ATLANTIC ANTS: a dataset of ants in Atlantic Forests of South America

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Abstract. Ants, an ecologically successful and numerically dominant group of animals, play key ecological roles as soil engineers, predators, nutrient recyclers, and regulators of plant growth and reproduction in most terrestrial ecosystems. Further, ants are widely used as bioindicators of the ecological impact of land use. We gathered information of ant species in the Atlantic Forest of South America. The ATLANTIC ANTS data set–which is part of the ATLANTIC SERIES data papers–is a compilation of ant records from collections (18,713 records), unpublished data (29,651 records), and published sources (106,910 records; 1059 references), including papers, theses, dissertations, and book chapters published from 1886 to 2020. In total, the data set

contains 153,818 ant records from 7,636 study locations in the Atlantic Forest, representing 10 subfamilies, 99 genera, 1,114 ant species identified with updated taxonomic certainty, and 2,235 morphospecies codes. Our data set reflects the heterogeneity in ant records, which include ants sampled at the beginning of the taxonomic history of myrmecology (the nineteenth and twentieth centuries) and more recent ant surveys designed to address specific questions in ecology and biology. The data set can be used by researchers to develop strategies to deal with different macroecological and regional-wide questions, focusing on assemblages, species occurrences and distribution patterns. Furthermore, the data can be used to assess the consequences of changes in land use in the Atlantic Forest on different ecological processes. No copyright restrictions apply to the use of this data set, but we request that authors cite this data paper when using these data in publications or teaching events.

Key words: Atlantic Forest fauna; Biodiversity Hotspot; Formicidae; Hymenoptera; Tropical Forests; species occurrence.

ALWAYS INCLUDE:

The complete data set is available as Supporting Information at: [*to be completed at proof stage*].

IF DATA ALSO APPEARS ON ANOTHER PLATFORM, INCLUDE:

Data Availability

Associated data is also available at https://github.com/LEEClab/Atlantic_series/Atlantic_Ants: [DOI assigned to deposited data/code].

Corresponding Editor: William K. Michener.

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ATLANTIC ANTS: a dataset of ants in Atlantic Forests of South America

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Frei Walter W. Kempf, O.F.M. (1920-1976), one of the precursors of ant taxonomy in Brazil, died precociously on the eve of presenting his data on the diversity and biogeographic perceptions of ants in the Atlantic Forest, at the XV International Congress of Entomology - the result of 20 years of his work. This study is dedicated to his memory, to express our gratitude and admiration for his contributions that inspired us to continue the work that he started.

Introduction

The Atlantic Forest - the second largest rainforest in South America - originally spanned from 3 to 31 degrees latitude south to 35 to 60 degrees longitude west, and from sea level to approximately 2800 m in elevation, encompassing wide latitudinal and steep longitudinal gradients from tropical to subtropical forests (Ribeiro et al. 2011). Covering over a million square kilometers, it represented 15% of Brazil, and extended into Argentina, Paraguay, and Uruguay (Rezende et al. 2018). Today, the biome covers less than 28% of its original area and it is extremely fragmented (Rezende et al. 2018), even more in its northern half; 80% of all forest patches are smaller than 50 ha (Ribeiro et al. 2009). The Atlantic Forest is considered one of five major global conservation hotspots given its high levels of species diversity and endemism (Myers et al. 2000). A few large fragments of forest remain, mostly in the Brazilian states of Paraná, São Paulo, Rio de Janeiro, and Bahia, as well as in Argentina's Misiones province.

Ants (Hymenoptera: Formicidae) are an important group of invertebrates that have inspired research in many fields, including behavioral ecology (Sudd and Franks 1987), biodiversity and conservation (Lach et al. 2010), ant-plant interactions (Oliveira and Koptur 2017), macroevolution and macroecology (Economo et al. 2018). Ants probably originated in the early Cretaceous, about 100 Mya (Ward 2014). There are currently 13 extant subfamilies of ants

311 in the Neotropical region, encompassing over 143 genera, with approximately 4,030 valid
312 species/subspecies (Bolton 2021), but the estimated number of species is much higher (Ward
313 2014) and the Neotropics probably harbors the highest level of ant diversity on Earth (Fernández
314 et al. 2019). Ants are characterized by a suite of morphological and behavioral adaptations
315 (including universal eusociality; Wilson 1971), have colonized most of the world's terrestrial
316 ecosystems, and play multiple ecological roles (Wilson 1987, Del-Toro et al. 2012, Elizalde et al.
317 2020); their species include generalist and specialist predators, scavengers, omnivores,
318 granivores, fungivores and herbivores (Brown Jr. 2000).

319 Although ants are among the best-studied invertebrate groups, knowledge about its
320 distribution and diversity is largely incomplete, especially in the Neotropical region (Guénard et
321 al. 2012, Fernández et al. 2019, Divieso et al. 2020). The most important obstacle to answer
322 questions about drivers and patterns of ant biodiversity is the lack of data and taxonomic
323 resolution, especially in places where diversity is high (Keil and Chase 2019). These data
324 deficiencies have precluded the large-scale analyses of invertebrates, commonplace for
325 vertebrate groups (Diniz-Filho et al. 2010, Economo et al. 2018).

326 Neotropical ant taxonomy has a long history. The first samples from the Atlantic Forest
327 biome, studied by several ant taxonomists, were collected in the nineteenth and twentieth
328 centuries. Studies published by Emery (1886–1923), Forel (1886–1922), Santschi (1912–1939),
329 Wheeler (1907–1942), and Mann (1916) all contributed to our knowledge on ant diversity and
330 distribution in the Atlantic Forest. In the twentieth century, Luederwaldt (1918–1920),
331 Borgmeier (1920–1959), Brown Jr. (1953–1981), Gonçalves (1942–1983), and Kempf (1949–
332 1978) made important contributions to our understanding of ant species from the Atlantic Forest.
333 More recently in Brazil, research groups led by Brandão (1983–2020), Delabie (1988–2020), and

Mayhé-Nunes (1995–2020) have conducted taxonomic studies and consequently expanded our knowledge about ant distribution in the Atlantic Forest. In Argentina, similar studies have been conducted mostly by Bruch (1915–-1934), Gallardo (1915–1934), Kusnezov (1949–1978), and more recently by Cuezzo (1999–2011), and Hanisch (2015–2018). There are few ant studies in Paraguay, where Fowler (1977–1985), who mainly studied leaf-cutter ants, and Wild (2002) have been the primary scientific reviewers. Late in the twentieth century and the beginning of twenty-first century, taxonomic studies by Bolton (1977–2000), Kugler (1984–1982), Mackay (1993–2010), Longino (1989–2013), Ward (1985–2017), Fernández (1993–2014), De Andrade and Baroni Urbani (1999), Lattke (1999–2007), Wild (2002–2009), Johnson (2014–2016), and Feitosa (2005–2016) have also added important information about ant species in the Atlantic Forest.

Pioneering structured inventories of ants in the Atlantic Forest have been conducted ecosystem-wide by Brandão (1980–2000s), Delabie (several studies from 1988–2019 particularly in northeastern Atlantic Forest), and Diehl-Fleig (1996–2017 in its southern limits). The Biota-Fapesp Program and the project "Biodiversity of Hymenoptera and Isoptera: richness and diversity along a latitudinal gradient in the Mata Atlântica–the eastern Brazilian rainforest", produced the widest ranging north-south study. Extending 2,700 km along almost 20^{o} of latitude this effort produced the richest inventory of Atlantic Forest leaf-litter ants (Silva and Brandão 2014). Delabie's studies over the last 30 years have produced the most detailed surveys of ants for any region in the Brazilian Atlantic Forest, many of which have emphasized Bahia (Delabie et al. 1998, Delabie et al. 2000ab, 2006, 2007, Leponce et al. 2010, Resende et al. 2011, Melo et al. 2014, Santos et al. 2017, Koch et al. 2019).

Ecological studies by Paulo S. Oliveira (1984–2020), Fowler (1982–1995), Majer (1992–

1997), Leal (1991–2017), Schoereder (2001–2016), Silva (1997–2014), and Morini (2006-2020) have also made major contributions to the ecology and biology of Atlantic Forest ants. It is clear from the analysis of our data set that systematic studies on ant diversity, assemblage-wide, have greatly increased the number of ant records and improved knowledge of ant distributions in the Atlantic Forest within the last 30 years.

Here we introduce the ATLANTIC ANTS data set and aim to summarize the knowledge of all ant species records in the Atlantic Forest. In the ATLANTIC ANTS data paper, we compiled published and unpublished information between 1803 and 2020. In total, we gathered 153,818 records of 138,912 occurrences and 14,906 quantitative data records of ant assemblages of 1,114 ant species and 2,235 codes for ant morphospecies. These data refer to 7,636 georeferenced locations in the Atlantic Forest of Brazil, Argentina, and Paraguay. The data set combines information from hundreds of published surveys and checklists scattered throughout the published literature and other sources of information (collections databases, abstracts of scientific meetings, book chapters, theses, and dissertations). Taken together these records hold key information on the distribution of ants in the Atlantic Forest. The ATLANTIC ANTS data set is by far the largest database on ant occurrences in any biome or ecoregion of the planet.

This ATLANTIC ANTS data paper is part of the studies on ATLANTIC, NEOTROPICAL and BRAZIL SERIES initiative, which aims to compile information on the biodiversity of the Atlantic Forests of South America and Neotropics as publicly available as possible (Table 1).

Table 1. List of data papers published in the ATLANTIC, NEOTROPICAL and BRAZIL SERIES initiative.

ATLANTIC SERIES		
	Organisms	**Source**
	Atlantic Bats	Muylaert et al. 2017
	Atlantic Frugivory	Bello et al. 2017
	Atlantic Camtraps	Lima et al. 2017
	Atlantic Small Mammals	Bovendorp et al. 2017
	Atlantic Butterflies	dos Santos et al. 2018
	Atlantic Amphibians	Vancine et al. 2018
	Atlantic Mammal Traits	Gonçalves et al. 2018a
	Non-Volant from Upper Paraná	Gonçalves et al. 2018b
	Atlantic Birds	Husui et al. 2018
	Atlantic Primates	Culot et al. 2019
	Atlantic Epiphytes	Ramos et al. 2019
	Atlantic Bird Traits	Rodrigues et al. 2019
	Atlantic Mammals	Souza et al. 2019
BRAZIL SERIES		
	Brazil Road-Kill	Grilo et al. 2018
NEOTROPICAL SERIES		
	Neotropical Jaguar GPS movement database	Morato et al. 2018
	Neotropical Xenarthrans	Santos et al. 2019
	Neotropical Carnivores	Nagy-Reis et al. 2020

	Neotropical Alien Species	Rosa et al. 2020

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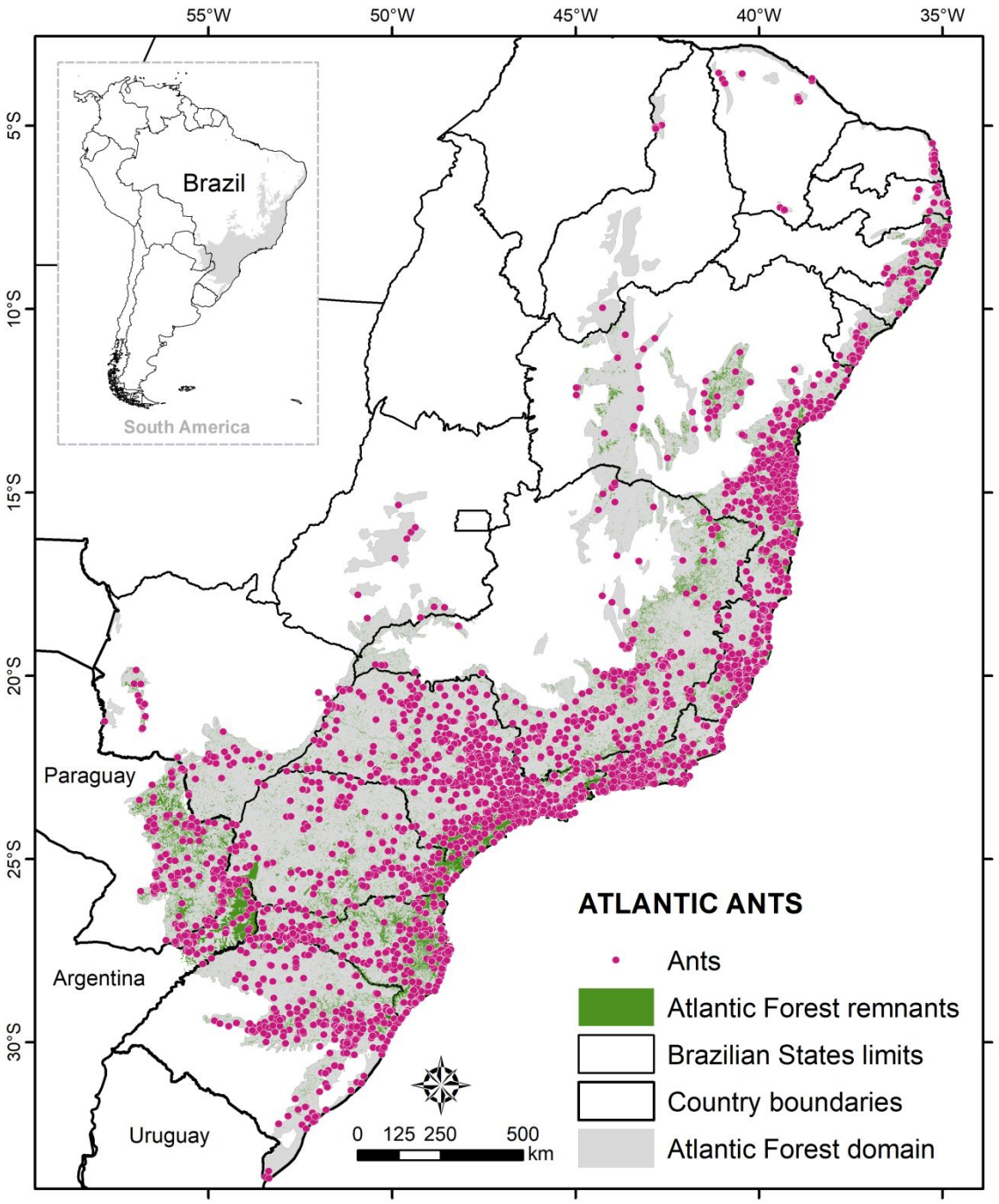
55°W
50°W
45°W
40°W
35°W
5°S
10°S
15°S
20°S
25°S
30°S
Brazil
South America
Paraguay
Argentina
Uruguay
0 125 250 500
km
ATLANTIC ANTS
Ants
Atlantic Forest remnants
Brazilian States limits
Country boundaries
Atlantic Forest domain

