ATLANTIC BATS: a dataset of bat communities from the Atlantic Forests of South America

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Introduction

Bats are one the most successful mammalian orders, as they represent 25% of all extant species with ~1,300 described species (Fenton and Simmons 2014). Because of their widespread distribution, diverse morphology, and complex behavior, bats successfully occupy a great variety of niches, which makes these flying mammals excellent models for understanding several ecological and evolutionary processes (Kunz and Fenton 2005, Gunnell and Simmons 2012). Bats draw a lot of attention from the public, as they transmit lethal diseases to humans, domestic animals, and wildlife (Leroy et al. 2005, Field 2009). For instance, bats can host more than 100 virus types (Luis et al. 2015). However, bats are also known to play vital roles as seed dispersers and pollinators of many tropical plants (Fleming and Kress 2013). Recently, several studies have shown the importance of bats in controlling invertebrate pests in agriculture providing an enormous ecosystem service (Boyles et al. 2011, Karp and Daily 2014, Cassano et al. 2016). Furthermore, bats are very important in cave ecosystems due to the large input of nutrients they provide (Kunz et al. 2011).

Studies on Neotropical bats date back to over 50 years ago, but ecological studies have been traditionally focusing on Central America (Heithaus et al. 1975, Fleming 1988). Although highly diverse, ubiquitous, and substantially studied in tropical ecosystems, bats are one of the least known mammalian orders in tropical forests. There are still many questions to be investigated about the biology of Neotropical bats (Mello 2010), and they are poorly represented in macroecological studies (Weber et al. 2014, Stevens and Willig 2002).

Community studies on Neotropical bats usually focus on the family Phyllostomidae due to the sampling bias introduced by mist-netting, the most common method used to capture bats in the wild (Meyer et al. 2015). In the last twenty years, a large number of studies on bats have been carried out in South America. One of the regions with highest bat diversity is the tropical and subtropical Atlantic Forest of South America (Galindo-Leal and Câmara 2003). The Atlantic Forest comprises several types of habitat with different rainfall regimes, altitudes, and land uses (Ribeiro et al. 2011).

In Brazil, this region hosts at least 117 bat species (Varzinczak et al. 2016), and in Misiones, a biodiverse province in Argentina, it harbors 38 bat species (Alurralde et al. 2016). The Atlantic Forest was one of the largest rainforest in South America, originally covering around 150 million ha along the Brazilian coast, and the inland Argentina and Paraguay. Nowadays, the Atlantic Forest are highly fragmented with about 12% of original area remaining, where 80% of the fragments are <50 ha in size and the mean distance between them being 1.4 km (Ribeiro et al. 2009).

In the present study, we compiled a dataset of bat communities comprising 135 studies carried out in 205 sites of the Atlantic Forest in Brazil, Argentina, and Paraguay (Figure 1). Bat inventories became popular in the region in the 90s (Marinho-Filho 1996) and have been carried out in most ecoregions within the Atlantic Forest domain. ATLANTIC BATS represent the largest dataset of bat species inventories for the Neotropical region. This dataset comprises the species composition, richness, and relative abundance (captures/net nights) for all the sites. This data-paper is part of the large effort of the ATLANTIC Research Team to compile information on the biodiversity of the Atlantic Forest, and some articles of this series have already been published or are under review: ATLANTIC FRUGIVORY (Bello et al. 2017) , ATLANTIC SMALL MAMMALS (Bovendorp et al. 2017), ATLANTIC CAMTRAPS (Lima et al. submitted), and ATLANTIC BIRDS (Hasui et al. submitted).

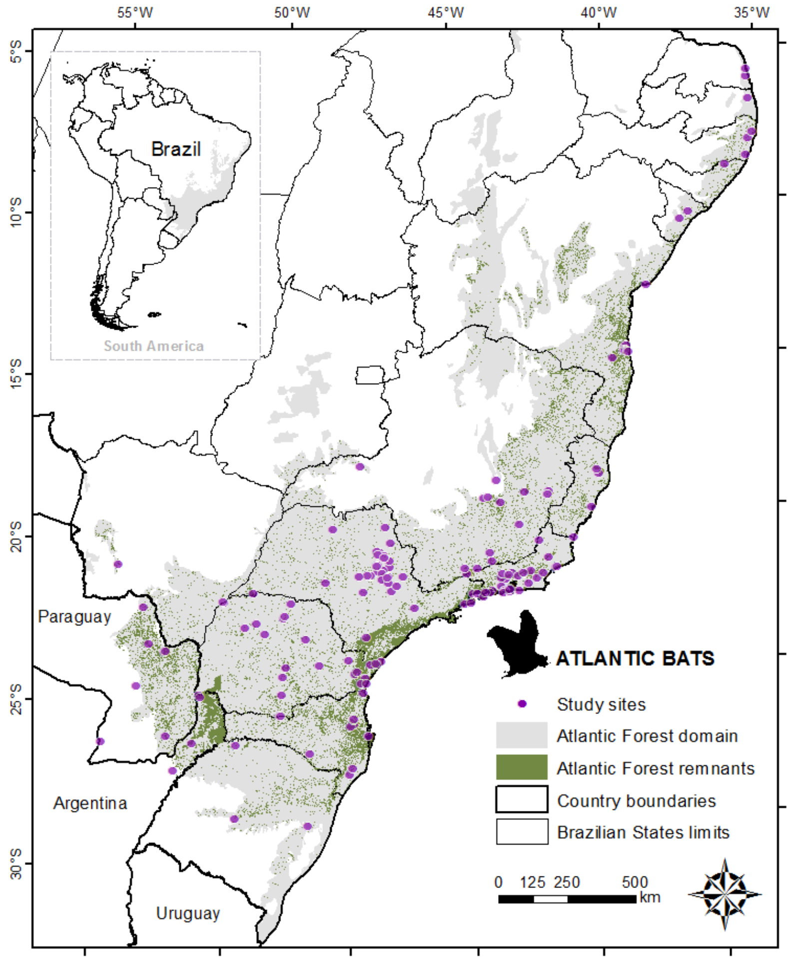

Fig. 1. Distribution of sampling locations included in ATLANTIC BATS. We only included studies where capture numbers were available, composing useful information for community studies.

METADATA

CLASS I. DATA SET DESCRIPTORS

A. Data set identity:

Title: ATLANTIC BATS: a dataset of bat communities from the Atlantic Forests of South America

B. Data set identification code:

Suggested Data Set Identity Codes:

ATLANTIC_BATS_Study_site.csv

ATLANTIC_BATS_Reference.csv,

ATLANTIC_BATS_Capture.csv,

C. Data set description:

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Abstract:

Bats are the second most diverse mammal order and they provide vital ecosystem functions (e.g., pollination, seed dispersal, and nutrient flux in caves) and services (e.g., crop pest suppression). Bats are also important vectors of infectious diseases, harboring more than 100 different virus types. In the present study, we compiled information on bat communities from the Atlantic Forests of South America, a species-rich biome that are highly threatened by habitat loss and fragmentation. ATLANTIC BATS dataset comprises 135 quantitative studies carried out in 205 sites, which cover most vegetation types of the tropical and subtropical Atlantic Forest: dense ombrophilous forest, mixed ombrophilous forest, semideciduous forest, deciduous forest, savanna, steppe, and open ombrophilous forest. The dataset includes information on more than 90,000 captures of 98 bat species of 8 families. Species richness averaged 12.1 per site, with a median value of 10 species (ranging from 1 to 53 species). Six species occurred in more than 50% of the communities: *Artibeus lituratus*, *Carollia perspicillata*, *Sturnira lilium*, *Artibeus fimbriatus*, *Glossophaga soricina*, and *Platyrrhinus lineatus*. The number of captures divided by sampling effort, a proxy for abundance, varied from 0.000001 to 0.77 individuals/hour*m^2 (0.04$\pm$0.007 individuals/hour*m^2). Our dataset reveals a hyper-dominance of eight species that together that comprise 80% of all captures: *Platyrrhinus lineatus* (2.3%), *Molossus molossus* (2.8%), *Artibeus obscurus* (3.4%), *Artibeus planirostris* (5.2%), *Artibeus fimbriatus* (7%), *Sturnira lilium* (14.5%), *Carollia perspicillata* (15.6%), and *Artibeus lituratus* (29.2%).

