



A “hotspot” within a hotspot: the reptiles of the Estação Ecológica and Área de Proteção Ambiental de Murici, Atlantic Forest of northeastern Brazil

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Abstract: Currently the Atlantic Forest hotspot has less than 11% of its original coverage. However approximately 300 species of reptiles are known to inhabit this ecoregion, of which 34% are endemic. The creation of protected areas represents a strategy for preserving ecosystems and managing land use, and for attaining the proper management of these protected areas, information on local biodiversity is essential. Herein we provide the first list of reptile species for the Estação Ecológica and Área de Proteção Ambiental de Murici, two overlapping protected areas located in the state of Alagoas, one of the most important sets of forest remnants for the conservation of the Atlantic Forest in the northeast of Brazil. The species list was constructed based on expeditions and occasional encounters in the area between 1994 and 2022. A total of 89 reptile species were obtained during the 28 years of collection, being two species of Crocodylia, three species of Testudines and 84 species of Squamata. This richness is by far one of the greatest ever documented for the Atlantic Forest. Additionally, two species registered in the area are considered threatened according to the national list (*Amerotyphlops paucisquamus* and *Bothrops muriciensis*) and six are defined as data deficient for the assessment of their conservation status. Three species are recorded for the first time in the Atlantic Forest north of the São Francisco River: *Dipsas indica*, *Trilepida salgueiroi* and *Cercophis auratus*. We claim that the species list provided here will serve as a starting point for further studies in this rich reptile “hotspot” within the Atlantic Forest.

Keywords: Conservation; Crocodylia; Checklist; Squamata; Testudines.

Um “hotspot” dentro de um hotspot: os répteis da Estação Ecológica e Área de Proteção Ambiental de Murici, Mata Atlântica do nordeste do Brasil

Resumo: Atualmente o hotspot da Mata Atlântica tem menos de 11% de sua cobertura original. Porém aproximadamente 300 espécies de répteis são conhecidas por habitar esta ecorregião, das quais 34% são endêmicas. A criação de unidades de conservação representa uma estratégia de preservação de ecossistemas e gestão do uso do solo, e para o manejo adequado dessas áreas protegidas é fundamental a informação sobre a biodiversidade local. Apresentamos aqui a primeira lista de espécies de répteis para a Estação Ecológica e Área de Proteção Ambiental de Murici, duas unidades de conservação parcialmente sobrepostas localizadas no estado de Alagoas, um dos conjuntos de remanescentes florestais mais importantes para a conservação da Mata Atlântica no nordeste do Brasil. A lista de espécies foi construída com base em expedições e encontros ocasionais na área entre 1994 e 2022. Um total de 89 espécies de répteis foram registradas durante os 28 anos de coleta, sendo duas espécies de Crocodylia, três espécies de Testudines e 84 espécies de Squamata. Essa riqueza é de longe uma das maiores já documentadas para a Mata Atlântica. Além disso, duas espécies registradas na área são consideradas ameaçadas segundo a lista nacional (*Amerotyphlops paucisquamus* e *Bothrops muriciensis*) e seis são definidas como dados insuficientes para a avaliação de seu status de conservação.

Três espécies são registradas pela primeira vez na Mata Atlântica ao norte do rio São Francisco: *Dipsas indica*, *Trilepida salgueiroi* e *Cercophis auratus*. Afirmamos que a lista de espécies aqui fornecida servirá como ponto de partida para novos estudos neste rico “hotspot” de répteis dentro da Mata Atlântica.

Palavras-chave: Conservação; Crocodylia; Lista de espécies; Squamata; Testudines.

Introduction

The origin of reptiles dates back 300 million years ago, and countless morphological, physiological and behavioral adaptations have enabled this group to diversify across environments worldwide (Reisz 1997, Pough et al. 2008, Roll et al. 2017). Currently, over 11,500 living species are described (Uetz et al. 2022), although recent studies have emphasized that this richness is still underestimated (Mora et al. 2011, Moura & Jetz 2021). Certainly, many reptile species will become extinct before they are discovered because, in addition to current threats, such as habitat loss and degradation, pollution, species trafficking, pathogens and the introduction of invasive species (Gibbons et al. 2000), their metabolic rate is dependent on external sources of heat (ectothermy), resulting in their classification as the terrestrial vertebrates that are most threatened by climate change (e.g., Araujo et al. 2006, Closes & Kohlsdorf 2012, IUCN 2022). Furthermore, it represents the taxonomic group of which more species will be described in future years (Moura & Jetz 2021), mostly in the Neotropical region. Reptile diversity is not evenly distributed globally (Roll et al. 2017) and the greatest richness is concentrated among the 36 areas considered as global biodiversity hotspots (sensu Myers et al. 2000, Conservation International 2022).

Among these areas, the Atlantic Forest, a Neotropical ecoregion that originally occupied most of the east coast of South America (3° – 31° South and 35° – 60° West), has been highlighted as a hotspot for reptiles (Tozetti et al. 2017, Costa & Bérnils 2018, Uetz et al. 2022). Its original cover is estimated to have occupied about 150 million ha, extending as a coastal arc at a high latitudinal range that encompassed tropical and sub-tropical regions (Ribeiro et al. 2009). However, since European colonization, this ecoregion has been greatly threatened, mainly due to deforestation and the conversion of its natural areas for the expansion of the agricultural industry, exploitation of resources and advance of urban frontiers (Ribeiro et al. 2009). Currently, it is estimated that the remaining Atlantic Forest represents less than 11% of its original coverage, and these remnants are distributed in small and isolated fragments immersed in large matrices of monocultures and pastures (Ribeiro et al. 2009). Despite the high level of degradation, approximately 300 species of reptiles are currently known to inhabit this ecoregion, of which more than 34% are endemic (Tozetti et al. 2017).

The climatic and elevational variations in the Atlantic Forest throughout its latitudinal amplitude (about 29° and 0–2,700 meters; Ribeiro et al. 2009), together with the precipitation gradient from the coast to the interior (Ribeiro et al. 2009, Haddad et al. 2013), resulted in the formation of areas with distinct vegetation (Pinto & Brito 2003), allowing evolutionary processes in to occur at large and small scales (Vasconcelos et al. 2014; Moura et al. 2017a, b). The heterogeneity of this ecoregion, the geomorphological processes and climatic changes that have occurred since the Tertiary have consolidated areas of endemism (Ribeiro et al. 2009, Freire et al. 2018). Based on these areas, the Atlantic Forest was subdivided into eight Biogeographic Sub-Regions (BSR).

Among these, one of the northernmost sub-regions is known as the Pernambuco Biogeographic Sub-Region (sensu Ribeiro et al. 2009), extending from the northern margin of the São Francisco River, in the state of Alagoas, to the remnants located in the state of Rio Grande do Norte. This BSR was historically the most deforested (only 12% of its original coverage remains) and still houses the least known biota of the entire Atlantic Forest (Ribeiro et al. 2009).

The delimitation of protected areas represents a strategy for preserving ecosystems and managing land use. In Brazil, for example, a country where more than 90% of the Atlantic Forest is located, there are over 2,400 protected areas in this hotspot (CNUC/MMA 2022). Despite the expressive number, the total area of these protected areas corresponds to less than 0.12% of the total coverage of the Atlantic Forest and when only considering the current remnants, these numbers are much smaller. Additionally, many of these protected areas are quite permissible in terms of use (protection category with similar objectives as the “VI: Protected area with sustainable use of natural resources” classified by the IUCN, sensu Dudley 2008), few being fully protected, and the growing pressure to search for resources and space means that even these areas considered as “protected” continue to suffer from a plethora of threats (Jones et al. 2018).

In order to properly manage these protected areas, biodiversity information is essential. As such, species lists become an essential tool and source for the development of management plans and strategies and the definition of priority areas for conservation (Ribeiro et al. 2009, Jones et al. 2018). Despite the importance of understanding the local biodiversity, the flora and fauna of many of these protected areas in the Atlantic Forest remain poorly studied (Pinto et al. 2006, Tabarelli et al. 2006, Ribeiro et al. 2009). Herein we provide the first list of reptile species for the Estação Ecológica and Área de Proteção Ambiental de Murici, two overlapping protected areas located in the state of Alagoas, one of the most important sets of forest remnants for the conservation of the Atlantic Forest from the northeast of Brazil.

Material and Methods

1. Study area

The Área de Proteção Ambiental (Environmental Protection Area/ APA) de Murici (APA de Murici; Figure 1; protection category with similar objectives as the “VI: Protected area with sustainable use of natural resources” classified by the IUCN, sensu Dudley 2008) is in the northeast of the state of Alagoas and partially covers the municipalities of Murici, União dos Palmares, São José da Laje, Ibateguara, Colônia Leopoldina, Novo Lino, Joaquim Gomes, Messias, Branquinha and Flexeiras. The total area is 133,100 ha, and within this protected area sustainable use is permitted (Law Decree No. 5.907/199; Alagoas 1997). Created in 1993, this APA is considered the largest terrestrial protected area in the state of Alagoas with its main objective being to protect the raised areas of the relief wrinkling for the Borborema Plateau and its water resources.

