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# The amphibians of Pará, Brazil

## Os anfíbios do Pará, Brasil

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**Abstract:** Pará is the second largest state in Brazil, with all its territory within the Amazonian rainforest. The state has a wide variety of habitats and bioregions and is home to a large diversity of species. In the race to uncover this diversity and to provide support for future research, we have compiled the first list of amphibian species occurring in Pará, based on the identification of specimens deposited in scientific collections and analysis of primary literature. We recorded 195 species of amphibians, 30 of which are endemic to the state, and five represented new occurrence records. Despite its large territory, high number of endemic species and very intense levels of deforestation, only five species are officially considered threatened with extinction. We discuss reasons as to why so few species are threatened and why this number is likely to increase soon. We also discuss issues related to taxonomy, such as the occurrence of multiple unnamed species that have already been discovered in Pará. Finally, we highlight some opportunities and challenges for future research areas with amphibian diversity and taxonomy in the state of Pará.

**Keywords:** Lissamphibia. Amazonia. Checklist. Herpetology.

**Resumo:** O Pará é o segundo maior estado do Brasil, com todo o seu território dentro da floresta amazônica. O estado possui grande variedade de habitats e bio-regiões e tem, portanto, potencial para ser um dos maiores depositários da biodiversidade de anfíbios da América do Sul. Na corrida para descobrir essa diversidade e fornecer subsídios para pesquisas futuras, compilamos a primeira lista de espécies de anfíbios do Pará, com base na identificação de espécimes depositados em coleções científicas e análise da literatura primária. Registramos 195 espécies de anfíbios, das quais 30 são endêmicas do estado e cinco representaram novos registros de ocorrência. Apesar de seu extenso território, elevado número de espécies endêmicas e níveis muito intensos de desmatamento, apenas cinco espécies são oficialmente consideradas ameaçadas de extinção. Discutimos as razões pelas quais tão poucas espécies estão ameaçadas e as razões pelas quais esse número provavelmente aumentará em breve. Também discutimos questões relacionadas à taxonomia, como, por exemplo, a ocorrência de várias espécies não nomeadas no Pará. Por fim, destacamos algumas oportunidades e desafios para futuras áreas de pesquisa com diversidade e taxonomia de anfíbios no estado do Pará.

**Palavras-chave**: Lissamphibia. Amazônia. Lista de espécies. Herpetologia.

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## INTRODUCTION

The Amazonian Rainforest (or simply, Amazonia) is distributed over nine countries in South America, with more than half of its area in Brazil (Ab'Saber, 1977). Knowledge about the species diversity, distribution and phylogeny of Amazonian organisms remains, nonetheless, incipient. Several areas of Amazonia have never been sampled and thousands of specimens of its biota have accumulated in scientific collections, fruits of decades of expeditions, have been insufficiently studied (Oren & Albuquerque, 1991; Ávila-Pires et al., 2010; Peloso, 2010; Jenkins et al., 2015; Steege et al., 2016; Prudente et al., 2018).

Like most biotic groups, information about Amazonian amphibians is limited, mostly due to a lack of basic studies on species taxonomy and distribution (Ávila-Pires et al., 2007; Stuart et al., 2008; Peloso, 2010; Guerra et al., 2020). Moreover, many Amazonian species have yet to be discovered or are awaiting formal taxonomic recognition (Vacher et al., 2020; Moura & Jetz, 2021). Combined, these factors cause uncertainty regarding species richness in the region, with discrepant estimates of the number of Amazonian amphibians varying from 221 species in older assessments (Caldwell, 1996; Duellman, 1999), to 609 (Mayer et al., 2019), to nearly 900 in more recent studies (Vacher et al., 2020).

Pará is the second largest Brazilian state, with 1,245,870.798 km$^2$ of territorial extension, second only to Amazonas (IBGE, 2019), also in the Amazonian region. Pará has all its territory in Amazonia, but includes several unique types of vegetation, such as savanna enclaves in the northern portion, and areas of Amazonia-Cerrado ecotone in the south, mainly along the border with the state of Tocantins, which confers a wide variety of phytophysiognomies (Goulding et al., 2003). Such characteristics make the State a depository of a unique biodiversity in South America. For example, Amazonia has been subdivided into 'areas of endemism' (geographic area that limits the distribution of several species), largely defined based on the co-distribution of terrestrial vertebrates (Silva et al., 2005). The consensus is that at least nine areas of vertebrate endemism can be easily identified in Amazonia (Silva et al., 2005). Due to its wide territory, geographic placement, and the fact that its territory is divided by three of the largest tributaries of the Amazon River (Tapajós, Xingu and Tocantins), Pará includes portions of five of the nine areas of endemism: Belém, Guyana, Rondônia, Tapajós and Xingu (Figure 1). Therefore, the State's fauna is extremely rich and has many endemic species.

The biodiversity of Pará has been studied since the first scientific expeditions to South America (Papavero et al., 2000; Papavero & Teixeira, 2011, 2013). Among the various explorers who passed through Pará, Spix and Von Martius stand out—they were in Belém in 1819 and described several animal species in Amazonia, including amphibians (Spix, 1824). Additional examples of amphibian species described from material certainly obtained in Pará since the 19$^{th}$ century exist (e.g., Günther, 1859 [1858]; Goeldi, 1907, figure 2), but despite almost two hundred years of documented research with amphibians in the state, the number of species, and their distribution in the Pará is largely unknown.

As in the rest of the Amazonia, Pará represents an area where the number of amphibian species described recently

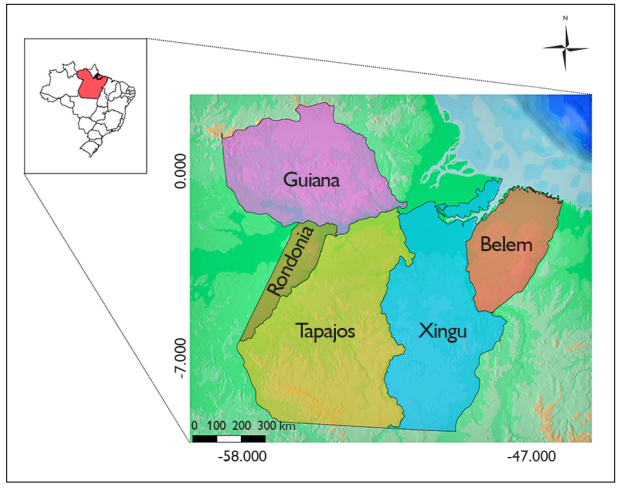


Figure 1. Map of northern South America representing the endemic areas of the state of Pará. Pará encompasses five areas of endemism and has a large number of endemic and endangered vertebrate species. Map: Gisele Cassundé (2021).

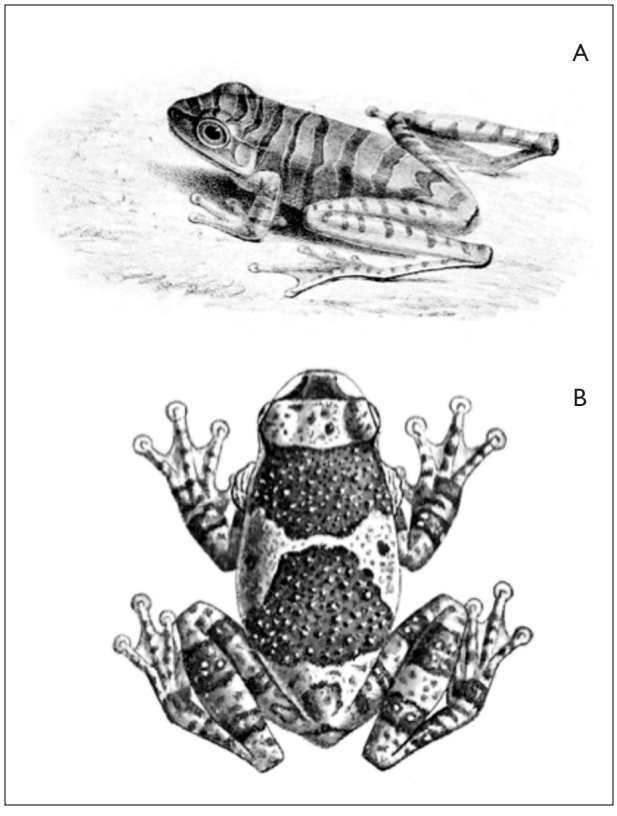


Figure 2. Reproduction of original figures of species named over a century ago and for which the type-locality is in Pará. Top: "*Hyla* (= *Boana) multifasciata*", by Albert Günther (Gunther, 1859 [1858]: plate 8, figure D). The type locality was given as "Pará", later interpreted as probably Belém (Bokermann, 1966). Bottom: "*Hyla* (=*Trachycephalus*) *resinifictrix*", by Emílio Goeldi (Goeldi, 1907). The type-locality for this species is *Missão Santo Antônio do Prata*, Maracanã river, Pará, Brazil.

is high (Maciel et al., 2018; Peloso et al., 2018; Pinheiro et al., 2018; Rojas-Zamora et al., 2018; Carvalho et al., 2019; Kaefer et al., 2019; Moraes et al., 2019; Simões et al., 2019; Carvalho et al., 2020; Oliveira et al., 2020) and current genetic studies indicate a great diversity of species not yet described occurring in the State (Fouquet et al., 2016; Peloso et al., 2018; Carvalho et al., 2020; Jaramillo-Martinez et al., 2020; Vacher et al., 2020; Fouquet et al., 2021b). However, the number of amphibian species in Pará has never been estimated based on a detailed review of biological collection data. Moreover, there is no compiled list of amphibians in Pará, although some punctual inventories have already been published for several locations in the state (e.g., Ávila-Pires & Hoogmoed, 1997; Azevedo-Ramos & Galatti, 2002; Ávila-Pires et al., 2010; Mendes-Pinto & Souza, 2011; Bernardo et al., 2012; Pinheiro et al., 2012; Vaz-Silva et al., 2015; Hoogmoed & Galatti, 2019).

