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Article

Amphibians and reptiles of the Refúgio Biológico Bela Vista – Itaipu Dam, state of Paraná, southern Brazil

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Abstract: Information regarding species occurrence is fundamental to understanding biodiversity distribution. However, the biodiversity from the west of the state of Paraná has been historically less studied, especially amphibians and reptiles. For this reason, we present the first reptile list of species from the west of the state of Paraná and extend the current list of anurans for the municipality of Foz do Iguaçu. The species list was based on a systematic field study conducted at Refúgio Biológico Bela Vista (RBV) a conservation area within the Hydroelectric Power Itaipu Binacional. We integrated the species list with previous species observations available in the literature for the same place where our sampling was conducted. A total of 41 species of amphibians and reptiles are presented. All amphibians species found were recorded in the field; however, from the 22 species of reptiles recorded, three were historical records obtained before this study. Species were all classified as Least Concern and/or had stable populational status according to the IUCN. Sampling sufficiency was achieved for anurans but not for reptiles, probably due to low abundance of several snake species. The most abundant species of anuran was *Dendropsophus nanus*, from the Hylidae family, whereas *Leptodactylus plaumanni* and *Scinax squalirostris* were represented by only one individual each. The lizard *Salvator merianae* was the most abundant reptile, and seven species were represented by only one individual each. The most successful sampling method for adult anurans was active search in water bodies whereas most of reptile species were observed by accidental encounters and not through a systematic sampling method. We found that herpetofauna composition from RBV was similar to other communities from Paraná state that also occur within the Semideciduous Seasonal Forest. Finally, as additional information to the species list, we offer species identification keys and discuss the importance of Refúgio Biológico Bela Vista to harbor the anuran and reptile diversity of the region.
Keywords: *Atlantic Forest; Herpetofauna; Identification keys; Semideciduous forest; Species inventory.*

Anfíbios e répteis do Refúgio Biológico Bela Vista – hidrelétrica Itaipu, estado do Paraná, sul do Brasil

Resumo: Informações sobre a ocorrência de espécies são fundamentais para a compreensão da distribuição da biodiversidade. Porém, a biodiversidade do oeste do Estado do Paraná tem sido historicamente menos estudada, especialmente a de anfíbios e répteis. Por esse motivo, apresentamos a primeira lista de espécies de répteis do oeste do Estado do Paraná e ampliamos a lista atual de anuros para o município de Foz do Iguaçu. A lista de espécies foi baseada em um estudo sistemático de campo realizado em uma área de conservação dentro da Usina Hidrelétrica Itaipu Binacional. Integramos a lista de espécies com observações de espécies anteriores disponíveis na literatura para o mesmo local onde nossa amostragem foi realizada. Um total de 41 espécies são apresentadas. Todas as espécies de anuros encontradas foram registradas em campo; entretanto, das 22 espécies de répteis registradas, três foram registros obtidos antes deste estudo. Todas as espécies foram classificadas como “Pouco Preocupante” e/ou tinham status de “População Estável” de acordo com a IUCN. A suficiência amostral foi alcançada para anuros,

mas não para répteis, provavelmente devido à baixa abundância de diversas espécies de serpentes. A espécie de anuro mais abundante foi *Dendropsophus nanus*, da família Hylidae, enquanto *Leptodactylus plaumanni* e *Scinax squalirostris* foram representados por apenas um indivíduo cada. O lagarto *Salvator merianae* foi o réptil mais abundante, e sete espécies foram representadas por um indivíduo cada. O método de amostragem mais bem sucedido para anuros adultos foi a busca ativa em corpos d'água, enquanto a maioria das espécies de répteis foi observada por encontros acidentais e não através de um método de amostragem sistematizado. Descobrimos que a composição da herpetofauna do Refúgio Biológico Bela Vista foi semelhante à de outras comunidades do estado do Paraná que também ocorrem dentro da Floresta Estacional Semidecidual. Por fim, como informações adicionais à lista de espécies, oferecemos chaves de identificação das espécies e discutimos sobre a importância da área de Itaipu para abrigar a diversidade de anuros e répteis da região.
Palavras-chave: *Mata Atlântica; Herpetofauna; Chave de identificação; Floresta semidecidual; Inventário de espécies.*

Introduction

The urgency of inventorying and monitoring biodiversity is paramount in light of the ongoing biodiversity crisis we are currently experiencing. The conduct of species inventories represents the most elementary information requisite for comprehending biodiversity distribution (Silveira et al. 2010). Herpetofauna occurrence data contribute to our knowledge of species' geographical distribution and are helpful in delineating effective management plans in threatened areas (Oliveira et al. 2016, Trindade-Filho et al. 2012). One of these areas is the Atlantic Forest, a biodiversity hotspot (Myers et al. 2000), which houses over 50% of all amphibians from Brazil, with prominent endemism (Rossa-Feres et al. 2017, Rojas-Padilla et al. 2020) and ca. 33% of all reptile species (Silva 2017). This higher biodiversity, however, may be linked to well-preserved areas, mainly in mountain areas in the Atlantic Forest (Silva et al. 2012; Rossa-Feres et al. 2017). In contrast, in human-modified or anthropized Atlantic Forest landscapes, species richness should be lower mainly due to habitat loss and degradation (Rodrigues 2005, Fiorillo et al. 2018). Novel studies on herpetofauna communities in modified tropical landscapes are necessary to elucidate species' sensitivity to disturbed environments (Ganci et al. 2022). Since community response to environmental modification might have regional-dependent characteristics (Pelinson et al. 2022), these studies can provide data that increase conservation planning and action on a regional and local scale (Palmeirim et al. 2017, Figueiredo et al. 2019).

Despite their enormous original extension, the Atlantic Forest is currently the most deforested Brazilian tropical forest (SOS Mata Atlântica 2018). It is estimated that only ca. 8 to 12% of its original area endured the deforestation that has taken place since the colonization (Myers et al. 2000, Ribeiro et al. 2009, Silva et al. 2017). In the state of Paraná, the original area of the Atlantic Forest from the Third Plateau of Paraná - the lower plateau in the western side - comprised ca. 45% of the state's vegetational formation (SOS Mata Atlântica 2018). The forest of this region is classified as Semideciduous Seasonal Forest (SSF), characterized by vegetation with deciduous leaves that during winter can lose up to 50% of the canopy cover (Veloso et al. 1991, Giraudo et al. 2003). The SSF is a critically threatened vegetational formation in the state of Paraná - because of its countryside position, this formation suffered the advance of cattle ranching and monoculture - remaining only ca. 0.1% of its original distribution (Medri et al. 2002). Hence, remnants of the SSF are mainly distributed in sparse fragments along the west side in the state of Paraná (Ribeiro et al. 2009), with the majority of these fragments lacking inventories of amphibians and reptiles.

One of the largest forest fragments in the western region of the state of Paraná is the Refúgio Biológico Bela Vista (RBV). The Itaipu Binacional Hydroelectric Power Plant (a binational entity of Brazil and Paraguay) established several extensive conservation areas as a compensatory program during hydroelectric dam construction (Ziober et al. 2014), with a substantial portion of this area referred to as the Refúgio Biológico Bela Vista. These areas were created primarily to shelter and protect regional biodiversity from the flooding derived from the dam construction, but it also have the potential for conservation over a longer period. These conservation areas are located marginally in the Paraná River, which was originally surrounded by riparian SSF forest. The Refúgio Biológico Bela Vista (RBV) is the largest Itaipu conservation area on the Brazilian side, classified as an Advanced Station in the Atlantic Forest Biosphere Reserve by UNESCO. Although the history of the area's establishment is well-documented, there is a lack of herpetofauna inventories in the region. There are no historical records of amphibians for the area, however, data on reptile species richness are available, which were collected during the creation of the Itaipu Dam (Ziober & Zanirato 2014), but the species composition is unavailable. Due to a long history of different types of land use in the region, the RBV is characterized by a miscellaneous of land uses, however, including reforestation areas and secondary forests in advanced successional stages that have not been interfered for over 30 years. Notwithstanding, the herpetofauna community of RBV could reflect recolonization events from surrounding communities since the Itaipu reservoir construction.

The forest remnants preserved by Itaipu Dam are interesting for studying long-term biological community response to landscape modification and, at the same time, provide essential information on species geographical distribution for understudied areas where no survey has been placed. A large gap in knowledge on herpetofauna communities remains for Western Paraná, where inventories are scarce. Only punctual records of reptile species have been observed for the region (e.g., Moura-Leite et al. 1996), and one study focused on amphibian community (Leivas et al. 2018). Due to the intensive degradation of the entire extension of SSF, inventories are important to understand how biodiversity currently occupies this threatened vegetational formation. Furthermore, comparing the composition of communities along different SSF localities can also provide insights into the regions that are somehow harboring similar species and, therefore, indistinguishable from each other; and consequently, which regions are unique in its composition.

