Carnivore Damage Prevention
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Issue 25 AUTUMN 2022

SPECIAL ISSUE FOCUSED ON CATTLE

APPROACHES TO COEXISTENCE OF CATTLE GRAZING AND LARGE CARNIVORES IN AFRICA, EURASIA AND AMERICA

RESEARCH ON THE COMPATIBILITY OF FREE-RANGING CATTLE AND BEARS IN SCANDINAVIA

NON-ELECTRIC FENCING TO PROTECT CATTLE FROM WOLVES

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EDITORIAL

In this issue of *CDPnews* we take a closer look at the impacts of predators on cattle across three continents. A complex picture emerges of diverse predators, farming practices and management strategies aimed at addressing the challenges of raising cattle in areas with large carnivores.

Sheep usually top tables of large carnivore damage statistics. Other types of livestock are often overshadowed by the ancient opposition between two highly symbolic species: the "evil" wolf and the "innocent" lamb. However, in many countries and regions, cattle play a dominant role in milk and meat production. Dairy cows characterise Alpine culture and associated agricultural products as well as nomadic cultures in many African countries. Cattle are often an expression of wealth, professional pride and vitality. Such symbolism and reverence are deeply embedded in many agrarian traditions worldwide, from ancient sacrificial cults to Hindu worship of cows to Spanish bullfights. When such a significant and valuable animal falls prey to large carnivores, both the monetary value of the damage and its symbolic meaning are greatly magnified.

Besides illustrating how the situation with cattle differs from that of sheep or goats, the contents of this issue provide examples of ways in which the impacts of predation can be mitigated. Research in Sweden (page 11) has found that it is possible to free-graze cattle in close proximity to large carnivores without losing productivity. Analyses from Germany (page 26) and Portugal (page 36) show that appropriate fence designs can protect cattle from wolves effectively while ranchers in the Americas are implementing various measures to cope with multiple predator species with excellent results (page 20). In Africa, too, non-lethal approaches are proving their worth in enabling coexistence of cattle breeding with some impressively large carnivores (page 20). Further practical examples of addressing conflicts successfully are included in our Videos section (page 49).

Cattle behaviour and production systems differ from those of small stock and often damage prevention measures can only be implemented after costly changes in pasture management. The choice of tools and techniques must be locally applicable. For example, fences may reach their limits in mountain pastures. In the Alps, damage to cattle by wolves has increased in recent years, fuelling calls for the regulation of large carnivore populations. Preventive measures should be carefully coordinated with population monitoring and management so that both carnivore conservation and livestock protection are taken into account.

This is the last issue of our current funding cycle and we thank WWF Switzerland for supporting its publication. We will launch the next series of issues in 2023 with some exciting innovations, inspired by the results of our reader survey (page 46), that will help us to provide you with even more useful and interesting content in the years to come!

The Editors

Feature

IMPROVING LIVESTOCK HUSBANDRY BENEFITS LIVELIHOODS AND CONSERVATION

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1. Introduction

Lion killing resulting from depredation of livestock is one of the chief causes of the drastic and ongoing decline in lion populations across Africa (Ogada et al., 2003). In the past century, the population and geographic range of the African lion (*Panthera leo*) has declined by more than 75 % (Schuette et al., 2013). At the same time, the loss of livestock to large carnivores threatens the tenuous livelihoods of pastoralists such as the Maasai of the Amboseli ecosystem of southern Kenya. Despite this conflict, the Amboseli ecosystem is widely regarded as an exemplar of livestock-carnivore coexistence, with Maasai herders tending thousands of grazing livestock amidst a suite of large carnivores.

Lion Guardians is a conservation organisation, founded in 2006, that supports culturally appropriate long-term solutions for people and lions to coexist in pastoral areas of East Africa. Since 2007, they have been working in the Amboseli ecosystem, where they employ a team of more than 50 Maasai *Ilmurran:* traditional warriors tasked with defending their communities, including from lions that kill livestock. Now, instead of killing lions, these lion guardians work to mitigate lion conflict using a diverse toolbox. This includes monitoring and reporting to communities on lion locations, intervening in potential lion hunts, identifying problem lions and otherwise promoting tolerance and coexistence (Jablonski et al., 2020).

By working with communities to understand their challenges and support holistic solutions, Lion Guardians has established a track record of significant reductions in lion killing, along with attendant increases in lion populations, compared to other conflict mitigation strategies (Dolrenry et al., 2016; Hazzah et al., 2014). However, their work is challenged by lost livestock: temporarily untended animals that are highly likely to be attacked by carnivores, often leading to retaliation. Lion Guardians staff estimate that lost livestock account for > 80 % of lion attacks on livestock in the Amboseli ecosystem.

Recognising that lost livestock present a major challenge to lion conservation, and believing their

(All photos: Philip Briggs)

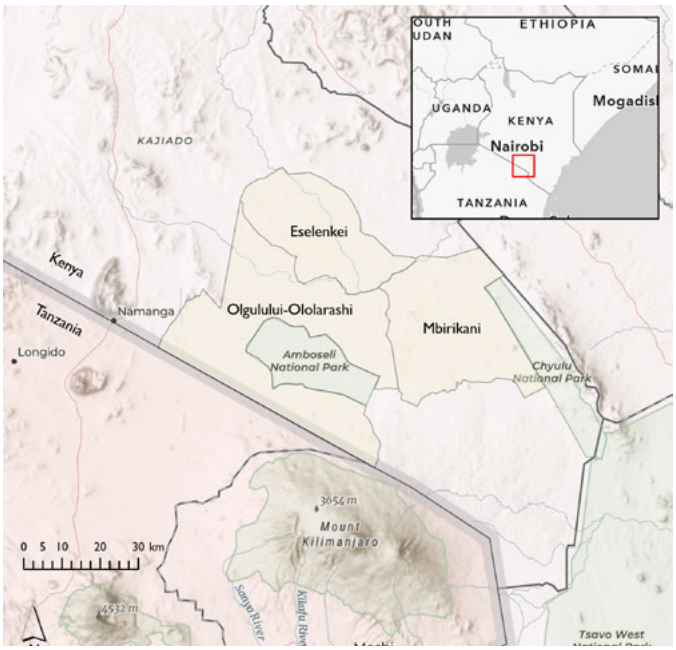

Fig. 1 Location of the study area, including the three Maasai group ranches

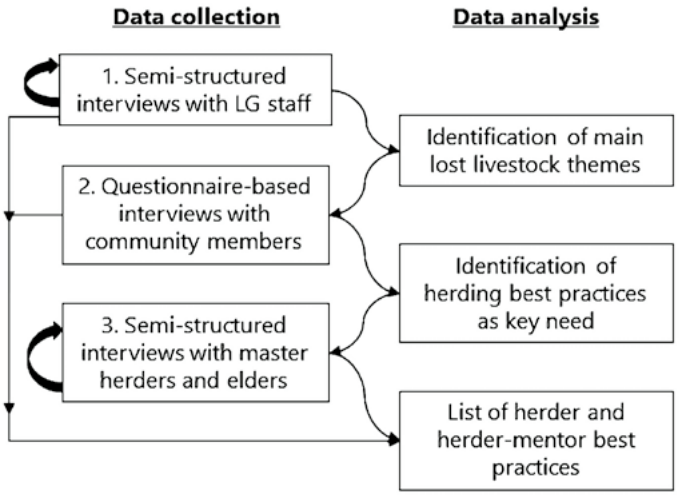

Fig. 2 The iterative data collection and analysis process, wherein each stage built upon what came before. Stages one and three were internally iterative, such that the conversation evolved as we proceeded. The data analysis column shows the key finding from each stage but is not comprehensive. All data collection stages informed the generation of herder and herder-mentor best practice lists.

numbers to be increasing, in 2017 Lion Guardians embarked on a project to increase understanding of the causes of lost livestock in the Amboseli ecosystem. They understood that they had to start with the local Maasai community and focus on improving livelihood outcomes if they were to achieve their goal of identifying win-win solutions for both pastoralists and lions. Ultimately, Lion Guardians believes that secure livestock-based livelihoods, supported by effective husbandry practices, are the best way to ensure the long-term viability of lion populations outside protected areas – a necessity if the species is to survive (Dolrenry et al., 2014; Ogada et al., 2003).

In this article, we summarise the outcomes of this project (for full details, see Jablonski et al., 2020) and describe the Master Herder programme that Lion Guardians launched in 2020 as a result of the findings. Though the work of cultural revitalisation fundamental to Master Herder is painstaking, and largely driven by the community, this nascent

programme nonetheless provides insights for carnivore conservation, community-based natural resource management and pastoral livestock production.

2. Study areas

The project was implemented within group ranches of the Amboseli ecosystem, which are pastoral lands collectively owned and managed by the Maasai in a landscape of semi-arid grasslands and savannas (Fig. 1). We focused work on three group ranches: Eselenkei (748 km^2), Mbirikani (1,229 km^2) and Olgulului-Ololarashi (1,427 km^2). Lion Guardians has had a long-term presence on each of these group ranches, with active guardian territories covering most of the area. Maasai herders on these ranches manage a total of more than 100,000 cattle, sheep, and goats, guiding the animals each day to forage and water while protecting them from lions, spotted hyenas (*Crocuta crocuta*), leopards (*Panthera pardus*), cheetahs (*Acinonyx jubatus*) and other carnivores. People and livestock also share the landscape with numerous wild herbivores, including zebra (*Equus quagga*), wildebeest (*Connochaetes taurnius*), Thompson's gazelle (*Eudorcas thomsonii*), Grant's gazelle (*Nanger granti*), giraffe (*Giraffa camelopardalis*) and elephant (*Loxodonta africana*). The presence of both diverse and abundant wildlife alongside significant livestock and human populations makes this ecosystem one of the world's great examples of coexistence between people and wildlife.

3. Methods

We studied lost livestock in the Amboseli ecosystem using constructivist qualitative methods within an iterative, interactive and pragmatic framework. We collected data in three different stages (Fig. 2), identifying different questions and different participants as our knowledge of the phenomenon advanced and we reached thematic saturation (Denzin and Lincoln, 2018; Saldaña, 2011). We also worked to adhere to guidelines for responsible research practice in indigenous communities (David-Chavez and Gavin, 2018), including Maasai staff and community members in every step of the process. The research was conducted with an exemption under Colorado State University IRB Protocol 204-18H, granted due to measures that guaranteed the anonymity of participants.

In stage one of data collection, we conducted semi-structured interviews with 21 Lion Guardians staff members, including 15 field-based lion guardians. The goal of this stage was to build a baseline level of understanding of lost livestock and their drivers. All but three participants in this stage were local Maasai. For stage two of data collection, we used a flexible, questionnaire-based survey to interview a diverse set of 80 Maasai community members, traveling across the three group ranches. In stage three, using our findings from the first two stages, we focused in on lengthy semi-structured interviews with 12 community-identified master herders from across the area. All data were collected in 2017–2019.

3. Results & Discussion

In stage one interviews with Lion Guardians staff we identified two core themes related to lost livestock. The first of these was declining herder skill and dedication, which many participants noted was the main driver of lost livestock issues on the group ranches. The key lesson of this theme was that increasing elementary education among Maasai children, along with more diversified adult livelihoods, had led to a lack of trained herders in the area. The second core theme that emerged was a decreased capacity to search for lost livestock. Because at least some lost livestock are inevitable, the search for lost livestock has long been a part of Maasai community life. However, our participants noted that both young warriors and older adults were now less able to assist in searches, for a variety of reasons.

With stage two focusing on specific questions related to these two core themes, we were able to increase our understanding of broader community perceptions of these phenomena. We found that 75% of participants felt that lost livestock was a problem in their communities and 53% felt that it was increasing in frequency. Only 16% of respondents said that lost livestock was neither a problem nor increasing. When it came to identifying causes of lost livestock, herder-related causes stood out, with 55% of participants citing herder skill and dedication and 31% saying that lack of skilled herders was an issue (multiple responses were possible). Others identified more

concrete concerns such as dense vegetation and widely dispersed forage, which can exacerbate herder-related challenges. Responses were mixed regarding the search for lost livestock, with "unsure" being the most common response to whether the capacity to search had changed.

Integrating the results of the first two stages of data collection, we decided to focus in on herding skills. Our conversations had revealed that an increase in school attendance had created a gap in the transmission of traditional herding knowledge and the enthusiasm that attends that transmission. We could see that there was a living generation of elders who had learned to herd through a long apprenticeship with older generations, but that their knowledge was in danger of dying with them as the youth showed little interest in it. We thus decided during stage three to speak with master herders, both elders and young adults, who had been identified by their communities during the first two stages as being particularly knowledgeable, adept and dedicated.

Because we had learned that herder mentorship is an essential component of effective herding, we identified both herder and herder-mentor best practices (Table 1). It is important to acknowledge that some are somewhat superficial and that there are surely practices that are difficult to describe because we sought to distil complex, culturally-embedded knowledge. Nevertheless, this set of practices captures the knowledge held by our master herders to the best of our abilities. If we could ensure that all herders in the Amboseli ecosystem were using these practices, we are confident that lion-livestock conflict would be greatly reduced and that livestock and pastures would be more productive.

Table 1 Herder and herder-mentor best practices.

Herder best practices	Herder-mentor best practices
Value and know your herd • Know the matrilineal houses • Focus on markings/colours • Track breeding status and health • Know your leaders and laggards • Use bells on indicator animals	**The right herder for the right herd** • No more than 200 cows per good herder (use assistants) • Strategic splitting/mixing of herds • Place bells on indicator animals • Give herders a phone • Paid herders rewarded with livestock for good performance
Have a morning routine • Awaken early • Examine the herd – are all animals present and healthy? • Update potential laggards • Discuss the daily route	**Mentorship** • Start young to inspire passion for livestock • Assign a mentor for each herder • Guide young herders through learning with different animals and ages • Train on bush skills and predator awareness • Spend the time needed to make a good herder

Keep the herd close (physically and mentally)
• Carry a stick and be active
• Position strategically
  • Lead through dense brush
  • Push away from water from the back
  • Be at side/middle in open areas
  • Always stay in sight of herd
• Keep herd as close together as pasture allows
• Whistle all day
• Shout in dense areas
• Count/identify animals regularly, especially when arriving at pasture
• Be predator aware
• Report lost livestock immediately
	Have a morning routine
	• Discuss and observe herd health
	• Discuss the grazing route
	• Trust the herder
	• Walk out with herder, observe the herd while walking

Return early with full bellies • Count/identify carefully • Monitor laggards	**Have an evening routine** • Meet herders as they come in, walk in with herd • Count/identify livestock • Check for full bellies • Review the day, discuss pasture condition
Have an evening routine • Review the day – be honest • Report pasture conditions • Count the herd and observe health	**Respect grazing committees and restricted areas** • Follow rules • Report violations • Provide input to leaders

3. Master Herder programme

In 2020, Lion Guardians launched a Master Herder programme aimed at promoting these best practices among herders and herder-mentors in the group ranches of the Amboseli ecosystem. The overall aim is to have a roster of master herders available across the landscape, with some working continuously and others called on in times of greater need.

A master herder's daily duties include a morning routine of traveling to check in with local livestock herders at their homes to identify any pressing needs, then significant time traveling to visit herders in the field and provide advice, training and mentoring. The master herders pay particular attention to 'hotspots': areas where livestock congregate or are otherwise easily lost, such as watering areas. They also focus on known weaker herders, assisting them in learning their trade and navigating difficult situations. This field work requires a strong knowledge of local herds and herders – a difficult task in an extensive landscape.

In the evening, master herders do rounds to check in with local herds and ensure that all livestock have made it home safely. If animals are lost, the master herder will assist in finding them. Other tasks of the master herders include informing herders about the location of lions (learned from their lion guardian colleagues), especially those known to target livestock, and aiming to be first responders to incidences of lion attacks on livestock, working hand-in-hand with the local lion guardian to intervene to prevent retaliation.

Over the course of two years of implementation, the Master Herder programme has grown to utilise master herders as 'jacks-of-all-trades' capable of addressing programmatic needs as they emerge in high-conflict areas. Currently, ten master herders are employed working in the Amboseli ecosystem. To assess the effect of master herders, Lion Guardians has developed a 'tension rating' to analyse the impact of master herders, using the following ratings:

1. depredations occur but there is high community tolerance, gaps between depredations, and no immediate threats to lions;
2. depredations of medium to high frequency, high threats to lions, active hunts;
3. high frequency depredations, low community tolerance, high tension (translocations required, threats, hot hunts, political challenges).

Though assessment of such complex phenomena is difficult and impacts are likely to occur over a long period of time, Lion Guardians has already recorded a slight overall decline in tension (-0.03 rating points) in areas covered by master herders, albeit with a limited number of data points.

3. Conclusion

In this project, we sought to identify the causes of, and potential solutions to, lost livestock, which is a major driver of carnivore conflict in the Amboseli ecosystem. Working in the local pastoralist communities to understand this phenomenon, we learned that the key factor leading to lost livestock is the skill and dedication of livestock herders, which appeared to be declining as livelihoods and lifestyles changed.

Ultimately, we learned that the education of herders is an essential component of traditional Maasai culture and that effective herding requires a long-term apprenticeship. As herders progress from managing young sheep and goats to large herds of cattle, they learn much more than herding skills. Through a lifelong conversation with their elders and their environment, they learn the proper place of the herd, and herder, in the world. They also gain a deep appreciation for Maasai culture. The loss of herding skills therefore threatens much more than livelihoods.

The practices that constitute effective herding simultaneously ensure that livestock find quality forage, that pastures are properly managed and that threatening encounters with potential predators are limited. By employing master herders to promote a best practice herding culture on the group ranches of the Amboseli ecosystem, Lion Guardians is therefore supporting social, economic and ecological resilience. They are also providing a practical example of Despret and Meuret's (2016, p. 35) contention that, "there are some places on Earth where the cosmos passes through the mouths of sheep" or, in this case, cattle.

