was provided, it was coded −2. The regularity of the farmers' involvement with the LGD was included by inquiring how often the farmer visited the farm (responses were coded as per Table 2). Farmer involvement was included in the care score,

as the responsibility for the LGDs' welfare ultimately rests with the farmers, not the herders or caretakers.

Data Selection and Analysis

Only one evaluation from a single farmer interview was chosen for analysis per dog. To increase the representation of older dogs in the dataset, the last interview was selected for those dogs that were evaluated multiple times. Four farmers had two LGDs that worked together guarding the same livestock and three farmers had multiple dogs (two, three, and four each, respectively) that guarded separate groups of livestock. These farmers were asked to evaluate each LGD's behavior separately. Where the LGDs worked together, responses regarding livestock losses since LGD introduction were only analyzed for the first LGD placed with the livestock. Where the LGDs worked separately, farmers were asked whether the LGDs had reduced losses from their respective groups of livestock.

The final sample comprised 164 dogs (81 male, 83 female). Due to the earlier placement of dogs on commercial farms in the initial phases of the CCF program (Marker et al., 2005), the sample included more data from commercial (118) than subsistence (46) farms. The average LGD age on all farm types was 42 ± 2.4 months old (mean ± S.E.). LGDs on commercial farms were not significantly older (44 ± 2.9 months, $n = 118$) than those on subsistence farms (36 ± 4.4 months, $n = 46$) ($U = 2256$, $Z = -1.68$, $p = .09$).

In the 2009–2010 survey only, farmers were asked to compare livestock losses experienced in the year period since LGD introduction (termed "the survey year" hereafter) relative to losses in the year before LGD introduction. Here, the sample size was reduced to 63 LGDs from the 79 evaluated, as some respondents could not provide data.

The LGD protectiveness (Table 1) and farmer care (Table 2) scores were compared with respect to the two farm types in this study, using the complete 2000–2010 survey data. The sample size was restricted to 146 LGDs for the care score data, as the necessary data required to inform this score was not available for some LGDs evaluated during 2000–2008. LGDs reportedly displaying chasing wildlife or staying home behaviors were compared to LGDs reportedly not displaying these behaviors, in terms of the care provided to the LGDs by commercial and subsistence farmers.

The data violated the assumption of normality according to Kolmogorov-Smirnov and Shapiro-Wilk tests. Thus, Mann-Whitney U and Kruskal-Wallis tests were used for between- and among-group analyses, respectively. Spearman's Rank Order correlation tests were used to analyze continuous data. Means are given with the standard error.

Results

Livestock Losses and Farmer Satisfaction

Of the 63 farmers in the 2009–2010 survey, 65% reported no livestock losses in the survey year, and 27% reported reduced livestock losses. Only 5% (three farmers) reported unchanged losses and 3% (two farmers) reported increased losses (Figure 2). When separated according to farm type, 96% of commercial farmers ($n = 45$) and 83% of subsistence farmers ($n = 18$) reported reduced or zero livestock losses in the survey year.

The mean farmer satisfaction score over the period 2000–2010 was .87 ± .016 ($n = 164$). Additionally, 82% of the respondents ($n = 164$) stated that the LGDs they used were economically beneficial. In the 2009–2010 survey, respondents reporting an elimination or reduction in losses since LGD introduction were highly satisfied with the LGDs (Figure 3).

