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Coexistence through the Ages: The Role of Native Livestock Guardian Dogs and Traditional Ecological Knowledge as Key Resources in Conflict Mitigation between Pastoralists and Large Carnivores in the Romanian Carpathians

Cosmin Marius Ivaşcu^{1,2*} and Alina Biro^{3,4}

Abstract. Livestock guardian dogs (LGDs) in the Romanian Carpathians are as old as the pastoral presence and activity in the region. The main role of these dogs is to protect livestock from predation by large carnivores. The Carpathian Mountains, as opposed to other European mountain ranges, have always had considerable populations of wolf, brown bear, and lynx; conflict with the herders is inevitable. Here, the shepherds rely only on themselves and their dogs to keep their animals safe from predation during pastoral movements. We investigated 12 sites from the historical regions of Banat and Transylvania, where we have collected traditional ecological knowledge (TEK) on the use of native LGDs as an ancient non-lethal method for the prevention of livestock depredation. By monitoring the behavior of their dogs, the shepherds establish a complex ethno-ethological relationship with them, which helps them foretell the movements and presence of large carnivores in their vicinity. We have also investigated the recent positive change of attitude of some of the Romanian nature conservationists towards the Romanian Carpathian Shepherd Dog breed, which is also currently promoted by important international nature conservation NGOs as an ecologically friendly method to mitigate the conflict with large carnivores. The uninterrupted use of endemic LGD breeds by pastoralists in Romania might be one of the main reasons for the survival and conservation of large carnivores here in the past and in the future.

Keywords: Romanian livestock guardian dogs, pastoralism, large carnivores, traditional ecological knowledge, bio-cultural heritage.

Introduction

Large carnivore protection and population recovery are some of the most important and controversial issues in nature conservation worldwide. The predatory behavior of large carnivores often inflicts considerable economic losses to livestock farming. Lethal control methods and market hunting are two management methods widely used in the past centuries and responsible for bringing these animals to the brink of extinction in many parts of the world (Gehring et al. 2010). For this reason, there is a growing interest in using non-lethal control methods like livestock

guardian dogs (from here on abbreviated as LGD) in large carnivore conservation initiatives. This approach represents the rediscovery and modern adaptation of ancient, non-lethal methods of carnivore attack prevention developed over millennia in the herding traditions in Asia and Central, South, and Eastern Europe (Gehring et al. 2010; Rigg 2001).

The popularity of LGDs as a prevention method is ever increasing among both livestock breeders and conservationists. The many projects involving LGD use around the world (Bommel and Johnson 2012; González et al. 2012; Rigg 2001; Salvatori

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2014; WolfLife 2018) in many cases has had considerable success in conflict mitigation (Potgieter et al. 2015; Rust et al. 2013; Zingaro et al. 2017). LGDs were first introduced in carnivore conservation efforts in the United States during the 1970s, following the ban of poison use in wild predator control (Shivik 2006).

Although LGDs are not native to the United States or either the North and South American continents, its successful use in the Rocky Mountains (Gehring et al. 2010, 2011a; Urbigkit and Urbigkit 2010) contributed to the spread of this non-lethal predator control method to Canada (Rigg 2001) and other countries with no herding traditions involving LGD use, such as Argentina (González et al. 2012), Australia (Bommel and Johnson 2012), South Africa (Rust et al. 2013), or Namibia (Potgieter et al. 2015). It is worth mentioning that the recovery of large carnivore populations in many parts of Western Europe led to the reintroduction and rediscovery of LGDs (Gehring et al. 2010). LGD breeds were recently introduced in European countries with no historical tradition in LGD use, like Finland and Norway (Otstavel et al. 2009), along with revival programs in countries where traditional knowledge regarding LGD use has disappeared (Slovakia) or remained very scarce (Bulgaria) (Rigg 2001).

LGDs have been shown to reduce predation of livestock by 11–100% (Gehring et al. 2010). Other studies report even higher end figures, like 60–100% (Leijenaar et al. 2015). Surveys showed high effectiveness of LGDs in livestock protection and, at the same time, relatively low costs (Urbigkit and Urbigkit 2010). However, the status of LGDs as a proactive and ecologically friendly method of wildlife conservation is currently under debate since dogs have predatory and territorial instincts and could potentially harass and inflict harm on wildlife (Whitehouse-Tedd et al. 2020). But the benefits of LGDs for wildlife and large carnivore conservation outweigh the

possible disadvantages when compared to lethal control methods (Eklund et al. 2017). Even physical barriers, like electric fences, without any proactive protection methods proved to be ineffective in the long run in both Europe and the United States (Gehring et al. 2011a). Moreover, researchers concluded that lethal interaction between LGDs and wild herbivores were rare and occurred on an individual basis (Whitehouse-Tedd et al. 2020). This unwanted behavior can also be corrected with proper training (Whitehouse-Tedd et al. 2020). Besides guarding, it has been reported that by deterring wild ungulates from pastures used by livestock, LGDs can prevent wildlife-transmitted infections (Bommel and Johnson 2016; Gehring et al. 2010, 2011b). Researchers also reported another possible ecological function of LGDs: protection of grassland birds by deterring mesopredators from pastures, a topic that needs further investigation (Gehring et al. 2011b).

