# CDP news

Carnivore Damage Prevention

Issue 24 WINTER 2022

**EXPERIENCE AND RECOMMENDATIONS FOR GUARD LLAMAS**

**PROTECTING HORSES FROM WOLVES AND BEARS**

**DONKEYS AS LIVESTOCK GUARDIAN ANIMALS**

LIFE EURO LARGE CARNIVORES

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# EDITORIAL

"Life is change", it has been said[1], and change often comes with uncertainty. In many countries, New Year saw the rapid spread of Omicron: a new and highly infectious variant of the SARS-CoV-2 virus. As the COVID19 pandemic continues to evolve, living with so much uncertainty while having to readapt to the ever-changing 'new normal' can be difficult.

And yet, "change is the only constant in life… all things go and nothing stays… you cannot step into the same river twice"[2]. Evidence of this constant change is all around us, affecting myriad aspects of our daily lives, including those related to the environment, wildlife management and conservation. The EU's Common Agricultural Policy (CAP), for example, is currently in the midst of another process of reform, with implications for coexistence with large carnivores, as explained in the EU Large Carnivore Platform secretariat's update on page 18.

Closer to home, this issue of *CDPnews* marks the end of our funding from the LIFE EuroLargeCarnivores project. A summary of the project is presented on page 47. We are very grateful to WWF-Switzerland and WWF-Germany who have stepped forward and committed to support us during our next publication cycle. This will allow us to maintain an objective presentation of practical guidance on how to adapt to the challenges posed by living with large carnivores.

Our editorial team is also mutating. We thank Rita Konrad for her work and wish her all the best for an enjoyable retirement. We are grateful to Daniel Straub and Jacqueline Meier for helping us with the layout for this issue. We would like to take this opportunity to acknowledge once again Armando Lopes, who created the current design of *CDPnews* within the LIFE MedWolf project in 2012–2017.

To bring some welcome continuity amongst so much change, we continue with the theme of horses from the previous issue. In this issue, two more articles deal with wolf predation on free-ranging ponies in NW Iberia and how damage might be reduced. An interview with a Montana outfitter shows how horses and bears can coexist and we have an article from Germany on the reaction of horses towards wildlife and guard dogs. Donkeys are included, with a review of their effectiveness as guard animals worldwide and a report on trials with cattle in Spain. We also take a look at recent experience with guard llamas in Switzerland. This issue is rounded out with our regular sections featuring abstracts, books, videos and news.

As we prepare to transition into a new funding period, *CDPnews* will probably also change. Your views and preferences are important – by taking a few minutes to participate in our reader survey, you can help us improve our content, format and accessibility. Please complete the questionnaire.

In these times of change, you can rely on *CDPnews* to continue to provide interesting and informative reading!

The Editors

[1] *https://www.psychologytoday.com/us/blog/your-write-health/201204/life-is-change*
[2] *https://iep.utm.edu/heraclit/#H3*

Perspective

# OBSERVATIONS OF WOLVES HUNTING FREE-RANGING HORSES IN NW IBERIA

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## 1. Introduction

In the mountains of NW Iberia, free-grazing horses *(Equus ferus)* have coexisted with wolves *(Canis lupus)* for millennia, developing a specific ecological relationship. Two breeds are recognised, the *Cabalo de Pura Raza Galega* in Galicia, NW Spain, and the *Garrana* in NW Portugal, which are known collectively as *garranos*. They are small[1], light horses (< 140 cm at the withers, < 300 kg; Pereira, 2018) that live in bands of one or more stallions with several mares, their foals and occasionally subadults from previous years (Lagos, 2013).

Although they are domesticated, *garranos* are left to graze year-round on common lands in the mountains, where there is hardly any human presence or influence over their breeding (Fig. 1). At least once a year, in May–October, their owners round them up for identification and deworming. Foals are taken for meat, which is the horses' main economic worth, although some are still used for riding, equestrian training or as draught animals (Gouveia et al., 2000; Pose-Nieto and Vázquez-Varela, 2005).

In recent decades, numbers of *garranos* have drastically declined due to socio-economic factors including rural abandonment, mechanisation of agriculture and crossbreeding with larger horses to increase meat production (Pereira, 2018). Recent surveys have found fewer than 3,500 free-ranging adult *garranos*, which is in contrast to the 1930s, when there were estimated to be up to 40,000 in Portugal alone (Pereira, 2018).

Wolf predation is also contributing to the plight of *garranos*. Due to low density and diversity of wild ungulates and a steady decline in numbers of small livestock (i.e. sheep and goats), horses are now the main livestock species preyed on wherever their range overlaps that of wolves, with foals being particularly heavily predated (López-Bao et al., 2013; Freitas and Álvares, 2021 in *CDPnews* issue 23). A better understanding of wolf hunting strategies and the defensive behaviour of horses may help to improve horse management and devise measures to reduce losses.

Wolves face different challenges when hunting according to the prey species involved, but some general principles seem to apply. MacNulty et al. (2007) described a sequence of phases: search, approach, watch, attack-group, attack-individual, and capture. Attack includes either pursuit (when prey flees) or harassment (if prey stands), in both cases including selection of an individual which, in the case of a

[1] Iberian wolves are also relatively small, with a shoulder height of c.60–70 cm and weight of 25–40 kg.

**Fig. 1** *Garrana* mare and foal in NW Portugal. *(Photo: Karin Boldt/ACERG)*

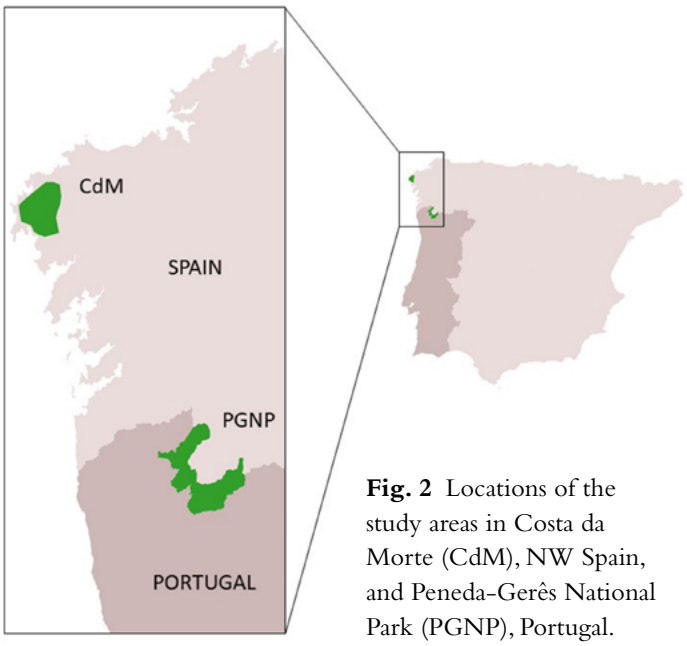


**Fig. 2** Locations of the study areas in Costa da Morte (CdM), NW Spain, and Peneda-Gerês National Park (PGNP), Portugal.

successful hunt, is followed by its capture. Capture can also follow search or approach when a wolf grabs immobile prey (e.g. new-born foals).

During encounters with wolves, prey may react by approaching wolves, standing their ground or fleeing (Mech, 1970). When prey flees, wolves almost always immediately give chase but, if they fail to get close enough to attack, they may give up the pursuit. If prey animals stand their ground, wolves typically harass them until one is separated from the group or succumbs to injuries. When large prey animals are involved, it may take several hours until wolves can safely approach to kill and eat them.

It is difficult to study the hunting behaviour of free-living wolves directly because they are mostly active at night and are wary of humans. The few studies that exist are mostly based on opportunistic observations of attacks on wild prey (Mech et al., 2015). Information on wolf–horse interactions is scarce, making every reliable record, albeit anecdotal, potentially important. In cases of second-hand reports, however, care must be taken to avoid bias by critically evaluating observer subjectivity and possible influence of myths. We therefore decided to share field notes describing sightings of predatory interactions between wolves and free-ranging horses made by the first author and statements by shepherds interviewed by the second author. We hope this may encourage others to divulge their own observations and records which might be useful to researchers and managers as well as horse owners.

## 2. Study areas

Direct observations and footage of wolf attacks on horses were made in Costa da Morte (CdM), Galicia, NW Spain. Interviews with shepherds took place in Peneda-Gerês National Park (PGNP), NW Portugal (Fig. 2). CdM is an Atlantic coastal environment characterised by rugged cliffs and low mountain ranges of up to 650 m. PGNP is a mountainous area in the transition zone to a Mediterranean environment, dominated by granitic rocks with deep valleys and elevations reaching 1,545 m. Mountain pastures are characterised by meadows, herbaceous plants, heather and gorse *(Ulex europaeus)*, with deciduous and pine forest patches, meadows and agricultural fields in the valleys (Fig. 3). Wild prey is present throughout both areas: wild boar *(Sus scrofa)* are common and roe deer *(Capreolus capreolus)* are increasing but not yet abundant (< 2.2 inds./100 ha in CdM, Xunta de Galicia, 2004; 1.5–5 inds./100 ha in PGNP, Ferreira, 2003). Wolves are present at high densities: ≥ 2.29 inds./100 km² in CdM (Xunta de Galicia, 2008) and ≥ 2.6 inds./100 km² in PGNP (Álvares, 2011).

Human population density in the study areas is low and settlements are dispersed. Agriculture and livestock breeding are the main activities, usually in small-scale family production systems although in Spain there are also professional dairy farms, mostly inland. Husbandry is characterised by extensive grazing of cattle and horses that reach high stocking densities (up to 19 head/100 ha in PGNP; INE, 2001).

There are also shepherded flocks of goats and sheep, mostly in Portugal (e.g. 18–21 head/100 ha in PGNP; INE, 2001), as well as smaller flocks of 10–20 sheep, mostly in Spain, which are grazed in pastures closer to villages.

Groups of horses comprise between six and 40 animals, sometimes of two or more owners. In Portugal, most are purebred *Garrana* but many in Spain result from crosses with larger breeds. There are considerable losses of free-ranging horses and cattle due to wolf predation (see Freitas and Álvares, 2021 in *CDPnews* issue 23). Damage is compensated by authorities after an assessment to confirm wolf predation but, for owners of free-ranging livestock, eligibility criteria are difficult to meet. For example, in Portugal compensation is conditional on the presence of a shepherd and livestock guarding dogs, which is generally considered unfeasible with free-ranging horses (but see Lagos and Blanco, 2021 in *CDPnews* issue 23).

**Fig. 3** Free-ranging band of *garranos* in PGNP, NW Portugal. *(Photo: ACERG).*

## 3. Direct observations

During the last 25 years, the first author of this article has regularly visited mountain pastures in Costa da Morte, Spain, to observe wolves and other wildlife. His field notes and extensive video recordings (made using a video camera attached to a telescope) include four records of predatory wolf–horse interactions. In the following sections, field notes of these observations are illustrated with images taken from the respective videos.

### 3.1 Mare protecting an injured foal from two wolves

**16th September 2012, 08:57–20:25**

"The intrusion at dawn by a hunter with his hunting dogs made me change the location of my usual vantage point. This inconvenience, however, enabled me an hour later to see two wolves on a mountain slope stalking a grey mare belonging to a band that, surprisingly, grazed several metres away. The wolves, a grey male and a browner female, were staring at the grey mare that seemed not to want to move away from a specific point, among some pine trees near a track. Located about 530 m away, I could see that she was protecting a foal that was trying, with difficulty, to stand up. From my position, the crown of a pine prevented me from seeing clearly what was happening to the foal. The first impression was that the wolves had tried to prey on a new-born, as the mare had a blood-stained flank. The wolves, patient, moved up to a point from where they could see the horses better (Fig. 4).

"They defecated and lay down. Shortly after I could see the foal and I estimated an age of two weeks old. The young horse had received several bites that left open wounds in the hindquarters and in the neck and was barely supporting itself. I understood that the foal was mortally wounded. The foal tried to follow the mother who was trying to join the band (grazing 200 m away). This triggered the predatory instinct of the two wolves that had retreated to a small rise nearby, waiting for the mare to leave the badly injured foal. The wolves hurried a last attack, but the mare got in the way and protected the foal (Fig. 5). The two wolves slowly moved away before the mare's corpulence, following the same route as before. They had time to lie down and watch the horses.

"The foal and his mother drifted away a few metres before the foal fell on the track. The wolves decided to retreat to an area of thick brooms on the opposite slope. The mother and foal were not able to join the band. They remained in the same spot, with the foal lying down, mortally wounded. The area was covered with thick fog. I left the area and came back in the afternoon. Through the fog I could see the wolves lying close to the foal and the mare (Fig. 6). At 20:15 I could hear the mare whinnying and running and, ten minutes later when the fog disappeared, I could only see a fox marking the area with a scat. The next day, at dawn, I saw a fox feeding on the foal's carcass."

**Fig. 4** "The wolves, patient, moved up to a point from where they could see the horses better." (The foal's hindquarters are visible to the right of the trees).

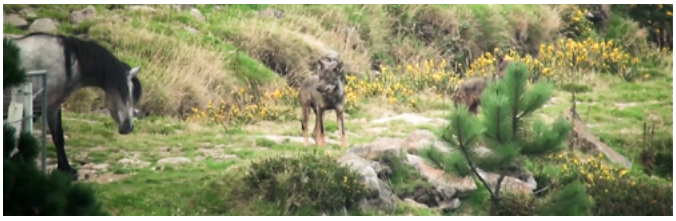

**Fig. 5** "The wolves hurried a last attack, but the mare got in the way and protected the foal."

**Fig. 6** "Through the fog I could see the wolves lying close to the foal and the mare."

**Fig. 7** "Slowly the wolves withdrew and the horses relaxed and resumed their grazing routine."

### 3.2 Mares regroup around foals to protect them from two wolves

**8th April 2017, 07:59–08:08**

"From my vantage point I could see three bands of horses: two less than one kilometre away (one behind me, towards the west, and the other in front of me) and another 2.8 km away (northward). At first light the whinnying of several horses on a mountain top caught my attention. I directed the camera's viewfinder and saw two wolves heading towards a group of nine horses with two foals, one a few weeks old and the other even younger. The movements were very fast and in a few seconds the wolves were close to the group of horses and were harassing them. The wolves directed their attack at the foals but, in a few seconds, the mares formed a group with the foals in the middle, protecting them. Slowly the wolves withdrew and the horses relaxed and resumed their grazing routine (Fig. 7). It was a failed attack that lasted only a few seconds but set the whole group on edge."

### 3.3 Wolves harass horses and wait until they lose interest in dead foal

**2nd August 2018, 07:37–10:20**

"It is 07:30. I leave the car and start along the trail to the vantage point. I go up to the rock where I am going to wait and, before sitting down, I hear several whinnies and turn my head towards a band composed of a stallion and four mares. I see two wolves harassing the horses, charging and retreating a couple of times (Fig. 8). The horses are in a pasture plot located on a mountainside enclosed by a metre-high stone wall. The most daring wolf quickly retreats before a furious onslaught of the stallion (Fig. 9). The horses seem to be protecting a foal, about two months old, lying dead close to a stone wall. Behind the wall, I can see two wolves running. There are a total of three wolves participating. A chestnut mare approaches the dead foal. It seems the wolves are retreating but one of them turns and runs across the meadow, behind the low wall that separates him from the stallion. Another wolf follows him. They stop and look. A wolf tries to charge the horses from the opposite side but comes back quickly.

"I am at a distance of more than half a kilometre. At times it seems the activity slows down, the horses graze but the wolves observe them from a safe distance or from behind the wall. The horses begin to leave the area. Little by little they move away from the wall. A female wolf approaches the dead foal from the other side of the wall. The chestnut mare grazes away from the foal but without losing sight of it. The wolf goes around the wall and straight to the carcass. When the wolf is a couple of metres away, the chestnut mare begins an onslaught directed at the wolf. She does not reach it and the wolf protects herself on the other side of the wall. The she-wolf moves away a little more and lies down. In the meadow, the first rays of sun begin to shine. Meanwhile another wolf arrives. I can see its residual mammary glands, indicating she is the

**Fig. 8** "I see two wolves harassing the horses, charging and retreating a couple of times."

**Fig. 9** "The most daring wolf quickly retreats before a furious onslaught of the stallion."

**Fig. 10** "All of them eat together until they are satisfied."

breeding female. The two wolves meet and the other female licks the breeder's muzzle.

"Once the mare is far away, the breeding female approaches the foal and, with prudence and measuring her steps, begins to eat. The other wolf approaches, fearful, and they both eat together. Suddenly the third wolf appears; it is a male. All of them eat together until they are satisfied (Fig. 10). The horses continue to graze on the meadow 100 m away."

### 3.4 A band protects the foals but wolves keep returning

**12th July 2020, 12:00–22:40**

"Chance, enormous effort and intensive monitoring of horse bands, with continuous counts of births and deaths, has given me my most unexpected field observation so far. Witnessing an attack from start to finish, in this case by five wolves on a band consisting of a stallion, three mares and three foals, is extremely rare. It was not, in the end, a successful attack with a kill, but nevertheless a huge insight into the ancestral relationship between wild horses and wolves, greatly contributing to my experience and knowledge of predator–prey relations.

"After an unsuccessful attempt to watch wolves from my vantage point, I went to check another group of horses. I had been monitoring this band since 11th May, when the three foals of the respective mares had already been born. When I found the band, suddenly I saw a wolf circling the horses. I focused the viewfinder on the foals and counted all three (about 10 weeks old at that time), but two of them had been bitten on the hindquarters and belly, the bright red colour of blood clearly seen. The wolf disappeared up the hillside. I persisted in waiting a couple of hours in case it came back but it did not. I returned in the afternoon and at 18:30 I saw the wolf again, resting in the bushes. The whole band was there together: the grazing horses and the semi-immobile and somewhat apathetic foals, close to their mothers.

"Hours later, at sunset after a calm and sunny evening, I noticed a lump to the left of the herd. Suddenly, it began a swift race toward the horses. It was a wolf, a male, and behind him two more appeared (one was the breeding female) from behind gorse bushes (Fig. 11). Shortly after, a fourth wolf (another female) joined the attack, running down from above. It was a surprise attack. The wolves harassed all the foals, but the mares protected them (Fig. 12). The three mares tried to kick the wolves with their hind legs and, with lowered heads, chased them away from the foals while the stallion chased any wolf that came closest to a foal. The male wolf persisted in threatening a brown foal and was the last to withdraw. In contrast, the breeding female, after the initial attack, was more cautious, observing the movements of her pack mates (Fig. 13). The non-breeding female was also quite persistent. After 2.5 minutes, the wolves withdrew without success. Except for the first moments, the foals were never left alone or helpless, nor did they move away from the band. The group made a strong and effective defence."

It is worth mentioning that, in this case, harassing wolves frequently exhibited play bows[2] when facing the horses, wagging their tails and sometimes leaping

[2] This is an easily recognisable behaviour in canids, characterised by bent forelegs and raised hindquarters.

forward (Fig. 14). This behaviour was either followed by fleeing, to avoid charging horses, or stopped if the horse turned its attention away from the wolf.

"The wolves withdrew but they did not forget the band. On 10th September I noticed the loss of one of the foals (which would have been approximately four months old). Due to this loss, the farmer moved the horses to a meadow near houses in the village. On 14th October they returned to their usual location.

**Fig. 11** "It was a wolf, a male, and behind him two more appeared (one was the breeding female) from behind gorse bushes."

**Fig. 12** "The wolves harassed all the foals, but the mares protected them."

**Fig. 13** "The breeding female, after the initial attack, was more cautious, observing the movements of her pack mates."

**Fig. 14** "…harassing wolves frequently exhibited play bows when facing the horses…"

On 23rd October I observed two wolves, the male and non-breeding female, revealing themselves from behind bushes after eating the second foal (at that time about 5.5 months old). On 3rd November I could see that there were no foals left in this band."

## 4. Interviews with shepherds

During interviews conducted in April–December 1995, shepherds in the PGNP region, NW Portugal, described a total of 166 wolf–livestock encounters. These accounts could not be verified, but they were considered credible by the interviewer (Ribeiro, 1996). Seven of them concerned alleged attacks on free-ranging horses, two others referred to wolves approaching grazing horses and one to the reaction of a band after detecting a wolf. Such statements were rarely the result of prolonged observations and shepherds usually reported having intervened to stop attacks. Their accounts of wolf–horse encounters can be grouped into several types of scenarios, as described below.

### 4.1 Wolves approaching horses

Shepherds reported that wolves frequently used landscape features (e.g. rocks, walls, water courses) and vegetation cover to approach horses without being detected. In two accounts, a shepherd described a situation where one wolf was hidden or lying down amongst vegetation, close to where a band of horses with foals was grazing. One of the foals seemed to be curious and approached the wolf. When the foal was far from the band its mother whinnied and it returned to her.

### 4.2 Horses bunching after detecting a wolf

Another account described the reaction of a band of nine mares and one stallion to an approaching wolf. The horses were scattered while grazing in woodland when they suddenly gathered together. The stallion and some mares raised their heads in an alert posture and, after a while, the observer saw a wolf moving along a nearby trail.

