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Anurans of Serra Negra da Mantiqueira, Zona da Mata of Minas Gerais, Brazil: a priority area for biodiversity conservation

Matheus Oliveira Neves[1,*], Elvis Almeida Pereira[2], Lúcio Moreira Campos Lima[3], Henrique Folly[4], Eliana Faria de Oliveira[1], Diego José Santana[1] and Renato Neves Feio[4]

Abstract. Amphibians are identified as the group that presents the largest decline in recent years and fauna inventories are primary to map conservation strategies. The Serra Negra da Mantiqueira, which belongs to the mountain complex of the Serra da Mantiqueira and is part of the Mantiqueira's Ecological Corridor, has high species diversity and represents a priority area for biological conservation. We present the first systematic anurofauna inventory for Serra Negra da Mantiqueira in the Municipalities of Rio Preto, Santa Bárbara do Monte Verde, Olaria and Lima Duarte, located in the Zona da Mata of Minas Gerais. We conducted 12 collections during two rainy seasons, from October 2013 to March 2014 and from October 2014 to March 2015. We inventoried 13 sampling sites through night active search over five days per month. The anurofauna of Serra Negra da Mantiqueira presented 48 species in ten families, Hylidae family being the richest (24 species), followed by Leptodactylidae family (eight species). In addition, we recorded two endemic species, *Hylodes perere* and *Hypsiboas cambui*. This study revealed a higher richness of anuran species in the Serra Negra da Mantiqueira than the anurofauna from adjacent regions such as the Parque Estadual do Ibitipoca and the city of Juiz de Fora.

Keywords: Anurans, Atlantic Forest, Inventory, Mantiqueira Complex

Introduction

Several amphibian populations have declined in recent years (Verdade et al., 2010). Studies related to conservation of species indicate human activities as the main causative agent of this decline due to the degradation and loss of habitat (Brooks et al., 2002; Gardner et al., 2007; Verdade et al., 2010). The Atlantic Forest is one of several endangered ecoregions and is classified as one of the global biodiversity hotspots (Myers et al., 2000). It has over 400 species of amphibians, where more than 340 are endemic to this area (Haddad et al., 2013). These species are directly affected by the deforestation of native area for agribusiness practices and constructions, affecting the integrity of the forest and the species that inhabit it (Myers et al., 2000; Haddad et al., 2013).

Within the domain of the Atlantic Forest, there are mountainous areas with high altitudes and preserved forests. These high altitude forest islands form isolated areas preventing genetic exchange between populations and favouring speciation, thus contributing to the high diversity of species and a high rate of endemicity (Hanski, 1998). In southeastern Brazil, the mountain complex of the Serra da Mantiqueira (CSM) stands out as an important region in the composition of anurofauna (Cruz and Feio, 2007). However, inventories are necessary and essential to reveal the patterns of diversity and endemism of these animals (Silvano and Pimenta, 2003).

The Serra Negra da Mantiqueira, located in the central portion of CSM, is recognized as a priority

[1] Universidade Federal de Mato Grosso do Sul, Centro de Ciências Biológicas e da Saúde. Cidade Universitária, CEP 79070-900, Campo Grande, Mato Grosso do Sul, Brasil.
[2] Universidade Federal Rural do Rio de Janeiro, Departamento de Biologia Animal, CEP 23890-000, Seropédica, Rio de Janeiro, Brasil.
[3] Universidade Federal de Juiz de Fora, Laboratório de Herpetologia, Departamento de Zoologia, Instituto de Ciências Biológicas. Campus Universitário, CEP 36036-900, São Pedro, Juiz de Fora, MG, Brasil.
[4] Universidade Federal de Viçosa, Museu de Zoologia João Moojen / Departamento de Biologia Animal. CEP 36570-000, Viçosa, Minas Gerais, Brasil
* Corresponding author e-mail: nevesmo@yahoo.com.br

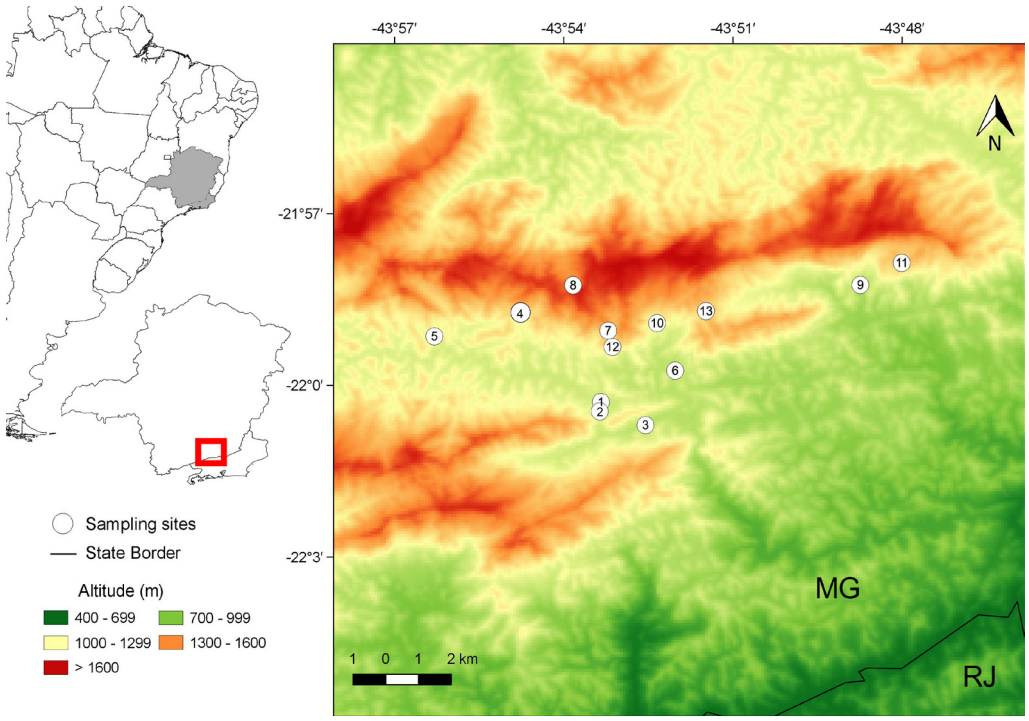

Figure 1. Sampling areas in the Serra Negra da Mantiqueira, Zona da Mata of Minas Gerais, Brazil: (1) Cambuí Forest, (2) Funil Village, (3) Toca do Coelho, (4) Dona Camila, (5) Tiririca Farm, (6) Inn Tiê, (7) Ninho da Égua, (8) Waterfall Marciano, (9) Três Cruzes Village, (10) Nene's stream, (11) Waterfall Chapadão da Serra Negra, (12) Waterfall Água Vermelha, and (13) Casinha's Marsh.

