



FOP Reports

2024 - 2025

Scientific and technical research activities to advance towards a Favourable Conservation Status of the brown bear and the conservation of its essential habitats in scenarios of climate change, international, and state competence

Abstracts



This document contains a summary of the results obtained in each of the activities developed within the framework of the three types of research that make up the project "Scientific and technical research activities to advance towards a Favourable Conservation Statuts of the brown bear and the conservation of its essential habitats in scenarios of climate change, international and state of competence," carried out by the Brown Bear Foundation from July 2024 to July 2025.

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1. BACKGROUND

The Bear as a Model for a More Socially Participatory Management of Our Biodiversity

The brown bear (*Ursus arctos*), an omnivorous species with a low reproductive rate, has historically inhabited the Cantabrian Mountains and the Pyrenees, coexisting in environments marked by the significant presence of human settlements and rural activities. In 2020, the Cantabrian population was estimated at 370 individuals. This species, listed as a priority under the Habitats Directive (Annex II), is classified in the Spanish Catalogue of Threatened Species as “endangered”. Despite moderate growth and range expansion since the late 20th century, various factors—such as declining social tolerance, insufficient conflict management with people, and the impacts of climate change—continue to pose significant challenges to achieving a Favorable Conservation Status (FCS).

As an “umbrella species,” conservation efforts targeting the brown bear—especially those related to habitat improvement—have significantly contributed to the fight against biodiversity loss. Protecting the bear indirectly safeguards its habitat and the full range of flora and fauna that share with. These are highly humanized territories, with numerous rural communities throughout the mountain range, traditional activities that have historically coexisted with bears, and a growing tourism sector. Therefore, society has the right to access environmental information held by public authorities and to participate in decision-making that may affect natural environments and/or their inhabitants, as established by the Aarhus Convention. This Convention was developed under the United Nations Economic Commission for Europe (UNECE) in 1998, ratified by Spain on December 15, 2004, and in force since 2005.

Under the same 2023 call for grants by the Ministry for Ecological Transition and the Demographic Challenge, the Brown Bear Foundation (FOP) produced the study “*Analysis and Proposals on the Implementation of International Agreements Signed by Spain Relevant to the Conservation of the Brown Bear as a Priority Apex Species.*” This study highlighted the lack of uniform criteria in applying the Aarhus Convention. Building on that work, this new project aimed to deepen, from a legal-technical perspective, the concept of “environmental information,” its proper interpretation, and its scope in biodiversity conservation. This will help public administrations better understand their obligations in this regard and enable civil society to know what is reasonable to request and expect under their environmental information access rights. The project also sought to identify and assess participation mechanisms (collegiate bodies, processes, etc.) in biodiversity conservation, using the brown bear as a model. Finally, recommendations were proposed for improving the application of the Aarhus Convention in Spain.

Coexisting with the Brown Bear: Actions to Advance Applied Conflict Management Research

The growth and expansion of the Cantabrian brown bear population present several challenges, including an expected increase in damage caused by certain individuals and more frequent bear presence in urban areas. This could lead to reduced tolerance among rural populations and potentially to greater social concern and illegal persecution. Although, in general, public attitudes toward bears in Europe are more favorable than toward other large carnivores like wolves, the growing conflict due to coexistence costs may affect critical human dimensions essential for the bear's future in the territory.

An analysis by the FOP, based on official claims recorded by regional administrations in the Cantabrian range between 2009 and 2018, revealed an average of 585 annual claims for bear damage (mainly to beehives and fruit trees, and to a lesser extent, livestock), amounting to approximately €250,000 per year in compensation. While such damage is inherent in living alongside bears, incidents also began occurring on human properties in or near villages—roofs, doors, fences, chicken coops, and even vehicles—where bears searched for food like feed. This habituation phenomenon among some individuals triggered increasing social alarm with serious negative consequences.

From 2019 to 2022, the FOP documented at least 58 significant alarm events due to bear presence inside or near towns in the western Cantabrian region—specifically in the municipalities of Belmonte de Miranda, Somiedo, Proaza, Cangas del Narcea, Degaña, and Ibias (Asturias) and Villablino, Páramo del Sil, and Palacios del Sil (León), where the species reaches its highest density in the Iberian Peninsula. These are undoubtedly the areas where such alarm situations are growing and require special attention. Between January 2023 and June 2024, during the execution of the study *“Monitoring Intervention Measures Applied to Habituated Bears and Capture, Handling, and GPS Tagging of Habituated or Potentially Conflictive Individuals,”* funded under the previous grant call (2023), 42 events involving habituated or potentially problematic bears were recorded just in the Asturian municipalities, and 5 bears were captured and GPS-tagged. The study also addressed the identification of bears habituated to human food sources via genetic analysis in rural settings and developed a proposal to revise the Intervention Protocol for Bears in the Cantabrian range. Continuing that line of work, this new project updated the database on potentially conflictive bears and those that habitually prey on livestock. As an innovative measure, a pilot test was launched to evaluate the effectiveness of light and sound deterrent devices to dissuade bears from accessing human food sources. A specific protocol was designed, and systematic data were collected through camera trapping to assess their efficacy in the Cantabrian context.