### 4.3 Wolves harassing and attacking horses

There were four accounts of attacks on single horses. Two of them described one wolf attacking a foal and the other two referred to two wolves attacking adult horses. In all cases, shepherds mentioned

that wolves were very agile and easily switched between frontal and rear attacks. Horses used their fore or hind legs to defend themselves. When attacking foals, wolves focused on the hindquarters (Fig. 15). In one case, a wolf managed to bring down a foal that was already weakened by injuries to its hindquarters before the observer was able to stop the attack.

The joint action of two or more wolves apparently greatly facilitated the capture of horses. For example, according to one of the accounts, two wolves took up positions in front and behind a horse. The wolf in front made a series of forward movements, alternating from one side of the horse to the other. The other wolf tried to bite the horse's hindquarters while avoiding its kicks. The shepherd mentioned that the wolf in front, "seemed to be playing with the horse, like dogs play with each other"[3]. In another description of an attack by two wolves on an isolated horse, the wolf in front managed to grab a horse by the neck when it turned its head back in response to attacks from behind by a second wolf. In this case, the shepherd intervened and both wolves ran away. According to shepherds, wolves usually flee when people approach them to stop attacks.

Two accounts described attacks on horse bands. In both cases, wolves focused on foals (Fig. 15), although other individuals that became separated from the band were also targeted and attacked. In one case, a single wolf moved around a band and made repeated attempts to grab one of the foals while avoiding the protective behaviour of the mare and other band members. In the other case, a wolf jumped to try to bite one of the foals in the neck but was forced back by the protective behaviour of other horses. Between attacks, the wolf sometimes lay down for a while a few metres from the band. The horses stayed together and fended off attacks from the rear by kicking backwards and from the front by trying to bite their assailant or using their forelegs to strike or stomp it. The stallion was said to circle around the band, moving between the mares or foals and the wolves.

**Fig. 15** An injured *Garrana* foal in PGNP, NW Portugal. Wolves usually targeted foals and tried to grab and bring them down with repeated attacks to the hindquarters. *(Photo: Helena Rio-Maior)*

### 4.4 Wolf attempting to grab a fleeing horse

In the only account of a wolf pursuing horses, a wolf was seen running alongside galloping horses and leaping up in an attempt to bite one of them in the neck. The wolf managed to grab an adult horse when it changed direction, but the horse was able to release itself and escape. The horses galloped in an almost linear formation, one behind the other.

## 5. Discussion

We collected and analysed a total of 14 eye-witness accounts from two different sources that provide insights into the behaviour and strategies of Iberian wolves and free-grazing horses during predatory interactions in NW Spain and Portugal.

### 5.1 Hunting strategies of wolves

Wolves apparently took advantage of landscape features and vegetation cover to get as close as possible to prey before attacking. This behaviour has been previously reported in wolves hunting both wild and domestic species, with wolves in some cases approaching to within 10 metres before being detected (Mech, 1970; Vyrypaev, 1980). One of the shepherds interviewed in Portugal described seeing play-like behaviour of a wolf toward a horse and play bows were filmed by the first author during an attack by several wolves on a horse band. Play is typically directed at conspecifics, but Fox (1971) also observed wolves occasionally exhibiting play behaviours when interacting with prey.

In the accounts we collated, the main points of attack were described as the neck and hindquarters (Fig. 16), which is in accordance with data collected by the second author while accompanying inspectors

[3] Compare this with play bowing described in section 3.4 and shown in Fig. 14.

examining horse carcasses at alleged damage sites as part of the process of assessing claims for compensation (Ribeiro, 1996). In 11 cases (three mares, eight foals), incomplete consumption by wolves and scavengers allowed identification of individual bite wounds. Bites to the neck were seen in 7/11 cases, to the hindquarters or groin in 4/11 cases and to the flank or abdomen in 2/11 cases. A similar pattern was found by Lagos (2013) when examining foals injured by wolves and by the third author during a study of wolf predation on horses in Galicia (Palacios unpublished data).

It can take several hours for wolves to weaken or kill an animal and, as seen by the first author, attacks may be resumed after a break of several hours, days or even weeks. Rest periods may be common during prolonged attacks and have been observed in single wolves or packs attacking large prey species including bison *(Bison bison)*, muskox *(Ovibos moschatus)* and moose *(Alces alces)* (Carbyn and Trottier, 1988; Gray, 1983; Mech, 1970). Capture success is higher for larger packs when hunting more formidable prey, since they seem to be more cooperative (MacNulty et al., 2014).

### 5.2 Defensive behaviour of horses

When they detected wolves, *garranos* became alert, grouped together and either stood their ground or moved away. This is similar to reported responses to wolf howls of Konik polski horses, which grouped together tightly and stood with heightened alertness (Janczarek et al., 2020). When attacked, *garranos* either galloped away (Fig. 17) or stood their ground in a defensive group and tried to fend off wolves with rushes, attempts to bite or kicks of the fore and hind legs. The use of forelegs was also observed by Ebhardt (1954) in a band of Irish wild horses in northern Germany that advanced toward foxes *(Vulpes vulpes)*, badgers *(Meles meles)* or domestic dogs in a tight group. Horses fleeing in a linear formation (see section 4.4) was reported in a group of wild horses in Alberta, Canada: when they detected a wolf a few metres away, 14 mares and a stallion, that had been dispersed while grazing, bunched together and calmly abandoned the site in a linear formation with the stallion protecting the rear (Salter, 1978 in Bouman, 1990).

According to our records and reports, wolves targeted foals whenever they were present. Foals are highly vulnerable, particularly when in small bands or separated from the group. Mares whinny to encourage their foals to move closer to them, presumably so they can be more readily defended from attack. Such behaviour was mentioned by Vyrypaev (1980), based on accounts from guards of the Chatkal Nature Reserve in the former USSR. In a study in NW Portugal, after simulated wolf howls, foals moved closer to adult horses, their alertness increased and in approximately one third of cases bands fled (Rio-Maior et al., 2006).

The experience and perseverance of mares as well as the stamina and protective behaviour of stallions seem to be important factors influencing the outcome of attacks. The level of cohesion in a band, which reinforces group defence, may also be important, including the ability of stallions to keep mares together, preventing them becoming separated from the band and thus more vulnerable. Feist and McCullough (1976) stated that band stability results from the leadership ability of the stallion and the fidelity of the mares to the group. Lagos (2013) highlighted the importance of band cohesion, since mares with stronger and more stable associations have a higher rate of foal survival (see the article by Lagos and Bárcena in this issue). This author also suggests that more experienced mares may reduce predation by increasing vigilance and avoiding areas where the risk of being ambushed by wolves is higher (Fig. 18). Thus, any human intervention in the composition of bands, namely by adding or removing animals, should be made with care to avoid disturbing their social structure and negatively affecting band cohesion and defensive success.

**Fig. 16** Foals can be severely wounded as a result of wolf attacks and may later succumb to serious injuries. *(Photo: Mónia Nakamura)*

## 6. Conclusions

Our article illustrates the potential of eye-witness accounts to supplement the rather limited information available on the strategies of wolves hunting free-ranging horses as well as the defensive behaviour of horses. Second-hand reports tend to be unverifiable but, if collected appropriately and interpreted cautiously, may provide some useful information. For example, the unusual play-like wolf behaviour described by one shepherd was later documented in video footage of another attack. The large body of material potentially available from informal observations could help guide further research on wolf–horse interactions as well as measures designed to improve horse husbandry and reduce losses to wolves.

**Fig. 17** Fleeing *(galloping)* is one of the strategies used by horses to escape wolf attacks. *(Photo: Karin Boldt/ACERG)*

**Fig. 18** A young *Garrana* foal rests while its mother grazes a few metres away in PGNP, NW Portugal. Experienced mares may reduce foal predation by increasing vigilance and avoiding areas where the risk of being ambushed by wolves is higher. *(Photo: ACERG)*

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Review

# ARE DONKEYS GOOD LIVESTOCK GUARDIANS?

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## 1. Introduction

Guard animals are familiar in many parts of the world as a method of protecting livestock from predators (Smith et al., 2000). The most common are livestock guarding dogs (LGDs), whose use is currently undergoing a revival (Linnell and Lescureux, 2015) and has spread well beyond their original Eurasian homelands (e.g. van Bommel and Johnson, 2012). Perhaps less well-known is that several other species, including equids and camelids, have been employed as livestock guardians (Dohner, 2007).

This article presents an overview of the use of guard donkeys, their pros and cons and the evidence for their ability to deter predators. Comparisons are made with LGDs and some notes on best practices for husbandry are included as well as a list of sources for more detailed practical information.

## 2. Donkeys as guard animals

The donkey was probably domesticated from wild asses *(Equus africanus)* over 5,000 years ago in Nubia (Wang et al., 2020), where it was used as a pack animal. It still serves this and other purposes in Africa, Eurasia and beyond (Fig. 1). European settlers took donkeys (or 'burros') to the Americas, and here as well as elsewhere they have since been put to new use as livestock guardians (Bourne, 1994).

**Fig. 1a** Donkeys are used around the world for transport in rural areas with little infrastructure. *(Photo: D.Mettler)*

**Fig. 1b** Mules are especially suitable for transporting heavy loads in difficult terrain. *(Photo: D.Mettler)*

**Fig. 2** Donkeys and sheep on an alpine pasture in western Switzerland. *(Photo: AGRIDEA)*

Donkeys, unlike LGDs and some llamas, do not "patrol" pastures (for more information on guard llamas, see the article by Derron-Hilfiker and Mettler in this issue). However, they are vigilant and, when kept with other livestock, their behavioural traits can provide protection from predators for the whole flock. In contrast to horses, which are usually more skittish and flee from danger (see Janczarek et al., 2020), donkeys tend to stand their ground and confront threats. They have an inherent dislike of canines. Donkeys typically respond to intruders by vocalising ('braying'), baring their teeth, running towards them and attempting to bite and kick them (Green, 1989). Mules (offspring of a male donkey and a female horse) show similar characteristics (Braithwait, 1996; Walton and Feild, 1989) and may be more aggressive than donkeys (Marker et al., 1996). Sheep seem to regard a familiar donkey as a protector and gather behind or close to it if they perceive a threat (Dohner, 2007) (Fig.2).

## 3. Do they work?

According to an assessment by a panel of independent experts for the Conservation Evidence project[1], the use of guard animals to deter predators from livestock is "beneficial", with scores of 70% for effectiveness and 67% for certainty – a measure of the quality of the evidence available (Littlewood et al., 2020). However, none of the studies cited in the evaluation was on donkeys. Nor were any studies on donkeys included in a recent systematic review of damage prevention measures (Khorozyan, 2021). So, is there any evidence that donkeys are effective guard animals?

In September 2021 I conducted a targeted literature review using Google and Google Scholar web-based search engines to find information on guard donkeys in agricultural extension service publications, scientific journals, books, conference proceedings, theses, reports and other 'grey literature'. I also checked the digital libraries of the IUCN/SSC Human-Wildlife Conflict Task Force[2], the Large Carnivore Initiative for Europe[3], ResearchGate[4] and past issues of Carnivore Damage Prevention News[5]. Potential sources were screened for relevance, reliability and quality.

## 4. The evidence

Experience in the southern USA suggests that guard donkeys can be effective against coyotes *(Canis latrans)*, red foxes *(Vulpes vulpes)*, domestic or feral dogs and possibly bobcats *(Lynx rufus)*. In their responses to a mail survey, 17 sheep and goat producers in Texas rated 59% of 58 donkeys as good or fair. In another survey, 40% of 60 Texas sheep and goat producers

[1] https://www.conservationevidence.com/actions/2433
[2] https://www.hwctf.org/livestock-guarding
[3] https://www.lcie.org/Publications
[4] https://www.researchgate.net/
[5] https://www.cdpnews.net

rated their donkeys as fair, good or excellent against coyotes and 42% of them rated donkeys likewise against dogs (Walton and Feild, 1989). In Ontario, Canada, about 70% of guard donkeys were rated as excellent or good (OMAFRA, 2018). There are also anecdotal accounts of trapped and trained feral donkeys protecting sheep from dingoes, feral dogs and foxes in Australia (Bough, 2016).

Preliminary reports suggest that the presence of donkeys among cattle reduces predation by felines such as jaguars *(Panthera onca)* in central America (Hoogesteijn and Hoogesteijn, 2014). Smuts (2008) stated that donkeys had been "quite successful" at protecting cattle against lions *(Panthera leo)* in Kenya. He recommended them against leopards *(Panthera pardus)*, cheetahs *(Acinonyx jubatus)* and black-backed jackals *(Canis mesomelas)*. Three out of three surveyed farmers in South Africa reported decreases in losses of lambs to jackals and caracals *(Caracal caracal)* following acquisition of donkeys (Botha, 2018). Namibian farmers reported that donkeys placed in calving herds worked well against jackals, caracals and cheetahs (Marker, 2000). One mentioned seeing a mule trample a leopard to death (Marker, 2000). It has been suggested that donkeys may be suitable for deterring lynx *(Lynx lynx)* in Europe (Reinhardt et al., 2012).

**Fig. 3** Winter pastures in Vashlovani, Georgia, where wolves were found to selectively prey on donkeys and horses. *(Photo: R. Rigg/FFI)*

In response to the renewed presence of wolves *(Canis lupus)* in Switzerland from the mid-1990s, several farmers bought donkeys to defend their sheep (Landry, 2000). Although there are some indications that they might protect livestock from individual wolves (e.g. Cadurisch and Lüthi, 2004), donkeys are thought unlikely to be effective when faced with high predation pressure and/or wolf packs or other large carnivores such as bears (Breitenmoser et al., 2005; Green, 1989; Macon, 2018). Moreover, they may themselves become prey. A study in Georgia (Fig. 3) found that wolves selectively preyed on donkeys and horses in winter pastures (Rigg et al. unpublished data; see Rigg et al., 2017 in *CDPnews* issue 15).

## 5. Recommendations for best practice

Practitioners and researchers have found that the level of success of guard donkeys can be highly variable, with improper husbandry practices and unrealistic expectations, in addition to individual differences among donkeys, apparently contributing to many of the failures (Walton and Feild, 1989). It is recommended to use medium to large donkeys, with a shoulder height of at least 112 cm/44 inches (OMAFRA, 2018). Experienced users generally recommend one 'jenny' (female), or a jenny with foal, for each flock or pasture. Geldings can be used, but most intact adult males ('jacks') are too aggressive and may harm other animals, especially young lambs and kid goats. Mare mules, castrated or intact jacks and horse mules can be used but are often more aggressive toward livestock (Braithwait, 1996; OMAFRA, 2018).

Sheep typically become accustomed to the novel presence of a donkey within 1–2 weeks, but it is recommended to allow at least 4–6 weeks for bonding (e.g. Green, 1989). While it is possible to add donkeys of any age to livestock, those without any prior

**Fig. 4** If several donkeys are used there is a risk they may stay together and offer less protection to the flock. *(Photo: AGRIDEA)*

contact may initially act aggressively when placed in the same pasture (Dohner, 2007). In Switzerland, a single donkey guarding up to 50 sheep in an enclosure, or 200–250 sheep in a cohesive flock in mountain pastures, seemed to work best (Landry, 1999, 2000).

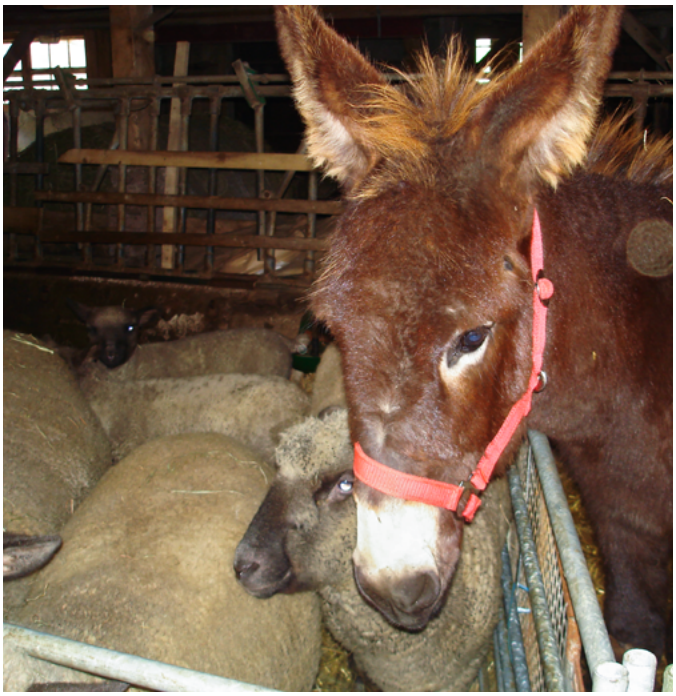

**Fig. 5** If donkeys and sheep are kept in a barn during the winter, there should be enough space to separate them. *(Photo: AGRIDEA)*

**Table 1** Summary of key considerations for using donkeys as guard animals (sources: in text).

| | |
|---|---|
| **Characteristics** | Independent, males are territorial.<br>Bond with other species when no conspecifics or other equines are present.<br>Alert to possible danger, excellent hearing and vision.<br>Aggressive to canines. |
| **Advantages** | Low cost, little training, easy management.<br>No special feed needed.<br>Typical lifespan of 20–30 years. |
| **Disadvantages** | Not suitable for some settings, such as large flocks and steep, large or brushy pastures.<br>May not be effective against larger predator species and/or those in groups.<br>Can be challenging to use with dogs, e.g. herding dogs. |
| **Effectiveness** | Provide protection against small to medium-sized predators, felines and possibly lone wolves but probably not bears or packs of canines.<br>Best results in open, clear terrain with small to medium-sized cohesive flocks.<br>Impaired by large or brushy pastures, large or scattered flocks, rough terrain. |
| **Husbandry** | Use medium-sized or large donkeys (not very small or miniature donkeys).<br>One jenny, gelding or jenny with foal per flock/herd/pasture.<br>To increase probability of bonding, raise foals with stock from birth or weaning and away from dogs.<br>Allow 4–6 weeks for older donkeys to bond with livestock.<br>Isolate guard donkeys from horses, mules and other donkeys.<br>Test for and select individuals with protective behaviour.<br>Watch for aggressive or possessive behaviour during lambing and remove donkey temporarily if necessary. |

**Fig. 6** Donkeys and dogs normally do not work well together but there can be exceptions, as in this example with livestock guarding dogs in Switzerland. *(Photo: AGRIDEA)*

Compared to other guard animals, donkeys act relatively independently (Müller, 2014) and, except for jennies with foals, show better protective behaviour when kept away from other donkeys (Pfister, 2009). Using several donkeys together or in adjacent pastures is not recommended (Fig. 4), as they tend to form their own group apart from other livestock (Green, 1989). Nearby horses may similarly distract donkeys. Not all individuals show optimal protective behaviour; this can be tested using dogs as surrogate 'predators' (see Cavalcanti and Knowlton, 1998) in order to identify and replace donkeys that respond passively. Such testing needs to be done carefully to avoid injury to dogs.

If livestock is confined to a barn in winter (Fig.5), donkeys should be kept close by in a stall large enough to allow them to roll on the ground (Landry, 2000). Some over-protective donkeys try to stop rams breeding ewes (OMAFRA, 2018). It may be necessary to temporarily separate a donkey from a flock during breeding and lambing to avoid such issues and to prevent harm to new-born lambs or disruption of ewe–lamb bonding (Green, 1989). It is preferable to time breeding so that donkeys give birth a month before calving/lambing, the goal being that the jenny will be protective of all young animals in the group as well as her own foal.

## 6. Comparisons with dogs

Donkeys have multiple advantages as guard animals (Table 1). Unlike LGDs, they do not have to be raised with livestock from a very young age or provided with their own special food on a daily basis. They need less care than dogs, have longer lifespans, are less prone to premature death (Lorenz et al., 1986) and are more compatible with lethal predator control measures that may be used concurrently (Andelt, 2004). Moreover, they are less likely to be involved in conflicts with hikers, cyclists and other land users (Mosley et al., 2020; Potet et al., 2021), to wander away from their flocks and negatively impact other people's livestock or wildlife (Smith et al., 2020).

On the other hand, guard donkeys probably offer less protection than dogs, especially against large carnivores and those in groups (Andelt, 2004; Wilbanks, 1995), although there is a lack of controlled trials in standardised conditions to confirm this assertion. LGDs are likely to be successful in a wider range of scenarios than donkeys. For example, in the USA they reportedly reduced losses to coyotes and dogs both in fenced pastures and on open range, whereas donkeys seemed best suited to fenced pastures of up to 120 hectares (Andelt, 2004). Larger flocks and bigger or brushier pastures can be protected with multiple dogs, whereas adding additional individuals is not appropriate with donkeys. In addition, donkeys may have difficulties grazing on steep mountain slopes (Landry, 1999, 2000).

## 7. Conclusions

Donkeys are relatively quick, cheap and easy to implement and avoid some of the potential problems and disadvantages of LGDs. This review shows that there have been very few scientific studies on guard donkeys, but many experienced users have attested to their effectiveness against a variety of canines. They might be useful where golden jackals *(Canis aureus)* predate on livestock (e.g. Fanin et al., 2018, Yom-Tov et al., 1995). There are also claims that they offer protection from felines, so they might be effective against lynx. More robust research, including controlled trials, is needed before firmer conclusions can be reached (cf. van Eeden et al., 2018; see also Rigg et al., 2019 in *CDPnews* issue 18 and Louchouarn et al., 2020 in *CDPnews* issue 19).

