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Front cover picture

Ein *Patou des Pyrénées* hütet eine Schafherde im Mercantour (Frankreich).
Patou des Pyrénées surveillant un troupeau de moutons dans le Mercantour (France).
Patou des Pyrénées guarding a flock of sheep in the Mercantour (France).
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Fotos
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Figure 1: The guard dog Orlando sniffing the nose of a lamb

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1. Introduction

Over the past 20 years, the distribution area and the number of wolves in Italy have shown a net increase. A small population of wolves has been known about in the Genova region since 1985 (Boitani & Ciucci 1993). Two wolves were seen for the first time in France (Alpes Maritimes) in November 1992 (Lequette *et al.* 1995). Since the end of the 1980s, sightings of wolves have increased in the French and Italian Alps.

The Swiss Alps contain the environmental conditions necessary for the survival of a small population of wolves (Landry 1997a). The mountains, however, are also exploited by man, namely for hunting, tourism and animal husbandry. This husbandry has led to densities of herbivores generally higher than those reached by wild species. Despite the abundance of game near areas of summer pasture, the losses of sheep which are not guarded are likely to be high (Kaczensky 1996). For example, at least 119 sheep were killed by at least two wolves from July 1995 to May 1996 in the Valais (Switzerland). The damage was estimated at more than SFr. 57,000 (Landry 1997b). The capture of an ovine animal is easier and less dangerous than that of a deer and involves less expenditure of energy (Valverde 1964). Unfortunately, a wolf (or a dog) can be seized with murderous frenzy within an artificial system such as a herd of sheep (just like a fox in a hen run) and it may kill a lot of animals without eating them. In a mountainous region, animals seized by panic can also easily fall from rocks. It will be necessary therefore to develop effective means of protection for livestock, adapted to the situation in the Swiss Alps, which are at the same time economically and socially viable for the farmer and the shepherd.

2. The use of dogs to protect sheep herds against large predators

2.1. Origins of guard dogs and of their use

All the present races of dog originate from the wolf (Scott 1968, Wayne & Jenks 1991). More precisely, the dog is believed to be descended from a small sized wolf, the Indian wolf (*Canis lupus pallipes*), according to Scott (1968). Its place of origin is believed to be the Near and Middle East (Scott 1968) and its appearance in the Mesolithic Age, more than 14,000 years ago (Scott 1968, Davis & Valla 1978, Nobis 1979). Remains of dogs, however, have been found at places far removed from each other, though nothing yet permits us to know if domestication took place several times independently or if it spread from one region (Olsen & Olsen 1977, Morey 1996). However, the great diversity of dogs which already existed long ago, suggests a varied genetic heritage (Clutton-Brock 1995). A more recent study (Vilà *et al.* 1997) confirms the wolf as the true ancestor of the dog, but puts the origin of the dog at more than 135,000 years ago (Gauthier in 1990 already suggested that the dog might go back 40,000 years). Wolves and dogs would have continued to exchange genes. It was only in the Neolithic Age, when the hunter-gatherer became cultivator, and therefore sedentary, that man certainly brought about a new selectiveness to the dog by isolating it more and more from wolves and letting it wander, for example, in the villages where it came to feed (R. Coppinger pers. comm.).

The far distant ancestor of guard dogs is said to be a mythical mastiff which lived on the high Tibetan plateaus from prehistoric times (Guardamagna 1995). Chinese chronicles relate that such a dog was offered to the Chinese emperor in 1121 B.C. (Guardamagna 1995). Very large dogs, however, already existed in Assyria in the 13th century B.C., as can be seen in representations of dogs on various bas-reliefs or on terracottas coming from the ruins of Babylon or Niniveh (Guardamagna 1995). Moreover, Alexander the Great is said to have received two dogs from an Indian king, which he brought back to Macedonia in 326 B.C., in the Molosses region. Since then, these dogs have been given the name of molosses (previously "Indian dog"). These molosses were used by the Romans for circus games, for combat and to guard their villas and estates (Guardamagna 1995). Anon (1913, quoted by Coppinger & Coppinger 1993) mentions the existence of a treatise on the management of Roman farms published in 150 B.C. The treatise is so well supplied with information on the use of guard dogs that if no other book existed, it could be used today (Coppinger & Coppinger 1993). The authors of this treatise mention two types of dog. One was used to hunt predators and game, the second to protect herds.

Other authors put the existence of these two types of dog well before the Roman period (Strebel 1905). The mythical mastiff of Tibet is said to have been the origin of the two principal stocks of molossoids:

- one with squat form, with short hair and a short muzzle, suited for fighting, for combat, and for guarding estate houses (*Canis villatices* and *Canis pugnatices)* and which gave rise to present-day bulldogs;
- the other with a more harmonious silhouette, long hair and normal muzzle, used to defend livestock against predators (*Canis pastoralis*) from which present-day mountain dogs are descended (Guardamagna 1995).

The first indications of the domestication of sheep (beginning with the Asiatic mouflon) and of the goat (starting with the bezoar goat) were found in western Asia (Iraq and Iran) and go back about 7.000 or

8,000 years B.C. (Leonard 1974, Gauthier 1990). Domestic dogs and sheep appear together for the first time in archaeological sites dated 3,585 B.C. (Olsen 1985). It is probable that the first ancestors of guard dogs arrived in Europe in the company of nomadic shepherds (Iberians originating in the Caucasus in the 6th century B.C., silk route, etc.) and spread in Europe (Grignon 1982, Coly 1994, Cruz 1995). It is also possible that some dogs arrived in Europe with the Phoenician merchants and Roman conquests (Tschudy 1926, Guardamagna 1995).

Table 1: The different races of guard dogs (Hubbard 1947, Hauck 1965, Coppinger & Coppinger 1978, Daniels-Moulin 1992, Räber 1993, Andreoli 1994, Bloch 1996, Horvath 1996, Guldenschuh 1998, Sider and Atlia Sedefchev, in Lit.) The spelling of the names' dogs can differ from one author to the other.

Country of Origin	Race
Morocco	Aidi (Atlas guard dog)
Portugal	Cao de Castro Laboreiro Cao de Serra de Estrela Rafiero do Alentejo
Spain	Pyrenean mastiff (or Navarre mastiff) Spanish mastiff Mallorquin guard dog
France	Pyrenean Mountain dog (Great Pyrenees) Alpine guard dog (Alpine Shepherd dog)
Switzerland	Great Swiss Bernese Mountain dog St-Bernard
Italy	Maremma-Abruzzese Bergamo shepherd dog
Hungary	Komondor Kuvasz
Poland	Owczarek Podhalanski (Tatra, Goral dog)
Slovakia	Slovensky Cuvac (Slovak Chuvach)
Rumania	Ciobanesc romanesc Carpatin Ciobanesc romanesc Mioritic
Bulgaria	Karakachansko kuche (Karakachan dog) Barachesto ovcharsko kuche (Barachesto shepherd dog)
Greece	Elinikos Pimenikos (Greek shepherd dog)
Macedonia (FYR)	Sarplaninac
Turkey	Akbash Kangal Kopegi (Sivas Kangal, Karabash) Kars dog Kurd Steppe Dog
Ex-Yugoslavia	Sarplaninac
Croatia	Croatian guard dog
Slovenia	Krasky ovchar (Kras shepherd dog)
Caucasus	Kavkaskaya ovcharka (Caucasian shepherd dog)-several local types (Georgia, Armenia, Azerbaydjan, Dagestan)
Russia	Kavkaskaya ovcharka (Caucasian shepherd dog)-mountains type and steppe type Southern Russian shepherd dog Sredneaziatskaya ovcharka (Central Asian shepherd dog) Iounjnorousskaia Ovcharka (Central Asian shepherd dog)
Turkmenistan	Alabay Koyunchi, Chokcha (Turkmenian shepherd dog)
Uzbekistan	Torkuz Sarkangik
Afghanistan	Sage Koochi
Kirgizia	Kirgizkaya ovcharka (Kirgizian shepherd dog)
Tadjikistan	Dahmarda (Tadjikian Mastiff)
Mongolia	Buryato (Mongolian shepherd dog)
Nepal, North India	Bhotia (Himalayan mastiff)
Tibet	Do-Khy (Tibetan mastiff)

Before the wars with the Germanic tribes, the Romans colonised Switzerland, which became a frontier post. The Roman legions were veritable nomadic towns. They took with them the famous Roman molosses (*Canis pugnaticus*) used for war, as well as the mastiffs (from the Latin *mansuetus*, tamed), which followed and guarded the herds (source of food) which accompanied the armies. These dogs also participated in guarding the camp (Morsiani 1993). At that time there were already "races" of "Swiss" dogs, which developed from the peat-bog dogs which appeared in the Bronze Age (Studer 1907, Hauck 1965). There was probably cross-breeding with the Roman dogs, but there are no scientific proofs that the Swiss Bouviers and the St. Bernard (often linked with guard dogs) are the result of such cross-breedings (Bärtschi & Spengler 1992, M. Nussbaumer pers. comm.).

