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Edentata

The Newsletter of the IUCN/SSC Anteater, Sloth and Armadillo Specialist Group

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Northern naked-tailed armadillo (*Cabassous centralis*). Drawing by Alberto Mejía-Paniagua.
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Letter from the Editors

Dear readers,

Welcome to ***Edentata* 21**! This year's issue features two full articles, two short communications, and two field notes. It includes an interesting review on the xenarthrans of Honduras; a description of the first camera trap records of giant anteaters in Baritú National Park, Argentina; and a report on the occurrence of ticks on free-ranging armadillos in Piauí, Brazil. Coincidentally, there are two contributions about giant armadillos and bees. One of them describes the attack of *Priodontes maximus* on a nest and its predation of stingless bees, whereas the other explores ways to reduce the conflict between beekeepers and giant armadillos. And don't miss the field note about the SlothBot, a cute environmental monitoring robot! Hopefully, the SlothBot will collect data for field ecologists in the rainforest canopy in the near future.

The **News** section includes, among others, exciting announcements about the partnership our Specialist Group has entered into with Nurtured by Nature, and the possibility to support our Specialist Group via PayPal. It also showcases some astonishing statistics from the First International Congress on Xenarthra Conservation, which was held online from November 30 to December 3 and was attended by over 500 participants! We hope many of you participated in this amazing congress and enjoyed the interesting talks and mini-courses. We would like to take the opportunity to thank Instituto Tamanduá for having organized this wonderful event. This was the first, but certainly not the last, International Congress on Xenarthra Conservation.

At the end of this edition, you will find updated **Instructions to Authors** in English, Spanish and Portuguese. We hope that these detailed instructions will help you prepare your manuscripts for submission to *Edentata*. We are looking forward to receiving your manuscripts!

Last, but not least, we would like to thank Benison Pang for his generous donation, which has allowed us to prepare this year's edition of *Edentata*, and Kansas City Zoo for their generous donation to the Pygmy Sloth Conservation Program. We are also grateful to Nurtured by Nature for their continuing support.

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Bee careful! Conflict between beekeepers and giant armadillos (*Priodontes maximus*) and potential ways to coexist

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Abstract Damage caused by wildlife is one of the main causes of human-wildlife conflict (HWC) worldwide and poses a significant threat to both biodiversity conservation and human livelihoods. Understanding the mechanisms that underpin such damage is critical to tackle HWC and foster coexistence. In this paper we provide information on the pattern and magnitude of damage by giant armadillos (*Priodontes maximus*) to apiaries in the Cerrado biome of Mato Grosso do Sul, Brazil. With the collaboration of 10 beekeeping associations we gathered information from 178 beekeepers. Seventy-three percent of these individuals reported beehive damage by giant armadillos in the last five years and 46% in the last 12 months, resulting in substantial economic losses. We used a combination of beekeepers' reports and camera traps to characterize the pattern of damage, and to evaluate the effectiveness, as well as pros and cons, of several non-lethal mitigation measures to deter giant armadillos from damaging beehives. In hopes of developing a win-win solution, we propose the implementation of a Honey Certification Scheme so that beekeepers and giant armadillos may not only coexist but thrive together.

Keywords: *Apis mellifera*, beekeeping, Cerrado, coexistence, human-wildlife conflict, wildlife damage

Tenha cuidado! Conflito entre apicultores e tatus-canastra e possíveis formas de coexistir

Resumo Danos causados pela vida silvestre constituem-se em uma das principais causas de conflitos humano-fauna (CHF) ao redor do mundo, ameaçando significativamente a conservação da biodiversidade e os meios de subsistência das pessoas. A compreensão dos mecanismos que sustentam tais danos é fundamental para combater o CHF e promover a coexistência. Neste artigo, fornecemos informações sobre o padrão e a magnitude do dano causado por tatus-canastra em apiários no Cerrado do Mato Grosso do Sul, Brasil. Com a colaboração de 10 associações apícolas, reunimos informações de 178 apicultores. Setenta e três por cento deles relatou danos às colmeias por tatus-canastra nos últimos cinco anos e 46% nos últimos 12 meses, resultando em perdas econômicas substanciais. Usamos uma combinação de relatos de apicultores e armadilhas fotográficas para caracterizar o padrão do dano e avaliar a efetividade, os prós e contras de algumas medidas de mitigação não-letais para impedir que os tatus-canastra danifiquem as colmeias. Na esperança de desenvolver uma solução onde todos os lados saiam ganhando, nós propomos a implementação de um esquema de certificação do mel para que apicultores e tatus-canastra possam não apenas coexistir, mas juntos prosperar.

Palavras-chave: apicultura, *Apis mellifera*, Cerrado, coexistência, conflito humano-fauna, danos causados pela vida silvestre

Introduction

Human-wildlife conflict (hereafter, HWC) is undoubtedly a challenging and urgent conservation issue worldwide (Hodgson *et al.*, 2020). One of its main causes is damage by wildlife, which threatens livelihoods and the mental well-being of people affected (Messmer, 2000). This often leads to retaliatory actions against the animals deemed responsible (Sifuna, 2005). HWC may also result in human-human disagreement about what should be done to remedy a situation (Redpath *et al.*, 2015). In South America, several examples of HWC have been documented. The most emblematic is the predation of domestic livestock by wild cats such as jaguars (*Panthera onca*; Inskip & Zimmermann, 2009), or by wild canids on domestic fowl (Bickley *et al.*, 2019). However, conflicts with armadillos have also been reported. The most-studied armadillo, the nine-banded armadillo (*Dasypus novemcinctus*), damages both agricultural crops and gardens (Gammons *et al.*, 2009). In Argentina, the large hairy armadillo (*Chaetophractus villosus*) and the six-banded armadillo (*Euphractus sexcinctus*) are reported to damage silo bags (Zufiaurre *et al.*, 2019). In Brazil, the six-banded armadillo is also persecuted and sometimes killed by ranch workers in the Pantanal because cattle and horses can step in the armadillos' burrows and break their legs (Desbiez, 2007). Finally, the giant armadillo (*Priodontes maximus*) in the Chaco of Paraguay damages water storage structures (Weiler & Núñez, 2012). In this study, we provide the first description of giant armadillo damage to apiaries in the Cerrado biome of Mato Grosso do Sul (MS), Brazil, and the resulting conflict with beekeepers.

The giant armadillo is the largest living cingulate, with adults measuring up to 1.5 m long and weighing up to 60 kg (Carter *et al.*, 2016; Desbiez *et al.*, 2019b). This species is naturally rare but widely distributed throughout 11 countries in South America, in habitats ranging from tropical forest to open savanna (Smith 2007; Abba & Superina, 2010). This large myrmecophagous species has an extensive home range, is solitary, nocturnal, and fossorial in habits and can therefore easily go unnoticed by the local population (Eisenberg & Redford,

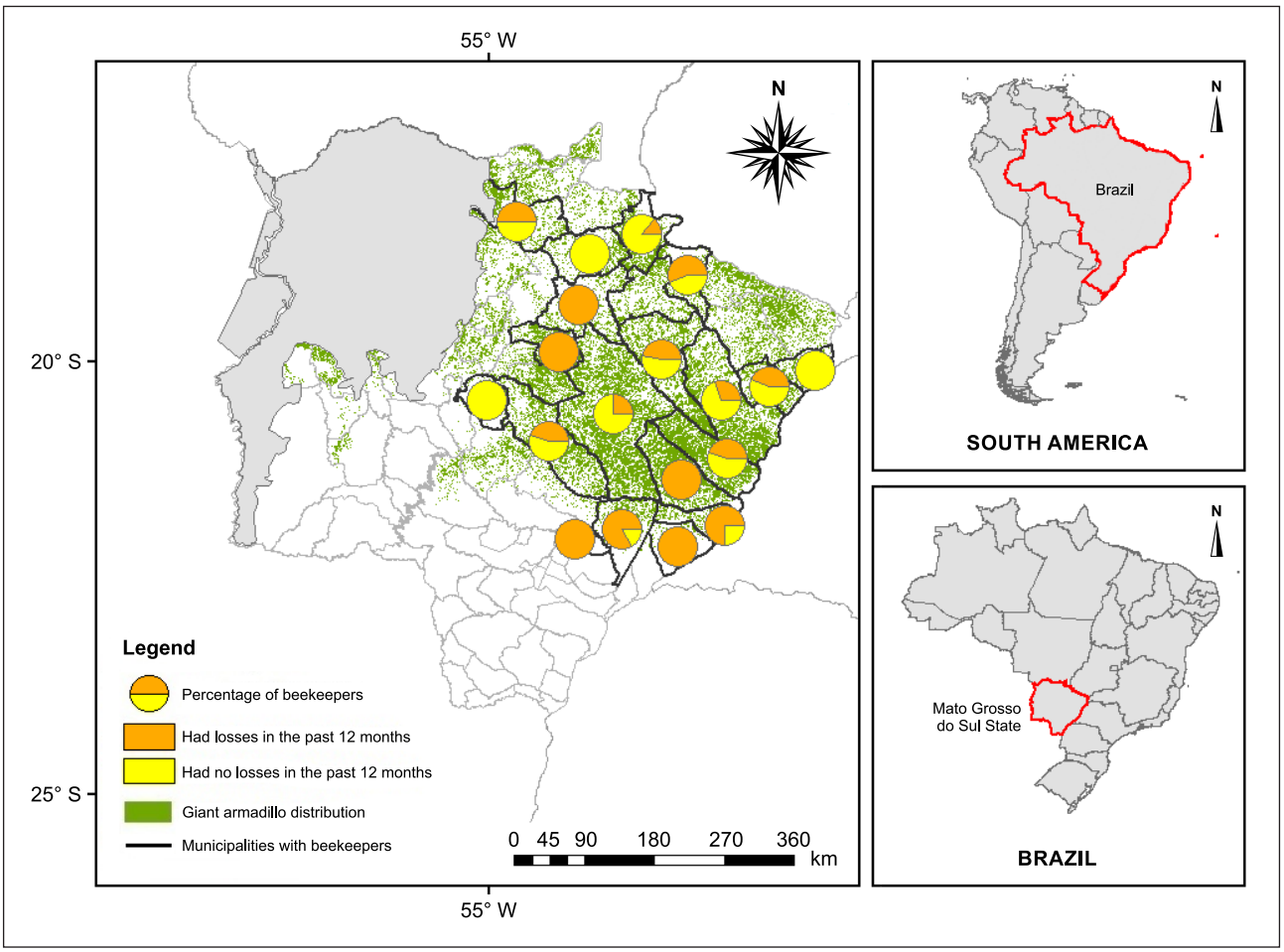

Figure 1. Prevalence of damage by giant armadillos (*Priodontes maximus*) to beehives in Mato Grosso do Sul state, Brazil from a survey conducted between July 2017 and October 2019: percentage of beekeepers who experienced damage by giant armadillos in the last year (orange) and those who did not (yellow). No conflict between giant armadillos and beekeepers was registered in the Pantanal, where giant armadillos also occur (grey shaded area).

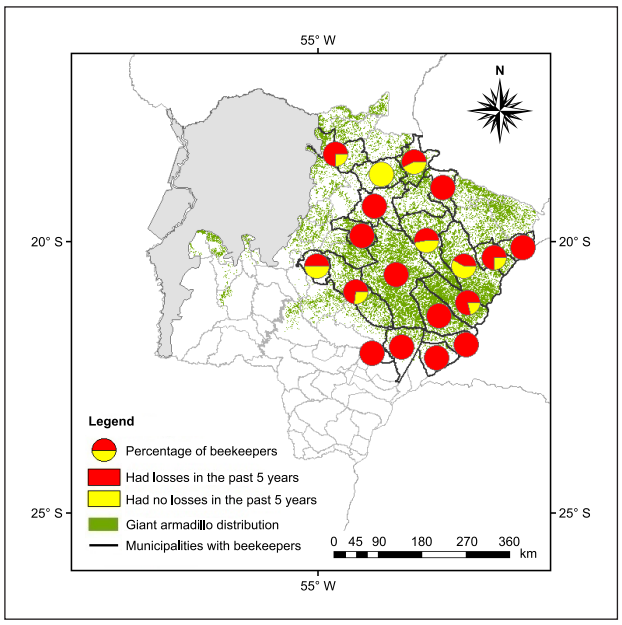

FIGURE 2. Prevalence of damage by giant armadillos (*Priodontes maximus*) to beehives in Mato Grosso do Sul state, Brazil from a survey conducted between July 2017 and October 2019: percentage of beekeepers who experienced damage by giant armadillos in the last five years (red) and those who did not (yellow). No conflict between giant armadillos and beekeepers was registered in the Pantanal, where giant armadillos also occur (grey shaded area).

1999; Silveira *et al.*, 2009; Desbiez *et al.*, 2020). Due mainly to habitat loss and hunting, the species is currently classified as "Vulnerable" (A2cd) on the IUCN Red List of Threatened Species (Anacleto *et al.*, 2014).

Brazil's Cerrado is a highly diverse savanna ecosystem that provides critical habitat for many endemic and rare species (Klink & Machado, 2005). The Cerrado is also home to the giant armadillo (Chiarello *et al.*, 2015). Although it is considered one of the world's biodiversity hotspots, more than 50% of Brazil's Cerrado has been transformed into pasture or agricultural lands planted with cash crops, and as little as 19.8% remains undisturbed (Green *et al.*, 2019). Deforestation rates have been 2.5 times higher in the Cerrado than in the Amazon rainforest, and conservation efforts have been modest (Strassburg *et al.*, 2017). Lemos and colleagues (2020) reported that giant armadillos can be found in highly human-modified Cerrado landscapes in central Brazil, but 83% of records occur in native vegetation. In Mato Grosso do Sul, however, the remaining areas of native Cerrado vegetation are highly fragmented and occur predominantly as small patches, with an average patch size of 9.05 ± 0.70 ha (Reynolds *et al.*, 2016). In the better-preserved Pantanal region adjacent to the Cerrado, the median adult home-range area for giant armadillos is 2,510 ha (Desbiez *et al.*, 2020), which suggests that individual giant armadillos in the Cerrado are likely to require several connected fragments to find the resources necessary for their survival.

Between April 2015 and July 2018, the Giant Armadillo Conservation Program launched a project to survey all native habitat fragments in over 500 micro watersheds throughout the Cerrado of Mato Grosso do Sul to map the distribution of the giant armadillo. During field work, we spoke with >1000 members of local communities to access native fragments on their land. During these informal conversations, it was reported that giant armadillos were adversely affecting beekeepers in several municipalities throughout the state. Beekeepers place their hives along the edges of the last fragments of native Cerrado vegetation so that their bees can be as close as possible to the native wild flowers. Unfortunately, these are also the fragments that sustain giant armadillos. Giant armadillos were reported to knock over and destroy beehives, but we also learned that beekeepers implemented a range of protection techniques to prevent this. Some of these strategies were non-invasive (*e.g.*, fencing), whereas others were potentially lethal (*e.g.*, poisoning). Beekeepers have reported retaliation against giant armadillos, which may explain why in some areas where our distribution models predicted the species should be present, we found no evidence of it. This leads us to believe that the conflict with beekeepers may be contributing to the local extinction of the species in some areas and should receive attention from conservationists.

Although damage does not necessarily translate into retaliatory behavior, several studies show that wildlife damage can affect people's evaluations of favorability towards a species and their willingness to protect it (*e.g.*, Lindsley *et al.*, 2005; Bickley *et al.*, 2019). Historically, the science of Wildlife Damage Management has sought solutions so that humans and wildlife can coexist (Conover, 2002). This goal is usually achieved through a variety of approaches, for example by changing the behavior of the species causing the problem (Branco, 2018), by trying to reduce the vulnerability of the target (Marchini *et al.*, 2011), or by influencing human behavior and attitudes so that people are more willing to tolerate the damage (Decker *et al.*, 2012). For any of these approaches, the first and most basic step is problem definition: determining the species causing the loss, the pattern of the damage, and the magnitude of the problem (Vercauteren *et al.*, 2010). Thus, in the present case, the first step to tackle is defining the threat that giant armadillos represent to the livelihood of beekeepers, and then explore potential approaches to alleviate this conflict. Hence, in this study we sought to: 1. estimate the prevalence of damage by giant armadillos to beehives throughout their range in the Cerrado biome of Mato Grosso do Sul; 2. characterize the pattern

Figure 3. Beekeeper holding a dead giant armadillo (*Priodontes maximus*) killed in retaliation for the damage caused to his beehives. The picture was provided by a beekeeper who agreed with the anonymous disclosure of the content.

of damage and understand how the giant armadillo successfully predates the hives; and 3. discuss the effectiveness of the different strategies that beekeepers are currently using to reduce damage. In addition, we explore solutions grounded not only in reducing the negative interactions between beekeepers and giant armadillos, but also in increasing positive relations between them.

Materials and Methods

All of the 10 beekeeper associations found across the range of the giant armadillo in the Cerrado of Mato Grosso do Sul were consulted. In order to assess the prevalence of damage, and to calculate the financial cost of a damaged beehive, from July 2017 to October 2019 we asked the beekeeper associations to help us gather the following information: 1. the total number of active associates; 2. how many associates experienced damage by giant armadillos in the past five years and in the past 12 months; 3. the amount of damage (in units of beehives) experienced by each of them in the two time frames (five years and the past 12 months), and 4. the financial loss incurred from a damaged beehive unit.

To document giant armadillo predatory behavior and evaluate mitigation measures, we collaborated with beekeeping associations and conducted informal conversations with beekeepers in the region. We recorded the different mitigation strategies adopted by beekeepers and ranked their effectiveness in preventing giant armadillo predation as high, medium or low. Measures were also extensively discussed with beekeepers to understand their pros and cons. 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 most apiaries.

In addition to the reports provided by beekeepers, we monitored the effectiveness of four mitigation methods (stands at less than 1.3 m, fencing, pallets, securing hives to the stand) using camera traps. Between July 2017 and November 2019, 21 camera traps (Reconyx XP9, Holmen, USA) were placed on six properties at nine different apiaries, with the authorization of the owners. The camera traps were fixed a few meters away from the beehives to ensure full view of the hives and surroundings. They were set on 1080P HD video at 30 frames per second. To make sure that any animal predating the beehive would be detected, two cameras were placed around the same hives in six apiaries and three cameras in three apiaries. Cameras were left in the same apiary for at least three months.

Results

A total of 178 beekeepers were consulted (**Fig. 1, 2**), of which 175 were men and three were women. Of these 178 individuals, 136 were members of the 10 beekeeping associations we consulted; the remaining 42 were non-member beekeepers who worked in neighboring municipalities. The number of hives per beekeeper ranged from four to 2,000, with an average of 230 (± 352 SD) hives per beekeeper. For 53% of these beekeepers, over half of their income came from beekeeping. Most of the beekeepers owned their own hives (81%), while the rest cared for their own hives as well as someone else's, or cared for only someone else's hives. Thirty percent of beekeepers lived near or on the land where the honey was produced; 25% actually owned some of the land where they produced honey. In general, most of the hives were placed on land that did not belong to the beekeeper and required some form of transport to access.

Prevalence and the cost of damage caused by giant armadillos to beehives

Forty-six percent of beekeepers reported damage by giant armadillos in the past 12 months (**Fig. 1**), for a total of 1,036 damaged beehives in this period. In the past five years, 73% of associates experienced losses due to giant armadillo predation (**Fig. 2**), with approximately 6,265 destroyed beehives. The cost of a destroyed beehive was estimated between R$500 and R$730 (Brazilian reais) or 100 to 150 USD (1R$ = 0.20 USD, 10 June 2020). The

total financial loss due to giant armadillo predation on beehives in this region (using the minimum beehive cost estimate) was valued at R$518,000 in the past 12 months (or $103,600 USD), and at over R$3,000,000 in the past five years ($626,500 USD).

Giant armadillos usually toppled a single hive, but could topple up to five hives in the same night. One beekeeper who had not visited his hives for more than two weeks reported he had 120 hives toppled and destroyed. The beekeeper who claimed the most damage reported the loss of 460 hives (R$230,000/$46,000 USD) during his 14 years as a beekeeper. Some beekeepers reported they have had to abandon specific areas where they produced honey due to the conflict. Some are aware of colleagues who gave up beekeeping altogether due to giant armadillo predation.

Characterizing beekeepers' strategies to prevent beehive damage

While some beekeepers adopted non-lethal mitigation strategies (described below), others used lethal methods to rid themselves of animals causing damage to hives, including poisoning and trapping (**Fig. 3**). Beekeepers reported that trapping was almost always unsuccessful, very time-consuming, and frustrating. Poisoning was usually successful as giant armadillos returned to feed on the fallen bee combs. Because the density of giant armadillos is very low (Desbiez *et al.*, 2020), once the culprit was killed, predation stopped for an average of three years according to beekeepers. Despite the extra financial and labor costs, some beekeepers voluntarily implemented non-lethal methods to prevent giant armadillo attacks. A total of 10 different methods to prevent giant armadillo predation were recorded and discussed with beekeepers and their representatives in the associations (**Table 1**).

Figure 4a. Pattern of damage by giant armadillos (*Priodontes maximus*) to beehives in Mato Grosso do Sul state, Brazil.

Figure 4b. Pattern of damage by giant armadillos (*Priodontes maximus*) to beehives in Mato Grosso do Sul state, Brazil.

Characterizing the damage

Camera traps recorded giant armadillo predation behavior on four occasions. Two of these involved hives that were on stands <1.3 m high and were not secured to the stand (https://youtu.be/g_ncD5rxhto and https://youtu.be/aL68MeemPPY). In the third case a giant armadillo dug under a fence and predated hives that were on low stands (https://youtu.be/2h-GQpjKniI). Finally, on the last occasion a giant armadillo predated hives secured on a pallet placed on two tires (https://youtu.be/4lrj1OAZvH4).

The video records show that giant armadillos use their skull and nose rather than their claws to knock over beehives. They walk on their hind legs using their strong tail for balance and use their head to push over beehives as heavy as 35 kg. They use their claws sometimes to hold on to structures to maintain balance. In Mato Grosso do Sul all bees are hybrids of European honey bees *Apis mellifera mellifera* with aggressive Africanized bees *Apis mellifera scutellata*. Videos show the armadillo's considerable resistance to bee stings, thanks to their thick skin and protective armor and scales. However, they were still inconvenienced by the bees, and we recorded images of giant armadillos rolling themselves on the ground and using their claws to rub the head, presumably as a means of getting rid of attacking bees.

Once a beehive was knocked on the ground the attacking giant armadillo proceeded to completely destroy it and dismantle all the frames (**Fig. 4a, b**).

TABLE 1. Description, benefits, costs, effectiveness, and number of beekeepers using methods to prevent giant armadillo (*Priodontes maximus*) predation to beehives in the Cerrado of Mato Grosso do Sul, Brazil.

Method	Description	Benefits	Costs	Effective-ness	Number of bee-keepers using the method
1. Elevated stands higher than 1.3 m (**Fig. 5a**)	• Hives are placed on stands that are a minimum of 1.3 m from the ground • Stands can be made of wood or steel and must be well planted deep in the ground to prevent an armadillo from digging at the base of the stand and destabilizing the structure • Most widely-used method • Documented to prevent damage by giant armadillos	• It is inexpensive • The materials are easily obtained • Beekeepers in MS are used to working with these types of stands	• It makes hive management and honey retrieval more difficult and time consuming • Beekeeper must use a stool or, if the hives are well-aligned and accessible, hives can be managed from the back of a truck • Limits the number of frames used in each hive because if the hive becomes too tall it will be even more difficult to access	High	58
2. Fencing with underground wall (**Fig. 5b**)	• Enclosing the apiary within a fence that is at least 1.3 m tall together with a brick foundation that extends at least 50 cm underground	• The hives can be kept close to the ground, which facilitates their management • It prevents other species such as tayras (*Eira barbara*) from predating the hives • It will be effective for a long time due to material durability	• High cost, so it can only be used for permanent apiaries • Beekeepers must have an easy way to exit in case of bee attack	High	1
3. Electric fences (**Fig. 5c**)	• Enclosing the apiary within an electric fence with at least one wire at 15–20 cm height	• Hives can be kept close to the ground, which facilitates their management • It prevents other species such as tayras (*Eira barbara*) from predating the hives • It will be effective for a long time due to material durability	• High cost • Requires frequent monitoring to ensure vegetation has not grown or fallen on the wire • Beekeepers must have an easy way to exit in case of bee attack	High	6
4. Hives on stands between 1 m and 1.3 m high secured with knots (**Fig. 5d**)	• Hives on stands that are between 1 m and 1.3 m from the ground, but that are tightly secured to the stand • Can be more or less effective depending on how the beekeeper secures them • Different materials (rope or wire) and knots can be used • X knot is the most effective	• It is inexpensive • Allows the beekeeper to work lower than 1.30 m, without a truck or a stool • Enables the beekeeper to keep working with stands (the way they normally work where there are no giant armadillos)	• Every time the hive is managed knots must be removed and then carefully retied, which is time consuming • If the hive is not well secured, it can be predated, so knots must be regularly tested • In some regions this is ineffective, while in others it seems to work	Medium	17
5. Hives on stands between 1 m and 1.3 m with nails on plank surrounding the hive (**Fig. 5e**)	• Hives are placed on a wooden plank with nails surrounding it. The plank must be wide enough so the animal cannot reach the hive between planks • The hive can be removed by the beekeeper by vertically lifting it but it cannot be tilted by a giant armadillo	• It is inexpensive • Allows the beekeeper to work lower than 1.3 m, without a truck or a stool • Enables the beekeeper to keep working with stands • Allows for easy hive manipulation	• It is not always efficient against giant armadillo predation • Nails must be monitored frequently	Medium	2
6. Four hives bolted on pallets on tires (**Fig. 5f**)	• Four hives are bolted on a pallet that is raised on top of several tires • It is very efficient in some regions, but not in others • Tires are used instead of wooden stands	• It is inexpensive • The materials are easy to obtain • Allows the beekeeper to work lower than 1.3 m	• It is difficult to manage and to transport the set hives + pallet • Method does not always prevent predation. It seems to depend on the region or maybe even individual armadillos	Medium	3
7. Fencing without underground wall (**Fig. 5g**)	• Fencing around the apiary with no concrete wall underground	• In some regions this has prevented giant armadillo predation • If it works, it will be effective for a long time due to material durability	• High cost • This method only seems to work in areas where the giant armadillo has not learned to predate hives •Animals can dig under the fence • Beekeepers must have a way to exit in case of bee attack	Medium	5
8. Stands lower than 1.3 m without knots or nails (**Fig. 5h**)	• Elevated stands lower than 1.3 m without knots • This is the way beekeepers work where there are no giant armadillos	• There are no benefits of using this method as it does not protect the hives against giant armadillo predation	• The animal can reach the hives	Low	60
9. Sensory methods (**Fig. 5i**)	• Visual methods such as hanging CDs, using a scarecrow, and hanging tarps and plastic • Olfactory methods such as perfume, bags of onions, human hair, and human urine • Loud noises, such as the use of fire crackers or pots and pans	• There are no benefits of using these methods. They do not protect the hives	• These methods actually just make the bees defensive and dangerous, so they should be avoided	Low	7
10. Hives on 200 l barrels (**Fig. 5j**)	• Large empty 200 l diesel drums are used instead of stands	• There are no benefits of using this method	• Hives are not high enough • Does not allow planks to be secured • Hives are unstable and can be knocked down	Low	3

