ROADKILL AND NEW RECORDS FOR GIANT ARMADILLO (*Priodontes maximus*) IN CENTRAL-WESTERN BRAZIL

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**ABSTRACT.** Despite the widespread distribution of the giant armadillo *Priodontes maximus*, this species is found at low densities, often in disrupted populations. Here we report 12 new records, including five incidents of roadkill of *P. maximus* in different points of the Cerrado and one in an Atlantic Forest fragment in central-western Brazil. In addition to the relevant records, we discuss the negative effects of roadkills, which is a serious issue for the conservation and maintenance of local populations of giant armadillo.

**RESUMO.** Atropelamentos e novos registros para tatu-canastra (*Priodontes maximus*) no centro-oeste do Brasil. Apesar da ampla distribuição do tatu-canastra *Priodontes maximus*, esta espécie apresenta baixas densidades em populações não conectadas. Aqui, relatamos 12 novos registros, incluindo cinco atropelamentos rodoviários de *P. maximus* em diferentes pontos de Cerrado e um em fragmento de Floresta Atlântica no centro-oeste do Brasil. Além dos registros relevantes, discutimos o efeito negativo da perda de espécimes por atropelamentos em estradas, o qual é um problema sério para a conservação e manutenção de populações locais de tatu-canastra.

**Key words:** Atlantic Forest. Cerrado. Geographical range. Species conservation. Vulnerable species.

**Palavras chaves:** Área geográfica. Cerrado. Conservação de espécies. Espécies vulneráveis. Floresta Atlântica.
becoming locally extinct and others nearing extinction in what is left of the Atlantic Forest (Anacleto et al. 2006; Srbek-Araujo et al. 2009; Carter et al. 2016). The giant armadillo has also been affected by poaching, in addition to the deforestation of its habitat, and is listed as “Vulnerable” by the International Union for Conservation of Nature and Natural Resources (Anacleto et al. 2014). Therefore, any available data concerning its natural status take on paramount importance for conservation initiatives.

Roads have tangible and evident negative effects on wildlife due to the reduction and disruption of natural environments (Forman 1998); they cause changes in natural ranges, movements, reproductive success, behavioral responses, and physiological state (Forman 2003; Van der Ree et al. 2011) of countless species. In addition to the their directly observable effects, roads also promote a plethora of indirect effects such as increased hunting, passive harassment of animals, increased susceptibility of ecological invasion, and the spread of diseases (Trombulak & Frissell 2001). *Priodontes maximus* has a widespread, but discontinuous distribution (see, Fig. 1) with individuals having a large home range, suggesting that large areas of suitable habitat are needed to sustain viable populations (~5.5 individuals/100 km²) (Carter et al. 2016). Although in recent years new information has been obtained about the giant armadillo, its biology is still poorly understood (Silveira et al. 2009; Porfirio et al. 2012). Information on giant armadillo ecology includes indirect signs, sporadic sightings, camera trapping, and also the carcasses of dead animals (Silveira et al. 2009). Nevertheless, roadkill has been seldom considered to be a substantial threat to *P. maximus* populations (Chiarello et al. 2008), despite the research by Fischer et al. (2003) which documented at least one individual of *P. maximus* that frequently crossed the road close to Emas National Park.

This communication reports 13 new records, including five roadkills of *P. maximus* in different areas of central-western of Brazil. We used Global Biodiversity Information Facility-GBIF (GBIF 2017), Species Link (Species Link 2017), and published articles (Anacleto & Marinho-Filho 2001; Vaz 2003; Mamede & Alho 2006; Srbek-Araujo et al. 2009; Porfirio et al. 2012; Desbiez & Kluyber 2013; Martinelli et al. 2014; Hannibal & Godoi 2015) as database for showing site-records of giant armadillo in South America.

