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Anurans in the region of the High Muriaé River, state of Minas Gerais, Brazil

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Abstract. The region of the High Muriaé River belongs to the Atlantic Forest domain, located in the Mantiqueira mountain complex, identified as one of the priority areas for studies related to amphibians in Brazil. Collections and observations were made aiming to investigate the anuran fauna from March 2005 to September 2007 in many locations in the region. We found 41 species of amphibians belonging to ten families: Brachycephalidae (3), Bufonidae (2), Craugastoridae (1), Cycloramphidae (2), Hylidae (19), Hylodidae (1), Leiuperidae (5), Leptodactylidae (6), Microhylidae (1) and Ranidae (1). This number of species corresponds to 27.3 % of the species known from the Atlantic Forest of the state of Minas Gerais. It can be considered a very significant number, considering the high environment degradation degree of the region.

Keywords. Zona da Mata, Atlantic Forest, amphibians, diversity, biogeography.

Introduction

The Neotropical region harbors the world's highest diversity of amphibians, with approximately 2,000 species, or approximately a third of the world's known species (Frost, 2008). Brazil currently hosts the highest richness of amphibians, with 849 known species (SBH, 2009).

In the tropical and subtropical forests east of the Andes, the anuran amphibians are highly diverse, whose basic zoogeographic aspects are just beginning to be elucidated (Cruz and Feio, 2007).

The Atlantic Forest morphoclimatic domain (*sensu* Ab'Saber, 1977) comprises a narrow zone of coastal forests in the Brazilian east, adjacent to mountainous regions. This biome is known for the richness of its anuran fauna, with more than 400 species in 22 endemic genera (Cruz and Feio, 2007) with more new species being described every year (Feio and Ferreira, 2005). The south and southeast mountain range complex (Serra Geral, Serra do Mar, and Serra da Mantiqueira, respectively) are perhaps the most important regions in terms of the anuran fauna diversity in the Atlantic Forest, containing many endemic species (Cruz and Feio, 2007).

Despite of this biome´s high diversity and endemism, only around 7% of its original forest remains due to habitat destruction (Drummond et al., 2005). Thus, this region is both one of the richest and one of the most threatened regions on the Earth (Mittermeier et al., 2005).

Knowledge of the diversity of amphibians in the Minas Gerais state is still limited (Drummond et al., 2005). Only two previous amphibian surveys have been published related to the Zona da Mata in Minas Gerais (Feio and Ferreira, 2005; Feio et al., 2008).

Located in the Atlantic Forest, the region of the High Muriaé River belongs to the Paraíba do Sul River basin, in "*Serra da Mantiqueira*" (Mantiqueira mountain range), a prioritary region for further studies of anuran fauna according to Cruz and Feio (2007). The present study presents a list of anuran species from the High Muriaé River region, which may facilitate the further study of the biogeography of the mountane regions in southeastern Brazil.

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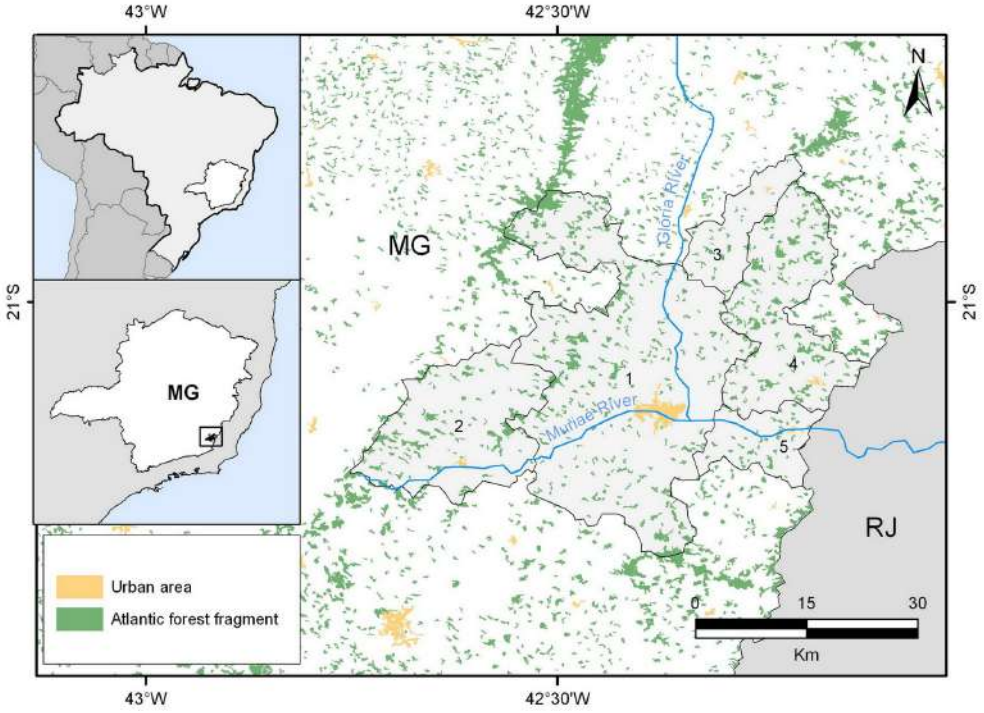

Figure 1. Region of the High Muriaé River, located in the southeast of the state of Minas Gerais. (1) Muriaé, (2) Miraí, (3) Vieiras, (4) Eugenópolis and (5) Patrocínio do Muriaé municipalities.

