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## Stakeholders perceptions of the endangered Egyptian vulture: Insights for conservation

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### ABSTRACT

The inclusion of perceptions, interests and needs of stakeholders in biodiversity conservation is critical for the long-term protection of endangered species. Yet, the social dimensions of endangered species conservation are often overlooked. We examined the social perceptions of the conservational importance of the globally endangered Egyptian vulture (*Neophron percnopterus*) in one of the most important breeding areas worldwide: the Bardenas Reales Protected Area, northern Spain. We assessed the factors that influence the stakeholders' views of its conservation importance and identified the management strategies that would have social support. We found that the understandings of the Egyptian vulture differed among stakeholders. Hunters had the highest level of knowledge about its presence, threatened status and role as provider of ecosystem services. Livestock keepers recognized the worth of the Egyptian vulture for carcass removal, whereas other regulating services (e.g. biological control) were frequently acknowledged by tourists. Hunters and livestock keepers were more critical about the effectiveness of ongoing conservation strategies for preserving the Egyptian vulture than tourists. Moreover, each stakeholder group identified different actions for the conservation of the Egyptian vulture in the area. The consideration of the diversity of conservation actions suggested by stakeholders could catalyze broader support for the preservation of the Egyptian vulture.

### 1. Introduction

Considerable time and effort have been invested to implement accurate conservation initiatives to preserve endangered species worldwide. The focus of conservation biology has evolved over time from preserving species in protected areas to including the importance of social systems for achieving sustainable human-wildlife interactions (Mace, 2014). Most conservation efforts have focused on the reduction of human pressure on wildlife species (Groom et al., 2006; Vié et al., 2008). However, it is now accepted that “conservation is as much about people as it is about species” (Mascia et al., 2003) and that conservation problems will never be solved by ignoring human dimensions (Balmford and Cowling, 2006; Chan et al., 2007; Sandbrook et al.,

2013; Martín-López and Montes, 2015; Bennett et al., 2017a,b). Indeed, Mace (2014) recognized that the current emphasis in biodiversity conservation relies on a ‘human in nature’ framing, in which a better understanding of human dimensions of conservation is required.

Social-ecological approaches for biodiversity conservation, where perceptions, knowledge, interests and needs of multiple social actors are explicitly acknowledged, have been recently pointed out in different conservation forums (e.g. Ban et al., 2013; Martín-López and Montes, 2015; Bennett et al., 2017a,b). Indeed, different conservation challenges have been addressed by applying a social-ecological approach, such as the management of protected areas (e.g. Palomo et al., 2014; Ferraro and Pressey, 2015), conservation planning (e.g. Ban et al., 2013; Levin et al., 2013; Guerrero and Wilson, 2017), wildlife

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protection (e.g. Manfredo, 2008; Carter et al., 2014; Pfeiffer et al., 2015) or the design of campaigns for the preservation of flagship species (Verissimo et al., 2014). Despite these developments, human dimensions of biodiversity conservation still remain underutilized in many conservation decisions and actions (Ban et al., 2013; Bennett et al., 2017b).

Avian scavenger populations are a case in point: in spite of the historical interaction between humans and vultures (Moleón et al., 2014, Cortés-Avizanda et al., 2015b, DeVault et al., 2016), the conservation approaches for vultures have predominantly relied on their biology (e.g. Houston, 2001; Donazar et al., 2009a). Vultures have abruptly declined worldwide, with populations collapsing in Asia, Africa, and Europe (Green et al., 2004, Ogada et al., 2011, 2015, Cortés-Avizanda et al., 2016; Buechley and Şekercioğlu, 2016). The primary reasons for the collapse of vultures worldwide are poisoning, persecution, habitat destruction, high concentration of antibiotic residues in their systems, decreased availability of food and the loss of traditional farming practices (Olea and Mateo-Tomás, 2009; Cortés-Avizanda et al., 2015b, 2016; Ogada et al., 2015; Buechley and Şekercioğlu, 2016). Furthermore, vultures declining has negative consequences on humans' quality of life because certain ecosystem services may be negatively affected, such as carcass removal and control of diseases, ecotourism or spiritual values (Markandya et al., 2008; Morales-Reyes et al., 2017). Despite the contributions of vultures to humans' quality of life and despite the conservation of vultures depends on human actions, social perceptions of vultures and their conservation have been largely ignored in conservation research and practice.

