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POPULAR PERCEPTIONS ABOUT BATS IN MARANHÃO, NORTHERN BRAZIL THAT OBSTACLES CONSERVATION ACTION

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ABSTRACT

Bats play a fundamental role in the ecology of several environments, although the general lack of knowledge on the relevance of these animals, frustrate many initiatives that contribute to the development of favorable attitudes and participative measures, that promote the conservation of those animals and the ecosystems they inhabit. In the current study, 398 person of eight different neighborhoods from Caxias town in Maranhão state, Brazil, were interviewed to verify their perceptions of bats. The interviewees were between 17 and 91 years old, and two-thirds of them (263; 66%) were women, while the other 135 were men (34%). Most of the interviewees described bats as ugly and disgusting animals, that look like rats, feed primarily on fruits, and gets people scared. These individuals also confirmed that bats are important for nature and should be protected just for the fact that they are living creatures. The statistics results shows a significant association between the fear of bats and to think that these animals are real vampires, and also that women are more likely to have fear of bats than men. There was also an association between a low education level and the belief that all bats are vampires. The present study provides important insights into the perception of bats by the local population, highlighting the prevalence of mythical beliefs, which hinder the implementation of effective conservation measures. Its results reinforce the need for initiatives in environmental education that provide more reliable information about the biology of bats and their ecological importance, thereby contributing to the conservation of bat diversity.

KEYWORDS: Chiroptera, ethnobiology, ethnozoology, environmental education, popular knowledge.

PERCEPCIONES POPULARES SOBRE LOS MURCIÉLAGOS QUE OBSTACULAN LA ACCIÓN DE CONSERVACIÓN EN MARANHÃO, NORTE DE BRASIL

RESUMEN

Los murciélagos juegan un papel importante en la ecología de muchos ambientes, pero el desconocimiento general sobre la relevancia de estos animales dificulta iniciativas que contribuyan al desarrollo de actitudes favorables y medidas participativas que promuevan la conservación de esta especie animal y los ecosistemas que habitan. En este estudio, 398 residentes de ocho barrios de la ciudad de Caxias del estado de Maranhão, Brasil, fueron entrevistados para verificar sus percepciones sobre los murciélagos. Los encuestados tenían entre 17 y 91 años, siendo dos tercios de estos (263; 66%) mujeres, mientras que los otros 135 eran hombres (34%). La mayoría de los entrevistados consideran a los murciélagos como animales feos y repugnantes que parecen ratones, los cuales se alimentan principalmente de frutas y generan miedo en las personas. Estos individuos también confirmaron que los murciélagos son de gran importancia para la naturaleza y deben ser protegidos por el simple hecho de ser criaturas vivas. Los análisis indican una asociación significativa entre el miedo a los murciélagos y la creencia de que todos estos animales son vampiros, y también que las mujeres tienen más probabilidades de temer a los murciélagos que los hombres. También hubo una asociación entre el bajo nivel de educación y la creencia de que todos los murciélagos son vampiros. El presente estudio aporta información importante sobre la percepción de los murciélagos por parte de la población local, destacando la prevalencia de creencias míticas, que dificultan la implementación de medidas de conservación efectivas. Los resultados obtenidos mediante esta investigacion refuerzan la necesidad de iniciativas de educación ambiental que brinden información más confiable sobre la biología de los murciélagos y su importancia ecológica, contribuyendo así a la conservación de la diversidad de los murciélagos.

PALABRAS CLAVE: Chiroptera, etnobiología, etnozoología, educación ambiental, saber popular.

INTRODUCTION

Bats belong to the Order Chiroptera and constitute one of the most diverse groups of mammals in the world (Simmons, 2005). They are widely distributed on almost the entire planet (Reis *et al*., 2007). Chiropterans play important roles in the environment (Nowak, 1994) and have a variety of eating habits (Reis *et al*., 2007) such as being frugivorous (Garcia *et al*., 2000), insectivorous (Goodwin and Greenhall, 1961), nectarivorous (Sipinski and Reis, 1995), carnivorous (Kunz and Pierson 1994) and hematophagous (Brass, 1994). Due to this last characteristic, the population does not realize the ecological importance of delete bats, relating these animals to myths and legends and creating an image associated with evil (Allen, 1967), making them non-charismatic creatures (Marinho-Filho and Sazima, 1997; Gomes and Neto, 2016; Gomes *et al*., 2017).

