

Livestock Guarding Dogs: from the Transhumance to Pre-Zygotic Selection

by
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Introduction

Why do livestock guarding dogs look and behave the way they do? It is because of their life-style and their very early development. It is because they were formed, over centuries of active working lives, by the rigors of the transhumance migrations in Europe and Asia.

This paper is about the effects of transhumance migrations on the populations of dogs used to protect the flocks. It begins with the most common questions people ask us about livestock guarding dogs:

- Do these dogs really work to protect livestock?
- Which breed is best?

Although we knew quite a bit about dogs when we began working with LGDs, mostly we knew about sled dogs, retrievers, and our own pets. We were as much novices about LGDs as the people who ask us those two questions. Our initial working and breeding stock came from Italy, Macedonia, and Turkey. We had seen dogs working with sheep there, and so we proceeded on the assumption that the dogs could also work in the USA. But as we tried to introduce dogs into American agriculture we were faced immediately by a debate on their effectiveness. It was a difficult question to answer because often farmers and ranchers had little record of how many livestock they lost to predators. Therefore it was impossible to measure any reduction brought about by adding a LGD. Adding to the quantification problem

was that predation rates are variable from year to year and even season to season. Thus an immediate drop in predation was not always attributable to the dog.

Do livestock guardian dogs really work?

The way to get data for analysis is to have a large sample size over many years. By the time we published a paper in 1988 on "A decade of use of livestock guarding dogs" (Coppinger et al. 1988), we were keeping records on 1,091 dogs that had been placed on farms and ranches in 37 states (Table 1). For the analysis, however, we relied on data collected from 1980 to 1986, dropping the first two years because of the youthfulness of the dogs. We collated 1,113 reports (individual dogs appear more than once, in succeeding years), and found good support for a "yes" answer to our first question. Some individual cases were spectacular, reducing losses from over two hundred animals per year to practically none. In other cases no benefit could be detected. Rarely were there increases in predation in the presence of a dog, but there were many producers who had problems with the dog itself. The dogs helped to reduce predation in the USA; not much variation occurred between years or between management systems.

Even with the indication of the data, the controversy about whether or not the dogs work still follows us around. Often it seems to be driven by self-interested motivations. Many leaders in agriculture, including government personnel, claimed that the dogs did not work, or that they may be successful in Eurasia but they could not work in the USA because of the kinds of predators or the differences in management systems. Often these detractors represented some agency, policy, or special-interest group for which it would not be in their interest to have the

Tab. 1: Effects of LGDs on predation by management system. Ranch: open range; Farm/Ranch: combination open range and fenced pasture; Farm: fenced pasture (Coppinger et al. 1988).

Management System	No Predation		Reduced Predation		Increase or No Change	
	No	%	No	%	No	%
Ranches	12	16	46	61	17	23
Farm/Ranches	18	11	113	72	26	17
Farms	190	22	559	63	132	15
TOTAL	220	20	718	64	175	16

dogs work. Sometimes the negative reactions appeared out of fear that the dogs **would** work—which might lead to unwanted changes in employment opportunities. For example, the US Department of Agriculture has a sub-section on Animal Damage Control, which has an annual budget of millions of dollars to support the trapping of depredatory animals.

In a law suit by the State of Wyoming vs the Environmental Protection Agency, the claim was made that poison was the only form of anti-predatory methodology that worked, and thus the farmers needed the rights to use the illegal and lethal compound 1080. In the USA, agency personnel involved with wolf reintroduction programs tend to emphasize stories where dogs have failed for one reason or other. Thus the data rarely are given as a ratio of good to bad dogs, but rather the reports focus on incidents where the dogs failed. Here again, such reports are intended to infer that dogs do not work and thus we need to keep the wolf control personnel on the payroll.

On the other hand, conservation organizations tend to want the dogs to be successful and often they exaggerate the case in their favor. Dogs and electric fences tend to be the only two working methodologies that are non-lethal, and thus are favored by those who wish to protect and preserve predators. There are others, however, such as fladry, which show some promise (see Musiani & Visalberghi, 2001, Rilling et al. 2002, Volpi et al. 2002).

And then there are the dog breeders. With the importation of dozens, perhaps hundreds, of Eurasian LGDs into the USA, the dog breeders have become part of every discussion about the abilities of the dogs. They tend to emphasize that their breed is best. The assertion is that this ancient breed (sexually isolated for several hundred years?) has proven its worth—with the emphasis on the assumption that the protecting behavior is genetic – which of course is only minorly true.

