



Insect galls on *Myrtaceae*: richness and distribution in brazilian restingas

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Abstract: Inventories in Brazilian restingas have been indicating that Myrtaceae are the plant family with the greatest richness of insect galls. A compilation of published data plus new records was elaborated with the aim of establishing the number of gall morphotypes on this family in this physiognomy of the Atlantic Forest, producing a list of galled species, pointing out the predominant gall features, evaluating the taxonomical knowledge of the gallers, listing the associated fauna, and based on host plant endemisms and monophagy proposing the endemism of some galling species. Myrtaceae harbor 111 morphotypes of insect gall (about 75% induced by Cecidomyiidae, Diptera) on 25 host plant species, 15 endemic. *Eugenia* L. highlights as the plant genus with the highest number of galled species and gall richness. Leaves are the most galled organ. There is a predominance of globoid and fusiform shapes, green color, glabrous surface and a single internal chamber. The taxonomical data on gallers is deficient as many records have been presented at supraspecific levels. The associated fauna is rich and includes parasitoids, inquiline and predators. Twelve species of Cecidomyiidae, a single species of Curculionidae (Coleoptera) and one species of Eriococcidae (Hemiptera) have been associated exclusively with endemic hosts and then are proposed in the present study as endemic too. The geographical distribution of many galls and respective gallers are restricted to the State of Rio de Janeiro, where most inventories have been carried out. For the first time, *Eugeniomyia dispar*, previously known from a rural area of Rio Grande do Sul and restinga areas of São Paulo, is recorded in the State of Rio de Janeiro.

Keywords: Atlantic Forest, diversity, endemism, plant-insect interaction.

Galhas de insetos em *Myrtaceae*: riqueza e distribuição nas restingas brasileiras

Resumo: Inventários em restingas brasileiras indicam as Myrtaceae como a família de planta com maior riqueza de galhas de insetos. Uma compilação das informações publicadas acrescida de novos registros foi elaborada com o objetivo de estabelecer o número de morfotipos de galhas, produzir uma lista das espécies botânicas com galhas, indicar as características morfológicas predominantes das galhas, avaliar o conhecimento taxonômico dos galhadores, relacionar a fauna associada, e com base no endemismo das plantas hospedeiras e monofagia, propor o endemismo de algumas espécies galhadoras. As Myrtaceae hospedam 111 morfotipos de galhas de insetos (a maioria induzida por Cecidomyiidae, Diptera) em 25 espécies de plantas, 15 endêmicas. *Eugenia* L. destaca-se como o gênero botânico com o maior número de espécies hospedeiras e riqueza de galhas. A folha é o principal órgão hospedeiro. Há predomínio das formas globoides e fusiformes, coloração verde, superfície glabra e uma única câmara interna. O conhecimento taxonômico dos galhadores ainda é deficiente com muitos registros em categorias supraespecíficas. A fauna associada é rica e inclui parasitoides, inquilinos e predadores. Doze espécies de Cecidomyiidae, uma espécie de Curculionidae (Coleoptera) e uma espécie de Eriococcidae (Hemiptera) estão associadas exclusivamente a hospedeiros endêmicos e são propostas neste estudo como endêmicas também. A distribuição geográfica de diversas galhas e seus respectivos galhadores está restrita ao estado do Rio de Janeiro, onde a maioria dos inventários foi realizada. Pela primeira vez, *Eugeniomyia dispar* (Cecidomyiidae), previamente conhecida de uma área rural do Rio Grande do Sul e de áreas de restingas de São Paulo, é registrada no estado do Rio de Janeiro.

Palavras-chave: Mata Atlântica, diversidade, endemismo, interação inseto-planta.

Introduction

Restingas are one of the Atlantic Forest phytophysiognomies, which are defined as long strips of marine sandy depositions, dated of Quaternary (Araújo 1992). In the past, they occupied about 80% of the Brazilian coast (Lacerda et al. 1993), but due to human activities, especially property speculation, this physiognomy has been suffering a great loss of area. For this reason, restingas are considered one of the most threatened Atlantic Forest physiognomies. The main formations are found from Bahia (Northeast region) to São Paulo (Southeast region) (Neiman 1989).

Restinga vegetation is adapted to extreme environmental conditions, such as high salinity, low water availability and strong sun radiation (Scarano et al. 2001). Nevertheless, this phytophysiognomy harbors a considerable biological diversity and a great variety of unique vegetal communities (Lacerda et al. 1982, Rizzini 1992) due to the topographic diversity of the environmental conditions (Araújo & Henriques 1984).

Myrtaceae are one of the most species-rich woody plant families in Brazilian restingas (Araújo 2000, Souza & Morin 2008, Lourenço & Barbosa 2012), the second most speciose in the Atlantic Forest biome (Stehman et al. 2009), and the fourth in Brazil (Forzza et al. 2010). In fact, this family is highly representative of a variety of biomes of the Neotropics.

The most speciose taxa of Myrtaceae in Brazilian restingas are *Eugenia* L. and *Myrcia* DC. (Giaretta & Peixoto 2015, Martins et al. 2008, Rosario et al. 2005). Both have been also pointed out as the most species-rich genera of Myrtaceae in Brazil with 350 and 260 species, respectively (Landrum & Kawasaki 1997, Sobral et al. 2018) and in the world with 1,038 and 753 species, respectively (Govaerts et al., 2014).

Several insect gall inventories have been conducted in restinga areas, all in the Southeast region of Brazil, mainly in the state of Rio de Janeiro (Angra dos Reis - Maia & Oliveira (2010), Mangaratiba - Rodrigues et al. (2014), Rio de Janeiro - Oliveira & Maia (2005) and Silva & Maia (2016), Maricá - Maia (2001a), Carapebus - Maia (2001a), Parque Nacional da Restinga de Jurubatiba - Monteiro et al. (2004), Parque Estadual da Costa do Sol - Carvalho-Fernandes et al. (2016), Arraial do Cabo - Monteiro et al. (1994), São João da Barra - Carvalho-Fernandes et al. (2016)), but also in the State of São Paulo (Bertioga - Maia et al. 2008) and Espírito Santo (Guarapari - Bregonci et al. (2010). Besides, additional records were provided by Maia et al. (2002), Silva & Rodrigues (2011) and Carvalho-Fernandes & Maia (2011). These inventories have been showing considerable insect gall diversity and highlighting Myrtaceae as the plant family with the greatest number of galled species and the highest gall richness (Table 1). Such richness probably is related to the hydrothermic stress caused by daily temperature contrasts, humidity, wind gusts, strong sun radiation and sandy soil (Monteiro et al. 1994, Maia 2001a, Monteiro et al. 2004).

As the available information about insect galls on Myrtaceae are scattered in several publications, the current knowledge is not consolidated. The present review aims to compile all published data on them, add new records and answer the following questions: 1) How many insect galls have been recorded on Myrtaceae in restingas?, 2) How many species of Myrtaceae are galled in this physiognomy?, 3) Which are the galled species?, 4) How is geographic distribution

of these plant species and what is their origin and conservational status?, 5) Which are the galled plant organs?, 6) Which are the most frequent gall features (shape, colour, presence or absence of trichomes, number of internal chamber)?, 7) Which are the galling taxa?, 8) How is the geographic distribution of the galling species?, 9) is there any endangered galler?, and 10) How is the composition of predaceous, inquiline and parasitoid guilds?.

Material and Methods

A bibliographic survey was done to elaborate a list of insect galls on Myrtaceae in restingas. It was carried out by consulting the database Web of Science using “insect gall” and “restinga” as keywords. It included ten published inventories (cited in the Introduction), an insect gall compilation (Maia 2013), scattered records (Maia et al. 2002, Carvalho-Fernandes & Maia 2011, Silva & Rodrigues 2011) and two catalogues of Cecidomyiidae (Diptera) of Rio de Janeiro (Maia 2005, Maia & Barros 2009). Only host plants identified at species level were considered.

Additionally, new records of insect galls are provided. They were obtained from surveys carried out in the Parque Natural Municipal Chico Mendes (Rio de Janeiro, RJ), in February, 2016. The park has 10 paths totaling five kilometers. These paths were pursued in the search of galls for two hours by two persons. The hiking method was adopted to allow the observation of a large number of specimens. Galls were photographed as voucher material.

Botanic names were updated and conservational status of all plant species as well as data on plant endemisms were verified, using the site Flora do Brasil (2020). Based on the high specificity of the galls in relation to the host plants, galling species associated exclusively with endemic plants were proposed as endemic. Similarly, galls associated exclusively with threatened plants were proposed as threatened too.

Unfortunately, the morphological gall characterization is not standardized in the literature. The fullest descriptions include galled plant organ, gall shape, color, presence or absence of trichomes, and number of internal chamber, but these features were not equally contemplated in the analysed inventories. Some of them offer very parsimonious descriptions. Part of the missing features was retrieved based on gall pictures whenever possible. Besides, different authors adopt different terms to refer to the same gall shape. They are listed in the present study. With regard to the gall morphology, published data are not standardized, resulting in not comparable descriptions as well as in information gaps. Furthermore, different terms have been used to describe the same gall shape. A total of 33 terms were retrieved from literature, but several correspond to the same shape: 1) conical = drop-shaped = triangular, 2) lenticular = discoid = epidermic = parenchymal, 3) globoid = globose = globular = spherical = spheroid, 4) cylindrical = tubular, 5) fusiform = elliptical, 6) edge leaf roll = marginal leaf roll, 7) leaf roll = total leaf roll = entire leaf roll, 8) rosette = leaves rosette. In the present study, the following terms were adopted: conical, lenticular, globoid, cylindrical, fusiform, marginal leaf roll, leaf roll, and rosette. Other recorded shapes were claviform, spiraled, ovoid, bivalve, star-shaped, pineapple-shaped, biconical, and leaf blade fold. These last terms were retained in this publication.