Table 1. Amphibian species recorded in the region of the High Muriaé River.

Brachycephalidae	*Ischnocnema guentheri* (Steindachner, 1864)
	Ischnocnema parva (Girad, 1853)
	Ischnocnema sp.
Bufonidae	*Rhinella granulosa* (Spix, 1824)
	Rhinella pombali (Baldissera-Jr, Caramaschi and Haddad, 2004)
Craugastoridae	*Haddadus binotatus* (Spix, 1824)
Cycloramphidae	*Proceratophrys boiei* (Wied-Neuwied, 1825)
	Thoropa miliaris (Spix, 1824)
Hylidae	*Aplastodiscus arildae* (Cruz and Peixoto, 1987 "1985")
	Dendropsophus branneri (Cochran, 1948)
	Dendropsophus elegans (Wied-Neuwied, 1824)
	Dendropsophus minutus (Peters, 1872)
	Dendropsophus decipiens (A. Lutz, 1925)
	Hypsiboas albomarginatus (Spix, 1824)
	Hypsiboas albopunctatus (Spix, 1824)
	Hypsiboas crepitans (Wied-Neuwied, 1824)
	Hypsiboas faber (Wied-Neuwied, 1821)
	Hypsiboas pardalis (Spix, 1824)
	Hypsiboas polytaenius (Cope, 1870"1869")
	Hypsiboas semilineatus (Spix, 1824)
	Phyllomedusa burmeisteri Boulenger, 1882
	Scinax alter (B. Lutz, 1973)
	Scinax cuspidatus (A. Lutz, 1925)
	Scinax eurydice (Bokermann, 1968)
	Scinax fuscovarius (A. Lutz, 1925)
	Scinax sp.[1] (gr. *catharinae*)
	Scinax sp.[2] (gr. *catharinae*)
Hylodidae	*Hylodes* sp.
Leiuperidae	*Physalaemus cuvieri* Fitzinger, 1826
	Physalaemus signifer (Girard, 1853)
	Physalaemus aff. *olfersii*
	Pseudopaludicola mystacalis (Cope, 1887)
	Pseudopaludicola sp.
Leptodactylidae	*Leptodactylus furnarius* Sazima and Bokermann, 1978
	Leptodactylus fuscus (Schneider, 1799)
	Leptodactylus labyrinthicus (Spix, 1824)
	Leptodactylus ocellatus (Linnaeus, 1758)
	Leptodactylus aff. *mystaceus*
	Leptodactylus sp. (gr. *marmoratus*)
Microhylidae	*Elachistocleis ovalis* (Schneider, 1799)
Ranidae	*Lithobates catesbeianus* (Shaw, 1802) Introduced

Material and methods

This study was performed in the High Muriaé River region, with observations in Muriaé, Miraí, Patrocínio do Muriaé, Vieiras and Eugenópolis municipalities, located at the east Zona da Mata in Minas Gerais State and belonging to the Rio Paraíba do Sul watershed (Figure 1).

The vegetation of the Atlantic Forest biome is characterized as mesophyllous semideciduous forest (Valverde, 1958). Nevertheless the vegetation cover encountered in the region consists of forest remants, usually on the tops of hillocks, interspersed by grazing and monoculture cultivations. The region presents altitudinal variation from 150 to 1500 m above sea level and average annual rainfall from 1,500 to 1,700 mm (Gonçalves et al., 2005).

Animals were inventoried during diurnal and nocturnal visual surveys at random localities within the municipality region, from March 2005 to September 2007. We surveyed a wide variety of environments, including ponds, brooks, forest interior, temporary puddles and other waterbodies. Observations took place between the gloaming until approximately 23:00 h (regardless of daylight saving time). Each study site was surveyed by least two people and no more than four people in each field team. Vocalizations were recorded using Sony P620® digital recorder with an internal microphone The calls were analyzed with SoundRuler (V. 0.9.4.1). Audiospectrograms were produced according to the following parameters: *FFT* = 256, *Frame* = 100, *Overlap* = 75 and flat top filter. Terminology follows Duellman and Trueb (1994).

