

## Where are the Brazilian ethnobotanical studies in the Atlantic Forest and Caatinga?

Heitor S.N. Liporacci<sup>1,4</sup>, Natalia Hanazaki<sup>1</sup>, Mara Rejane Ritter<sup>2</sup> & Elcida de Lima Araújo<sup>3</sup>

### Abstract

The Atlantic Forest and Caatinga ecosystems differ in terms of biodiversity and geoclimatic conditions but are similar in their rich socio-diversity and heterogeneity of vegetation types that comprise their floras. The objectives of this work were to map the ethnobotanical studies that have been conducted in these ecosystems and record the most investigated communities, regions, and vegetation formations related to this research. A literature review was made of ethnobotanical articles related to the use and knowledge of medicinal and food plants employed by local populations within the original territories of the Caatinga and Atlantic Forest. The areas with the highest concentrations of studies (Southeast and South regions in the Atlantic Forest and the states of Pernambuco and Paraíba in the Caatinga) reflect the presence of research groups in these regions. Until now, it was thought that ethnobotanical studies had been conducted throughout the Atlantic Forest and Caatinga; however, the results of this work show that both ecosystems contain areas that still need to be studied.

**Key words:** ethnobotany, food plants, literature review, medicinal plants.

### Resumo

Os ecossistemas Mata Atlântica e Caatinga apesar de diferirem em termos de biodiversidade e condições geoclimáticas se assemelham pela heterogeneidade de formações vegetais que compõem as suas floras e por serem detentores de uma rica sociodiversidade. O objetivo desta pesquisa foi de mapear as pesquisas etnobotânicas realizadas nos ecossistemas Mata Atlântica e Caatinga, chamando-se atenção para as comunidades mais investigadas, as regiões mais estudadas, assim como as formações vegetais em que se concentram maior número de pesquisas. Foi efetuada uma revisão bibliográfica sobre os artigos de cunho etnobotânico realizados em áreas pertencentes ao território original dos ecossistemas Caatinga e Mata Atlântica e que abordaram o uso ou o conhecimento de recursos vegetais medicinais e alimentícios por populações locais. As regiões com as maiores concentrações de estudos (região Sudeste e Sul na Mata Atlântica e os estados de Pernambuco e Paraíba na Caatinga), refletem a presença dos grupos de pesquisas localizados nessas regiões. As pesquisas etnobotânicas estão cumprindo o seu papel ao investigar e abranger todo o território ocupado pela Mata Atlântica e Caatinga, no entanto, diante do mapeamento realizado, percebe-se determinadas regiões em ambos os ecossistemas que ainda necessitam de um maior esforço de pesquisas.

**Palavras-chave:** etnobotânica, plantas alimentícias, revisão bibliográfica, plantas medicinais.

### Introduction

The Atlantic Forest and Caatinga ecosystems differ in terms of biodiversity and geoclimatic conditions but are similar in their rich socio-diversity and heterogeneity of vegetation types that comprise their floras. Over the past few

decades, ethnobotanical studies have documented local knowledge about the biodiversity of these ecosystems. For example, the cultural richness of the Caiçaras (Hanazaki *et al.* 2000; Albertasse *et al.* 2010), Azorean descendants (Giraldi & Hanazaki 2010), artisanal fisherman (Fonseca-Kruel &

<sup>1</sup> Universidade Federal de Santa Catarina - UFSC, Inst. Ciências Biológicas, Depto. Ecologia e Zoologia, Campus Universitário s/n, Córrego Grande, 88040-900 Florianópolis, SC, Brazil.

<sup>2</sup> Universidade Federal do Rio Grande do Sul - UFRGS, Inst. Biociências, Depto. Botânica, Av. Bento Gonçalves 9500, Campus do Vale, 91501-970, Porto Alegre, RS, Brazil.

<sup>3</sup> Universidade Federal Rural de Pernambuco - UFRPE, Depto. Biologia, R. Dom Manoel de Medeiros s/n, Dois Irmãos, 52171-900, Recife, PE, Brazil.

