

CDP **news**

Carnivore Damage Prevention

Issue 22

SUMMER 2021



LIVESTOCK GUARDIAN DOGS IN GREECE AND MONGOLIA
GOOD PRACTICE FOR NIGHTS PENS IN THE ALPS
IDENTIFYING BARRIERS TO THE UPTAKE OF
INNOVATIVE SOLUTIONS



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The LIFE EuroLargeCarnivores project (LIFE16 GIE/DE/000661) is funded by the LIFE Programme of the European Union. This publication reflects the authors' views. The European Commission is not responsible for the contents of this publication nor any use that may be made of the information it contains.

EDITORIAL

Carnivore Damage Prevention News (CDPnews) was launched in 2000 to raise awareness of practical solutions to coexisting with wildlife. Its founding editors noted that, "Large carnivores can survive in the long term only if the conflicts with local people can be restrained". Therefore, "protecting livestock, beehives and orchards against predation is a key to large carnivore conservation".

For the last two decades, *CDPnews* has provided a forum to facilitate collaboration and exchange of information between researchers, policy makers, wildlife managers, conservationists, agricultural consultants and practitioners. The 1st issue had only 12 pages and focused exclusively on Europe. In this, our 22nd issue, we travel across three continents: from Iberia to Asia, central Europe to southern Africa. Our guides are nomadic pastoralists, subsistence farmers, shepherds, dog breeders, researchers and conservationists. Along the way we encounter not only wolves and bears but also lions and snow leopards.

This journey in space and time shows us that there are many paths to coexistence of livestock and predators, whether through developing new tools and approaches or by adapting old ones. For an example of the former we go to Spain, where researchers have been studying wolf predatory behaviour with remote cameras to develop an electrified system for protecting calves. For the latter, we visit projects in Mongolia and Greece that are working to revive the millennia-old practice of using livestock guarding dogs. This not only improves herd protection but helps preserve traditional knowledge and endangered breeds whilst supporting farmers and safeguarding their ways of life. Good shepherds are often essential for effective protection of flocks, so we also include an interview with an experienced shepherd, a graduate of one of Europe's growing number of shepherd schools.

For any given setting, the most appropriate strategies are those best adapted to local conditions. These include characteristics of habitat, landscape and wildlife, farming traditions, societal norms and financial constraints as well as the specific communities, families and individuals involved. Our article on night pens on alpine summer pastures illustrates the importance of learning where, when and how to implement such measures in order to maximise their uptake and benefits. The Long Shields Community Guardians programme in Zimbabwe demonstrates how a non-lethal, community-based intervention can advance the well-being of both local people and large carnivores.

All these efforts help deepen our understanding of conflicts involving large carnivores and broaden our horizons in the search for solutions. The increasing quantity, quality and diversity of contributions to *CDPnews* reflect the complex challenges of living with predators, but also showcase the range of creative and innovative approaches being developed, tested and implemented around the world. Be inspired!

The Editors

P.S. We echo the words of our predecessors who encouraged everybody to make use of the content of *CDPnews*, to translate it to your local languages and to distribute it to those who need it most. Help us maintain and improve *CDPnews* by sending your comments, constructive criticism and contributions to info@cdpnews.net.

Project

THE MONGOLIAN BANKHAR DOG PROJECT: PROTECTING A NOMADIC WAY OF LIFE

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1. Introduction

Harmful human-wildlife interactions are a major issue for Mongolian herding communities. Although studies suggest that the wolf (*Canis lupus*) and snow leopard (*Panthera uncia*) prefer wild prey, when this is depleted they readily predate on domestic animals (Hovens and Tungalaktuja, 2005; van Duyne et al., 2009). The wolf commands significant symbolic power in Mongolian culture, with its central tenet of nomadism, being simultaneously venerated and regarded as an enemy. Loss of livestock frequently results in retaliatory killing of predators. Although this may not be effective in the long-term as a means of reducing damage to livestock (cf. Treves et al., 2016), it can have a substantial impact on predator populations. For example, displacement of natural prey species and retaliatory killing due to livestock predation are considered to be two of the main threats to the snow leopard (McCarthy et al., 2017).

Pastoralists worldwide have developed an array of lethal and non-lethal strategies to protect their animals (Linnell et al., 1996). Livestock guardian dogs (LGDs) are an ancient technique, the use of which declined with socio-economic changes and suppression of predator populations during the 20th century (Rigg, 2001). Nowadays, LGDs are an increasingly popular method of reducing losses, thereby enhanc-

ing coexistence of rural communities and large carnivores (Gehring et al., 2010; Linnell and Lescureux, 2015). However, in many regions, a period of low predation risk led to erosion of culturally informed methods of damage prevention that may be needed again when predator populations rebound (Lescureux and Linnell, 2013; Linnell and Cretois, 2018).

Mongolia is a prime example of the loss of traditional damage prevention methods. LGDs were utilised by Mongolian herders for millennia to deflect predation from their livestock. However, predation prevention approaches changed markedly as a result of collectivisation during the socialist period, which lasted from the 1920s to the 1990s (Scharf et al., 2010). Nomads were forcibly relocated into settlements and fences and corrals became more widespread, reducing the need for LGDs out on the steppe. Predation management shifted to collective wolf hunts and den raids to control wolf numbers (Charlier, 2015; Sneath, 1998). Many herders, their parents and grandparents recall Bankhar dogs being killed or their use as livestock guardians discouraged during this period (MBDP, unpublished data).

Abrupt decollectivisation of livestock herding during the capitalist transformation led to a sharp increase in livestock numbers together with a major decline



A snow leopard in the Gobi Desert of Mongolia leaving a spring after having “licked” its fill.

(Photo: Soyolbold Sergelen)

of efficiency of production. In the decade following democratisation in 1990, the total head of livestock increased by more than 20% nationally but offspring survival fell by 10% and consumption of livestock products fell by 20% (Sneath, 2003). In the late 20th century, herders therefore faced a significantly altered societal and political landscape, with less support than during collectivisation, a rapidly changing system and pressure to alter their herding practices to fit a newly privatised economy (Chuluun et al., 2018) while also enduring the impacts of climate change (Nandintsetseg et al., 2018). After decades of herding in relatively wolf-free pasturelands with collectivised means of predation management, herders found themselves under-resourced to cope with predation pressure on their herds (Scharf et al., 2010).

The privatised and under-regulated system that emerged has resulted in larger herd sizes and alterations in land use patterns, as well as displacement of natural prey species, leading to more frequent interac-

tions between wolves and livestock (Mijiddorj et al., 2018). Although there has yet to be a comprehensive study to determine wolf population size and distribution in Mongolia (Wingard and Zahler, 2006), there are probably several thousand individuals (Clark et al., 2006). Because of the abandonment of non-lethal deflection techniques practiced among Mongolian herders and other herding cultures in the region, it is estimated that 55% of poaching of snow leopards is a response to predation on livestock (Nowell et al., 2016). Wolf hunting is bolstered by increased access to vehicles and guns by rural populations (Wingard and Zahler, 2006). Nomadic herders concerned about the threat from predators increase the time they spend personally guarding their flocks, which they also tend to corral for longer and move less frequently, thereby contributing to problems of overgrazing (Elfström et al., 2019).

As their home ranges typically extend beyond the boundaries of protected areas, large carnivores inevi-

tably interact with livestock and human populations (van Duyne et al., 2009). A lack of effective damage prevention measures, paired with reduced local tolerance of predator species due to increased livestock losses (Bagshi and Mishra, 2006), can therefore fuel renewed persecution of apex predators in unprotected or poorly protected areas (cf. Rust et al., 2013). Moreover, if conservation programmes neglect the ‘human’ element of human-wildlife conflict issues, some people may become alienated and view such programmes and the organisations running them as being in opposition to their lives and livelihood (Madden, 2004). This reduces the capacity and willingness of local communities, often uniquely positioned in remote and vulnerable ecosystems, to contribute to wider conservation efforts. Ultimately, conservation suffers by creating a separation between biodiversity and human needs and wellbeing. Conservation efforts should therefore engage with local people and integrate specific, meaningful and empowered indigenous input.

2. Mongolian Bankhar Dog Project

The Mongolian Bankhar Dog Project (MBDP) was founded in 2011 with the goal of remediating the issue of livestock predation and retaliatory killing of predators by integrating a culturally relevant and historically rooted solution within nomadic herding communities (Elfström et al., 2019; see Box 1). The project is working to restore the use of LGDs, drawing on the cultural significance of the Bankhar dog (Fig. 1) as well as the effort and engagement of local people interested in returning to this traditional practice.



Box 1 The Mongolian Bankhar Dog Project was founded by biologist and expedition specialist Bruce Elfström. While working in Mongolia on an IMAX film, he witnessed a particularly

large predation event, during which wolves killed 17 horses, mostly foals. In retaliation, the affected herding community killed seven wolves. Bruce began researching an endemic livestock guardian dog, the Bankhar, as a possible solution already existing within Mongolian herding practices. He found that, although the Bankhar had become rare, some families still used them in remote areas of the country. Encouraged by this, he developed the premise for the project: find good dogs, breed them and distribute them to herders to improve the protection of livestock, thereby reducing the need to kill predators.

News of Bruce’s search for dogs reached Bankhar enthusiast Megdee Kholorsuren. Through conversations together, they realised that collaborating would be a win-win situation: Megdee could supply dogs and assistance, while Bruce’s breeding programme would help achieve Megdee’s goal of saving the Bankhar from extinction. This led to Megdee selling his dogs to the new project and leasing his kennels near Ulaanbaatar. Subsequently, a new facility was built with larger enclosures and more dogs were added from other areas in order to retain genetic diversity.



Fig. 1 A Bankhar dog watches over a mixed flock of sheep and goats in the Mongolian steppe.

(Photo: Zoë Lieb)

In collaboration with herding communities in several Mongolian provinces, the MBDP's objectives are: 1) to restore the widespread use of and access to Bankhar dogs and the knowledge needed to train them as livestock guardians; and hence 2) to reduce losses of livestock to predation; and thereby 3) reduce the motivation of herders to kill predators. An additional goal of the lead author of this article was to design and implement a study to test the efficacy of this approach in a nomadic herder setting and with the original, native type of LGD, thus contributing to an increasing body of scientific knowledge about culturally-oriented solutions to human-wildlife co-existence.

3. Livestock husbandry in the project area

Much of Mongolia's population is closely linked to herding, with approximately 170,000 households living as herders today (MICC, 2018). Mongolia is the second largest producer of cashmere worldwide (Fig. 2), accounting for over 25% of global supply (World Bank, 2003). However, the current state of herding has been drastically altered due to social and political upheaval and is widely considered to be under-managed and likely to be contributing to land degradation (Sneath, 2003).



Fig. 2 Goats herded for cashmere production in Nomgon soum, Ömnögovi, Mongolia. (Photo: Zoë Lieb)

The MBDP works with herding communities in a variety of habitat types in Undur Ulaan (Arkhangai Province), Noyon and Nomgon (Ömnögovi Province), Khustai National Park (Argalant Province) and Terelj National Park (Töv Province) (Fig. 3). Cashmere, meat and milk products are the most common types of production from participating herders. All herders have mostly sheep and goats (Fig. 4) although, depending on the environmental conditions of their region, they also herd larger stock. For example, herders in Undur Ulaan have yaks (Fig. 5), while herders in Noyon and Nomgon keep camels because of their adaptation to desert conditions (Fig. 6).

Fig. 3 Locations of the Mongolian Bankhar Dog Project breeding facility in Khustai National Park and participating herder groups (pentagons). Eco-regions of Mongolia are based on Olson et al. (2001).

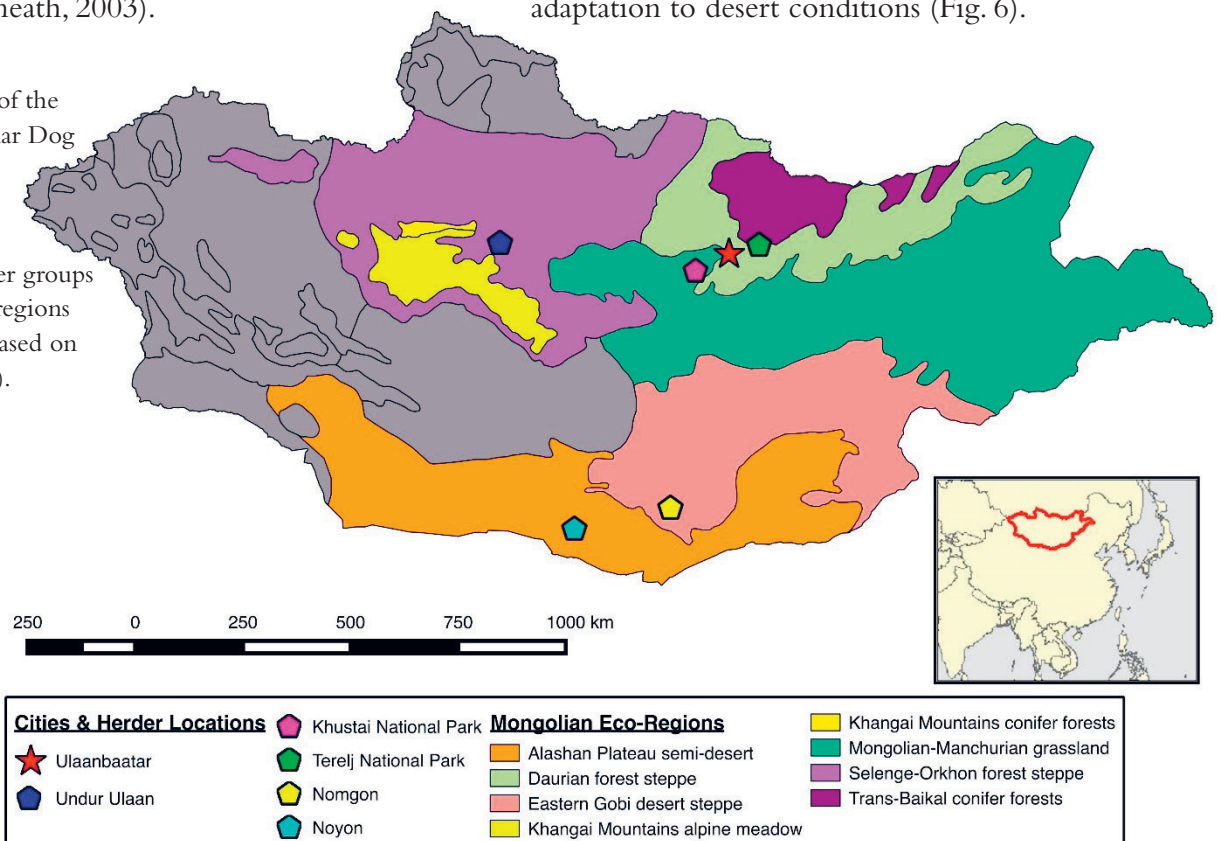




Fig. 4 A mixed herd of sheep and goats grazing in Nomgon soum, Ömnögovi, Mongolia with a herder on horseback watching over them. *(Photo: Zoë Lieb)*

Herders follow similar seasonal patterns: most families move multiple times over the summer to cover large open pastures and spend winter in more sheltered areas, with fewer movements during that season. Most herders accompany their animals throughout the day on horseback, motorcycle or on foot, especially in the winter. During summer months, because summer pastures are more open, herders often watch their livestock from a much greater distance. At night, sheep and goats are kept in half-covered corrals (Fig. 7).



Fig. 5 A herder separating yak calves from the herd in Undur Ulaan, Arkhangai, in spring 2017. *(Photo: Zoë Lieb)*



Fig. 6 Camels kept by herders in the desert steppe of southern Mongolia. *(Photo: Zoë Lieb)*



Fig. 7 Livestock camp on the Mongolian steppe. *(Photo: Zoë Lieb)*



Fig. 8 Sensory stimulation of a young Bankhar pup. Brief exposure to the cold, and being turned in different directions, can help pups during their development. (Photo: Zoë Lieb)



Fig. 9 Batbaatar Tumurbaatar of the MBDP team setting up a temporary fence for young pups. When pups are old enough to venture out of the shelter, this fence allows them to continue to be close to livestock without the risk of being trampled.

(Photo: Zoë Lieb)

4. The Bankhar as a livestock guardian

The Bankhar dog is an ancient landrace that originated in Eurasia and persists today in Mongolia as a powerful cultural symbol, representing the strength and independence of the herding way of life. While the use of the Bankhar as a livestock guardian was largely abandoned in socialist-era Mongolia, many herders remember the traditional practices of earlier generations and some aspects have been preserved (E. Batchuluun, personal communication). Moreover, the Bankhar has maintained its genetic distinctiveness (Shannon et al., 2015) and morphological characteristics that enable it to withstand a harsh climate, with temperatures ranging from 43 °C to -48 °C. Unusually among LGDs, the Bankhar's belly is completely furred. It has a compact structure with small eyes, short tail, small ears, tight snout, small feet, short muzzle and extremely dense, long fur¹.

Since 2014, the MBDP has operated a Bankhar dog breeding programme at its dedicated facility in the buffer zone of Khustai National Park. While the number of dogs living at the facility fluctuates, 21 adult Bankhar dogs are currently permanent members of the breeding programme. The first generation of dogs was sourced from an in-country enthusiast who had dogs from several provinces across Mongolia including Uvs, Hovd and Bayankhongor. Later, addi-

tional adult dogs were sourced from various locations in order to integrate additional genetic diversity and traits. The genetic diversity of available dogs and their suitability to form a sustainable breeding programme were assessed by researchers at Cornell University and the Institute of Canine Biology². They found the genetic diversity of the Bankhar to be very high, suggesting it may be one of the oldest known canine landraces (Shannon et al., 2015). Genetic analysis also confirmed that the project's Bankhars had not cross-bred with other dogs (many dogs in Mongolia, especially strays, are mixed-breeds).

Bankhar dogs at the breeding facility generally give birth between mid-November and early January. The project produces 10–17 pups per year. Livestock are co-housed with the mother Bankhar and her litter, ensuring that pups are exposed to sheep and goats from birth. An early life handling protocol³ is utilised to aid pups' development. This is based on recommendations of Dawydiak and Sims (2004), adapted for a Mongolian context and influenced by five years of implementation practice (Elfström et al., 2019). It includes sensory stimulation from shortly after birth (Fig. 8), socialisation approaches to discourage aggressive behaviour towards livestock or humans and basic obedience training ("stay" and "go to herd") before

¹ <https://www.bankhar.org/bankhar-dogs/>

² <https://www.instituteofcaninebiology.org/>

³ <https://www.bankhar.org/livestock-guardian-dog-care-use-manual/>



Fig. 10 An 8-month old Bankhar pup trained to follow sheep and goats at the MBDP facility. (Photo: Zoë Lieb)



Fig. 11 A yearling Bankhar dog guarding a flock of sheep and goats in Nomgon soum, Ömnögovi. (Photo: Zoë Lieb)

placement. Pups are kept at the MBDP facility for approximately four months, during which time they are vaccinated and spayed or neutered. They are kept in constant contact with livestock to prepare them for their future role as guardians (Figs. 9, 10). Pups are generally placed with herders in spring, when they are old enough to be trained to stay on the pasture (Fig. 11).

In 2015–2019, a total of 59 Bankhar pups were placed with nomadic herding communities in Nomgon (Ömnögovi province), Undur Ulaan (Arkhangai province), Khustai National Park area and Terej National Park. Either through partnering with other organisations, such as the Wildlife Conservation Society’s Sustainable Cashmere Project in Nomgon, or by directly collaborating with herder cooperatives as in Undur Ulaan, the MBDP interviews interested prospective recipients of Bankhar pups. Herders are selected on the basis of several criteria including their willingness to implement the training protocol, the absence of non-guardian dogs at their homestead (which could distract pups and/or crossbreed with Bankhars) and if they had lost livestock to predators. Successful candidates are provided with training protocols, support regarding dog behaviour, care and training, and check-ins from the MBDP team during the training progress.

The initial evaluation interviews and a series of follow-up interviews are used to assess the outcome of placing Bankhar pups with herder families. Follow-up visits also give the MBDP team the opportu-

nity to check on growing pups to determine if they are healthy and receiving adequate care and, if necessary, to modify the advice given to herders for their training. Pups were generally placed in a male and female pair. Herd sizes varied from 150 to 800 head of sheep and goats (most herders also have separate herds of horses, cattle, yaks or camels). Depending on initial training outcomes, there was an option for herders with large herds to receive a third or fourth dog in subsequent years. As of 2019, 30 herders had received Bankhar pups from the MBDP programme.

5. Findings so far

Sustained interest in reviving the use of Bankhar dogs within their husbandry practices was found among the herding groups (Elfström et al., 2019). We also found that most herders knew about Bankhar dogs as livestock guardians or had childhood memories of their grandparents using them in this way. Moreover, the herders involved in our evaluation demonstrated pride, joy and excitement at the prospect of participating in the programme. Many cited their cultural perspective of Bankhar dogs and recognition of them as a symbol and component of traditional herding methods, or a desire to set a good example for their community. Even more importantly, most herders we interviewed saw the reintroduction of Bankhar dogs as a benefit for their entire cooperative or herding group.

Nearly all the participating herders saw their livestock losses plummet after the first year of receiving their dogs. Initial results based on reports from 2015–2017 suggest that, on average, the presence of Bankhar dogs reduced livestock losses to predators by more than 90% (Elfström et al., 2019). A more rigorous analysis of the major outcomes of the project will be included in an upcoming study (Lieb et al., in prep.).

Another positive sign was that herders began to frequently refer one another to the project. Neighbours of participating herders would often tell us they wanted to get involved because they saw how successful the dogs were. This shows how the use of LGDs could continue to snowball beyond the scope of the project, with herding groups collectively growing interest in the method after an early-adopters phase. While the MBDP has ongoing work in assessing the effectiveness of the dogs, as well as investigating their possible deleterious impacts on wildlife (cf. Smith et al., 2020), the fact that there is support among herder groups themselves is encouraging.

6. Challenges

Successful realisation of the project has needed time, effort and perseverance. After its initial conception in 2003, the first eight years were taken up with a survey of the *status quo* and feasibility study. This was followed in 2012–2015 by a process of preparation, implementation and troubleshooting, during which time the project was officially launched, breeding facilities were established and the first pups were born but there was still a steep learning curve. It was only from late 2016 that the team was able to switch its focus to implementing core project activities (Elfström et al., 2019).

Operating in any setting that involves people, communities and their cultural landscapes requires extensive care and attention to the views, beliefs, needs and lifestyles of the local population. Working with a talented team of Mongolian scientists and specialists was instrumental in bridging the gap between the MBDP's scientific-conservation goals and the realities on the ground regarding solutions that would actually work for Mongolian herders.

