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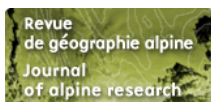
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Introduction

- 1 In the French Alps and Provence, a recent and innovative practice is the combination of fences and guard dogs alone to ensure protection against wolf for livestock being grazed in fenced pastures. This practice has been little studied compared to the situation with animals being herded by a constantly present shepherd (De Roince, 2016). The practical modalities to ensure its effective implementation raise several questions. The stakes are high, given the amount of losses from wolf depredation on livestock, which in France has shown a linear increase (+ 1000 killed animals per year, all species considered) between 2009 and 2019 (Meuret *et al.*, 2020), with a total of 12,451 livestock killed in 2019, 90% of which were in the Alps and Provence (Dreal AURA, 2020). Sheep farming is particularly affected, accounting each year for 90% of the total losses in France.

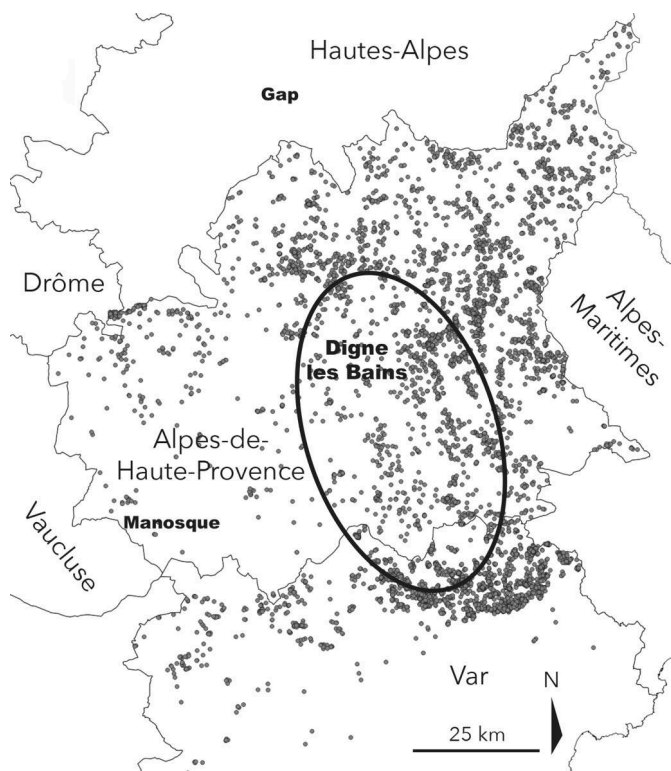
- 2 Wolves came back to France from Northern Italy in the early 1990s and first settled in the very south-eastern and alpine corner of the country. Up there, the large collective sheep flocks, herded during summer by shepherds on high-mountain pastures, i.e. wide unfenced areas, were the first to be affected by wolf predation (Vincent, 2011). As a consequence, starting in 1997, a series of national management plans and their sets of protective means aiming at limiting predation (Meuret *et al.*, 2017, 2020), first focused on summer high-mountain pastures and large collective sheep flocks. They have encouraged the implementation of three protection means: systematic grouping of livestock in electrified night pens, supplementary human presence day and night, and guard dogs.
- 3 Thus, since the end of the 1990s, livestock guard dogs (LGDs) have become widely used in the Alps. The use of such dogs against wolves is not a new practice. It is attested in Aristotle's History of Animals, written between 347 and 342 BCE. These dogs have continuously been used in several parts of the world where, faced with wolves and other predators, herds or flocks are herded and constantly watched over at pasture by cowherders or shepherds, especially in the mountains and steppes of Eurasia (Linnell and Lescureux, 2015).
- 4 Due to the demographic and spatial expansion of wolves in France (OFB, 2020), other types of livestock than those under constant herding have faced wolf predation. In most of them, farmers or shepherds are no longer permanently present with their animals. Above all, the flocks are often divided into several batches of animals, grazed simultaneously in distinct fenced pastures, all far from any human presence for their supervision during the day or night. Grazing in fenced pastures is a practice that has become commonplace over the past half century in the Alpine valleys, but also elsewhere in Europe, allowing farmers to avoid having to recruit shepherds and to pay their salary (Legeard *et al.*, 2010).
- 5 The use of LGDs to protect animals grazed in fenced pastures has thus gradually developed in the Alps and in Provence and represents a novel condition. Indeed, the working conditions of LGDs are very different here from those where they are constantly associated with a herder or shepherd. They are also very different from those of countries such as Australia, Southern Africa or United States, that have acquired the experience of using LGDs to protect herds and flocks at pasture against wild predators (Smith *et al.*, 2000; Urbigkit and Urbigkit, 2010; Van Bommel and Johnson, 2012). In these countries, livestock and their LGDs are grazed in wide pastures, several hundred or sometimes thousands of hectares in the case of Australia, and they rarely come into contact with humans other than those they already know well: breeder, rancher, or usual herder. The situation is vastly different in a small country like France, densely populated and urbanized, with much smaller pastures and, most of all, numerous humans (hikers, bikers, hunters...) using the same landscapes made of mosaics of private and public lands.
- 6 The implementation of this innovative practice raises three questions: how many guard dogs are to be used for each batch of livestock and fenced pasture; how to organize the complementarity of the dogs within their group; what is the area to be protected by the dogs in the case of fenced pastures of limited surface? These practical questions refer to two major concerns: how to ensure better efficiency of the practice to protect the flocks; how to sustain grazing in multi-use countryside areas when livestock is protected against predators?

