ETHNOBIOLOGY AND CONSERVATION

RESEARCH ARTICLE

Ethnobiology and Conservation, 13:17 (10 July 2024)
doi:10.15451/ec2024-07-13.17-1-17
ISSN 2238-4782 ethnobioconservation.com

Assessing the cognitive salience of wild fauna in the Barranca de Metztitlán Biosphere Reserve, Mexico

Zeltzin Ketzalken Zepeda Hernández[1], María Teresa Pulido Silva[1*] and Gerardo Sánchez Rojas[1*]

ABSTRACT

It is important to document the knowledge possessed by rural people regarding the flora and fauna species in their environment so that this knowledge can be incorporated into conservation efforts. We investigated the traditional knowledge of the inhabitants of the Barranca de Metztitlán Biosphere Reserve (BMBR) regarding the fauna in their environment, identifying the wild species they recognize and determining the cognitive salience they assign to them. We also compared knowledge between people who lived in the valley (*El Valle*) and the mountains (*La Sierra*), and between men and women, to determine whether this knowledge differed. We conducted semi-structured interviews between April 2016 and February 2017. To evaluate the traditional knowledge, we used the Smith index because it combines the frequency and order of mention of the elements listed. We found that the local people in the BMBR recognized 37 wildlife species, including 25 mammals, nine birds, two reptiles, and one unidentified species. Ethnozoological knowledge is structured by gender: while the men mentioned 100% of the species in the list generated by the interviews, women covered only 59.5%. Some wild animals exhibited significant differences in cognitive salience between *El Valle* and *La Sierra*. The local population has extensive knowledge about the wild species that inhabit the area, mainly mammals and secondarily birds and reptiles. This knowledge should be incorporated into conservation plans for the reserve.

Keywords: Arid environment; conservation; ethnozoology; local knowledge; mammals; Smith Index.

1 Universidad Autónoma del Estado de Hidalgo, Centro de Investigaciones Biológicas, Carretera Pachuca-Tulancingo km 4.5 s/n, Pachuca, Hidalgo, C.P. 42184, México.

* Corresponding author ✉. E-mail address: ZKZH (zeltzin.zepeda.deuterostomados@gmail.com), MTPS (mtpulido@yahoo.com), GSR (gsanchez@uaeh.edu.mx)

SIGNIFICANCE STATEMENT

This paper analyzes the relationships between humans and wildlife in a biosphere reserve in central Mexico. While many animals are recognized by the local population, the mammals are dominant. Some animals have a very different cognitive salience between the human sexes and different topographic areas (e.g. *El Valle* and *La Sierra)*. This study contributes to the understanding of the complex relationship between humans and fauna and provides some ideas for improving their cohabitation. It also highlights local concerns, an aspect that is particularly important in Biosphere Reserves.

INTRODUCTION

The perception of conservation biology has changed several times since its inception, from conservation thinking focused on "nature for itself," through conceptual frameworks of "nature despite people" and "nature for people", to the most recent thinking of "people and nature" (Mace, 2014; Campos et al., 2021). The concept of "salience" could serve to link different knowledge systems in a complementary and mutually enriching way (for researchers, civil authorities, and local populations). Salience involves all the characteristics of organisms (phenotypic, perceptual, ecological, and cultural) that explain why people remember and recognize a species (Gosler 2017).

The importance of animal or plant species for different human groups has been studied in ethnobiology using concepts such as cognitive salience (CS), which is "the place occupied by different elements of nature in human cognition and is generally obtained through the analysis of free listings" (Wajner et al. 2019), also CS allows us to determine the emic vision of a semantic domain. In the free list technique (Bernard 2006), respondents are asked to list organisms of interest to them. This method is grounded in psychology (Quinlan 2005; Bernard 2006) since the order in which these organisms are mentioned (hereafter, order of mention) and the frequency with which they are listed (frequency of mention) by the respondents are indicators of their relative importance or prominence (Smith and Borgatti 1998). Humans tend to prioritize the items that are most meaningful to us, and we tend to remember to items that are important to us. It is important to note that these items may have been listed as a result of both positive and negative attributes, as demonstrated by Tamburini et al. (2021).

The CS value of a taxon can be influenced by the intrinsic or extrinsic characteristics of the taxon. In the case of the former, the CS can be influenced by the frequency of use, specificity of use, spatial and temporal availability of the organism, and how conspicuously it is based on its morphology and/or behavior (Turner 1988). We utilize extrinsic characteristics and refer to socioeconomic and cultural factors (such as income, age, sex, and education level) because they influence the transmission of knowledge (Torres-Avilez et al. 2016; da Costa et al. 2021). Gender-structured systems of knowledge about taxa have been observed, especially in localities with differentiated gender roles (Pfeiffer and Butz 2005; Torres-Avilez et al. 2016). Different parts of the landscape and their associated species are known and observed and therefore used and appropriated, in different ways by women and men, depending on the work they carry out and the landscape units most frequently visited. Gender differences in knowledge and use have been documented for animals (Randler et al. 2021), plants (Torres-Avilez et al. 2016; da Costa et al. 2021), and fungi (Ruan-Soto et al. 2007; Stryamets et al. 2023).

Moreover, CS has been evaluated for different wild organisms, particularly animals. Human-animal relationships are complex and heterogeneous, varying across cultures and time, for this reason the CS is so different between places and people (Amiot and Bastian 2015). Large wild mammals are perceived by humans in different ways, depending on cultural, environmental, social, and economic factors (Santos et al. 2009; Ávila-Najera et al. 2018; Tamburini et al. 2021). Mammals are among the biological groups with which humans are most familiar, both in terms of differentiating species and understanding complex aspects of their life histories (Sosa-Escalante et al. 2016). While wildlife plays an important role in providing environmental and/or cultural services to humans (Lacher et al. 2019), it is also perceived as a potential risk to humans, particularly when large wild mammals approach human settlements (Nyhus 2016).

Reports of such close encounters are becoming increasingly common in various rural areas of Mexico, where there has been a growing number of records of large predators, such as jaguars (Hidalgo-Mihart et al. 2019; Lavariega et al., 2020), cougars (Castro-Campos et al. 2021), and black bears (Aguilar-López et al. 2019). Several initiatives have therefore been implemented to facilitate coexistence between humans and wildlife (Soulsbury and White 2016). Birds provide services and some disservices to people, but this is dependent on human density (Cox et al. 2018). In Mexico, dissemination activities have facilitated the harmonization of human-reptile relationships (Cupul-Cicero et al. 2019; Fernández-Badillo et al. 2021). While these are valuable efforts, it is also necessary to study the differential importance that wildlife can represent for human beings since this has implications for conservation.

The interactions between wildlife and human populations are diverse and complex. Humans develop a range of relationships with animal species, which may be emotional or even religious. They recognize their intrinsic value or consider them in their ecological dimension. However, humans also appreciate fauna in a utilitarian sense or associate them with harmful factors. Animals have provided food, medicine, companionship, decoration, traction, transportation, materials to make tools or shelters, entertainment, amulets and symbols of status, religion, and group membership (Gutiérrez-Santillán et al. 2018; Alves et al. 2018). Understanding which organisms are considered important by a given social group, and why,

is a fundamental aspect of biological conservation. This is a prerequisite for the appropriate management of fauna in areas of greatest interest for biological conservation that are inhabited by humans, such as biosphere reserves (BRs). The UNESCO Man and Biosphere Program recognizes the BRs as a means of protecting biodiversity, promoting solutions for conservation through sustainable use, and fostering research, education, and the enterprise (Halffter 2011).

The objective of this study was to investigate the traditional knowledge of the inhabitants of the Barranca de Metztitlán Biosphere Reserve (BMBR) regarding fauna, to determine which wildlife species they recognize and what cognitive salience they assign to them. We also sought to determine whether there were any differences in this cognitive salience between individuals of different sexes (men and women) and between those from two different topographic areas (*El Valle* and *La Sierra*). Three hypotheses are proposed:

1) We expect that the inhabitants of BMBR, living in long-established rural communities, will have a detailed knowledge of different wild animals irrespective of whether they have a positive or negative connotation.

2) Since there is still a gender role in this rural area, we expect that men will be able to name more wildlife species than women since the former work more frequently in the field.

3) We expect that *La Sierra* - with more coverage of natural ecosystems - will harbor more species of interest for conservation than *La Vega*, which is dominated by an agricultural matrix.

This information can serve as a basis for the development of a future management plan for reserves or the development of new conservation strategies, considering the needs of all actors involved in the system, in terms of harvesting and maintaining their natural resources.

MATERIAL AND METHODS

Study Area

The BMBR is located in the state of Hidalgo, Mexico. It has an area of 96,042.94 ha and includes eight municipalities (equivalent to counties) (Figure 1; CONABIO and SEMARNATH 2021). This area includes portions of the Mexican Altiplano and Sierra Madre Oriental biogeographic provinces (Morrone 2001). The reserve includes two distinct forms of topography, highly contrasting in terms of their orography, the conservation status of their ecosystems, and the economic activities carried out in them. The region *El Valle* comprises valleys surrounding the *Venados* River with an elevation of approximately 1100 masl (the lowest part of the basin found within the BMBR). The main economic activities include irrigated agriculture and commerce. In contrast, *La Sierra* comprises canyons, rolling hills, and plateaus of up to 2600 masl that harbor natural ecosystems. The economic activities in this region include seasonal (rain-fed) crop agriculture, livestock, and fishing (CONABIO and SEMARNATH 2021). Additional File 1 presents a visual comparison between *El Valle* and *La Sierra*.

In 2010, the estimated human population of the region was 26,533, with 1533 individuals belonging to indigenous groups (CONABIO and SEMARNATH 2021). These indigenous groups belong to the Oto-Mangue linguistic family, which is the largest and most diverse in the country: specifically, the Otomí linguistic group and the Hñähñú variant ("Otomí from the Mezquital Valley"). The indigenous population is distributed across approximately 34 locations within the BMBR (INALI 2009; CONABIO and SEMARNATH 2021). The Otomí people have inhabited these territories since at least 1395 when Chichimeca invaders commanded by Xolot forced them to relocate to the present territory of Metztitlán (Sánchez 2005).

In general, the climate is dry and warm. The mean annual precipitation is 500 mm in the lower areas and 600 to 700 mm at higher elevations. The rainy season in this region lasts from June to September (Vázquez-Cuevas and Roldán 2010). The dominant vegetation types are xerophilous scrub and crassicaule scrub (CONABIO and SEMARNATH 2021). The BMBR hosts a total of 270 genera and 83 families of vascular flora, including a number of economically and culturally important plant species, such as the maguey (*Agave* spp.), prickly pear (*Opuntia* spp.), palms (*Brahea dulcis*) and old man cactus (*Cephalocereus senilis*) (Pulido and Cuevas-Cardona 2013). The most well-conserved patches of vegetation are found in *La Sierra*.

