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Inventory

Anurans of a protected area from Mantiqueira Complex, Atlantic Forest of Minas Gerais state, Brazil

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Abstract: The ecological domain of the Atlantic Forest holds a remarkable diversity of anurans with a great degree of endemism, most of which are distributed in high altitude areas, mostly represented by the mountains along the Mantiqueira Complex and Serra do Mar. Despite its biological importance, the region still shows a gap of sampling concerning the amphibians. Thus, we present the first systematic survey of the anuran fauna from Área de Proteção Ambiental Boqueirão da Mira (APABM), in the region of Zona da Mata, Minas Gerais state, Brazil. Two fieldwork expeditions were performed where fifteen sample points were inventoried through active night search and day audiovisual survey in breeding and foraging sites. The anuran fauna of the APABM presented 43 species distributed in 12 families, with the Hylidae family being the richest (17 species). Besides, four species had their distribution increased due to our findings (*Hylodes perere*, *Physalaemus rupestris, Bokermannohyla ibitipoca* and *Ololygon cosenzai*), all of them as endemic to the Mantiqueira Complex. This study revealed that the APABM has a great diversity of anuran species, more representative than adjacent regions such as the Parque Estadual Ibitipoca and close to the richness presented for the Parque Estadual Serra Negra da Mantiqueira. This work demonstrates the great importance of the APABM for conservation, highlighting it as an area of high diversity of the regional anuran species.
Keywords: *Anuran fauna; Inventory; Enviromental Protected Area; Boqueirão da Mira.*

Anuros de uma Unidade de Conservação da Serra da Mantiqueira, Mata Atlântica do estado de Minas Gerais, Brasil

Resumo: O domínio ecológico da Mata Atlântica possui uma notável diversidade de anuros com grande grau de endemismo, a maioria distribuídos em áreas de alta altitude, representadas principalmente pelas montanhas ao longo da Serra da Mantiqueira e Serra do Mar. Apesar de sua importância biológica, a região ainda mostra uma lacuna de amostragem em relação aos anfíbios. Assim, apresentamos o primeiro levantamento sistemático da anurofauna da Área de Proteção Ambiental Boqueirão da Mira (APABM), na região da Zona da Mata, Minas Gerais, Brasil. Foram realizadas duas expedições de campo, onde quinze pontos amostrais foram inventariados por meio de procura ativa noturna e diurna audiovisual em locais de reprodução e forrageio. A anurofauna da APABM apresentou 43 espécies distribuídas em 12 famílias, sendo a família Hylidae a mais rica (17 espécies). Além disso, quatro espécies tiveram sua distribuição ampliada devido aos nossos achados (*Hylodes perere*, *Physalaemus rupestris, Bokermannohyla ibitipoca* e *Ololygon cosenzai*), todas elas sendo endêmicas do Complexo da Mantiqueira. Este estudo revelou que a APABM possui uma grande diversidade de espécies de anuros, mais representativas do que regiões adjacentes como o Parque Estadual do Ibitipoca e próximas à riqueza apresentada pelo Parque Estadual da Serra Negra da Mantiqueira. Este trabalho demonstra a grande importância da APABM para a conservação, destacando-a como uma área de alta diversidade de espécies de anuros regionais.
Palavras-chave: *Anurofauna; Inventário; Área de Proteção Ambiental; Boqueirão da Mira.*

Introduction

The Neotropics contain the greatest diversity of amphibians in the world, distributed throughout important ecoregions such as Amazonia, Atlantic Forest (AF) and Tropical Andes (Frost 2021). The AF comprises about 625 anuran species, of which more than 340 occur as endemic species (Haddad & Prado 2005, Haddad et al. 2013, Rossa-Feres et al. 2017). This significant diversity is due to the region's climate, vegetation structure and topography variation across the land, creating great complexes of mountains (*e.g.,* Serra do Mar and Mantiqueira Complex) (Cruz & Feio 2007, Carnaval & Moritz 2008, Carnaval et al. 2009, Vasconcelos et al. 2014). Nonetheless, the AF has been deeply impacted by urban expansion, mining activities, agriculture and livestock ranching (Morellato & Haddad 2000, Tabarelli et al. 2010), remaining solely around 11.4% -16% of the original extension (SOSMA 2021). Different morphoclimatic conditions and high species diversity, along with the serious degree of threat, aid to classify the AF as a biodiversity hotspot for conservation priorities worldwide (Mittermeier et al. 2004).

Along the AF, the highlands, mostly in the central-southern portion, hold a remarkable diversity of anurans, considered important for maintaining taxonomic diversity and evolutionary history, with a great degree of endemism (Cruz & Feio 2007, Neves et al. 2018, Silva et al. 2018). This is primarily because of heterogeneous habitats and the floristics assemblages, altitudinal gradients and humidity in the region (Cruz & Feio 2007, Vasconcelos et al. 2014). On the other hand, in addition to the human impact already mentioned, the chytridiomycosis has been strengthening the decline of amphibians in the AF (Toledo et al. 2006, Carvalho et al. 2017). This degradation has likely contributed to the decline or extinction of anuran populations in the Mantiqueira Complex (Silva et al. 2018). Lastly, despite the diversity and importance of the highlands, these areas remain poorly know, and inventories of species are still needed in order to better understand the complexity of these environments and fill a gap of sampling.

