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ORIGINAL RESEARCH

Influence of human emotions on conservation attitudes toward relevant wildlife species in El Triunfo Biosphere Reserve, Mexico

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Abstract
Human emotions had a significant impact on the survival of our ancestors throughout our evolutionary history. Nowadays, it is possible that our emotions still influence our attitudes in favor or against wildlife conservation. To analyze this hypothesis, we designed a study using eight iconic vertebrate species (two birds, five mammals, and a snake) with different ecological roles, some of which are threatened. The study was directed to 238 inhabitants of communities within El Triunfo Biosphere Reserve, Chiapas, Mexico. We built a Conservation Effort factor (CE) based on questions related to participants' attitudes toward the focal species. We analyzed the influence of variables (predictors) through a Sequential Canonical Analysis (SEQCA) using the next sequence: (1) participants' experiences with animals; (2) negative emotions; (3) positive emotions; and (4) CE. The model also considered the influence of sociodemographic variables (age, gender, participation in conservation activity, religion, and region). The model was significant and explained 25% of the variance. Although sociodemographic predictors had an influence on the participants' experiences with the focal species, these variables did not have an effect on the CE. The CE was significantly influenced by positive (happiness) and negative (fear) emotions. Our study revealed the importance of human emotions in conservation management strategies, especially with species such as large carnivores and snakes. We conclude that personality predictors could explain the remaining variance in the model. We propose further studies to examine the role of emotions and other personal predictors in human-wildlife interactions.

Keywords Conservation psychology · Empathy · Fear · Mammals · Snakes

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Introduction

Currently, one of the main environmental threats is the decline and loss of vulnerable wildlife populations (Young et al. 2016). In the Neotropical region, the current rate of vertebrate extinction is faster than in the five previous mass extinctions (Ceballos and Ortega-Baes 2011). This environmental problem has different reasons, and human attitudes toward animal species conservation are among the most relevant (Manfredo and Bright 2008). Attitudes are the predisposition to respond favorably or unfavorably towards an object, a physical or imaginary event, or an animal (Fishbein and Ajzen 1975). Attitudes toward wild animals may result from a diversity of social, evolutionary, and psychological factors (Herzog and Burghardt 1998; Dressel et al. 2015; Ambarlı 2016; Bhatia et al. 2021). However, a fundamental element of attitudes toward wildlife is personal experience. Emotional experiences are kept in the memory; they are learned to survive (Johansen et al. 2011) and could influence attitude formation (Eagly and Chaiken 1993).

Human experiences with animals such as sightings, local uses, affective interactions, and indirect information such as local knowledge (e.g., tales), could be able to promote emotions. Emotions are defined as an individual´s response to events appraised as relevant to his or her concerns (Frijda and Mesquita 1998), that cause fast changes in the body (Dalgleish 2004). There are six "basic" emotions: anger, fear, surprise, sadness, happiness, and disgust (Ekman et al. 1969; Ekman 1992). Some of these emotions could be grouped according to their valence: positive (happiness) and negative (anger, fear, sadness, disgust) (Nummenmaa et al. 2014). Emotions are stored and remembered by individuals for constructing judgments, attitudes, and behaviors (Kellert and Berry 1987; Dolan 2002; Eriksson et al. 2015). For example, a person could express fear in an encounter with a snake, which promotes his/her antagonistic reaction, ultimately motivated by self-defense (Antony and McCabe 2005). This negative experience further influences attitudes toward the reptile, which can negatively impact an individual's willingness to protect it (Pandey et al. 2016; Onyishi et al. 2021), regardless of the conservation status of the species. This experience could be integrated by evolution and cultural factors (Izard 2009). Ancestral hominids had many encounters with large predators and snakes. Consequently, they developed adaptations to avoid and survive in spaces where they shared (Treves and Palmqvist 2007). Fear is one example of these adaptations (Isbell 2005). Additionally, the information from experience become part of local knowledge, which is sometimes overestimated and contributes to creating negative attitudes toward animals (Jacques-Coper et al. 2019; Linares-Rosas et al. 2021).

