

Anurans from the Serra da Bocaina National Park and surrounding buffer area, southeastern Brazil

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ABSTRACT: Here, we review the species of anuran amphibian from the Serra da Bocaina National Park and its buffer area, in the Atlantic Forest of southeastern Brazil, comparing the data from a recent survey with museum records. We surveyed adult and larval anurans in ponds, marshes, and streams discontinuously from May 2008 to January 2011. In total, 63 anuran species were previously known to occur at the Park and its surrounding buffer area. In our survey, we recorded 46 species, of which five represented new records, and 22 appeared only in the historical list. Seven topotypic populations were not found in the present study. We suggest that conservation strategies for anurans in the Serra da Bocaina should also consider the surrounding areas that are subjected to anthropogenic pressure, due to the high diversity recorded, high altitudinal variation in species distribution, and various vegetation formations.

INTRODUCTION

Brazil is the home of 968 amphibian species, of which 932 are anurans (AmphibiaWeb 2014). The highest amphibian richness in Brazil occurs along the coastal Atlantic Forest, to which many species are endemic (Rossa-Feres *et al.* 2011; Haddad *et al.* 2013). This high richness is in part due to the environmental heterogeneity created by the various vegetation types, the altitudinal, and longitudinal and latitudinal variation along this biome (Haddad and Prado 2005; Araujo *et al.* 2009; Ribeiro *et al.* 2009), which limit the dispersal and favor the occurrence of species with small range sizes (Villalobos *et al.* 2013). Furthermore, the climatic refugia of the Pleistocene and neotectonism (Thomé *et al.* 2010) seem to play a key role in dictating the contemporary species richness of several taxa (Carnaval and Moritz 2008).

The Atlantic Forest is composed of two main vegetation types: Atlantic Rain Forest and Atlantic Semi-deciduous Forest (Morellato and Haddad 2000). The Serra da Bocaina National Park is a protected area in the Atlantic Forest in the Serra do Mar, at the border between the states of São Paulo and Rio de Janeiro, in Southeastern Brazil. The Park currently comprehends an area of 140,000 ha, from the sea level up to 2,088 m a.s.l. and is covered by the Atlantic Rain Forest, with natural and anthropogenic grasslands in high altitudes. Although many collections of amphibians have been carried out in the past (1925 to 1970), mainly by Adolpho and Bertha Lutz, and Werner C. A. Bokermann, no long-term ecological study encompassing an entire reproductive season had been conducted. These past research efforts resulted in 17 anuran species being described from the Park and its surrounding buffer area, which includes the Fazenda Bonito (Lutz 1925; Bokermann

1967a,b,c; Frost 2013). Eight species are only known to occur in the Park and the buffer area: *Brachycephalus vertebralis*, *Ischnocnema pusilla*, *Bokermannohyla ahenea*, *B. clepsydra*, *Scinax ariadne*, *Megaelosia bocainensis*, *Physalaemus barrioi*, and *Paratelmatobius gaigae* (Frost 2013).

Recently, two studies provided new information on the anuranfauna of the Serra da Bocaina highlands (Zaher *et al.* 2005; Serafim *et al.* 2008). Zaher *et al.* (2005) provided a list of anurans from the Bananal Biological Station, a protected area near the Serra da Bocaina National Park, and Serafim *et al.* (2008) provided a list of anurans from the surrounding buffer area of the Serra da Bocaina National Park. Despite this new information, data on anuran species composition in the area is yet fragmented and anecdotal at best. Here, we present the species list of anurans for the Serra da Bocaina National Park and its surrounding buffer area based on a recent field survey. We also gathered data about species occurrence from museum records available in online databases. Additionally, we also provide data on habitat use, which can subsidize both management plans and future research projects.

MATERIALS AND METHODS

Our survey was concentrated in the northern region of the Serra da Bocaina National Park, mainly in São José do Barreiro, São Paulo, Brazil (Figure 1). The climate in this region is of the type Cwb (humid subtropical highland; Peel *et al.* 2007), with moderated temperatures, dry winters (between April and September) and warm summers (from October to March). The annual rainfall varies between 400 and 2,100 mm, with mean annual temperature of 22° C. The buffer area is a ring of 10 Km wide surrounding the

Park, which includes areas of the cities of Arapeí, Areias, Bananal, Cunha, São José do Barreiro, Silveiras, Ubatuba in the state of São Paulo, and Angra dos Reis and Paraty in the state of Rio de Janeiro.

We surveyed tadpoles and adult anurans in 14 breeding sites monthly (May 2008 to June 2009, and November 2009 to February 2010), including ten ponds, three marshes, and one stream. These water bodies were sampled once during one week each month. We also surveyed other ten breeding sites (six streams and four ponds) occasionally. Tadpoles were sampled with hand dipnets along the entire margins of water bodies, with effort proportional to surface area (Skelly and Richardson 2010). To survey adult anurans, we employed three different and complementary methodologies: visual encounter surveys, survey at breeding sites (Scott and Woodward 1994), and also searched for direct-developing species on the forest floor and bromeliads, near water bodies or along trails. In every breeding site, we recorded calling males as well as adults that were not vocalizing. Further environmental data on sampling sites are available in Provete (2011). Pictures from the sampling points, along with their geographical coordinates, are available online at CalPhotos (bitly.com/Bocaina). A Google Earth file with sampling points is available at diogoprovete.weebly.com/publications.

We also conducted two surveys of three days each in a tourist trail, known as *Caminho do Ouro*, which crosses the Park from São José do Barreiro (22°44'03.7" S; 44°36'58.6" W) to Vila de Mambucaba in Angra dos Reis, Rio de Janeiro (23°00'27.9" S, 44°32'05.8" W; Figure 1), in

