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FULL RESEARCH ARTICLE

The case for case studies: A new approach to evaluating the effectiveness of livestock protection tools

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Livestock operations in California face livestock losses due to a range of carnivore species. Simultaneously, there is an increased call to reduce the use of lethal predator control methods and replace them with nonlethal methods. Livestock guardian dogs (*Canis lupus familiaris*) are one such nonlethal livestock protection tool (LPT), yet research is still lacking on the factors and situations that impact their effectiveness. Using three case studies, we demonstrate the value of objective analyses that explicitly address the inherent differences in ranch management, environment, and surrounding land uses in examining livestock guardian dogs as an LPT. We used semi-structured questionnaire surveys of livestock operators to collect information on effectiveness, behavior, and producer satisfaction of LGDs protecting poultry (*Gallus gallus domesticus*), calves (*Bovus taurus*), and sheep (*Ovis aries*) on private and public land and in conjunction with a variety of other livestock protection tools. We aimed to address all aspects related to the use of LGDs as a means of informing livestock operators' decisions on whether LGDs are an appropriate tool for a particular operation. The case studies demonstrated the complexities involved in applying LGDs as a LPT within the context of a livestock operation. In two of the three case studies, LGDs did not entirely eliminate livestock losses yet operator satisfaction remained high.

Key words: human-wildlife coexistence, livestock depredation, livestock guardian dog, livestock protection tools

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Livestock operations throughout California regularly face conflict with predators such as coyotes (*Canis latrans*), mountain lions (*Puma concolor)*, black bears (*Ursus americanus)*, bobcats (*Lynx rufus*), and (in northeastern California) gray wolves (*Canis lupus*). These conflicts are often intensified by public policy and perceptions that limit lethal predator

control options for livestock producers (Macon 2020). Consequently, many producers are increasingly turning to a variety of nonlethal livestock protection tools (LPTs), including livestock guardian dogs (LGDs) (*Canis lupus familiaris*), to protect their herds and flocks from predators. Objective evaluation of the efficacy of nonlethal LPTs, however, is extremely challenging, especially in a real-world setting. Every ranching operation – even those adjacent to one another – is different in terms of environmental variables, operational goals, management capacity, production calendars, livestock genetics, and many other parameters. The challenges inherent in utilizing randomized case-control study largely reflect the inability to control these variables within or between livestock operations (Ecklund et al. 2017). Furthermore, ethical considerations and economic pressures make designating an unprotected "control" group impractical and morally hazardous. After all, who wants to sacrifice livestock to help researchers determine if a particular nonlethal LPT is effective?

While controlled experiments regarding the effectiveness of these tools may be next to impossible to conduct, there is a pressing need for more information amongst producers, land and wildlife managers, and conservation professionals. Objective analyses that account for the inherent differences in ranch management, environment, and surrounding land uses can help practitioners gain a better understanding about where these tools may be effective and, just as importantly, where they may not work.

LGDs are perhaps the most complex of these livestock protection tools to study. In addition to the variables described above, LGDs add complexity in the form of their own behaviors, their interactions with humans (handlers and strangers both), their interactions with predators, and their relationships with specific livestock, just to name a few. Research has generally shown that LGDs can be effective at reducing livestock losses due to predators (Coppinger et al. 1988; van Bommel and Johnson 2012; Scasta et al. 2017; Kinka and Young 2019), but questions remain about which behavioral, operational, and environmental variables may contribute to a specific LGD's success or failure. That information is critical for an individual producer when deciding whether LGDs may be effective on a particular operation. In addition, little LGD research has been conducted in California. Finally, LGD efficacy in protecting livestock other than sheep or goats is not well understood.

We are suggesting an objective framework for documenting the success or failure of LGDs in real-world settings over specific timeframes. We believe that by standardizing the collection and description of the many variables involved in a working ranch setting that impact LPT effectiveness, we can begin to build a more objective body of data regarding LGDs. We also believe that this framework could be used for other LPTs (like FoxLights™, electric fencing, fladry, and human presence). Finally, we believe that these case studies may provide livestock producers and others with information that will help them better assess the potential for using these tools in their own specific settings.

Variables That Impact LPT Effectiveness

The effectiveness of specific LPTs, including LGDs, can be impacted by numerous factors, such as environmental variables, the predator species present in an area, operational characteristics, and a producer's attitude and experience. Producers should take some or all of these factors into account when deciding not only whether an LGD will be a good fit for the operation in general, but also the number, type, and sexual status of LGDs that should be used.