The previous example is useful for demonstrating the interrelated factors that create an attitude. Fear could be one of the first emotions triggering an attitude (Onyishi et al. 2021); however, the emotion also could be influenced by both the person's background and the physical and behavioral characteristics of the animal species (Castillo-Huitrón et al. 2020). Besides, attitudes are influenced also by personal sociodemographic variables such as gender, age, environment, and income (Herzog and Burghardt 1998; Røskaft et al. 2007). For instance, women hold positive attitudes toward wildlife species and their welfare (Signal and Taylor 2006; Herzog 2007; Lipták et al. 2023) but show negative attitudes (e.g., fear) of harmful wildlife species than men (Røskaft et al. 2003; Kaltenborn et al. 2006; de Pinho et al. 2014; Prokop et al. 2021). Older people are generally less willing to support wildlife species than younger people (Jin et al. 2016; Murphy et al. 2018), and people with higher incomes are more willing to pay for nature conservation than those with lower incomes

(Cheung and Jim 2014; Gong et al. 2020). Another factor that could influence conservation attitudes is religion. Some religions encourage people to get involved in nature experiences improving ethical values toward nature (Mcleod and Palmer 2015). In some cases, wild animals are icons of local religions. Species could be adapted as good or evil icons; as a consequence, attitudes could be in favor or against them (Jacques-Coper et al. 2019).

In recent decades, many conservation programs have been developed with a focus on social inclusion (Baldauf 2020). The involvement of local communities in conservation efforts has been shown to be a crucial factor in enhancing knowledge about wildlife and promoting positive attitudes (Daltry et al. 2001; Espinosa and Jacobson 2012). Identifying people's attitudes and the variables that could influence them is crucial for the conservation of species whose coexistence with people leads to conflicts, such as large mammal carnivores and reptiles (Makumbe et al. 2022).

Due to attitudes being a latent variable (it is not directly observable nor measured; it needs to be measured by a construct of questions); some methodologies have been designed for their study. Previous research has developed some indexing or grouping of questions to build tangible values (Parry and Campbell 1992; Perry et al. 2021). Multivariate analyses such as principal components (PCA), structural equation modeling (SEM), and generalized linear models (GLM) have successfully allowed the identification of predictors that influence conservation attitudes (Liordos et al. 2018; Bhatia et al. 2020; Perry et al. 2021). However, it is necessary to consider methodologies integrating interpretations of the contribution of several predictors in a single model. Sequential Canonical Analysis (SEQCA) consists of an analysis of a multivariate cascade of predictors. In the SEQCA, each predictor is also a subsequent predictor, and the analysis allows the integration of all predictors (Figueredo and Gorsuch 2007). Consequently, SEQCA is a good statistical procedure capable of identifying the influence that a series of independent variables have on several correlated criteria (Figueredo et al. 2017).

According to the hypothesis that human attitudes towards wildlife conservation have an integral influence on sociodemographic, experiential, and emotional variables, the objectives of this study were: (1) Build a Conservation Effort factor (CE) score with a metric of three variables related to human attitudes towards eight vertebrate species; (2) Analyze the direct and indirect influence of the sociodemographic predictors, the participants' experiences with the focal species, and emotional variables of the subjects of study on the CE. We considered the following prediction sequence: (i) sociodemographic variables: region, age, gender, participation in conservation activities, and religion; (ii) experiences; (iii) emotions; and (iv) CE.

This study was focused on eight vertebrate species: resplendent quetzal (*Pharomachrus mocinno*), horned guan (*Oreophasis derbianus*), Guatemalan pit viper (*Bothriechis bicolor*), white-tailed deer (*Odocoileus virginianus*), Baird's tapir (*Tapirus bairdii*), spider monkey (*Ateles geoffroyi*), jaguar (*Panthera onca*), and cougar (*Puma concolor*). These species were previously identified as the most important for the communities of El Triunfo Biosphere Reserve (ETBR) in southern Mexico (Castillo-Huitrón et al. 2023). The importance of the focal species was estimated based on their frequency of interactions of use, feelings, and conflict reported by the participants in the survey. This information as well as the ecological differences among focus species were elements allowing us to construct a broader and more complete analysis to explain the patterns of conservation attitudes observed in ETBR.

