Publication trends on vocalizations of anurans in Northeastern Brazil

Tendências em publicações sobre vocalizações de anuros no Nordeste do Brasil

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Abstract: Studies on anuran vocalizations have increased in Brazil in recent years. However, these studies remain asymmetrically distributed in terms of geographic and taxonomic coverage. In this study, we analyzed the current state of the art of anuran bioacoustics in the Northeast region of Brazil through a systematic online review of published scientific articles. We identified 123 scientific articles reporting research based on anuran vocalizations recorded in Northeastern Brazil. There has been an increase in the number of publications over the years, but the quality of available information was highly variable, with noticeable differences only in papers published in the last decade, when compared to previous years. Recordings could be assigned to 119 taxa, most belonging to the families Hylidae, Leptodactylidae, Bufonidae and Odontophrynidae. Most studies included recordings made in the Atlantic Forest and *Caatinga* biomes, whereas studies in locations within the *Cerrado* and the Amazon Forest biomes were scarce. Finally, we analyzed institutions and collaborations involved in the publications and found that there is a temporal trend of increase in the proportion of Northeastern institutions involved in the publications, along with a rise in the average number of authors per publication.

Keywords: Amphibians. Atlantic Forest. Bioacoustics. *Caatinga*. Communication.

Resumo: Os estudos com vocalizações de anuros têm aumentado no Brasil nos últimos anos. No entanto, ainda estão assimetricamente distribuídos em termos de cobertura geográfica e taxonômica. Neste estudo, analisamos o atual estado da arte da bioacústica de anuros na região Nordeste do Brasil por meio de uma revisão sistemática de artigos científicos publicados *online*. Foram encontrados 123 artigos científicos relatando pesquisas baseadas em vocalizações de anuros registradas no Nordeste do Brasil. Houve um aumento no número de publicações ao longo dos anos, mas a qualidade das informações disponíveis foi muito variável, com diferenças apenas entre os artigos publicados na última década, quando comparados aos anos anteriores. Os registros podem ser atribuídos a 119 táxons, a maioria dos quais correspondente a espécies das famílias Hylidae, Leptodactylidae, Bufonidae e Odontophrynidae. A maioria dos estudos incluiu registros feitos nos biomas Mata Atlântica e Caatinga, enquanto pesquisas em regiões dentro dos biomas Cerrado e floresta amazônica foram escassas. Por fim, analisamos as instituições e colaborações envolvidas nas publicações e descobrimos uma tendência temporal de aumento na proporção de instituições nordestinas envolvidas nas publicações, assim como no número médio de autores por publicação.

Palavras-chave: Anfíbios. Mata Atlântica. Bioacústica. Caatinga. Comunicação.

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INTRODUCTION

Communication mediates intra and interspecific interactions in the animal kingdom, and there are multiple ways through which communication can be achieved. Most animals rely on the transmission and reception of chemical, visual, electric, tactile, vibrational, or acoustic signals to convey biological information (Penar et al., 2020). Sound signals are especially important as part of communication systems in insects, fishes, birds, mammals, and amphibians, playing key roles in territorial defense and mate attraction, among other ecological and behavioral functions (Laiolo, 2010; Fletcher, 2014).

As an emerging science, bioacoustics is dedicated to recording, analyzing, and interpreting sound signals produced by living organisms and their relationships with the surrounding environment (Fletcher, 2014; Vallee, 2017; Penar et al., 2020). Through bioacoustics, recordings of sound signals or acoustic landscapes become a valuable source of biological data, which can be used to uncover the natural history of a particular species, to solve intricate taxonomic puzzles as part of integrative taxonomy approaches (e.g., Silva-Filho & Juncá, 2006; Andrade et al., 2020; Bang et al., 2020; Mângia et al., 2020), to evaluate species diversity at a given location (Vacher et al., 2017; Rakotoarison et al., 2017) or to investigate the evolution of communication as a response to environments characterized by different levels of background noise (Bee & Swanson, 2007; Zhang et al., 2015). In the last decades, bioacoustics has also become part of several conservation initiatives, with active or passive acoustic recordings being increasingly adopted as standard methods for species detection or monitoring (Noda et al., 2018; Sugai & Llusia, 2019; Obrist et al., 2010).

Male anurans emit advertisement calls to attract sexual mates and ward off conspecific males at calling sites (Wells & Schwartz, 2007; Toledo et al., 2014; Köhler et al., 2017). Advertisement calls are species-specific and, hence, useful for discriminating anurans belonging to different taxa. Advertisement calls are also subject to evolutionary forces, such as female sexual selection and selection imposed by background noise, competition for spectral acoustic space or genetic drift, and can provide valuable information on population differentiation and evolutionary mechanisms leading to speciation (Amézquita et al., 2006, 2009; Goutte et al., 2018). In addition to advertisement calls, many anuran species have an extended call repertoire, which may include sound signals used in specific behavioral contexts, such as courtship, agonistic interactions among males, or defense against predators (Toledo et al., 2014; Forti et al., 2018).

Brazil is home to the largest number of amphibian species in the world, with more than 1,188 species, of which 1,144 are anurans (Segalla et al., 2021). Endemism and naturally small geographic distributions are frequent among many clades of Brazilian anurans, and 59 are currently classified as species of conservation concern (Brasil, 2022). Bioacoustical studies of Brazilian anurans have mostly addressed their taxonomy, including the description of new species and the evaluation of species limits among cryptic taxa (Guerra et al., 2018). Fewer studies investigated acoustic signals of anurans in the contexts of reproductive behavior (e.g., Heyer & Carvalho, 2000; Vilela et al., 2014; Camurugi et al., 2015; Costa & Dias, 2019), natural history (e.g., Pimenta et al., 2007; Brandão et al., 2009; Malagoli et al., 2021), ecology (e.g., Protázio et al., 2014, 2019; Lima et al., 2019) or conservation (Simões et al., 2014; Sugai & Llusia, 2019). Additionally, research on advertisement calls in Brazil exhibits geographic and taxonomic biases, as well as biases related to the conservation status of the studied species (Guerra et al., 2018).

Northeastern Brazil encompasses more than 840,000 km^2 (IBGE & MMA, 2004) and is mostly covered by two ecologically distinct biomes, the Atlantic Forest and the semi-arid *Caatinga*. Despite extensive deforestation and human occupation, which can be traced back to the 15th Century, an expressive number of endemic species are found in the region (Garda et al., 2017, 2018; Abrahão et al., 2019). However, no comprehensive appraisal of anuran bioacoustics has been conducted for this region, hindering the effective planning of future research based on existing knowledge gaps.

In this work, we conduct a comprehensive assessment of the available scientific literature on bioacoustics of anurans in the Brazilian northeast. We evaluate temporal trends in the number of published scientific papers and the quality of those papers, based on whether a set of key methodological steps were reported in each publication.

Additionally, we assess the diversity of taxa studied and the geographic distribution of recorded populations. Lastly, we evaluate the number and affiliations of authors, in order to gain insight into the main institutions conducting bioacoustics studies in Northeastern Brazil and their research networks.

MATERIAL AND METHODS

We searched for published literature on bioacoustics of anurans of Northeastern Brazil in Google Scholar (Google, n.d.), Web of Science (Clarivate, n.d.) and SciELO (SciELO, n.d.), along the period between May 2020 and June 2021. We used a combination of search terms that encompassed taxonomy ('Amphibia,' 'Anura,' '*Anfíbio*,' '*Anuro*,' 'Frog'), bioacoustical terminology ('*canto*,' 'call,' '*vocalização*,' 'vocalization,' '*bioacústica*,' 'bioacoustics') and the geographic region of interest ('*Brasil*,' 'Brazil,' '*Nordeste*,' 'Northeast,' and the names of each Northeastern Brazilian state, entered separately on each search). Publications were added to our database when they met the following criteria: 1) research paper written in English or Portuguese language and published in an indexed journal; 2) research containing information on one or more sound recordings of anurans, conducted in one or more states in the Brazilian Northeast. Unpublished theses and monographs were not considered. Papers that presented reanalysis of acoustic data published earlier were also removed from the final database.

Taxonomy followed Frost (2024). We associated the geographic location of recordings with major biomes of Brazilian Northeast based on the biome classification proposed by *Instituto Brasileiro de Geografia e Estatística* (IBGE, 2017, 2019). When geographic coordinates or information on the locality where sound recordings were conducted were not reported, we considered the geographic coordinates of the centroid of the largest native vegetation remnant in the indicated municipality to locate the recording on the biome distribution map. The distribution map of recordings was produced in QGIS 3.16 (QGIS.org, n.d.), on biome distribution layers based on IBGE (2017, 2019).

All papers were read-through and, from each paper, we extracted the following information: 1) taxonomy of recorded species (family, genus and specific epithets); 2) name of the federation unit (state) where the specimens were recorded; 3) municipality where the species was recorded; 4) biome; 5) geographic coordinates of recording location; 6) date of recording; 7) number of recorded individuals; 8) number of calls analyzed; 9) call type (e.g., advertisement call, aggressive call, courtship call); 10) air or water temperature at the time of recording; 11) snout-to-vent length (SVL) of recorded individuals; 12) model of recorder and microphone used; 13) sampling rate of recording; 14) software used for acoustic analyses; 15) information on long-term storage of recording files (*i.e.*, deposit of files in a public repository or sound collection); 16) year of publication of the paper; 17) number of authors; 18) number of regional institutions involved in the study; 19) number of institutions located outside the Brazilian Northeast involved in the study. Additionally, to understand the nature of studies on anurans that use bioacoustics, papers were classified into one of the following categories: 1) species description; 2) call description; 3) ecological study; 4) behavioral study; 5) taxonomic review; 6) new geographic record; 7) other. In the latter category, we grouped interdisciplinary studies that addressed multiple topics, where bioacoustical data was provided along with information on larval morphology or reproductive biology, for example. We also classified the type of calls according to the anuran call classification proposed by Toledo et al. (2014).

We also assessed whether the quality of publications increased over the years, based on the availability of information essential to the replicability of the studies and for the use of bioacoustics data in future research. With this purpose, we adapted the method used by Guerra et al. (2018) and estimated a quality index based on the presence or absence of information on parameters 5 to 14 listed above, on the body of the text, or on figure captions. We attributed one point to each parameter informed, hence the quality parameter varied between zero (no information available on any parameter) and ten (information on all parameters was provided). In the case of articles containing recordings of several species in which data on a particular parameter were not provided for one or more species, a value of zero was assigned to that parameter. The arithmetic means among all papers published in the same year were used to evaluate the existence of temporal trends in the improvement of publication quality. The proportion of authors affiliated to academic or research institutions located in the Brazilian Northeast among papers published in the same year was used to assess trends in regional capacity and autonomy in bioacoustical studies.

RESULTS

QUANTITATIVE TEMPORAL TRENDS IN PUBLICATIONS

The database built from the systematic review of publications containing information on anuran vocalizations recorded in Northeast Brazil retrieved a total of 123 publications, including Brazilian and international journals. These publications covered a range of 21 years, from 2000 to 2020, with gaps in 2001 and 2002, when no publication was found by the search engines. The average number of publications was 6.47 scientific articles per year. There is notable growth in the average number of publications per year from the beginning of the 2010 decade to the present (Figure 1), and the number of publications almost tripled between the years 2011–2020 (totaling an average of 9,2 articles/year), in comparison with 2000–2010 (3.44 articles/year, in average). The year with the highest number of publications was 2020, with 13 publications.

QUALITATIVE TEMPORAL TRENDS IN PUBLICATIONS

Considering the index we used to access the quality of information available on the papers based on the presence of ten parameters essential for replicability and for the use of the original bioacoustical data in future studies, we did not observe a temporal trend of evolution in the quality of publications (Figure 2). In general, there is great variability in the quality of articles published each year, except in years with only a few publications (e.g., 2000, 2003). Between 2000 and 2010 only one work reached the maximum score of the index, whereas between 2011 and 2020, except for 2016, at least one article reached the maximum value of the index each year. The maximum score was obtained by approximately 19% of the published articles, whereas only a single paper achieved the lowest score recorded.

Among ten parameters used to assess the quality of the bioacoustical information provided in the articles, the

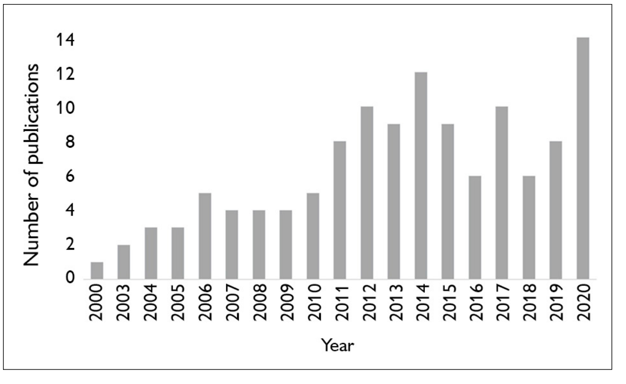

Figure 1. Variation in the number of scientific articles about vocalizations of anurans of the Brazilian Northeast between the years 2000 and 2020, as a result of bibliometric searches conducted on Google Scholar, Web of Science and Scielo. Graphic: the authors (2025).

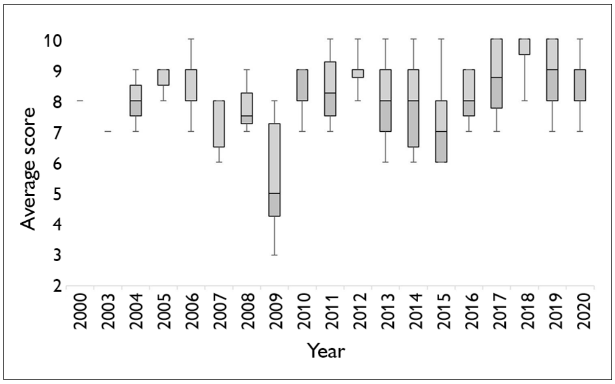

Figure 2. Variation in quality of bioacoustical information available in scientific articles addressing vocalizations of anurans recorded in the Brazilian Northeast, published between 2000 and 2020. The index is based on the reporting of ten parameters related to geographic information, recording conditions, equipment and recording, which guarantee the repeatability of the studies and the use of acoustic data in the future. The index ranged from zero (worst quality) to ten (best quality). Box-plots representing the index values for each year show the interquartile range (box) divided by the median of the values (cross line). The upper and lower limits of the vertical black lines indicate the most extreme values. Graphic: the authors (2025).

least reported were those related to data on body size of recorded individuals, sample size (i.e., number of calls analyzed), and environmental conditions. Information on body size or body mass of males recorded was absent in 56.1% of the published articles. The number of calls analyzed was not informed in approximately 42.2% of the articles, and geographic coordinates were not reported in 19.5% of them. On the other hand, information on software, type of call recorded, and model of recording gear was reported in the vast majority (> 97%) of the articles (Figure 3).

