

LIZARDS AND AMPHISBAENIANS OF CATAGUASES, MINAS GERAIS, SOUTHEASTERN BRAZIL

Jhonny José Magalhães Guedes^{1}, Clodoaldo Lopes de Assis¹, Renato Neves Feio¹ & Henrique C. Costa²*

¹Universidade Federal de Viçosa (UFV), Departamento de Biologia Animal, Museu de Zoologia João Moojen. Viçosa, MG, Brasil. CEP: 36570-900

²Universidade Federal de Minas Gerais (UFMG), Programa de Pós-Graduação em Zoologia. Belo Horizonte, MG, Brasil. CEP: 31270-901
E-mails: jhonnyguds@gmail.com, clodoassis@yahoo.com.br, rfeio@ufv.br, ccostah@gmail.com

ABSTRACT

The ‘Zona da Mata’ of Minas Gerais, southeastern Brazil, has less than 10% of remaining native vegetation and is home of a rich herpetofauna, still poorly surveyed. We present the results of an assessment of lizard and amphisbaenian species at Atlantic Forest fragments in the municipality of Cataguases, state of Minas Gerais, from 2009 to 2013. We used pitfall traps, occasional encounters, and local collectors, besides a literature review of records from Cataguases and neighboring cities. A total of 15 species in 12 families were found, three of them endemic to the Atlantic Forest (*Eckleopus gaudichaudi*, *Enyalius boulengeri*, and *Gymnodactylus darwini*). We also present a dichotomous key for identification of lizards and amphisbaenians of Cataguases.

Keywords: Atlantic Forest; inventory; reptiles; Squamata; Zona da Mata.

INTRODUCTION

Today, about 6,100 lizards and 200 amphisbaenian species are known worldwide, comprising 60% of all extant reptiles (Uetz & Hosek 2016). In Brazil, about 340 species of lizards and amphisbaenians have been described so far (Costa & Bérnils 2015). Most Brazilian species of lizards and amphisbaenians occur in Amazonia (Rodrigues 2005), but the Atlantic Forest stands out as a biodiversity hotspot (Mittermeier *et al.* 2005), with 30% of endemism among its reptilian species (Mittermeier *et al.* 2011). The Atlantic Forest has suffered intense reduction of its original area since Europeans arrived at the Brazilian coast in the 16th century, and is now reduced to 12% of its original cover (Ribeiro *et al.* 2011), of which only 1.6% are protected (Ribeiro *et al.* 2009).

The ‘Zona da Mata/Viçosa’, in southeastern Brazil, is one of the 55 subdivisions of the Atlantic Forest, and is characterized by the presence of semideciduous forests, mean elevation of 530 m, and only 9.9% of remaining forest cover (Ribeiro *et al.* 2011). The region was intensively explored for timber, charcoal production and agricultural activities – mainly coffee farms – in the past

(Cardoso *et al.* 2001), and eucalyptus plantations nowadays (JJMG pers. obs.).

Herpetological assessments are recent in the ‘Zona da Mata’ (e.g., Costa *et al.* 2009, 2010, Moura *et al.* 2012, Sousa *et al.* 2012), and have revealed high species richness and even new taxa (e.g., Lacerda *et al.* 2012, Santana *et al.* 2012, Assis *et al.* 2013, Costa *et al.* 2016, Guimarães *et al.* 2017). Besides increasing the knowledge of biodiversity, inventories are fundamental for conservation plans (Haddad 1998) and provide a set of valuable information for ecology (Droege *et al.* 1998) and macroecology (Moura *et al.* 2016). In this sense, we present a checklist and an identification key of lizards and amphisbaenians of Cataguases, Atlantic Forest of eastern Minas Gerais, Brazil, after a five-year assessment.

MATERIAL AND METHODS

Study site

The municipality of Cataguases (21°22’31” S, 42°41’08” W, WGS84) is located in the ‘Zona da Mata’ region, eastern Minas Gerais, southeastern Brazil. It has a total area of 491.7 km², with

elevations from 170 to 1,200 meters. The area is drained by the Pomba river sub-basin, part of the Paraíba do Sul river basin (Figure 1). Climate is tropical wet and dry, classified as type Aw in Köppen's system, with mean annual temperature varying between 22 and 24°C, mean annual precipitation around 1,300 and 1,600 mm (Alvares *et al.* 2014), with a rainy season from October to April and a dry season from May to September (Sá Júnior *et al.* 2012). The region is part of the Atlantic Forest biome (*sensu* IBGE 2004), and originally covered by montane and submontane seasonal semideciduous forests (Veloso *et al.* 1991). Currently, the municipality has 9% of forest remnants (SOS Mata Atlântica & INPE 2016), most of which located in hilltops, while lowlands were mostly converted into pastures.

Data collection

We collected data from 2009 to 2013, using three different methods for species record: pitfall traps, occasional encounters, and local collectors (Fitzgerald 2012). We installed linear pitfall trap arrays (Ribeiro-Júnior *et al.* 2011) in forest fragments from three

distinct areas: Serra do Sapecado/Serra da Neblina, Sinimbú, and Estação Ecológica de Água Limpa (Table 1 and Figure 2). They are among the largest forest fragments in the region, the latter being the only area protected by law in Cataguases, with 70 ha (Minas Gerais 1994; <http://www.wdpa.org/>). Also, the three areas differ in elevation gradient (Table 1), which could result in the presence of distinct habitats among studied sites (Veloso *et al.* 1991). Each trap array was 50 m long, made of six buckets buried in the ground and set at 10-m intervals, connected by a 50-cm tall drift fence of plastic canvas (Table 1).

Occasional encounters occurred during pitfall traps surveys. We also considered specimens recorded by local people and environmental police, herein referred as 'local collectors'. Voucher specimens (collected under permits from the Instituto Chico Mendes de Conservação da Biodiversidade-ICMBio 10504-1, 26008-1, 26008-2, 26008-4, and the Instituto Estadual de Florestas-IEF 102/08, 073/11) were deposited in the herpetological collection of the Museu de Zoologia João Moojen, Universidade Federal de Viçosa (MZUFV), Viçosa, Minas Gerais (Appendix 1).

