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Carnivore Damage Prevention

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BEARS AND DAMAGE PREVENTION IN THE ITALIAN ALPS

PREDATOR CONTROL ON LAND AND AT SEA

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LIFE EURO LARGE CARNIVORES

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EDITORIAL

It would be an understatement to say that the period covered by this issue of *CDPnews* has been extraordinary. While governments and people the world over grapple with the ongoing COVID-19 pandemic and struggle to adapt to a 'new normal', few sectors of society have been left untouched. The human health crisis has also impacted agriculture and wildlife management, including efforts to mitigate human-carnivore conflicts.

The pandemic's first wave in Europe coincided with Easter: a key time for the sale of lamb and goat meat. Producers struggled to find buyers or had to settle for lower prices as restaurants closed, exports were restricted and demand decreased. Cattle breeders, including dairy producers, were also affected, especially small-scale, family-based holdings. Lost income is likely to have had a detrimental effect on the ability of some farmers to implement damage prevention measures. Training events had to be cancelled, postponed or moved online, reducing the level of professional help on the ground.

Not all changes have been negative, however. Lockdowns and social distancing have been a chance to reconsider old habits and find new ways of working. A global decline in economic activity has resulted in dramatic reductions in pollution and shown the potential of ecosystems to recover. Limitations on travel and face-to-face interaction have driven a shift to virtual meetings and digital transfer of knowledge, often accessible to wider audiences. Farmers, too, have adapted, such as turning to social media to market their products and deliver direct to consumers. 'Buy national' campaigns have encouraged solidarity with local farmers, which could help make countries and communities more self-sufficient and resilient in the face of future emergencies.

An open question is what impacts the current crisis will have in the longer term. Support for damage prevention measures must not be forgotten at this time, otherwise there is a risk of human-carnivore conflicts increasing, adding to the already difficult economic situation of farmers, with potentially negative consequences for carnivores. We will do our part: promoting evidence-based practices and recommendations.

We are very grateful to the LIFE EuroLargeCarnivores project[1] for securing publication of *CDPnews* until 2022. We will present actions and results from this project as well as from the EU Platform on Coexistence between People and Large Carnivores[2] and the ENCOSH knowledge-sharing platform[3] in a series of pop-up features. We have also added a *News Roundup* section to highlight recent developments relating to conflicts and coexistence with large carnivores.

This issue has a distinctly southern European flavour, with articles on long-term efficacy of prevention measures in the Iberian peninsula; activities of the LIFE WolFlux project in Portugal; and a special feature on management of bears and wolves in Trentino, Italy. It also includes a novel comparison between marine and terrestrial environments based on the workshop *Predator controls: Lessons from land to sea* held at the World Marine Mammal Conference in Barcelona, Spain, in December 2019.

We wish you safe and inspiring reading!

The Editors

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

[2] https://ec.europa.eu/environment/nature/conservation/species/carnivores/coexistence_platform.htm

[3] https://encosh.org

Special feature

BROWN BEARS AND DAMAGE PREVENTION: THE TRENTINO EXPERIENCE IN THE ITALIAN ALPS

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1. Background

After the collapse of brown bear *(Ursus arctos)* numbers throughout the Alps due to environmental overexploitation and direct persecution arising from competition for resources, atavistic fears and government bounties, only a tiny relict population of bears persisted which slowly dwindled away during the 20th century. The last stronghold of Alpine bears was in the western portion of Trentino, Italy. Despite early legal protection of the species (from 1939) and some willing but naïve and unsuccessful attempts to recover the population through the release of captive-born young bears in 1959, 1969 and 1974, by the beginning of the 1990s the relict population was considered biologically extinct: only a few old individuals survived in the Brenta Dolomites range, without any indication of reproduction (Fig. 2, page 2).

In an effort to save the species in the Central Alps, a complex and ambitious project, LIFE Ursus[1,2], was

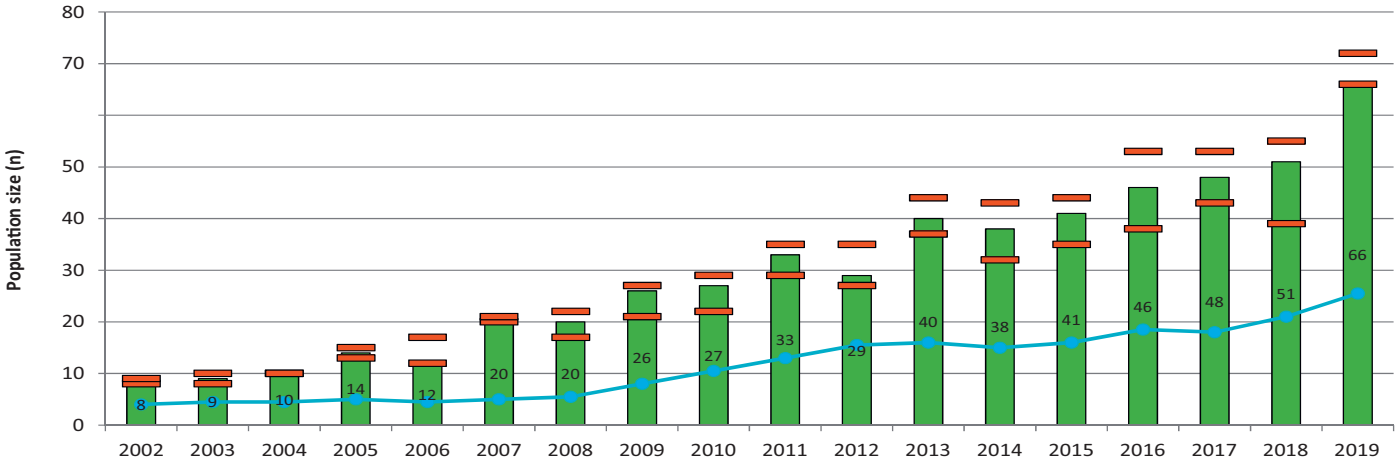

Fig. 1 Growth of the Central Alps brown bear population (excluding cubs), showing minimum and maximum annual estimates (red), the minimum certain number of individuals per year determined retrospectively using all available data (green) and effective population size Ne, i.e. estimated number of reproductive individuals (blue). *Source: APT Forestry and Wildlife Service.*

[1] https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=120
[2] https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=1731

Fig. 2 Probably the last native Alpine bear, an almost blind old male, captured by a trail camera in March 2000. It was repeatedly seen stalking young Slovenian females, trying to mate, but without success. The old bear died, presumably of natural causes, in the spring of 2002.
(Photo: C. Groff, APT Forestry and Wildlife Service archive)

Fig. 3 Brown bear female with three yearling cubs, newly emerged from their den in Western Trentino.
(Photo: M. Vettorazzi, APT Forestry and Wildlife Service archive)

developed by Adamello Brenta Nature Park with the participation of the Autonomous Province of Trento (Provincia Autonoma di Trento) and the National Wildlife Institute (ISPRA). Between 1999 and 2002, ten wild-born brown bears were captured in southern Slovenia, transported to Italy and released in Tovel Valley in the Brenta Dolomites. The newcomers did not waste time: what happened next is history, and daily news (Fig. 3). Just a decade since the last Slovenian bear was released in Trentino, there were more than 40 bears in the area including cubs. After another decade, this number has doubled (Groff et al., 2013; Groff et al., 2020) (see Fig. 1, page 1, for the growth trend and Fig. 4 for the geographic distribution).

These bears live in an ecologically rich and diverse landscape, with olive trees and glaciers just 15 km apart, where both natural and agricultural foods are abundant and easily available (Figs. 5, 6). But this lush, extremely varied environment is also teeming with people and infrastructure. Such a high level of proximity between bears and humans brings greater trophic opportunities for bears, but also leads to close encounters and damage to livestock, orchards and apiaries, making it difficult to build a new, more positive relationship between the species. In order to mitigate conflicts, a strengthened management programme to prevent damage by bears has been implemented since 2002. In this article, I present a summary of this programme, including a brief summary of what has worked or not worked and what, in the view of my department, still needs to be improved.

2. Conflict management

The Autonomous Province of Trento (APT) has financed damage prevention measures such as fences and livestock guarding dogs (LGDs) and compensated bear damage since 1976. To cope with the increasing complexity of coexistence since the LIFE Ursus project and the increase in bear numbers, the management system has been refined over time. The re-

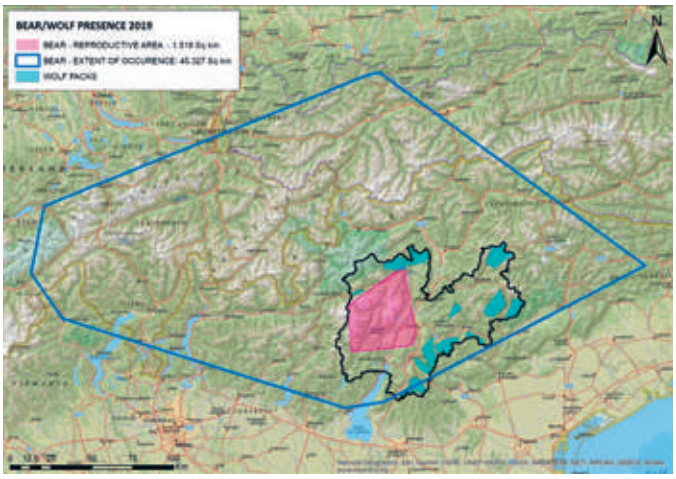

Fig. 4 The Autonomous Province of Trento, northern Italy, showing the core area of the Alpine bear population (pink shading) and recently established wolf packs (blue shading). The blue line indicates the maximum area of exploratory/dispersal movements of male bears. *Data: APT Forestry and Wildlife Service.*

Fig. 5 A young brown bear emerges from tree cover in the evening hours in Val d'Ambiez, Dolomiti di Brenta.
(Photo: M. Zeni, APT Forestry and Wildlife Service archive)

Fig. 6 Bear country: a large male brown bear is captured by a trail camera in Sporeggio Valley, Dolomiti di Brenta.
(Photo: M. Zeni, APT Forestry and Wildlife Service archive)

sponsible body is the APT Forestry and Wildlife Service (Servizio Foreste e Fauna), by means of the Large Carnivores Office (Settore Grandi Carnivori), comprised of a coordinator, two wildlife biologists and two damage prevention and compensation managers. Ten damage prevention assistants (with ten deputies) support the Large Carnivores Office in the field in ten different districts, with the help of 53 damage supervisors. Since 2011 there has been a similar management structure for the wolf *(Canis lupus),* which has expanded rapidly since its return to the province and by the end of 2019 there were at least 13 breeding packs (Groff et al., 2020) (Fig. 4).

2.1 Prevention measures

Measures to prevent damage by bears are mostly based on the loan or financing by APT of electric fences for apiaries and electric fences and/or LGDs for livestock and, in some cases, of wooden fences with electric wiring for livestock and permanent 'bee huts' (small wooden buildings to protect beehives), with funds from the EU Rural Development Programme (RDP) (Table 1).

2.2. Compensation

If damage by bear (or wolf) is suspected to have occurred, an inspection by a damage supervisor almost always follows within 24 hours (98% of cases). Self-certification is permitted in limited cases, generally concerning minor damage, e.g. a few poultry. In such cases, the affected person calls an emergency number to report the damage, provides pictures and fills out a self-certification form.

The full value of damaged items is refunded, usually within 60 days. Prices for livestock and apiaries are set every few years during a round-table with stakeholders' organisations. Compensation is not provided if the owner received damage prevention equipment from APT but did not use it properly. Whenever possible or appropriate, and in all cases when damage occurs, APT damage prevention assistants and supervisors inspect prevention equipment to assess if it is being used properly. A major, pre-arranged inspection, aiming to check 25% of loaned or financed fences (randomly selected) is currently under way. Data are not yet available.

2.3 Other mitigation tools

Other important means of conflict mitigation concern the management of bears. An emergency number is available nonstop, year-round, to report any incidents or damages. One of the 20 officers of the APT Forestry and Wildlife Service answers calls concerning large carnivores, providing information and support and dispatching damage supervisors or the emergency team, as appropriate. The emergency team is actually composed of seven teams of two operatives each (and a vet, if necessary) and is ready to act, 24/7, from 1st March to 30th November in the event of an emergency (e.g. a wounded bear, a bear attack, the persistent presence of a bear near settlements or livestock, etc.).

Table 1 Damage prevention measures loaned or financed by the Autonomous Province of Trento to mitigate damage by bears and wolves.

Duration	Conditions	Description
Electric fences (bear and wolf)		
Temporary use – emergency cases and during summer grazing of livestock in alpine pastures	Free loan (generally up to four months)	Mobile netting and multi-wire fences, up to 500 m depending on herd size (night corrals)
Long-term use	Free loan (after eight years the farmer can ask for a new fence; damaged items are repaired and fences recycled if no longer used)	Mobile netting and mobile/ semi-permanent multi-wire fences. Up to 250 m for apiaries, depending on the number of beehives, and up to 500 m for livestock, depending on herd size (night corrals)
Long-term use	Acquisition costs compensated: 90% for beehives and sheep/goats, 60% for cattle/equines	Mobile netting and mobile/ semi-permanent/permanent multi-wire fences. Up to 250 m for apiaries, depending on the number of beehives, and up to or more than 500 m for livestock, depending on herd size (night corrals)
Livestock guarding dogs (bear and wolf)		
Long-term use	Acquisition costs compensated: 90% for sheep/goats, 60% for cattle/equines	Pups of Maremmano-Abruzzese breed (mean market price 850 EUR)
Housing modules, to allow permanent presence of shepherds (bear and wolf)		
Temporary use – summer season in alpine pastures	Free loan (where permanent buildings are not available, up to four months)	Simple shelters (transported by helicopter to alpine pastures)
Wooded fences with electric wiring to protect livestock (bear and wolf), permanent apiaries or 'bee huts' (bear)		
Long-term use	Acquisition costs compensated: 60% of permanent, traditional wooded fences with electric wiring; 60% of permanent wooden 'bee huts'	Traditional wooden fences with electric wiring (up to or more than 500 m), permanent wooden 'bee huts'

A bear capture team is also available, formed of up to seven APT staff and one or two vets. Since 2006, 28 different bears have been captured in 41 separate capture events. This team may act to help injured bears or orphaned cubs, to fit bears with GPS/VHF collars for research or management or to capture/euthanise problem bears. Six bear dogs (Russo-European Laika and Jamthund), working with six specialised handlers, are also ready to act, including aversive conditioning of habituated or food conditioned bears (Fig. 7), investigation of bear-vehicle collisions and collection of genetic samples (e.g. at damage sites). Bear dogs belong to ancient, Nordic breeds (primitive spitz), traditionally used in Russia and Fennoscandia to hunt large wildlife (e.g. brown bear, moose, wild boar). They are reactive, agile dogs with strong instincts to hunt using their eyes and ears as much as their sense of smell. They silently search for and find prey, then they stalk and stop it, barking, waiting for their handler to come. Bear dogs have been used by agencies in North America and, more recently, also in Europe to manage bears (e.g. by aversive conditioning). They are also useful for finding genetic samples.

Individual bears implicated in attacks on humans or several episodes of damage ('problem bears') may be removed from the population and either placed in permanent captivity or euthanised, if prevention measures and multiple aversive conditioning actions fail to deter the bear from its problematic behaviour. This protocol is in accordance with the Alpine Bear Interregional Action Plan (AA.VV, 2010), agreed with the Ministry of the Environment, other Alpine regions of Italy and ISPRA.

To keep bears away from garbage, which is a particularly dangerous cause of food conditioning, bear-proof organic waste bins have been installed, starting

Fig. 7 Bear dog in action: aversive conditioning of a young, food conditioned bear (frame from a smartphone video).
(Photo: M. Baggia, APT Forestry and Wildlife Service archive)

in locations where young bears were attracted by garbage, and 240 organic waste bins have been modified by APT to be bear-proof. More bear-proof bins will be provided in the future.

2.4 Measures implemented and compensation paid

APT invests tens of thousands of euros each year on damage prevention measures (Fig. 8). From 1998 to 2019, a total of 1,318 electric fences were donated to farmers. Of these, 1,020 were entirely paid by APT,

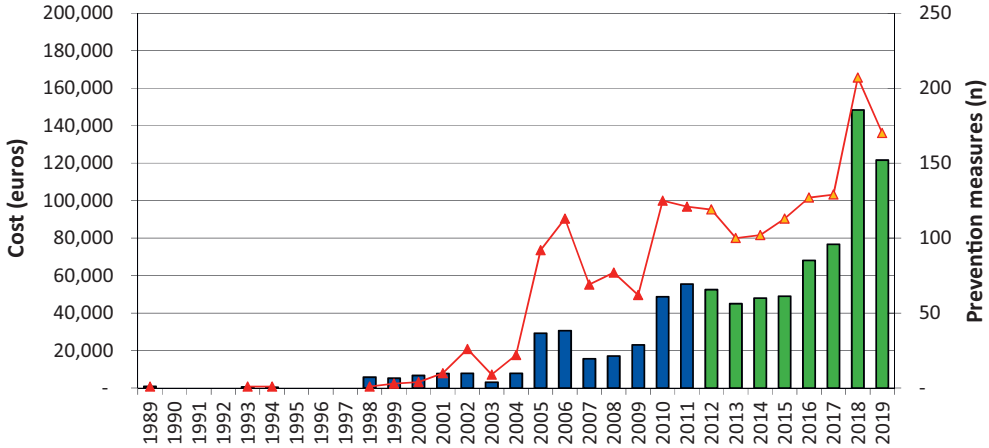

Fig. 8 Number (line) and economic value (bars) of prevention measures distributed by the Autonomous Province of Trento since 1989. Ten bears were released in the area in 1999-2002 as part of the LIFE Ursus project and wolves have been naturally recolonising the province since 2012.
(Data: APT Forestry and Wildlife Service)

Fig. 9 Multi-wire mobile fences to prevent brown bear damage to beehives. *(Photos: Daniele Asson, APT Forestry and Wildlife Service archive)*

Fig. 10 Multi-wire, semi-permanent electric fence to prevent large carnivore attacks on livestock. *(Photo: APT Forestry and Wildlife Service archive)*

279 partly by the LIFE Arctos[3] project and partly by APT and 19 partly by the LIFE DinAlp Bear[4] project and partly by APT. Each fencing unit included an energiser and batteries plus netting or multiple wires (Figs. 9, 10). During the same period, an additional 147 electric fences were co-financed (60 or 90% of the costs).

From 2014 to 2019, 53 pups of the Italian Maremmano-Abruzzese LGD breed were financed by APT (Fig. 11). On average, 15 housing modules per season are placed on high pastures (mainly sheep and goat pastures), to promote the permanent presence of shepherds near flocks during the summer season, where permanent buildings are not available (Fig. 12). Additionally, from 2016 to 2019, 14 wooden fences and five 'bee huts' were financed from the EU RDP.

Overall, since 1998 nearly 1,500 electric fences have been directly distributed or financed in Trentino, involving almost as many people (farmers and beekeepers). Despite this, increasing numbers of bears and the recent, rapid return of wolves have led to an increase in the mean annual number of damage events (Figs. 14, 15). Bear damage is increasing, in some years due to the activity of particularly active problem bears but, overall, following the increase in bear numbers and expansion of the population, with increasing damage to agricultural crops (Fig. 16), which are compensated by APT although not protected by

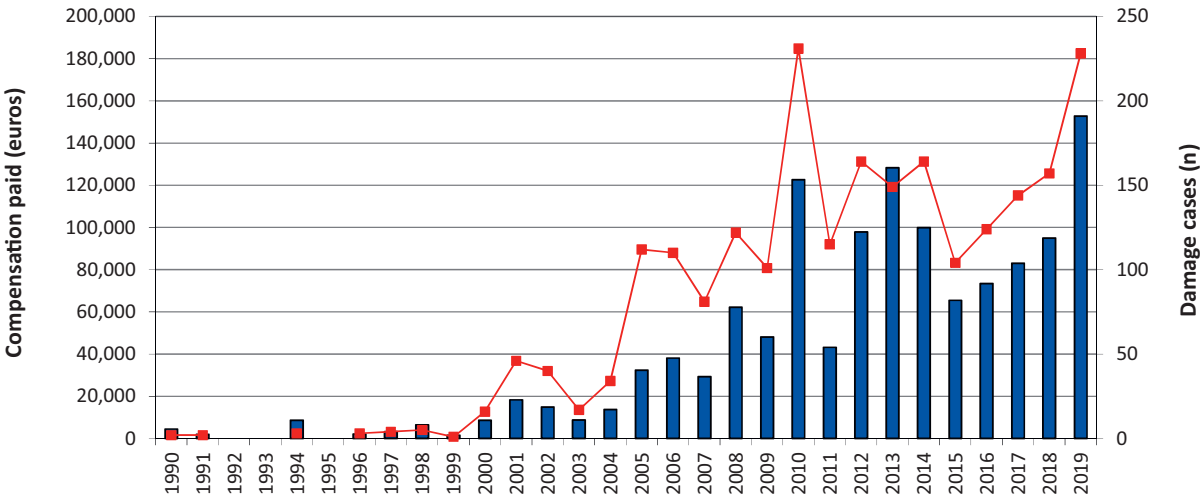

Fig. 14 Number of cases of bear damage (line) and compensation paid (bars) in Trentino since 1990. Peaks often relate to the activity of problem bears, i.e. single bears particularly inclined to cause damage. *(Data: APT Forestry and Wildlife Service)*

[3] http://www.life-arctos.it/ [4] https://dinalpbear.eu/en/

Fig. 11 Electric netting and Maremmano-Abruzzese LGD to prevent wolf and bear predation on livestock.
(Photo: D. Asson, APT Forestry and Wildlife Service archive)

Fig. 12 Housing module transported by helicopter to a summer pasture lacking shelter for shepherds.
(Photo: M. Zeni, APT Forestry and Wildlife Service archive)

prevention measures. (This is expected to change in 2021, when it will become necessary for professional farmers to insure against damage by large carnivores.) There is also increasing damage to livestock and apiaries in recently colonised areas, where prevention measures are uncommon.

3. Conclusions and Recommendations

Further growth of the bear population (numbers, possibly also density and a slow but steady expansion of the core area, i.e. the female range) is expected for western Trentino. An increasingly fast and strong comeback of the wolf is expected for the whole of the province. Such a scenario will require an even stronger commitment of the APT Forestry and Wildlife Service in the years to come, notwithstanding the complex organisation described and the many measures implemented and inspected, in order to cope with the future challenges of coexistence.