TAXONOMIC DIVERSITY, CALL TYPE AND RESEARCH SCOPE

The 123 publications contained data on vocalizations of 119 anuran species belonging to 34 genera distributed in 13 families (Appendix 1; Figure 4). In one article, it is not possible to infer which of the listed species were recorded in the Northeast region, so it was classified here as 'not specified.' The most representative families were Hylidae (60 species, 50.4% of the studied taxa), Leptodactylidae (27 species, 22.7%), Bufonidae (8 species, 6.7%), and Odontophrynidae (7 species, 5.9%). The most studied genera belonged to the families Hylidae (*Scinax*, 13 species; *Phyllodytes*, 11 species; *Dendropsophus*, 9 species) and Leptodactylidae (*Leptodactylus*, 10 species; *Physalaemus*, 9 species).

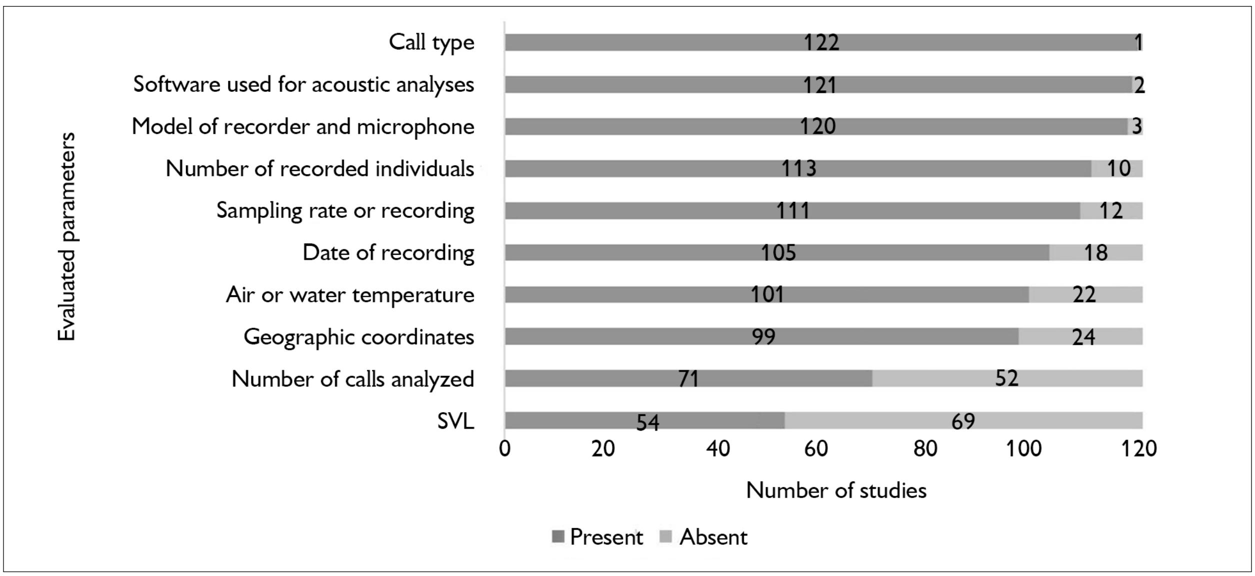

Figure 3. Frequency of reporting of ten qualitative parameters among 123 articles published between 2000 and 2020 which addressed the bioacoustics of anurans recorded in Northeastern Brazil. Graphic: the authors (2025).

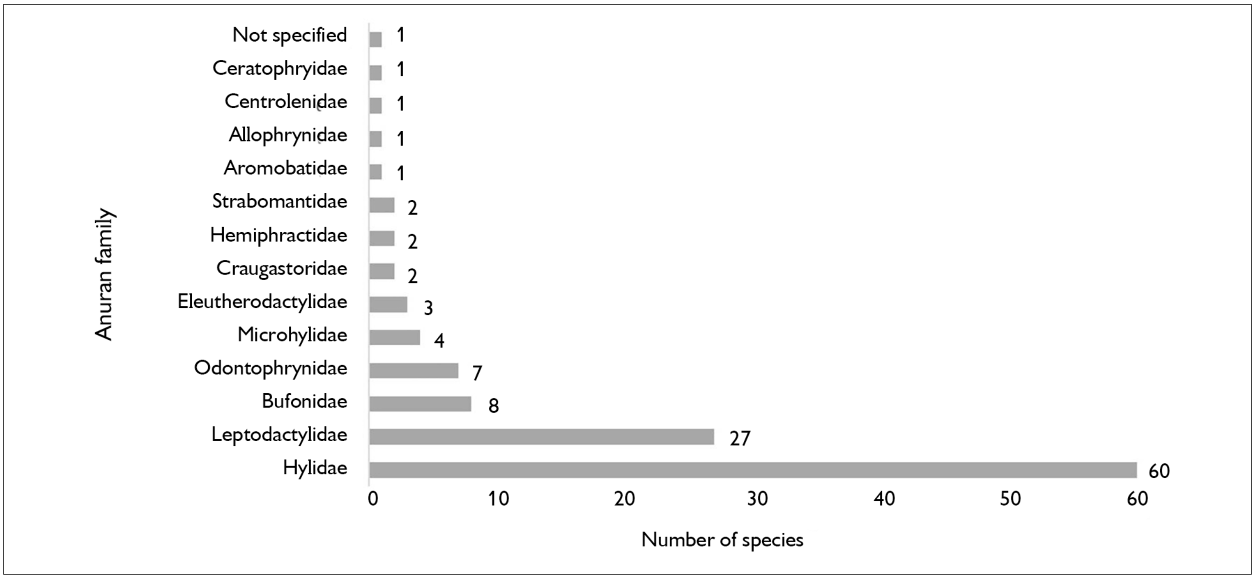

Figure 4. Cumulative number of species, per family, of anurans from the Northeast region of Brazil whose vocalizations were analyzed in studies published in scientific journals between 2000 and 2020. Graphic: the authors (2025).

Approximately 21% of the recorded species were present in more than one study. The most frequent species among the studies were *Pithecopus gonzagai* Andrade, Haga, Ferreira, Recco-Pimentel, Toledo, and Bruschi, 2020 (Hylidae, and *Proceratophrys cristiceps* (Müller, 1883) (Odontophrynidae), for which acoustic information was presented in seven publications. It was followed by *Pithecopus nordestinus* (Caramaschi, 2006) (Hylidae: Phyllomedusinae), and *Pseudopaludicola pocoto* Magalhães, Loebmann, Kokubum, Haddad, and Garda, 2014 (Leptodactylidae), whose vocalizations were analyzed in five studies (Appendix 2).

Few studies were dedicated to analyses of vocalizations other than the advertisement call. Advertisement calls were analyzed in 118 publications (95.9%), followed by territorial calls, assessed in 13 publications (10.6%), release calls and courtship calls assessed in five publications (4.1%), distress calls, assessed in four publications (3.2%). Amplexus and warning calls were reported in one publication each (0.8%). The type of vocalization was not informed in one publication. Nearly 17.9% of the articles presented data on the advertisement call and on at least one additional call type. Considering vocalization categories based on social context (*sensu* Toledo et al., 2014), reproductive calls were represented in 97.6% of the studies, aggressive calls in 11.4%, and defensive calls in 4.1%.

Considering the scope of the research published, we observed that 37.4% of the retrieved articles were call descriptions, with little or no additional data (*i.e.*, morphological, larval, molecular) and with no broader taxonomic scope. Analyses of vocalizations appeared as part of new species descriptions in 25.2% of the studies, and as part of taxonomic revisions in 6.5% of the articles surveyed. Multi-thematic articles, herein classified as 'others,' accounted for 17.9% of the articles. Less frequent types of publications included ecological studies (7.3% of the papers), new geographic records or range extensions (3.3%), and studies on anuran behavior (2.4%).

GEOGRAPHIC DISTRIBUTION OF CALL RECORDINGS

Publications encompassed the nine Northeastern Brazilian states (Figure 5). Most anuran call recordings

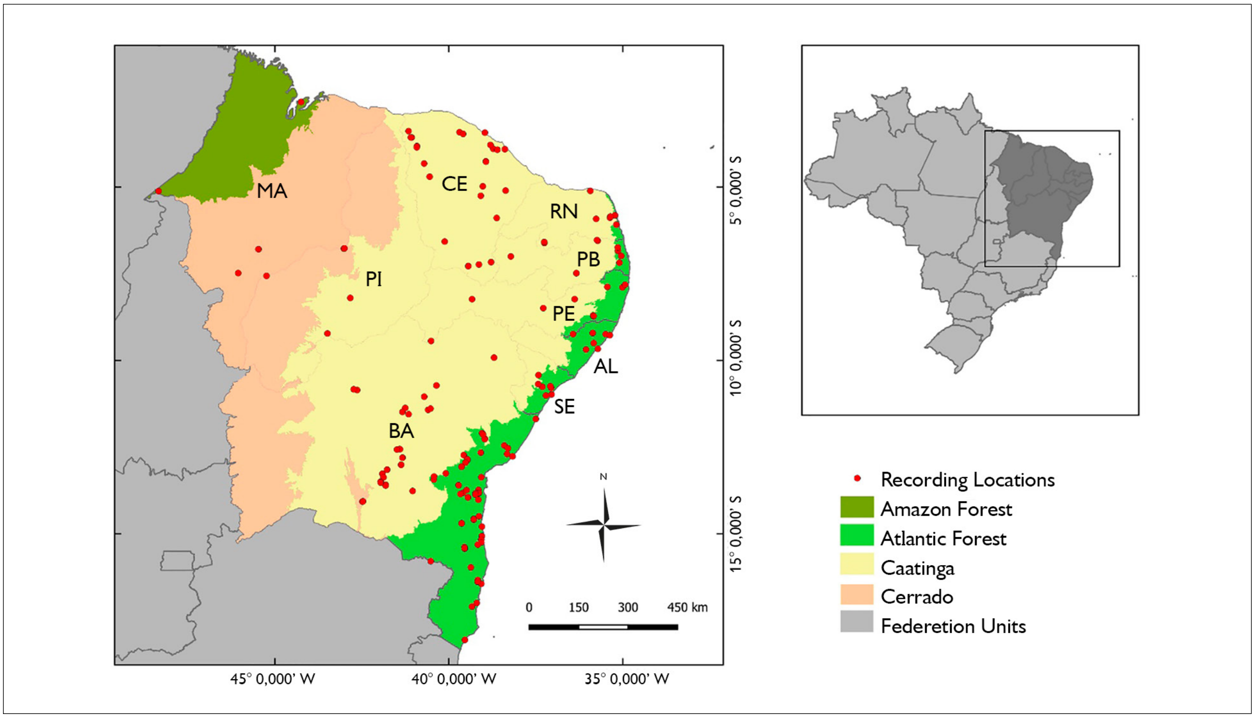

Figure 5. Distribution of geographic locations of recordings of anuran vocalizations in Northeastern Brazil reported in 123 scientific articles published between 2000 and 2020. Legend States: AL = Alagoas; SE = Sergipe; BA = Bahia; CE = Ceará; MA = Maranhão; PB = Paraíba; PE = Pernambuco; RN = Rio Grande do Norte. Map: the authors (2025).

were conducted in Bahia (81 studies, 65,9%), surpassing published data on recordings made in the other eight states combined. Pernambuco and Rio Grande do Norte were the second states with the most publications, with 13 records (10.6%) each. Recordings conducted in the states of and Paraíba were reported in 12 studies (9.8%). The two states with the lowest number of published anuran recordings were Maranhão and Piauí, with recordings proceeding from only three localities in each of these states. Coincidently, these are the states with the greatest coverage of the least studied Northeastern biomes (*Cerrado* and Amazon Forest). More than half of the studies were carried out in the Atlantic Forest (57.7%), followed by studies conducted in the semi-arid *Caatinga* (43.9%). Recordings in the *Cerrado* and in the Amazon Forest were the least frequent, with 4.9% and 1.6% of publications containing information on vocalizations recorded in these biomes, respectively.

MANAGEMENT AND STORING OF CALL RECORDINGS

The deposit of call recordings into a sound collection or into a zoological collection was reported in less than half of the studies (41.5%). Among the studies that indicated a destination to call recordings, those were deposited in 28 different biological collections or museums, of which 25 (89.3%) were located in Brazil and three (10.7%) were located abroad. Among collections in Brazil, 40% were in education or research institutions in Northeastern Brazil, 40% in the Brazilian Southeast, and 12% in the Midwest. Approximately 8% of the recordings were deposited in the private collection of one of the authors.

RESEARCH AUTHORSHIP

Scientific work on anuran bioacoustics in Northeastern Brazil has been mostly carried out by universities and other education institutions. We identified authors linked to 52 institutions, including colleges, universities, technical educational institutes, and research institutes distributed in the five Brazilian geographic regions (Northeast, North, Central-West, Southeast, and South). Most studies were produced by authors affiliated to more than one institution. The two institutions with the largest number of publications are located in Southeastern Brazil. Authors affiliated to *Universidade Federal do Rio de Janeiro* were involved in 29 studies (24.4% of the articles), followed by authors affiliated to *Universidade Estadual Paulista Júlio de Mesquita Filho*, which participated in 23 (19.3%) studies. These were followed by authors affiliated to five universities located in Northeastern Brazil: *Universidade Estadual de Santa Cruz* (22 publications), *Universidade Estadual de Feira de Santana* (21 publications), *Universidade Federal do Rio Grande do Norte* (19 publications), *Universidade Federal da Bahia* and *Universidade Federal da Paraíba* (16 publications each).

Considering collaboration networks based on publications, 35.8% of the studies had the participation of at least one institution located in Northeastern Brazil, 36.6% were produced exclusively by the latter and 27.6% of the studies were carried out by institutions outside Northeastern Brazil. From 2000 to 2020 there was an increase in the role of Northeastern institutions in anuran bioacoustics studies, most notably between 2011 and 2015, as well as a trend toward a greater proportion of works carried out as collaborations between Northeastern institutions and other national and international institutions (Figure 6). International collaborations were indicated in 17 studies (13.8%). Collaborations between universities and private environmental consulting companies were reported in five studies (4.1%). A single study was conducted as a collaboration between the university and a non-governmental organization.

All studies were conducted by more than one author. Most studies included five or more authors (35%), followed by three authors (30%), two authors (22%), and finally, four authors (13%). There was an increasing trend in the average number of authors per article over the years (Figure 7).