The Egyptian vulture (*Neophron percnopterus*) is a globally threatened medium-sized avian scavenger (ca 2 kg) with a breeding population in Europe estimated at 3000–4700 pairs (BirdLife International, 2015). Although formerly the Egyptian vulture was very abundant, the species has experienced a severe decline throughout its range due to human-related mortality. The Spanish population comprises ca. 97% of the European Union population and in some regions has seen a concerning decline in the last two decades (Margalida et al., 2010). Bardenas Reales Natural Park (northern Spain, see below) is one of the most important area for the species because it held one of the densest population of Egyptian vultures with up to 50 breeding pairs (1 pair/10 km<sup>2</sup>). However, the population currently has between 20 and 25 active breeding pairs, which mean a decrease of about 50% of the initial breeding pairs (Carrete et al., 2007; Cortés-Avizanda et al., 2009, 2015a; Sanz-Aguilar et al., 2017).

In this context, our primary goal was to understand the social perceptions of conservation of an emblematic avian scavenger, the Egyptian vulture, by different stakeholders. We specifically aimed to: (i) identify which were the factors that might affect the different stakeholders' perceptions of the importance of conserving the Egyptian vulture and (ii) explore the different conservation strategies that could foster the protection of the focal species whilst having the social support of diverse stakeholder groups. Ultimately, we intend to provide insights for the conservation of the Egyptian vulture in its most important European breeding areas.

## 2. Material and methods

### 2.1. Study area

The research was performed in the Bardenas Reales, northern Spain (Fig. 1), which encompasses around 50,000 ha and was declared a Natural Park by the regional government in 1999 and World Biosphere Reserve by UNESCO in 2000. It is a semiarid landscape with < 300 mm of annual precipitation and with an average annual temperature around 13 °C. This area is dominated by large flat areas and small hills (280–659 m.a.s.l.) with natural vegetation dominated by scrublands and small wooded patches (for more details, see Cortés-Avizanda et al., 2015a). It is also a unique site due to its geomorphology and because it

is home to charismatic steppe birds of high conservation priority such as Dupont's lark (*Chersophilus duponti*) and Pin-tailed Sandgrouse (*Pterocles alchata*). Bardenas Reales is also one of the most important breeding areas for the endangered Egyptian vulture. The site previously had the highest densities of breeding pairs in Europe (see above), although the number has declined by about 50% since 1990 (Cortés-Avizanda et al., 2009; Sanz-Aguilar et al., 2017).

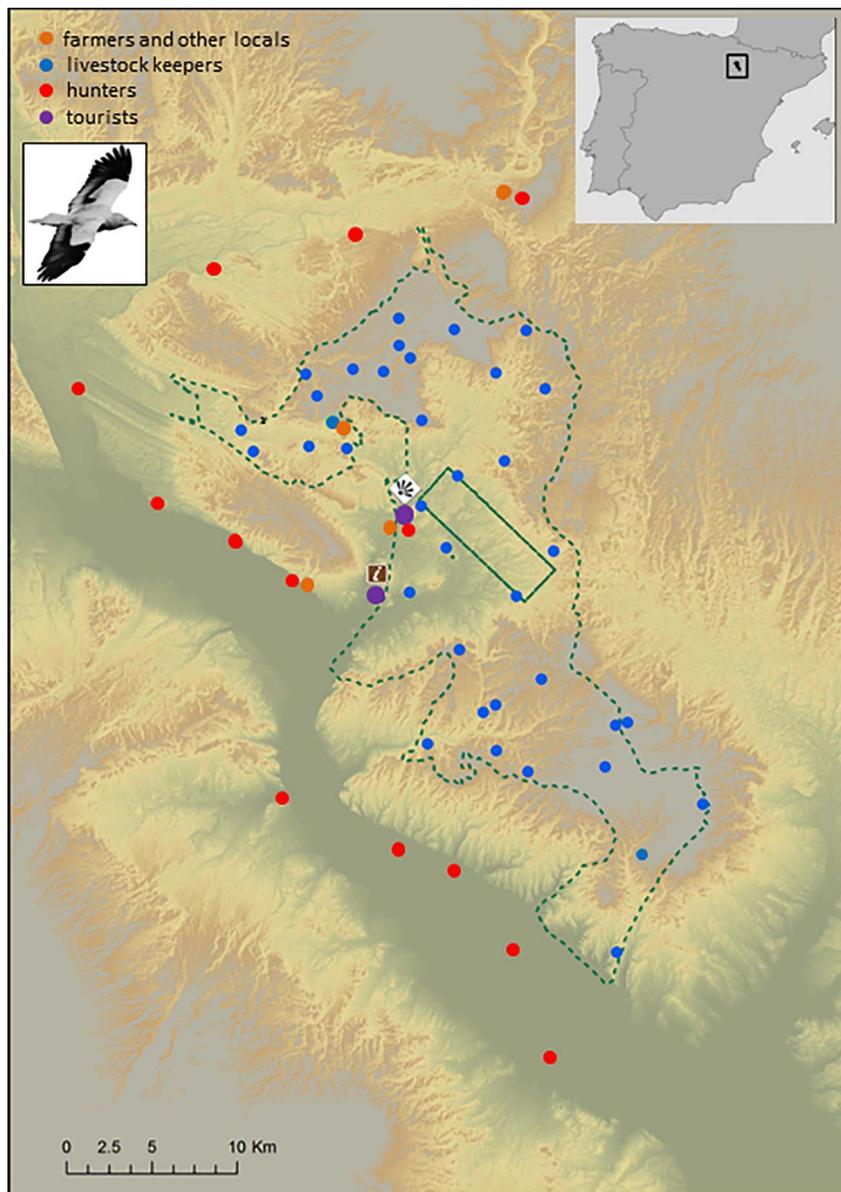
In the past, this protected area was devoted to traditional agricultural practices such as dry cereal croplands and pasturelands but human settlements no longer exist within the park boundaries. Currently, large numbers of domestic herds (up to 90,000 sheep) graze in this area from autumn to spring, when herders move from the Pyrenees to Bardenas Reales. The area outside the protected area is densely populated (> 150,000 people within a 30-km radius) and it is also used for intensive farming, such as large irrigated crops and intensive livestock management, as well as game preserves (Cortés-Avizanda et al., 2009, 2015a). The number of visitors in the Natural Park has increased since the last decade and currently reaches 56,094 visitors in 2016 (Information Center, personal communication). Because of these social and ecological characteristics, Bardenas Reales represents an optimal scenario to examine the role of stakeholders' perceptions for the conservation of endangered species, such as the Egyptian vulture.

