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ANALYSIS

Economic valuation of non-material contributions to people provided by avian scavengers: Harmonizing conservation and wildlife-based tourism

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ABSTRACT

Nature's contributions to people (NCP) are fundamental to human well-being. In particular, non-material NCP, defined as effects on personal perspectives which enhance people's quality of life, are currently the most abstract and least well-defined NCP. Avian scavengers are a globally threatened guild that plays a key role in our society but currently only valued for their NCP of disease control and carcass removal. We describe the first economic valuation of the recreational and educational experiences brought by avian scavenger-based tourism in Spain, concretely, at vulture supplementary feeding sites (SFS) in the Pyrenees and their important contribution to the incomes of the local human population. Between February 2018 and January 2020, we collected information on the management and characteristics of 53 (c. 80%) of the Pyrenean SFS using telephone interviews and questionnaires. We estimated that photography and avian scavenger-watching at SFS produce an average of US $4.90 ± 2.67 million annually, including US $2.53 ± 1.36 million in direct economic benefits to the local population. Using a conservative economic approach, this study is one of only a few to value some of the important non-material contribution provided by avian scavengers to our society. Our study also suggests that further research on non-material NCP provided by avian scavengers at SFS is needed. Finally, we discuss the delicate balance between recreational experiences arising from wildlife-based tourism and biodiversity conservation, contrasting the contribution of SFS to the income of local human populations against the problems they raise for vulture conservation.

1. Introduction

Ecosystem services are the direct and indirect benefits that humans obtain from ecosystems and therefore play an essential role in human well-being. They have received increasing attention over the last 20 years, especially since the term was popularized by the Millennium Ecosystem Assessment in 2005 (MA, 2005; Costanza et al., 2017). However, in 2017, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) introduced a new and closely related concept, Nature's Contributions to People (NCP) (Christie et al., 2019). NCP have been defined as all the contributions of living nature to people's quality of life, including both the positive (i.e. beneficial) and negative (i.e. detrimental) inputs that people obtain from the ecosystems (Díaz et al., 2018). Each specific cultural setting would condition their classification through three partially overlapping groups: material (actual goods provided by nature, such as food, energy, or medicinal products; e.g. Bondé et al., 2020), non-material (the effect of nature on the subjective or psychological aspects supporting people's quality of life such as recreational, aesthetic, learning, and inspirational experiences; Chan et al., 2011), and regulating NCP (functional and structural aspects of organisms, ecosystems and biodiversity that contribute to society's well-being by changing the environmental conditions which affect humans and regulate the other two kinds of NCP; e.g. Martín-López et al., 2019) (Díaz et al., 2018).

Only during the last two decades have non-material NCP (i.e. cultural services) been socially recognized. They are very difficult to assess, especially because they appear intangible and usually manifest as indirect benefits (Hernández-Morcillo et al., 2013; Milcu et al., 2013).

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Consequently, they have been given little or no scientific, social, or economic value, leading to some conservation decisions (e.g. ignoring local knowledge, and/or people perceptions) with serious negative consequences for our environment and society (Butler and Oluoch-Kosura, 2006; Zografos and Howarth, 2010; Barua et al., 2013). Since the end of the 20th century, one of the most common methods for trying to place a true value on these non-material NCP have been economic evaluations of recreational activities (Martín-López et al., 2009; Everard and Kataria, 2011; Milcu et al., 2013). Although the published information on NCP valuation is increasing, some important species or specialized guilds are frequently ignored by the general public and undervalued by scientific educationalists and the specific stakeholders directly related to them. Such is the case of the vertebrate scavengers (Moleón and Sánchez-Zapata, 2015; Cailly Arnulphi et al., 2017), a guild with a fundamental role in many ecological processes, functions, and ecosystem services (Moleón et al., 2014; De Vault et al., 2016).

Humans and vertebrate scavengers, including obligate scavengers (such as vultures, whose food comes exclusively from scavenging) and facultative scavengers (such as raptors, corvids, or mammalian carnivores), have been directly interdependent since the Late Pliocene, when our ancestors started to eat meat. Indeed, the NCP provided by this guild have benefited our species from the very first biped hominids (Moleón et al., 2014; Morelli et al., 2015). For example, humans have obtained different ornamental resources, such as feathers, from scavengers (a material NCP) (Finlayson et al., 2012). Regarding regulating NCP, scavengers' ability to dispose of waste and organic matter preventing disease transmission to humans (e.g. brucellosis, tuberculosis, or anthrax) and their role in the nutrient cycle in processing carcasses have been widely recognized as providing substantial benefits to human health (Swan et al., 2006; Markandya et al., 2008; Ogada et al., 2012a; O'Bryan et al., 2018), contribute to the long-term maintenance of soil structure (Wilson and Wolkovich, 2011; Beasley et al., 2015) and reduce environmental pollution (Markandya et al., 2008; Morales-Reyes et al., 2015). However, very few studies have highlighted the importance of scavengers in the provision of non-material NCP, for example where scavengers form the basis for spiritual experiences (rituals and celebrations), wildlife-based tourism (recreational experiences) or supporting personal identity (the satisfaction derived from knowing that a particular species exists) (see e.g. Becker et al., 2005; Morelli et al., 2015; Aguilera-Alcalá et al., 2020). Indeed, these cultural values are widespread in human societies and intertwined, connecting all NCP with each other.

