

## THE HERPETOFAUNA OF THE NEOTROPICAL SAVANNAS

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### Summary

The Cerrado biome (savannah ecoregion) occupies 25% of the Brazilian territory (2.000.000 km<sup>2</sup>) and presents a mosaic of the phytophysiognomies, which is often reflected in its biodiversity. Despite its great distribution, the biological diversity of the biome still much unknown. Herein, we present a revision about the herpetofauna of this threatened biome. It is possible that the majority of the living families of amphibians and reptiles of the savanna ecoregion originated in Gondwana, and had already diverged at the end of Mesozoic Era, with the Tertiary Period being responsible for the great diversification. Nowadays, the Cerrado harbors 152 amphibian species (44 endemic) and is only behind Atlantic Forest, which has 335 species and Amazon, with 232 species. Other South American open biomes, like Pantanal and Caatinga, have around 49 and 51 species, respectively. Among the 36 species distributed among eight families in Brazil, 10 species (4 families) are found in the Cerrado. Regarding the crocodylians, the six species found in Brazil belongs to Alligatoridae family, and also can be found in the Cerrado. Finally, the Squamata order, also harbors a great diversity, with 86 lizards (32 endemics), 24 amphisbaenians and 131 snakes (11 endemic). Well-sampled lizard assemblages in the core region of Cerrado harbor around 25 species. Hence, local lizard assemblages in Cerrado are as rich as Amazonian and Caatinga assemblages, but richer than those from Cerrado enclaves in other biomes, such as Amazonian Savannas. In spite of their fascinating ecology, studies on amphisbaenians are scarce and the

increasing number of species being described in recent years suggests that their richness in Cerrado is still underestimated. Snakes are extremely rare compare with lizards, for this reason well sampled local inventories still scarce. In addition, they are usually wide distributed, promoting the lower number of endemics.

## 1. Introduction

Brazil is one of the richest countries in the world in terms of biodiversity, and possesses the biggest reserves of freshwater as well as one third of the remaining tropical forests. In its 8.514.877 km<sup>2</sup> of extension, six biomes are recognized: Amazon; Caatinga, Pantanal, Pampa, Atlantic Forest, and Cerrado (savannah ecoregion). The current state of the Cerrado is worrying due to the fact that it counts, nowadays, with only 20% of its original vegetation located in protected areas. Among the 34 so called world “hotspots”, we can find biomes which are considered very rich and, presenting a high level of endemism, and which have been threatened by the strong anthropogenic pressure under which the have been.

The Cerrado biome, which occupies 25% of the Brazilian territory (2.000.000 km<sup>2</sup>) may be found in 10 states and is exceeded in size only by the Amazon rainforest. Along its territorial extension, one can easily notice its arrangement in the format of a mosaic of the phytophysiognomies in which closed habitat, such as the gallery forest, accompany the banks of rivers and creeks, and open habitats such as the humid fields, trails, dirty fields, cerrado (“narrow meaning”), cerrado over rocks, and so many other phytophysiognomies which differ in their floristic composition, in the density of their vegetation cover, and in respect to the relative importance of their vegetation stratum. Its climate is seasonal, with rainy summers and dry winters. During those dry winters, fires are common, and may generate significant impact in the structure as well as in the floristic composition of the vegetation.

The average annual rainfall varies between 1500 a 1750 mm. Even with the advance of research on topics related to fauna and flora of the Cerrado, the biological diversity of the biome is still very little known. Enormous areas have not yet been studied, and there are still many problems related to taxonomy, concerning some groups which, if better known, could help in the understanding of the main patterns of distribution of the fauna and the flora of the Cerrado. It is possible that the majority of the living families of amphibians and reptiles of the savannah ecoregion originated in Gondwana, and had already diverged at the end of Mesozoic Era, with the Tertiary period being one of great diversification.

Among the events which marked the differentiation of the herpetofauna of the Cerrado, we can distinguish: the establishment of a climate gradient and the formation of three floristic provinces (Província Microfloral das Palmeiras, P. M. Neotropical and P. M. Mista) at the beginning of the Tertiary; the vast marine transgression of the Miocene; the raising of the Planalto Central and the arrival of immigrants from Central and North Americas, at the end of the Tertiary; and the climatic fluctuations of the Quaternary.