Superstitions regarding bats have been observed since antiquity (Marinho-Filho and Sazima, 1997; Gomes and Neto, 2016). The Mayan civilization in the American continent associated these animals with cruel characters linked to death (Yalden and Morris, 1976; Hill and Smith, 1985). For this civilization the god of the dead was represented by a human body with a vampire bat head (Villa and Canela, 1998). For africans, some negative feelings such as fear were associated with bats twilight habit (Hill and Smith, 1985).

In some fables, around the world, the hematophagous eating habit of some bats takes on a fanciful character. As an example, we can mention Dracula´s legend that causes an even more negative image to this group of mammals leading to the belief that all bats are aggressive, ferocious and that they only feed with blood (Scravoni

et al., 2008). This legend lead society to believe that bats are old blind rats with wings, like worms or insects that only serve to transmit diseases (Arandas *et al*,. 2011). The name itself, bat, is derived from the latim "*muris*" (rat) and "*coecus*" (blind). In french, bats are called *chauve-souris* (bald rat), in spanish they are called *murciélagos* (old mice) and *fledermäuse* (flutter mouse) in German (Reis *et al.,* 2007; Gomes and Neto, 2016).

Despite the bad image, there were people who had bats as a symbol of something good, symbolizing happiness and fertility (Allen, 1967; Fenton, 1992). For example, in the eastern world they were a symbol of good luck and longevity and they were considered sacred animals in Egypt and also in India (Esbérard *et al*., 1996). In this context, there is ethnozoology that aims to analyze the various manifestations between humans (past and present) and fauna, whether inspired by affection, rejection, contempt or reverence, based on local beliefs and symbols. (Knight, 2008; Prokop and Tunnicliffe, 2008; Alves and Souto, 2011; Alves, 2012; Alves and Souto, 2015; Lyra-Neves *et al*., 2015).

Most ethno-zoological studies, in Brazil, are related to fish, insects and mollusks (Lyra-Neves *et al*., 2015). You can also find studies related to the wild animals hunting (Alves, 2012; Barbosa *et al*., 2018), and others related to conflicts between humans and animals, such as: mammals, birds and reptiles (Mendonça *et al*., 2011; Pereira *et al*., 2019; Lima *et al*., 2020; Santos *et al*., 2020). In a study conducted by Alves *et al*. (2018), these researchers make a list of animal species involved in conflicts with human beings in different parts of the world. There was also a growing number of publications with reports of animal use in the treatment of different diseases (Castillo and Ladio, 2019; Brito *et al*., 2019).

However, for bats, the research are scarce, restricted and specific to certain groups of people and localities (Andriguetto and Cunha, 2004; Prokop and Tunnicliffe, 2008; Forth, 2009; Rego *et al*., 2015; Bruno and Kraemer, 2010; Gomes and Neto, 2016; Gomes *et al*., 2017). These research show that decontextualized interpretations of bat behavior are responsible for the countless people who conceive chiropterans as dangerous and aggressive, representing evil (Wilson, 1997), distorting the true function of these animals in the environment (Scravoni *et al*., 2008). There is also some research on hunting and eating bat meat as food and for medical use (Van Vliet *et al.*, 2017), however, there still seems to be an information gap at the international level (Mildenstein *et al.*, 2016).

The lack of information of the ecological importance of bat species means that people do not have actions for the conservation and protection of these animals (Uieda, 2008), making it necessary to improve the environmental perception that the population has about these animals through environmental education (Andriguetto and Cunha, 2004). In addition, it is necessary a solid base of knowledge of the human - nature relationships (Rego *et al*., 2015; Wajner *et al*., 2019; Ballejo *et al*., 2019) to assist in the assessment of the impacts of human populations behavior on other animal species and thus subsidizing the development of sustainable management plans, fundamental for conservation (Alves and Souto, 2011; Alves and Souto, 2015). Thus, the present work aims to know the perceptions of the population of the Caxias city- MA, Brazil about bats in order to verify the main difficulties that obstruct community actions in the conservation of this animal group.