Do the dogs work? The question is a little like an assignment in a beginning logic course. Do all dogs work all the time against all possible predators? A Masai warrior told us that his dog protected his cattle against lions. “But a

lion would eat that dog!” was our incredulous response. “We hope he barks first,” was his proud reply.

Thus success or failure of the dog is a function of owner expectation.

Owner expectation, in many parts of the world, varies from flock to flock and region to region. Many areas have a unique race of dogs of which they are proud. Often these will be labeled “the national dog,” and there are countless claims to their success. Within regions there are dog experts who are knowledgeable about the nature of dogs. This culture can be dated back 2000 years to the Roman scholar Varro, who understood the need for LGDs to be “accustomed to follow the sheep”, and to Darwin, who described in 1859 how important early environment is in order to develop flock guardians. Darwin was reporting from Uruguay on the technique still used in Mexico today: the tradition of shepherds suckling their pups on sheep or goats in order to develop a bond between them.

Which breed is best?

Areas of the world that produce flock guardians have a tradition of livestock culture. Part of this culture is transhumance, the seasonal migration of sheep, goats and cattle, accompanied by shepherds and dogs, over distances of 500 to 1000 km from winter to summer grazing and back again. They have done this for hundreds and hundreds of years, wearing trails along



Fig. 1: Sheep flock on migration in Turkey. These trips on the transhumance are long and arduous, often with severe weather and difficult topography. (Photo: Ray Coppinger)

valleys and across mountains. The shepherds are not nomads but rather have a firm social and political base. They own property, have family and are part of a community structure. This is very important for the production of dogs that accompany livestock between the seasonal pastures.

Traditionally the brood bitches were often dogs of a village, dogs not owned by any individual, nor are they supported in any real sense, but rather they scavenged the village for food. The litters were born in places selected by the bitch, often in the proximity of livestock. Pup mortality was high. If discovered, the litters are commonly culled to two male pups. These formed social bonds with livestock, humans and other dogs.

Most of the dogs on the transhumance migration were males. This is because of culling practices and because the burden of rearing puppies left the females in poor condition. But many dogs, male and female, remained behind unless – and even if – the village was totally abandoned by people. Dogs that accompanied livestock were prone to high mortality rates. The trips were long and arduous, often with severe weather and difficult topography, a shortage of food, accidents and exposure to disease (Figure 1). Natural selection favored those animals that were the proper size for an easy, efficient gait, and also hardy and cautious. Following a transhumance migration, one observed many lost and dead dogs. Nowadays, in many countries, livestock are simply trucked between the two seasonal pastures. Dogs are still lost if they don't get back on the truck after a stop for feeding and watering the stock.

Dogs that complete a round trip (the survivors) have a better chance of reproduction. Dogs that are liked by humans for whatever reason – abilities as a sheepdog, size, color, or perhaps some unique conformation – have a better chance for survival and reproductive access. LGDs look the way they do because the humans they associated with came to prefer certain colors or sizes or behaviors, and they favored those dogs with extra attention, care and feeding. Biologists refer to this type of selection as post-zygotic, or post-mating – the dog already “on the ground” has the selective advantage. Their adaptive traits are important for their survival.

Not until the end of the nineteenth century was pre-zygotic selection widely practiced. In this case, selection occurs before any mating. Humans select which individual dogs to breed, and they often select on the sole basis of color, size, or morphology, with no reference to the adaptive quality of the desired trait.

The power of Post-Zygotic Selection

LGDs and other working types, races, or breeds of dogs were created by post-zygotic selection where humans favored and cared for dogs which had some morphological or behavioral characteristic that enabled the dog to outshine other dogs in the performance of some task. These animals were never sexually isolated from the greater dog population until recent times, and then mostly in the West by dog fanciers. Among the working LGDs on migration, dogs have a non-random frequency of morphological characters produced either by post-zygotic culling or founder effects. Due to the high disease rates in the dogs, population numbers oscillate widely. Repopulation by a few individuals will invariably affect the allelic frequency, commonly giving rise to populations of animals that are different and more uniform in some trait than was their ancestral population. Because of this, so-called breed characteristics such as color tend to be local and temporal – but never capricious.