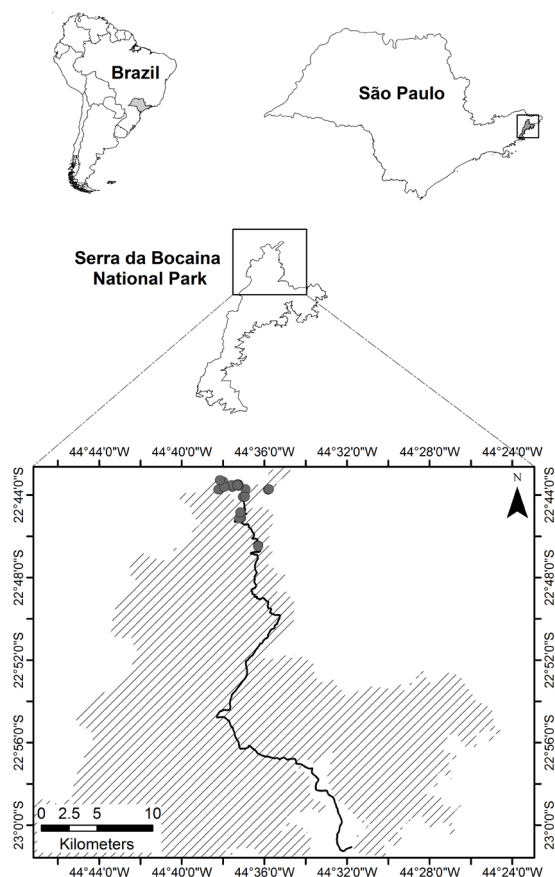


FIGURE 1. Location of the Serra da Bocaina National Park at the border between the states of São Paulo and Rio de Janeiro, in Southeastern Brazil. In detail, the Park showing the distribution of 14 water bodies sampled by us (gray circles), the Park area (crosshatched), and a tourist trail known as Caminho do Ouro (black line).

January 2010 and January 2011. During these surveys, we recorded anurans encountered visually (Crump and Scott 1994) and tadpoles in streams crossing the trail using a hand dipnet. Overall, our sampling effort comprised 141 survey days throughout 20 incursions in 18 months, with approximately 1,270 sampling hours/person, with two researchers conducting the samplings. IBAMA provided collecting permits (14474-1, 14861-1, and 16461-1).

Adult anurans collected were euthanized in 20% ethanol, fixed in 10% formalin, and stored in 70% ethanol. Voucher specimens are housed at the Célio F. B. Haddad collection (CFBH), Rio Claro, São Paulo, Brazil, and DZSJRP-Amphibia collection, São José do Rio Preto, São Paulo, Brazil. Tadpoles were killed and fixed in 10% formalin in the field and housed at the DZSJRP- Tadpoles collection, São José do Rio Preto, São Paulo, Brazil (Appendix 1).

To assemble the historical list of species, we searched for museum records and in the literature. Literature search took into account the locality (*e.g.*, Parque Nacional da Serra da Bocaina, Campo de Fruticultura, município de Bananal). Museum search included Museu de Zoologia da Unicamp (ZUEC-AMP; Campinas, Brazil) and Coleção Célio F. B. Haddad (CFBH; Rio Claro, Brazil) available online at www.splink.cria.org.br (captured on 10 January 2014), besides the amphibian collection of the Smithsonian National Museum of Natural History (USNM; Washington D.C., United States). Since this study was not designed to be a taxonomic revision, we did not checked the identity of each museum specimen, except for the specimens housed at the CFBH collection. We checked each record of the other museums to exclude any outlier or those species that are not known to occur in the Serra da Bocaina using the available geographic coordinates. Furthermore, uncertain identifications, such as “sp.,” “affinis,” or “group” were also excluded from our list. We looked for literature and catalogs mentioning material collected in the Serra da Bocaina and its buffer area (Lutz 1925; 1929; Lutz and Lutz, 1938; 1939; Lutz in Lutz 1950; Cochran 1955; Bokermann 1966; 1967a,b; Heyer 1985; Cruz and Peixoto 1984; 1985; Peixoto 1989; Giaretta, Bokermann and Haddad, 1993; Pombal and Hadad 1999; Pombal 2001; Napoli and Caramaschi 2004; Almeida and Angulo 2006; Prado and Pombal 2010; Martins and Zaher 2012; Frost 2013, Caramaschi and Cruz 2013; Appendix 2). In the case of the genus *Fritziana*, the historical list includes four species. However, those species in the genus occurring in southern Brazil seem to be a species complex, whose members are difficult to tease apart. Therefore, we took a conservative decision and list only one species. the nomenclature used here follows Frost (2013).

We run a Jackknife 2 to estimate the species richness based on the incidence of larvae and adults. We used this estimator because it can handle unequal sampling effort among habitats and is biased to species that occur in a few samples (Hortal *et al.*, 2006). Data were analyzed using software EstimateS ver. 8.2 (Colwell, 2006).

RESULTS

Sixty-three anuran species were previously known from the Serra da Bocaina National Park and its surrounding buffer zone (Table 1; Figures 2-3). In this study, we recorded 46 species (Jackknife 2 = 53 species), of which 41

also appear in museum records and five species represent new records from the Serra da Bocaina National Park. These records increased the list of the area to 68 species.

We recorded 26 (57%) out of 46 species as larvae, of which four (9%) were recorded exclusively using this sampling method. We recorded 42 species (91%) as adults, in which 20 (44%) were only recorded by adult sampling, and 22 species (48%) were found as both larvae and adults (Table 1). The majority of species were recorded in forested environments (41 species, 60%), 26% (18 species) in grasslands, and 9% (six species) in both. We recorded 34 species (49%) in lentic water bodies, 16 (24%) in lotic water bodies, 14 (21%) in leaf litter, two (3%) in bromeliads, and other two (3%) occurred in both lentic and lotic water bodies.

According to the IUCN Red list of threatened species (IUCN, 2008), 13 species (19%) are classified as Data Deficient (DD), whereas the remaining species were either Not Evaluated (NE) or not under any threatened status (LC). The São Paulo state red list (Garcia *et al.* 2009), includes 4 species as threatened: *Crossodactylus dispar* is endangered (EN), *Paratelmatobius gaigae* is vulnerable (VU), and *Bokermannohyla ahenea* and *Physalaemus barrio* are near threatened (NT).

DISCUSSION

The anuranfauna currently known in the Serra da Bocaina National Park and surrounding buffer areas represents approximately 13% of the species known to Atlantic Forest biome (Rossa-Feres *et al.* 2011; Haddad *et al.* 2013). Considering only the species richness along the Serra do Mar, the anuran diversity in the Park is similar to other localities with high altitudinal variation, such as the Boracéia Biological Station (65 species; Heyer *et al.* 1990) and Carlos Botelho State Park (65 species; Forlani *et al.* 2010). The high diversity along this mountain range is probably due to its high altitudinal variation, which favors the high species turnover along altitudinal gradients. Species turnover along altitudinal gradients in the Atlantic Forest has already been found in several groups (*e.g.*, Almeida-Neto *et al.* 2006), including anurans (Giaretta *et al.* 1999).