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News Roundup

In collaboration with the Food and Agriculture Organisation of the United Nations (FAO)[1], the IUCN SSC Human-Wildlife Conflict & Coexistence Specialist Group[2] (formerly the Human-Wildlife Conflict Task Force) is publishing a series of case studies to illustrate key principles of human-wildlife conflict management and coexistence. They emphasise the processes of understanding, planning and implementing action to address diverse scenarios. The first examples were released on World Wildlife Day in March 2022 and focus on key aspects of community engagement. So far, the following studies are available:

- Co-developing a community camera trapping programme to deliver benefits of living with wildlife
- Reducing human-carnivore conflict through participatory research
- Coexistence with large cats: experience from a citizen science project
- Developing and evaluating a beehive fence deterrent through stakeholder involvement
- Fostering coexistence through a poverty reduction approach
- Building communities' capacities to coexist with wildlife

By highlighting good processes, the lessons learnt are applicable to a wide range of situations, in different regions, involving different species and having different contexts. Further case studies are being developed to highlight additional principles to complement the IUCN SSC Guidelines on Human-Wildlife Conflict & Coexistence[3] that are in development. The case studies, together with recordings of a series of webinars in which they are presented and discussed, can be found here: https://www.hwctf.org/case-studies.

Human-wildlife conflict and possible solutions to it are also the focus of an Issues Brief[4] published by the International Union for Conservation of Nature

[1] https://www.fao.org/home/en/
[2] https://www.hwctf.org/
[3] https://www.hwctf.org/guidelines
[4] https://www.iucn.org/resources/brief/human-wildlife-conflict

(IUCN) in June 2022. IUCN briefing papers provide key information on selected issues and are aimed at policy-makers, journalists and anyone looking for an accessible overview of the often complex issues related to nature conservation and sustainable development. The IUCN Human-Wildlife Conflict & Coexistence Specialist Group has also issued further documents regarding the development of indicators of human-wildlife conflict to enable assessment of the target to be included in the Convention on Biological Diversity Post-2020 Global Biodiversity Framework. These and other IUCN policy and briefing documents on human-wildlife conflict and coexistence can be found at: https://www.hwctf.org/policies.

Webinar on livestock farming and large carnivores

On 29th June 2022 the European Parliament's *Biodiversity, Hunting, Countryside* Intergroup, in conjunction with the European Federation for Hunting and Conservation (FACE), held an online briefing session on *Livestock farming and large carnivores in Europe: Discussing a way forward*. Participating MEPs highlighted the impacts of expanding large carnivore populations on rural communities and called for greater efforts to find acceptable solutions and mechanisms to facilitate the co-existence of sustainable livestock farming and large carnivores. Several experts provided context, with a special focus on the human dimensions of conflicts. John Linnell of the Norwegian Institute for Nature Research, and Senior Advisor to *CDPnews,* noted that, while much is known about damage prevention, it is not really the technical aspects that lie at the heart of controversies. Rather it is a conflict over trust, values and different visions for the European countryside. He pointed out that pastoralists and environmentalists actually have much more in common than might at first appear and that there is an urgent need for them to work together. If you missed the event, you can watch a recording online[5].

Conference on bold wolves in Europe

According to experts of the Large Carnivore Initiative for Europe[6], a bold wolf is one that shows no fear of people and approaches them to within short

[5] https://www.facebook.com/watch/live/?ref=watch_permalink&v=579325453586831
[6] https://lciepub.nina.no/pdf/636870453845842163_PPS_bold%20wolves.pdf

distances. Although wolves rarely exhibit behaviours that threaten human safety, the occurrence of bold wolves is cause for concern and has been reported from several European countries. *Bold wolves: documented cases, perceptions and management guidelines was* the focus of the second thematic conference within the LIFE WolfAlps EU project. The conference, held in person and via live streaming on 29th April 2022, was divided into two parts. In the morning session, international experts examined specific cases and proposed possible solutions to bold wolves. This was followed by an afternoon round-table discussion among diverse stakeholders. A summary and recordings of the conference[7] can be viewed online.

New research on cattle and large carnivores

The Grazing in Carnivore Forests (CarniForeGraze[8]) project is studying the potential of using carnivore-exposed forests in SE Norway for livestock grazing. It aims to describe scenarios of sustainable livestock production in the boreal forest that are compatible with large carnivore presence and compatible or even positive for other ecosystem services. To achieve this, researchers from the Inland Norway University of Applied Sciences are seeking to identify risk factors for large carnivore depredation on cattle and, on the other hand, to describe success factors of herds with few or no losses within the wolf zone. Another goal is to understand the mechanisms and consequences of cattle-carnivore encounters to evaluate practical and ethical aspects of cattle ranging on forested outfield pastures. The researchers are studying how the space use, grazing activity and welfare of cattle are affected by carnivore encounters. They are also monitoring carnivore movement behaviour in order to assess the extent to which their space use and habitat selection overlap those of free-ranging cattle, hence enabling prediction of risky habitats.

Wolf predation on cattle and equids appears to have become more frequent in the Alps in recent years. The keeping of cattle, especially dairy cows, is characteristic of Swiss agriculture, of high economic importance and a central part of Swiss identity. A low-conflict coexistence between cow breeders and wolves is therefore central for the future of the wolf in Switzerland. A new study intends to address the challenges arising for the coexistence of large livestock breeders and wolves in Switzerland and to develop the scientific basis for appropriate management solutions. Researchers within the project *Wolves and Cattle* seek to identify factors affecting the risk of wolf attacks on bovids and equids with the aim of developing mitigation measures. The research is a collaboration between KORA – Carnivore Ecology and Wildlife Management[9], the Department of Ecology and Evolution at the University of Lausanne[10] and AGRIDEA – Swiss Association for the Development of Agriculture and Rural Areas[11].

Calls for changes to European policy

The year 2022 marks the 30th anniversary of the Habitats Directive[12] on the conservation of natural habitats and of wild fauna and flora, which forms a cornerstone of EU nature conservation policy. Large carnivores are listed amongst the species afforded legal protection but increases in their numbers and losses of livestock[13] have fuelled calls for changes to enable more active and flexible management[14]. It has been claimed, for example, that allowing carnivores to be hunted promotes their social acceptance and therefore successful coexistence with rural communities. When populations change, it is argued, their conservation status should also be changed[15]. This view is typically rejected by environmental and animal protection organisations[16], who want conflicts to be addressed through improved damage prevention measures[17] and compensation schemes.

Whilst such controversies are not new, there have been several notable developments this year. On 10th January, the European Parliament's AGRI

[7] https://www.lifewolfalps.eu/en/seconda-conferenza-internazionale-29-aprile-2022/
[8] https://www.innlarge.no/carniforegraze
[9] https://www.kora.ch/en/
[10] https://www.unil.ch/dee/home.html
[11] https://www.agridea.ch/en/
[12] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
[13] https://www.agriland.ie/farming-news/european-farmers-highlight-growing-concern-of-wolf-attacks-on-livestock/
[14] https://www.face.eu/2022/10/30-years-of-the-habitats-directive-the-return-of-europes-large-carnivores/
[15] https://www.eppgroup.eu/newsroom/news/change-wolves-protection-status
[16] https://eeb.org/library/joint-letter-about-the-motion-for-a-resolution-on-the-protection-of-livestock-farming-and-large-carnivores-in-europe/
[17] https://www.animalwelfareintergroup.eu/news/livestock-farming-and-wolf-protection-eu

Committee on Agriculture and Rural Development discussed a draft motion for a resolution[18] on the protection of livestock farming and wolves in Europe. The draft asked for action in support of farmers, including more flexibility in the management of carnivore populations and the mobilisation of additional funds to support herd protection measures and strengthen financial compensation for depredated livestock. Almost 300 amendments[19] were proposed by diverse lobby groups seeking to align the text with their particular positions.

In March, organisations representing farmers, hunters and landowners issued a joint statement on The rise of large carnivore conflicts in Europe[20] setting out their policy requests to deal with carnivore-related challenges facing the rural sector. The issue was also discussed during a meeting of the EU Agriculture and Fisheries Council in Brussels on 26th September[21]. The Austrian delegation, supported by Croatia, Finland, Hungary, Latvia, Romania and Slovakia, presented a note on Rising carnivore populations in Europe: Challenges for agriculture and rural areas[22]. The note echoed the AGRI draft motion in calling for changes to the Habitats Directive and more support for farmers in addition to the Common Agricultural Policy. The Environment, Oceans and Fisheries Commissioner acknowledged that the return of the wolf presents a challenge but stated that Member States already have adequate instruments, funds and tools at their disposal under current legislation[23]. The European Commission views the ongoing recovery of large carnivores as an important component of the restoration of European ecosystems. Its proposals for a new Nature Restoration Law[24] are expected to be discussed by the European Parliament's ENVI Committee on the Environment, Public Health and Food Safety in January 2023.

A joint motion for a resolution on the protection of livestock farming and large carnivores in Europe[25] was debated in the European Parliament plenary session in Strasbourg in November. The text differed markedly from the AGRI Committee's earlier draft motion, with emphasis on the importance of science-based decision-making, taking population-level approaches and harmonising monitoring across jurisdictions as well as recognising a need for improved documentation of damage and mitigation effectivity, more funding and constructive dialogue with stakeholders. Further amendments were tabled, several of which were adopted on 24th November when MEPs voted in favour of the motion[26] by a 306:225 majority. The texts adopted[27], whilst maintaining a strong emphasis on the need for better data, preventive measures, financial support and dialogue, also "insist that the Commission develop an assessment procedure without delay to enable the protection status of populations in particular regions to be amended as soon as the desired conservation status has been reached, in accordance with Article 19 of the Habitats Directive". Another of the adopted amendments welcomed a proposal by Switzerland to down-list the wolf from Appendix II to Appendix III of the Bern Convention on the Conservation of European Wildlife and Natural Habitats. This proposal was subsequently rejected during the 42nd meeting of the Standing Committee of the Bern Convention[28].

[18] https://www.europarl.europa.eu/committees/en/agri/documents/motions-for-resolution
[19] https://www.europarl.europa.eu/doceo/document/AGRI-AM-703134_EN.pdf
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Research

FREE-RANGING CATTLE AND BEARS IN SWEDEN: ARE THEY COMPATIBLE?

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http://bearproject.info/

1. Introduction

Large carnivores, including brown bears *(Ursus arctos)*, often prey upon livestock throughout their distribution range (Servheen et al., 1999). The resulting conflicts can lead to negative human attitudes towards large carnivores, which can result in the legal or illegal killing of carnivores (Kaczensky, 1999; Linnell et al., 1999). Reducing human–carnivore conflicts is therefore essential for the conservation of large carnivores and for biodiversity in general (Zabel and Holm-Muller, 2007).

Summer pasture farming used to be common in Europe, including in Sweden. Farmers moved their livestock to grazing grounds in forested areas outside villages during spring and summer, because pastures near villages were used to grow hay to feed livestock during winter (Larsson, 2009). Young family members usually accompanied livestock, moving them to suitable grazing areas, protecting them from depredation and typically confining them to pens or barns during the night (Larsson, 2009).

Nowadays, only about 200 summer farms remain in use in Sweden (Anon., 2007); most of them within the brown bear distributional range, which covers the northern two-thirds of the country. In 2018, there were an estimated 2,600–2,900 brown bears in Scandinavia, 95% of which were in Sweden (Bischof et al., 2020). Of these summer farms, 80% have dairy cattle (Elfström, 2005), which commonly range freely and unattended during daytime. However, they are penned overnight, because dairy cattle are milked

every day. Beef cattle are also often penned overnight, because Swedish animal welfare laws stipulate that livestock must have daily supervision (Anon., 2010).

In Dalarna Province, southcentral Sweden, genetic-based sampling in 2017 resulted in a population estimate of 322 bears (Bischof et al., 2019), or a population density of ~11 bears per 1000 km^2. Annual bear-caused cattle mortality accounts for only 0.0007 % of free-ranging cattle (calculated from data in Lidberg, 2009). However, 30 % of the summer-pasture farmers have claimed that they had experienced disturbances due to the presence of large carnivores (Elfström, 2005; Lidberg, 2009). Predator presence may cause increased stress levels in livestock and may lead to decreased milk production, decreased mass gain or handling difficulties (Murie, 1948; Zimmermann et al., 2003) as well as shifting grazing routines and habitat use (Brown et al., 1999; Kluever et al., 2009). Livestock depredations and potential stress caused by bear presence may therefore lead to loss of income. These arguments, among others, are often used by stakeholders to argue for reducing bear numbers in Sweden (Ericsson et al., 2010), in part to preserve the tradition of summer pasture farming (Sjölander-Lindqvist, 2009).

We conducted two studies to evaluate whether brown bears do, indeed, disturb free-ranging dairy cattle and, if so, to what extent. Sam Steyaert conducted a study of habitat selection by sympatric free-ranging dairy cattle and brown bears using GPS telemetry collars in 2008 (Steyaert, 2009; Steyaert et al., 2011). Christin Beate Johnsen followed this up in 2013 with an experimental study of the effects of exposure to bear scent (faeces) on milk production of pasture-grazing cows (Johnsen, 2017). Here, we provide a summary of the most important findings.

2. Study 1: Do bears influence habitat selection by free-ranging dairy cattle?

2.1 Methods

The first study investigated habitat selection of free-ranging cattle on six summer farms in Dalarna County, Sweden (Fig. 1). These farms kept their cattle inside pens during the night. No disturbance or depredation had been reported on three of these farms, but the other three reported disturbances caused by large carnivores. None of the farms had lost cattle to carnivore depredation, although one cow was injured by a bear in 2006.

As the cattle travelled and grazed together and almost never split up, we equipped one cow in the herd of each farm (herd sizes ranged from four to 28 head of adult cows) with a Global Positioning System (GPS) collar to represent herd movements. Collars were programmed to transmit one position every 30 minutes between 05:00 and 20:30 from

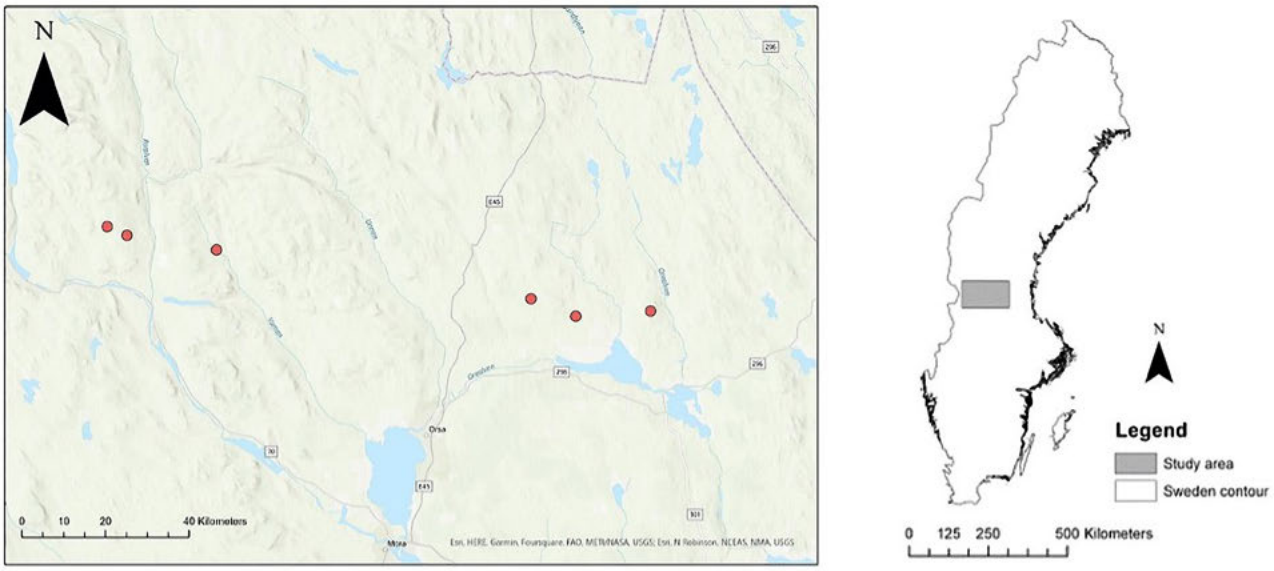


Fig. 1 Overview of the approximate study area in southcentral Sweden (right panel). The operational study area was centered around six cattle summer farms in Dalarna. All farms were located within the Swedish brown bear distribution range.

[1] www.bearproject.info

Overview of the study site at Norwegian University of Life Sciences, Ås, Norway. Dairy cattle were exposed to an experiment to test their reaction to predator scent. A camera mounted on a tripod was used to film the reaction of the cattle in a pasture enclosed by an electric fence (white wires) powered by an external battery (black box). *(All photos: Christin Beate Johnsen)*

14 June to 22 August 2008, i.e. the period when the cattle were ranging free and unattended in forests, forest pastures and roadside verges.

We also captured and equipped nine brown bears ≥3 years old (five males and four females, one of which had three yearling cubs) that frequented the cattle range with GPS collars as part of the Scandinavian Brown Bear Research Project[1]. The distribution range of brown bears overlapped with all studied farms. The GPS collars were programmed to obtain one position every 30 minutes, from 1 June to 31 August 2008. There is a pronounced seasonal shift in bear diet in the study area. Ungulates, forbs and insects dominated the diet during June and July and berries dominated in August-October (Stenset et al., 2016). As this dietary shift affects brown bear behaviour and habitat selection (Dahle & Swenson, 2003), we divided location data for both bears and cattle into two clearly distinct seasons, the pre-berry season (1–30 June) and the berry season (16 July–31 August). We did not include the transition period from 1 to15 July in the analyses.

2.2 Results & Discussion

Our results showed a significant negative relationship between habitat selection by brown bears versus that by cattle, i.e. bears avoided areas that were intensively used by cattle and vice versa. This difference in habitat selection was most likely explained by inverse responses to human habitation-related infrastructure and dense vegetation.

In general, cattle habitat selection was higher in proximity to human habitation-related variables (settlements, buildings, forest roads and trails) and in the habitat type 'other open', which comprised mostly forest pastures. Cattle avoided older forest and young dense forest, i.e. habitats generally more selected by bears. Young open forest and bogs did not contribute significantly to habitat selection by cattle, probably because these habitat types do not provide sufficient suitable food for them. Cattle are preferential grazers (Putman, 1986), which explains the selection for the habitat class 'other open', as well as their preferred proximity to forest roads and trails. Putman (1986) showed that roadside verges were the most preferred

habitat type for cattle in the New Forest, England. Roadside verges are also considered important grazing areas in forested parts of Scandinavia, because few other habitats with high-quality foods are available and the area of forest meadows and pastures has declined (Anon., 2009).