Local dogs, so-called village dogs, do not kill domestic stock. LGDs born into livestock cultures also tend not to prey on domestic stock. Animals that do molest livestock are killed. It is often thought that because of this culling practice, not killing stock is a genetic characteristic. This is only partly true. Village dogs can be trained for hounding genets and other vermin, even though they don't kill animals in the village.

Creating a livestock guarding dog

The key to the lack of predatory behavior in village dogs and their descendants such as LGDs is early socialization. Dogs go through a period of social development between 3 and 16 weeks, with the early weeks being the most important. The developing pups learn their species identity and who they will socialize with. They tend not to direct predatory behaviors to species with which they have been socialized. Thus, livestock in a village tend not to be preyed on by village-reared dogs. In our experience, many good sheep guarding dogs would, however, kill wildlife, because it is not part of the village environment.

Dogs that are raised in sheep cultures imprint on sheep and shepherds. During this period species imprinting is probably olfactory. It is a matter of fact that sheep and the shepherds who associate with them have common odors, which increases the bonding. Shepherds will often say, “The dogs won't bite

me because they know I'm a shepherd." Well, it's probably more like, "The dogs won't bite me because I smell like a sheep." On the other hand, dogs may be aggressive to other people who approach the flock, such as hikers, because of their novel appearance and odor. The same odor imprint applies to other livestock a dog may encounter. Dogs imprinted on sheep won't behave similarly to goats or cows. But whatever species of livestock the pup was socialized with during the critical period will escape any predatory tendencies the dog might have as an adult. The one little glitch in the system is that not all members of a species are identical, and people or goats or cattle can have novel characteristics, unusual among those the dog was socialized with, and the dog will react to that novelty. We have seen perfectly good dogs pick on an individual sheep – "for no apparent reason."

The most important point is that a livestock culture develops its own dogs. It is almost unavoidable. The evolving dogs look like breeds of dogs. This is also almost unavoidable, but it is deceptive. The LGDs of any region are going to be shaped by the climate, the terrain, the length of the migrations, as well as diseases and the nature of the food they are scavenging. Humans have little to do with any of the selective forces. They can however adopt favorite animals and care and support them, which will lead to a differential mortality within the population. By supporting a color variation, for example, the shepherds may increase the frequency of that color within the population. This is all post-zygotic selection. None of this shaping is done by design, by pre-zygotic selection of breeding pairs.

Most working LGDs were born either in the winter lowland village or perhaps the summer encampment. Being born in any other location increases the mortality. Newborn pups born on a migration are almost certainly lost to the system unless extraordinary care is given by the shepherds.

If most of the surviving pups were born in villages then why did they follow the livestock either to the pastures or on the migration? A variety of motivations will get a dog to move. They will move to forage, to reproduce, or to avoid hazards. Moving



Fig. 2: The young dogs in this picture, on migration in the former Yugoslavia, are obviously favored by their shepherds. The young shepherd is making sure they do not stray from the trail. (Photo: Ray Coppinger)

away from a village where the dog has been feeding successfully is not likely. If however the source of food moves out then the dog will go out. Dogs are a social animal and react nervously to being abandoned. But abandoned by whom? Perhaps the peculiar nature of the bonding process compels the dog to follow a certain individual preferentially (Figure 2). In our studies of shepherded flocks in the Italian *Gran Sasso* we found that 60% of the dogs were motivated to move by sheep movement and 30% by the movement of the shepherd. Ten percent of the dogs never left camp to follow on the daily foraging for grass (Coppinger et al. 1983).

There are also developmental relationships in a dog's life. Within a flock, four or five dogs might have a hierarchy. Thus if an older, upper-level dog was following the shepherd, lower or subordinate individuals would always be on the opposite side of the flock. Dogs staying in camp might not follow the flock because they were not properly bonded with the livestock, or the herdsman, or they had a food supply that needed protection. Maybe there was some social relationship with animals in the herd, be they the herdsman, other dogs or even some other animal that they were avoiding. Perhaps they had a health problem that inhibited movement. The rule is that a dog will move to a place where it feels physically and socially comfortable. In the several studies we did on the different aspects of LGD behavior, both in the USA and in Italy, we found the dogs to