According to data from the Brazilian Society of Herpetology, nowadays Brazil ranks first among the countries with the greatest diversity of amphibians and third as far as

reptiles are concerned. 832 species of amphibians (804 Anura, 1 Caudata e 27 Gymnophiona) and 693 of reptiles (36 Testudines, 6 Crocodylia, 62 amphisbaenians, 232 lizards, and 357 snakes) are recognized.

## 2. Amphibians

<b>Taxon</b>
<b>AMPHIBIA (152 species)</b>
<b>GYMNOPHIONA (2)</b>
<b>Caeciliidae (2)</b>
<i>Siphonops annulatus</i> (Mikan, 1820)
<i>Siphonops paulensis</i> Boettger, 1892
<b>ANURA (150)</b>
<b>Aromobatidae (1)</b>
<i>Allobates goianus</i> (Bokermann, 1975)*
<b>Brachycephalidae (6)</b>
<i>Barycholos ternetzi</i> (Miranda-Ribeiro, 1937)*
" <i>Eleutherodactylus heterodactylus</i> " (Miranda-Ribeiro, 1937)
<i>Ischnocnema juipoca</i> (Sazima & Cardoso, 1978)
<i>Pristimantis crepitans</i> (Bokermann, 1965)
<i>Pristimantis dundeei</i> (Heyer & Muñoz, 1999)
<i>Pristimantis fenestratus</i> (Steindachner, 1864)
<b>Bufonidae (11)</b>
<i>Rhaebo guttatus</i> (Schneider, 1799)
<b><i>Rhinella cerradensis</i> Maciel, Brandão, Campos &amp; Sebben, 2007*</b>
<i>Rhinella crucifer</i> (Wied-Neuwied, 1821)
<i>Rhinella granulosa</i> (Spix, 1824)
<i>Rhinella margaritifera</i> (Laurenti, 1768)
<i>Rhinella ocellata</i> (Günther, 1859 "1858")
<i>Rhinella ornata</i> (Spix, 1824)
<i>Rhinella pombali</i> (Baldissera-Jr, Caramaschi & Haddad, 2004)
<i>Rhinella rubescens</i> (A. Lutz, 1925)
<i>Rhinella schneideri</i> (Werner, 1894)
<i>Rhinella veredas</i> (Brandão, Maciel & Sebben, 2007)
<b>Centrolenidae (1)</b>
<i>Hyalinobatrachium eurygnathum</i> (A. Lutz, 1925)
<b>Cycloramphidae (7)</b>
<i>Odontophrynus americanus</i> (Duméril & Bibron, 1841)
<i>Odontophrynus cultripes</i> Reinhardt & Lütken, 1861"1862"
<b><i>Odontophrynus moratoi</i> Jim &amp; Caramaschi, 1980*</b>
<b><i>Odontophrynus salvatori</i> Caramaschi, 1996*</b>
<b><i>Proceratophrys cururu</i> Eterovick &amp; Sazima, 1998*</b>
<b><i>Proceratophrys goyana</i> (Miranda-Ribeiro, 1937)*</b>
<i>Thoropa megatympanum</i> Caramaschi & Sazima, 1984
<b>Dendrobatidae (3)</b>
<i>Ameerega braccata</i> (Steindachner, 1864)