The greatest sampling efforts, both in the past and in the present study, was concentrated on the northern areas, above 1,000 m a.s.l. In this area, we record the highest species richness. These data reinforce the need to increase sampling efforts in the southern region of the Park and areas of lower altitude, which certainly will prove fruitful.

Some topotypic populations and species known from museum records were not found in the current surveys. The majority of these species occur in the highlands, such as *Bokermannohyla clepsydra*, *Megaelosia bocainensis*, *Crossodactylus dispar*, *Cycloramphus granulosus*, *Paratelmatobius gaigae*, *Vitreorana eurygnatha*, and *Ischnocnema pusilla*. Some species present direct development on the forest floor (*Brachycephalus vertebralis* and *Holoaden suarezi*, Haddad and Prado 2005), or are stream breeders (*C. dispar* and *V. uranoscopa*, Haddad and Prado 2005), which were habitats poorly sampled in our study. Since our sampling effort was concentrated in high altitude areas, widely distributed species, such as *Hypsiboas faber*, *Leptodactylus labyrinthicus*, and *Leptodactylus*

mystacinus and also those known to occur in lower altitude areas (Serafim *et al.* 2008) were not recorded. The specific locality in which Bokermann (1972) found *B. clepsydra*, and Giaretta *et al.* (1993) found *M. bocainensis*, called Campo de Fruticultura (also known as Fazenda Ponte Alta) was surveyed for 14 consecutive months. However, we find neither adults nor tadpoles of these species. Probably, the lack of current records of *B. clepsydra* might be due to environmental changes, occurred since this area passed to the Park administration in the late 1970s. After that, the forest expanded and the landscape changed dramatically, which might have contributed to the local decline of this population. The same seems to be the case for other endemic species, which were known to inhabit the Campo de Fruticultura, such as *Physalaemus barrio* that now is found only in open areas in the buffer area of the Park (Provete *et al.* 2012).

The two survey techniques employed in this study demonstrated to be complementary. We recorded four species only by sampling tadpoles (*Phasmahyla cochraniae*, *Scinax ariadne*, *Scinax crospedospilus*, and *Thoropa taophora*). While 20 species were only recorded by adult sampling, and 22 species were found as both larvae and adults. Both methods contribute to a more accurate sampling of the anuran richness if applied together, as already pointed out by a recent study (Silva 2010).

We recorded the majority of species in forested environments, including most of the endemic species in the study area (Table 1). However, the high species richness in grasslands, with some of the species restricted to this environment (*e.g.*, *P. barrio*), highlight the need for conserving this type of environment, which currently is under high anthropogenic pressure in the surrounding buffer area.

The conservation status of most species was not evaluated yet, mainly due to lack of detailed information about natural history (IUCN 2008; Garcia *et al.* 2009). *Bokermannohyla ahenea* and *P. barrio* are both classified as Near Threatened and are also endemic to the Serra da Bocaina highlands. Two species listed as threatened in the state redlist (Garcia *et al.* 2009) are found in the Park: *C. dispar* (EN) and *P. gaigae* (VU). *Crossodactylus dispar* is widely distributed, occurring in the states of Rio de Janeiro, São Paulo, and Minas Gerais. *Paratelmatobius gaigae* is also endemic to the study area, occurring at the Fazenda do Bonito and Bananal Ecological Station (Zaher *et al.* 2005; Frost 2013). None of the former species were recorded by us, and more field work aiming specifically to collect those species seems to be necessary to evaluate their conservation status properly and extent of occurrence. In this study, we provided a list of anuran species, mainly for the northern portion of the Serra da Bocaina considering the current survey and museum data. Information about species richness and composition and current population trends are relevant to subsidize management plans and conservation strategies (Colombo *et al.* 2008). Furthermore, data about species distribution can have an additional practical application in providing data to studies on species distribution modeling under future climatic scenarios (Bini *et al.* 2006), as well as helping on-the-ground conservation measures by the protected area network in the Atlantic Forest of southeastern Brazil.