One example of this was the issue of neutering male dogs. While few herders cared about spaying female dogs (or had never heard of this being possible), most did not want to receive neutered male dogs.

Nearly all herders had the same concern about using neutered male dogs for guarding livestock: they thought they would not be “brave” enough to confront wolves. Herders also noted that, while a neutered male dog might live longer, it was not as useful to have an old, unhealthy dog. This compelled the project to adapt to the perspectives of the herding communities. We provided spayed female dogs and selected more carefully where to place unneutered male dogs with herders that did not have other dogs at their homestead.

The project also gained insights into the motivations of herders to hunt wildlife. As other researchers and community members from subsistence settings have noted, there is more to killing predators than simply wanting to protect livestock. Hunting is also an activity pursued for tradition, community engagement, education of young people and entertainment. It is therefore not enough to boil down the human experience of the environment to buzzwords such as ‘resource extraction’ and ‘ecosystem services’. In order to address the issues surrounding human–wildlife coexistence and human impacts on wildlife, conservationists must strive for greater understanding of the relationship herding communities have with the land, hunting practices and wildlife itself.

7. Moving forward

LGDs and other community-based approaches are still in need of continuous assessment and validation. There remains some reasonable criticism of adding more domesticated canines to landscapes already pressured by stray animals in view of the impact they may have on wildlife. Studies are needed to examine how working LGDs may interact with or contribute to stray dog populations, or if a shift in how herders utilise dogs may reduce the occurrence of strays. Nonetheless, community-based methods, especially those supported and welcomed by local people, warrant more support, study and innovation. Our ultimate goal is to re-establish widespread use of the Bankhar as a livestock guardian and thus negate the need for retaliatory killing of predators. This demonstrably effective and mobile means of protection also has the potential to facilitate diversification of livestock holdings, smaller herd sizes and more frequent relocations, thereby reducing overgrazing and soil loss.

If there is a key lesson we have learned from the project's outcomes to date, it is that effective, balanced, inexpensive and relevant solutions for the challenges subsistence communities face can be found within the cultural practices, histories and traditions of those

very same people. Finding the means to empower those with knowledge and understanding of particular cultural contexts and practices can reveal a treasure trove of improvements for how we protect the natural landscapes on which we all depend.



Acknowledgements

Many individuals and organisations have contributed to the project. Doug Lally, Devon Byrne and Greg Goodfellow expertly guided it to fruition. Special thanks to Batbaatar Tumurbaatar, the current project manager, for his dedication; to Soyolbold Sergelen for photography, translation and logistics; to Dulguun Gantulga for translation and field support; and to Joseph W. Bull for academic support. We also thank our collaborators at the Wildlife Conservation Society; our grantors, Zoos Victoria and Panthera; and donors to our 2018 crowdfunding campaign. Most importantly, we are grateful to the herders and their families who took on the task of bringing livestock guardians back to their pasturelands.

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News Roundup

Reports on wildlife and agriculture

Several reports have been published recently dealing wholly or partly with interactions between carnivores and agriculture in Europe. In February 2021, the EIP-AGRI Focus Group on wildlife and agricultural production produced its final report¹. In April, Euromontana and the LIFE Oreka Mendian project published a booklet showcasing good practices for sustainable management of mountain grasslands², including several examples related to large carnivores. In May, CIPRA published a final report from their project on *Knowledge transfer on the co-adaptation of humans and wolves in the Alpine region*³. Also in May, the CanOvis research project produced a report on *Le loup dans le système patorale*⁴, which presents insights from observations of wolves and livestock in the French Alps. Further details on each of these publications can be found in this issue's Reports section.

Conference and activities promoting coexistence with wolves in the Alps

The first thematic conference of the LIFE Wolf Alps EU project was held online on 27th May entitled *Coordinated actions for wolf-human coexistence across the Alps*. Members of the team provided updates on wolf status in each of the four countries included in the project. Marco Cipriani and Marco Notaro from the European Commission's Directorate General for the Environment talked about conservation and manage-

ment of the wolf at the European level while Angelo Salsi summarised projects on large carnivores financed by the LIFE programme. There was also a round table moderated by Luigi Boitani, chairman of the Large Carnivore Initiative for Europe, to discuss management plans for large carnivores, looking at the current situation and to the future. The afternoon was dedicated to an in-depth analysis of actions carried out by the project team on an international scale: from prevention of damage to farming activities through the establishment of intervention teams that support farmers, as well as activities to involve stakeholders in finding shared solutions for coexistence. A recording of the whole event can be viewed on the conference webpage⁵.

Despite the ongoing pandemic, all actions involving stakeholders planned within the LIFE WolfAlps EU project in recent months were carried out: platforms, meeting and the first stewardship agreements. Virtual training workshops for teachers and training for co-called Wolf Prevention Intervention Units were also held⁶. More than 300 veterinarians, park rangers, provincial police officers and forest Carabinieri have so far been trained to offer concrete help to farmers in preventing attacks on livestock by wolves⁷. In summer, the first prevention support teams will begin work in Italy and Austria. More teams will be added in the coming months in order to cover all main project areas. New teams are also planned in France and Slovenia.

¹ https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_fg_wildlife_and_agricultural_production_final_report_2021_en_final.pdf

² http://www.lifeorekamendian.eu/wp-content/uploads/2021/05/folleto_eur_ing.pdf

³ <https://www.cipra.org/en/cipra/international/projects/current/knowledge-transfer-on-the-co-adaptation-of-man-and-wolf-in-the-alpine-region>

⁴ <https://ipra-fjml.com/resources/hpfarmOlW9NyxMuH3GEp#/>

⁵ <https://www.lifewolfalps.eu/en/conference/>

⁶ <https://www.lifewolfalps.eu/en/damage-officials-discussing-the-importance-of-damage-prevention/>

⁷ <https://www.lifewolfalps.eu/en/al-via-la-prima-stagione-delle-squadre-di-supporto-alla-prevenzione-delle-predazioni-in-alpeggio/>

GOOD PRACTICE FOR NIGHT PENS ON ALPINE SUMMER PASTURES

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1. Introduction

Night enclosures for small livestock have a long tradition in many countries. Their use is still widespread, with flocks in many regions fenced or corralled during the night and accompanied by shepherds during the day for grazing (Haid, 2010). Night-time fencing serves both to control and to protect animals, although publications and studies often focus on only one aspect (Meuret and Provenza, 2014). It is also important to distinguish between the overnight practices of transhumance, summer pastures in mountainous regions and year-round farms, which have more permanent infrastructure such as stables or paddocks.

In most Alpine countries, night-time fencing was largely abandoned during the 20th century due to structural changes in small livestock management (Heurich et al., 2019). However, in the French Alps, “penning the sheep overnight by means of portable fencing has been in practice since the 1970s for many herders tending flocks on high mountain pastures” (Vincent, 2014). In Switzerland, the introduction of state summering contributions for pasture management and herding of sheep flocks has resulted in a revival of the practice of secure overnight penning¹.

Since the return of the wolf (*Canis lupus*) to Switzerland (Vogt et al., 2020), night pens are increasingly

used in the Alps as a protection measure. This can be either a long-term, planned approach to preventing attacks by predators or a short-term emergency measure after an attack has already occurred. So far, most attacks on livestock by large carnivores in Switzerland have occurred at night or in bad weather, usually in non-protected situations (Hahn et al., 2019). Livestock can therefore be protected efficiently with night pens and/or fenced sectors allowing continued grazing overnight.

Various types of night enclosures have proven to be effective against predators in a wide variety of agricultural, climatic and topographic contexts worldwide (e.g. Lichtenfeld et al., 2014; Samelius et al., 2020). However, the requirements for best practice of night penning are high. Their successful application requires the right choice of location, materials and design as well as correct installation and maintenance. Therefore, knowledge transfer in education and consulting is particularly important.

Various publications have contributed to the transfer and further development of practical experience in the Alpine region (e.g. ASPIR, 2017). AGRIDEA, the Swiss Association for the Development of Agriculture and Rural Areas², has been studying and monitoring the practice of night pens on summering pas-

¹ <https://www.blw.admin.ch/blw/de/home/instrumente/direktzahlungen/kulturlandschaftsbeitraege/soemmerungsbeitrag.html>

² <https://www.agridea.ch/en/>

tures in the Alps for over 20 years. Experience and know-how in the optimal use of night pens in Switzerland was gathered during workshops and training days. With the help of an advisory network and experienced herders, AGRIDEA recently published a booklet in three languages (German, French and Italian) that can be used for training and providing advice to herders and livestock owners (Mettler et al., 2020). In this article, we summarise the key points.

2. Herd protection and management

An essential prerequisite for protecting livestock from predators is appropriate grazing and flock management, without which damage prevention measures are unlikely to work. Planned management aims to keep the herd together in a flexible but compact way so that the animals can be protected, either by electric fences or, depending on the situation, with livestock guarding dogs. An electrified night pen can be used when the risk of attacks by large carnivores is high. The flock is driven into the pen every evening and, especially in Mediterranean and hotter climates, sometimes also at midday (Figs. 1–4).

The use of night pens must be adapted to the feeding cycle of ruminants. Sheep spend a total of 8–11 hours per day feeding in 4–7 grazing phases interspersed with rumination. If animals are fenced in mobile or fixed pens at midday and at night, no feed intake is possible during this time. Therefore, livestock must consume a sufficient quantity of fodder during grazing phases in order to be able to make optimal use of the remaining periods for ruminating. “Thus, a grazing circuit divides access to forage resources in an order designed to stimulate the animal’s appetite during meals in line with the schedule of use for these resources according to season and the grazing land” (Meuret, 2014).

This grazing circuit is crucial for the wellbeing of all the animals and the growing rates of young lambs. If forage resources and the needs of the sheep are properly matched, growth and vitality of the animals can be ensured. This is why, especially on alpine pastures where the vegetation can be relatively poor, the experience-based knowledge of the shepherd guiding the flock is a key factor for successful flock management. Agricultural consultancy services and professional breeding associations should organise educa-



Figs. 1–4 Herding dogs and shepherds ensure that all sheep are led into the night pen.

(Photos: AGRIDEA)

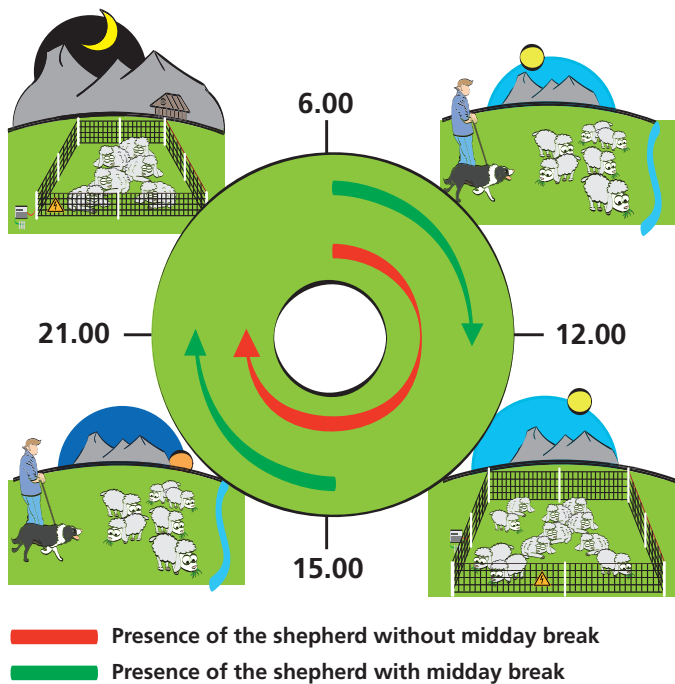


Fig. 5 Feeding cycle of sheep with midday and night pens. (Source: AGRIDEA)

tion and training opportunities to help maintain and improve the transfer of knowledge between generations of shepherds.

The daily use of fenced overnight pens can facilitate the herder's work rhythm. In addition, regular penning also makes the herd more compact for daily grazing management. In a system with night and midday pens (Fig. 5), the animals are let out of the pen and herded in the early morning hours. The feeding period lasts from morning to noon and from afternoon to evening. During approximately three hours at noon and during the night, the animals have sufficient time to ruminate.

3. Locating pens

Night pen locations are scheduled and changed regularly throughout the summer according to the grazing area and soil conditions. Careful site selection helps to optimise animal health, pasture quality and feeding value as well as herd protection. Long distances between pens and grazing areas are best avoided. In a system with sector grazing (Fig. 6), the alp is divided into several sectors. The night pen should be located centrally but the place should be changed regularly. The location of the night pen should be well-adapted to the practice of sectoral grazing to avoid soil damage and erosion. The existing infrastructure of paths and shelters also plays an important role in organising the division of the paddock optimally (Werder and Willems, 2018).

Overnight fencing locations must be selected to best accommodate herd movement patterns and forage availability. In the case of mobile fencing, experts recommend that locations should be changed on average every 3–4 days and no later than seven days. This will help reduce the risk of transmitting diseases, parasites and infections. Wet and soft, soil-rich ground increases the risk of disease transmission and requires more frequent rotations. Likewise, extremely dry or wet weather may require more frequent rotations. The length of time before returning to the same overnight site depends on weather, pasture management options and overall animal health (Mettler et al., 2020).

4. Specific requirements for alpine summer pastures

The topographical and climatic conditions of alpine summer pastures provide a suitable environment for extensive grazing of sheep. However, in order to have a positive impact on the landscape and biodiversity, systematic grazing management is required. This needs to consider both sensitive areas at high altitudes as well as areas at medium altitudes situated close to

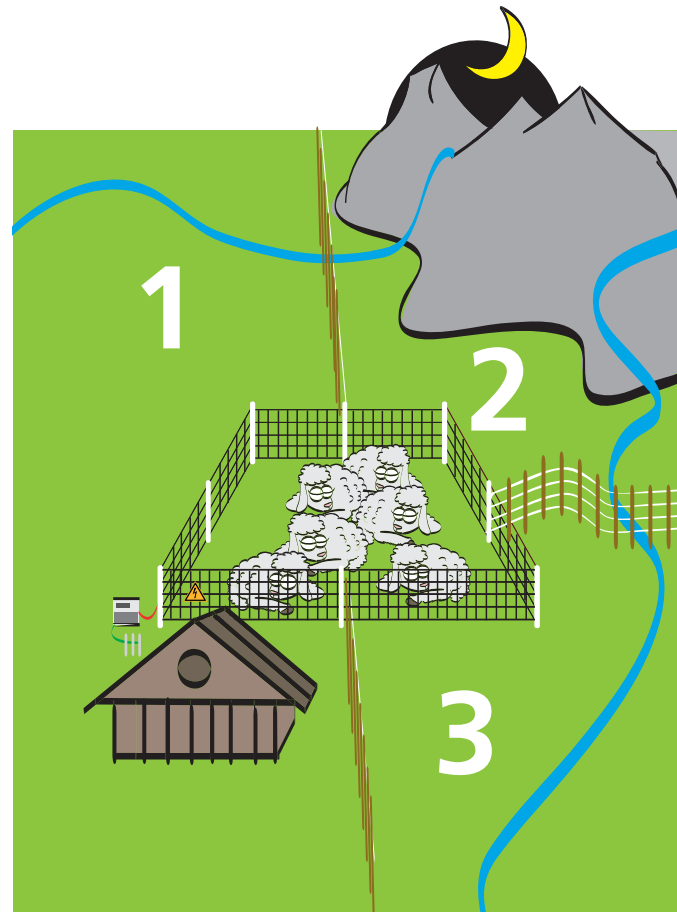


Fig. 6: Grazing sectors and night pens depend on topography and vegetation. (Source: AGRIDEA)



Fig. 7 Mobile fencing with electrical wires for protection at night.

(Photo: AGRIDEA)

the shrub- and tree-line and subject to gradual encroachment (Mettler and Hilfiker, 2017). There are several challenges to achieving successful management of alpine flocks:

- Sensitive soil and vegetation conditions;
- Sheep circuits and grazing patterns;
- Adaption to changing weather conditions;
- Knowledge of topographical and morphological constraints;
- Experience-based decision-making in a dynamic environment.

In general, sheep tend to move upwards towards young and fresh plants and to the highest zone, where soil and vegetation are vulnerable to overgrazing (Troxler and Chatelain, 2005). The shepherd has to take this fact into consideration when planning the daily circuit and grazing cycles. Good practice in the use of night pens is strongly linked with experience-based knowledge of vegetation, the behaviour of the flock and changing weather conditions. “The experienced shepherd ensures the installation of night pens before changing circuit and sector. With the constraint of a nightly penning, it is important to use different departure and arrival circuits from and to the pen to mitigate as much as possible the phenomenon of erosion” (ASPIR, 2017).

In the Alpine region, large flocks are often aggregations of different breeds from different owners brought together for the summer season. This makes herding challenging and requires a consistent presence of a shepherd with herding dogs. Only in this way can all animals be driven regularly into the night pen. When herding in difficult alpine terrain, animals move in their natural daily rhythm and are influenced by various other factors. A flock therefore moves in certain patterns that the shepherd must take into account when managing the pasture and penning (Fig. 7). “The pattern produced by a flock depends on the individual and group behaviour of sheep. Their behaviour is influenced by several factors, including the endogenous rhythms of sheep, previous activity, weather conditions, and the actions of the herder who regulates the edible vegetation ‘offer’ and controls the direction and speed of the flock” (Lécrivain et al., 2014).

Since weather conditions can change quickly in alpine zones, thunderstorms and snowy weather are an important risk factor in pasture management. Night or bad weather pastures can be used to herd and graze animals as safely as possible despite fog, snow and lightning (Figs. 8–9). Such fenced pastures provide a safe haven in extreme situations, allowing animals to feed in the morning, during the day and in

the evening for several days. The sizes of these pastures depend on the daily herding time, the number of animals, the quality of feed and the weather conditions. Compared to night pens, the advantage of fenced night pastures is that they extend the time available for feeding. Night and bad weather pastures can be securely fenced to provide protection from predators during feeding times. However, the fencing of medium to large areas requires much more material and a high additional input of labour, especially in difficult terrain. There is still a considerable number of alpine farms working without livestock guarding dogs (LGDs). In this situation night pens could be a good method to prevent damages during the night.

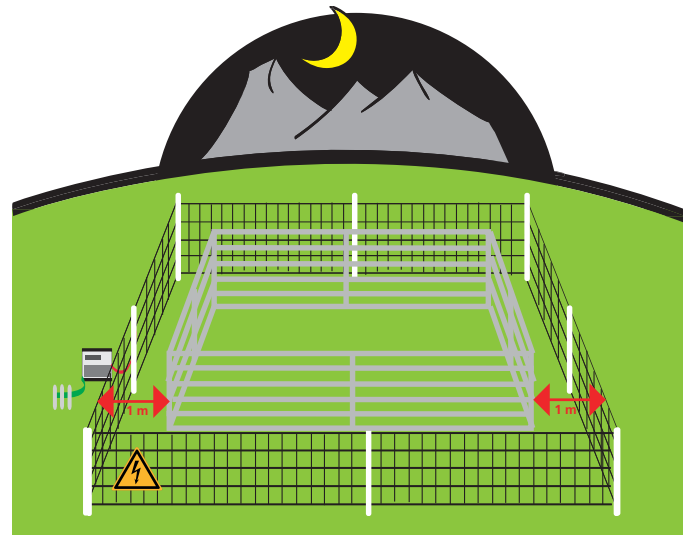


Fig. 10 Metal night pen reinforced with an electrical net. (Source: AGRIDEA)



Fig. 8 If guarding dogs are present the night pen is normally constructed with a simple electrified net. (Photo: AGRIDEA)

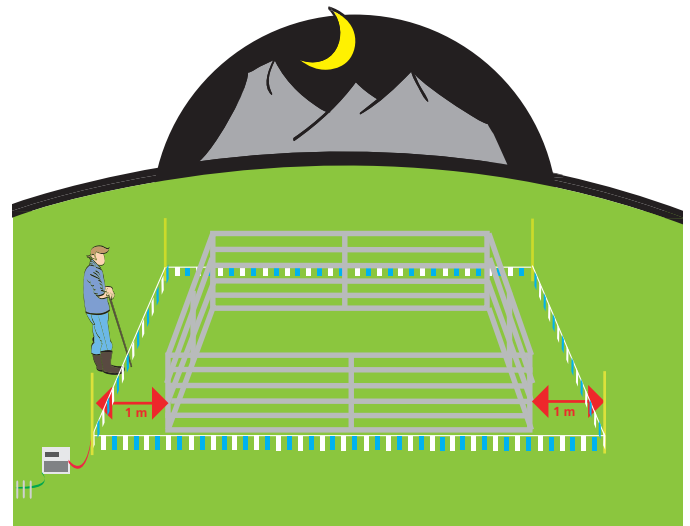


Fig. 11 Metal night pen reinforced with fladry. (Source: AGRIDEA)



Fig. 9 Fenced pasture for bad weather (snow or thunderstorms), mostly with 4-5 electrical wires. (Photo: AGRIDEA)

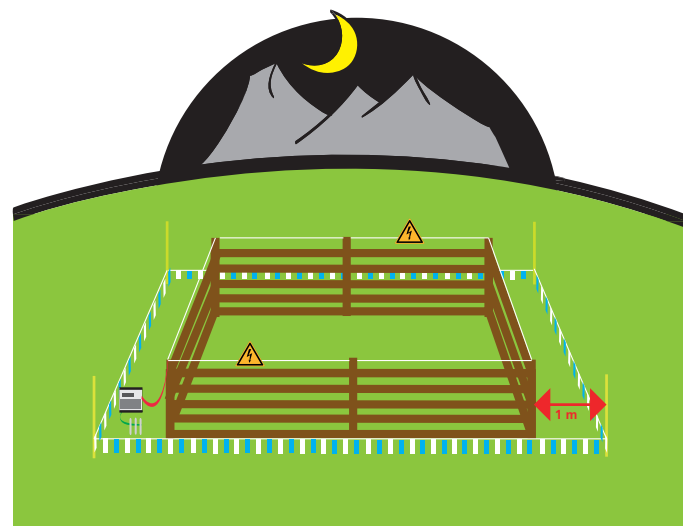


Fig. 12 Wooden fixed night pen reinforced with fladry. (Source: AGRIDEA)

5. Types of night pens and choice of material

Depending on site conditions and pasture planning, either mobile or fixed night pens can be used or combined in various ways. For example, a fixed night pen near a shepherd's hut can be combined with mobile night pens to ensure regular rotation. In the Alps, 'fixed' (permanent) night pens consist of fenced paddocks made of solid materials such as wood, iron, or stone with an average height of 1.20 m. Such pens rarely provide adequate protection from large predators, which can climb over them. Therefore, to protect flocks, they should be reinforced with additional electric fencing material or LGDs (Fig. 10). Night pens can be secured with additional strand fencing, willow netting or polytape. This should be installed 1–1.5 metres outside the fixed pen (Figs. 11–12).

