

Livestock Guardian Dogs Protect Sheep in the Alberta Foothills, Canada

by
Sondra Corff

I have had several livestock guardian dogs for more than 10 years. They are one of several strategies I use to protect my sheep from opportunistic predation and deliberate predation, mainly by coyotes. Around my farm, the most common predators are coyote *Canis latrans*, fox *Vulpes vulpes* and raven *Corvus corax*. There are also hawks *Buteo spec.*, occasional eagles *Aquila chrysaetos*, *Haliaeetus spec.* and, some times in winter, a wolf *Canis lupus*. Bears *Ursus arctos* are not a problem in my area. My land also supports deer *Odocoileus hemionus*, *Odocoileus virginianus* and elk *Cervus canadensis* (seasonally), Richardson ground squirrels *Spermophilus richardsonii*, and occasionally, badgers *Taxidea taxus*.

In 2004, when I was asked to write an article about the events and challenges of raising sheep in the foothill country of Alberta, I hesitated in doing so because my observations are casual and anecdotal and not the results of scientifically designed, 'controlled' research. However, these comments may provide a snapshot of my 'laboratory' and may be useful and encouraging to others.

Livestock depredation

My 230 acre (93 ha) farm contains rolling mixed

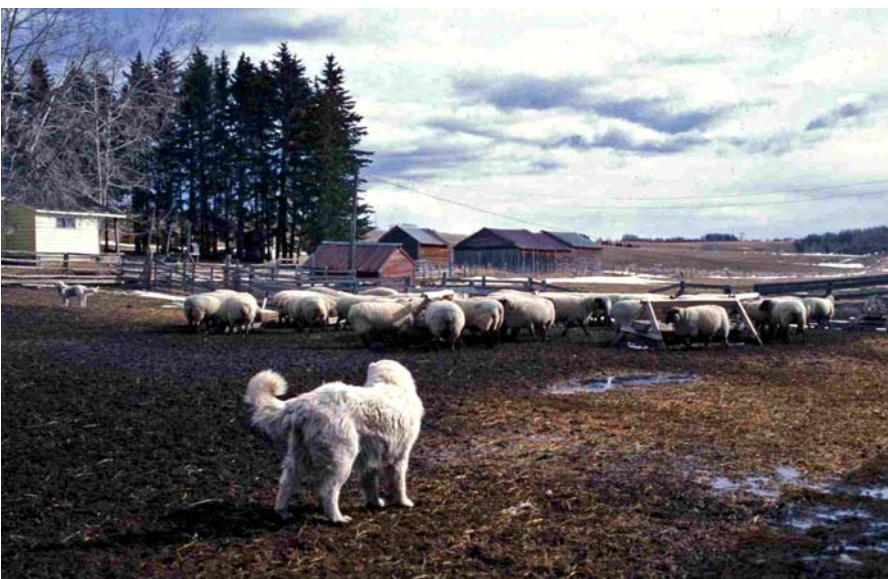


Fig. 1: Sheep in the corral guarded by two LGDs. (Photo: Colleen Campbell)

prairie land (Figure 1), some aspen *Populus spec.* stands, 70 acres of tame hay, and several large sloughs where long slough grasses and willow *Salix spec.* grow, providing excellent cover for the coyotes. Their boldness was demonstrated early in my farming experience, when two coyotes each took a small lamb while I was bottle-feeding another nearby, in the same pasture. I did give chase, causing them to drop the lambs, which recovered with appropriate treatment. The rolling landscape hides sheep and predators from the vigilant eye of both shepherd and guardian dog.

Whenever the sheep are in the paddock, I have spend a lot of time there, as well. It is an unfortunate condition of timing that lambs are present when coyotes are feeding their annual litter of pups, and then teaching them to hunt. Before I acquired the LGDs, I lost five or six lambs a summer to coyote predation. With myself and the LGDs present, there has been no loss to predation in recent years.