area for biodiversity conservation (Costa et al., 1998) and classified as of "High Biological Importance" (Drummond et al., 2005). The Serra Negra da Mantiqueira is part of the Ecological Corridor of Mantiqueira, which includes 42 municipalities (Valor Natural, 2005). The corridor includes important conservation areas such as the APA Fernão Dias, APA Serra da Mantiqueira, Parque Estadual do Ibitipoca, Parque Estadual da Serra do Papagaio and the Parque Nacional de Itatiaia. Several studies in Serra Negra da Mantiqueira with plants (Neto et al., 2009; Abreu and Neto, 2010; Abreu et al., 2011; Feliciano and Salimena, 2011; Valente et al., 2011; Blaser et al., 2012; Souza et al., 2012; Salimena et al., 2013), and a few studies with bats (Noble et al., 2009) and frogs (Silva and Benmaman, 2008; Oliveira et al., 2009) confirmed the high local diversity and identified a high number of species typical of mountainous regions, some of which are endemic (e.g. Silva and Benmaman, 2008; Matozinhos and Konno, 2011; Antunes et al., 2013; Pinheiro et al., 2016).

Research on faunal composition is fundamental for understanding biodiversity and for planning conservation strategies (Haddad, 1998; Provete, 2015). The sparse amount of data available on amphibians of tropical areas, however, difficult the understanding of ecological patterns and general trends, e.g. reproductive, trophic and thermal patterns, diversity patterns (Provete, 2015). Thus, in this study, we present an inventory of anuran species of Serra Negra da Mantiqueira, Zona da Mata of Minas Gerais, Brazil, an area of high biological importance in the Atlantic Forest.

Material and methods

Study area

The Serra Negra da Mantiqueira is located in the region of Zona da Mata of Minas Gerais state, between the cities of Lima Duarte, Rio Preto, Santa Bárbara do Monte Verde and Olaria (Fig. 1). Belonging to the CSM and inserted in the Ecological Corridor of Mantiqueira

Table 1. Sampling sites of the Serra Negra da Mantiqueira, with altitude, geographic coordinates (in decimal degrees), and brief description of each sampling site.

	Site	Altitude	Latitude	Longitude	Description
1	Cambuí Forest	900 m	-22.004820	-43.889028	Forest predominantly covered by Cambui trees, with a stream, ponds and marsh in open and closed area
2	Funil Village	905 m	-22.007549	-43.889365	Stream near the Funil Village with swampy areas in the surroundings
3	Toca do Coelho	855 m	-22.011556	-43.875861	Area with waterfalls and flooded with strong tourist stamp
4	Dona Camila	990 m	-21.984167	-43.913361	Dry marsh area with water only during a few months of the rainy season
5	Tiririca Farm	960 m	-21.985700	-43.938250	Abandoned farm with ponds and swamps
6	Inn Tiê	870 m	-21.995676	-43.867088	Two medium-sized weir, one of them presenting marginal vegetation
7	Ninho da Égua	1230 m	-21.984056	-43.886876	Wet stone wall with small water fillets
8	Waterfall Marciano	1340 m	-21.970827	-43.897250	Rocky field with streams and wetlands
9	Três Cruzes Village	850 m	-21.970734	-43.812352	Region near the village Três Cruzes with swamps and waterfalls
10	Nenê's stream	1005 m	-21.981861	-43.872444	Rocky field with streams and waterfalls
11	Waterfall Chapadão da Serra Negra	1110 m	-21.964305	-43.800136	Marsh and waterfalls area with bromeliads and high humidity in the surroundings
12	Waterfall Água Vermelha	1015 m	-21.988778	-43.885611	Weir with marginal vegetation and waterfall with large volume of water
13	Casinha's Marsh	1110 m	-21.978352	-43.857985	Water springs that form swampy areas

(Costa et al., 1998; Valor Natural, 2005), Serra Negra da Mantiqueira has a length of approximately 25 km (43°45'39.38"W, 21°56'21.09"S, *datum* WGS84) and is 12 km distant from the state border of Rio de Janeiro, and 28 km distant from the Parque Estadual do Ibitipoca. Its altitude ranges from 850 to 1698 m a.s.l., and the local average annual rainfall is 1886 mm (Noble et al., 2009; Salimena et al., 2013). The vegetation of the Serra Negra da Mantiqueira is a mosaic of countryside and forest areas, without a precise classification of grasslands that occur above 1000 m (Abreu et al., 2011). The forest type is classified as Ombrophilous High-Montane Forest and Ombrophilous Alluvial Forest, with a high richness of tree species (Valente et al., 2011).

Sampling of the anurofauna

We conducted the inventory in 13 sampling sites distributed in different environments in Serra Negra da Mantiqueira (Fig. 1), as follows: Cambuí Forest, Funil Village, Toca do Coelho, Tiririca Farm, Dona Camila, Inn Tiê, Ninho da Égua, Waterfall Marciano, Três Cruzes Village, Nene's Stream, Waterfall Chapadão da Serra Negra, Waterfall Água Vermelha and Casinha's Marsh (Tab. 1). We also used occasional records of anurans in the routes between sampling sites and secondary data from specimens deposited in the Coleção Herpetológica do Museu de Zoologia João Moojen at Universidade Federal de Viçosa (MZUFV).