DISCUSSION

In this work we investigated temporal trends in the number and quality of bioacoustics studies addressing vocalizations of anurans recorded in Northeastern Brazil published between 2000 and 2020. We detected an increase in the

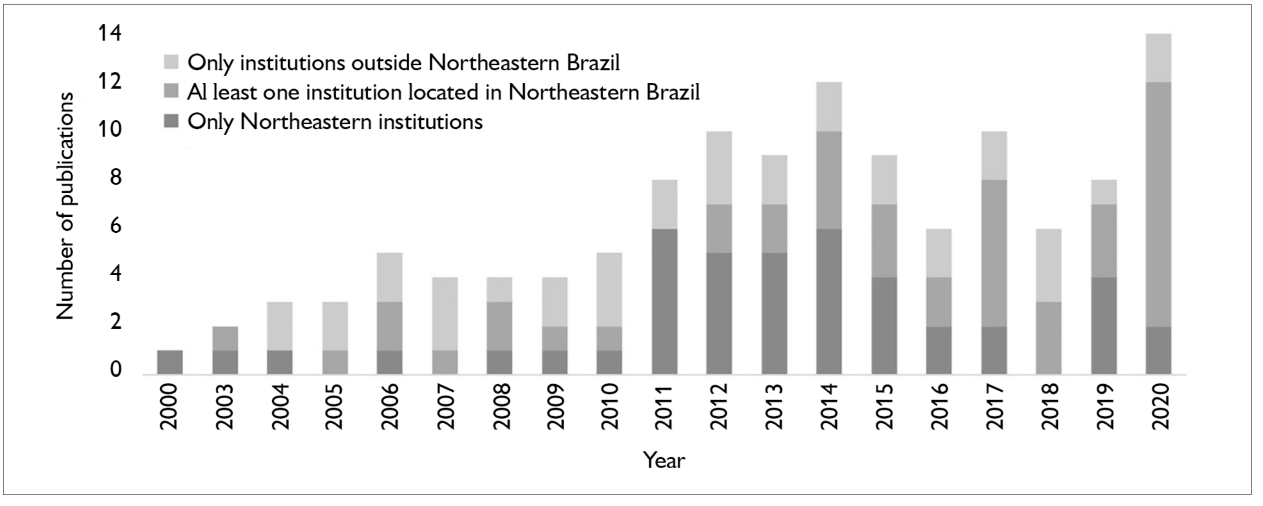

Figure 6. Relative contribution of research or education institutions in Northeastern Brazil, in other regions of Brazil and institutions abroad in authoring scientific articles addressing bioacoustics of anurans of Northeastern Brazil between 2000 and 2020. Graphic: the authors (2025).

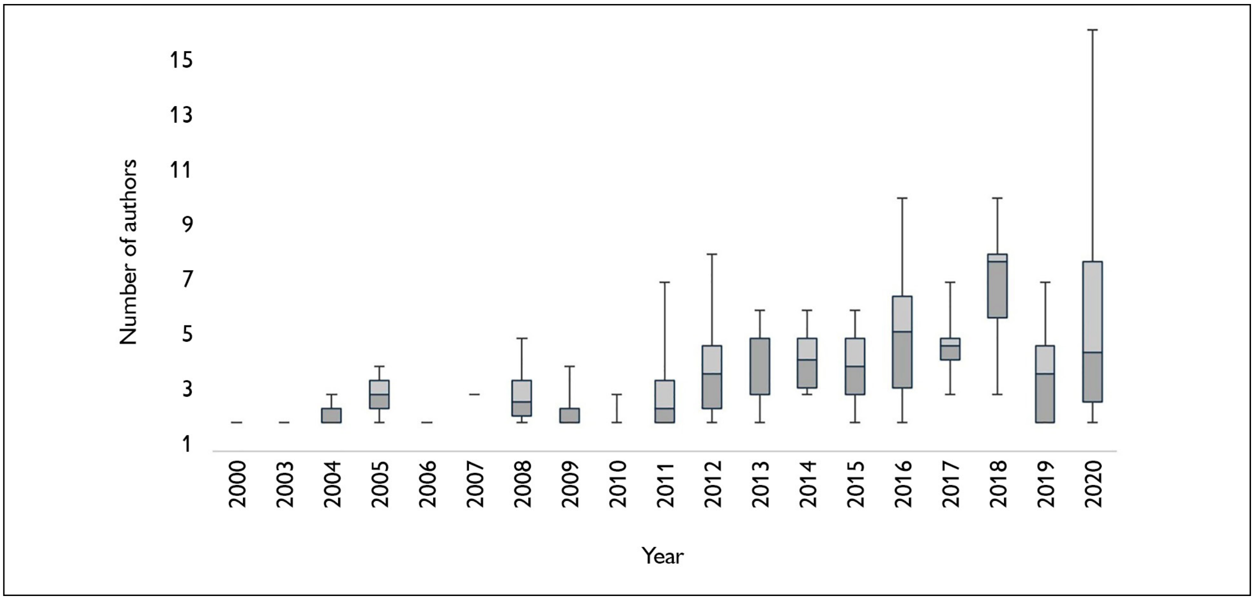

Figure 7. Variation in the number of authors of scientific articles addressing vocalizations of anurans recorded in Brazilian Northeast, published between 2000 and 2020. The interquartile range (box) is divided by the median number of researchers who authored each article (cross line). The upper and lower limits of the vertical black lines indicate the most extreme values. Graphic: the authors (2025).

number of papers published on the subject along the last two decades. Additionally, more recent studies were conducted by a relatively larger number of authors, affiliated to a larger number of education or research institutions, hinting at a temporal trend of increase in collaborative research. On the other hand, more recent articles did not improve in terms of reporting data associated with sound recording procedures in the field, with processing of sound recordings or with archiving of sound files, when compared to earlier studies.

Unfortunately, few studies have focused on the analysis of the quality of the information available in bioacoustics studies, even in animal groups other than anurans. State-of-the-art studies of bioacoustics studies were performed by Becker et al. (2022) and Guerra et al. (2018), but only the last one, which addressed works with anuran advertisement calls, was dedicated to the analysis of the information accessed in the publications. Guerra et al. (2018) also observed great variation in the data available in studies addressing advertisement calls of anurans in Brazil, but they noticed a temporal trend of increase in the metadata.

In relation to basic qualitative and quantitative recording parameters informed in the articles, body-size, sampling size, geographic coordinates and environmental temperature were the least reported. Among these parameters, body size generally determines the fundamental and dominant frequencies of the calls due to allometric relationships with the length of vocal cords (Ramer et al., 1983; Smith & Roberts, 2003; Nali & Prado, 2014). Likewise, environmental temperature directly affects metabolic rates in anurans, reflecting on call parameters such as call rate (Ryan, 1988; Gerhardt & Huber, 2002), call duration (Lingnau & Bastos, 2007; Moser et al., 2022) or call frequency (Kaefer et al., 2012; Moser et al., 2022). Hence, reporting the snout-to-vent length or mass of analyzed specimens and the environmental temperature at the time of recording is fundamental to allow for call comparisons between species or populations (Christensen-Dalsgaard, 2008; Köhler et al., 2017). Information on the recording location is essential for the characterization of local climate since the microhabitat can influence call traits (Röhr & Juncá, 2013; Camurugi et al., 2015; Röhr et al., 2020), in addition to more precisely delimiting the populations studied. Several studies addressing the phylogeography of Neotropical anurans suggest that geographically widespread taxa actually represent complexes of independent evolutionary lineages or cryptic species (Fouquet et al., 2012; Gehara et al., 2014; Nascimento et al., 2019; Trevisan et al., 2020). Thus, accurately indicating the location of the populations studied can avoid undue comparisons between morphologically similar species, while also reducing the effort spent in finding the referred populations in the future. With technologies as GPS trackers, digital thermometers and digital cameras being increasingly integrated to portable devices, we stress that obtaining the data mentioned above in the field is straightforward, and should be binding to manuscript acceptance by editors and reviewers.

A recent review of publications containing descriptions of anuran advertisement calls in Brazil (Guerra et al., 2018) reported that families Hylidae, Leptodactylidae and Bufonidae were the most recorded in the country. Despite the marked climatic differences among Northeastern Brazil (where hot and dry landscapes are predominant) and other geographic regions, the same families concentrate the largest number of bioacoustical studies, possibly as a result of their overall species diversity. Among the Northeastern Brazilian states, only Pernambuco (SEMAS PE, 2015) and Alagoas (Almeida et al., 2016) have comprehensive lists of anuran fauna occurring in their territory. There are also studies that provide data on anuran diversity by biome (Garda et al., 2017; Abrahão et al., 2019). However, since no biome is exclusive to the Northeast, these studies cannot be used for comparison with our study, which considers the entire Northeast region. Andrade et al. (2020) recognized the populations of *Pithecopus nordestinus* distributed north of the San Francisco River as a distinct taxon, *P. gonzagai*. Thus, studies published until 2020 may have analyzed the former (e.g. Vilaça et al., 2011), the latter (e.g.), or both species (e.g. Röhr et al., 2020). *P. nordestinus* and *P. gonzagai* are arboreal treefrogs whose geographic distribution extends widely across Northeastern Brazil, predominantly in the *Caatinga* and Atlantic Forest, but also extending into the *Cerrado* biome. After *P. nordestinus* + *P. gonzagai*, *Proceratophrys cristiceps* and *Pseudopaludicola pocoto* were the species studied more frequently. *Pr. cristiceps* had its taxonomy recently revised, and populations previously classified as *Pr. caramaschii* and *Pr. aridus* were considered junior synonyms. This expanded the known geographic distribution of *Pr. cristiceps* across the semi-arid *Caatinga* (Mângia et al., 2020). *Pseudopaludicola pocoto* also occurs across most of the *Caatinga* biome, and their very conspicuous calls makes the species easy to detect (Pereira et al., 2018). High local abundance, wide geographic distribution and very distinctive calls may be related to the relatively large number of papers which sampled these taxonomically unrelated species. An additional possibility is that the three species have extended reproductive seasons, with calling males being found most of the year, but data on interseason variation in call activity is currently lacking for these taxa.

It was expected that most studies in our survey addressed advertisement calls, possibly because of their potential application in taxonomy, which was also the most frequent subject of published articles using advertisement call recordings in our survey. Recording vocalizations not related to reproduction tend to be more costly and time consuming, as they are rarely detected, require more field observations, and sometimes require animal manipulation, as in the case of release calls (Toledo & Haddad, 2009). On the other hand, advertisement calls are frequently emitted, are easy to detect and easy to record (Köhler et al., 2017). However, we stress that the lack of data on other types of calls represents an important caveat to our understanding of complex behavioral interactions in most anuran species, including territoriality, male-male competition, courtship and defense against predators. Thus, studies aiming at the description of call repertoires, based on longer recording sessions, should be encouraged.

The low proportion of studies that deposited their sound recording archives in scientific collections echoed a trend also detected in Guerra et al. (2018) in their work with advertisement calls. Estimates suggest that, in recent decades, the practice of not depositing sound files in biological collections caused the loss of approximately six million U.S. dollars of investment in research of Brazilian anurans (Dena et al., 2019). The main reasons stated by herpetologists for not depositing the files were the lack of time, lack of knowledge of deposit procedures and the belief that depositing was not necessary (Dena et al., 2019). Recordings not deposited in scientific collections impair the potential for reproducibility of research, and hinder comparative studies. In addition, the biodiversity record for future generations and the information on the potential for evaluations of temporal changes in the acoustic landscape (*sensu* Sugai & Llusia, 2019) is lost. An alternative to encourage researchers to deposit their sound files in scientific collections is the requirement of scientific journals that vocalizations be deposited before the articles are published, which is already being done by some journals, and the adoption of simpler deposit procedures by managers of sound collections.

Bahia is the largest state in Northeastern Brazil (IBGE, 2019) and concentrated most of the anuran recordings studied. However, the distribution of studies among different states was not proportional to their area. The states with the second and third largest territories in Northeastern Brazil, Maranhão and Piauí, were the ones with fewer studies on anuran bioacoustics. The Atlantic Forest is historically the most studied Brazilian biome in terms of anuran species (Guerra et al., 2018; Lima et al., 2019), and it is absent in the latter two states. The Amazon Forest and ecotones between Amazon Forest and *Cerrado* covers approximately 35% of Maranhão (Araujo et al., 2016). But despite their outstanding amphibian diversity and despite being highly studied in other Brazilian geographic regions, the Amazon Forest and *Cerrado* areas in Maranhão are notoriously subsampled for anuran call recordings. Similarly, *Cerrado* regions in the remaining Northeastern states have been widely neglected by researchers. Future recording efforts should prioritize these biomes, potentially filling large biogeographic gaps on bioacoustical data.

Although the most productive institutions in terms of the number of studies on anuran vocalizations in the Northeast are located in Southeastern Brazil, the evaluation of collaboration networks revealed that most studies involved at least one institution located in the Brazilian Northeast, especially from 2011 onwards. Such finding indicates a consistent trend, in recent years, of local universities and research institutions in participating in the production of scientific knowledge in its own territory. As the number of studies also increased considerably in the same interval, this result may be related to the increase in investment in universities and human resources in the region. As identified in report from the *Centro de Gestão e Estudos Estratégicos* (CGEE, 2016), in 1996, the Southeast region held most of the graduate courses in Brazil and was responsible for 68% of the master's degrees and 89% of the doctoral degrees in the country. In 2014, this proportion decreased to 49% and 60%, respectively, as a result of a series of public policies created from 2003 onwards, which resulted in the increase of public universities, the creation of new campuses, and in the qualification of human resources and growth of industrial production in Northeastern Brazil (Silva et al., 2019). In addition to increased resources, research probably also benefited from collaborations among a larger number of institutions and authors. The increase in the number of authors per publications has been reported in several research fields over the last decades (Borenstein & Shamoo, 2015; Fontanarosa et al., 2017). The analysis of large databases, studies of varied cohorts and multidisciplinarity approaches are some of the advantages gained from collaborations among many authors (Fontanarosa et al., 2017). In short, the increase in the number of higher education institutions in the Northeast region allowed for the inclusion of these institutions in the network of collaborations with institutions already established and the feasibility of exploring problems in their own ecosystems, which includes the field of anuran bioacoustics.

CONCLUSION

In this study, we summarized the current knowledge on vocalizations of anurans in Northeastern Brazil, identifying knowledge gaps and many research opportunities. Gaps uncovered here can help selecting target regions and taxa for future studies, in addition to facilitating new research based on call samples already available. We hope that results based on our quality index will help researchers to optimize the information reported in scientific articles and other outlets, in order to ensure replicability and comparison among studies.