Our main objective was to compile the list of amphibian species in Pará. During the process of evaluation and construction of the list, we identified some of the major difficulties associated with the study of amphibians in the Amazonian rainforest. We conclude our contribution with an outline and definitions of a few priorities for future studies with amphibians in the State.

## MATERIAL AND METHODS

The List of Amphibians of Pará, presented in this study, was fundamentally based on the analysis of material deposited in the *Coleção Herpetológica Osvaldo Rodrigues da Cunha*, at the *Museu Paraense Emílio Goeldi* (MPEG), Belém, Pará, Brazil, and on the literature. However, we also included information on selected specimens deposited in other collections worldwide and analysed by us: AMNH (American Museum of Natural History, New York, EUA); CHUNB (*Coleção Herpetológica da Universidade de Brasília*, Brasília, Brazil); INPA-H (*Coleção de Herpetologia*, *Instituto Nacional de Pesquisas da Amazônia*, Manaus, Brazil); LZATM (*Laboratório de Zoologia de Altamira*, Altamira, Brazil); MNRJ (*Museu Nacional*, Rio de Janeiro, Rio de Janeiro, Brazil); MCP (*Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul*, Porto Alegre, Brazil); MZUSP (*Museu de Zoologia, Universidade de São Paulo*, São Paulo, Brazil); NHMW (*Naturhistorisches Museum, Zoologische Abtheilung*, Wien, Austria); USNM (Smithsonian, National Museum of Natural History, Washington, EUA). The inclusion of data from the literature was essential, as it allowed us to include species for which we did not find any specimens in the collections we examined. A list of voucher specimens used to confirm the species occurrence in Pará is given in Appendix 1.

## COLLECTION SPECIMENS FROM MPEG

The first step of the study consisted of identifying specimens deposited in natural history collections. The MPEG collection, the main source of data used here, was officially founded in 1965 by Osvaldo Rodrigues da Cunha, and currently holds over 40,000 specimens of amphibians, most of which collected in Pará (a little over 22,000). The collection holds invaluable material which testifies for the magnificent diversity of amphibians in the State. These holdings have been used to produce studies on the diversity of species in the region for over a century (Goeldi, 1907), and continues to do so in the present. For this reason, we relied heavily on the material listed in the MPEG collection to build the list.

A primary list was compiled from the database of the MPEG amphibian collection. An electronic spreadsheet was exported from the MPEG archives including all amphibian entries of the collection. This spreadsheet was filtered to include only specimens collected within the limits of Pará. After filtering, we derived a list of all taxa with occurrences in Pará. After this primary list was created, we checked the actual collection specimens to search for at least one voucher specimen for each species in the list. If a voucher specimen was found and its ID confirmed, the species occurrence was confirmed. However, in many cases, specimens are wrongly identified—in such cases, if no voucher specimen was found at MPEG, the species was not immediately included in the list. In these cases, we searched for records of the species in other collections, or in the primary literature (i.e., taxonomic literature).

## ADDITIONAL COLLECTIONS AND LITERATURE DATA

The second stage of the study consisted of confirming or adding species to the list based on the literature, and on data from additional collections (other than MPEG).

To verify that our search was nearly exhaustive, we initially investigated the official list of amphibians in Brazil, provided by the Brazilian Society of Herpetology (Segalla et al., 2021). From that list, we considered that all species recognized to occur in the Brazilian territory could potentially also occur in Pará. We then searched for each of these potential species in the electronic databases Amphibian Species of the World (Frost, 2022), AmphibiaWeb (AmphibiaWeb, 2022), and IUCN Red List of Threatened Species (IUCN, 2022)—these databases have information based on literature about the distribution of each species. Based on the data from these databases, those with records for Pará were preliminarily included in the list and we then searched for voucher specimens of such species in collections or in the literature. A species was only included if specimens were either analyzed by one of us or mentioned in recent and relevant taxonomic literature.

We immediately included in the list, formally named species for which type material (holotypes or at least one paratype) were obtained in Pará, even if we did not have access to the specimens for confirmation purposes. In the case of works, such as species lists, extensions of species distribution, taxonomic reviews, among others, the record was only included without the analysis of testimony material in some cases (e.g., recent taxonomic reviews, 2005–present; phylogenetic analyses with broad sampling that is sufficient to unambiguously identify a sample). Most of the time, we attempted to analyze the voucher specimens that support the registration to confirm the identification.

## RESULTS

We recorded 195 species composing the fauna of amphibians in the state of Pará. This diversity is mostly formed by Anura (178 species), followed by Gymnophiona (15 species), and Caudata (two species). Among these, five species are new occurrence records for the State: *Boana diabolica*, *Boana leucocheila*, *Pristimantis gutturalis*, *Pristimantis reichlei* and *Trachycephalus coriaceus.* Thirty species (about 15% of all species included) represent species that only exist in Pará (endemic species). These are: Anura—*Adelphobates castaneoticus*, *Adenomera*

*amicorum*, *Adenomera aurantiaca*, *Adenomera inopinata*, *Adenomera martinezi*, *Adenomera phonotriccus*, *Adenomera tapajonica*, *Allobates carajas*, *Allobates grillicantus*, *Allobates magnussoni*, *Allobates masniger*, *Allobates nunciatus*, *Allobates tapajos*, *Amazophrynella bilinguis*, *Amazophrynella gardai*, *Amazophrynella minuta*, *Amazophrynella xinguensis*, *Chiasmocleis papachibe*, *Dendropsophus minimus*, *Hyalinobatrachium muiraquitan*, *Pristimantis giorgii*, *Pristimantis latro*, *Rhinella magnussoni*, *Scinax villasboasi*, and *Trachycephalus helioi*; Caudata—*Bolitoglossa paraensis* and *Bolitoglossa tapajonica*; and Gymnophiona—*Microcaecilia butantan*, *Microcaecilia trombetas* and *Rhinatrema uaiuai*. The complete list of species currently known for Pará is given below (Table 1).

Table 1. List of amphibian species from the State of Pará, including a list of taxa currently considered endemic to the State. Information on the conservation status of the species by the IUCN was included considering the following categories: Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Not Evaluated (NE). (Continue)

| Taxon | IUCN | Endemic |
|---|---|---|
| AMPHIBIA | | |
| Order ANURA | | |
| Allophrynidae Savage, 1973 | | |
| *Allophryne ruthveni* Gaige, 1926 | LC | |
| Aromobatidae Grant, Frost, Caldwell, Gagliardo, Haddad, Kok, Means, Noonan, Schargel, & Wheeler, 2006 | | |
| *Allobates carajas* Simões, Rojas, & Lima, 2019 | NE | X |
| *Allobates crombiei* (Morales, 2002) | DD | |
| *Allobates femoralis* (Boulenger, 1884) | LC | |
| *Allobates grillicantus* Moraes, & Lima, 2021 | NE | X |
| *Allobates magnussoni* Lima, Simões, & Kaefer, 2014 | NE | X |
| *Allobates marchesianus* (Melin, 1941) | LC | |
| *Allobates masniger* (Morales, 2002) | DD | X |
| *Allobates nunciatus* Moraes, Pavan, & Lima, 2019 | NE | X |
| *Allobates sumtuosus* (Morales, 2002) | DD | |
| *Allobates tapajos* Lima, Simões, & Kaefer, 2015 | NE | X |
| *Anomaloglossus stepheni* (Martins, 1989) | LC | |
| Bufonidae Gray, 1825 | | |
| *Amazophrynella bilinguis* Kaefer, Rojas-Zamora, Ferrão, Farias, & Lima, 2019 | NE | X |
| *Amazophrynella bokermanni* (Izecksohn, 1994) | LC | |
| *Amazophrynella gardai* Mângia, Koroiva, & Santana, 2020 | NE | X |
| *Amazophrynella minuta* (Melin, 1941) | LC | X |
| *Amazophrynella xinguensis* Rojas-Zamora, Fouquet, Ron, Hernández-Ruz, Melo-Sampaio, Chaparro, Vogt, Carvalho, Pinheiro, Ávila, Farias, Gordo, & Hrbek, 2018 | NE | X |
| *Atelopus hoogmoedi* Lescure, 1974 | NE | |
| *Atelopus spumarius* Cope, 1871 | VU | |
| *Rhaebo guttatus* (Schneider, 1799) | LC | |
| *Rhinella* castaneotica (Caldwell, 1991) | LC | |

Table 1. (Continue)

| Taxon | IUCN | Endemic |
|---|---|---|
| *Rhinella dapsilis* (Myers & Carvalho, 1945) | LC | |
| *Rhinella diptycha* (Cope, 1862) | DD | |
| *Rhinella granulosa* (Spix, 1824) | LC | |
| *Rhinella major* (Müller & Hellmich, 1936) | NE | |
| *Rhinella magnussoni* Lima, Menin, & Araújo, 2007 | LC | X |
| *Rhinella margaritifera* (Laurenti, 1768) | LC | |
| *Rhinella marina* (Linnaeus, 1758) | LC | |
| *Rhinella mirandaribeiroi* (Gallardo, 1965) | NE | |
| *Rhinella ocellata* (Günther, 1858) | LC | |
| *Rhinella proboscidea* (Spix, 1824) | LC | |
| Centrolenidae Taylor, 1951 | | |
| *Hyalinobatrachium mondolfii* Señaris & Ayarzagüena, 2001 | LC | |
| *Hyalinobatrachium muiraquitan* Oliveira & Hernández-Ruz, 2017 | NE | X |
| *Hyalinobatrachium iaspidiense* (Ayarzagüena, 1992) | DD | |
| Ceratophryidae Tschudi, 1838 | | |
| *Ceratophrys cornuta* (Linnaeus, 1758) | LC | |
| Dendrobatidae Cope, 1865 (1850) | | |
| *Adelphobates castaneoticus* (Caldwell & Myers, 1990) | LC | X |
| *Adelphobates galactonotus* (Steindachner, 1864) | LC | |
| *Adelphobates quinquevittatus* (Steindachner, 1864) | LC | |
| *Ameerega braccata* (Steindachner, 1864) | LC | |
| *Ameerega flavopicta* (Lutz, 1925) | LC | |
| *Ameerega hahneli* (Boulenger, 1884) | LC | |
| *Ameerega munduruku* Neves, Silva, Akieda, Cabrera, Koroiva, & Santana, 2017 | NE | |
| *Ameerega trivittata* (Spix, 1824) | LC | |
| *Dendrobates tinctorius* (Cuvier, 1797) | LC | |
| *Ranitomeya amazonica* (Schulte, 1999) | DD | |
| Eleutherodactylidae Lutz, 1954 | | |
| *Adelophryne gutturosa* Hoogmoed & Lescure, 1984 | LC | |
| *Phyzelaphryne miriamae* Heyer, 1977 | LC | |
| Hemiphractidae Peters, 1862 | | |
| *Hemiphractus scutatus* (Spix, 1824) | LC | |
| Hylidae Rafinesque, 1815 | | |
| *Boana boans* (Linnaeus, 1758) | LC | |
| *Boana caiapo* Pinheiro, Cintra, Valdujo, Silva, Martins, Silva, & Garcia, 2018 | NE | |
| *Boana calcarata* (Troschel, 1848) | LC | |
| *Boana cinerascens* (Spix, 1824) | LC | |