Samplings were collected in two rainy seasons, from October 2013 to March 2014 and from October 2014 to March 2015. We recorded the anurofauna through night active search during five days per month. The collected individuals were euthanized under the process of immersion in water with benzocaine hydrochloride 250 mg/l, followed CFBio Ordinance No. 148/2012. Later, we fix the specimens with 10% formalin, and then we packed in 70% alcohol and deposited the specimens in the Coleção Herpetológica do Museu de Zoologia João Moojen at Universidade Federal de Viçosa (Collection License ICMBio 40743-1).

For each species recorded in the study area, we verified the conservation status under the Endangered Species List of the state of Minas Gerais (Drummond

Table 2. List of anuran species recorded in the Serra Negra da Mantiqueira, Zona da Mata of Minas Gerais satate, and the sampling sites where they were found: (1) Cambuí Forest, (2) Funil Village, (3) Toca do Coelho, (4) Dona Camila, (5) Tiririca Farm, (6) Inn Tiê, (7) Ninho da Égua (8) Waterfall Marciano, (9) Três Cruzes Village (10) Nene's stream (11) Waterfall Chapadão da Serra Negra (12) Waterfall Água Vermelha and (13) Casinha's Marsh.

FAMILY/SPECIES	Sampling sites
Brachycephalidae	
Brachycephalus sp.	11
Ischnocnema izecksohni (Caramaschi & Kisteumacher, 1989)	5, 10, 13
Ischnocnema juipoca (Sazima & Cardoso, 1978)	1, 4, 5
Ischnocnema parva (Girard, 1853)	8
Ischnocnema aff. *guentheri*	10
Bufonidae	
Dendrophryniscus sp.	11
Rhinella icterica (Spix, 1824)	2, 3, 6, 9
Rhinella ornata (Spix, 1824)	2, 5, 6, 9, 13
Centrolenidae	
Vitreorana uranoscopa (Müller, 1924)*	2, 8
Craugastoridae	
Haddadus binotatus (Spix, 1824)	10, 11
Cycloramphidae	
Thoropa miliaris (Spix, 1824)	2, 8
Hylidae	
Aplastodiscus arildae (Cruz & Peixoto, 1987)	8
Aplastodiscus leucopygius (Cruz & Peixoto, 1985)	8
Bokermannohyla circumdata (Cope, 1871)	9, 12
Bokermannohyla ibitipoca (Caramaschi & Feio, 1990)	7
Bokermannohyla luctuosa (Pombal & Haddad, 1993)	8, 9, 12
Dendropsophus decipiens (A. Lutz, 1925)	1
Dendropsophus elegans (Wied-Neuwied, 1824)	1, 2, 4, 5, 6, 9, 13
Dendropsophus microps (Peter, 1872)	1
Dendropsophus minutus (Peter, 1872)	1, 2, 3, 4, 5, 6, 9, 12, 13
Hypsiboas albomarginatus (Spix, 1824)	1, 6
Hypsiboas albopunctatus (Spix, 1824)	2, 3, 4, 5, 6, 9, 12, 13
Hypsiboas cambui Pinheiro, Pezzuti, Leite, Garcia, Haddad & Faivovich, 2016*	11
Hypsiboas faber (Wied-Neuwied, 1821)	2, 3, 5, 9, 12
Hypsiboas pardalis (Spix, 1824)	2, 4, 5, 12
Hypsiboas polytaenius (Cope, 1870)	2, 3, 4, 5, 6, 9, 12, 13
Phyllomedusa burmeisteri Boulenger, 1882	6, 12
Scinax sp. (gr. *catharinae*)*	5
Scinax cosenzai Lacerda, Peixoto & Feio, 2012	7, 8, 11
Scinax crospedospilus (A. Lutz, 1925)	5, 6, 12
Scinax eurydice (Bokermann, 1968)	5, 6, 9, 12, 13
Scinax flavoguttatus (Lutz & Lutz, 1939)	11
Scinax fuscovarius (A. Lutz, 1925)	1, 3, 12, 13
Scinax aff. *perereca*	12
Scinax sp. (*ruber* clade)*	1
Hylodidae	
Hylodes perere Silva & Benmaman, 2008	7, 8, 11, 12

Figure 2. Anuran species recorded in sample areas in the Serra Negra da Mantiqueira, the Zona da Mata of Minas Gerais. Family Brachycephalidae: (a) *Brachycephalus* sp., (b) *Ischnocnema izecksohni*, (c) *Ischnocnema juipoca*, (d) *Ischnocnema parva*, (e) *Ischnocnema* aff. *guentheri*; Family Bufonidae: (f) *Dendrophryniscus* sp., (g) *Rhinella icterica*, (h) *Rhinella ornata*; Family Centrolenidae: (i) *Vitreorana uranoscopa*; Family Craugastoridae: (j) *Haddadus binotatus*; Family Cycloramphidae: (k) *Thoropa miliaris*; Family Hylidae: (l) *Aplastodiscus arildae*. Photo credit: Elvis A. Pereira (c), Diego J. Santana (d, h, i), Lúcio M.C. Lima (a), Matheus O. Neves (b, e, f, g, j) and Priscila S. Hote (k, l).

et al., 2008), the Brazilian List of Threatened Species of the Ministry of the Environment (ICMBio, 2014) and the Red List of Threatened Species of the International Union for Conservation of Nature and Natural Resources (IUCN, 2016). The Endangered Species List of the State of Rio de Janeiro (Bergallo et al., 2000) was also checked, once the study area is near the border of this state.

Results

We recorded a total of 48 anuran species for the Serra Negra da Mantiqueira (Tab. 2; Appendix I). Among them, 43 species were recorded during the study, while the record of five other species was obtained by consulting herpetological collections. Anuran species recorded are divided into ten families: Brachycephalidae (5 species; Fig. 2), Bufonidae (3 species; Fig. 2), Centrolenidae (1 species; Fig. 2), Craugastoridae (1 species; Fig.