Environment.—Terrain, type of vegetation (e.g., grassland versus brushland), surrounding land uses, and the LPTs used on surrounding landscapes can influence the success or failure of a particular tool. For example, a FoxLight™ that may effectively protect animals in a corral will not likely afford much protection in dense brush in a more extensive setting. When it comes to LGDs, environmental factors that affect sightlines, auditory and olfactory detection of predators, or ease of mobility may influence their success.

Predators present on the landscape.— While there is overlap between the types and ages of livestock threatened by different predator species, certain predators often target particular livestock more frequently than others. For example, coyotes attack sheep (*Ovis aries*) more often than do other predators (Larson et al. 2019; Scasta et al. 2017), though they also will prey upon goats (*Capra aegagrus hircus*) and calves (*Bovus taurus*) (Mitchell et al. 2004). Wolves are the predator species in California most likely to attack adult cattle, but they will also predate on calves, sheep, and goats (Scasta et al. 2017). The effectiveness of any LPT will vary depending upon the predator species present on an operation. Aerial predators, for example, won't be excluded by a fence. They also require LGDs to look up instead of only looking on the ground for threats. An individual LGD that is very effective against coyotes may not recognize common ravens (*Corvus corax*) or golden eagles (*Aquila chrysaetos*) as a threat.

Predation risk and the effectiveness of a given LPT will vary depending a variety of factors related to both predator and wild prey species. Predator seasonal diet preferences and spatio-temporal use of grazing areas will impact the likelihood of livestock depredation. Seasonal shifts in movements or diet of both predators and their wild prey can lead to varying predation risk throughout the year. An individual predator's sex, age, physiology, and behavior, among other factors, will all contribute to variability in predation risk and the effectiveness of different LPTs.

Operational characteristics.—Specific operational characteristics also likely influence the success or failure of a specific tool or suite of tools. Obviously, the species and class of livestock are related to susceptibility to predation events. Generally, beef cattle tend to be less susceptible to most predators than small ruminants (sheep and goats). However, even within a specific livestock species, the class of livestock can influence susceptibility (newborn calves are more susceptible than yearling steers, for example).

An individual operation's annual production calendar can also influence predation exposure. For example, some research suggests that a sheep operator who lambs during a time of year when the predators have ample natural prey may face less pressure from coyotes than a producer who lambs during a period when prey is scarce (Macon et al. 2018). Running dry females (cows, ewes, or does) in extensive settings without young (e.g., open-range sheep on Forest Service grazing allotments) may be less risky than grazing pairs (females with their young).

Human presence often varies between seasons and operations. Open-range sheep operations, for example, typically employ herders who have day-to-day responsibility for a band of sheep (1,000 to 1,200 head). These herders camp on the range and are with the livestock around the clock. Cattle producers who operate on similar extensive rangelands, on the other hand, typically do not employ herders or range riders. Livestock may be observed weekly or even less frequently during the grazing season. The decision to use human presence as a predator deterrent is complicated. Considerations include access to and affordability of skilled labor.

Isolating one particular LPT from all others is difficult because many producers use a suite of tools. The potential interplay between various tools further complicates one's ability to quantify the effect of a single tool. For example, one producer might use electronet fencing and LGDs, while a neighboring producer might use llamas and FoxLights™. Furthermore, the relationship between physical tools (e.g., fencing, fladry, alarms, etc.) and biological tools (LGDs, llamas, etc.) is not well understood.

Finally, producer attitudes and perspectives likely influence the long-term adoption of specific tools. A producer who thinks electric fence is expensive and unlikely to work during dry conditions will probably not adopt that tool. Similarly, a producer who believes LGDs are effective will be more likely to continue to use this tool even when problems arise.

The Case for Case Studies

In light of these challenges and uncontrollable variables, we propose a case study format that objectively describes the variables described above but also draws upon the experience of the producer, as highlighted in McInturff et al. 2019. This approach incorporates both sociological perspectives (such as producer perceptions) and ecological data to better inform management than assessing either in isolation. In our model, a case study describes the outcome of a real-world deployment of LGDs and allows other producers the necessary information to understand the potential similarities and differences between their operation and the one described in the case study so they can decide what tools may or may not be effective for their particular situation. Our approach includes examining LGD challenges and shortcomings to provide vital information on the potential limitations of a LPT instead of promoting a false sense of security. We hope to help spark new ideas or inspire producers to try a new tool or an existing LPT in a novel way.