Terrestrial vertebrate scavengers (especially obligate scavengers and large mammalian scavengers) have been declared one of the world's most endangered guilds in recent decades (Hoffmann et al., 2010; Ogada et al., 2012b; Ripple et al., 2014). Old World vultures and condors are the most globally threatened avian functional guild due to the recently suffered severe declines in many of their populations across the globe (Buechley and Şekercioğlu, 2016; Safford et al., 2019). To mitigate these sharp population declines, many conservation and population rescue plans have emerged (Astore et al., 2017; Botha et al., 2017). Among other remedial initiatives, supplementary feeding sites (SFS, also known as "feeding stations" or "vulture restaurants") have been established. Feeding stations provided a conservation tool to: fight illegal poisoning and reduce lead or pharmacological toxic risks (the main threats to vulture mortality); encourage species dispersion into new areas; improve breeding success and survival; remedy population declines; and to compensate for decreases in carcass availability resulting from sanitary policies developed to reduce bovine spongiform encephalopathy (Houston, 2006; Donázar et al., 2009). The balance of pros and cons of the specific management and uses of this conservation tool has been broadly discussed (Piper, 2005; Donázar et al., 2009; Cortés-Avizanda et al., 2016). For instance, the initial conservation reason for constructing an SFS has recently been corrupted by the increasingly popular tendency to build SFS strictly to serve tourist interests (e.g. birdwatching, wildlife photography) with the consequent economic benefits. In fact, the wildlife-based touristic value of vulture breeding areas and SFS has become a notorious source of income for many local economies (Anderson and Anthony, 2005; Piper, 2005; Ferrari et al., 2009). Perhaps surprisingly, the scale of the economic benefits of these non-material contributions that vultures provide at SFS has not been quantified before.

Spain is one of the most popular European countries for ornithological tourism specifically to see scavengers, particularly vultures, since it hosts most of the European vulture population (Margalida et al., 2010). Concretely, there are more than 90% of the European breeding populations of cinereous (*Aegypius monachus*), 90% of the griffon (*Gyps fulvus*), 47% of the Egyptian (*Neophron percnopterus*), and 63% of the European bearded vultures (*Gypaetus barbatus*) (Margalida et al., 2010; Del Moral, 2017; Del Moral and Molina, 2018a; Del Moral and Molina, 2018b; Margalida and Martínez, 2020). Spain has also established a large network of SFS since the 1980s, most being built initially as management-conservation tools recurrently applied by administrations (Moreno-Opo et al., 2015). We based our study in the Spanish Pyrenees, taking advantage of the fact that it is inhabited by all four European vulture species and also has a wide network of SFS, and where efforts have been made to try to harmonize the conservation purposes of SFS with recreational experiences and environmental educative activities through wildlife-based tourism.

The main goal of this study was to evaluate the economic benefit of non-material NCP provided by the European avian scavengers through recreational and educational activities (i.e. wildlife-based tourism) at the SFS in the Pyrenees. In addition, we discuss the sensitive trade-off between recreational experiences associated with wildlife-based tourism and conservation in a situation in which, on the one hand, SFS provide important contributions to local human population's incomes and, on the other, must ensure the conservation of European avian scavengers.

2. Material and methods

2.1. Study area

The Pyrenees is a > 400 km long mountain range located on the border between southern France and northeastern Spain. There are currently at least 67 working SFS in the Pyrenean and Pre-Pyrenean area (seven in France and 60 in Spain) each with very different spatial and temporal feeding routines. Of these, 29.85% ($n = 20$) located in the eastern Spanish Pyrenees (Aragon and Catalonia autonomous communities) receive visitors (people who visit a hide or viewpoint specifically linked to an SFS normally under the guidance of the organization in charge of the SFS). Only the entrance of the field technicians directly to the SFS is allowed. Hides built, managed, and exclusively intended for photography were not included either in this study or in the descriptive statistics. All SFS considered here had been created for the principal purpose of scavenger conservation.

2.2. Data collection

Data were gathered between February 2018 and January 2020. Data collection was systematically divided into two main stages. First, basic information on the management and structural characteristics of each SFS was collected through telephone interviews with the managers of 53 (79.1%) of the Pyrenean SFS, 18 of which were part of the 20 SFS that formally receive visitors. The information obtained included the mean number of people visiting each SFS each year and the price, if any, of entrance and/or the main recreational activity offered (birdwatching, photography and/or educational activities). Of those SFS accessible to the public, 35% ($n = 7$) were inside a protected area (national or natural parks). Of these, we could only find data on the actual number of visits for two of them, so we did not include the other five (marked as "not considered" in Table A in the Appendix A) in the economic analysis. This

was because, unlike the other 15 SFS receiving visitors, we could not assume that the main reason for all public visits to the parks (some of which receive up to 561,000 visitors per year; GenCat, 2019) was mainly to enjoy watching avian scavengers (Tables 1 and A).

