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People and giant xenarthrans: a Human Dimensions approach to guide a better coexistence

Pessoas e grandes xenartros: uma abordagem das Dimensões Humanas para orientar a coexistência

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Pessoas e grandes xenartros: uma abordagem das Dimensões Humanas para orientar a coexistência

Aluna: Mariana Labão Catapani

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RESUMO

CATAPANI, Mariana Labão. Pessoas e grandes xenartros: uma abordagem das Dimensões Humanas para orientar a coexistência. 2021. Tese (Doutorado). Programa de Pós-Graduação em Ciência Ambiental (PROCAM), Instituto de Energia e Ambiente. Universidade de São Paulo, São Paulo, 2021.

A abordagem científica de Dimensões Humanas da Vida Silvestre oferece informações úteis ao planejamento e direcionamento de estratégias aplicadas para a conservação da fauna silvestre. Nesta tese, adotou-se tal abordagem para investigar três interações entre pessoas e duas espécies de Xenarthra ameaçadas de extinção: o tamanduá-bandeira e o tatu-canastra. O objetivo central foi compreender o contexto e os determinantes de tais interações, bem como suas implicações para a conservação das espécies e para os atores envolvidos. Nos três estudos aqui apresentados utilizou-se delineamento de métodos mistos em duas fases: (i) entrevistas informais e semiestruturadas, dispondo-se de roteiro de entrevista e (ii) entrevistas estruturadas, com a utilização de questionário. O objetivo do primeiro capítulo foi identificar os fatores psicológicos que afetam a probabilidade de colisões entre caminhoneiros e diferentes animais nas rodovias. Os resultados sugerem que promover atitudes positivas em relação à vida selvagem pode não ser eficiente em reduzir colisões. Isto porque a tomada de decisão dos motoristas é principalmente determinada pela percepção de risco; eles avaliam a segurança relativa de colidir em comparação com os perigos de evitar um animal na rodovia (i.e., frear ou desviar). No segundo capítulo, o objetivo foi identificar os determinantes das superstições de mau-agouro e suas implicações para a conservação do tamanduá-bandeira no Pantanal sul-mato-grossense. Os resultados indicam que, embora a influência social seja importante na disseminação de tais crenças, o fator-chave que prediz a adesão das pessoas às superstições é o baixo conhecimento factual sobre a espécie. Verificou-se ainda que as superstições podem ocasionar perseguição aos tamanduás-bandeira, mas também afetam o bem-estar psicológico de quem as detêm, além do risco a que estão expostos aqueles que se envolvem em comportamentos supersticiosos de contato com o animal. O terceiro capítulo utilizou um *framework* de análise de conflito com vistas a compreender o cenário envolvendo a destruição de colmeias por tatus-canastra em apiários do Cerrado do Mato do Grosso Sul e a eventual retaliação dos apicultores. A análise trouxe evidências de que o conflito está associado a fatores tangíveis (i.e., perda econômica dos apicultores), não envolvendo valores, crenças e identidades enraizadas e conflitantes entre os atores envolvidos. Isto sugere que a implementação de estratégias de mitigação do dano (e.g. redução da vulnerabilidade das colmeias) pode melhorar a relação dos apicultores com tatus-canastra. Investigações com abordagens interdisciplinares e integrativas que aproximem a

Ciência da prática têm maiores chances de serem implementadas e podem contribuir efetivamente para a persistência da vida silvestre de forma socialmente justa.
Palavras-chave: análise de conflito, colisões veiculares com fauna, interações humano-fauna, lacuna entre pesquisa e implementação, superstições.

ABSTRACT

CATAPANI, Mariana Labão. People and giant xenarthrans: a Human Dimensions approach to guide a better coexistence. 2021. Tese (Doutorado). Programa de Pós-Graduação em Ciência Ambiental (PROCAM), Instituto de Energia e Ambiente. Universidade de São Paulo, São Paulo, 2021.

The Human Dimensions of Wildlife scientific approach offers useful information for planning and directing strategies applied to the wildlife conservation. In this thesis, such an approach was adopted to investigate three interactions between people and two species of Xenarthra threatened with extinction: the giant anteater and the giant armadillo. The central objective was to understand the context and the determinants of such interactions, as well as their implications for the conservation of species and for the people involved. In the three studies presented here, a mixed-method design was used in two phases: (i) informal and semi-structured interviews, with an interview guide and (ii) structured interviews, using a questionnaire. The purpose of the first chapter was to identify the psychological factors that affect the likelihood of collisions between truck drivers and different animals on the highways. The results suggest that promoting positive attitudes towards wildlife may not be effective in reducing collisions. This is because the drivers' decision making is mainly determined by the perception of risk; they assess the relative safety of colliding against the dangers of avoiding an animal on the road (i.e., breaking or swerving). In the second chapter, the objective was to identify the determinants of bad omen superstitions and their implications for the conservation of the giant anteater in the Pantanal of Mato Grosso do Sul. The results indicate that, although social influence is important in the dissemination of such beliefs, the key factor that predicts people's adherence to superstitions is the low factual knowledge about the species. It was also found that superstitions can lead to persecution of giant anteaters, but they also affect the psychological well-being of those who detain them, in addition to the risk to those who are involved in superstitious behaviors of contact with the animal. The third chapter used a conflict analysis framework to understand the scenario involving the destruction of beehives by giant armadillos in apiaries in the Cerrado of Mato do Grosso Sul and the eventual retaliation of beekeepers. The analysis brought evidence that the conflict is associated with tangible factors (i.e., economic loss of beekeepers), not involving entrenched and conflicting values, beliefs and identities among the actors involved. This suggests that the implementation of damage mitigation strategies (e.g., reducing the vulnerability of hives) may improve the relationship between beekeepers and giant armadillos. Investigations with interdisciplinary and integrative approaches that bring Science and practice closer together are more likely to be implemented and can effectively contribute to the persistence of wildlife in a socially just manner.

Keywords: conflict analysis, human-wildlife interactions, research-implementation gap, wildlife-vehicular-collisions, superstitions.

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INTRODUÇÃO GERAL

As Ciências Naturais vinham, até recentemente, sendo consideradas a principal – e por vezes, única - fonte de informação para orientar as ações conservacionistas (Bennett *et al.*, 2017). De fato, a compreensão da biologia das espécies e dos hábitats é essencial ao sucesso da conservação. Por si só, todavia, não é suficiente, já que tudo nesse campo que não é exclusivamente sobre as espécies ou sobre o hábitat envolve pessoas (Decker *et al.*, 2012). Já nos anos 1930, Aldo Leopold observou que as pessoas são a variável mais importante na equação da conservação e manejo da vida selvagem. Desde então, pouco a pouco, conservacionistas têm tomado consciência de que as pessoas e a vida silvestre se afetam mutuamente em sistemas socioculturais e ecológicos complexos (Decker *et al.*, 2012). Assim, conservar a vida silvestre requer também informações e conhecimento a respeito das relações entre esses dois componentes, domínio que, usualmente, se intitula interações humano-fauna.

Contudo, essa temática ainda está altamente dispersa na literatura. De fato, uma diversidade de campos acadêmicos abordam tais interações e, dado que derivam de diferentes tradições intelectuais (variando da Psicologia à Literatura e Ecologia), diferem em termos de seus paradigmas, metodologias, e questões de pesquisa (DeMello, 2012). Em estudo recente, foram identificados 27 campos que investigam as interações humano-fauna não-materiais (*ver* Echeverri *et al.* (2018). Dentre esses referenciais teóricos, está o campo das Dimensões Humanas da Vida Silvestre (em inglês, Human Dimensions of Wildlife – HDW), o qual emergiu da tradição intelectual do Manejo de Vida Silvestre (Manfredo, 2008). Tal área de pesquisa utiliza o arcabouço teórico e metodológico das Ciências Sociais para investigar crenças, nível de conhecimento, atitudes, percepções, intenções comportamentais e comportamentos das pessoas em relação à vida silvestre (Bath, 1998). Para tal, parte da premissa de que tais fatores podem ser mensurados e quantificados (Echeverri *et al.*, 2018). O principal papel dessa área tem sido contribuir com conhecimentos sobre a natureza, extensão e implicações das interações humano-fauna, auxiliando no planejamento e direcionamento de estratégias aplicadas à conservação e gestão da vida silvestre (Manfredo, 2008).

Este estudo adotou a abordagem das Dimensões Humanas da Vida Silvestre para investigar interações entre humanos e duas espécies de Xenarthra: o tamanduá-bandeira (*Myrmecophaga tridactyla*) e o tatu-canastra (*Priodontes maximus*). As populações de ambas as espécies vêm sofrendo severa redução, com diversos eventos de extinções locais e regionais (Anacleto *et al.*, 2014; Miranda, F. *et al.*, 2014). De acordo com a última avaliação da Lista Vermelha de Espécies Ameaçadas da IUCN (Anacleto *et al.*, 2014; Miranda, F. *et al.*, 2014), bem como do Livro Vermelho da Fauna Brasileira Ameaçada de Extinção, ambas são classificadas como Vulneráveis (VU) (Chiarello *et al.*, 2015; Miranda, F. R. *et al.*, 2014). Suas

populações em vida livre estão sujeitas a uma série de ameaças, incluindo perda e degradação de habitat, queimadas, colisões veiculares, caça e perseguição (Chiarello *et al.*, 2015; Miranda, F. R. *et al.*, 2014). Por sua vez, todas essas ameaças têm algo em comum: são decorrentes do comportamento das pessoas. Apesar de estratégias de conservação dependerem da identificação clara da natureza das ameaças a fim de orientar diretrizes para seu enfrentamento, poucos estudos exploraram os motivadores subjacentes aos comportamentos humanos que afetam negativamente essas duas espécies.

Assim, o objetivo central desta tese foi investigar três tipos de interações entre as pessoas e essas duas espécies, buscando compreender o contexto em que ocorrem e suas implicações para a conservação desses animais e para os atores envolvidos nessas relações. O contexto inclui fatores psicológicos, culturais e econômicos. As implicações abrangem o risco à segurança, ao bem-estar psicológico e à subsistência dos atores envolvidos e, para as espécies, a perda de indivíduos. Foram apresentadas, ao final de cada capítulo, sugestões para o direcionamento de estratégias que melhorem a coexistência das pessoas com esses animais.

A tese está estruturada em três capítulos autocontidos, ou seja, cada qual com Introdução, Metodologia e Discussão própria, a fim de facilitar a redação de artigos para posterior publicação. O primeiro capítulo da tese aborda as colisões veiculares com a fauna, uma das maiores ameaças ao tamanduá-bandeira no Mato Grosso do Sul. O principal objetivo deste capítulo foi identificar os fatores psicológicos que afetam a probabilidade de colisões entre caminhoneiros e diferentes animais nas rodovias. No segundo capítulo, investigaram-se os determinantes e as implicações das superstições de mau-agouro para a conservação do tamanduá-bandeira no Pantanal sul-mato-grossense. O terceiro capítulo utilizou um *framework* de análise de conflito com vistas a obter uma compreensão mais aprofundada do cenário envolvendo a destruição de colmeias por tatus-canastra em apiários do Cerrado do Mato do Grosso Sul.

A escolha das interações abordadas na presente tese justifica-se em termos de políticas de conservação, por serem duas espécies ameaçadas com populações em declínio, mas também por razões científicas e pragmáticas. Científicas, pois sua compreensão teórica pode auxiliar na lacuna de conhecimento existente sobre tais temáticas no campo das Dimensões Humanas da Vida Silvestre, o que se discute mais a fundo em cada um dos capítulos. Além disso, fornecem informações que podem ser relevantes à conservação de outras espécies envolvidas nesses tipos de interações.

Em termos pragmáticos, tal escolha justifica-se pela parceria da pesquisadora com o Instituto de Conservação de Animais Silvestres (ICAS), uma organização não-governamental que atua no Mato Grosso do Sul e foca seus esforços na conservação dessas duas espécies. Tal aproximação da academia com a prática do terceiro setor é importante, por ao menos três

aspectos. Primeiro, a aproximação garantiu que as pesquisas aqui descritas fossem relevantes para as necessidades identificadas pelos conservacionistas que trabalham em campo com essas espécies. A importância desse aspecto já foi mencionada em workshops e estudos que discorreram sobre a audiência da literatura científica em conservação (*ver* Milner-Gulland *et al.* (2010). Segundo, a proximidade ajuda a evitar que a alocação de recursos limitados das organizações de conservação seja realizada sem embasamento científico. Por fim, tal aproximação possibilitará que os achados desta pesquisa não se limitem ao âmbito teórico, facilitando o preenchimento da lacuna existente entre a pesquisa e a implementação.

Assim, atendendo ao apelo da Academia por abordagens que estreitem os laços entre pesquisadores, planejadores e tomadores de decisão (ex. Gossa *et al*., 2015; Bertuol-Garcia *et al*., 2018; Marchini *et al*., 2019; Bertuol-Garcia *et al*., 2020; Ferraz *et al*., 2020), o referencial de Dimensões Humanas, aliado ao esforço colaborativo com o terceiro setor, ampliam o potencial de que os resultados aqui obtidos se traduzam em ações para melhorar efetivamente a relação das pessoas com as espécies-foco do estudo.

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CHAPTER 1

To hit or not to hit: the psychological dimensions of wildlife-truck collisions

Mariana L. Catapani, Freya A. V. St. John, Arnaud L. J. Desbiez & Carla Morsello

Abstract

Prior studies on animal roadkills have investigated mainly biophysical factors, whereas little attention has been paid to whether and how human factors – e.g., a driver's behaviour and its psychological determinants - affect the likelihood of collisions. Despite that, mitigating wildlife-vehicle collisions (WVC) may be accomplished by both influencing the behaviour of wildlife species and of drivers. Understanding what influences a driver's likelihood of hitting an animal is, therefore, essential before seeking to influence his/her behaviour. Thus, in this study, we identified which psychological factors affected the likelihood of WVC. To do so, we investigated hypothetical scenarios when three taxa appeared on a road: giant anteaters, armadillos and snakes. We interviewed 230 truck drivers at three highways of Mato Grosso do Sul, Brazil, adopting a mixed-method design in two phases: (i) semistructured and (ii) structured face-to-face interviews. Using NVivo software, we then analysed qualitative data with Template Analysis (TA). TA results indicated truck drivers' intention of hitting animals was associated with five factors: (1) general attitudes towards species; (2) attitudes towards hitting the species; (3) feelings of guilt and sorrow; (4) risk perception of hitting and (5) risk perception of avoidance reaction. With TA results, we designed a structured protocol to evaluate whether explanatory variables (the five themes) correlated with the response "intention of hitting". We firstly ran Exploratory Factor Analysis to identify dimensions underlying psychological correlates of "intention of hitting". After this, we ran Generalized Ordered Logit Regressions Models. Three dimensions influencing "intention of hitting" were identified and evaluated (i.e., "Attitudes", “Risk perception of hitting”, and “Risk perception of avoidance behaviours”). “Attitudes” (a driver’s tendency to think, feel, and act towards the taxon) were an important predictor of the frequency of hitting snakes, but not for giant anteaters and armadillos. This means, despite driver’s awareness of WVC threats and appreciation for the last two species, they would likely hit animals on the road for safety reasons. Therefore, mitigation measures are bound to fail if they try to avoid collisions by fostering positive attitudes towards wildlife. Design of conservation interventions need to acknowledge that WVC has negative impacts on both wildlife and drivers (economical, physical and psychological) and drivers are unlikely to avoid collisions with animals if this threatens more human safety. Arguments about the importance of reducing animals killed on roads can be perceived as

ethically biased which may cause low adhesion from drivers who may feel neglected. Thus, conservationists are more likely to reduce animal roadkill when they also address drivers' concerns.

1. Introduction

Roads are fundamental infrastructures for human societies, despite their concurrent adverse impacts on both people and biodiversity (Benítez-López *et al.*, 2010; Laurance *et al.*, 2009; Mumme *et al.*, 2000). An important driver of negative impacts is wildlife-vehicular collisions (WVC), which currently threaten several wildlife species (Gibbs; Shriver, 2002; Hels; Buchwald, 2001; Mumme *et al.*, 2000; Trombulak; Frissell, 2000), in addition to injuring numerous people and creating substantial repair costs (Abra *et al.*, 2019; Conover *et al.*, 1995). Reducing WVC is, therefore, vital for both wildlife and people.

Understanding the causes of WVC is crucial for devising appropriate management strategies. Current evidence shows that WVC rates are influenced by spatial landscape patterns (Ascensão *et al.*, 2017; Ascensão *et al.*, 2019), road traffic (Drews, 1995), road configuration (Forman; Alexander, 1998), seasonal patterns (Sadleir; Linklater, 2016) and species behaviour (Lima *et al.*, 2015). However, most research has focused on biophysical factors, with little attention given to the human dimension including driver's behaviour and how psychological determinants of their behaviour may affect the likelihood of collisions. Reduced WVC may be accomplished by both influencing the behaviour of wildlife species nearby roads (e.g. fencing, overpasses/underpasses, olfactory repellents) (Glista *et al.*, 2009), and by influencing driver's behaviour (e.g. lowering speed limits, warning signs, education and awareness campaigns). Understanding what influences a driver's likelihood of hitting an animal is, therefore, essential before seeking to influence his/her behaviour.

The reaction of a driver towards an imminent collision with an animal on the road may affect the animal's susceptibility to being hit. Models of decision making developed in Psychology can help to better understand the decisions taken by drivers when faced by imminent collisions. A first approach suggests that the briefness of emergencies, as in imminent collisions, may imply the driver cannot consciously choose what to do. Therefore, he/she needs to rely solely on primary reflexes or to use an intuitive (heuristic) approach (Kahneman, 2003). If so, we should expect all drivers to act equally (Muttart, 2005). While this view provides an important theoretical foundation for understanding certain nuances of drivers' responses, it probably does not represent the whole picture.

A second approach is founded on deliberate reasoning. This approach suggests that to avoid an imminent collision, drivers engage in complex decision-making, weighing up the animal's expected and actual behaviours (Lee *et al*., 2010), his/her action possibilities (Dilich *et al*., 2002), and the consequences they expect from their choice based on experience. Because this approach assumes the driver has a choice in how to respond, a body of research focusing on decision-making under stress and uncertainty may help to clarify what influences this decision-making process (Malaterre *et al*., 1988). This body of research suggests that a driver's decisions regarding vehicle manoeuvres are largely a function of the risk they perceive in the situation (Colbourn, 1978). Consequently, what determines whether a driver hits an animal or not, would be his/her comparative perception of the risks involved between two options.

The third approach is based on cognitive appraisal theories. These approaches consider that a driver's reactions to different *stimuli* while driving a vehicle is influenced by feelings and emotions (Groeger, 2013; Harris; Nass, 2011). In specific situations, emotions influence cognitive processing mechanisms and guide action decisions (Pêcher *et al*., 2009). For example, having a fear of snakes is noted throughout the literature (Murray; Foote, 1979; Özel *et al*., 2009) and can elicit quick negative emotional responses to the presence of a snake (Dimberg; Thunberg (1998). Consequently, certain drivers are likely to run over snakes at greater than random frequencies (Langley *et al*., 1989). Indeed, experiments conducted in the United States, Canada, and Brazil using animal dolls indicated snakes and turtles were intentionally hit by drivers (Langley *et al*., 1989; Paul Ashley *et al*., 2007; Secco *et al*., 2014). Although previous studies have suggested that drivers' perceptions and attitudes toward WVC (i.e. feelings of favour or disfavour) may vary by species (Crawford, B. A.; Andrews, 2016; Kioko *et al*., 2015) and explain why some taxa are at greater risk than others on roads (Kioko *et al*., 2015; Paul Ashley *et al*., 2007; Tucker *et al*., 2015), more evidence is needed to understand if drivers' attitudes towards hitting specific species when driving are proxies of driver behaviour.

Assessing a driver's actual behaviour is challenging. Several publications on traffic safety, for example, use driver's self-reported intention to predict how drivers will behave under given circumstances (e.g. Aghamolaei *et al*. (2013). In Social Psychology, a person's behavioural intention is considered to be the most proximal antecedent of behaviour. It is defined as a person's estimate of his/her likelihood of performing a given behaviour (Fishbein; Ajzen, 2011). In the context of WVC, this implies that the higher a person's perceived probability of hitting an animal whilst driving, the greater the likelihood that this behaviour will actually occur.

Assessing drivers' behavioural intentions when encountering different taxa on roads has the potential to enhance our ability to predict the frequency of taxa-specific WVC (Crawford, B. A.; Andrews, 2016) and to develop management strategies aimed at influencing driver behaviour. However, successfully influencing human behaviour depends on the correct diagnosis of behavioural predictors (St John *et al.*, 2010; Vlek; Steg, 2007). Yet, to our knowledge, no prior studies investigated the psychological correlates of drivers' behavioural choices in the WVC domain.

In this study, we aimed to identify which psychological factors affected the likelihood of collisions between truck drivers and animals on roads in the Mato Grosso do Sul state, Brazil. Specifically, we wanted to investigate hypothetical scenarios when three taxa appeared on a road: giant anteaters (*Myrmecophaga tridactyla*), armadillos (in general) and snakes (in general). These taxa were chosen because, first, they were among the most frequently killed animals on the roads of Mato Grosso do Sul state according to a dataset from the Anteaters and Highways Project (www.giantanteaters.org). Second, there were *ad hoc* suggestions that the following negative perceptions towards these animals could explain higher death rates to WVC. According to some locals, giant anteaters are perceived to bring bad luck (Bertassoni, 2012) potentially explaining why drivers might hit them on purpose. Further, some view armadillos as pests because of the relatively high abundance of certain species (e.g. six-banded armadillos *Euphractus sexcinctus*), while snakes often awaken people's fear. Understanding psychological factors underpinning WVC will assist in the development of more effective management strategies. We focused on truck drivers since they are the main users of highways in the study area and experienced drivers as well as key stakeholders in efforts to reduce WVC.

2. Methods

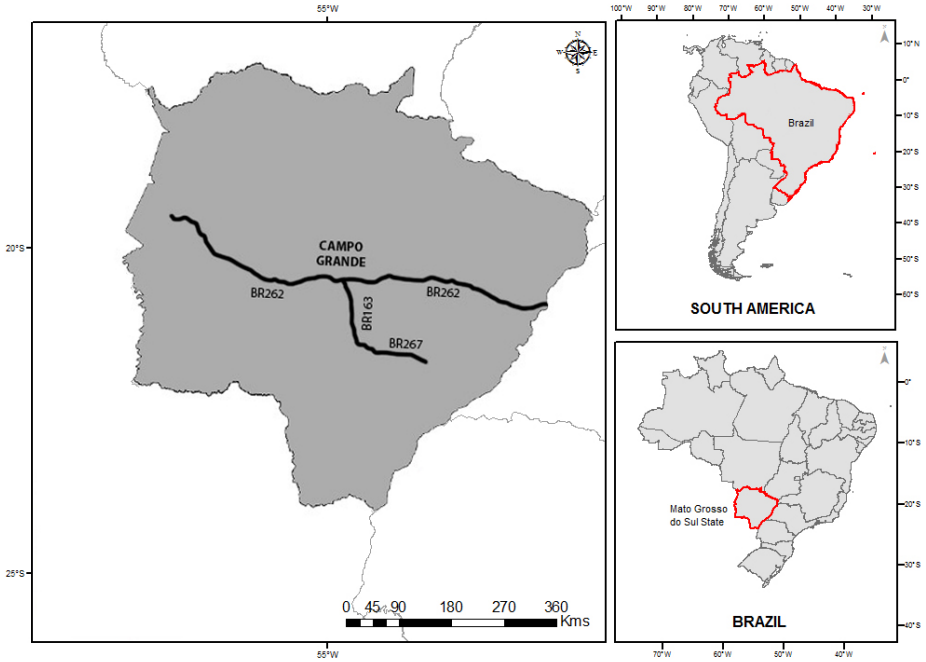
2.1. Study area

Our study was conducted in Mato Grosso do Sul (MS), a 357,145 km² Brazilian state inhabited by ~2.44 million people, 36.95% of which live in rural areas (IBGE, 2010). Throughout MS, the climate is tropical (Koppen's Aw), with marked wet (October-March) and dry (April-September) seasons. The state economy relies substantially on agriculture, which accounts for 30% of the state's Gross Domestic Product (IBGE, 2017). Infrastructure and geographical location explain why MS is a product redistribution hub from large Brazilian centres to the country's Midwest and Northern regions. Local road density is 0.17 km –2, of which ~13% are two-lane paved roads (www.dnit.gov.br, accessed 07/Aug/2018) and the road

network is responsible for high rates of wildlife mortality due to vehicle collisions (Ascensão *et al*., 2017; Ascensão *et al*., 2019; Fischer, 1997).

We collected data from truck drivers at rest and unloading areas of the three main state highways (BR262, BR163 and BR267, **Figure 1**), which were bordered by lands covered mainly with pastures and agriculture, remaining native vegetation, and a few urban areas (*see Ascensão et al. 2019 for an in-depth description of the study landscape*).

Figure 1. Location of Mato Grosso do Sul roads where data were collected



2.2. Data collection

We adopted a mixed-method design in two phases. Initially, we conducted ten informal interviews with truck drivers to understand their daily work dynamics (e.g., stop times for food and resting). Subsequently, we used semi-structured interviews (Newing, 2010) which utilised an interview script (Supplementary Material 1) to obtain information on truck drivers': (i) general relationship with roads; (ii) views towards WVC; and (iii) factors that affected their decisions or reactions when an animal appeared on the road. Respondents were selected, in this phase, through convenience sampling therefore their views cannot be assumed to be representative of the wider study population (Trochim; Donnelly, 2001). However, data collection during this phase continued until theoretical saturation was reached (Gentles *et al.*, 2015). To increase the likelihood that truck drivers would have time to participate, interviews were conducted at medium to long-term rest and unloading areas (e.g. gas stations, overnight parking and freight companies).

The interview was introduced to drivers as focusing on their relationship with the highway. We took handwritten notes instead of recording interviews to minimise potential embarrassment (Lincoln; Guba, 1985) or reservations over discussing colliding with animals on the highway. Notes were reviewed immediately after each interview while registering overall impressions (Bernard, 2006). Semi-structured interviews were completed between MLC and 82 truck drivers between 6 am - 9 pm, from June-August 2018. On average, interviews lasted 60 minutes (range= 40-120 minutes).

All interview notes were digitalised and Template Analysis (TA), implemented in NVivo® v.11., used to identify potential psychological factors associated with truck drivers' intention to hit animals on roads. Template Analysis is a systematic approach used to elicit underlying causes of human actions in qualitative studies, based on identifying, selecting, and encoding data hierarchically to organize them into analytical themes (Brooks *et al.*, 2015; King, 2012). The final template analysis (Supplementary Material 2) included five top-level themes associated with the intention to hit animals on roads: (1) general attitudes towards species; (2) attitudes towards hitting the species; (3) feelings of guilt and sorrow; (4) risk perception of hitting (encompassing risk to personal safety and concerns with truck damages); (5) risk perception of avoidance reaction (i.e. breaking or swerving which encompasses risk to personal and to other people's safety).

Based on the TA, we designed a structured questionnaire to evaluate how: (i) explanatory variables (the five themes measured through psychometric scales) related to (ii) intention to hit wildlife on roads. Regarding (ii), a note is needed. Our usage of the term 'intention to hit' does not imply that truck drivers intentionally manoeuvre their vehicles to purposefully hit an animal. Instead, it refers to 'behavioural intention' which is the subjective probability of performing a behaviour and follows the usage of terms in Social Psychology literature.

Because our estimates of 'intention to hit' could be affected by other factors, such as driver's speed, time of the day and road attributes, we presented drivers with a hypothetical scenario with fixed characteristics. Drivers were prompted to imagine they were driving their truck at the maximum speed allowed (i.e. 80 km/h), during the daytime, on the highway where we were meeting. Under these conditions, we enquired how likely it would be that they might hit (1) giant anteaters, (2) armadillos and (3) snakes. Data were collected on a six-point scale (1=definitely I would not hit, 6=definitely I would hit). We used 20 statements to measure the five themes identified via TA and hypothesised to influence 'intention to hit'; statements were repeated for the three taxa with data recorded on a five-point scales (**Table 1**).

The questionnaire was administered through face-to-face interviews following pre-testing with 21 truck drivers to (i) identify problems in understanding of questions and answers

formats, and (ii) test the internal validity and reliability of response scales and variable domains. To identify participants, we first identified all the resting and unloading points on the three main MS roads, we then randomly selected one point per road. After this, from October-November 2018, one out of every three truck drivers entering the selected points were approached between 5-12 am or 1-8 pm of alternate days. Interviews were completed in private with MLC. All parts of the study were approved by the Research Ethics Committee from the Brazilian National Commission for Research Ethics (CAAE nº 2.530.324). Free prior informed consent was obtained before interview or questionnaire completion and all participants have assured anonymity.

2.3. Data Analyses

We examined the internal consistency of the six scales used to measure intention to hit the three taxa and its predictors with Cronbach's Alpha reliability coefficient (Cronbach, 1951), considering 0.7 as the threshold (higher values imply greater reliability) (Nunnally, 1978).

In the qualitative phase, truck drivers mentioned three possible reactions when encountering animals on roads: hit/collide with animals, break, or swerve to avoid collisions (hereafter, the last two are "avoidance behaviours"). We compared, for the three taxa: (i) risk perceptions of hitting with that of avoidance behaviours, using Wilcoxon test; (ii) drivers' intention to hit, using the non-parametric Friedman test and post hoc Dunn's test for each pairwise comparison.

Exploratory Factor Analysis using Principal Axis Factoring (PAF) with oblique rotation (Field, 2013) was used to identify the dimensional structure of psychological determinants of "intention to hit". PAF offers a parsimonious representation of observed correlations between variables by latent factors. We retained factors based on both scree plot inspection (Cattell, 1966) and when the factors explained at least 80% of the total variance (Stevens, 2012). After this, to investigate the influence of the psychological dimensions obtained through PAF on a drivers' intention to hit each of the three taxa (response variables), we ran Generalised Ordered Logit Regressions Models (GOLRM) because our response variable was ordinal. We used the Stata ® 13.1 *gologit2* package and followed methods developed by Williams (2018). Because the GOLRM relaxes the proportionality of odds assumption (i.e., the equality of the log-odds across different cut points – categories – of the outcome variable), we used the autofit command option. Thus, the coefficients of variables for which the proportional assumptions are met were constrained, so there is just a single coefficient for each predictor, while the coefficients of the variables were allowed to vary when the premise of proportionality was not met (Agga; Scott, 2015). In this case, the GOLRM compares all the categories greater than the current category to those less than or equal to the current category (McCullagh, 1980).