Table 1. Plant families with the highest number of galled species and greatest gall richness in Brazilian restingas.

Localities (municipality/state)	Family with the highest number of galled species	Ratio between galled species on this family and total number of galled species in the locality	Family with the greatest gall richness	Ratio between gall morphotypes on this family and total number of gall morphotypes in the locality	References
Angra dos Reis/RJ	Myrtaceae	4/22 (18.18%)	Myrtaceae	9/36 (28.12%)	Maia & Oliveira (2010)
Mangaratiba/RJ	Myrtaceae	9/70 (12.86%)	Myrtaceae	20/147 (13.60%)	Rodrigues et al. (2014)
Rio de Janeiro/RJ	Myrtaceae	4/25 (16.00%)	Myrtaceae	7/43 (16.28%)	Oliveira & Maia (2005)
Rio de Janeiro/RJ	Fabaceae	4/24 (16.67%)	Fabaceae	6/31 (19.35%)	Silva & Maia (2016)
Maricá/RJ	Myrtaceae	6/41 (14.63%)	Myrtaceae	17/68 (25.00%)	Maia (2001a)
Carapebus/RJ	Myrtaceae	6/30 (20.00%)	Myrtaceae	17/61 (27.87%)	Maia (2001a)
Parque Nacional da Restinga de Jurubatiba/RJ	Myrtaceae	7/40 (17.50%)	Myrtaceae	25/72 (34.72%)	Monteiro et al. (2004)
Parque Estadual da Costa do Sol/RJ	Myrtaceae	9/68 (11.54%)	Myrtaceae	33/124 (26.62%)	Carvalho-Fernandes et al. (2016)
Arraial do Cabo/RJ	Myrtaceae	6/35 (17.14%)	Myrtaceae	10/51 (19.61%)	Monteiro et al. (1994)
São João da Barra/RJ	Myrtaceae	6/52 (11.54%)	Myrtaceae	9/66 (13.64%)	Carvalho-Fernandes et al. (2016)
Bertioga/SP	Myrtaceae	14/123 (11.38%)	Myrtaceae	31/236 (13.13%)	Maia et al. (2008)
Guarapari/ES	Nyctaginaceae	3/21 (14.28%)	Nyctaginaceae	5/38 (13.16%)	Bregonci et al. (2010)

Results

A total of 111 insect gall morphotypes on 25 plant species of nine genera were accounted (Table 2). This value represents 90.2% of the gall records on Myrtaceae for restinga, as 12 morphotypes were not included as they were associated with six undetermined plant species. *Eugenia* L. and *Myrcia* DC. showed the highest number of galled species (ten each) and the greatest gall richness (47 and 34 morphotypes, respectively). The other genera included a single galled species and from one to ten gall morphotypes. *Eugenia* and *Myrcia* together harbored about 73.0% of the gall richness.

All host plant species are native, being 15 endemic in Brazil. Among the last, 11 occur exclusively in the Atlantic Forest (Table 2). Concerning the conservational status, six plant species are less concerning, 18 have not been yet evaluated, and one is data deficient (Table 2).

Leaves were the most galled plant organ (about 63.0%), but galls on stems, buds, flowers (flower buds and flower peduncles) and fruits were also recorded (Table 3). The richness of bud and stem galls were similar, about 17.5% and 14.0%, respectively. Fruit and flower galls were rare (each with less than 3%).

The most frequent shapes were conical and globoid (both with 18 morphotypes), fusiform and lenticular (both with 13 morphotypes), and marginal leaf roll (10 morphotypes). The other shapes included from seven to a single morphotype. Green galls predominated (n=55, about 49.5%), but brown, yellowish, reddish, whitish and black galls were also found. Most galls exhibited a single color, whereas few varied in color. Most galls were glabrous (n=85, about 76.6%) and a single morphotype was hairy (0.90%). There is no information about the others. Seventy-four morphotypes were one-chambered (66.67%), eight were multichambered (7.21%) and a single one showed from one to three chambers (0.90%) (Table 3).

Most gallers were determined (n=80, about 67.0%), but only 21 (about 19.0%) were identified in species and ten (about 9.0%) in genus. Records in suprageneric categories predominated, especially at family (Table 3). The gallers were distributed in five orders: Diptera (Cecidomyiidae), Thysanoptera, Hymenoptera, Coleoptera, and Hemiptera. Cecidomyiids induced most galls (n=69, about 57.0%), while the others induced 4 (3.5%), 3 (2.7%), 2 (1.8%) and 2 (1.8%), respectively. Lepidopteran galls were not found (Table 3).

Twelve species of gall midges were identified, being distributed in ten genera, *Clinodiplosis* Kieffer, 1894, *Dasineura* Rondani, 1840, *Neolasioptera* Felt, 1908, *Bruggmannia* Tavares, 1906, *Eugeniomyia* Maia, Mendonça & Romanovski, 1997, *Jorgenseniella* Maia, 2005, *Myrciomyia* Maia, 1995, *Myrciariomyia* Maia, 1994, *Neomitranthella* Maia, 1996, and *Stephomyia* Rondani, 1840. *Dasineura* and *Stephomyia* were the most speciose genera associated with Myrtaceae in Brazilian restingas. *Pacholenus pelliceus* Boheman, 1836 (Coleoptera) and *Tectococcus ovatus* Hempel, 1900 (Hemiptera) were the other identified galling species.

Concerning the geographic distribution, 12 galling species have been recorded, until this moment, only in restingas of Rio de Janeiro State (Table 4). The other species have a less restricted distribution. *Eugeniomyia dispar*, previously known from a rural area of Rio Grande do Sul and restinga areas of São Paulo, is recorded for the first time in the State of Rio de Janeiro. The distribution of *Neolasioptera eugeniae* Maia, 1993 includes restinga areas of RJ and an ombrophilous Forest area of Minas Gerais. *Dasineura gigantea* Angelo & Maia, 1999 was described from Forest areas of Paraná and Santa Catarina, and later this species was reported in restinga areas of São Paulo. *Dasineura myrciariae* Maia, 1993 occurs in the states of Rio de Janeiro and Espírito Santo. *Jorgenseniella eugeniae* Maia, 2005 and *Pacholenus*

Table 2. Galled species of Myrtaceae, their synonyms, common names, origin, distribution in Brazilian phytogeographic domains, conservational status and number of gall morphotypes in restingas. DD – deficient data, LC – less concerning, NE – not evaluated, VU – vulnerable.

Plant species/Synonyms/Common names	Origin	Phytogeographic domain	Conservational status	Nr. gall morphotypes (n=111)
<i>Blepharocalyx salicifolius</i> (Kunth) O. Berg /-/ “maria-preta, murteira, murtinha”	Native	Atlantic Forest Caatinga Cerrado Pampa	LC	1
<i>Calyptanthes brasiliensis</i> Spreng. /-/ “guamirim-branco”	Native	Atlantic Forest Cerrado	NE	2
<i>Campomanesia guaviroba</i> (DC.) Kiaersk. /-/ “guabirobão, guabirobeira”	Native	Atlantic Forest Cerrado	NE	1
<i>Eugenia astringens</i> Cambess. /-/ <i>Eugenia rotundifolia</i> Casar., <i>Eugenia umbelliflora</i> O. Berg, <i>Eugenia adstringens</i> (misspelling error) / “jabuticaba-do-mangue, aberta-goela, apê-açu”	Endemic	Atlantic Forest	NE	8
<i>Eugenia copacabanensis</i> Kiaersk. /-/ “princesinha-de-Copacabana	Endemic	Atlantic Forest	LC	10
<i>Eugenia hiemalis</i> Cambess. /-/ <i>E. multiflora</i> (Lam.) DC. / “guamirim-burro”	Native	Atlantic Forest Cerrado	LC	6
<i>Eugenia monosperma</i> Vell. /-/ “araçarana”	Endemic	Atlantic Forest	NE	2
<i>Eugenia puniceifolia</i> (Kunt) DC. /-/ <i>Eugenia ovalifolia</i> Cambess. / “pitanga do campo, murta vermelha”	Endemic	Amazon Atlantic Forest Caatinga Cerrado	NE	8
<i>Eugenia seloi</i> B. D.Jacks. /-/ “pitangatuba”	Endemic	Atlantic Forest	NE	1
<i>Eugenia speciosa</i> Cambess. /-/ “laranjinha-do-mato, guamirim”	Native	Atlantic Forest	NE	2
<i>Eugenia sulcata</i> Spring ex Mart. /-/ “pitanga-preta”	Endemic	Atlantic Forest	NE	2
<i>Eugenia uniflora</i> L. /-/ “pitangueira, pitanga, pitanga-vermelha”	Native	Atlantic Forest Cerrado Pampa	NE	8
<i>Myrcia brasiliensis</i> Kiaersk. /-/ <i>Gomidesia schaueriana</i> O. Berg / “batinga, guamirim-araçá, guamirim”	Endemic	Atlantic Forest	NE	3
<i>Myrcia ilheosensis</i> Kiaersk. /-/ <i>Gomidesia fenziiana</i> O. Berg / “papa-güela”	Endemic	Atlantic Forest	NE	1
<i>Myrcia multiflora</i> (Lam.) DC. /-/ “cambuí, camboim”	Native	Amazon Atlantic Forest Caatinga Cerrado	NE	1
<i>Myrcia lundiana</i> Kiaersk. /-/ “araçá caiçara”	Endemic	Atlantic Forest	NE	6
<i>Myrcia ovata</i> Cambess. /-/ “guabijueiro”	Endemic	Atlantic Forest	LC	8
<i>Myrcia palustris</i> DC. /-/ “pitangueira-do-mato”	Native	Atlantic Forest Caatinga	NE	2
<i>Myrcia racemosa</i> O. Berg /-/ <i>Myrcia acuminatissima</i> O. Berg /-/	Endemic	Atlantic Forest Cerrado	NE	1
<i>Myrcia splendens</i> (SW.) DC. /-/ <i>Myrcia fallax</i> (Rich.) DC. / “guamirim-de-folha-fina, guamirim-miúdo”	Endemic	Amazon Atlantic Forest Caatinga Cerrado Pantanal	NE	11
<i>Myrcia tenella</i> (DC.) O. Berg /-/ “cambuí”	Native	Amazon Atlantic Forest Caatinga Cerrado	DD	1
<i>Myrciaria floribunda</i> (West ex Willdenow) Berg /-/ “uvaia, cambuizino, cambuí”	Native	Amazon Atlantic Forest Caatinga Cerrado	LC	10
<i>Neomitranthes obscura</i> (DC.) N. J. E. Silveira /-/ “guapeí-una, batinga preta, araçá preto, pitanga de cachorro pitanga da restinga”	Endemic	Atlantic Forest	LC	6
<i>Plinia cauliflora</i> (Mart.) Kausel Berg /-/ <i>Myrciaria jaboticaba</i> (Vell.) Berg / “jaboticaba”	Endemic	Atlantic Forest	NE	2
<i>Psidium cattleianum</i> Sabine /-/ “araçá-vermelho, araçá-amarelo, araçá-yaci, araçá-branco, araçá”	Endemic	Atlantic Forest Caatinga Cerrado	NE	8

