Protecting Small Livestock and Predators Alike: Early Successes

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ABSTRACT: Wildlife-livestock conflict is an ongoing challenge for both livestock production and conservation efforts. Predator kills of livestock are a serious economic concern for most ranching operations. In particular, small livestock such as sheep and goats are vulnerable to native predators including mountain lions and coyotes. Despite this challenge, livestock can be a powerful tool for habitat restoration and biodiversity conservation in disturbance-adapted landscapes such as coastal California. In 2014 and 2015 we used 1,400 goats to graze habitat in the Santa Lucia Mountains, California. To prevent wildlife-livestock conflict, we tested a livestock protection strategy that combines several methods: night penning goats within a double, portable electric mesh fence; using two guarding dogs inside the pen with the goats; monitoring predators with wildlife camera-traps placed on the fence's periphery; and placement of the pen near the herders' camp. Despite a predator-rich environment, no goats were lost to predators, and the only predator captured on the wildlife camera-traps over 161 nights was a single coyote. Often, when lions or other predators depredate livestock, the animal is lethally removed to prevent further depredation events. Preventing predators from killing livestock protects both livestock and predators.

KEY WORDS: *Canis latrans*, coyote, electric fence, goats, guarding dogs, livestock, mountain lion, predation, *Puma concolor*, trail cameras, wildlife damage management

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INTRODUCTION

The conflict between predators and livestock is as old as the practice of domestication. Often in the western United States, this conflict occurs in rangeland conditions where predators are adapted to stalking and killing native herding species such as bison, pronghorn, and elk. As these native herding populations have been reduced in numbers and range, domestic livestock have replaced them on the landscape, creating the potential for livestock-predator conflict. The ecological importance of both livestock and predators is well documented. Livestock grazing, when managed appropriately, can mimic the effect of large herding species that once roamed the West, increasing grassland species diversity, preventing brush encroachment into grasslands, and reducing fuel loads for wildfires (Derner et al. 2009, Ford and Hoorn 2013, Bartolome et al. 2014). The large predators of the western U.S. such as mountain lions (*Puma concolor*), bears (*Ursus* spp.), wolves (*Canis lupus*), and coyotes (*C. latrans*) can act as ecosystem engineers, regulating prey populations, keeping herbivores alert and on the move, and affecting the vegetation patterns on the land (Berger 1999, Bruno and Cardinale 2008, Ripple and Beschta 2011). Both grazing and predators are essential to the disturbance-adapted landscape of California; however, predation of livestock by native carnivores continues to be of great concern to ranchers and conservationists alike.

Losses caused by predation are quite variable across the western U.S. Although a given producer may lose only 1-5% of their herd to predators in a year, the economic impact can be significant on profit margins (Graham et al. 2005, Baker et al. 2008). Further, the negative impression and anti-predator attitudes resulting from the loss can be disproportionately large (Baker et al. 2008, USDA 2010, USDA 2015). Conflict with predators, either with livestock depredation or aggressive actions against humans and pets, often results in lethal take of the predator. In California, where the mountain lion is a specially protected species (California Wildlife Protection Act 1990), nearly 100 lions a year are removed through depredation permits issued by the California Department of Fish and Wildlife (CDFW 2013). Coyotes in California are managed as a non-game species, allowing for year-round harvest.

While predation loss in flocks and herds may seem low, given the large number of livestock operations throughout California, most livestock producers do not suffer "average" loss: some, because of geography, location, predator density and behavior, and livestock management strategies, incur heavy losses, while others rarely suffer predation (Treves et al. 2004, Kolowski and Holekamp 2006, Baker et al. 2008, Musiani et al. 2010). Improved livestock husbandry can limit predation, which would benefit both the producers and the predators.

Non-lethal Predator Management

A variety of non-lethal tools are available for protecting livestock in areas that support large carnivores. Methods include permanent and temporary electric fencing, trained guarding animals/dogs, herders, range-riders, proximity to human habitation, avoidance of habitat that provides predator cover, carcass burial or removal, chemical repellents, and scaring devices (e.g. fladry, motion-sensor lights, and noise-makers).

Electric fences have been employed for both livestock and wildlife management since the 1930s (McAtee 1939). Today a diversity of electric fence designs are used to both contain and protect livestock from a variety of predators including wolves, coyotes, mountain lions, and jaguars (Knowlton 1972, Dorrance and Bourne 1980, Nass and Theade 1988, Lance et al. 2010, Cavalcanti et al. 2012). A versatile option is temporary or portable electric fence in the form of either polywire (braided polyester string and electrified wires strung on portable pickets), or electrified

Figure 1. A) Electrified polywire with fiberglass posts. B) Electrified mesh fence.

mesh fencing (Figure 1). Each has strengths and weaknesses, depending on the species of livestock and predators involved.