Our field inventory methods followed the "Complete Species Inventories", "Visual Encounter Surveys" and "Audio Strip

Figure 2. Some species of anurans from the region of the High Muriaé River: A. *Ischnocnema guentheri*; B. *Ischnocnema parva* (in amplexus); C. *Ischnocnema* sp.; D. *Rhinella pombali*; E. *Haddadus binotatus*; F. *Proceratophrys boiei*.

Transects" guidelines of Heyer et al. (1994). Inventory data was supplemented by data obtained previously by other researchers in this region and deposited at the herpetological collection of Museu de Zoologia João Moojen (MZUFV), Universidade Federal de Viçosa, and Museu de Ciências Naturais (MCNAN), Pontificia Universidade Católica de Minas.

Voucher specimens were deposited in the herpetological collection of Museu de Zoologia João Moojen (MZUFV), Departamento de Biologia Animal, Universidade Federal de Viçosa. Nomenclature follows Faivovich et al. (2005), Frost et al. (2006), Grant et al. (2006) and Chaparro et al. (2007).

Results and Discussion

Forty-one anuran species (Tab. 1) were encountered in the region of the High Muriaé River during this study, including members of the families Brachycephalidae (3), Bufonidae (2), Craugastoridae (1), Cycloramphidae (2), Hylidae (19), Hylodidae (1), Leiuperidae (5), Leptodactylidae (6), Microhylidae (1), and Ranidae (1).

Among the species encountered, we noted a high number of generalist and widely distributed species, such as *Dendropsophus minutus*, *Leptodactylus ocellatus, L. fuscus*, *Elachistocleis ovalis*, *Physalaemus cuvieri*, *Scinax fuscovarius*, and *Hypsiboas albopunctatus* (Feio