3. Results

Except for one woman, almost all of 117 respondents were men averaging 46 y.o. (SD±9.9) and 20 years (SD=±10) of driving experience; most were self-employed (52.1%, n=61) other were employees (47,9%, n=56).

Intention to hit was high across all taxa (**Figure 2**) and differed statistically by taxa ($\chi2(2) = 54.568$, $p < .001$). Post hoc analysis revealed that drivers' intention to hit snakes (H=2.21, $p < .001$) was higher than the intention to hit giant anteaters (H=1.65, $p < .001$) and intention to hit armadillos (H=2.14, $p < .001$) was higher than the intention to hit giant anteaters.

The reason why drivers reported high intention to hit aligns with their risk perceptions. When comparing perceptions about the risk of avoiding collision with an animal on the road compared to hitting an animal (Wilcoxon test), taking action to avoid a collision was considered significantly riskier for snakes, armadillos and giant anteaters (23.2, 16 and 2.7 times higher, respectively). Moreover, the same applied when we enquired about the personal risk to the interviewee (snakes: Z=- 9.448; giant anteaters: Z=- 8,858; armadillos: Z=- 9.441; for all $p \leqq .001$), or to other drivers (snakes: Z = - 9.520; giant anteaters: Z = - 9,048; armadillos: Z = - 9.500; for all $p \leqq .001$).

Psychological factors predicting the intention of hitting

Results of the Exploratory Factor Analysis indicated that the five themes identified in the qualitative phase were explained by three factors. The first factor (Attitudes) consisted of three variables: attitudes towards species, attitudes toward roadkill and guilt/sorrow for hitting. The second (Risk of avoidance) consisted of risk perception of avoidance behaviours, including risk to self and to other drivers while the third (Risk of hitting) included perceived risk to self and to the truck of hitting an animal. Together, these three factors explained 91% of the variance among in the data for snakes, 81% for giant anteaters, and 87% for armadillos (**Table 2**).

Proportionality of the odds assumption was violated only in the "Attitudes" factor for armadillos ($p = 0.022$). Thus, using the partially constrained regression of the GOLRM (P.P.O), constraints were not imposed and were allowed to vary by the outcome categories in this factor. For all factors involving snakes (Attitudes p=0.314; Risk of avoidance p= 0.148; Risk of hitting p= 0.071) and giant anteaters (Attitudes p=0.558; Risk of avoidance p=0.055; Risk of hitting p=0.053), the proportional odds (P.O) assumption was not violated, the same was true for "Risk of avoidance" (p=0.095) and "Risk of hitting" (p=0.065) for armadillos.

For the six categories of the response variable (i.e. intention of hitting), five regression equations were fitted. For giant anteaters and snakes, as all variables met the proportional odds

assumptions, the odds-ratios and Beta coefficients across all the five regression equations are assumed to be constant. However, for armadillos, the only explanatory variable that violated the parallel regression assumptions, i.e., ‘Attitudes', those values were allowed to vary across the five regressions equations (**Table 3**).

Across all taxa, “Risk of hitting” was significantly and negatively associated with “Intention to Hit” (Snakes: Prop OR = 0.55; Giant anteaters Prop OR = 1.63; Armadillos Prop OR = 0.78); as the perceived risk of hitting an animal increased, intention to hit decreased. For all taxa, “Risk of avoidance” was positively and significantly associated (Snakes: Prop OR = 1.84; Giant anteaters Prop OR = 0.68; Armadillos Prop OR = 1.76) with “Intention to hit”. As the risk of swerving or breaking to avoid collisions increased, so did intention to hit these animals. In contrast, “Attitude” was not significantly correlated with the intention of hitting giant anteaters. For snakes, "Attitude” was significantly and negatively related to intention to hit; as feelings of disfavour towards snakes increased, so did drivers’ intention to hit them. For armadillos, “Attitudes” violated the proportional odds assumptions, so coefficients were allowed to vary across cut-off points of the response variable. One of the five resulting regressions was significant showing that, as for snakes, “Attitudes” were negatively related to intention to hit (Prop OR = 0.05). Attitudes towards giant anteaters were not significantly related to intention to hit.

Table 1. Descriptive statistics of variables and related statements included in Factor Analysis (explanatory variables) and "intention of hitting" the three species (response variables)

Variable / Statements						
	Mean ± SD	**Median**	**Mean ± SD**	**Median**	**Mean ± SD**	**Median**
1) Attitudes toward species (-2 to +2) a	**0.43 ± 1.1**	0.6	**1.48 ± 0.8**	1.8	**1.27 ± 0.8**	1.7
[ANIMAL] commonly disturb people.	0.44 ± 1.5	1.0	1.60 + 0.9	2.0	1.50 ± 1.1	2.0
Overall, I care a lot about [ANIMAL].	0.42 ± 1.6	1.0	1.30 ± 1.1	2.0	1.52 ± 1.0	2.0
I would be happy if no [ANIMAL] existed.	0.49 ± 1.5	1.0	1.30 ± 1.0	2.0	0.91 ± 1.2	2.0
The [ANIMAL] has its value, even if it does not have any advantage to me.	1.10 ± 1.3	2.0	1.40± 0.9	2.0	1.32 ± 1.0	2.0
[ANIMAL] deserve to be protected.	1.00 ± 1.4	2.0	1.70 ± 0.7	2.0	1.51 ± 0.9	2.0
Snakes are treacherous.	-'0.86 ± 1.3	-1.0	n.a.		n.a.	
Giant anteaters bring bad luck.	n.a.		1.50 ± 1.0	2.0	n.a.	
Armadillos are pest species.	n.a.		n.a.		1.21 ± 1.2	2.0
Cronbach alpha	0.90		0.89		0.89	
2) Attitudes toward hitting animals (-2 to + 2) b	**-0.55 ± 1.5**	-1.0	**-1.49 ± 0.8**	-2.0	**-1.24 ± 1.0**	-1.7
If the next time an [ANIMAL] shows up on the track, I run over it, that's ok because there are many of them.	-0.81 ± 1.6	-2.0	-1.75 ± 0.8	-2.0	-1.58 ± 1.0	-2.0
The run over of [ANIMAL] is a serious threat to the survival of these animals.	-0.63 ± 1.6	-2.0	-1.70 ± 0.8	-2.0	-1.52 ± 1.0	-2.0
If the next time an [ANIMAL] shows up on the track. I run over it, that's a favour I'm doing because it could disturb someone.	-0.44 ± 1.7	-1.0	-1.35 ± 0.8	-2.0	-0.97 ± 1.5	-2.0
It is a shame [ANIMAL] are being run over.	-0.33 ± 1.7	0	-1.17 ± 1.3	-2.0	-0.92 ± 1.4	-2.0
Cronbach alpha	0.91		0.80		0.83	
3) Guilt /sorrow of hitting animals (-2 to +2) c	**0.39 ± 1.6**	1.0	**0.97 ± 1.3**	1.7	**0.75 ± 1.5**	1.7
I would feel guilty if I run over [ANIMAL]	0.17 ± 1.7	1.0	0.55 ± 1.6	1.0	0.41 ± 1.6	1.0
If I run over an [ANIMAL], it doesn't even cross my mind that I could have done something to prevent it.	0.35 ± 1.7	1.0	1.00 ± 1.5	2.0	0.76 ± 1.6	2.0
If the next time an [ANIMAL] shows up on the track, I run over it, I would feel sorry for the animal.	0.52 ± 1.7	1.0	1.02 ± 1.4	2.0	0.85 ± 1.5	2.0
If the next time an [ANIMAL] shows up on the track, I run over it, I would feel as if nothing happened.	0.53 ± 1.6	1	1.32 ± 1.2	2.0	0.98 ± 1.5	2.0
Cronbach alpha	0.94		0.90		0.92	
4) Risk perception of hitting (1 to 5) d	**0.22 ± 0.8**	0	**2.74 ± 1.1**	2.5	**0.32 ± 0.8**	0
If an [ANIMAL] appears on the track, if you hold the wheel firmly and hit it, how dangerous would you consider it to you?	0.22 ± 0.8	0	1.89 ± 1.5	2.0	0.32 ± 0.8	0
If an [ANIMAL] appears on the track, if you hold the wheel firmly and hit it, how damaged would be your truck?	0.31 ± 1.0	0	3.60 ± 1.4	0	0.28 ± 0.8	4.0
Cronbach alpha	0.70		0.70		0.75	
5) Risk perception of the avoidance behaviours (1 to 5) e	**5.6± 0.5**	5.7	**5.6± 0.5**	5.7	**5.6± 0.5**	5.7
If an [ANIMAL] appears on the track and you try to dodge, how dangerous would you consider it to be to you?	5.69 ± 0.7	6.0	5.69 + 0.7	6.0	5.69 + 0.7	6.0
If an [ANIMAL] appears on the track and you try to break, how dangerous would you consider it to be to you?	5.36 ± 0.9	6.0	5.36 ± 0.9	6.0	5.36 ± 0.9	6.0
If an [ANIMAL] appears on the track and you try to dodge, how dangerous would you consider it to be to other drivers?	5.76 ± 0.5	6.0	5.76 ± 0.5	6.0	5.76 ± 0.5	6.0
If an [ANIMAL] appears on the track and you try to break, how dangerous would you consider it to be to other drivers?	5.54 ± 0.7	6.0	5.54 ± 0.7	6.0	5.54 ± 0.7	6.0
Cronbach alpha	0.71		0.71		0.71	
6) Intention of hitting (1 to 6) f	**4.67 ± 1.5**	5.0	**4.00 ± 1.5**	4.0	**4.51 ± 1.4**	4.5
The next time I'm driving appears an [ANIMAL]on the track I'll probably hit it.	4.76 ± 1.5	6.0	4.00 ± 1.5	4.0	4.60 ± 1.4	5.0
The next time I'm driving appears an [ANIMAL] on the track, I intend to hold on to the steering wheel and follow my path without trying to dodge or break, even hitting it.	4.59 ± 1.6	5.0	3.93 ± 1.7	4.0	4.42 ± 1.6	5.0
Cronbach alpha	0.83		0.81		0.84	

Notes: All item response scales ranged from: (a) -2 (most unfavourable) to 2 (most favourable); (b) -2 (most unfavourable to WVC) to 2 (most favourable to WVC); (c) -2 (low guilt/sorrow) to +2 (high guilt/sorrow); (d)(e) 1 (low perception) to 5 (high perception); (f) 1 (low probability) to 6 (high probability). n.a.= non applicable.

Figure 2. Truck driver's intention of hitting snakes, giant armadillos (*Myrmecophaga tridactyla*) and armadillos in a hypothetical scenario.

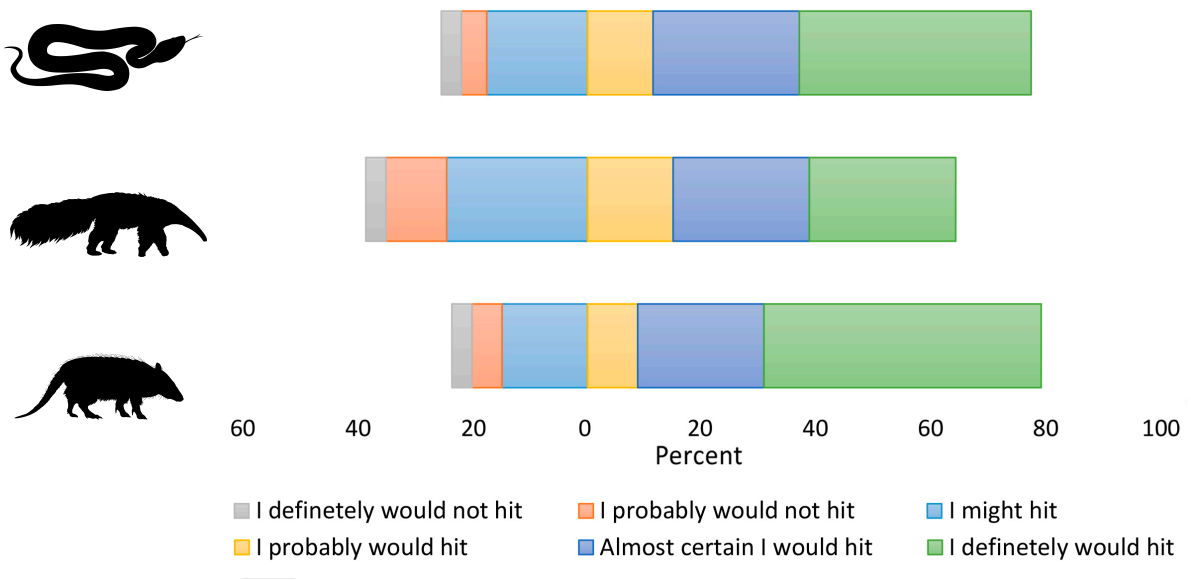


Table 2. Results of Exploratory Factor Analysis of psychological variables associated with the intention of hitting snakes, giant anteaters (*Myrmecophaga tridactyla*) and armadillos.

Variables	Factor loadings		
	Factor 1	**Factor 2**	**Factor 3**
			
Attitudes toward species	.925		
Attitudes toward hitting	-.945		
Sorrow/guilt	.889		
Risk perception - hitting			.996
Risk perception - avoidance behaviour		.998	
Eigenvalue	2.583	1.052	.930
% variance explained	51.6	21.0	18.6
			
Attitudes toward species	.829		
Attitudes toward hitting	-.834		
Sorrow/guilt	.796		
Risk perception - hitting			.837
Risk perception - avoidance behaviour		.811	
Eigenvalue	2.049	1.100	.938
% variance explained	40.9	21.9	18.7
			
Attitudes toward species	.878		
Attitudes toward hitting	-.905		
Sorrow/guilt	.865		
Risk perception - hitting			.999
Risk perception - avoidance behaviour		.996	
Eigenvalue	2.393	1.019	.955
% variance explained	47.8	20.3	19.0

Table 3. Results of Generalized Logistic Regressions (*Gologit2*) for the association between psychological factors and the intention of hitting three species.

Model	Animal	Variables	β Coefficient	Std. Err.	P>Z	Model Fit		
						LR Chi^2	*p*	Pseudo R2
1)		Risk of avoidance	0.61	0.179	.001*	37.47	0.000*	0.112
		Risk of hitting	-0.58	0.172	.001*			
		Attitudes	-0.64	0.205	.002*			
2)		Risk of avoidance	0.48	0.167	.023*	16.58	0.000*	0.043
		Risk of hitting	-0.37	0.173	.005*			
		Attitudes	-0.23	0.171	.163			
3)		Risk of avoidance	0.56	0.175	.001*	31.63	0.000*	0.089
		Risk of hitting	-0.25	0.167	.030*			
		Attitudes						
		5	-1.85	1.780	.299			
		4	-2.89	1.383	.037*			
		3	0.06	0.278	.808			
		2	0.56	0.175	.744			
		1	-0.40	0.197	.072			

Notes: We used proportional odds models (P.O) where variables met the proportional odds assumption and partial proportional odds models (P.P.O) if variables failed the proportional odds assumptions.
* Significant variables

4. Discussion

Our results show that in the event of an imminent wildlife collision, reactions of truck drivers can vary, but most would likely hit a snake, giant anteater or armadillo. The psychological dimensions underlying drivers' intention to hit animals on the road explained the prominence of risk in drivers' decision-making. Across the three taxa considered in this study, the influence of "Attitudes" on behavioural intention was weaker. Indeed, it was not related to drivers' intention to hit giant anteater. Our analyses revealed that positive attitudes towards a species, specifically giant anteaters and armadillos, do not necessarily translate into a lower probability of hitting them on the road. This important finding highlights that even drivers that have a positive predisposition towards certain animals, that associate guilt with WVC, and are aware that collisions threaten populations, believe that WVC are oftentimes inevitable – decision-making in the event of an imminent wildlife collision is driven by drivers' evaluation of risk.

In our study, drivers' perception of risk in an imminent collision was the crucial predictor of behavioural responses. Drivers' perceptions of risk have long been assumed to play an important role in guiding behaviour on the road (Charlton *et al.*, 2014) since there is an association between risk perception and risk behaviour (Li *et al.*, 2018). Harré (2000) reported

that drivers who perceived high risk in the road-environment would drive cautiously and avoid risks. Animals on the road can be a huge hazard for drivers, either due to the risk of impact, or the risk of attempting to avoid hitting an animal. We found that the perceived risk of both hitting and trying to avoid hitting animals were strong correlates of drivers' response when encountering any of the investigated taxa. In the US and Canada, 2.8-9.7% of reported deer-vehicle crashes resulted in human injuries (Huijser *et al.*, 2009), and in Europe, ungulates-vehicle collisions result in about 300 human fatalities and 30,000 human injuries per year (Bruinderink; Hazebroek, 1996). Although in South America little information is available on the risk that animal-vehicle collisions represent to human safety, a breakdown of São Paulo (Brazil) data made by Abra *et al.* (2019) revealed that between 2003 and 2013 there were 2,611 reported animal-vehicle crashes per year, of which 18.5% results in human injuries or fatalities. The risk associated with an animal-vehicle collision increases with the size of the animal. Some studies provide evidence that drivers are more likely to hit smaller animals since doing so is low risk and unlikely to cause significant damage to a vehicle (Kioko *et al.*, 2015; Rowden *et al.*, 2008). Our study corroborates this idea; drivers' risk perceptions of injury and truck damage (included in "Risk perception of hitting") increased with animal body mass. This observation may explain lower levels of intention to hit giant anteaters, which can weigh up to 30 kg, compared to snakes (usually less than 5 kg) and armadillos (usually less than 7 kg).

Beyond direct collisions between animals and vehicles, a substantial number of road incidents involve vehicles swerving to avoid animals and subsequently losing control and, on occasion, hitting oncoming vehicles (Conn *et al.*, 2004). Our analysis revealed that, for truck drivers, avoidance behaviours including braking and swerving were judged much riskier to themselves and other road users, than hitting any of the study species. According to the Centers for Disease Control and Prevention of the United States (2008), 44.8% of single-car accidents resulted from drivers trying to avoid hitting animals. Road manoeuvres, such as swerving, when done in small cars become increasingly dangerous when done in a 40-tonne truck typical of those driven by our participants. Trucks are wide, heavy vehicles that are difficult to manoeuvre quickly. Moreover, they have substantially longer stopping distances, for example, a small car might take 54 m to come to a full stop from an initial speed of 80 km/hour whereas a 40-tonne truck requires 119 m. Furthermore, if a truck's load is not positioned properly, load-movement can affect a driver's ability to maintain control. Given the potential consequences of an accident involving a 40-tonne truck, it is easy to appreciate why truck drivers prioritise minimising risk to themselves, their vehicles and other road users over avoiding hitting animals on the MS highways.

There is a notable variation in human preference toward certain species and groups of animals (Batt, 2009; Stokes, 2007) and a diversity of potential psychological and evolutionary

explanations for these preferences (see Kellert (1993); Kellert; Berry, 1980; Kellert; Wilson, 1995). In our study, this preference is captured by the "Attitudes" dimension, here referring to a driver's tendency to think, feel, and act positively or negatively toward the taxon in question. Our results indicated that truck drivers have more negative attitudes toward snakes and are less upset when hitting snakes than other taxa, as previously noted by (Crawford, Brian A. *et al.*, 2015) in a study that investigated drivers' attitudes toward wildlife-vehicle collisions. In contrast, Wolfe *et al.* (2019) found that urban Australian drivers held positive attitudes towards snakes, a high degree of concern for their welfare, and a high intention to rescue them from the road.

Our analysis showed that the "Attitudes" dimension was an important predictor of hypothetically hitting snakes. Truck drivers with negative attitudes towards snakes were more likely to report that they would hit a snake on the highway. We are unaware of other studies that have investigated the influence of attitudes on the intention of drivers to hit animals, but other work provides relevant insights. For example, in Australia, the cane toad (*Rhinella marina*) is considered an invasive species (Lever, 2001) and Beckmann & Shine (2012) verified through a survey with drivers that 25% of them reported intentionally targeting toads on roads, suggesting that this behaviour could be being motivated by the toads' perceived negative impacts on native fauna and domestic pets. Similarly, a study of college students in the US reported that 8% of students would deliberately hit a snake crossing the road when driving; authors suggested that snakes evoked this response due to people's fear and dislike of them (Langley *et al.*, 1989). Other authors who conducted experimental studies on intentional roadkill of snakes (see Langley *et al.*, 1989; Paul Ashley *et al.*, 2007; Secco *et al.*, 2014) propose this same hypothesis. Although in our study we have not specifically assessed the deliberate/purposeful hitting of snakes, the strong negative relationship between "Attitudes" and intention to hit suggests general dislike of snakes plays a part in drivers' decision-making. Although certain authors suggest educational programs addressing the value, usefulness and ecological role of snakes may help influence drivers' attitudes towards these animals (e.g. (Kioko *et al.*, 2015), improving factual knowledge does not necessarily increase positive attitudes, nor change behaviours toward snakes (Lahart, 1978; Tomažič, 2011). Educational and communication campaigns may benefit in exploring experiential and affect-based efforts, but currently, there is a need for information concerning how effective certain wildlife education approaches are in producing changes in people's psychological constructs (Dietz *et al.*, 2002).

5. Conservation Implications

There are many behavioural aspects to be explored in the WVC realm. Based on our results of the impact of psychological factors on the likelihood of collisions between truck drivers and animals we propose some recommendations for reducing WVC. First, our results indicated that even drivers who cared for particular animals, intended to hit them if they appeared on the road. Drivers' decision-making regarding an imminent wildlife collision was mostly driven by risk perception; they assessed the relative safety of hitting, compared to the dangers of avoiding an animal in the road. Thus, communication campaigns aiming to instil care or empathy for wildlife, as previously suggested (Crawford, B. A.; Andrews, 2016; Kioko *et al.*, 2015), are unlikely to reduce wildlife-truck collisions.

Some important ethical considerations should be highlighted at this juncture. Wildlife vehicular collisions negatively impact wildlife as well as drivers who might incur physical, psychological and economic costs as a result of an incident. Thus, conservationists may be more likely to reduce animal roadkill by addressing and showing concern towards all impacts of collisions including human safety, economic costs and not only biodiversity. One-sided campaigns promoting the importance of reducing roadkill are unlikely to secure widespread compliance amongst truck drivers who, as an unintended consequence of such campaigns, are likely to feel that the wellbeing of wildlife is considered a higher priority than their own currently neglected safety. Campaign messages should be carefully designed to gain support from the drivers. To this end, participatory approaches to campaign design based on tools of social marketing or science-based communication may have more potential to influence driver behaviour. Besides, citizen science programmes could also be explored as an avenue for engaging truck driver's participation in seeking solutions to decrease WVC. These approaches should focus on the human dimensions of WVC.

Whilst our study suggests that once animals are on the road, the most likely outcome is a collision, opportunities exist to explore behaviour approaches to reducing WVC. These include, for example, encouraging drivers to avoid night-time driving especially in WVC hotspots. According to data collected by the Anteaters & Highways project, most animals cross at night, dawn or dusk. This behavioural change could successfully reduce encounter rates of trucks and animals on roads. Similar approaches with the employers who dictate drivers' work regimes could also help to modify schedules and awareness. Whatever the behaviour one wants to influence, correct diagnosis is crucial, as well as the identification of motivations and barriers to change. Otherwise, efforts to encourage sustainable pro-conservation behaviours will struggle to succeed and scarce investments for conservation will be wasted.

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CHAPTER 2

From bad omen to persecution: Determinants and implications of giant anteaters' superstitions in the Brazilian Pantanal

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Abstract

Several animal species are threatened by bad omen superstitions. Even so, attention to such threat has been very low in human-wildlife studies. This potentially has negative consequences to the species involved, since decreasing the importance of wildlife superstitions may depend upon understanding how they are assimilated and disseminated. Our study relies on empirical data from giant anteaters in rural Brazilian Pantanal to provide support for three main issues. First, to assess the prevalence and detected specific superstitions beliefs and behaviours towards giant anteaters in our study area. Second, to compare the relative importance of sociodemographic, contextual and psychosocial factors in underpinning people's adherence to these beliefs. Last, to evaluate which are the main implications of holding superstitious beliefs to both the people who adhere to it and the species involved. We interviewed 283 rural inhabitants, adopting a mixed-method design in two phases: (i) semi-structured and (ii) structured face-to-face interviews. Results showed that giant anteaters perceived as a harbinger of bad luck is a common but not predominant belief in our study area and that superstitions vary in the circumstances in which they appear. Our regression analyses revealed that none of the individual characteristics (i.e. age, gender or schooling) evaluated explained holding the superstition, but that encountering giant anteaters more often makes a person less prone to hold superstitions about the species. Exploring the importance of psychosocial factors on superstitious beliefs about giant anteaters, we verified that although social influence matters, the key factor predicting people's adherence to superstitions is the low factual knowledge about the species. Regarding the implications of such beliefs, most of those who carried superstitions declared to be worried, distressed, and anxious when the trigger situations happened and about one-tenth declared their intention to hit giant anteaters' snouts to repel bad luck from happening. These behaviours may have negative implications for giant anteaters' wellbeing and conservation, but also expose people to the risk of injuries. Thus, we contend that reducing the importance of bad omen superstitions will likely benefit people, animals and species involved. We then suggest a few aspects that may contribute to conservation strategies for wildlife species associated with misfortune.

1. Introduction

Human evolution has been intrinsically associated with the exploitation of animal species, a relationship far more complex and multifaceted than food acquisition. In several cultures, human-wildlife interactions surpass material and utilitarian connections (Bakels *et al.*, 2016), encompassing broader symbolic levels (Bakels *et al.*, 2016), whether through religious and spiritual beliefs and practices (Bhagwat *et al.*, 2011) or moral codes (Jones *et al.*, 2008). Such cultural conceptions can either positively impact species and habitat conservation (Knight, 2000) when traditional beliefs reduce hunting or other killing pressures (Jones *et al.*, 2008). For instance, when species have mythological or symbolic importance that deters persecution (Allaby, 2010), or are subject to cultural protection via taboos, restrictions, or dietary avoidance (Ross *et al.*, 1978). However, cultural beliefs may also threaten biodiversity (Alves *et al.*, 2012), for example when animals or their parts are subject to religious practices (Waldau, 2006), or when thought to have healing, preventive or aphrodisiac properties (Djagoun *et al.*, 2013).

Recent research on human-wildlife interactions adopts multifaceted approaches to devise responses to wildlife threats ('t Sas-Rolfes *et al.*, 2019; Salazar *et al.*, 2019). Yet, wildlife cultural and symbolic dimensions have been little addressed, such as when a species is believed to harbing bad omen of sickness and death or, as usually named, superstition. Although definitions of superstitious beliefs vary in Psychology and Anthropology they share an underlying property: wrong causal reasoning, meaning the association of an effect to a cause even when the two events are independent (Delacroix; Guillard, 2008; Foster; Kokko, 2009; Kramer; Block, 2011).

Superstitions are abstract ideas but they often manifest in behaviours (Myers, 1999). When they induce persecutory behaviours (i.e., animal aggression or death), superstitions may threaten animal conservation. Such practice has already been described for reptiles (Ceríaco, 2012; Ceríaco *et al.*, 2011), owls (Mikkola, 2000), frogs (Tarrant *et al.*, 2016), hyenas (*Crocuta crocuta*) (Bohm; Höner, 2015), crows (*Corvus corax*) (Hagemeijer; Blair, 1997), bats (Prokop; Tunnicliffe, 2008; Schmidt, 1994), and giant anteaters (*Myrmecophaga tridactyla*) (Bertassoni, 2012; Gaudin *et al.*, 2018). For certain animals, superstitions can even be the main survival threat, as occurs with the aye-aye (*Daubentonia madagascariensis*), an endemic primate of Madagascar often associated with the harbinger of illness and death (Simons; Meyers, 2001). Even so, attention to such threats has been very low, with potentially negative consequences to the species involved, since decreasing the importance of wildlife superstitions may depend upon understanding how they are assimilated and disseminated.

Thus, this study was designed to provide empirical support for three particular issues. First, to identify which are the psychosocial factors driving superstitious beliefs about wildlife. Second, to compare the relative importance of sociodemographic, contextual and psychosocial factors in underpinning people's adherence to these beliefs. Third, to evaluate which are the main implications of holding superstitious beliefs to both the people who adhere to it and the species involved. Such information may allow conservationists to identify whether and how the evidence supporting such beliefs can be weakened, in addition to elucidating why weakening such cultural beliefs would be justified.

Below we introduce the reader to an overview of how Social Sciences' theories explain the emergence and diffusion of superstitions in a group. Thereafter, we focus on a study of superstition towards wildlife that seems ideal to accomplish our objectives.

Social Sciences lessons on the emergence and diffusion of superstitions

Contiguity, or the cognitive process of associating causes with effects, is the basis for the emergence of superstitious beliefs, according to a few authors (Devenport; Holloway, 1980; Gilovich *et al.*, 1985). A mechanism inherent to learning in both humans and other animals (Beck; Forstmeier, 2007), this cognitive process makes possible to predict results based on previous observations, and to influence or control events in the world around us (Lombard; Gärdenfors, 2017), therefore conferring adaptability to the environment (Steward, 1955). Yet, this process also makes us susceptible to illusory correlations, cognitive biases that may make us believe in non-existent causal correlations (Heider, 1944; Kahneman, 2011). Cognitive biases, such as this, are currently addressed by several research areas in the behavioural sciences. As for superstitions, two authors have made breakthrough contributions to our understanding of how superstitions arise: Skinner, a behavioural psychologist, and Malinowski, an anthropologist.

Skinner (1948) conducted a simple experiment: every 15 seconds, a device released food to pigeons, regardless of their actions or behaviours. After a few minutes, each bird developed a distinct ritual, which led Skinner to conclude that, for pigeons, there was a causal link between their behavioural rituals and the presentation of food. Following this line of thought, the author concluded that superstitions resulted from misleading interpretations of accidental contingencies. Skinner's observations, therefore, corroborated the Contiguity Theory (Guthrie, 1940), which previously postulated that the only necessary condition for the association of stimuli and responses was the existence of a close temporal relationship between them.

Despite Skinner's contributions, Malinowski (1948) was probably the most influential author for the construction of a theory of superstition, explaining its emergence in contexts of

uncertainty or risk. During his studies with the Trobriand Aborigines, the anthropologist noted that fishermen from coastal areas with calm waters, where the risks were low and the returns more consistent, tended to be less superstitious. Instead, fishermen from open seas, a context of greater variability and uncertainty in returns, became superstitious, following elaborate rituals that "would guarantee their success" in the fishery. According to Malinowski, uncertainties and risks would leverage the emergence of superstitions, an argument emphasised later by other authors (e.g. Irwin (2000); (Jahoda, 1970).

