

# EFFECTIVENESS OF BROWN BEAR DAMAGE PROTECTION MEASURES TO PROTECT APIARIES IN THE CANTABRIAN MOUNTAINS

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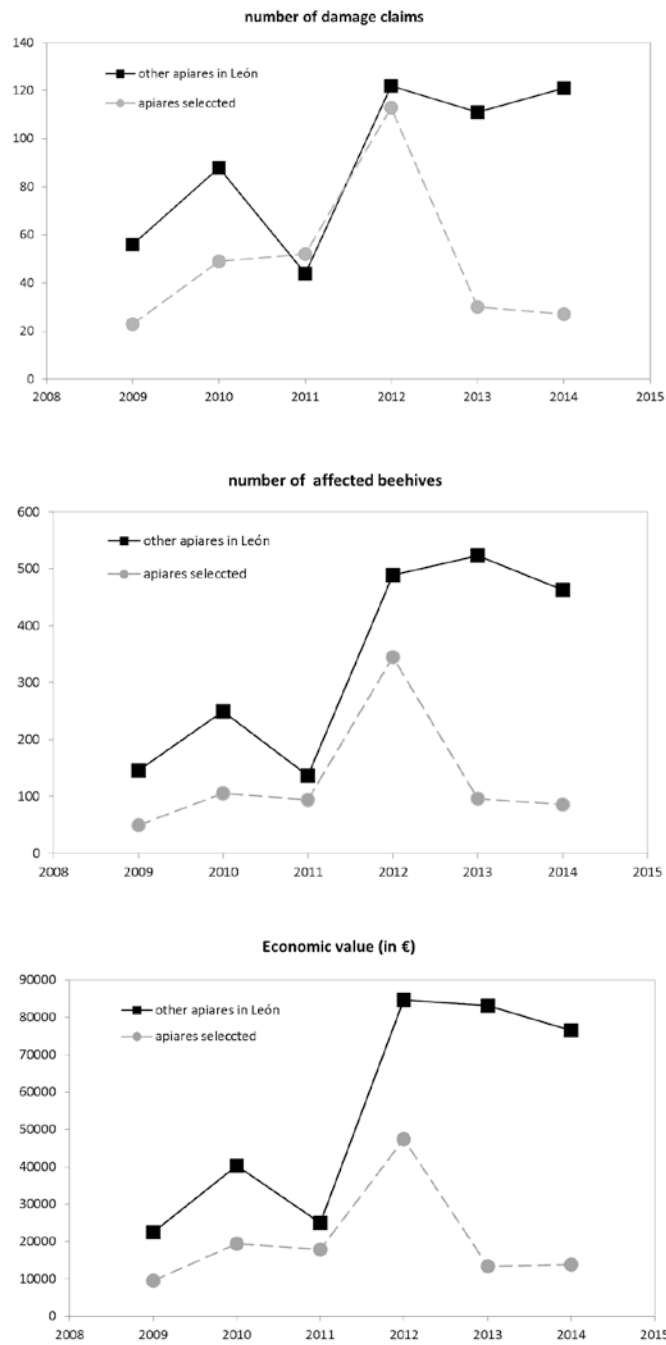
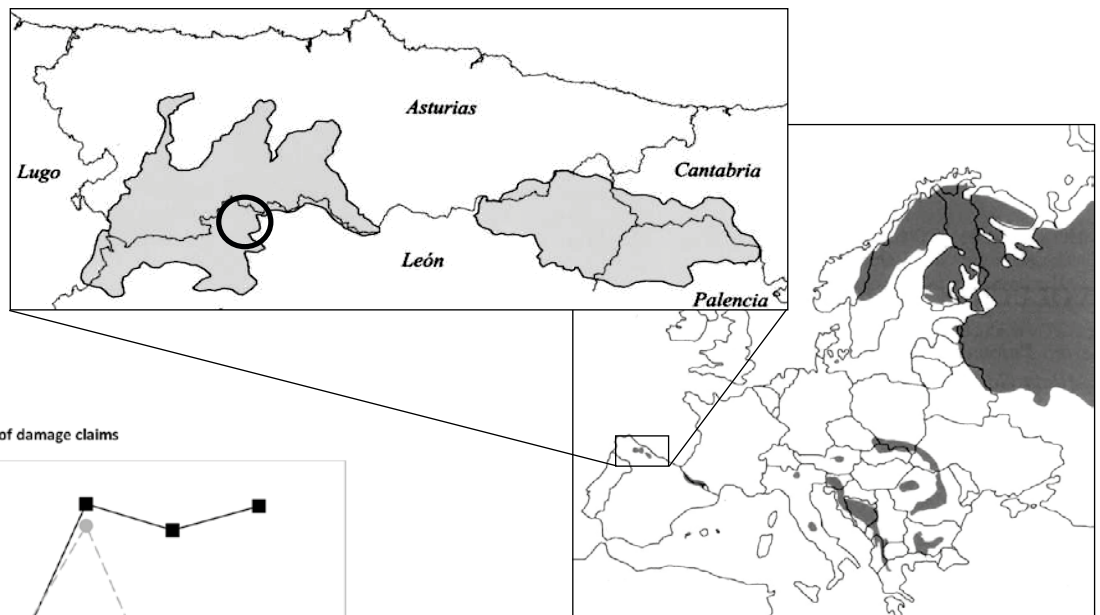
## 1. Introduction

