



# Avian scavengers' contributions to people: The cultural dimension of wildlife-based tourism



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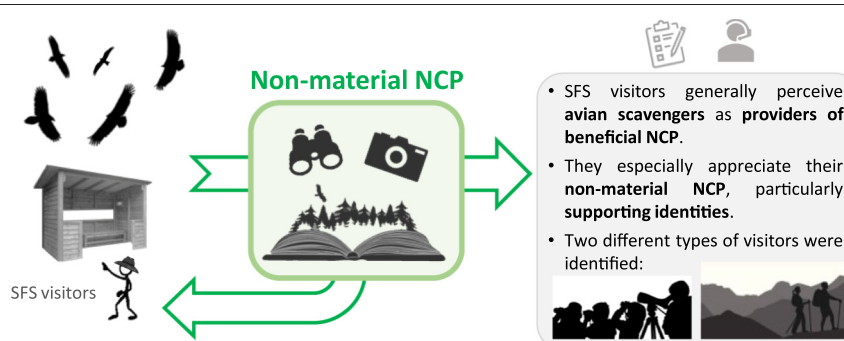
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## HIGHLIGHTS

- Scavengers provide significant non-material nature's contributions to people (NCP).
- SFS visitors were specialist avian scavenger-watchers or generalist nature-lovers.
- Most visitors (85%) perceived avian scavengers as beneficial NCP providers.
- SFS visitors could increase positive perceptions and awareness of scavengers.
- Scavenger-based tourism reflects changing perceptions of non-material NCP.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Scavengers provide significant nature's contributions to people (NCP), including disease control through carcass removal, but their non-material NCP are rarely considered. For the first time, we assess the extent and value of the NCP provided by European avian scavengers through a scavenger-based tourism at Pyrenean supplementary feeding sites (SFS). Using a two-step cluster analysis, two different types of visitor were identified (specialist avian scavenger-watchers and generalist nature-lovers) at those SFS offering recreational experiences ( $n = 20$ , i.e. birdwatching, educational, or photographic activities). Most visitors (85%) perceived avian scavengers as beneficial NCP providers, associating this guild with non-material NCP (mostly supporting identities), followed by regulating and maintenance of options NCP (<1%). Our findings help to characterize the type of people who participate in scavenger related recreation and to identify and value their perceptions of avian scavengers. There has not been much previous research on positive human-wildlife interactions, even though ignoring people emotional bonds with nature can be perilous for biodiversity conservation.

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## 1. Introduction

Nature is inherently imbricated with the existence of any living being. Humans have long tried to understand this involvement by delimiting the inflows that nature provides to our species. Many of the fundamental terms in the nature-people relationship were conceptualized during the

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late 20th century as interest in the subject blossomed. One such was the concept of ecosystem services (Costanza et al., 2017), the definition of which was consolidated in the 2005 Millennium Ecosystem Assessment (MEA, 2005). Ecosystem services were defined as the benefits provided by ecosystems functioning to human society. Recently, a more accurate term—nature's contributions to people (NCP)—has been coined by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Díaz et al., 2018) to include all of the detrimental and beneficial effects that living nature can exert on people's quality of life. This concept assumes culture to be the matrix where all the different NCP are developed and proposes a classification based on three partially overlapping groups: material, non-material and regulating NCP (Díaz et al., 2018). Material NCP are finite physically consumed goods such as water, energy, or building and ornamental materials; non-material NCP are those sustaining individual and collective well-being and psychology, such as aesthetic, experiential, recreational, intellectual and spiritual contributions; and regulating NCP are functions and structural features and ecosystems processes that regulate material and non-material NCP or influence environmental conditions which affect humans.

Due to their subjective nature, non-material NCP (i.e. cultural services) have always been the most abstract and least well-identified of the NCP (Milcu et al., 2013). These contributions to our culture which support learning and inspiring values, or create a sense of place or spiritual awareness, have not been given sufficient attention until recently (Hernández-Morcillo et al., 2013). However, non-material NCP are both critical in promoting nature conservation and enabling sustainable economic development (Eagles, 2004). Understanding people's emotional bonds with nature is key to involving society in any nature conservation strategy (Bennett, 2016). During the last two decades, the means of making non-material NCP visible have usually been based on financial assessments and determining socio-cultural preferences through interviews, surveys, or personal information posted on social media (Milcu et al., 2013, e.g. Vollmer et al., 2015; Oteros-Rozas et al., 2018).

Ecotourism and recreational wildlife-based activities are booming worldwide (Reynolds and Braithwaite, 2001; Balmford et al., 2015). In particular, birdwatching is now one of the most popular wildlife-based hobbies around the world (e.g. Şekercioğlu, 2002; Ma et al., 2013), and it has been estimated that in the United States alone, birdwatchers spend more than \$30 billion annually on travel and equipment and would be willing to pay \$35 to \$134 per day on birdwatching activities (LaRouche, 2003). One would therefore expect for a generally high social awareness of, and knowledge about the value of birds. But birds have not traditionally been recognised as ecological actors and providers of NCP (Şekercioğlu, 2006). Indeed, scientific studies about birds' group remain biased, omitting certain guilds such as avian scavengers (Şekercioğlu, 2006; DeVault et al., 2016). Despite being a worryingly endangered guild (Buechley and Şekercioğlu, 2016) playing an essential role in human well-being (DeVault et al., 2016), avian scavengers continue to be oblivious to society, or even seen as a threat (Lambertucci et al., 2021). There are very few studies on avian scavenger-based tourism, even though it currently provides a livelihood for many local communities (Ferrari et al., 2009). The slight attention given to this recreational experience has typically focused on its economic contribution to human society (e.g. Becker et al., 2005; García-Jiménez et al., 2021); hardly any studies have focused on the cultural value provided by scavenger-based tourism or the other diverse non-material NCP provided by avian scavengers (Morelli et al., 2015; Echeverri et al., 2020; Aguilera-Alcalá et al., 2020).

