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Amphibians of Vitória, an urban area in south-eastern Brazil: first approximation

Rodrigo Barbosa Ferreira[1,2], Thiago Silva-Soares[3] & Dennis Rödder[4,5]

[1)] Museu de Biologia Prof. Mello Leitão, Av. José Ruschi, 4, Centro, CEP 29650-000, Santa Teresa, ES, Brazil
[2)] Department of Wildland and Ecology Center, Utah State University, 5305 Old Main Hill, Logan, UT, USA
[3)] Universidade Federal do Rio de Janeiro, Departamento de Vertebrados, Museu Nacional, Quinta da Boa Vista s/n. CEP 20940-040. Rio de Janeiro, RJ, Brazil
[4)] Trier University, Biogeography Department, Am Wissenschaftspark 25+27, 54296 Trier, Germany
[5)] Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz, Rodovia Ilhéus Itabuna, km 16, CEP 45650-000, Ilhéus, BA, Brazil

Corresponding author: Rodrigo B. Ferreira, e-mail: rbfherpeto@gmail.com

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Resumo. Estudamos a composição da anfibiofauna do município de Vitória, uma área urbana no Sudeste do Brasil. O trabalho de campo foi realizado de fevereiro de 2004 a dezembro de 2005. Além disso, foram realizadas visitas a coleções científicas e pesquisa em literatura específica. Um total de 34 espécies de anfíbios foi registrado, estando distribuído em duas ordens: Gymnophiona, representada pela espécie *Siphonops annulatus*, e Anura, representada pelas famílias Bufonidae, Craugastoridae, Cycloramphidae, Hylidae, Leiuperidae, Leptodactylidae, Ranidae e Pipidae. A espécie invasora *Lithobates catesbeianus* foi registrada. A ampla distribuição geográfica da maioria das espécies demonstra predominância de espécies habitat-generalistas em Vitória. Mesmo assim, sugerimos um monitoramento constante e de longo prazo para garantir a sobrevivência das espécies dependentes de habitats florestais.

Palavras-chave. Diversidade, Espírito Santo, inventário, Mata Atlântica.

Abstract. We studied the composition of the amphibian fauna of the Vitória municipality, an urban area in south-eastern Brazil. Fieldwork was conducted from February 2004 to December 2005. Besides field expeditions, we searched in collections and specific literature to compose this inventory, comprising a total of 34 amphibian species in two orders: Gymnophiona, represented by the species *Siphonops annulatus*, and Anura, represented by the families Bufonidae, Craugastoridae, Cycloramphidae, Hylidae, Leiuperidae, Leptodactylidae, Ranidae and Pipidae. The alien invasive species *Lithobates catesbeianus* was also recorded from within the area. The wide geographical distribution of most species demonstrates a prevalence of habitat-generalists. Even so, we suggest a constant and long-termed monitoring programme to ensure the survival of species dependent on forest environments.

Key words. Atlantic Rainforest, Diversity, Espírito Santo, inventory.

Introduction

With currently 877 recognized species, Brazil harbours the highest amphibian diversity in the world (SBH 2010). Nevertheless, its real anuran richness is still considered to be substantially underestimated. In the past five years, more than 60 anuran species were described from Brazil (SBH 2010), more than a half of which occur within the Atlantic Rainforest biome in south-eastern Brazil (Haddad et al. 2008) where some of the world´s most diverse amphibian communities are to be found (Rödder et al. 2007a). For many areas, data on local-species composition, geographical distributions of species and their natural history have been rather scarce, however. This hampers an assessment of the conservation status of many taxa (Pimenta et al. 2005), which becomes increasingly important in the light of global amphibian declines caused by habitat loss, emerging infectious diseases, or anthropogenic climate change (Rödder et al. 2009, Stuart et al. 2004, Stuart et al. 2008). Besides important data from zoological collections that have not been published or only in non-indexed literature, a documentation of species inventories can therefore be an important tool for minimizing knowledge gaps and may facilitate the planning of conservation strategies (Haddad 2008).

A major threat to the Brazilian fauna within the Atlantic Rainforest biome is the dramatic habitat destruction as a result of approximately 500 years of intense human colonization (e.g., deforestation, agricultural expansion). In the 1500', Atlantic Rainforest still covered 1,350,000 km² (IBDF & IBGE 1993). Today, only 11.73% of the original forest remain (Ribeiro et al. 2009), mostly in the form of small fragments (<100 ha as suggested by Ranta et al. 1998) that are isolated from each other by a vast matrix of pasture, plantations or *Eucalyptus* (Chiarello 2000). This biodiversity hotspot with a 64% proportion of endemic species faces an ever-accelerating destruction even though it has been declared one of the top five hotspots of the world (Myers et al. 2000, IUCN et al. 2009). Thus, compiling data in this biome is an urgent task, especially because several studies have already detected changes and/or declines in some anuran populations (e.g., Heyer et al. 1988, Weygoldt 1989, Blaustein & Wake 1995, Izecksohn & Carvalho-e-Silva 2001).