Insect galls on myrtaceae in restingas

Table 3. Gall features on Myrtaceae in Brazilian restingas (shape, color, presence or absence of trichomes, number of internal chamber, galled plant organ, galling order and gallers' taxonomical categories). The total number of gall morphotypes varies due to the available information in the literature. The number of the gall morphotypes by host organ is higher than 111, because some galls were recorded in two different plant organs.

Gall features	Number of morphotypes	
Galled organ		
Leaf	72	64.86%
Bud	20	18.02%
Stem	16	14.41%
Flower	3	2.70%
Fruit	3	2.70%
Shape		
Conical	18	16.22%
Globoid	18	16.22%
Fusiform	13	11.71%
Lenticular	13	11.71%
Marginal leaf roll	10	9.01%
Cylindrical	7	6.31%
Leaf roll	6	5.40%
Ovoid	5	4.50%
Claviform	3	2.70%
Rosette	3	2.70%
Spiraled	1	0.90%
Bivalve	1	0.90%
Star-shaped	1	0.90%
Pineapple-shaped	1	0.90%
Biconical	1	0.90%
Leaf blade fold	1	0.90%
Color		
Green	55	49.54%
Brown	14	12.61%
Yellowish	12	10.81%
Reddish	12	10.81%
Whittish	1	0.90%
Black	1	0.90%
Trichomes		
Absent	85	76.60%
Present	1	0.90%
Number of internal chamber		
One-chambered	74	66.67%
Multichambered	8	7.21%
From one to 3	1	0.90%
Galling order		
Diptera	69	86.25%
Thysanoptera	4	5.00%
Hymenoptera	3	3.75%
Coleoptera	2	2.50%
Hemiptera	2	2.50%
Lepidoptera	0	0.00%
Gallers' taxonomical category		
Order	8	7.20%
Family	58	52.25%
Genus	10	9.01%
Species	21	18.92%
Others	7	6.31%

Table 4. Geographical distribution of galling species associated with Myrtaceae in Brazil.

Galling species	Geographical distribution
<i>Bruggmannia</i> sp.	RJ (Arraial do Cabo)
<i>Clinodiplosis profusa</i> Maia 2001	RJ (Mangaratiba: Ilha da Marambaia; Rio de Janeiro: Grumari; Maricá; Saquarema; Araruama; Cabo Frio; Arraial do Cabo; Carapebus; Parque Nacional da Restinga de Jurubatiba; São João da Barra)
<i>Clinodiplosis</i> sp.	SP (Bertioga)
<i>Dasineura copacabanensis</i> Maia, 1993	RJ (Maricá; Saquarema; Araruama; Cabo Frio; Arraial do Cabo; São João da Barra)
<i>Dasineura gigantea</i> Angelo & Maia, 1999	SP (Bertioga) PR (Piraquara, Pontal do Paraná) SC (Itapoá)
<i>Dasineura globosa</i> Maia, 1995	RJ (Mangaratiba: Ilha da Marambaia; Rio de Janeiro: Grumari, Niterói; Maricá; Saquarema; Carapebus; Araruama; Cabo Frio; Arraial do Cabo; Parque Nacional da Restinga de Jurubatiba, São João da Barra)
<i>Dasineura marginalis</i> Maia, 2005	RJ (Mangaratiba: Ilha da Marambaia, Rio de Janeiro: Grumari; Maricá; Saquarema; Araruama; Cabo Frio; Arraial do Cabo; Carapebus; Parque Nacional da Restinga de Jurubatiba)
<i>Dasineura myrciariae</i> Maia, 1995	RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes - new record; Maricá; Carapebus; Parque Nacional da Restinga de Jurubatiba) ES (Guarapari)
<i>Dasineura</i> sp. 1	RJ (Maricá)
<i>Dasineura</i> sp. 2	RJ (Maricá)
<i>Dasineura</i> sp. 3	RJ (Maricá, Arraial do Cabo)
<i>Dasineura</i> sp. 4	RJ (Araruama, Arraial do Cabo)
<i>Eugeniomyia dispar</i> Maia, Mendonça & Romanovski, 1997	RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes - new record) SP (Bertioga) RS (Porto Alegre)
<i>Eugeniomyia triangularis</i> Maia, 2011	RJ (Maricá)
<i>Jorgenseniella eugeniae</i> Maia, 2005	RJ (Cabo Frio; Macaé) SP (Bertioga)
<i>Myrciomyia maricaensis</i> Maia 1995	RJ (Maricá; Arraial do Cabo; Carapebus; Parque Nacional da Restinga de Jurubatiba)
<i>Myrciariomyia bivalva</i> Maia, 1994	RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes - new record; Maricá; Carapebus; Arraial do Cabo; Parque Nacional da Restinga de Jurubatiba)
<i>Neolasioptera eugeniae</i> Maia 1993	RJ (Paraty; Angra dos Reis: Ilha Grande; Rio de Janeiro: Parque Natural Municipal Chico Mendes - new record, Grumari; Maricá; Saquarema; Araruama; Cabo Frio; Arraial do Cabo; São João da Barra) MG (Itamonte)
<i>Neomitranthella robusta</i> Maia, 1995	RJ (Maricá; Saquarema; Araruama; Cabo Frio; Arraial do Cabo; Carapebus; Parque Nacional da Restinga de Jurubatiba)
<i>Pacholenus pelliceus</i> Boheman, 1836	RJ (Maricá) SP (Bertioga)
<i>Stephomyia clavata</i> (Tavares 1920)	RJ (Carapebus; Parque Nacional da Restinga de Jurubatiba; Araruama; Arraial do Cabo; São João da Barra) BA (Madre de Deus)
<i>Stephomyia espiralis</i> Maia, 1993	RJ (Mangaratiba: Ilha da Marambaia; Maricá; Araruama; Cabo Frio; Arraial do Cabo)
<i>Stephomyia mina</i> Maia, 1993	RJ (Maricá; Araruama; Arraial do Cabo; Carapebus)
<i>Stephomyia rotundifoliorum</i> Maia, 1993	RJ (Maricá; Saquarema; Araruama; Cabo Frio; Arraial do Cabo; Carapebus; Parque Nacional da Restinga de Jurubatiba; São João da Barra)
<i>Stephomyia tetraloba</i> Maia, 1993	RJ (Maricá; Arraial do Cabo)
<i>Stephomyia</i> sp.1	RJ (Carapebus)
<i>Stephomyia</i> sp.2	RJ (Mangaratiba: Ilha da Marambaia)
<i>Tectococcus ovatus</i> Hempel, 1900	Wide spread (Brazil, U.S.A. and Japan)

pelliceus Boheman, 1836 are known from records in restingas of RJ and SP. *Tectococcus ovatus* Hempel, 1900 has the widest geographical distribution, including U.S.A. (Florida and Hawaii) and Japan, due to the ornamental use of its host plant, *Psidium cattleianum*, which is endemic from Brazil and has been introduced in other countries to be used in garden landscaping (Vitorino et al. 2000).

In relation to their origin, 77 galling species are proposed as endemic in Brazil. Among them, 51 are considered endemic in the Atlantic Forest, 14 were identified in species - *Dasineura copacabanensis* Maia, 1993; *D. gigantea* Angelo & Maia, 1999; *D. globosa* Maia, 1993; *D. marginalis* Maia, 2005; *Jorgenseniella eugeniae* Maia, 2005; *Myrciamyia maricaensis* Maia, 1995; *Neomitranthella robusta* Maia, 1996; *Stephomyia clavata* (Tavares, 1920); *S. spiralis* Maia, 1993; *S. mina* Maia, 1993; *S. rotundifolium* 1993; and *S. tetraloba* 1993 (Diptera, Cecidomyiidae); *Pacholenus pelliceus* Boheman, 1836 (Coleoptera, Curculionidae) and *Tectococcus ovatus* Hempel, 1900 (Hemiptera, Eriococcidae). Concerning the conservational status, data are not sufficient to enable an evaluation.