<sup>4</sup> Author for correspondence: hliporacci@hotmail.com

Peixoto 2004; Merétika *et al.* 2010), indigenous groups (Albuquerque *et al.* 2008; Cunha *et al.* 2012), Quilombolas (Crepaldi & Peixoto 2010; Gomes & Bandeira 2012), Sertanejos (Andrade *et al.* 2006), as well as rural (Negrelli & Fornazzari 2007; Paulino *et al.* 2012) and urban (Dorigoni *et al.* 2001; Almeida *et al.* 2006) communities have been studied. In Brazil, Quilombolas are traditional people of Afro-Brazilian descent, and Sertanejos are traditional people that occupy the semiarid region, whose livelihood is usually associated with some degree of pastoralism (Diegues & Arruda 2001).

Within the original territories of these two ecosystems, there have been several ethnobotanical studies about local communities and native plant resources from different vegetation formations, such as dense ombrophilous forest (Pinto *et al.* 2006), restinga (Melo *et al.* 2008), mixed ombrophilous forest (Althaus-Ottmann *et al.* 2011) and seasonal semideciduous forest (Eichemberg *et al.* 2009), as well as distinct vegetation formations found in the Caatinga (Albuquerque & Andrade 2002a; Florentino *et al.* 2007; Roque *et al.* 2010).

Advances in the development of ethnobotanical studies (Oliveira *et al.* 2009; Liporacci *et al.* 2015) have led to various literature reviews. Some of these are more descriptive (Vieira & Martins 2000; Guarim-Neto & Morais 2003; Agra *et al.* 2007b; Agra *et al.* 2008; Oliveira *et al.* 2009) and others test hypotheses (Albuquerque *et al.* 2007; Santos *et al.* 2008b; Albuquerque *et al.* 2009; Morales & Ladio 2009), including the application of systematic reviews and meta-analyses (Medeiros *et al.* 2013a; Medeiros *et al.* 2013b). In addition, some of these review studies use different levels of approach, for example, the national (Ritter *et al.* 2015), regional (Agra *et al.* 2007b) or state level (Guarim-Neto & Morais 2003; Silva & Albuquerque 2005).

For Brazil, although ethnobotanical research has grown and contributed to the systematization of local knowledge associated with biodiversity, there has been little effort to map the distribution of studies about plant use to show where there has been a concentration of studies versus little or no research. Due to the importance of these review articles, the objectives of this work were to map the ethnobotanical studies that have been conducted in the Atlantic Forest and Caatinga ecosystems and record the most investigated communities, regions, and vegetation formations related to this research. These two ecosystems were chosen because they include regions where there are the most research groups that conduct ethnobotanical studies.

## Materials and Methods

### General characterization of the study area

The Atlantic Forest extends more than 3,300 km along coastal Brazil, covering 17 states from Rio Grande do Sul to the Northeast Region: Espírito Santo (100%), Santa Catarina (99.91%), Rio de Janeiro (98.59%), Paraná (96.65%), São Paulo (79.51%), Alagoas (52.01%), Minas Gerais (47.81%), Rio Grande do Sul (46.82%), Sergipe (32.45%), Bahia (31.36%), Pernambuco (18%), Mato Grosso do Sul (14.39%), Paraíba (11.92%), Piauí (9.08%), Rio Grande do Norte (6.19%), Ceará (3.33%), and Goiás (3.13%) (CN-RBMA, 2013). Originally, this forest occupied 1,481,946 km<sup>2</sup>, which is equivalent to 17.4% of the country (Metzger 2009). Today, most of the Atlantic Forest is gone or has been modified by humans. In 1992, the Atlantic Domain and associated ecosystems were legally recognized by the National Environmental Council (Conselho Nacional do Meio Ambiente or CONAMA) in Decree n° 6.600/2008 and Law 11.428/2006 (law of the Atlantic Forest), which were subsequently consolidated in Decree n° 6.660/2008 and the Map of the Area of Application in Law 11.428/2006. Variations in elevation and differences in soil and relief occur in the area occupied by the Atlantic Forest, and this has resulted in the heterogeneity of phytophysiognomies found in this region, for example, dense ombrophilous forest, mixed ombrophilous forest, open ombrophilous forest, seasonal semideciduous forest, seasonal deciduous forest, disjunctions of forest formations and swamps within other biomes, high altitude grasslands, pioneer formations (restinga, mangrove, saline fields, lakeside and riverside communities), vegetation refuges, disjunctions of steppe savanna and steppe, areas of ecological tension, and oceanic and coastal islands (MMA 2010).