The majority of the studies conducted in the Atlantic Rainforest have been limited to protected areas, and the urban fauna of Brazil might be regarded as largely unknown. Here, in anthropogenically modified environments, animals are exposed to several negative factors such as habitat alteration/degradation or loss, chemical pollution, exposure to pesticides, increased UV radiation, unnatural salinity, competition with exotic species, unnatural diseases, road mortality, and disturbances in hydrological features (e.g., Pearman 1997, Davidson et al. 2001, Gardner et al. 2007). These factors are likely to change the composition of local amphibian communities (Becker et al. 2007, 2009), paving the way for the introgression of habitat generalists that are adapted to more xeric conditions and therefore able to substitute the original habitat specialists. In this context, knowing the composition of amphibian communities in urban areas is essential to understand how these species communities respond to habitat alterations (Gardner et al. 2007). Here, we provide for the first time an overview of the amphibian fauna of the municipality of Vitória, an urban area in south-eastern Brazil.

Material and methods

Study site

The state of Espírito Santo covers a total area of 46,184 km². Within a distance of only 120 km, altitude in this state rises from sea level to 2,890 m above, resulting in a mixture of highly diverse microhabitats. The Atlantic Rainforest biome of this state can be subdivided into three distinct geomorphological formations. These are "Região serrana" (mountainous region), "Tabuleiros terciários", and "Planícies quaternárias" (coastal regions). The mountainous region differs by having a complex relief, including inselbergs, and being characterized by higher precipitation and lower temperatures as compared to the coastal regions. Furthermore, the geology of the mountainous region is dominated by sediments from the erosion of its inselbergs that are absent in the coastal regions. The coastal regions are influenced by the ocean, and the soils contain high percentages of sand, which result in different vegetation structures.

This study was carried out in the municipality of Vitória (20°10'S, 40°20'W), capital of Espírito Santo state, in south-eastern Brazil (Figures 1, 2). Vitória covers a total land area of 93.38 km² that is composed of an archipelago of 34 islands and a continental portion. The altitudinal range extends from sea level to 308 m above. Currently, the landscape within the municipality can be characterized as rather forested (Figure 2), with a ratio of 91 m² of green land per inhabitant, corresponding to a total of 1,478,947 m² that are available to an estimated 317,817 inhabitants (PMV 2010). This rate is noteworthy if compared to the 16 m² per inhabitant that are recommended for urban centres by the World Health Organization (WHO).

According to Köppen-Geiger Climate Classification (Köppen 1936), Vitória's climate is of the Aw Tropical type, with high temperatures, rainy summers and dry winters.

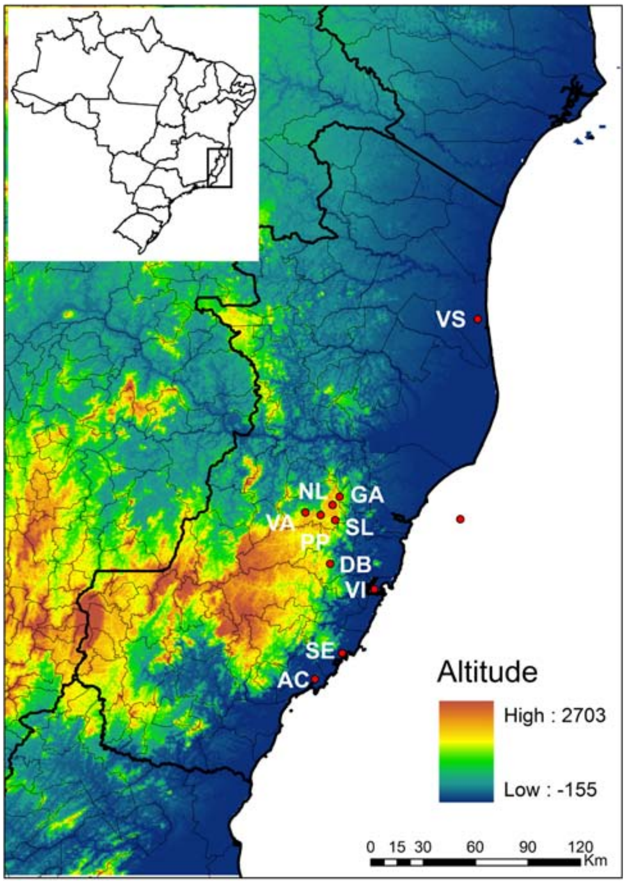

Figure 1. Location of Vitória in the state of Espírito Santo, south-eastern Brazil; collecting sites for which species lists are available are indicated by red circles. For abbreviations see Table 1.

Figure 2. Panoramic view of Vitória Municipality (Island), Espírito Santo State, Brazil. Photograph: André Alves.