At the same time, the current project placed strong emphasis on understanding social perceptions of brown bears in the region. The increase in bear-related events near human settlements has caused growing social alarm, potentially undermining positive attitudes toward the species. Media and social media reports about bear proximity to urban environments fuel a social conflict that tends to escalate. Surveys were conducted among local residents in municipalities where brown bears are present in the Cantabrian Mountains.

The FOP has extensive experience in studies on public perception and bear conservation. Notable among them is the study conducted at the end of the LIFE Oso Courel project (2017–2020), which analyzed changes in social perception in Galicia’s Sierra do Courel through 205 surveys with local groups like beekeepers, livestock farmers, hunters, and tourism professionals. Additionally, under the LIFE Natura 2000 + Bear project, two public opinion polls were conducted in 2018 and 2021 in 62 municipalities across Asturias, Cantabria, Huesca, León, Navarra, and Palencia, totaling 800 telephone interviews. Another 588 in-person surveys were conducted with local leaders and participants in awareness activities to improve appreciation for Natura 2000 and the brown bear. In 2019, funded by the same grant line, the FOP produced the report *“The Brown Bear as a Natural Resource: Methodology Analysis and Proposal of Indicators to Evaluate Its Sustainable Socioeconomic Impact in Rural Areas Over Time,”* based on 198 surveys with economic stakeholders in 32 bear-area municipalities across Asturias, León, Palencia, Cantabria, and Lugo. The results of these efforts were compiled in the scientific book *“Cantabrian Bears: Demography,*

Coexistence, and Conservation Challenges" (2021), which includes contributions from various research centers and was also funded by the Ministry for Ecological Transition and the Demographic Challenge.

As part of this new effort, the FOP designed a specific survey including questions used in previous projects, aiming for a comparative analysis and comprehensive reporting of results and conclusions. Additionally, a technical and legal analysis of bear spray use was conducted—both as a defensive tool for field teams and as part of the debate on its availability to the general public. Literature and international regulatory reviews were used to inform a well-founded proposal for potential regulation in Spain.

All these efforts are complemented by the LIFE *Human Bear Coex* project (2023–2027), coordinated by the FOP and co-funded by the European Commission, with participation from the nine municipalities most affected by conflictive bear events in the Cantabrian range. Key actions include training local technicians and leaders, clearing sensitive areas, deterrent plantings, facility protection, pilot testing of bear-proof containers, and tracking conflictive bears via GPS tagging. Activities from this grant call (A2.1, A2.2, and A2.3) are framed within this LIFE project.

Bear Habitat Conservation under Threat from the Climate Emergency

The latest report from the Intergovernmental Panel on Climate Change (IPCC) (2021) warned that mainland Spain and the Balearic Islands face increasing aridity, more wildfires, and extreme temperatures, along with reduced precipitation and snow cover. In the Cantabrian Mountains, snowfalls have declined by over 20% at all monitoring stations in the past two decades. According to the Met Office Hadley Center for Climate Science (MOHC), by 2080, the region is expected to see a 15% drop in precipitation and a 4°C rise in average temperature. Regionalized climate change scenarios for Spain also anticipate up to a 2°C rise in maximum winter temperatures by 2040. Wildfire risk is projected to rise throughout the century, especially in northern mountainous areas, which the National Climate Change Adaptation Plan (PNACC) has identified as highly vulnerable.

Scientific literature on the impact of climate change on bears shows a trend toward shorter hibernation periods and prolonged foraging at lower elevations. Warmer winters increase energy demand during dormancy, reducing reserves for reproduction and forcing bears to consume more during the hyperphagic phase (when they store fat for hibernation and reproduction). Forecasts also predict more human-bear conflicts in heavily humanized lowlands, particularly in winter. There have also been documented effects on key dietary species such as bilberries (*Vaccinium spp.*), whose production is declining, alongside increased forest diseases and fire risk, all reducing the availability of essential autumn foods like nuts.