<b><i>Ameerega flavopicta</i> (A. Lutz, 1925)*</b>
<i>Ameerega picta</i> (Bibron in Tschudi, 1838)
<b>Hylidae (76)</b>
<i>Aplastodiscus perviridis</i> A. Lutz in B. Lutz, 1950
<b><i>Bokermannohyla alvarengai</i> (Bokermann, 1956)*</b>
<i>Bokermannohyla circumdata</i> (Cope, 1871)
<i>Bokermannohyla ibitiguara</i> (Cardoso, 1983)
<b><i>Bokermannohyla martinsi</i> (Bokermann, 1964)*</b>
<i>Bokermannohyla nanuzae</i> (Bokermann & Sazima, 1973)
<b><i>Bokermannohyla pseudopseudis</i> (Miranda-Ribeiro, 1937)*</b>
<i>Bokermannohyla ravida</i> (Caramaschi, Napoli & Bernardes, 2001)
<b><i>Bokermannohyla saxicola</i> (Bokermann, 1964)*</b>
<i>Bokermannohyla sazimai</i> (Cardoso & Andrade, 1983"1982")
<i>Corythomantis greeningi</i> Boulenger, 1896
<i>Dendropsophus anataliasiasi</i> (Bokermann, 1972)
<b><i>Dendropsophus araguaya</i> (Napoli &amp; Caramaschi, 1998)*</b>
<i>Dendropsophus branneri</i> (Cochran, 1948)
<b><i>Dendropsophus cerradensis</i> (Napoli &amp; Caramaschi, 1998)*</b>
<i>Dendropsophus cruzi</i> (Pombal & Bastos, 1998)
<b><i>Dendropsophus elianeae</i> (Napoli &amp; Caramaschi, 2000)*</b>
<i>Dendropsophus jimi</i> (Napoli & Caramaschi, 1999)
<i>Dendropsophus melanargyreus</i> (Cope, 1887)
<i>Dendropsophus microcephalus</i> (Cope, 1886)
<i>Dendropsophus minimus</i> (Ahl, 1933)
<i>Dendropsophus minutus</i> (Peters, 1872)
<i>Dendropsophus nanus</i> (Boulenger, 1889)
<i>Dendropsophus rhea</i> (Napoli & Caramaschi, 1999)
<i>Dendropsophus rubicundulus</i> (Reinhardt & Lütken, 1862"1861")
<i>Dendropsophus sanborni</i> (Schmidt, 1944)
<i>Dendropsophus soaresi</i> (Caramaschi & Jim, 1983)
<i>Dendropsophus tritaeniatus</i> (Bokermann, 1965)
<i>Hypsiboas albopunctatus</i> (Spix, 1824)
<b><i>Hypsiboas buriti</i> (Caramaschi &amp; Cruz, 1999)*</b>
<b><i>Hypsiboas cipoensis</i> (B.Lutz,1968)*</b>
<i>Hypsiboas crepitans</i> (Wied-Neuwied, 1824)
<b><i>Hypsiboas ericae</i> (Caramaschi &amp; Cruz, 2000)*</b>
<i>Hypsiboas faber</i> (Wied-Neuwied, 1821)
<b><i>Hypsiboas goianus</i> (B. Lutz, 1968)*</b>
<i>Hypsiboas leucocheilus</i> (Caramaschi & Niemeyer, 2003)
<b><i>Hypsiboas lundii</i> (Burmeister, 1856)*</b>
<i>Hypsiboas multifasciatus</i> (Günther, 1859"1858")
<i>Hypsiboas pardalis</i> (Spix, 1824)
<b><i>Hypsiboas phaeopleura</i> (Caramaschi &amp; Cruz, 2000)*</b>
<i>Hypsiboas polytaeniatus</i> (Cope, 1870"1869")
<i>Hypsiboas pulchellus</i> (Duméril & Bibron, 1841)
<i>Hypsiboas punctatus</i> (Schneider, 1799)