Malinowski and Skinner's studies contributed to our understanding, above all, of the likely mechanisms that originate individual superstitions. However, most wildlife-directed superstitions are inherited from a person's cultural tradition (Jarvis, 1980). In neglecting social variables, this approach is criticised by sociologists (Abercrombie *et al.*, 1970) for not providing an adequate model to explain how and why existing superstitions are disseminated (Vyse, 2013). In general, the diffusion of information in a group, as would be the case with the transmission of superstitious beliefs, relies on social networks (Diffusion of Innovation Theory, see: Rogers (2010), and depends on three interrelated factors: i) the nature of the idea to be transmitted, ii) the social network transmission, and iii) people's assimilation processes.

The transmission of superstitions depends firstly on the nature of the idea to be transmitted. Only "memorable" ideas, in psychological terms, are transmitted and achieve cultural success (Crandall; Schaller, 2004; Sperber, 1996). When beliefs and concepts violate ontological structures and are inconsistent with rationality, as with superstitious beliefs, their "optimal" position regarding memorability is to occupy an intermediate state concerning counterintuition (Boyer, 1992). This means these ideas/beliefs must have certain ontologically contradictory characteristics (i.e., something that contradicts "normality"), as this makes the concept more seductive and interesting, but without going beyond the limits of what is understandable to the human mind (i.e., not to overdo it with reality, like believing in flying dolphins) (Norenzayan; Atran, 2004; Norenzayan *et al.*, 2006). According to this reasoning, superstitious beliefs that span generations – e.g., crows and owls considered a harbinger of bad omen since the Greek and Roman periods (Galaty, 1998; Järvinen *et al.*, 1977) - or that reach wide spatial distribution – e.g., owls vocalization as a synonym of bad omen in Finland (Mikkola, 2000), Costa Rica (Alba-Zúñiga *et al.*, 2009), and Malawi (Enriquez; Mikkola, 1997) - can be considered memorable and have potential to perpetuate.

Second, transmission depends on the social process, which tends to be more effective when carried out by someone from one's same social network, especially when social ties are close and that person is considered important. Additionally, when the number of surrounding people who hold the information is large, new members are more likely to acquire a certain belief (Abrahamse; Steg, 2013) (*see* Theory of Social Impact (Latané, 1981).

Third, transmission depends on the assimilation of ideas, which does not always occur passively. People may selectively retain information according to what they consider as evidence to support such information (Norenzayan; Atran, 2004). Thus, once understood what people consider as evidence to support existing superstitious beliefs, conservationists may be able to understand what could be done to weaken these superstitions.

The giant anteater: an empirical case of superstition towards wildlife

To accomplish our objectives, this study relies on empirical data from giant anteaters in rural Brazilian Pantanal. Giant anteaters have a wide geographical distribution throughout Southern and Central America, excluding the Andean region (Wetzel, 1985). Despite its vast distribution, the species is classified as vulnerable both in the IUCN Red List of Threatened Species (Miranda, F. *et al.*, 2014) and the Brazilian Red List (Miranda, F. R. *et al.*, 2014).

Giant anteaters can reach two meters' length and 39 kg (Eisenberg; Redford, 1992; Wetzel, 1985). Animals have peculiar morphological characteristics: an elongated skull with small ears and eyes, a long snout with a tiny tubular mouth with no teeth (Shaw; Carter, 1980), dense coat covering the body and a long fringed tail, with front legs ending in three large claws (Emmons; Feer, 1997). There is no sexual dimorphism in the species, which mainly presents solitary habits, except for periods of parental and reproductive care (Nowak; Paradiso, 1983) and on rare encounters between females (Catapani *et al.*, 2019).

In some places of their distribution, giant anteaters symbolize bad luck (Bertassoni, 2012). In fact, persecution motivated by superstitions has been argued to threaten the species by some authors (e.g. (Bertassoni, 2012; Gaudin *et al.*, 2018), and reported in the Brazilian National Action Plan (ICMBio, 2019). To date, however, there is no study investigating the magnitude, determinants and impacts of superstitious beliefs towards giant anteaters. Thus, in addition to the three objectives mentioned above, we will explore the prevalence and detect specific superstitions beliefs and behaviours towards the species in our study area. Together, our four aims provide conservationists with clues on the need, guidance and ethics for informing potential conservation strategies for giant anteaters and other species involved in superstitions.

2. Methods

2.1. Study area and participants

The study took place in the southern portion of the Brazilian Pantanal, covering the administrative districts of Corumbá, Aquidauana and Miranda in Mato Grosso do Sul state (**Figure 1**). Covering ~200,000 km2 across the borders of Brazil, Bolivia and Paraguay, the Pantanal is the world's largest wetland (Coutinho *et al.*, 1994). The region is characterised by sandy soils with mosaic vegetation of semideciduous forests, dispersed shrub vegetation, and

seasonally flooded fields (Rodela, 2006). Every year many parts of the biome range change from terrestrial into aquatic habitats. During the dry season, most of these flooded areas dry, when the water returns to the river beds or evaporates.

The region was settled by cattle ranchers over 200 years ago (Wilcox, 1999), and, historically, was divided into large farms in which social relations were organised (Girard, 2012). The activity is still the most important in economic and land-use terms (Girard, 2012), as well as encompassing most of the rural inhabitants.

Our study was conducted with rural inhabitants from Pantanal, regionally called *pantaneiros*. Human density in the Pantanal is very low (< 2 people per km^2) (Swarts, 2000) and, associated with seasonal floods, results in geographical isolation of the region.

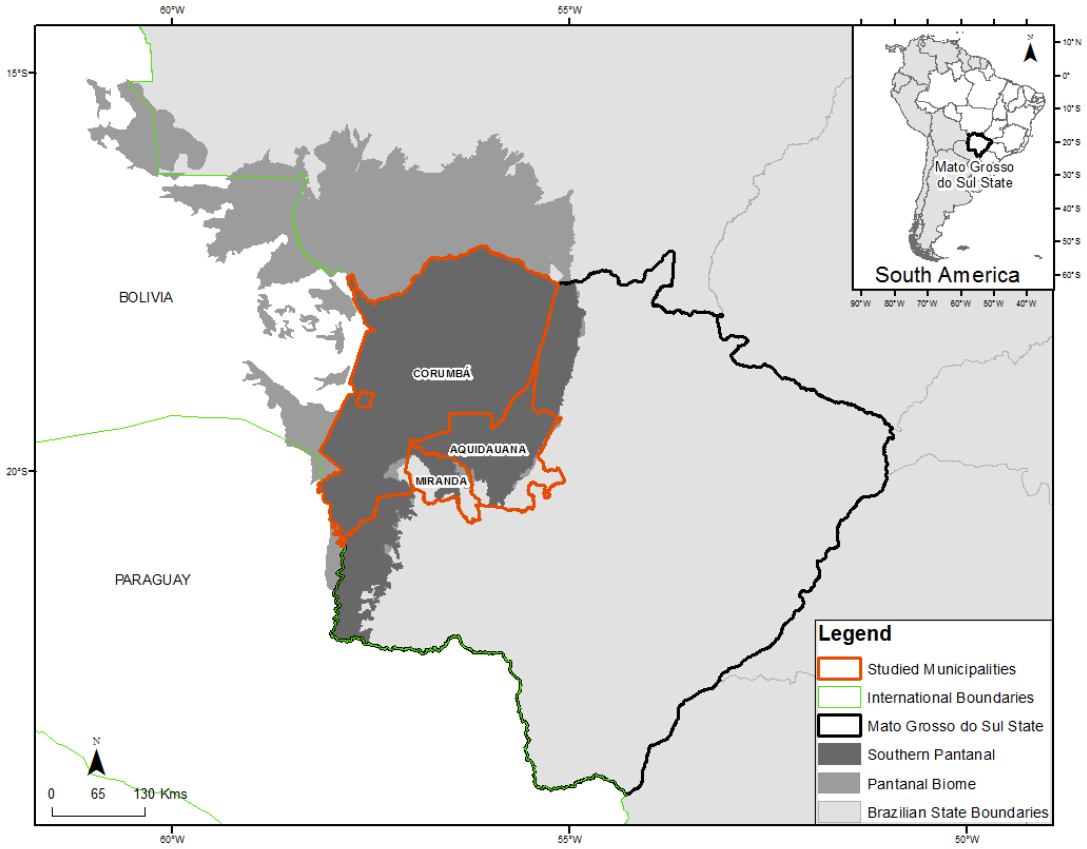
2.2. Data gathering and analysis

We adopted a mixed-method approach in two phases, combining semi-structured (qualitative) and a survey (quantitative) to collect and analyse data (Creswell, 2009).

2.2.1. Semi-structured interviews

From February to April 2017, we conducted 88 semi-structured interviews (Newing, 2010), based on an interview script, with men and women (>18 y.o.) selected through convenience sampling. This first step served to identify local superstitious beliefs about giant anteaters, besides contextual and psychosocial variables associated with them, in addition to becoming familiar with the local parlance for preparing the structured questionnaire. Lasting from 20 to 180 minutes (Avg= 60), these interviews were recorded and later transcribed. Then, their qualitative results were analysed with Template Analysis (TA), a systematic approach to identify, select and encode data hierarchically, organising it into analytical themes (Brooks *et al.*, 2015). To carry out TA, we adopted a six-step procedure, following recommendations by King (2012) and Brooks *et al.* (2015). Therefore, we began by highlighting words and excerpts from audio transcriptions associated with superstitions towards giant anteaters. Gradually, themes emerged from organising hierarchical and collateral relations in groups (clusters), which were then defined in specific categories. In the third step, we departed from this initial coding template which was iteratively adapted whenever new themes emerged from the interviews' interpretation. After coding all data, we investigated these codes for repetitions, similarities and differences (Ryan; Bernard, 2003). We then finalised the coding template and applied it to the analysis of the whole dataset. In the sixth and final step, we interpreted the systematised results to identify which variables should be gathered in the subsequent quantitative stage. The whole process was carried out in NVivo® v.11, a qualitative analysis software. **Figure 2** summaries the final coding template, which encompasses eight themes, covering superstitious beliefs about giant anteaters, the psychosocial factors associated them, as well as their implications to people and wildlife.

Figure 1. Municipalities where data were collected in Brazilian Southern Pantanal, Mato Grosso do Sul state.



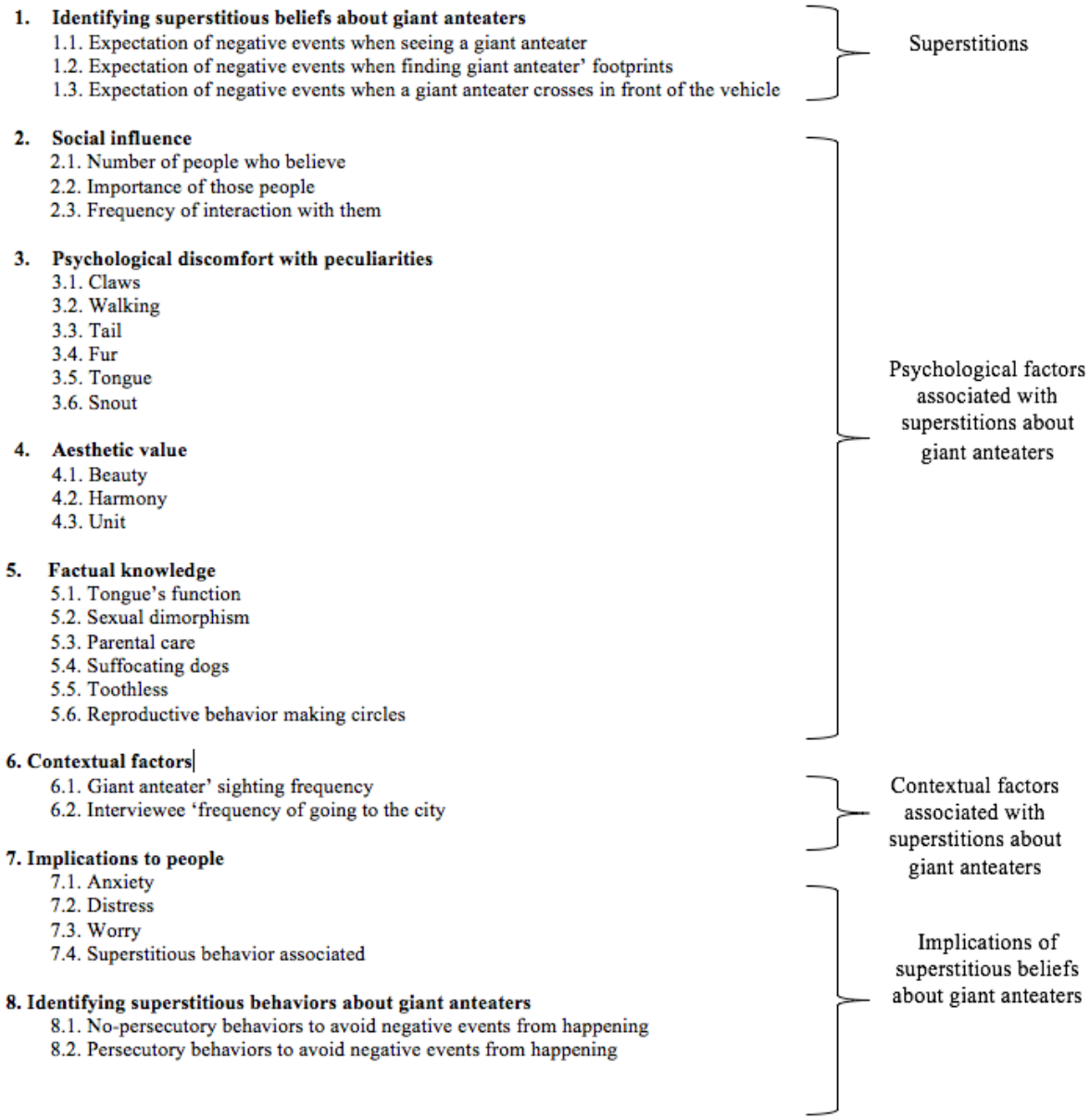
2.2.2. Survey

From August 2018 to July 2019, face-to-face interviews were conducted with a pre-prepared and pre-tested questionnaire. In this phase, we relied on a multi-stage probabilistic sampling design, which consists of taking successive samples, each involving some form of randomisation (Newing, 2010). Such a method is considered useful to sample populations dispersed in large territories (Trochim; Donnelly, 2001), as is the case of rural Pantanal population. To do that, we first selected three out of six sub-regions in the Southern Pantanal, because they combined two characteristics: (i) giant anteater occurrence and (ii) feasible access by car, as several rural areas can only be reached on several days' horseback riding trips. In the three chosen regions (i.e., Aquidauna, Nhecolândia and Miranda), we randomly selected rural properties to visit. To do so, we randomly draw points in satellite images using Google Earth® software. We then located the property inside or closest to the point draw, within a previously determined radius.

We then visited the property and, upon arrival, explained the research purpose and asked for the names of all residents (men and women) over 18 y.o. We draw the names of two residents from the list to be interviewed. When there were only two residents, one name was

draw. To avoid biases (most women at home and men in the field during the day), we waited until the end of the day for people's return to interview them. None of those selected refused to participate.

Figure 2. A simplified version of the final study template (top and second level themes only).



2.2.3. Variable definition

Each theme identified by the TA resulted in at least one variable included in the questionnaire (Supplementary material 3) and hereafter described.

Superstitions: superstitious beliefs about giant anteaters - i.e. agreement on the veracity of bad omen beliefs about this species – was estimated using a Likert-type scale with four statements reflecting information summarised from the previous qualitative phase (see details in *Results*).

Each respondent rated each of the four statements on a 5-points concordance scale (e.g. from totally agree to totally disagree). However, in the statistical analysis, data were recoded into a binary variable ("superstitious" =1; "non-superstitious" =0). Thus, people holding any level of superstition about giant anteater were coded as "1".

Social influence: reflects the social pressure exerted by people who believed that giant anteaters brought bad luck. In the qualitative phase, we identified three relevant aspects which were estimated with seven questions: (i) the number of people who believed in superstitions about giant anteaters (1 question); (ii) the strength of the source of impact (i.e., the importance those people had to the interviewee; 3 questions); (iii) the frequency of the interviewee' interactions with those people. We used response scales ranging from 0 (none, not at all important, and never, respectively) from 7 (a lot of people, very important to me, and always, respectively). A social influence value was then created through the sum of the marks.

Psychological discomfort with giant anteaters' peculiarities: this variable is a value that reflects the degree to which individuals are uncomfortable with unusual aspects of the giant anteaters' morphology and behaviour. The value was calculated from people's ratings of six statements which referred to peculiar characteristics of giant anteaters (e.g., claws, defence behaviour, hairy tail) identified as causing people's discomfort in the qualitative phase. Each respondent rated each statement in a 5-point scale ranging from 0 (nothing weird) to 4 (very weird). A psychological discomfort value was then created by summing the marks. We also included an option for those who never saw an anteater and rated it zero.

Perception of the giant anteaters' aesthetic value: the variable reflects people's evaluation of giant anteaters' aesthetic value (e.g, beauty, harmony and unity) and was estimated through a scale with three semantical differential statements, a scale type whereby alternatives are two adjectives with opposite meanings (Newing, 2010). Each statement ranged from -3 (very ugly, unpleasant to look at, and I have no interest in looking at, respectively) to +3 (very beautiful, nice to look at, and interesting to look at, respectively).

Factual knowledge about giant anteater's biology and behaviour: this variable estimates the level of people's knowledge about giant anteater's biology and behaviour. We departed from information gathered in the qualitative phase which suggested a few characteristics of the species' natural history that were misinterpreted likely leading to negative beliefs (e.g., sexual dimorphism, reproductive behaviour). To estimate this variable, we applied a knowledge test

about the species composed of six statements, half correct and half wrong, rated with three options (Correct (=1), Incorrect (=0), I don't know (=0). We then summed each people's values and the variable was analysed through the individual's score on the test.

Contextual factors potentially associated with the acceptance of superstitions about giant anteaters: qualitative interviews drew attention to two points that might be related to the superstitious belief about giant anteaters and were included in the questionnaire: the giant anteater' sighting frequency and the interviewee 'frequency of going to town.

Implications of superstitious beliefs to people: this aspect refers to the psychological consequences of experiencing situations seen as a trigger for superstitious beliefs. Three main psychological implications to people who hold superstitions were identified: anxiety, distress, and worry. They were measured through three semantical differential statement ranged from -2 (totally relaxed, not distressed at all, and not worried at all) to +2 (extremely anxious, extremely distressed, and extremely worried). This variable was estimated only for those holding superstitious beliefs.

Superstitious behaviours: refers to agreeing with the idea that performing specific actions – rituals - can prevent the bad luck associated with giant anteater's encounters. In the qualitative phase, we identified that some of these actions could be considered harmful to giant anteaters (i.e., persecutory behaviours), while others did not. We estimated this variable with a single-item measure. We counted the frequencies of the responses of each behaviour mentioned. This question was also posed only to those holding any superstitious belief.

Intention to perform persecutory behaviours. We considered people's intentions regarding two types of persecutory behaviours: to flog the animal and to kill the animal. In Social Psychology, a person's behavioural intention – estimated as the likelihood of performing a given behaviour - is the most proximal antecedent of this behaviour (Ajzen, 1985). To estimate these variables, we asked interviewees to evaluate three statements with a 5-point response scale (ranging from totally agree (+2) to totally disagree (-2). We examined the internal consistency of the scale with Cronbach's Alpha reliability coefficient (Cronbach, 1951), considering 0.7 as the threshold (higher values imply greater reliability).

Personal characteristics: we also gathered data on individual characteristics that could confound our analyses, specifically: gender (male/female), age, and completed years of formal education.

2.2.4. Data Analysis

Correlates of superstitious beliefs' assimilation

We performed a binary logistic regression to examine the effects of individual, contextual and psychological factors on the assimilation of superstitions about giant anteaters (our second objective). In the regression model, the dependent variable was "superstition about giant anteaters" [superstitious = 1, no superstitious = 0] and the independent variables included: (a) three sociodemographic variables (age [continuous], gender [male=1, female=2] and schooling [number of completed years of formal education]); (b) four psychological variables (social influence [score test ranging from 0 to 49], psychological discomfort with the species' peculiarities [score ranging from 0 to 36], perception of the species' aesthetic value [score ranging from -9 to +9] and knowledge about the biology and behavior of giant anteaters [score test ranging from 0 to 6], and (c) two contextual factors that seemed to be correlated with holding or not superstitions about giant anteater (the giant anteater' sighting frequency in the last 12 months [0 = none, 1 = very rarely, 2 = sometimes, 3 = oftentimes, 4 = almost every day, 5 = every day]; and the frequency of going to the city in the last 12 months [0= none, 1 = one or two times, 2 = three or four times, 3 = five or six times, 4 = seven or more times]). All statistical analyses were performed using IBM SPSS Statistics® software (v. 23).

3. Results

We interviewed 171 people ranging from 18 to 87 years old (mean 47.4, SD= 15), most of whom were men (82,5%), born in the study area (92.4%), and with low levels of schooling (Avg. number of years =3.7± 2.8). Less than half (40.4%; n = 69) of the sampled individuals held at least one superstitious belief about giant anteaters. Responses concerning specific superstitions reveal expectations of future negative events when people were involved with giant anteaters, more frequently when "sighting a giant anteater", "the animal crosses my path" or "when the animal crosses in front of the vehicle" (*see* **Table 1**). Expected negative outcomes from encounters varied widely, from failing to fish, to hunt and to close a deal, as well as getting ill or general misfortune.

Table 1. Prevalence of superstitious beliefs about giant anteaters (*Myrmecophaga tridactyla*) across our sample (n=171).

Superstitious beliefs about giant anteaters	N	%
The expectation of negative events when seeing a giant anteater	63	37
The expectation of negative events when crossing a giant anteater in the path	47	27.5
The expectation of negative events when crossing a giant anteater in front of the vehicle	43	25.1
The expectation of negative events when crossing a giant anteater's footprints	40	23.4

Determinants of superstitious beliefs about giant anteaters

Our logistic model predicted superstitious beliefs quite well. About 75% of the dependent variable variation was explained by the model and the model also correctly classified 92.3 % of interviewees in both "superstitious" and "no-superstitious" categories. None of the individual characteristics (i.e. sociodemographic information) evaluated explained holding a superstition. Instead, three variables predicted holding superstitious beliefs about giant anteaters: two psychological variables (social influence and factual knowledge about the species), and one contextual (frequency of sighting giant anteaters in previous 12 months).

Factual knowledge and the frequency of sighting anteaters reduced the probability of holding superstitions, whereas social influence increased this probability. Of these three variables, factual knowledge had the largest impact, as a 1- point increase in knowledge about giant anteaters reduced the chance of holding superstitious beliefs by 80.42%. The effect of sighting anteaters was also considerable since a 1-point increase in its frequency raised the chances of holding superstitions by 45%. Instead, despite consistent, the effect of social influence was weak (i.e. 1-point increase increased the chances of holding superstitious by 1.33%).

Implications of superstitious beliefs about giant anteaters

Of those who carried superstitions about the species, when the trigger situations happen 65.22% (n=45) of the interviewees declared to be worried or very worried, 60.9% (n=42) declared themselves distressed or very distressed, and 56.5% (n=39) declared feeling anxious or very anxious about the situation. About 95% of interviewees holding superstitions associated it with the belief in some action performed by themselves to avoid these negative events from happening. Non-persecutory behaviours (e.g., to dodge the animal or footprints) were the most frequently mentioned, while persecutory behaviours (such as to hit the snout or to kill giant anteaters) were mentioned by about one-tenth of the participants (**Table 3**). Almost the same

amount (n= 9.36%) reported a moderate to high intention to flog the animal. None have admitted an intention to effectively kill the animal in these situations.

Table 2. Results of binary logistic regression to predict superstitious beliefs about giant anteaters (n=117)

Variable	*β*	SE	Odds ratio	*p*-value
Individual characteristics				
Age	-.0043426	.0034291	.9956668	0.205
Gender	-.0173048	.0150888	.9828441	0.251
Education	-.1116877	.1059009	.8943235	0.292
Contextual				
Frequency of sighting giant anteaters in the previous 12 months	-2.917139	.6574536	.0540882	0.000**
Frequency of going to town in the previous 12 months	.2486939	.5006456	1.282349	0.619
Psychosocial				
Social influence	.0132131	.0052273	1.013301	0.011*
Psychological discomfort with giant anteater' peculiarities	.0257375	.0298829	1.026072	0.389
Perception of giant anteater 'aesthetic value	-.0444055	.0281326	.9565659	0.114
Factual knowledge about giant anteaters	-1.630705	.4376227	.1957915	0.000***

Pseudo R2 = 0.752, p = 0.000
Note: * = p < 0.05; ** = p < 0.01; ***p <0.00

Table 3. Prevalence of beliefs in superstitious behaviours likely to avoid bad luck.

Superstitious behaviours associated with giant anteaters	N	%
Non-persecutory behaviours to avoid negative events	48	28.1
Persecutory behaviours to avoid negative events	18	10.1

4. Discussion

Giant anteaters perceived as a harbinger of bad luck is a common but not predominant belief in our study area. Although 60% of respondents did not assimilate such a belief, 90% reported knowing someone who did. Albeit all the superstitions here identified regard giant anteaters, they vary in the circumstances in which they appear. For some, sighting an animal is a harbinger of bad luck, while for others, crossing footprints along the way is enough to raise the expectation of bad things.

In fact, rural Pantanal is home to many superstitions involving wildlife. The sight of an American barn owl (*Tyto furcata)*, the plaintive chant of the nocturnal bird *Nyctibius griseus,* or when someone dreams about snakes are all considered signs of misfortune. The process of seeking signs to follow in nature may be part of an adaptative process of rural people to the Pantanal. Observation of the environment is thought to enable many rural populations to make predictions and to cope with the adversities a landscape imposes on them (Nyong *et al*., 2007). For example, insect-eating birds flying low right before the rain, and ants building their anthills with higher, steeper sides is a sign that the flood will be intense. Although some Cognitive Psychology studies suggest this process of seeking associative causes may make people more susceptible to illusory correlations (Heider, 1944; Kahneman, 2011), care must be taken to argue that rural contexts favour the appearance of superstitions in general. Whilst the type and degree of superstitions may vary in different regions and cultures (Farooq; Kayani, 2012), believing in superstitions is a universal phenomenon and several studies have found a high prevalence of superstitious people in urban environments (e.g. George; Sreedhar (2006).

Even though superstitions are widespread, little is known about the crucial factors that contribute to people's adherence to such beliefs. Assessing the relationship between beliefs in superstitions about giant anteaters and individual characteristics, our regression analyses suggested that age, gender and schooling had none or little effect on superstitions, at least in our case. Past research on the correlates of superstition has found contradictory findings regarding the role of individual characteristics (Damisch, 2008). While a few articles that explored gender effect on superstition also revealed no differences between men and women (e.g. Buhrmann; Zaugg (1981); (Tobacyk; Milford, 1983), others found women to be more superstitious than men (e.g. (Irwin, 1993); Preece; Baxter (2000), and a few others the opposite way round (e.g. Neil *et al*. (1981).

Again, in contrast with our findings, upon inspection of the association between age and superstitions, some studies concluded that younger individuals are more superstitious than those older (e.g. Corrigan *et al*. (1980), whereas others suggest more superstitious beliefs with increasing age (e.g. Epstein (1993).

Findings on the relationship between educational level and superstitions are inconsistent as well. Historically, researchers have commonly treated superstitions as cognitive deficits (Risen, 2014). According to this perspective, more intelligent and educated people would have fewer superstitions than those less smart and educated. Yet, empirical findings on this association are mixed. Whereas some authors have found no correlation between education and superstitions (Salter; Routledge, 1971), others presented evidence of a negative correlation between years of formal education and superstitious beliefs (Musch; Ehrenberg, 2002).

Our findings on the influence of contextual variables on the adherence to superstitions indicate encountering giant anteaters more often makes a person less prone to hold superstitions about the species. But how would that be explained? Suppose you live in rural Pantanal and you have already heard that giant anteaters bring misfortune. Thus, somehow this information is available in your memory. If you happen to see a giant anteater and then something bad happens to you on the same day, you may make a connection between these two co-occurring but unrelated events and assimilate this belief. This psychological process is known as confirmatory bias, or the human tendency to remember, interpret or search for information to confirm initial beliefs or hypotheses (Klayman; Ha, 1987). Instead, if you see giant anteaters often and nothing happens, your earlier knowledge may be unconfirmed and therefore you begin to falsify the superstitious hypothesis. Indeed, we frequently heard from interviewees something such as: "Several times that I saw a giant anteater nothing bad happened to me, so I don't believe it". This finding is important because it may contribute to our understanding of the maintenance of superstitions involving rare and elusive animals since the rarity of an encounter decreases the likelihood of deconfirmatory evidence.

When we explored the importance of psychosocial factors on superstitious beliefs about giant anteaters, we obtained two important findings. First, unsurprisingly, social influence matters. As stated by psychologist Vyse (2013), superstitious beliefs are prompted by a social environment rich in believers. Thus, if superstitions are an active part of a group's culture, these influences make it more likely that new members will acquire them through oral communication (Madden *et al*., 2006). According to our results, individuals were more likely to adhere to giant anteater's superstitions when they mentioned knowing people who believed in it, especially when these people were close to them and interacted with them frequently. These findings corroborate the Social Impact Theory (Latané, 1981) which argues that social impact is moderated by the strength of relationships, immediacy of interactions, and the number of other people holding a certain belief in the social environment.

Humans have developed psychological mechanisms that enable cultural transmission, by being more receptive to information received through their reference group (Lintrop, 2002). Even so, ideas are not passively acquired, but depends on the quality of the evidence that supports them (Norenzayan; Atran, 2004). Our second psychosocial finding – that low factual knowledge about giant anteaters highly predicts people's adherence to superstitions about the species - indicates that misunderstandings contribute to the evidence supporting superstitions. Previous evidence in this regard is rare and again inconsistent. In a study with the aye-aye in Madagascar, Simons & Myers (2001) found that, despite having good levels of scientific knowledge about the species' biology, forestry agents held beliefs in superstitions and negative

attitudes like those without such knowledge. In contrast, certain authors claim that increasing scientific knowledge about a species' biology and behaviour reduces the importance of folk beliefs and superstitions. For example, in a study with Slovak students, Prokop & Tunnicliffe (2008) found that more scientific knowledge about bats correlated with fewer beliefs in superstitions. Likewise, Clark *et al*. (1978) suggested that, in Malawi, superstitions involving owls are born from the mistake of relating the usual presence of the species in cemeteries to the omen of evil. Instead, owl abundance in these places is explained by the fact they represent the few left wooded islands in a sea of deforested areas.