The fauna of the region comprises fish belonging to the families Poecilidae, Cichlidae, and Cyprinidae (CONABIO and SEMARNATH 2021). There are also seven species of amphibians, all belonging to the order Anura, distributed across five families and seven genera, 31 species of reptiles distributed across 14 families and 29 genera (Vite-Silva et al. 2010), and 271 bird species, belonging to 54 families and 17 orders. The birds include 117 resident species, 88 migratory species, 34 casual species, six species with resident and migratory populations, and 26 species with no determined status (Ortiz-Pulido et al. 2010). A total of 69 species of mammals, belonging to 49 genera, 20 families, and 7 orders have been identified. Of these,

the most diverse order is Chiroptera, with 30 species, followed by Rodentia with 20 species, and Carnivora with 13 species (Hernández 2009).

Study design and sampling

To collect information at the scale of the BMBR, 17 communities were chosen to include locations at different points in the BMBR polygon to represent several vegetation types (Table 1) and include two topographical areas: *El Valle* and *La Sierra*. In the selected communities, 67 semi-structured interviews were conducted from April 2016 to February 2017. Thirty-four interviews were conducted in *El Valle* and 33 in *La Sierra*. Of the interviewees, 24% were women, and the rest were men, ranging from 20 to 80 years of age. Most of the interviewees work as crop and/or livestock farmers or farm laborers. The first contact in each case was with the community authorities to make an initial introduction and ask for the necessary permission. Interview subjects were selected using the snowball method (Bernard 2006). In all interviews, the interviewers made it clear that any information received would be kept confidential. We selected adults of legal age, who worked in the field to some extent. The objective was not to make a comparison between locations but rather to gain a more regional perspective. Only those who agreed to the analysis of their responses were interviewed. In this case, a significant number of the women declined to participate in the interview.

The survey (Additional File 2) included a) the interviewee's general information (i.e., name, age, occupation, and education), b) livestock production activity (since this is one of the main activities practiced in the area), and c) knowledge about wildlife, including the animals the informant knew, frequencies and places of sighting, animals hunted, and the purposes and uses of these animals. To ascertain which wild animals the local population was aware of, visual stimuli (photographs) were employed during the interviews, as the interviewees often had their own nomenclature for the animals. They were asked to identify and describe each animal and then shown the image to corroborate the identification.

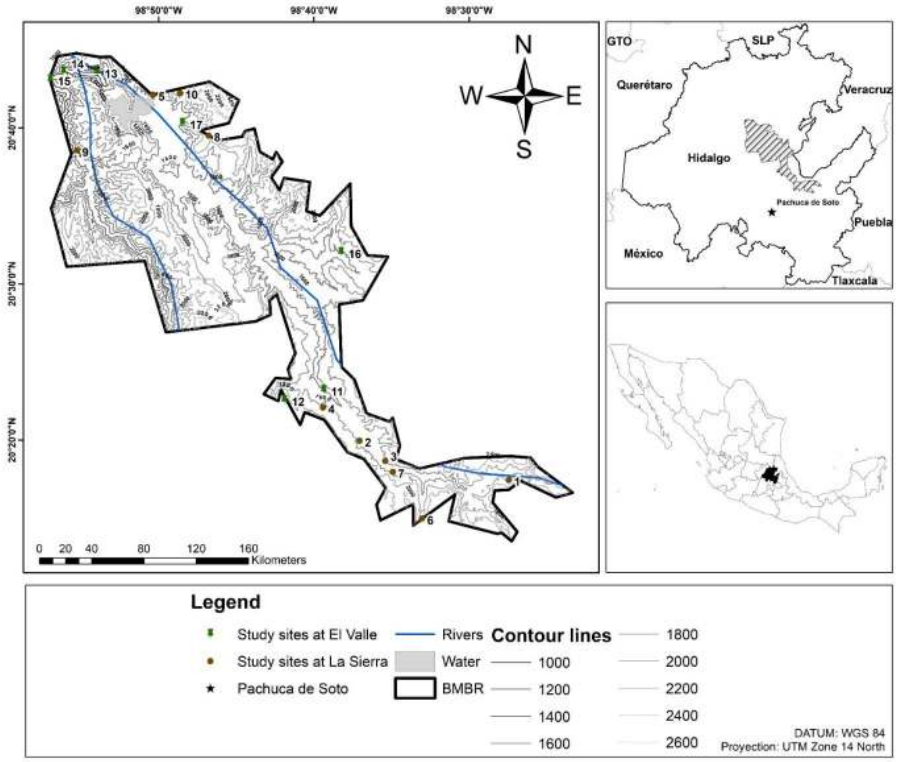
Data analysis

The Smith index (SI) is a highly useful tool for identifying the most important or salient elements among a list of numerous items. For this, the SI combines both the frequency and order of mention of the listed elements (Arruda et al. 2018; Ávila-Najer et al. 2018; Chaves et al. 2019). The frequency and position in which an item appears to have a psychological significance for people (Bousfield and Barclay 1950 cited by Gravlee 2002). The SI takes values between 0 and 1. The items that receive a numerical value closer to one are those that have extremely high salience for the people, as they are named more frequently and occupy the top places in the list.

To obtain the SI in our study, a list was recorded of the animals each interviewee mentioned in response to the question "What are the wild animals of the region that you know?". The order in which the items were mentioned was retained. This procedure yielded a numerical value for each of the species mentioned, providing a summary of their salience. To identify which elements of a free list are more salient than others, we employed a probabilistic method developed by Chaves et al. (2019). This method compares the real data with a null distribution for each item. The null distribution was calculated by generating 1,000 simulated populations obtained by the Monte Carlo method. For each population, 67 lists were generated, each including all items at least once. The lists generated were of different lengths, but always fell in the range between the shortest and longest lists recorded in the field data. The position of each item and its frequency were randomly assigned. Items with a p-value <0.05 were considered significant. The analysis was conducted in the language R (R Core Team 2020, R version 4.2.2) using the script Salience_V2. developed by Chaves et al. (2019).

The comparison between the null and observed models can produce three possible results: 1) Species with extremely high salience, defined as a high SI value, and which differ significantly from the null model; 2) Species whose salience does not differ significantly from that expected by chance (p-value >0.05), 3) Species with extremely low salience, defined as a low SI value, and which differ significantly from the null model (idiosyncratic species).

To analyze the discrepancy between the cognitive salience of the fauna as perceived by men or women, the free lists were analyzed separately according to sex. Subsequently, the SI values for all the species were graphed, with the values assigned by men on one axis and those by women on the other. The null model would have the value of this index being the same for men and women for each organism, without a sex effect, and the values for the different species would thus fall along a straight line. Values that are located at a distance from the line of the null model with high residuals would indicate that the corresponding organism has greater importance for one sex than for the other. The cognitive salience values of the fauna were also estimated and compared between the areas of *La Sierra* and *El Valle* in the same manner. The statistical differences in the mentions of the different species of fauna between the sexes (female



Hình 1. Study area showing the location of Barranca de Metztitlán Biosphere Reserve, in Hidalgo, Mexico. Labels (numbers) of study sites correspond to ID of Table 1.

and male) and between sites (El Valle and La Sierra) were evaluated with a t-test. This was performed with the number of species mentioned by each informant in each case.

RESULTS

Fauna recognized by local people in the BMBR

In the BMBR, local people recognized 37 wild species, comprising 25 mammals, nine birds, two reptiles, and one unidentified species. Most of these species are known by a single common name in the BMBR except for a few that are referred to by more than one name. The latter is exemplified by the *cacomixtle* (ring-tail cat, *Bassariscus astutus*), which is also called the *coapiote*. Another example is the *zorra* (gray fox), also known as the *coluda* (Table 2).

The degree of cultural salience of the 37 species varied considerably according to the Smith index, with values ranging from 0.5874 to 0.0009. The items identified as culturally salient were 11 species that were mentioned more frequently than would be expected by chance. The list included: the gray fox (*Urocyon cinereoargenteus)*, raccoon (*Procyon lotor*), coyote (*Canis latrans*), ring-tailed cat (*Bassariscus astutus*), American hog-nosed skunk (*Conepatus leuconotus*), Virginia opossum (*Didelphis virginiana*), rock squirrel (*Otospermophilus variegatus*), white-nosed coati (*Nasua narica*), western spotted skunk (*Spilogale gracilis*), armadillo (*Dasypus novemcinctus*), and hooded skunk (*Mephitis macroura*) (Group 1 in Table 2). The second set included animals with non-significant p-values, signifying that the number of mentions of these animals did not differ significantly from that expected by chance (Group 2 in Table 2). The second set included only the eastern cottontail (*Sylvilagus floridanus*), bobcat (*Lynx rufus*), and mountain lion (*Puma concolor*). The third group included the remaining 65% of the species mentioned (Group 3 in Table 2). These species presented extremely low salience (SI<0.0069) and p-values of <0.05, indicating that they were peripheral items from the perspective of the people of the study communities, and were named fewer times than would be expected by chance. Birds and reptiles were only named in the third group.

Bång 1. Number of respondents per community at the Barranca de Metztitlán Biosphere Reserve. ID of study sites are indicated in Figure 1.

ID	Community	Municipality	Population (2010 census)	Interviewees (men/women)	Sierra/Vega
1	La Calera	Acatlán	166	1 man	Sierra
2	Los Reyes	Atotonilco el Grande	123	1 man	Sierra
3	Padre Nuestro	Atotonilco el Grande	46	5 men/4 women	Sierra
4	San Martín	Atotonilco el Grande	503	2 men/5 women	Sierra
5	La Punta de Hualula	Eloxochitlán	67	3 men/2 women	Sierra
6	Barranca de Aguacatitla	Huasca de Ocampo	267	2 men	Sierra
7	San Bartolomé	Huasca de Ocampo	148	1 man	Sierra
8	Mesa Grande	Metztitlán	146	1 man	Sierra
9	San Pablo Tetlapayac	Metztitlán	73	3 men	Sierra
10	Tlaxco	Metztitlán	602	2 men/1 woman	Sierra
11	La Nogalera	Atotonilco el Grande	100	6 men/1 woman	Vega
12	Mesa San Lucas	Atotonilco el Grande	92	1 man	Vega
13	Almolón	Eloxochitlán	106	2 men/3 women	Vega
14	Chacaya	Eloxochitlán	62	6 men	Vega
15	San Juan Amajaque	Eloxochitlán	89	7 men	Vega
16	San Agustín	Metzquititlán	1673	1 man	Vega
17	Tezisco	Metztitlán	76	7 men	Vega

Bång 2. List of wild species as perceived by the inhabitants of the BMBR and arranged in decreasing order of cognitive salience (Smith index). The frequency is the percentage of respondents who mentioned that species. The average range is the position in which the people mentioned the species. The Smith index was calculated according to the frequency and average range (μ). Group 1: salient; Group 2: no different to that expected by chance; Group 3: very low but significant Smith Index.

