

People's perception of the brown bear reintroduction in the Spanish Pyrenees

Percepción pública sobre la reintroducción del oso pardo en el Pirineo español

Nuria Cases^{1*}, João Carvalho², Rita Tinoco-Torres², Nuno Negrões^{2,3}, Eduardo Ferreira², Carles Conejero¹, Roser Velarde¹, Santiago Lavín¹ & Emmanuel Serrano¹

1. Wildlife Ecology and Health Group (WE&H) and Servei d'Ecopatologia de Fauna Salvatge (SEFaS), Departament de Medicina i Cirurgia Animals, Universitat Autònoma de Barcelona, 08913 Bellaterra, Barcelona, Spain.
2. Departamento de Biología & CESAM, Universidade de Aveiro, Campus de Santiago, 3810-193, Aveiro, Portugal.
3. ACEAA-Conservación Amazónica, La Paz, Bolivia.

*Corresponding author: edelweiss004@gmail.com

Abstract

The brown bear (*Ursus arctos*) was reintroduced in the Pyrenees during the '90s. The bear population has increased in number and distribution, fostering human-wildlife conflicts in areas where the species was absent for more than a century. We analysed 236 questionnaires about people's perception toward the bear reintroduction in the Spanish Pyrenees, as well as the role of public administration in managing the damages caused by bears using regression trees. Our tree models explained 85% of the observed variability of people's perceptions being the main drivers of perception whether people consider brown bears to be overabundant, whether these mammals attract nature tourism, if bears represent a danger for humans and finally if the local administration compensates for brown bear damages. We conclude that local administration should create the appropriate social atmosphere for the coexistence of humans and brown bears through information and risk prevention campaigns, compensation of damages, and promoting the public valorisation of the species. These efforts to mitigate human-bear conflicts may promote a positive perception of local people towards this emblematic mammal.

Keywords Human-wildlife conflicts, large carnivores, public perception, species reintroductions, *Ursus arctos*.

Resumen

El oso pardo (*Ursus arctos*) fue reintroducido en el Pirineo durante la década de 1990. La población de osos del Pirineo ha ido aumentando tanto en número como en distribución, favoreciendo los conflictos entre humanos y osos en áreas donde la especie desapareció hace más de un siglo. En este trabajo analizamos 236 cuestionarios sobre la percepción de la gente hacia la reintroducción del oso, así como el papel de la administración pública en la gestión de los daños causados por la especie, utilizando la técnica de árboles de regresión. Nuestros modelos explicaron el 85% de la variabilidad observada en la percepción de las personas hacia el oso, siendo las principales cuestiones que condicionan la percepción si las personas consideran que los osos pardos son sobreabundantes, si estos mamíferos atraen al turismo de naturaleza, si los osos son peligrosos y, finalmente, si la administración local compensa por daños causados por los osos. La administración local debería crear un ambiente social adecuado para la convivencia entre humanos y los osos mediante campañas de información y prevención de riesgos, compensación de daños, y promoviendo la valorización de la especie. Estos esfuerzos para mitigar los conflictos entre humanos y osos pueden suscitar una percepción positiva de la población local hacia este mamífero emblemático.

Palabras clave: Conflictos con la fauna, grandes carnívoros, percepción social, reintroducción de especies, *Ursus arctos*.

Introduction

The brown bear (*Ursus arctos*) population of the Spanish Pyrenees is among the smallest and most threatened brown bear populations in Europe (Kaczensky *et al.* 2013). In 1995, after decades of human persecution, only five individuals remained in two valleys of the Western Pyrenees (Piédallu *et al.* 2019). To avoid the local extinction of brown bears, eleven individuals from the Balkans (Slovenia) were successfully reintroduced: two females and one male in 1995-1996 (Quenette *et al.* 2001), four females and one male in 2006, one male in 2016, and two females in 2018 (Quenette *et al.* 2019). These reintroductions were major stepping stones for the brown bear population increase, allowing the return of this species to areas where they had been extirpated. In 2021, it was estimated that a minimum of 70 individuals were established in the central Pyrenees (Vanpé *et al.* 2022). However, the return of the brown bear did not come without a social cost. Impacts on sheep husbandry and beehive depredation, for instance, have created social and political conflicts among the local population (Palazón 2017), which can jeopardize all the efforts made so far. Human perceptions and attitudes are key factors for guaranteeing the successful coexistence between human populations and large carnivores, especially in areas where these species were reintroduced after decades of absence (Grossmann *et al.* 2020). On a local scale, conservation success relies on the willingness of people living and working in the proximity of wildlife and accept the pros and cons underlying the presence of large carnivores (Marchini & Macdonald 2012). The fate of the reintroduced brown bear population in the Pyrenees is hence tightly linked to residents' perceptions, attitudes and tolerance, but also to the willingness of competent authorities (e.g., public administration) and organizations (e.g., academia, non-governmental organizations) to participate in the mitigation of human-brown bear conflicts.