MATERIALS AND METHODS

Study Area. The present study focused on the municipality of Caxias in the Maranhão state, Brazil. Caxias is part of the mesoregion of eastern Maranhão and has an area of 5,196.77 km^2 and its phytogeographic domain is Cerrado (Brazilian Biome). It is located near the Inhamum Municipal Environmental Protection Area (APA Inhamum), and other preserved areas, enabling people to have contact with the bats. It is neighbored to the north by the municipalities of Codó, Aldeias Altas, and Coelho Neto, to the west, by São João do Sóter and to the south, by Parnarama and Matões. The eastern limit of the Caxias municipality coincides with the western border of the state of Piauí (Figure 1). Caxias has a population of approximately 155,000 inhabitants, with a density of 30.1 citizens per km^2 (IBGE, 2010).

Collection and analysis of data. The data were collected using interviews, which were conducted during visits to households in eight neighborhoods of Caxias town, we randomly selected the different houses, and we only interviewed one person per house. The selected neighborhoods for the data collection were Baixinha, Cangalheiro, Cohab, Centro, Campo de Belém, Dinir Silva, Seriema, and Volta Redonda. All the interviews were conducted in 2015, and a total of 398 local residents were interviewed. This project was approved by the Ethics Committee of Maranhão State University (UEMA) through protocol number 1.837.255 and CAAE: 60681916.0.0000.5554.

The main objective of the interview was to understand the relationship between people and bats through the variables age, educational level and sex. The questionnaire had three sections. The first section included personal questions (name, age, and sex of the interviewee, and neighborhood), as well as their education level. The second section of the interview included questions about the individual's perceptions of bats, and also knowledge about bat biology (diet, habitat and behavior). The third section questions was about the importance of these mammal for the population and nature, that is, their conservation potential (Appendix A). The data were fed into an Excel spreadsheets for processing and quantitative and qualitative analyses. Statistical analyses were run in STATA, version 13 (STATACORP, 2013), with a $p < 0.05$ significance level.

RESULTS AND DISCUSSION

Profile of the interviewees. A total of 398 individuals were interviewed during the present study. The interviewees were between 17 and 91 years old, and two-thirds (263; 66%) were women, while the other 135 were men (34%). Overall, 5.28% of the interviewees were illiterate, 2.51% were literate (basic reading and writing skills, but had not graduated elementary school), 29.90% had graduated elementary school, 45.98% had graduated high school, and 16.33% had a college degree. No correlation was