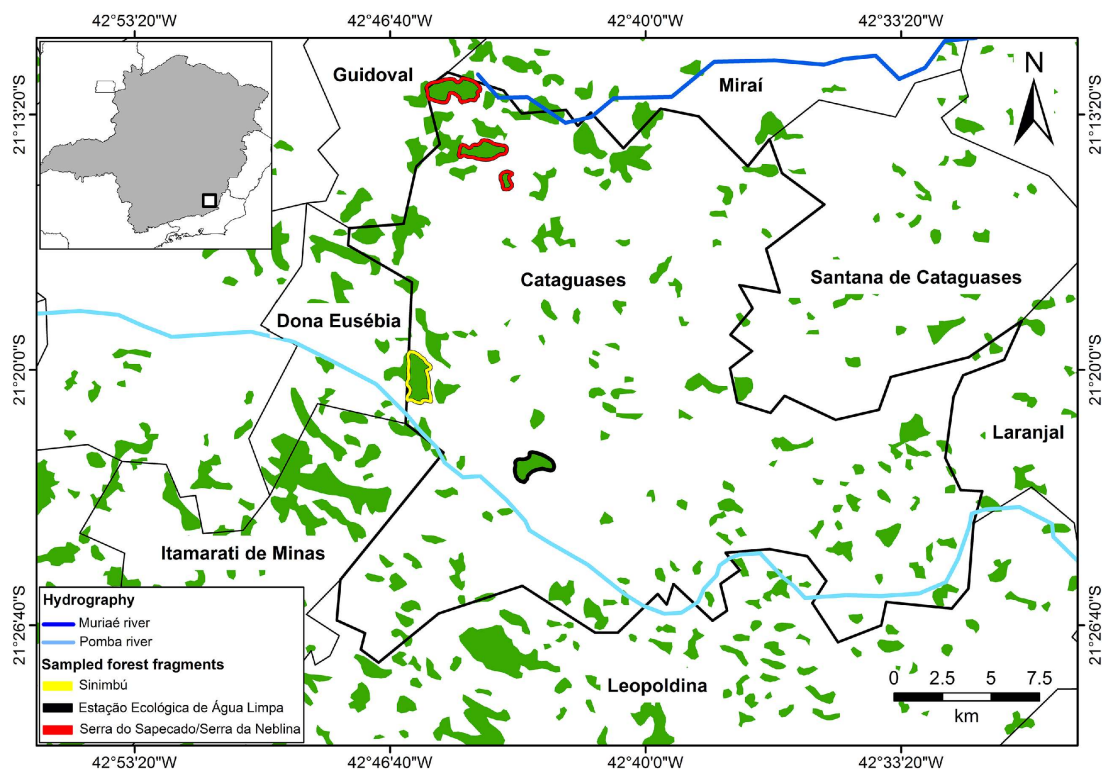


Figure 1. Map of Cataguases and neighbor municipalities, with forest remnants shown in green. The inset map shows the state of Minas Gerais in grey, with a small white square indicating the location of the municipality of Cataguases, Brazil.

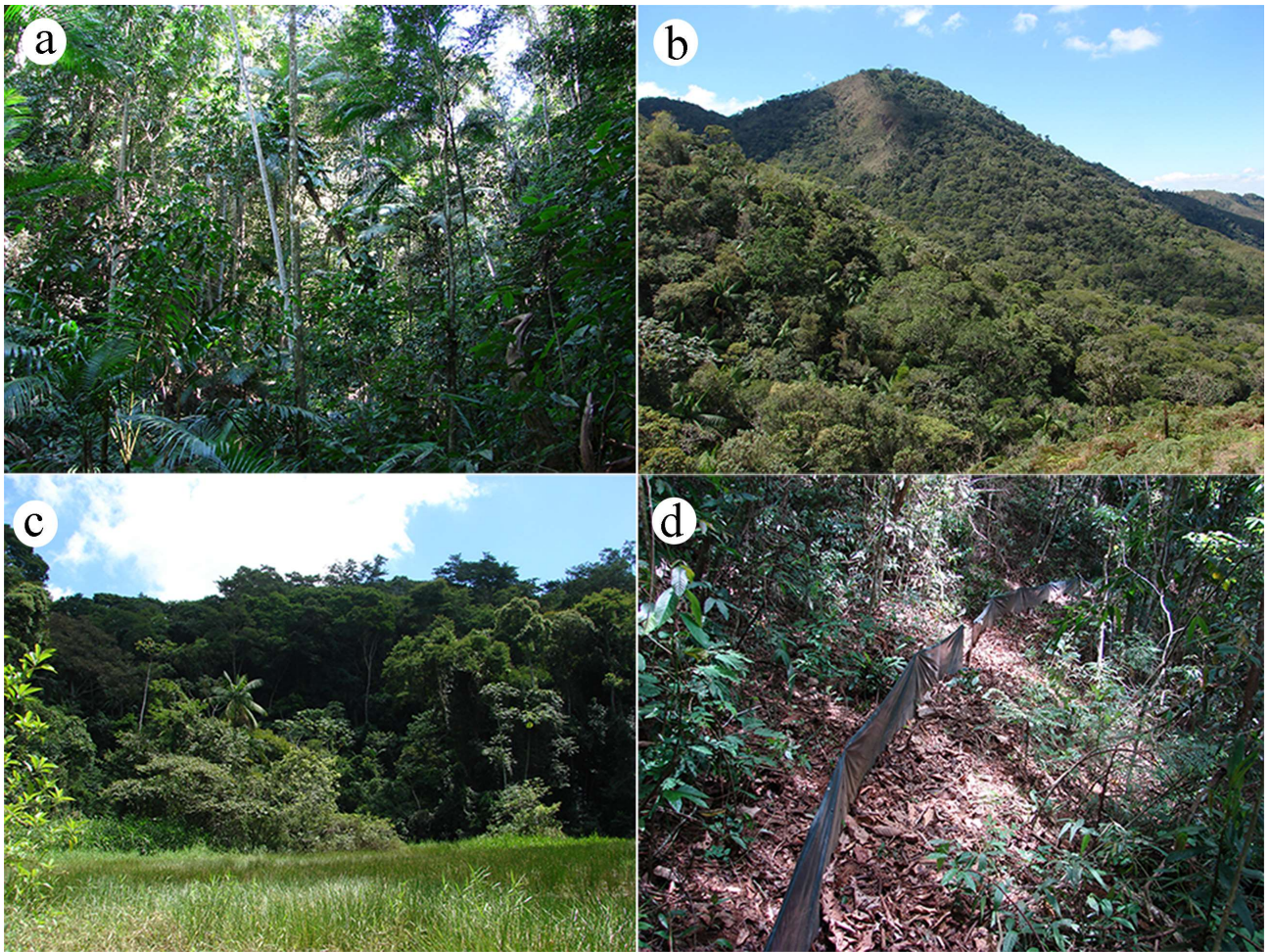


Figure 2. Localities sampled with pitfall traps in the municipality of Cataguases, state of Minas Gerais, Brazil. a) Estação Ecológica de Água Limpa; b) Serrado do Sapecado/Serra da Neblina; c) Sinimbú; d) Linear pitfall trap array.

Table 1. Detailed information about pitfall trap method used in three areas in the municipality of Cataguases, state of Minas Gerais, Brazil.

Method details/Area of study	Serra do Sapecado/Neblina	Sinimbú	Estação Ecológica de Água Limpa
Coordinates	21°13'19" S, 42°44'39" W	21°20'19" S, 42°45'46" W	21°22'27" S, 42°43'04" W
Altitudinal range (meters)	426 to 910	263 to 353	240 to 330
Nº of trap lines	5	6	5
Nº of buckets	30	36	30
Bucket capacity (liters)	65	65	100
Sampling period	Dec/2012 to Nov/2013	Feb/2011 to Apr/2012	Sep/2011 to Nov/2011
Nº of sampled months	12	15	3
Nº of sampled days per month	5	7	5
Total sampled days	60	105	15
Bucket/day effort	1800	3780	450

We also searched for records from Cataguases and neighboring municipalities (Dona Eusébia, Guidoal, Itamarati de Minas, Laranjal, Leopoldina, Mirai, and Santana de Cataguases) in the literature and the MZUFV collection. We based our species identification in the works of Peters & Donoso-Barros (1970), Gans (1971), Jackson (1978), Vanzolini (1978, 2002), Vanzolini *et al.* (1980), Rodrigues (1987), Ávila-Pires (1995), Borges-Martins (1998), Rodrigues *et al.* (2006), Harvey *et al.* (2008), Hedges & Conn (2012), Cacciali & Scott (2015), and Ribeiro *et al.* (2015). Information from those works was also gathered to produce a species identification key following the style presented by Costa *et al.* (2009) (Appendix 2). We also used specimens at the herpetological collection of MZUFV for comparisons. We follow the same nomenclature adopted by Costa & Bérnils (2015).

Data analysis

To evaluate the effectiveness of our sampling effort through pitfall trapping (the only method used with a measurable sampling effort), we built a sample based rarefaction curve (Gotelli & Colwell 2001) with 1,000 randomizations, using the richness estimators Jackknife 1 and Chao 2, with a respective 95% confidence interval. This analysis was made in the software EstimateS 9.1 (Colwell 2013).

RESULTS

We recorded a total of 75 specimens from 15 species (13 lizards and two amphisbaenians) in 12 families (Figures 3 and 4). The most abundant species were *Gymnodactylus darwinii*, *Ecpleopus gaudichaudii* and *Enyalius boulengeri* (Table 2). Two species (*Iguana iguana* and *Hemidactylus mabouia*) are not native from the region. We recorded 10 species in neighboring municipalities, one of them (*Strobilurus torquatus*) not recorded in Cataguases. The dichotomous key at the end of the article guides the identification of all species herein cited.