### 2.2. Data collection

Data sampling was conducted in two main phases. In September 2014, we conducted 10 semi-structured interviews with farmers, hunters, shepherds and rangers of the park, to identify: (i) stakeholders related with Bardenas Reales and its biodiversity, (ii) the main motivations for the conservation of biodiversity in the region, and the ecosystem services provided by the Protected Area and particularly by vultures. In this research, we understood ecosystem services as all the benefits that societies obtain from nature (Díaz et al., 2015), regardless of whether these benefits were directly perceived by people or not. We applied a snowball sampling technique to identify additional respondents, i.e. we asked respondents to name others who could be contacted for their knowledge about this region and its biodiversity and ecosystem services. Interviews were digitally recorded, transcribed and coded. All the interviews were conducted with the signed consent of interviewees.

From March–April 2015, we conducted 354 direct face-to-face questionnaires in the Protected Area. The population sampled was restricted to individuals over 18 years old and covered a wide range of people including local inhabitants, tourists, livestock keepers and hunters. For each stakeholder group, we estimated a representative sample size of respondents at a 95% confidence level, with a sampling error ranging between 4.4% and 6.0% (see Appendix A). We structured the questionnaire based on the information obtained through the semi-structured interviews. The questionnaire included four sections: (i) socio-demographic characteristics of respondents (i.e., place of residence, age and gender); (ii) their environmental behavior (i.e., frequency of visits to the Bardenas Reales Protected Area per year; number of other Protected Areas visited in the last year); (iii) their knowledge about Bardenas Reales Protected Area, particularly about the main reasons for having been declared a Natural Park and Biosphere Reserve, its management practices as well as the traditional uses and practices currently performed in the region; (iv) their perceptions about the species inhabiting in the Protected Area and their conservation status, with a particular focus on (v) the Egyptian vulture (i.e. presence in the Protected Area, its threatened status, ecosystem services that this species provides, the role of the Protected Area for its conservation and the suggested conservation actions to advance its conservation; see Appendix B for the questionnaire structure and content).

Variables belonging to the section regarding the Egyptian vulture (section v) were the response variables for data analysis. Variables



**Fig. 1.** Study area of the Bardenas Reales Natural Park and Reserve of Biosphere (northern Spain) and a breeding adult Egyptian vulture (*Neophron percnopterus*) with the locations of the surveys to different stakeholder groups. Surveys to livestock keepers were performed widespread within the protected area whereas the rest of stakeholders were also questioned at particular sites (e.g. scenic view point, information center of the park and nearest towns, see details at Supplementary material) because no human permanent settlements exist inside the Protected Area. The borders of the Protected Area are represented by a dashed line. The rectangle delimits a military area. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Source: CLC2000-100m version 17 (12–2013).

associated with respondents' environmental behavior (section ii), knowledge of the Protected Area (section iii) and knowledge of species in the Protected Area (section iv) comprised the set of explanatory variables.