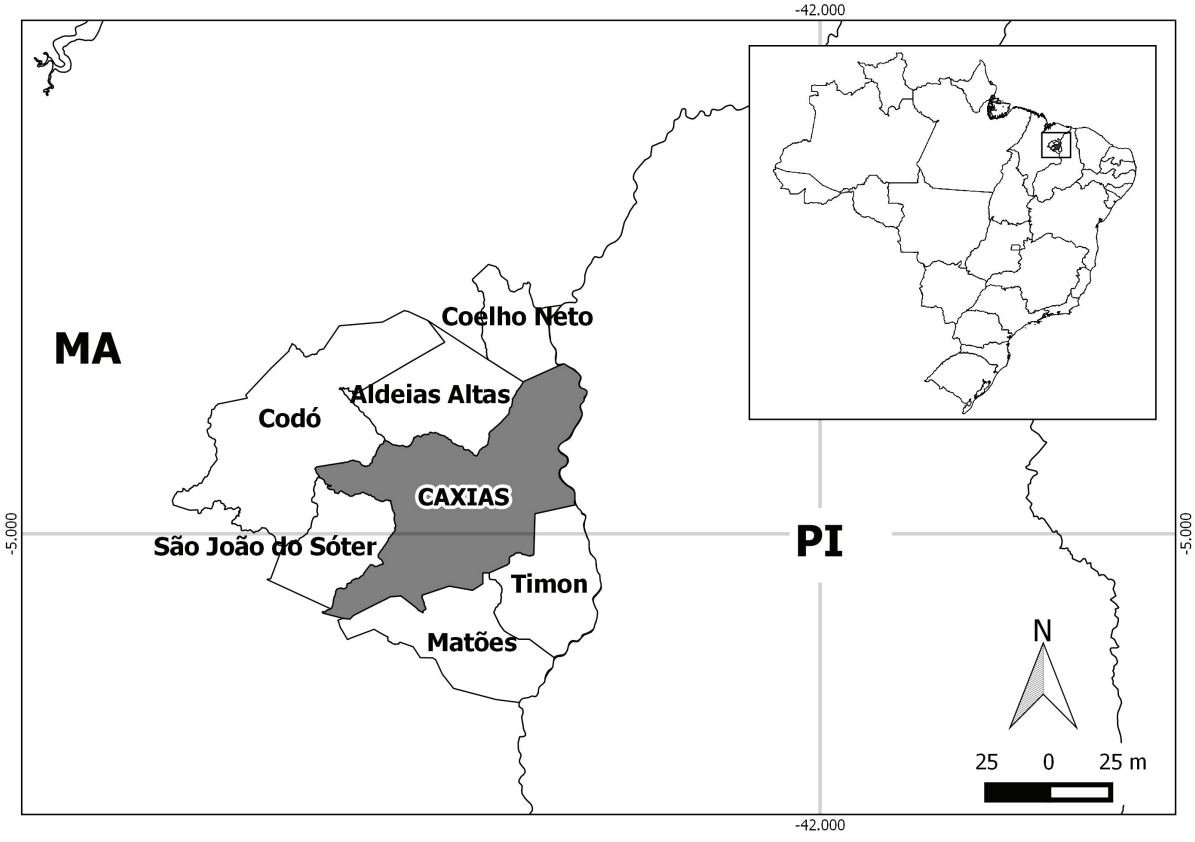


Figure 1. Municipality of Caxias in Maranhão, Brazil, and the neighboring municipalities in eastern Maranhão.

found between sex and education level (p = 0.521).

Descriptions of bats and the imagined perceptions of the individuals interviewed. Fifteen interviewees (3.77% of the total) doesn´t know bats personally, although they described them as ugly winged animals, black colored, that they are nocturnal, malodorous, cave dwellers and blood lovers, and also are rabies transmitters. These individuals stated that bats are similar to rats and birds.

The other 383 interviewees (96.23% of the total) reported that they knew bats. The characteristic most cited by these individuals was the ugliness of the bats, as well as being small size animal, hairy, with wings, and either black, brown or gray in color, and also that they sleep upside down, hanging by their legs. Irrespective of their age, sex or level of education (p > 0.46), these interviewees reported negative aspects of bats, such as the fact that they were frightening or disgusting, associated them with other animals, in particular rodents, with "*rats with wings*" being one of the most frequent descriptions. Only two of the 383 interviewees that confirmed knowing bats, referred to them as attractive animals. One of these interviewees was male and had a college degree, while the other was a female elementary school graduate. Almost half (49.25%) of the interviewees reported being afraid of bats, although experience did not influence their fear (p = 0.396), that is, individuals were afraid of bats whether they had seen one or not. Similarly, no correlation was found between a fear of bats and the level of education of the interviewee (p = 0.796).

Perceptions of the interviewees on bat diets. Most people mentioned that bats eat fruits. In several reports, people say they saw bats feeding or leaving seeds and scraps of fruits on the ground. Other foods mentioned were: insects, nectar, seeds, blood and a plant popularly known as monkey pepper (*Piper aduncum* L.).

A total of 19 interviewees (18 whom were female) were unable to provide an answer to this question. The 18 females included seven elementary school graduates, seven high school graduates, and three with college degrees, while the men were only high school graduates.