Table 1. (Continue)

| Taxon | IUCN | Endemic |
|---|---|---|
| *Boana courtoisae* Fouquet, Marinho, Réjaud, Carvalho, Caminer, Jansen, Rainha, Rodrigues, Werneck, Lima, Hrbek, Giaretta, Venegas, Chávez, & Ron, 2021 | NE | |
| *Boana dentei* (Bokermann, 1967) | LC | |
| *Boana diabolica* (Fouquet, Martinez, Zeidler, Courtois, Gaucher, Blanc, Lima, Souza, Rodrigues, & Kok, 2016) | NE | |
| *Boana geographica* (Spix, 1824) | LC | |
| *Boana icamiaba* Peloso, Oliveira, Sturaro, Rodrigues, Lima, Bitar, Wheeler, & Aleixo, 2018 | NE | |
| *Boana lanciformis* (Cope, 1871) | LC | |
| *Boana leucocheila* (Caramaschi & Niemeyer, 2003) | DD | |
| *Boana multifasciata* (Günther, 1859) | LC | |
| *Boana punctata* (Schneider, 1799) | LC | |
| *Boana raniceps* (Cope, 1862) | LC | |
| *Boana steinbachi* (Boulenger, 1905) | NE | |
| *Boana wavrini* (Parker, 1936) | LC | |
| *Dendropsophus brevifrons* (Duellman & Crump, 1974) | LC | |
| *Dendropsophus cachimbo* (Napoli & Caramaschi, 1999) | DD | |
| *Dendropsophus gaucheri* (Lescure & Marty, 2000) | LC | |
| *Dendropsophus haraldschultzi* (Bokermann, 1962) | LC | |
| *Dendropsophus leucophyllatus* (Beireis, 1783) | LC | |
| *Dendropsophus marmoratus* (Laurenti, 1768) | LC | |
| *Dendropsophus melanargyreus* (Cope, 1887) | LC | |
| *Dendropsophus microcephalus* (Cope, 1886) | LC | |
| *Dendropsophus minimus* (Ahl, 1933) | DD | X |
| *Dendropsophus minusculus* (Rivero, 1971) | LC | |
| *Dendropsophus minutus* (Peters, 1872) | LC | |
| *Dendropsophus nanus* (Boulenger, 1889) | LC | |
| *Dendropsophus ozzyi* Orrico, Peloso, Sturaro, Silva, Neckel-Oliveira, Gordo, Faivovich, & Haddad, 2014 | NE | |
| *Dendropsophus parviceps* (Boulenger, 1882) | LC | |
| *Dendropsophus reticulatus* (Jiménez de la Espada, 1870) | NE | |
| *Dendropsophus rossalleni* (Goin, 1959) | LC | |
| *Dendropsophus sarayacuensis* (Shreve, 1935) | LC | |
| *Dendropsophus schubarti* (Bokermann, 1963) | LC | |
| *Dendropsophus triangulum* (Günther, 1869) | LC | |
| *Dendropsophus walfordi* (Bokermann, 1962) | LC | |
| *Dryaderces inframaculata* (Boulenger, 1882) | DD | |
| *Lysapsus laevis* (Parker, 1935) | LC | |
| *Lysapsus limellum* Cope, 1862 | LC | |
| *Osteocephalus cabrerai* (Cochran & Goin, 1970) | LC | |

Table 1. (Continue)

| Taxon | IUCN | Endemic |
|---|---|---|
| *Osteocephalus leprieurii* (Duméril & Bibron, 1841) | LC | |
| *Osteocephalus oophagus* Jungfer & Schiesari, 1995 | LC | |
| *Osteocephalus taurinus* Steindachner, 1862 | LC | |
| *Pseudis paradoxa* (Linnaeus, 1758) | LC | |
| *Pseudis tocantins* (Linnaeus, 1758) | LC | |
| *Scarthyla goinorum* (Bokermann, 1962) | LC | |
| *Scinax boesemani* (Goin, 1966) | LC | |
| *Scinax fuscomarginatus* (Lutz, 1925) | LC | |
| *Scinax garbei* (Miranda-Ribeiro, 1926) | LC | |
| *Scinax nebulosus* (Spix, 1824) | LC | |
| *Scinax proboscideus* (Brongersma, 1933) | LC | |
| *Scinax rostratus* (Peters, 1863) | LC | |
| *Scinax ruber* (Laurenti, 1768) | LC | |
| *Scinax villasboasi* Brusquetti, Jansen, Barrio-Amorós, Segalla, & Haddad, 2014 | NE | X |
| *Scinax x-signatus* (Spix, 1824) | LC | |
| *Sphaenorhynchus lacteus* (Daudin, 1800) | LC | |
| *Trachycephalus coriaceus* (Peters, 1867) | LC | |
| *Trachycephalus cunauaru* Gordo, Toledo, Suárez, Kawashita-Ribeiro, Ávila, Morais, & Nunes, 2013 | NE | |
| *Trachycephalus hadroceps* (Duellman & Hoogmoed, 1992) | LC | |
| *Trachycephalus helioi* Nunes, Suárez, Gordo, & Pombal, 2013 | NE | X |
| *Trachycephalus resinifictrix* (Goeldi, 1907) | LC | |
| *Trachycephalus typhonius* (Linnaeus, 1758) | LC | |
| Leptodactylidae Werner, 1896 (1838) | | |
| *Adenomera amicorum* Carvalho, Moraes, Lima, Fouquet, Peloso, Pavan, Drummond, Rodrigues, Giaretta, Gordo, Neckel-Oliveira, & Haddad, 2021 | NE | X |
| *Adenomera andreae* (Müller, 1923) | LC | |
| *Adenomera aurantiaca* Carvalho, Moraes, Lima, Fouquet, Peloso, Pavan, Drummond, Rodrigues, Giaretta, Gordo, Neckel-Oliveira, & Haddad, 2021 | NE | X |
| *Adenomera heyeri* Boistel, Massary, & Angulo, 2006 | LC | |
| *Adenomera hylaedactyla* (Cope, 1868) | LC | |
| *Adenomera inopinata* Carvalho, Moraes, Lima, Fouquet, Peloso, Pavan, Drummond, Rodrigues, Giaretta, Gordo, Neckel-Oliveira, & Haddad, 2021 | NE | X |
| *Adenomera kayapo* Carvalho, Moraes, Lima, Fouquet, Peloso, Pavan, Drummond, Rodrigues, Giaretta, Gordo, Neckel-Oliveira, & Haddad, 2021 | NE | |
| *Adenomera martinezi* (Bokermann, 1956) | LC | X |
| *Adenomera phonotriccus* Carvalho, Giaretta, Angulo, Haddad, & Peloso, 2019 | NE | X |
| *Adenomera tapajonica* Carvalho, Moraes, Lima, Fouquet, Peloso, Pavan, Drummond, Rodrigues, Giaretta, Gordo, Neckel-Oliveira, & Haddad, 2021 | NE | X |

Table 1. (Continue)

| Taxon | IUCN | Endemic |
|---|---|---|
| *Engystomops freibergi* (Donoso-Barros, 1969) | LC | |
| *Hydrolaetare schmidti* (Cochran & Goin, 1959) | LC | |
| *Leptodactylus fuscus* (Schneider, 1799) | LC | |
| *Leptodactylus intermedius* Lutz, 1930 | NE | |
| *Leptodactylus knudseni* Heyer, 1972 | LC | |
| *Leptodactylus labyrinthicus* (Spix, 1824) | LC | |
| *Leptodactylus leptodactyloides* (Andersson, 1945) | LC | |
| *Leptodactylus longirostris* Boulenger, 1882 | LC | |
| *Leptodactylus macrosternum* Miranda-Ribeiro, 1926 | NE | |
| *Leptodactylus myersi* Heyer, 1995 | LC | |
| *Leptodactylus mystaceus* (Spix, 1824) | LC | |
| *Leptodactylus paraensis* Heyer, 2005 | LC | |
| *Leptodactylus pentadactylus* (Laurenti, 1768) | LC | |
| *Leptodactylus petersii* (Steindachner, 1864) | LC | |
| *Leptodactylus pustulatus* (Peters, 1870) | LC | |
| *Leptodactylus rhodomystax* Boulenger, 1884 | LC | |
| *Leptodactylus stenodema* Jiménez de la Espada, 1875 | LC | |
| *Physalaemus cuvieri* Fitzinger, 1826 | LC | |
| *Physalaemus ephippifer* (Steindachner, 1864) | LC | |
| *Lithodytes lineatus* (Schneider, 1799) | LC | |
| *Pseudopaludicola boliviana* Parker, 1927 | LC | |
| *Pseudopaludicola canga* Giaretta & Kokubum, 2003 | DD | |
| *Pseudopaludicola mystacalis* (Cope, 1887) | LC | |
| Microhylidae Günther, 1858 (1843) | | |
| *Chiasmocleis avilapiresae* Peloso & Sturaro, 2008 | LC | |
| *Chiasmocleis bassleri* Dunn, 1949 | LC | |
| *Chiasmocleis hudsoni* Parker, 1940 | LC | |
| *Chiasmocleis papachibe* Peloso, Sturaro, Forlani, Gaucher, Motta, & Wheeler, 2014 | NE | X |
| *Chiasmocleis shudikarensis* Dunn, 1949 | LC | |
| *Ctenophryne geayi* Mocquard, 1904 | LC | |
| *Elachistocleis carvalhoi* Caramaschi, 2010 | LC | |
| *Elachistocleis helianneae* Caramaschi, 2010 | LC | |
| *Elachistocleis magna* Toledo, 2010 | NE | |
| *Elachistocleis surinamensis* (Daudin, 1802) | LC | |
| *Hamptophryne boliviana* (Parker, 1927) | LC | |
| *Otophryne pyburni* Campbell & Clarke, 1998 | LC | |
| *Synapturanus ajuricaba* Fouquet, Leblanc, Fabre, Rodrigues, Menin, Courtois, Dewynter, Hölting, Ernst, Peloso, & Kok, 2021 | NE | |

