



Focus

# Improving protection of beehives from bears in the Cantabrian Mountains, Spain

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## Background: bears in Spain

The conflict between humans and brown bears (*Ursus arctos*) is an old and complex one, fuelled by damage to livestock, beehives and crops as well as fear [1]. As a result, bears were hunted to extinction in many European countries, but are now slowly recovering some of their former range [2]. In Spain, bears historically occurred throughout the country, as mentioned in the 14<sup>th</sup> century *Libro de la Montería* of King Alfonso XI [3]. Mainly due to human persecution, rather than habitat destruction, their numbers declined to a low of around 40 animals in the mid-20<sup>th</sup> century [4].

The species is currently listed as endangered in the Spanish Red Data Book (*Catálogo Español de Especies Amenazadas*) and is fully protected [5]. Thanks to legal protection, public awareness and the fact that the bear is no longer seen as vermin but instead as a driver of tourism, its numbers have shown a steady increase, reaching 230 individuals in the second decade of the 21<sup>st</sup> century, although this does not mean that it is no longer endangered [6].

Bears are confined to the mountains of northern Spain

and occur in two separate populations: the Cantabrian and the Pyrenean (Fig.1). The Cantabrian population is the most numerous and is distributed across the regions of Asturias, Castilla y León, Cantabria and Galicia (Fig. 2). It is divided into two subpopulations, the western and the eastern, with a combined area of permanent presence of about 8,600 km<sup>2</sup>, which in recent decades has steadily expanded [7]. Nevertheless, the two subpopulations remain largely isolated, with only sporadic exchange of males and no increase in the breeding area that might lead to joining of the western and eastern subpopulations.

## Bears, bees and people

Bee larvae and honey have always been exploited by bears as a food resource. There is evidence of this and of beekeeping in prehistoric times from India to western Europe, for example in Mesolithic rock paintings in Spain [8]. For people in western Asturias, honey represented a source of food and an important economic commodity. To protect their hives, people built stone walls around them, two metres or more in height and topped with protruding slate slabs (*llábana*) to prevent bears from climbing in.