Besides the inducers, other dwellers have been recorded as parasitoids, inquilines and predators (Table 5). Parasitoids were recorded in only 26 morphotypes (about 24%), all induced by Cecidomyiidae. They are represented by seven families of Hymenoptera: Eulophidae (14 gall morphotypes), Eurytomidae (7), Platygastriidae (7), Eupelmidae (4), Torymidae (4), Scelionidae (1) and Braconidae (1). None parasitoid was identified in species. Five parasitoid records were presented in genus, four in subfamily, 26 in family and nine in order. The number of records is greater than the number of parasited gall morphotypes due to multiparasitism. *Rileyia* Ashmead, 1888 (Eurytomidae), *Donquickeia* Marsh, 1993 (Braconidae), *Chrysonotomia* Ashmead, 1904 (Eulophidae) and *Proacrias* Ihering, 1914 (Eulophidae) were the reported genera, all found in a single gall morphotype, except the first, found in two morphotypes. Multiparasitism have been recorded in nine gall morphotypes.

Inquilines were recorded in 17 gall morphotypes. They were represented by Diptera, Lepidoptera, Hymenoptera, Coleoptera, Hemiptera, and Thysanoptera. All morphotypes hosted a single inquiline order, except two of them (1. bud or leaf vein gall on *Myrcia splendens*, and 2) marginal roll on *Neomitranthes obscura*). Diptera were found in five gall morphotypes, Lepidoptera and Hymenoptera in three each, Coleoptera and Hemiptera in two each, and Thysanoptera in one. Diptera were represented by Cecidomyiidae (*Dasineura tavaresi* Maia, 1995, *Resseliella* sp. and *Trotteria* sp.) and Sciaridae. Lepidoptera included *Stenoma annosa* (Butler, 1877) (Depressidae) found in two gall morphotypes on *Neomitranthes obscura*. *Stenoma annosa* is a free-living species, whose caterpillar feeds on leaves of several Myrtaceae. Eventually, it feeds on galls, causing their complete destruction, which results in the death of the galling species. Besides, other record, but in order category, is known on *Psidium cattleianum*. Hymenoptera included Eulophidae (*Aprostocetus* sp. and *Tetrastichinae* sp.), Formicidae (*Leptothorax* sp.) and a record in order category. Coleoptera were represented only by Curculionidae, Hemiptera included Coccidae and Membracidae, and Thysanoptera *Gynaikothrips uzeli* Zimmermann, 1900.

Predators were recorded in five gall morphotypes and they included *Lestodiplosis* sp. (Cecidomyiidae) found in four gall morphotypes, and *Novohorus* sp. (Olpidae), a pseudoscorpion found in a single morphotype.

Additionally, Bregonci et al. (2010) reported Thysanoptera and Formicidae (Hymenoptera) in galls of Cecidomyiidae on *Myrciaria floribunda*, but their habits were not informed.

Three gall morphotypes are described for the first time on *Myrciaria floribunda*: lenticular, globoid and rosette galls, all found in the Parque Municipal Chico Mendes (Rio de Janeiro, RJ). New occurrences of gall midges species are provided herein: *Eugeniamyia dispar* in the State of Rio de Janeiro, *Dasineura myrciariae* and *Myrciariamyia bivalva*

Table 5. Parasitoids, inquilines and predators recorded in insect galls on Myrtaceae in Brazilian restingas.

Dwellers habit	Host Plant	Gall morphotype	Galling insect
Parasitoids			
Order:			
Hymenoptera	<i>Eugenia astringens</i> Cambess.	Lenticular	<i>Dasineura globosa</i> Maia, 1995 (Cecidomyiidae)
	<i>Eugenia hiemalis</i> Cambess.	Marginal roll	<i>Stephomyia</i> cfr. <i>clavata</i> (Tavares, 1920) (Cecidomyiidae)
	<i>Eugenia puniceifolia</i> (Kunt) DC.	Cylindrical	<i>Stephomyia</i> sp.
		Globoid	Undetermined
	<i>Myrcia splendens</i> (SW.) DC.	Conical	Undetermined
		Globoid	Undetermined
		Fusifiform	Cecidomyiidae
	<i>Myrciaria floribunda</i> (West ex Willdenow) Berg	Star-shaped	Cecidomyiidae
	<i>Neomitranthes obscura</i> (DC.) N. J. E. Silveira	Fusifiform	<i>Stephomyia mina</i> Maia, 1993 (Cecidomyiidae)

Continuation Table 1.

Dwellers habit	Host Plant	Gall morphotype	Galling insect
Family:			
Eulophidae	<i>Eugenia astringens</i>	Claviform	<i>Stephomyia clavata</i>
		Cylindrical	<i>Stephomyia rotundifoliorum</i> Maia, 1993 (Cecidomyiidae)
		Marginal roll	<i>Dasineura marginalis</i> Maia, 2005 (Cecidomyiidae, Diptera)
	<i>Eugenia copacabanensis</i> Kiaersk.	Conical	<i>Dasineura copacabanensis</i> Maia, 1993 (Cecidomyiidae)
		Spiraled	<i>Stephomyia espiralis</i> Maia, 1993 (Cecidomyiidae)
	<i>Eugenia hiemalis</i>	Claviform	<i>Stephomyia</i> cfr. <i>clavata</i>
		Conical	Cecidomyiidae
		Marginal roll	Cecidomyiidae
	<i>Eugenia uniflora</i> L.	Conical	<i>Clinodiplosis profusa</i> Maia, 2001 (Cecidomyiidae)
		Lenticular	<i>Neolasioptera eugeniae</i> Maia, 1993 (Cecidomyiidae)
	<i>Myrcia ovata</i> Cambess.	Globoid	<i>Dasineura</i> sp. (Cecidomyiidae)
		Ovoid	<i>Myrciamyia maricaensis</i> Maia, 1995 (Cecidomyiidae)
	<i>Myrciaria floribunda</i>	Marginal roll	<i>Dasineura myrciariae</i> Maia, 1995 (Cecidomyiidae)
	<i>Neomitranthes obscura</i>	Pineapple-shaped	<i>Neomitranthella robusta</i> Maia, 1995 (Cecidomyiidae)
Eupelmidae	<i>Eugenia astringens</i>	Cylindrical	<i>Stephomyia rotundifoliorum</i>
	<i>Eugenia hiemalis</i>	Claviform	<i>Stephomyia</i> cfr. <i>clavata</i>
		Conical	Cecidomyiidae
		Marginal roll	Cecidomyiidae
Eurytomidae	<i>Eugenia astringens</i>	Claviform	<i>Stephomyia clavata</i>
		Cylindrical	<i>Stephomyia rotundifoliorum</i>
	<i>Eugenia copacabanensis</i>	Conical	<i>Dasineura copacabanensis</i>
		Spiraled	<i>Stephomyia espiralis</i>
	<i>Eugenia uniflora</i>	Conical	<i>Clinodiplosis profusa</i>
		Globoid	<i>Eugeniomyia dispar</i> Maia, Mendonça & Romanovski, 1996 (Cecidomyiidae)
	<i>Myrciaria floribunda</i>	Globoid	Cecidomyiidae
Platygastridae	<i>Eugenia hiemalis</i>	Claviform	<i>Stephomyia</i> cfr. <i>clavata</i>
		Cylindrical	<i>Stephomyia</i> sp.
Scelionidae	<i>Eugenia speciosa</i> Cambess.	Claviform	Schizomyiina (Cecidomyiidae)
	<i>Eugenia uniflora</i>	Conical	<i>Clinodiplosis profusa</i>
	<i>Myrcia ovata</i>	Ovoid	<i>Myrciamyia maricaensis</i>
	<i>Myrcia splendens</i>	Globoid	Undetermined
		Ovoid	Oligotrophini (Cecidomyiidae)
Torymidae	<i>Eugenia astringens</i>	Cylindrical	<i>Stephomyia rotundifoliorum</i>
		Marginal roll	<i>Dasineura marginalis</i>
	<i>Eugenia copacabanensis</i>	Rosette	Undetermined
	<i>Myrcia splendens</i>	Bud	Lasiopteridi (Cecidomyiidae)
Subfamily:			
Tetrastichinae	<i>Eugenia astringens</i>	Lenticular	<i>Dasineura globosa</i>

Continuation Table 1.