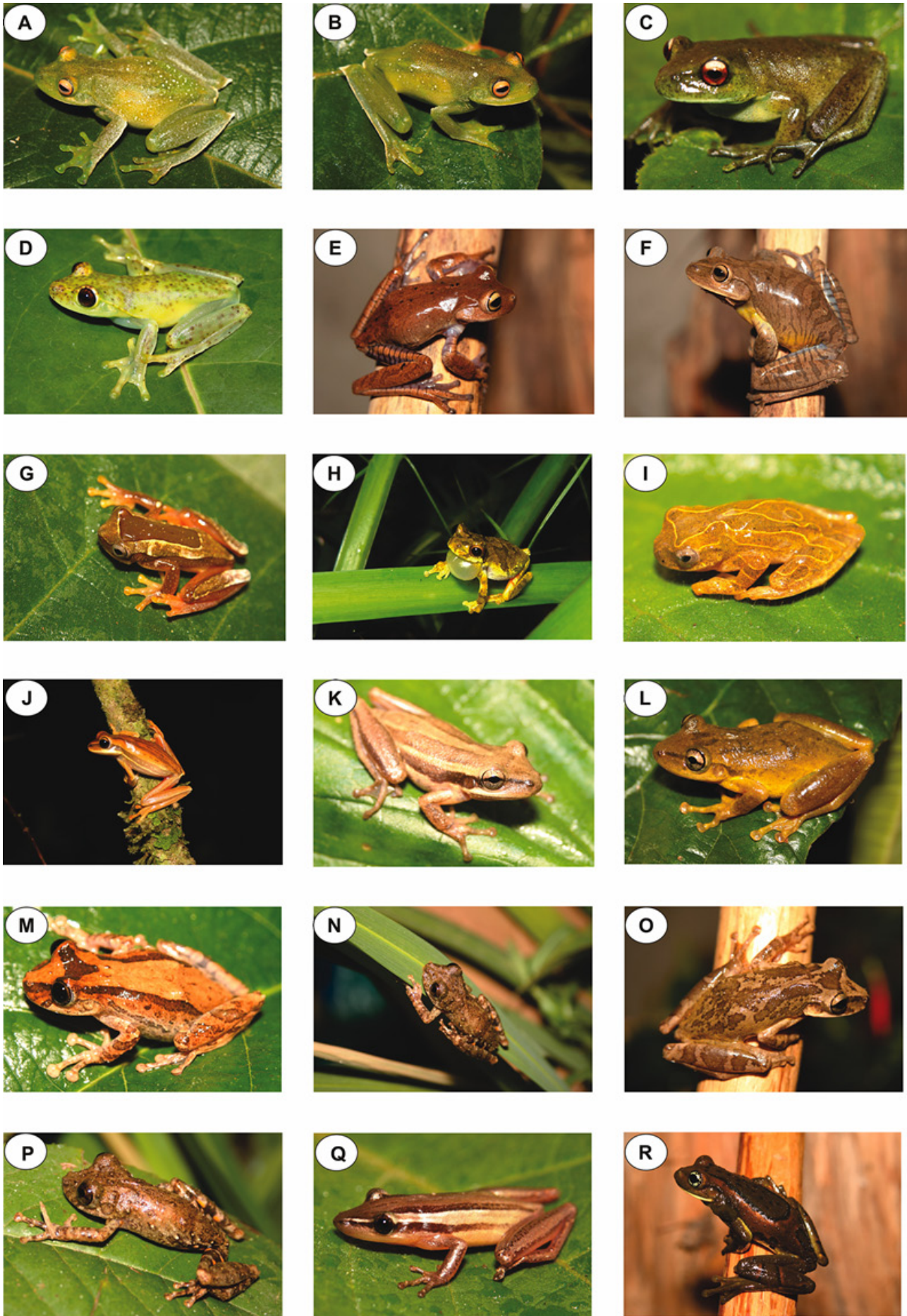


FIGURE 2. Some species of amphibians from the Serra da Bocaina National Park: (A) *Aplastodiscus albosignatus*; (B); *A. callipygius* (C) *A. perviridis*; (D) *A. arildae*; (E) *Bokermannohyla ahenea*; (F) *B. circumdata*; (G) *Dendropsophus elegans* (H) *D. microps*; (I) *D. minutus*; (J) *Hypsiboas bandeirantes*; (K) *Scinax* sp. (aff. *duartei*); (L) *Scinax hayii*; (M) *Scinax* sp. (aff. *obtriangulatus*); (N) *S. atratus*; (O) *S. eurydice*; (P) *S. flavoguttatus*; (Q) *S. squalirostris*; (R) *Trachycephalus imitatrix*.

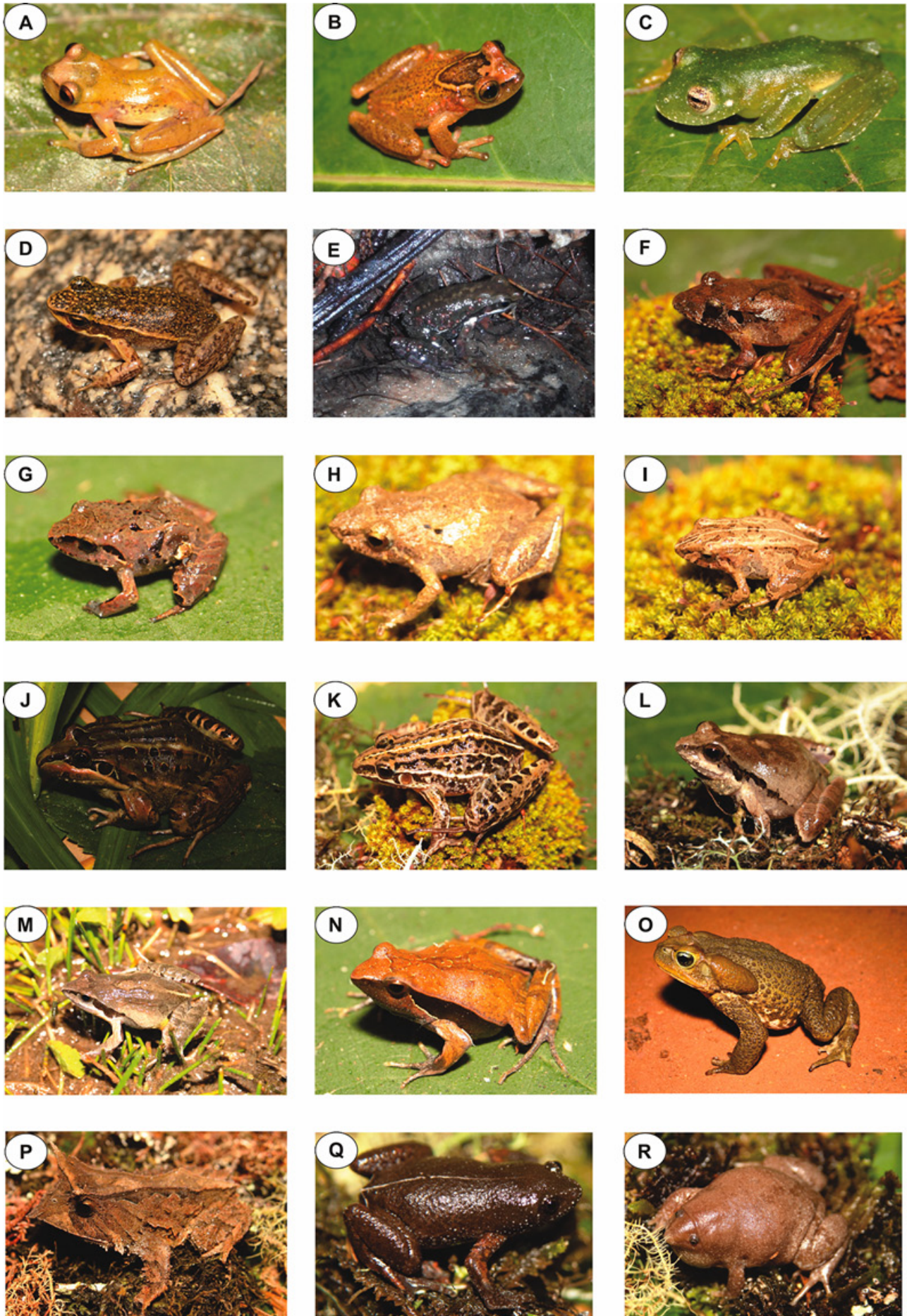


FIGURE 3. Some species of amphibians from the Serra da Bocaina National Park: (A) *Fritziana* sp.; (B) *Fritziana* sp.; (C) *Vitreorana uranoscopa*; (D) *Hylodes* sp.; (E) *Hylodes phyllodes*; (F) *Ischnocnema* sp. (aff. *guentheri*); (G) *I. parva*; (H) *I. vizottoi*; (I) *Ischnocnema* sp. (aff. *melanopygia*); (J) *Leptodactylus latrans*; (K) *L. furnarius*; (L) *Physalaemus barroioi*; (M) *P. cuvieri*; (N) *P. olfersii*; (O) *Rhinella icterica*; (P) *Proceratophrys melanopogon*; (Q) *Chiasmocleis mantiqueira*; (R) *Myersiella microps*.