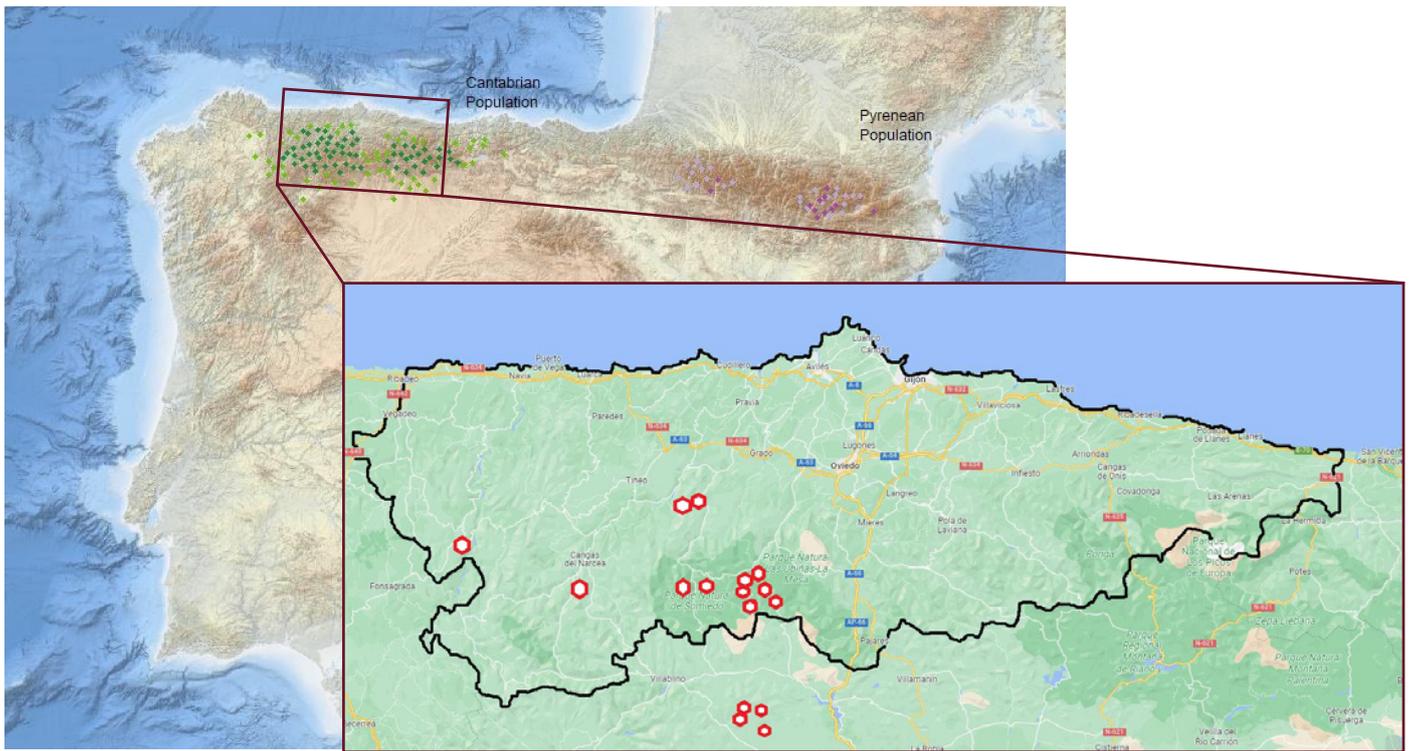


Fig. 1. Distribution of bears in the Pyrenees (purple dots) and Cantabrian Mountains (green dots). Darker colours indicate permanent presence, lighter colours sporadic presence (Source: FAPAS/FIEP [6]). The red and white polygons in the enlarged view show the locations of beehives protected with electrified enclosures as described in this article.

The access door was made of strong wood and just big enough for the beekeeper to get through. Another type of defensive structure resembled a tower, with access via a ladder that was removed when the beekeeper was not present. Depending on the area, the structures were known as *cortines*, *alvarizas*, *alvares* or *talameiros* (Fig. 3). They were abandoned when beekeeping declined and villages became depopulated. Many of them are now in a semi-derelict state but some are in good condition and a few can even be seen still in use.

As bears return to areas where they have been absent for decades and their numbers increase, there is a renewed need for effective means of protecting apiaries to avoid conflicts and the risk of people turning to other solutions such as poaching. In recent years, the highest rates of apiary damage per bear in Europe have occurred in the Cantabrian population [9,10]. Of €1.9 million paid in compensation related to bears in this region in 2009–2018, 60% was for damage to beehives, 23% for orchards and 13% for livestock [11]. Compensation for bear damage to apiaries is paid by regional administrations and linked to the use of prevention measures.

Restoring the use of traditional stone enclosures could be part of the solution. However, most of them are dam-

aged or located in places that are difficult to access and they would probably have to be adapted to the current needs of beekeeping. An alternative, and nowadays one of the most common measures used to protect beehives from bears in Europe and beyond, is electric fencing. However, there are various ways to build an electric fence and not all of them are effective at deterring bears. For example, simple fencing of the type used to contain or exclude livestock, with 1–3 wires spaced relatively far apart and high above the ground, is insufficient to deter foraging bears. On the other hand, some designs are too complex and expensive to be effective.



Fig. 2. Brown bears in the Cantabrian Mountains, Spain (Photo: FAPAS).



Fig. 3. Examples of stone structures built to protect apiaries from bears in the Cantabrian Mountains (Photos: FAPAS).

Here I describe a low-cost fence design developed by the Fund for the Protection of Wild Animals (FAPAS) and present some preliminary results of testing its efficacy in preventing bear damage to beehives. For more than 30 years, FAPAS has focused its efforts on the study and conservation of the Cantabrian bear population, to promote its expansion and facilitate coexistence with human activities. Our hope is that this simple, cost-effective approach will be readily accepted and implemented by beekeepers throughout the bear range.