Methods

Study area

This study was conducted in 11 communities of El Triunfo Biosphere Reserve (ETBR; 1,192 km^2) in southern Mexico (Fig. 1). The altitude of the study area ranges from 400 to 2,500 m. Five core areas occupies 22% of the ETBR surface, while the remaining 88% corresponds to a buffer zone where productive activities are carried out (Instituto Nacional de Ecologia [INE] 1998). The human population in the ETBR buffer zone is about 140,000, mainly of mixed origin, and the educational level is low in the majority of communities. The most important economic activity on the eastern slope of ETBR is coffee production (*Coffea arabica*), while livestock and coffee production prevail on the western slope (Martínez-Camilo 2014). The primary environmental threats in the ETBR region are the expansion of human activities such as deforestation, overhunting, and mining (Godínez-Gómez and Mendoza 2019).

Survey instruments

We chose full-body photographs of the eight focal species in their natural habitat from the private collection of the National Commission of Protected Areas (CONANP). Each photograph was processed using Photoshop software (CS5 Version 12.0) to give uniform brightness and contrast (Straka et al. 2020) and printed in a 39.1 cm x 25.1 cm size. Icons depicting six basic emotions: fear, disgust, surprise, anger, sadness, and happiness were added to each photograph (Darwin 1872; Ekman et al. 1969). These features allowed an easier understanding of the instrument by the participants.

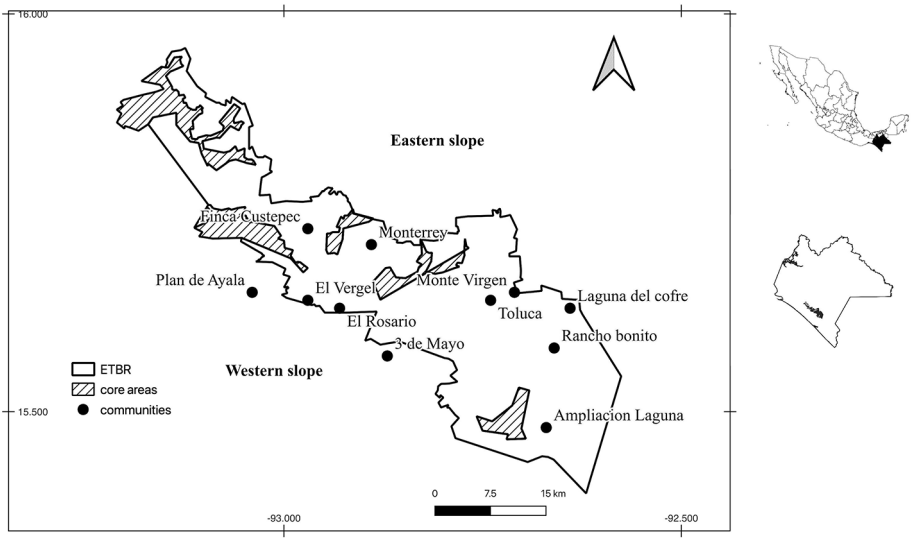

Fig. 1 Location of El triunfo biosphere reserve (ETBR), Chiapas, Mexico, and the communities included in the study

In addition, two forms were designed: (A) a table to record the emotions caused by the eight species, where the columns showed the icons of the six basic emotions and the rows the numbering of the species; and (B) a questionnaire with three queries corresponding to attitudes towards each species. These queries were: (1) attitude towards the increase, reduction, or stability of the wild species populations; (2) attitude towards the protection of each species; and (3) willingness to offer personal efforts (time and money) to protect the species.

Workshops

Between February and September 2021, we held workshops in the 11 communities within ETBR (Fig. 1). We did an open invitation in each community to participate in the workshops, which had 20 participants on average. Participants were isolated two meters among themselves to avoid the exchange of their answers. The printed forms A and B were handed to each participant. Subsequently, the facilitator showed the photograph of each animal species at the time that participants selected their emotions in form A. Subsequently, every question of form B was read by the facilitator and answered by participants. In each workshop, trained personnel helped and verified that participants had understood the activities.

Data coding

The six basic emotions caused by animal species in form A were coded using numbers. They were divided into positive (happiness) and negative (fear, anger, disgust), and surprise was considered neutral (Nummenmaa et al. 2014). The responses related to attitudes from form B were categorized using the Likert scale, assigning a numerical value to each response. A value of "1" was assigned to indicate a positive attitude toward the increase in the population of each species. This included a willingness to protect the species and offer personal efforts towards their conservation. The code of "-1" was related to negative responses toward reducing the species' population, opposing its protection, and refusing to make personal efforts to protect it. The neutral attitude was assigned a value of "0". The attitude value for each species was calculated by summing up the three responses to form B. This score was used to build a value of Conservation Interest for each species by each participant. The value varied from −3 to 3 according to the mean of the responses. The sociodemographic information of each participant was also coded for quantitative analysis.