Table 1. (Continue)

| Taxon | IUCN | Endemic |
|---|---|---|
| *Synapturanus mirandaribeiroi* Nelson & Lescure, 1975 | LC | |
| Odontophrynidae Lynch, 1969 | | |
| *Proceratophrys concavitympanum* Giaretta, Bernarde, & Kokubum, 2000 | DD | |
| *Proceratophrys rondonae* Prado & Pombal, 2008 | NE | |
| Phyllomedusidae Günther, 1858 | | |
| *Callimedusa tomopterna* (Cope, 1868) | LC | |
| *Cruziohyla craspedopus* (Funkhouser, 1957) | LC | |
| *Phyllomedusa bicolor* (Boddaert, 1772) | LC | |
| *Phyllomedusa vaillantii* Boulenger, 1882 | LC | |
| *Pithecopus hypochondrialis* (Daudin, 1800) | LC | |
| Pipidae Gray, 1825 | | |
| *Pipa arrabali* Izecksohn, 1976 | LC | |
| *Pipa pipa* (Linnaeus, 1758) | LC | |
| *Pipa snethlageae* Müller, 1914 | LC | |
| Ranidae Batsch, 1796 | | |
| *Lithobates palmipes* (Spix, 1824) | LC | |
| Strabomantidae Hedges, Duellman, & Heinecke, 2008 | | |
| *Pristimantis chiastonotus* (Lynch & Hoogmoed, 1977) | LC | |
| *Pristimantis fenestratus* (Steindachner, 1864) | LC | |
| *Pristimantis giorgii* Oliveira, Alves da Silva, Guimarães, Penhacek, Martínez, Rodrigues, Santana, & Hernández-Ruz, 2020 | NE | X |
| *Pristimantis gutturalis* (Hoogmoed, Lynch, & Lescure, 1977) | LC | |
| *Pristimantis latro* Oliveira, Rodrigues, Kaefer, Pinto, & Hernández-Ruz, 2017 | NE | X |
| *Pristimantis marmoratus* (Boulenger, 1900) | LC | |
| *Pristimantis ockendeni* (Boulenger, 1912) | LC | |
| *Pristimantis pictus* Oliveira, Alves da Silva, Guimarães, Penhacek, Martínez, Rodrigues, Santana, & Hernández-Ruz, 2020 | NE | |
| *Pristimantis zeuctotylus* (Lynch & Hoogmoed, 1977) | LC | |
| *Pristimantis zimmermanae* (Heyer & Hardy, 1991) | LC | |
| Order CAUDATA | | |
| Plethodontidae Gray, 1850 | | |
| *Bolitoglossa paraensis* (Unterstein, 1930) | DD | X |
| *Bolitoglossa tapajonica* Brcko, Hoogmoed, & Neckel-Oliveira, 2013 | NE | X |
| Order GYMNOPHIONA | | |
| Caeciliidae Rafinesque, 1814 | | |
| *Caecilia gracilis* Shaw, 1802 | LC | |
| *Caecilia tentaculata* Linnaeus, 1758 | LC | |

Table 1. (Conclusion)

| Taxon | IUCN | Endemic |
|---|---|---|
| Rhinatrematidae Nussbaum, 1977 | | |
| *Rhinatrema bivittatum* (Guérin-Méneville, 1838) | LC | |
| *Rhinatrema gilbertogili* Maciel, Sampaio, Hoogmoed, & Schneider, 2018 | NE | |
| *Rhinatrema uaiuai* Maciel, Sampaio, Hoogmoed, & Schneider, 2018 | NE | X |
| Siphonopidae Bonaparte, 1850 | | |
| *Brasilotyphlus guarantanus* Maciel, Mott, & Hoogmoed, 2009 | NE | |
| *Microcaecilia butantan* Wilkinson, Antoniazzi, & Jared, 2015 | NE | X |
| *Microcaecilia marvaleewakeae* Maciel & Hoogmoed, 2013 | NE | |
| *Microcaecilia rochai* Maciel & Hoogmoed, 2011 | NE | |
| *Microcaecilia trombetas* Maciel & Hoogmoed, 2011 | NE | X |
| *Siphonops annulatus* (Mikan, 1820) | LC | |
| Typhlonectidae Taylor, 1968 | | |
| *Atretochoana eiselti* (Taylor, 1968) | DD | |
| *Nectocaecilia petersii* (Boulenger, 1882) | LC | |
| *Potomotyphlus kaupii* (Berthold, 1859) | LC | |
| *Typhlonectes compressicauda* (Duméril & Bibron, 1841) | LC | |

In addition to the species included in the present list, others are candidates to be included in the list in the future—these taxa do occur in Pará (based on literature records): at least six species from the *Boana semilineata* group (one from the *Boana geographica* complex and five from the *Boana semilineata* complex) (Fouquet et al., 2016; Peloso et al., 2018), and two species of *Synapturanus* (Fouquet et al., 2021a) have already been confirmed to be new species (some of which already being described, PLVP, personal observation; Fouquet et al., 2021b).

A recent study with *Atelopus* suggests that an unnamed species of the genus occurs in southern Pará (the Tapajós river) (Jorge et al., 2020), but this is pending a more robust analysis of the taxonomic status of these populations.

An undergoing study on the *Microcaecilia* from Pará will probably provide additions of new caecilians. Maciel & Hoogmoed (2011a) denominated all populations of this genus from south of the Amazon River, and east to the Tapajós river as *Microcaecilia taylori* Nussbaum & Hoogmoedi, 1979 based on external morphology. New undergoing morphological and molecular analyses will change the taxonomic status of these populations and in the future a new *Microcaecilia* will compose the list of amphibians in the state of Pará (A. O. M., personal communication, 2022).

The species *Ameerega picta guayanensis*, currently considered a subspecies of *A. picta* (often, but unofficially, regarded as a synonym) may represent a valid taxon. Specimens from MPEG (MPEG 2803, MPEG 2805, MPEG 2807, MPEG 2815–2816, MPEG 2828, MPEG 17495–17503), obtained in the northern part of Pará, are compatible with diagnostic characters of this taxon. However, a more detailed taxonomic study is needed to confirm the status of this taxon.

Finally, we did not include *Chiasmocleis jimi* Caramaschi & Cruz, 2001 in our list—a species currently included and listed as valid in both Segalla et al. (2021) and Frost (2022), and for which paratypes are available at MPEG. The species was named based on specimens from Amazonas and Pará (type-locality Humaitá, Amazonas, Brazil). Peloso et al. (2014) suggested that both species are not unambiguously

differentiated based on a detailed analysis of morphology and advertisement call from throughout the range of both species (including the analyses of both types). De Sá et al. (2019) reinstated *C. jimi* as a valid species, based on their interpretation of genetic data. However, the clades labeled as *C. jimi* and *C. hudsoni* by De Sá et al. (2019) did not include the type-locality of *C. jimi*, whereas they form sister clades for which the distributions apparently overlap. Furthermore, many of the specimens included in the genetic study of De Sá et al. (2019) were examined (for morphology) by Peloso et al. (2014), including specimens in both clades. De Sá et al. (2019) did not provide any new evidence that could be used to diagnose both taxa. Given that the lineages labeled *C. jimi* and *C. hudsoni* by De Sá et al. (2019) form a clade that is diagnoseable based on morphological and acoustic characters, we suggest these two taxa should not be treated as separate species until more convincing evidence is available.

## NEW DISTRIBUTION RECORDS

### Hylidae

#### *Boana diabolica*

*Boana diabolica* is known to occur in most of French Guiana and in the state of Amapá, Brazil (Fouquet et al., 2016). The record of the species for Pará was anticipated, since some points of occurrence, defined by Fouquet et al. (2016), are close to the border between Amapá and Pará. A single specimen from Pará was found in MPEG (MPEG 33920), obtained in the municipality of Almeirim. This specimen was previously included in the genetic analysis of Peloso et al. (2018)—therein tentatively assigned to *B. diabolica.* After a detailed examination of that specimen, we concluded it is a member of that species and confirm the occurrence of *B. diabolica* in Pará.

#### *Boana leucocheila*

*Boana leucocheila* was described and named by Caramaschi & Niemeyer (2003), who suggested a distribution in the states of Mato Grosso (Aripuanã and Apiacás) and Rondônia (Nova Carolina), Brazil. Pansonato et al. (2011) confirmed its occurrence in Mato Grosso and expanded the range within that State. We confirm the presence of the species in Pará from specimens from the municipalities of Juruti and Itaituba (MPEG 14271; MPEG 27239–27244; MPEG 22393–22395; MPEG 22210–22211; MPEG 22347–22349; MPEG 33538; MPEG 37062). Most specimens we correctly identified as *Boana leucocheila* and in some cases as *B. lanciforms*. Despite most specimens being correctly labeled in the collection, the occurrence in Pará was never published and remained unavailable in the literature.