## Design and installation

The FAPAS fence design consists of two main elements: a wire mesh barrier, approximately 1.70 m tall, and several electrified wires (Fig. 4). The purpose of the mesh, which is of a type commonly used to confine sheep or chickens, is to deter/prevent bears from passing through the fence. It ensures that, when a bear touches an electrified wire and receives a shock, it will move backwards instead of forwards.

The first phase of installation is to enclose the perimeter of the apiary with wire mesh. In addition to the vertical barrier, a 25-cm wide mesh skirt is laid horizontally on the ground around the outside of the fence and held in place with rocks. This is to prevent bears digging under the fence and to increase the grounding of electric wires when a bear steps on the mesh (Fig. 5).

Next, on the outer side of the mesh, a minimum of five electric wires are attached to posts. If the mesh is part of an existing fence, a second set of posts can be installed for the electric wires. Otherwise, when a new fence is built from scratch, a single row of posts is sufficient to support both the mesh on the inside and the electric wires on the outside (Figs. 4 and 5). The bottom wire is placed 25 cm from the ground and subsequent wires are fixed at intervals of 25 cm, 30 cm, 30 cm and 40 cm, ensuring they are all under tension. An entrance gate is made between two posts with insulating handles to allow easy opening. A solar-powered energiser is connected to the wires (Fig. 5)

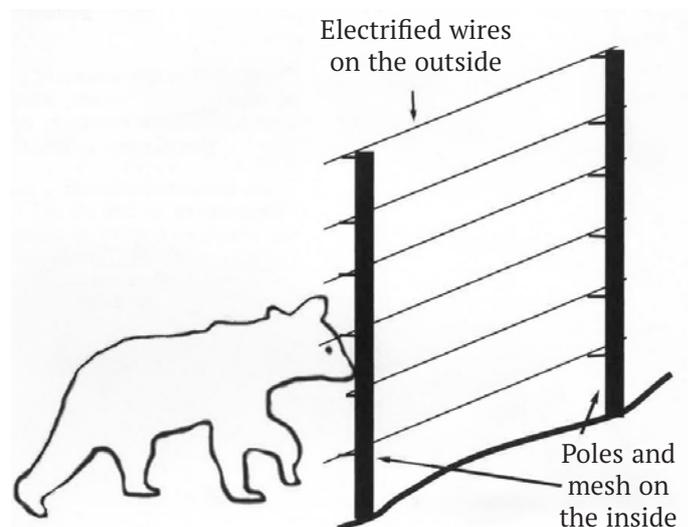


Fig. 4. Simplified schematic diagram of a 6-wire electrified enclosure for protecting apiaries from bears (Source: FAPAS).



Fig. 5. Electrified enclosures for protecting apiaries from bears showing outer mesh skirt held in place with rocks (Photos: FAPAS).

to generate pulses of 3,000–9,000 volts, which is sufficient to deter an animal that always has at least one paw on the ground to close the circuit.

## Efficacy

Between 2013 and 2023, fences were installed at ten FAPAS apiaries in the core area of the Cantabrian bear population in Asturias (Fig. 2) and at six apiaries that had been repeatedly visited by bears in the Omaña region of León, where FAPAS technicians have documented considerable growth of the bear population. To choose locations, an initial inventory was conducted which identified 84 apiaries in the area, 32 of which were visited by FAPAS workers. The apiaries were found to be poorly protected, or unprotected, from bears. Some were surrounded by mesh fences (Fig. 6); some had two or three electric wires as if to exclude free-ranging horses or cattle but not enough to keep bears out.