Many studies have reported avoidance of human-related infrastructure by brown bears (e.g., Kaczensky et al., 2003). Our results were consistent with these findings. Brown bears generally avoided human-related infrastructure, such as forest roads, trails, settlements, and buildings. This avoidance was especially prevalent during the berry season in summer and autumn, when the forest is also more intensively used by humans for hunting, fishing, and berry and mushroom picking (Nellemann et al., 2007).

Brown bears in our study area are mainly active during crepuscular and night-time hours and tend to rest most of the day (Moe et al., 2007). Because the husbandry system only allows cattle to range free during daytime, there is a mismatch between the two species' activity patterns, which likely reduces the relative probability of an encounter between them. Our results suggest that, with the current dairy cattle husbandry system, direct interactions between bears and dairy cattle are low, which is also reflected in the low reported depredation rate. Therefore, our results do not support the claim that a reduction of the bear population would help support the summer farming system.

Our study had some limitations. The ultimate causes (e.g., predator avoidance, activity budgets, and intrinsic behaviour) of the observed differences in habitat selection between the two species remain unknown. Thus, we cannot rule out that cattle avoid bears, resulting in a trade-off between safety and optimal habitat selection, which may reduce the cattle's fitness. With our approach in this study, we could not evaluate indirect effects by bears on dairy cattle. However, this aspect was addressed in the following study.

3. Study 2: Does bear odour reduce milk production in dairy cattle?

3.1 Background

Besides direct effects, predators can also have indirect, nonlethal effects on prey caused by fear (Altendorf et al., 2001), resulting in changes in habitat use, vigilance, foraging, or physiological stress that may affect the individual fitness of prey by reducing growth, survival or reproduction (Creel & Christianson, 2008). On a population level, predator-induced fear may cause effects in prey that can be more substantial than the direct effect of predation (Altendorf et al., 2001).

All mammals, predators included, leave behind urine, faeces, and glandular secretions (Hegab et al., 2015). Prey species can detect and respond to predator odour (Parsons and Blumstein, 2010), which may induce stress (Hegab et al., 2015). Predator stimuli often elicit similar responses in domestic and wild mammals (Kluever et al., 2009; Welp et al., 2004). For instance, Pfister et al. (1990) found that domestic cattle avoided feed bins contaminated with faecal odour from red fox *(Vulpes vulpes)*, coyote *(Canis latrans)*, mountain lion *(Puma concolor)* and American black bear *(Ursus americanus)*.

Brown bear fecal sample in a petri dish in a box presented to dairy cattle to test their reaction to predator scent at the Norwegian University of Life Sciences, Ås, Norway.

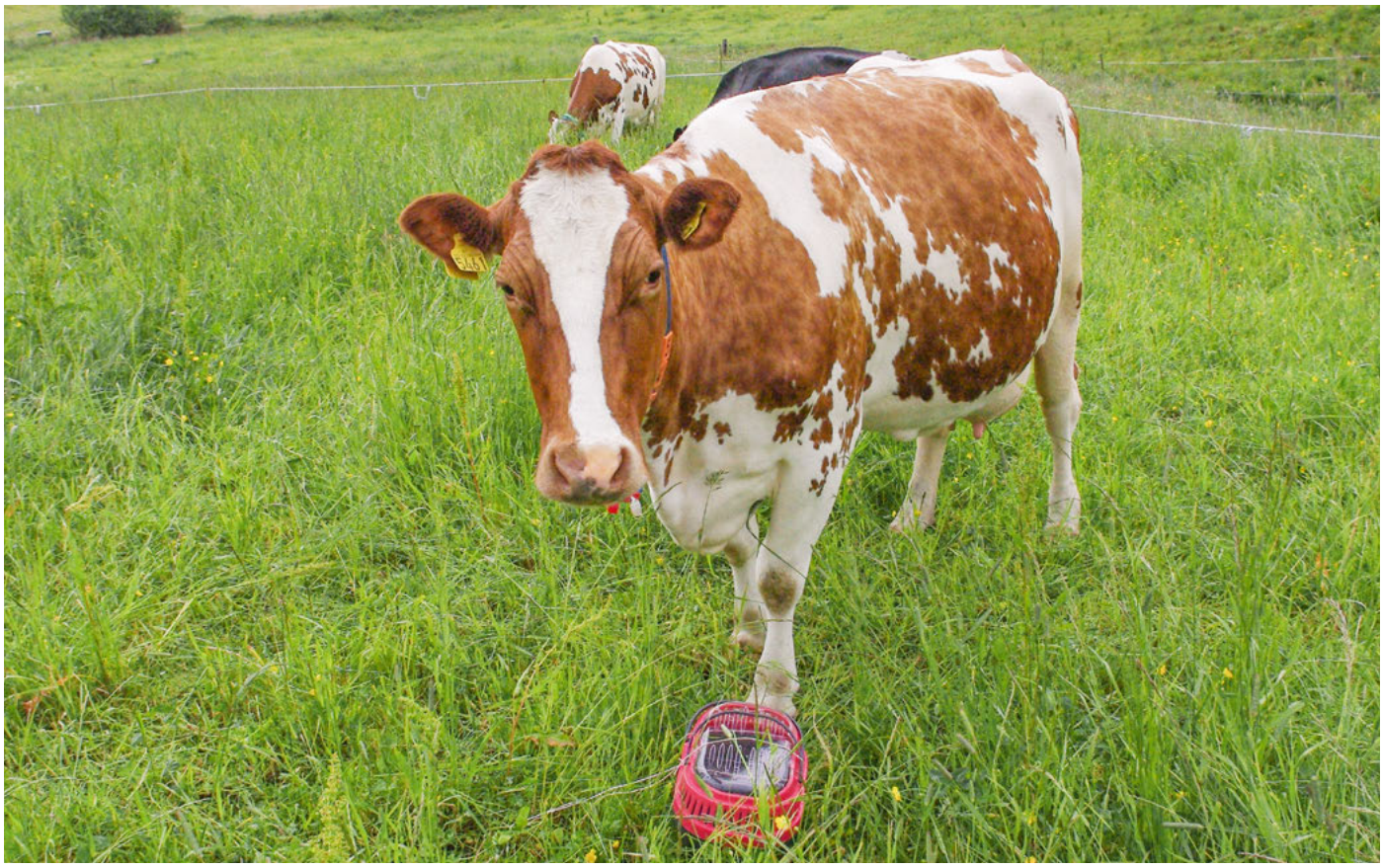


Fig. 2 Cow participating in an experiment to test the reaction of dairy cattle to predator scent at the Norwegian University of Life Sciences, Ås, Norway. The red box contains a brown bear fecal sample in a petri dish.

Dairy cattle farmers in Sweden sometimes argue that bears are not just problematic due to the threat of direct depredation, but that there may be severe indirect effects on cattle due to increased stress levels caused by the mere presence of bears in the same area, even in the absence of direct encounters (Steyaert et al., 2011). Farmers have claimed that the presence of bears, advertised by odour from bear faeces, urine or tracks, causes behavioural changes and lowers both the quality and quantity of milk in dairy cattle (Zimmermann et al., 2003). Reduced milk production in dairy cattle, due to such indirect effects of bear presence, could lead to loss of income for famers (Steyaert et al., 2011). Physiologically, such a stress response of cattle to a predator would be caused by the release of stress hormones via the blood stream into the mammary glands, reducing milk production (Jouan, 2006).

3.2 Methods

We tested the hypothesis that milk production in naïve dairy cattle would be affected when experimentally exposed to brown bear odour (faeces). We included odour (faeces) from another species (red deer *Cervus elaphus*) in the experiment to check if cattle responded to any novel odour rather than specifically to the odour of a predator, as well as a blank control (no odour) (Christensen et al., 2005). Because milk yield in cattle is highly affected by food intake and age (Grant and Albright, 2001), we also controlled for these variables in the analyses. Specifically, we predicted that: (i) milk yield would be lower when cattle were exposed to bear odour than when exposed to nonpredator odour (red deer) or no odour (blank); and (ii) milk yield would be lower during experimental periods, when cattle were exposed to odour treatments, in comparison to before or after experimental periods.

We used 37 lactating and pregnant individuals of the Norwegian Red Cattle breed, with a mean age of 3.7 ± 1.5 years (SD), located at the Norwegian University of Life Sciences, Ås, in southeastern Norway, which is outside the distribution range of brown bears. The cattle had no experience with the odour of bears or red deer prior to the experiment and were naïve to depredation events by carnivores. They were milked by milking machines in a barn twice per day, at approximately 06:30 and 15:30. Milk yield was recorded automatically via ID chips worn by all cattle.

The cattle were provided individual amounts of grain feed from an automatic feed dispenser and had access to silage hay in the waiting area before milking. The experiment was conducted in four one-week study periods during June–August 2013 in two 25 × 25 m enclosures with electric fencing on a large (> 5 ha) pasture. The enclosures were spatially separated by at least 150 m to decrease odour transfer. Due to grass depletion inside the enclosures, new experimental enclosures were established every day.

Four experimental cycles of four days each were divided into two periods of two days each. For each period, we randomly selected one group of ten cows and divided them into two subgroups. After morning milking, these subgroups were placed in the two experimental enclosures in the morning of day 1 and morning of day 2. Each subgroup was then randomly assigned one of three possible odour treatments: bear faeces, red deer faeces or control (blank, i.e. no odour). The only non-random requirement was that at least one of the subgroups on either day 1 or day 2 had to be exposed to bear faeces.

Odour samples were placed on sterile petri dishes and an empty petri dish was used for the control treatment. For presentation in the enclosures, petri dishes were placed in a small container that allowed odours to evaporate (Fig. 2). The containers were cleaned with chlorinated water every morning before use. The container with the odour treatment was placed randomly in the enclosure. Random placement was achieved by dividing the enclosure into a grid of 16 cells. The odour treatment was placed in the middle of a selected cell in the morning, where it remained until the cattle were collected for milking the next morning. Production of milk was measured four times during each 2-day experimental period: in the evening of day 1, in the morning and evening of day 2 and in the morning the day after the experimental period.

3.3 Results

A total of 236 measurements of individual milk yields were made on the 37 cows in the study under the three treatment regimes. No difference in

Dairy cattle participating in an experiment to test their reaction to predator scent at the Norwegian University of Life Sciences, Ås, Norway. The cattle are just on their way to the milking facility.

Dairy cattle participating in an experiment to test their reaction to predator scent at the Norwegian University of Life Sciences, Ås, Norway. A camera mounted on a tripod (visible in the background) was used to film the reaction of the cattle in a pasture enclosed by an electric fence (white wires) powered by an external battery.

milk yield was found among odour treatments. Cattle yielded on average 24.8 ± 4.4 L of milk when presented bear odour, 24.2 ± 4.6 L when presented odour from red deer and 24.4 ± 5.1 L when presented the blank (no odour) control. The cows produced significantly less milk before an experimental period (average = 22.8 ± 5.1 L) compared to during (24.5 ± 4.6 L) or after (24.6 ± 4.9 L).

The results did not support our main hypothesis that milk production in naïve dairy cows would be affected when experimentally exposed to brown bear odour, but rather suggested that bear faecal odour as a predator cue was not a strong enough stressor to elicit a physiological response affecting milk production. Our first prediction was therefore rejected, as milk yield did not differ significantly among odour treatments (i.e. bear, red deer, or blank). Moreover, our second prediction was also rejected, because milk yield was significantly lower before an experimental period, and not significantly different when comparing during an experimental period to after an experimental period.

3.4 Synthesis and implications

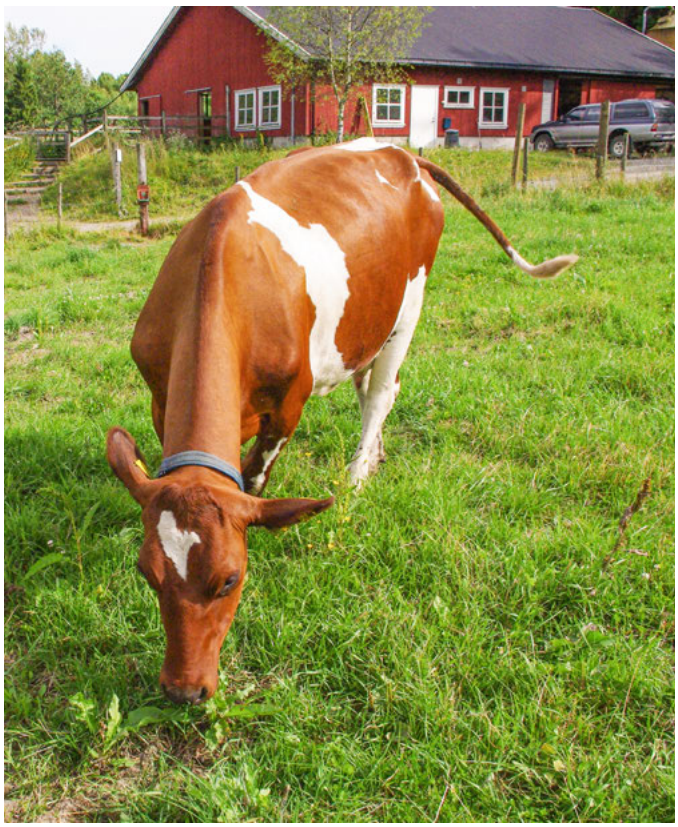
The results of our first study suggest that, with the current dairy cattle husbandry system, direct interactions between bears and dairy cattle are low. In our second study, cows exposed to bear odour did not respond with reduced milk production. Thus, our findings do not support the claim that a reduction of the bear population would help support the summer farming system.

The dairy cattle in our experiment were naïve to predators. Cattle may need stronger negative cues and experiences in relation to the presence of a predator, such as direct visual observation, fur-derived odours or even direct attacks, to evoke responses (Sarno et al., 2008; Sahlén et al., 2016). Although some studies have shown an innate recognition and response toward predator odours (Blumstein et al., 2002; Apfelbach et al., 2005), recognition may generally have to be learned (Blumstein et al., 2002). For example, North American moose *(Alces alces)* that were naïve to grey wolves *(Canis lupus)* failed to respond to wolf olfactory cues after the two species had been

separated for over 80 years, whereas bear-experienced moose showed increased vigilance in response to bear olfactory cues (Berger et al., 2001). Free-ranging dairy cattle in Sweden are potentially exposed to a variety of predator stimuli and could therefore elicit different responses than seen in our experiment. However, the mismatch in activity patterns and habitat selection between the two species, as well as the very low depredation rates on cattle by bears in Sweden, suggest a very low probability of free-ranging cattle learning to fear bears by experience and direct encounters. The income loss for farmers caused by the presence of bears can therefore likely be considered as low.

4. Conclusion

The conflict between free-ranging dairy cattle husbandry and brown bears in Sweden is apparently more imagined than real. In general, our results showed no support for the dairy farmers' concerns that the presence of bears negatively effects the traditional system of free-ranging dairy cattle. Thus, we conclude that these concerns are not substantiated and should not be a basis for a reduction in the bear population in areas with this traditional dairy system.



Cow participating in an experiment to test the reaction of dairy cattle to predator scent at the Norwegian University of Life Sciences, Ås, Norway. The red building in the background is the milking facility.

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Interview with Seth Wilson, Executive Director of the Blackfoot Challenge

FROM "ME" TO "WE": LEARNING TO WORK TOGETHER

Interviewer: Robin Rigg

https://blackfootchallenge.org/wildlife/

Where do you work?

The Blackfoot River watershed in western Montana, USA. It's a relatively undeveloped rural landscape south of a huge complex of wild lands with core populations of large carnivores.

In relation to cattle, which is the most problematic predator in the area?

Grizzly bears during the calving season and also wolves, to a lesser extent mountain lions.

When did issues with carnivores first arise?

The first conflicts involving grizzly bears began in the late 1990s. We had some calves killed and we were seeing some beehive-related conflicts. Then on 30th October 2001 an elk hunter was fatally mauled. He was going back to get an elk he'd killed and a female grizzly with cubs had taken over the carcass. It was one of those defensive encounter situations and he died from his injuries.

How did you get involved?

I was just finishing my PhD on human-bear conflicts in a different part of Montana and I saw something in the press about conflicts in the Blackfoot, which is fairly close to where I live in Missoula. It piqued my interest that bears were coming into this area with ranches and lots of private land. After the fatality, the Blackfoot Challenge hosted a meeting and we talked about the issues and how to address the problem. I offered to do some GIS mapping to help prioritise where to focus. Over the next year, I sat down with livestock producers and let them show me where their calving areas and bone yards were and where they were seeing bears, a sort of bottom-up approach to research.

During that first year, the Blackfoot Challenge helped bring people together and asked me to coordinate a new wildlife committee that we set up. There was no money, we had nothing, we were just eager and passionate about wanting to try to solve a problem that the community wanted us to address. But we had a lot of the right people in the room. The committee brought key stakeholders together: state

Reinforced sliding bear door at a Montana ranch.

(Photo: Blackfoot Challenge staff)

Electric fence installation with Challenge Wildlife Program Coordinator Eric Graham.

(Rebecca Reeves, US Fish and Wildlife Service)

Range Rider checking game camera.

(Photo: Jeremy Roberts, Conservation Media)

and federal wildlife managers, livestock producers and NGOs. I wrote some grants that helped get us started, then I had to raise money to keep our work going for the next 12 years.

What is the Blackfoot Challenge?

The Blackfoot Challenge is a non-government organisation (NGO) formed by landowners and ranchers in 1993, but its origins go back to the 1970s. In the face of growing threats to natural resources and their rural way of life, people realised that they could accomplish much more by working together and building partnerships with public agencies.

It really helped us to have that ready-made platform. It's a theme I see all over the world: the need for a trusted entity, an umbrella organisation, with the capacity to bring people together, to bring a framework to the discussions. It can be a state organisation or NGO, a researcher, a university, a local hunting club or a mayor. One of the lessons learned is to ask yourself the question, is there existing capacity that could help address the issue of reducing conflict? I think that's essential and one of the reasons we've had success over the years.

It might surprise our readers that an environmental NGO was started by cattle ranchers!