Second, 94 survey questionnaires (either in English or Spanish) were randomly distributed among 9 of the 15 SFS to gather information on the travel, subsistence (food, lodging), and opportunity costs (see Section 2.3(5)) incurred by each visitor (i.e. the trip characterization). Given the diverse management dynamic of the SFS (only two of the SFS surveyed offered scheduled visits), the questionnaires could not be made face-to-face. At each SFS, a hard copy of the questionnaires randomly distributed to each visitor at the end of the recreational and/or educational activities and they were fulfilled by each visitor. Questions covered information about where people came from, the duration of the entire trip (travel time / time spent at the SFS / time in the general area), the place (s) where they were lodging, the meals they were eating away from their accommodation, whether they came alone or with their children (how many), and their socio-economic status (monthly income) (see Table 1). We met the ethical standards governing social surveys by informing respondents in writing at the beginning of the questionnaire that their participation was voluntary and that their anonymity would be ensured.

2.3. Economic valuation

First, we used the descriptive nonparametric Wilcoxon and Mann-Whitney *U* tests ($\alpha = 0.05$) to explore if there were significant differences in the mean trip expenses and specific trip parameters such as distance travelled (distance by road in km) between the trip departure point and the SFS visited and trip duration (see Table 1) between visitors who started their trip from anywhere in Spain (national visitors) and those with departure points outside the country (international visitors). We used the Kruskal-Wallis test ($\alpha = 0.05$) to determine whether there were substantial differences in trip expenses depending on the SFS visited.

Table 1
Information obtained from telephone interviews with SFS managers and from the SFS visitors surveyed (questions included in the questionnaires are shown). The last column shows the possible answers to the multiple-choice questions.

Source of information	Type of information	Specific questions	Close-ended questions
SFS managers	Management characteristics of the SFS	Main activity offered	Birdwatching Educational Photography
		Mean number of annual visitors	–
		Entrance cost (in €)	–
SFS visitors	Trip characterization	Where did you start your trip? (city and country)	–
		Trip duration, including travelling time (in days)	–
		Accommodation	Hotel Hostel Apartment Camping Rural house Relatives' or friends' house Own house
		Meals usually eaten outside accommodation	Breakfast Lunch Dinner
		How many people are travelling with you?	–
		Are there any children travelling with you?	Yes / No
		If yes, how many?	–
	Socio-economic status	Average monthly income	< 1000€ 1000–2000€ > 2000€

Second, we calculated the specific costs of each trip parameter:

(1) *Travel costs*. For national visitors and those coming from southern France, we calculated the travelling costs considering the distance by road (km) between the departure point and the specific destination (the SFS visited). For international visitors and those from the Spanish Islands (considered national visitors in the non-parametric tests), we first calculated the distance by road (km) from their home to the closest city with an airport and then estimated the mean cost of a plane ticket from that airport to Barcelona. Then we calculated the distance by road (km) from Barcelona to the destination SFS and added the cost of renting a car (estimated mean US $17.4 per day after consulting the prices on several car renting websites in the Barcelona airport area). We calculated the cost of a round trip in all cases and used US $0.22 /km (0.19 €/km) as the cost of car travel expenses according to Spanish income tax claim guidelines (Orden EHA/3771/2005, 2021) and assumed the shortest route by road taking into account any necessary road tolls.
(2) *SFS entrance cost*. We collected data on the specific entrance price, if any, of the different SFS.
(3) *Accommodation costs*. We calculated a mean price for each type of accommodation for all the SFS surveyed by averaging the prices of three in the same category, for the high and low seasons separately, to arrive at a mean price per night for each type of accommodation. The overall mean price of US $33.7/adult and US $10.5/child per night was applied to those people who did not indicate their accommodation in the questionnaire ($n = 5$) (Table B in Appendix A).
(4) *Food costs*. We asked which of the three main daily meals the visitors were eating away from their accommodation, and then used that information combined with some approximate prices per meal in Spain (Table C in Appendix A). Children's costs were always estimated separately from adults' costs both for the accommodation and cost of meals.
(5) *Opportunity costs*. We included the opportunity cost of the time spent on the entire trip, taking four hours for the arrival and departure days and eight hours for each other day spent away. The opportunity cost is usually measured as the monetary value of what an individual could have been doing with their time instead of the activity they are on, generally calculated as 25% of the income of a working hour, at the given individual's salary (McKean et al., 1995; Becker et al., 2005). Working hours were assumed to be 40 h/week, as they would be in a normal full-time job in Spain. Children were omitted from the opportunity cost estimates.

