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Spatial variation in public attitudes towards brown bears in the French Pyrenees

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ABSTRACT

Human dimension is an important component of large carnivore management and conservation. Here, we focus on the human-wildlife conflict related to depredation of livestock by Pyrenean brown bears (*Ursus arctos*), despite the population being among the smallest in the world. Two reintroductions were performed in the past to ensure the survival of the population, yet its conservation status remains critical due to small size, heavy inbreeding and disagreements over its management. We investigated the often-neglected spatial variations in attitude towards predator presence to improve our understanding of the human dimensions surrounding this conflict. We used a questionnaire to assess the drivers explaining the attitude of the local human population ($n = 577$) of the Pyrenees towards bear presence. Our results show that spatial variables (place of birth and county of residence of the respondent) are strong predictors of attitude. The residents of two counties in particular (Haute-Garonne and Pyrénées-Atlantiques) displayed a positive attitude, while the residents of the Hautes-Pyrénées county had the most negative attitude. People born outside of the Pyrenees also showed a more positive inclination towards bear presence than people born and raised in France's southwestern mountain range. Both these results may imply a link between the history of local communities with predator presence and their current attitude. Accounting for small-scale spatial heterogeneity in social–ecological studies of human-wildlife conflicts will prove useful to get a more accurate mapping of attitudes and inform subsequent management decisions.

1. Introduction

Human dimensions play an essential role in the management and conservation of large carnivores (Treves and Karanth, 2003; Dressel et al., 2015). Focusing exclusively on the biological aspects of conservation may lead to persistent conflict (Redpath et al., 2013), marked by a lack of agreement and unilateral solutions, if any. Therefore, knowing the attitudes of local human populations is an essential step in the management of human-wildlife conflicts (Redpath et al., 2013).

The local attitudes towards wildlife populations are typically investigated using sociocultural parameters, such as gender (Bath et al., 2008; Gore and Kahler, 2012), age (Majić and Bath, 2010), scientific knowledge of the species' ecology (Kaczensky et al., 2004; Thornton and Quinn, 2009; Glikman et al., 2012), participation in activities related to wildlife (Bath et al., 2008; Majić et al., 2011; Gangaas et al., 2013) and involvement in farming/ranching (Kaczensky et al., 2004; Sponarski et al., 2013). However, the geographic location of the residence is rarely considered, except at very large spatial scales such as entire regions (Kaczensky et al., 2004; Majić and Bath, 2010) or countries (Gangaas et al., 2013). Smaller-scale spatial variations in attitudes within rural areas remain largely unexplored (Sponarski et al., 2013) despite their potential to improve our understanding of the sociological component of human-wildlife conflict. First, working at small-scale helps circumventing the risk of flawed inference if spatial variations are ignored as it is equivalent to consider the mean value of all attitudes – a statistic known to be highly sensitive to extreme values (van Belle et al., 2004) – which might lead to people holding very strong opinions in one way or another driving the population value. Second, increased spatial resolution in the assessment of attitudes allows for greater latitude through targeted conflict management and locally adapted solutions.

Here, we focused on brown bears (*Ursus arctos*) in the Pyrenees as a case study. Brown bear populations in Europe, like other large carnivores, exhibit a global increase in abundance and range expansion during the last twenty to thirty years (Chapron et al., 2014). However, the Pyrenean population, located on the border between Southwestern France and Northeastern Spain, remains among the smallest in Europe. After nearly going extinct in 1995 with 5 individuals remaining in two valleys of the Western Pyrenees, two reintroduction sessions with brown bears coming from Slovenia in 1996–1997 (one male, two females) and 2006 (one male, four females) led to a current population size of about 30 individuals. The reintroductions also led to the return of brown bears in geographical areas where they had disappeared for

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decades in Central Pyrenees, to form the Central-Eastern population core, while the Western population core kept declining and is currently functionally extinct with two males and no females. Based on demographic analyses, it was suggested that the Pyrenean bear population should be reinforced via reintroductions to ensure its viability (Chapron et al., 2009). The management of the population, however, is made complex by the various spatial scales involved (ranging from the country level to very small municipalities) and the different political situations and changing local actors from one area to another (Benhammou, 2007). The bulk of the bear population on the French side is located in Ariège where according to Benhammou (2007) stakeholders tend to oppose to its presence. Most reintroductions occurred in the neighboring county of Haute-Garonne in which a few local actors were advocating for an increase in the bear population. Political context combined with depredation of sheep (127 attacks and 178 animals killed in 2014, Camarra et al., 2015) and local distrust of scientific data on the Pyrenean bear hamper decision-making in bear management (Mermet and Benhammou, 2005).