In previous calls from the Ministry, the FOP addressed these concerns in works like the *“Review of the Expected Effects of Climate Change on the Brown Bear and Key Trophic Vegetation Species, and Potential Adaptation Strategies”* (2018), and, in collaboration with the University of Cantabria and other experts, the *“Analysis of Climate Change Adaptation Proposals in Brown Bear Conservation Plans Worldwide and Their Applicability to Iberian Populations”* (2020). The 2021 report on improving food availability and bear resilience to climate change identified native fruit species (e.g., cherry, elder, alder buckthorn, strawberry tree, whitebeam, apple, and chestnut) and defined priority areas for planting. These findings were compiled in *“Combating the Effects of Climate Change on the Cantabrian Brown Bear by Preparing Actions to Improve Trophic*

Availability and Adaptation in Critical Areas”, co-authored by the FOP and researchers from the Universities of Extremadura, Cantabria, and Oviedo. In the 2023 grant call, the study expanded to nut-producing species (acorn, beech, hazelnut, and chestnut), key food sources for bears in hyperphagia. Results indicated a decline in the suitability of beech and Atlantic oak, while Mediterranean oaks and chestnuts appeared more resilient. Key habitats were identified where chestnuts could become a strategic autumn resource for bears. This research has been extended to the Pyrenees in this call, home to an estimated 83 bears, mainly in the Lleida Pyrenees.

In parallel, recent large wildfires have seriously threatened Spain’s biodiversity—particularly in the northwest Iberian Peninsula, which has the highest fire frequency and burnt area (nearly half of all fires in Spain between 2012 and 2022). Cantabrian bears rely on high-quality but highly flammable forested habitats. Rising temperatures and prolonged droughts are driving increasingly uncontrollable fires and extending risk periods. Despite Spain’s strong firefighting capacity, the urgent need for preventive management is clear. A key principle in the Strategic Guidelines for Wildfire Management in Spain, published by the Ministry and approved in 2022, is strategic planning to safeguard ecosystems, biodiversity, ecosystem services, and landscapes. These guidelines also aim to promote rural development and bioeconomy goals aligned with national and international strategies. They recognize wildfire management as a complex issue requiring coordinated action by multiple public and private actors, as well as active public participation. In this context, the FOP developed the study *“Proposals to Reduce Climate Change Impacts on the Brown Bear through Analysis of Wildfire Risk and Magnitude in Cantabrian Climate Scenarios and Their Effects on Bear Key Species”*, funded under the 2022 grant call. Based on its findings and aligned with the Ministry’s strategic guidelines, the current project was designed to support a wildfire prevention strategy in the Cantabrian Mountains. This strategy takes a participatory approach, involving experts, conservation organizations, local leaders, and committed social actors in protecting Cantabrian bear habitats.

Additionally, the project incorporated Integrated Watershed Management (IWM), or more broadly, Integrated Water Resource Management. Defined at the 1992 Rio Summit as “a process that promotes coordinated water, soil, and resource management to maximize equitable economic and social welfare without compromising ecosystem sustainability,” this approach is part of both European (Water Framework Directive) and Spanish planning instruments. While more common in large river basins, successful applications have been documented in small sub-basins, combining new technologies with local knowledge and stakeholder participation.

Recent studies confirm the importance of addressing both social and ecological needs, as well as the impacts of climate change. The current scientific review of IWM, coupled with technological and organizational innovations, led to the design of a pilot program for river sub-basin headwaters in bear areas. This program aims to identify conservation mechanisms and improve the condition of public water domains in high-value environmental zones. Through European and international knowledge exchange and direct local action, the project aims to close knowledge gaps, improve decision-making, and promote good practices, institutional coherence, and long-term management for the brown bear and other species of European interest that share its habitat.

2. OBJECTIVES

General objective:

To carry out scientific and technical research activities for the conservation of the brown bear and its habitats, mainly aimed at promoting peaceful coexistence between bears and human activities, as well as the mitigation and adaptation to the effects of climate change.

Specific objectives:

- O1. To analyse the concept of environmental information and the mechanisms for public participation in brown bear conservation, and to establish recommendations for improved management of access rights and citizen participation.
- O2. To expand knowledge on habituated or potentially conflictive bears in a European context in order to advance towards a Favourable Conservation Status of the species and promote coexistence with people and their activities.
- O3. To assess variability in the availability of nuts for bears in the Pyrenees during hyperphagia under different climate scenarios.
- O4. To contribute to strategic preventive management of forest fires in climate change scenarios in the Cantabrian Mountains.
- O5. To test the effectiveness of implementing an Integrated Watershed Management Programme in bear-populated sub-watersheds as a solution to improve the conservation of inland surface water resources (DPH – Dominio Público Hidráulico).