- 7 Breeders from the Southern Alps have acquired empirical experience with the use of LGDs over ten to twenty years. We therefore sought to mobilize their knowledge to inform the three questions, in addition to knowledge sources from international scientific literature, expert reports requested by public policy about wolves and livestock breeding, but also current administrative and legal texts in France. Our objective is to try to contribute to improving the efficiency of the practice and, above all, to better anticipate its limits and new constraints, in order to promote the sustainability of pasture-based livestock farming in regions where wolves are permanently or occasionally present.
- 8 After presenting our material and methods, we recall the work expected from LGDs. We then present our results, focusing first on the three major issues for improving the efficiency of LGDs, and then on the constraints resulting from possible conflicting interactions between LGDs and the other land users.

Material and methods

- 9 We mobilized four sources of knowledge. First, the scientific literature, where the topic of LGD use against wild predators (all species) includes more than 500 references in English or French. When restricted to grazing conditions in fenced pastures, the number of references decreases to about 200, this considering the fact that, in countries that do not use or no longer use herders or shepherds to herd the animals along the day, grazing always and implicitly takes place behind fences (Provenza and Meuret, 2014). Our second source was public policy documents: the French national Wolf and Livestock management plan (MTES and MAA, 2018), its regulatory declinations and its preliminary expert reports. The third source was technical support documents for livestock farming in France, including those from the French livestock institute (Ducieux, 2018) and the Alpine pastoral advisory services (Candy *et al.*, 2019). Finally, the fourth and last source was our interviews conducted on their farms with experienced sheep breeders.
- 10 For our interviews with breeders, we defined an area in the two administrative French departments of the Alpes de Haute-Provence and the north of the Var (Figure 1), where there had been abundant and repeated wolf attacks on sheep flocks over at least 9 years, including outside the summer season in high mountains. The farmers had acquired experience there, having adopted the recommended means of protection, including LGDs. The first seven farmers to be interviewed were recommended to us by the Centre d'Études et de Réalisations Pastorales Alpes-Méditerranée (CERPAM), as its pastoral engineers have acquired 10 to 20 years of experience with the topic. These breeders suggested that we contact some other of their colleagues in order to cross a diversity of conditions and experiences. In total, we conducted 15 individual interviews (sociological method of the comprehensive interview), of about 3 hours duration each, entirely recorded. We carried out a thematic analysis of each interview, from our notes taken during the interviews and the partial transcriptions of the records.

Fig. 1 – Interview area (ellipse) in the Alpes de Haute-Provence and the north of the Var



The points represent the locations of wolf attacks and their confirmed losses in flocks, accumulated from 2010 to 2018 in these two administrative departments.