The most widely used LGD breeds are the Great Pyrenees, the Akbash, the Komondor, the Maremma, the Shar Planinetz, and the Anatolian Shepherd (Urbigkit and Urbigkit 2010). The latter is used especially in Australia and Africa due to similar climatic conditions as in Turkey, its place of origin (Bommel and Johnson 2012; Potgieter et al. 2015; Rust et al. 2013).

Despite being one of the few countries in Europe and around the world that maintained centuries of uninterrupted traditional LGD use and knowledge, alongside Italy (Breber 2008; Rigg 2001) and Turkey (Akyazi et al. 2018; Işık 2014), Romania's native LGD breeds remain fairly unknown outside of its borders. The traditional ecological knowledge and use of endemic LGD breeds has been preserved here despite everchanging socio-historical and socio-economic conditions. Communism in neighboring Bulgaria deeply affected LGD use and knowledge (Rigg 2001). In Slovakia, for example, lethal control methods of large carnivores have

led to a considerable population decrease, which, in turn, has led to the abandonment of LGD use in the mid-twentieth century (Rigg et al. 2011).

In Western Europe, large carnivores like the wolf (*Canis lupus*), bear (*Ursus arctos*), and lynx (*Lynx lynx*) have shown population increase recently and recolonized former landscapes from where they were eradicated centuries ago (Lescureux et al. 2014). This is not the case in Romania, where the Carpathian Mountains (70,000 km²) have maintained the highest density of large carnivores in Europe, except Russia (Mertens and Promberger 2001). Recent evaluations in the Romanian Carpathians found a population of 2840 wolves (Wolf-Life 2018), 6700 brown bears (Life for Bear 2018), and 1800 lynx (Mertens and Promberger 2001). In 2001, there were around nine million sheep and three million cattle in Romania; half of these animals spent the summer grazing on alpine and subalpine pastures. The Romanian Carpathians have the highest density of both large carnivore populations and livestock in the European mountain ranges (Mertens and Promberger 2001).

We investigated the herders' traditional ecological knowledge of LGD use in mountainous areas of Romania. Our research focused on knowledge and beliefs that herders still have regarding their dogs and the way they used them. We corroborated herders' observations with recent scientific studies regarding LGDs in other parts of the world. We have also investigated the recent change in attitudes of Romanian nature conservationists that, until very recently, had a negative image of LGDs and pastoralists in general. This change of viewpoint occurred only recently, as major projects regarding large carnivore conservation, like Life for Bear, WolfLife, and LIFE Connect Carpathians, presented favorable outcomes. We also argue that the uninterrupted use of traditional LGDs by farmers and pastoralists in Romania has played a major role (among other socio-cultural,

socio-economic, and ecological factors) in the survival of large carnivore populations in the Romanian Carpathians, as opposed to other regions in Europe.

History of the Main Breeds of LGDs Native to the Romanian Carpathians

For centuries, Romanian farmers and pastoralists selectively bred LGDs according to their own needs and likings. The first official undertakings in the selection of Romanian LGD breeds according to international standards started in 1935 along with the creation of the *Federația Română Canină* (Romanian Kennel Federation). In 1948, Romania became a satellite state of the Soviet Union and such undertakings were deemed elitist and forbidden. In 1969, the Romanian Kennel Association was reestablished, and on June 24, 1979, a dog show was held in Bucharest. At this time, 34 LGDs entered the competition, 18 belonging to the *Carpatin* breed (now Romanian Carpathian Shepherd Dog) and 16 to the *Barac* breed (now Romanian Mioritic Shepherd Dog). After this dog show, the selection of these breeds continued according to official standards developed by the Romanian Kennel Association (Puicin 2014).

The Romanian Shepherd Dog breeds (Supplementary Appendix 1) are similar to other European LGD breeds like the Great Pyrenees, the Maremma Sheepdog, the Tatra Mountain Sheepdog, the Kuvasz, the Serbian Homolian Shepherd Dog, or the Karakatchan Shepherd Dog of Bulgaria. There are significant similarities between the LGD breeds originating from the Balkans, Southern Europe, and Eastern Europe. Transhumance was probably the main driving factor for the gene exchange and distribution in the area (Coppinger and Coppinger 2001).