The concept of race for a dog is a fairly recent British invention, going back less than 200 years (Cruz 1995). Numerous races of guard dog have been recognised by the International Canine Federation (ICF) which has accepted or fixed standards for each race.

There are, however, different "races" of guard dog which are not recognised. In Table 1, the races recognised by the ICF are listed, as well as races which have been described but are not recognised, and races which have been personally put before me with supporting photos. Some authors (Guldenschuh 1998) give a huge range to the Asian central shepherd dog (western Himalayas, Pamir, Hindouhoush, Tadjikistan, Afghanistan, Turkmenistan and noth-east of Iran), while others (Sider and Atlia Sedefchev, in Lit.) border it to Russia, describing other

types of dog for the regions mentioned above.

The natural colour of early sheep was black, grey or brown and the dogs were of the same colour (Sharplaninatz, for example). Then, in the Roman era, wool of white colour was favoured, whence came certainly the selection of numerous races of guard dog of the same colour (Kuvasz, Pyrenean mountain dog, etc.) (Cruz 1995). The average weight of this type of dog varies from 35 to 65 kg, depending on the race**.**

2.2. Working principles for guard dogs

Dogs are born deaf and blind after about 63 days of gestation. Two periods are particularly important in the life of a puppy:

- The first is at the age of about two weeks, when it opens its eyes for the first time. The puppy is going to form a privileged relationship with the first creature (or moving object) which it sees - its mother in most cases. This is the impregnation described by Lorenz in 1937.

- The second period corresponds roughly to the age between three and 12 weeks (Fig. 2), when the puppy is going to establish a rapid social relationship with the young of the same litter, with social animals other than dogs or with humans (Scott & Fuller 1965, Scott & Stelzner 1966). This social attachment to another species is particularly marked between six and eight weeks (Freedman 1961, Scott 1962 & 1968). After 16 weeks, social attachment becomes difficult. For example, a dog which has not had contact with man before the age of four months will show signs of fear towards man in general. In the same way, a puppy taken too quickly from its mother and raised without the presence of other dogs will show signs of fear vis-à-vis other dogs (Scott & Fuller 1965). As a result, the ideal age for placing a puppy in a flock of sheep is about eight weeks (the best solution is for the puppy to be born among the ewes), because:

  1. It has had time to form a social relationship with dogs, which is important if it has to show good behaviour towards a canine predator;
  2. It will still have time to become attached to the sheep.

The principle for the working of guard dogs is based precisely on socialisation. Placing a dog in a flock of sheep before it is 12 weeks old favours a social relationship between the dog and the sheep. The dog is going to behave with the ewes in the same way as it behaved with its parents or the dogs in the litter.

Theoretically, it is possible to socialise a dog with any social species: sheep, goats, cows, horses, llamas, alpacas, ostriches, chickens, etc. (Coppinger 1992).

As adults, guard dogs have a tendency to keep the

Figure 2: A two months old Great Pyrenees with lambs

typical behaviour of puppies, such as licking the face of an adult to beg for food, playing or fighting, following parents or brothers and sisters, remaining near the house (or the stable or the den). In addition, the puppy barks readily when faced with something new and, above all, shows an absence of predatory behaviour (Lorenz & Coppinger 1986, Coppinger *et al*. 1987) or a very low predatory behaviour. The frequency of the appearance of these types of behaviour vary from one individual to another, but they can be encouraged and reinforced in a dog by the efforts of the sheep farmer and through positive experiences. The guard dog will then show this behaviour towards the sheep which he associates with his brothers and sisters or with his parents (Lorenz & Coppinger 1986). The dog which maintains juvenile behaviour when adult also shows a pedomorphosis (modification of the skeleton which maintains juvenile characteristics in the adult stage) (Coppinger & Coppinger 1982, Morey 1996).

To be fully effective, the guard dog must show three basic types of behaviour, attention, loyalty and protection towards the animals with which it has been socialised (Coppinger & Coppinger 1978, Coppinger *et al.* 1983).

1. **Attention**: The guard dog has been chosen for its ability to become attached to other animals. The dog is a social animal which needs the presence of social animals. That is why the dog is attentive to sheep, for they satisfy its social needs (Coppinger 1992). As a result, following a herd of sheep, sleeping and strolling among the animals is a sign of its attention (Lorenz & Coppinger 1986). The dog maintains permanent contact with the flock (Coppinger *et al.* 1983). A young dog which takes refuge among the herd at the approach of a stranger shows another sign of attention. This behaviour corresponds to that of a puppy which rushes to the paws of its mother at the approach of an intruder (Coppinger 1992).

   Stray dogs are often responsible for damage to livestock and wildlife (Pitt 1988). That is why wardens are often authorised to shoot this kind of dog. Moreover, American scientists (Lorenz *et al.* 1986) have found that guard dogs which roamed (therefore not attending to the herd) were more likely to be lost or shot. As a result, the fact that the dog remains with the herd also avoids problems for the farmer or shepherd.

2. **Loyalty:** The basis of loyalty is the absence of predatory behaviour. This is why a dog can be left alone with the sheep. The guard dog is chosen for its ability to show an investigative behaviour and a submissive behaviour towards the sheep (or other livestock). A dog which approaches a sheep with its ears flattened back, avoiding direct eye contact or which lies on its back is showing submissive behaviour. Sniffing the muzzle or the anal parts of a sheep is an investigative behaviour. These two types of behaviour indicate that the dog possesses good instincts and that it will work correctly. A loyal dog does not interrupt the sheep's activities (Coppinger & Coppinger 1980, Coppinger *et al.* 1983) and never injures the livestock (Lorenz 1985). A guard dog brought up since it was small with sheep may show sexual behaviour towards the sheep (eg. mounting a sheep). This behaviour is normal and should not be considered as a problem.

3. **Protection:** The basis of protection is the skill of the dog in reacting to a situation that is not routine. As a result, guard dogs are chosen for their ability to react (barking) to unusual or new activities. This behaviour is found in the puppy which will react to a new or strange situation by rushing towards it and barking with tail raised. If, however, it is challenged, it will take refuge in its corner, tail between the legs. This behaviour is called approach and withdrawal. The adult guard dog shows the same contradictory behaviour. It advances towards a predator barking, tail raised as a sign of dominance or aggression, but its ears are laid back and it avoids direct visual contact with the intruder, often a sign of submission or to avoid an increasing conflict. Nevertheless, this attitude may be followed by an aggressive dominating type of behaviour and it may follow the predator if it flees. The dog generally places itself between the intruder and the sheep (Lorenz & Coppinger 1986). A predator often avoids a dog which shows such behaviour, or its attention is diverted to the dog and no longer to the sheep (Coppinger *et al*. 1988, Coppinger & Schneider 1995). As a result, choosing a dog for its aggressivity is not necessary (Black & Green 1985). In general, an attentive dog, that rests with the herd, is also its protector (Lorenz & Coppinger 1986, Coppinger *et al.* 1988). It is the attention that the guard dog gives to the herd that is the key to success.

These three basic types of behaviour of the guard dog are developed during its first year of life (Table 2).