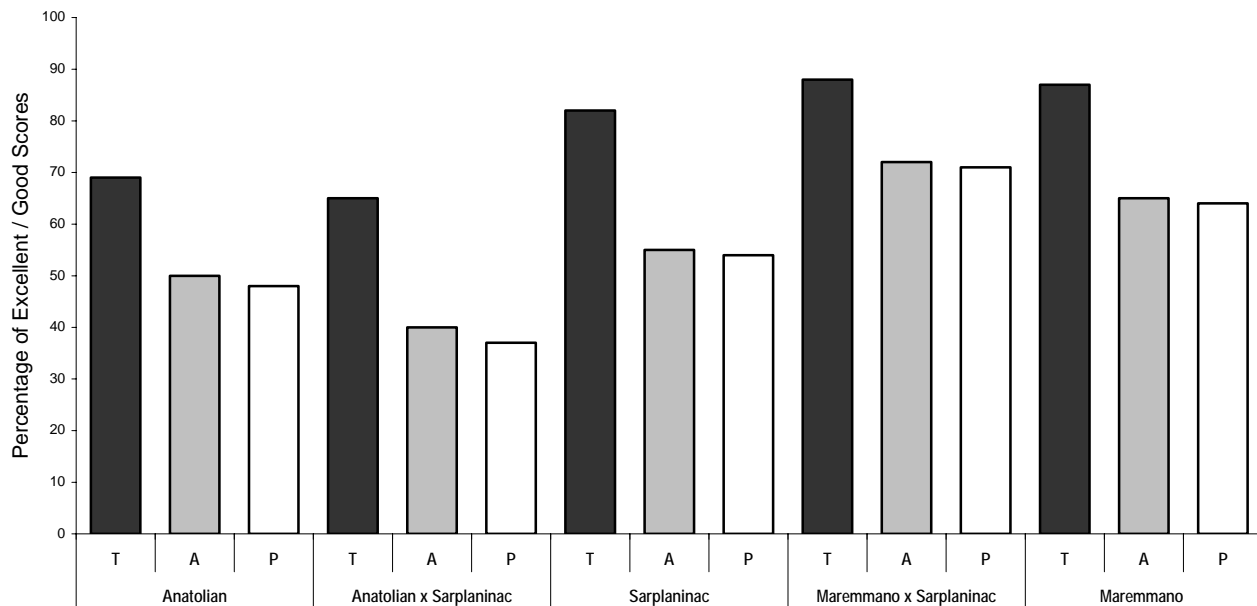


Fig. 2: Trustworthy, attentiveness and protectiveness of over 1100 LGDs of different breeds. The difference between the breeds is not significant. T = Trustworthy; A = Attentive; P = Protective (Coppinger et al. 1988)

be attentive to the sheep about 60% of the time (Coppinger et al. 1983).

Assuming that dogs are raised properly and are attentive to their livestock companions, why do they protect them? The answer is that dogs do what dogs do under their immediate circumstances. Dogs act toward other dogs, coyotes, jackals, or wolves in species-typical ways. The dogs in our studies treated male wolves and female wolves differently (Coppinger & Coppinger 1995). How they treated any individual depended on the age of the dog compared with the age and sex of the intruder. In many cases we observed that the dog appeared to “know” the animals in a given area. It also treated individual coyotes in a way that reflected the age, sex and intention of the coyote. Strange coyotes were treated in a similar way as a strange person, in that the dog might bark at them or show aggression. Familiar wolves might get the tail-sniffing routine, and the proximity of multiple wolves or coyotes might trigger a fear response from a number of dogs.

Reaction to a predator also depends on whether it was displaying predatory motor patterns. Or it might depend on the reaction of the livestock to the advancing predator. It is not just that the dog is bonded to the livestock, but the livestock too can be bonded to the dog. Often in transhumance cultures there are clear signs that the livestock look for the dog. They will bunch together with the dog if threatened. In our experiments on Western ranches we could effect a bond between the dog and sheep but not between

sheep and dog. The problems occurring with wolves and cattle in the Yellowstone National Park area are almost certainly of this type. Bonding dogs to cows is more difficult than to the smaller livestock species. Our own sheep that were accustomed to dogs would elicit very different behaviors from even good dogs, than did sheep that were nervous of dogs. The scenario of a good dog with nervous cows that takes up with a lonely wolf is not strange. The dog is a social animal with complex social behaviors – and it will take care of its social needs first.

So which breed of dog is best? After reading what the developmental requirements are for any single dog, the best response to the “Which breed is best?” question is, “All things being equal, then. . .” And of course all things are never equal. If we could, we would avoid the breed issue entirely and go directly to working stock. See a dog standing out in a pasture doing what you want it to do, and get a pup from that stock. Breed to the dog that does it right. Behavior is the most important quality.