Figure 3. Anuran species recorded in sample areas in the Serra Negra da Mantiqueira, the Zona da Mata of Minas Gerais. Family Hylidae: (a) *Aplastodiscus leucopygius*, (b) *Bokermannohyla circumdata*, (c) *Bokermannohyla ibitipoca*, (d) *Bokermannohyla luctuosa*, (e) *Dendropsophus decipiens*, (f) *Dendropsophus elegans*, (g) *Dendropsophus microps*, (h) *Dendropsophus minutus*, (i) *Hypsiboas albomarginatus*, (j) *Hypsiboas albopunctatus*, (k) *Hypsiboas cambui*, (l) *Hypsiboas faber*. Photo credit: Júlia Toledo (k), Matheus O. Neves (b, c, d, e, g, h, i, j, l) and Priscila S. Hote (a, f).

2), Cycloramphidae (1 species; Fig. 2), Hylidae (24 species; Figs. 2-4), Hylodidae (1 species; Fig. 4), Leptodactylidae (8 species; Fig. 5), Microhylidae (1 species; Fig. 5) and Odontophrynidae (3 species; Fig. 5). The Hylidae family presented the highest richness, followed by Leptodactylidae.

Species recorded exclusively in areas above 1000 meters include *Brachycephalus* sp., *Ischnocnema parva*, *Ischnocnema* aff. *guentheri*, *Dendrophryniscus* sp., *Hadaddus binotatus*, *Aplastodiscus arildae*, *Aplastodiscus leucopygius*, *Scinax cosenzai*, *Scinax flavogutattus*, *Scinax* aff. *perereca*, *Hylodes perere*, *Physalaemus rupestris* and *Proceratophrys mantiqueira*. Species such as *Dendropsophus elegans*, *Dendropsophus minutus*, *Hypsiboas albounctatus*, *Hypsiboas polytaenius*, *Leptodactylus fuscus* and *Leptodactylus latrans* were found abundantly in various locations. The Farm Tiririca was the area with the highest richness (16 species), followed by Inn Tiê (14 species) and the Waterfall Água Vermelha (13 species).

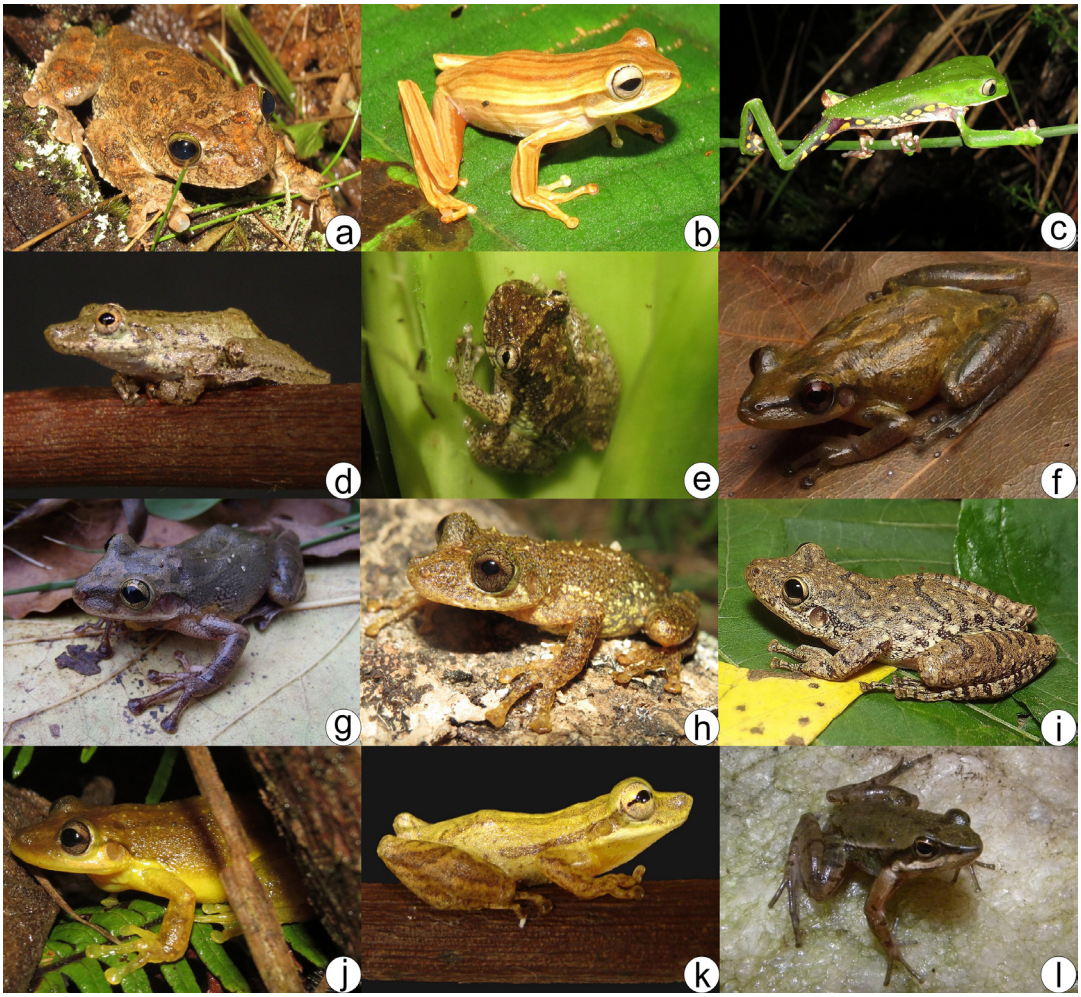

Figure 4. Anuran species recorded in sample areas in the Serra Negra da Mantiqueira, the Zona da Mata of Minas Gerais. Family Hylidae: (a) *Hypsiboas pardalis*, (b) *Hypsiboas polytaenius*, (c) *Phyllomedusa burmeisteri*, (d) *Scinax* sp. (gr. *catharinae*), (e) *Scinax cosenzai*, (f) *Scinax crospedospilus*, (g) *Scinax eurydice*, (h) *Scinax flavoguttatus*, (i) *Scinax fuscovarius*, (j) *Scinax* aff. *perereca*, (k) *Scinax* sp. (*ruber* clade); Family Hylodidae: (l) *Hylodes perere.* Photo credit: Diego J. Santana (f), Julia Tolledo (d, k) and Matheus O. Neves (a, b, c, e, g, h, i, j, l).