What has worked - Trentino Forestry and Wildlife Service is highly committed to preventing and compensating damage by carnivores and, through its responsive emergency team, has proven very effective in the last two decades, helping the bear population to grow, even in a highly human-dominated landscape where the probability of conflict is inherently high. When wolves started to return, this well-practiced organisation was ready to deal with them as well. If properly installed and maintained, electric fences are highly effective at preventing damage to beehives and livestock. In the case of livestock, this is especially true if there is also close human vigilance, and even more so if LGDs are also present. Without the great efforts made by APT in the field of damage prevention and compensation, the Alpine bear population would probably not have even become re-established.

What has not worked so well - Some electric fences are poorly maintained. The major inspection currently under way is aimed at quantifying the extent of the problem and fixing it. Better communication with farmers and beekeepers and tighter control are also needed. Another emerging issue is related to LGDs: if not properly socialised while young, such dogs may act too aggressively towards hikers and bikers, who are ever-present in the Alps.

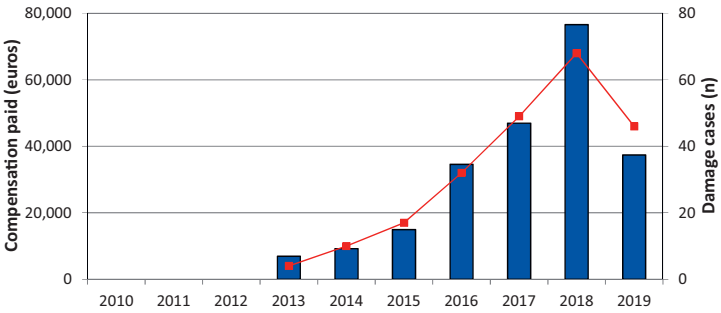

Fig. 15 Number of cases of wolf damage (line) and compensation paid (bars) in Trentino since the recent return of the species. The reduced level of damage in 2019 compared to 2018 occurred despite a doubling in the number of wolf packs from seven to 13 and may be a result of the adoption of prevention measures. However, an increase in damage is expected in subsequent years as the species continues to recolonise the province.
(Data: APT Forestry and Wildlife Service)

There are several major issues that need to be addressed. First, increasing polarisation between pro- and anti-bear people, enhanced by mass media and social networks, often exacerbated by fake news, complicates bear management. Furthermore, increasing pressure from animal rights extremists greatly affects APT's ability to effectively manage problem bears, which are increasing as the bear population expands and are responsible for much of the damage and cause many complaints among rural people. Second, attacks on people are on the rise: defensive attacks by bears (usually females protecting their cubs) sometimes require hospitalisation of victims. In the western Trentino Alps, relatively 'numerous' bears live alongside the many humans (both residents and tourists) who frequent the area without knowing much about bears, how to avoid them or how to manage close encounters. Moreover, bear spray, an effective defensive tool which is widely used in North America and increasingly available in several European countries, is forbidden in Italy. Third, despite a long-term campaign, there is still insufficient communication about large carnivores. A recent political shift in the APT administration has further undermined the communication effectiveness of the Large Carnivores Office.

Fig. 16 A female genetically identified as F5 ventures out of the forest, looking for plums under the cover of darkness.
(Photo: M. Zeni, APT Forestry and Wildlife Service)

Coexistence between bears and people in the Alps, the most anthropised mountain range in the world, brings important challenges for the years to come. To ensure a future for bears, great efforts by local and national governments are needed. In our opinion, the Autonomous Province of Trento must continue to secure funds for prevention measures. With the expanding trend of the bear population, neighbouring regions will probably soon have to do the same. The communication campaign must be improved, above all concerning prevention and management of damage as well as of close encounters. Bear spray should be legalised and steps taken to prevent bears becoming food conditioned.

We have to be more effective in managing problem bears, including removing them when necessary. This may, as a side effect, help increase acceptance by local communities of possible future releases of bears from Slovenia or Croatia, which would be desirable to increase the genetic variability of the Alpine bear population (the current population has only seven founders: two males and five females). We also need to achieve better communication with stakeholders. Human dimensions is, and always should be, a central discipline in the management of large carnivores. Animal rights extremism is a serious matter and, if not properly managed, could damage the delicate balance of coexistence between local communities and bears.

For more information on large carnivores and their management in Trentino, annual reports are available from the APT website[5] in Italian, English and, since 2019, also German.

Acknowledgements

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[5] https://grandicarnivori.provincia.tn.it/Rapporto-Orso-e-grandi-carnivori

News Roundup

Animals, COVID and One Health

The pandemic of coronavirus disease that emerged in 2019/20 has resulted in an ongoing global health crisis and economic recession as well as food shortages in some regions. Although there have been no documented cases of COVID-19 in farm animals except farmed mink[1], many aspects of this relatively new disease are unclear, including the susceptibility of livestock to infection with SARS-CoV-2, the virus that causes COVID-19, and the likelihood of human–livestock transmission[2]. A recent study found a greater potential for infection in cattle, bison, sheep, goats and water buffalo than among carnivores[3]. Nevertheless, the current pandemic is predominantly propagated by human-to-human transmission[4]. The risk of infection is higher where people gather together, including at many farms and farmers' markets. Biosecurity, hand hygiene and social distancing are therefore important measures to take in these settings, as elsewhere.

Cases have been documented of transmission from people to pets, zoo and other animals[5,6]. Although none of these involved free-ranging wildlife, there are concerns that if a wildlife population were infected it could become a reservoir for the virus, potentially posing risks to human health, other animal species and public perceptions of wildlife. The IUCN Wildlife Health Specialist Group[7] together with the World Organisation for Animal Health[8] have therefore produced guidance[9] to minimise the risk of human-to-animal transmission. The guidelines are intended for researchers, conservationists, veterinarians and others in direct contact (e.g. handling) or indirect contact (e.g. in a confined space) with free-ranging wild mammals, or working in situations in which animals may come in contact with surfaces or materials contaminated by infected personnel. The recommendations are based on first principles of biosecurity and hygiene, current knowledge of human-to-animal SARS-CoV-2 transmission and the precautionary principle.

SARS-CoV-2 is thought to have crossed into humans from an animal species, probably a bat[10]. New zoonoses (diseases that can spread between animals and humans) are expected to arise more frequently as human impacts on wildlife and habitats intensify[11]. The interconnectedness of human health and that of animals and our shared environment is increasingly recognised through the 'One Health' approach[12]. This calls for holistic solutions which integrate the needs of livestock, wildlife and human health, the interactions of which are complex and constantly evolving, as reflected in the pages of *CDPnews.*

EU moves towards more sustainable farming

New strategies to halt biodiversity loss while building a healthier, fairer and more nature-friendly food system were announced by the European Commission on 20th May 2020[13]. The Biodiversity Strategy and Farm to Fork Strategy bring together nature, farmers, businesses and consumers to work together towards a competitively sustainable future. They form part of the European Green Deal[14], which aims to make Europe climate neutral by 2050. The Commission has also proposed a substantial reinforcement for the European Agricultural Fund for Rural Devel-

[1] https://vet.osu.edu/about-us/news/covid-19-and-animals
[2] https://www.liebertpub.com/doi/10.1089/vbz.2020.2650
[3] https://www.pnas.org/content/117/36/22311
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[13] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_88
[14] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-an-green-deal_en

opment (EAFRD) as part of the Next Generation EU pandemic recovery package[15] to help rural areas achieve the targets of the Farm to Fork and Biodiversity Strategies[16]. In relation to this, the European Coordination Via Campesina (ECVC), a member of the largest grassroots international peasant movement, organised a webinar on 7th July to explore *Food Sovereignty and the Farm to Fork Strategy.* A video and report are available on the ECVC website[17].

The EU's Common Agricultural Policy (CAP) is also undergoing reform aimed at delivering sustainable food production, biodiversity conservation and climate change mitigation post-2020[18]. Eco-schemes proposed under the next CAP could support farmers transitioning to sustainable food systems. Wildlife including carnivores should be addressed as aspects of 'sustainability' along with broader considerations of energy and climate. This may present new opportunities to increase the involvement of rural people in economic activities that are harmonious with nature protection and restoration, whilst supporting improved measures of livestock protection, compensating damage and providing incentives for farmers to accept the presence of large carnivores[19].

EU Court of Justice rulings on management of protected species

On 10th October 2019 the Court of Justice of the European Union (CJEU) issued a judgement concerning the killing of wolves in Finland, where the wolf is among protected species listed in Annex IV of Council Directive 92/43/EEC (Habitats Directive)[20]. Case no. C-674/17 was referred to the CJEU after an environmental group challenged a decision by the Finnish Wildlife Agency to allow wolf hunting for 'population management purposes' in order to reduce poaching, prevent harm to dogs and improve the feeling of security of people living in areas with wolves. Article 16(1) of the Directive allows Member States to derogate from strict protection of species in Annex IV provided certain criteria are fulfilled: there must be no satisfactory alternative, derogations must not be detrimental to the maintenance of the population at favourable conservation status and may only be applied for specific reasons. The CJEU found that these conditions were not met in the Finnish case and reiterated the strict limitations on the use of such derogations for the hunting of wolves and other large carnivores.

Reflecting the contrasting views they tend to hold of large carnivores and their management, stakeholders differed markedly in their reactions to the ruling and its implications. Whereas the Humane Society stated that, "This decision by the CJEU makes it very clear that killing these protected animals should only ever be a last resort when all other preventative measures have failed"[21], the European Federation for Hunting and Conservation (FACE) pronounced that the ruling gave a "Green light for hunting as a management tool"[22]. It should also be noted that the judgement of the CJEU applies to species listed in Annex IV of the Habitats Directive. Listing of a species in Annex V allows hunting through quotas provided this does not jeopardise favourable conservation status, although there is still an obligation to undertake permanent, systematic surveillance, as for other species of Community interest.

In its judgement on case no. C-88/19 of 11th June 2020, the CJEU ruled that strict protection of species in the Habitats Directive also extends to those that leave their natural habitat and stray into human settlements. The case concerned the capture and relocation of a wolf from a village in Romania. The CJEU found that the 'natural range' of strictly protected an-

[15] https://ec.europa.eu/info/strategy/eu-budget/long-term-eu-budget/2021-2027_en

[16] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_940

[17] https://www.eurovia.org/report-and-video-of-the-webinar-food-sovereignty-and-the-farm-to-fork-strategy-building-a-fairer-and-more-just-agricultural-model-in-the-eu/

[18] https://ec.europa.eu/info/food-farming-fisheries/sustainability/sustainable-cap_en

[19] https://doi.org/10.1017/S0376892920000284

[20] http://curia.europa.eu/juris/document/document.jsf?text=&docid=221604&pageIndex=0&doclang=en&mode=req&dir=&occ=-first&part=1&cid=7586397

[21] https://www.europeaninterest.eu/article/european-court-justice-upholds-strict-protections-wolves/

[22] https://www.face.eu/2019/10/green-light-for-hunting-as-a-management-tool-for-wolf/

imal species includes human settlements if they occur there. Management actions within human settlements, if they involve capture or killing, therefore require the competent national authority to issue a derogation from the system of strict protection laid down in the Member State's full legislative framework under the EU Habitats Directive. The European Commission's *Guidance document on the strict protection of animal species of Community interest under the 'Habitats' Directive*[23], including recommendations for Member States on the use of articles 12, 13 and 16, is currently being updated in light of these cases.

Support network for Europe's beef cattle farmers

Although there are more than a quarter of a million farms in the European Union's bovine meat sector, until now there has been no network focussed on the needs of beef producers in Europe. The EU-funded Beef Innovation Network Europe (BovINE)[24] aims to fill this gap by providing an open platform – the BovINE Knowledge Hub – where beef farmers, advisers, member organisations and researchers can exchange knowledge and share experiences to drive awareness and adoption of innovative and proven practices.

Report seeks solutions to coexistence with wolves in France

Wolf predation on livestock has been a 'hot' topic in France for many years. Damage levels are amongst the highest in Europe despite substantial investment in prevention measures. The French Ministries of Environment and Agriculture therefore commissioned an independent consultancy report on *The wolf and animal husbandry activities: a European comparison within the framework of the national action plan 2018/2023*. In their balanced assessment of the situation and perspectives, the authors of the report[25] note that, although no system is infallible, examples from around Europe show that damage can be limited through appropriate measures adapted to local contexts.

The report focuses on wolf monitoring and damage prevention strategies implemented in Germany, Italy, Poland, Spain and Switzerland in order to identify lessons that could help improve coexistence of the wolf and livestock breeding in France. Although approaches vary among countries, several common aspects emerged from the analysis. In particular, the need for commitment from farmers to find effective lasting solutions was noted, as well as the key role of shepherds as an inseparable part of the pastoral system and the importance of ensuring the quality of livestock guarding dogs (LGDs) through breeding management. The authors recommend implementing a system to test LGD behaviour, including interactions with people, to consider the possibility of only supporting LGDs which have been tested and to check the implementation of damage prevention measures on the ground.

The Editors

[23] https://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

[24] http://www.bovine-eu.net/

[25] https://agriculture.gouv.fr/telecharger/105284?token=ee640c095462d3d4bfda6d0f7f0f60c5

National network for livestock guarding dog users, France

Predators and LGDs in France

Many regions in France are affected by the depredations of wolves, bears, lynx, foxes, badgers, crows and stray dogs. Back in French landscapes for more than 25 years already, wolves cause the most damage to livestock farmers.

Livestock guarding dogs (LGDs) are one of the best tools available to breeders to help protect their flocks. Thanks to their imposing morphology, they dissuade most intruders from approaching the herd. On the lookout for danger, LGDs confront threats and, if their warnings are not enough, escalate their response. They are adaptable and effective even in situations of strong predation pressure. For many years, farmers and shepherds in France found themselves without help to protect their flock with such dogs. Today, there are estimated to be at least 4,500 LGDs in France but we have information about very few of them.

For some people, LGDs were perceived as very easy to use: they thought they just had to buy a 'purebred' dog, put it in the herd and problems would disappear. This inadequate understanding has led many livestock breeders to acquire LGDs without asking for the 'instructions'. Today, there are real needs on the ground for transfer and sharing of know-how to improve the effectiveness of LGDs as a means to protect herds, in a context where improperly handled dogs can become embroiled in conflicts or incidents with other users of pastoral areas.

This section highlights initiatives dealing with large carnivore damage prevention worldwide published on the ENCOSH Platform. To check out other initiatives, submit your own and connect with colleagues working on human-wildlife interactions worldwide, go to: www.encosh.org

Description of the network

To support pastoralists and shepherds and give them the necessary means to successfully introduce LGDs into their herds and use them effectively, a national network for technical support[1] was set up in 2017 by the French Livestock Institute (Idele – Institut de l'Élevage) with support from the Ministry of Food and Agriculture. Its goal is to disseminate know-how in the use of LGDs. Knowledge is shared through collective training and individual support carried out on farms at the farmers' request.

The network is made up of around 20 contact persons (all breeders and users of LGDs) who are independent. Each of them has a geographical area of intervention assigned to them. Idele is responsible for coordinating the network and promoting its work, relying on local agricultural structures to organise collective training courses for breeders. Any farmer is free to get in touch with the contact person for their region to request individual technical support on his or her own farm. The network has established shared rules regarding the choice and use of LGDs, with the aim of making the job of future users as easy as possible.

A network of sheep breeders and shepherds experienced in the use of LGDs supports volunteer breeders and shepherds through group training and individual assistance directly on their farms to facilitate the use of LGDs. The network is active throughout France, although only breeders eligible for herd protection measures according to the National Action Plan for wolves can be financially supported.

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[1] http://chiens-de-troupeau.idele.fr

Perspective

PREDATOR CONTROL ON LAND AND AT SEA: A COMPARISON AND CALL FOR COMMON STANDARDS OF ASSESSMENT

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https://wildanimalwelfare.com

1. Introduction

Carnivores come into conflict with humans when they cause damage to livestock, crops and other property. Examples in Europe include wolves (*Canis lupus*) taking sheep, wolverines (*Gulo gulo*) preying on semi-domestic reindeer (*Rangifer tarandus*) and brown bears (*Ursus arctos*) damaging beehives and maize (Linnell and Cretois, 2018). However, conflict is not only a land-based issue. For example, pinnipeds (seals and sea lions) come into conflict with fisheries and aquaculture sites when they damage equipment and take or injure fish. As in terrestrial settings, human-wildlife conflict in the marine environment can have significant financial repercussions and present animal welfare issues (Box 1).

As with conflicts on land, no one-size-fits-all solution is available for the marine environment. The development of seal-proof fishing technologies is an on-going process that has attempted to reduce both predation of fish and damage to nets (e.g. Varjopuro, 2011). Consumers of farmed fish are increasingly demanding that fish farms minimise harm to marine mammals and the environment. As such, there is an increasing need to ensure that methods used by fish farms to deter marine mammals from destroying equipment and killing or damaging fish are not only effective but are also humane.

Fisheries and fish farms have used both lethal control (i.e. shooting) and non-lethal methods to prevent conflict with seals (Nunny et al., 2018). An example of a non-lethal method is the use of acoustic deterrent devices to produce uncomfortable levels of sound that scare away seals (Götz and Janik, 2013). Some fish farms also use anti-predator nets to stop seals from accessing the inner cage nets where fish are kept (Northridge et al., 2013). They surround either individual cages or the entire cage system. Seal blinds

Box 1

Predator control and animal welfare

Protecting harvests and livestock is challenging and there is increasing recognition that it should be done in ways that consider the welfare of both domestic animals and predators (Nunny, 2020). Animal welfare encompasses "the physical and mental state of an animal in relation to the conditions in which it lives and dies" (OIE, 2018). It considers how an animal copes with its environment and whether it is able to achieve its needs and wants (Broom, 1991; Dawkins, 2012).

The term 'humane' is often taken to mean without causing pain, suffering and distress, particularly in relation to killing methods (Sharp and Saunders, 2011). An assessment of animal welfare can include determining the humaneness of methods used to prevent conflict with wildlife.

Quantifying animal welfare can be done using scoring systems such as The Five Domains model, which comprises four physical/functional areas ('nutrition', 'environment', 'health' and 'behaviour') and a fifth 'mental' domain representing the animal's affective experience (Mellor, 2016). This type of model can be used to assess the overall welfare status of an animal as it takes into consideration both positive and negative elements in each of the domains.

are another non-lethal deterrent and are used to hide dead fish that have accumulated at the bottom of cage nets from seals approaching from underneath (Coram et al., 2014). The seal blind comprises an area of thicker material at the base of the net, making it stiffer and harder for seals to deform and access the fish within.

Conflict with wildlife can vary seasonally with availability of prey and changes in animal physiologies and behaviours. It is therefore necessary to consider seasonally appropriate tools to reduce conflicts. For example, there is evidence that conflict with large carnivores on land is greater under specific circumstances, such as when natural food resources are scarce and, for bears, when they are in hyperphagia – a period of intense caloric demand before hibernation (Artelle et al., 2016). Similarly, peak depredation by grey seals (*Halichoerus grypus*) at fish farms occurs after the breeding season when adult seals are recovering from fasting (Northridge et al., 2013).

Although there may be areas of common ground where sharing of data and experience could be useful, it appears that those managing conflict situations at sea rarely turn to terrestrial experts for help or advice. To encourage such knowledge-sharing, a workshop entitled *Predator controls: lessons from land to sea* was convened at the World Marine Mammal Conference in Barcelona, Spain in December 2019. Here, we summarise the most important topics addressed by a series of keynote speakers, their proposals and recommendations, and present the most relevant conclusions of the workshop.

2. Main topics and recommendations

The workshop's main aim was to bring together experts in human-wildlife conflict scenarios on land with those who deal with analogous conflicts at sea. The workshop was convened by Laetitia Nunny (Wild Animal Welfare) and Mark Simmonds (Humane Society International). It was attended by 39 participants from 14 countries in Europe, Asia and North America, the majority of whom work with or study marine mammals. Mark Simmonds facilitated the event and provided an introduction to the topic and an overview of the issues to be discussed. He noted that, on the marine side, the workshop would focus on issues with seals around fish farms, although there are many other conflicts between marine mammals and people such as dolphins interacting with fisheries (e.g. Butterworth and Simmonds, 2017).

Grey seals on Bardsey Island, North Wales, UK.
(Photo: Mark P. Simmonds)

Carlos Bautista (Institute of Nature Conservation, Polish Academy of Sciences) spoke about conflicts on land related to large carnivore damage, with a special focus on mitigation techniques. His talk was divided into two main parts. First he evaluated current programmes to compensate and prevent damage caused by brown bears, wolves, lynx (*Lynx lynx*) and wolverines in 27 European countries and the factors related to the economic costs of these programmes. He highlighted large differences in compensation costs between countries and species. Costs tend to be higher when husbandry practices are not adapted to the presence of predators, national economic wealth is high and effective prevention practices such as electric fences and livestock guarding dogs are not a prerequisite to receive compensation. He also noted that most European countries pay compensation on an ongoing basis but only half of them subsidise preventive measures regularly. He warned that an approach based on compensation rather than prevention can perpetuate conflicts, instead of mitigating them (Bautista et al., 2019).

Brown bear in the Catalan Pyrenees, Spain.
(Photo: Generalitat de Catalunya)

In the second part of his presentation, Bautista gave an overview of the available literature on the effectiveness of lethal predator control in comparison with non-lethal techniques to prevent wildlife damage and related conflicts. Lethal control programmes for large carnivores are not always effective at preventing damage (van Eeden et al., 2018; Artelle et al., 2016). Some may even be counterproductive, resulting in an increase in damage (e.g. Fernández-Gil et al., 2016). Furthermore, predator removal may compromise the long-term viability of the predator's population (e.g. Lennox et al., 2018) and so, depending on the species involved, might be contrary to conservation needs (Haber, 1996). Accordingly, Bautista asserted his support for the widely held recommendation that effective conflict mitigation should move away from predator removal and focus on damage prevention programmes that help to adapt husbandry practices to the presence of large carnivores.

Diederik van Liere (Institute for Coexistence with Wildlife) highlighted the notion that, in order to understand the origins of problems, it is necessary to look at local learning and how an individual animal adapts and develops its choice of prey species and killing strategies. He illustrated this with reference to the large differences between neighbouring wolf packs in their selection of livestock as prey regardless of abundance (Meriggi et al., 1996). In other wolf research, it has also been shown that prey preference cannot be fully explained by abundance (e.g. Imbert et al., 2016). Additional explanations for prey choice relate to learning and include developing hunting skills and learning from parents or other group members (e.g. Imbert et al., 2016). Experiences related to prey and habitat are transmitted and generally accepted as instrumental in preparing the next generation to efficiently survive in a habitat similar to the one in which they were reared (e.g. Davis and Stamps, 2004). If transmission of skills and prey choice is instrumental to survival, then it can be assumed that problematic prey choice and habitat preference will also be transferred and maintained across generations.