In addition, sociodemographic information was included in the forms: region, age, gender, conservation activity (i.e., community monitor, fire controller, and tourist guide), and religion. The methodological instruments were previously reviewed and authorized by ETBR staff and the ethics committee of El Colegio de la Frontera Sur, Mexico.

Statistical analyses

We applied a principal axis factor analysis (PAF) to the participants' index of Conservation Interest per species. We computed the Conservation Effort factor (CE) scores with a unit-weighed estimation procedure, a method that first standardizes the factor indicators and then calculates the factor scores as an average across the indicators' z-scores (Gorsuch 1983). Whereas the PAFs were computed with the PROC FACTOR function, the unit-weighted factor scores were estimated with the PROC STANDARD function. These calculations

were performed in SAS 9.4 (2015). Following these estimations, we did a sequential canonical analysis (SEQCA) in UniMult 2.0. This procedure required a pre-determined hierarchical organization of variables where the addition of criteria was generated as a statistical sequence. A hierarchical system of equations was created to predict the influence of each dependent variable on the ensuing criterion. Hence, a variable specified as a criterion in one step functioned as a predictor in a subsequent step (Figueredo et al. 2017). In this study, we predicted the following theoretically-based sequence: (1) personal experience; (2) negative emotions; (3) positive emotions; and (4) CE. The model also considered the influence of sociodemographic variables including region, age, gender, conservation activity, and religion (Fig. 2).

Results

A total of 238 inhabitants of ETBR communities participated in the study (Table 1). Our analyses revealed noticeable differences in the participants' mean Conservation Interest for each animal species. For instance, the Guatemalan tree viper scored the lowest, whereas the resplendent quetzal scored the highest (Table 2). Interestingly, participants had a moderate interest in conserving the jaguar and the cougar. Overall, our results suggest that participants exhibit clear preferences regarding the conservation of some species instead of others (Table 2).

The bivariate correlation analyses revealed positive, sizeable, and significant associations among the participants' responses concerning the conservation of the eight focal species (Table 3). The principal axis factor analysis supported the presence of a general CE loading positively and significantly onto the participant's concern for protecting the various animal taxa. The factor's loadings ranged from 0.636 to 0.804 (Table 4), with this latent dimension accounting for 99% of the variance. A similar pattern emerged after computing

Table 1 Sociodemographic description of the participants in the study

Variable	Number of participants (%)
Region	
Eastern slope (Frailesca)	107 (44.95)
Western slope (Costa)	138 (57.98)
Age	
8–12 years	64 (26.89)
13–30 years	74 (31.09)
31–50 years	84 (35.29)
>50 years	16 (6.72)
Gender	
Women	118 (49.60)
Man	120 (50.40)
Conservation Activity	
Participant in conservation activities	39 (15.96)
No participation	200 (84.03)
***Religion**	
Practician	220 (92.43)
Non practician	18 (7.56)

*Participants were categorized as practicians and non-practicians, and their reported religions included Catholicism, Seventh-day Adventism, and Presbyterian

Table 2 Descriptive statistics (means and standard deviations) of participants' responses regarding their Conservation Interest disaggregated by species (values from −3 to 3)

Conservation status (International Union for Conservation of Nature and Natural Resources). EN = endangered, NT = near threatened, LC = least concern

Indicators	Conservation status	*N*	Mean	Std. Dev.
Pharomachrus mocinno	NT	226	2.832	0.479
Odocoileus virginianus	LC	225	2.716	0.667
Oreophasis derbianus	EN	226	2.628	0.813
Tapirus bairdii	EN	225	2.098	1.395
Ateles geoffroyi	EN	223	2.072	1.327
Puma concolor	LC	225	0.582	2.099
Panthera onca	NT	225	0.578	2.034
Bothriechis bicolor	LC	225	-1.249	1.883