Source: GéoLoup national database - INRA-Selmet and Dreal Auvergne-Rhône-Alpes agreement, March 2019. Realization : B. Potet, C.H. Moulin, M. Meuret.

Livestock guard dogs: what kind of work being expected?

- 11 Historically, LGDs, of which there are now several dozen breeds worldwide, always have been an integral part of livestock grazing systems (Coppinger and Coppinger, 2005; Lescureux and Linnell, 2014). In systems with constant herding, shepherds or herders remain permanently present with their animals: herded livestock, horses or donkeys for carrying equipment, and dogs. Each evening, they group them in fixed or mobile pens, in an area located in the immediate vicinity of where humans will spend the night. Their LGDs have a scouting and interposition function against predators, but they also have a function of alerting humans (Andelt, 1992; Stone *et al.*, 2016). The ability of breeders and herders to actively defend livestock against wild predators by various means, including lethal ones (traps, spears, rifles ...), to chase and eliminate those who are too insistent, as well as to maintain in all of them the fear of humans, has always been part of pastoral systems around the world (Linnell and Lescureux, 2015; Lescureux *et al.*, 2018).
- 12 Yet, nowadays in France, LGDs are also responsible for protecting livestock grazed within fenced pasture, in farms where the land is fragmented, and the different plots of pasture are often located far from the farm or the village (Charbonnier, 2012). There are then no responsible humans to warn, within range of barking dogs, knowing how to

interpret it, and in turn, both able and legally authorized to actively repel the predator(s). Under these conditions, it is therefore expected that LGDs, alone, will deter predators from approaching and attacking the herds.

The three questions to better consider

How many guard dogs per herd?

- 13 The earliest known recommendations about guard dog numbers per flock or herd come from Varro's *Rerum rusticarum libri III*, written in 37-26 BCE (Linnell and Lescureux, 2015):

The number of dogs is usually determined by the size of the flock. It is thought to be about right for one dog to follow each shepherd, but the number varies according to circumstances. Thus, in countries where wild beasts are plentiful, there should be more, as is usually the case with those who escort the flocks to summer and winter pastures through remote woodland trails. On the other hand, for a flock grazing near a farm, two dogs are sufficient. They should be a male and a female, for in this case they are more watchful, as one makes the other keener, and if one of the two is sick that the flock may not be left without a dog.

- 14 Current public policy recommendations in France are less explicit. In the current technical instruction (MAA, 2019), the word “dog” dominates in the singular form and when referring to acquisition costs, those related to maintenance and health, but also for everything related to the dog's behaviour, to be evaluated by an authorized tester, including for “its potential aggressiveness towards humans.” The plural form is used for what concerns the ceilings of compensable expenses for the breeders, with reference to those who use several pastures simultaneously, or a combination of fenced pastures and herding with a shepherd, or also for the grouping of flocks and their respective LGDs during summer in high mountains. In these recommendations, guard dogs appear as cumulative entities, for which it is a question of ensuring the appropriate behaviour of each one, but without consideration of the effects related to their social group.
- 15 The preliminary investigation for the current Wolf Plan in France (de Roince, 2016) is primarily written in terms of prevailing ratios: one guard dog per 200 sheep on high mountain pastures and one dog per 100 sheep elsewhere, figures similar to those found for other countries by Reinhardt *et al.* (2012), e.g., one guard dog per 100 sheep in Sweden. This ratio approach would lead to using 8 or 10 LGDs with, respectively and for example, 1,500 or 2,000 sheep in a collective flock during summer on high mountain pastures. However, Duriez *et al.* (2010) noted that “the experience accumulated at this stage does not seem to have made it possible to define the specific criteria for determining the adequate number of guard dogs [per flock] with regard to the various environmental conditions and predation risks encountered.” Rossi *et al.* (2012) also pointed out that it is above all a question of adjusting the number of guard dogs according to local conditions: the nature of the land to be protected, herding methods, predation pressure and history, the number of wolves hunting in groups or not, etc. Landry *et al.* (2020) recommended a number of LGDs equal to or greater than 6 per flock on Southern Alps' high mountain pastures during summer.
- 16 In all conditions, and particularly in fenced pastures, the recommendation of a minimum of two guard dogs per batch of animals to protect, including batches of