Dwellers habit	Host Plant	Gall morphotype	Galling insect
Tetrastichinae	<i>Eugenia copacabanensis</i>	Spiraled	<i>Stephomyia espiralis</i>
	<i>Eugenia uniflora</i>	Conical	<i>Clinodiplosis profusa</i>
	<i>Neomitranthes obscura</i>	Pineapple-shaped	<i>Neomitranthella robusta</i>
Genus:			
<i>Chrysonotomia</i> Ashmead, 1904 (Eulophidae)	<i>Eugenia uniflora</i>	Conical	<i>Clinodiplosis profusa</i>
<i>Donquickeia</i> Marsh, 1993 (Braconidae)	<i>Eugenia astringens</i>	Cylindrical	<i>Stephomyia rotundifoliorum</i>
<i>Proacrias</i> Ihering, 1914 (Eulophidae)	<i>Myrciaria floribunda</i>	Marginal roll	<i>Dasineura myrciariae</i>
<i>Rileyia</i> Ashmead, 1888 (Eurytomidae)	<i>Eugenia astringens</i>	Cylindrical	<i>Stephomyia rotundifoliorum</i>
	<i>Eugenia copacabanensis</i>	Spiraled	<i>Stephomyia espiralis</i>
Inquilines			
Order:			
Lepidoptera	<i>Psidium cattleianum</i> Sabine	Globoid	Undetermined
Family:			
Curculionidae (Coleoptera)	<i>Eugenia astringens</i>	Cylindrical	<i>Stephomyia rotundifoliorum</i>
	<i>Neomitranthes obscura</i>	Pineapple-shaped	<i>Neomitranthella robusta</i>
Coccidae?	<i>Myrcia splendens</i>	Bud or leaf vein	Lasiopteridi (Cecidomyiidae)
Membracidae (Hemiptera)	<i>Campomanesia guaviroba</i> (DC.) Kiaersk.	Globoid	Cecidomyiidae
Sciaridae (Diptera)	<i>Eugenia speciosa</i> Cambess.	Claviform	Schizomyiina (Cecidomyiidae)
Subfamily:			
Tetrastichinae (Hymenoptera)	<i>Myrcia ovata</i>	Globoid	<i>Dasineura</i> sp. (Cecidomyiidae)
Genus:			
<i>Aprostocetus</i> sp. (Eulophidae, Hymenoptera)	<i>Myrcia ovata</i>	Ovoid	<i>Myrciamyia maricaensis</i>
<i>Leptothorax</i> sp. (Formicidae, Hymenoptera)	<i>Eugenia hiemalis</i>	Cylindrical	<i>Stephomyia</i> sp. (Cecidomyiidae)
<i>Resseliella</i> sp. (Cecidomyiidae)	<i>Eugenia astringens</i>	Lenticular	<i>Dasineura globosa</i>
<i>Trotteria</i> sp. (Cecidomyiidae)	<i>Eugenia astringens</i>	Lenticular	<i>Jorgenseniella eugeniae</i> Maia, 2005 (Cecidomyiidae)
	<i>Myrcia splendens</i>	Bud or leaf vein	Lasiopteridi (Cecidomyiidae)
Species:			
<i>Dasineura tavaresi</i> Maia, 1995 (Cecidomyiidae)	<i>Neomitranthes obscura</i>	Marginal roll	<i>Clinodiplosis</i> sp. (Cecidomyiidae)
<i>Gynaikothrips uzeli</i> (Zimmerman, 1909) (Thysanoptera, Phlaeothripidae)	<i>Eugenia uniflora</i>	Conical	<i>Clinodiplosis profusa</i>
<i>Stenoma annosa</i> (Butler, 1877) (Depressariidae, Lepidoptera)	<i>Neomitranthes obscura</i>	Marginal roll	<i>Clinodiplosis</i> sp.
	<i>Neomitranthes obscura</i>	Pineapple-shaped	<i>Neomitranthella robusta</i>
Predators:			
Genus:			
<i>Lestodiplosis</i> sp. (Cecidomyiidae)	<i>Eugenia astringens</i>	Marginal roll	<i>Dasineura marginalis</i>
<i>Lestodiplosis</i> sp.	<i>Myrcia multiflora</i>	Marginal roll	Thysanoptera
<i>Lestodiplosis</i> sp.	<i>Myrcia splendens</i>	Bud gall	Undetermined
<i>Lestodiplosis</i> sp.	<i>Myrciaria floribunda</i>	Marginal roll	<i>Dasineura myrciariae</i>
	<i>Myrcia multiflora</i> (Lam.) DC.	Marginal roll	Thysanoptera
Species:			
<i>Novohorus</i> sp. (Olpidae, Pseudoscorpiones)	<i>Eugenia astringens</i>	Cylindrical	<i>Stephomyia rotundifoliorum</i>

in the municipality of Rio de Janeiro, and *Neolasioptera eugeniae* in the Parque Municipal Chico Mendes.

Furthermore, the globoid gall of stems of *Eugenia uniflora* is reported for the first time in the State of Rio de Janeiro (it was previously known only in Espírito Santo and the galler is unknown). And finally, the records of star-shaped galls (induced by Cecidomyiidae) and leaf rolls (induced by Thysanoptera) on *Myrciaria floribunda* are new in the municipality of Rio de Janeiro.

The morphological characterization of galls on Myrtaceae in Brazilian restingas is compiled and presented below in alphabetical order of the host plant species. Data on galled organ, gall shape, color, indumentum, number of internal chamber, galler and other dwellers are presented whenever available. Informations about their geographical distribution in Brazilian restingas are added.

***Blepharocalyx salicifolius* (Kunth) O. Berg.**

1. Gall on leaf vein, woody, fusiform. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).

***Calyptranthes brasiliensis* Spreng.**

1. Gall on bud, conical, green or brown, glabrous, multichambered. Galler: undetermined. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
2. Gall on stem. Galler: undetermined. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).

***Campomanesia guaviroba* (DC.) Kiaersk.**

1. Gall on leaf vein, globoid, one-chambered. Galler: *Clinodiplosis* sp. (Cecidomyiidae). Locality: SP (Bertioga). Other dwellers: Membracidae (Hemiptera) – inquiline. Reference: Maia et al. (2008).

***Eugenia astringens* Cambess.**

1. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: *Dasineura marginalis* Maia, 2005 (Cecidomyiidae, Diptera). Other dwellers: *Lestodiplosis* sp. (Cecidomyiidae) – predator; Tetrastichinae (Eulophidae), Torymidae (Hymenoptera) – parasitoids. Localities: RJ (Mangaratiba: Ilha da Marambaia; Rio de Janeiro: Grumari; Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, Carapebus, Parque Nacional da Restinga de Jurubatiba. References: Maia (2001a), Maia et al. (2005); Monteiro et al. (1994), Monteiro et al. (2004), Oliveira & Maia (2005), Carvalho-Fernandes et al. (2016), Silva & Maia (2016).
2. Gall on bud, cylindrical, brown, glabrous, one-chambered. Galler: *Stephomyia rotundifoliorum* Maia, 1993 (Cecidomyiidae). Other dwellers: *Rileyia* sp. (Eurytomidae), *Donquickeia* (Braconidae), Eupelmidae, Eulophidae, Scelionidae, Torymidae (Hymenoptera) – parasitoids; *Novohorus* sp. (Pseudoscorpiones: Ophiidae) – predators. Localities: RJ (Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, Carapebus, Parque Nacional da Restinga de Jurubatiba, São João da Barra). References: Maia (1993b, 2001a), Monteiro et al. (1994), Carvalho-Fernandes et al. (2016).
3. Gall on leaf, lenticular, yellow, glabrous, one-chambered. Galler: *Dasineura globosa* Maia, 1995 (Cecidomyiidae). Other dwellers: *Resseliella* sp. (Cecidomyiidae) – inquiline; Hymenoptera – parasitoids. Localities: RJ (Mangaratiba: Ilha

da Marambaia; Rio de Janeiro: Grumari; Maricá, Saquarema, Carapebus, Araruama, Cabo Frio, Arraial do Cabo, Parque Nacional da Restinga de Jurubatiba, São João da Barra). References: Maia (1995, 2001a), Monteiro et al. (2004); Oliveira & Maia (2005); Rodrigues et al. (2014), Carvalho-Fernandes et al. (2016), Silva & Maia (2016).

4. Gall on leaf, conical. Galler: Cecidomyiidae. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
5. Gall on leaf, conical. Galler: Cecidomyiidae. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
6. Gall on leaf, claviform, reddish, glabrous, one-chambered. Galler: *Stephomyia clavata* (Tavares 1920) (Cecidomyiidae). Other dwellers: Eulophidae, Eurytomidae (Hymenoptera) – parasitoids. Localities: RJ (Rio de Janeiro, Carapebus, Parque Nacional da Restinga de Jurubatiba, Araruama, Arraial do Cabo, São João da Barra. References: Maia (2001a), Monteiro et al. (2004); Carvalho-Fernandes et al. (2016), Silva & Maia (2016).
7. Gall on stem, fusiform. Galler: undetermined. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
8. Gall on leaf, globoid, green, glabrous, one-chambered. Galler: undetermined. Localities: RJ (Araruama, Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).
9. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: *Jorgenseniella eugeniae* Maia, 2005 (Cecidomyiidae). Other dwellers: *Trotteria* sp. (Cecidomyiidae) – inquilines. Localities: SP (Bertioga), RJ (Cabo Frio, Macaé). References: Maia et al. (2005, 2008).

***Eugenia copacabanensis* Kiaersk.**

1. Gall on leaf, spiraled, reddish, glabrous, one-chambered. Galler: *Stephomyia spiralis* Maia, 1993 (Cecidomyiidae). Other dwellers: *Rileyia* sp. (Eurytomidae), Tetrastichinae (Eulophidae) (Hymenoptera) – parasitoids. Localities: RJ (Mangaratiba: Ilha da Marambaia; Maricá, Araruama, Cabo Frio, Arraial do Cabo. References: Maia (1993b), Maia (2001a), Monteiro et al. (2004), Carvalho-Fernandes et al. (2016).
2. Gall on bud, conical, green, glabrous, pedunculated. Galler: *Dasineura copacabanensis* Maia, 1993 (Cecidomyiidae). Localities: RJ (Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, São João da Barra). References: Maia (1993a), Monteiro et al. (2004), Carvalho-Fernandes et al. (2016).
3. Gall on young leaf, leaf roll, reddish, glabrous, one-chambered. Galler: *Dasineura* sp. (Cecidomyiidae). Locality: RJ (Maricá). Reference: Maia et al. (2002).
4. Gall on leaf. Galler: Cecidomyiidae. Locality: RJ (Maricá). Reference: Monteiro et al. (1994).
5. Gall on stem. Galler: Cecidomyiidae. Locality: RJ (Maricá). Reference: Monteiro et al. (1994).
6. Gall on stem. Galler: Hymenoptera. Locality: RJ (Arraial do Cabo). Reference: Monteiro et al. (1994).

