

Herpetofauna of Parque Estadual Altamiro de Moura Pacheco: one of the last remnants of seasonal forest in the core region of the Brazilian Cerrado

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Abstract. Studies in remnants of semi-deciduous seasonal forest of the Cerrado are needed to fill sampling gaps and improve basic knowledge of biodiversity. This study presents data on the herpetofauna of Parque Estadual Altamiro de Moura Pacheco, one of the last protected areas of seasonal forest in the core region of the Brazilian Cerrado. Fourteen sites were sampled between March 2007 and April 2008 using pitfall traps and active searches. A total of 35 anuran species were recorded, most of which were found in hygrophilous environments near forest fragments, open areas and riparian or gallery forest. A total of 29 reptile species were recorded, most of which were found in semi-deciduous forest and riparian or gallery forest. Fourteen of the amphibians and five of the reptiles are endemic to the Cerrado. The richness of amphibians and reptiles found in Parque Estadual Altamiro de Moura Pacheco is regionally representative, with communities typical of forest environments.

Key-Words. Semi-deciduous forest; Protected area; Mato Grosso de Goiás; Amphibians; Reptiles.

INTRODUCTION

The Cerrado Biome comprises a mosaic of vegetation in the central region of the South America with dry open areas, forest remnants along streams and rivers, and dense woodlands (Ab'Sáber, 1983; Ribeiro & Walter, 2008). Accelerated destruction of natural landscapes in the Cerrado makes it one of the most threatened biomes of the world (Mittermeier *et al.*, 2004). Current estimates show that only 47% of the Cerrado is covered by its natural vegetation (Beuchle *et al.*, 2015). Since many natural areas have been converted into agriculture and pasture, the creation and maintenance of protected areas is the fastest and most efficient way to conserve species of fauna and flora of the Cerrado (Bensusan, 2006; França *et al.*, 2015). Recent studies indicate that between 5.5% and 6.5% of original Cerrado vegetation is maintained by protected areas (Mittermeier *et al.*, 2004;

Françoso *et al.*, 2015). However, the effectiveness and purposes of these units should be the subject of deeper analyses, since protection efficiency is likely dependent on the type, use restriction, governing agency, size and age of the protected area (Paiva *et al.*, 2015).

Landscapes composed of open and forested remnants create mosaics of heterogeneous habitats throughout the Cerrado (Silva *et al.*, 2006). As a consequence, the Cerrado supports a high level of biological diversity, including 209 amphibian species (Valdujo *et al.*, 2012) and 103 squamate reptiles (Nogueira *et al.*, 2011). A significant part of this biodiversity can be found in protected areas, which may hold high species richness, both at local and regional scales (Nogueira *et al.*, 2009; Morais *et al.*, 2012; Santoro & Brandão, 2014). These areas may be effective for long-term *in situ* conservation of biodiversity and the maintenance of species' genetic variability (Bensusan, 2006;

Luque *et al.*, 2012). Thus, knowledge of the species occurring in protected areas is essential for the development of conservation strategies.

Increases in the number of wildlife inventories has improved knowledge regarding amphibians and reptiles, resulting in the expansion of the area of occurrence (range) of many species and descriptions of new species (*e.g.*, Brasileiro & Haddad, 2015; Vaz-Silva *et al.*, 2015), thus facilitating studies of distribution patterns (*e.g.*, Vasconcelos *et al.*, 2014). However, there are still remains large sampling gaps, most notably in remnants of seasonal semi-deciduous forest in the central region of the Cerrado. This type of forest formation occurs on interfluvial and places rich in nutrients, where fallen leaves contribute to increased organic matter in the soil (Ribeiro & Walter, 2008). Due to their high productivity, these forested areas have been exploited for decades and now are restricted to a few small preserved patches (Moura & Bucci, 1981). Currently, between 20% and 60% of the semi-deciduous forest of the Cerrado has been converted into agriculture and pasture areas, and have suffered from wood extraction and other human impacts (Silva *et al.*, 2006). Given this scenario of degradation and loss of natural habitats, studies on biodiversity in semi-deciduous seasonal forest remnants are of extreme importance, both to fill sampling gaps and to improve basic knowledge regarding the conservation status of species. In this context, the present study pres-

ents data about the species richness and composition of the herpetofauna of Parque Estadual Altamiro de Moura Pacheco, one of the last protected areas composed of remnants of semi-deciduous seasonal forest in the core region of the Brazilian Cerrado.

MATERIAL AND METHODS

Study area

Parque Estadual Altamiro de Moura Pacheco (PEAMP) is a protected area created to preserve one of the last remnants of seasonal and dry forest in the state of Goiás, Brazil (Fig. 1). The total area of PEAMP is about 32.46 km², and the predominant vegetation is seasonal semi-deciduous forest, which covers approximately 75.54% of its extension (Campos & Batista, 2010). This forest vegetation is characterized by an arboreal strata with an average height of between 15 and 25 m and canopy cover ranging from 70 to 95% in the rainy season and 50% or less in the dry season (Ribeiro & Walter, 2008). The vegetation of PEAMP also possesses gallery forests and small patches of woody savannah (Cerrado *sensu strictu*) and forest-like savannah (*Cerradão*). It is surrounded by landscapes modified for agricultural activities and urban centers. The main watercourse is the João Leite River, a tributary