Table 1. Comparison of inventories compiled for the state of Espírito Santo (modified from Rödder et al. 2007a). Legend: AC = Anchieta; DB = Parque Estadual de Duas Bocas; GA = Parque Estadual do Goiapaba-Açu; NL = Nova Lombardia; PP = Pousada Paradiso; SE = APA de Setiba; SL = Estação Biológica de Santa Lúcia; VA = Vargem Alta; VI = Vitória; VS = Vale do Suruaca. [C] coastal sites and [M] mountainous sites. * Protected area.

Place	Period sampled	~Area (m^2)	Species richness	Altitude (m)	References
AC [C]	60 months	3.500	21	13	Teixeira et al. (2007)
DB [M, C*]	24 months	29.100.000	46	200–738	Prado & Pombal (2005); Tonini (2008)
GA [M*]	24 months	37.400	41	720–840	Ramos & Gasparini (2004)
NL [M]	3 months	10.000	30	512	Rödder et al. (2007a)
PP [M]	3 months	2.000	21	684	Rödder et al. (2007a)
SE [C*]	120 months	15.000.000	38	0–15	Gasparini et al. (2007)
SL [M*]	>24 months	25.000	54	812	Rödder et al. (2007b)
VA [M]	3 months	10.000	23	862	Rödder et al. (2007a)
VI [C]	24 months	93.000	32	0–308	The present study
VS [C]	4 months	750	26	32	Teixeira et al. (2008)

During a 29-year-assessment (1976 to 2005), the weather station of Vitória recorded an average annual rainfall of 1,239 mm/year and an average annual temperature of 23.5°C. The region still has a particular climate dynamic as a function of the Atlantic Tropical current, which is hot and wet, and the Atlantic Polar current, which is dry and cold and comes to bear mainly during the winter season (SEMMAM 1996).

The vegetation of this urban area is framed in by the Atlantic Rainforest Domain (Ab'Saber 1977) and associated ecosystems such as mangroves and Restingas (sandy coastal plains). Vitória is officially composed of 63 conservation units designated by PMV (2010), totalling at 3,827 ha that are distributed over different stages of regeneration, protection, and conservation. These areas are largely fragmented and scattered throughout terrains of accentuated decline due to restricted human occupancy. In our study, we focus on the anuran fauna of the whole municipality except the Trindade and Martim Vaz island complex as it is so distant from the coast (1,200 km).

Field methods and data analyses

The data presented in this study have been compiled through random field surveys conducted by RBF and TSS from February 2004 to December 2005 in 362 man/hours of fieldwork. Additionally, we conducted a comprehensive bibliographic screening (i.e., Silva-Soares & Becacici 2005, Giovanelli et al. 2008) and analysed specimens housed in zoological collections (see Appendix). Acronyms of the collections analysed herein are: CFBH – Amphibian Collection Célio F. B. Haddad at the Universidade Estadual Paulista, Campus Rio Claro, São Paulo, Brazil; MNRJ – Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; MBML – Museu de Zoologia Prof. Mello Leitão, Santa Teresa, Espírito Santo, Brazil; ZUFRJ – Amphibian Collection of the Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil. Although some consulting reports cite some species as occurring in Vitória, we preferred to not consider them due to the absence of voucher specimens (e.g., Gasparini 2008 in Ferma Engenharia).

Systematic classifications and geographical distribution data used here follow Frost (2009). We defined three categories of distributional ranges of the species in order to assess the degree of habitat specialisation of each species. The categories were + = restricted (range less than 200 km in diameter), ++ = range more than 200 km in diameter, but restricted to the Atlantic Rainforest biome, +++ = widely distributed through more than one biome. Additionally, we compared habitat specialisation and the vulnerability to anthropogenic habitat alteration of the species making up the local community based on their IUCN Red List assessments (IUCN et al. 2009). Species were either classified as forest-depending, inhabiting open areas such as savannas or Restinga habitats, or as generalists tolerating habitat alteration.

Based on both similar altitudinal ranges and phytoecological characteristics, we selected three other studies in Espírito Santo state to compare local species compositions (Table 1). Teixeira et al. (2007) studied the amphibians in Anchieta municipality, which is situated 54 km SW of Vitória, Gasparini et al. (2007) studied amphibian assemblages in Setiba (33 km SW), and Teixeira et al. (2008) those in Vale do Suruaca (109 km NE). To be considered as likely to have occurred in Vitória in the past, we assumed that a species has to be recorded from at least one study site situated to the south and another to the north of our study site. To estimate the degree of similarity in amphibian assemblages among inventoried sites in the mountainous and coastal regions of Espírito Santo state, we computed a cluster analyses based on Jaccard Indices, comparing studies from Anchieta (AC), Parque Estadual de Duas Bocas (DB), Parque Estadual do Goiapaba-Açu (GA), Nova Lombardia (NL), Pousada Paradiso (PP), APA de Setiba (SE), Estação Biológica de Santa Lúcia (SL), Vargem Alta (VA), Vitória (VI), and Vale do Suruaca (VS).

