

Amphibians and reptiles from a protected area in western Brazilian Amazonia (Reserva Extrativista do Baixo Juruá)

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Abstract. Sampling gaps across the logistically challenging and extremely biodiverse Amazonia largely hamper our understanding of broad-scale amphibian and reptile diversity patterns in this ecosystem. The Juruá River basin, a southwestern tributary of the Amazon River, is one of these undersampled areas, with only punctual information documented for these vertebrates that are spatially or temporally biased. This is especially the case for the lower-middle courses of the Juruá River, which also has comparatively less protected areas than its upper course. In order to fill some biodiversity knowledge gaps associated with amphibians and reptiles in this river basin, we combined results of our field expeditions carried out in 1992, 2005–2007, and 2018 to the Reserva Extrativista (Extractive Reserve) do Baixo Juruá, a Brazilian protected area in the right bank of the lower Juruá River. Amphibians and reptiles were sampled using four complementary methods: active surveys, pitfall traps, funnel traps, and trammel nets. We identified species or updated their taxonomic status with a reanalysis of the external morphology of the preserved material in the light of novel taxonomic literature (more than 1,500 specimens) and employment of DNA barcoding analyses for some newly collected specimens with contentious taxonomic status. Our combined sampling evidenced 149 species of amphibians and reptiles occurring in this protected area (72 amphibians, 68 squamates, six chelonians, and three crocodylians). Recorded species highlight the value of the lower Juruá River region as harboring quite diverse assemblages for these vertebrates, with species typical of the western and southwestern Amazonia sub-regions. Remarkable species records are presented, as well as accounts on species with lower taxonomic resolution. Furthermore, we discuss the biogeographic affinities of recorded assemblages based on the species geographic range and preferred habitats, and the value of this protected area to preserve the regional biological diversity.

Keywords. Assemblages; Biological collection; Forest types; Herpetofauna, Juruá River.

INTRODUCTION

Amphibians and reptiles are among the most taxonomically and ecologically diverse vertebrates of the South American biota (Duellman, 1979). In the lowland tropical rainforest of South America (Amazonia), the largest and most diverse

tropical forest in the world, more than 350 and 370 nominal species of amphibians and reptiles are respectively known (Prudente, 2017; Ávila-Pires, 2018, 2020; Hoogmoed, 2019). Despite that, our understanding of the Amazonian amphibian and reptile diversity goes through a transition period. The relatively recent implementation of molecular

data in integrative approaches has significantly increased our understanding regarding how these vertebrates have diversified in this ecosystem (*e.g.*, Réjaud *et al.*, 2020; Carvalho *et al.*, 2021), and in their taxonomic boundaries and geographic distributions (*e.g.*, Ferrão *et al.*, 2016; Peloso *et al.*, 2016; Ribeiro-Júnior *et al.*, 2021; Vacher *et al.*, 2020). At the same time, molecular elucidation also highlighted how much we still do not know about this diversity, at different scales of knowledge (Jaramillo *et al.*, 2020; Vacher *et al.*, 2020). This lack of knowledge is largely influenced by the fact that Amazonia harbors historically undersampled localities (Fraga *et al.*, 2017), and our increased diversity resolution is restricted to more accessible areas, such as the margins of large rivers and highways (Oliveira *et al.*, 2016). As the biological diversity in some regions can be quite substantial, scientific novelties resulting from each new sampling event are common even at historically best explored localities (*e.g.*, Fonseca *et al.*, 2019, Jorge *et al.*, 2020).

Western Amazonia is one of its sub-regions with the lowest resolution in terms of amphibian and reptile taxonomy and geographic distributions, mainly due to inaccessibility (França & Venâncio, 2010; Pantoja & Fraga, 2012). Knowledge associated with the westernmost tributaries of the Amazon River often results from few long-term inventories that remained as the principal data source over decades (*e.g.*, Heyer, 1976; Gascon, 1996; Ávila-Pires *et al.*, 2009). One of the most representative examples is the river basin of the southern tributary Juruá River. While the upper course of this river has historically been better explored and is well known for harboring a high species richness of amphibians and reptiles (*e.g.*, see Ávila-Pires *et al.*, 2009; Souza, 2009; França & Venâncio, 2010; Bernarde *et al.*, 2013; Fonseca *et al.*, 2019), its middle and lower courses have largely contrasting less associated information (Pantoja & Fraga, 2012). Despite such undersampling, these river sections are frequently highlighted as having rarely recorded amphibian and reptile species (*e.g.*, Carvalho *et al.*, 2017, 2020). However, knowledge advance in this case is still highly restricted to punctual observations, and we lack studies summarizing the information on their assemblages.

Extensive geographic areas closer to the western limits of the Brazilian Amazonia are mainly protected by indigenous territories, though there are relatively fewer federal or state protected areas when compared to the eastern Amazonia (Silva-Jr. & Sites-Jr., 1995). The effective conservation of this region considerably benefits from its inaccessibility and unfavorable agroclimatic conditions, when compared to the highly threatened eastern Amazonia (Fearnside, 2008; Sombroek, 2001; Chomitz & Thomas, 2003). However, anthropogenic changes such as deforestation are surprisingly rapidly advancing across the entire Amazonia (Silva-Jr. *et al.*, 2021), and Brazilian government has been recently marked by anti-environmental policies (Ferrante & Fearnside, 2019). Under this scenario, establishing baselines on biotic diversity across western Amazonia is urgent not only so we can better characterize large scale biodiversity patterns and trends within the Amazonia, but also so that the potential an-

thropic impact in this region can be assessed to establish effective conservation strategies (Laurance *et al.*, 2011). In the Juruá River basin, a higher number of protected areas are currently delimited in its upper course (9 areas) and progressively decreases towards its middle (3 areas) and lower course (2 areas) (ICMBio, 2009). Only one of the protected areas at the lower Juruá River region reaches the margin of the Juruá River: the Reserva Extrativista do Baixo Juruá (Extractive Reserve of the lower Juruá, hereafter RBJ), focus of our study. As is common for Amazonian protected areas (Correia *et al.*, 2016), scientific knowledge associated with RBJ is still scarce.

Considering that the effective conservation of protected areas is highly dependent on our knowledge of their native biological diversity, here, we present and discuss the diversity of amphibian and reptile assemblages of the RBJ. Our study is based on a robust approach combining data collected in three distinct field expeditions to this protected area across three decades, allied with reanalyses of museum specimens from the region. We identified the recorded species combining morphological and molecular evidence, and discussed some remarkable records, biogeographic affinities of the assemblages, and conservation implications.

MATERIAL AND METHODS

Study area

The RBJ is a federal protected area created in 2001 and located on the right bank of the lower course of the Juruá River, state of Amazonas, northwestern Brazil (Fig. 1). This sustainable use protected area (*i.e.*, permit the direct use of natural resources) is contained within the limits of the municipalities of Juruá and Uarini and has 188,000 hectares (ICMBio, 2009). It is limited to the west by the Juruá River, to the south by the Andirá River and Igarapé do Branco (tributaries of the Juruá River), to the north by the Igarapé São Benedito (tributary of the Juruá River), and to the east by the Copacá River (tributary of the Uarini River) (ICMBio, 2009). The Juruá River flows to the north, also limiting the indigenous territory Kumaru do Lago Ualá (ICMBio, 2009), and the southern limits of the RBJ adjoin another protected area, the Floresta Nacional de Tefé (ICMBio, 2009) (Fig. 1).

This RBJ is home to *ca.* 16 traditional communities, but their areas correspond to low percentages of this terrain (ICMBio, 2009). The reserve is dominated by extensive and preserved landscapes of dense or open ombrophilous forests (Fig. 2), most of which are not subject to periodic flooding by the annual flood pulse of large rivers (ICMBio, 2009). As this non-flooded terrain is part of an Amazonian region that was only recently (Late Pleistocene; < 45,000 years ago) exposed to this flooding pulse regime (Pupim *et al.*, 2019), they can be considered as *paleovárzea*. On the margins of the large rivers, the seasonal flood pulse creates many distinct environments, including diverse *várzea* forests, pioneer species monodominant forests, grasslands, patches of aquatic macro-

phytes, and mud or sandy exposed banks (ICMBio, 2009) (Fig. 2). As is common in Amazonia, such environmental heterogeneity created by the flooding gradient largely influences the faunistic spatial occupation and diversity patterns (Moraes *et al.*, 2016, 2022a; Ramalho *et al.*, 2018).

The Juruá River is one of the major southern tributaries of the Amazon River. Their headwaters are in the Andean region and the river crosses the historically dynamic sedimentary basin of Western Amazonia (Sioli, 1968). As a consequence, this river carries high levels of suspended sediments (a white-water river; Sioli, 1984), and the low slope promotes a meandering morphology with highly dynamic margins subject to recent erosion and deposition processes (Kalliola *et al.*, 1991). Considering the lower course of the Juruá River, a dissimilar geomorphological influence is clearly noticed between its margins. At the region of the confluence with the Andirá River, the Juruá River acquires an uncentralized position in relation to its alluvial plain by following geological breaks (Fernandes *et al.*, 1977). As a result, the lower Juruá River has a higher proportion of higher terrains part of the Formação Solimões (Pleistocene deposition) on its right bank, where the RBJ is located, while the left bank has a broad and asymmetric extension of more recent alluvial plains (Holocene deposition) (Fernandes *et al.*, 1977). Such a dissimilarity directly influences the proportions of vegetation types found in each bank (prevalence of *várzea* in lower terrains and *paleovárzea* in higher terrains), as well as in human occupation in this region, which is higher on the right bank (ICMBio, 2009). Altitudes within the RBJ range from 40 to 100 m above sea level, and the region's climate is characterized as tropical (Af), being hot (mean annual temperature of 25°C) and humid (total annual rainfall of *ca.* 3,000 mm) (Alvares *et al.*, 2013).

Data collection and sampling effort

We generated a database based on data collected in our field expeditions and reanalyses of museum specimens deposited at the Collection of Amphibians and Reptiles (INPA-H) of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, state of Amazonas, Brazil. Three main field expeditions conducted by the authors (hereafter indicated with the initials of their names) formed the baseline of our data set. This periodic sampling covered the entire hydrological cycle of the flooding pulse in a timeframe of 31 years, resulting in the total sampling effort of 95 days. The first expedition was led by CG in 1991-1992 (*i.e.*, before the creation of the RBJ) through the entire Juruá River course and focused on amphibian sampling (see results in Gascon, 1996; Loughheed *et al.*, 1999; Gascon *et al.*, 2000). The study area was sampled in these expeditions from 02-19 May 1992 (18 sampling days) in a single locality (Table 1; see detailed information of this sampling in Patton *et al.*, 2000). The second inventory in this region was led by VTC thirteen years later (2005-2007), as part of the actions to generate a management plan for the recently created RBJ (ICMBio, 2009). During these years, both amphibians and reptiles were sampled using standardized efforts in eight distinct localities in the RBJ from 17 November-02 December 2005, 19 January-02 February 2006, 12 May-01 June 2006, and 04-13 May 2007 (62 sampling days). Lastly, eleven years later, remaining authors (LJCLM, RNR, FPW and AFSO) conducted a third amphibian and reptile inventory at the RBJ, sampling three distinct localities from 14-28 July 2018 (15 sampling days). In 2018, we also sampled through active surveys a locality of flooded habitats at the left margin of the Juruá River, *i.e.*, outside the limits of the RBJ (Appendix 1). However, in order to maximize

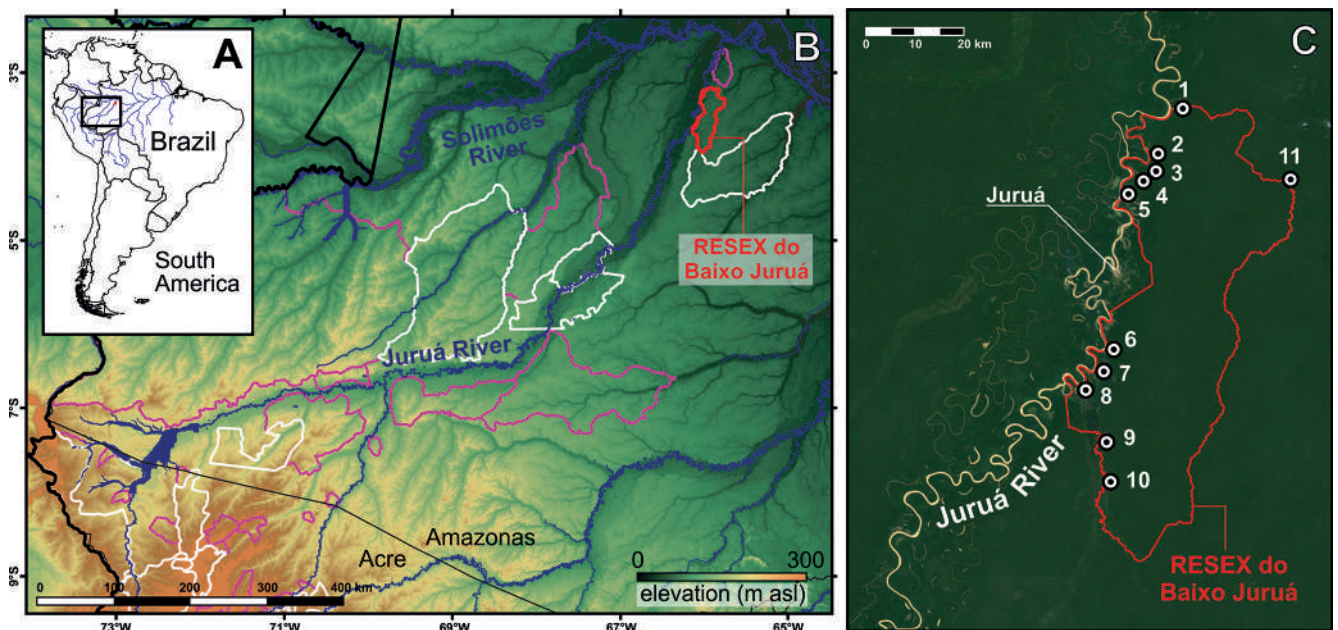


Figure 1. Geographic location of the Reserva Extrativista (RESEX) do Baixo Juruá in relation to South America (A) and the Juruá River basin, in Brazilian Western Amazonia (B); upon an elevation background). In (B), protected areas and indigenous territories that cover this river basin are delimited in white and pink, respectively. The focal area is zoomed at (C), showing the eleven localities sampled for amphibians and reptiles (numbered white symbols; see Table 1), and the Juruá municipality. Background in (C) is from Google Earth (Map data ©2015 Google/Landsat/Copernicus).

the assessment of diversity, we aggregate these few records in this study as part of the locality 8, which also represents flooded habitats but is within the limits of the RBJ (Fig. 1).