Another way to mitigate the impact of fragmentation on diversity is restoring lost natural areas by increasing connectivity between protected areas (Cabeza & Moilainen 2001). In the Mantiqueira Complex, the Mantiqueira Ecological Corridor encompasses part of 42 municipalities and embraces significant protected areas like Área de Proteção Ambiental (APA – *Environmental Protected Area*) Fernão Dias, APA Serra da Mantiqueira, Parque Estadual (PE – *State Park*) Serra Negra da Mantiqueira, PE do Ibitipoca, PE da Serra do Papagaio, PE Serra do Brigadeiro, Parque Nacional (PN – *National Park*) do Caparaó and the PN do Itatiaia (Valor Natural 2005). That ecological corridor also holds the APA Boqueirão da Mira (APABM, hereafter) which presents a vegetation mosaic containing a variety of phytophysiognomies (*e.g.,* forest, field, cropland, cloud dwarf forest, cloud forest, anthropic areas) according to Management Plan of the APABM (Lumiar & Xingu Rio 2019). Historically, the region was used in timber extraction, family agriculture and livestock, which explains the occurrence of modified areas (Lumiar & Xingu Rio 2019). Studies related to conservation highlighted the habitat loss and fragmentation, resulted from human exploitation, as the mainly reason for amphibians' population decline (Brooks et al. 2002, Gardner et al. 2007, Verdade et al. 2010). However, the APABM remains poorly sampled for many animal and plant groups, including anurans (Lumiar & Xingu Rio 2019). Faunistic inventories are extremely relevant in order to comprehend biodiversity and, consequently, for conservation action planning (Haddad 1998, Provete 2015). The lack of available data concerning anurans composition along the Mantiqueira Complex, affects negatively the establishment of general biological patterns for tropical species (*e.g.,* reproduction, trophic and thermal relations, population dynamics) (Provete 2015). Thus, we aimed to present herein the anuran species list from APABM located at the southeast portion of Minas Gerais state, with commentaries about those species and filling a gap of sampling for AF, a priority conservation region.

Material and Methods

1. *Study area*

We carried out the present study in the Área de Preservação Ambiental Boqueirão da Mira (APABM) (-22.0527 S, -44.0353 W, WGS84), located in the Zona da Mata region, southeast of Minas Gerais state, in the municipality of Santa Rita de Jacutinga (Figure 1a), Brazil. Placed at the Mantiqueira Ecological Corridor (Costa et al. 1998, Valor Natural 2005), the region belongs to the Mantiqueira Complex, with the altitudinal range varying from 450 to 1746 m above sea level. The APABM has an area of 8.515 ha and is located close to the borderline between Minas Gerais and Rio de Janeiro state (6 km straight line), and to Parque Estadual do Ibitipoca (30 km) and the Parque Estadual Serra Negra da Mantiqueira (6 km) (Figure 1b).

2. *Sampling methods*

We did the survey through 15 sampling points, distributed along different habitats in the APABM (Figure 1a, Table 1): (1) Mata do Espineli, (2) Serra da Água Santa, (3) Estrada Torres Furnas, (4) Brejos da Figueira, (5) Brejos Vila Cruzeiro, (6) Quilombo Hightech, (7) Boqueirão da Mira, (8) Fazenda Santa Clara das Palmeiras, (9) Mata Santa Clara das Palmeiras, (10) Brejos Fazenda Barro Branco, (11) Brejos estrada para Serra da Bandeira, (12) Ribeirão Santa Clara, (13) Lagoa temporária Serra do Chora, (14) Serra da Bandeira and (15) Serrote São Lourenço. More explanation about each area (habitat description, altitude and coordinates) is in the Table 1.

We did the fieldwork in two expeditions with five consecutive days in October and ten consecutive days in November of 2018. We applied the active night search and day audiovisual survey as the method for chasing amphibians, along the breeding and foraging sites (Heyer et al. 1994). The inventory was performed by three researchers, during five hours per day, resulting in a total effort of 75 hours person. Voucher specimens were killed under the process of immersion in water with hydrochloric of benzocaine 250 mg/l, following the recommendations of Portaria CFBio Nº 148/2012. Afterwards, we collected aliquots of liver for future molecular analysis, and those were conditioned in ethanol 100%. We fixed individuals according to the usual techniques described by Gomides et al. (2013) and deposited in the amphibian's collection of Universidade Federal de Juiz de Fora (CAUFJF) (Appendix I) (Colect Permission ICMBio 65519-1). We also gathered data from specimens previously collected within the APABM and deposited in the herpetological collection of Museu de Zoologia João Moojen of the Universidade Federal de Viçosa (MZUFV).

For each recorded species we verified the conservation status according to: List of threatened species for Minas Gerais state (Drummond et al. 2008), Brazilian List of threatened species (ICMBio 2018) and International Union for Conservation of Nature red-list (IUCN 2019).