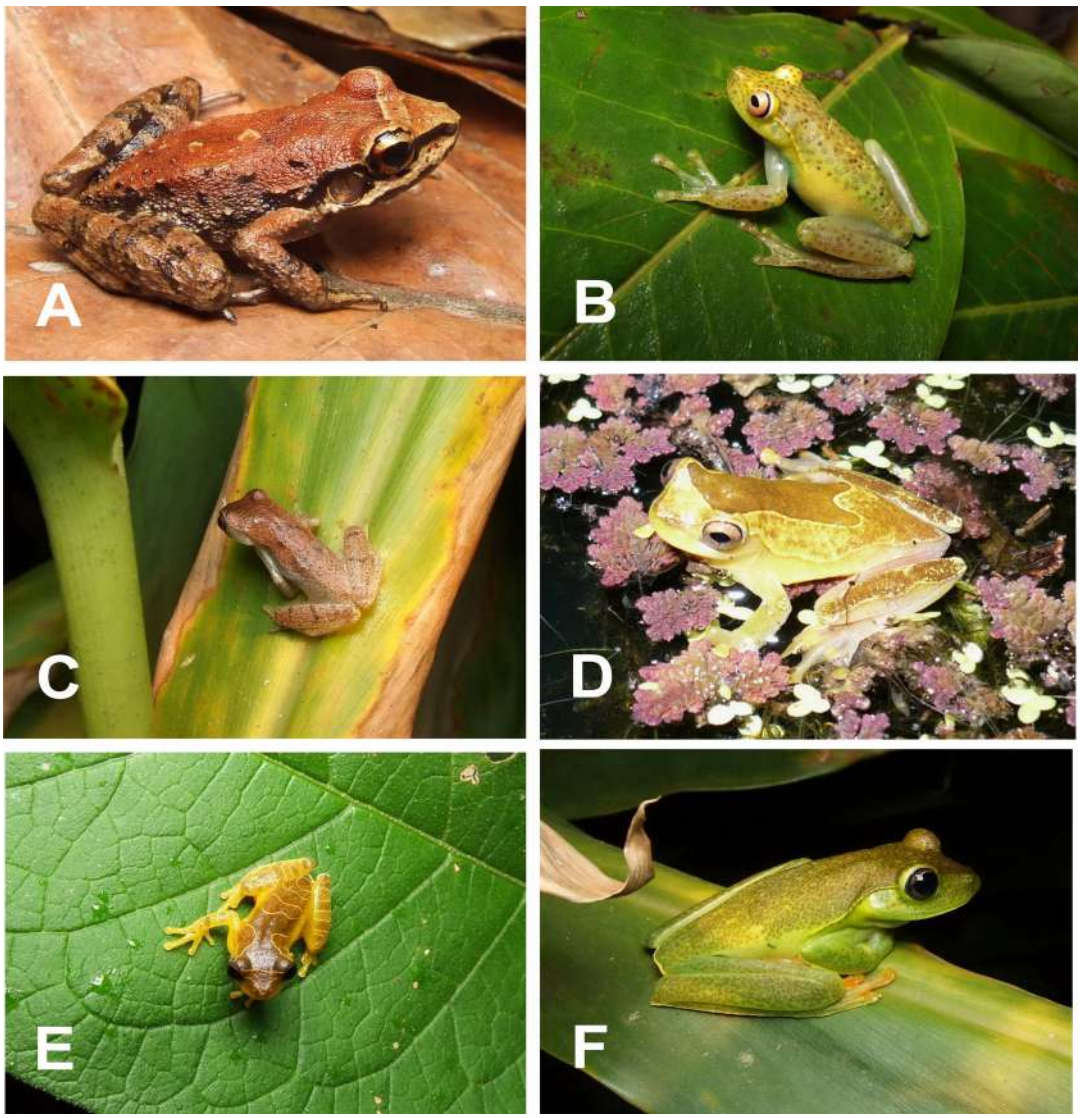

Figure 3. Some species of anurans from the region of the High Muriaé River: A. *Thoropa miliaris*; B. *Aplastodiscus arildae*; C. *Dendropsophus branneri*; D. *Dendropsophus elegans*; E. *Dendropsophus minutus*; F. *Hypsiboas albomarginatus*.

et al., 1998; Feio and Ferreira, 2005; Frost, 2008). Most of these species occur mainly in open areas (Feio and Ferreira, 2005). Although some species are typical of the rainforest, such as *Hypsiboas faber*, they are considered generalists as well, and can be found in anthropogenic areas (Feio and Ferreira, 2005). *Rhinella pombali*, *Dendropsophus branneri*, *D. elegans*, and *Scinax fuscovarius* were found in areas presenting high anthropogenic impact, such as urban areas close to gardens and residences. These species presents wide seasonal occurrence and are ecological generalists. Their predominance in the study area suggests an advanced degree of degradation around the forest remants we surveyed. Nevertheless, species related to forested areas, such as *Ischnocnema guentheri*, *I. parva*, *Ischnocnema* sp., *Procerathophrys boiei*, and *Scinax* sp. (gr. *catharinae*), were encountered only within forest fragments.

All encountered species that were identified to the species level are in agreement with their known geographic distribution. Two species were encountered at the limits of their respective ranges: *Leptodactylus furnarius* at its western limit and *Scinax alter* at its eastern limit.