METHODS

We conducted pilot-tested semi-structured questionnaire surveys of three livestock producers based in northern California. For the first case study, we examined a poultry operation in Marin County, which allowed us to examine the use of LGDs against aerial predators of poultry that were not effectively deterred by the other LPTs (electro-fencing and Foxlights™) utilized by the producer. The second and third case studies focused on sheep production in different settings in Placer and Nevada/Sierra Counties. In addition, we deployed camera traps on both sheep operations during the study period, allowing us to further examine local predator presence. We also interviewed the sheep herder who accompanied the sheep band in the third case study.

Case Study 1: Pastured Poultry Production in Marin County, California

Context.—While not as widely as discussed in the literature, LGDs are also used for poultry (*Gallus gallus domesticus*) production. We conducted a questionnaire survey of a free-range egg-laying chicken producer (who also runs Black Angus cows/calves) in the coastal region of northern California (in the general region of 38.093576, -122.828318). Our survey covered a study period of 12 months, from August 2019 through July 2020.

The operator purchased the LGDs to protect against bobcat, coyotes, and golden eagles (the biggest threats perceived by the producer), in addition to red-tailed hawks (*Buteo jamaicensis*) and the occasional long-tailed weasel (*Mustela frenata*). For bobcat, coyotes,

and golden eagles, the operator reported seeing or hearing the species or their sign on a daily basis. The producer noted that mountain lions had only been seen a handful of times over the years and never posed a threat to the livestock.

The operation had 4,500 chickens (commercial Production Reds) and 120 cows. The pastures were located on private land at around 90 m in elevation. The dominant habitats were grassland, riparian vegetation and marsh. The neighboring land was also private.

The producer owned four male LGDs (two pairs of siblings), and at the start of the study period one pair was two and a half years old and the other pair was one and a half years old. They were all Maremma x Great Pyrenees x Anatolian Shepherd crosses. One was neutered but the other three were intact, though the operator planned to neuter one more to reduce fighting between one of the sibling pairs. Each pair of sibling LGDs was kept together. The LGDs were purchased as puppies (8 to 10 weeks old) and were bonded to chickens under the producer's supervision. The adult size of the LGDs varied, with two siblings both weighing 45 kg and the individuals in the other pair weighing 54 and 38 kg. The producer had five years of experience with livestock guardian dogs.

Chickens were split between three pastures, and the two pairs of dogs were rotated among pastures. At any point in time, one group of chickens was without dogs. Shortly after the survey, the operator purchased two more LGD puppies to ensure each chicken flock would always be accompanied by a pair of LGDs. When the chickens were five weeks old, they were placed in the pastures with the LGDs. During calving season, which occurred August through September, some chickens and a pair of dogs were kept in the calving pasture to protect the calves from predators.

The chicken pastures were each one and a half to two acres in size. Most of the time, each pasture was surrounded by portable white electric net fencing. The typical grazing period per pasture was two weeks and chickens were never in the same pasture more than once in a year. The portable fencing was 122 cm tall and specifically made for poultry. It was erected for multiple purposes: to prevent chickens from wandering too far from the rest of the flock, to help exclude predators, to prevent the younger pair of dogs from roaming, and to make it easier to move chickens. The operator noted that the older pair of dogs would remain with the flock even without the presence of the electro fencing, but that was not the case for the younger pair.

In addition to the LGDs and electro fencing, the operation also deployed FoxLights™. Ideally, one was placed on every corner of each chicken pasture. During calving season, when the chickens were kept with the cows, the FoxLights™ were also placed at the corners of that pasture. The operator personally checked on the chickens at least three times per day and checked the calves (during calving season) once per day. The calves were kept in either traditional barb wire fencing or were on open range without a fence.

Results.— Over the 2019 calving season, three calves were lost to predators assumed to be coyotes, but the predator species was not confirmed. During the study period, one chicken was lost per month on average, compared with losing at least one to two chickens per day before using LGDs. During the times of year when there were more golden eagles in the area, the producer mentioned that it took a few days and a few losses for the LGDs to start actively protecting against the golden eagles.

Most chicken losses occurred in early morning, but some occurred midday. No chicken losses occurred at night, when chickens were inside mobile houses in the pasture. The producer attributed the fact that some losses were still occurring to the large number of

chickens that the LGDs needed to guard—they simply couldn't cover them all. There seemed to be more losses when the chickens were grazing closer to brush versus in an open field.