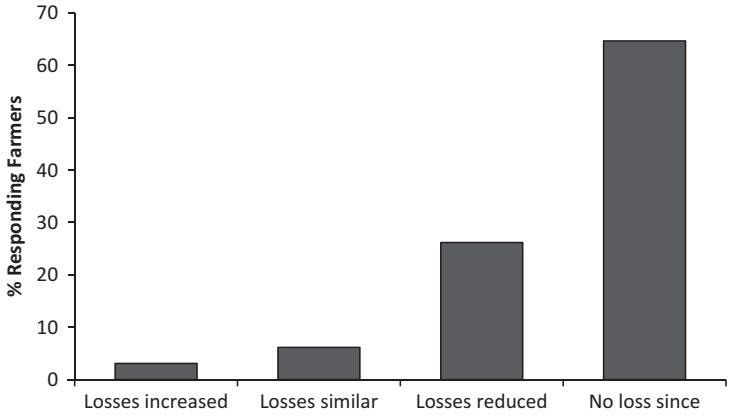

Figure 2. Percentage of farmers reporting different relative levels of livestock losses since receiving a LGD ($n = 63$).

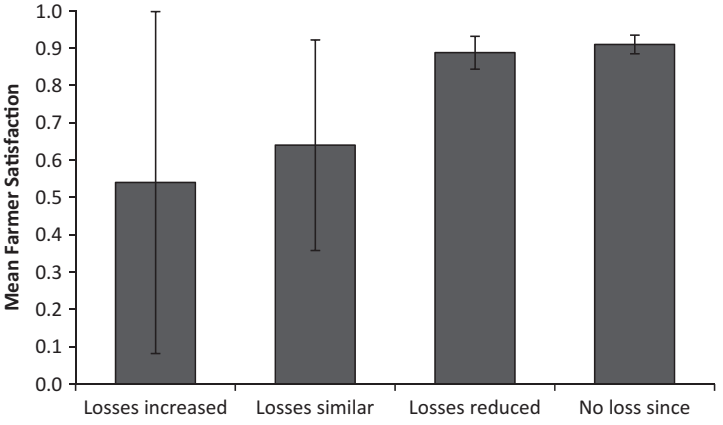

Figure 3. The satisfaction scores (mean ± S.E.) of farmers reporting increased ($n = 2$), similar ($n = 3$), reduced ($n = 17$), and no livestock losses ($n = 41$) in the year since LGD introduction, relative to the year prior to LGD introduction.

The remaining respondents ($n = 5$) that reported similar or increased losses since LGD introduction expressed variable satisfaction with the LGDs.

The variability in satisfaction among these five respondents (see Figure 3) was linked to their perceptions of their LGDs. In all these cases, the farmers themselves were interviewed, and questioned further about their perceptions. Three of these farmers were highly satisfied with the dog's performance. Two of them blamed the herder for the livestock losses rather than the dog and one farmer stated that the livestock losses were maintained at an acceptable level. The two least satisfied farmers (score .1) claimed that the dog no longer worked properly. In both cases, the dogs were malnourished and subsequently confiscated by CCF (CCF records).

The mean LGD behavior scores as perceived by the respondents were .90 ± .015 for attentiveness, .76 ± .021 for trustworthiness, and .74 ± .023 for protectiveness. Farmer satisfaction scores were positively correlated with each of these LGD behaviors; the strongest correlation was found for LGD attentiveness ($r = .50$, $p < .001$, $n = 164$),

followed by trustworthiness ($r = .40$, $p < .001$, $n = 164$) and protectiveness ($r = .38$, $p < .001$, $n = 162$).

The Management of LGDs by Commercial and Subsistence Farmers

Commercial farmers provided significantly more care for their LGDs than subsistence farmers ($U = 1264$ $Z = -3.25$, $p = .001$). Reported LGD protectiveness was not, however, correlated with the care provided ($r = -.51$, $n = 145$, $p = .54$), and the reported LGD protectiveness did not differ between the two farm types ($U = 2563$, $Z = -0.27$, $p = .78$).

On subsistence farms, the care provided declined with LGD age ($r = -.34$, $n = 35$, $p = .04$, Figure 4b). Despite this, reported LGD protectiveness did not decrease with LGD age on subsistence farms ($r = -.02$, $n = 45$, $p = .89$). On commercial farms, there was no relationship between care provided and LGD age ($r = -.081$, $n = 111$, $p = .40$, Figure 4b), or between reported LGD protectiveness and age ($r = .03$, $n = 117$, $p = .75$).