There's a long tradition of stewardship among livestock producers in places like Montana. They depend on clean water and sustainable uses of soil so grass productivity can feed their cattle. The tagline on our logo is "*Better rural communities through collaborative conservation*". Our chairman likes to say it's a people project and that conservation starts with conversations that lead to building trust. What's happened over decades of work is that bringing people together allows us to do conservation work and tackle other issues across the watershed, from grizzly bears to forestry to rivers and fish. It's enabled us to address multiple conservation issues in a holistic manner. Not every rancher likes bears but they know that there are people willing to help maintain their productivity and profitability. Sometimes the conservation community gets too narrowly focused on carnivores when they are just one of the issues people are dealing with. The fact that we can address other needs, too, makes it easier for ranchers to participate in our carnivore programmes. The ranchers always remind me that it's not just about bears and wolves!

Solving conflicts is not just about deploying fences and guard dogs?

It's beyond technical things. There's also empathy, value sharing. All my staff care about the individual producers we work with. Some are easier to work with than others, that's reality. I think that the producers, the landowners, really value knowing that we are there and although as trained conservation biologists we sometimes have different values we also respect and share some of the same values. David Mannix, one of the great ranchers in our project, said to me one day, "If the customers who support my ranch and want to buy my beef care about wolves and bears, I need to pay attention to that!". So, it's about evolving values over time. When you have conservation biologists and an environmental community that care about the sustainability of the ranchers and the land, those ranchers feel like they're in this with us together and that's powerful. It's not a fight – it's "we", it's "how can we all be better"?

We've got so many tools out there, it's really about bringing people together and building the goodwill to try to use them. If you focus on the people part and fostering good relations, the tools are more easily adopted. It's sort of like a pyramid. You build a foundation of trust and then they're like, "Oh, that's reasonable, we can try an electric fence, we can try range riders." The tools are really just the tip of the pyramid.

That's very different from the approach of many activists and advocates.

David talks about the "80/20 Rule". He says if we focus on the 80% of where we can find commonality we can get early successes which then allow us to

Electric mat group demonstration. *(Photo: Blackfoot Challenge staff)*

address the harder 20%. That's a good rule of thumb: start with the easier stuff, the "low-hanging fruit". Where are the common interests? Twenty years ago, there was a lot of concern about invasive weeds, so the Blackfoot Challenge focused on helping to deal with weeds, the War on Weeds in the West! [laughs] Everyone felt great about that, we were all dealing with weeds together. Over the years you build that trust and credibility through partnerships and then you start dealing with more complex and challenging issues that can be more polarising, like wolves and bears. By initially focusing on that 80% of commonality it allows you to discuss the harder issues in a civil way. If you're always fighting, you're never going to get it done.

Going back to bears, what specific measures were taken and did they work?

Electric fences, livestock carcass pick-up and composting, range riders and – in the case of wolves – fladry. They've all been really good tools. All the range riders are local residents so we're creating jobs which is always helpful. There's also management of garbage and other attractants. We're providing ranchers with shipping containers to protect their livestock feed. We've used a lot of electric fencing and we're developing drive-over electric mats[1] to be used in high-use areas like an entrance to a ranch so that you don't have to open and close gates. This makes it easier for someone to put a perimeter fence around their whole property, the residence and the calving area, to make it secure from predators but practical to work in. We use a lot of trail cameras to study wolf movements to understand where their denning and rendez-vous sites are so we don't bring cattle right in on top of wolves and we can think about where we might want to delay pasture use.

The one tool I wish we had more experience with and use of is livestock guarding dogs. We are mostly cattle-dominated and most folks here have not run their cattle with dogs, although there have been a few instances in Montana. Every context is different, but I've always been curious if that would be another tool for us to think about.

[1] https://blackfootchallenge.org/electric-fence/

Rancher Jack Rich with refuse containers secured from bears.

(Photo: Blackfoot Challenge staff)

Who pays for the range riders?

We do – the Blackfoot Challenge. We hire all the local riders. We depend on public and private sources of finance. One of the largest chunks of my job as Director is fundraising.

People are clearly a big part of your work.

Yes, it's like what academics call social capital: relationships that have been fostered and strengthened over time so you have a collective reservoir of trust. That allows you to experiment and try new things with an understanding that, if it fails, we can try something different but it doesn't mean that preventive measures are a failure or conservationists are silly for proposing them. It's a safer environment for trying riskier ideas because people trust each other and they are not just going to discount it out of hand or allow rumours to develop that none of this stuff works. Rumours like that can really set you back.

It seems that you're achieving a lot of success.

During the last 20 years we've got almost all the beehives protected with electric fences so we have very few if any beehive-related conflicts now. There's an occasional loss when there is a malfunction in a fence, for example, but in general beehive conflicts have been taken care of. We have higher rates of garbage-related conflicts than livestock losses, so we still have plenty of work to do in residential areas and campgrounds. We're working with our communities and public agency partners on bear-resistant dumpsters and managing attractants. We've got dozens of bear-resistant dumpsters, cans and rubbish containers but when they get old you have to replace them so it's a long-term, constant effort that's expensive and, as bears spread into new areas, we need to address attractants there, too.

The bear population has expanded, we had another human fatality in the summer of 2021, and people are asking some tough questions – How much is enough? How many bears do we need to live with? What do you do if a bear develops learned behaviour that's dangerous to people? Do we need to have swifter management responses? That kind of questioning is part of our process, where we can bring people together and have the science and management framework so that we can continue to be problem-focused and use the tools that reduce conflicts and help keep people safe and keep a viable population of bears. I have trust in our process and that we can make thoughtful and reasoned decisions about how to live alongside bears.

How do you establish and maintain that process?

If I showed you a map of our area, there is a patchwork of ownership and management jurisdictions from private lands to parcels in public ownership that are managed by both state and federal agencies like the US Forest Service or Bureau of Land Management. What makes us different from many other NGOs is that our board of directors is made up of the key decision-makers who own or manage the private and public lands in our area. In a sense, we've created a forum for conservation governance – and this takes a lot of meeting and discussions. We have monthly board meetings and our workgroups and committees meet regularly throughout the year. All told, this creates a continuous roundtable for information flow across all the relevant stakeholders.

Being community based, we listen to what's important to the local community and try to respond. We use science, we are informed by science, but our work is not driven by science – we avoid that hard-headed, "we know best" attitude. If you create a discussion space, you can have your science or your management information at the table to inform decision-making.

What happens if someone comes along who thinks they can solve a long-term problem by fighting hard for what they want and not compromising?

The Blackfoot Challenge really acts as a leveller. It helps to guard against that sort of Lone Ranger effect: "I'm gonna come in and I'm gonna do it!" and it's like "Wait, you may have some great ideas, and we can do it together." In some ways it's not worrying about who gets the credit. I think of this as intellectual divestment. If you bring a good idea into the discussion space and people think about it for a while and take it on, you shouldn't worry about whose idea it was. It becomes everybody's. As scientists and environmentalists we're not trained for that, right? We're trained to think it's our idea and we want recognition. That was one of the early lessons I learned: the sooner you can figure that out and stop worrying about getting credit, it's really important in this work – to move from "I" to "we".

A well-meaning environmentalist might come in with all the tools in their backpack, with the techno fix, and says, "This is how we're going to solve it!" but no one wants to do it. Why? Because they haven't felt like they're part of the process, they haven't felt invested in it, and they likely have many other issues they're dealing with. What we want is people to be able to live safely with bears, but you don't necessarily lead your conversations with the bears. You start with the people who are living with bears, whose livestock matter to them. You "meet people where they are" and go from there.

At the end of the day, the landowners who live here, work here, whose kids they'd like to see here, and depend on this place for their long-term livelihood, they're the glue that keeps all of us together. They are really invested in trying to do the right thing. You need some of that leadership literally from the ground up. If you have the landowners willing to work with all the different experts and bring those skills and resources, then you get something done.

Seth Wilson is an applied conservation biologist who has worked on resolving issues between people and wildlife in N. America and Europe for more than 20 years. He was born in New York and raised in Connecticut but from 1993 made his home in Montana where he earned his PhD. Seth began working for the Blackfoot Challenge in 2001 as the organization's first Wildlife Coordinator, helping to gather baseline data and develop strategies to reduce conflicts. He then spent three years in Slovenia as an advisor to the Slovenian Forest Service and partners from Austria, Croatia, Italy, Romania and Slovakia to support bear and lynx conservation and management. Returning to the Blackfoot Challenge, Seth became its Executive Director in 2019.

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Review

WOLVES AND CATTLE: OVERVIEW OF DAMAGE AND MANAGEMENT IN GERMANY

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1. Wolf population development

Following the return of wolves to Germany after an absence of more than 150 years, their numbers and range have rapidly increased (DBBW, 2021a). The first reproduction was recorded in Saxony in 2000. The current population, based on the 2020/21 monitoring year, consists of 157 packs, 27 pairs and 19 territorial individuals[1]. The majority are in Brandenburg (57 territories), Lower Saxony (44 territories), Saxony (34 territories), Saxony-Anhalt (26 territories) and Mecklenburg-Western Pomerania (24 territories) (Fig. 2; DBBW, 2021a,c). In 2020/21, territorial or transient wolves were documented in all federal states, except for the state of Saarland (DBBW, 2021a). Despite this increase, the conservation status of the wolf in Germany has so far been assessed as "unfavourable-poor" due to low numbers and limited distribution (BfN, 2019).

The wolf is strictly protected or protected in almost all European countries. In Germany, the species is listed in Appendix II of the Bern Convention and Annex IV of the Habitats Directive, i.e. strictly protected. The intentional disturbance, capture or killing of wolves is prohibited. Since the reunification of Germany in 1990, wolves have enjoyed the highest possible protection under the Federal Nature Conservation Act. However, as of September 2012 the wolf is listed in the hunting law of Saxony and, from May 2022, also in that of Lower Saxony, but without a hunting season. The inclusion of the wolf in the hunting laws of individual federal states has no relevance regarding permits for the lethal removal of individual wolves. As before, the taking of a strictly protected species requires an exception in accordance with the Federal Nature Conservation Act.

[1] According to official monitoring standards (Reinhardt et al., 2015), a pack is defined as a group of more than two wolves living in one territory/at least one sexually mature wolf with confirmed reproduction; a pair consists of a male and female marking their territory together but no reproduction (yet); and a territorial individual is a single animal that is detected in a definable area over a period of at least six months.

Fig. 1 The wolf returned to Germany at the turn of the century. *(Photo: Benny Trapp)*

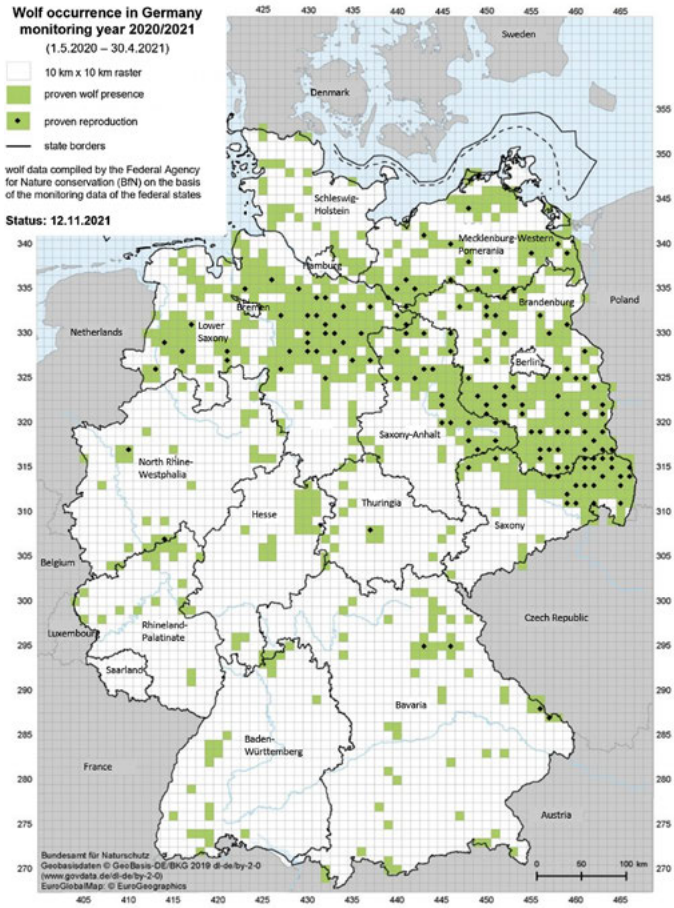

Fig. 2 Wolf occurrence in Germany in 2020/21. Compiled by the Federal Agency for Nature Conservation based on federal states monitoring data (Source: DBBW, 2021d).

Since the return of the species to Germany, the presence of wolves and wolf depredation on livestock have been recorded in all federal states. In order to obtain a nationwide overview of wolf damage statistics, the Federal Bureau of Documentation and Consultation Regarding the Wolf (DBBW) on behalf of the Federal Agency for Nature Conservation, conducts an annual survey in all federal provinces. Data are summarised in national statistics and published by the DBBW in yearly reports which form the basis of the following review.

2. Wolf attacks on cattle

Compared to sheep and goats, cattle are considered to be more defensive and their herd behaviour can provide some protection against wolf attacks (e.g. NLWKN, 2020). However, despite their large size and the defensive nature of some breeds, it should not be generally assumed that cattle can protect themselves from attack. Even single wolves have learned to kill adult cattle (DBBW, 2022).

In general, the number of attacks on cattle throughout Europe is significantly below the level of smaller livestock (Kaczensky et al., 2013). An analysis based of wolf compensation payments from 21 European

Fig. 3 Cattle pasture fenced with a single electric wire. *(Photo: FVA, Olga v. Plate)*

Table 1 Numbers and type of cattle in Germany in 2019 (Source: Statistisches Bundesamt, 2020, 2021).

Category	Total head
Total cattle stock	11,700,000
• non-dairy grazing cattle	2,341,000
• grazing dairy cows	1,221,900
Type of use	**Most represented breed (head)**
Dairy cattle	Holstein Schwarz-Bunt (4,307,700)
Beef cattle	Cross breeds (577,000)
Dual-purpose cattle	Fleckvieh (3,115,200)

Table 2 Damage to cattle by wolves in 2016–2020 in terms of the total number of cattle harmed (killed, wounded or missing); as a proportion of all livestock harmed; and the proportion of wolf attacks on livestock that involved cattle. NA = missing data. (Source: DBBW, 2015–2020).

Year	Number harmed (head)	Proportion (%)	
		of livestock harmed	of attacks on livestock
2016	67	6.2	(NA)
2017	140	8.3	(NA)
2018	136	6.5	(NA)
2019	127	4.3	13
2020	153	3.8	14

countries found that sheep, and to a lesser extent goats, are the species most preyed upon, with cattle damages being much lower, ranging from 0 to 19% of all damages (Linnell and Cretois, 2018).

Attacks by wolves on cattle have also been documented in Germany. There were 131,000 registered cattle farms in Germany in 2021 (BMEL, 2021). In 2019, 30% of cattle in Germany were held in systems with pasture grazing. The most represented breeds in pasture grazing were Holstein Schwarz-Bunt, crossbreeds and Fleckvieh (Table 1). In most cases, cattle pastures are semi-permanent and fenced with simple metal stakes and electric wires (Fig. 3). Often, these do not follow recommendations for secure fencing according to the AID brochure (Kamp, 2021; Wehrsporn et al., 2014). This is the reference source for the construction and operation of fencing systems for livestock in Germany, regardless of wolves. This

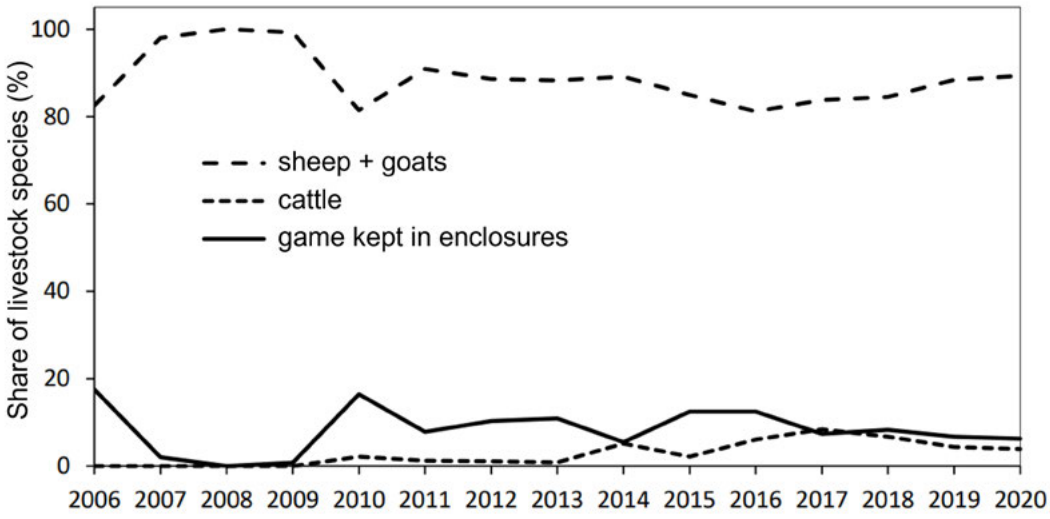

Fig. 4 Composition by species of animals killed / injured / missing due to wolf predation in 2006–2020 (Source: DBBW, 2021b).