7. Gall on leaf, fusiform, reddish, glabrous, one-chambered. Galler: *Stephomyia tetraloba* Maia, 1993 (Cecidomyiidae). Localities: RJ (Maricá, Arraial do Cabo). References: Maia (2001a), Carvalho-Fernandes et al. (2016).
8. Gall on leaf, conical, reddish, glabrous, one-chambered. Galler: *Bruggmannia* sp. (Cecidomyiidae). Locality: RJ (Arraial do Cabo). Other dwellers: Eulophidae, Eurytomidae (Hymenoptera) – parasitoids. Reference: Carvalho-Fernandes et al. (2016).
9. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: undetermined. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Carvalho-Fernandes et al. (2016).
10. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: undetermined. Localities: RJ (Araruama, Cabo Frio, Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).
11. Gall on leaf vein, globoid, green, glabrous, one-chambered. Galler: Hymenoptera. Locality: RJ (Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).
12. Gall on bud, rosette, green, glabrous, one-chambered. Galler: undetermined. Other dwellers: Torymidae (Hymenoptera) – parasitoids. Locality: RJ (Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).

Eugenia hiemalis Cambess.

1. Gall on bud, cylindrical, brown, glabrous, one-chambered. Galler: *Stephomyia* sp. (Cecidomyiidae). Other dwellers: *Leptothorax* sp. (Formicidae, Hymenoptera) – inquiline; Eupelmidae, Platygastriidae (Hymenoptera) – parasitoids. Locality: RJ (Carapebus). Reference: Maia (2001a).
2. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: Lasipteridi (Cecidomyiidae). Other dwellers: Hymenoptera – parasitoids. Locality: RJ (Carapebus). Reference: Maia (2001a).
3. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: Cecidomyiidae. Other dwellers: Eulophidae (Hymenoptera) – parasitoids. Locality: RJ (Carapebus). Reference: Maia (2001a).
4. Gall on leaf, conical, yellow, glabrous, one-chambered. Galler: Cecidomyiidae. Other dwellers: Eupelmidae, Eulophidae (Hymenoptera) – parasitoids. Locality: RJ (Carapebus). Reference: Maia (2001a).
5. Gall on leaf, claviform, green or reddish, glabrous, one-chambered. Galler: *Stephomyia* cf: *clavata* (Tavares, 1920) (Cecidomyiidae). Other dwellers: Eulophidae, Eupelmidae, Platygastriidae (Hymenoptera) – parasitoids. Locality: RJ (Carapebus). Reference: Maia (2001a).
6. Gall on leaf, conical, yellow, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Carapebus). Reference: Maia (2001a).

Eugenia monosperma Vell.

1. Gall on leaf, globoid, yellow, glabrous, one-chambered. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).
2. Gall on leaf, lenticular, glabrous, one-chambered. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).

Eugenia puniceifolia (Kunt) DC.

1. Gall on leaf, cylindrical, green or reddish, glabrous, one-chambered. Galler: *Stephomyia* sp. (Cecidomyiidae). Other dwellers: Hymenoptera – parasitoids. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
2. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
3. Gall on leaf. Galler: Cecidomyiidae. Locality: RJ (Arraial do Cabo). Reference: Monteiro et al. (1994).
4. Gall on stem, fusiform, brown, glabrous, multichambered. Galler: Lasipteridi (Diptera, Cecidomyiidae). Other dwellers: Hymenoptera – parasitoids. Localities: RJ (Mangaratiba: Ilha da Marambaia; Rio de Janeiro: Grumari; Saquarema, Cabo Frio). References: Oliveira & Maia (2005), Rodrigues et al. (2014), Carvalho-Fernandes et al. (2016).
5. Gall on stem. Galler: Hymenoptera. Locality: RJ (Maricá). Reference: Monteiro et al. (1994).
6. Gall on stem. Galler: undetermined. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
7. Gall on fruit, globoid, green or yellow, glabrous, multichambered. Galler: undetermined. Other dwellers: Curculionidae (Coleoptera) – inquiline; Hymenoptera – parasitoids. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
8. Gall on fruit. Galler: Cecidomyiidae. Locality: RJ (Maricá). Reference: Monteiro et al. (1994).

Eugenia selloi (O. Berg.) B. D. Jacks.

1. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: Cecidomyiidae. Localities: RJ (Saquarema, Araruama, Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).

Eugenia speciosa Cambess.

1. Gall on leaf, conical, yellow, glabrous, one-chambered. Galler: Schizomyiina (Cecidomyiidae). Other insects: Sciaridae – inquiline. Locality: SP (Bertioga). Reference: Maia et al. (2008).
2. Gall on leaf, claviform, green, glabrous, one-chambered. Galler: Schizomyiina (Cecidomyiidae). Other dwellers: Platygastriidae (Hymenoptera) – parasitoids. Locality: SP (Bertioga). Reference: Maia et al. (2008).

Eugenia sulcata Spring ex Mart.

1. Gall on bud, cylindrical, reddish, glabrous, one-chambered. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008)
2. Gall on bud, ovoid, green, glabrous. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).

Eugenia uniflora L.

1. Gall on leaf, globoid, spongy, whitish, glabrous, one-chambered. Galler: *Eugeniomyia dispar* Maia, Mendonça & Romanovski, 1996 (Cecidomyiidae). Other dwellers: Eurytomidae (Hymenoptera) – parasitoids. Localities: RJ (Parque Natural Municipal Chico Mendes – new record), SP (Bertioga). Reference: Maia et al. (2008).

2. Gall on leaf, conical, green or reddish, glabrous, one-chambered. Galler: *Clinodiplosis profusa* Maia 2001 (Cecidomyiidae). Other dwellers: *Chrysonotomyia* sp. (Eulophidae), Tetrastichinae (Eulophidae), Platygastriidae (Hymenoptera) – parasitoids; *Gynaikothrips uzeli* (Zimmerman, 1909) (Thysanoptera, Phlaeothripidae) – inquilines. Localities: RJ (Mangaratiba: Ilha da Marambaia; Rio de Janeiro: Grumari; Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, Carapebus, Parque Nacional da Restinga de Jurubatiba, São João da Barra). References: Maia (2001a,b); Monteiro et al. (1994), Monteiro et al. (2004), Oliveira & Maia (2005), Carvalho-Fernandes et al. (2016), Silva & Maia (2016).
3. Gall on leaf, lenticular, green, yellowish or black, glabrous, one-chambered. Galler: *Neolasioptera eugeniae* Maia 1993 (Cecidomyiidae). Other dwellers: Eulophidae (Cecidomyiidae) – parasitoids. Localities: RJ (Paraty, Angra dos Reis: Ilha Grande; Rio de Janeiro: Grumari, Parque Natural Municipal Chico Mendes – new record; Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, São João da Barra). References: Maia (1993a, 2001a), Maia & Oliveira (2010), Monteiro et al. (1994), Oliveira & Maia (2005), Carvalho-Fernandes et al. (2016), Silva & Maia (2016).
4. Gall on fruit, conical, reddish, glabrous, one-chambered. Galler: Cecidomyiidae. Other dwellers: Eurytomidae (Hymenoptera) – parasitoids. Localities: RJ (Maricá, Cabo Frio, São João da Barra). References: Monteiro et al. (1994), Carvalho-Fernandes et al. (2016).
5. Gall on leaf, conical, green, glabrous, one-chambered. Galler: *Eugeniamyia triangularis* Maia, 2011 (Cecidomyiidae). Locality: RJ (Maricá). Reference: Maia & Nava (2011).
6. Gall on bud flower, conical, reddish, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Rio de Janeiro: Grumari). Reference: Oliveira & Maia (2005).
7. Gall on stem, fusiform, brown, glabrous, one-chambered. Galler: undetermined. Localities: RJ (Angra dos Reis: Ilha Grande; Mangaratiba: Ilha da Marambaia). References: Maia & Oliveira (2010), Rodrigues et al. (2014).
8. Gall on leaf, fold, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).

***Myrcia brasiliensis* Kiaersk.**

1. Gall on stem, fusiform, brown, glabrous, one-chambered. Galler: *Pacholenus pelliceus* Boheman, 1836 (Coleoptera: Curculionidae). Locality: RJ (Maricá). Reference: Monteiro et al. (1994).
2. Gall on bud, ovoid, multichambered, glabrous. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).
3. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: *Bruggmanniella* cfr. (Cecidomyiidae). Locality: SP (Bertioga). Reference: Maia et al. (2008).

***Myrcia ilheosensis* Kiaersk.**

1. Gall on stem, fusiform, brown, glabrous, one-chambered. Galler: *Pacholenus pelliceus* Boheman, 1836 (Coleoptera: Curculionidae). Localities: SP (Bertioga), RJ (Maricá).

References: Monteiro et al. (1994), Vanin (2008), Maia et al. (2008).

***Myrcia lundiana* Kiaersk.**

1. Gall on leaf, globose. Galler: *Dasineura* sp. (Cecidomyiidae). Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
2. Gall on leaf. Galler: undetermined. Locality: RJ (Maricá). Reference: Monteiro et al. (1994).
3. Gall on bud, ovoid, grooved. Galler: *Myrciamyia maricaensis* Maia, 1995 (Cecidomyiidae). Locality: RJ (Parque Nacional da Restinga de Jurubatiba). References: Maia (1996), Monteiro et al. (2004).
4. Gall on peduncle flower, fusiform. Galler: Cecidomyiidae. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
5. Gall on leaf, lenticular. Galler: undetermined. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).
6. Gall on leaf vein. Galler: undetermined. Locality: RJ (Parque Nacional da Restinga de Jurubatiba). Reference: Monteiro et al. (2004).

***Myrcia multiflora* (Lam.) DC.**

1. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: Thysanoptera. Other insects associados: *Lestodiplosis* sp. – predator. Locality: SP (Bertioga). References: Maia et al. (2008).