None of the LGDs roamed during the study period, though the operator attributed it to the fact that the younger pair of LGDs were kept inside the electro fencing. While the LGDs did occasionally come down to the ranch house to check out the ranch dogs, there never was a problem with the LGDs choosing to remain at the house instead of with the poultry. The dogs have never been aggressive towards people and as adults, the LGDs have never killed a chicken. The LGDs did have to be kenneled or tied up, however, whenever a border collie was used for gathering cattle, because the LGDs were aggressive towards that dog.

Over the last year, the operator witnessed the LGDs chase coyotes, but he never saw the LGDs catch or physically engage with them or any other predators. There were no known instances of the LGDs killing or injuring a wild animal or the LGDs being injured by wildlife. The LGDs were fed once per day, by hand because the chickens would steal the food if automatic feeders were used. The estimated total annual cost for the four dogs over the last year was between $1080 and $1540, including vet bills and food.

Overall for the last year, on a scale of one to five, the operator ranked LGD effectiveness as a four, because while the LGDs protected most of the livestock, they had not eliminated predation entirely.

Case Study 2: Pasture-based Sheep Production in Placer County, California

Context.—Flying Mule Sheep Company grazed approximately 100 head of sheep on foothill annual rangeland west of Auburn, California (38.96108, -121.18484), from mid-December through early April. The flock was comprised of bred ewes (approximately 80 head) and replacement yearling ewes (approximately 20 head). The grazed landscape was a large-lot subdivision (8.09 ha – 16.18 ha). Individual parcels were connected via paved and unpaved private roads and Nevada Irrigation District canals. Many residences had domestic dogs; some had horses and donkeys. Vegetation in the grazed landscape included open grasslands, blue/live oak savanna, blue/live oak woodland, and riparian vegetation. The terrain was rolling hills at approximately 243-305 m above sea level. Surrounding land uses included grazing land (cattle, sheep, and goats) and a large regional park (mostly wildland).

Twelve game cameras were placed throughout the grazed landscape in late December 2019. Cameras were placed adjacent to game trails, roads, and canals to help determine the species of wildlife present and the frequency of camera "capture" in relationship to the proximity of livestock guardian dogs and sheep. In order of decreasing prevalence in game cameras from late December through early April 2020, coyotes, foxes, bobcats, and a single mountain lion (in the evening on 1 March 2020) were noted. Other wildlife caught on camera included blacktail deer (*Odocoileus hemionus columbianus*), raccoons (*Procyon lotor*),striped skunks (*Mephitis mephitis*), jackrabbits (*Lepus californicus*), and wild turkeys (*Meleagris gallopavo*).

Sheep were mostly grazed in 107-cm electro-net paddocks ranging in size from 1.2 – 6.1 ha. Some paddocks incorporated a hard-wire sheep or deer field fence on one or more sides. Sheep were moved every 3 to 10 days. The flock was protected by one or two livestock guardian dogs. Bodie, a three and a half year-old Maremma x Anatolian intact male weighing approximately 41 kg), was with the flock for the entire period. In late March, a second dog was added (Elko, a two-year-old Great Pyrenees x Akbash intact male weighing approximately 50 kg). Both dogs were acquired as puppies between 8 and 12 weeks

of age and were bonded with sheep under the supervision of the producer. The dogs were fed daily, at which time sheep were checked as well (there was no around-the-clock herder with the flock). This producer has used livestock guardian dogs for 15 years, with varying degrees of success.

Results.—During the graze period (15 December 2019 through 6 April 2020), the producer had no predator losses. In early February, the producer found a buck that was likely killed by a mountain lion, buried in leaves and duff approximately 400 m from the camera that captured the lion photo. On the night that the game camera documented the mountain lion (1 March 2020), the flock was in a 5.3 ha paddock, the boundary of which was about 27 m southwest of the camera location. The south, east, and north sides of the paddock were 106.6-cm electronet fencing. The west fence was 1.8-m deer fence. On that date, there were 47 lambs with the ewes (between the ages of 1 and 11 days). The sheep had been moved into this paddock on the morning of 1 March 2020. Three lambs were lost during the time the sheep were in that paddock due to starvation or mis-mothering. There were no known instances of LGDs chasing or directly interacting with wildlife.

The producer reported that his current set of dogs didn't wander from their sheep, even if there were a failure in the electronet fencing. The dogs were not human-aggressive, accepted herding dogs if used by the producer, and could even be herded with the sheep to new paddocks. The sheep seemed inclined to follow the livestock guardian dogs if the dogs were led in front of the flock. The producer rated the effectiveness of his livestock guardian dogs as a five on a scale of one to five. The annual cost per dog (including feed costs, veterinary costs, and depreciation) was $367.