Table 3 Correlation matrix across animal indicators. Significance values are presented below the diagonal and Pearson's *r* coefficient above the diagonal

Indicators	*P.* mocinno	O. derbianus	B. bicolor	A. geoffroyi	T. bairdii	O. virginianus	*P.* onca	*P.* concolor
P. mocinno	1.000	0.706	0.419	0.554	0.522	0.706	0.435	0.430
O. derbianus	<0.0001	1.000	0.412	0.583	0.551	0.653	0.461	0.475
B. bicolor	<0.0001	<0.0001	1.000	0.426	0.507	0.410	0.606	0.606
A. geoffroyi	<0.0001	<0.0001	<0.0001	1.000	0.706	0.639	0.511	0.514
T. bairdii	<0.0001	<0.0001	<0.0001	<0.0001	1.000	0.631	0.631	0.602
O. virginianus	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	1.000	0.482	0.473
P. onca	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	1.000	0.928
P. concolor	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	1.000

Table 4 Unit-weighted (UWF) and principal axis factor (PAF) loadings of a conservation effort factor

Indicator	PAF Loadings	UWF Loadings	*p*-value
P. mocinno	0.717	0.757	<0.0001
O. derbianus	0.732	0.769	<0.0001
B. bicolor	0.636	0.703	<0.0001
A. geoffroyi	0.756	0.790	<0.0001
T. bairdii	0.804	0.825	<0.0001
O. virginianus	0.767	0.795	<0.0001
P. onca	0.781	0.811	<0.0001
P. concolor	0.775	0.807	<0.0001

the unit-weighted factor with loadings ranging from 0.703 to 0.825. The reliability analysis determined that the CE featured a strong internal consistency (Cronbach's $\alpha = 0.909$).

Sequential canonical analysis

Table 5 displays the results of a SEQCA examining the influence of region, age, gender, conservation activity, experiences with animals, positive and negative emotions toward ani-

Table 5 Sequential Canonical Analysis exploring the effects of region, age, gender, conservation activity, experiences with animals, positive and negative emotions toward wild species, and the participants' Conservation Effort

Omnibus	Effect Size (E)	C. I.	F Ratio	df1 / df2	*p*-value
Overall (V = 0.250)	0.25	0.00, 0.52	2.80	20 / 840	< 0.0001
Variables	***Effect Size (sR)***	***C. I.***	***F Ratio***	***df1 / df2***	***p-value***
Y variable: Experiences with animals					
Region	−0.02	−0.15, 0.12	0.08	1 / 210	0.7700
Age	0.25	0.12, 0.37	15.88	1 / 210	< 0.0001
Gender	0.28	0.15, 0.40	19.68	1 / 210	< 0.0001
Conservation activity	0.14	0.01, 0.27	5.02	1 / 210	0.0300
Religion	0.00	−0.13, 0.14	0.00	1 / 210	0.9000
Multiple R (Xs only)	0.40	0.33, 0.47	8.13	5 / 210	< 0.0001
Y variable: Negative emotions					
Prior Y variable					
Experiences with animals	0.01	−0.12, 0.15	0.04	1 / 209	0.8500
X variables					
Region	0.08	−0.05, 0.21	1.44	1 / 209	0.2300
Age	0.11	−0.02, 0.24	2.66	1 / 209	0.1000
Gender	−0.03	−0.17, 0.10	0.26	1 / 209	0.6100
Conservation activity	−0.18	−0.31,-0.05	7.36	1 / 209	0.0070
Religion	−0.01	−0.15, 0.12	0.05	1 / 209	0.8200
Multiple R (Xs only)	0.23	0.02, 0.34	2.35	5 / 209	0.0400
Y variable: Positive emotions					
Prior Y variables					
Negative emotions	−0.32	−0.43,-0.19	23.55	1 / 208	< 0.0001
Experiences	0.03	−0.11, 0.16	0.17	1 / 208	0.6800
X variables					
Region	−0.06	−0.19, 0.08	0.81	1 / 208	0.3700
Age	−0.05	−0.18, 0.08	0.59	1 / 208	0.4400
Gender	0.08	−0.05, 0.22	1.67	1 / 208	0.2000
Conservation activity	−0.01	−0.15, 0.12	0.04	1 / 208	0.8400
Religion	−0.06	−0.19, 0.07	0.90	1 / 208	0.3400
Multiple R (Xs only)	0.13	0.00, 0.27	0.80	5 / 208	0.5500
Y variable: Conservation Effort (attitudes)					
Prior Y variables					
Positive emotions	0.29	0.16, 0.41	21.22	1 / 207	< 0.0001
Negative emotions	−0.22	−0.34,-0.09	11.86	1 / 207	0.0007
Experiences	0.14	0.00, 0.27	4.70	1 / 207	0.0300
X variables					
Region	0.00	−0.13, 0.13	0.00	1 / 207	0.9000
Age	−0.03	−0.17, 0.10	0.29	1 / 207	0.5900
Gender	0.03	−0.11, 0.16	0.21	1 / 207	0.6500
Conservation activity	0.11	−0.02, 0.24	3.02	1 / 207	0.0800
Religion	0.06	−0.08, 0.19	0.77	1 / 207	0.3800
Multiple R (Xs only)	0.13	0.00, 0.26	0.86	5 / 207	0.5100