Livestock guarding dogs (LGDs) likewise have a long history of use for protecting livestock (Smith et al. 2000, Andelt 2004). Studies have been conducted showing the reduction in livestock losses of 11-100% when LGDs are integrated into husbandry practices (Andelt 1992, Smith et al. 2000, Gehring et al. 2010a, Urbigkit and Urbigkit 2010).

Human presence is also believed to reduce the likelihood of predation events. In particular, the use of herders has been shown to reduce the number of livestock depredated (Ogada et al. 2003), though studies evaluating this practice are limited. Landscape features can also positively contribute to husbandry practices. Operators can place livestock in areas where there is less cover for predators, or areas that are away from attractants such as ponds. Additionally, operators may choose to move livestock to areas of low predator activity during vulnerable periods, such as when young are born. Despite the non-lethal methods available, the challenge of protecting livestock from predators persists, resulting in continued discussion about effective and reliable methods for controlling livestock-predator conflict.

Previous Depredation Events on the Study Site

The Santa Lucia Preserve (hereafter, "Preserve") is a 20,000-acre conservation development located in Carmel, California. With approximately 5,000 acres of grasslands and savannas, targeted grazing with livestock is an essential tool for habitat management and restoration efforts. In 2013, the Santa Lucia Conservancy ("Conservancy"), the land trust responsible for protecting and managing the lands of the Preserve, began a pilot grazing project, contracting with a sheep herder to graze a flock of 28 sheep. Sheep were contained in a 1-m-tall net electric fence both day and night with no incidents for two months. In October 2013, at night and during the first storm of the year, a mountain lion attacked the flock and killed 24 of the 28 sheep, at which time the sheep grazing was terminated. In February 2014, we began a seasonal collaboration with a local goat grazing operation to bring 1,400 goats and two herders to graze on the Preserve. Two nights into the goat grazing effort, we had another mountain lion attack, killing 18 goats and coinciding again with a large storm system. These attacks, particularly proximate to the herders' camp, suggested habituation or a lack of fear by the lion, and we assumed it may be the same lion involved in the sheep attack. We consulted with USDA-Wildlife Services, who concurred and provided advice that the lion could be taken under a CDFW depredation permit. The lion was live-trapped the following night. When approached, it exhibited no fear of humans, but instead demonstrated aggression at the front of the cage, making no attempt to move away from human approach. The mountain lion was euthanized, and a CDFW necropsy verified goat remains in the stomach. At our request, and in consultation USDA-WS, the goat operation immediately added two Maremma Sheepdog LGDs to their husbandry practices. There were no more depredation events through the goats' departure in early April, despite wildlife camera-trap evidence of additional lion activity in the area.

During a second collaboration with the goat operation, in the winter of 2014/2015, we placed an increased priority on protecting both livestock and predators. To achieve this, we combined multiple husbandry practices. The aims of our practice were to 1) protect the goats from mountain lions and coyotes, 2) prevent native predators from becoming habituated to human and livestock, 3) test an integrated protection strategy, and 4) share our methods with other producers and biodiversity conservation practitioners. This led to the demonstration presented here.

METHODS

This project was conducted on the Preserve, a 20,000-acre conservation development located outside of Carmel, California. The Preserve has a variety of habitats including grasslands and oak woodlands, and has documented year-round resident mountain lion and coyote populations. From November 13, 2014 to April 21, 2015, a flock of 1,400 goats grazed on the Preserve. During the day, goats were free-herded, with two Peruvian herders working the goats with two herding dogs.

Protective husbandry practices were applied from dusk until dawn, when we expected the highest predator pressure. Each night before dusk, goats were herded into a night pen, located within 50 m of the herders' camp to maintain a human presence. Night pens were approximately 0.5 acres and consisted of two portable electrified mesh fences (Premire 1, Washington, IA), charged to 4-10 kV (Stafix x6i Energizer, Stafix, Mineral Wells, TX), one inside the other. A 1.5-m-tall fence formed the interior (Premire Perma Net Fencing #19/68/6), surrounded by a 0.9-m-tall fence (Premire Electro Net Plus Net Fencing #9/35/12); there was a 1-m gap between the two fences (Figure 2). It took one person an average of 45 minutes to set up this pen. The pen was used 1-2 nights, depending on forage and grazing objectives, before being moved to a new location.

Two Maremma LGDs were placed in the night pen with the goats to discourage the predators and alert the herders of predator presence. When we anticipated storm systems, the night pen was located away from woodland and brushy habitat that could provide predators with stalking cover. On each of the corners of the night pen we deployed Reconyx PC800 HyperFire Professional Semi-Covert trail camera-traps (Reconyx, Holmen, WI) angled along the edge of the exterior fence and out into the open space to document wildlife activity along the fence edge (Figure 3). Camera-traps had a sensitivity range of 20 m, covering the length of one side of the night pen. Separate from this study we had a long-term camera-trap study with 70 other Reconyx cameras placed around the Preserve, which allowed us to document predator activity across the 20,000-acre property.