Husbandry practices and local conditions often have a substantial impact on the success or otherwise of damage prevention measures, including guard animals. Furthermore, not all individuals make equally effective guardians. Only those that clearly demonstrate protective temperaments should be used. Cavalcanti and Knowlton (1998) identified easily recognisable indicative traits to help select the most suitable llamas for guarding. Similar criteria are needed for donkeys.

Donkeys could be a good option for smaller operations such as hobby farms or supplementary income farms, on farms with a lot of visitors or for people not comfortable with large dogs (Dohner, 2007), especially where predation pressure is low or limited to small and mid-size predators. Before acquiring a guard animal for the first time, it is highly advisable to obtain more practical information. Detailed guidelines and recommendations on the use of donkeys and other livestock guardians are available from the following links:

- Guidelines for using donkeys as guard animals with sheep[6]
- Lamas und Esel[7] [in German]
- Livestock guard dogs, llamas and donkeys[8]
- Livestock guardians: using dogs, donkeys and llamas to protect your herd[9]
- Protecting livestock with guard donkeys[10]
- Selecting a guard donkey[11]
- Using guard animals to protect livestock[12]


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[6] https://www.ontario.ca/page/guidelines-using-donkeys-guard-animals-sheep

[7] http://www.protectiondestroupeaux.ch/zaeune-weitere-schutzmassnahmen/weitere-schutzmassnahmen/lamas-und-esel/

[8] https://mountainscholar.org/bitstream/handle/10217/182976/AEXT_ucsu2062212182004.pdf?sequence=1&isAllowed=y

[9] https://www.storey.com/books/livestock-guardians/

[10] https://open.alberta.ca/publications/2394184

[11] https://www.jandohner.com/

[12] http://www.predatorfriendly.org/how-to/how-to-pdf-docs/Using%20Guard%20Animals%20to%20Protect%20Livestock.pdf

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# Reform of EU agricultural policy and the financing of prevention measures

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**https://ec.europa.eu/environment/nature/conservation/species/carnivores/coexistence_platform.htm**

## 1. Common Agricultural Policy

The EU's Common Agricultural Policy (CAP) is one of the main EU funding streams to support implementation of the EU Biodiversity Strategy. One of its nine specific objectives is to contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes. Biodiversity measures can also include measures to prevent damages by protected species such as large carnivores. Under the 2014–2020 CAP, prevention measures in 12 Member States were financed using Rural Development Programmes (RDPs)[1]. The CAP 2023–2027 regulation was adopted in December 2021. Most Member States have submitted their CAP Strategic Plans to the Commission and a feedback process is underway before the plans are adopted from mid-2022 so that implementation can start in 2023.

## 2. CAP reform

The CAP is one of the oldest EU policies but is subject to constant reform to update it to meet new policy needs. It is made up of two different funds: the European Agricultural Guarantee Fund (EAGF), which provides direct support to farmers and covers a range of market measures, and the European Agricultural Fund for Rural Development (EAFRD), which funds rural development programmes across the EU. The regulations governing these funds are updated at the same time as the EU's overall budget (the Multi-annual Financial Framework, MFF). The last funding round was supposed to end in 2020 but has been prolonged until 2022.

Reform for the 2023–2027 period has been a long and drawn-out process and implementation of the new CAP is late. Over three years after publication of the Commission's suggestions in June 2018, the three regulations governing the CAP[2] (Horizontal on financing, management and monitoring; Strategic Plans; and Common Market Organisation) were adopted in December 2021 with their implementing regulations. Member States now need to set up the system for implementation so the new CAP will be in place at the start of 2023. The 2014–2020 CAP framework has been extended two years until 2022 and some measures under RDPs will continue to be applied until 2025[3].

## 3. New for 2023–2027

The main changes are to move the whole CAP to a 'programming approach', which was previously applied to rural development only, increased flexibility for Member States to define their intervention logic and a shift towards a results-based policy rather than a compliance-based policy. Member States will implement the future CAP with the so-called CAP Strategic Plan (CSP) at national level but with the possibility to further refine interventions at regional

[1] Marsden K and Hovardas T (2020) EU Rural Development Policy and the management of conflictual species, The case of large carnivores. Biological Conservation 243, 108464. https://doi.org/10.1016/j.biocon.2020.108464

[2] European Commission website: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/new-cap-2023-27_en#legalbases

[3] The N+3 budget commitments rule means that Member States have three years before they lose committed budget. For this reason, budget can continue to be paid out under the previous rural development framework until 2025, even though the new CAP framework will start in 2023.

level. CSPs combine a wide range of targeted interventions addressing the Member States' specific needs and delivering results in relation to ten EU-level objectives[4], while contributing to the Green Deal ambition[5].

The new CAP leaves more flexibility to Member States in its implementation. Various checks and balances aim to ensure that Member States consider EU priorities and their own environmental planning documents, including those linked to nature legislation, while formulating plans. The Commission defined specific objectives for each country against certain indicators[6] and sent each Member State broad recommendations on their CSP contents in December 2020[7].

## 4. CAP Strategic Plans

As a first step, Member States produced an assessment of their environmental and agricultural needs based on an analysis of strengths, weaknesses, opportunities and threats (SWOT). This fed into their strategic plans, which describe the interventions planned through both CAP funds. Discussion with the Commission occurred before official submission of the plans through a process of 'structured dialogue'. Production of CSPs as well as their implementation should involve both agricultural and environmental authorities as well as civil society in a continuous consultation process.

CSPs must also take account of other environmental planning documents including the Priority Action Frameworks (PAFs)[8] set out in the nature legislation in which Member States describe their intentions for financing the Natura 2000 network, connectivity and green infrastructure and species, including conflict species. This should also include any national large carnivore plans[9]. In countries where coexistence with large carnivores requires financial support, this should be described in the PAF, including the source of financing. If the CAP is listed as a financing source, it is a requirement that the funding need from the PAF should be taken into account in the CSP.

## 5. Large carnivores and livestock protection

As in previous programming periods, measures to protect livestock against depredation such as purchase, installation and maintenance of fencing, purchase, training and maintenance of livestock guarding dogs and shepherding can be financed through rural development measures. Additionally, the new eco-schemes funded as part of the annual direct payments to farmers can support shepherding, animal welfare measures or extensification in high nature value grazing[10]. Member States can choose whether or not to use these measures and must describe them in their CSPs.

CSPs are long, containing a significant amount of detail as well as a range of connected documents such as the full SWOT, the strategic environmental impact assessment (SEA), information on the consultation process, etc. They follow a fixed template[11], divided into eight segments (Table 1). In checking them for reference to a specific objective (in this case, the protection of livestock against depredation from

[4] European Commission. Key Policy Objectives of the new CAP: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/new-cap-2023-27/key-policy-objectives-new-cap_en

[5] European Commission SWD (2020) Analysis of links between CAP Reform and Green Deal: https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/sustainability_and_natural_resources/documents/analysis-of-links-between-cap-and-green-deal_en.pdf

[6] European Commission website: CAP specific objectives by country: https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/performance-agricultural-policy/agriculture-country/cap-specific-objectives-country_en

[7] European Commission Recommendations for the CAP Strategic Plans: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-strategic-plans_en

[8] European Commission Financing Natura 2000: https://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

[9] For example, the 2018–2023 French National Action Plan on the wolf and stock-rearing activities: https://www.auvergne-rhone-alpes.developpement-durable.gouv.fr/2018-2023-french-national-action-plan-on-the-wolf-a14244.html

[10] EU Platform on Coexistence between People and Large Carnivores Briefing on how livestock protection measures can be supported under the CAP 2023-2027: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/EU_Platform_CAP_and_large_carnivores_July21.pdf

[11] http://www.juntaex.es/filescms/con03/uploaded_files/PaginaPrincipal/DireccionesGenerales/DirGralPoliticaAgrariaComunitaria/PlanesEstrategicosDeLaPAC/3-PlanEstrategDeLaPAC_WK-11284-2018-ADD-1-EN-template.pdf

large carnivores), the most important part is section 5 (planned interventions) but there should be cross-references through the other parts of the programme to the interventions, justifying why a particular intervention should be financed.

## 6. Evaluation of plans

CSPs should have been submitted by 31st December 2021. Eighteen met the deadline and a further four were submitted by late January 2022. After submission of a plan, the Commission has three months to check it against their CSP toolkit and to send comments. The process is managed by DG AGRI with interservice consultation. Amongst other things, the Commission checks for consistency with other policy areas such as compliance with the nature directives. Following these initial comments, another three months is planned for feedback and sign-off.

**Table 1** Structure of CAP Strategic Plans and relevance to livestock protection measures.

| Section | Purpose | Reference to measures relevant to livestock protection |
|---|---|---|
| **1. Strategic statement** | Narrative organised around three general objectives of the CAP (article 5 of the CSP regulation): 1. Agriculture and food production; 2. Environmental protection; 3. Socio-economic fabric of rural areas. | Can include mention of supporting measures to reduce depredation (under objective 2 and potentially 3). |
| **2. Assessment of needs and intervention strategy** | For each of the nine specific objectives of the CAP:<br>• Summary of SWOT analysis;<br>• Identification of needs based on SWOT;<br>• Interventions to address each of the needs;<br>• Targets for the common indicators (can have specific targets);<br>• Justification of financial resources for the interventions to achieve the targets;<br>• Contribution to LIFE. | Relevant measures should be described under objectives related to environmental care or landscape. A description of how these measures meet the needs identified in the SWOT should be given.<br>The CAP strategic plan should build on the experience of the existing LIFE projects targeting farmlands, extend them at a larger scale and propose coordination with LIFE Strategic Nature projects. |
| **3. Consistency of the strategy** | Overview of interventions contributing to a coherent approach.<br>Overview of the environmental and climate architecture.<br>Overview of sector-related interventions. | Description of why measures are relevant to the livestock sector.<br>How other strategic plans such as the PAFs are taken into account. |
| **4. Elements common to several interventions** | A description of how certain elements which are relevant to all parts of the CAP implementation are put in place including:<br>• Definitions;<br>• Conditionality;<br>• Elements related to direct payments (entitlements, capping etc.);<br>• Technical assistance;<br>• CAP network;<br>• Coordination between EAFRD and other funds including LIFE. | Upscaling LIFE projects in CAP.<br>CAP network should involve large carnivore stakeholders. |
| **5. Description of the interventions** | A table must be completed for each intervention showing the fund used, scope, objectives, result indicator, beneficiaries. | Specific interventions should be planned for livestock protection measures. These can come under Rural development measures e.g. agri-environment or infrastructure measures or under the eco-schemes (see Briefing[12] for more information). |
| **6. Targets and financial plans** | Targets for results indicators.<br>Financial tables. | There are general indicators on the European level. Theoretically, Member States could include additional indicators relevant to livestock depredation. |
| **7. Governance and coordination systems** | Identification of the competent authorities, managing authorities, etc.<br>Description of monitoring and reporting structures | |
| **8. Modernisation and simplification** | Description of the setup of Agricultural Knowledge and Innovation Systems (AKIS) and digital technologies.<br>Plans for simplification and reduction of administrative burdens. | |

[12] EU Platform on Coexistence between People and Large Carnivores Briefing on how livestock protection measures can be supported under the CAP 2023-2027: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/EU_Platform_CAP_and_large_carnivores_July21.pdf

## Sources of information

Information in this text was sourced from a range of resources that the EU Platform on Coexistence between People and Large Carnivores has compiled on the use of rural development financing. These are available on the Platform website at the following links:

Letter by the Commissioner for Environment, Oceans and Fisheries and Commissioner for Agriculture to the EU Ministers for Environment and Agriculture: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/Letter_from_Commissioner_Sinkevicius_and_Commissioner_Wojciechowski.pdf

Briefing on how livestock protection measures can be supported under the CAP 2023-2027: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/EU_Platform_CAP_and_large_carnivores_July21.pdf

Rural development and large carnivores (use of RD support in the 2014–2020 funding period): https://ec.europa.eu/environment/nature/conservation/species/carnivores/case_studies_sub_rural_development_programmes.htm

Statement from the EU Platform on Coexistence between people and large carnivores: CAP reform and national support for coexistence with large carnivores: outlook for the next funding period: https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/190513_Plenary%20meeting%20statement%20CAP%20FINAL.pdf

Evaluation of the impact of the CAP on habitats, landscapes, biodiversity. See Evaluation Specific Question 6: to what extent have CAP instruments and measures addressed the impact of biodiversity on agriculture and forestry: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cmef/sustainability/impact-cap-habitats-landscapes-biodiversity_en

EIP Focus Group: Wildlife and agricultural production: https://ec.europa.eu/eip/agriculture/en/focus-groups/wildlife-and-agricultural-production

Further information on the CSP development can also be found here: ARC 2020 CAP Strategic plans: https://www.arc2020.eu/tag/cap-strategic-plans/

Euroactiv CAP tracker: https://www.euractiv.com/section/agriculture-food/linksdossier/cap-tracker-next-steps-for-the-national-strategic-plans/

CAP Strategic Plans are being published online here: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-strategic-plans_en#publishednationalstrategicplans

Interview with Jack Rich of Rich's Montana Guest Ranch

# ON HORSEBACK IN BEAR COUNTRY

**Interviewer: Seth M. Wilson** **http://richranch.com/**

***How did you start running backcountry trips?***

Our family started in the guiding business beginning in 1946 and we were originally based near Yellowstone National Park. My father brought the operation to the Blackfoot Valley of Montana in 1958. We provide backcountry trips for clients who like to hunt, fish, hike and experience nature on horseback. We have a permit with the United States Forest Service to operate our backcountry trips on public lands that are both national forest and designated wilderness areas. We've had that permit in use for 70 years now.

***What do you offer your guests?***

We operate with 60 or more horses and 24 pack mules that carry our gear. So, at any one time, we have 80–90 head of stock on the home ranch. We currently have ten year-round employees and another 12–14 during the summer season. On our wilderness pack trips we host up to ten guests with a crew of 4–5 for a maximum group size of 15 people. Back at the home ranch, we have 12 guest rooms and can accommodate up to 24 clients.

***What is your conservation philosophy and where do carnivores fit into that?***

Our core mission is about stewardship. We really believe in that and we are guided by Aldo Leopold's writings from his book *A Sand County Almanac*: "We abuse land because we see it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

I believe that there are 'Five fangs in the forest'. These are grizzly bears, black bears, wolves, mountain lions, and us. This makes up two broad ways to think about our place in the world and what we have to work with – both natural and cultural resources – we need both to be a good steward. Bears and wolves should not be vilified – they don't need human attributes, they have instincts and we are now learning to live with them again. We used to have zero tolerance; now we realise that it all matters and the big challenge we face is to live with them.

Our working ranch is where the rubber meets the road – where rural economies as an outfitting business can work in a place like this that has bears and wolves.


WELCOME
Rich's MONTANA

***What types of precautions do you take when guiding clients in bear country?***

First off, being on horseback is a huge advantage in terms of preventing negative encounters with bears. The horse itself helps to create a buffer and being on a horse makes you 'larger than life' to a bear. Simply being on a horse is a type of notification to both grizzly and black bears that people are in the forest.

Group sizes are another important way we minimise problems with bears. We are almost always in groups of two or more. Typically, we have groups of 10–15 people and bears will know that a group of this size is coming and will avoid people.

***What do you do when you encounter a bear on the trail?***

First, we stop and assess the situation. We need to know is the bear a cub? Is it a mother bear? How is the bear behaving? Is the bear behaving normally? These are the types of questions we ask. We want to understand what the bear is doing, and we want to give the bear the chance to make the right decision. We want the bear to understand that we are a group of people. We always provide distance between people and the bear – and typically the bear will move on. For more than seven decades we've been in the backcountry with the bears and we have never had a single injury by a bear to our guests and we've never had to retaliate to a bear.


***Might a horse bolt if it encounters a bear?***

First off, there is an inherent risk whenever you travel outdoors on horseback. A horse's instinct when it encounters potential danger is 'flight or flee' – to run from danger. It's important to be prepared for that, especially if you are in heavy timber or places where you might surprise a bear.

So, yes, there is risk. It's really important to move cautiously on horseback when you are in tight trail situations, so you can let a bear know about your presence ahead of time and not scare the bear. It's really about riding properly in bear country. You just need to be smart about it.

We've never had a bear on the charge and we've never had our horses bolt. We've had bears come close to us and the bears have woofed and snorted, but we've never had the horses in a situation where they felt they needed to escape. We've been careful and prepared for more than 70 years and we had a good record so far.

***Do you have an emergency plan for a bear attack?***

We always carry bear spray but we've never had to use it. We do carry side-arms, but this is mainly for the unfortunate situation if we have to put one of our horses or mules down. We also have our side arms for a signal shot in case of an emergency. It's a distant fourth reason for a bear. It would only be for a last resort.

***How about when you are in a back-country camp situation – what are your protocols?***

We don't tempt the bears. We keep a clean camp. We use bear resistant containers for everything – from our horse feed, human foods, anything that is an attractant. We have to account for the weight of the containers when we plan, but we always contain all foods that could otherwise attract a bear into our camp.

We also like to consolidate our 'footprint' when we are in a backcountry camp. In other words, we like to keep a smaller area that is designated for all activities – cooking, sleeping, and relaxing in camp. This helps let a bear know where all the activity is. We also always keep a person in camp if there are day trips going on and have never had a problem with a bear in our camps.

Over all of these years we have moved our camps around in the backcountry and that helps. We talk

about bears and we have safety talks but stress to clients that the risks are low. We are certainly 'bear aware' with our guests but we don't want them to be bear paranoid.

***What types of precautions do you take back at the home ranch?***

We do everything we have in our power to not reward the bears with any type of food or other attractants, like garbage and livestock feed for our animals. We have secured our barns and food storage areas with bear doors, which deter bears from entering by reinforcing existing doors with a user-friendly sliding door. We also use bear resistant containers for all of our trash.

If we see a bear that starts looking like it could cause problems, we contact the wildlife authorities for help. This might be if a bear initially 'stands its ground' instead of running away like they usually do. If that happens, it's important to know if the bear might be protecting a carcass or a mother bear might have a cub nearby.

Basically, I always try to understand the behaviour of the bears so that we can give them enough space to leave and we don't provoke them. We like having the bears here and we don't want to be the cause of the demise of a bear. If we are the cause of that because of something we should have done, then shame on us.

Rich's Montana Guest Ranch & Outdoor Adventures
Seeley Lake, Montana, USA
The Rich Ranch is located along the Blackfoot River Valley in the Rocky Mountains of western Montana, next to the Bob Marshall Wilderness Complex, and surrounded by over 4,000 km² of state and national forest.
Short video: https://www.youtube.com/watch?v=TSVmjIBSAF8&list=UUZBeQyB1VBGFshPO3qcs1wg
Long video: https://www.youtube.com/watch?v=Yyy-nLGG52U&t=8s

Focus

# HOW TO REDUCE WOLF PREDATION ON WILD PONIES IN GALICIA?

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## 1. Introduction

### 1.1 A tradition in peril

In uplands near Europe's Atlantic coast, from the British Isles to the Iberian Peninsula, free-ranging populations of wild ponies *(Equus ferus atlanticus)* live (Bárcena, 2012; Nuñez et al., 2016). In Galicia and NW Portugal, local people utilise them as a natural resource under a traditional system of minimal intervention. In the past the manes and tails of mares were cut to make rope or mattresses and ponies were removed from the mountains to be tamed and used as working animals and for transportation. Since the 1960s, foals have been taken for meat, which has become the main use of these ponies (Iglesia, 1973).

The traditional husbandry system is valued due to strong cultural ties between local communities, their ponies and social gatherings (Lagos, 2019; Nuñez et al., 2016), as well as anthropologic interest and copious symbolic aspects (Hartigan, 2020). During the annual *curro or rapa das bestas* (Shave of the Beasts festival), ponies are rounded up and driven into enclosures *(curros)* where the manes and tails of mares are sheared, foals are fire branded and some are taken for meat. For the rest of the year, they live in the mountains.

There is intrinsic value in wild horses living under natural dynamics and social organisation. Furthermore, the presence of Galician wild ponies in the mountains offers multiple ecosystem services. Native pony grazing is recognised as valuable for the conservation of habitats (Bárcena, 2020; Fraser et al., 2019). In particular, wet heathlands grazed by ponies (Fig. 1) have higher levels of plant biodiversity (Fagúndez, 2016). Ponies also contribute to wildfire prevention due to their consumption of inflammable shrubs such as gorse *(Ulex europaeus)* (Rigueiro et al., 2012).

**Fig. 1** Galician ponies on Atlantic wet heathland, an EU priority habitat. *(Photo: Laura Lagos)*

For various reasons, the traditional system is in decline. Today, there are around 10,000 free-roaming wild ponies in Galicia (Lagos et al., 2020), whereas in the 1970s there were about 22,000 (Iglesia, 1973). One of the factors contributing to this situation is predation, but the situation is complicated by bureaucracy, political decision-making and several other factors.