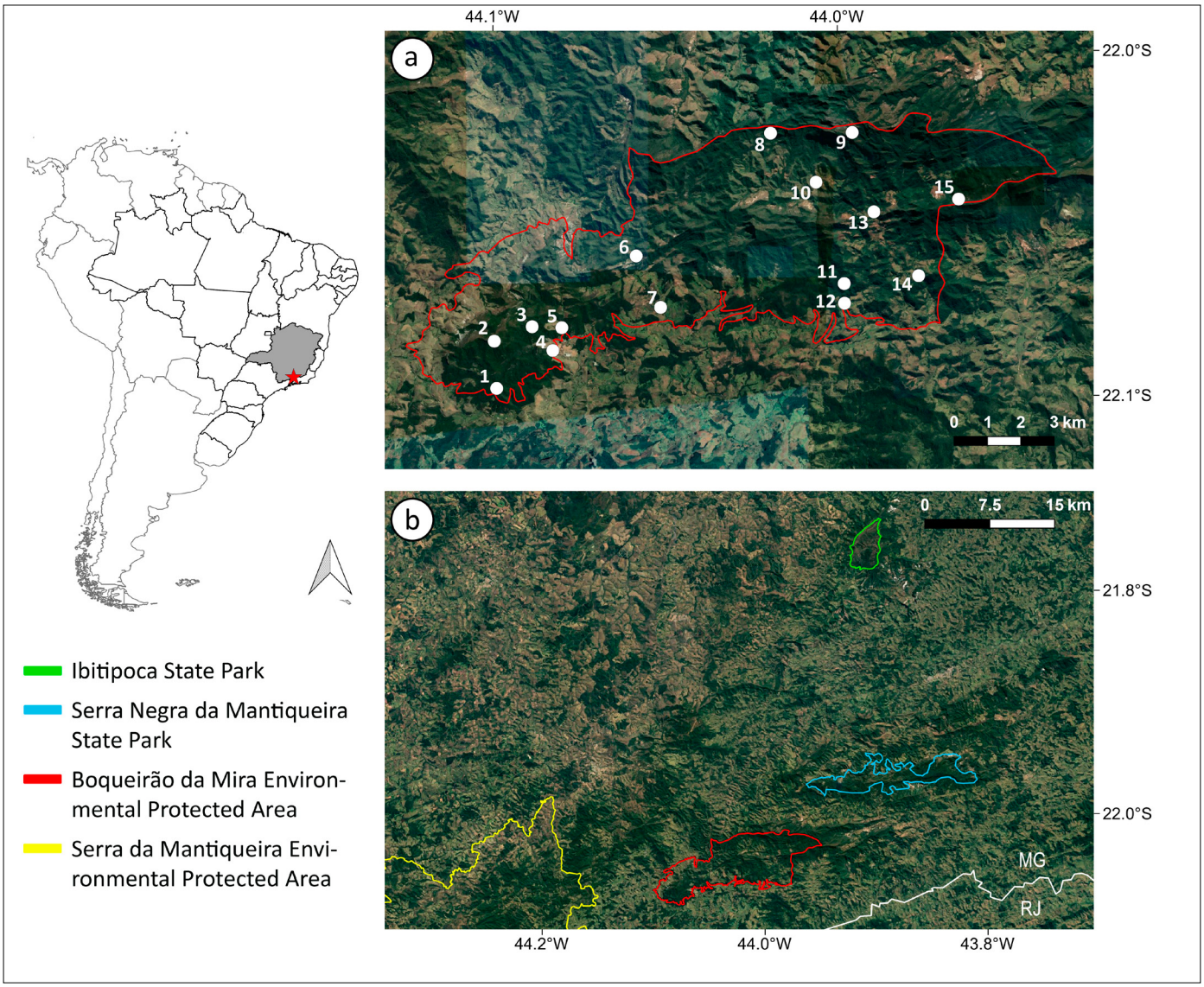

Figure 1. Location of the Área de Proteção Ambiental Boqueirão da Mira (APABM – red star) in the Minas Gerais state (gray background), municipality of Santa Rita de Jacutinga, Southeastern Brazil. (a) Delimitation (red polygon) and sampling areas throughout APABM. The numbers follow Table 1. (b) Proximity between different protected areas in the region connected by the "Serra da Mantiqueira" Ecological Corridor project. White stripe = state border; MG = Minas Gerais state; RJ = Rio de Janeiro state.

Results

We registered a total of 43 anuran species for the Área de Proteção Ambiental Boqueirão da Mira (APABM) (Table 2, Figure 2 - 6), belonging to 12 families: Brachycephalidae (5 species), Bufonidae (2 spp.), Centrolenidae (1 sp.), Craugastoridae (1 sp.), Cycloramphidae (1 sp.), Hemiphractidae (1 sp.), Hylidae (17 spp.), Hylodidae (2 spp.), Leptodactylidae (10 spp.), Microhylidae (1 sp.), Phyllomedusidae (1 sp.) and Odontophrynidae (1 sp.).

We considered Quilombo Hightech as the richest locality among the sampled areas (15 spp.), closely followed by Brejos Figueira (13 spp.) and Serra da Bandeira (12 spp.). *Ischnocnema* gr. *parva*, *Ischnocnema* sp., *Aplastodiscus arildae*, *Ololygon cosenzai*, *Ololygon* sp., *O. flavoguttata*, *Scinax* cf. *perereca*, *Hylodes perere*, *H. lateristrigatus* and *Physalaemus rupestris* were registered only above 1000 m of elevation. On the other hand, other species (*Dendropsophus elegans*, *D. minutus*, *Boana polytaenia*, *Leptodactylus fuscus, L. latrans* and *Rhinella icterica*) were profusely found on several localities.