All live-records occurred in the last three years, and we observed the armadillos during searches for mammals of different academic interest and research projects, therefore, records were opportunistic with no systematic sampling. We observed the records in several different places, such as Pantano farm (Ribas do Rio Pardo municipality), Mato Grosso do Sul state and Refúgio da Vida Silvestre Serra do Fartaleza conservation unit-RVSSF (Quirinópolis municipality), and the state of Goiás (Table 1). The giant armadillo sightings in Pantano farm were recorded by ten camera traps, as well as by footprints and burrows in woodland savanna fragments (5700 ha) and in areas of eucalyptus and pine plantations (12 500 ha). The sighting in RVSSF was made by the documentation of footprints near the edge of a semi-deciduous forest fragment and by burrows inside this fragment. The RVSSF comprised an area of 489.72 ha covered by semi-deciduous forest, gallery forest and vereda—a savanna formation dominated by *Mauritia flexuosa* (Walter 2006), and surrounded by an agricultural plantation as well as an exotic grass matrix.

The south-western record of giant armadillo was a roadkill on BR-267, in the Jardim municipality, in the state of Mato Grosso do Sul and the eastern record was a burrow in the Cristianópolis municipality, in the state of Goiás (Table 1, Figs. 1 and 2). In addition, four of five roadkill records occurred in the last two years, 2016 and 2017, on different roads in central-western Brazil (Table 1, Figs. 1 and 2). Our records were in concordance with the distribution range of *P. maximus* (Fig. 1). Cerrado grassland (savannah) of central South America comprises about 25% of the distribution of *P. maximus*, but the species also occurs in forests with significant undergrowth, but appears to be absent in areas settled by humans or in which cattle are raised (Carter et al. 2016). In contrast, there are reports of *P. maximus* in disturbed vegetation surrounding forest fragments of Cerrado, possibly moving between
Fig. 1. New records and roadkills of *Priodontes maximus* in central-western Brazil. Geographical range according to IUCN (2017) and old records according to GBIF (2016), Species Link (2017), and published articles (Anacleto and Marinho-Filho 2001, Vaz 2003, Mamede and Alho 2006, Srbek-Araujo et al. 2009, Porfírio et al. 2012, Desbiez and Kluyber 2013, Martinelli et al. 2014, Hannibal and Godoi 2015) (see Table 1 for information about the numbers).

Table 1

Information about giant armadillo (*Priodontes maximus*) new records and roadkills in central-western Brazil. Legend. Road: BR=interstates Brazilian roads, MS and GO=intrastate Brazilian roads; Record: B = burrow, C = camera trap, D = Direct observation, T = track; State: GO=Goiás state, MS=Mato Grosso do Sul state. For roadkills, we put the road name where the carcass was found.

| Point | Register | Record type | Municipality-State | Latitude (S) | Longitude (W) | Year of record |
|-------|----------|-------------|--------------------|--------------|---------------|----------------|
| 1     | BR-267   | B           | Jardim-MS          | 21°29'47"   | 56°17'44"    | 2007           |
| 2     | BR-267   | B           | Nova Alvorada do Sul-MS | 21°35'34"   | 54°01'55"    | 2017           |
| 3     | MS-040   | Roadkill    | Campo Grande-MS    | 21°08'17"   | 53°31'43"    | 2017           |
| 4     | BR-262   | B           | Ribas do Rio Pardo-MS | 20°27'50"   | 53°39'48"    | 2016           |
| 5     | GO-461   | B           | Santa Rita do Araguaia-GO | 17°14'32"   | 53°07'41"    | 2016           |
| 6     | B        | B           | Itaquiraí-MS       | 23°16'41"   | 54°13'01"    | 2015           |
| 7     | B, CT, T | B           | Ribas do Rio Pardo-MS | 20°57'48"   | 53°47'31"    | 2014           |
| 8     | B        | B           | Três Lagoas        | 20°47'15"   | 51°59'12"    | 2015           |
| 9     | T        | T           | Costa Rica-MS      | 18°48'34"   | 52°58'19"    | 2017           |
| 10    | T        | T           | Costa Rica-MS      | 18°48'50"   | 52°51'41"    | 2017           |
| 11    | DO       | T           | Itajá-GO           | 18°56'13"   | 51°42'13"    | 2016           |
| 12    | B, T     | B           | Quirinópolis-GO    | 18°14'47"   | 50°41'09"    | 2015           |
| 13    | B        | B           | Cristianópolis-GO  | 17°12'28"   | 48°38'10"    | 2017           |
Fig. 2. Roadkills of *Priodontes maximus* in central-western Brazil. A to D are respectively the road kill registers 2 to 5 in the Table 1 and Fig. 1.