We did not include the estimated cost of birdwatching and photographic equipment per visitor in the economic expenditure because we could not assume that the equipment had been acquired solely for scavenger-watching activities (especially for the cases where cameras were used).

Finally, we summed all these specific costs of each trip parameter for the entire trip to calculate the visitors' trip expenses and then computed a mean trip expenses/visitor value, as follows:

$$\text{Visitors'trip expenses} = \mathrm{T} + (\mathbf{SFSe} + \mathbf{A} + \mathbf{F} + \mathrm{O}) \times \text{trip duration}.$$

(Children's rates, shown **in bold**, were added if the visitor declared having made the SFS visit with accompanying children)

$$\text{Mean visitors'trip expenses} = \sum \text{Visitors'trip expenses} \Big/ \mathrm{n}.$$

where: travel costs (*T*); SFS entrance (*SFSe*, which depended on the trip duration only for SFS offering a photographic activity, but not for

the SFS offering birdwatching and educational activities, where we considered it as a fixed cost independent from the trip duration); accommodation costs (*A*); food costs (*F*); and opportunity costs (*O*). Costs were calculated in € and then translated into US $ (Table D in Appendix A), trip duration in days, and *n* represents the total number of visitors for which a visitor trip expense could be estimated ($n = 91$). Of these 91 visitors, four people did not respond to the trip duration question, so we assumed a minimum trip duration of two days based on the rest of the answers given in the questionnaire.

Based on the mean trip expenses per visitor and the mean annual number of visitors per SFS, we were able to estimate the annual expenses associated with the non-material NCP (recreational and educational experiences) provided by vultures at the Pyrenean SFS for which visits were allowed. We summed the total economic benefits estimated for the nine SFS surveyed and the estimated economic benefits for the other six, differentiating between the expenses resulting from visits made by nationals and international visitors to arrive at an average expense per person.

3. Results

3.1. SFS, visitors and trip characterization

We obtained a mean of 10 ± 4 completed questionnaires per SFS surveyed (range 3–17, Table A), whereas usable responses varied depending on the question, ranging from 76.6% ($n = 72$) answers giving monthly incomes to 98.9% ($n = 93$) answers giving the number of people who they were visiting the SFS with.

Of the respondents, 86.96% ($n = 80$ out of 92) were national visitors, coming mostly from the closest regions (Aragon and Catalonia, $n = 27$ and $n = 25$, respectively) within approximately 200 km of the SFS. However, national visitors came from all over Spain, 2500 km being the maximum distance travelled from the trip departure point (Canary Islands) to the SFS. The other 13.04% of respondents were international visitors starting their trip in a European country including Belgium, Denmark, France, Germany, Netherland, Hungary, Portugal, and the United Kingdom. The mean distance travelled by national visitors (mean ± SD: 543.57 ± 564.12 km) was significantly lower compared with that travelled by international visitors (2805.08 ± 933.07 km; Mann-Whitney *U* test, $U = 17$, $p < 0.001$; see Table E in Appendix A for median and range values).

The SFS entrance price ranged between US $0 and US $209 per day per person, depending on the specific SFS and the duration of the visit. Normally, the entrance price of an SFS offering a photographic recreational activity varies depending on the number of days spent visiting. The longer the stay is, the more economical the price per day becomes. The SFS offering birdwatching only frequently charge no entrance fee. Those promoting an educational activity have the most variable fees because are either linked to a museum with a nominal entrance price, managed by a nature conservation NGO which only accepts donations, or offer a paying guided environmental education activity.

Most visitors, 40.45% ($n = 36$) incurred no accommodation expenses because they stayed in their own homes or with friends. These options were almost entirely chosen by national visitors ($n = 35$; 97.22%). The other 59.55% of the respondents were nearly equally distributed between all the different types of accommodation, except rural houses (only one person chose this option) (Table B).

Visitors ate an average of 1.20 ± 0.79 meals away from their accommodation, lunch being the most frequent meal eaten outside; 74.39% ($n = 61$) of the visitors had lunch away from their accommodation, compared with 28.05% ($n = 23$) for breakfast or dinner.

We found significant differences in trip duration depending on the point of trip departure (national: 2.33 ± 1.67 days, $n = 76$ vs international visitors: 4 ± 2.27 days, $n = 11$) (Mann-Whitney U test, $U = 218$, $p = 0.008$; see Table E). Overall, 65.52% of the visitors ($n = 57$) spent only one or two days on their visit, most of them staying in their own home or with friends or relatives (57.89%; $n = 33$).