3. SUMMARY OF RESULTS

Objective 1

A1.1 The concept of environmental information and mechanisms for public participation in brown bear conservation. Analysis and recommendations.

The right of access to environmental information has become a key instrument of environmental democracy, enabling civil society to exercise effective oversight over the actions of public authorities and to participate in environmental protection. This right constitutes one of the fundamental pillars of contemporary Environmental Law. However, the fact that it is not subject to the demonstration of a legitimate interest—allowing any person to request the environmental information they need—makes it an extremely broad right, bringing with it potential risks and legal uncertainty. Moreover, the practical implementation of this right continues to face significant obstacles, such as the lack of transparency in certain public administrations, outdated environmental records, or the excessive invocation of grounds for

refusal. In light of the jurisprudence reviewed, it is considered beneficial to establish clear deadlines and sanctions for non-compliance with the obligation of proactive dissemination of environmental information. It also recommends the development of internal protocols within public administrations, the improvement of environmental information portals to ensure universal access and regular updates, and even the creation of a single national portal. Training public administration personnel in the application of the Aarhus Convention and relevant Spanish legislation is essential to avoid overly restrictive interpretations of the right of access. Additionally, implementing open and reusable data formats (open data) would facilitate citizen analysis and participation.

In short, access to environmental information is a cornerstone for environmental protection and citizen engagement, supported by legal frameworks such as the Aarhus Convention and Law 27/2006 in Spain. Nevertheless, persistent challenges remain, such as a lack of transparency and accessibility, highlighting that despite regulatory advances, practical implementation remains imperfect.

The report defines environmental information broadly, encompassing data on the state of the environment, affecting factors, and administrative measures, in accordance with Directive 2003/4/EC and Law 27/2006. In the context of biodiversity, it includes information about habitats and species such as the brown bear. The literature review reveals a lack of specific studies delineating this concept, suggesting a research gap that warrants greater legal-technical attention.

Public participation mechanisms in Spain—both at the national and regional levels—are analyzed, and tools such as citizen science and participatory modeling are explored. Although advisory bodies exist, their effectiveness is limited due to insufficient representativeness and a lack of functional clarity. International examples, such as Canada's GriZTracker program, are proposed as adaptable models for brown bear conservation, provided essential precautions are observed.

Five key recommendations are proposed to address the identified shortcomings and enhance public participation in brown bear and broader biodiversity conservation:

1. **Improve access to environmental information:** Propose setting concrete deadlines and sanctions for non-compliance with proactive disclosure obligations, improving environmental information portals, and training public administration staff in the Aarhus Convention and Spanish law.
2. **Strengthen participatory bodies:** Recommend reforming participation structures (such as advisory councils) to make them more representative, increasing civil society presence, and establishing clear criteria for appointing representatives.
3. **Promote environmental education and citizen science:** Recommend implementing educational programs and carefully designed citizen science projects to involve the public in conservation efforts, while avoiding risks to species such as the brown bear.

4. **Improve multi-level environmental governance:** Advocate for greater collaboration among government levels (national, regional, and local), NGOs, the private sector, and civil society in conservation projects.
5. **Continuously evaluate and adjust:** Propose establishing feedback mechanisms to evaluate and improve participatory processes on an ongoing basis.

The study was conducted by Carlos González-Antón and his legal team (Ecourban Consultores S.L.), consultant Alberto Navarro, and the Brown Bear Foundation (FOP).

Objective 2

A2.1 Capture, handling, and tagging with GPS transmitters of brown bear individuals located near villages or preying on livestock, with the aim of expanding and improving knowledge about extreme habituation processes and bear responses to aversive measures.

Between July 1, 2024 and June 30, 2025, a total of 24 cases have been recorded that generated public concern, related to bears located in or near towns and/or involving livestock depredation in the Asturian municipalities of Somiedo, Belmonte de Miranda, Proaza, Cangas del Narcea, Degaña, and Ibias. The incidents were primarily related to bears frequenting villages or hamlets to feed on fruit, with some cases involving apiaries or livestock feed, and repeated livestock attacks near populated areas. In all cases, the behavior of the animal was assessed, and the case was categorized based on the necessity and urgency of intervention. Of the total, 13 were non-conflictive alarm situations, and 11 required attention, although no cases of extreme habituation or food-conditioned bears were recorded. In 15 of the cases, the bear capture protocol using culvert traps was activated. As a result, five individual bears were captured and equipped with GPS-Iridium collars and/or GPS-GSM hair transmitters.