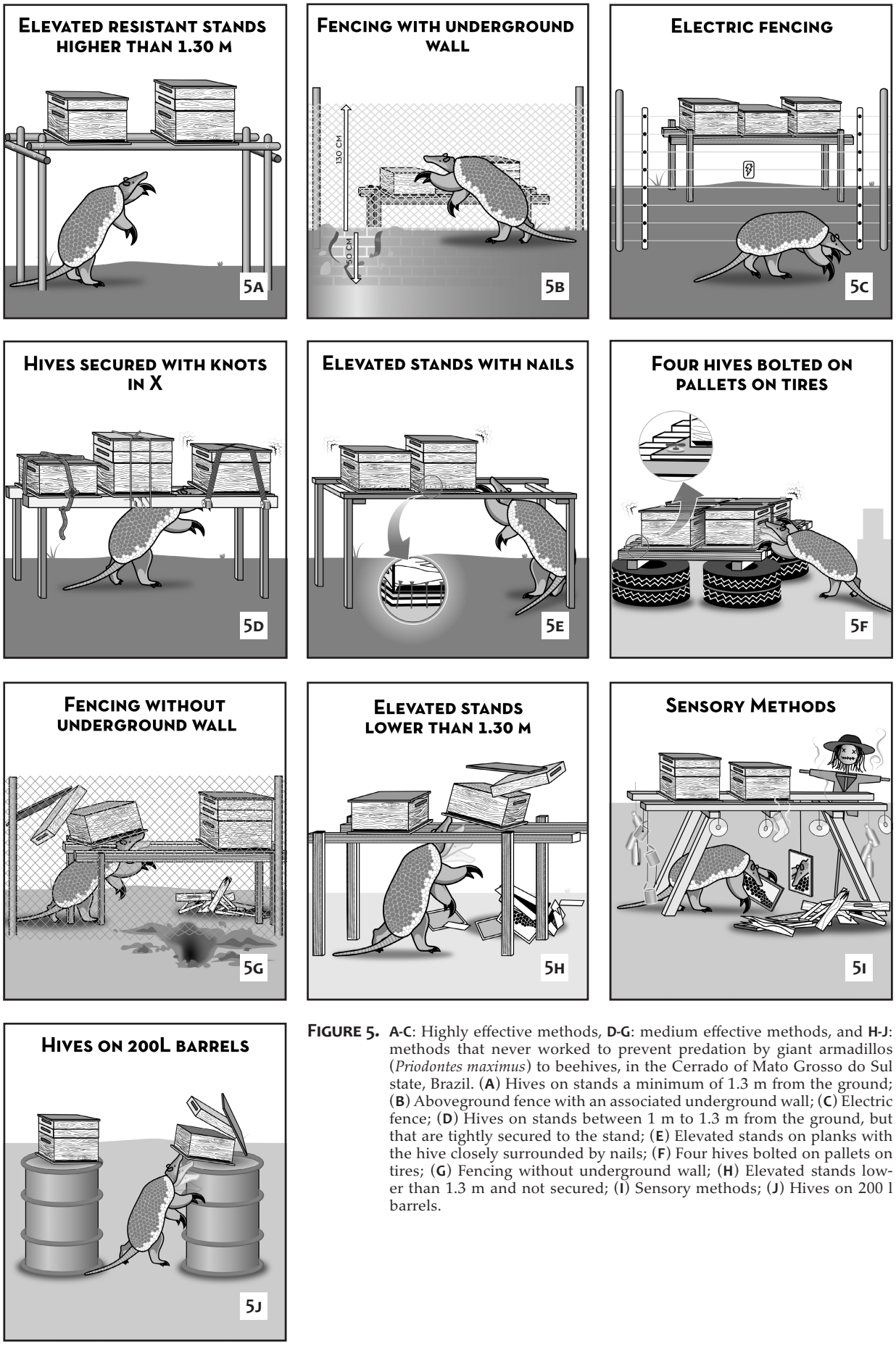

Figure 5. **A-C**: Highly effective methods, **D-G**: medium effective methods, and **H-J**: methods that never worked to prevent predation by giant armadillos (*Priodontes maximus*) to beehives, in the Cerrado of Mato Grosso do Sul state, Brazil. (**A**) Hives on stands a minimum of 1.3 m from the ground; (**B**) Aboveground fence with an associated underground wall; (**C**) Electric fence; (**D**) Hives on stands between 1 m to 1.3 m from the ground, but that are tightly secured to the stand; (**E**) Elevated stands on planks with the hive closely surrounded by nails; (**F**) Four hives bolted on pallets on tires; (**G**) Fencing without underground wall; (**H**) Elevated stands lower than 1.3 m and not secured; (**I**) Sensory methods; (**J**) Hives on 200 l barrels.

This was often done over the course of several nights, including up to five nights in a row. Beekeepers observed that giant armadillos were not consuming honey but rather the bee larvae because they dismantled and fed on the brood comb rather than the honey frames. Beekeepers were particularly angered by the waste of honey, in addition to the destruction of their equipment.

Our camera traps further showed that other species forage on the fallen, destroyed frames during the day, including: tayra (*Eira barbara*), giant anteater (*Myrmecophaga tridactyla*), southern tamandua (*Tamandua tetradactyla*), six-banded armadillo (*Euphractus sexcinctus*), red-legged seriema (*Cariama cristata*), and bare-faced curassow (*Crax fasciolata*).

Beekeepers mentioned other mammals that they believe can cause damage to beehives, especially when the hives are kept lower to the ground. These include the six-banded armadillo, lesser grison (*Galictis cuja*), hooded capuchin monkey (*Sapajus cay*), black and gold howler monkey (*Alouatta caraya*), and tayra. Tayras usually gnaw and break a side of the hive without toppling it (**Fig. 6**). If they topple the beehive, they do not completely destroy it as the giant armadillo does. Sometimes, tayras, giant anteaters, and six-banded armadillos were blamed for giant armadillo damage. In addition to mammals, beekeepers reported damage by frogs, native bees, ants, and beetles, as well as termites (that attack the wood of the hive).

Figure 6. Pattern of tayra (*Eira barbara*) damage to beehives. Note that the pattern of damage is different from that of a giant armadillo (*Priodontes maximus*), see **Fig. 4A, B**.

Discussion

Conflict between beekeepers and native wildlife occurs in various regions of the world, ranging from black bears in the United States to honey badgers in South Africa (Maehr & Brady, 1982; Otto & Roloff, 2015; Carter *et al.*, 2017). Testing and searching for adequate mitigation measures to promote co-existence with these species has been the focus of many studies (Maehr *et al.*, 1982; Begg & Begg, 2002). In our study we show that in some areas of Mato Grosso do Sul, giant armadillos have learned to predate beehives by knocking them over and destroying all the honeycombs to consume the bee larvae. We also compiled and rated the effectiveness of some of the mitigation methods used by beekeepers.

Most beekeepers in our study area experienced damage by giant armadillos at some point in their career as a beekeeper. However, it is not clear if giant armadillo predation of beehives is a widespread behavior throughout their South American range. The natural predation of a ground nest of stingless bees *Trigona amalthea* (Apidae: Meliponini) has been reported in the Serra do Divisor National Park, Acre, Brazil (Melo & Nogueira, 2020). Nests of stingless bees are common, and are often low and accessible to giant armadillos. They could therefore represent an important source of food for giant armadillos in the Amazon (Melo & Nogueira, 2020). We consulted three beekeeper associations in the neighboring region of the Pantanal of Mato Grosso do Sul; there were no recorded issues of conflict with giant armadillos in the municipalities of Corumbá, Miranda, and Aquidauana. Beyond Mato Grosso do Sul, we received reports of beekeepers suffering attacks from giant armadillos in Minas Gerais state, Brazil (J. Magnino, pers. comm., 26 May 2019), Castelli, in the Chaco Province of Argentina (Y. Di Blanco, pers. comm., 30 August 2019), and, more recently, in Vichada, Colombia (C. Rojano, pers. comm., 24 March 2020). The problem could therefore be going unreported in other areas of the species distribution. It is possible that in more pristine environments giant armadillos do not need to resort to predation on artificial beehives, while in highly fragmented areas there might be less resources available, making beehives an attractive alternative. In support of this hypothesis, in Minas Gerais the attack took place in a highly altered landscape. Vichada is one of the most conserved departments of Colombia, but the attack took place in an area with a forestry plantation. In Castelli, in the Chaco, the hives were at the edge of a native forest patch surrounded by agricultural fields.

Predation from giant armadillos may also be undetected if the wrong animal is blamed for beehive damage. For example, several of the beekeepers we spoke to reported that they thought giant anteaters were responsible for the attacks. That is because when they arrived at the apiary, they would find a giant anteater feeding on the honeycombs of a damaged beehive. Giant anteaters have been reported to predate a wild *Apis mellifera* colony (Miranda *et al.*, 2003); however, we have never recorded them even attempting to predate man-made beehives. Furthermore, in areas where the giant armadillo is absent but the giant anteater is present, no attacks from giant anteaters have been registered. We therefore believe giant anteaters are being wrongly accused. Giant anteaters can be active during the day, especially on colder days (Camilo-Alves & Mourão, 2006), while the giant armadillo is strictly nocturnal (Carter *et al.*, 2016). A beekeeper will therefore find a giant anteater feeding off the fallen combs when he arrives at his apiary, which probably explains why giant anteaters have been accused. Diurnal activity may also explain why six-banded armadillos have been accused too.

Giant armadillo predation of beehives is very destructive and can affect the beekeepers' livelihoods. Beekeepers report with aggravation that there is nothing they can salvage, having to throw everything away after a predation event, which creates a feeling of frustration and waste. As mentioned in the **Results**, several beekeepers commented that it bothered them that the armadillos do not even consume the honey. For all these reasons then, this conflict certainly creates a sense of resentment on the part of the beekeepers.

Because giant armadillos return to feed on fallen beehives for several nights in a row, they can easily be poisoned. Beekeeper associations mentioned eight beekeepers known to have killed giant armadillos. Only one individual openly admitted to doing this, but many beekeepers commented that they knew of colleagues who killed a giant armadillo in the past. As predation is usually done by a single animal, this solves the beekeeper's problem but it can have serious repercussions. Even in pristine habitats or protected areas, giant armadillo densities are always low, ranging from 1.27–7.65 individuals/100 km^2 (Noss *et al.*, 2004; Silveira *et al.*, 2009; Aya-Cuero *et al.*, 2017; Desbiez *et al.*, 2020). Therefore, we can assume densities will be even lower in highly degraded areas such as the Cerrado of Mato Grosso do Sul. Giant armadillos have low population growth rates (Carter *et al.*, 2016; Desbiez *et al.*, 2019a). Thus, the loss of a single animal in the fragmented Cerrado due to poisoning could precipitate local extinctions. In addition, many other species of animals that also forage on the predated beehives may be poisoned too.

Aside from poison, beekeepers who are victims of giant armadillo damage have a range of non-lethal

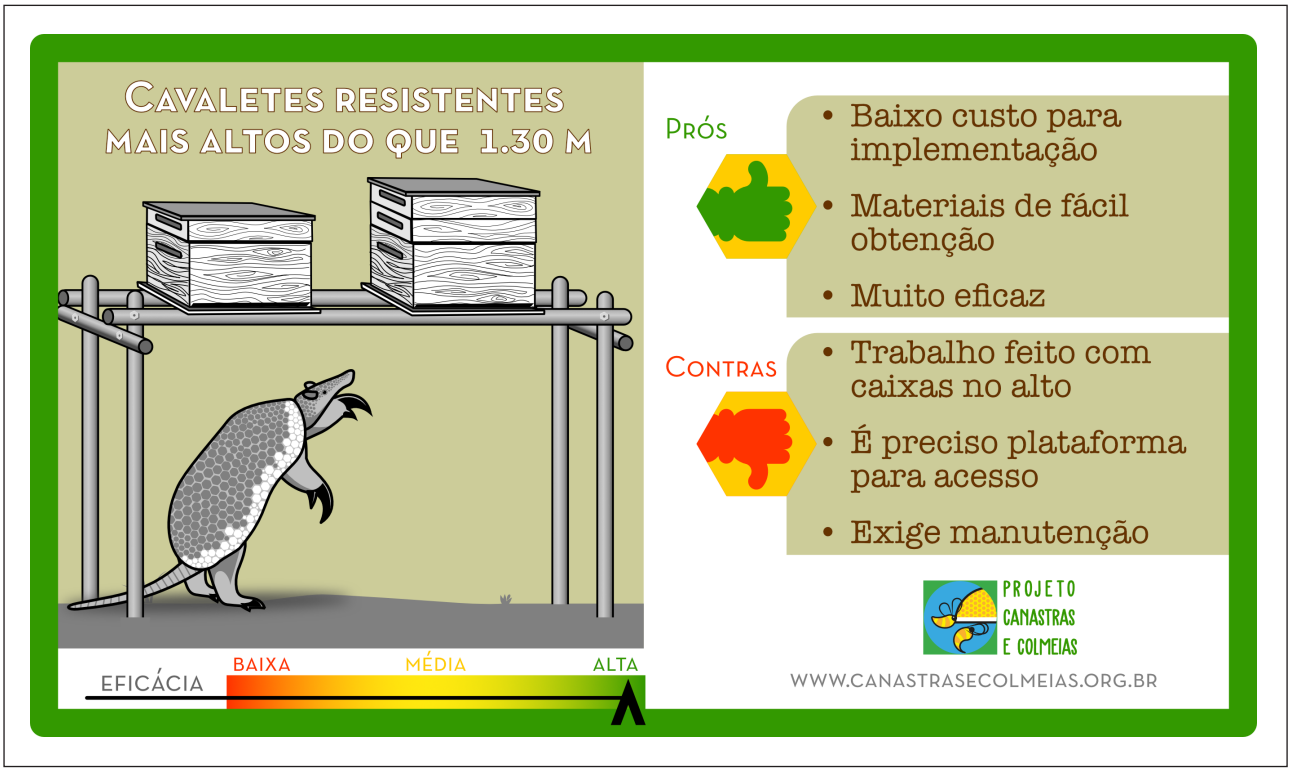

Figure 7. Example of an image sent by WhatsApp® to share mitigation strategies with beekeepers to prevent giant armadillo (*Priodontes maximus*) predation.

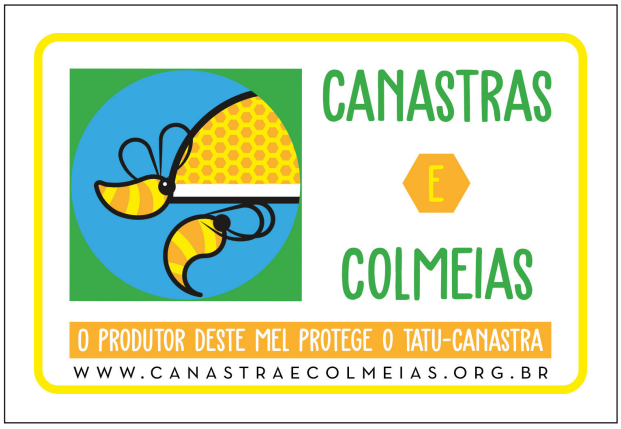

Figure 8. Logo that beekeepers can put on their product label if they produce honey within the giant armadillo's (*Priodontes maximus*) range and employ highly effective methods to prevent giant armadillo attacks on their beehives.

techniques available to them. However, these methods mean he/she will incur an extra monetary or labor cost. Our study is essential to better understand giant armadillo behavior relative to beehives so that effective techniques used by some beekeepers can be shared and promoted to reduce apiary losses. Currently, the most effective and cheapest method is to elevate the hives on stands at least 1.3 m high. Some of the techniques used by the beekeepers are similar to those used to prevent attacks from bears in the United States, such as electric fences (**Fig. 5c**; Maehr *et al.*, 1982), and those used against honey badgers in South Africa, where hives are also fastened to stands (**Fig. 5d-g**; Begg & Begg, 2002). We are currently developing a "Coexistence guide" for beekeepers in the study area. In this manual, each method is illustrated, and its pros and cons discussed. We formatted and created a version so it can easily be shared among beekeepers on social media and via communication tools such as WhatsApp® (**Fig. 7**). This material is not an exhaustive list and will be constantly updated as new techniques are used and tested.

Future directions to promote coexistence between giant armadillos and beekeepers

Human-wildlife interactions span a broad conflict-to-coexistence continuum (Frank, 2016). Coexistence implies not only "to exist in the same time and space" or to tolerate the species, but also suggests some level of harmony in interactions (Marchini *et al.*, 2019), with both sides' interests being satisfied (Frank, 2016). The mitigation methods discussed here can reduce damage to beehives but also require extra time, labor, and financial investment from the beekeepers. Adoption could fail to alleviate conflict if the additional costs and efforts of implementing these techniques lead to resentment towards the species (Kansky *et al.*, 2014). It is therefore essential to find alternatives for beekeepers not only to manage giant armadillo attacks but also to improve their livelihoods and benefit from the species' presence.

In seeking to turn this conflict into a positive interaction with giant armadillos, we are incorporating beekeepers as partners in the planning and implementation of a certification system for their honey (https://www.canastrasecolmeias.org.br). The same approach has been used to promote coexistence with other species considered problematic. For example, "Elephant-Friendly Honey" has successfully reduced crop-raiding by elephants and created an economic boost to rural communities in Kenya (see https://www.savetheelephants.org/). The "Dolphin Safe Certification Scheme" is one of the most successful and well-known certification schemes for wildlife protection. This system monitors more than 800 companies in 76 countries to ensure that tuna fish are caught by methods that do not harm dolphins, and protect the marine ecosystem. Through the program, dolphin deaths in tuna nets have declined by 99% since 1990 (see https://www.fisheries.noaa.gov/national/marine-mammal-protection/dolphin-safe-certification). Through the "Giant Armadillo-Friendly Honey" certification program we will encourage best practices, generate a more environmentally-sustainable activity, and add value to the honey produced. The initiative will share with beekeepers the different mitigation strategies available to them, and how to implement them, while also providing market opportunities through new partnerships and communication in the media to provide visibility to "Giant Armadillo-Friendly Honey". Certification will also highlight the sustainable practices that beekeepers commonly use, such as fire management, habitat conservation, and absence of chemical treatments. Thus, through participatory workshops and discussions with beekeeper associations, we are creating a set of standards for certification. At first, the certification will be tested for Mato Grosso do Sul but we hope to expand the scale of the project as needed. Beekeepers who abide by the standards will be provided with a certificate and be able to put a specific logo on their produce that will recognize that the beekeeper protects giant armadillos (**Fig. 8**). The Wildlife Friendly Enterprise Network (WFEN) has been pioneering the use of sustainability standards for wildlife around the world since 2007, and we are currently collaborating with them on this project. Our hope is that, thanks to the certification, beekeepers and giant armadillos may have the opportunity to live in peace with each other, and the presence of giant armadillos near beehives will become a benefit rather than a problem.

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The xenarthrans of Honduras: new records, main threats, and comments on their conservation status

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Abstract The Xenarthra are one of the least studied mammalian groups in Honduras. Their ecology, natural history, and distribution in the country are poorly known. Here we compile and discuss, for the first time, the available information about the seven species of Xenarthra that occur in Honduras. We also present new distribution records and comment on their main threats. The lack of specific scientific studies, poaching, illegal traffic, cultural beliefs, and deforestation are among the main threats to xenarthrans in Honduras.

***Keywords*:** anteaters, armadillos, Central America, sloths, Xenarthra

Los xenartros de Honduras: nuevos registros, principales amenazas y comentarios sobre su estado de conservación

Resumen Xenarthra es uno de los grupos de mamíferos menos estudiados en Honduras, y de los que menos se sabe sobre su ecología, historia natural y distribución en el país. Aquí recopilamos y discutimos, por primera vez, la información disponible de cada una de las siete especies de Xenarthra que ocurren en Honduras. También presentamos nuevos registros de distribución y comentamos sobre las principales amenazas. La falta de estudios científicos, la cacería y el tráfico ilegal, creencias culturales y la deforestación están entre algunas de las principales amenazas para los xenartros en Honduras.

***Palabras clave*:** armadillos, Centroamérica, hormigueros, perezosos, Xenarthra

Brief summary of mammalogy in Honduras: How many Xenarthra species do we have?

Honduras is the second largest country of the Central American isthmus (Hernández Oré *et al.*, 2016) (**Fig. 1**). Its territory includes an area of 112,492 km^2 (excluding the marine territory), and it has a population of some 9.02 million inhabitants (INE, 2018). According to Duarte *et al.* (2014), 48% of the national territory of Honduras is covered by forests and 27% are protected areas. Even though it is a biodiverse country, many ecosystems remain poorly studied (*e.g.*, dry forests, mangroves).

The baseline for mammalian research in Honduras was established by Goodwin (1942) in his seminal work *The mammals of Honduras*. Goodwin described 123 species of mammals within Honduras based on 2,213 specimens that had been collected primarily in the western and central region of the country by Cecil F. Underwood. Most species were based on a small number of scattered records. The lack of solid records from the entire extent of the country is still true; most of the available information on the mammals of Honduras, excluding large mammals, is based on technical reports, incomplete inventories, or specimens in personal collections that are not easily accessible. The exact number of mammal species in Honduras is uncertain, as research has mainly focused on certain taxonomic groups. For example, recent studies revealed that Chiroptera alone includes 113 species (Turcios-Casco *et al.*, 2020), a number that corresponds to 92.3% of all mammals known for Honduras by 1942. Most national and international universities, governmental, and non-governmental entities have concentrated their research efforts on large mammals, such as Cervidae, Felidae, Tapiridae, and Tayassuidae. However, taxa such as insectivores, marsupials, rodents, and xenarthrans remain poorly studied. Except for bats, most of the information on small and medium-sized mammals is based on sporadic records obtained while studying large mammals.

Xenarthrans remain particularly understudied in Honduras. Goodwin (1942) mentioned five species: three anteaters (*Cyclopes didactylus*—now *Cy. dorsalis*, Miranda *et al.* (2018)—*Myrmecophaga tridactyla*, and *Tamandua mexicana*) and two armadillos (*Cabassous centralis* and *Dasypus novemcinctus*). Interestingly, Goodwin (1942) presented convincing evidence for the occurrence of only two

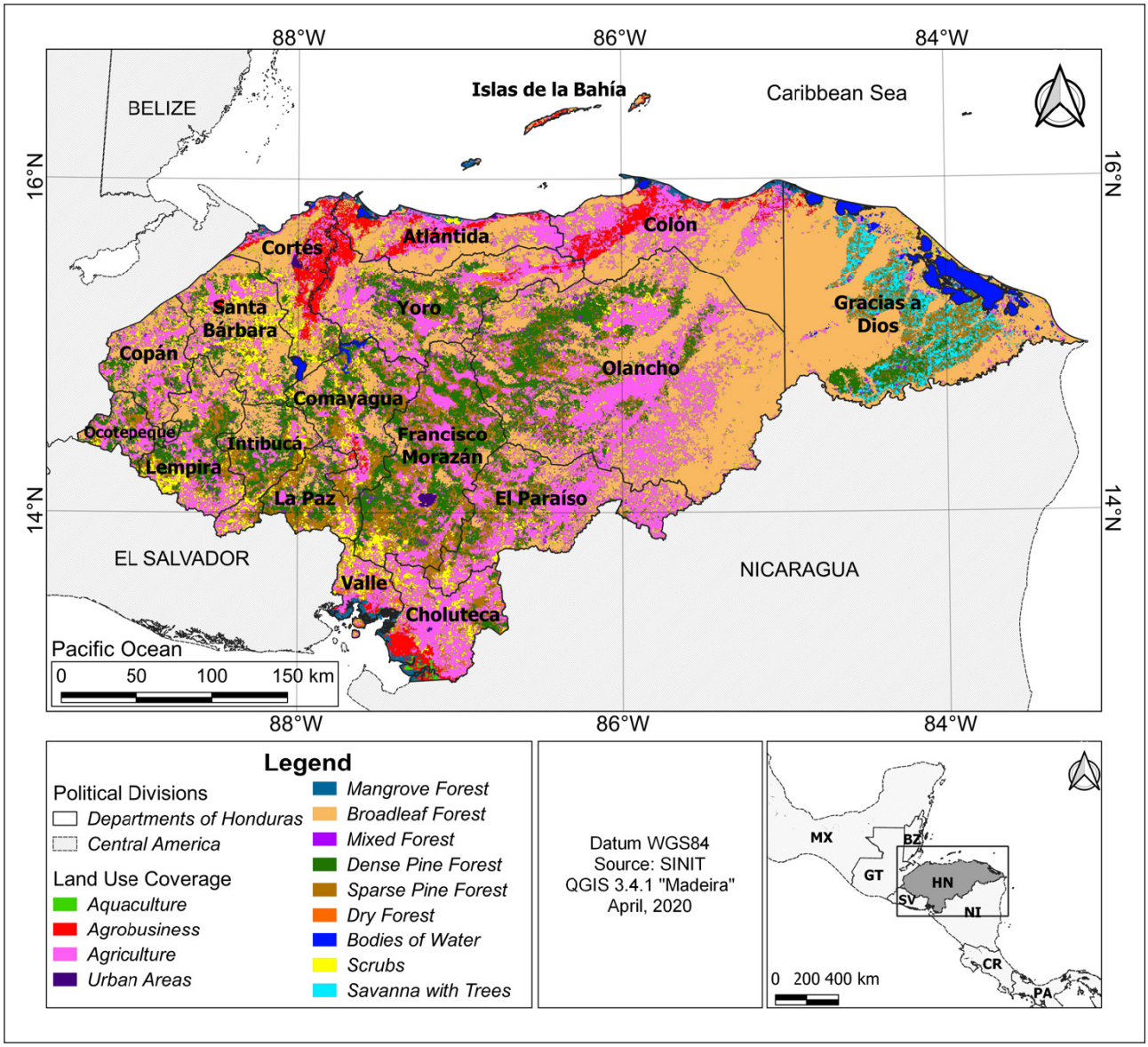

FIGURE 1. Geographical location and land use coverage of Honduras.

Table 1. Common names for Xenarthra in Honduras, in Spanish and different indigenous languages. Source: Jones (1965), Marineros & Martínez (1998), SDGEPIAH (2015), and this work.