mals, and the participants' conservation effort. The model was statistically significant and explained 25% of the variance. These results are also described in Fig. 2.

Experience with animals was positively and significantly predicted by the participants' age ($sR = 0.25$, $p < .0001$), gender ($sR = 0.28$, $p < .0001$), and conservation activity. It was not influenced by either region or religion. The set of predictors (restricted to the x-variables) was statistically significant and sizeable in magnitude (*Multiple* $R = .40$, $p < .0001$).

Negative emotions toward wild species animals were negatively and significantly predicted by the participants' involvement in conservation activity; this effect, however, was small in magnitude ($sR = 0.18$, $p < .0001$). Neither region nor the participants' age, gender, or religion significantly predicted the negative emotions. The set of predictors (restricted to the x-variables) was statistically significant and small in magnitude (*Multiple* $R = .23$, $p = .04$).

Positive emotions toward wild species were negatively and significantly predicted by the participants' negative emotions ($sR = -0.32$, $p < .0001$). Neither region nor the participants' age, gender, conservation activity, or religiosity significantly predicted the positive emotions. The set of predictors (restricted to the x-variables) was not statistically significant (Multiple $R = .13$, $p = .55$).

Finally, the CE was positively and significantly predicted by the participants' positive emotions towards animals ($sR = 0.29$, $p < .0001$), and negatively by the negative emotions ($sR = -0.22$, $p = .0007$). Neither region nor the participants' age, gender, conservation activity, nor religion significantly predicted the CE. The set of predictors (restricted to the x-variables) was not statistically significant (*Multiple* $R = .13$, $p = .51$).

Discussion

The participants' Conservation Interest showed different scores among wild species (see Table 2). The difference was evident between species such as the resplendent quetzal and the white-tailed deer in comparison to the Guatemalan pit viper. The value for felines (cougar and jaguar) was close to zero (0), which suggests a potential indifference of the participants

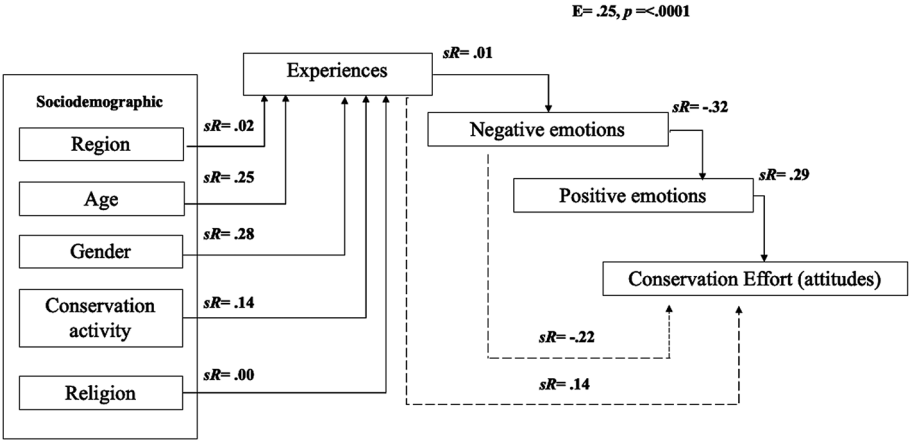

Fig. 2 The sequence of variables employed in the Sequential Canonical Analysis and their influence oneach variable. The spaced line represents an indirect effect, and the black lines represent direct effects