Additionally, a pilot trial was conducted to evaluate the effectiveness of light and sound deterrent systems in areas where local residents reported repeated bear presence, particularly around fruit trees near villages. Between 2024 and 2025, data were collected on 13 separate installations of cameras and light/sound deterrents. In 9 of these cases, the deterrent was used from the outset (Treatment group), while the remaining 4 were designated as Control sites (without deterrents). All events involved bears feeding on fruit trees in or near villages. In 4 out of the 9 Treatment cases, no bears were detected during the following week of monitoring. In contrast, in all 4 Control cases, bears were detected in the days following the initial report. In the Treatment group cases where bears were detected, 100% of the bears left the area, 20% returned on the same night, and 20% returned later that same week, resulting in a 40% probability of revisits to sites with deterrents. In none of the Treatment or Control areas was there evidence of daily bear visits throughout the monitoring period. Once a bear activated a deterrent, the frequency of visits decreased in the following days. Preliminary results, although requiring further data, suggest that even after the deterrent is removed, bears continue to show a lower daily visitation rate to the area where it had been installed. In 8 cases, a crossover design was successfully implemented: in Control areas, a deterrent was added (becoming Treatment),

and in Treatment areas, the deterrent was removed (becoming Control). In these, bears only visited the area in 3 cases. All visits, except for one, occurred at night.

The study was conducted by José Vicente López-Bao (Mixed Research Unit on Biodiversity – University of Oviedo – CSIC – Principality of Asturias), his research team, and the Brown Bear Foundation (FOP).

A2.2 Compilation of current legislation in EU Member States regarding the use of bear sprays, and literature review of experiences conducted over the past decade on their international effectiveness.

In the context of coexistence with large carnivores, wildlife managers have sought effective deterrent tools and techniques to use against bears. A bear deterrent is an aversive agent applied or used against bears to repel them or cause them the least possible pain or irritation for this purpose. However, given the sensitivity of today's Western society, ideally, the most effective techniques or elements are sought—those that do not cause irreversible or lethal harm to the animals.

This work concisely compiles and analyzes all real-world examples of bear spray use found in peer-reviewed scientific literature available up to May 2025. It also describes the results of trials conducted to assess the performance of bear sprays available on the market. Furthermore, the effects on humans, as reported in the reviewed literature, are detailed. The report also offers a series of recommendations and conclusions on the use of bear spray as a protection tool against bears, drawn from the analyzed studies. Additionally, results from a consultation with experts regarding aspects of its use in other European countries—particularly legal issues—are presented. To this end, the legislation in force in each country is also reviewed. Based on this analysis, a series of proposals are made for its legal use in Spain. Finally, due to increasing interest, the issue of bears being attracted to fruit trees in Europe is addressed, based on expert consultations.

Based on the available data, the success rate of bear spray use is >92%, higher than firearms. It is important to note that >98% of people carrying bear spray emerged uninjured—and in no cases were fatalities reported—after a close encounter with bears. In this regard, it is also important to highlight that no cases have been reported in which the use of bear spray caused a bear's death. Bear spray has proven effective even under harsh Arctic conditions, with only one case recorded where a crosswind of over 90 km/h nullified its effect. For the expert consultation, 30 individuals were selected, and 18 responses were obtained (60%), all of whom completed the questionnaire. Currently, bear spray is reportedly being used in 11 European countries where the species is present. However, an analysis of national legislation showed that it could potentially be used in 19 countries with brown bear presence (86.4%), while its use would not be permitted in 3 countries (Norway, Greece, and Italy). Generally, its regulation falls under firearms and ammunition legislation, where bear spray is classified as a non-lethal self-defense weapon that does not cause permanent harm, and is usable by adults.

Regarding the protection of fruit trees, based on responses from country-specific experts (n=17), the issue is considered a problem in 11 countries (64.7%), though of low importance in 4 of them (23.5%). Conversely, it is not considered a problem in 5 countries (29.4%), while its prevalence is unknown in one country. The main measures used to address the issue are electric fencing (6), followed by the use of dogs (3) and various forms of bear deterrents (3). The latter include electronic devices, fire, warning shots, and noise-making. Other measures mentioned include unspecified fencing (2) and simple walls (1). In one case, early fruit harvesting and tree cutting were mentioned. Regarding the perceived effectiveness of these measures, electric fencing was identified as effective by seven experts. Two measures were cited as highly effective: early fruit collection and tree removal. However, it was noted that both electric fencing and fruit collection may be impractical on a large scale, and tree cutting is highly unpopular due to emotional and cultural value.