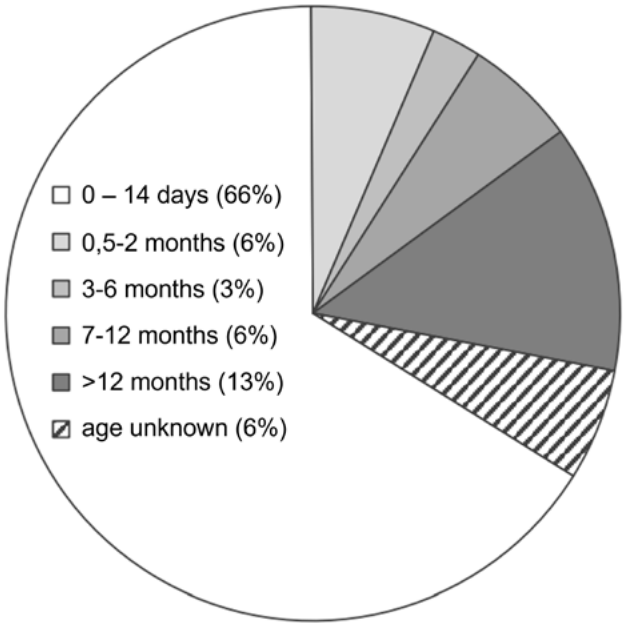

Fig. 5 Proportions of cattle killed / wounded / missing due to wolf predation in 2020 (n = 153) by age class (DBBW, 2021b).

continues to form the basis for assessing fence system safety. For cattle herds with calves in risk area 3, which refer to pastures located up to 500 m from sources of danger such as busy roads and railway lines, the AID brochure calls for a permanent fence with at least three galvanised steel wires and a fence height of 110 cm, primarily intended to prevent breakouts (AID, 2021).

Beginning in 2006, DBBW statistics on livestock damages due to wolves show a low overall proportion of cattle, with an upward trend until a maximum of 8.3% in 2017 (Fig. 4) followed by a slight decline to 2020 (Table 2). A more detailed look at the data for 2019–2020 shows a marked difference in the proportion of cattle in verified attacks versus that among animals killed, injured or missing (Table 2; DBBW, 2015–2020). This is due to the fact that the number of cattle killed in each attack is normally lower than that of sheep. In some attacks there are no cattle killed, only wounded. Young calves, especially those aged 0–14 days, represent a substantial share of losses (Fig. 5; DBBW, 2021b). Other criteria besides age, such as information on the herd composition, breed or weight of animals harmed in wolf attacks, are not recorded or compiled on a nationwide basis. Robust statements on these factors therefore cannot be made at this point.

According to official figures (DBBW, 2015–2020), the states most affected are Brandenburg (290 animals), Lower Saxony (135 animals) and Saxony-Anhalt (119 animals) followed by Mecklenburg-Western Pomerania (22 animals) and Schleswig-Holstein (16 animals). In recent years there have also been attacks in federal states with fewer resident wolves. In 2021 in Baden-Wuerttemberg, where there were three territorial individuals, a wolf killed a young cow (UM, 2022) and in North Rhine-Westphalia, where there were two packs in 2020/21, a calf was killed (DBBW, 2021a; LANUV, 2021).

Cattle damage is often concentrated in some areas, with hardly any damage recorded in other areas (Fig. 6; Kamp, 2021; LfU, 2021; NLWKN, 2021; NMUEBK, 2021). Among other factors, the level of damage seems to be linked to the degree of learning of local wolves (Sime et al., 2008).

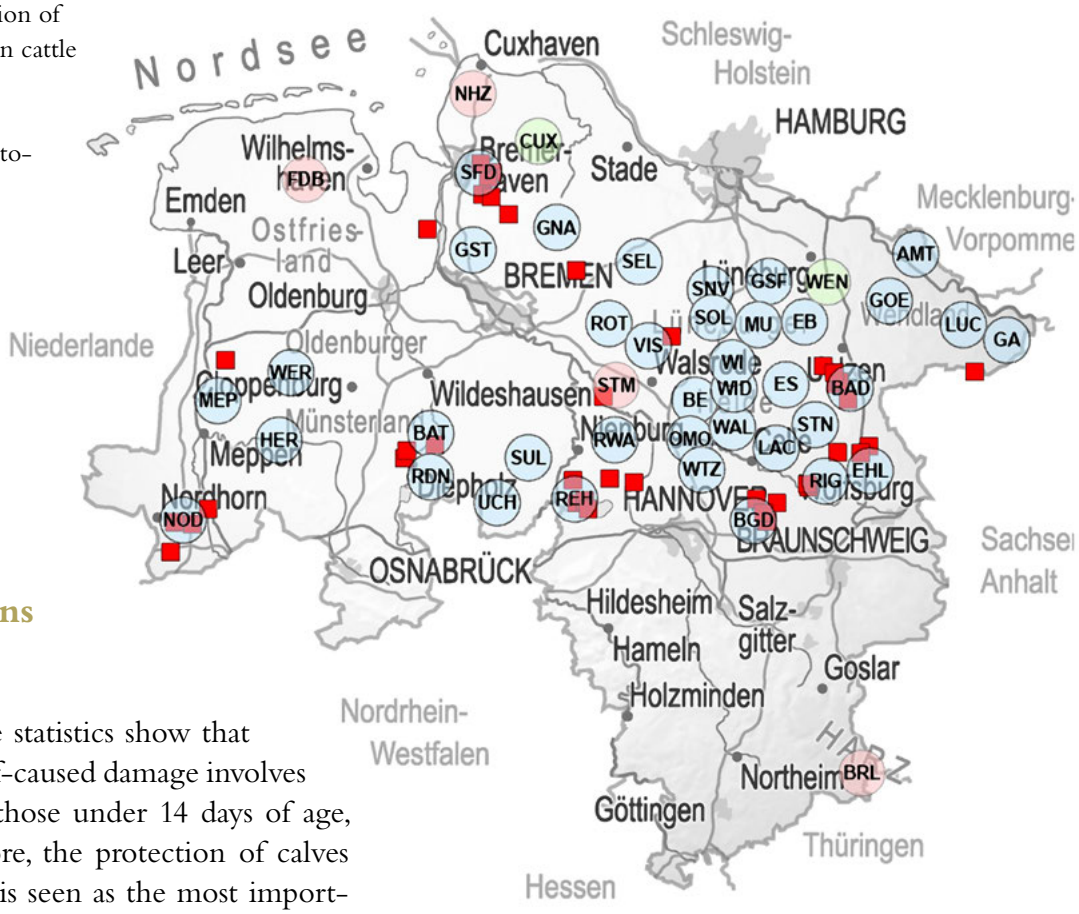

Fig. 6 Geographical distribution of confirmed attacks by wolves on cattle (red squares) that resulted in animals killed, injured or missing in 2021 and wolf territories confirmed by monitoring in 2020/21 (circles) in Lower Saxony (NMUEBK, 2021). Blue circles = packs, green circles = pairs, red circles = territorial individuals as defined in the official monitoring standards (Reinhardt et al., 2015).

3. Recommendations for risk mitigation

The reviewed damage statistics show that only about 4–8 % of wolf-caused damage involves cattle. Calves, especially those under 14 days of age, are most at risk. Therefore, the protection of calves in the first weeks of life is seen as the most important measure for cattle. Where individual wolves learn to kill adult cattle, the latter should also be protected from attack. The implementation of high-quality herd protection measures has an impact on livestock mortality and can be used effectively for cattle holdings (Hartleb et al., 2017; LAU, 2018). Herd protection measures recommended mainly for sheep and goats in many federal states in Germany, such as wolf-proof fencing, night pens and livestock guarding dogs (LGDs), can also be used for cattle protection, for example in calving areas and pastures (Figs. 7 and 8).

In addition, there are further options specifically for counteracting the risk of attacks on cattle. Recommended measures include seasonal calving, to simplify the establishment of designated and fenced calving pastures, as well as night-time stabling (Reinhardt and Kluth, 2007; VOSS, 2020). Altering the grazing sequence, especially for herds with calves and groups of young cattle, based on pasture area characteristics such as open terrain and distance to the farm, can reduce the cost for farmers of regular checking on their animals. Furthermore, targeting a herd composition that allows the formation of a defensive position and supports leadership and tranquillity by sufficiently experienced adult animals, can also reduce risks (Reinhardt and Kluth, 2007). Nevertheless, the level of reactivity towards wolves and protective qualities may depend on the traits of each specific breed as well as the characteristics of individual animals.

If fencing is done using only a single strand of electrified wire, calves can leave their herd's area of influence. In some grazing systems such as creep-grazing[2] this is intentional, in others it may be unintentional (e.g. calves look for shelter in higher grass outside the pasture). In both cases, the risk of wolf attacks on unprotected animals can be reduced by adding additional wires to deter calves from leaving pastures (Mettler and Schiess, 2021; Reinhardt and Kluth, 2007). Thorough pasture hygiene, with rapid and professional disposal of stillbirths and afterbirths, which does not allow wolves to establish a positive association with grazing animals, may help to reduce attacks on cattle herds in the long-term by potentially influencing wolf learning behaviour (VOSS, 2020).

[2] Placing an electric wire at c. 90–105 cm allows calves to pass under while deterring cows from jumping over or going under. In a rotational grazing system, calves can thereby advance to an adjacent paddock where forages are higher quality before rotating the cows to that paddock.

Under certain circumstances, the wolf's substantial capacity to learn can spread undesirable behaviours, resulting in concentration of damage in specific regions. Recording noticeable behavioural changes in cattle herds, such as sudden and excessive aggression towards dogs, as well as attacks on herds and individuals, allows early identification of damage clusters and patterns (BUL, 2018). With adequate monitoring, states and regions can react to such developments, for example through the designation of certain aid arrangements for protective measures explicitly for cattle in the affected areas.

In case of attack, measures such as 'Foxlights', (electrified) fladry fences and the reinforcement of existing fences with additional electrified wires or nets are currently used for short-term immediate protection in Germany. Keeping herds locked up at night to minimise the risk of further attacks is also an option at some farms.

The approaches described above do not represent a comprehensive list of all livestock protection measures available for cattle but show a selection of methods applied in Germany. Projects on various cattle protection measures are currently underway or planned in individual states to test their practicality, ability to be integrated into existing work processes and effectiveness. One such project focuses on the implementation of protection measures for cattle (such as electrified fences or technical upgrades of stables to prevent the intrusion of wolves) with continuing support during the steps from planning customised measures to applications for funding and maintenance for participating farms. This project, a cooperative venture between cattle associations, a nature park and a research institute, is planned to start in 2023 in Baden-Württemberg.

Fig. 7 Young cattle in the Rhön Mountains, Bavaria, within an electrified 5-wire fence, built according to Bavarian recommendations for protecting livestock from wolves. *(Photo: FVA /Ann-Kathrin Klotz)*

Fig. 8 Cattle in Saxony-Anhalt protected by livestock guarding dogs and a 5-wire electric fence.

4. Compensation payments and financial support for protection measures

Most federal states have set requirements for "basic protection", the correct application of which can be a prerequisite for compensation to be paid for some livestock species in the event of damage in designated areas (such as confirmed territories). In addition, some states have defined "recommended protection" measures which, according to experience in Europe, offer more reliable protection. These protection standards can differ from state to state and, therefore, we cannot give a consistent overview at this point.

In most federal states with wolf territories, no basic protection is required in order to be eligible to claim compensation for damage to cattle. This is due to the comparatively lower risk of attacks on cattle compared to sheep and goats, the large size of some cattle farms and the associated difficulty and expense in implementing comprehensive protection measures. An exception is the state of Bavaria, which requires basic protection according to Bavarian standards for example for the protection of cattle under 24 months of age where "necessary and possible" (LfL, n.d. a), corresponding to that for sheep and goats, as a prerequisite for compensation in the event of damage in areas with confirmed territories. For example, technical measures accepted as "basic protection" in Bavaria are electrified nets and wire fences at least 90 cm high with four (or five) wires at 20 cm, 40 cm, 65 cm, 90 cm (and 120 cm) above the ground (Fig. 8), or 90 cm high wire mesh fences with additional electrification 20 cm from the ground and 20 cm above the top of the fence to prevent passing under or over (STMELF, 2021). Shepherding or protection with at least two LGDs per herd of 50 or more mother animals, as well as night-time confinement in closed stationary or mobile stables protected by, for example, electrified or physical barriers according to Bavarian recommendations (STMELF, 2021; LfL, n.d.b) also meet the requirements. In Thuringia, the

(Photo: FVA / Laura Huber-Eustachi)

implementation of basic protection is required for cattle species with a height at the withers of up to 112 cm for adult animals (TMUEN, 2020).

In Germany, state subsidies for protection of small stock (sheep and goats) and enclosed game are provided in almost all federal states in areas with confirmed wolf territories. In most federal states, however, protection measures for cattle are only supported where cattle have been killed (DBBW, 2021b; decrees of the federal states). Some states designate specific funding areas in case of increased attacks within definable regions and in a temporal context, such as in Lower Saxony. Here, the funded protection of horses or cattle can be considered if wolf attacks on the respective species have occurred in at least three cases within a radius of 30 km during a period of twelve months (NI-VORIS, 2021). In addition, measures are funded in some federal states on a case-by-case basis after assessment by experts from the advising or funding institutions, for cattle up to a specific age in designated funding areas or dwarf cattle (e.g. STMELF, 2021; TMUEN, 2020). The funded measures and the amount of funding are determined by the federal states themselves and can include, for example, LGDs, electric fences or fencing accessories to upgrade existing fences.

In principle, compensation is paid in all federal states after attacks on cattle. Some states only pay if several conditions are met. For example, Saxony-Anhalt and Brandenburg require the use of fences in accordance with AID good professional practice. Furthermore, in areas of Bavaria with documented resident wolves, compensation is only paid if appropriate preventive measures meeting basic protection requirements were taken within a transitional period of one year (MLUE, 2019; LfL, n.d. a; MLUL, 2019).

5. Discussion & Conclusions

The occurrence of attacks on livestock is influenced by a wide range of factors, such as the availability of wild animals as a food source, the preferences and experience of individual wolves, the husbandry systems in place as well as the degree and quality of implementation of livestock protection measures as well as many others (Pimenta et al. 2017; Janeiro-Otero et al. 2020; Sidorovich et al., 2003; Sime et al., 2008). A general statement on the level of loss based solely on the number of wolves present is therefore not possible. Experience to date does not allow any precise conclusions to be drawn as to why, when and by which wolves cattle are attacked.

The protection of cattle is a challenging task that must be considered in the long term. Implementation of instant measures such as fladry fences and Foxlights can help to protect livestock in an acutely threatening situation, while interventions such as electrified fences or system measures target long-term protection. For cattle, experience has also shown the effectiveness of operational adjustments and livestock protection measures (e.g. Bruns et al. 2020). However, these measures are often challenging to implement and have an impact on farm operations and workload. Therefore, in order to make their use more possible, the involvement of practitioners such as farmers and fence-builders is needed in addition to funding programmes in order to review, develop and integrate practicable solutions.

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Research

FENCING TO PROTECT CATTLE FROM WOLVES IN PORTUGAL

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1. Introduction

Damage to livestock caused by wolves (*Canis lupus*) has been one of the most common impediments to their acceptance by rural communities. Persecution of the wolf in response to its impact on livestock caused the species to disappear from some regions which, in turn, led to the gradual abandonment of traditional husbandry such as shepherding and night confinement in favour of open-range grazing. Unprotected livestock is vulnerable to predators recolonising their former range (Chapron et al., 2014). When there are no adequate mitigation systems in place, retaliatory killings may follow livestock losses and are one of the most important factors hindering wolf survival and recovery (Liberg et al., 2012).

Non-lethal damage prevention measures are often promoted with the aim of reducing conflicts and thus increasing acceptance of wolf presence. General recommendations include shepherding, predator-proof fences, particularly mobile or permanent electric fences, night confinement and livestock guarding dogs (e.g. Boitani, 2000; Linnell and Cretois, 2018). Their use typically requires considerable investment by farmers, not only financial but also in terms of the effort to implement and maintain them in good condition and to make associated changes in husbandry practices. For this to be worthwhile, measures must be effective and efficient.

Assessing the efficacy of damage prevention measures is important to inform future recommendations on their use by farmers and validating them as relevant within wolf conservation actions, but also to establish trust in the measures and in the entities proposing them. Furthermore, it is also important to transmit reliable information on expected costs and possible problems as well as their potential advantages in order to avoid frustration and mistrust that may undermine efforts towards coexistence with wolves.

In Portugal, wolves have been strictly protected by national law since 1988, but the species is still endangered (Fig. 1). The population is stable overall, with recolonisation in some regions offset by reduction in numbers elsewhere (Álvares et al., 2015). It is divided into two nuclei: one north of the Douro River which is more stable and connected with the Spanish population and the other south of the river which is more fragmented and isolated (Pimenta et al., 2005).

Fig. 1 The Iberian wolf has been fully protected in Portugal since 1988 but is still endangered. *(Photo: Diana Barreto / Grupo Lobo)*

The latter was the focus of the LIFE MedWolf project (LIFE11 NAT/IT/069), implemented in 2012–2017 in Portugal and the Province of Grosseto, Italy (see Salvatori et al., 2021 in *CDPnews* issue 21). Its goal was to decrease the impact of the wolf on livestock in areas where the cultural tradition of coexistence with predators had been lost. In this article, we focus on Portugal.

A survey conducted within the project in 2016 in the Guarda and Castelo Branco districts found a 6-fold range expansion of wolves in the region since the last national survey in 2002/03. The presence of two packs was confirmed with a third considered probable, compared to only two probable packs in 2002/03, and a minimum density of 1.42 wolves/100 km^2 (Palacios et al., 2017; Pimenta et al, 2005). Although there have not been any studies of their diet, wolves in this area seem to be highly dependent on livestock for food, probably due to a scarcity of wild prey and high densities and availability of livestock (Álvares et al., 2015). An analysis of official damage records conducted within the MedWolf project revealed that from 2012 to 2016 a total of 449 predation events occurred resulting in 1,213 animals killed, wounded or missing (Palacios et al., 2017). Attacks were more frequent in the northern part of the project area. The highest number (149) occurred in 2014 and the lowest (65) in 2016. Most attacks were on cattle (50%) or sheep/goats (34%), with fewer on donkeys (9%) or ostriches (7%) (Fig. 2). However, sheep/goats (69%) were most often killed/injured/missing as a result of attacks, followed by cattle (24%). The average number of animals affected per attack was highest for sheep/goats (5.8), followed by ostriches (1.5), cattle (1.4) and donkeys (1.1).

Compensation for losses caused by wolves has been available throughout the wolf range in Portugal for 30 years. Payment is conditional on the use of

Fig. 2 Wolves preyed on ostriches at one farm in the project area, causing high economic losses. *(Photos: Grupo Lobo)*

prevention measures. An analysis of damage records in the intervention area carried out at the start of the project showed that shepherds were rarely present at the time of attacks and in 92% of cases where information was available livestock was unattended (Andrade et al., 2014). Where shepherds were present, they were accompanying goat and/or sheep flocks (Fig. 3). Furthermore, livestock guarding dogs (LGDs) were not present during most predation events (71%) where information was available. Livestock was insufficiently protected, especially at night, being left in fenced pastures permeable to wolves. We therefore identified improvements to night confinement as having the greatest potential to reduce predation.