Are all bats vampires? Are you scared of them? In response to the question "*Are all bats vampires*?" 22.03% (87) of the interviewees responded affirmatively, although 20 of these individuals were unable to justify their response. These 20 interviewees included two illiterate males, nine high school graduates (all female), six elementary school graduate (four female and two male), and three (two female, one males) college graduates. Most of the respondents justified their response based on the hematophagous diet of the bats, their teeth, body shape, images observed in films, and popular beliefs, which all indicate that bats drink blood and prefer this type of nutrient. In this case, a significant relationship (p < 0.001) was found between the belief that bats are vampires and the level of education of the interviewee, with a majority (42.52%) of the positive respondents being elementary school graduates, followed by high school graduates **(**35.63%).

The other 308 interviewees affirmed that not all bats are vampires, although 105 were unable to justify their response. These individuals included interviewees of different education levels, although the majority were female high school graduates, while the males had no formal qualifications. The other 203 interviewees justified their response, replying that bats "*eat fruits*", "*are mammals*", "*They don't just eat blood*", "*are different from vampires*", "*belong to a number of different species*", "*eat insects*", and "*are frugivorous*". Other included responses "*I have never heard of anyone being bitten*", "*they don't attack human beings*", "*different bats eat different things*", "*the vampires are from the United States*", "*only the hematophagous bats are vampires*", and "*there are no vampires in Brazil*".

Two thirds (66%) of the 308 interviewees that confirmed that not all bats are vampires were female, while the other 34% were male. As this is directly proportional to the number of male and female participants, there was no significant variation (p = 0.635) in the response to this question related to the sex of the interviewee.

In response to the question "*Are you afraid of bats?*" 199 interviewees responded "*no*", although three of these

individuals responded that they feel disgust, rather than fear. A total of 196 interviewees responded positively, including eight individuals who confirmed feeling both, fear and disgust. All these individuals were female. Three interviewees did not provide a response to this question. There is a clear correlation ($p < 0.0001$) between the sex of the individual and fear of bats, with women being significantly more likely to feel fear than men. The fear of bats was also significantly associated ($p < 0.001$) with the belief that all bats are vampires.

Perceptions on the conservation of bats. In the case of the question "*If you found a live bat, what would you do?*", the most frequent response was to "*kill it*" (Figure 2). This was the response of 84 women (nine illiterate, five with an elementary education, 28 elementary school graduates, 33 high school graduates, and nine college graduates) and 51 men (four illiterate, 42 elementary school graduates, three high school graduates, and two college graduates). Sixty-seven interviewees responded that they would "*do nothing*", including 36 women (11 elementary school graduates, one with an elementary education, 15 high school graduates, three who were illiterate, and six college graduates) and 31 men (13 elementary school graduates, one with an elementary education, nine high school graduates, two who were illiterate, and six college graduates). All the 39 individuals who replied that they would "*run away*" were female, including six elementary school graduates, 20 high school graduates, and 13 with a college degree.

The other 157 interviewees responded in different ways, including "*I would leave it where it is*" and "*I would keep my distance and scream*", while others confirmed that their response would depend on where the bat was, and in particular, that they would "*kill it*" if it were "*inside their home*". Only one person, a male college graduate, responded that, if he saw a live bat, he would "*admire it and take a photograph*".

In response to the question "*Do you think that bats are useful for nature or for the human beings?*" 254 answered positively (Figure 3). Most (164) of these individuals were female, including nine illiterate persons, two with an