#	Common name (Spanish)	Common name (English)	Frequency	μ	Smith Index	Group	Class	Order	Family	Species
1	Zorra	Gray fox	61	4.2	0.587	1	Mammalia	Carnivora	Canidae	*Urocyon cinereoargenteus*
2	Mapache	Raccoon	60	4.45	0.556	1	Mammalia	Carnivora	Procyonidae	*Procyon lotor*
3	Coyote	Coyote	41	3.15	0.482	1	Mammalia	Carnivora	Canidae	*Canis latrans*
4	Cacomixtle	Ring-tailed cat	56	5.13	0.471	1	Mammalia	Carnivora	Procyonidae	*Bassariscus astutus*
5	Zorrillo Albardón	American hog-nosed skunk	51	5.33	0.413	1	Mammalia	Carnivora	Mustelidae	*Conepatus leuconotus*
6	Tlacuache	Virginia opossum	39	4.64	0.363	1	Mammalia	Didelphimorphia	Didelphidae	*Didelphis virginiana*
7	Ardilla	Rock squirrel	41	5.68	0.329	1	Mammalia	Rodentia	Sciuridae	*Otospermophilus variegatus*
8	Coatí	White-nosed coati	31	4.13	0.308	1	Mammalia	Carnivora	Procyonidae	*Nasua narica*
9	Manchado	Western spotted skunk	36	6.22	0.257	1	Mammalia	Carnivora	Mustelidae	*Spilogale gracilis*
10	Armadillo	Armadillo	37	6.3	0.247	1	Mammalia	Cingulata	Dasypodidae	*Dasypus novemcinctus*
11	Rayado	Hooded skunk	28	6	0.211	1	Mammalia	Carnivora	Mustelidae	*Mephitis macroura*
12	Conejo	Eastern cottontail	17	5.47	0.153	2	Mammalia	Lagomorpha	Leporidae	*Sylvilagus floridanus*
13	Gato montés	Bobcat	23	7.09	0.144	2	Mammalia	Carnivora	Felidae	*Lynx rufus*
14	Puma	Mountain lion	12	6.92	0.072	2	Mammalia	Carnivora	Felidae	*Puma concolor*
15	Tigrillo	Margay	10	8	0.057	3	Mammalia	Carnivora	Felidae	*Leopardus wiedii*
16	Onza	Long-tailed weasel	12	8.17	0.054	3	Mammalia	Carnivora	Mustelidae	*Mustela frenata*
17	Gavilán	Sparrowhawk	6	5.83	0.045	3	Aves	Accipitriformes	Accipitridae	Not Available
18	Culebras	Snake	7	8.29	0.037	3	Reptilia	Squamata	nd	Not Available
19	Corre caminos	Greater roadrunner	6	7.67	0.036	3	Aves	Cuculiformes	Cuculidae	*Geococcyx californianus*
20	Cascabel	Rattlesnakes	4	5.25	0.032	3	Reptilia	Squamata	Viperidae	*Crotalus* sp.
21	Liebre	Black-tailed jackrabitt	3	5.33	0.025	3	Mammalia	Lagomorpha	Leporidae	*Lepus californicus*
22	Jabalí	Collared peccary	2	2	0.025	3	Mammalia	Artiodactyla	Tayassuidae	*Pecari tajacu*
23	Puerco espín	Mexican porcupine	3	6	0.021	3	Mammalia	Rodentia	Erethizontidae	*Sphiggurus mexicanus*
24	Águila	Eagle	4	7.25	0.020	3	Aves	Accipitriformes	nd	Not Available
25	Zopilote	Turkey vulture	2	7.5	0.017	3	Aves	Accipitriformes	Cathartidae	*Cathartes aura*
26	Temazate	Red brocket deer	2	7.5	0.016	3	Mammalia	Artiodactyla	Cervidae	*Mazama temama*
27	Lobo	Wolf	2	6.5	0.014	3	Mammalia	Carnivora	Canidae	*Canis lupus*
28	Cuervo	Crow	2	8.5	0.012	3	Aves	Passeriformes	Corvidae	*Corvus* sp.
29	Ardilla voladora	Southern flying squirrel	4	10.6	0.010	3	Mammalia	Rodentia		*Glaucomys volans*
30	Tuza real	Spotted paca	1	4	0.011	3	Mammalia	Rodentia	Cuniculidae	*Cuniculus paca*
31	Tepachichi	—	1	4	0.009	3	—	—	—	—
32	Paloma	Dove	2	9	0.009	3	Aves	Columbiformes	Columbidae	Not Available
33	Tuza	Gopher	1	9	0.005	3	Mammalia	Rodentia	Geomidae	Not Available
34	Jaguarundi	Jaguarundi	1	9	0.004	3	Mammalia	Carnivora	Felidae	*Puma yagouaroundi*
35	Halcón	Hawk	1	11	0.003	3	Aves	Falconiformes	Falconidae	Not Available
36	Lechuza	Owl	1	15	0.003	3	Aves	Strigiformes	Not Available	Not Available
37	Garza	Heron	1	17	0.001	3	Aves	Pelecaniformes	Ardeidae	Not Available

Culturally important wild animals according to sex

The results of the interview indicated that knowledge about the fauna of a region differed between men and women within the BMBR. A significant difference was found in the number of species mentioned by the men (9.45, SD=2.641) and women (8.00, SD=2.066), according to the t-test (t (65) = 2.010; p < 0.05) (Table 3). Men mentioned the 37 species recorded, covering 100% of the list generated by the interviews, while women only mentioned 22 species, which represents 59.5%.

The results were organized in descending order of the SI, revealing the presence of three distinct groups. The group with the highest salience for men (SI between 0.6122-0.2193 and p <0.05) included 11 species. For women, this group (SI between 0.5407-0.3775) comprised five species (see Figure 2). In a second group, the next most salient three species named by men (e.g. mountain lion) and the next 11 most salient species named by women (e.g. snake) had non-significant p-values. Finally, there were 23 species with an extremely low salience for the male group (SI between 0.0743-0.0012). For women, this group included only five species (SI between 0.0417-0.0063) (see Figure 2).

Figure 2 presents a Cartesian comparison of the salience values obtained for each animal, with the data segregated according to sex. This figure shows three large subgroups: animals with extremely high salience for men and/or women (11 items Indicated with a black and grey circle in Figure 2); animals that were mentioned in a manner that did not differ from that expected by chance (eastern cottontail, bobcat, and mountain lion, indicated with a blue circle in Figure 2); and animals with extremely low salience for both men and women (43 items – indicated by a white circle in Figure 2). The first subgroup can be further delineated into three categories: items with extremely high salience for men and women (e.g. coyote – Figure 2), items with extremely high salience for women only (nothing in this case), and items with extremely high salience for men only (e.g. Virginia opossum – indicated with a grey circle Figure 2).

Finally, the importance attributed to the same species differed between men and women in many cases, resulting in residuals that were greater than those with the null model. This is reflected in a Cartesian plane (Additional File 3). In comparison to the women, the men assigned greater importance to the raccoon and the ring-tailed cat. In contrast, women identified the squirrel as important and the eastern cottontail as very important. The points closer to the trend line represent the species that presented comparable values between men and women (e.g. American hog-nosed skunk - Additional File 3).

Culturally important wild animals according to site

A comparison between *El Valle* and *La Sierra* (Figure 3) revealed differences in the importance of the species but not in their total number. According to the t-test, there was no significant difference in the number of species mentioned between *La Sierra* (mean = 8.575, SD = 2.784) and *El Valle* (mean = 9.617, SD = 2.283) (t (65) = -1.677; p = 0.098) (Table 4). The most representative species for the inhabitants of the *El Valle* area were the white-nosed coati, spotted skunk, and raccoon. For the area of *La Sierra,* the most important species were the eastern cottontail, rock squirrel, and gray fox (Figure 3). Species with very similar values of importance between sites, plotted close to the trend line, include the coyote, and bobcat. Species that were not mentioned in the *El Valle* zone were crows, wolves, gophers, and *tepachichi.* In the *La Sierra* zone, there was no mention of the heron, sparrowhawk, hawk, jaguarondi, owl, or gopher (Figure 3).

The set of species with the highest salience varied between *La Sierra* and *El Valle.* In *La Sierra*, species with high salience (p <0.05) had SI values between 0.6125 and 0.2592 and included eight species (e.g. gray fox - Figure 3). In *El Valle*, this set included eigth species, some of which were shared with *La Sierra* (see Figure 3), with a salience interval between 0.6429 and 0.2434. The non-significant species, e.g., those with a salience that did not differ from that expected by chance, numbered four in La Sierra (e.g. white-nosed coati) and six in El Valle (e.g. armadillo). Finally, the set with an extremely low salience (SI between 0.0578 and 0.0076) included 18 species in *La Sierra.* In *El Valle*, this set with extremely low salience values ranged from 0.0562 to 0.0017 and included 19 species (see Figure 3).

The data presented above was plotted on a Cartesian map, revealing the existence of three large subgroups: the first comprised animals with high salience for *El Valle* and/or *La Sierra* (11 items); the second comprised animals that did not differ from that expected by chance (hooded skunk, bobcat, mountain lion, and sparrowhawk, indicated by a blue circle in Figure 3); and the third subgroup consisted of animals with extremely low salience, known as idiosyncratic items (42 items – Figure 3). It should be noted that the first subgroup includes items with extremely high salience in both sites (e.g. *Virginia opossum* – Figure 3, indicated by a black circles in Figure 3.), in *La Sierra* only (e.g. armadillo, indicated by a grey circle in Figure 3), and in *El Valle* only (e.g. white-nosed coati – indicated by a red circle in Figure 3).

In some instances, the importance attributed to the same species differed between *El Valle* and *La Sierra*, producing residuals that were greater than those of the null model. The importance of the raccoon and white-nosed coati is greater in *El Valle* than in *La Sierra* (Additional File 4).

DISCUSSION

Wild fauna recognized by local people

The inhabitants of the region possess a substantial amount of knowledge regarding the various species that represent only a fraction of the biological diversity found in the BMBR. These individuals have developed complex relationships with the 37 animal species identified. The mammals, birds, and reptiles mentioned here present three different levels of cognitive salience (CS). This perception appears to be positively or negatively influenced by various attributes of the species, including their ecological/biological characteristics (e.g., phenotype) and the cultural uses attributed to them. This is consistent with the findings of Wajner et al. (2019) and Tamburini et al. (2021). Furthermore, their increased positive or negative perception may be because these are the most frequently observed species (Sánchez-Rojas et al. 2016).