Species	Spanish	Lenca	Miskitu	Pesh	Tawahka	Garífuna
Bradypus variegatus	perezoso de tres dedos, perico lerdo, camaleón, pereza		siwaiku			
Choloepus hoffmanni	perezoso de dos dedos, pereza, camaleón, perico lerdo		siwaiku		um	
Cyclopes dorsalis	serafín, perezocito, osito del platanar, ceibita		likur		wísurh	
Myrmecophaga tridactyla	oso hormiguero, oso caballo, hormiguero gigante	sisitan	wingku tara	corauya	dánka-takálvas	liwa, oso gaballu
Tamandua mexicana	tamandua, oso melero, oso hormiguero pequeño, perico ligero, oso de colmena	zegüe, zapu, corca	wingku		kárkin	
Cabassous centralis	tumbo, tumbo armado, pitero de uña, cusuco lechoso			patáwã	tákan tákan	
Dasypus novemcinctus	cusuco, cusuco de nueve bandas, pitero	yagu	taiirraa, tahira, ukmiktaira	pantan waá, patáwã	úmika	gasigamu

xenarthrans, *D. novemcinctus* and *T. mexicana*, while he expected the other anteater and armadillo species, but not sloths, to occur in the country. At that time, there were only anecdotal records of *Bradypus variegatus* and *Choloepus hoffmanni* in Honduras, which were officially recorded more than 50 years later (McCarthy *et al.*, 1999), as discussed below. In addition, there is evidence of extinct xenarthrans in Honduras (Jackson & Fernandez, 2005; Lucas, 2008; Ferreira & Feijó Ramos, 2011; Zúniga *et al.*, 2019).

Hall (1981) considered six xenarthran species as occurring in Honduras: *B. variegatus*, *T. mexicana*, *M. tridactyla*, *Cy. dorsalis*, *D. novemcinctus*, and *C. centralis*, but no specific records were given for the last two species. Marineros & Martínez (1998) provided unconfirmed (and, in most cases, imprecise) localities for most of the mammalian species in the country, including all xenarthrans. No other reviews on the distribution, systematics, and conservation status of the Xenarthra of Honduras have been published.

The main objective of this work is to compile the available information on living xenarthrans in Honduras and to discuss the main threats they are facing. We provide published and new localities of anteaters, armadillos, and sloths in the country, and comment on their conservation status.

Materials and methods

We screened books, articles, dissertations, and theses found in academic research databases (*e.g.*, Google Scholar) as well as technical reports from Honduran government agencies and NGOs for records of xenarthrans. We also queried online databases such as Global Biodiversity Information Facility (GBIF) (https://www.gbif.org), VertNet (http://www.vertnet.org), Integrated Digitized Biocollections (iDigBio) (https://www.idigbio.org), and iNaturalist (https://www.inaturalist.org) with the terms *Bradypus*, *Cabassous*, *Choloepus*, *Cyclopes*, *Dasypus*, *Myrmecophaga*, and *Tamandua*, and filtered the results by country to limit them to Honduras. We then verified all coordinates of the obtained records. The following information was extracted for each individual record: species name, locality, municipality and department, year of record, basis of record, and geographic coordinates (when available). We excluded records lacking precise information or scientific evidence for species identification. When the verified coordinates did not match the description, we excluded the record from the map, but did include the written description of its location

in the text. We also included records registered by us, either by camera trapping (Bushnell, Moultrie, PANTHERA [V3, V4, and V5], Cuddeback, Reconyx, Browning units) or through direct observations, since 2010. Finally, we mapped all records per species; all those found in the literature were marked as "previous", and our unpublished records as "new". We determined the habitat types in which each species was recorded by overlaying the geographical layer of Life Zones (Holdridge, 1987) on the range maps. Detailed information on all obtained records can be found in the **Supplementary Material 1**.

Finally, we compiled the local common names of the seven species in Spanish and in different native languages of Honduras. They are given in **Table 1**.

Geographic distribution of the xenarthrans in Honduras

We found records of seven species of xenarthrans in Honduras, which correspond to those found in Nicaragua (Genoways & Timm, 2003). To our knowledge, this is the first use of "citizen scientist" observations of xenarthrans from Honduras to map their distribution. Databases such as iNaturalist hold a great potential for such analyses, provided the location data and identification are accurate.

Bradypus variegatus **(Fig. 2).** As mentioned above, Goodwin (1942) did not include this species in the list of mammals of Honduras. A few years later, Goodwin (1946) speculated that the distribution of *Bradypus* may extend to Patricia River (referring to Río Plátano in Departamento Gracias a Dios).

We confirmed 79 records distributed as follows: 21 new records presented herein, one from GBIF (2020), one from iNaturalist (2020), and 32 previous records by Von Hagen (1940), Marineros & Martínez (1998), McCarthy *et al.* (1999), Medina-Fitoria (2008), Castañeda *et al.* (2013b), Mérida Colindres & Cruz (2014), Marineros & Portillo Reyes (2015) (see **Supplementary Material 1** for a discussion of the origin of some of these records), and La Prensa (2018). In addition, there are 24 zoo specimens listed by Acosta (2016) of which we could not determine if they still are in captivity. We excluded two records from Islas de la Bahía in northern Honduras listed in iNaturalist (2020) because the origin of the individuals is unknown.

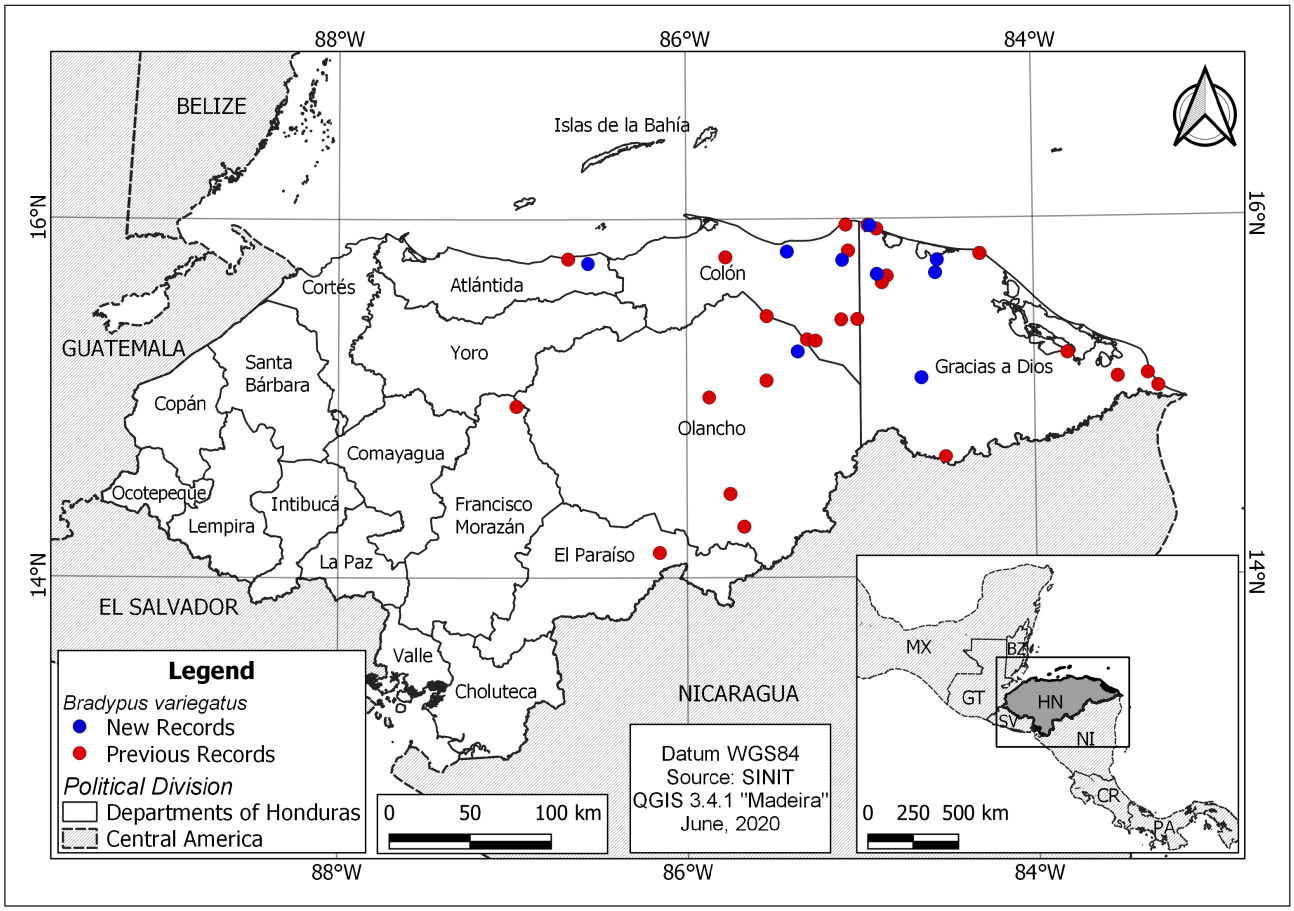

Figure 2. Previous and new records of *Bradypus variegatus* in Honduras.

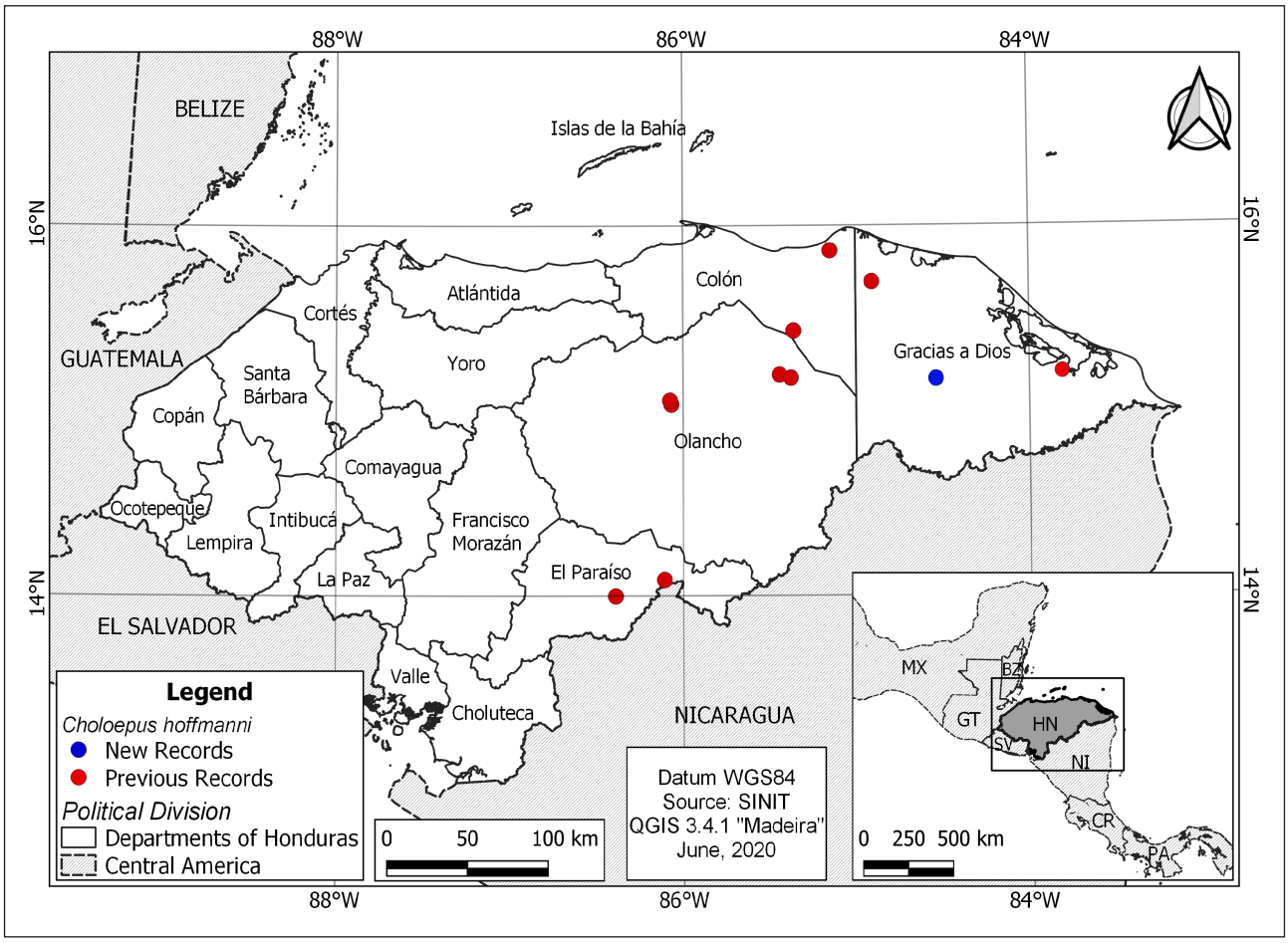

Figure 3. Previous and new records of *Choloepus hoffmanni* in Honduras.

McCarthy *et al.* (1999) reported specimens in the National Museum of Natural History (USNM) collection and located two *B. variegatus* skins with skulls (USNM 21010, male; 21011, female) that had been obtained by Perry on 1 June and 9 November 1891, respectively, in Patuca, Honduras. This locality may refer to the coastal settlement of Patuca (15°50'N, 84°17'W) or Barra Patuca at Punta Patuca (15°51'N, 84°18'W) (McCarthy *et al.*, 1999). McCarthy *et al.* (1999) also mentioned two photographs taken by Von Hagen (1940) of a harpy eagle (*Harpia harpyja*) attacking a *B. variegatus* in Montaña de la Flor, in central Honduras. The exact location of this observation is uncertain, as McCarthy *et al.* (1999) thought it occurred in Francisco Morazán, whereas Marineros & Portillo Reyes (2015) considered it in Yoro (see **Fig. 1**). We included this record as part of Francisco Morazán and not Yoro because the record occurred in the drainage of the Guarabuqui River in Orica, which is located in the western region of Francisco Morazán (see McCarthy *et al.*, 1999).

Confirmed records are concentrated in the eastern half of Honduras, in Atlántida, Colón, El Paraíso, Francisco Morazán (where it is thought to be extinct), Gracias a Dios, and Olancho.

Although sloths can be difficult to observe in most areas of the country, *B. variegatus* may be locally abundant, at least in Honduras. On 18 September 2008, one of us (FC) counted 11 *B. variegatus* along the canals between Benk and Capri near the village of Raya in eastern Honduras. These records have been cited by Marineros & Portillo Reyes (2015) with an erroneous location, Raista (see **Supplementary Material 1**), and omitting the original authorship. All sloths were resting on mangrove trees at a distance of 1–6 m from the canal. The observations were made from a moving boat along a 5.5 km transect in only 36 minutes.

The species may also occur in the tropical forests of Cortés and Yoro, but this needs to be confirmed. *Bradypus variegatus* has been found in subtropical wet forests and tropical moist forests, including mangroves, at elevations ranging from sea level to 658 m asl. Based on the frequency of records and the localities, *B. variegatus* seems to be the most common sloth species in Honduras.

Choloepus hoffmanni **(Fig. 3).** Hoffmann's two-toed sloth is only known from 18 records. The first specimens were mentioned by Gamero (1978) and McCarthy *et al.* (1999). Martínez *et al.* (2020b)

described 13 records obtained between 2012 and 2020, including those mentioned by Acosta (2016). Here we add one additional record in Wampusirpi, Gracias a Dios, in the buffer zone of Río Plátano Biosphere Reserve (RPBR).

The species presence has thus only been confirmed in eastern Honduras, in Colón, El Paraíso, Gracias a Dios, and Olancho. It is probable that it also occurs in Yoro. *Choloepus hoffmanni* has been recorded in subtropical wet forests and tropical moist forests, at elevations from 53 to 1,000 m asl.

Cyclopes dorsalis **(Fig. 4).** Only 18 localities of *Cy. dorsalis* have been recorded since 1891, with one of them (McCain, 2001) consisting of at least two individuals (see below). Eight of them are mentioned by Goodwin (1942), Marineros & Martínez (1998), McCain (2001), Zepeda *et al.* (2012), and Bedrossian (2017); nine are from GBIF (2020); and one from iNaturalist (2020). One additional record of unknown origin is listed in GBIF (2020). It is noteworthy that McCain (2001) documented several occurrences of this species in the RPBR, including a mother with her half-grown offspring, but she did not specify the exact number of individuals observed.

The species has been found in Atlántida, Colón, Cortés, El Paraíso, Gracias a Dios, Olancho, Santa Bárbara, and Yoro. It occurs in subtropical wet forests and tropical moist forests, at altitudes between 58 and 1,430 m asl. Based on the known distribution, it may also occur in northern Comayagua.

Myrmecophaga tridactyla **(Fig. 5).** The case of *M. tridactyla* is interesting because, even though Goodwin (1942) included the species for Honduras, he stated that "the great anteater has apparently not been recorded from Honduras. Although rare where it is known to occur in Central America, its range may possibly include suitable localities in Honduras" (Goodwin, 1942:149–150). Today, the giant anteater is considered the most threatened xenarthran in Honduras. It is known from 25 records published by McCain (2001), Marineros & Martínez (1998), Portillo *et al.* (2010), Herrera *et al.* (2011), Gonthier & Castañeda (2013), Mérida Colindres & Cruz Días (2014), and Martínez *et al.* (2020a). Records are from Atlántida, where it is possibly extirpated; Colón, Gracias a Dios, and Olancho. It is restricted to subtropical moist and wet forests and tropical moist forests, where it occurs at elevations from 3 to 598 m asl. We did not find evidence that the species may be present in other regions of Honduras.

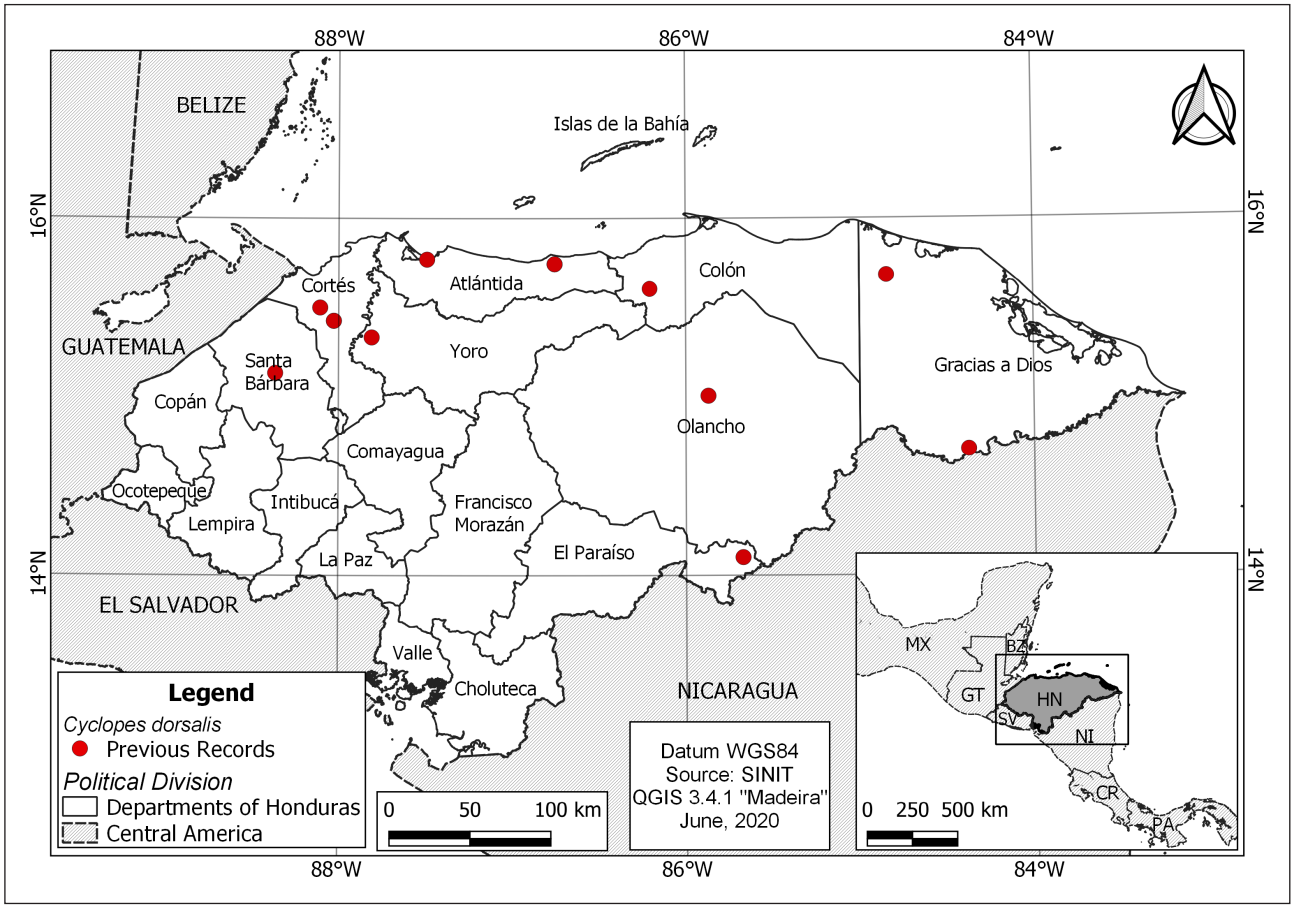

Figure 4. Previous records of *Cyclopes dorsalis* in Honduras. There are no new records reported.

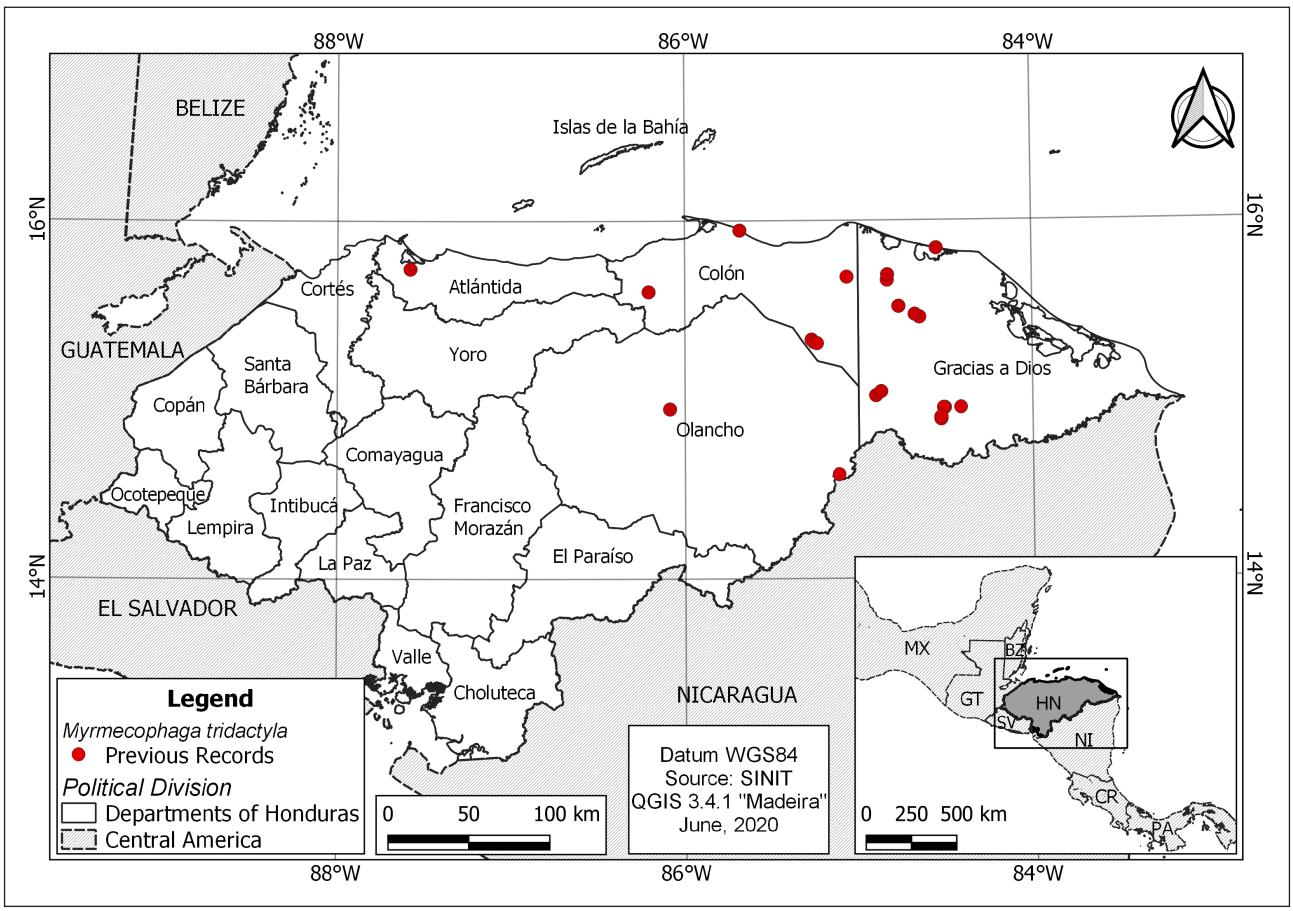

Figure 5. Previous records of *Myrmecophaga tridactyla* in Honduras. There are no new records reported for *M. tridactyla*.

Tamandua mexicana **(Fig. 6).** We compiled a total of 105 records of this species in Honduras. There are 47 records published by Benshoof *et al.* (1984), Marineros & Martínez (1998), McCain (2001), Komar *et al.* (2006), CATIE (2007), Medina-Fitoria (2008), Castañeda (2010), Portillo-Reyes & Hernández (2011), Portillo & Carrasco (2011), Castañeda *et al.* (2013a), Hoskins *et al.* (2018), Portillo *et al.* (2018), Portillo Reyes (2018), and King *et al.* (2019). Eight records are listed in GBIF (2020) and 12 in iNaturalist (2020). Seven zoo specimens are mentioned by Acosta (2016), but we could not determine if they are still in captivity. It should be noted that GBIF (2020) lists a record of *T. tetradactyla* from 1937 in "Atacamus". We consider this record to be *T. mexicana* because *T. tetradactyla* was a subspecies of the former at that time (Navarrete & Ortega, 2011). We could not find any locality called Atacamus; it probably refers to Catacamas in Olancho, where *T. mexicana* has been recorded previously. We also include 31 new species records. This anteater has a wide distribution in Honduras, and records are only lacking from Lempira, Ocotepeque, and Islas de la Bahía. Considering the lack of research in western Honduras, it is possible that *T. mexicana* occurs in Lempira and Ocotepeque, but simply has remained unrecorded. This species occurs in subtropical moist forests, subtropical wet forests, tropical dry forests, and tropical moist forests, from sea level to 1,845 m asl.