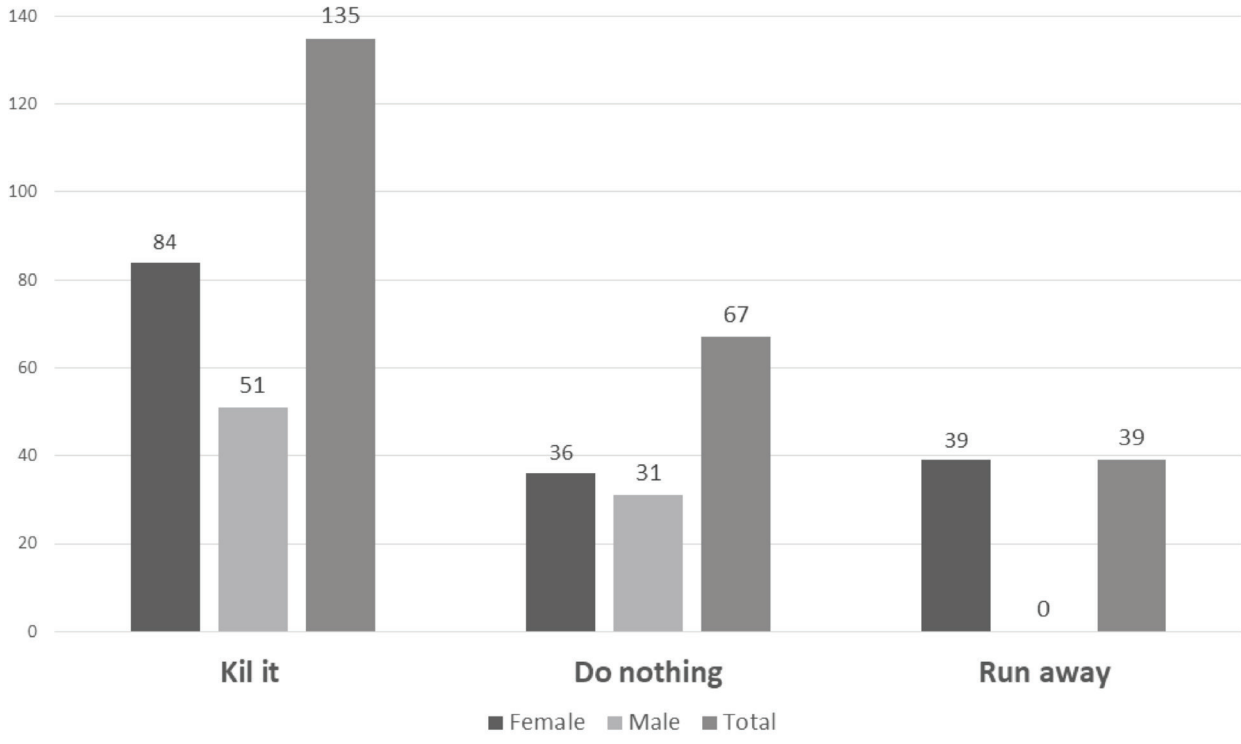


Figure 2. If you found a live bat, what would you do? Principal responses. The other 157 interviewees offered a number of different responses, which are covered in the text.

elementary education, 27 elementary school graduates, 92 high school graduates, and 34 college graduates. The other 90 were male, including four illiterates, one with an elementary education, 25 elementary school graduates, 41 high school graduates, and 19 college graduates. A total of 102 interviewees responded negatively, including 68 women (eight illiterate individuals, one with an elementary education, 23 elementary school graduates, 30 high school graduates, and six college graduates) and 34 men (three illiterate, one with an elementary education, 15 elementary school graduates, 12 high school graduates, and three college graduates). The other 42 interviewees (24 women and 18 men) either did not provide a response or did not know what to say.

About the interviewees that responded positively to the question on the usefulness of bats, 21 provided no justification, while 233 referred to ecological roles, such as seed dispersal, pollination, the control of insect pests, and their position in the trophic web. However, some individuals identified bats as vectors of diseases transmitter, in particular rabies disease. The sex of the interviewee did not influence significantly (p = 0.656) their response to this question, given that men and women provided similar responses to the question of the importance of bats for nature.

In relation to the question "*Do you think that bats deserve to live and should be protected, like other animals?*" 310 of the interviewees responded positively, 82 negatively, and six do not provide any answers. The principal responses are shown in Table 1. The sex of the interviewee did not influence the response to either question, i.e., whether bats deserve to live (p = 0.518) or should be protected (p < 0.707). A fear of bats (question 8) did not influence the response to this question (p = 0.674), nor whether the respondent felt that these animals should be protected (p = 0.135). Similarly, no systematic relationship (p = 0.135) was found between the fear of bats and the response to question 11 (whether bats should be allowed to live).