Several of the anteaters' body features differ from those of other species. For example, anteaters do not have sexual dimorphism, as other mammals do. Male's testicles are intra-abdominal, so males and females look the same. Because of that, some people misinterpret what they see, and attribute to other organs or body structures the function of penetration. Similarly, to reach termites, anteaters have long tongues - up to one-meter-long - which are attached to their sternum. Accordingly, this huge and strange tongues make locals raise odd explanations for it, such as it may serve to the reproduction, or allows anteaters to stick their tongues into the nostrils of people or dogs to kill them suffocated. In the interviews, we noted that these misunderstandings about giant anteaters ended up permeating the animal in an atmosphere of mystery, of unknown, and uncertainty. Our study, therefore, suggests that people tend to endorse superstitious beliefs not only in uncertain situations, as Malinowski (1948) previously noted, but also in face of uncertain creatures that are not well understood. These findings may help explain the maintenance of superstitious beliefs about other animals with unusual physical or behavioural characteristics. For example, the crow vocalisation, which can be considered aversive to people's ears, as well as that of owls, which, in addition to vocalisation, performs some uncommon behaviours (e.g., a head rotation of 270 degrees) or the distinct appearance of the aye-aye. Individuals may be more receptive to adhere to such beliefs to understand the complex and unfamiliar events or creatures around them.

Research on personality assessment found that uncertain situations tend to threaten our perception of control (Amoura *et al*., 2014). Additional evidence suggests that the locus of control predicts psychological discomfort and anxiety (Archer, 1979). Our results on the implications of superstitions corroborate this view since most of those who carried superstitions about giant anteaters declared to be worried, distressed, and anxious when the trigger situations happened. This is coherent with the view from cognitive psychologists that people seek to understand, predict, and control their environments to "maximise positive outcomes and to minimize negative ones" (Case *et al*., 2004). Perhaps, because the motivation for control has considerable adaptive value, many people deal with this engaging in certain behaviour – rituals

- in an attempt to repel bad luck from happening, therefore reducing anxiety levels (Jahoda, 1970; Keinan, 2002).

In fact, studies have verified the psychological benefits of superstitious behaviours, as they give an individual the illusion of controlling the situation (e.g. Rudski (2001); (Schippers; Van Lange, 2006). This need for controlling the situation was, perhaps, what led most of our interviewees who hold superstitious beliefs to engage in superstitious acts too. Whilst some of the mentioned acts were harmless to the animal (e.g., to dodge the animal or its footprints), others could threaten both people performing them and giant anteaters. About one-tenth of the interviewees declared their intention to hit giant anteaters' snouts to repel bad luck from happening. Although anteaters avoid human contact, they can defend themselves using their powerful forelimb claws when threatened. Human deaths caused by giant anteaters are rare but have already been reported to follow serious tissue laceration caused by the animal's sharp claws (Haddad Jr *et al*., 2014). Thus, superstitions about anteaters may play a negative role to people who hold them, causing anxiety and distress but also exposing those that effectively engage in superstitious acts to the risk of injuries.

5. Conservation implications

In this section, we examine the need, guidance and ethics of potential conservation strategies that may benefit giant anteaters and other species involved in superstitions. Regarding the need of conservation interventions, although none of the interviewees declared an intention to effectively kill giant anteaters, from a conservation viewpoint certain aspects require attention. Killing a giant anteater is a sensitive/illegal behaviour that people are probably not willing to admit for fear of punishment or judgment (Fisher, 1993). Thus, our *intention to kill* estimates probably do not accurately reflect interviewees' actual behaviours. For a reliable quantitative assessment of the direct threat of superstitions upon giant anteaters' conservation, further studies may benefit from using indirect questioning techniques such as the Bean Method (Lau *et al*., 2011) developed to increase response accuracy in such situations (Nuno; John, 2015). Indirectly, however, bad omen superstitions likely affect people's views about species involved, thus perhaps leading to less support to their conservation in the region (Catapani *et al*., in prep.). Our second claim it is about the one-tenth of interviewees expressing an intention to hit giant anteaters' snouts to repel bad luck. Anatomical and physiological studies describe the giant anteater frontal apparatus as a very noble and sensitive area that allows the vital functions of the animal (Macalister, 1875; Naples, 1985;1999). Veterinarians specialised in the species claim that trauma in this area can cause irreversible lesions, mainly in the digestive tract, such as the tongue, salivary glands and mandibular musculature. The animal may end up

not being able to feed and consequently can dye of starvation (D. Kluyber, personal communication, May 17, 2019; V. Gasparotto, personal communication, April 27, 2018). Indeed, two interviewees declared to witness a giant anteater's death after another person repeatedly hit the animal's snout. Another interviewee reported that a friend tied a giant anteater to a tree and hit the animal for three consecutive days to avoid bad luck. These cases appear, however, rare. Even so, although conservationists focus their attention mostly on species and habitats instead of individuals, from an ethical perspective there is an agreement in our society that animal welfare is important. When an animal is injured, its welfare is therefore compromised (Broom, 1991). Furthermore, in Brazil, persecuting wild animals is a crime (see Lei n. 9605/98 - Lei dos Crimes Ambientais), which is aggravated by giant anteater's status as an endangered species.

Given the negative consequences of superstitions for both people and species involved, we argue that it is important to reduce such beliefs wherever they are present. We suggest here a few aspects that may contribute to conservation strategies for wildlife species associated with misfortune. First, it is not a good idea to try to influence people's beliefs by mentioning them. Generally, people tend to keep information received in their memory, so it may be retrieved in any future co-occurring negative event involving target species. This may be enough for the assimilation of superstition, and later much effort would be required to deconfirmatory evidence. Thus, we suggest instead that conservationists should focus on reducing what people consider as evidence that supports their superstitions. According to our findings, one way to do this might be to provide information that demystifies the main misunderstandings about the species. We thus recommend, first, a careful identification, through qualitative in-depth interviews, of the main misconceptions about target species, as well as any peculiar or unusual characteristics that generate psychological discomfort in people. Although research on belief perpetuation suggests that, occasionally, beliefs do not yield to evidence – meaning people reject information challenging their beliefs (Anglin, 2019), belief systems are not static: they change and evolve in response to life experiences (Guidano; Liotti, 1983).

Divergent beliefs may create ethical dilemmas and disagreements. Whilst there is a general notion that differences in cultural beliefs should be respected, conservationists aim to protect species from harmful practices. Given that such an issue is more value judgment than scientific, we will not delve into this. Even so, we contend that reducing the importance of bad omen superstitions about wildlife will likely benefit people, animals and species involved. Securing a future for these species will demand from conservationists a nuanced understanding of the interactions between wildlife and cultural belief systems.

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CHAPTER 3

Using conflict analysis to guide strategies to help beekeepers and giant armadillos coexist

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Abstract

The degree to which conservation managers can alleviate human-wildlife conflicts (HWC) depends on their ability to identify the main drivers, complexity and scope of a given conflict. The integration of conflict analysis approaches into HWC management can advance managers' understanding of conflict scenarios and guide the strategies required for effective interventions. Although a recent framework proposal based on this view has been adapted to HWC, an evaluation of whether and how this framework can assist in planning conflict-mitigating interventions is still lacking. A conflict involving beekeepers and giant armadillos in the Brazilian Cerrado biome is ideal to test this framework as the negative interaction is likely caused only by economic losses due to armadillo's predation on beehives. We, therefore, adapted this framework incorporating the key suggested areas of analyses into our HWC assessment using quantitative and qualitative social research methods. From August to November 2018, we interviewed 111 beekeepers sampled through snowballing to assess at which level this conflict could be framed and what measures could be taken to alleviate the conflict. Our results showed the HWC analysed is shaped mainly by material disputes at the first level - the losses incurred are the core of beekeepers' dissatisfaction. This evidence contradicts recent research arguing that most HWC are rooted in less visible, more complex social disagreements between people and groups of stakeholders. It is recognised, however, that this is an individual scenario involving its own ecological, social, and economic attributes. We then suggest the key characteristics that any intervention would require to enable the peaceful and even beneficial coexistence between beekeepers and giant armadillos.

1. Introduction

Growing human demands for space and natural resources has increased the interactions between people and wildlife (Manfredo, 2008). When interactions are negative, due to competition for food and resources, or because a species is dangerous to people, human-wildlife-conflicts (HWC) arise (Nyhus *et al.*, 2005). Damage induced by wildlife is a major cause of HWC worldwide (Kansky *et al.*, 2014), because they often produce material and economic losses, threatening livelihoods (Messmer, 2009) and negatively impacting the mental health of people involved (Thondhlana *et al.*, 2020). Frequently, the solution envisaged by

affected people is the retaliatory killing of the animals blamed for damage (Cerri *et al.*, 2017), a practice responsible for endangering several species worldwide (Woodroffe *et al.*, 2005).

Conservationists and wildlife managers have been looking for ways to manage such conflicts for decades. Directly tackling negative impacts by wildlife is one of the possible approaches. Such approaches assume the higher the impact experienced, the deeper the HWC. Under this assumption, two main strategies are commonly used to reduce conflicts. The first is damage mitigation which seeks either to influence the behaviour of the damaging animal or to reduce the target vulnerability (e.g. preventive husbandry (Dickman *et al.*, 2018) and use of deterrents for crop-raiding elephants (King *et al.*, 2011). The second strategy relies on economic instruments to offset impacts such as insurance (Chen *et al.*, 2013), and compensation schemes for the losses incurred (Bauer *et al.*, 2017).

There is evidence that the level of wildlife damage or losses experienced is not always directly related to the conflict level (Dickman, 2010; Kansky *et al.*, 2016). For example, a meta-analysis involving different groups and taxa (*see* Kansky *et al.*, 2014) found that communal farmers were less likely to hold positive attitudes towards carnivores regardless of having experienced damage. Instead, commercial farmers and urban inhabitants were, on average, more positive towards carnivores irrespective of the damage inflicted. Results from this and other studies (e.g. Marchini and Macdonald, 2012) show that damage alone does not always explain people's attitudes towards carnivores. In such cases, therefore, measures to reduce damage or financial benefits may not incur in the desired conflict-reducing effects (Naughton-Treves *et al.*, 2003).

A plausible explanation for this mismatch between damage and conflict strength is the existence of other factors beyond tangible impacts to material goods or losses experienced (Dickman, 2010). These can include non-tangible aspects of the individual (e.g. empathy for the species), society (e.g. social identity), culture or institutions (*see* Pooley *et al.*, 2017; Thondhlana *et al.*, 2020). For example, Cavalcanti *et al.* (2010) found that human persecution to jaguars in Brazil was more related to the cultural status associated with jaguar hunting than to the economic impacts of their livestock depredation. Neglecting the less visible, non-tangible elements is argued to constrain problem definition, hinder appropriate solutions, thus causing ineffective interventions (Dayer *et al.*, 2019) and, occasionally, escalating the conflict (Madden, 2004).

Previous interdisciplinary research on the human dimensions of HWC has applied a range of approaches to better understand conflict motivators involving wildlife. Among these approaches, certain authors (see Madden and Mcquinn, 2014; Zimmermann *et al.*, 2020) have recently highlighted that the field of conflict analysis and peacebuilding can provide tools to

identify conflict types, hence guiding the implementation of more effective interventions. Madden & Mcquinn (2014) proposed an analytical model to differentiate the complexity and scope of a certain conflict. This model classifies three levels of conflict. The first is the tangible manifestation of the conflict when material and financial losses are the core of the problem. According to them, preventing or compensating losses should suffice to alleviate such conflicts. In the second level - underlying-level – people affected by damage may hold strong resentment towards the damaging species or other stakeholders addressing the issue. Planning interventions at this level of conflict may require strengthening relationships between stakeholders involved. The third and last level - deep-rooted conflict- involves conflicting values, beliefs and identities of involved people, which require complex approaches to reconcile antagonistic views and identities.

Recently, Zimmermann *et al.* (2020) offered a useful and applicable framework to determine in which of those levels proposed by Madden & Mcquinn (2014) a given conflict can be framed. The authors suggest five key areas of analysis: i) perception of the species blamed; ii) exploration of previous attempts to solve the situation; iii) questions about the situation itself (i.e., if the major concern is about losses or not); iv) the extent of willingness to find solutions, and v) views about others involved in seeking solutions. Depending on the responses of affected stakeholders, each level is most likely to characterise a given conflict. For example, evidence that a conflict is purely related to damage extent (the dispute-level conflict) is when the people affected manifest particular characteristics. First, they show empathy or understanding of the needs of the damaging species. Second, their main worry is about the losses experienced. Third, there is a high tolerance for damage. Fourth, previous attempts to damage mitigation are seen as helpful. Fifth, they are willing to work with third parties in trying to develop interventions to address the issue and interest in receiving assistance. The main contribution of this analytical method is to provide a more comprehensive approach to understand a conflict scenario, giving insights on how to best design an intervention capable of mitigating the conflict.

The theoretical framework by Zimmermann *et al.* (2020) advances knowledge on conservation practice, but to our knowledge, the extent of its usefulness in planning conflict-mitigating interventions has still not been assessed. To fill this gap we applied the conflict framework proposed by Zimmermann *et al.* (2020) to a case involving damage by giant armadillos (*Priodontes maximus*) to Brazilian apiaries. The chosen conflict is important because it threatens both an endangered species' conservation and beekeepers' livelihoods. Understanding the level of the conflict should allow conflict managers to design more effective interventions that are both supported by beekeepers and reduce the conflict. Additionally, this

case-study adds to our theoretical knowledge on the drivers of HWC, as it helps to disentangle whether material losses or other stakeholder's disputes may help to explain conflict situations.

Case study: conflict involving giant armadillos and beekeepers

Giant armadillos are the largest living species of its kind, with adults weighing up to 60 kg and measuring up to 1.5 m long (Carter *et al.*, 2016; Desbiez *et al.*, 2019). Despite their large size, giant armadillos go frequently unnoticed due to their solitary, nocturnal, and fossorial habitats (Eisenberg and Redford, 1992; Desbiez *et al.*, 2020). The species feed mainly on ants and termites (Anacleto and Marinho-Filho, 2001), but may opportunistically feed on bee larvae (De Melo A and Nogueirab, 2020). In the Brazilian Cerrado of Mato Grosso do Sul state beekeepers place hives along the edges of native vegetation remnants to allow wildflowers' visitation by bees. However, these native vegetation remnants area also the only habitat in which giant armadillos survive. Giant armadillos have learned to knock over beehives in apiaries to feed on the bee larvae (Desbiez *et al.*, *in press*). A single giant armadillo encounter with an unprotected apiary can result in beehive damage and colony loss, often imposing substantial economic losses to beekeepers. To overcome this problem, certain beekeepers implement non-lethal strategies listed by Desbiez *et al.*, 2020 (*in press*) which include strategies such as the use of hive elevation with platforms or electrical fences. Some strategies are more effective than others, but all have a cost and inconvenience to the beekeeper. For this reason, some beekeepers believe that poisoning is the easier strategy to solve the conflict. Indeed, giant armadillos are highly susceptible to poisoning because, after destroying beehives, they return to feed on then for several nights. Given giant armadillos have low population density and low population growth rates (Desbiez *et al.*, 2020) and are considered "Vulnerable" by both the IUCN (Anacleto *et al.*, 2014) and the Brazilian Endangered List (Chiarello *et al.*, 2015), the loss of a single animal to poisoning could precipitate local extinctions (Desbiez *et al*, *in press*).

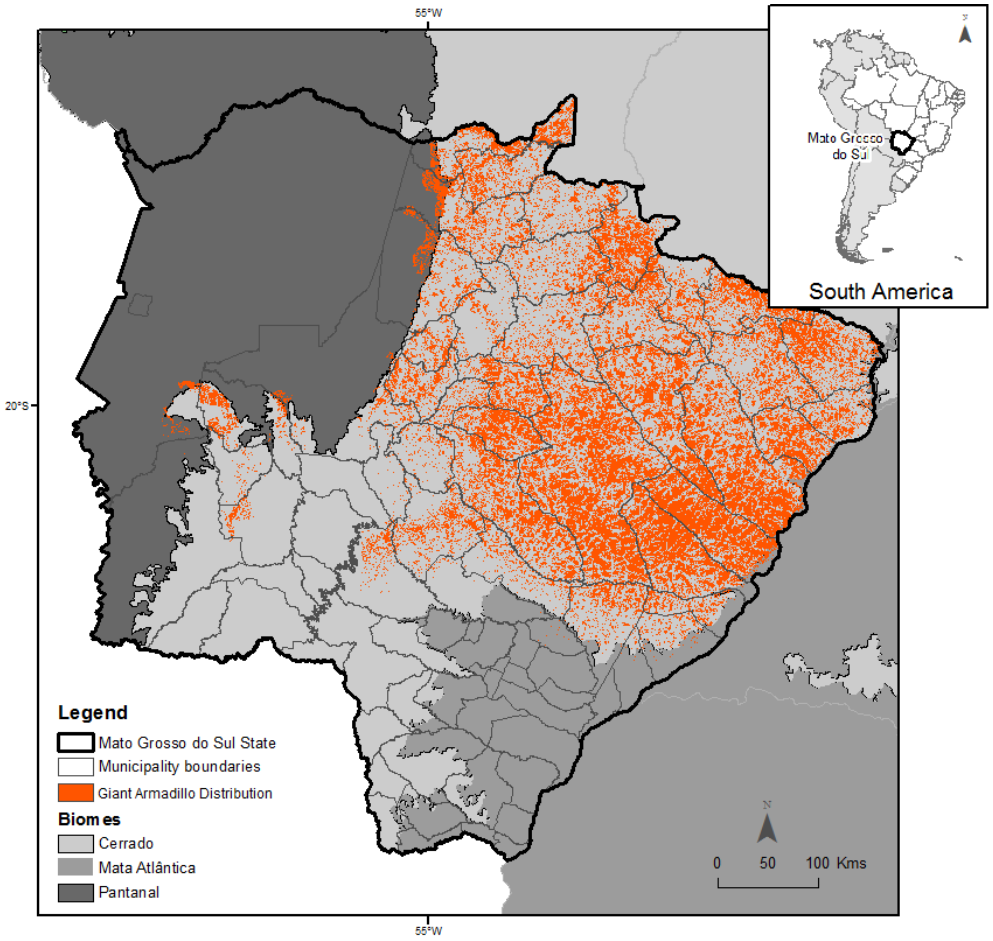
2. Methods

2.1. Study site

The study was conducted throughout the giant armadillo distribution in the Cerrado biome of Mato Grosso do Sul state, Brazil (**Figure 1**). Brazil's Cerrado is a highly diverse savanna ecosystem which provides critical habitat for many endemic and rare species (Klink and Machado, 2005). Yet more than 50% of the Brazilian Cerrado has been transformed into pasture or cash crop agriculture, while only 19.8% remains undisturbed (Green *et al.*, 2019). In Mato Grosso do Sul, there are currently 58,459 km^2 of remaining Cerrado, which is 16% of the total state area (Reynolds *et al.*, 2016). The remaining Cerrado in the state is highly fragmented

and predominantly in small patches (Reynolds *et al.*, 2016). Beekeepers place hives along the edges of these fragments to increase bees' proximity to wildflowers, therefore overlapping giant armadillos' habitat. Honey production is important to MS state, which has the largest production per hive/year in Brazil, 34 kg more than the18 kg national average (FEAMS, 2017). Beekeeping has also been steadily increasing in family agriculture practices worldwide, because of its potential inclusiveness amongst small rural producers (Gonçalves, 2006).

Figure 1. **Giant armadillo (*Priodontes maximus*) distribution in the Cerrado biome of Mato Grosso do Sul state, Brazil (Ferraz *et.al.*, *in prep*).**



2.2. Data gathering

We had access to lists of beekeeping associations in the giant armadillo area of occurrence in the Cerrado of Mato Grosso do Sul state. Using these lists, we randomly selected one beekeeper per municipality to be interviewed. To avoid biases associated with selecting only associated beekeepers, which were more likely to be organised and to employ similar management practices, we then adopted snowball sampling (Goodman, 1961). This technique is appropriate when dealing with difficult to access subjects (Newing, 2011), as was the case of

non-associated beekeepers. We, therefore, asked the initial interviewees to name another subject who then provided another name and so on. Using a semi-structured questionnaire pilot-tested previously (July 2018), from August to November 2018 we carried out face-to-face interviews with 111 beekeepers. We assessed sociodemographic information (sex, age, schooling, origin and income sources), beekeeping information (involvement period; associated or not) and HWC aspects.

To characterise HWC aspects, we followed the guidelines in Zimmerman *et al.* (2020) framework, thus incorporating the five key areas of analyses. Because the framework did not specify how key areas should be assessed, we devised indicators and associated measures for each of them using quantitative and qualitative social research methods (detailed below; *see* **Table 1**).

2.2.1. First key area: beekeepers' perceptions of giant armadillos

"Perception" is a concept that can mean different things depending on the discipline. We, therefore, adopted five perception indicators to cover the range of conceptualisations in the Human Dimensions' literature.

First, beekeepers' views about giant armadillos were investigated through a free listing of the first three words that came to the interviewee's mind when thinking about giant armadillos. This procedure is based on the rationale that words are symbolic representations of concepts, places or objects (Carlston, 2013). Second, the perceived benefit of the species 'existence, an aspect recognised as crucial for enhancing wildlife conservation (Bennett *et al.*, 2017). Third, beekeeper's attitudes towards giant armadillos, and therefore their tendency to respond with some degree of favourableness (or not) to the species (Eagly and Chaiken, 1993). In Social Psychology, attitudes are considered important to explain how people think, feel and respond to wildlife damage (Decker *et al.*, 2012). Fourth, the so-called *Not in My Back Yard* (NIMBY) sentiment. This sentiment considers people's opposition to the existence of undesirable things in their own neighbourhood (Dear, 1992). Finally, fifth, beekeepers' understanding of giant armadillos 'needs.

Table 1. Indicators devised to assess each of the five key areas of conflict analysis proposed by Zimmerman *et al.* (2020), data gathering and analyses associated.

Key areas of conflict analysis	Indicators used	Data gathering	Data analysis
1. Perception of the species	i. Beekeepers' views about giant armadillos	Free listing of views about giant armadillos (3 words)	Smith salience (combination of order and frequency of citation) Word cloud analysis
	ii. Perceived benefit of giant armadillo 'existence	Open question: There are any benefit about giant armadillo's existence? Probes for positive answers: What is (are) such benefit (s)?	Inductive content analysis and frequency of response 'categories
	iii. Attitudes towards giant armadillos	Likert scales of six statements Five points response scale (i.e., from totally agree to totally disagree)	Reliability of scale
	iv. Not in my back yard sentiment	Closed question: Which destination do you prefer for the giant armadillo in the future?, with five response categories	Frequency of response 'categories
	v. Understanding for the needs of giant armadillos	Open question: Why do you think the giant armadillo detroy the hives?	Inductive content analysis and frequency of response 'categories
2. Conflict situation itself	i. Limitations to beekeeping	Open question: What is the main limitations to beekeeping currently and in the past (5 year ago)?	Inductive content analysis and frequency of response 'categories
	ii. The severity of giant armadillo to beehives	Absolute number (last 12 months and 5 years ago) Percentage of the total production (last 12 months)	Descriptive analyses
	iii. Attitudes towards giant armadillo persecution	Likert scales of six statements (using target, action, context and time-specific). Five points response scale (i.e., from totally agree to totally disagree)	Reliability of scale
	iv. Relationship between damage and attitudes towards giant armadillos	Damage: number of beehives destroyed in the last 12 months Attitudes: Likert scales of six statements	Kruskal-Wallis test + Bonferroni post-hoc Multinomial logistic regression
	v. Relationship between damage and attitudes towards giant armadillos 'persecution	Damage: number of beehives destroyed in the last 12 months Attitudes: Likert scales of six statements	Kruskal-Wallis test + Bonferroni post-hoc Multinomial logistic regression
	vi. Beekeepers 'tolerance to damage by giant armadillos	The proportion of individuals who have a positive attitude toward a species despite suffering damage by the species	Tolerance to damage index
3. History of attempts to solve the conflict	i. Beekeepers' strategies to prevent damage by giant armadillos	Number of beekeepers using non-lethal and lethal strategies Strategies ranked in low, medium and high effectivity	Coding and frequency of response 'categories
4. Willingness to find solutions	i. Beekeepers 'willingness to adapt management practices	Closed question: How willing you would be to adapt your management practices to stop losing hives to giant armadillos?	Frequency of response 'categories
5. Others involved in the issue	i. Interest in receiving assistance by third parties ii. Perceived image of third parties	Closed question: Would you like to receive any assistance to alleviate this conflict? Probes: Can you tell me more about that? and Who do you think this help would come from?	Frequency of response 'categories Inductive content analysis

2.2.2. Second key area: the conflict situation

This key area requires understanding whether people's complaints arise from tangible impacts and experienced losses. To assess this, we first investigated beekeepers' perceptions of current limitations to beekeeping. Because respondents tend to interpret a given question in light of previous ones, to avoid biases, we posed this question at the interview beginning and before talking about damage by giant armadillos. Second, we asked about the severity of giant armadillo damage to beehives, to assess the intensity of the problem. Third, we assessed attitudes – i.e. how favourable a person was - towards giant armadillo persecution. This information provides insights on how beekeepers would behave in response to giant armadillos' damages (following the Theory of Planned Behavior (Ajzen, 1985). Fourth, the relationship between damage and attitudes towards giant armadillos and their persecution was questioned, to verify if the damage was an important predictor of attitudes. Fifth, we assessed beekeepers' tolerance to giant armadillo's damage. Tolerance is often associated with attitudes in wildlife management literature to understand HWC (Frank, 2016).

2.2.3. Third key area: previous attempts to address the conflict

We assessed both beekeepers' lethal and non-lethal strategies to prevent giant armadillos' damages, and also gathered information on their effectiveness.

2.2.4. Fourth key area: willingness to adapt to alleviate conflict

We used a single-item measure to obtain a direct evaluation of beekeepers' openness to change management practices to conflict reduction.

2.2.5. The fifth key area: others involved in the issue

Trust in the person/group delivering an intervention predicts people's levels of cooperation (Baynham-Herd *et al.*, 2020). Thus, besides beekeepers' openness, we gathered information also on who should deliver the message in the case of implement interventions.

All research procedures were approved by the Research Ethics Committee from the Brazilian National Commission for Research Ethics (CAAE nº 34264820.1.0000.516).

2.3. Data analyses

2.3.1. Beekeepers' perceptions towards giant armadillos

i. Free listing of words to describe perceptions about giant armadillos. This exercise was conducted to evaluate which aspects (i.e., positive, negative, neutral) (Weller and Romney, 1988) were most relevant to explain beekeepers' perceptions of giant armadillos. The Smith

salience index with Anthropac software, version 4.98 (Analytic Technologies, Kentucky) was calculated. Salience combines information on the frequency an item is reported and the rank order the items were cited by interviewees (Thompson and Juan, 2006). We classified words expressing fear, anguish and anger as negative (e.g. dangerous, violent, destructive), whereas those expressing admiration or enchantment were coded as positive (e.g. beautiful, interesting, powerful). Finally, we categorised items mentioning giant armadillo's physical attributes (e.g. heavy, light, large) as neutral. The analyses were performed for these three categories (i.e. positive, negative and neutral), obtaining salience, frequency and classification of each one. For a visual representation of word frequencies, we created a word cloud, an analysis in which the more commonly the term is cited, the larger the word in the generated image.

ii. Perceived benefits of giant armadillos: we coded different benefits reported by interviewees following Rodrigues *et al.* (2020), who presents material and non-material benefits of armadillos, and then calculated the frequency of each category.

iii. Attitudes towards giant armadillos: we examined the internal consistency of the six statements with Cronbach's Alpha reliability coefficient (Cronbach, 1951), considering a 0.7 threshold.

iv. Not in my backyard sentiment: we calculated the frequencies of each of the response categories.

v. Understanding of giant armadillos' needs: by applying Inductive Content Analysis, a qualitative method that allows distilling words into fewer content-related categories (Elo and Kyngäs, 2008), we identified three main response categories: "Because it needs to feed", "Because it's a destructive animal", and "I don't know" and calculated the frequency of each one.

2.3.2. The conflict situation

i. Responses on the major limitations to beekeeping were first categorised according to emerging themes. We then calculated the frequency of each category.

ii. Severity of giant armadillos' damage to beehives: we used descriptive statistics.

iii. Attitudes towards giant armadillos' persecution: we examined the internal consistency of the scale.

iv. / v. Association between damage and attitudes towards giant armadillos and to their persecution: We tested differences in attitudes among beekeepers who had experienced different magnitudes of damage by giant armadillos in prior 12 months. To do so, we first categorised beekeepers in three groups: no damage (no beehive destroyed in the past 12 months), low damage (<10), and medium to high damage (> = 10). We then compared the three

groups on damage x attitudes using non-parametric Kruskal-Wallis one-way analysis of variance by ranks (H), followed by Bonferroni corrected post-hoc.

To evaluate the association between the amount of damage during the prior 12 months on beekeepers' attitudes towards giant armadillos and towards their persecution, we estimated two multinomial logistic regressions, which are extensions of binary logistic regressions for categorical dependent variables. Our three outcome categorical variables were, in Model 1: negative attitudes (n = 24), neutral (n = 17), and positive attitudes (n = 70). For Model 2, the outcomes were attitudes towards persecution, specifically: unfavourable to persecution (n= 85), neutral (n=15), and favourable to persecution (n=10). In multinomial models, parameter estimates are compared to a baseline-category of the dependent variable. We adopted positive attitudes (Model 1) and unfavourable to persecution (Model 2) as the reference groups.

vi. Beekeeper' tolerance towards giant armadillo damage: based on (Kansky *et al.*, 2014), we computed a tolerance to damage index (TDI), as follows: TDI= proportion of individuals suffering damage – (1 – the proportion of individuals with positive attitudes towards the species). Negative values indicate low tolerance, whereas positive values show high tolerance value equal to 0 indicates neutrality, which means the proportion of respondents with positive attitudes is proportional to the percentage of respondents experiencing damage.