I first asked regional wildlife officers for advice and help in dealing with my coyote population problem. They suggested three options for controlling predators, particularly coyotes: trapping, poisoning, or shooting. They gave me poison pellets, in a chicken head, to be inserted in the carcass of a dead lamb and left for the coyotes. I considered this particular strategy undesirable because of the possibility of poisoning other wildlife, including birds, as well as dogs, possibly my own, without necessarily killing the coyotes that were taking the lambs.

I also had a coyote hunter try to get a shot at them, but he was not successful. All three approaches – poisoning, trapping, shooting – seemed inadequate. They all required continued use to be effective; when a breeding pair of coyotes is removed, other coyotes will simply move in. In my experience, when the grass in the pastures is high the coyotes simply slink towards their prey, quietly and unseen. What I wanted was a safe, effective solution with long-term efficacy. None of the above approaches had these attributes.

Electric fencing

At great expense, I pursued a second option that had been suggested, and surrounded the



Fig. 2: Sondra with some of her dogs. (Photo: Steve Swettenham)

pastures with an eight-strand electric fence. This was initially effective though I soon discovered that electric fencing requires regular maintenance to remove grass load and molehills from the bottom strands. Additionally, coyotes quickly learn to exploit any weakness in the fence: to dig under it and to jump through the horizontal strands. With all four feet in the air, they are no longer grounded and do not receive a strong enough deterring jolt. With some electric fencing, coyotes also learned to climb posts bracing the corner posts.

My first LGD

I hesitated getting a livestock guarding dog (LGD) because of my *Border Collies*, but in 1993, I bought CHARLIE, my first *Maremmano-Abruzzese* puppy from a sheep rancher in *Sundre*, Alberta (Figure 2). I raised him with the sheep and lambs and trained him as advised. The rancher from whom I purchased him was very helpful and I also gleaned advice from various shepherds' journals and provincial government literature, I also kept in mind that CHARLIE would also have contact with people visiting the farm. It was important to socialize him with humans as well as ensure that he bond with the sheep – a precarious balance of attributes.

It is testimony to their intelligence that *Maremmano-Abruzzeses* distinguish these equally important and very separate conditions. Prior to lambing, the sheep are sheared, given vaccination shots, dewormed and have their feet trimmed. Many inexperienced "farmhands" come to help and although the

sheep are being handled and disturbed, the LGDs stay out of the way while maintaining a watchful eye on the proceedings.

I have a commercial flock of mostly Suffolk (Blackface) sheep, a non-flocking breed. The size of my flock has varied over the years, growing from a few dozen to 250 to 300 at its most numerous. In Alberta, this is considered a substantial sheep operation. Recently, I have reduced the herd to about 50 sheep. It was clear that in the rolling terrain I would need more than one *Maremmano-Abruzzese* to guard my sheep effectively. CLYDE joined us in 1994, CASPER in 1997 and CANDY in 2001, all as puppies. In 2003, CANDY had a litter of pups and two of the litter, CLARA and CANDY, now work with their mother. Over the years, it became apparent to me that when the pups are strongly bonded to the sheep and when the flock was threatened, most of the sheep would gather and the dog would stay with them, possibly leaving sleeping lambs or slower sheep at risk, especially if no shepherd was present. I thought it might be beneficial in my situation to have some dogs not so tightly bonded to the sheep, who would be willing to leave them and chase the coyotes. When CANDY was a young dog and not strongly bonded she chased coyotes long distances from the main corral. Sometimes I could actually see three or four coyotes spaced around her as she was being lured away. As she matured, she continued to challenge coyotes even when they were far from the sheep but visible to her.

Maremmano-Abruzzese are very visual dogs and constantly scan the surroundings for anything that

appears threatening to their territory. As coyotes are willing to encroach right up to, and even into, the corrals, I wanted to encourage CANDY *and* her two female pups to respond to the more distant approach of predators – that is, to assume a slightly different role from the dogs closely living *with* the sheep. Consequently, the females are marginally bonded to the sheep and more willing to challenge intruders when they appear at a distance from the flock. The three females are also alert to warning barks from the dogs with the sheep, especially when they are all in the corrals. The three females are usually near each other and tend to position themselves where they can see along the drive to the road, as well as into the corrals and across the slope to the pastures and hills beyond. During a good part of the day, they may be seen catching up on their sleep in the corral with the sheep.

