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## Editorial

In English we have a number of eloquent sayings that summarise this special issue of Carnivore Damage Prevention News. The most relevant are "use a thief to catch a thief" or the "poacher turned into a gamekeeper". Together they describe the use of one carnivore (the domestic dog) to protect livestock against other carnivores (wolves, bears, lynx, cheetahs etc). In the face of costly losses to wild carnivores European livestock herders have bred a wide range of dog breeds to help protect their flocks. On one hand these dogs reflect part of our European cultural heritage. On the other hand they provide an effective tool to help reduce conflicts, and hopefully increase public acceptance for large carnivores. However, it was a close call. In the early to mid 20th century the use of these dog breeds declined, many breeds were on the edge of extinction, and the knowledge about of how to use them was rapidly becoming lost. Thankfully, they passed through this bottleneck and are now becoming used with increasing frequency, both in their European homelands and in new lands that never developed their own breeds such as Africa, North America and Scandinavia.

The articles in this issue bring experience from a range of habitats. If there is one weakness it is that few of the articles can present statistical measurement of the effect of the guarding dogs. So far, most of these projects are in the pilot stage, and sample sizes are not always sufficient for formal testing. However, when viewed as a whole we have the utmost confidence in stating that guarding dogs are an effective tool to reduce carnivore depredation on livestock. That being said, we must add the caveat that they are not a "magic bullet" that can be applied in all situations. For examples, where sheep are widely dispersed it is difficult for a dog to guard them. In virtually all cases, introducing livestock guarding dogs requires education and economic support as the herders adapt their husbandry system. Most countries now pay compensation for carnivore killed livestock. However, it is important that they begin to recognise the benefit of preventing conflicts before they occur and transfer some compensation funding to mitigation measures. This is especially important as we are now at the stage where some small studies pioneered by highly motivated researchers and conservationists need to be scaled up to reach many more herders across Europe.

The editors

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# Use of Livestock Guarding Dogs in Norway – a Review of the Effectiveness of Different Methods

by
Inger Hansen

## Introduction

The most traditional method where livestock guarding dogs (LGDs) are used is that they follow the sheep and their herder around the grazing areas. The intensity of shepherding is usually dependant upon factors such as herd size, flocking abilities of the sheep breed, terrain, vegetation, and predator density. LGDs may also work alone either with free roaming sheep or in enclosed pastures.

The principle of livestock guarding by dogs is based upon a strong social bonding between dogs and sheep. By rearing the pup together with sheep from the age of 6 weeks, and with restricted human contact, the dog will perceive the sheep as pack members, which it will defend if necessary.

The economy of sheep farming in Norway is based up on extensive management procedures using rough grazing during summer (usually forest or alpine tundra habitats), most often with supervision of the animals only once a week. The sheep tend to graze widely dispersed in small family groups. A pre-requirement for an effective livestock guarding by dogs is that the sheep are flocking, as a dog cannot guard sheep that are widely scattered, thus making use of traditional LGD methods in Norway difficult. If LGDs are to be used in Norway, sheep need to be herded or kept within a fenced pasture. As an alternative, one can develop new ways of using LGDs which are better suited for use with dispersed, free-ranging sheep.

Livestock depredation in Norway is a severe problem with several thousand animals killed by carnivores every year (Linnell and Brøseth 2003). 2.1 million sheep graze on open mountain or forest ranges in Norway every summer and another 0.3 million sheep graze within fenced infields (MD 2003). Of these, nearly 32,000 sheep were compensated as documented or likely killed by protected carnivores in 2002 (MD 2003).

Figure 1. A *Great Pyrenees* within a fenced pasture. This pasture actually is too big for the dog to work effectively because sheep are too scattered. (Photo: Inger Hansen)

## Data on LGD research in Norway

Three main LGD projects have been implemented in Norway during the past 8 years (Table 1). This includes a project with patrolling dogs, a project where LGDs were used in combination with shepherding and a three-year follow-up project, which followed 25 different dogs used in different ways on various farms. A total of four different LGD methods have been evaluated:

(M1) LGDs used in combination with herding and use of night corrals;
(M2) LGDs on fenced pastures (Figure 1);
(M3) LGDs alone with sheep on open range (Figure 2);
(M4) LGDs loose on patrol together with a range inspector (Figure 3).

LGDs on fenced patures (M2) is the least expensive method and shows the second best preventive effect (Nilsen et al. 2003). Losses can be reduced by close to 100%, dependant upon pasture size. This way of using dogs is not very time-consuming because the dogs may guard during both day and night without people being present. To be

able to guard sheep alone, the dog should be strongly socialized to sheep. Dogs which are more socialized to people may also perform well, however, this presupposes that the grazing area is located close to the farm.

The owners look after and feed the dogs once a day, as automatic feeders are not common. The fenced areas vary between 1 and 100 ha, but the smaller the areas are the better because sheep are "tighter" together and easier to guard in small enclosures. Non-electric wired sheep fencing is the most common (i.e. fences to restrain sheep but not to exclude predators). The fenced area usually has a natural water supply. Nevertheless, grazing on small and limited areas may result in problems with internal parasites and the lamb growth might be poor compared to free-ranging sheep (Nilsen et al. 2003, Hansen et al. 2004). Poor lamb growth might be caused by several things; poor plant quality, homogenous plant development, high density of internal parasites, too many sheep on a limited area etc. Fenced cultivated or forest pastures in Norway do not have the same plant quality and quantity as infields and cannot be compared to grazing fields in southern Europe. Very few sheep farmers have enough infield such that they can use them for summer grazing (instead they are used to grow hay for winter fodder or grass for silage).

The patrolling method (M4) implies that a range inspector patrols the grazing area together with a loose LGD in a systematic way, such that the range is covered during a certain time. LGD breeds are preferred to other dog breeds because they have a good combination of behaviours suited for this job: they are calm with respect to livestock, will chase carnivores away, and have a low hunting instinct towards other wildlife. M4 has a lower loss-reducing effect than M2, however, total losses (depredation, accidents and illness) have been reduced from 15% to as little as 2–3% in the area where the best results are achieved (Hansen et al. 2002). Furthermore, after this two year LGD study was finished and the dogs were taken away, losses increased again. Other studies (Mysterud et al. 1996, Hansen et al. 1998) have shown that patrolling without a dog has minor loss reducing effect.

The great advantage with this method is that it does not require the sheep to flock, and therefore is better suited to the scattered grazing pattern typical in Norway. The inspector does not control the flock, he just looks after animals and controls that everything seems OK in the grazing area. In the northern parts of Norway, with light summer nights, patrolling might be the most effective during night time, in southern areas the best time for patrolling is during dawn and dusk. To be effective, the dog must patrol the area frequently, therefore the area size is a limiting. During our research we have found that one man and a dog are able to patrol an area of 10–12 $km^2$ (1,000–1,200 ha), based on 15 hours work a week. If the range is bigger, more people and dogs are needed or the labour input per unit should be greater. To make the method more effective, one may restrict the range by patrolling only the most depredated areas and during the most critical months of the year (July, August, September in Norway). This has been tried in *Møre og Romsdal* county with promising results. Another advantage regarding patrolling dogs is that strong social bonding to sheep is not necessary. This means that the dog may be easier to keep as an ordinary family dog outside the grazing season.

**Fig. 2**: A *Tatra Mountains Shepherd Dog* used on open range with widely scattered sheep. The sheep farmer may need to gather the sheep before the night, in order for the dog to work as efficiently as possible. (Photo: Inger Hansen)

LGDs used in combination with herding in daytime and nightime corrals (M1) was tried in *Lierne* municipality, and is close to the traditional way of using LGDs. Again, a strong social bonding between dogs and

Table 1. Summary of LGD projects performed in Norway.

| **Project** | **Patrolling method (M4)** | **Guarding and herding (M1)** | **Experiences from different farms (M1, M2, M3, M4)** |
|---|---|---|---|
| **Years implemented** | 1996–1999 | 1997–1999 | 2000–2002 |
| **Localisation** | *Hattfjelldal* municipality | *Lierne* municipality | Different places |
| **Responsible research institute** | Planteforsk Tjøtta Development Centre | Norwegian Inst. of Nature Manage. | Planteforsk Tjøtta Development Centre |
| **Number of grazing areas** | 3 | 1 | 12 |
| **Number of herds** | 8 | 3 | 38 |
| **Number of LGDs used** | 4 | 4–7 | 25 in total (15–18 yearly), divided in 12–15 grazing areas |
| **Complimentary preventive measures** | Range inspector | Shepherds and nightime corrals | M1. Shepherds and night corrals<br>M2. Fences (non-electric)<br>M3. None<br>M4. Range inspectors |
| **Main problems** | - To cover the whole area frequently enough<br>- Conflicts with neighbouring sheep farmers | - High expenses<br>- Poor lamb growth rates<br>- Conflicts with neighbouring sheep farmers | M1. See "guarding and herding method"<br>M2. Poor lamb growth and not enough pastures available<br>M3. Poor preventive effect because of dispersing sheep<br>M4. See "patrolling method" |
| **Predator species (the most common named first)** | Wolverines, lynx , bears, foxes, golden eagles | Bears, wolverines, lynx, foxes, golden eagles | Wolverines, bears, lynx, foxes, golden eagles |
| **Predator densities** | No measures, but relatively scarce | No measures, but one of the most dense bear habitat in Norway (however low compared to some other European countries) | No measures. Predator densities differs between areas |
| **Livestock to be protected** | Sheep | Sheep | Sheep |
| **Livestock densities** | 33 sheep per $km^2$ at the most | Very high local density because the sheep were herded | Differs between herds and grazing areas |
| **Sheep keeping** | Free range | Shepherding | M1. Shepherding<br>M2. Within fenced pasture<br>M3. Free range<br>M4. Free range |
| **Number of sheep per herd** | 265 (ewes and lambs) | 200 (ewes and lambs) | 220 (ewes and lambs) |
| **Sheep mortality caused by predators** | 0.5–9.5% | 0.4% | 2–12% |
| **Sheep mortality caused by guarding dogs** | 0 | 1 sheep | 2 sheep and newborn lambs |
| **Mortality from illness and accidents** | Approx. 2.5% | Approx. 1.5% | Approx. 2.5% |
| **LGD breeds used (differs between years)** | *Great Pyrenees* (GP)<br>*Maremmano-Abruzzese* (MA) | MA<br>*Tatra Mountains Shepherd Dog* (TMSD) | GP<br>TMSD<br>MA |
| **Average no. of LGDs used within the grazing area (many herds may graze together in the same area)** | 1–2 | 4–7 (of these 2–3 young dogs) | 1–7 (depending on method used) |

| Project | Patrolling method (M4) | Guarding and herding (M1) | Experiences from different farms (M1, M2, M3, M4) |
|---|---|---|---|
| **Socialization** | Reared at sheep farms (but not in corrals with sheep) from the age of 8 weeks. More socially bonded to people than to sheep. Calm towards sheep. | MAs: Reared with sheep from birth and strongly socially bonded to sheep.<br>TMSDs: Reared with sheep from birth, but weaker socialization to sheep than the MAs because of more human contact | M1 & M3: Reared with sheep from birth and strongly socially bonded to sheep<br>M2. Some socialized to people, some to sheep<br>M4. Socialized to people |
| **Effectiveness** | Moderate | MA: Very good<br>TMSD: Moderate | Differs between methods and individual dogs |
| **Documented encounters between dogs and predators** | GP chased wolverine once<br>Foxes chased many times | MAs chased bears 3 times. Disturbing the predatory sequence because of the mere presence of the dogs | Incidents of chasing bears and foxes described |
| **Improvement of the effectiveness** | - Decreasing the patrol area by inspecting only the worst depredated areas systematically | - Using sheep breeds with better flocking behaviour<br>- Dogs should be strongly socialized to the sheep and visa versa<br>- Education of herders | - Correct socialization program for the specific LGD method used<br>- Supervision of new LGD owners and breeders<br>- More and better genetic material to select dogs from (import necessary) |
| **Annual dog-keeping costs (Approx. farmer income: NOK 300.000 per year; NOK 1 = $ 0.15)** | NOK8,000 (approx. 2.7% of yearly income) | NOK8,000 (approx. 2.7% of yearly income) | NOK8,000 (approx. 2.7% of yearly income) |
| **Puppy price** | NOK8–10,000 | NOK8–10,000 | NOK8-10,000 |
| ***Weekly labour costs per farmer (200–250 sheep) during the grazing season** | Approx. 26% of income | Approx. 97% of income | Costs vary between farms and methods:<br>M1. 97%<br>M2. 2%**<br>M3. 43%***<br>M4. 26% |
| **Main problems with the dogs** | - Play chasing<br>- Too eager to hunt (birds, hares etc.)<br>- They might get lost or stay with sheep carcasses they have found | - Aggressiveness towards herding dogs<br>- Biting /chasing sheep<br>- They did not stay with the sheep (TMSD) | - Aggressiveness towards people<br>- Chasing/wounding sheep<br>- Poor guarding skills due to poor genetic material |

* Presuppositions: Yearly income: NOK300,000 (NOK 1.- = $ 0.15) of which NOK160,000 is income from the sheep production, the rest from other work. Weakly income: NOK5,770. Payment of hired labour per hour: NOK100. All estimations based on hired labour costs. The preventive measure will be cheaper, the more work input the farmer can do himself.

** Extra costs due to the management of sheep grazing within fenced pastures rather than on open ranges are not accounted for. (Investment in fences (fixed and mobile); purchase of additional winter feed and/or hire of additional farmed land; working hours spent on prophylactic internal parasite treatments; the rotation of sheep to different pastures; maintenance of the fence and so on.

***Time/work spent to gather the sheep every evening, so that the dog(s) may guard as effectively as possible, is included.

Figure 3. A *Tatra Mountains Shepherd Dog* used on patrol in "*Ulvådalen*", a mountain range in *Møre og Romsdal* county. The sheep are scattered all over the valley. (Photo: Inger Hansen)

sheep is needed. M1 is the significantly most successful loss-reducing method, but also the most expensive due to the need for continuous herding (Krogstad et al. 2000). Additionally, the limitation placed on grazing pattern may result in reduced lamb growth. The *Lierne* project showed that daily lamb growth was reduced by 23% (mean of three years) for *Dala* breed lambs that were herded and put in nightime corrals, compared to neighbouring herds grazing on open range (Krogstad et al. 2000). However, herded lambs of the lighter *Spæl* breed showed better growth rates than herded *Dala* lambs. Due to unrealistic high costs and poor lamb growth Planteforsk Tjøtta Development Centre cannot recommend this method in Norway, unless most of the expenses incurred are supported by Government funding.

LGDs alone with sheep on open range (M3) requires dogs that are strongly socialized to sheep. This method is not to be recommended under Norwegian condition because this way of dog-keeping might be too uncontrolled, and as already mentioned, widely scattered free-ranging sheep make the guarding difficult (Hansen et al. 2002, Nilsen et al. 2003).

During the three-year follow-up project, 8 out of the 25 dogs were put down for behavioural reasons. One (TMSD) did not have the right guarding skills, one (MA) showed aggressiveness towards herding dogs, three (1 TMSD, 2 MAs) had wounded sheep and three (MAs) were aggressive towards people (Figure 4, Nilsen et al. 2003). During the first 8 years of LGD research in Norway, two dogs have been killed by LGDs. Conflicts with hikers have not been a big problem so far, even though all free ranges are open to the public. However, we recommend that the owners put up signs where LGDs are on duty. We also recommend that dogs showing aggressiveness towards people should be put down as soon as possible. There have been some conflicts between local people and LGDs, especially because the dogs may roam and also because they may chase unfamiliar sheep. But the hardest criticism has come from other sheep farmers: "LGDs as a preventive measure are too expensive."

Today, about 20 LGDs are working in Norway and another 10–20 LGDs are used as "property" guardians; They are socialized to people, but are guarding everything that is on the property (sheep, horses, geese, people etc.).

**Recommendations**

Based upon the effectiveness of the dogs and cost/benefit analyses of different LGD methods, two methods could be recommended under Norwegian conditions (Hansen et al. 2002, Nilsen et al. 2003):

1. LGDs used alone within fenced pastures and
2. LGDs patrolling the mountain or forest range together with a range inspector.

Because the use of LGDs within fenced pastures is a very good preventative measure, but requires a total alteration in sheep management, we recommend this method only in areas with high carnivore densities – in areas where the alternatives are either to drastically change the sheep management procedures or to abandon sheep farming. To reduce the size of the guarded area as much as possible and at the same time achieve an optimal lamb growth, a system of rotational grazing should be practised.

Well planned rotational grazing, cultivating measures and a good treatment regime against internal parasites are decisive to achieve satisfactory growth in lambs grazing within restricted pastures (Hansen et al. 2004).

LGDs on patrol are recommended in areas where depredation accounts for up to 15% of losses, preferably in areas with damages caused by foxes *Vulpes vulpes*, lynx *Lynx lynx* and wolverines *Gulo gulo* (typical for the majority of the sheep farming areas in Norway). The method alone is too "weak" for areas with frequent bear *Ursus arctos* or wolf *Canis lupus* damage. Some communities have already received governmental financial support to use patrolling LGDs as a preventive measure. In practice, the community administration or the local sheep grazing association will hire a range inspector with a LGD to patrol one or more ranges throughout the grazing season. There are not many countries which practice free grazing in open mountain or forest ranges, but the countries which do this, should try the patrolling method. It would be interesting to get results from other countries, as well.

To date, the use of LGDs has not been a great success in Norway. High costs, widely dispersing sheep and also strict laws for dog keeping in Norway, might be the reasons. However, one should bear in mind that LGD work took 10–15 years of introduction in the USA, before it was accepted and used frequently as a preventive measure. Furthermore, use of LGDs is not an "easy" measure. Many things may go wrong, specially regarding the dog and it's behaviour (Table 1). In Norway we need to import good working dogs to get a wider genetic material to select the best dogs from.

Economical estimates have shown that none of the LGD methods are cost effective, mainly because of the high wages in Norway (Table 1). Nevertheless, LGDs should be used for other ethical, animal welfare- and psychological reasons. To motivate the farmers even more, we suggest that LGDs used as a preventive measure should receive governmental financial support.

Figure 4. A *Maremmano-Abruzzese* used on patrol. This dog had to be put down because he attacked a person. (Photo: Inger Hansen)

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## Livestock Guarding Dogs in Sweden: a Preliminary Report

by
Maria Levin

Sweden has no modern knowledge of working with guarding dogs to protect livestock from large predators and there are no special breeds of livestock guarding dogs from Scandinavia. Records from people living in the 19th and the beginning of the 20th centuries inform us however that some kind of dogs in those days were used as all-round dogs, some of them accompanying livestock and people during the days in the forest. On some occasions some of them actually got into fights with both wolves *Canis lupus* and bears *Ursus arctos*. In time these dogs were bred as hunting dogs and the "old grey dogs" eventually became lost. Still, the interest in guarding dogs is aroused again and both farmers and the authorities want to learn more about how they work and how to raise and keep them.