The correct use of this type of dog provides an effective method of protection (but never 100%) which also saves the predator. And this is particularly important when the predator is a protected species. Moreover, it seems that predators do not leave their territories because of the presence of dogs among the herds (Coppinger *et al.* 1988). Thus, the protection of one mountain pasture should not necessarily increase pressure on a neighbouring pasture. The terri-

Table 2: The different stages of development in the guard dog. The length of each stage is approximate, since each stage can vary from one individual to another (according to Coppinger 1992a):

Attention behaviour		
Phase 1	Neoteny: 0-2 weeks	The puppy is isolated from the outside world. It demands attention, cries, sucks, crawls, nestles towards a source of warmth.
	Transition phase: 2-3 weeks:	The eyes open, teeth appear. Non-reflex learning behaviour begins. The mother stops responding to the puppy's cries.
	Primary socialisation 3-8 weeks (until weaning):	The ears and eyes begin to function. It notices the presence of other animals. It begins to form a primary social relationship which will later become an attachment behaviour. It can eat solid food. Beginning of domination behaviour over food and of contest with others in the litter.
Phase 2	Early youth 8-16 weeks:	Beginning of the second phase of socialisation, attachment to other animals or species. Beginning of non-reflex attention behaviour such as submission behaviour. Period in which the guard dog socialises with the livestock. After 16 weeks, social attachment is
Phase 3	Secondary youth 4-5 months (end of puberty):	Social behaviour in the second stage must be reinforced. The puppies must be kept with the livestock all the time and they must be prevented from having too much contact with other dogs or with humans, unless the puppy is in the pasture with an adult guard dog which is playing the part of educator. Any flight behaviour or inattentiveness must be corrected immediately.
Loyalty behaviour		
Phase 4	Sub-adult 6-12 months:	The puppy displays a series of types of predation behaviour and of games, such as hunting movements, seizing and biting, pulling at the wool of ewes, chewing the ears of ewes. If the puppy is not immediately corrected, this behaviour will become frequent. Later it will be difficult to suppress it. If the dog is trained correctly, these types of behaviour will not appear any more in the dog's behaviour pattern. Females begin to come on heat, and this may lead to unexpected behaviour, such as flight or chewing the ears of ewes. Males may flee if a female in heat is nearby.
Protective Behaviour		
Phase 5	Adult: > 12 months	Caring behaviour, attention and sexual maturity appear: a dog which has been correctly socialised and not allowed to disturb the sheep should be an effective dog at this point. However, the first experiences of the dog with large predators must be followed. The dog still needs support to gain confidence in itself.

tory of a pack of wolves, however, may cover several herds and those which are not protected can then become a favourite target of the predators.

Fights between the dog and the predator are rare, because the first instinct of the predator is not to feed, but to avoid risky situations (Coppinger & Coppinger 1993). However, several livestock guard dogs were reported to have been killed by wolves in North America (E. Bangs & D. Pletscher pers. comm.).

Since instinct (behaviour that is not learned, but can be influenced) plays an important role, it is difficult to use other types of dogs to protect a herd. The Navarro Indians, however, have always used mongrels to protect their sheep from coyotes (Black 1981, Black & Grenn 1985). Dogs that work badly are systematically eliminated. Nevertheless, Coppinger and his colleagues (1985), Green & Woodruff (1990) think that races of guard dogs are nevertheless better adapted and much more efficient, especially against large predators.

2.3. Differences between guard dogs and herd dogs

The herd dog, contrary to the guard dog, does not live permanently with the livestock. It is used mainly to shepherd or assemble the animals and shows itself to be a valuable help for man.

There is a fundamental difference in the behaviour of puppies of the two groups. Guard dogs display behaviour involving social games (contests, hunting, submission-domination), but not predation behaviour. On the other hand, among herd dogs types of predation behaviour appear rapidly, such as fixation on an object (Fig. 3) or sibling followed by a predatory approach and sometimes by a pursuit (hunt) (Coppinger *et al*. 1987). Thus we get two groups of herd dog:

- herd dogs which encircle the livestock, such as the Border Collie;
- herd dogs which pincer the livestock, such as the Appenzell Bouvier.

Shepherds have therefore managed to select two types of dog (Annex 1):

- those which display incomplete predation behaviour (herd dogs);
- those which never show predation behaviour (guard dogs).

The herd dog behaves with livestock as though it were a question of prey**,** while the guard dog behaves with the livestock as if it concerned members of its own species (Clemence 1992).

A guard dog which is not loyal does not necessarily have predation behaviour, but it tends to play with the sheep as it would play with other dogs (Coppinger *et al.* 1987). If the sheep does not react or stops in its flight, the dog seeks another playmate or else the dog's play behaviour turns into an investi-

Figure 3: Border collie stalking a sheep while the St-Bernard remains neutral

gation of the sheep type of behaviour. Unfortunately, this type of game can sometimes end in the death of the sheep or lamb. Nevertheless, there are guard dogs which may hunt game or a neighbour's livestock. This type of dog may be the result of bad selection and should be systematically eliminated if the hunting instinct is too strong.

2.4. Present use of guard dogs in different countries

The guard dog is often used in pastoral regions when transhumance (summering in the mountains, wintering in the plains) is traditional. The use of milk-ewes enables the dogs to be fed with whey, by-product of the manufacture of cheese and source of protein (Breber 1977).

With the eradication of the wolf in many countries, the guard dog has also disappeared from many regions. It is still used in today in districts where there are wolves. Unfortunately, the tradition is also being lost in these areas. The dog is often replaced by poison and gun or used in an inadequate manner, as Bloch (1994) has shown in Slovakia (chained dog). Moreover, with modernisation many shepherds do not want to remain permanently in the mountains. Difficult living conditions and solitude often impel them to abandon sheep for a time to rejoin civilisation (F.P. Fonseca & C. Julot pers. comm.). Sometimes owners engage incompetent shepherds (V. Guberti &. L Boitani, pers. comm.) or send children to watch the herds. Their inexperience often leads to the loss of animals (F.P. Fonseca pers. comm.).

Spain
Dogs are used in the north-west (Castile y Leon, Galicia, Navarro) and in the Cantabrian mountains. Several dogs (3-8) accompany a shepherd who remains permanently with the sheep during the summer. The animals are penned for the night. The animals are often left alone with the dogs. In winter, the animals are brought in every evening. In the Cantabrigian mountains, several dogs accompany a herd of cows (20-30) which are left alone in the summer. The dogs feed from an automatic distributor which the shepherd comes to fill every week (V. Vignon pers. comm.)

France
Some farmers still work in the traditional manner in the Pyrenees with Pyrenean Mountain dog to protect sheep from bears and dogs. There is a project at present to restart traditional pastoralism.

According to various sources, stray dogs kill 100,000 domestic animals every year in France (Pitt 1988). In 1985, the ITOVIC (Institut technique de l'élevage ovin et caprin) and the departmental federations for sheep in the Rhône-Alpes region started a "guard dog" programme to help farmers to protect their sheep. One dog generally suffices to protect a herd. In 1989, the farmers who use guard dogs grouped together in an association: l'Association pour la Promotion des Animaux de Protection (J. Pitt pers. comm.). Since 1994, guard dogs have also been used in the Mercantour to protect herds against wolves.

Italy
The sheep economy is mainly based on the manufacture of cheeses. The sheep are milked in the morning, then led to pastures accompanied by several guard dogs (5-15) which form a pack, in which each individual has a precise function (P. Breber pers. comm.). The sheep are brought back in the evening for milking. Some dogs remain at the stables, others accompany the shepherd (Coppinger *et al.* 1983, Landry pers. obs.). In the evening, when the sheep are together, the dogs may leave the flock and go off to roam in bands. These dogs cause a lot of damage in neighbouring flocks (V. Guberti pers. comm.) The shepherds use different races of dogs or mongrels to protect their flocks (V. Guberti pers. comm.). The dogs, Maremma-Abruzzese shepherd dogs, are not always correctly socialised (Landry pers. obs.). These two problems partially explain the damage caused in flocks of sheep.

Coppinger and his colleagues (1983) observed that in some regions (Monti della Laga) the ewes fed in wooded areas, without shepherds, but under the surveillance of guard dogs. Nevertheless, the ewes were brought in every evening.

In the north of Italy, the milk-ewes were often replaced by ewes for meat which needed less attention. The farmers tend more or less to leave the sheep in alpine pasturage without surveillance (F. Francisci pers. comm.). The Bergamo shepherd dog was a race which was traditionally used for the protection of herds, but it seems that the use of the dog has become rare (F. Francisci pers. comm.). This dog was used in the Grisons to protect sheep from predators (Tschudi 1859).

Poland
The sheep (up to 500) are taken up to the mountain pasture from the end of April until the end of September and protected by guard dogs and shepherds. The sheep are brought together every evening in an enclosure that can be dismantled (flexinet) (Bloch 1994).

Slovakia
The sheep (milk-ewes) and goats which are taken to mountain pastures belong to several proprietors (50 or more) or to a cooperative, or sometimes to a single person. These proprietors rent the services of several shepherds to milk the ewes up to three times a day. The number of ewes to a flock varies from

250 to 400 (Coppinger & Coppinger 1994).

The dog is chained near the flocks. The shepherds have been persuaded that the animal will become more aggressive and therefore more effective. But as the dog remains chained all the time, it cannot work correctly (Coppinger & Coppinger 1994).