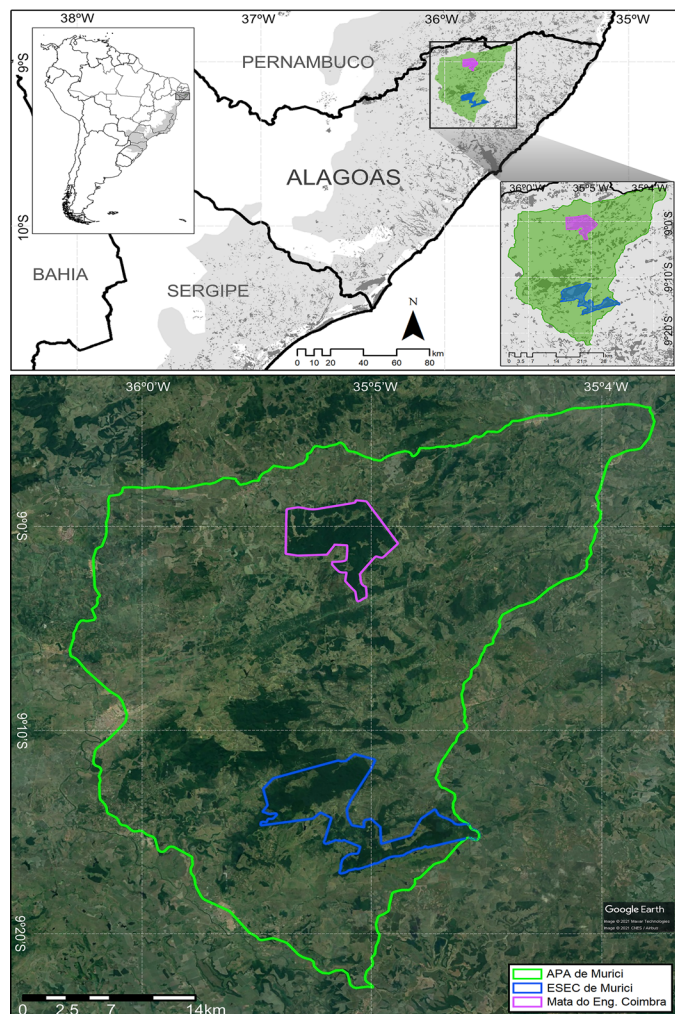


Figure 1. Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. A = Location and limits of APA (green) and ESEC (blue) de Murici and *Mata do Engenho Coimbra* (purple) and original cover (light green; adapted from IBGE 2022) and remaining cover (dark-grey; adapted from SOS MATA ATLÂNTICA 2022) of Atlantic Forest. B = Satellite image highlighting the limits of APA (green) and ESEC (blue) de Murici and *Mata do Engenho Coimbra* (purple). Inset map: South America.

Inserted within the limits of the APA de Murici, the Estação Ecológica (Ecological Station/ ESEC) de Murici (ESEC de Murici; Figures 1–2; protection category with similar objectives as the “Ia: Strict Nature Reserve” classified by the IUCN, sensu Dudley 2008) comprises a federal protected area of restrictive use and comprises one of the largest and continuous remnants of the original Atlantic Forest to the north of the São Francisco River. This ESEC was recently created by the decree of law s/No. of May 28, 2001 (Brasil 2001) and has an area of approximately 6,130 ha, partly covering the municipalities of Murici, Flexeiras and Messias.

In general, the forest remnants located in both protected areas have different phytophysionomies, varying from Ombrophilous Forest, with dense and tall tree phytophysionomies towards Seasonal Forest and wide rocky outcrops (Assis 2000). Elevation varies from 150 to 640 meters. The climate is tropical humid and sub-humid, with a dry period from October to March, and a rainy period from April to September. The annual precipitation and temperature range from 800 to 1,800 mm and 20 to 25 °C, respectively (Alvarez et al. 2013, SEMARH 2022).

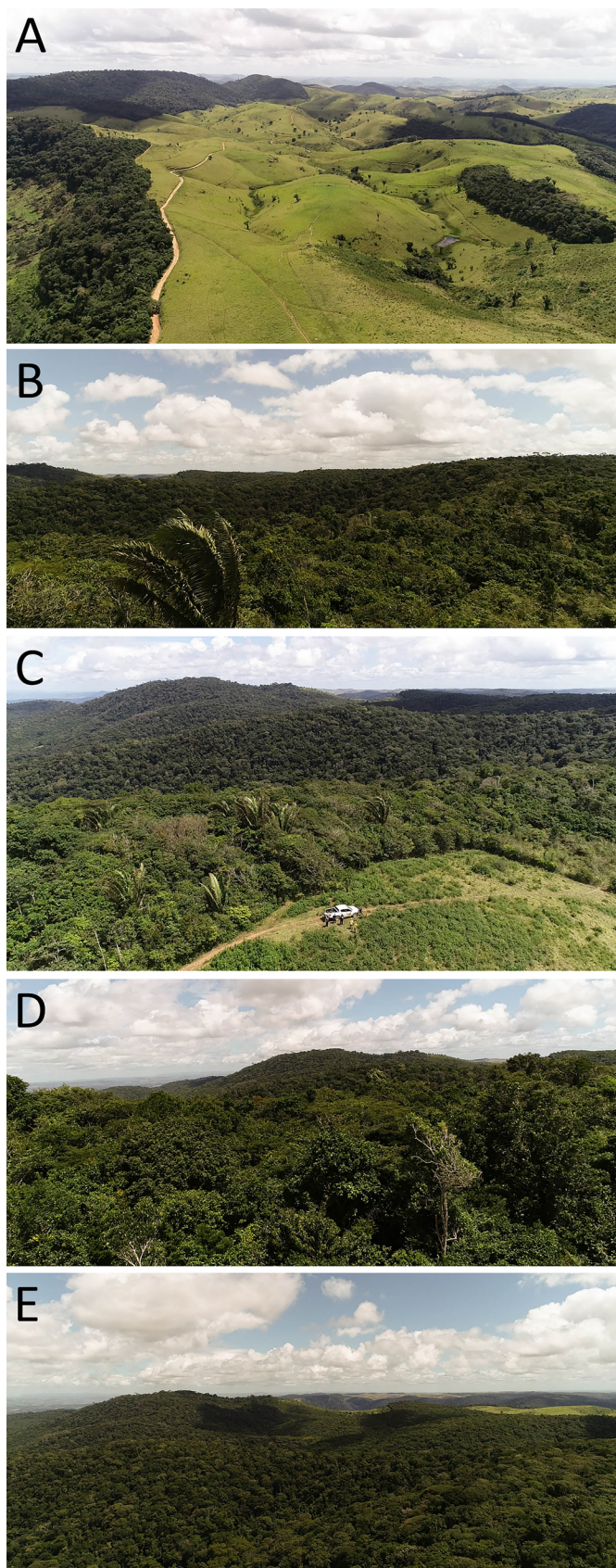


Figure 2. Aerial view of Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. A = Highlight for the small fragments surrounded by the pasture; B – E = Vegetation of the largest forest remnant (*Mata da Bananeira*). Photos: Rafael Cordeiro.

2. Data collection

The species list was constructed based on expeditions and occasional encounters in the APA and ESEC de Murici between 1994 and 2022 by different researchers. Specifically, in the ESEC de Murici and *Mata do Engenho Coimbra* (inserted in the limits of the APA de Murici, located 19 km north of the ESEC de Murici) intensive and standardized sampling efforts using different collection methods, were employed.

For the ESEC de Murici, expeditions were carried out every two months of 3 to 4 consecutive days by EMXF, ST and collaborators between the years 1994 to 1996. The sampling effort was entirely employed using the active search method, totaling 1,450 hours/person (Foster 2012). Expeditions were then performed between 2012 and 2015 by JVAN, ICST, BSL and collaborators. A total of 18 campaigns (totaling 114 field days) were carried out, with monthly visits lasting seven days between December 2012 and December 2013 and visits every two months lasting five days between March 2014 and March 2015. During the first year of sampling (December 2012 to December 2013), 24 sets of pitfall traps were installed at different points in the main fragment of the ESEC de Murici, called *Mata da Bananeira* (Figure 2B–E). Each station consisted of four 60-liter buckets, arranged in a “Y” and interconnected by a guide fence measuring four meters in length and 70 cm in height (adapted from Cechin & Martins 2000, Foster 2012). The traps were opened for five days during each expedition, totaling 1,440 hours/bucket. Additionally, three glue traps (dimensions 20 x 15 centimeters) were installed within a radius of six meters from each of the pitfall stations (totaling 72 traps), one in a fallen log and two in vertical logs (0.3–1.5 meters above from soil). Like the pitfalls, the glue traps were kept for five days during each expedition, totaling 1,440 hours/trap.