limited size, is becoming widespread among advisors in France and Switzerland (see in particular: Lüthi *et al.*, 2005; Garde, 2012; Mauriès, 2015; Candy *et al.* 2019). The breeders we interviewed unanimously stated: “There should always be a pair of guard dogs per pasture, one that will stay inside the flock, that will tighten the sheep, and the other that will go into contact with the predator, wolf, wild boar, human or dog” (Breeder 11). But it is above all the risk of being confronted with more than one wolf at a time that motivates the breeders: “A dog, if there is only one wolf, it can do it, perhaps. But as soon as there are two wolves, it's no longer feasible, because one [of the wolves] will attract [the dog] and the other will attack” (Breeder 9). In this regard, Ducreux *et al.* (2018) recommend “(...) having as many effective guard dogs as adult wolves present during an approach and possible attack.” Candy *et al.* (2019) confirm, but they pointed out several other factors to consider: “the surface occupied by the grazing flock (defining the total area to be defended), the vulnerability of the terrain (and the ease of approach by wolves), the intensity of the threat (depending on the number of wolves to be faced), (...)”

How to recognize and facilitate collective work within a guard dogs' group?

- 17 Most scientists and field experts recognize the relevance for a breeder to form a group of guard dogs (the notion of group already applying to a duo), sometimes called a “team”, “crew”, or “pack”, having social coherence and a hierarchical structure to be kept as stable as possible (Coppinger and Coppinger, 2005; Iliopoulos *et al.*, 2009; Urbigkit and Urbigkit, 2010; Van Bommel and Johnson, 2012; Allen *et al.*, 2016; Herrera *et al.*, 2017; Ribeiro *et al.*, 2017; Candy *et al.*, 2019). Let us emphasize here what scientists and breeders we interviewed have identified: a social organization and mutual support established within the groups of guard dogs, which must be anticipated and encouraged.
- 18 Breeders go beyond identifying individual temperaments in dogs and differences in their daily movement patterns, as noted by scientists. They identify complementary roles held by guard dogs within groups, which they interpret according to breed, sex, age, work experience, inter-individual affinity and character. According to them, there are “watchers” (or sentinels), “scouts” (or patrollers), and also “chasers” (or land cleaners): “Those who are a little more fearful or reserved are often those who stay a little closer to the sheep. And the ones that are confident are the ones that go out and clean up the terrain a little bit. And so, in a pack [of dogs], it's interesting to have those complementarities.” (Breeder 8).
- 19 The collective organization of the protection by several guard dogs holding distinct roles within their group raises questions for breeders who manage their flock with several batches of animals distributed in distinct fenced pastures. How to avoid the situation where dogs, when reassigned individually due to a reorganization of animal batches at the farm during the year (e.g., when part of the flock is put out of the shed for the first time to pasture in the early spring), have to reconsider their affinities, reorganize their hierarchy and complementarities of roles for guarding, with a probable loss of efficiency, even if only temporarily? How to avoid generating strong tensions within a stabilized social group, following the introduction of a new dog,

certified by an appointed dog tester, but whose efficiency at work would still have to be evaluated in a real environment and under collective working conditions?

- 20 Under the conditions discussed here, each breeder must first program his guard dogs' group(s), followed by a few regulations as needed (choice of mating for reproduction, temporary rest, removal of a disruptive individual, or definitive culling), rather than steering each of the dogs during the day as shepherds do with their herding dogs.
- 21 Guard dogs are educated but not trained: "They are autonomous, they manage things themselves" (Breeder 9). However, several breeders told us that they had to behave as a "pack leader" towards their LGDs, i.e. to succeed in maintaining a necessary and unquestionable authority over them. This is true even in the case of grazing in fenced pastures, where neither the herder nor the shepherd is permanently present and likely to call to order any distracted or absentee dog. Here, once the puppy's education phase is over, the breeder will briefly remind the dogs of his dominant role each evening, when he will distribute the dog's food and will then allow his dogs to swallow their meals on command.

How much space should dogs protect in the case of grazing in fenced pastures?

In the world but also at the scale the French Alps, a wide diversity of fenced pastures...