The development of foraging routines in wolves is recognized from their use of specific travel routes within their territories, linked to successful past hunting experience (Mech and Boitani, 2003). This might explain the observation that the same sheep farms are repeatedly attacked (e.g. van Liere et al., 2013). To solve such problems, van Liere therefore recommended deterring predators at the moment they are detected on travel routes. This can be done by placing sensors on the route that immediately activate deterrents, such as recordings of shouting humans, pepper spray or lights.

In addition, signals that predators may use to predict that there is a reward to be gained need to be removed or disrupted. Conflict can be reduced by moving reinforcing stimuli away from predators' travel routes, e.g. by relocating fish farms when there is problematic predation by seals, or relocating livestock in the case of terrestrial predators, and by negatively rewarding the different elements of hunting behaviour (chasing, biting, consuming) that are in themselves reinforcing. The chances that predators will detect the new site depend on several factors including the senses they use to locate potential prey and what (if any) management actions have been taken to obscure tell-tale signs. For instance, up-wind location of a flock of sheep and the presence of goats increase the chance of wolf attacks because of the wolf's use of sound and smell (van Liere et al., 2013).

It was noted by workshop attendees that the same issues related to learning and routines may apply to seals in the marine environment. It might therefore be possible, for example, to disrupt individual seals that behave in predictable ways around fish farms or fishing nets. Some research has been carried out on 'rogue' seals that seemingly specialise on feeding on salmon in rivers or raiding salmon traps (Graham et al., 2011; Königson et al., 2013). Perhaps their routines and learning experiences can be disrupted to prevent conflict, such as by disturbing or masking the currents that swimming fish produce. Using propellers or other means to change water flow may interfere with the ability of seals to use their whiskers to hydro-dynamically track fish (Schulte-Pelkum et al., 2007). Further research is needed on this aspect.

Beehives protected by electric fence in Poland.
(Photo: Carpathian Brown Bear Project)

Santiago Palazón (Fauna and Flora Service, Generalitat de Catalunya) described practical methods used to prevent damage by wolves and bears in the Catalan Pyrenees in Spain. He highlighted the claim that non-lethal methods of protecting livestock are more effective than killing carnivores. In Catalonia, there is a focus on building coexistence between large predators and people through education and long-term action plans which include working alongside all interested stakeholders (e.g. PirosLife, 2018). Improving living conditions for shepherds is a key component of this and includes building mountain cabins and supplying them with materials. As predators are legally protected in the area, since 2007 compensation has been paid to livestock owners and beekeepers for any damage caused.

Various damage prevention methods have been used in Catalonia. Beehives are protected using several electrified wires combined with metal fences, which are often partly buried to prevent bears from digging under them. Sheep and goats are protected through a combination of measures: grouping smaller flocks together into one bigger flock, employing shepherds to stay with the livestock 24 hours a day for four to five months during summer, installing electric fences for protection at night and using livestock guarding dogs (Palazón, 2017). Flocks without protection are seven times more likely to be attacked than flocks protected using this multifaceted system (PirosLife Team, 2019). However, cows and horses are not brought into enclosures at night but are left to graze freely in mountain pastures.

Palazón compared beehives and night-time livestock enclosures to aquaculture sites as they are all focus points that attract large predators and where protection measures can be implemented. He noted that it is much more difficult to record and quantify losses due to predators in the sea and, in some cases, to identify the species responsible for causing the damage.

Canadian fish farms have a long history of developing and trying different means to deter pinnipeds from accessing fish held in net pens. Some of the methods reviewed by Andrew Trites (University of British Colombia) during the workshop include acoustic deterrence and harassment, types of netting, low-voltage electric wires, anti-predator nets and lethal and non-lethal removals. For the most part, these methods have been developed and shared among individual fish farms and have not been scientifically

Steller sea lions (*Eumetopias jubatus*) in British Columbia, Canada. *(Photo: Andrew Trites)*

evaluated. Broader acceptance and use of proven mitigation methods that meet international expectations of animal welfare standards can be achieved through collaborative studies involving scientists and fish farm personnel.

Trites presented a framework for evaluating the effectiveness and impact of different mitigation measures on animal welfare based on a model for assessing the welfare implications of control methods for a range of terrestrial invasive animals (Sharp and Saunders, 2011). The assessment process consists of two parts. Part A categorises the overall impact of a control method on welfare as either extreme, severe, moderate, mild or no impact and combines it with the duration of the impact to give a humaneness score from 1 (most humane) to 8 (least humane). This is the only relevant score for non-lethal control methods. For lethal control methods, Part B of the assessment combines the intensity of suffering experienced before the animal becomes insensible (no suffering, mild suffering, moderate suffering, severe suffering or extreme suffering) with the duration of suffering to give a score from A (most humane) to H (least humane). Humaneness scores for lethal methods are determined by combining the result from Part A with the result from Part B so that welfare prior to killing is considered as well as how the animal is killed. The most humane method would score 1A and the least humane 8H.

Trites noted that scoring the different methods used at Canadian fish farms by degree of effectiveness and their impact on animal welfare is a promising means to quantify the combined effectiveness and humaneness of methods used to deter marine mammals from fish farm sites. Such an approach is also a promising means to establish global standards for use of anti-predator technologies at sea.

3. Main conclusions

The workshop ended with an expert panel, a question and answer session and a final discussion from which the following conclusions were derived:

1. Whilst there appears to be little transfer of anti-predator technologies between land and sea, people who farm and fish have common issues including ensuring the effectiveness of the measures deployed. This warrants a formal assessment of the common issues and solutions and a proper assessment of their welfare implications.

2. The welfare implications of conflict mitigation methods concerned many attending the workshop. How control methods impact predator welfare depends on the method used and how it is applied.
3. Standard protocols to assess the welfare and effectiveness of conflict mitigation techniques need to be developed and endorsed by the international community and could apply equally to land and sea situations. The approach used by Sharp and Saunders (2011) was noted as promising, as is the welfare assessment tool developed by the International Whaling Commission (Nicol et al., 2020).
4. Reducing conflict requires a thorough understanding of the situation, including socio-economic aspects, determining whether the conflict is limited to individual problem animals or is more pervasive and evaluating how the problem at the site has developed. In addition, it is necessary to determine whether the conflict is more prevalent at a particular time of year, in a particular location or under certain ecological conditions or geopolitical circumstances.

Conflict resolution requires gathering as much information as possible about the conflict in order to take appropriate actions and is an area where marine experts can learn from the experiences of terrestrial experts and vice versa. For this reason, providing platforms to marine and terrestrial experts to exchange knowledge and experience can benefit the conservation and welfare of wild predators on land and in the sea.

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Telling unheard stories – video is worth a million words

Nowadays, livestock farming is facing severe problems, including low prices for agricultural products, overwhelming paperwork and growing rural exodus. On top of what seems like a depressing situation, livestock farmers are confronted with the return of large carnivores to the European landscape, with the wolf (*Canis lupus*) in the lead.

With backing from the European Commission (LIFE16 GIE/DE/000661), the EuroLargeCarnivores project (ELC) is studying measures that governments and farmers can implement when working and living in areas where large carnivores are present. The grassroots work of organisations such as AGRIDEA[1] and other contributors to *CDPnews* has demonstrated that damage prevention measures can reduce losses of livestock to predation. However, if fences are not set up correctly, guarding dogs are not raised appropriately and agricultural workers are not adequately trained in their use, even these measures will not protect livestock.

The ELC project recognises the need to support rural residents, livestock owners and shepherds. We therefore decided to create a platform, a kind of 'stage', for people dealing with large carnivores. The aim is to tell their remarkable stories and emphasise the challenges that wolves, bears, lynx and wolverines can present.

What is the best way to create awareness and catch attention? Social media moguls and experts agree that video will soon become the dominant source of news for most people[2]. In 2019, video marketing was named the best performing content type for businesses and NGOs alike, averaging the most views, as well as highest engagement and response rates, compared to other social media content[3]. One viral sensation of recent years is *Follow the Frog*[4], which promotes Rainforest Alliance-certified products and has been watched over five million times on YouTube. So, while it is often said that "a picture is worth a thousand words", a video may be worth millions[5]!

To create videos that capture the essence of the life of farmers, shepherds and hunters and their interactions with large carnivores, the ELC project hired professional film crews all around Europe. With compelling footage of honest people telling their side of the story, we aim to reach a broad audience, especially urban residents who support the return of large carnivores without knowing what rural people have to deal with on a daily basis.

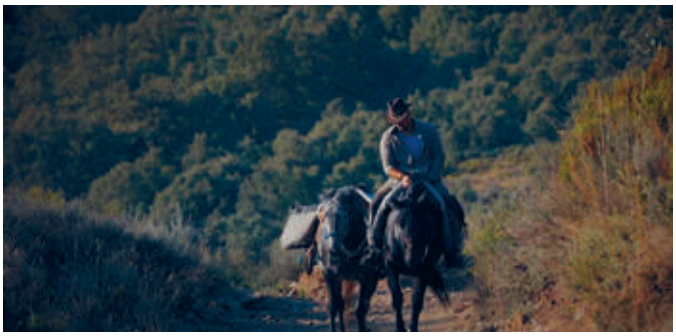
The *Stories of Coexistence* video campaign[6] has reached several hundred thousand people on Facebook and Instagram and thousands have watched the videos on YouTube. In some countries they have even made it onto prime-time national television. This fantastic success gives us hope that the campaign will ultimately contribute to an increase in recognition for hardworking people and inspire others to find the means and strength to coexist with large carnivores.

These videos are part of the Europe-wide campaign #StoriesOfCoexistence by the LIFE EuroLargeCarnivores project. More than 30 people, mostly from remote rural communities in 12 European countries, share their experiences through visual storytelling. Farmers, shepherds, ecotourism operators, beekeepers, hikers, hunters and villagers explain how they deal with the challenges and opportunities that come with the presence of large carnivores and find ways to accept and even come to appreciate them.

[1] https://www.agridea.ch/en/
[2] https://www.popsci.com/mark-zuckerberg-within-five-years-facebook-will-be-mostly-video/
[3] https://www.socialmediatoday.com/news/video-marketing-statistics-for-2020-infographic/566099/
[4] https://www.youtube.com/watch?v=3iIkOi3srLo
[5] https://idearocketanimation.com/4293-video-worth-1-million-words/
[6] https://www.eurolargecarnivores.eu/en/stories-of-coexistence

Video 1 ***'Sharing the Land'***

This short documentary film, made by Hakawati Film for WWF Spain, shows the testimonies of shepherds and farmers who have learned to live close to wolves, demonstrating that coexistence is possible if people are given enough support and the right tools to protect their flocks. *Sharing the Land*[7] was included in the Official Selection of films at the Wildscreen Festival[8], which is the equivalent of the Oscars for wildlife documentary film-makers.



Video 2 ***'Of Cheese and Bears***

In this short documentary film, produced by the LIFE EuroLargeCarnivores project, Yannick Lamazou tells how he lives with bears in the French Pyrenees. He promotes his products with the image of the coexistence of sheep and bears. He stands for a simple and tolerant lifestyle in the mountains.

Video 3 ***'Cooperation as a Key to be Prepared'***

In this short documentary film, produced by the LIFE EuroLargeCarnivores project, farmer Thomas Schranz explains the importance of communal approaches to management on alpine pastures in Austria. He calls for a new culture of shepherding in the context of the return of the wolf.

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[7] https://www.youtube.com/watch?v=n1zYBIcD2Tc
[8] https://www.wildscreen.org/festival/official-selection/

Project

LIFE WOLFLUX: HELPING FARMERS AND WOLVES IN PORTUGAL

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1. Introduction

According to the last national census, in 2002–2003 there were approximately 300 Iberian wolves (*Canis lupus signatus*) in Portugal (Fig. 1), most of them north of the Douro River (Pimenta et al., 2005). This census provided the most recent snapshot at a national level of wolf population size in Portugal and will soon be updated by data from the ongoing Wolf National Census. Between 2004 and 2013 other studies developed medium-term monitoring programmes (of at least four years) for 22 packs (34% of the area covered by the 2002–2003 national census) showing a stable population trend (Álvares et al., 2015).

South of the Douro, there is a small subpopulation of fewer than 50 wolves which is currently fragmented and highly isolated from the rest of the Iberian population due to ecological and social barriers. The main threats to the species acting as barriers to conservation and connectivity south of the Douro are: habitat transformation due to agriculture and urbanisation along the Douro River; habitat destruction caused by fires and infrastructure; low diversity and abundance of wild prey and consequent dependence on livestock for feeding (which leads to a high conflict with husbandry in certain areas); and direct human persecution (Álvares et al., 2015).

At the European level, the wolf is a species of Community interest which currently has an Unfavourable-Inadequate Conservation Status in the Mediterranean biogeographical region (EEA, 2019). The wolf in Portugal is included in Annex II and Annex IV of the Habitats Directive, requiring special areas for conservation and strict protection. At the national level, the Iberian wolf has been a strictly protected species since 1988 (Law 90/88) and is listed as 'Endangered' in the Portuguese Red Data Book of Vertebrates (Cabral et al., 2005). Portuguese authorities recently approved The National Action Plan for the Conservation of the Iberian Wolf (PACLobo – Despacho 9727/2017) which aims to improve the situation of the species.

The LIFE WolFlux[1] project aims to promote the ecological and socio-economic conditions needed to support the viability of the Portuguese wolf subpopulation south of the Douro River. In order to achieve this, the project intends to promote the necessary con-

[1] www.life-wolflux.com

Fig. 1 Iberian wolf pup photographed by camera trap within the LIFE WolFlux project area. *(Photo: Zoo Logical)*

ditions for the wolf to play its role as a top predator in the ecosystem, reducing its current dependence on livestock (Torres et al., 2015) and animal by-products (e.g. from aviaries) for feeding (Quaresma, 2002 in Pimenta et al., 2005), while at the same time increasing human tolerance towards the wolf and creating a spirit of coexistence in the region.

The 5-year project, which began in January 2019, is being coordinated by Rewilding Portugal, in partnership with Rewilding Europe, Zoo Logical, the University of Aveiro and Associação Transumância e Natureza. These partners bring to the project years of experience working with the Iberian wolf, its prey species and local stakeholders, as well as know-how about communications and nature-based enterprises, which together will allow the partnership to implement the foreseen project actions. The LIFE WolFlux project is also working closely with the Portuguese national authority for the environment, the ICNF (Instituto da Conservação da Natureza e das Florestas), and collaborating with other entities that also work on wolf monitoring and promotion of wild prey (e.g. ACHLI – Iberian Wolf Habitat Conservation Association), as well as entities involved in previous LIFE projects in the region (e.g. Grupo Lobo and ESACB – School of Agriculture of the Polytechnic Institute of Castelo Branco; LIFE Coex and LIFE MedWolf projects) in what concerns damage prevention measures.

2. Intervention Area

The project area includes the current known distribution of the Iberian wolf south of the Douro River, where there are estimated to be from seven to ten wolf packs according to data from 2003 to 2013 (Álvares et al., 2015), of which seven have been confirmed in several studies (Pimenta et al., 2005; Cadete et al., 2015; Palacios et al., 2017; Roque et al., 2017; Torres et al., 2018) (Fig. 2).

The Natura 2000 sites of Montemuro (Fig. 3) and Serras da Freita e Arada cover 35 to 50% of the wolf sub-population (ICNB, 2008). There are also some wolf packs in the centre of the project area that, due to their more central location and breeding stability, can play an important role connecting Montemuro/Freita e Arada with the rest of the Iberian population through the Spanish border. This is extremely important considering that the wolf subpopulation is very isolated genetically, particularly the packs in Cinfães/Freita and Arada (Silva et al., 2018). In the east, the Natura 2000 sites of Douro International and Mal-

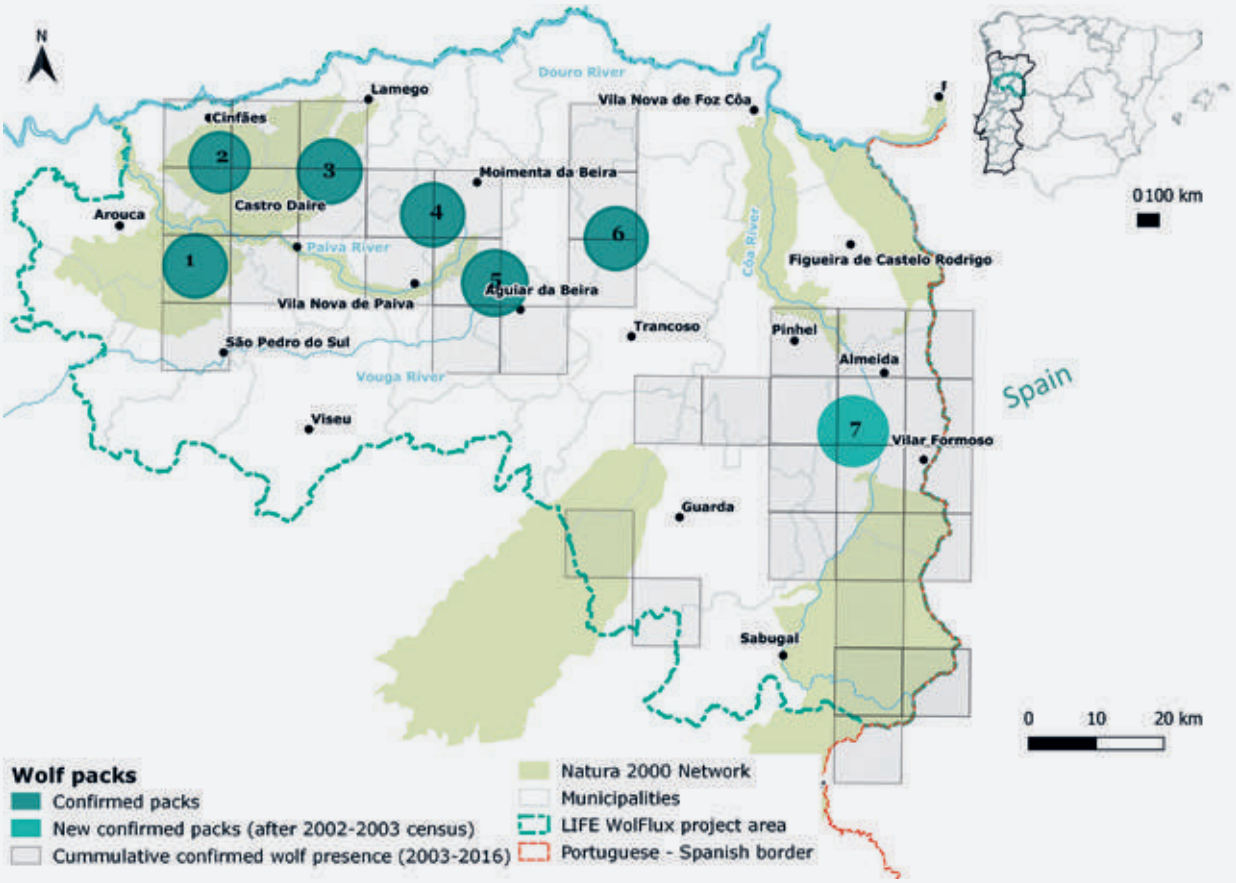

Fig. 2 Location of the project area, confirmed wolf packs from 2002 to 2016 and cumulative wolf presence (10 × 10 km UTM squares) (Sources: Pimenta et al., 2005: Cadete et al., 2015; Palacios et al., 2017; Roque et al., 2017; Torres et al., 2018). Wolf presence has been confirmed throughout the years by different projects with different methods and sampling efforts. The location of the pack territories is approximate and based on Pimenta et al. (2005).

cata, next to the border with Spain, are currently the known limits of wolf distribution. This is a transborder area of more irregular wolf presence (Álvares et al., 2015).

3. Project Actions

During 2019, a set of preparatory actions took place to better understand:

- Wolf distribution, density, genetic flow and feeding ecology through a non-invasive genetic monitoring programme and camera trapping.
- The distribution and abundance of prey species, particularly roe deer (*Capreolus capreolus*), through camera trapping and transects.
- Attitudes towards the wolf and potential social barriers by interviewing key stakeholders on the ground, such as livestock breeders and hunters, among others.
- Recent hotspots of predation, through the analysis of official damage records.

These actions will allow us to compile baseline information for the conservation measures which will be implemented from 2020 onwards. The measures will include:

- Setting up a surveillance team to monitor important areas for Iberian wolves such as rendezvous sites, as well as to strengthen fire prevention monitoring during the summer months.
- Setting up a veterinary team trained in the use of damage preventive measures, consisting of two local vets; working with livestock breeders to deploy 100 livestock guarding dogs (LGDs) in at least 50 livestock holdings and at least ten fences. Fixed metal or electric fences will be used, depending on the type of management, needs and conditions of the terrain. Interventions will be designed with the livestock owners to ensure long-term use and efficacy.
- Restoring habitat for roe deer and carrying out population reinforcements in areas of low density to ensure roe deer are a viable source of food for wolves.

Fig. 3 High grazing areas in Serra de Montemuro, part of the wolf range south of the Douro River. *(Photo: Rewilding Portugal)*

These actions are expected to address the main threats to the long-term viability of the Iberian wolf subpopulation. Additional communication, awareness-raising and enterprise-related actions are foreseen in the project, to ensure local communities are informed about project actions, become better informed about ways to coexist with large predators and also benefit from their presence, improving local rural economies through nature-based enterprises. Specifically, the project will:

- Carry out informative sessions with stakeholders throughout the project area.
- Support the development of wildlife tourism in the area, especially that related to the Iberian wolf.
- Develop a brand that recognises local products benefiting the conservation of wildlife in the region.
- Carry out an environmental education programme in local schools.
- Set up media partnerships to ensure a more balanced narrative about coexistence with Iberian wolves in Portugal.

In addition to these actions, the project team will also seek ways to collaborate with other LIFE projects. Furthermore, the project will try to establish cooperation with Spanish authorities such as the Junta de Castilla y Léon, to promote transboundary cooperation on wolf conservation.

4. Improving damage prevention

Conflict with husbandry is identified as one of the main threats to the wolf in Europe (Boitani, 2018). A characterisation of wolf damage on livestock has been carried out, based on official records from 2012 to 2016, made available by the ICNF, and damage hotspots have been identified (Aliácar, 2019). In this report, areas with the highest incidence of wolf attacks were mapped and priority areas for the implementation of conservation measures were selected (Fig. 4).