Supplementary feeding sites (SFS, also called “feeding stations” or “vulture restaurants”) have been one of the most popular conservation tools supporting the feeding of scavengers during spatial or temporal carcass shortages. However, this management-conservation tool has pros and cons, with some potential benefits but also ecological constraints when SFS are used to manage scavengers' populations and distribution (Cortés-Avizanda et al., 2016). SFS can also be employed to raise social awareness in landowners, farmers, and the general public,

while being used for recreational activities (i.e. ecotourism) (DeVault et al., 2016). However, various studies have shown that SFS cannot be used as permanent solutions because they can impact population fecundity (Carrete et al., 2006; Cortés-Avizanda et al., 2016), reduce the dispersion of sub-adult individuals (Margalida et al., 2013) and increase pathogen transmission (Marin et al., 2018). Consequently, SFS must not be created or sustained purely to appeal to tourists (Newsome and Rodger, 2008). Conservation requirements must dictate SFS management, even at the cost of potentially important economic opportunities for local communities (García-Jiménez et al., 2021).

Old World vulture populations suffered a sharp decline in the late 20th century (Buechley and Şekercioğlu, 2016). SFS were widely established to reverse this trend by reducing the potential impact of non-natural mortality due to habitat transformation, food shortages, and illegal poisoning (Donazar et al., 2009). Currently, Spain is one of the best European countries in which to view obligate (i.e. vultures) and facultative avian scavengers (e.g. eagles, kites, corvids, etc.). More than 90% of the European vulture population lives in Spain (Margalida et al., 2010) as well as numerous species of facultative avian scavengers, including some endangered species, such as the endemic Spanish imperial eagle *Aquila adalberti* or the red kite *Milvus milvus*. Notwithstanding, Spain still maintains a broad network of operational SFS, the first being built more than 50 years ago (Donazar et al., 2009).

Our goal was to identify and quantify the NCP provided by avian scavengers through recreational and educational activities (i.e. wildlife-based tourism) at the SFS in the Pyrenees. Specifically, we aimed to: (i) characterize visitor profile at SFS and (ii) examine the perceptions, interest in, and knowledge of SFS visitors regarding European avian scavengers.

## 2. Material and methods

### 2.1. Study area

Our study was conducted in the Pyrenees, a mountain range of 50,000 km<sup>2</sup> located in southwest Europe on the border between France and Spain. All four European vulture species (cinereous *Aegypius monachus*, griffon *Gyps fulvus*, Egyptian *Neophron percnopterus*, and bearded vulture *Gypaetus barbatus*) occur there as well as a diverse community of facultative scavengers (e.g. red kites, black kites *Milvus migrans*, ravens *Corvus corax*, and golden eagles *Aquila chrysaetos*), all of which regularly visit the SFS network (Moreno-Opo et al., 2016). Currently, at least 67 SFS operate in the Pyrenees and adjoining Pre-Pyrenean area (seven in France and 60 in Spain). All of the SFS considered in this study were created principally for scavenger conservation (i.e. hides built, managed, and exclusively intended for photography were not included), and are managed either by public or private operators. Currently, at least 20 Pyrenean SFS are open to visitors (García-Jiménez et al., 2021), providing wildlife-based tourism and/or environmental educational activities in addition to serving conservation purposes.

### 2.2. Data collection

#### 2.2.1. SFS characteristics

Between February 2018 and January 2020, 53 (79.1%) of the Pyrenean SFS managers were interviewed by telephone to gather basic information on the management and characteristics of each SFS, including whether the access to the general public was allowed. We interviewed 90% of the 20 Pyrenean SFS receiving visitors, all located in the eastern Spanish Pyrenees (Aragon and Catalonia regions). The information obtained included the activities offered beyond supplementary feeding of avian scavengers and showed that those SFS with recreational activities (n = 20 out of 67 Pyrenean SFS) provided at least one of the following: (i) *birdwatching* (30%); (ii) *education* (20%); (iii) *photography* (25%); and *education and photography* (25%) (see García-Jiménez et al., 2021 for an individualized characterization of SFS).

### 2.2.2. Visitor information

To characterize the SFS visitor profiles enjoying the recreational and educational activities on offer and identify their perceptions of the avian scavenger guild, we carried out individual surveys in the same two-year period (February 2018–January 2020). We only considered 15 of the publicly accessible 20 SFS to survey the visitors. Five SFS were discarded because they were inside a protected area, and we could not assume that watching avian scavengers was the main reason for peoples' visits (see García-Jiménez et al., 2021 for details). We met the ethical standards for social surveys by informing respondents in writing, at the beginning of the questionnaire, about the nature of their voluntary participation and their guaranteed anonymity.

A total of 94 survey questionnaires (either in English or Spanish) were randomly distributed among nine of the 15 SFS considered (the remaining six SFS did not agree to participate in the study). The questionnaire comprised 14 questions, divided into two sections: (1) a general section, with questions about visitors' personal interest in, perceptions of, and knowledge of the NCP provided by scavengers; and (2) questions characterizing their socio-economic status (see Table A.1 in Appendix A). As part of the questionnaire, we provided visitors with color images of 14 species of obligate and facultative avian scavengers generally present in the Pyrenees (the four European vultures, six birds of prey and four corvids; see Table A.2 in Appendix A) and asked if they could visually identify and name the species. The only species absent in the Pyrenees is the Spanish imperial eagle, an important avifaunal icon of the Iberian Peninsula – thus, culturally representative – and easy to identify visually. It was included in the questionnaire in order to present two *Aquila* spp., allowing us to evaluate the visual identification and cultural recognition (i.e., species recognised but which could not be named) skills of the visitors (see Table A.3 in Appendix A).

We obtained an average of  $10 \pm 4$  completed questionnaires per SFS surveyed (range 3–17). Given the diverse dynamics of the SFS (only two presented scheduled visits), the questionnaires were self-answered by each visitor, so usable responses varied from 66% ( $n = 62$  answers, Q13) to 100% ( $n = 94$  answers, Q2; Table A.1) depending on the question.