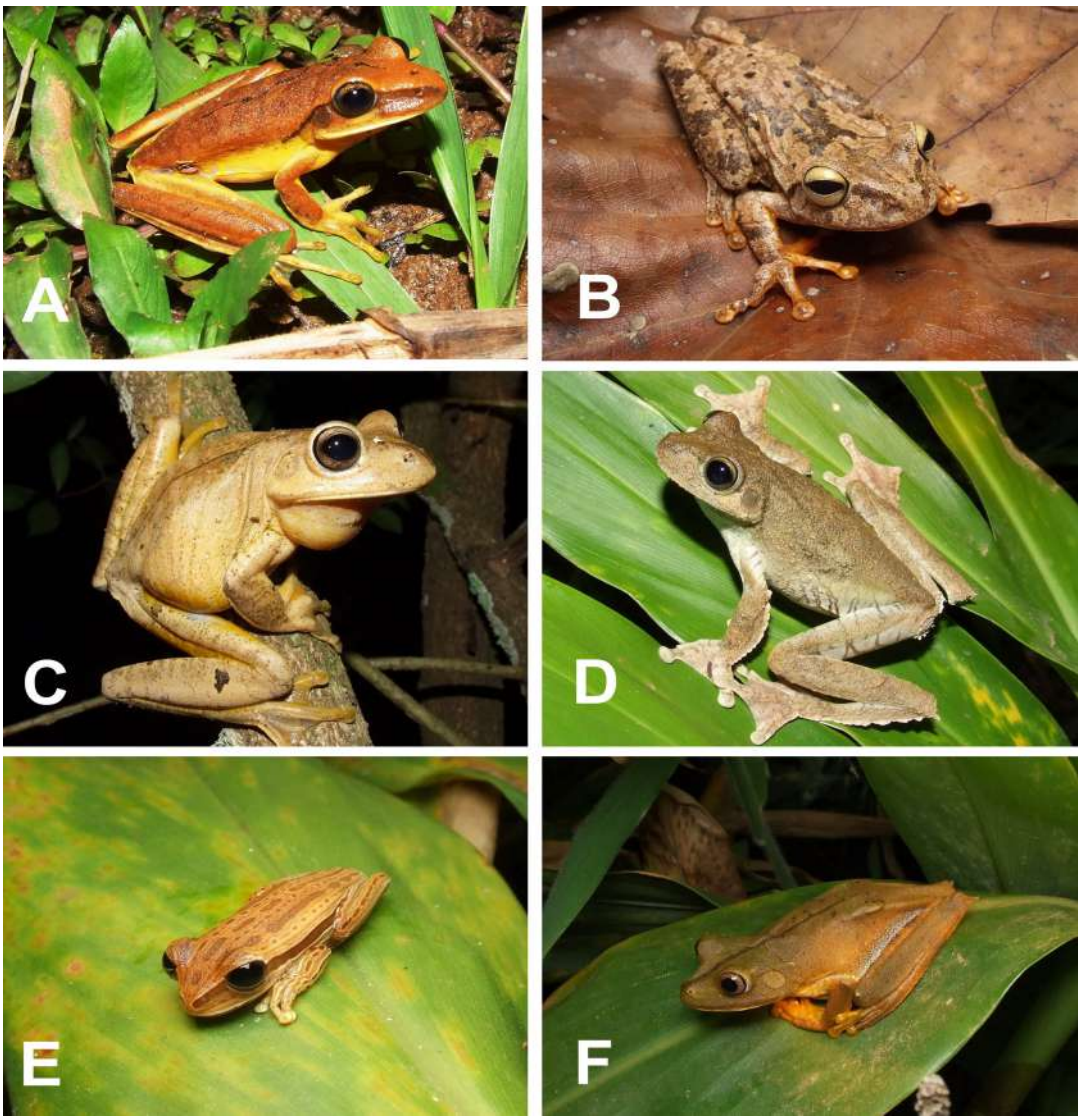

Figure 4. Some species of anurans from the region of the High Muriaé River: A. *Hypsiboas albopunctatus*; B. *Hypsiboas crepitans*; C. *Hypsiboas faber*; D. *Hypsiboas pardalis*; E. *Hypsiboas polytaenius*; F. *Hypsiboas semilineatus*.

Physalaemus aff. *olfersii* was also recorded in the Zona da Mata, at the "Serra do Brigadeiro" by Feio et al. (2008). It is a new species in description (C.S. Cassini, pers. comm.). Two *Scinax* species of the *catharinae* group were encountered in streams located on montane slopes. *Scinax* sp. 1 is bigger than *Scinax* sp. 2 and presents a darker pattern of dorsal color (Scinax sp. 2 presents a pattern of dorsal color more grayish). Only one juvenile of *Hylodes* was captured, which we could not identify to the species level. The two *Pseudopaludicola* species are very difficult to identify. Only *P. mystacalis* was diagnosed and differentiated from *Pseudopaludicola* sp. mainly by the call structure. The advertisement call of *Pseudopaludicola mystacalis*, as described previously in Haddad and Cardoso (1987), is pulsed, constituted from 3 to 6 pulses, while *Pseudopaludicola* sp. has the advertisement call (Figure 8) consists a single note of harmonic structure, reminding a whistle (calls recorded in 27 December 2007 at 16:30 h). These species can be found in sympatry in the study region. They are typical of Brazilian Cerrado biome (Silveira, 2006), occurring in open areas and calling from protected sites within the vegetation on the humid ground or in swamp, as observed by Santana and Tostes (2007).