Cabassous centralis **(Fig. 7).** A total of 23 records exist for Honduras. There is one record in GBIF (2020), two in iNaturalist (2020), and 12 published records by Miller (1899), Marineros & Martínez (1998), Komar *et al.* (2006), Castañeda *et al.* (2013b), Portillo Reyes & Elvir (2013), Hoskins *et al.* (2018), and MiAmbiente & Panthera (2018). We did not consider the record of Flores *et al.* (2019) in Choluteca because their work was based on interviews with local people, and no other evidence supports the species occurrence in southern Honduras. We add eight new records, including the first one in Comayagua. *Cabassous centralis* is only known from Atlántida, Cortés, Comayagua, Copán, Francisco Morazán, Olancho, and Yoro, at altitudes from 14 to 1,868 m asl. The species has been recorded in lower montane wet forests, tropical dry forests, subtropical moist forests, tropical moist forests, and subtropical wet forests.

Dasypus novemcinctus **(Fig. 8).** This is the most widely distributed xenarthran in Honduras. We confirmed 162 records from 1887 to 2020. Eight of the 29 records in GBIF (2020) and iNaturalist (2020)

are from unknown locations in eastern Honduras. Ninety-three records are available in the literature by Goodwin (1942), Cruz *et al.* (1993), Marineros & Martínez (1998), McCain (2001), Komar *et al.* (2006), Portillo (2006), Portillo *et al.* (2006), Medina-Fitoria (2008), Portillo Reyes & Vásquez (2009), Portillo Reyes & Hernández (2011), Portillo & Carrasco (2011), Castañeda *et al.* (2013a, b), Gonthier & Castañeda (2013), ASESORA (2009), Portillo Reyes & Elvir (2013), Mora *et al.* (2014), Portillo Reyes *et al.* (2016a,b), Encalada Caicedo (2018), Flores *et al.* (2018), Hoskins *et al.* (2018), MiAmbiente & Panthera (2018), Portillo Reyes (2018), Portillo Reyes & Elvir (2018), Portillo *et al.* (2018), and King *et al.* (2019). We excluded a recent record of *D. novemcinctus* from Islas de la Bahía, as this individual was probably illegally brought to the island to be kept as a pet. There is no evidence that any xenarthran naturally occurs on these islands. We list 40 new records distributed across the country, including the first official evidence in Ocotepeque. *Dasypus novemcinctus* is the only xenarthran that has been found in all departments of Honduras, except Islas de la Bahía. It occurs in lower montane moist and wet forests; subtropical dry, moist, and wet forests; and tropical moist forests, at elevations between 28 and 2,133 m asl.

Main threats to xenarthrans in Honduras

Several threats are affecting the xenarthrans in Honduras:

Cultural belief. The popular Honduran folk song "El pitero" tells the story of a man trying to catch an armadillo. The theme of this song suggests that, in the past, armadillo consumption was part of the Honduran culture. The song says *al indio le gusta el maíz amarillo pero más le gusta el pitero tordillo* ('the Indios like yellow corn, but they like the dapple-gray armadillo even more'). *Pitero* is one of the common names of *D. novemcinctus* (**Table 1**), but the dapple-gray coloration may rather point towards *C. centralis*. Finally, the song concludes with *tamal de piteros no lo como yo, porque mi abuelita de eso se murió* ('I don't eat armadillo tamales because that's what killed my grandmother'). This last verse may be the basis for the popular belief that armadillos, and specifically *C. centralis*, are venomous. Due to this belief, armadillos are killed indiscriminately in some regions of Honduras.

Intentional fires. According to the IUCN Red List of Threatened Species, three xenarthrans, *M. tridactyla* and both *Tamandua* species, are threatened by fires (IUCN, 2020; Superina & Abba, 2020). There is no doubt that forest fires would also directly affect

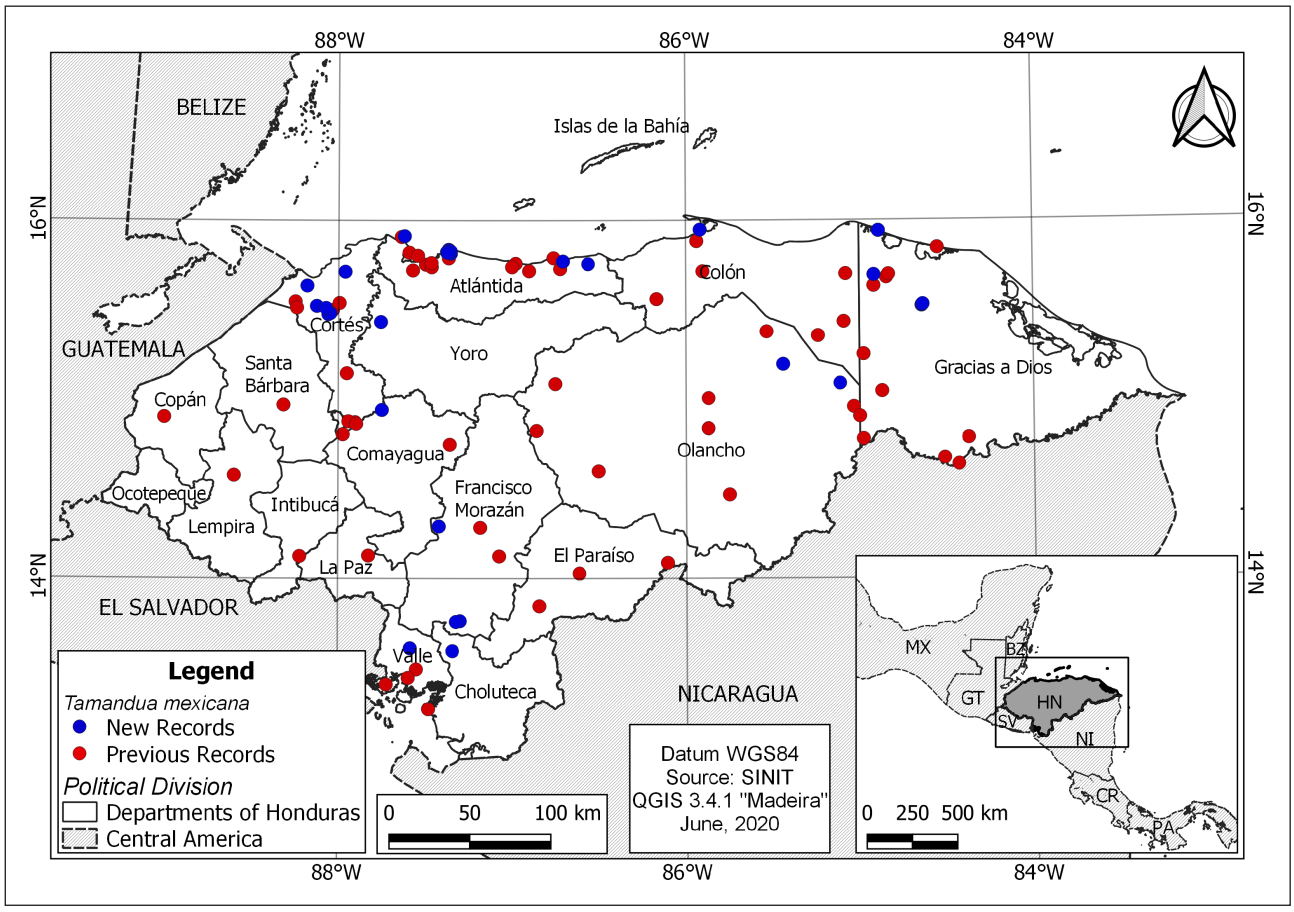

Figure 6. Previous and new records of *Tamandua mexicana* in Honduras.

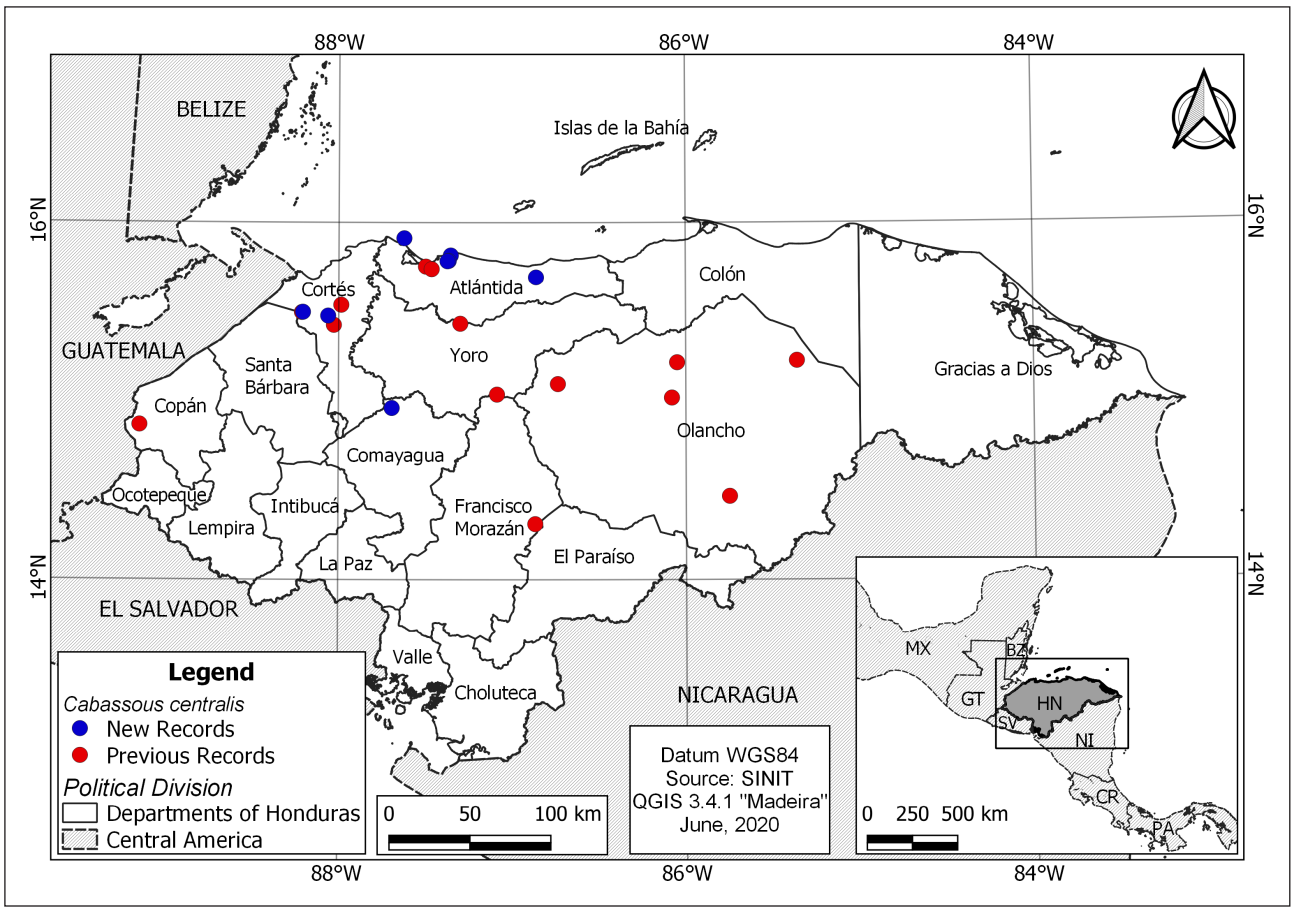

FIGURE 7. Previous and new records of *Cabassous centralis* in Honduras.

sloths and silky anteaters due to their limited ability to escape, and indirectly through the loss of suitable habitat. In this sense, wildfires are an increasingly important threat to xenarthrans in Honduras, although their impact has not been quantified. In the last decade, Honduras has lost 564,000 hectares of forest due to fires. An estimated 64% of wildfires are intentionally set, especially in the eastern part of the country, a region known as Honduran Mosquitia that encompasses Colón, Olancho, and Gracias a Dios. In this area, fire is used to clean pine forests (Medina-Moncada, 2018). Six of the seven xenarthrans have been recorded in this area, and it is reasonable to assume that a considerable number of individuals have succumbed during fires. In addition, poachers set fire to warrens, burrows, and caves, and kill the animals that emerge while trying to escape the fire or smoke. We have found burrows that had been set on fire as well as a tamandua hiding in a burned tree (**FIG. 9A**) in Mico Quemado and Las Guanchías Wildlife Refuge in Yoro. In addition, the most recent outbreak of the pine beetle (*Dendroctonus frontalis*) occurred between 2014 and 2016 and decimated more than 500,000 hectares of pine forest in 16 of the 18 departments of Honduras (ICF, 2017). Extensive fires have followed across the areas affected by the beetle, most likely reducing populations of *D. novemcinctus* and *T. mexicana*, the most common xenarthrans in the pine forest of Honduras.

Habitat loss. Around 1.7 million hectares have been deforested in Honduras during the last 40 years (López, 2015). Deforestation is especially affecting the Honduran Mosquitia. For instance, approximately 58,000 hectares are lost every year in Gracias a Dios (López, 2015). Habitat loss also occurs within the RPBR, which encompasses 832,339 ha (Escuela Nacional de Ciencias Forestales, 2013). Although it is the largest protected area in the country and has one of the most intact forests in Mesoamerica, RPBR is losing 2,700 ha of native vegetation every year (SIGMOF, 2020). This could negatively affect the xenarthrans whose main distribution within the country lies in this area.

Hunting. Agreement 045-2011 allows subsistence hunting in cases of extreme poverty, which must be supported by socioeconomical studies (La Gaceta, 2012). Interestingly, of the seven species of xenarthrans occurring in Honduras, only *D. novemcinctus* is used for subsistence hunting by the ethnic groups of Tawahkas, Miskitus, Pesh, Garífunas, and Mestizos (Portillo, 2007). On the other hand, Article 117 of the Law of Forestry, Protected Areas, and Wildlife, approved by Decree 156-2007, prohibits hunting or capturing threatened and endangered

species, and stipulates that commercial or sports hunting of non-threatened species may be permitted by the corresponding authorities (Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre; La Gaceta, 2008). The latter also have the faculty to ban hunting, declare hunting seasons, and regulate the activity. Permits for sports hunting are only issued if updated data on the species distribution, population density, and abundance are available. No authorizations for sports hunting of xenarthrans are currently in place. Illegal hunting does, however, occur. It especially affects armadillos, which are used as trophies, as a protein source, and to manufacture handcrafts (*e.g.*, bags). Armadillos are sold—alive or dead—on roadsides, a phenomenon we have often observed on the southern main road of Honduras. In addition, they are captured, injured, and used as baits to hunt larger-sized animals, especially felids. Poaching occurs both outside and within protected areas, such as Jeannette Kawas National Park and Nombre de Dios National Park. Hunters are usually accompanied by trained dogs that will attack and injure or kill almost any animal they can find, including sloths. Nonetheless, the term *perro cusuquero* is common in rural areas of Honduras and translates as 'armadillo-dog', referring to dogs that are specially trained to find and hunt armadillos. Poachers with dogs will usually try to avoid *M. tridactyla* as this large xenarthran can injure or kill dogs. Despite this, poachers will kill giant anteaters precisely due to the threat they represent to their dogs.

Illegal traffic. To our knowledge, no xenarthrans have been exported from Honduras to other countries in the past several years, which suggests that international traffic is currently not a threat. There are no records of any legal export of *M. tridactyla*, the only Honduran xenarthran listed in the CITES Appendices (*T. mexicana* is listed in Appendix III only for Guatemala, and *Ch. hoffmanni* was removed from Appendix III, where it was only listed for Costa Rica, in November 2019; CITES, 2020). McCain (2001) reports on an attempt to illegally export a giant anteater to Asia, but we could not find any other evidence of potential international traffic. There is, however, regional traffic for the pet trade of all xenarthrans, except *M. tridactyla*, that could potentially affect their wild populations. For example, half of the known records of *Ch. hoffmanni* correspond to confiscated animals or specimens that are located in *ex situ* conservation centers, which probably have been confiscated from traffickers (Martínez *et al.*, 2020b). It is therefore possible that

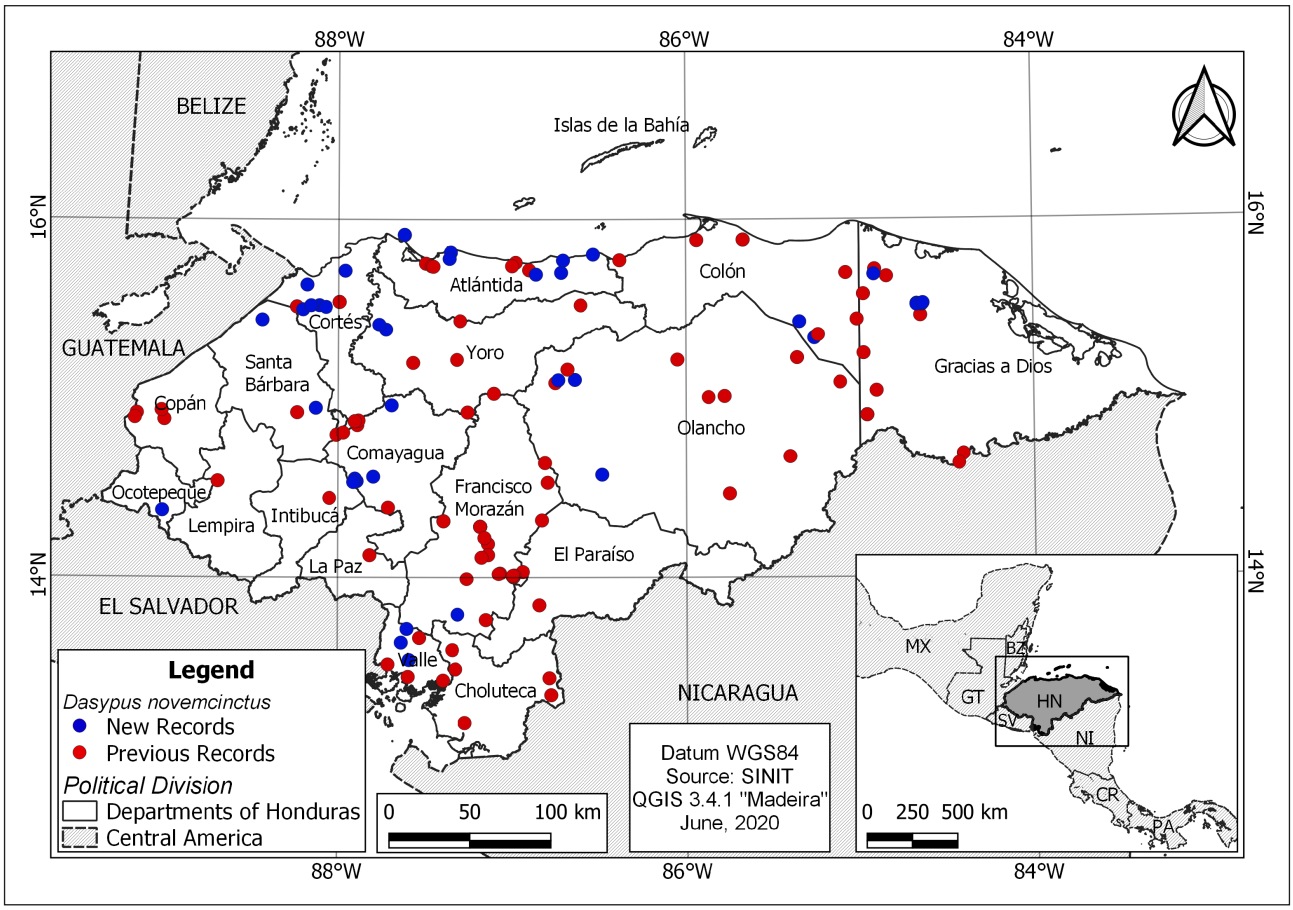

FIGURE 8. Previous and new records of *Dasypus novemcinctus* in Honduras.

these activities are affecting the wild sloth populations, and especially those of *Ch. hoffmanni*, in Honduras. On the other hand, 29% of the known records of *B. variegatus* correspond to individuals confiscated in 2018 (**Fig. 9B**), suggesting an increasing pressure on this species. For example, in November of 2018, ten *B. variegatus* were found in a cage inside a house in Puerto Lempira, Gracias a Dios. This house was, supposedly, the base for a wildlife trafficking operation in which many different species were held before being shipped outside of La Mosquitia. The sloths were confiscated and returned to their natural habitat, but no arrests or legal actions were taken. Such a large number of seized sloths could have been easily captured by the traffickers at the Raya canals mentioned above, where the species is (or was) abundant. It is difficult to assess the extent of this threat due to the lack of law enforcement and high levels of corruption in most terrestrial, aerial, and marine ports and frontiers, allowing for trafficked animals to pass unnoticed and for law offenders to remain in impunity.

Lack of knowledge, conservation strategies, and awareness. Most armadillo and tamandua records are based on camera trap studies targeted at other species, such as *Panthera onca*. Research specifically aimed at investigating the ecology, behavior, and natural history of xenarthrans is virtually non-existent in the country. For instance, *Cy. dorsalis* is a notoriously understudied mammal, and the scarcity of records may be due to the lack of research targeted at this small, inconspicuous species. Especially in southern Honduras, *T. mexicana* is persecuted due to a lack of awareness. For example, the rescue center "El Ocotal" received three injured tamanduas from Pespire (Choluteca) and La Venta (Francisco Morazán) in three years. One of them had been injured with a machete because it had been "invading" a private property, and the other two had been attacked by locals who thought they were harmful animals. Furthermore, there are no actions taken specifically for the conservation of xenarthrans in Honduras.

Roadkills. Vehicle collisions are an important cause of mortality for many xenarthrans (Superina & Abba, 2020). This is also true in Honduras, especially on the main roads that cross the country from north to south. New roads are especially problematic, and more so if they border or cross a protected area. Not only do these roads fragment native habitats and increase the chances of wild animals being hit by a vehicle; in addition, people use them to access previously undisturbed forested areas to carry out motocross and other recreative activities that disturb or directly affect wildlife. We have observed *T. mexicana* roadkills on the new road that connects Copán with Cortés, and found dead tamanduas and armadillos on the road that crosses the Nombre de Dios National Park to connect Atlántida and Colón. As there are plans to extend this road, we expect an increase in vehicle-induced mortality of xenarthrans, but also other wild species, in the near future.

"**Selfie tourism".** The use of wildlife as photo props is an increasing cause of concern in terms of animal welfare, especially if it involves direct physical contact between tourists and animals (Carder *et al.*, 2018). Although handling wildlife is illegal in many countries, offering wild animals as photo props is a source of income in many touristic areas (World Animal Protection, 2017). It may also represent a conservation threat, as the animals offered as photo props are often extracted from the wild —which may involve illegal trade—, maintained in inappropriate conditions, and simply replaced by other individuals after their death (Osterberg & Nekaris, 2015; World Animal Protection, 2017). This is especially true for *Bradypus*, which are appealing for the wildlife trade and are used as photo props due to their docile nature, but difficult to maintain in captivity (Moreno & Plese, 2006; Superina *et al.*, 2008; World Animal Protection, 2017; Carder *et al.*, 2018). We have identified "sanctuaries" in northern Honduras that advertised themselves as "*ex situ* conservation sites", but illegally kept wildlife—including jaguars, capuchin monkeys, and sloths—and charged visitors for taking selfies with the animals. Some animals had been trained using cruel methods, mutilated, or sedated to avoid tourists being harmed during the "selfie time". The fact that sloths are offered as photo props on Islas de la Bahía, where they do not naturally occur, is worrisome, as these animals must have been extracted from the wild in other parts of the country.

Are there any conservation measures in place for the xenarthrans in Honduras?

In 1998, the environmental authorities (Administración Forestal del Estado-Corporación Hondureña de Desarrollo Forestal, AFE-COHDEFOR) issued Resolution GG-APVS-003-98 to legally protect some species of interest in Honduras. It includes six of the seven Xenarthra species, which is surprising because, as mentioned above, the presence of the two sloth species in Honduras was scientifically documented a year after the resolution (see McCarthy *et al.*, 1999).

Bradypus variegatus and *Ch. hoffmanni* are listed as rare, with importance for ecotourism, and priority for conservation in certain areas; *C. centralis* as a species of cultural importance; *M. tridactyla* as endangered, with priority for conservation in certain areas; *Cy. didactylus* (now *Cy. dorsalis*) as rare, with importance for ecotourism, trade and consumption, and priority for conservation in certain areas; and *T. mexicana* as threatened, with importance for

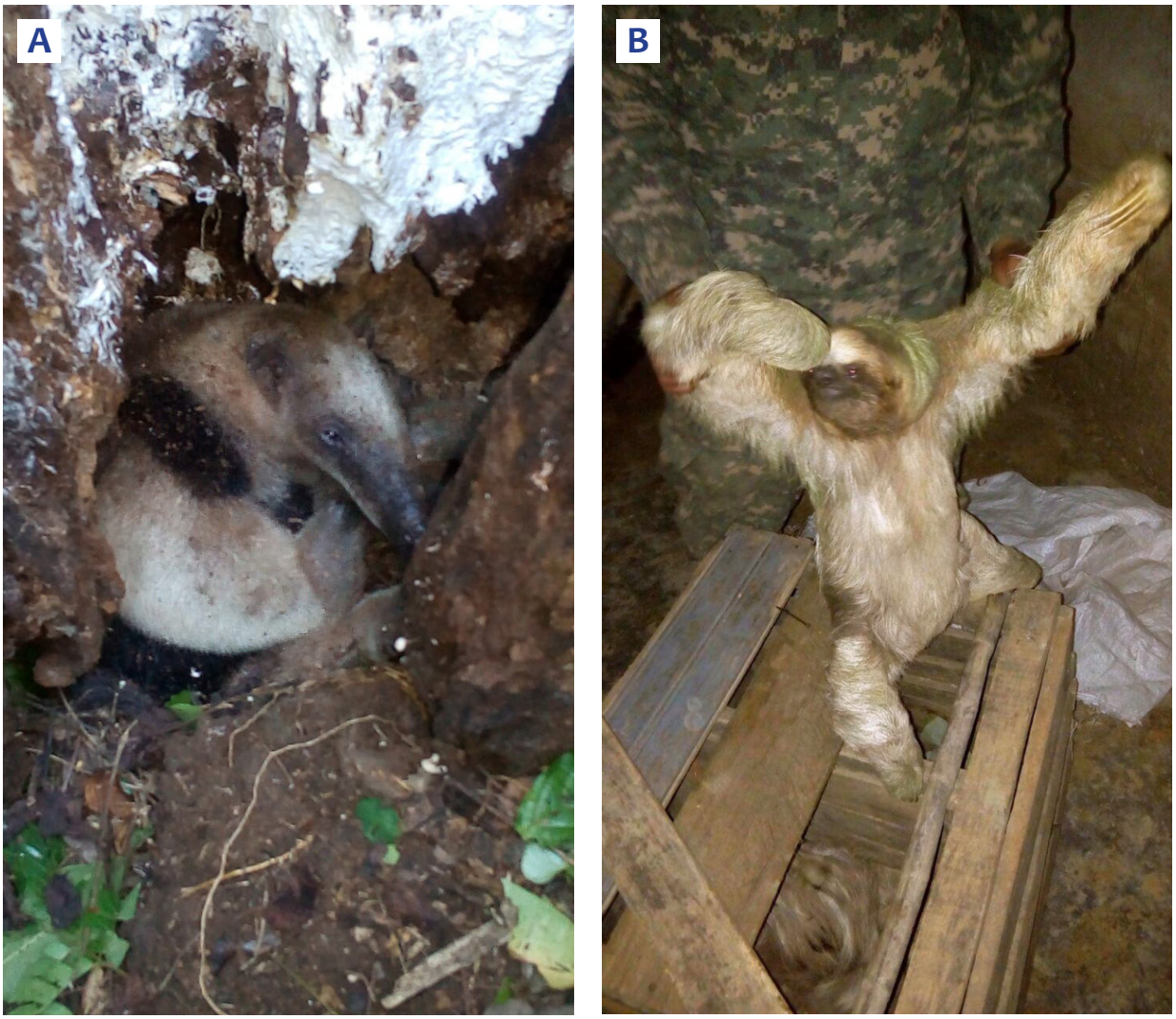

Figure 9. A. A *Tamandua mexicana* sheltered in the hole of a tree that had been set on fire. **B.** *Bradypus variegatus* confiscated by military soldiers in Farallones, Colón, in 2018.

ecotourism. It should be noted that species in the category "importance for trade and consumption" may be relevant for either of these two activities, but not necessarily for both of them.