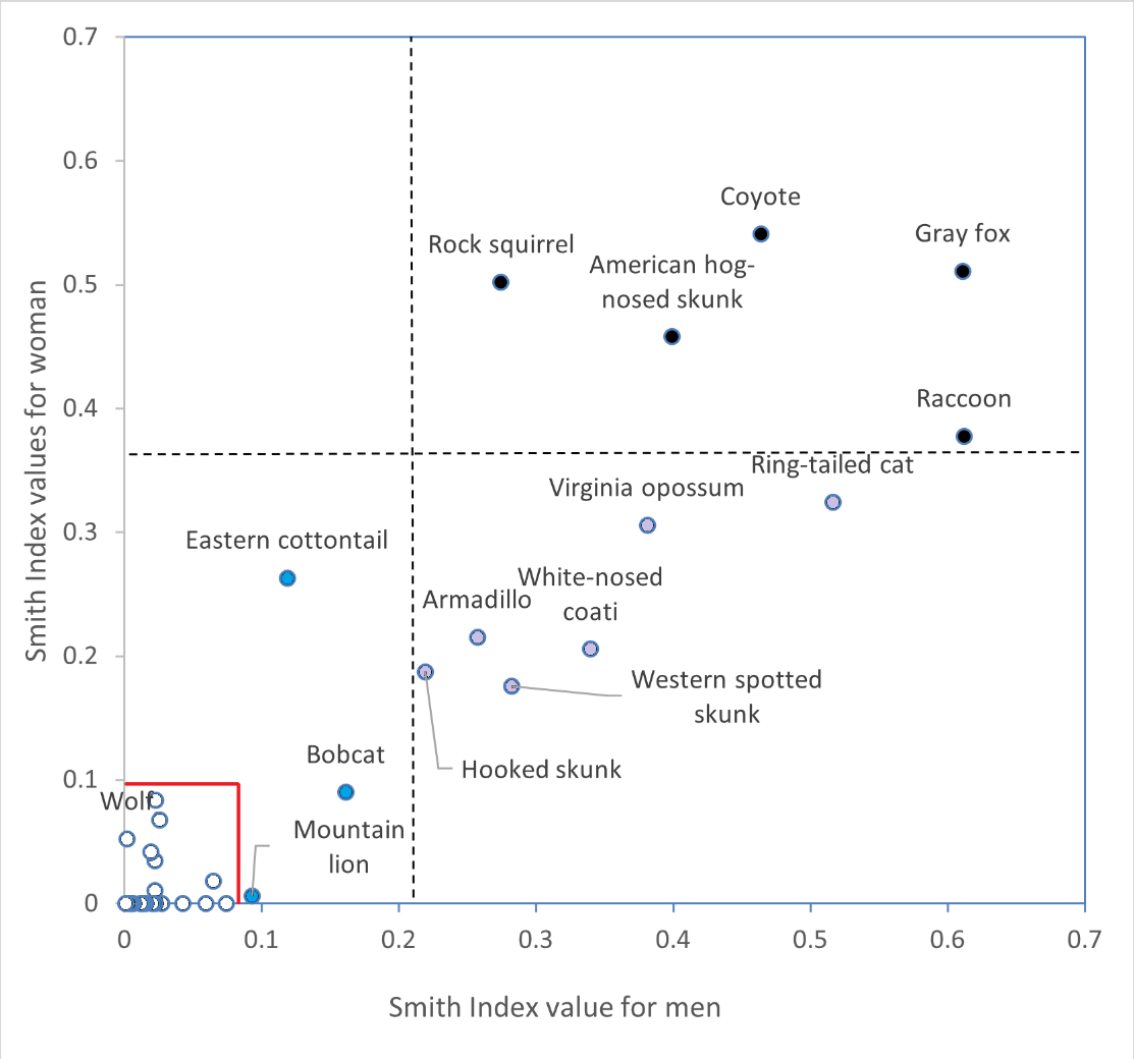
The species with the highest cognitive salience values, i.e., those that people are most aware of, are mammals that are perceived as common by the inhabitants, who seem to be most aware of these species because they live in close proximity or are the animals most likely to be frequently observed (group 1 in Table 2). During the interviews, the respondents indicated that they recognized different species, including their habitats, dietary habits, tracks, and behavioral characteristics. They also mentioned consumption of the meat of wild animals (e.g., raccoon, squirrel, armadillo).

In this manner, people within the BMBR identified the organisms that attract their attention for a variety of reasons, be it for their usefulness, danger, or ease of observation. However, numerous organisms were overlooked in this process. For instance, of the 69 species of mammals documented within the reserve, 30 are bat species that are recognized generically, yet none of the interviewees mentioned them. With regard to the second most diverse group, the rodents with 20 species, the inhabitants only recognized five species (gopher, spotted paca, rock Squirrel, flying squirrel, and porcupine). However, people only named these because they are used as food and therefore they are perceived as important.

The CS is a parameter that captures multiple valuations from the local inhabitants (Wajner et al. 2019). In our study, the gray fox is the first species to be discussed. It appears to be the most representative since, as the interviewees commented, these animals can be seen at any time of day, on hills, on roads, or near houses. People even see them in their yards or corrals because the foxes hunt the hens and chickens. This is to be expected result considering it is one of the most abundant species in the area (Hernández 2009). The raccoon is well-known to the general population due to its prevalence in the field and its reputation as a pest (Gallegos et al. 2010). People can recognize its tracks and comment that they are often seen near bodies of water. The same species can be assigned contrasting perceptions. In the case of the raccoon, it is given a negative perception for the damage it causes to crops and a positive perception for the use of its meat. The coyote is identified very well by its call, so the humans know when it is close, and they take more care of their animals. It is known that coyote's prey on some domestic animals. This is not unexpected, given that there have been cases documented where the coyote is perceived as the main predator of domestic animals, for example, in the Perote valley (Gómez-Vásquez et al. 2004). Likewise, the ring-tailed cat and three different species of skunks are often seen in hen houses or people find their tracks because people believe that the animals are looking for chickens or eggs (Hernández-Melo et al. 2021). The opossum, armadillo, rock squirrel, and white-nosed coati are included in this group of highest saliences for a few reasons. They are often seen on roads or found as roadkill, and consumption of their meat is not uncommon.

The species with a non-statistically significant p-value; i.e., those for which their mention did not differ from that expected by chance (group 2 in Table 2), were the eastern cottontail, bobcat, and mountain lion. The presence of the eastern cottontail is surprising since it is one of the most appreciated species for the consumption of animal protein in Mexico (Zarazúa-Carbajal et al. 2020). However, it is rare to observe them or find traces of them in the reserve (Sánchez-Rojas et al., 2016). While the two felines are known, neither is mentioned in the first group, probably because they are not frequently observed from day to day nor are they used as food.

The species with the lowest cognitive salience values, i.e., those considered idiosyncratic (group 3 in Table 2), represent 65% of the total number of species identified by the local people in the BMBR. This set of species shares the attribute that they are more difficult to observe and/or that the places they tend to inhabit are difficult to access. This aspect was suggested by the residents of the Reserve and may have caused people to mention them less frequently and further down on the lists. This may also be related to the fact that



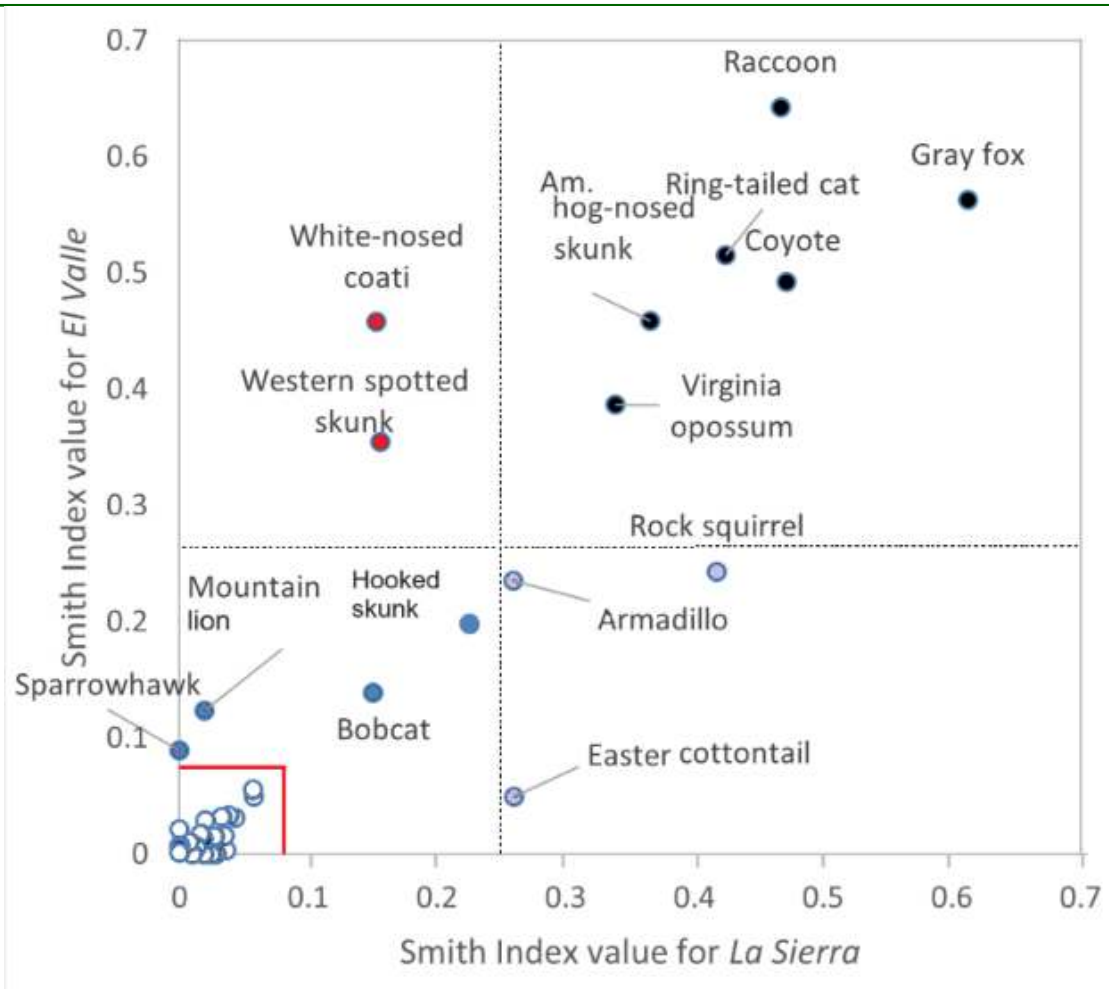
Hình 2. Cultural importance of wild fauna as perceived by men and women of the Barranca de Metztitlán Biosphere Reserve, from zero to the red line are the idiosyncratic species, between the red line and the dotted line are the species with non-significant saliency, and beyond the dotted line are species with significant saliency.