In recent years, various quantitative studies of the attitudes of local populations towards bears in potentially conflictual areas have been performed in different European countries, with some results showing positive attitudes such as in Slovenia (Kaczensky et al., 2004), Italy (Glikman et al., 2012) or Romania (Dorresteijn et al., 2014), while some other results pointed to negative attitudes towards bear presence such as in Croatia (Majić et al., 2011). In France, according to Mermet (1998), the conflict surrounding bears primarily pits environmentalists willing to augment the bear population against livestock breeders viewing bears as dangerous predators — mostly upon sheep. Bears in the Pyrenees are strictly protected by the National (France, 1976, Loi No. 76-629 du 19 Juillet 1976 relative à la protection de la nature) and European (European Union, 1992, Annexes II and IV) laws, and management which includes compensation for livestock losses if signs of predation on the carcass can be attributed to the bear by an agent of the National Game and Wildlife Agency (ONCFS). Only one qualitative assessment of attitudes (conducted through interviews with selected stakeholders) towards bears in the Pyrenees was carried out almost 10 years ago (Benhammou, 2007), and described the complex politics surrounding bear presence in several distinct areas that displayed varying histories and attitudes regarding bear conservation. Quantitative studies of attitudes of local residents have yet to be performed, with the aim of encompassing a larger sample of the Pyrenean population and describing their attitudes through a statistical analysis as well as mapping of the attitudes towards bear presence.

By controlling for a large variety of variables whose effect on attitudes has previously been documented (such as age or scientific knowledge of the bear ecology), we aim to investigate spatial heterogeneity in the attitude of local populations towards bear presence in the Pyrenees. We hypothesize that the recent history of the Pyrenean areas with bear presence (since 1996 and the first reintroductions) could influence the attitudes of its residents even at a small scale, and that the place of birth could also influence the attitudes of the local populations, with people born in the Pyrenees exhibiting more reserved attitudes towards bear presence after being directly or indirectly confronted with depredation or conflicts involving bears (Ericsson and Heberlein, 2003).

2. Methods

2.1. Study area

We performed the study on the French side of the Pyrenees mountains that form the border between Southwestern France, Northeastern Spain and Andorra (Fig. 1). We considered as a target for the survey the 387 municipalities (in 6 Pyrenean counties) where bear presence had been confirmed between 2008 and 2013 by the ONCFS. These six counties are characterized by different past and present histories with bear presence. Pyrénées-Atlantiques (PA) always had bears, and the remaining five bears in 1995 lived in the valleys of Aspe and Ossau, south of Oloron-Sainte-Marie, and the valleys of Isaba (Navarre), Hecho and Anso (Aragon). One bear currently lives in this county. In contrast, in the Hautes-Pyrénées (HP), bears only returned in the 2000s, with one bear entering in 2001, another one settling in 2006 and remaining there ever since, and one female being reintroduced in 2006 and died in 2007. While most reintroductions were performed in Haute-Garonne (HG) from 1996 onwards, the bulk of the population in the Central Pyrenees currently resides in Ariège (AR). In both counties, previous bear observations were made in the 1970s. There has been on-and-off bear presence in Aude (AU) and the Pyrénées-Orientales (PO) between 2000 and 2011, with the most recent observations in 2011 and 2010, respectively.

The 387 municipalities were classified by postcode, and we selected 36 of these postcodes as targets for the survey. All of the postcodes that included municipalities with permanent bear presence (tracks found in three or more years between 2008 and 2013) were included along with those with the largest number of municipalities with occasional bear presence (one or two years between 2008 and 2013). One postcode was specifically added to include the urban area of Lourdes in HP. This addition was performed because PA included an urban area in the foothills in the mountains (Oloron-Sainte-Marie), hence allowing comparison of the two Western counties because the demographic compositions of their human population samples were similar. Postcodes were split between Rural and Urban ones for AR, HG, PA and HP (Table A.1) — an urban postcode being defined as including at least one municipality with more than 2500 inhabitants according to the National Institute of Statistics and Economical Studies (INSEE). Although oversimplified, this definition of rural and urban areas ensured that both rural and urban areas were targeted during the survey, even though almost all municipalities on which signs of bear presence had been found were rural (375 out of 387, 96.9%).

2.2. Sampling and data collection

The 3000 questionnaires were split between Rural and Urban postcodes for four of the six counties (Table A.1). In total, 1200 questionnaires were sent in the Western population core area (PA, HP) and 1800 in the Central-Eastern population core area (HG, AR, AU, PO) to reflect the smaller size of the Western population core. We sent more questionnaires in AR than in HG due to AR containing the largest part of the bear population, and bear presence being identified in 169 municipalities versus 48 municipalities in HG. Fewer questionnaires were sent in AU and PO that have no current bear presence.

Within these postcodes, we performed a random sampling without targeting any gender, age or social class. We used χ^2 tests of independence to assess whether there was a bias in the return rate in some counties, or according to gender and age, by comparing our sample to the Pyrenean population (INSEE, 2014). The mail questionnaires were sent in June 2014, with answers registered until September 2014.

Besides mail questionnaires that targeted the general public, we performed interviews in order to obtain a large enough sample of livestock breeders filling in the questionnaire by traveling in the areas of interest. Even though livestock breeders were the ones that were mostly targeted, we also received answers from hunters, beekeepers, tourism professionals or other members of the public showing an interest in the questionnaire. The field survey was performed over one month in June 2014 using snowball sampling (asking each respondent for possible acquaintances that may be interested in the survey, Dillman et al., 2014) by traveling in the Pyrenees and mostly meeting local livestock breeders, along with occasional members of the general public that did not breed livestock and either showed an interest in the conflict, or whose activity could be linked to bear presence, such as tourism or hunting.