Here, using face-to-face interviews, we evaluated people's perceptions of the brown bear population and the role of the local administration in managing the potential damages caused by the species. Since human perceptions of wildlife are partially driven by previous experiences (Conejero *et al.* 2019), we hypothesize that resident perceptions toward brown bears will rely on the emotional and economic rewards that people have garnered from wildlife nature tourism and the local administration.

Material and methods

Our study was conducted in the Pallars Sobirà region, a mountain rural community of 1,377 km² in northern Lleida, Catalonia, Spain (Fig. 1). According to the Statistical Institute of Catalonia, approximately 70% of this territory is protected and human density is low (5 inhabitants/km²). Our survey was oriented to assess the people's knowledge and perceptions regarding i) the brown bear population and reintroduction; ii) the impact of brown bears on human activities, especially livestock and tourism and iii) the work and capacity of local administration to manage human-bear conflicts (see table S1 and table S2 in supplementary material). People were directly interviewed between July 2018 and April 2019 by the same person (NC). All questions included a free comment section for additional details. Then, we used regression trees (RT) to assess the relationship between participant characteristics and their perceptions toward brown bear reintroduction and their perception of the actions carried out by local administrations to compensate for the damages caused by bears. The average perception score was used as a response variable in our recursive partitioning procedure. Tree-based models are a flexible and robust analytical method perfect for dealing with nonlinear relationships and high-order interactions among predictors (Carvalho *et al.* 2018). Cross-validation to get the final tree with the lowest validation error was performed and explanatory variables were ranked in decreasing value of importance using the variable importance criterion (VI). RT models were implemented in the "rpart" package version 4.1-15 (Therneau *et al.* 2019) of the statistical R software version 4.3.2 (R Core Team 2023).

Results

We collected 236 questionnaires (87.3% from local people and 12.7% from non-residents). All interviewees were adults (80% over thirty) and the sex ratio was 1:1. Our RT model aimed at evaluating people's knowledge and perceptions towards brown bear reintroduction explained 85% of the variability of the perceptions. The main variables characterising people's perceptions towards the brown bear were (in decreasing order of importance): whether people consider brown bears abundant, if brown bear enhances tourism activity,

