

# 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<sup>1</sup> (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.

<sup>1</sup> [ec.europa.eu/easme/en/life](http://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)*

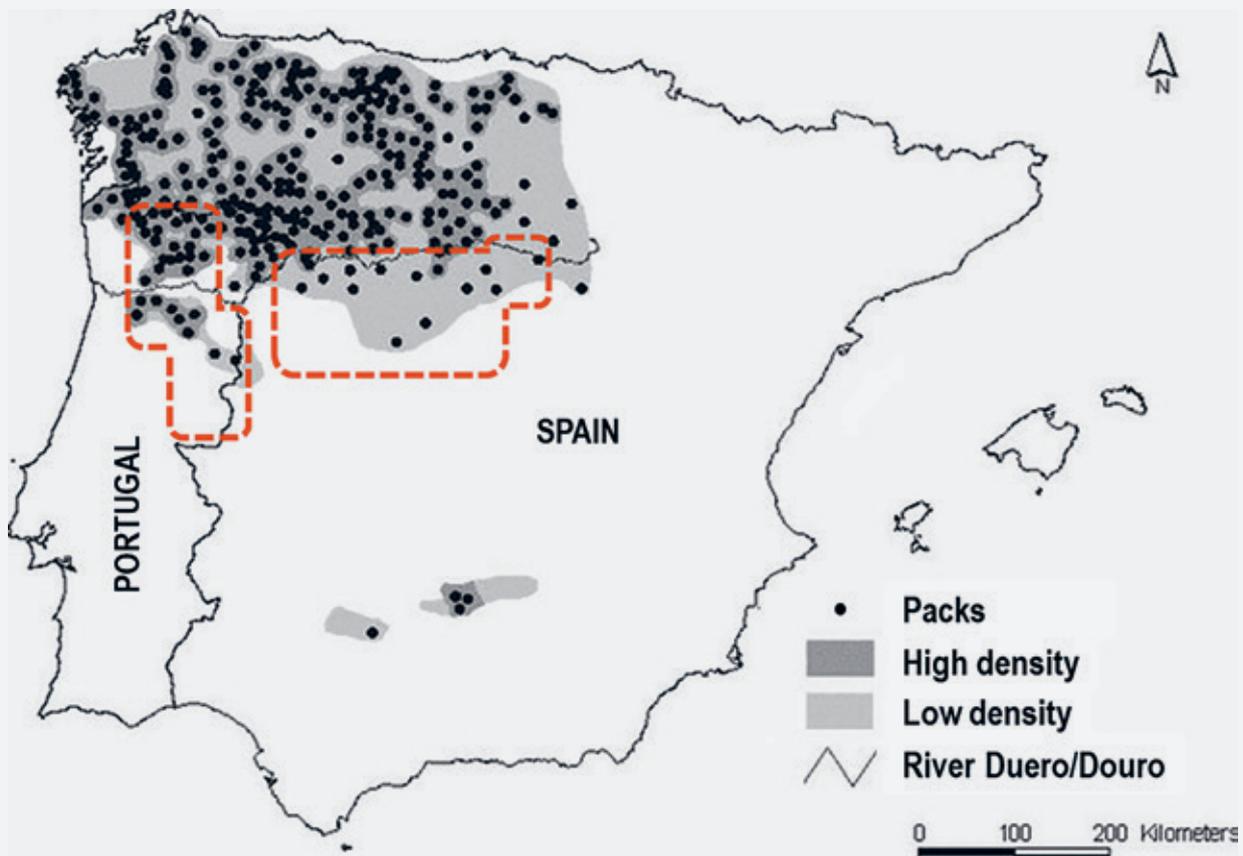
The Iberian wolf population is the largest in Western Europe and is considered Near Threatened (Boitani, 2018). Since the 1970s, wolves in Spain have been spreading southwards and eastwards, recolonising many territories where they had been exterminated. The latest estimates report around 300 packs in 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<sup>2</sup> 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<sup>3</sup>, 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

<sup>2</sup> A continuation of the Duero River in Spain.

<sup>3</sup> 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<sup>2</sup> 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*<sup>4</sup> 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.

<sup>4</sup> 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	%
<b>Spain</b>						
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
<b>Portugal</b>						
Electric fences	0	0	12*	5.7	12	5.4
LGDs	1	7.7	91	43.1	92	41.1
<b>Combined</b>						
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
<b>Total</b>	<b>13</b>	<b>100</b>	<b>211</b>	<b>100</b>	<b>224</b>	<b>100</b>

\* 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<sup>5</sup> 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	%
<b>Spain</b>			
Electric fences	18	10	55.6
Conventional fences	10	8	80.0
LGDs	28	20	71.4
<b>Portugal</b>			
LGDs	30	15	50.0
<b>Combined</b>			
LGDs	58	35	60.3
<b>Total</b>	<b>86</b>	<b>53</b>	<b>61.6</b>

**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	%
<b>Spain</b>					
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
<b>Portugal</b>					
LGDs	53	33	62.3	47	88.7
<b>Combined</b>					
LGDs	92	60	65.2	81	88.0
<b>Total</b>	<b>134</b>	<b>87</b>	<b>64.9</b>	<b>111</b>	<b>82.8</b>

<sup>5</sup> 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<sup>6</sup>. These should be considered minimum costs, since in some cases it was difficult to estimate real values.