Based on expert consultation and the review of regulations in European countries with brown bear presence, a primary conclusion is that current regulations are mainly focused on human self-defense. In fact, only one country—Finland—explicitly includes the use of bear spray against animals in its legislation. While the ideal way to regulate the acquisition, possession, use, and technical specifications of bear spray in the EU would be to include it in Directive (EU) 2021/555, this directive only applies to firearms and leaves the regulation of other weapons to individual Member States. Including bear spray in the directive would be the most effective approach, ensuring automatic and uniform application across the EU. Given the effectiveness of bear spray and the context of increasing bear populations and expansion, it is recommended that its use be regulated in Spain, where it is currently prohibited.

The study was conducted by José Vicente López-Bao (Mixed Research Unit on Biodiversity – University of Oviedo – CSIC – Principality of Asturias), the specialized legal consultancy team Ecourban Consultores S.L., and the Brown Bear Foundation (FOP).

A2.3. Assessment of social perception towards the brown bear in the Cantabrian Mountains in a context of population growth and expansion, and identification of potential areas where social perception has worsened in recent years.

In a context of population recovery and expansion, as currently experienced by the brown bear in the Cantabrian Mountains, maintaining a level of public acceptance toward the increasing presence of the species is key to ensuring its long-term conservation. This is particularly relevant in areas where such charismatic species as the brown bear have been absent or present at very low densities over the past decades, or in regions where bears are now being observed near or even within villages. In such a scenario, the possibility of bears and people coexisting in the same territory, the compatibility of the species with certain activities like livestock farming, or the idea that the bear is a dangerous animal, are issues that can arise repeatedly in public debates and the media, influencing how people perceive the idea of living alongside the species. Given the recent increase in human-bear interactions, it is necessary to gather information regularly over time to detect possible shifts in public perception toward the species. Monitoring changes in levels of acceptance at the local scale can help identify areas where negative perceptions may

have grown in recent years, allowing for targeted efforts such as specific communication campaigns or the reinforcement of preventive measures against bear-related damage or deterrence actions. This study assessed the social perception of the brown bear in the Cantabrian Mountains within a context of population growth and expansion, identifying potential areas where perception may have worsened in recent years. A total of 1,873 people from 155 different municipalities were interviewed. Current perceptions were compared with data from nearly 800 people interviewed in the late 2010s. Overall, the Cantabrian brown bear continues to be generally valued positively across its distribution range. However, there is evidence suggesting that this positive perception may be declining in recent times. Most respondents (51%) would prefer the population to remain at current levels. A number of municipalities were identified where there has been a notable change in the percentage of people who believe the presence of the bear is compatible with rural life, comparing data from the 2010s to the present day. The greatest concern among respondents regarding possible bear attacks centers on livestock. Therefore, the implementation of preventive measures to reduce bear access to various anthropogenic food sources is a key strategy to promote coexistence between bears and humans.

The study was conducted by José Vicente López-Bao (Mixed Research Unit on Biodiversity – University of Oviedo – CSIC – Principality of Asturias) and his research team, along with the Brown Bear Foundation (FOP).

Objective 3

A3.1. Assessment of the climate change adaptation capacity of the main nut-producing plant species in the Pyrenees and identification of areas where their availability will be limited under different climate scenarios, with the aim of guiding future conservation and nature restoration actions.

Climate change poses a significant threat to biodiversity and ecosystem functioning, particularly in mountainous areas such as the Pyrenees, where climatic and biogeographic variability influences forest structure and productivity, as well as wildlife distribution. One of the most relevant consequences for the brown bear is the alteration in the availability of nuts, a key resource for the species during hyperphagia, a stage in which it needs to accumulate energy reserves for hibernation and reproduction. The study area covers the entire Pyrenean mountain range, characterized by a strong altitudinal gradient and the coexistence of alpine, Atlantic, and Mediterranean regions, each with its own climate and vegetation. The main objective was to assess the impact of climate change on nut-producing species relevant to the brown bear's diet, analyze the functional complementarity among them, and identify vulnerable areas, proposing conservation strategies adapted to new environmental conditions. To achieve this, a georeferenced database of occurrences of eight nut-producing tree species was compiled using national forest inventories and international databases. Data were filtered to ensure spatial accuracy, and records from areas under human management were excluded. Relevant soil and climate variables were selected, and species distribution models (SDMs) were applied using the Random Forest algorithm, balancing presences and absences to avoid bias. Future habitat

suitability for the eight species was projected under different climate scenarios and time periods, integrating data from five global climate models and two socioeconomic pathways. Stacked Species Distribution Models (SSDMs) were built to estimate the richness of nut-producing species, and vulnerable areas were identified using a moving window analysis, taking into account the species' spatial ecology. Areas with fewer than two projected nut-producing species were defined as vulnerable. The results show that the availability of trophic resources for the brown bear is at risk due to climate change, highlighting the need to implement conservation strategies that ensure the future availability of nuts for the species.