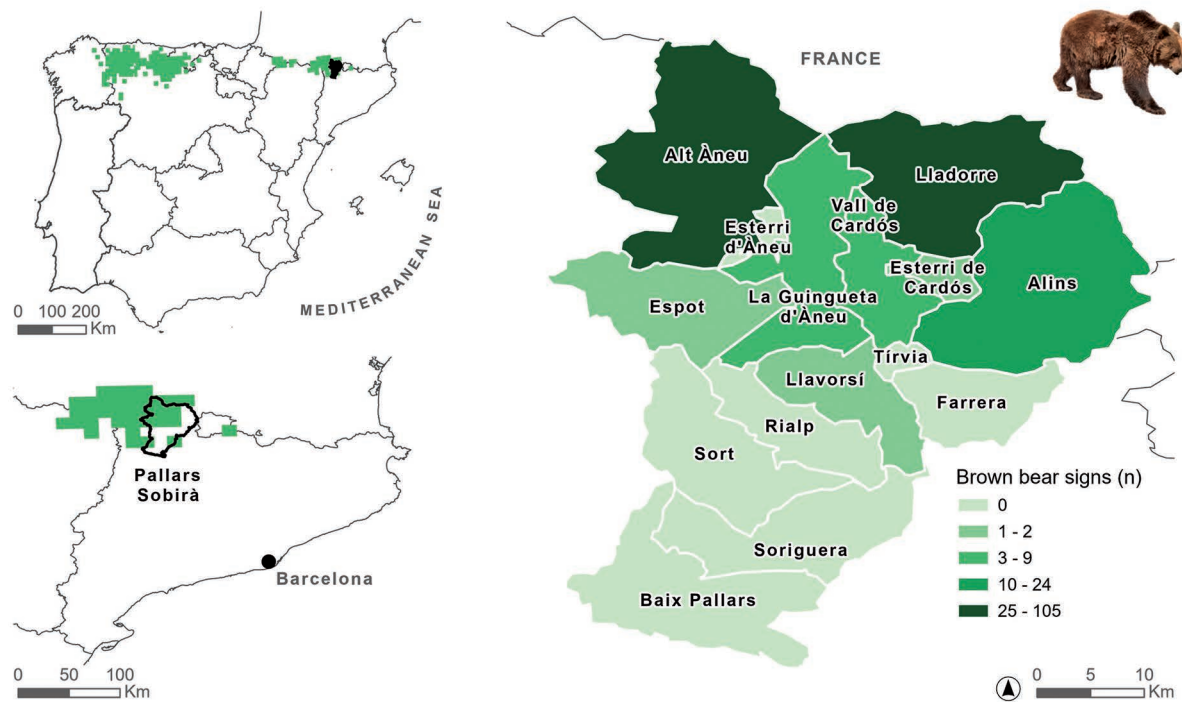


Figure 1. Location of the study area (Pallars Sobirà county, NE Spain) with an indication of the number of brown bear signs (footprints, scats, camera trapping, direct observations, $n = 237$) per municipality ($n = 15$), reported by the Parc Natural de l'Alt Pirineu in 2020. The upper left and lower left maps depict the brown bear distribution (*Atlas y Libro Rojo de los Mamíferos Terrestres de España*) in Spain and Catalonia, respectively.

if brown bears are dangerous for humans, and, finally, if the authorities compensate for brown bear damages. The perception scores ranged from -3.8 (very negative) to 4.4 (very positive). People who think brown bears are overabundant and negative for local tourism have a negative perception towards the species (perception score = -3.8). On the contrary, people who think brown bears are rare and inoffensive for people got high positive values in the perception score (perception score = 4.4). Finally, people thought brown bears posed a risk to human interests, but the local administration compensates for the potential damages and also had a positive perception (perception score = 3.6). The positive perception toward brown bears decreases when people think that the local administration does not compensate for damages (perception score 1.2). Considering the public perception towards the administrative actions to compensate for the damages caused by the brown bear, our RT model explained 75% of the variability of the perceptions. People who perceive that local administration helps farmers protect livestock from brown bear attacks had a more positive perception toward the efforts of local administration to deal with the potential damages caused by bears (perception score = 12).

Discussion

In recent years, it has been widely acknowledged that human perceptions and attitudes towards large carnivores, like brown bears, play a central role in the conservation of these species (Treves & Karanth 2003, Carter *et al.* 2012). The general results are promising as different studies throughout Europe have shown that people generally have a positive perception and attitude towards brown bear presence (*e.g.*, Slovenia, Kaczensky *et al.* 2004; Italy, Glikman *et al.* 2019; Romania, Dorresteijn *et al.* 2014). Yet, a study in the French Pyrenees highlighted that public attitudes may vary regionally. The authors showed that people born outside the Pyrenees have a more positive attitude to the presence of species (Piédallu *et al.* 2016). On the other hand, Glikman *et al.* (2019), suggested that greater exposure of the local population to the brown bear results in less fear of a potential encounter. These results demonstrated that the local history of coexistence, and the cultural, social, and political nuances of a region drive human-brown bear relationships. Our study revealed that human perceptions, and probably further attitudes, regarding brown bear reintroduction in the Pyrenees, are partially driven

by the proactivity of local administration to deal with human-brown bear conflicts. Public opinion about the role of local administration relies on the importance of aiding and economic support to mitigate and/or compensate for potential damages caused by the brown bear in different human activities. The importance of local administration and management policies for the conservation of large carnivores was previously demonstrated. For instance, in Croatia, Maji *et al.* (2011) suggested that more centralized bear management deteriorates public attitudes regarding bear presence. The adoption of effective management policies based on the local context is therefore key for the conservation of large carnivore populations, even in highly modified and human-populated regions (Linnell *et al.* 2001). The lack of information is also considered a problem as local people show a considerable lack of knowledge regarding the brown bear population. For example, nearly half of the interviewed people (108 of 236), think that bears are overabundant and dangerous for humans, even considering that only 76 brown bears are currently established in the Central Pyrenees (only 38 in Catalunya, Generalitat de Catalunya, 2023), and no attacks have been recorded to date. However, land abandonment exacerbated by climate change has led to increased woody plant encroachment of mountain grasslands in the Pyrenees (Gartzia *et al.* 2014). This process reduces the meadows for livestock (Espunyes *et al.* 2019) increasing livestock aggregation and the likelihood of bear encounters. In this scenario, the dialogue among stakeholders, conservationists, and social scientists is thus crucial to prevent the expected increase of human-bear conflicts. Local administrations in charge of nature protection should create the appropriate social atmosphere for the coexistence of humans and brown bears increasing education or information campaigns, compensation of damages, risk prevention campaigns and the public valorisation of the species.