382

383 **Fig. 1.** Distribution of the 152,810 records in the ATLANTIC ANTS data set throughout the

384 Atlantic Forest, compiled from 1803 to 2020. Limits of the Atlantic Forest were defined by

385 Ribeiro et al. (2009) and Muylaert et al. (2018).

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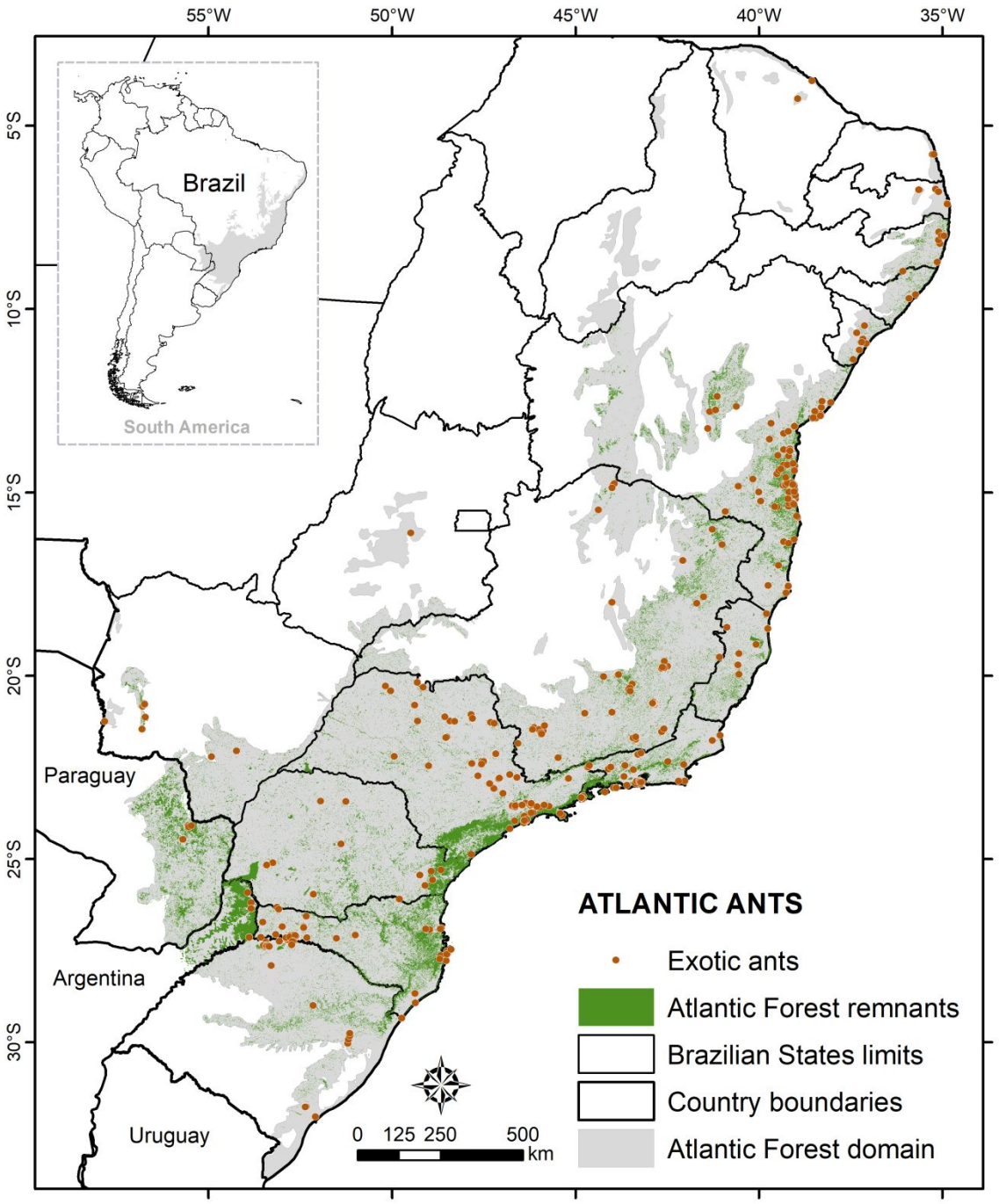
55°W
50°W
45°W
40°W
35°W
5°S
10°S
15°S
20°S
25°S
30°S
Brazil
South America
Paraguay
Argentina
Uruguay
ATLANTIC ANTS
Exotic ants
Atlantic Forest remnants
Brazilian States limits
Country boundaries
Atlantic Forest domain
0 125 250 500
km

Fig. 2. Distribution of the 1,008 records of exotic ants in the ATLANTIC ANTS data set throughout the Atlantic Forest, compiled from 1803 to 2020. Limits of the Atlantic Forest were defined by Ribeiro et al. (2009) and Muylaert et al. (2018).

METADATA S1

Class I - Data set descriptors

A. Data set identity

Title: ATLANTIC ANTS: a data set of ant assemblages and occurrences in Atlantic Forests of South America

B. Data set and metadata identification code

Data set: ATLANTIC_ANTS_dataset.txt

Data set: ATLANTIC_ANTS_references.docx

Metadata: MetadataS1.pdf

C. Data set description

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2. ABSTRACT: Ants, an ecologically successful and numerically dominant group of animals, play key ecological roles as soil engineers, predators, nutrient recyclers, and regulators of plant growth and reproduction in most terrestrial ecosystems. Further, ants are widely used as bioindicators of the ecological impact of land use. We gathered information of ant species in the Atlantic Forest of South America. The ATLANTIC ANTS data set–which is part of the ATLANTIC SERIES data papers–is a compilation of ant records from collections (18,713 records), unpublished data (29,651 records), and published sources (106,910 records; 1059 references), including papers, theses, dissertations, and book chapters published from 1886 to

2020. In total, the data set contains 153,818 ant records from 7,636 study locations in the Atlantic Forest, representing 10 subfamilies, 99 genera, 1,114 ant species identified with updated taxonomic certainty, and 2,235 morphospecies codes. Our data set reflects the heterogeneity in ant records, which include ants sampled at the beginning of the taxonomic history of myrmecology (the nineteenth and twentieth centuries) and more recent ant surveys designed to address specific questions in ecology and biology. The data set can be used by researchers to develop strategies to deal with different macroecological and regional-wide questions, focusing on assemblages, species occurrences and distribution patterns. Furthermore, the data can be used to assess the consequences of changes in land use in the Atlantic Forest on different ecological processes. No copyright restrictions apply to the use of this data set, but we request that authors cite this data paper when using these data in publications or teaching events.

D. Key words

Atlantic Forest fauna; Biodiversity Hotspot; Formicidae; Hymenoptera; Tropical Forests; species occurrence.

Description

The complete data set comprises 178,976 historical and current ant records (from 1803 to 2020), of which 155,274 in the Atlantic Forest (1,456 invalid) and 23,702 in other biomes. About 68% of the records were obtained from peer-reviewed articles or other published material such as theses and dissertations, and 19% come from the unpublished data of the authors. Although the data set results from efforts to gather a maximum of current and historical occurrence localities

of Atlantic Forest ants, it cannot be considered a complete list of ant records because museum collections are underrepresented.

All numbers given hereafter in the text consider only (i) the ant records in the Atlantic Forest as depicted in **Fig. 1** (records inside the extended limit, i.e., 20 km polygon) and (ii) the taxonomically validated records (i.e., after consulting the updated classification available at AntCat.org and taxa experts). Our data set for the Atlantic Forest includes location records of 1,114 nominal ant species and 2,235 morphospecies codes belonging to 99 genera, as well as 28 exotic species/morphospecies **(Fig. 2)**. Local species richness as defined by locality codes in the data set varied from 528 species (São Paulo) to a single recorded species (6,134 localities). We gathered 248 records for endangered species, 300 for vulnerable species and five for critically endangered species according to the Brazilian Red List of Threatened Species (ICMBio 2018).

Regarding the number of records by taxa (nominal species and morphospecies), the most frequently recorded subfamily was Myrmicinae (n = 85,121; 55.3%), followed by Ponerinae (n = 22,696; 14.8%), Formicinae (n = 19,604; 12.8%), Dolichoderinae (n = 7,857; 5.1%), Ectatomminae (n = 6,520; 4.2%), Pseudomyrmecinae (n = 4,622; 3.0%), Dorylinae (n = 4,181; 2.7%), Heteroponerinae (n = 1,495; 1.0%), Amblyoponinae (n = 1,162; 0.8%), and Proceratiinae (n = 560; 0.4%) **(Fig. 3**).

In terms of species richness (not including morphospecies), Myrmicinae was also the richest subfamily (605 species), followed by Formicinae (148), Ponerinae (115), Dolichoderinae (66), Dorylinae (65), Ectatomminae (46), Pseudomyrmecinae (43), Amblyoponinae (11), Heteroponerinae (10), and Proceratiinae (5 species) **(Fig. 4).**

We recorded 99 ant genera in the Atlantic Forest, with *Pheidole* (n = 22,456), *Solenopsis* (n = 13,046), *Camponotus* (n = 10,289), *Strumigenys* (n = 8,832), *Hypoponera* (n = 8,064),

Crematogaster (n = 5,439), *Pseudomyrmex* (n = 4,622), *Brachymyrmex* (n = 4,333), *Acromyrmex* (n = 3,911), and *Wasmannia* (n = 3,602) being the ten most frequent genera (nominal species and morphospecies), accounting for 60% of all records (**Fig. 5**). Regarding the number of species (morphospecies excluded) per genus in the Atlantic Forest, the richest genus was *Pheidole* with 159 recorded species. The genera with more than 20 recorded species included *Camponotus* (91), *Strumigenys* (57), *Solenopsis* (55), *Crematogaster* (47), *Pseudomyrmex* (43), *Cephalotes* (37), *Neivamyrmex* (36), *Gnamptogenys* (31), *Neoponera* (30), *Procryptocerus* (25), *Brachymyrmex* (24), *Hypoponera* (23), and *Acromyrmex* (22) (**Fig. 6**). Among genera, morphospecies records were higher than nominal species in *Pheidole* (17,253 *vs.* 5,203), *Solenopsis* (10,897 *vs.* 2,149), *Hypoponera* (5,494 *vs.* 2,570), *Brachymyrmex* (2,956 *vs.* 1,377), *Nylanderia* (2,993 *vs.* 458), *Sericomyrmex* (1,197 *vs.* 965), *Apterostigma* (858 *vs.* 587), and *Dorymyrmex* (713 *vs.* 518) (**Fig. 7**).

The ten most frequently recorded ant species in the Atlantic Forest were *Strumigenys denticulata* Mayr 1887 (n = 2,215), *Wasmannia auropunctata* (Roger, 1863) (n = 2,079), *Pachycondyla striata* Smith, 1858 (n = 1,825), *Odontomachus meinerti* Forel, 1905 (n = 1,557), *Strumigenys elongata* Roger, 1863 (n = 1,114), *Gnamptogenys striatula* Mayr, 1884 (n = 1,019), *Ectatomma edentatum* Roger, 1863 (n = 1010), *Camponotus rufipes* (Fabricius, 1775) (n = 915), *Pachycondyla harpax* (Fabricius, 1804) (n = 903), and *Crematogaster brasiliensis* Mayr, 1878 (n = 859). The five most frequent species per subfamily represented 18% of our data set (**Fig. 8**). Remarkably, *Strumigenys denticulata* can be ranked among the most common organisms in the Atlantic Forest given its relatively wide distribution and local abundance in quantitative surveys (Silva and Brandão 2010).

Morphospecies in the data set represents 41% of ant records and therefore, a large

505 proportion of abundance and occurrence data comes from unidentified specimens. Only 11%
506 (14,906/138,912) of records represent quantitative data, which means that a large part of the ant
507 records obtained from published sources is only available as occurrence data. Species records
508 were mostly obtained with Winkler extractors used as the sampling method (n = 47,272; 50.5%),
509 followed by pitfall traps (n = 26,182; 28.0%), hand collecting (n = 6,820; 7.3%), attractive baits
510 (4,920 records; 5.3%), and Berlese funnels (n = 2,397 records; 2.6%).