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REFERENCES

Abrahão, C. R., Moura, G. J. B., Freitas, M. A., & Escarlate-Tavares, F. (2019). *Plano de ação nacional para a conservação da herpetofauna ameaçada da Mata Atlântica nordestina*. ICMBio. https://www.gov.br/icmbio/pt-br/assuntos/biodiversidade/pan/pan-herpetofauna-do-nordeste/1-ciclo/pan-herpetofauna-do-nordeste-livro.pdf

Almeida, J. P. F. A., Nascimento, F. A. C., Torquato, S., Lisboa, B. S., Tiburcio, I. C. S., Palmeira, C. N. S., Lima, M. G., & Mott, T. (2016). Amphibians of Alagoas State, northeastern Brazil. *Herpetology Notes*, *9*, 123-140. https://www.biotaxa.org/hn/article/view/13116

Amézquita, A., Hödl, W., Lima, A. P., Castellanos, L., Erdtmann, L., & Araújo, M. C. (2006). Masking interference and the evolution of the acoustic communication system in the Amazonian dendrobatid frog *Allobates femoralis*. *Evolution*, *60*(9), 1874-1887. https://doi.org/10.1111/j.0014-3820.2006.tb00531.x

Amézquita, A., Lima, A. P., Jehle, L., Castellanos, L., Ramos, O., Crawford, A. J., Gasser, H., & Hödl, W. (2009). Calls, colours, shapes, and genes: A multi-trait approach to the study of geographic variation in the Amazonian frog *Allobates femoralis*. *Biological Journal of the Linnean Society*, *98*(4), 826-838. https://doi.org/10.1111/j.1095-8312.2009.01324.x

Andrade, F. S., Haga, I. A., Ferreira, J. S., Recco-Pimentel, S. M., Toledo, L. F., & Bruschi, D. P. (2020). A new cryptic species of *Pithecopus* (Anura, Phyllomedusidae) in north-eastern Brazil. *European Journal of Taxonomy*, *723*(1), 108-134. https://doi.org/10.5852/ejt.2020.723.1147

Araujo, L. S., Silva, G. B. S., Torresan, F. E., Victoria, D. D. C., Vicente, L. E., Bolfe, E. L., & Manzatto, C. (2016). *Conservação da biodiversidade do estado do Maranhão: cenário atual em dados geoespaciais* (Série Documentos). Embrapa Meio Ambiente. http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/1069715

Bang, D. L., Lisboa, B. S., Teixeira, B. F. V., Giaretta, A. A., & Carvalho, T. R. (2020). A comparative acoustic analysis of species of *Vitreorana* (Anura: Centrolenidae) from the Brazilian Atlantic Forest and Cerrado, with a description of the call of *V. baliomma* and insights into the taxonomic status of Cerrado populations. *Phyllomedusa: Journal of Herpetology*, *19*(1), 35-47. https://doi.org/10.11606/issn.2316-9079.v19i1p35-47

Becker, F. K., Shabangu, F. W., Gridley, T., Wittmer, H. U., & Marsland, S. (2022). Sounding out a continent: seven decades of bioacoustics research in Africa. *Bioacoustics*, *31*(6), 646-667. https://doi.org/10.1080/09524622.2021.2021987

Bee, M. A., & Swanson, E. M. (2007). Auditory masking of anuran advertisement calls by road traffic noise. *Animal Behaviour*, *74*(6), 1765-1776. https://doi.org/10.1016/j.anbehav.2007.03.019

Borenstein, J., & Shamoo, A. E. (2015). Rethinking authorship in the era of collaborative research. *Accountability in Research*, *22*(5), 267-283. https://doi.org/10.1080/08989621.2014.968277

Brandão, R. A., Álvares, G. F., Crema, A., & Zerbini, G. J. (2009). Natural history of *Phyllomedusa centralis* Bokermann 1965 (Anura: Hylidae: Phyllomedusinae): tadpole and calls. *South American Journal of Herpetology*, *4*(1), 61-68. https://doi.org/10.2994/057.004.0108

Brasil. Ministério do Meio Ambiente. (2022, 7 jun.). Portaria MMA nº 148, de 7 de junho de 2022. *Diário Oficial da União*. https://in.gov.br/en/web/dou/-/portaria-mma-n-148-de-7-de-junho-de-2022-406272733

Camurugi, F., Röhr, D. L., & Juncá, F. A. (2015). Differences in advertisement calls and vocal behavior in *Hypsiboas atlanticus* (Anura: Hylidae) among microhabitats. *Herpetologica*, *71*(4), 243-251. https://doi.org/10.1655/HERPETOLOGICA-D-14-00070

Centro de Gestão e Estudos Estratégicos (CGEE). (2016). *Mestres e doutores 2015 - estudos da demografia da base técnico-científica brasileira*. https://www.cgee.org.br/web/rhcti/mestres-e-doutores-2015

Christensen-Dalsgaard, J. (2008). Amphibian bioacoustics. In D. Havelock, S. Kuwano, & M. Vorländer (Eds.), *Handbook of signal processing in acoustics* (pp. 1861–1885). Springer. https://doi.org/10.1007/978-0-387-30441-0_102

Clarivate. (n.d.). *Web of Science*. https://www.webofknowledge.com/

Costa, S. M., & Dias, E. J. R. (2019). Comportamento territorial, vocalização e biologia reprodutiva de *Allobates olfersioides* (Anura: Aromobatidae). *Iheringia,* Série Zoologia, *109*, e2019031. https://doi.org/10.1590/1678-4766e2019031

Dena, S., Rebouças, R., Augusto-Alves, G., Zornosa-Torres, C., Pontes, M. R., & Toledo, L. F. (2019). How much are we losing in not depositing anuran sound recordings in scientific collections? *Bioacoustics*, *29*(5), 590-601. https://doi.org/10.1080/09524622.2019.1633567

Fletcher, N. H. (2014). *Animal bioacoustics*. In T. D. Rossing (Ed.), *Springer Handbook of Acoustics* (pp. 821–841). Springer. https://doi.org/10.1007/978-1-4939-0755-7_19

Fontanarosa, P., Bauchner, H., & Flanagin, A. (2017). Authorship and team science. *Jama*, *318*(24), 2433-2437. http://doi.org/10.1001/jama.2017.19341

Forti, L. R., Zornosa-Torres, C., Márquez, R., & Toledo, L. F. (2018). Ancestral state, phylogenetic signal and convergence among anuran distress calls. *Zoologischer Anzeiger*, *274*, 1-5. https://doi.org/10.1016/j.jcz.2018.02.004

Fouquet, A., Loebmann, D., Castroviejo-Fisher, S., Padial, J. M., Orrico, V. G., Lyra, M. L., Roberto, I. J., Kok, P. J. R., Haddad, C. F. B., & Rodrigues, M. T. (2012). From Amazonia to the Atlantic forest: Molecular phylogeny of Phyzelaphryninae frogs reveals unexpected diversity and a striking biogeographic pattern emphasizing conservation challenges. *Molecular Phylogenetics and Evolution*, *65*(2), 547-561. https://doi.org/10.1016/j.ympev.2012.07.012

Frost, D. R. (Ed.). (2024). *AmphibiaWeb*. University of California. https://amphibiaweb.org

Garda, A. A., Stein, M. G., Machado, R. B., Lion, M. B., Juncá, F. A., & Napoli, M. F. (2017). Ecology, biogeography, and conservation of amphibians of the Caatinga. In J. M. C. Silva, I. R. Leal, & M. Tabarelli (Eds.), *Caatinga: the largest tropical dry forest region in South America* (pp. 133-149). Springer. http://dx.doi.org/10.1007/978-3-319-68339-3_5

Garda, A. A., Lion, M. B., Lima, S. M. D. Q., Mesquita, D. O., Araujo, H. F. P. D., & Napoli, M. F. (2018). Os animais vertebrados do bioma Caatinga. *Ciência e Cultura*, *70*(4), 29-34. http://dx.doi.org/10.21800/2317-66602018000400010

Gehara, M., Crawford, A. J., Orrico, V. G., Rodriguez, A., Loetters, S., Fouquet, A., Barrientos, K. S., Brusquetti, F., De la Riva, I., Ernst, R., Urrutia, G. G., Glaw, F., Guayasamin, J. M., Hölting, M., Jansen, M., Kok, P. J. R., Kwet, A., Lingnau, R., Lyra, M., . . . Koehler, J. (2014). High levels of diversity uncovered in a widespread nominal taxon: continental phylogeography of the Neotropical tree frog *Dendropsophus minutus*. *PLoS ONE*, *9*(9), e103958. https://doi.org/10.1371/journal.pone.0103958

Gerhardt, H. C., & Huber, F. (2002). *Acoustic communication in insects and anurans: common problems and diverse solutions.* University of Chicago Press.

Google. (n.d.). *Google Scholar*. https://scholar.google.com.br

Goutte, S., Dubois, A., Howard, S. D., Márquez, R., Rowley, J. J., Dehling, J. M. P., Grandcolas, P., Xiong, R. C., & Legendre, F. (2018). How the environment shapes animal signals: a test of the Acoustic Adaptation Hypothesis in frogs. *Journal of Evolutionary Biology*, *31*(1), 148-158. https://doi.org/10.1111/jeb.13210

Guerra, V., Llusia, D., Gambale, P. G., Morais, A. R. D., Márquez, R., & Bastos, R. P. (2018). The advertisement calls of Brazilian anurans: Historical review, current knowledge and future directions. *PLoS ONE*, *13*(1), e0191691. https://doi.org/10.1371/journal.pone.0191691

Heyer, W. R., & Carvalho, C. M. (2000). Calls and calling behaviour of the frog *Leptodactylus natalensis* (Amphibia: Anura: Leptodactylidae). *Proceedings of the Biological Society of Washington*, *113*(1), 284-290.

Instituto Brasileiro de Geografia e Estatística (IBGE) & Ministério do Meio Ambiente e Mudança do Clima (MMA). (2004). *Mapa de biomas do Brasil - primeira aproximação*. IBGE/MMA.

Instituto Brasileiro de Geografia e Estatística (IBGE). (2017). *Bases cartográficas contínuas - Brasil*. IBGE. https://www.ibge.gov.br/geociencias/cartas-e-mapas/bases-cartograficas-continuas/15759-brasil.html

Instituto Brasileiro de Geografia e Estatística (IBGE). (2019). *Bases cartográficas contínuas*. https://www.ibge.gov.br/geociencias/informacoes-ambientais/vegetacao/15842-biomas.html

Kaefer, I. L., Tsuji-Nishikido, B. M., & Lima, A. P. (2012). Beyond the river: underlying determinants of population acoustic signal variability in Amazonian direct-developing *Allobates* (Anura: Dendrobatoidea). *Acta Ethologica*, *15*(2), 187-194. https://doi.org/10.1007/s10211-012-0126-0

Köhler, J., Jansen, M., Rodriguez, A., Kok, P. J., Toledo, L. F., Emmrich, M., Glaw, F., Haddad, C. F. B., Rödel, M., & Vences, M. (2017). The use of bioacoustics in anuran taxonomy: theory, terminology, methods and recommendations for best practice. *Zootaxa*, *4251*(1), 1-124. https://doi.org/10.11646/zootaxa.4251.1.1

Laiolo, P. (2010). The emerging significance of bioacoustics in animal species conservation. *Biological Conservation*, *143*(7), 1635-1645. https://doi.org/10.1016/j.biocon.2010.03.025

Lima, M. S. C. S., Pederassi, J., Pineschi, R. B., & Barbosa, D. B. S. (2019). Acoustic niche partitioning in an anuran community from the municipality of Floriano, Piauí, Brazil. *Brazilian Journal of Biology*, *79*(4), 566-576. https://doi.org/10.1590/1519-6984.180399

Lingnau, R., & Bastos, R. P. (2007). Vocalizations of the Brazilian torrent frog *Hylodes heyeri* (Anura: Hylodidae): Repertoire and influence of air temperature on advertisement call variation. *Journal of Natural History*, *41*(17-20), 1227-1235. http://dx.doi.org/10.1080/00222930701395626

Malagoli, L. R., Pezzuti, T. L., Bang, D. L., Faivovich, J., Lyra, M. L., Giovanelli, J. G. R., Garcia, P. C. A., Sawaya, R. J., & Haddad, C. F. B. (2021). A new reproductive mode in anurans: Natural history of *Bokermannohyla astartea* (Anura: Hylidae) with the description of its tadpole and vocal repertoire. *PLoS ONE*, *16*(2), e0246401. https://doi.org/10.1371/journal.pone.0246401

Mângia, S., Camurugi, F., Pereira, E. A., Carvalho, P., Röhr, D. L., Folly, H., & Santana, D. J. (2019). Release calls of four species of Phyllomedusidae (Amphibia, Anura). *Herpetozoa*, *32*, 77-81. https://doi.org/10.3897/herpetozoa.32.e35729

Mângia, S., Oliveira, E. F., Santana, D. J., Koroiva, R., Paiva, F., & Garda, A. A. (2020). Revising the taxonomy of *Proceratophrys* Miranda-Ribeiro, 1920 (Anura: Odontophrynidae) from the Brazilian semiarid Caatinga: Morphology, calls and molecules support a single widespread species. *Journal of Zoological Systematics and Evolutionary Research*, *58*(4), 1151-1172. http://dx.doi.org/10.1111/jzs.12365

Moser, C. F., Schuck, L. K., Olmedo, G. M., & Lingnau, R. (2022). Individual variation in the advertisement call of *Aplastodiscus albosignatus* (Anura: Hylidae) is correlated with body size and environmental temperature. *Zoologia (Curitiba)*, *39*, e21008. https://doi.org/10.1590/S1984-4689.v39.e21008

Nali, R. C., & Prado, C. P. (2014). Complex call with different messages in *Bokermannohyla ibitiguara* (Anura, Hylidae), a gladiator frog of the Brazilian Cerrado. *Journal of Herpetology*, *48*(3), 407-414. https://doi.org/10.1670/13-090

Nascimento, J., Lima, J. D., Suarez, P., Baldo, D., Andrade, G. V., Pierson, T. W., Fitzpatrick, B. M., Haddad, C. F. B., Recco-Pimentel S. M., & Lourenco, L. B. (2019). Extensive cryptic diversity within the *Physalaemus cuvieri–Physalaemus ephippifer* species complex (Amphibia, Anura) revealed by cytogenetic, mitochondrial, and genomic markers. *Frontiers in Genetics*, *10*, 719. https://doi.org/10.3389/fgene.2019.00719

Noda, J. J., Sánchez-Rodríguez, D., & Travieso-González, C. M. (2018). A methodology based on bioacoustic information for automatic identification of reptiles and anurans. In D. R. Aguillón Gutiérrez (Ed.), *Reptiles and Amphibians* (pp. 67-84). InTech. http://doi.org/10.5772/intechopen.74333

Obrist, M. K., Pavan, G., Sueur, J., Riede, K., Llusia, D., & Márquez, R. (2010). Bioacoustics approaches in biodiversity inventories. *Abc Taxa*, *8*(2010), 68-99.