Bảng 3. Number of species mentioned by the interviewed population separated into male and female responses.

	N	Minimum	Maximum	Average	Standard deviation	Median	t
Men	51	5	17	9.45	2.641	9.000	$t = 2.010$ $p < 0.05$
Women	16	5	12	8.00	2.066	7.500	

these species are not assigned any positive or negative perception (Martínez 2013) since the people do not use them and they do not cause any issues.

Within this last group, species that are not found within the reserve were mentioned, such as wolves (*Canis lupus*). In this case, the species was mentioned by two of the respondents, a man and a woman. It is possible that this was a confusion or that it was an animal name know because it is mentioned in different media such as radio, TV or social networks. The respondents also mentioned a species known as "*tepachichi*", which could not be identified. Only one interviewee mentioned it, and that man described it as a four-legged animal, small, like a domestic cat, yellow,



Hình 3. Wild fauna of the zones of *La Sierra* and *El Valle* ranked by the Smith index, from zero to the red line are the idiosyncratic species, between the red line and the dotted line are the species with non-significant saliency, and beyond the dotted line are species with significant saliency.

Bảng 4. Number of species mentioned by the interviewed population separated into responses from *La Sierra* and *El Valle.*

	N	Minimum	Maximum	Average	Standard deviation	Median	t
La Sierra	33	5	17	8.58	2.784	8.000	t = -1.677 p= 0.098
El Valle	34	5	17	9.62	2.283	9.500	

and not very large, that lives in the trees. Given this description, the interviewee was shown pictures of the night monkey or *martucha* (*Potos flavus*), as well as the long-tailed weasel (*Mustela frenata*) and the tayra (*Eira barbara*), but he said that it was not any of those. The interviewee clarified that the "*tepachichi*" lives in very remote places in the most conserved areas.

Several publications agree that the spotted paca, collared peccary, white-tailed deer, and armadillo are the mammalian species with the highest cultural importance in Mexico (Racero-Casarrubia et al. 2008; García del Valle et al. 2015). These studies argue that these animals have a higher frequency of mention because of their importance as food and their good flavor. Our results show a very different picture: Since the red brocket deer, collared peccary, and spotted paca are valued as food, they have a very low density within the reserve (Sánchez-Rojas et al.

2016) and are very rarely seen and used by the residents at present. Furthermore, in our study, the frequency of sightings and proximity to humanized habitats appeared to determine the cognitive salience. It should be noted that our study was conducted in a dry area, in contrast to the other studies that have traditionally been conducted in humid forests. More studies are therefore required in desert and dry scrub areas to draw accurate conclusions about the factors that influence the cultural salience of the fauna, particularly in Mexico (a country dominated by dry areas).

Gender differences in the salience of wild fauna

Gender differences were revealed among the BMBR respondents in which women sometimes preferred that their husbands answer the questionnaire because they were shy or assumed that they would not know the answers. This reflects, among other things, a culture of machismo. In these cases, the interview was not conducted and, consequently, a limitation of the present study is that more men than women were interviewed.

Given the bias from the outset in terms of the number of women and men responding, the results should be interpreted with caution. In the area, women were much more reluctant to participate in the study, mainly because they reasoned that a man (husband, father, brother, etc.) would know more, even though a woman (ZKZH) conducted the interviews, and that it was not possible to equalize the sample size between genders. Despite this, we believe that ethnozoological knowledge is structured by gender in the BMBR. While men mentioned all the species of wild animals recorded through the interviews, women mentioned only a portion (59.5%) of the species. In addition, the cognitive salience value for some species was assigned differently between men and women. One of the factors behind this discrepancy is related to the differences in roles between genders, which act to influence knowledge (Pfeiffer and Butz 2005).

In this case, the men mentioned a longer list of wild animals because they went to more places and carried out more activities outside the home. For example, they go to cultivate crops, graze animals, and hunt, whereas women usually remain in spaces closer to their homes and villages. While both men and women carry out activities such as collecting firewood and grazing goats, they do so in different places. As mentioned by the men, they moved farther away, conducting activities in more remote places, while the women did so nearer the town.

Using the residuals from the comparison between the men and women (Additional File 1), we found that the men may assign greater cognitive salience to the raccoon, ring-tail cat, western spotted skunk, white-nosed coati, and mountain lion, compared to the women. In contrast, the women named the rock squirrel and cottontail. This is because squirrels are frequently found where there are walnuts available, and these tend to be in the anthropic spaces close to the villages. When women take animals to graze, they often observe eastern cottontails. When hunting, men may recognize different wild animals from those recognized by women since the men hunt to simultaneously achieve two purposes: control of conflictive species and acquisition of food (Rosales et al. 2010). Knowledge also varies according to social norms and beliefs, which is why women sometimes limit their responses (Torres-Avilez et al. 2016). Our second hypothesis was that knowledge between the sexes would be biased by the role of gender, and our data seem to support this.

Wildlife perceived with higher cognitive salience between sites

The scrub and forest have greater coverage and higher levels of conservation in *La Sierra*, while *El Valle* is mainly covered by anthropic vegetation. Therefore, according to the proposed hypothesis, there would be a greater diversity of wild animals in the *La Sierra* zone. According to the t-test, there was no significant difference between the median number of species mentioned by the inhabitants of Sierra and the median number of species mentioned by the inhabitants of *El Valle*. There were differences in the composition of the wildlife species mentioned by the people, so our third hypothesis was rejected. The diversity of species obtained in *El Valle* can be explained by the fact that wild animals can find a greater availability of food in the zone of *El Valle*. For example, raccoons and coatis feed on crops, and this resource is more easily found there. In addition, these species readily adapt to anthropogenic conditions. In contrast, species such as the gopher are more selective about both their food and the area in which they live.

The difference between *La Sierra* and *El Valle* is not only biological and topographical, but also economic since *El Valle* has a higher economic level (Jimenez-Sierra et al. 2020), which is reflected in the greater number of stores, butcher shops, pharmacies, and services. The most important towns in the BMBR are in *El Valle* (e.g., in the municipality of Metztitlán). In contrast, in *La Sierra*, people are obliged to go to *El Valle* to buy groceries, see a doctor, and earn their daily wages. Animals such as the eastern cottontail and the rock squirrel are more important in *La Sierra*, where people mention that they still consume the meat of wild animals. Although species such as the

squirrel are present in areas of *El Valle* zone, since these areas are more anthropic, people from there report that it is rare for them to consume this type of meat since they consider it more feasible to go to the butcher shop to buy meat. This reflects the fact that this Biosphere Reserve provides a variety of animals that are important non-timber forest products for local people, particularly for the poorest. This also reflects the different perceptions that people may have according to their interests, aspirations, or motivations due to the heterogeneity of society (Tamburini et al. 2021). Another aspect that influences the variation in perceptions is the traditional knowledge transmitted between generations (Santos et al. 2009), which reflects patterns of differences between people, groups, localities, and regions (Parra-Colorado et al. 2014), in this case between *El Valle* and *La Sierra*.

Implications for the conservation

Documenting the local knowledge of the species that make up the flora and fauna of the system allows us to determine and establish conservation objectives since we can identify those species that are perceived in a negative way (conflict). This opens an opportunity to propose strategies that minimize conflict and maximize coexistence. On the other hand, those species that are perceived positively because they are useful or that, through well-designed programs, could become flagship species of sustainability and improve the conditions of local populations. This exchange of knowledge with researchers can be the key to joint working that allows us to visualize common objectives with the inhabitants.

CONCLUSION

The population of the BMBR has knowledge of their local wild species; 37 species, 25 of which are mammals, as well as birds and reptiles, inhabit the area. The most salient of these were eleven mammal species. Ethnozoological knowledge is structured by gender: while men mentioned all the wildlife species, women mentioned only some of the species. The cognitive salience value for some species was assigned differently between men and women. *El Valle* and *La Sierra* produced similar mentions of animals, but the Smith indices for some species differ considerably. Further studies are required to understand the factors that influence the cognitive salience of the wild fauna, particularly in dry regions of Mexico. We are convinced that evaluating the knowledge of local people regarding different aspects of biodiversity is an essential measure for conservation work; you cannot love what you do not know.

ACKNOWLEDGMENTS

Thanks are due to the inhabitants of the communities of the BMBR who opened their doors to the researchers and generously shared their knowledge. We also thank Juan Alfonso Hernández Melo for his support on all field trips. Ferdinand Torres Angeles and Jocelyn M. Briseño Tellez produced Figure 1. Leonardo da Silva Chaves provided additional information about the Monte Carlo script. Numa P. Pavón made important suggestions to the first draft.

FUNDING

The study was financed by the National Commission of Protected Natural Areas (CONANP, by its Spanish acronym) for support through the PROCER/CCER/DRCEN/04/2016 project. GSR and MTPS thank CONAHCYT and SIIN for their support of this research.

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 have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: GSR, ZKZH.
Carried out the experiment: ZKZH.
Carried out the data analysis: ZKZH, MTPS, GSR.
Wrote the first draft of the manuscript: ZKZH, MTPS.
Review and final write of the manuscript: ZKZH, MTPS, GSR.

REFERENCES

Aguilar-López M, Monter-Vargas JL, Cornejo-Latorre C, Hernández-Saintmartin A (2019) **First photo evidence of the American black bear (*Ursus americanus*) in the southwestern limit of its distribution.** *Western North American Naturalist* 79(1): 124-129. doi: 10.3398/064.079.0112.

Alves, R. R. N., Souto, W. M. S., & Albuquerque, U. P. (2018). **Ethnozoology: conceptual and historical aspects**. Pp 9-24 In *Ethnozoology* . (Alves, R.R. & Albuquerque U.P Editors). Academic Press. doi: 10.1016/B978-0-12-809913-1.00002-8.

Amiot CE, Bastian B (2015) Toward a Psychology of Human–Animal Relations. *Psychological Bulletin* 141:6–47. doi: 10.1037/a0038147.

Arruda JC, da Silva CJ, Sander NL, Pulido MT (2018) **Conhecimento ecológico tradicional da ictiofauna pelos quilombolas no Alto Guaporé, Mato Grosso, Amazônia meridional, Brasil**. *Boletim do Museo Paraense Emílio Goeldi. Ciências* Humanas 13(2):315-329. doi: 10.1590/1981.81222018000200004.