The areas with higher elevations had the lowest richness, such as the Ninho da Égua and the Nenê's Stream (both with three species), followed by Waterfall Chapadão da Serra Negra (five species) (Tab. 2).

None of the anuran species recorded in Serra Negra da Mantiqueira are listed in the Endangered Species List of the state of Minas Gerais (Drummond et al., 2008), in the Brazilian List of Threatened Species of the Ministry of the Environment (ICMBio, 2014) or in the Red List of Threatened Species of the International Union for Conservation of Nature and Natural Resources (IUCN, 2016). Only *Vitreorana uranoscopa* presents some degree of risk in the state of Rio de Janeiro (Bergalo, 2000), classified as presumably threatened. Some species are categorized as "Data Deficient" (DD), including *Bokermannohyla ibitipoca*, *Dendropsophus microps*, *Physalaemus rupestris* (Drummond *et al*., 2008), *Hylodes perere*, *Physalaemus rupestris* (ICMBio, 2014), *Ischnocnema izecksohni*, *Bokermannohyla ibitipoca* and *Physalaemus rupestris* (IUCN, 2016). The

Figure 5. Anuran species recorded in sample areas in the Serra Negra da Mantiqueira, the Zona da Mata of Minas Gerais. Family Leptodactylidae: (a) *Leptodactylus furnarius*, (b) *Leptodactylus fuscus*, (c) *Leptodactylus* cf. *jolyi*, (d) *Leptodactylus latrans*, (e) *Physalaemus cuvieri*, (f) *Physalaemus* cf. *feioi*, (g) *Physalaemus rupestris*, (h) *Physalaemus signifer*; Family Microhylidae: (i) *Elachistocleis cesarii*; Family Odontophrynidae: (j) *Odontophrynus americanus*, (k) *Proceratophrys boiei*, (l) *Proceratophrys mantiqueira*. Photo credit: Diego J. Santana (a), Julia Tolledo (g), Matheus O. Neves (b, c, d, e, h, i, j, k, l) and Priscila Hote (f).

IUCN Red List (IUCN, 2016) also points out that the species *Ischnocnema parva*, *Vitreorana uranoscopa*, *Bokermannohyla circumdata*, *Bokermannohyla luctuosa* and *Scinax flavoguttatus* are facing population declines.

Among the recorded species in this work, we registered *B. circumdata* and *B. luctuosa* occurring in the same environments at Serra Negra da Mantiqueira (Fig. 6), configuring the first sympatric record for these species.

We were not able to identify the population of *Leptodactylus* cf. *jolyi* from Serra Negra da Mantiqueira. We analyzed nine vocalizations from two males found in the Toca do Coelho, in Serra Negra da Mantiqueira. The advertisement call of this population consists of a single note with duration of 0.02 to 0.04s, dominant frequency ranging from 2153 to 2326Hz and the note with one to three harmonics (Fig. 7). The acoustic parameters of the advertisement call of *L.* cf. *jolyi* recorded by us present differences between the songs of *L. jolyi* and *L. sertanejo* already described (Tab. 3).

Table 2. Continued.

FAMILY/SPECIES	Sampling sites
Leptodactylidae	
Leptodactylus furnarius Sazima & Bokermann, 1978	5
Leptodactylus fuscus (Schneider, 1799)	2, 3, 4, 5, 6, 9
Leptodactylus cf. *jolyi*	3
Leptodactylus latrans (Steffen, 1815)	2, 3, 5, 6, 9, 13
Physalaemus cuvieri Fitzinger, 1826	3, 5, 6, 13
Physalaemus cf. *feioi*	1
Physalaemus rupestris Caramaschi, Carcerelli & Feio, 1991*	8
Physalaemus signifer (Girard, 1853)	1
Microhylidae	
Elaschistocleis cesarii (Miranda-Ribeiro, 1920)	4, 6
Odontophrynidae	
Odontophrynus americanus (Duméril & Bibron, 1841)	1
Proceratophrys boiei (Wied-Neuwied, 1825)	1
Proceratophrys mantiqueira Mângia, Santana, Cruz & Feio, 2014	8

* Secondary record based on specimens from herpetological collections.

Although this taxon identification is not accurate, this is the first record of this group in the CSM (Fig. 8).

Discussion

Some species of the Serra Negra da Mantiqueira have their conservation status in the "Data Deficient" category and require greater attention in order to be better evaluated (Bland et al., 2012). However, few studies were performed with endangered or data deficient species. Considering the interval between the years 2000 and 2010, only 16% of the published articles dealt with taxa categorized under some degree of threat (Campos et al., 2014). The scarcity of studies with these species is due to obstacles related to restricted distribution and/or difficult access to localities of occurrence, and because of their nocturnal or fossorial habits (Morais et al., 2013).