SERNA (2008) published a list of "species of special concern in Honduras", which was meant as an update of Resolution GG-APVS-003-98 but does not replace the latter. None of the xenarthrans was considered by SERNA (2008) to be regionally threatened.

The Law of Forestry, Protected Areas, and Wildlife (Decree 156-2007) stipulates that capturing, hunting or trading wildlife without permission from the corresponding authorities, or mutilating, harming, hitting, causing malnutrition, maltreating, or killing wildlife is a crime against the Honduran fauna that may be sanctioned with 1–9 years of incarceration (La Gaceta, 2008). We are only aware of confiscations of xenarthrans from the illegal trade, but not of any case in which the lawbreaker was sanctioned with incarceration.

Honduras has legal and conservation tools to protect and monitor many species, such as the jaguar (*Panthera onca*) (ICF, 2011) and the emerald hummingbird (*Amazona luciae*) (ASESORA, 2009). There are, however, no official documents that specifically mention the importance of, or actions aimed at, the conservation of xenarthrans in Honduras. Hence, their conservation currently depends on the actions of local people and a handful of researchers who have started paying attention to these charismatic species. Xenarthrans do, however, indirectly benefit from action plans for other species, such as jaguars. The latter is considered an umbrella species, and protecting jaguars also helps the conservation of other taxa, including xenarthrans (Figel *et al.*, 2018).

Conservation status

The seven xenarthran species that occur in Honduras remain poorly studied, and determining their conservation status at the national level is therefore difficult. At first sight, the range maps (**Figs. 2–8**) would suggest that all species have a relatively wide distribution within the country, but they mask the fact that records of some species, such as *C. centralis*, *Cy. dorsalis*, and *M. tridactyla*, are so scarce that even their exact distribution is unclear. Two species, *D. novemcinctus* and *T. mexicana*, are present in most of the country and relatively abundant (**Figs. 6, 8**). It would thus be reasonable to assume that they should be listed as Least Concern. Any attempt to determine the conservation status of the other species would be educated guesswork at best until additional field data are available. Even though the xenarthrans are protected by law against illegal traffic and poaching, they are hunted and traded in several areas of the country, including in protected areas. Cultural traditions and beliefs, road collisions, deforestation, and selfie tourism could also be negatively affecting the xenarthrans, but the impact of these threats on the wild populations is difficult to assess due to the lack of research.

Conclusion

There is no doubt that we have a lot of work ahead of us to be able to understand and protect the xenarthrans of Honduras. We hope this review helps the research community to know how and where to start, and that it will encourage researchers to initiate ecological and systematic studies about the xenarthrans of Honduras.

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SHORT COMMUNICATION

Ticks parasitizing free-ranging armadillos in the Caatinga biome, Brazil

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Abstract This study reports the occurrence of ticks on free-ranging armadillos in the Serra das Almas Natural Reserve located in the interior of the state of Piauí, northeastern Brazil. Collected ticks were morphologically identified by using standard taxonomic keys and stereomicroscope. We provide the first records of *Amblyomma sculptum* on *Tolypeutes tricinctus*, in addition to *A. auricularium* adults on *Dasypus septemcinctus* in the Brazilian exclusive biome, the Caatinga.

***Keywords*:** Acari, Cingulata, Chlamyphoridae, Dasypodidae, Ixodidae

Carrapatos parasitando tatus de vida livre no bioma Caatinga, Brasil

Resumo O presente estudo teve como objetivo relatar a ocorrência de carrapatos em tatus de vida livre na Reserva Natural Serra das Almas, localizada no interior do estado do Piauí, Nordeste do Brasil. Os carrapatos coletados foram identificados morfologicamente utilizando-se chaves taxonômicas e estereomicroscópio. Fornecemos os primeiros registros do carrapato *Amblyomma sculptum* em *Tolypeutes tricinctus*, além de adultos de *A. auricularium* em *Dasypus septemcinctus* no bioma exclusivo brasileiro, a Caatinga.

***Palavras-chave*:** Acari, Cingulata, Chlamyphoridae, Dasypodidae, Ixodidae

Ticks are known worldwide for parasitizing a wide range of hosts, including domestic and wild mammals. These ectoparasites are important for veterinary medicine and public health, since they are related to the transmission of several pathogens both to animals and to humans (Nava *et al.*, 2017). Ticks of the genus *Amblyomma* are of great medical and veterinary importance in Brazil. Nevertheless, there are few studies on ticks in the Caatinga biome in Brazilian territory (Barros-Battesti *et al.*, 2006; Horta *et al.*, 2011). The tick genus *Amblyomma* includes the most abundant species in Brazil, with 33 species already registered in the country (Martins *et al.*, 2010, 2016, 2019; Krawczak *et al.*, 2015). Within the limits of the national territory there is a wide diversity of armadillos distributed in the families Chlamyphoridae (*Priodontes maximus*, *Euphractus sexcinctus*, *Cabassous tatouay*, *C. unicinctus*, *Tolypeutes matacus*, *T. tricinctus*) and Dasypodidae (*Dasypus septemcinctus*, *D. novemcinctus*, *D. kappleri*, and *D. hybridus*) (ICMBio, 2015). The Caatinga is the only exclusively Brazilian biome, with an area of approximately 82 million hectares, occupying 11% of the national territory. It is the main ecosystem of the northeast region of the country, being very important from the biological point of view. It has a vast biodiversity with endemic flora and fauna species, many of which are threatened with extinction (Cortez *et al.*, 2007).

Table 1. Ticks collected from free-living armadillos in the Serra das Almas Natural Reserve, Buriti dos Montes municipality, Piauí state, Brazil.

Armadillo species	Sex	Capture date	Ticks species: number per stage*
Tolypeutes tricinctus	♀	2 September 2013	*Amblyomma sculptum*: 1 ♀
T. tricinctus	♀	8 April 2016	*A. sculptum*: 6 ♂
T. tricinctus	♀	10 April 2016	*A. sculptum*: 2 ♂
T. tricinctus	♂	4 August 2016	*Amblyomma auricularium*: 5 ♂, 1 N
T. tricinctus	♀	7 August 2016	*A. auricularium*: 5 ♂
T. tricinctus	♂	8 August 2016	*A. auricularium*: 4 ♂
T. tricinctus	♀	8 August 2016	*A. auricularium*: 7 ♂
T. tricinctus	♂	8 August 2016	*A. auricularium*: 3 ♂, 2 N
Dasypus septemcinctus	♂	5 August 2016	*A. auricularium*: 4 ♀

*Tick stages shown as adult male (♂), adult female (♀) and nymph (N)

The Brazilian three-banded armadillo (*T. tricinctus*), locally known as "tatu-bola", is the smallest and least known armadillo species in Brazil. It occurs exclusively in the country, predominantly in the Caatinga and in some areas of the Brazilian Cerrado (Guimarães, 1997; Feijó *et al.*, 2015). The species suffers a high degree of threat from hunting and destruction of its habitat. It has been included in the Official List of Brazilian Fauna Threatened with Extinction in the category "Vulnerable", and recently its risk of extinction has been raised to "Endangered" (ICMBio, 2014; 2015). The seven-banded armadillo (*D. septemcinctus*) is distributed from the southeastern portion of the Amazon basin to the extreme north of Argentina, bounded to the west by Mato Grosso and Chaco in Paraguay, and encompassing central and southern Brazil (Faria-Corrêa *et al.*, 2015). It is a common species, relatively tolerant to environmental changes, with a broad distribution and therefore categorized as Least Concern (LC) by the Official List of Brazilian Fauna Threatened by Extinction (ICMBio, 2015).

Due to the importance of the tick systematics for the provision of information for the management of captive and free-ranging populations, especially for those threatened with extinction, the present study aimed to report tick species parasitizing free-ranging armadillos in the Caatinga biome. For this purpose, this study was carried out in the Serra das Almas Natural Reserve (5°15'–5°00'S, 40°15'–41°00'W), located in Buriti dos Montes municipality, in a highly preserved area of the Caatinga biome in the state of Piauí, Brazil.

Captures of armadillos consisted of active search, their capture by hand, and physical-chemical restraint. A combination of anesthetic drugs (8 mg/kg ketamine hydrochloride; Dopalen, Ceva, São Paulo, Brazil; and 1 mg/kg midazolam hydrochloride; Dormire, Cristália, São Paulo, Brazil) was used for sedation. This dosage allowed safe handling of the animals for 30–45 minutes. Emergency equipment and drugs capable of improving cardio-respiratory capacity were available at pre-calculated doses. Changes in doses of anesthetics and other drugs were performed as needed to meet all emergency situations. During the anesthetic procedure, heart rhythm and rate, respiratory rate, and oxygen saturation were monitored, the latter using a pulse oximetry device (Nellcon®, Medtronic, United Kingdom). Other procedures were performed during immobilization, such as transponder application, sexing, and collection of morphometric data. Clinical evaluations and collection of blood, fecal samples, swabs, ectoparasites, and skin biopsies were also performed for different studies.

During the clinical examinations, all armadillos (8 *T. tricinctus* and 1 *D. septemcinctus*) were found to be infested by ticks, which were collected and shipped in 70% ethyl alcohol to the Laboratory of Parasitic Diseases of the Department of Veterinary Preventive Medicine and Animal Health of the Faculty of Veterinary Medicine and Animal Science of the University of São Paulo (FMVZ–USP). The ticks were identified using a stereomicroscope (ZEISS, Stemi, DV4, Germany), taxonomic keys, and corresponding literature (Barros-Battesti *et al.*, 2006; Martins *et al.*, 2010, 2016). All ticks were deposited at the tick collection "Coleção Nacional de Carrapatos Danilo Gonçalves Saraiva" of the FMVZ–USP, under the accession numbers CNC 3386–3387. In

eight *T. tricinctus*, eight males and one female of *Amblyomma sculptum* were identified, as well as 24 males and three nymphs of *Amblyomma auricularium*. In a *D. septemcinctus*, four females of *A. auricularium* were collected. All associations between ticks and armadillos are shown in **Table 1**.

Amblyomma sculptum was already registered in Brazil on armadillos by Witter *et al.* (2016), who found adult ticks on *E. sexcinctus* and nymphs on *C. unicinctus*. On the other hand, Miranda *et al.* (2010) and Martins *et al.* (2011) reported *A. sculptum* adults (published as *Amblyomma cajennense*), and Kluyber *et al.* (2016) adults and nymphs of *A. sculptum*, on *P. maximus*. Kluyber *et al.* (2016) also recorded *A. sculptum* adults on *C. unicinctus*, and adults and nymphs on *E. sexcinctus* and *D. novemcinctus*. Botelho *et al.* (1989) and Campos Pereira *et al.* (2000) recorded adults of *A. sculptum* on *D. novemcinctus*, and Medri *et al.* (2010) adults of the same species on *E. sexcinctus* (all published as *A. cajennense*). Martins *et al.* (2017) also collected adults of this same tick species from *D. novemcinctus*. Thus, the present work reports for the first time the parasitism of *A. sculptum* on *T. tricinctus*.

In a compilation of previous records of *A. auricularium* on armadillos, Nava *et al.* (2017) reported this tick in 11 species of armadillos, of which only six occur in Brazil. Tick records refer to *A. auricularium* adults on *E. sexcinctus*, *T. tricinctus*, *D. kappleri*, and *D. hybridus*, as well as adults, nymphs, and larvae on *T. matacus* and *D. novemcinctus*. In the Caatinga biome, Horta *et al.* (2011) reported adults of *A. auricularium* on *E. sexcinctus*, Fonseca *et al.* (2013) described adults and nymphs on *D. novemcinctus*, and Maia *et al.* (2018) found adults and a nymph on *T. tricinctus*. Thus, the present study records for the first time adults of *A. auricularium* on *D. septemcinctus* in the Brazilian Caatinga.

Regarding the medical and veterinary relevance of the two tick species found in this study, *A. sculptum* is an important vector of *Rickettsia rickettsii*, a bacterium that causes a severe human disease known as Brazilian spotted fever in southeastern Brazil (Krawczak *et al.*, 2014; Martins *et al.*, 2016). While this disease is also known to affect domestic dogs (Labruna *et al.*, 2009) and capybaras (*Hydrochoerus hydrochaeris*) (Ramírez-Hernández *et al.*, 2020), nothing is known about the pathogenicity of *R. rickettsii* to any armadillo species or if these animals could act as amplifying hosts of the bacterium to tick vectors. On the other hand, there are some records of *A. auricularium* infected by *Rickettsia amblyommatis* in the Caatinga biome (Saraiva *et al.*, 2013; Lugarini *et al.*, 2015). This *Rickettsia* species is currently considered of unknown pathogenicity (Karpathy *et al.*, 2016). To date, there has been no indication of harmful effects of ticks on armadillos, nor has there been a record of pathogens transmitted by ticks on armadillos. This scenario is probably linked to the absence of studies in this field.

Amblyomma auricularium was the most prevalent and abundant tick species in the present study. In fact, this tick species is very common in the Caatinga biome, where armadillos are well known as their natural hosts (Saraiva *et al.*, 2013; Nava *et al.*, 2017). Hence, the conservation of armadillos in the Serra das Almas Natural Reserve will result in the conservation of their natural ticks, such as *A. auricularium*. On the other hand, infestations of armadillos by *A. sculptum* should be considered unusual, since larger mammal species are considered more important for sustaining populations of *A. sculptum* in Brazil (Martins *et al.*, 2016).

Finally, we found no clinical alterations of the tick-infested armadillos, a condition possibly related to the low tick load (< 10 ticks per armadillo), which is expected to be found in highly preserved areas such as the Serra das Almas Natural Reserve.

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COMUNICACIÓN BREVE

Primeros registros mediante cámaras trampa de oso hormiguero gigante (*Myrmecophaga tridactyla*) en el Parque Nacional Baritú, provincia de Salta, Argentina

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Resumen El oso hormiguero gigante (*Myrmecophaga tridactyla*) se distribuye desde Honduras hasta el norte de Argentina, donde es más abundante en la región chaqueña, pero también habita las Selvas de Yungas y la Selva Paranaense. Su presencia en el Parque Nacional Baritú había sido referida con anterioridad mediante el hallazgo de huellas. Durante un monitoreo de yaguareté con cámaras trampa en el nombrado Parque, la Red Yaguareté y la Administración de Parques Nacionales obtuvieron dos registros fotográficos de la especie en los años 2015 y 2017, los que constituyen los primeros con esta metodología.

Palabras clave: áreas protegidas, cámaras trampa, especies amenazadas, Myrmecophagidae, Yungas

First camera trap records of giant anteater (*Myrmecophaga tridactyla*) in Baritú National Park, Salta province, Argentina

Abstract The giant anteater (*Myrmecophaga tridactyla*) occurs from Honduras to northern Argentina, where it is most abundant in the Chaco region but also inhabits the Yungas and the Paranaense forests. Its presence in Baritú National Park had only been reported through the record of its tracks. During a jaguar monitoring carried out with camera traps in Baritú National Park, Red Yaguareté and the National Parks Administration obtained two photographic records of the species in 2015 and 2017, which constitute the first records with this method in the area.

Keywords: camera trap, Myrmecophagidae, protected areas, threatened species, Yungas

El oso hormiguero gigante (*Myrmecophaga tridactyla*) es uno de los tres representantes de la familia Myrmecophagidae que puede ser encontrado en bosques húmedos tropicales, bosques secos, hábitats de sabana y pastizales abiertos (Bertassoni, 2018). Su presencia ha sido registrada desde Honduras en América Central, pasando a través de Sudamérica hasta la región del Gran Chaco ubicada en Argentina, Bolivia y Paraguay (Gaudin *et al.*, 2018). En Argentina, en particular, se lo puede encontrar con mayor abundancia en la región chaqueña y en un número significativamente menor en la selva misionera, en las yungas del noroeste y en la ecorregión de los Esteros del Iberá, donde se reintrodujo exitosamente (véase Chebez & Cirignoli, 2008; Jayat & Ortiz, 2010; Di Blanco *et al.*, 2015; Jiménez Pérez *et al.*, 2015; Quiroga *et al.*, 2016). Como producto de una fuerte transformación y pérdida de los bosques de la región chaqueña hacia una agricultura intensiva, junto con un consecuente aumento de los riesgos de mortalidad por cacería y atropellamiento en rutas, se lo ha categorizado recientemente como Vulnerable (Di Blanco *et al.*, 2019), al igual que la categoría global que presenta la especie (Miranda *et al.*, 2014).

Entre 2014 y 2019 la Fundación Red Yaguareté y la Administración de Parques Nacionales llevaron

adelante un monitoreo continuo de yaguareté (*Panthera onca*) mediante el uso de cámaras trampa en el Parque Nacional Baritú, ubicado en el departamento Santa Victoria, en la provincia de Salta, Argentina (22°34'17,82"S, 64°38'23,73"W).

El área de estudio abarca parte de la región biogeográfica de las Yungas, dominio amazónico (Cabrera & Willink, 1980). Esta región resguarda cerca del 50% de la biodiversidad del país (Grau & Brown, 2000) y ha sido categorizada como en peligro, con la máxima prioridad de conservación en América Latina (véase Brown *et al.*, 2001, 2002). Esta selva se extiende en las laderas orientales de las sierras subandinas a una altitud aproximada de 400 a 2.500 o 3.000 metros sobre el nivel del mar.

El Parque Nacional Baritú (725 km^2) es una de las áreas protegidas más septentrionales de Argentina, y está casi libre de presencia humana, con la excepción de los poblados de Lipeo y Baritú, y de un establecimiento sobre la costa del río Bermejo, con escasos registros de cazadores más hacia áreas de borde. La zona es drenada por numerosos ríos, como el Lipeo, que constituye el límite norte del parque; el Porongal, que lo atraviesa por el centro en sentido oeste-este; y el Pescado en el sur, todos pertenecientes a la Alta Cuenca del río Bermejo. El clima es tropical serrano, con una temperatura media de 20 °C en invierno y de 30 ºC en verano. Las precipitaciones son estivales, se concentran más del 90% en el verano y llegan a superar los 2.000 mm anuales.

La zona del presente estudio se ubica siguiendo el cauce del río Porongal (con excepción del año 2018, cuando las cámaras se instalaron sobre el río Lipeo, límite norte del área protegida, y quebradas afluentes). Esta es una zona con vegetación de selva montana.

Se muestrearon un total de 37 sitios independientes (13 en 2014, 13 en 2015, 10 en 2016, 14 en 2017 y 9 en 2018) distantes entre sí alrededor de 1–4 km. Cada estación estaba conformada por dos cámaras trampa colocadas enfrentadas entre sí a una distancia de entre 6 y 8 m. Los muestreos se realizaron de agosto a noviembre de 2014 y 2015, y entre agosto y septiembre de 2016, 2017 y 2018. Las cámaras se colocaron entre 712 y 1.030 msnm,

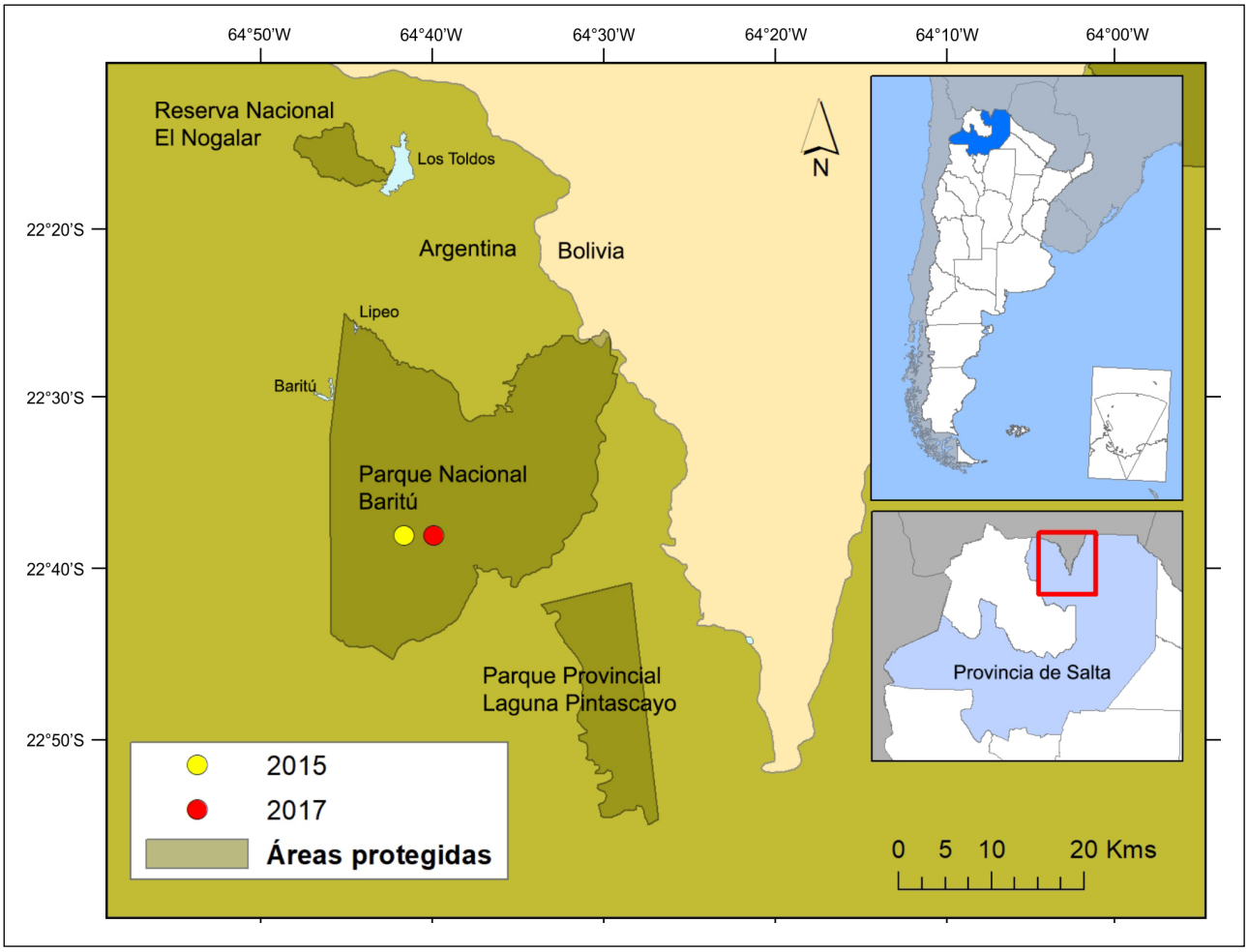

FIGURA 1. Ubicación de los registros de oso hormiguero gigante (*Myrmecophaga tridactyla*) en el Parque Nacional Baritú, provincia de Salta, Argentina.

Figura 2. Ejemplar de oso hormiguero gigante (*Myrmecophaga tridactyla*) captado en la estación de muestreo ubicada en 22°38'1,96"S, 64°39'41,52"W, en el Parque Nacional Baritú, provincia de Salta, Argentina.

mayormente sobre valles de ríos, en particular de los ríos Porongal, Lipeo y afluentes. Se realizó un esfuerzo de muestreo total de 5.153 días/cámara (2.315 en 2014, 1.119 en 2015, 977 en 2016, 742 en 2017 y 701 en 2018, respectivamente) (véase Lodeiro Ocampo *et al.*, 2019).

En el transcurso de estos monitoreos se obtuvieron, en dos oportunidades, imágenes de *M. tridactyla*. En la **Fig. 1** se puede visualizar la ubicación geográfica de ambos registros.

El primer registro (**Fig. 2**) se efectuó el día 12 de agosto de 2015 a las 18:38 hs en una estación de muestreo ubicada en 22°38'1,96"S, 64°39'41,52"W. La temperatura registrada en ese momento fue de 7 °C y la luna se encontraba en posición menguante. El segundo registro (**Fig. 3**) fue el día 3 de septiembre de 2017 a las 16:51 hs en otra estación de muestreo, ubicada en 22°38'1,03"S, 64°41'25,80"W. La temperatura tomada por la cámara en el momento del registro fue de 21 °C y la luna se encontraba en cuarto creciente. La distancia entre un registro y otro es de aproximadamente 3.006 metros.

Estos son los primeros registros fotográficos de la especie dentro del área protegida, cuya presencia había sido mencionada con anterioridad por algunos autores (*e.g.*, Heinonen Fortabat & Chebez, 1997; Gil & Heinonen Fortabat, 2003) y confirmada en un muestreo realizado en los años 2005 y 2006 mediante la observación de sus huellas (Braslavsky *et al.*, 2007).

Probablemente la especie ocurra en baja densidad poblacional, ya que, a pesar del gran esfuerzo de muestreo, solamente fue detectada en dos oportunidades.

Finalmente, se pretende destacar la importancia de la preservación de este sector de las Yungas, más allá de que esta selva ya fue categorizada como en peligro y mencionada como máxima en prioridad de conservación en América Latina (véase Brown *et al.*, 2001, 2002). Este trabajo es una demostración más de la relevancia de esta zona como refugio y contención de especies que actualmente se encuentran amenazadas y con sus poblaciones disminuidas, como *M. tridactyla*.