Penar, W., Magiera, A., & Klocek, C. (2020). Applications of bioacoustics in animal ecology. *Ecological Complexity*, *43*, 100847. https://doi.org/10.1016/j.ecocom.2020.100847

Pereira, E. A., Folly, H., Rebouças, R., & Santana, D. J. (2018). Distribution extension, geographic distribution maps and comments on the advertisement call of *Pseudopaludicola pocoto* Magalhães, Loebmann, Kokubum, Haddad and Garda, 2014 (Anura: Leptodactylidae: Leiuperinae). *Herpetology Notes*, *11*, 1055-1059. https://www.biotaxa.org/hn/article/view/31983

Pimenta, B. V. S., Nunes, I., & Cruz, C. A. G. (2007). Notes on the poorly known Phyllomedusine frog *Hylomantis aspera* Peters, 1872 (Anura, Hylidae). *South American Journal of Herpetology*, *2*(3), 206-214. https://doi.org/10.2994/1808-9798(2007)2[206:NOTPKP]2.0.CO;2

Protázio, A. S., Albuquerque, R. L., Falkenberg, L. M., & Mesquita, D. O. (2014). Acoustic ecology of an anuran assemblage in the arid Caatinga of northeastern Brazil. *Journal of Natural History*, *49*(15–16), 957–976. https://doi.org/10.1080/00222933.2014.931482

Protázio, A. S., Protázio, A. S., & Mesquita, D. O. (2019). Niche partitioning between two *Physalaemus* species (Anura, Leptodactylidae) in semiarid Caatinga in Northeast Brazil. *North-Western Journal of Zoology*, *15*(2), 157-167. https://biozoojournals.ro/nwjz/content/v15n2/nwjz_e191501_Protazio.pdf

QGIS.org. (n.d.). *QGIS Geographic Information System*. https://qgis.org/

Rakotoarison, A., Scherz, M. D., Glaw, F., Koehler, J., Andreone, F., Franzen, M., Glos, J., Hawlitschek, O., Jono, T., Mori, A., Ndriantsoa, S. H., Raminosoa, N. R., Riemann, J. C., Rödel, M., Rosa, G. M., Vieites, D. R., Crottini, A., & Vences, M. (2017). Describing the smaller majority: integrative taxonomy reveals twenty-six new species of tiny microhylid frogs (genus *Stumpffia*) from Madagascar. *Vertebrate Zoology*, *67*(3), 271-398. https://doi.org/10.3897/vz.67.e31595

Ramer, J. D., Jenssen, T. A., & Hurst, C. J. (1983). Size-related variation in the advertisement call of *Rana clamitans* (Anura: Ranidae), and its effect on conspecific males. *Copeia*, (1), 141-155. https://doi.org/10.2307/1444708

Röhr, D. L., & Juncá, F. A. (2013). Micro-habitat influence on the advertisement call structure and sound propagation efficiency of *Hypsiboas crepitans* (Anura: Hylidae). *Journal of Herpetology*, *47*(4), 549-554. http://dx.doi.org/10.1670/10-210

Röhr, D. L., Camurugi, F., Martinez, P. A., Sousa-Lima, R. S., Juncá, F. A., & Garda, A. A. (2020). Habitat-dependent advertisement call variation in the monkey frog *Phyllomedusa nordestina*. *Ethology*, *126*(6), 651-659. https://doi.org/10.1111/eth.13017

Ryan, M. J. (1988). Energy, calling, and selection. *American Zoologist*, *28*(3), 885-898. https://doi.org/10.1093/icb/28.3.885

Scientific Electronic Library Online (SciELO). (n.d.). https://www.scielo.org/

Secretaria de Meio Ambiente e Sustentabilidade de Pernambuco (SEMAS PE). (2015). Resolução SEMAS nº 1 de 09/01/2015. Reconhece como espécies de anfíbios da fauna pernambucana ameaçadas de extinção aquelas constantes da lista oficial e dá outras providências. *Diário Oficial do Estado*. https://www.legisweb.com.br/legislacao/?id=280590#

Segalla, M. V., Berneck, B., Canedo, C., Caramaschi, U., Cruz, C. A. G., Garcia, P. C., Grant, T., Haddad, C. F. B., Lourenço, A. C. C., Mângia, S., Mott, T., Nascimento, L. B., Toledo, L. F., Werneck, F. P., & Langone, J. A. (2021). Brazilian amphibians: list of species. *Herpetologia Brasileira*, *10*(1), 121-216.

Silva, T. S., Milani, A. M. R., & Antunes, V. N. B. (2019). Análise regional das políticas de apoio à C, T&I: um estudo preliminar da estrutura científica e tecnológica do Nordeste. *Revista Econômica do Nordeste*, *50*(3), 107-123. https://doi.org/10.61673/ren.2019.923

Silva-Filho, I. S. N., & Juncá, F. A. (2006). Evidence of full species status of the neotropical leaf-frog *Phyllomedusa burmeisteri bahiana* (A. Lutz, 1925) (Amphibia, Anura, Hylidae). *Zootaxa*, *1113*(1), 51-64. https://doi.org/10.11646/zootaxa.1113.1.5

Simões, P. I., Stow, A., Hödl, W., Amézquita, A., Farias, I. P., & Lima, A. P. (2014). The value of including intraspecific measures of biodiversity in environmental impact surveys is highlighted by the Amazonian brilliant-thighed frog (*Allobates femoralis*). *Tropical Conservation Science*, *7*(4), 811-828. https://doi.org/10.1177/194008291400700416

Smith, M. J., & Roberts, J. D. (2003). Call structure may affect male mating success in the quacking frog *Crinia georgiana* (Anura: Myobatrachidae). *Behavioral Ecology and Sociobiology*, *53*(4), 221-226. https://www.jstor.org/stable/4602206

Sugai, L. S. M., & Llusia, D. (2019). Bioacoustic time capsules: Using acoustic monitoring to document biodiversity. *Ecological Indicators*, *99*, 149-152. https://doi.org/10.1016/j.ecolind.2018.12.021

Toledo, L. F., Fernando, C., & Haddad, B. (2009). Defensive vocalizations of Neotropical anurans. *South American Journal of Herpetology*, *4*(1), 25-42. https://doi.org/10.2994/057.004.0104

Toledo, L. F., Martins, I. A., Bruschi, D. P., Passos, M. A., Alexandre, C., & Haddad, C. F. (2014). The anuran calling repertoire in the light of social context. *Acta Ethologica*, *18*(2), 87-99. https://doi.org/10.1007/s10211-014-0194-4

Trevisan, C. C., Batalha-Filho, H., Garda, A. A., Menezes, L., Dias, I. R., Solé, M., Canedo, C., Juncá, F. A., & Napoli, M. F. (2020). Cryptic diversity and ancient diversification in the northern Atlantic Forest *Pristimantis* (Amphibia, Anura, Craugastoridae). *Molecular Phylogenetics and Evolution*, *148*, 106811. https://doi.org/10.1016/j.ympev.2020.106811

Vacher, J. P., Kok, P. J., Rodrigues, M. T., Lima, J. D., Lorenzini, A., Martinez, Q., Fallet, M., Courtois, E. A., Blanc, M., Gaucher, P., Dewynter, M., Jairam, R., Ouboter, P., Thébaud, C., & Fouquet, A. (2017). Cryptic diversity in Amazonian frogs: Integrative taxonomy of the genus Anomaloglossus (Amphibia: Anura: Aromobatidae) reveals a unique case of diversification within the Guiana Shield. *Molecular Phylogenetics and Evolution*, *112*, 158-173. https://doi.org/10.1016/j.ympev.2017.04.017

Vallee, M. (2017). The science of listening in bioacoustics research: Sensing the animals' sounds. *Theory, Culture & Society*, *35*(2), 47-65. https://doi.org/10.1177/0263276417727059

Vilaça, T. R. A., Silva, J. R. S., & Solé, M. (2011). Vocalization and territorial behaviour of *Phyllomedusa nordestina* Caramaschi, 2006 (Anura: Hylidae) from southern Bahia, Brazil. *Journal of Natural History*, *45*(29-30), 1823-1834. https://doi.org/10.1080/00222933.2011.561018

Vilela, B., Lisboa, B. S., & Nascimento, F. A. C. D. (2014). Reproduction of *Agalychnis granulosa* Cruz, 1989 (Anura: Hylidae). *Journal of Natural History*, *49*(11-12), 709-717. https://doi.org/10.1080/00222933.2014.897764

Wells, K. D., & Schwartz, J. J. (2007). The behavioral ecology of anuran communication. In P. M. Narins, A. S. Feng, R. R. Fay, & A. N. Popper (Eds.), *Hearing and sound communication in amphibians* (pp. 44-86). Springer. https://doi.org/10.1007/978-0-387-47796-1_3

Zhang, F., Chen, P., Chen, Z., & Zhao, J. (2015). Ultrasonic frogs call at a higher pitch in noisier ambiance. *Current Zoology*, *61*(6), 996-1003. https://doi.org/10.1093/czoolo/61.6.996

AUTHORS' CONTRIBUTION

L. C. Moura contributed to conceptualization, data curation, formal analysis, investigation, methodology, software and writing (original draft); and P. I. Simões contributed to conceptualization, formal analysis, investigation, methodology, supervision and writing (review and editing).

Appendix 1. List of species from the Northeast region of Brazil with vocalizations analyzed in studies published in scientific journals. (Continue)

Family	Species
Allophrynidae	*Allophryne relicta* Caramaschi, Orrico, Faivovich, Dias, and Solé, 2013
Aromobatidae	*Allobates olfersioides* (Lutz, 1925)
Bufonidae	*Frostius erythrophthalmus* Pimenta and Caramaschi, 2007
	Frostius pernambucensis (Bokermann, 1962)
	Rhinella casconi Roberto, Brito, and Thomé, 2014
	Rhinella crucifer (Wied-Neuwied, 1821)
	Rhinella dapsilis (Myers and Carvalho, 1945) *Rhinella diptycha* (Cope, 1862)
	Rhinella granulosa (Spix, 1824)
	Rhinella hoogmoedi Caramaschi and Pombal, 2006
Centrolenidae	*Vitreorana baliomma* Pontes, Caramaschi, and Pombal, 2014
Ceratophryidae	*Ceratophrys joazeirensis* Mercadal de Barrio, 1986
Craugastoridae	*Haddadus aramunha* (Cassimiro, Verdade, and Rodrigues, 2008)
	Haddadus binotatus (Spix, 1824)
Eleutherodactylidae	*Adelophryne maranguapensis* Hoogmoed, Borges, and Cascon, 1994
	Adelophryne mucronata Lourenço-de-Moraes, Solé, and Toledo, 2012
	Bahius bilineatus (Bokermann, 1975)
Hemiphractidae	*Gastrotheca fissipes* (Boulenger, 1888)
	Gastrotheca recava Teixeira, Vechio, Recoder, Carnaval, Strangas, Damasceno, Sena, and Rodrigues, 2012
Hylidae	*Aplastodiscus ibirapitanga* (Cruz, Pimenta, and Silvano, 2003)
	Aplastodiscus sibilatus (Cruz, Pimenta, and Silvano, 2003)
	Boana atlantica (Caramaschi and Velosa, 1996)
	Boana crepitans (Wied-Neuwied, 1824)
	Boana exastis (Caramaschi and Rodrigues, 2003)
	Boana freicanecae (Carnaval and Peixoto, 2004)
	Boana pombali (Caramaschi, Pimenta, and Feio, 2004)
	Boana raniceps (Cope, 1862)
	Bokermannohyla capra Napoli and Pimenta, 2009
	Bokermannohyla diamantina Napoli and Juncá, 2006
	Bokermannohyla flavopicta Leite, Pezzuti, and Garcia, 2012
	Bokermannohyla itapoty Lugli and Haddad, 2006
	Bokermannohyla juiju Faivovich, Lugli, Lourenço, and Haddad, 2009
	Bokermannohyla lucianae (Napoli and Pimenta, 2003)
	Bokermannohyla oxente Lugli and Haddad, 2006
	Dendropsophus branneri (Cochran, 1948)
	Dendropsophus elegans (Wied-Neuwied, 1824)
	Dendropsophus haddadi (Bastos and Pombal, 1996)

Appendix 1. (Continue)

Family	Species
Hylidae	*Dendropsophus minutus* (Peters, 1872)
	Dendropsophus nanus (Boulenger, 1889)
	Dendropsophus nekronastes Dias, Haddad, Argôlo, and Orrico, 2017
	Dendropsophus novaisi (Bokermann, 1968)
	Dendropsophus oliveirai (Bokermann, 1963)
	Dendropsophus studerae (Carvalho-e-Silva, Carvalho-e-Silva, and Izecksohn, 2003)
	Hylomantis aspera Peters, 1873
	Hylomantis granulosa (Cruz, 1989)
	Julianus camposseabrai (Bokermann, 1968)
	Nyctimantis arapapa (Pimenta, Napoli, and Haddad, 2009)
	Ololygon agilis (Cruz and Peixoto, 1983)
	Ololygon strigilata (Spix, 1824)
	Phasmahyla timbo Cruz, Napoli, and Fonseca, 2008
	Phasmahyla spectabilis Cruz, Feio, and Nascimento, 2008
	Phyllodytes acuminatus Bokermann, 1966
	Phyllodytes amadoi Vörös, Dias, and Solé, 2017
	Phyllodytes edelmoi Peixoto, Caramaschi, and Freire, 2003
	Phyllodytes gyrinaethes Peixoto, Caramaschi, and Freire, 2003
	Phyllodytes kautskyi Peixoto and Cruz, 1988
	Phyllodytes magnus Dias, Novaes-e-Fagundes, Mollo, Zina, Garcia, Recoder, Vechio, Rodrigues, and Solé, 2020
	Phyllodytes megatympanum Marciano, Lantyer-Silva, and Solé, 2017
	Phyllodytes melanomystax Caramaschi, Silva, and Britto-Pereira, 1992
	Phyllodytes praeceptor Orrico, Dias, and Marciano, 2018
	Phyllodytes tuberculosus Bokermann, 1966
	Phyllodytes wuchereri (Peters, 1873)
	Phyllomedusa bahiana Lutz, 1925
	Pithecopus gonzagai Andrade, Haga, Ferreira, Recco-Pimentel, Toledo, and Bruschi, 2020
	Pithecopus nordestinus (Caramaschi, 2006)
	Scinax alter (Lutz, 1973)
	Scinax auratus (Wied-Neuwied, 1821)
	Scinax x-signatus (Spix, 1824)
	Scinax cretatus Nunes and Pombal, 2011
	Scinax eurydice (Bokermann, 1968)
	Scinax fuscovarius (Lutz, 1925)
	Scinax juncae Nunes and Pombal, 2010
	Scinax montivagus Juncá, Napoli, Nunes, Mercês, and Abreu, 2015
	Scinax pachycrus (Miranda-Ribeiro, 1937)
	Scinax ruber (Laurenti, 1768)

Appendix 1. (Continue)

Family	Species
Hylidae	*Sphaenorhynchus cammaeus* Roberto, Araujo-Vieira, Carvalho-e-Silva, and Ávila, 2017
	Sphaenorhynchus mirim Caramaschi, Almeida, and Gasparini, 2009
	Sphaenorhynchus palustris Bokermann, 1966
	Trachycephalus atlas Bokermann, 1966
Leptodactylidae	*Adenomera saci* Carvalho and Giaretta, 2013
	Leptodactylus caatingae Heyer and Juncá, 2003
	Leptodactylus fuscus (Schneider, 1799)
	Leptodactylus luctator (Hudson, 1892)
	Leptodactylus macrosternum Miranda-Ribeiro, 1926
	Leptodactylus natalensis Lutz, 1930
	Leptodactylus oreomantis Carvalho, Leite, and Pezzuti, 2013
	Leptodactylus payaya Magalhães, Lyra, Carvalho, Baldo, Brusquetti, Burella, Colli, Gehara, Giaretta, Haddad, Langone, López, Napoli, Santana, de Sá, and Garda, 2020
	Leptodactylus jolyi Sazima and Bokermann 1978
	Leptodactylus troglodytes Lutz, 1926
	Leptodactylus vastus Lutz, 1930
	Physalaemus aguirrei Bokermann, 1966
	Physalaemus albifrons (Spix, 1824)
	Physalaemus caete Pombal and Madureira, 1997
	Physalaemus camacan Pimenta, Cruz, and Silvano, 2005
	Physalaemus cicada Bokermann, 1966
	Physalaemus cuvieri Fitzinger, 1826
	Physalaemus erikae Cruz and Pimenta, 2004
	Physalaemus kroyeri (Reinhardt and Lütken, 1862)
	Physalaemus nattereri (Steindachner, 1863)
	Pleurodema diplolister (Peters, 1870)
	Pseudopaludicola canga Giaretta and Kokubum, 2003
	Pseudopaludicola florencei Andrade, Haga, Lyra, Leite, Kwet, Haddad, Toledo, and Giaretta, 2018
	Pseudopaludicola jaredi Andrade, Magalhães, Nunes-de-Almeida, Veiga-Menoncello, Santana, Garda, Loebmann, Recco-Pimentel, Giaretta, and Toledo, 2016
	Pseudopaludicola mystacalis (Cope, 1887)
	Pseudopaludicola pocoto Magalhães, Loebmann, Kokubum, Haddad, and Garda, 2014
	Rupirana cardosoi Heyer, 1999
Microhylidae	*Chiasmocleis cordeiroi* Caramaschi and Pimenta, 2003
	Chiasmocleis crucis Caramaschi and Pimenta, 2003
	Elachistocleis cesarii (Miranda-Ribeiro, 1920)
	Elachistocleis piauienses Caramaschi and Jim, 1983