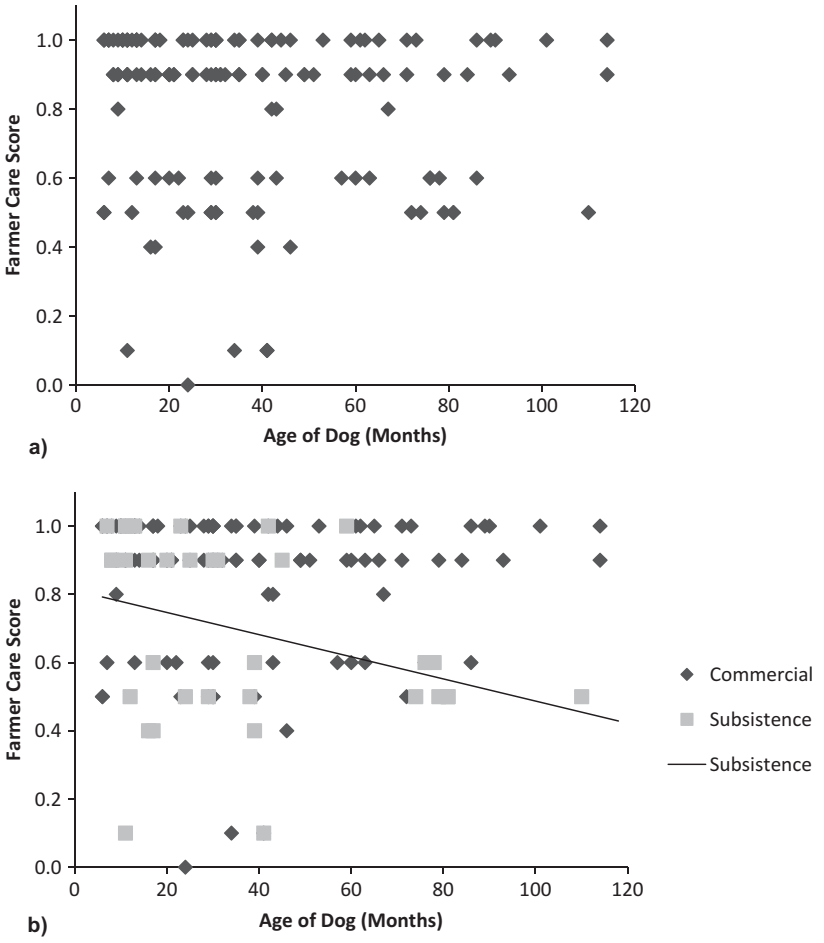

Figure 4. The relationship between mean farmer care score and the LGD age for (a) all farm types and (b) separated according to farm type. The line represents the correlation for subsistence farms only, where $p = .04$.

From the sample of 164 LGDs, 63 (38%) reportedly displayed behavioral problems. The most commonly reported behavioral problems were staying home (18% of LGDs), chasing wildlife (15%), and biting livestock (9%); only three (2%) dogs were reported to attack people. For the LGDs on all farm types, there was no significant difference in mean farmer care score between dogs that reportedly stayed at home and those that did not ($U = 717$, $Z = -1.54$, $p = .12$, $n = 115$). A similar result was found for the care of dogs that reportedly did and did not chase wildlife ($U = 884$, $Z = -0.51$, $p = .61$, $n = 115$).

On subsistence farms, the LGDs reported to stay home (5 LGDs, 15%) were provided less care than those dogs that did not stay at home (29 LGDs, 85%) ($U = 21$, $Z = -2.56$, $p = .01$, Figure 5a). There was no difference in care provided for LGDs reported to chase wildlife (4 LGDs, 12%) than for those that did not (30 LGDs, 88%) ($U = 30$, $Z = -1.64$, $p = .10$, Figure 5b). None of the dogs on subsistence farms were reported to stay at home and chase wildlife.