The Caatinga, unlike many other vegetation formations, is found only in Brazil, occupies an area of 844,453 km<sup>2</sup> (MMA 2012), and occurs in the states of Ceará (100%), Rio Grande do Norte (95%), Paraíba (92%), Pernambuco (83%), Piauí (63%), Bahia (54%), Sergipe (49%), Alagoas (48%), Maranhão (34%), Tocantins (9%) and Minas Gerais (2%) (IBGE 2012; MMA 2012). According to the Ministry of the Environment (2011), the Caatinga occupies 60% of the states of the Northeast Region and 13% of the country. Variations in elevation, soil, relief, and precipitation create heterogeneity in the vegetative physiognomy of this

ecosystem. However, unlike the Atlantic Forest, the classification of different vegetation subtypes in the Caatinga is still somewhat indefinite. According to Giullietti *et al.* (2004), given the diversity of vegetation patterns found in the Caatinga, it is still not possible to define an ideal classification system for these formations. Despite this issue, most studies conducted in the Caatinga recognize and use at least four types, shrubby/woody (predominant type), shrubby caatinga, woody caatinga and park caatinga, which was the classification adopted for the present study.

### Literature review and selection of articles

A literature review was conducted of ethnobotanical studies from areas within the original territories of the Caatinga and Atlantic Forest ecosystems that investigated the use or knowledge of medicinal and/or food plants employed by local populations. Only scientific articles that were published in national and international journals were included. Organization and selection of articles were made in two stages. The first stage involved the construction of a database using two principle search portals for scientific literature (Web of Science and Scopus). For both portals, searching was standardized by using the keywords “Ethnobotany + Brazil.” The only peculiarity of each portal was in relation to the search fields. In Scopus the keyword “Ethnobotany” was used in the field “ALL TOPICS” and “Brazil” in the field “TITLE-ABS-KEY,” and in the Web of Science “Ethnobotan\*” in the field “Topics” and “Brazil\*” in the field “Topics.” In both portals, searches were made for articles published until the end of 2014. The articles recovered from each search were analyzed and those that were not made in the study areas were excluded.

In the second stage, websites of Brazilian journals that publish ethnobotanical studies were searched, including the following: 1) *Revista Brasileira de Plantas Mediciniais*; 2) *Revista Brasileira de Farmacognosia*; 3) *Acta Botanica Brasílica*; 4) *Rodriguésia*; 5) *Revista Biotemas*; 6) *Revista Brasileira de Biociências*; 7) *Acta Scientiarum* (Jornal específico de Ciências Biológicas e Ciências da Saúde); 8) *Anais da Academia Brasileira de Ciências*; 9) *Revista Brasileira de Farmácia*; 10) *Bio Terra - Revista de Biologia e Ciência da Terra*; 11) *Revista Saúde e Ambiente*; 12) *Revista Caatinga*; 13) *Neotropical Biology and Conservation*; 14) *Iheringia - Série Botânica*; 15) *Ethnobiology and Conservation*;

16) *Sitientibus - Série Ciências Biológicas*; 17) *Revista Fitos*; 18) *Revista Acadêmica de Ciências Agrárias Ambientais*; 19) *Revista Vértices*; 20) *Revista Científica Eletrônica de Engenharia Florestal*; 21) *Revista de Estudos Ambientais*; 22) *Revista Semina*; 23) *Boletim do Museu de Biologia Mello Leitão*; 24) *Bioscience Journal*; 25) *Revista de Ciências Farmacêuticas Básica e Aplicada*; 26) *Unesco & Ciência - ACBS*; 27) *Interações - Revista Internacional de Desenvolvimento Local*; 28) *Revista Brasileira de Agroecologia*; 29) *Revista Biodiversidade*; 30) *Revista Árvore*; 31) *Boletim do Museu Paraense Emílio Goeldi - Ciências Humanas*; 32) *Revista Floresta e Ambiente*; and 33) *Revista Geografar*. The search was made using the website for each journal and included all the articles available from the first volume of the journal to the last volume of 2014. To find additional articles the literature cited in articles selected was reviewed for publications covering the study topic. If a new article was found, the literature cited in the publication was also reviewed.