None of the species we found at APABM were categorized in any threatening level. However, some of them are classified as "Data Deficient" (DD): *Bokermannohyla ibitipoca* and *Physalaemus rupestris* (Drummond et al. 2008); *Hylodes perere* and *Physalaemus rupestris* (ICMBio 2018); and *Ischnocnema izecksohni*, *Bokermannohyla ibitipoca, Physalaemus rupestris* and *Leptodactylus jolyi* (IUCN 2019). Although being out of the IUCN (2019), *Ischnocnema* gr. *parva*, *Vitreorana uranoscopa*, *Bokermannohyla circumdata*, *B. luctuosa* and *Ololygon flavoguttata* are facing population decreasing nowadays (IUCN 2019).

Discussion

In this study, we present the first anuran species list for the Área de Proteção Ambiental Boqueirão da Mira (APABM). Our results (43 species) reveal 6,9% of the known anurans richness for the Atlantic Forest (AF) (625 species; Rossa-Feres et al. 2017) and show a similar

Table 1. Sampling points of Área de Proteção Ambiental Boqueirão da Mira.

Sample point	Locality	Altitude (m)	Latitude	Longitude	Habitat description
1	"Mata do Espineli"	900	-22.0980	-44.0989	Forest at the Serra da Água Santa valley, with open like and forest swamps, creeks and lakes
2	"Serra da Água Santa"	1500	-22.0843	-44.0996	Rocky mountain fields "Campo rupestre"
3	"Estrada Torres Furnas"	1250	-22.0808	-44.0911	Cloud forest; presence of massive antropic activity
4	"Brejos da Figueira"	900	-22.0870	-44.0826	Swamp area, flooded during all months of the year
5	"Brejos Vila Cruzeiro"	600	-22.0745	-44.0513	"Seco" swamp, flooded only in the rainy season
6	"Quilombo Hightech"	1000	-22.0804	-44.0800	Forest with creeks and swamps inside
7	"Boqueirão da Mira"	800	-22.0596	-44.0584	Valley on the Piraputanga river, with forests, and open like swamps
8	"Fazenda Santa Clara das Palmeiras"	680	-22.0733	-43.9979	Valley soaked by the Santa Clara stream, with forest, open like and forest swamps and grassland
9	"Mata Santa Clara das Palmeiras"	900	-22.0676	-43.9980	Huge patch of seasonal forest, with creeks, open like and forest swamps
10	"Brejos Fazenda Barro Branco"	800	-22.0653	-43.9764	Swamp in the edge of a big forest patch
11	"Brejos estrada para Serra da Bandeira"	900	-22.0382	-44.0062	Swamp area in open habitats
12	"Ribeirão Santa Clara"	900	-22.0468	-43.9894	Seasonal forest with the Santa Clara stream
13	"Lagoa temporária Serra do Chora"	1300	-22.0240	-44.0194	Temporary lake surrounded by humid forest
14	"Serra da Bandeira"	1730	-22.0238	-43.9957	Rocky field ("Campo rupestre") with swamps, waterfalls, bromeliads, and cloud forest
15	"Serrote São Lourenço"	1200	-22.0431	-43.9648	Humid forest, waterfalls and forest swamps

diversity amongst other studies in the AF (*e.g.*, Moura et al. 2012, Campos & Lourenço-de-Moraes 2017, Neves et al. 2017a, 2017b, Roberto et al. 2017), with Hylidae presenting the highest richness among the families. This pattern is commonly found in anuran species inventories along the AF, which includes those from the Mantiqueira Complex (Silva et al. 2018). Furthermore, we registered four species that are endemic to the Mantiqueira Complex (*Bokermannohyla ibitipoca*, *Ololygon cosenzai*, *Physalaemus rupestris* and *Hylodes perere*) (Silva & Benmaman 2008, Lacerda et al. 2012, Neves et al. 2017b). In addition, our list shares a great number of species which were also registered by Neves et al. (2017b) to the Serra Negra da Mantiqueira region, which reinforces the importance of connectivity between these highlands. Despite the importance of these areas, both localities might be considered essential for the maintenance of biodiversity in the Brazilian AF altogether (Cruz & Feio 2007, Silva et al. 2018).

Notably, some species we found in our study can be considered as taxonomic uncertainties. *Scinax* cf. *perereca* was recorded in open-like swamps at "Brejos Fazenda Barro Branco" and "Brejos estrada para Serra da Bandeira" (Table 2). We decided to identify as *S.* cf. *perereca* as long as it is a taxonomic complexity, mainly due to morphological similarities among the group (Nunes et al. 2012). The specimens we found here morphologically resemble the true species *S. perereca* Pombal, Haddad & Kasahara, 1995, which is broadly distributed along Southern AF. Likewise, other populations considered as *Scinax* aff. *perereca* have been found in the region (Canelas & Bertoluci 2007, Moura et al. 2012, Pirani et al. 2012, Pimenta et al. 2014, Neves et al. 2017b). Nonetheless, the taxon still remains without a precise identification to the species level. Individuals of *Leptodactylus* cf. *jolyi* of APABM were not identified to the specific level due to the taxonomic complexity presented by this group. The species is morphologically similar to *L. sertanejo* which was described from Uberlândia by Giaretta & Costa (2007) and is considered endemic of Cerrado vegetation. Since *L. sertanejo* was described based on different characteristics of individuals previously recognized as *L. jolyi*, and due to the lack of a clear distribution map for late species, we carefully assume the specimen from APABM as *Leptodactylus* cf. *joyli*. The same name was used by Neves et al. (2017b) after analyzing acoustic parameters between *L. sertanejo, L. jolyi* and *L.* cf. *jolyi* from "Serra Negra da Mantiqueira". All this reveals the need for future revisions regarding the group, with the aid of integrative tools. Moreover, we recorded other four anuran species which we were not able to identify to the species level: *Gastrotheca* sp., *Adenomera* sp., *Ololygon* sp. and *Ischnocnema* sp. Firstly, *Gastrotheca* sp. is an anuran difficulty to find, since it lives and reproduces in the canopy of trees in the AF, becoming difficult to record and rare in scientific collections (Izecksohn & Carvalho-e-Silva 2008). Although we found this species only recording the vocalization high in the trees, which were in accordance with the ones of the genus *Gastrotheca*, it was at the same sort of environment the species usually lives. So, we carefully decided to register this species only at the genus level. Second, both genus *Adenomera* and *Ischnocnema* present a complex taxonomy (Gehara et al. 2013, Cassini et al. 2020), and