Figura 3. Ejemplar de oso hormiguero gigante (*Myrmecophaga tridactyla*) captado en la estación de muestreo ubicada en 22°38'1,03"S, 64°41'25,80"W, en el Parque Nacional Baritú, provincia de Salta, Argentina.

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FIELD NOTE

Giant armadillo (*Priodontes maximus* Kerr, 1792; Cingulata: Chlamyphoridae) attacks nest of stingless bee *Trigona amalthea* (Olivier, 1789) (Hymenoptera: Apidae)

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Abstract The giant armadillo (*Priodontes maximus*) has a wide distribution in South America and is naturally rare and difficult to observe, which contributes to the little existing knowledge about its biology and natural history, especially in the Amazon. We report, for the first time, an attack on a nest and the predation of stingless bees *Trigona amalthea* by *P. maximus*, contributing to the knowledge of their diet in the wild.

Keywords: Amazon forest, diet, Meliponini, predation, wild

Ataque de tatu-canastra (*Priodontes maximus* Kerr, 1792; Cingulata: Chlamyphoridae) em ninho de abelha sem ferrão *Trigona amalthea* (Olivier, 1789) (Hymenoptera: Apidae)

Resumo O tatu-canastra (*Priodontes maximus*) tem uma ampla distribuição na América do Sul e é naturalmente raro e difícil de se observar, o que contribui para o pouco conhecimento existente sobre sua biologia e história natural, especialmente na Amazônia. Relatamos, pela primeira vez, o ataque a um ninho e a predação de abelhas sem ferrão *Trigona amalthea* por *P. maximus*, contribuindo para o conhecimento de sua dieta na natureza.

Palavras-chave: dieta, Floresta Amazônica, Meliponini, predação, selva

The giant armadillo (*Priodontes maximus* Kerr, 1792; Xenarthra: Cingulata: Chlamyphoridae) is the largest species of armadillo, weighing up to 60 kg and reaching over 1.30 m in total length (Sigrist, 2012; Carter *et al.*, 2016; Desbiez *et al.*, 2019). It is widely distributed in South America east of the Andes, but is usually rare and occurs in low densities (Sigrist, 2012; Carter *et al.*, 2016). Giant armadillos are found in several types of habitats, from forests to savannas, typically in natural areas far from human settlements; the presence of substantial food reserves seems to be decisive for the occurrence of the species. Observations of the species in nature are rare, partly due to its nocturnal and fossorial habits, and the fact that animals can remain in their burrows for many hours and even days (Sigrist, 2012; Carter *et al.*, 2016; Desbiez *et al.*, 2019). It is considered Vulnerable by the International Union for Conservation of Nature (IUCN), with populations in decline especially due to hunting for meat (usually subsistence) and loss of habitat (IUCN, 2020).

The natural history and ecology of *P. maximus* is little known (Aya-Cuero *et al.*, 2015), and most of the knowledge about its biology and ecology is

based on observations made in the Cerrado (Anacleto & Marinho-Filho, 2001; Anacleto, 2007; Silveira *et al.*, 2009) and Pantanal of Brazil (Desbiez & Kluyber, 2013; Desbiez *et al.*, 2020), and the Llanos of Colombia (Aya-Cuero *et al.*, 2017). Information about Amazonian forest populations is practically nonexistent.

Priodontes maximus has a diet that consists almost exclusively of ants (Formicidae) and termites (*Cornitermes*), although it does feed occasionally on other invertebrates found in the nests of these insects. In a study conducted in the Cerrado of central Brazil, it was found that termites of the genus *Cornitermes* Holmgren, 1912 were the main prey consumed by giant armadillos (Anacleto, 2007). Reports of giant armadillos feeding on ants in the genus *Atta* Fabricius, 1805 suggest that they usually do not destroy an entire colony while feeding (Anacleto & Marinho-Filho, 2001; Sigrist, 2012; Carter *et al.*, 2016).

There are no records of attacks by *P. maximus* on nests of stingless bees (Insecta: Hymenoptera: Apidae: Meliponini), even though the nests are often built in the ground, in hollow trunks, exposed, or even in association with termite or anthills and, thus, would seem accessible to the armadillos (Roubik, 2006; Michener, 2007; Rasmussen & Camargo, 2008).

Even though stingless bees do not have the ability to sting, they use other defense mechanisms, such as soiling the enemy with plant resins, feces of other animals, acids, or biting (Roubik *et al.*, 1987; Nogueira-Neto, 1997; Lehmberg *et al.*, 2007). The stingless bees of the genus *Trigona* Jurine, 1807, such as *T. amazonensis* (Ducke, 1916), *T. spinipes* (Fabricius, 1793), and *T. amalthea* (Olivier, 1789), are known for their aggressive defense of the nest, as exemplified by the many workers that act as guards, and by attacking the enemy with bites (Shackleton *et al.*, 2015).

Trigona amalthea generally builds its own nest (external type) with plant material mixed with resins, in which the outer layer is composed of chewed green leaves; when dried it resembles rotten trunks or termite nests (Wille & Michener, 1973). Occasionally, nests are built inside termite nests (Schwarz, 1948), or soil is used as an external involucrum (Rasmussen & Camargo, 2008).

Here we present the first documented observation of *P. maximus* preying on a nest of the stingless bee *T. amalthea*.

The observation was made in the Serra do Divisor National Park (07°31'55.5"S, 73°43'38.9"W), a Conservation and Integral Protection Unit of 8,430 km^2, located in the municipality of Mancio Lima, in the far west of the state of Acre, Brazil.

Four individual bees were collected under the authorization of Sistema de Autorização e Informação em Biodiversidade – SISBIO (72686-1), identified, and later deposited in the Collection of Invertebrates of the Instituto Nacional de Pesquisas da Amazônia – INPA (Manaus, Amazonas, Brazil) (**Fig. 1**). The identification of the bees was performed using a Leica M165C stereomicroscope, coupled

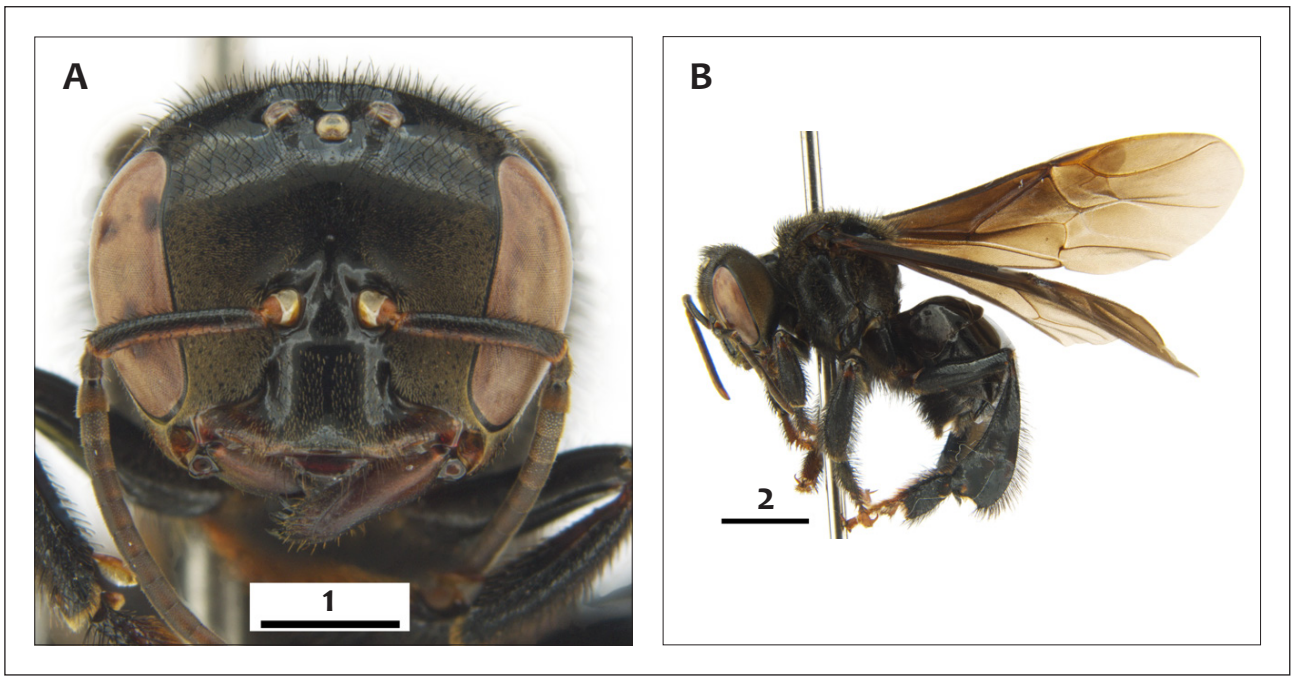

Figure 1. Worker of *Trigona amalthea* (Olivier, 1789). A: Head in frontal view. B: Body in lateral view. Scale in millimeters. Photos: David Silva Nogueira.

with a Leica WILD M3Z digital camera. Images were captured using IM 50 software (Image Manager) and the images were merged by Auto-Montage. The identification was made by comparison with material deposited in the INPA Collection and previously identified by the stingless bee specialist J.M.F. Camargo.

Giant armadillos are known to occupy the area where the nest was located (Calouro, 1999). On 2 December 2019, at 7:44 hr, an adult *P. maximus* was observed walking near the edge of a dry land forest. The animal raised its body, leaning on its hind legs, and sniffed for a few seconds (**Fig. 2**). Upon entering the forest again, the giant armadillo used its front claws to begin opening a nest of *T. amalthea* that was on the ground.

The nest was located in a dense forest area and was of the exposed type, located above the ground, in leaf litter and between branches. Its external involucrum was built with plant material and was very tough.

The nest was about the same size as the giant armadillo and was immediately defended by the bees, which flew in great numbers around the animal, landing all over its body and making bites. However, these attacks did not seem to disturb the predator, possibly due to its thick carapace. The *P. maximus* was observed removing pieces of the nest and inserting its tongue in the openings, consuming both adults and larvae (Melo, 2020). After about 20 minutes, the giant armadillo moved away from the nest and disappeared into the understory. The nest did not appear to be completely destroyed, because the attack was concentrated on one side. However, a closer inspection was not possible due to the defensive behavior of the bees, which continued to fly around the nest.

The observation we report here is consistent with other studies that have documented occasional, opportunistic feeding by giant armadillos on prey such as spiders (Aranea), scorpions (Scorpiones), cockroaches (Blattaria), beetles (Coleoptera), Diplopoda, worms, small snakes, and carrion (Anacleto & Marinho-Filho 2001; Carter *et al.*, 2016), or even leaves of grasses, seeds (Anacleto & Marinho-Filho, 2001), and figs (Wallace & Painter, 2013). Consumption of stingless bees by *P. maximus* reinforces the importance of Hymenoptera in its diet, but also suggests that the diet may be broader than has been thought. We believe this is the first observation of *P. maximus* feeding in the Amazon forest and, because stingless bees are common there, bees may represent an important portion of the giant armadillo diet in this biome.

Figure 2. *Priodontes maximus* Kerr, 1792 resting on its hind legs and sniffing before locating the *Trigona amalthea* (Olivier, 1789) nest. Photo: Tomaz Nascimento de Melo.

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FIELD NOTE

The SlothBot: an ecologically inspired environmental monitoring robot

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Abstract Inspired by the low-energy lifestyle of the three-toed sloth (*Bradypus* sp.), the SlothBot is an energy-efficient, solar-powered robot designed to have a persistent presence in tree canopies. Organized around the novel robotics paradigm that surviving takes precedence over goal-driven actions, the SlothBot only moves when it absolutely has to. Since May 2020, it has been taking climate measurements in the treetops of the Atlanta Botanical Garden. We envision that, in the future, teams of SlothBots can be deployed in a rainforest canopy to collect data for field ecologists.

Keywords: *Bradypus*, canopy, climate measurements, data collection, mobile robot

El SlothBot: un robot que monitorea el ambiente, inspirado por la ecología

Resumen Inspirado en el estilo de vida de baja energía del perezoso de tres dedos (*Bradypus* sp.), el SlothBot es un robot que funciona a energía solar y ha sido diseñado pensando en lograr una alta eficiencia y en tener una presencia persistente en el dosel. Organizado en torno al novedoso paradigma de la robótica, según el cual sobrevivir tiene prioridad sobre las acciones impulsadas por objetivos, el SlothBot solo se mueve cuando es absolutamente necesario. Desde mayo de 2020 ha estado tomando medidas climáticas en las copas de los árboles del Jardín Botánico de Atlanta. Esperamos que en el futuro equipos de SlothBots podrán ser instalados en el dosel de la selva tropical para recopilar datos para los ecólogos de campo.

Palabras clave: *Bradypus*, colecta de datos, dosel, mediciones climáticas, robot móvil

The normal way of designing robot behaviors is to define a goal, something the robot is supposed to achieve, and then maximize a reward function that encodes how well the goal is being realized (Thrun *et al.*, 2000; Choset *et al.*, 2005). Examples include how quickly a fetch-and-carry robot can deliver an item in a warehouse or how precisely a surgical robot can track a reference trajectory (LaValle, 2006). However, for robots that are to be deployed over truly long periods of time in natural environments, *e.g.*, for the purpose of monitoring environmental phenomena in order to build up ecological niche models or capture local microclimates, simply "surviving" in the environment becomes much more important than to maximize any particular reward function (Campbell *et al.*, 2010; Steinberg *et al.*, 2016). For robots, surviving could entail things such as not running into objects, never getting stranded somewhere with completely depleted batteries, or to always be in communication range with a base station. In fact, such considerations can be phrased in terms of constraints rather than rewards (Egerstedt *et al.*, 2018), which is where connections can be made between robotics and ecology, where richness of behavior oftentimes results from environmental constraints.

The SlothBot is a manifestation of this "robot ecology" idea. A collaboration between roboticists and ecologists, the SlothBot is a slow and energy-efficient, solar powered robot that is suspended on wires up in the tree canopy, measuring different climate-relevant factors (Notomista *et al.*, 2019).

FIGURE 1. The SlothBot at the Atlanta Botanical Garden.

Examples of measurements that are currently being made by the SlothBot include temperature, atmospheric pressure, humidity, solar radiation, and air quality. The benefit as compared to more traditional weather stations is that the SlothBot can spend time deep under the tree canopy, taking relevant measurements, and then use its mobility to go out into the sunshine to recharge the batteries as needed.

It is modeled on the low-energy life-style of three-toed sloths (*Bradypus* spp.), which have evolved a suite of adaptions to minimize energetic expenditure, such as anatomical specializations related to foraging digestion and locomotion, reduced activity patterns, and unique thermoregulatory behaviors (Cliffe *et al.*, 2014; Cork *et al.*, 2014; Pauli *et al.*, 2014; Dill-McFarland *et al.*, 2016). Together, these shared traits are strategies for a species to survive in the face of a precarious energy balance (Pauli *et al.*, 2016).

The SlothBot, then, does little except survive, meaning that it should not run into trees, and it should always have enough battery charge available to be able to move to a sunny spot to recharge. Since May 2020, the SlothBot has been on display among the trees in the Atlanta Botanical Garden, USA (**FIG. 1**). Currently, the SlothBot's ecological work in the Garden is limited to data collection. However, we envision a scenario where teams of SlothBots are deployed in a rainforest canopy as a highly useful and versatile companion to field ecologists by tracking pollinators and other key organisms to the overall biodiversity as well as providing the abiotic measurements needed to construct ecological niche models. If nothing else, it is certainly already serving as an inspiration to visitors to the Atlanta Botanical Garden interested in the interface of ecology and robotics.

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News

Partnership with Nurtured by Nature

We are proud to announce that our Specialist Group has entered a partnership with **Nurtured by Nature**. Nurtured by Nature is dedicated to the conservation of wildlife and their habitats. This is achieved through an international portfolio of conservation, research and education projects. Through their interactive programs and significant social media following, this non-profit organization based in California is able to influence and promote conservation and preservation by endearing humans to animals and their habitats. Nurtured by Nature shares the Anteater, Sloth and Armadillo Specialist Group's interests and aspirations for the global conservation of xenarthrans and their ecosystems. Combining the expertise and resources of both organizations will allow us to collaboratively increase general awareness of the plight of xenarthrans and to enhance their conservation.

Support Xenarthra conservation through PayPal!

Our Specialist Group can now receive donations via PayPal! If you wish to support our activities, please visit our website (https://www.xenarthrans.org/donations/), where you will find a new "donate" button. You can also use the QR code included here. Our group depends on these charitable donations to advance our conservation work and publication efforts. All donations are administered by our partner institution Nurtured by Nature and are tax deductible. We thank you in advance for your support!

Happy birthday, Instituto Tamanduá!

Instituto Tamanduá was founded by Flávia Miranda in 2005. While it initially focused on the research and conservation of anteaters, with time it extended its activities to other xenarthrans. Today, Instituto Tamanduá is widely recognized as the leading institution dedicated to Xenarthra conservation in Brazil, if not in all of South America. Its team of biologists, veterinarians, administrators, and volunteers works on a wide range of projects, primarily in Piauí, Bahia, and the Pantanal. In addition to performing field studies on the biology and ecology of xenarthrans, Instituto Tamanduá has developed considerable experience in *in situ* and *ex situ* population management and has helped create public conservation policies in several South American countries. More recently, the team has been involved in landscape protection by reforesting areas of importance for the conservation of xenarthrans. In September 2020, Instituto Tamanduá celebrated its first fifteen years of tireless work, and the team's passion and dedication for these amazing creatures is stronger than ever. *Happy birthday!*

Happy birthday, Green Heritage Fund Suriname!

This success story started with the care of one orphaned baby sloth in 2005. On 24 October 2005, Green Heritage Fund Suriname (GHFS) was established to help sloths that were in trouble. Over the past 15 years, GHFS has grown into a foundation dedicated to protecting nature and wildlife in

Suriname. It provides professional care to sloths, anteaters, and armadillos (and the occasional porcupine). Since 2018, GHFS staff have been fortunate to provide this care in a professional shelter in the forest. Over the years, its team has rescued, cared for, and released over 1000 animals into safe environments. In recent years, the foundation's education and research program has also been further developed. GHFS's many volunteers and interns, both from the Surinamese community and from abroad, have contributed to the creation of educational materials, collection of scientific data, and the training of individuals in wildlife conservation. *Happy birthday, GHFS!*

First International Congress on Xenarthra Conservation

The First International Congress on Xenarthra Conservation (CICX) was held from November 30 to December 3, 2020. In this very difficult and atypical year, Instituto Tamanduá saw the opportunity to celebrate their 15th birthday by organizing a virtual congress that would bring together Xenarthra experts and fanatics from all over the world. The packed program consisted of 33 talks by renowned experts from 10 countries on the biology, paleontology, phylogeny, systematics, medicine, captive management, nutrition, and conservation of xenarthrans. In addition, several mini-courses provided even more information about the biology and ecology of the Xenarthra, *ex situ* conservation, and Xenarthra medicine. To reach a wide audience, all talks were pre-recorded and subtitled in English, Spanish, and Portuguese. And there's more! Ten of the 68 accepted abstracts were selected for an oral presentation, which gave talented young researchers the opportunity to talk about their research in this international, albeit virtual, setting.

The congress was an immense success. It was attended by 520 participants from 26 countries, representing five continents. It was a celebration of the passion we share for these amazing mammals, and we are already looking forward to the second edition of this congress!

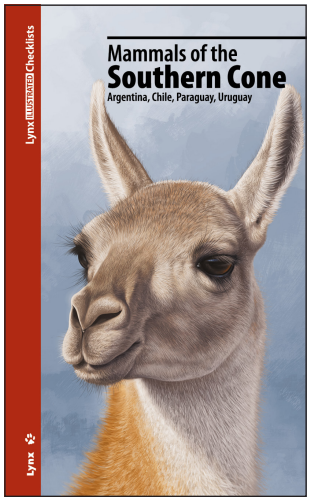
We would like to take the opportunity to thank Instituto Tamanduá for their excellent work organizing this congress; the official sponsor, Concessionária Litoral Norte (CLN), for their generous support; Foundation for International Aid to Animals, for having sponsored 200 grants that allowed many students and young professionals to participate; and the congress partners Sociedade Brasileira de Mastozoologia, Quimtia, and Armadillos de Chile.

If you missed the congress, you can still register and watch all pre-recorded talks as they will be available for the next six months! Please visit the Congress website <https://congresse.me/eventos/cicx> for additional information.

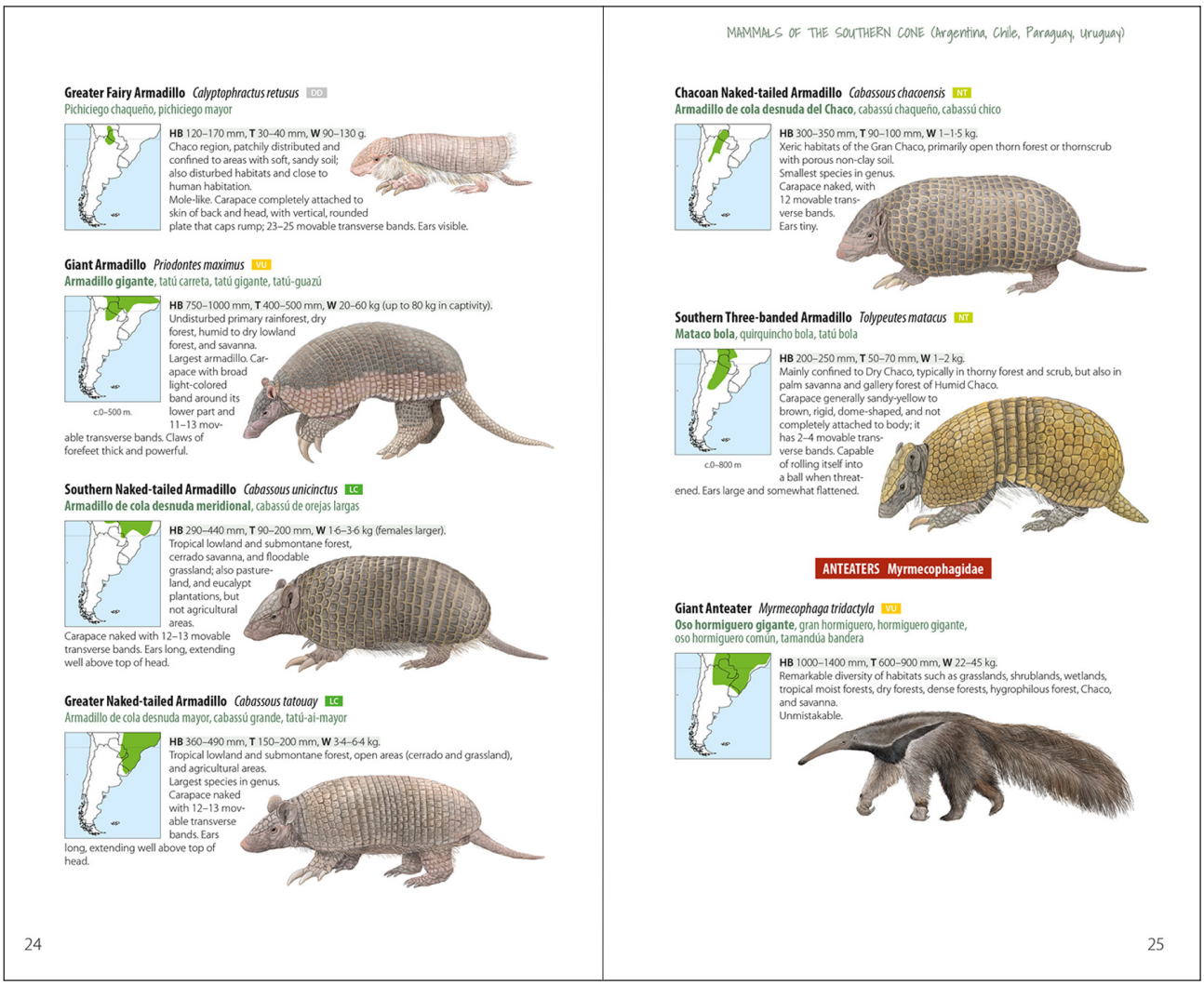
Virtual Specialist Group Meeting

Our Specialist Group held a virtual meeting on December 3, 2020. It was attended by 16 members and two representatives of Nurtured by Nature. The meeting provided an opportunity for an open and informal discussion on the group's structure, its priorities, and the range of activities we would like to accomplish during the next IUCN quadrennium (2021–2024). There was agreement that our Specialist Group would benefit from having thematic sub-groups, as this would enhance membership engagement and increase outputs. The proposed thematic groups were taxonomy, trade, conservation planning, education and outreach, and *ex situ* conservation. The exchange of ideas and discussion of possible activities was highly motivating and inspiring, and the participants agreed that the Specialist Group should hold regular virtual meetings. We thank all members for their active participation!

Armadillos, Sloths, and Anteaters in a New Illustrated Checklist of the Mammals of the Southern Cone



This Illustrated Checklist is based on the book series *Handbook of the Mammals of the World* (*HMW*). It covers all 486 mammal species, including 17 introduced species with established wild populations and three domesticated species, of Argentina, Chile, Paraguay, Uruguay, and south-eastern Brazil, representing 26% of the total land area of South America. The Checklist includes 18 species of Xenarthra: *Dasypus novemcinctus*, *D. septemcinctus*, *D. mazzai*, *D. hybridus*, *Euphractus sexcinctus*, *Chaetophractus vellerosus*, *C. villosus*, *Zaedyus pichiy*, *Chlamyphorus truncatus*, *Calyptophractus retusus*, *Priodontes maximus*, *Cabassous unicinctus*, *Ca. tatouay*, *Ca. chacoensis*, *Tolypeutes matacus*,



Greater Fairy Armadillo *Calyptophractus retusus* DD
Pichiciego chaqueño, pichiciego mayor

HB 120–170 mm, **T** 30–40 mm, **W** 90–130 g.
Chaco region, patchily distributed and confined to areas with soft, sandy soil; also disturbed habitats and close to human habitation.
Mole-like. Carapace completely attached to skin of back and head, with vertical, rounded plate that caps rump; 23–25 movable transverse bands. Ears visible.

Giant Armadillo *Priodontes maximus* VU
Armadillo gigante, tatú carreta, tatú gigante, tatú-guazú

c.0–500 m.

HB 750–1000 mm, **T** 400–500 mm, **W** 20–60 kg (up to 80 kg in captivity).
Undisturbed primary rainforest, dry forest, humid to dry lowland forest, and savanna.
Largest armadillo. Carapace with broad light-colored band around its lower part and 11–13 movable transverse bands. Claws of forefeet thick and powerful.

Southern Naked-tailed Armadillo *Cabassous unicinctus* LC
Armadillo de cola desnuda meridional, cabassú de orejas largas

HB 290–440 mm, **T** 90–200 mm, **W** 1·6–3·6 kg (females larger).
Tropical lowland and submontane forest, cerrado savanna, and floodable grassland; also pastureland, and eucalypt plantations, but not agricultural areas.
Carapace naked with 12–13 movable transverse bands. Ears long, extending well above top of head.