Individuals were recorded in those inventories using complementary sampling methods established for herpetofauna in Amazonia: (1) diurnal and nocturnal active surveys (Heyer *et al.*, 1994), where the individuals are detected in all the microhabitats visually accessible or, in

the case of anurans, through their vocalizations (all the inventories; total sampling effort of 245 person-days); (2) pitfall traps (Heyer *et al.*, 1994) (Fig. 2), composed by stations of 7-12 100-liter buckets buried linearly with drift fences that were installed only in non-flooded forests (2005-2007 and 2018 inventories; 886 trap-days; details of sampling effort at Table 1). During sampling at locality 11 in 2007, due to logistical issues, only buckets were buried (*i.e.*, without drift fences) in a "Y" setup

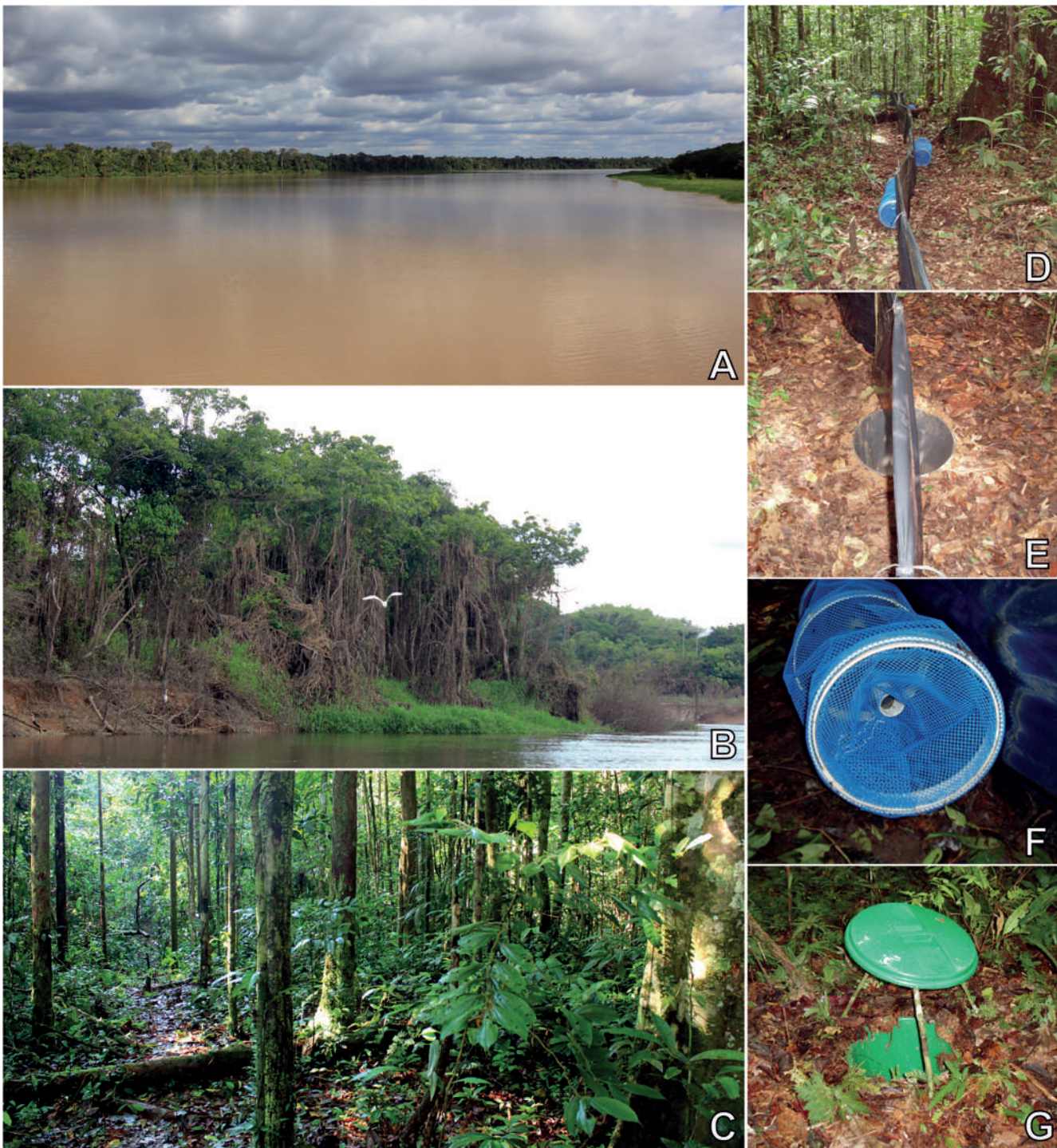


Figure 2. Panoramic view of the white-water Juruá River at its lower course (A); some habitats recently sampled for amphibians and reptiles at the Reserva Extrativista do Baixo Juruá, state of Amazonas, Brazil: (B) seasonally flooded habitats at the confluence of the tributary Andirá River, and (C) non-flooded forest (*pa-leovárzea*); as well as different trap methods and setups used during sampling: (D, E) linear pitfall trap stations, with drift fences, (F) funnel traps, installed between the buckets of pitfall traps, (G) bucket part of a pitfall trap station in "Y" without drift fences. Photographs by LJCLM (A-C) and VTC (D-G).

Table 1. Data on the eleven localities sampled for amphibians and reptiles at the Reserva Extrativista do Baixo Juruá (RBJ), western Brazilian Amazonia. For each locality are presented reference names and geographic coordinates, main habitats, sampling periods and traps sampling effort (when applicable). Habitats: (AQU) Aquatic; (FLH) Seasonally flooded habitats – margin of large rivers; (NFF) Non-flooded forests.

Localities	Reference name	Coordinates	Habitat	Sampling year	Pitfall traps (PT)	Funnel traps (FT)	PT/FT sampling days	PT+FT sampling effort (trap-days)
1	Comunidade Botafogo (CB)	-3.192500, -65.950833	NFF, AQU	2005	7	12	20	380
2	Comunidade Antonina (CA)	-3.269444, -65.991944	NFF, AQU	2006	10	18	10	280
3	Comunidade Vai-Quem-Quer (CV)	-3.298889, -65.996944	NFF, AQU	2006	10	18	10	280
4	Lago Vai-Quem-Quer (LC)	-3.316667, -66.016667	NFF, FLH, AQU	1992	—	—	—	—
5	Flutuante Sacado do Planeta (SP)	-3.337404, -66.053272	FLH, AQU	2006	—	—	—	—
6	Comunidade Socó (CS)	-3.601944, -66.066944	NFF, AQU	2006	12	22	10	340
7	Comunidade Forte das Graças (CF)	-3.638611, -66.085278	NFF, AQU	2006	12	22	10	340
8	Boca do Andirá (BA)	-3.664277, -66.118176	FLH, AQU	2018	—	—	—	—
9	Comunidade Cumaru (CC)	-3.757111, -66.083167	NFF, AQU	2006/2018	—/10	20/—	3/15	210
10	Andirá (AN)	-3.825222, -66.077306	NFF, AQU	2018	10	—	10	100
11	Rio Copacá (RC)	-3.308889, -65.763333	NFF, AQU	2007	8	12	7	140

(Fig. 2); (3) funnel traps (Enge, 2001), installed in pairs between the buckets of pitfall traps, ranging from 12–22 funnel traps per pitfall station (2005–2007 inventories; 1,184 trap-days) (Fig. 2). During sampling at the locality 9 in 2006, only funnel traps were installed in a drift fence station; and (4) trammel nets with distinct opening sizes to sample aquatic animals (2005–2007 inventories; non-standardized). Specimens were also recorded through non-standardized occasional encounters made by us or by members of local communities and other teams in the multidisciplinary expeditions.

We performed rarefaction (interpolation) and extrapolation curves with 95% confidence intervals (Chao *et al.*, 2014) to compare the observed and expected species richness of amphibians and reptiles in the RBJ, as well as to investigate the effectiveness of our sampling effort in assessing the local diversity of those groups. The extrapolated rarefaction curves were generated using the R statistical software package “iNEXT” (Chao *et al.*, 2014). We also estimated species richness for amphibians and reptiles in the RBJ based on our sampling using the Chao and Jackknife estimation indices implemented in the “specpool” function of the R package “vegan” (Oksanen *et al.*, 2022). Due to the lack of standardization among our sampling events and the uncertainties associated with historical data, we only consider data associated with voucher specimens for these estimation analyses.

We collected specimens and/or tissue samples following appropriate ethical and legal guidelines, under the permits 67798-1 and 02005.001056/06-05 provided by the Brazilian Federal Agencies Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) and Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA). Voucher specimens and tissue samples were respectively deposited in the INPA-H and the Genetic Resources Collection (INPA-HT) of the same institute (INPA). During 2018–2020, we reanalyzed all the voucher specimens from the target region deposited at INPA-H (1,560 specimens, see Appendix 1), providing support for the species list of amphibians and reptiles inhabiting the study area. Taxonomic identifications were

performed under combined approaches of external morphology analyses (for newly collected and historical material) and DNA barcoding (only for some specimens collected in 2018). We followed the taxonomic arrangements of Frost (2022) for amphibians and Uetz *et al.* (2022) for reptiles.

Species identification: morphology

We compared the external morphology (morphometric and meristic characteristics, and coloration patterns) of specimens with original species’ descriptions, dichotomous keys, geographically related inventories, and field guides (*e.g.*, Peters & Donoso-Barros, 1986; Dixon *et al.*, 1993; Ávila-Pires, 1995; Gascon, 1996; Loughheed *et al.*, 1999; Gascon *et al.*, 2000; Morales, 2002; Peloso & Sturaro, 2008; Moravec *et al.*, 2009; Souza, 2009; Angulo & Icochea, 2010; Maciel & Hoogmoed, 2011; Gordo *et al.*, 2013; Brcko *et al.*, 2013; Fouquet *et al.*, 2014, 2021; Peloso *et al.*, 2014, 2016; Caminer & Ron, 2014, 2020; Caminer *et al.*, 2017; Rivadeneira *et al.*, 2018; Simões *et al.*, 2018; Cunha *et al.*, 2019; Ferrão *et al.*, 2020, 2022; Sturaro *et al.*, 2020; Magalhães *et al.*, 2020; Rainha *et al.*, 2021; Ribeiro-Júnior *et al.*, 2021), as well as through direct comparisons with other voucher specimens deposited at INPA-H. Evidence for color in life were based on photographs taken during the expeditions of 2005–2007 and 2018.

In some cases of the reappraisal of museum specimens, we rely on their external morphology data to determine their updated taxonomic status. Under this approach, we are able to identify divergent taxa, but preserved specimens lose relevant diagnostic characters and historical taxonomic uncertainties are pervasive for some of the analyzed specimens. Based on this, we opt to be conservative in assigning taxonomic status in these cases, while pending the acquisition of additional data (*e.g.*, vocalizations, color in life, behavior, or molecular information). However, to ease future attribution of their taxonomic status, we provide brief morphological descriptions for uncertain taxa.

Species identification: DNA barcoding

In order to expand the investigation of taxonomic status, we applied a DNA-based identification approach for some recently collected specimens, mainly focused on recognized species complexes where further resolution is needed. We focused on genetic markers widely recognized in barcoding studies with these groups and sequenced fragments of mitochondrial DNA (mtDNA) loci: the RNA *16S subunit ribosomal RNA (16S)* and the protein-coding gene (CDS) *cytochrome oxidase I (COI)* for amphibians, and the CDS *cytochrome b (CYTB)* and *NADH dehydrogenase subunit 4 (ND4)* for squamates. Genomic DNA was extracted from liver tissue samples using standard protocols of a commercial kit (Wizard® Genomic DNA Purification Kit, Promega, Wisconsin, USA), and the target loci were amplified via Polymerase Chain Reaction (PCR), using the primers and following the protocols described in Palumbi *et al.* (1991) (*16S*), Che *et al.* (2012) (*COI*), Bickham *et al.* (1995) (*CYTB*), and Arévalo *et al.* (1994) (*ND4*). PCR products were purified with PEG (polyethyleneglycol) 8000 and submitted to a sequencing reaction under standard protocols of the Big Dye Terminator Kit (Applied Biosystems, Waltham, USA). Sequences were generated in an ABI 3130 XL automated sequencer (Applied Biosystems, Waltham, USA) at the Laboratório Temático de Biologia Molecular (LTBM) of INPA.

After editing the sequences using Geneious, version 8 (Kearse *et al.*, 2012), we submit them to a BLAST® search under the Standard Nucleotide BLAST function (*blastn*) (Johnson *et al.*, 2008). For each analyzed sample, we downloaded the 100 most similar sequences from the GenBank online repository (GB; Clark *et al.*, 2016), and aligned each dataset using the MAFFT online server with default parameters, except by the use of the E-INS-i strategy for the RNA and G-INS-i strategy for the CDS (Katoh & Standley, 2013). Uncorrected pairwise genetic distances were estimated for each alignment and we inferred the taxonomic status of samples considering the minimum distance among sequences. We consider the possibility of candidate unnamed species when genetic divergence was above 3% (*16S*), 5% (*COI*), 23% (Gekkota *CYTB*), and 10% (*ND4*), based on thresholds recognized in the literature for these loci and taxonomic groups (Fouquet *et al.*, 2007; Bergmann & Russel, 2007; Kok *et al.*, 2018; Carvalho *et al.*, 2021). Newly generated sequences were deposited on GB under the accession numbers MT472181-MT472182 (Carvalho *et al.*, 2020), MZ018807-MZ018827 (Rainha *et al.*, 2021), MW916091 (Ribeiro-Júnior *et al.*, 2021), and OP296595-OP296615, OP314270-OP314276 and OP277918 (this study).

Biogeographic affinities

To investigate the relative biogeographic influence on the assemblages composition of amphibians and reptiles in the focal area, we firstly classified the recorded species according to the main habitats of occurrence,

based on our sampling evidence: non-flooded forests (NFF), seasonally flooded habitats – margin of large rivers (FLH), anthropic (ANT), and aquatic (AQU). Aquatic interface was subdivided in lakes (AQU-L) and streams (AQU-S). Additionally, we also classified the species according to their known geographic distributions verified in literature, using as categories some subdivisions of Amazonia based on the limits of its main geological compartments and major rivers (Gibbs & Barron, 1993; Aleixo & Rossetti, 2007; Hoorn *et al.*, 2010). Such Amazonian geographic subdivisions were selected because they are widely known as sharing biotic similarities (Ávila-Pires, 1995; Silva-Jr. & Sites-Jr., 1995; Réjaud *et al.*, 2020). Therefore, species were classified in the following categories: widely distributed in Amazonia (WD), for species with geographic ranges encompassing various of the major subdivisions delimited; western Amazonia (WA) and eastern Amazonia (EA), for species typical of these macro-regions, influenced by the sedimentary basin of the Amazon River and crystalline shields, respectively; central Amazonia (CA) for species with distribution encompassing the internal boundary between WA and EA, but not their extremes; central southern Amazonia (SA) and southwestern Amazonia (SW), for species typical of the southern bank of the Amazon River, and restricted to the westernmost portion of this river bank, respectively. Finally, we also considered species that are potentially endemic to the study area (PE) or occur at punctual restricted localities (PR) within major subdivisions delimited. We calculated relative percentages by dividing the number of species and specimens from each category by the total recorded for both amphibians and reptiles.

RESULTS

Combining the results of our three inventories, we recorded 149 species of amphibians and reptiles occurring at the RBJ (Table 2). Regarding amphibians, after the taxonomic update, we found that 37 species were recorded in the first inventory (1992). This number increased to 60 in the 2005-2007 inventories, and finally to 72 after the 2018 inventory. Amphibians were represented by a single species of the Order Caudata, two of the Order Gymnophiona, and 69 of the Order Anura (13 families). Among the anurans, the most species-rich family was Hylidae (28 species), followed by Leptodactylidae (14 species), Strabomantidae (six species), Microhylidae and Bufonidae (five species each), Aromobatidae (three species), and Dendrobatidae (two species). The remaining anuran families recorded were represented by single species: Allophrynidae, Ceratophryidae, Eleutherodactylidae, Phyllomedusidae, Pipidae, and Ranidae.

Regarding reptiles, the increase in species richness reported for the RBJ went from 69 in the 2005-2007 inventories to 77 after the 2018 inventory. Squamates were represented by 29 lizard species and 39 snake species. Gymnophthalmidae was the most species-rich lizard family (six species), followed by Dactyloidae and Teiidae (five

Table 2. List of amphibian and reptile species recorded at the Reserva Extrativista do Baixo Juruá (RBJ), western Brazilian Amazonia, with respective localities and main habitats of occurrence, sampling methods and geographic distributions. Habitats: (ANT) = Anthropic; (AQU-L) = Aquatic-lakes; (AQU-S) = Aquatic-streams; (FLH) = Seasonally flooded habitats at the margin of large rivers; (NFF) = Non-flooded forests. Sampling methods: (AS) = Active survey; (FT) = Funnel traps; (OE) = Occasional encounters; (PT) = Pitfall traps. Geographic distributions: (WD) = Widely distributed in Amazonia; (WA) = Western Amazonia; (SA) = Southern Amazonia; (SW) = Southwestern Amazonia; (CA) = Central Amazonia; (PE) = Potentially endemic to the RBJ; (PR) = Punctual restricted localities; (UN) = Unknown.