#### *Trachycephalus coriaceus*

*Trachycephalus coriaceus* is widely distributed in Amazonia, but interestingly, no record of the species existed for Pará. The species was originally described for Suriname, with vague information about its type locality (Peters, 1867). However, over the years its distribution broadened to include French Guiana, Guyana, Upper Amazon Basin in Colombia, Ecuador, Peru, Bolivia, and downstream into Rondônia and Amazonas, near Manaus, Brazil (Frost, 2022). In Brazil, there are known records from the state of Acre (Souza, 2009), Amazonas (Zimmerman & Rodrigues, 1990) and, more recently, Rondônia (Meneghelli et al., 2017). The species occurrence for Pará was confirmed for the municipalities of Marabá (MPEG 35500) and Parauapebas (MPEG 41293).

### Strabomantidae

#### *Pristimantis gutturalis*

*Pristimantis gutturalis* was described by Hoogmoed et al. (1977) and listed as occurring in French Guiana. Later, its distribution was expanded to Suriname and Brazil (Amapá) (Ouboter & Jairam, 2012; Frost, 2022). Here, we expand the distribution of the species to Pará (MPEG 21395–21396, MPEG 27873–27874) from Porto Trombetas, municipality of Oriximiná.

*Pristimantis reichlei*

*Pristimantis reichlei* was described and named by Padial & De La Riva (2009), as occurring for Bolivia and Peru. The first record of the species for Brazil was in 2010, for the municipality of Senador Guiomard, Acre (Melo-Sampaio & Souza, 2010). After ten years, no other records for the country have been published. During the analysis of MPEG specimens, originally identified as *P. peruvianus* in the collection database, we concluded that the specimens are actually *P. reichlei*, collected in the municipalities of Vitória do Xingu and Itaituba (MPEG 36826–36827, MPEG 39015–39019).

## DISCUSSION

Few Brazilian states have recent (i.e., from 2000 to present) lists of amphibian species occurring within their political limits, namely: Rio Grande do Sul—86 species (Machado & Maltchik, 2007); Espírito Santo—133 spp. (Almeida et al., 2011); São Paulo—236 spp. (Rossa-Feres et al., 2011); Piauí—55 spp. (Roberto et al., 2013); Alagoas—74 spp. (Almeida et al., 2016); Ceará—57 spp. (Roberto & Loebmann, 2016); Rio de Janeiro—201 spp. (Dorigo et al., 2018); Mato Grosso do Sul—97 spp. (Souza et al., 2017); Tocantins—90 spp. (Silva et al., 2020). A list for Goiás reported 39 species (Santos et al., 2014), but a recent publication that jointly reports the richness in Goiás and Distrito Federal included 114 species (Vaz-Silva et al., 2020). In addition to these carefully elaborated lists, Toledo & Batista (2012) provided estimates of number of species for all States, based on IUCN's and amphibian collection's data—their data show numbers that are similar to the individually published lists, but also provide estimates for states where official lists have never been published. In Toledo & Batista (2012) the greatest species richness was found in Amazonas (212 spp.), Minas Gerais (259 spp.), São Paulo (241 spp.), and Rio de Janeiro (205 spp.)—the authors estimated a total of 148 species for Pará, considerably less than what we report herein.

Our data shows that Pará is among states with the largest number of amphibian species registered among published lists and when compared to numbers given in Toledo & Batista (2012), followed by São Paulo, Minas Gerais and Rio de Janeiro. However, comparing the number of species from different regions can be relatively uninformative, especially if we consider the different methodologies applied, intrinsic differences between the regions, differences in the size of the areas, disparate sampling efforts, and especially the number of taxonomists and taxonomic work published within these regions (Duellman & Thomas, 1996; Martins & Oliveira, 1998). Pará covers a large territorial area with several areas that are little studied or have never been sampled at all, whereas the states of São Paulo and Rio de Janeiro, for example, have been much better studied historically (Guerra et al., 2020). These factors certainly contribute to São Paulo and Rio de Janeiro having a better understanding of its biodiversity, resulting in relatively large lists of amphibians, and further highlighting the urgent need for additional work with amphibians in Pará (see also Guerra et al., 2020).

Considering the size of the state of Pará (larger than Colombia), we consider that the amphibian fauna in this region has so far been poorly studied. Although several sites across Pará have been studied and inventoried for amphibian diversity, only a few local/regional lists have been published—discussing these is beyond the scope of this work, but some are worth mentioning.

Crump (1971) studied amphibian diversity in the vicinities of Belém and reported the occurrence of at least 41 species (37 frogs, 3 caecilians, one salamander) in the region. Her study detailed habitat use, abundance, and several other ecological aspects for most species, and is a fairly complete account of the amphibian fauna in the capital of Pará. A later study reported 55 species over the same general area (Galatti et al., 2007), and more recently, a study focused on Parque Estadual do Utinga (PEUT, a relatively large and well-preserved forest fragment within Belém) reported a list comprising of 50 amphibian species (Ávila-Pires et al., 2018). Surprisingly, these are the only detailed studies of amphibian diversity published for Belém,

the second largest city of the Brazilian Amazonia. These studies are further discussed below (see section "Endemic and Threatened Species").

Additional studies reported over the amphibian fauna from broad geographical areas (based on short-term surveys), or narrow areas that have been more densely sampled and studies over time. Examples of the first is a series of expeditions conducted to the northern part of Pará (Ávila-Pires et al., 2010)—north of the Amazonas River (part of the Guiana Shield). Over the course of seven expeditions to different localities, a team of researchers mostly from *Museu Paraense Emílio Goeldi* reported a total of 80 amphibian species in the region, with the number of species per site varying from 21 to 36 (Ávila-Pires et al., 2010). In another example, Vaz-Silva et al. (2015), compiled data on species richness over a large area known as Volta Grande do Xingu (in the Xingu River)—109 species of amphibians were recorded for this region, a diversity considerably higher compared to the other inventories carried out in Pará (representing over 52% of all species found in the state). At least one other region has been relatively well studied and have relatively detailed accounts about amphibian diversity published—Floresta Nacional de Carajás where species richness has been reported to be as high as 71 species (Neckel-Oliveira et al., 2012; Pinheiro et al., 2012).

To generate a better understanding of the geographical distribution of species richness in Pará, further studies are urgently needed. This will be a hard task to accomplish, as many areas have not been sufficiently sampled, and specimens collected sporadically over the area of the State are spread across multiple collections (often misidentified). This is aggravated by the fact that many places where inventories had been carried out have not seen these lists published or were published in the so-called grey literature (e.g., annals of meetings, technical reports, websites without a permanent link). Noticeable places with large amounts of material available at the MPEG collection but without lists published are, for example, the upper and middle Tapajós River regions, the upper Xingu River, and the Marajó island.

## ON THE QUALITY OF THE SPECIES LIST

Data on the geographical and temporal distribution of organisms are often obtained from direct information from databases of zoological collections, and, more recently, citizen science (Dickinson et al., 2010; Callaghan et al., 2019). Very often, in the case of natural history collections, data from the registration books are made available worldwide, and are used for further studies without careful reviews of original entry identifications (Goodwin et al., 2015). Some examples involving information obtained from online databases without a careful assessment of the quality of the information can be seen in Feeley & Silman (2011), Escalante et al. (2013), and Meyer et al. (2015).

Although the metadata from collection databases is extremely important for meta-analysis in studies on biodiversity, the practice is not without problems and criticism (Goodwin, et al., 2015; Peloso, 2010; Vollmar et al., 2010). Erroneous data recorded in collections and museums are the result of a chain of problems that can accumulate over time. The mistaken and outdated identifications in regional, national or global databases consequently provide erroneous information about species diversity and distribution patterns. In an assessment of the accuracy of identifying plants deposited in scientific collections worldwide, Goodwin et al. (2015) mention that more than half of the studied specimens were incorrectly identified. Although the study was restricted to only a few groups of plants, the authors mention the expectation that the pattern will be the same for most taxonomic groups.

In the case of our list, a preliminary study involving only specimens from a frog family deposited in the MPEG collection also revealed a reasonable rate of identification errors (Ferreira et al., 2016). The list of Microhylidae based on raw (uncorrected) data from MPEG led to a total of 15 species, but after re-identification of the material in the collection, the list was reduced to only 13 species. It is noteworthy, however, that despite the similar numbers, the corrected list is considerably different from the original list, with only nine species common to both lists (Table 2: see also Ferreira et al., 2016).

Among the factors pointed out by Goodwin et al. (2015) and Ferreira et al. (2016) as probable causes of the high rate of misidentifications in the collections are the lack of recent systematic review works for most groups (which causes new errors to be incorporated into the collections), and the lack of constant review of the identification of the material incorporated in the collections (which means that errors inserted in the databases are not corrected despite sufficient taxonomic information to do so). It is clear from these two examples, how important taxonomic revision work and periodic revision of the material deposited in the collections are. For example, the correct re-identification of several specimens of Microhylidae from MPEG was only possible because two of the largest genera of Microhylidae have undergone relatively recent systematic reviews (Caramaschi, 2010; Peloso et al., 2014).