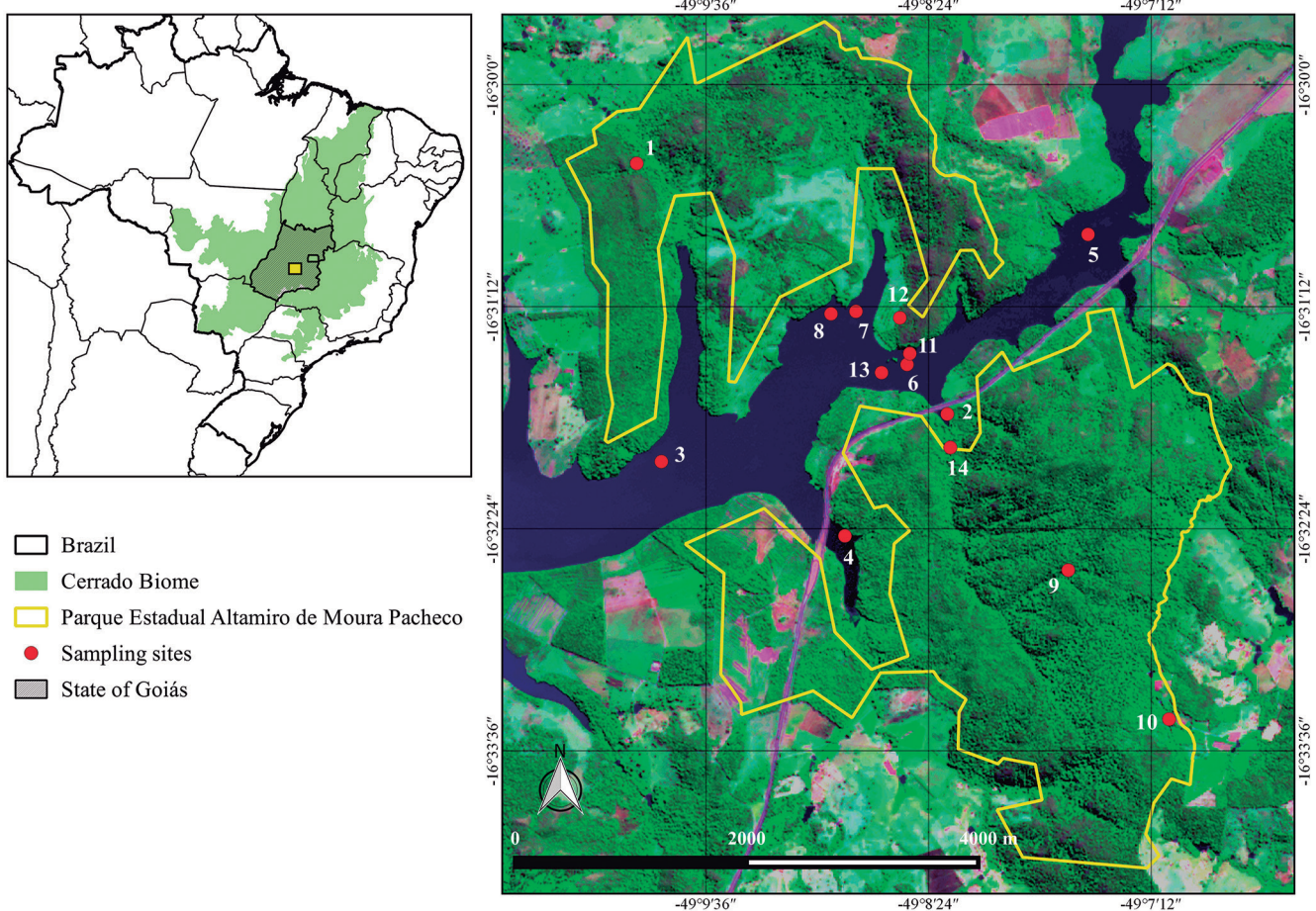


Figure 1. Geographic location of Parque Estadual Altamiro de Moura Pacheco in the state of Goiás, central Brazil. Sampling sites 2-8, 11 and 13 are currently flooded by the João Leite Reservoir.

Table 1. Sampled sites in Parque Estadual Altamiro de Moura Pacheco, Goiás, Brazil, with sampling methods used, geographic coordinates and type of environments sampled.

Site	Method	Geographical coordinates		Environments
S1	Active search, pitfall	16°30'27.18"S	49°09'59.86"W	Gallery forest
S2	Active search, pitfall	16°31'46.54"S	49°08'20.38"W	Hygrophilous near to forest; disturbed areas
S3	Active search, pitfall	16°32'03.88"S	49°09'51.88"W	Seasonal semi-deciduous forest
S4	Active search	16°32'24.15"S	49°08'55.71"W	Hygrophilous near to forest; disturbed areas
S5	Active search	16°30'50.21"S	49°07'33.83"W	Hygrophilous in open areas; palm grove marsh; disturbed areas
S6	Active search, pitfall	16°31'32.40"S	49°08'32.39"W	Riparian forest
S7	Active search, pitfall	16°31'15.17"S	49°08'48.92"W	Seasonal semi-deciduous forest
S8	Active search, pitfall	16°31'15.95"S	49°08'56.98"W	Gallery forest
S9	Active search	16°32'39.08"S	49°07'40.23"W	Seasonal semi-deciduous forest; gallery forest
S10	Active search	16°33'27.41"S	49°07'07.61"W	Hygrophilous in open areas; disturbed areas
S11	Active search, pitfall	16°31'28.85"S	49°08'31.51"W	Riparian forest
S12	Active search, pitfall	16°31'17.25"S	49°08'34.70"W	Seasonal semi-deciduous forest
S13	Active search	16°31'35.04"S	49°08'40.64"W	Seasonal semi-deciduous forest
S14	Active search	16°31'57.01"S	49°08'18.84"W	Hygrophilous near to forest; seasonal semi-deciduous forest

of the Meia Ponte River and one of the main tributaries of the Paranaíba basin. During field sampling (2007 and 2008), the PEAMP had dams and flooded zones covering approximately 0.03% of its area (Campos & Batista, 2010). This percentage is currently much higher since part of the vegetation was removed for the insertion of the João Leite Reservoir (between 2009 and 2010), which was constructed to supply water to the municipality of Goiânia (Fig. 1).