Taxon	Habitat	Localities	Sampling methods	Geographic distribution
Class Amphibia				
Order Anura				
Family Allophryniidae				
<i>Allophryne resplendens</i> Castroviejo-Fisher et al., 2012	NFF	2	OE	PR (WA)
Family Aromobatidae				
<i>Allobates femoralis</i> (Boulenger, 1884)	NFF	10, 11	AS, PT, FT, OE	WD
<i>Allobates vanzolinius</i> (Morales, 2002)	FLH	4	AS	PE
<i>Allobates</i> sp.	NFF, FLH, ANT	1, 4	AS, PT	UN
Family Bufonidae				
<i>Amazophrynella</i> sp.	NFF, FLH	1, 4	AS	UN
<i>Rhinella castaneotica</i> (Caldwell, 1991)	NFF, FLH	1, 2, 3, 4, 8, 9, 10, 11	AS, PT, FT, OE	UN
<i>Rhinella exostolica</i> Ferrão et al., 2020	NFF	1, 4, 9, 10, 11	AS, PT, FT, OE	WA
<i>Rhinella</i> aff. <i>margaritifera</i>	NFF	1, 2, 3, 4, 9, 10, 11	AS, PT, FT, OE	UN
<i>Rhinella marina</i> (Linnaeus, 1758)	NFF, FLH, ANT	1, 2, 3, 7, 8, 9, 10, 11	AS, PT, FT, OE	WD
Family Ceratophryidae				
<i>Ceratophrys cornuta</i> (Linnaeus, 1758)	NFF	2, 9, 10	AS, PT	WD
Family Dendrobatidae				
<i>Ameerega hahneli</i> (Boulenger, 1884)	NFF	1, 2, 3	AS, PT, FT	WD
<i>Ameerega trivittata</i> (Spix, 1824)	NFF	1, 2, 6, 7, 9, 10, 11	AS, PT, FT, OE	WD
Family Eleutherodactylidae				
<i>Phyzelaphryne nimio</i> Simões et al., 2018	NFF	9, 10	AS, PT	PR (WA)
Family Hylidae				
<i>Boana appendiculata</i> (Boulenger, 1882)	NFF, FLH	8, 9	AS, OE	WD
<i>Boana boans</i> (Linnaeus, 1758)	NFF, FLH	3, 7, 9, 11	AS, OE	WD
<i>Boana calcarata</i> (Troschel, 1848)	FLH	1, 8	AS	WD
<i>Boana cinerascens</i> (Spix, 1824)	NFF, FLH	4, 8, 9	AS	WD
<i>Boana geographica</i> (Spix, 1824)	FLH	6, 5, 8	AS, OE	SA
<i>Boana lanciformis</i> (Cope, 1871)	NFF, FLH, ANT	1, 5, 9	AS, OE	WD
<i>Boana punctata</i> (Schneider, 1799)	FLH	5, 8	AS, OE	WD
<i>Boana raniceps</i> (Cope, 1862)	FLH	5, 8	AS, OE	WD
<i>Boana steinbachi</i> (Boulenger, 1905)	NFF	9, 10	AS	SA
<i>Boana</i> aff. <i>steinbachi</i>	NFF, FLH, ANT	1, 8, 9, 10	AS, OE	SA
<i>Dendropsophus kamagarini</i> Rivadeneira et al., 2018	NFF	4, 10	AS	SW
<i>Dendropsophus mopinguari</i> Peloso et al., 2016	FLH	4	AS	PR (CA)
<i>Dendropsophus miyatai</i> (Vigle & Goberdhan-Vigle, 1990)	FLH	4	AS	PR (WA)
<i>Dendropsophus reticulatus</i> (Jiménez de la Espada, 1870)	FLH	2, 7, 6	AS, OE	WA
<i>Dendropsophus rossalleni</i> (Goin, 1959)	FLH	3, 4, 7, 9	AS	WA
<i>Osteocephalus castaneicola</i> Moravec et al., 2009	NFF	1, 9, 11	AS	SW
<i>Osteocephalus helenae</i> (Ruthven, 1919)	FLH	8	AS	WD
<i>Osteocephalus</i> aff. <i>lepieurii</i>	NFF, FLH	8, 9, 10	AS, OE	SA
<i>Osteocephalus taurinus</i> Steindachner, 1862	NFF, FLH	3, 4, 8, 9, 10, 11	AS, OE	WD
<i>Scarthyla goinorum</i> (Bokermann, 1962)	FLH	6, 8	PT, OE	WD
<i>Scinax cruentomma</i> (Duellman, 1972)	NFF	4	AS	WA
<i>Scinax garbei</i> (Miranda-Ribeiro, 1926)	NFF, FLH	3, 4, 6, 8	AS, PT	WD
<i>Scinax nebulosus</i> (Spix, 1824)	FLH	1	AS	WD
<i>Scinax ruber</i> (Laurenti, 1768)	NFF, FLH, ANT	1, 2, 4, 5, 7, 8, 9, 11	AS, OE	WD
<i>Sphaenorhynchus dorisae</i> (Goin, 1957)	NFF, FLH	6, 7, 8	AS, OE	WA
<i>Sphaenorhynchus lacteus</i> (Daudin, 1800)	FLH	7	AS	WD
<i>Trachycephalus cunauaru</i> Gordo et al., 2013	FLH	8, 9	AS	WD
<i>Trachycephalus typhonius</i> (Linnaeus, 1758)	FLH, ANT	9, 11	AS, OE	WD
Family Leptodactylidae				
<i>Adenomera andreae</i> (Müller, 1923)	NFF, FLH, ANT	1, 2, 3, 4, 6, 7, 9, 10, 11	AS, PT, FT, OE	WD
<i>Adenomera hylaedactyla</i> (Cope, 1868)	FLH, ANT	8	AS	WD
<i>Adenomera simonstuarti</i> (Angulo & Icochea, 2010)	NFF	3, 4, 9, 10	AS, PT	WA
<i>Edalorhina perezii</i> Jiménez de la Espada, 1870	NFF, FLH	2, 3, 4, 9	PT	WA

Table 2. Continued.

Taxon	Habitat	Localities	Sampling methods	Geographic distribution
<i>Engystomops petersi</i> Jiménez de la Espada, 1872	NFF	1, 2, 3, 4, 6, 7	AS, PT, FT, OE	WA
<i>Leptodactylus discodactylus</i> Boulenger, 1884	NFF	9, 10, 11	AS, PT	WA
<i>Leptodactylus fuscus</i> (Schneider, 1799)	FLH, ANT	5	OE	WD
<i>Leptodactylus macrosternum</i> Miranda-Ribeiro, 1926	FLH, ANT	5, 7, 9	AS, OE	WD
<i>Leptodactylus</i> cf. <i>mystaceus</i>	NFF	1, 2, 3, 4, 7, 11	PT, FT, OE	UN
<i>Leptodactylus pentadactylus</i> (Laurenti, 1768)	NFF, FLH, ANT	1, 2, 3, 4, 7, 9, 10, 11	AS, PT, OE	WD
<i>Leptodactylus petersii</i> (Steindachner, 1864)	NFF, FLH	1, 2, 3, 4, 8, 9	AS, PT, OE	WD
<i>Leptodactylus rhodomystax</i> Boulenger, 1884	NFF	2, 4, 6, 11	AS, PT	WD
<i>Leptodactylus stenodema</i> Jiménez de la Espada, 1875	NFF	1, 2, 3, 11	AS, PT, FT, OE	WD
<i>Lithodytes lineatus</i> (Schneider, 1799)	NFF	2, 9, 11	AS, PT	WD
Family Microhylidae				
<i>Chiasmocleis avilapiresae</i> Peloso & Sturaro, 2010	NFF	7, 9	PT, FT	SA
<i>Chiasmocleis bassleri</i> Dunn, 1949	NFF	4, 9, 10	PT	WD
<i>Chiasmocleis hudsoni</i> Parker, 1940	NFF	9, 10	PT	WD
<i>Chiasmocleis ventrimaculata</i> (Andersson, 1945)	NFF	9	PT	WA
<i>Ctenophryne geayi</i> Mocquard, 1904	NFF	2, 9	PT	WD
Family Phyllomedusidae				
<i>Phyllomedusa vaillantii</i> Boulenger, 1882	NFF	4, 9	AS	WD
Family Pipidae				
<i>Pipa pipa</i> (Linnaeus, 1758)	FLH	2, 11	OE	WD
Family Ranidae				
<i>Lithobates palmipes</i> (Spix, 1824)	FLH	11	AS	WD
Family Strabomantidae				
<i>Oreobates quixensis</i> (Jiménez de la Espada, 1872)	NFF	3, 6, 7, 9, 10	AS, PT, FT, OE	WA
<i>Pristimantis</i> cf. <i>diadematus</i>	NFF	4, 6	AS	SW
<i>Pristimantis fenestratus</i> (Steindachner, 1864)	FLH	8	AS, PT	UN
<i>Pristimantis</i> aff. <i>ockendeni</i>	NFF	4	AS	UN
<i>Pristimantis reichlei</i> Padiá & de la Riva, 2009	NFF	4, 11	AS, PT	SW
<i>Strabomantis sulcatus</i> (Cope, 1874)	NFF	11	PT	WA
Order Caudata				
Family Plethodontidae				
<i>Bolitoglossa</i> sp.	NFF	4	AS	UN
Order Gymnophiona				
Family Caeciliidae				
<i>Caecilia tentaculata</i> Linnaeus, 1758	NFF	2	PT	WD
Family Typhlonectidae				
<i>Potamotyphlus kaupii</i> (Berthold, 1859)	AQU	1	TN	WD
Class Reptilia				
Order Squamata				
Suborder "Sauria"				
Family Alopoglossidae				
<i>Alopoglossus atriventris</i> Duellman, 1973	NFF, FLH	1, 2, 3, 6, 9, 10, 11	AS, PT, OE	SW
<i>Alopoglossus brevifrontalis</i> (Boulenger, 1912)	NFF	1, 2, 6, 9, 10	PT	WD
<i>Alopoglossus indigenorum</i> Ribeiro-Júnior et al., 2021	NFF	10	OE	WA
Family Dactyloidae				
<i>Anolis fuscoauratus</i> D'Orbigny, 1837	NFF, FLH	2, 8, 9, 10	AS, OE	WD
<i>Anolis ortonii</i> Cope, 1868	ANT	3, 9	AS	WD
<i>Anolis punctatus</i> Daudin, 1802	NFF	9	AS	WD
<i>Anolis tandai</i> Ávila-Pires, 1995	NFF	1, 2, 9, 10	AS, PT, OE	SA
<i>Anolis transversalis</i> Duméril, 1851	NFF	6, 10	AS, PT, OE	WA
Family Gekkonidae				
<i>Hemidactylus mabouia</i> (Moreau de Jonnés, 1818)	ANT	9	OE	WD
Family Gymnophthalmidae				
<i>Arthrosaura reticulata</i> (O'Shaughnessy, 1881)	NFF	1, 2, 3, 9, 10	AS, PT, OE	WD
<i>Cercosaura bassleri</i> Ruibal, 1952	NFF, FLH	2, 8	AS, PT	SW
<i>Cercosaura argulus</i> Peters, 1862	NFF	7	AS	WD
<i>Iphisa elegans</i> Gray, 1851	NFF	1, 2, 9, 10, 11	PT, FT, OE	WD
<i>Loxopholis percarinatum</i> (Müller, 1923)	NFF	10	PT	WD
<i>Loxopholis snethlageae</i> (Ávila-Pires, 1995)	NFF	1, 3, 9, 10, 11	PT, OE	WA

Table 2. Continued.

Taxon	Habitat	Localities	Sampling methods	Geographic distribution
Family Iguanidae				
<i>Iguana iguana</i> (Linnaeus, 1758)	NFF, FLH, ANT	1, 6	OE	WD
Family Phyllodactylidae				
<i>Thecadactylus salimoensis</i> Bergamnn & Russell, 2007	NFF	9	AS	WA
Family Scincidae				
<i>Copeoglossum nigropunctatum</i> (Spix, 1825)	NFF, FLH, ANT	1, 2, 8, 9	AS, FT, OE	WD
Family Sphaerodactylidae				
<i>Chatogekko amazonicus</i> (Andersson, 1918)	NFF	1, 6, 9, 11	AS, PT, OE	WD
<i>Gonatodes humeralis</i> (Guichenot, 1855)	NFF, FLH, ANT	1, 2, 3, 8, 9, 10	AS, OE	WD
<i>Lepidoblepharis heyerorum</i> Vanzolini, 1978	NFF	6	PT	WD
Family Teiidae				
<i>Ameiva ameiva</i> (Linnaeus, 1758)	NFF, FLH, ANT	7, 9	AS, PT, OE	WD
<i>Crocodilurus amazonicus</i> Spix, 1825	FLH	1, 5, 8	AS, OE	WD
<i>Kentropyx altamazonica</i> Cope, 1876	NFF, FLH	2, 5	AS, PT, OE	WA
<i>Kentropyx pelviceps</i> Cope, 1868	NFF	1, 2, 9, 11	AS, PT, FT, OE	WA
<i>Tupinambis teguixin</i> (Linnaeus, 1758)	NFF, FLH	1, 9	AS, PT, OE	WD
Family Tropiduridae				
<i>Plica plica</i> (Linnaeus, 1758)	NFF, FLH	2, 6	PT, OE	WD
<i>Plica umbra ochrocollaris</i> (Spix, 1825)	NFF	1, 9	AS	WD
<i>Uranoscodon superciliosus</i> (Linnaeus, 1758)	NFF, FLH	1, 8, 11	AS, OE	WD
Suborder Serpentes				
Family Aniliidae				
<i>Anilius scytale</i> (Linnaeus, 1758)	ANT	1	OE	WD
Family Boidae				
<i>Corallus hortulana</i> (Linnaeus, 1758)	NFF	1, 9	AS, OE	WD
<i>Epicrates cenchria</i> (Linnaeus, 1758)	NFF	1, 2	FT, OE	WD
Family Colubridae				
<i>Chironius fuscus</i> (Linnaeus, 1758)	NFF, ANT	1, 2	OE	WD
<i>Drymaluber dichrous</i> (Peters, 1863)	NFF	11	FT	WD
<i>Leptophis ahaetulla</i> (Linnaeus, 1758)	FLH, ANT	1, 5	OE	WD
<i>Oxybelis aeneus</i> (Wagler, 1824)	ANT	1	AS, OE	WD
<i>Oxybelis fulgidus</i> (Daudin, 1803)	FLH	5	OE	WD
<i>Spilotes sulphureus</i> (Wagler, 1824)	NFF	6	OE	WD
Family Dipsadidae				
<i>Atractus major</i> Boulenger, 1894	NFF	1, 11	PT	WD
<i>Atractus poeppigi</i> (Jan, 1862)	NFF	1, 2, 9	PT, FT	WA
<i>Atractus snethlageae</i> Cunha & Nascimento, 1983	NFF	10	PT	WD
<i>Atractus aff. snethlageae</i>	NFF	9, 10	PT	WA
<i>Atractus torquatus</i> Duméril et al., 1854	NFF	6, 10	PT	WD
<i>Dipsas catesbyi</i> (Santzen, 1796)	ANT	1	OE	WD
<i>Drepanoides anomalus</i> (Jan, 1863)	NFF	1, 11	FT	WD
<i>Erythrolamprus aesculapii</i> (Linnaeus, 1758)	NFF	1	OE	WD
<i>Erythrolamprus pygmaeus</i> (Cope, 1868)	NFF	1, 6	PT	WD
<i>Erythrolamprus reginae</i> (Linnaeus, 1758)	FLH	1, 6, 8	AS, PT, OE	WD
<i>Erythrolamprus typhlus</i> (Linnaeus, 1758)	NFF	11	FT	WD
<i>Helicops angulatus</i> (Linnaeus, 1758)	NFF	2, 11	AS, PT	WD
<i>Helicops hagmanni</i> Roux, 1910	FLH	1, 11	FT, OE	WD
<i>Helicops polylepis</i> Günther, 1861	FLH	8	OE	WD
<i>Imantodes cenchoa</i> (Linnaeus, 1758)	NFF, FLH	6, 9	AS	WD
<i>Leptodeira annulata</i> (Linnaeus, 1758)	NFF, ANT	1, 10	AS, OE	WD
<i>Oxyrhopus melanogenys</i> (Tschudi, 1845)	NFF	2, 11	PT, FT	WD
<i>Oxyrhopus occipitalis</i> (Wied-Neuwied, 1824)	NFF	11	OE	SA
<i>Pseudoeryx plicatilis</i> (Linnaeus, 1758)	NFF	2	OE	WD
<i>Siphlophis cervinus</i> (Laurenti, 1768)	NFF	2	OE	WD
<i>Thamnodynastes pallidus</i> (Linnaeus, 1758)	NFF	2, 6	PT, OE	WD
<i>Xenodon rabdocephalus</i> (Wied-Neuwied, 1824)	NFF, ANT	9, 11	FT, OE	WD
<i>Xenoxybelis boulengeri</i> (Procter, 1923)	FLH	6	OE	SA
Family Elapidae				
<i>Micrurus hemprichii ortonii</i> Schmidt, 1953	NFF	3	PT	WA

Table 2. Continued.

