WEBBIA Journal of Plant Taxonomy and Geography

Firenze University Press
www.fupress.com/webbia

OPEN ACCESS

Citation: Guilherme Medeiros Antar, Roberto Baptista Pereira Almeida, Marco Antonio Palomares Accardo-Filho, Rafael Gomes Barbosa-Silva (2022) Tracking Brazil's Colonization Footprints: First record of the tea plant (*Camellia sinensis* (L.) Kuntze - Theaceae) naturalized in the Atlantic Forest Hotspot. *Webbia. Journal of Plant Taxonomy and Geography* 77(1): 177-183. doi: 10.36253/jopt-12854

Received: March 3, 2022

Accepted: April 11, 2022

Published: April 20, 2022

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Competing Interests: The Author(s) declare(s) no conflict of interest.

Editor: Riccardo M. Baldini

ORCID
GMA: https://orcid.org/0000-0001-8109-4544
RBPA: https://orcid.org/0000-0002-4629-1080
MAPA-F: https://orcid.org//0000-0002-2658-5794
RGB-S: https://orcid.org/0000-0002-0668-4840

Tracking Brazil's Colonization Footprints: First record of the tea plant (*Camellia sinensis* (L.) Kuntze – Theaceae) naturalized in the Atlantic Forest Hotspot

Guilherme Medeiros Antar[1,2,*], Roberto Baptista Pereira Almeida[1], Marco Antonio Palomares Accardo-Filho[3], Rafael Gomes Barbosa-Silva[2,4]

[1] *Universidade de São Paulo, Instituto de Biociências, Departamento de Botânica, Rua do Matão 277, 05508–090, São Paulo, SP, Brazil*
[2] *Instituto Tecnológico Vale, Rua Boaventura da Silva, 955, Belém, PA 66055-090, Brazil*
[3] *Fundação Oswaldo Cruz, Herbário da Coleção Botânica de Plantas Medicinais, Campus Fiocruz – Mata Atlântica, R. Sampaio Correa, s/n - Taquara, Rio de Janeiro - RJ, 22713-560, Pavilhão Olympio da Fonseca, sl. 2, Brazil*
[4] *Museu Paraense Emílio Goeldi, Coord. Botânica, Av. Perimetral 1901, 66077-830, Belém, PA, Brazil*
*Corresponding author. E-mail: guilherme.antar@gmail.com

Abstract. The colonization of Brazil by Portugal left deep marks in Brazil's current society and economy. The same applies to the country's biodiversity, with several introduced plants persisting as naturalized or invasive species. Among these, the tea plant, *Camellia sinensis*, is a notable case. The species was first cultivated in Rio de Janeiro state during the 19th century, but the crops were later abandoned mostly due to the presence of parasite fungi in cultivations, so that the species' cultivation continued in other states only. During recent fieldwork in the Atlantic Forest in the municipality of Petrópolis, Rio de Janeiro state, naturalized individuals of the tea plant were discovered. This finding, alongside ecological evidence, highlights a new threat to the biodiversity of an area of high species endemism. We provide historical information on the introduction of the species in Brazil and discuss the threats it imposes to the flora in a world hotspot. Our finding adds *C. sinensis* to the list of naturalized plants of Flora do Brasil 2020 and emphasizes the importance of monitoring the invasive potential of the species in the area, given its allelopathic potential on the germination of other species and competition with native plants.

Keywords: conservation monitoring, endemism, naturalization, plant introduction, protected areas.

INTRODUCTION

The colonization of Brazil by the Empire of Portugal left deep permanent marks in the country's society and economy, such as the Portuguese as

national language, and agriculture as main economic activity. There are long-standing marks in the country's biodiversity as well, with many exotic plants introduced, intentionally or not, during the colonization period (Zenni and Ziller 2011). Some of them are now part of the 700 naturalized or invasive land plant species recorded in the country (Flora do Brasil 2020). These plants were brought mostly as a source of food or beverages, such as the coffee plant (*Coffea arabica* L.) and the jack tree (*Artocarpus heterophyllus* Lam.), both naturalized in the Atlantic Forest, or for medicinal use, including the castor oil plant (*Ricinus communis* L.), now an invasive species in disturbed areas across the country (Zenni and Ziller 2011; Flora do Brasil 2020). Another plant that was brought by the Portuguese during the colonial period due to its value as a drink (Namita et al. 2012) is the tea plant (*Camellia sinensis* (L.) Kuntze. – Theaceae).