For example, it was suggested that the adoption of communication campaigns coupled with learning programs targeting increased understanding of brown bear ecology, behaviour and benefits will help to increase acceptance of brown bear population (Glikman *et al.* 2019). Our work was partially focused on the people's perceptions towards the role of public administration, however, we do not neglect the utmost importance of non-governmental organizations to support the conservation of brown bears through research and public awareness.

Although some proposed solutions often consider the spatial segregation of human activities and wildlife or the economic compensation of local populations, our study also suggests that a proactive and non-coercive position of public administration may produce better social outcomes. The active involvement of the local population and the promotion of synergies between stakeholders is vital to guarantee the success of brown bear conservation and management in the Spanish Pyrenees. Bearing in mind that human perception and attitudes toward large carnivores may vary locally, the identification of human-brown bear conflict hotspots (*e.g.*, honey production, livestock depredation, damages in orchards) and the implementation of communication campaigns are welcome steps to prioritize mitigation efforts on a local or regional scale and to properly allocate conservation and management budgets.

Acknowledgements

We would like to express our gratitude to the Generalitat de Catalunya, rural agents and people who support and participate in this work. J. Carvalho and R. T. Torres are supported by a research contract (CEECIND/01428/2018 and 2021.00690.CEECIND, respectively) from the Fundação para a Ciência e a Tecnologia (FCT). E. Ferreira is funded by national funds (OE) through FCT in the scope of the Decree-Law 57/2016, of August 29. We acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020), through national funds.

References

- Carter N.H., Riley S.J. & Liu J. 2012. Utility of a psychological framework for carnivore conservation. *Oryx*, 46 (4): 525-535. DOI:10.1017/S0030605312000245
- Carvalho J., Santos J.P.V., Torres R.T., Santarém F. & Fonseca C. 2018. Tree-based methods: concepts, uses and limitations under the framework of resource selection models. *Journal of Environmental Informatics*, 32: 112-124. DOI: 10.3808/jei.201600352
- Conejero C., Castillo-Contreras R., González-Crespo C., Serrano E., Mentaberre G., Lavín S. & López-Olvera J.R. 2019. Past experiences drive citizen perception of wild boar in urban areas. *Mammalian Biology*, 96: 68-72. DOI: 10.1016/j.mambio.2019.04.002
- Dorresteijn I., Hanspach J., Kecskés A., Latková H., Mezey Z., Sugár S. ... & Fischer J. 2014. Human-carnivore coexistence in a traditional rural landscape. *Landscape Ecology*, 29: 1145-1155. DOI: 10.1007/s10980-014-0048-5