Within the LIFE MedWolf project, we planned to implement electric and permanent metal fences with the aim of reducing losses to wolves of extensively grazed cattle and sheep. Farmers in the Portuguese project area expressed little interest in electric fences: they were perceived to be less effective at preventing damage in larger pastures (tens of hectares), which are common in the project area, and requiring extra work for regular maintenance. Permanent, non-electric metal fences, on the other hand, were regarded more favourably for fencing smaller areas to confine livestock in specific situations (e.g. night confinement, during calving/lambing) and were implemented within the project mainly to protect cattle, although some sheep flocks and one ostrich farm were also included. Here, we present our main findings and assess the advantages and disadvantages of the methods used.

2. Intervention area

The project area was in the centre of Portugal, bordering Spain and south of the Douro River (Fig. 4). It consists of a plateau (elevations of 300–900 m) with Mediterranean habitats composed of mixed oak forests and shrubs. The humanised landscape consists mainly of agricultural patches interspersed with forested areas and small scattered villages. It covers seven municipalities and includes four protected areas[1], one Natura 2000 site (Malcata) and one private natural reserve (Faia Brava). It is characterised by a low human population density, with an average of 18.8 inhabitants/km^2 (INE, 2013), where farming and husbandry are the main economic activities.

Cattle, sheep and goat flocks, raised for meat production, are grazed in large areas that include pastures, brush and forest patches. These are typically fenced for confinement purposes using 1–1.2 m high wire mesh or 4–5 strands of barbed wire or, sometimes, a single electrified wire (Fig. 5). Shepherds, LGDs and night confinement are rarely used. Livestock, especially cattle, may be kept in pastures year-round, including during calving (Fig. 5). Farmers usually visit their livestock once a day, checking for new-borns

[1] International Douro Natural Park, Estrela Mountain Natural Park, Malcata Mountain Natural Reserve, International Tejo Natural Park.

Fig. 3 Shepherds and livestock guarding dogs accompanied some sheep/goat flocks but were not common in the project area. *(Photos: Clara Espírito-Santo, Grupo Lobo)*

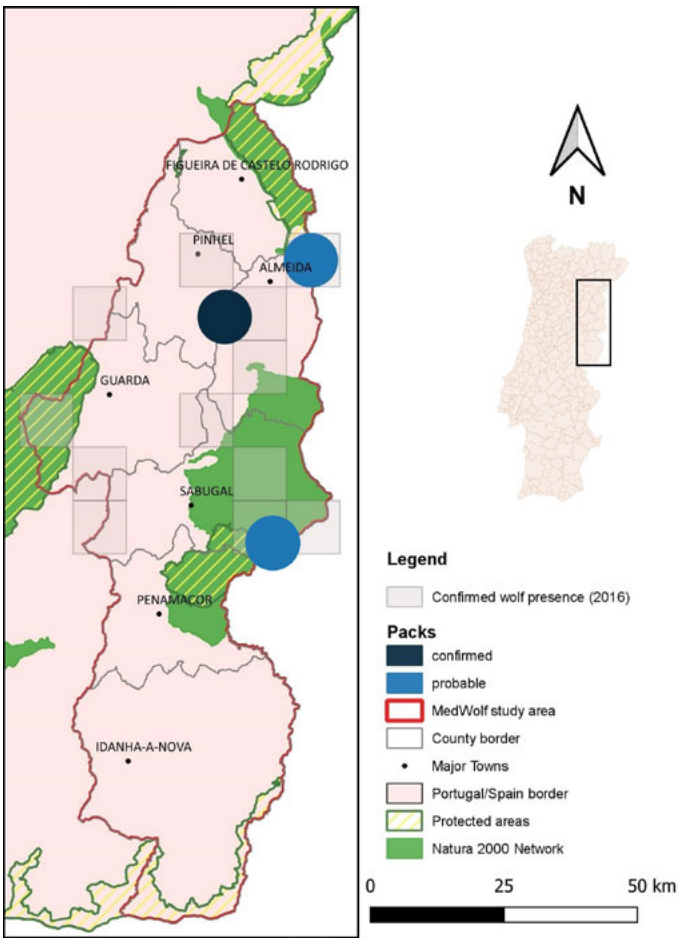

Fig. 4 Location of the project area showing municipalities, wolf range and packs in 2016 (Source: Palacios et al., 2017).

and any problems as well as providing additional food or water if necessary.

Within the project, an initial survey was conducted of 50 farmers with reported damages during the preceding six years or in high-risk areas. Information on wolf damage was provided by the national entity that manages this issue (ICNF). High-risk areas were considered to be those within confirmed wolf pack territories. Cattle herds ranged from four to 100 head (mean = 36) and goats/sheep were kept in flocks of between five and 600 animals (mean = 79) (Andrade et al., 2014). There was also an ostrich farm with 70 animals. Around 44% of farms kept from one to 34 horses or donkeys (mean = 4.5), which were used mainly for breeding or leisure. The average size of farms was 256 ha, with most (60%) in the range 40–320 ha.

Wild prey occurred at low densities, mostly outside the wolf range. Estimated densities of wild boar (*Sus scrofa*) ranged from zero in the north to 1.7 inds./km^2 in the south (Bosch et al., 2012). Red deer (*Cervus elaphus*) were expanding in the southern part, having reached the central area in 2009, and roe deer (*Capreolus capreolus*) were recorded in northern and central areas at the end of the 20th century (Salazar, 2009). Wild ungulate numbers seem to be increasing but this has not been systematically evaluated.

According to the national agriculture census, numbers of sheep and goats in the wider region decreased by 32% and 51%, respectively, whereas the number of cows increased by 12% from 1999 to 2009 (INE, 2011). The average number of sheep (67.4) and goats (10.7) per farm was fairly stable during this period but the number of cows increased from 8.8 to 30 head per farm. In 2009, there were around 61,800 cattle and 425,400 sheep/goats with a total livestock density of 41 head/km^2, far higher than that of wild ungulates.

Fig. 5 Free-ranging cattle are grazed year-round in large pastures with permeable fences that leave them vulnerable to wolves.

(Photos: Grupo Lobo)

3. Methods

In the extensive system of livestock grazing common in the project area, fencing all the pastures was considered unfeasible for ecological and financial reasons, so efforts were focused on identifying and securing the most vulnerable situations. Fences were built to protect calving cows, newborn/young livestock during the day or night or the entire herd/flock at night. The project donated fencing material (metal wire/mesh and poles) at an average cost of €3,500 per farm and farmers were responsible for building the fences and providing gates, with technical support from project staff.

This collaborative approach maximised the number of farmers that could be supported from the available budget and helped ensure that farmers were involved in the process and took responsibility for proper use and maintenance of fences. Participating farmers signed an agreement in which they undertook to comply with project guidelines for fence construction and obtaining necessary licenses, maintaining fences, informing project staff of any problems and allowing them to conduct on-site monitoring.

3.1. Farm selection

Farms were included in the project based on the following criteria: i) they had experienced wolf damage; ii) farmers were committed to long-term operation; iii) farmers were motivated to use fences; iv) farms with cows and sheep were prioritised; v) the terrain was considered suitable for fence construction; vi) included farms had a minimum size of 5 ha and 10 livestock units (LSU). We used data from the initial survey to identify potentially suitable farms which were then visited to conduct an ad-hoc questionnaire survey.

3.2. Fence design and construction

The specific characteristics and site of each fence were adapted to individual farm context and needs. However, all fences were made of welded iron mesh

Fig. 6 Fencing to protect sheep and cattle from wolves, constructed from iron mesh welded panels, cement and granite poles and a concrete plinth under the gates to prevent digging. *(Photos: Dario Petrucci, Grupo Lobo)*

Fig. 7 Chain-link mesh fence at an ostrich farm with cement poles and concrete (masonry) base to prevent digging. *(Photos: ESACB, Grupo Lobo)*

panels (15 × 15 cm mesh for cows, 10 × 10 cm for sheep) with a height of 200–220 cm plus 20–40 cm buried underground. Poles were made of iron, cement or granite. A concrete or rock plinth was placed beneath iron gates to prevent digging (Fig. 6). The ostrich farm had irregular terrain, so a more malleable material was used: chain-link with 10 × 10 cm mesh. The bottom of this fence was concreted to prevent digging and in some places was topped with barbered wire and an outward-facing overhang (Fig. 7).

A total of 34 fences (1–3 per farm) were built at 19 farms, mostly in Almeida municipality (Fig. 8). The first fences started to be built in 2013 and most were finished in 2015. On average, they enclosed an area of 12,509 m^2 with a perimeter length of 390 m (Table 1).

3.3. Assessment of efficacy

The efficacy of project fences was assessed in three ways: 1) a before/after analysis of damage levels; 2) comparison of damage at farms with fences (treatment)

versus neighbouring farms without; and 3) ratings of user satisfaction. To compare levels of damage, we used official records, i.e. compensation claims made by farmers and verified by wardens via site visits. For treatment farms / herds, damage that occurred within fences or in pastures near fences where livestock could have been confined was included in the analysis. Fences were monitored to ensure they were properly used and maintained and that husbandry practices did not change.

A total of 22 fences at 16 farms (11 cattle, four sheep, one ostrich) were included in the before/after analysis. This analysis was done in 2014–2016 and did not include fences that were only recently completed at the end of this period. As the date of completion varied among fences, we defined the "before" period separately for each fence as the number of months during which damage was monitored before the fence was completed (mean = 23 months / fence, 31 months / farm) and then summed this for all fences combined (total = 499 months). Similarly, the duration of the after "period", when fences were in use, was calculated for each fence separately (mean = 13 months / fence, 19 months / farm) and summed for all fences across all fences combined (total = 306 months). For each period, the total number of attacks and total livestock killed, injured or missing were summed for all fences combined and then averaged to obtain values per farm and per month.

For the second comparison, we considered 26 project fences (18 for cattle and eight for sheep) at 15 farms that were in operation throughout the period from September 2016 to September 2017. The ostrich farm was excluded from this analysis since there was no other ostrich farm nearby. Neighbouring farms were all those that i) had the same livestock species as the nearest project farm; ii) reported damage during the observation period; and iii) were within 7.7 km of a project fence. This distance was based on the average

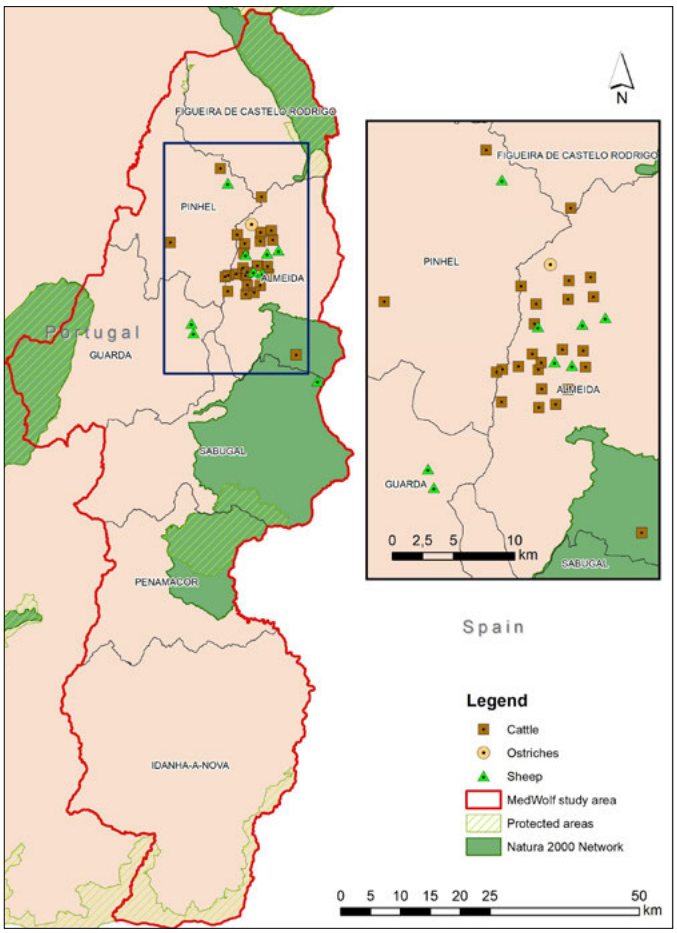

Fig. 8 Location of project fences in relation to municipalities and protected areas.

radius of a wolf pack territory, whose size (mean = 185 km^2) was estimated by telemetry studies in the region (Álvares et al., 2015). Total livestock damage that occurred during the period of analysis was compared at project farms versus neighbouring farms. A period of one year was considered to account for the annual grazing movements of livestock and for wolf bio-ecological dynamics that might have influenced predation rates.

At the end of the project, participating farmers involved in the neighbouring farm analysis were asked to rate their level of satisfaction with the fences using

Table 1 Numbers and characteristics of farms, livestock and fences included in the project.

Farm		Livestock (head)			Fences		
Type	**n**	**Range/farm**	**Mean/herd**	**Total**	**n**	**Perimeter (m)**	**Area (m^2)**
Cattle	12	30–600	173	2,044	24	80–1,160	400–54,000
Sheep	6	32–320	147	881	9	60–400	240–8,400
Ostriches	1	26	26	26	1	1,370	63,770
Total	19	–	–	2,951	34	13,260	425,306
Average	–	–	137	–	–	390	12,509

a four-point scale, from 'very satisfied' to 'not at all satisfied'. They were also asked to describe any problems or advantages they may have experienced while using them.

4. Results

There were no attacks by wolves on cattle or sheep within completed fences and no attempted entry (digging) was detected. At the ostrich farm, three adult birds were killed in one attack 18 months after the fence was completed. This was probably due to terrain irregularity outside the fence, that enabled a wolf to jump over the fence. Following this incident, the fence was immediately improved by raising its height in some sections by 50 cm or adding extra strands of barbed wire and no further attacks occurred during the subsequent 27 months until the end of the project.

4.1. Before / after analysis

The number of wolf attacks on livestock and the number of livestock affected were both substantially lower after fences were constructed compared to the period before. There was an 83% reduction in the average number of attacks per month and an 88% decrease in the average number of livestock killed, injured or missing per month (Table 2).

Table 2 Comparison of damage before and after fence construction at 16 farms.

Number of wolf attacks	Before	After
Total across all farms	119	11
Mean / farm	7.44	0.69
Mean / month	0.24	0.04
Livestock killed/injured/missing		
Total across all farms	210	14
Mean / farm	13.13	0.88
Mean / month	0.42	0.05

4.2. Comparison with neighbouring farms

Throughout the one-year monitoring period, only one project farm (with two fences) was impacted by wolf predation, with a total of 12 sheep killed, one injured and seven missing as a result of five attacks. At least three of the attacks occurred when the flock was left outside the fence at night instead of being confined within it. Wolves caused significantly more damage at neighbouring farms without project fences ($Z = -3.77$, $p < 0.001$). On average, eight cattle and one sheep farm within 7.7 km of each project fence registered wolf damage during the monitoring period affecting a total of 200 head (139 cattle, 61 sheep).

4.3. Farmer satisfaction

Most farmers asked (60% of 15) were 'satisfied' or 'very satisfied' with their fences. They invested considerable labour, time and money in their construction and in some cases replicated project fences or increased the size of fenced areas at their own expense.

No problems or accidents were reported with the use of the fences or the movement of livestock in and out. Besides reducing losses to wolves, farmers mentioned several other benefits: i) protection against other predators (e.g. dogs and foxes); ii) improved livestock management and animal handling; iii) a predator deterrent effect of higher human presence; iv) peace of mind knowing that livestock is well protected.

When asked if they experienced any problems or disadvantages in using permanent fences, farmers mentioned higher production costs and increased daily workload. This included additional time needed to confine livestock at night and take them to pasture in the morning when compared to the 'traditional' daily visit that can be done at any time. This was particularly pertinent for farms with two or three fences, which were sometimes far apart. The number of fences needed may also be a constraint, considering the cyclical movements of livestock during the year through different pastures, often distant from one another. In such cases, building several fences would further increase costs and labour. Some farmers considered the fences too small, limiting any possible increase in livestock numbers.

5. Discussion and Conclusions

Within the LIFE MedWolf project we helped farmers to construct permanent, non-electric fences to protect their livestock from wolves. Designed to be solid, durable, easy to build and low maintenance, the fences are intended to provide protection at vulnerable times, especially at night or during sensitive physiological states such as parturition and early suckling, weaned animals and replacement heifers. Our

(Photo: Grupo Lobo)

analyses confirmed their efficacy in reducing losses to predation in the extensive grazing systems which are common in areas recently recolonised by wolves in Portugal. The number of wolf attacks and the number of animals killed, injured or missing declined after completion of fences and was lower than at neighbouring farms without such fences. The occurrence of attacks on sheep left outside a fence at night further illustrates the effectiveness of the measure, which can be optimised through consistent proper use.

Participating farmers recognised the efficacy of the fences when used properly, but also noted the extra cost and effort they entail. Long-term provision of financial incentives by the state may help to alleviate this aspect. Night-time confinement of livestock requires changes to current husbandry practices in the area, which may not always be easy to implement due to socio-cultural, economic or technical constraints. New measures often take time to be accepted and adequately implemented as motivation to use them is influenced by multiple factors including knowledge and awareness, confidence in the measures, their cost effectiveness, trust in experts and the availability of economic incentives. It is therefore important to provide farmers with technical support and encouragement over a prolonged period until new ways of working become embedded and self-sustaining. (*Editor's note:* For a case study on identifying and overcoming barriers to the uptake of innovative solutions, see Sibanda et al., 2021 in *CDPnews* issue 22.)

Choice of tools and techniques should be considered within a wider damage prevention strategy. In many instances, the best outcome is likely to be achieved with a combination of measures (see Espuno et al., 2004). Where it is not possible or desirable to keep livestock permanently confined, LGDs can offer useful protection of grazing animals during the day. On the other hand, not all farmers are able to provide suitable conditions to enable LGDs to be effective guardians. In such cases, fencing may be a more straightforward option.