Appendix 1. (Conclusion)

Family	Species
Odontophrynidae	*Macrogenioglottus alipioi* Carvalho, 1946
	Proceratophrys ararype Mângia, Koroiva, Nunes, Roberto, Ávila, Sant'Anna, Santana, and Garda, 2018
	Proceratophrys cristiceps (Müller, 1883)
	Proceratophrys minuta Napoli, Cruz, Abreu, and Del Grande, 2011
	Proceratophrys redacta Teixeira, Amaro, Recoder, Vechio, and Rodrigues, 2012
	Proceratophrys renalis (Miranda-Ribeiro, 1920)
	Proceratophrys sanctaritae Cruz and Napoli, 2010
Strabomantide	*Pristimantis ramagii* (Boulenger, 1888)
	Pristimantis rupícola Taucce, Nascimento, Trevisan, Leite, Santana, Haddad, and Napoli, 2020

Appendix 2. Analyzed publications. (Continue)

Abrunhosa, P. A., Pimenta, B. V. S., Cruz, C. A. G., & Haddad, C. F. B. (2005). Advertisement calls of species of the *Hyla albosignata* group (Amphibia, Anura, Hylidae). *Arquivos do Museu Nacional*, *63*(2), 275-282. https://biostor.org/reference/248131

Amorim, F. O., Schmaltz-Peixoto, K. E., Araújo, L. C. S. S., & Santos, E. M. (2009). Temporada e turno de vocalização de *Leptodactylus natalensis* Lutz, 1930 (Amphibia, Anura) na mata atlântica de Pernambuco, Brasil. *Papéis Avulsos de Zoologia*, *49*(1), 1-7. https://doi.org/10.1590/S0031-10492009000100001

Andrade, F. S., Haga, I. A., Ferreira, J. S., Recco-Pimentel, S. M., Toledo, L. F., & Bruschi, D. P. (2020). A new cryptic species of *Pithecopus* (Anura, Phyllomedusidae) in north-eastern Brazil. *European Journal of Taxonomy*, *723*(1), 108-134. https://doi.org/10.5852/ejt.2020.723.1147

Andrade, F. S., Haga, I. A., Lyra, M. L., Leite, F. S. F., Kwet, A., Haddad, C. F. B., Toledo, L. F., & Giaretta, A. A. (2018). A new species of *Pseudopaludicola* Miranda-Ribeiro (Anura: Leptodactylidae: Leiuperinae) from eastern Brazil, with novel data on the advertisement call of Pseudopaludicola falcipes (Hensel). *Zootaxa*, *4433*(1), 71-100. https://doi.org/10.11646/zootaxa.4433.1.4

Andrade, F. S., Leite, F. F., Carvalho, T., Bernardes, C. S., & Giaretttta, A. (2017). First record of *Pseudopaludicola pocoto* Magalhães, Loebmann, Kokubum, Haddad & Garda, 2014 (Anura, Leptodactylidae, Leiuperinae) in Bahia state, northeastern Brazil, with further data on its advertisement call. *Check List*, *13*(1), 1-4. https://doi.org/10.15560/13.1.2047

Andrade, F. S., Magalhaes, F. M., Nunes-de-Almeida, C. H. L., Veiga-Menoncello, A. C. P., Santana, D. J., Garda, A. A., Loebmann, D., Recco-Pimentel, S. M., Giaretta, A. A., & Toledo, L. F. (2016). A new species of long-legged *Pseudopaludicola* from northeastern Brazil (Anura, Leptodactylidae, Leiuperinae). *Salamandra*, *52*(2), 107-124.

Araújo, K. C., Santos, M. V., Lima, T. G. P., Andrade, E. B., & Weber, L. N. (2015). First record of *Adenomera saci* Carvalho & Giaretta, 2013 (Anura: Leptodactylidae) for the State of Maranhão, Northeastern Brazil. *Herpetology Notes*, *8*, 183-185. https://www.biotaxa.org/hn/article/view/9742

Araujo-Vieira, K., Pombal Jr., J. P., Caramaschi, U., Novaes-e-Fagundes, G., Orrico, V. G. D., & Faivovich, J. (2020). A neotype for *Hyla x-signata* Spix, 1824 (Amphibia, Anura, Hylidae). *Papéis Avulsos de Zoologia*, *60*, e20206056. https://doi.org/10.11606/1807-0205/2020.60.56

Ávila, R. W., Pansonato, A., Perez, R., Carvalho, V. T., Roberto, I. J., Morais, D. H., Almeida, A. P., Rojas, R., Gordo, M., & Farias, I. P. (2018). On *Rhinella gildae* Vaz-Silva, Maciel, Bastos Pombal 2015 (Anura: Bufonidae): Phylogenetic relationship, morphological variation, advertisement and release calls and geographic distribution. *Zootaxa*, *4462*(2), 274-290. https://doi.org/10.11646/zootaxa.4462.2.9

Bang, D. L., Lisboa, B. S., Teixeira, B. F. V., Giaretta, A. A., & Carvalho, T. R. (2020). A comparative acoustic analysis of species of *Vitreorana* (Anura: Centrolenidae) from the Brazilian Atlantic Forest and Cerrado, with a description of the call of *V. baliomma* and insights into the taxonomic status of Cerrado populations. *Phyllomedusa: Journal of Herpetology*, *19*(1), 35-47. https://doi.org/10.11606/issn.2316-9079.v19i1p35-47

Campos, T. F., Lima, M. G., Nascimento, F. A. C. D., & Santos, E. M. (2014). Larval morphology and advertisement call of *Phyllodytes acuminatus* Bokermann, 1966 (Anura: Hylidae) from Northeastern Brazil. *Zootaxa*, *3779*(1), 93-100. https://doi.org/10.11646/zootaxa.3779.1.10

Camurugi, F., Röhr, D. L., & Juncá, F. A. (2015). Differences in advertisement calls and vocal behavior in *Hypsiboas atlanticus* (Anura: Hylidae) among microhabitats. *Herpetologica*, *71*(4), 243-251. https://doi.org/10.1655/HERPETOLOGICA-D-14-00070

Caramaschi, U., Orrico, V. G. D., Faivovich, J., Dias, I. R., & Solé, M. (2013). A new species of *Allophryne* (Anura: Allophrynidae) from the Atlantic rain forest biome of eastern Brazil. *Herpetologica*, *69*(4), 480-491. http://dx.doi.org/10.1655/HERPETOLOGICA-D-13-00029

Carneiro, M. C. L., Magalhães, P. S., & Juncá, F. A. (2004). Descrição do girino e vocalização de *Scinax pachycrus* (Miranda-Ribeiro, 1937) (Amphibia, Anura, Hylidae). *Arquivos do Museu Nacional*, *62*(3), 241-246. https://revistas.ufrj.br/index.php/amn/article/view/48739

Carvalho, T. R., Roberto, I. J., Dias, E. G., Santos, R. L. D., & Santos, E. M. D. (2020). The advertisement call of *Physalaemus caete* Pombal & Madureira, 1997 (Anura: Leptodactylidae: Leiuperinae), an endangered species endemic to Brazil's northern Atlantic Forest. *Zootaxa*, *4822*(3), 439-442. https://doi.org/10.11646/zootaxa.4822.3.9

Carvalho, T. R., Leite, F. S. F., & Pezzuti, T. L. (2013). A new species of *Leptodactylus* Fitzinger (Anura, Leptodactylidae, Leptodactylinae) from montane rock fields of the Chapada Diamantina, northeastern Brazil. *Zootaxa*, *3701*(3), 349-364. https://doi.org/10.11646/zootaxa.3701.3.5

Appendix 2. (Continue)

Casal, F. C., & Juncá, F. A. (2008). Girino e canto de anúncio de *Hypsiboas crepitans* (Amphibia: Anura: Hylidae) do estado da Bahia, Brasil, e considerações taxonômicas. *Boletim do Museu Paraense Emílio Goeldi. Ciências Naturais*, *3*(3), 217-224. https://doi.org/10.46357/bcnaturais.v3i3.674

Costa, S. M., & Dias, E. J. R. (2019). Comportamento territorial, vocalização e biologia reprodutiva de *Allobates olfersioides* (Anura: Aromobatidae). *Iheringia, Série Zoologia*, *109*, e2019031. https://doi.org/10.1590/1678-4766e2019031

Costa, T. B., Laranjeiras, D. O., Röhr, D. L., Magalhães, F. D. M., Juncá, F. A., & Garda, A. A. (2014). The advertisement call of *Haddadus aramunha* (Cassimiro, Verdade & Rodrigues, 2008) (Anura, Craugastoridae). *Zootaxa*, *3784*(1), 94-96. http://dx.doi.org/10.11646/zootaxa.3784.1.8

Cruz, C. A. G., Napoli, M. F., & Fonseca, P. M. (2008). A new species of *Phasmahyla* Cruz, 1990 (Anura: Hylidae) from the state of Bahia, Brazil. *South American Journal of Herpetology*, *3*(3), 187-195.

Cruz, C. A. G., & Napoli, M. F. (2010). A new species of smooth horned frog, genus *Proceratophrys* Miranda-Ribeiro (Amphibia: Anura: Cycloramphidae), from the Atlantic Rainforest of eastern Bahia, Brazil. *Zootaxa*, *2660*(1), 57-67. http://dx.doi.org/10.11646/zootaxa.2660.1.5

Cruz, C. A. G., & Pimenta, B. V. S. (2004). New species of *Physalaemus Fitzinger*, 1826 from southern Bahia, Brazil (Anura, Leptodactylidae). *Journal of Herpetology*, *38*(4), 480-486. http://dx.doi.org/10.1670/214-02A

Cruz, C. A. G., & Pimenta, B. V. S. (2004). The tadpole and advertisement call of *Physalaemus aguirrei* Bokermann, 1966 (Amphibia, Anura, Leptodactylidae). *Amphibia-Reptilia*, *25*(2), 197-204.

Cruz, D., Marciano-Jr., E., & Napoli, M. F. (2014). Advertisement and courtship calls of *Phyllodytes wuchereri* (Peters, 1873) (Anura: Hylidae). *Zootaxa*, *3774*(1), 97-100. http://dx.doi.org/10.11646/zootaxa.3774.1.8

Dias, I. R., Novaes-e-Fagundes, G., Neto, A. M., Zina, J., Garcia, C., Recoder, R. S., Vechio, F. D., Rodrigues, M. T., & Solé, M. (2020). A new large canopy-dwelling species of *Phyllodytes* Wagler, 1930 (Anura, Hylidae) from the Atlantic Forest of the state of Bahia, Northeastern Brazil. *PeerJ*, *8*, e8642. https://doi.org/10.7717/peerj.8642

Dias, I. R., Rödder, D., Weinsheimer, F., Kwet, A., & Solé, M. (2011). Description of the advertisement call of *Phasmahyla spectabilis* Cruz, Feio & Nascimento, 2008 (Anura). *Zootaxa*, *2767*, 59-64. http://dx.doi.org/10.11646/zootaxa.2767.1.6

Dias, I. R., Haddad, C. F. B., Argôlo, A. J. S., & Orrico, V. G. D. (2017). The 100th: an appealing new species of *Dendropsophus* (Amphibia: Anura: Hylidae) from northeastern Brazil. *PloS ONE*, *12*(3), e0171678. https://doi.org/10.1371/journal.pone.0171678

Dias, I. R., Mira-Mendes, C. V., Souza-Costa, C. A., Juncá, F. A., & Solé, M. (2017). The advertisement call and comments on the distribution of *Eleutherodactylus bilineatus* Bokermann, 1975, an endemic frog of Bahia State, Brazil (Amphibia, Anura). *ZooKeys*, *677*, 151. http://dx.doi.org/10.3897/zookeys.677.12309

Dias, I. R., Lourenço-de-Moraes, R., & Solé, M. (2012). Description of the advertisement call and morphometry of *Haddadus binotatus* (Spix, 1824) from a population from southern Bahia, Brazil. *North-Western Journal of Zoology*, *8*(1), 107-111.

Faraulo, M. S. (2019). Vocalisations and reproductive pattern of *Boana pombali* (Caramaschi *et al.,* 2004): a tree frog endemic to the Atlantic. *Herpetology Notes*, *12*, 1121-1131. https://www.biotaxa.org/hn/article/view/43731

Forlani, M. C., Mendes, C. V. M., Dias, I. R., Ruas, D. S., Tonini, J. F. R., & Sá, R. O. (2013). The advertisement calls and distribution of two sympatric species of *Chiasmocleis* (Méhely 1904) (Anura, Microhylidae, Gastrophryninae) from the Atlantic Forest. *South American Journal of Herpetology*, *8*(1), 46-51. http://dx.doi.org/10.2994/SAJH-D-12-00027.1

Forti, L. R., Silva, T. R. Á., & Toledo, L. F. (2017). The acoustic repertoire of the Atlantic Forest Rocket Frog and its consequences for taxonomy and conservation (Allobates, Aromobatidae). *ZooKeys*, *692*, 141-153. https://doi.org/10.3897/zookeys.692.12187

Freitas, M. O., & Toledo, L. F. (2020). Treefrogs with distinct advertisement calls produce similar territorial signals. *Bioacoustics*, *30*(1), 1-13. http://dx.doi.org/10.1080/09524622.2020.1791733

Appendix 2. (Continue)

Gally, M. C., & Zina, J. (2013). Reproductive behaviour of *Physalaemus kroyeri* (Anura: Leiuperidae) in the municipality of Jequié, state of Bahia. *Journal of Natural History*, *47*(23-24), 1627-1644. https://doi.org/10.1080/00222933.2013.769643

Garda, A. A., São Pedro, V. A., & Lion, M. B. (2010). The advertisement and release calls of *Rhinella jimi* (Anura, Bufonidae). *South American Journal of Herpetology*, *5*(2), 151–156. https://doi.org/10.2994/057.005.0209

Giaretta, A. A., Haga, I. A., & Andrade, F. S. (2018). The advertisement call of two species of the *Rhinella granulosa* group (Anura: Bufonidae). *Phyllomedusa: Journal of Herpetology*, *17*(2), 255–265. https://doi.org/10.11606/issn.2316-9079.v17i2p255-265

Giaretta, A., Brandão, T. F., & Martins, L. B. (2016). On the advertisement call of *Bokermannohyla oxente* Lugli and Haddad, 2006 (Anura, Hylidae). *Neotropical Biodiversity*, *2*(1), 19. https://doi.org/10.1080/23766808.2016.1251810

Heyer, W. R., & Juncá, F. A. (2003). Leptodactylus caatingae, a new species of frog from eastern Brazil (Amphibia: Anura: Leptodactylidae). *Proceedings of the Biological Society of Washington*, *116*(2), 317–329.