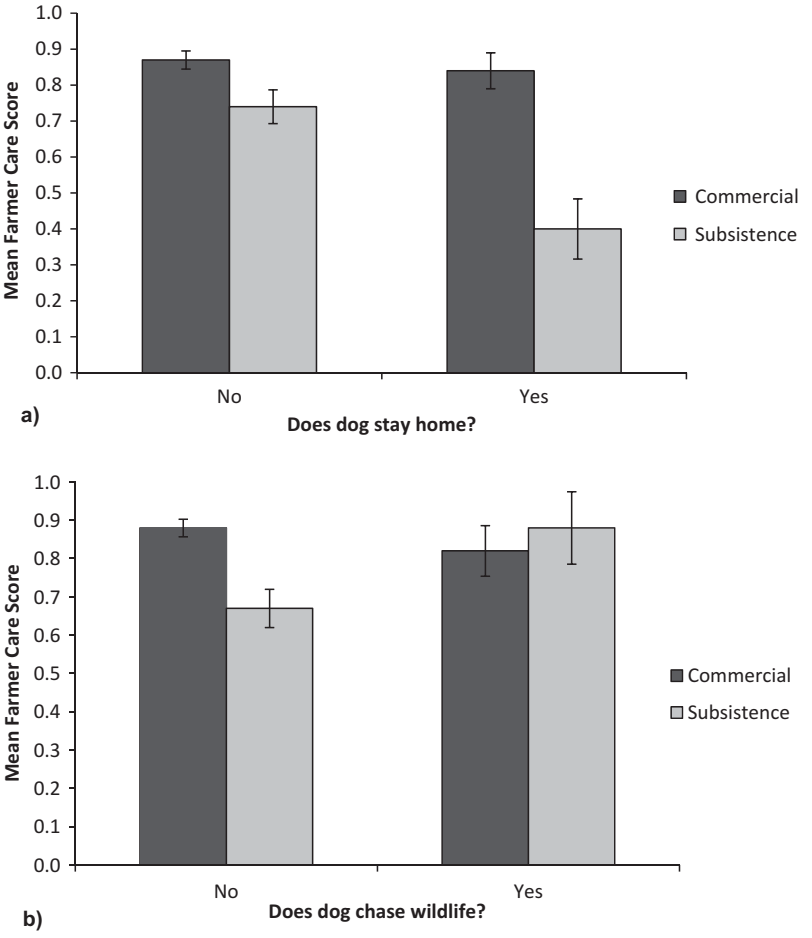

Figure 5. Comparisons between the mean farmer care score (±S.E.) for (a) dogs that do or do not stay at home on commercial ($n = 14$ and $n = 67$, respectively) and subsistence ($n = 5$ and $n = 29$, respectively) farms and (b) dogs that do or do not chase wildlife on commercial ($n = 16$ and n = 65, respectively) and subsistence ($n = 4$ and $n = 30$, respectively) farms.

On commercial farms, LGDs reported to stay at home (14 LGDs, 17%) were provided no less care than those that did not (67 LGDs, 83%) ($U = 422$, $Z = -0.63$, $p = .53$, Figure 5a). A similar result was found for the care provided for LGDs that reportedly chased wildlife (16 LGDs, 20%) compared to those that did not (65 LGDs, 80%) ($U = 472$, $Z = -0.62$, $p = .54$, Figure 5b). Seven LGDs on commercial farms (9% of 81 LGDs) reportedly chased wildlife and stayed at home.

Discussion

The reported 92% of LGDs ($n = 63$) reducing and/or eliminating livestock losses in this study is similar to that previously reported in the CCF program (Marker et al., 2005) and at the high end of the range of LGD success rates reported elsewhere (66–90%, reviewed by Smith et al., 2000). These results, therefore, support the current reputation of LGDs as a useful tool for farmers to reduce livestock losses (Rigg, 2001; Shivik, 2006). This is further reflected in the increasing number of farming communities adopting LGDs as part of their livestock management practices (Andelt & Hopper, 2000; Stannard, 2006).