### Selection of articles: adopted criteria

For the articles included in the study, the following criteria were used: 1) study area located completely (or predominantly) within the original area of the Atlantic Forest or Caatinga; 2) study focus about the knowledge and/or use of medicinal and food plants by local communities, including works exclusively about medicinal or food plants, those that included both categories and those that covered many categories, including medicinal and food plants; 3) study used methods characteristic of ethnobotanical research (mainly interviews); and 4) study was published before 2015.

Studies conducted in transition areas (Atlantic Forest/Pampa, Atlantic Forest/Cerrado, Caatinga/Cerrado) were not included, except when the study site was confirmed to be within the original area of Atlantic Forest or Caatinga (even when the study region was on the border of other vegetation types), such as Macedo *et al.* (2007) and Eichemberg *et al.* (2009).

Studies related to selling plants in fairs and public markets were also excluded because they did not reference the location of where all of the plants were obtained. In addition, studies were excluded if they only used common names of species, were literature reviews or were checklists or floristic surveys that did not cover what is known about the use of local or traditional plants.

## Classification of the Phytophysiognomies and mapping the reviewed studies

Defining the phytophysiognomy for each study area was based on information provided in the article. If this was not mentioned by the authors it was inferred using maps and by consulting specialists. For the Atlantic Forest phytophysiognomy, the *Atlas dos Remanescentes Florestais da Mata Atlântica* was used (SOS Mata Atlântica/INPE 2015) following the classification of the domain and associated ecosystems in Law nº 11.428 (2006). There are no detailed maps of the the Caatinga so classifying this phytophysiognomy was based on municipality, as done by Araújo *et al.* (2007). If a study was conducted in *Carrasco*, a xerophytic vegetation in the Northeast Region of Brazil (Andrade-Lima 1978), it was recorded as occurring in the Caatinga.

Mapping the study areas based on the publications was done in QGIS 2.8.1<sup>®</sup>. When the coordinates of the municipalities were not mentioned in the articles they were obtained using the website (<<http://www.apolo11.com>>) and converted from degree/minute/second to decimal degrees using the website (<<http://www.dpi.inpe.br/calcula/>>). The converted data was then imported into a Microsoft EXCEL<sup>®</sup> 2010 spreadsheet and saved in CSV format.

## Results and Discussion

### Reviewed articles and local communities

The literature search resulted in 173 scientific articles. In relation to the biomes, 112 articles were studies made within the original area of the Atlantic Forest (Tab. 1 in supplementary material <<https://figshare.com/s/a48efa9b2e384a902a7d>> - DOI: 10.6084/m9.figshare.5327596), 63 articles were of studies made within the original area of the Caatinga (Tab. 2 in supplementary material <<https://figshare.com/s/8250192e6a27eae9010>> - DOI: 10.6084/m9.figshare.5327599) and 4 studies were from transition zones between the Atlantic Forest and Caatinga (Tab. 3 in supplementary material <<https://figshare.com/s/c280b515507b205837f7>> - DOI: 10.6084/m9.figshare.5327602).

Based on the compiled studies, the local communities in the Atlantic Forest and Caatinga contain great cultural diversity (Fig. 1a,b). A higher number of works were made in non-urban