## 2.3. Data analyses

### 2.3.1. SFS visitor profiles

Based on visitors' knowledge, perception and interest in the avian scavenger guild, and their socio-economic status, we built a two-step cluster analysis (Norusis, 2003) to evaluate a possible structuring of the SFS visitors into distinct "groups". This is a probabilistic model proper to include mixed variables and provides the distance between two clusters through the decrease in the log-likelihood function resulting from merging. We used five categorical variables: (i) the reason for their visit; (ii) the extent of their previous experiences with birds; (iii) the relationship between their occupation and birds, (iv) their educational level and (v) their average monthly income. The seven numerical variables were: (i) the material brought to the SFS (e.g. bird guides, binoculars, camera; see Table A.4 in Appendix A); (ii) the visitor's self-rated interest in the avifauna; and (iii) the number of birdwatching excursions per year, plus four indices devised to determine the knowledge and perceptions of visitors regarding the avian scavenger guild: (iv) *species identification index* (ability to recognise and name a species); (v) *species recognition index* (ability to recognise a species, but not name it); (vi) *positive perception index*; and (vii) *less positive perception index* (see Table A.1 and Appendix B). The Schwarz Bayesian criterion (BIC) for each cluster within a specified range was used to estimate the number of clusters. This estimate was then refined by finding the largest increase in distance between the two closest clusters at each hierarchical clustering stage. Background noise was screened out. The questions unanswered by the visitors were considered as non-available data (7.3% out of 1580), but included in this specific ordination analysis as estimated values computed by the mean (of the numerical variables) and the mode (of the categorical variables).

After this cluster analysis, we conducted a chi-squared test ( $\alpha = 0.1$ ) to study the distribution of the different groups of SFS visitors among SFS offering three different types of recreational activities: educational, photographic, or both. Birdwatching was not included in these analyses because no questionnaires were completed in any of the SFS offering birdwatching exclusively (see García-Jiménez et al., 2021 for details).

### 2.3.2. SFS visitor knowledge and perceptions regarding avian scavengers

In order to evaluate visitors' knowledge regarding the avian scavengers, we considered two separate variables individually per visitor: (1) *visual species identification* (i.e. percentage of species correctly identified visually,  $n = 74$  answers) and (2) *cultural species recognition* (i.e. percentage of species correctly culturally recognised,  $n = 77$  answers) (see examples in Table A.3). Mean  $\pm$  SD values were then estimated for both variables. We conducted a Mann-Whitney *U* test ( $\alpha = 0.1$ ) to determine any differences among functional groups regarding *visual species identification* and *cultural species recognition*. Kruskal-Wallis tests ( $\alpha = 0.1$ ) and posteriori multiple comparison Dunn test post hoc contrast were conducted to analyze differences among taxonomic groups regarding the same two variables.

To analyze SFS visitors' perceptions of avian scavengers and the NCP provided by them, we computed descriptive statistical analyses using two indexes: (1) an *NCP perception index* (i.e. a written reasoned comment expressing why a visitor gave a more or less positive value to each species); and (2) an *NCP valuation index* (i.e. a numerical valuation of each species as a provider of NCP using a five-point scale from least positive (1) to most positive (5)). Only reasoned comments mentioning beneficial or detrimental NCP were considered to compute this index. Combining both types of valuation methods (*NCP perception index* and *NCP valuation index*), we were able to understand and analyze the reasons for people enjoyment of avian scavengers through recreational activities, and to identify the scavenger species perceived as NCP providers and whether they were perceived more or less positively.

We transformed visitors reasoned comments into an *NCP perception index* as follows. First, we divided visitors' comments into usable or unusable (the latter comprising: unanswered questions, unsubstantiated like/dislike answers, and comments mentioning biological and/or behavioural traits which we could not relate to an NCP (e.g. reference to red kite as a facultative scavenger or raven as a thief)). We identified 557 usable comments, but in some cases, people included more than one argument in an answer, so these answers could be associated with more than one NCP, resulting in a total of 631 different perceptions. Second, we classified these perceptions into four types: abundance (e.g. SFS visitors argued that they could frequently see/not see a species), intrinsic value, detrimental NCP, and beneficial NCP (see in Tables 1, and A.5 and A.6 in Appendix A examples of the original reasoned comments of SFS visitors questioned classified as beneficial and detrimental NCP). NCP were classified according to the IPBES framework (Díaz et al., 2018).

Finally, we constructed the *NCP valuation index*, by classifying visitor numerical valuations as either less positive (from 1 to 2), neutral (3), and positive (from 4 to 5) (see details of the questionnaire in Table A.1).

## 3. Results

### 3.1. SFS visitor characterization

Visitors to SFS were normally Spanish adult (87% from Spain; 13% from other European countries) 47 years old on average, 81.7% in couples, and 72.6% parents with children. There was a high gender bias (only 29.9% were female). About 68.2% of visitors had taken higher education, and most were middle or high economic earners (54.2% and 31.9%, respectively) (see Table A.7 in Appendix A).

Cluster analyses indicated that the best model identified two cluster-groups of visitors: (1) specialist avian scavenger-watchers; and (2) generalist nature-lovers (Table 2). These two clusters were unevenly

**Table 1**

Beneficial NCP related to the 14 European avian scavengers studied as perceived by SFS visitors. Examples of the original reasoned comments are given. Classification of beneficial NCP based on Díaz et al. (2018).

NCP group	NCP category	Examples
Material	-	-
Non-material	Learning and inspiration	It informs me about eagles' presence. It warns the other species in the woods.
	Physical and psychological experiences	Appearance (e.g. beauty, color of the plumage, silhouette, size, elegance). It is nice to watch while flying (agility). Pleasant/unpleasant squawk. A species rarely photographed. It is boring.
	Supporting identities	Singularity, peculiarity. Nature icon, an ecology symbol. They play their role, they are necessary, they are all important. Intelligence. Threat level.
Regulating	Regulation of detrimental organisms and biological processes	I see it in my village, close to my home. It is a hunting/scavenger/super-predator species. They have a cleaning role in the nature. Facultative scavengers cover those tasks that larger scavengers cannot. It has an essential role in the food chain. Sanitary role. It maintains the balance.
Maintenance of options	-	It is a conservation thermometer.

This is a summary table. For an extended version with the corresponding numerical valuations and more examples of the reasoned comments see Table A.6.

distributed among the SFS offering different types of recreational activities ( $\chi^2 = 12.63, P = 0.002$ ; Fig. A.1 in Appendix A). Generalist nature-lovers predominantly visited SFS providing educational activities (66.7%), while specialist avian scavenger-watchers preferred those offering photographic facilities (75%). SFS offering both educational and photographic experiences simultaneously received a more equitable proportion of visitors from both groups, i.e.: 63.2% specialist avian scavenger-watchers vs. 36.8% generalist nature-lovers.

