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USE OF TERRESTRIAL WILD MAMMALS AND SOCIOECONOMIC FACTORS THAT MOTIVATE THIS IN THE NORTHERN SIERRA OF PUEBLA, MEXICO

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ABSTRAC

The Sierra Norte de Puebla is a region diverse in flora and fauna; however, rural communities suffer from a high degree of marginalization, a situation that makes natural resources susceptible to overexploitation. We aimed to analyze the relationship between the use of medium and large terrestrial wild mammals, depending on the socioeconomic level of the population, in two municipalities in the Sierra Norte de Puebla. 158 interviews were carried out with heads of families; their socioeconomic level (SEL) was calculated and their use of medium and large wild mammals assessed. To identify the relationship between socioeconomic level and use of mammals, a logistic regression analysis was performed. The families interviewed have a low socioeconomic level and 48.7% of them use medium or large wild mammals. Although SEL did not significantly influence the use of wild mammals, occupation was significantly associated with the use of these mammals.

Keywords: local fauna, occupation, social class, use.

INTRODUCTION

Mexican territory represents a mega-diverse country due to great richness in terms of species and endemism (Salazar-Vallejo *et al*. 2018); it is the habitat of between 10 and 12% of planet Earth's diversity, which is relevant because this includes many endemic species (Durand, 2017). This diversity of species is favored by the orography of the land, with varying climates that create diverse habitats (ranging from coastal to perpetual snow), where a variety of organisms are found. However, particularly in rural areas, the conservation of natural resources as well as wildlife has been affected by human activities, in the struggle for adequate survival.

In Mexico, interaction between human activities and nature and wildlife, in the last 400 years, has led to 5.2% of the world's extinct species being documented in national territory; where it is estimated that more than 2,500 species are at some risk (Durand, 2017). This is a consequence of an expanding society with a lack of ecological awareness, together with insufficient environmental legislation, caused jointly by different social actors (government, civil society, universities and research centers) that are designed to resolve problems resulting from the activities of civil society, residing in various territorial areas.

The use of wildlife by residents of rural communities varies according to their habits and customs, which depend on the geographic area. In this regard, in the Mixteca Poblana,

the use of wildlife is mainly for food, medicine, trophies, amulets, adornment, trade, hunting, ritual, clothing, taxidermy and as pets (Estrada-Portillo *et al*., 2018). Similarly, García *et al*. (2019), describe the use of wildlife in the communities of Tepoztlán and Tlaltizapán, Morelos, as divided into the categories of food, crafts, medicine, companion species (badger, raccoon, white-tailed deer), fertilizer, adornment and mystical-religious practices (rabbit, white-tailed deer); the category of use food stands out, consisting of eight species, in accordance with uses and customs, particularly among poor families, who do not have access to other types of animal protein, due to lack of financial solvency.

In Mexico, several studies have been carried out on the use value of wildlife, mainly by people who live in rural areas; in most of these, food, medicinal and craft use stand out (Cortés-Gregorio *et al*., 2013; Medina-Torres *et al*., 2016 and Valle *et al*., 2021), as being the most important. This type of use mainly includes hunting of medium and large mammals, which are included in the diet of peasant families, as well as for medicinal and artisanal use. It should be considered that these actions on the part of families, related to uses and customs, represent savings in terms of curing an illness or economic income derived from the sale of the product that contribute to family sustenance.

Today, wildlife is threatened by poaching, deforestation and people's growing needs (food, livestock and agriculture), so it is necessary to reevaluate conservation and curtail hunting where possible; monitoring and respecting the closed seasons (Cortés-Gregorio *et al*., 2013). The irrational use of fauna, ignoring the importance of their reproductive cycles, combined with population growth, can lead to extinction of local species (Chablé and Delfín, 2010; Melo *et al*., 2014).

Moreover, it is apparent that the rural population, by making use of wild fauna for food, does not fully appreciate the ecological, biological, economic and social value of conservation. In those communities where they perceive direct economic benefits, they try to preserve wildlife, through the establishment of Management Units for the Conservation of Wildlife (Zavala-Sánchez, 2018); however, this type of conservation and use of wildlife is restricted to certain species, contributing to their management, while neglecting those species whose management is not possible or which are at high risk (carnivores).

In general, studies that have been carried out in Mexico on the use value of wild fauna, do not consider whether the poorest or richest people represent those who make greater or lesser use of this resource, however, although the majority of these have been carried out in rural areas and regions with indigenous populations, classified as suffering from high and very high marginalization, the information on the use made of mammals has been generalized, and fails to take into account socioeconomic strata. Various causes are considered, but the factor present in all cases is anthropogenic activity (Pouteau, 2021). This study addresses the problem of using wild mammals, taking an anthropogenic approach to consider the human activities and socioeconomic status that contribute to the use and conservation of mammals (Torres *et al*., 2018; Polaina, 2015), specifically medium and large mammals, in the geographical region of the northern mountains of Puebla.

In order to assess how the socioeconomic condition of an individual can affect their use of wildlife and corroborate whether the use of fauna depends on the economic condition of the user, it is important to know how to measure their socioeconomic status and poverty. In this regard, the National Commission for the Knowledge and Use of Biodiversity [CONABIO] (2006) and the United Nations (1987) consider that poverty is both the cause and effect of environmental problems, but moreover, the relationship between economic development and environmental detriment is mainly due to the strong dependence on natural resources, because with the transformation of many habitats, productive processes are promoted.