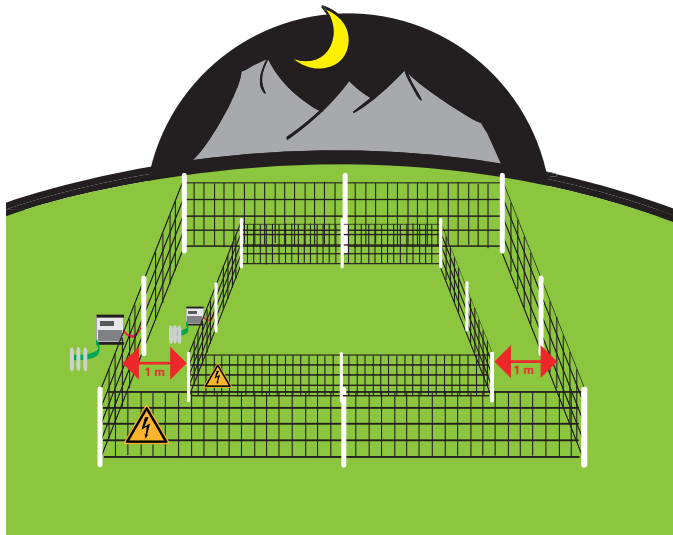


Fig. 13 Doubled electric mobile fence. (Source: AGRIDEA)

The term 'mobile' night pen is used when flexible fencing material such as willow netting or strand fencing is used. An electrified mobile night pen can provide good protection even without LGDs if it is properly constructed and maintained. With mobile pens, there is a higher risk of animals escaping if they have not eaten enough or a night-time disturbance occurs. It may be helpful to establish a buffer zone to reduce the risk of escape. This can be done by installing a double electric fence (Fig. 13) with strands of willow netting and electrified flutter tape 1–1.5 metres outside the first fence (Fig. 14). Another option is a so-called stop fence. This consists of simple fence extensions at the corners of the pen which prevent large carnivores from running around the pen and causing panic through rapid movement (Fig. 15).

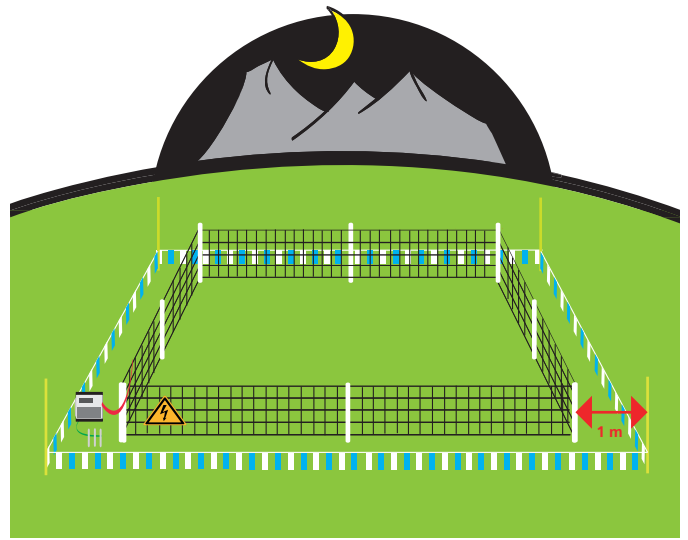


Fig. 14 Electric fence reinforced with fladry.

(Source: AGRIDEA)

The shape of the night pen should be adapted to the terrain. Narrow passages or acute angles should be avoided, as they increase the risk of escape. The size and stocking density of the pen must be adapted to the number of animals, weather and soil conditions as well as the type of vegetation. Animals should be able to avoid each other within the fence, so that herd movements do not immediately lead to escape. Depending on these factors, allow 1–5m² per mother animal (Probo and Perotti, 2020). Thanks to the action of the animals' hooves and the increased nutrient concentration from their dung, even targeted pastures which were abandoned for a while can be improved.

When choosing and installing fencing material, make sure that fences are highly visible. Fences with contrasting colours, such as blue-and-white or black-and-white, have proven to be particularly effective.

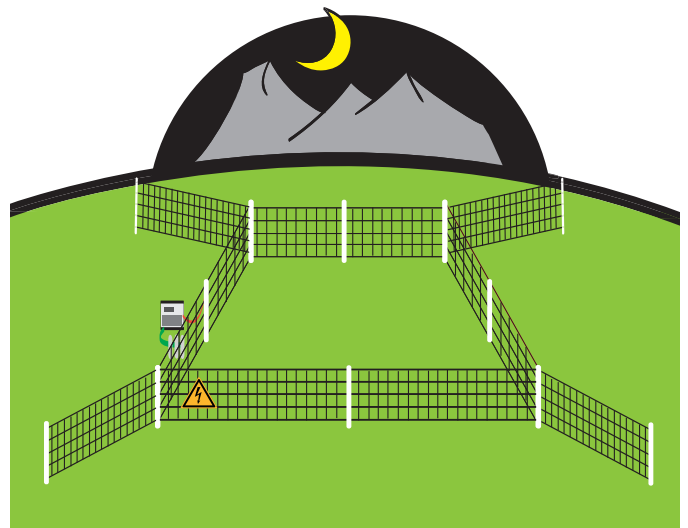


Fig. 15 Electric mobile fence with corner extensions to stop predators running around the fence. (Source: AGRIDEA)

The visibility of existing fencing material can be increased by adding blue-and-white fluttering ribbons. It is also important to maintain sufficient voltage in electric fences at all times: 3,000 volts or more is recommended for mobile fences. For this purpose, 12-volt battery-powered units or solar fencing units installed with solid grounding are suitable (Mettler and Schiess, 2016). If electric fences are not to be used for an extended period of time, they should be disassembled so that they do not pose a danger to wildlife and livestock.

Brochure “Safe night confinement for small livestock” (Mettler et al., 2020), www.protectiondestroupeaux.ch



6. Conclusion

Night pens and night pastures help shepherds make more careful and balanced use of summer grazing areas through a controlled feeding cycle. By respecting the constraints of the vegetation and the behaviour of ruminants, soil can be protected while maintaining or even improving fodder quality and plant diversity. At the same time, pens and other forms of fencing provide the opportunity to secure a safe haven for livestock at night, when it is usually at highest risk of predation. The key to safe protection using night pens is to lead the complete flock into the protected area in the evening. Disciplined herd management is a prerequisite for smooth penning. Only in this way can the protection potential of the various fencing and overnight systems be exploited to the maximum.

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Research

IDENTIFYING BARRIERS TO THE UPTAKE OF INNOVATIVE SOLUTIONS

A CASE STUDY WITH LIONS IN ZIMBABWE

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1. Introduction

Wildlife impacts on humans are complex conservation problems that, if not tackled adequately, might turn into social conflicts (Redpath et al., 2013). Mitigating such impacts requires targeted interventions that engage the people expected to live with wildlife including large carnivores (Vucetich et al., 2018). Conservationists around the world have invested much time and resources in designing interventions to mitigate negative impacts from wildlife as well as to provide positive benefits from conservation efforts (van Eeden et al., 2018). These interventions range from low-cost methods such as livestock herding (Ogada et al., 2003) and education programmes (Marchini and Macdonald, 2019), to more sophisticated techniques such as flashlights around corrals to deter predators at night (Lesilau et al., 2018) and in-depth farmer training programmes (Vaughn et al., 2016). However, many technical tools have not been evaluated scientifically (van Eeden et al., 2018).

One widely-known species prone to conflict with humans is the African lion (*Panthera leo*) (IUCN, 2016). Lions are threatened throughout their range, with a population reduction of almost 40% over the

last three decades (Bauer et al., 2016). Conflict with farmers over livestock depredation is a major threat to lion populations, especially those alongside the protected area interface (Riggio et al., 2012). This is true for lions in Zimbabwe's Hwange-Matetsi Protected Area Complex (HMPAC), part of the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA), which hosts one of six remaining populations numbering over 1,000 individuals (IUCN, 2016). In the HMPAC, the impacts of humans on lions (and vice versa) are well-studied. Most lion attacks on livestock occur at night, when livestock are left to freely graze instead of being secured overnight in protective enclosures (Kuiper et al., 2015).

Attitudes and perceptions towards lions in the area are strongly negative, and are influenced by the geographic location in which farmers live as well as the farmers' ethnic group (Sibanda et al., 2020a). Between 2008 and 2016, lions killed more than 1,000 domestic animals, with farmers killing approximately 50 lions in response to attacks on livestock (Loveridge et al., 2017). This conflict presented an opportunity to develop and implement locally relevant conservation

interventions to help prevent further negative livelihood impacts, to safeguard the local lion population in the future, as well as to raise awareness and build knowledge and skills amongst farmers (Sibanda et al., 2020a).

In 2012, we developed the Long Shields Community Guardians (hereafter “Long Shields”) programme in the HMPAC: a non-lethal, community-based, human-lion conflict intervention (Sibanda et al., 2020b). This programme was inspired by the Lion Guardians model in Amboseli, Kenya (Hazzah et al., 2014), and was designed to advance the well-being of both local people and lions. We used Theory of Change (ToC), a methodology that follows a logical and chronologically ordered sequence of causal linkages, to conceptualise and plan the inputs, activities and outcomes of the Long Shields programme (Woodhouse et al., 2015). These included: (a) implementing educational outreach amongst local farmers to encourage and train for optimised adoption of conflict mitigation techniques (e.g. livestock herding); (b) providing employment opportunities to local farmers (as Long Shields Community Guardians); (c) safeguarding local food and income opportunities (e.g. livestock); (d) cultivating pride in sharing the landscape with lions; and, (e) safeguarding lion populations for the future (Sibanda et al., 2020b).

In 2017, we used our ToC model (Fig. 1) to evaluate the effectiveness of the Long Shields programme, specifically farmers’ perspectives of the programme and their adoption of conflict mitigation techniques. Our results revealed that, in the five years since the introduction of the programme, incidents of livestock attacks by lions had dropped by almost half (Sibanda et al, in review). However, our results also indicated that a minority of farmers in villages that were part of the Long Shields programme continued to suffer higher livestock losses to lions than others participating in the same intervention programme. This, as part of a broader case-study, prompted an investigation of the reasons for continued livestock loss.

One plausible reason for ongoing losses might be late adoption by farmers of the conflict mitigation approaches introduced by the Long Shields programme. We chose to investigate our research question using the Diffusion of Innovation (DoI) theory (Rogers, 2004), which categorises people into different cohorts of innovation adopters (Hubbard and Sandmann, 2007) to understand better how an innovation spreads through a social system.

We did this by exploring the characteristics of two farmer groups: (a) those who had persistent or higher livestock losses even after the implementation of the Long Shields programme; and (b) those that did not.

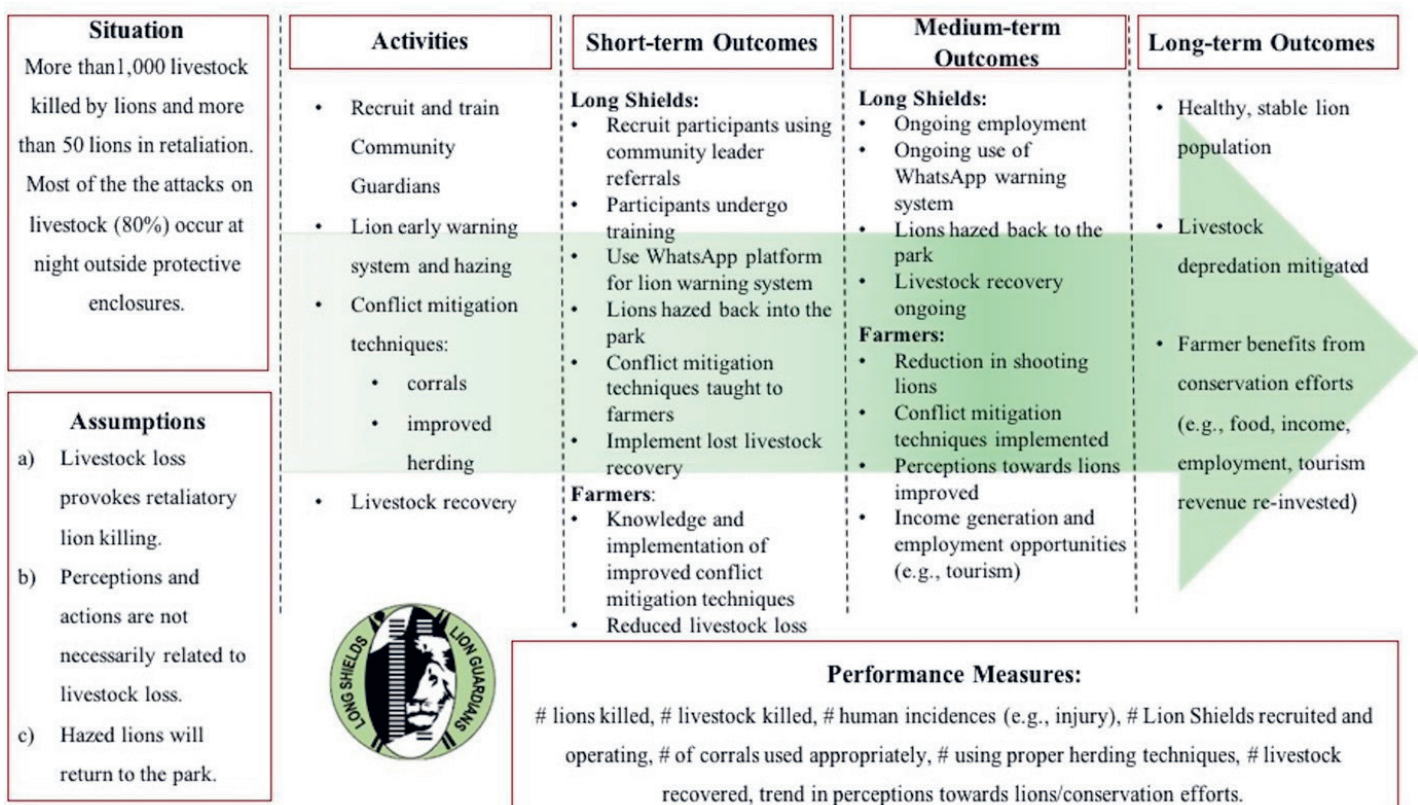


Fig. 1 The community-based programme’s Theory of Change.

We looked at characteristics that might explain these differences in terms of early- or late-adoption of the Long Shields intervention.

We hypothesised that persistent or higher livestock losses and, related to this, economic loss and increased risk to personal safety, might be predicted by late adoption by farmers of the Long Shields interventions. Farmers who had persistent or higher livestock losses after the implementation of the programme, and those that did not, would therefore differ in their: (a) frequency of communication with Community Guardians; (b) levels of participation in specific programme activities such as lion tracking and chasing; (c) active involvement in the early-warning system WhatsApp group; (d) confidence in the programme's effectiveness; and (e) trust in their Community Guardians. Our results provide insight into the utility of a ToC for programme design and evaluation, as well as the factors that can limit or advance human-carnivore coexistence interventions through the use of DoI theory.

2. Methods

Theoretical framework

The DoI is a behavioural theory that systematically seeks to explain why and how new ideas or practices (i.e. innovations) are adopted (or not) by different members of a social system (Rogers, 2004). This theory has been used in health care (Scott et al., 2008), agriculture (Rogers, 2004) and, increasingly, in conservation efforts (Mbaru and Barnes, 2017) to provide valuable insight into the barriers and motivations to adopt or reject new ideas or practices (Hubbard and Sandmann, 2007). A hallmark of the theory is 'diffusion', referring to the rate at which an innovation spreads through a social group over time, and 'innovation', which refers to the novel idea or practice that is to be adopted. As suggested by Hubbard and Sandmann (2007), "the diffusion framework is a fairly involved framework that includes several 'sub-theories' or concepts [which] provide insight into human and social nature, including how new information is accepted (or not accepted) by potential users".

According to DoI, several factors can help or hinder how and why people adopt innovations, including: (a) innovation characteristics; (b) socio-ecological contexts; and (c) adopter characteristics (Rogers, 2004; Mohammadi et al., 2018). Innovation charac-

teristics refer to the relative advantage or the superiority of the introduced intervention relative to other interventions as perceived by the adopters. The theory postulates that clear, coherent and relatable innovations, which align with an individual's or group's values, experiences and needs, are more likely to be adopted (Rogers, 2004).

Socio-ecological characteristics refer to factors such as cultural context, government policies, land settlement and use patterns or, as in our study, conflict with wildlife species, all of which can affect the adoption of an innovation (Rogers, 2004; Mascia and Mills, 2018). Additionally, social relationships and networks among people can affect the adoption of innovation, including how and what information about the innovation is communicated, level of trust in the source and the channels through which information is shared (Mbaru and Barnes, 2017).

Adopter characteristics refer to the personal traits of adopters, such as demographics, risk orientation (whether or not the adopters feels they are at high risk), perceptions of and confidence in the innovation, familiarity with and the level of connectedness amongst other adopters, all of which can influence the rate of adoption (Rogers, 2004; Mohammadi et al., 2018). Adopters can be characterised as innovators, early-adopters, early-majority adopters, late-majority adopters and laggards, represented by an S-shaped or bell curve indicating the cumulative number of adopters across categories and resulting normal distribution (Rogers, 2004).

Study area

The Long Shields programme was introduced in three separate rural communities situated in communal lands in northwestern Zimbabwe: (a) Tsholotsho (Matupula and Siphoso Chieftainships: 2,171 km²); (b) Mabale (Dingani Chieftainship: 480 km²); and (c) Victoria Falls (Mvuthu and Shana Chieftainships: 655 km²) (Fig. 2). Tsholotsho and Mabale communities are situated adjacent to the Hwange National Park (HNP), while Victoria Falls community is located adjacent to the Zambezi National Park (ZNP). Both HNP and ZNP are part of the HMPAC (Sibanda et al., 2020a). While the programme was implemented in these three communities, for our retrospective study we only selected Tsholotsho, as this community had less interaction with other research organisations outside our Long Shields programme

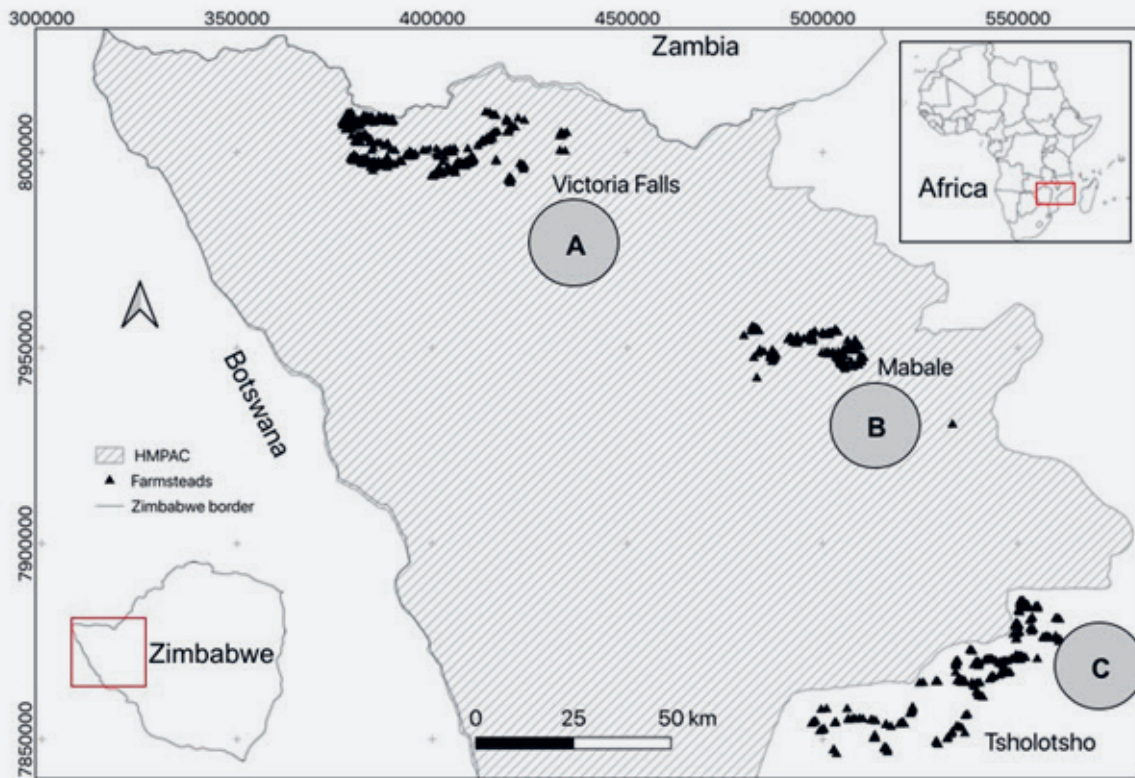


Fig. 2 A map of our study area in northwestern Zimbabwe.

which may have affected attitudes or behaviours towards lions.

Ecologically, the area is semi-arid (annual rainfall: 550–600 mm) (Guerbois et al., 2013), with three distinct seasons: a cold-dry season (May–August), a hot-dry season (September–November) and a wet season (December–April) (Loveridge et al., 2017). Livestock rearing and crop farming are the primary sources of livelihood, with cattle, donkeys, sheep and goats as the primary livestock and maize, millet and sorghum as the main crops (Sibanda et al., 2020a). High-value livestock, such as cattle and donkeys, is commonly depredated by lions and spotted hyaenas (*Crocuta crocuta*). Leopards (*Panthera pardus*), African wild dogs (*Lycaon pictus*), cheetahs (*Acinonyx jubatus*) and black-backed jackals (*Canis mesomelas*) occasionally prey on smaller, lower-value stock such as sheep and goats (Loveridge et al., 2017). Conflict with wild carnivores is seasonal and peaks during the wet months, when farmers herd their livestock in areas closer to the national park and further away from human communities, exposing livestock to high depredation risk (Kuiper et al., 2015). Farmers do not receive any financial compensation from the government for any losses to wild animals (Sibanda et al., 2020a).