forest fragments (Anacleto et al. 2006), which show that political and management actions are urgently needed to effectively protect this giant xenarthran species of Cerrado hotspots.

The record in the Atlantic Forest fragment was a recent burrow (Fig. 1, Table 1) recorded in technical study regarding the viability of the implementation of a double track railroad in southern Mato Grosso do Sul. The last occurring fragments of the interior Atlantic Forest are under severe threat, being considered the most threatened phytosociognomy in this domain (Ribeiro et al. 2009). The forest fragment surveyed in this study borders 3.2 kilometers of a paved road, and the implementation of tunnels and a fence alongside the road was recommended to the road managers.

Camera traps have been shown to be an efficient and non-invasive tool to study important ecological aspects of *P. maximus*, such as activity patterns, density estimates, habitat use, home range, and interaction with other species (Silveira et al. 2009; Srbek-Araujo et al. 2009; Porfirio et al. 2012). The occurrence of *P. maximus* during the rapid ecological assessment in the RVSSF motivated the creation of that conservation unit (Ministério Público de Goiás 2015). The majority studies involving new records and the ecology of giant armadillo in the Pantanal (Porfirio et al. 2012; Desbiez & Kluyber 2013), Cerrado (Silveira et al. 2009; Martinelli et al. 2014) and Atlantic Forest (Srbek-Araujo et al. 2009) has been done in conservation units and protected areas, and have demonstrated the value of these places for giant armadillo conservation. In Emas National Park, biometry, home range, density, activity patterns, and habitat of *P. maximus* were extensively studied throughout a period of three years, which greatly contributed to the
published observations of its biology (Silveira et al. 2009), which until then, had been poorly understood. Similarly, we expect that other studies involving the giant armadillo may also take place during the management plan of other conservation units in Cerrado.

Although Chiarello et al. (2008) and Fischer et al. (2003) have cited that roadkill might be a threat for giant armadillo conservation, no roadkill record was made during a seven-year period (2001 to 2008) on over 3900 kilometers of roads that cover the Atlantic Forest and Cerrado of south-western Brazil (Cáceres et al. 2010). Only one carcass of an adult individual was found close to the border of the Reserva Biológica de Sooretama (RBS) in the state of Espírito Santo in 2009 along the federal highway BR-101 that crosses 5 kilometers of the reserve. However, that carcass had no sign of injuries, lacerations, or perforations (Srbe-k-Araujo et al. 2009), indicating that its death was more likely due to natural causes. Therefore, our roadkill data seems to be both new and relevant to the scientific community.

Recently, new traffic signs alerting about the presence of wild animals have been posted along Brazilian highways (DNIT 2010). However, drivers routinely ignore these signs and commute at high speeds, well above the recommended limits, causing fatalities of many vertebrates, including threatened mammals (Srbe-k-Araujo et al. 2009, 2015; Cáceres et al. 2010). Deaths of giant armadillo in Brazil due to roadkill are likely to be more common than previously thought. However, these records are scarce and not available in scientific literature. Despite its wide home range, Priodontes maximus naturally occurs in low densities, and in East and Central Brazil the populations are often disrupted (Anacleto et al. 2014; Carter et al. 2016). Consequently, the negative effects of the loss of specimens due to vehicle collisions represent a serious challenge for giant armadillo conservation.

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