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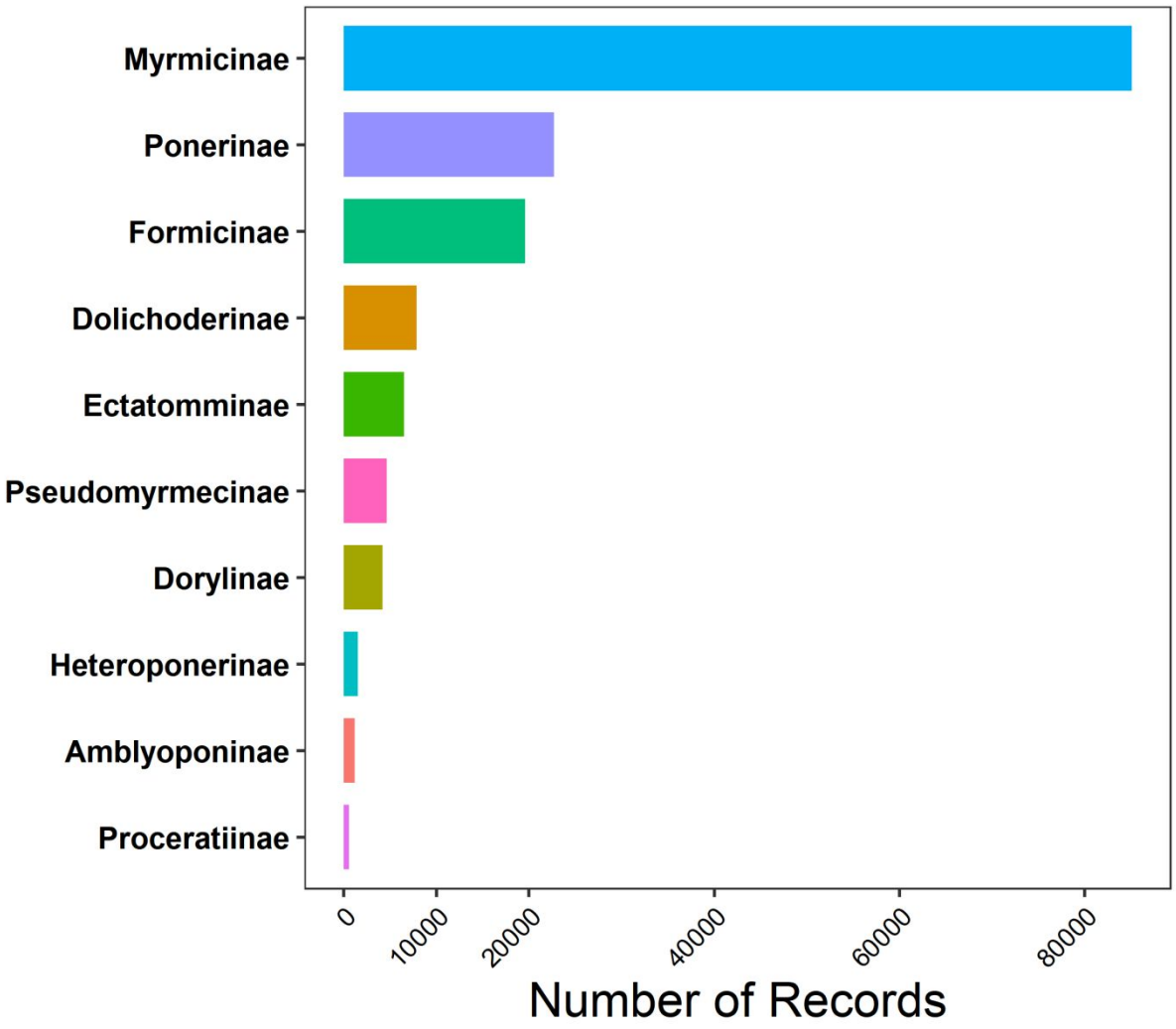

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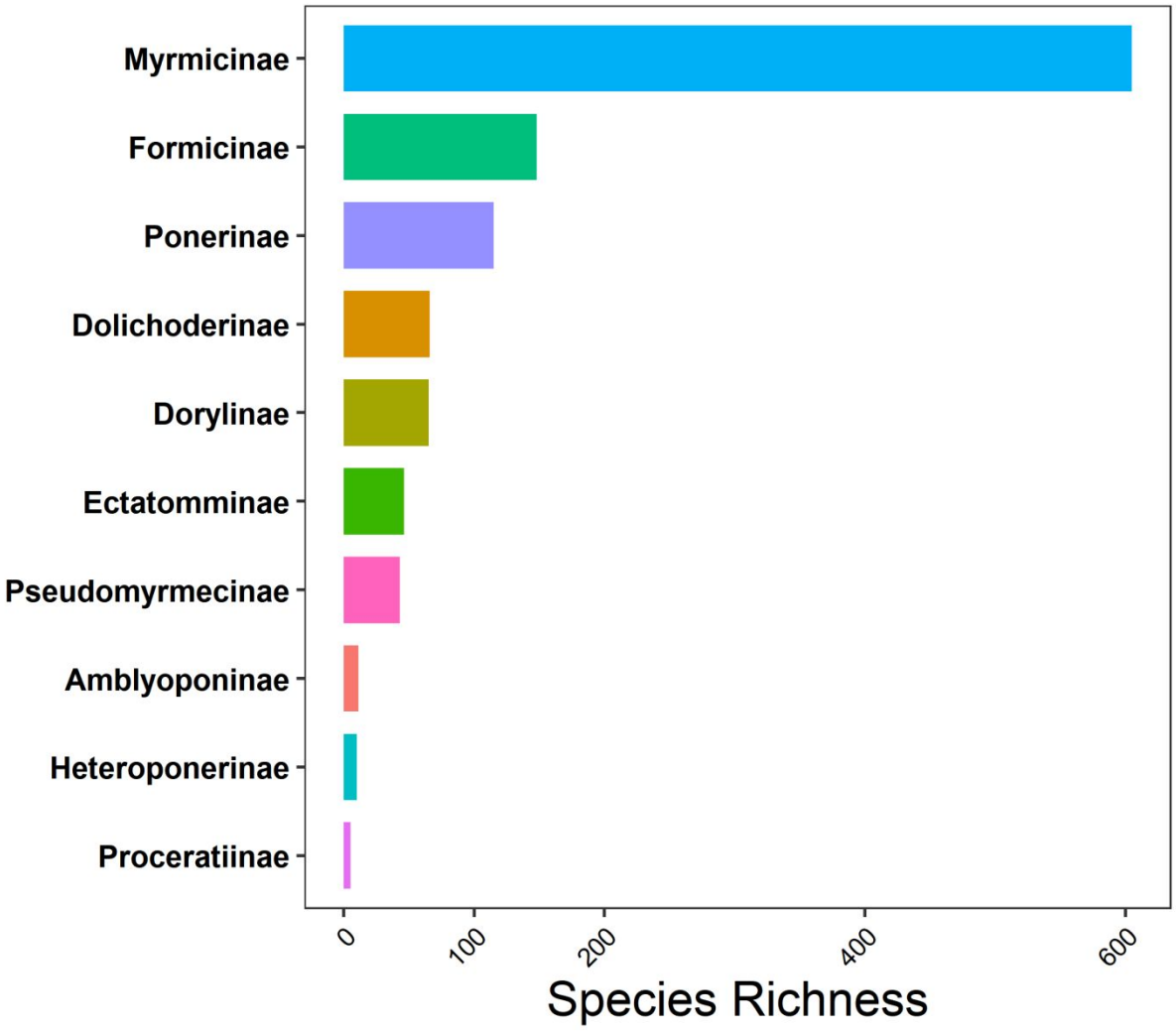
516 Fig. 3. Number of records per ant subfamily in the ATLANTIC ANTS data set.



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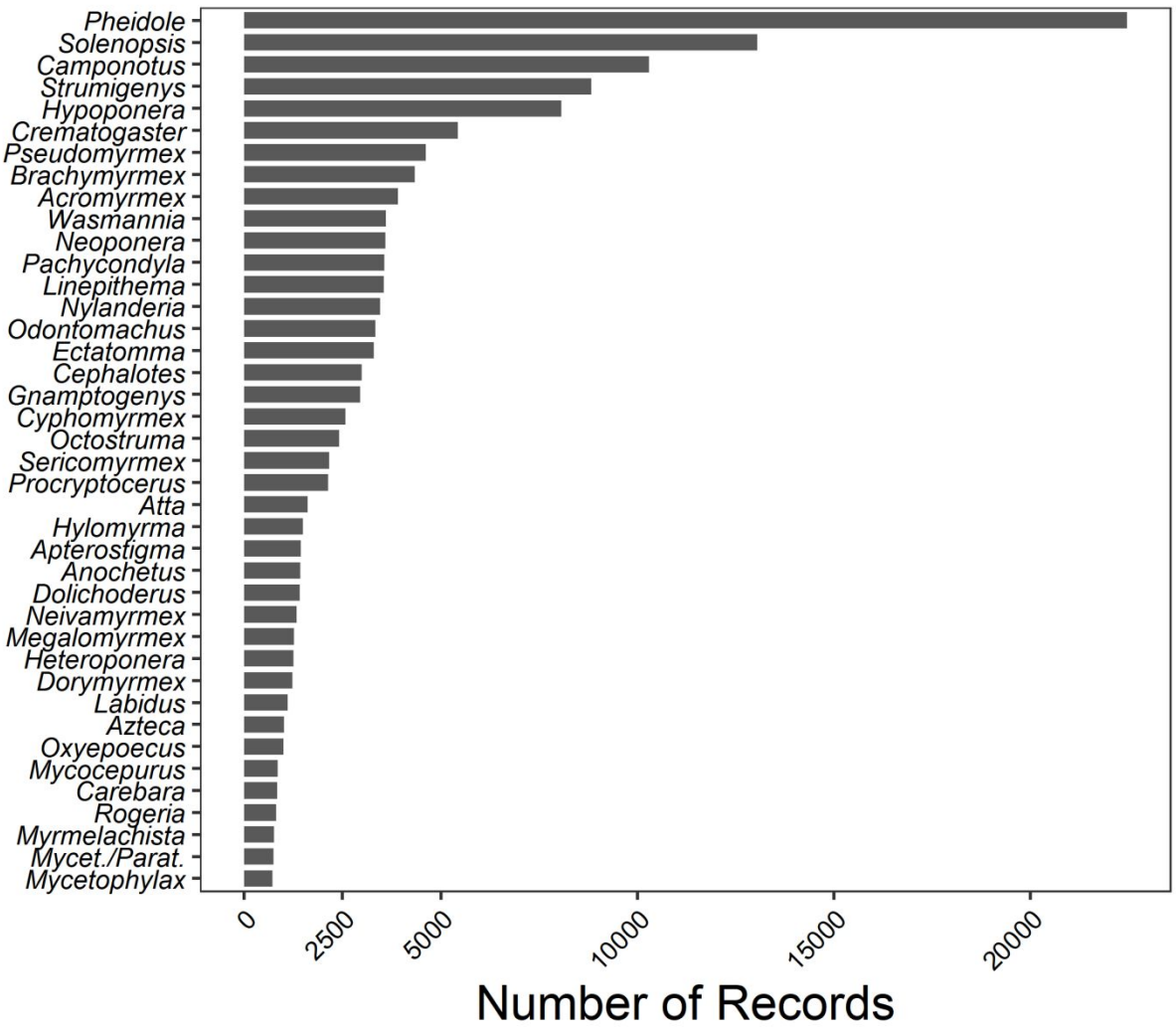
519

520 Fig. 4. Number of species per ant subfamily in the ATLANTIC ANTS data set.



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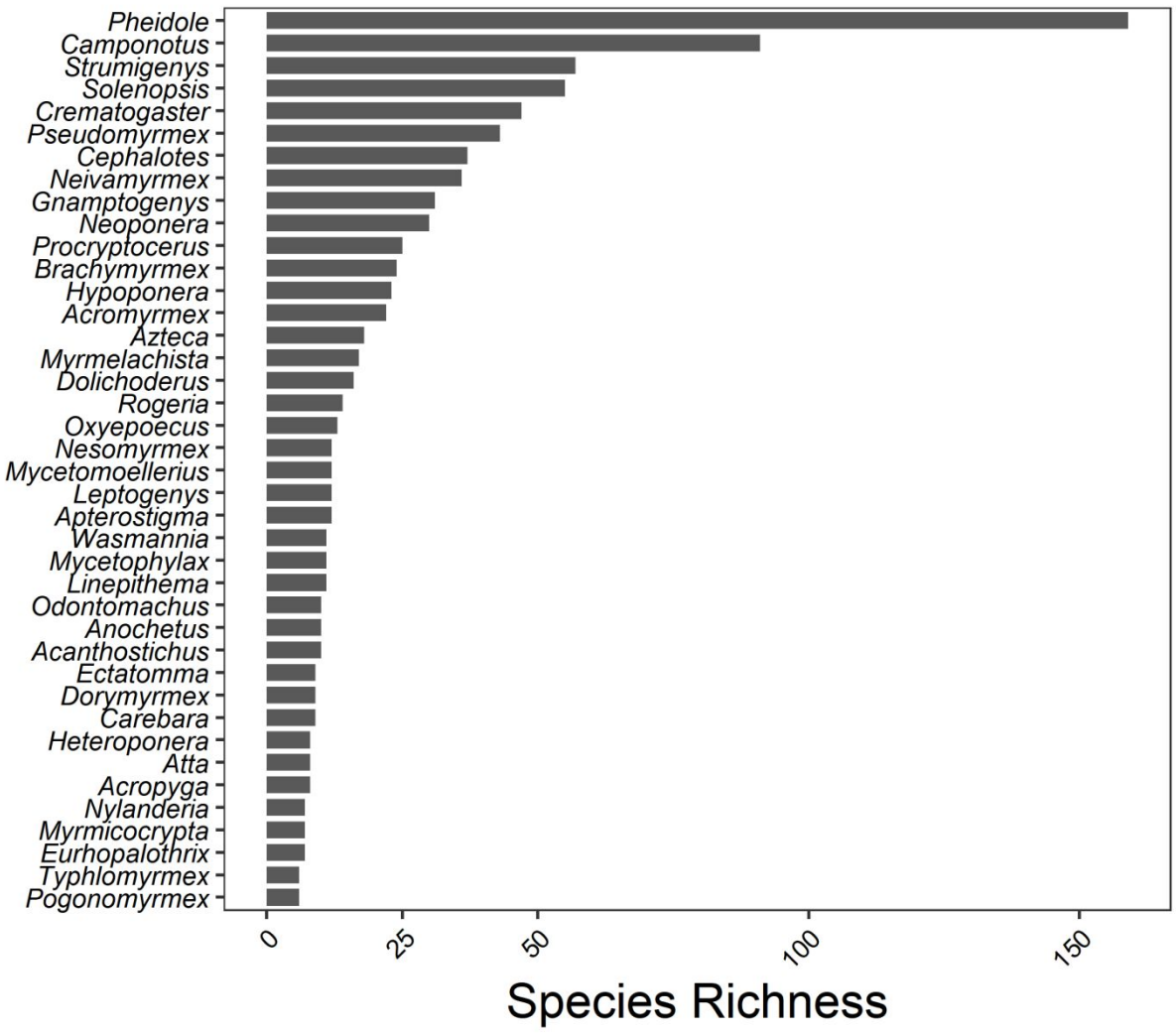
523 Fig. 5. The top 40 most recorded ant genera in the ATLANTIC ANTS data set. *Mycet./Parat.* =

524 *Mycetomoellerius/Paratrachymyrmex*.