Camellia sinensis is native to China, Northeast India, South Japan, South Korea, Laos, Myanmar, Thailand, and Vietnam in subtropical humid forests (Tianlu Min and Bartholomew 2007). In the past 4000 years, the species was domesticated as a medicinal plant at least three independent times in southern China and northern India (Meegahakumbura et al. 2016), and its use as a beverage dates back to 5000 years ago (Majumdar et al. 2012). Since the mid-16th century, Europeans began to drink it, leading to a worldwide consumption of what would become the most popular non-alcoholic beverage nowadays. Tea contains terpenes, phenolics, and nitrogen-containing metabolites that can provide health benefits as antioxidant, besides having anti-cancer, anti-allergic and anti-cardiovascular disease properties (Xiu et al. 2020).

In Brazil, *Camellia sinensis* was brought for cultivation in the early 19th century and was established as a regular crop in some areas, mostly in Minas Gerais and São Paulo states, and later in Paraná. However, crops were later abandoned in other areas, especially in Rio de Janeiro state (Bediaga 2007). Although the cultivation of *C. sinensis* in Brazil dates to two centuries ago, the species has never been regarded as naturalized or invasive in the country (BFG 2015; Flora do Brasil 2020). In an unpublished study on the Theaceae from Rio de Janeiro state (Accardo-Filho 2004), the species was considered potentially naturalized, but the author stressed that more evidence was needed. During recent fieldwork in Petrópolis municipality, Rio de Janeiro state, reproductive and seedling individuals of *C. sinensis* were found in a natural, well-preserved area of Atlantic Forest. Here we report this finding, providing a brief history of the introduction of *C. sinensis* in Brazil, and highlighting the invasive potential of the species in the Atlantic Forest hotspot.

MATERIAL AND METHODS

A field expedition to Abismo Institute (22°32'50"S, 43°12'07"W), Petropolis municipality, was carried out in September 2019. The area presents Atlantic Forest vegetation in advanced stage of recovery, with no previous record of agricultural activity. The collected specimens were prepared using the standard botanical protocols described by Fidalgo and Bononi (1989) and then deposited in the herbarium of the University of São Paulo (SPF), in São Paulo, Brazil.

The species was first identified by Msc. Bianca Schindler using photos and later by specimen comparison in SPF herbarium, together with specialized literature (Accardo-Filho 2004; Ming and Bartholomew 2007).

In addition, the BHCB, GUA, R, RB, SAMES, and SPF herbarium collections (acronyms follow Thiers, continuously updated) were examined together with the SpeciesLink (2022), Reflora Herbário Virtual (2022), Tropicos (2022), and GBIF (2022) databases to verify other possible records of naturalized *Camellia sinensis* in the country.

The map was prepared with the software QGIS (QGIS Development Team 2020), using the shapefile of SOS Mata Atlântica to represent the remnants of the Brazilian Atlantic Forest (Fundação SOS Mata Atlântica & INPE 2015).

Historical research about *Camellia sinensis* introduction in Brazil was primarily based in Bediaga (2007) and Bediaga and Drummond (2007) with further references consulted in original documents available at the digital collection of the National Library of Brazil (http://bndigital.bn.gov.br/) and the newspaper library of the National Library of Brazil (http://bndigital.bn.gov.br/hemeroteca-digital/), using and combining key words "chá", "thea", "plantação", "Rio de Janeiro", "Jardim Botânico", "Brazil", and restricting the searched timespan between 1810 and 1900.

RESULTS AND DISCUSSION

Historical view

The origin of the first tea plantations in Brazil is unclear. One possibility is that they were arranged by the Chief of Division Luiz de Abreu, who brought seeds from Reunion Island, in the first decade of the 19th century, to be acclimatized in the Botanical Garden of Rio

de Janeiro (JBRJ) (Junqueira 2018). Another study indicates Macau and the year of 1812 as the origin of the Tea's seeds brought to Brazil (Bediaga and Drummond 2007). It is known that between 1810 and 1812, two noblemen and politicians, Conde da Barca and Conde de Linhares, arranged the immigration of Chinese workers from Hubei to work on the acclimatization and future tea plantations in Brazil. The original plan was to use the JBRJ as an acclimatization site from where the seedlings would be transferred to the Royal Farm. This locality is in the borough of Santa Cruz, in Rio de Janeiro city, in a place that would be known later as Morro do Chá (Tea Hill, in English) (Freitas 1987).