D. Key words: forest fragmentation, mist nets, Chiroptera, Phyllostomidae, biodiversity hotspot, mammal communities, hyper-dominance, emerging diseases, seed dispersal, pollination, crop pest suppression, nutrient flux.

E. Description:

The dataset covers the main vegetation types found in the Atlantic Forest of tropical and subtropical Brazil (195 sites), Paraguay (7), and Argentina (3) (Ribeiro et al. 2009) (Figure 1). About 75% of data were obtained from published articles in peer reviewed journals, whereas 25% origin from unpublished data from the authors, as well as theses and dissertations. The duration of the studies varied from 1 night to over 4 years of continuous sampling in the same site.

The data set comprises 205 sites sampled in 135 quantitative studies and three data files. In total, the dataset contains 98 confirmed bat species (Table 1, Table 2), one not confirmed species (*Peropteryx* cf. *kappleri*), and five cases where the actual specific name could not be specified (*Artibeus* sp., *Carollia* sp., *Lonchophylla* sp., *Micronycteris* sp., and *Molossus* sp.), which might represent a larger number of species. Among the species, one is classified as endangered and two as near threatened according to the IUCN global assessment (IUCN 2013, Figure. 2).

We included 91,906 capture records in the dataset, which varies between 1 and 7,725 captures per site (448.32 ± 58.71 SE). The most frequently captured bat species was *Carollia perspicillata* (87.3% of the sites), followed by *Artibeus lituratus* (84.8%) and *Sturnira lilium* (75.6%). The average frequency of occurrence was 12.3%, and there were 12 species as singletons (0.48%), 11 as doubletons (0.97%), and 5 species appeared in only three locations (1.46%). The most frequent non-phyllostomid bats were from the genus *Myotis* (41% sites, Figure 2).

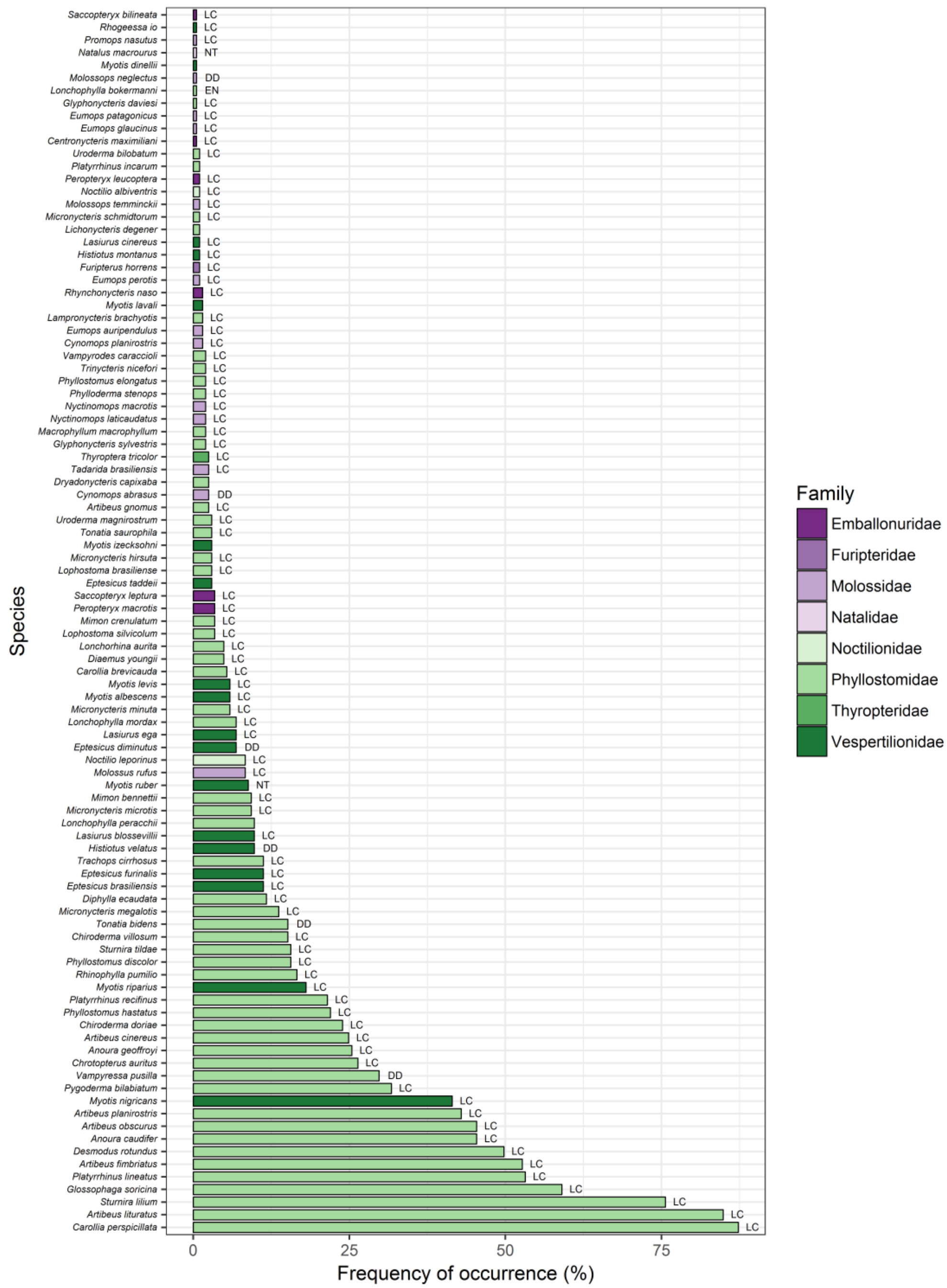

Fig. 2. **Distribution of frequencies of occurrence of bat species in communities in the Atlantic forests colored by family and IUCN status**. The symbols from the global assessment were: LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered, DD = data deficient. Not available data were left in blank.

The most abundant bat species was *Artibeus lituratus*, followed by *Carollia perspicillata* and *Sturnira lilium*, clearly showing their hyper-dominance in mist net studies. Eight species were responsible for 80% of captures: *Platyrrhinus lineatus* (2.3%; 2,175), *Molossus molossus* (2.8%; 2,628), *Artibeus obscurus* (3.4%; 3167), *Artibeus planirostris* (5.2%; 4,789), *Artibeus fimbriatus* (7%; 6,454), *Sturnira lilium* (14.5%; 13,392), *Carollia perspicillata* (15.6%; 14,423), and *Artibeus lituratus* (29.2%; 26,928). On the contrary, 90 species were responsible for only 10% of captures (Figure 3). The rarest species were *Glyphonycteris daviesi*, *Promops nasutus*, *Eumops glaucinus*, *Myotis dinellii*, *Rhogeessa io*, and *Micronycteris schmidtorum*. Together, they represent less than a thousandth (0.001) of all captures.