Table 2. List of taxa of the Microhylidae family registered for the state of Pará obtained from the raw data from the MPEG collection database (Original List), and after reviewing the specimens of the collection (Refined List). Table adapted from Ferreira et al. (2016).

| Taxon | Original List | Refined List | Justification |
|---|---|---|---|
| *Chiasmocleis avilapiresae* | Present | Confirmed | - |
| *Chiasmocleis bassleri* | Present | Confirmed | - |
| *Chiasmocleis hudsoni* | Present | Confirmed | - |
| *Chiasmocleis papachibe* | Absent | Added | Species recently described and endemic to Pará (Peloso et al., 2014) |
| *Chiasmocleis shudikarensis* | Present | Confirmed | - |
| *Chiasmocleis ventrimaculata* | Present | Removed | Species with no occurrence in Eastern Amazonia. Specimens reidentified as *C. bassleri*, *C. papachibe* |
| *Ctenophryne geayi* | Present | Confirmed | - |
| *Elachistocleis bicolor* | Present | Removed | Specimens reidentified as *E. carvalhoi, E. helianneae*, *E. surinamensis* |
| *Elachistocleis carvalhoi* | Present | Confirmed | - |
| *Elachistocleis helianneae* | Absent | Added | Several specimens in the collection previously identified as *E. bicolor*, *E. ovalis* |
| *Elachistocleis magna* | Absent | Added | Several specimens in the collection previously identified as *E. ovalis* |
| *Elachistocleis pearsei* | Present | Removed | Specimens reidentified as *E. carvalhoi* |
| *Elachistocleis surinamensis* | Absent | Added | Specimens reidentified as *E. carvalhoi* |
| *Hamptophryne boliviana* | Present | Confirmed | - |
| *Otophryne pyburni* | Present | Confirmed | - |
| *Synapturanus mirandaribeiroi* | Present | Confirmed | - |
| *Synapturanus salseri* | Present | Removed | Specimens reidentified as *S. mirandaribeiroi* or as unnamed species of *Synapturanus* |
| *Chiasmocleis jimi* | Present | Removed | Junior synonym of *C. hudsoni* (Peloso et al., 2014). See text for details |
| *Elachistocleis ovalis* | Present | Removed | Nominal species is not valid (Caramaschi, 2010). Specimens reidentified as *E. carvalhoi*, *E. helianneae*, *E. magna* |

In the present study, the problem was once again detected, although not quantified. Systematic and recent reviews by some groups allowed for the easy and accurate re-identification of most of the analyzed material. For example, due to the relative low diversity and the existence of recent reviews for several taxa in Gymnophiona and Caudata (Maciel & Hoogmoed, 2011b; Brcko et al., 2013, respectively) the identification of the material of these groups was greatly facilitated. Likewise, recent work with some Anura groups has also been of great value (examples in Caramaschi, 2010; Caminer & Ron, 2014; Caminer et al., 2017; Carvalho et al., 2020; Peloso et al., 2014). Finally, recent genetic studies have also helped to identify some MPEG specimens with a high degree of reliability (Castroviejo-Fisher et al., 2011; Jungfer et al., 2013; Fouquet et al., 2014, 2016, 2021b; Peloso et al., 2018). For several other groups, however, the lack of recent review work and known taxonomic problems made it extremely difficult to identify the available material. Consequently, the degree of reliability in the identifications is much higher for some groups than for others. Some species were not possible to identify to the species level, due to confusion in their diagnosis or due to the presence of a set of similar species indistinguishable morphologically. For example, *Hyalinobatrachium* has, in theory, three species occurring in Pará: *H. mondolfi*, *H. muiraquitan* and *H. iaspidiense* (Oliveira & Hernández-Ruz, 2017). However, in the literature (Castroviejo-Fisher et al., 2011) *H. mondolfi* and *H. iaspidiense* are indistinguishable when based solely on morphological characters. The overlap of characters between *H. mondolfi*, *H. iaspidiense*, *H. taylori* and H. *tricolor* hindered the diversity sampling of the Centrolenidae family in Pará. It is possible that some of the specimens identified as *H. iaspidiense* refer to *H. tricolor*. The same occurs with *H. mondolfi*, where some of the specimens may represent records of *H. taylori*. Moreover, several specimens in several collections (including MPEG) remain unidentified.

## TAXONOMY, A GREAT CHALLENGE

Many species of amphibians are difficult to identify based solely on the evaluation of morphological characters—many important characters are lost or altered once the animals are preserved, while other characters are subjective. Moreover, some species cannot be distinguished at all based on morphology alone, and one must rely on alternative sources of data, such as bioacoustics, genetics, or behavior. Peloso (2010) reinforced that morphological, molecular and bioacoustic data, when used in an integrated manner, are extremely effective tools for the identification of amphibians in the Brazilian Amazonia. Several are the examples where integrative taxonomy helped in the discovery and characterization of Amazonian species, including species from Pará (Padial et al., 2010; Jansen et al., 2011; Simões et al., 2013; Caminer & Ron, 2014; Peloso et al., 2014, 2018; Fouquet et al., 2016, 2021a; Carvalho et al., 2020).

Despite recent advances and the efforts of several researchers working directly in systematic studies of Amazonian amphibians, an enormous number of species still await formal description. Several lineages have already been formally recognized as species, but not described and named, are still awaiting validation by taxonomists. As examples, we highlight some lineages recognized as independent evolutionary units (species) through genetic studies, which were never named (Fouquet et al., 2012, 2014, 2016, 2021b; Funk et al., 2012; Jungfer et al., 2013; Caminer & Ron, 2014; Caminer et al., 2017; Peloso et al., 2018). Among these species not described, some occur in Pará, as shown by our analysis of specimens of collection and the provenance of the samples used in those studies. The discovery of these taxonomic holes highlights the need to renew and intensify efforts to discover and catalog amphibians in the Amazon region, especially in Pará, where the destruction and fragmentation of the forest is extremely higher compared to other regions. Finally, it is easy to point out several examples of groups that need more systematic studies. Many groups with difficult identification and low genetic sampling need more

attention. Always problematic are the specimens of the genera *Allobates*, *Amazophrynella*, *Atelopus*, *Bolitoglossa*, *Dendropsophus*, *Leptodactylus*, *Microcaecilia*, *Pristimantis*, *Rhinella* (especially those of the *Rhinella margaritifera* group), and *Scinax*. Despite some major improvement in some of these groups, a lot remains to be done—all have in common the fact that they include several species that are morphologically similar, but genetically and biologically distinct (i.e., cryptic species).

## ENDEMIC AND THREATENED SPECIES

The distribution of organisms in the world is not random, resulting in the tendency for biodiversity to aggregate on specific areas (Sigrist & Carvalho, 2008). The concentration of organisms with restricted distribution, generated by historical factors, define the areas of endemism (Harold & Mooi, 1994; Morrone, 1994; Linder, 2001). These areas are important for providing support to postulate hypotheses about the history of the biotas and for harboring unique species (Cracraft, 1988, 1994; Morrone, 1994; Morrone & Crisci, 1995; Silva et al., 2004).

We recorded 30 species endemics to Pará (Table 1; Figure 3). Although many species can represent actual endemism, it is also possible that some will be found in neighboring states and countries. This is especially true for recently named species. For example, several of the endemic species were only named in the last five years, with the majority between the years 2019 and 2022 (e.g., *Adenomera amicorum*, *Adenomera aurantiaca*, *Adenomera inopinata*, *Adenomera phonotriccu*s, *Adenomera tapajonica*, *Allobates carajas*, *Allobates nunciatus*, *Allobates tapajos*, *Amazophrynella bilinguis*, *Amazophrynella xinguensis*, *Hyalinobatrachium muiraquitan*, *Microcaecilia butantan*, *Pristimantis giorgii*, *Pristimantis latro*, and *Rhinatrema uaiuai*). The sole fact that these species are endemic to the state of Pará suggests that additional conservation attention is warranted to these species.

Despite its large territory, great diversity (almost 200 species), high levels of endemism, and very intense levels of deforestation, very few species of Pará are officially considered threatened with extinction. The current official Brazilian red list ("Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção", MMA, 2014) includes 42 species of amphibians, of which only one is known from Pará: the salamander *Bolitoglossa paraensis* (Vulnerable) (Figure 4). The last update for the list of threatened species of Pará was published by the state government in 2007 ("Lista de Espécies da Flora e da Fauna Ameaçadas no Estado do Pará", Governo do Estado do Pará, 2007) and includes three species: the salamander *Bolitoglossa paraensis*, and two frogs, *Rhinella ocellata* and *Pseudopaludicola canga* (Figure 4). The IUCN Red list includes *Atelopus spumarius* as threatened with extinction, and our list include this species.

Why so few species threatened with extinction, given the large diversity, a considerable number of endemic species, and major threats to the environment? Peloso (2010) discussed some of the reasons why, and many of which also likely apply here. Among the most important factors impeding correct assessment of threats and number threatened species is taxonomy, and considerable deficiencies in data related to geographical distributions. For example, Peloso (2010) mentioned the problems related to taxonomy and conservation in *Adenomera.* At the time, diversity of the group was vastly underestimated, and two species were considered widespread in the Amazonia (*A. andreae* and *A. hylaedactyla*), despite evidence that they might represent distinct species—both considered as Least Concern (LC). Peloso (2010) then posed some questions: Are all known, but undescribed, species in the complexes also of Least Concern? Are those widespread entities? Time has shown that these concerns were warranted. Fouquet et al. (2014) based on genetic data showed that both *A. andreae* and *A. hylaedactyla* represented complexes of many species, some with considerable narrow ranges. Since then, ten new species of *Adenomera* had been named, mostly from Amazonia, and several of them from Pará (Carvalho et al., 2019, 2020; Frost 2022). Among these at least one, *A. phonotriccus*, has an extremely narrow geographic range,


Figure 3. Example of amphibian species endemic to the state of Pará: A) *Amazophrynella xinguensis*; B) *Rhinella magnussoni*; C) *Pristimantis latro*; D) *Adelphobates castaneoticus*; E) *Adenomera phonotriccus*; F) *Chiasmocleis papachibe*; G) *Bolitoglossa tapajonica*; H) *Rhinotrema uaiuai*. All photos by PLVP, except (H), by T.C. Ávila-Pires.

and occur within a devastated portion of Pará's Amazonian forest (Carvalho et al., 2019). It is likely that *A. phonotriccus* is threatened with extinction, although an official assessment by IUCN is pending. This conclusion was only possible due to the concentrated effort the resolve the taxonomic status of these likely endangered populations (Carvalho et al., 2019, 2020). It is likely that more species relate to the example above—narrow range, threatened species being treated as widespread, Least Concern taxa. We urge that stakeholders invest heavily in initiatives that accelerate taxonomy and the collection/publication of distribution and natural history data on Amazonian biodiversity.


Figure 4. Endangered species of amphibians from Pará: A) Pará's Lungless Salamander (*Bolitoglossa paraensis*). The only species from Pará included in the Brazilian redlist ("Lista nacional oficial de espécies da fauna ameaçadas de extinção": MMA, 2014). Photo from Santa Bárbara do Pará, Pará, Brazil; B) *Pseudopaludicola canga*, from Carajás; and C) *Rhinella ocellata*, from Serra do Cachimbo. Both *P. canga* and *R. ocellata* were included in the state's red list ("Lista de espécies da flora e da fauna ameaçadas no estado do Pará": Governo do Estado do Pará, 2007).