According to Alves (2012), the relationship between man and other animals varies throughout history and depends on the human cultures with which animals interact. In this way, animals play an important role in the folklore of almost all cultures, and these influence the

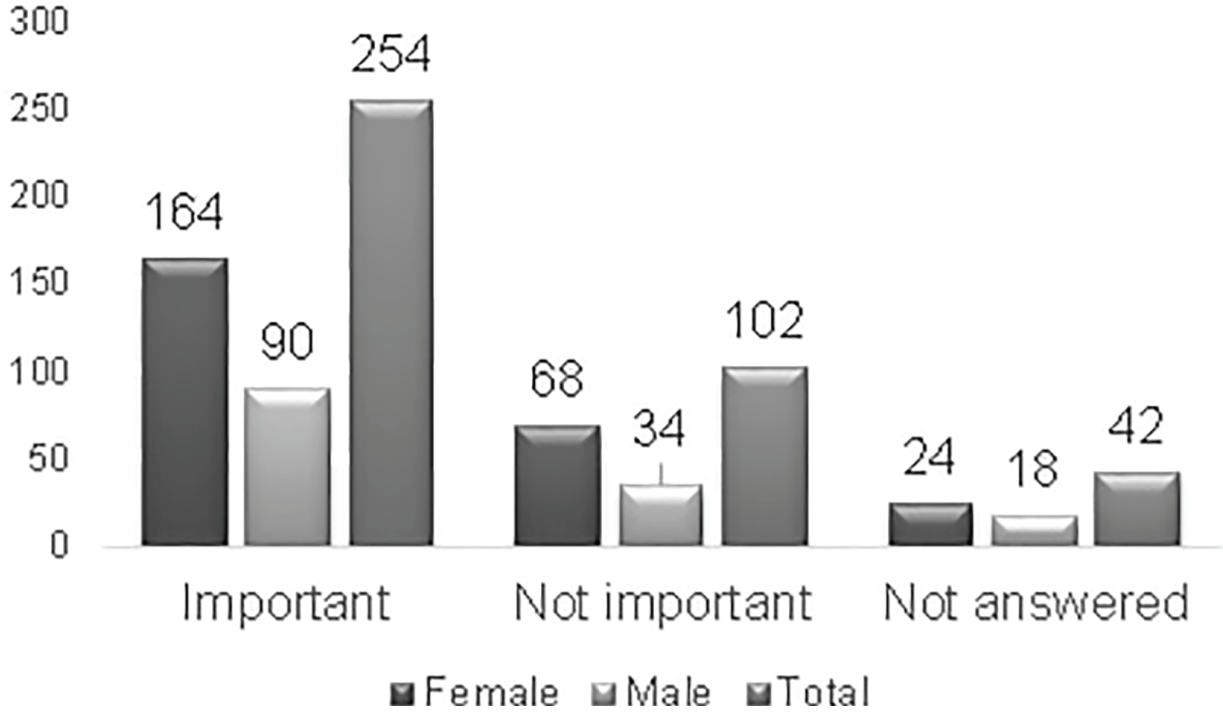


Figure 3. Do you think that bats are useful for Nature or human beings? Responses of the interviewees in Caxias, Maranhão, Brazil.

Table 1. Do you think that bats deserve to live and should be protected, like other animals? Most frequent responses.

RESPONSE OF THE INTERVIEWEE	JUSTIFICATION
Yes	"*Because they are living organisms*"
	"*Because every living thing has the right to live*"
	"*Because they are useful to Nature*"
	"*They deserve to live, but they shouldn't be protected because they have no use to anyone*"
No	"*Because they are useless to anyone*"
	"*Because they harm other animals, kill them and suck their blood*"
	"*Because they are deseases transmitters*"
	"*Because they are ugly, disgusting, and frightening*"

Source: Prepared by the authors

attitudes of men towards other species. Knowing these relationships can provide crucial information to support more effective conservation actions. This study highlights the relationship between man and bats, revealing that most interviewees do not recognize the importance of bats as environmental bioindicators, pest controllers, pollinators, as they did not report these habits when interviewed.