The study was conducted by Pedro Álvarez-Álvarez (Department of Organisms and Systems Biology, University of Oviedo) and his research team, José Vicente López-Bao (Mixed Research Unit on Biodiversity – University of Oviedo – CSIC – Principality of Asturias), the team from the Consorci Centre de Ciència i Tecnologia Forestal de Catalunya, and the Brown Bear Foundation (FOP).

Objective 4

A4.1. Proposals for the prevention of forest fires in the Cantabrian Mountains developed through a participatory process involving society.

In the context of increasingly evident climate change and profound transformations in land use, the Cantabrian Mountains face a growing threat from wildfires. This report emerges as a response to this issue and presents the results of a participatory process that involved various social sectors in the development of prevention proposals, with a special focus on the Cantabrian range distribution area of the brown bear, which is highly vulnerable to these events.

The work was carried out through three workshops held in Pola de Somiedo (Asturias), Villablino (León), and Potes (Cantabria) in June 2025, with the participation of nearly one hundred people from diverse backgrounds: representatives of public administration and the primary sector, as well as professionals from conservation, hospitality, research, and active citizen groups. The sessions combined technical presentations on the new wildfire scenarios with group dynamics for diagnosis, reflection, and proposal, following a participatory action-research methodology.

Most participants acknowledged that wildfires are a real problem in their territories. In fact, over 70% reported having experienced a major wildfire in their surroundings in recent years. Although not all reported direct impacts on their daily lives, many shared experiences involving material losses, damage to landscapes and biodiversity, or a sense of insecurity and neglect. There was also an almost unanimous awareness that wildfires will become an even greater threat in the near future unless decisive action is taken.

Among the causes identified by participants were: arson, negligence, lack of forest management, and the progressive abandonment of rural areas. Participants also highlighted the historical use of fire as a land management tool for agriculture and livestock, suggesting that — if properly applied — it could be part of the solution.

Throughout the workshops, numerous proposals were generated and then grouped and prioritized by participants, resulting in a coherent set of strategies organized around three main lines of action:

1. Forest management and preventive planning: Participants emphasized the need to recover active land management, including clearing, prescribed burning, planned firebreaks, and strategic use of small livestock to manage vegetation. Together, these measures would help create so-called “mosaic landscapes”, which are more fire-resistant and can help slow wildfire spread. This section also included the importance of establishing clear regulations—such as minimum planting distances for fire-prone species—and supporting landowners in managing their properties.
2. Training, environmental education, and public awareness: Participants agreed that any prevention strategy must involve a deep and ongoing educational process, targeting both children and adults, and aimed at recovering traditional knowledge about the use of fire. There was also strong support for training local residents in basic self-protection techniques, promoting a culture of shared responsibility in wildfire prevention.
3. The structural challenge of rural depopulation: For many, the key to long-term wildfire prevention lies in reversing the abandonment of rural areas. This requires improving living conditions in rural settings: access to basic services, digital connectivity, housing, and job creation linked to land stewardship. In this sense, the report includes proposals aimed at developing new opportunities within a green and sustainable economy, such as silvopasture, ecotourism, or remote work, while respecting local identity and knowledge.

Cross-cutting the report are two key demands. First, the need to simplify bureaucracy, especially for small-scale producers and rural landowners, who currently face complex administrative procedures for basic land management activities and second, the call for decentralizing powers and providing greater technical and financial resources to municipalities and local councils, which best understand the terrain and are well-positioned to lead actions tailored to local realities.

The study was conducted by Virginia Carracedo (Department of Geography, Urbanism and Land Planning, University of Cantabria) and her research team, the cooperative "Altekio, iniciativas para la sostenibilidad", and the Brown Bear Foundation (FOP).

Objective 5

A4.1. Review of the evolution of the different Integrated Watershed Management (IWM) solutions and their application in designing a pilot program for the sub-watersheds in bear habitat areas.

The report addresses the evolution of Integrated Water Management (IWM) solutions and their application in designing a pilot program for the sub-watersheds in brown bear habitats. It highlights the importance of IWM since the Rio Summit in 1992, which promotes the

coordinated management of water, land, and related resources to maximize economic outcomes and social well-being without compromising the sustainability of ecosystems.

The methodology of the report includes a review of IWM strategies and methods in the scientific literature, an analysis of successful case studies in areas of high environmental value, and the design of pilot programs for the sub-watersheds in bear-inhabited zones. The report emphasizes the participation of diverse stakeholders, including user communities, local authorities, livestock farmers, fishers, businesses, and conservation organizations.