Pitfall traps captured 57 specimens from eight species; occasional encounters resulted in three species, but two of them (*Tropidurus torquatus* and

Hemidactylus mabouia) were not quantified due to the high abundance at urban areas; local collectors recorded 16 specimens from 10 species; and 3 species were recorded in the literature. *Dactyloa punctata* and *Aspronema dorsivittatum* were only recorded by pitfall traps, *T. torquatus* only by occasional encounters, *Polychrus marmoratus*, *Psychosaura macrorhyncha* and *I. iguana* were exclusively recorded by local collectors, and *Leposternon infraorbitale* and *Enyalius bilineatus* only by literature records.

The rarefaction curve based on pitfall trapping did not reach the asymptote (Figure 5). Estimated richness based on pitfall trap is 10.98 (± 1.71) species for Jackknife 1 and 9.49 (± 2.58) species for Chao2.

DISCUSSION

The lizard and amphisbaenian species richness of Cataguases represents 16% of the known diversity of these groups in the state of Minas Gerais (H. C. Costa, unpublished data). Most species have wide geographical ranges and are commonly found in habitats with human interference like forests patches in urban areas (e.g., Costa *et al.* 2009, Moura *et al.* 2012, Sousa *et al.* 2012, Cruz *et al.* 2014). Only three species (*Ecpleopus gaudichaudii*, *Enyalius boulengeri*, and *Gymnodactylus darwinii*, 20% of observed richness) are considered endemic to the Atlantic Forest. The occurrence of few endemic species seems to be a common pattern in lizard assemblages in southeastern Atlantic Forest (e.g., Moura *et al.* 2012, Santos 2013, Cruz *et al.* 2014).

Gymnodactylus darwinii was the most abundant species in forested areas, followed by *En. boulengeri* and *Ec. gaudichaudii*. In a study in forested areas in Rio de Janeiro state, *G. darwinii*, *Ec. gaudichaudii*, and *En. brasiliensis* (until recently conspecific with *En. boulengeri*) were also the most abundant lizards (Almeida-Gomes & Rocha 2014). In fact, *G. darwinii*, *Ec. gaudichaudii* and *Enyalius* spp. usually are among the most common lizards in forest fragments in southeastern Brazil (Dixo & Verdade 2006, Cicchi *et al.* 2009, Condez *et al.* 2009, Costa *et al.* 2014).

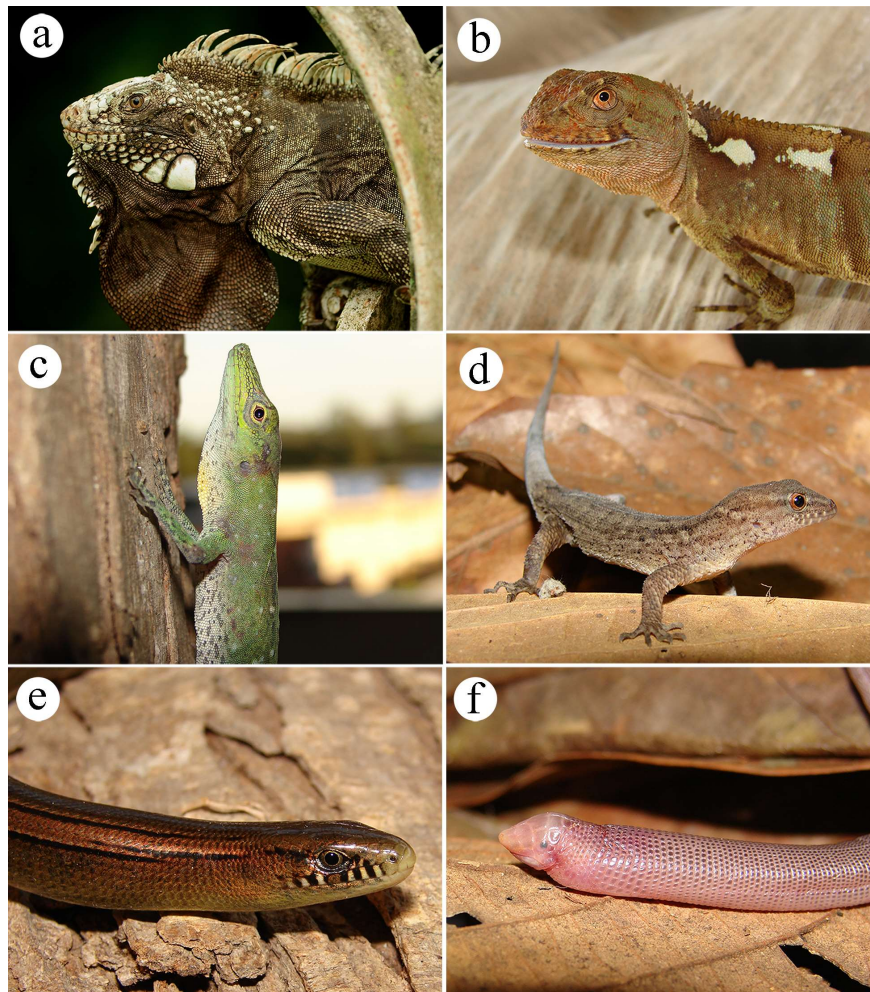


Figure 3. Some species recorded in the municipality of Cataguases, state of Minas Gerais, Brazil. a) *Iguana iguana* (exotic); b) *Enyalius boulengeri* (female); c) *Dactyloa punctata*; d) *Gymnodactylus darwini*; e) *Ophiodes fragilis*; f) *Leposternon microcephalum* (Photos: Clodoaldo L. de Assis).

We recorded two exotic species in the study area: *Hemidactylus mabouia* and *Iguana iguana*. The first is an African species introduced in the New World probably during the first trans-Atlantic navigations (Vanzolini 1978, Carranza & Arnold 2006). Currently, this species occupies mainly anthropic and perianthropic environments (Vanzolini 1978, Vanzolini *et al.* 1980), but have also been recorded in natural areas (Rocha *et al.* 2011). During field work, *H. mabouia* was commonly seen at buildings in rural areas, but a specimen was captured in a pitfall trap inside the forest fragment of Estação Ecológica de Água Limpa. This reinforces previous observations that *H. mabouia* may be interacting with native species in natural habitats (Rocha *et al.* 2011).

The other exotic species, *I. iguana*, was

recorded based on two specimens from the urban area of Cataguases, one found in a backyard and the other in a vacant lot. In Brazil, this species occurs naturally in lowland areas of the Amazon, Cerrado, Caatinga and northern Atlantic Forest (Ribeiro-Júnior 2015; Oliveira & Castro 2017). In Minas Gerais, there are records from the northern region of the state in transitional areas between Cerrado and Caatinga (Ribeiro-Júnior 2015), about 660 km from the present study area. *Iguana iguana* is targeted by animal trafficking due to its value as one of the most popular reptile pets in many countries (Renctas 2001). An apprehension of *I. iguana* in the nearby municipality Juiz de Fora may indicate that specimens found in Cataguases could be pet animal released purposely or accidentally by their owners (Borges *et al.* 2006).