Description of the Long Shields programme

In consultation with local traditional leaders, the ToC guided the development of a logic model illustrating the Long Shields programme and its intended outcomes (Sibanda et al., in review; Morehouse et al., 2020). We recruited 14 local farmers (two women and 12 men, aged 21–65 years) to be trained as Long Shields Community Guardians (hereafter “Community Guardians”) based on recommendations from community leaders and using the following criteria: geographic location, physical fitness, English literacy, respectability and trust within their community and previous direct experience with lions (e.g. physically chased a lion). Community Guardians were then trained by the Trans-Kalahari Predator Programme (WildCRU, University of Oxford) in lion tracking, the use of radio-telemetry and GPS equipment, data collection protocols (e.g. livestock depredation assessment) and conflict mitigation techniques (e.g. herding, enclosure reinforcement). Additionally, Community Guardians were trained to use the lion early-warning system through the WhatsApp smartphone platform (WhatsApp Inc., California, USA).

As part of this system, we identified and collared 23 lions (6 females and 17 males across 9 prides), selected

because their home ranges significantly overlapped with local farming communities outside protected areas. Collars were set to record one location every two hours. Whenever lions were within three kilometres of the park boundary, an alert message was sent via the Community Guardians to a network of farmers within participating villages. Lions that crossed the park boundary and approached human settlements were hazed by the Community Guardians plus village volunteers with the use of a *vuvuzela*: a plastic horn that produces an irritating sound of about 127 decibels (dBA) (Fig. 3).

3. Data collection

Sampling

Participants were selected for interview based on their reported livestock losses to lions after the implementation of the Long Shields programme. We used a conflict register held by the WildCRU's Trans-Kalahari Predator Programme to select a total of 50 farmers living in villages in the Tsholotsho communal area who participated in the Long Shields programme. Specifically, we selected 25 individuals who reported persistent or larger livestock losses post-intervention (i.e. mean yearly loss after implementation \geq mean yearly loss before) as well as 25 individuals who reported a decrease in livestock losses post-intervention (i.e. mean yearly loss after implementation $<$ mean yearly loss before). The calculated mean livestock loss prior to implementation was $3.07 \pm SD = 1.58$ per household (Sibanda et al., 2020b).

Survey instrument

We began our study in February 2019 using in-depth face-to-face interviews consisting of closed and open-ended questions. Semi-structured interviews were preferred over structured techniques because they are flexible and allow the conversation to flow freely (Schensul et al., 1999). We attempted to interview men and women (self-reported heads of households) as equally as possible. Recognising the importance of ethics in conservation activities (Brittain et al., 2020), we fully explained the purpose of the study before commencing each interview, with all respondents giving verbal free and informed consent to voluntarily participate. All farmers were told they were allowed to stop the interview at any time if they did not feel like continuing. To help minimise response bias (e.g. social desirability), we did not provide monetary compensation



Fig. 3 Long Shields Community Guardians blowing a *vuvuzela* during a lion chase event. *Photo: L. Mathe*

to participate. Each interview lasted c.45 minutes and was conducted in *isiNdebele*; responses were recorded in English. We also recorded the interviews using a mobile smartphone to facilitate effective translation.

Factors that influenced the continuance of higher livestock losses to lions

Factors that influenced the continuance of higher livestock losses to lions were investigated by asking a series of questions that explored farmers' knowledge about and adoption of the Long Shields programme. This included questions about: (a) their awareness of the programme; (b) the purpose of the programme; (c) how often farmers communicated with their Community Guardians; (d) frequency of communication; (e) participation in specific programme activities; (f) confidence in the programme's effectiveness; and (h) relative importance of the programme to farmers and lions. A full list of factors tested and questions asked are given in Table 1.

Evaluating factors that influenced the persistence of higher livestock losses to lions

Factors that influenced a farmer's losses to lions were analysed using ordinal regression models in R statistical software (R Core Team, 2019). We fitted the models using the '*clm*' function in the 'ordinal' package (Christensen, 2015). The response variable was the farmer's losses to lions, i.e. (a) those who had persistent or larger livestock losses and (b) those that did not. 'Village ID' was included as a random variable to control for possible clustering of similar responses. Our final model evaluated the explanatory power

Table 1 A list of factors thought to be influencing the adoption of the Long Shields programme resulting in the continuance of higher livestock losses to lions.

Factor	Question asked	Response code
Knowledge	Have you ever heard of the Long Shields programme? (<i>Yes/No</i>)	Categorical
	What is the role of the Long Shields programme to you?	Descriptive
Communication	How often do you communicate with your community guardian? (response: <i>rarely, daily, weekly, monthly, never</i>)	Categorical
	What communication channel do you use to communicate with your Community Guardian? (<i>mobile phones, none, community guardians come in-person, both, neighbours</i>)	Categorical
	Are you or someone in your house part of the Long Shields WhatsApp group and why? (<i>Yes/No</i>)	Categorical
	If yes, do you respond to messages from the Community Guardians and if so how?	Descriptive
Participation	Have you participated in the Long Shields programme activities? If yes, which activities?	Categorical
Early-warning system	Are you or anyone in your household part of the Long Shields WhatsApp group and why? (<i>Yes/No</i>)	Categorical
Confidence	Do you feel the Long Shields programme could help you reduce livestock losses and why (<i>Yes/No</i>)?	Categorical
Perception	How important is the Long Shields programme to you? (<i>very unimportant, unimportant, neither, important, very important</i>)	Likert
Risk orientation	Do you feel your livestock are vulnerable to lions when they are out grazing? (<i>very invulnerable, invulnerable, neither, vulnerable, very vulnerable</i>)	Likert
Trust	How much do you agree with this statement and give a reason: I don't trust the Community Guardians (<i>strongly disagree, disagree, neither, agree, and strongly agree</i>)?	Likert

Table 2 Model estimates of factors thought to influence farmers' losses to lions.

Factor	Df	AIC	χ^2	Pr (> Chi)
Communication frequency	4	46.45	16.63	.00*
Early-warning system	1	46.64	10.82	.00*
Responsiveness to warnings	1	55.92	20.10	.00*
Participation in activities	1	39.04	3.22	.07
Confidence	1	44.90	9.08	.00*
Behaviour change	1	39.25	3.43	.06
Relative risk	3	32.50	0.68	.88
Trust	4	42.81	12.99	.01*



Lions in Hwange National Park, Zimbabwe.

(Photo: WildCRU TransKalahari Predator Project)

of the following eight explanatory variables: communication frequency; early-warning system participation; responsiveness to warnings; participation in activities; confidence in the intervention; self-reported behaviour change; perceived risk; and trust (full explanations listed in Table 1). We tested for multiple collinearity between explanatory variables using the function ‘*lm*’. We used the package ‘*MuMIn*’ (Bartoń, 2019) for model averaging and ranking of the candidate models using the Akaike Information Criterion (AIC) value (Burnham and Anderson, 2002). Possible non-linear effects in the ordinal predictors were explored graphically using the package ‘*sure*’ (Liu and Zhang, 2018). To support our analysis, we also include key quotes from the interviews to highlight farmers’ perspectives in their own voices.

4. Results

We interviewed a total of 50 farmers (response rate = 100%), 54% of whom were men and 46% were women, with equal representation between those that continued to experience similar or larger livestock losses to lions post-intervention and those that experienced a decrease in livestock losses. Eight interviews

were excluded in the final analysis because they lacked clear answers to our primary questions, leaving us with a total of 42 responses for final analyses (52% men, 48% women).

Factors that influenced the persistence of higher livestock losses to lions

The following variables were associated with persistent or higher livestock losses to lions: (a) the frequency of communication with Community Guardians ($\chi^2 = 16.63$; $df = 4$; $P < 0.001$); (b) whether or not the farmer received warning messages of approaching lions via the Long Shields early-warning WhatsApp group ($\chi^2 = 10.82$; $df = 1$; $P < 0.001$); (c) farmer responsiveness to warnings ($\chi^2 = 20.10$; $df = 1$; $P < 0.001$); (d) whether or not a farmer had confidence in the Long Shields programme ($\chi^2 = 9.08$; $df = 1$; $P < 0.001$); and (e) whether or not a farmer had trust in their Community Guardians ($\chi^2 = 12.99$; $df = 4$; $P = 0.01$) (Table 2).

We further describe these factors below, to highlight the differences between farmers who continued to report persistent or larger livestock losses post-intervention compared to those that experienced a decrease in livestock losses.



Community Guardians tracking lion spoor along the protected area-community interface. (Photo: L. Mathe)

Characteristics of farmers who experienced a decrease in livestock loss

Farmers who experienced a decrease in livestock loss to lions after the implementation of the Long Shields programme lost an average of $1.27 \pm SD = 0.67$ animals per year compared to $3.07 \pm SD = 1.58$ prior to programme implementation. These farmers had characteristics of early-adopters, i.e. they were aware of the Long Shields programme and its activities, and 73% indicated that they frequently communicated with their Community Guardians, at least once a week. For example, one male farmer said, “These people [Community Guardians] assist us villagers to protect our livestock against lions. Guardians send us messages via WhatsApp daily to remind us to herd our cows and sometimes come in-person to warn us when the lions move outside the park towards our villages.”

Sixty-two per cent of these farmers mentioned they actively use and heed the Long Shields early-warning WhatsApp group, while the remaining 38% said they were not formally part of the group but relied on their neighbours who engaged in the Long Shields WhatsApp early-warning system for their daily warnings. For example, one farmer mentioned that, “I do not have a smartphone compatible with WhatsApp myself [nor anyone in this household], but we always hear of these warnings from our neighbour, who happens to be a relative and is part of the lion guardian WhatsApp group.”

Another farmer mentioned that, although she was not part of the WhatsApp group, her son, working elsewhere, was part of the group and made sure his mother received all critical messages concerning li-

ons: “The only person who is part of the group is my son in South Africa, and if there is any important warning he always rings me to make sure I got the warning.”

When asked whether or not they participate in Long Shields programme activities, the majority of farmers (70%) in this group indicated that they actively participated in tracking and chasing lions. For example, one farmer mentioned, “When we hear of lions, we quickly gather our livestock and bring them close to home and we go on to assist Guardians to chase the lions back into the park.”

When asked if they thought the Long Shields programme was essential to them or not, 100% of these farmers felt the Long Shields programme was important and were confident the programme assists them to deal with problem lions. One farmer mentioned, “These people [Community Guardians] are critical; we used to herd our livestock in fear, not knowing if the lions were outside the park or not. Today, we have Guardians who give us a regular update of lions and alert us when lions with collars are close to the fence, and we move our livestock to safety. Guardians are doing a good job, especially with the collared lions, and it is now the non-collared lions that cause us problems.”

When asked about trusting their Community Guardians, 100% of the farmers who experienced a decrease in livestock losses to lions indicated they trust the competence of their Community Guardians. One farmer mentioned that, “Community Guardians have helped us protect our livestock from lions. Since they started, incidents with lions have gone down. Had it not been for these people, we could be counting our losses”.

Characteristics of farmers who experienced persistent or larger livestock loss

Farmers who reported persistent or higher livestock losses to lions post-intervention implementation lost an average of $3.56 \pm SD = 2.01$ animals per year compared to $3.07 \pm SD = 1.58$ prior to programme implementation. Further, farmers in this group had characteristics of late-adopters, i.e. although they were aware of the Long Shields programme, the majority (83%) did not clearly understand the roles and aims of the programme. Notably, one farmer mentioned, “We know they are called Guardians, but I am not entirely sure what they do”. As a result, these farmers did not participate in the programme. For example, one farmer said: “I do not participate in their activities because I do not know what they do, and they have never invited me”.

When asked, 50% of farmers who experienced persistent or higher losses of livestock to lions indicated they do not communicate with their Community Guardians and cited the challenges of acquiring a mobile smartphone as the main reason. The remaining 50% mentioned they sometimes (less than once a month) communicated with their Community Guardians, but specified they did not have a mobile phone compatible with the WhatsApp platform. Unsurprisingly, none of the farmers in this group participated in the Long Shields early-warning WhatsApp group. However, when asked whether they participated in other Long Shields programme activities, such as tracking and chasing lions, 26% mentioned they did. That said, 67% of these farmers indicated they did not think the Long Shields programme was essential to them, and did not think the programme would help them deal with problem lions. For example, one farmer mentioned, *“I don’t think the Long Shields programme is important to me because I am still losing to lions like before, nothing has changed. I don’t perceive any change in the future unless the government fences the national park.”* When asked about the level of trust they had in their Community Guardians (e.g. competence), 87% of the farmers indicated they did not trust them, with one farmer mentioning they lost all trust and respect for their Community Guardian after he got divorced. Asked to explain further, the respondent, said: *“The woman that was married to the Guardian is my relative and the bad divorce changed the way I view him, including all the respect I had for this Community Guardian”*.

5. Discussion

For wildlife impact interventions to be effective, they first need to be adopted (Eklund et al., 2017). Factors that limit or advance participation and adoption of human-wildlife conflict intervention programmes have received very little attention, even though this enables researchers to learn from their mistakes and prevent them from continually testing ‘square wheels’, i.e. ineffective methods (Gunaryadi et al., 2017). As part of a broader case study, we explored the possible reasons why a minority of farmers engaged with the Long Shields programme continued to suffer persistent or higher livestock losses to lions. We hypothesised that late adoption by farmers was a predictor of continued livestock depredation and we chose to investigate this question using the Dif-

fusion of Innovation theory (Rogers, 2004), which categorises people into different cohorts of innovation adopters.

Our results from this exploratory study indicate that those farmers who experienced a decrease in livestock loss to lions after the implementation of the Long Shields programme had characteristics of early adopters. For example, they were familiar with the programme including its roles. They expressed confidence in the programme and were eager to participate. Further, they were actively involved in programme activities such as tracking and chasing lions. In contrast, those farmers who had persistent or larger livestock losses even after programme implementation had characteristics of late adopters. They were less familiar with the roles of the programme, less confident about the programme and less eager to use the intervention programme.

The underlying reasons for early or late adoption of our intervention programme are not apparent but others have found that factors such as age, social status, level of education, cultural norms and local politics influence an individual’s rate of adoption (Rogers, 2004). For example, older people tend to be less inclined to engage with the latest technology because of anxiety and the fear of making mistakes and therefore may not own or be able to use the latest technology (such as a smartphone) (Berkowsky et al., 2018; Knowles and Hanson, 2018). Kotzé et al. (2016) found that women were more ‘technophobic’ than men. Additionally, poorer people are more likely to be late adopters because they may not own the necessary technology (Morawczynski and Pickens, 2009). In Laikipia, Graham and Ochieng (2008) found that the reason for late adoption of farm-based treatment to deter crop-raiding elephants (*Loxodonta africana*) was because farmers feared that participation in the intervention would compromise their ability to receive government support. However, this is less likely to be a problem in our area given that the local farmers do not receive compensation for losses incurred due to wildlife (Sibanda et al., 2020a). Further, It also seems unlikely that benefits from the CAMPFIRE programme contribute to late adoption as they do not seem to reach the community and are not received at an individual level, so are unlikely to offset the individual costs of livestock depredation (Sibanda et al., 2020a). We recommend further research on this subject to explore in-depth the underlying socio-cultur-

al, political and economic factors that influence late adoption of human-wildlife conflict intervention programmes.

With regards to livestock losses, our findings suggest that persistent or higher livestock losses to lions were influenced by various barriers grouped together into three main categories: (a) poor communication; (b) negative perceptions towards the innovation; and (c) lack of trust in the programme itself, as well as in programme personnel. Acting together, these barriers negatively influenced participation and adoption of the Long Shields programme by this minority, resulting in persistent or higher livestock losses to lions.

Poor communication

The Long Shields programme was designed in conjunction with local communities and one key role of this community-based programme is to directly involve farmers in mitigating the human-lion conflict situation in the area through regular communication using the WhatsApp Messenger platform, which serves to (a) educate, (b) encourage farmers to herd their livestock and (c) alert farmers of approaching lions (Sibanda et al., in review). Between 2013 to 2017, more than 2,000 WhatsApp messages were sent to farmers warning them of approaching lions (Sibanda et al., 2020b). Further, Sibanda et al. (2020b) show that participating farmers mentioned that this was the most critical role of the programme because it enabled them to move their livestock to areas of lower depredation risk. Using the WhatsApp platform for communicating with villagers has several advantages, for example, WhatsApp is open-source, cheap software and allows a single message to be broadcast to several users within a short space of time (WhatsApp Inc, 2009).

However, our results indicate that the WhatsApp platform was not sufficient to communicate with the farmers with late-adopter characteristics. We found that 50% of farmers with late adopter characteristics did not own mobile phones while the remaining 50% owned phones which were not compatible with WhatsApp. Consequently, compared to those farmers with early-adopter characteristics, we found that the majority (83%) of farmers with late-adopter characteristics did not fully understand the role of the Long Shields programme. This suggests that there is a need to improve methods of communication and to design a channel of communication that can reach all

relevant farmers, including, for example, those that do not have WhatsApp-compatible smartphones to ensure that the programme's message and purpose is clear (Madden, 2004).

Certainly, the DoI theory suggests that knowledge and understanding influence participation and ultimately, the decision to either adopt the innovation or not (Rogers, 2004; Mohammadi et al., 2018). For example, in Uganda, Webber et al. (2007) found that lack of knowledge and understanding was one reason why a primate live-trap programme was less often adopted by farmers. Therefore, we suggest that communicating via various channels, including 'old fashioned' means (e.g. community meetings, face-to-face, sending SMS) as well as a 'phone tree' (i.e. where those who are part of the WhatsApp group inform their immediate neighbours) is likely to solve the problem. Moving forward, those identified as having characteristics of late-adopters could be engaged by the Long Shields programme through other means, such as social marketing tools to educate farmers on the roles of the Long Shields programme as well as the benefits associated with participation.

Negative perceptions

Perceptions refer to how an individual observes, interprets and evaluates an experience, object, action or other social entity (Pickens, 2005). Indeed, perceptions can influence how an individual assesses the value of a conservation action and, ultimately, the decision to either adopt the innovation or not (Bennett, 2016). In this study, we found that compared to those farmers with early-adopter characteristics, farmers with late-adopter characteristics held negative perceptions of, and were less confident in, the Long Shields programme. We suggest this was because these farmers did not fully understand, or misunderstood, the objectives of the Long Shields programme, which illustrates the hazard of failed communication. Elsewhere, lack of confidence in the intervention was the reason why methods of mitigating human-elephant conflict using chilli as a deterrent in Indonesia and Laikipia (Kenya) were less adopted by local farmers (Graham and Ochieng, 2008; Gunaryadi et al., 2017). We therefore recommend demonstrating the effectiveness of the interventions to farmers before implementation to increase confidence, as this has been shown to improve intervention uptake in other areas (Webber et al., 2007; Gunaryadi et al., 2017), although

some authors have argued that this might not always be the case (Sitati and Walpole, 2006).

Lack of trust

Trust in humans results from the judgment that one individual is trustworthy and that the individual will perform in a certain way in risky situations (Mayer et al., 1995). This judgement is based on the perception as well as the integrity of the individual (Tams et al., 2018). In this study, we found that those farmers with late-adopter characteristics tended not to trust their Community Guardians. One example illustrates the intricacy of the interpersonal relationships involved: the social ramifications of the divorce of one Community Guardian jeopardised the programme's impact in parts of the community. This finding parallels examples in marketing where sales have fallen when the behaviour of a brand ambassador incurs disapproval (Ogunsiji, 2012). This episode highlights the importance of trust, and societal mores, in the outcome of community-based interventions, and there-

fore the necessity of sensitive mindfulness of inter-personal relationships in the design and delivery of such programmes (Madden, 2004; Hughes et al., 2020).

Though small sample sizes are not uncommon in non-random purposive sampling (Rust, 2016; Morehouse et al., 2020), we acknowledge that our sample size was small and our findings will therefore need to be confirmed in subsequent studies. Nonetheless, our work provides a framework within which to evaluate conservation programmes mindful of the perspective of the people expected to adopt them.

6. Conclusion

We used a Diffusion of Innovation theory to explore reasons why a minority of farmers engaged with the Long Shields programme continued to suffer similar or higher livestock losses to lions than did others in the same treatment group. We found that (a) poor communication, (b) negative perceptions toward the innovation and (c) lack of trust in the programme



itself as well as programme personnel were important barriers that negatively influenced participation and adoption of the Long Shields programme by a minority of community members. With the cattle of the farmers who adopted the intervention not being available for depredation, it seems the cattle of late adopters became more vulnerable to lion depredation and we suggest this resulted in persistent or higher livestock losses to lions. Results of our work provide insight into barriers, several of them intangible (e.g. trust and confidence), that can limit or advance human-carnivore coexistence programmes. Our study

highlights that the DoI theory provides a way to explore how people adopt (or reject) conservation interventions and in turn, can help identify paths forward for enduring actions (Mascia and Mills, 2018).

Ethics Statement

The study was approved by the Social Science and Humanities Interdivisional Research Ethics Committee of the University of Oxford ref. R52851/RE001, Research Council of Zimbabwe ref. 02786 and the Zimbabwean Ministry of Rural Development ref. P/13/3.

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Interview with Lean Jabali, a shepherdess in Switzerland

THE SHEPHERD'S CHALLENGE: LEARNING BY BEING

Interview: Daniel Mettler

Photographs: Lean Jabali



Lean was born 1980 in Jordan to a Bedouin father and a Swedish mother. When she was nine years old, the family moved to Sweden where she finished school and studied art, philosophy and cultural studies. After working with autistic children, she looked for a new challenge and moved to the Austrian Alps to snowboard in winter and herd cattle in summer. Her next move was to Switzerland to pursue her dream of making cheese.

How and why did you become a shepherd?

During my work milking cows and goats in the Swiss Alps I discovered a new world of landscape and animals. The milking process was interesting and challenging, but I was looking for even closer contact with the flock. With my wish to work only with animals I discovered sheep and shepherding. I have been working as a shepherdess for nine years now on various Swiss alpine farms, mainly in the canton of Graubünden, and I feel in love with this fascinating profession.

Can you describe your fascination of working with sheep?

The most fascinating thing about sheep is that you become small when you work with a big flock. You have to stay flexible because of the movements and the dynamic of the flock. It changes every moment and you have to stay constantly in contact with the flock. With cattle, I had more individual contact with the animals. With sheep, the flock as a whole is much more important, even if you keep an eye on some individual animals that have a special character or are sick. The relationship with the flock plays the key role in my fascination. And, of course, my devoted colleagues, the sheep dogs, without whom I wouldn't be a herder.

What was the biggest challenge when you started this work?

The first season I worked alone with 800 sheep, mostly the White Alpine breed. I had a very hard summer, but I had to learn fast. This pressure was the best apprenticeship for me. But after the first summer I wanted to give up. I don't know why, but next year I went up again. I wasn't looking for help, I wanted to learn myself, and I realised that I have to trust the sheep more, not to follow my head, but to follow the spirit of the sheep and the whole flock. And it started to change. I discovered the crucial role of "learning by being and observing".