3.2. Economic valuation

We calculated the trip expenses of 91 visitors. The overall average expense per person per trip (i.e. mean visitor's trip expenses) was US $441.74 ± 372.70. However, there were significant differences depending on which SFS was being visited (Kruskal-Wallis test, $\chi^2 = 51.38$, df = 8, $p < 0.001$) ranging from US $46.09 ± 14.23 to US $791.13 ± 524.86 and depending on the departure point of the trip (Wilcoxon test, $W = 88.5$, $p < 0.001$). The trip expense was quite variable among visitors (Fig. A in the Appendix A), but on average it was higher for international (US $956.85 ± 425.33) than for national visitors (US $363.50 ± 353.40) (Tables D and E). Accordingly, the higher mean visitor trip expenses were spent in the SFS receiving higher proportions of international visitors.

The mean number of visitors was 812 ± 1,816 people per year per SFS (range 4–6,829 people depending on the SFS). The SFS receiving most visitors per year were those dedicated to educational activities, such as group guided visits around the SFS whose main focus was the vultures, or those linked to a nature conservation museum specializing in scavengers. In fact, when we excluded those SFS mainly promoting educational activities and look at those focusing on birdwatching and avian scavenger photography, we obtained a mean of 113 ± 137 visitors per year per SFS. The total number of people visiting the studied SFS in the Pyrenees in 2019 were 12,668 ($n = 20$, Table A).

We found an annual expense estimated at US $4,900,930.20 ± 2,629,779.10 accruing from the non-material NCP provided by European avian scavengers through recreational and educational wildlife-based activities at the SFS in the Pyrenees, comprising 32.13% in travel expenses, 22.93% in SFS entrance fees, 10.78% in accommodation expenses, 17.92% in food expenses, and 16.24% in opportunity costs (Fig. 1). This means that, in the region overall, at least US $2,530,350.26 ± 1,357,754.95 (51.63% of total annual economic profits; i.e. SFS entrance cost + accommodation expenses + food expenses) are injected annually into local Pyrenean communities thanks to recreational and educational experiences based on avian scavenger-focused tourism at SFS alone (Table D).

4. Discussion

4.1. The relevance of the economic valuation of NCP provided by avian scavengers

Our findings showed that the non-material NCP provided by European avian scavengers through recreational and educational activities (i.e. scavenger-based tourism) at SFS produces a relevant economic income to the Pyrenean community. On average, we estimated an annual economic value of US $4.90 ± 2.67 million; including US $2.53 million ±1.36 million of direct economic benefits to the local community (see Table D for results in Euros). It is important to note that this economic assessment is probably an underestimate because of our conservative approach to estimation of the individual trip expense parameters (e.g. car rental and food costs). In addition, accounting for the median trip durations of the national (two days) and international visitors (three-four days) estimated in our study (Table E) and the difficult access to the SFS (only available by road and not always waymarked), we assumed that the main reason of the visitors for doing the trip was to watch avian scavengers. Indeed, interestingly national visitors were willing to cross over half of the country (i.e. mean of 544 km) to arrive to the SFS just for a weekend visit, and, on the other hand, international visitors were willing to travel almost across the whole European continent (i.e. mean of 2800 km) to watch and enjoy avian scavengers at SFS (Table E). This is an interesting result in the case of Europe, where the distances between different countries is tiny compared with other continents (e.g. Africa or America), and also specifically in the case of the Pyrenees, a

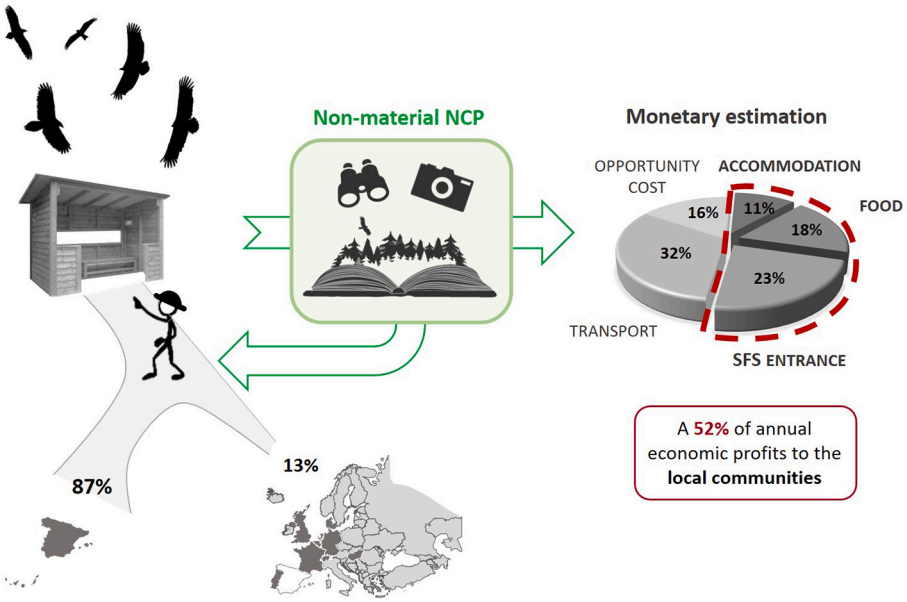

Fig. 1. Schematic representation of the economic valuation of the non-material contributions to people (non-material NCP) provided by avian scavengers through recreational and educational activities (i.e. wildlife-based tourism) at Supplementary Feeding Sites (SFS) receiving visitors in the Spanish Pyrenees. The main activities were birdwatching, photography and/or environmental education focused on scavengers. All these non-material NCP not only bring significant economic benefits to local communities, but also have an important effect on people's well-being in today's societies.