Ávila-Nájera DM, Naranjo EJ, Tigar B, Villarreal O, Mendoza GD (2018) **An Evaluation of the Contemporary Uses and Cultural Significance of Mammals in Mexico**. *Ethnobiology Letters* 9(2):124-135. doi: 10.14237/ebl.9.2.2018.1106.

Bernard HR (2006) **Research Methods in Anthropology: qualitative and quantitative approaches**. 4ed. Altamira Press, Oxford, USA

Bousfield WA, Barclay WD (1950) **The relationship between order and frequency of occurrence of restricted associative responses**. *Journal of Experimental Psychology* 40(5):643-647. doi: 10.1037/h0059019.

Campos CM, Moreno C, Cappa FM, Ontiveros Y, Cona MI, Torres ML (2021) **"Weaving" Different Knowledge Systems through Studying Salience of Wild Animals in a Dryland Area of Argentina**. *Journal of Ethnobiology* 41(2):292-306. doi: 10.1037/h0059019.

Castro-Campos F, Valenzuela-Galván D, Meneses MA, Chávez-Tovar JC, Pacheco-Bahena F, Barrera-Suárez MA, Rueda-Rosas A (2021) **Noteworthy records of puma (*Puma concolor*) in Morelos, México.** *Therya Notes* 2:39-46. doi: 10.12933/therya_notes-21-33.

Chaves LS, Nascimento ALBD, Albuquerque UP (2019). **What matters in free listing? A probabilistic interpretation of the salience index**. *Acta Botanica Brasilica* 33: 360-369. doi: 10.1590/0102-33062018abb0330.

CONABIO and SEMARNATH (2021) **La biodiversidad en Hidalgo: Estudio de estado.** Comisión Nacional para el Conocimiento y uso de la Biodiversidad and Secretaría de Medio Ambiente y Recursos Naturales del Estado de Hidalgo, México. https://www.biodiversidad.gob.mx/region/EEB/estudios/ee_hidalgo Accesed 12 july 2023.

Cox, DTC, Hudson, HL, Plummer, KE, et al. (2018) **Covariation in urban birds providing cultural services or disservices and people**. *Journal of Applied Ecology* 55:2308– 2319. doi: 10.1111/1365-2664.13146.

da Costa FV, Guimarães MFM, Messias MCTB (2021) **Gender differences in traditional knowledge of useful plants in a Brazilian community.** *PLoS One* 16(7):e0253820. doi: 10.1371/journal.pone.0253820.

Cupul-Cicero, V., Aguilar Cordero, W. D. J., Chablé Santos, J., Sélem Salas, C. I. (2019). **Conocimiento etnozoológico de la herpetofauna de la comunidad maya de Santa Elena, Yucatán, México**. *Estudios de cultura maya*, 54, 285-314. doi: 10.19130/iifl.ecm.2019.54.994.

Fernández-Badillo L, Zuria I, Sigala-Rodríguez J, Sánchez-Rojas G, Castañeda Gaytan G 2021. **Revisión del conflicto humano-serpiente en México.** *Animal Biodiversity and Conservation* 44 (2) 153-174. doi: 10.32800/abc.2021.44.0153.

Gallegos A, Bello J, De la Cruz AJ (2010) **Cuantificación del daño ocasionado por mamíferos terrestres a cultivos de maíz en el ejido Oxolotán del municipio de Tacotalpa, Tabasco, México.** In: Guerra MM, Calmé S, Gallina S, Naranjo EJ (eds) Uso y manejo de Fauna Silvestre en el norte de Mesoamérica. Serie Hablemos de Ciencia y Tecnología. Gobierno del Estado de Veracruz - Instituto de Ecología - Colegio de la Frontera Sur, México, pp 297-313.

García del Valle Y, Naranjo EJ, Caballero J, Martorell C, Ruan-Soto F, Enríquez PL (2015) **Cultural significance of wild mammals in mayan and mestizo communities of the Lacandon Rainforest, Chiapas, México**. *Journal of Ethnobiology and Ethnomedicine*. doi: 10.1186/s13002-015-0021-7.

Gómez-Vásquez E, Gónzalez-Romero A, Sosa-Fernández V, Sevín-Martínez J (2004) **Importancia del coyote para la ganadería menor en *El Valle* de Perote, Puebla-Veracruz, México.** In: Cabrera E, Mercolli C, Resquín R (eds) Manejo de Fauna Silvestre en la Amazonia y Latinoamérica, México, pp 190-194.

Gosler, A. G. (2017). **The human factor: ecological salience in ornithology and ethno-ornithology**. *Journal of ethnobiology*, 37(4), 637-662. doi: 10.2993/0278-0771-37.4.637.

Gravlee L (2002) **The uses and limitations of free listing in ethnographic research.** Research Methods in Cognitive Anthropology. http://gravlee.org/ang6930/freelists.htm Accessed 12 October 2018.

Gutiérrez-Santillán, T. V., Moreno-Fuentes, Á., Sánchez-González, A., & Sánchez-Rojas, G. (2019).

Knowledge and use of biocultural diversity by Nahua in the Huasteca region of Hidalgo, Mexico. *Ethnobiology and Conservation*, 8: 7. doi: 10.15451/ec2019-06-8.07-1-31.

Halffter G (2011) **Reservas de la biosfera: problemas y oportunidades en México**. *Acta Zoológica Mexicana* 27(1):177-189.

Hernández S (2009) **Diversidad y distribución del ensamblaje de mamíferos en la Reserva de la Biosfera Barranca de Metztitlán, Hidalgo, México**. MSc. dissertation, Universidad Autónoma del Estado de Hidalgo, México.

Hernandez Melo JA, Sánchez Rojas G, Bravo Cadena J (2021). Conocimiento y uso de los mamíferos medianos y grandes en Atotonilco el Grande. In: (CONABIO edit) La biodiversidad en Hidalgo. Estudio de Estado. CONABIO México, pp 15- 22.

Hidalgo-Mihart MG, Jesus-de La Cruz A, Contreras-Moreno FM, Juárez-López R., Bravata-de La Cruz Y, Friedeberg D, Bautista-Ramírez P (2019) **Jaguar density in a mosaic of disturbed/preserved areas in southeastern Mexico**. *Mammalian Biology* 98:173-178. doi: 10.1016/j.mambio.2019.09.009.

INALI (2009) **Catálogo de las Lenguas Indígenas Nacionales: Variantes Lingüísticas de México con sus autodenominaciones y referencias geoestadísticas.** Instituto Nacional de Lenguas Indígenas, México.

Jiménez-Sierra CL, Matias-Palafox ML, Sosa-Ramírez J, Arriola-Padilla VJ, Torres-Orozco Jiménez D, Aguilar-López M (2020) **Results of Socio-ecosystem Institutional Management: Analysis of Two Protected Natural Areas of Central Mexico**. In: Ortega-Rubio A (ed) Socio-ecological Studies in Natural Protected Areas: Linking Community Development and Conservation in Mexico, Springer, pp. 461-481.

Lacher TE, Davidson AD, Fleming TH, Gómez-Ruiz EP, McCracken GF, Owen-Smith N, Peres CA, Vander Wall SB (2019) **The functional roles of mammals in ecosystems**. *Journal of Mammalogy* 100(3): 942-964. doi: 10.1093/jmammal/gyy183.

Lavariega MC, Ríos-Solís JA, Flores-Martínez JJ, Galindo-Aguilar RE, Sánchez-Cordero V, Juan-Albino S, Soriano-Martínez I (2020). **Community-based monitoring of jaguars (*Panthera onca*) in the Chinantla region, Mexico**. *Tropical Conservation Science* 13:1-16 doi: 10.1177/1940082920917825.

Mace, G. M. 2014. Whose Conservation? Science 345:1558–1560. doi: 10.1126/science.1254704.

Martínez GJ (2013) **Use a fauna in the traditional medicine of native Toba (qom) from the Argentine Gran Chaco region: an ethnozoological and conservation**. *Ethnobiology and Conservation* 2:2 doi: 10.15451/ec2013-8-2.2-1-43.

Morrone JJ (2001) **Biogeografía de América Latina y el Caribe**. Manuales y Tesis, SEA, Zaragoza.

Nyhus PJ (2016) **Human–wildlife conflict and coexistence**. *Annual Review of Environment and Resources* 41:143-171. doi: 10.1146/annurev-environ-110615-085634

Ortiz-Pulido R, Bravo-Cadena J, Martínez-García V, Reyes D, Mediola-González ME, Sánchez G, Sánchez M (2010) **Avifauna de la Reserva de la Biosfera Barranca de Metztitlán, Hidalgo, México**. *Revista Mexicana de Biodiversidad* 81(2):373-391.

Parra-Colorado JW, Botero-Botero Á, Saavedra CA (2014) **Percepción y uso de mamíferos silvestres por comunidades campesinas andinas de Génova, Quindío, Colombia.** *Boletín Científico Centro de Museos Museo de Historia Natural* 18(1):78-93.

Pfeiffer JM, Butz RJ (2005) **Assessing cultural and ecological variation in ethnobiological research: the importance of gender**. *Journal of Ethnobiology* 25(2): 240-279 doi: 10.2993/0278-0771_2005_25_240_acaevi_2.0.co_2.

Pulido MT, Cuevas-Cardona C (2013) **Cactus Nurseries and Conservation in a Biosphere Reserve in Mexico.** *Ethnobiology Letters* 4:96-104. doi: 10.14237/ebl.4.2013.58.

Quinlan MB (2005) **Considerations for collecting freelists in the field: examples from ethobotany**. *Field Methods* 17(3):219-234. doi: 10.1177/1525822X05277460.

Racero Casarrubia JA, Vidal CC, Ruiz OD y Ballesteros J. (2008) **Percepción y patrones de uso de la fauna silvestre por las comunidades indígenas Embera-Katíos en la cuenca del río San Jorge, zona amortiguadora del PNN-Paramillo.** *Revista de Estudios Sociales* 31: 118-131. http://journals.openedition.org/revestudsoc/17539

Randler C, Adan A, Antofie M, et al. (2021) **Animal welfare attitudes: effects of gender and diet in university samples from 22 Countries**. *Animals* 11(7):1893. doi: 10.3390/ani11071893.

Rosales M, Hermes M, Morales J (2010) **Caracterización de la caería de subsistencia en comunidades Maya-Q'eqchi' del área de**

influencia del Parque Nacional Laguna Lachuá, Guatemala. In: Guerra M, Calmé S, Gallina S, Naranjo E (eds) Uso y manejo de Fauna Silvestre en el Norte de Mesoamérica, 1st edn. Secretaría de Educación del Gobierno del Estado de Veracruz de Ignacio de la Llave, Mexico, pp. 25-52.