For *Mata do Engenho Coimbra*, four expeditions lasting 20 days each were carried out by Ubiratan Gonçalves and collaborators during 2006 and 2007, of which two were performed during the dry period (November to December 2006 and April 2007) and two during the rainy season (August to September 2007 and September to October 2007), totaling 80 field days. The sampling effort was directed towards the registration and collection of lizards, resulting in 524 hours/person of active and visual searches. During the period of field expeditions, three sets of pitfall traps were installed at different points in the fragment. Each station consisted of 32 buckets of 25–37 liters (96 buckets in total), arranged in a “Y” and interconnected by a guide fence measuring four meters in length and 70 cm in height. The traps were opened 15 days before each expedition and remained open during the 20 days in the field, totaling 3,360 hours/bucket.

All specimens collected (Collection and Transport License ICMBio/SisBio 33507) were euthanized using 10% lidocaine, fixed in 10% formalin (Beaver 2001) and incorporated into the Coleção Herpetológica do Museu de História Natural da Universidade Federal de Alagoas (MHN-UFAL), Coleção Herpetológica da Universidade Federal do Rio Grande do Norte (UFRN-CH), Coleção Herpetológica da Universidade Federal Rural de Pernambuco (CHP-UFRPE), and Coleção Herpetológica do Museu de Zoologia da Universidade de São Paulo (MZUSP). Material identification was carried out using the available literature and by consulting specialists in this area. The taxonomic nomenclature followed Uetz et al. (2022) (except Dipsadidae which follows Zaher et al. [2019]).

3. Conservation status

The conservation status of each taxon was determined following the Redlist of the International Union for the Conservation of Nature (IUCN 2022) and the Brazilian Redlist, the *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção* of the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio 2018).

Results

A total of 89 reptile species were obtained during the 28 years of collection. Seventy-six species were recorded within the limits of the ESEC de Murici (85% of the total) of which 17 were recorded only in this protected area. As for the APA de Murici, 72 species (81% of the total) were recorded, of which 12 were only recorded in this protected area. Within Crocodylia, two species of Alligatoridae were recorded. Within Testudines, three species were recorded, two of Chelidae and one of Kinosternidae. Within Squamata, two species of amphisbaenians were recorded, both belonging to Amphisbaenidae family. Twenty-seven species of lizards were recorded, where Gymnophthalmidae was the most diverse family with four species, followed by Dactyloidae, Dipoglossidae, Scincidae, Teiidae and Tropiduridae (3 spp. each), Phyllodactylidae, Polychrotidae and Sphaerodactylidae (2 spp. each), Gekkonidae, Iguanidae and Leiosauridae (1 spp. each). Fifty-four species of snakes were recorded, of which Dipsadidae was the most diverse family with 30 species, followed by Colubridae (8 spp.), Viperidae (5 spp.), Boidae (4 spp.), Elapidae and Typhlopidae (2 spp. each), Anomalepididae and Leptotyphlopidae (1 spp. each). Of these, two are currently considered endangered: *Amerotyphlops paucisquamus* and *Bothrops muriciensis* (Vulnerable [VU] and Endangered [EN], respectively, according to the national list; ICMBio 2018). The complete species list including information about voucher, the protected area of the record and global and national conservation status is provided in Table 1 (Figures 3 - 9).

Table 1. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. Collection acronym: MHN-UFAL= Coleção Herpetológica do Museu de História Natural da Universidade Federal de Alagoas; UFRN-CH= Coleção Herpetológica da Universidade Federal do Rio Grande do Norte; CHP-UFRPE= Coleção Herpetológica da Universidade Federal Rural de Pernambuco; MZUSP= Museu de Zoologia da Universidade de São Paulo. Area of record: ESEC= Estação Ecológica de Murici; APA= Área de Proteção Ambiental de Murici. Conservation status: EN= Endangered; VU= Vulnerable; LC= Least Concern; DD= Data Deficient; NE= Not Evaluated. For specimens that do not have a voucher, there is photographic record (Figures 3 – 9) or personal observation (P.O.).

SPECIES	VOUCHER	Recorded in		Conservation status	
		ESEC	APA	ICMBIO	IUCN
CROCODYLIA					
Alligatoridae					
<i>Caiman latirostris</i> (Daudin, 1801)	MHN-UFAL 16463		●	LC	LC
<i>Paleosuchus palpebrosus</i> (Cuvier, 1807)	Figure 3B	●	●	LC	LC

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SPECIES	VOUCHER	Recorded in		Conservation status	
		ESEC	APA	ICMBIO	IUCN
TESTUDINATA					
Chelidae					
<i>Mesoclemmys tuberculata</i> (Luederwaldt, 1926)	P.O.		●	LC	NE
<i>Phrynops Geoffroanus</i> (Schweigger, 1812)	Figure 3C		●	LC	NE
Kinosternidae					
<i>Kinosternon s. scorpioides</i> (Linnaeus, 1766)	MHN-UFAL 12175	●	●	LC	NE
SQUAMATA					
AMPHISBAENIAS					
Amphisbaenidae					
<i>Amphisbaena alba</i> Linnaeus, 1758	MHN-UFAL 1883	●	●	LC	LC
<i>Amphisbaena pretrei</i> Duméril & Bibron, 1839	MHN-UFAL 1411	●	●	LC	LC
"LIZARDS"					
Dactyloidae					
<i>Dactyloa punctata</i> (Daudin, 1802)	MHN-UFAL 10827	●	●	LC	LC
<i>Norops fuscoauratus</i> (D'Orbigny, 1837)	MHN-UFAL 10877	●	●	LC	LC
<i>Norops ortonii</i> (Cope, 1868)	MHN-UFAL 11555	●	●	LC	NE
Diploglossidae					
<i>Diploglossus fasciatus</i> (Gray, 1831)	MHN-UFAL 1643	●	●	LC	LC
<i>Diploglossus lessonae</i> Peracca, 1890	MHN-UFAL 1403	●	●	LC	LC
<i>Ophiodes striatus</i> (Spix, 1824)	MHN-UFAL 12269	●	●	DD	LC
Gekkonidae					
<i>Hemidactylus mabouia</i> (Moreau De Jonnés, 1818)	MHN-UFAL 1562	●	●	NE	LC
Gymnophthalmidae					
<i>Acratosaura mentalis</i> (Amaral, 1933)	UFRN-CH 2323		●	LC	LC
<i>Cercosaura olivacea</i> (Gray, 1845)	P.O.		●	NE	NE
<i>Dryadosaura nordestina</i> Rodrigues, Freire, Pellegrino & Sites, 2005	MHN-UFAL 10875	●	●	LC	LC
<i>Stenolepis ridleyi</i> Boulenger, 1887	MHN-UFAL 11686	●	●	LC	LC
Iguanidae					
<i>Iguana i. iguana</i> (Linnaeus, 1758)	MHN-UFAL 16135		●	LC	LC
Leiosauridae					
<i>Enyalius aff. catenatus</i> (Wied, 1821)	MHN-UFAL 10728	●	●	-	-
Phyllodactylidae					
<i>Gymnodactylus darwini</i> (Gray, 1845)	MHN-UFAL 2123	●		LC	LC
<i>Phyllopezus lutzae</i> (Loveridge, 1941)	MHN-UFAL 10872	●	●	LC	LC
Polychrotidae					
<i>Polychrus acutirostris</i> Spix, 1825	MHN-UFAL 1594	●		LC	LC
<i>Polychrus marmoratus</i> (Linnaeus, 1758)	MHN-UFAL 10943	●	●	LC	LC
Scincidae					
<i>Copeoglossum nigropunctatum</i> (Spix, 1825)	MHN-UFAL 10845	●		LC	LC
<i>Psychosaura agmosticha</i> (Rodrigues, 2000)	P.O.	●	●	LC	LC
<i>Psychosaura macrorhyncha</i> (Hoge, 1946)	MHN-UFAL 1587	●		LC	LC
Sphaerodactylidae					
<i>Coleodactylus elizae</i> Gonçalves, Torquato, Skuk & Sena, 2012	MHN-UFAL 11417	●		DD	NE
<i>Coleodactylus meridionalis</i> (Boulenger, 1888)	MHN-UFAL 10838	●	●	LC	LC
Teiidae					
<i>Ameiva a. ameiva</i> (Linnaeus, 1758)	MHN-UFAL 10996	●	●	LC	LC
<i>Kentropyx calcarata</i> Spix, 1825	MHN-UFAL 10921	●	●	LC	LC
<i>Salvator merianae</i> Duméril & Bibron, 1839	Figure 5D	●	●	LC	LC
Tropiduridae					
<i>Strobilurus torquatus</i> Wiegmann, 1834	MHN-UFAL 10834	●	●	LC	LC
<i>Tropidurus hispidus</i> (Spix, 1825)	MHN-UFAL 10945	●	●	LC	LC
<i>Tropidurus semitaeniatus</i> (Spix, 1825)	MHN-UFAL 10944	●	●	LC	LC
SNAKES					
Anomalepididae					
<i>Liotyphlops trefauti</i> Freire, Caramaschi & Argolo, 2007	MZUSP 12178		●	DD	DD
Boidae					
<i>Boa c. constrictor</i> Linnaeus, 1758	MHN-UFAL 12020	●	●	LC	LC
<i>Corallus hortulana</i> (Linnaeus, 1758)	MHN-UFAL 10879	●	●	LC	NE
<i>Epicrates assisi</i> Machado, 1945	CHP-UFRPE 6019		●	LC	LC
<i>Epicrates cenchria</i> (Linnaeus, 1758)	MHN-UFAL 12241	●	●	LC	NE