Before the new enclosures were built, damage occurred at each of the 16 apiaries, year after year. The level of damage could be significant: in the year immediately prior to the installation of electric fencing, on average 50% of beehives were damaged and in several cases all the hives in an apiary were damaged (Table 1). Considering the costs of honey (around €300/hive), a bee colony (approx. €100) and hive (approx. €50), the estimated financial losses per apiary in the year before building new

fences ranged from €900 to €13,500. Since the installation of FAPAS fences, no further damage by bears has been recorded at any of the protected apiaries, despite the continued presence of bears in the surrounding area. The design has thus so far been 100% effective at protecting apiaries from bears in Asturias and León.



Fig. 6. Examples of fencing that does not offer sufficient protection from bears (Photos: FAPAS).

Table 1. Damage caused by bears at 16 apiaries in the year prior to installation of electric fencing. Financial loss is an estimate of the value of lost honey production, cost of damage to beehives and money invested in treating the bees that year.

Apiary	Beehives in apiary (n)	Beehives damaged		Financial loss (€)	Year fence installed
		n	%		
#1	30	5	17	2,250	2013
#2	11	11	100	4,950	2013
#3	10	10	100	4,500	2013
#4	26	2	8	900	2013
#5	32	6	19	2,700	2014
#6	16	16	100	7,200	2016
#7	20	12	60	5,400	2016
#8	25	20	80	9,000	2016
#9	43	17	40	7,650	2017
#10	14	14	100	6,300	2017
#11	30	13	43	5,850	2018
#12	32	6	19	2,700	2018
#13	26	4	15	1,800	2020
#14	25	6	24	2,700	2022
#15	76	30	39	13,500	2023
#16	19	8	42	3,600	2023

## Cost and value

To instal this type of electric fence around an apiary with a perimeter of 100 metres (providing enough space for 80 beehives) cost about €500. Considering a market price for quality honey of around €11/kg (varying according to the type of flower visited by the bees) and an average annual production of 20 kg per colony (beehive), an apiary with 80 beehives could be expected to produce 1,600 kg of honey with a value of €17,600 per year. Taking into account an average financial loss due to bears of more than €5,000 at apiaries with insufficient protection (Table 1), it is evident that the cost of investing in an effective electric fence can be quickly recouped from the savings made by preventing damage. Moreover, damage often involves not only lost honey production but also destruction of the beehives and colonies themselves. Support may be available to assist beekeepers with fencing. FAPAS provides some materials (reused from other fences) as well as free labour to help with installation. The Regional Government of Asturias occasionally provides aid for purchasing electric fences.

## Sharing know-how

From the results presented above it can be concluded that electrified enclosures of the type described greatly reduced damage by bears to apiaries, thereby improving the coexistence of beekeeping and bears, at relatively little cost. Implementing such measures is especially important at new apiaries to avoid high levels of losses if bears identify them as food sources and, potentially, even habituate to human presence. They should be implemented in advance of bear population expansion to prevent damage in areas where beekeepers are not used to bear presence and could resort to poaching, hindering population recovery. As improving the protection of one apiary may result in increased damage at neighbouring apiaries [12], it is important to protect all apiaries in an area at the same time. Furthermore, after installation and on an ongoing basis, it is essential to check and maintain fences regularly to ensure their proper functioning, including periodically checking the voltage and clearing any vegetation or objects in contact with electrified wires.

In order to share bear-related information and experi-



Fig. 7. Disseminating information on bears and damage prevention measures to members of the Leonese Association of Beekeepers (Photo: FAPAS).

ence, FAPAS was invited by the Leonese Association of Beekeepers to meetings with its members (Fig. 7). The goal was to raise awareness of the importance of proper prevention and to help professional and amateur beekeepers to minimise bear damage to their apiaries, preventing conflicts and avoiding animosity towards bears, thus contributing to bear conservation in the region. There was also a practical demonstration of the system at an existing apiary attended by several beekeepers from the area as well as environmental agents from the Junta

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de Castilla y León and staff of the Biosphere Reserve of Omaña y Luna. Beekeepers in Omaña expressed their satisfaction with the results obtained.

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