### 3.2. SFS visitor knowledge and perceptions of avian scavengers

#### 3.2.1. Visitor knowledge of avian scavengers

All species comprising the avian scavenger guild were better culturally recognised than visually identified and all the three taxonomic groups were differently visually identified and culturally recognised ( $\chi^2 = 8.98, P = 0.011$  and  $\chi^2 = 7.70, P = 0.021$ , respectively). Vultures were significantly better visually identified by SFS visitors than birds of prey ( $Z = 2.99, P = 0.008$ ) and significantly better culturally recognised than corvids and birds of prey ( $Z = 1.97, P = 0.074$  and  $Z = 2.71, P =$

0.020) (Fig. 1). No significant differences were found among the rest of taxonomic groups comparisons.

Seventy seven percent of the visitors correctly visually identified the four European vulture species at the same time and 84.4% simultaneously recognised them culturally. Overall, obligate scavengers were significantly better visually identified than facultative scavengers ( $89.9 \pm 5.7\%$  vs.  $63.5 \pm 13.4\%$ ;  $U = 39.0, P = 0.003$ ) and likewise cultural recognition of the two groups ( $92.9 \pm 4.8\%$  vs.  $77.8 \pm 7.8\%$ ;  $U = 39.0, P = 0.008$ ). Among all the avian scavenger species tested, the bearded vulture had the best visual identification and cultural recognition scores (97.3% and 98.7% respectively), while the Western marsh harrier *Circus aeruginosus* and common buzzard *Buteo buteo* were least frequently identified species (47.3% and 48.7%, respectively). The Western marsh harrier was also the least culturally recognised (66.2%) (see Fig. 1).

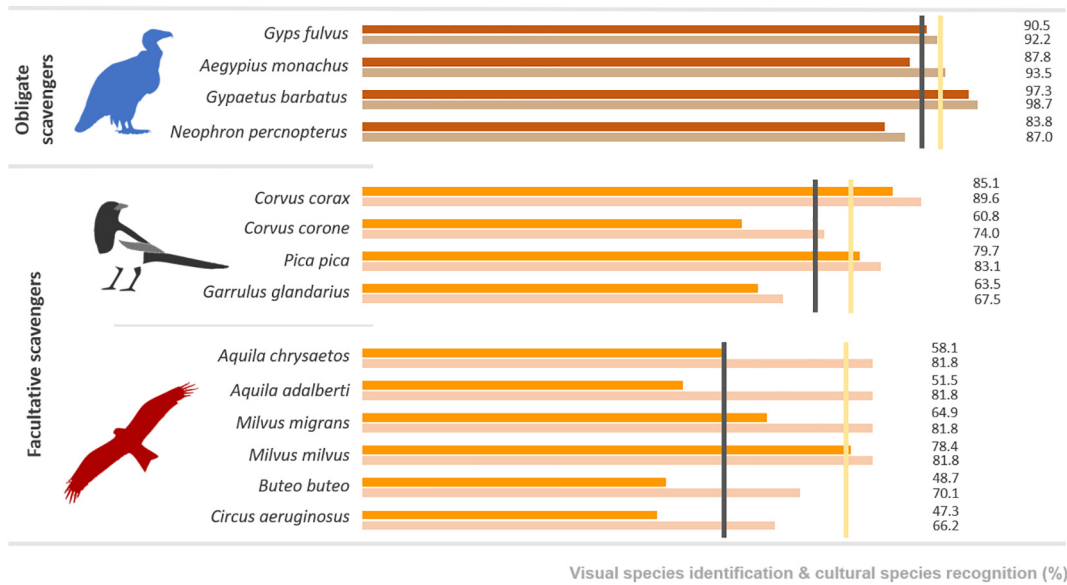
#### 3.2.2. Visitor perceptions of and interest in avian scavengers

According to the NCP perception index ( $n = 631$  SFS visitors' reasoned comments), most visitors perceived avian scavengers as providers of beneficial NCP (84.9%), followed by visitors who valued avian