### 2.3. Data analysis

To identify the social factors that affected stakeholders' perceptions towards the Egyptian vulture, we conducted two different analyses. First, we explored the associations between the current perceptions about the Egyptian vulture (i.e., presence in the Protected Area, its threatened status, ecosystem services that this species provides) and the stakeholders identified (i.e. livestock keepers, farmers and other local people, hunters and tourists) by conducting a Chi-squared test. Secondly, we applied logit regression analyses to identify which social factors determine the respondents' perceptions and knowledge about (i) the presence of the Egyptian vulture, (ii) its threat status and (iii) its capacity to provide ecosystem services. The three dependent variables were coded as '1' when the respondents properly stated that the Egyptian vulture (i) exists in the Protected Area, (ii) its endangered

status, and (iii) the provision of ecosystem services, respectively. A stepwise-forward regression procedure was performed to identify the most important variables explaining the three response variables according to their Wald test scores.

To understand how different stakeholders perceive the conservation strategy to preserve the Egyptian vulture in the Bardenas Reales Protected Area, we performed two different analyses. First, we performed a Chi-squared test to analyze whether there was an association between the different stakeholders (i.e. livestock keepers, farmers and other local people, hunters and tourists) and the perception of conservation actions. For the perception of conservation actions, we used two different variables: (1) the level of adequacy (i.e. adequate or inadequate) of current conservation actions to protect the Egyptian vulture and (2) the perception of the effect (i.e. positive or negative) of the declaration of the Natural Park in 1999 on its conservation status. Secondly, we carried out a Multiple Correspondence Analysis (MCA) to determine whether there was an association between the various conservation strategies perceived as the most suitable for protecting the Egyptian vulture in Bardenas Reales Protected Area and the different stakeholder groups.

**Table 1**  
Characterization of sampled population according to socio-demographic information, relationship with the study area and knowledge and perceptions about Bardenas Reales Protected Area.

Characteristics	Livestock keepers	Farmers and other locals	Hunters	Tourists
<i>Socio-demographic</i>				
Male	100%	36.9%	100%	52.3%
Female	0%	63.1%	0%	47.7%
Age (years)	53.0 (14.58)	41.5 (19.33)	48.1 (12.01)	45.0 (13.56)
Time living in the area (years)	48.9 (19.39)	38.5 (18.76)	46.3 (13.11)	4.2 (13.86)
<i>Environmental behavior</i>				
Frequency of visits to Bardenas PA	3.9 (0.4)	1.9 (1.15)	3.3 (0.94)	0.6 (0.84)
Number of other PAs visited in the last year	0.39 (0.55)	0.63 (0.99)	1.03 (1.30)	1.68 (1.60)
<i>Knowledge about Bardenas PA</i>				
Existence of the PA	97.2%	77.9%	98.5%	95.4%
Reasons for being declared PA	66.7%	59.8%	71.2%	53.8%
Traditional uses	97.2%	97.5%	100%	66.9%
<i>Knowledge about biodiversity in Bardenas PA</i>				
Knowledge of the fauna	100%	84.4%	100%	63.1%
Knowledge of threatened fauna	47.2%	33.6%	74.2%	30.8%
Number of species known to be endangered	6.5 (1.68)	5.2 (2.11)	7.3 (1.66)	3.7 (1.63)

Standard deviation is shown in parenthesis. PA: Protected Area. Some tourists expressed that they 'live in the area' because they recently moved to the surroundings of the Protected Area and they do not considered themselves as locals.