Case Study 3: Open-range Sheep Production on National Forest Land

Context.—Talbott Sheep Company grazed three bands of non-lactating (dry) ewes and rams on two grazing allotments on the Tahoe National Forest (39.497577/-120.1297558) between 9 July 2020, and 20 September 2020. Each band had at least one LGD with it and was managed by a herder, who camped with the sheep. Camps were moved every five to eight days to new bed grounds; sheep were taken to grazing areas and water in the early morning, bedded down near camp at mid-day, and taken back to grazing and water in mid-afternoon. The sheep were bedded near the camp at night. The operation was entirely open range; no fences (temporary or otherwise) were used. Each camp was supplied by a camp tender who assisted in moving camps and bands to new grazing areas.

The sheep bands were comprised of yearling and older ewes without lambs, along with approximately ten rams per band. Sheep were western whiteface (Rambioullet and Rambioullet-cross). Ewes weighed approximately 68-77 kg, while rams weighed approximately 113-136 kg.

For the questionnaire survey, we focused on the band that grazed from Kyburz Flat north of Stampede Reservoir down the east side of the Little Truckee River between Stampede and Boca Reservoirs. This band consisted of approximately 1200 sheep. The dogs were a three-year-old Great Pyrenees x Akbash cross male and a three-year-old Great Pyrenees male. The dogs were fed daily at the camp and roamed freely within the grazing area.

Rangeland types in the grazed landscape included sagebrush steppe, mountain meadows and associated riparian systems, and east side pine forest. The terrain was relatively flat to mountainous, ranging in elevation from 1,740 m above sea level to 1,950 m. Surrounding land uses included cattle grazing (on Forest Service and private lands) and heavy recreation

use (including developed and dispersed camping, off-highway vehicle use, boating, fishing, and hunting.

Twelve game cameras were placed throughout the grazed landscape for 70 trap days from early July to mid-September 2020. Cameras were placed adjacent to game trails to help determine the species of wildlife present and the frequency of camera "capture" in relationship to the proximity of livestock guardian dogs and sheep. Coyotes were the predator most frequently captured by the cameras, but some instances of bobcats were also recorded. Other wildlife caught on camera included mule deer (*Odocoileus hemionus*), golden-mantled ground squirrels *Callospermophilus lateralis*), jackrabbits (*Lepus californicus*), and sandhill cranes (*Grus Canadensis*).

In addition to interviewing the operator, we conducted a semi-structured interview with the herder on three occasions during the grazing season to determine the frequency of predator observations and to better understand predator impacts. The surveys were conducted via oral interviews in Spanish.

Results.—During the first two-week period that the band was grazing on the allotment, the herder reported the loss of a single ewe. He observed bear sign (tracks and scat) near the carcass and reported hearing bears frequently at night. Subsequent to that single event, no further predator conflicts were noted. A count of the band at load-out (20 September 2020) confirmed a single loss.

On 2 August 2020, the Great Pyrenees x Akbash cross LGD was picked up by a concerned citizen camping northeast of Stampede, who thought the dog was lost. The dog was taken to the animal control shelter in Truckee, California. The Talbott Sheep Company foreman retrieved the dog after paying a fine, and the dog was kept at the camp tender's camp near Hobart Mills for the remainder of the grazing season. From 2 August 2020 through 20 September 2020, this band was guarded by a single LGD, with no additional predator conflicts.

The producer reported that his dogs sometimes wander from their sheep, but typically not more than 800 m. The dogs were not human-aggressive and also accepted herding dogs used by the herder and other company staff. There were no known direct interactions between the LGDs and wildlife. The producer rated the effectiveness of his livestock guardian dogs as a five on a scale of one to five and the annual cost per dog was estimated at under $400.

DISCUSSION

Given the increasing need for implementing effective nonlethal livestock protection tools in California, information on how LPTs work in practice is vital. As has been shown elsewhere, the LGDs in these case studies promoted human-wildlife coexistence on both public and private lands. These three case studies exemplified the range of situations that LGDs can be implemented, from protecting poultry to sheep, working on public or private land, and in conjunction with a variety of other LPTs. Our approach explicitly addressed potential behavioral and situational challenges that producers should consider when making an informed decision on whether to use LGDs or not. While all three producers believed their LGDS had reduced livestock losses, in two of the three operations LGDs did not eliminate them entirely. Differences in individual LGD behavior, surrounding land use, and operation characteristics may contribute to unexpected challenges arising that are unrelated to the dogs themselves (e.g., recreationists "rescuing" an LGD assumed to be lost), yet still need to be considered.