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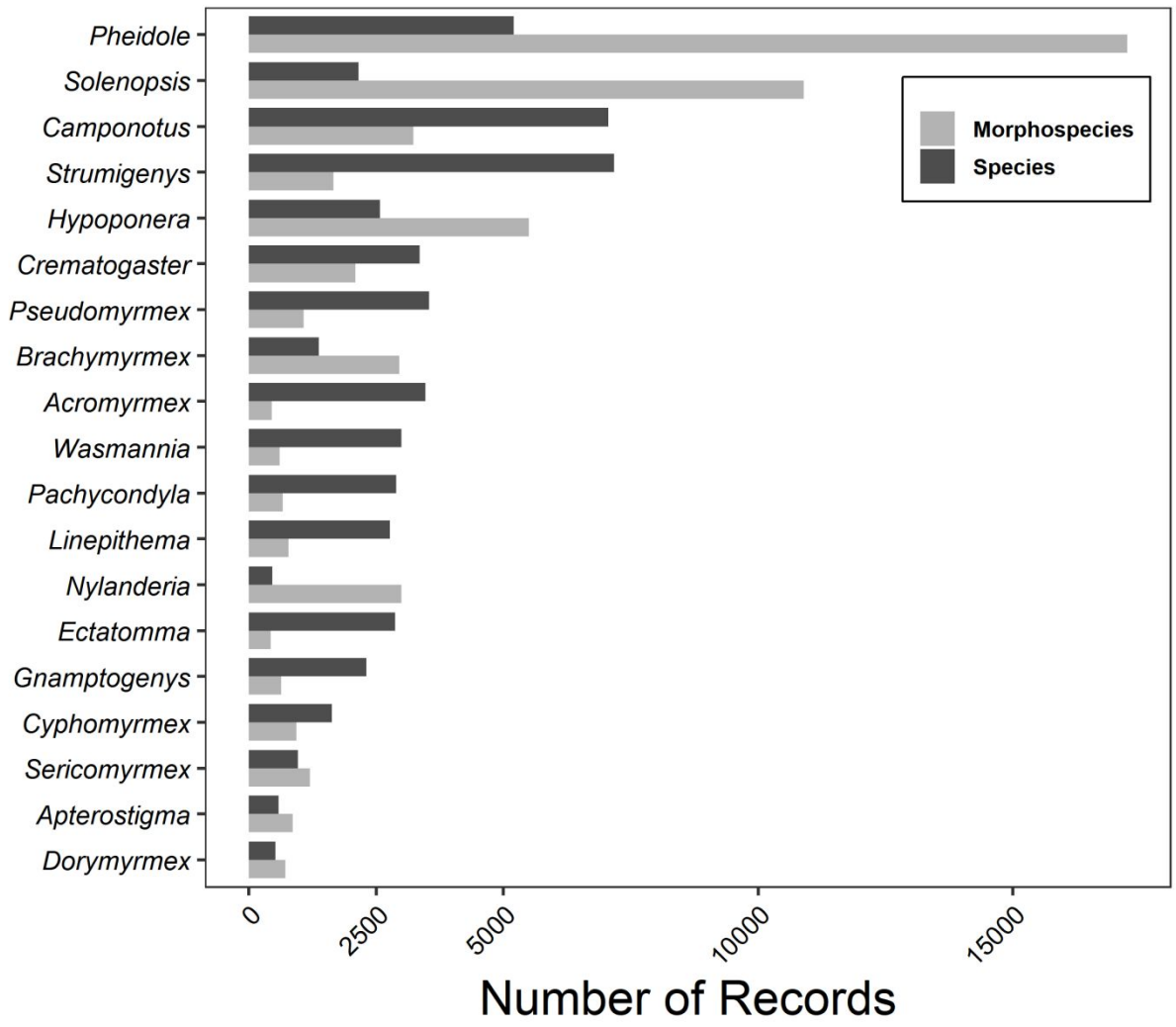
527 Fig. 6. The top 40 most species-rich ant genera in the ATLANTIC ANTS data set.



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530 Fig. 7. The top 20 most recorded species and morphospecies per ant genus in the ATLANTIC

531 ANTS data set.

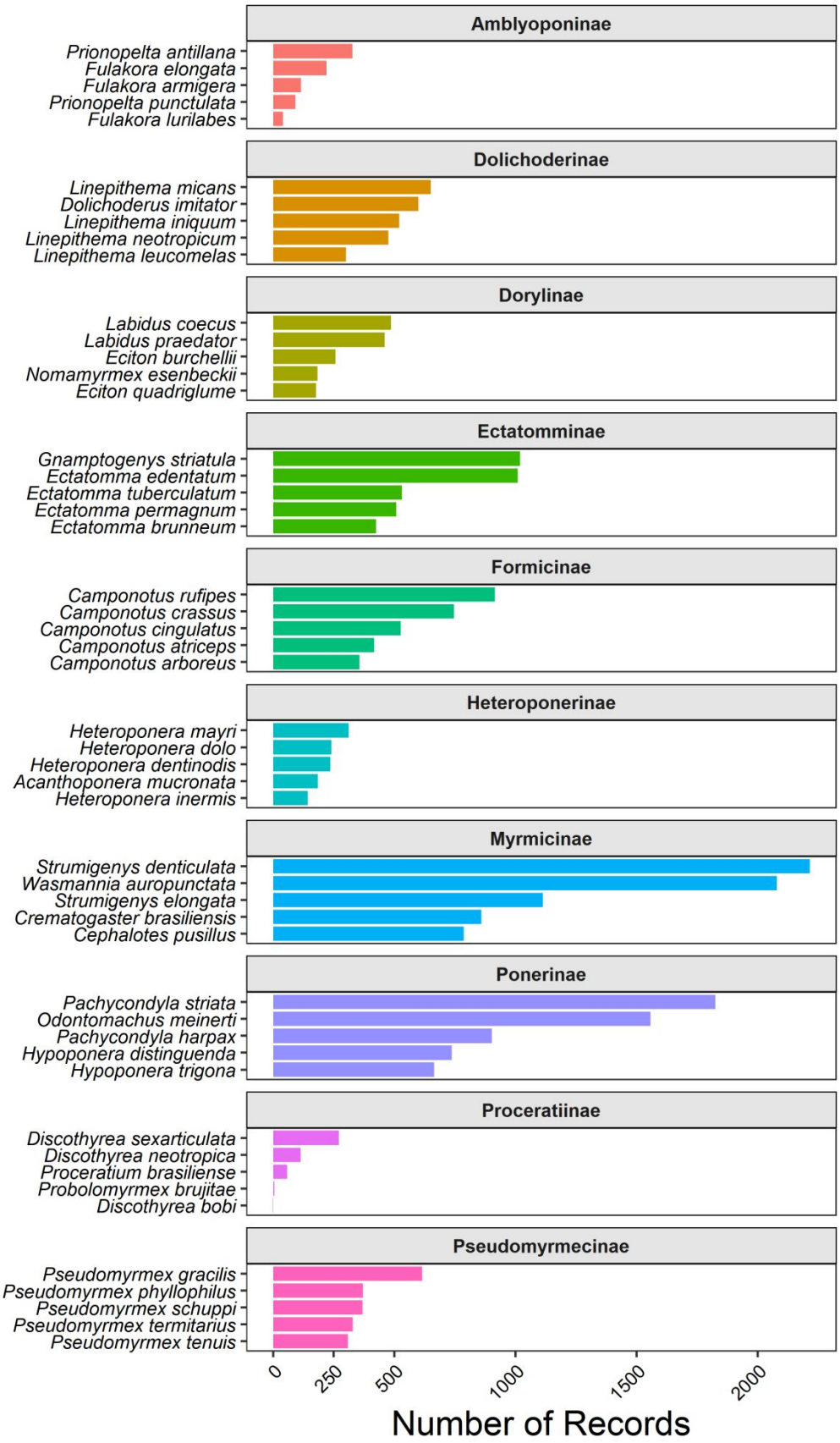

Amblyoponinae
Prionopelta antillana
Fulakora elongata
Fulakora armigera
Prionopelta punctulata
Fulakora lurilabes
Dolichoderinae
Linepithema micans
Dolichoderus imitator
Linepithema iniquum
Linepithema neotropicum
Linepithema leucomelas
Dorylinae
Labidus coecus
Labidus praedator
Eciton burchellii
Nomamyrmex esenbeckii
Eciton quadriglume
Ectatomminae
Gnamptogenys striatula
Ectatomma edentatum
Ectatomma tuberculatum
Ectatomma permagnum
Ectatomma brunneum
Formicinae
Camponotus rufipes
Camponotus crassus
Camponotus cingulatus
Camponotus atriceps
Camponotus arboreus
Heteroponerinae
Heteroponera mayri
Heteroponera dolo
Heteroponera dentinodis
Acanthoponera mucronata
Heteroponera inermis
Myrmicinae
Strumigenys denticulata
Wasmannia auropunctata
Strumigenys elongata
Crematogaster brasiliensis
Cephalotes pusillus
Ponerinae
Pachycondyla striata
Odontomachus meinerti
Pachycondyla harpax
Hypoponera distinguenda
Hypoponera trigona
Proceratiinae
Discothyrea sexarticulata
Discothyrea neotropica
Proceratium brasiliense
Probolomyrmex brujitae
Discothyrea bobi
Pseudomyrmecinae
Pseudomyrmex gracilis
Pseudomyrmex phyllophilus
Pseudomyrmex schuppi
Pseudomyrmex termitarius
Pseudomyrmex tenuis
0
250
500
1000
1500
2000
Number of Records

Fig. 8. Number of records per ant species in the ATLANTIC ANTS data set (the top five most recorded species per subfamily are included).

The ATLANTIC ANTS data set includes records from 38 states/provinces/departments in Brazil, Argentina, and Paraguay. We extracted state, province or department names using the coordinates based on the South America shapefile from the Environmental Systems Research Institute (http://tapiquen-sig.jimdo.com). These sampling site records are concentrated in the few states/provinces/departments that comprised 99% of records: São Paulo (n = 16,661), Bahia (n = 15,567), Minas Gerais (n = 12,291), Santa Catarina (n = 8,932), Rio de Janeiro (n = 6,494), Rio Grande do Sul (n = 4,082), Paraná (n = 4,030), Espírito Santo (n = 1,940), Alagoas (n = 1,626), Mato Grosso do Sul (n = 1,345), Sergipe (n = 706), Pernambuco (n = 523), Paraíba (487), Ceará (n = 323), Goiás (n = 172), and Rio Grande do Norte (n = 119) in Brazil; Misiones (n = 2,914) in Argentina (n = 3,683); Canindeyú (n = 1,387), Alto Paraná (n = 190), and Amambay (n = 112) in Paraguay **(Fig. 9)**. However, sampling site records relative to area from the first-order administrative divisions suggest larger number of records per km^2 in smallest states/provinces/departments: Rio de Janeiro (0.149 records/km^2), Misiones, Canindeyú, and Santa Catarina (0.09 records/km^2), São Paulo (0.06 records/km^2), and Alagoas (0.05 records/km^2) **(Fig. 10)**.