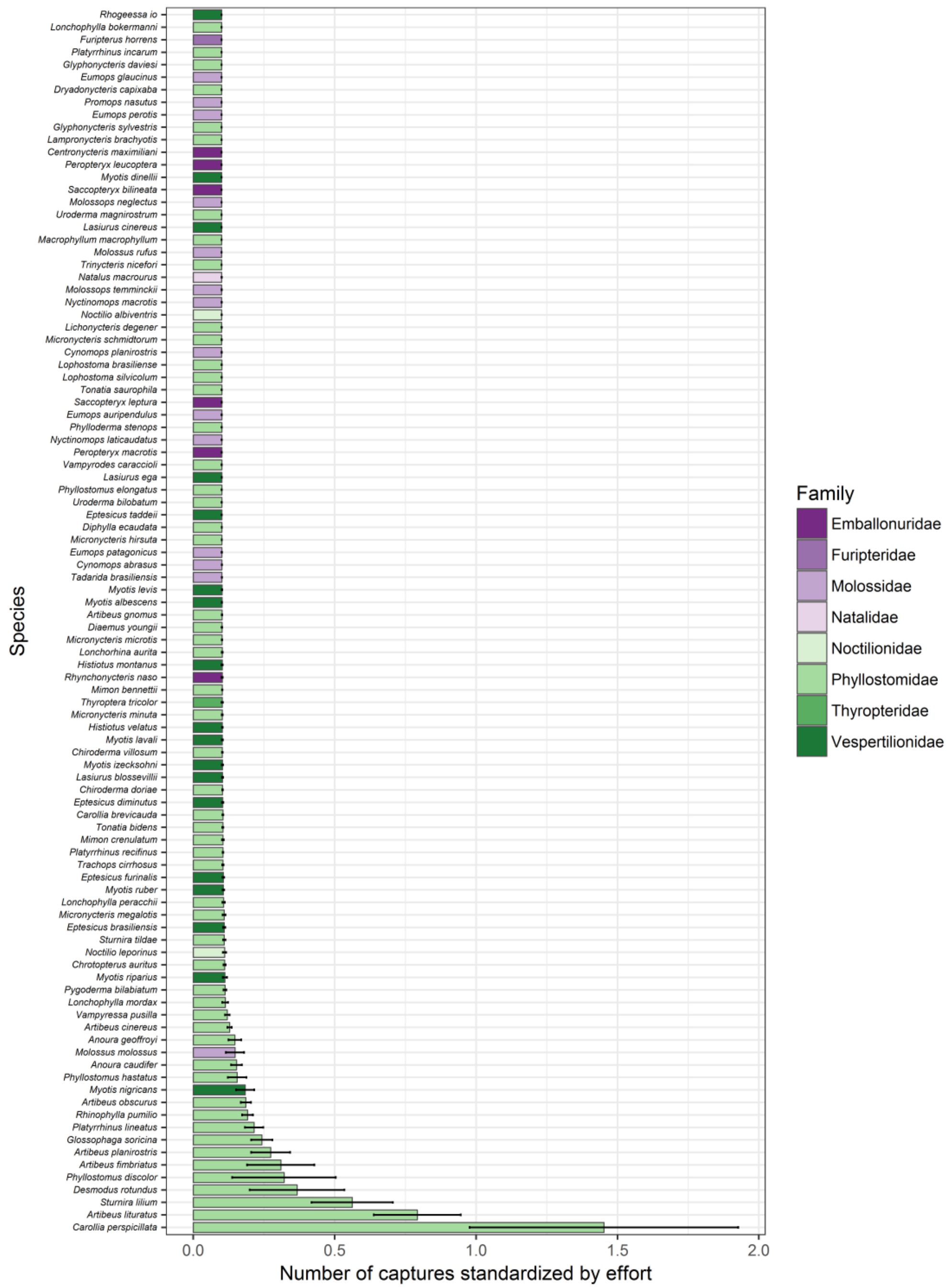

Fig. 3. Standardized bat capture numbers per survey. Capture success was standardized following Straube and Bianconi (2002), and given in number of captures/hours net area (100*hours*m^2). For better visualization of low values, 0.001 was added to values.

The sampling effort standardized using the Straube and Bianconi unit (Straube and Bianconi 2002) averaged 28,875 h.m^2 (total number of hours of capture multiplied by the average area of the mist nets used), with a median of 7,513.33 and a maximum of 534,240. The number of mist nets used in a single night in each site reached up to 30 (regardless of size, see metadata). Canopy nets were used on only nine sites. The total number of captures, which can be used as a proxy for local abundance, increased with sampling effort (adjusted $R^2 = 0.31$, slope = 5.75 ± 0.66, df = 155, $p<0.001$, Figure 4). Voucher specimens of the studies were deposited in 37 collections (Table 3) most of them located in Brazil. Surveys per State/Province/Department varied with a mean of 10 surveys per state. São Paulo/Brazil (49) and Rio de Janeiro/Brazil (49) were the states with the largest numbers of sampling sites. The states with the largest total number of captures were Canindeyu/Paraguay (12,225 captures) and Rio de Janeiro/Brazil (33,769 captures), reaching a maximum of 7,725 captures and 3,509, respectively (Table 4). Most studies were conducted in the following Brazilian Atlantic Forest subregions (BSRs *sensu* Ribeiro et al. (2009): Serra do Mar (62 sites), Pernambuco (7), Araucária Forest (11), Interior Forest (78), and Bahia (37). Among the studied sites with information on the type of protected area (Table 2), 84% were located in protected areas, including biological reserves, ecological stations, indigenous lands, national parks, national reserves, natural monuments, parks, private reserves, protected forests, wildlife refuges, and world heritage sites. The area of the study sites ranged from 1 to for more than 60,000 ha, e.g. Iguaçu National Park (Brazil and Argentina), and Mbaracayu Forest Nature Reserve (Paraguay).

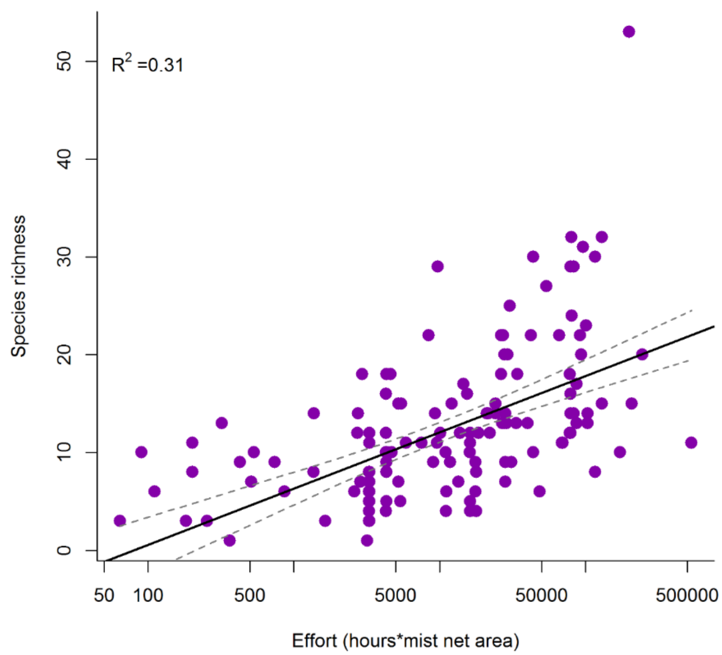

Fig. 4. Taxonomic richness and sampling effort applied on capturing bat species in communities in the Atlantic forests. Non-confirmed records (see the text) were removed for species counting. Linear regression shows a positive effect of sampling effort on observed taxonomic richness from the ATLANTIC BATS dataset (adjusted R^2= 0.31, slope= 5.75 ± 0.66, df=155, p<0.001). Grey dashed lines represent 95% confidence intervals of predicted values.