Greater Naked-tailed Armadillo *Cabassous tatouay* LC
Armadillo de cola desnuda mayor, cabassú grande, tatú-ai-mayor

HB 360–490 mm, **T** 150–200 mm, **W** 3·4–6·4 kg.
Tropical lowland and submontane forest, open areas (cerrado and grassland), and agricultural areas.
Largest species in genus.
Carapace naked with 12–13 movable transverse bands. Ears long, extending well above top of head.

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MAMMALS OF THE SOUTHERN CONE (Argentina, Chile, Paraguay, Uruguay)

Chacoan Naked-tailed Armadillo *Cabassous chacoensis* NT
Armadillo de cola desnuda del Chaco, cabassú chaqueño, cabassú chico

HB 300–350 mm, **T** 90–100 mm, **W** 1·1–1·5 kg.
Xeric habitats of the Gran Chaco, primarily open thorn forest or thornscrub with porous non-clay soil.
Smallest species in genus.
Carapace naked, with 12 movable transverse bands.
Ears tiny.

Southern Three-banded Armadillo *Tolypeutes matacus* NT
Mataco bola, quirquincho bola, tatú bola

c.0–800 m

HB 200–250 mm, **T** 50–70 mm, **W** 1–2 kg.
Mainly confined to Dry Chaco, typically in thorny forest and scrub, but also in palm savanna and gallery forest of Humid Chaco.
Carapace generally sandy-yellow to brown, rigid, dome-shaped, and not completely attached to body; it has 2–4 movable transverse bands. Capable of rolling itself into a ball when threatened. Ears large and somewhat flattened.

ANTEATERS Myrmecophagidae

Giant Anteater *Myrmecophaga tridactyla* VU
Oso hormiguero gigante, gran hormiguero, hormiguero gigante, oso hormiguero común, tamandúa bandera

HB 1000–1400 mm, **T** 600–900 mm, **W** 22–45 kg.
Remarkable diversity of habitats such as grasslands, shrublands, wetlands, tropical moist forests, dry forests, dense forests, hygrophilous forest, Chaco, and savanna.
Unmistakable.

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Myrmecophaga tridactyla, *Tamandua tetradactyla*, and *Bradypus variegatus*.

The concise species descriptions include descriptive notes to facilitate their identification, such as head-body and tail measurements, mean weight, and relevant details about the habitats they occupy. Common names in English and Spanish, and the conservation status according to The IUCN Red List of Threatened Species, are also given. All species descriptions include a beautiful illustration and a range map.

It is difficult to compare this Checklist with the *HMW*, as the latter includes a huge amount of information, including detailed descriptions of families and species. The Checklist's advantage is that, with a size of 14 × 22.8 cm and a weight of 340 g, it is a compact and useful compilation that can be taken in the field—something we would not suggest to do with the original *HMW8* that measures 24 × 31 cm and weighs 4.13 kg. At roughly 20 Euros for this entire compilation *vs.* 140 Euros per book of the *HMW* series, its price is also more accessible.

In summary, this by-product of the *HMW* is a very attractive complement or alternative that allows quick and practical access to basic information on the many Xenarthra species and other mammals that share their habitats.

Vilalta, A.M. (compiler). 2020. Mammals of the Southern Cone, Argentina, Chile, Paraguay, Uruguay. Lynx Edicions, Barcelona. 160 pp. ISBN 978-84-16728-26-8. Available at: <https://www.lynxeds.com/es/producto/mammals-of-the-southern-cone/>.

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GUIDELINES TO AUTHORS

Edentata is the official, peer-reviewed, annual publication of the IUCN SSC Anteater, Sloth and Armadillo Specialist Group. It aims to publish information that contributes to the conservation of xenarthrans.

Edentata accepts manuscripts of original research findings related to any aspect of xenarthran conservation. It also encourages submission of short communications, field notes, thesis abstracts, news items, recent events, book reviews, congress announcements, and the like.

A broad range of topics is welcomed and encouraged, including taxonomy, systematics, genetics, biogeography, ecology, conservation, behavior, and health. All manuscripts must clearly demonstrate how they relate to, or benefit, the conservation of xenarthrans. Manuscripts must describe original research findings that have not been published or submitted simultaneously to other journals. Any overlap of contents with already published papers should be minimal.

Language

Manuscripts may be written in English (please use American English), Portuguese or Spanish. Authors whose first language is not English should please have their texts *carefully reviewed* by a native English speaker or a professional translator.

Review process

Once the manuscript has been received, the editors will perform a first evaluation. Manuscripts not satisfying the editorial instructions will be returned to the author without review. Manuscripts that comply with the editorial instructions will be handled by an editor. The editor in charge will select at least two external reviewers who are specialists in the topic of the manuscript. Once the external reviews are received, the editor will inform the corresponding author about the results of the evaluation and the steps that need to be taken once the manuscript has been accepted for its publication. Please note that to avoid confusions, the editor will only communicate with the corresponding author but not with co-authors.

Conservation research ethics

When submitting their work, authors must confirm in writing that their research protocols have been approved by an authorized animal care or ethics committee and/or the authors had the necessary permits to carry out their research. Authors must be aware of, and adhere to, all laws, treaties and regulations currently applying to their work.

Editorial instructions

Format

Please type all parts of the manuscript (including references, figure and table legends, and appendices) in 12-point font, Times New Roman or Arial. Justify the text to the left and double-space it throughout. Do not use footnotes.

Number all pages, including the title page, in the lower right corner. Insert "Line Numbers" continuously for the whole document. Submit the main text as a DOCX, DOC or RTF file, and the tables and figures in separate files.

Style

The style of writing should be simple and concise. Avoid large, complex sentences that are difficult to read.

Words in other languages

Words in other languages, including allowed abbreviations, should be written in *italics*.

Nomenclature

The taxonomic nomenclature must follow the updated rules and recommendations of the International Code of Botanical Nomenclature and the International Code of Zoological Nomenclature. Scientific names, of generic or inferior category, must be written in *italics*.

Equipment and drugs

Indicate the name, city, and country of the manufacturer in parentheses for all equipment and drugs. **Example:** spring scale (Pesola AG, Baar, Switzerland).

In the case of drugs, also indicate the product name. **Example:** 5 mg/kg enrofloxacin (Enrofland, 100 mg/ml; Laboratorios Veterland Ltd., Bogotá, Colombia).

The chemical names of drugs, such as anesthetics and antibiotics, must be written in lower case (**example:** ketamine instead of Ketamine).

Abbreviations

Use the decimal metric system for all measurements. Abbreviate units of measure when preceded by a numeral and write them out in all other cases (**example:** 5.4 m or several meters).

Spell out numbers at the beginning of a sentence. Also, spell out all numbers under ten unless they are associated with units of measure. **Example:** three armadillos, one sloth and 12 anteaters.

Express fractions as decimals (**example:** 0.25 instead of ¼). Use a decimal comma in Spanish and Portuguese, and a decimal point in English texts. The symbols > and < may be used if accompanied by a dimension (**example:** < 2 m).

Abbreviations should end with a period, except those corresponding to measurements and distances, such as kg, m, km, µm, which are symbols. Use the abbreviation Fig. or Figs. when referring to figures within the text (**example:** Fig. 1, Figs. 2–4; as shown in Fig. 2…).

Leave a space between numbers and their dimensions (**example:** 2 km or 07:15 hr; do not write 2km or 07:15hr).

Report dates in the day – month (spelled out) – year format, with no period or comma (**example:** 25 August 2010). Use the 24-hr system for time, followed by the abbreviation "hr" (**example:** 07:15 hr or 21:00 hr).

Please indicate geographical coordinates in degrees, minutes, seconds and, if necessary, fractions of seconds. Write the latitude first, followed by the longitude (**example:** 36°35'00.10"S, 68°00'10.20"W).

Organization

First page

The first page of each manuscript must include the following items in the order given:

Title: It should be concise and informative, and include the species involved (with scientific name) when applicable.

Author names and affiliations: Please give full name details for all authors and mark the corresponding address with an upper-case superscript letter. List the affiliation addresses of all authors (where the actual work was done) below the names, starting with the corresponding upper-case superscript letter. Provide the full postal address of each affiliation, including the institution's section or department, the institution's full name, street and number, postal code, city, country name and, if available, the email address of each author.

Present/permanent address: If an author has moved since the work described in the article was done, a "present address" may be indicated and marked with an upper-case superscript letter after the author's name.

Corresponding author: Please indicate with a superscript Latin number who is willing to handle correspondence at all stages of the review, publication, and post-publication process.

Second page

Abstract: Please provide an abstract of no more than 250 words in English in the case of regular articles, and no more than 150 words for short communications and field notes. Manuscripts in English must also include a title and an abstract in Spanish or Portuguese. Manuscripts submitted in Spanish or Portuguese must include an abstract in the original language, plus an English translation of the title and the abstract. The abstract must be completely self-explanatory and intelligible in itself, and state briefly the purpose of the research, the principal results, and major conclusions. Do not include references or uncommon abbreviations.

Keywords: Please list up to six keywords in the two languages used for the abstract, in alphabetical order and separated by commas, that best describe the nature of your work. Make sure you do not repeat words that are already included in the title. Include the scientific and/or common name of the principal species studied in case they are not included in the manuscript title.

Main body of the manuscript

The standard format consisting of **Introduction**, **Materials and Methods**, **Results**, and **Discussion** should be used for full-length manuscripts. Short communications and field notes should not be divided into sections.

Headings

Three classes of headings are allowed within the text of a manuscript:

First-level headings (the most inclusive) are written in **bold**, justified to the left, and not followed by punctuation.

Second-level headings are written in *italics*, **not** bold, justified to the left, and are not followed by punctuation. The corresponding text starts on the next line, as a new paragraph.

Third-level headings are written in *italics*, **not** bold, justified to the left, and end with a period. The paragraph text follows on the same line.

Lists of items within the text should be preceded by Arabic numerals followed by a period (1.) or by bullets (•).

Introduction

The **Introduction** should state the objectives of the work and provide an adequate background.

Materials and Methods

This section should include sufficient detail to allow the study to be replicated. Whenever applicable, study sites should be clearly identified and geographical coordinates included. Adequate references should be included for methods that have already been published elsewhere. Commonly used statistical methods need not be described in detail, but adequate references should be provided.

Results

This section should highlight the key results and not repeat data already included in figures or tables.

Discussion

The discussion may be combined with the **Results**. It should interpret the results in the context of other published work. In addition, it should discuss the significance or the implications of the findings for species or ecosystem conservation.

Conclusions

Where applicable, significant conclusions may be included to highlight the most important findings.

Acknowledgements

Acknowledgements follow the **Discussion** or **Conclusions** section and precede the **References** section. Information on grants received should be included here.

References

Please ensure that every reference cited in the text is also listed in the reference section, and vice-versa. Unpublished results and personal communications should not be included in the **References** list, but rather be cited in the text.

In-text citations

Single author citations should include only the author's surname and the year of publication, separated by a comma. Citations with two authors should list both authors' names, separated by an ampersand (&). In the case of three authors or more, the first author's surname is followed by *et al.* (in *italics*).

Groups of references should be listed first chronologically, then alphabetically. In this case, citations should be separated by semicolons. **Examples:** (Wetzel, 1985a, b; Nowak, 1991; Anacleto, 1997; Emmons & Feer, 1999; Noss *et al.*, 2004). McDonough & Loughry (2001) stated that…

When citing a book that has been edited by an institution whose name is usually abbreviated, use the abbreviation in the in-text citation. In the **References** section, write the abbreviation, followed by a dash and the institution's entire name. **Example:** The in-text citation (MMA, 2008) is listed in the References as MMA – Ministério do Meio Ambiente do Brasil. 2008.

Textual quotations must be reproduced exactly as they appear in the original work and be enclosed in double quotation marks (" "). Their source must be indicated by specifying the author, year, and page number in parenthesis in the following format: (author, year:page); **example:** (Wetzel, 1985:14).

References section

In the **References** section, citations should be listed in alphabetic order by the first author's surname. Please note that the initials of authors and editors must be separated by a space.

If a reference has 7 or more co-authors, write only the name of the first author followed by *et al.* If there is more than one article by authors whose names appear in the same order in each paper, the articles are listed in chronological order. Articles with multiple authors but the same lead author are arranged together, alphabetically by second, and then by third, author, etc. Articles by the same authors in the same year are assigned a letter suffix (**example:** 1985a).

Only the first word and proper nouns in titles of articles and books begin with a capital letter. Names of journals should not be abbreviated. Only mention issue numbers of a volume if the pages of the latter are not numbered consecutively from the first issue on.

Examples

Journal publication:

Gallo, J.A., L. Fasola & A.M. Abba. 2019. Armadillos as natural pests control? Food habits of five armadillo species in Argentina. Mastozoología Neotropical 26: 117–127.

McDonough, C.M., S.A. McPhee & W.J. Loughry. 1998. Growth rates of juvenile nine-banded armadillos. Southwestern Naturalist 43: 462–468.

Please note that in this last example, the issue number (4) has not been included because the pages of volume 43 are numbered consecutively from

its first volume on. In other words, instead of writing 43(4): 462–468, only 43: 462–468 is used.

Book:

MMA – Ministério do Meio Ambiente do Brasil. 2008. Livro vermelho da fauna brasileira ameaçada de extinção. 2 Volumes. Fundação Biodiversitas, Belo Horizonte. 1420 pp.

Montgomery, G.G. 1985. The evolution and ecology of armadillos, sloths, and vermilinguas. Smithsonian Institution Press, Washington and London. 451 pp.

Book chapter:

Superina, M., F. Miranda & T. Plese. 2008. Maintenance of Xenarthra in captivity. Pp. 232–243 in: The biology of the Xenarthra (S.F. Vizcaíno & W.J. Loughry, eds.). University Press of Florida, Gainesville.

Wetzel, R.M. 1985. The identification and distribution of recent Xenarthra (= Edentata). Pp. 5–21 in: The evolution and ecology of armadillos, sloths, and vermilinguas (G.G. Montgomery, ed.). Smithsonian Institution Press, Washington and London.

Proceedings and congress abstracts:

Noss, A. 1999. La sostenibilidad de la cacería de subsistencia izoceña. P. 80 in IV Congreso Internacional sobre manejo de fauna silvestre en Amazonia y Latinoamérica, Asunción.

Rogel, T.G., C.E. Pellegrini, J.A. Agüero, A.R. Bamba, P.C. Paez & E.M. Virlanga. 2005. Caracterización de la dieta de dasipódidos del chaco árido riojano. P. 128 in XX Jornadas Argentinas de Mastozoología (SAREM, ed.), Buenos Aires.

Dissertation or Thesis:

Abba, A.M. 2008. Ecología y conservación de los armadillos (Mammalia, Dasypodidae) en el noreste de la provincia de Buenos Aires, Argentina. Doctoral Thesis, Universidad Nacional de La Plata, La Plata. 246 pp.

Steuber, J.G. 2007. The cost of an emerging disease: *Mycobacterium leprae* infection alters metabolic rate of the nine-banded armadillo (*Dasypus novemcinctus*). Master's Thesis, University of Akron, Akron. 31 pp.

Website or Webpage:

Anacleto, T.C.S., F. Miranda, I. Medri, E. Cuellar, A.M. Abba & M. Superina. 2014. *Priodontes maximus*. The IUCN Red List of Threatened Species 2014: e. T18144A47442343. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T18144A47442343.en. Accessed on 22 July 2020.

IUCN. 2020. The IUCN Red List of Threatened Species 2020–2. International Union for Conservation of Nature and Natural Resources. <http://www.iucnredlist.org/>. Accessed on 20 July 2020.

Tables

Please submit tables in a separate file, and never within the main body of the text. Type each table on a separate page and number them consecutively in Arabic numerals. List the table captions on a separate page at the end of the manuscript, following the **References** section. Table captions should be concise and descriptive enough to be able to stand alone. Please omit all vertical lines in tables; place single horizontal lines under the title, under the column headings, and at the bottom of the table. Do not use footnotes.

Figures

Articles may include small high-quality photographs (color or black and white), figures, and maps. If maps are included in the manuscript, they should be surrounded by a border with geographic coordinates in degrees (**example:** 36°S) or degrees and minutes (**example:** 36°10'S). They should also include a map showing the location of the study site within the country and the continent. List the figure captions on a separate page of the manuscript, following the Table captions. Please use vector instead of bitmap images whenever possible (**example:** for maps and diagrams), and submit them in any of the following electronic file formats: AI, EPS, SVG, CDR, PDF. Bitmap (or raster) images are more appropriate for photographs and drawings; they should have a resolution of 200 DPI and a width of 17 cm. Please submit them as uncompressed JPG, PNG, TIF, PSD, CPT or PDF. All figures should be submitted in separate files, with the file name referring to the corresponding figure number.

Manuscript submission

Manuscripts should be submitted to the Editor in electronic format using the following email address: <edentata@xenarthrans.org>. Please remember to submit the main text in DOCX, DOC or RTF format, the tables in a separate DOCX, DOC or RTF file, and each figure as an individual file.

Correspondence regarding your manuscript should be directed to the handling editor or the Editor-in-Chief: Mariella Superina, IMBECU – CCT CONICET Mendoza, Casilla de Correos 855, Mendoza (5500), Argentina. Tel. +54-261-5244160, Fax +54-261-5244001, e-mail: <edentata@xenarthrans.org>.

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INSTRUCCIONES PARA LOS AUTORES

Edentata es la publicación oficial, anual y revisada por pares del grupo de especialistas en hormigueros, perezosos y armadillos de la IUCN SSC (IUCN SSC Anteater, Sloth and Armadillo Specialist Group). Está dedicada a la difusión de información que contribuya a la conservación de los xenartros.

Se aceptan manuscritos que se encuentren dentro de una amplia variedad de temáticas, incluyendo: taxonomía, sistemática, genética, biogeografía, ecología, conservación, comportamiento y salud. Todos los manuscritos tienen que demostrar claramente una relación o beneficio para la conservación de los xenartros. Deben ser trabajos originales y no haber sido publicados ni enviados simultáneamente a otros medios de publicación. La superposición de contenidos con artículos relacionados ya publicados debe ser mínima.

Edentata acepta artículos sobre investigaciones originales relacionadas con cualquier aspecto de la conservación de xenartros. También se alienta el envío de comunicaciones breves, notas de campo, resúmenes de tesis, noticias, información sobre eventos, revisiones de libros, avisos de congresos, etc.

Idioma

Los manuscritos pueden estar redactados en inglés (por favor utilice el inglés americano), portugués o español. En el caso de autores cuya lengua materna no sea el inglés y envíen manuscritos en ese idioma, deberán someter el texto a una *revisión detallada* por una persona angloparlante nativa o traductor profesional para garantizar el uso correcto del inglés.

Proceso de revisión

Una vez recibido el manuscrito, el Comité editorial realizará una primera evaluación y los manuscritos que no cumplan con las normas establecidas que se indican más abajo serán devueltos a los autores sin pasar al proceso de revisión por pares. Los manuscritos que pasen esta etapa estarán a cargo de un Editor, quien a su vez seleccionará al menos dos revisores especialistas en la temática del manuscrito. Una vez recibidas las revisiones externas, informará al autor para correspondencia sobre los resultados de la evaluación y los pasos a seguir en caso de que el manuscrito sea aceptado para su publicación. Por favor, tenga en cuenta que para evitar confusiones el editor solo se comunicará con el autor para correspondencia pero no con los coautores.

Ética de investigación y conservación

Al enviar su manuscrito los autores deben confirmar por escrito que sus protocolos de investigación han sido aprobados por un comité científico de cuidado animal o de ética y que los autores poseían los permisos pertinentes para trabajar con fauna silvestre. Los autores deben conocer y respetar todas las leyes, acuerdos y regulaciones aplicables a su trabajo.

Normas editoriales

Formato

El texto del manuscrito (incluyendo las referencias y leyendas de figuras, tablas y apéndices) deberá estar escrito en Times New Roman o Arial, tamaño 12 puntos, a doble espacio, justificado a la izquierda. No utilice notas al pie de página.

Todas las hojas, incluyendo la primera página, deberán ser numeradas correlativamente en el ángulo inferior derecho e incluir los números de línea en formato continuo.

El texto principal se preparará en un archivo en formato DOCX, DOC o RTF. Las figuras y tablas se realizarán en archivos independientes del texto principal.

Estilo

El estilo de escritura debe ser simple y conciso. Se deberán evitar oraciones largas y complejas, que dificulten la lectura del texto.

Palabras en otro idioma

Las palabras en otro idioma, incluyendo las abreviaturas permitidas, deberán estar escritas en *cursiva*.

Nomenclatura

La nomenclatura de los taxones deberá seguir las reglas y recomendaciones actualizadas del Código Internacional de Nomenclatura Botánica y del Código Internacional de Nomenclatura Zoológica. Los nombres científicos a nivel de género y categorías inferiores se escribirán en letra *cursiva*.

Equipamiento y fármacos

Para todos los equipamientos, aparatos y fármacos utilizados se deben indicar el nombre, ciudad y país del fabricante entre paréntesis. **Ejemplo:** balanza de 10 kg (Pesola AG, Baar, Suiza).

En el caso de los fármacos, también se debe indicar el nombre comercial del producto. **Ejemplo:** 5 mg/kg enrofloxacina (Enrofland, 100 mg/ml; Laboratorios Veterland Ltd., Bogotá, Colombia).

Los nombres químicos de fármacos, como anestésicos o antibióticos, deben escribirse con minúsculas (**ejemplo:** ketamina en lugar de Ketamina).

Abreviaturas

Las medidas serán expresadas en el sistema métrico decimal. Las mismas deberán estar abreviadas cuando acompañan a un número y escritas sin abreviar en caso contrario (**ejemplo:** 5,4 m o varios metros).

Los números al principio de una oración deberán estar escritos en letras. Cuando se utilicen números en el texto sin referirse a dimensiones, se pondrán en letra los menores de 10; **ejemplo:** tres armadillos, un perezoso y 12 hormigueros.

Las fracciones deben estar expresadas como decimales (**ejemplo:** 0,25 en lugar de ¼). La fracción decimal de un número estará separada del entero por una coma en textos en español o portugués, y por punto en textos en inglés. Los signos > y < podrán usarse si acompañan a una magnitud (**ejemplo:** < 2 m).

Las abreviaturas deberán terminar en un punto, a excepción de aquellas correspondientes a medidas y distancias, como kg, m, km, µm, que son símbolos. Las figuras deberán ser referidas en el texto mediante la abreviatura Fig. o Figs. (**ejemplo:** Fig. 1, Figs. 2–4; en la Fig. 2 se puede observar…).

Los números estarán separados de las dimensiones por un espacio (**ejemplo:** 2 km o 07:15 hs; no escriba 2km ni 07:15hs).

Las fechas se indicarán en el formato día – mes (escrito en palabras) – año, sin comas ni puntos (**ejemplo:** 25 de agosto de 2010). Se deberá utilizar el sistema de 24 horas para designar el tiempo de reloj, seguido por la abreviatura «hs» (**ejemplo:** 07:15 hs o 21:00 hs).

Las coordenadas geográficas se indicarán en el formato de grados, minutos, segundos y, si corresponde, fracciones de segundos, colocando primero la latitud y luego la longitud (**ejemplo:** 36°35'00,10"S, 68°00'10,20"O).

Organización

Primera página

La primera página del manuscrito deberá contener los siguientes ítems en el orden indicado:

Título: el título deberá ser conciso e informativo y, si corresponde, incluir la especie involucrada (con el nombre científico).

Nombres de autores y direcciones laborales: indique los nombres completos de todos los autores. Señale a cada autor con letra mayúscula, en superíndice, consecutivamente para relacionar la institución a la que pertenece. Debajo de los nombres, indique la filiación laboral (en el momento de la realización de la investigación) de cada autor, empezando con el superíndice correspondiente. Esta incluirá la sección o departamento de la institución, el nombre completo de la institución, la dirección postal, el código postal, la localidad, el país y la dirección de correo electrónico.

Dirección actual/permanente: en el caso de que un autor haya cambiado su filiación después de haberse presentado el trabajo, podrá indicar una «dirección actual» y marcarla con letra mayúscula, en superíndice, detrás de su nombre.

Contacto: marque con superíndice numérico quién es el responsable de la correspondencia, tanto durante las etapas del proceso editorial como después de la publicación.

Segunda página

Resumen: incluya un resumen de no más de 250 palabras para artículos regulares, y de no más de 150 palabras para comunicaciones breves y notas de campo. En el caso de manuscritos cuyo texto principal esté escrito en español o en portugués, deberá incluirse una traducción del título y del resumen al inglés. Los manuscritos en inglés tendrán que incluir, además, un título y un resumen en español o en portugués. El resumen debe ser claro y describir brevemente el objetivo de la investigación, los resultados y las principales conclusiones. No incluya referencias bibliográficas ni abreviaturas poco comunes.

Palabras clave: agregue no más de seis palabras clave en los dos idiomas utilizados en el resumen, en orden alfabético y separadas por comas, que sean indicativas del contenido del manuscrito y que no estén incluidas en el título. Incluya el

nombre común y/o el científico de la especie estudiada en el caso que no estén incluidos en el título.

Texto principal del manuscrito

El texto de los artículos regulares se dividirá preferentemente en las secciones tradicionales: **Introducción**, **Materiales y Métodos**, **Resultados** y **Discusión**. No utilice división por secciones en comunicaciones breves y notas de campo.

Niveles de encabezado

Se admiten tres niveles de encabezado:

El primer nivel (más inclusivo) se escribirá en **negrita**, justificado a la izquierda, sin punto final.

El segundo nivel se escribirá en *cursiva*, **sin** negrita y justificado a la izquierda, sin punto final. El texto correspondiente comenzará en la línea siguiente como un nuevo párrafo.

El tercer nivel se escribirá en *cursiva*, **sin** negrita y justificado a la izquierda. Finalizará en un punto, a continuación del cual comenzará el párrafo correspondiente, en la misma línea.

En el caso de que se enumere una lista de ítems en el texto corrido, los mismos serán precedidos por numerales arábigos seguidos de un punto (1.) o por viñetas (•).

Introducción

La introducción mencionará los objetivos del trabajo y proporcionará un marco teórico apropiado.

Materiales y Métodos

Esta sección incluirá suficientes detalles para permitir que el estudio sea repetido. Identifique claramente los sitios de estudio, incluyendo las coordenadas geográficas correspondientes, siempre que sea aplicable. En el caso de que los métodos de estudio ya hayan sido publicados previamente, solo deberá incluir las referencias correspondientes. No es necesario describir detalladamente los métodos estadísticos usados comúnmente, pero deberá proporcionar sus referencias bibliográficas.