<i>Hypsiboas raniceps</i> Cope, 1862
<b><i>Hypsiboas stenocephalus</i> (Caramaschi &amp; Cruz, 1999)*</b>
<i>Itapotihyla langsdorffii</i> (Duméril & Bibron, 1841)
<i>Lysapsus caraya</i> Gallardo, 1964
<i>Lysapsus limellum</i> Cope, 1862
<b><i>Phasmahyla jandaia</i> (Bokermann &amp; Sazima, 1978)*</b>
<i>Phyllomedusa azurea</i> Cope, 1862
<i>Phyllomedusa ayeaye</i> (B. Lutz, 1966)
<i>Phyllomedusa burmeisteri</i> Boulenger, 1882
<b><i>Phyllomedusa centralis</i> Bokermann, 1965*</b>
<b><i>Phyllomedusa megacephala</i> (Miranda-Ribeiro, 1926)*</b>
<b><i>Phyllomedusa oreades</i> Brandão, 2002*</b>
<i>Phyllomedusa tetraploidea</i> Pombal & Haddad, 1992
<i>Pseudis bolbodactyla</i> A. Lutz, 1925
<i>Pseudis paradoxa</i> (Linnaeus, 1758)
<b><i>Pseudis tocantins</i> Caramaschi &amp; Cruz, 1998*</b>
<i>Scinax acuminatus</i> (Cope, 1862)
<b><i>Scinax canastrensis</i> (Cardoso &amp; Haddad, 1982)*</b>
<b><i>Scinax centralis</i> Pombal &amp; Bastos, 1996*</b>
<b><i>Scinax constrictus</i> Lima, Bastos &amp; Giaretta, 2004*</b>
<b><i>Scinax curicica</i> Pugliese, Pombal &amp; Sazima, 2004*</b>
<i>Scinax duartei</i> (B. Lutz, 1951)
<i>Scinax fuscomarginatus</i> (A. Lutz, 1925)
<i>Scinax fuscovarius</i> (A. Lutz, 1925)
<i>Scinax luizotavioi</i> (Caramaschi & Kisteumacher, 1989)
<b><i>Scinax machadoi</i> (Bokermann &amp; Sazima, 1973)*</b>
<b><i>Scinax maracaya</i> (Cardoso &amp; Sazima, 1980)*</b>
<i>Scinax nebulosus</i> (Spix, 1824)
<i>Scinax pinima</i> (Bokermann & Sazima, 1973)
<i>Scinax squalirostris</i> (A. Lutz, 1925)
<i>Scinax x-signatus</i> (Spix, 1824)
<i>Trachycephalus nigromaculatus</i> Tschudi, 1838
<i>Trachycephalus venulosus</i> (Laurenti, 1768)
<b>Hylodidae (3)</b>
<b><i>Crossodactylus bokermanni</i> Caramaschi &amp; Sazima, 1985*</b>
<i>Crossodactylus trachystomus</i> (Reinhardt & Lütken, 1862"1861")
<i>Hylodes otavioi</i> Sazima & Bokermann, 1983"1982"
<b>Leiuperidae (14)</b>
<i>Eupemphix nattereri</i> Steindachner, 1863
<i>Physalaemus albonotatus</i> (Steindachner, 1864)
<i>Physalaemus centralis</i> Bokermann, 1962
<i>Physalaemus cicada</i> Bokermann, 1966
<i>Physalaemus cuvieri</i> Fitzinger, 1826
<b><i>Physalaemus deimaticus</i> Sazima &amp; Caramaschi, 1988"1986"*</b>
<b><i>Physalaemus evangelistai</i> Bokermann, 1967*</b>
<i>Pleurodema fuscomaculata</i> (Steindachner, 1864)

<i>Pseudopaludicola boliviana</i> Parker, 1927
<i>Pseudopaludicola falcipes</i> (Hensel, 1867)
<b><i>Pseudopaludicola mineira</i> Lobo, 1994*</b>
<i>Pseudopaludicola mystacalis</i> (Cope, 1887)
<i>Pseudopaludicola saltica</i> (Cope, 1887)
<i>Pseudopaludicola ternetzi</i> Miranda-Ribeiro, 1937
<b>Leptodactylidae (21)</b>
<i>Leptodactylus bokermanni</i> Heyer, 1973
<b><i>Leptodactylus camaquara</i> Sazima &amp; Bokermann, 1978*</b>
<i>Leptodactylus chaquensis</i> Cei, 1950
<b><i>Leptodactylus cunicularius</i> Sazima &amp; Bokermann, 1978*</b>
<b><i>Leptodactylus furnarius</i> Sazima &amp; Bokermann, 1978*</b>
<i>Leptodactylus fuscus</i> (Schneider, 1799)
<i>Leptodactylus hylaedactylus</i> (Cope, 1868)
<b><i>Leptodactylus jolyi</i> Sazima &amp; Bokermann, 1978*</b>
<i>Leptodactylus labyrinthicus</i> (Spix, 1824)
<b><i>Leptodactylus martinezi</i> (Bokermann, 1956)*</b>
<i>Leptodactylus mystaceus</i> (Spix, 1824)
<i>Leptodactylus mystacinus</i> (Burmeister, 1861)
<i>Leptodactylus ocellatus</i> (Linnaeus, 1758)
<i>Leptodactylus pentadactylus</i> (Laurenti, 1768)
<i>Leptodactylus petersii</i> (Steindachner, 1864)
<i>Leptodactylus podicipinus</i> (Cope, 1862)
<i>Leptodactylus pustulatus</i> (Peters, 1870)
<i>Leptodactylus siphax</i> Bokermann, 1969
<b><i>Leptodactylus tapiti</i> Sazima &amp; Bokermann, 1978*</b>
<i>Leptodactylus troglodytes</i> A. Lutz, 1926
<i>Leptodactylus wagneri</i> (Peters, 1862)
<b>Microhylidae (6)</b>
<i>Chiasmocleis albopunctata</i> (Boettger, 1885)
<b><i>Chiasmocleis centralis</i> Bokermann, 1952*</b>
<i>Chiasmocleis mehelyi</i> Caramaschi & Cruz, 1997
<i>Dermatonotus muelleri</i> (Boettger, 1885)
<i>Elachistocleis bicolor</i> (Valenciennes in Guérin-Ménéville, 1838)
<i>Elachistocleis ovalis</i> (Schneider, 1799)
<b>Ranidae (1)</b>
<i>Lithobates palmipes</i> (Spix, 1824)