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SPECIES	VOUCHER	Recorded in		Conservation status	
		ESEC	APA	ICMBIO	IUCN
Colubridae					
<i>Chironius carinatus</i> (Linnaeus, 1758)	CHP-UFRPE 6010	●	●	LC	NE
<i>Chironius flavolineatus</i> Jan, 1863	MHN-UFAL 10888	●	●	LC	LC
<i>Dendrophidion atlantica</i> Freire, Caramaschi & Gonçalves, 2010	MHN-UFAL 12021	●	●	DD	NE
<i>Drymoluber dichrous</i> (Peters, 1863)	MHN-UFAL 10957	●	●	LC	LC
<i>Oxybelis aeneus</i> (Wagler, 1824)	MHN-UFAL 10891	●	●	LC	LC
<i>Spilotes s. sulphureus</i> (Wagler, 1824)	MHN-UFAL 11036	●	●	LC	LC
<i>Spilotes p. pullatus</i> (Linnaeus, 1758)	MHN-UFAL 11060	●		LC	LC
<i>Tantilla melanocephala</i> (Linnaeus, 1758)	MHN-UFAL 10956	●	●	LC	LC
Dipsadidae					
<i>Atractus maculatus</i> (Günther, 1858)	MHN-UFAL 12342	●		DD	LC
<i>Cercophis auratus</i> (Schlegel, 1837)	MHN-UFAL 16636	●		LC	DD
<i>Dipsas i. indica</i> Laurenti, 1768	MHN-UFAL 11037	●		LC	LC
<i>Dipsas m. mikanii</i> (Schlegel, 1837)	MHN-UFAL 1886	●	●	LC	LC
<i>Dipsas neuwiedi</i> (Ihering, 1911)	MHN-UFAL 12888	●	●	LC	LC
<i>Dipsas sazimai</i> Fernandes, Marques & Argôlo, 2010	MHN-UFAL 12890	●		LC	LC
<i>Dipsas variegata</i> (Duméril, Bibron & Duméril, 1854)	MHN-UFAL 13005	●	●	LC	LC
<i>Echinanthera cephalostriata</i> Di Bernardo, 1996	MHN-UFAL 12345	●		-	-
<i>Erythrolamprus aesculapii venustissimus</i> (Wied, 1821)	MHN-UFAL 12793	●	●	LC	LC
<i>Erythrolamprus miliaris merremii</i> (Wied, 1821)	Figure 7C–D			LC	LC
<i>Erythrolamprus p. poecilogyrus</i> (Wied, 1824)	MHN-UFAL 13922		●	LC	LC
<i>Erythrolamprus reginae</i> (Linnaeus, 1758)	MHN-UFAL 11033	●		LC	LC
<i>Erythrolamprus taeniogaster</i> (Jan, 1863)	MHN-UFAL 10426	●	●	LC	LC
<i>Erythrolamprus v. viridis</i> (Günther, 1862)	MHN-UFAL 12800	●	●	LC	LC
<i>Helicops angulatus</i> (Linnaeus, 1758)	MHN-UFAL 10752	●	●	LC	LC
<i>Imantodes cenchoa</i> (Linnaeus, 1758)	MHN-UFAL 10835	●	●	LC	LC
<i>Leptodeira a. annulata</i> (Linnaeus, 1758)	MHN-UFAL 10835	●	●	LC	LC
<i>Oxyrhopus guibei</i> Hoge & Romano, 1977	MHN-UFAL 12358	●	●	LC	LC
<i>Oxyrhopus petolaris digitalis</i> (Reuss, 1834)	MHN-UFAL 12350	●	●	LC	LC
<i>Oxyrhopus trigeminus</i> Duméril, Bibron & Duméril, 1854	MHN-UFAL 10427	●		LC	LC
<i>Philodryas nattereri</i> (Steindachner, 1870)	Figure 8D		●	LC	LC
<i>Philodryas olfersii</i> (Lichtenstein, 1823)	CHP-UFRPE 6014	●	●	LC	LC
<i>Pseudablades patagoniensis</i> (Girard, 1858)	MHN-UFAL 16637		●	LC	LC
<i>Pseudoboa nigra</i> (Duméril, Bibron & Duméril, 1854)	MHN-UFAL 12352	●	●	LC	LC
<i>Siphlophis compressus</i> (Daudin, 1803)	MHN-UFAL 12214	●	●	LC	LC
<i>Taeniophallus affinis</i> (Günther, 1858)	MHN-UFAL 10723	●		LC	LC
<i>Taeniophallus occipitalis</i> (Jan, 1863)	MHN-UFAL 10724	●	●	LC	LC
<i>Thamnodynastes pallidus</i> (Linnaeus, 1758)	MHN-UFAL 10611	●	●	LC	LC
<i>Xenodon merremii</i> (Wagler, 1824)	Figure 8J	●	●	LC	NE
<i>Xenodon r. rabdocephalus</i> (Wied, 1824)	MHN-UFAL 1655	●	●	LC	LC
<i>Xenopholis scalaris</i> (Wucherer, 1861)	MHN-UFAL 12354	●	●	LC	LC
Elapidae					
<i>Micrurus ibiboboca</i> (Merrem, 1820)	MHN-UFAL 10750	●	●	DD	NE
<i>Micrurus carvalhoi</i> Roze, 1967	MHN-UFAL 12349	●		LC	LC
Leptotyphlopidae					
<i>Trilepida salgueiroi</i> (Amaral, 1955)	CHP-UFRPE 4957	●		LC	LC
Typhlopidae					
<i>Amerotyphlops arenensis</i> Graboski, Filho, Silva, Prudente & Zaher, 2015	MHN-UFAL 10874	●	●	LC	LC
<i>Amerotyphlops paucisquamus</i> (Dixon & Hendricks, 1979)	MHN-UFAL 2058		●	VU	LC
Viperidae					
<i>Bothrops b. bilineatus</i> (Wied, 1821)	MHN-UFAL 10753	●	●	LC	NE
<i>Bothrops leucurus</i> Wagler, 1824	MHN-UFAL 1551	●	●	LC	NE
<i>Bothrops muriciensis</i> Ferrarezzi & Freire, 2001	MHN-UFAL 10751	●	●	EN	NE
<i>Crotalus durissus cascavella</i> Wagler in Spix, 1824	MHN-UFAL 12343	●	●	LC	LC
<i>Lachesis muta</i> (Linnaeus, 1766)	MHN-UFAL 13784	●	●	LC	LC