Notably, the more serious the environmental problems, the more difficult it will be to solve them and the quality of life and well-being of society at a local and global level will be threatened (Cuevas, 2009). For its part, CONABIO (2011) alludes to the fact that rural communities suffering from a high and very high degree of marginalization cause natural resources to become vulnerable to exploitation. An example of this is the extraction of 5,000 tons per year for the production of ironwood (*Oneya tesota*) crafts (Gasca-Rodríguez and Guevara-Chumacero; 2022).

Marginalization reflects the socioeconomic factors that categorize social groups at various levels; this social stratification is organized in ascendance, from the lowest strata layer to the highest (Duek & Inda, 2014; Rivas 2008). Social stratification enables us to describe the inequalities that occur in social groups and between each level of a social group, so that social inequality implies differences in socioeconomic status (Hoffman, 2008), where the individual can have a low social position, going up to the highest.

According to the National Center for Education Statistics (NCES, 2012), socioeconomic level indicates an individual's access to financial, social, cultural and human capital resources; therefore, it is an indicator that identifies the strata in a society and, likewise identifies poverty, as resulting from inequality in the distribution of income in society. The Mexican Association of Market and Opinion Intelligence Agencies [Asociación Mexicana de Agencias de Inteligencia de Mercado y Opinión, AMAI] (2016) indicated that socioeconomic level relates to a statistical model, which groups and classifies households in Mexico, based on their ability to fulfill the needs of their members.

Interest in this research arises because human activity has had a negative impact on wildlife, either because people make direct use of it, or due to the transformation of natural habitats also resulting from a lack of ecological education and the cultural relationship with mammals in the indigenous regions of Mexico (Corona-Mendoza and Escalante; 2021). This causes fauna in general, and mammals in particular, to become endangered in the territory (Saito and Koike, 2013); in addition to reducing populations of other species, due to hunting (Mayor *et al*, 2017). Notably, wild terrestrial mammals are categorized as; small, up to five kilograms, medium; between 5 to 10 kg and large; those that weigh more than 10 kg, (Ceballos and Oliva, 2005). It seems there is a relationship between the lack of knowledge on the part of those who use wild fauna and their socioeconomic status, so that the objective of the research was to analyze the relationship that exists between the

use of mammals; medium and large terrestrial wildlife, and the socioeconomic level of the population in two municipalities of the Sierra Norte de Puebla.

METHODOLOGY

Study area

This work was undertaken in two rural communities in the Sierra Norte of Puebla; San Miguel Tzinacapan, municipality of Cuetzalan del Progreso and Huehuetla; municipal capital of the same name. The first municipality suffers from a high degree of marginalization and the second, a very high degree of marginalization; both have indigenous groups present (CONAPO, 2015). In this region, the Nahuatl language predominates and to a lesser extent, Totonac; some inhabitants wear typical clothing, and they also practice regional dances and make crafts (Morales, 2012). In this area the climate is semi-warm, sub-humid, with rain all year round, which favors the presence of mountain and pine cloud forests, with abundant plant species (National Institute for Federalism and Municipal Development [INAFED], 2010). Fauna is diverse; it is home to a wide variety of songbirds, up to 48 species are found and 6 reptiles, in various habitats (Basilio-González *et al.*, 2022). Regarding wild mammals in the area, up to 22 species have been documented (Hernández *et al.*, 2017; Arriaga *et al.* 2000; Gual-Díaz and Rendón, 2014). As a result of agricultural activities, original vegetation has been lost; however, as it is located in the climate transition zone, some rain forest and wooded areas can be observed (CONABIO 2011).

This research is descriptive and correlational. Simple random sampling was used to select the interviewees, and to determine sample size, the following formula was applied (Vivanco, 2005):

$$n = \frac{NZ_{\alpha/2}^2 p^2}{Nd^2 + Z_{\alpha/2}^2 p^2}$$

where N: total population (taking into account that N is the total number of households in each municipality); $Z_{\alpha/2}$: confidence coefficient=1.96; d: precision=0.1; p: maximum variance=0.5.

For the town of San Miguel Tzinacapan with 700 families, estimated sample size consisted of 80 surveys and for Huehuetla with 423 families, sample size was 78. To define the socioeconomic level (SEL) of the population and assess the use of medium and large wild mammals by the inhabitants of the communities, the questionnaire was used as an instrument to compile information. Likewise, a display showing printed images of these mammal species was employed as visual support for the identification of medium and large-sized wild mammals by interviewees, taken from the CONABIO (2017) and Aranda (2012) image bank.

Study variables

A. Sociodemographic of the head of the family (age, sex, occupation, ethnic group, marital status).

B. Sighting, hunting and use of medium and large mammals.
C. SEL index, to determine this index, three aspects of the family were taken into account: 1) characteristics of the head of the family, 2) housing conditions and 3) material assets owned. Specifically, the SEL was generated, considering the following variables: education level of head of family, type of home ownership, number of rooms, type of floor, type and number of bathrooms, type of wall, type of floor, type of services, showers, gas stove, number of light bulbs, cars, telephones and televisions. A score was assigned to each of the variables and ultimately, a total was obtained, to indicate the socioeconomic level of the interviewed household.
To calculate the SEL, the method of the Mexican Association of Market Intelligence and Opinion (AMAI, 2016) was adapted. SEL was determined by applying a measurement scale, taking into account seven levels (Table 1) (AMAI, 2016).