Here, we provide a species inventory of amphibians and reptiles in a conservation area of the Semideciduous Seasonal Forest on the most Western side of the state of Paraná. More specifically, our study had the following aims: (i) we presented the comprehensive inventory of amphibians and reptile for this region, which is the first reptile species list in the region; (ii) we evaluated the effectiveness and synergistic potential of a range of methodologies used in the collection of amphibian and reptile data; (iii) we carried out a comparative analysis of the compositions of amphibian and reptile communities in contrast to other herpetofauna communities in the Semideciduous Seasonal Forest, shedding light on their distinctions and similarities; and (iv) we produced taxonomic identification keys, specifically designed to expedite the identification of amphibian species, encompassing both adults and tadpoles, as well as reptilian fauna. We expect that the species composition among communities will be related to geographic distance. The similarity of species composition between communities tends to decrease with increased distance, this pattern is observed across various taxa (Astorga et al. 2012), including amphibians (Garey & Silva 2010). This is attributed to limitations in dispersion and the spatial structuring of environmental characteristics (Astorga et al. 2012). Even though some differences might appear due to the land-use history of the locals. We discuss some remarkable records and the importance of this area for herpetofauna conservation.

Materials and Methods

1. Study area

This study was conducted in the conservation area Refúgio Biológico Bela Vista (RBV) maintained and managed by Itaipu Binacional, situated in Foz do Iguaçu municipality, state of Paraná, Brazil (25°44′90″S, 54°55′42″W) (Figure 1). Foz do Iguaçu is located in the south of Brazil, in the western portion of Paraná state, neighboring territories with Paraguay and Argentina. The local climate is temperate and humid with hot summer, Cfa, following Köppen's classification (Alvares et al. 2013). The region has one of the biggest annual thermal amplitudes in the state of Paraná, an approximate value of 11 °C of the average difference between the winter (June to August) and summer (December to March). Summers usually average around 33 °C, eventually surpassing the 40°C. Conversely, winter can present temperatures below zero during the passage of cold fronts with polar air masses. Rainfalls are usually evenly distributed throughout the year, with a slight decrease during winter, with annual precipitation totaling around 1800mm (Delgado et al. 2016). The area belongs to the morphostructural subunit of the Foz do Iguaçu plateau, characterized by flat and gently undulating top relief not exceeding 540 m in elevation (Santos et al. 2006).

The RBV represents 1.920 ha from 41.039 ha of the Itaipu area and has an altitudinal variation from ca. 100 to ca. 250 m. a.s.l. RBV was characterized by a heterogeneous landscape with different formations that endured three asynchronous types of land use transformation (secondary forest, reforestation, and anthropized). Before the hydroelectric construction, the area was partly covered by SSF vegetation (Roderjan et al. 2002) that experienced selective cutting and partly by grazing pasture. After the construction of the reservoir, the remnants of pasture fields were initiated in reforestation activities approximately 40 years ago. Excluding forested landscapes, other areas were profoundly anthropized, corresponding to the locations where Itaipu constructions were present. It can be found in these areas open fields, buildings, roads, and a fish pass system liking the Paraná River to Itaipu Reservoir that allowed migratory fishes to find suitable spawning in tributaries of Itaipu Reservoir and the floodplain located upstream (See Makrakis et al. 2007 for more details), called Canal da Piracema. The RBV is not a conservation unit under any government office (federal, state, or municipal) or a private reserve; hence it is administrated only by Itaipu Binational.

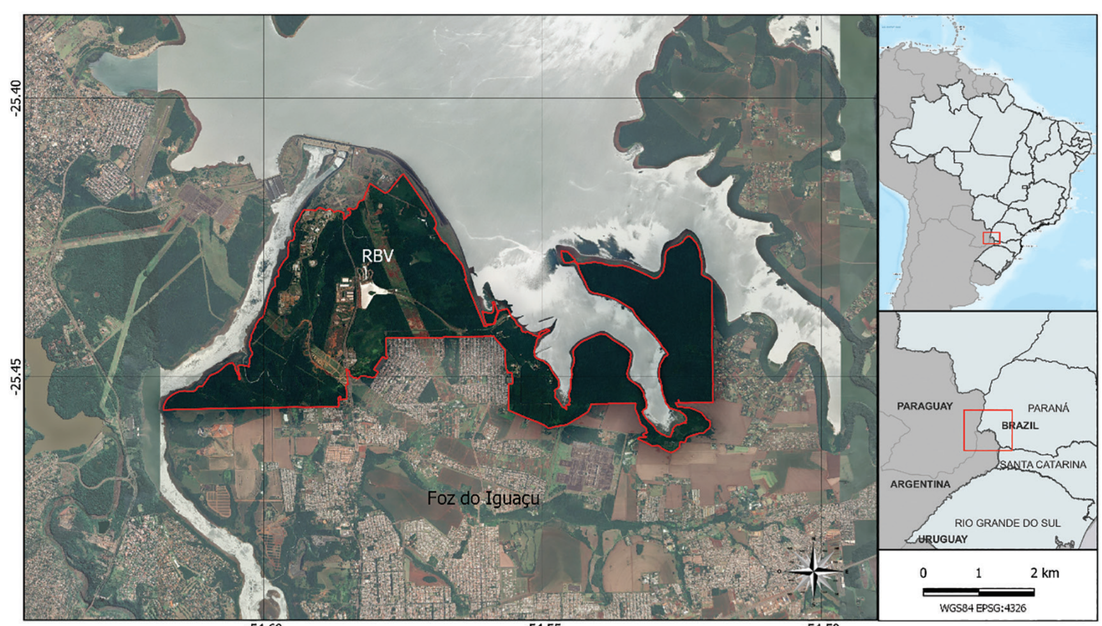

Figure 1. Geographical location of the study area: Refúgio Biológico Bela Vista (RBV), Foz do Iguaçu municipality, state of Paraná, Southern Brazil.

2. Data collection

We sampled amphibians and reptiles from January 2021 to July 2022. Sampling events were carried out bimonthly, with 15 days of field activities and a 45-day interval between sampling events, totaling 120 days of fieldwork. Over these 15 days, we sampled adult anurans, anuran larvae (tadpoles), and reptiles from terrestrial and aquatic environments. Additionally, to incorporate our database and embrace a better temporal perspective of the species that could be found in the RBV, we provide information on the species recorded previously to this study (historical records), even though they were not included in the rarefaction or cluster analyses.

Sampling amphibians and reptiles in terrestrial environments was performed by visual encountering through time-constrained searches in transects (Mackey et al. 2010), pitfall traps with drift fences (Greenberg et al. 1994, Cechin & Martins 2000), and accidental encounters (Martins & Oliveira 1998). Our sampling design for time-constrained searches in transects consisted of 18 transects of 100 m with a sampling effort of one hour in each transect. Each transect was searched two times, once in the first week at daylight and night during the second week, totaling 288 hours. We used 24 pitfall traps; each was a straight line of drift fence made of a black canvas of 70 cm height and 100-m long, and with five plastic buckets of 60 L, equally spaced by 20-m. We perforated the bottom of the buckets and added a small piece of polystyrene to prevent animal death by drowning in the case of rain. During the first week of each expedition, all 24 pitfall traps were checked daily for herpetofauna specimens, totaling 960 hours. Finally, accidental encounters included all specimens visualized by the researchers and civilians at any location and day, as long as it was within the Itaipu border and occurred within the study period (2021 to 2022). Only individuals found through accidental encounters identified by the researchers of this study were part of our database.

In aquatic habitats, we registered adult anurans through surveying at breeding sites (Scott et al. 1994), herein named as time-constrained searches (*sensu* Corn & Bury 1990) in water bodies, and tadpoles by a quantitative sampling of tadpoles (Scott et al. 1994). Reptiles were sampled using double-ended funnel traps (Greenberg 1994). In time-constrained searches in water bodies, we sampled adult anurans and tadpoles at 16 water bodies: one temporary lotic, two perennials lotic, six temporary lentic, and seven perennial lentic water bodies. Time-constrained searches in water bodies sampling occurred at night, with a sampling effort of one hour in each water body, totaling 128 hours. During the campaigns, the sampling order of the environments was randomized to minimize the effects of variation in species activity throughout the night. Tadpole sampling occurred during the daylight by sweeping dipnets in the same water bodies where adults were sampled. Dipnets consisted of a round 30-cm diameter frame supporting a 3 mm nylon mesh with a 1.5-m handle. Each water body was sampled for tadpoles for one hour in each campaign, totaling 128 hours of sampling effort. All species seen or heard were recorded for further identification. Four funnel traps were placed in water bodies and with the longitudinal half portion immersed in the water. Funnel traps were left in water bodies for five days consecutively during each campaign, totaling 3840 hours. Funnel traps consisted of a 100 cm long cylinder of nylon line net with two funnels - oriented to the inside - on both extremities (double-ended trap) made of aluminum hoops; the large hoop of the funnel had 45 cm of diameter, and the smaller hoop 20 cm of diameter. Chicken giblets and cow's kidneys were used as baits inside a 15 cm plastic pipe to attract freshwater turtles and alligators.

