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Multiple assessments to value wild animals in the analysis of human-wildlife relationships: a case study from the Argentine Dry Chaco

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ABSTRACT

Different perceptions of wildlife are usually involved in decision-making processes on the use of environmental commons and in human choices; therefore, knowing how people value nature can enhance our understanding about human-wildlife relationships. We propose to broaden the concept of cultural value by considering the trade-offs between positive and negative nature's contributions to people (NCP), including trade-offs influenced by near-past contexts. Field work was conducted with inhabitants of a rural community of the Dry Chaco of Argentina, aiming at knowing the importance of fauna in people´s lives. We conducted free listings and semi-structured interviews and calculated the cognitive salience index and five cultural value indexes (differing in the number and types of NCP categories considered). Local inhabitants were found to assess wild species by considering the satisfaction of material needs, immaterial aspects, and/or the damages that certain species may cause. The ethnospecies most widely and frequently used with material purposes in the near past and at present, and those considered the most harmful showed the highest salience values. The cultural value index that integrates both positive and negative assessments was positively correlated with cognitive salience; this relationship supports the results, showing that cognitive salience not only is conditioned by positive assessments but also captures multiple fauna assessments, including the negative ones.

Keywords: Cultural value; Cognitive salience; Material and non-material values; Nature's Contributions to People; Ethnozoology.

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SIGNIFICANCE STATEMENT

Our article aims to revitalize the discussion about cultural value in ethnozoology and its assessment. Drawing upon the conceptual framework of Nature's Contributions to People, we performed a methodological exercise to calculate an alternative cultural value index (CV) of wildlife in rural communities of the Dry Chaco of Argentina. In the evaluation we considered not only material and positive values (the traditional way of calculating the CV), but also complementary perceptions (e.g., non-material values), even the negative ones. This approach attempts to better represent the target groups' perceptions of wildlife. We highlight the importance of widening the spectrum of aspects to be considered during this kind of valuation exercises, as well as of being more cautious when trying to relate quantitative indexes to people's perceptions.

INTRODUCTION

Wildlife has historically played an important role in indigenous and rural communities as the basis of material and spiritual life (Altrichter 2006; Alves et al. 2009; Ulloa 2002). Because different perceptions of wildlife are usually involved in decision making processes (Gosler 2017; Wajner et al. 2019; Zamudio and Hilgert 2018), knowing how people value nature can enhance our understanding about human-wildlife relationships.

From the perspectives of natural and economic sciences, the values of nature have been estimated with a focus on ecosystem services (ES). This approach proposes the estimation of the ES supply (e.g., Díaz et al. 2018; Fletcher 2010; Pascual et al. 2017), based on the principles of satisfaction of human needs (MEA 2005). Recently, a similar framework for this estimation has been proposed with a significant epistemological shift: nature's contributions to people (NCP) (Díaz et al. 2018; Pascual et al. 2017), which arises from the need to incorporate a broader set of views and stakeholders. It advocates for a better representativeness of local knowledge and of the different cosmologies, interests, and values of local populations. Similarly to ES, NCP calls for the inclusion of all positive (benefits) and negative (losses or damages) contributions that people obtain from living nature (Díaz et al. 2018; Pascual et al. 2017). According to this approach, cultural aspects are not a single compartment, but permeate all other aspects of NCP (Díaz et al. 2018). In our work, we draw on this theorical framework to explore the multiple ways of assessing wildlife from an ethnobiological perspective and considering a long-standing relationship between people and wild animals in the Dry Chaco of central Argentina.

Following different approaches, ethnobiology has long been concerned with the importance of assessing the role played by animals or plants in different local contexts (Santos-Fita et al. 2009). As a synthesis exercise to meet this objective, the discipline has proposed to estimate the cultural importance of a species, defined as the value or role that this species plays in a certain culture (Hunn 1982). Various quantitative indexes were used to evaluate cultural importance, especially of medicinal plants (Castaneda and Stepp 2007; Da Silva et al. 2006; Medeiros et al. 2011; Phillips et al. 1994; Reyes-García et al. 2006; Tardío and Pardo de Santayana 2008). The relative importance of a plant (i.e., cultural importance) is quantified through the "simple summation of the numbers of the uses (or activities) per use category, taxon or type of vegetation" (Phillips 1996: 181-182). In general terms, the developed cultural importance indexes assume that the most widely used, most agreed upon and most frequently cited plants would be the culturally most important ones (see Medeiros et al. 2011). Thus, the cultural importance of animals or plants has been estimated principally by quantifying its material value (Bennet and Prance 2000; Monroy and Flores 2015; Pieroni 2001; Reyes-García et al. 2006 and others).

In an attempt to integrate multiple valuations, Reyes-García et al. (2006) propose a new way of valuing plant species in cultural, practical and economic dimensions, although considering only positive and material valuations. On the other hand, Bentley and Rodriguez (2001) proposed that people from a given culture may identify other species categories of local cultural priorities (like species for relieving pain, playing, getting food and shelter, and managing pests) as much as for their nuisance value and for their utility. Recently, Coe and Gaoue (2020), tested if commonly used cultural importance indexes predict species cultural keystone status, revitalizing discussions about the cultural importance and quantification in ethnobiology. They examined the potential limitations of these indexes as a way of avoiding erroneous or misleading conclusions. Because these indexes are calculated at species level, they propose that phylogenetic relatedness in ethnobotanical predictive models should be controlled to test redundancy among existing indexes (Coe and Gaoue 2020).

Another way of highlighting the importance of natural elements in people's lives is resorting to cognitive presuppositions (i.e., salience) that are affected by attitude, behaviour, and functions of the human mind (Robbins and Nolan 2019; Sutrop 2001; Zamudio and Hilgert 2018). The most common way of approaching cognitive relevance is based on the free listings methodological technique, in which the interviewees are asked to list elements of a given semantic domain (Bernard 2006; Quinlan 2005; Sutrop 2001). According to Quinlan (2005: 223), "the order in which people list items reveals psychological or cultural preeminence of items given a certain prompt". While salience analysis takes into account the frequency at which an item is mentioned, it also weights its position in the list (see Sutrop 2001), and unlike cultural importance indexes, it does not resort to the individual valuation in material terms of the mentioned items. Therefore, cognitive salience is a non-transparent and multi-layered concept that explains the place that different elements of nature occupy in human cognition (see Gosler 2017; Hunn 1999; Quinlan 2005); however, the real dimension of cognitive salience is not given a *priori* and must be evaluated in each case. It can be influenced by a subset of species attributes (e.g., phenotypic, perceptual, cultural and ecological) or their combination (Hunn 1999). For example, cognitive salience value may be correlated with the material importance of plants and animals, their con-

spicuousness or appearance, ecological aspects such as abundance, and/or a combination of positive and negative assessments of those species (see Lucena et al. 2012; Wajner et al. 2019; Zamudio and Hilgert 2018).

Although many studies have evaluated the cultural importance of wild animals in people's lives, few quantitative ethnobiological studies have considered their symbolic and non-material importance, or their local negative assessments (García del Valle et al. 2015; Herrera-Flores et al. 2019; Wajner et al. 2019) and, as far as we know, no studies have evaluated the trade-offs between different NCP (both positive and negative) provided by wild animals to people. Among those studies, García del Valle et al. (2015) incorporate the non-material categories "harmful" and "narratives" and use the frequency of records as an indicator of cultural Importance. Herrera-Flores et al. (2019) incorporate the "damage control" category in the estimate of the cultural importance index based on the modified index from Figueroa-Solano (2000) and in turn modified from Turner (1988). To know people's perceptions on wild animals, Wajner et al. (2019) made three free lists of "beneficial, harmful and dangerous animals", which were later unified in a single list to generate a cultural value using Sutrop's (2001) cognitive prominence analysis for their calculation.

Accordingly, we argue that assessment of local perception of wild animals would not only reflect its material or utilitarian importance (positive or beneficial NCP) but also show alternative or complementary perceptions, such as animal-human conflicts, fears and other representations (Nolan et al. 2006; Castillo-Huitrón et al. 2020) as well as non-material assessments. These points are central to our analysis, since some animals such as top predators and/or agricultural pests tend to be negatively perceived in some situations or contexts, whereas they can be considered positive in others (Castillo-Huitrón et al. 2020; García del Valle et al. 2015; Herrera-Flores et al. 2019; Tamburini and Cáceres 2017; Wajner et al. 2019). In turn, perceptions may be influenced by historical and dynamic contexts, e.g., those animal products that were profitable in the past and that are currently prohibited, no longer used, or undergoing changes in species abundance (Gosler 2017). In other words, does the cultural importance of a certain plant or animal disappear when it is no longer materially used?