TABLE 1. Species list of anurans from the Serra da Bocaina National Park and surrounding buffer area, southeastern Brazil. * = endemic species to the Serra da Bocaina; ** type locality is the Serra da Bocaina. Museum record: ZUEC = Museu de Zoologia da Unicamp; CFBH Coleção Célio F. B. Haddad; USNM = Smithsonian National Museum of Natural History; MZUSP = Museu de Zoologia do Rio de Janeiro; Survey data: P = Present study; M = Museum or literature record, or B = both; Environment: forest, open areas, or both; Habitat used for reproduction: FF = forest floor; LE = lentic and lotic; BR = bromeliads. Altitude: altitudinal variation in which the species was recorded; Survey method with which the species was recorded: A = adult; T = tadpole; or B = both. IUCN conservation status and São Paulo State Red List: EN = endangered; VU = vulnerable; NT = near threatened; DD = data deficient; LC = least concern; NE = Not evaluated.

FAMILY /SPECIES	REFERENCE/MUSEUM RECORD	SURVEY DATA	ENVIRONMENT	HABITAT	ALTITUDINAL RANGE (M)	METHOD	IUCN STATUS	SÃO PAULO STATE RED LIST
Brachycephalidae								
<i>Brachycephalus ephippium</i> (Spix, 1824)	Zaher et al. 2005; CFBH	M	Forest	FF	?	-	LC	LC
<i>Brachycephalus vertebralis</i> Pombal, 2001**	Pombal 2001; CFBH; MNRI	M	Forest	FF	?	-	DD	DD
<i>Ischnocnema parva</i> (Girard 1853)	Zaher et al. 2005; Serafim et al. 2008; USNM	B	Forest	FF	1,200-1,600	A	LC	LC
<i>Ischnocnema pusilla</i> (Bokermann, 1967)**	Bokermann 1967a; MZUSP	M	Forest	FF	1,600	-	DD	DD
<i>Ischnocnema vizoitoi</i> Martins & Haddad, 2010	Martins and Haddad 2010	B	Both	FF	1,400-1,600	A	NE	NE
<i>Ischnocnema</i> sp. (aff. <i>guentheri</i>)	Zaher et al. 2005; Serafim et al. 2008; USNM	B	Forest	FF	300-1,600	A	NE	NE
<i>Ischnocnema</i> sp. (aff. <i>melanopygia</i>)	-	P	Forest	FF	1,400-1,600	A	NE	NE
<i>Ischnocnema</i> sp. (gr. <i>lactea</i>)	Serafim et al. 2008	B	Forest	FF	1,500	A	NE	NE
Bufonidae								
<i>Rhinella icterica</i> (Spix, 1824)	Zaher et al. 2005; Serafim et al. 2008; USNM	B	Open areas	LE	1,400-1,600	B	LC	LC
<i>Rhinella ornata</i> (Spix, 1824)	Serafim et al. 2008	B	Forest	LE	100-200	A	LC	LC
Centrolenidae								
<i>Vitreorana eurygnatha</i> (Lutz, 1925)	Lutz 1925; Serafim et al. 2008; Heyer 1985; CFBH; USNM; ZUEC; MZUSP	M	Forest	LO	1,200-1,700	-	LC	LC
<i>Vitreorana uranoscopa</i> (Müller, 1924)	Heyer 1985; CFBH; USNM	B	Forest	LO	1,400-1,600	A	LC	LC
Ceratophryidae								
<i>Ceratophrys aurita</i> (Raddi, 1823)	USNM	M	?	LE	?	-	LC	LC
Craugastoridae								
<i>Haddadus binotatus</i> (Spix, 1824)	Zaher et al. 2005; Serafim et al. 2008; CFBH	M	Forest	FF	Up to 1,100	-	LC	LC
<i>Holoaden suarezi</i> Martins & Zaher, 2013	Zaher et al. 2005; Martins and Zaher 2013; MZUSP	M	Forest	FF	900 – 1,300	-	NE	NE
Cycloramphidae								
<i>Cycloramphus eleutherodactylus</i> (Miranda-Ribeiro, 1920)	Zaher et al. 2005	M	Forest	FF	?	-	DD	LC
<i>Cycloramphus granulatus</i> Lutz, 1929	Lutz 1929; USNM; ZUEC	M	?	FF	1,200-1,700	-	DD	LC
<i>Thoropa taophora</i> (Miranda-Ribeiro, 1923)	-	P	Forest	LO	200-500	T	NE	NE
Hemiphractidae								
<i>Fritziana</i> sp.	Serafim et al. 2008; USNM; ZUEC	B	Open areas	BR	1,500-1,600	A	NE	NE
Hylidae								
<i>Aplastodiscus albosignatus</i> (Lutz & Lutz, 1938)	USNM	B	Forest	LO	1,300-1,600	B	LC	LC
<i>Aplastodiscus arildae</i> (Cruz & Peixoto, 1987)	Zaher et al. 2005; CFBH; USNM; ZUEC	B	Forest	LE	1,300-1,400	A	LC	LC
<i>Aplastodiscus callipygius</i> (Cruz & Peixoto, 1985)**	Cruz and Peixoto 1984; CFBH; MZUSP, MNRI	B	Forest	LO	1,300-1,500	B	LC	LC
<i>Aplastodiscus leucopygius</i> (Cruz & Peixoto, 1985)	Zaher et al. 2005; Serafim et al. 2008; CFBH	M	Forest	LE	1,100-1,500	-	LC	LC
<i>Aplastodiscus perviridis</i> Lutz 1950**	Lutz 1950; Serafim et al. 2008; CFBH; ZUEC; MNRI	B	Open areas	LL	1,300-1,600	B	LC	LC
<i>Bokermannohyla ahenea</i> (Napoli & Caramaschi, 2004)**	Napoli and Caramaschi 2004; CFBH, MZUSP, MNRI	B	Forest	LO	1,500-1,600	B	DD	NT
<i>Bokermannohyla circumdata</i> (Cope, 1871)	Zaher et al. 2005; Serafim et al. 2008; CFBH; ZUEC	B	Open areas	LE	1,500-1,600	B	LC	LC
<i>Bokermannohyla clepsydra</i> (Lutz, 1925)*	Lutz 1925; Bokermann 1972; MNRI; MZUSP	M	Forest	LO	?	-	DD	DD
<i>Dendropsophus elegans</i> (Wied-Neuwied, 1824)	Zaher et al. 2005; Serafim et al. 2008	B	Open areas	LE	1,400-1,600	A	LC	LC
<i>Dendropsophus microps</i> (Peters, 1872)	Zaher et al. 2005; Serafim et al. 2008; CFBH; ZUEC	B	Both	LE	1,000-1,600	B	LC	LC
<i>Dendropsophus minutus</i> (Peters, 1872)	Zaher et al. 2005; Serafim et al. 2008; CFBH; ZUEC	B	Both	LE	1,000-1,600	B	LC	LC
<i>Hypsiboas bandeirantes</i> Caramaschi & Cruz, 2013	Zaher et al. 2005; Serafim et al. 2008; Caramaschi and Cruz 2013; CFBH; USNM; MNRI; ZUEC	B	Both	LE	1,000-1,600	B	NE	NE