### 1.2 Wild ponies, wolves and regulations

Throughout history, Galician wild ponies have coexisted with Iberian wolves *(Canis lupus signatus)*. Their free-roaming lifestyle in the mountains is vulnerable to predation, especially on foals, and wherever both species coexist ponies constitute the main prey of wolves (Álvares, 2012; Lagos and Bárcena, 2018; López-Bao et al., 2013). The impact of predation, which can be especially high where wild prey populations are depleted, has been estimated at 33 foals per 100 mares (Lagos, 2013). This could entail a loss of € 2,000 – 5,000, depending on current market prices each year (see the article by Freitas and Álvares in this issue).

In the past, pony exploitation was not regulated and had no administrative charges, so management costs were low, which to some extent compensated for economic losses due to predation. Under national and regional laws from 2008, the system has been regulated as livestock production, with hardly any consideration of its peculiar system. Local people who exploit ponies, called *besteiros* in Galicia, are now considered professional farmers. They have to register their animals and identify them with an electronic transponder according to the European regulation for the identification of equids (Commission Implementing Regulation (EU) 2015/262)[1]. The derogation considered by this regulation for equids living in wild or semi-wild conditions in certain areas, establishing that they shall be identified only when they are removed from such areas or brought into domestic use, has not been applied in Galicia.

If ponies are duly registered and identified they, like all horses, are included in the Galician system for compensating damage to livestock by wolves, which started in 2003. As is customary in such schemes, compensation is only paid if carcasses are located and the cause of death determined. However, finding the remains of foals that were predated by wolves in the mountains is a difficult task.

Under these circumstances, the perception of loss by *besteiros* has increased since ponies are now associated with a higher bureaucratic and economic burden and, at the same time, they often do not receive compensation for losses since predated foals are difficult to locate. As a result, in some areas the wolf is now considered by pony owners as the main impediment to the survival of this traditional system of equine exploitation (Lagos et al., 2019). In addition, the significant reduction in numbers of wild ponies in Galicia (Fagúndez et al., 2017), which had a range of causes[2], may have led to a concentration of damage on those animals still dwelling in the mountains.

Despite recognition of the benefits of Galician wild ponies on the landscape, when looking for solutions to reduce losses to wolves, the only prevention measures that are suggested and subsidised are the same as for cattle, sheep and goats: electric fences and livestock guarding dogs (LGDs). However, these methods are not compatible with free-ranging animals in large mountain landscapes without the regular human presence that is characteristic of livestock husbandry. Owning LGDs implies a cost and attention that has never been devoted to this activity and that is not worthwhile because of its low profitability. In addition, pony herds or 'bands' inhabit remote places that are not frequently visited, which poses a problem for feeding LGDs. Often, multiple bands live in the same area, each of which would have to be accompanied by dogs. Furthermore, bands are formed of ponies from several different owners. Mares changing bands, or stallions attempting to steal mares from other bands, could make it difficult for LGDs to protect all the animals in a band effectively. Even the process of socialising LGDs with ponies is difficult to manage as it necessitates a period of confinement that hardly fits with wild pony behaviour and management. Therefore, both electric fences and LGDs could entail a change in management towards the confinement of ponies or their rotation among fenced pastures, resulting in the loss of a traditional system and the ecosystem services associated with it.

Finding ways to make pony bands less vulnerable to wolf predation can improve coexistence of humans and wolves without necessitating the abandonment of the free-roaming system. This could be beneficial for wolf conservation and, at the same time, may allow an increase of pony populations in areas where their presence is important for habitat conservation.

[1] https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32015R0262

[2] These include the disappearance of most of the traditional uses of ponies, conflicts with other land uses (forestry, intensive livestock production systems that mean the transformation of heathlands into improved pastures where ponies are excluded), collisions with vehicles, administrative burdens and an aging and declining rural population (Lagos et al. 2020).

### 1.3 Identifying best management practices

Within this context, it is necessary to find solutions based on scientific knowledge to reduce the vulnerability of Galician ponies to wolves without radically changing the husbandry system. Best management practices therefore have to go beyond simply dogs and fences. Other measures are needed to help maintain the traditional system including improving the administrative consideration of wild ponies, reducing conflicts with other land uses and preventing vehicle collisions with ponies.

Here, we summarise the findings of a study on the ecology of wolf predation on wild ponies in Galicia (Lagos, 2013), including an assessment of variables that may be managed in order to reduce predation risk. On the basis of these results, we suggest management practices aimed at achieving a pony band social structure that is likely to be more resilient when faced with wolves.

## 2. Predator-prey ecology

The ecological relationship between wolves and horses is little known worldwide, because a large proportion of current populations of free-roaming or wild horses, such as mustangs in North America, feral horses in Australia and ponies in the British Isles, inhabit areas outside the occupied wolf range (Bureau of Land Management, 2014; Boitani et al., 2018; Nuñez et al., 2016). We therefore conducted research in Galicia, NW Spain, with the aim of improving knowledge of predator-prey interactions between wolves and Galician ponies (Lagos, 2013).

### 2.1 Study area and methods

We assessed births and deaths in a population of 74 adult ponies in the Dorsal Galega mountains (Fig. 2) using an individual-based approach. The ponies formed six bands, with 12–28 adults in each, in three mountain areas 3 km apart. There were 1–2 wolf packs in the area and the total number of adults fluctuated in the range of 9–22 during the three years of the study, 2006–2008. The wider region has c.5–10 wolves/100 km$^2$, which is among the highest densities in Europe. Wolf diet is centred on ponies (34% of occurrence in scats), extensively and semi-extensively grazed cattle (32%) and carrion from pig farms (14%) (Lagos and Bárcena, 2018). Roe deer *(Capreolus capreolus)* and wild boar *(Sus scrofa)* are present but scarce.

We visited bands once every 15 days to check for new-born foals and search for carcasses. We used VHF ear-tag transmitters with mortality sensors (Fig. 3) to assess foal survival and, if they died, to find their carcasses and determine cause of death. Pony bands were gathered in early summer to fit transmitters to 15 foals in 2007 and 12 in 2008.

We estimated levels of wolf predation and assessed pony characteristics that could influence survival rates. We considered foal sex, coat colour and birth date as well as the sociability of mares. Social structure was analysed using associations; individuals were considered associated if they were in the same group (Whitehead, 2008; Franks et al., 2010). We used the Simple Ratio Index (SRI) as a measure of the proportion of time each dyad (pair of individuals) was associated (Whitehead and Dufault, 1999). We analysed the temporal pattern of associations using the Lagged Association Rate (LAR) (Whitehead, 2009). More details on methods can be found in Lagos (2013).


**Fig. 2** Study area in Galicia, NW Spain.

### 2.2 Main results

We documented a total of 149 foals born, of which 45–74% (average = 59%) died each year due to predation. No adult ponies were killed by wolves during the study. We located the carcasses of 42% of known foal mortalities.

**Fig. 3** Foal with ear tag radio transmitter with mortality sensor. *(Photo: Felipe Bárcena)*

In all but one case, the cause of death was wolf predation. Foals younger than two months were consumed in one night leaving hardly any remains. Carcasses of older, larger foals were easier to find. As a result, the proportion of carcasses found compared to total known mortality increased with foal age (Fig. 4).

Birth date and coat colour influenced foal survival. Foals born at the start of the foaling season (March–April) had double the survival index of those born later. At the same time, fewer bay-coloured foals (Fig. 5) survived compared to black and chestnut foals.

The size and stability of their group also seemed to influence foal survival (Fig. 6). Our results indicated higher survival of foals from mares integrated in groups larger than nine adult individuals. At the same time, mares with a higher index of productivity (a combination of foal birth and survival) had a well-defined group size of around ten. Therefore, results suggest that mares integrated in medium-sized groups of around ten adults achieve a higher survival rate of their foals. The LAR analysis showed that the foals of mares which maintained more stable relationships had higher survival rates, whereas mares that changed

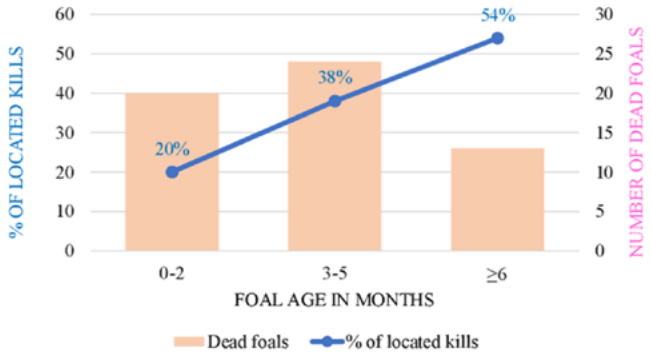


**Fig. 4** Percentage of dead foals that could be located for each age class (blue line) and number of dead foals of each age (pink bars).

bands were more likely to lose their foals. This highlights the importance of social ties and group cooperation in the defence of foals.

## 3. Recommendations to reduce losses

Of all the variables found to influence the vulnerability of foals to wolf predation, the ones that can be managed are those related to social structure, i.e. group size and stability of associations. Selective breeding to reduce the frequency of bay coat colour is not recommended as it is characteristic of Galician wild ponies. Thus, management practices to reduce wolf predation on wild ponies should focus on stable groups of intermediate size. Horses exhibit a polygynous

**Fig. 5** Foal with bay coat and born early in the season which survived. *(Photo: Felipe Bárcena)*

**Fig. 6** Example of mares integrated in a cohesive band. *(Photo: Felipe Bárcena)*

mating system. Therefore, in order to achieve the desired band size, owners can manipulate the overall sex ratio of the pony population in their area, allowing a sufficient number of males in a certain mountain range so bands of one stallion and around nine mares can form.

Regarding stability, some practices, such as changing stallions or bringing new mares from other mountain ranges, spawn instability in bands causing some mares to change groups, and hence should be avoided. Splitting bands to move some individuals to pastures could also decrease social cohesion and increase instability, so movements should include the whole band. Good management for increasing band stability includes minimising changes of stallion or introduction of mares from other areas and avoiding moving individual ponies from their bands or home ranges in the mountains. However, these recommendations should be taken with caution as they are based on work carried out in specific conditions of wolf density.

Knowing the importance of free-ranging ponies to preserving mountain habitats, and as prey for wolves in parts of Galicia as well as northern Portugal, and the difficulties of finding carcasses of foals, a new system of financial support is recommended. Instead of the current system of compensation based on finding and documenting predated foals, a positive payment system linked to the number of mares in the mountains and related to the ecosystem services they provide should be designed and implemented. In addition, providing wolves with more alternative prey through regulation of hunting to increase wild ungulates in the area is also highly recommended.

Some ponies meet the morphological criteria to be classified as the official breed *Cabalo de Pura Raza Galega*, basically brown or black coat and absence of white markings. Owners of these animals receive subsidies for rare breed conservation under the EU Common Agricultural Policy and may have a higher market price. New management practices have emerged for these ponies, such as more vigilance and confinement in fenced areas. In this case, other damage prevention measures could be applied, such as LGDs (see the article by Lagos and Blanco in this issue). Besides this, the emergence of new management practices by which ponies are moved to lowland pastures may render other protection systems both necessary and viable, but they are not applicable to the traditional husbandry system.

The desirability for environmental and cultural reasons of maintaining free-roaming ponies in the mountains of NW Iberia calls for protection measures compatible with the traditional system. Stable bands of the desired size can be achieved with minimal human intervention. However, this requires awareness-raising and training, including demonstrations to show pony owners that such an approach can result in bands of ponies that are more resilient to wolf predation.

## Acknowledgements

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Short communication

# LLAMAS FOR LIVESTOCK PROTECTION – EXPERIENCE AND RECOMMENDATIONS

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## 1. Introduction

Since the return of large carnivores to Switzerland in the late 20th century, the use of different livestock protection measures has been discussed. Livestock guarding dogs (LGDs) and electric fences are established methods, financially supported by the Federal Office for the Environment (Bundesamt für Umwelt, 2019; Hahn, 2019; Mettler and Schiess, 2020). Experience in the field and various international studies have demonstrated their effectiveness (Herrera et al., 2017, Hansen, 2018a).

However, complete electric fencing of livestock is not possible in all circumstances, depending on the soil, topography and flock size. On the other hand, using LGDs poses a challenge to smallholders, especially in tourist areas and close to villages, where interactions between dogs and people can lead to conflicts. Moreover, LGDs require considerable additional time, which is not always worthwhile for small-scale livestock farmers, especially if they only farm to supplement their main income from other activities. In many regions of the Alps, small flocks are kept as a hobby rather than a main source of income. Therefore, alternative protection measures are frequently discussed and it is important to learn from experience gained in other countries (Heurich et al., 2019).

## 2. Guard llamas

Llamas were first used to protect livestock against coyotes *(Canis latrans)* in the USA in the early 1980s (Markham et al., 1993). Today, guard llamas are found mainly in the USA and Australia, where they protect flocks of sheep from coyotes, dingoes and stray dogs (Drufke, 2000; Franklin and Powell, 1994, 2006; Meadows and Knowlton, 2000). Their protective effect is based on a natural aversion to unknown intruders, especially canines. Llamas form social bonds with other species (Fig. 1) and, as they stay near them, are able to defend them from predators by biting, kicking, screaming, spitting and/or chasing them away (Franklin and Powell, 1994; Giudicelli and Giudicelli, 2013; Jenkins, 2003).

A good guard llama does not flee from predators but instead either stops or approaches out of curiosity or defence. This behaviour, combined with the llama's unusual appearance, can unsettle predators and hence prevent an attack. Overall, experience shows that the protective behaviour of llamas is useful against small predators and most effective in situations where predators do not attack in social groups. The available evidence for this is based largely on anecdotal accounts (Mettler et al. 2013). We could not find any scientific studies that assessed the efficacy of guard llamas against packs of wolves.

**Fig. 1** Llamas are vigilant, have good eyesight and readily bond with sheep. *(Photo: AGRIDEA)*

## 3. Pilot project in Switzerland

There is little experience of livestock protection with llamas in Europe. Therefore in 2012–2016 the Swiss Association for the Development of Agriculture and Rural Areas (AGRIDEA) carried out a pilot project to identify under which conditions their use can be worthwhile to protect sheep from foxes, lynx and wolves in Swiss alpine pastures and husbandry systems.

The size of sheep flocks in Switzerland varies greatly, ranging from 10 to 1,500 head depending on the region. Around half of all flocks are kept in valleys year-round, spending the winter in stables or farmyards and the remaining months in fenced pastures. Other flocks spend the summer months in mountain pastures. Swiss alpine pastures are often steep, difficult to access and with limited visibility. Sheep are partly fenced, partly free-grazed or accompanied by a shepherd who leads them between pastures (see Mettler et al. 2021 in *CDPnews* issue 22).

To evaluate in which pastures llamas could protect sheep from predators, several studies were carried out. The behaviour of llamas newly integrated into flocks was observed, the degree of socialisation with sheep was evaluated using llama–sheep proximity as a proxy for bonding and their reaction to canids was tested using unfamiliar dogs (Ineichen, 2013). In addition, GPS collars were used to study the spatial behaviour of llamas and sheep when kept together. Llama keepers were interviewed face-to-face to gather accounts of their experience (Hansen 2018b; Hilfiker and Mettler, 2015). Here, we summarise the main findings of the pilot project and suggest recommendations for best practice. We conclude with an overview of the current situation in Switzerland regarding the use of llamas as livestock guardians.

## 4. Findings and recommendations for best practice

### 4.1 Which individuals are suitable?

Preliminary tests with dogs showed that the behaviour of llamas varied greatly. Some individuals reacted aggressively, lashing out, biting or screaming, while others approached in a curious, non-aggressive manner. Some positioned themselves between the dog and the sheep but otherwise remained calm. There were also some llamas that reacted nervously and ran away (Ineichen, 2013). Therefore, selection of the 'right' llamas is crucial.

In addition to their protective behaviour, attention should be paid to llamas' interactions with humans. They are mostly friendly towards people, but llamas are 'flight animals' (i.e. when they sense danger they tend to flee) and are very sensitive to any physical contact. They approach humans to within a short distance out of curiosity but may flee at the slightest movement. Although it is possible to train llamas to allow handling, patience is often needed (Müller, 2014). A llama breeder should always be available to advise on selection of suitable individuals. This requires considerable knowledge of the different characters of individual llamas and their behaviour towards humans and other animals of all types.

Another important criterion for selection is dominance behaviour. A good combination of dominant and subordinate animals may make the best protection 'team'. Two llamas together in one flock were seen to complement each other (Horn, 2014). During observations, a dominant llama tended to circle round the flock while a subdominant llama stayed more within the flock (Fig. 2). Even though it was not seen in all cases, such 'job-sharing' seems to have parallels with the protection behaviour of groups of LGDs (Horn, 2014).

### 4.2 Integration into flocks

In order for llamas to protect their flock, they must be bonded with livestock. Bonding is fostered through 2–4 months of close contact with a homogeneous group of sheep (Hilfiker et al., 2015). This should take place in a stable or small, fenced pasture before llamas accompany sheep to alpine pastures. During the integration phase, changes of pasture and animals should be minimised. In addition to llamas bonding with the flock, sheep also become accustomed to the presence of llamas. In some cases, sheep may even begin to follow llamas (Ineichen 2013).

Keeping llamas individually is prohibited in Switzerland due to animal welfare concerns. Therefore, at least two llamas must be used together for livestock protection (Fig. 3). With two llamas, bonding to livestock is less strong but, on the other hand, they can complement each other. Experience has shown that multiple llamas often look in different directions and so are probably more likely than a single animal to detect possible predators (Hilfiker et al., 2015; Ineichen, 2013). However, if more than two llamas are used there is a risk of them forming a separate group, away from the flock, leading to loss of their protective function. Nor is it advisable to use young animals with their mother. Ideally, two adult castrated llama stallions should be integrated into one flock. The use of uncastrated llama stallions can be problematic as they may attempt to mount ewes, leading to injuries (Franklin and Powell, 1994).

### 4.3 Maintenance and care

Once llamas have been integrated into a flock, they can be maintained with little financial outlay or additional work (Fig. 3). Neither summer nor winter husbandry with sheep cause any difficulties. Llamas eat the same food as sheep, they can live up to 20 years, they are typically robust and have little

**Fig. 2** Llamas, with their long necks, have a better overview of meadow than the sheep. *(Photo: AGRIDEA)*

**Fig. 3** Two llamas protecting a flock of sheep in a Swiss alpine pasture. *(Photo: AGRIDEA)*

susceptibility to diseases. In principle, the usual vaccinations for sheep are also recommended for llamas. They can be susceptible to internal parasites, however, so regular deworming is necessary (Hilfiker et al., 2015).

Llamas are classified as Tylopoda (meaning "calloused foot"). If they are kept mainly on soft ground, their toenails have to be trimmed twice a year. On harder ground their nails wear down naturally and do not require trimming. In addition, if llamas are not regularly brushed, they should usually be shorn once a year in spring (Hilfiker et al., 2015).

### 4.4 Optimal conditions for effective protection

Since llamas detect potential threats primarily by sight, pastures with good visibility are needed for them to exercise their protective function in the best possible way. Llamas are ideally suited to protection of small, cohesive flocks of between 10 and 100 sheep (Fig. 4). If the flock is kept compact by a shepherd or fence, llamas can protect up to 200 individuals. It is preferable for the sheep to belong to a single owner and be used to each other so they are more likely to stay together rather than splitting into separate groups. This makes it much easier for llamas to protect them (Mettler and Ineichen, 2013).

Fencing can be very helpful to keep the flock compact and hence optimise its protection. In this case, fences do not have to keep predators out but primarily keep the flock and llamas together in the pasture. Electric nets (with a minimum height of 90 cm) or fences with at least two electrified wires can be used to prevent sheep spreading out too much. Especially in areas where it is not possible to install electric fencing without weak points, llamas can be a good additional measure. While fencing keeps the flock together, llamas deter predators from entering the pasture. Llamas are very sure-footed and can cope with steep terrain (Ineichen, 2013, Horn, 2014, Hilfiker et al 2015).

**Fig. 4** Llamas can be kept together with sheep without much extra effort but beware: they like to peel fruit trees. *(Photo: AGRIDEA)*

**Fig. 5** Llamas are ideal for the protection of small, compact sheep flocks. *(Photo: AGRIDEA)*

## 5. Swiss working group

In order to ensure exchange of experience and transfer of knowledge after the end of the pilot project, the Llamas and Herd Protection working group[1] was founded in 2017. AGRIDEA is responsible for coordination on the national level, financed by the Association of New World Camelids Switzerland[2], WWF Switzerland[3] and CHWolf[4]. Members are experienced llama and sheep keepers as well as livestock protection consultants who work in areas where llamas are already used for livestock protection or where there is interest to use them.

The aim of the working group is to promote the transfer of knowledge between interested llama and small livestock keepers and to maintain a national network. Individual projects and information materials are also financed with the help of donors.