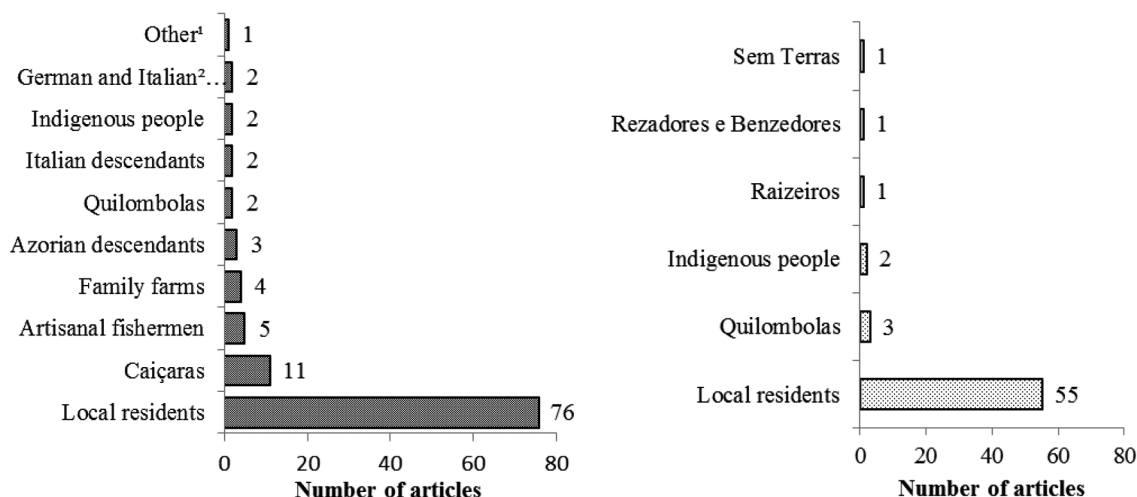
areas (areas not located within the perimeters of cities) in both the Atlantic Forest and Caatinga; however, ethnobotanical studies within cities are becoming more common (Fig. 2a,b).

Pilla *et al.* (2006) and Costa & Mayworm (2011) emphasized the broad scope of ethnobotanical studies in different types of communities, which were mainly conducted in rural and urban areas. A high frequency of studies in rural areas was also noted by Ritter *et al.* (2015), who conducted a study at the national level of ethnobotanical research made between 1988 and 2013. The number of ethnobotanical studies made in urban communities, mainly in the Atlantic Forest, is due to many factors, such as decrease in vegetation cover, widespread real estate speculation and rampant urban growth (MMA 2010). According to IBGE (2010), 84% of the Brazilian population lives in urban areas. In addition, over the last few decades, ethnobotanical studies focused on conservation of biodiversity in home gardens (Pulido *et al.* 2008; Eichemberg *et al.* 2009) have contributed to an increase in studies in urban areas because these gardens generally have many *ex situ* cultivated, native and exotic species (Costa & Mayworm 2011). Ritter *et al.* (2015) also note the high number of immigrants in Brazilian cities as fundamental to understanding the introduction of medicinal species into the Brazilian pharmacopeia.

For the Atlantic Forest, some important studies have been made in coastal communities (such as the Caiçaras, Azorian descendants and artisanal fisherman), which were mostly conducted by research centers in the Southeast and South regions. In addition, the high number of studies of rural communities in the Caatinga is because of research centers in the Northeast Region that are predominantly in rural communities; although, these research centers also study communities in northeastern Atlantic Forest (Ritter *et al.* 2015).

Despite the indigenous cultural diversity in Brazil, and considering the last IBGE census recorded 817,963 indigenous people in 305 ethnic groups (IBGE 2010), it is worth noting the low representativeness of published studies about indigenous peoples from the Atlantic Forest and Caatinga. According to Coutinho (2002), as of 2002 the ethnobotany of less than one third of the indigenous cultures in Brazil had been completely studied. After fourteen years the situation has not changed, which can be seen in the review by Ritter *et al.* (2015) that included all