Description of socioeconomic levels

Level E (population in extreme poverty): This is typified by the head of the family not having had access to education or not having completed primary school. These families reside in very modest homes that are either borrowed or rented, which are also inadequate, as they do not provide basic services, which would constitute decent housing, Official Gazette of the Federation (Diario Oficial de la Federación [DOF], 2006).
Level D (class in poverty): the housing conditions at this level may be better than those at level E, but they still lack some basic services and commonly, the head of the family is the owner of the abode.
Level D+ and C- (lower middle class): in this class, the homes have basic services and minimum sanitary requirements, they also have more space; so overcrowding is reduced.
Level C (middle class): These homes have more technology and the family has more purchasing power to satisfy both basic services and certain comforts.
Level C+ (upper middle class): the inhabitants of the home are capable of covering all basic services and healthcare at home, they have slightly more comforts and space, so their quality of life is better. However, they have very little chance of generating any savings or investment

Table 1. Classification of socioeconomic Level.

Level	Points
A	205 or more
C+	166 to 204
C	136 to 165
C-	112 to 135
D+	90 to 111
D	48 to 89
E	0 – 47

Source: AMAI, 2016.

Level A/B (upper class): people in this category cover all their basic needs, have more amenities than at any other level and are able to indulge in luxuries and generate savings and investments.

D. The overcrowding index was calculated by dividing the number of inhabitants in the home by the number of rooms. A value of less than two indicated that there was no overcrowding and greater than two indicated overcrowding in the home (Cabrera *et al*, 2009).

E. Level of well-being (total individual monthly income) was obtained by dividing the total family income between all members of the household, the latter was compared with the well-being level established for rural areas by the National Council for the Evaluation of the Social Development Policy CONEVAL (2016), where an income of less than $933.19 pesos/month means that a household is poor.

A descriptive analysis was carried out, prepared from frequency tables and the preparation of contingency tables, in order to identify the socioeconomic status of the population interviewed.

Logistic regression analysis was carried out to discover the relationship between the use of wild mammals and socioeconomic level. The dependent variable referred to the use of medium and large wild mammals. This was obtained through dichotomous response to questions, where 1 represented use and 0 represented non-use. The independent variables were: SEL, sex, age, ethnic group (EG), education, marital status (MS), employment sector (ES), welfare level (WL), overcrowding, crop damage (CD) and mammal sighting (M.S). SPSS software (Static Package for Social Sciences) version 19 was used, with the following statistical model (Jovell, 1995):

$$\text{Ln}\,[P(\text{use of mammals}=1)]=b0+b1\bullet x1+\ldots+bn\bullet xn$$

$$Ln\left[P\left(\text{use of mammals}=1\right)\right]=b_0+b_1\left(SEL\right)+b_2(sex)+b_3(age)+$$
$$b_4\left(GE\right)+b_5(education)+b_6(marital\ status)+b_7(SL)+b_8(LB)+$$
$$b_9\left(overcrowding\right)+b_{10}(DC)+b_{11}(AM)$$

where P is the probability that the population uses wild mammals and is equal to 1; b_0, b_1,..., b_{12} are the coefficients of the variables that explain the dependent variable, that is, when one unit of these variables increases (SEL, sex, age, etc.), the probability that mammals will be used, multiplies by the exponential of bn: $e^{(bn)}$.

RESULTS

Population characteristics. Of the interviewed population, 84.2% were men and 15.8% were women; the average age was 50 years (a minimum of 19 and a maximum of 85 years). 47.5% of people were married, 30.4% in a common law union, 10.8% single, 7.5% divorced or separated and 3.8% widowed. Most of the population have not completed

their primary education (32.9%), 29.1% have completed it, 10.8% finished secondary school and 9.5% never studied; the rest of the interviewees have completed various levels of education. In both municipalities, homes have electricity, gas, water, landline telephone and television; 58.2% of the population lives in overcrowded conditions. 85% own their home. Most of those interviewed speak native languages: 32.9% Totonac, 51.3% Nahuatl, 5.1% Totonac and Nahuatl. However; although they speak an indigenous language, they do not consider themselves to be part of an ethnic group.

Evidently, 60.1% stated that they are dedicated to the agricultural sector, 22.8% to commerce and services, the rest are involved in construction (8.9%) and 8.2% are dedicated to the home. In this region, the largest percentage of inhabitants are mainly involved in the cultivation of coffee, consisting of an average surface area of (0.620 ha); a plant highly adapted to the region. Second in line corresponds to the cultivation of maize, with an average surface area of 0.456 ha; and thirdly, the planting of maize together with beans, with an area of 0.518 ha; and finally, crops such as pepper, banana and orange, among others.

Concerning the raising of farm animals, the average consists of 12 chickens, besides, an average of 1 horse, 5 cows, 86 melipona bee hives, 5 pigs and 4 rabbits.

Sighting, hunting and use of wild mammals. It was found that 98.1% of the population in the study has seen medium and large wild mammals. They indicate the following species as the most commonly observed: armadillo (91.6%), fox (76.8%), raccoon (74.8%) and badger (72.9%) (Table 2). The armadillo, coyote and cacomixtle were seen near their homes; and raccoons and badgers were seen in farmed areas. People indicated that the ocelot, lynx, fox and coyote are frequently observed on the trails and roads. Other mammals such as white-tailed deer, brocket deer and margay were seen mainly in hard-to-access places in the forest (Table 3).