Table 1. Checklist of the Cerrado Amphibians (\* endemic).

Knowledge about the Brazilian Anura is still limited, and most of the studies about them were developed in the northern and central regions of the country. Those works, carried out for one or few species, focused mainly on the description of the species, their geographic distribution, their reproduction, bioacoustic evidences, their diet, the use they make of the environment, the ecology of the tadpoles, among others. Although there has been a growing interest in the study of the amphibians, the necessity for more data

concerning the basic biology of most species is evident. Among the locations in savannah ecoregion (Cerrado), for which there has been publications about the local composition of amphibians, we can distinguish: the Federal District – DF, with 48 species; Ecological Station of Águas Emendadas – DF, with 27; Serra do Cipó – MG, with 43; the region of the project Formoso-Araguaia – TO, with 17; the region of the medium Jequitinhonha River – MG, with 45; João Pinheiro – MG, with 37; High Rio Tocantins Valley – GO, with 44; the region which is under the influence of the Manso hydroelectric power in the Chapada dos Guimarães – MT, with 43; Jalapão – TO, with 25; the region of Xingu River – MT, with 14; the Ecological Station of Itirapina – SP, with 28; Serra da Canastra – MG, with 29; Ouro Preto – MG, with 32; and Nova Itapirema – SP, with 27. So far, there are 152 species of amphibians recorded in the Cerrado (Table 1), which corresponds to 18.27% of those described for Brazil, among which 44 (29%) are endemic to the biome (Table 1). These species are divided into two orders (Gymnophiona and Anura), and 13 families (Aromobatidae, Brachycephalidae, Bufonidae, Caeciliidae, Centrolenidae, Cycloramphidae, Dendrobatidae, Hylidae, Hylodidae, Leiuperidae, Leptodactylidae, Microhylidae, and Ranidae; *sensu* Frost, 2008).

Each year, new species are being described for the Cerrado, which contributes to the addition of new names to the existing lists. In the last 10 years alone, 15 new species have been described in the biome, such as, *Pristimantis dundeei*, *Rhinella cerradensis*, *R. pombali*, *R. veredas*, *Dendropsophus elianeae*, *D. jimi*, *D. rhea*, *Hypsiboas buriti*, *H. ericae*, *H. leucocheilus*, *H. phaeopleura*, *H. stenocephalus*, *Phyllomedusa oreades*, *Scinax constrictus*, and *S. curicica*. Due to the fact that it is located in a more central region of the country, Cerrado is in contact with various other biomes, such as the Caatinga, Amazon, Atlantic Forest and Pantanal, which is accessory to an increase in the number of species in these localities.

According to the information available in the literature of the area, related to the Brazilian biomes, the Cerrado occupies, at the present moment, the third place in terms of the richness of amphibians, with 152 reported species (Table 1), and is only behind Atlantic Forest, which has 335 species and Amazon, with 232 species. Concerning the species richness of amphibians found in other biomes adjacent to Cerrado, Pantanal is reported to have 49 species and Caatinga 51. In a study developed by Bastos *et al.* (2003), inventories of 41 Brazilian localities, which are distributed in several biomes, were compared. The results of that study point to a bigger similarity between the anurofauna of the Cerrado and that found in the Caatinga and Pantanal. In João Pinheiro, Minas Gerais, three species, is common to Caatinga biome, have been observed: *Physalaemus cicada*, *Dendropsophus soaresi* and *Leptodactylus troglodytes*. In this case, the existence of a relationship between the anurofaunas of those two biomes was suggested, possibly along the basin of San Francisco River. Thus, the presence of species common to Caatinga in a nuclear area of the Cerrado could be justified. Some species which are typical of Caatinga were observed in the region of the medium Jequitinhonha River, in the Northeast of Minas Gerais, an area which is considered to be transitional between Cerrado, Caatinga and Rainforest.