Hylodes perere is in the category "Data Deficient" and is recorded only in the Serra Negra da Mantiqueira (Silva and Benmaman, 2008). Although this species is abundant in various locations above 1000 meters above sea level in the study area, the distribution of *Hylodes perere* is restricted to less than 50 square kilometres. Besides this species, *Hypsiboas cambui* also has its type locality in Serra Negra da Mantiqueira, from where it is endemic. The etymology of his epithet refers to the Cambuí Forest, where it has been exclusively found (Pinheiro et al., 2016). These species have been not registered in other areas of high altitude near the Serra Negra da Mantiqueira, as Parque Estadual do Ibitipoca, Parque Nacional do Itatiaia, Parque Estadual da Serra do Papagaio and the city of Juiz de Fora (IBDF, 1982; Cruz et al., 2009; IEF, 2009; Neves et al. unpublished data). In addition, the occurrence of *Hylodes perere* and *Hypsiboas cambui* is restricted to private properties that suffer from human-induced activity. *Eucalyptus* plantations and pasture are prevalent at altitudes below 800 meters. Thus, population studies and concise evaluation of their habitats should be carried out urgently to check precisely in what conservation category these species fit.

The *Dendrophryniscus* genus was recently revised and is now restricted to the coastal region of Bahia to Rio Grande do Sul states (Fouquet et al., 2012). We compared the specimens found in this study with *Dendrophryniscus carvalhoi* and *Dendrophryniscus brevipollicatus*. The first species occurs only in the northern part of the CSM in the state of Espírito Santo (Izecksohn, 1993; Cassimiro et al., 2008; Fouquet et al., 2012.). The other species is distributed in the coastal region of the states of Rio de Janeiro, São Paulo and Paraná (Fouquet et al., 2012), besides to the occurrence reported in Parque Nacional do Itatiaia (IBDF, 1982). Although *Dendrophryniscus* sp. share morphological

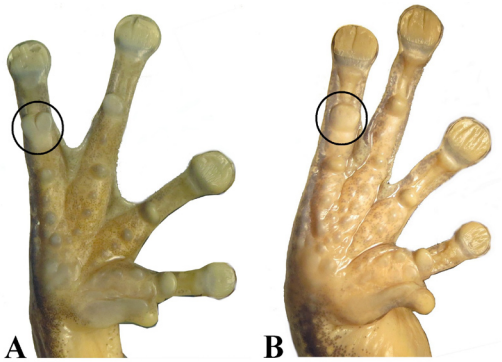

Figure 6. View of the right hand of the two species showing the lobe finger IV, which is (A) bilobed in *Bokermannohyla circumdata* (MZUFV 14694) and (B) ovoid in *Bokermannohyla luctuosa* (MZUFV 14987).

similarities to both species, the population of Serra Negra da Mantiqueira can not be identified to the species level due to the low number of specimens collected (n = 6). The *Dendrophryniscus* record in Serra Negra da Mantiqueira shows that this genus has a larger geographic distribution than previously known.

A few other species were not identified to the species level because they belong to groups with complicated taxonomy. For example, *Ischnocnema* aff. *guentheri* presents morphological characteristics similar to *Ischnocnema guentheri*; but *I. guentheri* is considered endemic to the Tijuca Forest, in Rio de Janeiro (Gehara et al., 2013). Gehara et al. (2013) identified a likely new species (referred to as "candidate species 3") from the Serra do Itatiaia and Juiz de Fora city (both in the CSM), about 100 and 50 km of Serra Negra da Mantiqueira, respectively. The population of *Ischnocnema* aff. *guentheri* from Serra Negra da Mantiqueira, which occurs between the populations of these two locations, are probably the same species.

The genus *Scinax* Wagler, 1830 is composed of 115 species difficult to identify due to their morphological similarities, thus presenting a confusing taxonomy (Nunes et al., 2012; Frost, 2016). Specimens of *Scinax* aff. *perereca* are distinguished from specimens of *S. perereca* mainly by differences in the advertisement call (Pombal et al., 1995; Magrini and Giaretta, 2010). Other populations of *Scinax* aff. *perereca* have been recorded in the region (Canelas and Bertoluci., 2007; Moura et al., 2012; Pirani et al., 2012; Pimenta et al., 2014) but remain without identification to the specific level. An integrative review evaluating several data bases is required for taxonomic consolidation and conservation purposes.

Bokermannohyla circumdata occurs in Atlantic Forest areas from Santa Catarina to the south of Bahia (Napoli et al., 2011), while *Bokermannohyla luctuosa* occurs from south and southeast of São Paulo to the southern part of the CSM (Napoli, 2005). The two species are easily diagnosable, mainly by vocalization and the lobe present in IV finger of the hand (Pombal Jr. and Haddad, 1993). In this case, the lobe is bilobed in *B. circumdata* and ovoid in *B. luctuosa* (Napoli, 2005) (Fig. 6). The record of *Bokermannohyla circumdata* and *Bokermannohyla luctuosa* in the Serra Negra da Mantiqueira is the first reporting sympatric occurrence of these species.

Some species are restricted to high altitude areas, such as the species of the group *Physalaemus deimaticus*, which occur predominantly in rocky fields (Oliveira et al., 2009). One of them, *Physalaemus rupestris,* until then endemic in the Parque Estadual do Ibitipoca (Caramaschi et al., 1991), was recently recorded in Serra Negra da Mantiqueira (Oliveira et al., 2009). However, after this record no other specimen was captured in the study area. *Physalaemus rupestris* is categorized as "Data Deficient" in the list of endangered species in the

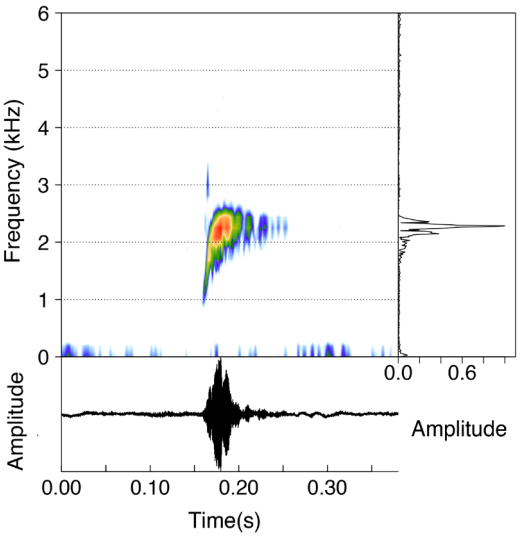

Figure 7. Spectrogram (upper graphic) and oscilogram (lower graphic) of the advertisement call of *Leptodactylus* cf. *jolyi* (SVL=51mm) from the Serra Negra da Mantiqueira**.**