Initially, CANDY was very protective while teaching her pups who are now fully grown. I notice that they often play in ways that hone their skills for any potential contact fighting with predators. The presence of the three “patrolling” dogs has pushed the predators back from the main pastures and the corrals. Though coyotes can be seen and heard in habitat that is surrounding the sheep pastures, they have become more cautious about approaching my sheep. Summer 2004 was the first season I was able to leave sheep and lambs in pasture without a shepherd for many hours without the loss of any animals to coyotes.

The *Maremmano-Abruzzese* is considered less territorial and less aggressive than some other LGD breeds. I have no evidence that my guardian dogs have ever killed a coyote, although I have watched them chase coyotes into the woods. I no longer must get up at 3:00 a.m. to protect the sheep and lambs in panic from the howls or presence of a predator.

In my situation, the LDGs are definitely advantageous in protecting livestock. Of course they require monitoring and regular attention. When the *Maremmano-Abbruzeses* were young, they had to be carefully disciplined and socialized to the livestock. Vigilance is especially important when lambs are present with young pups. Coyote predation is greater in the late summer when coyote pups are growing and learning to hunt for themselves. In addition, dispersing coyotes are opportunistic hunters; at any time of day, a coyote can happen across a young lamb. The hills around the farm give resident coyotes perfect vantage and I can feel their eyes monitoring my every move.

To date, I have only lost *Maremmano-Abruzzeses* to the deteriorating health of old age, never to predators or accident.

Recommendations

- Shepherds need to be educated about the nature of LGDs and how to work with them.
- Puppies should be selected from working lines to ensure good traits.
- The most effective breed of LGD should be selected for the particular needs of the rancher.
- Flock management and monitoring by a shepherd is always required for effective use of LGDs.
- It is important to keep yards and corrals clean, removing livestock carcasses before they might be scavenged.
- It might be useful to teach LGDs to work with each other by first bonding them independently to livestock and, while they are still young, putting them into situations where they work together with the livestock.
- In some situations, it may be necessary to socialize LGDs pups with people.

Sheep ranching in Alberta depends on small operations, with most ranchers subsidizing their sheep operation with other kinds of farming and/or off-farm work. Though the neighbouring province, Saskatchewan, pays half the costs of LGD puppies and supports some of the other costs of keeping LGDs, Alberta offers no subsidies for any preventative methods a sheep operator might engage to protect their flock. Current statistics about sheep farming in Alberta is available through the the Alberta Sheep and Wool Commission (<http://www.absheep.com>). The value of a lamb ranges from \$50 to \$125, depending on when it is taken to market. Sheep loss to predation is not compensated by government programs. Overall, it is hard to imagine sheep ranching without the dogs to protect my flocks. They are partners in the care of my sheep and it is part of my work to ensure their general well being. This requires both time and financial commitment. Well-bred livestock guardian pups cost about (Canadian) \$300 and the average per year cost for food and veterinary care is about (Canadian) \$550. In conclusion, LGDs are very effective in my situation as a solo rancher and for this particular landscape.

Lastly, thanks to my friends Colleen Campbell and Marco Musiani for the prodding and encouragement without which this article would not have been written.

