Biological Conservation 207 (2017) 17–26

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/bioc

Wolf predation on cattle in Portugal: Assessing the effects of husbandry systems

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ARTICLE INFO

Article history:
Received 9 June 2016
Received in revised form 15 December 2016
Accepted 12 January 2017
Available online 25 January 2017

Keywords:
Livestock predation
Farming systems
Damage compensation
Large carnivores
Cattle
Portugal

ABSTRACT

Mitigating conflicts associated with predation on livestock is essential for conserving large carnivores in human dominated landscapes. This is generally addressed by targeting at individual management practices affecting predation risk, often disregarding that different livestock husbandry systems (i.e., groups of farms sharing similar resource bases, production patterns and management practices) with different vulnerabilities to predation may coexist within predator ranges, each of which requiring tailored prescriptions to reduce predation. Here we evaluated the importance of considering both husbandry systems and individual management practices to mitigate conflicts due to cattle predation by wolves in Portugal, where attacks on cattle increased >3 times in 1999–2013. Government records from 2012 to 2013 indicated that only <2% of cattle farms suffered wolf attacks, of which <4% had >10 attacks per year. We found that attacks were concentrated in the free-ranging husbandry system, which was characterized by multi-owner herds, largely grazing communal land far from shelter, and seldom confined. Protecting these herds at night in winter was the most important factor reducing wolf attacks, which could be achieved by changing practices of ≈25% of farmers in this system. Attacks were much lower in the semi-confined system, probably because herds grazed pastures closer to shelter, and they were often confined with fences or in barns. Farms bringing calves <3 months old to pastures were associated with about 90% of attacks, but changing this practice would involve ≈50% of farmers in this system. Our results underline the importance of identifying livestock husbandry systems and to adjust mitigation strategies to each system.

1. Introduction

Livestock predation by large carnivores is one of the main causes of human-wildlife conflicts worldwide (Treves and Karanth, 2003; Treves and Bruskotter, 2014). Therefore, the effective management of conflicts is key to the conservation of large carnivores, since people perceiving economic risks from wildlife can severely hinder conservation efforts (Treves and Karanth, 2003). Although there is growing evidence that coexistence between large carnivores and humans is possible, there is still considerable uncertainty on the most effective policies and management strategies to mitigate conflicts and thus to promote such coexistence (Linnell et al., 2001; Chapron et al., 2014).

The wolf (*Canis lupus*) is often involved in major human-wildlife conflicts due to predation on livestock (e.g. Treves et al., 2004; Gazzola et al., 2008; Iliopoulos et al., 2009; Li et al., 2013). As a consequence, there is considerable controversy over wolf conservation, particularly in landscapes where extensive livestock production is an important economic activity, and thus wolves are often legally controlled or illegally killed (Treves et al., 2004; Woodroffe and Redpath, 2015). The problem has exacerbated in recent years, in part because successful wolf conservation over the last decades has allowed its geographic expansion and thus increased the contact between wolves and livestock (Breck and Meier, 2004; Chapron et al., 2014). In this context, predation on cattle is of particular concern, given its high socio-economic value (Iliopoulos et al., 2009). Furthermore, there is widespread extensive cattle rearing, virtually without vigilance and protection measures, in areas were the wolf has been absent for a long time and is recently recolonizing, such as pastureland in the European Alps and *dehesas* in western Spain (Blanco and Cortés, 2009; Marucco and McIntire, 2010; Kaczensky et al., 2013). Clearly, finding solutions to mitigate wolf predation on cattle would be useful to facilitate the sharing of landscapes by wolves and humans, particularly in regions holding important wolf populations within human dominated landscapes .

Compensation for damages is one of the potential tools to mitigate conflicts with large carnivores including wolves (Boitani et al., 2010;

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http://dx.doi.org/10.1016/j.biocon.2017.01.008
0006-3207/

Dickman et al., 2011). In general, governmental agencies or conservation organizations pay for animals killed by wolves, which is expected to increase tolerance towards the species (Boitani et al., 2010; Treves and Bruskotter, 2014). Despite its potential value, this system is costly and may have limited impact to improve human attitudes towards predators (Naughton-Treves et al., 2003; Schwwerdtner and Gruber, 2007; Zabel and Holm-Müller, 2008). As a consequence, other solutions have been sought, often in combination with compensation schemes, by promoting management practices that reduce predation risk (Boitani, 2000; Boitani et al., 2010; Gazzola et al., 2008). For instance, livestock-guarding dogs or fencing at night are often suggested as useful methods to reduce wolf predation, and thus may help reducing the cost of compensation schemes (Linnell et al., 2012; Gehring et al., 2010; Rigg et al., 2011). To be effective, however, this strategy requires detailed identification of management practices increasing the risk of wolf attacks, and the design of alternatives that can help reducing such risk. Furthermore, they require information on how to foster the uptake of favourable practices by livestock herders, as this often involves logistic difficulties and costs of implementation (Linnell et al., 2012).

The farming system approach may be valuable to understand the interactions between livestock management and wolves. The concept of farming system was developed in agricultural economics, and it is based on the idea that there are groups of farms sharing similar resource bases, production patterns and management strategies, which are likely to impact on the landscape in similar ways, and to show similar responses to biophysical conditions, as well as policy and market drivers (Dixon et al., 2001; Köbrich et al., 2003; Ribeiro et al., 2014). A key aspect of this concept is that each farming system is associated with a particular set of practices, which are selected by farmers in response to economic, biophysical and logistic constraints (Ribeiro et al., 2016). Therefore, conservationists wanting farmers to adopt more environmentally friendly practices may need to understand the farming system as a whole, rather than focusing on specific practices on an individual basis (Ribeiro et al., 2016). This is essential because some practices may be impossible to change without changing the farming system, while other practices may be more flexible and thus easier to change. In the case of livestock-wolf conflicts, therefore, it should be essential to identify livestock husbandry systems and their vulnerability to wolf predation, and how management practices within each system affect such vulnerability.