We obtained the abundance data for each species by summing the total number of individuals observed during a single sampling campaign when the species exhibited the highest abundance considering all sampling methods together. We provided the conservation status for each species of amphibians and reptiles at international, federal, and state levels. Status was attributed based on the IUCN Red List (2022) for the international level classification, the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio 2018a, b) for federal and the Livro Vermelho de Fauna Ameaçada no Estado do Paraná (Mikich & Bérnils 2004) for the state level classification.

We collected some voucher specimens following ethical and legal guidelines according to Brazilian laws (collection license ICMBio/SISBIO 73800 and 73839). The identity of the species was validated by specialists in the taxonomy of tadpoles (PhD. Denise de C. Rossa Feres) and adults of anurans (PhD. Célio F. B. Haddad) and reptiles (PhD. Júlio C. Moura Leite). Voucher specimens were posteriorly deposited in the herpetological collection of Universidade Federal da Integração Latino-Americana (UNILA), Foz do Iguaçu municipality, state of Paraná, Brazil. See the Supplementary Material to access the specimens collected and included in the Bertha Lutz Herpetological Collection.

3. Data analyses

Sample success was described as the proportion of the richness sampled by each sampling method in relation to the total richness, separated between anurans (adults and tadpoles) and reptiles. Sampling sufficiency was evaluated through individual-based rarefaction curves and extrapolation (Gotelli & Colwell 2001). We generated 1000 rarefaction curves based on individual randomization using interpolation and extrapolation methods from the *iNEXT* package (Hsieh et al. 2016). We created a rarefaction curve for total of reptiles and the total of amphibians separately because of contrasting observed abundances. We implemented the Hill series with the *q* exponent of 0, which is a measure of observed richness, without considering abundance (Chao et al. 2014).

In addition, we compared the RBV herpetofauna community with other inventories from the Semideciduous Seasonal Forests formation of the Atlantic Forest. For this analysis, only species identified up to the species level were considered. Therefore, species with uncertain taxonomy (e.g., 'sp.', 'gr.', 'aff.', and 'cf.') were not included. The assemblages included in the cluster were: Bertoluci et al. (2009), Cacciali et al. (2015), Garey & Silva (2010), Leivas et al. (2018), López & Garey (2021), López & Prado (2012), Mesquita et al. (2018), Moura et al. (2012), Neves et al. (2017), Protázio et al. (2021), Rampim et al. (2018), Shibatta et al. (2009), Souza Filho & Oliveira (2015), Souza-Costa et al. (2020), Souza et al. (2012), Uetanabaro et al. (2007), Zina et al. (2007). Due to methodological differences among studies, we only considered data on the presence and absence of species in each inventory. We constructed two dendrograms, one for squamates and one for amphibians, based on a Jaccard similarity index (*vegan* package; Oksanen et al. 2022). Reptile clustering accounted only for squamates because of the difficulty of finding more studies that included all types of reptiles in SSF assemblages. Therefore, we did not construct a cluster for all reptiles so as not to inflate assemblages' differences. We chose the best clustering method that had the higher cophenetic correlation score; the competitive methods tested were: Single Linkage, Complete Linkage, Unweighted Pair-Group Method using Arithmetic average (UPGMA), Weighted Pair-Group Method using Arithmetic average (WPGMA), Unweighted pair-group method using centroids (UPGMC), Weighted pair-group method using centroids (WPGMC) and Ward's Minimum Variance Clustering. Dendrograms were constructed using UPGMA for both anurans and reptiles. All statistical analyses were conducted in R environment (R Core Team 2022).

The identification key was elaborated to separate anurans, tadpoles, and reptiles at species terminal level. We used external morphology characters that can be easily observed from naked eye or using a stereomicroscopes. The identification key of adult anuran was elaborated based only on the specimens collected at Refúgio Biológico Bela Vista. As we were unable to record tadpoles of all species in RBV, we utilized specimens already included in the collection and relied on external morphological characteristics available in the articles (De Sá et al. 1997, Rossa-Feres & Nomura 2006). For reptiles, some species characters were described based on general morphology of individuals of the species because we did not have testimony specimens, i.e., *Caiman latirostris, Phrynops geoffranus, Chelonoidis carbonarius*, *Eunectes noteaus, Erythrolamprus aesculapii, Oxyrhopus guibei* and *Xenodon merremi.*

Results

We recorded 38 species of amphibians and reptiles from the Anura, Squamata, Crocodylia, and Testudines orders. A representative fraction of the species collected is shown in Figures 2 and 3. Adding the historical records with the species sampled during this study, the RBV presented 41 species of anurans and reptiles. Based solely on species recorded from our field data, we found 19 species of anurans from five families (Table 1, Figure 4), at least one adult of the same species was collected for each tadpole species sampled.

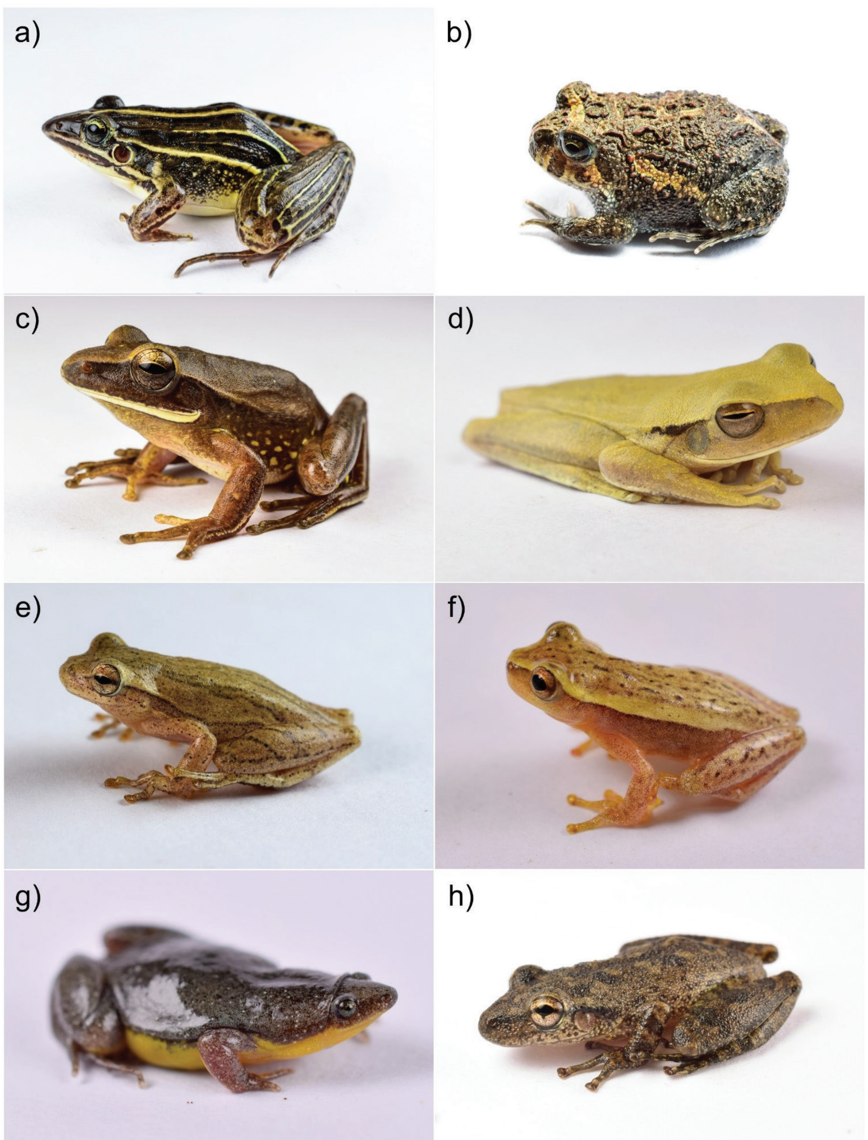

Figure 2. Some anuran species recorded in the Refúgio Biológico Bela Vista (RBV) at Foz do Iguaçu, state of Paraná. (a) *Leptodactylus plaummani*; (b) *Odontophrynus reigi*; (c) *Boana albopunctata*; (d) *Boana raniceps*; (e) *Dendropsophus nanus*; (f) *Dendropsophus minutus*; (g) *Elachistocleis bicolor*; (h) *Scinax berthae* (Photos by GSVF and TAK).

Figure 3. Some reptile species recorded in the Refúgio Biológico Bela Vista (RBV) at Foz do Iguaçu, state of Paraná. (a) *Bothrops jararaca*; (b) *Bothrops moojeni*; (c) *Erythrolamprus macrossomus*; (d) *Micrurus corallinus*; (e) *Dipsas mikanii*; (f) *Liotyphlops beui*; (g) *Amphisbaenia mertensi*; (h) *Tropidurus catalanensis* (Photos by GSVF and TAK).