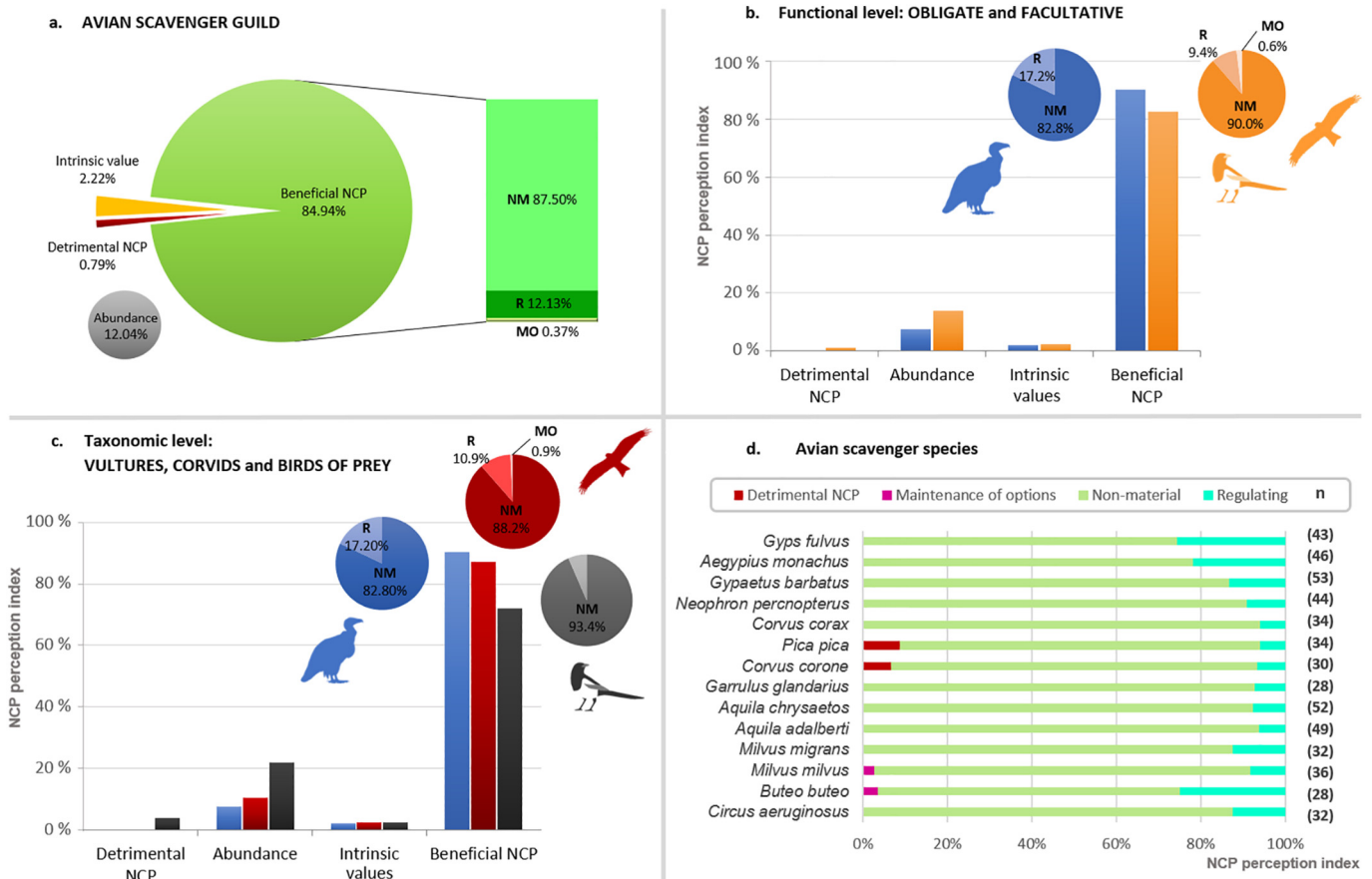
**Table 2**

Classification of SFS visitors from a two-step cluster analysis. Each characteristic is assigned to its originating question in the questionnaire (in parentheses). Characteristics were ordered from top to bottom in decreasing order of importance on the predictor. See Table A.1 for a detailed description of the variables included in the analysis and Appendix B for details on the indexes used. The number of species identified and recognized is the 14 species included in this study (listed in Table A.2).

Characteristics	Visitors to SFS (%)		Value of importance on the predictor
	Specialist avian scavenger-watchers 60.6% (57)	Generalist nature-lovers 39.4% (37)	
Previous experience with birds (Q3)	High	Some	1.00
Species visually identified (Q6)	12 ± 2 species	7 ± 4 species	0.58
Species culturally recognized (Q8)	13 ± 1 species	9 ± 4 species	0.47
Self-rated interest in the avifauna (Q4)	9.4 ± 0.9	7.7 ± 1.8	0.47
Species positively perceived (Q8)	11 ± 3 species	7 ± 4 species	0.34
Material (Q2)	A material combination that includes binoculars (and probably photographic camera and/or bird guides)	A material combination that includes a photographic camera (and possibly also bird guides)	0.31
Times per year going to birdwatching (Q7)	64.9 ± 76.0	10.8 ± 15.6	0.27
Photography as one of the main reasons for visiting the SFS (Q1)	Yes	No	0.26



**Fig. 1.** SFS visitor knowledge of avian scavenger species. *Visual species identification* by visitors (%; n = 74 answers; dark top bar for each species) and *cultural species recognition* (%; n = 77 answers, light bottom bar for each species). Vertical bars show mean values of visual species identification (black; vultures  $89.9 \pm 5.68\%$ , corvids  $72.3 \pm 12\%$ , and birds of prey  $58.1 \pm 11.9\%$ ) and cultural species recognition (yellow; vultures  $92.9 \pm 4.8\%$ , corvids  $78.6 \pm 9.7\%$ , and birds of prey  $77.3 \pm 7.1\%$ ) within each taxonomic group. Species were grouped by functional groups (bar color): obligate (browns) and facultative scavengers (oranges); and taxonomic groups (colored silhouette): vultures (blue), corvids (black) and birds of prey (red). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



**Fig. 2.** SFS visitor perceptions of avian scavengers (*NCP perception index*): (a) at the avian scavenger guild level (all species together) (n = 615 reasoned comments); (b) at the functional level – obligate (blue) and facultative scavengers (orange) (n = 615); (c) at the taxonomic level – vultures (blue), corvids (black), and birds of prey (red) (n = 615); and (d) at the species level (n shown in brackets). Beneficial NCP include: non-material (NM), regulating (R), and maintenance of options (MO). In b and c, bar diagrams show the proportion (%) of reasoned comments grouped by abundance, intrinsic values, detrimental, and beneficial NCP (i.e. *NCP perception index*) and pie charts show the proportion (%) of reasoned comments classified by beneficial NCP groups (i.e. NM, R, and MO). Note that in d, abundance and intrinsic values were not included. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

scavengers because of their abundance and ease of observation (12%), or their intrinsic value (2.2%), whereas only 0.8% of SFS visitors considered avian scavengers to be providers of detrimental NCP. Among the beneficial categories of NCP, non-material NCP were the most often mentioned (87.5%), followed by regulating NCP (12.1%), and maintenance of options (0.4%) (Fig. 2a).

At the functional level, abundance comments for facultative scavengers (14.3%) were twice that of obligate scavengers (7.3%), although the beneficial NCP were greater for obligate than facultative scavengers (90.7% vs. 82.2%, respectively) (Fig. 2b). At the taxonomic level, corvids received the highest proportion of reasoned comments related with the abundance (22.3%), contrasting with vultures (7.3%). In contrast, more respondents recognised the beneficial NCP of vultures (90.7%) compared with birds of prey (86.8%), or corvids (71.5%). The intrinsic value of a species was equally, though only rarely, noted for all taxonomic groups and species, while detrimental NCP were only recorded for corvid species (Fig. 2c and d).

Non-material NCP were the most mentioned NCP category, ranging from 82.8% of comments for vultures to 93.4% for corvids. Regulating NCP were associated mainly with obligate scavengers (17.2%), but were only mentioned in 9.43% of the beneficial NCP comments for facultative scavengers, concretely 10.9% for birds of prey and 6.6% for corvids (Fig. 2b and c). Maintenance of options was only mentioned by one visitor, who recognised the future benefits for biodiversity associated with the presence of red kite and common buzzard (Fig. 2d). In contrast, regarding detrimental NCP, SFS visitors mentioned the damage to animal biodiversity caused by two species: common magpies *Pica pica* and carrion crows *Corvus corone* (see Fig. 2d and Table A.5).