In this study we evaluate the importance of considering both husbandry systems and individual management practices to address human-wildlife conflicts involving livestock predation by large carnivores. We focused on cattle predation in Portugal, where wolves are strictly protected, feed heavily on domestic livestock and predation on cattle is among the highest documented worldwide (Álvares, 2011). To reduce conflicts, an *ex post* compensation scheme managed by a governmental agency has been in place since 1990, and several conservation initiatives have tried to increase livestock protection (e.g., guarding-dogs, fencing) (IEA, 2008, 2014). However, the costs of compensation have escalated in recent years, particularly due to damages on cattle, though the wolf population remained stable (Álvares et al., 2015). There is thus a need to revise the strategy adopted so far, which requires a better understanding of the factors affecting cattle vulnerability to wolves. In this study, we (i) characterize the spatial and temporal patterns of cattle predation by wolves using official records of damage compensation payments; (ii) identify cattle husbandry systems and the practices associated to each system, based on enquiries to cattle breeders; and (iii) quantify wolf predation in relation to cattle husbandry systems and individual management practices. Results were then used to identify potential solutions for reducing conflicts between cattle breeders and wolf and, more generally, to discuss the value of the farming system approach to address conflicts due to predation on livestock.

2. Material and methods

2.1. Study area

The study was conducted within the wolf distribution range in Portugal, corresponding to about 20,000 km^2 (40° 11′–42° 9′ N, 41° 34′–41° 50′ E; Fig. 1). The area is characterized by low to medium altitude mountains, with 85% of the territory at >400 m (average 544 m) above sea level. Land cover is mainly agricultural land (48%), forests (33%) and shrub land (17%) (IGP, 2009). Human density is relatively low, with most of the area (82%) with <50 inhabitants/km^2 and 64% with <25 inhabitants/km^2 (INE, 2011a). Livestock production is an

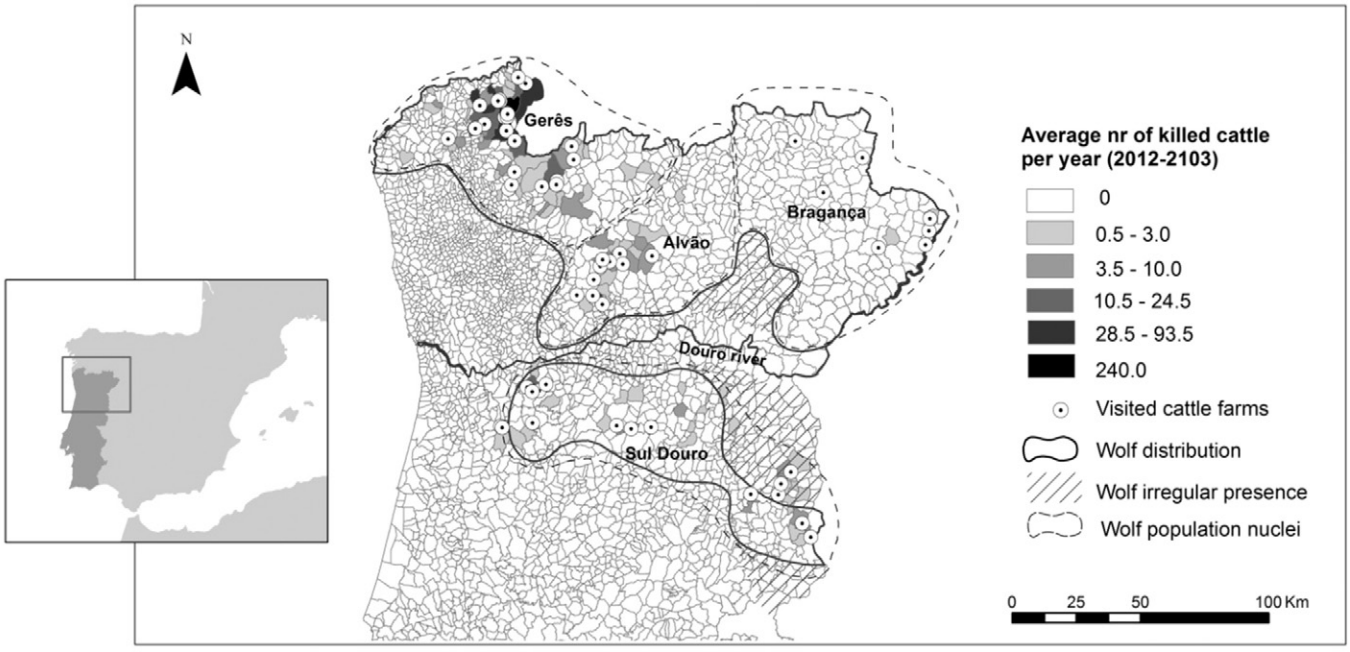

Fig. 1. Map of the study area in northern Portugal, showing the four wolf population nuclei: A – Gerês; B – Alvão; C – Bragança; D – Sul Douro. The map also shows the average annual number of cattle killed by wolf reported per parish for 2012–2013, and the location of cattle farms where enquiries to livestock breeders were conducted.