- 22 When there are wolves, livestock fences have to fulfil two concomitant roles: always contain the grazing animals in a dedicated space, in order to manage their feeding and the renewal of forage resources, but also to discourage predators. The presence of LGDs in fenced pastures is expected to discourage them much more strongly than fences alone, of which no model except those of zoos or wild animal parks can be considered impassable by predators capable of jumping or digging (Kerley *et al.*, 2018).
- 23 A very wide diversity of fenced pastures exists round the world, varying in size and content, facing a variety of predators. In Australia, where dingoes and wild dogs live, the pastures are huge and the numbers of livestock are equally large: 10,000-40,000 sheep, or 3,000-5,000 cattle per ranch (Allen *et al.*, 2016). In South Africa, fenced pastures are also very large, but there is a range of predators that require a wide range of fencing, such as "a non-lethal first line of defence" (Kerley *et al.*, 2018). In North America, predators are just as numerous and varied, including bears that can climb over high fences, and pastures are often one or several hundred hectares in size (Danvir *et al.*, 2018). In France, fenced pastures are not as large, but diversity is also great: from very small areas with mobile fences (0.5 to 2 ha, or even less) on forage crops or cultivated meadows, to fixed permanent fences around pastures of several tens, or more exceptionally, hundreds of hectares on natural grassland, scrublands, and small woods.

... Which has consequences for the management of guard dogs' groups

- 24 What is particular to several European countries, including France, is that this diversity of sizes and contents of fenced pastures is often found within the same livestock farm: small fenced pastures on cultivated or natural grassland adjoining large fenced

pastures on more or less scrubby and woody rangelands, with all the intermediate cases.

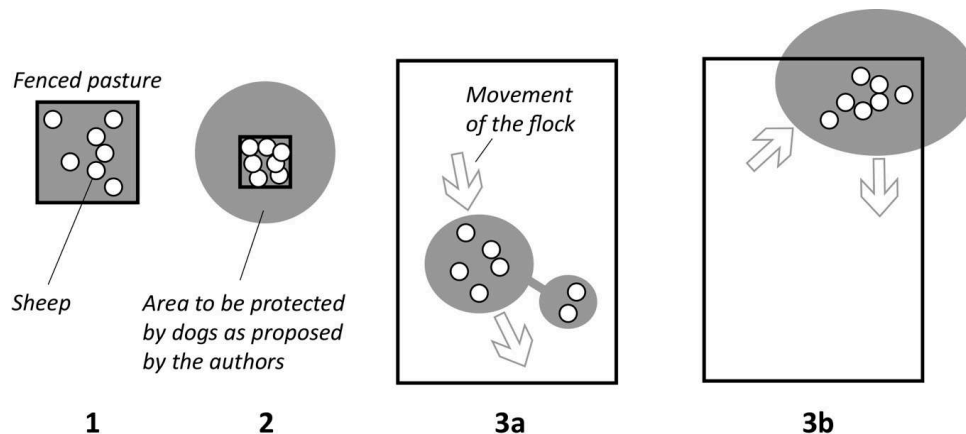
- 25 According to most scientists (e.g. Coppinger and Coppinger, 2005; Pfister and Nienhuis, 2017), but also to the breeders interviewed, dogs are not cumulative entities, nor are their groups divisible and then groupable without consequences, according to the dimensions and levels of vulnerability of each grazing location to predation. This requires from the breeders, not only a good knowledge of the temperaments and inter-individual affinities of their guard dogs, but also the capacity to anticipate the consequences of their choices of reorganization of their social groups. In this regard, scientific knowledge and technical recommendations are still lacking, if not non-existent.
- 26 The question of the adjacency or proximity between different fenced pastures belonging to several breeders, each with their LGDs having various affinities, is hardly dealt with in science, nor to this day by the technical advice in livestock farming. Given the size of the grazing places, this question does not arise in Australia or in the Western United States, but it appears fundamental to breeders in the landscapes of France, and it concerns both rangelands and grasslands. Two situations are particularly dreaded: the neighbour's female dog in physiological heat that monopolizes the attention of their own male dogs; and close or adjoining fenced pasture whose respective dogs do not tolerate each other and favour their confrontations over their guard work. The needs and possibilities of coordination between neighbouring or nearby breeders should be considered.