Among the 1,237 municipalities recorded, the 20 most sampled hold approximately 30% of the sampling sites in the Atlantic Forest: Viçosa (Brazil, n = 413), Marliéria (Brazil, n = 231), San Ignacio (Argentina, n = 159), Ilhéus (Brazil, n = 144), Iguazú (Argentina, n = 132), Villa Ygatimí (Paraguay, n = 132), Rio de Janeiro (Brazil, n = 126), São Paulo (Brazil, n = 121), Ouro Preto (Brazil, n = 114), Florianópolis (Brazil, n = 99), Cachoeiras de Macacu (Brazil, n = 89),

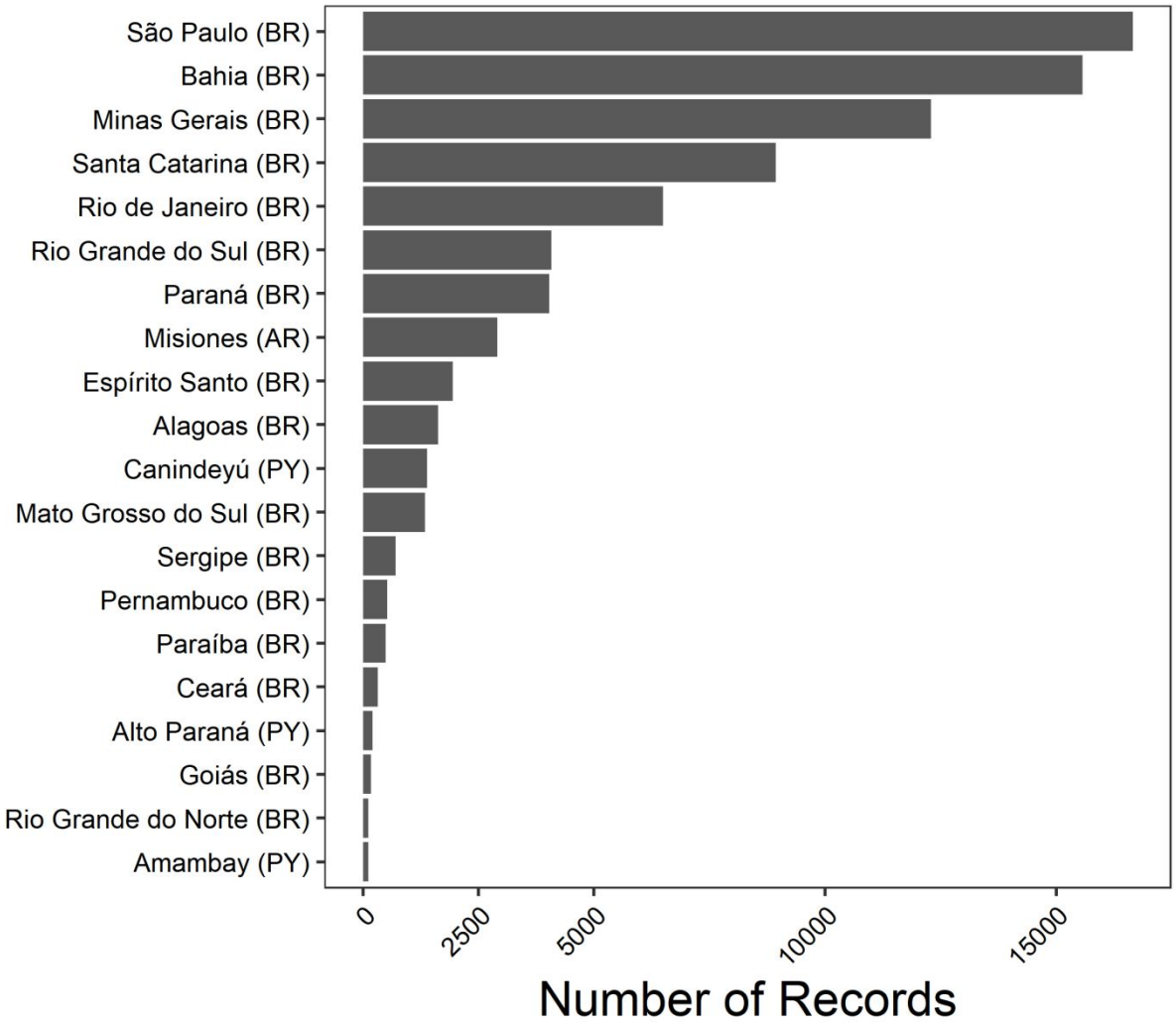
São Francisco de Paula (Brazil, n = 87), Mogi das Cruzes (Brazil, n = 65), Salesópolis (Brazil, n = 61), Una (Brazil, n = 59), Linhares (Brazil, n = 54), Conceição da Barra (Brazil, n = 51), Ubatuba (Brazil, n = 50), Vassouras, and Rio Claro (Brazil, n = 47) (**Fig. 11**).

The ant records gathered here were obtained in most forest types of the Atlantic Forest domain (Dense Ombrophilous, Mixed Ombrophilous forests, as well as Semi Deciduous forests, Altitude fields and Restinga, in addition to ecotones and areas in regeneration) in eastern Brazil, Paraguay and Argentina (Ribeiro et al. 2009, Morrone 2014). Our data set also includes records from urban fragments, agrosystems (e.g., cocoa plantations shaded by native and exotic tree species), plantations of *Eucalyptus* and *Pinus,* other transformed areas (such as pastures), and records in the Cerrado at boundaries of the Atlantic Forest (the Cerrado biome). Most of the sampling site records (n = 2,344) were in Secondary Forests (n = 429), Seasonal Semi-Deciduous Atlantic Forest (n = 271), Restinga (n = 245), 'Forests' (n = 193), Dense Ombrophilous Atlantic Forest (n = 152), Riparian Forest (n = 137), 'Atlantic Forest' (n = 129), Ecotone Forest and Lake (n = 111), Agrosystem (n = 69), and Forestry (n = 66) (**Fig. 12**). Note that the distribution of ant records regarding habitat types in the Atlantic Forest was determined by the authors of bibliographical references and other sources compiled here, and therefore do not follow a particular habitat classification for the Atlantic Forest ecoregions.

The annual mean temperature recorded per sampling site extended from 13.6 to 27.4 °C (mean = 20.83; SD = 2.5), but most were in the hottest climate range between 20 and 25 °C (n = 4,844; 62%) (**Fig. 13**). The annual precipitation ranged from 602 to 2,884 mm (mean = 1,487.0; SD = 323.5), while precipitation in sampling sites was mainly distributed between 1,100 and 2,100 mm (n =7009; 89%) (**Fig. 13**). The elevation per sampling site ranged from -1 to 2,609 meters (mean = 460.0; SD = 372.9). Most records of sampling sites in the Atlantic Forest were

579 concentrated between 0–1000 m (n = 7,133), representing 95% of data records (**Fig. 13**).

580 Therefore, sampling in Montane Atlantic Forest areas is largely incomplete.



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583 Fig. 9. Number of ant records per sampling sites and state/department/province in the

584 ATLANTIC ANTS data set (the top 20 most sampled first-order administrative division are

585 included). AR = Argentina; BR = Brazil; PY = Paraguay.

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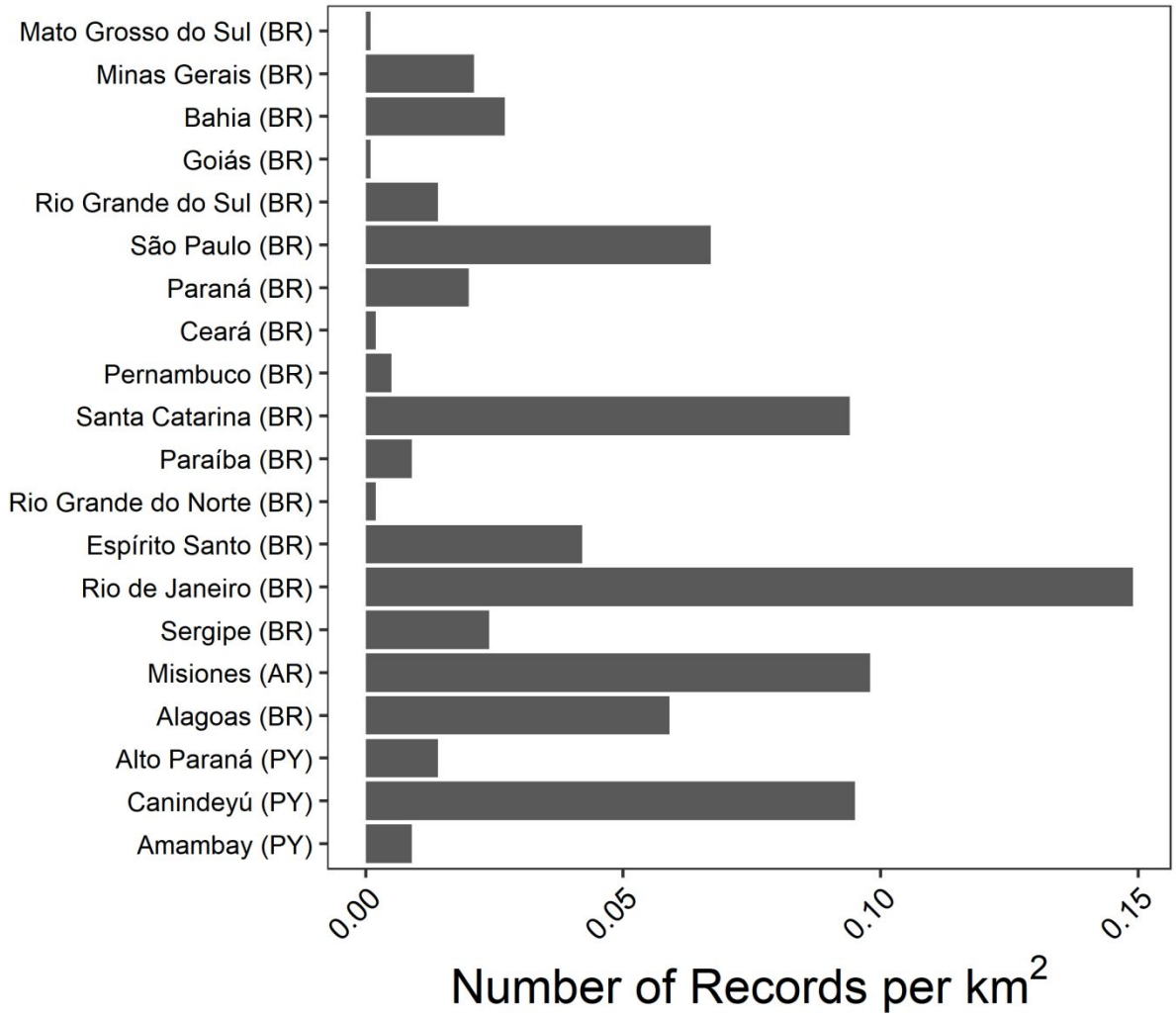


588
589

590 Fig. 10. Number of ant records per km^2 in sampling sites and state/department/province in the
591 ATLANTIC ANTS data set (the top 20 most sampled first-order administrative division are
592 included, ordered by area in km^2 from largest to smallest). AR = Argentina; BR = Brazil; PY =
593 Paraguay.

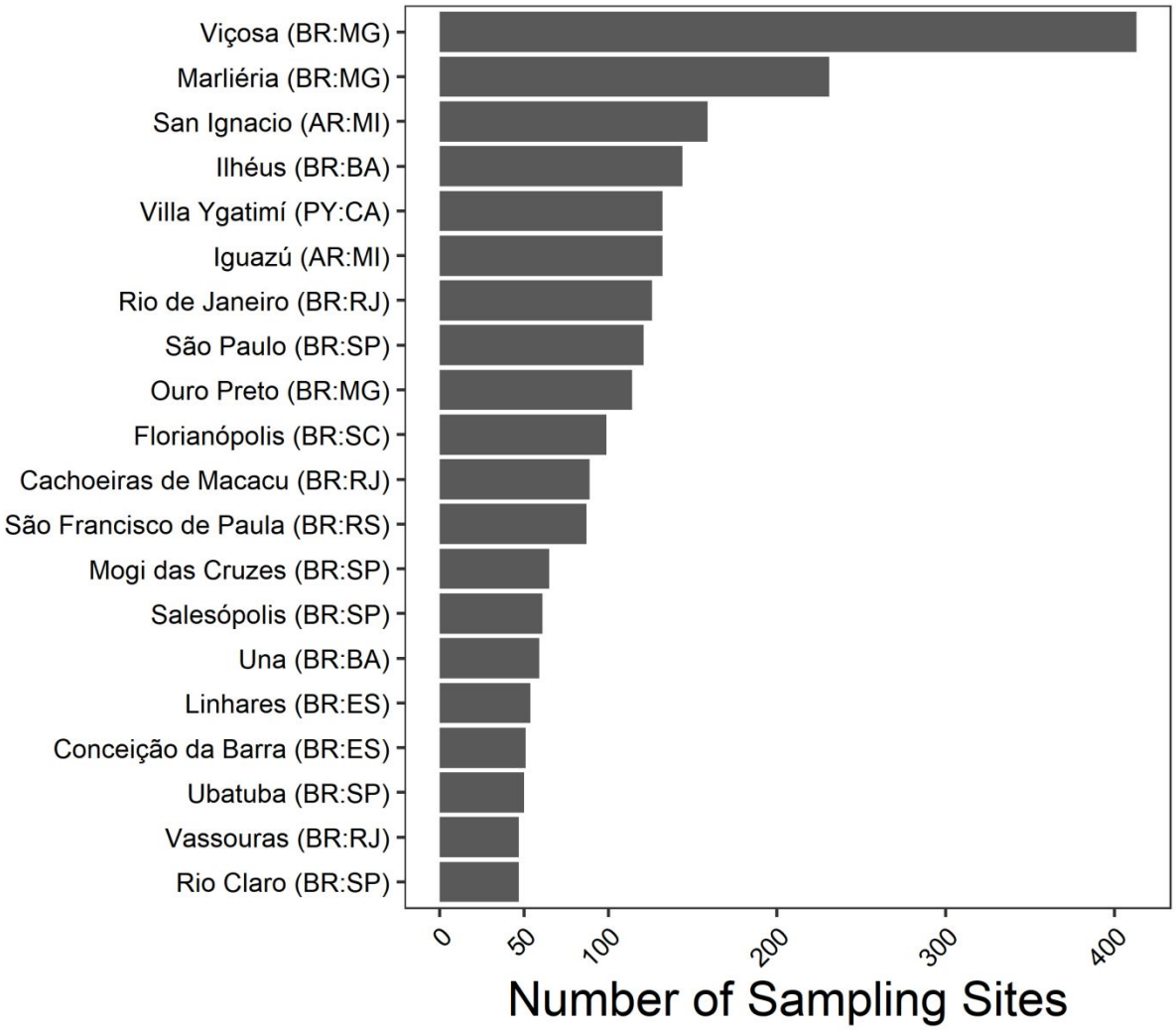
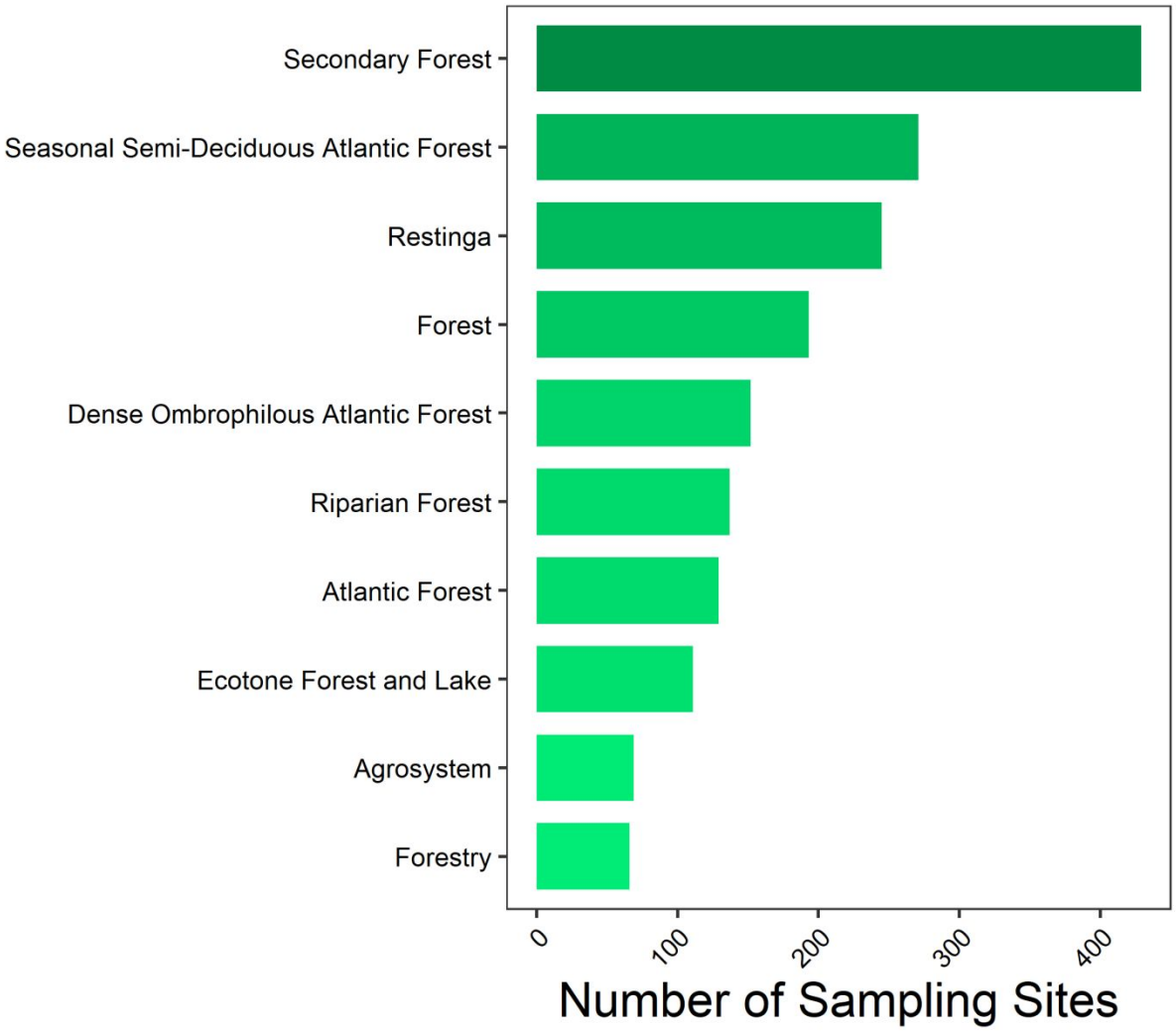