Results

Our investigation revealed a total number of 34 amphibian species belonging to two orders (Anura and Gymnophiona) within the municipality of Vitória (Table 2). The order Gymnophiona is uniquely represented by *Siphonops annu-*

Table 2. Amphibian species recorded in the municipality of Vitória, Espírito Santo, south-eastern Brazil. Legend: Geographic distribution: (+) restricted range, (++) wide range in the Atlantic Rainforest, and (+++) wide distribution through other biomes. Sampling methods: Vi = visual encounter surveys, Ca = calling male, Co = in collection, Li = in literature. Habitat: F = forest-dependent, O = preferring open areas, G = generalist tolerating habitat degradation. * Need accurate identification to delimit their geographic distribution.

Taxa	Geo. Dist.	Sampling Method	Habitat
BUFONIDAE (2 spp.)			
Rhinella crucifer (Wied-Neuwied, 1821)	+++	Vi/Ca	F/G
Rhinella granulosa (Spix, 1824)	+++	Vi/Ca	O/G
CYCLORAMPHIDAE (2 spp.)			
Proceratophrys schirchi (Miranda-Ribeiro, 1937)	++	Vi/Ca	F
Thoropa miliaris (Spix, 1824)	++	Vi/Ca	O/G
CRAUGASTORIDAE (1 sp.)			
Haddadus binotatus (Spix, 1824)	++	Vi	F
HYLIDAE (22 spp.)			
Aparasphenodon brunoi Miranda-Ribeiro, 1920	++	Vi/Ca	F/O
Dendropsophus branneri (Cochran, 1948)	+++	Co	O/G
Dendropsophus bipunctatus (Spix, 1824)	++	Vi/Ca	O/F/G
Dendropsophus decipiens (Lutz, 1925)	++	Co	O/F/G
Dendropsophus elegans (Wied-Neuwied, 1824)	+++	Vi/Ca	F/G
Dendropsophus gr. *microcephalus*	*	Co	–
Dendropsophus haddadi (Bastos & Pombal, 1996)	++	Vi/Ca	F/O/G
Hypsiboas albomarginatus (Spix, 1824)	+++	Vi/Ca	F/O/G
Hypsiboas faber (Wied-Neuwied, 1821)	+++	Vi/Ca	F
Phyllodytes luteolus (Wied-Neuwied, 1824)	++	Vi/Ca	F/O
Scinax agilis (Cruz & Peixoto, 1983)	++	Co	F/O/G
Scinax alter (B. Lutz, 1973)	++	Vi/Ca	O/G
Scinax argyreornatus (Miranda-Ribeiro, 1926)	++	Vi/Ca	F/O
Scinax cuspidatus (A. Lutz, 1925)	++	Vi/Ca	O
Scinax fuscovarius (A. Lutz, 1925)	+++	Vi/Ca	O/G
Scinax gr. *ruber*	*	Vi/Ca	G
Scinax aff. *eurydice*	*	Co	G
Scinax gr. *perpusillus* No. 1	*	Co	F/O
Scinax gr. *perpusillus* No. 2	*	Co	–
Scinax x-signatus (Spix, 1824)	+++	Co	G
Sphaenorhynchus planicola (A. Lutz & B. Lutz, 1938)	++	Co	O/G
Trachycephalus nigromaculatus Tschudi, 1838	+++	Vi/Ca	F/O/G
LEIUPERIDAE (2 spp.)			
Physalaemus crombiei Heyer & Wolf, 1989	++	Vi	F
Physalaemus sp. (aff. *signifer*)	*	Co	F
LEPTODACTYLIDAE (2 spp.)			
Leptodactylus fuscus (Schneider, 1799)	+++	Vi/Co	O/G
Leptodactylus latrans (Linnaeus, 1758)	+++	Vi/Ca	O/G
PIPIDAE (1 sp.)			
Pipa carvalhoi (Miranda-Ribeiro, 1937)	+++	Vi	O
RANIDAE (1 sp.)			
Lithobates catesbeianus (Shaw, 1802)	+++	Li	F/O/G
CAECILIIDAE (1 sp.)			
Siphonops annulatus (Mikan, 1820)	+++	Co	F/O/G

latus. Anurans are represented by 33 species arranged in eight families and 15 genera. Hylidae is the family with the greatest representation with 21 species, followed by Bufonidae, Cycloramphidae, Leiuperidae, and Leptodactylidae with two species each, and finally Craugastoridae, Pipidae, and Ranidae with one species each. All these species are listed in the category "Least Concern" of the Red List by Stuart et al. (2008) and IUCN et al. (2009). The invasive