CLASS II. RESEARCH ORIGIN DESCRIPTORS

A. Overall project description:

Identity: Compilation of bat communities captured with mist nets in the Atlantic Forests of South America.

Period of study: Data collection reported on studies range from 1991 to 2016.

Objectives: We aimed to 1) make available a large amount of data collected and available only in the literature in Portuguese, Spanish or English; 2) describe main patterns of data regarding species captured; and 3) inform the status of knowledge on assemblages to facilitate use of the ATLANTIC database. This work is part of the ATLANTIC biodiversity series, providing information on Atlantic Forest diversity and community composition (e.g. Bovendorp et al. 2017, Bello et al. 2017, Lima et al. submitted).

Abstract: Same as above.

Sources of funding: The data construction is supported by São Paulo Research Foundation (FAPESP 2014/01986-0, 2015/17739-4, 2013/50421-297/07075-1). The studies that produced the information compiled in our dataset were funded by grants, scholarships, and fellowships given by the Brazilian Council for Scientific and Technological Development (CNPq 153423/2016-1, 303757/2012-4, 312045/2013-1, 312045/2013-1, 312292/2016-3), US National Science Foundation, Brazilian Coordination for the Improvement of Higher Education Personnel (CAPES: Science Without Borders and PNPD programs), São Paulo Research Foundation (FAPESP 2011/06810-9, 2016/02568-2, 2011/22663-6, 2013/50421-2, 2014/24219-4, and 2015/17739-4), Rio de Janeiro Research Foundation (PAPDRJ FAPERJ/CAPES), Research Council of Norway through its Centres of Excellence Funding Scheme (223257), the Norwegian University of Science and Technology (NTNU), Project for the Conservation and Sustainable Use of Brazilian Biological Diversity (PROBIO-PRONABIO/MMA-CNPq), Research Program of the Biodiversity of the Atlantic Forest (PPBio-MA/CNPq), Bat Conservation International (BCI), Lincoln Park Zoo, Idea Wild, Ecotone, Minas Gerais Research Foundation (FAPEMIG), German Academic Exchange Service (DAAD), and Alexander von Humboldt Foundation (AvH).

Site description:

The Atlantic Forest of South America is a biome originally distributed in the tropical and subtropical coast of Brazil and in the countryside of Argentina and Paraguay (Olson et al. 2001). It harbors 8% of the world's total species richness, and at least 15,519 plant species (3,343 trees) (Zappi et al. 2015), 891 birds (Moreira-Lima 2014), 543 amphibians (Haddad et al. 2013), 200 reptiles (Bérnils and Costa 2015), 350 fishes (MMA 2010), and 298 mammals (Paglia et al. 2012), out of which 117 species are bats (Varzinczak et al. 2016). The Atlantic Forest comprises tropical and subtropical evergreen and semideciduous forests with highly heterogeneous environmental conditions (Morellato and Haddad 2000).

Seventy-two percent of the Brazilian population live in areas originally covered by the Atlantic Forests domain (~145 million people) (IBGE 2013). Therefore, many anthropogenic activities such as logging, forest fragmentation, agricultural fields, industrialization, and unplanned urban expansion have contributed to the ecosystem deterioration. The conservation of Atlantic Forest is critical, the natural remnants accounting for only 12% of the original biome, and more than 80% of these remnants are less 50 ha in size (Ribeiro et al. 2009).

Data compilation:

We conducted a wide literature search for published and unpublished documents found on the internet. Additionally, we invited several researchers to contribute with unpublished data on bat communities. Then, we checked for taxonomy and compiled information on mammal collections. We searched the literature on Google Scholar and included also studies to which the PIs already had access. The following keywords in English were used on Google Scholar: "bats, survey, inventory, abundance, Atlantic forest, mist nets" with (439 results). In Portuguese, we used the following keywords:

“morcegos, inventário, abundância, Mata Atlântica, redes-de-neblina” (223 results). We also looked for following keywords in Spanish: “murciélagos, inventario, abundancia, Bosque Atlantico, redes-de-neblina” (21 results). Studies with no information on capture number were excluded from our compilation, such as from Willig et al. (2000). We also searched for theses and dissertations on the online libraries of South American universities.

Research Methods:

In this database, we included studies that reported sampling of bat species, survey design and methods, strata sampled, sampling effort, and number of captures. Lacking information was labelled with NA. However, some studies that did not provide substantially detailed information on captures were excluded. We also included information from the geographical location (latitude, longitude, locality, municipality, state and country). Species information (occurrence and abundance) were compiled from 108 articles and from personal database on bat diversity mentioned as follows: Bat Diversity Laboratory LADIM, UFRRJ; Database on bat diversity from the Ecological Synthesis Lab, UFMG; Database on bat diversity from the Stevens Lab, Texas Tech University; and Database on bat diversity from the Evolutionary Ecology Lab, UNESP.

Bat capture data were compiled from (Campanha and Fowler 1993, Peracchi and Albuquerque 1993, Aguiar 1994, Sipinski and Reis 1995, Reis et al. 1996, 2003, 2006, Graipel et al. 1997, Pedro and Taddei 1998, Geraldes 1999, Portfors et al. 2000, Pedro et al. 2001, Sekiama et al. 2001, Dias et al. 2002, Bergallo et al. 2003, Esbérard 2003, Falcão et al. 2003, Félix 2003, Passos et al. 2003, Sa Neto 2003, Aguiar and Marinho-Filho 2004, 2007, Bianconi et al. 2004, Gorresen and Willig 2004, Rosa 2004, Mello and Schittini 2005, Ortêncio-Filho et al. 2005, 2014, Bertola et al. 2005, Esbérard et al.

2006, Faria 2006, Carvalho and Zocche 2007, Althoff 2007, Mikalauskas 2007, Arnone and Passos 2007, Zanon and Reis 2007, Bosco-Breviglieri 2008, Carvalho 2008, Alves 2008, Camargo et al. 2009, da Silva 2009, Evangelista 2009, Luz et al. 2009, Nobre et al. 2009, Oprea et al. 2009, Ortêncio-Filho and Reis 2009, Reus 2009, Bernardi et al. 2009, Tahara 2009, Mello 2009, Brito et al. 2010, Gallo et al. 2010, Lourenço et al. 2010, Oliveira 2010a, 2010b, Silveira et al. 2010, Brito 2011, Cirignoli et al. 2011, Munster 2011, Muylaert and Mello 2011, Weber et al. 2011, Brito and Bocchiglieri 2012, Gruener et al. 2012, Sánchez et al. 2012, Carvalho et al. 2013, Godoy 2013, Morais 2013, Nascimento et al. 2013, Nunes 2013, Pimenta 2013, Pires and Fabián 2013, Muylaert et al. 2014, 2016, Rubio et al. 2014, Bortolotti 2015, Cherem and Althoff 2015, Gomes et al. 2015, Jacomassa 2015, Martins et al. 2015, Miranda and Zago 2015, Souza et al. 2015, Milano 2016, Pedrozo et al. 2016, Pereira 2016, Angelo et al. 2017, Barros et al. 2017).

We extracted spatial and geographical information through available databases (IBGE in Brazil) and Google maps. We used the spatial join function in ArcGIS 10.5 to extract values to the points representing localities where bats were sampled. Then, we checked locations with missing information of protected area types filling with information from reserve websites. Here we only provide studies that reported capture number and our own data stored in personal databases. Studies where information on number of captures (used to calculate standardized abundance) were not informed were removed from dataset.