Reptiles of ESEC and APA de Murici

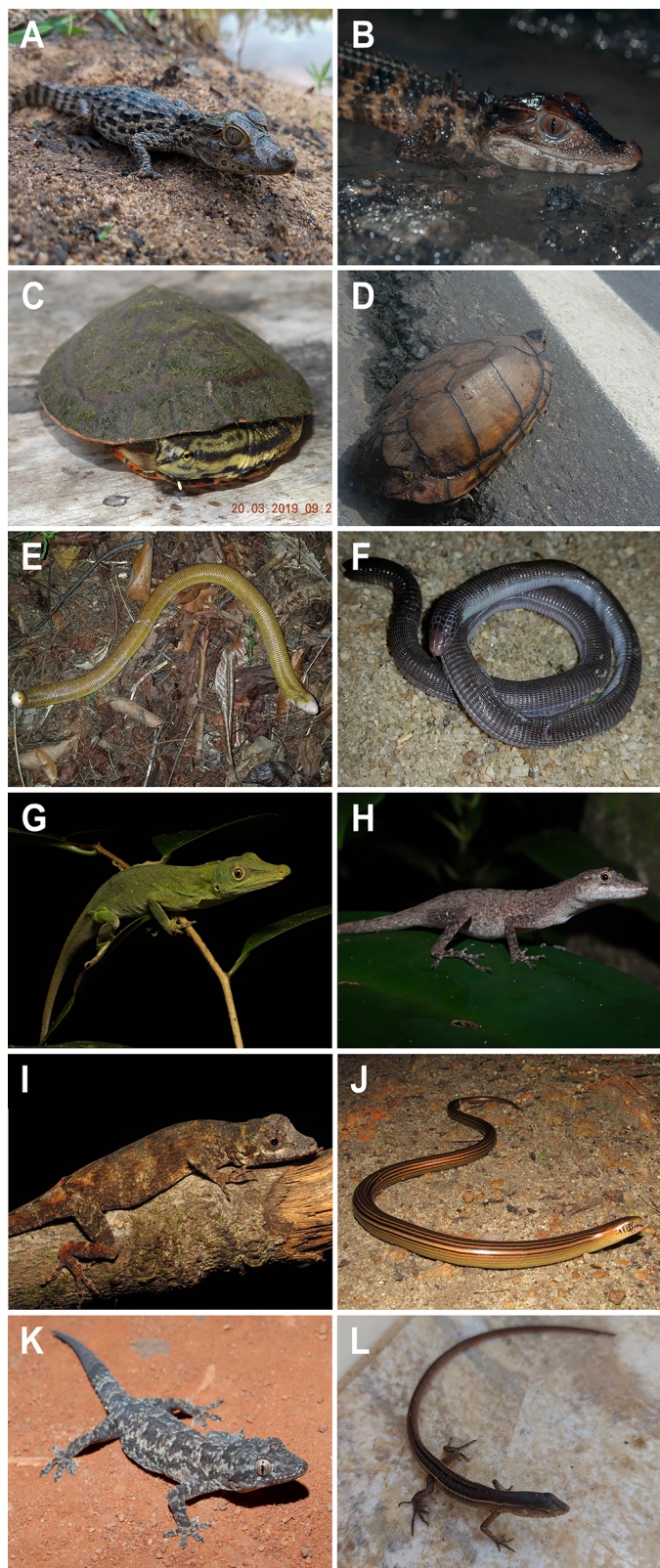


Figure 3. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Caiman latirostris*; **B** - *Paleosuchus palpebrosus*; **C** - *Phrynops geoffroanus*; **D** - *Kinosternon s. scorpoides*; **E** - *Amphisbaena alba*; **F** - *A. pretrei*; **G** - *Dactyloa punctata*; **H** - *Norops fuscoauratus*; **I** - *N. ortonii*; **J** - *Ophiodes striatus*; **K** - *Hemidactylus mabouia*; **L** - *Cercosaura olivacea*. All photos were taken from individuals found in the study area. Photos: A, C, D, E, F (Marco de Freitas); B, G, H, K (Marcos Dubeux); I, J (José Neto); L (Ubiratan Gonçalves).

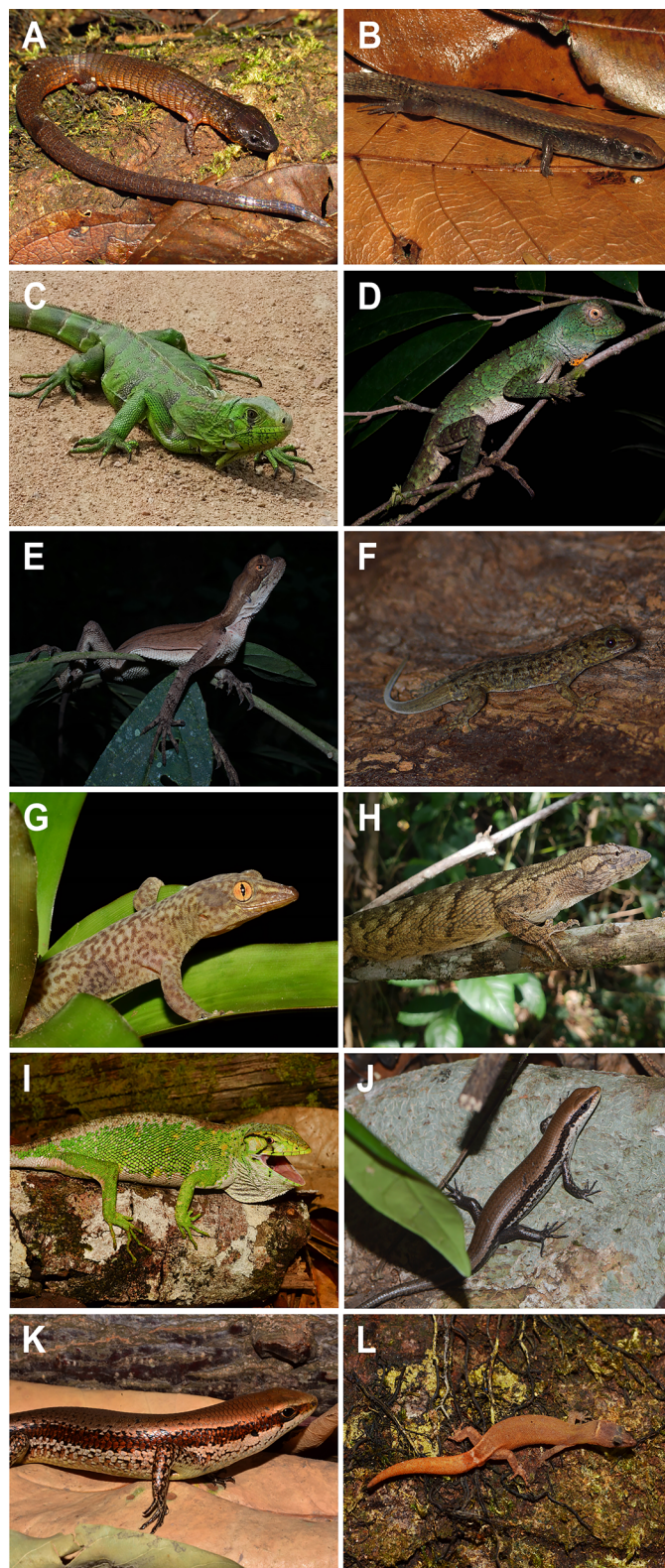


Figure 4. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Dryadosaura nordestina*; **B** - *Stenolepis ridleyi*; **C** - *Iguana i. iguana*; **D** - *Enyalius aff. catenatus* (male); **E** - *E. aff. catenatus* (female); **F** - *Gymnodactylus darwini*; **G** - *Phyllopezus lutzae*; **H** - *Polychrus acutirostris*; **I** - *P. marmoratus*; **J** - *Copeoglossum nigropunctatum*; **K** - *C. nigropunctatum*; **L** - *Coleodactylus elizae*. All photos were taken from individuals found in the study area. Photos: A, B (José Neto); C, H, J (Marco de Freitas); D, E, M (Marcos Dubeux); F (Márcio Campelo); G, I, K, L (Barnagleison Lisboa).

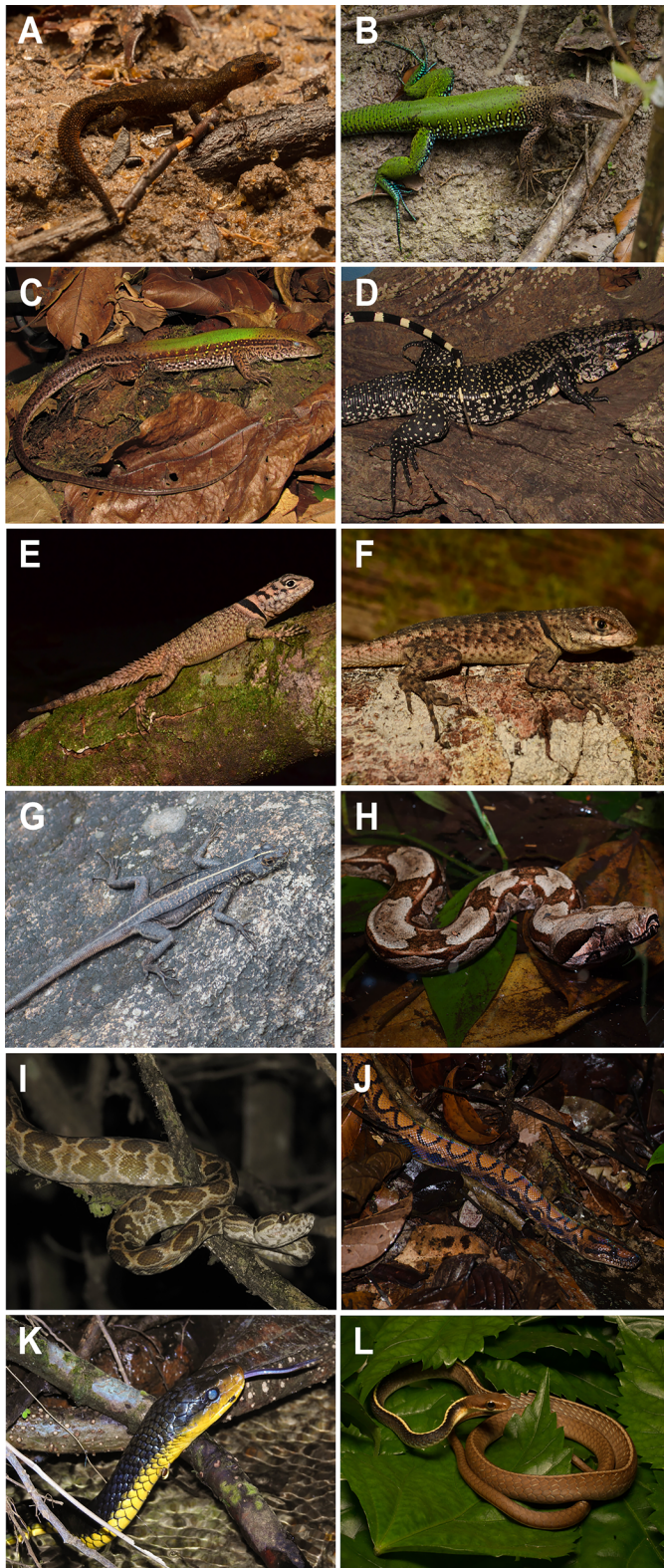


Figure 5. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Coleodactylus meridionalis*; **B** - *Ameiva a. ameiva*; **C** - *Kentropyx calcarata*; **D** - *Salvator merianae*; **E** - *Strobilurus torquatus*; **F** - *Tropidurus hispidus*; **G** - *T. semitaeniatus*; **H** - *Boa c. constrictor*; **I** - *Corallus hortulana*; **J** - *Epicrates cenchria*; **K** - *Chironius carinatus*; **L** - *C. flavolineatus*. All photos were taken from individuals found in the study area. Photos: A, H, L (Marcos Dubeux); B, I, J (Hermínio Vilela); C, D (José Neto); E, F (Barnagleison Lisboa); G (Márcio Campelo); K (Marco de Freitas).