Figure 2. Double electric mesh fence night pen. A 1.5-m-high electric net fence forms the interior boundary with a 0.9-m-high electric net fence surrounding the interior fence.

RESULTS

Over the course of 161 days and nights, no livestock were lost to predators. The herders reported seeing coyotes in the area on two occasions during the day; however, the camera-traps posted on the corners of the night pen only detected one coyote in December walking past the night pen within approximately 10 m, but it showed no interest in the goats. Despite several storm systems passing through the Preserve, no evidence of predator activity was noted on those nights by the herders or the cameras. In the separate larger camera trapping study, both mountain lions and coyotes were documented across the property both day and night throughout the study (data not shown).

DISCUSSION

Despite the presence of mountain lions and coyotes on the Preserve, no goats were attacked by predators through the duration of this project. The protective methods we employed in this project were a combination of existing practices and technologies. The placement of the night pens near the herders' camps was to utilize the human presence to discourage predator activity and increase herder responsiveness to a predator threat. The use of small "double" night pen was intended to keep the goats tightly gathered, reducing the ability of a predator to single out an individual to attack inside the fence. Having the LGDs inside the pen allowed them to place themselves between the goats and the threat and act defensively.

A few studies have evaluated the combination of electric fence and LGDs (Gehring et al. 2010b, Macon 2014); however, the use of a double portable electric fence design has not been previously documented in the literature. The double fence was designed to prevent a mountain lion from jumping into the pen with the goats, making it difficult for the lion to gauge the distance required for a single leap into the pen. With only a 1-m space between the two electrified fences, we assumed that it would be more difficult for the lion to clear the second fence if it jumped in between the two fences.

The wildlife camera-traps were intended to record predator presence and activity. At the start of the project, we suspected that the novelty of a large herd of livestock new to the area might attract all types of wildlife; however, there was a general lack of activity directly around the pens. The wildlife camera-traps used in a separate but concurrent study documented year-round mountain lion and coyote activity across the property, indicating predators were present in the areas where goats were present. It is possible that predators may have visited the night pen but remained out of range of the camera-traps located on the pens.