The phytophysiognomies sampled in PEAMP were classified as: DA = disturbed areas; HF = hygrophilous environments next to forest fragments; HO = hygrophilous environments in open areas; RF = riparian or gallery forest; SF = seasonal semi-deciduous forest; and VE = palm grove marsh (*vereda*) (Table 1). The climate of the region is characterized tropical (Aw of Köppen), with two well-defined seasons, one rainy and one dry (Peel *et al.*, 2007). The average monthly temperature is 24.77°C, with the highest temperatures in September (26.90°C) and the lowest in June (22.79°C). The average monthly relative humidity is 59.61%, with highest humidity in December (72.72%) and the lowest in August (37.67%). The average monthly rainfall is 137.80 mm, with the greatest rainfall in December (319.68 mm) and the least in August (2.34 mm) (averages obtained for 2007 to 2016; Brasil, 2018).

Data collection

Fieldwork was conducted between March 2007 and April 2008 during six field trips (March, May, July and October 2007; January and April 2008), each lasting ten days for a total of 60 sampling days. We use a combination of two field sampling methods: pitfall trap arrays with drift fences (see Ribeiro-Júnior *et al.*, 2011) and visual and auditory searches (Heyer *et al.*, 1994). Eight sites were selected to set up the pitfall trap arrays (Table 1), with each site containing a single array of four 20-liter buckets buried in the soil in a "Y"-shaped arrangement and interconnected by a 5-meter long, 50-cm high bar-

rier. The total sampling effort with this method was approximately 46,080 bucket hours. We conducted active searches along 14 transects of ~1,000 meters in length (Table 1), during morning (09:00h-12:00h), afternoon (15:00h-18:00h) and night (19:00h-22:00h). Each transect was sampled for approximately one hour by two or three researchers. The total effort resulting from active searches was approximately 504 person hours.

Voucher specimens were collected, anesthetized with 5% lidocaine, fixed in 10% formalin and preserved in 70% alcohol. The compilations available in Frost (2018) and Costa & Bérnils (2018) were followed for nomenclature for anurans and reptiles, respectively. Voucher specimens were deposited in Coleção Zoológica da Universidade Federal de Goiás (ZUFG) and Coleção de Herpetologia do Centro de Estudos e Pesquisas Biológicas of the Pontifícia Universidade Católica de Goiás (CEPB), Goiânia, Goiás, Brazil (collection permit #015/2007, process #5601.01383/2007-4). Species of amphibians and reptiles collected on other occasions by other researchers and placed in the collections of CEPB and ZUFG were also considered in the compilation of the species lists (Appendix 1).

Species distribution patterns and the degree of association with the Cerrado were obtained from information available in Valdujo *et al.* (2012) for amphibians and Nogueira *et al.* (2011) for reptiles. Species with occurrences in more than two biomes were considered widely distributed. The conservation status of the species was based on the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN, 2017).

RESULTS

Amphibians

We recorded 35 anuran species distributed among seven families (Table 2; Figs. 2-4). The richest families were Hylidae and Leptodactylidae, both with 13 species, followed by Microhylidae (three species),

Table 2. List of amphibian species recorded in Parque Estadual Altamiro de Moura Pacheco, Goiás, Brazil, and their occurrence, sampling method, and distribution pattern in the Cerrado Biome. Threat Status (TS): NA = Not Evaluated, LC = Least Concern. Distribution (DS): END = Endemic, W = Widely distributed, CE = Cerrado, AF = Atlantic Forest. Habitat: DA = Disturbed areas, HF = Hygrophilous environments next to forest fragments, HO = Hygrophilous environments in open areas, RF = riparian or gallery forest, SF = Seasonal semi-deciduous forest, and VE = palm grove marsh (*vereda*). Method: AS = Active search, PT = Pitfall trap.