Looking at predation occurrence, intensity and economic impact of wolf attacks, there are 17 parishes which have been identified as damage hotspots. Parishes with more than eight attacks per year on average during the period 2012–2016 were considered damage hotspots. In terms of management, this provided a good coverage of parishes within the home ranges of all wolf packs and made possible the identifica-

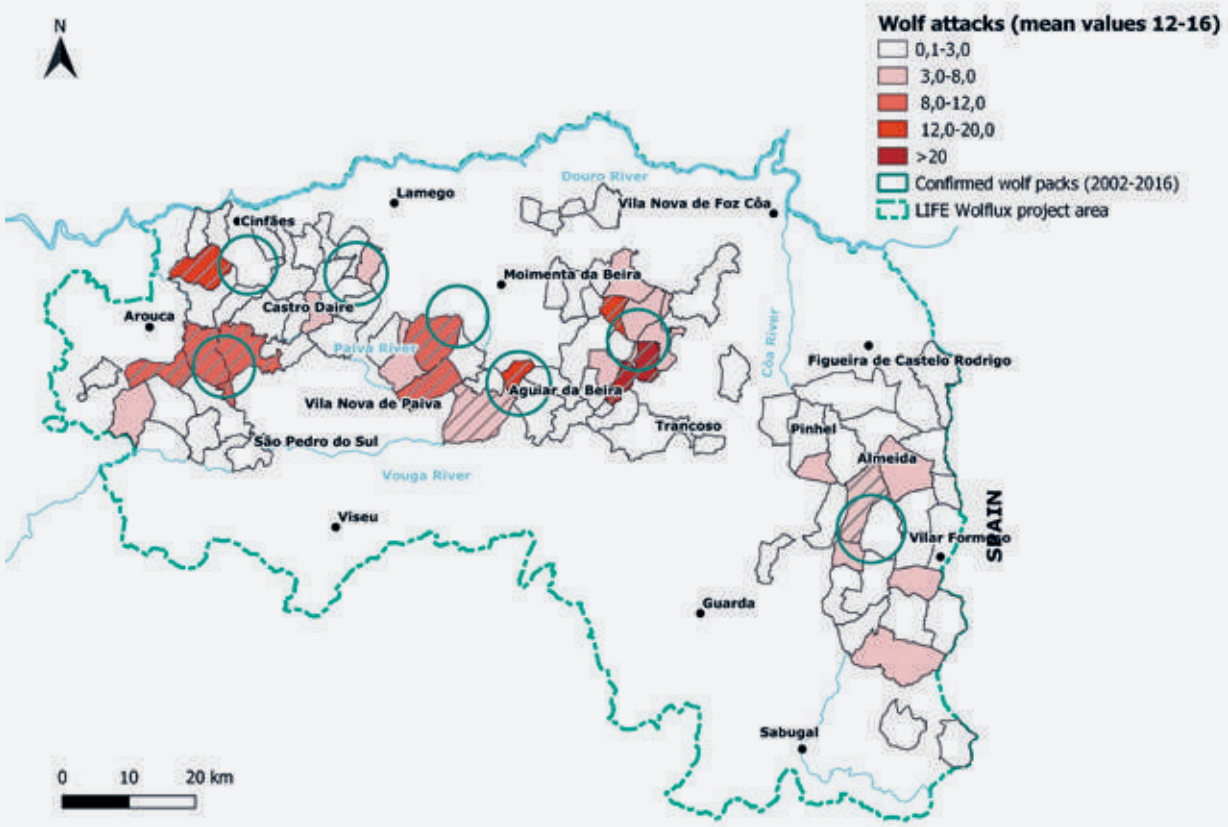

Fig. 4 Wolf predation occurrence per parish in the period from 2012 to 2016. Damage hotspots from 2012 to 2015 are highlighted with cross-hatching. Classes were defined manually. Source of data on damage: ICNF. Sources of data on wolf packs: Pimenta et al. 2005, Cadete et al. 2015, Torres et al. 2016, Roque et al. 2017.

tion of areas with higher risk of predation. Focusing the limited resources of a project on damage hotspots has proven to be an efficient strategy in previous LIFE projects (e.g. LIFE SloWolf – LIFE08 NAT/SLO/244) and it was recommended in a recent study that modelled the risk of wolf predation on livestock in Portugal (Pimenta et al., 2018), which also highlighted some of the same areas as damage hotspots at a national level.

Key actors in parishes with damage hotspots were interviewed in 2019. Key actors, including livestock breeders, were considered to be people who influence management of the area in a way that can affect the wolf and were selected using a non-random approach (based on Lopes-Fernandes et al., 2018). From a total of 53 interviewed livestock breeders, 57% reported having LGDs of native breeds, Estrela Mountain Dog and Castro Laboreiro Dog, or a shepherd (40%) or a combination of both (Aliácar et al., 2020). None of them had fences that protected livestock from wolves. Livestock breeders interviewed managed a total of 5,416 head of livestock: 2,517 sheep, 1,708 cattle and 1,191 goats. For the majority of them (74%, n = 39), breeding livestock was their main economic activity (Aliácar et al., 2020).

The most recent official data available on wolf damages south of the Douro, from 2016–2017, were explored in more detail to understand the baseline situation in the study area before project implementation. The most affected type of livestock was sheep (Fig. 5). Cattle accounted for 10% of attacks but for 35% of compensation payments due to their higher value (average compensation per cow was between 3.4 and 5.6 times higher than for sheep). This high-

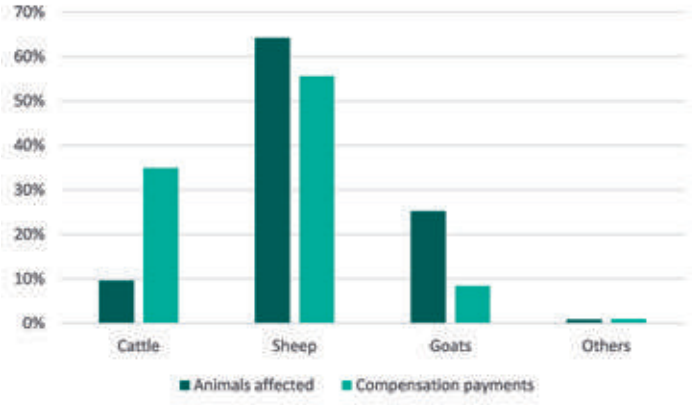

Fig. 5 Wolf predation on different types of livestock in the study area in 2016–2017 as a proportion of the total number of animals affected (1,278) and compensation paid (€183,395). 'Others' includes horses, donkeys and dogs. *Data source: ICNF*

lights the importance of the LIFE WolFlux project increasing the use of damage preventive measures among cattle holdings. For this reason, areas not identified as hotspots but with high economic losses due to current numbers of attacks have also been considered as priorities for project actions.

An adaptive management approach will be adopted when implementing damage prevention measures during the project. In addition to hotspots, other areas may need to be taken into account, for instance areas recently recolonised by wolves. The willingness of local communities to cooperate with the project team is another critical factor when selecting intervention areas.

The project team has already identified 25 breeders of cattle and sheep interested in damage prevention measures in the project area. Interested livestock breeders are identified in a continuous process through several sources of information: the support of the ICNF rangers that are responsible for carrying out damage inspections, through project actions such as interviews (Fig. 6) and through other organisations that work in the area. All livestock breeders are visited in order to assess if they meet the criteria to be supported by the project. These include having suffered wolf attacks within the last five years or being in an

Fig. 6 Interviews were carried out with key actors throughout the project area to understand the reality on the ground.
(Photo: Rewilding Portugal)

area of high risk of predation (areas of irregular wolf presence with intermittent peaks of attacks); that preventive measures can be implemented and are likely to be effective considering the type of management and the problems experienced; and the person is willing and capable of implementing the measures correctly. Other criteria, such as the number of head of livestock or having correctly implemented preventive measures in the past, are also considered.

Priority areas for targeting support include damage hotspots, livestock holdings that suffer chronic attacks, areas where there is an anomalous peak of attacks likely to lead to social conflict and areas of recent wolf recolonisation that are important for increasing connectivity among packs but where damage prevention practices have been lost and it is vital to provide good examples. This last scenario occurs in the border area with Spain where extensive husbandry with cows predominates. In order to amplify and coordinate efforts and benefit from their know-how, the team will also work closely with Grupo Lobo and ESACB, who have vast experience implementing damage preventive measures, particularly working with native breeds of LGDs and permanent metal/electric fences. Their technicians will provide consultancy to the project team and training for staff and veterinaries involved in the LIFE WolFlux project, as an exchange of experience between LIFE projects.

Fig. 7 A juvenile male short-hair Estrela Mountain Dog guarding his sheep flock in the Montemuro Mountains.
(Photo: Rewilding Portugal)

A veterinary team has already been created, with two vets responsible for integrating LGD pups into flocks in Guarda and Viseu districts and monitoring their physical and behavioural development. Food and veterinary care are provided until the age of 18 months. Monitoring of behaviour will be more regular during this period, but close contact with farmers will continue until the end of the project. Three Estrela Mountain Dog pups have already been placed (Fig. 7): two with sheep flocks for meat production

Fig. 8 Male short-hair Serra da Estrela Mountain Dog pup placed with a sheep flock in the Pinhel region by the LIFE WolFlux project. *(Photo: João Cosme)*

that are also watched over by a shepherd inside fenced pastures or in the mountains and one with a herd of 52 cows that in summer grazes freely in the mountains during the day accompanied by two other guarding dogs and confined in a fence at night and in winter grazes in lower-lying pastures closer to the village and kept in stables at night. All livestock holdings have had damage in the past seven years and are in areas of high predation risk.

Pups came from working parents and were microchipped, vaccinated, dewormed and donated after weaning (at 2–3 months old). An agreement was signed with the livestock owners establishing conditions for their upbringing and welfare, as well as the responsibilities of the project team and of the livestock owners to ensure that conditions are in place for the pups to become good guardians. Whenever possible, dogs will be filmed during monitoring visits to record their behaviour in order to better assess their behavioural development, while providing relevant material for training and information actions planned for vets, technicians and farmers. These videos, about LGD behaviour, common problems and how to solve them, will be included in an online library to disseminate the knowledge gathered.

The project expects to reduce wolf attacks suffered by farmers who choose to implement damage preventive measures and will work closely with participating farmers to find the best solutions for each particular case. It is also expected to contribute to the dissemination and greater establishment of the use of adequate prevention measures (i.e. well-raised and protective LGDs, well-built and maintained fences), expanding and reinforcing the work developed in previous LIFE projects, and currently being done by Grupo Lobo in a few overlapping areas. Working closely with livestock breeders to address their specific problems and providing the necessary technical support will build trust with the project team, which is fundamental for successful implementation of the measures and to mitigate conflicts with wolves.

Ultimately, the long-term viability of the Iberian wolf south of the Douro River will depend on three critical aspects: the availability of suitable habitat and wild prey; social acceptance by local communities (which in turn requires the effective deployment and maintenance of damage preventive measures); and transboundary cooperation with Spain, to improve the genetic connectivity between Spanish and Portuguese packs in this region.

Acknowledgements

The LIFE WolFlux project: Decreasing socio-ecological barriers to connectivity for wolves south of the Douro River (LIFE17 NAT/PT/000554) is funded by the LIFE Programme of the European Union, the EU's funding instrument for the environment and climate action. The project is co-financed by the Endangered Landscapes Programme (ELP). The ELP is managed by the Cambridge Conservation Initiative and is funded by Arcadia, a charitable fund of Peter Baldwin and Lisbet Rausing. To find out more about the project or for any queries, please email info@rewilding-portugal.com or visit the project website.

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EU Platform on Coexistence between People and Large Carnivores

Meetings

The 7th annual meeting of the EU Platform on Coexistence between People and Large Carnivores[1], held on 9th June 2020, took place online due to the COVID-19 pandemic. A range of relevant policy initiatives were discussed, such as the new EU Biodiversity Strategy and proposed changes to the Common Agricultural Policy (CAP). The Platform's work plan was updated, including future events and discussion of the establishment of regional platforms[2]. Smaller working groups focused specifically on tourism and the synergies and conflicts that can arise between carnivore-related tourism activities and other land uses. The Platform proposes to organise a regional workshop on the subject in 2021.

The 10th regional workshop of the Platform, hosted by WWF and the European Landowners Organisation, was organised as a side event of the LIFE EuroLargeCarnivores project conference on *Livestock protection in the Alpine region*[3]. The conference took place from 21st to 23rd January in Salzburg, Austria, and was attended by more than 200 participants. Over the three days, experts and practitioners exchanged knowledge about livestock protection. Around 40 speakers from Europe and the USA showcased possible solutions for coexistence with wolves, funding opportunities and the practical implementation of conflict mitigation measures such as electric fences and livestock guarding dogs (LGDs).

The EU Platform workshop focused on the use of the European Agricultural Fund for Rural Development (EAFRD) and other EU funding mechanisms and policy actions to support coexistence measures as well as selected examples of Member States' own approaches to financing livestock protection. Workshop participants visited a local horse breeder in Ramsau, Germany, to hear about his experiences of working with LGDs and to see the dogs interact with horses and visitors. Further details are available in the workshop report[4] and presentations can be downloaded from the Platform website[5]. A thematic webinar focusing on the role of stakeholders in monitoring large carnivores is planned for later in the year.

Case studies of practical and financial support

The following are examples of how coexistence between people and large carnivores can be supported. Further details of these and other case studies are available on the Platform website[6]. The inclusion of human-carnivore coexistence measures in Rural Development Programmes across the EU has been reviewed by Marsden et al., 2018 (in *CDPnews* issue 17) and Marsden and Hovardas, 2020 (see the Abstracts section of this issue).

Bulgaria

Coexistence measures have been included in Bulgaria's Rural Development Programmes (RDPs) since 2007. Stockbreeders carrying out traditional livestock management (seasonal pastoralism) in areas with large carnivores are supported through the agri-environment scheme. Subsidies are paid per hectare of grass-

[1] https://ec.europa.eu/environment/nature/conservation/species/carnivores/coexistence_platform.htm
[2] https://ec.europa.eu/environment/nature/conservation/species/carnivores/regional_platforms.htm
[3] https://www.eurolargecarnivores.eu/en/livestock-conference-salzburg
[4] https://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/200122_LC%20Platform%20workshop%20report-SZG.pdf
[5] https://ec.europa.eu/environment/nature/conservation/species/carnivores/events_sub_workshop_Salzburg_Austria.htm
[6] https://ec.europa.eu/environment/nature/conservation/species/carnivores/case_studies.htm

land to compensate for the costs of extra work and measures to protect livestock from large carnivores.

During the period 2007–2011, flocks protected with at least two LGDs were paid €110/ha/year compared to €100 if no dogs were used. In 2012–2013, the respective payments were €165 versus €152 and for the 2014–2020 programme they are €182 versus €179, respectively. These changes are due to recalculation of additional costs associated with the measure. The total funding provided in the most recent programme period, which covered 35,000 hectares in three National Parks, was €52.4 million. Monitoring is carried out to measure the impact of the measure and to verify the number of hectares involved, the type and number of livestock, authorisation to graze pastures in the national park and the use of at least two LGDs. Environmental NGOs and farming representatives are involved in the design of the measures and both sit on the Programme Monitoring Committee.

This approach has successfully supported the continued use of the traditional Karakachan dog breed and the grazing of mountain pastures. At the same time, losses of livestock to predators and ensuing conflicts have decreased. It is recommended to further increase the involvement of stakeholders in planning and to provide more advice on implementation.

Slovenia

Slovenia has more experience than most Member States of including measures for coexistence in RDPs. Animal husbandry in core areas of large carnivore occurrence has been supported through the agri-environment scheme since 2004. Payments are made per acre of grassland, linked to the use of damage prevention measures (mobile electric fences or nets, LGDs and shepherds). A wide range of stakeholders have been involved in planning and are represented on the Programme Monitoring Committee, including farmer representatives, environmental NGOs and the Slovenian Forest Service. The total expenditure in 2007–2014, financed from the EAFRD and national co-financing, was €1.3 million, with an average of €2,090 per beneficiary.

The implementation of damage prevention measures has resulted in a reduction in the number of attacks on livestock despite increasing numbers of large carnivores. This is usually accompanied by increased tolerance towards large carnivores and coexistence with them. To be effective, fences must be properly installed, whilst integrating LGDs into flocks requires considerable time and effort. It is recommended to expand the role of farmers as advisors within the programme. Transfer of good practice in damage prevention methods needs to take into account the local context in terms of landscape and farm characteristics as well as farming practices.

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Research

A DECADE OF USE OF DAMAGE PREVENTION MEASURES IN SPAIN AND PORTUGAL

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1. Introduction

Damage to livestock is the main cause of conflict between human activities and the grey wolf (*Canis lupus*) throughout most of the species' range. In the past, people responded by persecuting wolves, eradicating them from many areas (Boitani, 2003). Later, wolves received legal protection in many countries and damage compensation schemes were implemented as part of a strategy to alleviate conflicts.

In recent decades, the wolf has been naturally recovering in many regions of Europe (Chapron et al., 2014), returning to areas with high densities of livestock but where traditional methods to protect them from predators are no longer used (Linnell and Cretois, 2018). Various methods to protect livestock from wolves and other large carnivores have been tested around the world (Linnell et al., 1996; Shivik, 2006). These differ in terms of effort and cost to install and maintain, user-friendliness, longevity, flexibility and, of course, effectiveness (Gehring et al., 2010). Not all techniques are suitable in every situation: methods should be chosen and adapted to the predation risk and specific conditions in each holding (Linnell and Cretois, 2018). Among the most widely used and recommended measures to prevent damage and hence promote coexistence are livestock guarding dogs (LGDs) and electric fences (e.g. Boitani, 2000; Breitenmoser et al., 2005; Rigg, 2001; Wade, 1982).

In Europe, many projects and initiatives have aimed to reduce damage caused by large carnivores, some of them funded by the EU LIFE Programme[1] (Salvatori, 2013). One such project, LIFE Coex (LIFE04 NAT/IT/00144), was implemented from 2004 to 2008 in Portugal, Spain, France, Italy and Croatia. One of its main activities was to implement and promote damage prevention measures for livestock, beehives and crops. During the project, 290 electric fences, 22 conventional wire-netting fences and 245 LGDs were implemented, monitored and assessed (see: LIFE Coex, 2008; Salvatori and Mertens, 2012). In Spain and Portugal, measures were focused on reducing losses of livestock to wolves at a total of 144 holdings.

[1] ec.europa.eu/easme/en/life

Iberian wolves are recolonising parts of their original range, expanding into areas where livestock is kept at high densities and traditional methods of protection from predators are no longer used, leaving them vulnerable to predation. *(Photo: J.C. Blanco)*

The Iberian wolf population is the largest in Western Europe and is considered Near Threatened (Boitani, 2018). Since the 1970s, wolves in Spain have been spreading southwards and eastwards, recolonising many territories where they had been exterminated. The latest estimates report around 300 packs in the northwest of the country. During the last two decades, the species has expanded its range south of the Duero River, where there are now around 27 packs (9% of the Spanish population) (MAGRAMA, 2015). In Portugal, where the wolf has been protected by national legislation since 1988, the population has been stable overall, with recolonisation in some regions offset by reduction in numbers elsewhere (Álvares et al., 2015). There are approximately 64 packs, 90% of them north of the Douro River[2] and contiguous with the Spanish population and the remainder more-or-less isolated from other nuclei (Pimenta et al., 2005).

In Spain, autonomous regions compensate all damage caused by wolves except in Castilla y León. In this region, which hosts around 60% of packs, damage is compensated everywhere south of the Duero River[3], but in the north only damage in regional game reserves, which cover a small part of the wolf range, is compensated. In Portugal, compensation has been in place for more than 30 years in the entire wolf range, being conditional on the use of prevention measures. Subsidies for maintaining LGDs do not exist in the Spanish intervention area but have been implemented in Portugal since 2015.

Despite the extensive use of conflict mitigation tools worldwide, few studies have monitored their effectiveness in the medium and longer-term (Khorozyan and Waltert, 2019; but see: Coppinger et al., 1988; Green et al., 1994). Assessments over time are useful to evaluate the lasting impact of short-term

[2] A continuation of the Duero River in Spain.

[3] Wolves south of the Duero River are included in Annexes II and IV of the Habitats Directive while those to the north are in Annex V and managed as a game species.

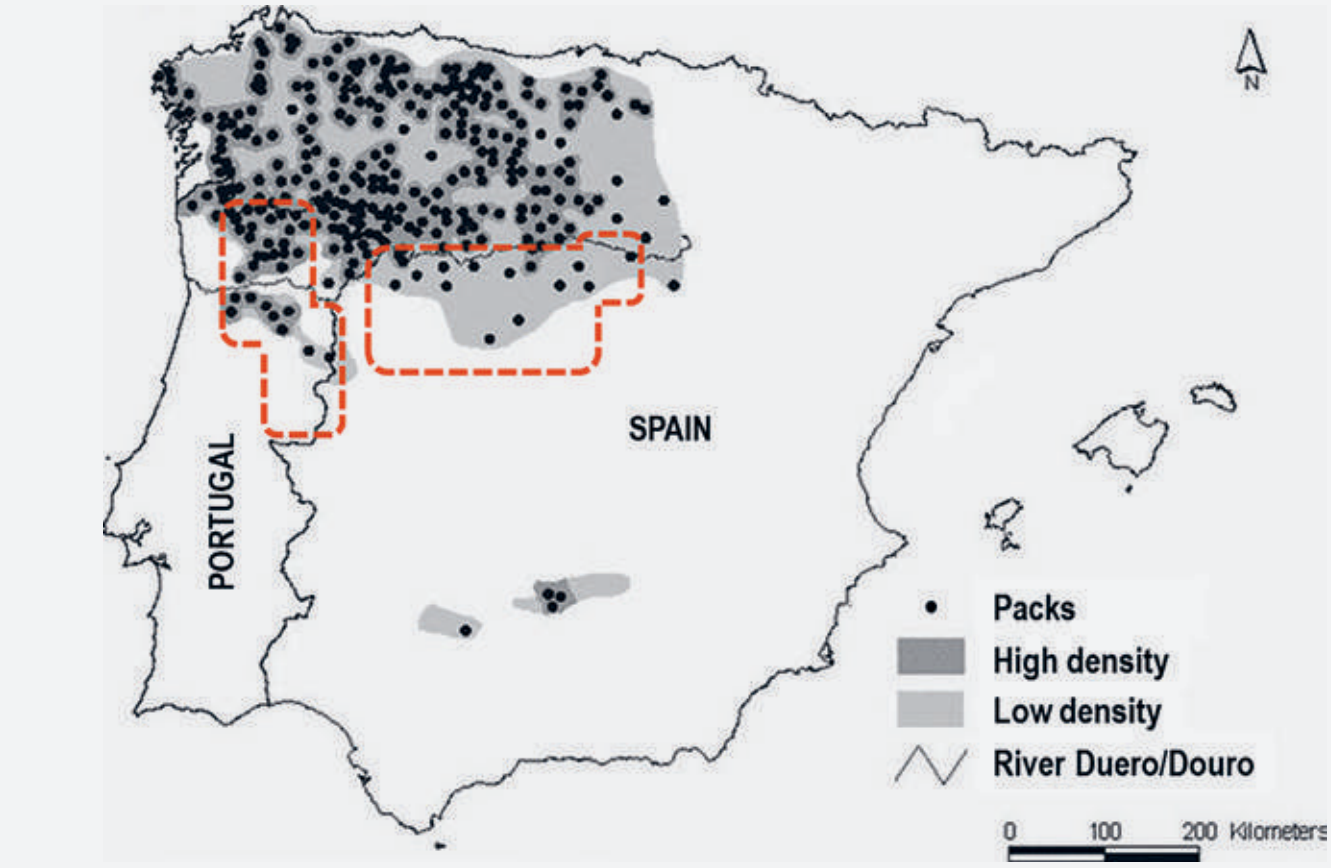

Fig. 1 Wolf distribution in the Iberian Peninsula showing locations of confirmed packs in 2005, at the start of the LIFE Coex project, and delimitation of the intervention areas in Portugal and Spain (dashed lines). The north-western Spanish population has since expanded slightly to the south but the isolated population of Sierra Morena is functionally extinct. Wolf recovery is slower in Portugal, with the range being stable overall in recent decades (Adapted from Álvares et al., 2005).

projects, the sustainability of measures used and the level of consistence achieved. This can be important when setting priorities for public funding policies and clarifying their usefulness and efficacy (Gubi, 2006; Karlsson and Sjöström, 2011; Salvatori, 2013).