Taxon	Habitat	Localities	Sampling methods	Geographic distribution
<i>Micrurus langsdorffi</i> (Wagler, 1824)	NFF	7, 11	FT, OE	WA
<i>Micrurus lemniscatus</i> (Linnaeus, 1758)	NFF	11	FT	WD
Family Viperidae				
<i>Bothrops atrox</i> (Linnaeus, 1758)	NFF, FLH	1, 8	AS, FT, OE	WD
<i>Bothrops brazili</i> Hoge, 1954	NFF	1	OE	SA
<i>Botrocophias hyoprora</i> (Amaral, 1935)	NFF	6	AS	SA, WA
<i>Lachesis muta muta</i> (Linnaeus, 1766)	NFF	11	OE	WD
Order Crocodylia				
Family Alligatoridae				
<i>Caiman crocodilus</i> (Linnaeus, 1758)	AQU-L, FLH	1, 7, 8, 9	AS, OE	WD
<i>Melanosuchus niger</i> (Spix, 1825)	AQU-L, FLH	1, 7, 9	AS, OE	WD
<i>Paleosuchus trigonatus</i> (Schneider, 1801)	AQU-L, AQU-S	7	AS, OE	WD
Order Testudines				
Family Chelidae				
<i>Mesoclemmys raniceps</i> (Gray, 1855)	FLH	10	TN	WD
<i>Platemys platycephala</i> (Schneider, 1792)	NFF	2	PT	WD
Family Podocnemididae				
<i>Podocnemis expansa</i> (Schweigger, 1812)	AQU-L, FLH	6, 9, 10	TN, OE	WD
<i>Podocnemis sextuberculata</i> (Cornalia, 1849)	AQU-L, FLH	1, 5, 6, 8, 9, 10	TN, OE	WD
<i>Podocnemis unifilis</i> Troschel, 1848	AQU-L, FLH	1, 2, 9, 10	TN, OE	WD
Family Testudinidae				
<i>Chelonoidis denticulata</i> (Linnaeus, 1766)	ANT	1	OE	WD

species each), and Alopoglossidae, Sphaerodactylidae, and Tropiduridae (three species each). Among snakes, the most species-rich family was Dipsadidae (23 species), followed by Colubridae (six species), Viperidae (four species), Elapidae (three species), and Boidae (two species). The remaining squamate families recorded were represented by single species: Gekkonidae, Iguanidae, Phyllodactylidae, Scincidae (lizards), and Aniliidae (snakes). The order Testudines was represented by six species, with the family Podocnemididae evidenced as the most species-rich (three species), followed by Chelidae (two species) and Testudinidae (one species). In addition, three species of the Order Crocodylia were recorded, all members of the family Alligatoridae.

The species rarefaction curves showed that our sampling was well representative considering the expected amphibian and reptile richness for the RBJ, as for both groups the observed data almost reached the asymptotes of curves (Fig. 3). However, as expected, both rarefaction curves also indicate that the RBJ still has potential to harbor additional species not recorded in our samplings, notably for reptiles. According to the applied estimation indices, the expected amphibian richness in the RBJ ranges from 80-87 species based on our sampling richness (representing an increment of 11-21% in the observed richness), while for reptiles this estimate ranges from 78-94 species (representing an an increment of 16-40% in the observed richness).

As for biogeographic affinities, disregarding the widely distributed species in the lowland Amazonia (53% of amphibians and 78% of reptiles), the recorded assemblage was mostly composed of typical species from western, southwestern, and southern lowland Amazonia (33% of amphibians and 22% of reptiles) (Table 2). We detected changes in species richness and composition among habitat types. Assemblages from non-flooded

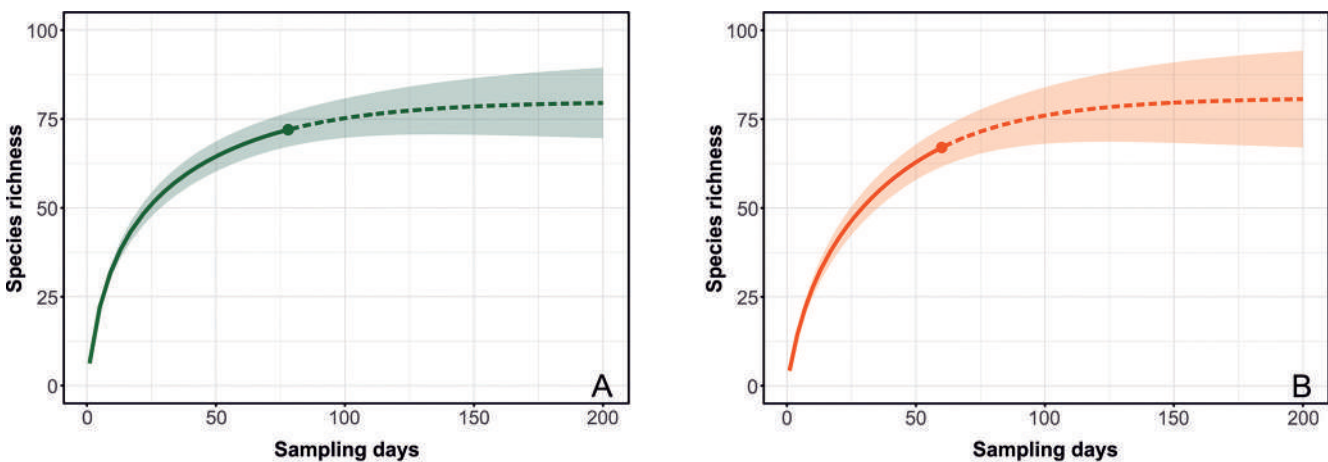


Figure 3. Extrapolated rarefaction curves showing variation in amphibian (A) and reptile (B) species richness in the Reserva Extrativista do Baixo Juruá in relation to our sampling effort. Observed data are in full lines and extrapolated in dashed lines. Shaded areas represent 95% confidence intervals (bootstrap with 1,000 replications).

forests (*paleovárzea*) were the most species-rich, with 107 recorded species (73 unique species). Other 65 species compose the assemblages from the flooded habitats (*várzea*) (24 unique species) (Table 2). We also recorded 25 species using anthropic habitats, while seven species are typical from the aquatic interface (Table 2).

Changes in species richness and composition were also detected among sampling localities. None of the recorded species was homogeneously sampled in all sampling localities, indicating relevant assemblage turnovers across the RBJ. The most geographically widespread species were the amphibians *Adenomera andreae* (Müller, 1923) (9/11 localities), *Rhinella castaneotica* (Caldwell, 1991), *Rhinella marina* (Linnaeus, 1758), *Scinax ruber* (Laurenti, 1768), and *Leptodactylus pentadactylus* (Laurenti, 1768) (8/11 localities), and the lizards *Alopoglossus atriventris* Duellman, 1973 and *Gonatodes humeralis* (Guichenot, 1855) (6/10 localities). Conversely, 48 species were exclusively recorded in a single sampling locality (Table 2). Regarding the sampling methods for terrestrial animals, active surveys provided unique records for 28 species, pitfall traps for 17 species, and funnel traps for 4 species (Table 2). Other 21 species were exclusively recorded by occasional encounters (Table 2). Some examples of recorded amphibian and reptile species are depicted in Figs. 4-14.

Taxonomic status clarified with DNA barcoding

Newly generated DNA sequences were useful to assess the taxonomic status of some recorded species. Under this approach, we confirmed the occurrence of evolutionary units corresponding to the following 13 nominal species (GB accession numbers of most similar sequences and percentage of similarity in parenthesis): *Allobates femoralis* (Boulenger, 1884) (DQ502117, 99.8%) (Fig. 4A), *Phyzelaphryne nimio* Simões et al., 2018 (MG572224-25, 98.7%) (Fig. 5C), *Osteocephalus castaneicola* Moravec et al., 2009 (KF002035, 99.5%) (Fig. 6G), *Osteocephalus helenae* (Ruthven, 1919) (KF002051, KF002043-44, 99.0%) (Fig. 6H), *Adenomera simonstuarti* (Angulo & Icochea, 2010) (KF674577, 99.5%) (Fig. 7G), *Engystomops petersi* Jiménez de la Espada, 1872 (EF470279, 98.4%) (Fig. 8A), *Pristimantis fenestratus* (Steindachner, 1864) (KY712671-73, 99.4%), *Boana calcarata* (Troschel, 1848) (JN970631, 98.7%) (Fig. 5E), *Trachycephalus cunauaru* Gordo et al., 2013 (KU495603-04, 99.8%), *Atractus poepigii* (Jan, 1862) (P.R. Melo-Sampaio, unpublished data) (Fig. 12F), *Atractus torquatus* Duméril et al., 1854 (P.R. Melo-Sampaio, unpublished data) (Fig. 12G), *Atractus snethlageae* Cunha & Nascimento, 1983 (P.R. Melo-Sampaio, unpublished data), and *Thecadactylus solimoensis* Bergamnn & Russell, 2007 (AY604486, 98.5%). The sample of *Osteocephalus* aff. *leprieurii* (Fig. 7A) matched to the related "candidate species 2" sensu Jungfer et al. (2013) (KF002070-71, 99.5%). Despite the above-threshold genetic distances of our samples of *Dendropsophus reticulatus* (Jiménez de la Espada, 1870) (KY406416 and KY406418, 95.8%) (Fig. 6D, E), *Dendropsophus kamaga-*

rini Rivadeneira et al., 2018 (MN172514, 96.6%) (Fig. 6C), *Leptodactylus discodactylus* Boulenger, 1884 (AY943239, 94.5%) (Fig. 8B), and *Leptodactylus petersii* (Steindachner, 1864) (JN691200, 95.6%) (Fig. 8E), we refrain to designate them as candidate new species because deep conspecific divergences are common events within these taxa (Caminer et al., 2017; Vacher et al., 2020; Gazoni et al., 2021, Carvalho et al., 2022). Furthermore, our analyses of voucher specimens revealed that their morphology fitted in the reported variation for these nominal species (Heyer, 1997; Caminer et al., 2017; Rivadeneira et al., 2018; Gazoni et al., 2021).

Under the DNA barcoding approach, we also detected the occurrence of two divergent mtDNA lineages under the species complexes *Rhinella margaritifera* (Laurenti, 1768) (Fig. 4C, D), *Boana steinbachi* (Boulenger, 1905) (Fig. 6B), and *Boana geographica* (Spix, 1824) (Fig. 6G). With the genetic distances at the 16S fragment ranging to 4%, 3.2%, and 4.5%, respectively, those divergent lineages most likely correspond to distinct sympatric species. The first lineage of the *R. margaritifera* species complex (*R. aff. margaritifera*) matched to sequences from Atlantic Forest (AY680262 and KU495504, 99.2%), while the second one matched to sequences of the recently described *Rhinella exostosica* Ferrão et al., 2020 (KF992145, 99.6%). These distinct lineages are indeed morphologically divergent, with *R. aff. margaritifera* corresponding to a candidate species with head longer than wide, absence of prominent bony knobs at the angle of jaws, and females possessing considerably extended supratympanic crests (Fig. 4C), whereas the specimens of *R. exostosica* have the head as wide as long, prominent bony knobs at the angle of jaws, and females with less extended supratympanic crests (Fig. 4D). Sequences of another bufonid from our sampling matched to *R. castaneotica sensu stricto* from eastern Amazonia (MF479716 and MF479717, 98.8%) (Fig. 4B), but given the overall low resolution in the taxonomy of this group (Santos et al., 2015; Ferrão et al., 2022), this status should be considered preliminary, and the chances of this population belong to a new species are high. Specimens of *R. castaneotica* from the RBJ share a small body size (mean snout-vent length; SVL = 46.7 mm) and lacks supratympanic crests in both sexes, therefore differing from the two sympatrically recorded larger species of the *R. margaritifera* species group (mean SVL = 57.9 and 54.3 mm; supratympanic crests present).

Within the *Boana steinbachi* species complex (Fig. 6B), the two divergent genetic lineages detected at the RBJ are not conspecific with the nominal *Boana alfaroi* (Caminer & Ron, 2014) or *Boana tetete* (Caminer & Ron, 2014). In fact, one of the lineages is more closely related to the *Boana* "clade J" sensu Caminer & Ron (2014) (JN790138, 96%), which corresponds to *B. steinbachi* (Fouquet et al., 2021; Rainha et al., 2021). The other lineage is genetically divergent from any nominal or candidate species and most likely represents an undescribed species (Fig. 6B). Analyzing the external morphology of specimens, we are unable to detect any distinctly evident qualitative or quantitative character segregating



Figure 4. Amphibians recorded at the Reserva Extrativista do Baixo Juruá. (A) *Allobates femoralis*; (B) *Rhinella castaneotica*; (C) *Rhinella* aff. *margaritifera*; (D) *Rhinella exostolica*; (E) *Rhinella marina*; (F) *Ceratophrys cornuta*; (G) *Oreobates quixensis*; (H) *Pristimantis reichlei*. Photographs by VTC (A, C, E, F, H) and LJCLM (B, D, G).

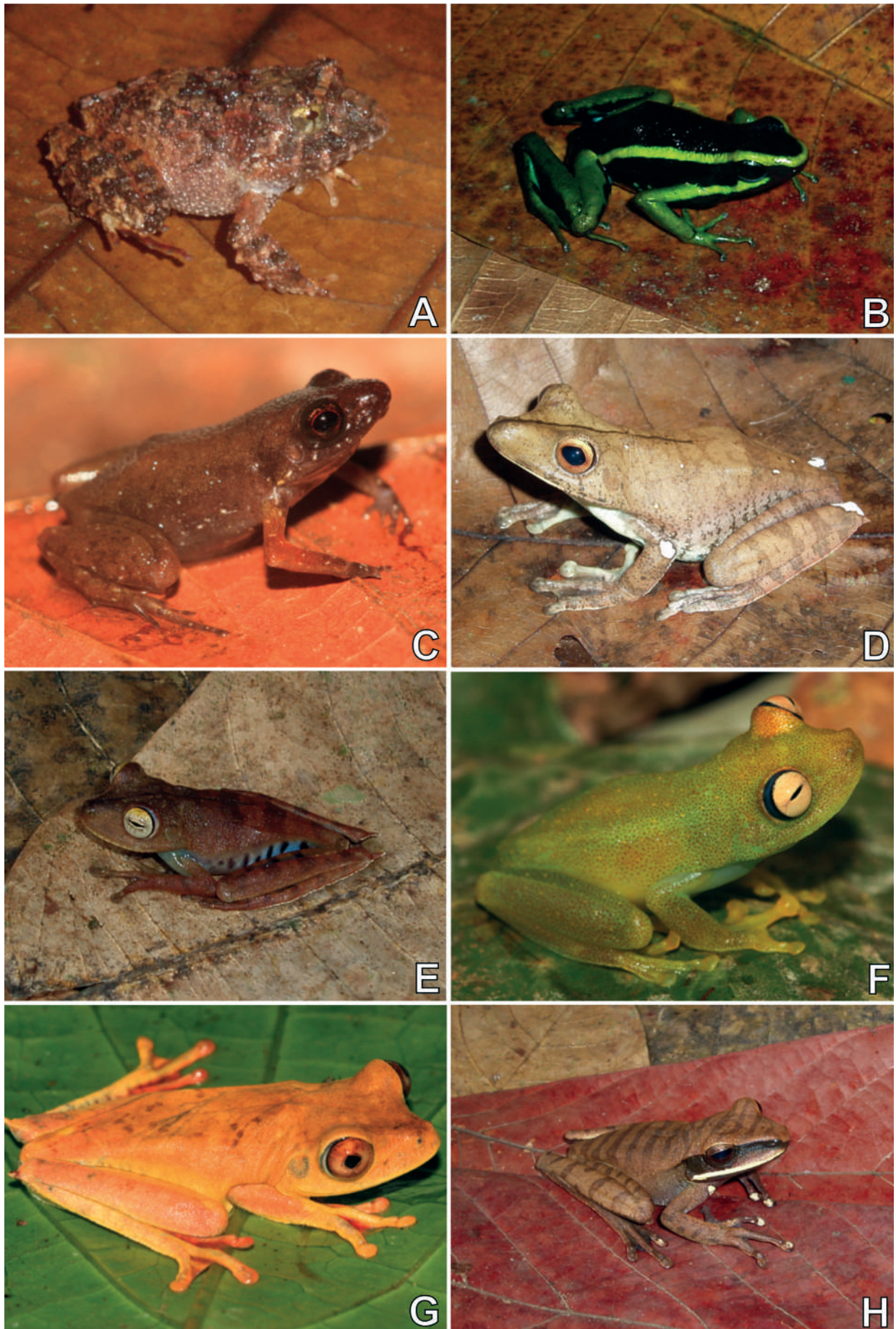


Figure 5. Amphibians recorded at the Reserva Extrativista do Baixo Juruá. (A) *Strabomantis sulcatus*; (B) *Ameerega trivittata*; (C) *Phyzelaphryne nimio*; (D) *Boana boans*; (E) *Boana calcarata*; (F) *Boana cinerascens*; (G) *Boana geographica*; (H) *Boana lanciformis*. Photographs by VTC (A, B, D, E, H) and LJCLM (C, F, G).