Rumania
In summer, the animals (milk-ewes or meat-ewes) are taken up to the mountain pasture and guarded by several shepherds and guard dogs. The number of dogs varies from five to 12, according to the size of the herd (100 to 500). The sheep are guarded the whole year and brought in every evening. The dogs are often not properly socialised with the sheep, but defend a territory. The dogs are said to tend to hunt game (C. Promberger pers. comm.).

Bosnia
The sheep spend the summer in the mountain pastures in company with shepherds and guard dogs. The sheep are brought in every evening for milking. The milk is used mainly for making cheese. The shepherds take pigs and chickens with them (A. Prêtre pers comm.).

Charplaninna (frontiers between Macedonia, Kosovo and Albania)
Dogs are used to protect sheep and cows against predators or to defend the inhabitants of this region against marauders. Shepherds traditionally put spiked iron collars on the dogs and protect their loins with a leather covering against bites and scratches from predators (Grignon 1992). The sheep spend the summer in the mountain pastures (Coppinger & Coppinger 1992). One or more shepherds always accompanies the flock (milk-ewes). In the evening, the dogs sleep among the sheep (Laurans 1975).

Bulgaria
The sheep are taken up to the mountain pasture for the summer season, but the use of guard dogs is no longer common. The shepherds who use them still have two to five, which remain permanently with the sheep. The latter are brought together every evening. The dogs protect the flocks against predators and livestock thieves (K.Georgiev pers. comm.).

Georgia (Caucasus)
The sheep are put to mountain pasture in summer, The flock (2000 head in this case) is divided into four groups of about 500 animals and every morning after milking a shepherd leaves with his flock, accompanied by one or two guard dogs. In the evening, the shepherds meet the sheep at the base camp to milk them and pass the night.

2.5. Ongoing projects in various countries

The natural return of the wolf or the risk of its extinction in numerous European regions, as well as its protection by different European conventions and directives, has compelled numerous scientists to seek solutions to protect livestock while at the same time preserving the predator. Many people are interested once again in the use of guard dogs. This forgotten European tradition was taken up by American biologists more than 20 years ago to protect flocks of sheep against coyotes. The ultimate paradox is that most European scientists are today asking advice from their overseas colleagues.
With the increase, the expansion or sometimes introduction and the protection of large carnivores in several countries of Europe, human interests like livestock, beehive, orchard, etc. need to be preserved from these intruders.

Several projects in Europe are dealing with this matter, but unfortunately often apart from any collaboration with other projects. It is the aim of the Large Carnivore Initiative for Europe (LCIE), "to maintain and restore, in coexistence with people, viable populations of large carnivores as an integral part of ecosystems and landscapes across Europe". Nowhere in Europe, large carnivores can live without confronting people and their livestock. For the survival of large predators in Europe, it is indispensable to solve the carnivore – livestock conflict. Therefore, a "Depredation Prevention" Newsletter could be a good opportunity to bring together all the effort on livestock damage prevention by creating an European network of exchange of information, knowledge and needs. (Annex 2). This newsletter aims to assist the development and spread of any ideas and concepts to mitigate the damage to livestock caused by predators. In this respect, it will not only inform about prevention measures strictly speaking, but also cover the discussion about compensation of losses or removal of predators.

3. Effectiveness of this preventive system

3.1. Problems and limitations of guard dog use

Effectiveness of dogs
The guard dog can be an effective means of protection, but never 100% (G. Bloch & J. Pitt pers. comm.). In the U.S., where losses due to predators (coyotes) are estimated at 10% (Coppinger & Coppinger 1982), predation on sheep flocks where guard dogs have been placed has diminished by 64 to 100% (Coppinger *et al.* 1988). Thanks to these same dogs, 82% of farmers made economies in comparison with the period when they used (or did not use) other means of protection (Grenn & Woodruff 1988). At present, many American farmers admit that without guard dogs they could not continue their

work (Coppinger & Coppinger 1993).

In France, guard dogs are a very effective means of protecting sheep herds from stray dogs (J. Pitt pers. comm.). Farmers and shepherds of the Mercantour region admit that since they had dogs, the number of sheep killed by wolves is acceptable, while their neighbours who do not have them often suffer heavy losses (L. & Ch. Vallet & E. Loret pers. comm.) The same observation has been made in the U.S. (Coppinger 1992b).

Problems linked to the dogs

The use of a guard dog is not easy, since it implies the socialisation of the puppy with the sheep and a careful follow-up is necessary during this socialisation phase to correct the dog. That requires a good knowledge of dog behaviour and a lot of availability and patience. In any case a year is necessary before knowing if the dog is going to work correctly (Coppinger 1992a). Moreover, it is important to follow up the dog in its second year to support and encourage it in its protective function, especially against large predators (Lorenz 1985). As a result, it is not possible to put such a dog in any hands (J. Pitt pers. comm.). The guard dog has a special behaviour, generally unknown to sheep herders. In actual fact, since it does not have to obey, this dog is able to live in the midst of ewes, without any contact with man. A relationship of trust must be established between the shepherd and his dog, and not one of power and submission such as characterises the relationship between the shepherd and his herd dog (Pitt 1988). On the other hand, once the dogs work in a herd, it is easier to introduce a puppy, which will be initiated by the adults (Vallet pers. comm.). The guard dog is not fully effective before it is one or two years old, depending on the race (Lorenz & Coppinger 1986, Pitt 1988, Coppinger 1992a).

The guard dog can sometimes prevent the herd dog from doing its work. In extreme cases, it is necessary to tie up the guard dog so that the herd dog can work correctly (J. Pitt pers. comm.). During the period of heat, the males tend to leave the herd. The females have the same tendency and they also let local dogs penetrate their surveillance territories. It is the period in which the dogs are least effective (Pitt 1988).

Against a predator such as the wolf, it is necessary to have several dogs, especially if the wolves attack in a pack. The presence of at least two dogs enables them to encourage each other mutually (Coppinger & Coppinger 1995) and to avoid the dog becoming bored and returning to the farm (Pitt 1988). The dogs may leave the herd to pursue the wolves which roam round it at night. (Landry pers. obs.) The sheep thus remain without surveillance for several minutes (sometimes more than 10 minutes Landry pers. obs.) and can then be attacked by other wolves (pack divided into two groups E. Loret pers. comm.). In Spain, it can happen that a dog which is pursuing a wolf gets killed, for the dog falls into a trap set by several wolves (M. Gallego pers. comm.). A six-month-old dog is said to have been killed by wolves in the Mercantour in the summer of 1996 (J. Pitt pers. comm.). It can happen that a person out walking may be "surprised" by a herd, or insist on passing through it despite the threats of the dog. In two specific cases (Poland and Mercantour), a dog bit a walker on the leg (G. Bloch & L. Vallet pers. comm.).

Lorenz and his colleagues (1986) noted that dogs died more easily in the mountain pastures (USA) and that half the deaths were due to "accidents" (dogs shot, poisoned, crushed by vehicles or disappearing) occurring particularly before the age of 30 months.

Limitations

A guard dog can only work correctly with animals which are more or less grouped together. As a result, only races of gregarious sheep can be effectively protected (Coppinger & Coppinger 1982). Races such as the "black-faced" or "Suffolk", which scatter over the whole pasture are not recommended, for the dog does not find the unity of the herd which is necessary for its good functioning.

Ideally the herd should be brought together every evening in an enclosure so that the dog can work effectively during the night. Nevertheless, if the animals group together themselves in the usual place for the night, it may also work.

In times of fog, surveillance of the herd should be reinforced by the presence of the shepherd. It would be preferable to bring the herd together to facilitate the work of the dog, whose senses are diminished by the fog.

It is difficult to bring together two herds under the guard of a single dog which has not been socialised with one of the two herds. The animals of the two herds do not mix and sometimes do not even graze in the same places (up to 1000 or 2000 m apart).

The presence of the shepherd on the pasture requires a minimum of infrastructures (cabin, water, provisioning, fire, access, etc.).

The use of guard dogs requires extra work from the farmer, a not negligible financial investment (purchase of dog, insurance, food, veterinary, infrastructures in the pasture, etc.) and demands time to put this system of prevention in place. Moreover, Coppinger (1992) recommends placing the dogs before the arrival of the predator.