Within this framework, our overall goal is to broaden the assessment of cultural importance to find the best way to represent how the rural people of the Dry Chaco of Córdoba (Argentina) value local fauna. Drawing upon people's local ecological knowledge about wildlife, we pose the following research questions: a) What place does each species of wildlife occupy in the cognition of this social group?; b) How does the cultural importance of species vary when different NCP categories (material and immaterial, and positive and negative values) are considered in the calculations?; c) Does the cultural importance and cognitive salience indexes explain the same aspects about wildlife?, are these indexes redundant? In this work, we propose a methodological exercise that seeks to shed light on the difficult task of assigning values to nature from local people's point of view, and to find the best way to represent it.

MATERIAL AND METHODS

Study area and people

We conducted our study in Pocho Department, located in the west of the province of Córdoba, Argentina (Figure 1). The area holds one of the last native forest formations of the Dry Chaco (the southernmost extreme of the Gran Chaco, Naumann 2006), dominated by *Aspidosperma quebracho-blanco, Prosopis flexuosa, P. nigra, P. torquata, Parkinsonia praecox* and other species of smaller size like *Mimozyganthus carinatus* and *Larrea divaricata* (Cabido et al. 2003). The average altitude is 390 m a.s.l. There are two protected areas in this region, Chancaní Provincial Natural Park and the newly created Traslasierra National Park, which protect fragments of the Dry Chaco Forest. The climate is temperate, characterized by absolute maximum and minimum temperatures of about 42°C and -6°C, respectively (mean annual of 18°C). Average annual rainfall (480 mm) is concentrated in the warmer months (November to February), and there are no permanent water courses (Cabido et al. 2003). Due to the environmental limitations and poorly developed irrigation systems in most of the region, annual-crops cultivation is not common.

The population of Pocho Department, one of the poorest departments in the province, is mainly rural, showing a low density (average of 0.5 to 0.7 inhabitants/km^2) (INDEC 2010). The study area included the rural village of Chancaní and 12 neighbouring settlements. Inhabitants are Spanish-speaking mestizo peasants (also called *campesinos*), gathered in approximately 400 families. The settlers are small-scale farmers, mainly dedicated to livestock production, mostly goats (between 15 and 150 heads per family), and a few cattle to a lesser extent. The families are spread throughout the forest and depend on it for diverse purposes (Cáceres et al. 2015). Most families combine small market-oriented production (principally goat kids for meat) with other activities for their own consumption, such as hunting, small-scale

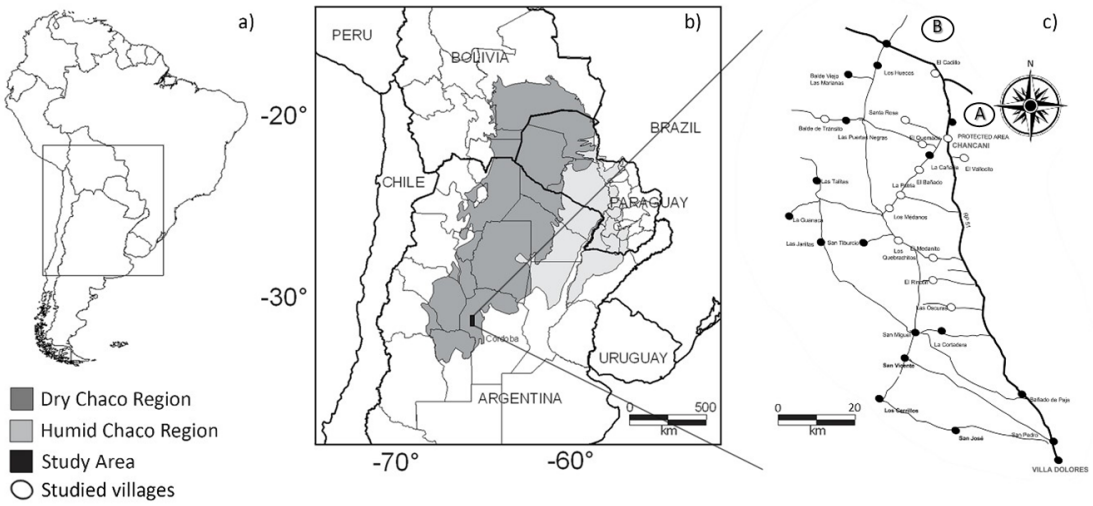

Figure 1. Study area within the Dry Chaco region (a, b, based on Olson et al. 2001; c, based on Tapella 2012). A, Chancaní Protected Area; B, Traslasierra National Park.

cropping, and harvest of non-timber products, like medicinal plants and edible pods. In the last three decades, some political and socio-economic changes have led to modifications in the use and access of some forest products (e.g., legal norms). In this regard, wildlife skins and hides were widely used in the past and represented an important source of income to the families. Currently these products have no market value because of local and international trade prohibition (see Tamburini and Cáceres 2017). On the other hand, some of the social policies promoted during the last 15 years improved the economic security of many peasant families through pension schemes or social security plans (Cáceres et al. 2015; Tapella 2012).

Methods

The present work is based on a study carried out on hunting (Tamburini 2016; Tamburini and Cáceres 2017), in which we interviewed 40 adult men of 25 to 77 years of age, between 2010 and 2012. Although most family members usually hold valuable knowledge about wildlife, productive and extractive activities that take place in the forest are carried out by men (e.g., herding and protecting domestic livestock, repairing cattle fences and hunting), so they are in close contact with wildlife. All the interviewed collaborators are permanent residents with family histories rooted in the area; therefore, they can be considered a relatively homogeneous group (Tamburini 2016). We first met key informants (e.g., the natural-reserve ranger) who have a deep knowledge of the community and are well-informed about wildlife in the study area. They were briefed about the research aims and we asked their advice about possible suitable interviewees (Bernard 2006). Once we conducted the first interviews, we used a snow-ball sampling method and asked the interviewees for other candidates to further our interviews (candidates had to be men who live in one of the rural villages in the region and who agreed to be interviewed). We stopped interviewing when we achieved a satisfactory level of theoretical saturation (Bowen 2008).

Field work was carried out following the guidelines established by the Code of Ethics of the Latin American Ethnobiology Society (SOLAE Ethics Committee et al. 2018) throughout the study. During the first visit to the interviewees, we focused on introducing ourselves and communicating the objectives of our research. Informed consent was obtained orally since many of the interviewees are illiterate. In the second stage, we used two different sampling strategies to collect information. First, we conducted free listings by asking the interviewees: “please, name the animals you know in the region" (Bernard 2006; Quinlan 2005; Sutrop 2001); after obtaining a first list, we asked again: “any other that comes to your mind?" in order to guarantee that they listed all the fauna they considered worth mentioning. At the end of this instance and in the same visit, we conducted semi-structured interviews asking about the role of wildlife in their lives and its importance in terms of benefits and/or losses (currently and in the past). The information obtained was classified into beneficial or positive and/or negative groups of values (material, non-material, regulating and detrimental), and then were linked to the different types of NCP based on the proposal of Díaz et al. (2018) (Figure 2). During the interviews, local terminology and vernacular

names were used to name the fauna, and specific bibliography and photos were used to identify the species (Cabrera 2009; Canevari and Vaccaro 2007; Narosky and Yzurieta 2010). Domestic animals and generic categories (i.e., "birds", "lizards") were used only for a general list but were not included for the formulation of the indices explained below.

To know the place that each ethnospecies occupies in the cognition of this social group, we calculated the Cognitive Salience (S) index using the Sutrop's proposal (2001) (Figure 2a). The S index shows the psychological relevance of a series of items (ethnospecies) within a free list, by combining the frequency of references and the average position of each item. The average position was obtained by averaging the place that each ethnospecies occupied in the free listing (first= 1, second= 2, etc.) provided by each respondent who mentioned that ethnospecies. Cognitive salience index estimation is not affected by the length of the individual lists and reaches values between 0 and 1 (from least to most prominent). This procedure yielded a single list of ethnospecies, which was ordered from highest to lowest cognitive salience. The ethnospecies mentioned fewer than three times were not taken into account because they were considered of low consensus (Sutrop 2001). On the other hand, the number of total records of each ethnospecies was considered as a proxy of people's local knowledge about them (hereinafter LK), considering the cultural consensus as a knowledge expression (Rommey et al. 1986).