SFS visitors mentioned beneficial NCP in 536 reasoned comments, of which 98.9% could be classified into different categories (Fig. 3). Among non-material NCP, *supporting identities* was by far the most common non-material NCP mentioned in valuing scavenger species, ranging between 73% ( $n = 255$ ) for birds of prey and 75.5% for vultures ( $n = 183$ ). *Physical and psychological experiences* were slightly more associated with birds of prey (26.6%,  $n = 255$ ) than vultures (23.2%,  $n = 183$ ), or corvids (22.1%,  $n = 92$ ). *Learning and inspiration* were the least frequently mentioned and were associated with particular species. They were mentioned once each for griffon and cinereous vultures, carrion crow and Eurasian jay *Garrulus glandarius*. Within the regulating NCP, only the category of “regulating of detrimental organisms and biological processes” was mentioned, although it was linked to all species (Fig. 3). Examples of the reasoned comments of SFS visitors classified as beneficial NCP provided by avian scavengers (i.e. *NCP perception index*) and the associated numerical valuations of avian scavengers (i.e. *NCP valuation index*) are presented in Table A.6.

Regarding the *NCP valuation index* ( $n = 77$  answers), 10 species (71.4%) received more than 50% positive numerical valuations (i.e. *NCP valuation index* = 4 or 5) and these species presented less than 10% of the less positive ones (i.e. *NCP valuation index* = 1 or 2). Vultures were perceived by SFS visitors as the most beneficial functional group, followed by birds of prey and corvids. The bearded vulture received the most positive valuations (89.6% with scores of 5 and 6.5% with scores of 4), but the only vulture not receiving any less positive valuations was the Egyptian vulture. The only other species that did not receive any less positive valuations was the golden eagle. In contrast, the raven (5.2% with scores of 1 and 13.0% with scores of 2) and the common magpie (7.8% with scores of 1 and 11.7% with scores of 2) were the species whose NCP were valued lowest (Fig. 4).

#### 4. Discussion

This study is the first to identify and quantify, from a non-economic perspective, the NCP provided by European avian scavengers through scavenger-based tourism at the SFS and analyze the profile of Pyrenean SFS visitors. We identified and measured the perceptions of people who enjoy scavenger-related activities, a social group consistently overlooked

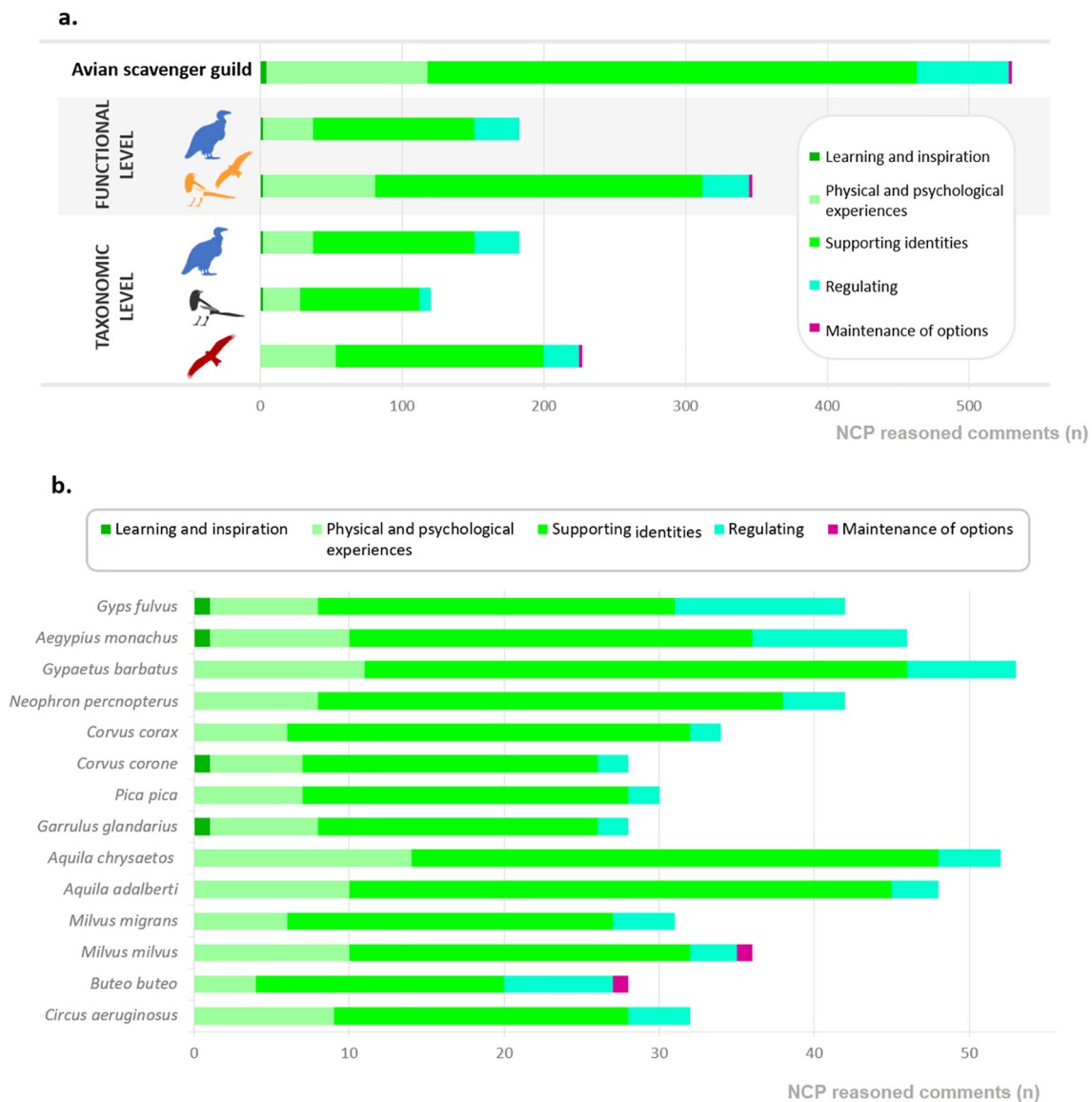
in both the scavenging and the ecotourism worlds. The study showed that SFS visitors generally perceive avian scavengers as providers of beneficial NCP, especially appreciating their non-material NCP, particularly the supporting identities value. In general, SFS visitors were found to be knowledgeable and positive regarding scavengers, although to varying degrees depending on the species.