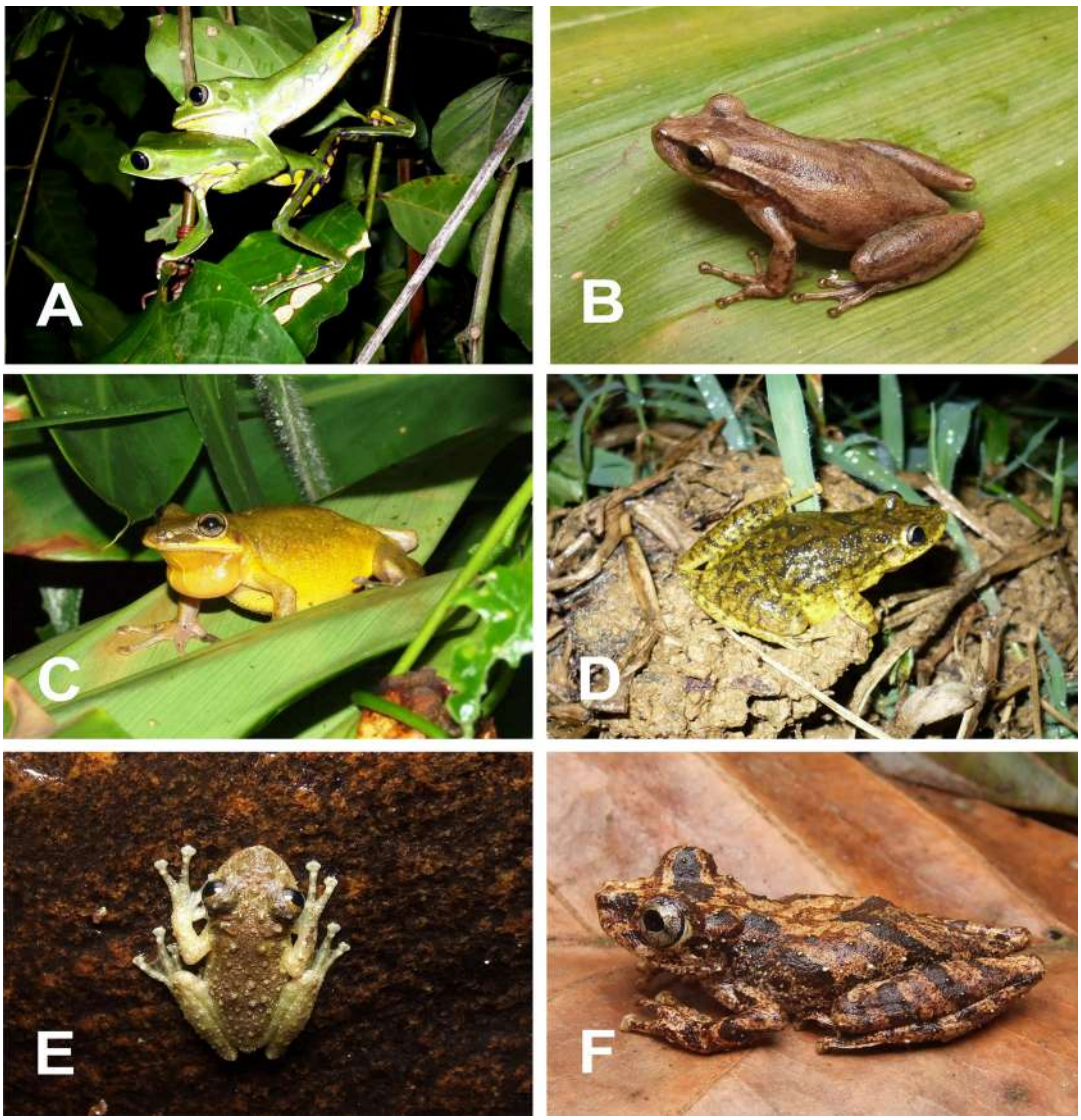

Figure 5. Some species of anurans from the region of the High Muriaé River: A. *Phyllomedusa burmeisteri* (males fighting); B. *Scinax alter*; C. *Scinax eurydice*; D. *Scinax fuscovarius*; E. *Scinax* sp. 1. (gr. catharinae); F. *Scinax* sp. 2. (gr. catharinae).

Table 2. Number of anurans species registered at some places with area of Atlantic forest in the state of Minas Gerais.

Locality	Number of species	Time of study	Reference
Region of the high Muriaé River	41	3 years	Present Work
Rio Novo municipality	20	2 mounths	Feio and Ferreira, 2005.
Serra do Brigadeiro*	38	> 5 years	Feio et al. 2008.
Northeastern of Minas Gerais	30	2 years	Feio and Caramaschi, 2002.
Serra do Ouro Branco*	41	1 year	São Pedro et al. 2008.
Parque Estadual do Rio Doce*	38	> 5 years	Feio et al. 1998.
Serra do Caraça*	43	1 year	Canelas and Bertoluci, 2007.