To calculate the cultural importance of each ethnoespecies we relied on the proposal of Reyes-García et al. (2006), the Cultural Value index, using the equation: $CV = Uci \cdot Ici \cdot \sum IUci$, where Uc is the total number of NCP categories reported for the ethnospecies i divided by the possible NCP categories considered in the study; Ic stands for the number of interviewees who mentioned the ethnospecies i divided by the total number of interviewees; and IUc indicates how many times a participant mentioned NCP categories of the ethnospecies divided by the total number of participants. Unlike the original proposal, which includes only the "uses" of ethnospecies (material NCP), in this work we also consider other categories, like non-material (or intangible) and regulating NCP, even the negative assessments (Figure 2b). We assume that each record in each category has the same value (e.g. if an ethnospecies was valued for meat and for its role in the ecosystem, it has a value of 1+1) so that the number of references in each category acts as a magnitude value not influenced by researchers' decisions. We think that by giving an equal value to each reference is a way of exercising impartiality, since it would be unwise for researchers to assign a higher value to any record of one category over another. In this sense, we believe that the diverse use of categories and the frequency of records will end up closely reflecting (not certainly) what the cultural importance of an animal from the perspective of rural people is.

As a methodological exercise, and in order to identify subtle changes in the importance of the ethnospecies when considering different NCP categories (i.e., food, medicine, harm, etc.), we calculated five different CV indexes based on the same equation proposed by Reyes-García et al. (2006) detailed above. Each one includes variations in the NCP number and categories (positive and/or negative) in the equation of CV (Figure 2c). The Past Material CV (PMCV) includes six NCP categories, and the Current Material CV (CMCV) five categories, all of them only material NCP (see Figure 2c). The difference between them is that the former also includes the hides/skins category, a product that was important in the past because it was sold, but whose trade was prohibited about 20 years ago. The Positive CV (PCV) with eight categories includes all material and non-material values, and the role of ethnospecies in the ecosystem (regulating values) (Figure 2c). The Negative CV (NCV, with five categories) was calculated only considering danger and damage caused by wildlife mentions. Finally, the Integral Cultural Value (ICV, 12 categories) includes all NCP categories (i.e., both positive and negative fauna values, except for hides or skins for trade) (Figure 2c).

For example, the Pampas Fox (*Lycalopex gymnocercus*) was cited by 36 participants; it was mentioned for five NCP: 10 citations for its skin uses in the past, one citation referring to his ethical/hedonic category, three citations in its role in the ecosystem (all of them positive values). It was also mentioned 38 times as a cause of damage to domestic animals and three times as a cause of damage to the ecosystem (both negative values).

Then, if $CV = Uci \cdot Ici \cdot \sum IUci$;

- Its CMCV=0 because it was not mentioned in any current or material use in any of the five NCP categories included in this CV index (Figure 2c).
- Its $PCMV$ = (1 skin use /5 NCP categories) $*$ $(36/40) * (0 + 0 + 10 + 0 + 0/40) = 0.113$
- Its $PCV = (2/5)*(36/40)*(0+1+3+0+0/40) = 0.026$
- Its $NCV = (2/5) * (36/40) * (0 + 38 + 0 + 3 + 0/40) = 0.351$
- Its $ICV = (4/12) * (36/40) * (0 + 1 + 3 + 0 + 0 + 0 + 38 + 0 + 3 + 0 + 0 + 0 + 0 + 0/40) = 0.323$

To calculate Cognitive Salience (S) and Cultural Value indexes, only the ethnospecies recorded in the

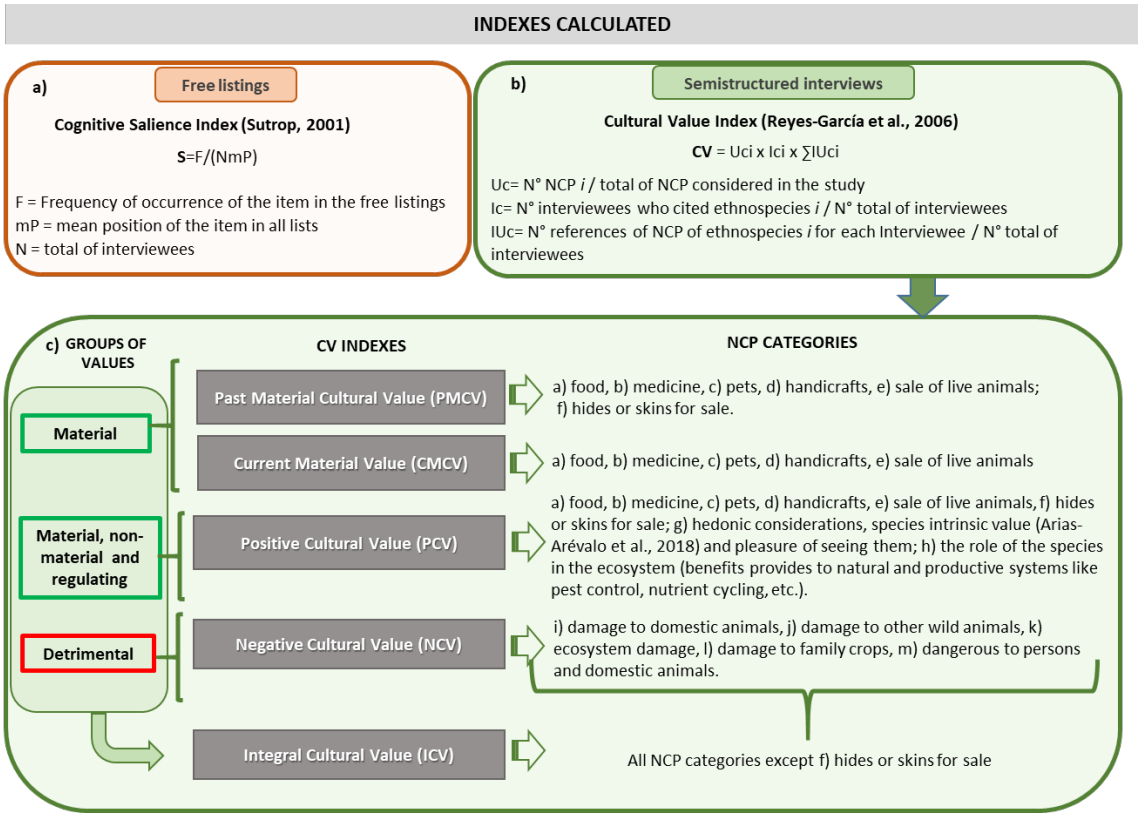

Figure 2. Summary of the methodology used to calculate: a) Cognitive Salience (S), b) general formula of Cultural Value; c) five Cultural Value indexes, describing the type of data included in each case (beneficial or positive NCPs in green boxes; negative NCPs in the red box) and their respective NCP categories.

free listings and the information about them from the interviews were used.

Data analysis

Through the analysis of the interviews, we obtained descriptive statistical parameters, such as the number of ethnospecies mentioned, number of uses and values for each one, which allowed us to know the ethnospecies knowledge consensus. Then, the ethnospecies were classified into groups of values according to their benefits or damages reported by people in: material, non-material, regulating and detrimental, and were linked to the different NCPs categories. The number of total citations of each ethnospecies was considered a proxy of LK (each citation for each ethnospecies and its significance category). For the calculation of S and CV indexes, only the ethnospecies from the free listings (and the associated information from the interviews) were used. Species that were mentioned in other instances of the fieldwork were included in the list of total species and in the general analyses (see Table 1). The relationship between S, PCV and NCV indexes, and LK was analysed through a principal component analysis (PCA). This analysis allows us to study the interdependence of the metric variables (correlations) and the two-dimensional representation of the variability of the data. The objective is to reduce the size of the data and therefore simplify the analysis (Di Rienzo et al. 2009).