Family/Species	TS	DS	Habitat	Method
Anura				
Bufonidae				
<i>Rhinella sebbei</i> Vaz-Silva, Maciel, Bastos, & Pombal, 2015	NA	END	SF	AS/PT
<i>Rhinella diptycha</i> (Cope, 1862)	LC	W	HO, HF, SF, VE	AS/PT
Craugastoridae				
<i>Barycholos ternetzi</i> (Miranda-Ribeiro, 1937)	LC	END	SF, RF	AS/PT
Odontophrynidae				
<i>Proceratophrys goyana</i> (Miranda-Ribeiro, 1937)	LC	END	SF, RF	AS/PT
<i>Odontophrynus cultripes</i> Reinhardt & Lütken, 1862	LC	END	SF, RF	AS/PT
Hylidae				
<i>Boana albopunctata</i> (Spix, 1824)	LC	W	DA, HF, HO, VE	AS
<i>Boana lundii</i> (Burmeister, 1856)	LC	END	HF, RF, VE	AS
<i>Boana paranaiba</i> (Carvalho, Giaretta, & Fature, 2010)	LC	END	HF	AS
<i>Boana raniceps</i> (Cope, 1862)	LC	W	HF, HO, RF, VE	AS
<i>Dendropsophus cruzi</i> (Pombal & Bastos, 1998)	LC	END	HF, HO, RF	AS
<i>Dendropsophus minutus</i> (Peters, 1872)	LC	W	HF, HO, VE	AS
<i>Dendropsophus nanus</i> (Boulenger, 1889)	LC	W	DA, HF, HO	AS
<i>Dendropsophus rubicundulus</i> (Reinhardt & Lütken, 1862 "1861")	LC	CE, AF	HF, HO	AS
<i>Pseudis bolbodactyla</i> Lutz, 1925	LC	CE, AF	HF, HO, VE	AS
<i>Scinax constrictus</i> Lima, Bastos, & Giaretta, 2005	LC	END	HF, HO	AS
<i>Scinax fuscomarginatus</i> (Lutz, 1925)	LC	W	HF, HO	AS
<i>Scinax</i> aff. <i>fuscovarius</i>	—	—	DA, HF, HO	AS
<i>Trachycephalus typhonius</i> (Linnaeus, 1758)	LC	W	DA, HF, SF	AS
Phyllomedusidae				
<i>Pithecopus hypochondrialis</i> (Daudin, 1800)	LC	END	HO, HF, VE	AS
Leptodactylidae				
<i>Adenomera</i> aff. <i>hylaedactyla</i>	—	—	RF, SF, DA	AS
<i>Leptodactylus fuscus</i> (Schneider, 1799)	LC	W	HO, HF, DA	AS
<i>Leptodactylus labyrinthicus</i> (Spix, 1824)	LC	W	DA, HF, HO, SF, RF	AS
<i>Leptodactylus latrans</i> (Steffen, 1815)	LC	W	DA, HF, HO, RF	AS
<i>Leptodactylus mystaceus</i> (Spix, 1824)	LC	W	RF, VE	AS
<i>Leptodactylus mystacinus</i> (Burmeister, 1861)	LC	CE, AF	HO, SF, RF	AS/PT
<i>Leptodactylus podicipinus</i> (Cope, 1862)	LC	W	HF, HO, SF, RF, VE	AS/PT
<i>Leptodactylus</i> gr. <i>melanonotus</i>	—	—	HF, HO	AS
<i>Physalaemus atim</i> Brasileiro & Haddad, 2015	NA	END	HF	AS/PT
<i>Physalaemus centralis</i> Bokermann, 1962	LC	END	HO, HF	AS/PT
<i>Physalaemus cuvieri</i> Fitzinger, 1826	LC	W	DA, HF, HO, SF, RF	AS/PT
<i>Physalaemus nattereri</i> (Steindachner, 1863)	LC	END	HO, HF	AS
<i>Pseudopaludicola facureae</i> Andrade & Carvalho, 2013	NA	END	HO	AS
Microhylidae				
<i>Chiasmocleis albopunctata</i> (Boettger, 1885)	LC	END	SF, RF	AS/PT
<i>Elachistocleis cesarii</i> (Miranda-Ribeiro, 1920)	LC	CE, AF	HF, HO	AS
<i>Dermatonotus muelleri</i> (Boettger, 1885)	LC	W	HF, HO	PT

Bufonidae and Odontophrynidae (two species each), and Craugastoridae and Phyllomedusidae (one species each). Most species were recorded during active searches (34 species), with 23 being exclusively encountered by this method. Twelve species were recorded using pitfall traps, with *Dermatonotus muelleri* being exclusively sampled by this method (Table 2).

The majority of amphibian species were recorded in hygrophilous environments near forest fragments (26 species), open areas (24 species) and riparian or gallery forests (14 species). Twelve species were recorded in seasonal semi-deciduous forest, and nine in disturbed areas

and palm grove marsh. Fourteen species are endemic to the Cerrado and four occur in Cerrado and Atlantic Forest, while the remaining 14 species are widely distributed. None of the species are considered at any level of threat with most being classified as Least Concern, while three have yet to be evaluated (Table 2).

Reptiles

We recorded 29 reptile species distributed among 13 families of two orders (Table 3; Figs. 5 and 6). For