Currently, there is an ongoing debate on the existence of another breed of shepherd dog from Romania called *Bălan*. This breed is not recognized by the Romanian Kennel Club (2020). However, shepherds recog-

nize and differentiate this type of LGD. It is similar to the Romanian Carpathian Shepherd Dog, but its coat color is completely white (Figure 1). There is a growing interest in the selection of this breed, called by many shepherds and amateur dog breeders “Romanian White Shepherd Dog” (*Ciobănesc Românesc Bălan*) (Teacă 2016).

Historical documents from the medieval period show that noblemen and the royal courts of Transylvania, Wallachia, and Moldova kept many greyhounds and bloodhounds (Puicin 2014). Pastoral activities increased greatly and were of great economic importance during this time (Puicin 2014); medieval documents frequently mention the travel routes of transhumant and non-transhumant shepherds, as well as the taxes they had to pay (Constantinescu-Mirceşti 1976). However, their dogs are rarely mentioned.

In 1652, one of the first Romanian legislative codes called *Îndreptarea legii* (The Amendment of the Law) (Colectivul

de Drept Vechi Românesc 1962) mentions for the first time the use of LGDs in the Romanian Principalities. This legislative code combines canonical and secular laws of local Romanian customs along with the Byzantine legislative codes. Beyond its cultural and linguistic importance, this code also contains a chapter entitled *Pentru luptarea a dobitoacelor şi pentru vătămarea lor. Glava 308* (On animal fights and the injuries brought upon them. Amendment 308). In this chapter, there are three articles related to the protection of LGDs. The first article (Zac. 65) forbids the organization of dogfights under the punishment of ten lashes with a stick. The second article (Zac. 66) prohibits the killing of a type of dog called *câinele păstoresc, ce să zice dulău de turmă de oi* (a shepherd’s dog that is also called a sheep flock dog); the perpetrator is obliged to pay double the value of the dog. The third article (Zac. 67) strictly forbids the poisoning of LGDs, the punishment for which was restitution double the value of



Figure 1. A Romanian White Shepherd Dog in the village of Ieud (Maramureş) wearing a yoke (*jujeu*). The red tassels have an apotropaic role, protecting him from the evil eye. Photo by C. Ivaşcu.

the dog and 100 lashes. The same article calls these dogs the *socotitorul turmei* (the reckoner of the flock). In cases where the dog killed was particularly skilled at live-stock protection, then the perpetrator was also required to compensate for damages to the flock in addition to standard fines. This legal code indicates that LGDs had an important economic role at that time.

Materials and Methods

Study Area

The study was carried out in 12 sites (Figure 2) in the historical regions of Transylvania and Banat, Romania. We have collected original data from nine sites. Valuable data from manuscripts and ethnographic literature (Cireșan-Loga 1981-1982; Herseni 1934; Teacă 2016) was used for another three sites. All of the sites (Table 1) are located in hilly and/or mountainous areas in the Northern, Western, and Southern Romanian Carpathians (average elevation is 515 m.a.s.l.).

These sites tend toward cool, temperate continental climate, typical of mountain areas of Romania, with warm summers and cold winters. Subtypes also occur in some of our sites. The Forotic and Duleu

sites have a strong Sub-Mediterranean influence (dry summers and mild winters). Climate, vegetation, and herding traditions are different in these two sites as a consequence. In these two sites, bears are absent and the Eurasian lynx is extremely rare; however, the jackal (*Canis aureus*) has been recently spotted as a newcomer in the area. The landscape near the settlements is a mosaic of meadows, forest patches, and small arable fields. Extensive forested areas lie outside each site.

Data Collection

Starting in 2014, we conducted multiple semi-structured interviews (Supplementary Appendix 3) based on an open-ended interview (Supplementary Appendix 2) and we collected narratives along with participant observation. Local experts within the community were identified through snowball sampling. Our research mainly focused on traditional ecological knowledge (TEK) related to hay meadows, pastoralism, and forest use. We also tried to explore interactions with large carnivores, which are present in these areas in large numbers. Our interest in this topic was further motivated by ethno-ethological approaches (Lescureux 2018; Lescureux

Table 1. Study sites characteristics (Institutul Național de Statistică 2011; Google Earth 2020).

Site	County	Settlement type	Average elevation (m.a.s.l.)	Population (2011 census)
Șugag	Alba	commune	500	2726
Râșnov	Brașov	city	646	15002
Drăguș	Brașov	commune	486	1162
Forotic	Caraș-Severin	village	155	553
Duleu	Caraș-Severin	village	160	218
Slatina-Timiș	Caraș-Severin	commune	325	3074
Verendin	Caraș-Severin	village	509	1758
Râșca	Cluj	commune	929	1446
Covasna-Voinești	Dâmbovița	commune	400	7203
Târsa	Hunedoara	village	955	201
Petroșani	Hunedoara	city	637	34331
Ieud	Maramureș	village	471	4318



Figure 2. The study sites; in red - original data; in yellow - data from literature. Map by S. Belu.

and Linnell 2014; Lescureux et al. 2014; Linnell and Lescureux 2015; Savalois et al. 2013), but also by the emerging debate about the role of LGDs and shepherds in nature conservation in Romania.