What are the boundaries of the areas to be protected by guard dogs?

- 27 According to current recommendations in France (MAA, 2019), the question does not arise: the area to be protected by guard dogs is that of the fenced pasture where animals are put out to graze, circumscribed by fixed or mobile fences. The instruction is: "[to obtain financial support] the [breeders] must ensure the presence of guard dogs near the flock at all times, day and night." And it is also recommended that inexperienced LGDs be taught not to cross fences: "place the [young] dog in a small pasture [fenced with electric netting] and teach it to stay there (...) (possibly using an electric collar)." The recommendations focus on the fencing material and its proper electrification. In fenced pastures, fences and LGDs form the inseparable couple of livestock protection, the former defining the working perimeter of the latter (Garde, 2012).
- 28 Due to the diversity of contexts in the world, however, scientists are less unanimous about that question: in order to gain efficiency against predatory canids, should dogs be allowed to sometimes cross fences? This question is controversial, even in the case of large Australian or North American pastures. Some authors argue for encouraging the patrolling behaviour of dogs, which is thought to allow them to establish a territory (barking and urine markings) that sometimes extends beyond fences and which would serve to deter predators from approaching and crossing them (Van Bommel and Johnson, 2014). For their part, Gehring *et al.* (2011) and Allen *et al.* (2016) argue against this, the latter having observed wild canids incursions in "raid mode" into sheep fenced pasture, despite the extension of dogs guarding to the periphery of the area.

- 29 In France, the question of whether or not to contain guard dogs within the fenced pasture perimeters seems to be interesting to re-examine, at least from the point of view of confrontational relations between canids (Lescureux and Linnell, 2014; Landry *et al.*, 2020). Our interviews allowed us to identify four typical situations of fenced pastures among farmers, according to pasture size (small, medium, large), its occupation by the flock (grouped or scattered), and the visibility (presence of forest edge, tall scrubland species, slope break, etc.) (Figure 2).

Figure 2 - Diagrams of the four typical situations of fenced pastures and their areas to be protected by guard dogs, based on the actual situations of farmers we interviewed



Situation 1: Medium-sized pasture (4 to 10 ha) with good visibility from everywhere, including beyond the fences; the flock is almost continuously dispersed over a third or half of the pasture; Situation 2: Small or very small pasture (< 2 ha) on a cultivated or natural meadow, with fences placed at the edge of the forest or hedgerows and the flock occupies almost constantly all the space of the pasture; Situations 3a,b: Large pasture (> 10 ha), or very large pasture (several tens of ha), with small woods, scrubby areas, rocks, uneven terrain, with numerous breaks in visibility and olfactory detection capacity; in this case, even when it is very dispersed, the flock is never in complete occupation of the fenced area, it moves according to spontaneous grazing circuits and sometimes divides into sub-groups. In situation 3b, the flock moved temporarily along a fence on the edge of a forest or a high and dense scrubland.

Realization : B. Potet, C.H. Moulin, M. Meuret.

- 30 Given the great olfactory abilities of canids (Lord, 2013; Rosell, 2018), LGDs are able to spot wolves long before they come close to a fenced pasture. For dogs that enjoy “going to contact” as interviewed breeders say, it is likely frustrating that they are not allowed to actively repel the wolf or wolves before they cross the fence. In turn, wolves may learn they can approach and walk along a fence, sometimes at short distances to test or distract LGDs, without risking a direct confrontation.
- 31 From these situations, we can formulate suggestions on the areas (grey zones, Figure 2) that would be relevant to protect in each case by LGDs. In medium-sized pastures (situation 1), the interior space of the fenced area would be protected. In small or very small pastures, where the sheep occupy all the space of the pasture, would it not be worth extending the area to be protected to the periphery of the pasture, at the risk of the LGDs having to wait for the wolves to jump the fences before being able to intervene? As in the case of night pens, it is then often too late to avoid a wolf attack on densely grouped and panicked animals with a large number of victims. In large or very large pastures (situations 3a,b), such as on an unfenced high mountain pasture, the area to be protected by LGDs would not be the entire pasture, but the portion occupied by the grazing flock and its periphery at a given time. When the flock has moved along

the edge of a forest or high and dense scrubland, would it not be worth extending the zone to be protected to the adjacent portion outside the pasture, in order to avoid the LGDs having to wait until the wolves jump over the fence before being able to repel them?