***Myrcia ovata* Camb.**

1. Gall on leaf, globose, yellow, glabrous, one-chambered. Galler: *Dasineura* sp. (Cecidomyiidae). Other dwellers: Tetrastichinae (Eulophidae, Hymenoptera) – inquiline. Localities: RJ (Maricá, Arraial do Cabo). References: Maia (2001a), Maia et al. (2002), Monteiro et al. (2004), Carvalho-Fernandes et al. (2016).
2. Gall on leaf. Galler: undetermined. Locality: RJ (Maricá). Reference: Monteiro et al. (1994).
3. Gall on bud, ovoid, green, grooved, glabrous, one-chambered. Galler: *Myrciamyia maricaensis* Maia, 1995 (Cecidomyiidae). Other dwellers: Platygastriidae (Hymenoptera) – parasitoids; *Aprostocetus* sp. (Eulophidae, Hymenoptera) – inquiline. Localities: RJ (Maricá, Cabo Frio, Arraial do Cabo, Carapebus, Parque Nacional da Restinga de Jurubatiba). References: Maia (1996, 2001a), Monteiro et al. (2004).
4. Gall on peduncle flower, fusiform, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Maricá). References: Maia (2001a), Monteiro et al. (2004).
5. Gall on leaf vein, conical, green, glabrous, one-chambered. Galler: *Dasineura* sp. (Cecidomyiidae). Localities: RJ (Araruama, Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).
6. Gall on leaf, conical, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).
7. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: Thysanoptera. Locality: RJ (Cabo Frio). Reference: Carvalho-Fernandes et al. (2016).

8. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: undetermined. Locality: RJ (Cabo Frio). Reference: Carvalho-Fernandes et al. (2016).

***Myrcia palustris* DC.**

1. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).
2. Gall on bud, ovoid, brown, glabrous, multichambered. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).

***Myrcia racemosa* (O. Berg.) Kiaersk.**

1. Gall on stem, globoid, brown, glabrous, multichambered. Galler: undetermined. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).

***Myrcia splendens* (SW.) DC.**

1. Gall on leaf, globoid, green, glabrous, one-chambered. Galler: undetermined. Other dwellers: Hymenoptera – parasitoids. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
2. Gall on leaf, conical, yellow or green, glabrous, one-chambered. Galler: undetermined. Other dwellers: Hymenoptera – parasitoids. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
3. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: undetermined. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
4. Gall on leaf, leaf roll, reddish, glabrous, one-chambered. Galler: undetermined. Locality: SP (Bertioga). Reference: Maia et al. (2008).
5. Gall on bud, globoid, green or brown, glabrous, multichambered. Galler: undetermined. Locality: RJ (Mangaratiba: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
6. Gall on stem, globoid, brown, glabrous. Galler: Lasioteridi (Cecidomyiidae). Other dwellers: Platygastriidae (Hymenoptera) – parasitoids. Locality: SP (Bertioga). Reference: Maia et al. (2008).
7. Gall on vein leaf, globoid, brown, glabrous, one-chambered. Galler: Lasioteridi (Cecidomyiidae). Other dwellers: Platygastriidae (Hymenoptera) – parasitoids. Locality: SP (Bertioga). Reference: Maia et al. (2008).
8. Gall on bud. Galler: Lasioteridi (Cecidomyiidae). Other dwellers: Torymidae (Hymenoptera) – parasitoids. Locality: SP (Bertioga). Reference: Maia et al. (2008).
9. Gall on stem, fusiform, multichambered. Galler: Cecidomyiidae. Locality: SP (Bertioga). Reference: Maia et al. (2008).
10. Gall on stem or leaf vein. Galler: Lasioteridi (Cecidomyiidae). Other dwellers: Hemiptera (Coccidae?), *Trotteria* sp. (Cecidomyiidae) – inquiline. Locality: SP (Bertioga). Reference: Maia et al. (2008).
11. Gall on bud, conical. Galler: undetermined. Other dwellers: *Lestodiplosis* sp. (Cecidomyiidae) - predator. Locality: SP (Bertioga). Reference: Maia et al. (2008).

***Myrciaria floribunda* Miq.**

1. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: *Dasineura myrciariae* Maia, 1995 (Cecidomyiidae). Other dwellers: *Lestodiplosis* sp. (Cecidomyiidae) – predator;

Proacrias sp. (Eulophidae, Hymenoptera) – parasitoids. Localities: RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes – new record; Maricá, Carapebus, Parque Nacional da Restinga de Jurubatiba), ES (Guarapari). References: Maia (1995), Monteiro et al. (1994), Monteiro et al. (2004), Bregonci et al. (2010).

2. Gall on leaf, leaf roll, green, glabrous, one-chambered. Galler: Thysanoptera. Localities: RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes – new record; Maricá, Arraial do Cabo). References: Monteiro et al. (1994), Carvalho-Fernandes et al. (2016).
3. Gall on bud, bivalve, yellow, glabrous, one-chambered. Galler: *Myrciariamyia bivalva* Maia, 1994 (Cecidomyiidae). Localities: RJ (Rio de Janeiro: Parque Natural Municipal Chico – new record; Maricá, Carapebus, Arraial do Cabo, Jurubatiba). References: Maia (1994, 2001a), Monteiro et al. (1994), Monteiro et al. (2004).
4. Gall on leaf, star-shaped, yellow, one-chambered. Galler: Cecidomyiidae. Other dwellers: Hymenoptera – parasitoids. Localities: RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes – new record; Maricá, Carapebus). Reference: Maia (2001a).
5. Gall on leaf, lenticular, green, glabrous, one-chambered. Galler: undetermined. Locality: RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes – new record).
6. Gall on leaf, globoid, glabrous, one-chambered. Galler: *Eugeniomyia dispar* Maia, Mendonça & Romanovski, 1996 (Cecidomyiidae). Locality: (Rio de Janeiro: Parque Natural Municipal Chico Mendes – new record).
7. Gall on stem, globoid, green, glabrous, one-chambered. Galler: undetermined. Localities: RJ (Rio de Janeiro: Parque Natural Municipal Chico Mendes – new record), ES (Guarapari). Reference: Bregonci et al. (2010).
8. Gall on leaf, globoid, green, hairy, one-, bi- or three-chambered. Galler: Cecidomyiidae. Other dwellers: *Prodecatoma* (Eurytomidae, Hymenoptera) – parasitoids, Thysanoptera and Formicidae (no data on habits). Locality: ES (Guarapari). Reference: Bregonci et al. (2010).
9. Gall on leaf, cylindrical, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Arraial do Cabo). Reference: Carvalho-Fernandes et al. (2016).
10. Gall on bud, rosette, green, glabrous, one-chambered. Galler: undetermined. Locality: RJ (Parque Natural Municipal Chico Mendes – new record).

***Myrciaria tenella* (DC.) O. Berg**

1. Gall on young leaf, leaf fold, green, glabrous, one-chambered. Galler: Hemiptera. Localities: RJ (Araruama, São João da Barra). Reference: Carvalho-Fernandes et al. (2016).

***Neomitranthes obscura* (DC.) Silveira**

1. Gall on leaf, conical, green, glabrous, one-chambered. Galler: Cecidomyiidae. Localities: RJ (Maricá, Arraial do Cabo, Carapebus e Parque Nacional da Restinga de Jurubatiba). References: Maia & Couri (1997), Maia (2001a), Monteiro et al. (2004).
2. Gall on leaf, leaf roll, green, glabrous, one-chambered. Galler: Thysanoptera. Localities: RJ (Maricá, Araruama, Arraial

- do Cabo). References: Maia 2006, Monteiro et al. (1994), Carvalho-Fernandes et al. (2016).
3. Gall on leaf, fusiform, green, glabrous, one-chambered. Galler: *Stephomyia mina* Maia, 1993 (Cecidomyiidae). Other dwellers: Hymenoptera – parasitoids. Localities: RJ (Maricá, Araruama, Arraial do Cabo, Carapebus). References: Maia (1993b, 2001a), Monteiro et al. (2004), Carvalho-Fernandes et al. (2016).
 4. Gall on leaf, roll marginal, green, glabrous, one-chambered. Galler: *Clinodiplosis* sp. (Cecidomyiidae). Other dwellers: *Dasineura tavaresi* Maia, 1995 (Cecidomyiidae), *Stenoma annosa* Butler, 1877 (Lepidoptera) – inquilines. Localities: RJ (Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, Carapebus, Parque Nacional da Restinga de Jurubatiba), ES (Guarapari). References: Maia (1995, 1996, 2001a), Monteiro et al. (2004), Carvalho-Fernandes et al. (2016), Silva & Maia (2016).
 5. Gall on bud, pineapple-shaped, green, glabrous. Galler: *Neomitranthella robusta* Maia, 1995 (Cecidomyiidae). Other dwellers: inquilines – *Stenoma annosa* (Lepidoptera), parasitoids – Tetrastichinae (Eulophidae, Hymenoptera). Localities: RJ (Maricá, Saquarema, Araruama, Cabo Frio, Arraial do Cabo, Carapebus, Parque Nacional da Restinga de Jurubatiba). References: Maia (1996, 2001a), Monteiro et al. (2004), Carvalho-Fernandes et al. (2016).
 6. Gall on stem, fusiform, brown, glabrous, one-chambered. Galler: undetermined. Localities: RJ (Saquarema, Araruama, Arraial do Cabo, Parque Nacional da Restinga de Jurubatiba). References: Monteiro et al. (2004), Carvalho-Fernandes et al. (2016).

***Plinia cauliflora* Kausel**

1. Gall on leaf, marginal roll, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Angra dos Reis: Ilha Grande). Reference: Maia & Oliveira (2010).
2. Gall on bud, cylindrical, green, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Angra dos Reis: Ilha Grande). Reference: Maia & Oliveira (2010).