Before each interview, we asked for consent to record, respecting the International Society of Ethnobiology Code of Ethics (2006). We investigated and focused on the herder's perception and knowledge on the use, effectiveness, and behavior of LGDs in traditional grazing systems by using ethno-ethological methods (Lescureux 2006). We use extensive quotations in the text to highlight this knowledge, as recommended for TEK studies (Berkes 2017).

In Maramureș, we spent over 100 days with the local community. Six days were spent in Ieud at a sheepfold in the mountains belonging to Dunca Ș. (Inf. 6), a key consultant in our study, and to the experi-

enced shepherd Gradovici G. (Inf. 3). We have also interviewed Radu Popa (Fauna & Flora International Romania, Vice President of Club Carpatin) and Dr. Radu Chiriac (National Agency for Environmental Protection Vrancea County, WolfLife Director), who were the first people from Romania to promote the use of the Romanian Carpathian Shepherd Dog in major nature conservation projects.

An unpublished, 370-page, handwritten manuscript, dated 1981-1982, of a late, self-educated scholar and herder was given to us by a close friend and collaborator of the author. Entitled *Din viața păcurarilor (From the Life of the Shepherds)* (Cireșan-Loga 1981-1982) and written in the local Romanian sub-dialect used in Banat, the manuscript is a vivid recollection of the life and herding traditions in the shepherd's village, but also of the use of LGDs.

Results

Traditional Grazing System

Three major types of pastoral systems have been used historically in Romania: long distance transhumance, short distance transhumance or pendulation, and local agricultural pastoralism (Huband et al. 2010; Vuia 1964). Șugag is the only village investigated where, in the past, locals practiced long distance transhumance (traveling over 300 km to reach lowland pastures in the winter). Except for two sites from Western Banat (Forotic and Duleu), in all the other villages, short distance transhumance was practiced. As the name implies, short distance transhumance is the movement or pendulation of livestock from nearby settlements, where flocks/herds spend the colder part of the year, to the subalpine or alpine pastures in late spring/early summer, and back again to permanent settlements. This pendulation is possible because of the existence of extensive grasslands in the Romanian Carpathians. Most of these grasslands were manmade centuries ago by forest clearances, sustained grazing, and traditional management practices (Emanuelsson 2009). Villagers practicing this form of pastoralism also have summer settlements that are situated at mid-altitude near the forest and are used mostly for cows and horses that graze on fenced private parcels. In the hilly areas of Banat, local agricultural pastoralism is practiced. Livestock is grazed on communal pastures in late spring and summer and does not leave the village territory.

Traditional Practices and Beliefs in LGD Selection

LGDs were selected from the locally available dogs based on their physical attributes, behavior as younglings, and the working traits of their parents (Coppinger and Coppinger 2001; Gehring et al. 2010; Rigg 2001).

Among the first physical attributes that shepherds take into consideration for selecting valuable future LGD puppies is linked to the appearance and size of the paws. If the pups have big paws and a large head, then that means they will be large sized adults (Inf. 39; Inf. 45). This selection method was present in all of the investigated sites; however, it is known that shepherds from Abruzzo also select the largest puppies (Breber 2008).

Shepherds also check the color of a pup's palate (roof of the mouth). They believe that if the palate is black, then the dog will become aggressive and brave at maturity (Inf. 39; Inf. 45). But most importantly, herders select future LGDs by monitoring their behavior in all situations from an early age because most of them are born into a pack of adult livestock guard dogs. This is part of the bonding process, integrating the young into the future pack. Herders know that adult dogs are not aggressive towards pups. On the contrary, they exhibit a playful behavior towards them (Inf. 39). Another shepherd further explained:

A pack will always accept young pups. They want to integrate the young one, train it and make it one of their own. Dogs have their own agreements with each other. (Inf. 47)

A peculiar practice for selecting LGDs from pups was used in Târsa:

Shepherds would check how many hairs they have under their chin. As pups they usually have one, two or three very long hairs, different from their coat, long and straight. If the dog had one or three hairs, then it would be a good guarding dog. If it had two hairs, this meant he wouldn't be. (Inf. 45)

This might be a folk belief related to a Romanian legend, according to which

wolves have three distinctive hairs on their head inherited from the devil (Coman 1986). As mentioned by other researchers (Rigg 2001), beliefs in supernatural forces might have played a great role in LGD selection in the traditional rural communities of the past.