Ruan-Soto F, Mariaca R, Cifuentes J, Limón F, Pérez-Ramírez L, Sierra-Galván S (2007) **Nomenclatura, clasificación y percepciones locales acerca de los hongos en dos comunidades de la Selva Lacandona, Chiapas, México**. *Revista Etnobiología* 5:1-20.

Sánchez IF (2005) **Propuesta de diseño del producto ecoturístico y su comercialización para la Reserva de la Biosfera "Barranca de Metztitlán", Hidalgo**. MSc. dissertation, Instituto Politécnico Nacional, Mexico.

Sánchez-Rojas G, Hernández Flores SD, Castillo-Cerón J, Mejenes-López S, Aguilar-López M, Bravo-Cadena J, García-Becerra A, García-Morales R y Hernández-Silva D (2016) **Riqueza, composición y conservación de los mamíferos del Estado de Hidalgo, México**. In: Briones-Salas M, Hortelano-Moncada Y, Magaña-Cota G, Sánchez-Rojas G y Sosa-Escalante JE (eds) Riqueza y Conservación de los Mamíferos en México a Nivel Estatal. Universidad Nacional Autónoma de México, Asociación Mexicana de Mastozoología A. C. y Universidad de Guanajuato, Ciudad de México, pp. 281-309.

Santos D, Costa EM, Cano-Contreras EJ (2009) **El quehacer de la Etnozoología**. In: Costa EM, Vargas M, Santos FD (eds) Manual de Etnozoología. Una guía teórico-práctica para la investigar la interconexión del ser humano con los animales. 1st edn. Tundra Ediciones, Valencia, España, pp. 281-309.

Smith JJ, Borgati SP (1998) **Salience Counts—And so does accuracy: correcting and updating a measure for Free-List-Item Salience.** *Journal of Linguistic Anthropology* 7(2): 208-209.

Sosa-Escalante JE, Sánchez-Rojas G, Briones-Salas M, Hortelano-Moncada Y, Magaña-Cota G (2016) **Riqueza y conservación de los mamíferos mexicanos con una visión estatal.** In: Briones-Salas M, Hortelano-Moncada Y, Magaña-Cota G, Sánchez-Rojas G, Sosa-Escalante JE (eds) Riqueza y Conservación de los Mamíferos en México a Nivel Estatal. 1st edn. UNAM, Asociación Mexicana de Mastozoología A. C. y Universidad de Guanajuato, CDMX, pp. 23-38.

Soulsbury CD, White PC (2016) **Human–wildlife interactions in urban areas: a review of conflicts, benefits and opportunities**. *Wildlife Research* 42(7):541-553 doi: 10.1071/WR14229.

Stryamets N, Mattalia G, Pieroni A, Sõukand R (2023) **"Mushrooms (and a cow) are A Means of Survival for Us": Dissimilar Ethnomycological Perspectives among Hutsuls and Romanians Living Across The Ukrainian-Romanian Border**. *Environmental Management* 72:363-381. doi: 10.1007/s00267-022-01619-6.

Tamburini DM, Zamudio F, Cáceres DM (2021) **Multiple assessments to value wild animals in the analysis of human–wildlife relationships: a case study from the Argentine Dry Chaco**. *Ethnobiology and Conservation* 10 doi: 10.15451/ec2021-08-10.29-1-21.

Torres-Avilez W, Muniz de Medeiros P, Albuquerque UP (2016) **Effect of gender on the knowledge of medicinal plants: systematic review and Meta-Analysis.** *Evidence-Based Complementary and Alternative Medicine*. doi: 10.1155/2016/6592363.

Turner N (1988) **The importance of a rose. Evaluating the cultural significance of plants in Thompson and Lillooet Interior Salish.** *American Anthropologist, new series* 90:272-290.

Vázquez-Cuevas GM, Roldán IE (2010) **Evaluación de los cambios de cobertura del suelo en la Reserva de la Biosfera Barranca de Metztitlán, Hidalgo, México (1973-2006).** *Papeles de Geografía* 51:330-335.

Vite-Silva VD, Ramírez-Bautista A, Hernández-Salinas U (2010) **Diversidad de anfibios y reptiles en la Reserva de la Biosfera Barranca de Metztitlán, Hidalgo, México**. *Revista Mexicana de Biodiversidad* 81(2):473-485.

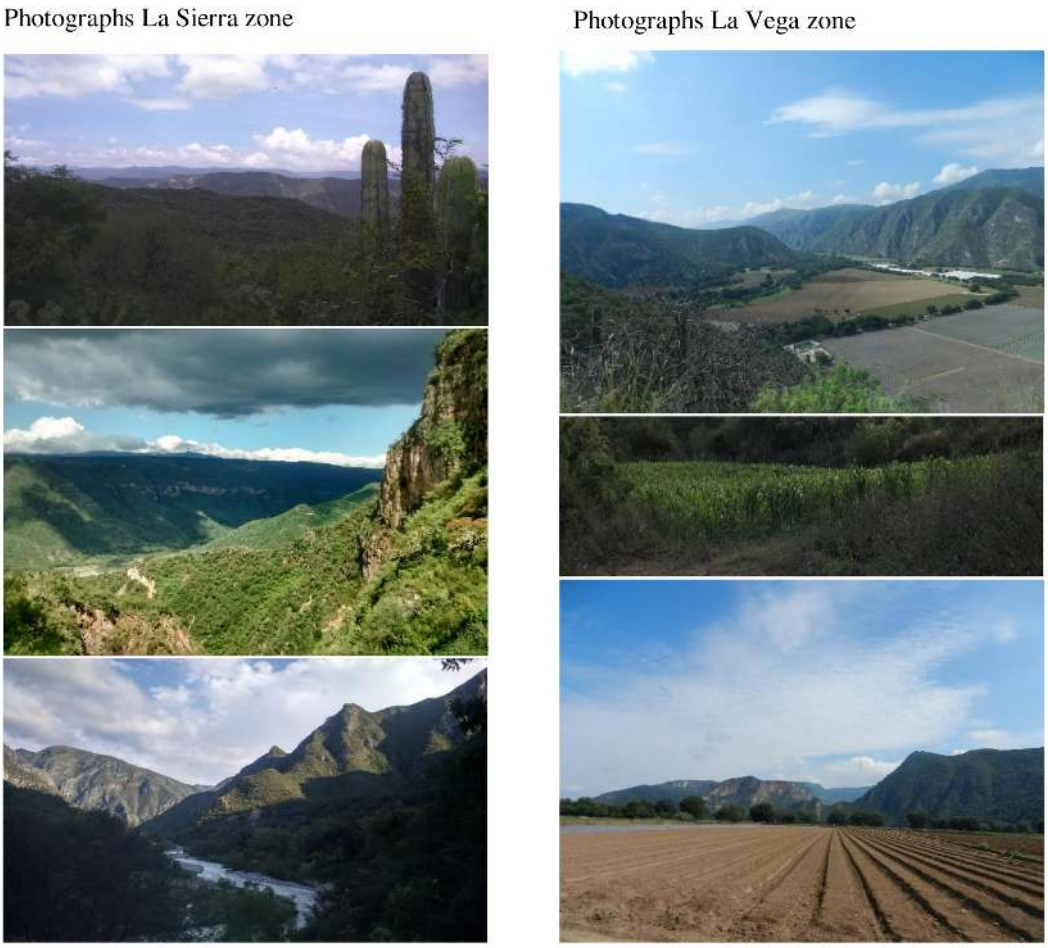
Wajner M, Tamburini D, Zamudio F (2019) **Ethnozoology in the mountains. What does the cognitive salience of wild animals tell us?** *Ethnobiology and Conservation* 8:9. doi: 10.15451/ec2019-07-8.09-1-23.

Zarazúa-Carbajal M, Chávez-Gutiérrez M, Romero-Bautista Y, Rangel-Landa S, Moreno-Calles AI, Ramos LFA, Casas A (2020) **Use and management of wild fauna by people of the Tehuacán-Cuicatlán Valley and surrounding areas, Mexico**. *Journal of Ethnobiology and Ethnomedicine* 16:1-23. doi: 10.1186/s13002-020-0354-8.

Received: 21 December 2023
Accepted: 28 June 2024
Published: 10 July 2024

Editor: Ulysses Albuquerque

Additional Files



Add File 1. Visual comparison between *La Sierra* and *El Valle* at Barranca de Metztitlán Biosphere Reserve.

Add File 2. Interview applied.

Semi-structured interview applied (in Spanish).

Cláusula de confidencialidad: La información contenida en este cuestionario es de carácter confidencial y será empleada únicamente para los fines de la investigación. Agradecemos su tiempo para responderla

Fecha: _____ # Cuestionario_____ Encuestador: _____

Localidad: _____ Municipio: _____

Datos demográficos

*1.*Nombre: _____

2. Edad: a) de 15-24 b) de 25-34 c) de 35-44 d) de 45 a 54 e) de 55 a 65 f) más de 65

3. Género: a) Mujer b) Hombre

4. Escolaridad: a) Primaria incompleta b) Primaria completa c) Secundaria d) Med.Sup.

e) Superior

5. Tipo de propiedad: a) Privado b) Ejido c) Avecindado d) Lo desconozco

6.- Nombre del predio: _____ *6´*Extensión: ha)_____

7. Tipo de Veg:_____ *7´*Cuerpos de agua en el predio: a) Si b) No

8. Principal Actividad económica: a) Agricultura b) Ganadería c) Comercio d) Obrero Otra: _____

9. Ocupación económica complementaria: a) Agricultura b) Ganadería c) Comercio d) Obrero Otra: _____

Producción y manejo pecuario

10. Características de producción pecuaria

Especie producida	Cantidad actual	Cantidad de animales muertos en el último año	Causa
Ovinos			
Caprinos			
Vacunos			
Equinos			
Aves de Corral			
Otro (cual)			

11. Tipo de manejo: a) Intensivo b) Extensivo

12. ¿Propósito de tenencia de sus animales? a) Autoconsumo b) Fondo de ahorro c) Costumbre d) Sustento económico principal

13. ¿Cuánto tiempo invierte en el cuidado de sus animales?

a) Nada b) Todos los días c) 1-3 días a la semana d) cada semana e) Dos veces al mes f) Una vez al mes

14. ¿A qué hora acostumbra campear a sus animales? (para quienes tiene ganado vacuno y ovino o caprino)

a) Mañana b) Medio Día c) Tarde d) Noche e) No sale

15. ¿Revisa el estado de salud de sus animales? a) Si b) No

16. ¿Tiene perros? A) Si ¿Cuántos?_____ b) No

17. ¿Cuál considera es el motivo principal de pérdida de sus animales?

a) Extravío b) Robo c)Enfermedad d) Mal Parto e) Depredación f) Accidente g) Sequia
Otro:_____

18. En el último año, ¿Cuántos animales ha perdido por cada causa?

_____

19. ¿Qué medidas toma actualmente para evitar la pérdida de su ganado?:

_____

Sobre Depredación

20. En el último año ¿Ha tenido pérdidas por depredación? a) Si b) No

21. Temporada de depredación: (Mes):_____: a) lluvia b) Secas

22. Hora en que ocurrió la depredación: a) Mañana b) Tarde c) Noche

23. ¿Dónde se encontraban sus animales al ser atacados?
a) Monte b) Corrales y/o establos c) Otro lugar: ¿Cuál? _____
(en caso de poder acceder y confirmar el sitio) Ubicación (UTM):_____ Vegetación_____

24. ¿Qué animal fue el responsable del ataque?:_____

25. ¿Cómo identifica qué animal atacó a su ganado?
_____

26. ¿En qué parte del cuerpo fue atacado su animal?
_____

27. ¿Realiza algún reporte sobre las pérdidas de su ganado por depredación? (Sólo pérdidas por ganado vacuno y ovino)
a) Si ¿Dónde? _____ No ¿Por qué?_____

28. ¿Considera que esas pérdidas las pudo haber evitado? a) Si b) No

29. ¿Cómo?:
_____

30. ¿Qué animales considera nocivos para sus animales?

a) Coyotes b) Puma c) Zorra d) Perros e) Otro _____

30´. ¿Por qué? _____

31. ¿Qué métodos ha empleado para el control de los depredadores?