2.3.3. History of attempts to solve conflicts

We ranked the effectiveness of strategies beekeepers used to prevent giant armadillo damage in preventing giant armadillo predation as high, medium or low, according to beekeepers' perception. Effectiveness was considered to be high if every beekeeper who used the method prevented giant armadillo predation, medium if the measures worked only on some occasions, and low if they did not prevent giant armadillo raids in any apiaries. The frequency of each response category was calculated.

2.3.4. Willingness to find solutions

We calculated the frequency of each response category.

2.3.5. Others involved in the issue

First, the frequency of both response categories (yes/no) were calculated. Second, to interpret meaning from the content of interviewee responses we used a conventional qualitative content analysis approach (Hsieh and Shannon, 2005).

3. Results

Among the 111 interviewees, less than half of the interviewees (43,24%) were born in the study area, and almost the totality was male (99,1%) with an average age of 50.1 years (+- 12,54; range = 27 to 89). On average, interviewees had 7.4 +- 3.2 years of schooling, although about a third of the sample (32.4%) studied less than four years. Beekeeping was the main source of family income for 41.1% of the interviewees, who relied on honey for half or more of their income. Most beekeepers (64%) had over 10 years of experience in this activity, whereas only 7.2% had less than 5 years. Most beekeepers (60%) were members of beekeeping associations.

3.1. Beekeepers' perceptions towards giant armadillos

Free listing results indicated that the salience of beekeepers' perceptions about giant armadillos (i.e. combination of frequency and rank order) tends to neutral. Besides more salient, neutral aspects were also the items most frequently reported – around three times more than either positive or negative aspects (**Table 2**), as can also be visualised in the word cloud (**Figure 2**). This figure highlights six most frequently used words of which four are neutral: big (grande), strong (forte), rare (raro), high (alto), one is positive: beautiful (bonito) and one negative: ugly (feio).

Table 2. Frequency, average rank and salience of beekeepers' perception about giant armadillos (*Priodontes maximus*) through free-lists.

Category	Frequency (%)	Average rank	Salience
Neutral	94,2	2,54	0,447
Positive	39,8	1,71	0,298
Negative	30,1	2,03	0,193

On average, beekeepers had favourable attitudes towards giant armadillos (**Table 3**) and most beekeepers (82%) regarded giant armadillos' as beneficial, even if about half of them could not specify why (provided vague answers: "must have, every species has"). Among the benefits identified, pest control (i.e. eating social insects) was the most often mentioned (16%), followed by benefits associated with burrowing (i.e., seed germination and dispersal, ecosystem engineering, 11%), and species' intrinsic value (i.e., value irrespective of use/service, 9%).

Figure 2. Word cloud of beekeepers' perceptions towards giant armadillos (*Priodontes maximus*) based on the free listing.

The analysis of NIMBY sentiment (**Figure 3**) indicated most beekeepers do not feel giant armadillos should be eradicated either globally or locally, but did wish fewer animals occurred in their neighbourhoods. In contrast, some of them stated they would prefer the population of giant armadillos remained stable or increased in their region.

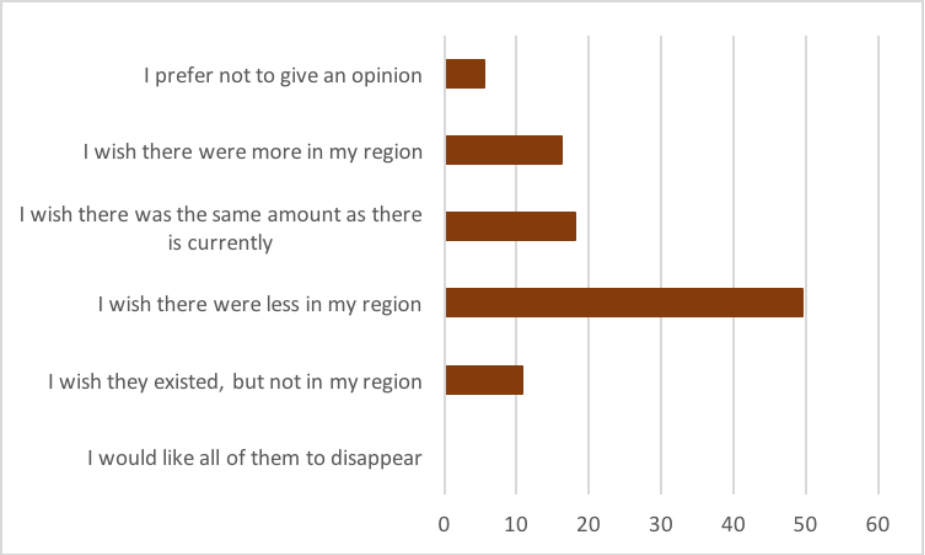
Table 3. Descriptive statistics of beekeepers' attitudes towards giant armadillos (*Priodontes maximus*) and towards its persecution.

Variable	Mean ± SD	Median	Min [a]	Max [b]
Attitudes towards giant armadillos	3.51 ± 6.1	4	-11 (-12)	12 (12)
Attitudes towards giant armadillos' persecution [c]	-5 ± 4.4	-8	-12 (-12)	8 (12)

[a.] Minimum value observed and minimum possible value observed (in parenthesis)
[b.] Maximum value observed and maximum possible value observed (in parenthesis)
[c.] Negative values indicate unfavourability to persecution; positive values indicate favourability to persecution

Finally, when asked about the reasons why giant armadillos destroy hives, 97,3% stated the animal does it because it needs to feed, showing a high understanding for the needs of giant armadillos, whereas only 2,7% believe that they do it because they are destructive animals.

Figure 3. Frequency of responses' category to investigate the beekeepers' NIMBY (*Not in my back yard*) sentiment about giant armadillos (*Priodontes maximus*).



3.2. Conflict situation

Damage by giant armadillos was cited as a current limitation to beekeeping by 27,9%, second only to the use of pesticides cited by 39,6%. When asked about the main limitation to beekeeping five years ago, 48.6% of respondents stated giant armadillos were their biggest problem then. Forty-six per cent of respondents reported beehive damages by giant armadillos in the last 5 years, almost the same rate (44,14%) reported for the last 12 months. The largest percentage of interviewees (38%) who had experienced damage reported losing 25–50% of their beehives in the last 12 months while 42% lost <25% and 20% lost >50% of their beehives.

The damage was an important factor explaining beekeepers' attitudes towards giant armadillos. When comparing attitudes towards the species among three groups of beekeepers (no damage, low damage and medium/high damage) a Kruskal-Wallis test indicated there was a difference ($X2 = 11.981$, d.f. =2, $p < 0.001$) between the mean ranks of at least one pair of groups. Dunn's pairwise tests for the three pairs of groups evidenced a consistent difference ($p < 0.001$, Bonferroni correction adjusted) on attitudes between beekeepers who experienced medium to high damage ($H = 35.53$) and those that did not ($H = 64.36$). There was no evidence of a difference between the other pairs ($p > 0.05$).

The Kruskal-Wallis test also indicated there was an effect of the group on attitudes towards the giant armadillo persecution [$X2= 14.997$; d.f. = 2, $p < 0,001$]. Dunn's pairwise tests ($p < 0.001$) adjusted using Bonferroni correction showed that beekeepers groups differed in how much they agreed with the persecution of giant armadillos. Beekeepers who experienced medium/high damage ($H = 81,56$) differed from those who did not ($H = 48,67$). The same was found when comparing the group that experienced low damage ($H = 57,64$) and the one that

experienced medium to high damage. There was no evidence that beekeepers' attitudes differed between those that experienced low damage and those that did not ($p > 0.005$).

The results from the multinomial regressions assessing the effect of damage on attitudes towards giant armadillos show a similar trend. The first multinomial regression tested the importance of damage on beekeepers' attitudes towards giant armadillos (**Table 4**). Pearson [$X^2(208)199.287$, $p = .656$] and Deviance chi-square [$X^2(208)157.454$, $p = .996$] tests indicated that our model fits the data well and supported the existence of a relationship between the extent of damage in the last 12 months and attitudes toward giant armadillos [Model $X^2(d.f.=12) = 44.396$, $p < 0.001$; classification accuracy rate 69.4% higher than the proportional by chance accuracy rate]. Damage ($b = 0.54$, s.e.=.016, $p < .001$, odds =1.055) was a significant predictor of attitudes towards the species as beekeepers scoring higher on this variable were more likely to hold negative attitudes toward the species. The odds ratio indicates that an increase in damage of 1 beehive destroyed would increase the chance that the beekeeper holds negative attitudes toward giant armadillos by a factor of 1.055. Beekeeping experience ($b = .051$, s.e.=.026, $p<.05$, odds=1.052) and age ($b=0.49$, s.e.=.024, $p<.05$, odds=1.050) were also significant predictors in the model. Years of formal education, being a member of the beekeeping association and having beekeeping as a main source of income did not correlate with attitudes towards the species.

According to the goodness-of-fit tests (Pearson [$X^2(206)168.337$, $p = .974$] and Deviance chi-square [$X^2(206)105.679$, $p=.999$] of the second multinomial regression model (**Table 4**), data supported the effect of damage on attitudes towards giant armadillo persecution [Model $X^2(d.f.=12) = 45.882$, $p < 0.001$; classification accuracy rate 71.2% higher than the proportional by chance accuracy rate]. Extension of damage and social norms (i.e., the one's perception about what constitute appropriate conduct by their peers) contributed significantly to the model, but age, beekeeping as the main source of income and beekeeping experience did not contribute to the model. Beekeepers who experienced damage were 1.048 times more likely to be in the favourable to persecution group than in the unfavourable group and believing that other beekeepers are favourable and would approve giant armadillos' persecution (i.e., social norms) increased the odds of being in the favourable to persecution group by 5.23.

Non-negative attitudes toward the species were presented by 65,3% of beekeepers who experienced damage, showing a Tolerance to Damage Index of 0,09.

3.3. History of attempts to solve the conflict

While some beekeepers adopted non-lethal mitigation strategies, others used lethal methods to get rid of hive-damaging animals, including poisoning and trapping. Beekeepers reported that trapping was almost always unsuccessful, time-consuming, and hence frustrating.

Poisoning was reported as very successful, as giant armadillos returned to feed on the fallen bee combs in the following nights.

Almost all (94,6%) beekeepers have voluntarily implemented at least one among 10 non-lethal methods intended to prevent giant armadillo attacks in the last 12 months. Three of them were considered highly effective, although only 30,6% of beekeepers have attempted to implement them, four were considered moderately effective ant three little effective. Less than half of the interviewees (41,4%) had previously tested at least one among the measures of low effectiveness that failed to prevent giant armadillo damage to their beehives.

3.4. Willingness to find solutions

Almost all beekeepers (96.4%) were willing or very willing to make changes in how they raise bees so as not to lose more hives to the giant armadillo.

3.5. Others involved in the HWC

The large majority (82%) of interviewed beekeepers would like or would like very much to receive third-party assistance to end the attack of giant armadillos on hives. We identified four potential stakeholders in beekeepers' narrative: government agencies, beekeeper's associations, silvicultural companies, and NGOs. None of them was negatively viewed by beekeepers, although they were somehow ambivalent about the perceived trustworthiness in receiving support from government agencies. While some local agencies instilled more confidence (e.g. SENAR and AGRAEL), others were considered suspect. Even so, beekeepers did not deny future collaboration with them to find conflict solutions. Beekeeping associations, where they exist, are active and appreciated institutions because beekeepers periodically rely on them for expert advice. These associations are often linked to silvicultural companies, who seek ways to implement environmental compensation schemes through promoting honey production in planted forests and agroforestry systems. These companies are also positively viewed by beekeepers, as many of them were trained and received the initial equipment to get started in beekeeping. Few beekeepers mentioned non-governmental organisations (NGOs) as potential supporters.

Table 4. Multinomial logistic regressions of the association between Beekeepers' characteristics/ experience and: (i) attitudes toward giant armadillos (*Priodontes maximus*) (Model 1) and (ii) attitudes towards their persecution (Model 2).

Response variable group	Predictor variable	*Exp (B)*	*P*	95% Confidence Interval for *Exp(B)*	
				Lower limit	Upper limit
Model 1 [a]					
Negative attitudes	Intercept		.028		
	Damage	1.055	.001*	1.024	1.088
	Schooling years	.841	.084	.692	1.023
	Beekeeping experience	1.052	.047*	1.001	1.107
	Being part of an association	.887	.839	.279	2.820
	Age	1.050	.044*	1.001	1.101
	Beekeeping as the main source of income	.573	.623	.062	5.274
Neutral attitudes	Intercept		.252		
	Damage	.971	.470	.898	1.051
	Schooling years	.943	.550	.778	1.143
	Beekeeping experience	1.096	.001*	1.039	1.156
	Being part of an association	1.049	.944	.275	3.996
	Age	.989	.671	.939	1.042
	Beekeeping as the main source of income	2.98	.273	2,98E-06	2,98E-06
Model 2 [b]					
Favourable to persecution	Intercept		.052		
	Damage	1.048	.035*	1.003	1.096
	Schooling years	.987	.933	.725	1.343
	Beekeeping experience	1.100	.033*	1.008	1.201
	Age	1.054	.270	.960	1.159
	Beekeeping as the main source of income	.121	.062	.013	1.113
	Social norms	5.232	.003*	1.780	15.380
Neutral to persecution	Intercept		.028		
	Damage	1.046	.007*	1.012	1.081
	Schooling years	1.047	.649	.860	1.274
	Beekeeping experience	.993	.810	.935	1.054
	Age	1.040	.136	.988	1.095
	Beekeeping as the main source of income	.404	.174	.109	1.493
	Social norms	1.274	.402	.723	2.244

a. Reference category: positive attitudes
b. Reference category: unfavourable to persecution

*P<0.05
Pseudo R^2 (Model 1) = 0.39
Pseudo R^2 (Model 2) = 0.46
Log likelihood (Model 1) = 157.454
Log likelihood (Model 2) = 105.679

4. Discussion

Understanding the intricacies of a HWC is necessary before deciding whether and how to suggest management practices or strategies. By using the conflict analysis framework proposed by Zimmermann *et al.* (2020), we gained a more thorough and transparent assessment of the conflict scenario involving beekeepers and giant armadillos. For instance, the evidence gathered within this framework allowed us to recognize that this is an individual scenario where the conflict over wildlife is not yet rooted in less visible, more complex social disagreements between people and groups (Madden and Mcquinn, 2014). In contrast, much of the conflict analysed here is shaped by material disputes at the first level, since the material losses incurred are indeed the core of beekeepers 'dissatisfaction. However, our findings also provided some clues that the conflict could be approaching the second level, as there is beginning to be resentment towards the species causing the damage. A closer examination of each of the five key areas of analysis helps us to understand why.

Five indicators were used to assess the first key area – beekeepers' perceptions towards giant armadillos. These indicators contributed appropriate contextual information on how local beekeepers perceive giant armadillos, with slight variations in the perception' domain. The conflict analysis framework suggests that when stakeholders appreciate a species – i.e. they have neutral or positive perceptions about it, the conflict is at the first level (Zimmermann *et al.*, 2020). Our first indicator – the result of the free listing – showed that negative terms about giant armadillos were less frequent and less salient, with a predominance of neutral characteristics when referring to giant armadillos (usually physical attributes), followed by positive aspects. Three indicators (i.e., attitudes, perception of species' benefits and understanding for its needs) pointed out that most beekeepers highly value, understand, and appreciate giant armadillos. Although damage associated with wildlife often decreases a species' appreciation (Dickman, 2010), the cost-benefit balance of living with damage-causing wildlife is accounted as influencing people's views about the species (Treves and Bruskotter, 2014). Thus, when beekeepers were asked about giant armadillos without mentioning their potential damages, positive perceptions were high.

However, our last indicator to assess perceptions, the NIMBY (Not in my back yard) sentiment, revealed beekeepers' low preference for spatial proximity with giant armadillos. NIMBY term was coined to characterise residents' motivations to protect their turf from the installation of generally undesirable facilities (e.g. incinerators, jails) (Dear, 1992). The concept assumes people often approve a certain facility and demand its benefits; even so, they are unwilling to pay the costs of hosting it in their backyards (Hamazaki and Tanno, 2002). Similarly, giant armadillos are often positively valued, but hosting them locally may be undesirable for those depending on beekeeping. The unwanted consequence, i.e. giant armadillos' damage to

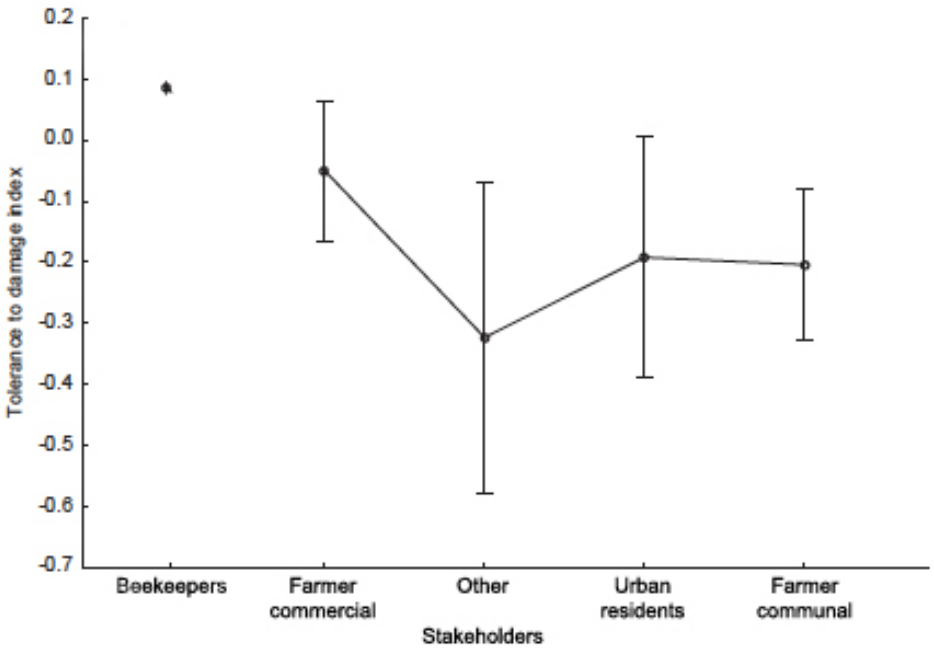
beehives, can be very destructive, therefore affecting beekeepers' livelihoods (Desbiez *et al.*, 2020). Because strong NIMBY sentiment often results in antagonism between those who do not need to host and the "host group" (Dear, 1992), beekeepers' perceptions that living close to giant armadillos has high negative consequences suggests this conflict is approaching the second level, when groups' disagreements may arise (e.g. between beekeepers and wildlife conservationists).

The second key area of analysis suggests the tangible impacts - losses inflicted by giant armadillos - are the core of beekeepers' dissatisfaction, in line with level-1 conflicts. This is evidenced by three of our findings. First, the damage claimed is very salient (i.e., frequent and very destructive). Most interviewees experienced damage by giant armadillos at least once, occasionally with substantial economic losses. A few were even forced to abandon certain honey production locations, due to the extent of giant armadillos' depredation. Certain conflicts, when closely analysed, suggest the negative impacts claimed are not always real, but perceived as such (Dickman and Hazzah, 2016). For instance, Maasai inhabitants in Kenya reported high levels of conflict with lions; however, actual rates of damage were quite low, with less than 5 % of all depredation events attributed to lions (Hazzah *et al*., 2009). In those conflicts, often there are other factors behind people 'dissatisfaction. In the case of the giant armadillos' conflict the negative impact claimed -the destruction of beehives- is real.

Second, damage plays an important role in explaining beekeepers' attitudes towards giant armadillos and to their persecution. Beekeepers affected by higher level of losses were more likely to hold negative attitudes towards giant armadillos and more favourable to their persecution. This contrasts with other studies that claim the extent of the damage experienced does not directly correlate with the conflict intensity or the attitude direction (e.g. Naughton-Treves *et al.*, 2003; Shelley *et al.*, 2011). When damage does not drive stakeholders' attitudes toward species, mitigating damage would not alleviate conflict. In this case, damage clearly drives stakeholders' attitudes toward species.

Third, beekeepers' tolerance to giant armadillo's damage is high, another aspect suggested by Zimmerman et *al.* (2020) to classify a given conflict in the first level. In comparison, a meta-analysis conducted by Kansky *et al.* (2014) to investigate attitudes and tolerance towards four groups of damage-causing mammals (carnivores, ungulates, elephants, primates) found lower values of tolerance for all stakeholders evaluated (**Figure 4**).

Figure 4. Comparison of the beekeepers' Tolerance Index with mean values/dispersion of tolerance to damage index by stakeholder group of a meta-analysis conducted by Kansky *et al* (2014). A tolerance value of zero indicates neutrality (i.e., the proportion of respondents with a positive attitude is proportional to the percentage of respondents experiencing damage). Negative values indicate low tolerance, whereas positive values indicate high tolerance.



The third and fourth key area of analysis (i.e. the history of attempts to solve conflicts and willingness to find solutions) are closely related to each other and, therefore, can be analysed altogether. Zimmerman and colleagues (2020) indicate that high willingness to adapt management habits to reduce losses can be a demonstration of first-level conflicts, but a history of unsatisfactory attempts to address previous incidents may evidence second level conflicts. Recent research on giant armadillo behaviour in beekeeping locations showed that beehives at ground level were specific targets to giant armadillos' raids (Desbiez *et al*., *in press*). In our study, almost all beekeepers were willing or very willing to change their bee management practices to avoid hive losses to giant armadillos. In fact, most of them have already voluntarily implemented at least one non-lethal method to prevent giant armadillos' raids in the last 12 months, reporting variable rates of success. This shows their high willingness to attempt loss reduction without resorting to methods harmful to giant armadillos.

However, less than a third of the interviewees were satisfied with the effectiveness of the attempts and 41,4% of interviewed beekeepers had previously used at least one of the measures that failed to prevent damages to their beehives. Frustrating attempts can lead to resentment towards the species, thus leading beekeepers to use easier to implement lethal strategies such as poisoning. According to beekeepers, poisoning is highly successful as giant

armadillos return to feed on fallen bee combs. Once the culprit is killed, predation stop for an average of three years.

In many parts of the world, wildlife is a nuisance to beekeepers (e.g. Otto and Roloff, 2015; Carter *et al.*, 2017). Some of the highly effective non-lethal methods reported by interviewed beekeepers are similar to those used to prevent attacks to beehives from bears in the United States, such as electric fences (Maehr and Ds, 1982), and those used against honey badgers in South Africa, where hives are also fixed to stands (Begg and Begg, 2002). These authors, however, highlight that alternative methods may reduce damage but require extra time, labour, and financial investments from beekeepers.

The fifth key area of analysis contemplates other stakeholders involved in the issue. The quality of relationships between stakeholders and organisations in a conflict setting is supposedly important drivers of the tolerance to damaging species. Individuals who perceive involved organisations negatively will more likely perceive a species' associated costs to their livelihoods than its benefits, therefore leading to lower tolerance to damage (Kansky *et al.*, 2016). In our study, we did not identify resentment to any of the third parties identified by beekeepers as potential contributors to conflict solving. This observation reinforces our argument that the conflict arises from beekeepers' negative interactions with giant armadillos and not with other human stakeholders. Additionally, within a conservation conflict context, mistrust and misunderstanding with third parties can potentially lead to non-compliance and opposition to conservation initiatives (Young *et al.*, 2016; Baynham-Herd, 2020). Therefore, our results indicate there is an open path to interaction and collaboration between parties to seek conflict alleviating solutions.

5. Conservation implications

Conflict resolution initiatives must adapt approaches according to the strength and characteristics of a given conflict. Adopting the Zimmerman and colleagues' conflict analysis framework, we obtained a complete and reliable assessment of the conflict scenario, with important considerations to inform management interventions. Firstly, given that conflicts involving giant armadillos are predominantly shaped by negative beekeepers-giant armadillo impacts, we suggested that interventions to mitigate those impacts are appropriate. For example, if beekeepers learn how to prevent giant armadillos' raids - and a high percentage are willing to do so- then they are more likely to keep their positive attitudes about the species while protecting their livelihoods. We note, however, that most mitigation methods to protect hives require extra time, labour, and financial investment from beekeepers. The adoption of such interventions could fail to alleviate conflicts if the additional costs and human effort demanded

increased resentment towards the species. Identifying low-cost alternatives to manage giant armadillos' attacks but also to improve people's livelihoods are therefore warranted, especially those able to benefit people from the species' presence.

Additionally, our analyses indicate there are open opportunities to build trust and relationships among involved stakeholders to find solutions that alleviate conflict. Initiatives could benefit from incorporating beekeepers' suggestions into the management planning and implementation process. This may help to ensure sustained engagement of beekeepers and long-term conflict resolution. Finally, we recall initiatives cannot take long to be implemented since Level 1 conflicts can worsen over time and even high tolerance levels can deteriorate quickly (Gureja, 2007).

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CONSIDERAÇÕES FINAIS

Compartilhar o espaço com a vida silvestre pode representar ameaça à segurança, subsistência e bem-estar psicológico das pessoas. Por vezes, essa convivência se traduz em respostas retaliatórias e pouco apoio, ou mesmo rejeição, à conservação das espécies envolvidas, além de divergências entre grupos sobre qual a melhor forma de resolver a situação (IUCN, 2020). A abordagem interdisciplinar utilizada neste estudo forçou-nos a perceber que as três interações humano-fauna investigadas provocam algum tipo de impacto negativo nas espécies envolvidas, mas também nas pessoas que convivem com elas. No primeiro capítulo foi visto que, embora as colisões veiculares sejam grave ameaça à fauna, elas incorrem em custo psicológico, financeiro e risco à segurança dos condutores que trafegam nas rodovias. No segundo capítulo, verificou-se que a superstição pode ocasionar perseguição aos tamanduás-bandeira, mas também afeta o bem-estar psicológico de quem a detém, além do risco a que estão expostos aqueles que se envolvem em comportamentos supersticiosos de contato com o animal. O terceiro capítulo mostrou que o principal motivo por trás da retaliação ao tatu-canastra nos apiários é a insatisfação do apicultor pela predação de suas colmeias e consequente prejuízo financeiro. Assim, a compreensão das nuances dessas interações trouxe a oportunidade de pensar em estratégias integrativas para melhorar a relação das pessoas com esses animais. Com esta finalidade, no final de cada capítulo, apresentaram-se sugestões práticas para a melhoria das interações humano-fauna aqui exploradas. A parceria estabelecida com a ONG ICAS vem possibilitando a implementação dessas sugestões na área de estudo onde a presente pesquisa foi conduzida. Portanto, além de contribuir com informações novas à Ciência da Conservação, a partir de aporte teórico ou metodológico das Ciências Sociais, talvez o ponto mais forte desta tese resida em mostrar como resultados científicos podem ser diretamente aplicados. Ou seja, por meio de colaborações entre a universidade e organizações da sociedade civil, é possível ir além do discurso sobre a lacuna ciência-prática, para a implementação direta – e rápida - do conhecimento gerado. A breve descrição a seguir das ações que estão sendo conduzidas, através desse esforço colaborativo com o terceiro setor, serve para ilustrar este argumento.

No âmbito das colisões veiculares com a fauna, foi recentemente aprovada uma proposta submetida à Fundação Segre (*ver* www.fondationsegre.org) intitulada “Anteaters & Highways II: Human, Political, and Institutional dimensions to reduce Wildlife -Vehicle Collisions”. Parte dos objetivos da proposta estão diretamente relacionados aos resultados aqui obtidos. Por exemplo, a criação do programa de Ciência Cidadã *Heróis das Estradas,* o qual visa incentivar caminhoneiros autônomos a reduzirem a direção noturna nos *hotspots* das colisões veiculares

com fauna em um trecho da BR 262, assim como engajá-los na pressão ao poder público por rodovias mais seguras. No decorrer dos três anos desse projeto, serão também realizadas campanhas de *marketing* social que estimulem a valorização dos caminhoneiros perante a sociedade. Outro objetivo da proposta é engajar as empresas de transporte a aderirem a um esquema de certificação, através da redução da direção noturna de seus funcionários, buscando soluções individualizadas para as barreiras identificadas.

Em relação às superstições sobre o tamanduá-bandeira no Pantanal sul-mato-grossense, foi desenvolvido o livreto infantil *O Incrível Tamanduá-bandeira* (Material suplementar 4). O material traz informações simples e diretas sobre as principais características não-compreendidas da espécie, identificadas através deste estudo como motivadoras da assimilação de superstições sobre o animal. Com o apoio do Greenville Zoo, Fundação Segre e Reid Park Zoo, foram impressos 5000 exemplares desse livreto. Elaborou-se, ainda, um segundo material: *O Incrível Tamanduá – Manual do Professor* (Material suplementar 5). Na publicação, há informações adicionais sobre a espécie e sugestões de atividades para serem realizadas em sala-de-aula. Com foco nas questões centrais da interação humano-fauna, o material busca oferecer subsídios para que os educadores possam abordar o tema na comunidade escolar. Ambas as publicações foram desenvolvidas através do ICAS, com apoio da Fundação Segre e do Instituto de Pesquisas Ecológicas – IPÊ. A equipe de Educação Ambiental do ICAS vem utilizando esses materiais no trabalho de longo prazo que está sendo conduzido nas escolas rurais do município de Aquidauana (MS).

No que diz respeito à interação dos apicultores com os tatus-canastra, a análise de conflito conduzida neste estudo trouxe segurança de que a mitigação do dano gerado pelo tatu-canastra às colmeias pode constituir uma estratégia adequada para melhorar a relação entre as partes. Assim, a equipe do ICAS identificou e testou medidas de baixo custo, fácil implementação e alta efetividade em proteger as colmeias dos tatus-canastra (*ver* Desbiez *et al*., 2020, no prelo). Apicultores vem sendo incorporados como parceiros no processo de planejamento e implementação de um esquema de certificação do mel, para aqueles que adequarem seus apiários às novas práticas propostas. Entende-se que a estratégia poderá gerar benefícios aos apicultores não só por meio da proteção de suas colmeias, mas também potencial expansão do comércio de seus produtos para setores do mercado verde.

Acredita-se que a compreensão interdisciplinar do contexto no qual as interações humano-fauna ocorrem, aliada ao esforço colaborativo entre diversos atores envolvidos, pode gerar soluções para a persistência da vida silvestre de forma socialmente justa.