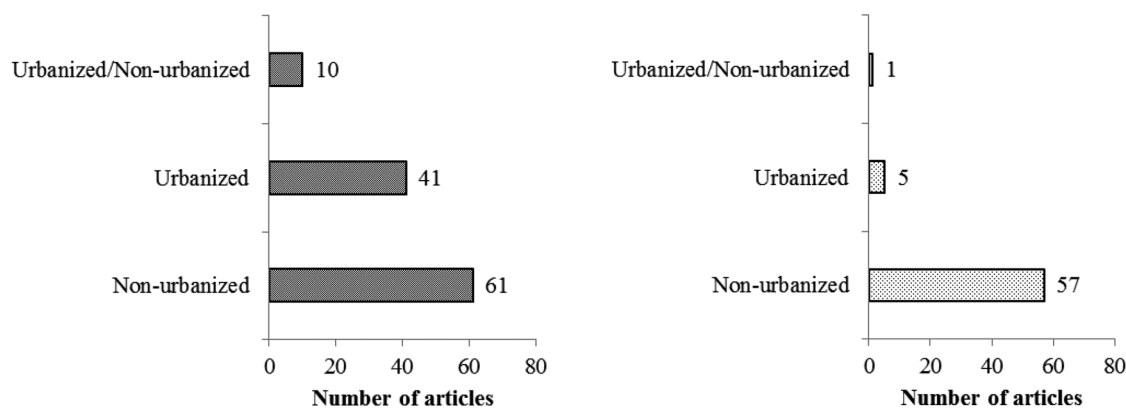


**Figure 1** – a. communities involved in ethnobotanical studies in areas of the Atlantic Forest. [<sup>1</sup> = Other communities: Sitiantes (1), Woodsman (1), Two communities in the same article (1), Pais e Mães de Santo (1), Producers (1); <sup>2</sup> = German and Italian descendants (N=112)]. b. communities involved in ethnobotanical studies in areas of the Caatinga (N=63).

of the biomes in Brazil and recorded few articles about indigenous groups. According to Haverroth (2010), in Amazonia this scenario has also been observed and may reflect the lack of specialists in the region as well as laws that restrict access to genetic resources and associated traditional knowledge. Another factor that could be attributed to this is the time it takes to complete studies about indigenous groups, especially considering the large amount of legal bureaucracy involved and the significant amount of time needed for the researcher/indigenous person to build a working relationship, which is often incompatible with the

time given to complete a master’s or PhD degree (Liporacci *et al.* 2015; Pedrollo & Kinupp 2015).

It is also important to note the works that did not define the cultural groups, including 71 (66.35%) from the Atlantic Forest and 36 (55.38%) from the Caatinga, which are classified in the present study as “local residents”. The same results were found by Ritter *et al.* (2015), where 143 articles (55.4%) involved one particular social group. According to the same authors, this may be a reflection of the difficulties of defining specific ethnic groups in Brazil, especially because of the high cultural diversity in the country.



**Figure 2** – a. urbanization of the communities involved in ethnobotanical studies made in areas of the Atlantic Forest (N=112). b. urbanization of the communities involved in ethnobotanical studies in areas of the Caatinga (N = 63).

### Representativeness of studies by state and region

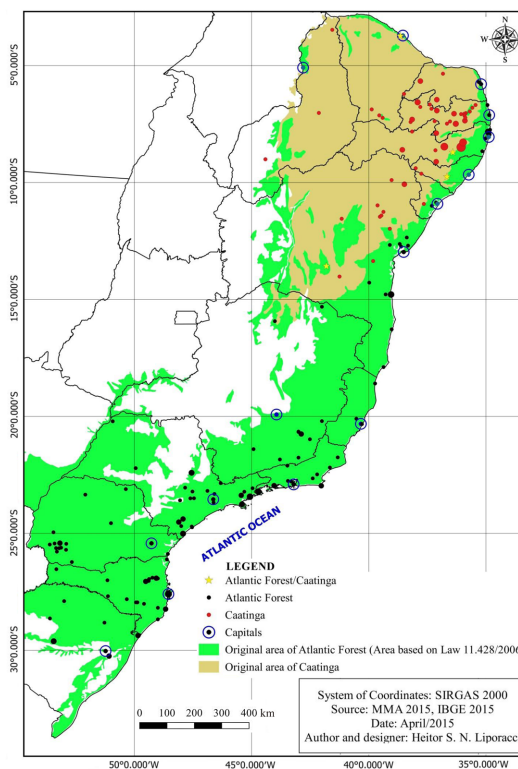
For the Atlantic Forest, ethnobotanical articles were found that involved medicinal and food plants from the following 12 states: Santa Catarina (20 articles), Rio de Janeiro (16), São Paulo (16), Bahia (13), Minas Gerais (12), Rio Grande do Sul (9), Paraná (9), Pernambuco (7), Espírito Santo (3), Paraíba (3), Sergipe (2), Rio Grande do Norte (1) and more than one state (1). The only study that exclusively involved food plants was made in the Vale do Paraíba in the state of São Paulo (Pilla & Amorozo 2009). At a regional scale, most of the works are from the Southeast Region (47 articles), followed by the South (38) and Northeast regions (25). There were no ethnobotanical studies for five of the 17 states with Atlantic Forest (Mato Grosso do Sul, Goiás, Ceará, Piauí, Alagoas). However, the representativeness of the Atlantic Forest biome in these states is small compared to the states that are completely within the biome, such as Santa Catarina, Paraná, Rio de Janeiro and Espírito Santo. Another reason for the concentration of ethnobotanical studies and publications is that most of the ethnobotany research groups are in these states.