Table 2. Amphibian species recorded at the Área de Preservação Ambiental Boqueirão da Mira. Taxon: (Family/Species); habitat (FA – forest area; OA – open area; OS – open swamp; FS – forest swamp; CF –cloud forest; FC – forest creek; RI – rivers); and sampling point according to the Table 1. * Represents distribution extension records.

Family/Specie	Habitat	Sampling sites
Brachycephalidae		
Ischnocnema izecksohni (Caramaschi & Kisteumacher, 1989)	FA	1, 2, 3, 4, 6, 14, 15
Ischnocnema juipoca (Sazima & Cardoso, 1978)	FA	1, 6, 14
Ischnocnema gr. *parva*	FA	14, 6
Ischnocnema gr. *lactea*	FA	1, 6, 14
Ischnocnema sp.	CF	14
Bufonidae		
Rhinella icterica (Spix, 1824)	FA, OA	1, 2, 3, 4, 5, 6, 9, 14, 15
Rhinella ornata (Spix, 1824)	FA,OA	8, 9, 10
Centrolenidae		
Vitreorana uranoscopa (Müller, 1924)	RI	9
Craugastoridae		
Haddadus binotatus (Spix, 1824)	FA	1, 2, 3, 6, 7, 9, 12, 15
Cycloramphidae		
Thoropa miliaris (Spix, 1824)	OA	14
Hemiphractidae		
Gastrotheca sp.	FA	15
Hylidae		
Aplastodiscus arildae (Cruz & Peixoto, 1987)	FA, CF	6, 14
Bokermannohyla circumdata (Cope, 1871)	FA	13
Bokermannohyla ibitipoca (Caramaschi & Feio, 1990) *	CF	13
Bokermannohyla luctuosa (Pombal & Haddad, 1993)	CF	3
Dendropsophus decipiens (A. Lutz, 1925)	OS	8, 10, 11
Dendropsophus elegans (Wied, 1824)	OS	1, 4, 5, 7, 8, 9, 10, 11
Dendropsophus minutus (Peters, 1872)	OS	1, 4, 5, 7, 8, 9, 10, 11
Boana albopunctata (Spix, 1824)	OS	1, 4, 5, 7, 10, 11
Boana faber (Wied, 1821)	OS	1, 4, 5, 7, 10, 11
Boana pardalis (Spix, 1824)	OS	1, 4, 5, 7, 10, 11
Boana polytaenia (Cope, 1870)	OS	4, 5, 10, 11
Ololygon cosenzai (Lacerda, Peixoto & Feio, 2012) *	CF	3, 14
Ololygon flavoguttata (A. Lutz & B. Lutz, 1939)	CF	3, 6, 14
Ololygon sp.	CF	10, 11
Scinax eurydice (Bokermann, 1968)	OS	5
Scinax fuscovarius (A. Lutz, 1925)	OS	4, 5
Scinax cf. *perereca*	OS	10, 11
Hylodidae		
Hylodes perere Silva & Benmaman, 2008 *	FC	6, 14, 15
Hylodes lateristrigatus (Baumann, 1912)	FC	1
Leptodactylidae		
Adenomera marmorata Steindachner, 1867	OA	
Adenomera sp.	OA	6
Leptodactylus furnarius Sazima & Bokermann, 1978	OS	4
Leptodactylus fuscus (Schneider, 1799)	OS	2, 3, 4, 5, 6, 9
Leptodactylus cf. *jolyi* Sazima & Bokermann, 1978	OS	3
Leptodactylus labyrinticus (Spix, 1824)	OS	2, 3, 4, 6, 9, 13
Leptodactylus latrans (Steffen, 1815)	OS	2, 3, 4, 6, 9, 13
Physalaemus cuvieri Fitzinger, 1826	OS	3, 4, 6, 13
Physalaemus rupestris Caramaschi, Carcerelli & Feio, 1991 *	CF	13, 14
Physalaemus signifer (Girard, 1853)	FS	10
Microhylidae		
Elaschistocleis cesarii (Miranda-Ribeiro, 1920)	OS	5, 6
Phyllomedusidae		
Phyllomedusa burmeisteri Boulenger, 1882	FS	5, 10, 11
Odontophrynidae		
Proceratophrys boiei (Wied, 1824)	FA	1

molecular integrative approaches could elucidate the species complex hypothesis in both groups and arise with new candidate species or an accurate identification. For that reason, we prefer to assign both species only at the genus level. Also, we highlight the need for future investigations regarding this topic using molecular approaches. Finally, regarding the *Ololygon* sp., we recorded this species only in one sampling point ("Serra da Bandeira") at 1.700m above sea level. It corresponds to two individuals that we were not able to reach the proper identification till specific level. We firmly believe that could be an undescribed species, but further specimens sampling and examination should clarify this assumption.