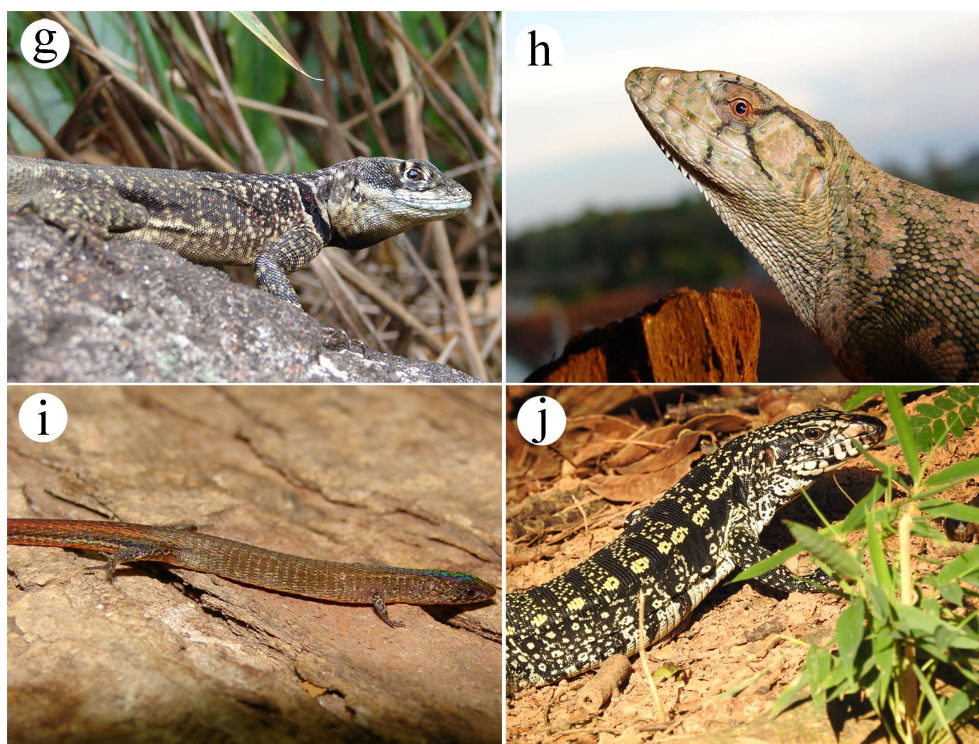


Figure 4. Some species recorded in the municipality of Cataguases, state of Minas Gerais, Brazil. g) *Tropidurus torquatus*; h) *Polychrus marmoratus*; i) *Ecleopopus gaudichaudii*; j) *Salvator merianae* (Photos: Clodoaldo L. de Assis [g-i] and Leandro Avelar [j]).

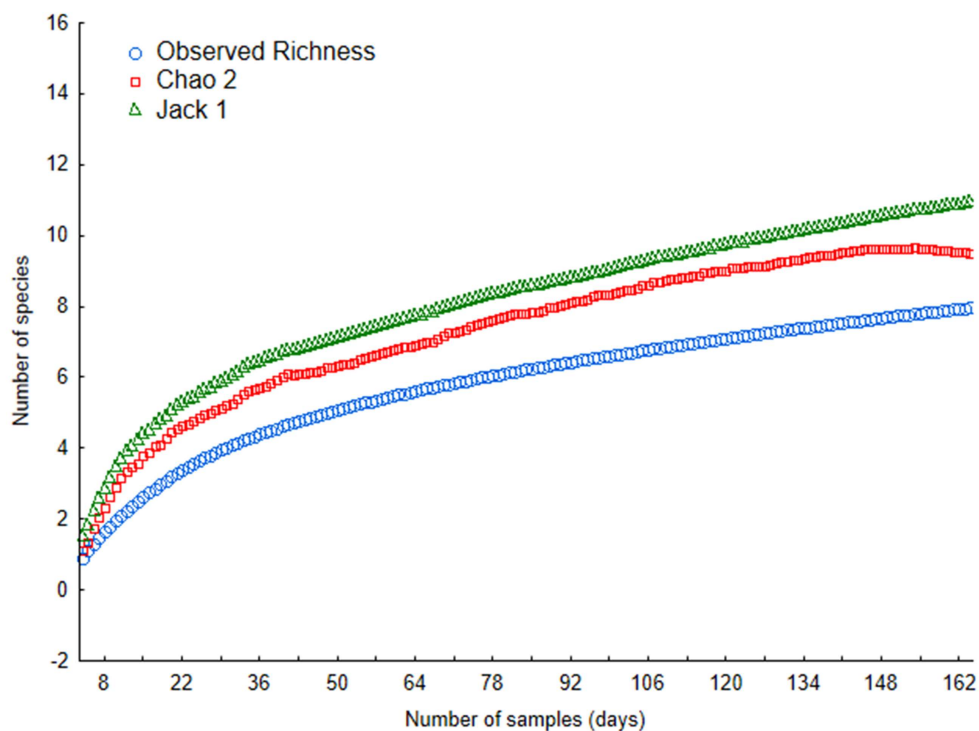


Figure 5. Sample-based rarefaction curves of lizard and amphisbaenian species recorded in Cataguases, Minas Gerais, based on pitfall trapping, using Jackknife 1 and Chao 2 estimators.

One species (*Strobilurus torquatus*) was only recorded in a neighbor municipality, thus with possible occurrence in the study area. This species is predominantly associated to lowland Atlantic Forest (Rodrigues 2000, Rodrigues *et al.* 2013) and was recorded at the area flooded by the Barra do Braúna hydroelectric power plant dam, in the municipality of Leopoldina (21°26'42.363 S, 42°25'43.683 W), about 10 km East in a straight line from Cataguases. Considering the proximity between the areas, as well as the environmental similarity along the region, it seems reasonable that this species is also present in forested areas of Cataguases.

Pitfall traps and local collectors recorded two and four exclusive species respectively, reinforcing the well-known importance of using different sampling methods for a better reptile assessment (Bernarde 2012, Fitzgerald 2012). Local collectors are usually applied in snake inventories (Zanella & Cechin 2006, São-Pedro & Pires 2009, Silveira *et al.* 2010, Moura *et al.* 2012) but had also been used in lizard surveys in northeastern Brazil (*e.g.*, Vanzolini 1976, Rodrigues 1991, Vitt 1995), improving assessment results.

As expected, species collected by pitfall traps are mostly terrestrial, semi-arboreal or fossorial. The only exception is *Anolis punctatus*, considered an arboreal species (Avila-Pires 1995, Vitt *et al.* 2003), but eventually captured in pitfall traps (*e.g.*, Garda *et al.* 2012, Waldez *et al.* 2013). On the other side, most species exclusively recorded by local collectors are difficult to capture in pitfall traps due to arboreal (*Polychrus marmoratus*) or bromeliculous habitats (*Psychosaura macrorhyncha*), or even the large size of adult specimens (*I. iguana* and *Salvator merianae*).

Only three species have been cited so far for Cataguases in literature records: *Enyalius bilineatus* (Jackson 1978), *G. darwinii* (Vanzolini 1953), and *Leposternon infraorbitale* (Ribeiro *et al.* 2008). The first two were cited for Sereno, a district of Cataguases. Our sampling methods failed to record *Enyalius bilineatus* and *L. infraorbitale*, highlighting the importance of bibliographic reviews for better assessments. *Enyalius bilineatus* is semi-arboreal, but is more commonly found in disturbed areas (Costa *et al.* 2009, Sousa *et al.* 2012), a type of environment not

systematically sampled in this study. *Leposternon infraorbitale* is a fossorial species and may have not been collected by chance – seven specimens of its congener, *L. microcephalum*, were recorded (two from pitfall traps and five from local collectors). The lack of sampling methods like glue traps or active searches might explain the low number or even the absence of records of arboreal species. Such methods have been used with success in many localities (*e.g.*, Ribeiro-Júnior *et al.* 2006, Waldez *et al.* 2013, Caldas *et al.* 2016) and would be important for future assessments in Cataguases.