RESULTS

During the implementation of the free listings and semi-structured interviews, the interviewees mentioned a total of 73 animal ethnospecies, with a different degree of consensus. Each interviewee mentioned between 12 and 35 species, belonging to four groups of vertebrates: 26 mammals, 32 birds, 14 reptiles and one amphibian. No fish species were mentioned because there are no permanent water courses. Among mammals, two cited ethnospecies, the Wild Boar (*Sus scrofa*) and the European Hare (*Lepus europaeus*) are exotic. Of the mentioned ethnospecies, 53 were valued for their benefits (20 mammals, 25 birds, seven reptiles and one amphibian), and classified according to the different NCP categories (Table 1). Among the detrimental ethnospecies, 32 were mentioned: 14 mammals, nine birds and 10 reptiles. In some cases, the same species was mentioned in both categories,

and others were considered neutral, i.e., those that do not represent particular benefits or damages, but whose presence is recognized in the area (Table 1). The link of a species with certain harms or benefits does not exclude it from being linked in the opposite direction. That is, a species may be beneficial in one sense and detrimental in another. There were also neutral ethnospecies not associated with any specific benefit or harm (Table 1).

The material value of fauna was the most important (87% of all positive mentions), including the NCP categories of food, medicine, pet, commercial value of hides and skins, and for the sale of live individuals. The least significant group of values were the non-material (including NCP categories such as hedonic considerations, species' intrinsic value and the pleasure of seeing them) and regulating (the role of the species in the ecosystem), with 8% and 5% of the references, respectively. Among the benefits, the role of fauna as food source was the most important, with mammals being the most widely mentioned group. In this regard, one interviewee commented: "*Viscachas, Chacoan Cavy ... I think that all the animals in the forest yield some kind of benefit. When we need some meet, we go hunting and kill one for eating...*" (DM, El Medanito). The Viscacha (Lagostomus maximus) was one of the most appreciated species by interviewees. The sale of meat (like that of Armadillos) was reported as occasional and exclusively on request. The sale of live animals, mainly songbirds, was also reported, but in a lower proportion, as well as the sale of live animals (Table 1).

Other ethnospecies are a source of medicine, such as the fat of Puma (*Puma concolor*) to treat bone pains (rheumatism), bumps and bruises. The fat of Boa (*Boa constrictor occidentalis*) and Red Tegu (*Salvator rufescens*) is used to treat distemper in domestic animals (contagious catarrhal viral disease), and to remove thorns and heal wounds in people and animals. An interviewee mentioned how to use it: "*Red Tegu, Boa and Puma are all good. These are the most wanted ones* [as medicine]. *The fat is melted and then used with a warm piece of cloth. It's good to pull out thorns and for bone pain. Puma's fat has many good properties*" (AS, Las Oscuras). Another interviewee mentioned the use of feathers of Greater Rhea (*Rhea americana*) to cure earache, and the warm blood of the Southern Three-banded Armadillo to treat facial paralysis (human use). According to one interviewee, asthma can be treated by placing a live Chaco Tortoise (*Chelonoidis chilensis*) under the bed of the affected person during bedtime, until the person is completely cured. The use of some animals' skins and hides was also mentioned in a lower proportion for making handicrafts and braided leather ties (e.g., Chacoan Cavy - *Dolichotis salilincola*, Gray Brocket-Deer - *Mazama gouazoubira* and other species; see Table 1). The sale of skins and hides was an important practice in the past, but currently this activity is not relevant. One interviewee recounted the importance of the sale of skins and hides to families: "*In the past* [several decades ago], *during winter, money was very scarce. So, people hunted to sell hides and skins. There were plenty of Pampas Foxes and people hunted them a lot! Tegu' skins had a good price in summer, so they were hunted in summer*" (CT, Las Oscuras). Currently, the sale of Pampas Fox (*Lycalopex gymnocercus*) skins is considered an exceptional event.

Interviewees also expressed the value of ethnospecies that they did not consume or use (non-material NCP). These species had an intrinsic value for the interviewees, who benefitted from knowing that the species were in the forest (5%). Finally, regarding the regulating NCP (indirect use value), the interviewees highlighted the role of some ethnospecies in the ecosystem (8%). Among these, diggers such as Viscachas and Cavies (Common Cavy - *Galea leucoblephara*- and Northern Cavy -*Microcavia maenas*) were cited as playing a role in water infiltration through the soil, since they move and loosen the soil when they dig. The Pampas Fox was also mentioned as a controller of harmful species, because it preys on puma's offspring. In addition, scavenger species were cited consuming decaying biomass and therefore keeping the ecosystem free of the carcasses. One interviewee stated: "*To me, Viscachas are also useful because they dig burrows and water gets into the soil and the forest grows well!* [Viscachas] *produce a benefit with their very hands and nails!*" (IA, Santa Rosa). Some birds were mentioned as consumers of insects of sanitary importance. For example, the Scimitar-billed Wood creeper (*Drymornis bridgesii)* consumes winchuka (*Triatoma infestans*); this common hematophagous insect transmits the flagellated protozoan *Trypanosoma cruzi*, agent of Chagas disease.

Table 1. Total of ethnospecies grouped according to the different NCP categories (in parentheses: number of mentions of each significance category). References: Positive NCP: Food (F), Hides/Skin (HS), Spiritual value (SV), Ecosystem role (E), Sale of living organisms (S), Medicine (M), Handicrafts (H), Pets (P). Negative NCP: Damage to domestic animals (DA), Dangerous to persons and domestic animals (D), Ecosystem damage (ED), Damage to family crops (FC), Damage to other wild animals (WA). **In bold font: past uses.**

Scientific name	Common names	Positive	Negative	Neutral
MAMMALS				
Didelphis albiventris	White-eared opossum	F (1); **HS (2)**; E (1)	DA (9)	
Thyllamys pulchellus/T. pallidior	Chacoan Fat-tailed Mouse / Pallid Fat-tailed Opossum			x
Tamandua tetradactyla	Southern Tamandua			x
Chaetophractus vellerosus	Screaming Hairy Armadillo	F (29)	FC (1)	
Chaetophractus villosus	Large Hairy Armadillo	F (38)	FC (1)	
Cabassous chacoensis	Chacoan Naked-tailed Armadillo	F (4)		
Tolypeutes matacus	Southern three-banded armadillo	F (33); M (1)		
Chlamyphorus truncatus	Pink Fairy Armadillo			x
Lycalopex gymnocercus	Pampas Fox	**HS (10)**; SV (1); E (3)	DA (38); WA (3)	
Leopardus geoffroyi	Geoffroy's Cat	F (2); **HS (12)**	DA (17); WA (2)	
Leopardus colocolo	Pampas Cat	**HS (2)**	WA (1)	
Herpailurus yagouaroundi	Jaguarundi	F (1); **HS (3)**	DA (11); WA (2)	
Puma concolor	Puma	F (8); M (2)	DA (40); WA (3)	
Conepatus chinga	Molina's Hog-nosed Skunk	**HS (4)**; E (1)	DA (16); WA (1)	
Galictis cuja	Little Grison		DA (3); WA (1)	
Pecari tajacu/Catagonus wagneri	Collared Peccary / Chacoan Peccary	F (36); H (1)	FC (1)	
Sus scrofa	Wild Boar	F (29)	DA (1); ED (1); FC (5)	
Lama guanicoe	Guanaco			x
Mazama gouazoubira	Gray Brocket	F (31); H (2); SV (7)		
Lepus europaeus	European Hare	F (9); SV (1)		
Lagostomus maximus	Viscacha	F (37); M (1); **HS (1)**; E (1)	ED (9)	
Galea leucoblephara/Microcavia maenas	Common Cavy / Northern Cavy	E (1)		
Dolichotis salinicola	Chacoan Cavy	F (37); H (2)		
Dolichotis patagonum	Patagonian Mara	F (25); P (1); H (1)		
Ctenomys bergi	Córdoba Tuco-tuco	E (1)		
Ratt	Indeterminate rodent		FC (1)	
BIRDS				
Rhea americana	Great Rhea	F (1); P (1); H (1); E (1); M (1)		
Eudromia elegans	Elegant Crested Tinamou	F (16)		
Nothoprocta cinerascens / Nothura darwini	Brushland Tinamou / Darwin's Nothura	F (30)		
Coragyps atratus	American Black Vulture			x
Sarcoramphus papa	King Vulture			x