Four species had their distribution increased according to our findings in this study. Firstly, *Bokermannohyla ibitipoca* (Figure 3f) was described to the Parque Estadual (PE) Ibitipoca, in an area of cloud savanna and cloud shrubland with gallery forests along the creek (Caramaschi & Feio 1990, Moreira et al. 2018), and it was recorded in a temporary pond at the APABM. Although the species has already been found in PE Serra Negra da Mantiqueira (Neves et al. 2017b), PE Serra do Brigadeiro (Feio et al. 2003; Moura et al. 2012) and Serra da Boa Vista (Moura et al. 2008), is categorized as Data Deficient (Drummond et al. 2008, IUCN 2019). Now, we increase its distribution, coming out with a new occurrence record. *Hylodes perere* (Figure 5a), a medium-sized torrent frog, registered at three sampling points (*see* Table 2), is also categorized as Data Deficient (ICMBio 2018, IUCN 2019). The species is described to the PE Serra Negra da Mantiqueira and it is known only for the type locality heretofore (Silva & Benmaman 2008). Herein we increase the range distribution of the species to the APABM region and even presenting a short distance, this is the first record for *H. perere* outside Serra Negra da Mantiqueira. Additionally, we increase the number of locality records of *Physalaemus rupestris* (Figure 6b), originally described only to the type locality, in the PE Ibitipoca (Caramaschi et al. 1991). We registered *P. rupestris* in a temporary high elevation pond and in a forest swamp (Table 2). Besides our record, the species has been found at the Serra Negra da Mantiqueira (Oliveira et al. 2009, Neves et al. 2017b). Lastly, *Ololygon cosenzai* (Figure 4c) , described by Lacerda et al. (2012) to the PE Serra do Brigadeiro, was found in high elevations forests at the "Estrada Torres Furnas" and "Serra da Bandeira" (Table 2). Exclusively inhabiting bromeliads and belonging to *O. perpusillus* species group (Peixoto 1987, Brasileiro et al. 2005), *O. cosenzai* has been also found in other places throughout the Mantiqueira Complex (Neves et al. 2016, 2017b). The species conservation status was not evaluated neither by IUCN (2019) nor Brazilian List of threatened species (ICMBio 2018).

Conclusively, despite the fact of most of the species recorded presenting a wide distribution along the AF, several species exhibit a restricted distribution and/or have been included as "Data Deficient" in Lists of Threatened Species (Drummond et al. 2008, ICMBio 2018, IUCN 2019). This reinforces the necessity of standing the APABM as an essential part of the maintenance of Mantiqueira Complex's biodiversity. Finally, our findings contribute to the struggle against the Wallacean shortfall (Lomolino 2004), since we presented new

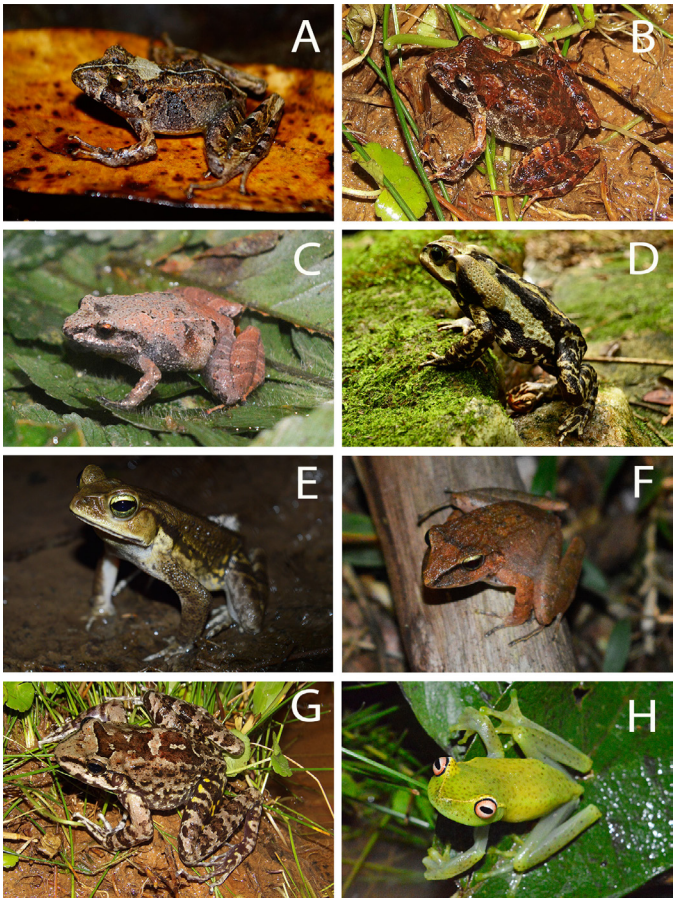

Figure 2. Anuran species from Área de Proteção Ambiental Boqueirão da Mira: (A) *Ischnocnema izecksohni*; (B) *I. juipoca*; (C) *I.* gr. *parva*; (D) *Rhinella icterica*; (E) *R. ornata*; (F) *Haddadus binotatus*; (G) *Thoropa miliaris*; and (H) *Aplastodiscus arildae*.