The lizard and amphisbaenian species richness found in Cataguases is similar to that of two close sites, Juiz de Fora (17 spp.) and Viçosa (16 spp.) (Costa *et al.* 2009, Sousa *et al.* 2012), but is smaller than that of the forest corridor between Simonésia and Caratinga (25 spp.), which is composed of several forest fragments (Santos 2013). The absence of stability in the rarefaction curves of pitfall trapping (Figure 5) suggests that more species may be found with increasing sampling effort. It is interesting to note that eight species were recorded by pitfall traps in Cataguases, and the richness estimated for this method by Jackknife 1 (10.98) and Chao 2 (9.49) means that with three more species all taxa able to be sampled by this method in the region would have been recorded. Five terrestrial, semi-arboreal and fossorial species recorded by other methods (*E. bilineatus*, *L. infraorbitale*, *P. macrorhyncha*, and *S. merianae*) could be captured by pitfall traps with additional sampling effort. This suggests that, together, our methods seem to have satisfactorily sampled the terrestrial, fossorial, and semi-arboreal lizard and amphisbaenian fauna of Cataguases. However, comparing with data from close sites (Sousa *et al.* 2012, Costa *et al.* 2014), we do not discard the possibility of more terrestrial and fossorial species occurring in forest patches of Cataguases, such as *Amphisbaena alba*, *Heterodactylus imbricatus*, and *Placosoma glabellum*.

Despite the history of deforestation in the study area, with only 9% of forest remnants, most species (n = 9) were recorded in such fragments, reinforcing the importance of even small forest patches in the conservation of Atlantic Forest reptile populations (Lion

et al. 2016). However, most forest remnants in Cataguases are not protected areas and suffer with fire, illegal logging and cattle activity. Increasing the network of protected areas in Cataguases will thus be an important step for the conservation of its reptile fauna.

An identification key was also produced for those interested in the lizard and amphisbaenian fauna of Cataguases, especially beginners and the non-taxonomists (Appendix 2). Despite keys being useful tools, few are published in the context of comparing species of a single area or region (e.g., Avila-Pires 1995, Costa et al. 2009, Silveira et al. 2010). The most comprehensive key of Neotropical lizards ever published is now outdated (Peters & Donoso-Barros 1970), reinforcing the need to fill this gap of

information, even in local scales.

ACKNOWLEDGEMENTS

We thank Felipe Eugênio Parizzi, Sebastião V. de Jesus, Alberto F. Iasbik, and Instituto Estadual de Florestas (IEF) for collection permits and field support in Estação Ecológica de Água Limpa; Tatiana R. Rosa, Rayldo Reis, and Isaias J. Reis (Instituto Chico Mendes de Conservação da Biodiversidade [ICMBio] and Centro Nacional de Pesquisa e Conservação de Répteis e Anfíbios [RAN]), for helping with permissions for research activities; Hermelindo R. dos Santos, Luzia R. Santos, José Geraldo Soares, Inácio Cardoso, Dineia Martins Teixeira, José Brás Teixeira, Otoni Machado, Wanderlan Santos, Maria Helena, Gilberto Norato, Walter Nunes, Cleide Furtado, and Verônica R. dos Santos for kindly receiving us on their properties. We also thank the Environmental Police of Cataguases for helping in data collection. HCC receives a D.Sc. scholarship from CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior). JJMG received a scholarship from CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico).

Table 2. Species of lizards and amphisbaenians recorded in the municipality of Cataguases, state of Minas Gerais, Brazil. Habit: A = arboreal; F = fossorial; SA = semi-arboreal; SX = saxicolous; TR = terrestrial (includes leaf-litter dwellers). Habitat types of record: FE = forest environment; UA = urban area; NA = not available. Sampling Method: PT = pitfall traps; OE = occasional encounter, LC = local collectors; LT = literature. NQ = not quantified. * = endemic to the Atlantic Forest.

Taxon	Habit	Habitat Types		Method and number of specimens recorded			
		FE	UA	PT	OE	LC	LT
Amphisbaenidae							
<i>Leposternon infraorbitale</i> Berthold, 1859	F	NA	NA	0	0	0	NQ
<i>Leposternon microcephalum</i> Wagler in Spix, 1824	F	X	X	2	0	5	0
Anguidae							
<i>Ophiodes fragilis</i> (Raddi, 1820)*	T	X	X	1	2	1	0
Dactyloidae							
<i>Dactyloa punctata</i> (Daudin, 1802)	A	X	-	3	0	0	0
Gekkonidae							
<i>Hemidactylus mabouia</i> (Moreau de Jonnés, 1818)	A, SX	X	X	1	NQ	0	0
Gymnophthalmidae							
<i>Eckleopus gaudichaudii</i> Duméril & Bibron, 1839*	T	X	-	11	0	1	0
Iguanidae							
<i>Iguana iguana</i> (Linnaeus, 1758)	SA	-	X	0	0	1	0
Leiosauridae							
<i>Enyalius bilineatus</i> (Duméril & Bibron, 1837)	SA	NA	NA	0	0	0	NQ
<i>Enyalius boulengeri</i> Etheridge, 1969*	SA	X	-	15	0	1	0
Mabuyidae							
<i>Aspronema dorsivittatum</i> (Cope, 1862)	T	X	-	2	0	0	0
<i>Psychosaura macrorhyncha</i> (Hoge, 1946)	SA	NA	NA	0	0	1	0
Phyllodactylidae							
<i>Gymnodactylus darwini</i> (Gray, 1845)*	SA, T	X	-	21	0	3	NQ
Polychrotidae							
<i>Polychrus marmoratus</i> (Linnaeus, 1758)	A	NA	NA	0	0	1	0
Teiidae							
<i>Salvator merianae</i> Duméril & Bibron, 1839	T	X	X	0	0	2	0
Tropiduridae							
<i>Tropidurus torquatus</i> (Wied, 1820)	SX	-	X	0	NQ	1	0