Did you transfer this experience to your way of life?

No, I didn't think about this. I'm not a philosopher, thinking with concepts. But I realised that with an-



imals I can gain freedom with routine, responsibility and trust. With my full awareness I can forget myself and be completely in the present. Somehow, it is an exercise of self-control which leads to a confidence in what you are doing. This confidence and the attachment to the animals gives me a feeling of satisfaction.

What do you think about exchanging knowledge and experience?

Exchange is a good thing, and a lot of people need it to achieve confidence in their work. I did a shepherding course in Switzerland, organised by AGRIDEA (*Editor's note: see Box 1*), but theory and practice are two worlds apart. Technical skills and knowledge are important but herding and interaction with sheep and dogs are only improved by experience. I would definitely recommend doing an apprenticeship with an experienced herder the first summer as the education demands.

What are the most important skills for a shepherd?

First of all, you should be interested in animals and you should have a good capacity to observe them and infer from their behaviour. You should know how to read the weather, the vegetation and especially all the

interactions between these factors. Additionally, you should be able to handle loneliness and physical fitness is also very important. I think with all these aspects you also need a lot of patience.

Do you remember any moments of fear?

Yes, especially in the first year, when I started working with sheep: fear of losing animals, fear of constant movement of the flock, fear of being responsible for accidents or sick animals. During the second year I lost this fear thanks to better self-control and more experience. The responsibility and the stress can be huge when nobody is around to share your problems. You need self-control to manage fear and loneliness and you learn to accept that you cannot control everything.

As a seasonal shepherd you don't own sheep. How is the contact with the owners of the sheep where you work?

I was lucky because the owners trusted me and they let me do it my way, which I really appreciated. As a woman, I was always respected and people were mostly very helpful and supportive. I never felt discriminated or treated without respect. Through my work and my motivation I was respected and with more experience and self-confidence it's easier to be part of the "sheep world".

What is the impact of wolves on your work?

It's a threat to the flock like storms, falling rocks or diseases. I don't separate it from other threats that we have to handle and to live with it. It's a danger that you have to take into account during your work. As a shepherd, my job is to protect the flock from any possible dangers and I do what I can with my herding knowledge and my dogs.



Have you had any wolf attacks in recent years?

Yes, I have. I had two summers with quite heavy wolf presence. A few years ago I lost ten sheep, the next summer 11. If the wolf specialises on livestock and kills too many sheep, I would like to shoot it. Swiss wolf management is actually going in this direction with a system of damage thresholds. So, if all my efforts and my dogs aren't effective, I would shoot the wolves to avoid more damage. If the wolf eats the whole animal, I have a certain respect for the behaviour of the wolf. But it's very difficult to accept that it kills more animals than it can eat.

How do you protect your flock?

Since I've been working with sheep, I always have five to eight livestock guarding dogs in the flock. After the attacks, I have been putting the whole flock in a pen every night. Since doing that I haven't had any more attacks. The most important thing is to control the flock during night and day in the difficult topography of alpine pastures. For seasonal summer grazing most big flocks are a mix of different breeds from more than ten owners. From the moment you start in the first paddock in spring you have to keep the sheep together, to achieve a compact flock and to create a guided unit with this mixture of sheep. This is a very tricky and typical point for the herding management in the Alps.

What impact do the dogs have?

The livestock guarding dogs are a part of the flock and they have negative and positive impacts. Younger dogs (less than two years old) can be a problem if they disturb the flock or harass the lambs. Say you have two dogs that constantly fight with each other, they bring stress to the flock and to the other dogs. But



they can also help with herding. For example, to cross a river where the sheep are afraid, the dogs go ahead and then the sheep follow. They can play a role by pulling instead of pushing like herding dogs do. They show me when a sheep is sick or, for example, if there is a dead animal around. An important thing is that the dog team gels and works well together. I wouldn't go on a sheep alp without them!

In your seasonal job you have to handle sheep and dogs that you don't know. How do you manage this?

I learnt a lot from observing the animals and their behaviour. There are big differences between sheep breeds. Some have a stronger herd instinct, some much less. With the dogs it is the same. You have to learn to understand them. I see this more like a positive thing, it's challenging to accept the differences between sheep breeds, between individual guarding dogs and also herding dogs. It is like an apprenticeship to accept the diversity of individuals and situations. There's no recipe or quick fix, that's why you have to find your own way.

What is the biggest challenge to protect your flock?

With the fact that you have different types of sheep breeds from several owners it's difficult to build a homogenous group that stays together. The Suffolk has a completely different behaviour compared to the White Alpine. To protect the flock you have to keep them together, that's the only way the livestock guarding dog can protect the flock in difficult topography.

What do you think about the future of shepherding in Switzerland?

I can see two trends. On the one hand, there's a tendency that the hard work of shepherding is done



more and more by foreign people and, on the other hand, there's a need to go back to nature, to look for alternatives to urban daily life. But it will be more and more difficult to find herders with a lot of experience. Our seasonal job is not easy to combine with another job during the rest of the year. I hope that the profession will be more respected in the future, with higher wages. Maybe such a change could motivate young people to join the passion of herding.

Can you imagine working as a shepherd for the rest of your life?

Yes, when I discovered sheep, the job of shepherding opened my eyes to a new world. I cannot imagine doing any other job, actually. Shepherding has

become my life. With the animals I am at home and I feel I'm doing something meaningful, I can forget myself and be in the moment.



Box 1 Training shepherds in Europe

Shepherding is closely intertwined with protection of livestock. Along with night pens, fences and guarding dogs, permanent human presence is recognised as a key method of deterring predators. In many contexts, shepherds are a prerequisite for the implementation of the other measures. Moreover, the skill and experience of the shepherd in guiding the flock is often critical to ensuring safe grazing, especially in mountainous terrain (see Mettler et al.'s article on *Good practice for night pens on alpine summer pastures* in this issue).

This age-old tradition has declined markedly in recent decades, particularly in more economically developed countries such as those of central and western Europe. As large carnivores return, however, there is renewed demand for effective damage prevention measures, including shepherds. This calls for greater efforts to motivate, train and support the next generations of profession-

al shepherds, providing them with the necessary knowledge and other resources.

To meet the current need for more shepherds in Europe, there are a growing number of training courses and schools. AGRIDEA collaborates with the Visp and Landquart agricultural schools to run training courses for shepherds in Switzerland¹. Artzain Eskola² was created in 1997 to revitalise and maintain grazing in the Basque Country (Spain) by increasing the professional level of shepherds. More recently shepherd schools³, Escola de Pastores⁴, have been set up in Portugal. Pastoral organisations, networks and research groups in Italy have launched a national pastoral school⁵. Other examples of training and apprenticeship programmes in France, Germany and the Netherlands were featured in a special issue of *CDPnews* focused on shepherds⁶.

The Editors

¹ <http://www.protectiondestroupeaux.ch/en/hirten/ausbildung/>

² <https://www.gomiztegi.eus/>

³ <https://queijoscentrodeportugal.pt/2021/05/06/2a-edicao-da-escola-de-pastores/>

⁴ <http://escoladepastores.pt/>

⁵ <https://www.scuolanazionalepastorizia.it/>

⁶ http://www.protectiondestroupeaux.ch/fileadmin/doc/International/CDP_and_General_Infos/CDPNews14-Shepherd_Issue_2017.pdf

Research

DESIGNING AND TESTING AN ELECTRIFIED FLADRY-TYPE SYSTEM PROTECTING CALVES FROM WOLVES IN SPAIN

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1. Introduction

Asturias is a largely mountainous autonomous community in northwest Spain. A variety of settings are used for livestock production, with optimal areas for grazing ranging from meadows near the coast to pastures in the Cantabrian mountains over 2,000 metres above sea level (Fig. 1). Livestock farmers share the landscape with brown bears (*Ursus arctos*) and, especially, wolves (*Canis lupus*).

There are wolves in more than 75% of Asturias, with nearly 40 packs documented in the last census (GPA, 2019; MAGRAMA, 2015). They feed on both wild and domestic prey and their diet varies across Asturias. In some western areas, roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*) and other wild prey comprise more than three quarters of wolf diet. In other areas, livestock (mainly horses) are the main



Fig. 1 Typical landscape of middle mountains in central Asturias.

(All photos: FAPAS)



Fig. 2 Spanish Mastiff guarding cattle and horses in the Cantabrian mountains.

prey (CARA, 2015). There are nearly 16,000 cattle farms with more than 400,000 head, typically for meat production and mostly of the local Asturiana de los Valles breed (SADEI, 2017). Wolf damage has been compensated since 1997 by the regional administration. According to official records, in recent years an average of 3,000 animals have been killed annually (CARA, 2015).

In rural middle mountain areas, at elevations from 500 to 900 metres, the most important economic activity is extensive cattle grazing. This is vulnerable to predation and suffers the highest level of damage by wolves due to the husbandry system, which lacks adequate protection measures. Young calves graze with their mothers during summer on private lands, usually of a couple of hectares in size, and may not always be confined in stables during the night. The owners live far from their livestock, which is not supervised on a daily basis, and they are mostly dependant on financial support from the EU's Common Agricultural Policy. This management system is completely different from that in the high mountains, where cattle graze freely and without young calves, which are kept in lower areas and protected by livestock guarding dogs (Fig. 2).

Wolves are not a game species in Asturias, but population management is based on culling, with annual quotas set according to wolf abundance, complaints of livestock depredation and social conflicts. North of the River Duero, wolves are included in annex V of the European Union's Habitats Directive, which permits a more flexible regime of lethal control. Each year 6–32 wolves (mean = 16) are culled as part of the regional management plan (CARA, 2015). However, this strategy does not eliminate predation on

livestock. Although a period with no damage may follow the killing of wolves, the problem soon recurs when new wolves reoccupy the territory.

To prevent wolf damage to extensively grazed cattle in Asturias, the Fund for the Protection of Wildlife (FAPAS) has been studying wolf predatory behaviour in order to identify the most suitable husbandry system and to develop new damage prevention measures. Specifically, the goal was to devise a type of fencing that is practical to use in mountainous terrain and can protect young calves during their first few weeks of life, when they are most vulnerable to wolf predation, thus reducing losses to the livestock sector and mitigating conflicts with wolves in the region.

2. Study of wolf predatory behaviour

In 2016, FAPAS started using camera traps and video monitoring, complemented with direct observations, to study wolves in areas with donkeys and Asturcon horses. A total of 16 cameras were set up in pastures of 0.5–2 hectares at elevations of around 900 metres. During a 4-year period, a total of 3,500 images were obtained, which were used to analyse wolf behavioural patterns linked to attacking and feeding on livestock. From these records it was evident that, when hunting large livestock, wolves exhibited more wary, vigilant and elusive behaviour than when hunting wild ungulates, presumably in order to remain undetected and avoid potential danger (Fig. 3). In contrast to those on wild prey, attacks on livestock were slower and took place after a cautious approach (e.g. moving slowly with the body close to the ground and tail between legs). Wolves abandoned their attacks in all cases in which they were disturbed or startled.

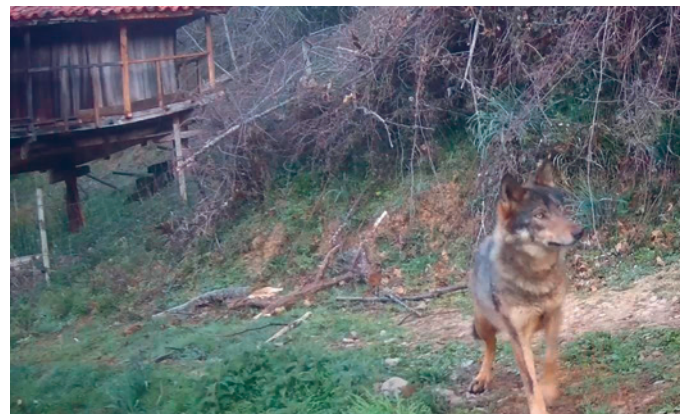


Fig. 3 Wolves are typically very wary when approaching livestock or carcasses. This image from a camera trap shows a wolf reacting to movement in the vicinity of a carcass.



Fig. 4 A young calf bitten by a wolf on the hind leg.

No group attacks or high-speed stalking were observed and on many occasions interactions between wolves and cattle did not involve attacks, i.e. wolves approached or walked through a group of animals without disturbing them, or the livestock chased them away. This behaviour may result from the fact that in this area there are mostly small groups of 2–3 wolves. This is probably because the population is depleted by culling, although of course wolf numbers increase again after breeding. It could be helpful to know more about local wolf population dynamics and how these small family groups use the area. Unfortunately, the regional government in Asturias does not allow FAPAS to capture wolves for telemetry studies in areas with livestock.

3. Pilot experiment to protect calves

In March 2019 we enclosed an area of one hectare (perimeter 100 × 100 m) with a fence to develop and field-test a system that could prevent wolf attacks. To

this end, we reached an agreement with the owner of a small family-run cattle ranch in the Council of Grado (in the centre of Asturias) which has suffered losses of cattle to wolves. The owner lives in town, 60 km away from the ranch, so controlling and managing his cattle due to wolf presence implies a considerable daily effort. Between January and April, three of his calves were attacked (wounded or killed) by wolves. It was clear from the wounds on the young calves (Fig. 4) that a single wolf was responsible: multiple wolves could have killed the calves and a larger pack would have consumed it completely. We therefore faced a typical situation of wolf attacks on cattle in these middle mountain areas in Asturias.

A fence was used to enclose nine calves and their mothers in the pasture during the day. The herd was confined in stables at night. The fence was developed based on our observations of wolf predatory behaviour, which suggested that a design involving unpredictable and erratic movements could deter wolves. Using PVC poles at 3-metre intervals, we installed an electric tape for horses at a height of one metre above the ground, from which 80 cm long pieces of the same tape were stapled every 25 cm so that they moved freely in the wind. A ‘gate’ was made with a plastic handle for electric fences, allowing a section of the fence to be opened easily (Fig. 5). To prevent calves passing under the fence, a metal wire was added below the tape, 30 centimetres above the ground, attached to the same PVC poles (Fig. 6). The entire fence (tapes and metal wire) was electrified with a voltage of 3–5 kilovolts using a 12V battery.

Five cameras were set up around the fence to monitor any wolf approaches during the monitoring period, from April until the calves were sold in July (calves are usually sold when 4–6 months old) and the herd was moved to another pasture. While the



Fig. 5 General view of the fladry fence, showing the handle (red) used to open the ‘gate’.

fence was installed, no wolf passed it and no damage occurred inside the fence, although an adult cow was found dead nearby.

4. Improving the fence

We have reached a new agreement with the cattle breeder to allow us to improve the fence and make it simpler to use whilst also resolving issues that arose during the first trial. For example, some of the hanging tapes tangled in the metal wire, although they usually disentangled themselves and this was not considered a major problem for the efficacy of the fence. Some hanging tapes were torn off by strong wind and subsequently tied onto the horizontal tape. Shortening these tapes could help avoid loss of power in the fence due to touching tall grass.

We plan to test the fence with only the metal wire electrified in order to determine whether wolves are deterred by the movement of the hanging tapes or the electric shock received when fence elements are touched. A further trial will also enable us to gather more data about the duration of the deterrent effect



Fig. 6 A cow and calf inside the electric fence. The arrows indicate the position of a metal wire that prevents calves from passing under the fence.

on wolves. With similar types of barriers such as turbo-fladry, an initial period of neophobia (see Nuninger et al., 2017 in *CDPnews* issue 13) is likely to be followed by habituation (e.g. Lance et al., 2010).

Acknowledgements

I would like to thank FAPAS biologist Doriana Pando for many hours spent analysing photographs and videos; my colleagues Luis, Monchu and Cristina for their work building the fence; and Antonio, a cattle breeder of Restiello, who allowed us to conduct trials at his farm.

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EU Platform on Coexistence between People and Large Carnivores



Minimizing Conflicts

Finding Solutions

Annual meeting

The 8th plenary meeting¹ of the EU Platform on Coexistence between People and Large Carnivores took place online on 20th May 2021. Plenary meetings are annual exchanges between the core group of Platform members (representative stakeholder groups) and act as a forum for exchange and work planning.

During the morning, Platform members discussed a range of policy initiatives relevant to their work. These included a focus on the EU Biodiversity Strategy to 2030 and the restoration plan. Under the strategy, Member States have a new commitment to ensure that at least 30% of species and habitats not currently in favourable status are in that category or show a strong positive trend. The Commission is currently working on guidance to help them select the species to focus on. Member States will be expected to submit first draft 'pledges' on the species they will address as a priority by the end of 2022. The Commission is also currently drafting new, legally binding common EU nature restoration targets to be ready by the end of 2021. Specific targets will be set to restore different types of degraded ecosystems, with a particular focus on 'win-wins' (e.g. ecosystems that also provide other services such as carbon capture or water storage).

Another area of specific interest to the Platform is the ongoing reform of the Common Agricultural Policy (CAP). The CAP Strategic Plans, which every Member State must produce with the support of the Commission, are expected to act as the basis of new governance with strengthened cooperation between different levels of government. An integral part of the planning process is involving stakeholders in the discussions. The plans must also refer back to the Priority Action Frameworks (PAFs) in which Member States lay out their priorities for financing nature pro-

tection, including conflict species such as large carnivores. The potential for using the new eco-schemes for funding coexistence measures was also discussed. The schemes, funded under Pillar 1 of the CAP, can include support for shepherding and animal welfare such as fencing and housing.

In the afternoon, the Platform members broke up into small groups to explore how to better communicate the Platform messages. All agreed that, in an era where fake news is of increasing concern, providing sound, science-based arguments is an important role of the Platform. The Frequently Asked Questions and Common Misconceptions² section of the Platform website provides an important information source on some of the most commonly encountered myths related to large carnivores.

Webinar: stakeholder involvement in management

Sweden has a long history of participatory management. Together with the Swedish Environmental Protection Agency and Regional Platforms on Large Carnivores, on 12th April the EU Platform co-organised a thematic webinar on *Stakeholder involvement in large carnivore management in Europe: Example of Swedish Wildlife Management Delegations and international comparisons*. Results were presented from a survey organised by the EU Platform Secretariat on stakeholder participation in wildlife management in Sweden. This provided baseline information on the relationships between stakeholders in the different Swedish Wildlife Management Delegations but also in the Regional Platforms³ established as pilots and financed by the European Institutions. The survey showed that the

¹ https://ec.europa.eu/environment/nature/conservation/species/carnivores/events_plenary_meeting_2021.htm

² <https://ec.europa.eu/environment/nature/conservation/species/carnivores/faq.htm>

³ https://ec.europa.eu/environment/nature/conservation/species/carnivores/regional_platforms.htm



(Photo: J. Linnell)

situation differs across wildlife delegations, although in general such ‘exchange platforms’ were viewed positively, providing a space for discussion where conflict was generally lower than in surrounding regions. However, such platforms cannot be expected to eradicate conflict entirely and their success or otherwise depends very much on local circumstances.

Further presentations focused on the ongoing update of Large Carnivore Management Plans in Sweden. The EU-financed regional platform pilot project will support this process by organising a series of facilitated exchanges on the national, regional and local

levels. The webinar also compared the Swedish situation to that in Finland, where new ‘Wolf Territorial Groups’ have been established in areas where wolves are returning. The webinar can be viewed online⁴.

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⁴ https://ec.europa.eu/environment/nature/conservation/species/carnivores/events_sub_thematic_webinar_2021.htm

Project

ARCTUROS GREEK SHEEPDOG BREEDING PROGRAMME

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1. Introduction

The Greek Sheepdog, also known as the Hellenic Shepherd Dog or Ellinikos Poimenikos, has its origins in classical antiquity. Writing in the 4th century BC, Aristotle described two distinct forms of dogs, one for hunting and the other for guarding livestock and property (Hancock, 2000). They were kept by the Molossi, an ancient Greek tribe who lived in the mountainous region of Epirus, now shared between north-western Greece and southern Albania.

Today, the Kennel Club of Greece recognises three indigenous breeds of flock guardians: the Molossus of Epirus¹, the Greek White Shepherd² and the Greek Sheepdog³ (Fig. 1). However, the traits that are favoured by modern dog breeders, with an emphasis on appearance, are not always the same as those needed for good working dogs (see Giannakopoulos et al., 2017 in *CDPnews* issue 16). Characteristics inherited from Molossian dogs and preserved due to the region's isolation and inaccessibility are in danger of being lost. At the same time, there is a renewed need for effective methods of protecting livestock as numbers of wolves (*Canis lupus*) and bears (*Ursus arctos*) increase. In the case of wolves, the problem is compounded by a scarcity of wild prey which compels



Fig. 1 A Greek Shepherd Dog. (Photo: Arcturos archive)

them to predate on livestock (Iliopoulos et al., 2009; Petridou et al., 2019).

This article describes the Greek Sheepdog breeding programme run by Arcturos, which aims to revitalise the breed and provide shepherds with good quality flock guardians. It summarises key milestones and presents the main achievements and results so far. It also includes the findings of a recent follow-up study assessing the performance of dogs given to shepherds and their role in facilitating the coexistence of livestock and wild predators in Greece.

¹ <http://www.koe.gr/index.php/el/greekbreeds/molosos-tis-hpeirou>

² <http://www.koe.gr/index.php/el/greekbreeds/leyko-elliniko-tsopanoskylo>

³ <http://www.koe.gr/index.php/el/greekbreeds/ellinikos-poimenikos>

2. The Greek Sheepdog

The characteristics of the Greek Sheepdog have been shaped by the natural environment in which it lives and the task it performs. For centuries, pastoralism in mountainous areas was based on transhumance: exploiting pastures at higher elevations in summer and spending the winter in lower-lying areas. Guarding dogs accompanied flocks and herders on these seasonal migrations, often travelling great distances with a meagre diet and little time to rest. This required a combination of endurance, adaptability and bravery in confronting predators (OFEP, 2012).

Husbandry practices gradually changed to more permanent locations and housing livestock in barns. Some shepherds turned to breeds from elsewhere, such as the Caucasian Shepherd Dog, or crossbred flock guardians with other types of dogs in the belief that bigger dogs would be more capable of winning fights with bears and wolves. These factors contributed to a decline of the Greek Sheepdog, which for several years appeared to be threatened with extinction. Nowadays, dogs with many different morphologies can be found in the countryside of Greece, but not all are suitable for the protection of livestock. Larger, heavier dogs become tired more easily and those with thick coats, in particular, may struggle to cope with hot summers. The characteristics espoused by the breed standard for the Greek Sheepdog (Box 1) are therefore ideally suited to conditions in Greece.