- 32 In Australia, where dingoes and wild dogs abound, LGDs are not legally allowed to leave the ranch property, and thus the fenced pasture boundaries, in the absence of responsible humans (Allen *et al.*, 2016). In France, LGDs, when at work, are legally allowed to cross fenced pasture boundaries, as they are not considered “roaming” even when they are no longer “under the effective supervision of their master and within range of his voice” (Code rural et de la pêche maritime, 2005, Article L. 211-23). However, the French rural code also warns about “dogs likely to present a danger [chasing and biting] to people or [other] domestic animals,” such as hikers' or hunters' dogs. A parliamentary working group recently stressed that “a reflection must be undertaken in order to envisage a clearer and fairer legal regime of responsibilities for each of the parties in the event of an attack by a livestock guard dog on a human.” (Boyer and Taurine, 2020).
- 33 The current ministerial specifications for LGDs commit breeders to “ensure the presence of guard dogs near the flock at all times, day and night”, including when grazing is conducted in fenced pastures (MAA, 2020, Appendix 1, page 25). However, it does not specify the size of these pastures, locations and landscape contexts, nor does it encourage patrol and tracking dogs outside of the pastures, even if they are relevant to improve the effectiveness and persistence of the protection. “With complementary dogs, some that stay with the flock and some that don't hesitate to wander off to chase a wolf, I think it's not bad. A wolf that has been chased by two dogs, it seriously cuts off its willingness to come back!” (Breeder 6). This breeder is taking a risk, especially in the case of multi-use landscapes. His guard dogs may venture out of the fenced area, but only on the strict condition that they pose no risk to humans, pets or hunting dogs.

The risk with guard dogs and fenced pasture on multi-use countryside areas

- 34 Among the concerns of the breeders interviewed, the risk of conflict with other land users comes first: “For the moment, I almost have more problems with people [hikers or hunters] than with wolves!” (Breeder 4). When placed in fenced pastures, and particularly those of small to medium size, guard dogs may behave more aggressively than elsewhere toward those they consider possible intruders, including humans, especially when accompanied by their pets or hunting dogs. Garde (2012) hypothesizes that this may stem from the strict and artificial delimitation of LGDs' territory, leading to loud barking, aggressive attitudes, and running around the inner periphery of fences. It also turns out, according to the breeders interviewed, that most of their dogs develop a strong animosity towards unfamiliar cars, motorcycles, as well as bicycles, especially when the latter are electrically powered and perhaps very noisy to the dogs' hearing.
- 35 In Montana (USA), a recent study recommended keeping sheep flocks and their LGDs 400 meters or more away from any recreational or residential areas to minimize the potential for encounters and conflicts with hikers or community residents (Mosley *et al.*

2020). This would be nearly impossible to achieve in Western European landscapes, given the layout of pasture areas. Administrations as well as livestock farming support services in France are now making problematic interactions between LGDs and other land users a priority topic (MAA, 2019; Réseau pastoral AURA, 2020). They are trying to anticipate conflicts by better informing hikers and bikers, most of whom still have to learn appropriate attitudes when encountering guard dogs, but also by stricter selection of dogs based on their behaviours towards unknown humans.

- 36 As the LGDs are likely to represent, not only an important nuisance of neighbourhood (day and night barking), but also a problem of public security (pursuit of hikers and bikers, impressive barking and sometimes bites), it appears imperative to the breeders to adapt, at the risk of seeing themselves one day excluded from their local grazing lands: "Following the complaints, our mayor summoned me to ask me to equip my guard dogs with anti-bark collars. (...) I told him that my dogs would then have no more use!" (Breeder 15).
- 37 In the eyes of some interviewed breeders, the social acceptability of the means of protecting flocks against wolves appears to be a determining factor in ensuring the sustainability of livestock farming at pasture in France. One of the interviewees made this clear to us: "Wolves, flocks, it's not going to be the wolves that will make the flocks leave, it's going to be the other land users who are going to accept, or not, all our protection means, who prevent them from hiking, and all that. They're going to tell us: you're [bothering us too much] with your guard dogs, your electric fences, or... with your gunshots!" (Breeder 13).