We cannot discount the possibility that lower levels of damage observed at farms with fences may reflect, at least to some extent, deflection of wolf

attacks to neighbouring farms where livestock was less protected. If so, the effectiveness of the fences might decline as their use spreads to more farms. A shift in the relative availability of wild versus domestic prey could also play a role. The efficacy of fences should be re-assessed if contexts change to guide adaptive management and selection of measures to be implemented.

Overall, our results indicate the feasibility of protecting livestock with non-electric fences. We want to emphasise that our findings are specific to the intervention area and the farms involved. Prevention measures should always be adapted to the husbandry of individual farms and farmers' ability to implement them.

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Short communication

CDPNEWS READER SURVEY RESULTS

Robin Rigg, Silvia Ribeiro, Valeria Salvatori, Micha Herdtfelder, Daniel Mettler

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1. Goal and method

As members of the editorial team, we constantly strive to make Carnivore Damage Prevention News *(CDPnews)* a valuable source of information for you, our readers. To help us better understand your preferences and guide our editorial decision-making, in spring this year we conducted a reader survey.

We prepared a questionnaire in Google Forms consisting of 21 items organised into five sections covering characteristics of respondents and their ratings of the content, style, format, accessibility and usefulness of *CDPnews*. Most items were closed questions, with multiple-choice or Likert-type scale responses, but we also included a few open questions to allow more detailed expression of opinions.

A link to the online survey was featured in issue 24 and associated emails sent to mailing lists as well as on our website. Between 17th March and 24th May 2022, we received a total of 90 responses which were used for the following analysis.

2. Results

2.1 Respondents

Respondents most frequently described their main role in relation to carnivores as researcher (40%), practitioner (16%), expert advisor (14%), manager (8%) or conservationist/environmentalist/naturalist (7%). They stated that they work mostly in Europe (75%) followed by North America (12%), Asia (6%), Africa (5%) and South America (2%). Within Europe, Germany (34%) was most frequently mentioned, followed by Portugal (26%), Italy (10%), Spain (7%) and Switzerland (7%).

Respondents most frequently stated that they first heard about *CDPnews* by word of mouth (34% of responses), in a mailing list (26%) or website (22%). Most of them indicated that they had read a few (47%) or most (30%) issues, typically focusing on the parts that interest them (73%) or reading it from cover to cover (19%). Most began reading *CDPnews* after AGRIDEA became the publisher (53%) or during the preceding period of the LIFE MedWolf project (28%). The majority of respondents (76%) said they receive *CDPnews* by email (e.g. mailing list, newsletter) and 30% download it from the *CDPnews* website.

2.2 Content

When asked about the usefulness of various types of content, articles were most often rated as "very useful" or "useful", followed by abstracts, news roundup, books/reports, interviews, events, videos and, lastly, editorials (Fig. 1). Only 1–7% of responses indicated that any of these items was considered "not useful".

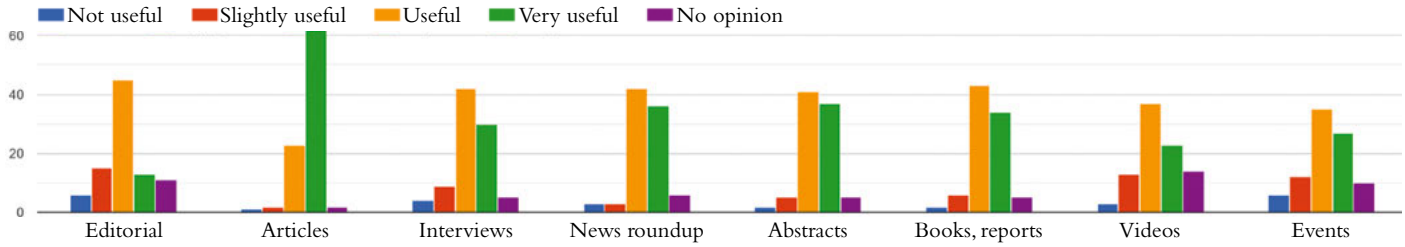

Fig. 1 Responses to the item, "Please rate the usefulness of the following sections".

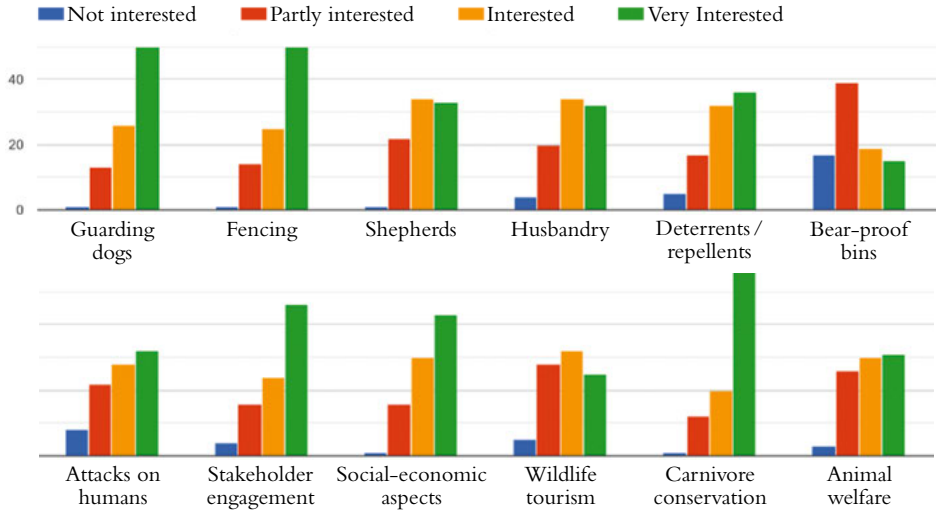

Fig. 2 Responses to the item, "Please indicate your interest in reading about the following topics".

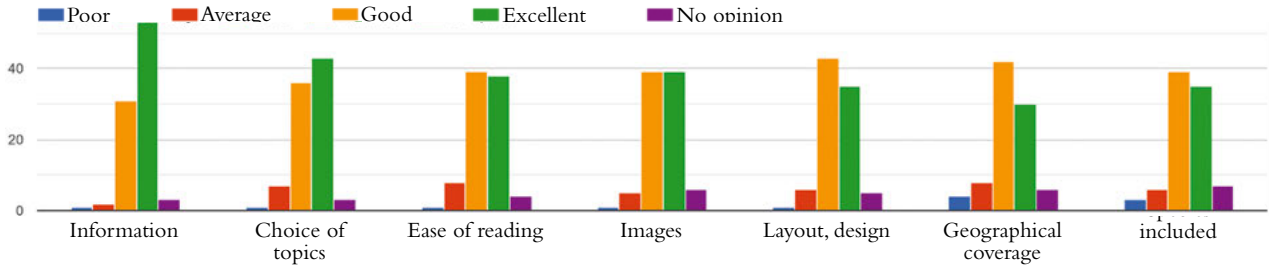

Fig. 3 Responses to the item, "Please rate the quality of CDPnews".

Respondents were most commonly "very interested" or "interested" in carnivore conservation followed by guarding dogs and fencing, stakeholder engagement, socio-economic aspects, deterrents / repellents, shepherds, husbandry, attacks on humans, animal welfare, wildlife tourism and, lastly, bear-proof bins (Fig. 2). Twenty respondents also took the opportunity to mention other topics that they would like to read about, such as damage caused by golden jackals, methods to facilitate coexistence with urban carnivores and countering disinformation.

2.3 Quality

Under the item which asked respondents to assess the quality of *CDPnews*, all seven listed aspects were rated positively much more often than they were rated neutrally or negatively. Information content was most often rated favourably ("excellent" or "good"), followed by choice of topics, images, ease of reading, layout / design, species included and geographical coverage (Fig. 3).

2.4 Style

A clear majority of respondents (71%) "like the current style". Far fewer would prefer it to "contain more scientific data and analysis" (19%) or, conversely, "be more like a magazine: less technical" (8%). Similarly, most respondents rated the current length of *CDPnews* (the number of pages per issue) as "usually about right" (69%), with the remainder considering it "a bit too long" (14%) more often than "a bit too short" (4%).

2.5 Format and accessibility

The preference of most respondents for viewing *CDPnews* is in the form of whole-issue pdfs (62%) and/or an online version (59%). Minorities would like there to be separate pdfs for each article (26%) and/or a paper version (19%). Online publication of individual articles as they are completed was the least preferred option (7%). No other formats were suggested by respondents.

Most respondents (79%) stated that language is not an obstacle for them or their colleagues to read *CDPnews* (this finding is probably biased because people for whom language is a barrier would have been less able to complete the questionnaire). Those who answered that language was an obstacle would most often prefer to read it in German, followed by French.

2.6 Usefulness

A large majority of respondents rated *CDPnews* as "useful" (49%), "very useful" (37%) or somewhat useful (13%) for their work. A total of 51 responses were received to the item, "Please specify in what way(s) *CDPnews* is useful for your work or, if it is not, what changes could help to make it more useful for you?" All the responses were positive, expressing appreciation of *CDPnews* as an accessible source of up-to-date information and a platform for exchange of knowledge, experience, new ideas and perspectives. The only specific suggestion for improvement, made as part of a positive response, was to add more scientific information (control vs. treatment) and analysis.

When asked what other sources of information on carnivore damage prevention they use regularly, respondents most often mentioned scientific publications (31% of all responses), peers, colleagues or other personal contacts (13%), the internet (10%), seminars, webinars, conferences or other meetings (10%).

Conclusions

Although the survey method has inherent biases and weaknesses (for example, we do not know if the opinions of those people who opted in are representative of our readership as a whole or what are the views of people who are not current readers of *CDPnews*), the responses to the questionnaire provide valuable information and insights that we will utilise in our planning process for the next cycle of issues as we prepare for a new funding period.

Overall, the results are very encouraging. It seems that the majority of readers like the existing format, style and content of *CDPnews* and rate its quality favourably. There is no obvious call for major changes except that a majority of respondents want to have an online version of *CDPnews*. In addition, a substantial minority of respondents would welcome separate pdfs for each article. If archived in an online database within the *CDPnews* website, this would have the added benefit of enabling searches by topic, species, country and so on. There is also an opportunity to refresh the layout/design for the next publication period.

The survey results provide good evidence that *CDPnews* is reaching its target audience. While the largest proportion of respondents identified themselves as researchers, an almost equal number stated their main role as practitioner, expert advisor or manager. The exclusively positive nature of responses to the open question on its usefulness also indicates that *CDPnews* is making an impact by disseminating up-to-date information and sharing knowledge and experience among field workers.

We are very grateful to everyone who completed the survey. If you did not do so and would like to offer feedback or make suggestions, you can contact us by writing to: info@cdpnews.net.

ABSTRACTS OF SCIENTIFIC ARTICLES

DIVERSE PREVENTION MEASURES

KEEPING PREDATORS OUT: TESTING FENCES TO REDUCE LIVESTOCK DEPREDATION AT NIGHT-TIME CORRALS

Gustaf Samelius et al.

Oryx:
May 2021

https://doi.org/10.1017/S0030605319000565

Livestock depredation by large carnivores is a global conservation challenge, and mitigation measures to reduce livestock losses are crucial for the coexistence of large carnivores and people. Various measures are employed to reduce livestock depredation but their effectiveness has rarely been tested. In this study, we tested the effectiveness of tall fences to reduce livestock losses to snow leopards (*Panthera uncia*) and wolves (*Canis lupus*) at night-time corrals at the winter camps of livestock herders in the Tost Mountains in southern Mongolia. Self-reported livestock losses at the fenced corrals were reduced from a mean loss of 3.9 goats and sheep per family and winter prior to the study to zero losses in the two winters of the study. In contrast, self-reported livestock losses in winter pastures, and during the rest of the year, when herders used different camps, remained high, which indicates that livestock losses were reduced because of the fences, not because of temporal variation in predation pressure. Herder attitudes towards snow leopards were positive and remained positive during the study, whereas attitudes towards wolves, which attacked livestock also in summer when herders moved out on the steppes, were negative and worsened during the study. This study showed that tall fences can be very effective at reducing night-time losses at corrals and we conclude that fences can be an important tool for snow leopard conservation and for facilitating the coexistence of snow leopards and people.

A COST-EFFECTIVE APPROACH TO MITIGATE CONFLICT BETWEEN RANCHERS AND LARGE PREDATORS: A CASE STUDY WITH JAGUARS IN THE MAYAN FOREST

J. Antonio de la Torre et al.

Biological Conservation:
April 2021

https://doi.org/10.1016/j.biocon.2021.109066

Conflicts between humans and large carnivores are exacerbated in poor rural areas where people's livelihood depends on livestock ranching. Here we present a pseudo-experimental and co-participatory approach to test the effectiveness of a program to mitigate conflicts with jaguars (*Panthera onca*) in Mexico's Mayan Forest. We worked with eleven ranchers with a recent history of livestock predation by jaguars to codesign, implement, and evaluate changes in their husbandry practices intended to reduce the risk of predation and to increase livestock productivity. We used four parameters to evaluate the effectiveness of the program and found that (1) the use of electric fences and night enclosures greatly reduced the rate of predation on the livestock; (2) the cost of building such protection infrastructure was financially offset by the lack of losses to predation; (3) the application of more science-based husbandry practices led to an overall increase in livestock productivity; and (4) jaguar presence in at least seven of the eleven ranches, showing that the lack of predation was not due to jaguar absence. Our neat results show that conflict between local communities and large carnivores can be largely mitigated through ranchers' capacity building and applying evidence-based husbandry techniques. This approach leads to win-win situations for both jaguars and the local communities and hence can be scaled up to promote coexistence between people and large carnivores in the Mayan Forest and elsewhere.

PATHWAYS TOWARDS COEXISTENCE WITH LARGE CARNIVORES IN PRODUCTION SYSTEMS

L. Boronyak et al.

Agriculture and Human Values: March 2022

https://doi.org/10.1007/s10460-021-10224-y

Coexistence between livestock grazing and carnivores in rangelands is a major challenge in terms of sustainable agriculture, animal welfare, species conservation and ecosystem function. Many effective non-lethal tools exist to protect livestock from predation, yet their adoption remains limited. Using a social-ecological transformations framework, we present two qualitative models that depict transformative change in rangelands grazing. Developed through participatory processes with stakeholders from South Africa and the United States of America, the models articulate drivers of change and the essential pathways to transition from routine lethal management of carnivores towards mutually beneficial coexistence. The pathways define broad actions that incorporate multiple values in grazing systems including changes to livestock management practices, financial support, industry capacity building, research, improved governance and marketing initiatives. A key finding is the new concept of 'Predator Smart Farming', a holistic and conscientious approach to agriculture, which increases the resilience of landscapes, animals (domesticated and wild) and rural livelihoods. Implementation of these multiple pathways would lead to a future system that ensures thriving agricultural communities, secure livelihoods, reduced violence toward animals, and landscapes that are productive and support species conservation and coexistence.

FACTORS INFLUENCING DAMAGE AND CONFLICTS

OCCURRENCE AND LIVESTOCK DEPREDATION PATTERNS BY WOLVES IN HIGHLY CULTIVATED LANDSCAPES

Martin Mayer et al.

Frontiers in Ecology and Evolution: February 2022

https://doi.org/10.3389/fevo.2022.783027

Attacks by large predators on livestock are an important driver of conflicts. Consequently, knowledge about where predators occur, where livestock depredation takes place and what factors influence it will aid the mitigation of stakeholder conflicts. Following legal protection, wolves (*Canis lupus*) in Central Europe are recently spreading to areas dominated by agriculture, bringing them in closer contact with livestock. Here, we analyzed habitat selection and livestock depredation rates of 43 wolves identified by genotyping on the Jutland peninsula, consisting of mainland Denmark and the northernmost German federal state Schleswig-Holstein. Occupancy by resident wolves correlated positively with forest and other non-forested semi-natural land cover (habitat for natural ungulate prey), whereas occupancy by non-resident wolves correlated with increasing forest cover and sheep density. The latter effect likely reflected increased sampling probability of highly mobile dispersers killing livestock. We recorded 565 livestock depredation events (85 in Denmark and 480 in Schleswig-Holstein), of which 42% (55 in DK and 185 in SH) could be assigned to 27 individual wolves based on DNA evidence. Livestock (mostly sheep) were killed by wolves in 16% of the study area. Our results indicate that wolves mostly killed livestock as a context-dependent response, i.e., being dispersers in agricultural areas with low availability of wild ungulate prey and high livestock densities, and not because of behavioral preferences for sheep. Moreover, the livestock depredation was lower in areas with livestock protection measures (implemented in areas with established pairs/packs). We conclude that while wolf attacks on livestock in established wolf territories generally can be reduced through improvement of fences, livestock depredation by non-resident wolves in agricultural areas constitutes a bigger challenge. Albeit technically possible, the economic costs of implementing predator-proof fences and other preventive measures in such pastoral areas infrequently visited by wolves will be considerable. Experiences so far further indicate that lethal removal of identified "problem wolves" may be inefficient in practice.

DO ANTHROPOGENIC SOURCES OF FOOD INCREASE LIVESTOCK PREDATION IN THE AREA SURROUNDING RUAHA NATIONAL PARK?

Montan M Kalyahe et al.

Environmental Conservation: March 2022

https://doi.org/10.1017/S037689292200008X

Wild carnivores are threatened by human activities, particularly by lethal responses to livestock predation. As natural prey populations decline, predation of livestock and consumption of discarded livestock 'waste' (carcasses and body parts) should increase. We investigated whether parameters linked to the production of livestock waste affected the likelihood of livestock predation. We interviewed 160 households near Ruaha National Park in Tanzania to obtain information on households, livestock ownership, predation and parameters linked to livestock waste production. Our analysis identified parameters that affected the likelihood of predation on cattle, sheep and goats. When these parameters were controlled for, we found an increased likelihood of cattle predation as waste from diseased and slaughtered cattle increased. Sheep predation was more likely and cattle predation was less likely as sheep deaths from starvation increased. Goat predation was more likely in medium-sized than smaller or larger villages, suggesting a trade-off to predators between the increasing benefit of more livestock waste and the costs of higher human disturbance and diminishing natural prey abundance as village size category increased. Our findings suggest that improved disposal of livestock waste from slaughtered cattle and measures to decrease cattle deaths from disease should reduce predation of highly prized cattle

FINANCIAL MECHANISMS

ASSESSING THE EFFECTIVENESS OF A COMMUNITY-BASED LIVESTOCK INSURANCE PROGRAM

Justine Shanti Alexander et al.