Referências

IUCN. 2020. IUCN SSC Position Statement on the Management of Human-Wildlife Conflict. IUCN Species Survival Commission (SSC) Human-Wildlife Conflict Task Force. Available at: www.iucn.org/ theme/species/publications/policies-and-position-statements.

DESBIEZ, A. L. J.; OLIVEIRA, B.; CATAPANI, M.L. 2020. Bee careful! Conflict between beekeepers and giant armadillos (*Priodontes maximus*) and potential ways to coexist. Edentata. *In press*.

SUPPLEMENTARY MATERIAL 1

PROCAMUSP		**Interview date:**____/____/2018 **Start of interview:**____:____hs **End of interview:**____:____hs
HUMAN DIMENSIONS OF WILDLIFE TRUCK-COLLISIONS	Semi-structured interviews	**Locality:** _____ **Number of the interviewee: |_____|**

Interviewer presentation and study objectives presentation

Hello. My name is Mariana, I am a student at the University of São Paulo and I am doing research with truck drivers to better understand how this profession is and how is the relationship of the truck drivers with the road. Last year I talked to some truckers who told me a little about what's good and what's bad in your profession. So this time, I want to explore each of these points further. Do you have time now? The whole interview should take about 50 minutes.

If the potential interviewee agrees to participate: I would like to thank you for participating in this study. Please excuse me to write down the answers because it is too much to remember and I do not want to get confused later. Please, if you have any questions during the interview, you may ask. I will first ask some more general questions about you.

A – INTERVIEWEE GENERAL INFORMATION

A1. *Gender: |__| Male |__| Female |_| Other*

A2. How old are you? *|_| years*

A3. In what state were you born? _____

A4. In what state do you live? _____

A5. In which professional category do you fall into?

|__| *Self–employed* |__| *Commissioned* |__| *Employee* |__| *Other*: _____

B – BEING A TRUCK DRIVER

B1. Could you tell me a little bit about being a truck driver?

Probe [How long have you been a truck driver?]

[What motivates you to choose the profession?]

[Are you united as a group?]

[Are you proud to be one of them?]

B2. What do you enjoy most about your profession?

To note: salience (write down the order in which things are mentioned)

For each factor mentioned, go deeper.

Probe: [How is it?]

[How do you feel about it?]

Probe if not mentioned: [How is the issue of freedom?]

B3. Is there something you think is bad in your profession?

To note: salience (write down the order in which things are mentioned)

For each factor mentioned, go deeper.

Probe: [How is it?]

[How do you feel about it?]

[What could be done to solve this?]

B4. What is the hardest part of being a truck driver?

Probe if not mentioned: [How much time do you usually spend away from home?]

[How long on average do your trips last?]

[What are the intervals between one trip and another?]

B5. Do you think that your job is dangerous?

[What kind of dangers are there?]

[Can you do something to prevent these things from happening or are things beyond your control?]

B6. What are your biggest fears when you're on the road?

To note: salience (write down the order in which things are mentioned)

[How do you feel about it?]

B7. Do you have any superstitious rituals to bring luck or protection?

Probe: [Tell me a bit about it]

C– THE DAILY ROUTINE

C1. Could you tell me a little bit about your daily routine at work?

C2. Do you cook your own meal?

Probe: [How is it?]

C3. Where do you usually sleep (in the truck or hotel near the stop points)?

Probe: [How is it?]

C4. How do you choose your stop points?

Probe: [Do you have a certain schedule when you make the stops?]

[Do you stop always in the same places?]

[The choice for a stop point take into account meeting other truck drivers, meeting friends or acquaintances?]

C5. Do you have many trucker friends?

Probe: [Do you have any moments you get together with other drivers to chat?]

[Do you usually tell to each other about the things that happened on the travels?]

[Do you chat to other truckers via messages and whatsapp?]

C6. Do you prefer to drive by day or night?

Probe: [What are the advantages and disadvantages of driving at each of these times?]

C7. Do you usually travel alone or does someone accompany you?

Probe: [Who is this person?]

[What are the reasons for this person to accompany you?]

D – ANIMALS APPEARING ON THE TRACK

D1. I have heard that in this region many animals cross the road lane. It is true?

Probe: [How is it?]

D2. What do you usually do when you see an animal on the track?

Probe: [Why?]

D3. Do you think there's something bad about this animals being on the track?

[What is it?]

[How do you feel about it?]

If it not appears: [...and for the animals, do you think this is bad for them?]

[Why?]

If it not appears: [...and for the drivers, do you think this is bad for you?]

[Why?]

D4. Is there anything you do to prevent encounters with animals on roads?

[What is it?]

D5. Are you afraid of crash with any animal on the track when driving?

Probe: [What animals?]

[Why?]

E – ATTITUDES TOWARD GIANT ANTEATERS

E1. On the way from town here I saw one giant anteater near the road. Do you usually see this animal in this region?

Probe: [How would you describe this animal?]

[Do you like this animal or not?]

[Do you think it's a beautiful or an ugly animal?]

E2. What about the other truckers, what do they think about this animal?

E3. Are you afraid of this animal for any reason?

Probe: [Why?]

E4. Do you think the number of anteaters is increasing or decreasing in recent years?

Probe: [Why?]

E5. Did you wish the amount of anteaters to increase, decrease or do you think it is good as it is?

Probe: [Why?]

E6. Is it common to see giant anteaters' run over here?

Probe: [And why do you think it's so run over?]

E7. For you, how is when a giant anteater appears on the track?

F – ATTITUDES TOWARD GIANT ANTEATERS SUPERSTITIONS

F1. Have you ever heard any superstitions about the giant anteater? *(If the interviewee has never heard of it, skip to the next session).*

Probe: [How is it?]

[And is that really true?]

[How do you feel about it?]

[Are there a lot or a few people who say that?]

[Where do you think this came from?]

[Is there anything you can do to avoid this bad luck?]

G – ROADKILLS

G1. Have you ever crashed with any animal on highways in those years as a trucker?

Probe: [How many times do you remember crashing into animals on highways?]

[Can you remember what animals have you crashed?]

[Can you remember what animals have you crashed in the last 12 months?]

[How was it?]

[When was it?]

G2. Have these collisions caused any damage to the truck?

Probe: [What is it?]

G3. Have you ever had to stop the truck after a crash with animal?

Probe: [Why?]

G4. Have you had any financial losses with these crashes?

Probe: [What types of damage occurred to the truck?]

G5. What are the animals that, if you crash, can bring you some kind of danger?

Probe: [How is it?]

G6. What are the animals that, if you crash, can bring you some kind of financial loss?

Probe: [How is it?]

G7. How do you feel when you crash an animal?

Probe: [Why?]

G8. What is the first thing that comes to your mind when it happens?

Probe: [Could you tell me a little bit about it?]

G9. Why do you think this area has so many animals being run over?

Probe: [At what times of the day is most common for animals to be run over?]

[In what type of highways is most common for animals to be run over?]

G10. What are the animals most often killed on the highways here?

To note: salience (write down the order in which animals are mentioned)

For each animal mentioned: [And why do you think it's so run over?]

H – ATTITUDES TOWARD ROADKILL

H1. Do you think that roadkill is a serious threat to wildlife here in the region?

Probe: [For what animals?]

[Why?]

H2. In your opinion, who is to blame for it? (the animal, the driver, the government, the highways dealership?)

Probe: [Why?]

H3. Do you think something could be done to prevent these roadkills?

Probe: [What is it?]

H4. Do you think the government should do something?

Probe: [What is it?]

H5. Do you think the animal is to blame for being run over?

Probe: [Why is it?]

H6. Do you think the highways dealership should do something?

Probe: [What is it?]

I – CITIZEN SCIENCE

I1. Do you think that drivers could do something to minimize this problem of wildlife crash?

Probe: [What is it?]

I2. What do you think you, in particular, could do to minimize this problem of wildlife crash?

I3. Do you think knowing where these roadkillers are most concentrated can somehow help minimize the number of it?

Probe: [How?]

I4. Would you like to participate in a project that monitors these runovers, that is, participate in a program that chooses some drivers to help saying where they saw these run over animals, and then gathering the locations of these data would give to know where there are more run over and perhaps with this, propose structural measures for these sites to minimize these crashes?

Probe: [How it could be?]

I5. Would participating in something like this bring you something good?

Probe: [What is it?]

[Why?]

I6. How would you feel about participating in this?

Probe: [Why?]

I7. Do you see any disadvantages in participating in this?

Probe: [What is it?]

[Why?]

J – LOGISTICAL ISSUES OF IMPLEMENTING A CITIZEN SCIENCE PROJECT

J1. Are you part of any Truckers Cooperative or Association?

Probe: [What is it?]

[Where is?]

[For how long have you been part of this?]

J2. And how does this membership work?

Probe: [Do you see any benefit in being part?]

[Are there any disadvantages?]

[Is there any financial contribution you have to make to be part of this Cooperative?]

J3. Do you travel with any cell phone?

Probe: [Does this device have internet access?]

[Do you use wifi when you arrive somewhere or do you have 3G, 4G?]

[In what moments do you use the internet in your cell phone?]

J4. Do you have Whatsapp?

*Probe***:** [How often do you use it?]

[What other apps do you have on your phone?]

J5. Do you have email?

Probe: [Do you use email for something?]

How often?

K– INTENTIONAL ROADKILL

K1. Is there any animal that disturbs you that you think that is ok to run over it?

Probe: [What animals?]

[Why?]

K2. Are there any animals that you would feel good running over for some reason?

Probe: [What animals?]

[Why?]

K3. Is there any animal that you think, because it has many of them, ends up being good to run over, to avoid having too much?

Probe: [What animals?]

[Why?]

K4. Are there any animals that, in particular, you would feel bad about running over?

Probe: [What animals?]

[Why?]

K5. Are there any animals that, if it cross in front of you on the track, you think is unlucky?

Probe: [What animals?]

[Why?]

[Is there something you can do to avoid this bad luck?]

K6. Do you think most wildlife truck collisions are accidental or intentional? When I say "intentional", I mean those cases where the driver dodge the truck to hit the animal or when the driver accelerates to hit the animal or when one would be able to divert or brake safely, but choose not to do so or because don't like the animal or for some other reason.

Probe: [How's that?]

[Do you think that little or a lot of truck drivers run over animals on the roads on purpose?]

[What animals do you think are run over on purpose by truck drivers?]

[What are the motivations of these truck drivers who runs over on purpose?]

K7. And about other vehicles, like small cars, do you think most of the collisions with animals are accidental or intentional?

Probe: [How's that?]

[Do you think that little or a lot of small cars run over animals on the roads on purpose?]

[What animals do you think are run over on purpose by these drivers?]

[What are the motivations of these drivers who runs over on purpose?]

[Do you think they are afraid of being punished for it?]

Probe: [Why?]

K8. Do you usually talk about it? Do you hear friends or acquaintances tell about it?

Probe: [How's that?]

[People who do it like to talk about it or not?]

[Why is it?]

L – EXPLORING PEERS' BEHAVIOR

L1. Could you tell me the number of your close friends that you know with certainty have run over purposely any animal on roads?

Probe: [What animals?]

[They tell you why they did it?]

M – TESTING THE RANDOMIZED RESPONSE TECHNIQUE

We are almost done here. Now we are going to do something like play a game. I will ask you a question and I will say some things for you, you can consider it as the rules of the game, all righ?

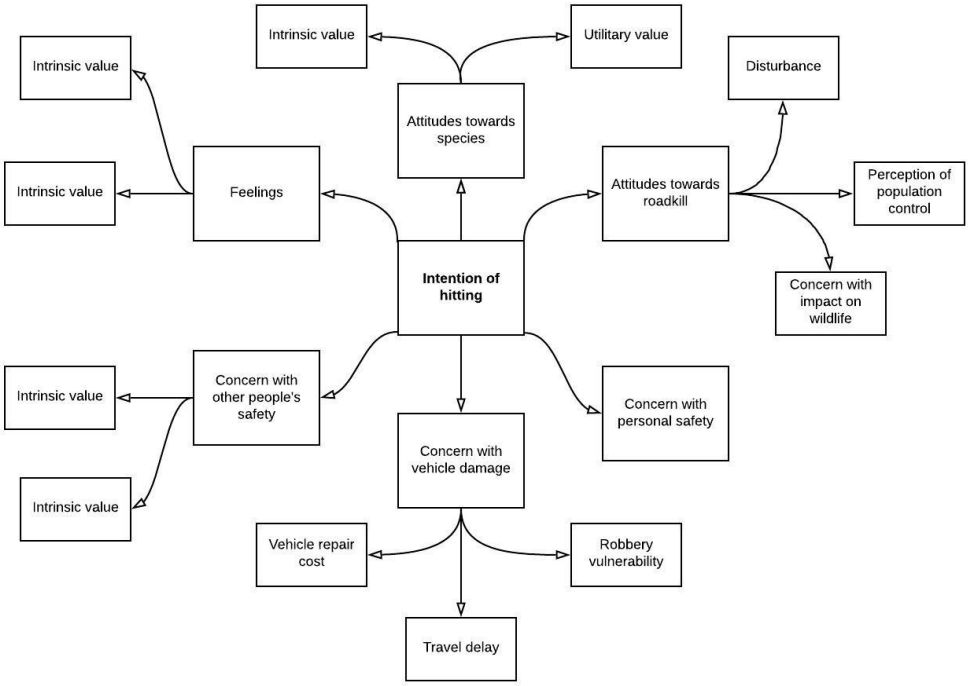
For this question, I want you to answer **yes or no**. But I want you to consider the number of your dice throw. If 1 shows on the dice, tell me "no". If 6 shows, tell me "yes". But if another number, like 2 or 3 or 4 or 5 shows, tell me your own opinion about the question that I will ask you after you throw the disse *[turn away from the respondent].* Now you throw the dice so that I cannot see what comes. Please do not forget the number that come out [*wait to turn around until respondent says yes to:*] Have you thrown the dice? Have you picked it up?

M1. In the last 12 months did you run over a giant anteater ON PURPOSELY?

When I say "ON PURPOSELY", I mean those cases in you dodge the truck to hit the animal or you accelerates to hit the animal or when it would be able to divert or brake safely, but you choose not to do so or because you don't like the animal or for some other reason.

Well, we're done. I would like to thank you very much for your willingness to help us with this research. I hope it can contribute in some way to having slightly safer roads in the state for you and for other drivers.

SUPPLEMENTARY MATERIAL 2



SUPPLEMENTARY MATERIAL 3

PROCAMUSP		**Data da entrevista:** ____/____/2019 **Início da entrevista:** ____:____ hs **Término:** ____:____ hs
INTERAÇÕES HUMANO-TAMANDUÁ	Entrevistas Estruturadas	**Localidade:**_____ **Número do indivíduo entrevistado: |_____|**

Nota: Os trechos em itálico são instruções ao entrevistador e não devem ser lidas ao entrevistado.

Bom dia/Boa tarde, eu sou estudante em uma Universidade em São Paulo e estou fazendo uma pesquisa para entender melhor qual é a opinião dos moradores daqui sobre alguns bichos que tem na região. A cada dia, a gente pergunta sobre um bicho. Hoje, nós queremos saber sobre o tamanduá-bandeira. O(A) senhor(a) teria um tempinho para nos ajudar? Nossa conversa deve demorar cerca de X minutos, mas se estiver ocupado(a) agora, a gente pode esperar.

Caso o potencial entrevistado aceite participar: Gostaríamos desde já de agradecer a participação do(a) senhor(a) neste estudo. Pedimos licença para anotar as respostas porque é muita coisa para lembrarmos de cabeça e para não nos confundirmos depois. Por favor, se ao longo da entrevista o(a) senhor(a) tiver alguma dúvida, pode perguntar.

Vou fazer primeiro algumas perguntas mais gerais sobre o(a) senhor(a).

I – CARACTERÍSTICAS DO ENTREVISTADO

1.1. *Sexo do entrevistado: |__| Homem |__| Mulher |__| Outro*

1.2. Você nasceu aqui no Brasil mesmo?

|__| Sim |__|Não

1.3. *Se não*, em que país nasceu? _____

Se sim, em que estado e município você nasceu? Estado _____ Município _____

1.4. Você mora aqui nesse município? |__| Sim |__|Não *Se não:* Em que município mora? _____

1.5. *Há* quantos anos você mora na área rural? |__||__| anos **OU** desde que nasceu |___| **OU** desde que tinha |___| anos

1.6. Você sabe sua data de nascimento? |__|__| |__|__||__|__| *ou* quantos anos completos você tem? _____

1.7. Você frequentou a escola em algum momento de sua vida? |__| Sim |__|Não (*se não → vá para **1.9***)

1.8. Até qual série da escola você estudou?

|_____| (*calcular anos de estudo*)

1.9. Você tem alguma religião? |__| Sim |__|Não

1.10. *Se sim*, qual?

|___| Adventista |___| Espírita
|___| Protestante |___| Test. Jeová |___| Outra
|___| Católico |___| Umbanda e Candomblé

1.11. Você frequenta algum local religioso? |__| Sim |__|Não

1.12. Nos últimos 12 meses, ou seja, de X até hoje (*mencionar o mês em que estamos*), com qual frequência você foi a esse local?

|___|Nenhuma vez |___| De 1 a 3 vezes |___| De 4 a 6 vezes |___| De 7 a 9 vezes |___| 10 ou mais vezes

1.13. Nos últimos 12 meses, ou seja, de X até hoje (*mencionar o mês em que estamos*), quantas vezes você foi à cidade?

|___|Nenhuma vez |___| De 1 a 2 vezes |___| De 3 a 4 vezes |___| De 5 a 6 vezes |___| 7 ou mais vezes

II – O TAMANDUÁ-BANDEIRA

2. Bom, agora eu gostaria de iniciar nossa conversa falando um pouco sobre o tamanduá-bandeira.

2.1. Você já viu um tamanduá-bandeira alguma vez na vida? |__| Sim |__|Não

2.2. *Se sim:* Você já viu na natureza mesmo, zoológico ou outro lugar? |__| Natureza |__|Zoo |__|Outro lugar

2.3. *Se na natureza*: Qual a frequência com a qual você viu esse animal nos últimos 12 meses, ou seja, de X até hoje?

|__|Nenhuma (= 0) |__|Muito raramente (=1) |__| Algumas vezes (=2)
|__|Muitas vezes (=3) |__|Quase todo dia (=4) |__|Todos os dias (=5)

2.4. Tem alguma coisa na aparência desse animal que te chame a atenção?

_____

III – APRECIAÇÃO ESTÉTICA DA ESPÉCIE

3. Gostaria que o(a) senhor(a) me dissesse o que o(a) senhor(a) acha do tamanduá-bandeira. Por favor, olhe para este papel (*mostrar a escala para ajudar a responder).* Quanto mais para o lado da carinha vermelha (*correr o dedo da esquerda para a direita)*, mais o (a) senhor (a) acha algo negativo sobre ele, e quanto mais para o lado da carinha verde, mais o (a) senhor (a) acha algo positivo sobre ele. Na sua opinião, o tamanduá-bandeira é um animal:

Usar a seguinte escala:

3.1. Muito bonito |____| |____| |____| |____| |____| |____| |____| Muito Feio
+3 +2 +1 0 -1 -2 -3

3.2. Agradável de olhar |____| |____| |____| |____| |____| |____| |____| Desagradável de olhar
+3 +2 +1 0 -1 -2 -3

3.3. Interessante |____| |____| |____| |____| |____| |____| |____| Que eu não tenho interesse em ver
+3 +2 +1 0 -1 -2 -3

IV – DESCONFORTO COM PARTICULARIDADES DA ESPÉCIE

4. Agora vamos falar de algumas **características específicas** do tamanduá-bandeira. Eu gostaria que o(a) senhor(a) me dissesse se o(a) senhor(a) acha esta característica nada ou muito esquisita. Por favor, indique na folha (*mostrar a escala para ajudar a responder*) o quanto você acha essa característica do animal esquisita. A **carinha da esquerda** quer dizer que o(a) senhor(a) **não acha a característica nada esquisita.** Indo para a direita, quanto mais para direita você me indicar, (*correr o dedo da esquerda para a direita)*, mais o(a) senhor(a) acha esquisita. A **carinha que está mais à direita quer dizer que você acha a característica demais de esquisita.**

Usar a seguinte escala:

4.1. Você já viu **a unha** do tamanduá-bandeira? Você acha a unha dele é:

|____| |____| |____| |____| |____| |____|

Nunca viu (0) Nada esquisita (0) Um pouquinho esquisita (1) Meio esquisita (2) Bem esquisita (3) Demais de esquisita (4)

4.2. Você já viu um tamanduá-bandeira andando? Você acha **o jeitão do tamanduá-bandeira andar é:**

|____| |____| |____| |____| |____| |____|

Nunca viu (0) Nada esquisito (0) Um pouquinho esquisito (1) Meio esquisito (2) Bem esquisito (3) Demais de esquisito (4)

4.3. Você já viu **o rabo** de um tamanduá-bandeira? Você acha que o rabo dele é:

|____| |____| |____| |____| |____| |____|

Nunca viu (0) Nada esquisita (0) Um pouquinho esquisita (1) Meio esquisita (2) Bem esquisita (3) Demais de esquisita (4)

4.4. Você já viu **o pelo** do tamanduá-bandeira? Você acha que o pelo dele é:

|____| |____| |____| |____| |____| |____|

Nunca viu (0) Nada esquisita (0) Um pouquinho esquisita (1) Meio esquisita (2) Bem esquisita (3) Demais de esquisita (4)

4.5. Você já viu **a língua** do tamanduá-bandeira? Você acha que a língua dele é:

|____| |____| |____| |____| |____| |____|

Nunca viu (0) Nada esquisita (0) Um pouquinho esquisita (1) Meio esquisita (2) Bem esquisita (3) Demais de esquisita (4)

4.6. Você já viu **o nariz** do tamanduá-bandeira? Você acha que o nariz dele é:

|____| |____| |____| |____| |____| |____|

Nunca viu (0) Nada esquisita (0) Um pouquinho esquisita (1) Meio esquisita (2) Bem esquisita (3) Demais de esquisita (4)

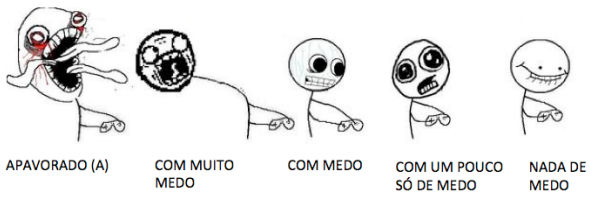
V – EMOÇÕES

Agora, eu gostaria de saber sobre o que o(a) senhor(a) sente pelo *tamanduá-bandeira* quando o(a) senhor(a) **ENCONTRA com** ele. Vou falar algumas emoções e gostaria que o(a) senhor(a) me dissesse se o(a) senhor(a) sente pouco ou muito delas. Por favor, aponte neste papel (*mostrar a escala para ajudar a responder*), qual é a emoção mais próxima do que você sente. Para este lado, você não sente nada de medo. *Para este outro lado, um pouco só de medo, muito medo ou fica apavorado* (*correr o dedo do bonequinho de um sentido para outro).*

MEDO

5.1. Quando você **encontra** um tamanduá-bandeira, você fica:

Usar a seguinte escala:



|____| |____| |____| |____| |____|

Apavorado (4) Com muito medo (3) Com medo (2) Com um pouquinho só de medo (1) Com nada de medo (0)

FELICIDADE

Agora eu queria saber se você fica feliz ou se você não fica feliz se você encontra com um tamanduá. A carinha mais para esse lado quer dizer que você não fica nada feliz, aí vindo pra cá (*correr o dedo do bonequinho da esquerda para direita) você fica um pouquinho feliz, meio feliz, bem feliz ou muitíssimo feliz.*

Usar a seguinte escala

5.2. Quando você **encontra** um tamanduá-bandeira, você fica:

|____| |____| |____| |____| |____|

Nada feliz (0) Um pouco feliz (1) Meio feliz (2) Bem feliz (3) Demais de feliz (4)

VI – ATITUDES EM RELAÇÃO À ESPÉCIE

6. Agora, nesta parte da entrevista, eu vou falar uma série de frases para você. Depois disso, gostaria de saber a sua opinião, ou seja, o que você acha mesmo, pois não tem opinião certa ou errada, cada um tem a sua. Para cada uma das frases que eu ler, por favor diga-me **se você concorda**, ou seja, se acha que o que a frase diz é verdade. E, nesse caso, se concorda só um pouco, pois acha que não é totalmente verdadeiro, ou se concorda muito, pois acha que é totalmente verdadeiro. Ou pelo contrário, **se você discorda** do que a frase diz e, novamente, se nesse caso discorda um pouco, ou discorda muito*. Ler a frase / você concorda ou discorda? Se concorda, concorda um pouco ou concorda muito? (Lembrar que as frases a seguir devem ser lidas afirmativamente e não como uma pergunta).*

Frases	Concordo muito	Concordo pouco	Nem concordo nem discordo	Discordo pouco	Discordo muito
6.1. O tamanduá-bandeira é um animal útil (+)					
6.2. O tamanduá-bandeira é um animal esquisito demais (-)					
6.3. O tamanduá-bandeira é um animal importante para mim (+)					
6.4. Encontrar um tamanduá-bandeira me deixa preocupado (-)					
6.5. Eu gostaria que existissem mais tamanduás-bandeira aqui na minha região (+)					
6.6. O tamanduá-bandeira é um animal que eu não gosto de ter por perto (-)					

VII – CONHECIMENTO FACTUAL SOBRE A ESPÉCIE

7. Agora eu vou falar para o senhor (a) algumas frases sobre o tamanduá-bandeira . Gostaria que você me dissesse se acha que a frase está certa, se você acha que a frase está errada ou se você não sabe se está certa ou errada.

7.1. Os tamanduás-bandeira se reproduzem com a língua.

|___| Certo (0) |___| Errado (1) |___| Não sei (0)

7.2. Só existem fêmeas de tamanduás-bandeira.

|___| Certo (0) |___| Errado (1) |___| Não sei (0)

7.3. É a fêmea de tamanduá-bandeira que cuida do filhote.

|___| Certo (1) |___| Errado (0) |___| Não sei (0)

7.4. Os tamanduás-bandeira colocam sua língua no nariz dos cachorros para se defenderem, matando os cachorros sufocados.

|___| Certo (0) |___| Errado (1) |___| Não sei (0)

7.5. Os tamanduás-bandeira são animais sem dentes.

|___| Certo (1) |___| Errado (0) |___| Não sei (0)

7.6. Os tamanduás-bandeira se reproduzem em roda, fazendo um círculo.

|___| Certo (0) |___| Errado (1) |___| Não sei (0)

VIII – CRENÇAS SUPERSTICIOSAS

8. Agora nós vamos entrar numa parte da nossa conversa que eu gostaria de saber se o senhor (a) acha que **o tamanduá-bandeira tem alguma coisa a ver com boa sorte ou com má sorte**. Sabe essas coisas de que ver um animal é sinal de algo bom que vai acontecer ou de algo ruim? Eu vou te falar algumas frases e gostaria que você me mostrasse na folha, apontando nessas carinhas (*mostrar a escala para ajudar a responder*) qual resposta você acha que combina mais com o que você pensa (*correr o dedo do bonequinho de um sentido para outro).*

Usar a seguinte escala:

EXCELENTE | MUITO BOM | BOM | NÃO É SINAL DE NADA | RUIM | MUITO RUIM | PÉSSIMO

8.1. Para o (a) senhor (a), encontrar um tamanduá-bandeira é um sinal de que o dia vai ser:

|____| |____| |____| |____| |____| |____| |____|

Demais de bom (0) Muito bom (0) Bom (0) Não é sinal de nada (0) Ruim (1) Muito ruim (2) Demais de ruim (3)

8.2. Se uma pessoa estiver saindo para pescar e encontrar um tamanduá-bandeira no caminho, é um sinal de que a pescaria vai ser:

|____| |____| |____| |____| |____| |____| |____|

Demais de bom (0) Muito bom (0) Bom (0) Não é sinal de nada (0) Ruim (1) Muito ruim (2) Demais de ruim (3)

8.3. Para o (a) senhor (a), passar pela batida de um tamanduá-bandeira é um sinal:

|____| |____| |____| |____| |____| |____| |____|

Demais de bom (0) Muito bom (0) Bom (0) Não é sinal de nada (0) Ruim (1) Muito ruim (2) Demais de ruim (3)

8.4. Se um tamanduá-bandeira atravessar na frente do carro em uma estrada é sinal de que irá acontecer algo:

|____| |____| |____| |____| |____| |____| |____|

Demais de bom (0) Muito bom (0) Bom (0) Não é sinal de nada (0) Ruim (1) Muito ruim (2) Demais de ruim (3)

IX – IMPLICAÇÕES PARA A PESSOA

9. Agora, nesta parte da entrevista, eu gostaria de saber como você se sente na situação X (acima mencionada(s)).

9.1. Muito preocupado |____| |____| |____| |____| |____| Nada preocupado
+2 +1 0 -1 -2

9.2. Muito angustiado |____| |____| |____| |____| |____| Nada angustiado
+2 +1 0 -1 -2

9.3. Muito ansioso |____| |____| |____| |____| |____| Nada ansioso
+2 +1 0 -1 -2

X – INFLUÊNCIA SOCIAL

10. Há gente aqui na região que acha que o tamanduá-bandeira dá azar, outros acham que ele dá sorte.

10.1. Por favor, mostre neste papel (*mostrar a escala para ajudar a responder*) a quantidade de pessoas que você conhece que acham que o tamanduá dá azar. Quanto mais para a direita (*correr o dedo de um sentido para outro),* mais

pessoas você conhece que acham isso, e quanto mais para esquerda, menos pessoas você conhece que acham isso. Aqui no 3, no meio, seria um ponto central, se você conhecer só algumas pessoas que acham isso.

Ninguém | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Muitas pessoas**

0 1 2 **3** 4 5 6 7

Algumas pessoas

(Se "Ninguém", passar para o tópico 5)

Você se lembra de alguém que ache isso? *Em caso afirmativo:*

10.2. Quem? |____|Família |____|Amigo (a) |____|Vizinho (a) |____|Outro (a)

10.3. Quanto essa pessoa é importante para você? Por favor, indique na folha (*mostrar a escala para ajudar a responder*), sendo que quanto mais para a direita (*correr o dedo de um sentido para outro),* mais essa pessoa é importante para você e, quanto mais para esquerda, menos importante ela é para você.

Nada importante | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Muito importante**

0 1 2 3 4 5 6 7

10.4. E o quanto você vê essa pessoa? Por favor, indique na folha (*mostrar a escala para ajudar a responder*), sendo que quanto mais para a direita (*correr o dedo de um sentido para outro),* mais você vê essa pessoa e, quanto mais para a esquerda, menos você vê essa pessoa.