In this article, we present results from an assessment of the use of three types of damage prevention measures in Portugal and Spain a decade after they were implemented during the LIFE Coex project in 2004–2008. Specifically, we wanted to know the lev-

Goats are the most important prey for wolves in the northern part of the Portuguese study area.

(Photo: Grupo Lobo)

Extensive grazing of cattle, such as these Avileña breed cows, is common in the Spanish part of the project area.

(Photo: Y. Cortés)

el of satisfaction of the beneficiaries, their perceptions of the efficacy and maintenance costs of the measures or, if applicable, their main reasons for no longer using them, as well as their suggestions to encourage other farmers to implement them. Whenever appropriate, a comparison was made with assessments made at the end of the project.

2. Study area

The intervention area was located in wolf range south of the Duero/Douro River on both sides of the border and the central area of its northern range in Portugal (Fig. 1). It covered a total of nearly 44,500 km^2 with mountains up to 1,500 m a. s. l., extensive stable shrublands as well as foothills and lowlands dedicated to agriculture. There were around 200 wolves in 38 packs in the region, which also has important natural areas, including Natura 2000 sites.

On the Spanish side, *dehesas*[4] predominated and livestock raising occurred mainly in the form of extensive sheep grazing and free ranging cattle. There were good populations of roe deer (*Capreolus capreolus*) and red deer (*Cervus elaphus*). The wolf population was contiguous and there were high levels of conflict with farmers.

In Portugal, wild ungulates were absent or scarce apart from wild boar (*Sus scrofa*). Flocks of mostly goats with some sheep and cattle were grazed throughout the year in communal pastures at higher elevations and in smaller pastures or agricultural fields closer to villages. They were usually shepherded or kept in fenced pastures and confined in stables during the night. The impact of predation was high in the northern area, where goats and sheep constituted more than 70–80% of wolf diet (Passinha, 2018). Feral/stray dogs were also present and sometimes attacked livestock, especially at the edges of the wolf range (Álvares et al., 2015).

3. Methods

Semi-structured telephone interviews were conducted with farmers who had benefited from damage prevention measures within the LIFE Coex project. Data were obtained on the length of time that measures were used, perceptions of their efficacy, estimated costs and requirements for continued use. Interviews were carried out in summer 2018 in Spain and throughout 2019 in Portugal, in both cases by the technician who was originally involved in implementing the measures in each country.

[4] A landscape consisting of pastures interspersed with a savannah-like forest of holm and/or cork oak trees, used for agriculture, livestock raising and forest exploitation.

Pups are placed with livestock from an early age, such as this Estrela Mountain Dog (short-hair variety) in Portugal and these Spanish mastiffs with cattle in Spain.

(Photos: Grupo Lobo, Y. Cortés)

Livestock and dogs are mostly confined in stables during the night in Portugal, as at this farm south of the Douro River. *(Photo: Grupo Lobo)*

Livestock in Portugal is mostly grazed in mountain pastures and shepherded. *(Photo: Grupo Lobo)*

3.1 Use of prevention measures

Information on the current number and type of livestock was recorded for all holdings. In cases where changes had occurred, the reasons for the change were also noted. Information on the origin of existing LGDs were requested in order to determine if they were descended from those donated during LIFE Coex or were replacement dogs from other farmers.

3.2 Effectiveness and satisfaction

Detailed official data on damage to livestock were not available for the entire period since the end of the LIFE Coex project. Farmers were therefore asked about damage suffered during the previous year (from August 2017 to September 2018 in Spain and during 2018 in Portugal). Only holdings located in areas with confirmed wolf presence (based on an official survey and the authors' own data) were included. Whilst farmers' reports of damage are often higher than compensation payments, there is a widely held view amongst the farming community that the latter under-estimate losses to wolves because some carcasses are consumed almost entirely or are not found, making it impossible to confirm predation. Although we do not have data to verify this claim, there are precedents from elsewhere (e.g. Boitani et al., 2010).

Farmers were asked to rate their level of satisfaction with prevention measures on a four-point scale: Very Satisfied, Satisfied, Slightly Satisfied or Not Satisfied. Level of satisfaction is a valid method to evaluate the success of prevention measures, since their implementation depends on acceptance by farmers (Bohlen, 1964 in Coppinger et al., 1988). In the case of LGDs, perceived effectiveness may be related to observations of dog behaviour rather than levels of damage (Potgieter et al., 2013). Behaviour was assessed on the basis of three behavioural traits considered necessary for good working dogs: attentiveness, trustworthiness and protectiveness (Coppinger and Coppinger, 1980). In this analysis, opinions of farmers no longer active or using prevention measures were also considered.

3.3 Maintenance costs

Farmers were asked to provide estimates of the annual costs for maintaining the measures. In the case of electric or conventional fences, expenses to replace or fix lost, stolen, broken or malfunctioning equipment, or to hire someone to set it up, were based on average prices during LIFE Coex (not adjusted to inflation). For LGDs, costs including food, veterinary care, licensing and insurance were considered for adult dogs only (young dogs usually incur additional expenses, e.g. microchipping, extra vaccines). Data were obtained from farmers still using LGDs or, if they were not certain of costs, these were estimated from average values mentioned by neighbouring farmers. The purchase price of LGDs among farmers was considered to be up to €300, since it was uncommon to buy more expensive pups from professional breeders. Farmers often obtained dogs for free, either from other farmers or by breeding their own dogs.

All LGDs donated in Spain were Spanish Mastiffs and most were placed with sheep, although some were placed with cattle.
(Photo: I. Carbonell)

The mobile electric fences donated in Spain were mainly used to protect flocks of sheep or goats at night. *(Photo: I. Carbonell)*

With information on all costs incurred by farmers since the LIFE Coex project (i.e. during a 10-year period), it was possible to roughly estimate the total annual cost for each measure, including maintenance as well as acquisition/construction cost. For LGDs, acquisition expenses since the end of the LIFE Coex project were based on the average longevity estimated for project dogs in Portugal, where date of death was obtained for 85% of dogs (excluding those retired from holdings). Average longevity was estimated to be 5.5 years. Thus, during the 10-year period farmers had to acquire two additional pups at a total annual acquisition cost ranging from zero to €60.

3.4 Reasons for discontinued use and suggestions to encourage uptake

Farmers who no longer used prevention measures were asked to explain their reasons. They were also asked what they would have needed to continue using them. When inadequate behaviours were mentioned as the reason for discontinued use of LGDs, these were classified according to the behavioural components mentioned above. Farmers still using prevention measures were requested to mention any problems they faced. All farmers were asked if they had any suggestions for responsible authorities to promote the use of damage prevention measures.

4. Results and Discussion

We considered a total of 224 damage prevention measures deployed during the LIFE Coex project: 167 LGDs (75%), 42 electric fences (19%) and 15 conventional fences (7%). Most were at sheep/goat flocks (94%) and the remainder at cattle herds (Table 1). LGDs were of local breeds: the Spanish Mastiff in Spain and the Castro Laboreiro and Estrela Mountain Dog in Portugal. In most cases, two dogs were placed per holding; a third was only donated to replace a dead/lost dog. Details on the setting-up of electric and conventional fences and the LGD placement protocol, as well as on monitoring and assessment procedures, can be found in Salvatori and Mertens (2012).

In holdings where fences were set-up, flocks/herds ranged in size from 30 to 1,500 head (average 539) in Spain and from 20 to 1,020 head (average 503) in Portugal. Spanish flocks/herds guarded by LGDs ranged from 14 to 1,700 sheep/goats (average 562) and 30 to 1,000 head of cattle (average 243). In Portugal, sheep/goat flocks ranged from 15 to 950 head (average 188) and there was one herd of 10 cattle.

Table 1 Damage prevention measures donated by the LIFE Coex project, according to country and type of livestock.

Country and type of measure	Cattle		Sheep/Goats		Total	
	N	%	N	%	N	%
Spain						
Electric fences	1	7.7	29	13.7	30	13.4
Conventional fences	3	23.1	12	5.7	15	6.7
LGDs	8	61.5	67	31.8	75	33.5
Portugal						
Electric fences	0	0	12*	5.7	12	5.4
LGDs	1	7.7	91	43.1	92	41.1
Combined						
Electric fences	1	7.7	41	19.4	42	18.8
Conventional fences	3	23.1	12	5.7	15	6.7
LGDs	9	69.2	158	74.9	167	74.6
Total	**13**	**100**	**211**	**100**	**224**	**100**

* In this case, a sheep flock was grazed jointly with a cattle herd.

Of 134 farmers in our study area who received prevention measures from LIFE Coex, we contacted 90%. In Spain, 96% of 70 farmers were contacted, of whom 13 were no longer in production: seven due to sale of livestock (not due to the wolf) and the remaining six because the owner retired. In Portugal, 83% of 64 farmers were contacted, of whom 14 had sold their livestock. In eight holdings, the original livestock was considerably reduced in numbers and replaced with a new species. Fences were implemented in 11 holdings in Portugal, but as these were mostly outside the wolf range and only a few farmers could be contacted, here we only present results regarding LGDs.

4.1 Use of prevention measures

Overall, 65% of all holdings were still using prevention measures at the time of our survey, but this figure increases to 83% if we include farms which are no longer active but used prevention measures until they closed down (Table 2). In Spain, where data allowed comparison of the three types of measures, conventional fences (93% still in use) and LGDs (87%) had greater longevity than electric fences (61%). The level of ongoing use of LGDs was very similar in Portugal. In most active holdings (74%), LGDs donated by the project[5] or their descendants were still being used, indicative of the importance and success of the founding stock to keep the measure going. In the remainder, dogs originated from other farmers.

4.2 Effectiveness and satisfaction

Overall, 62% of holdings in areas with recent attacks that were still using prevention measures had not reported damage in the preceding year (Table 3). In Spain, there was no reported damage at 80% of holdings with conventional fences, 71% of those with LGDs and 56% of those with electric fences. At the end of the LIFE Coex project, reductions were doc-

Table 3 Holdings in areas with confirmed wolf presence and from which no damage was reported for the year preceding our survey.

Country and type of measure	Holdings in areas with attacks	Holdings with no damage	
	N	N	%
Spain			
Electric fences	18	10	55.6
Conventional fences	10	8	80.0
LGDs	28	20	71.4
Portugal			
LGDs	30	15	50.0
Combined			
LGDs	58	35	60.3
Total	**86**	**53**	**61.6**

Table 2 Continued use of prevention measures 10 years after implementation.

Country and type of measure	Holdings contacted	Current use		Currently used or used until farm closure	
	N	N	%	N	%
Spain					
Electric fences	28	15	53.6	17	60.7
Conventional fences	14	12	85.7	13	92.9
LGDs	39	27	69.2	34	87.2
Portugal					
LGDs	53	33	62.3	47	88.7
Combined					
LGDs	92	60	65.2	81	88.0
Total	**134**	**87**	**64.9**	**111**	**82.8**

[5] In three cases, the original donated LGDs were still working in 2018: one 10-year old female and two males aged 10 and 12 years old.

umented of 61–100% in number of livestock lost and 65–100% in number of attacks on holdings that implemented prevention measures. In Portugal, 50% of holdings with LGDs did not suffer any damage. The LIFE Coex project registered a reduction in damage at 74% of holdings and a decrease of 13–100% in the number of livestock lost (LIFE Coex, 2008). These results should not be taken as a direct measure of the effectiveness of fences and LGDs, since we do not know if the measures were working properly at the time of attack. Nevertheless, they reveal farmers' perceptions of relative levels of losses with versus without prevention measures.

In terms of farmers' satisfaction with the measures, 94% of those contacted were satisfied or very satisfied (Fig. 2). In Spain, the highest level of satisfaction was for conventional fences (100% of recipients were satisfied or very satisfied). The level of satisfaction with LGDs (95% of recipients either satisfied or very satisfied) was higher than in the assessment of adult dogs (86%) in the last year of the project (LIFE Coex, 2008). In Portugal, 96% of farmers who received LGDs were satisfied or very satisfied with them as a damage prevention tool. This result is identical to that obtained in the final assessment of the project. In two holdings that were no longer active farmers were not satisfied with their last LGDs, but this was not the reason why they stopped using them.

4.3 Maintenance costs

The initial set-up cost of conventional fences was higher compared to other measures, but maintaining them had negligible annual costs to farmers (Table 4). In the case of electric fences, 60% of 15 farmers who replied reported having to replace components including the battery and energiser while 27% had only minor costs, referring mostly to wires and insulators (i.e. less than € 10 during a 10-year period).

Annual maintenance costs per LGD were, on average, higher in Spain (€ 300) than in Portugal (€ 183), reflecting differences in prices of products and services (Table 4). For most farmers in both countries, costs did not exceed € 400 (Table 5). In Portugal, more than 90% of farmers spent less than € 350/year, which is the current value of the annual subsidy paid for one LGD[6]. These should be considered minimum costs, since in some cases it was difficult to estimate real values.

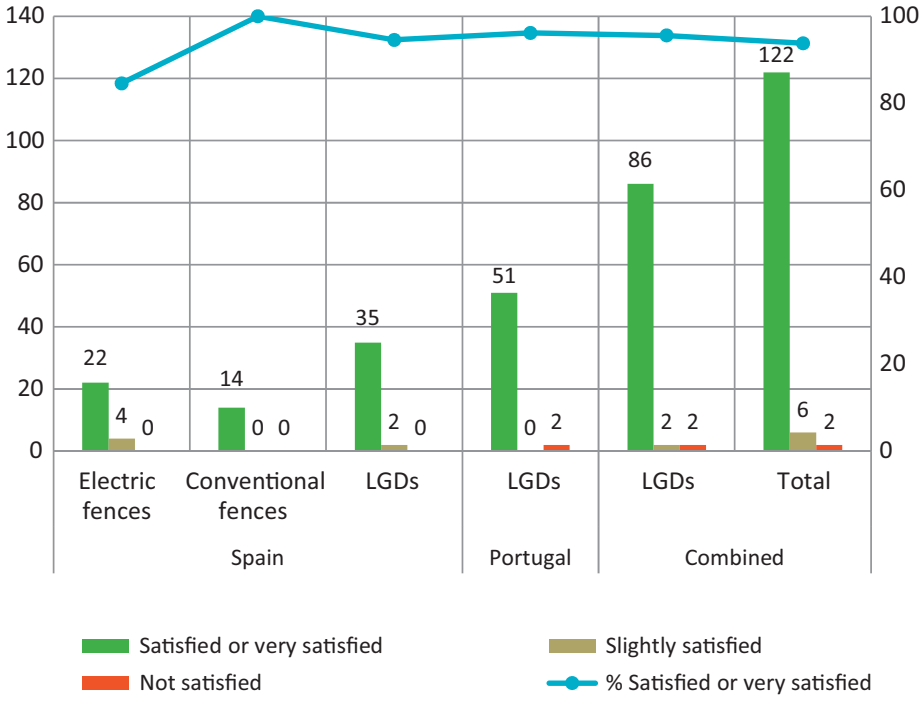

Fig. 2 Level of satisfaction of farmers with damage prevention measures.

[6] Subsidies are paid by IFAP (Financing Institute for Agriculture and Fisheries) for up to two LGDs at a value of € 350 each. To qualify, a holding must have a minimum of 2.5 ha of prairies and permanent pastures, mostly located within the defined intervention area, and a minimum of 5 LSU (5 head of cattle >2 years old or 33 head of sheep/goats >1 year old).

4.4 Reasons for discontinued use

The main reason given by farmers in both countries for no longer using prevention measures was ceasing farming activity (63%). Malfunction of fencing equipment (23–50%), loss/death of LGDs (15%) or the fact that they were no longer considered necessary (15%) were also cited as reasons (Table 6).

Of 26 farmers in Spain who no longer used prevention measures, the main reason was retirement of the farmer or sale of livestock (58%), unconnected with the wolf. In the case of LGDs, another reason was death or loss of dogs. There was only one case in which inadequate behaviour (roaming due to insufficient attentiveness) led to LGDs no longer be-

Table 4 Average costs of acquisition/construction, annual maintenance and total costs, for each prevention measure, during a 10-year period.

Country and type of measure	Costs (EUR)		
	Acquisition/ Construction	Maintenance	Total average cost per annum*
Spain			
Electric fences	700	200	90
Conventional fences	5,500	50	555
LGDs	0–600	300	300–360
Portugal			
LGDs	0–600	183	183–243

* Refers to the average annual costs incurred by farmers during a 10-year period since the LIFE Coex project.

Table 5 Classes for annual maintenance costs of LGDs.

Country	< €100		€100–200		€200–300		€300–400		> €400		Total
	N	%	N	%	N	%	N	%	N	%	
Spain	2	11	4	22	5	28	5	28	2	11	18
Portugal	9	29	14	45	4	13	2	6	2	6	31
Combined	11	17	18	27	9	14	7	11	4	6	49

Table 6 Reasons given by farmers for discontinuation of prevention measures.

Country and type of measure	Sale/Retired		Equipment lost/broken, dog died		Problems in use		No longer useful		Total
	N	%	N	%	N	%	N	%	
Spain									
Electric fences	6	46.2	3	23.1	2	15.4	2	15.4	13
Conventional fences	1	50.0	1	50.0	0	0	0	0	2
LGDs	8	72.7	2	18.2	1	9.1	0	0	11
Portugal									
LGDs	14	70.0	1	5.0	0	0.0	5	25.0	20
Combined									
LGDs	22	71.0	3	9.7	1	3.2	5	16.1	31
Total	**29**	**63.0**	**7**	**15.2**	**3**	**6.5**	**2**	**15.2**	**46**

ing used. In decreasing order of importance, the main reasons for abandoning the use of electric fences were: breakage; no longer useful to farmer; practical problems (sheep or dogs were scared of it). Finally, two conventional fences were no longer used due to retirement of the owner and damage caused by inclement weather.

In Portugal, 20 farmers no longer used LGDs. Ten of them had stopped farming due to personal and/or economic reasons and four had retired due to physical incapacity. Economic reasons for stopping farming were connected with reduced income or lack of staff to properly manage the holding. In five cases, the use of LGDs was considered to be unnecessary after flock size was reduced and the predation risk was perceived to be lower.

Overall, 68% of farmers who were no longer using fences or LGDs did not mention any resources or support as being necessary (Table 7). For the remaining 32%, some technical help or new equipment or dogs would have been required for them to continue using prevention measures.

4.5 Suggestions to encourage use

When asked to make suggestions to responsible authorities, interviewed farmers gave a total of 126 responses which we grouped into 25 items (Table 8). Most of them (14 items, 62% of responses) related to damage prevention or compensation for the impact of wolves on livestock breeding. There was a clear difference between countries. In Spain, 59% of responses concerned subsidies for the acquisition, construction or maintenance of prevention measures and several farmers mentioned a need to adapt the existing legal framework to the use of LGDs. In Portugal, only 5% of responses were linked with use of LGDs while 30% called for an easier and less bureaucratic system to report losses including less stringent criteria to confirm cause of death. This could reflect the fact that 81% of the Portuguese farmers were already benefiting from subsidies for LGDs.

Some suggestions were not directly linked to prevention measures or compensation but are, nevertheless, important to understand the context of wider socio-economic conflicts that can develop around wolves if their impact on livestock is not adequately addressed (Linnell and Cretois, 2018). Many suggestions from Portuguese farmers were aimed at alleviating economic uncertainties and financial burdens. Most concerned factors that have been identified as drivers for change in small-scale farming, promoting rural-urban migration (Linnell and Cretois, 2018). This also contrasted with responses from Spain, 15% of which expressed a desire for reduction or elimination of wolves from the region, although most farmers who gave this response also wanted help to implement LGDs or fences, thus opening the door to coexistence.

Table 7 Needs of farmers to continue using prevention measures.

Country and type of measure	None		Practical help (repairing fences / socialising LGDs)		Material help (more equipment / another LGD)		Total
	N	%	N	%	N	%	
Spain							
Electric fences	8	80.0	1	10.0	1	10.0	10
Conventional fences	1	50.0	1	50.0	0	0	2
LGDs	4	57.1	2	28.6	1	14.3	7
Portugal							
LGDs	4	66.7	0	0	2	33.3	6
Combined							
LGDs	8	61.5	2	15.4	3	23.1	13
Total	**17**	**68.0**	**4**	**16.0**	**4**	**16.0**	**25**

Table 8 Suggestions of farmers to encourage the use of damage prevention measures, compensate predation impact and improve livestock breeding activity.