The farmers' satisfaction score reported here (.87 ± .016) was somewhat higher than the .77 reported by Marker et al. (2005). Additionally, more respondents (82% of 164) stated that their LGDs were economically beneficial, compared to the 69% reported by Marker et al. (2005); our results are similar to the 84% reported by Green, Woodruff, and Tueller (1984). The LGD trustworthiness score reported here (.76 ± .021) was higher than the .44 reported by Marker et al. (2005), while the attentiveness (.90 ± .015) and protectiveness (.74 ± .023) scores were similar to those in the previous study (.88 and .71, respectively (Marker et al., 2005)). The higher trustworthiness score reported in our study relative to Marker et al.'s (2005) study indicates that LGDs in the CCF program are reportedly displaying fewer behavioral problems than previously. As the previous study used data collected during the early days of the program (1994–2001), it is likely that reported LGD trustworthiness has increased due to improvements in CCF's training methods.

Farmer satisfaction was not directly related to livestock losses in this study, but it was correlated with LGD attentiveness, trustworthiness, and protectiveness. The presence of attentive and trustworthy behavior indicates that the LGDs are well-bonded with the livestock, which is predicted to drive LGD protectiveness (Coppinger et al., 1983). Protective behavior is difficult to observe, as LGDs will only become protective in response to a threat, whereas the other two behaviors are constantly displayed around livestock. Furthermore, farmers who owned LGDs that did not reduce livestock losses had mixed opinions regarding their LGDs' effectiveness. Respondents that witnessed attentive and trustworthy LGD behavior tended to be more satisfied with the LGDs, with less consideration given to actual livestock losses experienced.

The main difference between the use of LGDs by commercial and subsistence farmers in this study was the care provided for the dogs. Declining care with LGD age on subsistence farms suggests that the maintenance costs of large-breed LGDs may be too high for these farmers to afford in the long term. Nonetheless, LGDs reportedly remained protective on both commercial and subsistence farms and this behavior was apparently unaffected by declining care on the latter farm type. However, the lack of care provided by a few subsistence farmers appears to be linked to LGDs reportedly staying at home. Some LGDs placed on subsistence farms by CCF have subsequently been confiscated due to malnourishment. In some of these cases, the confiscated LGD no longer accompanied the livestock, which was likely due to lack of energy. Several such confiscated LGDs are successfully

rehabilitated and re-placed on other farms; these LGDs have performed satisfactorily for their new owners (unpublished CCF records).

The reasons for LGDs reportedly chasing wildlife on either farm type or staying home on commercial farms were not easily identified in our study. Inattentive (staying home) and untrustworthy (chasing wildlife) behaviors are usually linked to a lack of LGD-livestock bonding and training while the dog is young (Dawydiak & Sims, 2004; Lorenz & Coppinger, 1986). Additionally, CCF's training materials suggest that LGDs may be encouraged to chase wildlife by herders who want to hunt wildlife for personal use, or that LGDs may start chasing wildlife habitually if they are not corrected in the early stages of behavioral development (Schumann, 2003). Direct observational studies of LGDs placed in areas where they are likely to encounter wildlife while guarding their livestock would be valuable to inform LGD training methods.

Conclusion

This study indicates that Namibian farmers perceive the use of LGDs as a practical means of livestock protection, which can subsequently reduce their conflict with predators. The LGDs were reported to be effective on both commercial and subsistence farms, despite declining care provided for the LGDs on the latter farms. Malnourished LGDs, however, may stay at home due to lack of energy, thus becoming inattentive to the livestock. Further investigation is required to determine the reasons for LGDs displaying undesirable behaviors when the care provided to them remains consistent.

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