REFERENCES

- Assis, C. L., Santana, D. J., Silva, F. A., Quintela, F. M., Feio, R. N. 2013. A new and possibly critically endangered species of casque-headed tree frog *Aparasphenodon* Miranda-Ribeiro, 1920 (Anura, Hylidae) from southeastern Brazil. *Zootaxa*, 3716(4), 583-591. DOI: 10.11646/zootaxa.3716.4.6
- Almeida-Gomes, M., & Rocha, C. F. D. 2014. Diversity and distribution of lizards in fragmented Atlantic Forest landscape in Southeastern Brazil. *Journal of Herpetology*, 48(3), 423-429. DOI: 10.1670/12-187
- Alvares, C. A., Stape, J. L., Sentelhas, P. C., Gonçalves, J. L. M., Sparovek, G. 2014. Köppen's climate classification map for Brazil. *Meteorologische Zeitschrift*, 22(6), 711-728. DOI: 10.1127/0941-2948/2013/0507
- Ávila-Pires, T. C. S. 1995. Lizards of Brazilian Amazonia (Reptilia: Squamata). *Zoologische Verhandlungen*, 299, 1-706.
- Bernarde, P. S. 2012. Anfíbios e répteis: introdução ao estudo da herpetofauna brasileira. Curitiba: Anolis Books: p. 320.
- Borges-Martins, M. 1998. Revisão taxonômica e sistemática filogenética do gênero *Ophiodes* Wagler, 1828 (Sauria, Anguillidae, Diploglossinae). Pontifícia Universidade Católica do Rio Grande do Sul. p. 239.
- Borges, R. C., Oliveira, A., Bernardo, N., Costa, R. M. M. C. 2006. Diagnóstico da fauna silvestre apreendida e recolhida pela Polícia Militar de Meio Ambiente de Juiz de Fora, MG (1998 e 1999). *Revista Brasileira de Zoociências*, 8, 23-33.
- Cacciali, P., & Scott, N. J. 2015. Key to the *Ophiodes* (Squamata: Sauria: Diploglossidae) of Paraguay with the description of a new species. *Zootaxa*, 3980(1), 042-050. DOI: 10.11646/zootaxa.3980.1.2
- Caldas, F. L. S., Costa, T. B., Laranjeiras, D. O., Mesquita, D. O., Garda, A. A. 2016. Herpetofauna of protected areas in the Caatinga V: Seridó Ecological Station (Rio Grande do Norte, Brazil). *Check List*, 12(4), 1929. DOI 10.15560/12.4.1929
- Cardoso, I. M., Guijt, I., Franco, F. S., Ferreira-Neto, P. S. 2001. Continual learning for agroforestry system design: university, NGO and farmer partnership in Minas Gerais, Brazil. *Agricultural Systems*, 69, 235-257. DOI: 10.1016/S0308-521X(01)00028-2
- Carranza, S., & Arnold, E. N. 2006. Systematics, biogeography, and evolution of *Hemidactylus* geckos (Reptilia: Gekkonidae) elucidated using mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution*, 38, 531-545. DOI: 10.1016/j.ympev.2005.07.012
- Cicchi, P. J. P., Serafim, H., Sena, M. A., Centeno, F. C., Jim, J. 2009. Herpetofauna em uma área de Floresta Atlântica na Ilha Anchieta, município de Ubatuba, sudeste do Brasil. *Biota Neotropica*, 9(2), 201-212. DOI: 10.1590/S1676-06032009000200019
- Colwell, R. K. 2013. EstimateS: statistical estimation of species richness and shared species from samples. University of Connecticut, Connecticut.
- Condez, T. H., Sawaya, R. J., & Dixo, M. 2009. Herpetofauna dos remanescentes de Mata Atlântica da região de Tapiraí e Piedade, SP, sudeste do Brasil. *Biota Neotropica*, 9(1), 157-185. DOI: 10.1590/S1676-06032009000100018
- Costa, H. C. & Bérnils, R. S. 2015. Répteis brasileiros: lista de espécies 2015. *Herpetologia Brasileira*, 4(3), 75-93.
- Costa, H. C., Fernandes, V. D., Rodrigues, A. C., Feio, R. N. 2009. Lizards and amphisbaenians, municipality of Viçosa, state of Minas Gerais, southeastern Brazil. *Check List*, 5(3), 732-745. DOI: 10.15560/5.3.732
- Costa, H. C., Pantoja, D. L., Pontes, J. L., Feio, R. N. 2010. Serpentes do Município de Viçosa, Mata Atlântica do Sudeste do Brasil. *Biota Neotropica*, 10(3), 353-377. DOI: 10.1590/S1676-06032010000300033
- Costa, H. C., Rodrigues, A. C., Coelho, C. A., Feio, R. N. 2014. Répteis da Mata do Paraíso. In: G. S. Lima, G. A. Ribeiro, W. Gonçalves, S. V. Martins & M. P. Almeida. (Eds.), *Ecologia de Mata Atlântica: estudos ecológicos na Mata do Paraíso*. pp. 113-131. Viçosa: Supremo.
- Costa, H. C., Santana, D. J., Leal, F., Koroiva, R., Garcia, P. C. A. 2016. A new species of *Helicops* (Serpentes: Dipsadidae: Hydropsini) from Southeastern Brazil. *Herpetologica*, 72(2), 157-166. DOI: 10.1655/HERPETOLOGICA-D-15-00059
- Cruz, A. J. R., Drummond, L. O., Lucena, V. D., Magalhães, A. P., Braga, C. A. C., Rolin, J. M., Pires, M. R. S. 2014. Lizard fauna (Squamata, Sauria) from Serra do Ouro Branco, southern Espinhaço Range, Minas Gerais, Brazil. *Check List*, 10(6), 1290-1299. DOI: 10.15560/10.6.1290
- Dixo, M., & Verdade, V. K. 2006. Herpetofauna de serrapilheira da Reserva Florestal de Morro Grande, Cotia (SP). *Biota Neotropica*, 6, 1-20. DOI: 10.1590/S1676-06032006000200009
- Drooge, S., Cyr, A., & Lavirée, J. 1998. Checklists: an under-used tool for the inventory and monitoring of plants and animals. *Conservation Biology*, 12(5), 1134-1138. DOI: 10.1046/j.1523-1739.1998.96402.x
- Fitzgerald, L. A. 2012. Finding and capturing reptiles. In: R. McDiarmid, M. Foster, C. Guyer, J. W. Gibbons & N. Chernoff (Eds.). *Reptile biodiversity: standard methods for inventory and monitoring*. pp. 77-88. Berkeley and Los Angeles: University of California Press.
- Gans, C. 1971. Redescription of three monotypic genera of amphisbaenians from South America: *Aulura* Barbour, *Bronia* Gray and *Mesobaena* Mertens. *American Museum Novitates*, 2475, 1-32.
- Garda, A. A., Wiederhecker, H. C., Gainsbury, A. M., Costa, G. C., Pyron, R. A., Vieira, G. H. C., Werneck, F. P., Colli, G. R. 2012. Microhabitat variation explains local-scale distribution of terrestrial Amazonian lizards in Rondônia, Western Brazil. *Biotropica*, 45(2), 245-252. DOI: 10.1111/j.1744-7429.2012.00906.x
- Gotelli, N. J., & Colwell, R. K. 2001. Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecology Letters*, 4, 379-391. DOI: 10.1046/j.1461-0248.2001.00230.x
- Guimarães, C. S., Luz, S., Rocha, P. C., Feio, R. N. 2017. The dark side of pumpkin toadlet: a new species of *Brachycephalus* (Anura: Brachycephalidae) from Serra do Brigadeiro, southeastern Brazil. *Zootaxa*, 4258(4), 327-344. DOI: 10.11646/zootaxa.4258.4.2
- Haddad, C. F. B. 1998. Biodiversidade dos anfíbios no Estado de