To define Atlantic Forest boundaries, we followed the same procedure as Lima et al. (submitted). We merged available geographic information from the main used limits informing Atlantic forest extents: the Brazilian government limit (IBGE 2016), the limit provided by the Atlantic Forest Law initiative (MMA 2006), the one used as mask to calculate the remaining Atlantic Forest (Ribeiro et al. 2009), and the one reported in (Olson et al. 2001) also adopted by WWF and available online (https://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world). From the terrestrial ecosystem shapefile (Olson et al. 2001) we made a subset from Atlantic Forests and Atlantic dry forests categories inside and outside Brazil.

Taxonomy and systematics:

We used the *taxize* package in R to update taxonomy and conservation status via the IUCN Red List of threatened species (R Core team 2015, Chamberlain et al. 2016). Taxonomy was then checked by a bat taxonomist (G. Garbino). Then, Taxize outputs were double checked in IUCN website to verify the category for each species from the Red List. When reported, the location where specimens were kept or where vouchers were deposited was noted. We used collection names in their original language, since they are indexed in the databases by these names.

We followed the taxonomic arrangement of Gardner (2008), with the following exceptions: 1) we use the name *Platyrrhinus incarum* instead of *P. helleri*, following Velazco et al. (2010), who recognized both taxa as distinct species with the latter restricted to northern South America and Central America; 2) we use *Natalus macrourus* for the Atlantic Forest populations of *Natalus*, following the taxonomic revision of Tejedor (2011) and nomenclatural correction of Garbino and Tejedor (2013); 3) for *Myotis,* we include *M. izecksohni* and *M. lavali*, considered distinct from *M. nigricans* Moratelli et al. (2011) and consider *M. dinellii* separate from *M. levis* following (Miranda et al. 2013); 4) we include the recently described *Lonchophylla peracchii*, following Dias et al. (2013) who recognized it as distinct from *L. bokermanni*. Considering the restrict distribution of the latter (Teixeira et al. 2015), we assigned only the records from the Serra do Cipó to this species. All previous records of *L. bokermanni* from Rio de Janeiro (i.e. Pão de Açúcar and Poço das Antas), and the one from Rio Doce State Park, from the Database on bat diversity from the Ecological Synthesis Lab, and from Baptista and Mello (2001) and Mello (2009) were assigned to *L. peracchii*; 5) we include *Dryadonycteris capixaba*, a recently described species which has been previously mistaken by *Choeroniscus minor* in southeastern Brazil (Nogueira et al. 2014, Rocha et al. 2014). We agree with Rocha et al. (2014) that the records of *"Choeroniscus minor*" in the Atlantic Forest probably refer to *D. capixaba*, and, also taking into consideration that it has been recently recorded for the geographically close Rio Doce State Park (Gregorin et al. 2014), assign the record from Caratinga (Aguiar 1994) to this species.

We decided not to use the generic name *Dermanura*, keeping instead *Artibeus* for *A. cinereus* and *A. gnomus*, following (Gardner 2008) and the more recent classification of (Baker et al. 2016). We consider all records of *Uroderma bilobatum* from São Paulo, Paraná and Rio de Janeiro states to be erroneous and thus have removed the record of this species from "Mata dos Godoy", which is located in Paraná (see discussion in Garbino and Nogueira 2017). The specimens identified as *U. bilobatum* by the authors were released and their identity cannot be ascertained, as it could be a misidentified *Chiroderma* or *Platyrrhinus* species.

The *Thyroptera* sp. captured in Guapimirim (from the Database on bat diversity from the Ecological Synthesis Lab) is identified as *Thyroptera tricolor* due to this being the only species of *Thyroptera* occurring in southeastern Brazil (Esbérard et al. 2007). In addition, we considered the records of *Lichonycteris obscura* as erroneous, since it only occurs in South America along the Pacific coast of Colombia and Ecuador (Griffiths and Gardner 2008). Records of *Lichonycteris obscura* reported at Una (Faria 2006) and at Usina Serra Grande (Sa Neto 2003) probably refer to *L. degener*, and we assigned them to this species.

Finally, we could not accurately determine the identity of *Peropteryx* cf. *kappleri*, *Artibeus* sp., *Carollia* sp., *Lonchophylla* sp., *Molossus* sp., and *Micronycteris* sp., and thus we have maintained on the main table the identification as they were originally reported, and this information was not considered in further analyses.

C. Data limitations and potential enhancements:

We recognize that documenting all bat species present in megadiverse ecosystems is a challenging task because many species are hard to capture in mist nets. New techniques, such as bioacoustics, thermal images, and cave roost counting, can also provide important complementary information on the bat community, but are still hardly used. Most surveys in our database are heterogeneous, with sampling efforts unstandardized (e.g. sampling design, number of nets, sampling days), precluding more comprehensive diagnosis of diversity. In addition, the length of studies is highly variable, and most of them have been conducted recently, with usually up to one year of captures, limiting the ability to obtain reliable population estimates.

There are mist nets of several kinds of mesh, material, heights, and lengths that could affect the capture of bats, but this information is rarely reported in the studies. Moreover, despite some tests that have been made (Lazo 2011), mist net position or configuration does not seem to be a consensus among bat ecologists, and there are few studies testing efficiency of net trap position (see Lazo 2011, Kunz and Brock 1975). Usually, studies set the nets transversally or perpendicularly to some possible route for bats, such as trails in the forest, or roost entrances, but this is not an information clearly exposed in the publications. Additionally, most studies do not provide information on the mist net length, mesh size, model, or material. Standard mist net models vary from 2.5 m to 3 m height (Peracchi and Nogueira 2010).

Bats are prone to exhibit population fluctuations in response to seasonal changes associated to rainfall, fruit production, and temperature. In addition, population sizes of bats may also respond to more drastic events, climatic (as El Niño and La Niña) and this data set comprises a "snapshot" of the communities in a given year and location. Recently, a paper gave a simple solution for standardizing effort on mist net inventories (Straube and Bianconi 2002). This was welcomed among scientists and became commonly used. We retrieved Straube and Bianconi effort values from 84% of surveys (174/205) by readily obtaining the value reported on paper, or when possible, by checking the availability of information to calculate the effort ourselves.

We obtained the two main measures of effort used by researchers to quantify bat abundance, one is the product of the number of hours times the total area of mist nets (Straube and Bianconi 2002), and the other is the total number of captures (Peracchi and Nogueira 2010). We found that our dataset is spatially biased and there is a clear gap in the northeast portion of the Atlantic forests, especially in transition areas between Atlantic forest and the Caatinga. Some regions are poorly inventoried in Brazil (Alagoas, Mato Grosso do Sul, Paraíba) and Paraguay. Future initiatives should aim to fill these gaps. On the other hand, the species accumulation curve comprising the 205 points of study does increase but nearly stabilizes, suggesting that ATLANTIC BATS dataset covers an adequate representation of the bat communities within Atlantic Forest (Figure 5). It worth mentioning that sites such as Sooretama (Espírito Santo, Brazil) have more than 53 recorded species during one survey (Pimenta 2013), and other sites in Espírito Santo may inhabit over 50 bat species (Peracchi et al. 2011). Mist nets usually present a significant bias because of potential vertical stratification of certain species. Detectability and rarity are not well studied among bat taxa, and gap analysis should enlighten this issue improving the palling of long term or even rapid assessments (Bernard et al. 2011). Little is known about insectivorous bats that occur in the high canopy (Kalko 1998).