3.2. Other means of prevention

Non-lethal methods

The donkey

Another method of protection mentioned by Pitt

Figure 4: Donkey in a flock of sheep

(1988), Raveneau & Daveze (1994) and Bourne (1994) is the donkey. At present, 78 races are recognised by the FAO (Food and Agriculture Organisation). The donkey is believed to have been domesticated more than 5000 years ago from a wild ass *Equus asinus nubicus*, which is still found today in the Sudan (Raveneau & Daveze 1994). Depending on the race and individual, weights can vary from 80 kg (dwarf races) to 480 kg (Baudet du Poitou) (Raveneau & Daveze 1994). In numerous engravings and pastoral stories, the donkey is found in the middle of the sheep (Pitt 1988). The donkey was, and is still, used in many mountain regions for the transport and provisioning of shepherds in summer (Pitt 1988). The donkey can today be an excellent guard (Fig. 4), able to give warning by loud and unusual braying at any problem or of an inopportune visit. Its aversion for canids seems to be used in many European countries. It is used to guard herds of sheep**,** goats and cows. Its presence is particularly effective against stray dogs and foxes (Pitt 1988, Raveneau & Daveze 1994). Female donkeys are also good guards, on condition that they are not pregnant, since they are at risk of aborting (Raveneau & Daveze 1994).

This method is currently used in Alberta (USA) against coyotes (Bourne 1994) and in Namibia against cheetah (L. Marker pers. comm.). Aubert (1989) of the Centre d'étude nationale vétérinaire et alimentaire (CNEVA) even recommends the use of donkeys in enzootic zones to protect sheep (which have not been vaccinated) against possible rabid foxes. Donkeys hate dogs, coyotes and foxes and are very aggressive towards them, and therefore provide protection to the livestock (Bourne 1994). They are sensitive to disturbance among the flock and intervene to chase the predator or intruder away (Bourne 1994).

Donkeys have excellent vision, acute hearing and a good sense of smell (Raveneau & Daveze 1994). They use these three senses to detect intruders. They bray, show their teeth, pursue and try to bite or rush at the dogs and coyotes (Bourne 1994). The braying of a donkey can be heard for several kilometres. The donkey brays to indicate some problem. Some castrated males, however, no longer bray (Raveneau & Daveze 1994).

Bourne (1994) reports that some donkeys also pursue deer, bears, foreign livestock, etc.

The donkey functions quite well with small herds which it can see at a single glance (Bourne 1994). The mere presence of an animal bigger than the sheep seems enough to make the coyotes, dogs and other predators avoid the place (Bourne 1994). It seems that the donkey functions better when it is alone in the herd, because it seeks contact with the sheep. If there are two they keep each other company and do not necessarily follow the herd.

The donkey also probably protects the herd indirectly. When danger is felt, the sheep group around the donkey instead of fleeing, thus creating a mass to face the predator, with a much bigger animal in the middle. A female donkey or a castrated male is recommended, since a stallion may be very aggressive and disturb the herd's tranquillity.

It is also possible to habituate the donkey to a livestock guard dog and to have them both guarding the flock.

Cattle

Pitt (1988) mentions the use of cattle to protect sheep herds. But there is little information on this subject. According to Pitt, it would seem that there are races of beef cattle which are used (Charolais, Limousin, etc.) and whose aptitude for defence is based more on the individual than on a particular race. Anderson and his colleagues (1988) observed that if a predator (in this case a Border Collie trained for this purpose) approached a mixed herd of sheep and cows, the sheep approached the cows to form a single group with them, as long as they were socially linked. If not, the animals fled to their own group. It seems that, in Rumania, bulls which graze with the cows and calves can sometimes protect the herd against bear attacks.

Llama

The llama has been used to protect sheep from small predators, such as the coyote. This type of protection remains rare and, as far as we know, has never been used to protect sheep from predation by the wolf. Linnel and colleagues (1996) cite the work of Franklin & Powell (1993) as one of the only complete studies on llamas used as herd guards. The authors of this research mention that losses caused by predation declined from an average of 11% (between 1972 and 1991) to an average of 7%, following the introduction of llamas into the herd. Most farmers (88%) declared themselves satisfied with their llamas. The authors of this study, however, remain sceptical about the effectiveness of the llamas. Moreover, Linnel and colleagues (1996) report that many llama farmers resort to guard dogs to protect their animals.

Electric fences

Electric fences are also used in Alberta to protect sheep from coyotes (Linhart *et al.* 1982, Rodtka & Bourne 1992, Acorn & Dorrance 1994).

For this system to be completely effective against the coyote, the fence must measure at least 1.68 m in height, with 12 electric wires starting very close to the ground and a little wider apart at the top (Linhart *et al*. 1982).

This system can only be used on a flat surface and it is costly. In Sweden, electric fences (1.20 m high, 5 wires) seem to be effective to protect herds of sheep against wolves (L. Berg pers. comm.)

Metal fences

In Spain, in the Sierra de la Culebra (Castille y Leon) region, sheep are grouped every evening in metal enclosures built from fitting sections. This type of enclosure measures about 1.70 m in height and consists of several horizontal metal bars spaced 15 cm apart (Landry pers. obs.). The same type of fence is used in the Valais, but only measures one metre in height. These two types of fence are heavy and often have to be transported by vehicle. In Spain, the sheep are left alone at night with guard dogs around.

Lighting appliances

Halogen lamps (flashes) are placed round the place where sheep are grazing (Fritts 1982). The method tested by Fritts (1982) did not prove conclusive. In general, this kind of prevention seems more effective on small open plots of land rather than in large wooded areas, since it is not possible to surround the livestock correctly.

Sound appliances

Some American rangers have used different sources of sound to frighten coyotes away. Even though this system may seem to prove effective, it seems that the coyotes get accustomed in the long run. The radios (or other apparatus) are placed at various places in the pen and remain switched on all night. The barking of big dogs can be recorded and played back automatic.

Repellent baits

Baits consisting of minced beef mixed with a solution of lithium chloride are hidden in carcasses of cattle and placed near areas occupied by cows. The idea is to make the wolves disgusted by beef and therefore by cows. The results, however, are not very conclusive (Fritts 1982).

Fladry

Another technique suggested by Landry to some farmers in the Valais is the “fladry”. To hunt (Carbyn 1977) or capture wolves (H. Okarma pers. comm.), this works well. Recent researches on captive wolves in the zoo of Rome have shown the possibility to bar their access to one part of the enclosure (M. Musiani pers. comm.). To begin with, the fladry is constructed with the help of a string which can measure several hundreds of metres to which red bands 10 cm wide and 40 to 50 cm long are attached every 35 to 40 cm. It is possible to surround a pack of wolves with the fladry. For some unknown reason, the wolves do not cross it. The Americans tried to use this technique to protect herds of cows during the 1980s, but the experiment was not conclusive (Fritts 1982). It seems that this system is more suitable for small open pieces of land. Fritts (1982) thinks it would be necessary to carry out complementary studies to judge the effectiveness of the system. As far as we know, it has never been used for sheep, but it could work (H. Okarma pers. comm.). Two farmers in the Valais tried this method in the spring of 1996 to protect sheep in his pen. But since

no attack was recorded, it is impossible to draw any conclusions.

Shepherd
One or more shepherds remain permanently with the herd in the mountain pasture. The herd must be brought together every evening to allow better protection against predators. The guard dog is generally an indispensable ally, since the shepherd alone cannot usually protect a herd efficiently against predators such as the wolf.

Reinforcement of game populations
To diminish the impact of the wolf on cattle, it should be possible to reintroduce or reinforce populations of wild ungulates. It is important, however, to reintroduce several species at a time on a large scale, so as to offer the best food choice to the wolf. Meriggi & Lovari (1996) showed that in Italy and in the Iberian peninsula, a number of species of wild ungulates present in a region seems to diminish the impact on cattle, while this is not the case when only one species is present.

According to Meriggi & Lovari 1996, wolves should theoretically choose domesticated ungulates for preference, because their distribution in the meadows is easy to predict, and their reconnaissance ability and capacity to flee are weak. The authors of this study put forward the hypothesis that the risk of being disturbed or of being killed by the shepherd or sheep farmer means that wild game remains more profitable since the carcase can be eaten entirely. In the Mercantour, however, the main pack ate as many wild as domestic animals, despite the presence of six wild ungulates (Poulle *et al.* 1997). Patalano and Lovari 1993 found similar results (four wild ungulates present).
In a hunting reserve of the Cantabrian mountains, altogether 46.6 red deer, 316.1 roe deer, 167.8 chamois and 85.3 wild boar were counted in 100 km^2 (Blanco *et al.* 1992). Despite the abundance of game, the losses caused by wolves on livestock which was not guarded remained high. The balance between the saving in energy that a prey may provide and the danger of capture (risk of being wounded) may be a factor in the choice of a prey species (Huggard 1993). It is clear that, for a wolf, a sheep is easier and less dangerous to take than a red deer. However, Smietana & Klimek (1993) attribute the small number of attacks in their study area (eastern Carpathians in Poland) to two factors: (1) the sheep are constantly watched by guard dogs and shepherds and (2) there is a high density of wild ungulates able to support a population of wolves. In this case, it is probable that the presence of a dog or several guard dogs makes the capture of a sheep more difficult and more risky.