Today, most livestock in Sweden is fenced, either within electrical fences (wires), traditional sheep wire-netting fences, or with sheep wire-netting fences supplemented with two electrical wires. The 210,000 (adult) Swedish sheep are found in 7,600 flocks. Only 1,000 herds have more than 50 adult sheep. Only a small number of farms have more than 200 sheep. Some of them are situated in areas with large carnivores, mainly wolves and lynx *Lynx lynx*. The Wildlife Damage Centre has worked intensively with electrical fences to protect against large predator depredation since 1997 (Levin 2002). The knowledge about this is becoming more and more widespread among farmers and quite a few have invested (with grants from the regional authorities) in these types of fences. These fences are however, not completely safe and especially lynx might jump through them in exceptional cases. Large herds of sheep that still suffer from predation problems can probably benefit from having a livestock guarding dog or two in the enclosure.

A minority of farmers (i.e. less than a hundred) let their animals range freely during the summer. These farms are situated in boreal areas in the central to north central parts of Sweden. A majority of them are located in the same area as dense, or growing, populations of bears and wolves. During the last 10 years problems have been reported from a few farms with free ranging sheep or dairy cattle. The confirmed number of free ranging animals being killed or injured by large predators is not high, but there is a widespread anxiety that something will happen and some farmers are also convinced that the actual presence of predators in the neighbourhood stresses the livestock and causes indirect damage, like failed ovulation, abortions, decreasing milk production, etc. In these situations a livestock guarding dog might be of help, as long as it can work by itself. There are no shepherds in Sweden and it will probably be very difficult, if not impossible, to get people to work as shepherds. Less than 2% of the economically active population is engaged in farming. We welcome all advice and happily share other countries experience from similar situations.

The Wildlife Damage Centre encourages farmers with certain needs to get puppies of good quality guarding dogs and also recommends that the county councils subsidise the purchase of the dogs. Our intention is to follow the development of these dogs under Swedish conditions in the long term. We do this with a yearly survey for each dog, as well as annual meetings with the dogs' owners to discuss and

Figure 1. A *Maremmano-Abruzzese* protecting a flock of alpacas that was attacked by wolves before. The dog is working in electrified enclosures. (Photo: Maria Sandgren)

share experience. At the moment there are nine dogs (of our knowledge) working actively to protect livestock in Sweden. Eight of the dogs are of the same breed, *Maremmano-Abruzzeze*, and work within fenced areas. The dogs are born in a Swedish kennel, but have Italian working dogs as parents (the bitch is imported). The breeders have lived in Italy and spent a lot of time learning about the dogs from shepherds in the *Abruzzi* mountains. All the working dogs were raised with livestock at the same farms where they now live. Two of these dogs protect alpacas in a flock that was attacked by wolf two years ago (Figure 1; the dogs were obtained after the attack), the rest protect sheep in areas with both lynx, wolves and (at one farm) occasionally bears (Figure 2). The ninth dog is an *Anatolian Shepherd Dog*. This dog was first raised in a town, but was taken to a farm as a two-year-old. The introduction seems to have gone well so far, and last summer the dog was protecting free ranging goats in an area with bears, lynx and occasionally wolves.

The Wildlife Damage Centre has also produced a "manual" for raising and training guarding dogs, based on the booklet "Livestock Guarding Dogs: Protecting Sheep from Predators" Agriculture Information Bulletin Number 588, published by the Unites States Department of Agriculture. The manual is just about to be printed and will eventually also be presented as a pdf-file on our web-site as well as sent to the LCIE.

We are very interested in getting into contact with people or projects who work actively with guarding dogs as a protection measure against large carnivores. We have many questions, e.g. concerning free ranging animals: Is it possible to get dogs to work well with free ranging animals without shepherds? How does one train them to achieve this? Are there certain breeds that are preferable for this task?

We probably depend on importing dogs from abroad, since 8 out of 9 dogs working in Sweden are closely related, and welcome all advice on who we should get into contact with and what breeds we should go in for.

Our "program" has only run for a little more than a year, and consequently we don't have much to report. In about five years we hopefully have enough Swedish "data" to make some kind of evaluation which can lead to general recommendations on working with guarding dogs in Sweden.

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Figure 2. A *Maremmano-Abruzzese* protecting sheep near the farm. The sheep are kept in within a sheep wire-netting fence supplemented with two electrical wires. (Photo: Inga Ängsteg)

# Use of *Tatra Mountains Shepherd Dog* in the *Bieszczady* Mountains and the *Bieszczady* Foothills, Poland

by
Wojciech Śmietana

## Introduction

Livestock guarding dogs (LGDs) are traditionally used in Poland only by *Tatra* mountain shepherds. The *Tatra* Mountains are a mountain range within the Carpathians arc. To defend flocks of sheep from large carnivores they use a breed called *Tatra Mountains Shepherd Dog*. Some *Tatra* sheep breeders successfully use *Tatra Mountains Shepherd Dog* crossbreed with *St. Bernard Dog* or *Caucasian Shepherd Dog* or *Central Asiatic Shepherd Dog*. My project is situated in another range of *Carpathians*, in the *Bieszczady* Mountains and its surroundings, about 200 km east from the *Tatra* Mountains. The *Bieszczady* Mountains and the *Bieszczady* Foothills (total 2,100 km$^2$) are inhabited by about 40–80 wolves *Canis lupus*, 40–60 lynxes *Lynx lynx* and 30-50 brown bears *Ursus arctos* (Śmietana 2000*a*, Śmietana et al. 2000, Śmietana upubl., Jakubiec unpubl.); all fully protected - although poaching of wolves is common. Analyses of wolf, lynx and brown bear scats (Frąckowiak and Gula 1992, Śmietana and Klimek 1993, Śmietana 2002, and Śmietana unpubl.) indicate that livestock is a negligible portion of their diet. Human density is about 6 ind./km$^2$ in *Bieszczady* Mountains and about 30 ind./km$^2$ in *Bieszczady* Foothills. About 80% of the *Bieszczady* Mountains and about 65% of *Bieszczady* Foothills are covered by forest. The red deer *Cervus elaphus* is the most common ungulate species, followed by roe deer *Capreolus capreolus*, wild boar *Sus scrofa* and bison *Bison bonasus*. Some individuals of moose were also noted in the area. The *Bieszczady* Mountains were almost completely depopulated after the Second World War. Human recolonisation started in the 1950's. Settling people came from all over Poland and brought along different livestock grazing practices. About 3,000–4,000 thousand sheep and 2,000 cattle, 500 horses and 500 goats are grazing on pastures in the region. There are a small number of sheep breeders who originated from the *Tatra* Mountains region who traditionally use *Tatra Mountains Shepherd Dogs* (Figure 1) for protecting sheep. These farmers use remote and open mountain pastures for sheep grazing during the summer period. Traditionally used livestock guarding dogs accompany shepherds who watch flocks. The second group of sheep breeders, originating from the Polish lowlands and inhabiting mostly the *Bieszczady* Foothills (Figure 2), use pastures, usually surrounded by about 1.2 m high wire-netting or wooden fences, next to the farm buildings for sheep and goat grazing. They usually do not guard their flocks. My interviews with local sheep breeders in the early 1990's indicated that shepherds who use *Tatra Mountains Shepherd Dogs* to guard livestock on remote pastures, where potentially wolves can cause severe damages, lose annually one third the number of sheep that sheep breeders who keep animals close to the farm buildings would lose, even though these areas are usually avoided by wolves (Śmietana 2000*b*). Wolves kill about 110 sheep per year in the region; about 2% of the total sheep number in the area. Other livestock is killed very rarely. Most losses occur in the *Bieszczady* Foothills. Wolves attack sheep mostly in May and September-October (Śmietana 2002). Damages cause by wolves, brown bears and lynx are compensated by the State. About 100–150 sheep and about 10–20 individuals of other livestock species, killed mostly by wolves, are reported from the area. For predator killed livestock farmers receive a compensation which equals to the market value of the

Figure 1. *Tatra Mountains Shepherd Dog.* (Photo: Wojciech Śmietana)

Figure 2. *Tatra Mountains Shepherd Dog* guarding a flock of sheep in the *Bieszczady* Foothils. The picture shows a typical sheep farm at the *Bieszady* Foothills. (Photo: Wojciech Śmietana)

lost animal from the *Podkarpacie* Province Administration.

**Project**

The goal of the project has been to reduce losses from wolf predation, identifying problems associated with rearing and training dogs and promoting the use of livestock guarding dogs among breeders who never used such dogs. Rearing and training dogs generally followed the instructions by Green and Woodruff (1983) and by Lorenz and Coppinger (1986). Between 1995 and 2001 13 *Tatra Mountains Shepherd Dog* pups (without pedigree) were introduced to 11 sheep or sheep-goat farms. Any farmer who had at least 50 sheep-mothers (goats) could take part in the project. In nine cases 1 pup and in two cases two pups were introduced. Flocks of sheep (plus goats in two cases) number from 50–250 individuals and are grazed on pastures close to villages in summer. Introduced dogs (5 females and 8 males) were aged from 46–82 days. Eleven pups were purchased (€uros 45–70 per pup) from *Tatra* sheep breeders (pups were born in vicinity of sheep) and two pups originated from an experimental farm organised by myself in 1998 (these pups were born among goats). Parents of all pups were used to guard sheep or goats. Pups were introduced to new farms from early March to late November. The project supplied vaccinations and food for 10 pups during the first year of their life. Afterwards dogs became the property of the farmers who covered all the costs of their maintenance. Socialising pups with sheep/goats during the summer was much more difficult to organise properly. Changing sheep in the dog's pen and providing food for them was too laborious and time consuming for some breeders, in effect some pups introduced in summer were socialised only to a few sheep from the flock. It turned out that it is much easier for breeders to start working with a new pup during late fall/ winter period, when sheep stay inside and breeders can spend more time to organise proper socialising of pups, and there are usually no strange persons (tourists, visitors) who can interact with the dog.

**Problems**

Despite these problems socialisation with sheep/goat was successful in all but one case. This dog was socialised with only two lambs and the rest of the flock never accepted the dog. The problem was related to the breeder and his sheep, which were generally very afraid. It was much more difficult to get the dog to remain with the flock on pastures. Relatively small pastures (30–80 ha, often divided into several sections) situated close to the villages, presence of humans (tourists, neighbours and children who sometimes offered stroking and snacks to pups) and non-working dogs in the neighbourhood caused these difficulties. The problem of a dog's wandering around could be solved by adding an electrically charged wire at the top of existing fences, what also provides additional protection from carnivores. On my experimental farm, where numerous hikers pass nearby during summer, a 3-strand (80 cm high) electric fence is successfully used to keep goats and dogs on pasture. Other problems with the proper rearing and training of pups were related to breeders beliefs. Some of them deeply believed, despite my repeated explanations, that *Tatra Mountains Shepherd Dog*, once mature, will be successful livestock guardian without any special rearing and that guarding dogs can work also as herding dogs. Another common believe was that these dogs are very aggressive.

Chasing lambs, play-biting of wool and chewing

of ears was observed. But only in one case was this behaviour developed to an unacceptable degree. This case occurred in the flock where two pups (sisters) were introduced at the same time. When pups aged about six month they exhibited typical "pack behaviour" and the dominant dog first injured several lambs during play and later on started to kill them. But both dogs still remained submissive to adult sheep. Surprisingly, after removal of the dominant dog the second one became an excellent guardian. Regardless of these problems 3 dogs became excellent livestock guardians, they stay permanently with the flock and are aggressive towards non-human intruders, 6 others guard flocks only by night inside corrals and/or together with shepherds on more remote pastures, two dogs moved away with the owner, and two others changed owners.

Dogs involved in the project display investigative behaviour when people approach the flock, but no serious problems of aggression towards people were noted, except one dog. This dog became aggressive towards people after one hiker hit him with a stick. Some farmers even complain that the dogs should be more aggressive towards humans.

## Cost and effectiveness

The annual cost of a *Tatra Mountains Shepherd Dog* is rather high (about € 200 for food, which is about 3–5% of the annual income of an average sheep farm in the region) and there is no guarantee that the acquired pup will become a successful livestock guardian. Nevertheless, I recommend this method to these breeders who like to work with dogs, and even when the dog will be not a fully effective guardian, it can be used to assist the shepherd, guard the sheep in corrals at night or supplement electric fencing. To improve protection of sheep on 5 cooperating farms, corrals made from 2 m high wire-netting were constructed. Corrals from 0.01 to 0.5 ha are used to keep sheep and dogs inside at night. A combination of these fences and LGDs solved the problem of night attacks on sheep. Only once a sheep was killed by a wolf inside such a corral, but it was not eaten. Attacked by two dogs – *Tatra Mountains Shepherd Dog* and a *Scottish collie* – the wolf escaped. There was no repeated attack. The combination of 1–2 LGDs, depending on the flock size, with 2 m high wire-netting corrals is quite expensive (1 m of fence costs about € 2; including materials and labour) but it is the most accepted method by local breeders and probably the most successful one to protect sheep from large carnivore depredation at night under local conditions. I do not have enough detailed data to evaluate the effectiveness of the dogs but it seems that their introduction led to reduced losses. Firstly, no multiple kills happened after adult dogs were integrated into the flocks (previously up to 11 were killed during one wolf attack), and only one sheep was killed inside the corral where a dog was also present.

There is a lot of interest among local livestock breeders to introduce non-lethal methods of carnivore damage control but they need financial support to do so. Unfortunately, such a system is still not provided by the State. Compensation of damages caused by wolves and other large carnivores alone does not solve the problem.

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# Livestock Guarding Dogs in the Western Part of the Polish Carpathians

by
Sabina Nowak and Robert W. Mysłajek

## Introduction

Livestock damage caused by large carnivores represents one of the most important issues in their conservation everywhere these species occur. From an economic point of view it is not a severe problem in Poland as the amount of compensation paid is quite small. It is paid by the administration of every province and reaches on average €uro 50,000 per year for the whole country. However, predation on livestock provokes negative attitudes among farmers and makes this issue interesting for the media. The result is numerous sensational press and TV reports which influence social attitudes towards large carnivores. Additionally hunters use this as an argument for including wolves, which are protected in Poland, on the game list again.

In Poland there are two projects which are attempting to resolve large carnivore/farmer conflicts by the introduction of Livestock Guarding Dogs (LGDs) into livestock flocks. The first one is conducted in the *Bieszczady* Mountains (eastern range of the Polish Carpathians) by the Institute of Nature Conservation, Polish Academy of Sciences (Śmietana 2002). The second, with which this paper is concerned, has been initiated by the Association for Nature WOLF in the Western *Beskidy* Mountains (Nowak and Mysłajek 2002, 2003).

## Project Area

We conduct our project in the western-most range of the Polish *Carpathians* (49°23'–49°53'N, 18°45'–19°48'E), near the border with Slovakia and the Czech Republic. The region includes the *Silesian Beskidy* Mts. (SBM) and *Żywiecki Beskidy* Mts. (ZBM) (total area 745 km$^2$), both of which are protected as landscape parks. The altitude ranges from 300 to 1,557 m a.s.l. Most of the area is covered with exploited forests, mainly spruce *Picea abies* with an admixture of beech *Fagus silvatica* and fir *Abies alba*. Within the forests large meadows are present, some of them still used as pastures for livestock grazing. The region is densely inhabited by humans, with an average of 150 persons per km$^2$. Numerous towns and villages are located mostly within river valleys and on lower, deforested slopes (up to 600 m a.s.l.). There is some agriculture and livestock farming, where small flocks of sheep, cows and goats are frequent (Figure 1). There are also a large number of weekend cabins and recreation centres along forest peripheries, as well as many ski lifts, ski routes, and tourist paths in the forest. Human activity in the forest is especially intense during weekends and holidays.

## Large carnivores and livestock in the region

The guild of large predators in this region includes the wolf *Canis lupus*, the lynx *Lynx lynx* and the brown bear *Ursus arctos*, all of which are protected in Poland. There are differences in the situation of their populations in the ZBM and SBM. In the ZBM, there are approximately 4 brown bear individuals, about 10 lynxes and three wolf packs (about 12 individuals), while the SBM is inhabited by two wolf packs (about 10 individuals), and brown bear and

Figure 1. Landscape of the *Beskidy* Mountains. Sheep flocks and cattle graze on meadows among and adjacent to forests. (Photo: Robert W. Mysłajek)

lynx appear only sporadically (Pierużek-Nowak 2002, Jakubiec 2001, Jędrzejewski et al. 2002).

## Damage

All large predators, including dogs, cause damage. However, the wolf seems to be the most important. A detailed study of wolf ecology in this region showed that wolves prey mainly on wild ungulates (95% of food biomass), while livestock constituted only 3% of wolf food biomass (Pierużek-Nowak 2002). In 1997–2001, we collected data from farmers on 172 domestic animals killed by wolves in 35 attacks. Amongst livestock, sheep are the most common prey of wolves (88%), followed by goats, cows and dogs. Annually from 15 to 48 livestock were killed, on average 34 animals. Wolf attacks occurred from May to November, with the highest intensities recorded in August (44% of attacks) and September (26%). It was only possible to obtain complete information on depredation for wolves in the SBM, due to wolf packs in the ZBM having parts of their home ranges in Slovakia, which makes gathering information difficult. Based on data from farmers and local communities we estimated the number of livestock within wolf range in the SBM to be about 360 animals (varied from 320–420). During the grazing season wolves in this area killed about 26 domestic animals annually, which made up about 7% of the total number.

## Husbandry methods

Sheep farming in the area of the SBM and ZBM is focussed on meat and milk, while wool usage is very limited. The scale of damage caused by wolves is strictly correlated with methods of livestock protection. Three types of local sheep farming have been identified.

Firstly there are owners of just a few sheep, who give them every year to professional shepherds for the grazing season. At present, only two groups of such professional shepherds work within the study area. All collected sheep then form a large flock of several hundred animals, and graze under the regular supervision of several shepherds and *Tatra Mountains Shepherd Dogs* during the whole summer. Cases of successful wolf attacks were rare in such flocks. In autumn, after the pasturage, sheep are returned to owners and if weather permits they are grazed further. Towards the end of the grazing season breeders keep several unguarded sheep on meadows adjacent to forests during the whole day (or even by night). It was during this period when the most successful wolf attacks occurred on these farms.

The second type applies to bigger farms (40–100 sheep each), where owners graze sheep on their own, for the whole season. Livestock stay on pastures throughout the night in a wooden pen without human supervision, but with dogs – mongrels or *German Shepherd Dogs*. These dogs are tethered to prevent escape from pastures or aggressiveness towards passing people. On these farms damage occurred throughout the whole season.

The third type involves owners of several animals who never pass their livestock to professional shepherds, but graze them for the whole season on pastures adjacent to their houses. The farms may be sporadically fenced or the sheep are collected in wooden pens at night, sometimes guarded by a tethered dog. If the farm is located near the forest, damage has been shown to occur all through the season.

Before the beginning of our project almost none of the farms in the Western *Carpathian* Mts., which suffered wolf attacks were protected by *Tatra Mountains Shepherd Dogs.*

## Structure of the project

The model programme of wolf conservation in the Western Carpathians began in 1996 and includes several complementary components:

1. A research project including: monitoring numbers and distribution of wolf populations; estimation of breeding success and death rate; research into diet and pressure of wolf predation on both natural prey and livestock, as well as a regional landscape analysis and prediction of favourable wolf habitat (Pierużek-Nowak 2002).
2. Resolving human/wolf conflicts through promotion of different methods of livestock protection against wolf attacks: providing training to livestock owners (lectures, presentations on farms); development and distribution of professional publications (Nowak and Jędrzejewski 1998, Nowak and Mysłajek 1999); introduction of Livestock Guarding Dogs and mobile fences, called “fladry”.
3. Education of local communities about the natural history, ecology and behaviour of the wolf, by organising lectures and workshops for school pupils, students, foresters and staff of landscape and national parks and by producing a number of publications (books, leaflets, posters, stickers etc.).