We found only four studies that used canopy mist nets, making a huge effort to distinguish between understory, midstory, and canopy strata. Therefore, most studies presented here sample bats that forage up to 3 m in the forest strata. Moreover, our dataset best represents phyllostomid species, but we also include information of other species that forage above the canopy wherever they were captured.

In addition, many species of bats, like small rodents and marsupials, are difficult to identify to the species level in the field. Many studies did not collect voucher specimens or did not report the collection where vouchers or genetic samples were placed. Nevertheless, we recognize the massive research effort by field ecologists and biologists who carried out these studies. This impressive collection of data represents the best information of communities of bats in tropical and subtropical forests. We expect that the community of scientists will be able to characterize macro-ecological patterns as well as determine: i) the priority areas to sample bat communities; ii) the minimum sampling effort to obtain consistent information on bat assemblages; iii) lists of voucher specimens and reference material, and the institutions where they are housed; and iv) the minimal sampling protocol that will standardize the study of bats for species-rich ecosystems.

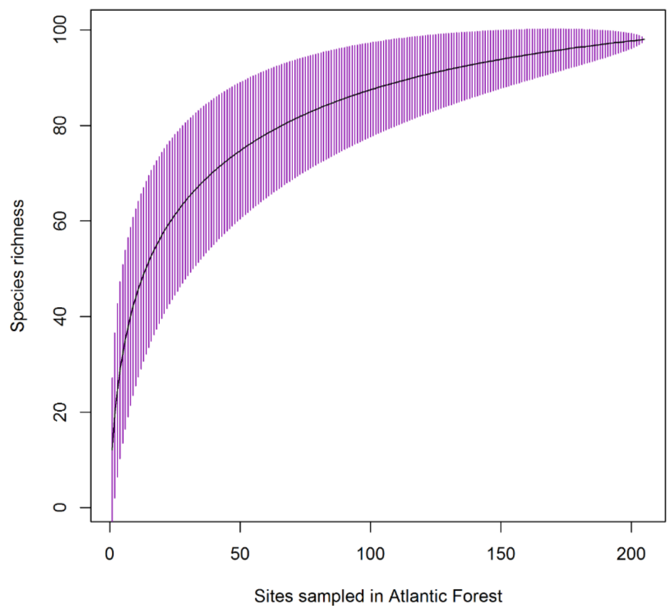

Fig. 5. Species accumulation curve of the number of confirmed species with expected number of species along 205 site surveys in ATLANTIC BATS dataset. Note that asymptote is almost reached, and it accumulates in 98 species from 117 found in the entire biome.

CLASS III. DATA SET STATUS AND ACCESSIBILITY

A. Status

Latest update: May 2017

Latest archive date: May 2017

Metadata status: Last updated May 2017, version submitted

Data verification: Assemblage abundance information were compiled as is, except for taxonomic checking. Geographic coordinates were double-checked since many studies give wrong coordinates that represent city centroids or base stations of conservation units. Most corrected geographic coordinates represent an approximation of the survey locality reported in decimal degrees (Datum WGS 84) using maps, coordinates provided by from papers, personal information of authors, and Google Maps. In most cases, they are inaccurate but provide accessibility or reproducibility approximation.

B. Accessibility

Contact person(s): Renata Muylaert (renatamuy@gmail.com), Mauro Galetti (mgaletti@rc.unesp.br), or Richard D. Stevens (richard.stevens@ttu.edu).

Copyright restrictions: None

Proprietary restrictions: Please cite this data paper if the data are used in publications and teaching events. The ATLANTIC team intend to keep this data paper up to date (see server link above).

Costs: None

CLASS IV. Data structural descriptors

A. Data set file

Identity:

(1) ATLANTIC_BATS_Study_Site.csv

(2) ATLANTIC_BATS_Reference.csv

(3) ATLANTIC_BATS_Capture.csv

Size:

(1) ATLANTIC_BATS_Study_Site.csv, 205 locations, 46.8 KB

(2) ATLANTIC_BATS_Reference.csv, 135 studies, 60.7 KB

(3) ATLANTIC_BATS_Capture.csv, 20,604 records, 4.12 MB

Format and storage mode: data tables formatted as comma-separated values (*.csv)

Alphanumeric attributes: Mixed

Data anomalies: If no information is available for any cell, this is indicated as 'NA'. In this dataset, we have NA values.

B. Variable information

1) Table 2. Site Information

2) Table 3. Reference Information

3) Table 4. Capture Information

CLASS V. SUPPLEMENTAL DESCRIPTORS

A. Data acquisition

1. Data request history: None

2. Data set updates history: None

3. Data entry/verification procedures

G. History of data set usage:

Stevens (2013) used a small part of this dataset to investigate gradients of bat diversity in Atlantic Forest.

ACKNOWLEDGMENTS:

This paper is part of the ATLANTIC research group. We thank Carolina Bello, Fernando Lima, Felipe Martello, Andreia Magro, and Annia Streher. To the many students, technicians and colleagues who helped us in the field. To the brave bat workers and to the property owners and guards, who helped us with kindness and security measures during the long nights. This paper is dedicated to important bat specialists: Ivan Sazima, Adriano Peracchi and Valdir A. Taddei (in memoriam) for

their long contribution and formation of Brazilian researchers.

TABLES

Table 1. Species information: Description of species present in ATLANTIC BATS. Species without confirmed identification (cf. and sp.) were not used for species counting: LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered, DD = data deficient, NA= not available at the time.

Superfamily	Family	Species	Status
Emballonuroidea	Emballonuridae	*Centronycteris maximiliani*	LC
Emballonuroidea	Emballonuridae	*Peropteryx leucoptera*	LC
Emballonuroidea	Emballonuridae	*Peropteryx macrotis*	LC
Emballonuroidea	Emballonuridae	*Rhynchonycteris naso*	LC
Emballonuroidea	Emballonuridae	*Saccopteryx bilineata*	LC
Emballonuroidea	Emballonuridae	*Saccopteryx leptura*	LC
Noctilionoidea	Furipteridae	*Furipterus horrens*	LC
Noctilionoidea	Noctilionidae	*Noctilio albiventris*	LC
Noctilionoidea	Noctilionidae	*Noctilio leporinus*	LC
Noctilionoidea	Phyllostomidae	*Anoura caudifer*	LC
Noctilionoidea	Phyllostomidae	*Anoura geoffroyi*	LC
Noctilionoidea	Phyllostomidae	*Artibeus cinereus*	LC
Noctilionoidea	Phyllostomidae	*Artibeus fimbriatus*	LC
Noctilionoidea	Phyllostomidae	*Artibeus gnomus*	LC
Noctilionoidea	Phyllostomidae	*Artibeus lituratus*	LC
Noctilionoidea	Phyllostomidae	*Artibeus obscurus*	LC
Noctilionoidea	Phyllostomidae	*Artibeus planirostris*	LC
Noctilionoidea	Phyllostomidae	*Carollia brevicauda*	LC
Noctilionoidea	Phyllostomidae	*Carollia perspicillata*	LC
Noctilionoidea	Phyllostomidae	*Chiroderma doriae*	LC
Noctilionoidea	Phyllostomidae	*Chiroderma villosum*	LC
Noctilionoidea	Phyllostomidae	*Chrotopterus auritus*	LC
Noctilionoidea	Phyllostomidae	*Desmodus rotundus*	LC
Noctilionoidea	Phyllostomidae	*Diaemus youngii*	LC
Noctilionoidea	Phyllostomidae	*Diphylla ecaudata*	LC
Noctilionoidea	Phyllostomidae	*Dryadonycteris capixaba*	NA
Noctilionoidea	Phyllostomidae	*Glossophaga soricina*	LC
Noctilionoidea	Phyllostomidae	*Glyphonycteris daviesi*	LC
Noctilionoidea	Phyllostomidae	*Glyphonycteris sylvestris*	LC
Noctilionoidea	Phyllostomidae	*Lampronycteris brachyotis*	LC
Noctilionoidea	Phyllostomidae	*Lichonycteris degener*	NA