Between producers recording sign and camera traps capturing predators, we were able to confirm that livestock on all three operations overlapped with predator species known to attack sheep, calves, and chickens. Despite the presence of LGDs and other LPTs, livestock losses weren't entirely eliminated in two of the three case studies, highlighting the difficulty in eliminating human-wildlife conflict for livestock producers. However, we cannot determine whether the predators recorded on the operations would have killed more livestock (rather than wildlife prey) if they had the opportunity, nor do we know if these predators took livestock from nearby unprotected herds or flocks during the study period.

Regardless of the complexities involved when examining LPTs in real-world settings, "Attempts to increase the involvement of these actors [producers, managers, and researchers], contributing together to evidence-based approaches, may be one way to alter the odds in a favourable direction. We are not suggesting that farmers or managers should do nothing until evidence is available, but merely encourage these actors to promote collaborative approaches, and work together in order to increase the proportion of studies aiming to quantify the effect of interventions." (Eklund et al. 2017). A continued compilation of case studies that apply our objective approach to the variables affecting LPTs and that span the wide spectrum of livestock operations in California will be critical for informing human-wildlife coexistence measures that benefit livestock, their producers, and wildlife.

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SUPPLEMENTARY MATERIAL

Questions—semi-structured interview

1. How many LGDs do you own?
2. What breed(s) are your LGD(s)? If a cross, please mention all breeds.
3. Is your dog(s) male or female?
4. How old is your LGD?
5. Is your LGD intact?
6. What type of livestock are with your LGDs?
7. What age classes of livestock are with your LGDs?
8. How many head of livestock are with your LGDs? If have multiple herds/flocks with different dogs, please clarify how many livestock are in each herd and how many LGDs each herd has. If "it depends," please describe your thought process as to how many dogs go with what herd.
9. How much does your dog(s) weigh?
10. What predators are you hoping your LGD(s) protects against?
11. How often do you see or hear those predator species or see fresh sign?
    ____ every day/night____ on a weekly basis ____ monthly____ never
12. How many years of experience do you have with LGDs?
    a. If have experience: How effective do you think your previous LGDs were at protecting your livestock? Did you ever have to rehome a LGD?
13. On a scale of 1-5, how effective do you think your LGD(s) is at protecting your livestock from predators?
14. Have you had any losses since you've been using LGDs? In the last year or grazing period?
    a. If yes: how many livestock, of what age class, and what predator was responsible? Please provide as much information as you can accurately remember—habitat (or do you remember the exact location)? Time of day? Why do you think the LGD did not protect against that loss? Did you change anything (including adding other protection tools) as a result of the loss?
    b. How often do you check for losses?

15. Did you have any losses before you got the LGD?
16. Do you have a herder with your livestock?
    a. If yes: are they with livestock during the day only or also at night?
17. What kind of setting do you have your livestock in?
    a. Hard wire fencing
    b. Electric fencing (permanent or mobile?)
    c. Open rangeland
    d. Other: please explain _____
18. Do you use any other nonlethal tools to protect your livestock? Pease describe.
19. Are you aware of any nonlethal tools being used to protect livestock on adjacent properties?
20. Have you noted any of the following problems with your LGD(s)? Check all that apply.
    - Roaming (how often? Has dog returned on its own or did someone find it and contact you?)
    - Remaining at house/barn instead of staying with stock (has this always been an issue? Or did it develop at a certain age?)
    - Chasing or harming livestock
    - Biting people
        i. Was the person a recreationist? Someone who works on your operation? Were they walking? Riding a bike? Please describe situation as best you can.
    - Fighting with other dogs in the operation
    - Have you noted any other problems not included on the list? Please describe. _____
21. What was the age of your LGD when you purchased it?
22. What costs have you incurred over the lifetime of your LGD?
23. Do you have insurance to cover potential liabilities for your LGD?
24. What type of land do you graze your livestock? (public, private?)
25. What's the dominant habitat type(s) in the areas where you graze your livestock?
26. If a cattle producer, when is your calving season? And what breed(s) of cattle do you have?
27. Have you ever witnessed your LGD physically engage with a predator? What happened?
28. As far as you are aware, has your LGD ever killed or injured a wild animal?
29. Has your LGD ever been injured by a wild animal?