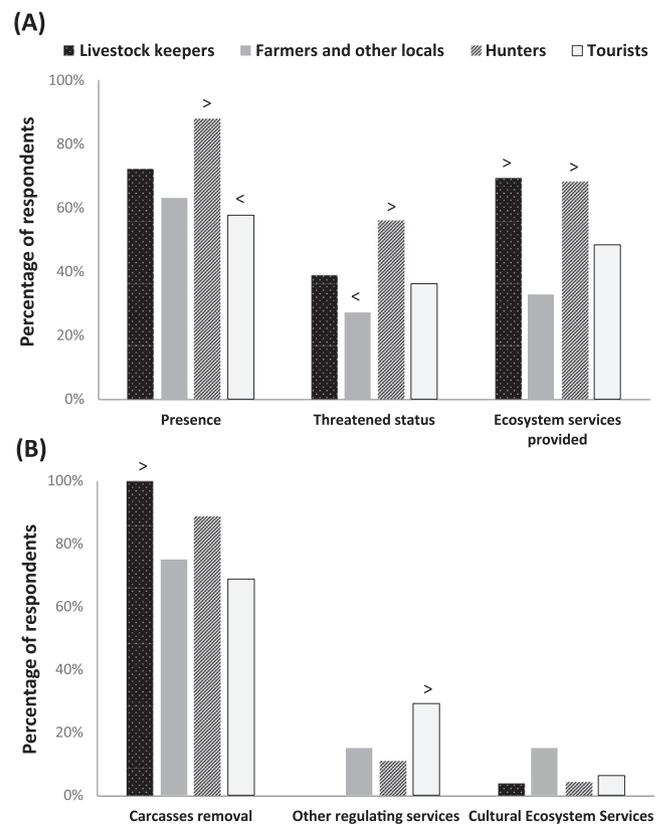
### 3. Results

#### 3.1. Characterization of sampled population

Stakeholders included in the survey were (i) livestock keepers (10.2% of total respondents,  $N = 36$ ), (ii) farmers and other local inhabitants (34.5%,  $N = 122$ ), (iii) hunters (18.6%,  $N = 66$ ) and (iv) tourists (36.7%,  $N = 130$ ). Livestock keepers and hunters are those who have lived in the area for long time (mean 48.9 ( $\pm 19.4$ ) and 46.3 ( $\pm 13.1$ ) years, respectively) (Table 1). Overall, these stakeholders were also those who regularly visited the Protected Area (livestock keepers: mean 3.9 ( $\pm 0.4$ ), hunters: mean 3.3 ( $\pm 0.9$ ) visits per year) and had the highest level of knowledge of this region and its biodiversity (see Table 1). By contrast, tourists were the stakeholder group with the lowest frequency of visits to Bardenas Reales Protected Area (mean 0.6 ( $\pm 0.8$ ) visits per year) and with the lowest rate of knowledge about the Protected Area itself and its biodiversity (Table 1). However, tourists were the stakeholder group with the highest frequency of visits to other protected areas (mean 1.68 ( $\pm 1.6$ ) visits in the last year).

#### 3.2. Social perceptions and knowledge of the Egyptian vulture

Knowledge regarding the Egyptian vulture significantly varied among stakeholders for presence in the Bardenas Reales Protected Area ( $\chi^2 = 19.27$ ;  $p \leq 0.001$ ), its threatened status ( $\chi^2 = 14.86$ ;  $p = 0.002$ ) and as an ecosystem services provider ( $\chi^2 = 33.83$ ;  $p \leq 0.001$ ) (Fig. 2a). Overall, hunters were the stakeholder group with the highest level of knowledge about the Egyptian vulture according to these three variables, although livestock keepers also had high level of knowledge about the ecosystem services provided by this species (Fig. 2a). Tourists had the lowest level of knowledge about the presence of the Egyptian vulture in the Bardenas Reales Protected Area, whilst farmers and other local inhabitants had the least knowledge of its threatened status



**Fig. 2.** Knowledge of the Egyptian vulture in the Bardenas Reales Protected Area differed among social actors: (A) general knowledge and (B) knowledge about the ecosystem services provided by this species. (>) Positive and significant association at  $p \leq 0.05$ ; (<) negative and significant association at  $p \leq 0.05$ .

(Fig. 2a).

Among those respondents who perceived that the Egyptian vulture provided ecosystem services to society, 81.0% perceived that carcass removal was the most important service. Few respondents, however, perceived the Egyptian vulture as an important provider of other regulating services (15.8%), such as biological control or habitat construction for other species, or cultural ecosystem services (7.6%). The perception of the ecosystem services provided by the Egyptian vulture significantly varied among stakeholders. Livestock keepers most frequently noted the role of the Egyptian vulture for contributing to carcass removal ( $\chi^2 = 13.30$ ;  $p = 0.004$ ); whereas tourists referenced its role in providing other regulating services, such as biological control ( $\chi^2 = 11.89$ ;  $p = 0.008$ ) (Fig. 2b). We found no significant differences of the perception of the capacity of Egyptian vulture to provide cultural ecosystem services among stakeholders ( $\chi^2 = 4.35$ ;  $p = 0.226$ ).