In the study localities, 48.7% hunt medium or large wild mammals. People who hunt mammals, indicated the armadillo as the most hunted, followed by the badger, the raccoon and Paca. The four species of mammals least hunted are the margay, peccary, ocelot and white-tailed deer (Table 4).

Hunted mammals are used for various purposes; they hunt the armadillo on average once a year, the main use is for food (72%), they also use the shell, legs and tail to make crafts, and the fat is used to treat wounds and coughs.

The badger is hunted, mainly because it causes damage to agriculture, 89.3% of the interviewed population occasionally eats its meat, 1% use its skin or some part of the animal as decoration and sometimes it is kept captive as a pet. The raccoon, like the badger, causes damage to crops and is also hunted. 100% consume it, 2.6% use the skin as decoration, 1% keep it as a pet or use its fat to combat acne.

People hunt paca for food, they do not offer any medicinal use, occasionally their skin is kept for decoration.

The fox is hunted because it eats poultry, 50% of these people do not use any part of the animal, 37.5% use the meat for food, 12.5% use the fat to treat coughs and the skin is used to decorate.

Table 2. Sighting of medium and large wild mammals, in the municipalities of Cuetzalan and Huehuetla of the Sierra Norte of Puebla.

Type of wild mammal	Percentage	Use
Armadillo (*Dasypus novemcinctus*)	91.6	F, M, Cr
Fox (*Urocyon cinereoargenteus*)	76.8	F, M, Cr
Raccoon (*Procyon lotor*)	74.8	F, O, M
Badger (*Nasua narica*)	72.9	F, O, Pe
Coyote (*Canis latrans*)	42.6	F, M
Cacomixtle (*Bassariscus astutus*)	40.0	F, Cr, S
Paca (*Cuniculus paca*)	32.3	F
Skunk (*Mephitis macroura*)	30.3	M
Margay (*Leopardus wiedii*)	21.9	Cr
Collared peccary (*Pecari tajacu*)	12.3	F
Ocelot (*Leopardus pardalis*)	8.4	F
Anteater(*Tamandua mexicana*)	5.2	N
Brocket deer (*Mazama temama*)	3.2	F
White tailed deer (*Odocoileus virginianus*)	1.9	F

Considering F: Food, M: Medicine, Cr: Crafts, O: Ornament, Pe: Pet, S: Sale and N: None of these.
Source: self elaborated with data from research.

Table 3. Sighting locations of medium and large wild mammals in the municipalities of Cuetzalan and Huehuetla in the Sierra Norte de Puebla.

Mammals seen by people	Places where people have seen them				
	Near their homes	Fields	Paths	Countryside	Other
Armadillo	42.96%	13.38%	9.15%	19.01%	15.49%
Fox	26.05%	10.08%	26.89%	24.37%	12.61%
Raccoon	7.76%	34.48%	12.07%	26.72%	18.97%
Badger	7.08%	30.09%	14.16%	28.32%	20.35%
Coyote	36.36%	4.55%	24.24%	25.76%	9.09%
Cacomixtle	33.87%	4.84%	12.90%	32.26%	16.13%
Paca	18%	16%	24%	38%	4%
Skunk	8.51%	8.51%	21.28%	42.55%	19.15%
Possum	42.50%	7.50%	2.50%	27.50%	20%
Margay	5.88%	2.94%	14.71%	76.47%	0%
Collared Peccary	0%	0%	10.53%	84.21%	5.26%
Ocelot	0%	0%	38.46%	53.85%	7.69%
Anteater	0%	0%	12.50%	87.50%	0%
Brocket deer	0%	0%	20%	80%	0%
White tailed deer	0%	33.33%	0%	66.67%	0%

Source: self elaborated with data from research.

Table 4. Medium and large wild mammals hunted in the municipalities of Cuetzalan and Huehuetla in the Sierra Norte de Puebla.

Wild mammals	Percentage
Armadillo	74.05
Badger	61.00
Raccoon	46.75
Paca	19.55
Fox	12.95
Cacomixtle	9.00
Coyote	7.80
Skunk	6.55
Margay	3.85
Collared Peccary	2.55
Ocelote	1.30
White tailed deer	1.30

Source: self elaborated with data from research.

70% of people who hunt cacomixtle do not consume it because they do not like its flavor, but 30% do; the animal is mainly hunted because of the damage it causes to poultry kept in backyards.

The coyote is hunted little, half of the people who hunt it, do not use it, 16.7% use it as food and 33.4%, in addition to consuming it, use its fat to combat rheumatism (generic name for pain) of joints, bones, muscles, tendons or ligaments, which can have up to 200 causes).

The skunk is hunted for medicinal purposes, 80% use its meat and fat to treat cough, whooping cough and tuberculosis, the rest have no use for it.

Peccaries are rarely seen, so it is unusual for people to hunt them and when they do, they consume them; half of the people who manage to hunt this animal, do so once a year and the other 50% report having done so once, ten years ago or more.

The ocelot and white-tailed deer are rarely hunted; the population that claimed to have hunted them did so for food purposes.