Environmental Management: April 2021

https://doi.org/10.1007/s00267-021-01469-8

Financial mechanisms to mitigate the costs of negative human-carnivore interactions are frequently promoted to support human coexistence with carnivores. Yet, evidence to support their performance in different settings is scarce. We evaluated a community-based livestock insurance program implemented as part of a broader snow leopard conservation effort in the Tost Tosonbumba Nature Reserve, South Gobi, Mongolia. We assessed program efficiency and effectiveness for snow leopard conservation using a results-based evaluation approach. Data sources included program records from 2009 to 2018, as well as surveys conducted in 2016 and 2017, which allowed us to compare key indicators across communities that participated in the insurance program and control communities. Program coverage and number of livestock insured rapidly increased over the years to reach 65% of households and close to 11,000 livestock. Participants expressed satisfaction with the program and their contributions increased over time, with an increasing proportion (reaching 64% in 2018) originating from participant premiums, suggesting strong community ownership of the program. Participants were less likely to report the intention to kill a snow leopard and reported fewer livestock losses than respondents from control communities, suggesting increased engagement in conservation efforts. These results together suggest that the insurance program achieved its expected objectives, although it is challenging to disentangle the contributions of each individual conservation intervention implemented in intervention communities. However, in the first three years of the program, snow leopard mortalities continued to be reported suggesting that additional interventions were needed to reach impact in terms of reducing retaliatory killings of large carnivores.

PUBLIC WILLINGNESS TO PAY FOR GRAY WOLF CONSERVATION THAT COULD SUPPORT A RANCHER-LED WOLF-LIVESTOCK COEXISTENCE PROGRAM

Lily M. van Eeden et al.

Biological Conservation: August 2021

https://doi.org/10.1016/j.biocon.2021.109226

Financial tools can present a solution to conservation conflicts. However, their effectiveness may be limited unless they address the underlying drivers of conflict. The restoration of controversial megafauna can be tied to a clash of urban and rural values and rejection by rural landowners of government control over their actions. Here, we consider a latent financial opportunity presented by general public support for large predator restoration to maintain a wolf-livestock coexistence program in Washington state, USA. We measured respondents' (N = 420) willingness-to-pay for gray wolf (*Canis lupus*) conservation and their preferences for program funding mechanisms, including voluntary contributions, mandatory taxes, and a 'predator-friendly' ranching certification scheme. Respondents were supportive of a publicly funded program, which represented around USD246 million in estimated economic value. This benefit is more than 150 times the cost of the current government-run program. There were mixed preferences for funding mechanisms, so we recommend adopting multiple approaches. A new funding source would allow the program to be rancher-led, shifting agency from government to rural communities, as well as providing outreach opportunities for ranchers to the urban public. As such, our proposal addresses two of the major socio-political conflicts underlying the wolf debate in North America while also generating funding to protect the ranching industry.

HUMAN DIMENSIONS AND ATTITUDES

PREDATOR TOURISM IMPROVES TOLERANCE FOR PUMAS, BUT MAY INCREASE FUTURE CONFLICT AMONG RANCHERS IN CHILE

Omar Ohrens et al.

Biological Conservation: June 2021

https://doi.org/10.1016/j.biocon.2021.109150

Predator tourism is one strategy to improve tolerance for predators, and support biodiversity and ecosystem health. Torres del Paine National Park (TdP) – a UNESCO Biosphere Reserve in southern Chile – supports productive livestock industries and nascent puma tourism. We compared interviews conducted in the region prior to puma tourism, with results from interviews collected across 45 ranches post-puma tourism. We assessed rancher attitudes regarding pumas, puma-livestock conflict, puma tourism, and linked them with socio-ecological factors. Respondents who viewed pumas as a threat experienced higher livestock losses. Respondents who reported higher sheep losses were inclined to support the lethal removal of livestock-killing pumas, and to initiate a puma hunt, whereas respondents who supported puma tourism disagreed with hunting pumas. Using the Potential for Conflict Index, we found that participants exhibited the highest consensus on the benefit of puma tourism and the lowest consensus over lethal removal of pumas. Our results suggest predator tourism has increased tolerance for pumas but is creating new potential for conflict. Previous to puma tourism, ranchers were almost entirely negative about pumas and unanimously supported illegal puma hunting. Now, most believe that pumas are part of Patagonia's heritage. This divide was best explained by distance to TdP: ranches closer to TdP experienced greater losses to pumas but had neighbours that benefitted most from puma tourism. Therefore, we suggest that tourism revenues supplement community compensation insurance programs that reimburse rancher losses to pumas to mitigate the growing divide between those benefiting from pumas and those experiencing economic hardship.

EVALUATING THE IMPACT OF WARRIOR WATCH: BEHAVIOUR CHANGE TO PROMOTE HUMAN-LION COEXISTENCE

Alexandre Chausson et al.

Biological Conservation:
July 2022

https://doi.org/10.1016/j.biocon.2022.109571

Promoting human-wildlife coexistence is one of the most complex and pressing global conservation challenges faced today, particularly for large carnivore species. Effective conservation of large carnivores rests on interventions fostering coexistence in human-dominated landscapes, across the large ranges on which they depend. However, there is a paucity of research evaluating such interventions, and impact on the social determinants of behavioural outcomes. To bridge this evidence gap, we evaluate the impact of Warrior Watch, a grassroots intervention established in 2010 that draws on the traditional social structures and roles of Samburu pastoralists in northern Kenya to mitigate human-lion conflict peacefully. Using a novel approach blending elements of theory-based methods and traditional impact evaluations, and tailored to local resources and capacities, we evaluate the impact of Warrior Watch on a) attitudes towards lions and b) killing intentions as a proxy for tolerance. We show that warriors in the intervention site reported significantly more positive attitudes towards lions and were significantly less likely to indicate intentions to kill lions than their counterparts in the comparison conservancy. Furthermore, respondents in the intervention site were significantly more likely to report positive changes in their attitudes and tolerance towards lions since the inception of Warrior Watch, and to attribute these changes to the intervention. Our study demonstrates how evaluations tailored to local capacities and resource-limited situations can produce robust insights to support the adaptive management of interventions and increase the evidence-base to guide conservation practice.

EMOTIONS AND CULTURAL IMPORTANCE PREDICT THE ACCEPTANCE OF LARGE CARNIVORE MANAGEMENT STRATEGIES BY MAASAI PASTORALISTS

Arjun Dheer et al.

Frontiers in Conservation Science:
July 2021

https://doi.org/10.3389/fcosc.2021.691975

Management strategies to reduce human-carnivore conflict are most effective when accepted by local communities. Previous studies have suggested that the acceptance depends on emotions toward carnivores, the cultural importance of carnivores, and livestock depredation, and that it may vary depending on the types of strategies and carnivores involved. However, no study so far considered these factors simultaneously to compare their influence on the acceptance of management strategies. We quantified the predictive potential of these factors on the acceptance of three management strategies frequently applied to mitigate human-carnivore conflict: no action, relocation, and lethal control. We interviewed 100 members of the Maasai community in Ngorongoro Conservation Area in Tanzania. We used structured, closed questionnaires and focused on the three large carnivores involved in the most depredation regionally: spotted hyenas (*Crocuta crocuta*), lions (*Panthera leo*), and leopards (*Panthera pardus*). We found that the majority of respondents accepted no action and rejected relocation and lethal control for all three carnivores. The acceptance of the management strategies was strongly influenced by the emotion joy and by the cultural importance of carnivores, and the effects of joy and cultural importance were stronger than the effect of livestock depredation. We conclude that authorities should evaluate the emotions and cultural importance that local communities associate with carnivores when seeking to gain acceptance of management strategies and account for differences between species. Finally, we recommend that future human-carnivore coexistence studies should consider the socio-psychology of local communities and be done longitudinally to detect shifts in cultural, emotional, and ecological factors over time.

THE IMPORTANCE OF TANGIBLE AND INTANGIBLE FACTORS IN HUMAN–CARNIVORE COEXISTENCE

Kim S. Jacobsen et al.

Conservation Biology:
August 2021

https://doi.org/10.1111/cobi.13678

Conflict with humans is one of the major threats facing the world's remaining large carnivore populations, and understanding human attitudes is key to improving coexistence. We surveyed people living near Hwange National Park about their attitudes toward coexisting with lions. We used ordinal regression models with the results of the survey to investigate the importance of a range of tangible and intangible factors on attitudes. The variables investigated included the costs and benefits of wildlife presence, emotion, culture, religion, vulnerability, risk perception, notions of responsibility, and personal value orientations. This was for the purpose of effectively tailoring conservation efforts but also for ethical policy making. Intangible factors (e.g., fear and ecocentric values) were as important as, if not more important than, tangible factors (such as livestock losses) for understanding attitudes, based on the effect sizes of these variables. The degree to which participants' fear of lions interfered with their daily activities was the most influential variable. The degree to which benefits accrue to households from the nearby protected area was also highly influential, as was number of livestock lost, number of dependents, ecocentric value orientation, and participation in conflict mitigation programs. Contrary to what is often assumed, metrics of livestock loss did not dominate attitudes to coexistence with lions. Furthermore, we found that socioeconomic variables may appear important when studied in isolation, but their effect may disappear when controlling for variables related to beliefs, perceptions, and past experiences. This raises questions about the widespread reliance on socioeconomic variables in the field of human–wildlife conflict and coexistence. To facilitate coexistence with large carnivores, we recommend measures that reduce fear (through education and through protective measures that reduce the need to be fearful), reduction of livestock losses, and ensuring local communities benefit from conservation. Ecocentric values also emerged as influential, highlighting the need to develop conservation initiatives tailored to local values.

MANAGEMENT AND POLICIES

EFFECTIVENESS OF INTERVENTIONS FOR MANAGING HUMAN-LARGE CARNIVORE CONFLICTS WORLDWIDE: SCARE THEM OFF, DON'T REMOVE THEM

Charlotte Lorand et al.

Science of the Total Environment:
September 2022

https://doi.org/10.1016/j.scitotenv.2022.156195

Human-wildlife conflicts are associated with a threat to large carnivores, as well as with economic and social costs, thus challenging conservation management around the world. In this study, we explored the effectiveness of common management interventions used worldwide for the purpose of conflict reduction using an evidence-based framework combining expert assessment of intervention effectiveness, impact and uncertainty of assessment. We first conducted a literature review of human-large carnivore conflicts across the world. Based on this review, we identified three main types of management interventions (non-lethal, translocations, and lethal management) and we assessed their effectiveness. Our review indicates that, although the characteristics of conflicts with large carnivores are heavily influenced by the local context and the species, the main issues are depredation on livestock, space-sharing, and attacks on humans. Non-lethal interventions are more likely to reduce conflict, whereas translocations and lethal interventions are mostly ineffective and / or harmful to carnivore populations, without fostering successful long-term coexistence. The literature on conflict management is often imprecise and lacks consistency between studies or situations, which generally makes comparisons difficult. Our protocol allows for the reliable comparison of experiments characterized by heterogeneous standards, response variables, protocols, and quality of evidence. Nevertheless, we encourage the use of systematic protocols with common good standards in order to provide more reliable empirical evidence. This would clarify the relative effectiveness of conflict management strategies and contribute to the global reduction in the occurrence of human-large carnivore conflicts across the world.

FOSTERING COEXISTENCE BETWEEN PEOPLE AND LARGE CARNIVORES IN AFRICA: USING A THEORY OF CHANGE TO IDENTIFY PATHWAYS TO IMPACT AND THEIR UNDERLYING ASSUMPTIONS

Sarah M. Durant et al.

Frontiers in Conservation Science: Janaury 2022

https://doi.org/10.3389/fcosc.2021.698631

Coexistence with large carnivores poses challenges to human well-being, livelihoods, development, resource management, and policy. Even where people and carnivores have historically coexisted, traditional patterns of behavior toward large carnivores may be disrupted by wider processes of economic, social, political, and climate change. Conservation interventions have typically focused on changing behaviors of those living alongside large carnivores to promote sustainable practices. While these interventions remain important, their success is inextricably linked to broader socio-political contexts, including natural resource governance and equitable distribution of conservation-linked costs and benefits. In this context we propose a Theory of Change to identify logical pathways of action through which coexistence with large carnivores can be enhanced. We focus on Africa's dryland landscapes, known for their diverse guild of large carnivores that remain relatively widespread across the continent. We review the literature to understand coexistence and its challenges; explain our Theory of Change, including expected outcomes and pathways to impact; and discuss how our model could be implemented and operationalized. Our analysis draws on the experience of coauthors, who are scientists and practitioners, and on literature from conservation, political ecology, and anthropology to explore the challenges, local realities, and place-based conditions under which expected outcomes succeed or fail. Three pathways to impact were identified: (a) putting in place good governance harmonized across geographic scales; (b) addressing coexistence at the landscape level; and (c) reducing costs and increasing benefits of sharing a landscape with large carnivores. Coordinated conservation across the extensive, and potentially transboundary, landscapes needed by large carnivores requires harmonization of top-down approaches with bottom-up community-based conservation. We propose adaptive co-management approaches combined with processes for active community engagement and informed consent as useful dynamic mechanisms for navigating through this contested space, while enabling adaptation to climate change. Success depends on strengthening underlying enabling conditions, including governance, capacity, local empowerment, effective monitoring, and sustainable financial support. Implementing the Theory of Change requires ongoing monitoring and evaluation to inform adaptation and build confidence in the model. Overall, the model provides a flexible and practical framework that can be adapted to dynamic local socio-ecological contexts.

Videos

Learning in Practice webinar series
UN Food and Agriculture Organisation and IUCN SSC Human-Wildlife Conflict & Coexistence Specialist Group, January – October 2022

The Learning in Practice webinar series, hosted by the FAO and IUCN, provides an opportunity to link theory of principles in human-wildlife conflict engagement with practical experience and insights from projects on the ground through a series of case studies. Each webinar focuses on a particular aspect of conflict management and provides an opportunity for an in-depth discussion on lessons learned, insights, potential pitfalls and practical advice from practitioners and the Human-Wildlife Conflict & Coexistence Specialist Group.

This first webinar focuses on key aspects of community engagement processes and includes case studies on reducing human-carnivore conflict through participatory research and community camera trapping:

The second webinar, on community-led management of wildlife impacts, focuses on supporting communities in preventing negative interactions with wildlife via a discussion of case studies on developing a community guardian programme to reduce livestock depredation, response teams for efficient conflict management and building community capacity to coexist with wildlife:

The third webinar focuses on incentives and financial instruments for coexistence. Case studies include an example of supporting communities to develop alternatives to cattle farming and a discussion of the opportunities and challenges of insurance schemes:

BOOKS

Collection of herd protection information

Publisher: Landcare Germany (DVL e.V.), 2022

Language: German

https://www.herdenschutz.dvl.org/dvl-infosammlung

The return of the wolf to Germany and other countries where it was previously eradicated presents a new challenge for today's livestock farmers. Attacks on livestock tend to occur most often in areas where wolves are re-establishing themselves and livestock owners have not yet adjusted to their presence. In many cases, knowledge of effective methods of protecting livestock is lacking where wolves have been absent for a long time. The Landcare Germany (DVL e.V.) project on *Livestock protection in grazing animal husbandry* aims to improve protection of livestock from wolf attacks by informing and supporting livestock owners to assess risks and implement appropriate preventive measures. The DVL provides training courses with practical instruction and is building up a nationwide network of demonstration farms.

Within the project, DVL has produced a collection of practical information on selected aspects of herd protection aimed at livestock farmers as well as consultants and breeders. The content is based on online training courses and workshop discussions to compile and evaluate the current state of knowledge and new technologies. It offers a deeper examination of those aspects that discussions with experts and practitioners have shown to be of most practical relevance. The following chapters are available which can be downloaded, printed out and assembled in any order:

- Earthing fences correctly. Basics of the electrical circuit and practical tips for installing grounding.
- Keeping electric fences free of plant growth. Practical tips and hints.
- Fencing ditches and water bodies to repel wolves. Practical tips and hints.
- Recognising and avoiding step-in aids. Information for grazers, farmers and foresters, landowners as well as municipalities and associations.
- Setting up anti-digging protection effectively. Protecting against undermining of electric fences and gates.
- Solution-oriented communication in herd protection – basics and information on strategic approaches for advisory and landscape conservation organizations.

The project is part of the Model and Demonstration Projects (MuD) Animal Welfare, funded by the Federal Ministry of Food and Agriculture (BMEL), which serves to introduce new findings in farm animal science into agricultural practice. For more information, see: https://www.herdenschutz.dvl.org/

UPCOMING EVENTS

International Conference on Human-Wildlife Conflict and Coexistence

30th March – 1st April 2023 in Oxford, UK.

This much anticipated event, postponed since April 2020 due to the COVID19 pandemic, will (hopefully!) finally go ahead in spring 2023. Co-hosted by the IUCN's Human-Wildlife Conflict & Coexistence Specialist Group, the Global Wildlife Program and Oxford University's Wildlife Conservation Research Unit, the conference will bring together representatives from governments, NGOs, intergovernmental organisations, academic and business sectors, indigenous and local communities from across the globe to understand human-wildlife conflict through various viewpoints, learn from each other and build new links and collaborations.

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

Wolves Across Borders

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

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

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

Pathways Conference: Managing Wildlife in an Era of Mutualism

31st May – 3rd June 2023 in Fort Collins, Colorado, USA.

Pathways: Human Dimensions of Wildlife is a conference and training programme designed to address the myriad issues that arise as people and wildlife struggle to coexist in a sustainable and healthy manner. The 2023 event will be held at Colorado State University.

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

XIII European Vertebrate Pest Management Conference

28th August – 1st September 2023 in Florence, Italy.

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. EVPMC 2023 will be held at the Novoli Campus of the University of Florence.

For details and updates see: https://evpmc2023.com/

NEXT ISSUE

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The next issue of *CDPnews* is due out in summer 2023

CDP news
Carnivore Damage Prevention