The relevance of a species to society is reflected in its bioculture and is related to the way it is known, perceived and being determined by biological and cultural factors (Vargas Melgarejo, 1994; Ballejo *et al*., 2019; Gutiérrez-Santillán *et al*., 2019). This type of knowledge is transmitted orally or through shared practical experiences, maintaining biocultural memory across generations (Toledo and Barrera-Bassols, 2009; Ballejo *et al*., 2019). In this study, 96.23% of the interviewees had already seen a bat and described them as ugly, small sized, winged, hairy animals that can be black, brown or gray colored, with a rat or bird face.

The ethno-zoo study with bats, in Brazil, reveals that people have a negative connotation in relation to these animals (Bredt *et al*., 1996). Thus, the present study shows that people have a mixture of beliefs and empirical knowledge in relation to bats as well as misconceptions about them. According to Andriguetto and Cunha (2004), the legends and myths attributed to bats are related to their nocturnal habit, to rest "upside down" and little similarity with other mammals.

Another characteristic that contributes to people's imagination is the blood-sucking habit of some bats, causing these animals to be associated with vampirism (Zinn *et al*., 1998). Although this knowledge is widespread among people, 78% of respondents believe that bats are not vampires showing a positive view of these animals. This view is built by the fact that they see bats feeding or leaving seeds and fruits scraps on the ground. This fact was corroborated when 64.32% of the interviewees cited frugivorous as the feeding habit of bats. These results are similar to those found by Rego *et al*. (2015), when 61% of their interviewees also mentioned frugivorous.

It is important to emphasize that among more than 1,120 known bat species only three of them are hematophagous: *Desmodus rotundus* ("*commonly known as the vampire bat*"), *Diphylla ecaudata* ("*hairy-legged vampire bat*") and *Diaemus youngi* ("*white-winged vampire bat*"). Regarding the diet in addition to frugivores, the nectaryvores / polynivores and carnivores mentioned by the interviewees, bats also can be classified as piscivores and omnivores according to Reis *et al.* (2011).

The lack of information about the ecological importance of bat species means that the population does not have friendly and protective attitudes towards them (Scravoni

et al., 2008). A significant number of respondents (64%) do not see bats as good animals, wanting to stay away from them, run away from them, scream of fear and even kill them. Gomes *et al*. (2017), obtained results similar to ours. In their survey 50% of their respondents would have reactions of terror and panic and reported that they kill or try to kill the animals.

Medicinal use for increasing fertility in women has also been reported (Tuladhar-Douglas, 2008; Mildenstein *et al*., 2016 and Van Vliet *et al*., 2017). Mildenstein *et al*., (2016) still reports on the meat consumption of these animals and that affects at least 167 species of bats in Africa, Asia, the islands of Oceania and to a lesser extent, in Central and South America. This behavior had brought about a decrease in bat populations. In the present study, this perception was not observed in the people interviewed.

In this sense, it is necessary to demystify beliefs and make people aware of the ecological importance of the different species of bats and the real medical-sanitary dangers that involve them, especially on blood-sucking bats. According to Alves (2012) and Alves and Souto (2015), ethno-zoological studies can help in assessing the impacts that human populations have on native animal species and in the development of management plans. Ethnozoology associated with environmental education is an alternative to provide information about bats, to alert the population about the environmental role of bats, to the threats of extinction that some species pass through and consequently to provide a differentiation in the population's perception of these animals. Corroborating with Barreiro and Filho (2016), it is believed that in this way it would be possible to emphasize information on the various ecological roles of the chiropterans, arousing curiosity for research and for the conservation of species.

CONCLUSIONS: The results of this study provide an understanding of how people perceive bats, making it clear that there is a lack of knowledge of biological and ecological aspects. Actions must be take such as environmental education works, through surveys, lectures and other activities to be developed in schools and associations that publicize the characteristics of this group of animals, their ecological importance and their participation in the transmission of diseases. In this way, it will be possible to develop attitudes for the conservation of bats.

DECLARATIONS

ETHICS APPROVAL AND CONSENT THE PARTICIPATE

This project was approved by the Ethics Committee the Maranhão State University (UEMA) through protocol number 1.837.255 and CAAE: 60681916.0.0000.5554. It is available on the link: http://plataformabrasil.saude.gov.br/login.jsf

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