	Spain		Portugal		Combined
	N	%	N	%	%
1. Donations of electric fences	3	4.5	0	0	2.4
2. Construction or subsidies for conventional fences	14	21.2	0	0	11.1
3. Donations of LGDs	8	12.1	0	0	6.3
4. More support for LGDs (food/veterinary care/insurance)	14	21.2	3	5.0	13.5
5. Solutions to legal problems of LGDs	6	9.1	0	0	4.8
6. Monitor proper use of LGDs (to ensure subsidies and compensations are well used and prevent conflicts)	0	0	1	1.7	0.8
7. Prompt and fair payment of compensation	3	4.5	2	3.3	4.0
8. Less bureaucratic and strict process for claiming compensation	0	0	18	30.0	14.3
9. Fixed annual compensation payment based on damages in previous year	0	0	1	1.7	0.8
10. Compensate lost profit	1	1.5	0	0	0.8
11. Payment for living in wolf areas	1	1.5	0	0	0.8
12. Tax on wolf tourism paid to farmers	1	1.5	0	0	0.8
13. Raise awareness of LGDs amongst tourists and visitors	1	1.5	0	0	0.8
14. More information for farmers on aid, compensation, regulations, etc.	0	0	1	1.7	0.8
Sub-Total	**52**	**78.8**	**26**	**43.3**	**61.9**
Other suggestions					
1. No wolves or less wolves	10	15.2	0	0	7.9
2. More support to farmers (compensate losses and lower income, find markets)	0	0	15	25.0	11.9
3. Local councils should give more support and aid to farmers	0	0	4	6.7	3.2
4. Payment for services provided by livestock in maintaining mountain pastures and reducing fire risk	0	0	1	1.7	0.8
5. Support for veterinary expenses	0	0	6	10.0	4.8
6. Less obstacles to extensive livestock	1	1.5	2	3.3	2.4
7. Better access and more watering places for livestock/people in summer	0	0	1	1.7	0.8
8. Forbid the use of herbicides along roads (bad for livestock)	0	0	2	3.3	1.6
9. Controlled burns and create fire-breaks to reduce risk of large fires in summer	0	0	1	1.7	0.8
10. Control stray dogs to prevent damage to livestock and car accidents	0	0	2	3.3	1.6
11. Compensate damage by wild ungulates to crops, cull them to prevent damage and disease transmission	3	4.5	0	0	2.4
Sub-Total	**14**	**21.2**	**34**	**56.7**	**38.1**
Total	**66**	**100**	**60**	**100**	**100**

Mobile electric fences can be transported and installed by a single person in a short time.

(Photo: I. Carbonell)

▲▼ Due to their height and other characteristics, permanent metal fences turned out to be invulnerable to wolves and other predators.

(Photo: Y. Cortés)

Dogs like this Castro Laboreiro in northern Portugal are perceived as a valuable tool to prevent wolf damage, with most adults exhibiting appropriate behaviour. *(Photo: Grupo Lobo)*

Juvenile Castro Laboreiro with a mixed goat-sheep flock in northern Portugal. *(Photo: Grupo Lobo)*

▶ Farmers were satisfied with their dogs, such as these adult Spanish Mastiffs, considering them to be effective in preventing damage by wolves to extensively grazed sheep or goats. *(Photo: Y. Cortés)*

5. Conclusions

This study illustrates the potential for prevention measures to contribute to mitigating wolf-human conflicts in the long-term. Most measures were still being used a decade after they were implemented. Damage remained low and farmers continued to be satisfied. Although such positive results may be linked to high motivation of farmers who chose to take part in the project, it is important to note that such people may be the most effective advocates, demonstrating correct use and sharing experience (and LGD pups) with their peers, which could result in wider use of these tools.

Our follow-up assessment also confirms the importance of concrete actions within the LIFE Programme in promoting coexistence with large carnivores. Planning for long-term evaluation of LIFE projects has already been proposed through the implementation of ex-post monitoring, which would allow assessment of the impact of interventions on wolf populations, since effects are usually difficult to measure at the time when project actions end (Salvatori, 2013).

We found that annual maintenance costs differed between measures and countries, being higher for LGDs, although none of the farmers had stopped using them due to cost. Support for prevention measures was frequently requested while technical issues (e.g. inadequate dog behaviour, mortality, malfunction of equipment) were also cited as reasons for abandoning their use. This is an indication that many farmers (even those openly against wolves) are convinced of the importance of incorporating measures to prevent wolf damage and are willing to continue implementing them, given proper financial and technical support.

Adopting new measures can be difficult for many farmers and the wider problems they face should be considered when requiring or recommending prevention measures, which must be economically feasible and accepted by the farming community. Integrating such measures into broader rural development policies will address the challenges of extensive livestock farming (e.g. low profitability, problems to find markets and experienced help, lack of generational replacement) and stimulate extensive production and pastoralism (Linnell and Cretois, 2008). Financial aid should be accompanied by advisory programmes and monitoring of their effectiveness. In the case of LGDs, legal and social constraints must be mitigated to promote their use while making pups from good working stock more easily available, such as by developing farmers' networks.

The responses of farmers we interviewed indicate that current compensation systems, although regarded as a useful tool to promote tolerance towards wolves, may be failing to address many farmers' concerns. Delayed and incomplete payments can exacerbate conflicts, undermining trust in authorities and promoting animosity (Nyhus et al., 2003). Basing payments on updated market prices, possibly including costs over and above the replacement value of lost livestock, can help to ensure that the real impact of predation is fully compensated. We found that farmers in Portugal were critical of the bureaucracy of damage assessment. Most of them considered the new system as failing to meet their expectations, leaving them to endure most losses on their own. A few farmers in both countries suggested alternative ways to encourage coexistence such as revenue-sharing, payment for services or for exposure to risk: possible signposts for the future.

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The title of this article is a reference to the 1988 paper by Raymond Coppinger and collaborators, *A decade of use of livestock guarding dogs*, highlighting their important work on LGDs.

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[7] www.grupolobo.pt/programa-cao-de-gado

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Short Communication

PARTICIPATORY PROCESSES FOR MITIGATING CONFLICTS AMONG STAKEHOLDERS: REGIONAL PLATFORMS ON LARGE CARNIVORES IN EUROPE

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1. Introduction

The conservation and sustainable management of large carnivores is one of the most challenging tasks facing conservationists and decision-makers in Europe. After centuries of persecution, wolves (*Canis lupus*), bears (*Ursus arctos*) and, to a lesser extent, lynx (*Lynx lynx*) are currently recovering across many areas of Europe for several reasons, including recovery of prey species, enhanced public support and a protective legal framework (Chapron et al., 2014). Part of the challenge, however, is that most European landscapes have been modified by human activities for millennia and large carnivores now occur in human-dominated, or cultural, landscapes, often causing an impact on human activities.

Coexistence between large carnivores and humans is complex. The on-going recovery has intensified impacts on a wide range of human activities, particularly private livestock breeding (Linnell & Cretois, 2018). Although depredation can be mitigated through the adoption of protection measures (e.g. fencing and guarding dogs; see Gehring et al., 2010), this usually requires an additional workload from farmers (Tudini et al., 2020). There is a need to understand the perceptions of famers towards large carnivores and management procedures adopted by authorities (Lance et al., 2010). On the other hand, disagreement about how large carnivores and their impacts should be managed can result in conflicts between different societal groups (Redpath et al., 2013; Lute et al., 2018; Hartel et al., 2019). The European Commission has made significant efforts in recent years to engage key stakeholders in discussions regarding conflict species. In 2014, the Commission established the EU Platform on Coexistence between People and Large Carnivores, a grouping of seven organisations representing different interest groups with a joint mission to try to minimise large carnivore related conflicts[1] (Marsden et al., 2018). This has provided a means of sharing views and issues at a higher level, but members recognised that conflicts varied significantly by region, depending for example, on the socio-economic activities, biogeographic and natural conditions in areas where large carnivores are returning (Morehouse et al., 2020). The Platform therefore supported the es-

[1] http://ec.europa.eu/environment/nature/conservation/species/carnivores/coexistence_platform.htm

tablishment of regional platforms[2] following a similar model in different localities across the EU and in 2018 opened a call for offers to implement them in three areas across Europe, for which the Istituto di Ecologia Applicata was contracted.

2. Areas of implementation

The Commission selected locations for regional platforms on the basis of (a) a longlist of proposals by experts on large carnivores and (b) reported difficulties in managing increasing large carnivore populations as assessed on the basis of contacts made with the European Commission. The province of Avila (Spain), the province of Grosseto (Italy) and the county of Harghita (Romania) were chosen (Fig. 1).

Fig. 1 Map of project areas (red lines: 1 = Avila, 2 = Grosseto, 3 = Harghita) Updated distributions of brown bear and wolf are represented in the background. *(Source: IUCN 2018)*

2.1 Ávila (Spain)

The province of Avila (8,050 km^2) is in the south of Castile and Leon Autonomous Region. It is characterised by pastures and grasslands (41% of the provincial territory) and small remnant forest patches with extensive cattle breeding, mainly of the local Avila breed, for meat production. Over 50% of the Spanish wolf population is in Castile and Léon, mainly north of the Duero River (Blanco & Cortés, 2002). Wolves reproduced for the first time in Ávila in 2001, and in 2017 official figures listed 10 packs in the province, with 944 reported attacks (Saens de Buruaga, 2018). Wolves are strictly protected in Castile and Leon south of the Duero River (Annexes II and IV of the Habitats Directive), while they are managed as a game species north of the river (Annex V). The Regional Administration has used derogations to provide permits for the removal of a limited number of individuals in Ávila, but environmental organisations have argued that the conditions for derogation from strict protection are not fulfilled.

2.2 Grosseto (Italy)

The Province of Grosseto extends over 4,479 km^2 in central Italy. It is characterised by a largely agricultural landscape (54% of the area), featuring a mosaic of extensive cultivation, shrubs, fallows and pastures, interspersed with broad-leaved forest patches (Selvi, 2010). The landscape is mainly hilly, with the highest areas reaching 1,738 m a.s.l. in the north. Grosseto has one of the lowest human population densities among Italy's provinces (< 50 inhabitants/km^2). Historically, it has been shaped by agriculture and livestock production continues to be an important economic activity together with rural tourism, often associated with agricultural production.

Permanent wolf occurrence has been recorded in the area since the early 1980s (Boitani & Ciucci, 1993). In 2012–2014 there were a minimum of 13 packs (Salvatori et al., 2019), while in 2017 the population was estimated at c. 100 individuals in 22–24 packs (Ricci et al., 2018a). An average of 330 depredation events/year were reported in 2014–2017 (Ricci et al., 2018b). The regional government and the EU have funded compensation and prevention measures, but these solutions have not been considered satisfactory (Marino et al., 2016) and conflicts have arisen among interest groups.

2.3 Harghita (Romania)

The County of Harghita is situated in the Eastern Carpathians of central Romania. It extends over 6,635 km^2, with elevations from 490 m to 1785 m a.s.l., and terrain characterised by narrow valleys and steep slopes. Around 30% is agricultural land, of which 80% is semi-natural grasslands largely used for extensive livestock and honey production (Scarlat et al., 2011). Forest habitats cover about 40% of the area.

Harghita hosts brown bears, Eurasian lynx and wolves, but the most abundant and, from the perspective of human-large carnivore coexistence, the

[2] https://ec.europa.eu/environment/nature/conservation/species/carnivores/regional_platforms.htm

most relevant, is the bear, which was managed as a game species until the country joined the EU in 2007 (Enescu & Hălălişan, 2017). Since then, derogations have been used to control the population but in 2016 a ban was imposed on bear hunting following pressure from environmental associations questioning the reliability of population estimates used to set yearly quotas (Popescu et al., 2019). Bears come close to human settlements and feed on human-related food sources, often resulting in accidents with humans, several of which have been fatal (Bombieri et al., 2019).

Overarching management decisions on large carnivore conservation, derogations, hunting and compensation are taken at the national level by the Ministry of Environment, Water and Forests while the Ministry of Agriculture and Rural Development is responsible for decisions on agricultural financing. There are no schemes yet in place regarding advice or funding for prevention measures.

3. Stakeholders involved and platform members

The process for selecting platform participants started by contacting scientists and managers involved in large carnivore conservation and management in the three areas, who were able to produce a preliminary list of people and organisations to be contacted. These candidates were interviewed and asked to suggest other potential participants following a snowballing process. Table 1 lists all interest groups identified in the project areas and the number of interviews made in order to assess their positions and record all issues they reported (Balian & Salvatori, 2018; Salvatori et al., 2018; Salvatori, 2018).

The majority of people interviewed stated they would be willing to take part in the platforms, either representating an organisation or bringing their own individual positions and values. Many stated that their willingness to take part was conditional on it leading to concrete solutions. At the end of each interview an overview of planned steps was given.

The process of selection and engagement of participants was overseen by a team of nine experts from the fields of carnivore conservation, social science, policy and conflict mitigation. Up to three members of this team contacted participants and attended meetings, while the rest were consulted for planning and de-briefing after each stage.

Table 1 Number of interviews held in each project area divided by interest group

Group		
Avila	Grosseto	Harghita
Institutions		
3	4	5
Livestock breeders/Beekeepers (also represented by associations)		
9	4	3
Hunters/Foresters/Land owners		
3	1	2
Environmentalists		
3	2	4
Animal welfare		
0	2	0
Scientists		
2	1	0
Total		
20	**14**	**14**

4. Tasks and approaches

Task A: platform establishment

We foresaw a series of steps aimed at implementing the approach most suited to local conditions (Fig. 2), following the suggestion of Redpath et al. (2013). In order to do this, an initial *scoping* phase had the objective of collecting all information available from each project area in order to map existing conflicts (Salvatori et al., 2020). Once the main issues were identified, a professional facilitator was contacted for each project area and the first meeting for *establishing the process* was carefully planned.

While interacting with platform members, the expert team always followed the principles of:

Neutrality with regard to the issues under discussion. The team would only make suggestions on the process to be followed but this would also be adaptable depending on requests of the participants.

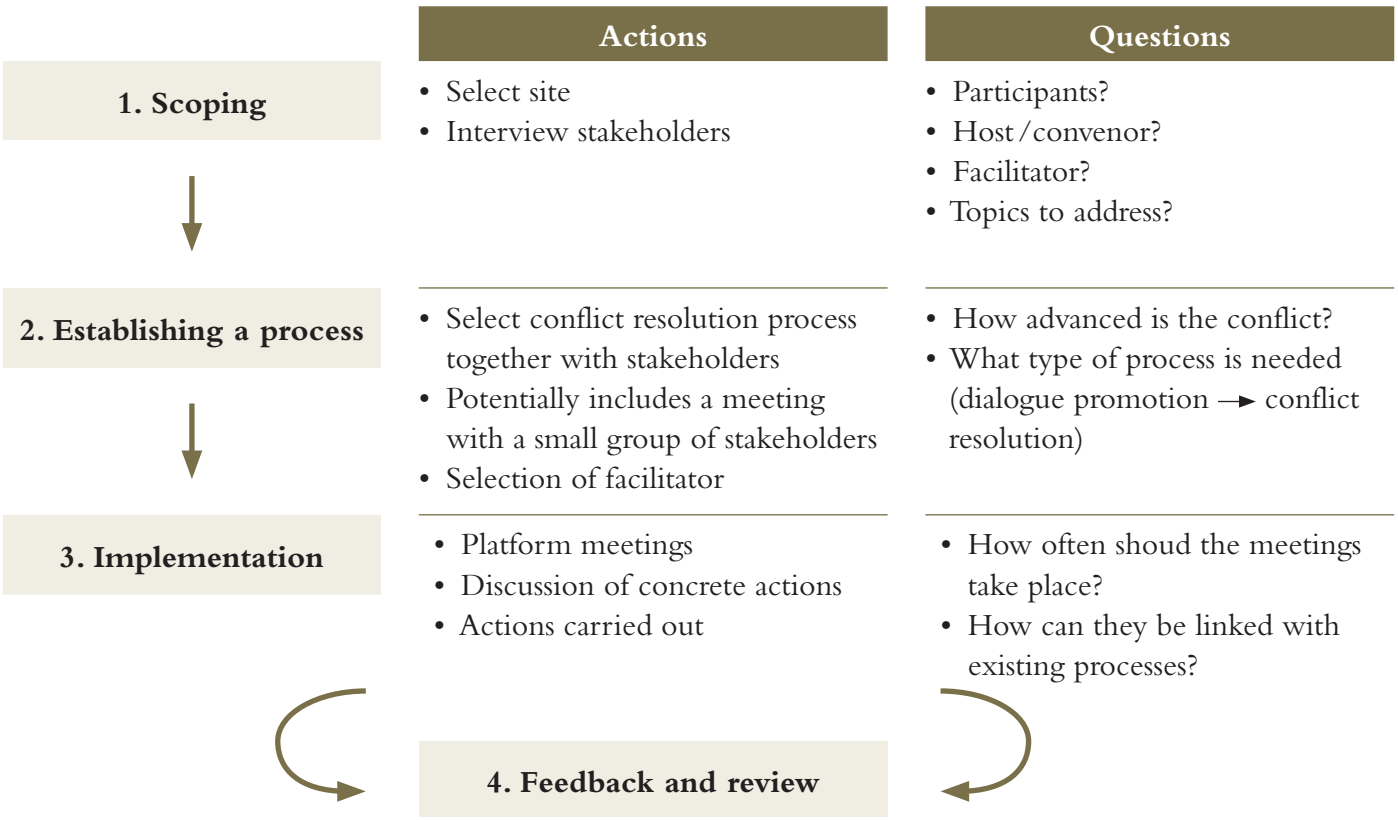

Fig. 2 Steps adopted for implementation of Task A: platform establishment.

Equality in supporting every stakeholder equally in terms of understanding what is important to her/him. Considering all viewpoints as being of equal worth and taking proper account of knowledge shared from different sources.

Transparency with regard to decisions made by the team on the process and the reasons for making them.

Confidentiality with regard to who provides the team with what information. Information gathered (e.g. through interviews) was reported to the Commission as well as to the other stakeholders involved but no information was linked to specific individuals.

The approach for the implementation of the platform will include a series of activities aimed at increasing trust and confidence among participants and for supporting them in the identification of common ground that could potentially lead to the development of agreed concrete interventions for improving current conditions during Task B. This phase is currently being developed and adapted to local conditions.

Task B: implementation of concrete solutions

Once a list of agreed interventions has been ranked against set criteria, participants will be asked to express their interest in taking part in the implementation of the highest ranking ones and a budget of c. € 40,000 will be made available. In some cases, there could be matched funding from other sources.

Task C: communication

This was considered a critical issue in all project areas and, apart from the first meeting held in Harghita, where a journalist was present who published articles on the beginning of the work of the platform, information to the outside world about the activities undertaken during the meetings and the results achieved was not shared locally. Technical reports were regularly published on the Platform website of the European Commission. Information flow with the EU Platform was always maintained, while a wider communication of the results achieved was only agreed upon once the list of concrete actions was produced.

5. Results

Given that the processes are ongoing in all three project areas, only the results of completed steps are presented here. The *scoping* phase was successfully achieved for all three project areas and interviewees reported a series of consistent issues regardless of the species of large carnivore and the geographic area. A

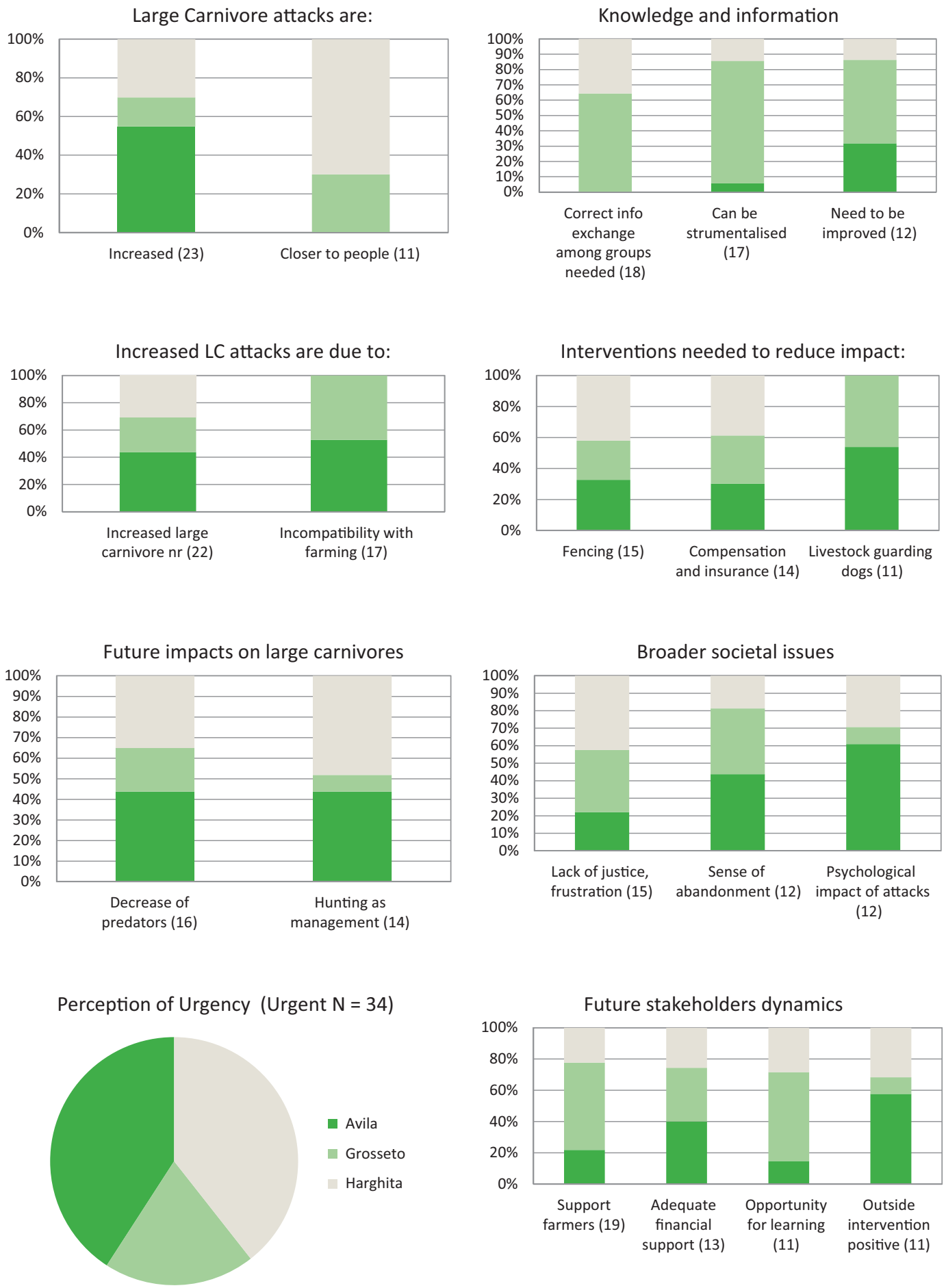

Fig. 3 Main issues reported by at least 25% of interviewees in each of the project areas.

summary of the issues reported by at least 25% of interviewees (N=11) is shown in Fig. 3. Further details can be found in Salvatori et al. (2020).