For reptiles, we recorded 19 species, one of which is a species of alligator from the Alligatoridae family, two are tortoises from Testudinidae, eleven snake species from four families, and five lizard species from five families at Refúgio Biológico Bela Vista (RBV), Foz do Iguaçu, state of Paraná, southern Brazil. Based on adult anuran individuals, the most abundant species was *Dendropsophus nanus* representing ca. 38% of the total anurans, and the least abundant was both *Leptodactylus plaumanni* and *Scinax squalirostris*, representing less than 1% of the anurans total (one individual of each species). For the reptiles, *Salvator merianae* ca. 20% of the total reptiles. *Caiman latirostris*, the second highest abundant reptile, representing ca. 17%, and *Bothrops moojeni*, counted ca. 15% of the total. Several species were equally rare and were represented by only one individual. These species were *Bothrops jararaca, Bothrops jararacussu, Philodryas olfersii, Micrurus corallinus,* and *Chelonoidis carbonarius*, each representing less than 1% of the total of reptiles.

Approximately 74% of the amphibian species recorded in RBV exhibit stable populations, while 16% have unknown population trends, and 10% of species remain unassessed (Table 1). As for reptiles, 50% of species display stable populations, 32% have unknown status, and 18% have not been evaluated by the IUCN (Table 1). Species recorded at RBV were not classified as threatened in any of the endangered list of species: state (Paraná red list), national (ICMBio), or international (IUCN Red List). Notwithstanding, the Cope's toad *Rhinella diptycha* is assessed as Data Deficient, and consequently, its populational trend is Unknown due to its taxonomic status, the extent of occurrence, and ecological requirements (IUCN Red List). This species is common in the region where the study was conducted, possibly with stable and high populational density. Still, some species have been recently elevated to the taxonomic category of species, and no information is available on the IUCN Red List (Table 1).

Table 1. List of herpetofauna species recorded in the Refúgio Biológico Bela Vista (RBV), municipality of Foz do Iguaçu, state of Paraná, southern Brazil. Maximum abundance per species (N), sampling method (Method), and habitat type (Habitat). TCW – time-constrained search in water bodies, TCT – time constrained in transects, PT – pitfall traps with drift fences, AE – accidental encounter. SF – secondary forest, RE – restoration forest, DI – disturbed areas. Population status according to the IUCN (2022): Stb – stable, Unk – Unknown, Dec – Decreasing, Inc – Increasing.

TAXA	N	Method	Habitat	IUCN
AMPHIBIA				
ANURA				
Bufonidae				
Rhinella diptycha (Cope, 1862)	37	TCW, TCT, PT, AE	SF, RE, DI	Unk
Hylidae				
Boana albopunctata (Spix, 1824)	53	TCW, TCT	SF, RE, DI	Stb
Boana raniceps (Cope, 1862)	55	TCW, TCT	SF, RE, DI	Stb
Dendropsophus minutus (Peters, 1872)	333	TCW, TCT	SF, RE, DI	Stb
Dendropsophus nanus (Boulenger, 1889)	745	TCW, TCT	SF, RE, DI	Stb
Scinax berthae (Barrio, 1962)	2	TCW	SF	Stb
Scinax fuscovarius (Lutz, 1925)	31	TCW, TCT, PT, AE	SF, RE, DI	Stb
Scinax granulatus (Peters, 1871)	12	TCW, TCT	SF, RE, DI	Stb
Scinax squalirostris (Lutz, 1925)	1	TCW	RE	Stb
Trachycephalus typhonius (Linnaeus, 1758)	15	TCW, TCT	SF, RE, DI	Stb
Microhylidae				
Elachistocleis bicolor (Guérin-Méneville, 1838)	62	TCW, TCT, PT	SF, RE, DI	Stb
Leptodactylidae				
Leptodactylus elenae Heyer, 1978	70	TCW, TCT, PT	SF, RE, DI	Unk
Leptodactylus fuscus (Schneider, 1799)	86	TCW, TCT	SF, RE, DI	Stb
Leptodactylus plaumanni Ahl, 1936	1	TCW	DI	Stb
Leptodactylus luctator (Steffen, 1815)	58	TCW, TCT, PT	SF, RE, DI	NA
Leptodactylus podicipinus (Cope, 1862)	284	TCW, TCT, PT	SF, RE, DI	Stb
Physalaemus cuvieri Fitzinger, 1826	99	TCW, TCT, PT, AE	SF, RE, DI	Stb
Odontophrynidae				
Odontophrynus reigi Rosset, Fadel, Guimarães, Carvalho, Ceron, Pedrozo, Serejo, Souza, Baldo, and Mângia, 2021	4	TCW, TCT	DI	NA
Proceratophyrs avelinoi Mercadal de Barrio and Barrio, 1993	7	TCW, PT	SF, RE	Unk
REPTILIA				
CROCODYLIA				
Alligatoridae				
Caiman latirostris (Daudin, 1801)	16	TCT	SF, RE, DI	Stb
TESTUDINES				
Chelonoidis carbonarius (Spix, 1824)	1	-	-	NA
Phrynops geoffroanus (Schweigger, 1812)	1	-	-	NA
SQUAMATA				
Amphisbaenidae				
Amphisbaenia mertensi Strauch, 1881	3	TCT, PT	SF, RE, DI	Unk
Hemidactylidae				
Hemidactylus mabouia (Moreau de Jonnès, 1818)	5	AE	DI	Stb
Tropiduridae				
Tropidurus catalanensis Gudynas & Skuk, 1983	11	AE	DI	Unk
Teiidae				
Salvator merianae (Duméril & Bibron, 1839)	19	PT, AE	SF, RE, DI	Stb

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TAXA	N	Method	Habitat	IUCN
Scincidae				
Notomabuya frenata (Cope, 1862)	3	PT	SF	Stb
Anomalepididae				
Liotyphlops ternetzii (Amaral, 1924)	4	TCT, PT	SF, DI	Unk
Boidae				
Eunectes notaeus Cope, 1862 [P]	-	-	-	Stb
Colubridae				
Dipsas mikanii Schlegel, 1837	4	TCT, PT, AE	RE, DI	Stb
Erythrolamprus macrosomus (Amaral, 1936)	4	PT, AE	SF, RE, DI	NA
Erythrolamprus aesculapii (Linnaeus, 1758) [P]	-	-	-	Stb
Leptophis marginatus (Cope, 1862)	2	AE	DI	NA
Philodryas olfersii (Lichtenstein, 1823)	1	AE	DI	Stb
Dryophylax hypoconia (Cope, 1860)	2	TCT	SF, DI	Stb
Xenodon merremi (Wagler, 1824) [P]	-	-	-	Stb
Oxyrhopus guibei Hoge & Romano, 1977	1	AE	SF	Stb
Elapidae				
Micrurus corallinus (Merrem, 1820)	1	AE	RE	Unk
Viperidae				
Bothrops jararaca (Wied-Neuwied, 1824)	1	AE	SF	Unk
Bothrops jararacussu Lacerda, 1884	1	TCT	RE	Unk
Bothrops moojeni Hoge, 1966	14	TCT, PT, AE	SF, RE, DI	Unk
Total = 41	2049			

P (previous observations) – Historical records: species that were previously recorded at the Refúgio Biológico Bela Vista, which were not found in the present study.

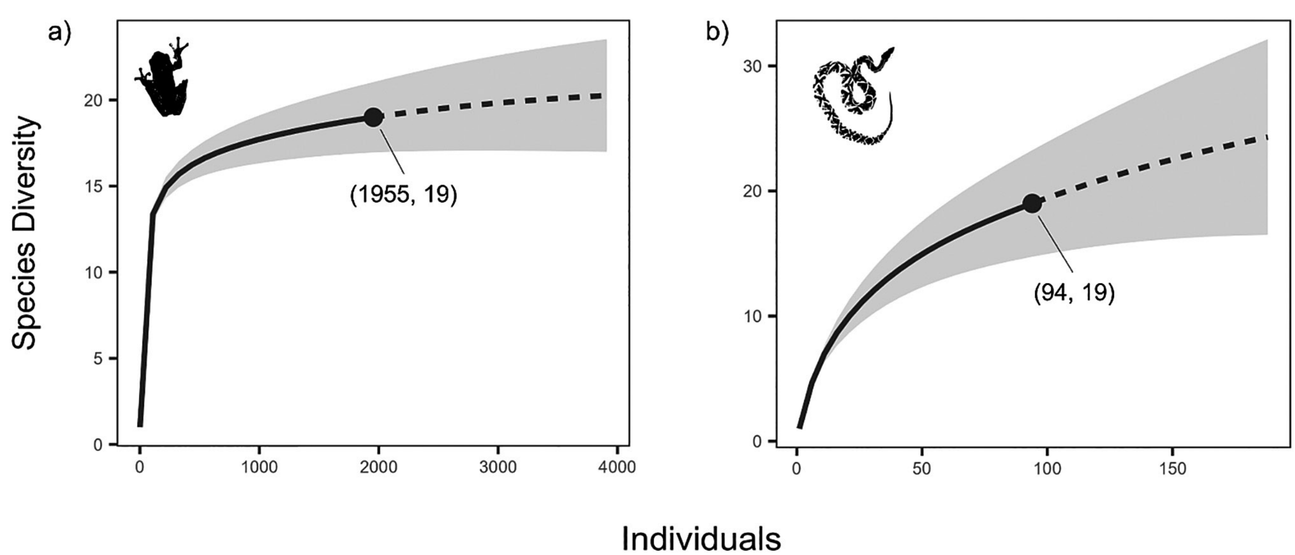

Figure 4. Anuran (adults and tadpoles) and reptile individual-based rarefaction curves and species richness estimation. Solid lines are interpolated diversity, and the dot, in the end, represents the observed abundance; the dashed line is the extrapolated diversity with the end at the observed abundance of anurans. The curve is based on species diversity rarefaction according to Hill number of q = 0, equivalent to species richness.