32. ¿Estaría de acuerdo en implementar medidas para la prevención de las pérdidas?

a) Nada de acuerdo b) Poco de acuerdo c) No sé d) De acuerdo e) Muy de acuerdo

33. ¿Cuánto considera podría invertir en las medidas de prevención de pérdidas?

a) Nada b) de 500-1000 c) de 1000-2000 d) de 2000 a 5000 e) Más de 5000

Conocimiento sobre Fauna Silvestre

34. ¿Qué animales silvestres o de monte sabe que hay en su comunidad?

_____

35. ¿Cada cuánto ve estos animales?: a) Diario b) 1-3 veces/semana c) cada semana d) cada mes

36. ¿En qué sitios es frecuente ver estos animales?:

a) Caminos/carreteras b) Cuerpos de agua c) Milpas d) Potreros e) Monte

37. ¿Qué animales son cazados en su comunidad?

38. ¿Caza animales de monte? a) Si b) No
¿Cuáles?_____

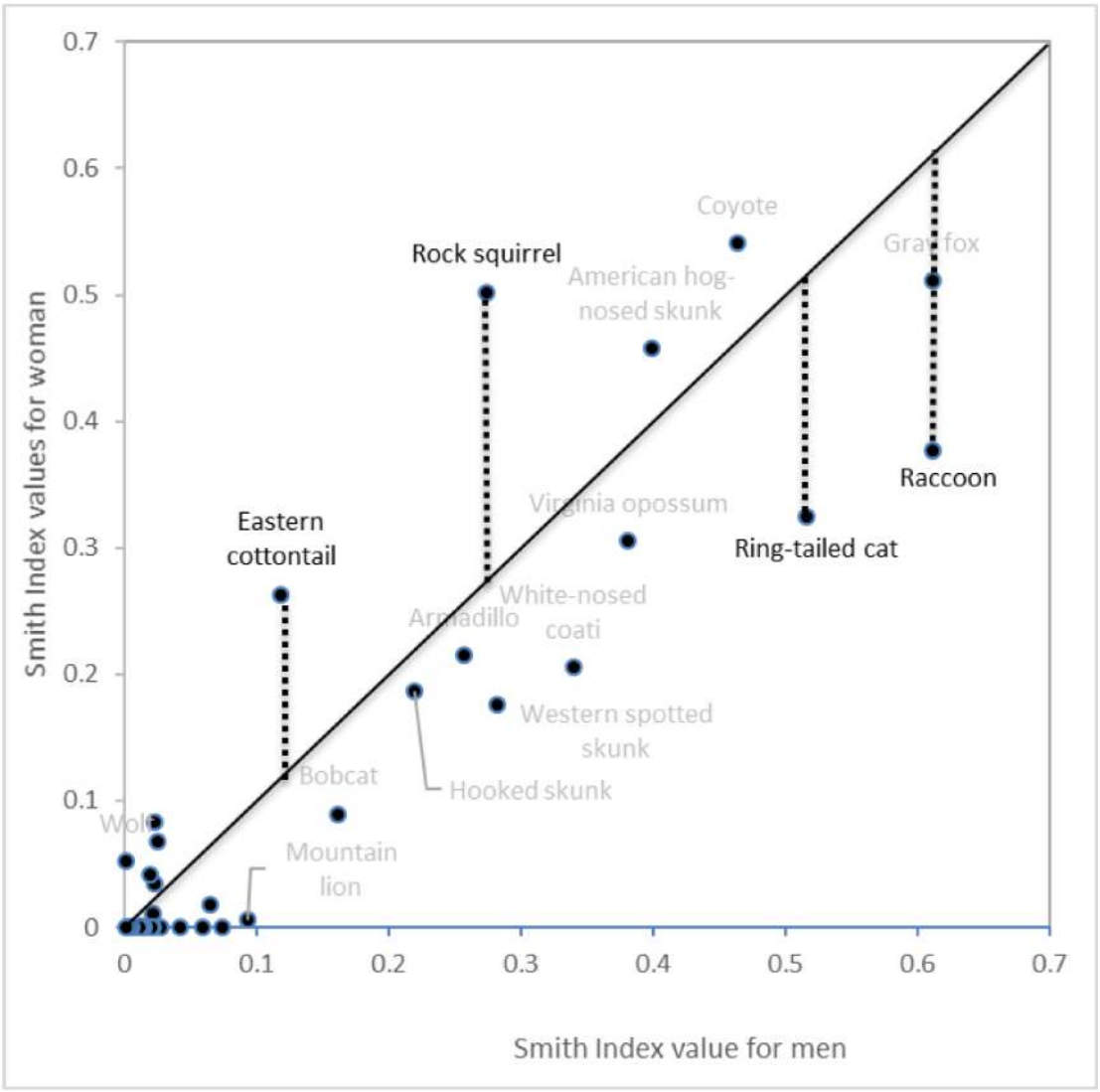
39. ¿Con qué finalidad o uso?

_____

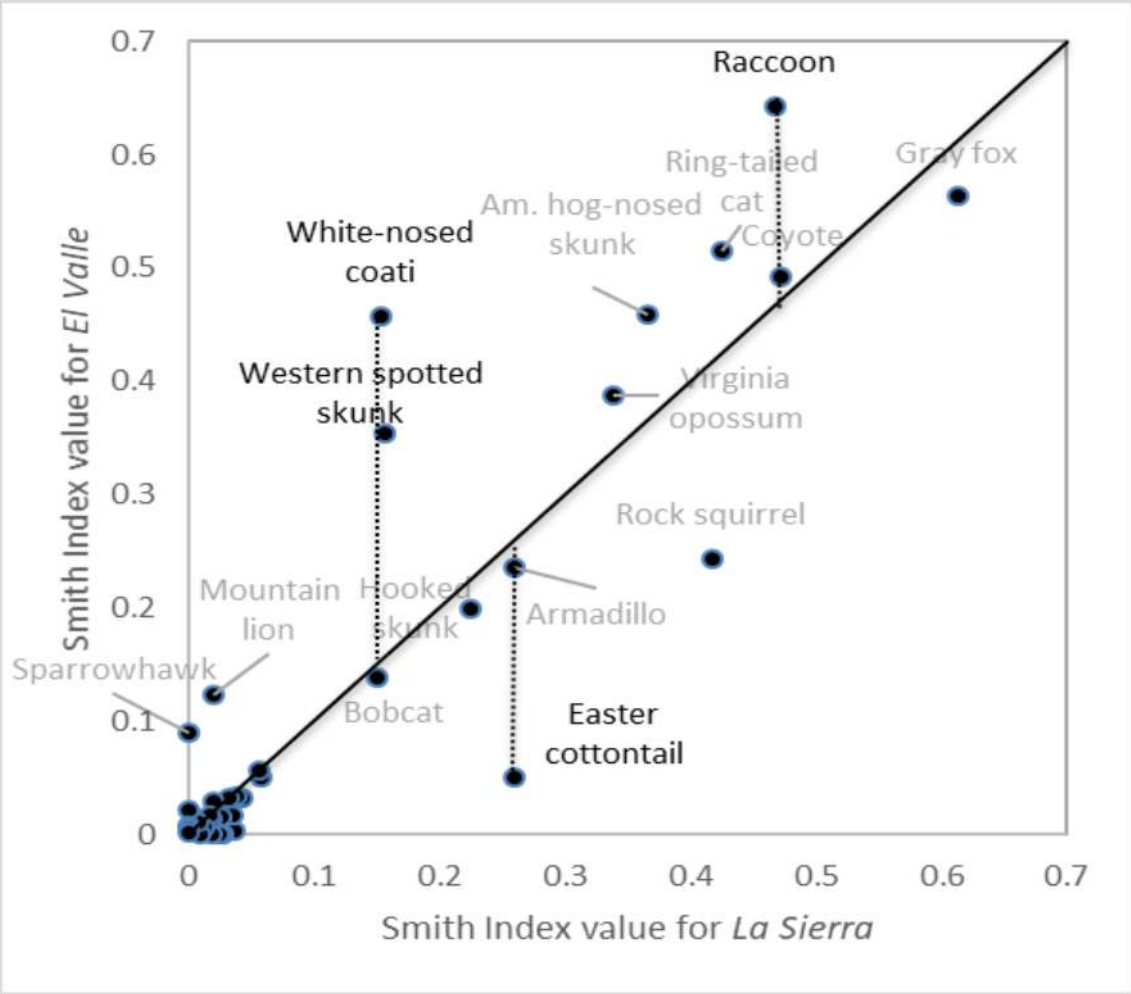
40. ¿Sabe si alguno de estos animales está protegido por las leyes mexicanas? a) Si b) No

41. ¿Cómo obtuvo esa información?

_____



Add File 3. Cognitive salience of wild fauna as perceived by men and women of the Barranca de Metztitlán Biosphere Reserve. The points close to the trend line represent the species that had similar perception values for men and women. Dotted lines represent the residuals.



Add File 4. Wild fauna of the zones of *La Sierra* and *El Valle* ranked by the Smith index. The points close to the trend line represent the species that had similar perception values between *El Valle* and *La Sierra*. The dotted lines represent the residuals.