4. Wildlife tourism focused on areas where predators occur, by organising Wolf Seminars, as well as practical work experience for students from abroad (Nowak and Mysłajek 2002).

**Introduction**
**and training of livestock guarding dogs**

During the years 2002–2004 we introduced twelve *Tatra Mountains Shepherd Dogs* (Figure 2) into ten farms, four dogs each year. The *Tatra Mountains Shepherd Dog* is the only native breed of LGD in Poland, bred by local highlanders several centuries ago in the area of the *Tatra* Mountains (part of the Polish *Carpathians*) and traditionally used for protection of sheep flocks against large carnivore attacks, mostly in this region. As an adult, it is a massive, completely white dog – its weight can reach about 60–70 kilos, height at the shoulders 85 cm – possessing a suite of extremely useful features such as attentiveness, vigilance, intelligence and exposing a defensive posture, with high raised and wagging tail while barking (Nowak and Mysłajek 1999). Shepherds whom we selected as receivers of LGDs were those which had both the biggest flocks in the region and damage from wolves in the last five years. In 2002 and 2004 only male LGDs were passed on, but in 2003 we gave two females to farmers, to have pups for further extension of the project. Dogs were introduced from March to July as 6–8 week-old pups. Pups were purchased from recom-mended dog breeders (local sheep farmers and veterinarians) in the *Tatra* Mountains region, and they originated from parents positively assessed for breeding. All pups were vac-cinated against rabies and other illnesses. The cost of one pup was € 120–140. The dogs were donated to farmers free of charge, but they were obligated to feed them properly and provide further veterinary assistance. Dogs were introduced on eight farms to protect sheep, and on two farms to protect cows and horses. Each livestock owner received only one dog, with the exception of the biggest farm (about 500 sheep) where 3 pups (two males and one female, from different litters) were introduced, first two males and the following season a female. At the same time shepherds received a guidebook entitled "Protection of livestock against wolf attacks" (Nowak and Mysłajek 1999), describing how to raise and train a LGD pup. The basic rule is to keep pups with the flock at night from the very beginning (in a pen located within or next to the flock enclosure) to facilitate habituation to each other, and to avoid unnecessary contact between pups and other people not directly involved in breeding. During the day pups are kept in a pen near the farmhouse. The real work of a young dog starts when it reaches an age of six months and becomes tough enough to walk with the grazing flock through mountainous terrain, accompanying shepherds. From this moment dogs stay with livestock day and night on meadows away from the farms, even if the owner or shepherds leave a flock for a night. In two cases adult dogs protected flocks mostly at night staying outside a pen and not tethered, while during the day they were tied up on a pasture or walked on a leash with the shepherd. However, in the biggest flocks dogs were working with livestock all day long. The male LDG introduced to a herd of several cows, calves and horses displayed a similar attentiveness towards these livestock as those dogs staying with

Figure 2. Three years old *Tatra Mountains Shepherd Dog* on a pasture.
(Photo: Sabina. Nowak)

sheep flocks. As a pup it was kept in a pen near cows in a stable and then on pasture. As an adult it regularly made rounds of cattle and horses grazing in different parts of the meadow, and tried to prevent dispersion and fights between them. The livestock accepted the dog and did not display aggression towards it.

## Problems

*LGDs*

During the project we have recorded only a few problems with LDGs. One male LGD (1 year old) regularly abandoned its flock and visited female dogs in the nearest village for a while, but then returned and stayed with the flock. Secondly one was infected by mange, which caused some problems with its appetite and then its growth. After veterinarian treatment its condition improved. We also noticed a conflict between one LGD (1 year old) and another male dog working with flock maintenance, which caused a number of fights and injuries and forced the owner to keep the LGD on a chain during the day. Fortunately it stopped after half a year, and now the dogs live in harmony.

*Humans*

There were many more problems with sheep owners and shepherds who are, due to the poor profitability of this activity, mostly very old or poorly educated people, and sometimes very conservative. In several cases they made mistakes during training or took poor care of their dogs. During the first year of the project we lost one dog, because the shepherd gave it to an unknown person without notifying us. Secondly, one had to have a change of owner because of very poor care, and now it stays in the next farm. To avoid such situations, the following year we prepared a clear agreement to be signed, which described the responsibilities of new owners and our rights to be informed about the situation of the dog. On one farm, the shepherd has not obeyed the training procedure and allowed children to play with the LGD pup. In consequence the adult female prefers to stay with people, and does not like to be alone with livestock.

Thus, from twelve LGDs that we gave to farmers in 2002–2004, five adult dogs work permanently with flocks, two dogs stay mostly at farm houses and do not work constantly with livestock on pastures, one dog left the area of the project (but according to the former owner it is still involved in sheep husbandry), and the last four pups are still undergoing training. The large size of an adult *Tatra Mountain*s *Shepherd Dog* and its defensive posture during barking can evoke fear in people. However, during the whole period we have not recorded any cases of an LGD attack on tourists, local people or other dogs.

## Efficiency of LGDs

At present we can assess the efficiency of five dogs on four farms. It is hard to receive direct proof that LGDs deter wolves from a flock, due to the lack of direct observation, but we can support this by several facts. All farmers which received LGDs, have had previous damage caused by wolves, which varied from 1 to more then 20 individuals killed per year. After maturation of the introduced LGDs damage abruptly stopped, while during extensive surveys we still noticed the presence of wolves (scats, tracks, howling) in the adjacent area and attacks occurred on neighbouring farms. However, one owner of a LGD also used “fladry" that he received from us before LGD introduction, to surround a pen with a flock at night, which might have aided the young dog with protection of the sheep. He stopped the use of fladry this year and left the whole burden of sheep protection on the LGD. In three other farms shepherds stayed with flocks at night, but slept in wooden cabins. So the absence of depredation could be a combination of all these factors: presence of people, “fladry” and the impact of LGDs.

## Conclusions

Based on experiences of shepherds from the *Tatra* Mountains and results of our and Dr. Śmietana’s projects (see article on page 10 from Śmietana), we can conclude that the *Tatra Mountains Shepherd Dog* can be successfully used as a method of livestock protection against wolf attacks, both for sheep and cattle.

The most common mistakes made by farmers in the care and training process (poor care leading to diseases and allowing the dog to play with children) have the biggest impact on the failures in the use of LGDs.

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# Livestock Depredation and Livestock Guarding Dogs in Slovakia

by
Robin Rigg

**Introduction**

Slovakia lies not only geographically but in many ways also culturally and politically between western and eastern Europe. Its native large carnivores were never completely eradicated and had already recovered from excessive sport hunting and persecution by the 1980s. Nevertheless the impacts of the recovery are still being felt and debates continue to rage as to whether legal protection for large carnivores should be strengthened or if they are now "over-populated". Being a young and little-known country, whose carnivore populations are not as substantial as those in Romania, not as threatened as some of those in the Iberian peninsula, not as controversial as those in Norway nor in the process of recovery such as those in the Alps, Slovakia has received much less attention in the action plans, case studies, model projects and other international initiatives of recent years. The inward flow of new techniques and results from abroad has been slow due to political, financial and lingual barriers and as a result modern research on large carnivores is still largely missing. However, much can be learned from the situation here, such as how economic development might affect carnivore-livestock conflicts in eastern Europe or how long the process of psychological adjustment to the reality of recovered carnivore populations might take in central Europe.

In 2001–2003 I studied carnivore-livestock conflicts in Slovakia for a Masters degree at the

University of Aberdeen. The study, part of the Protection of Livestock and Conservation of Large Carnivores (PLCLC) project, had the following aims:

1. To study the impact of native predators on domestic animals in Slovakia by
   a) quantifying the diets of wolves and bears in livestock-raising areas with high levels of reported losses;
   b) analysing the extent and patterns of reported damage by carnivores to livestock.
2. To investigate the possibility of using livestock guarding dogs (LGDs) to protect sheep in Slovakia by
   a) conducting a literature survey on the use of LGDs throughout the world (Rigg 2001);
   b) examining the reasons why the LGD tradition had been abandoned in Slovakia;
   c) performing field trials of LGDs with livestock at working farms in order to:
      - observe the development from pups of different guarding dog breeds;
      - test their ability as yearlings to protect a flock of sheep by observing their responses to mock attacks;
      - compare the levels of losses in flocks with and without free-ranging LGDs;
      - identify any barriers to the feasibility of revitalizing the LGD tradition in Slovakia.

**Large carnivores and livestock**

The main predators on livestock in the Slovak Carpathians are the wolf *Canis lupus* and brown bear *Ursus arctos*. Official estimates of carnivore numbers are compiled by adding together estimates for each species from the 1,747 hunting grounds that together cover c.90% of the country (mean area 25 km$^2$), without correcting for multiple counts. It is widely acknowledged that these estimates are considerably exaggerated, but there is considerable disagreement about how much. Based on snow tracking in early winter, the density of wolves seems to be c.1 ind./100 km$^2$. Using the same method or by direct observation above the timberline in spring, bear density in some mountain ranges of central and northern Slovakia has been estimated at 11–13 inds./100 km$^2$. However, large carnivores are not evenly distributed throughout their ranges, partly because their habitats are becoming increasingly fragmented by highway construction and other development. Using estimated density in a model area of 800 km$^2$ obtained by snow tracking and extrapolating to the estimated size of occupied wolf range in Slovakia (c.20,000 km$^2$) suggests a population in early winter of <200 wolves. Dividing the number of wolves found by snow tracking in the model area by the official estimate for the area and multiplying by the official national estimate yields a revised estimate of 212–242 individuals. In reality the lower figure may be more accurate because official estimates are for 31$^{st}$ March whereas the snow tracking was done in early December, i.e. before the majority of mortality in winter and the open hunting season (currently 1$^{st}$ November to 15$^{th}$ January, unlimited bag). The same calculation for bears produces a revised estimate of 810–940 individuals in Slovakia, which is slightly higher than the widely accepted "guestimate" of 600–800.

Wolves and bears are reported to occasionally kill cattle and goats. Bears also kill some poultry, pigs and rabbits, while wolves sometimes prey on dogs and occasionally cats. Sheep, however, are the most frequently predated domestic species. Around 89% of all sheep in Slovakia are in regions with bears and/or wolves. The overall density of sheep across these regions is c.943 inds./100 km$^2$. Variation among regions in the number of sheep reported lost in 2002 correlated slightly more strongly with number of sheep than with number of predators as estimated by hunters ($r_s$ = 0.733, $P$ = 0.001 versus $r_s$ = 0.697, $P$ = 0.001 for bears, $r_s$ = 0.633, $P$ = 0.003 versus $r_s$ = 0.606, $P$ = 0.005 for wolves). Significant, high correlations were also found between number of sheep and percentage of flocks affected by bear predation ($r_s$ = 0.736, $P$ = 0.001) and percentage of all sheep reported lost to bears ($r_s$ = 0.723, $P$ = 0.001), indicating a marked relationship between sheep available and bear predation. The respective correlations to estimated bear numbers were lower ($r_s$ = 0.684, $P$ = 0.002 and $r_s$ = 0.702, $P$ = 0.001 respectively). In the case of wolves, percentage of flocks affected and percentage of all sheep reported lost were more strongly correlated to numbers of wolves ($r_s$ = 0.642, $P$ = 0.002 and $r_s$ = 0.609, $P$ = 0.004 respectively) than to numbers of sheep (no significant correlation and $r_s$ = 0.552, $P$ = 0.012 respectively). Scat analysis suggests that livestock is not an important component of the diet of either species in Slovakia: remains of domestic mammals were not found in any of 373 bear scats collected in 2001–2003 and in only one of 70 wolf scats collected in the same period. Wild ungulates are present at medium-high densities and constitute >90% (mean percentage of scat volume) of the diet of wolves. Plant

material constituted 90.8% of total bear scat volume and 83.5% of estimated dry matter ingested by bears. A total of 1,455 sheep (or in a few cases goats) were reported lost to predators ("lost" includes killed, missing never found or died/destroyed due to injuries) during the period 2001–2003 at 164 surveyed flocks. Of these, 78.8% were said to have been lost to wolves, 20.0% to bears, 1.0% to domestic dogs and 0.1% to lynx *Lynx lynx*. The mean reported loss to predation was 2.6–4.3 sheep/flock/year. Not all the reported losses were verified. In some cases the accounts of shepherds differed from those of the respective farmers/owners and in some cases the reported figures were known to have been exaggerated, particularly for alleged wolf predation. In each year, ≤14.0 % and ≤29.4% of surveyed flocks were allegedly affected by bear and wolf predation respectively (Figure 1). Based on the predation rates reported at surveyed flocks, the annual loss to bear predation in 2001–2003 was estimated at 0.06-0.15% of all sheep (c.266,400) in regions with bears, i. e.160–400 sheep/year or the equivalent of 0.2–0.7 sheep/bear/year. The annual loss to wolf predation was estimated at 0.5–0.7% of all sheep (c.302,200) in regions with wolves, i.e. 1,511–2,115 sheep/year or the equivalent of 4.5–10.4 sheep/wolf/year. Although wolves were reported to cause considerably higher losses than bears, wolf predation is known to be difficult to distinguish from that of dogs and, because attitudes to wolves were more negative than those to bears (Wechselberger et al. in prep.), aggravated by a lack of compensation for damage caused by wolves prior to 01/01/2003, there may have been a tendency to exaggerate the extent of wolf predation. On the other hand, wolf attacks tended to result in more livestock killed than was usual during bear attacks and instances of surplus killing were more common. Red fox *Vulpes vulpes*, raven *Corvus corax* and golden eagle *Aquila chrysaetos* might cause very minor losses. Feral dogs are not common in Slovakia but damage by domestic dogs and theft are occasional problems for some farms.

**Influence of husbandry on level of losses**

In addition to lambs sold for meat at Easter, the focus of production at contemporary upland sheep farms in the Slovak Carpathian Mountains is on milk. Sheep are sheared twice per year but wool is of little or no economic importance. Most flocks are based at temporary camps called "salaše" from spring until autumn in order to allow pastures more distant from the home farm or village to be utilized whilst sheep can still be milked daily. It is here that most losses to predation are reported to occur. Pastures are unfenced, typically forming part of a mosaic of agricultural land and forest cover or lying at the edge or in the midst of extensive forest-covered mountains (Figure 2). One shepherd with a herding dog accompanies each flock during the day. The mean number of sheep per flock at 164 flocks surveyed in 2003 was 480 (range 100–2,000). No

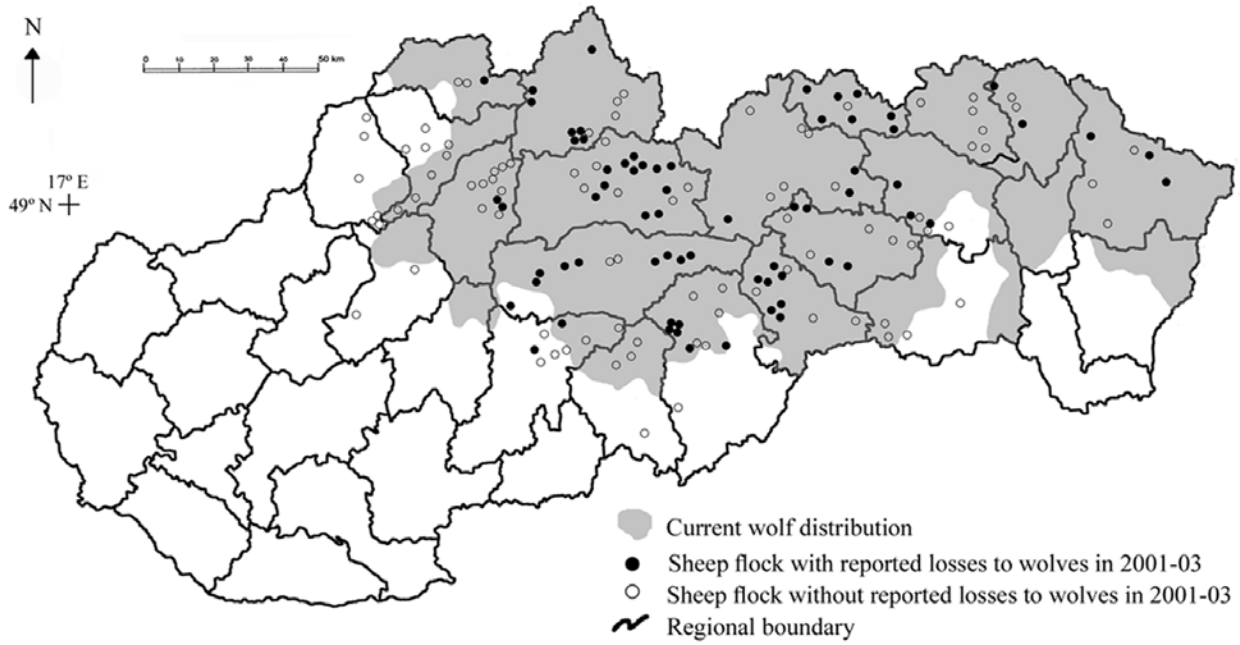


Figure 1. Flocks affected by wolf predation in 2001–2003 as reported by shepherds and farmers.

Figure 2. Typical mosaic of agricultural land and spruce forest patches in northern Slovakia. The mountains in the background are the Western *Tatras* (up to c.2,250 m a.s.l.) in the *Tatras* National Park. Seasonal grazing was common in those mountains until the 1960s, but was gradually excluded by the park authorities. Sheep and cattle are now grazed on pastures among the forest patches on the plains in the foreground and right up to the foot of the mountains, where continuous forest cover starts at about 900 m a.s.l. (Photo: Robin Rigg)

significant correlations were found between size of flock and either total number of sheep reported lost or percentage of flock reported lost to bears and wolves combined in 2003 (respectively $n$ = 139, $r_s$ = -0.009, $P$ = 0.916 and $n$ = 139, $r_s$ = -0.049, $P$ = 0.566).

Reported losses peaked in August-October, with a lesser peak in May (Figure 3). This pattern of losses can be explained as followed: in May flocks are moved to pastures in close proximity to forest cover and so become more vulnerable to predation; the decrease in losses in early summer may be due to the availability of wild ungulate fawns; the increase in predation on livestock in late summer and autumn is perhaps due to the increasing food demands of growing wolf pups and of bears fattening up for winter; the rapid decline in losses in November is caused by the unavailability of livestock confined in barns for the winter.