Figure 6. Amphibians recorded at the Reserva Extrativista do Baixo Juruá. (A) *Boana raniceps*; (B) *Boana* aff. *steinbachi*; (C) *Dendropsophus kamagarini*; (D) *Dendropsophus reticulatus*; (E) *D. reticulatus* (reticulated morph); (F) *Dendropsophus rossaleni*; (G) *Osteocephalus castaneicola*; (H) *Osteocephalus helena*. Photographs by VTC (A, D-F) and LJCLM (B, C, G, H).

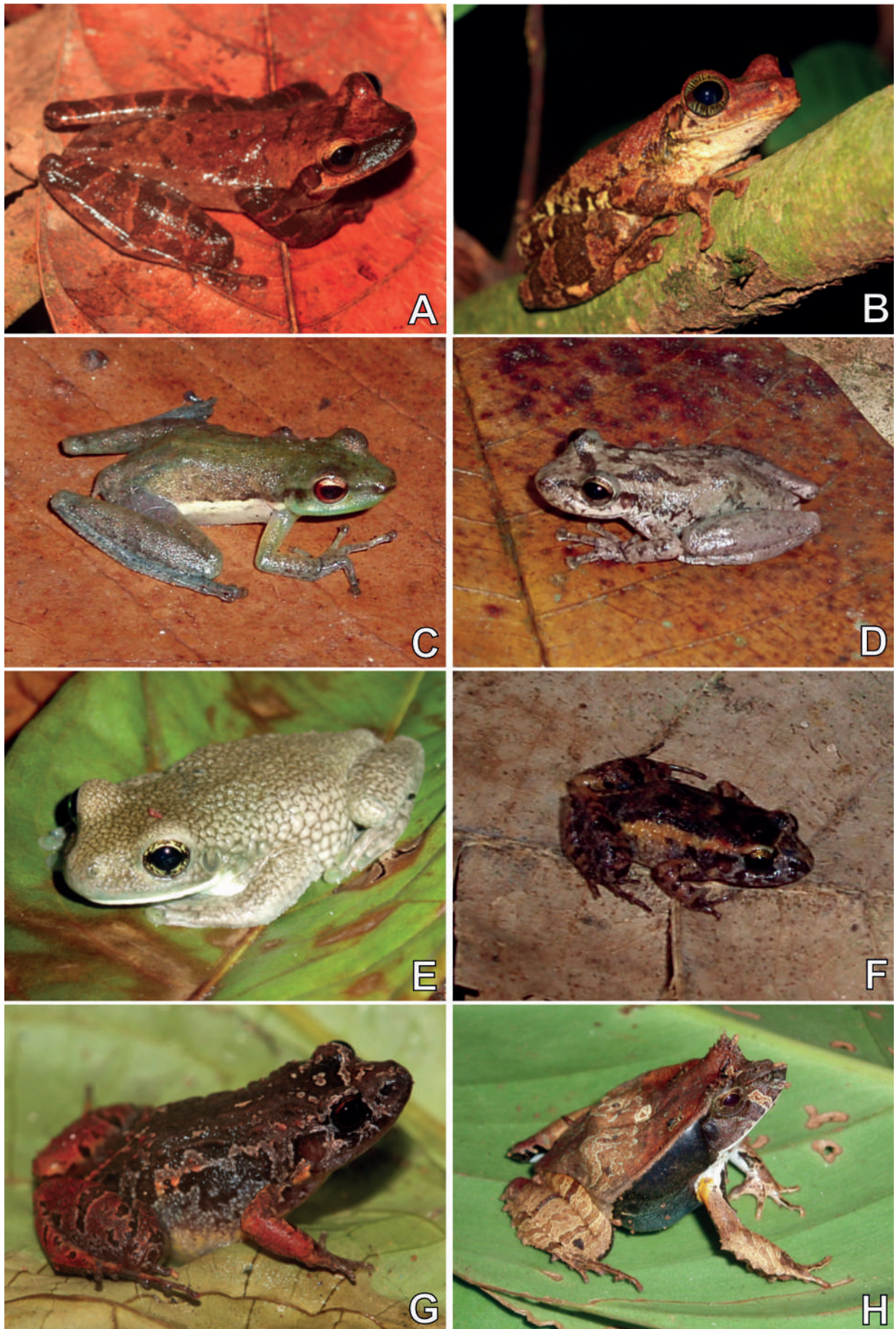


Figure 7. Amphibians recorded at the Reserva Extrativista do Baixo Juruá. (A) *Osteocephalus* aff. *ieprieurii*; (B) *Osteocephalus taurinus*; (C) *Scarthyla goinorum*; (D) *Scinax ruber*; (E) *Trachycephalus typhonius*; (F) *Adenomera andreae*; (G) *Adenomera simonstuarti*; (H) *Edalorhina perezii*. Photographs by LJCLM (A, B, G) and VTC (C-F, H).

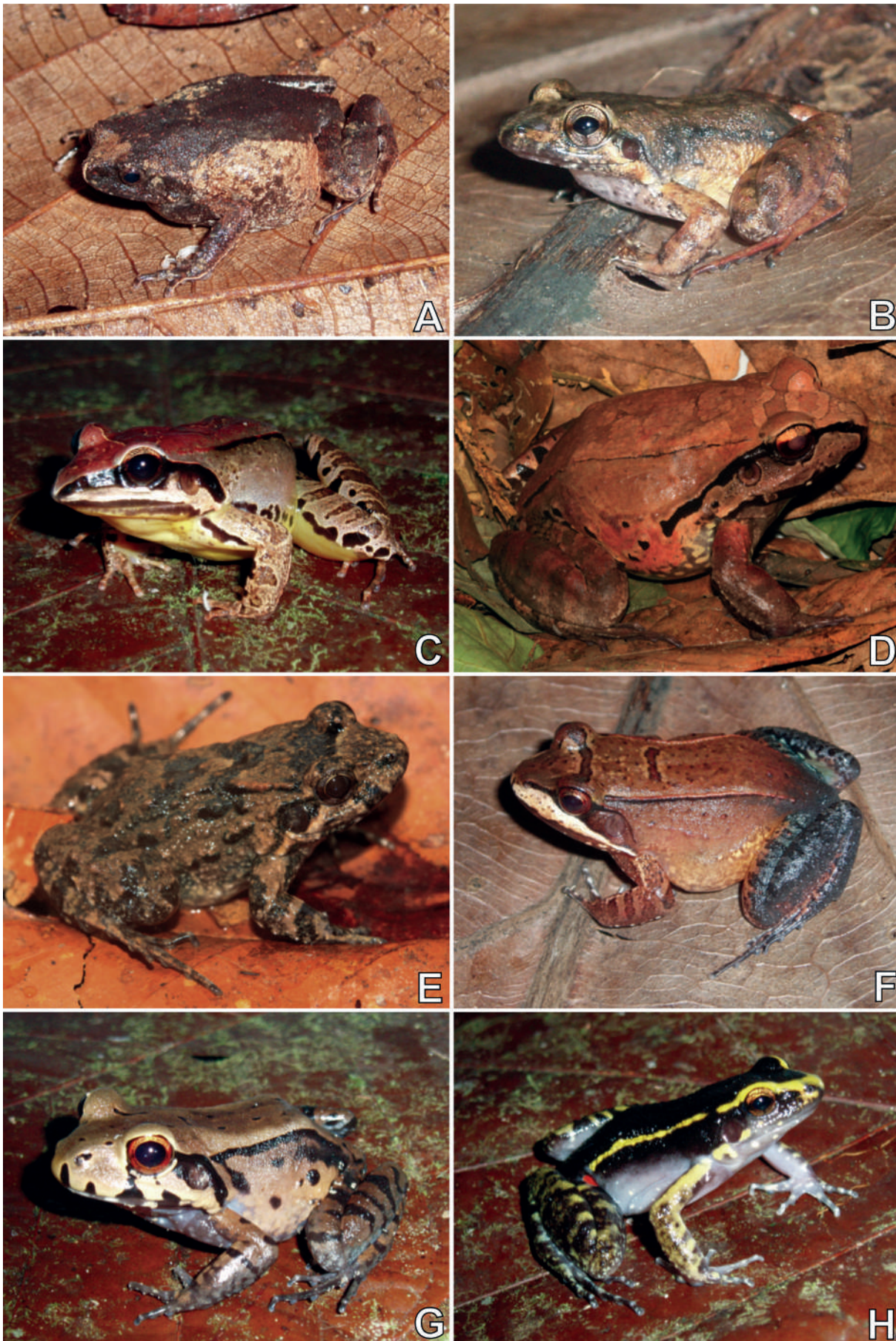


Figure 8. Amphibians recorded at the Reserva Extrativista do Baixo Juruá. (A) *Engystomops petersi*; (B) *Leptodactylus discodactylus*; (C) *Leptodactylus cf. mystaceus*; (D) *Leptodactylus pentadactylus*; (E) *Leptodactylus petersii*; (F) *Leptodactylus rhodomystax*; (G) *Leptodactylus stenodema*; (H) *Lithodytes lineatus*. Photographs by VTC (A-C, F-H) and LJCLM (D, E).

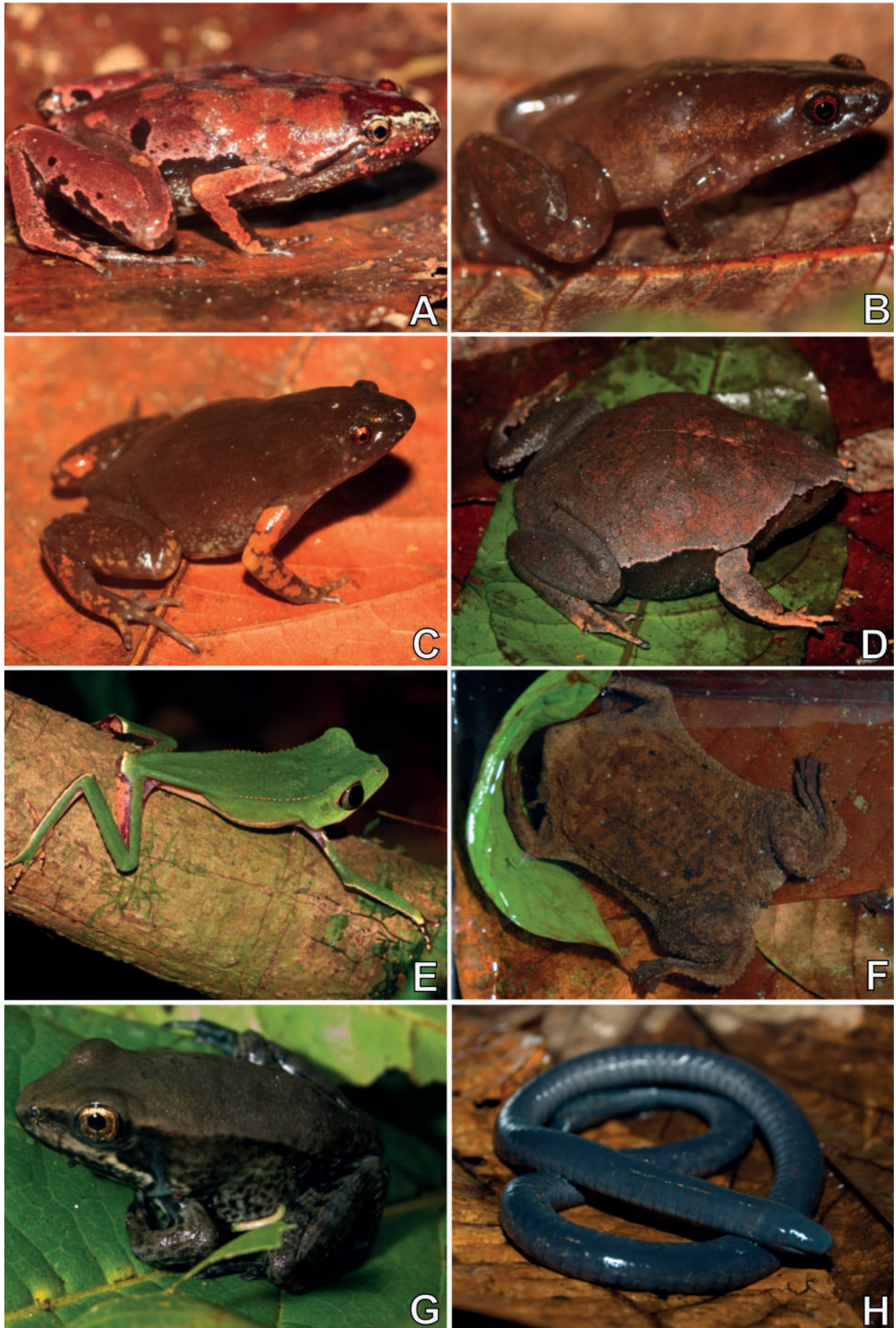


Figure 9. Amphibians recorded at the Reserva Extrativista do Baixo Juruá. (A) *Chiasmocleis bassleri*; (B) *Chiasmocleis hudsoni*; (C) *Chiasmocleis ventrimaculata*; (D) *Ctenophryne geayi*; (E) *Phyllomedusa vaillantii*; (F) *Pipa pipa*; (G) *Lithobates palmipes* (metamorph); (H) *Caecilia tentaculata*. Photographs by LJCLM (A-E) and VTC (F-H).