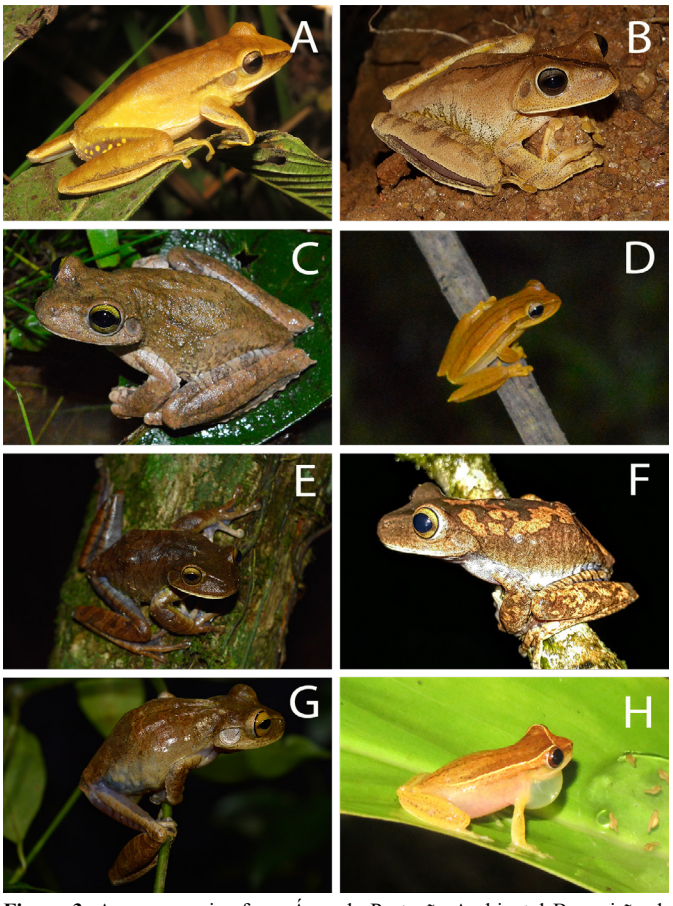

Figure 3. Anuran species from Área de Proteção Ambiental Boqueirão da Mira: (A) *Boana albopunctata*; (B) *B. faber*; (C) *B. pardalis*; (D) *B. polytaenia*; (E) *Bokermannohyla circumdata*; (F) *B. ibitipoca*; (G) *B. luctuosa*; and (H) *Dendropsophus decipiens*.

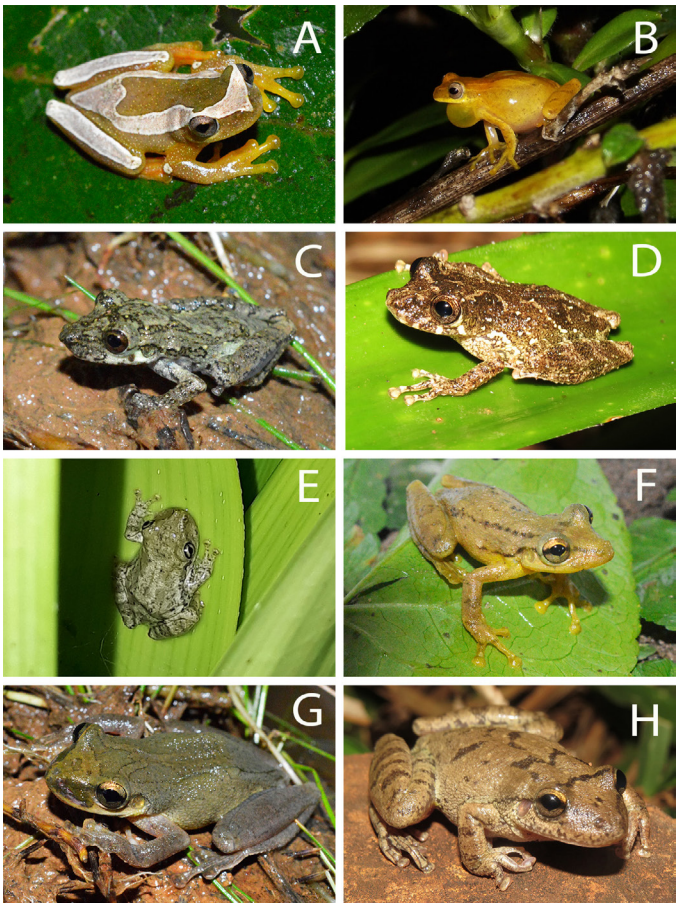

Figure 4. Anuran species from Área de Proteção Ambiental Boqueirão da Mira: (A) *Dendropsophus elegans*; (B) *D. minutus*; (C) *Ololygon cosenzai*; (D) *O. flavoguttata*; (E) *Ololygon* sp.; (F) *Scinax* cf. *perereca*; (G) *S. eurydice*; and (H) *S. fuscovarius*.