In all project areas, the majority of people reported an increased number of attacks on livestock by large carnivores in recent years, with higher intensity in Avila and Harghita. In Grosseto and Harghita attacks were said to be closer to people. The reason behind this was identified as an increased presence of large carnivores clashing with extensive farming. Technical tools for reducing such impacts were mentioned, among them fencing, compensation of damage and livestock guarding dogs (the latter particularly in Avila and Grosseto).

Knowledge and information issues were reported mainly in Grosseto and Harghita, but interviewees from Avila also thought that information needed to be improved. In this respect, increased interaction with other stakeholders was seen by many as an opportunity for learning from other sectors and the majority of people wished to see more support to farmers through adequate financial support in the near future. A general sense of frustration, abandonment and lack of justice was expressed, mainly from the agricultural sector in all project areas. The general impression was that if the situation remained the same large carnivores would decrease in the near future, due to either natural or human causes. In all cases interventions for improving the situation were considered urgent.

6. Conclusions and way forward

The results obtained through the *scoping* phase provided the necessary background for entering into the next steps of *platform establishment* through the engagement of stakeholders. Face-to-face interviews established a connection with people and, during the work ahead, attention will be paid to maintaining this personal connection. All interviewees declared they were willing to take part in a participatory process, even if they had already been engaged in other negotiations or projects in the past, showing a positive attitude. In Harghita and Grosseto, local contact people have previous working experience in the area and good relationships with stakeholders and the local administration. In Avila, gaining approval from the regional authorities and local delegation was more challenging and continued efforts will be made to engage them.

Work ahead includes the identification of local professional facilitators and implementation of participatory processes through a series of workshops in order to support participants in the co-production of agreed solutions. The project is due to end in December 2020.

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FENCES AND WOLVES IN SAXONY

In their article on *Effectiveness of fences at protecting livestock from wolves* in *CDPnews* issue 19, authors Hansen et al. included the following statement: "There was an interesting report from Saxony, a region with a relatively high density of wolves. In Saxony, standard electric fences such as 90 cm nets or 4-wire fences were recommended and usually worked quite effectively. It appeared, however, that some individual wolves had learned to jump over these. Initially, it was recommended to attach an additional wire above the fence at a height of about 120 cm. But after they had offered protection for a few weeks, these extra high fences were also jumped over."

Following publication of the German translation of *CDPnews,* we received a request for a clarification of this statement from Ilka Reinhardt of LUPUS German Institute of Wolf Monitoring and Research. In her comments, which we include here, she stresses that so far there has been no proven case in Saxony of a wolf repeatedly jumping over a correctly installed electric fence with polytape attached above the fence. Her detailed analysis of the circumstances in which wolves have occasionally exploited weak points shows how electric fence design can be improved and complemented with additional measures such as polytape, fladry and livestock guarding dogs.

The Editors

Statement from Ilka Reinhardt

In 2007, in the Neustadt territory, a wolf jumped over 90 cm high electric netting several times and killed sheep within the fence. In this region, it was recommended to add a strand of white polytape above the nets at a height of 120 cm from the ground and 20–30 cm from the top of the netting. Sheep owners were provided with the additional fence material (polytape and fence posts) and there have been no subsequent attacks on sheep protected in this way.

There were similar cases in the Milkel territory in 2008. Since the wolf responsible (a yearling female) came from the Neustadt pack, it is suspected that she jumped over electric net fences in Neustadt and then repeated this behaviour in her newly-founded Milkel territory. The same paddock was attacked successfully three times. The owner refused to add polytape to the fence so, after the third attack, the authorities announced that they would not pay compensation for any further attacks. Another attack occurred and damage inspectors found that polytape had been added, although it was 50–60 cm above the top of the net instead of the recommended 20–30 cm and it could not be verified if it was installed before or after the attack. The flock was then temporarily protected with fladry around the electric netting until, with the help of the Swiss intervention team, livestock guarding dogs were integrated into the flock. There were no further attacks on this flock or on other animals protected by electric nets topped with polytape.

In 2017 there were four attacks on sheep in the Rosenthal territory that were protected with electric nets and polytape. In every case, sheep broke out of the fencing. In at least three cases, dead sheep were found outside the paddock and there was no indi-

cation that a wolf passed the fence and got into the paddock. In one of these cases, the net had become embedded in the ground, so that functionality was no longer guaranteed (the voltage in the fence was not measured). In one case, the shepherd reported that there were dead sheep inside the paddock, but the carcasses were removed before the inspector arrived. In this case, the polytape was found to be hanging partly below the upper edge of the net. Therefore, none of these cases involved a wolf jumping over correctly installed electric fences topped with polytape.

The Rosenthal wolf pack had access to insufficiently protected sheep for several years prior to these incidents. Since the pack was established in 2013, there has been an increase in attacks, mostly on sheep within non-electric fences. The adults of this pack have obviously learned that non-electric fences are relatively easy to negotiate. In cases where sheep were protected with electric fences, the sheep had often broken out and were killed outside the paddock. In short, the wolves (parent animals) of this pack have learned over the years to recognise and exploit weak points in fences.

To conclude, there has been good experience in Saxony with the use of electric nets topped with a strand of polytape, provided that they are set up correctly. Electric nets are available commercially with every second pole extended to facilitate the addition of polytape, which eases the workload considerably. Such fences offer good, long-term protection from wolves. Of course, a wolf may learn to overcome this type of fence, too. So far, however, there is no proven case of this happening in Saxony. After an attack, it is often difficult to assess the protective measures that were in place before the attack, especially if livestock escaped through the fence. Therefore, before concluding that a wolf has learned to overcome certain protection measures, it should be proven beyond doubt that it managed to do so at least twice.

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ABSTRACTS OF SCIENTIFIC ARTICLES

LIVESTOCK GUARDIAN DOGS

LIVESTOCK GUARDIAN DOGS AND CATTLE PROTECTION: OPPORTUNITIES, CHALLENGES, AND METHODS

Cat D. Urbigkit

Human–Wildlife Interactions: Spring 2019

https://doi.org/10.26076/6cqj-mq38

Producer interest in using livestock guardian dogs (*Canis lupus familiaris;* LGDs) to protect domestic cattle (*Bos taurus*) is driven by expanding large carnivore predator populations and increased public concerns regarding lethal predator control in North America. However, few resources exist to guide livestock producers regarding the use of LGDs to protect cattle. This paper summarizes published information and personal ranch experiences regarding the use of LGDs to protect cattle, describes livestock-producer identified challenges to more widespread adoption of this method to deter predators, and provides guidelines for introducing pups to LGD-naïve cattle herds. I recommend more extensive research on the use of LGDs with cattle, increased development of programs to place LGDs with cattle herds, as well as educational efforts targeting resource managers, livestock producers, and the general public.

REPORTED LIVESTOCK GUARDING DOG-WILDLIFE INTERACTIONS: IMPLICATIONS FOR CONSERVATION AND ANIMAL WELFARE

K. Whitehouse-Tedd, R. Wilkes, C. Stannard, D. Wettlaufer, D. Cilliers

Biological Conservation: January 2020

https://doi.org/10.1016/j.biocon.2019.108249

Livestock depredation by carnivores is a key cause of detrimental human-wildlife interactions around the world. Recently, the use of livestock-guarding dogs (LGDs) to reduce livestock depredation has been challenged in terms of their impact on wild animal welfare and survival, but the prevalence of LGD-wildlife interactions is poorly understood. Using data for 225 LGDs on South African farms, we determined the prevalence of farmer-reported LGD-wildlife interactions to contextualise the potential concerns. Wildlife interactions were reported for a total of 71 dogs (32%); McNemar's tests revealed non-lethal herbivore interactions (8%) were significantly lower than non-lethal predator interactions (17%; $p < 0.01$), but no significant difference was detectable in the proportion of lethal interactions according to type of wildlife (9% for herbivores and 10% for predators). All reported predator interactions were defensive, compared to only 25% of reported herbivore interactions ($p = 0.016$). Of the dogs for which data on corrective measures were available, 44% were successfully corrected following intervention. Of those deemed uncorrected, 42% had ceased exhibiting this behaviour independently or were acting defensively, 21% were removed from the programme, 26% had unclear intervention outcomes and 11% had died. Reported interactions with predators were rare, entirely defensive, and predominantly non-lethal. However, interactions with non-target species (herbivores) were more prevalent, necessitating remedial interventions. Overall, the conservation benefit of LGDs does not appear to be outweighed by ethical implications of their use; LGDs were shown to be highly targeted and discriminatory towards predators attempting to predate on livestock.

LIVESTOCK GUARDING DOGS ENABLE HUMAN-CARNIVORE COEXISTENCE: FIRST EVIDENCE OF EQUIVALENT CARNIVORE OCCUPANCY ON GUARDED AND UNGUARDED FARMS

Katie Spencer, Melissa Sambrook, Samantha Bremner-Harrison, Deon Cilliers, Richard W. Yarnell, Rox Brummer, Katherine Whitehouse-Tedd

Biological Conservation: January 2020

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Livestock guarding dogs (LGDs) are advocated to reduce livestock depredation on agricultural lands. However, LGDs have been proposed as excluding carnivores from guarded farms; this study is the first to test this hypothesis in an African ecosystem. We investigated carnivore occupancy (black-backed jackal, leopard and brown hyaena) from 1029 camera-trap days (126 camera locations) in relation to the presence of LGDs and a range of habitat and land-use covariates across eight South African farms, five of which utilised an LGD. Models containing LGDs had little support in explaining leopard or black-backed jackal occupancy, although LGD presence had a positive relationship with brown hyaena occupancy (ß = 1.14, 95% CI = 0.05, 2.23). Leopard detection was positively related to the presence of black-backed jackals (ß = 1.47, 95% CI = 0.18, 2.74) and sheep (ß = 1.13, 95% CI = 0.14, 2.12), whilst black-backed jackal detection was negatively related to lures (ß = −1.33, 95% CI = −2.00, −0.65) and positively related to the presence of brown hyaena (ß = 0.90, 95% CI = 0.43, 1.40). Previous research in this LGD population has demonstrated the cessation of livestock depredation in 91% of cases, making dog ineffectiveness unlikely to explain their lack of influence on carnivore occupancy. Our results provide the first empirical evidence based on ecological data of the capacity for LGDs to promote human-carnivore coexistence in an African agricultural context, further validating the use of specialist guarding dogs as a conservation tool of benefit to both human and wildlife populations

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

Jeffrey C. Mosley, Brent L. Roeder, Rachel A. Frost, Smith L. Wells, Lance B. McNew, Patrick E. Clark

Rangeland Ecology & Management: May 2020

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

FACTORS INFLUENCING PREDATION

NON-LINEAR RELATIONSHIPS BETWEEN HUMAN ACTIVITIES AND WOLF-LIVESTOCK DEPREDATIONS

Nicholas L. Fowler, Jerrold L. Belant, Dean E. Beyer Jr.

Biological Conservation:
August 2019

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Livestock depredations present real and perceived threats to property and human livelihood, undermining carnivore conservation and management. Considerable research has been aimed at identifying factors influencing depredations but contradictory relationships indicate our predictive ability still needs improvement. Previous approaches have relied primarily on linear correlation modeling not considering that some factors may promote and limit depredations across the range of observed conditions. We investigated relationships between wolf (*Canis lupus*) depredations of livestock and indices of human activity in Michigan's Upper Peninsula (UP), USA. Using binomial generalized linear models at three spatial scales (site scale, radius [r] = 0.9 km; area of mean 50% wolf core area [core area scale], r = 4.4 km; and 95% wolf territory area [territory scale], r = 9.0 km), we tested the hypothesis that the relationship between depredation probability and indices of human activity is nonlinear, and that the greatest probability of depredations occurs at an intermediate level of conditions. Across spatial scales we found support for quadratic relationships between cattle density, human density, and proportion of agricultural lands with the occurrence of wolf-livestock depredations (n = 260). We also demonstrated that at the wolf territory scale, increased road density reduced the probability of depredations. Using test data, model prediction accuracy for estimating depredations was 90% (n = 28) at the land section scale and 84% (n = 26) at the core area scale. We provide demonstrative use of non-linear modeling to evaluate factors influencing depredations robust to wolf and prey distribution and abundance.

IMPROVING PREDATION RISK MODELLING: PREY-SPECIFIC MODELS MATTER

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Hystrix, the Italian Journal of Mammalogy:
November 2019

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Globally, large carnivore livestock predations are major causes of conflicts with humans, thus identifying hotspots of carnivore attacks is fundamental to reduce the impact of these, and hence promote coexistence with humans. Species distribution models combining predictor variables with locations of predation events instead of species occurrences (also known as predation risk models) are increasingly used to predict livestock depredation by carnivores, but they are often developed pooling attacks on different livestock species. We identified the main factors related to predation risk on livestock using an extensive dataset of 4,604 locations of verified wolf predation events on livestock collected in northern and central Italy during 2008–2015 and assessed the importance of pooling versus splitting predation events by prey species. We found the best predictors of predation events varied by prey species. Specifically, predation risk increased with altitude especially for cattle, with grasslands especially for cattle and sheep and with distance to human settlements, especially for goats and livestock but only slightly for cattle and sheep. However, predation risk decreased as human population density, human settlements and artificial night-time light brightness increased, especially for cattle. Finally, livestock density was positively related to predation risk when herd exceeds 500 heads for km^2. Moreover, prey-specific risk models are better tools to predict wolf predation risk on domestic ungulates. We believe that our approach can be applied worldwide on different predator-prey systems and landscapes to promote human-carnivore coexistence. Actually, while pooling predation events could be primarily used by managers and personnel of wildlife agencies/offices in developing general policies, splitting predation events by prey species could be used at farm-level to better identify livestock owners at risk in high-priority areas and which prevention tools and deterrents (e.g. electric fences, guarding dogs, predator-proof enclosures) should be applied, as the most effective measures differ by species.

PATTERNS OF COYOTE PREDATION ON SHEEP IN CALIFORNIA: A SOCIO-ECOLOGICAL APPROACH TO MAPPING RISK OF LIVESTOCK-PREDATOR CONFLICT

Alex McInturff, Jennifer R.B. Miller, Kaitlyn M. Gaynor, Justin S. Brashares

Conservation Science and Practice: April 2020

https://doi.org/10.1111/csp2.175

Conflict between livestock producers and wild predators is a central driver of large predator declines and simultaneously may imperil the lives and livelihoods of livestock producers. There is a growing recognition that livestock-predator conflict is a socio-ecological problem, but few case studies exist to guide conflict research and management from this point of view. Here we present a case study of coyote-sheep predation on a California ranch in which we combine methods from the rapidly growing field of predation risk modeling with participatory mapping of perceptions of predation risk. Our findings reveal an important selection bias that may occur when producer perceptions and decisions are excluded from ecological methods of studying conflict. We further demonstrate how producer inputs, participatory mapping, and ecological modeling of conflict can inform one another in understanding patterns, drivers, and management opportunities for livestock–predator conflict. Finally, we make recommendations for improving the interoperability of ecological and social data about predation risk. Collectively our methods offer a socio-ecological approach that fills important research gaps and offers guidance to future research.

AN ECOLOGICAL FRAMEWORK FOR CONTEXTUALIZING CARNIVORE-LIVESTOCK CONFLICT

Christine E. Wilkinson, Alex McInturff, Jennifer R. B. Miller, Veronica Yovovich, Kaitlyn M. Gaynor, Kendall Calhoun, Harshad Karandikar, Jeff Vance Martin, Phoebe Parker-Shames, Avery Shawler, Amy Van Scoyoc, Justin S. Brashares

Conservation Biology: May 2020

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Carnivore predation on livestock is a complex management and policy challenge, yet it is also intrinsically an ecological interaction between predators and prey. Human–wildlife interactions occur in socioecological systems in which human and environmental processes are closely linked. However, underlying human–wildlife conflict and key to unpacking its complexity are concrete and identifiable ecological mechanisms that lead to predation events. To better understand how ecological theory accords with interactions between wild predators and domestic prey, we developed a framework to describe ecological drivers of predation on livestock. We based this framework on foundational ecological theory and current research on interactions between predators and domestic prey. We used this framework to examine ecological mechanisms through which specific management interventions operate, and we analysed the ecological determinants of failure and success of management interventions in 3 case studies: snow leopards (*Panthera uncia*), wolves (*Canis lupus*), and cougars (*Puma concolor*). The varied, context-dependent successes and failures of the management interventions in these case studies demonstrated the utility of using an ecological framework to ground research and management of carnivore-livestock conflict.

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

Gustaf Samelius, Kulbhushansingh Suryawanshi, Jens Frank, Bayarjargal Agvaantseren, Erdenechimeg Baasandamba, Tserennadmid Mijiddorj, Örjan Johansson, Lkhagvasumberel Tumursukh and Charudutt Mishra

Oryx: February 2020

https://doi.org/10.1017/S0030605319000565

Abstract 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. 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.

MANAGEMENT AND POLICIES

DESERT-ADAPTED LIONS ON COMMUNAL LAND: SURVEYING THE COSTS INCURRED BY, AND PERSPECTIVES OF, COMMUNAL-AREA LIVESTOCK OWNERS IN NORTHWEST NAMIBIA

John M. Heydinger, Craig Packer, Jendery Tsaneb

Biological Conservation: August 2019

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Though subsistence pastoralism is the primary land-use throughout much of Africa, lions (*Panthera leo*) living outside protected areas are largely overlooked in discussions of pan-African lion conservation. In northwest Namibia, a unique population of desert-adapted lions has grown by >400% over the past twenty years. This growth has primarily taken-place upon communal conservancy land. Human-caused lion mortality following human-lion conflict (HLC) is now the primary direct threat to the persistence of these lions. HLC exacerbates challenges faced by pastoralists from an ongoing drought. Our survey is the first-ever attempt to quantitatively and qualitatively examine local pastoralists' perceptions of the desert-adapted lions and the impacts of living with lions in northwest Namibia. Results show that losses, due to drought and lions, are differentiated by livestock species and that the magnitude of livestock losses during the drought has been exacerbated by predation. Respondents in different conservancies reported different levels of hostility towards lions. Across all conservancies, though 83.9% do not benefit from living with lions, 75.9% state that it is important to continue to share communal land with lions. We discuss the cultural and livelihood effects of livestock losses as well as the implications of balancing the costs and benefits of living with lions for lion conservation.

IMPACTS OF NORWEGIAN LARGE CARNIVORE MANAGEMENT STRATEGY ON NATIONAL GRAZING SECTOR

Inger Hansen, Geir-Harald Strand, Auvikki de Boon, Camilla Sandström

Journal of Mountain Science: November 2019

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Increasing populations of large carnivores are leading to tension and conflicts with livestock production, a situation that potentially might escalate. In Norway the objective of the large carnivore policy is two-folded: to ensure viable carnivore populations and to secure a sustainable grazing industry. The main instrument is zonation, with carnivore management zones (CMZs) prioritized for reproduction of the large carnivore species separated from other areas prioritized for grazing livestock. The objective of this paper is to describe current knowledge about the impact of the zoning management strategy on the grazing industry. This is done by documenting status and changes in sheep production, losses of livestock to predating carnivores, and the use of grazing areas inside and outside the CMZs. CMZs offering protection for lynx, wolverine, bear and wolf cover 55% of the Norwegian mainland. 30% of the sheep and 50% of the Sami reindeer grazing areas are found inside the CMZs. Livestock (semi-domestic reindeer excluded) is using 59% of the available natural pasture areas outside the CMZs, but only 26% inside the CMZs. The lowest use of available grazing areas was found inside zones for wolves (12%) and brown bears (6%). Livestock in these zones are confined to fenced enclosures, mostly on the farm itself, or moved to pastures outside the management zone for summer grazing. Livestock losses increased in the affected regions during the period when carnivores were reestablished. Later, losses declined when CMZs were established and mitigation efforts were implemented in these zones. The bulk of sheep and reindeer killed by carnivores are now found in boundary areas within 50 km off the CMZs, where sheep are still grazing on open mountain and forest ranges. Therefore, instruments to protect livestock in areas close to the CMZs are also needed. The number of sheep declined inside the CMZs from 1999 to 2014, but increased outside the zones. The reduction in the absolute number of sheep in the CMZs is balanced by a similar increase outside, thus the total sheep production in Norway is maintained. We conclude that although of little consequence for the total food production in Norway, the economic and social impact of the large carnivore management strategy can be serious for local communities and individual farmers who are affected. There is a need for more exact carnivore population monitoring to quantify the carnivore pressure, better documentation of reindeer losses, and a clearer and stricter practicing of the zoning strategy. Increased involvement of social sciences is important in order to understand the human dimension of the carnivore conflicts.