A different selection method was employed in Forotic, where locals used to select LGDs according to their coat color. White dogs (*bălan*) and the one called *florian* (white with black marks) in the local dialect were preferred to other dogs that were grey or reddish in color. The latter two types were kept as household guardians, while the *bălan* and the *florian* were brought to guard the sheep.

Our elders believed that a grey dog looks similar to a wolf. Then the sheep could confuse the wolf with the dog, and it would not be scared of it anymore. It was believed that sheep must fear dark colors. (Inf. 23)

Giving preference to puppies born with all-white color coat was also part of the selection process in the Abruzzo (Breber 2008). However, prominent Roman writers like Columella in *De re Rustica* (65 CE) and Varro in *Res rusticae* (36 BCE) also wrote that ancient Roman shepherds preferred white dogs as they could be easily distinguished from wolves and other predators (Rigg 2001).

Raising and Training

The main LGD characteristics (attentiveness, trustworthiness, protectiveness) have been obtained by centuries of enhanced genetic selection (Coppinger and Coppinger 2001). In Maramureş, herders select their dogs mostly according to their behavioral characters. The shepherds rear the brave specimens and hope that the offspring will inherit the characteristics of their parents. After the female gives birth, she is extremely aggressive and, in many cases, bites even her owners. The puppies are nurtured by her until they can eat food by themselves (until

two months old). Like other LGD breeds, such as Central Asian Ovcharkas and the Karkatchan (Urbigit and Urbigit 2010), Romanian LGD breeds are raised together with the sheep and cattle from their birth. Herders consider this to be the first precondition for becoming a valuable LGD. The selection process is a complex one and it implies multiple factors:

When the dog is two months old, when it starts moving around, it is good for it to be alongside the sheep. Its mother will teach him things, but also the shepherd. (Inf. 23)

Puppies up to three months old will develop strong bonds with livestock (Rigg 2001). Scientific studies have also indicated that an LGD's failure to bond with livestock was linked to the age of the pups (González et al. 2012; Rigg 2001).

The training of the LGD by the shepherd is limited. Being out with the sheep and learning from older dogs is fundamental for future guarding behavior. According to an experienced shepherd from Ieud:

The shepherd knows which dog will be the best one, because it will grow up under his watch. The dogs who will be teaching should be around two to three years old, the other ones should be younger because the elder dogs refuse to learn from a young one. Teaching an old dog should be avoided, because you cannot make a good dog from an old one. If it was trained in a bad way, it will remain that way. You can tell when they are little which one will become a good dog, depending on the nature of their mother. (Inf. 22)

A shepherd from Drăguş says:

A good dog is one who senses the danger first, it runs towards it and it is able to guide the sheep by itself; when the shepherd calls it, it understands; it is well behaved, smart and it tries its best at all times. (Herseni 1934)

LGDs are also considered by specialists to be the most effective when they reach maturity (at two years old) (Rust et al. 2013). Unfamiliar adult dogs are rarely accepted in the pack.

The pups are also subjected to some body modifications/mutilations, but the practice is becoming rare as more people acknowledge such modifications as “superstitions.” Tail removal or cropping ears are the most common. The main belief is that it alters the dogs’ behavior, making it either more aggressive or more cautious while on the job. These practices have been documented also in Italy (Breber 2008) and Turkey (Işık 2014).

Bonding to livestock is done by keeping the pups from an early age together with livestock. This is the oldest method by which dogs develop a strong affiliative and protective behavior towards the livestock (Coppinger and Coppinger 2001; Rigg 2001), as mentioned by all herders. For the bonding process to be successful, there are certain rules that have to be followed:

You are not allowed to play too much with the dogs. You have to give them limited attention, otherwise they will protect you and not your sheep. (Inf. 22)

Research on newly introduced LGDs documents a similar situation in Patagonia, where newly introduced LGDs did not bond with livestock because of previous human contact (González et al. 2012). Likewise, in Turkey, some Kangal Dogs spent more time closer to the herder than to the flock (Akyazi et al. 2018). Romanian herders command dogs to stay away from them and close to the sheep (Inf. 39).