##### 4.1. SFS visitor characterization

Many factors have been reported as shaping the perception of wildlife (e.g. Hough, 2014; Schwartz et al., 2014). Regarding birds, some research has shown that species knowledge (including perceived diversity, spatial distribution, and abundance), past nature-related experiences, and surrounding cultural context (e.g. religion, stories, and films) can all influence human awareness and perception of an avifauna (Cox and Gaston, 2015; García-Alfonso et al., 2019; Leong et al., 2020). This study corroborated that the knowledge of visitors to SFS (measured as the ability to visually identify and culturally recognise avian scavenger species), self-rated interest in birdlife, and avifauna relatedness (defined as the number of bird-related experiences of a visitor prior to the SFS visit) were some of the most influential factors characterizing different visitors' profiles. Species knowledge and awareness (both closely linked to human-nature relatedness and individual interest in nature and biodiversity) were recently shown to influence farmers' perceptions and local ecological knowledge about ecosystem services provided by scavengers (Morales-Reyes et al., 2018; García-Alfonso et al., 2019) and to positively influence multiple stakeholders' perceptions regarding these species (e.g. Cortés-Avizanda et al., 2018).

Photography, which was one of the primary motivational triggers for someone to visit an SFS, resulted a representative factor in defining a visitors' profile, as it also did the material brought, the frequency of self-guided birding explorations, and the positive perception of a species. Therefore, contrary to studies indicating a homogeneous birdwatcher profile (Şekerciöglü, 2002, 2003), and in line with those showing the heterogeneity of birdwatchers' as a group (e.g. Scott and Thigpen, 2003; Kim et al., 2010), we identified two well-differentiated types of SFS visitor: *specialist avian scavenger-watchers* and *generalist nature-lovers*. Photographic opportunities were among the main reasons for an SFS visit by a specialist avian scavenger-watcher, explaining the observed tendency of this type of SFS visitor to prefer visits to SFS offering photographic activities. Photographing scavengers in the wild has previously been associated with certain physical and psychological experiences, particularly those regarding aesthetic and supporting identity values (Aguilera-Alcalá et al., 2020). However, both types of visitors went to SFS offering all kinds of recreational activities and interestingly, generalist nature-lovers mostly visited SFS with educational activities, showing their interest in increasing their lesser knowledge of avian scavenger species.

As for French and USA birders, our results showed that the average SFS visitor was an older adult (around 47 years old), in a couple, with a high level of education, and of medium to high economic status (see e.g. LaRouche, 2003; Carver, 2013; Schwartz et al., 2014; Belaire et al., 2015). However, contrary to the slightly higher presence of female birders in USA population (LaRouche, 2003; Carver, 2013), we detected a strong predominance (70%) of male SFS visitors. Furthermore, neither the education level, nor economic status were determinant factors defining the SFS visitor types found in our study, as is usual when the demographic parameters of birdwatchers were previously evaluated (Şekerciöglü, 2002; Carver, 2013). In contrast, and in agreement with De Salvo et al. (2020), SFS visitor knowledge regarding avian scavengers, and their commitment and behaviour (i.e. material brought, self-rated interest in birdlife, and personal relationship to birds) had high relative importance in defining the two SFS visitor groups. Also consistent with the data reported by LaRouche (2003) and Carver (2013) regarding USA birdwatchers, a majority of the SFS visitors (87%) were nationals coming mostly from the 200 km closest to the SFS (see García-Jiménez et al., 2021). The



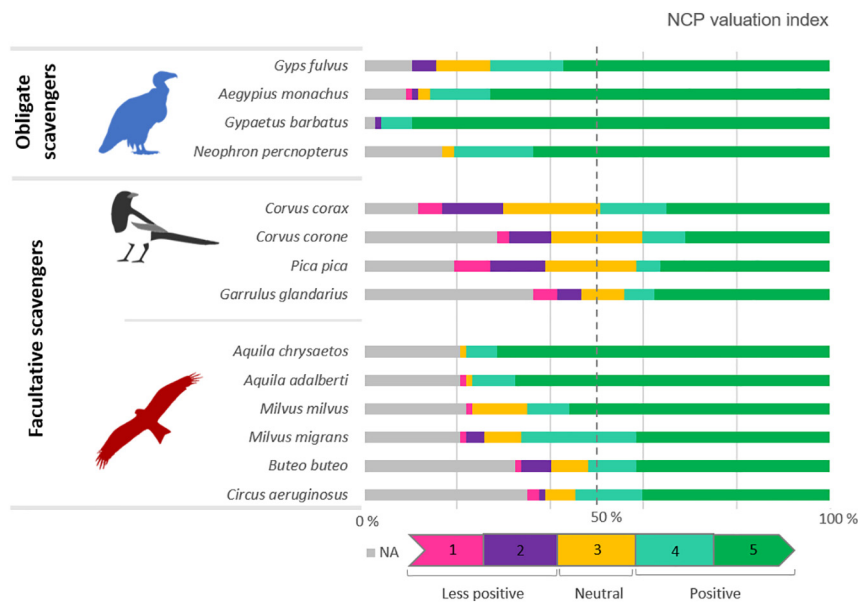
**Fig. 3.** Classification of the beneficial NCP provided by avian scavengers mentioned by SFS visitors (*NCP perception index*;  $n = 530$  reasoned comments). NCP were grouped into: non-material (divided into the categories: *learning and inspiration*, *physical and psychological experiences*, and *supporting identities*; green bars), *regulating* (blue bar), and *maintenance of options* (i.e. future benefits; fuchsia bar). (a) For the avian scavenger guild (all species together) at the functional level obligate – blue, and facultative scavengers – orange, and at the taxonomic level vultures – blue, corvids – black, and birds of prey – red; and (b) at the species level. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

European Commission reported in 2015 that Spanish people were one of the European cultures most concerned about human responsibility for nature conservation (European Commission, 2015). It is precisely this tendency for regional tourism what makes possible to plan community-based avian scavenger conservation strategies (Roe et al., 2009; Störmer et al., 2019), at least in Spain. Thus, SFS visitors could provide a link between avian scavengers and general public perceptions to facilitate an increasing positive awareness of the NCP value of scavengers to society and to promote avian scavenger conservation.