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The Use of Livestock Guarding Dogs in Portugal

by
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Introduction

Conflicts with wolves that result from depredation on livestock are not new and different strategies have been used to deal with them. Historically people aimed to reduce conflicts by exterminating the predator. In Portugal, human persecution led to Iberian wolf, *Canis lupus signatus*, extinction in 80% of the country, particularly since the 1970s (Petrucci-Fonseca 1990). Alternatively and simultaneously to wolf persecution, original and effective non-lethal methods of livestock protection have also been developed. These methods reflect an ancient knowledge that resulted from a long coexistence between wolves and livestock. The most widespread is the presence of a shepherd accompanied by livestock guarding dogs (LGDs). Nevertheless, in Portugal the use of good LGDs and the knowledge on how to raise them is being lost and non-efficient dogs, namely small-medium sized hunting or mongrel dogs and dogs not raised in a correct manner are generally used. Since the wolf became protected in

1988, the inefficient protection of most livestock has led to increased depredation and conflicts.

Predation on livestock

Due to the scarcity of wild ungulates, wolf diet is based on livestock leading to considerable damages. On a national level, annual damages to livestock reach a total of 1,000-1,500 goats or sheep and 250-300 cattle or horses (data supplied by the Institute for Nature Conservation – ICN). Confirmed wolf damages are compensated by the ICN according to the current market value. Compensation has presently reached a total annual amount of 600,000 € (729,000 US\$) (ICN). Wolves prey on the domestic species available. This availability depends not only on the abundance of the species but also on the ease of capture by the predator. In wolf range there are around 347,000 sheep, 123,000 goats, 131,000 cattle and 28,800 horses. Roe deer, *Capreolus capreolus*, densities are low to moderate and red deer, *Cervus elaphus*, is only locally common in the North-eastern part of the country. Despite being very abundant the wild boar, *Sus scrofa*, is a difficult prey for the wolf. In *Alvão* Natural Park and adjacent mountains (North), the wolf diet is essentially based on goat (70%) and wild boar (14%) (Carreira & Petrucci-Fonseca 2000). However, in the most Northern mountains in *Peneda-Gerês* National Park, where cattle and horses are free-grazed, wolves prey mainly on goats (37%), horses (27%), especially young, and cattle (19%) (Álvares et al. 2000). In the Centre of the country wolves feed mainly on cattle (33%) and goats (23%), and to a lesser extent on horses/donkeys (9%), sheep (7%) and wild boar (7%) (Quaresma 2002). Outside the wolf distribution range, stray dogs are also responsible for damages on livestock (Ribeiro & Petrucci-Fonseca 1998). In these areas, the use of livestock protection measures has decreased since wolf disappearance and attacks by dogs usually result in multiple killing or maiming of livestock.



Fig. 1: Juvenile female *Cão de Castro Laboreiro* alert to the presence of strangers near the flock on a mountain pasture. (Photo: Raquel Simões)

Implementation of the LGD project

To help reduce this constant conflict Grupo Lobo has developed an

action plan that aims to recover the use of LGDs and evaluate its use as an efficient livestock protection method to contribute to wolf conservation. At the same time it also aims to contribute to the conservation of the Portuguese breeds of LGDs, some of them also endangered, like the *Cão de Castro Laboreiro* (Figure 1) or the short-haired variety of the *Cão da Serra da Estrela* (Figure 2).

Although initially defined in 1988 this action plan only began in 1996. Since then a series of consecutive funds enabled the continuation and expansion of the project. Besides its experimental basis, the project also promoted a series of studies on LGD behaviour, genetics and morphology. These studies have been performed by several undergraduate, master and doctoral students. Behaviour studies have been developed to increase the knowledge about LGD behavioural development and the process of socialization that are the basis for efficient LGD. Besides considerations about the origin and relationship between breeds, inbreeding analysis and biometric studies are also very useful for breed management and conservation. Other methods of livestock protection are also being tested and implemented as well as the gathering of information on methods traditionally used.

The project operates in 4 phases. The first consists in the selection of livestock producers (based on the number of damages, the existence of conditions to receive a dog and the willingness to participate, which is evaluated during a personal interview) and of the litters and dogs available (based on the characteristics and working ability of the parents and on the behaviour/health/morphology of the pups).

In the second phase the pup is integrated into the flock and in the third phase dog's behavioural and physical development is monitored until it reaches adulthood (18-24 months of age). During monthly visits the dogs are physically examined and their behaviour is evaluated. This evaluation is based on observations of the dog during the grazing period of the flock or while with the livestock in the barns and complemented with inquiries to the livestock producer.