Nunca | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Sempre**

0 1 2 3 4 5 6 7

10.5. Você conhece mais alguém que ache isso?*(Em caso da pessoa conhecer alguém, repetir até 2 x isso) (Se "Não", passar para o tópico 5). Em caso afirmativo:*

10.6. Quem? |____|Família |____|Amigo (a) |____|Vizinho (a) |____|Outro

10.7. O quanto essa pessoa é importante para você?

Nada importante | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Muito importante**

0 1 2 3 4 5 6 7

10.8. O quanto você vê essa pessoa?

Nunca | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Sempre**

0 1 2 3 4 5 6 7

10.9. Tem mais alguém que você lembre que acha isso? *(Se "Não", passar para o tópico 5). Em caso afirmativo:*

10.10. Quem? |____|Família |____|Amigo (a) |____|Vizinho (a) |____|Outro

10.11. O quanto essa pessoa é importante para você?

Nada importante | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Muito importante**

0 1 2 3 4 5 6 7

10.12. O quanto você vê essa pessoa?

Nunca | ____ | ____ | ____ | ____ | ____ | ____ | ____ | **Sempre**

0 1 2 3 4 5 6 7

XI – VIÉS DE CONFIRMAÇÃO

11.1. Já houve alguma vez que uma coisa ruim aconteceu com você por causa de você ter visto um tamanduá, a batida dele ou por ele ter passado na sua frente?

|____| *Não (0)*

Se sim, você poderia me dizer se isso aconteceu:

|____| Apenas uma vez *(1)*

|____| Poucas vezes *(2)*

|____| Muitas vezes *(3)*

XII – IDENTIFICAÇÃO DO COMPORTAMENTO

12. Agora, nesta parte da entrevista, eu gostaria de saber se, caso o (a) senhor (a) veja um tamanduá-bandeira ou a batida dele, tem alguma coisa que o (a) senhor (a) possa fazer para afastar a má sorte.

12.1. |____| Não (0) |____| Sim (1)

Se não, encerrar a entrevista.

12.2. *Se sim*, o que é?

|____| *Desviar do animal (1)*

|____| *Desviar da batida do animal (2)*

|____| *"Surrar" o animal (3)*

|____| *Matar o animal (4)*

|____| *Outro (5)*

XIII – AQUIESCÊNCIA X CONFUSÃO ONTOLÓGICA

13.1. E isso é verdade mesmo ou você não acredita, mas faz mesmo assim só porque não custa nada?

|____| *Realmente acredita (1) – Confusão ontológica*

|____| *Não acredita, mas faz mesmo assim (2) – Aquiescência*

XIX– CRENÇAS COMPORTAMENTAIS

14. Eu vou falar várias frases e gostaria que você me indicasse, na sua opinião, qual a chance dessas coisas acontecerem. Para cada frase, por favor, mostre sua resposta apontando para as bolas dessa folha. A **bola menor** é para coisas que o(a) senhor(a) acha que **não tem a menor chance de acontecer.** Quanto maior o tamanho da bola, quer dizer que tem mais chances tem de acontecer. A **bola maior** é para coisas que o(a) senhor(a) acha que **tem muita chance de acontecer**.

Nós vamos falar daqui até o final sobre o **comportamento de açoitar o tamanduá-bandeira**. Açoitar é a mesma coisa que bater com algum objeto como cipó, vara, e quando eu falar em açoitar eu estou querendo dizer então bater ou surrar o animal, ok? Então vamos lá. Eu vou falar as frases e você me indica, na sua opinião, qual a chance dessas coisas acontecerem.

Usar a seguinte escala:

14.1. Se você açoitar o tamanduá-bandeira a próxima vez que encontrar o animal, você **afasta a má sorte**?

Pouco provável | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito provável

0 1 2 3 4 5 6

14.2. Se você açoitar o tamanduá-bandeira a próxima vez que encontrar o animal, você **terá boa sorte?**

Pouco provável | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito provável

0 1 2 3 4 5 6

14.3. Se você açoitar o tamanduá-bandeira a próxima vez que encontrar o animal, você **pode ser atacado (a) pelo animal**?

Pouco provável | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito provável

0 1 2 3 4 5 6

14.4. Se você açoitar o tamanduá-bandeira a próxima vez que encontrar o animal, o (a) senhor (a) **pode ser pego pela polícia ambiental?**

Pouco provável | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito provável

0 1 2 3 4 5 6

Agora, gostaria que você me dissesse o quanto cada uma dessas coisas são **importantes** para a sua vida, desde **nada importante** para o(a) senhor(a) (*apontar a bola **menor***), até **muito importante** para o(a) senhor(a) (*apontar a bola **maior***). Para cada frase, por favor, me diga o quanto o senhor acha ser importante o que eu vou dizer. **Para o(a) senhor(a):**

Usar a seguinte escala:

14.5. Afastar a má sorte é:

Nada importante | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito importante

0 1 2 3 4 5 6

14.6. Ter boa sorte é:

Nada importante | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito importante

0 1 2 3 4 5 6

E o quanto cada uma das coisas que vou dizer seriam ruins se acontecessem com você, desde **só um pouco ruim** (*apontar a bola **menor***), até **muito ruim** (*apontar a bola **maior***). **Para o(a) senhor(a):**

14.7. Ser atacado pelo tamanduá-bandeira seria:

Um pouco ruim | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito ruim

0 1 2 3 4 5 6

14.8. Ser pego pela polícia ambiental seria:

Um pouco ruim | ____ | ____ | ____ | ____ | ____ | ____ | ____ | Muito ruim

0 1 2 3 4 5

XV – ATITUDES FRENTE AO COMPORTAMENTO DE PERSEGUIR (SURRAR / MATAR)

15. Vou começar a falar algumas frases e gostaria que, para cada uma destas frases, o(a) senhor(a) completasse com uma opção de acordo com o que o(a) senhor(a) acha. Lembrando que não tem uma resposta certa. Por favor, mostre na escala o quão _____ (1º extremo; à esquerda) ou _____ (2º extremo; à direita) o(a) senhor(a) acha que seria **o comportamento de açoitar o tamanduá-bandeira para tirar a má sorte a próxima vez que você encontrar esse animal.**

Usar a seguinte escala:

15.1. Desnecessário |____| |____| |____| |____| |____| |____| |____| Necessário

+3 +2 +1 0 -1 -2 -3

15.2. Inútil |____| |____| |____| |____| |____| |____| |____| Útil

+3 +2 +1 0 -1 -2 -3

15.3. Perigoso |____| |____| |____| |____| |____| |____| |____| Seguro

+3 +2 +1 0 -1 -2 -3

15.4. Desagradável |____| |____| |____| |____| |____| |____| |____| Agradável

+3 +2 +1 0 -1 -2 -3

XVI – NORMAS

16. Agora eu vou falar algumas frases e gostaria que o (a) senhor (a) me dissesse se **concorda**, ou seja, se acha que o que a frase diz é verdade. E, nesse caso, se concorda um pouco, pois acha que não é totalmente verdadeiro, ou se concorda muito, pois acha que é totalmente verdadeiro. Ou pelo contrário, **se você discorda** do que a frase afirma (e, novamente, se nesse caso discorda um pouco, ou discorda muito).

Frases	Concordo muito	Concordo pouco	Nem concordo nem discordo	Discordo pouco	Discordo muito
16.1. A maioria das **pessoas que são importantes para mim** pensam que quando eu encontrar um tamanduá-bandeira eu deveria açoitar o animal para tirar a má sorte.					
16.2. A maioria das **pessoas que eu respeito e admiro** aprovariam o fato de eu açoitar o tamanduá-bandeira quando eu encontrar com um para afastar a má sorte.					
16.3. A maioria das **pessoas cujas opiniões eu valorizo** acham que eu deveria açoitar o tamanduá-bandeira quando eu encontrar com um para afastar a má sorte.					
16.4. Eu acho que a maioria das **pessoas que são importantes para mim** acabam açoitando o tamanduá-bandeira se encontram com um para afastar a má sorte.					
16.5. Eu acho que a maioria das **pessoas cujas opiniões eu valorizo** açoitam o tamanduá-bandeira para afastar a má sorte quando encontram com um					
16.6. Eu acho que a maioria das **pessoas que eu respeito e admiro** açoitam o tamanduá-bandeira para afastar a má sorte quando encontram com um.					

XVII – PERCEPÇÃO DE CONTROLE

Frases	Concordo muito	Concordo pouco	Nem concordo nem discordo	Discordo pouco	Discordo muito
17.1. Para mim, açoitar um tamanduá-bandeira para tirar o azar **seria muito fácil**.					
17.2. Eu me sentiria **confiante de que sou capaz de** açoitar um tamanduá-bandeira para tirar o azar.					
17.3. Se eu quisesse, eu conseguiria açoitar um tamanduá-bandeira para tirar o azar, **sem que o tamanduá-bandeira me pegasse.**					

XVIII – EXPERIÊNCIA PASSADA

18. Eu gostaria que você me dissesse a quantidade de vezes que o (a) senhor (a) já teve que açoitar um tamanduá-bandeira para tirar o azar quando viu o animal.

|____| |____| |____| |____ | |____|

Nenhuma vez (0) Só uma vez (1) Algumas vezes (2) Muitas vezes (3) Sempre (4)

XVIII – INTENÇÃO COMPORTAMENTAL

Frases	Concordo muito	Concordo pouco	Nem concordo nem discordo	Discordo pouco	Discordo muito
18.1. A próxima vez que eu encontrar um tamanduá eu vou ter que açoitar ele para tirar o azar.					
18.2. Se eu estiver andando e encontrar com um tamanduá-bandeira, a única forma de eu tirar o azar vai ser açoitando o animal.					
18.3. Eu provavelmente vou ter que açoitar o tamanduá-bandeira para tirar o azar na próxima vez que eu ver esse animal.					

Gostaríamos de agradecer imensamente pela sua disposição em nos receber e por todas as suas respostas. A sua participação é muito importante para o sucesso desse estudo.

SUPPLEMENTARY MATERIAL 4

O INCRÍVEL TAMANDUÁ-BANDEIRA

Mariana Catapani Bruna Oliveira
Arnaud Desbiez Pedro Busana

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O Incrível Tamanduá-bandeira

Por
Mariana Catapani, Bruna Oliveira, Arnaud Desbiez
Ilustrações
Pedro Busana

Livro desenvolvido por
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em associação com
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Impresso nos EUA

O tamanduá-bandeira é um animal incrível, mas que muita gente não entende.

Tem gente que acha que ele tem dentes, mas na verdade ele é banguela. Com uma língua de até um metro, que sai do seu longo focinho, ele consegue alcançar formigas e cupins.

Tem gente que acha que ele é agressivo, mas na verdade ele usa suas garras para quebrar os duros cupinzeiros e só vai brigar com outro animal quando não conseguir fugir.

Tem gente que não gosta dele, mas na verdade ter um tamanduá por perto é sinal de muita sorte! Ele é um grande ajudante do homem no controle de pragas, podendo comer até 30 mil insetos por dia.

Tem gente que acha sua cauda desengonçada, mas é com ela que ele se cobre para dormir. Grande como uma bandeira, ela deixa apenas seu nariz de fora para sentir cheiros.

Tem gente que se surpreende com a pegada do tamanduá. Pois é! Ela é muito parecida com a pegada de uma pessoa, mesmo que o resto do seu corpo seja tão diferente!

Tem gente que se surpreende por não saber quem é o macho e quem é a fêmea. Pois é! Eles são bem parecidos mesmo. Mas quando o filhote nasce, é só a mãe que carrega ele nas costas, como se fosse uma mochila.

Mas o que pouca gente sabe é que ele gosta mesmo é de ficar limpinho. Adora tomar um banho! Além de nadar muito bem, consegue também escalar, mesmo sendo grandalhão.

São todas essas coisas, que podem parecer estranhas, que tornam o tamanduá-bandeira tão único e especial. Ele realmente é o Incrível Tamanduá!

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família o que você
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SUPPLEMENTARY MATERIAL 5

O INCRÍVEL TAMANDUÁ:

Manual do Professor

Mariana Labão Catapani, Nathália Formenton da Silva, Pedro Rodrigues Busana e Arnaud Léonard Jean Desbiez

Instituto de Conservação de Animais Silvestres

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Manual do Professor

Mariana Labão Catapani, Nathália Formenton da Silva, Pedro Rodrigues Busana e Arnaud Léonard Jean Desbiez

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Capítulo 1. Apresentação

Prezado (a) educador (a),

Este Manual que você está recebendo vem acompanhado de alguns exemplares do livro infantil “O incrível tamanduá-bandeira”. Ambas as publicações fazem parte de um conjunto de ações para a conservação dessa espécie e foram desenvolvidas no âmbito do projeto “Bandeiras e Rodovias”, uma iniciativa do ICAS - Instituto de Conservação de Animais Silvestres.

Durante nossa trajetória de trabalho com o tamanduá-bandeira, temos a oportunidade de estar em contato com comunidades que convivem com essa espécie. Através disso, percebemos que há um baixo conhecimento sobre sua biologia, comportamento e papel ecológico, o que leva as pessoas a interpretarem mal algumas de suas particularidades, gerando muitas vezes preconceito e uma percepção negativa em relação a esse animal. O fato de sua aparência ser considerada diferente da dos outros animais acaba agravando ainda mais a hostilidade em relação à espécie, o que ameaça sua conservação.

Para que as crianças possam identificar comportamentos naturais do animal, que aprendam sobre ele e já cresçam com um olhar mais livre de preconceitos, foi lançado o livro infantil “O incrível tamanduá-bandeira”. O objetivo desse Manual é contextualizar esse livro infantil, oferecendo aos educadores subsídios para que possam abordar esse tema na comunidade escolar. Apresentamos ainda nessa publicação algumas sugestões de atividades para serem realizadas em sala de aula, que podem ser abordadas inclusive pela ótica de como o preconceito com o diferente e desconhecido acaba influenciando nossas relações com as pessoas no dia-a-dia.

Com isso, esperamos contribuir não só com a disseminação do conhecimento sobre o tamanduá-bandeira, mas também estimular uma reflexão crítica sobre a questão do preconceito na vida das crianças. Todo o conteúdo apresentado está disponível para download no site do Projeto Bandeiras e Rodovias (http://www.anteatersandhighways.com).

Você, como professor/a, é o mais importante agente multiplicador do conhecimento por meio de ações educativas. Contamos com sua participação para o sucesso dessa ação!

Os autores

Capítulo 2. O Tamanduá-bandeira

2.1. Biologia e Comportamento

Um dos bichos mais icônicos da fauna sul-americana, o tamanduá-bandeira é também a maior entre todas as espécies de tamanduás do mundo, podendo chegar a dois metros de comprimento, um metro de altura e a pesar até 45 kg.

Seus parentes mais próximos são o tamanduá-mirim, o tamanduá-mexicano e o tamanduaí, sendo essas as quatro espécies existentes de tamanduá atualmente. O tamanduá-bandeira também é parente distante das preguiças e tatus, todos pertencentes à Superordem Xenarthra, caraterizada por animais que possuem xenartria (um processo vertebral diferenciado dos outros mamíferos, que permite a alguns desses animais assumirem uma postura bípede). Esses animais possuem um metabolismo lento e uma temperatura corporal mais baixa, tornando-os bastante suscetíveis ao calor e ao frio e também possuindo uma digestão mais lenta. Trata-se de um grupo antigo exclusivo da região Neotropical, espalhado pela América do Sul e Central e parte da América do Norte. Quando lhe é possível, sua adaptabilidade permite que ele ocupe diferentes tipos de ambientes, contando que haja alimento para saciá-lo. Podem ser encontrados tanto em local semiárido, planícies abertas, ou em florestas tropicais úmidas.

Seu nome científico é *Myrmecophaga tridactyla*, que, em latim, significa “comedor de formigas com três dedos”, apesar de o animal possuir o mesmo número de dedos que um ser humano. Já seu nome popular se refere à sua volumosa e peluda cauda (similar a uma bandeira), utilizada tanto para se cobrir enquanto dorme, quanto para equilibrá-lo durante seu bamboleante andar característico. Diferente dos outros tamanduás, o tamanduá-bandeira anda sobre os nodos dos dedos das mãos (chamada de postura nodopedálica), sendo mais terrícola do que arborícola – o que não anula suas habilidades de escalador. Curiosamente, o animal também é um excelente nadador, podendo se banhar nas margens de rios e cruzá-los a nado sem dificuldades.

Sua pelagem (geralmente cinza amarronzada) possui uma listra negra que cruza seu peito e ombros e é margeada por faixas brancas, o que torna o animal visualmente muito reconhecível. Além disso, o filhote quando nasce possui uma faixa branca que cruza a cabeça e vai até a ponta de seu rabo, sumindo aos poucos conforme cresce. O pelo do tamanduá-bandeira é denso, seco e áspero, muito similar ao toque de uma vassoura de palha. Isso permite a ele se embrenhar pela vegetação espinhosa e afiada sem se machucar e o protege da picada de insetos (não apenas mosquitos, mas também dos cupins e formigas de que se alimenta), também sendo um bom isolante contra o frio e o calor. Contudo, tal pelagem é um

grande alvo para carrapatos e pulgas de diversas espécies, além de torná-lo bastante suscetível ao fogo.

A espécie possui olhos estreitos e uma boca pequena e desdentada, localizada ao final de um longo e cônico focinho. Desta boca é que se origina à célebre e viscosa língua desses animais (com 40 a 60 cm de comprimento), usada principalmente como ferramenta para captura de alimento. Com um movimento rápido e contínuo, o animal consegue projetá-la até 160 vezes por minuto, garantindo a ele consumir até 30 mil insetos em um único dia (o equivalente a um saco de 1kg de arroz). A visão e audição fracas do tamanduá são compensadas por um olfato bem desenvolvido, que chega a ser 40 vezes mais apurado do que o do ser humano. Com este faro, o tamanduá consegue detectar alimento e ameaças a longas distâncias, principalmente se o vento estiver a seu favor. Após farejarem atrás de um cupinzeiro ou formigueiro, suas garras robustas em formato de foice possibilitam quebrar as duras estruturas dos ninhos para se alimentar dos insetos.

Seu maior predador natural é a onça-pintada (*Panthera onca*), com quem rivaliza em força e trava combates perigosos quando acuado. Também podem ser presa de suçuaranas (*Puma concolor*) ou de jacarés e outros predadores menores quando o tamanduá é jovem.

Assim como nas outras espécies de tamanduás, a fêmea protege seu filhote carregando-o em suas costas até que alcance a maturidade para se defender sozinho, utilizando o padrão de listras de ambos como artifício para camuflar o juvenil ao corpo da mãe. A gestação dura aproximadamente seis meses, sendo apenas a mãe responsável por cuidar do filhote. Ela irá amamentá-lo pelos próximos meses, mas permanecerão juntos por até 1 ano até que ele possa se defender sozinho. O tamanduá-bandeira é um animal solitário, aceitando a companhia da sua espécie apenas em ocasiões reprodutivas ou então num contexto mãe e filhote. Algumas situações pouco estudadas apresentam fêmeas procurando alimento juntas, ao passo que machos quase sempre costumam ser territoriais entre si. Como forma de demarcar seus territórios, eles marcam as árvores da região com urina, cheiros e arranhões para delimitar seu espaço e evitar conflitos físicos.

2.2. Ameaças à espécie

Originalmente, o tamanduá-bandeira era uma espécie com vasta distribuição, ocorrendo de Belize até o sul da América do Sul. Atualmente, entretanto, encontra-se ameaçado de extinção ao longo de toda a sua área de ocorrência, sendo considerado o mamífero mais ameaçado da América Central. A espécie foi extinta do Uruguai, Guatemala, El Salvador e Belize, enquanto, no Brasil, foi extirpada nos Estados de Santa Catarina e Espírito Santo. Em muitas regiões onde o animal ainda ocorre, o que lhe resta é um ambiente descontínuo e fragmentado.

No Brasil, a principal ameaça ao tamanduá-bandeira é a perda de habitat, causada sobretudo pela expansão das atividades agropecuárias. Outra grave ameaça são os atropelamentos rodoviários, sendo que na região Central do país ele é um dos animais que lidera os rankings de colisões com veículos. Devido à sua pelagem altamente inflamável e à sua baixa mobilidade, o tamanduá-bandeira acaba sendo vítima de incêndios florestais, que se constituem em outro importante fator de impacto para as populações da espécie. Nas regiões Norte e Nordeste do país, o animal é caçado para fins alimentares e para o uso de seu couro. Outras ameaças, ainda pouco compreendidas, é o impacto do uso de agrotóxicos e a perseguição das pessoas motivadas por superstições de mau-agouro a seu respeito.

Capítulo 3. Conflito humano-fauna: o que o tamanduá-bandeira tem a ver com isso?

Uma das questões mais urgentes da conservação da biodiversidade são os conflitos entre pessoas e animais silvestres. Gerados pela proximidade e disputa de área, tais conflitos se intensificam com a expansão da população e o consequente aumento da demanda por espaços. Em geral, tais conflitos surgem quando uma espécie é considerada uma ameaça à segurança, à subsistência ou ao bem-estar psicológico de um indivíduo ou de uma comunidade, podendo isso ser baseado em fatos ou somente na percepção. De uma forma ou de outra, a resposta para isso quase sempre é a perseguição à espécie. Diferente da caça, onde o que se procura é um recurso, a perseguição humana se constitui na agressão e/ou morte do animal para fins de retaliação. Admite-se, atualmente, que esse processo levou à diminuição significativa de populações de animais silvestres em todo o mundo.

Em linhas gerais, há duas razões principais na base do surgimento desses conflitos. A primeira é aquela que tem motivações econômicas, pois surge de danos e perdas materiais. É o caso das situações em que fazendeiros perdem, pela predação de carnívoros, animais

domésticos que são fonte de renda, como gado e ovinos, ou quando agricultores perdem suas culturas para animais silvestres herbívoros que delas se alimentam (como javalis e queixadas). A segunda razão tem por base alguns motivadores socioculturais, como o prestígio, o medo de ataque e o preconceito.

No caso do tamanduá-bandeira, a perseguição humana em algumas regiões está associada ao preconceito baseado em crendices populares, que relacionam o animal à má sorte, o que leva algumas pessoas a agredirem ou até mesmo matarem o animal se esse cruzar seu caminho.

Tendo isso em vista, esse material tem por objetivo contextualizar o livro infantil “O Incrível tamanduá-bandeira”, auxiliando o educador para que sejam desmistificados alguns aspectos de sua aparência, biologia e comportamento, já que a má-compreensão desses fatores acaba agravando essas crenças e favorecendo sua perseguição.

Alguns conflitos entre pessoas e animais silvestres no Brasil

Conflito humano-capivara

A capivara é o maior roedor do mundo. Com o avanço das cidades e a diminuição das áreas nativas, a capivara foi se adaptando facilmente às áreas urbanas e, devido à ausência de predadores nesses locais, suas populações podem aumentar desordenadamente. As principais queixas em relação à capivara nas cidades são o receio da transmissão de doenças como a febre maculosa e, devido ao seu grande tamanho, o perigo de colisão com esse animal nas rodovias.

Conflito humano-onça

O ser humano, através da caça e do desmatamento das florestas, está diminuindo o espaço disponível e a quantidade de animais que servem de alimento para as onças (queixadas, capivaras, jacarés). Assim, algumas vezes, quando uma onça encontra vacas ou bezerros, ela acaba se alimentando deles, fazendo com que produtores matem o animal como forma de retaliação. Outra razão que faz as pessoas matarem as onças é o medo, mas na verdade as onças são animais arredios, que evitam a presença de gente e só atacam se estiverem mexendo com ela.

Conflito humano-javali

O javali-europeu é um animal exótico à fauna brasileira. Ele foi introduzido no país há algumas décadas para exploração comercial, porém a atividade não se desenvolveu, resultando na liberação dos animais na natureza. Os javalis se adaptaram bem ao Brasil, cresceram em número e podem causar danos ambientais (principalmente por competirem com espécies nativas como queixadas e catetos), econômicos e sanitários (por abrigarem patógenos causadores de doenças que colocam em risco nossa produção agropecuária). Eles acabam ainda se alimentando da lavoura, o que faz com que os agricultores persigam o animal. Enquanto algumas pessoas são a favor da caça ao javali, outras pessoas não concordam, alegando que foi o ser humano que introduziu o animal em um ambiente que não era o dele.

Conflito entre humanos e animais envolvidos em superstições

Algumas pessoas acreditam que certos animais trazem má sorte quando cruzam seu caminho, o que faz com que sejam agredidos e até atropelados propositalmente, achando que isso vai “tirar o azar”. Tamanduás-bandeira, corujas e até o gato-preto, que é um animal doméstico, acabam sofrendo com essas crendices populares. Outra situação parecida é algumas pessoas acreditarem que certas partes de alguns animais trazem boa sorte, como o olho do lobo-guará e o guizo da cascavel, e, da mesma forma, acabam matando o animal para obter essas partes.

Capítulo 4. Relação de Figuras do Livro “O Incrível Tamanduá”

A tabela abaixo tem o objetivo de auxiliar na abordagem dos capítulos do livro “O Incrível Tamanduá”, dando informações adicionais e sugestões de como tratar os temas apontados no texto das imagens.

Página	Imagem	Como abordar
Página 1		A imagem de apresentação do livro visa retratar um tamanduá-bandeira perfeitamente à vontade em seu ambiente natural, em um clima de paz e serenidade típico do final de tarde no Pantanal-Sul-mato-grossense. Atrás dele, há alguns elementos da fauna e flora do Brasil, como a curicaca (*Theristicus caudatus*), o caraguatá (*Bromelia pinguin*) e alguns insetos e outras plantas.
Página 2		A segunda figura tem o intuito de mostrar o tamanduá-bandeira de um ângulo que poucas pessoas estão acostumadas a observar, com a vista frontal do animal em evidência enquanto caminha por uma região de campo aberto. As aves no primeiro plano são espécies nativas do Pantanal e Cerrado, chamadas de periquito-rei (*Eupsittula aurea*) e príncipe- negro (*Aratinga nenday*).
Página 3		Esta imagem, vista pelo ponto de vista dos cupins de dentro de um cupinzeiro sob ataque do tamanduá, fala sobre o hábito alimentar do animal e o papel ecológico que ele desempenha na natureza, que também beneficia o homem. Comendo muitos cupins e formigas, ele ajuda a combater pragas de graça, usando para isso uma língua que chega 60 cm de comprimento. Importante salientar que sua boca não tem dentes, logo, ele não pode morder uma pessoa.
Página 4		Aqui se enfatiza o papel das garras, que, diferentemente do que a maioria pensa, não servem apenas para se defender, mas sim quebrar cupinzeiros enquanto procura por alimento. Embora não seja considerada uma espécie agressiva, o tamanduá pode tornar-se quando precisa defender a si mesmo ou a seu filhote. Para isso, o animal adota uma postura ereta e com os membros dianteiros projetados em direção ao agressor, de modo a prensá-lo com suas garras numa espécie de abraço. Contudo, sempre que tem

opção, um tamanduá vai preferir fugir a lutar, sendo este seu último recurso. Um tamanduá bravo geralmente avisa antes de atacar, fazendo sons guturais bem graves e altos, eriçando os pelos do dorso e às vezes secretando uma substância branca leitosa ao redor dos olhos.

Página 5

Um tamanduá que come 30 mil formigas por dia equivale a uma pessoa comendo um saco de 1 kg de arroz, mostrando o grande benefício que é ter este animal por perto. Se pensarmos a quantidade de formigas que vários tamanduás juntos podem consumir ao longo da vida, acaba valendo mais a pena manter estes animais vivos e por perto do que se não existissem. Logo, a convivência não só é possível, como desejável.

Página 6

A cauda do tamanduá-bandeira é sua característica mais notável. É ela que o torna icônico e reconhecível para a maioria das pessoas. Seu pelo, ao contrário do que parece, é bem duro e áspero, semelhante a uma vassoura de palha. Cobrindo-se com sua cauda enquanto dorme, o tamanduá fica protegido do frio, da noite e dos insetos. Além de servir como um cobertor, ela ajuda bastante no equilíbrio enquanto o animal anda.

Página 7

Muitas lendas são associadas ao tamanduá. Uma delas é a “criança da noite”, derivada do fato deste animal gostar de andar à noite e da aparência da sua pegada. Isso se deve por suas patas traseiras serem plantígradas, isto é, se apoiam totalmente em contato com o chão. É exatamente dessa maneira que nossos pés também são, o que torna a pegada traseira do tamanduá-bandeira muito parecida com a do pé de uma criança. Contudo, este desenho busca desmistificar esse conceito, mostrando que o animal apenas carrega uma curiosa semelhança com o ser humano, sendo preciso desmistificar a associação com uma assombração.

Página 8

Este desenho, juntamente com o texto que o acompanha, visa quebrar o mito de que tamanduás possuem um único sexo. Na realidade, fêmea e macho não possuem dimorfismo sexual evidente, o que os tornam muito parecidos. Os testículos do macho estão dentro do abdômen, o que torna realmente difícil diferenciá-lo da fêmea. Contudo, apenas a fêmea carrega o filhote nas costas e o pai não auxilia em momento nenhum da criação. A gestação dura seis meses e mãe e filhote ficam juntos por até 1 ano.

Página 9

Essa imagem tem o objetivo de mostrar comportamentos do tamanduá-bandeira que são muito frequentes ou muito pouco conhecidos. O ato de se banhar na espécie é comum e muitas pessoas gostam de assistir pela semelhança com o comportamento humano (como lavar o pé, as axilas, a cabeça e enxaguar a barriga). Já o comportamento de escalar é pouco visto, mas muito impressionante.

Página 10

Por fim, a última imagem busca trazer a contemplação do tamanduá na natureza e com muitos outros animais brasileiros à sua volta. A mensagem é que depois de conhecer o animal, você consegue se maravilhar com sua verdadeira história e não tem mais que se apoiar em mitos e superstições para achá-lo interessante. Tal como o leitor, todos os animais ao redor estão admirando o tamanduá.