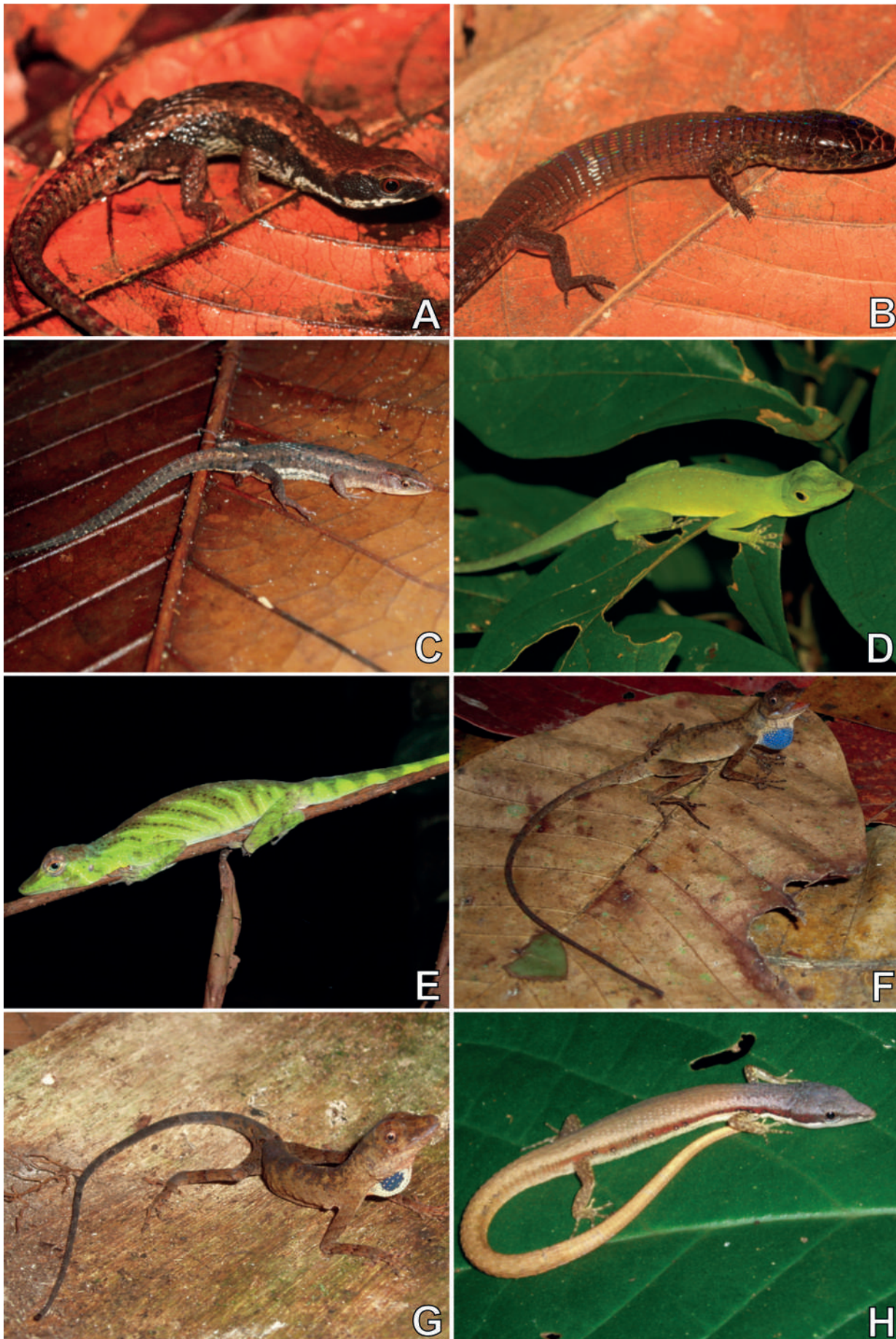


Figure 10. Lizards recorded at Reserva Extrativista do Baixo Juruá. (A) *Alopoglossus atriventris*; (B) *Alopoglossus brevifrontalis*; (C) *Alopoglossus indigenorum*; (D) *Anolis punctatus*; (E) *Anolis transversalis*; (F) *Anolis tandai* (male); (G) *Anolis tandai* (female); (H) *Cercosaura argulus*. Photographs by LJCLM (A, B, D) and VTC (C, E-H).



Figure 11. Lizards recorded at Reserva Extrativista do Baixo Juruá. (A) *Loxopholis snethlageae*; (B) *Iguana iguana*; (C) *Copeoglossum nigropunctatum* (juvenile); (D) *Gonatodes humeralis*; (E) *Crocodilurus amazonicus*; (F) *Kentropyx pelviceps*; (G) *Plica umbra ochrocollaris*; (H) *Uranoscodon superciliosus*. Photographs by LJCLM (A, D) and VTC (B, C, E-H).



Figure 12. Snakes recorded at Reserva Extrativista do Baixo Juruá. (A) *Anilius scytale*; (B) *Epicrates cenchria*; (C) *Chironius fuscus*; (D) *Drymoluber dichrous*; (E) *Atractus major*; (F) *Atractus poeppigi*; (G) *Atractus torquatus*; (H) *Dipsas catesbyi*. Photographs by VTC.



Figure 13. Snakes recorded at Reserva Extrativista do Baixo Juruá. (A) *Drepanoides anomalus*; (B) *Erythrolamprus pygmaeus*; (C) *Erythrolamprus reginae*; (D) *Erythrolamprus typhlus*; (E) *Helicops angulatus*; (F) *Helicops polylepis*; (G) *Oxyrhopus melanogenys*; (H) *Oxyrhopus occipitalis*. Photographs by VTC (A-E, G, H) and LJCLM (F).

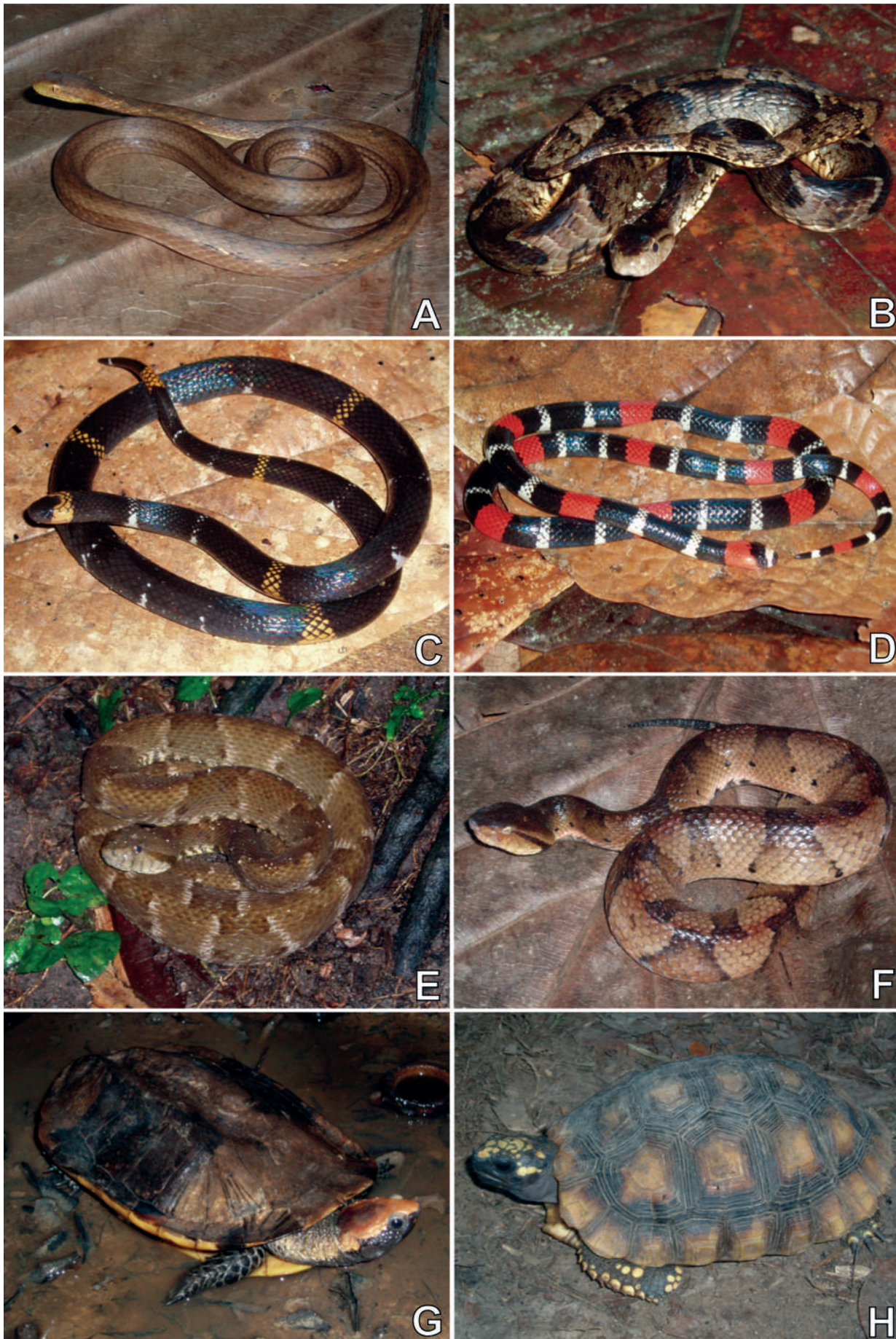


Figure 14. Snakes and chelonians recorded at Reserva Extrativista do Baixo Juruá. (A) *Thamnodynastes pallidus*; (B) *Xenodon rabdocephalus*; (C) *Micrurus hemprichii ortonii*; (D) *Micrurus lemniscatus*; (E) *Bothrops atrox*; (F) *Bothrocophias hyoprora*; (G) *Platemys platycephala*; (H) *Chelonoidis denticulata*. Photographs by VTC.

these two evolutionary units, indicating a likely case of cryptic speciation, which is common in this species complex (Caminer & Ron, 2014; Fouquet et al., 2021). Considering the *B. geographica* species complex, we found that one lineage matched to the nominal *B. geographica* (KU168897-98, 100%) (Fig. 5G) and the second matched to the recently revalidated *Boana appendiculata* (Boulenger, 1882) (MG840867, 99.8%) (Caminer & Ron, 2020). Morphological analysis of the preserved material referred to the nominal *B. geographica* fully agreed with the species diagnosis (reviewed by Fouquet et al., 2016), differing from the *B. appendiculata*, for example, by having dark spots on belly (vs. immaculate belly in *B. appendiculata*), and orange-reddish hand and foot webbing (vs. cream colored in *B. appendiculata*). Lastly, two recorded specimens from the snake genus *Atractus* Wagler, 1828 represent a molecular lineage highly divergent from their congeners. However, this lineage is cryptic to the syntopic species *A. snethlageae* considering external morphology, and we opt to designate a conservative taxonomic status (*Atractus* aff. *snethlageae*) while pending the acquisition of additional data.

Uncertain taxonomic status

Allobates sp.

Allobates sp. is a species with smaller body size (maximum SVL = 17.8 mm) compared to the two sympatric large-sized *Allobates* Zimmermann & Zimmermann, 1988 (*A. femoralis* – Fig. 4A – and *Allobates vanzolinus* [Morales, 2002], with minimum SVL = 19.6 mm), also differing by its cryptic coloration (vs. brightly colored in *A. femoralis*), and cream-colored throat in males, in some specimens punctuated with small black dots (vs. uniformly dark throat in males of *A. vanzolinus*). Some of these specimens could correspond to *Allobates gasconi* (Morales, 2002), as INPA-H 004986 is a paratype of this species. However, we opt to maintain a conservative taxonomic status, due to the combination of overall uncertainty in attributing taxonomic status of cryptically colored *Allobates*, historical composite type series (Melo-Sampaio et al., 2018), and the fact that Juruá River basin harbor many morphologically similar small-bodied species. We also cannot safely discard the occurrence of more than one species contained under this taxon.

Amazophrynella sp.

Preserved specimens of *Amazophrynella* sp. have a cream-colored belly punctuated with small black dots, and males have mean SVL = 15.7 mm. Such characteristics are shared by some nominal species from western Amazonia (Rojas et al., 2018), leading to uncertainty on the identity of these populations. In fact, several populations of *Amazophrynella* Fouquet et al., 2012 across Amazonia remain uncertainly identified even after the latest taxonomic and biogeographic studies with the genus, which prove the occurrence of extensive morpho-

logical conservatism among species (Rojas et al., 2018; Moraes et al., 2022b).

Bolitoglossa sp.

The taxonomic status of the *Bolitoglossa* Duméril, Bibron & Duméril, 1854 populations from the lower Juruá River basin has been reviewed in a broader Amazonian context, but remains unresolved (Brcko et al., 2013). Given the high morphological similarity among the lowland Amazonian species of *Bolitoglossa* and the recent indication of at least four genetically distinct lineages occurring at the Juruá River basin (Jaramillo et al., 2020), we opt to designate a conservative taxonomic status for these specimens, only recorded in the 1992 expedition. We also cannot discard the occurrence of more than one species contained under this taxon.

Pristimantis sp.

A small-sized species of speciose genus *Pristimantis* Jiménez de la Espada, 1870, with external morphology overlapping with the known variation of many species (relatively short hind limbs, tuberculate dorsum with a “W” scapular pattern, and an immaculate areolate venter). Historically, populations sharing this general morphology have been attributed across Amazonia to the name *Pristimantis ockendeni* (Boulenger, 1912). However, it is already evidenced that many undescribed species are masqueraded under this name (Elmer & Cannatella, 2008). In this case, assignments to any taxonomic status would be putative without additional data because of the same reasons for the case of *Allobates* sp. Therefore, we also cannot discard the presence of more than one species contained under this taxon.

Pristimantis cf. *diadematus*

A morphologically diagnosable subgroup within the *Pristimantis unistrigatus* (Günther, 1859) species group shares very large digital tips, relatively short hind limbs, tuberculate dorsum, a “W” scapular pattern, and prominent leg barring (Hedges & Schlüter, 1992). However, this subgroup (*Pristimantis diadematus* series) was evidenced to be non-monophyletic (Hedges et al., 2008). We recorded at the RBJ one species attributed to this morphological subgroup, with its characteristic mostly fitting in the diagnosis of *Pristimantis eurydactylus* Hedges & Schlüter, 1992, notably by possessing a visible tympanum and a smooth dorsum. However, *P. eurydactylus* is little known and much of its associated information comes only from its original description (Hedges & Schlüter, 1992). In addition, its diagnostic characteristics are quite subject to variation and is difficult to elucidate the taxonomic and geographic boundaries between *P. eurydactylus* and *Pristimantis diadematus* Jiménez de la Espada, 1875, which is more widely distributed in the Amazonian Andean foothills and adjacent lowlands (Jiménez de la Espada, 1875; Frost, 2022). Without a finer taxonomic resolution and new field data, it is impossible to assign

a more precise taxonomic status to this RBJ's population. In addition to the aforementioned characters, *P. cf. diadematus* has a belly marked by contrasting small dark dots and greenish flanks in life.

***Leptodactylus cf. mystaceus* (Fig. 8C)**

The species-pair *Leptodactylus mystaceus* (Spix, 1824) and *Leptodactylus didymus* Heyer, García-Lopez, & Cardoso, 1996 is totally cryptic with regard to external morphology, only being phenotypically distinguished by advertisement calls (pulsed in *L. mystaceus* and non-pulsed in *L. didymus*) (Heyer et al., 1996). *Leptodactylus didymus* is known to occur at southwestern Amazonia, with punctual records at the lower Juruá River region (Heyer et al., 1996), while *L. mystaceus* is more widely distributed in Amazonia (Heyer et al., 1996; Silva et al., 2020). However, the widest knowledge gap on the distribution of this species pair is spatially congruent to where they are potentially sympatric, including our study area (Heyer et al., 1996; Silva et al., 2020). As external morphology was the only available information for the assignment of taxonomic status in this case, we opt to be conservative until acoustic vouchers are obtained in the focal area.

Remarkable records

***Strabomantis sulcatus* (Cope, 1874) (Fig. 5A)**

This species is the most widespread in the genus *Strabomantis* Peters, 1863, which is more diverse in upland areas of the Andean mountain range (Lynch, 1997; Hedges et al., 2008). This record represents an extension of its distribution range, ca. 400 km east of the nearest known locality of occurrence (see Lynch, 1997). As *S. sulcatus* is the only species of the genus widely distributed in lowland Amazonia, this record also expands the known distribution for the genus *Strabomantis* (Hedges et al., 2008). Based on the fact that *Strabomantis* species are rarely reported for Brazilian Amazonia, are quite similar considering external morphology, and we still have little knowledge on the genetic variation within *S. sulcatus*, other species could likely be masqueraded under this name across lowland Amazonia.

***Phyzelaphryne nimio* Simões et al., 2018 (Fig. 5C)**

Several populations of small eleutherodactylids in lowland Amazonia are historically attributed to a single taxon of the genus *Phyzelaphryne* Heyer, 1997 (*Phyzelaphryne miriamae* Heyer, 1977). Recently, the real diversity within the widespread *P. miriamae* has been clarified, indicating that at least two molecularly divergent lineages representing candidate new species were masqueraded under this name (Simões et al., 2018). Considering this taxonomic history, we initially thought

that specimens from the RBJ could be conspecific with the "candidate new species 1" *sensu* Simões et al. (2018), which occur at the middle Juruá River basin, or representatives of a never sampled new species. Surprisingly, our molecular and morphological evidence supports the identity of this population as conspecific with the recently described *P. nimio*, known only from the Japurá River basin (Simões et al., 2018). This record represents a south-east extension of ca. 280 km for the distributional range of *P. nimio*, as well as the first evidence of its occurrence at the southern bank of the Amazon River.

***Rhinella exostosica* Ferrão et al., 2020 (Fig. 4D)**

Recent descriptions of Amazonian species of the taxonomically challenging *R. margaritifera* species group (Santos et al., 2015; Ávila et al., 2020; Ferrão et al., 2020) significantly improved the taxonomic resolution of different populations across this ecosystem. Due to these advances, we were able to confirm the presence of *R. exostosica* in the RBJ. This species was recently described to the extreme southwestern Amazonia, and our record represents the first in the state of Amazonas, extending its distribution by ca. 650 km northeast. Such a finding rejects the hypothesis that *R. exostosica* distribution is limited to the west by the Madeira River (Ferrão et al., 2020), at least considering a broad spatial scale.