[1] https://www.protectiondestroupeaux.ch/fr/planung-beratung/projekte/projekt-lamas-und-herdenschutz
[2] http://www.nwks.ch/info/
[3] https://www.wwf.ch/de
[4] https://chwolf.org/

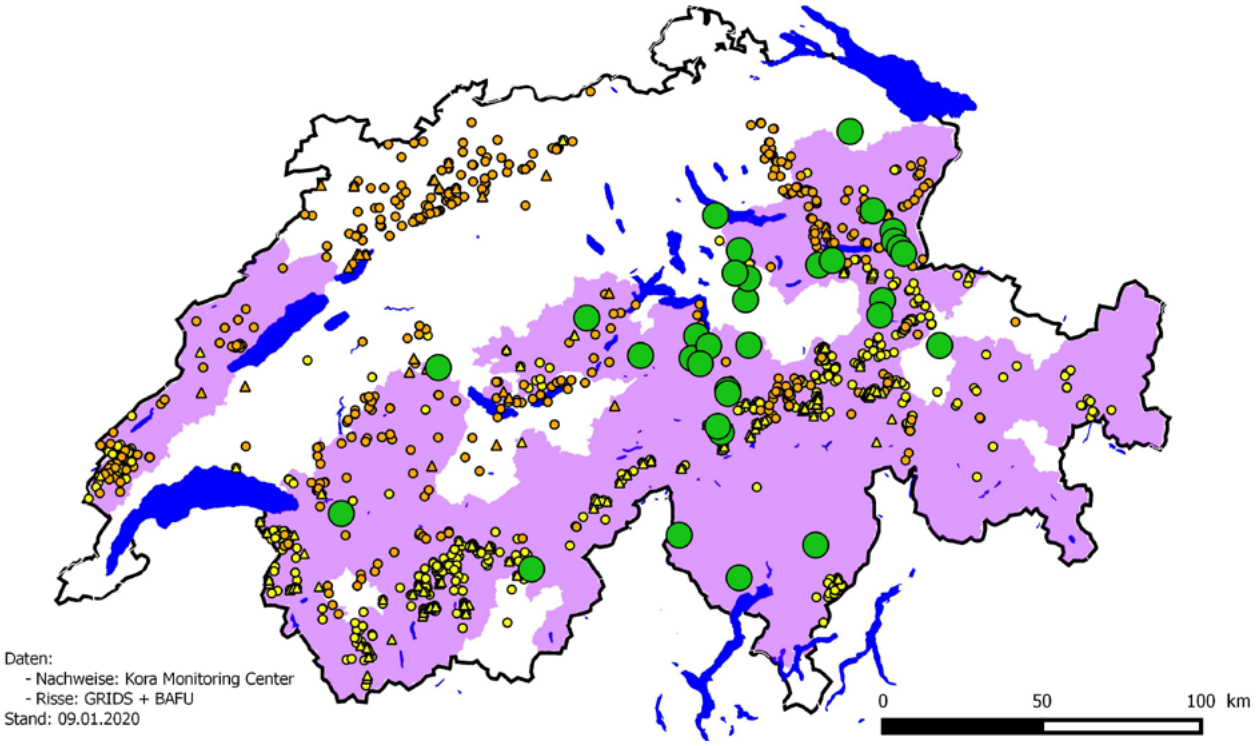


**Fig. 6** Map of Switzerland showing locations of farms using llamas for livestock protection as of 2019 (green dots); damage by lynx (orange triangles); confirmed lynx occurrence (orange dots); wolf damage (yellow triangles); confirmed wolf presence (yellow dots); and regions where wolf presence was likely based on data from 1999–2018 (purply shading). Source of wolf and lynx data: KORA[5].

## 6. Current situation in Switzerland

Currently, about 35 farms in Switzerland have llamas to protect sheep or goats against lynx, foxes, wolves or stray dogs. It is difficult to prove their efficacy scientifically. However, since the start of the pilot project in 2012, there has been no damage by lynx to flocks protected by llamas under recommended conditions even though the majority of them are in regions with confirmed lynx presence and, in some cases, there was damage before the acquisition of guard llamas. There are also no officially recorded cases of foxes or stray dogs causing damage, although records are not kept in a standardised way for these species. Moreover, most flocks with llamas have not experienced any wolf attacks since 2012 even though almost all are located in regions where wolf presence is likely (Fig. 5). In the nine years since the pilot project began, there has only been one case of wolf damage to a sheep flock in which llamas were used in accordance with the recommendations described above. One sheep was killed. In two other cases, sheep were spread out across large pastures or were kept in pastures without good visibility so that llamas were not able to perform their protective function effectively (Hansen, 2018b)

So far in Switzerland llamas have only been used in areas with single wolves. Where there are packs of wolves, llamas are not recommended as the sole method of protecting small livestock. In such cases, the use of llamas is only recommended in combination with electric fences. Guard llamas are not financially supported by the Swiss government since their protection function has not yet been scientifically proven. However, most users report positive experiences and a general analysis of interviews and surveys with farmers showed that, at least against small predators and single wolves, llamas could be a viable alternative to more costly prevention measures. Even if they are limited in their effectiveness against large carnivores, llamas have proven their worth as a livestock protection measure in many flocks. They offer farmers an easy way into livestock protection and sheep breeders often enjoy having such unusual, long-necked protectors watch over their flocks (Hansen, 2018b)

[5] https://kora.ch

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# News Roundup

## New guidance documents for large carnivore management

The LIFE EuroLargeCarnivores project has published a set of Standard Operating Procedures for Improved Management of Large Carnivores in Europe. Addressed mainly to wildlife managers in regional and national administrations, these documents provide information and guidance on key topics of large carnivore management and conservation based on experience from around Europe and beyond. Several of them are directly relevant to damage prevention:

- Managing problem individuals, with a focus on bold wolves
- Establishing a livestock guarding dog programme
- Inspecting and testing damage prevention measures
- Investigating damage hotspots
- Verifying livestock damage and compensation claims
- Discouraging bears from areas of high human use
- Setting standards for livestock protection measures

The full set of documents is available on the LIFE EuroLargeCarnivores project website[1].

## Help with protecting livestock

The LIFEstockProtect[2] project in Austria, Bavaria and South Tyrol is preparing a series of livestock protection courses. Starting in spring, they will include training for shepherds on building fences and working with livestock guarding dogs.

Practical advice and know-how are also available in written form in the brochure *Livestock protection: Basic information for livestock owners and stakeholders.* Based on the experience of farmers, shepherds, hunters and other wildlife specialists, it shows which measures have proven to be effective and how to use them correctly. The brochure was produced as part of the LIFE EuroLargeCarnivores project and is available to download from the project website[3].

[1] https://www.eurolargecarnivores.eu/en/sops

[2] https://lifestockprotect.info/

[3] https://drive.google.com/file/d/1cFqzvjUf2DRvdTYOZE6Aal232Uf-I05L/view

Many activities within the LIFE WolfAlps EU project are also focused on finding solutions to prevent livestock losses to wolves. For example, in Slovenia electric fencing is being installed[4]. Livestock breeders who require immediate help to prevent further damage after wolf attacks are provided with temporary intervention kits and given advice on how to implement permanent protection.


## Publications on human-wildlife conflicts and coexistence

'Coexistence' between wildlife and humans is a commonly used term, but what does it actually mean? The journal Frontiers in Conservation Science has produced a special issue on this topic. *Understanding Coexistence with Wildlife* explores the concept through a collection of articles from a diverse range of backgrounds and perspectives. They go beyond understanding and addressing human-wildlife impacts and conflicts to recognise different ways of valuing and interacting with wildlife and the natural world, particularly in mixed-use landscapes that people share with wildlife on a daily basis. The articles, together with an editorial by members of the IUCN SSC Human-Wildlife Conflict Task Force, are available on the Frontiers website[5].

The Task Force has also released a new briefing paper explaining its perspectives on human-wildlife coexistence, outlining its scope, complexities, key characteristics and approaches to coexistence. *Perspectives on Human-Wildlife Coexistence* can be accessed from the Task Force's policies page[6].

Additionally, the Task Force has published an *Information document on the inclusion of a target on human-wildlife conflict in the UN CBD Post-2020 Global Biodiversity Framework*[7]. This follows on from having organised a webinar on monitoring human-wildlife conflicts[8] during the Collaborative Partnership on Sustainable Wildlife Management (CPW) Wildlife Forum. It is working with partners to encourage the development of suitable indicators and to help direct resources and capacity towards addressing this issue at a global level. To support this process, the Task Force has also published an *Information document on developing indicators for a target on human-wildlife conflict in the framework*[9].


[4] https://www.lifewolfalps.eu/en/damage-prevention-measures-implemented-in-slovenia-in-2021/
[5] https://www.frontiersin.org/research-topics/16562/understanding-coexistence-with-wildlife#articles
[6] https://www.hwctf.org/policies
[7] https://www.hwctf.org/_files/ugd/7acc16_647ceff2283f4fd2a8c1525ac7e3a400.pdf
[8] https://www.hwctf.org/post/cpw-wildlife-forum-2021
[9] https://www.hwctf.org/_files/ugd/7acc16_7379592635484b70bb7c7959afe39603.pdf

Project

# TRIALS OF ZAMORANO-LEONESE DONKEYS TO PROTECT CATTLE

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## 1. Introduction

The presence of large carnivores such as wolves *(Canis lupus)* often leads to a clash of interests with livestock production when losses to predation occur. Preventive measures represent one of the best solutions to achieve coexistence by actively reducing damage to livestock. Among the options available, livestock guarding dogs (LGDs) are one of the most well-known (Linnell and Lescureux, 2015). While there is good evidence of their effectiveness against many predators, LGDs can cause problems such as conflicts with other land-users and often have high rates of premature death. Other guard animals, including donkeys, may represent a better alternative in some scenarios, but scientific studies of their efficacy are rare (see the review by Rigg in this issue).

The Spanish Zamorano-Leonese donkey is a large, strong, long-haired breed giving it a formidable appearance and the ability to withstand extreme weather conditions. These characteristics, together with the typical aversion of some donkeys to canids, might make the Zamorano-Leonese well-suited to the role of livestock guardian.

In 2014–2016, we implemented a pilot project in the province of Zamora, the main goals of which were: I) to assess the efficacy of the Zamorano-Leonese donkey in protecting livestock from wolves and other canids; II) to improve coexistence between wolves and livestock in Zamora; and III) to promote this autochthonous breed by enhancing its value with a new use. Here, we report the main findings of the project.

## 2. The Zamorano-Leonese donkey

One of five breeds of donkey currently recognised in Spain (Yanes García, 2006), the Zamorano-Leonese originated in Zamora and neighbouring provinces of Castilla and Leon, NW Spain (Fig. 1). It is a large and powerful animal, up to 145 cm at the withers, with large muzzle and ears, long and strong limbs and large hooves. The coat is reddish-black with white tones on the snout, eyes, belly and upper part of the limbs (Fig. 2). The tail is long, as is the hair on the ears, forehead and cheeks, with typical strands of wool on the chest and belly. The breed has specific reproductive characteristics: long pregnancy (12 months), late age of first breeding (three years) and a long breeding interval (usually two years).

In the past, many households kept a couple of donkeys to accompany shepherds with their flocks or on short trips, to plough vineyards and transport water from wells to houses. The Zamorano-Leonese

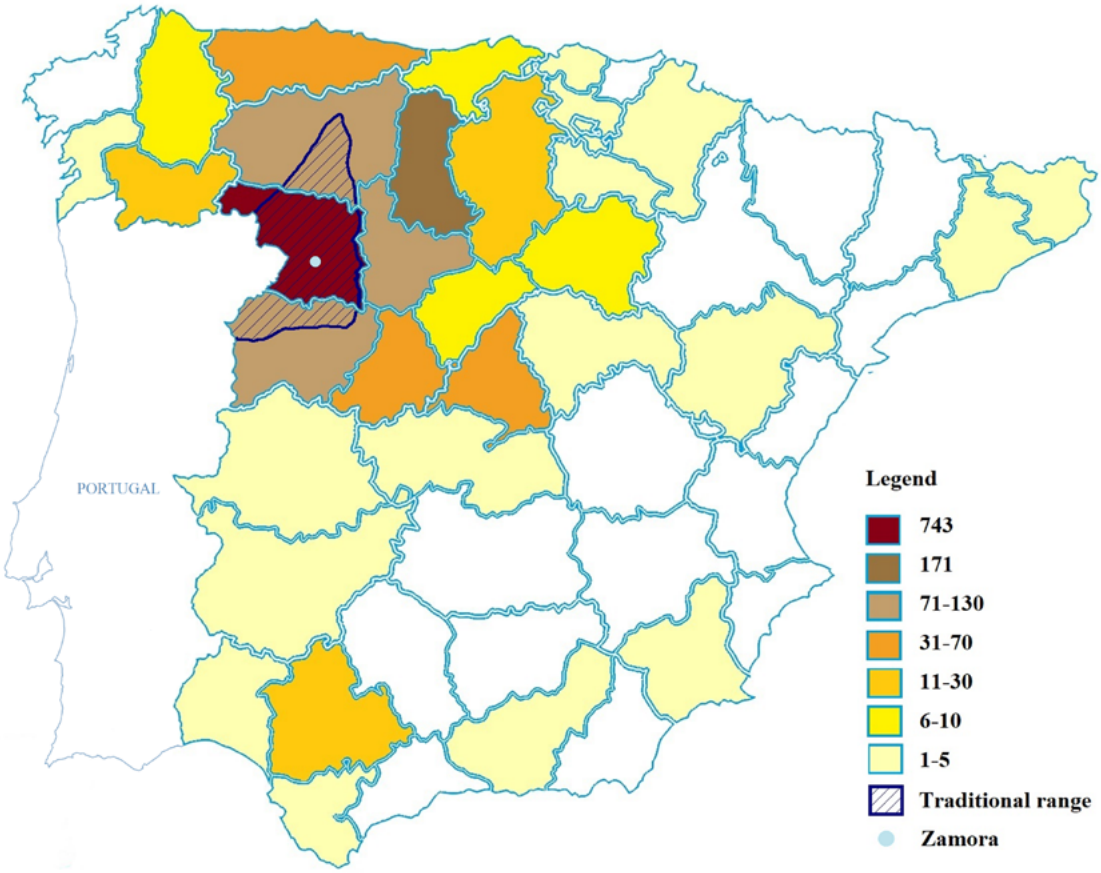


**Fig. 1** Traditional and current distribution of the Zamorano-Leonese donkey, showing the number of donkeys per province according to a 2020 survey. *(Source: Spanish Ministry of Agriculture, Fisheries and Food)*

**Fig. 2** Male Zamorano-Leonese donkeys. *(Photos: ASZAL)*

increased in value after the 18th century when it was often crossed with horses to supply regional markets with mules, which acquired great importance as traction and transport animals. This practice fell out of use with the arrival of motor vehicles, resulting in the rapid regression of the breed to the heartlands of traditional breeding.

By 1987 the breed was considered 'in danger of extinction', a status maintained to this day. A breed association, the Asociación Nacional de Criadores de la Raza Asnal Zamorano-Leonesa (ASZAL), was created in 1995 to ensure its purity, selection and promotion. In the same year, owners began to receive EU funds for the conservation of endangered livestock breeds. These days, not many people have the interest, space or means to keep Zamorano-Leonese donkeys. A 2020 census[1] recorded about 1,500 animals, mostly in Castilla and Leon, particularly Zamora (Fig. 2). Many of them are now ageing, like much of the farming community who still use them.

[1] https://www.mapa.gob.es/es/ganaderia/temas/zootecnia/razas-ganaderas/razas/catalogo-razas/equino-asnal/zamorano-leones/iframe-ejemplo-arca.aspx

**Fig. 3** Two male mules were also included in the study. *(Photo: Javier Talegón)*

## 3. Methods

### 3.1 Selection and testing of donkeys

To select the most suitable animals for the project, available males[2] belonging to ASZAL and the first author of this article were subject to a test in which their reaction to a shepherd dog on a leash was assessed within and near their corrals. Due care was taken to avoid any harm to the dog. Twelve donkeys that showed the most aggressive reaction were selected: those that rushed at the dog and tried to attack it until it fled. They were all castrated males, from three to six years of age. Two 6-year old male mules, offspring of Zamorano-Leonese donkeys (Fig. 3), showed good reactions in the dog test so were also selected. Of these 14 animals, six were placed on farms and integrated into herds of cattle (see below).

### 3.2 Participating farms

Information provided by the Territorial Environment Service of the Junta de Castilla y León was used to select farms most affected by wolf and stray dog attacks. Locations of wolf packs in the province of Zamora in 2013 and 2014 were also obtained to provide additional information on predation risk to inform the selection process. A total of 26 farms were identified and visited to explain the project goals and gather additional information about problems with predators.

Despite these efforts and widespread publicity of the project through local authorities, the media, social networks and a donkey fair in 2015, not much interest was generated among farmers. Their main doubts seemed to be concern about the extra work involved and a lack of belief about the usefulness of donkeys against wolves.

Four farms were included in the project, all south of the Duero River in Zamora province. Participating farmers signed a collaboration agreement with ASZAL in which they agreed to comply with protocols and guidelines set by the project, safeguard the welfare of the animals provided, alert ASZAL to any problems and provide all assistance and cooperation necessary for successful completion of the study.

### 3.3 Placement of donkeys on farms

Four donkeys and two mules were integrated into herds of cattle: Charolais x Limousin crossbreeds kept for meat or Lidias bred for fighting bulls (Fig. 4). In most cases, one donkey was placed at each farm, as multiple donkeys might stay together, away from other livestock (Green, 1989). An exception were the mules, which had been raised together and were previously in a herd of around 20 mules, so they were kept together and placed at a farm that had regular losses to canids. This was a relatively large farm with cattle separated into different lots of cows and calves, so a donkey was also placed at this farm in a second herd. In all cases, the number of cattle in each herd (adult and subadult cows) was limited to 20–50 head per guard animal (Table 1).

**Table 1** Details of farms, livestock, pastures and guard animals.

| Farm | Municipality | Cattle breed (production) | Guard animals | Head of cattle/ guard animal | Area of pasture ($m^2$) |
|---|---|---|---|---|---|
| #1 | La Bóveda de Toro | Lidia (fighting bulls) | 1 donkey | 45 | 45,000 |
| | | Lidia (fighting bulls) | 2 mules | 20 | 17,000 |
| #2 | Guarrate | Charolais x Limousin (meat) | 1 donkey | 30 | 35,000 |
| #3 | El Maderal | Charolais x Limousin (meat) | 1 donkey | 35 | 15,000 |
| #4 | Fuentelapeña | Lidia (fighting bulls) | 1 donkey | 50 | 30,000 |

[2] Females were used for breeding and hence were unavailable.

**Fig. 4** Donkeys were placed in herds of cattle: Charolais x Limousin crossbreeds kept for meat (left) or Lidias bred for fighting bulls (right). *(Photos: Javier Talegón)*

### 3.4 Bonding donkeys with cattle

We followed guidelines and recommendations in the published literature (e.g. Bourne, 1994; Walton and Feild, 1989) and advice provided by experienced researchers. Guard animals must go through a process of socialisation with the stock they are to protect so that they become familiar with each other and will subsequently stay together in a cohesive group, a typical behaviour of social herbivores. According to the literature (e.g. Bourne, 1994; Green, 1989; OMAFRA, 2018), up to six weeks may be allowed for this, but 1–2 weeks are usually recommended.

In our study, donkeys and mules were kept in an enclosure adjacent to cattle for ten days, where they were able to see, hear and smell each other (Fig. 5). During this period, contact with farm and cattle dogs was avoided to prevent the donkeys becoming familiar with them, which might have diminished their instinctive aversion to canids.

After the initial bonding phase, donkeys and mules were released with cattle into pastures for the remainder of the study. Small or medium-sized fenced pastures were chosen, with open areas and good visibility, mostly with few or no trees (Fig. 6).

**Fig. 5** Bonding donkeys with cattle. *(Photos: Javier Talegón)*

**Fig. 6** After socialisation, donkeys guarded cattle in fenced pastures with open areas and good visibility. *(Photos: Javier Talegón)*

### 3.4 Monitoring and evaluation

Farms were visited weekly or fortnightly to ensure that the agreed husbandry guidelines were being followed and to monitor the adaptation, behaviour and welfare of donkeys and mules. Whenever a farmer was absent from the farm during such visits, the required information was obtained by telephone. The following data were also gathered for each farm: damages (number of animals killed, injured or disappeared) and the predator held responsible (dog, wolf or fox); changes in herd size; and any changes in the pastures that may have occurred. Official records (see section 3.2) of damage to livestock attributed to wolves and dogs during the 12 months preceding the trial were used to compare with the level of losses after placement of donkeys and mules.

## 4. Results

### 4.1 Placement and socialisation

All donkeys and mules were successfully integrated into cattle herds. Farmers generally followed the agreed protocols and guidelines, although there was a lack of compliance at two farms. During monitoring visits we observed that some animals were not always kept in the agreed pastures or with the specified number of cattle.

### 4.2 Behavioural problems

Two donkeys attacked new-born calves, leading to early termination of the trials at two farms (Table 2). One of them bit a calf and was immediately removed from the herd. The second donkey inflicted fatal injuries to three calves before it was removed. Another donkey protected cattle feed *(tacos)*, preventing cattle from accessing it, and was thought to have injured one of the cows, which led to curtailment of the trial at a third farm (Fig. 7).