toward the conservation of both species. Something similar was found in the perception of wolves by the general public in Sweden (Ericsson and Heberlein 2003). The dissimilar interest in conserving different animal species could be explained by evolutionary aspects. People tend to express greater attraction and feelings of empathy and compassion for species that are phylogenetically closer to us (Miralles et al. 2019). Our research partially supports this idea as mammals, mainly three herbivorous species, received higher attractiveness scores than the Guatemalan pit viper, which is phylogenetically more distant from humans. On the other hand, both bird species investigated (the horned guan and the resplendent quetzal) received higher attractiveness scores than mammals. Unlike the herbivorous mammals in this study, both birds are colorful, which could significantly contribute to their perceived attractiveness (Frynta et al. 2010), rather than phylogenetic closeness (Fančovičová et al. 2022).

Besides evolution, the economic value that species represent to people and the individual experiences with wild animals could explain the differences in the interest for species conservation (Serpell 2004; Carlson 2010). In this sense, the overestimation of experiences such as predation, damage to crops, or misconceptions related to the biology and ecology of wild species could influence the conservation interest (Bhatia 2021). These aspects may be helpful to explain why participants expressed more interest in the conservation of the resplendent quetzal and the white-tailed deer (see Table 2). The resplendent quetzal is the official icon of ETBR and has been used in education events to promote conservation awareness (Castro 2019). Meanwhile, the white-tailed deer is one of the most representative and symbolic mammals in Mexico due to its traditional uses (e.g. food, amulet, stories). Besides, this deer has a link to positive feelings (i.e., empathy; Santos-Fita et al. 2015; Herrera-Flores et al. 2019).

In contrast, predators have been associated with negative aspects throughout human history (Castaño-Uribe 2016). In ETBR, the two felids have been responsible for cattle predation, while the Guatemalan pit viper often bit humans during the coffee harvest, although no deaths have been recorded (Castillo-Huitrón et al. 2023). Besides, the phenotype of snakes is very distant from what humans use to consider a charismatic animal (Estren 2012; Albert et al. 2018). The scarce interest of local people in conserving snake species has been reported in the Neotropical region (López-del-Toro et al. 2009; Auqui-Calle et al. 2020). It is important to consider that human preferences for conserving charismatic species could have negative impacts on ecosystems in the long term due to the ecological importance of those animals (Marcot and Heyden 2001). Benefits from coexistence with snakes and their value in ecological services (Beaupre and Doluglas 2009) need to be properly communicated to the general public.

The correlation coefficients among the Conservation Interest of the eight species support the existence of a general CE (Table 3). According to previous studies, we expected that this Factor would separate species into groups according to their ecological role (prey and predators). This result suggests that the questionnaire applied in this study could be used to collect information about the general attitudes of ETBR residents to conserve other wild animals. Besides, the methodological instrument could also be applied to identify key stakeholders within the reserve who can implement education strategies.

Emotions, the main predictors of conservation attitudes in ETBR

The predictors of attitudes toward wildlife conservation did not follow a linear order between them, but rather they influence each other jointly (Kideghesho et al. 2007; Ajzen and Gilbert 2008). The methodology used in this study provided a perspective on the effect that sociodemographic, experiential, and emotional predictors have on each other and their influence on the CE. The sociodemographic predictors identified with a significant relationship with experiences were gender, age, and participation in conservation activities. This relationship could be explained in part by human history and the different people's activities concerning wildlife. Men tend to engage in hunting, fishing, bird watching, and other outdoor activities; in contrast, women interact with animals through empathetic attitudes such as feeding birds and husbandry of selected species (Kellert and Berry 1987; Vásquez-Dávila 2014). Some of these gender-specific activities continue in the communities of ETBR and may influence attitudes toward the conservation of animal species.

Regarding the age predictor, it is evident that the probability of having experiences with wildlife increases if the individual spends more time in the natural environment. One aspect to highlight about this predictor is that the interests and context of each generation differ from others. Following this idea, in past decades (1970–2000), human societies had experiences with wildlife more frequently than today (Enríquez et al. 2019). This may be due to landscape transformations (e.g., less natural environments and more infrastructure), social change (i.e., new generations less interested in nature than older ones; Soga and Gaston 2023), migration (Roblero 2017), and shifts in economic activities. The decrease in experiences with wildlife could also be due to species-specific aspects, such as population abundance and its spatial-temporal variations (Gosler 2017).