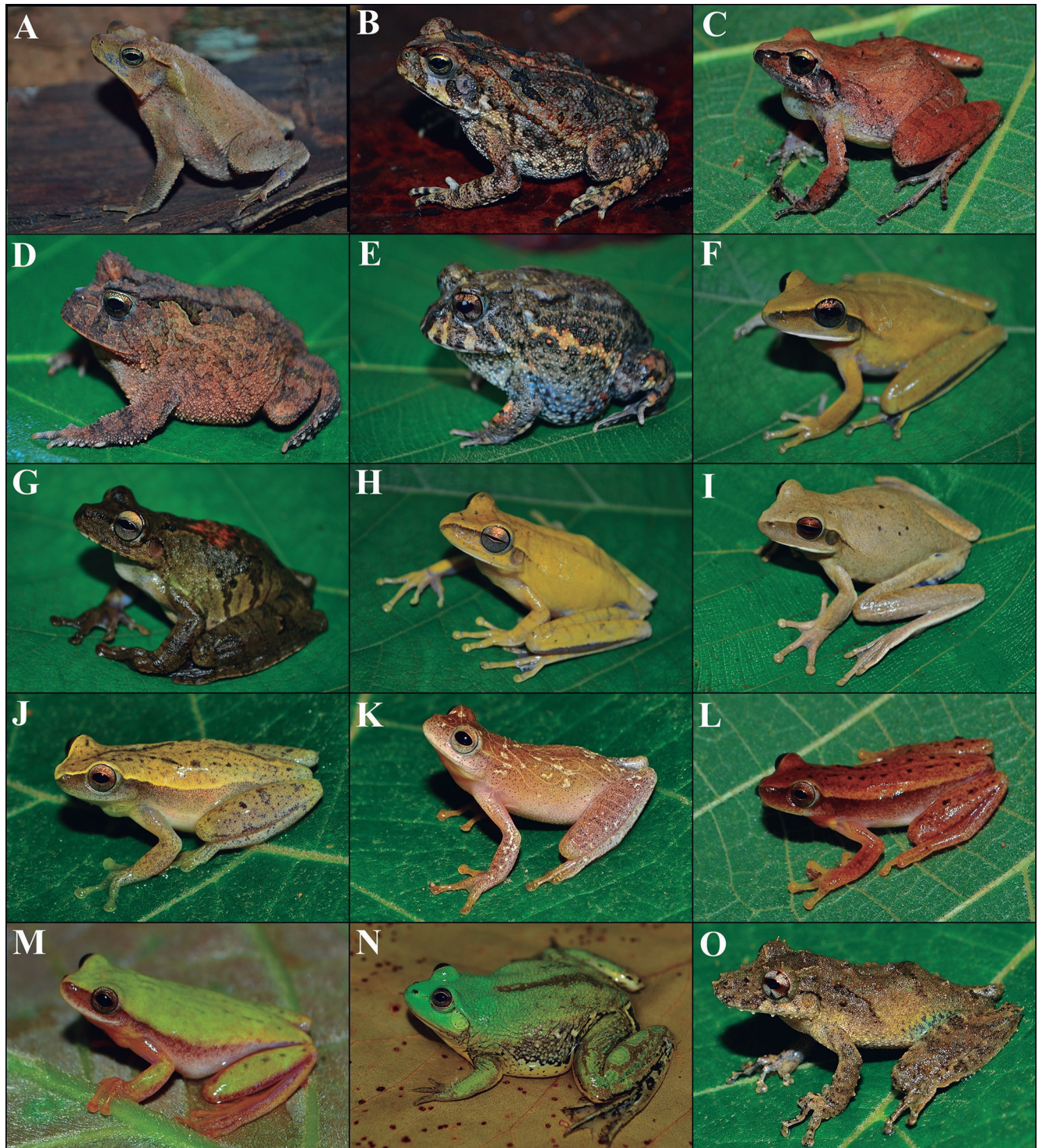


Figure 2. Species of anurans recorded in Parque Estadual Altamiro de Moura Pacheco, state of Goiás, central Brazil: (A) *Rhinella sebbeni*, (B) *Rhinella diptycha*, (C) *Barycholos ternetzi*, (D) *Proceratophrys goyana*, (E) *Odontophrynus cultripes*, (F) *Boana albopunctata*, (G) *Boana lundii*, (H) *Boana paranaíba*, (I) *Boana raniceps*, (J) *Dendropsophus cruzi*, (K) *Dendropsophus minutus*, (L) *Dendropsophus nanus*, (M) *Dendropsophus rubicundulus*, (N) *Pseudis bolbodactyla*, (O) *Scinax constrictus*.

Squamata, the richest families were Dipsadidae (10 species) and Boidae (three species); five other families (Mabuyidae, Tropicuridae, Teiidae, Amphisbaenidae and Viperidae) were represented by two species, and four families (Gekkonidae, Dactyloidae, Anguidae and Colubridae) by one species. Testudines were represented by one species of Chelidae and one of Testudinidae (Table 3). Most reptile species were recorded during active searches (27 species), with 22 being exclusively en-

countered by this method. We recorded five species using pitfall traps, with no species being exclusively found by this method. The species *Amphisbaena anaemariae* and *Atractus albuquerquei* were included from secondary data (specimens housed in scientific collection – CEPB) (Table 3).

The majority of species were recorded in seasonal semi-deciduous forest (20 species) and riparian or gallery forests (16 species). Thirteen species were recorded in



Figure 3. Species of anurans recorded in Parque Estadual Altamiro de Moura Pacheco, state of Goiás, central Brazil: (A) *Scinax fuscomarginatus*, (B) *Scinax* aff. *fuscovarius*, (C) *Trachycephalus typhonius*, (D) *Pithecopus hypochondrialis*, (E) *Adenomera* aff. *hylaedactyla*, (F) *Leptodactylus fuscus*, (G) *Leptodactylus labyrinthicus*, (H) *Leptodactylus latrans*, (I) *Leptodactylus mystaceus*, (J) *Leptodactylus mystacinus*, (K) *Leptodactylus podicipinus*, (L) *Leptodactylus* gr. *melanonotus*, (M) *Physalaemus atim*, (N) *Physalaemus centralis*, (O) *Physalaemus cuvieri*.

disturbed areas and five in hygrophilous environments. Most reptile species (23 species) are widely distributed among the Brazilian biomes, while five are endemic to the Cerrado, one occurring in Cerrado and Atlantic Forest and one occurring in Cerrado and Amazon Rainforest. None of the species are considered at any level of threat; however, the majority has yet to have their conservation status evaluated (Table 3).

DISCUSSION

Amphibians

The species richness of amphibians found in PEAMP was similar to that of other localities with a predominance of open vegetation (Kopp *et al.*, 2010; Ramalho *et al.*, 2014; Santoro & Brandão, 2014) and Cerrado forests