**Fig. 7** We found that some donkeys may protect certain types of cattle feed *(e.g. tacos),* although apparently not hay. *(Photo: Javier Talegón)*

### 4.3 Before/after comparison of damage

Four donkeys and two mules were used to protect five cattle herds at four farms for a combined total of 11 months, during which no losses to predators were recorded in any of the herds. In contrast, a combined total of 18 head of cattle (1–8 per herd) had been lost to predation during the 12 months prior to guard animals being integrated into the herds at rates of 0.08–0.57 head per month per herd (Table 2).

## 5. Discussion and conclusions

Our pilot project shows that Zamorano-Leonese donkeys can be socialised with cattle. Except for some farmers not always following protocols and guidelines, there were no major difficulties with initial adaptation of donkeys or mules to herds, even of Lidias, which are usually relatively aggressive. However, several behavioural problems arose later which resulted in cattle being injured (some new-borns fatally), leading to permanent removal of some donkeys from herds, the premature end of those trials and an understandable lack of interest of the affected farmers to continue collaborating.

**Table 2** Reported losses to predation (in total and per month) before and after guard donkeys/mules were placed in cattle herds and reasons for curtailing trials.

| Farm | Guard animals/herd | No. of cattle killed (per month) | | Trial duration | Reason for ending trial |
|---|---|---|---|---|---|
| | | Before | After | | |
| #1 | 1 donkey | 8 (0.57) | 0 (0) | 3 months | Farmer no longer committed to the project |
| | 2 mules | 4 (0.33) | 0 (0) | 3 months | |
| #2 | 1 donkey | 1 (0.08) | 0 (0) | 1 month | Donkey prevented cattle accessing feed, injured a cow |
| #3 | 1 donkey | 2 (0.17) | 0 (0) | 1 month | Donkey injured a new-born calf |
| #4 | 1 donkey | 3 (0.25) | 0 (0) | 3 months | Donkey killed new-born calves |

These incidents may have been the result of over-protective behaviour as described in the literature (Bourne, 1994; OMAFRA, 2018). The unfamiliar odours, sounds and movements of new-born calves elicit strong responses in some donkeys which may try to expel them from the herd. To avoid such problems, special care should be taken during calving, when it may be necessary to separate donkeys from livestock. As an alternative, donkeys could be used with subadult cattle, which are more vulnerable to predation than adult cows.

One of the donkeys in our trail prevented cattle from accessing feed. We have not found mention of this in the literature, so it might be rare behaviour, but we suggest further investigation and due consideration of measures to prevent it.

The small number of farms (four) and guard animals (six) included in our study, and the short duration of trials (1–3 months each), limit the strength of conclusions that we can draw regarding the effectiveness of Zamorano-Leonese donkeys and mules to protect livestock from predators. Nevertheless, our findings suggest that they might be capable of protecting cattle from canids. This is supported by the statements of some other farmers in Zamora and neighbouring provinces who told us that, in their experience, Zamorano-Leonese donkeys can be effective against foxes, stray dogs and single wolves. Therefore, we believe that they have potential to be a useful damage prevention measure, especially for small farms and where LGDs[3] or other measures such as anti-predator fencing are unsuitable, too costly or require too much time or effort to deploy.

For Zamorano-Leonese donkeys to play a greater role in protecting livestock from predators, additional trials over longer periods and with larger numbers of animals are necessary in order to gather sufficient data for a more thorough assessment of their effectiveness. Research is also needed to identify best practices concerning selection, raising and use of guard donkeys and mules to prevent problems such as those encountered in our pilot project.

We think that donkeys could be a good first tool to deploy in areas of potential and recent wolf expansion, where wolf density is low, since they are easily integrated with livestock and can start protecting it within a few weeks. Despite the apparently low level of motivation to use guard donkeys in Zamora, we have seen increasing interest in neighbouring provinces such as Salamanca and in Ávila and Madrid, where the wolf is currently recolonising parts of its former range, which could bode well for the future of the Zamorano-Leonese breed.

## Acknowledgements

The pilot project was financed by the Zamora Provincial Council and implemented by the Asociación Nacional de Criadores de la Raza Asnal Zamorano-Leonesa. We would like to thank Jean-Marc Landry and Daniel Mettler for their help during the early stages in providing information and sharing their experience with guard donkeys in Switzerland.

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[3] For a comparison of donkeys and LGDs, see the review by Rigg in this issue.

Pop-up feature

# THE END OF THE LIFE EUROLARGECARNIVORES PROJECT

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Beginning in 2017, the LIFE EuroLargeCarnivores project (LIFE16 GIE/DE/000661) sought to better understand and address the opportunities and challenges presented by the return of large carnivores in Europe. More than 250 events were organised in 15 countries with the aim of improving human-carnivore coexistence through communication, cross-border cooperation and knowledge exchange.

Over the past five years, the project team met, discussed and collaborated with more than 3,000 people living and working with large carnivores. We tried our best to learn from everyone we encountered about the challenges involved: the overworked damage inspector showing us 1,000+ photographs of livestock carcasses; horse owners worried about the first indication of wolf presence along their preferred weekend riding route; government officials scrambling to implement the EU Habitats Directive; the shepherd in panic after a wolf pack attacked his livestock at nightfall; and the scientists struggling for decades to get their colleagues over the border to use the same monitoring protocol; to name just a few.

Whenever we identified knowledge gaps, we encouraged and financially supported researchers to investigate the topic, resulting in six peer-reviewed scientific publications during the project period.[1] Studies included the socio-economic impacts of large carnivore presence in Europe (Rode et al., 2021), the distribution of LIFE project funding for large carnivores in Europe (Navarro et al., forthcoming), the effectiveness of LIFE projects on coexistence (Oliviera et al., 2021), systematic approaches to stakeholder mapping (Grossmann et al., 2020), as well as a piece on the narratives underlying people's opinions of the wolf (Juergens et al., forthcoming).

We collected tens of thousands of individual records of attacks on livestock that were documented by 263 regional authorities across Europe in the years 2018 to 2020 and had independent researchers analyse the data (Singer et al., forthcoming). Over 70% of the regions we have data from reported less than 50 large carnivore attacks on livestock per year and only a small fraction, 9%, reported an average of more than one case per day across the year.

Collaborating with the regional administrations of the Benelux countries, we understood how important it is to provide authorities with blueprints of the administrative processes which the presence of large carnivores requires and how they can be lawfully implemented. We therefore published an initial set of Standard Operating Procedures for Improved Management of Large Carnivores in Europe[2] that provide information about different types and aspects of governance for situations that can arise due to the

[1] https://www.eurolargecarnivores.eu/en/publications
[2] https://www.eurolargecarnivores.eu/en/sops

presence of large carnivores and encompass technical, economic, social, educational and political best-practice interventions. The three overarching themes addressed are risk and damage prevention, monitoring of large carnivores and species management at individual and population level.

Sharing the experience of people that live and work with large carnivores has been a central theme of this project. We have featured over 70 people from all over Europe including hunters, farmers, researchers, officials and many others, providing them with a space to share their narratives and directives on coexistence with large carnivores but also encapsulating their stories in captivating videos[3]. On social media alone, more than 1.5 million people watched our videos. The Spanish and Slovak short films were among the most prominently featured in the media, being broadcast during prime time on public television. These videos are available with subtitles in over ten languages.

European policy has seen significant improvements for coexistence with large carnivores in recent years, most prominently the availability of EU Common Agricultural Policy funds to cover the cost of livestock damage prevention measures. From this year even nomadic shepherds' salaries can be covered as high value nature farming. It is now in the hands of Member States and regional governments to distribute these funds to farmers and shepherds.

As populations of large carnivore, particularly the wolf, expand across the continent, we recommend Member States and regions to move quickly in professionalising their responses. They should adopt and improve Standard Operating Procedures for key processes; secure sufficient staff to assist livestock owners in need; provide financial support to farmers in a timely fashion; check the quality of damage prevention measures; train administrative staff adequately; and ensure they know and work with their counterparts across regional and national borders. For further recommendations, see the project website[4].

We would like to use this occasion to extend our gratitude to all the people that made time to work with us over the last five years, including the editorial team of *CDPnews*. While this is the last issue financially supported by the LIFE EuroLargeCarnivores project, the organisations involved in the project will continue to make good use of the material available on the project website[5], including the translation of *CDPnews* into other languages. The final conference[6] of the project will be held virtually on 16th March 2022 from 09:00 to 13:00 CET.

[3] https://youtu.be/JBnW1uWufZM
[4] https://www.eurolargecarnivores.eu/en/recommendations
[5] https://www.eurolargecarnivores.eu
[6] https://www.eurolargecarnivores.eu/en/final-conference

Research

# REACTIONS OF HORSES TO WILDLIFE AND LIVESTOCK GUARDING DOGS

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## 1. Introduction

A combination of natural habitat loss (Cimatti et al., 2021) and the ongoing recovery of large carnivores in Europe (Chapron et al., 2014) brings challenges for coexistence with predators such as the grey wolf *(Canis lupus)* in human-dominated landscapes. Measures to protect livestock from attack, including the use of livestock guarding dogs (LGDs) and electric fences (Bruns et al., 2020), tend to focus on smaller species such as sheep and goats, with less attention paid to horses. This may be because wolves most often kill small stock (see Freitas et al., 2021 in *CDPnews* issue 23) or because it is assumed that horses have sufficient anti-predator responses (DBBW, 2021a).

Nevertheless, between 2012 and 2016, an average of 645 horses per year were compensated for losses attributed to wolves across the European Union (Linnell and Cretois, 2018). Free-ranging ponies constitute an important prey for wolves in NW Iberia (see Freitas and Álvares, 2021 in *CDPnews* issue 23). Furthermore, attacks on horses have increased significantly in some countries. For example, in Slovenia 14 attacks on horses were recorded in 2016/17 rising to 50 attacks in 2018/2019 (Dušanka Jordan, personal communication).

In the federal state of Lower Saxony, Germany, with confirmed presence of 35 wolf packs, five pairs and thrtee solitary animals in 2020/21 (DBBW, 2021b), attacks have been recorded on foals, ponies and yearling horses, which were mostly kept without any protection measures (Niedersächsisches Ministerium, 2021). This has intensified the debate regarding the possibility of some wolf packs specialising on hunting particular types of livestock, namely horses. As a result, the German Equestrian Federation has called for further measures to reduce attacks by wolves on horses and other livestock (Deutsche Reiterliche Vereinigung (FN), 2020).

The value of horses is thought to differ from that of other livestock due to factors including their emotive value, monetary value, role as a signal of social status and their perception in politics (Grönemann, 2015). Diverse stakeholder groups are involved to

a greater or lesser extent in the debate about the return of wolves, including breeders, farmers, horse owners, professional riders and their sponsors, hunters, conservationists and state and local authorities and organisations), thus there is a need for sustainable solutions for conflict-reduced coexistence with wolves. Furthermore, horse keepers and owners fear that wolf presence and attacks may trigger fear reactions in horses leading to flight responses, escapes from pastures and road accidents (Grönemann, 2015).

Probably because experiments in the field are challenging, research on anti-predator responses of ponies and horses is rare (but see the observations of Lema et al. in this issue). Few researchers have addressed the reactions of domestic horses towards predator stimuli. Christensen and Rundgren (2008) reported that predator odour (from wolf fur), associated with a sudden auditory stimulus, increased the level of vigilance of individually tested horses. Recent studies on two groups of different breeds found that horses increased their alertness, gaits and grouping in response to predator vocalisations (Janczarek et al., 2020).

Protection measures for small livestock cannot be readily adopted for horses without prior assessment to avoid risk of injury. For example, guidelines for horse fences (BMELV, 2009) were drafted before wolves returned to Germany and their suggestions do not necessarily meet requirements for protection from wolves (Reinhardt et al., 2012). According to these recommendations, the lowest bar or wire of fences for horses should be at least 40 cm above the ground (BMELV, 2009) to avoid the risk of leg injuries if horses kick or roll under the fence, but this allows wolves to crawl under the fence. Several possible solutions have been proposed, such as the attachment of lower wires outside fences (DLG, 2020) or the use of low injury risk materials. Their effectiveness needs to be validated (see Schütte, 2021 in *CDPnews* issue 23).

Currently, scientific studies on damage prevention measures for the equine sector are limited. Electric fences are usually recommended (DLG, 2020; NABU Niedersachsen, 2020; Schütte, 2021), although alternatives could include the use of LGDs (NABU, 2015; see also Lagos and Blanco, 2021 in *CDPnews* issue 23). LGDs are used to protect livestock from predation worldwide (Rigg, 2001) and effectively reduce depredation on sheep, goats, cattle and other species of domestic animals (Gehring et al., 2010).

To contribute to this topic by increasing knowledge of horse reactions to the presence of wolves and the possibility of using LGDs to protect them, we implemented two case studies. The aim of the first study was to obtain information about the reactions of horses kept in pastures under semi-natural conditions to wolves, as well as to other wildlife and domestic animals. We also evaluated the usefulness of monitoring groups of horses via GPS in combination with camera trapping. The second study aimed to evaluate the potential of protecting horses with LGDs by analysing the reactions of a group of horses towards guarding dogs. We evaluated whether a social bond, which forms the basis for protective behaviour in LGDs (Coppinger et al., 1983), can be established with horses.

## 2. Study areas

Both studies were implemented in the 2018/2019 wolf monitoring year. The first study was conducted in the rural district of Celle, Lower Saxony (Fig. 1). The landscape was characterised by alder forests,

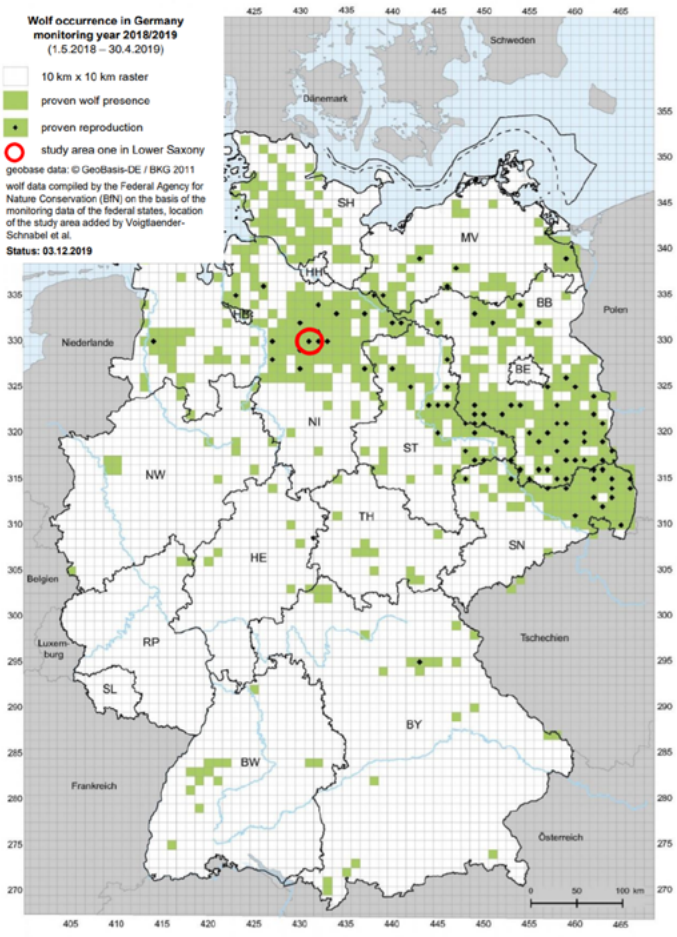


**Fig. 1** Location of the Lower Saxony study area showing wolf occurrence in Germany in the 2018/19 monitoring year.

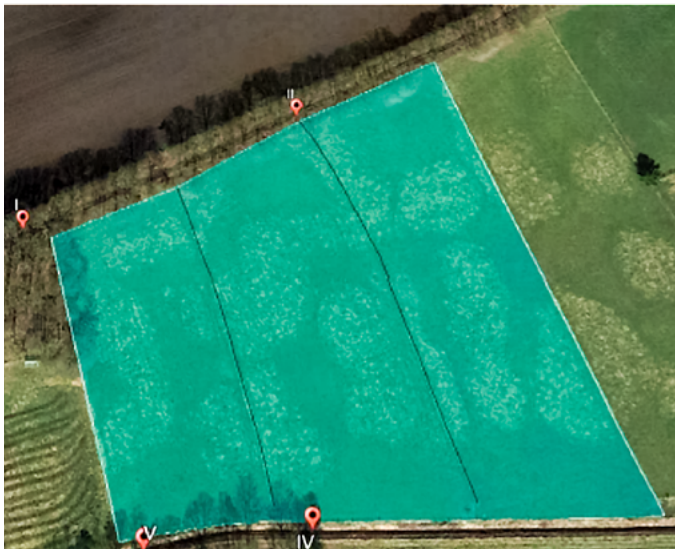


**Fig. 2** Group 1 pasture indicating the positions of wildlife cameras.

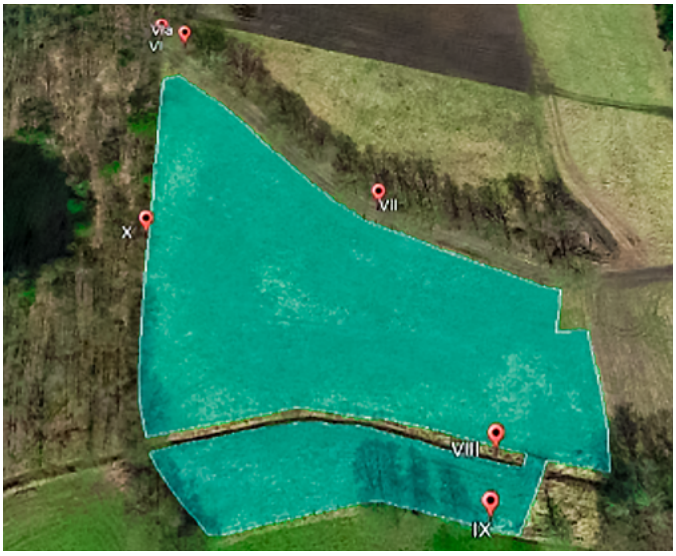


**Fig. 3** Group 2 pasture indicating the positions of wildlife cameras.

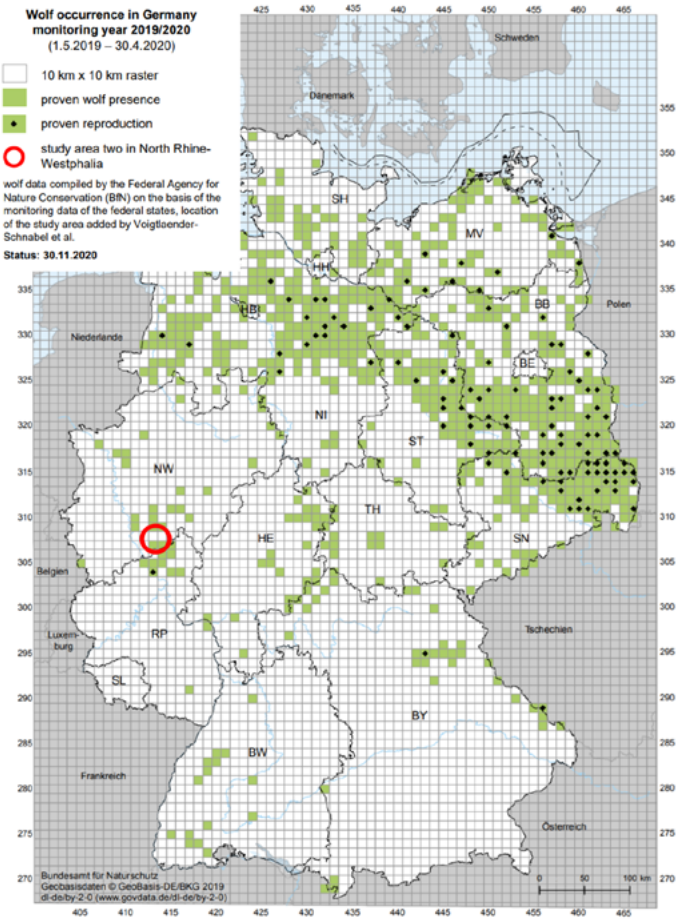


**Fig. 4** Location of the North Rhine-Westphalia study area showing wolf occurrence in Germany in the 2019/20 monitoring year.

meadows and moor. Two horse groups were placed in two different pastures, 460 m apart from each other. Group 1's pasture was about 2.39 ha, surrounded by small forests (on two sides), pasture and farmland (Fig. 2). In addition, a dirt road bypassed one side of the pasture behind adjacent bushes. Group 2's pasture was about 1.25 ha, surrounded by forests, farmland and grassland (Fig. 3). Wildlife in this area was rich in deer, raccoons, foxes and rabbits. The study area was located near the territory of the 'Osterholzer Moor' wolf pack, which consisted of two adults and five pups (Landesjägerschaft Niedersachsen, 2021).

The second study was implemented in the Rhine-Sieg district of North Rhine-Westphalia (Fig. 4). It was conducted on private land where three Arabian stallions were kept year-round in an open stall in a 1.3 ha pasture surrounded by fields, meadows and forests. The property was located in the 'Wahnbachtal' water protection area, which restricted use of pastures in winter. The area was located in the 'Oberbergisches Land' wolf area near the 'Leuscheid' wolf territory, where one pair of wolves was documented during the study (DBBW, 2021c).