Noctilionoidea	Phyllostomidae	*Lonchophylla bokermanni*	EN
Noctilionoidea	Phyllostomidae	*Lonchophylla mordax*	LC
Noctilionoidea	Phyllostomidae	*Lonchophylla peracchii*	NA
Noctilionoidea	Phyllostomidae	*Lonchorhina aurita*	LC
Noctilionoidea	Phyllostomidae	*Lophostoma brasiliense*	LC
Noctilionoidea	Phyllostomidae	*Lophostoma silvicolum*	LC
Noctilionoidea	Phyllostomidae	*Macrophyllum macrophyllum*	LC
Noctilionoidea	Phyllostomidae	*Micronycteris hirsuta*	LC
Noctilionoidea	Phyllostomidae	*Micronycteris megalotis*	LC
Noctilionoidea	Phyllostomidae	*Micronycteris microtis*	LC
Noctilionoidea	Phyllostomidae	*Micronycteris minuta*	LC
Noctilionoidea	Phyllostomidae	*Micronycteris schmidtorum*	LC
Noctilionoidea	Phyllostomidae	*Mimon bennettii*	LC
Noctilionoidea	Phyllostomidae	*Mimon crenulatum*	LC
Noctilionoidea	Phyllostomidae	*Phylloderma stenops*	LC
Noctilionoidea	Phyllostomidae	*Phyllostomus discolor*	LC
Noctilionoidea	Phyllostomidae	*Phyllostomus elongatus*	LC
Noctilionoidea	Phyllostomidae	*Phyllostomus hastatus*	LC
Noctilionoidea	Phyllostomidae	*Platyrrhinus incarum*	NA
Noctilionoidea	Phyllostomidae	*Platyrrhinus lineatus*	LC
Noctilionoidea	Phyllostomidae	*Platyrrhinus recifinus*	LC
Noctilionoidea	Phyllostomidae	*Pygoderma bilabiatum*	LC
Noctilionoidea	Phyllostomidae	*Rhinophylla pumilio*	LC
Noctilionoidea	Phyllostomidae	*Sturnira lilium*	LC
Noctilionoidea	Phyllostomidae	*Sturnira tildae*	LC
Noctilionoidea	Phyllostomidae	*Tonatia bidens*	DD
Noctilionoidea	Phyllostomidae	*Tonatia saurophila*	LC
Noctilionoidea	Phyllostomidae	*Trachops cirrhosus*	LC
Noctilionoidea	Phyllostomidae	*Trinycteris nicefori*	LC
Noctilionoidea	Phyllostomidae	*Uroderma bilobatum*	LC
Noctilionoidea	Phyllostomidae	*Uroderma magnirostrum*	LC
Noctilionoidea	Phyllostomidae	*Vampyressa pusilla*	DD
Noctilionoidea	Phyllostomidae	*Vampyrodes caraccioli*	LC
Noctilionoidea	Thyropteridae	*Thyroptera tricolor*	LC
Vespertilionoidea	Molossidae	*Cynomops abrasus*	DD
Vespertilionoidea	Molossidae	*Cynomops planirostris*	LC
Vespertilionoidea	Molossidae	*Eumops auripendulus*	LC
Vespertilionoidea	Molossidae	*Eumops glaucinus*	LC
Vespertilionoidea	Molossidae	*Eumops patagonicus*	LC
Vespertilionoidea	Molossidae	*Eumops perotis*	LC
Vespertilionoidea	Molossidae	*Molossops neglectus*	DD
Vespertilionoidea	Molossidae	*Molossops temminckii*	LC
Vespertilionoidea	Molossidae	*Molossus molossus*	LC
Vespertilionoidea	Molossidae	*Molossus rufus*	LC
Vespertilionoidea	Molossidae	*Nyctinomops laticaudatus*	LC
Vespertilionoidea	Molossidae	*Nyctinomops macrotis*	LC
Vespertilionoidea	Molossidae	*Promops nasutus*	LC
Vespertilionoidea	Molossidae	*Tadarida brasiliensis*	LC
Vespertilionoidea	Natalidae	*Natalus macrourus*	NT
Vespertilionoidea	Vespertilionidae	*Eptesicus brasiliensis*	LC

Vespertilionoidea	Vespertilionidae	*Eptesicus diminutus*	DD
Vespertilionoidea	Vespertilionidae	*Eptesicus furinalis*	LC
Vespertilionoidea	Vespertilionidae	*Eptesicus taddeii*	NA
Vespertilionoidea	Vespertilionidae	*Histiotus montanus*	LC
Vespertilionoidea	Vespertilionidae	*Histiotus velatus*	DD
Vespertilionoidea	Vespertilionidae	*Lasiurus blossevillii*	LC
Vespertilionoidea	Vespertilionidae	*Lasiurus cinereus*	LC
Vespertilionoidea	Vespertilionidae	*Lasiurus ega*	LC
Vespertilionoidea	Vespertilionidae	*Myotis albescens*	LC
Vespertilionoidea	Vespertilionidae	*Myotis dinellii*	NA
Vespertilionoidea	Vespertilionidae	*Myotis izecksohni*	NA
Vespertilionoidea	Vespertilionidae	*Myotis lavali*	NA
Vespertilionoidea	Vespertilionidae	*Myotis levis*	LC
Vespertilionoidea	Vespertilionidae	*Myotis nigricans*	LC
Vespertilionoidea	Vespertilionidae	*Myotis riparius*	LC
Vespertilionoidea	Vespertilionidae	*Myotis ruber*	NT
Vespertilionoidea	Vespertilionidae	*Rhogeessa io*	LC

Table 2. Site information: Description of the fields related with the location of each study site.

Type of information	Variables	Description	Levels	Example
SITE INFORMATION	**ID**	Identification code for each record, making it easier to connect with other ATLANTIC series data	bat1001-bat1205	bat1001
	Country	English name of the country	Brazil, Paraguay, Argentina	Brazil
	State	State, Province or Department of the study site derived based on the geographic coordinates	20	RIO DE JANEIRO
	Municipality	Municipality of the study site derived based on the geographic coordinates	119	PATY DOS ALFERES
	Study_location	Local name of the study site derived based on the information in the reference paper. There are sites with more than one survey		Parque Estadual de Porto Ferreira
	Latitude	Corrected and transformed coordinates of the latitude in decimal degrees (Datum WGS84). The precision of the reported coordinates in the reference papers were mostly inexact. We used the centroids of sampling sites as our sampling point (x, y). Correction was conducted with the help of the clues in the reference papers, such as vegetation type, approximate coordinates, trails, rivers, and reserve names. These clues	decimal degree	-25,08685287