TABLE 1. CONTINUED.

FAMILY /SPECIES	REFERENCE/MUSEUM RECORD	SURVEY DATA	ENVIRONMENT	HABITAT	ALTITUDINAL RANGE (M)	METHOD	IUCN STATUS	SÃO PAULO STATE RED LIST
<i>Hypsiboas pardalis</i> (Spix, 1824)	Zaher et al. 2005; Serafim et al. 2008; USNM	B	Open areas	LE	900-1,000	A	LC	LC
<i>Hypsiboas faber</i> (Wied-Neuwied, 1821)	Zaher et al. 2005; Serafim et al. 2008; ZUEC	M	Open areas	LE	?	-	LC	LC
<i>Phasmahyla cochranae</i> (Bokermann, 1966)**	Bokermann 1966; MZUSP; USNM; ZUEC	B	Forest	LO	1,300-1,400	T	LC	LC
<i>Scinax ariadne</i> (Bokermann, 1967)*,**	Bokermann 1967c; CFBH; MZUSP; ZUEC	B	Forest	LO	1,300-1,400	T	DD	DD
<i>Scinax atratus</i> (Peixoto, 1989)**	Peixoto 1989; MZUSP	B	Forest	BR	1,200-1,300	A	DD	DD
<i>Scinax crospeiospilus</i> (Lutz, 1925)	-	P	Forest	LE	1,400-1,500	T	LC	LC
<i>Scinax eurydice</i> (Bokermann, 1968)	-	P	Open areas	LE	1,500-1,600	A	LC	LC
<i>Scinax flavoguttatus</i> (Lutz & Lutz, 1939)**	Lutz and Lutz 1939; USNM	B	Forest	LE	1,200-1,300	B	LC	LC
<i>Scinax fuscoguttatus</i> (Lutz, 1925)	Serafim et al. 2008	M	Open areas	LE	1,300-1,500	-	LC	LC
<i>Scinax fuscovarius</i> (Lutz, 1925)	Serafim et al. 2008	B	Open areas	LE	1,400-1,500	A	LC	LC
<i>Scinax hayii</i> (Barbour, 1909)	Zaher et al. 2005; Serafim et al. 2008; USNM	B	Open areas	LE	1,300-1,600	B	NE	NE
<i>Scinax squallirostris</i> (Lutz, 1925)**	Lutz 1925; Serafim et al. 2008; USNM; ZUEC	B	Open areas	LE	1,500-1,600	B	LC	LC
<i>Scinax</i> sp. (aff. <i>duartei</i>)	CFBH; ZUEC	B	Both	LE	1,400-1,600	B	NE	NE
<i>Scinax</i> sp. (aff. <i>obtriangulatus</i>)	ZUEC	B	Forest	LE	1,200-1,600	B	NE	NE
<i>Sphaenorhynchus orophilus</i> (Lutz & Lutz, 1938)	Lutz and Lutz 1938; USNM;	M	?	LE	?	-	LC	LC
<i>Trachycephalus imitatrix</i> (Miranda-Ribeiro, 1926)	CFBH; USNM; ZUEC	B	Forest	LE	1300-1400	B	LC	DD
Hylodidae								
<i>Grossodactylus dispar</i> Lutz, 1925	Lutz 1925; USNM	M	Forest	LO		-	DD	EN
<i>Hylodes asper</i> (Müller, 1924)	USNM	B	Forest	LO	200-600	A	LC	LC
<i>Hylodes phyllodes</i> Heyer & Cocroft, 1986	-	P	Forest	LO	200-600	A	LC	LC
<i>Hylodes</i> sp.	Serafim et al. 2008	B	Forest	LO	1300-1500	B	NE	NE
<i>Megaelosia bocainensis</i> Giaretta, Bokermann & Haddad, 1993***	Giaretta et al. 1993, MNRJ	M	Forest	LO		-	DD	DD
<i>Megaelosia goeldii</i> (Baumann, 1912)	USNM; MNRJ	M	Forest	LO		-	LC	LC
Leptodactylidae								
<i>Adenomera bokermanni</i> (Heyer, 1973)	Almeida and Angulo 2006; USNM	M	Both	FF		-	LC	LC
<i>Leptodactylus furnarius</i> Sazima & Bokermann, 1978	Zaher et al. 2005; USNM; ZUEC	B	Open areas	LE	1500-1600	B	LC	LC
<i>Leptodactylus labyrinthicus</i> (Spix, 1824)	Serafim et al. 2008;	M	Open areas	LE		-	LC	LC
<i>Leptodactylus latrans</i> (Steffen, 1815)	USNM	B	Open areas	LE	1500-1600	A	LC	LC
<i>Leptodactylus mystacinus</i> (Burmeister, 1861)	Zaher et al. 2005;	M	Open areas	LE		-	LC	LC
<i>Paratelmatobius gaigeae</i> (Cochran, 1938)**,*	Cochran 1938; Zaher et al. 2005; MZUSP; USNM	M	Forest	LE	1160-1230	-	DD	VU
<i>Physalaemus barrioi</i> Bokermann, 1967***	Bokermann 1967b; Provete et al. 2012; CFBH; MZUSP; USNM; ZUEC	B	Open areas	LE	1500-1600	B	DD	NT
<i>Physalaemus cavieri</i> Fitzinger, 1826	Serafim et al. 2008;	B	Open areas	LE	1500-1600	B	LC	LC
<i>Physalaemus maculiventris</i> (Lutz, 1925)	Zaher et al. 2005	M	Forest	LE	Up to 1100	-	LC	LC
<i>Physalaemus olfersii</i> (Lichtenstein & Martens, 1856)	Serafim et al. 2008; Zaher et al. 2005; ZUEC; USNM	B	Forest	LE	1400-1500	B	LC	LC
Microhylidae								
<i>Chiasmocleis mantiqueira</i> Cruz, Feio & Cassini, 2007†	Zaher et al. 2005	B	Forest	LE	1400-1500	B	DD	DD
<i>Myersiella microps</i> (Duméril & Bibron, 1841)	Zaher et al. 2005; CFBH	B	Forest	FF	1400-1600	A	LC	LC
Odontophrynidae								
<i>Proceratophrys appendiculata</i> (Günther, 1873)	MZUSP	B	Forest	LO	300-900	A	LC	LC
<i>Proceratophrys boiei</i> (Wied-Neuwied, 1824)	Serafim et al. 2008; Zaher et al. 2005	B	Forest	LE	Up to 1100	A	LC	LC
<i>Proceratophrys melanopogon</i> (Miranda-Ribeiro, 1926)	Zaher et al. 2005; Provete et al. 2013; MZUSP; ZUEC	B	Forest	LL	1300-1500	B	LC	LC