border area where visitors could be registered as "international", but come mainly from the South of France, having travelled only a few hundreds of kilometers. Moreover, this economic assessment is strongly dependent on the number of SFS visitors and, as it is a factor highly variable over time (on a yearly scale), even if we worked with yearly means of visitors, extrapolations to the future economic benefits obtained though scavenger-based tourism at SFS must account for this variability.

Because of an innate bird enthusiasm and the consequent investment that birdwatchers are willing to pay to practice this activity, birding is becoming "the fastest-growing and most environmentally conscious segment of ecotourism and the best economic hope for many beleaguered natural areas" (Salzman, 1995). Nevertheless, currently, there are very few studies that empirically assess the recreational (Becker et al., 2005, 2009, 2010), sanitary (Markandya et al., 2008) or environmental economic value (Margalida and Colomer, 2012; Morales-Reyes et al., 2015) provided by vultures. Thus, to our knowledge, this is the first economic valuation of recreational and educational experiences through avian scavenger-based tourism in a European country. Becker et al. (2005) estimated that 85% of the visitors to a nature reserve in Israel (i.e. Gamla) came specifically to view threatened griffon vultures, and that this activity produced a potential annual value of US $1.1–1.2 million. Then, also Becker et al. (2009) estimated through the travel cost method (TCM) an economic benefit of US $2.4 million and of US $2.94 million per year at two different nature reserves in Israel (i.e. Hai-Bar and Gamla, respectively) for the enjoyment of visiting the areas fitted with griffon vultures and a willingness to pay (WTP) for protecting this species of US $0.98 million at Hai-Bar and US $2.70 million at Gamla. Some of these sums resemble the benefits that we found were injected annually into local communities in the Pyrenees (US $2.35 million), which were generated uniquely through specific recreational/educational wildlife-based activities associated with the non-material NCP provided by the European avian scavengers. And that is only considering the SFS scavenger-based tourism of the region, leaving out of account specific avian scavenger festivals or guided photographic tours around the Pyrenean area, or even visitors looking for nature enjoyment beyond avian scavengers watching (further on detailed in Section 4.2). This is a significant amount, especially if we consider that, according to a Spanish Environmental Ministry report of 2017, the estimated national economic revenue of direct expenses derived from nature-based tourism (i.e. a tourism mainly motivated by the development of recreational, leisure, interpretive, educational and sport activities in nature) was on average 9 million € (i.e. US $10.47 million) (SGAPC and MAPAMA, 2017).

Markandya et al. (2008) calculated the human health cost of medicines, doctor remuneration, and work compensation associated with human rabies transmitted by feral dog bites in India at an estimated annual mean of US $2.43 billion. Such rabies transmission increased alarmingly almost three decades ago following the dramatic decline of vultures in India. This drastic and sudden vulture decline resulted in an increase of facultative scavenger populations (e.g. feral dogs), which led to an increase in dog bites, and consequently rabies cases in humans. On the other hand, the monetary value of regulating NCP is undeniably relevant considering that, in Spain, vulture populations have been estimated to dispose of an average of >8000 metric tons of animal biomass annually, saving the country an estimated US $1.6 million each year (Margalida and Colomer, 2012). Likewise, Morales-Reyes et al. (2015) estimated that natural removal of extensive livestock carcasses by scavengers would yearly save Spain 77,344 metric tons of CO_2 eq. emissions produced by the artificial collection and transport of this rotting matter to authorized plants and US $50 million yearly in payouts to insurance companies. Studies like these (including this present one) clearly demonstrate the important social and economic benefits that avian scavengers provide to humans.

Our results showed the need to do more analyses of this type —and not only from an economic perspective— to improve appreciation of the societal value of both the avian scavenger guild, and the individual scavenger species. Economic valuations, such as the presented here, provide interesting perspectives on the important roles played by the scavenger guild and ornithological tourism in Spanish society today. They can help to reveal the as yet often hidden benefits for human well-being arising from the non-material NCP provided by scavengers.

Given the relevant potential to improve the financial and environmental well-being of local communities that birdwatching tourism has demonstrated (Şekercioğlu, 2003), highlighting the revenue and financial savings provided by vultures' NCP could help to promote the conservation of these globally threatened species. However, the economic outcome should not be taken as the sole reference to valuate NCP, since it is largely determined by the prevailing temporal and socio-institutional contexts, which means that this value is neither universal nor invariable across time or cultures (Kallis et al., 2013). Economic valuation needs to be complemented by other innovative NCP evaluation and analysis methodologies, such as social multi-criteria analysis (Munda et al., 1994; De Marchi et al., 2000), or deliberative valuation

(Howarth and Wilson, 2006; Kelemen et al., 2013; Kenter et al., 2016).