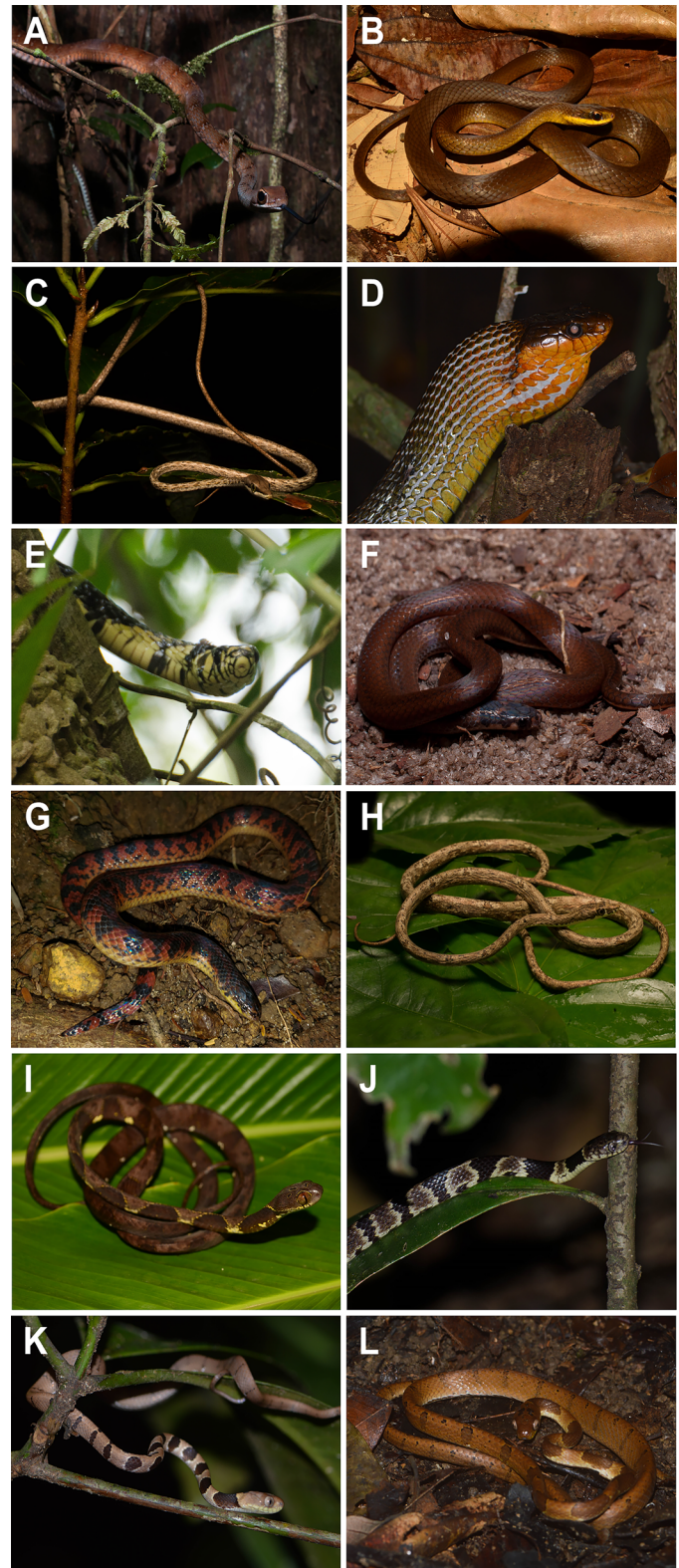


Figure 6. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Dendrophidion atlantica*; **B** - *Drymoluber dichrous*; **C** - *Oxybelis aeneus*; **D** - *Spilotes s. sulphureus*; **E** - *S. p. pullatus*; **F** - *Tantilla melanocephala*; **G** - *Atractus maculatus*; **H** - *Cercophis auratus*; **I** - *Dipsas i. indica*; **J** - *D. newwiedi*; **K** - *D. sazimai* (juvenile); **L** - *D. sazimai* (adult). All photos were taken from individuals found in the study area. Photos: A, C, F, H (Marcos Dubeux); B, I (Barnagleison Lisboa); D, K, L (Márcio Campelo); E, J (Hermínio Vilela); G (Marco de Freitas).

Reptiles of ESEC and APA de Murici

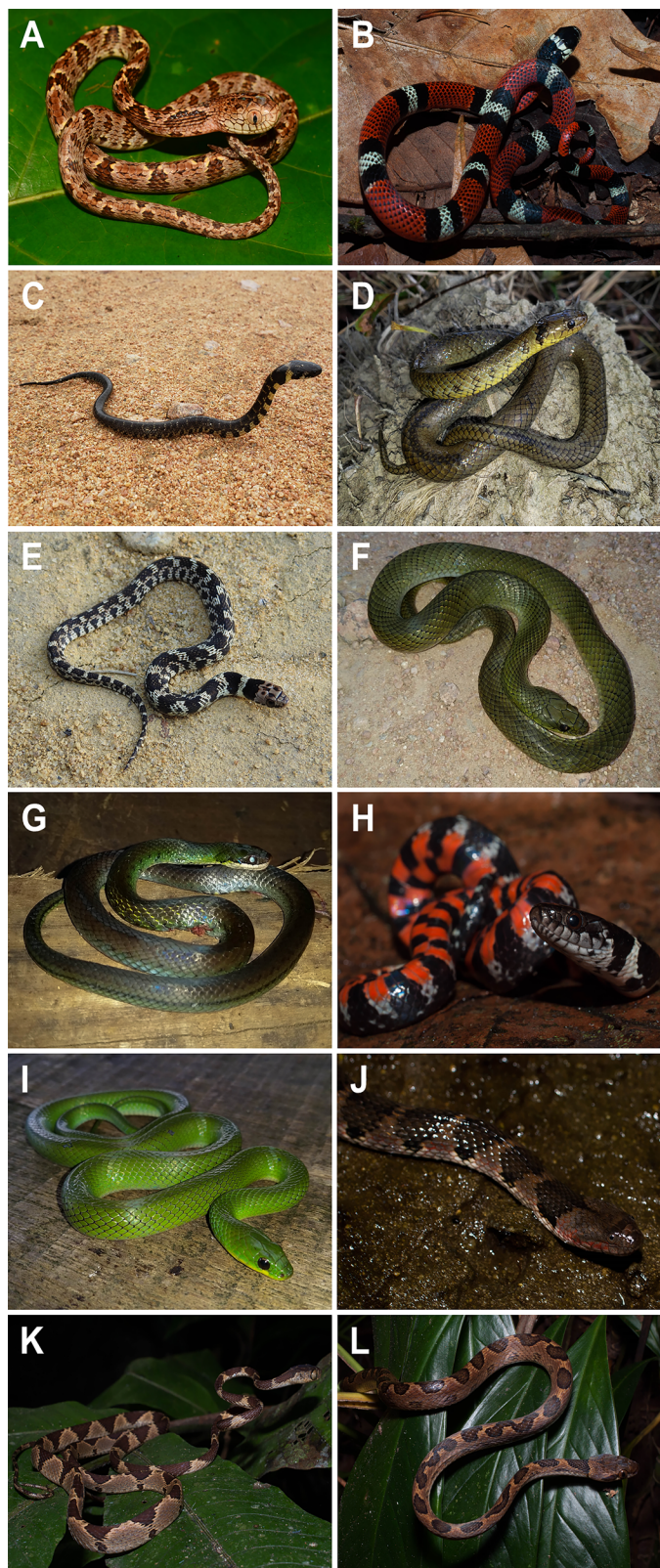


Figure 7. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Dipsas variegata*; **B** - *Erythrolamprus aesculapii venustissimus*; **C** - *Erythrolamprus miliaris merremii* (juvenile); **D** - *E. miliaris merremii* (adult); **E** - *E. p. poecilogyrus* (juvenile); **F** - *E. poecilogyrus* (adult); **G** - *E. reginae*; **H** - *E. taeniogaster*; **I** - *E. v. viridis*; **J** - *Helicops angulatus*; **K** - *Imantodes cenchoa*; **L** - *Leptodeira a. annulata*. All photos were taken from individuals found in the study area. Photos: A (Barnagleison Lisboa); B, H, J, K, L (Marcos Dubeux); C, D, E, F, G, I (Marco de Freitas).