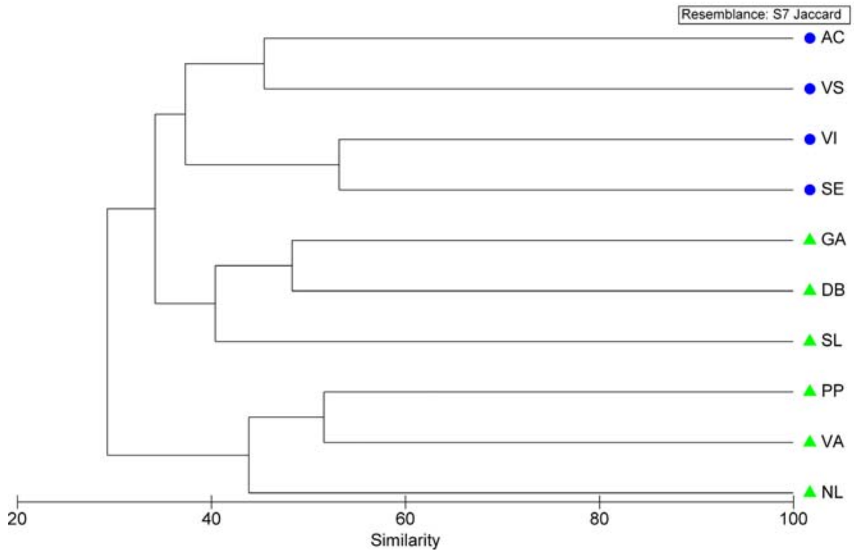

Figure 3. Cluster analysis showing the similarity of amphibian assemblages amongst inventoried areas in the state of Espírito Santo, based on Jaccard Indices. Legend: Green triangles = Mountainous region and blue dots = Coastal region. For abbreviations see Figure 1.

American bullfrog *Lithobates catesbeianus* is cited to occur in Vitória (Giovanelli et al. 2008). Amongst the 34 amphibian species recorded, only eight species (25 %) are strictly forest-dependent, 11 (34.38 %) inhabit only open areas, and 11 (34.38 %) occur in both open and forested habitats. The majority of the species (19 spp., 59.38 %) are known to tolerate anthropogenic habitat modifications at least to some extent (Table 2).

Anuran richness varied among inventoried areas of Espírito Santo from 21 species in Três Poças, Anchieta, coastal region, to 54 species to Estação Biológica de Santa Lúcia, mountain region (Table 1). The cluster analysis suggests the formation of three distinct groups, which are primarily based on different altitudinal ranges (Figure 3). The species *Chiasmocleis schubarti, Dendropsophus anceps, Dendropsophus minutus, Hypsiboas semilineatus, Phyllomedusa rohdei,* and *Rhinella schneideri* have been recorded from other coastal areas to the north and south of our study site, but were not found in Vitória. From the species found in Vitória, 50 % have large distribution ranges in the Atlantic Rainforest, and the other 50 % occur well beyond this biome (Table 2).

Discussion

Our study revealed that, with 34 amphibian species, the species richness and ß-diversity of amphibians in Vitória is equivalent to those reported from nearby protected areas (e.g., Nova Lombardia in Rödder et al. 2007a) and others with a better conservation status (Pousada Paradiso and Vargem Alta, both in Rödder et al. 2007a). The highest diversity of Hylidae corresponds to the pattern also found in various studies conducted in south-eastern Brazil (e.g., Salles et al. 2009, Pombal 1997, Rödder et al. 2007a,b). This richness is thought to be associated with the presence of adhesive pads in hylid toes (Cardoso et al. 1989). This feature allows these frogs to make use of a greater variety of vertical microhabitats than other taxa, reducing competition for reproductive sites, and making them less susceptible to terrestrial predators such as snakes. The record of two specimens of *Siphonops annulatus* (Gymnophiona) is not surprising due to the lack of specific sampling effort. Gymnophiona constitutes one of the least-known vertebrate orders, because most of the species have fossorial habits (Junqueira et al. 1999).

The cluster analysis indicates two groups in mountainous sites, which vary from 200 to 840 m a.s.l. in altitude. Although the sites are similar as to precipitation, temperature, and vegetation patterns, this segregation probably can be led back to different degrees of anthropogenic habitat alteration or differences in sampling efforts applied per site. In VA, NL, and PP, only about three months of sampling effort were spent, while GA, DB, and SL were afforded more than 24 months, which probably resulted in a more comprehensive assessment of the anuran fauna of the latter. The third group is composed of coastal sites, which range from 0 m to 200 m above sea level in altitude. These coastal sites are exposed to similar abiotic conditions (temperature, humidity, and precipitation), which influences the vegetation structure and as a consequence might determine the composition of anuran communities in these areas.