***Dendropsophus kamagarini* Rivadeneira et al., 2018 (Fig. 6C)**

The taxon *Dendropsophus parviceps* (Boulenger, 1882), formerly considered to be widespread in western Amazonia, was recently taxonomically revised under integrative approaches (Rivadeneira et al., 2018). This revision revealed three molecularly and morphologically diagnosable lineages contained under this name (Rivadeneira et al., 2018). However, due to the under-sampling in this study, an overall low resolution on the identity of "*D. parviceps*" populations occurs in Brazilian Amazonia. Our molecular and morphological analyses support the presence in the RBJ of the "southwestern clade" of the former widespread *D. parviceps*, now named *D. kamagarini* (Rivadeneira et al., 2018).

***Dendropsophus mapinguari* Peloso et al., 2016**

A member of the *Dendropsophus leucophyllatus* (Beireis, 1783) group recently described, *D. mapinguari* is until now only known to three localities in central Amazonia, Brazil (Peloso et al., 2016). In the original description, authors suggest that this narrow distribution could be underestimated, as they are segregated by large rivers already recognized as geographic barriers for some Amazonian frogs (Fouquet et al., 2014), and *D. mapinguari* frequently exploit the flooded habitats, which favors individual dispersion and gene flow (Harvey et al., 2017). In fact, *D. mapinguari* was recently reported for a new locality in the Negro River basin (Igor

Fernandes, *pers. comm.*), and this record extends the known distribution of this species ca. 600 km west of this (nearest) locality.

***Dendropsophus miyatai* (Vigle & Goberdhan-Vigle, 1990)**

This small-sized and elusive species is originally described as distributed in Ecuadorian Amazonia (Cisneros-Heredia, 2005). Since then, populations within western lowland Amazonia in Peru, Colombia, and Brazil have been attributed to this name. However, these localities of occurrence are in some cases patchily distributed, and the full range of this species is overall irresolute (Cisneros-Heredia, 2005). This is partially explained by the fact that the species mostly exploit seasonally flooded habitats, which are historically neglected in standardized inventories (Moraes *et al.*, 2022a), and by misidentification with other *Dendropsophus* Fitzinger, 1843. In the light of available evidence, *D. miyatai* is widely distributed in the margins of the main western Amazonian rivers, extending through the east following the course of the Amazon River.

***Alopoglossus indigenorum* Ribeiro-Júnior *et al.*, 2021 (Fig. 10C)**

Both the analyses of molecular and morphological (meristic) variation of a recently collected specimen of the *Alopoglossus angulatus* (Linnaeus, 1758) species complex from the RBJ showed that it represented an undescribed taxon. This species was then recently described as *A. indigenorum*, containing the specimen from the RBJ as part of its type series (Ribeiro-Júnior *et al.*, 2021). The species is distributed in the extreme western Brazilian Amazonia, at south of the Amazon River.

***Atractus poeppigi* (Jan, 1862) (Fig. 12F)**

The combination of cryptozoic habits of species and shortfalls of biological knowledge on Amazonia usually provide challenging cases in defining distributional limits for the snake genus *Atractus* Wagler, 1928 (Fraga *et al.*, 2017). For instance, *A. poeppigi* (already considered a synonym of *Atractus elaps* Günther, 1858 [Dixon *et al.*, 1976]) is a representative of an *Atractus* species with an irresolute distribution, composed by patchily distributed localities of occurrence. With occurrence records ranging from the Andean foothills to the central lowland Amazonia (Nogueira *et al.*, 2019), *A. poeppigi* can be considered widely distributed, and records in the RBJ (three individuals) help to fill some of the knowledge gaps in its distribution.

DISCUSSION

Our study reinforces the importance of maintaining effective protected areas at the lower Juruá River

and shows the value of the RBJ as a conservation unit in the context of the Amazonian amphibian and reptile diversity, also helping to promote relevant subsidies for its management. This assumption was exemplified by the presence of many species in the RBJ usually rarely recorded across Amazonia, typical of the western and southwestern Amazonia sub-regions, or potentially endemic to the study area.

Our first sampling at the RBJ (1992) provided initial insights regarding the local diversity of amphibians and reptiles, while most recent expeditions (2005-2007, 2018) complemented this knowledge and supported the creation, management and monitoring of this protected area. Even after the first two expeditions carried out to this region, 18 new species of amphibians and reptiles were reported for the RBJ in 2018. Therefore, an increase in the species richness of these vertebrates known for the RBJ as a result of new inventories and refinement in their taxonomic resolution in Amazonia is very likely. In fact, additional inventories on the RBJ are highly encouraged in order to bring taxonomic resolution to amphibian species with uncertain status in the genera *Allobates*, *Pristimantis*, *Bolitoglossa*, *Leptodactylus*, and *Amazophrynella*, as well as to investigate the presence and current population status of species that were only reported in the 1992 sampling, as *A. vanzolinus*, *D. miyatai*, *D. mapinguari*, and *Scinax cruentomma* (Duellman, 1972).

By sampling a western Amazonian locality over a long period through active surveys, Duellman (1978) concluded that the vast majority of local species (75%) were recorded in the first 100 person-days of fieldwork. Based on this result and on our estimated rarefaction curves, we believe that the combination of our 245 person-days of active survey sampling plus other three sampling methods (including 2,070 trap-days) has sufficiently assessed the typical assemblages of amphibians and reptiles occurring in the RBJ. Rare species were found through active surveys in the locality sampled by Duellman (1978) only after more than 1,000 person-days of fieldwork. Therefore, and as evidenced in our richness estimation analyses, the list of species presented here certainly should expand with the advancement of knowledge. This might be the case especially considering reptile diversity, which were standardized sampled only in two of our expeditions, and have many species barely detectable due to secretive habits and natural lower densities (Fraga *et al.*, 2014). In this sense, many snake species inhabiting broad geographic ranges in Amazonia, such as *Chironius scurrulus* (Wagler, 1824), *Atractus latifrons* (Günther, 1868), *Hydrops martii* (Wagler, 1824), *Hydrops triangularis* (Wagler, 1824), *Siphlophis compressus* (Daudin, 1803), and *Xenopholis scalaris* (Wucherer, 1861), are highly expected to occur in the RBJ (see Nogueira *et al.*, 2019).

Data obtained on our expeditions were relevant to improve the knowledge on the effects of the Juruá River as geographical barriers to amphibians (see Gascon, 1996; Loughheed *et al.*, 1999; Gascon *et al.*, 2000), but also on the taxonomy of Amazonian amphibians and reptiles. For example, the microhylid *Chiasmocleis avilapiresae*

(Peloso & Sturaro, 2008), the aromobatids *A. vanzolinus* and *A. gasconi* (Morales, 2002), and the gymnophthalmid *A. indigenorum* (Ribeiro-Júnior et al., 2021) were described using this material. Furthermore, specimens collected at the RBJ also provide relevant geographic novelties, supporting distribution extensions for the allophrynid *Allophryne resplendens* Castroviejo-Fisher et al., 2012 (Carvalho et al., 2017), the leptodactylid *A. simonstuarti* (Carvalho et al., 2020), the dipsadid *Erythrolamprus pygmaeus* (Cope, 1868) (Kawashita-Ribeiro et al., 2011), and the viperid *Botrocophias hyoprora* (Amaral, 1935) (Carvalho et al., 2013). Conversely, some of the records reported to the RBJ in the literature are uncertain and noteworthy. In a revision dealing with Amazonian caecilians diversity, Maciel & Hoogmoed (2011) reported a specimen of the siphonopid *Siphonops annulatus* (Mikan, 1822) to the RBJ (INPA-H 004401). However, this specimen was actually collected in the upper Juruá River, and to our knowledge, no record of this species is unambiguously attributed to the RBJ. Similarly, the specimen INPA-H 002417, defined as a paratype of the hylid *T. cunauaru* (Gordo et al., 2013), was collected in the middle Juruá River, but mistakenly reported to the RBJ. We eventually confirmed the presence of *T. cunauaru* in the RBJ in our inventories, but *S. annulatus*' presence remains uncertain. Such a pattern of geographic errors associated with the material collected in the 1991-1992 expedition across the Juruá River indicates that such mistakes may be occurring more widely in the literature using this material.

Although Amazonia represents a region of historical interest for inventories of amphibians and reptiles, the comparability across studies over time is hampered by the highly distinct sampling efforts caused by logistical challenges and pervasive biodiversity shortfalls, which introduce many biases in the reported results (Bush & Lovejoy, 2007; Hortal et al., 2015; Oliveira et al., 2016). However, some biogeographic patterns are repeatedly recovered and appear to be robust. For instance, a west-east gradient of decrease in species richness is consistently reported considering broad taxonomic scales (e.g., Rangel et al., 2018; Oberdorff et al., 2019; Ritter et al., 2019). The west-east diversity gradient is also noticed on a regional scale in the Juruá River basin. In addition to the higher diversity reported in the upper Juruá River basin, there are several species substitutions reported along the course of this river (Gascon et al., 2000; Azevedo-Ramos & Galatti, 2002). Such a spatial variation in species composition and richness along the course of the Juruá River was also noticed for plants (Tuomisto et al., 2016), and other vertebrates as small mammals (Patton et al., 2000). This diversity gradient is likely a result of the geological, geomorphological, and pluviometric gradients crossed by this river basin (Patton et al., 2000; Tuomisto et al., 2016; Pupim et al., 2019). In fact, a considerable number of amphibian species are geographically constrained to the upper Juruá River basin (Gascon et al., 2000; Fonseca et al., 2019), particularly in the montane region of the Serra do Divisor, which emerges as one of the most species-rich localities for these vertebrates in

the entire Neotropics (Souza, 2009). Even so, our study reveals that much of the diversity previously reported in the Juruá River basin is underestimated by limited sampling effort, since the number of species found in the RBJ is among the highest reported for single Amazonian localities (see compilation by Freitas et al., 2020).

Amphibian and reptile species substitutions across Amazonian assemblages are also especially evident considering: (1) the main geological compartments, i.e., sedimentary basin of western Amazonia vs. Quaternary crystalline shields of eastern Amazonia (e.g., Ávila-Pires, 1995; Silva-Jr. & Sites-Jr., 1995; Rojas et al., 2018; Réjaud et al., 2020; Ribeiro-Júnior et al., 2021); and (2) the Amazon River as a geographic barrier, i.e., its northern vs. southern banks (e.g., Silva-Jr. & Sites-Jr., 1995; Godinho & da Silva, 2018; Rojas et al., 2018). Considering these main biogeographic units, the RBJ is inserted at western Amazonia sedimentary basin and at the southern bank of the Amazon River. This influence is particularly evident considering the high number of species recorded which are typical of these biogeographic units, while no species typical from the eastern Amazonia was recorded. Meanwhile, a degree of faunistic compositional homogeneity in the entire southwestern Amazonia sub-region is expected because of the high course dynamism of the Juruá River, and this pattern has already been evidenced for amphibians and small mammals (Gascon, 1996; Gascon et al., 2000). However, some species typical of western Amazonia recorded in the RBJ should not be considered as homogeneously distributed in the eastern direction, i.e., limited by the Madeira River, historically attributed as a boundary of a southwestern Amazonia area of endemism for birds (Cracraft, 1985). In fact, some of the species recorded in the RBJ have their geographic distribution expanding towards the central Juruá-Purus interfluve (Prudente et al., 2010, 2013), but apparently no longer occurring further East (e.g., the amphibians *S. sulcatus*, *A. simonstuarti*, *A. resplendens*, *P. nimio*, *Edalorhina perezii* Jiménez de la Espada, 1870, and the lizard *A. indigenorum*). This is supported by absence of these species reported so far in the Purus-Madeira interfluve, which has been historically well-sampled for both amphibians and reptiles (see Dias-Terceiro et al., 2015; Ferrão et al., 2016; Peixoto et al., 2019; Nogueira et al., 2019). This distributional pattern suggests that the RBJ's longitudinal zone may represent the maximum limit for their geographic occurrence. This would explain their rarity in our samplings, and they may also constitute isolated populations (see Carvalho et al., 2020). In addition to the Purus River as a geographic barrier, the distribution and dispersal of these species typical from the western Amazonia may be controlled by subtle gradients of climate, soils and vegetation types (see Tuomisto et al., 2019).

Regarding conservation status, according to the latest national list of threatened species (ICMBio, 2018), the amphibian and reptile species reported here for the RBJ are mostly in the Least Concern category (LC; 79%), which is a common event for Amazonian species since many of them are attributed to large extents of occurrence (Neckel-Oliveira et al., 2013). However, a consid-

erable percentage of the recorded species has not yet been properly assessed as to its conservation status (NE; 12%); the strabomantid *Pristimantis reichlei* Padial & de la Riva, 2009 is considered as Data Deficient (DD); and the three podocnemidids *Podocnemis expansa* (Schweigger, 1812), *Podocnemis sextuberculata* (Cornalia, 1849), and *Podocnemis unifilis* Troschel 1848 are considered to be Near Threatened (NT) of extinction. It is noteworthy that the scenario of ongoing and future anthropic changes in Amazonia is quite worrying (e.g., Latrubesse et al., 2017) and can directly or indirectly affect the biological diversity even in localities that are difficult to access such as the case of the RBJ.

Many traditional communities live in the RBJ, surviving mostly from extractivism, and the effective conservation of these environments can only be achieved by following the sustainable use of natural resources (ICMbio, 2009). In fact, even with a more permissive character, the value of sustainable use protected areas as the RBJ in preserving Amazonian habitats has been proven (Milien et al., 2021). We also highlight the need to monitor the expansion of the Juruá municipality, the largest urban nucleus in this region. This municipality is completely surrounded by the boundaries of the RBJ (ICMbio, 2009), and the permissive character of this conservation unit can lead to unsustainable advances that would irreversibly alter some of the RBJ habitats and associated biodiversity. It is also noteworthy the biased conservation caused by environmental differences between the banks of the lower Juruá River. While the non-flooded habitats are more protected on the right bank of the Juruá River by the RBJ and the indigenous territory Kumaru do Lago Ualá, an immense portion of seasonally flooded habitats on the left bank are less represented by protected areas. These habitats are essential contributors to the generation and maintenance of regional diversity, and we strongly suggest that this environmental difference should be taken into account in future assessments of biological conservation in this region.

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APPENDIX 1

Morphologically examined specimens.

BRAZIL: Amazonas: Juruá: Reserva Extrativista do Baixo Juruá.