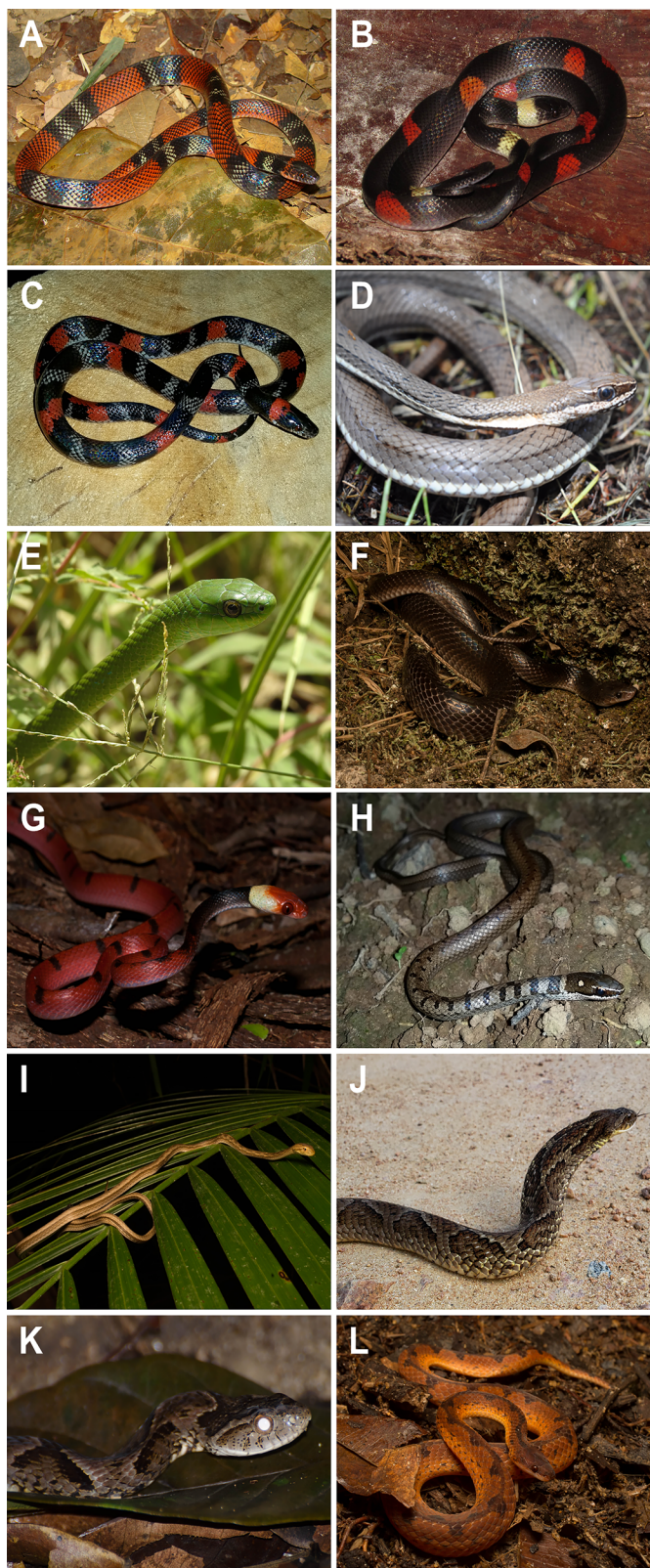


Figure 8. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Oxyrhopus guibeii*; **B** - *O. petolaris digitalis*; **C** - *O. trigeminus*; **D** - *Philodryas nattereri*; **E** - *P. olfersii*; **F** - *Pseudoboa nigra*; **G** - *Siphlophis compressus*; **H** - *Taeniophallus occipitalis*; **I** - *Thamnodynastes pallidus*; **J** - *Xenodon merremii*; **K** - *X. r. rabdocephalus*; **L** - *Xenopholis scalaris*. All photos were taken from individuals found in the study area. Photos: A, B, C, E, H, J (Marco de Freitas); D, F, G, I, L (Marcos Dubeux); K (Herminio Vilela).

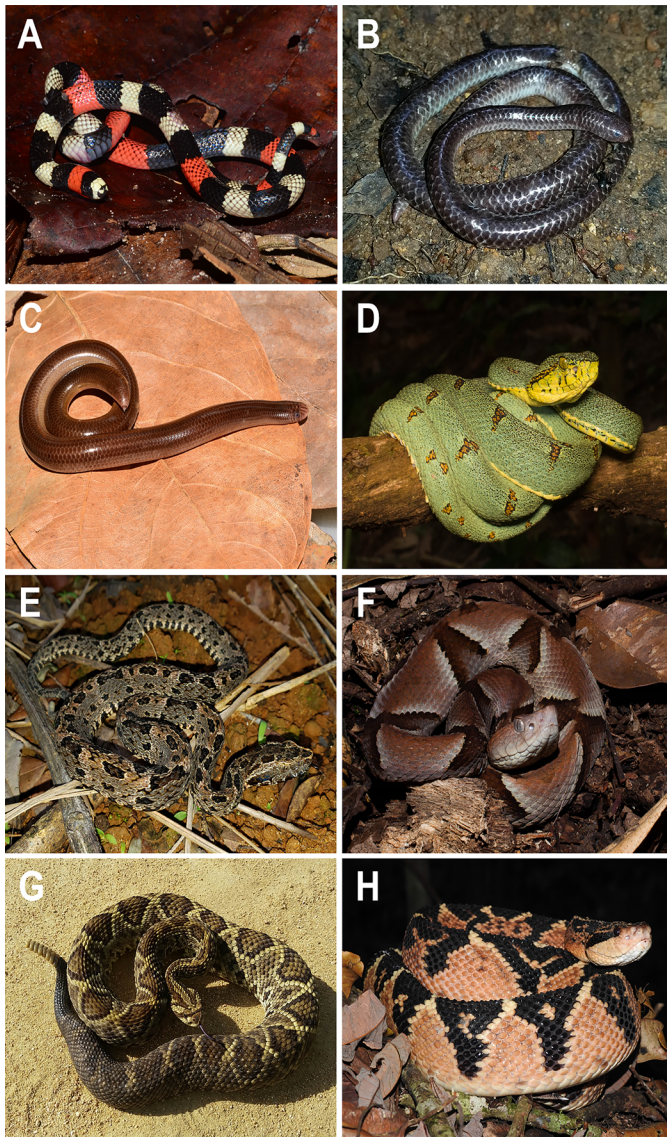


Figure 9. Reptiles recorded in the Estação Ecológica and Área de Proteção Ambiental de Murici, Alagoas state, northeastern Brazil. **A** - *Micrurus ibiboboca*; **B** - *Trilepida salgueiroi*; **C** - *Amerotyphlops arenensis*; **D** - *Bothrops b. bilineatus*; **E** - *B. leucurus*; **F** - *B. muriciensis*; **G** - *Crotalus durissus cascavella*; **H** - *Lachesis muta*. All photos were taken from individuals found in the study area. Photos: A, C (Barnagleison Lisboa); B, E, G, H (Marco de Freitas); D, F (Marcos Dubeux).

Discussion

The reptile richness recorded for the APA and ESEC de Murici is by far one of the greatest ever documented for the entire Atlantic Forest (e.g., Santana et al. 2008, Roberto et al. 2015, Roberto et al. 2017, Mesquita et al. 2018, Melo et al. 2018, Barbosa et al. 2019, Lima et al. 2021, Oliveira et al. 2021). This expressive richness is also the result of the high sampling effort and collection time applied in the study area, which is one of the more well sampled areas in the entire state of Alagoas. With 89 registered species, these protected areas surpass, in terms of number of species, the areas that previously housed the greatest reptile richness of the Atlantic Forest north of the São Francisco River - the Reserva Biológica (Biological Reserve) Guaribas, Paraíba state, and the Reserva Biológica de Pedra Talhada, Alagoas and Pernambuco states, both with 72 recorded reptile species (Roberto et al. 2015, Mesquita et al. 2018).