SEL index. In these communities, most families were found at the D+ socioeconomic level, where typically the home has basic services and sanitary conditions, but with limited space; the second largest percentage corresponded to level C-, this refers to the lower middle class, where the home has adequate space (Table 5).

Correlation of study variables. For the area studied, the logistic regression analysis did not identify any significant relationship between socioeconomic level and the use of medium and large wild mammals, nor was there a significant relationship between the use of mammals and the variables studied, with the exception of the labor sector variable, which had a significant relationship with the dependent variable (use of wild mammals), as labor sectors, other than agriculture obtained an acceptable level of significance ($P < 0.05$) (Table 6).

Table 5. Percentage of homes according to the socioeconomic level detected in the municipalities of Cuetzalan and Huehuetla in the Sierra Norte of Puebla.

SEL (Socioeconomic Level)						
E	D	D+	C-	C	C+	A
Social class						
Extremely poor	Poor	Lower middle class		Middle class	Upper middle class	Upper class
1.90	17.65	51.75	21.00	6.40	1.30	0.0

Source: self elaborated with data from research.

Probability calculated by use, based on the number of wild mammals, was obtained as follows:

$$\text{Ln}(P[\text{use of mammals}=1])=b_0+b_1 \bullet x_1+\ldots+bn \bullet x_n$$

where x_1: hogar=1; x_3: sector comercio y de servicio=3
Ln(P[use of mammals=1])=0.916+(-1.928)•(1)+(-1.654)•3
Ln(P[use of mammals=1])=-5.974
P[use of mammals=1]=$e^{(-5.974)}$
P[Use of mammals=1]=0.0025

The value of P[use of mammals=1]=0.0025 indicates that for each member of the population who is dedicated to activities in the home and commercial or service sectors, the probability of hunting wild mammals is 0.0025. Furthermore, the b coefficients with a negative sign indicate an inverse correlation between the explanatory variables and the use of medium and large wild mammals.

Table 6. Result of logistic regression for factors significantly related to the use of medium and large wild mammals.

	Variables in the equation						
	X_n	B_2	E.T.	Wald	gl	Sig.	Exp (b_n)
Labor sector				10.248	3	0.017	
Household	1	-1.928	0.831	5.380	1	0.020	0.145
Business and service	3	-1.654	0.696	5.647	1	0.017	0.191
Constant		0.916	0.592	2.399	1	0.121	2.500

Source: self elaborated with data from research.

DISCUSSION

In the Sierra Norte region of Puebla, individuals have a sense of belonging to an indigenous group (Totonac and Nahuatl) manifested in their customs, mother tongue and geographical location, however, this perception may vary depending on the circumstances in which the individual finds himself (Smith, 1997). They are mostly involved in agriculture and subsist on self-consumption of the agricultural products they grow and farm animals they raise. These products are also shared with family and acquaintances, or a minimum percentage is sold; this mainly relates to a survival strategy practiced by residents of the region, which aims to strengthen social cohesion. Concerning diversification of productive and service activities, to guarantee a minimum income for the family unit, Flores-Vaquiro and Luna-Contreras (2018) indicate that this multi-activity has been established as a family subsistence strategy. In terms of production, they employ different agroeco-systems throughout the year, depending on the different crop cycles and species of animals they exploit, which is not exempt from effects on natural resources, both fauna and flora. Contreras *et al*. (2013), describe how the Lacandón indigenous people make efficient use of their agroecosystems, with the aim of reducing the impact on the rainforest and can generate an effect on the forest surface, either by changing land use or extracting forest species (Romero et at., 2022). The sighting of mammals in different environments, particularly close to homes such as the armadillo, possum, cacomixtle or fox and others in more distant environments such as the anteater, Brocket deer and particularly close to crops, is due to adaptation and their sensitivity to their environment being disturbed. The behavior of mammals in the study region is also described by Label *et al*. In 2010; the author indicates that the alteration of mammal habitats causes some species to become extinct, others to migrate or adapt or results in more frequent sightings or conflicts.

The main uses of medium and large wild terrestrial mammals in this region are food, artisanal and medicinal; in accordance with what was discovered by Valle *et al*. (2021), that the use value of wild mammals that families appropriate are mainly nutritional, with medicinal use in second place. The use of mammals, in addition to the aspects indicated, adds to the disposition, proximity and involvement in the customs of rural areas concerning fauna resources (Brashares *et al*., 2011; Cajaiba *et al*., 2015; Hernández-López *et al*., 2013) and for Burgos *et al*. (2017), the hunting of mammals may relate to the subsistence of residents or be retaliation for damage to their crops. In this sense, in the study region, the use of wild mammals has to do with the damage caused to crops (mainly maize) and farm animals and sometimes, due to traditions and beliefs, or for the trade of species (Puc and Retana, 2012; Ávila-Nájera *et al*., 2011 and Cruz *et al*., 2019).