Using logit regressions, we identified two variables that positively explained the knowledge about the presence of the Egyptian vulture, its threatened status and its role as a provider of ecosystem services, i.e. the knowledge about the reasons for declaring the region as a Natural Park and the number of endangered species known (Table 2). Moreover, being a hunter, livestock keeper or tourist, also positively influenced the respondents' perceptions of the Egyptian vulture as a provider of ecosystem services (Table 2). We also found that hunters' knowledge was positively associated with the presence of the Egyptian vulture in the Protected Area (Table 2).

#### 3.3. Conservation actions for the Egyptian vulture in the Protected Area

The perception among stakeholders regarding the conservation of the Egyptian vulture significantly varied in terms of the adequacy of the strategies applied ( $\chi^2 = 55.97$ ;  $p \leq 0.001$ ) and in terms of the effect of

**Table 2**  
Estimated coefficients of the variables that determine the likelihood of being aware about (i) the presence of the Egyptian vulture, (ii) its threatened status and (iii) its capacity to provide ecosystem services, which were calculated through Logit regressions.

Characteristics	Presence of the Egyptian vulture	Threatened status	Ecosystem services provider
Constant	- 0.975 (0.258)***	- 2.632 (0.365)***	- 3.169 (0.452)***
Number of other PAs visited in the last year			0.298 (0.232)
Reasons for being declared PA	0.701 (0.256)***	0.596 (0.263)**	1.074 (0.267)***
Number of species known to be endangered	1.010 (0.201)***	1.279 (0.247)***	1.191 (0.260)***
Livestock keepers			1.236 (0.444)***
Hunters	0.700 (0.429)*	0.140 (0.311)	0.907 (0.361)**
Tourists			0.708 (0.343)**
Log-Likelihood	384.55	405.12	390.54
Chi-square (Wald)	18.97***	22.35***	16.62**
AIC	392.55	413.12	404.54
Percent of current predictions (%)	73.09%	71.67%	74.79%

Standard errors between brackets. PA: Protected Area; AIC: Akaike Information Criterion.

\*\*\* Statistical significance at 1% level.

\*\* Statistical significance at 5% level.

\* Statistical significance at 10% level.

**Table 3**  
Factor loadings derived from the multiple correspondence analysis (MCA) to show the association between conservation strategies perceived as the most suitable and social actors. Values displayed in bold are significant at 5% level. Statistics of the MCA are shown in the bottom part of the table.

Conservation strategies	F1	F2	F3	F4
Environmental education	0.388	- 0.978	- 2.857	1.477
Supplementary feeding	- 0.507	- 2.163	2.213	- 0.270
Landscape planning	- 1.045	- 1.539	1.029	2.166
Species monitoring	<b>2.988</b>	- 0.708	1.796	- 0.784
Traditional uses	- 1.158	<b>2.800</b>	1.302	2.563
Vehicles restriction	<b>2.579</b>	0.282	- 1.403	0.604
Ecotourism	0.147	<b>2.297</b>	0.791	1.645
Environmental taxes	<b>5.978</b>	0.799	2.025	1.428
Social actors				
Livestock keepers	- 0.064	- 0.033	0.060	0.162
Farmers and other locals	- 0.205	0.024	0.043	0.045
Hunters	0.140	- 0.104	0.070	0.021
Tourists	0.139	0.039	- 0.093	- 0.098
MCA statistics				
Eigenvalue	0.152	0.137	0.127	0.114
Inertia explained (%)	41.088	16.525	6.000	0.163
Inertia accumulated (%)	41.088	57.613	63.613	63.776

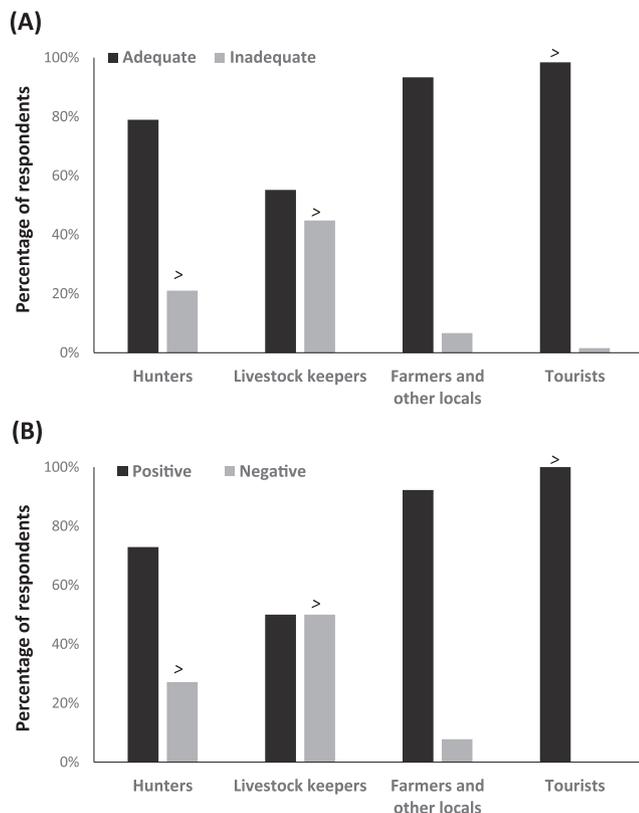
negative effect (Fig. 3).