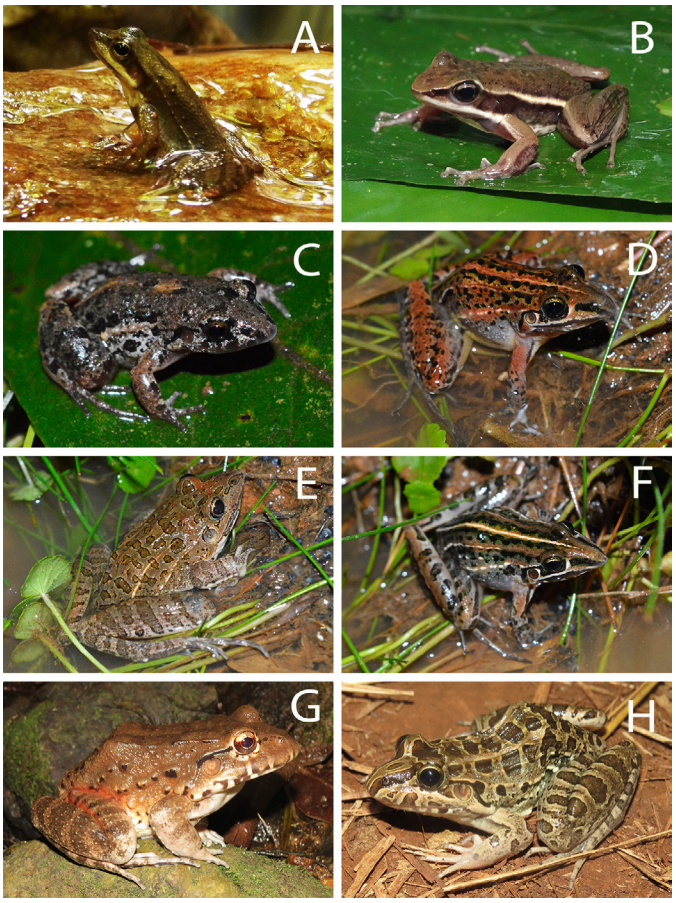

Figure 5. Anuran species from Área de Proteção Ambiental Boqueirão da Mira: (A) *Hylodes perere*; (B) *H. lateristrigatus*; (C) *Adenomera marmorata*; (D) *Leptodactylus furnarius*; (E) *L. fuscus*; (F) *L.* cf. *jolyi*; (G) *L. labyrinthicus*; and (H) *L. latrans*. Photo (B) Clodoaldo Assis.

records and distribution for some species and filled a gap of anurans composition in the Zona da Mata region, at Minas Gerais state, Brazil, a fragmented AF area.

Supplementary Material

The following online material is available for this article: Appendix I.

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Author Contributions

Lúcio Moreira Campos Lima: Substantial contribution to the conception and design of the work; contribution to data analysis

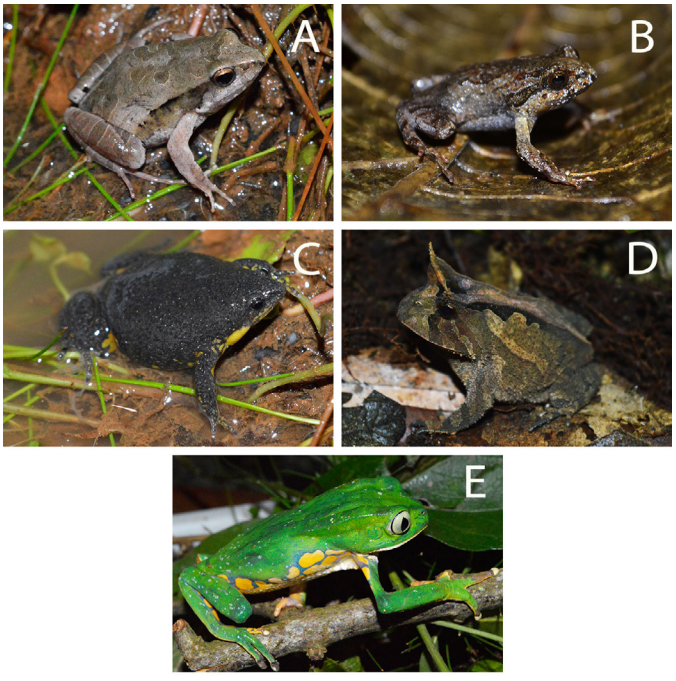

Figure 6. Anuran species from Área de Proteção Ambiental Boqueirão da Mira: (A) *Physalaemus cuvieri*; (B) *P. rupestris*; (C) *Elachistocleis cesarii*; (D) *Proceratophrys boiei*; and (E) *Phyllomedusa burmeisteri*.

and interpretation; contribution to data acquisition; contribution to manuscript preparation.

André Yves: Substantial contribution to the conception and design of the work; contribution to data analysis and interpretation; contribution to data acquisition; contribution to manuscript preparation.

Victor Gomes de Almeida: Contribution to manuscript preparation; contribution to data acquisition.

Matheus Oliveira Neves: Contribution to data analysis and interpretation; contribution to critical revision, adding intellectual content.

Bernadete Maria de Sousa: Contribution to critical revision, adding intellectual content.

Conflicts of Interest

The author(s) declare(s) that they have no conflict of interest related to the publication of this manuscript.

Ethics

The authors presente the license Colect Permission ICMBio 65519-1 it's material and methods item of the Principal.doc document.

Data Availability

All inventory data is exposed in the principal.doc document.

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