Although comparisons of anuran richness between studies can be biased due to differences in sampling effort, sizes of sampled areas, differences in abiotic factors, characteristics and the conservation status of individual localities (Pombal 1997, Duellman 1999), we consider them an essential tool to evaluate the possible human impact on Vitória's amphibians. Amongst all the studies compared, the municipality of Vitória is the most anthropogenically modified area, with some small forest remnants surrounded by an unfavourable matrix. Thus, it is not surprising that most of the listed species are habitat generalists that are not threatened with extinction (Table 2). Most of them have wide distribution ranges in the Atlantic Rainforest and other biomes, and are known for their high ecological plas-

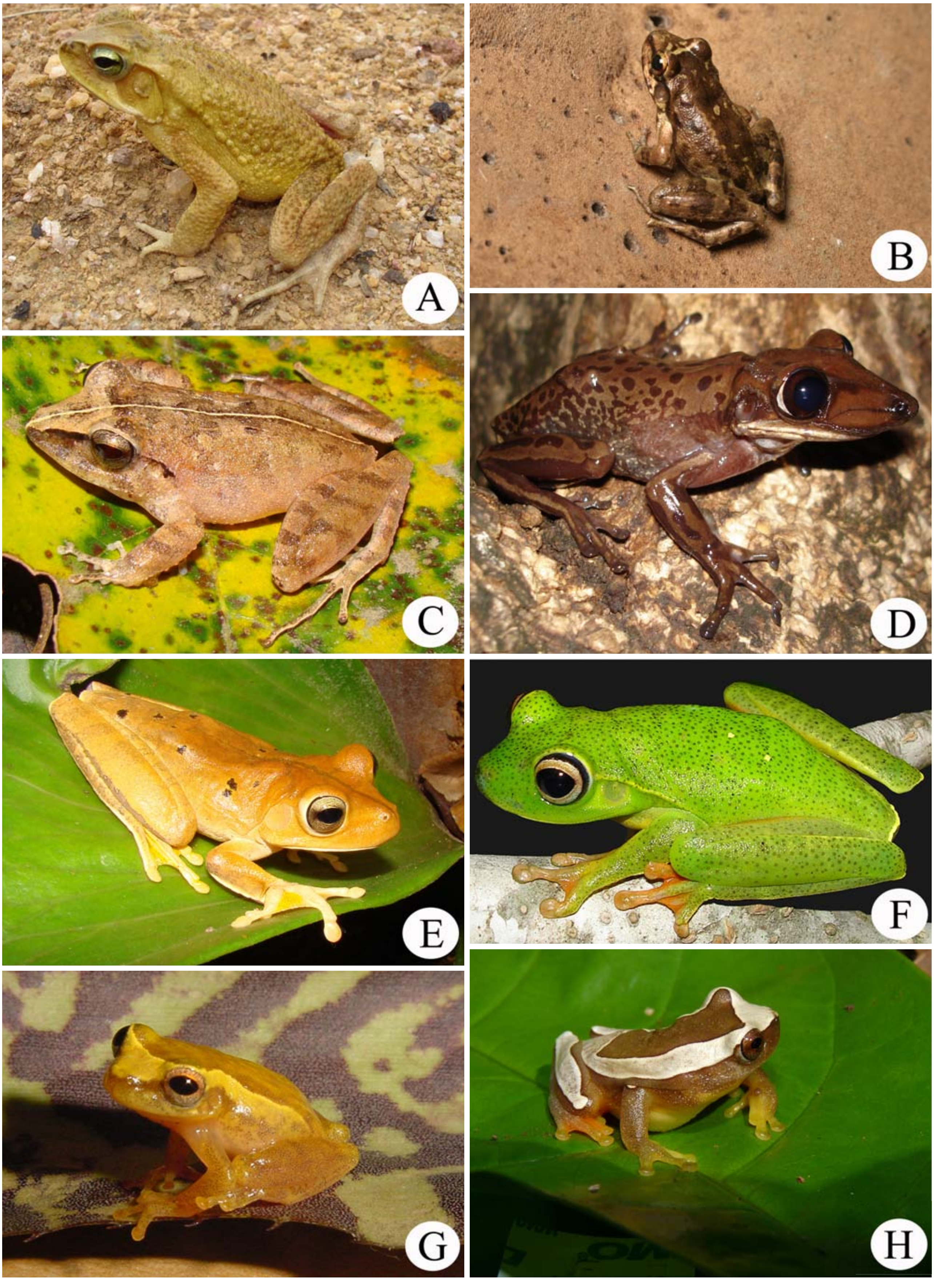

Figure 4. Anurans from Vitória municipality, Espírito Santo State, Southeastern Brazil. A. *Rhinella crucifer*; B. *Thoropa miliaris*; C. *Haddadus binotatus*; D. *Aparasphenodon brunoi*; E. *Hypsiboas faber*; F. *Hypsiboas albomarginatus*; G. *Dendropsophus haddadi*; H. *Dendropsophus elegans*. RBF's photos: A; C; D; E; F. TSS's photos: B; G; H