## CONCLUDING REMARKS

Great challenges lie ahead on our path to a decent understanding of amphibian diversity in Amazonia. Our study highlighted a high species richness of amphibians in Pará—a total of 195 species registered, of which five represent new records, and 30 are considered endemic to the region. This is the largest species richness among all Brazilian states with published or estimated species lists, after São Paulo and Rio de Janeiro, respectively. The high diversity is not surprising, giving the size of the state and the diversity of habitats present therein. Nonetheless, we are certain this list is still underestimated. This work represents an important step towards a better understanding of the vertebrate diversity of the State. However, the difficulty in determining the species of the group is latent, and we reinforce those additional studies must be carried out to estimate the true diversity of species in the group. The next natural step is the refinement of the list we generated here. Some of the obvious improvements will be possible corrections of potential errors of conforming identification, and the addition of eventual omissions. Other, less obvious, steps are improvements to the knowledge of species included herein—e.g., maps of distributions, compilation of known natural history data, and threat assessments for newly named, geographically restricted species. We expect that this list will continue to grow in the next few years, as new areas are explored, and some taxa are studied in more detail.

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## AUTHORS' CONTRIBUTIONS

G. F. Cassundé contributed to formal analysis, conceptualization, data curation, investigation, validation, and writing (original draft); M. J. Sturaro to data curation, investigation, and writing (review and editing); A. O. Maciel to data curation, investigation, and writing (review and editing); A. L. C. Prudente to data curation, resources, and writing (review and editing); J. F. M. Sarmento to data curation, and writing (review and editing); and P. Peloso to project administration, funding acquisition, conceptualization, data curation, supervision, and writing (original draft).

Appendix 1. Voucher of testimony specimens used to generate the list of amphibians in the State of Pará.

## Order Anura

***Adelophryne gutturosa***: BM 1983.1139; LACM 44277; LACM 44278; ***Adelphobates castaneoticus***: MPEG 10329; MPEG 10581; MPEG 22000; MPEG 25186; ***Adelphobates galactonotus***: MPEG 2921-2924; ***Adelphobates quinquevittatus***: MPEG 6691; MPEG 6709; MPEG 6947; ***Adenomera amicorum***: INPA-H 40490–40499; INPA-H 40501–40510; ***Adenomera andreae***: MPEG 30747; ***Adenomera aurantiaca***: INPA-H 40518–40521; **Adenomera** ***heyeri***: MPEG 30095–30101; ***Adenomera hylaedactyla***: MPEG 30903; ***Adenomera inopinata***: INPA-H 40517; ***Adenomera kayapo***: CFBH 43885; MPEG 41619–41620; ***Adenomera martinezi***: CHUNB 40218; CHUNB 40220; ***Adenomera phonotriccus***: MPEG 41155–41156; ***Adenomera tapajonica***: INPA-H 40515–40516; ***Allobates carajas***: INPA-H 38635; INPA-H 38642; INPA-H 38643; ***Allobates crombiei***: MPEG 37859; MPEG 37860; ***Allobates grillicantus***: MPEG 43038–43050; ***Allobates femoralis***: MPEG 29444–29445; MPEG 33686–33687; MPEG 33799; MPEG 33800–33882; ***Allobates magnussoni***: MPEG 30888–30891; MPEG 33623-33627; ***Allobates marchesianus***: MPEG 16193; MPEG 18187; MPEG 18193; MPEG 18201–18202; MPEG 18206; ***Allobates masniger***: USNM 303585–303587; MZUSP 69166; MZUSP 69167; ***Allobates nunciatus***: INPA-H 40305; INPA-H 40307; INPA-H 40482; INPA-H 40486; ***Allobates sumtuosus***: USNM 303591–303593; MZUSP 69157; MZUSP 69158–69160; ***Allobates tapajos***: MPEG 3198–31801; MPEG 35854–35855; ***Allophryne ruthveni***: MPEG 2972; MPEG 3751; MPEG 10083; MPEG 30390; ***Amazophrynella bilinguis***: INPA-H 39780; INPA-H 39782; INPA-H 39784; ***Amazophrynella bokermanni***: MPEG 24656; MPEG 24669; MPEG 27191; MPEG 27201; MPEG 27204; MPEG 27208; ***Amazophrynella gardai***: ZUFMS-AMP12821–12828; ***Amazophrynella minuta***: MPEG 23228; MPEG 23234; MPEG 23239; MPEG 23243; ***Amazophrynella xinguensis***: INPA–H 35471; INPA–H 35482, INPA–H 35493; INPA–H 35472; ***Ameerega braccata***: MPEG 712; MPEG 2860; MPEG 2864; MPEG 3207; MPEG 3266; MPEG 3268; MPEG 3313; ***Ameerega flavopicta***: MPEG 28442–28443; ***Ameerega hahneli***: MPEG 25076–25083; MPEG 25373; MPEG 29425; MPEG 30291; ***Ameerega munduruku***: ZUFMS-AMP 03762; ZUFMS-AMP 03747–03749; ***Ameerega trivittata***: MPEG 30687–30691; ***Anomaloglossus stefeni***: MPEG 17175; MPEG 15185–15186; ***Atelopus hoogmoedi***: MPEG 25071–25075; MPEG 30988–30998; ***Atelopus spumarius***: MPEG 22606; MPEG 34479; ***Boana boans***: MPEG 21969–21971; MPEG 21973; MPEG 33461–33462; ***Boana caiapo***: MZUSP 138987–139009; ***Boana calcarata***: MPEG 25634; MPEG 25657; MPEG 30468; MPEG 38866–38870; ***Boana cinerascens***: MPEG 35593–35595; MPEG 25638–25643; ***Boana courtoisae***: MPEG 30336; MPEG 30341–30342; ***Boana dentei***: MPEG 30299–30300; ***Boana diabolica***: MPEG 33920; ***Boana geographica***: MPEG 1316–1317; MPEG 8162; ***Boana icamiaba***: MNRJ 89836–89839, MNRJ 90997–91000; MPEG 27245–27249; MPEG 40100–40110; ***Boana lanciforms***: MPEG 17118–17122; MPEG 37451–37453; ***Boana leucocheila***: MPEG 14271; MPEG 22210–22211; MPEG 22347–22349; MPEG 22393–22395; MPEG 27239–27244; MPEG 33538; MPEG 37062; ***Boana multifasciata***: MPEG 31637–31638, MPEG 33324, MPEG 39182, MPEG 39185; ***Boana punctata***: MPEG 8813; MPEG 761; MPEG 37414; MPEG 32313; MPEG 19804; ***Boana raniceps:*** MPEG 21264–21268; MPEG 11722–11727; MPEG 8308; MPEG 6387; MPEG 6337; MPEG 6347; MPEG 21158; ***Boana steinbachi***: MPEG 39405; MPEG 39532; MPEG 39534–39535; MPEG 25661; MPEG 29648–25650; MPEG 36753; ***Boana wavrini***: MPEG 11718–11721; MPEG 5923; MPEG 27247; MPEG 37061; ***Callimedusa tomopterna***: MPEG 4330–4334; MPEG 11157; MPEG 11159-11162; MPEG 31978; ***Ceratophrys cornuta***: MPEG 15625; MPEG 1525; MPEG 28987–28988; ***Chiasmocleis avilapiresae***: MPEG 23276–23280; MPEG 23287–23293; ***Chiasmocleis bassleri***: MPEG 18574; MPEG 28326; ***Chiasmocleis hudsoni***: MPEG 14172; MPEG 32696–32704;