Some recent complementary studies have emphasized the conservation values of the non-material NCP provided by vultures, highlighting their importance in addition to the purely economic benefits (Cortés-Avizanda et al., 2016; De Vault et al., 2016; Echeverri et al., 2020; Aguilera-Alcalá et al., 2020). In this context, further research is needed to evaluate also other non-material NCP provided by avian scavengers at SFS such as their contributions to aesthetic and learning values, sense of place, or spiritual awareness.

4.2. Characterizing avian scavenger-based tourism

We have evaluated a form of wildlife-based tourism aimed at a specific stakeholder group interested in enjoying a birdwatching, photographic, or educational activity focused specifically on the avian scavenger guild. However, we should not forget the interests not covered by our study. Non-specialist visitors to the region surrounding the study area and other national and natural parks also make an economic contribution: hunters and sportspeople, or those with a more generalist interest in nature and landscape-based leisure activities. They do not travel to protected regions specifically to see avian scavengers, but enjoy the general psychological, physical, and social benefits of being in contact with nature (Velarde et al., 2007; Abraham et al., 2010; Hausmann et al., 2020). That said, such visitors would likely profit from some of the direct and indirect non-material contributions provided by avian scavengers and appreciate their positive added value.

The recreational and educational experiences linked to SFS mainly promote domestic tourism, since 87% of the people visiting the SFS described here were national visitors (departing from somewhere inside Spain), while only 13% were international visitors coming from multiple European countries. National visitors came from all over Spain (travelling an average 544 km), although most were from areas surrounding the SFS; 87% of the national visitors came from a 200 km radius. The proximity of these visitors to SFS (mostly staying at their home or with friends) enabled an average stay in the study area of only two days. In contrast, international visitors, whose average journey was five-fold longer, spent twice as much time in the area. Interestingly, a study by Puhakka et al. (2016) in Finnish protected areas demonstrated that increasing length of stay, and especially the number of nights spent in the protected region, was positively correlated with an increase in the perceived well-being benefit felt by visitors, and the same is probably true for people visiting Pyrenean SFS. This relationship is probably linked to the feeling of escape from everyday routine that is one of the most common motivations in tourism (Iso-Ahola, 1982), and is probably an important subjacent reason for spending more than one day visiting an SFS, where the recreational and/or educational activities proposed (i.e. birdwatching, educational, or photography) could be easily done in a single day.

A longer stay also meant that international visitors spent significantly more on their trip expenses than national visitors. The most common plan for up to 65.52% of visitors was to sleep at a friend's or relative's house (an option generally preferred by national visitors) and to eat only one meal away from their accommodation each day. As many as 74.39% of the visitors ate lunch away from their accommodation during their visit, while fewer than half took breakfast or dinner out. This meant that restaurants and food markets earned almost double the money taken by landlords and hotels as a result of visiting tourists.

Our findings also indicate that the SFS promoting educational activities (more likely to be visited by families) received higher incomes each year than those only offering photographic activities (usually specifically aimed at keen photographers, foreign visitors, or those with greater purchasing power). This is because SFS with an educational agenda generally get more visitors and therefore obtain greater annual incomes despite their lower entrance fees. Beyond solely recreational experiences, some SFS also play an important role in providing non-material learning and inspiration NCP, values that start to be assessed in vertebrate scavengers by some scientists (Aguilera-Alcalá et al., 2020). Regardless of the recreational and educational offer, SFS can offer professional training opportunities for field technicians and provide valuable resources for population censuses, demographic studies, and tagging of avian scavengers for scientific population monitoring (e.g. Margalida et al., 2020). Some studies analyzing these specific non-material NCP have already been published (e.g. Brink et al., 2020), but more studies should be designed to quantify and evaluate the impacts of these cultural contributions. In any case, we should never lose sight of the fact that scavengers are the NCP providers and the SFS only some platforms (although not the unique ones) that allow us to enjoy and benefit from these non-material NCP.

4.3. Conservation value and economic balance of SFS

Previous research in two nature reserves in Israel performed a cost-benefit analysis of the conservation efforts to preserve the endangered griffon vultures (Becker et al., 2009), showing that to be economically efficient, SFS should help increase the vulture population by an average of 0.24–2.20 individuals per year. In addition, Donázar et al. (2009) estimated the cost of building a new SFS, either in France or Spain, at between US $21,900 and US $54,700, plus US $21,900 each year for its maintenance costs. If we project this data to the 67 SFS currently operating in the Pyrenees, it results in approximately US $1.47 million to US $3.66 million in building expenses and US $1.47 million in annual maintenance costs. Therefore, even taking into consideration the highest SFS estimated expenditures, a simple monetary balance shows that the mean annual economic benefit indirectly accruing to the Pyrenean human community from SFS avian scavengers-based tourism represents almost half of this initial building investment. Considering our conservative approach, at least US $2.53 million are recovered annually from visitor expenditure on accommodation, food, and SFS entrance costs. This is an interesting reflection especially if we take on board that most of the investment to build and maintain SFS originated with a conservation purpose are publicly funded in Spain.