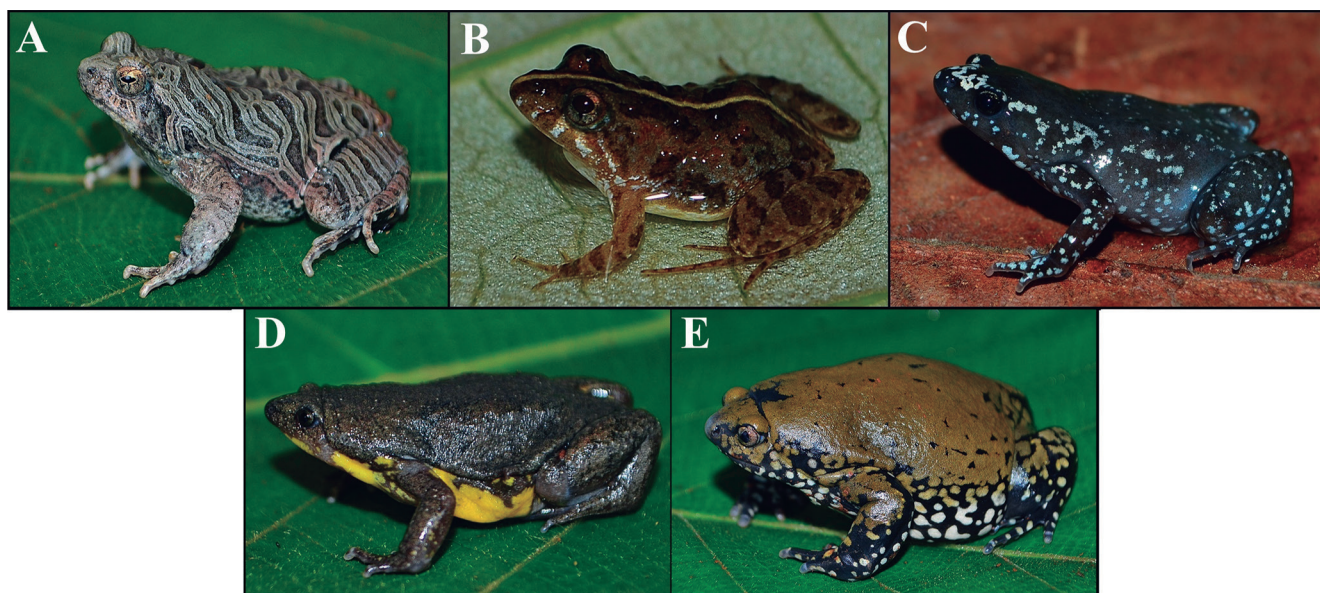


Figure 4. Species of anurans recorded in Parque Estadual Altamiro de Moura Pacheco, state of Goiás, central Brazil: (A) *Physalaemus nattereri*, (B) *Pseudopaludicola facureae*, (C) *Chiasmocleis albopunctata*, (D) *Elachistocleis cesarii*, (E) *Dermatoneotus muelleri*.

(Morais *et al.*, 2012; Melo *et al.*, 2013). This high richness testifies to the importance of the area for species preservation, especially since it is located close to regions of intense urban development.

The predominance of species from the families Hylidae and Leptodactylidae is a common pattern in the Neotropical Region (Duellman, 1999; Wiens *et al.*, 2011), including studies performed close to PEAMP (Campos & Vaz-Silva, 2010; Morais *et al.*, 2012; Santos *et al.*, 2014), thus indicating that the sampling methods allowed the recording of species with different ecological requirements (Lynch, 2005). The active search method was more effective than pitfall traps for anuran sampling. However, complementary sampling methods need to be considered since some fossorial species and/or species with explosive breeding (*e.g.*, *D. muelleri*) are more difficult to find using observational sampling methods.

Although we recorded many species that are considered habitat generalists (*e.g.*, *Boana albopunctata*, *B. raniceps*, *Leptodactylus labyrinthicus*, *L. podicipinus* and *Physalaemus cuvieri*), none of them occurred in all of the sampled environments. The majority of anurans were found in hygrophilous environments, where *Boana paranaíba* and *Physalaemus atim* were found exclusively next to forest fragments, while *Pseudopaludicola facureae* is typical of open areas. Seasonal semi-deciduous, riparian and gallery forests also possessed several exclusive species, such as *Rhinella sebbeni*, *Barycholos ternetzi*, *Proceratophrys goyana*, *Odontophrynus cultripes*, *Leptodactylus mystaceus* and *Chiasmocleis albopunctata*. Other species seem to depend on waterbodies with forest cover, such as *Boana lundii*, *B. paranaíba* and *P. atim*. The differing preferences among some species for open or forest environments indicates spatial segregation (Gambale *et al.*, 2014; Santos *et al.*, 2014; Dória *et al.*, 2015).

A significant part of the anuran richness found (40%) is endemic to the Cerrado Biome, where some were re-

corded exclusively in forest environments (*e.g.*, *R. sebbeni*, *B. ternetzi*, *P. goyana*, *O. cultripes*, *C. albopunctata*). Among these, *P. atim* and *R. sebbeni* were recently described (Brasileiro & Haddad, 2015; Vaz-Silva *et al.*, 2015), and thus information about their natural history and geographic distribution are lacking, making the assessment of their true conservation status difficult (Morais *et al.*, 2018). Research efforts should be directed towards filling the knowledge gaps for these species, including information about their ecology, natural history and distribution (Guerra *et al.*, 2018). Non-evaluated species represent taxonomic uncertainty (*Scinax* aff. *fuscovarius*, *Adenomera* aff. *hylaedactyla* and *Leptodactylus* gr. *melanotus*) or are still under evaluation because they have recently been described (*e.g.*, *P. facureae*). Nonetheless, none of the species are included threat categories.

Reptiles

The reptile richness found in PEAMP was similar to that of other localities with a predominance of forest environments in the core region of the biome (Morais *et al.*, 2012; Oda *et al.*, 2017); however, it can still be considered low when compared to regions with open vegetation types (Recoder & Nogueira, 2007; Valdujo *et al.*, 2009; Recoder *et al.*, 2011). Therefore, although the richness of reptiles is within that expected for Cerrado areas, which varies from 15 to 70 species (Costa *et al.*, 2007), the finding confirms a pattern of greater richness in open environments in the biome (Nogueira *et al.*, 2005, 2009).