Human-wildlife conflicts associated with large carnivores have led to their persecution and eradication from large areas of the Earth since ancient times (Ripple et al., 2014). In recent times, large carnivore populations have recovered in Europe with new populations in many areas becoming established in highly humanized environments. This is resulting in increasingly frequent human-wildlife conflicts, mainly due to damages caused to human properties (Chapron et al., 2014; Treves and Karanth, 2003). Finding solutions to resolve the conflicts thus arisen (economic, social, and emotional) is an important challenge to ensure the conservation of these species (Treves and Karanth, 2003).

To mitigate the conflict and improve tolerance over these species, monetary compensation is commonly utilized (Dickman et al., 2011); although this procedure has been often criticized because of its low efficiency at reducing conflicts (Boitani et al., 2010; Bulte and Rondeau, 2005). To reduce these conflicts, it is necessary to improve the knowledge about the factors that cause them, (demographic, ecological, socioeconomic; e.g. Naves et al., 2012; Suryawanshi et al., 2013) and integrate this knowledge into the design and use of effective prevention and dissuasive measures (e.g. Salvatori and Mertens, 2012).

In the case of the brown bear (*Ursus arctos*), recurrent damages can stimulate bear habituation behaviour to human presence, when approaching villages or

**Fig. 1.** Distribution map of brown bear in Europe.  
 a. Present distribution of brown bear in Europe.  
 b. Distribution of brown bear in the Cantabrian Mountains and location of the study area (circle).



**Fig. 2.** Number of total bear-related damage records, beehives affected and economic losses in the apiaries of the essay, compared to the rest of the León province.

places with human activities in search of food resources (Swenson et al., 2000). The risk of accidents from encounters between bears and people can increase in these situations and the resulting effects on conservation policies can be very dramatic (Loe and Roskaft, 2004).

The brown bear population in the Cantabrian Mountains is included in the Spanish Catalogue of Endangered Species in the category “Endangered Species” and is one of the most endangered brown bear populations in the world (Zedrosser et al., 2001). The conservation policies for this population has included, for over three decades, the payment of monetary compensation and in some cases provision of material, namely electric fences, to farmers to protect their property. This population may represent a model case not only for Spain but also for all Europe, since its recent population growth (Pérez et al., 2014) is combined with a significant increase in damages (Sánchez-Corominas and Vázquez, 2006 - for Asturias 1988-2003 period; Pollo, 2006 - for León 1974-2003 period); and in some regions, i.e Asturias, during the 1991-2008 period, the rate of increase in damages to beehives was three times higher than the rate of increase in the bear population (Naves et al., 2012).

These data could indicate that other factors may be contributing to this trend but also confirms the need to quickly reduce the human-wildlife conflicts being generated. In the Cantabrian Mountains there are about 400 claims for damages attributed to bears (annual average for 2005-2010) of which 70% involve beehives (Javier Naves and Juan Seijas, unpublished data), a figure that gives an idea of the importance of this type of human-wildlife conflict.

In the case of bear attacks to beehives, the use of electrified fences has been one of the most common protection procedures (Honda et al., 2009; Otto and Roloff, 2015). In the Cantabrian Mountains the authorities as well as NGOs promote the use of different types of electrified enclosures or fences to protect the apiaries. However there have not any systematic evaluations about the efficiency of these prevention systems.

In the framework of a new program of the Spanish Ministry of Agriculture, Food and Environment for promoting methods to mitigate human-wildlife conflicts caused by large carnivores, this study evaluates the effectiveness of different electric fence systems to protect apiaries from bears.

## 2. Study Area

The study area was located in the León province (northern Spain) (Fig. 1). Here, during 2009 and 2012 there was an annual average of 137 claims for bear attacks on apiaries; this meant an average of 400 beehives affected each year. The annual economic cost accounted for 66,700 € (Servicio Territorial de León - Junta de Castilla y León, unpublished data).