Trustworthy, attentive, and protective behavior

In our studies we measured three behaviors that LGDs must display in order to be effective: Trustworthy, Attentive and Protective. We arranged them by “breed” (and “crossbreed”) to see if any one breed outshone any other. Trustworthy behavior seemed to be created when pups were raised with sheep, as described above. Attentive behavior also

resulted from that bonding with sheep, because the growing dog would feel most comfortable being near the animals it was raised with. Trustworthy and Attentive behavior usually resulted in Protective behavior. It would be a rare dog that could be trained with a whistle or a treat or a punishment to behave in any of these ways. The three behaviors result from the correct environment beginning at a pup's birth.

The chart shows that just under 60% of the dogs were judged by their owners to be Protective. When they were sorted by breed, the crossbred maremma x sarplaninac scored best in all behaviors. Maybe it was hybrid vigor or maybe it was chance. Even with over 1100 dogs in the sample we were never able to detect a significant difference – with the exception of two years when we could measure significance in Trustworthy and Attentive behaviors between breeds. Our favorite report came from an Italian, who argued that the *Maremmano-Abruzzese* had to be the best breed, because the Renaissance started in Italy. Fair enough.

The mistake of pre-zygotic selection

Breeds as we know them are a twentieth-century invention. The operative words here are “as we know them.” In most of the nineteenth century the term “breed” was used for a phenotype – what the dog looked like or how it behaved. There were books that would instruct on how to get two breeds in the same litter. And there are records of both komondors and kuvaz in the same litter. For nineteenth-century breeders, breeds were differences in color or coat length and other characteristics that had little to do with behavior. The major selective character in nineteenth-century breeding practices was performance. Selection for other traits was simply capricious.

Twentieth-century breeders changed the definition of a breed from phenotype to genotype. A breed became a lineage or a genealogy. There was a changing assumption in Western Europe in about Darwin's time that traits were the product of nature and had little to do with nurture. Rich people were rich and famous because they had the nature – the genes to be that way. The same became true of dogs. Good dogs came from good pedigrees. The assumption is, if you have a dog with papers as long as your arm, it must be a good dog.

Thus when someone asks which breed is best, they are assuming that the quality of the dog's performance is in its genes. The dog will perform because it has genes for guarding sheep. Cattle dogs naturally have an attraction to cattle. Those assump-

tions got many of us in a lot of trouble in the early days of introducing LGDs to the American western agricultural community. Breeds are the products of breed clubs. The *Anatolian Shepherd Dog* club sent us to Turkey to purchase some foundation stock for their newly-formed club. Of all the different dogs that were in Turkey at the time, our criterion for selection was first and foremost working performance, at least for their parents, and then for superficial characteristics. It was generally assumed that the *karabash* coloration, a fawn color with a black muzzle, was preferred. Later, other collectors for other clubs preferred white animals and only collected white animals – from an infinite variety of colors, sizes and shapes.

For these new clubs this was the transition moment when a few individual dogs were selected for export to the USA from the existing **race** of dogs in Turkey that had been created by natural selection, founder effect, and post-zygotic selection. Once in the USA, those few dogs were bred to each other in order to establish a **breed** (pre-zygotic selection). Those exported Anatolians that had existed in Turkey as a phenotype became a genotype in America.

If the initial selection process demands that the animals have the working qualities, and the superficial qualities of coat color or size are just an extra, then one might argue that this system of creating a genotypic breed isn't that bad. But it is probably a disaster.

First, it is hard for the collector to judge working quality. One is often buying pups, which have no record. It is hard to buy good adult dogs simply because the shepherds feel they need and depend on those animals. And for most of us there is the underlying assumption that the working behavior is built in and if the proper phenotype is selected then the working behavior will appear miraculously. The collector probably does not understand that good working behavior is the ability of the genotype to respond appropriately to the developmental environment. It is not the guarding behavior that is represented in the genes – but rather the response of those genes during development – that is being selected for.

Second, selecting a small number of dogs of a particular genotype leads to a massive reduction in genetic variability. To collect even as many as a hundred animals from some remote location and close the gene pool to them, immediately places them in genetic jeopardy. To create a breed by bringing a few animals from some faraway pasture to the USA or anywhere else immediately reduces the genetic diversity that enables succeeding generations to

adapt to its environment. Those few individuals could not possibly represent the genetic spectrum of the population they were taken from. Thus, the breed is not a breed in the purebred sense, but really it is a race, a nonrandom distribution of gene alleles removed from its geographic source.