Hawk	Indeterminate raptor	E (1)	DA (3)	
Caracara plancus	Southern caracara		DA (5)	
Milvago chimango	Chimango Caracara		DA (4)	
Chunga burmeisteri	Black-legged Seriema	F (23); E (2)		
Patagioenas maculosa	Spot Winged Pigeon	F (8)	FC (1)	
Zenaida auriculata	Eared Dove	F (4); SV (1)	FC (1)	
Columbina picui	Picui Dove	F (2)		
Thectocercus acuticaudatus	Blue-crowned Parakeet	SV (2)		
Myiopsitta monachus	Monk Parakeet	F (2); P (2); S (2); SV (2)	ED (10); FC (9)	
Amazona aestiva	Turquoise-fronted Parrot	S (1); SV (7)		
Athene cunicularia	Burrowing Owl	E (1)	DA (1)	
Strix chacoensis	Chaco Owl			x
Asio clamator	Striped Owl			x
Colaptes campestris	Campo Flicker	E (1)		
Colaptes melanochloros	Green-barred Woodpecker	E (1)		
Veniliornis mixtus	Checkered Woodpecker	E (1)		
Dryocopus schulzi	Black-bodied Woodpecker	E (1)		
Furnarius rufus	Rufous Hornero	SV (1)		
Pseudoseisura lophotes	Brown Cacholote	SV (1)	DA (2)	
Drymornis bridgesii	Scimitar-billed Woodcreeper	E (1)		
Pitangus sulphuratus	Great Kiskadee	SV (1)		
Machetornis rixosus	Cattle Tyrant			x
Turdus chiguanco	Chiguanco Trush	SV (3)		
Sicalis flaveola	Saffron Finch	SV (1)		
Pheucticus aureoventris	Black-backed Grosbeak	S (7); SV (4)		
Cyanocompsa brissonii	Ultramarine Grosbeak	S (6); SV (8)		
Molothrus spp.	Cowbirds	SV (4)	ED (1)	
REPTILES				
Teius teyou	Four-toed Tegu			x
Salvator rufescens	Red Tegu	F (7); M (2); **HS (19)**; E (2)	DA (21); WA (2)	
Salvator meriane	Black and white Tegu	**HS (3)**		
Tropidurus etheridgei	Etheridge's Lava Lizard			x
Homonota fasciata	South American Marked Gecko		D (3)	
Boiruna maculata	Mussurana		D (4)	
Oxyrhopus rhombifer bahcmanni	Amazon False Coral Snake	E (1)	D (4)	
Philodryas psammophideus	Günther's Green Racer		D (4)	
Xenodon merremi	Wagler's Snake		WA (1); D (8)	
Crotalus durissus terrificus	South American Rattlesnake	SV (1); E (2)	D (30)	
Bothrops diporus	Lancehead Snake	E (1)	D (26)	
Boa constrictor occidentalis	Argentine Boa	F (4); M (3); **HS (17)**; E (5)	DA (27)	
Micrurus pyrrhocryptus	Argentinian Coral Snake		D (15)	
Chelonoidis chilensis	Chaco Tortoise	SV (1); M (1)		

AMPHIBIANS			
Rhinella arenarum	Toad	M (1); E (1)	
Total mentions		**605**	**344**
Summary of each category (%):			
Positive NCP: F=69%, HS=12%, SV=7,6%, E=5%, S=2,7%, M=2%, H=1,2%, P=0,7%.			
Negative NCP: DA=58%, D=27% ED=6%, FC=4,4%, WA=4,7%			

In relation to damages or injuries caused by wildlife, the damage to domestic animals were the most negative aspects reported (58%) principally by Puma and Pampas Fox, and the predation on wild species of local interest, i.e., a negative assessment of species that compete with humans for the same resource (4.7%) (Table 1). For example, respondents mentioned that Viscachas are predated by Boas and Pumas. One interviewee commented: "*Lampalagua, yes, that one has spread a lot, it is also another predator of fauna. It eats the Quirquincho* [Armadillo], *the Fox, the Viscacha, the Tinamou, it kills and eats everything it can catch*" (CT, Las Oscuras). The species referred to as dangerous were the venomous snakes, mainly the Chaco Lancehead (*Bothrops diporus*) and the South American Rattlesnake (*Crotalus durissus terrificus*), which may bite people, domestic animals and pets. One reference in this sense: "*Snakes... we are always very careful with snakes. I always have a torch and batteries* [to spot them at night]. *I fear them much more than any other animal in the forest. I don't fear Pumas or Wild Boars, at all. But I fear snakes! When I go hunting, I wear tall boots and I feel much more relaxed*" (RS, El Medanito).

Finally, some species presented negative connotations because they affect the ecosystem or some of its components, such as some herbivores that feed on grasses and their roots, and affect the availability of grasses for cattle, and some birds, which consume fruits of forage trees with high food value (e.g., pods of Algarrobo, *Prosopis* sp.). Another harmful ethnospecies mentioned was the Wild Boar; indeed, the interviewees reported that its arrival in the region (about 15 or 20 years ago) displaced the populations of collared Peccaries to mountainous or marginal areas. In addition, Wild Boars often mate with domestic pigs, leading to undesirable crosses.

Cognitive Salience

The interviewees named 55 ethnospecies in the free listings; then, after removing those with fewer than three references, the total number of species was reduced to 33 (see Table 2). The 15 most prominent ethnospecies according to the S index were mammals (top 12 places) followed by Tinamous (birds) and Tegu (a reptile) (Figure 3). Mammals not only stood out in the total percentages but also had the highest relative proportion within the first third, i.e., 9 of 11 ethnospecies of high cognitive salience with values between 0.21 and 0.06. These species groups show a great variety in terms of size, behaviour, and habits. However, apparently there is no clear reason why these species stand out from others, since some were prioritised for their meat, others for their dangerousness or for the damage they caused to domestic animals, or for the value of their hides in the past. But they definitely seem to be a good sample of the diversity of the fauna of the Dry Chaco.

Cultural Value

The CV indexes yielded variable results according to the type and quantity of NCP categories incorporated in each one. The current material CV ranged from 0 to 0.352, and the past material CV from 0 to 0.601; the positive and negative CVs ranged from 0 to 0.387 and 0.351 respectively; finally, the integral CV (ICV) ranged from 0 to 0.370 (Table 2). In all the CV indexes, some species had values equal to 0, meaning that they were not mentioned for the group of NCP categories included in that index (CMCV 21%; PMCV 15%; PCV 9% and NCV 36%).

Although different indexes were calculated, in several cases the results were unfailingly similar because similar data sets were used, allowing us to identify subtle shifts in the order of species values (Figure 4).

The Argentine Boa and Red Tegu presented a high Past Material CV (0.260 and 0.207, respectively) because they were the most widely hunted ethnospecies in the past, when market value of their hides was very high (Figure 4d). When past material values were not considered (i.e., when we calculated the CMCV), the importance of other species valued for their meat, such as Viscacha and Chacoan Cavy, increased, modifying the order of the 15 species with the greatest cultural value. Pampas Fox was not present among the 15 most important species, although it was one of the most culturally valuable species (Figure 4e).

On the other hand, when we calculated the Positive Cultural Value (PCV), the incorporation of regulating and non-material or intangible values to the calculation did not produce important changes in the valuation of the species. This is explained by the low number of times the ethnospecies was mentioned in this category. The Viscacha was the ethnospecies with the highest values of all positive indexes due to its use as food source and, to a lesser extent, the utilitarian value of its skin, its role in the ecosystem, and the reported medicinal uses. The Chacoan Cavy and the Gray Brocket were also recorded as highly valued ethnospecies by positive indexes. In addition to their appreciated meat, they were also valued for the quality of their hides, since they were used for the production of diverse elements for the house or the farm, such as ropes and reins (Figure 4a).

Table 2. Local knowledge (LK), Cultural Value (CV) Indexes: CMCV (Current Material CV), PMCV (Past Material CV), PCV (Positive CV), NCV (Negative CV), ICV (Integral CV), and Cognitive Salience Index (S) of ethnospecies. Values are ordered from highest to lowest ICV. *Mammals, **Birds, ***Reptiles. **In bold**: exotic ethnospecies (cells with —: animals not mentioned).