The reptile rarefaction curve of richness indicated that more species might be found in the sampled area (Figure 4b). Estimation on asymptote suggested a potential an additional five species of reptiles after hypothetically sampling more than 188 individuals (ca. 24 species ± 17.00 – 32 95% CI). By comparison, the anuran's curve is much closer to the asymptote (Figure 4a). Estimation on asymptote for anuran suggested the addition of two species if the double of individuals is recorded (ca. 20 species ± 17.00 – 23 95% CI).

Table 2. Sampling success obtained by each method. Number of species sampled by method (Observed), accompanied by the relative percentage of the total richness of anurans and reptiles separately. Methods implemented are pitfall traps with drift fence (Pitfall trap), time-constrained searches in transects (TCSt), time-constrained search in water bodies for adult anuran (TCSw), time-constrained search in water bodies for tadpole (tadpoles), double ended funnel trap (FT) and accidental encounter (AE).

Sampling method	Observed	% of total richness
Anurans		
Pitfall trap	8.00	8%
TCSt	15.00	78%
TCSw	19.00	100%
Tadpoles	13.00	68%
AE	2.00	10%
Reptiles		
Pitfall trap	7.00	36%
TCSt	7.00	36%
AE	13.00	68%
FT	1.00	0.5%

Sample efficiency was different among groups accordingly to the sampling method used (Table 2). Considering species incidence, active search on water bodies was the most effective method, registering all 19 anuran species, whereas the least effective was accidental encounters, registering only two species. In contrast, 13 reptile species were recorded by the accidental encounter, and both active searches in transects and pitfall traps registered seven species each. The funnel-trap was the most time consuming method – more than three thousand hours of effort – and sampled only one individual of *Caiman latirostris*. Several species were recorded only by one method for both anurans and reptiles (See Table 1).

The cluster analysis revealed that the assemblage of anurans at RBV is closer to Parque Nacional do Iguaçu (a western Paraná) and Misiones in Argentina, positioning Londrina municipality as a sister group of the western Paraná and Misiones group (Figure 5a). For reptiles, the assemblage that grouped with RBV was also Londrina municipality, but in this case, both assemblages formed a closed group; in other words, RBV had its composition more similar to Londrina than with any other assemblage studied (Figure 5b). In general, the most dissimilar assemblages for both anurans and reptiles were those from northeast Brazil, i.e., Pernambuco and Bahia states (Figure 5b). However, the most different reptile assemblage included was from Araçatuba municipality.

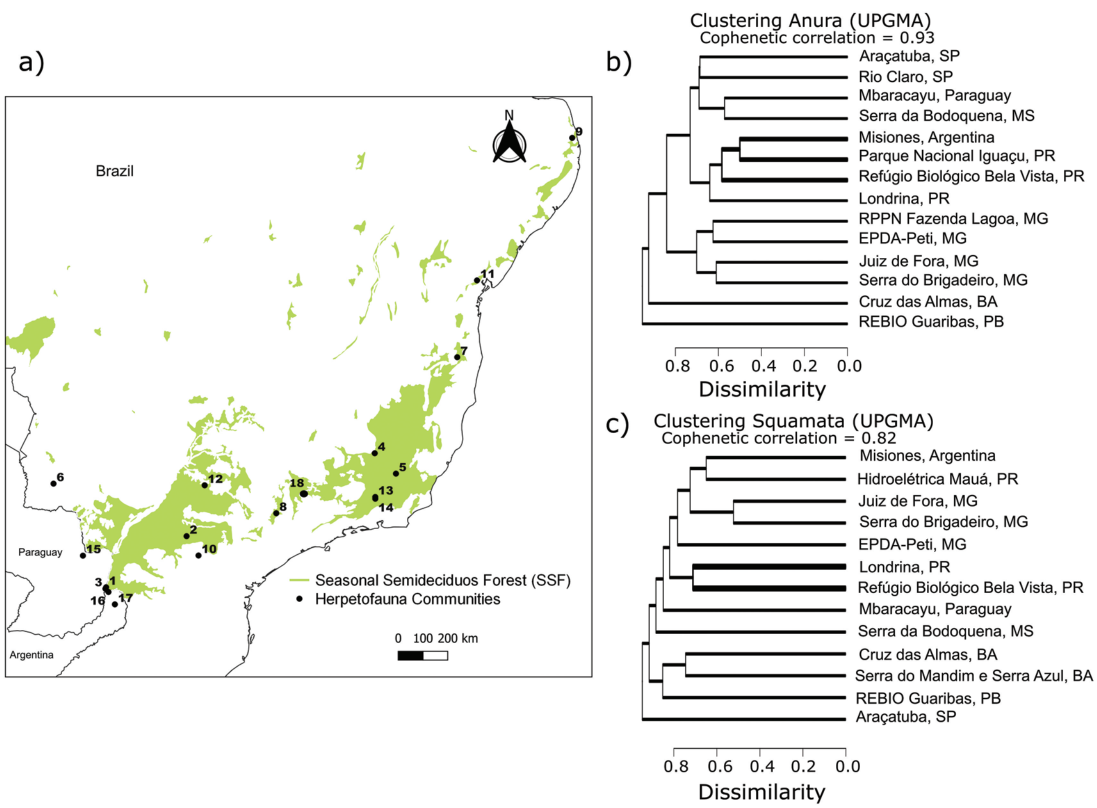

Figure 5. Dendrograms of cluster analyses using Jaccard Indices and map distribution of herpetofauna communities. a) map of the herpetofauna communities (black points) used to create the clustering b) dendrogram of the anuran and; c) reptile species composition from 17 localities in the Semideciduous Seasonal Forest in the Atlantic Forest. Numbers represent herpetofauna from 1 – Refúgio Biológico Bela Vista (RBV); 2 – Londrina, PR; 3 – Parque Nacional do Iguaçu (PNI), PR (anurans); 4 – EPDA, Peti, MG; 5 – Serra do Brigadeiro, MG; 6 – Serra da Bodoquena, MS; 7 – Serra do Mandim e Serra Azul, BA (reptiles); 8 – Rio Claro, SP (anurans); 9 – REBIO Guaribas, 10 – Hidrelétrica de Mauá, PR; 11 – Cruz das Almas, BA; 12 – Araçatuba, SP; 13 – Juiz de Fora, MG (reptiles); 14 – Juiz de Fora, MG (anurans); 15 – Mbaracayú, Paraguay; 16 – Misiones, Argentina (anurans), 17 – Misiones, Argentina (reptiles), 18 – RPPN Fazenda Lagoa, Monte Belo, MG (anurans). Green area represents the Semideciduous Seasonal Forest within Brazil border according to Brazil National Agency of Water (Agência Nacional de Águas – ANA).

Discussion

We registered 19 species of anurans and 19 reptiles in a mosaic of land cover within Itaipu in western Paraná state. At least to our knowledge, this is the first study to list the species of reptiles from a locality in the west of Paraná state. Even though records of the snake species *Eunectes notaeus* from the Boidae family, and *Xenodon merremi* and *Erythrolamprus aesculapii* from the Dipsadidae family have been found in the literature in the same area studied here (Morato 1996, Moutra-Leite et al. 1996). The presence of *Phrynops geoffroanus* in the surroundings of RBV has also been recorded by workers of RBV, who took photographs that enabled us to confirm the species identification. Also, we registered two new occurrences of anuran species for the region that have not been included in previous lists of species for the west of Paraná (i.e., Leivas et al. 2018): *Leptodactylus plaumanni* and *Odontophrynus reigi.* Therefore, the species richness of anurans recorded at RBV in the present study represents ca. 13% of the species occurrence for the state of Paraná (137 total; Santos-Pereira et al. 2018) and ca. 44% of the species occurrence for the west of Paraná (36 total; Leivas et al. 2018). The reptiles represent 10% of the state (156 total; Costa et al. 2022).