Breeds result from what geneticists call a “founder effect”

Founder effects are common in the animal world. Sometimes they are referred to as genetic bottlenecks. In any given area the population of dogs will grow until it reaches the limits of its resources (in the niche). The population should stabilize at that point and selection will occur. But quite often dog populations are severely reduced by disease, e.g., rabies, distemper, or parvovirus, all of which we observed in Turkey. A few individuals will be spared and these are the animals that create the new population. The few individuals that start the re-population process cannot possibly represent the total genetic variation of the population they descended from. Thus the allelic variance will be reduced. And across the population, allelic variance will be non-randomly distributed. The non-random distribution of genes geographically distributed is the definition of subspecies and race. Thus every region will have a race of dogs. These races are not created by people breeding dogs (although they could be created by post-zygotic selection) but rather by chance events. Founder principle simply states that the founding individuals of any population will not and cannot genetically represent their ancestors.

Were the genes for some undefined developmental processes that produced good guarding dogs in their native sheep cultures captured and represented in the new founding population? The real question would be: Is the developmental environment in the western sheep culture similar enough to that ancestral sheep culture to elicit the proper behavior from the dogs? – if indeed they had any of those genes left because of founder effects.

Non-lethal control with large guarding dogs

Breeds are the products of hobbyists, who rarely know anything about genetics, especially behavioral genetics. The number of hobbyists who use the term “developmental environment” is small. Breeds come with a lot of mythological baggage. The stories of single dogs defending against packs of wolves are fantasies. And yet the wolf-kill stories are prominent

among breed chauvinists. It is hard to impress upon them that the reason we want LGDs is because they don’t kill wolves – the methodology is called non-lethal predator control. We are trying to create a peaceable kingdom model where the lion lies down with the lamb. For many years the American sheep and goat industry was seriously frightened of ever trying a LGD. The dogs were advertised by breeders as big and aggressive, and producers were afraid of the liabilities of owning such a dog. Nobody was selling the image of our 25-kg female Ellen who belonged to a Community Supported Garden where the public was coming every day to pick up vegetables, and their little kids reached through the fence to pat her. Coyotes created a predation problem, which Ellen did well with. She stayed in the sheep pasture, was sweet with the paying customers and worked well in the small family farm culture. Would she be great – and she was a great dog – on a western ranch next to Yellowstone National Park protecting cows against wolves? Of course not. The different livestock cultures need to develop their own dogs.

So, which breed is best? That is the wrong question. The answer to the problem of developing good LGDs is not in the selection of a breed. The point is that there are many breeds or races or types of LGDs available, adapted to the local livestock cultures, and working well to protect their animals. They are not necessarily large. Most of the time their job is to distract or warn away a potential predator. Predators avoid fights, where they might get injured. In the flock as in the wild, animals rely on ritualized face-offs to discourage encroachments. The answer is, select individuals from the parents of working dogs. Having done this and established their offspring with your flock or herd, very quickly you should return to post-zygotic culling. The good dogs are those that stick with your livestock and successfully defend them from wolves or coyotes – in other words those dogs that are cost effective. They should be supported and cared for and allowed to breed with other cost-effective guarding dogs. We need a system that emulates the centuries-old traditions. We need to develop our own dogs, adapted to our own livestock cultures.

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What is wrong with Romanian Livestock Guarding Dogs? A Discussion

by

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Introduction

Romania is one of the few places in Europe where livestock guarding dogs (LGDs) are still commonly used. This is because the coexistence of livestock and wild predators (wolves *Canis lupus*, bears *Ursus arctos* and lynx *Lynx lynx*) has encouraged the maintenance of traditional damage prevention methods.

In most of the livestock camps in the mountains the sheep are grazed on pastures interspersed in the forest. The pastures are of very variable sizes and in several cases sheep are grazed in the vicinity of the forest edge. Although it is forbidden, the flocks often enter the forests to graze, also because many pastures that are used by the same herd are separated by forested areas. Once they are brought back to the camps in the evening, the flocks are kept in close proximity of the camp, either penned or free. In most cases at least the ewes are penned at night, usually in wooden corrals/enclosures (Figure 1). Also the other animals are kept in the vicinity of the camp. The cattle and pigs are sometimes penned whereas horses



Fig. 1: Typical Romanian livestock camp with wooden enclosure. (Photo: Annette Mertens)