Scientific name	Common name	LK	CMCV	PMCV	PCV	NCV	ICV	S
**Lagostomus maximus*	Viscacha	37	352	601	387	42	370	213
**Lycalopex gymnocercus*	Pampas Fox	36	0	113	26	351	323	164
**Puma concolor*	Puma	36	36	30	26	351	264	205
****Boa constrictor occidentalis*	Argentine Boa	26	46	260	84	85	206	70
**Pecari tajacu* / *Parachoerus wagneri*	Collared Peccary / Chacoan Peccary	27	250	208	178	3	160	95
**Pediolagus salinicola*	Chacoan Cavy	33	322	268	230	—	134	168
**Mazama gouazoubira*	Gray Brocket	21	173	217	225	—	131	56
**C. villosus*	Large Hairy Armadillo	32	152	127	109	4	130	135
****Salvator rufescens* / *S. merianae*	Red Tegu / Black and white Tegu	16	36	207	47	72	121	39
****Sus scrofa***	Wild Boar	23	83	69	59	40	111	78
**Dolichotis patagonum*	Patagonian Mara	21	213	177	152	—	89	69
***Myiopsitta monachus*	Monk Parakeet	9	20	23	26	41	73	14
**Leopardus geoffroyi*	Geoffroy's Cat	19	5	55	3	90	62	56
****Crotalus durissus terrificus*	South American Rattlesnake	16	—	—	9	32	48	31
**C. vellerosus*	Screaming Hairy Armadillo	15	54	45	39	2	47	46
**Tolypeutes matacus*	Southern three-banded armadillo	25	103	86	74	—	43	95
***Chunga burmeisteri*	Black-legged Seriema	13	37	62	58	—	34	26
***Nothoprocta cinerascens* / *Nothura darwini*	Brushland Tinamou / Darwin's Nothura	20	75	63	54	—	31	49
**Conepatus chinga*	Molina's Hog-nosed Skunk	13	—	11	1	46	30	32
****Bothrops diporus*	Lancehead Snake	15	—	—	1	28	25	31
**Herpailurus yagouaroundi*	Jaguarundi	10	1	8	1	30	20	24
**Didelphis albiventris*	White-eared opossum	9	1	8	3	10	15	20
***Cyanocompsa brissonii*	Ultramarine Grosbeak	6	12	20	26	—	15	10
****Micrurus pyrrhocryptus*	Argentinian Coral Snake	11	—	—	—	15	6	19
***Pheucticus aureoventris*	Black-backed Grosbeak	5	4	7	10	—	6	8
****Lepus europaeus***	European Hare	9	10	17	16	—	9	20
***Eudromia elegans*	Elegant Crested Tinamou	8	16	13	11	—	7	13
***Patagioenas maculosa*	Spot Winged Pigeon	7	7	6	5	1	7	11
***Zenaida auriculata*	Eared Dove	6	3	5	5	1	6	12
***Rhea americana*	Great Rhea	5	6	6	7	—	4	10
***Amazona aestiva*	Turquoise-fronted Parrot	4	1	1	6	—	3	7
****Xenodon merremi*	Wagler's Snake	4	—	—	—	5	2	6
***Caracara plancus*	Southern caracara	6	—	—	—	4	0	15

The species with the highest Negative Cultural Value (NCV) were Puma and Pampas Fox, due to predation on livestock and other minor domestic animals such as poultry (or their eggs). Species such as Argentine Boa, Red Tegu and Geoffroy's Cat are valued negatively for the same reasons, although to a lesser extent. Venomous snakes, especially the Chaco Lancehead and the Rattlesnake, are feared for their venom (Figure 4b).

Interestingly, in the Integral Cultural Value (ICV) which includes all NCP categories (positive and negative ones) except the sale of skins and hides, the first three ethnospecies in decreasing order of importance are Viscacha, Pampas Fox and Puma (Figure 4c). The first one is an ethnospecies that has high positive ratings but was also mentioned as harmful (it is an herbivore that competes for grasses with livestock). The other two are considered principally harmful, but in certain circumstances they can take positive values. The Pampas Fox hunts Puma cubs for food and Puma's meat is valued for its taste.

Cognitive salience and its relationship with cultural importance

Principal components (PC) 1 and 2 of the Principal Component Analysis (PCA) relating Cognitive Salience (S) values, Integral Cultural Value (ICV), Positive and Negative Cultural Value (PCV and NCV) and local knowledge (LK) about ethnospecies explained 95% of the variability of the data (Figure 5). PC 1 (73.6%) discriminates horizontally the ethnospecies that are important for local people on the right side (either because of their material value, or for being considered harmful or dangerous) from another group of ethnospecies with lowest value for people on the left. This explains the relationship between ethnospecies and people, since cultural values, local knowledge (given by number of references) and salience of ethnospecies are highly correlated (R2 values between 0.88 and 0.94). PC 2 (19.6%) vertically separates ethnospecies into three well-defined groups: those of great importance as food source, such as Viscacha, Chacoan Cavy, Gray Brocket and Peccaries are in the lower right quadrant are, showing a high correlation with all positive valuations (PCV, CMCV and PMCV); the harmful ethnospecies such as Puma and Pampas Fox, are in the upper right quadrant, and were correlated with Negative Cultural Value (NCV). The ICV index which includes positive and negative cultural values and is positioned in an intermediate location, highly correlated with both local knowledge (LK) and the vector of cognitive salience (S).

DISCUSSION

Rural inhabitants of western Córdoba value wild species based on several aspects, including the satisfaction of material needs, hedonic aspects (pleasure of hearing or seeing animals' beauty), or the benefits or harms to their own or common property, and also because they improve some ecosystem processes. The most important NCP for this social group is linked to the consumption of bushmeat, especially in periods of economic hardship (Tamburini and Cáceres 2017). However, according to our results, other non-utilitarian variables appear to be responsible for a large proportion of the local values attributed to fauna, as it is discussed below.

The contribution of indexes to wildlife assessments

Early assessments of ecosystem service (ES) have generated a large number of valuation approaches (Naidoo et al. 2008); however, interdisciplinary ES assessments remain the exception (Abson and Hanspach 2014). Some opinions, perceptions and knowledge of people may not be easily identifiable, since the categories that researchers create to analyse the link between nature and society do not always reflect, or sometimes mask, other values that are important for some people. For example, Hein et al. (2006) showed that stakeholders at different spatial scales may have different interests in ecosystem services. Such mismatch is possibly the rule if we consider that societies are heterogeneous and composed of a great diversity of actors with different aspirations, perceptions, motivations and interests. The nature´s contributions to people (NCP) approach explicitly recognizes the existence of a range of views that permeates all three broad NCP groups and highlights the central role that societies play in defining all links between people and nature (Díaz et al. 2018). In our study, the different types of the cultural material value on wildlife (PMCV and CMCV), even the one that includes intangible and regulating values (PCV), yielded similar results, since practically the same small group of species was the most highly valued (Figure 4). Although the position of some species in the order of importance changes due to the incorporation of new NCP categories, we think that a more thorough documentation of intangible and regulating values (i.e., spiritual values, ecological functions, etc.) could contribute to more accurate valuations, since only a small percentage of the species of our study were mentioned in this type of valuation (Table 2). Although it may seem contradictory, a more ethnographic approach can produce more precise quantifications. From a methodological point of view, it is still a challenge