The rarefaction curve of anuran richness is very close to the asymptote, indicating that we were able to sample the community sufficiently; that is, our composition and richness data are representative of the species pool. On the other hand, the reptile rarefaction curve showed that six more species are pruned to be collected if more sampling effort is made. However, due to the wide range of microhabitats used by reptiles, including high heights in the vegetation, cryptic habitats, and seasonal abundance peaks that are not necessarily yearly, possibly only long-duration studies would approximate the real reptile richness (Henderson et al. 2016, Michael et al. 2018).

Sampling method showed different sampling success as demonstrated in previous studies (Hutchens & DePerno 2009). Sampling efficiency was different for anurans and reptiles. For capturing anurans, active search in water bodies was the most efficient method whereas accidental encounter was the least effective. On the other hand, reptiles were mostly sampled through accidental encounters and funnel trap only recorded one individual of a juvenile *Caiman latirostris*. Even though the funnel trap was the most time-consuming method, there were only four funnel traps distributed, which could be one explanation for its low success in capturing aquatic reptiles, particularly alligators. Capturing success is expected to vary due to its bias toward specific functional groups. For example, pitfall traps are pruned to sample terrestrial and fossorial reptiles and anurans (e.g., Ribeiro-Júnior et al. 2008, Ali et al. 2018). Considering that most anurans lives associated with water bodies for reproduction, it is expected less anuran species captured by pitfall traps rather than by active searching in water bodies. Some reptiles, like snakes, are secretive animals, therefore, it is common that individuals are found occasionally when moving around the area more than by in pitfall traps or active search, particularly in forested environments where several species use arboreal substrate (Bernarde 2012).

As expected, the anuran species composition from RBV is mostly similar to Parque Nacional do Iguaçu anuran assemblage, likely due to its geographic proximity (ca. 20 km). Hence, the assemblage from The Parque Nacional do Iguaçu and its surroundings have been registered with 36 species of anuran (Leivas et al. 2018), 17 more than we found at RBV. Both assemblages share 16 species, meaning that species from RBV are not necessarily a portion of Parque Nacional do Iguaçu. However, it also includes three species that were not in Leivas et al. (2018), such as *Odontophrynus reigi, Leptodactylus elenae,* and *Leptodactylus plaumanni.* Leivas et al. (2018) indicated the occurrence of *Trachcephalus dibernadoi* in Parque Nacional do Iguaçu; however, upon consulting the mentioned specimen, we have determined that it is an individual of *T. typhonius*. In another survey conducted at Parque Nacional do Iguaçu, *O. reigi*, and *L. plaumanni* were also not registered (Nazaretti 2016). For anurans, the most dissimilar assemblages included in the cluster analysis were those from northeast Brazil. However, the separation of the northeast group from the southern assemblages could be explained by the biogeographic barrier imposed by the Rio Doce river present in the states of Espírito Santo and Minas Gerais. A study that compiled data on anurans from the entire extension of the Atlantic Forest has demonstrated that Rio Doce is a geographical feature that can explain part of the composition of amphibian species and traits along the Atlantic Forest (Lourenço-de-Moraes et al. 2019). Hence, despite the similar vegetational formation, Semideciduous Seasonal Forest assemblages are expected to differ positively with increasing geographic distance, as it harbors differences in spatially structured environmental variables (Chen et al. 2011).

For reptiles, the positioning of Araçatuba reptile assemblage as an outgroup was unexpected. Araçatuba municipality is located in São Paulo state and is geographically closer to RBV (ca. 630 km) than the assemblages from the state of Minas Gerais, e.g., Juiz de Fora (ca. 1,215 km), and Serra do Brigadeiro (ca. 1,345 km). The dissimilarity between Araçatuba with the other southern assemblages might be because the reptiles and amphibians of Araçatuba were sampled from urbanized and rural environments. Assemblages sampled from modified environments, like grazing pastures, are pruned to present a composition different from the expected from natural areas (Ernst & Rodel 2005). Especially for modified Semideciduous Seasonal Forests, the process of savannization and physiognomic changes could have induced compositional shifts that tend to be more similar to the Cerrado biome (Sales et al. 2020). On the other hand, the greatest similarity in composition was observed between RBV and Londrina. This result was already expected due to the geographic proximity. Londrina is the only assemblage in the analysis that belongs to Paraná state and is relatively close to RBV (ca. 500 km). Besides geographical proximity, both assemblages were sampled from forest and modified environments, which could also contribute to compositional similarity (Silva et al. 2011, Figueiredo et al. 2019). Even though the closer assemblage from RBV included in the cluster is Misiones, this assemblage is positioned distant from RBV. One explanation could be the extremely large area of Misiones province where the assemblage was sampled (over 29,000 km^2). Hence, species composition from the south edge of the province could be more similar to a Pampa phytophysiognomy (Arana, 2017) and then generate an assemblage composition different from the north edge, which is the region closer to RBV.

The only evidence of reptile richness from the past in the extreme western region of Paraná registered 17 species. This number refers to reptiles rescued during the construction of the Itaipu Dam (Ziober & Zanirato 2014). Based on this information, our study reveals that no substantial richness loss has happened in the region compared to past decades. Although, no conclusions can be made regarding composition turnover that could have occurred since the construction of Itaipu and the RBV because any species list has been previously published. Information of previous species recorded at Itaipu was also sampled years after its construction and accounts for only three snake species (Morato 1996, Moutra-Leite et al. 1996). Surveys in other localities in western Paraná could increase the chance of adding new occurrences of species to the list. For example, inventories at the Parque Nacional do Iguaçu would probably register new species occurrences due to their large area and more preserved environment (Leivas et al. 2018).

The prevalence of species classified as "Least Concern" and populational trend as "Stable" are related to the predominance of common and relatively abundant species. Anuran species, like *D. nanus, D. minutus,* and *L. podicipinus,* and reptile species, like the snakes from the *Bothrops* genus and the lizard *S. merianae* are widely distributed and are frequently associated with disturbed environments and urbanization (Oda et al. 2017, Lima et al. 2009). Anurans assemblages found in modified habitats are usually composed of species that present traits that allow survival in anthropic environments, attributes that differ from intact forests associated with particular environmental variables, like less water availability and microhabitat availability (Riemann et al. 2017). Therefore, even though RBV has a great area of preserved SSF, its anuran composition could reflect its land cover composed of forested areas proximal to urbanized areas.

Due to the absence of previous compositional information on reptile species from western Paraná, we cannot conclude whether the RBV assemblage is similar to previous assemblages that naturally occurred in the region or has experienced species turnover through time. Also, when comparing reptile assemblages from SSF, one should consider the longitudinal and latitudinal gradients. Climatic, pluviometry, and seasonality vary among longitudes and latitudes within SSF (Oliveira-Filho et al. 2000), and it could interfere with the historical processes conducting herpetofauna composition structure. Thus, more studies on the western limits of SSF formation are necessary to fill the gaps where no surveys have been done. For example, an information gap exists regarding the herpetofauna from the south of Mato Grosso do Sul state and the northwest, western, and central areas of Paraná state. These localities are close to Foz do Iguaçu and are linked by the presence of the Paraná and Iguaçu rivers which probably contributed to the region's biogeography. Furthermore, the largest fragment of SSF in Brazil is the Parque Nacional do Iguaçu, which has never been systematically inventoried for reptiles.

In conclusion, our study registered two new occurrences of anuran species of anurans for the western Paraná found in an area of conservation and restoration. Moreover, we show that even though species found in RBV are not a conservation priority, the RBV can function as an important refugee to anuran and reptile biodiversity, housing more than 13% of amphibians and 10% of reptiles from the state of Paraná. The RBV could, eventually, harbor anuran species of conservation priority present at Parque Nacional do Iguaçu, e.g., *Crossodactylus schmidti, Proceratophrys bigibbosa, Vitreorana uranoscopa* and *Limnomedusa macroglossa (*Leivas et al. 2018, IUCN 2022*)*. The possible exchange of species between Parque Nacional do Iguaçuand the RBV must be explored in future studies. Thus, investigations aiming to understand how biological corridors influence the community structure between these areas are crucial for regional conservation actions. Currently, two extended and preserved fragments of vegetation could function as a bridge: the riparian forest of the Paraná River and the "Ecological Corridor of Santa Maria", a band of remnant forest that passes through rural properties. In addition, due to the history of land use in the state of Parana countryside, more surveys on current herpetofauna could clarify how diversity is distributed and how community structure and dynamics relate to a modified environment by anthropogenic actions.