MAINSTREAMING HUMAN AND LARGE CARNIVORE COEXISTENCE THROUGH INSTITUTIONAL COLLABORATION

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Achieving coexistence between large carnivores and humans in human-dominated landscapes (HDLs) is a key challenge for societies globally. This challenge cannot be adequately met with the current sectoral approaches to HDL governance and an academic community largely dominated by disciplinary sectors. Academia (universities and other research institutions and organizations) should take a more active role in embracing societal challenges around conservation of large carnivores in HDLs by facilitating cross-sectoral cooperation to mainstream coexistence of humans and large carnivores. Drawing on lessons from populated regions of Europe, Asia, and South America with substantial densities of large carnivores, we suggest academia should better embrace the principles and methods of sustainability sciences and create institutional spaces for the implementation of transdisciplinary curricula and projects; reflect on research approaches (i.e., disciplinary, interdisciplinary, or transdisciplinary) they apply and how their outcomes could aid leveraging institutional transformations for mainstreaming; and engage with various institutions and stakeholder groups to create novel institutional structures that can respond to multiple challenges of HDL management and human-large carnivore coexistence. Success in mainstreaming this coexistence in HDL will rest on the ability to think and act cooperatively. Such a conservation achievement, if realized, stands to have far-reaching benefits for people and biodiversity

EU RURAL DEVELOPMENT POLICY AND THE MANAGEMENT OF CONFLICTUAL SPECIES: THE CASE OF LARGE CARNIVORES

Katrina Marsden, Tasos Hovardas

Biological Conservation:
March 2020

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With the return of large carnivores to significant areas of Europe, the interest in broad-scale, widely-applicable approaches to deal with resulting conflicts has increased. Since the most significant conflicts are based on depredation of livestock by large carnivores, compensation and damage-prevention measures have been put in place in many European countries. This requires significant financial investment, and many countries have been turning to their Rural Development Programmes, co-financed under the second pillar of the EU Common Agricultural Policy. To date, however, little has been published on the different approaches used in the Rural Development Programmes to facilitate human-carnivore coexistence. In this policy analysis, we describe how member states have included human-carnivore coexistence measures in their Rural Development Programmes across the EU. The number of Rural Development Programmes targeting large carnivore species in Europe (wolf, bear, lynx, wolverine) increased substantially in the second programming period examined (2014-2020) compared to the first (2007-2013). However, measures were limited to practical support in the form of damage prevention methods such as electric fences and livestock guarding dogs. We demonstrate the potential for a broader use of Rural Development Programmes to facilitate human-carnivore coexistence and reduce conflict. Therefore, we use our findings to recommend that a wider range of measures to support human-carnivore coexistence be included in Rural Development Programmes under the Common Agricultural Policy 2021-2027. Moreover, we draw upon previous research into agri-environment schemes to examine how the lessons learnt relating to stakeholder incentives and landscape-scale approaches could be applied to human-carnivore coexistence.

HUMAN DIMENSIONS

PREDATOR-FRIENDLY BEEF CERTIFICATION AS AN ECONOMIC STRATEGY TO PROMOTE COEXISTENCE BETWEEN RANCHERS AND WOLVES

Carol Bogezi, Lily M. Van Eeden, Aaron Wirsing, John Marzluff

Frontiers in Ecology and Evolution: December 2019

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Real and perceived economic losses are key factors driving negative attitudes and lack of tolerance toward carnivores. Alleviating economic losses through compensation and market-based strategies is one tool for addressing negative human-carnivore interactions. Despite general support among the public for market-based economic incentives to improve coexistence with predators, products marketed as 'predator-friendly' are rare in mainstream markets. We explored stakeholders' perspectives on certification of predator-friendly beef as a market-based economic incentive to enable ranchers to better coexist with gray wolves (*Canis lupus*) in Washington state, USA. We conducted semi-structured interviews (N = 104) and explored narratives using grounded theory to understand the perspectives of stakeholders involved in the cattle-wolf relationship, including ranchers, wildlife agency personnel, environmental non-government organization employees, beef industry workers, and politicians. Both economic and social factors motivated and constrained ranchers to participate in a program creating a predator-friendly beef label. Ranchers largely perceived marketing their products as predator-friendly to be more of a public outreach opportunity than a new source of income. Most stakeholders perceived an economic opportunity for predator-friendly beef facilitated by existing pro-environmental markets and existence of a private beef processing plant. Based on these results, we propose a design for effectively implementing a predator-friendly beef market. We recommend focusing on the type and objective of the rancher, ensuring local access to beef processing facilities to process small volumes of custom beef, developing a product brand that is favored by ranchers and beef processors, considering viable product pricing , and developing a regulatory process for a potential predator-friendly beef label on the mainstream market.

PERSPECTIVES OF TRADITIONAL HIMALAYAN COMMUNITIES ON FOSTERING COEXISTENCE WITH HIMALAYAN WOLF AND SNOW LEOPARD

Naresh Kusi, Claudio Sillero-Zubiri, David W. Macdonald, Paul J. Johnson, Geraldine Werhahn

Conservation Biology: March 2020

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The Himalayan wolf *Canis* sp. and snow leopard *Panthera uncia* are found in the Nepalese Himalayas where conservation efforts target the latter but not the former. We conducted semistructured questionnaire surveys of 71 residents in upper Humla, upper Dolpa, and Kanchenjunga Conservation Area (KCA) during 2014–2016 to understand people's knowledge, perceptions, attitudes and interactions with these two carnivores. We fitted a cumulative link mixed model to predict Likert scale ordinal responses from a series of Generalized Linear Mixed Models. Overall, attitudes were more positive toward snow leopards than wolves. Livestock depredation was the main predictor of the general negative attitude toward wolves (Estimate = −1.30873; p = .029866) but there was no evidence for an effect for snow leopards (Estimate = −0.3640; p = .631446). Agropastoralists had more negative attitudes than respondents with other occupations toward both carnivores and men had more positive attitudes than women. Among our study areas, respondents in the community-owned KCA had the most positive attitudes. Our findings illustrate the need to reduce human-carnivore conflict through a combined approach of education, mitigation, and economic cost-sharing with respectful engagement of local communities. Specifically, to encourage more villagers to participate in livestock insurance schemes, they should be improved by including all large carnivores and adjusting compensation to the market value of a young replacement of the depredated livestock type. Carnivore conservation interventions should target the whole predator guild to achieve long-term success and to protect the Himalayan ecosystem at large.

ARE WE COEXISTING WITH CARNIVORES IN THE AMERICAN WEST?

Michelle L. Lute, Neil H. Carter

Frontiers in Ecology and Evolution:
March 2020

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Human-carnivore coexistence is an oft-stated goal but assumptions about what constitutes coexistence can lead to goal misalignment and undermine policy and program efficacy. Questions about how to define coexistence remain and specific goals and methods for reaching coexistence require refining. Co-adaptation, where humans adapt to carnivores and vice versa, is a novel socioecological framework for operationalizing coexistence but has yet to be comprehensively examined. We explored co-adaptation and two additional coexistence criteria through analysis of three case studies involving large carnivores in the American West, each addressing differing approaches on how and what it means to coexist with carnivores: Mexican gray wolves (*Canis lupus baileyi*) in Arizona and New Mexico, grizzly bears (*Ursus arctos horribilis*) in the Greater Yellowstone Ecosystem and coyotes (*Canis latrans*) throughout the American West. We used a multiple case study design that analyzed within and across cases to understand coexistence broadly. For each case, we asked (1) are landscapes shared in space and/or time, (2) is co-adaptation occurring and (3) do stakeholders consider risks tolerable? To identify whether coexistence criteria are met, we investigated peer-reviewed published articles and news media and conducted key informant interviews. We found clear evidence to support land-sharing between humans and coyotes and limited spatial overlap between humans and grizzly bears and Mexican gray wolves. Co-adaptation was variable for wolves, possible with bears and clearly evident with coyotes. Tolerable risk levels are likely achievable for bears and coyotes based on the available literature assessing risk perceptions and tolerance. But disagreement regarding risk management is a driver of conflict over wolves and persistent barrier to achieving coexistence among diverse stakeholders. Patterns in coexistence criteria did not emerge based on taxonomy or geography but may be influenced by body size and behavioral plasticity. The common key to coexistence with each considered carnivore may be in more equitable distribution of costs and benefits among highly diverse stakeholders. Better understanding of these three coexistence criteria and innovative tools to achieve them will improve coexistence capacity with controversial carnivores on public and private lands in diverse American West contexts and beyond.

MYTHS AND ASSUMPTIONS ABOUT HUMAN-WILDLIFE CONFLICT AND COEXISTENCE

Adrian Treves,
Francisco J. Santiago-Ávila

Conservation Biology:
May 2020

https://doi.org/10.1111/cobi.13472

Recent extinctions often resulted from humans retaliating against wildlife that threatened people's interests or were perceived to threaten current or future interests. Today's subfield of human-wildlife conflict and coexistence (HWCC) grew out of an original anthropocentric concern with such real or perceived threats and then, starting in the mid-1990s, with protecting valued species from people. Recent work in ethics and law has shifted priorities toward coexistence between people and wild animals. To spur scientific progress and more effective practice, we examined 4 widespread assumptions about HWCC that need to be tested rigorously: scientists are neutral and objective about HWCC; current participatory, consensus-based decisions provide just and fair means to overcome challenges in HWCC; wildlife threats to human interests are getting worse; and wildlife damage to human interests is additive to other sources of damage. The first 2 assumptions are clearly testable, but if they are entangled can become a wicked problem and may need debunking as myths if they cannot be disentangled. Some assumptions have seldom or never been tested and those that have been tested appear dubious, yet the use of the assumptions continues in the practice and scholarship of HWCC. We call for tests of assumptions and debunking of myths in the scholarship of HWCC. Adherence to the principles of scientific integrity and application of standards of evidence can help advance our call. We also call for practitioners and interest groups to improve the constitutive process prior to decision making about wildlife. We predict these steps will hasten scientific progress toward evidence-based interventions and improve the fairness, ethics, and legality of coexistence strategies.

HUMAN-CARNIVORE CONFLICTS AND MITIGATION OPTIONS IN QINGHAI PROVINCE, CHINA

Yunchuan Dai, Yadong Xue, Charlotte E. Hacker, Yuguang Zhang, Yu Zhang, Fang Liu, Diqiang Li

Journal for Nature Conservation: February 2020

https://doi.org/10.1016/j.jnc.2019.125776

Human-carnivore conflicts often result in reduced tolerance by local communities for long-term carnivore species conservation. Increasing conflicts and inefficient resolutions exacerbate fear for personal safety and loss of property. We analysed the current status and patterns of human-carnivore conflicts in Qinghai province based on reported incidents from January 2014 through December 2017. The results show that: (1) a total of 7494 incidents were reported, with $4,030,918 USD paid to victims as compensation over the 4 year period; (2) 27 counties reported incidents, primarily in Zhiduo (n=4296, 57 %); (3) conflict types consisted of livestock depredation, house break-ins and attacks on humans; (4) all attacks on humans and house break-ins were caused by brown bears, while most livestock depredation was caused by wolves; (5) autumn is the peak season for reports of livestock predation and house break-in incidents, while summer is the peak season for reports of attacks on humans; and (6) conflict areas were primarily found in or adjacent to national parks. We propose various measures and research options to mitigate human-carnivore conflicts with snow leopards, wolves and brown bears, including a wildlife damage compensation program, electric fences, bear spray, diversionary feeding and ceasing small mammal poisoning.

PREDATOR CONTROL

CULLING RECOLONIZING MESOPREDATORS INCREASES LIVESTOCK LOSSES: EVIDENCE FROM THE SOUTH AFRICAN KAROO

Nicoli Nattrass, Beatrice Conradie, Jed Stephens, Marine Drouilly

AMBIO A Journal of the Human Environment: November 2019

https://doi.org/10.1007/s13280-019-01260-4

Populations of adaptable mesopredators are expanding globally where passive rewilding and natural recolonization are taking place, increasing the risk of conflict with remaining livestock farmers. We analysed data from two social surveys of farmers in the Karoo, South Africa, where black-backed jackals (*Canis mesomelas*) and caracals (*Caracal caracal*) have re-emerged as a threat to sheep farms in the context of falling agricultural employment and the expansion of natural areas. We show that irrespective of measurement approach, lethal control of mesopredators in this fragmented socio-economic landscape was associated with increased livestock losses the following year. Terrain ruggedness was positively, and number of farmworkers negatively, associated with livestock losses. Our study provides further evidence that lethal control of mesopredators in this context is probably counter-productive and supports calls to develop, share and financially support a range of non-lethal methods to protect livestock, especially where natural recolonization of mesopredators is occurring. A graphical abstract can be found in Electronic supplementary material.

PREDATOR CONTROL NEEDS A STANDARD OF UNBIASED RANDOMIZED EXPERIMENTS WITH CROSS-OVER DESIGN

Adrian Treves, Miha Krofel, Omar Ohrens, Lily M. van Eeden

Frontiers in Ecology and Evolution: December 2019

https://doi.org/10.3389/fevo.2019.00462

Rapid, global changes, such as extinction and climate change, put a premium on evidence-based, environmental policies and interventions, including predator control efforts. Lack of solid scientific evidence precludes strong inference about responses of predators, people, and prey of both, to various types of predator control. Here we formulate two opposing hypotheses with possible underlying mechanisms and propose experiments to test four pairs of opposed predictions about responses of predators, domestic animals, and people in a coupled, dynamic system. We outline the design of a platinum-standard experiment, namely randomized, controlled experiment with cross-over design and multiple steps to blind measurement, analysis, and peer review to avoid pervasive biases. The gold-standard has been proven feasible in field experiments with predators and livestock, so we call for replicating that across the world on different methods of predator control, in addition to striving for an even higher standard that can improve reproducibility and reliability of the science of predator control.

BOOKS

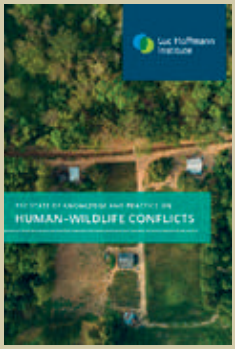
Human-Wildlife Interactions
Turning Conflict into Coexistence

Editors: Beatrice Frank, Jenny Glikman, Silvio Marchini
Publisher: Cambridge University Press, UK, 2019
Language: English
ISBN: 9781108402583

Human-wildlife conflict (HWC) is one of the most complex and urgent issues facing wildlife management and conservation today. Originally focused on the ecology and economics of wildlife damage, the study and mitigation of HWC has gradually expanded its scope to incorporate the human dimensions of the whole spectrum of human-wildlife relationships, from conflict to coexistence. Having the conflict-to-coexistence continuum as its leitmotiv, this book explores a variety of theories and methods currently used to address human-wildlife interactions, illustrated by case studies from around the world. It presents some key concepts in the field, such as values, emotions, social identity and tolerance, and a variety of insights and solutions to turn conflict into coexistence, from individual level to national scales, including conservation marketing, incremental and radical innovation, strategic planning, and socio-ecological systems. This volume will be of interest to a wide range of readers, including academics, researchers, students, practitioners and policy-makers.

Describes a variety of new perspectives and solutions focusing on coexistence rather than conflict, and intends to catalyse a paradigm shift in wildlife management and conservation from human-wildlife conflict to human-wildlife interactions and coexistence. Presents a newly developed concept to foster the inclusion of tolerance and coexistence in human-wildlife research: the conflict-to-coexistence continuum. Case studies illustrate frameworks on coexisting with urban wildlife, explore governance for long distance migration, discuss effectiveness and acceptability of interventions for coexistence, and define the place wildlife holds in different landscapes.

https://doi.org/10.1017/9781108235730



The State of Knowledge and Practice on
Human–Wildlife Conflicts

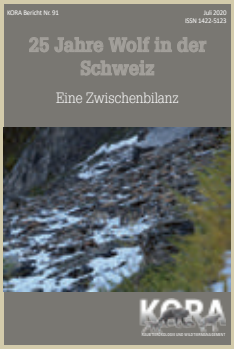
Authors: Isla D. Hodgson, Steve M. Redpath, Camilla Sandström, Duan Biggs
Editors: Martin O'Neill, Jessica Villat
Publisher: Luc Hoffmann Institute, Gland, Switzerland, 2020
Language: English

The way to solve human-wildlife conflict (HWC) may not be as straightforward as people think. Conflicts are fundamentally social and political issues between people and groups of people, but the language of conflict is often associated with negative interactions between wild animals and people, hence the rise of the common term 'human-wildlife conflict'. As the human population grows and environmental issues such as climate change and habitat degradation escalate, negative interactions between wildlife and people are predicted to increase in both frequency and intensity. This in turn leads to conflicts between groups of people with different interests, values and power. Most often, the people directly affected by the depredations of wild animals have very little of the latter. Such conflicts are widespread, and in some cases seriously threaten the worldwide goals of biodiversity preservation and sustainable development.

Who makes the decisions where there are negative interactions between wild animals and people? Who writes the rules, and who implements them? Who mediates and what is 'good' governance in these circumstances?

There is a widespread acceptance in some parts of the conservation community that profound changes are required in the way 'human-wildlife conflict' is understood, addressed, and managed. However, there are few visible expressions of this awareness being translated in a practical context. Duan Biggs of Griffith University in Australia is convinced that there are some simple tools that can make a significant difference – especially standards and best practice guidelines – and the Luc Hoffmann Institute has been incubating his ideas so that they take shape and have impact. As part of this work the institute has been helping Duan and others unpack and analyse what is already going. The new report on 'The state of knowledge and practice on human-wildlife conflicts' arises from this analysis. Compiled by leading specialists in the field of HWC, it points the way to developing a standard to guide and improve approaches to HWC globally. The report addresses fundamental governance questions and uses existing research on relevant standards from natural resources management and wider conservation practice to advise on the factors to consider and the potential design for a new standard.

https://luchoffmanninstitute.org/wp-content/uploads/2020/03/LucHoffmannInstitute-humanwildlifeconflict-web.pdf



25 Years of the Wolf in Switzerland

Authors: Kristina Vogt, Manuela von Arx, Ralph Manz, Fridolin Zimmermann, Florin Kunz, Urs Breitenmoser
Publisher: Stiftung KORA, Thunstr. 31, CH-3074 Muri, www.kora.ch
Language: German, English, French (a French and an English version of the report are in progress)

In 1995 wolves from the Italian-French Alps returned to Switzerland. On the occasion of the 25th anniversary of the re-colonisation of Switzerland by the wolf, KORA has published a comprehensive monograph on the subject.

Various aspects of wolves are discussed, including the evolution of the wolf situation in Switzerland and in Europe, conflicts with livestock farmers and hunters, wolves in the law and in society.

The German report can be downloaded as PDF. Printed versions in French and German can be ordered from KORA for a contribution towards expenses. An English version is currently in preparation.

https://www.kora.ch/fileadmin/file_sharing/5_Bibliothek/52_KORA_Publikationen/520_KORA_Berichte/KORA_Bericht_91_D_25_Jahre_Wolf_in_der_Schweiz.pdf

Humans and Lions

Conflict, Conservation and Coexistence

Author: Keith Summerville
Publisher: Taylor and Francis Ltd., 2019
Language: English
ISBN-10: 1138558036;
ISBN-13: 978-1138558038

This book traces man's relationship with lions through history – from early hominids to the Roman empire, through Africa's colonial occupation and independence, to contemporary conservation politics. It is a coherent, evidence-based assessment of the human-lion experience, and thus a detailed history of conflict that ultimately stems from two related developments: declining lion numbers and increasing human numbers.

As human populations in Africa surge, the ever-increasing demands on land threaten the future of lions. Somerville explores the daunting task of conserving lions in the wild. This includes the valiant efforts of a handful of conservationists to reverse lion population decline amid rural poverty, and mitigate situations where human lives and livestock are threatened. At stake are the precarious livelihoods of communities that live among lions. The book also explores the positive aspects and negative consequences of lion hunting.

Somerville searches for the best forms of lion conservation in the current environmental crisis, exacerbated by the tension between Western animal-welfare concepts and sustainable use and development. He admits that, emotionally, lion hunting may be viewed as a contradiction, but concludes that science-based, regulated lion hunting does not endanger lion populations and can become part of the strategy to protect lions. This can be seen in Southern Africa, where lion numbers recently have grown.

To the future of lions in the wild, the main dangers are loss of habitat, the expansion of humans into lion country and bushmeat poaching, which depletes the prey base of lions. The best solution, Somerville writes, is to ensure that rural African communities benefit economically from coexisting with lions.

MEET THE EDITORS

Robin Rigg is a zoologist focused on large carnivore management, ecology and coexistence with people. He has over 20 years' experience of implementing and evaluating damage prevention measures. He has served in the IUCN Bear Specialist Group's Human-Bear Conflict expert team and is a member of the Large Carnivore Initiative for Europe and the Slovak Wildlife Society. He has studied at the universities of Cambridge, Aberdeen, Newcastle, Oxford and Ljubljana and wrote his Masters thesis on livestock guarding dogs.

Daniel Mettler studied philosophy and economics. He worked for several years as a shepherd and created the Centre for Livestock Damage Prevention for Switzerland at AGRIDEA. He has published several articles, technical papers and guidelines on protection measures. He is currently responsible for a variety of topics including regional development in mountain areas and the management of alpine pastures.

Silvia Ribeiro is a biologist at Grupo Lobo, Portugal, with extensive experience in conflict mitigation, particularly the use of livestock guarding dogs to prevent damage by wolves. She has trained in animal welfare and her Masters in ethology focused on the ontogeny of social preferences in livestock guarding dogs. She is currently concluding her PhD on physiological aspects of canine social attachment.

Micha Herdtfelder is a trained mediator and specialist in human dimensions of wildlife. He is head of the large carnivore working group at the Forest Research Institute in Baden-Wuerttemberg, Germany. He promotes fact-based, trust-building communication between stakeholders in order to find viable solutions for coexistence with carnivores, including damage prevention. He studied geoecology in Karlsruhe, focusing on wildlife ecology and hunting techniques, and wrote his PhD thesis on Eurasian lynx.

Valeria Salvatori is a conservation biologist who has focused her work on carnivore ecology and management for the last 20 years. She is a member of the Large Carnivore Initiative for Europe and has led LIFE projects aimed at mitigating the impacts of large carnivores on agricultural production. She gained her Masters degree at Sapienza University, Rome, on the ecology of South American foxes and her PhD at Southampton University on habitat suitability assessment for wolves, bears and lynx in the Carpathian mountains.

UPCOMING EVENTS

The following meetings have been rescheduled due to the COVID-19 pandemic:

International Conference on Human-Wildlife Conflict and Coexistence
This event, co-hosted by the IUCN's Human-Wildlife Conflict Task Force, the Global Wildlife Program and Oxford University's Wildlife Conservation Research Unit, was due to be held in April 2020 in Oxford, UK, but has been postponed. Rescheduled dates had yet to be announced when *CDPnews* went to press but are expected to be in September 2021 or March 2022. For details see: https://www.hwcconference.org/

International Conference on Bear Research and Management
IBA conferences showcase recent developments in research, management and conservation of all bear species worldwide. The 27th IBA Conference, which was due to be held in September 2020 in Kalispell, Montana, USA, has been postponed until autumn 2021. There are contingency plans for a virtual conference if an in-person conference is not possible, or alternatively a hybrid of both. Registration is on hold until a decision is made on the format in early 2021. For details see: https://iba2020mt.com/

Pathways Europe 2020: Human Dimensions of Wildlife Conference and Training
Originally due to be held in September 2020 in Wageningen, the Netherlands, this event has also been postponed. Rescheduled dates had yet to be confirmed when *CDPnews* went to press but are expected to be in autumn 2022. For details see: https://sites.warnercnr.colostate.edu/pathways-europe/

NEXT ISSUE

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The next issue of *CDPnews* is due out in winter 2020/21

CDPnews Carnivore Damage Prevention

LIFE EURO LARGE CARNIVORES