- São Paulo. In: R. M. C. Castro (Ed.). Biodiversidade do Estado de São Paulo, Brasil (Série Vertebrados). pp. 15-26. São Paulo: FAPESP.
- Harvey, M. B., Aguayo, R., & Miralles, A. 2008. Redescription and biogeography of *Mabuya cochabambae* Dunn with comments on Bolivian congeners (Lacertilia: Scincidae). *Zootaxa*, 1828, 43-56.
- Hedges, S. B., & Conn, C. E. 2012. A new skink fauna from Caribbean islands (Squamata, Mabuyidae, Mabuyinae). *Zootaxa*, 3288, 1-244.
- IBGE - Instituto Brasileiro de Geografia e Estatística. 2004. Mapa de biomas do Brasil. Primeira Aproximação. Escala 1:5.000.000.
- Jackson, J. F. 1978. Differentiation in the genera *Enyalius* and *Strobilurus* (Iguanidae): implications for Pleistocene climatic changes in eastern Brazil. *Arquivos de Zoologia*, 30(1), 1-79. DOI: 10.11606/issn.2176-7793.v30i1p1-79
- Lacerda, J. V. A., Peixoto, O. L., & Feio, R. N. 2012. A new species of the bromeligenous *Scinax perpusillus* group (Anura; Hylidae) from Serra do Brigadeiro, State of Minas Gerais, Southeastern Brazil. *Zootaxa*, 3271, 31-42.
- Lion, M. B., Garda, A. A., Santana, D. J., Fonseca, C. R. 2016. The conservation value of small fragments for Atlantic Forest reptiles. *Biotropica*, 48(2), 265-275. DOI: 10.1111/btp.12277
- Minas Gerais. 1994. Decreto nº 36.072, de 27 de setembro de 1994. Cria a Estação Ecológica de Água Limpa. Diário do Executivo, 28/09/1994.
- Mittermeier, R. A., Gil, P. R., Hoffmann, M., Pilgrim, J., Brooks, J., Mittermeier, C. G., Lamourux, J., & Fonseca, G. A. B. 2005. Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions. Washington: Cemex: p. 392.
- Mittermeier, R. A., Turner, W. R., Larsen, F. W., Brooks, T. M., Gascon, C. 2011. Global biodiversity conservation: the critical role of hotspots. In: F. E. Zachos & J. C. Habel (Eds.), *Biodiversity hotspots: distribution and protection of conservation priority areas*. pp. 3-22. Berlin Heidelberg: Springer-Verlag. DOI: 10.1007/978-3-642-20992-5_1
- Moura, M. R., Motta, A. P., Fernandes, V. D., Feio, R. N. 2012. Herpetofauna da Serra do Brigadeiro, um remanescente da Mata Atlântica, em Minas Gerais, Sudeste do Brasil. *Biota Neotropica*, 12(1), 209-235. DOI: 10.1590/S1676-06032012000100017
- Moura, M. R., Argôlo, A. J., & Costa, H. C. 2016. Historical and contemporary correlates of snake biogeographical subregions in the Atlantic Forest Hotspot. *Journal of Biogeography*, 640-650. DOI: 10.1111/jbi.12900
- Oliveira, J. C. F., & Castro, T. M. 2017. Range extension of *Iguana iguana* Linnaeus, 1758 (Squamata: Iguanidae): the first record of an established population in southeastern Brazil. *Check List*, 13(2), 2097. DOI: 10.15560/13.2.2097
- Peters, J. A., & Donoso-Barros, R. 1970. Catalogue of the Neotropical Squamata. Part II. Lizards and amphisbaenians. *Bulletin of the United States National Museum*, 297(2), 1-293.
- Renctas. 2001. 1º Relatório nacional sobre o tráfico de fauna silvestre. Retrieved February 10, 2017, from http://www.renctas.org.br/wp-content/uploads/2014/02/REL_RENCTAS_pt_final.pdf
- Ribeiro, M. C., Metzger, J. P., Martensen, A. C., Ponzoni, F. J., Hirota, M. M. 2009. The Brazilian Atlantic Forest: how much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation*, 142(6), 1141-1153. DOI: 10.1016/j.biocon.2009.02.021
- Ribeiro, M. C., Martensen, A. C., Metzger, J. P., Tabarelli, M., Scarano, F., Fortin, M.-J. 2011. The Brazilian Atlantic Forest: a shrinking biodiversity hotspot. In: F. E. Zachos & J. C. Habel (Eds.), *Biodiversity hotspots: distribution and protection of conservation priority areas*. Berlin Heidelberg: Springer-Verlag. DOI: 10.1007/978-3-642-20992-5_21
- Ribeiro, S., Vaz-Silva, W., & Santos-Jr, A. P. 2008. New pored *Leposternon* (Squamata, Amphisbaenia) from Brazilian Cerrado. *Zootaxa*, 1930, 18-38.
- Ribeiro, S., Santos-Jr, A. P., & Zaher, H. 2015. A new species of *Leposternon* Wagler, 1824 (Squamata, Amphisbaenia) from northeastern Argentina. *Zootaxa*, 4034(2), 309-324. DOI: 10.11646/zootaxa.4034.2.4
- Ribeiro-Júnior, M. A. 2015. Catalogue of distribution of lizards (Reptilia: Squamata) from the Brazilian Amazonia. I. Dactyloidae, Hoplocercidae, Iguanidae, Leiosauridae, Polychrotidae, Tropiduridae. *Zootaxa*, 3983(3), 001-110. DOI: 10.11646/zootaxa.3983.1.1
- Ribeiro-Júnior, M. A., Gardner, T. A., & Avila-Pires, T. C. S. 2006. The effectiveness of glue traps to sample lizards in a tropical rainforest. *South American Journal of Herpetology*, 1(2), 131-137. DOI: 10.2994/1808-9798(2006)1[131:TEOGTT]2.0.CO;2
- Ribeiro-Júnior, M. A., Rossi, R. V., Miranda, C. L. Avila-Pires, T. C. S. 2011. Influence of pitfall trap size and design on herpetofauna and small mammal studies in a Neotropical Forest. *Zoologia*, 28(1), 80-91. DOI: 10.1590/S1984-46702011000100012
- Rocha, C. F. D., Anjos, L. A., & Bergallo, H. G. 2011. Conquering Brazil: the invasion by the exotic gekkonid lizard *Hemidactylus mabouia* (Squamata) in Brazilian natural environments. *Zoologia*, 28(6), 747-754. DOI: 10.1590/S1984-46702011000600007
- Rodrigues, K. C., Delfim, F. R., de Castro, C. S. S., França, F. G. R., Filho, E. L., Mesquita, D. O., de Oliveira, F. A., dos Santos, A. C. A., Ferrari, S. F., Montenegro, M. M. V. 2013. *Strobilurus torquatus* Wiegmann, 1834 (Squamata: Tropiduridae): new records from the Brazilian state of Paraíba and a geographic distribution map. *Check List*, 9(3), 614-617. DOI: 10.15560/9.3.614
- Rodrigues, M. T. 1987. Sistemática, ecologia e zoogeografia dos *Tropidurus* do grupo *torquatus* ao Sul do Rio Amazonas (Sauria, Iguanidae). *Arquivos de Zoologia*, 31(3), 105-230. DOI: 10.11606/issn.2176-7793.v31i3p105-230
- Rodrigues, M. T. 1991. Herpetofauna das dunas interiores do rio São Francisco, Bahia, Brasil. I. Introdução à área e descrição de um novo gênero de microteiidídeos (*Calyptommatius*) com notas sobre sua ecologia, distribuição e especiação (Sauria, Teiidae). *Papéis Avulsos de Zoologia*, 37(19), 285-320.
- Rodrigues, M. T. 2000. A new species of *Mabuya* (Squamata: Scincidae) from de semiarid caatingas of northeastern Brazil. *Papéis Avulsos de Zoologia*, 41(2), 313-328.
- Rodrigues, M. T. 2005. Conservação dos répteis brasileiros: os