## 3. Material and Methods

The five apiaries with most damage records were selected to be provided with protection measures. These five apiaries had suffered an annual average of 59 bear damage claims and 148 affected beehives during the 2009-2012 period. This represents 42% of bee damage and 34% of beehives affected in the whole of León province. The damage caused on these five apiaries reached in the previous four years 94,000 €, 21% of the total for the province (Servicio Territorial de León - Junta de Castilla y León, unpublished data).

This disproportionate amount of damage is due to these five apiaries being part of very productive farms, with 72 beehives on average per unit, which is relatively high compared to those in other areas of the Cantabrian Mountains. Also, bear “habituation” cases possibly occurred in these farms.

The apiaries selected for the study had already installed a simple fence with 3-4 electrified wires, and the fifth apiary had a double fence of similar characteris-



Brown bear digging around an apiary to avoid electrified wires. Photo: Junta de Castilla y León.



Brown bear pushing the wood stake of an electrified fence to avoid electrical discharge. Photo: Junta de Castilla y León.

tics. But these fences had not always worked properly, supposedly due to poor wire insulation in contact with vegetation, malfunctioning electrical grounding and poor maintenance of batteries.

Since 2013, several improvements were installed in successive stages to test their effectiveness in different settings (levels of incidence or intensity of attacks). The improvements consisted in clearing the vegetation around apiaries to avoid electrical shunts, periodical checking on the effectiveness of the electrical grounding depending on ground moisture, installation of fences with aluminium wire (better conductor than nylon) to ensure electrical conduction and/or installation of 1,5 m high electrified fences and finally, photovoltaic energizers installation that ensured continuity in the intensity of the power supply (9,2 kV), without requiring constant maintenance (as in the case of batteries). These materials were provided by the project.



Inspection of a bear damage event by an official ranger from the competent authority. Photo: J.M. Seijas.



Maintenance work during the essay. Photo: J.M. Seijas.



Photovoltaic energizer used during the essay. Photo: J.M. Seijas.



Monitoring work. Verification of the continuity of the electric discharge's intensity over time. Photo: J.M. Seijas.

## 4. Results

Considering the two years in which this protection measures have been applied up to now (2013 and 2014, Fig. 2), the percentage of bear-damage records associated with these five improved-protection beehives changed from 48% (of the total of the León province) in the previous year (2012) to 20%. Considering the number of beehives attacked, these holdings accounted for 16% against 41% of previous year.

From an economic point of view, damage caused in these five beehives during 2012 account for 47,500 €, against an annual average of 13,600 € for 2013 and 2014. A cost of 750 € in raw materials was required to build a photovoltaic energized mesh fence and 450 € for the energized wire fence. The labour for installation, mowing and maintenance should also be considered in addition.

In general, trial results suggest that in some cases the electrified fence (1.5 m seems high enough), whether mesh or wire, with no derivation set up (e.g. no contact with vegetation), a good electrical grounding connection and a maintenance program that ensured continuity in the intensity of the electric discharge overtime could be enough to prevent or reduce the bear attacks to beehives. For cases in which repeated attacks occurred (possible “habituation” cases), a double fencing or netting fence electrified at a suitable distance (20-30 cm), with independent energizing wires, can solve the problem by significantly reducing the number of damages or even preventing them totally.

## 5. Conclusions

A primary conclusion is that effective protection requires the right equipment set-up and constant maintenance.

The test results are quite satisfactory because they demonstrate the possibility of reducing or eliminating the number of damages in a bee farm in an efficient manner, by installing and maintaining relatively cheap protective measures.

Due to the practical goal of this trial, these preliminary results were used to develop technical recommendations – “Protecting apiaries” – for good practices or improved techniques to prevent damage to beehives. This document is included in the “Catalogue of measures to protect agriculture and livestock

interactions with wildlife,” by the Ministry of Agriculture, Food and Environmental Affairs (MAGRAMA ([http://www.magrama.gob.es/es/biodiversidad/temas/conservacion-de-especies/ce\\_silvestres\\_resolucion\\_oso\\_pardo\\_colmenares\\_tcm7-358443.pdf](http://www.magrama.gob.es/es/biodiversidad/temas/conservacion-de-especies/ce_silvestres_resolucion_oso_pardo_colmenares_tcm7-358443.pdf)).

The project will continue throughout 2015 and 2016. Besides confirming the previous results and deploying

these measures in other apiaries of Cantabrian mountains, we will try to develop new protective methods to study the relationship between natural food availability and intensity of the damage on apiaries, habituation of some individuals and the effect of protective measures applied to other apiaries or other types of farming (cattle, orchards) around the study area.

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