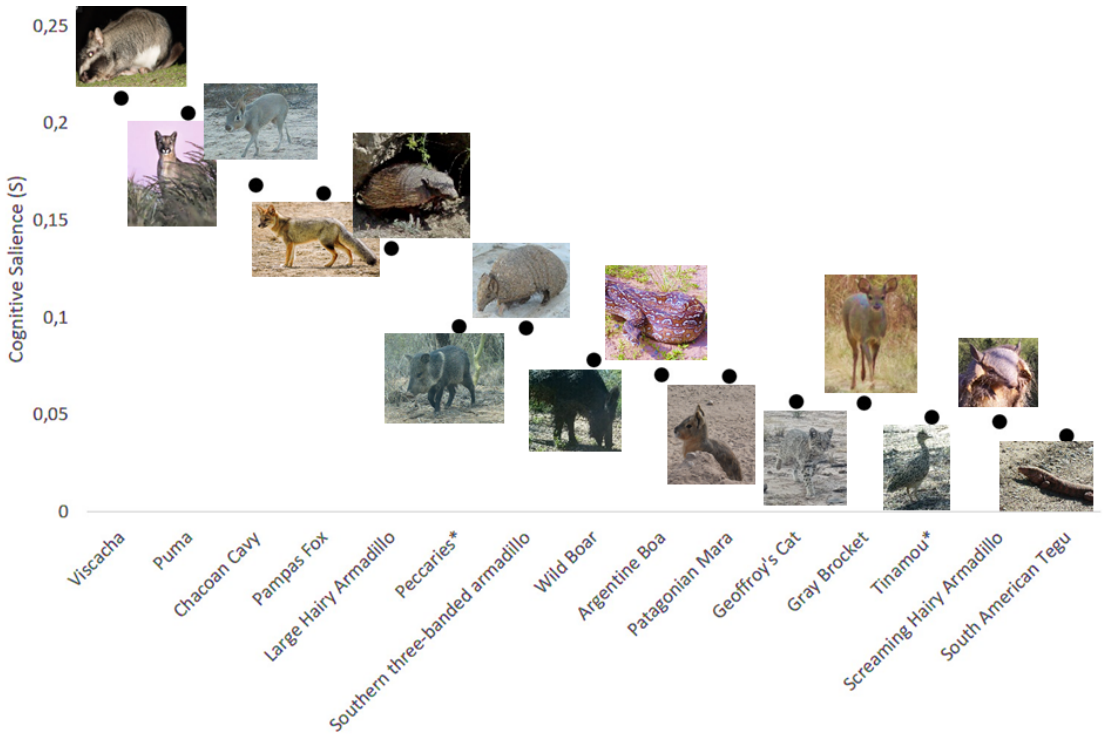

Figure 3. Cognitive Salience (S) of the 15 most highly valued ethnospecies according to the Sutrop's formula (2001). *Generic names: Peccaries (*Pecari tajacu* and *Catagonus wagneri*) and Tinamous (*Nothoprocta cinerascens* and *Nothura darwini*).

to address these issues and to identify intangible values that are often encrypted in local thinking (e.g., hidden categories), or are difficult to translate, from local to academic concepts or vice versa (see Furlan et al. 2020).

Reyes-García et al. (2006) point out that the cultural value of a plant species does not necessarily correspond to its practical or economic values. They introduced the frequency of use as a relevant variable in species cultural quantification. Although we did not quantify use frequency, we think that Current Material CV (CMCV) represents the species that they prefer because of their taste and because they frequently hunt those animals. Among the species with high CMCV are Viscacha, Chacoan Cavy, Gray Brocket, Peccaries and other animals appreciated for their meat ("clean meat"), as well as the three species of armadillos, usually the most used ones as a source of bushmeat in the study area (see Tamburini and Cáceres 2017). Chacoan Cavy and Armadillos are the most frequently hunted wild animals in the Gran Chaco region (Altrichter 2006; Camino et al. 2018; Noss et al. 2004).

In relation to the assessment of the ethnospecies, those characterized by their positive value were located in a separate group from those that present other types of values, in particular those that represent damages and losses to local people (Figure 4). However, this classification is not obvious in all cases, and can change over time depending on wildlife regulations (i.e., permitting or prohibiting their use), wild animal local abundance as well as on people's interests. Changes in population abundance of species that were positively valued for their hides in the past but that currently are negatively perceived, result in a double discount (Reyes-García et al. 2006). That is, Pampas Fox and Viscacha were given high but opposite ratings; the former was appreciated for its skin in the past, but now is killed because it is considered a "pest", while its abundance has increased markedly according to the inhabitants due to hunting prohibition. These results are consistent with the findings reported by Wajner et al. (2019) in the mountains of central Argentina. Likewise, Viscacha was considered important for its meat and role in the ecosystem, whereas it was also considered harmful to pastures and crops, to a lesser extent. This dual or opposite perception over some species has been observed in other studies carried out in rural communities. For example, in Mexico the Jaguar (*Panthera onca*) is one of the most widely mentioned species by indigenous and mestizos people and is indicated both as a species with utilitarian (such as food) and as non-utilitarian (being mentioned in the narratives) value, but also as

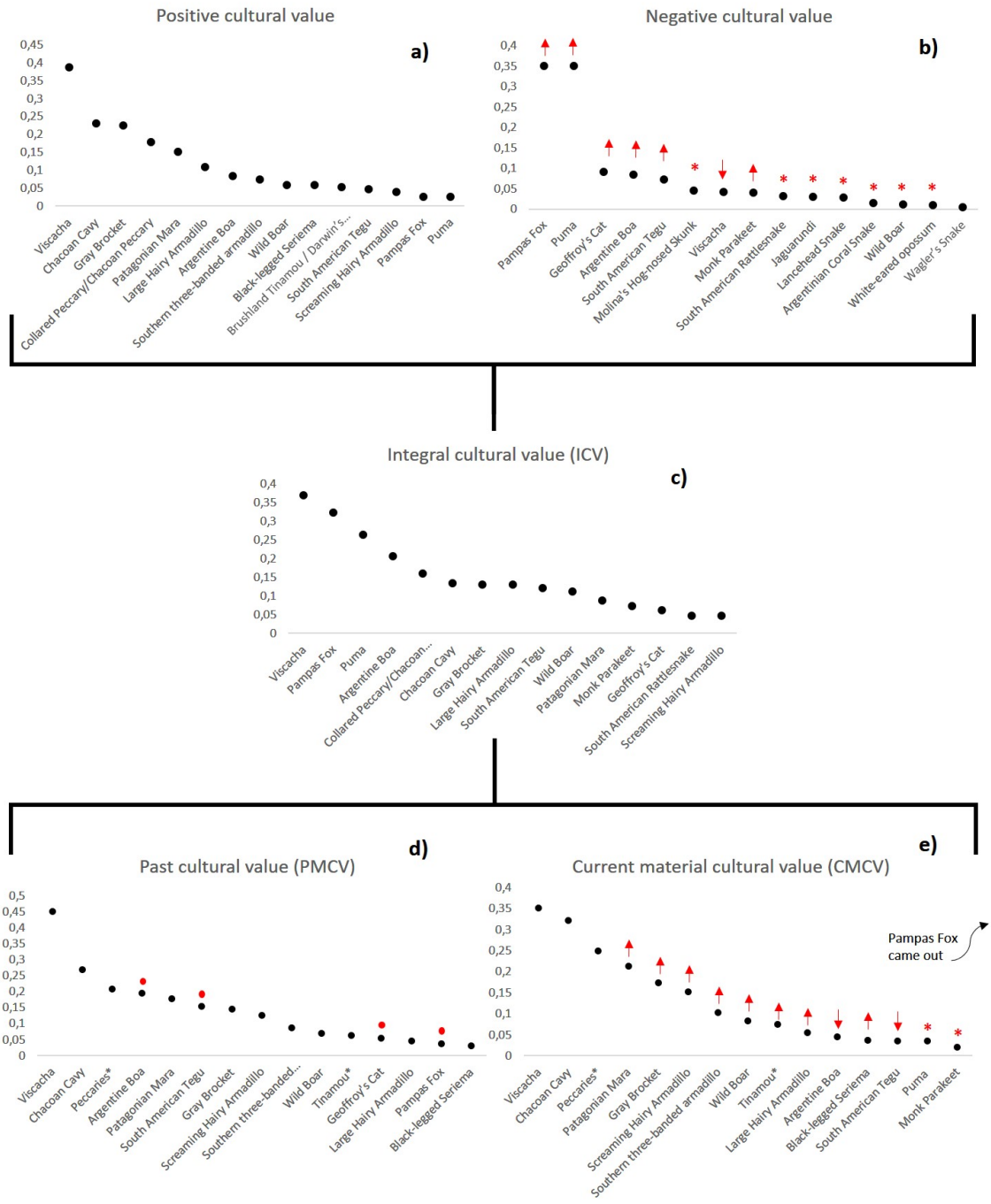

Figure 4. Cultural Value of the 15 ethnospecies of greatest cultural value according to the different indexes: a) Positive Cultural Value, b) Negative Cultural Value, c) Past Cultural Value, d) Current Cultural Value, e) Integral Cultural Value. References: ↑↓ increase or decrease of cultural value of ethnospecies regarding the preceding index (PCV), ∗ appears for the first time among the first 15 most culturally important ethnospecies (see the NCV), • ethnospecies valued for their skins/hides. Finally, the ICV gathers both PCV and NCV of the species. Graphs presented only for illustration purposes.

a dangerous species (García del Valle et al. 2015).