Resultados

Esta sección resaltará los resultados principales, sin repetir información ya incluida en figuras o tablas.

Discusión

Esta sección podrá ser combinada con los **Resultados**. Interprete los resultados en el contexto de otros trabajos publicados. Además, discuta la importancia o implicancias de los hallazgos para la conservación de especies o ecosistemas.

Conclusiones

Puede incluir conclusiones para resaltar los hallazgos más importantes.

Agradecimientos

Incluya los agradecimientos debajo de la sección **Discusión** o de las **Conclusiones** y antes de las **Referencias**. Mencione en esta sección las becas y subsidios utilizados para el estudio descrito.

Referencias

Asegúrese de que cada referencia citada en el texto esté incluida en la sección de **Referencias** y viceversa. No se admiten resultados sin publicar ni comunicaciones personales en la lista de **Referencias**, pero pueden citarse en el texto.

Citas en el texto

Para citas de un solo autor, incluya solo el apellido del autor y el año de publicación, separados por coma. Para trabajos de dos autores, coloque los apellidos de ambos, separados por un signo *et* (&). Para trabajos de más de dos autores, escriba el apellido del primer autor seguido de *et al.* (en letra *cursiva*).

Cuando deba citar numerosos autores en un párrafo, ordene las citas cronológicamente y luego alfabéticamente. En este caso, las citas van separadas por punto y coma. **Ejemplos:** (Wetzel, 1985a, b; Nowak, 1991; Anacleto, 1997; Emmons & Feer, 1999; Noss *et al.*, 2004). McDonough & Loughry (2001) mencionaron que…

Al citar un libro editado por una institución que lleva un nombre que generalmente se abrevia, utilice la abreviatura en la cita en el texto y aclare el nombre completo en la lista de referencias detrás de la sigla, separado por un guion. **Ejemplo:** (MMA, 2008); en la lista de referencias figura como MMA – Ministério do Meio Ambiente do Brasil. 2008.

Las citas textuales deben reproducirse tal cual se encuentran en el original y encerrarse entre comillas angulares (« »). Se debe indicar la fuente especificando el autor, el año y el número de páginas entre paréntesis en el siguiente formato: (autor, año:página); **ejemplo:** (Wetzel, 1985:14).

Lista de referencias

En la sección de **Referencias**, enumere las citas en orden alfabético por el apellido del primer autor. Nótese que las iniciales de los autores y editores llevan espacio entre ellas.

Si una referencia tiene 7 o más coautores, escriba solo el nombre del primero seguido por *et al.* Cuando haya más de un artículo de los mismos autores y que estos figuren en el mismo orden, ordénelos por orden cronológico. Cuando haya varios artículos que tengan el mismo primer autor, ordénelos por orden alfabético del segundo, luego del tercer autor, etc. En el caso de artículos que tengan los mismos autores y el mismo año, agrégueles una letra como sufijo (**ejemplo:** 1985a).

En los títulos de artículos y de libros, solo escriba la primera palabra y nombres propios con mayúscula. No abrevie los nombres de las revistas. Solo indique el número de volumen dentro de un mismo tomo si este último no está numerado consecutivamente.

Ejemplos

Publicación en revista:

Gallo, J.A., L. Fasola & A.M. Abba. 2019. Armadillos as natural pests control? Food habits of five armadillo species in Argentina. Mastozoología Neotropical 26: 117–127.

McDonough, C.M., S.A. McPhee & W.J. Loughry. 1998. Growth rates of juvenile nine-banded armadillos. Southwestern Naturalist 43: 462–468.

Nótese en este último ejemplo que no se incluyó el número del volumen (4) ya que el tomo 43 está numerado consecutivamente a partir de su primer volumen. O sea, en vez de escribir 43(4): 462–468, solo se escribió 43: 462–468.

Libro:

MMA – Ministério do Meio Ambiente do Brasil. 2008. Livro vermelho da fauna brasileira ameaçada de extinção. 2 Volumes. Fundação Biodiversitas, Belo Horizonte. 1420 pp.

Montgomery, G.G. 1985. The evolution and ecology of armadillos, sloths, and vermilinguas. Smithsonian Institution Press, Washington and London. 451 pp.

Capítulo de libro:

Superina, M., F. Miranda & T. Plese. 2008. Maintenance of Xenarthra in captivity. Pp. 232–243 in: The biology of the Xenarthra (S.F. Vizcaíno & W.J. Loughry, eds.). University Press of Florida, Gainesville.

Wetzel, R.M. 1985. The identification and distribution of recent Xenarthra (= Edentata). Pp. 5–21 in: The evolution and ecology of armadillos, sloths, and vermilinguas (G.G. Montgomery, ed.). Smithsonian Institution Press, Washington and London.

Resumen de congreso:

Noss, A. 1999. La sostenibilidad de la cacería de subsistencia izoceña. P. 80 in IV Congreso Internacional sobre manejo de fauna silvestre en Amazonia y Latinoamérica, Asunción.

Rogel, T.G., C.E. Pellegrini, J.A. Agüero, A.R. Bamba, P.C. Paez & E.M. Virlanga. 2005. Caracterización de la dieta de dasipódidos del chaco árido riojano. P. 128 in XX Jornadas Argentinas de Mastozoología (SAREM, ed.), Buenos Aires.

Disertación o Tesis:

Abba, A.M. 2008. Ecología y conservación de los armadillos (Mammalia, Dasypodidae) en el noreste de la provincia de Buenos Aires, Argentina. Tesis doctoral, Universidad Nacional de La Plata, La Plata. 246 pp.

Steuber, J.G. 2007. The cost of an emerging disease: *Mycobacterium leprae* infection alters metabolic rate of the nine-banded armadillo (*Dasypus novemcinctus*). Tesis de Maestría, University of Akron, Akron. 31 pp.

Sitio o página web:

Anacleto, T.C.S., F. Miranda, I. Medri, E. Cuellar, A.M. Abba & M. Superina. 2014. *Priodontes maximus*. The IUCN Red List of Threatened Species 2014: e. T18144A47442343. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T18144A47442343.en. Acceso el 22 de julio de 2020.

IUCN. 2020. The IUCN Red List of Threatened Species 2020–2. International Union for Conservation of Nature and Natural Resources. <http://www.iucnredlist.org/>. Acceso el 20 de julio de 2020.

Tablas

Las tablas se enviarán en un archivo separado, nunca intercaladas en el texto del manuscrito. Coloque cada tabla en hoja aparte y numérela en formato arábigo. Incluya las leyendas correspondientes al final del manuscrito, en hoja aparte, después de las **Referencias**. Las mismas deben ser concisas y autoexplicativas. No incluya líneas verticales en las tablas; solo coloque líneas horizontales debajo del título, debajo de los títulos de columnas y al final de la tabla. No utilice notas de pie.

Figuras

Los artículos pueden incluir pequeñas fotografías de alta calidad (en color o en blanco y negro), figuras y mapas. En el caso de que se incluyan mapas en el manuscrito, estos deben tener un borde con coordenadas geográficas en el formato de grados (**ejemplo:** 36°S), o grados y minutos (**ejemplo:** 36°10'S). Se deberá incluir, además, un mapa que muestre la ubicación del sitio de estudio en el país y el continente. Numere cada figura en formato arábigo y enumere todas las leyendas de figuras al final del manuscrito, en hoja aparte, después de las leyendas de las tablas. Se alienta el uso de formatos de imagen vectoriales en lugar de mapas de bits cuando la naturaleza de una ilustración lo admita (**ejemplo:** en el caso de mapas y diagramas). Se aceptarán los siguientes formatos de archivo para vectores: AI, EPS, SVG, CDR y PDF. Los mapas de bits (o *raster*) deberían ser usados idealmente en el caso de las fotografías y de los dibujos, los cuales deberían tener una resolución de 200 DPI y un ancho de 17 cm. Por favor envíelos en formato JPG sin comprimir, PNG, TIF, PSD, CPT o PDF. Envíe todas las figuras en archivos separados y asegúrese de que el nombre del archivo incluya el número de figura correspondiente.

Envío de manuscritos

Los manuscritos deben ser enviados a la editora en formato digital al siguiente correo electrónico: <edentata@xenarthrans.org>. Recuerde enviar el texto principal en un archivo en formato DOCX,

DOC o RTF, las tablas en un archivo DOCX, DOC o RTF independiente, y cada figura en un archivo separado.

Por favor dirija la correspondencia relacionada con su manuscrito al editor responsable del mismo o a la editora en jefe: Mariella Superina, IMBECU – CCT CONICET Mendoza, Casilla de Correos 855, Mendoza (5500), Argentina. Tel. +54-261-5244160, Fax +54-261-5244001, e-mail: <edentata@xenarthrans.org>.

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NORMAS PARA AUTORES

Edentata é a publicação oficial, anual e revisada por pares científicos do grupo de especialistas em tamanduás, preguiças e tatus da IUCN SSC (IUCN SSC Anteater, Sloth and Armadillo Specialist Group). É dedicada à difusão de informações que contribuam com a conservação dos xenartros.

São aceitos manuscritos que se encontrem dentro de uma ampla variedade de temas, incluindo: taxonomia, sistemática, genética, biogeografia, ecologia, conservação, comportamento e saúde. Todos os manuscritos devem demonstrar claramente uma relação ou benefício para a conservação dos xenartros. Devem ser trabalhos originais e não terem sido publicados ou enviados simultaneamente a outros meios de publicação. A sobreposição de conteúdos com artigos relacionados e já publicados deve ser mínima.

Edentata aceita artigos sobre pesquisas originais relacionadas com qualquer aspecto de conservação de xenartros. Também são aceitas as submissões de comunicações breves, notas de campo, resumos de teses, notícias, informações sobre eventos, revisões de livros e anúncios de congressos, etc.

Idioma

Os manuscritos podem ser redigidos em inglês (por favor, utilize inglês americano), português ou espanhol. Aos autores cuja língua materna não seja o inglês, e que optem por enviar manuscritos nesse idioma, solicita-se uma revisão idiomática detalhada por pessoa nativa ou tradutor profissional para garantir o uso correto do inglês.

Processo de revisão

Uma vez recebido o manuscrito, o Comitê Editorial procederá com uma primeira avaliação e os manuscritos que não cumpram com as normas estabelecidas, indicadas abaixo, serão devolvidos aos autores sem passar pelo processo de revisão pelos pares. Os manuscritos que passem esta etapa estarão a cargo de um Editor, que por sua vez selecionará ao menos dois revisores especialistas no tema do manuscrito. Uma vez recebidas as revisões externas, o Editor informará ao autor correspondente sobre os resultados da avaliação e os próximos passos nos casos de manuscritos aceitos para publicação. Por favor, tenha em conta que para evitar confusões, o Editor somente se comunicará com o autor correspondente e não com os coautores.

Aspectos éticos da pesquisa e conservação

Ao enviar seu manuscrito, os autores devem confirmar por escrito que seus protocolos de pesquisa foram aprovados por uma Comissão de Ética no Uso de Animais e/ou comitê científico apropriado, como também possuir as licenças pertinentes para o desenvolvimento da pesquisa com fauna silvestre. Os autores devem conhecer e respeitar todas as leis, acordos e regulamentos aplicados ao seu trabalho.

Normas editoriais

Formato

Redija todos os itens do manuscrito (incluindo as referências, legendas de figuras e de tabelas, e apêndices) em fonte Times New Roman ou Arial, tamanho 12 pontos, com espaçamento duplo, justificado à esquerda. Não utilize notas de rodapé.

Todas as páginas, inclusive a primeira, deverão ser numeradas no ângulo inferior direito e o número de linhas deve ser incluído em formato contínuo. O texto principal deverá estar em formato DOCX, DOC ou RTF. As figuras e tabelas devem ser enviadas em arquivos separados ao manuscrito.

Estilo

O estilo da escrita deve ser simples e conciso. Evite sentenças longas e complexas, que dificultem a leitura do texto.

Palavras em outro idioma

As palavras em outro idioma, incluindo-se as abreviaturas permitidas, devem estar escritas em *itálico*.

Nomenclatura

As nomenclaturas taxonômicas devem seguir as regras e recomendações atualizadas do Código

Internacional de Nomenclatura Botânica e do Código Internacional de Nomenclatura Zoológica. Nomes científicos em nível de gênero, e categorias inferiores, devem ser escritos em *itálico*.

Equipamento e fármacos

Para todos os equipamentos, aparelhos e fármacos utilizados devem ser indicados o nome, cidade e país do fabricante em parênteses. **Exemplo:** balança de 10 kg (Pesola AG, Baar, Suíça).

No caso dos fármacos, também, deve-se indicar o nome comercial do produto. **Exemplo:** 5 mg/kg enrofloxacin (Enrofland, 100 mg/ml; Laboratorios Veterland Ltda., Bogotá, Colombia).

O nome químico dos fármacos, como antibióticos e anestésicos, devem estar escritos em letras minúsculas (por exemplo, cetamina ao invés de Cetamina).

Abreviaturas

As medidas serão expressas pelo sistema métrico decimal. As unidades de medida deverão estar abreviadas quando acompanharem um número e escritas por extenso nos demais casos (**exemplo:** 5,4 m ou vários metros).

Os números no começo de uma sentença deverão ser escritos por extenso. Também deverão ser escritos por extenso números que não refiram-se a dimensões e aqueles menores que 10 (**exemplo:** três tatus, uma preguiça e 12 tamanduás).

As frações devem ser expressas em decimais (**exemplo:** 0,25 ao invés de ¼). Use vírgula para fração decimal nos textos em espanhol ou português e use ponto nos textos em inglês. Os símbolos > e < podem ser usados se forem acompanhados de uma medida de magnitude (**exemplo:** < 2 m).

As abreviaturas devem terminar com ponto, com exceção daquelas correspondentes a medidas e distâncias, como kg, m, km, µm, que são símbolos. As figuras devem estar indicadas no texto com a abreviatura Fig. ou Figs. (**exemplo:** Fig. 1, Figs. 2–4; na Fig. 2 observa-se…).

Deixe um espaço entre os números e as dimensões (**exemplo:** 2 km ou 07:15 hs; não escreva 2km nem 07:15hs).

Indique as datas no formato dia – mês (por extenso) – ano, sem vírgulas ou pontos (**exemplo:** 25 de agosto de 2010). Use o sistema de 24 horas para designar tempo de relógio, seguido pela abreviatura "hs" (**exemplo:** 07:15 hs ou 21:00 hs).

As coordenadas geográficas devem ser indicadas no formato de graus, minutos e segundos e, se aplicável, frações de segundos, colocando primeiro a latitude e depois a longitude (**exemplo:** 36°35'00,10"S, 68°00'10,20"O).

Organização

Primeira página

A primeira página do manuscrito deverá conter os seguintes itens, na ordem indicada:

Título: O título deverá ser conciso e informativo e, se corresponde, incluir a espécie envolvida (com o nome científico).

Nomes dos autores e filiações institucionais: Indique os nomes completos de todos os autores. Assinale cada autor com uma letra maiúscula, em superíndice, consecutivamente para relacionar a instituição a que pertence. Debaixo dos nomes, indique a filiação institucional (no momento da realização da pesquisa) de cada autor, começando com o superíndice correspondente. A filiação deverá incluir a seção ou departamento da instituição, nome completo da instituição, código postal / CEP, localidade, país e o correio eletrônico (email).

Filiação atual/permanente: Em caso de que um autor tenha trocado sua filiação, depois de ter realizado a pesquisa, poderá indicar o endereço atual e marcá-lo com letra maiúscula, no superíndice, após o seu nome.

Autor para correspondência: Marque com superíndice numérico o autor para correspondência, tanto durante as etapas do processo editorial como depois da publicação.

Segunda página

Resumo: Inclua um resumo de no máximo 250 palavras para artigos regulares e não mais de 150 palavras para comunicações breves ou notas de campo. No caso de manuscrito cujo texto principal está escrito em espanhol ou português, deverá ser incluído uma tradução do título e um resumo em inglês. Os manuscritos em inglês terão que incluir um título e um resumo em espanhol ou português. O resumo deve ser auto-explicativo e descrever brevemente o objetivo da pesquisa, os resultados e as principais conclusões. Não incluir referências bibliográficas nem abreviaturas pouco comuns.

Palavras-chave: Agregue no máximo seis palavras-chave nos dois idiomas utilizados no resumo, em ordem alfabética e separadas por vírgulas, que sejam indicativas do conteúdo do manuscrito e não estejam contempladas no título. No caso da espécie estudada não ser citada no título, incluir o nome comum e/ou o científico nas palavras-chave.

Texto principal do manuscrito

O texto dos artigos regulares deverá conter as seguintes seções tradicionais: **Introdução**, **Materiais e Métodos**, **Resultados** e **Discussão**. Não utilizar essas divisões para comunicações breves e notas de campo.

Níveis de sub-seção

São aceitos três níveis de sub-seção:

O primeiro nível (mais inclusivo), deve ser escrito em **negrito**, justificado à esquerda, sem ponto final.

O segundo nível deve ser escrito em *itálico*, **sem** negrito e justificado à esquerda, sem ponto final. O texto correspondente deve começar na linha seguinte, como um novo parágrafo.

O terceiro nível deve ser escrito em *itálico*, **sem** negrito, justificado à esquerda e finalizado com um ponto final. O texto deverá ser iniciado na mesma linha.

No caso de que se enumere uma lista de itens no texto corrido, os mesmos serão precedidos por numerais arábicos seguidos de um ponto [1.] ou por ponto acima (•).

Introdução

A introdução deve conter os objetivos do trabalho e proporcionar um marco teórico apropriado.

Materiais e Métodos

Esta seção deve incluir detalhes suficientes para permitir que o estudo seja replicável. Identifique claramente a(s) área(s) de estudo, incluindo as coordenadas geográficas correspondentes, sempre que seja aplicável. Nos casos em que os métodos de estudo já tenham sido publicados previamente, somente deverão ser incluídas as referências correspondentes. Não é necessário descrever detalhadamente os métodos estatísticos usados comumente, mas indicar adequadamente suas referências bibliográficas.

Resultados

Esta seção deve destacar os resultados principais e não deverá repetir informações já incluídas em figuras e tabelas.

Discussão

Esta seção poderá ser combinada com os **Resultados**. Os resultados deverão ser interpretados no contexto de outros trabalhos publicados. Discuta a importância ou as implicações dos seus achados para a conservação das espécies ou dos ecossistemas.

Conclusões

Quando aplicável, poderá incluir conclusões para destacar os achados mais importantes.

Agradecimentos

Incluir os agradecimentos abaixo da seção de **Discussão** ou das **Conclusões** e antes das **Referências**. Mencionar nesta seção as bolsas e financiamentos recebidos para a execução do estudo.

Referências

Assegure-se de que cada referência citada no texto está presente na seção de **Referências** e vice-versa. Não se deve incluir resultados não publicados nem comunicações pessoais na lista de referências, mas podem estar citados no texto.

Citações no corpo do texto

Para citações de um único autor, incluir somente o sobrenome do autor e o ano de publicação, separados por vírgula. Para trabalhos de dois autores, colocar o sobrenome de ambos, separados pelo símbolo "&". Para trabalhos com mais de dois autores, escrever o sobrenome do primeiro autor seguido de *et al.* (em *itálico*).

Ao citar vários autores em um mesmo parágrafo, ordenar as citações cronologicamente e em seguida alfabeticamente. Neste caso, as citações vão separadas por ponto e vírgula. **Exemplos:** (Wetzel, 1985a, b; Nowak, 1991; Anacleto, 1997; Emmons & Feer, 1999; Noss *et al.*, 2004). McDonough & Loughry (2001) mencionaram que…

Ao citar um livro que foi editado por uma instituição cujo nome é comumente abreviado, use a abreviatura na citação no texto. Na seção de **Referências**, escreva a sigla, seguido por um travessão e o nome completo da instituição. **Exemplo:** (MMA, 2008) deve figurar na lista de referências como MMA – Ministério do Meio Ambiente do Brasil. 2008.

As citações textuais diretas devem ser reproduzidas exatamente como aparecem na obra original e ser colocadas entre aspas duplas (" "). Sua fonte deve ser indicada especificando o autor, ano e número da página entre parênteses no seguinte formato: (autor, ano:página); **exemplo:** (Wetzel, 1985:14).

Lista de referências

Na seção de **Referências**, organizar as citações em ordem alfabética por sobrenome do primeiro autor. Note que as iniciais dos autores e editores deverão ser espaçadas. Quando houver 7 ou mais coautores, escreva somente o nome do primeiro seguido por *et al.* Quando houver mais de um artigo dos mesmos autores e estes se apresentarem na mesma ordem, ordená-los cronologicamente. Quando houver vários artigos que tenham o mesmo primeiro autor, ordená-los por ordem alfabética do segundo autor, e logo do terceiro, etc. Em caso de artigos que tenham os mesmos autores e mesmo ano, assinalar uma letra como sufixo (**exemplo:** 1985a).

Nos títulos de artigos e livros somente a primeira palavra deve ser escrita com letra maiúscula, além dos nomes próprios. Não abrevie os nomes

dos periódicos. Somente indique o número do volume dentro de um mesmo tomo se este último não estiver numerado consecutivamente.

Exemplos

Publicação em periódico:

Gallo, J.A., L. Fasola & A.M. Abba. 2019. Armadillos as natural pests control? Food habits of five armadillo species in Argentina. Mastozoología Neotropical 26: 117–127.

McDonough, C.M., S.A. McPhee & W.J. Loughry. 1998. Growth rates of juvenile nine-banded armadillos. Southwestern Naturalist 43: 462–468.

Note que este último exemplo não inclui o número do volume (4) já que o tomo 43 está numerado consecutivamente a partir de seu primeiro volume. Ou seja, em vez de escrever 43(4): 462–468 escreva somente 43: 462–468.

Livro:

MMA – Ministério do Meio Ambiente do Brasil. 2008. Livro vermelho da fauna brasileira ameaçada de extinção. 2 Volumes. Fundação Biodiversitas, Belo Horizonte. 1420 pp.

Montgomery, G.G. 1985. The evolution and ecology of armadillos, sloths, and vermilinguas. Smithsonian Institution Press, Washington and London. 451 pp.

Capítulo de livro:

Superina, M., F. Miranda & T. Plese. 2008. Maintenance of Xenarthra in captivity. Pp. 232–243 in: The biology of the Xenarthra (S.F. Vizcaíno & W.J. Loughry, eds.). University Press of Florida, Gainesville.

Wetzel, R.M. 1985. The identification and distribution of recent Xenarthra (= Edentata). Pp. 5–21 in: The evolution and ecology of armadillos, sloths, and vermilinguas (G.G. Montgomery, ed.). Smithsonian Institution Press, Washington and London.

Resumo de congresso:

Noss, A. 1999. La sostenibilidad de la cacería de subsistencia izoceña. P. 80 in IV Congreso Internacional sobre manejo de fauna silvestre en Amazonia y Latinoamérica, Asunción.

Rogel, T.G., C.E. Pellegrini, J.A. Agüero, A.R. Bamba, P.C. Paez & E.M. Virlanga. 2005. Caracterización de la dieta de dasipódidos del chaco árido riojano. P. 128 in XX Jornadas Argentinas de Mastozoología (SAREM, ed.), Buenos Aires.

Dissertação ou Tese:

Abba, A.M. 2008. Ecología y conservación de los armadillos (Mammalia, Dasypodidae) en el noreste de la provincia de Buenos Aires, Argentina. Tese de Doutorado, Universidad Nacional de La Plata, La Plata. 246 pp.

Steuber, J.G. 2007. The cost of an emerging disease: *Mycobacterium leprae* infection alters metabolic rate of the nine-banded armadillo (*Dasypus novemcinctus*). Dissertação de Mestrado, University of Akron, Akron. 31 pp.

Website or Webpage:

Anacleto, T.C.S., F. Miranda, I. Medri, E. Cuellar, A.M. Abba & M. Superina. 2014. *Priodontes maximus*. The IUCN Red List of Threatened Species 2014: e. T18144A47442343. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T18144A47442343.en. Acceso em 22 de julho de 2020.

IUCN. 2020. The IUCN Red List of Threatened Species 2020–2. International Union for Conservation of Nature and Natural Resources. <http://www.iucnredlist.org/>. Acceso em 20 de julho de 2020.

Tabelas

As tabelas devem ser enviadas em um arquivo separado, nunca intercaladas com o texto do manuscrito. Coloque cada tabela em uma página à parte e numere em formato arábico. Inclua as legendas correspondentes ao final do manuscrito, em página à parte, depois da seção de **Referências**. As legendas devem ser concisas e autoexplicativas. Não inclua linhas verticais nas tabelas; somente coloque linhas horizontais sob o título, sob os títulos das colunas e ao final da tabela. Não utilize notas de rodapé.

Figuras

Os artigos podem incluir pequenas fotografias de alta qualidade (colorida ou em preto e branco), figuras e mapas. No caso de incluir mapas no manuscrito, estes devem ter uma borda com as coordenadas geográficas em formato de graus (**exemplo:** 36°S), ou graus e minutos (**exemplo:** 36°10'S). Um mapa de detalhe que mostre a localização da área de estudo em referência ao país e ao continente deve ser adicionado ao mapa principal. Numere cada figura em formato arábico e inclua todas as legendas das figuras ao final do manuscrito, em página à parte, depois das legendas das tabelas. O uso de formatos de imagens vetoriais em vez de *bitmaps* é encorajado onde a natureza de uma ilustração o suporta (**exemplo:** no caso de mapas e diagramas). Serão aceitos os seguintes formatos de arquivos vetoriais: AI, EPS, SVG, CDR e PDF. As figuras em *bitmaps* (ou *raster*) devem ser usadas idealmente no caso de fotografias e desenhos, que devem ter resolução de 200 DPI e largura de 17 cm. Por favor, envie-os em formato JPG sem compressão, PNG, TIF, PSD, CPT ou PDF. Envie todas as figuras em arquivos separados e verifique que o nome do arquivo inclua o número da figura correspondente.

Envio de manuscritos

Os manuscritos devem ser enviados à editora em formato digital para o seguinte endereço eletrônico: <edentata@xenarthrans.org>. Lembre-se de enviar o texto principal em arquivo em formato DOCX, DOC ou RTF, as tabelas em DOCX, DOC ou RTF em arquivos independentes, e cada figura em um arquivo separado.

Por favor, encaminhe a correspondência relacionada ao seu manuscrito para o editor responsável pelo manuscrito ou para a editora-chefe: Mariella Superina, IMBECU – CCT CONICET Mendoza, Casilla de Correos 855, Mendoza (5500), Argentina. Tel. +54-261-5244160, Fax +54-261-5244001, e-mail: <edentata@xenarthrans.org>.

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IUCN/SSC
Anteater, Sloth
& Armadillo
Specialist Group

Edentata

The Newsletter of the IUCN/SSC Anteater, Sloth and Armadillo Specialist Group
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