For the Caatinga biome, which is found in 11 states, articles of studies from the following eight states were found: Pernambuco (22 articles), Paraíba (18), Bahia (7), Rio Grande do Norte (7), Piauí (3), Ceará (2), Alagoas (1), Sergipe (1), Pernambuco/Paraíba (1) and Ceará/Pernambuco (1). The only work found that exclusively studied food plants in the Caatinga was about two rural communities, one in Pernambuco and the other in Paraíba (Nascimento *et al.* 2012). No publications were found of studies from Tocantins, Maranhão and Minas Gerais. In addition, Ceará occurs almost completely within the Caatinga biome but there are few ethnobotanical studies from this state. Tocantins, Maranhão and Minas Gerais contain the lowest proportion of Caatinga biome compared to the other northeastern states, which is a possible reason for the lack of published articles from these areas. The concentration of ethnobotany research groups in Pernambuco and Paraíba could be the main reason why these two states have the highest number of publications.

In the territory originally occupied by Atlantic Forest, the majority of the studies are from coastal regions (Fig. 3), which is evidence that there is a predominance of studies near the capitals. Studies have also been conducted in inland regions; however, for states with Atlantic Forest,

most of the interior regions that have communities with people with knowledge about medicinal and food plants are poorly studied. In addition, few ethnobotanical studies have been conducted in the northeastern portion of the Atlantic Forest (Silva & Andrade 2005).

There was a similar concentration of studies for the the original area occupied by the Caatinga (Fig. 3). Many studies have been conducted in rural areas of the Northeast Region, with gaps in the north, south and central parts of Bahia, all of Ceará, western Pernambuco and most of Piauí; these are potentially good places for new studies. Considering the Atlantic Forest and Caatinga are ecosystems with high biodiversity and anthropic activity, it is extremely important that future research is conducted in unstudied areas. The present review of the entire area occupied by these biomes can help determine these regions and will help in the collection and analysis of data about food and medicinal resources used by local communities. In addition, based on the gaps found in the present study, more research about food plants is needed.



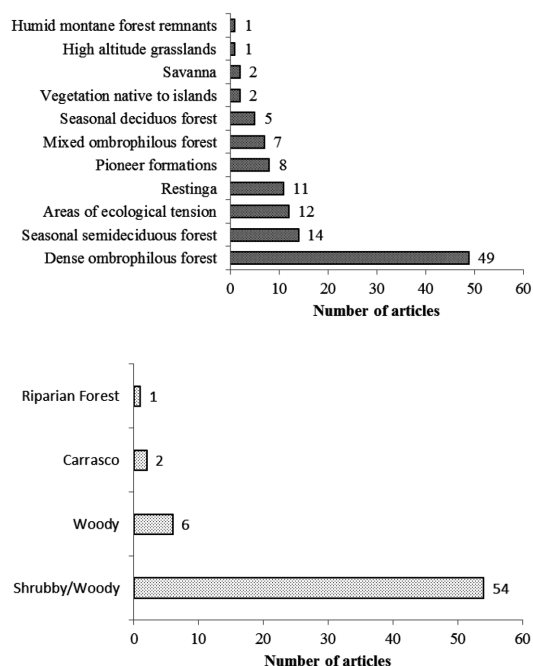
**Figure 3** – Geographic distribution of published articles about use and knowledge of plants for food and medicine in Atlantic Forest and Caatinga.