According to Brandão & Araújo (2001), the gallery forests can form connections between populations of species which are typical of the forests, through the

hydrographic (river) system, thus reducing the expectations of great endemism in the savannah ecoregion. Nevertheless, these gallery forests may contribute to increase regional wealth, due to the fact that they provide the necessary conditions for species which are typical to the forest to expand their distribution in a non-forest biome.

In a survey conducted in the National Park Serra da Bodoquena – MS, 38 species of frogs and 25 of reptiles were observed. This region is part of the long diagonal of open formations in South America, which extends from the Caatinga in northeastern part of Brazil to the Chaco in Argentina. Data obtained in the survey in that locality were compared to information available about the wealth of other open areas of the Caatinga, Cerrado, and Chaco. A greater similarity between the herpetofauna of that region and the one found in the Cerrado was observed, probably because this is the biome in this area.

**Aromobatidae:** this family was recently given a name, and its representatives were previously housed in the family Dendrobatidae. It is distributed along the Andes hillsides, on the west side of Columbia and Ecuador, on east side of Venezuela and Bolivia, in the whole Amazon region, as well as in the Atlantic Forest; south of Nicaragua as far as Columbia. As far as the savannah ecoregion is concerned, the family is represented by one species, *Allobates goianus*, well known in the type locality, Chapada dos Veadeiros, and has one reported in the National Forest of Silvânia, both in the state of Goiás. This species is found on litter, inside gallery jungles, next to streams or small ponds. They lay their eggs on the ground, and the tadpoles are transported by parents as far as the streams where they complete their development.



Figure 1. *Barycholos ternetzi*

**Brachycephalidae:** before the last taxonomic revisions, Brachycephalidae used to group only the genus *Brachycephalus*, exclusive of Atlantic Forest, which totaled 11 species. Some modifications were suggested in these past few years, and the family thereon included genres which previously belonged to the family Leptodactylidae such as: *Barycholos*, *Ischnocnema* (*Eleutherodactylus*), *Pristimantis*, among others, reaching a number of 823 species (*sensu* Frost, 2008). This family is distributed in the tropics and subtropics regions of the southwestern United States and south of Antilhas, as far as the south of South America. Despite the existing proposal of a relocation of some members of that family into a new one, we have chosen not to use it, until the level of acceptance



of those changes has been verified. In the Cerrado, Brachycephalidae is represented by six species (Table 1) arranged in the genres previously reported. They have a direct development, and some present parental care, as we have reported in respect to *Baricholos ternetzi* (Figure 1).

**Bufonidae:** the family is of a cosmopolitan distribution, except in relation to Australia, Madagascar and ocean regions, although they have been widely introduced in some of those localities. In the Cerrado, it is represented by 11 species (Table 1), among which one is endemic to the biome (*Rhinella cerradensis*). They are popularly known in Brazil as “sapos cururus” (Figures 2-5). The eggs of the representatives of this family, which can be found in the Cerrado, are laid in jelly strings straight into the water, where the development of the tadpoles is completed. This is considered the ancestral mode of reproduction the anurans.



Figure 2. *Rhinella schneideri*



Figure 3. *Rhinella rubescens*



Figure 4. *Rhinella granulosa*

**Centrolenidae:** the family is represented by 146 species, occurring from the sea level to an altitude of 3200 meters, with a distribution that goes from Mexico to Paraguay and Brazil. They are small “pererecas” (the name given in Brazil for a tree frog of the family Hylidae), and their color is bright red; they have big and protuberant eyes, and a transparent belly which allows the visualization of their internal organs, fact which lead them to be known as ‘glassfrogs’, or “pererecas-de-vidro” in Brazil. They are observed on the vegetation along the streams of permanent running water; this vegetation may vary from bushes or small trees to high trees that may reach 15 m. Their eggs are laid in a jelly-like mass, around leaves over the water. The larvae in an advanced stage are carried or, otherwise, fall from the gelatinous bodies of the tree frogs into the running water right below. The tadpoles look for stillness of streams on the accumulation of dry leaves, until the metamorphosis is completed. Regarding the Cerrado, there is a report of only one species, *Hyalinobatrachium* cf. *eurygnathum*, for the region of Serra do Cipó, in Minas Gerais. It may even be a new species for science.