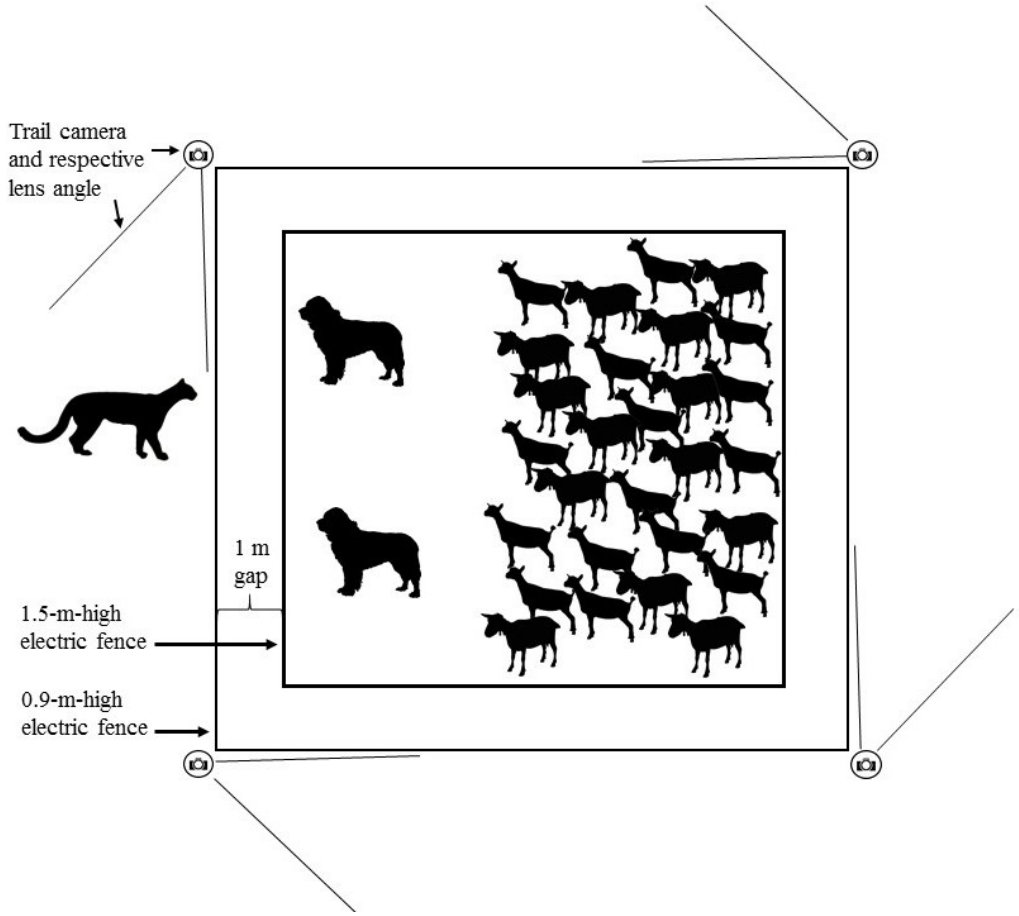

Figure 3. Schematic of night pen design and protective livestock husbandry which applied two electric net fences and two livestock guarding dogs to discourage predators and four wildlife camera-traps placed on the exterior corners to document predator activity.

Baker et al. found that much of the operators' resistance to adopting these more involved husbandry practices is the lack of data (Baker et al. 2008), particularly data evaluating preventing lion attacks on livestock, and we hope that our observations can contribute to future applications of these methods. Operators may also be concerned about the cost associated with purchasing the materials and the increased labor. While this method may be more labor intensive than current practices of fixed fencing and leaving animals out in larger pastures, the loss of livestock may have larger economic impacts than the labor required to conduct a more integrated protection strategy such as we utilized.

The larger "cost" of predators habituated to livestock killing and human presence is difficult to quantify but should be addressed. We suspect the same lion was responsible for both attacks, though without molecular forensic techniques we cannot be sure (Ernest and Boyce 2003). It is possible that the attack on the sheep in October 2013 at the Preserve may have contributed to the lion becoming habituated to the basic husbandry practices and learning to kill livestock, thus possibly increasing the likelihood to attack the goats in February of 2014. In considering bringing the goats back fall of 2014, we were particularly interested in preventing other local mountain lions from learning to kill small livestock as well. Though extremely difficult to test, it is hypothesized that predators can learn to kill domestic livestock and in such cases will continue to seek out and kill livestock (Stander 1990, Linnell et al. 1999). In California, those lions can be lethally removed under a depredation permit issued by CDFW. Preventing the initial learning experience with small livestock was our primary concern in this project, and is essential for the Conservancy's continued use of small livestock for biodiversity conservation purposes.

In California, depredation permits are the only method for targeted removal of offending mountain lions to protect livestock and property. However, a recent study indicated this can be a large source of mortality for mountain lions in Southern California (Vickers et al. 2015). Though numbers have decreased in recent years, an average of 97.5 lions were harvested under a depredation permit from 1990 to 2013 (CDFW 2013; Figure 4). In the study by Vickers et al. (Vickers et al. 2015), 17% of the collared animals in their population ecology study were killed under depredation permits. Statewide, lion populations are crudely estimated at approximately 4,000-6,000 individuals (CDFW 2007), suggesting approximately 2% of the lion population may be removed each year by depredation permits.

Given that livestock operators report losing an average of 1-5% of their livestock to predators, and an estimated 2% of lions as well as an unrecorded number of coyotes are killed each year in response to predation events on

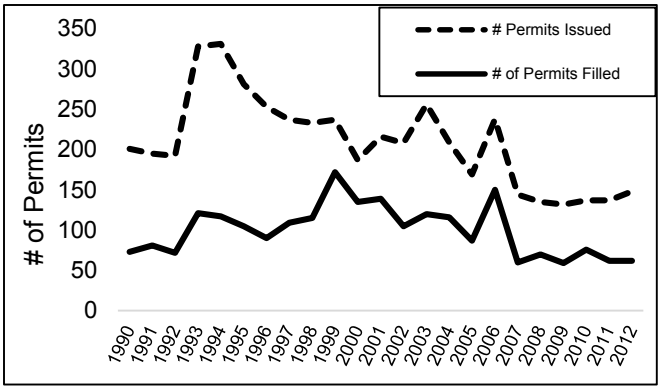

Figure 4. Number of depredation permits issued by California Department of Fish and Wildlife for lethal take of mountain lions compared to number of permits reported "filled" by lethal take of a mountain lion. (CDFW 2013)

livestock, it is likely that improved livestock husbandry could reduce the amount of killing on both sides of the fence. Preventing predators from having successful livestock kills not only protects livestock but also protects predators.

While this project was a demonstration, we have encouraged other livestock operators to try this protective strategy. We hope that with more operators employing the husbandry practices outlined here and with continued use in our grazing program we can show the benefit of an integrated livestock protection strategy and decrease the number of livestock-predator conflicts.

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