Heyer, W. R., & Carvalho, C. M. (2000). Calls and calling behaviour of the frog *Leptodactylus natalensis* (Amphibia: Anura: Leptodactylidae). *Proceedings of the Biological Society of Washington*, *113*(1), 284-290.

Juncá, F. A., & Lugli, L. (2009). Reproductive biology, vocalizations, and tadpole morphology of *Rupirana cardosoi*, an anuran with uncertain affinities. *South American Journal of Herpetology*, *4*(2), 173–178. http://dx.doi.org/10.2994/057.004.0208

Juncá, F. A., Napoli, M. F., Nunes, I., Mercês, E. A., & Abreu, R. O. (2015). A new species of the *Scinax ruber* clade (Anura, Hylidae) from the Espinhaço Range, northeastern Brazil. *Herpetologica*, *71*(4), 299–309. https://doi.org/10.1655/HERPETOLOGICA-D-14-00032

Juncá, F. A., Röhr, D. L., Lourenço-de-Moraes, R., Santos, F. J., Protázio, A. S., Mercês, E. A., & Solé, M. (2012). Advertisement call of species of the genus *Frostius* Cannatella 1986 (Anura: Bufonidae). *Acta Herpetologica*, *7*(2), 189-201. http://dx.doi.org/10.13128/Acta_Herpetol-9898

Juncá, F. A., Napoli, M. F., Cedraz, J., & Nunes, I. (2012). Acoustic characteristics of the advertisement and territorial calls of *Phyllodytes tuberculosus* Bokermann, 1966 (Amphibia: Anura: Hylidae). *Zootaxa*, *3506*(1), 87-88. https://doi.org/10.11646/zootaxa.3506.1.7

Lacerda, J. V. A., Bilate, M., & Feio, R. N. (2011). Advertisement call of *Sphaenorhynchus mirim* Caramaschi, Almeida, and Gasparini, 2009 (Anura: Hylidae). *South American Journal of Herpetology*, *6*(3), 211–214. https://doi.org/10.2994/057.006.0307

Lantyer-Silva, A. S. F., Matos, M. A., Gogliath, M., Marciano-Jr., E., & Nicola, P. A. (2016). New records of *Pseudopaludicola pocoto* Magalhães, Loebmann, Kokubum, Haddad & Garda, 2014 (Amphibia: Anura: Leptodactylidae) in the Caatinga Biome, Brazil. *Check List*, *12*(6), 1989. https://doi.org/10.15560/12.6.1989

Lima, D. C., Borges-Nojosa, D. M., & Cechin, S. Z. (2014). The advertisement call of *Adelophryne maranguapensis* (Anura, Eleutherodactylidae). *Zootaxa*, *3835*(2), 299-300. http://dx.doi.org/10.11646/zootaxa.3835.2.11

Lima, M. S. C. S., Pederassi, J., Pineschi, R. B., & Barbosa, D. B. S. (2019). Acoustic niche partitioning in an anuran community from the municipality of Floriano, Piauí, Brazil. *Brazilian Journal of Biology*, *79*(4), 566-576. https://doi.org/10.1590/1519-6984.180399

Lima, M. G., Lingnau, R., & Skuk, G. O. (2008). The advertisement call of *Phyllodytes edelmoi* (Anura, Hylidae). *South American Journal of Herpetology*, *3*(2), 118–121. http://dx.doi.org/10.2994/1808-9798(2008)3[118:TACOPE]2.0.CO;2

Lima, T. G. P., Andrade, E. B., Araújo, K. C., Leite, J. R. S. A., & Weber, L. N. (2015). First record of *Leptodactylus sertanejo* (Anura: Leptodactylidae: Leptodactylinae) in the state of Maranhão, northeastern Brazil. *Check List*, *11*(5), 1-4. https://doi.org/10.15560/11.5.1776

Loebmann, D., Zina, J., Araújo, O. G. dos S., Toledo, L. F., & Haddad, C. F. B. (2008). Acoustic repertory of *Hypsiboas exastis* (Caramaschi and Rodrigues, 2003) (Amphibia, Hylidae). *South American Journal of Herpetology*, *3*(2), 96–100. https://doi.org/10.2994/1808-9798(2008)3[96:AROHEC]2.0.CO;2

Lopes, A. G., Lee Bang, D., & Giaretta, A. A. (2019). Revisiting the advertisement call features of *Scinax montivagus* (Anura: Hylidae). *Neotropical Biodiversity*, *5*(1), 41–46. https://doi.org/10.1080/23766808.2019.1646065

Appendix 2. (Continue)

Lourenço-de-Moraes, R., Solé, M., & Toledo, L. F. (2012). A new species of *Adelophryne* Hoogmoed and Lescure 1984 (Amphibia: Anura: Eleutherodactylidae) from the Atlantic rainforest of southern Bahia, Brazil. *Zootaxa*, *3441*(1), 59-68. http://dx.doi.org/10.11646/zootaxa.3441.1.6

Lourenço-de-Moraes, R., Lantyer-Silva, A. S. F., Toledo, L. F., & Solé, M. (2013). Tadpole, oophagy, advertisement call, and geographic distribution of *Aparasphenodon arapapa* Pimenta, Napoli and Haddad 2009 (Anura, Hylidae). *Journal of Herpetology, 47*(4), 575–579. https://doi.org/10.1670/11-326

Lugli, L., & Haddad, C. F. B. (2006). A new species of the *Bokermannohyla pseudopseudis* group from central Bahia, Brazil (Amphibia, Hylidae). *Herpetologica*, *62*(4), 453-465. https://www.jstor.org/stable/3893602

Lugli, L., & Haddad, C. F. B. (2006). New species of *Bokermannohyla* (Anura, Hylidae) from Central Bahia, Brazil. *Journal of Herpetology*, *40*(1), 7-15. https://doi.org/10.1670/67-05A.1

Magalhães, F. M., Loebmann, D., Kokubum, M. N. C., Haddad, C. F. B., & Garda, A. A. (2014). A new species of *Pseudopaludicola* (Anura: Leptodactylidae: Leiuperinae) from northeastern Brazil. *Herpetologica*, *70*(1), 77-88. http://dx.doi.org/10.1655/HERPETOLOGICA-D-13-00054

Magalhães, F. M., Lyra, M. L., Carvalho, T. R., Baldo, D., Brusquetti, F., Burella, P., Colli, G. R., Gehara, M. C., Giaretta, A. A., Haddad, C. F. B., Langone, J. A., López, J. A., Napoli, M. F., Santana, D. J., Sá, R. O., & Garda, A. A. (2020). Taxonomic review of South American butter frogs: phylogeny, biogeographic patterns, and species delimitation in the *Leptodactylus latrans* species group (Anura: Leptodactylidae). *Herpetological Monograph*, *34*(1), 131-177.

Mângia, S., Koroiva, R., Sales Nunes, P. M., Roberto, I. J., Ávila, R. W., Sant'Anna, A. C., Santana, D. J., & Garda, A. A. (2018). A new species of *Proceratophrys* (Amphibia: Anura: Odontophrynidae) from the Araripe Plateau, Ceará State, Northeastern Brazil. *Herpetologica*, *74*(3), 255-268. https://doi.org/10.1655/Herpetologica-D-16-00084.1

Mângia, S., Carvalho, P., Pereira, E. A., Cavalcanti, L., Simões, C. R., & Santana, D. J. (2017). Release call of *Scinax eurydice* (Bokermann, 1968) (Anura, Hylidae) and advertisement call of northeastern populations. *Herpetology Notes*, *10*, 237-243. https://www.biotaxa.org/hn/article/view/24694

Mângia, S., Camurugi, F., Pereira, E. A., Carvalho, P., Röhr, D. L., Folly, H., & Santana, D. J. (2019). Release calls of four species of Phyllomedusidae (Amphibia, Anura). *Herpetozoa*, *32*, 77-81. https://doi.org/10.3897/herpetozoa.32.e35729

Mângia, S., Oliveira, E. F., Santana, D. J., Koroiva, R., Paiva, F., & Garda, A. A. (2020). Revising the taxonomy of *Proceratophrys* Miranda-Ribeiro, 1920 (Anura: Odontophrynidae) from the Brazilian semiarid Caatinga: Morphology, calls and molecules support a single widespread species. *Journal of Zoological Systematics and Evolutionary Research*, *58*(4), 1151-1172. http://dx.doi.org/10.1111/jzs.12365

Mângia, S., & Garda, A. A. (2015). Distress call and defensive display of *Proceratophrys cristiceps* (Müller, 1883) (Amphibia, Anura, Odontophrynidae). *Herpetology Notes*, *8*, 11-14.

Marciano-Jr., E., & Lantyer-Silva, A. S. F., & Solé, M. (2017). A new species of *Phyllodytes* Wagler, 1830 (Anura, Hylidae) from the Atlantic Forest of southern Bahia, Brazil. *Zootaxa*, *4238*(1), 135-142. https://doi.org/10.11646/zootaxa.4238.1.11

Marinho, P., Roberto, I. J., & Lisboa, B. S. (2020). The advertisement call of *Boana freicanecae* (Carnaval & Peixoto, 2004) (Anura: Hylidae), an endemic and poorly known treefrog from northeastern Brazil. *Zootaxa*, *4853*(3), 442-446. https://doi.org/10.11646/zootaxa.4853.3.7

Mendes, C. V. M., & Ruas, D. S. (2012). The advertisement call of *Gastrotheca fissipes* Boulenger, 1888 with comments on its distribution. *Zootaxa*, *3312*(1), 62-64. https://doi.org/10.11646/zootaxa.3312.1.4

Mendes, C. V. M., Marciano Jr., E., Ruas, D. S., Oliveira, R. M., & Solé, M. (2013). Advertisement call of *Scinax strigilatus* (Spix, 1824) (Anura: Hylidae) from southern Bahia, Brazil. *Zootaxa*, *3647*(3), 499-500. https://doi.org/10.11646/zootaxa.3647.3.8

Mira-Mendes, C. V., Dias, I. R., Silva, G. T., Novaes-e-Fagundes, G., Martins, R. A., Le Pendu, Y., & Solé, M. (2020). The advertisement and release call of the Bahia forest frog *Macrogenioglottus alipioi* (Anura: Odontophrynidae) with comments on its morphometry, from southern Bahia, northeastern Brazil. *Biologia*, *75*, 2271–2276. https://doi.org/10.2478/s11756-020-00488-w

Appendix 2. (Continue)

Muniz, S. L. S., Moura, C. C. M., Moraes, A. T. A., Galindo, M. K. F., Chaves, L. S., Kokubum, M. N. C., & Moura, G. J. B. (2016). Acoustic characteristics of the advertisement call of *Dendropsophus elegans* (Anura: Hylidae). *Herpetology Notes*, *9*, 99-102. https://www.biotaxa.org/hn/article/view/12475

Napoli, M. F., & Pimenta, B. V. S. (2003). Nova espécie do grupo de *Hyla circumdata* (Cope, 1870) do sul da Bahia, Brasil (Amphibia, Anura, Hylidae). *Arquivos do Museu Nacional*, *61*(3), 189-194. https://revistas.ufrj.br/index.php/amn/article/view/48684

Napoli, M. F., & Pimenta, B. V. S. (2009). A new species of the *Bokermannohyla circumdata* group (Anura: Hylidae) from the coastal forests of Bahia, Northeastern Brazil. *Copeia*, *2009*(4), 674-683. http://dx.doi.org/10.1643/CH-08-224

Napoli, M. F., Abreu, R. O., Cruz, D., Herrera, J. B., Petersen, E., & Klein, W. (2014). Advertisement call of *Dendropsophus studerae* (Carvalho-e-Silva, Carvalho-e-Silva and Izecksohn, 2003) (Anura: Hylidae), with new record and geographic distribution extension. *Zootaxa*, *3878*(6), 593-596. https://doi.org/10.11646/zootaxa.3878.6.6

Napoli, M. F., & Cruz, I. C. S. (2005). The advertisement call of *Hyla atlantica* Caramaschi & Velosa, 1996, with considerations on its taxonomic status (Amphibia, Anura, Hylidae). *Arquivos do Museu Nacional*, *63*(2), 283-288.

Napoli, M. F., & Juncá, F. A. (2006). A new species of the *Bokermannohyla circumdata* group (Amphibia: Anura: Hylidae) from Chapada Diamantina, state of Bahia, Brazil. *Zootaxa*, *1244*(1), 57–68. https://doi.org/10.11646/zootaxa.1244.1.4

Nascimento, J. S., Abreu, R. O., Menezes, L., Trevisan, C. C., Solé, M., Juncá, F. A., & Napoli, M. F. (2019). The Advertisement Call of *Proceratophrys minuta* Napoli, Cruz, Abreu, and Del Grande, 2011 (Anura: Odontophrynidae), with comments on acoustic parameters in the genus. *South American Journal of Herpetology*, *14*(1), 24-36. https://doi.org/10.2994/SAJH-D-17-00021.1

Novaes, G., & Zina, J. (2016). Advertisement call of *Scinax camposseabrai* (Bokermann, 1968) (Anura: Hylidae), with comments on the call of three species of the *Scinax ruber* clade. *Zootaxa*, *4084*(2), 258-266. http://dx.doi.org/10.11646/zootaxa.4084.2.5

Nunes, I. L., Loebmann, D., Cruz, C. A. G., & Haddad, C. F. B. (2015). Advertisement call, colour variation, natural history, and geographic distribution of *Proceratophrys caramaschii* (Anura: Odontophrynidae). *Salamandra*, *51*(2), 103-110.

Nunes, I., Canedo, C., & Carvalho, R. R. (2010). Advertisement call and geographic distribution of *Elachistocleis piauiensis* caramaschi & Jim, 1983 (Amphibia, Microhylidae), with notes on the presence of post-commissural gland in the genus. *South American Journal of Herpetology*, *5*(1), 30-34. https://doi.org/10.2994/057.005.0103

Nunes, I., Fusinatto, L. A., & Cruz, C. A. G. (2007). The tadpole and advertisement call of *Sphaenorhynchus palustris* Bokermann, 1966 (Amphibia, Anura, Hylidae). *South American Journal of Herpetology*, *2*(2), 123–128. http://dx.doi.org/10.2994/1808-9798(2007)2[123:TTAACO]2.0.CO;2

Nunes, I., & Juncá, F. A. (2006). Advertisement calls of three leptodactylid frogs in the state of Bahia, northeastern Brazil (Amphibia, Anura, Leptodactylidae), with considerations on their taxonomic status. *Arquivos do Museu Nacional*, *64*(2), 151–157.