Finally, concerning the results of the logistic regression of the study variables proposed as causes of the use of mammals, it was observed that there was no significant relationship between socioeconomic level and the use of wild mammals; where there was an inverse relationship, it was with the main activities of the population dedicated to the home, or commercial and service sectors. This result coincides with what was found by Mendonca *et al*. (2016), who did not find a correlation between income level, age or education of

hunters and meat consumption. It is important to note that in areas or regions, where the population consumes more meat from domesticated species, the pressure on wild species is reduced (Spira *et al*., 2019). For Banchón *et al*., (2020), when performing a chi-square analysis, they found a relationship between income level, age and educational level. Cultural factors, concerning uses and customs of each community, are also linked to the use of wild mammals (Puc and Retana, 2012; Aiyadurai *et al*., 2010). The indigenous communities in this region participate in various religious and cultural activities, such as the festival of the patron saint and carnival, where fauna play an important role, as sometimes it is the protagonist of the dances and artistic performances (Govers, 2013; Cortés -Gregorio *et al*., 2013), and above all, if this is considered a legitimate individual or collective right for various uses of the wild fauna existing in their natural environment, strengthening their local and regional cultural identity, which will attribute value to the biocultural heritage (Ellison, 2020).

Research regarding wildlife must involve society, bearing in mind that this is an element in constant change and evolution; this must be directed towards creating knowledge regarding the causes for exploitation of natural resources, to then propose strategies that help mitigate or prevent damage caused to faunal resources in particular, and to the environment, in general.

CONCLUSIONS

The study population hunts and uses wild mammals mainly because of the damage they cause to crops, or to their domestic animals, or in relation to customs and traditions, but not for subsistence. The results indicated that there is no significant relationship between socioeconomic level and the use of medium and large wild mammals. However, when analyzing each of the variables considered in order to determine socioeconomic level, taking variables such as education, health, occupation, housing conditions and income, with the use of mammals (dependent variable), it was found that , the only variable that has a significant and inverse relationship, was the one that corresponds to the labor sector; meaning that if the population dedicates its activities to a sector other than agriculture, the probability that they use wild mammals decreases. Research regarding wildlife must involve society, bearing in mind that this is a factor in constant change and evolution; the aim here is to expand knowledge of the causes of exploitation of natural resources in order to propose strategies that will help mitigate or prevent damage to the environment.

REFERENCES

Aiyadurai A, Singh NJ, Milner-Gulland EJJ. 2010. Wildlife hunting by indigenous tribes: a case study from Arunachal Pradesh, north-east India. ORYX. 44(4). 564-572. doi.org/10.1017/S0030605309990937.

Aranda MJ. 2012. Manual para el rastreo de mamíferos silvestres de México. 1a. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

Arriaga CL, Espinoza-Rodríguez JM, Aguilar-Zúñiga C, Martínez-Romero E, Gómez-Mendoza L, Loza EL. (coords). 2000. Regiones Terrestres Prioritarias de México. Comisión Nacional para el Conocimiento y el Uso de la Biodiversidad. México. http://www.conabio.gob.mx/conocimiento/regionalizacion/doctos/Tlistado.html.

Asociación Mexicana de Inteligencia de Mercado y Opinión. 2016. ¿Qué es NSE? Disponible en: http://nse.amai.org/nseamai2/ (Consultado: el 18 de enero de 2017).

Ávila-Nájera DM, Rosas-Rosas OC, Tarango-Arámbula LA, Martínez-Montoya JF, Santoyo-Brito E. 2011. Knowledge, use and cultural value of six prey of jaguar (*Panthera onca*) and their relationship with this species in San Nicolas de los Montes, San Luis Potosí, Mexico. Revista Mexicana de Biodiversidad. 82(3).1020-1028.

Banchón Torres AB, Vite Cevallos H, Carvajal RH. 2020. Perfil socioeconómicos y ambiental de la pesca artesanal en la comuna Reveras de Huayla. Revista Metropolitana de Ciencias Aplicadas. 3(2). 199-205.

Basilio-González R, Hernández-Guzmán K, Fajardo-Franco ML, Aguilar-Tlatelpa M, Molina-Mendoza P. 2022. Estructura de la diversidad en aves y reptiles en la localidad de Lipuntahuaca, Huehuetla, Puebla. E-Cucba. 9(17). 192-200.

Brashares JS, Golden CD, Weinbaum KZ, Barrett CB, Okello GV. 2011. Economic and geographic drivers of wildlife consumption in rural Africa. Proceedings of the National Academy of Sciences of the United States of America. 108(34).13931–6. doi/10.1073/pnas.1011526108.

Burgos LR, Alfonso RAF, Rodrigues LLR, Mendes PAR. 2017. Terrestrial mammal assemblages in protected and human impacted areas in Northern Brazilian Amazonia. Nature Conservation. 22. 147–167. doi: 10.3897/natureconservation.22.17370.

Cabrera LA, Rodríguez PMC, Domínguez CS, Rodríguez DC, Rodríguez AC, Aguirre JA, El Grupo CDC. 2009. Validación del modelo REI para medir la clase social en la población adulta. Revista Española de Salud Pública. 83(2). 231-242.

Cajaiba RL, Silva WB, Piovesan PRR. 2015. Animais silvestres utilizados como recurso alimentar em assentamentos rurais no município de Uruará, Pará, Brasil. Desenvolvimento e Meio Ambiente. 34. 157-168.

Ceballos G y Oliva G. 2005. Los mamíferos silvestres de México. Fondo de Cultura Económica. México. p 956.

Chablé J, Delfín H. 2010. "Uso tradicional de la fauna silvestre", en R. Durán y M. Méndez (eds.) Biodiversidad y desarrollo humano en Yucatán. México: CICY, PPD-FMAM, CONABIO, SEDUMA. 496 p.