At the beginning of the 19th century, the JBRJ was commanded by the imperial administration, and the arrival of Chinese workers in the colony was one of the several incentives given by prince regent D. João VI – later King of the United Kingdom of Portugal, Brazil, and the Algarves – to produce tea (Dean 1989). In 1812, this effort took c. 300 Chinese workers to Rio de Janeiro to work in tea production at both JBRJ and Royal Farm (Rugendas 1835). However, with the end of the Napoleonic war in 1815 and the increase of political tensions in Portugal, D. João VI returned to Lisbon, Portugal, in 1821. His departure weakened tea production efforts in Brazil. In 1824, the newly appointed Director of the JBRJ, Frei Leandro do Sacramento, found the tea plant cultivation in poor condition, and made efforts to revitalize the crop (Gama 1869). His efforts were praised by the Business Secretary of the Empire, Marquês de Olinda, who, in speech before the Parliament in 1828, reported the harvest of 50 arrobas of tea from JBRJ alone in the last three years (Lima 1828), and 33 more in the following two years (Rodrigues 2017). Under Sacramento's management, seedlings were successfully introduced in provinces such as Pará, Pernambuco, Bahia, and São Paulo (Cerdan 2019), focusing on exporting to the emerging European market.

The press covered with enthusiasm the early success of newly established tea farms in Brazil. The editor of *Diário Fluminense*, in 1830, praised the tea plantation in São Paulo and the recent experiences in Minas Gerais, and considered the possibility of making tea an expanding and economically viable alternative to more traditional crops such as coffee, albeit for internal supply (Artigos de Offício 1830). Although tea production in these two provinces would prove to be a lasting success, accounting for almost all the tea consumed in the country until the 21st century, the situation was different in Rio de Janeiro state. There, production steadily declined, likely due to infestations by fungi of the genus *Ceratobasidium* D.P.Rogers, which damages young leaves and shoots, the main parts used in tea production (Silva 2013). This fact ended the experimental cultivation in JBRJ in the 1840s (Bediaga 2007), where few individuals of *Camellia sinensis* remain nowadays (JABOT 2022).

Camellia sinensis and Petrópolis-RJ

Decades later, Francisco Werneck started a profitable tea plantation in Paty de Alferes, countryside of Rio de Janeiro state, and published his results, methods, observations, and innovations (Werneck 1863) largely based on the previous experiences of Frei Leandro. He also recommended that tea, rather than coffee, was planted along the old Commerce Road because of the suitable climate; the Commerce Road crossed both the Vale do Paraíba, where his farms were located, and the Serra dos Órgãos, passing through Petrópolis municipality and finally reaching the city of Rio de Janeiro.

In the municipality of Petrópolis, the tea plant was cultivated mainly by the Royal Family House, which remained there throughout the colonial period, until Independence was declared in 1822. The period when the Royal family resided in Petrópolis contributed to the city's development and, with that, the tea plant was brought in, and its cultivation promoted. Indeed, the remaining individuals of *Camellia sinensis* in Petrópolis are probably descendants of old crops planted to supply the imperial court, but which were abandoned in the Republic.

Petrópolis has two Protected Areas that house the highest diversity of endemic species in the state of Rio de Janeiro: the Parque Nacional da Serra dos Orgãos has 175 endemic plant species, and the Área de Proteção Ambiental de Petrópolis has 245 endemic plant species (Loyola et al. 2018). This is a region of extreme conservation priority regarding endemic flora, as most species are in Endangered or Critically Endangered conservation status. As for the number of threatened species, Petropolis ranks third among the municipalities in the state of Rio de Janeiro, with 122 threatened species recognized in the municipality (Martinelli et al. 2018).

Here we report the first unequivocal record of naturalization of a *Camellia sinensis* population in the municipality of Petrópolis, Rio de Janeiro state, amid a forest in advanced stage of recovery (Figure 1). In fact, *C. sinensis* was one of the dominant species in the forest understory and presented individuals in different stages of development, e.g., reproductive individuals and recently established seedlings (Figure 1 C-E). After careful review of herbarium collections and database search, several possibly naturalized specimens of *C. sinensis* were found, indicating that this species likely occurs in