- desafios para um país megadiverso. *Megadiversidade*, 1(1), 87-94.
- Rodrigues, M. T., de Freitas, M. A., Silva, T. F. S., Bertolotto, C. E. V. 2006. A new species of lizard genus *Enyalius* (Squamata, Leiosauridae) from the highlands of Chapada Diamantina, state of Bahia, Brazil, with a key to species. *Phyllomedusa*, 5(1), 11-24. DOI: 10.11606/issn.2316-9079.v5i1p11-24
- Sá Junior, A., Carvalho, L. G., Silva, F. F., Alves, M. C. 2012. Application of the Koppen classification for climatic zoning in the state of Minas Gerais, Brazil. *Theoretical and Applied Climatology*, 108, 1-7. DOI: 10.1007/s00704-011-0507-8
- Santana, D. J., Fonseca, E. M., Neves, M. O., Carvalho, R. M. H. 2012. A new species of *Adelophryne* (Anura: Eleutherodactylidae) from the Atlantic Forest, southeastern Brazil. *Salamandra*, 48(8), 187-192.
- Santos, P. S. 2013. Herpetofauna do corredor Sossego-Caratinga, Mata Atlântica no Sudeste do Brasil: estrutura das comunidades e influência da paisagem. Departamento de Biologia Geral da Universidade Federal de Minas Gerais. p. 201.
- São-Pedro, V. A., & Pires, M. R. S. 2009. As serpentes da região de Ouro Branco, extremo sul da Cadeia do Espinhaço, Minas Gerais. *Revista Ceres*, 56(2), 166-171.
- Silveira, A. L., Pires, M. R. S., & Cotta, G. A. 2010. Serpentes de uma área de transição entre o Cerrado e a Mata Atlântica no sudeste do Brasil. *Arquivos do Museu Nacional*, 68(1-2), 79-110.
- SOS Mata Atlântica & INPE. 2016. Atlas dos remanescentes florestais da Mata Atlântica. Período 2014-2015. Relatório Técnico. São Paulo. p. 70.
- Sousa, B. M., Gomides, S. C., Hudson, A. A., Ribeiro, L. B., Novelli, I. A. 2012. Reptiles of the municipality of Juiz de Fora, Minas Gerais state, Brazil. *Biota Neotropica*, 12(3), 35-49. DOI: 10.1590/S1676-06032012000300002
- Uetz, P. & Hosek, J. The reptile database. 2016. Retrieved October 26, 2016, from <http://www.reptile-database.org/>
- Vanzolini, P. E. 1953. Sobre a diferenciação geográfica de *Gymnodactylus geckoides* (Sauria, Gekkonidae). *Papéis Avulsos de Zoologia*, 11(14), 225-262.
- Vanzolini, P. E. 1976. On the lizards of a cerrado-caatinga contact: evolutionary and zoogeographical implications (Sauria). *Papéis Avulsos de Zoologia*, 29(16), 111-119.
- Vanzolini, P. E. 1978. On South American *Hemidactylus* (Sauria, Gekkonidae). *Papéis Avulsos de Zoologia*, 31(20), 307-343.
- Vanzolini, P. E., Ramos-Costa, A. M. M., & Vitt, L. J. 1980. Répteis das Caatingas. Rio de Janeiro: Academia Brasileira de Ciências: p. 161.
- Vanzolini, P. E. 2002. An aid to the identification of the South American species of *Amphisbaena* (Squamata, Amphisbaenidae). *Papéis Avulsos de Zoologia*, 42(15), 351-362. DOI: 10.1590/S0031-10492002001500001
- Veloso, H. P., Rangel Filho, A. L. R., & Lima, J. C. A. 1991. Classificação da vegetação brasileira adaptada a um sistema universal. Rio de Janeiro: IBGE, Departamento de Recursos Naturais e Estudos Ambientais. p. 124.
- Vitt, L. J. 1995. The ecology of tropical lizards in the Caatinga of northeast Brazil. *Occasional Papers of the Oklahoma Museum of Natural History*, 1, 1-29.
- Vitt, L. J. Avila-Pires, T. C. S., Espósito, M. C., Sartorius, S. S., Zani, P. A. 2003. Sharing Amazonian Rain-Forest trees: ecology of *Anolis punctatus* and *Anolis transversalis* (Squamata: Polychrotidae). *Journal of Herpetology*, 37(2), 276-285. DOI: 10.1670/0022-1511(2003)037[0276:SARTEO]2.0.CO;2
- Waldez, F., Menin, M., & Vogt, R. C. 2013. Diversidade de anfíbios e répteis Squamata na região do baixo rio Purus, Amazônia Central, Brasil. *Biota Neotropica*, 13(1), 300-316. DOI: 10.1590/S1676-06032013000100029
- Zanella, N. & Cechin, S. Z. 2006. Taxocenose de serpentes no planalto médio do Rio Grande do Sul, Brasil. *Revista Brasileira de Zoologia*, 23(1), 211-217. DOI: 10.1590/S0101-81752006000100013

Submitted: 07 April 2017

Accepted: 10 July 2017

Associate Editor: Ana C. Delciellos

APPENDICES

Appendix 1. Voucher specimens from the municipality of Cataguases, state of Minas Gerais, Brazil.

Aspronema dorsivittatum - MZUFV 1307, 1308. *Dactyloa punctata* - MZUFV 1232, 1298, 1299. *Eupleopus gaudichaudii* - MZUFV 1250, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, 1263, 1329, 1367. *Enyalius boulengeri* - MZUFV 1229, 1267, 1268, 1270, 1271, 1272, 1286, 1288, 1290, 1291, 1292, 1293, 1294, 1296, 1309, 1366. *Gymnodactylus darwini* - MZUFV 1221, 1222, 1234, 1276, 1277, 1278, 1279, 1280, 1281, 1282, 1283, 1284, 1285, 1287, 1300, 1301, 1302, 1303, 1304, 1305, 1306, 1368, 1386, 1387. *Hemidactylus mabouia* - MZUFV 1274. *Iguana i. iguana* - MZUFV 1070. *Leposternon microcephalum* - MZUFV 1231, 1264, 1265, 1266, 1295, 1297, 1370. *Ophiodes fragilis* - MZUFV 1247, 1248, 1289, 1369. *Polychrus marmoratus* - MZUFV 1223. *Psychosaura macrorhyncha* - MZUFV 1228. *Salvator merianae* - MZUFV 1364, 1365. *Tropidurus torquatus* - MZUFV 1395.

Appendix 2. Identification key for lizards and amphisbaenians of the municipality of Cataguases and vicinities.

- 1a.** Front limbs absent 2
1b. Front limbs present 4
2a. Hind limbs vestigial, flap-like; eyes well-developed, eyelids present; body covered by cycloid scales
..... *Ophiodes fragilis*
2b. Hind limbs absent; eyes vestigial, eyelids absent; body covered by rings composed of small square scales
..... 3
3a. Two supralabials, the first larger than the second; 192-229 rings after pectoral region
..... *Leposternon microcephalum*
3b. Three supralabials, the first smaller than the second; 229-285 rings after pectoral region
..... *Leposternon infraorbitale*
4a. Scales on dorsum of head very small and granular; eyelids absent. 5
4b. Scales on dorsum of head variable in size, but never granular; eyelids present. 6
5a. Digits flat, with a double row of lamellae; dorsum covered by heterogeneous tubercles.....
..... *Hemidactylus mabouia* (exotic)
5b. Digits not compressed; dorsum covered by tubercles organized in longitudinal rows. *Gymnodactylus darwini*
6a. Scales on dorsum of head numerous, arranged irregularly. 7
6b. Scales on dorsum of head arranged in regular plates, relatively few in number. 13
7a. Vertebral crest present 8
7b. Vertebral crest absent 10
8a. A large gular fan bordered anteriorly by a series of spikes; a large, flat, round scale below ear-opening; up to about 450 mm snout-vent length in adult specimens. *Iguana iguana* (exotic)
8b. Absence of a gular fan and a large, flat round scale below ear-opening; maximum snout-vent length in adults less than 120 mm. 9
9a. Infradigital lamellae keeled; enlarged subocular scale absent; tail less than twice the snout-vent length.
..... *Enyalius boulengeri*
9b. Infradigital lamellae smooth; enlarged subocular scale present; tail more than twice the snout-vent length.
..... *Enyalius bilineatus*
10a. A flat or sac-like gular fan present, more developed in males; body slightly to moderately compressed laterally; fringe of scales on anterior part of ear opening absent. 11
10b. Gular fan absent; body moderately compressed dorsoventrally; fringe of scales on anterior part of ear opening present. 12
11a. Gular fan flat; digits flat; eyelids movable, not fused; femoral pores absent; fourth toe the longest.
..... *Dactyloa punctata*
11b. Gular fan sac-like; digits cylindrical; eyelids partially fused; femoral pores present; third toe as long as the fourth.
..... *Polychrus marmoratus*
12a. Tail, shorter or equal to snout-vent length, with enlarged, heavily keeled and mucronate scales.
..... *Strobilurus torquatus*

- 12b.** Tail longer than snout-vent length, without enlarged spiny scales. *Tropidurus torquatus*
- 13a.** Ventral scales cycloid. 14
- 13b.** Ventral scales squarish or hexagonal. 15
- 14a.** Three (rarely four) supraoculars; large black lateral stripe bordered above and below by a white line; thin black middorsal lines present. *Aspronema dorsivittatum*
- 14b.** Four (rarely three) supraoculars; middorsal stripes absent; black lateral stripe bordered above by a white stripe, followed by a black dorsolateral stripe; below, the black lateral stripe is bordered by a narrow white line that fades after the arm. *Psychosaura macrorhyncha*
- 15a.** Nasals separated by frontonasal; dorsal scales hexagonal and keeled; ventral scales hexagonal and smooth. Maximum snout-vent length about 50 mm in adults. *Ecleopus gaudichaudii*
- 15b.** Nasals in contact medially; dorsal scales small, oval to squarish, smooth; ventral scales squarish, smooth, and much larger than dorsals; snout-vent length of hatchling longer than 50 mm, reaching about 400 mm in adults. *Salvator merianae*