Cruz BV, Aguilar CWJ, Montes PR, Tuz CM. 2019. Conocimiento tradicional y uso de los vertebrados terrestres en el área natural protegida "Otoch ma´ax yetel koh", Yucatán, México. Revista Etnobiología. 17(3). 66-77.

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. 2017. Banco de Imágenes CONABIO. Disponible en: http://bdi.conabio.gob.mx/fotoweb/inicio.fwx (Consultado: el 1 de febrero de 2017).

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. 2011. La biodiversidad en Puebla: Estudio de Estado. 1a. México: CONABIO, BUAP. Disponible en: http://www.biodiversidad.gob.mx/region/EEB/pdf/BiodiversidadenPuebla.pdf

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. 2006. Capital natural y bienestar social. D.F. México.

Consejo Nacional de Evaluación Política de Desarrollo Social. 2016. Medición de la pobreza: evolución de la línea de bienestar y canasta alimentaria. http://www.coneval.org.mx/Medicion/MP/Paginas/Pobreza_2014.aspx [Consultado enero 18, 2017].

Consejo Nacional de Población. 2015. Población total, indicadores socioeconómicos, índice y grado de marginación por municipio. Estimaciones del CO-NAPO con base en el INEGI, Encuesta Intercensal 2015.

Contreras CLNU, Caso BL, Aliphat FM y Mariaca MR. 2013. Manejo de los agreoecosistemas en la comunidad lacandona de Nahá, Chiapas. Etnobiología. 11(3). 34-44.

Corona-Mendoza W, Escalante T. 2021. Aspectos ambientales y culturales de los nodos panbiogeográficos prioritarios para mamíferos terrestres del centro-sur de México. Acta Zoológica Mexicana. 37. 1-28.

Cortés-Gregorio I, Pascual-Ramos E, Medina-Torres SM, Sandoval-Forero EA, Lara-Ponce E, Piña-Ruíz HH, Martínez-Ruíz R, Rojo-Martínez GE. 2013. Etnozoología del pueblo mayo-yoreme en el norte de Sinaloa: uso de vertebrados silvestres. Agricultura, sociedad y desarrollo. 10(3). 335–358.

Cuevas AB. 2009. El desarrollo económico y el medio ambiente: el caso de México. Acta Republicana: Política y Sociedad. 8(8). 27–40. http://148.202.18.157/sitios/publicacionesite/pperiod/republicana/pdf/ActaRep08/ActaRep08_3.pdf.

DOF (Diario Oficial de la Federación). 2006. Ley de vivienda. http://www.diputados.gob.mx/LeyesBiblio/ Última reforma publicada DOF 14-05-2019.

Duek C, Inda G. 2014. La teoría de la estratificación social de Parsons: una arquitectura del consenso y de la estabilización del conflicto. Revista THEOMAI. 29. 155-175.

Durand L. 2017. Naturalezas desiguales: discursos sobre la conservación de la biodiversidad en México. Cuernavaca, Morelos. Universidad Nacional Autónoma de México. Centro Regional de Investigaciones Multidisciplinarias. 157 p.

Estrada-Portillo DS, Rosas-Rosas OC, Parra-Inzunza F, Guerrero-Rodríguez JD, Tarango-Arámbula LA. 2018. Valor de uso, importancia cultural y percepciones sobre mamíferos silvestres medianos y grandes en la Mixteca Poblana. Acta Zoológica Mexicana (nueva serie). 34. 1–15. https://doi.org/10.21829/azm.2018.3412131.

Flores-Vaquiro N, Luna-Contreras N. 2018. Hogares rurales y estrategias fa-miliares de vida en México. Revista latinoamericana de Población. 12 (23). 109-147. Doi:10.31406/n23a6.

Gasca-Rodríguez A, Guevara-Chumacero LM. 2022. Biodiversidad y artesanías de México. Investigación y Ciencia de la Universidad Autónoma de Aguascalientes. 30(87). 1-15.

Govers C. 2013. La práctica de la comunidad: representación, ritual y reciprocidad en la Sierra Totonaca de México. Primera edición. INAH, CEMCA. D.F. México.

Gual-Díaz M, Rendón A. 2014. Bosques Mesófilos de Montaña de México: diversidad, ecología y manejo. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Primera edición. D.F. México.

Ellison N. 2020. Altepet /ChuChutsipi: Nahua-Totonaca Territorial Cosmopolitics and Biocultural Heritage in the Sierra Nororiental of Puebla, Mexico. Trace [online].78. 88-122. https://doi.org/10.22134/trace.78.2020.742.

Hernández-López A, López-Alamilla E, Rodríguez RA, Aquino-Bravata A. 2013. Diagnóstico del uso de la fauna silvestre, en el área de protección de flora y fauna "Cañón del Usumacinta", Tenosique Tabasco. Ra Ximhai. 9(1). 1–14.

Hernández RE, Ramírez-Bravo OE, Hernández TG. 2017. Patrones de cacería de mamíferos en la Sierra Norte de Puebla. Acta Zoológica Mexicana. 33(3) 421-430.

Hoffman, R. 2008. Socioeconomic Differences in Old Age Mortality. Dordrecht: Springer Netherlands (The Springer Series on Demographic Methods and Population Analysis) 25, doi: 10.1007/978-1-4020-8692-2.