In the last phase the evaluation of the dog's efficiency is performed. This is done according to three criteria: 1) reduction in damages; 2) behaviour of the dog; and 3) satisfaction of the owner. The behaviour is evaluated according to the model proposed for



Fig. 2: Adult female *Cão da Serra da Estrela* of the short-hair variety integrated into a sheep flock on the plains in the Northeast of Portugal. (Photo: Silvia Ribeiro)

LGDs by Coppinger & Coppinger (1980) that defines three components: 1) attentiveness; 2) trustworthiness; 3) protectiveness. Attentiveness is evaluated according to the methodology defined by Coppinger et al. (1983).

Veterinary care and food are provided until the dog reaches adulthood. To guarantee the correct education and welfare of the dog, and consequently its efficiency, an agreement is signed with the livestock producers establishing the rules to be followed regarding dog ownership, education, health care, feeding, breeding and legal responsibility. Dogs that died were replaced, if their death did not result from a fault of the livestock producer. To improve the knowledge of livestock producers about LGD breeds, education and behaviour, a leaflet was produced and given to participating and other interested livestock producers. A second leaflet was also produced concerning basic veterinary care, feeding and breeding of LGD as well as general legal aspects regarding dog ownership.

Project intervention area

The project is being developed mainly in the mountainous areas of the North and Centre of Portugal, including the Districts of *Vila Real*, *Viseu* and *Guarda*. In these regions livestock production has a big economic importance, human density is low and distributed through small villages. Geography is very diverse and can change from plateaus to steep valleys with altitudes that can reach 1,400 meters. Due



Fig. 3: Juvenile male *Cão da Serra da Estrela* of the short-hair variety near the corral where its flock is confined during the night. (Photo: Raquel Simões)

to the frequent fires, vegetation cover consists mainly of bushes that can sometimes attain considerable heights (Figure 1). Pine, *Pinus sp.*, eucalyptus, *Eucalyptus sp.*, or oak, *Quercus sp.*, woods are still found. Precipitation is medium to high, occasionally with snow, and temperatures are low in winter. Goats are the most common livestock species. Previous studies found a density of 2.6 wolves/100 km² in the North (Carreira & Petrucci-Fonseca 2000) and of 3.4 wolves/100 km² in the Centre of the country (Alexandre et al. 2000).

Some dogs have also been introduced in flocks in the eastern parts of the Centre and North of the country, in the Districts of *Castelo Branco* and *Bragança*, respectively. These are less mountainous regions located outside or at the border of the wolf distribution area. In these areas the climate is drier and warmer and sheep are more abundant. Plantations of olive, *Olea europaea*, and cork trees, *Quercus suber*, and occasionally eucalyptus are common (Figure 2). Stray dogs are present although their abundance can vary considerably between years and time of the year.

Husbandry systems

Livestock production focuses mainly on meat and occasionally also on milk production. Flocks can vary from 10 to 700 animals - although bigger communal flocks can occur, with a mean number of 180, and are typically herded by one, and occasionally, two shepherds. In mountainous areas flocks are

guarded during the day and confined during the night in stables located close to villages. Although some flocks of sheep can be kept unguarded in fenced pastures, this is rare and is usually only for some hours of the day. In the flatter and warmer regions flocks are usually confined into light and mobile corrals for the night, during the summer, protected by dogs (Figure 3). Scaring devices like plastic bags or old clothes are occasionally hung close to the corral. Flocks are accompanied by an average of 2-3 dogs, although this number can range from 0-10 dogs, depending on the size of the flock. These dogs are usually small mongrel/hunting dogs or dogs raised incorrectly that are not effective. The reasons why

small dogs are used are not known, but it may be related with the wolf decrease and the cross-breeding of the existing LGDs with smaller hunting dogs and their consequent and progressive replacement with smaller and hunting type or mongrel dogs.