It also reviews theories and key documents calling for a reassessment of traditional water management models, stressing the need to abandon fragmented and sectorial approaches in water policies. The importance of an integrated methodology is underlined—one that regards water as a system intimately linked to economic development, water conservation, pollution control, flood prevention, and spatial planning.

Furthermore, the report analyzes international declarations in support of IWM, including the Dublin Statement on Water and Sustainable Development and Agenda 21, adopted at the 1992 Rio Conference. These documents emphasize the need to integrate water management with economic, social, and environmental protection goals.

In the European context, the report examines the Water Framework Directive, which adopted river basin management as the essential model and established principles such as integrated water resource management, full cost recovery, and public participation. The directive seeks to coordinate goals such as the protection of drinking water sources, bathing areas, valuable habitats, and aquatic ecosystems. However, its implementation has been slow and challenging.

The report also presents successful examples of public participation supported by IWM, such as river contracts and user/irrigator community associations. It analyzes the hydrographic demarcations of the Cantabrian Mountains and includes case studies in sub-watersheds such as Alto Sil, Alto Luna, and Alto Carrión.

Meetings were held with many stakeholders involved in these sub-watersheds to better understand the institutional landscape of user communities. Efforts were made to promote the creation of user community associations, though this was only achieved in the Alto Luna sub-watershed.

The study is currently producing conclusions and proposals for legislators, planners, and managers, as a significant institutional weakness has been identified in the organizations responsible for water management in the sub-watersheds of the Cantabrian valleys. This finding calls for decisive action from those responsible for water and environmental policy in Spain.

The study was conducted by Carlos González-Antón and his legal team (Ecourban Consultores S.L.), along with the Brown Bear Foundation (FOP).

4. CONCLUSIONS

The research carried out by the Brown Bear Foundation (FOP) within the framework of the grant program of the Ministry for the Ecological Transition and the Demographic Challenge has deepened the legal, ecological, and social study of brown bear conservation in Spain. It provides a comprehensive view of the main challenges and opportunities for ensuring a Favourable Conservation Status for the species. This work has been particularly significant due to its cross-cutting approach, integrating environmental law, citizen participation, climate change analysis, conflict management, and social perceptions related to this emblematic species.

One of the main achievements of this research has been the clarification of the concept of “environmental information” within the Spanish and international legal context, using the Aarhus Convention as a reference point. The report shows that, despite the formal recognition of the right to access environmental information and citizen participation, its practical application still faces significant shortcomings. These include administrative opacity, regulatory fragmentation, outdated records, and a lack of training among technical staff in this area. In response, concrete recommendations have been made to ensure more effective and transparent management, such as the creation of a unified national portal, the adoption of open data formats, training of public personnel, and the establishment of deadlines and penalties for administrative inaction.

Furthermore, the project has contributed significantly to applied knowledge on human-bear coexistence, in a context marked by the species’ population growth and expansion of its distribution range. The implementation of measures such as GPS tagging, the identification of individuals habituated to urban environments, and the testing of deterrent devices has demonstrated the effectiveness of certain preventive actions. These findings are crucial for developing rapid response strategies to risk situations and promoting harmonious coexistence between humans and wildlife.

Another key focus has been the assessment of social perception toward brown bears in rural areas. Although the overall perception remains positive, the research identified municipalities where acceptance has significantly declined. This shift may be linked to damage incidents, the increased presence of bears in humanized settings, or the lack of effective institutional communication strategies. In this regard, the study underscores the urgency of strengthening environmental education, enhancing awareness campaigns, and encouraging citizen participation in decisions that affect their territories.

The impacts of climate change on ecosystems and forest species crucial to the brown bear’s diet have also been rigorously analyzed. The research shows that, in the Pyrenees, the loss of suitable habitats for key species such as blueberries, oaks, and beeches poses a future risk to the bear’s survival. These findings reinforce the need for anticipatory ecological restoration strategies adapted to climate conditions, with a focus on areas that could serve as climate refugia. The report also calls for promoting multi-level environmental governance, enhancing coordination between administrations, scientists, NGOs, and local communities.

Lastly, the growing challenge of wildfires in the Cantabrian Mountains has been addressed from a participatory perspective. The involvement of local stakeholders in identifying causes and solutions has led to specific proposals such as the restoration of mosaic landscapes, promotion of silvopastoral systems, strategic use of fire, and streamlining of bureaucratic procedures for small landowners. These actions not only strengthen resilience to fire, but also support sustainable development and the revitalization of rural areas, helping to curb depopulation and ensure the continuity of livelihoods compatible with biodiversity conservation.