Identification keys – Adult Anurans (see Figure 6)

Identification key to Family or Species

1. Paratoid glands present...... **BUFONIDAE *Rhinella diptycha***
   Paratoid glands absent 2
2. Robust body shape; rough skin all over the body ....
   .... **ODONTOPHRYNIDAE**
   Elongated body shape; smooth or lumpy skin 3
3. Oval body shape in dorsal view; reduced head and forelimbs
   .... **MICROHYLIDAE *Elachistocleis bicolor***
   Body of another shape 4
4. Fingertip dilated forming an adhesive disc ...... **HYLIDAE**
   Fingertip not dilated .... **LEPTODACTYLIDAE**

Identification key to Species

ODONTOPHRYNIDAE

1. Skin bulges at edge of eyelid present; white stripe in the middle dorsal region absent ....
   .... ***Proceratophrys avelinoi***
   Skin bulges at the edge of the eyelid absent; white stripe in the middle dorsal region present ....
   ....***Odontophrynus reigi***

LEPTODACTYLIDAE

1. Snout–vent length (SVL) from 15 to 35 mm; dark dots on the gular region extending below the pectoral region present
   ....*(Physalaemus)* ***Physalaemus cuvieri***
   Greater than 35 mm of SVL; dark spots on the gular region absent or if present limited to above the pectoral region
   ....(*Leptodactylus*) 2
2. Presence of a white stripe in the middle dorsal region, extending from the pelvic girdle to the middle of the head and medial location of the nostril between the eye and snout
   .... ***Leptodactylus plaumanni***
   Absent of a white stripe in the middle dorsal region of the dorsum, but if present, the nostril is positioned closer to the snout than the eyes 3
3. Pair of dorsolateral white stripes on each side of the body starting at the pelvic girdle present 4
   Pair of dorsolateral white stripes on each side of body starting at pelvic girdle absent 5

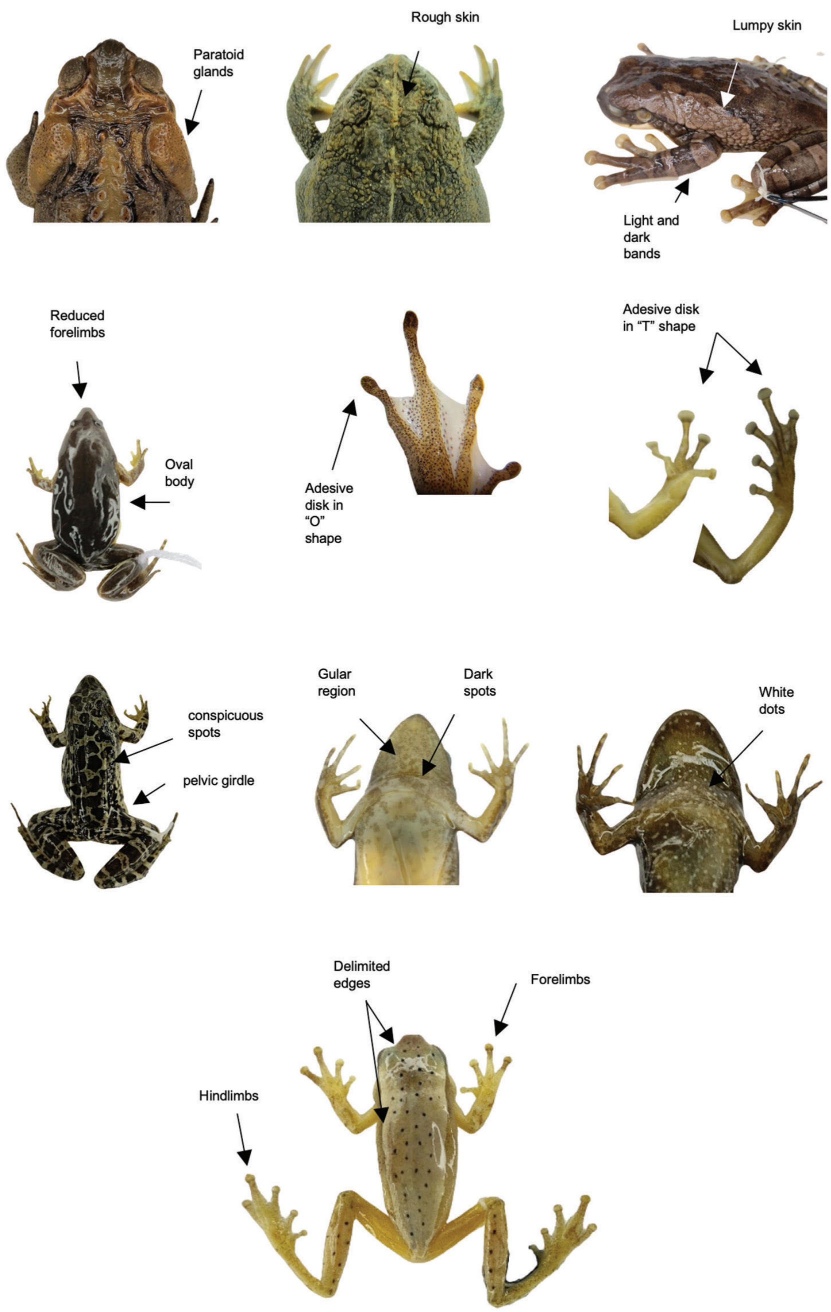

Figure 6. Morphological structures of adult anurans used in the identification key.

4. Dark and conspicuous blotches on the dorsum .... ***Leptodactylus fuscus***
   Gray dorsum or with light spots; a black stripe on the side of the head, crossing the eyes and the tympanum over a white stripe above the lips .... ***Leptodactylus elenae***
5. White dots scattered along all the ventral region present ....***Leptodactylus podicipinus***
   White dots in the ventral region absent; trapezium-shaped interocular spot .... ***Leptodactylus luctator***

HYLIDAE

1. Lumpy skin on the dorsolateral and ventral region; light and dark bands around fore and hind limbs .... *(Trachycephalus)* ***Trachycephalus typhonius***
   Smooth skin on the dorsolateral and ventral region 2
2. Adhesive disks of the digits and toes in a "T" shape (except for *Scinax squalirostris*) *Scinax* 3
   Adhesive disks digits and toes in an "O" shape 5
3. SVL less than 28 mm; pair of white stripes absent; uniformly brown dorsal region ....***Scinax berthae***
   SVL greater than 28 mm 4

4. SVL greater than 40 mm; adhesive disk of the longest digit of the forelimb smaller than the diameter of the tympanum (proportion of 3/4 of the ratio) ....***Scinax fuscovarius***
   SVL less than 37 mm; adhesive disc of the longest digit of the forelimb smaller than the diameter of the eardrum (4/5 ratio of the ratio) ....***Scinax granulatus***
5. Pair of longitudinally oriented white stripes on the dorsolateral region present; elongated snout ... .***Scinax squalirostris***
   Pair of longitudinally oriented white stripes on dorsolateral region absent 6
6. SVL greater than 40 mm ....*Boana* 7
   SVL less than 40 mm ....*Dendropsophus* 8
7. Sparse white dots on the back of the thigh ....***Boana albopunctata***
   Dark stripes on the ventral thigh .... ***Boana raniceps***
8. Irregular dark-colored spots on the back of the body or homogeneous color .... ***Dendropsophus minutus***
   Dorsum light-colored with delimited edges ....***Dendropsophus nanus***

Identification key – Tadpoles (see Figure 7)

Identification key to Species

1. Oral disc with labial flap; nostrils absent ....***Elachistocleis bicolor***
   Oral disc without labial flap and nostrils present 2
2. Oral disc with keratinized structures and papillae 3
   Modified oral disc in protractile tube ....***Dendropsophus nanus***
3. Marginal papillae row with gap on the anterior and posterior lips 4
   Marginal papillae row with gap only on the anterior lip......5
4. Body black; inclined snout (side view) .....***Rhinella diptycha***
   Body brown; round snout (side view) ... ***Physalaemus cuvieri***
5. One or no row of anterior labial teeth; body triangular (lateral view) .... ***Dendropsophus minutus***
   Two or more rows of anterior labial teeth 6
6. Four or more rows of anterior labial teeth .... ***Trachycephalus typhonius***
   Three or two rows of anterior labial teeth 7
7. Oral disc not emarginated 8
   Oral disc emarginated 10
8. Lower jaw W-shaped ....***Scinax berthae***
   Lower jaw in another shape 9
9. Lower jaw U-shaped ....***Leptodactylus plaumanni***
   Lower jaw V-shaped .... ***Leptodactylus fuscus***
10. Oral disc laterally emarginated 11
    Oral disc not laterally emarginated 13
11. Oral disc prominently emarginated................................... .... ***Proceratophrys avelinoi***
    Oral disc with regularly emarginated.............................12
12. Tadpoles with a total length greater than 45 mm; oral disc uniformly pigmented around the jaws (brown) ....***Odontophrynus reigi***
    Tadpoles with total length below 35 mm; oral disc not uniformly pigmented around the jaws .... ***Leptodactylus elenae***
13. Posterior labial teeth without gap 14
    Posterior labial teeth with gap (any row) 15