Results obtained in the Mercantour in the years 1994 and 1995 clearly show that predation on livestock can be considerable, despite the abundant presence of wild ungulates in the vicinity. It is also probable that the accessibility of chamois and mouflons may be more complicated, while that of the sheep is easy. Wolves eat more cattle in summer than in autumn, and this leads to the supposition that predation on sheep is partly due to the abundance of sheep (Poulle *et al.*1997).

Lethal methods

Trapping
Specialists intervene at the latest 24 hours after the complaint by a farmer to identify the author of the attack. If the wolf is recognised as guilty, traps are placed in the surrounding area (up to 400 m) for 10 days to try to capture the wolf responsible and "euthanise" it (Fritts 1982). It seems that, in certain cases, trapping can help to reduce damage (Fritts 1982).

Poison
The use of strychnine to poison wolves in a livestock area (Alberta, Canada) to reduce damage caused by them has proved efficient (Bjorge & Gunson 1985). Vacant territories, however, are quickly colonised by other wolves and poison also kills other animals, such as the lynx (Bjorge & Gunson 1985). The 26 wolves killed in this experiment cost U$ 8,325 or U$ 320 per wolf.

In Australia, the use of poison 1080 (*Sodium fluoracetate*) placed in baits to "control" a population of stray dogs proved little conclusive. The effectiveness of poison fades quickly and baits are immediately dispersed by other predators (McIlory *et al.* 1986).
Toxic collars for livestock
A poisoned collar is placed round the sheep's neck. When the predator fixes its teeth in the collar it absorbs a fatal dose of poison (*Sodium fluoracetate*). This method may seem selective, but it does not spare scavengers. Moreover, the poison seems extremely dangerous (the amount of poison contained in a teaspoon can kill between 30 and 100 people) and contrary to what McIlory and his colleagues (1986) found in their study, the poison may persist a long time in the environment (Swart 1996).

3.3. Comparison between use of guard dogs and other preventive systems

The lethal methods cited above are contradictory to the Swiss federal ordinance on hunting and to the various European conventions and directives. These methods will not, therefore, be touched on in this chapter.

The guard dog remains an effective protection, which has been proved over the centuries. Compared with other systems of prevention, referred to in the preceding chapter, it remains one of the best solutions for protecting herds of sheep (Green 1990, Coppinger 1992a). In some conditions, the donkey could provide another interesting preventive system. Other protective methods do not seem to be suitable for the Swiss situation and their cost is often high (electric fences except for night enclosures). Their effectivness are not proved in a mountain pasture (lighting appliances) or sometimes the results achieved leave much to be desired (repellent baits), or else there is still have too little experience with them (fladry). Many of the preventive systems require the presence of man on the mountain pasture, either to switch on the radio or to change and check the batteries. Moreover, these systems should only be used as a complement to another more efficient means of protection (dog or donkey). These various methods, however, would be more easily usable in the valleys in spring or in autumn when the sheep are enclosed. As regards the llama, I remain sceptical, since a llama which tried to protect its young was killed in a zoo by an escaped wolf. In addition, it is not an animal originating in the Alps. The purchase price varies from SFr. 1,500 for a male to SFr. 2,500 for a female. Llamas have to be taken out every day in winter.

The donkey is much simpler to use than the dog and it has an adaptive ability (change of owner, climate, activity) definitely higher than the dog. Its upkeep does not need specific knowledge and its daily consumption is the same as that of four to five sheep (8 kg of hay or less, depending on the donkey's size). In winter (150 days), 1 tonne of hay and one tonne of straw must be reckoned. Its stall must measure about 10 m^2, as the donkey must be able to roll on the ground (Pitt 1988). Donkeys readily eat the leavings of sheep in pens.

An interesting argument in favour of the donkey is that it can be given a pack-saddle and thus used for transport to the mountain pasture (stakes, salt, food, etc.). A donkey can live up to 30-35 years (Raveneau & Daveze 1994) compared with 10-12 years for a dog (Lorenz & Coppinger 1986). A sheep farmer, however, can maintain a small breeding unit and always have dogs at his disposal.

Several farmers in the Valais (Switzerland) have bought donkeys to place in their herds. The purchase price varies from SFr. 900 to SFr. 1,500. The introduction of a donkey in the herd has not posed major problems. About a week was needed for the sheep to become accustomed to its presence. It seems that a donkey can be introduced into a herd at any age, unlike the dog. It is advisable, however, to introduce the donkey into the herd while it is very young to get the best results. In the stable, the donkey is placed in a stall near the sheep, especially during lambing. In fact, the farmers are afraid that a donkey might inadvertently crush a lamb. The presence of a donkey in the pen (in spring and autumn) seems to reassure the sheep (they are less nervous) and at night it sleeps with the sheep. One of them even acquired the custom of assembling the sheep every evening. It seems that the donkey is very attentive at night. At the least suspicious sound or smell, it starts to bray. Its voice can be so loud that it can be heard several kilometres away, hence perhaps there are some future problems with the neighbours. The donkeys have shown themselves very discouraging towards dogs which roam around the pen (tourists' dogs). The donkey is able to sense dogs from very far and thus warns the sheep, which are not surprised by the sudden appearance of a canid. In the mountain pasture, sheep have the time to move to avoid contact with the dog. The donkey is able to run off and at the same time kick with one or both of its hind legs, then turn quickly and rush at the dog with its head lowered, ears flattened on its nape (Landry pers. obs.). Moreover, a German shepherd dog was killed by a donkey in a mountain pasture when it was harassing the sheep. The donkey's aversion for canids is such that it has to be taken separately (cattle truck) to the mountain pasture, since it impedes the work of the herd dogs during the journey by running after them. It seems, however, that it is possible to habituate the donkey to the herd dog or to another type of dog (guard dog).

In the mountain pasture, the donkey stays with the sheep, but it is still too early to know if it is capable of following them everywhere. In general, the donkey always stays near the herd. But if the herd divides into several groups, the donkey may visit them each day one after the other, and this can diminish its effectiveness, depending on the distance separating the groups. The presence of other equids nearby may incite the donkey to take off and it may attack them, especially the stallion,. Several farmers have kept the donkey "lower down" for fear it might fall from rocks. One of the farmers, however, was surprised by the agility and intelligence of his donkey, which went up to the top of the mountain pasture with the sheep and came down, apparently without a problem. This same farmer had some difficulties with tourists who took to feeding the donkey and taking it away from its work. On the other hand, another donkey tended instead to rush at people who approached the enclosure.

All the farmers noted aggressiveness by the donkeys in autumn. They tend to pull the wool from the backs of the ewes and to lift up lambs weighing up to 40 kg and walk around with them. One of the farmers had to remove his donkey which was preventing a ram from mounting the sheep.

A donkey stallion is much more aggressive than a female or a castrated male. All the donkey breeders

advised against buying such an animal to guard a flock.

It is still too early to draw conclusions about the use of the donkey as a guard animal in the Alps. But, from the first results, it appears to be the ideal solution to protect sheep in an enclosure. Moreover the presence of a donkey in a pen is more reassuring than that of a large dog, which may frighten people. In addition, it is not necessary to go every day to feed the donkey, unlike the dog. On the other hand, it seems that the donkey can only be used in small herds (up to 200-250) in mountain pastures, and its effectiveness against wolves is not yet known. Dogs remain the only preventive system valid for large herds. The donkey could typically be the solution for protecting small herds of black-faced sheep in the Haut Valais (Switzerland).

4. The use of guard dogs in Switzerland

4.1. Preliminary conditions for the introduction of guard dogs in Switzerland

The use of dogs is not always compatible with different systems of farming used at present in Switzerland. For example, in the Valais, many farmers are "agricultural farmers" who have to reduce their time with the sheep as much as possible to make their activity profitable, since they have other work (hay, second crop, spreading manure, cleaning the ground, wood, etc.). Other farmers also need a subsidiary activity, such as mountain guide, labourer, etc., to live and remain in the mountains, so that they are not able to remain permanently with their herd. The Tessin, the Valais and the Grisons have the most alpine pastures reserved for sheep and goats. The animals are put for summering for about 100 days a year. (Werthemann & Imboden 1982). The sheep graze freely without guarding. Surveillance is limited to one or two visits a week or one visit daily if a shepherd is present. But in no case are sheep assembled at night. Summer is also the period in which the most attacks on sheep have been recorded in several European countries (Kaczensky 1996). It is clear that Swiss farming is not suited to the presence of a large predator and that it is necessary to find protective means adapted to the Swiss situation.