† The name *Chismocleis mantiqueira* seems to be more adequate to designate the population of this species occurring in the study area, instead of *Chiasmocleis leucosticta*, from which it was separated (M. Forlani, pers. comm.).

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APPENDIX 1. Specimens collected in the study area during the course of this study.

Brachycephalidae: *Ischnocnema parva* (DZSJRP 13963-4); *Ischnocnema vizottoi* (CFBH 29433-34; DZSJRP 13988-90); *Ischnocnema* sp. (aff. *guentheri*) (DZSJRP 13937, 12069-71; CFBH 28818-19); *Ischnocnema* sp. (aff. *melanopygia*) (DZSJRP 14003-12); **Bufonidae:** *Rhinella icterica* (DZSJRP 11717-21, 12103, 12157-8); **Centrolenidae:** *Vitreorana uranoscopa* (DZSJRP 11705); **Hemiphractidae:** *Fritziana* sp. (DZSJRP 11733, 12156, 12159; CFBH 28886); **Hylidae:** *Aplastodiscus albosignatus* (DZSJRP 13980-1); *Aplastodiscus arildae* (DZSJRP 11730, 12122, 13924); *Aplastodiscus callipygius* (DZSJRP 13982); *Aplastodiscus perviridis* (DZSJRP 12087-91, 13924; CFBH 28807-9); *Bokermannohyla ahenea* (DZSJRP 12124-7, 13920, 13947; CFBH 28796-8); *Bokermannohyla circumdata* (DZSJRP 12111-2, 13927-8, 13934; CFBH 28887); *Dendropsophus elegans* (DZSJRP 12072-3; CFBH 28782); *Dendropsophus microps* (DZSJRP 11731-2, 11739, 12137-42; CFBH 28874-5); *Dendropsophus minutus* (DZSJRP 11731-2, 12113-8; CFBH 28786-7); *Hypsiboas bandeirantes* (DZSJRP 11707-12, 11735-7; CFBH 28830-1, 28835-36); *Hypsiboas pardalis* (DZSJRP 11704); *Phasmahyla cochranæ* (DZSJRP L2008.1); *Scinax ariadne* (DZSJRP L2031.1, L2033.1, L2098.1); *Scinax atratus* (DZSJRP 13960, 14000-01); *Scinax crosopodospilus* (DZSJRP L1969.2); *Scinax eurydice* (DZSJRP 12153); *Scinax flavoguttatus* (DZSJRP 11706); *Scinax fuscovarius* (CFBH 28820-1); *Scinax squalirostris* (DZSJRP 12092-7, 13919; CFBH 28778-9); *Scinax* sp. (aff. *duartei*) (DZSJRP 12128-36; CFBH 28861-64); *Scinax hayii* (DZSJRP 12076-81; CFBH 28822-5); *Scinax* sp. (aff. *obtriangulatus*) (DZSJRP 11713-6, 11740-1, 12121; CFBH 28852-3); *Trachycephalus imitatrix* (DZSJRP 12123, 14160, 14002); **Hylodidae:** *Hylodes* sp. (DZSJRP 12154, 13961); *Hylodes asper* (13983-13987); **Leptodactylidae:** *Leptodactylus furnarius* (DZSJRP 12098-9, 12100-2; CFBH 28774-76); *Leptodactylus latrans* (DZSJRP 12155); *Physalaemus barrioi* (DZSJRP 13965-76; CFBH 28817); *Physalaemus cuvieri* (DZSJRP 12082-4; CFBH 28814-16); *Physalaemus olfersii* (DZSJRP 13958, 13999); **Microhylidae:** *Chiasmocleis mantiqueira* (DZSJRP 12147-52; CFBH 28800-03); *Myersiella microps* (DZSJRP 12074-5); **Odontophrynidae:** *Proceratophrys appendiculata* (DZSJRP 12143-6); *Proceratophrys melanopogon* (DZSJRP 12085-6, 13925-6; CFBH 28811-12).

APPENDIX 2. Specimens from museum records.