3. Arcturos breeding programme

Arcturos is a Greek non-profit, non-governmental organisation founded in 1992 and dedicated to the protection of wildlife and natural habitats. It maintains sanctuaries for bears and wolves that cannot be returned to the wild. It also runs various carnivore conservation projects, mainly on bears in the Pindos and Rodopi Mountains in the north of the country and on wolves throughout the mainland.

Arcturos first became involved in breeding Greek Sheepdogs in the late 1990s as part of the LIFE Lycos project Conservation of *Canis lupus* and its habitats in Central Greece⁴ (LIFE97NAT-GR-04249). Arcturos co-operated with shepherds to establish a livestock guarding dog breeding programme (Arcturos, 1999). In these early stages, no genetic research was conducted and dogs were selected for the programme on the basis of the following criteria:

- Excellent working dogs;
- No hereditary disease or unwanted behaviours (e.g. aggressiveness);
- Conform to the breed's morphological characteristics.

⁴ <https://cordis.europa.eu/project/id/LIFE97NAT-GR-004249>

Box 1 Characteristics of the Greek Shepherd Dog

According to the breed standard approved by the Kennel Club of Greece, the Greek Sheepdog is a courageous dog with good body structure, characterised by a strong skeleton with good muscle coverage, able to move all day under adverse weather conditions, in difficult terrain and in need of little nutrition.

Character: The Greek Sheepdog is independent, decisive, loyal, a good worker with a strong sense of duty and strong protective instinct for the animals it accompanies and for its environment.

Important proportions: The ratio of the length of muzzle to skull is 2:3; the body length is larger than the height by 7–10%; the width of the skull is almost equal to its length.

Coat: Dense and abundant, with two layers. The undercoat has soft and dense wool while the topcoat is longer with straight or slightly curly hair (of harsh texture). Various colours, uniform or with markings. Short hair and long hair variations.

Height at the withers: males 68–73 cm, females 63–68 cm.

Weight: males 40–55 kg, females 32–42 kg.



Fig. 2 Female Greek Sheepdog Hanna guarding a flock of sheep in Nevrokopi, Drama prefecture, Greece.

(Photo: Arcturos archive)

The founding group of dogs thus collected was used for breeding and their pups were given to shepherds working in areas with wolves or bears (Fig. 2).

As the years passed, the breeding programme became more refined, with the addition of genetic testing. A standard was established but, unfortunately, the breed is still not recognised by the World Canine Organisation (FCI) because there is not a sufficient number of bloodlines officially registered with the Kennel Club of Greece.

In 2008, Arcturos established the Greek Sheepdog Breeding Centre which today is home to 16 female and three male breeding dogs (Fig. 3). They were either bred and raised by Arcturos or provided by the breed club, the Group of Friends of the Greek Shepherd⁵. More than 50 additional dogs given to shepherds or private owners are also used as breeding dogs within the programme. Breeding dogs are screened to reduce the risk of hereditary conditions appearing in pups.



Fig. 4 Volunteers help to feed, groom, walk, train and socialise dogs.

(Photo: Giorgos Moutafis, Arcturos archive)



Fig. 3 Arcturos Greek Sheepdog Breeding Centre in Agrapidia, Florina.

(Photo: Nikos Grammenopoulos)

The youngest dog currently at the Centre has a five-generation pedigree of breeding by Arcturos. Dog breeding is conducted following the advice of the Arcturos veterinary team and in consultation with the Veterinary School of the Aristotelian University of Thessaloniki. The programme is funded by Arcturos and volunteers from all over the world assist with the everyday care of the dogs (Fig. 4).

Pups remain at the Centre until they are at least nine weeks old (Figs. 5–6). They are vaccinated, microchipped (from 2003 onwards), dewormed and socialised with other dogs and humans before being distributed to shepherds (Fig. 7). There is great demand for pups, but priority is given to shepherds who live and work in areas with predators. A contract is signed specifying that Arcturos remains the owner of the dog but the shepherd has the use of it. Arcturos supports and advises the shepherd throughout the life of the dog. The shepherd is responsible for covering any subsequent veterinary costs and must inform Arcturos if the dog is injured, stolen, dies or needs to be rehomed, for example if the livestock are sold. Arcturos staff can confiscate a dog if it is not kept in appropriate conditions or the terms of the contract are broken. This has happened less than ten times during the programme; dogs were rehomed successfully in all cases. According to the contract, shepherds should not breed the dogs without approval. If breeding is agreed, shepherds can keep any pups they want and the rest are given to the programme to be distributed to other shepherds.

⁵ <http://www.ofep.gr/>



Figs. 5–7 Clockwise from top-left: Greek Sheepdog Fiona with her pups at the Arcturos breeding facilities; one week old pups; a shepherd receiving a new pup from the programme. *(Photos: Melina Avgerinou, Arcturos archive)*

When a shepherd receives a pup, it is put in a barn in direct contact with the animals it is meant to protect so that it learns to recognise them as its own social group. Pups are usually placed with sheep and/or goats, mostly of local breeds or crosses, but some are placed with cattle or other livestock (Fig. 8). Since the programme began, more than 1,500 pups have been distributed to shepherds all over Greece. From 2003 until today, Arcturos has bred and distributed 758 pups (405 males and 353 females). Most shepherds take two pups (from different litters and bloodlines), although some want only one (usually a male, in order to avoid having litters of their own).

4. Study of outcomes

Arcturos closely monitors pups and working dogs throughout their lives. In order to evaluate their effectiveness as livestock guarding dogs (LGDs), as well as to identify any new problems that shepherds might be facing in regard to coexistence with wildlife, in

early 2020 Arcturos conducted additional follow-up research with shepherds who had received pups from the programme.

4.1 Methods

A questionnaire survey was administered by telephone or during site visits to a total of 171 shepherds who had received LGD pups from the programme between 2008 and 2019. This included questions on the following aspects:

- Livestock and landscapes where the dogs work;
- Levels of damage to livestock;
- Shepherds' perceptions of LGDs, attitudes towards coexistence with large carnivores and opinions of existing management measures;
- Dog behaviour;
- Dog health, welfare and causes of mortality.

Some questions were evaluated on a per-flock basis (i.e. if a shepherd had more than one dog, answers for all dogs were pooled), whereas responses to other



Figs. 8 Greek Sheepdogs with livestock.

(Photos: Web archive, www.arcturos.gr)

questions were evaluated for each individual dog. Reported losses were grouped into categories as follows: 0–1, 2–4, 5–9, ≥10 head of livestock per year.

4.2 Results

4.2.1 Livestock and landscapes

The shepherds included in the survey had received a total of 274 dogs (131 males, 143 females) from the programme. Most of them worked in areas with large carnivores, although there were some elsewhere who faced damage by packs of stray dogs. Most surveyed shepherds, as is typical in Greece, kept sheep (75 respondents), goats (26) or both (31). Some bred cattle (32) and the rest (7) had pigs, horses, etc. (Fig. 9). Almost all of them were based permanently in one location; only two utilised different pastures in summer and winter. Most flocks were 100–450 head, fewer up to 1,000, and usually grazed on rangelands or in fences pastures.



Fig. 10 Sheep killed by wolves in Emporio village, Kozani, Greece. (Photo: Arcturos archive)

dogs to 80% afterwards. All other categories of losses decreased, most notably the proportion of shepherds reporting the highest levels of loss (≥10 head of livestock per year), which declined from 28% to 10% following the acquisition of LGDs (Fig. 11).

4.2.3 Shepherds' opinions and attitudes

The vast majority of shepherds agreed that the use of Greek Sheepdogs is a good measure for preventing predation by wild animals: 90% responded that it is the best solution for their problems and 91% indicated that they would recommend them to others. Almost all of them (97%) considered the Greek Sheepdog a relatively 'cheap' damage prevention measure.

Paradoxically in light of the above, when they were asked if the frequency of damage by wild predators dropped after receiving Greek Sheepdogs, only 32% of shepherds answered yes while 62% said no. Of

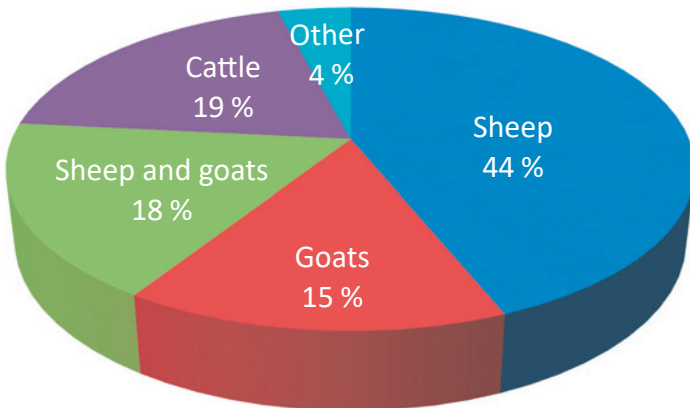


Fig. 9 Types of livestock kept by shepherds included in the survey.

Shepherds with programme dogs worked in landscapes with forest (41%), low vegetation (27%), grass meadows (26%) and in mixed or more complex terrain with fields, lakes, etc. (6%). Most (60%) reported having lost livestock to predators before they received Greek Sheepdogs, while those who had not nevertheless wanted to use LGDs to prevent such damage occurring. Shepherds were usually most concerned about wolves (Fig. 10), to a lesser extent bears, and some mentioned problems with wild boar (*Sus scrofa*), jackals (*Canis aureus*) or stray dogs.

4.2.2 Damage levels

The proportion of shepherds who reported having negligible or no losses (0–1 animal lost annually) increased from 49% before acquisition of Greek Sheep-

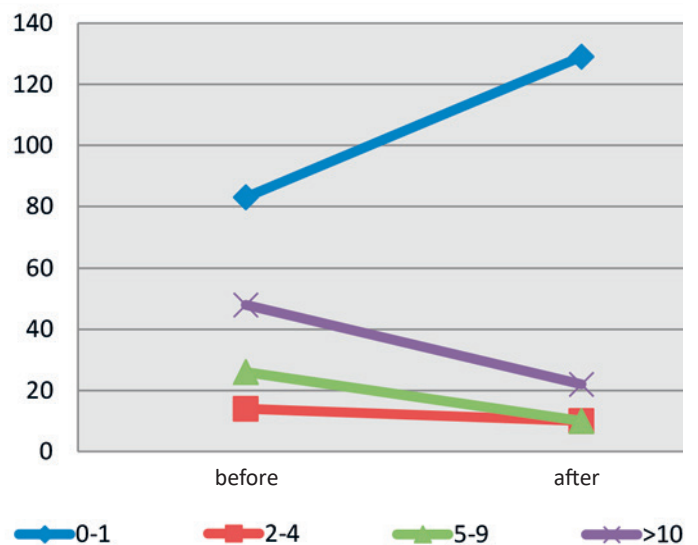


Fig. 11 Reported numbers of livestock lost to predators annually (in four categories) before and after acquisition of Greek Sheepdogs.

those who stated that they saw no change in damage frequency, 51% reported having had damage before acquiring dogs. However, when they were asked about the number of animals lost in all wild predator attacks, most agreed that the use of Greek Sheepdogs had significantly reduced the total number of animals lost.

All participating shepherds, without exception, considered the existing damage compensation system in Greece to be insufficient. All of them found the procedure extremely difficult and some stated that they do not apply for compensation because they thought they would not get it anyway. Of 136 who mentioned having claimed for damage in the past, almost half (46%) had not received compensation. Shepherds were evenly divided in their opinions of coexistence with large carnivores: 39% viewed it as normal, 37% considered it problematic and the remaining 24% were indifferent. In most cases, shepherds reported that their opinions had not changed since receiving LGDs to help protect their livestock.

4.2.4 Behavioural analysis

A large majority (85%) of the 274 dogs provided by the programme exhibited no behavioural problems. The remainder showed some deficiencies: 12 dogs (4%) did not follow the herd; nine (3%) were aggressive towards people; six (2%) killed and ate chickens; three (1%) were aggressive towards other

dogs; three (1%) were fearful; three (1%) were disobedient; two (1%) were aggressive to sheep and lambs; and <1% ate their puppies, chased cars or became aggressive after a bear attack. Fourteen of the shepherds (8%) with a total of 23 dogs indicated that they spent time on the proper training of their dogs, while the remaining 92% stated that this was not necessary. Only 13 (5%) of all dogs were neutered, even after behavioural problems appeared.

4.2.5 Health, welfare and mortality

At the time of the survey, 9% of all dogs included in the research had had some health-related issues. The most common problems were various parasitic diseases and skin or ear infections (Fig. 12). A minority of dogs (23%) were fed exclusively with specialised dogfood; the rest were fed pasta, rice, bread, meat, milk, dead animals, leftover corn flour, bran, etc.

At the time of the survey, 133 dogs placed with 81 different owners had already died. Of these, 46 (35%) were less than one year old when they died and another 45 (34%) died at the age of 1–5 years. Seventeen dogs (13%) died when 5–10 years old and seven (5%) were older than ten when they died. In the remaining 18 cases, the owners did not remember the exact age of death. However, these percentages are distorted by the fact that 141 dogs placed with 90 different shepherds were still alive at the time of the survey. When all 274 dogs are considered, mortality at ≤1 year of age was up to 17%.

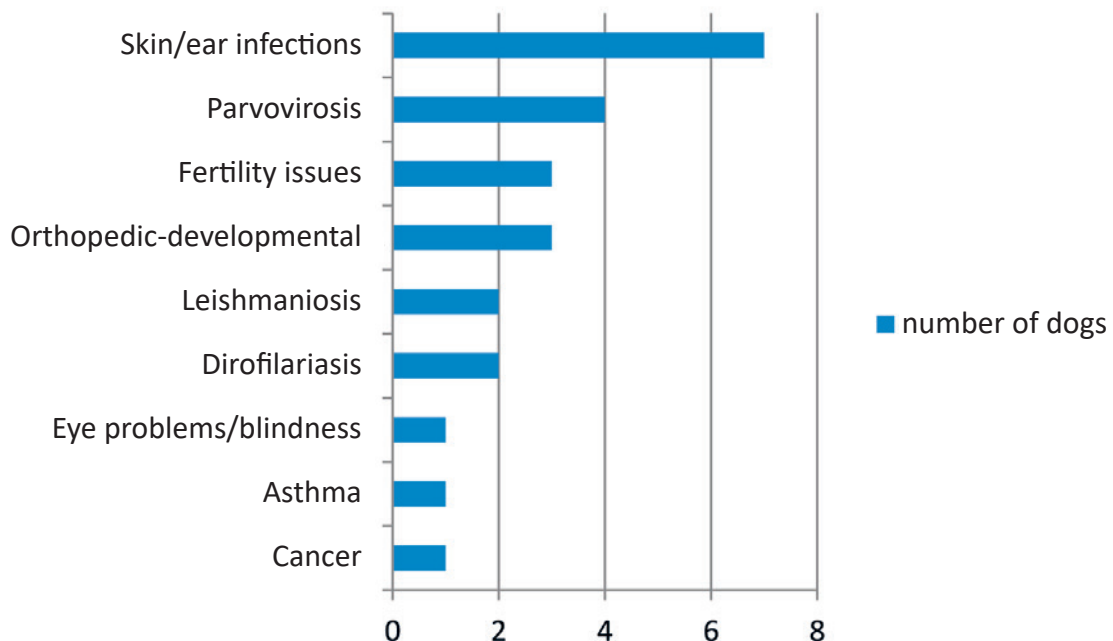


Fig. 12 Health problems of pups and adult dogs in the breeding programme.



Fig. 13 Poisoned Greek Shepherd Dog rescued by the vet team. (Photo: Melina Avgerinou, Arcturos archive)

Shepherds reported that most dogs for which cause of death could be determined died due to disease (20 dogs), encounters with snakes, bears, wolves or wild boar (20) or natural causes i.e. old age (16). Additionally, 19 dogs were poisoned (Fig. 13), 15 were killed in fights with other dogs and 13 died due to collisions with motor vehicles. The remaining 30 dogs died of unknown causes (Fig. 14).

5. Conclusions and recommendations

This long-running breeding programme, started by Arcturos more than 30 years ago, shows that Greek Sheepdogs retain their original working characteristics. Our results show that the use of these dogs as flock guardians is an excellent preventive measure against predation on livestock by wild predators and stray dogs.

The vast majority of shepherds participating in our research agreed that LGDs were the best solution for them and recommend them to others. Greek Sheepdogs are a very efficient tool, since they can reduce losses substantially and are also relatively easy to implement by shepherds, who consider them inexpensive to maintain. When combined with other measures (continual shepherd presence, electric fencing, etc.), they probably represent the optimal approach to protecting livestock from predators in Greece.

While our findings are encouraging in terms of the effectiveness and efficiency of Greek Sheepdogs as a working tool, concerns arise about whether shepherds are able to raise and care for them appropriately and

secure their health and wellbeing. We found considerable interest among shepherds in acquiring pups but an apparent lack of information about modern animal husbandry. Many shepherds still adhere to more traditional practices of raising dogs with minimal intervention. Besides continuing to breed and distribute quality dogs, efforts should therefore be focused on better education of shepherds regarding animal welfare.

Dogs living and working in outdoor environments are exposed to various dangers and therefore do not have the same life expectancy as dogs that live in more protected environments such as a house, yard or fenced area. However, a significant percentage of early deaths might be avoidable with better care, including vaccination followed by regular booster shots against canine parvovirus, anti-parasite collars for *Leishmania* and *Dirofilaria*, limiting the number of dogs with each flock to avoid fights, providing a safe fenced environment during the night and taking measures against poisoning (see Infante and Beatriz, 2017 in *CDPnews* issue 16).

Illegal poisoning is rapidly becoming one of the biggest dangers faced by working dogs and wildlife in Greece (Ntemiri et al., 2018). It occurs mainly in late August to early September, before the hunting season, but can happen during several different periods throughout the year. The intended targets are usually

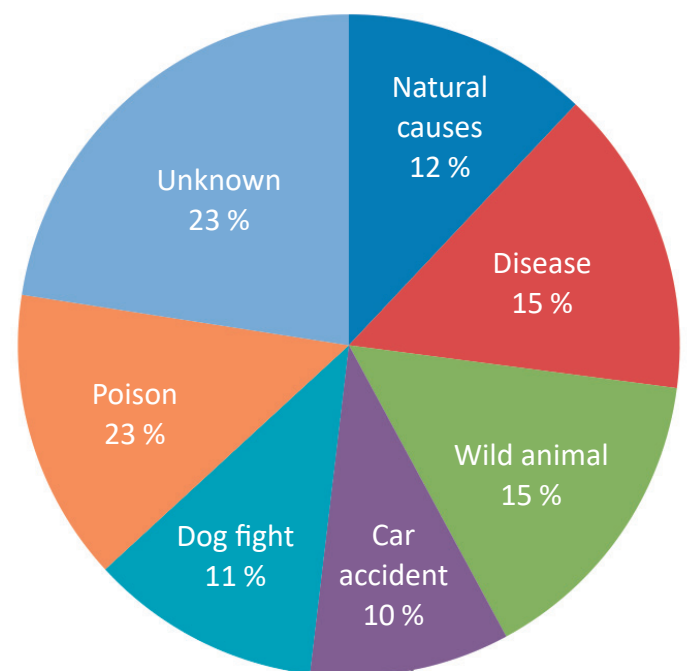


Fig. 14 Cause of death of working Greek Sheepdogs.

predators including wolves and stray dogs, but some people accuse hunters or even authorities of deliberately spreading poisoned baits to kill sheepdogs.

It is to be expected that people negatively impacted by wildlife may not support its conservation unless measures are also taken to protect their livelihoods and property. The rather ambivalent responses of the shepherding community to the question of coexistence with large carnivores may be influenced by widespread dissatisfaction with the damage compensation system. Arcturos has striven for years to achieve a fairer and more efficient system of compensation, which could provide an additional motivation for shepherds to support, or at least to tolerate, the pres-

ence of large carnivores. Informing shepherds about the value of wildlife in their area may also help to foster better coexistence.

Finally, for the Greek Sheepdog to be officially recognised by the FCI requires years of work to collect information and pedigrees of at least 1,000 dogs from eight different bloodlines with at least three generations of unrelated dogs and many other requirements that shepherds cannot meet. Although this is not a priority for Arcturos at the moment, most programme dogs and litters are registered with the Kennel Club of Greece in order to keep official records. Genetic testing from time to time may also provide useful information.

Acknowledgements

On behalf of the Arcturos team I would like to thank Vana Paidá, who conducted the main questionnaire work with shepherds, and all the volunteers of the Greek Sheepdog breeding programme who took care of the dogs. Thanks also go to Royal Canin for supplying dog food and to veterinarian Nikolaos Patsinakidis and the veterinary department of the Aristotelian University of Thessaloniki for providing health care.

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REPORTS



EIP-AGRI Focus Group on wildlife and agricultural production: final report

Publisher: EIP-AGRI Focus Group wildlife and agricultural production, 2021

Language: English

Available: https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_fg_wildlife_and_agricultural_production_final_report_2021_en_final.pdf

The main task of the EIP-AGRI Focus Group on wildlife and agricultural production was to identify opportunities to implement innovative solutions to prevent and control damage to agriculture by wild animals while, at the same time, protecting wildlife. In particular, the short-term expert group sought to:

- Map the most common types of damage caused by wild animals, particularly mammals and birds, on farms across Europe.
- Identify strengths and weaknesses of available solutions at the farm level that can help prevent, monitor and control wildlife damage to agricultural production.
- Identify good farming practices, within a wider wildlife management approach, that contribute to limiting harm to the local fauna.
- Identify opportunities to implement innovative solutions at farm or at landscape level through forms of collaboration (including with foresters, hunters, and others).
- Identify needs from practice and possible gaps in knowledge that may be solved by further research.
- Suggest innovative solutions and provide ideas for EIP-AGRI Operational Groups and other innovative projects.

In addition to a final report published in February 2021, several mini-papers are available on the EIP-AGRI website¹ which cover: collaboration between stakeholder groups; conflict management at the farm level; managing farmer-wildlife relations under a territorial framework; and instruments to reduce conflict between wildlife and farming.



Le loup dans le système pastorale

Authors: Jean-Luc Borelli, Jean-Marc Landry

Publisher: IPRA-FJML, 2021

Language: French

Available: [https://ipra-fjml.com/resources/hpfarmOlWgNyxMuH-3GEp#/#](https://ipra-fjml.com/resources/hpfarmOlWgNyxMuH-3GEp#/)

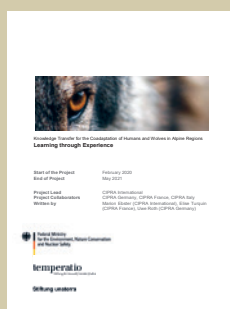
In a response to a steady increase in damage to sheep flocks caused by wolf predation in France and a lack of effective knowledge about this predator in the pastoral environment, the Can-Ovis research project was launched in 2013. Its objective was to improve the tools and strategies for protecting flocks by studying the relationships and interactions between wolves, flocks and protection methods, particularly livestock guarding dogs.