Livestock mortality

Prophylactic veterinary care for livestock is not very common and mortality due to disease can be very high, especially among young animals. During 2004, according to the data gathered through an inquiry to participating livestock producers, in 22 flocks an average of 54 animals died per flock, ranging from 2 to 260 animals, mainly due to diseases. This corresponds to a mortality rate of 15%, 88% of which were young animals. An overall juvenile mortality rate of 28% was registered, reaching 63% of the yearly kid or lamb production in some flocks and an economic loss of 13,750 €. Wolf damages are comparatively low and correspond to an average of 26% of the overall livestock mortality. In flocks with high mortality wolf damages can be as low as 8% of the total mortality.

LGDs

Since 1997 a total of 97 dogs, 48 males and 49 females have been integrated into 63 flocks. These dogs are mainly from the *Cão de Castro Laboreiro* (n = 44) and the short-haired variety of *Cão da Serra da Estrela* breeds (n = 32), although 11 belong to the



Fig. 4: Fig. 4. Adult female *Rafeiro do Alentejo* integrated into a sheep flock on the Eastern plains in the Centre of Portugal. (Photo: Silvia Ribeiro)

long-haired variety of the *Cão da Serra da Estrela* and 10 to the *Rafeiro do Alentejo* breeds (Figure 4). The dogs were selected from litters after weaning and were mainly integrated into the flocks at the age of 7-13 weeks, although 27 were integrated at an older age, at 14-25 weeks of age. Most of the older puppies were descendent from working dogs and were born in the midst of livestock and others were offered by dog breeders (Figure 5).

Pups were integrated into sheep, goat or mixed flocks that range in size from 30-400 animals, with a mean number of 175 animals. After integration, pups were always kept with the livestock. This was also recommended for adult dogs to prevent wandering and other potential problems or accidents (Figure 6). Usually only one dog was integrated per flock although in 9 and 6 flocks, respectively, one or two additional pups were later integrated to increase protection and also to form breeding pairs. This enabled the production of 57 new pups that were integrated into flocks, 38 of which were monitored by the project.

Behaviour and efficiency of LGD

Of all the adult dogs, 92% were evaluated as excellent or good in attentive behaviour, 98% in trustworthy behaviour and 90% in protective behaviour. It is interesting to note that 8 of the 10 dogs that were integrated later into flocks and survived until adulthood, are considered excellent or good. Of those, 5 dogs were descendents from guard/companion dogs and 3 from working dogs and were born among live-

stock. Of all the dogs that were born among livestock and later integrated, the adults are considered excellent and the juveniles good and exhibiting adequate behaviours. Three dogs were transferred to other flocks due to non-compliance of the livestock producers with the guidelines initially established regarding LGD raising and education. Four adult and juvenile dogs were also transferred due to inadequate behaviours towards livestock (inattentiveness and untrustworthiness) and recovered/improved. One dog was transferred due to excessive aggressiveness toward strange livestock leading to attacks to neighbouring flocks, seriously in-

cluding three animals. Three dogs were excluded, one because of reduced attentiveness to the flock and two because of untrustworthy behaviour. Lack of protection was only registered in the case of attacks by stray dogs. This situation happened in two flocks and can be explained by the fact that LGDs became habituated to the presence of familiar stray dogs, since they were previously observed chasing dogs from the flock. Regular monthly monitoring of 19 dogs during the grazing period after they were integrated into the flock revealed that before 6 months of age pups exhibit an unstable behaviour. Before that age interactions with livestock (e.g. investigatory behaviours) are frequent, especially play behaviour that steadily increases until 6 months and then abruptly decreases. After 5-6 months of age pups progressively increased their distance from shepherds and reduce their distance to the flock (staying most of the time at less than 5 meters). Pups exhibit a progressive independence from the shepherds and an increased orientation towards the flock. Agonistic behaviour has only been observed from livestock to dogs, except for adult dogs that protected their food from livestock and the above mentioned dogs that exhibited untrustworthy behaviour.