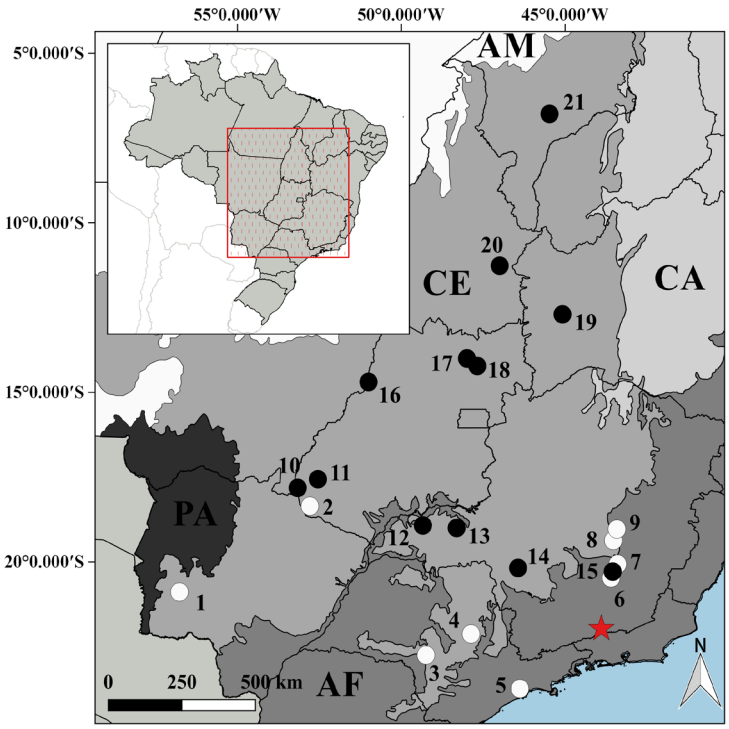

Figure 8. Geographical distribution of *Leptodactylus jolyi* (white circles) and *Leptodactylus sertanejo* (black circles), and the record *Leptodactylus* cf. *jolyi* (star) in the location Serra Negra da Mantiqueira, Rio Preto, Minas Gerais. AM: Amazon; CA: Caatinga; CE: Cerrado; AF: Atlantic Forest; PA: Pantanal. *Leptodactylus jolyi*: (1) Serra da Bodoquena (Uetanabaro et al., 2007), (2) Rio Sucuriú (Uetanabaro et al., 2006), (3) Estação Ecológica de Santa Bárbara (Araújo et al., 2013), (4) Estação Ecológica de Itirapina (Brasileiro et al., 2005), (5) Rio Grande da Serra (Giaretta and Costa, 2007) and the type locality in Paranapiacaba (Sazima and Bokermann, 1978), (6) Ouro Branco (São Pedro and Feio, 2011), (7) Serra do Caraça (Canelas and Bertoluci, 2007), (8) Serra do Cipó (Eterovick and Sazima, 2004) and (9) micro-region of Conceição do Mato Dentro (Pimenta et al., 2014). *Leptodactylus sertanejo*: (10) Parque Nacional das Emas (Kopp et al., 2010), (11) Municipality of Mineiros (Vaz Silva, 2009), (12) Rio Tijuco (Conte et al., 2013), (13) type locality in Uberlândia (Giaretta and Costa, 2007), (14) São Roque de Minas, Serra da Canastra (Carvalho et al., 2013), (15) Municipality of Ouro Preto (Pirani et al., 2012), (16) Municipality of Aruanã (Melo et al., 2013), (17) Parque Nacional da Chapada dos Veadeiros (Santoro and Brandão, 2014), (18) Alto Paraíso de Goiás (Carvalho et al., 2013), (19) São Desidério (Valdujo et al., 2009), (20) Estação Ecológica Serra Geral do Tocantins (Valdujo et al., 2011) and (21) Parque Estadual do Mirador (Lima et al., 2015).

Table 3. Advertisement call parameters of *Leptodactylus sertanejo* and *L. jolyi* (Giaretta and Costa, 2007), and *L.* cf. *jolyi* from Serra Negra da Mantiqueira.

Taxa	SVL (mm)	Notes/Call	Wrists	Duration (s)	Dominant frequency (Hz)	Harmonics	Reference
L. sertanejo	51 – 54	1	2	0.02 - 0.03	2000 – 2400	*	Giaretta and Costa, 2007
L. jolyi	45	1	1 – 3	0.03 - 0.04	1800 – 2400	*	Giaretta and Costa, 2007
L. cf. *jolyi*	51 – 53	1	1	0.02 - 0.04	2153 – 2326	1 a 3	This study

*Not mentioned

state of Minas Gerais, Brazil and also in the red list of IUCN (ICMBio, 2014; IUCN, 2016).