Instituto Nacional para el Federalismo y el Desarrollo Municipal. 2010. Enciclopedia de los municipios y delegaciones de México: Puebla. Disponible en: http://www.inafed.gob.mx/work/enciclopedia/EMM-21puebla/index.html [Consultado enero 19, 2017].

Jovell AJ. 1995. Análisis de Regresión Logística. Editorial Centro de In-vestigaciones Sociológicas. Madrid. España.

Mayor P, El Bizri H, Bodmer RE, Bowlwe M. 2017. Assessment of mammal reproduction for hunting sustainability through community-based sampling of species in the wild. Conservation Biology. 31(4). 912-923. DOI 10.111/cobi.12870.

Medina-Torres SM, Cortés-Gregorio I, Lara-Ponce E, Sandoval-Forero EA. 2016. Uso de mamíferos silvestres entre Yoremes y Yoris de el fuerte, Sinaloa, México. Agricultura, Sociedad y Desarrollo. 13. 529-545.

Melo RS, Silda OC, Souto A, Alvez RRN, Schiel N. 2014. The Role of Mammals in Local Communities Living in Conservation Areas in the Northeast of Brazil: An Ethnozoological Approach. Tropical Conservation Science. 7(3). 423–439.

Mendonca LET, Vasconvellos A, Souto CM, Oliveira TPR, Alves RRN. 2016. Bushmeat comsumption and its implications for wildlife conservation in the semiarid region of Brazil. Regional Environmental Change. 16(6). 1649-1657. DOI 10.1007/s10114-015-0901.3.

Morales MC. 2012. "Hacia una comunidad de práctica con enfoque inter-cultural: la escuela telesecundaria Tetsijtsilin en Tzinacapan, Cuetzalan, Puebla". Revista de Investigación Educativa. (14). 18–43.

National Center for Education Statistics. 2012. "Improving the Measurement of Socioeconomic Status: A Theoretical Foundation". NCES. Disponible en: https://nces.ed.gov/nationsreportcard/pdf/researchcenter/Socioeconomic_Factors.pdf (Consultado: el 19 de enero de 2017).

Puc GRA y Retana GOG. 2012. Uso de la Fauna Silvestre en la Comunidad Maya Villa De Guadalupe, Campeche, México. Etnobiología. 10(2). 1–18. Disponible en: http://asociacionetnobiologica.org.mx/revista/index.php/etno/article/view/59.

Polaina E, González-Suárez M y Revilla E. 2015. Socioeconomic correlates of global mammalian conservation status. Ecosphere. 6(9):146. http://dx.doi.org/10.1890/ES14-00505.1

Pouteau R, Brunel C, Dawson W, Essl F, Kreft H, Lenzner B, Meyer C, Pergl J, Pyšek P, Seebens H, Weigelt P, Winter M, Van-Kleunen M. 2022. Environmental and socioeconomic correlates of extinction risk in endemic species. Diversity and Distributions. 28. 53–64. https://doi.org/10.1111/ddi.13438.

Rivas RR. (2008). Dos enfoques clásicos para el estudio de la estratificación social y de las clases sociales. Espacio Abierto. 17(3). 367-389.

Romero RJ, Aguilar-Ávila J, Santoyo CVH, Diakite DL. 2022. Transiciones del cambio de uso de suelo en el estado de Puebla (1980-2016), México. Investigaciones geográficas. (109). 1-17.

Saito M, Koike F. 2013. Distribution of Wild Mammal Assemblages along an Urban–Rural–Forest Landscape Gradient in Warm-Temperate East Asia. Plos One. 8(5). e 65464 doi:10.1371/journal.pone.0065464.

Smith A. 1997. La identidad nacional (A. D. Ruiz-Jiménez, Trad). Trama. (obra original publicada en 1991)

Spira C, Kirkby A, Kujirakwinja D, Plumptre AJ. 2019. The socioeconomics of artisanal minig and bush-meat hunting around protected are-as:Kahuzi-Biega National Park and Itombwe Nature Reserve, eastern Demo-cratic Republic of Congo. Oryx, 53(1). 136-144. DOI: /10.1017/S003060531600171X.

Torres DF, Oliveira ES, Alves RR. (2018). Conflicts between humans and terrestrial vertebrates: a global review. Trop. Conserv. Sci.11. 1-15. doi: 10.1177/1940082918794084

United Nations. 1987. Development and International Economic Cooperation: Environment. Report of the World Commision on Environment and Development: Our Common Future. Disponible en: http://www.un.org/en/ga/search/view_doc.asp?symbol=A/42/427.

Valle MR, García FA, Colín BH. 2021. Fauna silvestre con valor de uso en la Reserva de la Biosfera Sierra de Huautla, Morelos, México. Revista peruana de biología 28(4): e19921 doi: http://dx.doi.org/10.15381/rpb.v28i4.19921.

Vivanco M. 2005. Muestreo Estadístico: Diseño y aplicaciones 1a., Santiago de Chile: Editorial Universitaria S.A.

Zavala-Sánchez Z, Segura-Pacheco ER, Ávila-Nájera DM, Herrera-Castro ND, Barrera-Catalán E, Sarabia-Ruiz G. 2018. Valoración cultural y uso de la fauna silvestre en san Vicente de Benítez, Guerrero, México. Revista Etnobiología. 16 (3). 78-92.