The predominance of species from the family Dipsadidae is a common pattern often for the Neotropical Region (Cadle & Greene, 1993; Costa & Bérnils, 2018). This family includes snakes from different ecological groups (Vidal *et al.*, 2010), and is the richest snake family in the Neotropical Region (Uetz *et al.*, 2018). Other squamate families were represented by few species, cor-

Table 3. List of reptile species recorded in Parque Estadual Altamiro de Moura Pacheco, Goiás, Brazil, and their occurrence, sampling method, and distribution pattern in the Cerrado Biome. Threat status (TS): NA = Not Evaluated, LC = Least Concern. Distribution (DS): END = Endemic, W = Widely distributed, CE = Cerrado, AF = Atlantic Forest. Habitat: DA = Disturbed areas, HF = Hygrophilous environments next to forest fragments, HO = Hygrophilous environments in open areas, RF = riparian or gallery forest, and SF = Seasonal semi-deciduous forest. Method: AS = Active search, SC = Scientific collection, PT = Pitfall trap.

Family/Species	TS	DS	Habitat	Method
Testudines				
Testudinidae				
<i>Chelonoidis carbonarius</i> (Spix, 1824)	NA	W	SF, RF	AS
Chelidae				
<i>Phrynops geoffroanus</i> (Schweigger, 1812)	NA	W	DA, HF, RF	AS
Squamata				
Sauria				
Gekkonidae				
<i>Hemidactylus mabouia</i> (Moreau De Jonnés, 1818)	NA	W	DA, SF	AS
Mabuyidae				
<i>Copeoglossum nigropunctatum</i> (Spix, 1825)	NA	W	SF, DA, RF	AS/PT
<i>Notomabuya frenata</i> (Cope, 1862)	NA	W	SF, RF	AS
Dactyloidae				
<i>Norops brasiliensis</i> (Vanzolini & Williams, 1970)	NA	END	SF	AS
Tropiduridae				
<i>Tropidurus oreadicus</i> Rodrigues, 1987	NA	CE, AM	SF, DA, RF	AS
<i>Tropidurus torquatus</i> (Wied-Neuwied, 1820)	LC	CE, AF	SF, DA	AS/PT
Anguidae				
<i>Ophiodes</i> aff. <i>striatus</i>	—	—	RF	AS
Teiidae				
<i>Ameiva ameiva ameiva</i> (Linnaeus, 1758)	NA	W	SF, DA, RF	AS/PT
<i>Salvator merianae</i> Duméril & Bibron, 1839	LC	W	SF, DA, HO, RF	AS/PT
Amphisbaenia				
Amphisbaenidae				
<i>Amphisbaena alba</i> Linnaeus, 1758	LC	W	DA	AS
<i>Amphisbaena anaemariae</i> Vanzolini, 1997	NA	END	—	SC
Serpentes				
Boidae				
<i>Boa constrictor amarali</i> (Stull, 1932)	NA	W	DA, SF, RF	AS
<i>Epicrates crassus</i> Cope, 1862	NA	END	SF, RF	AS
<i>Eunectes murinus</i> (Linnaeus, 1758)	NA	W	RF	AS
Colubridae				
<i>Spilotes pullatus pullatus</i> (Linnaeus, 1758)	NA	W	SF, RF	AS
Dipsadidae				
<i>Apostolepis albicollaris</i> Lema, 2002	NA	END	SF	AS
<i>Atractus albuquerquei</i> Cunha & Nascimento, 1983	LC	W	—	SC
<i>Erythrolamprus reginae macrosoma</i> (Amaral, 1935)	NA	W	HF, SF, RF	AS
<i>Hydrodynastes gigas</i> (Duméril, Bibron & Duméril, 1854)	NA	W	RF	AS
<i>Oxyrhopus petolaris digitalis</i> (Reuss, 1834)	NA	W	SF, RF	AS
<i>Oxyrhopus guibei</i> Hoge & Romano, 1978	NA	W	SF	AS
<i>Philodryas olfersii</i> (Lichtenstein, 1823)	NA	W	SF	AS
<i>Sibynomorphus mikanii mikanii</i> (Schlegel, 1837)	NA	W	DA	AS
<i>Taeniophallus occipitalis</i> (Jan, 1863)	NA	W	DA	AS
<i>Xenodon merremii</i> (Wagler, 1824)	NA	W	SF	AS
Viperidae				
<i>Bothrops moojeni</i> Hoge, 1966	NA	END	DA, HO, HF, SF, RF	AS/PT
<i>Crotalus durissus collilineatus</i> Amaral, 1926	LC	W	SF, DA	AS

roborating what has been found in other Cerrado areas (França & Braz, 2013; Oda et al., 2017; Rios et al., 2017). Interestingly, families composed of species common in open phytophysiognomies of the Cerrado, such as those of Gymnophthalmidae, as well as some other lizard (e.g., *Ameivula ocellifera*) and snake (e.g., *Bothrops pauloensis*) species typical of open environments, were not found. The absence or rarity of these species seems to differen-

tiate the structure of the reptile community of PEAMP from other nearby localities with a predominance of open environments.