Differences among social groups also emerged when comparing the suggested conservation strategies to be applied for the future conservation of the Egyptian vulture. The MCA revealed two main components accounting for 57.6% of the variance of conservation strategies suggested by different stakeholders (Table 3). Interestingly, the tourists suggested controlling vehicle access, implementing taxes to visit the Protected Area and fostering ecotourism; hunters recommended monitoring the population of the Egyptian vulture and developing environmental education programs; farmers and other locals suggested a conservation strategy that relied on preserving the traditional landscape uses; and finally, livestock keepers proposed maintaining the supplementary feeding stations as well as integrative landscape planning.

#### 4. Discussion

Identifying diverse social perceptions towards a particular endangered species can contribute to its conservation. These social insights, shaped by values, knowledge and rules, can foster behaviors and actions (Colloff et al., 2017) and, enable (or inhibit) public support for particular conservation interventions (Bennett, 2016; Toomey et al., 2016). In our study, we found that perceptions were not homogenous and that the perceived importance of the Egyptian vulture differed between stakeholders. In particular, we found that the knowledge of the presence and endangered status of the Egyptian vulture in the Protected Area is higher for hunters than other local residents and visitors. Furthermore, we also observed that hunters and livestock keepers assessed the importance of the Egyptian vulture as a provider of ecosystem services more often than other local residents and tourists. The difference between visitors and local inhabitants has been demonstrated in previous studies about human attitudes towards endangered species (e.g. Fischer and van der Wal, 2007; Martín-López et al., 2007a; Dressel et al., 2014; Kinsky et al., 2014), support for conservation programs of endangered species (e.g. Martín-López et al., 2007a; Kim et al., 2012; Resurreição et al., 2012) and management actions (e.g. Fischer and van der Wal, 2007; García-Llorente et al., 2008).

Understanding the diverse ways that different stakeholders perceive endangered species can help to identify the relevant factors that underpin positive attitudes towards biodiversity conservation. The fact that hunters and livestock keepers perceived the conservation importance of the Egyptian vulture because of its endangered status and



**Fig. 3.** Perceptions of the suitability of conservation strategies used to protect the Egyptian vulture in the Bardenas Reales Protected Area differed among stakeholders: (A) general adequacy of the conservation strategies and (B) type of effect of the declaration of the Protected Area in 1999. (>) Positive and significant association at  $p \leq 0.05$ .

the Protected Area on its conservation ( $\chi^2 = 67.10; p \leq 0.001$ ). In both cases, tourists considered that existing conservation strategies and the declaration of Bardenas as Natural Park had a positive effect on the Egyptian vulture, whereas hunters and livestock keepers perceived a

its capacity to provide ecosystem services can be explained by their level of experience or local ecological knowledge, i.e. understandings, practices, beliefs and insights acquired through extensive observation of an area or species (Huntington et al., 2004). This is consistent with a recent study that demonstrates the importance of local ecological knowledge for preserving scavengers and the ecosystem services they provide (Morales-Reyes et al., 2017). Knowledge about other endangered species inhabiting the Protected Area positively related with higher rates of perception of the presence of the Egyptian vulture, its endangered status, and its role for providing ecosystem services. In addition, we found that the formal knowledge about the reasons by which the studied area was declared a Natural Park had a positive influence on the perceptions of the Egyptian vulture. Similarly, Bremmer and Park (2007) found that people with prior knowledge of conservation and management actions show higher levels of support for conservation and management in the case of invasive alien species. Previous research has also demonstrated that increased knowledge about endangered species results in positive attitudes and higher support for their conservation (e.g., Bandara and Tisdell, 2003; Wilson and Tisdell, 2005; Martín-López et al., 2007b; Sawchuk et al., 2015). Our results together with previous literature indicate the importance of awareness and education to convey a conservation message in society and thus enhance public support for conservation policies.