From spring to autumn flocks that are not returned to barns at night are either assembled into light, mobile sheepfolds or left loose on the pasture. Shepherds sleep nearby in a trailer or small building. 85% of attacks by bears were reported to have occurred at night, whereas wolf attacks were reported to occur equally during the day (51.1%) and at night (48.9%). Wolf attacks at night seemed to cause a higher mean loss of sheep (6.7 ± 4.3, 95% confidence interval) than those during the day (3.1 ± 2.1, 95% confidence interval) and therefore accounted for a greater proportion (67.1%) of the total reported losses, although the difference is not statistically significant (Mann-Whitney $U$ test,

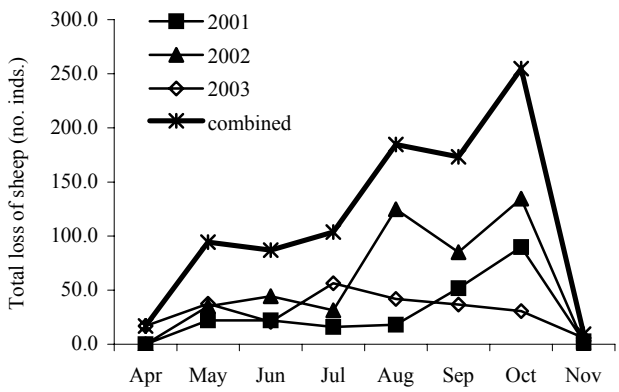


Figure 3. Seasonality of reported sheep losses due to wolf predation in Slovakia, 2000–2003.

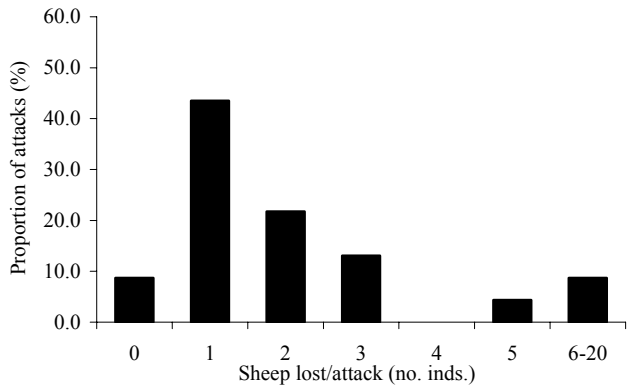


Figure 4. Number of sheep lost per attack by bears as reported by shepherds and farmers.

Table 1. Details of seven cases of surplus killing of sheep/goats in Slovakia in 1999-2003.

| Date (time) | Predator | Loss | Circumstances | Preventive measures |
|---|---|---|---|---|
| 26/06/1999 | wolf | 16 sheep and 7 goats killed. | Fog and rain. Flock wandered into forest. | None – flock left unattended. |
| May 2000 (night) | wolf | 7 sheep killed | Sheep panicked and ran out through fencing. | Poorly constructed and incomplete electric fence. |
| July 2000 (night, before 02.00h) | wolf | 11 sheep killed and 11 injured later died | Storm. Flock of yearling sheep kept overnight on remote pasture surrounded by forest cover. | 1 shepherd and 1 herding dog sleeping in nearby trailer. |
| 19/07/2001 (02.00–05.30h) | wolf | c.18 sheep missing, 2 found alive but died, 19 seriously injured | "Bad weather". Flock from same farm and in same location as July 2000 attack. | 1 shepherd and 1 herding dog sleeping in nearby trailer. |
| 08/05/2002 (c.01.30h) | wolf | 17 adult sheep and ≥16 lambs/kids killed | Small flock of lambing sheep and goats fenced within lines of bushes. Flock of ewes in nearby open area with several chained dogs not attacked. | Several shepherds attempted to chase wolves away with firecrackers and lights. |
| c.30/08/2003 (c.04.00h) | wolf | 8 sheep killed (2 thoroughly eaten), ≥14 injured | Flock of yearling sheep in sheepfold <100 m from forest edge with some trees/bushes nearer. | 3 chained dogs. |
| 9-10/12/2003 (night) | bear | 5 sheep killed, 15 missing | Flock still on remote pastures several days after substantial snowfall. | Had been left inside insecure barn. |

$P > 0.05$) if length of day is not taken into account. According to the reports of shepherds and farmers, 87% of attacks by bears and 70.1% of attacks by wolves resulted in 0–3 sheep being lost (Figure 4). However, in each year from 2001–2003 surplus killing events or multiple attacks at between four and nine flocks accounted for >50% of all reported losses at 141–149 surveyed flocks. Surplus killing was associated with a lack or failure of preventive measures (Table 1).

Flocks that reportedly suffered some losses to bears or wolves in 2002 were significantly more likely than expected by chance to also allegedly suffer losses in 2003 ($n$ = 131, $\chi^2$= 27.01, d.f. = 1, $P < 0.001$). Flocks that reportedly suffered some losses to wolves during the period 2001–2003 were significantly more likely than expected by chance to also allegedly suffer losses to bears ($\chi^2$= 10.23, d.f. = 1, $P < 0.001$). These results suggest that some aspect(s) of individual flocks or their location rendered them more vulnerable to predation. In order to investigate factors which could account for differences in reported losses among flocks, two extreme categories were formed: "no losses" included all flocks at which no losses to predation were reported during the period 2001–2003 ($n$ = 61) while "high losses" were those which suffered predation by bears or wolves in ≥2 of the three years and/or allegedly lost ≥10 sheep in any one year ($n$ = 51). Flocks in the "high losses" group accounted for 83.2–96% of all reported losses each year. The most significant difference detected (chi-square test of association using actual frequencies of occurrence, $\chi^2$ = 21.41, d.f. = 1, $P < 0.001$) between the two groups was in the method of night-time confinement. In the "no losses" group, 26/61 flocks (43%) were kept in a temporary sheepfold or left loose on the pasture and 35/61 (57%) were always or sometimes confined in a barn or farmyard at night, whereas in the "high losses" group the respective figures were 43/51 (86%) and 8/51 (16%). Considering all flocks with complete data on night confinement and reported losses for 2003, flocks kept in a sheepfold or left free on the pasture at night ($n$ = 93) had mean reported losses to wolves and bears of 3.6 sheep/flock whereas flocks always or sometimes returned to a barn (n = 47) lost a mean of 0.4 sheep/flock, a highly significant difference (Mann-Whitney $U$ test, $P < 0.001$).

In October-November and March-April flocks or

small groups of sheep are grazed near villages or farms, usually accompanied by a shepherd. During the period of snow cover (approximately late November until March-April) most sheep are kept permanently in barns, either within fenced farmyards or in villages. Most lambing occurs in barns in January-February. Successful attacks by predators are rare during this period. In the last decade or so there has been a trend towards flocks being grazed on pastures nearer villages and returned to the farmyard or barn at night throughout the year. A significant negative correlation ($r_s$ = -0.546, $P$ = 0.013) was found between the percentage of flocks in a region kept in a barn at night and the percentage of flocks in the region affected by predation in 2003.

**Livestock guarding dogs**

The situation in Slovakia is quite unusual in that, although many aspects of the traditional herding system are still used, knowledge about how to raise livestock guarding dogs has been lost. When the PLCLC project began in 2000 there were LGDs at almost all upland sheep farms but very few were free-ranging and attentive to sheep. Instead, most were used in one of three ways:

1. permanently chained near the sheepfold or farm buildings, which may have provided some protection, mainly by barking to alert shepherds at night;
2. chained during the day but released at night;
3. left free to wander.

There are various possible explanations for why shepherds began to chain up LGDs. Perhaps socio-economic change, especially a decline in agriculture, led to the loss of traditional knowledge. Large carnivores were almost eradicated in the first half of the 20th century. Predation being less of a concern than theft by humans, chaining them up might then have become simply the easiest way to keep dogs near what they were supposed to guard, and this became the habit. Many farmers and shepherds have not yet adjusted to the recovery of large carnivore populations. In 2003 dogs were found to be permanently chained at 125 out of 155 (80.6%) flocks surveyed, with a mean of 2.9 chained dogs/flock. Dogs were reported to be released at night at 26/155 (16.8%) flocks, with a mean of 1.8 dogs/flock released at night. There were no significant differences in reported losses to wolves, bears or wolves and bears combined in 2003 for flocks where some dogs were said to be free-ranging or released at night ($n$ = 66) versus those where only chained dogs were mentioned ($n$ = 76)

Figure 5. Two *Slovensky Cuvac* within a flock of sheep. (Photo: Robin Rigg)

Figure 6. A *Caucasian Shepherd Dog* within a flock of sheep. (Photo: Robin Rigg)

(Mann-Whitney $U$ test, $P > 0.05$), suggesting that inappropriately raised dogs are ineffective against predators even when released.

As part of the PLCLC project in 2000–2002 a total of 50 pups were placed at farms in central, northern and eastern Slovakia and raised with sheep. We mostly included the native breed, the *Slovensky Cuvac* (Figure 5), as well as *Caucasian Shepherd Dogs* (Figure 6), but a few crossbreeds (*Slovensky Cuvac* x Tat*r*a *Mountains Shepherd Dog)* and dogs without pedigree papers were also used. Pups were bought from dog breeders (in a few cases from shepherds) and placed with sheep mainly when between 5 and 8 weeks of age, in rare cases up to 13 weeks of age. No significant correlations were found between age when pups were first put with sheep and various outcome measures and behavioural scores. Initially one or two dogs were placed with each flock in order not to overburden shepherds, with the intention to subsequently increase the number of dogs through breeding on site. There was some evidence that two dogs put together before six months of age expressed more playful and obnoxious behaviour towards livestock than dogs raised singly. As the project progressed and the dogs matured and began to breed, pups born to sheep-attentive dogs were seen to quickly become socialised to sheep and remained sheep-attentive when relocated to other flocks.

Shepherds have reported many instances of encounters between project LGDs and predators. Some young dogs (<1 year old) apparently fled from bears or wolves or only barked at them without approaching, but more self-confident and older LGDs were said to have chased both wolves and bears away from flocks and sometimes also chased wild boar *Sus scrofa*. The chi-square test of association indicated that at flocks with well-raised, free-ranging LGDs placed as part of the PLCLC project ($n = 13$) there were significantly fewer reported losses to bears and wolves combined in 2002 than expected ($\chi^2 = 20.58$, d.f. = 1, $P < 0.001$) in comparison to other flocks in the same regions without such dogs ($n = 42$). The mean and maximum losses of sheep (or goats) reported for flocks with and without well-raised, free-ranging PLCLC project LGDs were respectively 1.1 versus 3.6 sheep/flock and 5 versus 35 sheep, suggesting that LGDs might reduce the likelihood of surplus killing as well as total losses. The protectiveness of four PLCLC project LGDs at three different flocks was tested during mock attacks by a substitute predator (an unfamiliar *German Shepherd Dog*). A dog handler endeavoured to remain hidden behind vegetation while approaching to <100 m of the nearest sheep. He then released the "predator" and, if necessary, encouraged her to run towards the flock. After the first such trial, the "predator" was led away, sheep and dogs were given time to settle and the procedure repeated from a different direction. The following were recorded: 1) the distance of the "predator" from the nearest sheep and the LGD when it was detected by the LGD; 2) the LGD's immediate response on detecting the "predator"; 3) the LGD's behaviour when confronting the "predator". Two dogs in the same flock appeared to be more confident, protective and effective at confronting the threat than one. Other anecdotal evidence supports this conclusion. For example, a single young (c.6 months old) LGD bitch with sheep early in her first grazing season was attacked and badly scared by a dog accompanying a horse, whereas two 4-month old C*a*ucasian *Shepherd Dogs* together chased away an unfamiliar and aggressive 5–6 year old *German Shepherd Dog*.

The greatest difficulties we encountered were in cooperation with shepherds. Typically, shepherds in Slovakia are not the owners of most of the sheep they look after, are not held responsible for losses to predators and in many cases are employed only seasonally. They therefore have little incentive to develop good preventive measures and are extremely difficult to work with. Some were unwilling to exert extra effort to raise dogs properly, others interpreted normal problems as signs of failure or did not follow standard guidelines (see Dawydiak and Sims 2004) for raising LGDs because they did not consider details such as isolating pups from other dogs important. In the worst cases, shepherds did not take proper care of dogs (give sufficient food, treat illness/infection, vaccinate). Sometimes they removed dogs from sheep and tethered them because they were fearful that they might attack people or kill sheep. Some shepherds had unrealistic expectations of LGDs or were too quick to judge them as failures, e.g. when a young dog on its own failed to repel a bear during its first encounter with one.

A quantitative focal observation protocol was devised involving four continuous hours of observations every two months for each pup >6 months old. Using this protocol a total of 128h of observations were conducted in 2002 by the researcher during the morning grazing period for sheep on pastures or, for pups with sheep in barns, during and after morning feeding. Dogs were scored at one-minute intervals for variables including identity of nearest neighbour, distance from sheep and instantaneous behaviour. In the assessment of developmental environments, the

method of raising pups was rated by marking a cross on a scale drawn between the minimum expression (not at all following recommended guidelines) and maximum expression (perfectly following guidelines) of the item being assessed (Martin and Bateson 1993). The rating was then converted into a score as follows: lower third of the range = 1 ("poor"); middle third = 2 ("intermediate"); upper third = 3 ("good"). This method was also used to generate observer-rated scores for overall attentiveness, trustworthiness and protectiveness, allowing comparison among dogs in different circumstances. These subjective scores corresponded very well to quantitative measures obtained using the focal observation protocol. Twelve of the 14 pups (86%) studied in detail showed intermediate-good patterns of behaviour according to observer-rated scores of attentiveness to sheep, degree of trustworthiness and protectiveness. However, as yearlings only half of these were allowed to accompany flocks regularly. The rest were generally excluded from flocks due to problems that could probably have been solved with further training, had shepherds been patient enough. An analysis of outcome measures used to assess the degree to which LGDs became integrated into flocks was consistent with the conclusion that success or failure was determined more by the attitudes and knowledge of shepherds, their willingness (and ability) to accept free-ranging LGDs and do the extra work required to provide them with appropriate developmental environments, than by genetically determined differences in behaviour among the dogs tested. The likelihood of dogs becoming successful guardians can probably be increased by careful consideration of the time of year and location in which they are raised, over winter in barns or farmyards being preferable to temporary summer camps. In addition, strengthening the link between compensation payments and the implementation of effective preventive measures might be helpful in motivating shepherds and farmers. Compensation is paid at market value of the lost animal(s) by the state or, if the damage was done by a bear and a licence for bear hunting was in effect, by the local hunting club.

The majority of pups showed some obnoxious behaviour during the socialisation period, typically chasing, biting and mounting sheep. Skittish sheep that fled from LGDs were likely to be chased and some dogs learned to provoke sheep into running. This problem was worse with lambs or yearling sheep than with ewes or rams. Sheep seemed more likely to run from the larger, dark-coloured *Caucasian Shepherd Dog* (males can be >90 kg) than the smaller, more sheep-like *Slovensky Cuvac*. Chasing often also occurred when adolescent dogs began to accompany flocks to pasture. The attitudes of shepherds were very important in this regard. Tolerant shepherds recognised that dogs exhibiting obnoxious behaviours were being attentive to sheep and so tried to correct undesirable behaviour without removing LGDs permanently from the flock. In general, the frequency of obnoxious behaviour decreased as dogs grew older. Less tolerant shepherds concerned about possible loss of lambs or reduced milk production tended to solve problems of trustworthiness by removing LGDs from livestock, particularly milking ewes.

Six out of 30 dogs (20%) placed in 2000–2001 had been lost (killed or missing) by the end of 2002. Three were known or believed to have been shot by hunters, two were hit by vehicles and one was poisoned. Less sheep-attentive or temporarily inattentive dogs (typically males) were more vulnerable to being shot or hit by vehicles. All dogs had been left intact to allow later breeding; neutering might have helped reduce wandering. Some dogs aggravated local residents by scaring them when wandering through villages or because they chased and killed chickens. Dogs were chased away following such incidents so it is not known if they would have eaten the chickens. Playful behaviour sometimes became very rough and resulted in the injury or even death of sheep, particularly young or sickly lambs. According to shepherds, one or more lambs died as a result of chasing or rough play by 4 out of 14 pups (29%). None was consumed. It is possible that some of them died due to previous ill health, as shepherds often put very weak animals in training enclosures with LGDs. On the other hand, several dogs >6 months old were left either alone or in pairs with lambing ewes without causing any problems.

Environment, experience and learning as well as inherited traits seemed to influence the degree of obnoxious behaviour. For example, a female *Slovensky Cuvac* who had had minimal contact with sheep during the critical period for forming social attachments, persistently ignored sheep completely or harassed them relentlessly. This behaviour was clear at four months of age and was still apparent when she was three years old. A similar bipolar pattern of either ignoring or harassing sheep was shown by two other dogs following an extended period of being chained up outside the barn. Some dogs chased cats and small birds, while others ignored them or reacted to them cautiously and playfully. One or two dogs showed some signs of stalking-type predatory behav-

iour at the age of 6–10 months, but this soon disappeared. Some dogs chased wild animals (one was thought to have killed a young wild boar), others apparently did not. A male *Caucasian Shepherd Dog* showed typical protective behaviour when roe deer *Capreolus capreolus* passed his flock. That free-ranging LGDs might chase after and kill game animals has been a source of grievance among some local hunters.

**Aggressiveness towards people**

A major concern among shepherds that is often given in explanation for why they cannot have free-ranging LGDs is that dogs might bite people. Livestock grazing areas are frequented by many people in summer and autumn, mainly berry/mushroom pickers, walkers/tourists in the general area and people visiting farms to buy cheese. Farmers and shepherds were advised to put up signs warning of the presence of LGDs and to put coloured collars on dogs to identify them, but they did not often do so. In general LGDs within the PLCLC project rarely or never showed unprovoked aggression towards people. Sometimes LGDs playfully chased after people who ran away from them. The *Slovensky Cuvac* seems to be less likely to be aggressive towards people than the *Caucasian Shepherd Dog*. Three out of 8 of the dogs raised with sheep in the first year of the PLCLC project bit people once or twice during their first season on pastures: a *Slovensky Cuvac* x *Tatra Mountains Shepherd Dog* female bit a woman passing through the flock on pasture; a male *Caucasian Shepherd Dog* twice seriously injured drunk people; a male *Slovensky Cuvac* attacked a farm visitor after she screamed hysterically. There have been a few additional incidents involving other dogs. A male *Slovensky Cuvac* chased and very lightly injured a motorbike rider after dark. Typically dogs in the PLCLC project >6 months old were more attentive, vigilant and protective during twilight and darkness and were then more likely to show aggression to people. A male *Caucasian Shepherd Dog* also chased vehicles and exhibited dominant behaviour if a bitch was in heat. Such incidents caused local problems with the people involved, led to the respective dogs being chained up and may have been the reason for one LGD being poisoned. In a different kind of incident, a male *Slovensky Cuvac* bit a shepherd who tried to tether him shortly after he had been relocated to a new farm, apparently out of fright. There was a similar problem with a male *Caucasian Shepherd Dog*; several other dogs were relocated without such problems.

Another set of difficulties was presented by socio-economic change. The continuing decline of the sheep industry plus uncertainty and reform leading up to and following Slovakia's entry to the EU in May 2004 made it difficult to implement a longer-term strategy such as LGDs. Several sheep farms involved in the PLCLC sold their flocks during the course of the project. However, cost cannot be said to be a limiting factor to the use of LGDs in Slovakia, as most farms have many dogs - up to 15. When bought from breeders, *Slovensky Cuvac* pups with pedigree papers typically cost € 150 for a male and € 100 for a female. *Caucasian Shepherd Dogs* cost € 200–400 for a pup with papers. Pups without papers cost around € 30–50.