The bond between LGDs and sheep is perceived by shepherds as a strong friendship:

Guarding dogs are very fond of the sheep. They are happy to see the sheep and be around them. Have you noticed how they behave when a sheep gives

birth? The dog is very happy, it smells the newborn lamb and licks it. It is because they grow up among them. (Inf. 6)

The Romanian LGD breeds can work together, similar to the Karakatchan Dog (Urbigkit and Urbigkit 2010). Shepherds consider this evolutionary trait to be their dogs’ most important feature, making them excellent working dogs:

A good dog has very good instincts, is very protective with the sheep and obeys its owner. You only need two to three brave dogs that will lead all the dogs from a sheepfold, the rest are just for the numbers. (Inf. 22)

You need to have a two-year-old dog among your dogs so the puppies will learn from it. If this dog is brave and he will jump on the wolf, then the young dogs will follow his example. (Inf. 5)

The herder corrects inattentiveness and other behavioral problems. As soon as the pups move around the flock with the other dogs, the shepherd begins to teach it basic instructions, like the return command, by whistling or name calling. If the dog is unwilling to obey commands, it is physically punished or chained at the sheepfold (Inf. 46). If the dog continues to misbehave, then it is not a good LGD and it will be brought to the village and used as a house guard. According to local people, dogs have their own distinct personalities and some of them will eventually become good LGDs while others will not, no matter how hard the herder tries to train them (Inf. 22; Inf. 45).

Traditionally, LGDs were fed with a mixture called *cir* (*gălbuş* in Banat), which is made of corn flour and boiled water (fluid consistency). They are fed in the morning and evening. During summer, the portion size is larger because they are more active. The whey that remains after making the cheese or *urda* (like Italian ricotta) is

also given to them (Figure 3). If a sheep dies from sickness or injuries brought upon them by predators, the meat is not safe for human consumption, so after boiling, it is given to dogs. Nevertheless, the Romanian LGDs' diet is mostly vegetarian, as is that of the Kangal, which are also fed with boiled corn flour (Işik 2014). In winter, they are less active and eat less, being fed once a day in the morning.

Shepherds always value a good LGD and, currently, such a dog costs 300 to 400 euros or two young sheep in leud (Inf. 14), a good ram in Târsa (Inf. 45), four to five young sheep in Braşov (Inf. 46), and three sheep or one sheep and a one-year-old ram in Voineşti-Covasna (Teacă 2016).

Traditional Methods of Carnivore Attack Prevention

The basis of carnivore attack prevention is good communication. In all investigated areas, shepherds knew their dogs very well and could tell from the cadence of their bark what type of danger they are about to

face. Other studies have similarly indicated human recognition of specialized barking (Jéghe-Czinege et al. 2020). As a shepherd from Maramureş pointed out:

The dog barks in a certain way at humans, another way at wolves and in another way at bears. When it senses the wolf nearby it starts with a long whimper then right after it starts barking and running in the direction of the wolf. When sensing a bear, they bark very seldomly: woof! And then it stops. Woof! And then it stops again. This is also because the bear is moving more slowly than the wolf. When strangers are coming, the dogs bark similarly like it would at a bear. (Inf. 6)

Other herders suggest that the way the dogs bark at the bear is similar to how they bark at a wild boar or horse:

It is a seldom bark. Whilst when they bark at the wolf it is more alert. They are very furious. (Inf. 45)



Figure 3. LGDs at supper eating whey, in Maramureş. Photo by C. Ivaşcu.

By what I have observed, the dogs bark differently at bears, wolves and people because the shepherds know by how the dogs bark what type of danger they face. The dogs run like they would chase a rabbit when they smell the wolf because the wolf also runs when it feels surrounded; at the bear they bark like they would at a cow, standing in place. To protect the sheep, they surround them and the shepherds help them by yelling, throwing pieces of wood and even by using a gun. Bears are also scared of fire and gun shots. (Herseni 1934)

On the other hand:

When dogs smell a roe deer, wild boars, rabbits or fox, then they howl and bark exactly like hunting dogs. (Inf. 39)

The most important role of LGDs is to keep watch for potential dangers:

Their role is to alert me. They let you know. If they would not sense the wolf coming, how could I know my animals are in danger? (Inf. 9)

When the herder is out with the animals on the pasture, the dogs have to always be on alert:

It must keep watch at the margins and be close to the sheep, not around the shepherd. The wolf comes from the margins. The dog has to have sharp instincts. It has to pick up the track of the wolf, bark and chase it away. If the shepherd is behind the flock, the dog is in the front. If it is raining outside, the dog has to sit closer to the flock and watch in all directions. Also, during the night, he stays near the corrals. (Inf. 7)

LGDs are also very active at night. "At night, when wild animals threaten the sheep, the dogs bark to wake up the shepherds and then they start chasing away the predators so that they don't take any sheep" (Herseni

1934). "They rest during the night by taking turns at keeping guard" (Inf. 47).

The movement of LGDs in the pasture is also important in preventing livestock depredation (Gehring et al. 2010). This aspect highlights the attentiveness of individual dogs and the success of the bonding process. Herders stress that dogs know exactly where to go according to their hierarchy within the pack.