Besides the importance of formal knowledge, our study also demonstrated the relevance of local ecological knowledge in shaping positive perceptions towards an endangered species, even for those stakeholders that often might present negative attitudes towards wildlife, such as hunters (e.g. Ericsson and Heberlein, 2003; Røskoft et al., 2007; Dressel et al., 2014; Kinsky et al., 2014). However, it is important to point out that having a higher level of knowledge about endangered species does not guarantee favorable conduct for their conservation (Ericsson and Heberlein, 2003).

Understanding the stakeholders' perceptions towards endangered species can be useful to determine the level of acceptability and support of a particular conservation action (Bennett, 2016). Interestingly, we found that stakeholders suggested diverse management strategies to enhance the conservation status of the Egyptian vulture according to the experiences developed in the Protected Area. For example, tourists suggested developing ecotourism programs in the area that can actively contribute to preserve the Egyptian vulture. In addition, they also identified the problem of increasing number of visitors in the breeding area and thus suggested controlling vehicle access and implementing a conservation program based on fees or taxes for visiting the Protected Area. The suggestion to charge fees for entrance might be explained by the fact that they had previously visited Protected Areas with this funding system. Although this funding system is not common in Spain (nor in our study area), many public areas under protection worldwide charge fees for entrance (Emerton et al., 2006; Buckley, 2010). Interestingly, none of the conservation measures suggested by tourists is applied in the study area, possibly for fear of a decrease in the number of visitors and their possible impact on local economies.

Local stakeholders tended to suggest conservation actions associated with their experience in the region. Livestock keepers and farmers proposed conservation actions based on integrating traditional uses, such as extensive livestock practice and dry farming. For example, they suggested an integrative plan for landscape planning where the different traditional uses would be made compatible with the conservation requirements of the Egyptian vulture. Livestock keepers particularly suggested the provision of food by supplementary feeding stations as a measure to enhance the Egyptian vulture population. This suggestion is not unexpected as by the end of the 20th century; the appearance of the Bovine Spongiform Encephalopathy in Europe caused the prohibition of the abandonment of livestock carcasses in the field by shepherds and farmers provoking a great impact on scavengers species and communities structure (EC 1774/2002, Donazar et al., 2009a, 2009b; Cortés-Avizanda and Pereira, 2016; Cortés-Avizanda et al.,

2016) and an arise of human-vultures conflict (see details in Margalida et al., 2014). In this context, new regulations were approved (EC 142/2011) to allow farmers to leave extensive livestock carcasses in the so-called 'Protection areas for the feeding of necrophagous species of European interest' (PAFs, Morales-Reyes et al., 2016). PAFs in Spain, although require improvements, (see details in Morales-Reyes et al., 2016), may help to the conservation of less competitive endangered scavenger species whereas are considered a popular strategy fostered by local wildlife managers and birdwatchers (see also, Arrondo et al., 2015; Cortés-Avizanda and Pereira, 2016; Cortés-Avizanda et al., 2015b, 2016).

Finally, hunters also suggested conservation actions according to their experiences. Firstly, they proposed developing an observation-based monitoring program of the Egyptian vulture. However, it is important to point out that, since 1980, a monitoring program already exists in the Protected Area of Bardenas (Cortés-Avizanda et al., 2009, 2015a, Sanz-Aguilar et al., 2017). Hunters also suggested developing environmental education programs, a strategy that has been highly demanded by conservationists to counteract, for example, the use of illegal non-selective methods of control of nongame predators (Delibes-Mateos et al., 2013). However, greater effort is needed to establish environmental education programs that engage hunters. This stakeholder group is the least targeted by the communication, education, and public awareness and participation actions in Spain (Jiménez et al., 2014).

Overall, our findings emphasize the need for implementing a multi-programmed conservation approach that included different actions to sustain and enhance support for the conservation of the Egyptian vulture by multiple stakeholders. This study empirically demonstrated that the conservation of a particular endangered species is understood and interpreted in various ways by the different stakeholders. Additionally, this work represents the first step towards a new approach to the conservation of endangered avian scavengers and other birds of prey where knowledge of stakeholder perceptions is used to target future conservation actions. In our case study, most of the conservation measures proposed by stakeholders (e.g. control of visitors, application of fees or develop ecotourism and educational programs) have not been historically implemented, although these measures are considered important by both conservationists and decision-makers. Over the long-term, monitoring programs could be used to evaluate the viability of conservation measures suggested by stakeholders and to monitor potential changes in their perceptions. Acknowledging the myriad ways people perceive species conservation can improve understanding of how humans relate with biodiversity, and encourage society to support and be engaged in conservation actions.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.biocon.2017.09.028>.

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