**Other preventive measures currently used**

Twenty-eight out of 152 flocks (18.4%) surveyed in 2003 were found to have an electric fence. At some flocks where fences had been installed shepherds left them switched off. In other cases the fences were inadequate (did not conform to recommended parameters for predator-exclusion fencing), did not

Table 2. Preventive measures reported by Slovak shepherds and farmers to have been very effective in preventing or reducing losses of sheep to wolves and bears.

| Preventive measure | No. mentions |
|---|---|
| close the flock in a barn or farmyard at night or when it rains | 8 |
| have good livestock guarding dogs | 5 |
| change location, e.g. graze the flock nearer the village | 3 |
| chase predators away | 3 |
| use an electric fence | 2 |
| increase vigilance (sleep nearer flock, keep watch, chain dogs nearer) | 2 |
| provide alternative food for bears nearby | 2 |
| (nothing helped) | (2) |

encircle the whole sheepfold and/or had been badly set up. Predators apparently sometimes succeeded in passing between, over or under electrified wires and killed sheep, or livestock frightened by predators stampeded out of the fence and were subsequently attacked and killed. The ineffectiveness of electric fences currently used to protect flocks in Slovakia is shown by the finding that there was no significant difference (Mann-Whitney $U$ test, $P > 0.5$) in numbers of sheep reported lost to bears, to wolves or to bears and wolves combined at flocks with electric fences ($n = 27$, mean loss = 2.4 sheep/flock, range 0–18) compared to those without ($n = 104$, mean loss = 2.4 sheep/flock, range 0–21).

Of 136 shepherds and farmers who answered a questionnaire on preventive measures, 34 (25%) said that they used methods besides livestock guarding dogs and electric fences to protect sheep from carnivores. Shepherds regarded fireworks and firecrackers, lamps and other aversive devices as helpful but some said that predators quickly habituate to them. In a few cases attacking predators were chased away without losses, in others wolves and bears were said to be "not afraid of anything" and succeeded in killing sheep despite attempts by shepherds to repel them. Actively repelling predators obviously depends on an attack being detected. In this regard chained dogs might be of some help, but cases were reported in which chained dogs remained silent during attacks. Measures that shepherds said had been very effective in preventing or reducing losses to predators are listed in Table 2.

**Summary of main findings and recommendations**

1. Predation on livestock

- Remains of livestock were not found in any of 373 bear scats and in only one of 70 wolf scats collected in the *Tatra* and *Fatra* Mountains from March to November 2001–2003. As some of the highest levels of losses to carnivores are reported from farms within or near these regions, it can be concluded that livestock does not form a significant component of bear or wolf diet in Slovakia.
- Overall, 48.0% of flocks surveyed ($n = 127$) were not affected by wolf or bear predation at all during the period 2001–2003. In each year, ≤14.0% and ≤ 29.4% of surveyed flocks were allegedly affected by bear and wolf predation respectively.
- According to the reports of shepherds and farmers, 87.0% of attacks by bears and 70.1% of attacks by wolves resulted in 0–3 sheep being lost.
- Losses to wolves seemed to be considerably higher than those to bears. Wolves were often reported to attack during the day as well as at night. The main peak of losses to both bears and wolves was in August-September (October) but attacks in May were also reported to result in substantial losses. Shepherds should be prepared for attacks during these seasons.
- The distribution of reported losses was not adequately explained by estimates of the numbers of carnivores, particularly of bears. Various factors appeared to increase the vulnerability of flocks and predispose them to attack. Very high losses were generally associated with poor husbandry and/or inadequate preventive measures.

Particularly in the case of wolves, one farm suffering substantial losses to its various flocks (in single surplus killing events or as a result of multiple attacks) could account for up to a third of total losses in a particular year at all surveyed farms combined. Future efforts to improve livestock protection methods should be focussed on these farms. Where only bears are present, installing adequate electric fencing around flocks at night should reduce or eliminate losses. Where wolves are causing losses, free-ranging and sheep-socialised livestock guarding dogs are a better choice as they can provide protection on the pasture during the day.

2. Livestock guarding dogs

- *Slovensky Cuvac* and *Caucasian Shepherd Dogs* in Slovakia retain traits desirable for livestock guarding dogs. Almost all the dogs tested seemed capable of becoming effective guardians.
- The presence of LGDs alone did not necessarily deter predators or stop all losses, but the mean and maximum reported losses at flocks with one or more free-ranging LGDs were significantly lower than those at other flocks in the same regions.
- There was some anecdotal evidence for differences between breeds. *Caucasian Shepherd Dogs* were perhaps more likely than *Slovensky Cuvac* to exhibit aggressive protective behaviour which may make them more effective at repelling determined predators. However, they suffered more from heat and caused more initial disturbance to flocks. The *Slovensky Cuvac* might be a better choice where there are concerns about dog-human encounters.
- The environments in which dogs were raised had an important influence on the development of attentive and trustworthy behaviour patterns and in

some cases were the limiting factor in the outcome of integrating LGDs into flocks. The likelihood of dogs becoming successful guardians can probably be increased by careful consideration of the time of year and location in which they are raised. Beginning in late summer or autumn with a few lambs in the farmyard followed by over-wintering in a barn with more sheep produced the best outcomes.

- A successful outcome was not guaranteed by bonding pups to livestock. Shepherds' concerns about sub-adult dogs disrupting flocks with over-attentive behaviour often led to dogs being removed from contact with sheep. This tended to discourage attentiveness and aggravated problems of untrustworthy behaviour, in some cases leading to dogs that would probably have become good guardians being permanently excluded from flocks. The attitudes of shepherds were therefore of key importance in the success or failure of established free-ranging, sheep socialised LGDs.
- Many farmers and shepherds were reluctant to undertake extra work in order to implement more effective preventive measures against predators, even where high losses had been reported. Strengthening the link between compensation payments and the implementation of effective preventive measures might be helpful in this regard.
- Several external factors hindered revitalizing the proper use of LGDs, including dogs being shot by hunters, encounters with walkers and farm visitors and socio-economic changes both within the livestock industry and on a broader scale. An outreach programme could help to alleviate some of these problems by explaining the role and behaviour of livestock guarding dogs.

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# Using Livestock Guarding Dogs as a Conflict Resolution Strategy on Namibian Farms

by
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## Introduction

Once widespread across Africa, Asia and the Middle East, cheetahs *Acinonyx jubatus* have undergone a serious decline over the past century, with population estimates falling from around 100.000 animals in 1900 to perhaps 15,000 by 1990 (Marker 1998). They have been extirpated from at least 13 countries during the past 50 years, and many of their remaining populations, especially in the Middle East and north and west Africa, are now too small and fragmented to be viable in the long term (Marker 1998). One of the few remaining strongholds for cheetahs is in Namibia, in south-western Africa, which is thought to contain the largest population of free-ranging cheetahs in the world, estimated at 3,000 adult animals (Morsbach 1987). Due to a combination of reasons, including competition from other large carnivores such as lions *Panthera leo* and spotted hyenas *Crocuta crocuta*, and the impact of diseases such as anthrax, the majority of Namibia's cheetahs live outside the country's vast protected areas, but mainly on the commercial farmlands, mainly in the north-central regions of the country. Eradication of lions and spotted hyenas by commercial farmers means reduced competition for cheetahs, while the abundance of free-ranging game and permanent water-points on the farmland creates favorable habitat.

However, this distribution has resulted in a high degree of conflict with local farmers, who perceive cheetahs as posing a significant threat to their livestock and farmed game (Marker-Kraus et al. 1996). Although there is little empirical evidence to support this perception (Marker et al. 2003a), such conflict has resulted in the widespread killing or capture of cheetahs on the farmlands, with almost 7,000 cheetahs reportedly removed from the Namibian farmlands during the 1980's alone (CITES 1992). This level of removal evidently has substantial conservation implications, and the Cheetah Conservation Fund (CCF) was established in Namibia in 1990, in order to examine the reasons for cheetah removals and try to develop ways in which farmers could co-exist with cheetahs and other predators on their land.

Using livestock guarding dogs to protect stock has a long history, and has proved effective in a wide variety of situations, from guarding stock against bears in Europe to protecting them against wolves and coyotes in the U.S. (Linhart et al. 1979, Sims and Dawydiak 1990). We were interested in seeing whether the technique could be useful in an African livestock system, which has stock that often range untended over vast areas, and has a large guild of predators on the farmlands, including cheetahs, leopards *Panthera pardus*, caracals *Felis caracal* and black-backed jackals *Canis mesomelas*. Our research was primarily conservation-oriented, with the aim of gaining a better understanding of whether guarding dogs would be effective at reducing conflict on the farmlands, and what factors affected the dogs' success, but it also had an academic component, as we

Figure 1. Herder with two *Anatolian Shepherd Dogs* accompanying a flock of goats. (Photo: Courtesy of Cheetah Conservation Fund)

felt that it would be useful to conduct a comprehensive study of the behavior and efficacy of these dogs in a novel situation. This research involved quantifying those behavioral traits of dogs identified as important by Coppinger and Coppinger (1980) for successful guarding, namely attentiveness, protectiveness and trustworthiness. In addition, we examined the care given to the dogs by the farmers, and investigated how satisfied farmers were with the performance of their guarding dog. We also examined the mortality rates of livestock guarding dogs placed on Namibian farms, determined causes of mortality, and gathered information regarding behavioral problems exhibited by the dogs.

**Study area**

The Namibian farmlands support reasonably high densities of carnivores, with estimates of 0.05–0.1 cheetahs/100 km$^2$ and 0.5–1 leopards /100 km$^2$ in the country (Stander & Hanssen 2004). The study area covered the north central regions of the country where the highest density of cheetahs are known to occur. The area covered approximately 275,000 km$^2$, which encompassed both commercial farms, where livestock (usually cattle, with some goats and sheep) and/or farmed game are managed and sold for profit, and communal farms, where sheep and goats are the most common stock and are farmed on a subsistence basis. Livestock are commonly allowed to roam over large areas in the day, sometimes accompanied by a herder (Figure 1) , and are usually brought back into a corral at night (Marker-Kraus et al. 1996). On average, livestock farms in the study area had 118 goats and 78 sheep, with a mean flock size of 134 animals (Sartini 1994).

Farmers in the study area utilized a variety of techniques aimed at reducing livestock depredation, including employing herders to look after smallstock while grazing, the placement of donkeys as guardian animals within cattle herds, and the use of baboons *Papio ursinus* to protect smallstock (Marker-Kraus et al. 1996). Local dogs were sometimes kept with smallstock to protect them, but these dogs were not bred specifically for livestock guarding and often showed herding tendencies, which made them less suitable for guarding (Marker-Kraus et al. 1996). In addition, farmers often had corrals near to the farmhouse where vulnerable stock, such as calves under six months old, could be kept in, and some commercial farmers installed electric fencing in order to protect particularly valuable game on their land (Marker-Kraus et al. 1996).

**Placement and cost of livestock guarding dogs**

The first livestock guarding dogs were imported into Namibia in 1994, when 10 *Anatolian Shepherd Dogs* (Figure 2) were brought in and used to initiate a breeding program. This ia a Turkish breed, however the dogs we imported were from the Birinci kennels in the USA, where they were bred and housed with smallstock. After researching the available breeds, we decided to import the *Anatolian Shepherd Dogs* for use in Namibia, due to certain characteristics such as its large size, short coat, and independent nature, which we felt would make it best suited to the conditions faced on the Namibian farmlands. One litter of *Rhodesian Ridgeback/ Anatolian Shepherd*

Figure 2. *Anatolian Shepherd* Dog with a flock of goats. (Photo: Courtesy of Cheetah Conservation Fund)

*Dog* crossbreeds were bred and placed as guardians, but all the rest of the dogs placed were pedigree *Anatolian Shepherd Dogs*. The *Ridgeback/Anatolian* crossbreeds appeared to work well, but there were too few crossbreeds (n = 10) to make a reasonable comparison with the pedigree dogs, so all analyses were restricted only to purebred *Anatolian Shepherd Dods*. Since 1994, 215 purebred puppies have been born in 24 litters from 8 males and 9 females, representing bloodlines from 16 founding dogs (8 males and 8 females).

Puppies were born and raised until placement in a working corral, which familiarized them with livestock, and human contact was kept to a low level to ensure that dogs primarily bonded with the stock. Puppies were usually placed with the stock they were intended to guard between 6–8 weeks of age. Livestock guarding dogs were either placed with sheep, goats, or a mixed herd of both species. Dogs were not placed with cattle due to the aggressive nature of the breeds of cattle in Namibia, and the extensive system of their management. Farmers were encouraged to use other management techniques, such as guarding donkeys, for cattle. Dogs were placed singly, but on some occasions, for instance where a farmer had several herds of stock, another dog was later placed with the same farmer. Farmers often had their own dogs with the stock as well, and we found no effect of other dogs on the efficacy of livestock guarding dogs placed (Marker et al. accepted *a*).

Regular checks were conducted, both in person and over the telephone, once dogs had been placed with farmers, and farmers were encouraged to contact CCF with any problems with the dog as soon as it arose. In some instances, dogs were removed from their first home, usually because farmers had reported persistent behavioral problems, and these dogs were subsequently transferred to a new situation. These transferred dogs proved to be no less effective at protecting stock than those that were placed with their stock as young puppies (Marker et al. accepted *a*).

Until 2003, all livestock guarding dogs were provided to farmers free of charge, with CCF bearing all the costs for breeding, raising and vaccinating the puppies, and began neutered the puppies at 6 months old with no cost to the owners in 1996. Since then, we neuter all dogs placed as guardians, unless there was an agreement with CCF that the dog would later be used in the breeding program, and we found that neutering made no difference to the effectiveness of guarding dogs. As of 2003, commercial farmers were asked to pay the costs incurred while raising the puppy to placement age, and for its neutering, although all costs were still covered for owners on communal farms. In 2003, the cost for commercial farmers usually came to N$800 (approximately US$ 130) for both male and female puppies, including neutering, which still made them very cheap compared to the sale price of such dogs in South Africa, where livestock guarding dogs routinely fetch around N$4,000 (US$600). (J. Steyn and C. Stannard pers. com.). Farmers did not pay for adolescent or adult dogs that were transferred to new homes.

**Effectiveness of the dogs**

Research conducted on dogs placed between 1994 and 2002 showed that livestock guarding dogs were very effective at reducing the reported rates of stock depredation on Namibian farms (Marker et al. accepted *a*). Almost three-quarters of responding farmers reported a large decline in the levels of stock loss since getting a livestock guarding dog, and the majority of farmers felt that they had benefited economically from having a guarding dog. We have compiled the results of this long-term research into two papers, one on the overall effectiveness of the dogs (Marker et al. accdpted *a*) and one on the mortality of dogs placed on Namibian farms (Marker et al. accepted *b*).

We have some observational data on how the livestock guarding dogs interacted with predators, with the dogs becoming very agitated and barking loudly at the approach of the predator. In some instances, farmers have witnessed their dogs fighting with predators, and the dogs have been recorded as killing jackal, leopards and baboons that were threatening the stock. Although adult *Anatolian Shepherd Dogs*, which weigh approximately 40 kg, outweigh baboons by 20–25 kg, they are fairly similar in size to leopards, which averaged 46 kg for males and 30 kg for females in our study area (Marker & Dickman in press).

**Mortality**

As of December 2001, just over half of the 143 livestock guarding dogs placed by CCF were still working on Namibian farms (Marker et al. accepted *b*), and by August 2004, 103 dogs (56%) were working on farms. Over a third of placed dogs died while working as guardians (n = 78), mainly due to accidents such as being hit by cars, being bitten by snakes, or drowning (one dog was reported to have drowned in a reservoir), while 21 dogs were moved

out of a working situation, either to become pets or for breeding purposes. Culling by the owner, primarily in the early part of the study, also accounted for a substantial proportion of working dog deaths, particularly on commercial farms, usually as a result of the dog chasing or harassing stock. We received no reports of livestock guarding dogs being killed either by predators (i.e. cheetahs or leopards) or by other dogs, although there were two reported incidents of young dogs being killed by baboons.

**Problems encountered**

One of the main problems with the livestock guarding dog program in Namibia is the sheer distances involved, as the recipient farmers are widely distributed across a vast area of the country. Communication can be hard, especially in the communal areas where phones are not available. This makes regularly visiting and checking all the placed dogs an arduous, time-consuming and expensive task. A lack of rigorous and reliable record-keeping also makes it hard to accurately quantify the real impact that these dogs are having on the levels of stock loss, as there are few data on the levels and causes of stock loss before and after dog placement.

There was a high prevalence of behavioral problems exhibited by the dogs themselves: almost all the dogs evaluated were reported as showing problems at some stage (Marker et al. accepted *a*). The three most common problems were chasing game (which sometimes resulted in the dogs killing and occasionally feeding on wildlife such as kudu *Tragelaphus strepsiceros*), staying at home instead of going out with the stock, and harassing or killing livestock (Marker et al. accepted *a*). However, we found that the majority of problems were correctable with the appropriate training, and encourage farmers to contact CCF as soon as possible and work through problems instead of resorting to culling the dog or transferring it into a pet situation.

**Summary**

Overall, our research has shown that the placement of livestock guarding dogs on Namibian farms can have a very positive effect for local farmers, in terms of reducing stock losses and having an economically beneficial impact. Although studies have indicated that cheetah removals have dropped in the study area over the time that guarding dogs were placed (Marker et al. 2003*b*), it is hard to measure the extent to which these changes were due to conflict resolution measures such as dog placement, and how much was due to other factors, such as education, or changes in cheetah population size. Nevertheless, numerous other studies have demonstrated a link between levels of stock depredation and the removal of those predators blamed (Ogada et al. 2003, Shivik et al. 2003), so the placement of these dogs on Namibian farms may well have had a positive effect in terms of reducing cheetah removal rates. Despite the inevitable problems encountered with any conflict resolution measure, this study has shown that the use of livestock guarding dogs can be an effective tool for both communal and commercial farmers in Namibia, and could have important implications in many similar situations elsewhere.

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# Livestock Guarding Dogs and Wolves in the Northern Rocky Mountains of the United States

by
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## Introduction

The grey wolf *Canis lupus* was once distributed throughout North America (Nowak 1995). Conflict with livestock and historic public hatred of wolves resulted in extirpation of wolf populations in the western United States (U.S.) by 1930 (Mech 1970). In 1974, wolves were protected by the federal Endangered Species Act of 1973 (ESA) and their recovery became the responsibility of the U.S. Fish and Wildlife Service (USFWS). Wolf restoration in the western U.S. began in 1986 when a 'Canadian' pack denned in *Glacier* National Park, Montana (Ream et al. 1989). Management in northwestern Montana emphasized legal protection and building local public tolerance of non-depredating wolves (Bangs et al. 1995). Wolves from Canada were reintroduced to central Idaho and *Yellowstone* National Park in 1995 and 1996 to accelerate restoration (Fritts et al. 1997, Bangs et al. 1998). The wolf population grew to an estimated 800–850 wolves in the *Northern Rocky* Mountains (NRM) of Montana, Idaho, and Wyoming by late 2004 (USFWS et al. 2005). Since 1987, wolves have killed a minimum of 410 cattle, 1,044 sheep, 70 dogs [18 of which were being used to guard livestock], 12 goats, 9 llamas, and 3 horses. To minimize conflicts, we moved wolves 117 times and killed over 275 (Bradley 2003, USFWS et al. 2005). We encourage sheep producers to use livestock guarding dogs (LGDs) and other methods to reduce the risk of wolf depredation (Bangs et al. In press, Bangs et al. 2004, Bangs and Shivik 2001). A private group, Defenders of Wildlife, helps pay for LGDs with sheep producers to encourage their widespread use. LGDs are working well against a diverse carnivore guilde but this paper is intended to show some novel aspects of their use against wolves. We discuss some interactions we have observed between LGDs and wolves and speculate about increasing the effectiveness of LGDs to protect livestock from wolf depredation.