Nunes, I., & Pombal Jr., J. P. (2010). A new snouted treefrog of the speciose genus *Scinax* Wagler (Anura, Hylidae) from northeastern Brazil. *Herpetologica*, *67*(1), 80–88. https://doi.org/10.1655/HERPETOLOGICA-D-10-00026.1

Nunes, I., Santiago, R. S., & Juncá, F. A. (2007). Advertisement calls of four hylid frogs from the state of Bahia, northeastern Brazil (Amphibia, Anura, Hylidae). *South American Journal of Herpetology*, *2*(2), 89–96. https://doi.org/10.2994/1808-9798(2007)2[89:ACOFHF]2.0.CO;2

Oitaven, L. P. C., Santos, J. R. O., Silva, A. O., Gambale, P. G., & Moura, G. J. B. (2017). Description of vocalizations and Analysis of variation intra and inter-individual of *Pristimantis ramagii* (Boulenger, 1888) in an upland swamp, Northeast Brazil. *Herpetology Notes*, *10*, 197-203. https://biotaxa.prod.amazon.auckland.ac.nz/hn/article/view/27662

Oliveira, R. M., Ruas, D. S., Mendes, C. V. D. M., & Solé, M. (2014). Advertisement call of *Rhinella crucifer* (Wied-Neuwied, 1821) (Anura: Bufonidae) from southern Bahia, Brazil. *Zootaxa, 3784*(1), 97–98. https://doi.org/10.11646/zootaxa.3784.1.9

Orrico, V. G. D., Dias, I. R., & Marciano-Jr, E. (2018). Another new species of *Phyllodytes* (Anura: Hylidae) from the Atlantic Forest of northeastern Brazil. *Zootaxa*, *4407*(1), 101–110. https://doi.org/10.11646/zootaxa.4407.1.6

Appendix 2. (Continue)

Pansonato, A., Mudrek, J. R., Strüssmann, C., Veiga-Menoncello, A. C. P., Recco-Pimentel, S. M., Martins, L. B., & Giaretta, A. A. (2014). Geographical variation in morphological and bioacoustic traits of *Pseudopaludicola mystacalis* (Cope, 1887) and a reassessment of the taxonomic status of *Pseudopaludicola serrana* Toledo, 2010 (Anura: Leptodactylidae: Leiuperinae). *Advances in Zoology*, *2014*, 563165. https://doi.org/10.1155/2014/563165

Pederassi, J., Pansonato, A., Mudrek, J. R., Veiga-Menoncello, A. C. P., Martins, L. B., Strüssmann, C., & Giaretta, A. A. (2015). Redescription of the advertisement call of *Physalaemus albifrons* (Spix, 1824) (Amphibia, Anura, Leptodactylidae). *Zootaxa*, *3994*(3), 449–450. https://doi.org/10.11646/zootaxa.3994.3.10

Pereira, E. A., Folly, H., Rebouças, R., & Santana, D. J. (2018). Distribution extension, geographic distribution maps and comments on the advertisement call of *Pseudopaludicola pocoto* Magalhães, Loebmann, Kokubum, Haddad and Garda, 2014 (Anura: Leptodactylidae: Leiuperinae). *Herpetology Notes*, *11*, 1055-1059. https://www.biotaxa.org/hn/article/view/31983

Pimenta, B. V. S., Nunes, I., & Cruz, C. A. G. (2007). Notes on the poorly known Phyllomedusine frog *Hylomantis aspera* Peters, 1872 (Anura, Hylidae). *South American Journal of Herpetology*, *2*(3), 206-214. https://doi.org/10.2994/1808-9798(2007)2[206:NOTPKP]2.0.CO;2

Pombal Jr, J., & Nunes, I. (2010). A new *Scinax* Wagler (Amphibia, Anura, Hylidae) from the Atlantic rain forest remains of southern State of Bahia, north-eastern Brazil. *Amphibia-Reptilia*, *31*(3), 347–353.

Prado, G. M., Bilate, M., & Wogel, H. (2007). Call diversity of *Leptodactylus natalensis* Lutz, 1930 (Anura; Leptodactylidae). *Papéis Avulsos de Zoologia*, *47*(6), 97–103. https://doi.org/10.1590/S0031-10492007000600001

Protázio, A. S., Albuquerque, R. L., Falkenberg, L. M., & Mesquita, D. O. (2014). Acoustic ecology of an anuran assemblage in the arid Caatinga of northeastern Brazil. *Journal of Natural History*, *49*(15–16), 957–976. https://doi.org/10.1080/00222933.2014.931482

Protázio, A. D. S., Protázio, A. S., Conceição, L. C., Braga, H. S. N., Santos, U. G. D., Ribeiro, A. C., & Souza, I. C. A. (2017). The advertisement call of *Dendropsophus novaisi* (Bokermann, 1968) (Anura: Hylidae: Dendropsophinae). *Zootaxa*, *4294*(1), 127-129. https://doi.org/10.11646/zootaxa.4294.1.8

Protázio, A. S., Protázio, A. S., & Mesquita, D. O. (2019). Niche partitioning between two *Physalaemus* species (Anura, Leptodactylidae) in semiarid Caatinga in Northeast Brazil. *North-Western Journal of Zoology*, *15*(2), 157-167. https://biozoojournals.ro/nwjz/content/v15n2/nwjz_e191501_Protazio.pdf

Roberto, I. J., & Ávila, R. W. (2013). The advertisement call of *Phyllodytes gyrinaethes* Peixoto, Caramaschi & Freire, 2003 (Anura, Hylidae). *Zootaxa*, *3669*(2), 193–196. https://doi.org/10.11646/Zootaxa.3669.2.13

Roberto, I. J., Araujo-Vieira, K., Carvalho-e-Silva, S. P., & Ávila, R. W. (2017). A new species of *Sphaenorhynchus* (Anura: Hylidae) from northeastern Brazil. *Herpetologica*, *73*(2), 148-161. https://doi.org/10.1655/HERPETOLOGICA-D-16-00021

Roberto, I. J., Brito, L., & Cascon, P. (2011). Temporal and spatial patterns of reproductive activity in *Rhinella hoogmoedi* (Anura: Bufonidae) from a tropical rainforest in northeastern Brazil, with the description of its advertisement call. *South American Journal of Herpetology*, *6*(2), 87–97. https://doi.org/10.2994/057.006.0202

Roberto, I. J., Brito, L., & Thomé, M. T. C. (2014). A new species of *Rhinella* (Anura: Bufonidae) from northeastern Brazil. *South American Journal of Herpetology*, *9*(3), 190–199. https://doi.org/10.2994/SAJH-D-13-00028.1

Roberto, I. J., Cardozo, D., & Ávila, R. W. (2013). A new species of *Pseudopaludicola* (Anura, Leiuperidae) from western Piauí State, northeast Brazil. *Zootaxa*, *3636*(2), 348–360. https://doi.org/10.11646/zootaxa.3636.2.6

Roberto, I. J., Santos, E. M. D., & de Carvalho, T. R. (2019). The vocalization of *Gastrotheca fissipes* (Boulenger, 1888) (Anura, Hemiphractidae) from the state of Pernambuco, northeastern Brazil. *Zootaxa*, *4543*(2), 284. https://doi.org/10.11646/zootaxa.4543.2.6

Rocha, P. C., Thompson, J. R., Leite, F. S. F., & Garcia, P. C. D. A. (2016). The advertisement call of *Bokermannohyla flavopicta* Leite, Pezzuti & Garcia, 2012 (Anura: Hylidae) from the mountains of Chapada Diamantina, Bahia, Brazil. *Zootaxa*, *4061*(3), 277–280. https://doi.org/10.11646/zootaxa.4061.3.6

Appendix 2. (Continue)

Röhr, D. L., & Juncá, F. A. (2013). Micro-habitat influence on the advertisement call structure and sound propagation efficiency of *Hypsiboas crepitans* (Anura: Hylidae). *Journal of Herpetology*, *47*(4), 549-554. http://dx.doi.org/10.1670/10-210

Röhr, D. L., Camurugi, F., Martinez, P. A., Sousa-Lima, R. S., Juncá, F. A., & Garda, A. A. (2020). Habitat-dependent advertisement call variation in the monkey frog *Phyllomedusa nordestina*. *Ethology*, *126*(6), 651-659. https://doi.org/10.1111/eth.13017

Röhr, D. L., Camurugi, F., Paterno, G. B., Gehara, M., Juncá, F. A., Álvares, G. F. R., Brandão, R. A., & Garda, A. A. (2020). Variability in anuran advertisement call: A multi-level study with 15 species of monkey tree frogs (Anura: Phyllomedusidae). *OSF Preprints*. http://dx.doi.org/10.31219/osf.io/gspzc

Ruas, D. S., Mendes, C. V. M., Dias, I. R., & Solé, M. (2012). Description of the advertisement call of *Dendropsophus haddadi* (Bastos and Pombal 1996) (Anura: Hylidae) from southern Bahia, Brazil. *Zootaxa*, *3250*(1), 63–65. https://doi.org/10.11646/zootaxa.3250.1.5

Santana, D. J., Rodrigues, R., Albuquerque, R. L., Laranjeiras, D. O., Protázio, A. D. S., França, F. G. R., & Mesquita, D. O. (2011). The advertisement call of *Proceratophrys renalis* (Miranda-Ribeiro, 1920) (Amphibia: Anura: Cycloramphidae). *Zootaxa*, *2809*(1), 67–68. https://doi.org/10.11646/zootaxa.2809.1.6

Santana, D. J., Mesquita, D. O., & Garda, A. A. (2011) Advertisement call of *Dendropsophus oliveirai* (Anura, Hylidae). *Zootaxa*, *2997*(1), 67–68. https://doi.org/10.11646/zootaxa.2997.1.5

Santos-Silva, C. R. D., Ferrari, S. F., & Juncá, F. A. (2012). Acoustic characteristics of the advertisement call of *Trachycephalus atlas* Bokermann, 1966 (Anura: Hylidae). *Zootaxa*, *3424*(1), 66-68. https://doi.org/10.11646/zootaxa.3424.1.4

São-Pedro, V. A., Medeiros, P. H., & Garda, A. A. (2011). The advertisement call of *Rhinella granulosa* (Anura, Bufonidae). *Zootaxa*, *3092*(1), 60–62. https://doi.org/10.11646/zootaxa.3092.1.4

Silva-Filho, I. S. N., & Juncá, F. A. (2006). Evidence of full species status of the neotropical leaf-frog *Phyllomedusa burmeisteri bahiana* (A. Lutz, 1925) (Amphibia, Anura, Hylidae). *Zootaxa*, *1113*(1), 51-64. https://doi.org/10.11646/zootaxa.1113.1.5

Silvano, D., Cruz, C. A. G., & Pimenta, B. (2005). A new species of the genus *Physalaemus* Fitzinger, 1826 (Anura, Leptodactylidae) from the Atlantic Rain Forest of southern Bahia, Brazil. *Amphibia-Reptilia*, *26*(2), 201–210.

Simões, C. R. M. A., Pontes, B. E. S., Trevisan, C. C., Abreu, R. O., Juncá, F. A., Solé, M., Araújo, C. B., & Napoli, M. F. (2020). The advertisement call of *Proceratophrys redacta* (Anura, Odontophrynidae). *Zootaxa*, *4750*(3), 447–450. https://doi.org/10.11646/zootaxa.4750.3.14

Simon, J. E., & Peres, J. (2012). Revisão da distribuição geográfica de *Phyllodytes kautskyi* Peixoto & Cruz, 1988 (Amphibia, Anura, Hylidae). *Boletim do Museu de Biologia Mello Leitão*, *29*, 17–30.

Taucce, P. P. G., Pinheiro, P. D. P., Leite, F. S. F., & Garcia, P. C. A. (2015). Advertisement call and morphological variation of the poorly known and endemic *Bokermannohyla juiju* Faivovich, Lugli, Lourenço and Haddad, 2009 (Anura: Hylidae) from Central Bahia, Brazil. *Zootaxa*, *3915*(1), 99–110. https://doi.org/10.11646/zootaxa.3915.1.4

Taucce, P. P. G., Nascimento, J. S., Trevisan, C. C., Leite, F. S. F., Santana, D. J., Haddad, C. F. B., & Napoli, M. F. (2020). A New Rupicolous Species of the *Pristimantis conspicillatus* Group (Anura: Brachycephaloidea: Craugastoridae) from Central Bahia, Brazil. *Journal of Herpetology*, *54*(2), 245–257. https://doi.org/10.1670/19-114

Teixeira Jr., M., Dal Vechio, F., Recoder, R. S., Carnaval, A. C., Strangas, M., Damasceno, R. P., Sena, M. A., & Rodrigues, M. T. (2012). Two new species of marsupial tree-frogs genus *Gastrotheca* Fitzinger, 1843 (Anura, Hemiphractidae) from the Brazilian Atlantic Forest. *Zootaxa*, *3437*(1), 1–23. https://doi.org/10.11646/zootaxa.3437.1.1

Toledo, L. F., Martins, I. A., Bruschi, D. P., Passos, M. A., Alexandre, C., & Haddad, C. F. (2014). The anuran calling repertoire in the light of social context. *Acta Ethologica*, *18*(2), 87-99. https://doi.org/10.1007/s10211-014-0194-4

Toledo, L. F., Loebmann, D., & Haddad, C. F. B. (2010). Revalidation and redescription of *Elachistocleis cesarii* (Miranda-Ribeiro, 1920) (Anura: Microhylidae). *Zootaxa*, *2418*(1), 50–60. https://doi.org/10.11646/zootaxa.2418.1.2

Appendix 2. (Conclusion)

Toledo, L. F., Fernando, C., & Haddad, B. (2009). Defensive vocalizations of Neotropical anurans. *South American Journal of Herpetology*, *4*(1), 25-42. https://doi.org/10.2994/057.004.0104

Vilaça, T. R. A., Silva, J. R. S., & Solé, M. (2011). Vocalization and territorial behaviour of *Phyllomedusa nordestina* Caramaschi, 2006 (Anura: Hylidae) from southern Bahia, Brazil. *Journal of Natural History*, *45*(29-30), 1823-1834. https://doi.org/10.1080/00222933.2011.561018

Vilela, B., Lisboa, B. S., & Nascimento, F. A. C. D. (2014). Reproduction of *Agalychnis granulosa* Cruz, 1989 (Anura: Hylidae). *Journal of Natural History*, *49*(11-12), 709-717. https://doi.org/10.1080/00222933.2014.897764

Vörös, J., Dias, I. R., & Solé, M. (2017). A new species of *Phyllodytes* (Anura: Hylidae) from the Atlantic Rainforest of southern Bahia, Brazil. *Zootaxa*, *4337*(4), 584–594. https://doi.org/10.11646/zootaxa.4337.4.9

Zaidan, B. F., & Leite, F. S. F. (2012). Advertisement call of the rare, explosive breeding caatinga horned frog *Ceratophrys joazeirensis* Mercadal de Barrio, 1986 (Anura, Ceratophryidae). *Zootaxa*, *3540*(1), 65–66. https://doi.org/10.11646/zootaxa.3540.1.5