### Representativeness of studies by phytophysiology

In relation to the original area of Atlantic Forest, the majority of the studies were conducted in dense ombrophilous forest (Fig. 4a). For the Caatinga, most studies were made in shrub/woody caatinga (Fig. 4b).

According to the National Council of the Atlantic Forest Biosphere Reserve (Conselho Nacional da Reserva da Biosfera da Mata Atlântica 2013), within the Atlantic Forest, the largest formation is seasonal forest (635,552 km<sup>2</sup> or 48.65%) and the second largest formation is ombrophilous forest (406,446 km<sup>2</sup> or 31.11%), which has three phytophysiology subtypes (dense ombrophilous forest, mixed ombrophilous forest and open ombrophilous forest). The same source notes that the Atlantic Forest domain was originally 1,306,421 km<sup>2</sup>.

The large areas these phytophysionomies occupy partially explain the high number of studies made in ombrophilous formations. This is supported by the predominance of studies



**Figure 4** – a. number of studies made in the diverse phytophysionomies that comprise the Atlantic Forest biome (N= 112). b. number of studies made in the diverse phytophysionomies that comprise the Caatinga biome (N = 63).

conducted in dense ombrophilous forest, which is found in 11 of the 17 states with Atlantic Forest. Another reason for the high number of studies is related to the history of the coastal region (where these formations are more concentrated), which was the first area to be cleared and inhabited by humans (Thomaz & Monteiro 1997). Besides containing the largest cities and number of people, traditional communities are found in this area, such as the Caiçaras, fisherman and Azorian descendants (CN-RBMA 2013). Research centers that study ethnobotany are also present in these phytophysionomies. In addition, although the seasonal forest formation is larger, it contained fewer studies compared to ombrophilous forest.

In relation to the Caatinga, the studies were made predominantly in areas with shrubby/woody caatinga. Unlike the studies in Atlantic Forest, the ethnobotany studies made in Caatinga did not cite the vegetation type. However, shrubby/woody Caatinga is the predominant type in this ecosystem so we assumed that most of the studies were made in areas with this phytophysionomy.

It is important to note that the present work considered studies that were made in areas within the original territories of the Atlantic Forest and Caatinga, which existed before human exploration. Today, these ecosystems have been heavily impacted by humans and there are few untouched natural areas. Due to large scale industry, the exploration of fossil fuels and globalization, more than three quarters of the the land on Earth has been transformed into anthropogenic biomes (anthromes) (Ellis 2015). Humans live in the era of the Anthropocene and some of the consequences of this period are the alteration of species richness of native vegetation and an increase in the introduction of exotic species (Ellis 2012). Thus, when referring to biomes and global ecosystems it is necessary to disconnect from the idea of pristine ecosystems.

### Conclusion

In Brazil, the socio-biodiversity of the Caatinga and Atlantic Forest ecosystems has contributed over time to the advancement of ethnobotanical studies related to medicinal and food plants. There has been an increase in focusing on non-urban communities (rural communities) in both the Caatinga and Atlantic Forest. However, studies in urban areas, such as large cities, have also contributed to new aspects of ethnobotanical research.

The regions with the highest concentrations of research (Southeast and South regions for the Atlantic Forest and the states of Pernambuco and Paraíba for the Caatinga) reflect the presence of research groups in these areas that conducted these studies and have accumulated a lot of ethnobotanical knowledge, especially about medicinal plants. Although the Atlantic Forest and Caatinga contain heterogeneous vegetation formations and the ethnobotanical studies conducted in them are concentrated in certain areas, in general this research is playing a role in investigating the entirety of these important Brazilian ecosystems. Nevertheless, mapping these studies shows there are regions in both the Atlantic Forest and Caatinga that still need to be studied.

Considering the vast area that these ecosystems cover and the socio-biodiversity of Brazil, there is no doubt that there is still much to be explored in this field, mainly in relation to ethnobotanical knowledge of Brazilian indigenous peoples that have not been studied.

The map made in this work will help with planning future studies by allowing researchers to select new areas for ethnobotanical investigations and by stimulating discussions related to this area of science. In turn, this will increase the knowledge about native species from different vegetation formations that comprise the ecosystems of Brazil.

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