The renewed interest in the cognitive aspects of human communities (Ludwing 2018) allows us to understand the relationship between cognition and action and, at the same time, analyse the scope and limitations of some of the variables we use. For example, in our study, Viscacha is the ethnospecies that ranks first both in all positive CV and in the cog-

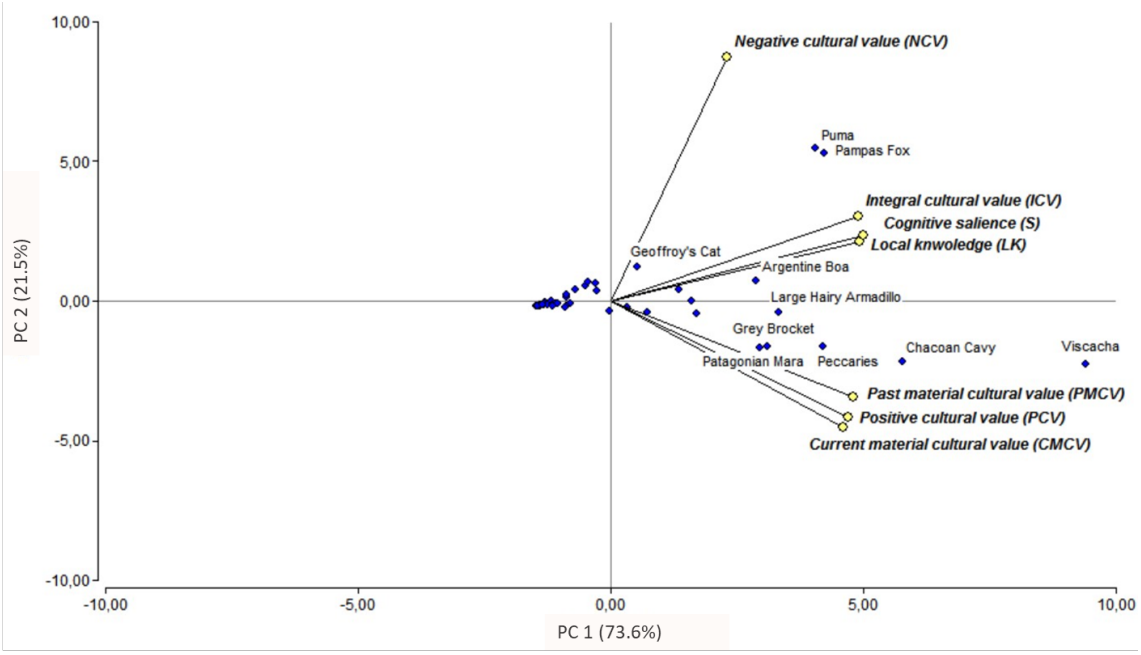

Figure 5. PCA showing the relationship between Cognitive Salience (S), Integral Cultural Value (ICV), Positive Cultural Value (PCV), Negative Cultural Value (NCV), Current and Past Cultural Value (CMCV and PMCV), and interviewees' knowledge about ethnospecies (LK): yellow points; ethnospecies: blue points.

nitive salience indexes (S), although this ethnospecies currently shows a marked population decrease in Córdoba province (Torres 2018) and is scarcely hunted for meat at present, according to our interviewees, showing a decrease in its current use (Tamburini and Caceres 2017). This striking fact led us to wonder why the Viscacha is the most cognitively salient ethnospecies, even though it is currently not very abundant and little hunted. This fact could indicate that the free listings methodological technique covers and contains memories over a period of time longer than the recent past, or that goes beyond recent experiences in the lives of our interviewees. By contrast, Pires de Sousa et al. (2016) retrieve information about medicinal plants using free listings, and they found that the order of the items mentioned by the participants was influenced by recent memories of use. However, the case of Viscacha is best explained by Gosler's arguments (2017) about the relationship between ecological salience and cultural importance. According to this author, the ecological salience given by the abundance or conspicuousness of an animal precedes the cultural importance, but cultural importance can be maintained even when its abundance decreases. This is why, in our case, Viscacha's meat was highly appreciated despite the decline in its abundance. In addition, due to their social behavior, they build very noticeable burrows that are true landmarks. Therefore, synergies between the outstanding properties of the organisms (i.e., noticeable burrows and appreciated meat) could be responsible for their presence in people's memory until now, as proposed by Brown (1979). However, this fact may also be influenced by other factors, such as the type of domain analysed, emotional meanings of the remembered event, or the dual positive and negative consideration (Nolan 2006; Wajner et al. 2019). It may be also related to the type of questions we asked, which were quite general in terms of beneficial and harmful species.

Another relevant aspect of our results is the close relationship among S and ICV indexes, and LK variables. These relationships support the results that cognitive salience is not only conditioned by positive assessments of those ethnospecies of high material value (e.g., valued as food), but as a variable that captures multiple assessments of the fauna, including the negative ones. Thus, these two ways of analyzing the data (cultural value and cognitive salience) can show different but complementary aspects of the relationship between people and wildlife. Our results are consistent with findings of Wajner et al. (2019), who reported that the four mammals with greatest cognitive salience also occupy a dominant place in the lists of cultural value but with antagonistic characteristics, i.e., Puma the most harmful, and Viscacha the most valued as food resource. In the same line, Herrera-Flores et al. (2019) also included the category "damage control" in their assessments of the Cultural Importance Index and found that the highest values are attributed to both edible and harmful species.

Studies based on indexes of cultural values and cognitive salience, such as our work, contribute to the understanding of human-wild animal relationships, at least in two aspects. On the one hand, they provide a comprehensive understanding of the multiplicity of values of each ethnospecies from communities' perspectives. Accordingly, we support the idea of incorporating all the assessments in the analyses of cultural importance, and not only the material uses referred to the species. On the other hand, this approach allows us to generate a more inclusive and integral baseline for the elaboration of policies for the management and conservation of wildlife. Although fauna is a key component of ecosystems, its management and in some cases the various forms of wildlife use by local communities have still not been incorporated into legal frameworks in our region. Undoubtedly in Córdoba, greater efforts are required to define actions for its management. Environmental policy guidelines and regulations related to wildlife management that are developed (at national and regional levels) must effectively incorporate the conservation of natural habitats, as well as the social and economic dimensions related to the use of fauna as a livelihood alternative for local communities (Tamburini and Torres 2018). We hope that studies like the present one will raise awareness about the necessity of incorporating social perceptions and needs into policies, and to recognize the importance of considering multiple points of view and values, especially local people's perspectives.

CONCLUSION

Our work aims at improving the understanding of the links between humans and fauna as the basis to develop a dialogue of knowledge where local and academic perspectives are both contemplated and considered equally relevant. The elaboration of the kind of indexes proposed in this paper should be considered as a methodological practice. We show that free listings are an important methodological technique that allows us to know the most important elements of nature, but to enquire which aspects make some species stand out from others, it is necessary to resort to other sources of information through more ethnographic or qualitative approaches. Furthermore, through the use of the cognitive salience index we can rapidly identify which species are significant for a given social group. However, it does not provide information about the reasons for their significance; hence, the cognitive salience index should be complemented with a further analysis, such as the cultural value indexes. Therefore, we believe that our methodological proposal might improve the understanding of differential value allocations of the elements of a certain knowledge domain. Using different combinations of significance categories allows us to build indexes that include the multiple values of both the material and intangible wildlife heritage, thus providing methodologies and conceptual discussions for NCP assessment.

However, it is necessary to bear in mind that while the cultural value indexes are frequently used in ethnobiological studies, it is essential to focus on the kind of information to be collected, as well as to evaluate the variables that make up a given index in order to ensure a reliable data interpretation and a better understanding of the interactions between species and local communities (Coe and Gaoue 2020).

The analysis of local perceptions and knowledge, and the values associated with the different NCP helps to understand why a certain social group is related to environmental goods and how these goods are valued. We believe that a step forward would be to involve local people in the definition and assignment of categories in order to be more respectful and faithful to the "reading" of their cultural heritage (Alexiades 1996). Recognizing the diverse types of knowledge held by people is a crucial challenge for the conservation of Chaco ecosystems and their sustainability. This requires a necessary process of collective construction that should occur in broader contexts of discussion; in those contexts, wildlife NCPs should be valued considering the local perspective of the categories of significance, and where the boundaries between private and public spheres should be redefined.

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DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: DMT, FZ.
Carried out the experiment: DMT, DMC.
Carried out the data analysis: DMT, FZ.
Wrote the first draft of the manuscript: DMT, FZ.
Reviewed and wrote the final version of the manuscript: DMT, FZ, DMC.
Supervised: DMT, FZ, DMC.

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