## Study Sites

The NRM Wolf Recovery Plan identified preferred wolf habitat as large areas of public land with adequate year-round wild prey and few livestock (USFWS 1987). Based on those criteria, northwestern Montana, central Idaho, and the *Greater Yellowstone* Area (GYA) were recommended for wolf restoration (USFWS et al. 2004, maps at http://westerngraywolf.fws.gov/) (Figure 1). Each area has a large core of national park or national forest wilderness, where livestock grazing is limited. Other mountainous habitat is undeveloped federal public land, managed for multiple uses such as forestry, mining, hunting, recreation, and summer livestock grazing. Lower elevation valleys are often private agricultural lands. Coyotes *Canis latrans* are numerous. Black bears *Ursus americanus*, mountain lions *Felis concolor*, and golden eagles *Aquila chrysaetos* are common. In the GYA and parts northwestern Montana brown bears *Ursus arctos* are common. Wild ungulates, numbering between 100,000–250,000 per recovery area, (mule deer *Odocoileus hemionus*, elk *Cervus canadensis*, moose *Alces alces*, white-tailed deer *Odocoileus virginianus*, bighorn sheep *Ovis canadensis*, antelope *Antilocapra americana*, and bison *Bison bison*) typically disperse to higher elevations in summer but winter at lower elevations. Consequently, many wolves also use private land at least part of the year.

Livestock are commonly raised on these private lands year-round. Livestock are also grazed on the majority of adjacent public lands during the summer grazing season (May-October). We estimated that in the central Idaho and Yellowstone recovery areas there were about 350,000 cattle and 110,000 sheep on private land each spring. Each summer 82,000 to 145,000 cattle, 223,500 to 265,000 sheep, and about 1,200 horses were grazed on public land in these areas. Private ranches and public land grazing allotments are large [often 1,000s of ha.] and remote. Cattle are typically grazed in a highly dispersed fashion as cow/calf pairs or yearlings from April-October. Cattle are not closely herded in summer and are often checked only weekly or less often. Range sheep are typically grazed on remote pastures from June-October in bands of 1,000 ewes and 1,200 lambs while farm flocks are typically a few hundred or less and grazed in fenced pastures. Bands are typically managed by 1–2 shepherds with herding dogs

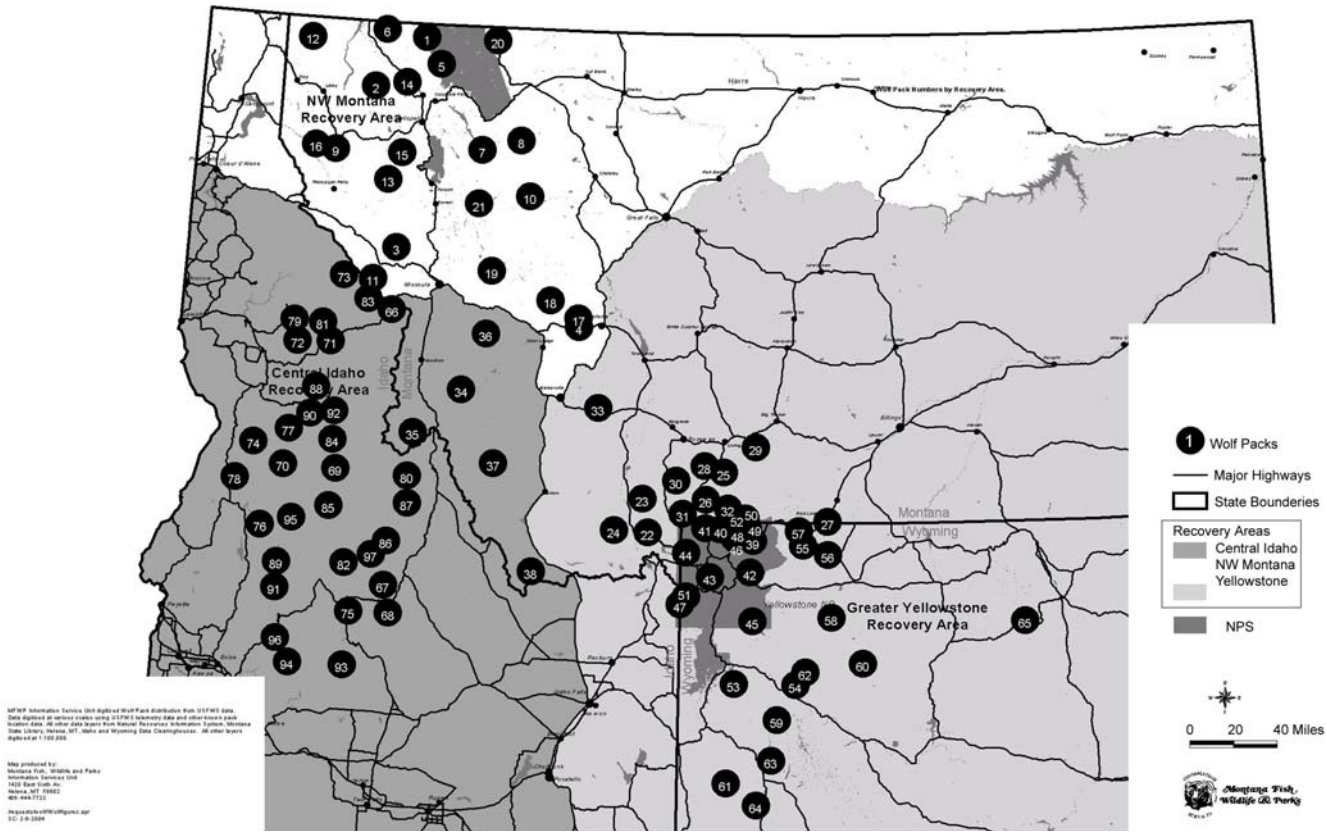


Figure 1. Wolf packs in the Central Idaho, Northwest Montana and Great Yellowstone Wolf Recovery Area. (Map produced by Montana Fish, Wildlife and Parks Information Services Unit)

and often protected by 1–5 LGDs. Bands are usually night-bedded and herders camp near the bands. Horses are grazed in small herds of less than 40 and are typically in fenced and accessible pastures. Other types of livestock are not grazed on public land and are rare on private land. In northwestern Montana livestock are almost exclusively cattle, but sheep are more common in the Idaho and *Yellowstone* areas. Due to global markets, sheep grazing is increasingly less common. Livestock guarding dogs (primarily *Great Pyrenees*, but also some *Anatolian Shepherd Dods*, and other breeds), and sometimes llamas on private pastures, are used to guard sheep from predators, primarily coyotes that cause the vast majority of all predator damage (Bangs et al. In press). Dogs that guard cattle in summer are often 'pets' in winter and are kept at the farm house. Sheep and cattle are commonly herded with dog breeds such as collies, heelers, and shepherds that physically accompany the human shepherd or rider.

Livestock producers in Montana, Idaho and Wyoming reported to the National Agricultural Statistics Service that predators killed 8,500 sheep and 33,100 lambs in 1999 (NASS 2000). Sheep producers said coyotes were responsible for 67% of sheep losses and 80% of lamb losses to predators. Sheep producers protected their sheep by using lambing sheds (average of 56% reported using them), night pens (50%), guard dogs (40%), fencing (36%), herding (12%) and frightening devices (7%). Cattle producers in Montana, Idaho, and Wyoming reported losing about 400 adult cattle and 6,700 calves to predators in 2000 (NASS 2001). They believed coyotes caused most of those losses (73%). Cattle producers reported protecting their cattle by carcass removal (36%), guard dogs (27%), fencing (26%), herding (12%) and night pens (9.9%).

## Wolf attacks on dogs

Wolves infrequently kill dogs and usually do not eat them in North America (Kojola and Kuittinen 2002, Fritts and Paul 1989, Treves et al. 2002). Only a few of the dogs killed in the NRM were fed upon and most conflicts appear related to inter-species competition (Figure 2). Adult wolves in our area are large. Males weigh up to 50 kg, females 45 kg. To date 70 dogs (10 pet, 18 guard, 19 hunting (almost exclusively <20 kg hounds used to chase and tree mountain lions and black bears), 18 herding, and 5 undocumented breeds have been confirmed killed by wolves in the NRM from 1987 until the end of 2004. From 1 to 4 dogs were killed per attack (average 1.2). Breeds range in size from a *Pomeranian* to *Great Pyrenees*. Although Humane Society organizations in each state euthanize thousands more dogs than wolves kill, wolf depredation on dogs is a serious and emotional social issue. It is one of the most difficult conflicts that we address because people form particularly strong emotional bonds with dogs. Depredations near homes also raise fears for human safety and anger over the perceived violation of personal space. Private compensation, up to (US) $ 2,000, is only provided for herding and guarding dogs confirmed killed by wolves. Wolves that attack dogs on private land can be legally relocated or killed (USFWS 2003), but to date none have been because most attacks were isolated incidents in remote areas. In this paper we only address fatal agency-confirmed wolf depredation on LGDs that were being used to protect livestock (Table 1). We recognize that confirmed fatal wolf/LGD encounters are a fraction of all wolf-caused LGD deaths, since a LGD may simply disappear and its fate never documented, however our data show a pattern in wolf interactions with LGDs.

Figure 2. Farmer preying over his wolf-killed LGD. (Photo: Rick Williamson)

Table 1. Confirmed fatal Livestock Guarding Dog [LGD] depredations caused by wolves in Montana (MT), Idaho (ID), and Wyoming (WY), USA. The three wolf recovery areas are; northwestern MT (NW MT) where naturally dispersing wolves from Canada first denned in 1986; and the *Greater Yellowstone* Area (GYA) and central ID were wolves were re-introduced in 1995 and 1996. Anatolian (*Anatolian Shepherd Dog*), Pyrenees (*Great Pyrenees*).

| Date | Area/Location | Livestock guarded | Breed | Wolf Pack | Notes |
|---|---|---|---|---|---|
| 08/00/1995 | NW MT, Ninemile, MT | cattle in summer | Anatolian | Ninemile | near house, eaten |
| 06/16/1996 | NW MT, Ninemile, MT | cattle in summer | Pyrenees | Ninemile | near house, eaten |
| 07/16/1996 | ID, Boise NF, ID | band of sheep | Anatolian | unknown | range |
| 04/21/1998 | GYA, Dubois, WY | cattle in summer | Pyrenees | Washakie | near house |
| 10/03/1998 | GYA, Tom Miner, MT | flock of sheep | Pyrenees | Chief Joe | near house |
| 03/29/1999 | ID, Iron Creek, ID | flock of sheep | Pyrenees | Jureano | range |
| 11/06/1999 | GYA Soda Springs, ID | band of sheep | pup Pyrenees | Lone wolf | 2 LDGs wounded |
| 01/25/2000 | GYA, Tom Miner, MT | flock of sheep | Pyrenees | Chief Joe | near house |
| 03/03/2000 | NW MT, Ninemile, MT | cattle in summer | Pyrenees | Ninemile | by house |
| 07/24/2000 | GYA, Tom Miner, MT | flock of sheep | Pyrenees | Chief Joe | near house, eaten |
| 08/17/2000 | GYA, Dubios, WY | cattle in summer | Pyrenees | Washakie | range |
| 09/20/2000 | GYA Jackson, WY | cattle & camp in summer | 3 Catahula | Gros Ventre | range |
| 06/10/2001 | ID, Stanley, ID | band of sheep | Pyrenees | Whitehawk | range |
| 08/10/2002 | ID, Hill City, ID | band of sheep | unknown | Chimney Creek | range |
| 08/30/2004 | GYA, Dillon, MT | band of sheep | 2 Pyrenees | Freezeout | range |
| 11/29/2004 | ID, McCall, ID | band of sheep | Anatolian | Florence | range |

## Wolf interactions with LGDs

At least 18 LGDs have been killed by wolves (Table 1). We do not typically record the sex or age, but of the 18 LGDs killed, 11 were *Great Pyrenees*, 3 *Anatolian Shepherd Dogs*, and 3 *Catahula Hounds*. Our limited data do not allow us to determine if some LGD breeds are more effective or less likely to be killed by wolves. LGDs can be relatively effective at protecting herded livestock from coyotes, mountain lions, and bears and are commonly used by sheep producers for such purposes (Coppinger and Coppinger 1978, 1980a, 1980b, 1982, Green and Woodruff 1983, Green, Woodruff and Tueller 1984, Linhart et al. 1979, McGrew and Blakesley 1982). Cattle producers in range operations rarely use LGDs because of the highly dispersed cattle grazing strategies used in the western U.S. Coyotes (10–15 kg) are much smaller than LGDs. Mountain lions, black bears, and to a much lesser extent brown bears, seem naturally wary/frightened of dogs - even relatively small ones. We speculate that this is likely because they evolved with gray wolves – which have been documented to chase, harass, or kill these other large predators. As expected, our data suggest, as others have, that dogs are most likely to be killed by wolf packs. Conflicts peak in summer when wolves are rearing pups and LGDs are in remote areas and most likely to encounter wolves. Some conflicts occur in winter when wolf breeding behavior seems to make them more territorial and wolves seemed to seek out dogs. All dog conflicts including LGDs suggest attacks are more likely when people are not present and the dogs are outnumbered or out-weighed. We describe several reported interactions between LGDs and wolves where we have data collaborating at least parts of these stories (dead livestock, dead LGDs, dead wolves, radio telemetry data). These incidents illustrate the complex and variety of relationships that can occur between LGDs and wolves. Behavioral interactions between guard dogs and wild wolves are very difficult to obtain and are often primarily stories related from herders or others working with livestock. Such data may be extremely biased since only interactions that were perceived a 'problem' were reported - who knows how many times dogs and wolves have interacted without serious consequences or without documentation. Therefore we urge caution in any attempts to interpreting these data/stories more broadly than intended.

## Lone LGD interactions with lone wolves

In Fall 1996, 10 wolf pups from a pack that was killed because of chronic cattle depredations in NW Montana were placed in a large pen with 2 subadults near the center of *Yellowstone* National Park. The 12 wolves were released in Spring 1997. One of

those pups, female #68, now a yearling, dispersed from the Park in early August and we lost radio-telemetry contact with her. She traveled about 100 miles south, through many other grazed areas – primarily cattle – and some rural developed areas. She apparently settled where domestic sheep were being grazed in Wyoming. Before depredations were confirmed, the herder reported that his lone LGD (sex unknown) had been behaving aggressively toward a lone 'wolf' for several days and reportedly chased it and howled back and forth with it at night. However, he reported that eventually the two seemed to adjust to one another and were actually seen bedded near one another. On August 14, 1997, 38 lambs and 3 ewes were confirmed as wolf kills. Wolf #68 was captured in a leg hold trap and relocated back into the center of *Yellowstone* National Park on August 16. On September 4, wolf #68 was seen bedded near the LGD in the same flock of sheep. Fifteen more sheep were confirmed wolf-kills shortly thereafter. She was killed by an agency control action in that same area on September 9, 1997. It seems likely that wolf #68's quick return to the sheep flock was not related to food, since prey is abundant everywhere that time of year and her primary interest was returning to the LGD, that apparently had become a companion. There were few other wolves south of *Yellowstone* National Park at that time. We have documented less than a dozen other instances (unpublished data) where lone dispersing wolves and dogs were reportedly not overtly aggressive or appeared only mildly curious of one another. We have antidotal information suggesting a lone wolf and a LGD guarding sheep in southern Idaho became companions while sheep were being killed. After we killed the depredating wolf, the LGD continued to prey on sheep and was also euthanized. We have never documented wild wolves and dogs breeding in the wild.

**Interactions between groups of wolves to LGDs**

Wolves in packs normally have territories that they aggressively defend from other canids. One of the primary causes of adult wolf death, other than people, is other wolves (Mech and Boitani 2003). Not surprisingly, wolf packs will kill dogs when they can. The usual result of a lone dog fighting a wolf pack is a dead dog. There is a wolf pack territory in the *Gravelly* Mountain range west of *Yellowstone* National Park that includes public allotments grazed by sheep bands. This area has been used by the Freezeout pack in 2001 (6 wolves, 4 pups, no depredations), 2002 (9 wolves, 6 pups, 2 cattle, 2 sheep killed), 2003 (8 wolves, 4 pups, 20 sheep killed), and 2004 (12 wolves, 5 pups, 2 LGDs and a herding dog killed). The sheep producer in this area has herders who travel with and camp near where the sheep are night-bedded on his public grazing allotment. The herders use herding dogs and 1–2 LGDs. We provide them telemetry receivers and the collar frequencies for members of the Freezeout pack. They report that their herders commonly hear the wolves howling or pick up their radio signals near the sheep in summer. If the dogs start barking and acting aggressively the herders quickly move toward the wolves to protect the dogs and scare away the wolves. They have had few losses on their public grazing allotment due to their diligence. However in 2004, 2 LGDs and a herding dog fought with wolves as they approached the sheep at night. Before the herder could intervene a herding dog and a LGD were killed, and the other LGD was badly wounded. It disappeared that night and likely died. No sheep were killed. We also know of a large sheep producer in central Idaho who used herders and up to 5 LGDs per band. They were very pleased with the low numbers of wolf-caused losses, until this year. In 2004 at least 140 sheep and probably over 300 were killed in those bands despite a similar level of protection to previous years. No LGDs were killed. Some of this could be random chance but we suspect it has to do with the increasing distribution of wolves and larger packs that are raising pups on those sheep ranges.

In 1998 the Chief Joseph pack (9 wolves, 6 pups) that lives in and out of the northwestern corner of *Yellowstone* National Park killed a LDG at a farm in Tom Miner Basin. LGDs were replaced by a conservation group. In 1999, they (8 wolves, 3 pups) killed six sheep protected by LDGs at that farm. In January 2000, (13 wolves, 6 pups) the pack returned to that farm and killed another LGD. In May the pack returned and killed a calf from a small cow/calf herd nearby. In July they killed another LGD on the sheep farm. It appeared that when the pack came into Tom Miner Basin they routinely went to the sheep farm/house and howled at, scent marked, and attempted to intimate/fight the LGDs. There were other farms and dogs in the Basin but the wolves tended to repeatedly visit this farm. After the third LGD was killed, we and a conservation group helped him construct a fence to night pasture his sheep and protect his remaining dog. However, he reported that he still had to lock up his guard dog in a horse trailer at night because the wolves seemed more attracted to them than his sheep. He believed the wolves were coming

to his farm so often to harass the LGDs. He ended up moving his LGDs and sheep to another farm for 2 years because they were primarily used by his wife for her weaving hobby and he approved of efforts to restore large carnivores in *Yellowstone* National Park. In summer 2004 he brought a LGD and 15 ewes back to his farm and a sheep was killed by a wolf in November 2004.