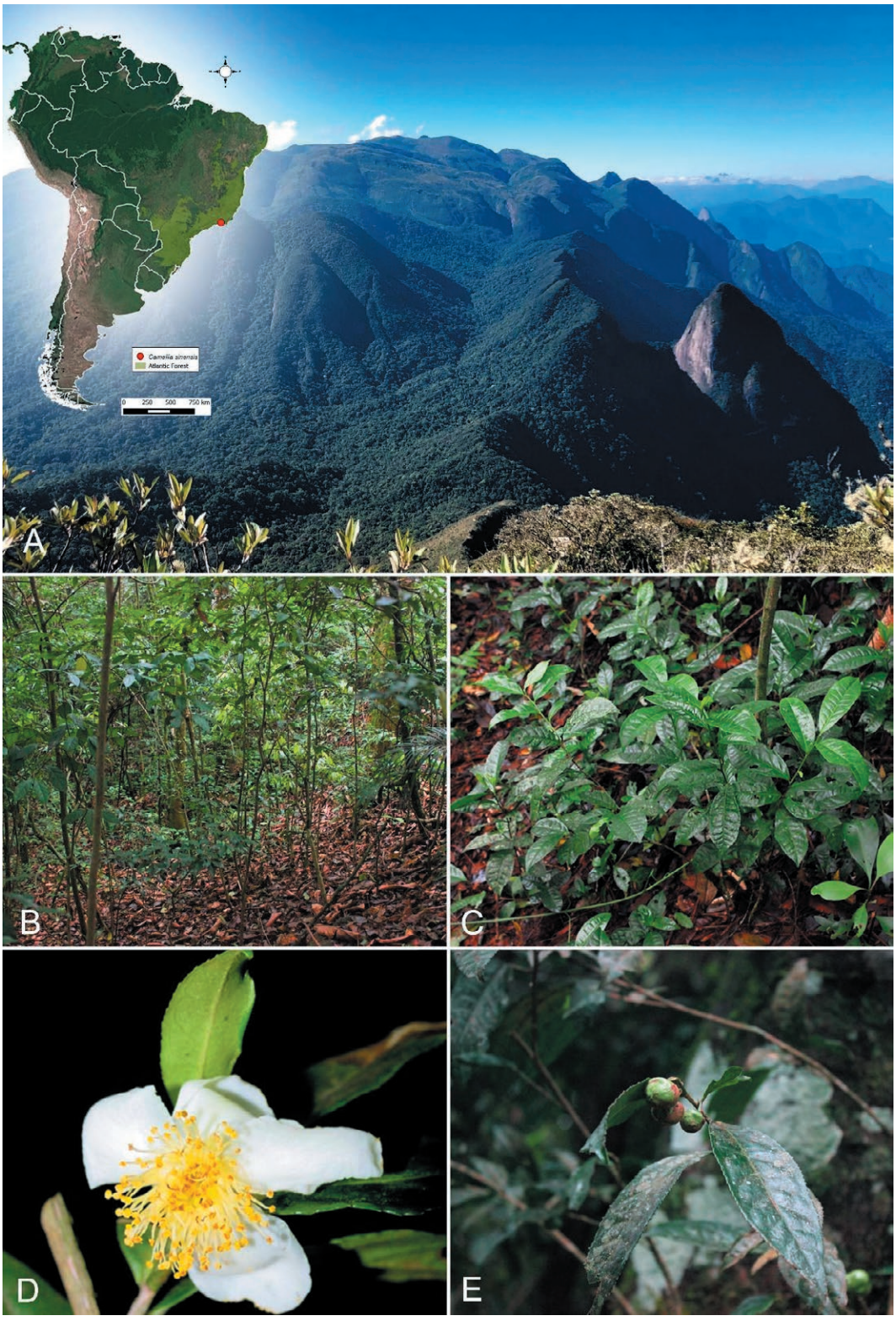

Figure 1. A. View of the landscape of the Atlantic Forest hotspot in the municipality of Petrópolis. The red dot at the upper left map denotes the first record of naturalized *Camellia sinensis* in Brazil. B. The understory of the Atlantic Forest where *C. sinensis* is reproducing in Petrópolis. C. Regeneration of *C. sinensis*. D. *C. sinensis* flower. E. *C. sinensis* fruit. Photos: H. Bernandes (A), G.M.A. (B-C and E), M.A.P.A-F. (D).

naturalized form in other states. The first known collection of this species dates from 1832 (*Gaudichaud s.n.* [P05286346]), but this record is probably of a cultivated individual from Rio de Janeiro municipality. Unfortunately, based on the information provided in the specimen label from this and other records, it is not possible to accurately determine whether the case at hand is from a naturalized or invasive population of *C. sinensis*, or from cultivated individuals or crop remnants.