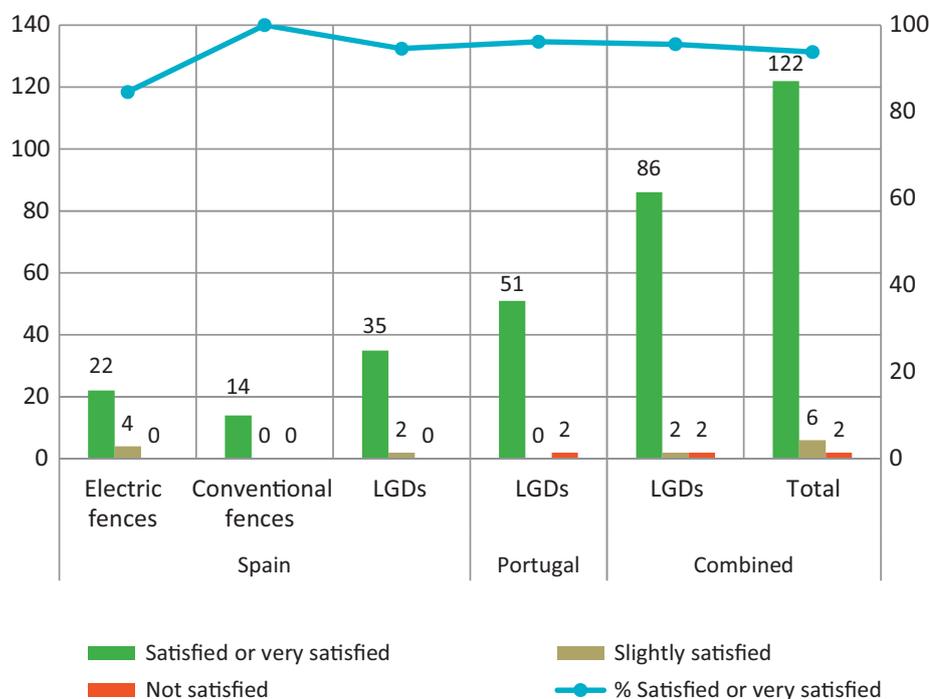


Fig. 2 Level of satisfaction of farmers with damage prevention measures.

<sup>6</sup> 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*
<b>Spain</b>			
Electric fences	700	200	90
Conventional fences	5,500	50	555
LGDs	0–600	300	300–360
<b>Portugal</b>			
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	%	
<b>Spain</b>	2	11	4	22	5	28	5	28	2	11	18
<b>Portugal</b>	9	29	14	45	4	13	2	6	2	6	31
<b>Combined</b>	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	%		
<b>Spain</b>										
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	
<b>Portugal</b>										
LGDs	14	70.0	1	5.0	0	0.0	5	25.0	20	
<b>Combined</b>										
LGDs	22	71.0	3	9.7	1	3.2	5	16.1	31	
<b>Total</b>	<b>29</b>	<b>63.0</b>	<b>7</b>	<b>15.2</b>	<b>3</b>	<b>6.5</b>	<b>2</b>	<b>15.2</b>	<b>46</b>	

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	%	
<b>Spain</b>							
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
<b>Portugal</b>							
LGDs	4	66.7	0	0	2	33.3	6
<b>Combined</b>							
LGDs	8	61.5	2	15.4	3	23.1	13
<b>Total</b>	<b>17</b>	<b>68.0</b>	<b>4</b>	<b>16.0</b>	<b>4</b>	<b>16.0</b>	<b>25</b>

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

	Spain		Portugal		Com- bined
	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
<b>Sub-Total</b>	<b>52</b>	<b>78.8</b>	<b>26</b>	<b>43.3</b>	<b>61.9</b>
<b>Other suggestions</b>					
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
<b>Sub-Total</b>	<b>14</b>	<b>21.2</b>	<b>34</b>	<b>56.7</b>	<b>38.1</b>
<b>Total</b>	<b>66</b>	<b>100</b>	<b>60</b>	<b>100</b>	<b>100</b>



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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<sup>7</sup> [www.grupolobo.pt/programa-cao-de-gado](http://www.grupolobo.pt/programa-cao-de-gado)

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