Data on the efficiency and behaviour of 40 dogs was also gathered during personal interviews with livestock producers. The effect on damage was analysed by comparing yearly livestock losses to predation before and after the dogs' integration. According to the obtained data, after the integration of the dogs damages decreased in 75% of the cases, did not change in 7.5% while 17.5% of the livestock produc-



Fig. 5: Litter of *Cão de Castro Laboreiro* that was born in the stable among a goat flock. (Photo: Silvia Ribeiro)

ers said they increased or did not know. Dogs were always considered responsible for the observed damage reduction that ranged from 13-100%. Interestingly, in some cases where the amount of damage did not change or even increased, dogs were also considered responsible for reducing potential damages (taking into account the depredation in neighbouring flocks). In fact, annual predation rate is dependent on many factors that influence predator density and availability of prey and can change significantly from one year to the next (Ribeiro & Petrucci-Fonseca 2004). The mean number of animals killed before and after the dogs' integration was 8 and 5, respectively. In terms of performance 90% of the adult dogs were classified by livestock producers as being excellent or good, only 3 were considered sufficient and none was considered bad. Regarding the behavioural components, livestock producers evaluated 80% of the dogs as excellent-good in attentiveness, as well as 98% in trustworthiness and 92% in protectiveness.

Nearly 23% of the pups injured young animals in the flock and one killed a kid goat during play behaviour. After they have grown up no other incidents have been recorded and dogs are left together with lambing goats/ewes without causing problems. During pursuit of strange animals most dogs did not go farther than 500 meters from the flock and returned within 5-30 minutes, although some could go away for longer periods and distances.

On 10 occasions dogs were observed to face wolves that attacked the flocks, but only one dog was slightly injured on the shoulder. Most dogs barked at (83%) and barked/pursued (65%) dogs that approached the flock, while 43% attacked and 23%



Fig. 6: Adult male *Cão da Serra da Estrela* of the short-hair variety confined in the stable with its flock. (Photo: Silvia Ribeiro)

wounded other dogs. Most dogs were not considered to be aggressive towards strange people that approached the flock. They usually barked at (90%) and approached/followed (23%) the stranger until he went away from the flock. Only two females and one male were considered to be more aggressive: two tried to attack a person that entered the stable where the dog was with the livestock and the other tried to attack a person that passed through the flock. In both cases no injuries resulted. Regarding strange domestic animals that approach the flock (cattle and other flocks) 73% of the dogs barked and 48% also pursued them away from the flock. Encounters with other livestock were less frequent for the remaining dogs. One dog attacked and seriously injured three animals from other flocks (see above). Nearly 83% of the dogs were observed chasing wildlife (mainly foxes, *Vulpes vulpes*, but also rabbits, *Oryctolagus cuniculus*, and wild boar) but only on three occasions were foxes or rabbits killed. Contrary to chasing foxes, that usually lasted for 15-20 minutes (but could be longer), chases to rabbits did not last long and did not result in active hunting behaviour, but were elicited when a rabbit suddenly ran past a dog.

Mortality of LGDs

During the last 7.5 years a total of 25 dogs died, corresponding to a mortality rate of 26%. This rate is higher before the age of 24 months, with 68% of all deaths occurring during this period. After two years of age, mortality was reduced to 0.7 dogs per year. No significant differences were found between male and female mortality. The main causes of mortality (including also dogs that disappeared or were ex-

cluded because of disease) were disease (44%) (e.g. leishamniosis, leptospirosis, hip dysplasia) and accidents (56%). Two dogs (1 adult and 1 pup) were killed by wolves and 5 (4 adults and 1 pup) disappeared while accompanying the flock. Four dogs died after eating illegal poisoned baits (meant for predators) and one was shot by hunters (unintentionally).