Figure 5. *Rhinella crucifer*



**Cycloramphidae:** The representative of this family has also been included in Leptodactylidae, which was divided into various families. It occurs in northwestern Brazil and the vicinities of Bolivia, as far as the temperate of Chile and Argentina. In the Cerrado, it is represented by seven species (Table 1), four of which are endemic: *Odontophrynus maratoii*, *O. salvatori*, *Proceratophrys cururu* and *P. goyana*. In general, they are associated with wood environment, where they are cryptic to the substrates they occupy (Figures 6, 7).



Figure 6. *Proceratophrys goyana*



Figure 7. *Odontophrynus cultripes*

**Dendrobatidae:** they are present in Nicaragua, as far as Amazon basin of Bolivia and Guyanas, as well as in southeastern Brazil. They are represented in the Cerrado by three species of the genre *Ameerega* (Table 1). *Ameerega flavopicta* (Figure 8) is endemic to

the biome. This species is diurnal, aposematic, and the males vocalize in well-lit environments such as rupestrian fields. Females lay their eggs on the surface of the ground, and the tadpoles are found in small puddles on the rocks or in streams.



Figure 8. *Ameerega flavopicta*

**Hylidae:** they occur in South and North America, western India and in the Australian-Papua region; also found in temperate Eurasia, including the north extreme of Africa and the Japanese archipelago. It was introduced in New Caledonia, New Hebrides (Vanuatu), Guam and New Zealand (Frost, 2008). This family is well represented in the Cerrado area, with a total of 76 species, of these 24 (31.6%) are endemic (Table 1) (Figures 9-29). This family has a diverse reproductive ways, with species that selects the more ancestral way of laying the eggs directly in the slow moving water such as the *Dendropsophus branneri* species, those with the laying on leafs of marginal vegetation by the water like the *Phyllomedusa azurea*.



Figure 9. *Aplastodiscus perviridis*





Figure 10. *Bokermannohyla pseudopseudis*



Figure 11. *Dendropsophus cruzi*



Figure 12. *Dendropsophus melanargyreus*



Figure 13. *Dendropsophus minutus*



Figure 14. *Dendropsophus nanus*



Figure 15. *Dendropsophus rubicundulus*



Figure 16. *Hypsiboas albopunctatus*



Figure 17. *Hypsiboas faber*



Figure 18. *Hypsiboas goianus*





Figure 19. *Hypsiboas lundii*



Figure 20. *Hypsiboas punctatus*



Figure 21. *Hypsiboas raniceps*





Figure 22. *Pseudis bolbodactyla*



Figure 23. *Phyllomedusa azurea*



Figure 24. *Phyllomedusa oreades*



Figure 25. *Scinax centralis*



Figure 26. *Scinax constrictus*



Figure 27. *Scinax fuscomarginatus*



Figure 28. *Scinax fuscovarius*



Figure 29. *Trachycephalus venulosus*

**Hylodidae:** members of this family were in the past grouped among the Leptodactylidae. This species can be found in the northwest part of Brazil and North of Argentina. Three species have been reported in the Cerrado area (Table 1), such as the *Crossodactylus bokermanni* also endemic of the same area.

**Leiuperidae:** found in the south of Mexico, in all of Central America through the south of South America. This species used to be part of the Leptodactylidae family and currently they have their own family. Regarding the species of the cerrado area, 13 species are recognized of these families *Eupemphix*, *Physalaemus*, *Pleurodema* and *Pseudopaludicola* (Figures 30-33).





Figure 30. *Eupemphix nattereri*

Four endemic species of this family can be found in the Cerrado area (Table 1). This family does not have nocturnal habits, like the species of the *Pseudopaludicola*.



Figure 31. *Physalaemus centralis*



Figure 32. *Physalaemus cuvieri*



Figure 33. *Pleurodema fuscomaculata*

**Leptodactylidae:** found south part of Texas (EUA), Sonora (Mexico) and the North of the Antilhas through the south part of Brazil. In the Cerrado area, there are 21 species of genre *Leptodactylus* (Table1) (Figures 34-43). Seven endemic species reported. Some of the species of the tree frogs of larger size are represented by the *Leptodactylus labyrinthicus* and *L. ocellatus*. Sometimes this species is consumed by people in the rural area.