- Espunyes J., Lurgi M., Büntgen U., Bartolomé J., Calleja J.A., Gálvez-Cerón A. ... & Serrano E. 2019. Different effects of alpine woody plant expansion on domestic and wild ungulates. *Global Change Biology*, 25: 1808-1819. DOI: [10.1111/gcb.14587](https://doi.org/10.1111/gcb.14587)
- Gartzia M., Alados C.L. & Pérez-Cabello F. 2014. Assessment of the effects of biophysical and anthropogenic factors on woody plant encroachment in dense and sparse mountain grasslands based on remote sensing data. *Progress in Physical Geography: Earth and Environment*, 38 (2): 201-217.
- Glikman J.A., Ciucci P., Marino A., Davis E.O., Bath A.J. & Boitani L. 2019. Local attitudes toward Apennine brown bears: Insights for conservation issues. *Conservation Science and Practice*, 1: e25. DOI: [10.1111/csp2.25](https://doi.org/10.1111/csp2.25)
- Grossmann C.M., Patkó L., Ortseifen D., Kimmig E., Cattoen E.M. & Schraml U. 2020. Human-large carnivores co-existence in Europe - A comparative stakeholder network analysis. *Frontiers in Ecology and Evolution*, 8: 1-18. DOI: [10.3389/fevo.2020.00266](https://doi.org/10.3389/fevo.2020.00266)
- Linnell J.D.C., Swenson J.E. & Andersen R. 2001. Predators and people: Conservation of large carnivores is possible at high human densities if management policy is favourable. *Animal Conservation*, 4: 345-349. DOI: [10.1017/S1367943001001408](https://doi.org/10.1017/S1367943001001408)
- Kaczensky P., Blazic M. & Gossow H. 2004. Public attitudes towards brown bears (*Ursus arctos*) in Slovenia. *Biological Conservation*, 118: 661-674. DOI: [10.1016/j.biocon.2003.10.015](https://doi.org/10.1016/j.biocon.2003.10.015)
- Kaczensky P., Chapron G., von Arx M., Huber D., André H. & Linnell J. 2013. *Status, management and distribution of large carnivores - bear, lynx, wolf & wolverine - in Europe*. IUCN/SSC Large Carnivore Initiative for Europe.
- Marchini S. & Macdonald D.W. 2012. Predicting ranchers' intention to kill jaguars: Case studies in Amazonia and Pantanal. *Biological Conservation*, 147: 213-221. DOI: [10.1016/j.biocon.2012.01.002](https://doi.org/10.1016/j.biocon.2012.01.002)
- Majic A., Bodonia A.M.T., Huber D. & Bunnefeld N. 2011. Dynamics of public attitudes toward bears and the role of bear hunting in Croatia. *Biological Conservation*, 144: 3018-3027. DOI: [10.1016/j.biocon.2011.09.005](https://doi.org/10.1016/j.biocon.2011.09.005)
- Palazón S. 2017. The Importance of Reintroducing Large Carnivores: The Brown Bear in the Pyrenees. Pp. 231-249. In: J. Catalan, J.M. Ninot & M.M. Aniz (eds). *High Mountain Conservation in a Changing World*. Springer International Publishing, Cham.
- Piédallu B., Quenette P.Y., Bombillon N., Gastineau A., Miquel C. & Gimenez O. 2019. Determinants and patterns of habitat use by the brown bear *Ursus arctos* in the French Pyrenees were revealed by occupancy modelling. *Oryx*, 53: 334-343. DOI: [10.1017/S0030605317000321](https://doi.org/10.1017/S0030605317000321)
- Piédallu B., Quenette P.Y., Mounet C., Lescureux N., Borelli-Massines M., Dubarry E. ... & Gimenez O. 2016. Spatial variation in public attitudes towards brown bears in the French Pyrenees. *Biological Conservation*, 197: 90-97. DOI: [10.1016/j.biocon.2016.02.027](https://doi.org/10.1016/j.biocon.2016.02.027)
- Quenette P.Y., Alonso M., Chairon L., Cluzel E., Dubarry D. & Dubreuil S. 2001. Preliminary results of the first transplantation of brown bears in the French Pyrenees. *Ursus*, 12: 115-120.
- Quenette P.Y., Jonozovic M., Marinsic A., Camarra J.J., Guinot-Ghestem M., Sentilles J. ... & Alban N. 2019. First translocation of females in the French Western Pyrenees: a new step in the long process of brown bear restoration in the Pyrenees Mountains. *International Bear News*, 28, 11-13.
- R Core Team, 2023. *R: A language and environment for statistical computing*. R Foundation for Statistical Computing.
- Therneau T., Atkinson B. & Ripley B. 2019. *Rpart: Recursive partitioning for classification, regression and survival trees*. CRAN R Package, version 4.1-15.
- Treves A. & Karanth U. 2003. Human-Carnivore Conflict and Perspectives on Carnivore Management Worldwide. *Conservation Biology*, 17 (6): 1491-1499.
- Vanpé C., Piédallu B., Quenette P.-Y., Sentilles J., Queney G., Palazón S. ... & Gimenez O. 2022. Estimating abundance of a recovering transboundary brown bear population with capture-recapture models. *Peer Community Journal*, 2: e71. DOI: [10.24072/pcjournal.199](https://doi.org/10.24072/pcjournal.199)

Submitted: 9 November 2023

Accepted: 8 January 2024

Associate editor was J. María López-Martín

Supplementary information: The online version contains supplementary material available at <https://doi.org/10.7325/Galemys.2024.A1>