Capítulo 5. Sugestão de atividades em sala de aula

Este capítulo do manual do professor conta com sugestões de atividades que podem ser desenvolvidas com os alunos dentro ou fora da sala de aula, de acordo com a atividade. Todas as atividades sugeridas nesse material foram elaboradas de acordo com o referencial teórico da Educação Ambiental crítica, uma das vertentes da área de educação ambiental, a qual prevê abordagens e atividades críticas, de modo que tanto o professor quanto o aluno, pensem e ajam criticamente em relação às problemáticas socioambientais. Com isso, todas as atividades deste manual preveem dinamismo, ludicidade, pensamento crítico e reflexivo, de modo que o professor aborde os temas aqui apresentados de forma dinâmica, coletiva, cooperativa, contínua, interdisciplinar, democrática e participativa, envolvendo todos os alunos nas atividades e temas.

Também é muito importante que o professor deixe claro para todos os alunos que eles participem das atividades respeitando os demais colegas, o próprio professor e os animais que estão estudando. Ou seja, que ajam com respeito quando outro colega ou o professor estiver falando, que respeite a opinião do outro ainda que não concorde com a ideia e que contribuam para que todos os presentes participem e interajam igualmente nas atividades. As atividades descritas abaixo podem ser seguidas à risca ou também podem ser adaptadas pelo professor de acordo com: o número de alunos presentes, a ordem dos temas abordados pelo professor, a realidade da região onde a escola está inserida ou onde os alunos vivem, dentre outros. Além disso, cada atividade permite tratar de um ou mais animais simultaneamente, porém é importante que o professor sempre destaque para os alunos que apenas irão trabalhar com animais da região que eles vivem, ou seja, animais brasileiros e que possivelmente todos já viram ou conhecem. Outro ponto importante é a idade dos alunos. As atividades estão em ordem crescente de complexidade e de envolvimento dos alunos, o que prevê uma maior maturidade deles. Porém, o professor não precisa se preocupar, pois ele pode pular algumas atividades ou apenas escolher as que mais se encaixam com a realidade dos seus alunos. Além disso, o professor pode adaptar as atividades, deixando-as mais simples e menos trabalhosas.

Divirtam-se!

Atividade 1: Dinâmica "Encontre a mesma espécie"

Duração: de 50 a 60 minutos

Número de participantes: indeterminado. Atentar-se para ter os números iguais de animais e alunos.

Objetivos:

- Promover um clima agradável entre os alunos e “quebrar o gelo”;
- Discutir o papel de cada animal na natureza e sua relação com o ser humano.

Observação: podem ser discutidos vários temas a partir dessa dinâmica, como por exemplo, características gerais dos animais, onde vivem, se o conhecem, se vivem perto da casa do aluno, se o aluno já o viu de perto, etc.

Materiais necessários:

- Fotos de animais ou simplesmente o nome do animal escrito em um papel (importante: escolher animais que ocorrem na região);
- Pregadores de roupa ou fita-crepe;
- Quantidade dos materiais: o suficiente para atender todos os participantes.

Desenvolvimento:

- Para a escolha dos animais para esta atividade, ver a sugestão no box na página 11;
- O educador prepara o material, sendo duas fotos ou dois nomes de cada animal e, com o pregador de roupa ou a fita-crepe, fixa o papel nas costas de cada aluno;
- Antes de começar a brincadeira, algumas regras devem ser esclarecidas e seguidas por todos: não falar e não olhar qual é o seu animal;
- Os participantes se misturam e cada um deve encontrar o outro animal da mesma espécie, formando um par. Para que os animais iguais se encontrem, os demais alunos têm que ver o nome ou foto do animal nas costas dos amigos e ir juntando as duplas. Vale lembrar que a regra de não falar e não olhar o seu próprio animal deve ser seguida;
- Depois de todos os animais encontrados e as duplas formadas, cada dupla vai fazendo perguntas para os demais alunos para tentarem adivinhar qual é o seu animal. As perguntas podem ser, por exemplo: onde vivo (eu, o animal), o que como, se acreditam que corro perigo de extinção, como sou, trago algum problema para os humanos, etc;

- Assim que todos falarem, o educador pode fazer alguns questionamentos a respeito do que os participantes disseram, como por exemplo, por que vocês acreditam que o tamanduá-bandeira traz mal agouro? Por que o fulano que cria galinhas mata o lobo guará? E dentre outros questionamentos. Assim, gera-se um debate inicial para que o educador possa, a partir das falas dos alunos, delinear seu plano de trabalho, escolhendo, por exemplo, um tema específico a partir de algum problema apresentado.

Atividade 2: Diagnóstico socioambiental inicial

Duração:

- Para entrevistas: livre, mas o professor pode estipular alguns dias para que os alunos consigam entrevistar algumas pessoas. O professor deve definir o número de entrevistas por aluno ou por grupo, lembrando que não precisam ser muitas, pode ser no máximo 3.
- Para debates em sala de aula: de 50 a 60 minutos

Número de participantes: dividir os participantes em grupos para a entrevista.

Objetivos:

- Incentivar a prática do diagnóstico de conflitos humano-fauna na fase das atividades;
- Levantar e identificar dados que aproximem os participantes da sua própria realidade;
- Oferecer subsídios para que os participantes se interessem na elaboração de uma proposta participativa e de aprender-participando.

Materiais necessários:

- Roteiro para entrevistas;
- Papel e caneta para anotações;
- Câmera para filmagem, se necessário, ou gravador de voz.

Observação: O professor deve elaborar previamente algumas questões para a entrevista, assim os alunos serão guiados a iniciar o tema proposto.

Desenvolvimento:

- O educador pede para os participantes fazerem algumas entrevistas com os moradores da região onde vivem, pode ser seus próprios pais, avós, tios e tias, primos e primas, amigos, o moço da padaria, a moça da farmácia...
- O intuito é que os participantes questionem os entrevistados sobre o tamanduá-bandeira e demais animais em busca de identificar quais animais da região trazem problemas para as pessoas e, além disso, quais superstições, mitos ou crenças as pessoas contam sobre eles;
- O educador deve orientar os alunos para o objetivo da atividade e como podem fazê-la, sendo por anotações ou por gravação de áudio e/ou vídeo;
- Depois, os principais temas que aparecerem nas entrevistas podem ser trabalhados em sala de aula, gerando debates e conversas sobre eles.

Dica: O professor pode realizar diversas atividades para o levantamento de dados do diagnóstico de conflitos humano-fauna, como entrevistas, observações, fotografias, mapas, visitas, entre outras. Uma sugestão é a utilização de roteiros específicos e direcionados para os participantes levantarem determinados dados. Abaixo colocamos um quadro como um exemplo de roteiro.

Observação: as questões do roteiro são apenas sugestões e o educador juntamente com os alunos podem criar seu próprio roteiro.

- O diagnóstico de conflitos humano-fauna pode ser usado como uma atividade inicial de levantamento de dados da região onde os participantes moram, assim eles conhecem melhor a realidade do local e são envolvidos nela, de forma que podem querer participar mais das atividades e projetos sobre os temas. Além disso, esta atividade inicial pode servir como subsídio para outras atividades de interação educativa.

Roteiro de entrevista para diagnóstico socioambiental – tema: tamanduá-bandeira

6. *Qual o seu animal favorito e por quê?*
7. *Qual o animal mais bonito e por quê?*
8. *Qual/is animal/is você não gosta e por quê?*
9. *Qual/is animal/is você mais gosta e por quê?*
10. *Qual animal você tem mais medo e por quê?*

Atividade 3: Dinâmica do concordo e discordo

Duração: de 50 a 60 minutos

Número de participantes: de 10 a 50

Objetivos:

- Identificar as percepções e opiniões dos participantes em relação aos temas escolhidos pelo educador;
- Propiciar reflexão e gerar um debate sobre os temas abordados;
- Contribuir para o respeito às opiniões do próximo.

Materiais necessários:

- Roteiro de afirmativas (ver quadro de exemplo na página 20);
- Fita-crepe.

Preparação:

- Para realizar a atividade é importante um espaço aberto e amplo, porém é possível aplicá-la dentro da sala de aula, afastando as carteiras e deixando espaço livre no centro;
- No chão, passe a fita-crepe formando 3 linhas paralelas entre si, porém distantes umas das outras, pois os participantes irão posicionar-se entre elas.

Desenvolvimento:

- Os participantes ficarão posicionados na linha central no ambiente. O educador fará as afirmações sobre a temática e cada aluno vai posicionar-se na linha do "concordo" ou na linha do "discordo". Quem não tiver opinião sobre o tema pode permanecer "em cima do muro", na linha central. Após todos posicionarem-se, o educador pode anotar quantas pessoas estão em cada lugar ou ainda pode fazer alguma pergunta para aprofundar rapidamente aquele tópico em questão. Em seguida, todos voltam à posição original para a próxima afirmação;
- Essa atividade pode promover debates e permitir que o educador identifique e conheça as percepções e conhecimentos prévios dos participantes. A partir desta, o professor pode desenvolver outras atividades que a complementam e seguir trabalhando para desmistificar o/os animal/is em questão;

- Ao final da atividade, identifique quais afirmações geraram mais divergência de respostas e mais polêmica e então promova um debate/conversa sobre o tema, a fim de levantar os prós e contras das diferentes opiniões.

Dica: peça para os participantes refletirem e escolherem sua posição mentalmente antes de tomarem seu lugar na atividade, pois as crianças e jovens costumam posicionar-se a partir da escolha do amigo, o que pode prejudicar a atividade e ainda mascarar a real percepção do educador.

Observação: O quadro abaixo com algumas afirmativas é apenas um exemplo de frases que podem ser usadas nessa atividade. O professor pode usar questões/temas e afirmativas que surgiram no diagnóstico de conflitos humano-fauna, o que torna a atividade mais contextualizada e próxima à realidade do aluno.

Exemplos de afirmativas – tema: tamanduá-bandeira

1. O tamanduá-bandeira é perigoso e ataca facilmente.
2. A cauda do tamanduá-bandeira só atrapalha e não serve pra nada.

Atividade 4: Mural interativo: conhecendo o tamanduá-bandeira

Duração: de 50 a 60 minutos

Número de participantes: independente

Objetivos:

- Contribuir para a percepção dos alunos sobre o animal escolhido;
- Contribuir e potencializar o debate entre os participantes acerca do tema;
- Desmitificar o tamanduá-bandeira.

Materiais necessários:

- Imagem grande do tamanduá-bandeira (anexo na página 35);
- Fita-crepe ou dupla face;
- Pedaços de papel em formato de fichas.

Observação:

- O professor pode usar a imagem do tamanduá-bandeira que está no final deste manual ou pode levar a imagem que desejar. Ou ainda pode pedir que os alunos levem imagens do animal;
- O professor pode preparar as fichas de papel para que os próprios alunos escrevam características do animal. Ou pode levar as fichas com as características já pré-definidas e estas podem ser escolhidas de acordo com o diagnóstico de conflito humano-fauna (primeira atividade).

Preparação:

- O educador cola a imagem do animal na lousa/quadro. A imagem pode ser apenas do animal ou mostrando-o em seu habitat.

Desenvolvimento:

- A ideia dessa atividade é elencar todas as características do animal, de qualquer natureza, mas principalmente chegar àquelas que dizem respeito às crendices, preconceitos, superstições e etc. O educador pode deixar a atividade fluir e, se tais características não forem aparecendo, pode-se conduzir a atividade para isso por meio de perguntas que estimulem os alunos;
- A atividade tem 3 etapas. A primeira delas é iniciar explicando como é a atividade e o que será feito. Também nesse momento, o educador fixa a imagem do animal na lousa/quadro. A segunda etapa consiste em cada aluno colar na imagem as características do animal, de modo que fique visível para todos. A terceira etapa consiste na discussão sobre o tamanduá-bandeira, assim, o educador pede para que os alunos olhem a imagem e as características coladas e reflitam sobre elas. Nessa etapa é essencial que o principal objetivo seja tratar dos conflitos entre humanos e o tamanduá. Por exemplo, o educador pode questionar a turma sobre o porquê colocaram determinadas características, de onde esses “mitos” veem, ou com quem ele aprendeu sobre o tamanduá, etc. Vale lembrar que é importante usar informações que surgiram no diagnóstico de conflitos humano-fauna. O professor pode fazer várias outras perguntas que instiguem a conversa e o debate sobre o tema.

Dica: essa atividade pode ser feita com outros animais, não apenas com o tamanduá-bandeira, pode-se escolher outro ou ainda escolher vários e trabalhar com o tema falando de vários animais. Ver o box com outros animais na página 11.

Atividade 5: Jogo da memória

Duração: de 30 a 60 minutos

Número de participantes: independente. Separe os alunos em grupos para permitir que todos joguem. O ideal é que tenham alguns kits das cartas do jogo, assim os grupos podem jogar simultaneamente.

Objetivos:

- Permitir a assimilação dos conteúdos já trabalhados pelo educador;
- Contribuir para potencializar o debate entre os participantes acerca do tema;
- Desmitificar o tamanduá-bandeira (e demais animais do box da página 11).

Materiais necessários:

- Cartas do jogo da memória (anexo no fim do manual)

Observação: As cartas do jogo da memória podem servir como sugestão e o professor pode confeccionar seu próprio jogo. Ou ainda, o professor pode usar estas cartas, xerocando-as ou imprimindo-as diretamente da versão digital do livro.

Preparação:

- Divida os alunos em grupos com número igual de participantes.
- Distribua as cartas para cada grupo.

Desenvolvimento:

- O jogo contém cartas com a foto do tamanduá-bandeira em diversos contextos e também cartas com um pequeno texto descrevendo alguma característica do animal;
- No jogo, as cartas devem ficar com as informações (foto e textos) viradas para baixo e o aluno deve virar duas cartas e ver se a imagem ilustra o que o texto diz. Cada aluno joga apenas uma vez e, se acerta as cartas, tira-as do jogo.

Atividade 6: Defendendo o animal

Duração: de 50 a 60 minutos (ou mais, dependendo do envolvimento de todos).

Número de participantes: independente, mas separe os alunos em grupos.

Importante: Acreditamos que esta atividade funcione melhor com crianças com idade acima de 14 anos, ou seja, para o ensino médio, uma vez que as de idade inferior podem, todavia, não lidarem bem com atividades de confrontos de ideias e divergências de opiniões. Porém, o professor pode ainda adaptar a atividade e utilizá-

la com as crianças menores, ou ainda aproveitar esta atividade para ensinar diversos outros conceitos, questões éticas e cidadãs aos alunos.

Objetivos:

- Permitir a assimilação dos conteúdos já trabalhados pelo educador;
- Contribuir para potencializar o debate entre os participantes acerca do tema;
- Desmitificar o tamanduá-bandeira (e demais animais do box da página 11);
- Proporcionar a conversa e respeito mútuo entre os participantes.

Materiais necessários:

- Empolgação

Observação: para essa atividade é importante que os alunos já tenham tido boa parte dos conteúdos sobre o tema ou, ainda, que tenham feito uma pesquisa prévia sobre o tema, para que tenham argumentos para o debate.

Preparação:

- Separe os alunos em grupos (de igual número de participantes) de modo que cada grupo tenha um animal diferente. Por exemplo, o grupo 1 fica com o lobo guará, o grupo 2 com o tamanduá-bandeira, o grupo 3 com a cascavel, o grupo 4 com a coruja, e etc;
- Explique as regras aos participantes.

Desenvolvimento:

- Cada grupo deve ter em mente características sobre o seu animal, principalmente relacionadas aos conflitos entre humanos e o animal em questão. O primeiro grupo fala algumas características sobre o seu animal e os demais grupos fazem perguntas e contestam o que o grupo está falando, ficando contra aquele animal, assim, o grupo tem que defender seu animal e quebrar os argumentos dos grupos questionadores. E assim a atividade segue, fazendo o mesmo com todos os grupos;
- A ideia da atividade é que ao final os alunos percebam o verdadeiro papel dos animais na natureza e a relação do ser humano com cada um deles, de modo que entendam os principais conflitos que envolvem cada um.

Atividade 7: A fauna silvestre na mídia: questionando referências

Duração: de 50 a 60 minutos

Número de participantes: independente, mas separe os alunos em grupos.

Objetivos:

- Permitir a assimilação dos conteúdos já trabalhados pelo educador;
- Contribuir para potencializar o debate entre os participantes acerca do tema;
- Perceber como a mídia aborda questões relacionadas à fauna silvestre, proporcionando uma visão crítica sobre os meios de comunicação e a influência que estes exercem sobre nós.

Materiais necessários:

- Computador com acesso à internet;
- Datashow;
- Reportagens de jornal e/ou revista ou impressos da internet;
- Material para anotação.

Preparação:

- O educador pode separar reportagens ou vídeos (podem ter uma linguagem mais próxima dos jovens) que mostram notícias sobre a fauna, de preferência as que tratam do tema de forma errônea, dando a entender que a culpa é do animal silvestre, e também aquelas que tratam muito bem do tema, mostrando os diferentes pontos de vista das questões envolvidas. Por exemplo, onça parda que apareceu na cidade; onça que matou x cabeças de gado do fazendeiro fulano; lobo guará que comeu tantas galinhas da produtora tal; mais um tamanduá-bandeira atropelado na estrada x, e etc. Outra ideia é pedir para que os próprios alunos pesquisem tais notícias. Ou ainda, o educador pode mostrar uma reportagem/vídeo de exemplo e em seguida pedir para que os alunos procurem mais reportagens/vídeos desse tipo.

Desenvolvimento:

- A ideia dessa atividade é que o educador mostre aos alunos reportagens sobre o tema e discuta como a mídia aborda tais notícias, ou seja, se contribuiu ainda mais para uma imagem ruim do animal ou se realmente mostra a realidade, atentando os alunos para a linguagem contida na reportagem/vídeo, objetivos

(e se foram atendidos), mensagem final, informações sobre o animal noticiado e etc;

- Após mostrar e ler algumas reportagens/vídeos pode-se iniciar o debate e conversar sobre os conflitos humano-fauna que aparecem noticiados.

Atividade 8: Personagens do conflito humano-fauna

Duração: de 40 a 60 minutos

Número de participantes: independente, a atividade pode ser adaptada ao número de participantes, diminuindo ou aumentando o número de personagens. Pode-se ainda dividir o número de alunos em grupos, sendo que cada grupo representará uma personagem.

Objetivos:

- Proporcionar os diferentes pontos de vista diante de um problema socioambiental;
- Incentivar o respeito mútuo entre os participantes e também o respeito a diferentes formas de conhecimento e percepção da realidade;
- Colocar-se no lugar do outro para buscar entender seu ponto de vista de acordo com sua realidade;
- Promover o diálogo para buscar soluções.

Materiais necessários:

- Fichas com a descrição de cada personagem (ver exemplo na página 27).

Preparação

- Prepare previamente as fichas com a descrição de cada personagem. É importante ressaltar que essa atividade deve ser adaptada de acordo com a faixa etária dos participantes, uma vez que esta pode tornar-se complexa, o que será uma barreira para a discussão. Para torná-la mais simples, para alunos de ensino fundamental II, por exemplo, basta tirar alguns personagens e deixar apenas os mais essenciais. Já para alunos de ensino médio (ou para alunos de EJA) podem-se deixar alguns personagens na atividade. Porém, é o educador que conhece seus alunos e pode adaptar a atividade.

Desenvolvimento:

- A atividade consiste em uma simulação de reunião para tratar de algum problema socioambiental, o qual deve ser uma situação concreta, plausível, e, prioritariamente, que ocorra/ocorreu próximo de onde os participantes moram;
- Se o educador for desenvolver a atividade em apenas uma aula, ele deve pesquisar previamente sobre o tema e sobre as personagens para contextualizar os participantes. Já se o educador preferir fazer a atividade em mais de uma aula, pode-se solicitar aos participantes que eles façam essa pesquisa e cheguem à aula preparados;
- A atividade se inicia com a apresentação da situação escolhida e a divisão das personagens entre os participantes (ou entre os grupos). A breve descrição das personagens deve ser entregue aos participantes. Além da descrição, o educador, em seguida, pode fazer algumas perguntas para incentivar a criatividade de cada participante, como por exemplo:
  - O que essa personagem pensa sobre o problema apresentado?
  - Como essa pessoa se sente frente ao problema?
  - Quais suas reivindicações?
  - Quem pode resolvê-las?
- Após alguns minutos para reflexão, deve-se iniciar a simulação. O educador pode fazer a mediação e também pode, inclusive, assumir uma personagem que ocuparia esta mesma função;
- Algumas recomendações podem ser adotadas para a melhor condução da atividade:
  - Incentivar que todos participem do diálogo e incorporem a personagem;
  - Organizar as falas de modo que todos tenham oportunidades iguais de fala e apresentação de seus argumentos;
  - Propiciar um ambiente de respeito, evitando interrupções nas falas;
  - Tomar cuidado para que as personagens não sejam caracterizadas de forma preconceituosa e/ou estereotipadas;

Ao final do debate, o educador conduz uma conversa sobre o andamento da atividade, analisando cada personagem, sua dinâmica e como se relacionou com os demais. Além disso, questionar como foi para cada um se colocar no lugar de outra

pessoa para resolver um conflito, mesmo que possivelmente não concorde com os pensamentos e reivindicações da personagem.

Apresentamos um exemplo de tema e cada personagem: o tema pode ser o conflito entre produtores rurais e a presença da onça-parda; e os personagens podem ser: pequeno proprietário, grande proprietário, biólogo, educador ambiental, gestor de UC, secretário do meio ambiente, prefeito, presidente de ONG, etc. Vale lembrar que a atividade pode ser adaptada pelo educador.

Exemplo de uma situação (retirado de OLIVEIRA et al, 2016) que pode ser usada nessa atividade:

Simulação de uma reunião promovida pelo conselho de Meio Ambiente do município para resolver o problema da predação de animais de criação por onças-pardas na região. Um caso foi levado recentemente ao conselho pelo prefeito: um grande proprietário alegar ter prejuízo com a presença de onças em sua fazendo e reivindica uma solução pelo órgão ambiental da cidade.

Personagens da atividade:

Pequeno proprietário: dono de um sítio onde vive com sua família e cria galinhas e carneiros. Tem uma vida simples e trabalha arduamente para garantir seu sustento. Recentemente teve dois de seus carneiros mortos por uma onça. Costuma sair para caçar, mas nunca matou uma onça.

Grande proprietário: Possui uma grande fazenda com centenas de cabeças de gado que herdou de seu pai, porém mora na cidade e sua renda principal vem da fazenda. Recentemente, cinco de seus bezerros foram mortos por uma onça e decidiu reivindicar uma providência junto ao prefeito da cidade.

Cientista: Biólogo, estuda genética da população de onças-pardas na região há 10 anos e tem constatado o perigo de extinção da espécie em um futuro próximo. Identificou como as principais ameaças para as onças: o desmatamento, os atropelamentos, e a

morte por retaliação por produtores rurais. Porém sabe que diversos ataques a animais domésticos não são causados pelas onças.

Educador ambiental: preza a busca de soluções por meio do diálogo entre os diferentes atores sociais envolvidos. Também percebe as dificuldades dos produtores rurais, especialmente dos pequenos, mas também defende o direito à vida de todos os animais.

Gestor de unidade de conservação: é chefe de um parque estadual na região, o qual é um abrigo importante para as onças. O objetivo de seu trabalho é a conservação da biodiversidade. Trabalha com recursos escassos e uma equipe pequena.

Secretário de meio ambiente da cidade: foi pressionado pelo prefeito para encontrar uma solução para o problema, uma vez que as propriedades rurais geram dinheiro para o município. Marcou uma reunião acreditando que pode haver uma saída que contemple todos os envolvidos.

Prefeito: foi pressionado pelo grande proprietário para encontrar uma solução para o problema com as onças. Não conhece muito bem as questões ambientais, mas confia na sua equipe técnica. Precisa garantir que o fazendeiro saia satisfeito da reunião.

Presidente de ONG ambientalista: desenvolve projetos na região e conhece bem o contexto e os problemas ambientais. Está muito preocupado com a sobrevivência das onças, pois já ocorreram mortes desses animais por retaliação.

Atividade 9: Elaborando mídias e divulgando conhecimentos

Duração: depende do aprofundamento do tema, da mídia escolhida e do tempo disponível.

Número de participantes: independente, a atividade pode ser adaptada ao número de participantes. Pode-se também dividir o número de alunos em grupos, sendo que cada grupo pode escolher um tipo de mídia. Ou ainda, todos podem trabalhar juntos em uma única mídia e cada grupo se responsabiliza por uma tarefa.

Objetivos:

- Construir, junto com os alunos, algo que possa ser passado a outras pessoas, divulgando conhecimento e sensibilizando a população local, abordando problemas, questões ou temas que os próprios alunos apresentaram no diagnóstico de conflito humano-fauna;
- Os participantes devem escolher alguma mídia: fanzine (jornal alternativo), jornal da escola, vídeo, livrinho informativo, gibi, exposição de fotos/cartazes, etc.

Materiais necessários:

- Materiais de papelaria (papel, cartolina, cola, tesoura, canetas, tintas, etc);
- Materiais de audiovisual (computador, internet, Datashow, câmera de foto e vídeo, etc).

Preparação:

- Essa atividade pode ser desenvolvida após o processo de sensibilização e conscientização sobre o tema proposto, assim, os participantes já estarão envolvidos e familiarizados com a temática e, possivelmente, encantados pela conservação.
- Desde o início (ou meio) do processo, o educador pode falar desta atividade e começar a envolver os participantes para que eles possam ir escolhendo e pensando no que desejam produzir. Vale lembrar que essa é uma atividade de educomunicação e que os participantes precisam se envolver e estarem dispostos a criar o produto final.

Desenvolvimento:

- Para essa atividade é importante que os próprios alunos escolham qual/is mídia/s querem usar. O educador deve dar todo o suporte e orientação para que avancem nas produções. Além disso, também é papel do educador esclarecer algumas regras, como por exemplo, todos os participantes têm que ajudar e, para isso, pode haver uma divisão de tarefas e cada um pode ficar responsável por algo durante o processo de criação.
- Ao final de todos os encontros e quando o produto final estiver pronto, todo o grupo pode divulgar, ou seja, se for um vídeo, todos podem usar as redes

sociais para compartilhá-lo; se for um jornal da escola, podem distribuir na própria escola ou ainda levar às demais; e etc.

- Certamente todos ficarão orgulhosos do resultado e, simultaneamente, estão contribuindo para a conservação da fauna na região, desmitificando diversos aspectos sobre os animais e auxiliando na resolução de conflitos entre o ser humano e a fauna silvestre.

Sobre os Autores

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Arnaud é formado como Zoólogo (McGill University, Canadá) e tem mestrado em Manejo de Recursos Naturais (Cranfield University, UK) e doutorado em Manejo da Biodiversidade (Universidade de Kent, UK). É presidente e fundador do Instituto de Conservação de Animais Silvestres (ICAS) e coordenador dos Projetos Tatu-Canastra e Bandeiras & Rodovias. Atua nas áreas de biologia da conservação, pesquisa e ecologia de espécies e uso de recursos naturais.

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Nathália Formenton da Silva é formada em Ciências Biológicas (licenciatura plena) pela Universidade Federal de São Carlos – campus São Carlos – UFSCar, e desde a graduação demonstra interesse pela conservação da fauna e pela educação ambiental. Atualmente é mestre em Conservação da Fauna pelo Programa de Pós-Graduação em Conservação da Fauna, também pela UFSCar, em parceria com a Fundação Parque Zoológico de São Paulo (FPZSP). O seu trabalho consistiu no desenvolvimento de um curso de formação de professores das escolas do entorno de uma unidade de conservação em São Paulo. Também trabalha na elaboração de materiais didáticos e educativos para a conservação da fauna.

PEDRO RODRIGUES BUSANA

Pedro Rodrigues Busana nasceu e cresceu na cidade de São Paulo, tendo desde cedo gosto pelo desenho e paixão pelos animais. Formado em Ciências Biológicas Licenciatura pela Universidade Federal de São Carlos (UFSCar) do Campus Sorocaba, aprendeu como casar seus dois maiores interesses, além de também fazer caricaturas e elaborar histórias em quadrinhos. Atualmente é mestre pelo Programa de Pós-Graduação em Conservação da Fauna da Universidade Federal de São Carlos em parceria com a Fundação Parque Zoológico de São Paulo, estudando e trabalhando com ilustração biológica, didática e artística, com ênfase em animais. Está sempre buscando se aprimorar como biólogo, ilustrador e divulgador científico.

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FOTOGRAFIA PARA A ATIVIDADE 3

Foto: Pedro Rodrigues Busana

CARTAS PARA JOGO DA MEMÓRIA DA ATIVIDADE 5

O tamanduá-bandeira vive no Cerrado. Ele tem uma cauda longa e peluda que caracteriza seu nome por parecer uma bandeira. Também tem uma faixa preta, margeada por faixa branca na lateral do seu corpo. E tem o focinho longo.

O tamanduá-bandeira possui olhos estreitos e uma boca pequena e desdentada, localizada ao final de um longo e cônico focinho.

O tamanduá-bandeira se alimenta de formigas e cupins e usa sua língua grande e fina para alcançar esses insetos. Ele também ajuda o homem combatendo pragas.

O tamanduá-bandeira usa suas garras para quebrar cupinzeiros e formigueiros, facilitando sua alimentação. Quando ameaçado, ele prefere fugir a lutar.

O tamanduá-bandeira ajuda o homem no controle de pragas, pois come cerca de 30 mil formigas por dia. Então, ter esse animal por perto é muito importante.

O pelo da cauda do tamanduá-bandeira é áspero e duro, mas ajuda o animal a se cobrir quando dorme, protegendo-o do frio, da chuva e dos insetos. Além disso, a cauda ajuda no equilíbrio do animal enquanto anda.

A pegada do tamanduá-bandeira é muito parecida com a pegada do ser humano, parecendo com a pegada de uma criança, o que gera algumas lendas. Porém, são apenas lendas, o tamanduá não faz nenhum mal.

O tamanduá-bandeira não tem diferenças visíveis entre machos e fêmeas, pois os testículos dos machos ficam dentro do abdômen. Sabemos diferenciá-los apenas quando vemos o filhote nas costas da fêmea, pois apenas ela cuida da cria por até 1 ano após o nascimento.

O tamanduá-bandeira tem o hábito de se banhar, assim como o ser humano (lavar os pés, as axilas, a cabeça, enxaguar a barriga). Também tem o hábito de escalar árvores. Curioso, não é?

O tamanduá-bandeira é um animal incrível e muito importante para o meio ambiente. Ele não faz mal para o ser humano e nem traz má sorte. Ter esse animal por perto é fantástico!

O INCRÍVEL TAMANDUÁ:

Manual do Professor

Apoio e Patrocínio de

FONDATION SEGRÉ

PROJETO TATU CANASTRA

Bandeiras & Rodovias

greenvillezoo SOUTH CAROLINA

REID PARK ZOO