The ideal conditions for the use of dogs are the following:

- assembling the herd every evening or owning sheep which group on their own for the night;
- owning a herd of gregarious sheep, so that the sheep can be more easily "groupable" in the evening or in bad weather,
- owning a mountain pasture which includes several places where the sheep can be assembled or assemble themselves for the night;
- the presence of a shepherd;
- owning enough sheep to pay for the services of a shepherd;
- owning a herd of at least 20 sheep;
- putting bells on several sheep to help the dog find them more easily in case of problems;
- working in a mountain pasture which allows the sheep to remain in a group. In some hilly sectors, the sheep must have more freedom so as to exploit the grass better and avoid rock falls (F. Volluz pers. comm.);
- the presence of a cabin on the pasture or nearby to accommodate the shepherd;
- a follow-up programme put in place to advise and help farmers who adopt the solution of a guard dog or of a donkey to protect their herds;
- the setting up of a research programme to adapt the protective methods to Swiss farming or to try to adapt some farming to the constraints of the presence of large predators;
- the establishment of an effective system of verification and indemnity for damage;
- the setting up of information for tourists.

In some cases, it will be possible to modify the type of farming to adapt it to the requirements linked to the use of guard dogs. In other cases, that will certainly not be possible. Solutions must be found (such as the use of the donkey) to protect sheep as an alternative to radically modifying the farming system (promoting milk-ewes, for example) or seeing farming ventures disappear. Many farmers can never pay for the services of a shepherd. As a result, it is essential to try to find other solutions (for example, leaving the dog alone with the ewes, as in France and in the U.S.). Since research in the field of protection has only just begun, it is probable that other means of protection will be available in the near future. Nevertheless, if conditions are observed, the guard dog could be used in Switzerland to protect sheep, goats and calves (Hérens race, for example).

4.2. Limitations on the use of guard dogs in Switzerland

Type of mountain pasture

In order for the guard dog to be really efficient, it is necessary for the sheep to remain more or less grouped together in the pasture, for a stray dog can attack the herd at any moment of the day. Wolves attack the animals particularly at night and in fog or rain. The configuration of the pastures does not always allow the sheep to remain together. Sometimes it is difficult to keep all the sheep in the same place, for they seek out the grass and can thus cover long distances without stopping (F. Volluz pers. comm.) The remoteness and sometimes difficult accessibility of the pasture do not allow the farmers to go there

every day, whence the desirable presence of a shepherd or of dogs which remain alone with the sheep. To finance a shepherd, it is necessary to own a herd of at least 500-600 sheep. Many mountain pastures do not allow such a number, otherwise they would be over-exploited (F. Volluz pers. comm.).

Type of farming
The guard dog cannot function with any race of sheep. It is illusory to want to use this type of dog with a non-gregarious race such as the "black face" or the Suffolk, which scatter over the pasture in small groups.

Other types of farming bring together several herds under the care of a shepherd (Grisons). In this particular case, the use of a guard dog (or of a donkey) can prove problematical, for it will not necessarily have been socialised with all the sheep and they may be frightened by the dog. Coppinger (1991), however, thinks that a dog socialised with one herd may accept another, for the dog seeks social contact with the sheep. The problem is that sheep coming from different stables only mix with difficulty in the pasture, and this gave rise to several herds. In this context, the ideal would be to own several dogs, but the dogs must be accustomed to the sheep (L. Coppinger 1991, R. Coppinger 1991).

Number of sheep
Dogs do not always work correctly with small flocks (<20). Bigger herds seem to suit guard dogs better (Coppinger 1990).

Climatic conditions
Frequent fog in some regions of the Alps poses a problem in bringing and keeping a herd together, since it is impossible to find the animals. Moreover, the shepherd may get lost or fall from rocks while trying to find the animals, because of the sometimes very restricted visibility.

In the Alps, the sheep must be brought in for the winter (about five months). Guard dogs have to remain with the animals in the stables, which are often near habitation. In this context there may be problems with the neighbourhood. Many people are not ready to accept the presence of big dogs, which often bark during the night or wander round the stable or in the village, as was usual and normal in the past.

Tourism
A herd with a dog in a tourist region can sometimes pose problems. The dog guarding a herd may frighten tourists by its barking and its "threatening" behaviour. The dog may also attack dogs which are not on a leash. In other cases, tourists may negatively influence a young docile dog by giving it food. Nevertheless, an adult dog that has been correctly socialised never leaves the herd (R. & L. Coppinger pers. comm.).

Follow-up of dog use
The socialisation of the dog with the herd of sheep requires the collaboration of a specialist who can help and guide the farmer in this task, for he does not always understand the basic behaviour of the dog (Coppinger *et al.* 1988). The setbacks in socialisation are more frequent among novice farmers than among their colleagues who have more experience with guard dogs (Coppinger 1992).

4.3. Necessary infrastructures and financial implications for the use of guard dog

Shepherd
A shepherd is paid at least about SFr. 1,700 net a month, board, laundry and lodging included. With social charges, the employer has to pay out about SFr. 2,600 a month, that is, about SFr. 10,000 for the summering period. To make it worthwhile, the farmer must own at least 500-600 sheep (F. Volluz pers. comm.)

Cabin
The permanent presence of a shepherd in the mountain pasture requires the existence of a cabin insulated against cold and water-tight, where he can sleep and cook. A solar panel will provide electricity. The Mercantour National Park (France) has installed cabins 8m^2, provided with solar panels, which cost FF 35,000 each. Unfortunately these cabins appear not always to be water-tight and insulated. Moreover, it is not always possible to make a fire and cook.

Transport
Food for the shepherd and dog has to be brought up to the cabin by car and on foot or by helicopter (SFr. 200 for a trip by Air Glacier, if the helicopter is already in that area or SFr. 34.50/min).

Upkeep of the dog
The upkeep of a dog amounts to SFr. 50 to SFr. 100 a month (food, veterinary expenses, tax). The purchase of a dog in France costs between SFr. 450 and SFr. 650 (for a dog without pedigree). In summer, the dog can certainly remain outside in all weathers. In winter, it can be put in the stable with the sheep.

The food can be composed of croquettes, rice, maize flour, oats, etc. In certain countries, supplies of dead sheep and lambs often complete its diet (Pitt 1988, Landry, pers. obs.), but it is not recommended. The daily consumption of a Pyrenean Patou is about 800 g. (600 to 1,000g.). A puppy has supplementary needs during growth (1000 to 1600 g. a day).

Follow-up programme

The choice of puppies is very important for obtaining good guard dogs. That requires selection and follow-up of the puppies, as at present in France.

The sheep farmers who own guard dogs can arrange for the female to breed and can sell the puppies. Each puppy sold should be registered so as to follow up and manage selection. Any dog with a problem (dysplasia, aggressiveness, inattentiveness to the herd, etc.) should be removed from the selection so as to avoid future problems in the pasture.

4.4. Possibility of using working dogs of Swiss race as guard dogs

Switzerland has four races of working dog which are still functioning among Swiss farmers. Formerly these different races were used in farms and their morphology might vary according to the cross-breeding practised. Peasants sought above all to "select" behaviour suitable to the dog's function:

- The two smaller dogs, the Appenzell bouvier and the Entlebuch Bouvier were mainly used to herd cattle. The colour of the coat or the standard was not important, as long as the dog worked correctly (H. Räber pers. comm.)
- The two bigger dogs, the Bernese Bouvier and the Swiss Grand Bouvier, were used more to guard the herd or the farm. The Swiss Grand Bouvier was mainly known to butchers who toured the countryside to buy cattle. The dog's function was to guard the herd against predators and cattle thieves. The Bernese Bouvier guarded herds in the fields or drew milk-carts (Bärtschi & Spengler 1992). Once again, the coat colour and standard did not matter, as long as the dog won the trust to be left alone with the herd.

To safeguard these types of dog, Professor Heim fixed different standards for each race at the beginning of the century. The name of each race was chosen according to its provenance. The dogs of today are different from their ancestors. Selection has, for example, shortened the muzzle of the Bernese Bouvier in the space of 30 years (M. Nussbaumer pers. comm.).