Figure 34. *Leptodactylus* cf. *hylaedactylus*





Figure 35. *Leptodactylus furnarius*



Figure 36. *Leptodactylus fuscus*



Figure 37. *Leptodactylus jolyi*



Figure 38. *Leptodactylus mystaceus*



Figure 39. *Leptodactylus mystacinus*



Figure 40. *Leptodactylus ocellatus*





Figure 41. *Leptodactylus siphax*



Figure 42. *Leptodactylus podicipinus*



Figure 43. *Leptodactylus labyrinthicus*





Figure 44. *Chiasmocleis albopunctata*

**Microhylidae:** these species can be found in North and South America, Africa Subsaariana; India and Korea through the North of Australia. Six species can be found in the Cerrado area (Table 1) (Figures 44-46) and one endemic (*Chiasmocleis centralis*). They are known as fast reproductive animals.



Figure 45. *Dermatotonotus muelleri*



Figure 46. *Elachistocleis* cf. *ovalis*

**Ranidae:** cosmopolitan, except for the southern part of South America and a great part of Australia. One species is found in the Cerrado area the *Lithobates palmipes*. This species is not common in Brazil and as well as in South America. In Brazil only *Lithobates palmipes* and *L. catesbianus* are found, this last species is more exotic.

**Caeciliidae:** Found in the tropics of North America, South America, east and West of Africa, in the Golfo da Guiné islands, Seychelles and India islands. Only family of the “cobras-cegas” found in the Cerrado area. Two species are recognized as being in the *Siphonops* species (Table 1) (Figure 47). This species has fossorial habits.



Figure 47. *Siphonops paulensis*

## 2.1 Reproduction of the Amphibians

Amphibians look for flooded areas or humid because of the ecological, physiological and reproductive characteristics. In general these are nocturnal species preferring humid environments minimizing the drying effects of their skin. The reproductive period are



during restricted times of the year, regarding the rain and temperatures, usually in the warmest and rainy months, more favorable to the development of the tadpoles. This pattern can be observed in most of the species in the Cerrado area. The reproduction period can also happen in the dry season, along the river banks, such as the small rivers and lakes. In general the laying of the eggs is done in the water, on top of plants, in burrows or on the ground (Figures 48-50). In some instance the tadpoles produced in terrestrial environments are carried by the parents to the water; whereas other can have direct development. A great majority of anurans found in the Cerrado area reproduce in areas of open vegetation.



Figure 48. Foam nest of *Leptodactylus ocellatus*



Figure 49. Arboreal eggs of *Phyllomedusa azurea* on the leaves



Figure 50. Nest in pond built for *Hypsiboas lundii*

The availability of micro-habitats (heer-roost vocalization) in open environments is much smaller, and the number of species is generally larger than the ones found in the forest formation. Therefore, the spatial overlapping is very extensive among the anurans of the Cerrado area. The amphibian family has the most diverse reproductive way among the terrestrial vertebrates, they can be defined as a gathering of factors relating to the development and with the reproduction, with the area where the eggs are laid, characteristics of the litter, duration of the development, stages and the feeding of the tadpoles and the presence or not of parental care.

Based on these characteristics, 39 categories were elected and are adopted today as suggested by (Haddad & Prado, 2005). Regarding the Cerrado, a great number of species still needs further investigation relating to the reproduction. The reproduction that takes place only in the rainy season is common between the species of open vegetation environments and the expected pattern for the anurans of the Cerrado. There are two reproductive behaviors in amphibians that is usually discussed, such as: the “explosive reproductive pattern”, characterized by a short reproductive period, low selection of the males by the females, elaboration of the sound noises and the high perception of the approach of the opposite sex, and the “prolonged breeding pattern”, with larger periods, with the males being more territorial and more selective females. Regarding Bastos (2007) based on the difficulty of the natural history of these species of the Cerrado area, it shows that the species of anurans found in this biome, demonstrate one of the following characteristics: (a) the reproduction period is during the rainy season; (b) the individuals form clusters in water banks; (c) have longer reproduction periods; (d) are territorial.

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