Conclusion

- 38 A practice which has been going on for thousands of years, the use of guard dogs to defend herds and flocks against wild predators, can suddenly be confronted with many questions and sometimes serious limitations when the dogs' tasks and working conditions change to such an extent. In the present case, it is no longer herders or shepherds who graze and watch over animals on the steppes or mountains of Eurasia, little frequented areas, but batches of animals grazed in relatively small fenced pastures, where the LGDs have to operate alone during the day, and sometimes also at night, and which sometimes see dozens of hikers passing by every day. These dogs no longer have the function of alerting responsible humans who are constantly close to the flock, armed and experienced, who will also take charge of repelling the predator(s).
- 39 Also, in a country like France, which eradicated wolves a century ago, livestock farming at pasture has developed in the absence of these predators and the memory of the rules of acceptable coexistence practices have gradually been lost, not only among breeders and shepherds but also among other public lands users, starting with hikers, whose numbers are growing in the Alps, who are mostly of urban origin and quite inexperienced in terms of the attitudes to be adopted when crossing with flocks and their LGDs. A practice thus reimported after a century of abandonment becomes an innovation, all the more so because the practice of fencing parts of land to manage sheep grazing did not exist in France, or existed only to a very limited extent, at the time of the last wolves (Montméas, 2007; Cochet and Ducourtieux, 2018). It is therefore appropriate to consider the combination of fences and LGDs as an innovation, in what

still has to be invented, adjusted, considered realistic or too risky, before concluding on the performance and viability.

- 40 In terms of knowledge to be mobilized in an attempt to improve the practice and, above all, to better anticipate its limits and constraints on multi-use public lands, the knowledge of experienced breeders and shepherds deserves to be more carefully and systematically considered. This knowledge is local and therefore necessarily fragmentary and contextualized. Nevertheless, with all the usual precautions when considering emerging knowledge about dynamic assemblages of living beings, in this case guard dogs, sheep, and wolves, but also various kinds of more or less naïve or already experienced humans, it not reasonable to make unequivocal and all-purpose recommendations (e.g., “to avoid wolf attacks, all you need to do is to put in guard dogs of the right lineage”), and to make innovation a success, requires constant adjustments.
- 41 Over the centuries, livestock farming at pasture has shown its great capacity to adapt to strong and sometimes unexpected constraints. Will it succeed once again, even if it becomes, due to its practices of protection against wild predators, too much of a nuisance for other land users? It is also a question of trying to ease coexistence, this time between livestock farming and other outdoor human activities.

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ABSTRACTS

Predation by wolves affects all livestock farming systems, including those having different batches of animals being simultaneously grazed in distinct and sometimes distant fenced pastures scattered over a landscape. In the absence of a responsible human herding and watching

over his flock or herd, livestock protection by the sole combination of fences and guard dogs is a new practice in France, that has not yet received much attention in public policy recommendations. We used several sources of knowledge, from the scientific literature to experiences of breeders interviewed in the Southern Alps, to analyse three issues to improve the effectiveness of the practice: the number of guard dogs required per batch of animals, the complementarity of dogs within their working group, and the land area to be protected by dogs. In each case, several dogs are necessary. Within their group, the guard dogs can play complementary roles and this optimizes protection. The rearrangement of dog groups during the year can cause difficulties. It may be appropriate sometimes to allow guard dogs to cross fences, so that they do not have to wait for wolves to jump or dig underneath. But in a densely populated and frequented country such as France, allowing protection by dogs on the periphery of fenced pastures faces a high risk of conflict with other land users. When grazing lands become risky areas for hikers or hunters confronted with guard dogs, the sustainability of outdoor livestock farming may be called into question.

INDEX

Keywords: Predators, Public policy, Livestock systems, Land multiple use, Territories

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