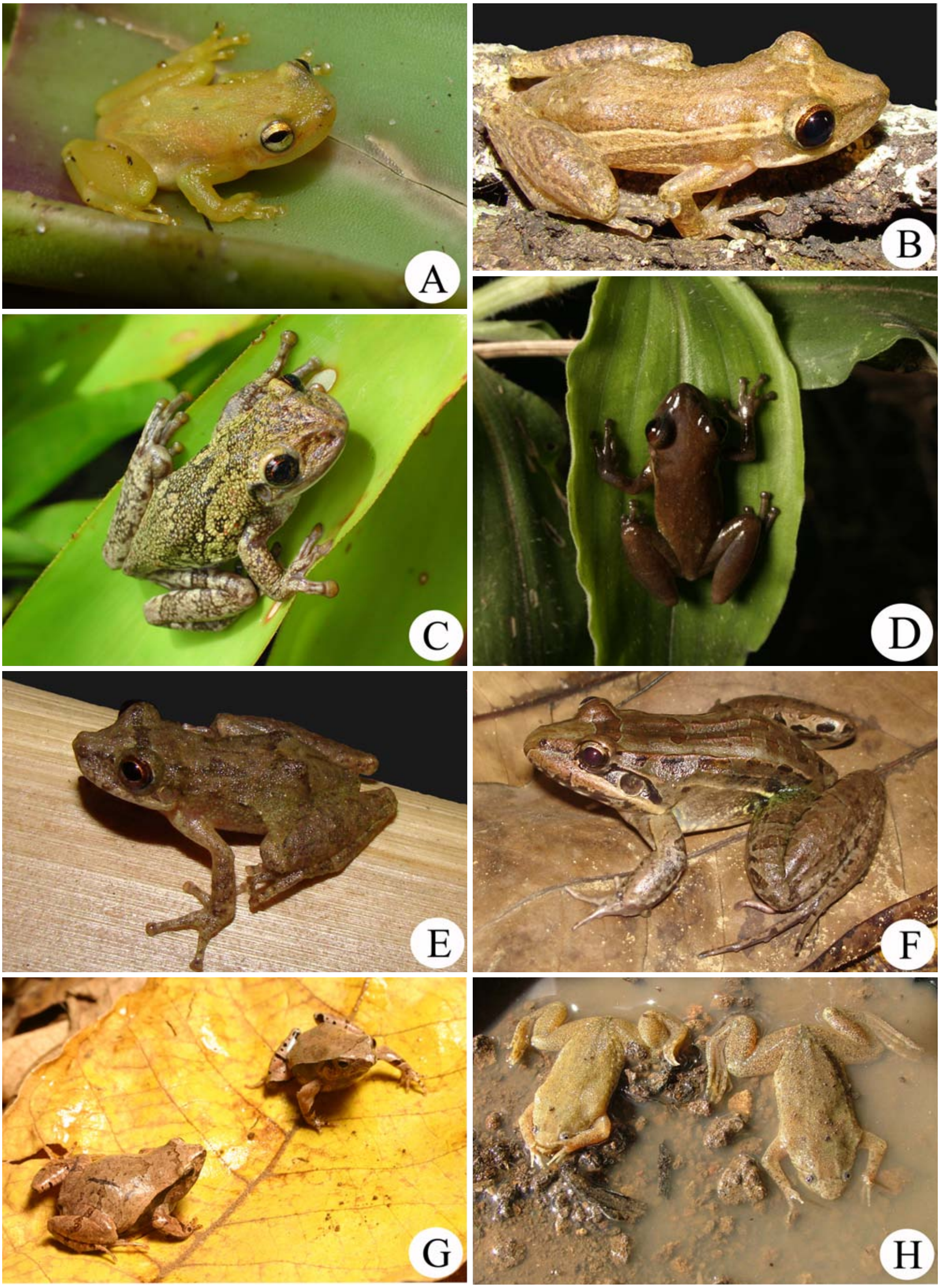

Figure 5. Anurans from Vitória municipality, Espírito Santo State, Southeastern Brazil. A. *Phyllodytes luteolus*; B. *Scinax alter*; C. *Trachycephalus nigromaculatus*; D. *Scinax cuspidatus*; E. *Scinax argyreornatus*; F. *Leptodactylus latrans*; G. *Physalaemus crombiei*; H. *Pipa carvalhoi*. RBF's photos: B; C; E; F. TSS's photos: A; D; G; H.

ticity. Even so, some species previously reported from Espírito Santo state and considered 'habitat-generalists' were not recorded from Vitória, including *Dendropsophus anceps*, *Dendropsophus minutus, Hypsiboas semilineatus*, and *Leptodactylus natalensis*. Further field studies should be carried out to confirm the absence of these species from the region.

According to Cardoso et al. (1989), effects of anthropogenic habitat disturbances are more alarming when it comes to 'habitat-specialists' that need particularly stable environments of a certain type. From the 33 species, three need to be singled out as more strictly associated to forested environments. These are *Pipa carvalhoi,* which is found only in the Parque Estadual da Fonte Grande in Vitória; *Proceratophrys schirchi,* which reproduces only in lentic streams of the forest of PEFG, and *Haddadus binotatus,* which depends on leaf litter in the forest as spawning site. Therefore, the possibility of some species having been negatively affected by habitat degradation must be considered in future studies specifically designed to address this question. Forest anurans with aquatic larvae are the most likely to be negatively affected by fragmentation of forest remnants in that they may be separated from their breeding sites (Becker et al. 2007, 2009).