Costs of using LGDs

The price of a LGD pup can vary widely, from 250 € to 500 €, depending on the parents and the breed. These costs include first vaccinations, microchips and registry in the Portuguese Kennel Club. An estimate of the annual maintenance expenses (including medium quality food, vaccinations and parasite treatment) can vary from 170 € to 300 €, if an estimate of the expenses with occasional veterinary care is also included. Expenses in the first year are mainly due to the dogs' acquisition and in the following years to feeding expenses. To be cost-effective, in the first two years after being integrated a LGD must cause a reduction in the damages of at least 600 €. In practical terms, it means the dog should prevent the killing of 5-9 (depending on the expenditure value considered) adult animals of the flock in its first year of life and of 2-4 in the following years, considering the mean current market value of adult goat/sheep. In the studied flocks where predation rate was medium to high, the use of LGD was very profitable and the amount saved in damages could reach 3,000 €. This was not true in those cases where predation was low (less than 5 animals per year) or no reduction in the number of damages was observed. In many cases the expenses with the dogs were paid off after two years. When predation is an episodic event the constant presence of a LGD can be compensatory, because livestock producers can have significant damages in only 1 or 2 attacks for a period of several years. We should also consider the fact that most livestock producers spend little money on dog food (using less expensive food or leftovers), thus greatly reducing maintenance expenses. Another important aspect to take into account in this analysis is the high mortality rate of LGD in the first two years of life. This will reduce their economic efficiency, since it means acquiring and raising another pup. Providing pups at reduced (or no) cost and supporting part (or all) of the occasional veterinary expenses with the dogs are important to reduce the costs associated with the use of LGDs, thus making them cost effective even when predation rates are low.

Problems and recommendations

The lack of compliance of livestock producers with the guidelines for LGD integration and education was the major cause for inattentive behaviour. This stresses the need for monitoring the social conditions where LGDs are raised. On the other hand reduced socialization with people made it difficult to catch and examine the dogs when necessary. This was more common in some litters and with pups that were integrated later. Untrustworthy behaviour of pups, due to excessive play, occasionally caused serious injuries or the death of very young animals, so special attention should be taken during the first lambing season. These situations should be promptly solved by rephending the dog immediately after it happens or, in more serious cases, by separating it from the animals that elicit the behaviour until the dog "grows out of it". Nevertheless, in most cases livestock producers were very tolerant to these situations since they would be compensated by the future benefits in using the dog. In some cases LGDs can attack hunting dogs that approach the flock or chase vehicles. These behaviours should be prevented and controlled by the shepherd during the dog's development to avoid reinforcing them. Cases of inappropriate behaviour can sometimes be corrected or improved by changing the dog to a different environment (flock). Monitoring the social environment in which the dog is raised is crucial for developing its potential effectiveness. This should be done during the socialization period but it is also important to control the raising conditions until the dog reaches maturity. Another problem is the fact that males often stray when females (from villages or other flocks) are in heat, thus leaving the flock unprotected. To avoid potential accidents males should be restrained during a couple of weeks. The initial selection of the livestock producers to participate in the project also proved to be very important. Selecting the most motivated livestock producers (and not necessarily those with higher damages) made it easier to successfully raise efficient LGDs. This greatly contributed to overcome the initial distrust regarding the use of LGDs from the project and increased the willingness of other livestock producers to start using them after recognizing the working abilities of the dogs that were integrated.

Impacts of the project

One important impact has been the increased tolerance towards the wolf. The support given by the pro-

ject in what concerns LGDs and the payment of damages are referred by some livestock producers as the main causes that prevent the use of illegal lethal methods to reduce predation. Another impact was the overall increase in concern by livestock producers regarding the welfare of the dogs integrated in the project. There was also a higher regard for these dogs in comparison to others, due to their performance and contribution to flock protection. One factor that contributed to the acceptance of the project and the acknowledgment of the importance of using good LGDs has been the reputation achieved by some of the dogs integrated in the project. One of the most important means of diffusion of the use of LGDs has been the transfer of information between livestock producers. This is evident in the more than 40 requests for dogs by new livestock producers, in the last few years.

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