Fig. 11. Number of ant records per sampling site and municipality in the ATLANTIC ANTS data set (only the 20 most frequently sampled municipalities are included). AR = Argentina; BR = Brazil; PY = Paraguay.



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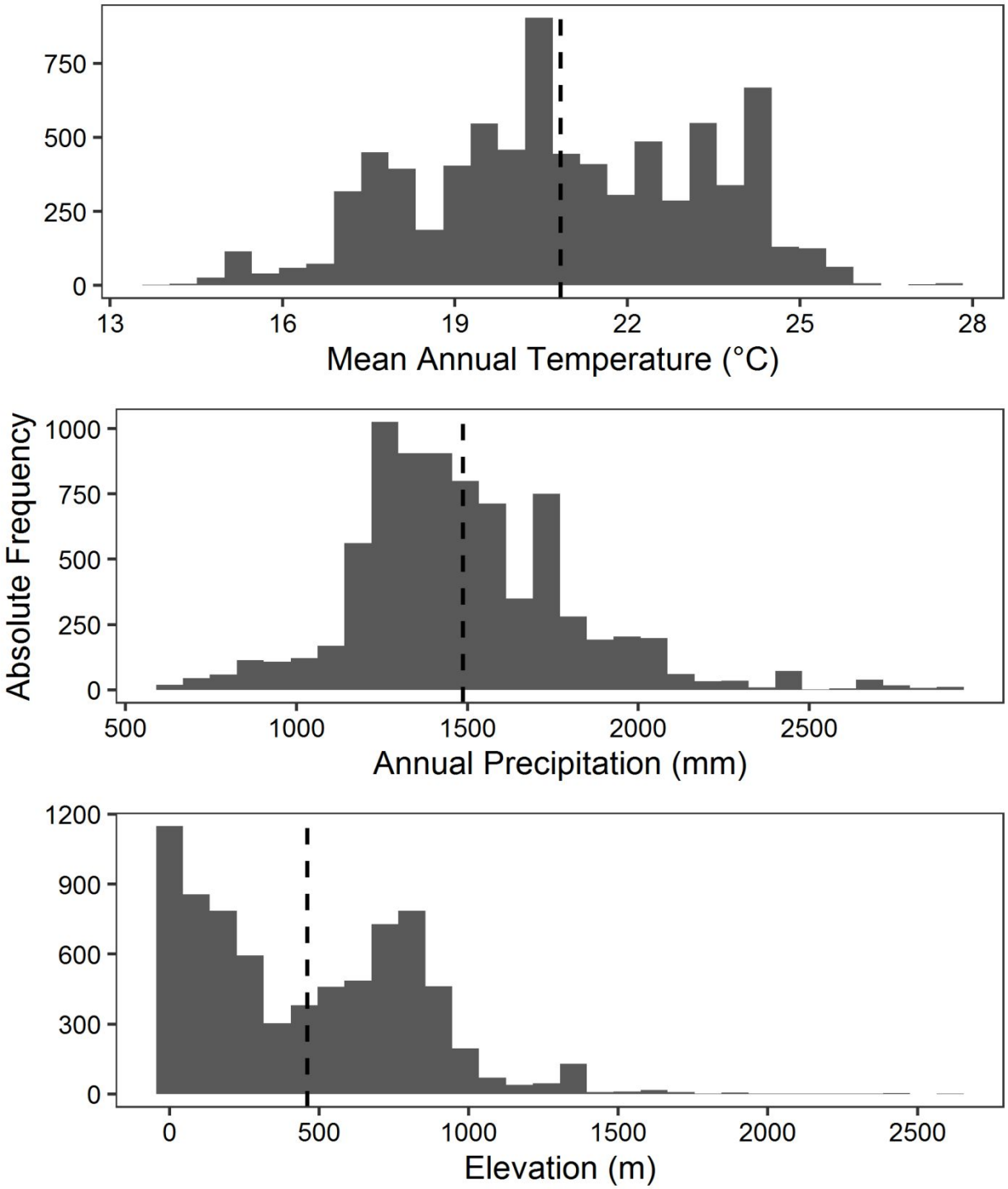
601

602 Fig. 12. Number of ant sampling sites records per habitat type in the ATLANTIC ANTS data set

603 (only the ten most frequently recorded habitat types are included).



604

605

606 Fig 13. Variations in the elevation, mean annual temperature, and mean annual precipitation (top

607 to bottom) of the ant sampling sites in the ATLANTIC ANTS data set. Dashed lines represent

608 the mean of the distribution of values.

609

610 **CLASS II - RESEARCH ORIGIN DESCRIPTORS**

611 **A. Overall project description**

612 **Identity:** A compilation of ant (Hymenoptera: Formicidae) records occurrence and assemblage
613 composition in the Atlantic Forest Domain of Brazil, Argentina, and Paraguay.
614 **Period of Study:** Dates of source publications and museum specimens range from 1803 to 2020.
615 **Objectives:** Our study has three main goals: (1) to make available unpublished and published
616 data of ant occurrences and assemblage composition, (2) to summarize information about the
617 distribution of ant species in the Atlantic Forest, and (3) to allow the identification of gaps in ant
618 studies in the Atlantic Forest to guide future sampling efforts. Our data set is the first attempt to
619 produce a synthesis of ant regional biodiversity in the Atlantic Forest, with potential applications
620 in macroecological studies, community ecology research, and establishment of conservation
621 strategies.

622

623 **Abstract:** Same as above.

624

625 **Sources of funding:**

626 The collection of the primary data and compilation of this dataset was supported by numerous
627 grants, fellowships, and scholarships by the following institutions:
628 **1)** Administrative Department of Science, Technology and Innovation "Colciencias" and the
629 Universidad del Magdalena in Colombia to RJG (agreement #008-2015);
630 **2)** Belgian National Fund for Scientific Research (F.R.S.-FNRS) to RA and ML;

3) CEMIG - Companhia Energética de Minas Gerais S.A. Postdoctoral Fellowship (P&D 611 - Descomissionamento da PCH Pandeiros: uma experiência inédita na América do Sul) to ACMQ; **3)** Consejo Nacional de Ciencia y Tecnología - CONACYT (Mexico), which provided support to RA (CONACYT scholarship, CVU 771787); **4)** Empresa Brasileira de Pesquisas Agropecuárias (Embrapa) (Project:02.11.01.031.00.00) to MFOM; **5)** Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (FAPESC) (Process No. 6.309/2011-6/FAPESC) to MFOM; **6)** Consejo de Investigaciones de la Universidad Nacional de Tucumán to DL, AG y FC; **7)** Consejo Nacional de Investigaciones Científicas y Técnicas - Argentina (CONICET) to AFS-R, DL, FC, AG, LAC, LC, and LE; **8)** Conselho Nacional de Desenvolvimento Científico e Tecnológico - Brazil (CNPq) to BKCF (No. 159106/2018-4), CAB (No. 190306/2013-0), EB (No. 504655/2013-2), EVS (No. 372188/2017-6), FRMG (No. 308760/2015-8), GPC (No. 140338/2014-4), IOF (PhD scholarship), IRL (No. 471904/2004-0, 304346/2007-1), JDM, JHCD (No. 3055033/2005-7, 428819/2018-4, 304629/2018-9), NBES (No. 141439/2011-4), NL (No. 131363/2017-4), NVHS (No. 130856/2016-9), OGMS (No. 142012/2018-1, 300131/2018-6), PSO (No. 306115/2013-1, 302219/2017-0), REV (No. 313839/2019-0), RMF (No. 301495/2019-0, 302462/2016-3), TJ (No. 128319/2017-8), VML (No. 142299/2020-0), WF (No. 141234/2018-0), WFAJ (No. 307998/2014-2), RRCS (No. 306739/2019-0), AVC (No. 478938/2011-0), AVLF (No. 303834/2015-3), ACF (No. 140260/2016-1), GML (No. 155895/2014-1) AMO (No. 132561/2018-2), MFOM (No. 140260/2016), FBR (No. 290075/2014-9); PROTAX program to ADS, CRFB, KSR, MAU and TOA (No. 440574/2015-3); PCI/MPEG-CNPq/MCTI to FVA

(No. 302198/2020-2), LPP (No. 313168/2016-4), and REV (No. 301081/2017-4). Further, AVC, LEM-R, JCMC, RA, BMT, DLA, DOS, and SMP were supported by CNPq scholarships;

9) Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) finance codes 001 to ACR (PPM No. 00243/14), AAO, BC, BL, LPP, CAB, ELSS (No. 88887.466580/2019-00), EAS, ELHG, FAE (CAPES-PDEE, BEX: 5340/09-8; CAPES-DS Entomology-FFCLRP/USP: 33002029018P1), FN, FSC, HSO, IOF (PhD scholarship, and postdoctoral fellowship CAPES/PNPD 88887.372176/2019-00), JAS, LNP, MUVR, PHSAC, RS, and RSJ; grants to FSN, GML (process 88881.133074/2016-01), HCO (project 88887.136354/2017-00), IRL (No. 2009-09-9 and PROBRAL CAPES-DAAD No. 257/07), JMQ (No. 23038.001221/2014-87), NBES (No. 7080/2014-0), RS, and TSRS (40001016005P5), RD (No. 88887.351866/2019-00);

10) Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo (FFCLRP-USP CAPES/PROAP: 56/07-3) to FAE;

11) Fundação de Amparo à Pesquisa do Estado da Bahia-FAPESB to VMO; RJS (INOMEP-UFBA/FAPESB); CSFM, FSN, IOF, ICN, JHCD, KSC, RRS, RS, TPLP, WDDR, WFAJ (APP0049/2009, PNX0016/2009); AA, BC, CSFM, EBAK, EASN, ESA, JHCD, PSS, RJS (APP0090/2016).

12) Fundação de Amparo à Pesquisa do Estado de Mato Grosso to REV (No. 0602346/2017);

13) Fundação de Amparo à Pesquisa do Estado de Minas Gerais - Brazil (FAPEMIG) to ACR, FN, FSC, HB, IJMTG; LEM-R, RA; HFP-N, BP-S, BBM, ESA-O, LJC-L, and LAMR;

14) Fundação de Amparo à Pesquisa do Estado de São Paulo - Brazil (FAPESP) to ADS (No. 2016/50378-8, 2017/07366-1), ATO (No. 2016/50378-8, 2017/07366-1), CRFB (No. 98/05083-0, 03/11170-2, 2010/16063-3, 2016/50378-8, 2017/07366-1), DCR (No. 12/24118-8,

2014/50280-2, 13/50718-5), FBN (No. 04/04820-3), HCO (No. 17/07366-1), KSR (No. 2016/50378-8, 2017/07366-1), MAP (No. 95/02409-3), MAU (No. 2012/21309-7, 2015/06485-1, 2018/11453-0), MSCM (No. 2010/50973-7, 2010/50294-2, 2012/50197-2, 2013/16861-5, 2015/051268), PSO (No. 2014/23141-1, 2017/16645-1), RSP (No. 2010/17051-9), VRT (No. 2018/20691-1). Further AVLF acknowledges FAPESP for the financial support (No. 2011/50225-3);

15) Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro - Brazil (FAPERJ) to JMQ (No. 101.472/2010);

16) Fundação de Apoio à Pesquisa e à Inovação Tecnológica do Estado do Sergipe - Brazil (FAPITEC/SE/FUNTEC) to RPSA (No. 13/2012-NAPs);

17) Fundação de Apoio ao Desenvolvimento do Ensino, Ciência e Tecnologia do Estado de Mato Grosso do Sul- FUNDECT- Chamada FUNDECT/SECTEI N° 29/2016 - Museus de Coleções Científicas Biológicas - to RS.