**Patrolling dogs**
**and their interactions with wolf packs**

A cattle producer in Wyoming used a pack of 6 *Catahula Hounds* (25–30kg) to help patrol his public grazing allotment and camp, often near him and his riders. He believed the dogs 'aggressive' behavior helped to reduce damage from grizzly bears that were common in the area and routinely depredated on his cattle. This was a very uncommon livestock husbandry practice and hounds are rarely used to guard livestock. His allotment bisected the territories of the Teton (4 wolves-no pups) and Gros Ventre (6 wolves, 3 pups) packs. In mid July 2000 the Gros Ventre pack wounded a cattle herding dog but it lived. On September 20, 2000, the Gros Ventre pack (including the alpha male and female) killed one of his calves on a public grazing allotment. The hounds encountered the wolves at the carcass and two hounds were killed. A day or so later, the pack apparently searched out and killed another of his hounds.

**Discussion**

We have recorded two instances where lone wolves have fought with groups of 3–4 LGDs, but in only one instance was a LGD killed, and it was a young pup [11/06/1999 Soda Springs]. However in those instances 2–3 adult LGDs were injured. We do not have many other examples of multiple LGDs interacting with lone wolves. We suspect this is because lone wolves probably go out of their way to avoid groups of strange canids. Dispersing lone wolves must constantly avoid resident wolf packs, lest they be detected and killed. We speculate that multiple LGDs can repel lone wolves if the wolf does attempt to challenge them, and behaviorally, multiple LGDs might be less likely to 'accept' a strange wolf as a companion. More conflicts between a lone wolf and multiple LGDs might go unreported since LGDs appear less likely to be killed in fights with a lone wolf.

The case studies presented in this paper show a pattern where wolf packs with established territories and pups perceive dogs as trespassing 'wolves'. They actively searched out certain dogs and when possible attempted to attack and kill them. Dogs killed during these types of encounters are usually not eaten. This could just be a function of these encounters occurring near people and the dog's carcasses being discovered relatively quickly, but we believe it is more because the dogs are killed in territorial battles. This territorial behavior is well documented and appears to mainly manifest itself most strongly when the wolves outnumber or outweigh the dogs involved. Wolves routinely chase, attack, and kill coyotes if the opportunity presents itself. Perhaps a more evenly matched battle might still occur between multiple LGDs and wolves, but with less injury to LGDs, although wolf-to-wolf conflict often results in dead wolves. However we speculate that in contrast to defense of food (Coppinger and Coppinger 1995) defense of territory/pups is often considered a life or death matter by wolves. We also speculate that areas with resident dogs that are considered trespassers by wolves may be deliberately visited by wolves who repeatedly attempt to harass or kill them. This could mean that LGDs that are roaming with bands of livestock may encounter wolves on a more random basis rather than having wolves deliberately searching the dogs out at homes or farms. Our observations also suggest that after a pack detects dogs, it may for a short period of time increase its attentiveness and aggressiveness toward them.

**Recommendations**

We cautiously recommend the following to make LGDs more effective in protecting livestock from wolves. Of course all the standard livestock protection issues should continue to be followed- graze healthy livestock, keep carcass-free pastures, have vigilant herders, calve/lamb in protected environments away from large predators, free-graze larger older livestock, vigorously harass any predators near livestock, and whenever possible have effective predator-resistant barriers or fencing. To be protected, livestock must be within the LGD's ability to detect predators, so fenced, confined, or closely night-bedded livestock are more easily protected by LGDs than dispersed livestock. Such barriers or confinement can also protect LGDs. Conflicts can occur at any time, but at night extra vigilance and protection is wise. LGDs should be protected by people or wolf packs can kill them. Multiple LGDs should be

used, both to increase their ability to detect wolves and defend themselves, and to reduce the opportunity for a lone LGD to react non-aggressively toward a lone wolf. Lastly, LGDs can help reduce livestock losses, but some livestock losses are inevitable in the presence of wolves. The smaller the livestock, the more likely it can be easily killed by wolves, the more will be killed per wolf attack, and the more the livestock needs to be protected by people. LGDs can help to reduce losses and are most likely to be successful when used in combination with other techniques to reduce the potential for depredations on livestock by wolves.

## Summary

The pattern we have observed between wolves and dogs, including LGDs, is very similar to that detected elsewhere (Fritts and Paul 1989). We speculate that the vast majority of wolf-dog conflicts in our area have not been related to food. The numbers of wolves in our relatively new and rapidly expanding population is very low compared to wild prey and livestock availability. Most of the encounters we have documented appeared to involve intra-species aggression. In most instances, dogs were killed but not eaten. Almost all of the dogs, including LGDs, were killed in areas within resident pack territories and were not being directly protected by people. However, in several instances wolves fought dogs in yards or even porches with people very close by, but in nearly all of those cases the wolf(s) were driven-off before the dog was killed. Multiple LGDs accompanied by herders appear to be a viable tool to reduce the potential of wolf depredation on confined or closely herded livestock. LGDs appear ineffective at protecting highly dispersed livestock and LGDs must be protected from wolf packs.

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# Livestock Guarding Dogs: a New Experience for Switzerland

by
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## Introduction

Wolves *Canis lupus* were eradicated from Switzerland about 150 years ago. However, since 1995, dispersing wolves from Italy and France have regularly attacked livestock. Swiss sheep farming is no longer adapted to large carnivores because sheep are free-grazed unguarded on alpine pastures. Losses to wolves can potentially be high: surplus killing is common and sheep panicking often fall over cliffs in mountainous regions. Moreover the wolf in Switzerland is fully protected, implying that solutions must be found through changes to sheep husbandry rather than through wolf control. To try to deal with this situation, the Swiss Agency for the Environment, Forest and Landscape (SAEFL) instigated the Swiss Wolf Project (SWP) in 1999. The prime goal was to set up mitigation measures, to monitor wolves, and to spread information about wolves and mitigation measures. For financial and political reasons, the project ended in December 2003. In 2004 a new project was initiated involving more agriculture interests, and dealing only with mitigation measures. This paper discusses the implementation of livestock guarding dogs (LGDs) during the SWP (1999–2003). A separate article in CDPNews No 9 will present briefly the concept of the new project led by the Service Romand de Vulgarisation Agricole (SRVA, information center for agriculture).

## Sheep farming in Switzerland

Since the Uruguay round of world trade negotiations in the early 1990s, Switzerland was forced to adapt its highly conservative agricultural sector to the world trade rules. Trying to reduce the number of farms that were closing, the government defined a new multifunctional role for the agricultural sector (e.g. to preserve natural resources, to keep livestock in an environmentally responsible way, etc). These new responsibilities are considered as public services and are not influenced by the market prices since farmers are subsidised by direct governmental compensations (FOAG[1] 2000). However, the farmers' wages are slowly decreasing forcing them to look for another job to complement their incomes (SFU[2] 2002). Since 1992, the price of the lamb meat declined by 20%. Small farms (≤49.4 acres or 20 ha) are disappearing while big farms are slowly expanding (FOAG 2002). The agricultural context makes the future of many sheep farmers uncertain, even if for many of them, keeping sheep is only a supplementary job or hobby. Prices and markets will no longer be guaranteed (e.g. as of 2007, lamb meat is expected to loose 30–50% of its actual value) and financial support will be reduced. The wolf could not choose a more turbulent period to return to Switzerland.

Since the Second World War, shepherding was abandoned to decrease the costs. Sheep are currently free ranging on alpine pastures and checked once a week. Today the average size of a flock of sheep does not exceed 300 animals in 99.6% of the farms in Switzerland and in 77% of the alpine pastures. Only a few big flocks are still guarded by shepherds. Alpine pastures can be located at more than 2,500 m

Figure 1. Alpine pasture where sheep are grazed during the 100–140 day summer season. (Photo: Jean-Marc Landry)

[1] Swiss Federal Office for Agriculture
[2] Swiss Farmers'Union

a.s.l. and can be very steep (Figure 1). Unguarded sheep are allowed to roam over large areas of up to several km$^2$, generally delimited by natural borders like ridges, rock faces or forests. However, the flocks are well manageable even if they scatter in small groups because pastures are often at a mountain side of a valley. To make them stay on the pasture and to return to the same night time places they are fed regularly with salt at the same places. As the sheep of a flock normally belongs to one breeder they know each other and stay more or less in a flock. Some flocks are fenced at the beginning of the summer season until mid-august and then are allowed to roam free. If a shepherd is present, daily or weekly sectors are delimited to graze the flock. In spring and fall, flocks are usually kept in the bottom of valleys in small wire netting or electrified enclosures. Most of these pastures are located near forests or are overgrown with bushes and small trees. Since the winter is severe, the sheep are kept in barns from December to late March/mid April. The lambing season runs from January to March and the lambs are sold in autumn for the meat. If LGDs are present, they are always living with the flock, event if it is unguarded or in winter time in the barn.

**Consequences of the return of the wolf to Switzerland**

Until now, the wolf has reappeared only in the south of Switzerland (cantons of Valais, Tessin and Grisons), which represents 36.7% of the Swiss territory (15,142 km$^2$). This is where nearly half (44%) of the alpine pastures are located and in which nearly $^2/_3$ (59%) of the sheep graze during the 100–140 day summer season (147,000 heads or nearly 10 sheep/km$^2$). Lots of cattle (119,000 heads or nearly 8 cows/km$^2$) are also grazing in this area, on pastures situated at lower altitudes. Besides these livestock, some 94,000 wild ungulates (chamois *Rupicapra rupicapra*, red deer *Cervus elaphus* and roe deer *Capreolus capreolus*) share this area.

From 1998 to 2003, 456 sheep and goats have been compensated as wolf kills. The carcasses are checked by a local gamekeeper. In 1999, 128 sheep, which "disappeared" after wolf attacks, were also compensated. In 2000, 105 sheep killed by an unknown canid (probably a wolf) were compensated as well (damage statistic for wolf see: www.kora.unibe.ch). The amount of the compensation paid from 1999 to 2002 for 387 sheep/goats killed in 123 attacks reached € 161,000 (a mean of € 416 per animal). It is generally admitted that 1–4% losses during summer grazing is normal (without predation). There is no official data on dog attacks on livestock, but interviews with sheep owners seems to show that it is not negligible.

**Predators and management plans**

Officially, there are about 3 to 6 wolves in the southern part of Switzerland (2004). All wolves that have been reported in Switzerland since 1995 originate from the Italian population (Valiere et al. 2003). There are regular wolf observations elsewhere in Switzerland, but they have never been confirmed scientifically (genetic analysis, good pictures, dead animals). The lynx *Lynx lynx* was reintroduced in Switzerland in the early seventies. Presently, there are about 100 adults; about 20 in the Jura Mountains, 70 in the Alps and a small population of 8 recently translocated lynx in the eastern part of the country. These lynx kill about 50–100 sheep / goats per year

Figure 2. *Great Pyrenees* on alpine pasture. (Photo: Jean-Marc Landry)

on average. A wolf and a lynx management plan allows the culling of predators under certain conditions (see www.kora.unibe.ch for more details).

**The Swiss Wolf Project**

The initiative to introduce livestock guarding dogs (LGDs) came from two sheep owners who faced the first wolf attacks in 1995. They bought two *Great Pyrenees* (Figure 2) pups in the Alps Maritime (*Mercantour*, South of France) in 1996. Unfortunately, they were already strongly bonded to people and not trustworthy with the sheep. J.-M. Landry had the opportunity to follow them to try to find solutions to correct them with advice from Ray and Lorna Coppinger and the rich information gathered in the DogLog Newsletter (Lorna Coppinger editor), from Joël Pitt, who introduced the first LGDs in France and from Günther Bloch (German Wolf Society) who shared his experience and his literature on LGDs. This first experience has influenced our further mode of working with LGDs. We have developed a strong bond from the dog to the sheep to the detriment of the relationship with the owner. Today, some sheep owners can still not catch their dogs (e.g. to give vaccinations or worm treatments, etc.) or to move the LGD without the sheep / goats (e.g. vet control), which complicates the management of the LGD. In 1998, we introduced the first pup (*Great Pyrenees* female) in the flock of one of the two already "experienced" sheep owners. She is still working today. After a series of wolf attacks at the end of 1998, the SAEFL was initiating the SWP led by KORA (Coordinated research projects for the conservation and management of carnivores in Switzerland).

Our main objective was to examine the feasibility to protect a flock of sheep and goats in the Swiss Alps against wolves and to determine the advantages and the limits of the methods. Livestock guarding dogs were one of the main subjects. Besides, we have also tested the implementation of fences (Angst et al. 2002), fladry, the use of donkeys (Landry 2001), flashlights, protection collars like those used to protect the neck of the sheep against lynx attacks (Angst et al. 2002) and sheep herding. We tested techniques to correct problem dogs as well. We have also tried the option to leave a dog alone with the flock on an alpine pasture during the entire summer and have taken the opportunity to test and improve automatic dog feeders. In addition, we have experimented with the possibility to introduce an adult LGD in a flock recently attacked by a wolf. Finally, our role was to communicate our data through publications and talks and to share our knowledge with sheep owners, from whom we have learned a lot. As KORA was in charge of both the Swiss Wolf and Lynx Project, we rapidly applied LGDs to protect some flocks against lynx attacks. The results obtained by the SWP have been compiled in a final report (Burri et al. 2004).

**LGDs in the projects**

We have placed pups in flocks according to the methods of Lorenz (1985), Lorenz & Coppinger (1986), Coppinger (1992) and Coppinger et al. 1983. As the use of the LGDs was unknown by the sheep

Figure 3. *Maremmano-Abruzzese* accustoming to the sheep on the first day after their arrival at their new farm. (Photo: Damiano Torriani)

Figure 4. *St-Bernard Dog* in the sheep pen. (Photo: Jean-Marc Landry)

Figure 5. *Spanish Mastiff* with sheep on alpine pasture. (Photo: Jean-Marc Landry)

breeders – and by ourselves as well – we first wrote a short synthesis on the use of this kind of dogs (Landry 1999). From 1998 to 2003, 64 LGDs were introduced in flocks in Switzerland. 3 other LGDs were bought by sheep owners but followed by our project. We acquired 20 *Great Pyrenees* directly from France (10 females and 10 males, from three distinct regions) and four *Maremmano-Abruzzese* (Figure 3) from Italy (*Abruzze* province). Every LGD was bred from working parents. We also bought 3 St-*Bernard* (Figure 4) pups at the St-Bernard Hospice. We have received two *Spanish Mastiffs* (Figure 5) and one *Mioritic* from a Romanian worker from *Brasov* as well. 42 pups were directly born in our project from 9 litters and 36 (19 females and 17 males) were introduced in flocks, the others in families. In several cases, we have introduced adults already socialised with sheep. Besides, we had to move 4 adult LGDs to new flocks: one sheep owner had to leave Switzerland and the three other LGDs were not trustworthy with the flock. The problems disappeared after they have been introduced into their new flock.

At the end of the project, 41 LGDs (64%) were still working, while 36% (23) of them died (12 = 19%) or were removed (11 = 17%). Six were euthanised, three for skeletal problems (2 hip-joint dislocation and 1 knee lateral dislocation) and three for behavioural disturbances[3]. Two had a stomach torsion, one was killed by another LGD in a barn (food domination) and three died for unknown reasons. Of the eleven LGDs placed in families, 8 were too friendly with humans and were not attentive to sheep, two were removed following mistreatment and one was chasing wildlife. Generally, the socialisation process with the sheep was not adequate and was outside of our control[4]. We are convinced that the possibility to choose the pups and a ensure a good follow-up can reduce the number of problems with LGDs.

## Academic research on LGDs

Since LGDs are working in tourist areas with up to 25,000 hikers crossing some alpine pastures in one season, we have also observed the LGDs behaviours towards hikers (Landry 2004). This work led to recommendations for the government, the sheep owners, shepherds and hikers to deal with potential conflicts with tourism and local people. If any dog had

Figure 6. LGD following a group of tourists along the electrified fence. (Photo: Jean-Marc Landry)

[3] One was untrustworthy with the sheep and was shoot by the owner, one was not anymore attentive and was put to sleep by the owner. The last one was not socialised with humans at all and developed fear aggression behaviours.

[4] Three LGDs were given to us, the three *St-Bernard Dogs* were not born with sheep and therefore were already strongly bonded to people.

bitten someone, a lot of people would be afraid of LGDs. Tourists generally do not know how to interpret and behave when they face a LGD.

*LGDs and hikers*

We observed the interactions[5] of 14 LGDs (13 *Great Pyrenees* and a *Spanish Mastiff*) towards hikers and their dogs during three years (2000–2002), mainly on alpine pastures (Landry 2004). We took into account 1,221 encounters from 2,071 persons. In 57% of the encounters the LGDs didn't react (barking or approaching). When approaching hikers, LGDs generally kept a distance of at least 10 m (75%). In the vicinity of the hikers, LGDs showed neutral behaviour (e.g. walked aside, Figure 6) or presented friendly behaviours (e.g. greetings). One LGD occasionally frightened hikers by barking close to them. It was then temporally removed. Nevertheless, the probability of approaches increases considerably when a companion dog accompanies the hikers ($P < 0.00001$[6]). In general, there have been no problems with tourists, but one LGD especially bit hikers' dogs, two of them were even on a lead and not in the vicinity of the flock.

To minimize the risks, recommendations were addressed to the new LGDs commission in 2004, which was mandated by SAEFL to make proposals regarding the management of the LGDs in Switzerland. Two of them are:

1. To monitor the LGD breedings to obtain LGDs that are both tolerant to people and effective against predators.
2. To join the national ongoing programme PAM (Prevention des Accidents par Morsures[7]) dedicated to children (especially) and adults. This program was initiated by the Swiss Federal Veterinary Office to teach the right behaviours to adopt when encountering a dog (known or unknown) to reduce the number of accidents.

In the future we may have problems with LGDs attacking other dogs. In our country with many tourists, it is difficult to teach a LGD to defend the flock from predators and stray dogs, but to respect dogs on a lead, even if it is only passing the flock. We think that LGDs interact with other dogs not only to defend territory limits or to safeguard the flock. These interactions may have other explanations. The role of the pheromones and the phenotype of the dog may have an influence, which is not yet known.

Some municipalities have attempted to ban LGDs on their alpine pastures. Since 2004, the canton of Valais has elicited a list of "dangerous" breed, comprising the *Spanish Mastiff*. These breeds must be constantly muzzled and be kept on a lead! The canton of Valais can at any time modify the list. Therefore, the next step of this study is to measure the tolerance of LGDs towards hikers related to their capacity to protect efficiently a flock of sheep against a mock predator. This work might help us to select LGDs, which fit the best in our "political" tourist context.

## Cost of a livestock guarding dog

The yearly average cost of a LGD is € 712 ($ 937 US), including the food, the vet, dispersing the cost of the dog over 8 years and the trip to get the dog. The price of the food and the travelling expenses vary a lot. In our case, we had a special agreement with a dog food manufacturer (60% reduction). In a rich country like Switzerland, the acquisition and the support of a LGD seems not to be a problem. However, in our sheep-farming context, the average annual cost for three LGDs, the minimum theoretical number to protect a flock against a pack of wolves, can reach a monthly salary. The project has financed the dogs, the food, the vaccinations and the vermifuges during the whole project. A contract described the obligations of the sheep owner and the responsibilities of the project.