* protected areas

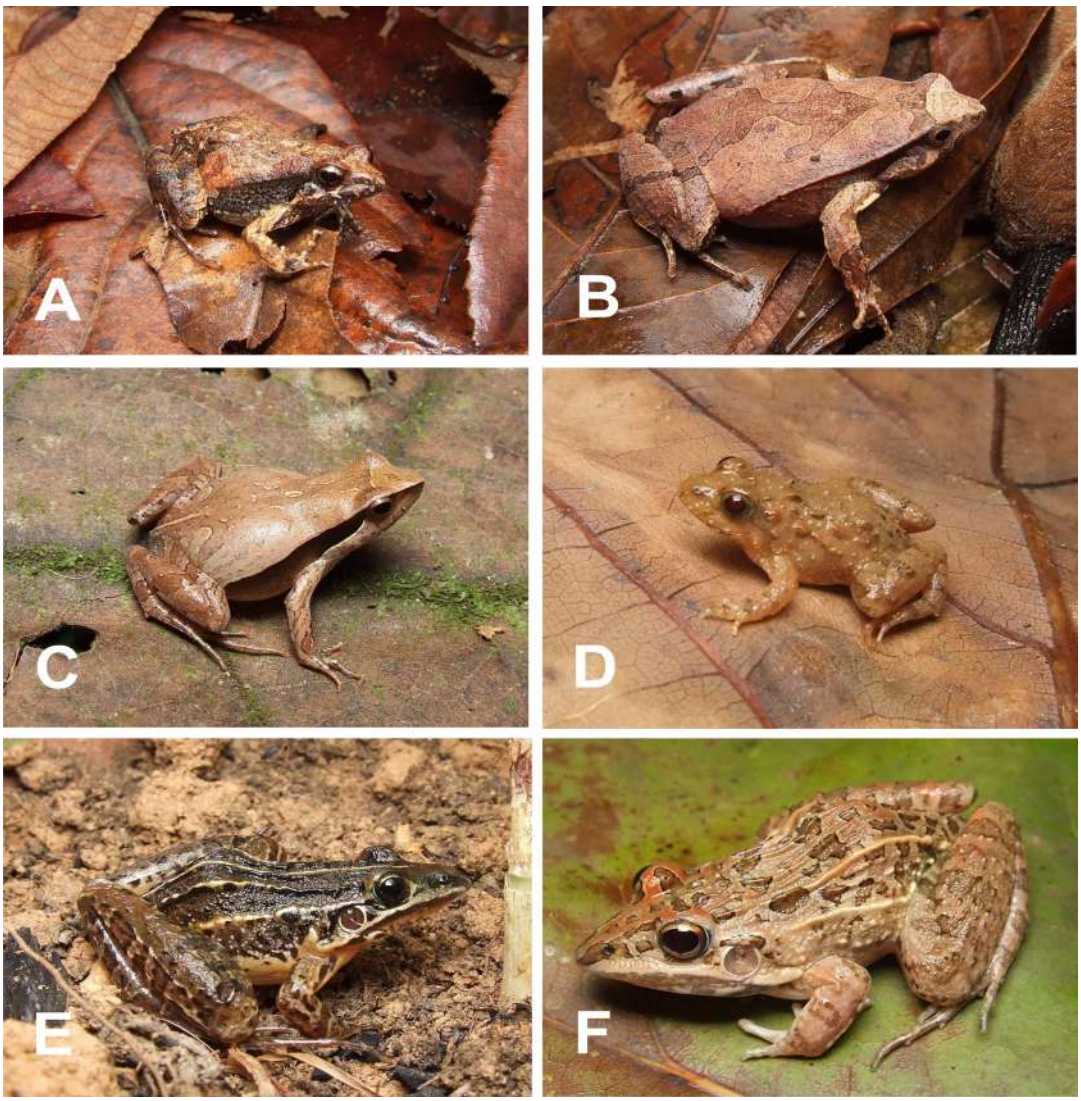

Figure 6. Some species of anurans from the region of the High Muriaé River: A. *Physalaemus cuvieri*; B. *Physalaemus signifier*; C. *Physalaemus aff. olfersii*; D. *Pseudopaludicola mystacalis*; E. *Leptodactylus furnarius*; F. *Leptodactylus fuscus*.

Lithobates catesbeianus, also found in the study region, is an introduced species. Individuals of this species can be found in natural environments at some collect points, e.g., teh São João do Glória district, but there are no data on its potential negative impact on the native fauna within this region. *Lithobates catesbeianus* is a voracious predator known to prey on native amphibians in parts of its introduced range (Werner et al. 1995).

We recorded three species typical of sloped habitats: *Dendropsophus branneri*, *Hypsiboas albomarginatus* and *Rhinella granulosa*. These species ranged from the north of the Rio de Janeiro state, through the Rio Paraíba valley to the region of the High Muriaé River.

The anuran fauna from the High Muriaé region includes 27% of the species known from the Atlantic Forest of the state of Minas Gerais (Nascimento et al., 2009). Comparing the richness of species founded in the region with other areas of Atlantic forest in the state of Minas Gerais (Table 2), we observed a that the number of species is equivalent to the number of species observed in protected areas. We consider this a rather impressive number of species, considering the high environment degradation affecting the region. The anuran fauna found in the mountain range in the studied area is very similar to the one observed in the Serra do Brigadeiro. We predict that the other species registered by Feio et al. (2008) could also be encountered in the Muriaé region in the future.

Figure 7. Some species of anurans from the region of the High Muriaé River: A. *Leptodactylus labyrinthicus*; B. *Leptodactylus* aff. *mystaceus*; C. *Leptodactylus ocellatus*; D. *Leptodactylus* sp. (gr. marmoratus); E. *Elachistocleis ovalis*; F. *Lithobates catesbeianus*.