The predictor of religion was expected to be related to emotional predictors and conservation attitudes. In previous studies, religion has been reported as a factor through which awareness and protection of nature can be influenced (Mcleod and Palmer 2015). However, no relationship was found with any of the predictors in this study. The negligible effect of religion on attitudes may also be due to the external and recent religious practices by communities (Catholicism and Seventh-day Adventism). In some indigenous religious practices is common to develop care and empathetic relationships with nature (Allendorf et al. 2014). On the other hand, likely, individual conservation attitudes toward animals are not determined by his/her affiliation to a religious group (Bhatia et al. 2016).

In this study, the predictors corresponding to positive and negative emotions were not related to sociodemographic variables (see Table 5). Previous studies reported that negative emotions such as fear differed between gender, with women presenting this emotion more frequently and intensely than men (Alves et al. 2014). Moreover, the learned information about species and how it is transmitted can influence the intensity of fear manifested in the presence of real or imaginary animals (DeLoache and LoBue 2009). These results could be an opportunity to design strategies based on decreasing the fear emotions through significant experiences with wild animals (Prokop and Fančovičová 2016).

The opposite relationships between positive and negative emotions and between the CE and negative and positive emotions highlight the importance of emotional factors in conservation issues. These results are consistent with previous studies. For example, Pandey et al. (2016) identified that 86% of a sample of residents in southern Nepal expressed fear of snakes, and 49% reported an attitude of exterminating all venomous snakes. Negative

emotions such as fear, disgust, and anger caused by animal species have begun to take importance in the design of conservation measures. Some strategies are based on animal experience activities (Randler et al. 2012; Prokop and Fančovičová 2016) or on outreach campaigns to reduce misinformation about species (Lambertucci et al. 2021) and promote attention toward species related to the cultural interests of people (Daltry et al. 2001). Considering the relationship between CEF and participation in conservation actions, we propose the continuity of alternative activities that could contribute to appreciating species for their inherent value and ecological function. Ecological information about wildlife species (Boso et al. 2021), community monitoring, ecotourism, and citizen science activities could be considered in this regard at ETBR (Daltry et al. 2001).

The SEQCA model explained 25% of the variation in predictors of the CE. This value is consistent with that reported in previous studies (Kideghesho et al. 2007; Perry et al. 2021). Although it could be considered a low value, it is still significant. These results suggest that other, unknown predictors may influence wildlife conservation attitudes more strongly. Among them could be, for example, the individual knowledge about the biology and ecology of species, risk perception (especially for predators), the level of interaction that each person has with nature (Bhatia et al. 2020), and the intangible or economic value attributed to each species (Ajzen and Fishbein 1980). Finally, personality traits could also influence both emotions and conservation attitudes. Figueredo et al. (2023) identified that the level of closeness with wild and domestic animals positively influences attitudes of empathy. In contrast, personality traits referring to the dark triad (narcissism, machiavellianism, and psychopathy) and aggression, negatively influence attitudes toward animals. In their analyses, these predictors showed greater influence than sociodemographic or environmental variables (Figueredo et al. 2023). We propose to direct future studies at the individual level considering psychometric scales to record information on features like empathy and aggression. This proposal would allow for identifying personality characteristics that environmental managers require for conservation messages to be effective.

This study is the first approach to the analysis of human emotional and attitudinal factors regarding wildlife conservation in the ETBR region. We suggest further research with more participant samples to explore in depth the effect of the different kinds of experiences (e.g. seeing animals, predation events, bites by palm vit snake) on peoples' emotions and attitudes.

Conclusions

We conclude that wildlife conservation strategies need to consider the human emotion factor. We recommend studying the influence of negative emotions (fear) caused by species like large carnivores and snakes, and their impact on conservation attitudes. Our results suggest that the involvement of people in conservation activities could help mitigate negative emotions (fear) and improve conservation attitudes. These findings are novel for the Neotropical region and we encourage the direction of conservation measures through social psychology and human ecology disciplines.

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Declarations

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