18) National Science Foundation - United States (NSF) to EZA (grant number DEB1654829), AVLF, and PSW;

19) Peter Buck Postdoctoral Fellowship Program at Smithsonian Institution - United States to EZA;

20) Universidade Estadual de Minas Gerais – UEMG Pró-Reitorias de Pesquisa e Extensão da UEMG to HFP-N, BP-S, BBM, ESA-O, LJC-L, and LAMR;

21) United States Agency for International Development – USAID (PEER grant AID-OAA-A-11-00012) to AVLF.

In addition, CMOS was supported by División de Investigación de Bogotá (DIB), Facultad de Ciencias, Universidad Nacional de Colombia and the Colciencias program

"Proyectos de Investigación Científica y Tecnológica" of 2010 (110152128319 CT 413–2011), Ernst Mayr Grant in 2011 (MCZ Harvard University), Colciencias program "Jóvenes Investigadores e Innovadores—Virginia Gutiérrez de Pineda" 2010– 2011, the Smithsonian National Museum of Natural History grant for Colombians installed by Dr. Cristian Samper and ANR-JCJC-EVOLINK of the French Agence Nationale de la Recherche. EPE was supported by subsidy funding to the Okinawa Institute of Science and Technology and a JSPS Kakenhi Grant-in-Aid (No. 17K15180). MCR thanks to FAPESP (No. 2013/50421-2, 2020/01779-5), CNPq (No. 312045/2013-1, 312292/2016-3, 442147/2020-1) and PROCAD/CAPES (No. 88881.068425/2014-01) for their financial support.

B. Specific Subproject description

Site Description: The Atlantic Forest was once one of the largest rainforests in the world. It encompasses tropical and subtropical evergreen and semi deciduous forests lying along the eastern coast of Brazil and small portions of northeastern Argentina and southeastern Paraguay (Morellato and Haddad 2000). As an important biodiversity hotspot in South America (Willis et al. 2007, Culot et al. 2019), the Atlantic Forest biome supports up to 8% of all species in the world and has one of the highest rates of endemism (Myers et al. 2000). The Atlantic Forest is known to harbor at least 15,519 plant (Zappi et al. 2015), 350 fish (MMA 2009), 543 amphibian (Haddad et al. 2013), 200 reptile (Bérnils and Costa 2015), 891 bird (Moreira-Lima 2014), and 321 mammal (Graipel et al. 2017) species. Nineteen primate species (almost three-fourths of this fauna) are endemic to this forest (Graipel et al. 2017).

Currently, the Atlantic Forest covers less than 28% of its original area (Rezende et al. 2018), and more than 80% of these remnants consist of small fragments (< 50ha) (Ribeiro et al.

723 2009). Seventy-two percent of the human population of Brazil (~145 million people) lives within
724 the Atlantic Forest domain (IBGE 2013). Industrialization plus agricultural and unplanned urban
725 expansion are the main causes of landscape fragmentation and ecosystem disturbance (Scarano
726 and Ceotto 2015). The negative effects of anthropogenic impacts have removed large mammals
727 from 80% of Atlantic Forest fragments (Galetti et al. 2009, Jorge et al. 2013). The immediate
728 conservation of the Atlantic Forest is critically urgent to stop ongoing local extinctions of
729 organisms, including the dominant animal group of animals in all terrestrial ecosystems,
730 invertebrates (Hallmann et al. 2017).
731 **Data Compilation:** We created a collaborative network of researchers who had published and
732 unpublished data on ant occurrences and assemblages in the Atlantic Forest and invited everyone
733 to contribute to the ATLANTIC ANTS data paper by including their material in our data set.
734 After two rounds of data compilation, we performed a systematic review of published literature
735 on ant diversity in the Atlantic Forest. We did an extensive literature search on Google Scholar
736 (https://scholar.google.com.br/), Web of Science (http://scientific.thomson.com/isi/), and
737 SciELO the Scientific Electronic Library Online (www.scielo.org/) to find published documents
738 that report ant occurrence and assemblages composition in Atlantic Forest using the following
739 combination of keywords in English: “Atlantic Forest + ants” and “Atlantic Forest +
740 Formicidae” and their equivalent in Portuguese and Spanish. We did not restrict the search to
741 checklist papers such as papers related to species geographic distribution, distribution summaries
742 or list of species. Similarly, we did not limit our search to specific years of publication or
743 methods. In collaboration with the Global Ant Biodiversity Informatics (GABI) Project (Guénard
744 et al. 2017), we obtained ant occurrence data in the Atlantic Forest (46,430 ant records) compiled
745 from a thousand papers, including literature in regional journals not published in English. In

total, our data set represents ant records compiled from 1,059 papers (106,910 records) and 13 book chapters (677 records) published between 1886 and 2020. Further, it includes 12,865 records compiled from 57 documents gleaned from other sources such as dissertations, theses, monographs, and congress abstracts, plus 18,713 records from collections databases (the oldest record dates back to 1803). Finally, we were able to gather 29,651 records from unpublished data.

We collected occurrence data from the following museums and institutions: Museu de Zoologia da Universidade de São Paulo (MZSP), São Paulo, Brazil; Museu Paraense Emílio Goeldi (MPEG), Belém, Pará, Brazil; Instituto Nacional de Pesquisa da Amazônia (INPA), Manaus, Amazonas, Brazil; Centro de Pesquisas do Cacau (CPDC), Ilhéus, Bahia, Brazil; Universidade Federal de Viçosa (UFV), Viçosa, Minas Gerais, Brazil; Universidade Federal de Santa Catarina (UFSC), Florianópolis, Santa Catarina, Brazil; Coleção Entomológica Padre Jesus Santiago Moure (DZUP), Universidade Federal do Paraná, Curitiba, Paraná, Brazil; Coleção de Hymenoptera do Museu de Biodiversidade da Universidade Federal da Grande Dourados (HYMB-UFGD), Dourados, Mato Grosso do Sul, Brazil, and records from online specimen repositories such as AntWeb.org as implemented by the California Academy of Sciences, San Francisco, California, United States.

3. Research Methods: In this data set, we included geographic location (coordinates) for all ant records obtained from published and unpublished literature. We converted the coordinates of all records to decimal degrees with datum WGS 84 (if coordinates were in other formats). Some coordinates refer to specific localities such as municipalities, roads, or farms, and not to the sampling areas. When coordinates were not available, we georeferenced the records using

769 Google Maps (www.google.com.br/maps/). Such records were mainly to historical occurrences.
770 For these, we recorded in the "PRECISION" column an estimate of the largest distance between
771 the approximate center of the location and the limit of the municipality area (or other
772 administrative divisions of areas). We recorded those cases as "gloc_aants" or "gloc_gabi" in the
773 "SOURCE LAT_LON" column to indicate coordinates that were estimated by the ATLANTIC
774 ANTS or GABI project (Guénard et al. 2017), respectively.

775 We defined the boundaries of the Atlantic Forest using the same procedure as Muylaert et
776 al. (2018) and Hasui et al. (2018), described as follows. We merged available geographic
777 information from the main boundaries that inform the extent of the Atlantic Forest: the official
778 boundary used by Brazilian government (IBGE 2016), the Atlantic Forest Law Initiative
779 Boundary (MMA 2006), the boundary used to extract the remaining Atlantic Forest (Ribeiro et
780 al. 2009), and the boundary provided by Olson et al. (2001) that was also used by the WWF and
781 that is available online (https://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-
782 world). We made a subset of the Atlantic Forest and Atlantic Dry Forest categories inside and
783 outside Brazil from the terrestrial ecosystem shapefile (Olson et al. 2001). We considered
784 records in the Atlantic Forest when they were within a 20 km buffer around the Atlantic Forest
785 boundaries. We did not exclude the records from other biomes sent by collaborators.

786 We extracted spatial and geographical information from the various data sets using the
787 "raster" package (Hijmans 2020) and "spatialEco" package (Evans 2020) for R version 4.0.0 (R
788 Core Team 2020). We determined the elevation, mean annual temperature, and mean annual
789 precipitation for all records inside the Atlantic Forest. We obtained the environmental data using
790 the *getData* function from the raster R package (Hijmans 2020), which retrieved raster files
791 corresponding to temperature and precipitation data from the WorldClim database

(http://www.worldclim.org) with a spatial resolution of 30 seconds (~ 1 km^2) and elevation data from the CGIAR-SRTM Digital Elevation database with a spatial resolution of 90 m (https://cgiarcsi.community/data/srtm-90m-digital-elevation-database-v4-1/). We then used the extract function from the raster R package (Hijmans 2020) to overlap the geographic coordinates with the climate and elevation layers.

We organized the entire data set in a single database, combining assemblage information and occurrence information. Accumulated records refer to ants collected via several sampling methods (e.g., Winkler, pitfall, bait) or a combination of them. The quantitative information associated with those records contains all quantitative assemblage data, such as number of occurrences or number of individuals. Occurrence information contains all individual and occasional records of ant species without quantitative information and total abundance in each locality (i.e., sampling effort). This occurrence information was also based on several sampling methods, obtained mainly by hand collected material associated with historical records from the ant taxonomic literature, as well as from material held in museums or contributed data sets from ant taxonomists. When several records were available for the same study site (but from different years and/or different authors), we kept them all in the data sets. In addition, these records sometimes come from different locations within the same study site, hence allowing comparisons of ant occurrences and/or ant assemblages. Missing information was labeled as "NA" in the ATLANTIC ANTS data set.

The literature used to compile the ant records (1,284 references in alphabetical order) can be consulted in a supplementary metadata file (Appendix S1).

Taxonomic data: We followed the taxonomy from AntCat.org, An Online Catalog of the Ants

of the World (Bolton 2021) and updated the names of some species to reflect the most recent nomenclature. However, the name as originally published was kept, allowing the taxonomic history to be recovered.

Validation: Specialists checked the localities recorded for each ant species and excluded the points if that species record was dubious. In this case, we indicated in the "Exclude" column if the record could be erroneous. We maintained taxonomic uncertainties, as well as the morphospecies codes adopted for each author, but standardized spelling (for example, *Pheidole* sp2 as *Pheidole* sp02). However, morphospecies codes from different source citations (as indicated by each contributor dataset) do not represent comparable biological entities and user must not assume such hypotheses. For example, *Solenopsis* sp.01, the commonest morphospecies in the AANTS, is not the same species in all the different surveys (i.e., source citations). The "Morpho_AANTS_code" field assign a unique code to each morphospecies in the AANTS dataset. The user should, however, take this as an approximation when using morphospecies in comparative analyses.

The taxonomic accuracy of each ant record was checked by specialists according to their expertise, which covered most of the taxa listed in our dataset. Each record was screened considering the known occurrence for the ant in Brazil. At the end of verification, non-credible occurrences (i.e., taxa that were not previously reported to Brazil or those for which the presence in the Atlantic Forest was considered improbable by the taxonomist expert) were invalidated. In addition, each entry in the list is backed by at least one taxonomic published reference. The taxonomic validation of records was conducted by an experienced group of ant systematists composed by Rodrigo M. Feitosa, Alexandre Casadei-Ferreira, Emília Zoppas de Albuquerque,

838 Júlio Chaul, Lívia Pires do Prado, Mônica A. Ulysséa, Otávio Guilherme Silva, Thiago da Silva,
839 and Weslly Franco.
840
841 **C. Data Limitations and Potential Enhancements**
842 Although ants are among the best studied invertebrate taxa, assessing the fine-scale
843 distribution of each species in the Atlantic Forest remains challenging. We recognize the massive
844 effort of field myrmecologists who collected the data compiled here, which represents the largest
845 data set of ant occurrences in a tropical forest biome so far organized. Our data set is a
846 heterogenous mixture of point observations (specimens hand collected by the earliest generations
847 of myrmecologists), surveys studies using systematic sampling schemes, and regional checklists,
848 all varying in area and sampling methods.
849 One limitation of this dataset is the relatively small number of records coming from
850 museum collections (18,651 or 12%) in comparison to the number of occurrences from the
851 literature. Another issue is the high number of morphospecies adopted in ecological studies,
852 representing 40% of the Atlantic Forest data set (i.e., regarding only those records inside the
853 Atlantic Forest). Indeed, one of the main impediments for comparative studies on assemblage
854 structure is the presence of morphospecies in ant surveys, although some efforts have been made
855 to build a global database of ant species abundance (Gibb et al. 2017). The efforts required to
856 compile functional trait data pose a major challenge in ant community ecology (Parr et al. 2017,
857 Lessard 2019), and establishing functional trait databases for ants in the Atlantic Forest that
858 include morphospecies will be an important step enabling large scale analyses of ants in the
859 Atlantic Forest data set.
860 The uneven distribution of the sampling effort across the Atlantic Forest constitutes

another drawback. For instance, just three Brazilian states account for 66% of the records: Bahia (N=42,965, 28%), São Paulo (N=29,721, 19%), and Minas Gerais (N=28,653, 19%). It is important to note that our data set gathers presence-only data and not presence-absence data, which should be considered by users when analyzing the data.

Another important limitation is the low geographic accuracy reported by some studies. For instance, some coordinates refer to neighboring instead of the sampled sites. We tried to correct these coordinates using satellite images or directly contacted the authors. Otherwise, we provided a precision measure for these records as one attribute in the dataset. However, 49,359 records or 32% of the Atlantic Forest database had georeferenced coordinates, and users should be aware of this when analyzing the data. Finally, the Atlantic Ants data set has some redundancy in data information (not currently quantified) that occurred when data about the same specimens or assemblages was shared by different sources; such data overlaps need to be investigated prior to analyses.