***Chiasmocleis papachibe***: MPEG 30683; MPEG 27788; ***Chiasmocleis shudikarensis***: MPEG 6603; MPEG 30396–30404; ***Cruziohyla craspedopus***: MPEG 38389; ***Ctenophryne geayi***: MPEG 11400–11401; ***Dendrobates tinctorius***: MPEG 27875; 27877; MPEG 19965; ***Dendropsophus brevifrons***: MPEG 25558–25561; MPEG 14367–14368; MPEG 25516; MPEG 11647–11657; ***Dendropsophus cachimbo***: MZUSP 21912; MNRJ 17298–17299; MZUSP 21911, 21913–21918, 21920–21926; ***Dendropsophus gaucheri***: MPEG 38719; ***Dendropsophus haraldschultzi***: MPEG 33289–33290; ***Dendropsophus leucophyllatus***: MPEG 8808; MPEG 19008–19023; ***Dendropsophus marmoratus***: MPEG 20515; MPEG 27459; MPEG 27461; MPEG 12076–12077; ***Dendropsophus melanargyreus***: MPEG 31466–31483; MPEG 18945–18954; ***Dendropsophus microcephalus***: MPEG 35553; MPEG 35544; MPEG 35555; MPEG 15104; MPEG 27546; ***Dendropsophus minimus***: NHMW 19436; ***Dendropsophus minusculus***: MPEG 7560; MPEG 16428–16444; ***Dendropsophus minutus***: MPEG 16481–16489; MPEG 31700–31704; MPEG 30910–30920; ***Dendropsophus nanus***: MPEG 21635; 21642; MPEG 21659; MPEG 21647; MPEG 21634; ***Dendropsophus ozzyi***: MPEG 27263–27279; ***Dendropsophus parviceps***: MPEG 38719; ***Dendropsophus reticulatus***: MPEG 19565; MPEG 16025; ***Dendropsophus rossalleni***: MPEG 16365; MPEG 20050–20052; ***Dendropsophus sarayacuensis***: MPEG 61340; ***Dendropsophus schubarti***: MPEG 25537–25541; ***Dendropsophus triangulum***: MPEG 32310–32311; MPEG 15976; ***Dendropsophus walfordi***: MPEG 17104–17115; ***Dryaderces inframaculata***: MPEG 35725–35728; ***Elachistocleis carvalhoi***: MPEG 3200; MPEG 3258; MPEG 3260; ***Elachistocleis helianneae***: MPEG 1767; MPEG 8929–8931; MPEG 29415–29420; MPEG 6875; MPEG 6934; MPEG 6939; MPEG 20566; MPEG 21423–21479; MPEG 35720–35724; MPEG 6929–6931; MPEG 5992; MPEG 6353; ***Elachistocleis magna***: MPEG 23785; MPEG 31705–31709; MPEG 34579–34581; ***Elachistocleis surinamensis***: MPEG 28130–28132; MPEG 28444; MPEG 28445; MPEG 35710–35713; MPEG 35866; ***Engystomops freibergi***: MPEG 40244–40246; ***Hamptophryne boliviana***: MPEG 24705–24710; MPEG 30488–30491; ***Hemiphractus scutatus***: INPA-H 38116–38118; ***Hyalinobatrachium iaspidiense***: MPEG 30871; MPEG 38896; MPEG 38899; ***Hyalinobatrachium mondolfii***: MPEG 38906; MPEG 30872; MPEG 38898; ***Hyalinobatrachium muiraquitan***: LZA 841; LZA 842; LZA 843; LZA 844; ***Hydrolaetare schmidti***: MPEG 8790; MPEG 18330–18333; ***Leptodactylus fuscus***: MPEG 31713–31719; ***Leptodactylus intermedius***: CFBH 39668–39669; ***Leptodactylus knudseni***: MPEG 17589; MPEG 32314–32326; ***Leptodactylus labyrinthicus***: MZUSP 21734; MPEG 5784; MPEG; 14197; MPEG 14207; MPEG 14320; MPEG 14326; ***Leptodactylus leptodactyloides***: MPEG 11516; MPEG 11537; MPEG 14404–14406; ***Leptodactylus longirostris***: MPEG 30831–30848; MPEG 33282-33285; ***Leptodactylus macrosternum***: CHUNB 31189; ***Leptodactylus myersi***: MPEG 30758–30765; MPEG 19744–19746; ***Leptodactylus mystaceus***: MPEG 29113–29114; MPEG 34048–34052; ***Leptodactylus paraenses***: MZUSP 69318; MPEG 25764–25770; MPEG 33319; MPEG 32588–32590; ***Leptodactylus pentadactylus***: MPEG 25771–25774; MPEG 25781–25783; ***Leptodactylus petersii***: CFBH 16742; CFBH 167423; ***Leptodactylus pustulatus***: MPEG 35832–35834; ***Leptodactylus rhodomystax***: MPEG 25871–25876; ***Leptodactylus stenodema***: MPEG 20643; MPEG 20648; MPEG 21403–21405; MPEG 29423–29424; ***Lithobates palmipes***: MPEG 29451–29452; ***Lithodytes lineatus***: MPEG 25707–25709; MPEG 30849–30869; ***Lysapsus laevis***: MPEG 33751–33754; MPEG 20015–20021; MPEG 33631–33632; MPEG 33277–33281; ***Lysapsus limellum***: MPEG 19805–19809; ***Osteocephalus cabrerai***: MPEG 27212–27222; ***Osteocephalus leprieurii***: MPEG 38937; MPEG 38942; MPEG 27900; MPEG 37614–37617; ***Osteocephalus oophagus***: MPEG 38134; MPEG 38130–38131; ***Osteocephalus taurinus***: MPEG 40258; MPEG 22205–22207; MPEG 29991–29996; ***Otophryne pyburni***: MPEG 17605; ***Phyllomedusa bicolor***: MPEG 38121–38123; MPEG 39890; ***Phyllomedusa vaillantii***: MPEG 12121–12128; MPEG 36583; MPEG 36605; MPEG 29009; 29391; ***Physalaemus cuvieri***: MPEG 19759–19760; MPEG 30882–30887; ***Physalaemus ephippifer***: MPEG 6125–-6128; MPEG 34624–34626; ***Phyzelaphryne miriamae***:

USNM 239363; ***Pipa arrabali***: MPEG 25155–25158; MPEG 27915; MPEG 31305; ***Pipa pipa***: MPEG 8791–8800; MPEG 25935; MPEG 32486; ***Pipa snethlageae***: MPEG 16939; MPEG 23275; ***Pithecopus hypochondrialis***: MPEG 20631; MPEG 40218–40222; MPEG 9301–9324; ***Potamotyphlus kaupii***: MPEG 7345; ***Pristimantis chiastonotus***: MPEG 32222; MPEG 32224; MPEG 32227; MPEG 32229; ***Pristimantis fenestratus***: MPEG 33477–33480; ***Pristimantis giorgii***: LZAG 1381–1389; MPEG 21145–21147; MPEG 34838–33847; MPEG 35610–35613; ***Pristimantis gutturalis***: MPEG 21395; MPEG 21396; MPEG 27873; MPEG 27873; ***Pristimantis latro***: LZATM 0063; LZATM 139; LZATM 197; LZATM 467; LZATM 739; LZATM 747; MPEG 26050; MPEG 26059; MPEG 31415–31416; ***Pristimantis marmoratus***: MPEG 30085; MPEG 30088; ***Pristimantis ockendeni***: MZUSP (field number BM153); ***Pristimantis pictus***: ZUFMS–AMP 8540–8543; ***Pristimantis zeuctotylus***: MPEG 29684–29692; MPEG 30892–30899; ***Proceratophrys concavitympanum***: MPEG 40377; MPEG 40379; ***Proceratophrys rondonae***: MPEG 33451; MPEG 22517; ***Pseudis paradoxa***: MPEG 18328; ***Pseudis tocantins***: MPEG 34803–34805; MPEG 35827–35829; MPEG 28111; MPEG 38102; ***Pseudopaludicola boliviana***: UFMT 15981; UFMT 16176; UFMT 16177; UFMT 16178; UFMT 16181; ***Pseudopaludicola canga***: ZUEC 6088; ZUEC 6274; ZUEC 6275; ***Pseudopaludicola mystacalis***: AAG-UFU 6262; ***Ranitomeya amazonica***: MPEG 22742; MPEG 19706; MPEG 24602–24608; MPEG 17417; ***Rhaebo guttatus***: MPEG 30693; MPEG 3422; MPEG 39567–39570; ***Rhinella castaneotica***: MZUSP 67162; ***Rhinella dapsilis***: CFBHT 12072; ***Rhinella diptycha***: MPEG 39197; ***Rhinella granulosa***: MPEG 21983–21988; ***Rhinella magnussoni***: INPA-H 19527–195310; ***Rhinella major***: MPEG 31779– 31780; MPEG 31782; MPEG 31790–MPEG 31792; ***Rhinella margaritifera***: MPEG 30766–30790; ***Rhinella marina***: MPEG 39194–39196; MPEG 39198– 39199; ***Rhinella mirandaribeiroi***: MPEG 31757–31760; ***Rhinella ocellata***: CHUNB 40244; ***Rhinella proboscidea***: MPEG 33829–33831; ***Scarthyla goinorum:*** CZPB-AA 949–950; ***Scinax boesemani***: MPEG 16565–16577; MPEG 33675–33677; MPEG 22356–22357; ***Scinax fuscomarginatus***: MPEG 31325–31359; ***Scinax garbei***: MPEG 30301–30304; MPEG 31827; MPEG 36831–36832; ***Scinax nebulosus***: MPEG 37622–37624; MPEG 31631–31634; MPEG 31636; MPEG 24993–25503; ***Scinax proboscideus***: MPEG 29668; ***Scinax rostratus***: MPEG 28060–28061; ***Scinax ruber***: MPEG 28100; MPEG 31608–31610; MPEG 37427–37428; MPEG 6350; ***Scinax villasboasi***: CHUNB 34498—34500; CHUNB 34502; CHUNB 34505—34510; CHUNB 40156–40157, CHUNB 40159—40161; ***Scinax x-signatus***: MPEG 16506–16507; MPEG 6008; MPEG 6012–6014; MPEG 6017–6018; ***Sphaenorhynchus lacteus***: MPEG 36842; MPEG 3106; MPEG 739; MPEG 33709; MPEG 6136–3138; MPEG 6185; MPEG 6187; ***Synapturanus ajuricaba***: MPEG 29453–29454; MPEG 29456–MPEG 29458; INPA-H 28519; INPA-H 35751; INPA-H 38464; ***Synapturanus mirandaribeiroi***: MPEG 19962–19964; MPEG 20007–20011; ***Trachycephalus coriaceus***: MPEG 35500; 41293; ***Trachycephalus cunauaru***: MZUSP 71146; ***Trachycephalus helioi***: MPEG 32558; MPEG 39200; MPEG 20507; ***Trachycephalus hadroceps:*** MPEG 43224;***Trachycephalus resinifictrix***: MPEG 15507; MPEG 8650; MPEG 16961; MPEG 14710; ***Trachycephalus typhonius***: MPEG 38068; MPEG 34057; MPEG 20873.

### Order Caudata

***Bolitoglossa paraensis***: MPEG 31682; ***Bolitoglossa tapajonica***: MPEG 22176.

### Order Gymnophiona

***Atretochoana eiselti***: MPEG 33621; ***Brasilotyphlus guarantanus***: MPEG 22170; ***Caecilia gracilis***: MPEG 8368; MPEG 9848; MPEG 15857; ***Caecilia tentaculata***: MPEG 22068–22073; MPEG 22811; ***Microcaecilia butantan***: MZUSP 143389; ***Microcaecilia marvaleewakeae***: MPEG 21896; ***Microcaecilia rochai***: MPEG 14596–14597; ***Microcaecilia trombetas***:

MPEG 26476; ***Nectocaecilia petersii***: UFOPA-H 1231; ***Potamotyphlus kaupii***: MPEG 7345; ***Rhinatrema bivittatum***: MPEG 23548–23549; ***Rhinatrema gilbertogili***: MPEG 16975; MPEG 17435; MPEG 19966–19967; ***Rhinatrema uaiuai***: MPEG 26477; ***Siphonops annulatus***: MPEG 33734; ***Typhlonectes compressicauda***: MPEG 7337–7339; MPEG 7355–7361; MPEG 7363–7374.