***Psidium cattleianum* Sabine**

1. Gall on leaf, biconical, green, glabrous, one-chambered. Galler: *Tectococcus ovatus* Hempel (Eriococcidae, Hemiptera). Locality: RJ (Angra dos Reis: Ilha Grande). Reference: Maia & Oliveira (2010).
2. Gall on leaf or bud, globoid, yellow, glabrous, one-chambered. Galler: Cecidomyiidae. Locality: RJ (Angra dos Reis: Ilha Grande). Reference: Maia & Oliveira (2010).
3. Gall on stem, fusiform, brown, glabrous, multichambered. Galler: undetermined. Locality: RJ (Angra dos Reis: Ilha da Marambaia). Reference: Rodrigues et al. (2014).
4. Gall on leaf, tubular, green, glabrous, one-chambered. Galler: Lasipteridi (Cecidomyiidae). Locality: SP (Bertioga). Reference: Maia et al. (2008).
5. Gall on bud, green, rosette, glabrous. Galler: *Dasineura gigantea* Angelo & Maia, 1999 (Cecidomyiidae). Locality: SP (Bertioga). Reference: Maia et al. 2008.

6. Gall on leaf, conical, with small apical projections, green, glabrous. Galler: Cecidomyiidae. Locality: SP (Bertioga). Reference: Maia et al. (2008).
7. Gall on leaf, globoid, one-chambered. Galler: undetermined. Locality: SP (Bertioga). Other dwellers: Lepidoptera – inquiline. Reference: Maia et al. (2008).
8. Gall on leaf or leaf vein, lenticular. Galler: Cecidomyiidae. Locality: SP (Bertioga). Reference: Maia et al. 2008.

Discussion

In Brazilian restingas, Myrtaceae included from 18.18% to 11.38% of the total number of galled plant species (Table 1). In other physiognomies of the Atlantic Forest, the rates were lower, 0.00% in Semidecidual Seasonal Forest (Flor et al. 2018) and Altitude Fields (Coelho et al. 2013), from 3.86% to 11.11% in Ombrophilous Forest (Maia 2014, Maia et al. 2014 and Maia & Mascarenhas 2017), 8.16% in High Altitude Wetland Forest (Santos et al. 2011), and 9.75% in Tableland Forest (Maia & Carvalho-Fernandes 2015). Furthermore, Myrtaceae were not the plant family with the greatest number of galled species in these physiognomies. This position is occupied by Sapindaceae (in Semidecidual Seasonal Forest – Flor et al. 2018), Asteraceae (in Altitude Fields – Coelho et al. 2013 and Ombrophilous Forest – Maia et al. 2014 and Maia & Mascarenhas 2017), Melastomataceae (Ombrophilous Forest – Maia 2014), Nyctaginaceae (High Altitude Wetland Forest – Santos et al. 2011), and Fabaceae (in Tableland Forest – Maia & Carvalho-Fernandes 2015). The rates of gall morphotypes on Myrtaceae varied from 34.72% to 13.13% of the total number of gall morphotypes in Brazilian restingas (Table 1). In other physiognomies of the Atlantic Forest, these rates were lower, 0.00% in Semidecidual Seasonal Forest (Flor et al. 2018) and Altitude Fields (Coelho et al. 2013), from 6.40% to 10.89% in Ombrophilous Forest (Maia 2014, Maia et al. 2014 and Maia & Mascarenhas 2017), 8.86% in High Altitude Wetland Forest (Santos et al. 2011), and 9.09% in Tableland Forest (Maia & Carvalho-Fernandes 2015). These data revealed that Myrtaceae are an important host plant family mainly in restingas, while in other physiognomies of the Atlantic Forest this family can contribute to the gall richness as in the Ombrophilous Forest, High Altitude Wetland Forest and Tableland Forest or not as in Semidecidual Seasonal Forest and Altitude Fields. *Eugenia* and *Myrcia* highlighted as the Myrtaceae genera with the greatest number of galled species and gall morphotypes. Both are important components of the restinga flora, being the best represented genera of Myrtaceae in this physiognomy (Lourenço & Barbosa 2012, Souza & Morim 2008). The hypothesis of taxon size (Fernandes 1992) could explain the greater insect galls richness on Myrtaceae, *Eugenia* and *Myrcia*. It predicts that richer taxa have potentially more hosts and, consequently, a greater number of associated galling insects.

Leaves have been reported as the most galled plant organ in all regions of the world. This pattern was observed for the first time by Felt 1940 and has been confirmed in several studies (Maia & Fernandes 2004, Santos et al. 2011, Maia & Carvalho-Fernandes 2016, Maia & Mascarenhas 2017), probably because leaves represent an abundant, frequent and predictable resource.

Green galls predominated, probably because this is the color of the most frequent galled organ, leaf. Most galls were glabrous and one-chambered. These features have been observed as the most frequent in several Brazilian inventories, not only in restingas, but also in other physiognomies of the Atlantic Forest, as well as in other domains phytogeographic (Maia & Fernandes 2004, Santos et al. 2011, Maia & Carvalho-Fernandes 2016, Maia & Mascarenhas 2017).

Only 19% of the galling species have been identified in species. These results show how the taxonomical knowledge of the gallers is still incipient. Cecidomyiidae induced most galls as in all other inventories in the world. Among the gall midges genera, *Clinodiplosis* Kieffer, 1894 and *Dasineura* Rondani, 1840 have a wide world distribution, while *Neolasioptera* Felt, 1908 occurs in the Nearctic and Neotropical regions, and the others, *Bruggmannia* Tavares, 1906, *Eugeniomyia* Maia, Mendonça & Romanovski, 1997, *Jorgensiella* Maia, 2005, *Myrciomyia* Maia, 1995, *Myrciariomyia* Maia, 1994, *Neomitranthella* Maia, 1996, and *Stephomyia* Rondani, 1840 are exclusively Neotropical. Among them, five have been recorded only in Brazil: *Eugeniomyia*, *Myrciariomyia*, *Jorgensiella*, *Myrciomyia*, and *Neomitranthella*, being the last three restricted to restingas. *Clinodiplosis*, *Dasineura*, and *Neolasioptera* are speciose genera, with 476, 103 and 134 described species, respectively. *Bruggmannia*, *Eugeniomyia*, *Myrciariomyia*, and *Stephomyia* include 19, 2, 3 and 7 species, respectively. The others are monotypic (Gagné & Jaschhof 2017). *Clinodiplosis*, *Dasineura*, and *Neolasioptera* induce galls on several plant families, whereas most *Bruggmannia* species occurs on Nyctaginaceae, the other genera are exclusively associated with Myrtaceae (Gagné & Jaschhof 2017).

Rio de Janeiro is the most investigated Brazilian State, for this reason, it harbors most records. The geographical distribution of all galled plants is wider than that of the gallers, indicating that these insects can probably have a greater area of occurrence.

Galling species that occur exclusively on endemic plants were proposed as endemic too, based on their specificity of hosts. Concerning the conservational status, the gallers could not be evaluated as data on the host plants are deficient.

The presence of parasitoids, inquiline and predators has been frequently reported in gall inventories, not only in restingas and in Myrtaceae, but also in other ecosystems and plant families (Maia 2001a, Maia & Fernandes 2004, Maia et al. 2014, Maia & Carvalho-Fernandes 2016). Parasitoids have been considered the most frequent natural enemies of galling insects (Gagné 1994). Although all parasitoid families found in the present study are associated with several plant families in restinga, they are more diverse and frequent on Myrtaceae (Maia & Azevedo 2009). Concerning the parasitoids genera, *Donquickeia* and *Proacrias* are associated exclusively with Myrtaceae in restingas, while *Rileya* and *Chrysonotomia* have been recorded in other families, too (Maia & Azevedo 2009). Most records are in family categories, revealing that their taxonomical knowledge is still poor in Brazilian restingas. Multiparasitism have been recorded not only in Myrtaceae, but also in other plant families (Maia & Monteiro 1999, Maia & Tavares 2000, Maia & Azevedo 2009). All predaceous and most inquiline taxa recorded on galls in Myrtaceae of restingas have been reported in other plant families too (Maia 2001a, 2002), as well as in other phytogeographic domains (Maia 2001a, Maia & Fernandes 2004, Maia et al. 2014, Maia & Carvalho-Fernandes 2016). But some of them, as *Leptothorax* sp. (Hymenoptera), *Stenoma annosa* (Lepidoptera), and

Gynaikothrips uzeli (Thysanoptera) are known only on Myrtaceae at restingas. These diverse associated fauna highlights the importance of the galling species as ecosystem engineers, as they provide a new niche, the gall, which can be used by several arthropods.

Although restingas are the best studied phytophysiology of Brazil, new records were added, as many areas have not yet been studied.

Conclusions

Myrtaceae harbor a great richness of insect galls in Brazilian restingas, 111 morphotypes, in 25 host plant species (15 endemic). Most morphotypes are induced by Cecidomyiidae. Twelve gall midge species (Diptera, Cecidomyiidae), one beetle species (Coleoptera, Curculionidae) and one scale-insect species (Hemiptera, Eriococcidae) are associated with endemic hosts. These gallers are proposed as endemic.

Eugenia L. is the plant genus with the greatest richness of host species and gall morphotypes. Leaves are the most frequent galled organ. Globoid shape, green color, absence of trichomes and a single internal chamber are the predominant gall traits. Many arthropods, mainly insects, have been reported as dwellers of galls, where they play the role of parasitoids, inquilines and predators, highlighting the importance of the gallers as ecosystem engineers. The taxonomical knowledge of the galling species and other dwellers is still deficient. Great efforts are necessary to refine it, involving field trips, rearing, and taxonomist participation.

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Author Contributions

Valéria Cid Maia: Substantial contribution in the concept and design of the study; Contribution to data collection; Contribution to data analysis and interpretation; Contribution to manuscript preparation; Contribution to critical revision, adding intellectual content.

Conflicts of interest

The author declares that she has no conflict of interest related to the publication of this manuscript.

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