## Problems with livestock guarding dogs and techniques to improve them

Apart from the "normal" problem encountered with young dogs – chasing, grab-biting, wool-pulling, tail-biting, and ear-biting – our two main problems were to deal with the oestrus period of the bitches and to prevent certain LGDs from escaping from an enclosure to roam around. Unfortunately, sheep owners often do not watch the heat of their females. Consequently, we had several crossbreeds between herding dog males and LGD females. The pups were all euthanised , except one litter. These pups were placed in families. In one case, the father bred with his daughter on the alpine pasture. These were dogs of two owners regrouping their flocks during summer time. These pups were also euthanised. To help to control the heats, we have recommended that dogs' owners give injections or permanently sterilize the bitch. The first method requires that injection

[5] Their behaviours towards hikers when they approach and bark at them and when they are in their vicinity.

[6] We have used the logistic regression through the GLM procedure after normalizing the data. We have taken into account the number of reactions ($n = 696$). We have tested the influences of four variables (number of persons, presence or absence of a companion dog, distance of detection and distance of reaction) to predict the probability of the variable "approach". The variable "presence or absence of a companion dog" is very significant ($P = 7.97e\text{-}011$) $T = 6.60$ (this value follows a distribution of Student and allows to calculate the p-value. T-value = value of the logistic regression divided by the standard error). Degree of freedom (df) = 691.

[7] Prevention of the accidents from dog bites.

dates are carefully followed while still allowing occasional heats to prevent uterus infection. Generally, the dogs' owners do not want to sterilize their bitch, because they hope to have pups one day to sell them. In one case we have obliged the sheep owner to operate his female, because she had successively four litters.

When a dog escaped from the enclosure to defecate, to get water from the stream instead of water from the bucket, to mark or to roam, we – and the sheep owner –often received complaints form local people, and the local gamekeeper has threatened to shoot the dogs on several occasions. Consequently, we have implemented techniques to try to correct the LGDs behaviour. Initially, we have used the electric shock collar. This system is very time consuming if you are not able to provoke the dog to leave the enclosure to correct him at this precise moment. Moreover, the dog often knows that you are in the vicinity and stays quiet in the middle of the sheep. Therefore, we have improved the invisible fence so it does not require our presence. The pasture is surrounded by an electric lead connected to a box which gives electric impulsions. The dog wears a light electric collar giving at first an acoustic signal and then a smooth electric shock when the dog approaches the fence. We were able to cover even one kilometre fences in very difficult terrains. The two systems described above work quiet well, but the results are never definitive! That means that the experience must be regularly repeated. (e.g. in springtime when the sheep and the LGDs join the spring pastures or in autumn when the flock descends from the alpine pastures to be kept in fences).

## Effectiveness

Because wolves are quite rare in Switzerland, it is impossible to estimate the effectiveness of our LGDs. However, sheep owners recognized that their dogs are very effective against fox *Vulpes vulpes* and raven *Corvus corax* predation on lambs and against stray dogs. We have observed and even filmed LGDs encounters with other dogs and found dead foxes and badgers Meles meles near flocks. The presence of one or several LGDs seems to calm the herd, which may panic less when predators approach.

In contrast, we have good evidences that LGDs are effective against lynx predation (Burri et al. 2004). In flocks with repeated lynx kills, the damages ceased after the introduction of two or three LGDs. Since forest or bushes often surround the pastures on lynx territories, one dog is not always enough. Nevertheless, we should be careful before drawing any conclusion, because lynx predation depends as well on other factors like lynx and prey density, presence of lynx that specialised on livestock etc. (Angst et al. 2002). Moreover, the number of protected flocks involved (n = 8) still remains small.

## Importance of the shepherd on the effectiveness of the LDG

Sheep herding is a lost tradition in Switzerland and usually alpine pastures have no infrastructure for shepherds. As most sheep are free grazing and shepherds are very rare in Switzerland, we tested the possibility to leave LGDs alone accompanying the sheep during 100 days. We experimented with three flocks: one herd with a lone LGD, one herd with two LGDs and one herd containing the sheep of two owners with one LGD each. Several automatic dog feeders (Figure 7) were placed where the sheep used to bed. The sheep owners controlled the flock every 7–10 days. The dogs followed the sheep wherever they went for grazing during the day and returned with

Figure 7. LGD feeding on an automatic dog feeder on an alpine pasture. (Photo: Alberto Stern)

them to the night places where the sheep owners placed salt for the sheep and the automatic dog feeders. These experiments have shown that it is possible to leave LGDs alone with a flock of sheep during at least 100 days, with a weekly control. The dogs stayed with the flock during the whole trial. However, the majority of LGDs are under supervision of shepherds.

However, the sheep used to scatter in small groups which makes efficient protection difficult. Moreover, one flock was attacked several times by an unknown predator, which killed preferentially an isolated ewe whereas its lamb was saved. A shepherd and two LGDs from the project stayed during one week with the flock. He penned the sheep with the LGD around every night and no further losses were recorded. Unfortunately, there was no cabin and due to bad weather, he had to leave the area. The predation restarted immediately. The next year, we hired a shepherd. The first day when he arrived with the herd, sheep were attacked during the night. The herder then always penned the sheep with the two LGDs at night. The predation ceased for the whole season. This is however the way shepherds are working with LGDs on alpine pastures in Switzerland.

These experiences demonstrate that the presence of a shepherd is important to increase the effectiveness of the LGDs. His work is to look after the flock, to manage the grass and to group the sheep – preferentially in an electrified enclosure – to assist the work of the LGDs. Nevertheless, the shepherd also needs a cabin where he can warm himself, dry his clothes and cook his food. That requires investment in infrastructure. On the other hand, sheep owners should provide LGDs that work properly, because shepherds typically don't have time to spend time to correct problematic LGDs.

## Problems dealing with the project

LGDs like wolves quickly became a political object! As a result, the KORA team was often held responsible for the political decisions – e.g. the strict wolf protection – and often accused of having reintroduced the wolves. In general, sheep breeders were not in favour of getting a LGD. For them, accepting a LGD and mitigation measures means accepting the wolf. As a majority of the sheep breeders are not able to finance the mitigation measures (LGDs, salary of the shepherd, etc.), they also wanted to be reassured that the SAEFL will support the mitigation measures for a long time. We tried to find solutions to help sheep owners to manage their dogs' problems, to encourage them in their work and to improve our communication. We organised annual meetings to talk about the results of the previous year and to listen to their wishes, which were directly transmitted to the SAEFL. During the last year of the SWP (2003), we organised a new sheep association (SSALGD[8]). The prime goal of this association is to be the main interlocutor about LGDs in Switzerland and to collaborate with the new project at the SRVA, which was mandated by the SAEFL as interlocutor for damage prevention in Switzerland.

## Cost for optimal prevention measures on alpine terrain

The prevention measures (3 LGDs, a shepherd, costs of a caravan, helicopter flights, etc) to protect an alpine pasture during 120 days (which was the average number of grazing days in the SWP) cost € 14,000 ($ 18,425). Summer grazing of sheep on alpine pastures is subsidised by the state. To be able to afford this amount only due to the subsidizes dedicated to summer grazing sheep, the sheep owners need to collect a minimum of 800 animals on the alpine pasture. Presently, this size flock represents only 5–8% of the sheep grazed pastures in Switzerland. Even if flocks are gathered, the majority of the alpine pastures remains too small to reach the limit of 800 animals. Therefore, subsidizes for summering sheep, already at the level of those for cows, should be augmented for flocks of sheep below 800 to allow protection. However, the FOAG will not subsidize sheep more than cows for political reasons: the sheep industry only corresponds to 0.8% of the national agricultural incomes, unlike the cow industry, which reaches 48%. Due to the government's restricted budget policy planned for the next years, the actual ability of the SAFEL to finance the mitigation measures is compromised. Due to the new agrarian policy, more and more farmers are working two jobs and therefore have less time to implement mitigation measures and have less personal funds to finance them.

## Recommendations

Our experiences with LGDs and sheep owners during the five years of the SWP allow us to make recommendations especially to the Swiss government, to politicians, and to the new LGDs commission.

- It is essential to involve the sheep owners directly in the project through an existing – or to be created – sheep association, like the SSALGD. We

[8] The Swiss Sheep Association of sheep breeder owners of Livestock Guarding Dogs

think it is important that sheep owners pay for their own LGD, which might make them more responsible. The government should help to finance the rest of the mitigation measures. It is fundamental to select the sheep owners who really want to protect their flocks.

- It is vital to follow the genealogy of the dogs and to note down their behaviours and temperaments to be able to select the dogs which fit best in the project. In tourist areas, each dog that shows aggression towards people should be taken off the breeding program. We are convinced that the genetics of the dogs can facilitate the attachment to the sheep and decrease the common problems. We should bear in mind that several "breeds" have been selected more for a phenotype than for a behaviour.
- It is very important to take into account the psychology of the sheep owner and the behaviour of his flock before choosing, which dog to introduce. A LGD, which does not work in one herd, can be successful in another one. Not every LGD works in a team with other dogs. Taking into account the temperament of the dog helps to compose the best pack or to resolve problems by removing a dog.
- Implementation of infrastructure on alpine pastures to welcome shepherds should be facilitated by constructing cabins and provide them with fresh water.

## Conclusion

We need to learn more from our LGDs to facilitate their integration in flocks. This will improve the acceptation of dogs by sheep farmers, who have often less and less time to spend time correcting the dogs. LGDs on alpine pastures, which do not react to hikers, may also help to smooth the acceptance of LGDs. A professional survey of our LGDs and a genetic selection for further breeding will be the next step.

The natural return of the wolf questions the way we deal with sheep husbandry in the Alps. There are methods that further the coexistence between predators and livestock, but they are costly. Politicians do not see the need to invest in funds to help to restore an old tradition. The problem is easily resolved through minimal prevention measures accompanied by a wolf management, which could allow the selective culling wolves when necessary. Yet, we should see the prevention measure in a broader view in term of the possibility to manage and conserve alpine pastures in the long term, to control the sanitary state of the livestock daily, to protected the flocks against "normal" predation like stray dogs, foxes, ravens or theft. However, the conservation of large carnivores (especially the wolf) and the implementation of mitigation measures depend on political decisions. Without public money, there will be no mitigation measures and no possible coexistence with large predators.

## Acknowledgements

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## Publications

**Mishra, C. 2004. Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects. Environmental Conservation 4: 338–343.**

Livestock depredation by the snow leopard, *Uncia uncia*, and the wolf, *Canis lupus*, has resulted in a human-wildlife conflict that hinders the conservation of these globally-threatened species throughout their range. This paper analyses the alleged economic loss due to livestock depredation by these carnivores, and the retaliatory responses of an agro-pastoral community around Kibber Wildlife Sanctuary in the Indian trans-Himalaya. The three villages studied (80 households) attributed a total of 189 livestock deaths (18% of the livestock holding) over a period of 18 months to wild predators, and this would amount to a loss per household equivalent to half the average annual per capita income. The financial compensation received by the villagers from the Government amounted to 3% of the perceived annual loss. Recent intensification of the conflict seems related to a 37.7% increase in livestock holding in the last decade. Villagers have been killing the wolf, though apparently not the snow leopard. A self-financed compensation scheme, and modification of existing livestock pens are suggested as area-specific short-term measures to reduce the conflict. The need to address the problem of increasing livestock holding in the long run is emphasized.

Download at:
http://www.ncf-india.org/pubs/Mishra%201997.pdf

**Gunther, K.A., M.A. Haroldson, K. Frey, S.L. Cain, J. Copeland and C.C. Schwartz. 2004. Grizzly bear–human conflicts in the Greater Yellowstone ecosystem, 1992–2000. Ursus 15(1):10–24.**

For many years, the primary strategy for managing grizzly bears (Ursus arctos) that came into conflict with humans in the Greater Yellowstone Ecosystem (GYE) was to capture and translocate the offending bears away from conflict sites. Translocation usually only temporarily alleviated the problems and most often did not result in long-term solutions. Wildlife managers needed to be able to predict the causes, types, locations, and trends of conflicts to more efficiently allocate resources for pro-active rather than reactive management actions. To address this need, we recorded all grizzly bear–human conflicts re-

ported in the GYE during 1992–2000. We analyzed trends in conflicts over time (increasing or decreasing), geographic location on macro- (inside or outside of the designated Yellowstone Grizzly Bear Recovery Zone [YGBRZ]) and micro- (geographic location) scales, land ownership (public or private), and relationship to the seasonal availability of bear foods. We recorded 995 grizzly bear–human conflicts in the GYE. Fifty-three percent of the conflicts occurred outside and 47% inside of the YGBRZ boundary. Fifty-nine percent of the conflicts occurred on public and 41% on private land. Incidents of bears damaging property and obtaining anthropogenic foods were inversely correlated to the abundance of naturally occurring bear foods. Livestock depredations occurred independent of the availability of bear foods. To further aid in prioritizing management strategies to reduce conflicts, we also analyzed conflicts in relation to subsequent human-caused grizzly bear mortality. There were 74 human-caused grizzly bear mortalities during the study, primarily from killing bears in defense of life and property (43%) and management removal of bears involved in bear–human conflicts (28%). Other sources of human-caused mortality included illegal kills, electrocution by downed power-lines, mistaken identification by American black bear (Ursus americanus) hunters, and vehicle strikes. This analysis will help provide wildlife managers the information necessary to develop strategies designed to prevent conflicts from occurring rather than reacting to conflicts after they occur.

**Huygens, O.C., F.T. van Manen , D.A. Martorello, H. Hayashi and J. Ishida. 2004. Relationships between Asiatic black bear kills and depredation costs in Nagano Prefecture, Japan. Ursus 15(2): 197–202.**

Over 1,000 Asiatic black bears (Ursus thibetanus) are killed each year in Japan to control depredation activity. Our objective was to determine if killing bears reduces depredation costs. We focused our study on Nagano Prefecture, where 2,562 nuisance bears were reported killed and where reported depredation cost exceeded ¥1,430 million between 1979 and 1999. We used mixed models with repeated measures to determine if annual depredation costs were associated with the number of bears killed. Our dataset included 15 years (1985–99) of kill and cost data for 122 municipal jurisdictions within 10 regions. We performed analyses at the regional level based on combined harvest and nuisance kill data, and at the municipal level based only on nuisance kill data. We classified the number of kills into 3 classes (low, medium, high). Analyses were repeated using prior-year kills to examine whether a possible time-lag existed. Annual depredation costs were positively associated with the kill data at the regional level ($F$ = 5.51; 2, 72.3 df; $P$ = 0.006) during the same year. However, we observed no association based on prior-year kill data ($F$ = 0.96; 2, 65.1; $P$ = 0.390), suggesting that depredation costs and bear kills are a function of nuisance bear numbers rather than reflecting a causal relationship between the 2 measures. Nuisance bear numbers may in turn be affected either by the availability of natural foods or by general population trends. At the municipal level, depredation costs were not associated with the number of nuisance bears killed during the same year ($F$ = 1.36; 2, 466 df; $P$ = 0.258) or the prior year ($F$ = 0.42; 2, 459 df; $P$ = 0.656). Our results suggest that systematically killing Asiatic bears may not be an effective tool for mitigating nuisance costs. In municipalities where nuisance costs remain high, we recommend that alternative methods be tested for their efficacy in mitigating costs. Such methods may include public education, changing or removing financial incentives to kill bears, changing crop rotations to crops that are not attractive to bears in risk areas, promoting natural food production, using electric fences, and applying aversive conditioning techniques.

**Jo Kleiven, Tore Bjerke, Bjorn P. Kaltenborn, 2004. Factors influencing the social acceptability of large carnivore behaviours. Biodiversity and Conservation, 13(9): 1647-1658.**

A survey on attitudes toward large carnivores was conducted in a representative sample of the Norwegian population ($n$ = 3134). People were asked about the acceptability of carnivores living in remote wilderness, close to where people live, killing livestock, killing pets, or threatening humans. Large differences in acceptability appeared across the five situations. Wolves and bears were less acceptable than lynx and wolverines when observed close to where people live. Negative associations were found between acceptability and lack of personal control, economic loss, and respondents' age. Acceptability was higher among males than among females, and higher among urban than among rural residents. The results showed that general measures of attitudes alone toward large carnivores were of limited value in wildlife management. The situational and social specifi-

city of these attitudes should be given more attention.

**Kvam, T., K. M. Rosendal, E.M. Rosvold, A. Aune, S.M. Rosendal, K. Brøndbo, P.F. Moa. (2004). Sheep mortality in an area close to a major city 2002-2003. Nord-Trøndelag University College HINT Utredning 55: 1-57. (In Norwegian)**

Summer mortality of free-grazing lambs in two forested grazing areas west of the Norwegian capital Oslo had increased dramatically from 3-6% to 11-17% between 1997 and 2001. To identify causes of mortality lambs were equipped with radio-transmitters in 2002 (n=317) and 2003 (n=299). All of the other lambs in the flocks were equipped with "dummy" transmitters. Mortality among the radio-collared lambs was 18% in 2002 and 12% in 2003. Lynx were responsible for 65% and 24% of mortality in these radio-collared lambs in 2002 and 2003, respectively. Other causes of mortality included disease, drowning, red fox predation and problems with insect larvae.

## Meetings of interest

**June 13-15, 2005**
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*Location*: Jokkmokk, Sweden
*Information*:
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e-mail: camilla.wikenros@nvb.slu.se

**July 31 - August 5, 2005**
Nineth International Mammalogical Congress
formerly *International Theriological Congress, ITC*
*Location*: Sapporo, Japan
*Information*: www.imc9.jp
e-mail: MAMMAL2005@hokkaido-ies.go.jp.

**September 27 - October 1, 2005**
Sixteenth International Conference on Bear Research and Management
*Location*: Riva del Garda, Trentino, Italy
*Information*:
www.provincia.tn.it/foreste/16IBAconference/

**23-27 August 2006**
1st European Congress of Conservation Biology
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## LCIE card

**The Large Carnivore Initiative for Europe aims**
*"To maintain and restore, in coexistence with people, viable populations of large carnivores as an integral part of ecosystems and landscapes across Europe".*

According to this mission statement, the LCIE defines four important fields of activity:
1. conservation of large carnivore populations and their habitats;
2. integration of large carnivore conservation into local development of rural areas;
3. support for large carnivores through appropriate legislation, policies and economic instruments;
4. the human dimension (information and public awareness with the aim of obtaining the acceptance of large carnivores by all sectors of society).

To solve the conflict arising from the predation of large carnivores on livestock, the prevention of damages is of high priority. For more information on the LCIE please visit the LCIE website (www.lcie.org) or contact the LCIE co-ordinator, Agnieszka Olszanska (olszanska@iop.krakow.pl)

## Contributions desired

Dear subscribers,
The CDP News will only thrive with your active participation. Articles should be as „down to the earth" as possible. Please send us any contribution on the following topics (please see article guidelines on our website):

- Prevention measures
- Prevention measures that did not work
- Statistics on damage
- Compensation systems
- Technical articles
- Problem animal management
- Opinion and forum papers

[1] The financial support by the LCIE allows us to distribute the CDP News for free. However, to minimise postal taxes, we prefer distribution by e-mail wherever possible.