		were cross-validated against Google Earth satellite images.		
	Longitude	Corrected and transformed coordinates of the longitude. See above for further information.	decimal degree	-47,92796182
	Precision	Coordinate precision of the study site. Precise: the grid, transect or vegetation patch coordinates are reported. Non-precise: the coordinates of the municipality are reported, or the coordinates mismatch the written information in the reference paper.	Precise	Precise
	Reserve_Area	Reserve area reported in the reference paper, value in hectars (ha)	1 to 50650	45
	Altitude	Meters above sea level reported in the reference paper or obtained later based on the corrected coordinates		64
	Altitude1km	Altitude in meters above sea level, from the Hydro-1K dataset (United States Geological Survey – USGS, 2001. HYDRO 1K: Elevation Derivative Database. Available from: <http://edc.usgs.gov/products/elevation/gtopo30/hydro/namerica.html>) on May 5th	0 to 2043	13
	Annual_mean_temperature	Annual mean temperature. WorldClim v. 1.4., in Celsius degrees, available in http://www.worldclim.org/version1. Access on May 5th, 2017.	From 12.13-25.7	24.2
	Annual_rainfall	Annual rainfall. WorldClim v. 1.4., in mm, available in http://www.worldclim.org/version1. Access on May 5th, 2017.	From 965 to 2490	1551
	Olsong200r	Olson bioregion (Olson et al. 2001), represented by G200_REGIO column of the shapefile wwf_terr_ecos	Atlantic Forests, Cerrado Woodlands and Savannas	
	Olsoneconame	ECO_NAME column of the shapefile wwf_terr_ecos available in WWF website (Olson et al. 2001).	Serra do Mar coastal forests	Atlantic Coast restingas
			Atlantic Coast restingas	
			Araucaria moist forests	
			Alto Parana Atlantic forests	
			Cerrado	

			Bahia coastal forests	
			Bahia interior forests	
			Pernambuco coastal forests	
			Southern Atlantic mangroves	
			Humid Chaco	
			Campos Rupestres montane savanna	
			Southern Cone Mesopotamian savanna	
			Caatinga	
			Pernambuco interior forests	
			Uruguayan savanna	
	ribeirovegtype	Type of vegetation sensu Ribeiro et al. (2009)	Dense Ombrophilous Forest	Dense Ombrophilous Forest
			Mixed Ombrophilous Forest	
			Semideciduous Forest	
			Deciduous Forest	
			Savana	
			Stepe	
			Open Ombrophilous Forest	
	BSRs	Type of biogeographical sub-regions (BSRs) sensu Ribeiro et al. (2009)	Serra do Mar	

			Pernambuco	
			Florestas de Araucaria	
			Interior Forests	
			Bahia	
	uc	Level of protection of the study site area. Yes: protected areas, including Botanical Parks, National, State Parks. No: study site is not located in a protected area.	Y, N	Y
	protectedtype	Type of the protected area column DESIG of shapefile available in WDPA IUCN and UNEP-WCMC (year), The World Database on Protected Areas (WDPA) [Online], [insert month/year of the version downloaded], Cambridge, UK: UNEP-WCMC. Available at: www.protectedplanet.net.	Park	Park
			Protected Forest	
			World Heritage Site	
			Biological Reserve	
			Indigenous land	
			Wildlife refuge	
			Ecological Station	
			Area of relevant ecological interest	
			Private Reserve	
			National Park	
			Natural Monument	
			National reserve	

Table 3. Reference information. Description of the fields related to the reference information and voucher collection of each study.

Type of information	Variable	Description	Levels	Example
REFERENCE INFORMATION	**ID**	Identification code for each record.	bat1001-bat1205	bat1001
	Authors	Short name of author without special characters	factor	Mello
	Type	Type of publication. Thesis refer to monographs, theses and dissertations.	Database Thesis Article	Article
	Reference	Reference in Ecology style	factor	Mello, M. A. R., and G. M. Schittini. 2007. Ecological analysis of three bat assemblages from conservation units in the lowland Atlantic forest of Rio de Janeiro, Brazil. Chiroptera Neotropical 11:206–210.
	Voucher_Specimens	Name of the collection where voucher specimens were deposited. It is possible to find more than one reference per study ID.	factor	Coleção Zoológica de Referência, Universidade Federal de Mato Grosso do Sul (ZUFMS), Campo Grande, MS, Brazil

Table 4. Capture information. Description of the fields related with bat capture information.

Type of information	Variables	Description	Levels	Example
CAPTURE INFORMATION	**ID**	Identification code for each record.	bat1001-bat1205	bat1001
	Year_start	Year of the beginning of the study	1991-2016	2008
	Year_finish	Year of the end of study. Many were vague.	1997-2016	2016
	Duration	Unstandardized duration of study. Several were vague.		1 year
	Season	Season reported in the reference paper	dry, wet, both	both
	Method	Capture method used for capturing bats	mist nets mist nets, active capture and harp trap mist nets and active search in roosts	mist nets
	Strata_sampling	Vertical strata location where capturing was performed	Understory ground nets (U) From Canopy to Understory (UC), below canopy (BC), Canopy (C)	UC
	Nights	Total number of capture nights	1 to 140	15
	hours_per_night	Duration of capture, i.e. number of hours mistnets were open. We reported the maximum as 12 hours also for the studies conducted during the dry season.	1 to 12	6
	number_of_mistnets	Number of mistnets used, regardless of their length, mesh, or material.	1 to 32	6
	effort_straube_bianconi	Effort accounting area of the mistnets and duration of the survey given in hours*square meters (Straube and Bianconi 2002). Since many studies do not report mistnet size or model, this standardized measure is common for comparing bat inventories.	52.5 to 534240	3300
	Sampling_habitat	Brief description of the area where the mist net stations were placed. Information was obtained from the reference paper or	Forest trails and surroundings	Forest trails and surroundings

		from the author of unpublished data.		
			Forestry understorey	
			Restinga	
			Native vegetation trails and surroundings	
			Interior of control forest	
			Edge of Control area	
			Interior of forest patch	
			Edge of forest patch	
			Capoeira	
			Interior of control forest are	
			Edge of control forest area	
			forest interior and forest edge	
			Forest and surroundings	
			Pinus forest with dense understory full of Piper	
			Riparian forest	
			Edges of primary forest and edges with sugarcane	
			Edges of forest and edges with sugarcane	
			Forest trails and edge with sugarcane	
			Seasonal Forest interior and Tree plantations	
			Seasonal Semi-Deciduous Forest and abandoned forestry	
			Coastal Atlantic Forest interior	
			Seasonal Atlantic Forest	
			Rocky Grasslands and Cerrado	
			Coastal Atlantic Forest	
			Cloud forest	
			lowland moist forests, with areas also covered by restinga and mangroves	
			Open and flooded shrubland	
			Capoeira, secondary forests, edges with surroundings including fields and periurban areas	
			Open fields, moist Chaco, Islands of Parana	
			Paranean forest	
			Forest trails and surroundings	

			Restored area since 1998 up to 8m height	
			Restored area since 1987 up to 10m	
			Restored area since 50s up to 15m	
			Native vegetation trails and surroundings up to 20m	
			Regenerating vegetation up to 20m	
			Secondary forest	
			Open shrubland and forest patches	
	Community	Reported bat assemblage. All: when all bat assemblage was reported. Leafnosed: phyllostomid species data (leaf-nosed bats) were reported.	all, leafnosed	leafnosed
	Class	Taxonomic class		Mammalia
	Order	Taxonomic order	Chiroptera	Chiroptera
	Superfamily	Taxonomic superfamily	Noctilionoidea, Vespertilionoidea, Emballonuroidea	Noctilionoidea
	Family	Taxonomic family	Phyllostomidae, Molossidae, Vespertilionidae, Emballonuridae, Thyropteridae, Natalidae, Noctilionidae, Furipteridae	Phyllostomidae
	Capture_number	Number of captures	0-5350	20
	Species	Species name		*Anoura geoffroyi*
	Status	Status in global assessment of IUCN Red List	LC, DD, NA, NT, EN	LC

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