## 3. Methodology

### 3.1 Study 1: Reactions of horses to wildlife

Data on horse–wildlife interactions were obtained from analysis of the movement behaviour of seven horses in two groups (Table 1). Group 1 comprised four mares, each with a 5-months old foal. For this group, hay was available *ad libitum* in the pasture throughout the trial period. In addition, mares were fed with concentrated feed each morning. Group 2 comprised three 2-year-old mares in a second pasture. All horses were familiar with the pastures, having either grown up on the farm or lived there for

**Table 1** Details of horses included in Study 1.

| Group | Horse | Breed | Age | State of health |
|---|---|---|---|---|
| 1 | B | Holsteiner | 16 | healthy |
| 1 | C | Hanoverian | 11 | mild ataxia |
| 1 | D | Hanoverian | 6 | healthy |
| 1 | E | Hanoverian | 17 | mild osteoarthritis |
| 2 | F | Hanoverian | 2 | healthy |
| 2 | G | Pony | 2 | healthy |
| 2 | H | Hanoverian | 2 | healthy |

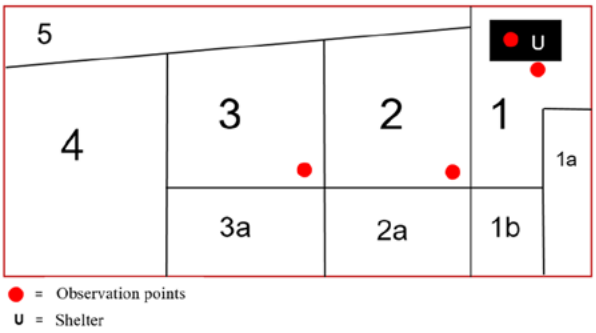


**Fig. 5** Diagram showing the five meadows and subdivisions in Study 2.

several years. They were warmbloods, including one pony, and the farm veterinarians considered them to be in good condition and health, except two which had slight movement constraints due to mild forms of ataxia and osteoarthritis (Table 1).

The mares in both groups were equipped with GPS devices (GPS Lap Timer BT-Q1000eX) and, over a period of six weeks from 20th August to 30th September 2018, their movements were recorded every night from 18:00 (sunset c.20:00) to 08:00 (sunrise c.06:00) as wolf attacks on livestock are known to take place primarily during the night (Boitani, 1992). Longitude, latitude and moving speed were recorded once per second for each horse. Foals were not fitted with GPS devices as previous research has demonstrated that foals < 6 months of age mostly follow their mothers (Berger, 1986).

Around each pasture we positioned five camera traps (SecaCam Raptor, SecaCam HomeVista, Wild-Blick) at a maximum distance of 10 m from the fence and oriented towards the pasture. They were attached to tree trunks or fence posts 73–116 cm above the ground. Cameras were set to picture mode from

**Table 2** Details of Arabian stallions and livestock guarding dogs in Study 2.

| Species | ID | Year of birth | Sex | Kinship |
|---|---|---|---|---|
| horse | P1 | 2009 | male | no |
| | P2 | 2012 | male | no |
| | P3 | 2013 | male | no |
| dog | dm1 | 2015 | male | parents of m2 and f2 |
| | df1 | 2016 | female | |
| | dm2 | 2017 | male | offspring of m1 and f1 (different litters) |
| | df2 | 2018 | female | |

20th August to 10th September, taking four pictures followed by a 30-second break after each trigger. To check whether video mode enhanced the likelihood of documenting wolves, they were then switched to record 15 seconds of video at each trigger until the end of the trial. The ten cameras operated for 41 days resulting in a sampling effort of 410 trap nights. Detected animals were categorised as 'carnivores' or 'other animals'.

Horse moving distance, speed, position and distances within the group were matched with animals recorded by camera traps resulting in a total of 19 assessment nights. Movements were categorised according to speed: fast (> 12 km/h), slow (< 12 km/h) or close to zero (< 0.129 km/h) (Zierman, 2006) and later associated with the presence of animals recorded by the cameras. Horses were considered to have reacted to animals whenever they showed fast movements within a 10-minute time frame from five minutes before to five minutes after animals were registered by a camera trap. 'Speed concerted' were intervals[1] with at least one horse showing speed movements (> 12 km/h); including either the speed movement of one horse, two, three or all horses of a group.

### 3.2 Study 1: Reactions of horses to wildlife

The second study examined social interactions between LGDs and horses, based on analysis of affiliative and agonistic behaviours shown by horses towards dogs. Since 2016, three Arabian stallions (male, uncastrated) had been protected by two Šarplaninac (Yugoslavian Shepherd Dogs) (dm1 and df1). The dogs had pups in 2017 (dm2) and 2018 (df2) which were raised from a young age in close proximity to

[1] An interval was defined as the timespan when a defined movement category starts until it ends, e.g. starts when speed movement is > 12 km/h and ends when speed is < 12 km/h.

the horses. To promote the socialisation of dm1 and df1 with the stallions, they were first kept in a separate area next to the horses. After two to three weeks, horses and dogs were put together in an area of 1.3 ha.

During the observation period, the area was divided into five meadows of different sizes (Table 2, Fig. 3), only the first three of which were open for grazing. The other two meadows could be entered by the dogs but not by the horses. Area 1 had a shelter for horses and dogs, a paddock, two hay feeding stations and a watering trough. Areas 1a, 1b, 2a and 3a were separated from the other sections by mobile fences and electric nets and were not accessible to the horses. Section 1a was a nature conservation area. Sections 1b, 2a and 3a were used as a separation area for LGD dm2 during the feeding time of other dogs.

The entire area was surrounded by a wooden fence with two battens at 30 cm and 100 cm above the ground. Additionally, an electrified wire to prevent wolves crawling underneath the fence was attached 10 cm above the ground outside the wooden fence. Electric nets were only used to separate the dogs from each other and were out of reach of the horses. Fences were connected to the power network at night.

Behavioural observations were conducted for a total of 46 hours over seven separate days, from November 2019 to January 2020. Different locations were chosen for observations due to the influence of the weather on horse movements between shelter and meadows (Fig. 5). The first observation day included a period from 09:00 to 12:00 for the horses to habituate to the observer. During subsequent observations, sampling was initiated when the horses ignored the presence of the observer. Continuous, all occurrence behaviour sampling (Altmann, 1974), was implemented simultaneously for all animals in the group by the same observer from 09:00 to 12:00 and 13:00 to 17:00. An ethogram describing affiliative and agonistic behaviours was adapted from McDonnell and Haviland (1995) and used to register horse behaviour towards the dogs (Table 3). A separate recording sheet was used for each observation period.

We also recorded submissive behaviour of dogs towards horses. In case of aggression by livestock, LGDs should retreat, lay down and look away (AGRIDEA, 2010). Dog behaviour unrelated to horses, such as barking and running to fences, was noted along with the reaction of the horses to such behaviour, but was not analysed statistically as the sample size was too small.

### 3.3 Data analysis

Data were analysed with R and SPSS software. GPS data were analysed using a newly developed R script. Some data were not normally distributed (Shapiro-Wilk test). Correlations between parameters and comparisons of means were analysed with a Generalised Linear Model (GLM), allowing multivariate calculation of non-parametric data. The dependent variable is tested against several predictors to determine which is the most significant. Frequency distributions of the behaviours shown by each horse towards LGDs were analysed with chi-square tests and binomial tests. The level of significance was set to $p < 0.05$ and all tests were two-sided.

**Table 3** Ethogram of horse social behaviours towards livestock guarding dogs (McDonnell and Haviland, 1995).

| Affiliative behaviours | Behaviour components |
|---|---|
| 1. social play | 1.1 play fighting (head/neck/chest nip) |
| | 1.2 running |
| 2. rest/feeding together | 2.1 feeding together |
| | 2.2 rest standing |
| | 2.3 rest sleeping |
| 3. vigilance/social behaviour | 3.1 attentive ears and looking in the dog's direction |
| | 3.2 neighing |
| | 3.3 following dogs |
| 4. comfort/investigation | 4.1 allogrooming |
| | 4.2 olfactory investigation |

| Agonistic behaviours | Behaviour components |
|---|---|
| 1. threat | 1.1 ears laid back/pinned |
| | 1.2 kick threat |
| 2. avoidance | 2.1 facing away |
| | 2.2 leaving |
| 3. attack | 3.1 kick |
| | 3.2 biting |
| | 3.3 bite threat/chasing |
| 4. impose/posturing | 4.1 strike |
| | 4.2 arched neck threat |
| | 4.3 squeal |

**Table 4** Animal species detected and horse reactions.

| Species | Number of records | Number of 'fast movements' |
|---|---|---|
| *Carnivores* | | |
| marten | 40 | 6 (23%) |
| fox | 33 | 6 (23%) |
| domestic cat | 28 | 2 (8%) |
| badger | 21 | 4 (14%) |
| domestic dog | 12 | 2 (8%) |
| raccoon dog | 8 | 1 (4%) |
| raptor | 3 | 0 |
| raccoon | 1 | 0 |
| dog or wolf | 1 | 0 |
| polecat | 1 | 0 |
| *other animals* | | |
| rabbit | 55 | 2 (8%) |
| deer | 13 | 2 (8%) |
| unidentified small animal | 6 | 1 (4%) |
| small bird | 5 | 0 |
| bat | 1 | 0 |
| **TOTAL** | **228** | **26** |

## 4. Results

### 4.1 Study 1: Reactions of horses to wildlife

A total of 228 animal occurrences were identified from camera trap images: 158 at the Group 1 pasture and 70 at the Group 2 pasture. Most occurrences were of carnivores (martens, foxes, badgers and various other wildlife species as well as cats and dogs) or herbivores (rabbits, deer). No definite record of a wolf was obtained from the cameras (Table 4). Group 1 horses showed fast movements (including *speed concerted*) in 15 occurrences (9.5%) compared to 11 occurrences (15.7%) for Group 2. No significant difference was found in the number of movement reactions to 'carnivores' versus 'other animals'.

Analysis of the GPS data showed when horses reacted to animal occurrence they moved significantly slower (mean speed animal occurrence: 1.28 km/h) than the average speed of horses without documented animal occurrence (mean speed no animal occurrence: 17.2 km/h) in fast movement (GLM $N = 64$, $t = 2.574$, $p = 0.013$). In general, analysis of the distance between individual horses revealed that, in slow movements, horse pairs were significantly closer to each other (mean distance slow movement: 22.7 m) than in speed concerted movements (mean distance speed movements: 30.6 m) (GLM $N = 153$, $t = 5.755$, $p < 0.001$). The distance between moving horses during speed concerted intervals decreased when they reacted to animals (mean distance animal occurrence: 26.5 m) (GLM $N = 84$, $t = 5.919$, $p < 0.001$). At very slow speeds (< 0.126 km/h), the distance between horses within each group varied greatly (distance very low movement speed: 6.6 – 24.8 m).

### 4.2 Study 2: Reactions of horses to LGDs

A total of 493 behaviours were recorded comprising affiliative (71%) and agonistic (29%) reactions of horses towards LGDs. Although the frequency of the two categories differed between horses, all three showed significantly more affiliative behaviours (binomial test for P1: $N = 154$, $p < 0.001$; P2: $N = 144$, $p < 0.001$; P3: $N = 195$, $p = 0.015$). All three horses showed 'vigilance/social behaviour' significantly more often (62%) than 'rest/feeding together' (29%), 'comfort/affection' (5%) or 'social play' (4%) (chi-square test: $N = 350$, $X2 = 303.55$, $df = 3$, $p < 0.001$) (Fig. 6). When data for all three horses were combined, 'attentive ears and looking in the dog's direction' (56%) was significantly more often shown than the other affiliative behaviour components (chi-square test: $N = 350$; $X2 = 855{,}95$, $df = 8$, $p < 0.001$) (Fig. 7).

The distribution of agonistic behaviour was similar for horses P1 and P2. In contrast, P3 showed significantly more agonistic reactions towards the dogs, especially 'threat' (chi-square test: $N = 114$, $X2 = 11.558$, $df = 2$, $p < 0.003$) and 'posturing' (binomial test: $N = 18$, $p < 0.001$) (Fig. 8). Overall, 'ears laid back/pinned' was significantly more often exhibited towards LGDs than any other agonistic behaviour (chi-square test: $N = 143$, $X2 = 313$, $df = 7$, $p < 0.001$) (Fig. 9).

LGDs reacted by immediately retreating when horses showed agonistic behaviour ($n = 104$). Horses displayed the behaviour 'ears laid back/pinned' in a total of 86 instances and 'kick threats' in 18 instances. In 100% of such cases, LGDs retreated from the horses (Fig. 10).

In several situations when LGDs ran to fences and barked, horses showed the affiliative behaviour 'vigilance/social behaviour'. In particular, they showed 'attentive ears & looking in the dog's direction. In three situations of play-fighting between horses, LGDs reacted by running towards the horses and barking, which caused the horses to stop their

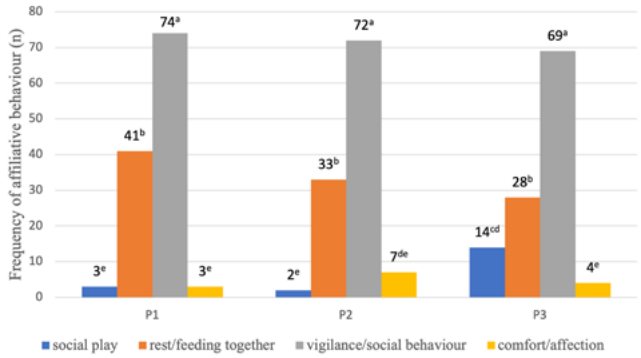


**Fig. 6** Frequency of occurrence of affiliative behaviour shown by three horses (P1, P2 and P3) towards LGDs. Letters (a, b, c, d, e) show significant differences.

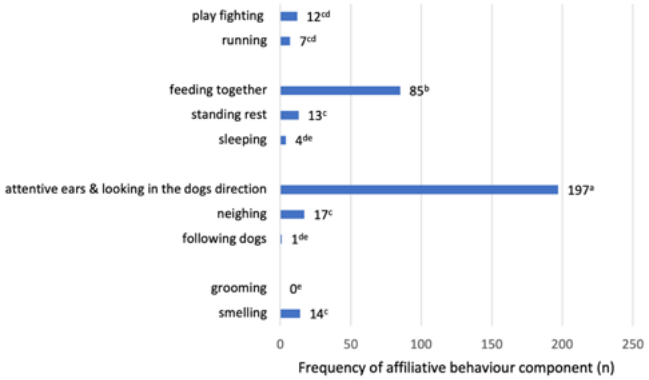


**Fig. 7** Frequency of occurrence of affiliative behaviour components shown towards LGDs by three horses combined. Letters (a, b, c, d, e) show significant differences.

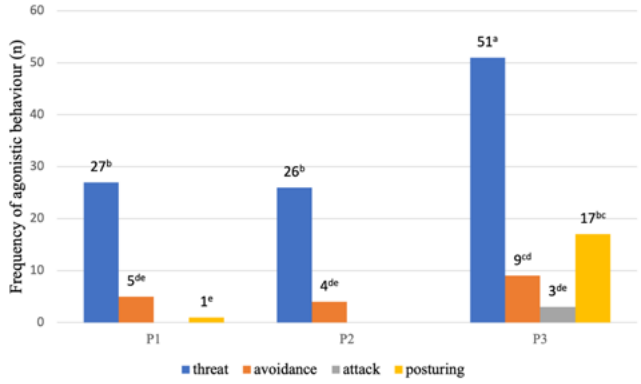


**Fig. 8** Frequency of occurrence of agonistic behaviours shown by three horses (P1, P2 and P3) towards LGDs. Letters (a, b, c, d, e) show significant differences.

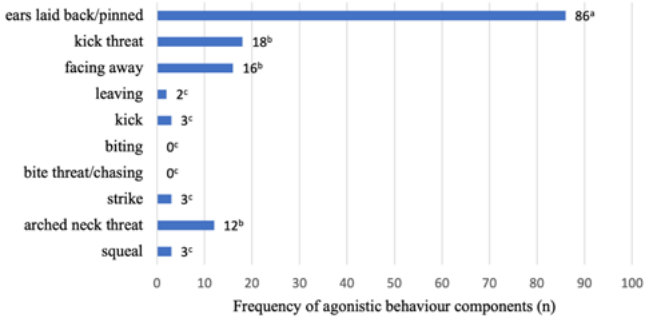


**Fig. 9** Frequency of occurrence of agonistic behaviour components shown towards LGDs by three horses combined. Letters (a, b, c, d, e) show significant differences.

**Fig. 10** A horse, disturbed from rest by the approach of a LGD, warns the dog to keep its distance with threatening facial expressions. The dog immediately retreats. *(Photo: B. Greiner)*

encounters and to threaten the dogs with agonistic behaviour. In one case, horse P3 injured dog df1 by kicking.

## 5. Discussion

### 5.1 Study 1: Reactions of horses to wildlife

Prior to the study, intensive investigations of wolf presence in the observation areas were done in 2017 and 2018. However, severe drought in the summer of 2018/2019 caused wolves to leave the area. Therefore, due to the lack of wolf detections by camera traps, conclusions for horse behaviour towards wolves cannot be drawn. Nevertheless, this study provides a first insight into reactions of horses towards other species and GPS monitoring allowed analysis of group structures between speed concerted intervals and slow movements of horses. The average speed of horses associated with wildlife presence was significantly slower than their average speed without wildlife occurrence, which suggests that the presence of wildlife does not cause fleeing but may lead to more alert reactions. Horses may have slowed down to inspect animals. It is important to mention that the camera traps only monitored a certain part of the pastures and may not have detected all wildlife occurrences.

Since the presence of wildlife was only recorded by camera traps, it is not clear if the horses reacted to visual, olfactory or auditory stimuli or to a combination of these stimuli. Horses are polyphasic, being active during day and night (Murphy et al., 2009). Their eyes are well adapted to recognising movement and shapes in very dark environments (Hanggi and Ingersoll, 2009). Their sound-localisation acuity is less developed than that of some other mammals, which could be due to their

evolutionary history (e.g. visual capabilities are more relevant in open plains) (Heffner and Heffner, 1984).

Christensen and Rundgren (2008) demonstrated that predator odour increased vigilant behaviour in horses, but fear reactions were only seen after a sudden auditory stimulus. Horses appear to react with flight behaviour to a combination of at least two predator stimuli, which may pay in natural settings, as flight reactions demand more energy (Christensen and Rundgren, 2008). In contrast, in a recent study, auditory stimuli of predators (grey wolf, Arabian leopard and golden jackal) alone caused alertness, faster movements and grouping in horses (Janzcarek et al., 2020). It remains unclear whether the number, type or strength of predator cues plays the main role in eliciting flight responses in horses.

In our study, only smaller predators were documented. The fact that horses showed faster movements in only 11% of animal occurrences might be related to the horses' excellent vision during the night, which enables them to evaluate the potential danger of wildlife very well. Another reason could be the learned response to certain wildlife odours. In mammals, the response to predator smell is innate, but odour perception also depends on learning (Nielsen, 2017). The horses in the present study may have learned to recognise the odour of non-threatening species.

The breed and size of horse groups seem to influence their reaction to certain predator stimuli (Janzcarek et al., 2020). Differences in reaction to fearfulness tests are also related to horse breed (Budzyńska et al., 2018). Warmblood breeds such as Holsteins were less reactive than Thoroughbreds in fearfulness tests (Janiszewska et al., 2004), which may explain the mild response to wildlife occurrences of the horses in the present study. Holsteins and Hanoverian are characterised as uncomplicated, enthusiastic, strong-nerved and reliable.

However, it should be noted that the recording of a *slow average speed during wildlife occurrence* may have been influenced by the recording period, which was from five minutes before to five minutes after the first movement in connection with wildlife occurrence set in. We assumed that any wildlife captured by cameras was in the immediate vicinity of the pastures during this 10-minute period.

Analysis of the distance between members of a group indicates that the horses in the present study reduced their individual distance in alert situations and moved closer together, as reported for other predator responses (Rees, 2017). Reducing the distance to conspecifics in threatening situations reduces the risk of being attacked (Duranton and Gaunet, 2016). In a previous case study, different formation strategies were shown in Koniks (circular herd formation) and Arabians (linear group formation) (Janczarek et al., 2020). Further analysis of GPS data might show whether similar formation strategies were used by the horses in the present study. To validate the results from the first study, further research on horse groups with different sizes and compositions and the application of network analysis is needed (Rubenstein, 2015).

### 5.2 Study 2: Reactions of horses to LGDs

The study was conducted with a small group of male horses. These stallions showed more affiliative than agonistic behaviour towards LGDs. This leads to the conclusion that horses and LGDs can be socialised and bonding between the two species is possible. Furthermore, horses were more alert when LGDs barked and ran to fences. Therefore, we suggest that horses may recognise dog behaviour as an indicator of potential danger. However, our sample size of such observations was small and this conclusion needs to be treated with caution until further studies replicate our findings.