AMPHIBIA: ANURA: ALLOPHRYNIDAE: *Allophryne resplendens*: INPA-H 023098; **AROMOBATIDAE:** *Allobates femoralis*: INPA-H 004784, 004921 004980, 005432, 028487, 028488, 028510, 028511, 028547-028549, 028551-028553, 039924, 039925; *Allobates vanzolinus*: INPA-H 004896 (holotype), 004903-004905, 004912 (paratypes); *Allobates* sp.: INPA-H 004787, 004798, 004799, 004803, 004863, 004869, 004870, 004875-004877, 004880, 004881, 004883, 004886-004888, 004889 (paratype of *A. gasconi*), 004891, 004901, 004906, 004910, 004911, 004913, 004914, 005274, 005275, 005347, 005348, 005366, 005416, 005418, 005431, 005502, 005580, 028475, 029864; **BUFONIDAE:** *Amazophrynella* sp.: INPA-H 004884, 004907, 004908, 004960, 005381, 005382; *Rhinella castaneotica*: INPA-H 004796, 004916, 004964, 015913, 015914, 015916-015920, 018817, 018823, 018827-018829, 019649, 019651-019653, 019655-019657, 019661, 019663, 019668-019675, 019678-019684, 019686-019690, 040058, 040061, 040063, 040064, 040065, 040068, 040069; *Rhinella exostosica*: INPA-H 005296, 005420, 015915, 015921, 018812, 018821, 018824, 040044, 040055, 040056, 040066, 040070; *Rhinella* aff. *margaritifera*: INPA-H 004890, 004892, 004895, 004918, 004922, 004947, 004954-004956, 004961, 004967, 004968, 004974, 005286, 005342, 005367, 015910-015912, 018818-018820, 018822, 019633-019648, 019650, 019654, 019658-019660, 019662, 019664-019667, 019676, 040045, 040047, 040048, 040050, 040051, 040053, 040054, 040060, 040071; *Rhinella* gr. *margaritifera*: INPA-H 004840, 004879, 004894, 004897, 004942, 004950, 004953, 004958, 004966, 004969, 004970, 005272, 005276, 005292-005295, 005300, 005336, 005349, 005350, 005409, 005413, 005460, 005471, 015922, 018813-018816; 018825; 018826, 018830, 018831, 019677, 019685, 019691, 019692, 040059, 040062; *Rhinella marina*: INPA-H 002222-002228, 005345, 015886-015890, 016246-016278, 017204, 017205, 017207, 017209, 017210, 040075, 040083, 040087, 040088, 040093; **CERATOPHRYIDAE:** *Ceratophrys cornuta*: INPA-H 004986, 004991, 016220, 040046, 040049, 040052, 040057; **DENDROBATIDAE:** *Ameerega hahneli*: INPA-H 004783, 004786, 004795, 004797, 004810, 004813, 004815, 004816, 004819, 004823, 004824, 004825, 004827, 004829, 004830, 004832-4851, 004856, 004858-004860, 004864-004867, 004871-004874, 004878, 004909, 004915, 004929-004931, 004933-004936, 004938-004941, 004943, 004944, 004948, 004962, 004996-004999, 005236-005255, 005257-005260, 005266, 005267-005271, 005303-005333, 005338, 005351-005353, 005355-005365, 005375-005380, 005384-005408, 005436-005453, 005455, 005457-005459, 005474, 005476-005480, 005482-005483, 005485-005500, 017300-017313, 028499, 028500, 028550, 028554; *Ameerega trivittata*: INPA-H 004800, 004811, 005334, 015863-015872, 017199-017203, 018779-018788, 029844, 039888, 039939-039950, 040072-040074; **ELEUTHERODACTYLIDAE:** *Phyzelaphryne nimio*: INPA-H 039787, 039791, 039794, 039801, 039816, 039817; **HYLIDAE:** *Boana appendiculata*: INPA-H 039855, 039856, 039860; *Boana boans*: INPA-H 017136, 017137, 018796, 040090; *Boana calcarata*: INPA-H 015940, 039865; *Boana cinerascens*: INPA-H 039835; *Boana geographica*: INPA-H 017248, 017249, 039850-039852; *Boana lanciformis*: INPA-H 015928, 017165, 017166, 017326, 017327, 040094, 040095, 040099; *Boana punctata*: INPA-H 002202-002210, 002214-002220, 028533-028540; *Boana raniceps*: INPA-H 002201, 016312-016318, 017138-017143, 017246, 017247, 039837; *Boana steinbachi*: INPA-H 039902, 039912, 039916; *Boana* aff. *steinbachi*: INPA-H 039858, 039901, 039903, 039905-039908, 039910, 039914, 039915, 039918, 039919, 039921, 039922; *Boana steinbachi* species complex: INPA-H 004808, 004927, 005374, 005425, 005426, 005429, 015948-015950; *Dendropsophus kamagarini*: INPA-H 004985, 039833; *Dendropsophus mapiquari*: INPA-H 004952; *Dendropsophus miyatai*: INPA-H 005464, 005466, 005468; *Dendropsophus reticulatus*: INPA-H 002221, 017126, 017168-017176, 017251, 017252, 039839; *Dendropsophus rossalleni*: INPA-H 005461-005463, 005465, 005467, 005469, 017250; *Osteocephalus castaneicola*: INPA-H 015943, 028512, 028514, 040015, 040033; *Osteocephalus helenae*: INPA-H 040031; *Osteocephalus* aff. *leprieurii*: INPA-H 040012, 040021, 040027, 040029, 040030, 040032, 040034, 040036-040040, 040042; *Osteocephalus taurinus*: INPA-H 004820, 004925, 004926, 004928, 004983, 005335, 005340, 005341, 005412, 005427, 005507, 005513, 040016, 040017, 040019, 040023, 040025, 040026, 040028, 040035, 040041, 040079, 040080; *Scarthyia goinorum*: INPA-H 017332; *Scinax cruentomma*: INPA-H 004788, 004792, 004793, 004801, 004802, 004804, 004807, 004812, 004818, 005368; *Scinax garbei*: INPA-H 004951, 017328, 017329, 028556; *Scinax nebulosus*: INPA-H 028556; *Scinax ruber*: INPA-H 002230-002233, 015923-015925, 015947, 017314-017317, 017331, 028480, 028481, 039857, 039861, 039863, 039867, 039911, 039913; *Sphaenorhynchus dorisae*: INPA-H 017704, 028468-028472, 039836; *Sphaenorhynchus lacteus*: INPA-H 028489, 028490, 028492-028497; *Trachycephalus cunauaru*: INPA-H 039917; *Trachycephalus typhonius*: INPA-H 028476, 028482; **LEPTODACTYLIDAE:** *Adenomera andreae*: INPA-H 004785, 004805, 004854, 004893, 004920, 004963, 004971-004973, 004977, 004979, 005284, 005289, 005414, 005421, 005470, 005472, 005473, 005475, 018801-018810, 019572-019599, 029871, 029873, 029875, 039786, 039788-039790, 039793, 039797-039800, 039803-039805, 039807-039809, 039812, 039818, 039819, 039909; *Adenomera simonstuarti*: INPA-H 005337, 029866-029870, 029872, 029874, 029876, 039792, 039796, 039813, 039814; *Edalorhina perezi*: INPA-H 005291, 016209-016214, 039810; *Engystomops petersi*: INPA-H 004789, 004809, 004853, 004861, 004862, 004917, 004923, 004924, 004959, 004965, 004976, 004988, 005287, 005288, 005346, 005369, 005410, 005411, 005415, 005417, 005503-005505, 015873-015884, 016279-16306, 017019-017114, 028491, 028498, 039996, 040001; *Leptodactylus discodactylus*: INPA-H 029865, 039880, 039881, 039893, 039894, 039896-039898; *Leptodactylus fuscus*: INPA-H 016319-016324; *Leptodactylus macrosternum*: INPA-H 017128, 039890, 039891, 039895, 039899; *Leptodactylus* cf. *mystaceus*: INPA-H 005290, 005428, 015908, 015909, 016215-016217, 017164, 018793; *Leptodactylus pentadactylus*: INPA-H 004794, 004806, 004814, 004898, 004899, 005343, 005344, 005419, 015927, 016225, 016226, 016227, 016228, 017127, 017215, 017244, 040077, 040091,

040097; *Leptodactylus petersii*: INPA-H 002211, 004957, 004975, 004978, 004992, 004993, 004994, 004995, 005297, 005301, 005302, 005434, 005501, 028559, 028560, 028561, 028562, 028563, 039795, 039811, 039884, 039892; *Leptodactylus rhodomystax*: INPA-H 005383, 016325, 017167, 018811; *Leptodactylus stenodema*: INPA-H 015904, 015905, 016331, 016332, 018790, 018791, 018792; *Lithodytes lineatus*: INPA-H 016221, 039882, 039883; **MICROHYLIDAE**: *Chiasmocleis avilapiresae*: INPA-H 017258, 017259 (paratypes); *Chiasmocleis bassleri*: INPA-H 005285, 039900, 039997, 040003, 040006, 040008-040010, 040014, 040022; *Chiasmocleis hudsoni*: INPA-H 040005, 040013, *Chiasmocleis ventrimaculata*: INPA-H 040000, 040002, 040004, 040007, 040011; *Ctenophryne geayi*: INPA-H 016234-016245, 039993-039995, 039998, 039999; **PHYLLOMEDUSIDAE**: *Phyllomedusa vaillantii*: INPA-H 005423, 039859; **PIPIDAE**: *Pipa pipa*: INPA-H 017245; **RANIDAE**: *Lithobates palmipes*: INPA-H 018794; **STRABOMANTIDAE**: *Oreobates quixensis*: INPA-H 004822, 004946, 004982, 004987, 004990, 005273, 005299, 016334, 016335, 017177-017183, 039868-039877, 039879; *Pristimantis reichlei*: INPA-H 005435, 028474; *Pristimantis* aff. *ockendeni*: INPA-H 004791, 004821, *Pristimantis* cf. *diadematus*: INPA-H 004984, 005339, 005424, 005506, 0017330; *Strabomantis sulcatus*: INPA-H 029919; **CAUDATA**: **PLETHODONTIDAE**: *Bolitoglossa* sp.: INPA-H 004981, 004989, 005422, 005430, 005433; **GYMNOPHIONA**: **CAECILIIDAE**: *Caecilia tentaculata*: INPA-H 016208, **TYPHLONECTIDAE**: *Potamotyphlops kaupii*: INPA-H 015931. **REPTILIA**: **SQUAMATA**: **ALOPOGLOSSIDAE**: *Alopoglossus atriventris*: INPA-H 015891-015894, 015936, 016354-016364, 017196-17198, 019600-019603, 039951, 39955, 039959, 039960, 039966, 039969, 039973, 039976; *Alopoglossus brevifrontalis*: INPA-H 015938, 015939, 016224, 039956, 039964, 039965, 039967, 039982; *Alopoglossus indigenorum*: INPA-H 039953 (paratype); **ANILIIDAE**: *Anilius scytale*: INPA-H 016201; **BOIDAE**: *Corallus hortulana*: INPA-H 017239, 040102; *Epicrates cenchria*: INPA-H 017231, 017232; **COLUBRIDAE**: *Chironius fuscus*: INPA-H 017293-017297; *Drymoluber dichrous*: INPA-H 018776; *Leptophis ahaetulla*: INPA-H 016205, 016206; *Oxybelis aeneus*: INPA-H 015859-015861; *Spilotes sulphureus*: INPA-H 017220; **DACTYLOIDAE**: *Anolis fuscoauratus*: INPA-H 015937, 017125, 017323-017325, 028557, 039828, 039840, 039846, 039847; *Anolis ortonii*: INPA-H 028558; *Anolis punctatus*: INPA-H 039844; *Anolis tandai*: INPA-H 015933-015935, 017124, 017318-017322, 039820, 039821, 039822, 039823, 039824, 039825, 039826, 039827, 039829, 039841, 039843, 039845, 039848, 039887; *Anolis transversalis*: INPA-H 017152-017154, 039842, 039889; **DIPSADIDAE**: *Atractus major*: INPA-H 015885, 018769, 018770; *Atractus poeppigi*: INPA-H 015862, 016204, 039736; *Atractus snethlageae*: INPA-H 039986, 039989; *Atractus* aff. *snethlageae*: INPA-H 039987, 039988; *Atractus torquatus*: INPA-H 017299, 039886, 039990; *Dipsas catesbyi*: INPA-H 015932, 017256; *Drepanoides anomalus*: INPA-H 016049, 018774; *Erythrolamprus aesculapii*: INPA-H 01620; *Erythrolamprus pygmaeus*: INPA-H 017160-017162; *Erythrolamprus reginae*: INPA-H 015930, 017155, 017156; *Erythrolamprus typhlus*: INPA-H 018775; *Helicops angulatus*: INPA-H 016470, 017157, 017158, 017235, 018771, *Helicops hagmanni*: INPA-H 015951; *Helicops polylepis*: INPA-H 039992; *Imantodes cenchoa*: INPA-H 017134, 040098; *Leptodeira annulata*: INPA-H 016202, 039991; *Oxyrhopus melanogenys*: INPA-H 016471, 017224, 018772; *Oxyrhopus occipitalis*: INPA-H 018773; *Pseudoeryx plicatilis*: INPA-H 013193, 017233, 017234; *Siphlophis cervinus*: INPA-H 017159; *Thamnodynastes pallidus*: INPA-H 017236, 017237; *Xenodon rabdocephalus*: INPA-H 018765; *Xenoxybelis boulengeri*: INPA-H 017163; **ELAPIDAE**: *Micrurus hemprichii ortonii*: INPA-H 016203, 017123; *Micrurus langsdorffi*: INPA-H 017253, 018766, 018767; *Micrurus lemniscatus*: INPA-H 018768; **GEKKONIDAE**: *Hemidactylus mabouia*: INPA-H 039931; **GYMNOPHTHALMIDAE**: *Arthrosaura reticulata*: INPA-H 015929, 016307-016311, 017260, 017261, 017267, 039952, 039954; *Cercosaura argulus*: INPA-H 017268; *Cercosaura bassleri*: INPA-H 016222, 016223; *Iphisa elegans elegans*: INPA-H 015897-015899, 015944, 016338, 018797-018799, 039962, 039963, 039968, 039971, 039972, 039980, 039983; *Loxopholis percarinatum*: INPA-H 039974, 039978, 039979; *Loxopholis snethlageae*: INPA-H 015945, 015946, 016339, 022953-022957, 028467, 039957, 039958, 039961, 039970, 039975, 039977, 039981, 039984, 039985; **IGUANIDAE**: *Iguana iguana*: INPA-H 015856, 016478, 016479, 017257; **PHYLLODACTYLIDAE**: *Thecadactylus solimoensis*: INPA-H 040101; **SCINCIDAE**: *Copeoglossum nigropunctatum*: INPA-H 015900-015902, 039938; **SPHAERODACTYLIDAE**: *Chatogekko amazonicus*: INPA-H 017255, 030344-030346; *Gonatodes humeralis*: INPA-H 015941, 015942, 028531, 028532, 039926, 039928, 039930, 039932, 039934, 039935; *Lepidoblepharis heyerorum*: INPA-H 017254; **TEIIDAE**: *Ameiva ameiva*: INPA-H 017117-017119, 017130, 017131, 017225-017227, 040078, 040085, 040086, 040092, 040100; *Crocodylurus amazonicus*: INPA-H 015857, 015858, 017228, 040089; *Kentropyx altamazonica*: INPA-H 016229-016231, 016336, 016337, 017121, 017122, 017132, 017133, 017229, 017230, 017241; *Kentropyx pelviceps*: INPA-H 015895, 015896, 016218-017120, 018795, 039927, 039929, 040096; *Tupinambis teguixin*: INPA-H 017240, 040076; **TROPIDURIDAE**: *Plica plica*: INPA-H 017115, 017116, 017243; *Plica umbra ochrocollaris*: INPA-H 015903, 017184-017194; *Uranoscodon superciliosus*: INPA-H 015853-015855, 017144-017151, 017242, 018800, 040082, 040084; **VIPERIDAE**: *Bothrocophias hyoprora*: INPA-H 017135; *Bothrops atrox*: INPA-H 015906, 017217, 017218, 017238, 017262-017264, 039885; *Bothrops brazili*: INPA-H 015907; *Lachesis muta muta*: INPA-H 018777.

BRAZIL: Amazonas: Juruá: left margin of the lower Juruá River, opposed to the Andirá River confluence.

AMPHIBIA: **ANURA**: **BUFONIDAE**: *Rhinella* gr. *margaritifera*: INPA-H 040067; *Rhinella marina*: INPA-H 039802, 039806; **HYLIDAE**: *Boana appendiculata*: INPA-H 039832, 39866; *Boana geographica*: INPA-H 039853, 39854; *Boana punctata*: INPA-H 039834; *Boana raniceps*: INPA-H 039838; *Boana* aff. *steinbachi*: INPA-H 039904, 039920, 039923; *Osteocephalus helenae*: INPA-H 040043; *Osteocephalus* aff. *leprieurii*: INPA-H 040018; *Osteocephalus taurinus*: INPA-H 040020, 040024; *Scinax garbei*: INPA-H 039862; *Scinax ruber*: INPA-H 039830, 039831, 039864; **LEPTODACTYLIDAE**: *Adenomera hylaedactyla*: INPA-H 039815; *Leptodactylus petersii*: INPA-H 039795; **STRABOMANTIDAE**: *Pristimantis fenestratus*: INPA-H 039878. **REPTILIA**: **SQUAMATA**: **DACTYLOIDAE**: *Anolis fuscoauratus*: INPA-H 039849; **SCINCIDAE**: *Copeoglossum nigropunctatum*: INPA-H 039936, 039937; **SPHAERODACTYLIDAE**: *Gonatodes humeralis*: INPA-H 039933; **TROPIDURIDAE**: *Uranoscodon superciliosus*: INPA-H 040081.