During six summer seasons in 2013–2018, several sheep pastoral units were monitored in areas of permanent wolf presence in the southern French Alps. Nocturnal interactions of wolves with flocks and protection systems were observed using thermal imagery. The large number of documented events highlights, on one hand, the considerable overlap between wolves and pastoral systems that share the same landscapes and, on the other, that attacks and damage are only the tip of the iceberg of relations between wolves and livestock.

The results presented in this report aim to reduce the discrepancies between human representations of the wolf and the reality of its behaviour in a pastoral environment. They suggest that protection measures used to date generally work but not necessarily for all wolves, which have different personalities, unequal interest in livestock and contrasting responses to protection measures.

Based on their observations, the authors elaborate a behavioural model of the wolf in a pastoral environment, proposing a new ethological concept describing evolutionary patterns. They propose a re-reading of the vulnerability of livestock, a new way of viewing livestock guarding dogs and a different approach to protection and adaptive management of predation risk.

¹ <https://ec.europa.eu/eip/agriculture/en/focus-groups/wildlife-and-agricultural-production>



Knowledge transfer for the co-adaptation of humans and wolves in Alpine regions: learning through experience

Authors: Marion Ebster, Elise Turquin, Uwe Roth

Publisher: CIPRA, 2021

Language: English

Available: <https://www.cipra.org/en/cipra/international/projects/current/knowledge-transfer-on-the-co-adaptation-of-man-and-wolf-in-the-alpine-region>

The recovery of large carnivores has caused a hardening of fronts between different stakeholder groups. In the Alps, the wolf is the most widespread and widely debated carnivore to return. It provokes reflection about boundaries: the concrete demarcation of grazing livestock by fences as well as more elusive divides between nature/wilderness and culture/civilisation. Wolves have adapted to live in landscapes dominated by humans, while people try to develop ways to maintain their livelihoods after the return of wolves. The development and implementation of such coadaptation strategies often entail major changes for some sectors of society, leading to fear and conflict.

In order to create an overview of coadaptation from different perspectives and across administrative, social and cultural borders, CIPRA conducted 35 interviews with shepherds and livestock breeders, administration staff, environmental experts, technical service providers and scientists from all Alpine countries. The final report of this preparatory project provides a synopsis of human responses to recolonisation by wolves during the last 10–20 years. The findings reveal what has worked and why but also what measures have failed and for what reasons, leading to a series of recommendations of “how to” and “how not to” in regions where the wolf has just started to reappear. For example, communication should be fact-based, calm and transparent in order to build trust and spread knowledge. The ideas and insights offered can be a helpful source of knowledge for regional and national administrations, technical services, shepherds, agricultural colleges, journalists and the public.

Another focus of the work was on shepherds, who have a special role to play in coadaptation processes in the Alpine region. They are ‘at the coalface’ of practical dealings with wolves and, at the same time, are a rather small and marginalised sector of Alpine society. The second part of the report therefore examines the potential benefits and challenges of setting up a transnational shepherd organisation in the Alps. Since the return of large carnivores, shepherds are more important than ever and there is a need to professionalise training and networking as well as to improve their social reputation and financial remuneration.



Sustainable management of mountain grasslands: a collection of good practices

Publisher: Euromontana, 2021

Language: English, French

Available: <http://www.lifeorekamendian.eu/en/booklet-of-goog-practices/>

Biodiversity and traditional farming practices in mountain areas are closely linked. By maintaining open landscapes, pastoralism contributes to the conservation of grasslands with a higher biodiversity index than shrublands or mountain forests. On the other hand, overgrazing, undergrazing, changes in pastoral management, land intensification or abandonment, some forms of tourism, climate change and other factors negatively impact mountain grassland habitats. Actions are needed that consider all three dimensions of sustainability: the environment, economy and society.

This booklet, published by Euromontana and the LIFE Oreka Mendian project, is intended to inspire farmers, livestock breeders and other local actors. It showcases 31 inspiring examples of good practices from 18 European countries divided into 11 thematic sections: biodiversity conservation; climate change mitigation and adaptation; prevention of natural disasters; valuing products and services; economic diversification; innovation through modern technology; coexistence with wildlife; improving working conditions and access to land; transferring knowledge and skills; revaluing pastoral and rural life; and rural–urban linkages. Two activities are described which specifically target the interface between large carnivores and agricultural production:

- The ‘MapLoup²’ dynamic alert and mapping system puts regional predation data at the service of not only political decision-makers but also herders and pastoralists. Integrating multiple datasets and a detection system to identify wolf attacks, its real-time notification system makes it an innovative tool for preventing damage and developing potential solutions.
- Bear-friendly labelling in Slovenia encourages people to consider bears as a marketing tool to promote their products and services in exchange for using bear-friendly practices, thereby supporting the coexistence of humans and bears (*Editor’s note*: for further details, see the article by Kavčič and Majić Skrbinšek in *CDPnews* issue 18).

Other initiatives relevant to the focus of *CDPnews* include virtual fences in the Pyrenees; GPS tracking for extensive livestock; the ‘FindMy’ livestock monitoring system; and the Basque Shepherding School.

² <https://maploup.fr/>

ABSTRACTS OF SCIENTIFIC ARTICLES

DIVERSE PREVENTION MEASURES

ARTIFICIAL EYESPOTS ON CATTLE REDUCE PREDATION BY LARGE CARNIVORES

Cameron Radford,
John Weldon McNutt, Tracey Rogers,
Ben Maslen, Neil Jordan

Communications Biology:
August 2020

[https://doi.org/
10.1038/s42003-020-01156-0](https://doi.org/10.1038/s42003-020-01156-0)

Eyespots evolved independently in many taxa as anti-predator signals. There remains debate regarding whether eyespots function as diversion targets, predator mimics, conspicuous startling signals, deceptive detection, or a combination. Although eye patterns and gaze modify human behaviour, anti-predator eyespots do not occur naturally in contemporary mammals. Here we show that eyespots painted on cattle rumps were associated with reduced attacks by ambush carnivores (lions and leopards). Cattle painted with eyespots were significantly more likely to survive than were cross-marked and unmarked cattle, despite all treatment groups being similarly exposed to predation risk. While higher survival of eyespot-painted cattle supports the detection hypothesis, increased survival of cross-marked cattle suggests an effect of novel and conspicuous marks more generally. To our knowledge, this is the first time eyespots have been shown to deter large mammalian predators. Applying artificial marks to high-value livestock may therefore represent a cost-effective tool to reduce livestock predation.

CO-EXISTING WITH DINGOES: CHALLENGES AND SOLUTIONS TO IMPLEMENTING NON-LETHAL MANAGEMENT

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Australian Zoologist:
August 2020

<https://doi.org/10.7882/AZ.2020.024>

Where wild carnivores such as the Australian dingo interact with and impact on livestock enterprises, lethal control and landscape-scale exclusion are commonly employed. However, interest in alternative non-lethal management approaches has recently increased. This is evidenced by several reviews of non-lethal methods that can be said to be working toward improved coexistence. Nevertheless, and despite centuries of conflict, our non-lethal human-wildlife coexistence toolkit remains remarkably deficient. Innovation and evaluation of non-lethal methods should be prioritised to ensure that the economic, ecological, cultural and intrinsic values of dingoes are retained, while minimising the economic and emotional costs of conflict with livestock producers. In this paper we summarise some of the practical tools that might be effective in relation to the dingo, particularly those yet to be formally investigated, and discuss some of the possible hurdles to implementation. We conclude by suggesting pathways for human-dingo coexistence, and the steps necessary for appropriately evaluating non-lethal tools.

ECOLOGICAL DOCTORS IN MAASAILAND: IDENTIFYING HERDING BEST PRACTICES TO IMPROVE LIVESTOCK MANAGEMENT AND REDUCE CARNIVORE CONFLICT

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Frontiers in Sustainable Food Systems:
August 2020

<https://doi.org/10.3389/fsufs.2020.00118>

Ilkisonko Maasai pastoralists in the Amboseli ecosystem of southern Kenya earn livestock-based livelihoods in a difficult environment exacerbated by a range of challenges. In this setting, many stakeholders, including the Maasai themselves, have come to see traditional extensive pastoralism as essential to long-term social-ecological resilience. This includes the maintenance of communal land tenure, which protects both unfragmented landscapes and the cultural practices necessary to thrive therein. This land tenure system has also been well-documented to support diverse wildlife populations, including large carnivores such as the African lion. Lion Guardians is a conservation organization working on the group ranches of the Amboseli ecosystem to reduce human-lion conflict using culturally appropriate strategies, with a 13-year track record of reductions in lion killing as compared to other conflict mitigation approaches. However, in recent years, they have noted a marked increase in the amount of lost livestock. Lion Guardians' data indicate that untended livestock account for >80% of lion attacks, making them a primary driver of human-lion conflict in the ecosystem. In this paper, we present the results of a community-based qualitative study aimed at identifying the causes of lost livestock, in pursuit of win-win solutions for people and lions. Using an iterative multistage research process, we conducted interviews with more than 120 Maasai community members. Finding general agreement that lost livestock are a problem and that poor herding practices are the primary cause, we next sought to identify both herder and herder-mentor best practices. For this, we focused on the knowledge of elders and "master herders," those identified by their communities as especially adept and responsible herders. In creating these lists, we learned that herding best practices relevant to carnivore-conflict prevention are inseparable from those related to pasture management and livestock productivity and largely inseparable from traditional Maasai culture. This means that good herders, who have been called "ecological doctors," can support the vitality of not only plants and pastures but also lions, ecosystems, and entire human cultures.

AUTOMATED SHEPHERDS: RESPONSES OF CAPTIVE DINGOES TO SOUND AND AN INFLATABLE, MOVING EFFIGY

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Pacific Conservation Biology:
September 2020

<https://doi.org/10.1071/PC20022>

Human-carnivore coexistence can be aided through non-lethal approaches that limit interaction between predators and livestock. Yet, investigations into effective deterrents, particularly in the Australian context with dingoes, are rare. We investigated two potential methods: an acoustic deterrent (series of gunshot noises), and an oversized inflatable human effigy that we dubbed 'Fred-a-Scare'. The devices were deployed to determine whether they would deter captive dingoes ($n = 12$), from accessing food. The acoustic deterrent did not appear to repel the dingoes during the first trial (11/12 accessing the food; the same as control). However, use of the effigy device was associated with a significant reduction in dingoes approaching, with only 25% (9/36) accessing food across all trials. On the third and final trial (which were repeated daily), 42% (5/12) of dingoes accessed food. Used in conjunction with other devices and methods, and at intervals that reduce the risk of habituation, the inflatable effigy could provide a valuable tool for deterring dingoes, and perhaps other species, from particular areas, even where food (or potential prey) is present. This has potential for use in human-dingo conflict hotspots, such as campgrounds and some small livestock enterprises, but field trials are required to evaluate the technique in these contexts and with free-ranging dingoes.

VARIATION AND CONSERVATION IMPLICATIONS OF THE EFFECTIVENESS OF ANTI-BEAR INTERVENTIONS

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Scientific Reports:
September 2020

<https://doi.org/10.1038/s41598-020-72343-6>

Human–bear conflicts triggered by nuisance behaviour in public places and damage to livestock, crops, beehives and trees are among the main threats to bear populations globally. The effectiveness of interventions used to minimize bear-caused damage is insufficiently known and comparative reviews are lacking. We conducted a meta-analysis of 77 cases from 48 publications and used the relative risk of damage to compare the effectiveness of non-invasive interventions, invasive management (translocations) and lethal control (shooting) against bears. We show that the most effective interventions are electric fences (95% confidence interval = 79.2–100% reduction in damage), calving control (100%) and livestock replacement (99.8%), but the latter two approaches were applied in only one case each and need more testing. Deterrents varied widely in their effectiveness (13.7–79.5%) and we recommend applying these during the peak periods of damage infliction. We found shooting (–34.2 to 100%) to have a short-term positive effect with its effectiveness decreasing significantly and linearly over time. We did not find relationships between bear density and intervention effectiveness, possibly due to differences in spatial scales at which they were measured (large scales for densities and local fine scales for effectiveness). We appeal for more effectiveness studies and their scientific publishing in regard to under-represented conflict species and regions.

EVALUATING RED WOLF SCAT TO DETER COYOTE ACCESS TO URBAN PASTURELAND

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Human–Wildlife Interactions:
September 2020

<https://doi.org/10.26077/39c3-4222>

Depredation of domestic livestock by wildlife is a leading source of human–wildlife conflict, often requiring intervention at the local level. Historically, these interventions have resulted in the use of lethal methods to remove the offending animal. In response to increased public opposition to lethal control methods, wildlife managers have sought to identify effective nonlethal biological options to mitigate wildlife depredations. In 2018, we tested the concept of a biological deterrent using red wolf (*Canis rufus*) scat that had historically been spread along fence lines to prevent depredation of lambs (*Ovis aries*) and kid goats (*Capra aegagrus hircus*) at the North Carolina State University College of Veterinary Medicine 32-ha Teaching Animal Unit (TAU), North Carolina, USA. To conduct the study, we deployed paired camera traps at 3 locations where we had previously observed coyotes (*C. latrans*) accessing the TAU. The study was conducted over a 94-day period alternating between no scat and freshly collected scat that was placed every 3 days from adult male red wolves. The study period overlapped lambing and kidding season. In addition to coyotes, the camera traps routinely detected red foxes (*Vulpes vulpes*) and raccoons (*Procyon lotor*). The red wolf scat we placed at the access point did not deter any of the mesocarnivores from entering the pasture.

ADVANCING BEST PRACTICES FOR AVERSION CONDITIONING (HUMANE HAZING) TO MITIGATE HUMAN–COYOTE CONFLICTS IN URBAN AREAS

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Human–Wildlife Interactions:
October 2020

<https://doi.org/10.26077/5cbf-f8f9>

Coyotes (*Canis latrans*) are now recognized as a permanent feature in urban environments across much of North America. Behavioral aversion conditioning, or humane hazing, is increasingly advocated as an effective and compassionate alternative to wildlife management strategies, such as trap and removal. Given a growing public interest in humane hazing, there is a need to synthesize the science regarding methods, outcomes, efficacy, and other relevant considerations to better manage human–coyote conflicts in urban areas. This paper was prepared as an outcome of a workshop held in July 2019 by Coyote Watch Canada (CWC) to synthesize the literature on aversion conditioning. The paper also includes the deployment experiences of members of the CWC Canid Response Team. Herein, we propose best practices to enhance the efficacy of aversion conditioning for the management of urban wildlife, particularly coyotes. We detail recommendations concerning: the importance of consistency, adaptability, humaneness, and clear goals; training and proactive implementation; and the need for a comprehensive wildlife coexistence program. We further detail additional considerations surrounding domestic dogs (*C. lupus familiaris*), public perceptions, and defining behavior and conflict. We hope this synthesis will assist wildlife managers and local governments in identifying and deploying nonlethal human–coyote conflict mitigation strategies that are effective, humane, and community supported.

DOES PUBLIC INFORMATION ABOUT WOLF (*CANIS LUPUS*) MOVEMENTS DECREASE WOLF ATTACKS ON HUNTING DOGS (*C. FAMILIARIS*)?

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Nature Conservation:
October 2020

<https://doi.org/10.3897/natureconservation.42.48314>

The threat that wolves (*Canis lupus*) pose to hunting dogs is one reason why Finnish hunters have negative attitudes towards wolves and one of the potential motivations for the illegal killing of wolves. During 2010–2017, wolves killed an average of 38 dogs (range 24–50) per year in Finland. Most of the attacks (91%) were directed at hunting dogs during the hunting season. To decrease the risk of attacks, the last seven positions (one position per hour) of GPS-collared wolves were accessible to the public with a 5 × 5 km resolution during the hunting seasons (from August 20th to February 28th) of 2013/2014 (from September 2nd onwards), 2015/2016, 2016/2017 and 2017/2018. The link was visited more than 1 million times in 3 of the 4 seasons. Fatal attacks on dogs occurred on 17% of the days during the hunting seasons of our study (n = 760 days). Both the attacks and visits peaked in September–November, which is the primary hunting season in Finland. According to the general linear model, the number of daily visits to the website was higher on days when fatal attacks occurred than on other days. Additionally, season and the number of days passed from the first day of the season were significantly related to the daily visits. Visits were temporally auto-correlated, and the parameter values in the model where the dependent variable was the number of visits on the next day were only slightly different from those in the first model. A two-way interaction between season and attack existed, and the least squares means were significantly different in 2017/2018. The change in daily visits between consecutive days was related only to the number of days from the beginning of the season. We examined whether this kind of service decreased dog attacks by wolves. Wolf attacks were recorded in 32% of the wolf territories, where at least one wolf had been collared (n = 22). However, within the territories without any GPS-collared wolves, the proportion of territories with wolf attack(s) was significantly higher than those elsewhere (50%, n = 48). Although public information decreased the risk of attacks, it did not completely protect dogs from wolf attacks and may in some cases increase the risk of illegally killing wolves. The most remarkable benefit of this kind of service to the conservation of the wolf population might be the message to the public that management is not overlooking hunters' concerns about wolf attacks on their dogs.

PREDATOR CONTROL

POPULATION REDUCTION BY HUNTING HELPS CONTROL HUMAN–WILDLIFE CONFLICTS FOR A SPECIES THAT IS A CONSERVATION SUCCESS STORY

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PLoS ONE:
August 2020

[https://doi.org/10.1371/
journal.pone.0237274](https://doi.org/10.1371/journal.pone.0237274)

Among the world's large Carnivores, American black bears (*Ursus americanus*) are the foremost conservation success story. Populations have been expanding across North America because the species is adaptable and tolerant of living near people, and because management agencies in the U.S. and Canada controlled hunting and other human-sources of mortality. As a result, human-black bear conflicts (damage to property, general nuisance, threat to human safety) have dramatically increased in some areas, making it urgently important to develop and deploy a variety of mitigation tools. Previous studies claimed that legal hunting did not directly reduce conflicts, but they did not evaluate whether hunting controlled conflicts via management of population size. Here, we compared temporal patterns of phoned-in complaints about black bears (total ~63,500) in Minnesota, USA, over 4 decades to corresponding bear population estimates: both doubled during the first decade. We also quantified natural bear foods, and found that large year-to-year fluctuations affected numbers of complaints; however, since this variation is due largely to weather, this factor cannot be managed. Complaints fell sharply when the management agency (1) shifted more responsibility for preventing and mitigating conflicts to the public; and (2) increased hunting pressure to reduce the bear population. This population reduction was more extreme than intended, however, and after hunting pressure was curtailed, population regrowth was slower than anticipated; consequently both population size and complaints remained at relatively low levels statewide for 2 decades (although with local hotspots). These long-term data indicated that conflicts can be kept in tolerable bounds by managing population size through hunting; but due to the bluntness of this instrument and deficiencies and uncertainties in monitoring and manipulating populations, it is wiser to maintain a population at a level where conflicts are socially-acceptable than try to reduce it once it is well beyond that point.

MANAGEMENT AND POLICIES

PROMOTING GRAZING OR REWILDING INITIATIVES AGAINST RURAL EXODUS? THE RETURN OF THE WOLF AND OTHER LARGE CARNIVORES MUST BE CONSIDERED

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Environmental Conservation:
September 2020

[https://doi.org/10.1017/
S0376892920000284](https://doi.org/10.1017/S0376892920000284)

The human abandonment of rural areas facilitates rewilding, which is also supported by European projects and initiatives. Rewilding often implies the return of iconic predators such as the wolf (*Canis lupus*), leading to human-wildlife conflicts. To reverse human depopulation, initiatives such as the European Union's Common Agricultural Policy (CAP) subsidize extensive grazing of areas unsuitable for intensive agriculture. Therefore, rewilding and reversing depopulation initiatives seem to be mutually incompatible, and further insight into controversial aspects of the return of apex predators is needed when considering the reform of the CAP for post-2020. To develop understanding of these different objectives in the context of large carnivore recolonizations, we analysed wolf attacks on livestock in central Spain, where livestock is managed differently between the plateau and the mountains. As with other European regions, this area is undergoing rural abandonment and is subsidized by the CAP. Free-roaming cattle at higher elevations were subject to increased attacks irrespective of the abundance of wild prey. Efforts to subsidize human repopulation of areas experiencing recolonization by large carnivores require consideration of a model of cohabitation with these predators assisted by mitigation and compensation measures. Rewilding could bring alternative sustainable income based on the values brought by the presence of large carnivores and associated ecosystem services.

MISSION IMPOSSIBLE? PURSUING THE CO-EXISTENCE OF VIABLE PREDATOR POPULATIONS AND SUSTAINABLE REINDEER HUSBANDRY IN FINLAND

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Journal of Rural Studies:
August 2020

[https://doi.org/10.1016/
j.jrurstud.2020.08.017](https://doi.org/10.1016/j.jrurstud.2020.08.017)

The recovery and expansion of large carnivores have increased livestock damage in Europe, one example being the reindeer husbandry in northern Fennoscandia. Mostly free-ranging reindeer herds have been exposed to increased predation. We studied connections between the contemporary predator management approach and the consequences of predation in reindeer husbandry within the reindeer management area in Finland. National and supranational management policies aim at biodiversity conservation; predator populations with favourable conservation status play an important role in this. The metapopulation status of large carnivores has been suffering from weak connections between Finland and Scandinavia, but such connections have the potential to be improved due to increased population sizes and changes in carnivore distribution in Finland. Although the sustainability of rural livelihoods is pursued concurrent with the recovering predator populations, the increasing amount of predation-caused reindeer damage has locally compromised the economic sustainability of reindeer husbandry and well-being of herders in Finland. If co-existence is pursued in the present situation, it will require both the development of novel coping strategies by herders to prevent damage, and adaptive management of predator populations. To increase the acceptance of predator protection by local communities, it is crucial to develop more interactive predator management strategies with a concrete role of local stakeholders to address trust issues between herders, policy makers and researchers. Open discussion on the population goals for predators in the reindeer management area as well as the desired role and status of reindeer husbandry is also needed.