Habitat loss and fragmentation, degradation of remaining forest areas, biological invasions, climate change, and other anthropogenic disturbances influence the presence and abundance of insects (Thomas et al. 2004, Shortall et al. 2009, Potts et al. 2010, Ollerton et al. 2014, Hochkirch 2016, Thomas 2016). One recent synthesis about ant community responses to human disturbance claims that habitat openness is a key driver of variation in ant communities, and that evolutionary and biogeographic history mediates the effect of habitat openness (Andersen 2019). We did not have information about ant population persistence in Atlantic Forest fragments, although global declines in insect diversity and abundance have been increasingly documented within temperate regions (Shortall et al. 2009, Hallmann et al. 2017, Cardoso et al. 2020, Didham et al. 2020, Wagner 2020), with its extent remaining more uncertain

within tropical regions. Therefore, attention must be paid to the dates of ant records, which range from 1803 to 2020.

Despite these limitations, this data set is the largest and broadest that exists on the distribution of ants in the Atlantic Forest (Silva and Brandão 2014). We expect that the users of this data set will be able to: (i) detect patterns of species distributions; (ii) suggest priority areas for biodiversity conservation; (iii) point out temporal and spatial variation of ants; (iv) identify the species in greatest need of further studies; (v) indicate localities or regions requiring more sampling, and (vi) fulfill many other conservation-related knowledge gaps.

CLASS III - DATA SET STATUS AND ACCESSIBILITY

A. Status

Latest update: December 2020

Latest Archive date: December 2021

Metadata Status: Latest update May 2021, version submitted

Data verification: Data from published and unpublished sources. We searched for extreme values, corrected any transcription errors, and homogenized text and the taxonomic information. Special characters were removed from the data set.

B. Accessibility

1. Storage location and medium

The data set can be accessed on the ECOLOGY repository in .txt format as well as the GitHub Inc. repository (https://github.com/LEEClab/Atlantic_series). Regular updates are planned in the future to include new occurrence records from literature, collections, and data from new field

908 expeditions planned to cover sampling gaps.

909

910 **11. Contact persons**

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919 **Copyright restrictions:** None

920 **Proprietary restrictions:** Please cite this data paper when the data is used in publications. We
921 also request that researchers and teachers let us know how they are using the data.

922 **Costs:** None

923

924 **CLASS IV - DATA STRUCTURAL DESCRIPTORS**

925 **A. Data set File**

926 **Identity:**

927 ATLANTIC_ANTS_dataset.txt

928 **Size:** 178,976 records, 114.530 KB

929 **Format and storage mode:** tab-separated values (.txt)

930 **Header Information:** See column descriptions in section B.

Alphanumeric attributes: Mixed.

Data anomalies: If no information is available for a given record, this is indicated as 'NA'.

Data reading suggestion in R: read.csv ("atlantic_ants_dataset.txt", header = TRUE, stringsAsFactors = FALSE, na.strings = c("","NA"), fileEncoding = "UTF-8", sep = "\t", dec=".")

B. Variable Information

Table 2. Description of the fields related to the data set linked to the file ATLANTIC_ANTS_dataset.txt.

Field	Description	Levels	Example
AANTS.code	Identification code of each collection record. Each code is exclusive and represents the record of the Atlantic Ants dataset	178,976	AANTS_000024
Record.id	Identification code in Atlantic Ants datasets provided by each contributor	91,289	AW0442
Municipality	Municipality of the sampling site as described in the reference source, and	2,027	Marlieria

	not extracted from the coordinates		
State	State or Department of the sampling site	97	Minas Gerais
Country	Country of the sampling site	17	Brazil
ID.codLoc	Name or code of the sampling area provided by the reference paper	12,679	TT2C
Latitude.y	Latitude corrected and transformed into decimal degrees (datum WGS84)	-80.32200 to 47.50012	-19.68972
Longitude.x	Longitude corrected and transformed into decimal degrees (datum WGS84)	-120.50150 to 57.63539	-42.55306
LatLon.source	Describes the origin of coordinates. “aants” refers to coordinates determined by Source.Citation; “antweb” refers to coordinates from the AntWeb;	aants antweb gloc_aants gloc_gabi	aants

	"gloc_aants" refers to coordinates georeferenced by the the Atlantic Ants Database; "gloc_gabi" refers to coordinates georeferenced by the Global Ant Biodiversity Informatics project		
Precision.meters	Coordinate precision of the sampling site. Precise: if the coordinate reported is from the exactly sampling area; Otherwise: precision in meters for the coordinates	520	precise
Regional.name	Regional name of the sampled area	3,052	Parque Estadual do Rio Doce
Subfamily	Subfamily name of Formicidae	13	Dorylinae
Genus	Valid genus name	127	Leptanilloides

Subgenus	Subgenus name	19	Diplorhoptrum
Species	Valid scientific species name at the time of releasing the database or morphospecies code	1,978	atlantica
Group	Group of species	83	gr. globularia
Qualifier	Qualifier appended to species name to indicate the degree of uncertainty associated with species identification	1	nr.
Morphospecies	Information on whether species record is or not a morphospecies. 0 = not a morphospecies; 1 = yes, a morphospecies	0 - 1	0
Morpho.AANTS.code	AANTS identification code of each morphospecies collection record. Each code identifies unique morphospecies as assigned by Source.Citation and	26,942	MORPHO_AANTS_000001

	fl.nm fields		
Measurement.Type	Whether the ant records were based on occurrence or abundance	abundance occurrence	occurrence
Start.day	Day of data collection started	01 - 31	30
Start.month	Month of data collection started	01 - 12	10
Start.year	Year of data collection started	1803 to 2019	1998
End.day	Day of data collection ended	01 - 31	30
End.month	Month of data collection ended	01 - 12	10
End.year	Year of data collection ended	1836 to 2019	1998
Total.Transects.Plots	Total number of sampled transects or plots	01 to 750	1
Length.m	Length in meters of transects or plots	1 to 5,000	2500
Width.m	Width in meters of transects or plots	0.5 to 1000	1

Plot.Transect.Separation.m	Distance in meters between transects or plots sampled	2 to 23,000	50
Method	Sampling method(s) described in the source reference	81	Winkler
Method.Description	Detailed sampling methods in the source reference	597	Fall traps installed in the soil
Pitfall.Number	Number of pitfall samples	1 to 1,309	20
Pitfall.Spacing.m	Distance measured in meters between adjacent pitfall samples	1 to 50	10
Pitfall.Duration.h	Sampling effort measured in hours to the pitfall samples	12 to 1,608	48
Baits.Number	Number of bait samples	2 to 1,395	20
Baits.Spacing.m	Distance measured in meters between adjacent bait samples	2 to 50	10
Baits.Duration.h	Sampling effort measured in hours to the bait samples	1 to 3,720	60
Winkler.Number	Number of Winkler samples	1 to 360	50

Winkler.Spacing.m	Distance measured in meters between adjacent Winkler samples	5 to 50	50
Berlese.Number	Number of Berlese samples	6 to 94	50
Berlese.Spacing.m	Distance measured in meters between adjacent Berlese samples	5 to 50	50
Total.Ant.Abundance	Total ant species abundance for sample site, combining sampling methods and data collection events	0.016 to 8,412	1
Habitat.Type	Dominant vegetation for sampled site	142	Dense Ombrophylous Atlantic Forest
Disturbance	“Undisturbed” refers to undisturbed site; “Disturbed” refers to disturbed site; “Transformed” refers to site with cleared vegetation by agriculture, forestry, etc; “Disturbed_and_Transform	5	Undisturbed

	ed" refers to records in both disturbed and transformed sites; "Undisturbed_and_Disturbed" refers to records in both undisturbed and disturbed sites		
Disturbance.Category.1	Dominant disturbance category	41	Restoration
Disturbance.Category.2	If there is > 1 disturbance type	31	Grazing
Habitat.Description	Any additional information regarding the habitat	762	Mosaic of arboreal/arbustive restinga near sand dunes, sample points only in arboreal patches along a trail
Source.Data	Type of data: "Database collection" refers to records from databases in ant collections;	5	Database Collection

	"GABI" refers to records from the Global Ant Biodiversity Informatics project; "Museum Specimen" refers to records obtained from Museum specimens; "Published Manuscript" refers to records extracted from published sources (articles, book chapters, undergraduate dissertations, M.S. theses, Ph.D. dissertations, and Congress abstracts). Unpublished data refers to information shared by Atlantic Ants contributors and not published		

Source.Citation	Study reference in *Ecology* style (without special characters), or museum acronyms or database collection code for specimens	9,607 references	Kempf, W. W. 1972. Catalogo abreviado das formigas da regiao Neotropical. Studia Entomologica 15:3-344.
Source.Citation.Classified	Published sources from Source.Citation as classified in: “book_chapter” “database_collection” “literature” “M.S._thesis” “Ph.D._dissertation” “symposium”	7	Literature

	"undergraduate_dissertation"		
OBS	Any extra information regarding ant records	3,132	LatLon is that of CEPLAC, Ilheus.
fl.nm	File name for Atlantic Ants datasets from contributors	113	ATLANTIC_ANTS_LITERATURE_TEAM_PUBLISHED_DATA_validchar.txt
Species.as.published	Species name as published in source references	10,895	Strumigenys_denticulata
Exclude	Taxonomic validation of species occurrence in Atlantic Forest. 0 = species occur in the Atlantic Forest; 1 = species does not occur in the Atlantic Forest	0 - 1	0
Exotic	Refer to exotic species records in the Atlantic Forest. Yes = exotic species; No = native species	Yes No	No
ma.lmt	Refer to species records inside the extended limit of	0 - 1	1

	the Atlantic Forest. 0 = coordinate not in the limit of the Atlantic Forest; 1 = coordinate inside the limit of the Atlantic Forest		

941

942 **CLASS V. SUPPLEMENTAL DESCRIPTORS**

943 **A. Data acquisition**

944 **1. Data request history:** None

945 **2. Data set updates history:** None

946 **3. Data entry/verification procedures**

947 **B. History of data set usage**

948

949 **ACKNOWLEDGMENTS**

950 This paper is part of the ATLANTIC Series initiative. We thank the ATLANTIC ANTS team for
951 all support to make this work possible. (1) BL acknowledges Jacques Delabie for ant
952 identification, (2) BP-S the Pró-Reitoria de Pesquisa da UEMG and FAPEMIG by the PIBIC-
953 FAPEMIG-UEMG scholarships; (3) ESA-O the Pró-Reitorias de Pesquisa e de Extensão da
954 UEMG by the scholarship PIBIC-PAPq-UEMG and PAEx-UEMG; (4) FSN thanks CNPq,
955 FAPEMIG, ICMBio/Serra do Cipó National Park, GSG and Vellozia Reserve for their logistic
956 support; (5) HFP-N the Pró-Reitorias de Pesquisa e Extensão da UEMG and FAPEMIG by
957 scholarships for undergraduate students; (6) LAMR the Pró-Reitorias de Pesquisa da UEMG by
958 the scholarship PIBIC-FAPEMIG-UEMG; (7) LJC-L acknowledges ESA-O; (8) MAP

959 acknowledges I. R. Leal and C. R. F. Brandão for ant identification, the Scientific Initiation
960 Grant Program (BIC/UEG) and the Research and Scientific Production Incentive Grant Program
961 (BIP/UEG); (9) MAU the Seleção Natural – Inovação em Projetos Ambientais; (10) LPP and
962 MAU are also grateful to the Seleção Natural - Inovação em Projetos Ambientais; PHSAC and
963 AVC thank the Fundação Florestal de São Paulo and the staff of CBSP for the research license
964 and logistic support; (11) RJG thanks the Administrative Department of Science, Technology
965 and Innovation "Colciencias" and the Universidad del Magdalena for financial support; (12) CB
966 thanks to Concer - Companhia de Concessão Rodoviária Juiz de Fora/Rio de Janeiro (LO No.
967 1187/2013 e ABIO No. 514/2014); (13) This work is a contribution to the CPER research project
968 CLIMIBIO and CMOS thank the French Ministère de l'Enseignement Supérieur et de la
969 Recherche, the Hauts de France Region and the European Funds for Regional Economic
970 Development for their financial support; (14) FRMG thanks the Conselho Nacional de
971 Desenvolvimento Científico e Tecnológico (CNPq) Research Productivity Grant; (15) RS thanks
972 the ICMBio - Serra da Bodoquena National Park for logistical support; (16) ACMQ thanks the
973 Instituto Estadual de Florestas de Minas Gerais (IEF-MG) and Universidade Federal de Lavras
974 (UFLA) for logistical support; (17) FAE is grateful to: Prof. Carlos Alberto Garofalo, Renata
975 Andrade Cavallari, and the graduate program in Entomology, FFCLRP-USP; Museum of
976 Zoology of the University of São Paulo; Forestry Institute of São Paulo; Parque Estadual da
977 Serra do Mar, Picinguaba, and Parque Estadual Carlos Botelho, Sete Barras, São Paulo; (18)
978 CLK and CG thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil
979 (CAPES) for scholarships (financial codes 001 and 88887.161587/2017-00, respectively); (19)
980 VMO and MSM thank the Programa Arboretum de Conservação e Restauração da Diversidade
981 Florestal for logistical support; (20) CIP, PEH, AA and AFSR thank to Maria Paula Bertolini,

Raúl Flores and Alejandro Rodriguez of Temaikén Foundation for their logistic support; (21) RRCS is thankful to CNPq and FAPEMIG for their financial support and to UFV and IEF-MG/Parque Estadual Serra do Brigadeiro staff for logistical support; (22) WD and LRP thank to Valério D. Pillar for coordinating the Campos Sulinos SISBIOTA and PPBIO Projects.

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