The majority of reptile species was associated with forest environments and many were found exclusively in these environments, including chelonians (e.g., *Chelonoidis carbonarius*), lizards (e.g., *Notomabuya frenata*, *Ophiodes* aff. *striatus*) and snakes (e.g., *Epicrates cras-*



Figure 5. Species of reptiles recorded in Parque Estadual Altamiro de Moura Pacheco, state of Goiás, central Brazil: (A) *Chelonoidis carbonarius*, (B) *Phrynops geoffroanus*, (C) *Hemidactylus mabouia*, (D) *Copeoglossum nigropunctatum*, (E) *Notomabuya frenata*, (F) *Norops brasiliensis*, (G) *Tropidurus oreadicus*, (H) *Tropidurus torquatus*, (I) *Ophiodes* aff. *striatus*, (J) *Ameiva ameiva ameiva*, (K) *Salvator merianae*, (L) *Amphisbaena alba*, (M) *Amphisbaena anaemariae*, (N) *Boa constrictor amarali*, (O) *Epicrates crassus*.

sus, *Apostolepis albicollaris*, *Oxyrhopus petolarius digitalis*). The snake *Erythrolamprus reginae macrosoma* was also always associated to sites with waterbodies. By contrast, open environments had lower richness and few exclusive species, such as *Amphisbaena alba*, *Sibynomorphus mikanii mikanii* and *Taeniophallus occipitalis*. This pattern of segregated distribution is well known for the Cerrado biome (Nogueira et al., 2009), and demonstrates the lim-

itations that open and forest environments represent for the distributions of reptiles.

Most reptile species recorded (72%) have wide distributions among Brazilian biomes, while one lizard (*Norops brasiliensis*), three snakes (*E. crassus*, *A. albicollaris* and *Bothrops moojeni*) and one amphisbaenid (*A. anaemariae*) are endemic to the Cerrado. Despite being classified as a Cerrado endemic (Nogueira et al.,



Figure 6. Species of reptiles recorded in Parque Estadual Altamiro de Moura Pacheco, state of Goiás, central Brazil: (A) *Eunectes murinus*, (B) *Spilotes pullatus pullatus*, (C) *Apostolepis albicollares*, (D) *Atractus albuquerquei*, (E) *Erythrolamprus reginae macrosoma*, (F) *Hydrodynastes gigas*, (G) *Oxyrhopus petolarius digitalis*, (H) *Oxyrhopus guibeii*, (I) *Philodryas olfersii*, (J) *Sibynomorphus mikanii mikanii*, (K) *Taeniophallus occipitalis*, (L) *Xenodon merremii*, (M) *Bothrops moojeni*, (N) *Crotalus durissus collilineatus* (Photo "F" by D. Lopes).

2011), the snake *A. albuquerquei* should be considered as having wide distribution due to recent records in the Amazon (França *et al.*, 2017). The number of endemic squamate reptiles recorded for PEAMP can be consid-

ered low relative to the high levels expected in regions of open high plateaus (Nogueira *et al.*, 2011). None of the reptile species recorded are considered at any level of threat.

As one of the last protected areas of seasonal semi-deciduous forest of the Cerrado, PEAMP is very important for biodiversity conservation. The anuran and reptile richness found is regionally representative, with communities typical of forest environments. The communities are composed by endemic species that are mainly adapted to forest areas, habitat-specific and with restricted distributions, and thus are in need of more research efforts to obtain information on geographic distribution, ecology and natural history. Furthermore, since approximately 50% of the points sampled during the present study were flooded during the filling of the João Leite reservoir, the data presented here will be valuable to any future research that assesses the impact of the insertion of the reservoir on the local herpetofauna.

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APPENDIX 1

Vouchers specimens were deposited in the Coleção Zoológica da Universidade Federal de Goiás (ZUFG) and Centro de Estudos e Pesquisas Biológicas (CEPB) of the Pontifícia Universidade Católica de Goiás. Amphibians: *Adenomera aff hylae-dactyla*: ZUFG-11098; *Barycholos ternetzi*: ZUFG-2186; ZUFG-3187; ZUFG-3199. *Boana albopunctata*: ZUFG-4027. *Boana paranaíba*: ZUFG-3252. *Chiasmocleis albopunctata*: ZUFG-3192; ZUFG-3193; ZUFG-3194; ZUFG-3195. *Dermatonotus muelleri*: ZUFG-11103. *Elachistocleis cesarii*: ZUFG-11102. *Leptodactylus mystaceus*: ZUFG-3196; ZUFG-3202. *Leptodactylus mystacinus*: ZUFG-3200; ZUFG-3201. *Odontophrynus cultripes*: ZUFG-3198. *Physalaemus atim*: ZUFG-11099. *Physalaemus centralis*: ZUFG-3197. *Physalaemus cuvieri*: ZUFG-3249; ZUFG-3250; ZUFG-3251. *Physalaemus nattereri*: ZUFG-11100. *Pithecopus hypochondrialis*: ZUFG-3205. *Proceratophrys goyana*: ZUFG-3204. *Pseudopaludicola facureae*: ZUFG-11101. *Rhinella seb-beni*: ZUFG-3190; 3191; ZUFG-3203; ZUFG-3246. *Scinax constrictus*: ZUFG-3243; ZUFG-3244; ZUFG-3245; ZUFG-3247; ZUFG-3248. Reptiles: *Ameiva ameiva ameiva*: ZUFG-1258. *Amphisbaena anaemariae*: CEPB-1838. *Atractus alburquerquei*: CEPB-8793. *Bothrops moojenii*: ZUFG-1247. *Copeoglossum nigropunctatum*: ZUFG-1255. *Norops brasiliensis*: ZUFG-1256. *Notomabuya frenata*: ZUFG-1245. *Oxyrhopus trigeminus*: ZUFG-1241. *Oxyrhopus guibei*: ZUFG-1260. *Oxyrhopus petolar-ius digitalis*: ZUFG-1246. *Philodryas olfersii*: ZUFG-1261. *Salvator merianae*: ZUFG-1259. *Sibynomorphus mikanii mikanii*: ZUFG-1244. *Tropidurus torquatus*: ZUFG-1257.