Leaving aside the simple economics of SFS, their sensitive contribution to conservation strategies must also be considered (Brink et al., 2020; Cortés-Avizanda et al., 2016). While their potential benefits for wild fauna conservation and reintroduction are clear, a number of recent studies have shown that SFS are only useful conservation tools in specific contexts (i.e. when food availability is low, or there are risks from illegal poisoning) and during limited periods of time (i.e. critical breeding periods such as when chick are hatching and during their first days of life). Indeed, some studies have shown that the aggregating effect of SFS on the Pyrenean population of bearded vultures may cause reduced geographical expansion, declining breeding output, and the loss of habitat quality due to a conspecific attraction/aggregation and consequent shrinkage of territories and increase in intra-specific competition (Carrete et al., 2006; Margalida et al., 2016). SFS have been shown to cause monopolization of resources by certain species or individual age classes (Cortés-Avizanda et al., 2012; Duriez et al., 2012; Moreno-Opo et al., 2020), and can also act as sources of pharmaceutical rich residues in carcass debris from domestic livestock or promote the spread of pathogens from livestock to wildlife and the existence of multi-drug resistant pathogens (e.g. Plaza et al., 2020).

Therefore, even if SFS do act as a significant economic engine through nature-related sustainable tourism, we must not forget their original purpose of avian scavenger conservation. SFS are conservation feeding structures that may offer some exceptional times (i.e. only 30% of Pyrenean SFS) recreational and educational activities. Thus, SFS are not designed for tourism, but because of a conservation necessity. Consequently, they are ruled by conservation principles and when they are no longer needed, they stop working. In this sense, the scavenger-based tourism promoted by SFS could be considered such as the one linked to some no massed wildlife watching trips used to the population census, or environmental conservation projects that are partially funded

and supported by volunteering work (Ellis, 2003; Wearing, 2004; Hughes et al., 2014), where the conservation practices would be equally developed even in the absence of tourists/volunteers and the main priority is the ecosystem preservation.

On balance, we need to ensure that potential cultural added value and economic and social benefits of SFS in fostering recreational activities (birdwatching, educational, or photographic opportunities) add to, rather than detract from, their conservation aims. To do so, a scientific lead is required to determine conservation priorities such as specific species needs, increasing carrying capacity in relation to food availability and expansion of scavenger species' geographic range (e.g. Margalida et al., 2020). Future management of SFS should therefore determine the priorities of the existing SFS and how best to harmonize conservation with recreational activities. Scientist should apply their professional expertise to supervising periodic monitoring of the continuing conservation value of SFS. This would be the only strategy to prevent at all times the possibility that this kind of wildlife-based tourism provoke short- or long-term behavioural disorders in the local wildlife (as it has already happened, for example, with sharks, marine mammals, polar bears, turtles, and birds in wildlife tourism experiences, e.g. Corkeron, 2004; Dyck and Baydack, 2004; Arcangeli et al., 2009; Landry and Taggart, 2010; McFadden et al., 2017; Cisneros-Montemayor et al., 2020).

5. Conclusions

In a society where the scavenger guild is frequently neglected regardless of its fundamental role in a multitude of ecological processes and key role in human well-being (Moleón et al., 2014; De Vault et al., 2016), there is an urgent need to make the NCP provided by these species known and put them in value. Our findings contribute to highlighting the important role of avian scavengers in providing non-material NCP through recreational/educational activities at SFS. To this end, this study supports last years' call to better integrate scavenger conservation into the IPBES (Martín-López et al., 2018 and improve our understanding of the link between the today's human society and the scavenger guild. Nowadays, wildlife-based tourism is an important source of income for many local communities. Touristic activities associated with SFS have been discussed by Anderson and Anthony, 2005; Piper, 2005; and Ferrari et al., 2009, which frequently point out that the necessary harmonization between nature conservation and economic development is all too often forgotten. While recognizing that SFS construction should always follow conservation needs, and that scientific monitoring is necessary to constantly evaluate their usefulness as management tools, multiple cultural experiences based on the non-material NCP of avian scavengers can be promoted as means of increasing people's quality of life and generating local revenue. Birdwatching, educational, or photographic activities enrich the recreational experience of visitors to SFS, provide added cultural value to the regional landscape, and make a real contribution to the income of local communities. Future research in this area should seek to discover more about the potential value of SFS and the social value of iconic species as providers of non-material NCP, including the role they play in shaping visitors' perceptions of the scavenging fauna.

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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Appendix A. Supplementary data

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