Brachycephalidae: *Brachycephalus ephippium* (CFBH 22562-7); *Brachycephalus vertebralis* (CFBH 3415-8; MNRJ 11098-9, 11130, 2053, 10599, 11094-6, 11100-2, 11105-7, 11112, 11114, 11116-8, 11120, 11122, 11123, 11125-129, 11131, 11132); *Ischnocnema pusilla* (WCAB-MZUSP 31461); *Ischnocnema* sp. (aff. *guentheri*) (USNM 96724-7, 96752); *Ischnocnema parva* (USNM 96753-5); **Bufonidae:** *Rhinella icterica* (USNM 96640-1, 207957-9); **Centrolenidae:** *Vitreorana eurygnatha* (CFBH 19254-55, 19278; USNM 96558, 96560-61, 96562, 96563, 96651-661, 217661-69; MZUSP 53052-59; ZUEC 944-46); *Vitreorana uranoscopa* (CFBH 22587-89; USNM 96557, 96559, 96722-

3); **Ceratophryidae:** *Ceratophrys aurita* (USNM 241298-9, 208078-83); **Craugastoridae:** *Haddadus binotatus* (CFBH 22590); *Holoaden suarezi* (MZUSP 131872, 94415); **Cycloramphidae:** *Cycloramphus granulatus* (USNM 96742-51, 217903-5; ZUEC 2166); **Hemiphractidae:** *Fritziana fissilis* (USNM 164026-30; ZUEC 942-43); *Fritziana goeldii* (USNM 96664-78, 96680-6, 96688-9, 96690-1, 96705); *Fritziana ohausi* (USNM 241301, 217722-4); *Fritziana* sp. (USNM 318181-2); **Hylidae:** *Aplastodiscus albosignatus* (USNM 96644); *Aplastodiscus arildae* (CFBH 17518; USNM 96564-5, 96567, 96601-3, 96605-7, 207960-1; ZUEC 6542); *Aplastodiscus callipygius* (CFBH 19264-66; WCAB-MZUSP 31190, 42587-95, 42210-3; MNRJ 4176); *Aplastodiscus leucopygius* (CFBH 18109); *Aplastodiscus perviridis* (AL-MNRJ 2132; CFBH 232, 18118-9, 21957-60; ZUEC 7542, 7545, 7572, 7564); *Bokermannohyla ahenea* (CFBH 17517, 18111-2, 18122-3, 19259-63, 21240-1; MZUSP 93493, 93465-4, 93478-9, 93480-1, 93482-4, 93485-6, 93488-90, 93492, 93495, 93497-98, 93500-1, 93487, 93496, 93502-503, 93505-8, 93504, 93509-12, 93514-20, 93522-5, 93527-8, 93530-5, 93537-40, 93513, 93521, 93526, 93536, 93529, 93541-6, 93597-600; MNRJ 25437-8); *Bokermannohyla circumdata* (CFBH 19257-8; ZUEC 2027); *Bokermannohyla clepsydra* (WCAB-MZUSP 31236-42, 39269-73, 42551-67, 46213-4; AL-MNRJ 976); *Dendropsophus microps* (CFBH 18410-4, 18125; USNM 96595-600, 96708-9, 96711; ZUEC 1087-89, 6346-47, 6349-51, 6481-85, 6545, 6563, 6565-66, 7145-48); *Dendropsophus minutus* (CFBH 17520, 18115, 19270-75; USNM 96569-80, 96697-704); *Hypsiboas bandeirantes* (CFBH 228, 17507-17514; USNM 96706-7, 81125-7, 96581-94; MNRJ 83700-1, 3288, 3290-3327, 13727-13728, 83696-83698, 83699, 55578-55581, 56446-56449, 76679-76684; AL-MNRJ 1540-1545, 2112-2116, 2339-2342; ZUEC 7142-43); *Hypsiboas faber* (ZUEC 6541); *Hypsiboas pardalis* (USNM 81128); *Phasmahyla cochranæ* (USNM 96548-56, 96642; WCAB-MZUSP 31184; ZUEC 3376-77, 2026, 15982); *Scinax ariadne* (CFBH 585, 18103, 18105-06, 18124, 19543; WCAB-MZUSP 24492-537; ZUEC 2023-24, 16186); *Scinax atratus* (WCAB-MZUSP 31326); *Scinax flavoguttatus* (USNM 96564-7, 96601-7); *Scinax squalirostris* (USNM 96719-21, 96608-13; ZUEC 6598, 16700-08); *Scinax* sp. (aff. *duartei*) (CFBH 229; ZUEC 6599-602, 6336-39); *Scinax hayii* (USNM 96712-8); *Scinax* sp. (aff. *obtriangulatus*) (ZUEC 6476-6478); *Sphaenorhynchus orophilus* (USNM 96692-6); *Trachycephalus imitatrix* (CFBH 18110; ZUEC 2327-29; USNM 164089); **Hylodidae:** *Crossodactylus dispar* (USNM 96738-40, 96617, 96619, 96623-6, 96737, 96741); *Hylodes asper* (USNM 96627-32, 96761-2, 81153); *Megaelosia bocainensis* (MNRJ 15900); *Megaelosia goeldii* (USNM 96763; AL-MNRJ 2306); **Leptodactylidae:** *Adenomera bokermanni* (USNM 536905); *Leptodactylus furnarius* (USNM 81133-4, 96614-6, 96728-36; ZUEC 6474-75, 6597, 16168); *Leptodactylus latrans* (USNM 208107-08); *Paratelmatobius gaigae* (USNM 96759-60; MZUSP 132601, 132603, 138448, 138783, 138380, 138453-4, 138365, 138432, 138424, 138377-8, 138358); *Physalaemus barrioi* (CFBH 227, 17516, 17519, 18120, 24182, 22541; WCAB-MZUSP 31294-8; USNM 96756-8; ZUEC 2025, 6472, 6353, 9259, 9276-9286); *Physalaemus olfersii* (USNM 96634-9; ZUEC 941, 6354-58, 6544, 6560, 6562); **Microhylidae:** *Myersiella microps* (CFBH 20511); **Odontophrynidae:** *Proceratophrys appendiculata* (MZUSP 131929, 131931, 131934, 131936, 131938, 131941, 131944-45, 131947-48, 131950, 131954-5, 131958, 131961, 133453, 133455-56, 133459, 53044, 31360); *Proceratophrys melanopogon* (ZUEC 3504; MZUSP 131930, 131933, 131937, 131940, 131942-43, 131946, 131949, 131951-53, 131957; 76711-12, 96120-21, 96333-60, 96361-67, 0931, 31357, 56036, 56038, 53041-43, 53046-67, 31359, 53036-43, 53045-51).