Dogs will spread on the pasture around the flock. The good ones will assign the other ones to their places. A good dog is always around and after the flock. (Inf. 22)

When grazing in pastures with shrubs or in forested areas, the dogs inspect the area:

When the sheep approached the bushes, the dogs were going to inspect every bush; they also checked further away near the creeks, in the forest. (Cireşan-Loga 1981-1982)

This behavior was observed by other herders:

If there is a forest nearby, it goes at the margin of the forest, it is sniffing around and then returns to the sheep. (Inf. 45)

Recent studies using GPS tracking collars have shown that the sheep–dog distance varies according to landscape (Zingaro et al. 2017); in forested areas, they wandered further away from the livestock.

Like the Karakatchan (Urbigkit and Urbigkit 2010), endemic Romanian LGDs harass and chase wolves away over long distances. Although their behavior might not be as aggressive as a Kangal Dog, herders reported that, in some very limited cases, extremely brave LGDs managed to kill lone wolves. However, when chasing the wolf away, shepherds must not let all their dogs run or go very far, since wolves can trick the dogs by using a decoy. "One wolf drives all the dogs away from the sheep, while the rest of the pack attacks them from another direction" (Inf. 3).

Another very important part in the training and effectiveness of LGDs is to get them accustomed to the presence of wolves, bears, and other predators, as this experienced herder told us:

If the dog sees a wolf once in every three years, then it will not know what to do. Since his early years, the dog needs to confront the wolf. The females have better instincts than the male dogs, they protect the sheepfold better. A good dog is always around the sheep and between them, it picks the trails of the predators and is always on watch. A good shepherd dog does not chase the deer, they keep close to the flock instead. The dog listens to you when it is well fed and well kept. (Inf. 23)

Contrary to herder's beliefs, studies have shown that there is no significant difference between male and female dogs in their effectiveness against depredation (Leijenaar et al. 2015), nor in the levels of aggressive behavior exhibited towards humans (Marion et al. 2018).

The arrival of new species of mesopredators, like the jackal, might pose new

challenges for the Romanian pastoralists located in the lowlands of the country, as they have no knowledge regarding them. A herder told us that dogs are confused by this new encounter.

I have to be always on the watch. This is the first year since they appeared in this area. My dogs did not know what to do. Some rushed and started playing with it. It has already taken two lambs from my flock. (Inf. 42) (Figure 4)

The average number of dogs used at a sheepfold is between five and eight. In Maramureş, the optimal number for a sheepfold is around eight, two of which should be especially brave. In the hilly areas of Banat (Figure 5), two good dogs are considered to be enough for a flock of 200 sheep.

Discussion and Conclusion

Nowadays, there is a growing general interest in LGDs around the world. The remaining breeds are seen as important cultural icons of pastoral communities, but also as important tools for the conservation of large carnivores (Linnell and Lescureux



Figure 4. Inf. 42 grazing his sheep, while the loyal companion keeps watch in the Semenik National Park.



Figure 5. A lithography made by Auguste Raffet (Nineteenth Century), portraying a Romanian shepherd from Banat and his two dogs.

2015), with unique conservation value (Gehring et al. 2010). We have found that the Romanian herders in all the investigated sites could tell the presence and type of predators in their vicinity by the type of barking their dogs used. By using this method, the herders could react and prepare better for a possible encounter with large carnivores and could avoid livestock depredation. The TEK behind herding and LGD use is rich and still alive in many

of the visited sites. Herders' observations on the behavior and traits of LGDs and large carnivores appear to be reliable and corroborate many recent studies (Rust et al. 2013; Zingaro et al. 2017).

In December 2015, a conflict between politicians and shepherds arose when a newly proposed hunting law limited the number of dogs at sheepfolds. The law was rapidly rescinded due to incidents in Bucharest provoked by 2000 protesting

herders (Ivaşcu and Rakosy 2017). The press asserted at the time that there was an underlying conflict between hunters—supported by politicians—and shepherds. Many Parliament members are hunters and the hunting lobby is very strong in Romania, especially given that the Romanian Carpathians hold large populations of game species.

The interest in the use of LGDs as an ecologically friendly method for conflict mitigation between humans and large carnivores in Romania is rather recent (Inf. Chiriac S.; Inf. Popa R.). Centuries of uninterrupted LGD use by Romanian pastoralists and farmers might be one of the reasons why large carnivore populations have survived in the Romanian Carpathians. Similarly, in Italy, wolf researchers argue that the survival of wolf populations is strongly linked to the continuous use of endemic LGDs by the Italian shepherds (Ginsberg and Macdonald 1990). Current research has shown a strong connection between LGD use and increasing tolerance towards large carnivores around the world. For example, in Patagonia, the introduction of LGDs led 88% of goat farmers to cease carnivore killings (González et al. 2012). The same phenomenon was recorded in South Africa, where LGD use led to a 79% increase in tolerance towards cheetahs (Rust et al. 2013). Whereas in Namibia, farmers halted retaliatory killings on protected apex predators (cheetah and leopard) but increased the killing of mesopredators (jackal and caracal) (Potgieter et al. 2015).