Agonistic behaviour shown by horses towards LGDs, such as 'ears laid back/pinned' and 'kick threat', led to immediate retreat by the dogs. It can be assumed that dogs have learned how to identify threats by horses. Further agonistic behaviour such as attack ('kicking') was shown only in connection with fights between stallions. The dogs started to bark and ran between the horses while the horses were play-fighting, which in one case resulted in injury of a dog. Dogs intervene in play and aggressive encounters of their conspecifics (Wars et al., 2009), similar to horses which also intervene in the conflict of others to reduce the level of aggression within the group and to establish social bonds (Schneider and Krueger, 2012). Behavioural analogies appear to exist between dogs and horses which may facilitate communication between species and assist horses to develop strong bonds with dogs (Maglieri et al., 2020). The observed interspecies intervention behaviour of LGDs during horse play-fighting also suggests that the dogs in our study established some level of social bond with the horses. Analysis of intervention behaviour between

two different species (e.g. Landry et al., 2020) is highly interesting in itself and may enhance understanding of interactions between LGDs and livestock, including horses.

Further studies are needed to enlarge the data set and to consider different horse and dog groups, husbandry systems, social structures within horse groups, different dog and horse breeds and ages as important factors. Moreover, training strategies for bonding LGDs with horses must be evaluated in detail to avoid potential injuries to pups.

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# ABSTRACTS OF SCIENTIFIC ARTICLES

## DIVERSE PREVENTION MEASURES

### OPTIONS AND LIMITATIONS OF PROTECTING HORSE HUSBANDRIES IN TIMES OF GROWING WOLF POPULATIONS IN GERMANY. REVIEW OF THE LITERATURE AND HORSE OWNER QUESTIONNAIRE ON RISK ASSESSMENT

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**Objective** Since 2000 the wolf population is reestablishing itself in Germany. In consequence to increasing numbers, livestock damage caused by wolves is on the rise, with horses likewise being affected. The aim of the study was to provide an overview of this challenge and its possible solutions.

**Material and methods** Based on a literature research, data on the wolf population in Germany, wolf-related damage as well as possibilities and limitations of herd protection for horses were evaluated. An online survey addressed to horse owners/keepers served to determine the actual and/or perceived threat posed by wolves and the resulting effects on horse husbandry.

**Results** The literature search showed a continuous increase of the wolf population in recent years as well as a significant increase of wolf-caused livestock damage in general especially since 2016; although horses were rarely affected. Half of the 574 evaluated questionnaires were from Brandenburg and Lower Saxony. The greatest influence on the individual risk assessment concerning their own horses by the growing wolf population was the horse owners' knowledge of wolf attacks in their own county. Especially the aspects of keeping young horses as well as pasture keeping played a significant role. 64% of respondents indicated that they had not changed their horse management practices despite the increasing wolf population. Only 8 of 576 horse owners had reported officially confirmed wolf attacks and 30 respondents had not reported a suspected wolf damage to official agencies. More than half of the respondents who had contact with a wolf advisor described the cooperation as either not or only slightly purposeful.

**Conclusion and clinical relevance** The number of officially confirmed wolf attacks on horses is low. These numbers could be objectified by a routinely performed genetic test in case of corresponding suspicion. Despite the awareness of an increasing danger of horses by wolves, horse owners mostly do not undertake prophylactic protection measures. The communication between responsible authorities for wolf monitoring and horse owners seems to be in need of improvement.

# FACTORS INFLUENCING DAMAGE AND CONFLICTS

## EVERY CASE IS DIFFERENT: CAUTIONARY INSIGHTS ABOUT GENERALISATIONS IN HUMAN-WILDLIFE CONFLICT FROM A RANGE-WIDE STUDY OF PEOPLE AND JAGUARS

Alexandra Zimmermann,
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Carlos A. Lopez-Gonzalez,
Claudio Sillero-Zubiri,
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Throughout their range, jaguars *(Panthera onca)* are persecuted for killing livestock, posing a widespread and serious threat to their survival. Human-jaguar conflict occurs across a very large variety of geographic, agronomic and socio-economic contexts and across heterogeneous communities. We conducted seventeen case studies across seven countries in central and south America to search for patterns in socio-economic predictors of human-jaguar conflict that could help up-scale management of this range-wide jaguar conservation challenge. Our study revealed that within and across case studies there were considerable differences in farmers' education levels, economic dependence on livestock, personal experience with livestock losses, as well as tolerance of and attitudes and social norms towards jaguars. Among this diversity, we sought common predictors of tolerance of jaguars, but found that no quantifiable single contextual factor could be used to predict how farmers perceive jaguars and deal with depredation. While patterns did exist within individual case studies, none of these were consistent across a majority of cases. We conclude that observations of patterns in human-wildlife conflict are valid only for informing action at a local scale, and even if a small number of case studies appear to show similar patterns this does not make the observation universally true. It is important to remember not to generalise from case studies. Nevertheless, although each case is likely to require individual solutions, insights from aggregate or wide-range studies can provide insights into the range of possible scenarios, adding breadth of information to depth of local knowledge.

## THE POLITICAL ECONOMY OF HUMAN-WILDLIFE CONFLICT AND COEXISTENCE

Robert Fletcher,
Svetoslava Toncheva

Biological Conservation:
August 2021

https://doi.org/10.1016/j.biocon.2021.109216

Researchers have highlighted a conspicuous dearth of analysis focused on political-economic structures and processes in the rapidly expanding literature exploring human-wildlife conflict and coexistence. In this paper, we respond by highlighting the importance of attending to the influence of such dynamics in understanding and addressing both conflict and coexistence in human-wildlife interactions in particular locations and well as across levels and scales. We describe how analysis from the perspective of the capitalist political economy and the "uneven geographical development" (UGD) it produces can help to shed light on how different forms of such interaction arise in specific places and times. We illustrate this mode of analysis through comparative discussion of two contrasting case studies of human-wildlife interaction in Costa Rica and Bulgaria. We demonstrate how the particular positioning of our research sites within the overarching societies – as well as each society's positioning within an evolving capitalist world-system – encourages either conflict or coexistence between people and wildlife depending on this positioning. We conclude by calling for more researchers to also explore the overarching political-economic structures shaping human-wildlife interaction in their own contexts of study in order to more effectively address this important formative factor in patterns of conflict as well as coexistence.

## ECOLOGICAL CORRELATES OF LARGE CARNIVORE DEPREDATION ON SHEEP IN EUROPE

Vincenzo Gervasi, John D.C. Linnell, Tomaž Berce, Luigi Boitani, Rok Cerne, Paolo Ciucci, Benjamin Cretois, Daniela Derron-Hilfiker, Christophe Duchamp, Adrienne Gastineau, Oksana Grente, Djuro Huber, Yorgos Iliopoulos, Alexandros A. Karamanlidis, Ilpo Kojola, Francesca Marucco, Yorgos Mertzanis, Peep Männil, Harri Norberg, Nives Pagon, Luca Pedrotti, Pierre-Yves Quenette, Slaven Reljic, Valeria Salvatori, Tõnu Talvi, Manuela von Arx, Olivier Gimenez

Global Ecology and Conservation: October 2021

https://doi.org/10.1016/j.gecco.2021.e01798

Sharing space with large carnivores on a human-dominated continent like Europe results in multiple conflictful interactions with human interests, of which depredation on livestock is the most widespread. We conducted an analysis of the impact by all four European large carnivores on sheep farming in 10 European countries, during the period 2010–2015. We ran a hierarchical Simultaneous Autoregressive model, to assess the influence of several ecological factors on the reported depredation levels. About 35,000 (SD = 4110) sheep kills were compensated in the ten countries as caused by large carnivores annually, representing 0.5% of the total sheep stock. Of them, 45% were recognized as killed by wolves, 24% by wolverines, 19% by lynx and 12% by bears. We found a positive relationship between wolf distribution and the number of compensated sheep, but not for the other three species. Depredation levels were lower in the areas where large carnivore presence has been continuous compared to areas where they disappeared and returned in the last 50 years. Our study shows that a few large carnivores can produce high damage, when the contribution of environmental, social, and economic systems predisposes for it, whereas large populations can produce a limited impact when the same components of the system reduce the probability that depredations occur. Time of coexistence plays in favour of a progressive reduction in the associated costs, provided that the responsible agencies focus their attention both on compensation and co-adaptation.

# HUMAN DIMENSIONS AND ATTITUDES

## PAYING FOR THE PAST: THE IMPORTANCE OF FULFILLING PROMISES AS A KEY COMPONENT TO RESOLVING HUMAN–WILDLIFE CONFLICT

Brandon P. Anthony

Sustainability: July 2021

https://doi.org/10.3390/su13137407

Damage-causing animals (DCAs) originating from protected areas which inflict damage on persons and property are particularly contentious when promises to satisfactorily address such conflicts, either by protected areas or other management institutions, are left unfulfilled. Human-wildlife conflicts (HWCs) of this nature can erode trust and if not adequately resolved, assure the maintenance of tense relationships between parks and neighboring communities. This paper, based on archival research, interviews and community focus groups, examines management responses to the long history of DCAs exiting the Kruger National Park (KNP), South Africa. First, I document historical promises of compensation and the subsequent responses by conservation agencies to local communities to address these past injustices. Recent strategies to the DCA problem at KNP have been multi-faceted and include a wildlife damage compensation scheme initiated in 2014 which entails financial retribution given to affected farmers who have lost, and continue to lose, livestock to DCAs originating from the park from 2008 to date. I then present livestock farmers' recent perceptions of DCAs, the compensation scheme itself, and proposed avenues for going forward. Despite continuing challenges in the process, I demonstrate that fulfilling promises is a key step to building relational trust and legitimacy and must be considered in similar contexts where protected areas and other conservation agencies are key actors in managing HWC.

# LIVESTOCK GUARDING DOGS

## INTERACTIONS BETWEEN LIVESTOCK GUARDING DOGS AND WOLVES IN THE SOUTHERN FRENCH ALPS

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Jean-Luc Borelli,
Marine Drouilly

Journal of Vertebrate Biology:
December 2020

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Thirty years after the return of grey wolves *(Canis lupus)* to the French Alps, the number of livestock losses is on the rise despite livestock guarding dogs (LGDs) being widely used. Their relevance is, therefore, questioned by some sheep owner associations. To date, no study has investigated how LGDs interact with wolves in pastures. We present the results of a 6-year study totalling 3,300 hours of direct night-time observations to record the nature, frequency and outcomes of LGD-wolf interactions in the southern French Alps. We recorded 476 wolf events in the presence of LGDs, including 175 interactions, 66 % of which were agonistic. Most (65 %) of the interactions occurred at a distance > 100 m from the flock and on average involved more LGDs than wolves. In the presence of LGDs, wolves approached the flocks 134 times resulting in no attack (65 %), attacks with no sheep victim (24.6 %), or attacks with ≥ 1 sheep victim (10.4 %). Our results suggest that LGD-wolf interactions are complex and do not simply occur in the immediate vicinity of the flock. We recommend using groups > 6 LGDs and reinforcing the presence of LGDs in a wider radius around the flock to limit the presence of isolated groups of sheep and to improve protection against wolf attacks.

## THE ECOLOGICAL EFFECTS OF LIVESTOCK GUARDING DOGS (LGDS) ON TARGET AND NON-TARGET WILDLIFE

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Richard Yarnell,
Antonio Uzal,
Katherine Whitehouse-Tedd

Journal of Vertebrate Biology:
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Livestock guarding dogs (LGDs) are used across the world to reduce livestock depredation by free-ranging predatory wildlife. In doing so, they reduce the need for lethal predator control and are considered beneficial for conservation. However, LGDs might be perceived as predators by wildlife and induce a multitude of both positive and negative ecological effects. We conducted a literature review to evaluate the ecological effects of LGDs and found 56 publications reporting LGDs interacting with or affecting wildlife. Featuring in 77 % of the publications, LGDs were widely reported to chase and kill wildlife, leading to species-specific behavioural responses. A total of 80 species were affected by LGDs, 11 of which are listed as Near Threatened or higher on the IUCN Red List. Of the affected species, 78 % were non-target species, suggesting that any benefits arising from the use of LGDs likely occur simultaneously with unintended ecological effects. However, the frequency of LGD-wildlife interactions and the magnitude of any resulting ecological effects have rarely been quantified. Therefore, more empirical studies are needed to determine the net ecological outcome of LGD use, thereby ensuring that negative outcomes are minimised, while benefiting both farmers and wildlife.

## 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,
Alina Biro

Journal of Ethnobiology:
December 2020

https://doi.org/10.2993/0278-0771-40.4.465

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.

## IMPACT OF LIVESTOCK GUARDIAN DOGS ON LIVESTOCK PREDATION IN RURAL MONGOLIA

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Bruce Elfström,
Joe Bull

Conservation Science and Practice:
July 2021

https://doi.org/10.1111/csp2.509

Much like subsistence farmers the world over, Mongolian herders depend directly on their herds for food, materials, and income. Consequently, any loss of livestock through predation from wild carnivores (including wolves, foxes, snow leopards, and birds of prey) is a major challenge. With a lack of non-lethal mitigation methods currently available to them, herders in Mongolia frequently manage conflict with predators with retaliatory hunting, negatively impacting populations of wild predators. Livestock guardian dogs (LGDs) are an increasingly popular non-lethal means worldwide for discouraging livestock predation. However, empirical evaluations of the efficacy of using LGDs in contemporary landscapes are rare throughout Asia. Evaluating these human-wildlife conflict prevention strategies are especially important in areas used to produce globally traded commodities, such as cashmere in the case of Mongolia. We implemented longitudinal structured interview-based surveys to evaluate the use and effectiveness of LGDs as a conflict mitigation strategy for semi-nomadic herders in three locations across Mongolia. Sixteen herders in Nomgon, Ömnögovi, Undur-Ulaan, Arkhangai, Khustain Nuruu National Park area, and Gorkhi Terelj National Park area were surveyed between 2015 and 2019, throughout the process of receiving and training LGDs. Our analysis suggested herders experienced a significant reduction in the annual losses of livestock to predation after receiving LGDs (Wilcoxon signed-rank test, $Z = -3.329$, $p = .001$, $n = 16$), including when accounting for background predation rates. Consequently, we consider LGDs likely to be a viable method for livestock protection alongside the conservation of predators in Mongolia, and potentially elsewhere in Asia. We finish by exploring important considerations should this approach be used more intensively throughout the country and beyond.

# Videos

**Learning from experience**
*CSUExtension, March 2021*

An informative video for Colorado ranchers using Western ranchers' experiences to prepare for the wolf's return to Colorado. Produced by Colorado State University Extension.


**Rethinking livestock management on a predator filled landscape**
*CSUExtension, March 2021*

A presentation by Cameron Krebs, a rancher in Eastern Oregon, on his approach to keep his sheep herd safe from predator animals.


**Horse and Wolf: How does it work? Information from science and practice (Pferd und Wolf: wie geht das? Informationen aus wissenschaft und praxis)**
*LIFE EuroLargeCarnivores Project, September 2021 (in German)*

As wolves return to Germany, proper protection of extensively grazed livestock, including horses, is a main concern. In this video, scientific information on wolves' expansion in Germany and their ecology is presented, namely on their food habits and impact on livestock, and on how humans should behave around wolves, focusing on the use of damage prevention measures to prevent attacks on extensive grazed horses and promote coexistence with wolves.

# BOOKS

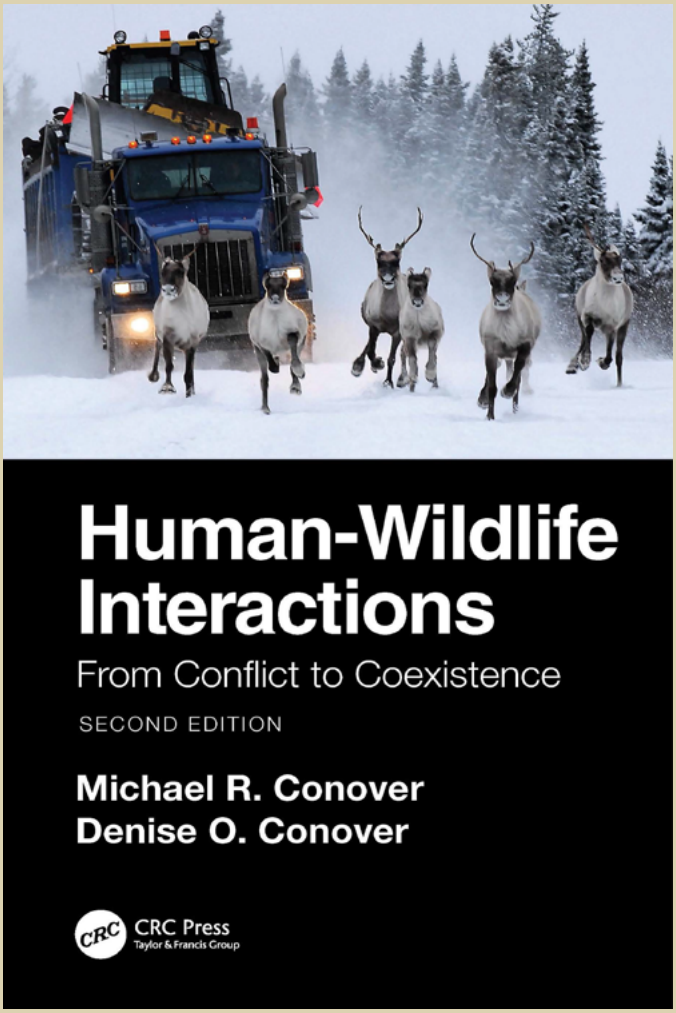
**Human-Wildlife Interactions: From Conflict to Coexistence**
*Publisher: CRC Press, 2022*
*Language: English*
*ebook ISBN: 9780429401404*
*https://doi.org/10.1201/9780429401404*

**Publisher's summary**

Human-wildlife interactions increase exponentially as more and more humans and wildlife crowd into the same limited space. Such interactions often become conflicts when wildlife threaten human health and safety, well-being, or the food supply. This second edition of Human-Wildlife Interactions: From Conflict to Coexistence provides a comprehensive review of the severity of these problems and the methods used to resolve clashes between humans and wildlife.

During his forty-year career as a wildlife professor and scientist, Dr. Michael Conover, founder of journal Human-Wildlife Interactions, has become a recognized leader of the scientific field of human-wildlife interactions. In this book, he presents the range of methods for wildlife damage management, including employing lethal methods; distributing supplemental food; changing the behavior of either humans or wildlife; and excluding or repelling wildlife. Backed by numerous case studies and informative side bars, the book documents resolutions to specific human-wildlife conflicts throughout the literature.

Containing full color illustrations throughout, the second edition of Human-Wildlife Interactions: From Conflict to Coexistence provides authoritative coverage and depth of both theoretical and practical information. It serves as an invaluable resource for students, researchers, and professional wildlife managers.



# UPCOMING EVENTS

**International Conference on Human-Wildlife Conflict and Coexistence**

**1st – 3rd September 2022 in Oxford, UK.**

This major event, co-hosted by the IUCN's Human-Wildlife Conflict Task Force, the Global Wildlife Program and Oxford University's Wildlife Conservation Research Unit, was due to be held in April 2020 but had to be postponed multiple times due to the COVID-19 pandemic. When *CDPnews* went to press, the organisers were hoping to be able to run the conference in September 2022.

For details see: https://www.hwcconference.org/

**Pathways Europe: Human Dimensions of Wildlife**

**9th – 12th October 2022 in Wageningen, the Netherlands.**

Pathways is a conference and training programme designed to address the myriad issues that arise as people and wildlife struggle to coexist in a sustainable and healthy manner. The Pathways Europe 2020 event was postponed until October 2022 due to the COVID-19 pandemic.

For details and updates see: https://sites.warnercnr.colostate.edu/pathways-europe/

**Wolves in a Changing World**

**13th – 16th October 2022 in Minneapolis, Minnesota, USA.**

International Wolf Symposium organised by the International Wolf Center.

For details see: https://wolf.org/programs/symposium2022/

**6th Human-Bear Conflicts Workshop**

**16th – 20th October 2022 in Tahoe, Nevada, USA.**

These collaborative workshops are designed to encourage participants to share solutions, explore ideas and foster open discussions that lead to real progress forward in preventing human conflicts with all eight species of bears. The theme of the 6th workshop is Pathways to Progress: Connecting People, Conserving Bears.

For details see: https://humanbearconflicts.org/

**Wolves Across Borders**

**7th – 11th May 2023 in Stockholm, Sweden.**

The goal of this International Conference on Wolf Ecology and Management is to facilitate open conversation and knowledge exchange between nations that support wolf populations and the researchers, managers, non-profits and stakeholders that work with wolf ecology, management and conflict resolution. The conference has been rescheduled from May 2022.

For details and updates see: https://www.wolvesacrossborders.com/

**XIII European Vertebrate Pest Management Conference**

**September 2023 in Belgrade, Serbia.**

EVPMC conferences have been organized since 1997 and attract participants from around the world to discuss the latest research, developments, opportunities and achievements in vertebrate pest management. Due to ongoing concerns about COVID-19, the 13th meeting has been rescheduled from September 2022.

For details and updates see: www.13evpmc.com

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# NEXT ISSUE

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**The next issue of *CDPnews* is due out in summer 2022**

CDPnews Carnivore Damage Prevention

LIFE EURO LARGE CARNIVORES