#### 4.2. SFS visitor perceptions of avian scavengers

Even though bird-based tourism is increasing worldwide (Şekercioglu, 2003), the appreciation by birdwatchers of the NCP provided by birds has not often been considered in the literature (e.g. Belaïre et al., 2015; Leong et al., 2020), particularly in relation to the avian scavenger guild. According to Methorst et al. (2020), among vertebrates, birds' contributions to people have not received extensive

scientific attention, yet birds was the only taxon in which beneficial NCP were predominantly reported. Our findings showed that a majority of SFS visitors perceived avian scavengers as beneficial NCP providers (85% of the comments analyzed), being their perceptions mainly related to the appreciation of non-material NCP, followed by regulating NCP, and maintenance of options NCP. Interestingly, these perceptions of SFS visitors to avian scavengers contrast with those of farmers, who mostly appreciate their scavenging service (Morales-Reyes et al., 2018). In a world where scientific research has traditionally focused on the detrimental NCP arising from human-wildlife conflicts (Peterson et al., 2010), this study highlights the positives in human perception of wildlife. Thus, vultures and eagles were positively perceived as significant providers of NCP in the Pyrenees, followed to a lesser extent by kites and other birds of prey. In contrast, corvids were little valued as NCP providers, although only some corvid species were specifically mentioned as providers of detrimental NCP and only by a few SFS visitors. These conclusions are similar to those of Morales-Reyes et al. (2018) in their analysis of Spanish farmers' perceptions of



**Fig. 4.** SFS visitor perceptions of avian scavengers as providers of NCP by species (NCP valuation index;  $n = 77$  answers). Each bar shows the percentage of the numerical valuations of avian scavenger species as providers of NCP on a five-point scale from less positive (pink) to more positive (green) values by SFS visitors. Non-available data (grey) were also included. For example, considering  $n = 77$  answers, the griffon vulture shows 10.4% of NA data (grey), 0% of which have a score of 1 (pink), 5.2% have a score of 2 (purple), 11.7% have a score of 3 (yellow), 15.6% have a score of 4 (turquoise), and 57.1% have a score of 5 (green), showing that this species was perceived as a very positive NCP provider by SFS visitors. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

the scavenger guild, but contrary to the perceptions observed in farmers in Argentinian Patagonia, who perceive avian scavengers as harmful to livestock (Ballejo et al., 2020).

While regulating NCP have often been associated with scavengers (e.g. disease control, or recycling of organic matter through carcass removal, Şekerioğlu, 2006; Whelan et al., 2008), and the material NCP of scavengers are widely tradable in Africa (Buij et al., 2016), non-material NCP have rarely been considered, much less evaluated. This knowledge gap arises in part because non-material NCP are intangible and abstract in nature and have generally been the least studied of the NCP (Chan et al., 2012) being assumed to have no marketable value. However, many studies showing the positive relationship between birds and human psychological well-being have been performed over the last two decades (Luck et al., 2011; Cox and Gaston, 2015). Although often focused on green spaces in urban environments, these studies have related bird species richness, behaviour and/or abundance with improved mental health (Wheeler et al., 2015; Cox et al., 2017), and lower psychological stress (Medvedev et al., 2015), eventually increasing personal and neighborhood well-being (Luck et al., 2011). Bird species richness has even been associated with life-satisfaction at a whole-continent level, being probably as relevant as income or access to green space for Europeans (Methorst et al., 2021). Still, even though previous research has shown the positive effects on people of enjoying watching and interacting with birds (Belaire et al., 2015), fewer studies have evaluated the non-material NCP provided by birds in the wider environment (Mackerron and Mourato, 2013), and only a few have studied it for avian scavengers (Becker et al., 2005; Echeverri et al., 2020; Aguilera-Alcalá et al., 2020).

This study introduces an interesting evaluation of the mindset of a previously unexplored social actor (i.e. SFS visitors) and analyzes the perspective of people who enjoy wild avian scavengers at both the regional and international scales. Our findings demonstrate that non-material NCP are those most highly valued by SFS visitors (88% of the comments among beneficial NCP perceived), similar to findings for other groups who enjoy bird-based leisure activities (especially in urban environments; e.g. Cox and Gaston, 2015; Wheeler et al., 2015). We show that the non-material NCP mostly perceived in avian scavengers were those linked to the supporting identities NCP, while those related to physical and psychological experiences were less frequently

mentioned, but also present for all the species examined. Interestingly, learning and inspirational values were positively perceived for vultures (griffon and cinereous) and corvids (carrion crows and Eurasian jays), although Aguilera-Alcalá et al. (2020) observed that this kind of non-material NCP within the scavenger guild was normally predominantly focused on mesocarnivores.

The maintenance of options NCP, which includes all the processes which support ecosystem resilience and underpin all current and future NCP, has previously been observed in evaluations of human-wildlife interactions (Störmer et al., 2019). Here, we confirm this NCP observation for the first time in the analysis of perceptions of the scavenger guild, particularly for black kites and common buzzards. Because the maintenance of options NCP spans all of the material, regulating, and non-material NCP groups, its presence in local people's perceptions of scavengers is a strong argument in support of the conservation of these species and the encouragement of more inclusive social attitudes towards management plans and conservation strategies to increase their effectiveness and social acceptance (Bennett, 2016).

## 5. Conclusion

All the NCP analyzed in this study are generally non-tradable in traditional markets but are frequently perceived as public “cost-free” goods with one and the same value to all beneficiaries (Wenny et al., 2011). In consequence, they are usually overlooked by society and therefore undervalued, and lack methodologies to evaluate them holistically (Milcu et al., 2013). By revealing the general mindset of people interested in scavenger-based tourism, this study contributes to closing a noteworthy knowledge gap regarding the non-material NCP provided by vertebrate scavengers. Our findings support the potential for growth of a flourishing scavenger-based recreational tourism, reflecting a powerful emerging interest in, and appreciation of, the non-material NCP provided by European avian scavengers. This study also reinforces recent calls made by the IPBES to conserve the threatened populations of avian scavengers (Martín-López et al., 2018). Further multidisciplinary analysis, including multiple social actors, is needed to provide a more integrated and holistic perspective on the social role of avian scavengers in society.



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## CRediT authorship contribution statement

**Ruth García-Jiménez:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft. **Juan M. Pérez-García:** Conceptualization, Writing – review & editing. **Antoni Margalida:** Conceptualization, Funding acquisition, Project administration, Writing – review & editing. **Zebensui Morales-Reyes:** Conceptualization, Supervision, Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendices A and B. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.scitotenv.2021.150419>.

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