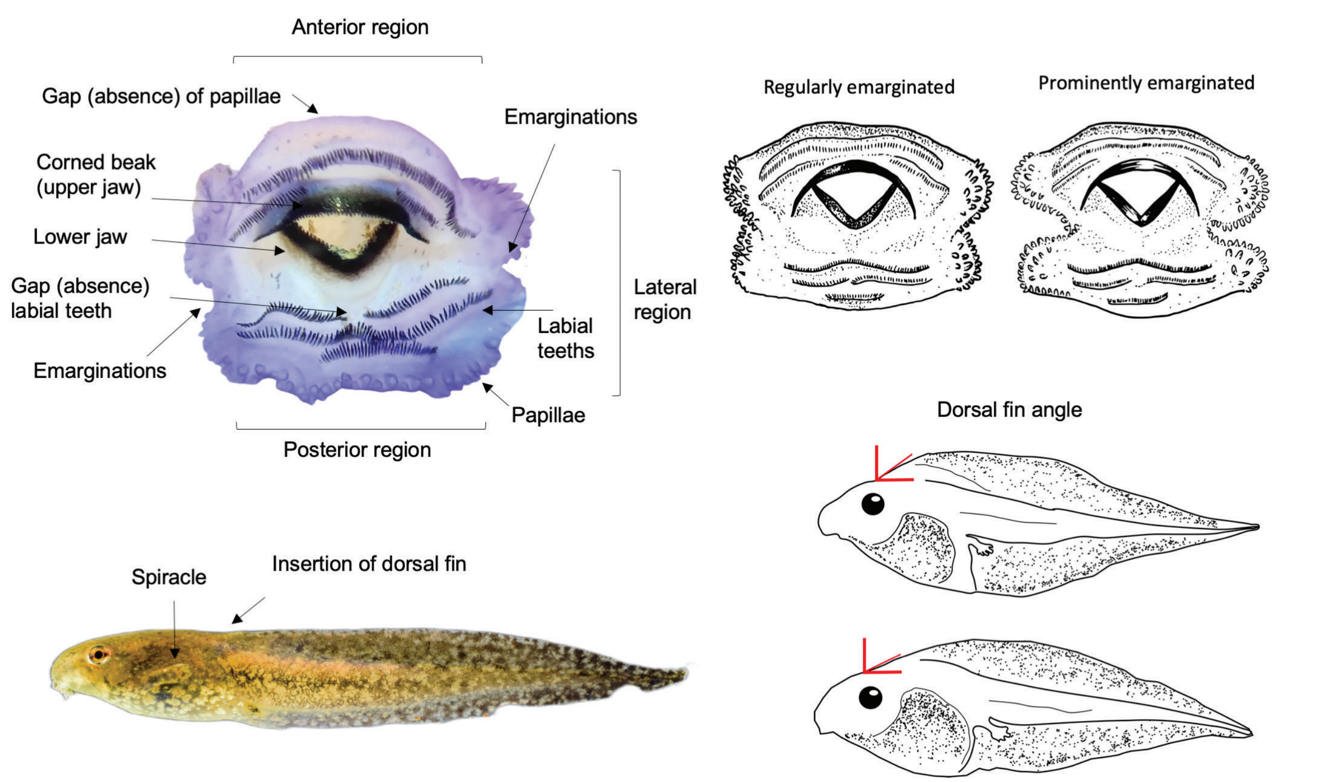

Figure 7. Morphological structures of tadpoles used in the identification key.

14. Second anterior (A2) labial tooth row with gap .... *Leptodactylus podicipinus*
Second anterior (A2) labial tooth row without gap .... *Leptodactylus luctator*
15. Spiracle inner wall not fused with the body; globular body (lateral view) 16
Spiracle inner wall fused with the body; triangular body (lateral view) 17
16. Body and tail yellowish; dorsal fin with pronounced tapering with triangular margin .... *Boana raniceps*
Dorsal region of body lighter than the dorsolateral region; dorsal fins with gradual tapering, with convex margin .... *Boana albopunctata*
17. Body elongated-oval (dorsal view); base of tail muscle higher than the body .... *Scinax squalirostris*
Body depressed (dorsal view) 18
18. The angle between where dorsal fin originates and the body surface close to 45 degrees; mostly silver cover over the intestine (ventral region of the body); ventral fin margin extends beyond the body .... *Scinax fuscovarius*
The angle between where dorsal fin originates and the body surface less than 45 degrees; mostly brownish cover over intestine (ventral region of the body); ventral fin margin does not extend beyond the body ...... *Scinax granulatus*

Identification keys – Reptiles

Identification Key to Family or Species

1. Body protected by carapace and plastron 2
Body without carapace and plastron 3
2. 11 to 12 shields in the plastron ....**TESTUDINIDAE** *Chelonoidis carbonarius*
13 shields in the plastron ....**CHELIDAE** *Phrynops geoffranus*
3. Body with front and hind limbs 4
Body elongated without limbs 5
4. A double vertical row of caudal crests starting at the dorsal region of the tail base ....**ALLIGATORIDAE** *Caiman latirostris*
Absence of vertical crests on the dorsal region of the tail 11
5. Vestigial eyes, covered by scales 6
Developed eyes, without coverage scales 7
6. Pre-cloacal pores present ....**AMPHISBAENIDAE** *Amphisbaena mertensii*
Pre-cloacal pores absent 7
7. Undifferentiated dorsal and ventral scales ....**ANOMALEPIDIDAE** *Liotyphlops ternetzii*
Differentiated dorsal and ventral scales 8
8. Ventral scales differentiated from the dorsal scales and covering the entire ventral 9
Ventral scales differentiated from the dorsal scales but narrower, without occupying the entire ventral region ....**BOIDAE** *Eunectes notaeus*
9. Solenoglyphous fang .... **VIPERIDAE**
Other type of dentition 10
10. Proteroglyphous fang .... **ELAPIDAE** *Micrurus corallinus*
Opisthoglyphous fang or aglyphous dentition .... **COLUBRIDAE**
11. A pair of internasals scales in contact with each other 12
Three or more scales in the nasal region 13
12. Pores on the ventral region and on the inner surface of the thighs present .... **TEIIDAE** *Salvator merianae*
Pores on the ventral region and on the inner surface of the absent .... **SCINCIDAE** *Notomabuya frenata*
13. A large intraparietal scale, much larger than all other surrounding scales ....**TROPIDURIDAE** *Tropidurus catalanensis*
Head scales numerous and of uniform size, without great differentiation .... **GECKONIDAE** *Hemidactylus mabouia*

Identification Key to Species

VIPERIDAE

1. Area between dorsal dark triangular spots 1.5 to 2 times larger than the spots 2
Area between dorsal dark triangular spots approximately the same size as the spots; white marks around sharp spots; lateral band on head broad and dark .... *Bothrops jararacussu*
2. Well-demarcated dorsal dark triangular spots; spaces between spots without darker circular marks .... *Bothrops jararaca*
Blurred dorsal dark triangular spots, light brown post-orbital band, spaces between spots with several dark circular marks .... *Bothrops moojeni*

COLUBRIDAE

1. Banded/coralline coloration pattern (red, black and white) 2
Other coloring pattern 3
2. Head with white and black bands .... *Erythrolamprus aesculapii*
Head with red and black bands .... *Oxyrhopus guibei*
3. Scales on the top of the head with black edges.................. .... *Leptophis marginatus*
Scales on the top of the head of another pattern 4
4. Apical pits on the dorsal scales present 5
Apical pits on the dorsal scales absent 6
5. Post-orbital black line present .... *Philodryas olfersii*
Post-orbital black line absent .... *Xenodon merremii*
6. Longitudinal stripes along the body absent ... *Dipsas mikanii*
Longitudinal stripes along the body present 7
7. Longitudinal stripes along the entire body starting just after the head .... *Dryophylax hypoconia*
Longitudinal stripes starting at the final third of the body..... .... *Erythrolamprus macrossomus*

Supplementary Material

The following online material is available for this article:

Appendix - List of specimens from Refúgio Biológico Bela Vista deposited in the Herpetological Collection of Bertha Lutz of the

Universidade Federal da Integração Latino-Americana, Foz do Iguaçu, Paraná.

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Associate Editor

Denise de Cerqueira Rossa-Feres

Author Contributions

Gabriel S. Vicente-Ferreira: contributed to data collection; contribution to data analysis and interpretation; contribution to manuscript preparation.

Eloize F. do Nascimento: contributed to the concept and design of the study; contribution to data collection; contribution to critical revision, adding intellectual content.

Camila S. Batista: contributed to the concept and design of the study; contribution to data collection.

Tarik A. Kardush: contributed to the concept and design of the study; contribution to data collection.

Kathia Luz Burdiles Reyes: contributed to data collection.

Michel V. Garey: contributed to the concept and design of the study; contribution to manuscript preparation; contribution to critical revision, adding intellectual content.

Conflicts of Interest

The authors declare no conflict of interest related to this manuscript.

Data availability

Supporting data are available at https://doi.org/10.48331/scielodata.NCQEPO.

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