PREDATION COSTS AND COMPENSATIONS IN REINDEER HUSBANDRY

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Wildlife Biology:
September 2020

<https://doi.org/10.2981/wlb.00684>

Conflicts often arise when large predators and free-ranging livestock share a common area. Various compensation schemes are used to attempt solving these conflicts, but the costs of predation to suffering stakeholders are often unknown. Semi-domesticated reindeer husbandry and large carnivores form one such system, where conflicts between predator conservation and the traditional livelihood are common. We apply an age- and sex-structured reindeer-lichen model to examine the effects of predation on reindeer management. Based on the previous studies we specify age- and sex-class-specific mortalities due to various predators, and study optimal reindeer husbandry under predation pressure and the costs of predation. We show that the costs of predation highly depend on the age-class-specific killing rates of reindeer by various predator species, but not on interest rate or pasture conditions. Regarding species that are more likely to kill adult reindeer in addition to calves, the total predation costs are clearly higher than the net slaughtering value of the predated animals. The decrease in steady-state yearly net income is highest for the gray wolf and lower for other predator species. Adapting to predation pressure includes increasing the size of the reindeer population in winter and changing the slaughtering age of males towards young adults, thus reducing the importance of calf harvesting. This result contrasts with the previous results from stage-structured models that do not fully include time lags related to long-living ungulate species. The costs of predation appear to be much higher in an ex post system than in a territorial compensation system, as in an ex post system herders have not adapted to the predation pressure and must search for the predated reindeer to gain compensations. Our results suggest that co-existence of a viable gray wolf population and profitable reindeer husbandry in the same area is not possible in most cases.

HUMAN-LARGE CARNIVORES CO-EXISTENCE IN EUROPE – A COMPARATIVE STAKEHOLDER NETWORK ANALYSIS

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Frontiers in Ecology and Evolution:
October 2020

<https://doi.org/10.3389/fevo.2020.00266>

Improving human co-existence with large carnivores (LC) is considered necessary for reaching one of the goals of the EU Council Directive on the conservation of natural habitats and of wild fauna and flora (1992). This study is part of the EU LIFE project EuroLarge-Carnivores, providing a scientific analysis of current stakeholder networks of the project partners (mainly WWF offices), a necessary foundation for “Improving human co-existence with large carnivores in Europe through communication and transboundary cooperation.” We conducted systematic participatory and transdisciplinary primary research in 14 European countries. The research design consists of three phases: stakeholder identification (Phase 1), participatory stakeholder-mapping (Phase 2a), a comparative network analysis (Phase 2b), and an Individual Stakeholders’ Perception Survey (Phase 3). We use the realistic method based on perceptions of the stakeholders involved. Phase 1 identifies 10 relevant Stakeholder Categories and specific agents. Phase 2a provides distinct comprehensive regional stakeholder maps with a special focus on the quality of multilateral relationships and stakeholders which are not yet actively involved in the networks. Phase 2b concludes with a comparative network analysis. The composition, density and quality of stakeholder networks as well as the interconnectivity of the project partners differ substantially. We reveal common denominators across Europe, varying relationships between stakeholder categories, and the potential positive role of foresters and veterinarians, for example. Phase 3 provides complementary insights into the involvement of the 10 Stakeholder Categories and their attitudes to large carnivore management. It also tests the institutional representation of membership in formal organizations. We challenge the perception of distinct stakeholder categories and whether involving institutional representatives in networking activities is sufficient. The results indicate the need for a more comparable implementation of EU regulations at national level, and for regional adaptations of support strategies for distinct stakeholders and networks. Based on current conflict constellations and best practice examples, we conclude with recommendations for strategic stakeholder engagement to: (a) broaden and strengthen the stakeholder networks to (b) improve human-human conflict management in the context of expanding large carnivore populations and their management.

HUMAN DIMENSIONS AND ATTITUDES

LEVELS OF CONFLICT OVER WILDLIFE: UNDERSTANDING AND ADDRESSING THE RIGHT PROBLEM

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Conservation Science and Practice:
August 2020

<https://doi.org/10.1111/csp2.259>

Human-wildlife conflicts are complex and defy simple explanations and solutions. The fields of conflict analysis and peacebuilding offer insights into the intensity, intractability, and possible approaches to addressing different kinds of conflict. Building on these fields, as well as advances in conservation practice, we adapt a framework for human-wildlife conflict that consists of three levels of conflict over wildlife: Level 1 conflicts are disputes over issues such as crop or livestock loss or concerns about safety, yet typically involve relatively high tolerance of the damage inducing species. In level 2 conflicts, in addition to visible impact of wildlife, there is a history of unsatisfactory attempts to address these issues, creating underlying resentment, tensions, and a sense of injustice among at least one of the parties. Level 3 conflicts are deep rooted and become intertwined with the identities of the parties and community involved, and extend to broader tensions over social identities and clashing values and beliefs. Such conflicts require mediated reconciliation dialogues and conflict transformation approaches. A structured understanding how to address a conflict before it escalates to a deeper level is fundamental for managing conservation challenges as complex and dynamic as conflicts over wildlife.

UNDERSTANDING DRIVERS OF HUMAN TOLERANCE TO GRAY WOLVES AND BROWN BEARS AS A STRATEGY TO IMPROVE LANDHOLDER-CARNIVORE COEXISTENCE

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Conservation Science and Practice:
September 2020

<https://doi.org/10.1111/csp2.265>

Despite recent recovery of large carnivores throughout Europe such as the brown bear (*Ursus arctos*) and the gray wolf (*Canis lupus*), some of their populations are still threatened and their viability depends on human tolerance to share mixed landscapes. We investigated the drivers of landholders' tolerance in Abruzzo (Italy), a region with a long history of cohabitation, by applying the Wildlife Tolerance Model (WTM) (Kansky et al., 2016, Biological Conservation, 201, 137–145). Using structural equation modeling we assessed relationships between WTM variables. This framework hypothesizes that exposure to a species and experiences with a species drive perceptions of benefits and costs, and ultimately tolerance. We then sought to understand similarities and differences in tolerance drivers between the two species and across two areas that differed in the duration of human–carnivore cohabitation. Results showed both similarities and differences in drivers between species and areas, resulting in seven management proposals to foster tolerance. Increasing intangible benefits and positive experiences were two strategies that were similar for both species and areas, while five strategies differed across species and areas. Our methodological approach can be applied in other landscapes with other species to determine the extent to which multispecies management across landscapes is possible.

UNDERSTANDING PEOPLE'S RESPONSES TOWARD PREDATORS IN THE INDIAN HIMALAYA

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Animal Conservation:
October 2020

<https://doi.org/10.1111/acv.12647>

Research on human–wildlife interactions has largely focused on the magnitude of wildlife caused damage, and the patterns and correlates of human attitudes and behaviors. We assessed the role of five pathways through which various correlates potentially influence human responses toward wild animals, namely, value orientation, social interactions (i.e. social cohesion and support), dependence on resources such as agriculture and livestock, risk perception and nature of interaction with the wild animal. We specifically evaluated their influence on people's responses toward two large carnivores, the snow leopard *Panthera uncia* and the wolf *Canis lupus* in an agropastoral landscape in the Indian Trans Himalaya. We found that the nature of the interaction (location, impact and length of time since an encounter or depredation event), and risk perception (cognitive and affective evaluation of the threat posed by the animal) had a significant influence on attitudes and behaviors toward the snow leopard. For wolves, risk perception and social interactions (the relationship of people with local institutions and inter community dynamics) were significant. Our findings underscore the importance of interventions that reduce people's threat perceptions from carnivores, improve their connection with nature and strengthen the conservation capacity of local institutions especially in the context of wolves.

MULTIPLE FACTORS INFLUENCE LOCAL PERCEPTIONS OF SNOW LEOPARDS AND HIMALAYAN WOLVES IN THE CENTRAL HIMALAYAS, NEPAL

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Per Wegge

PeerJ:
October 2020

<https://peerj.com/articles/10108/>

An understanding of local perceptions of carnivores is important for conservation and management planning. In the central Himalayas, Nepal, we interviewed 428 individuals from 85 settlements using a semi-structured questionnaire to quantitatively assess local perceptions and tolerance of snow leopards and wolves. We used generalized linear mixed effect models to assess influential factors, and found that tolerance of snow leopards was much higher than of wolves. Interestingly, having experienced livestock losses had a minor impact on perceptions of the carnivores. Occupation of the respondents had a strong effect on perceptions of snow leopards but not of wolves. Literacy and age had weak impacts on snow leopard perceptions, but the interaction among these terms showed a marked effect, that is, being illiterate had a more marked negative impact among older respondents. Among the various factors affecting perceptions of wolves, numbers of livestock owned and gender were the most important predictors. People with larger livestock herds were more negative towards wolves. In terms of gender, males were more positive to wolves than females, but no such pattern was observed for snow leopards. People's negative perceptions towards wolves were also related to the remoteness of the villages. Factors affecting people's perceptions could not be generalized for the two species, and thus need to be addressed separately. We suggest future conservation projects and programs should prioritize remote settlements.

FACTORS INFLUENCING DAMAGE AND CONFLICTS

RELATIVE INFLUENCE OF WILD PREY AND LIVESTOCK ABUNDANCE ON CARNIVORE-CAUSED LIVESTOCK PREDATION

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Ecology and Evolution:
September 2020

<https://doi.org/10.1002/ece3.6815>

Conservation conflict over livestock depredation is one of the key drivers of large mammalian carnivore declines worldwide. Mitigating this conflict requires strategies informed by reliable knowledge of factors influencing livestock depredation. Wild prey and livestock abundance are critical factors influencing the extent of livestock depredation. We compared whether the extent of livestock predation by snow leopards *Panthera uncia* differed in relation to densities of wild prey, livestock, and snow leopards at two sites in Shey Phoksundo National Park, Nepal. We used camera trap based spatially explicit capture-recapture models to estimate snow leopard density; double observer surveys to estimate the density of their main prey species, the blue sheep *Pseudois nayaur*; and interview based household surveys to estimate livestock population and number of livestock killed by snow leopards. The proportion of livestock lost per household was seven times higher in Upper Dolpa, the site which had higher snow leopard density (2.51 snow leopards per 100 km²) and higher livestock density (17.21 livestock per km²) compared to Lower Dolpa (1.21 snow leopards per 100 km²; 4.5 livestock per km²). The wild prey density was similar across the two sites (1.81 and 1.57 animals per km² in Upper and Lower Dolpa, respectively). Our results suggest that livestock depredation level may largely be determined by the abundances of the snow leopards and livestock and predation levels on livestock can vary even at similar levels of wild prey density. In large parts of the snow leopard range, livestock production is indispensable to local livelihoods and livestock population is expected to increase to meet the demand of cashmere. Hence, we recommend that any efforts to increase livestock populations or conservation initiatives aimed at recovering or increasing snow leopard population be accompanied by better herding practices (e.g., predator proof corrals) to protect livestock from snow leopard.

IS THE BANANA RIPE? ANDEAN BEAR-HUMAN CONFLICT IN A PROTECTED AREA OF COLOMBIA

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Human–Wildlife Interactions:
September 2020

<https://doi.org/10.26077/6e5e-089e>

The Andean bear (*Tremarctos ornatus*; bear) is endemic to the tropical Andes Mountains of South America. Previous assessments predict that bear populations will decline by > 30% in the next 30 years. The species may face the greatest threats within its historical distribution in Colombia where rapid agricultural expansion into natural habitats is increasing human–bear conflicts. Between April 2017 and March 2018, we studied bear feeding behavior on plantain (*Musa sapientum*) and banana (*M. paradisiaca*) crops within the Barbas-Bremen protected area in the central mountain range of Colombia to describe the magnitude of crop damage, economic losses, and spatial distribution of feeding sites where human–bear conflicts would most likely occur. We also identified all affected farmers and used structured interviews to determine their attitudes toward the bears and their conservation. We recorded 237 damaged plants and identified 57 bear feeding area locations on 9 farms. Bear damage consisted of bites to the trunk of each plant and consumption of the centers. The damage polygon covered 198 ha, and it was located in the northwestern portion of the protected area. Although we estimated that the magnitude of crop consumption by bears and social and economic dimensions of damage caused by the species in Colombia. Our research also provides insights on how human–bear conflicts may be mitigated in the study area.

DO URBAN RED FOXES ATTACK PEOPLE? AN EXPLORATORY STUDY AND REVIEW OF INCIDENTS IN BRITAIN

Bethany Bridge, Stephen Harris

Human–Wildlife Interactions:
September 2020

<https://doi.org/10.26077/d6f5-f6f3>

Human–wildlife interactions are believed to be increasing worldwide, and a number of studies have analyzed the risks posed by larger carnivores. However, people can also perceive smaller species of carnivores as threatening, particularly in urban areas. Red foxes (*Vulpes vulpes*) started to colonize British cities in the 1930s, and there is growing public concern about foxes biting people, particularly babies. These events are generally described in the press as attacks and generate intense media coverage and speculation that foxes view human infants as potential prey. Because foxes rely primarily on auditory cues for hunting, we conducted acoustic playback experiments in the gardens of 15 residential houses in northwest Bristol, United Kingdom, in December 2015 and 11 gardens from May to June 2016 to determine whether urban foxes were attracted to infant distress calls (cries). Foxes were not more likely to be attracted to infant cries or laughs than silence, although a minority of foxes cautiously approached and contacted the source of both types of infant vocalization. Their behavior appeared to be investigative rather than aggressive or predatory. Our review of the incidents reported in the British media showed that most people were bitten or scratched while sleeping, and adults were more likely to be bitten than children. The nature of the interactions and the wounds inflicted suggest that the foxes were using their mouth or forefeet to investigate an unusual object. Most incidents occurred inside people's homes, even though it is unusual for foxes to enter houses. The data suggested that incidents where people were bitten were chance events, possibly involving a particularly bold fox. To minimize the risk to the public, more quantitative data are required on the age, social status, and health of the foxes that enter houses and those that bite people.

RESOURCE USE BY AMERICAN BLACK BEARS IN SUBURBIA: A LANDHOLDER STEP SELECTION APPROACH

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Human–Wildlife Interactions:
September 2020

<https://doi.org/10.26077/2af3-235d>

Range expansion of American black bears (*Ursus americanus*; bear) and residential development have increased the bear presence in suburbia. Suburban landscapes exhibiting patchworks of variable-sized parcels and habitats and owned by landowners with diverse values can create large areas of suitable habitats with limited public access. These landscapes may limit the effectiveness of hunting as a traditional bear population management tool. Managers require better information regarding landowner attitudes about hunting before implementing harvest regulations intended to mitigate conflicts in suburban areas. To address this need, in 2013, we surveyed landowners to identify properties that allowed bear hunting in 3 suburban areas of Pennsylvania, USA where bear sightings or human–bear conflicts have increased. We then used location data obtained for 29 bears equipped with global positioning system transmitters from 2010 to 2012 to model their resource selection in the study area. We assessed the influence of hunting access, housing density, land cover, and topographic variables on radio-marked black bears monitored 10 days before, during, and after the bear hunting season. We found that resource selection of radio-marked bears was similar for all 3 periods and bears selected for forested land in all 3 seasons and herbaceous cover in the pre-hunting and hunting periods. Resource selection by bears was not influenced by hunting access in the pre-hunting and hunting periods. For the post-hunting period, lands closed to hunting had support as the second-best model. All of the radio-marked bears in our study were vulnerable to harvest. However, they did not change resource selection during the hunting season, nor did they avoid areas open to hunting. Integrating human dimension data with bear habitat use studies, especially in suburban landscapes, has the potential to address bear space use and population management needs often overlooked by traditional research designs.

DISTRIBUTION AND ACTIVITY PATTERNS OF LARGE CARNIVORES AND THEIR IMPLICATIONS FOR HUMAN-CARNIVORE CONFLICT MANAGEMENT IN NAMIBIA

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Human–Wildlife Interactions:
September 2020

<https://doi.org/10.26077/658e-e8a8>

Human–wildlife conflicts (HWCs) are increasing globally and contributing to the decline of wildlife species. In sub-Saharan African countries such as Namibia, most of the suitable land has been or is currently being converted to crop and livestock production to support income or subsistence agriculture. These changes in land use often incur increased levels of HWCs because of crop and livestock depredation by native species. To quantify livestock predation risks posed by carnivores in Namibia, we deployed 30 trail cameras on a 6,500-ha farm in the Khomas region of Namibia from May to July 2018. We developed occupancy models to make inferences about the factors influencing presence and temporal activity patterns of 2 carnivore species. We found that livestock were most at risk from predation by black-backed jackals (*Canis mesomelas*) at night in agricultural areas and from brown hyenas (*Parahyaena brunnea*) at night in riparian habitats. Our results suggest that farmers can reduce HWC risks by implementing animal husbandry practices to include protecting livestock at night using methods such as nighttime corrals and livestock guarding dogs (*C. lupus familiaris*), or herders. Increasing livestock producer access to funding (i.e., individual donations or governmental agencies) to implement improved animal husbandry practices could reduce HWCs.

SEASONALITY, LOCAL RESOURCES AND ENVIRONMENTAL FACTORS INFLUENCE PATTERNS OF BROWN BEAR DAMAGES: IMPLICATIONS FOR MANAGEMENT

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Journal of Zoology:
October 2020

<https://doi.org/10.1111/jzo.12839>

Coexistence of humans and large carnivores is a major challenge for conservation and management, especially in human modified landscapes. Ongoing recovery of some large carnivore populations is good conservation news, but it also brings about increased levels of conflict with humans. Compensation payments and preventive measures are used worldwide as part of conservation programmes with the aim of reducing such conflicts and improving public attitude towards large carnivores. However, understanding the drivers triggering conflicts is a conservation priority, which helps prevent and reduce damages. Here, we have analysed the spatio temporal patterns of brown bear *Ursus arctos* damages to apiaries, crops and livestock in the two small, isolated and endangered bear populations in northern Spain. The increase in the number of damages varied in parallel with the increase in bear numbers, which is probably a primary cause determining the occurrence on damages. Damages also varied among years, seasons and bear populations and seemed to mainly depend on the local availability of natural food items, weather conditions and the availability of apiaries and livestock. Fluctuating availability of food items may explain the frequency of conflicts, which is yet another call to apply preventive measures in carnivore damage to human property in seasons and years when natural food availability is lower than usual. Understanding and preventing damage is in turn essential to mitigate conflicts where humans and large carnivores share the same landscape.

PUMA-LIVESTOCK CONFLICTS IN THE AMERICAS: A REVIEW OF THE EVIDENCE

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Mammal Review:
October 2020

<https://doi.org/10.1111/mam.12224>

1. Loss of livestock is one of the greatest sources of conflict between humans and large felids worldwide. The puma *Puma concolor* is the most widespread apex predator in the Americas, and conflicts between this felid and humans are common throughout its geographical range. In response to predation on livestock, humans persecute and hunt pumas.

2. We identified the main environmental and anthropogenic variables that define puma-livestock conflict areas in the Americas as 12 conflict predictor variables, and explored the techniques proposed to mitigate conflicts between the puma and livestock producers.

3. We conducted a systematic search and subsequent review of the scientific literature and found 92 publications on puma-livestock conflicts. Through single variable analyses and generalised linear models (GLM), we identified which of the 12 conflict predictors were most predictive of the occurrence of predation.

4. The single variable analyses showed that high livestock density (goat, sheep, and cattle), low latitudes, low habitat steepness, low co predator richness, high distance to habitat (shrub), and high distance to roads characterised areas with conflict. The binomial GLM indicated that areas with conflicts were primarily located in the temperate southern hemisphere and characterised by densities of livestock. The most frequently cited conflict mitigation techniques were 'improving livestock management', 'predator control', and the 'use of fencing'.

5. Although our knowledge about the puma and its relationships with human communities has improved, there are wide geographical gaps, and many facets of puma-livestock conflicts are still little understood. Scientists should work with local stakeholders to generate reliable information regarding the ecological and societal consequences of puma-livestock conflicts, and to develop conflict mitigation techniques that could facilitate the coexistence of pumas and humans..

LIVESTOCK GUARDING DOGS

MITIGATING HUMAN CONFLICTS WITH LIVESTOCK GUARDIAN DOGS IN EXTENSIVE SHEEP GRAZING SYSTEMS

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Rangeland Ecology & Management:
September 2020

[https://doi.org/10.1016/
j.rama.2020.04.009](https://doi.org/10.1016/j.rama.2020.04.009)

Livestock guardian dogs (LGDs) are an effective tool for limiting livestock depredation by wild and feral predators. Unfortunately, LGDs have bitten hikers, joggers, and mountain bikers. Strategies are needed to mitigate LGD-human conflicts, especially in landscapes inhabited by large, aggressive predators where the threat of livestock depredation is greatest. One recommendation is to keep groups of sheep protected by LGDs at least 400 m from high-use recreational sites, but few data exist to support or refute this strategy. We monitored sheep and LGDs with Global Positioning System collars at seven ranches during a 3-yr period to evaluate how far, and under what circumstances, LGDs roamed from their sheep. One band of sheep (i.e., flock) was studied per ranch, with a typical band composed of 600–800 mature ewes with 900–1 200 lambs. Sheep were herded in extensive grazing systems within their traditional summer or fall grazing areas in foothill and mountain landscapes of southwestern and west-central Montana. Three bands of sheep inhabited landscapes with a greater threat of depredation by gray wolves and grizzly bears, and 4 bands of sheep inhabited landscapes where the threat of depredation was mostly from coyotes. The mean and median LGD-sheep distance across all LGDs and time periods was 164 m and 86 m, respectively. LGDs roamed farther from their sheep during nighttime and crepuscular periods than during daytime; farther when the moon was more fully illuminated; farther during fall than summer; and farther in landscapes without gray wolves and grizzly bears. Female LGDs roamed farther than males. Juvenile LGDs did not roam farther than adult LGDs. Overall, our results from extensive domestic sheep grazing systems suggest that keeping range sheep 400 m away from recreation sites and rural residences will likely prevent > 90% of agonistic LGD encounters with humans.

Videos

Fence building tutorial

LIFE EuroLargeCarnivores, February 2021
(in German with English subtitles)

This tutorial provides step-by-step instructions and a list of all required materials and tools for livestock owners to build a permanent electric fence. Wolf expert Peter Schütte and his team of volunteers demonstrate how to set up a permanent wolf-repellent electric fence to protect a herd of sheep in Lower Saxony, Germany.



UPCOMING EVENTS

XIII European Vertebrate Pest Management Conference

7 – 10th September 2021 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 current concerns about COVID-19, the 13th meeting will be an online conference.

For details see: www.13evpmc.com

27th International Conference on Bear Research and Management

14 – 16th and 21st – 23rd September 2021 in Kalispell, Montana, USA

IBA conferences showcase recent developments in research, management and conservation of all bear species worldwide. The 27th meeting was postponed from September 2020 due to the COVID-19 pandemic and will be held as an entirely virtual event.

For details see: <https://iba2020mt.com/>

Wolves Across Borders

8 – 12th May 2022 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. For details see:

<https://www.wolvesacrossborders.com/>

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The next issue of *CDPnews* is due out in autumn 2021