Individuals of *Leptodactylus* cf. *jolyi* of Serra Negra da Mantiqueira were not identified to the specific level due to the dynamic taxonomic present in this group. Giaretta and Costa (2007) described *L. sertanejo* from populations of *L. jolyi* based on the differences of the advertisement call and snout-vent length between species (*L. jolyi* males about 45 mm and *L. sertanejo* with 51 to 54 mm). The samples collected in the study area have the snout-vent length ranging from 51 to 53 mm, fitting on the parameters of the description of *L. sertanejo*. However, acoustic patterns of the advertisement call of the Serra Negra da Mantiqueira population (Fig. 7) are more similar to the vocalizations of *L. jolyi* (Tab. 3). *Leptodactylus sertanejo* is considered an endemic specie of the Cerrado, distributed in the states of Goiás, Bahia, Tocantins, Maranhão and Minas Gerais (Giaretta and Costa, 2007; Valdujo et al., 2009; Vaz Silva, 2009; Kopp et al., 2010; Pirani et al., 2012; Conte et al., 2013; Melo et al., 2013). *Leptodactylus jolyi* is restricted to its type locality, Rio Grande da Serra in the state of São Paulo (Giaretta and Costa, 2007). However, the latter species has also been identified in other locations in the states of Mato Grosso do Sul, Goiás, Minas Gerais and São Paulo (Sazima and Bokermann, 1978; Eterovick and Sazima, 2004; Brasileiro et al., 2005; Uetanabaro et al., 2006; Canelas and Bertoluci, 2007; Uetanabaro et al., 2007; São Pedro and Feio, 2011; Araújo et al., 2013; Pimenta et al., 2014). Lima et al. (2015) considered as *L. sertanejo* all specimens of this complex found in the Cerrado, classifying populations that had previously been identified as *L. jolyi*. Given this scenario, there is a need to use integrative taxonomy tools (e.g. Padial et al., 2010) to delimit the group, revealing its evolutionary patterns and thus allowing to infer more precisely the identity of the population found in Serra Negra da Mantiqueira. We used cautiously the name *L.* cf. *jolyi* considering the possibility of *L. sertanejo* be junior synonym of *L. jolyi.*

Conclusion

The Serra Negra da Mantiqueira presents a great diversity of amphibians when compared to other areas of the region, such as the Parque Estadual do Ibitipoca (Cruz et al., 2009) and the city of Juiz de Fora (Neves et al. unpublished data), and other areas located in CSM, including the Parque Estadual Serra do Brigadeiro (Moura et al., 2012). Moreover, previous studies classify the region as of high biological importance and as a priority area for conservation (Costa et al., 1998; Drummond et al., 2005). Thus, the records of species with restricted distribution (i.e. P*hysalaemus rupestris*, *Hypsiboas cambui* and *Hylodes perere*, the last two endemics to the Serra Negra da Mantiqueira), and species still unidentified (i.e. *Ischnocnema* aff. *guentheri*, *Dendrophryniscus* sp., *Scinax* aff. *perereca*, *Scinax* sp. (*ruber* clade), *Leptodactylus* cf. *jolyi* and *Physalaemus* cf. *feioi*), increases the diversity of amphibians known to Serra Negra da Mantiqueira and reinforce the need to preserve this area. This study represents an important basis for the knowledge of the areas covered by the Ecological Corridor of Mantiqueira that in the future may become the Parque Estadual Serra Negra da Mantiqueira.

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APPENDIX I: Testimony specimens deposited in Coleção Herpetológica do Museu de Zoologia João Moojen da Universidade Federal de Viçosa: *Ischnocnema izecksohni* (MZUFV 9043, MZUFV14291), *Ischnocnema juipoca* (MZUFV 14292, 14293, 14780), *Ischnocnema* aff. *guentheri* (MZUFV 13991), *Dendrophryniscus* sp. (MZUFV 15982, 15983, 15984), *Rhinella icterica* (MZUFV 12994, 13995, 13996, 13997, 14269), *Rhinella ornata* (MZUFV 14271, 14303, 14782), *Vitreorana uranoscopa* (MZUFV 9019), *Haddadus binotatus* (MZUFV 13990, 13992), *Thoropa miliaris* (MZUFV 15745), *Aplastodiscus arildae* (MZUFV 14784), *Aplastodiscus leucopygius* (MZUFV 14785), *Bokermannohyla circumdata* (MZUFV 14694, 14786), *Bokermannohyla ibitipoca* (MZUFV 14795, 14796), *Bokermannohyla luctuosa* (MZUFV 13944, 14287), *Dendropsophus decipiens* (MZUFV 15749, 14750, 15751, 15752), *Dendropsophus elegans* (MZUFV 13961, 13962, 14005, 14006, 14262), *Dendropsophus microps* (MZUFV 9026, 9027, 15610, 15611), *Dendropsophus minutus* (MZUFV 13952, 13953, 13954, 14011), *Hypsiboas albomarginatus* (MZUFV 14263, 15613), *Hypsiboas albopunctatus* (MZUFV 13885, 13886, 13969, 14000), *Hypsiboas faber* (MZUFV 13971, 14003, 14272), *Hypsiboas pardalis* (MZUFV 14290, 14298, 14229, 14695), *Hypsiboas polytaenius* (MZUFV 13882, 13967, 14703), *Hypsiboas cambui* (MZUFV 9016, 9017), *Phyllomedusa burmeisteri* (MZUFV 13998, 13999, 15614), *Scinax* gr. *catharinae* (MZUFV 9033, 9034, 9035), *Scinax cosenzai* (MZUFV 15985, 15986), *Scinax crospedospilus* (MZUFV 14015, 14282, 15622), *Scinax eurydice* (MZUFV 14284, 14294, 14295), *Scinax fuscovarius* (MZUFV 14690, 14691, 14012), *Scinax* aff. *perereca* (MZUFV 9018, 14014, 14281, 14283), *Scinax* sp. (*ruber* clade) (MZUFV 9020, 9021), *Hylodes perere* (MZUFV 9041, 9042, 14787, 14788), *Leptodactylus furnarius* (MZUFV 14698), *Leptodactylus fuscus* (MZUFV 14285, 14286, 14303), *Leptodactylus* cf. *jolyi* (MZUFV 14304, 15746, 15747), *Leptodactylus latrans* (MZUFV 13883, 13884, 14265, 14266), *Physalaemus cuvieri* (MZUFV 14278, 14279, 14288), *Physalaemus* cf. *feioi* (MZUFV 15755), *Physalaemus rupestris* (MZUFV 9039, 9040), *Physalaemus signifer* (MZUFV 9023, 9024, 15755), *Elachistocleis cesarii* (MZUFV 14702), *Odontophrynus americanus* (MZUFV 15618, 15619, 15620), *Proceratophrys boiei* (MZUFV 14781, 15615), *Proceratophrys mantiqueira* (MZUFV 9044).

Accepted by Vinicius Caldart