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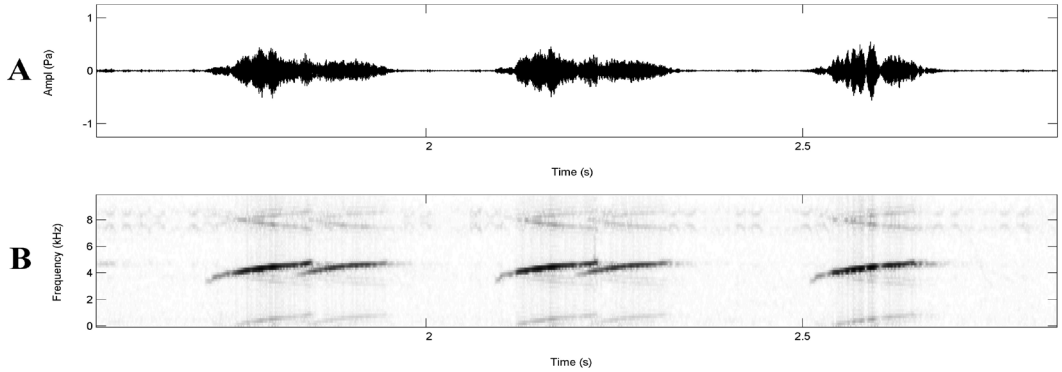

Figure 8. *Pseudopaludicola* sp., advertisement call: (A) oscillogram and (B) audiospectrogram of a session of three notes. (air temperature = 36ºC).

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Appendix 1. Voucher specimens.

Aplastodiscus arildae – MZUFV 7925; *Dendropsophus branneri* – MZUFV 7078, 7730, 8090, 8344; MCNAN 4751, 4752, 4753, 4755; *Dendropsophus elegans* – MZUFV 7690, 7749; *Dendropsophus minutus* – MZUFV 7493-7499; *Elachistocleis ovalis* – MZUFV 8989-8990; *Haddadus binotatus* – MZUFV 7077, 7691-7692, 8038, 8883; *Hylodes* sp. – MZUFV 7716; *Hypsiboas albomarginatus* – MZUFV 4475, 7081, 7149-7150, 8366, 8988; *Hypsiboas albopunctatus* – MZUFV 8474, 8477; MCNAN 4748, 4749; *Hypsiboas crepitans* – MZUFV 8917, 8928; MCNAN 4750; *Hypsiboas faber* – MZUFV 7689, 8364, 8473, 8476, 8951, 8993; *Hypsiboas pardalis* – MZUFV 7072, 7147-7148, 7405-7406, 7423; *Hypsiboas polytaenius* – MZUFV 7414-7417, 8925; *Hypsiboas semilineatus* – MZUFV 7071, 8750-8751, 8901-8904, 8906; *Ischnocnema parva* – MZUFV 7404-7409, 7718-7722, 7726-7728, 8959-8960; *Ischnocnema guentheri* – MZUFV 7688, 7729, 8884, 8926; *Ischnocnema* sp. – MZUFV 8894-8900; *Leptodactylus furnarius* – MZUFV 7733-7734, 8049; *Leptodactylus fuscus* – MZUFV 8918, 8933; *Leptodactylus ocellatus* – MZUFV 7645, 8345, 8352, 8365, 8749, 8927, 8987, 9008-9010*; Leptodactylus* aff. *mystaceus* – MZUFV 7633, 7646, 7748, 8087-8088, 8919; *Leptodactylus* sp. (gr. *marmoratus*) – MZUFV 8890-8893; *Lithobates catesbeianus* – MZUFV 8943-8946, 8984-8986, 9003-9007; *Phyllomedusa burmeisteri* – MZUFV 8475, 8916; *Physalaemus cuvieri* – MZUFV 7647, 8348; *Physalaemus signifier* – MZUFV 8956, 8996; *Physalaemus aff. olfersii* – MZUFV 8359-8363, 8953-8955, 8957-8958, 8998-8999; *Proceratophrys boiei* – MZUFV 8952, 8994-8995; *Pseudopaludicola mystacalis* – MZUFV 7073-7076, 7410, 7418-7420, 7735, 8051-8058, 8353-8354, 8393-8394, 8920-8924; *Rhinella granulosa* – MCNAN 4746, 4747; *Rhinella pombali* – MZUFV 8050, 8349-8351, 8881-8882, 8905, 9011; *Scinax alter* – MZUFV 7648, 8947-8950, 8991-8992; *Scinax cuspidatus* – MZUFV 7079-7080, 7421-7422, 7500-7505, 7717, 7723-7725, 8347, 8355-8358, 8997; *Scinax eurydice* – MZUFV 8472; *Scinax fuscovarius* – MZUFV 8089, 8346, 8478; *Scinax* sp_1. (gr. *catharinae*) – MZUFV 7926-7933, 8035-8037; *Scinax* sp_2. (gr. *catharinae*) – MZUFV 7151-7155, 8885-8889; *Thoropa miliaris* – MZUFV 7587-7589, 7644, 8034, 8085-8086, 8915.

Accepted by Sebastian Steinfartz