These different races, however, are still used on farms as working dogs. As a result, these dogs have perhaps not lost their original behaviour, i.e. herding flocks for some, and guarding flocks or farms for others. If my hypothesis is correct, it should be possible to use the Bernese Bouvier and the Swiss Grand Bouvier as guard dogs (with which they had a common origin). It would be enough to select a working dog that shows the best disposition towards the protection of the herd. The basic behaviour of guard dogs is well known (Coppinger *et al.* 1985, Coppinger & Coppinger 1993, Coppinger & Schneider 1995) at could easily be compared to those of our two Swiss races of dog, to learn whether they could or not be used as guard dogs.

Another Swiss race of dog, related to the Pyrenean mountain dog and the Leonberg (Guardamagna 1995), could also be used as a guard dog. That is the St. Bernard (Fig. 5). But there is nothing in the literature about the use of this dog as a guard dog. However, an engraving by F.N. König (1765 – 1832, Kunstmuseum, Berne) shows a herd of sheep attacked by a bearded vulture and defended by a shepherd and a large dog, which oddly resembles the St. Bernard. I compared this dog with old engravings of the St Bernard in the possession of the Museum of Natural History in Berne and the dog corresponds exactly to those owned by the hospice at the same period. Marquis (1988) notes that the St. Bernard was used in the Middle Ages as a guard dog in the cantons of Valais, Vaud, and the Bernese Oberland. Moreover, according to Schmutz & Schmutz (1971) and Morsiani (1993), the primary function of the St. Bernards kept at the hospice of the same name was to guard the buildings and protect the monks when they travelled in the mountains. The modern selection of St. Bernards has made it compltely different from the famous Barry shown at the Natural History Museum in Berne, both on the morphological and craniometric level (M. Nussbaumer pers. comm.). However, if the St. Bernard has preserved its original protective behaviour, it would be possible by selection to make it a Swiss guard dog. What a symbol for the Great St. Bernard region! Besides, one St Bernard has been used in Poland and another in the U.S. as a guard dog (V. Smietana & R. Coppinger pers. comm.).

I am aware that such selections require time and it will be necessary at first to use guard dogs which have already been proven from other countries to protect Swiss herds in these coming years. But we are convinced that a Swiss race of guard dogs would be better accepted by the farmers of some regions of the Alps and Pre-Alps. It is also possible that a dog from our country would be tolerated better by the neighbourhood and tourists.

5. Conclusion

The type of farming practised in Switzerland is no longer adapted to the presence of a big predator such as the wolf. Traditional methods of guarding, which were valid over the centuries, no longer necessarily suit our time. The challenge of these coming years will be to adapt or find methods of protection suited to our socio-economic reality. It will also be necessary to make modifications, sometimes radical, to our farming system. Nevertheless, this challenge cannot be taken up without the collaboration of

Figure 5: St-Bernard guarding a flock in the canton of Valais

farmers and shepherds.

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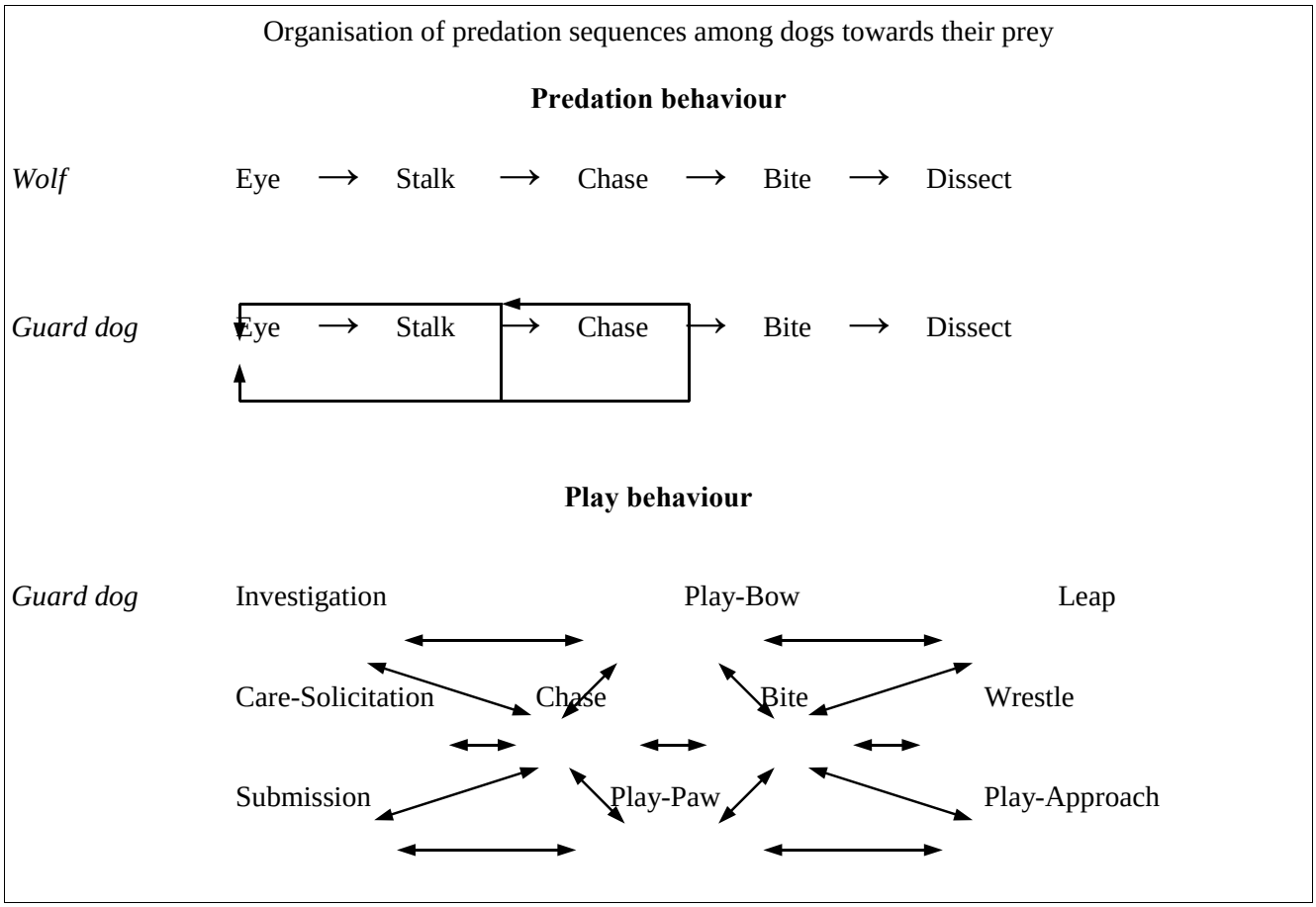
7. Annexes

Annex 1. Schematic representation of elements in the behaviour of three groups of canids. The absence of the predation sequence in guard dogs is the reason why it can be left alone with the sheep (adapted from J. Glendinning, 1982, *in* Coppinger 1992).

Explanation: Play-Bow: the dogs lies down, keeping its hindquarters raised and wags its tail often.
Play-Paw: the dog taps the ground with its fore-paws.



Annexe 2

Proposal for a Depredation Prevention Newsletter in the frame of the LCIE

Proposal

1. Objective: Publish a newsletter to improve the exchange of information between people working on depredation prevention projects.

2. Target publics are (1) individuals doing research in depredation prevention (these people are at the same time the contributors of articles and information and will get the Newsletter for free), (2) anybody who is using or is interested in damage prevention, and (3) the interested public.

3. The Newsletter will contain (1) original articles by people working on prevention measures, (2) news, (3) information about publications and reports, (4) an updated list of addresses of people involved in prevention projects.

4. The geographical distribution of the newsletter will be mainly the LCIE area. Subscribers from other countries are welcome, but not actively searched in a first step.

5. The newsletter will be published two to three times a year. Ways of distribution are (1) hard copy via mail, (3) digital version via eMail to individuals, (3) via internet (homepage of the LCIE). Electronic distribution will be favoured wherever possible.

6. The newsletter will be published in English. Each local group is welcome to translate it (partially) into other languages and to make practical use of any information.

7. J.-M. Landry and C. Angst (both KORA) will collect and edit the articles for the Newsletter; John Linnell (NINA) will be asked to edit the English.

8. The format of the Newsletter will be A4 (A3 folded), either 8 or 12 pages per issue (see KORA Info). The Newsletter will be prepared by KORA using Microsoft Publisher.

9. A test issue ("No. 0") will be prepared for the next LCIE meeting in summer 1999. There, it will be distributed to all participants for comments and subscription.

If your are interested to receive the newsletter, please write, fax or e-mailed your address to

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Published KORA Reports:

KORA Bericht Nr. 1, Landry, J.M., 1997. La bête du Val Ferret.

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