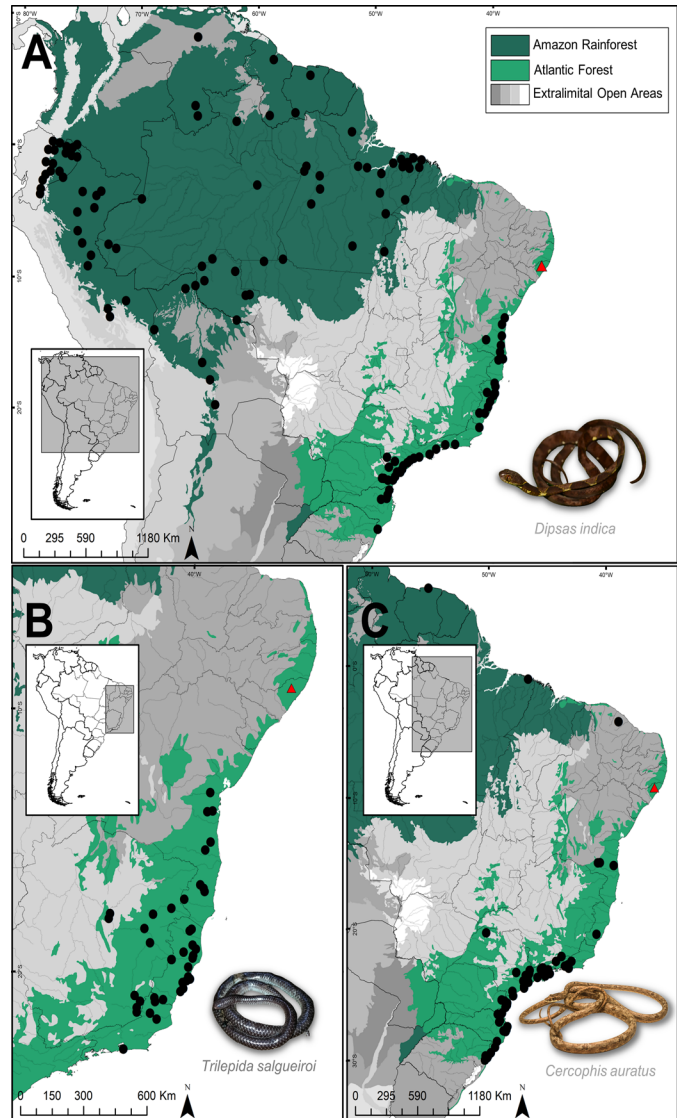


Figure 10. Geographical distribution and new records for **(A)** *Dipsas indica*, **(B)** *Trilepida salgueiroi* and **(C)** *Cercophis auratus* in the Atlantic Forest of Northeastern Brazil. Black circles = literature records (Nogueira et al. 2019); Red triangle = new records. Inset map = South America.

It is worth noting that although the ESEC de Murici area is comprised of only 6,130 ha, it has the most conserved forest fragments in the region and is home to more than 96% of the species recorded here. When considering its small geographic coverage, the ESEC de Murici can be considered the richest area, in terms of reptile fauna, in the entire Brazilian territory. This ESEC represents one of the last forest fragments of the Atlantic Forest north of the São Francisco River, and undoubtedly has an important conservation value (Filho et al. 2021).

Although there was a considerable sampling effort and the use of complementary sampling methodologies (active and passive), this effort was not evenly distributed temporally and geographically in the study area. This fact makes it difficult to present statistics on species richness and sampling effort or methodological comparisons covering the entire set of data obtained. In fact, these data will be better explored in future studies with a specific focus on the evaluation of techniques for collecting amphibians and reptiles in the northern Atlantic Forest (MJMD unpublished data).

Two species registered in the area are considered threatened. *Amerotyphlops paucisquamus* is considered a Vulnerable [VU] species according to the national list (ICMBio 2018; not evaluated in the international list, IUCN 2022). This species of fossorial snake has a restricted distribution in the Atlantic Forest north of the São Francisco River and in some forest areas in the state of Maranhão (Dixon & Hendricks 1979, Rodrigues et al. 1988, Graboski et al. 2019, Nogueira et al. 2019). Since it is restricted to forested areas, deforestation and the consequent loss of habitat are considered the main threats to this snake (ICMBio 2018). *Bothrops muriciensis* (Figure 9F) is classified as Endangered [EN] on the national list (ICMBio 2018; not evaluated in the international list, IUCN 2022). This species is endemic to ESEC de Murici and known to occur in only a single forest remnant called *Mata da Bananeira*. Knowledge about basic aspects of its biology is still scarce and up until 2012 the species was known by only nine individuals, all found close to its original area of description (Ferrarezzi & Freire 2001, Freitas et al. 2012). Recent studies have been refining this knowledge and although still restricted to the ESEC de Murici, new records of the species have been described in recent years (MJMD unpublished data).

Additionally, six recorded species are defined as Data Deficient [DD] for the assessment of their conservation status (*Coleodactylus elizae*, *Ophiodes striatus*, *Liotyphlops trefauti*, *Atractus maculatus*, *Cercophis auratus* and *Micrurus ibiboboca*). These species are lonely and elusive, making an accurate assessment difficult due to the incomplete knowledge of their geographic distribution and population sizes, as well as their ecological and environmental requirements (ICMBio 2018). The evaluation of these taxa is necessary, as some are currently only known to occur in a few localities, such as *Coleodactylus elizae* (Figure 4L) which presents a disjointed distribution and is only known to occur in the ESEC de Murici and for its type locality, 37 km away in the municipality of Maceió, state of Alagoas (Gonçalves et al. 2012). While others, although widely distributed, are considered complexes of cryptic species, for example, *Ophiodes striatus* and *Micrurus ibiboboca* (Figure 3J and 9A; ICMBio 2018, Schools & Hedges 2021), where the current taxonomic context can give the false impression of widespread species rather than restricted distribution under different threats. Additionally, some species are known to be distinct evolutionary lineages and potential candidates for new species (e.g., *Enyalius* aff. *catenatus*; Rodrigues et al. 2014).

Three of the snakes found at the ESEC de Murici correspond to the first record of the species for the Atlantic Forest north of the São Francisco River (França et al. 2020). *Dipsas indica* (Figure 6I) is an arboreal Dipsadidae found in the interior of forests. The species has a widely disjointed distribution, occurring throughout practically the entire Amazon region and in the Atlantic Forest, from the states of Bahia to the extreme south of the state of Santa Catarina (Freitas 2015, Costa & Bérnils 2018, Arteaga et al. 2018, Nogueira et al. 2019; Figure 10A). The new record corresponds to the northernmost occurrence of this species, expanding its distribution 560 km north of its closest location (municipality of Jaguaripe, state of Bahia; Nogueira et al. 2019). The species was registered by a single individual (MHN-UFAL 11037), found in the interior of *Mata da Bananeira*.

The second species recorded was *Trilepida salgueiroi* (Figure 9B), a tiny snake belonging to the family Leptotyphlopidae with fossorial and semi-fossorial habits (Passos et al. 2005). The species is known to occur in the Atlantic Forest in the states of Bahia, Espírito Santo, Minas Gerais and Rio de Janeiro (Costa et al. 2009, Figueiredo-Andrade et al. 2011, Nogueira et al. 2019; Figure 10B).

The new record corresponds to the northernmost occurrence of the species, expanding its distribution 585 km north of its closest location (municipality of Laje, state of Bahia; Nogueira et al. 2019). The species was described by a single individual (CHP-UFRPE 4957), found dead near the edge of the forest.

The third record was of *Cercophis auratus* (Dipsadidae; Figure 6D), an arboreal snake with diurnal habits found within forests (Morato & Bérnils 1989, Marques 2000). This species is the only representative of the genus *Cercophis* and has a disjointed distribution in the Amazon Forest (where its type locality is located), in the southern portion of the Atlantic Forest and in the *Brejo de Altitude* in the state of Ceará (Hoogmoed et al. 2019, Nogueira et al. 2019, Bezerra et al. 2020, Figure 10C). The new record expands the known distribution of the species 814 km north of its closest location (municipality of Barra do Choça, state of Bahia; Bezerra et al. 2020). The species was described by a single individual (MHN-UFAL 16636), found under vegetation at a height of approximately 1.5 m high on the banks of a stream in the interior of *Mata da Bananeira*.

Although the APA and ESEC de Murici have been receiving attention from researchers in recent decades, little information has been made available so far on the herpetofauna in the region, especially regarding reptile fauna. The information available so far is limited to the description of some species (Ferrarezzi & Freire 2001, Fernandes et al. 2010), distribution extensions (Andrade-Lima et al. 2020) and some specific information on natural history (Santos et al. 2018, Dubeux et al. 2019, Dubeux et al. 2020, Dubeux & Gonçalves 2021) and conservation (Freitas et al. 2012). We hope that the species list provided here will serve as a starting point for paving the way for further studies in this “hotspot” of reptile diversity.

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Author Contribution

Marcos Jorge Matias Dubeux: Contribution to the conception and design of the work, data acquisition, data analysis and interpretation; writing and critical review of the manuscript, adding intellectual content.

José Vieira de Araújo Neto: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Ingrid Carolline Soares Tiburcio: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Barnagelison Silva Lisboa: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Selma Torquato: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Marco Antônio de Freitas: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Eliza Maria Xavier Freire: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Miriam Camargo Guarnieri: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Tamí Mott: Contribution to the conception and design of the work and data acquisition; writing and critical review of the manuscript, adding intellectual content.

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this work

Data Availability

Supporting data are available at <https://doi.org/10.48331/scielodata.1KX6SA>

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