Some species predominantly occurring in Restinga habitats, such as *Aparasphenodon brunoi,* might be severely affected by habitat loss, leading to population declines or even extinctions in the future. For example, a large area of Restinga has been earmarked for the expansion of the airport of Vitória. This area was formerly covered by ca. 200 ha of vegetation in different succession stages and was the last Restinga remnant in Vitória (Pereira & Assis 1998). In spite of this, government agencies, based on private consultant studies (e.g., Gasparini 2008 in Ferma Engenharia), obtained authorisation for enlarging the airport. Increased isolation affects species richness capacities according to the island theory, which proposes a smaller number of species in smaller and more isolated areas (MacArthur & Wilson 1967). On the other hand, human interferences possibly resulted in an increase of certain amphibian populations. According to Haddad (1991), certain species benefit from anthropogenic events such as forest decimation or burning. This might be the case with *Leptodactylus latrans* and *Scinax alter* populations at the Universidade Federal do Espírito Santo, where they are now very abundant all over the campus (Ferreira & Mendes, in press). It illustrates the higher aptitude of adaptation to disturbed anthropogenic environments (ecological valence) by these 'habitat-generalist' species.

Species of particular interest is *Lithobates catesbeianus*, an alien invasive Ranid that has intentionally been brought to Brazil for commercial harvest (Giovanelli et al. 2008). It has been considered one of the most harmful invasive species due to its voracious feeding habits, predating upon a large variety of invertebrates and native amphibians as well (Werner et al. 1995, Lowe et al. 2000, Kraus 2009). Furthermore, it was suggested that *L. catesbeianus* may be one of the major vectors of the amphibian chytrid fungus *Batrachochytridium dendrobatidis* (Daszak et al. 2004, Garner et al. 2006), which is currently still unknown from Espírito Santo, but may find suitable environmental conditions in current and future climates (Rödder et al. 2009, Rödder et al. 2010) and is most likely the cause of enigmatic amphibian declines around the world (Lötters et al. 2009).

Conclusions

The amphibian species richness encountered in Vitória is rather impressive considering the high degree of degradation of natural environments in the region. This richness is probably supported by the number of forest patches in the municipality and shows in the still relatively high proportion of forest-dependent species (Table 1). Forest remnants can be shelters or foraging grounds for anurans (see Silva & Rossa-Feres 2007). This demonstrates that the continued of conservation of these green areas is essential to conserve the local amphibian diversity. We suggest a constant and long-termed monitoring programme be implemented to ensure the survival of species dependent on forest environments in the highly urbanised Vitória region.

Acknowledgements

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Appendix

Voucher specimens of Amphibians from the municipality of Vitória, Espírito Santo state, Brazil.

Bufonidae: *Rhinella crucifer* (MBML 1773), *Rhinella granulosa* (MBML 4447, 6433, 7124; ZUFRJ 9919–20); **Craugastoridae:** *Haddadus binotatus* (MNRJ 66401); **Cycloramphidae:** *Proceratophrys schirchi* (ZUFRJ 9873–5), *Thoropa miliaris* (MBML 4448); **Hylidae**: *Aparasphenodon brunoi* (MBML 4746, 7166–68), *Dendropsophus branneri* (MBML 2108), *Dendropsophus haddadi* (MBML 7177–80), *Dendropsophus decipiens* (MBML 7172–76), *Dendropsophus bipunctatus* (MBML 6560–61), *Dendropsophus elegans* (MBML 4433), *Dendropsophus* gr. *microcephalus* (MBML 7182), *Hypsiboas albormaginatus* (MBML 4434, 7171, 7164–65), *Hypsiboas faber* (MNRJ 66402), *Phyllodytes luteolus* (MNRJ 50120, 5386, 6616), *Scinax* aff. *perpusillus* (MNRJ 68298), *Scinax agilis* (MBML 4903), *Scinax alter* (MBML 4081, 4435–38), *Scinax argyreornatus* (MBML 4439, 4441), *Scinax* aff. *eurydice* (MBML 5423), *Scinax fuscovarius* (MBML 922), *Scinax* gr. *ruber* (MBML 4080), *Scinax* sp. (MBML 4444–48, 6380, 6402, 6557–58), *Scinax x-signatus* (MNRJ 389570), *Sphaenorhynchus planicola* (MBML 4112), *Trachycephalus nigromaculatus* (MNRJ 66400); **Leiuperidae** *Physalaemus* aff. *signifer* (UNESPRC 9977–78); **Leptodactylidae**: *Leptodactylus fuscus* (ZUFRJ 9922, 7150–62), *Leptodactylus latrans* (MBML 5376–78, 5956–57); **Pipidae**: *Pipa carvalhoi* (ZUFRJ 9871–72); **Caeciliidae**: *Siphonops annulatus* (MNRJ 37356, UNESPRC 581).