The historic use of LGDs might also be responsible for the tolerant attitude towards these species in rural areas of Romania. The presence of large carnivores in the Carpathians is seen as something normal by local farmers and herders; having some losses due to predation within their flocks is part of a shepherd's yearly business plan (Inf. Chiriac S.). In Maramureş, older shepherds would say:

If a wolf comes and takes away one of your sheep that means it was destined for it. God Himself gave that sheep to the wolf. Wolves come and take only what was meant for them. (Inf. 6)

However, there might be regional differences in these traditional attitudes regarding large carnivore presence in rural areas within Romania. In the Southern Carpathians, in the area of the famous transhumant shepherds of Southern Transylvania, locals have asserted that, in the past, there were not as many large carnivores as nowadays and implied that lethal control methods were more widely employed (especially by hunters from the area) (Inf. 45). The development of transhumant pastoralism in Southern Transylvania was linked to the development of the textile industry in Sibiu and Braşov (Huband et al. 2010) and, thus, linked to the emergence of a pre-capitalist worldview among transhumant pastoralists (Constantin 2003; Dragomir 2014).

Interactions between herders and large carnivores are extremely complex. Herders have deep ecological knowledge regarding their behavior as shown by other researchers (Lescureux 2006, 2018; Lescureux and Linnell 2014; Lescureux et al. 2014). Locals perceive the wolf as an extremely intelligent animal; some herders claim that the wolf knows if the LGDs in the sheepfold are brave just by the way they bark and it can plan accordingly (Inf. Popa R.).

Lethal control methods were also employed in Romania like in other parts of the world. These actions occurred on an individual and collective basis (Vuia 1980) and were not as widespread as in the rest of Europe. With the advent of communism, a systematic extermination campaign started in 1949 and lasted until 1979. Beginning in 1980 the campaign was halted because it exterminated the last remaining vultures in the Carpathians and had a severe impact on wolf populations (Filipaşcu 1977; Geacu 2009). Along with lethal and non-lethal

control methods, farmers also used what in cultural ecology is called *passive environmental manipulation* (Sutton and Anderson 2014). Traditional Romanian communities were holding several holidays but also used taboo names or performed specific rituals during these holidays which were meant to keep livestock safe from wolf and bear depredation. In the interwar period, peasants had over 35 holidays dedicated to the wolf alone (Candrea 2001).

A small first endeavor in linking the use of native LGDs and large carnivore conservation was undertaken by the Faculty of Forestry in Braşov, followed by the larger WolfLife Project, coordinated by the Agency for Environmental Protection, Vrancea. Another initiative was coordinated by the Fauna & Flora International Romania under the LIFE Connect Carpathians umbrella. All these projects offered free purebred Carpathian Shepherd Dogs to local herders to decrease predation by wolves and bears. Currently, WWF Romania and Conservation Carpathia Foundation (Foundation Conservation Carpathia 2019) are conducting similar campaigns.

At the beginning of the WolfLife Project, experts involved realized that decreasing livestock numbers lead to a decrease in expert herders and purebred LGDs. Herders became involved in this program and now many of them have registered kennels. The experts involved in this project acknowledged that the herder's TEK and observations played a major role in the successful implementation of their project (Inf. Chiriac S.).

Another important development, as Radu Popa, an experienced conservationist, noted, was the emergence of a new trend among pastoralists. Native LGDs were replaced with more aggressive LGD breeds like the Kangal or the Caucasian Shepherd. These breeds are not well adapted to the climate of the Carpathians nor to the threats they face here. LGD breeds from Asia are notorious for their uncontrolled aggressiveness and territorial behavior.

They are especially dangerous in touristic areas, where there are reports that tourists have been mauled. The Carpathian Shepherd Dog was chosen for this campaign because it is not as aggressive as other dogs, towards both wildlife and humans, and it was a good opportunity to increase the popularity of the breed (Inf. Popa R.).

The LIFE Connect Carpathians Project was carried out in the Apuseni Mountains and in the Southern Carpathians. The project studied the genetic makeup of LGDs and concluded that most shepherds had mixed LGDs of the native Romanian Shepherd Dog breeds (63% of cases). The Romanian Mioritic Shepherd Dog followed, along with the Romanian Bucovina Shepherd Dog in the top preferences of the herders (Connect Carpathians 2020).

Besides their crucial value in livestock management, LGD breeds also present historical and ethnographical value as cultural trademarks of the geographical space where they were bred. As the rural landscapes of Europe continue to change due to modern farming techniques and strong emigration trends, these dogs prove to be, as always, highly adaptable. Their continued use could lead to a higher efficiency in other conservation efforts worldwide, not just that of large carnivores in the Romanian Carpathians.

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