Camellia sinensis as a naturalized species and invasiveness potential

Camellia sinensis found a favorable environment for survival and reproduction in the Atlantic Forest of Petrópolis. We observed Euglossineae bees visiting flowers of *C. sinensis*, herbivory in leaves, and autocorous fertile fruits and seeds that, due to the large number of seedlings, have high viability. The species is behaving like a semi-ciophile species and can be replacing native species that are important for the plant diversity in the Atlantic Forest. Some genera of Rubiaceae (e.g., *Faramea, Palicourea, Rudgea*), Piperaceae (*Piper*), Gesneriaceae (*Besleria*), and Melastomataceae (*Miconia*), all of which are very diverse in the Atlantic Forest, have habits similar to *C. sinensis*. Thus, if *C. sinensis* proves to act as an invasive species, native species of similar niche may be excluded locally by competitive exclusion. Thus, we argue that the presence of *C. sinensis* must be monitored carefully in the Atlantic Forest of Petrópolis, including populational and phytosociological studies.

Furthermore, tea leaf litter is known to inhibit the sprouting and development of seedlings of concurrent species by releasing its own chemical compounds into the soil (Rezaeinodehi et al. 2017; Sha et al. 2020). Mature plants of *C. sinensis* can dominate their surroundings by preventing other species from growing around them, while allowing tea seeds to germinate and grow in compact formations (Ciccurza and Kokotos 2007). In addition, *C. sinensis* has already been identified as naturalized in Argentina (Keller et al. 2011) and Tanzania (Ciccurza and Kokotos 2007). Therefore, considering that individuals of *C. sinensis* have the potential to survive in natural areas, it is very important to monitor the natural habitats where tea crops have already been found.

Finally, the presence of well-established populations of tea plant in Petrópolis allows us to speculate on the possibility of commercial tea production in the region. The constant increase in global demand, the continuous saturation of land suitable for tea cultivation, and the depletion of these lands by climate change are factors that favor a shift from traditional cultures to tea production, particularly in regions where the plant can be grown successfully (FAO 2018). If done sustainably ¾ e.g., in an agroforestry system, accompanied by long-term studies to avoid the species propagation to natural areas ¾ this could represent an economic opportunity for the municipality.

Specimens examined

BRAZIL: Rio de Janeiro, Petrópolis, Fundação Abismo, 22°32'50"S, 43°12'07"W, 872 m, 21 Sep. 2020, *G.M. Antar et al. 3104* (SPF, RB).

Other possible naturalized specimens

BRAZIL: Minas Gerais, Mercês, 1957, *J.M. Pinheiro-Sobrinho 2226* (BHCB); [Ouro Preto], lower slopes of Pico de Itacolomí, ca. 3 km S. of Ouro Preto, 31 Jan. 1971, *Irwin et al. 29513* (NY, UB, US); Ouro Preto, Parque Estadual do Itacolomi, 20°24'29"S, 43°30'25"W, 13 May 1998, *J.A. Lombardi 2274* (BHCB); idem, desvio da estrada de Ouro Preto para Lavras Novas, 5 km após o trevo, na margem da estrada, 7 km após a entrada do desvio, *L.L. Giacomin & L.H.Y. Kamino 26* (BHCB); idem, estrada para o Morro de São João, 6 May 2009, *G.D. Colleta et al. 68* (ESA, SPF); idem, Parque Estadual do Itacolomi, 30 Apr. 2018, *F.R.S. Tabosa et al. 68* (BHCB). **Paraná**, Castro, PCH Rio Iapó, Fazenda Marumbi, 24°44'14"S, 50°07'12"W, 980 m, 14 Feb 2016, *J.M. Silva et al. 9224* (HCF, MBM).

ACKNOWLEDGEMENTS

We thank the curators of the herbaria consulted; Thiago Rocha-Pitta, André Rossetti, and Luiz Montes for their help in the fieldwork; Fundação Abismo for permitting access to the area; and Bianca Schindler for helping to identify the species. This study was partially funded by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) under the funding code 001. GMA thanks CAPES for financial support; RBPA thanks CNPq and INCT for financial support.

REFERENCES

Accardo-Filho MAP. 2004. Theaceae no Estado do Rio de Janeiro [dissertation]. Rio de Janeiro (RJ): Universidade Federal do Rio de Janeiro, Museu Nacional.

Artigos de Offício. 1830. Império do Brasil; Diário Fluminense, Rio de Janeiro, 13 de novembro de 1830. 15th ed. vol. 116. Rio de Janeiro (RJ). [Acessed 2021 Oct. 29] http://memoria.bn.br/DocReader/DocReader.aspx?bib=706744.

Bediaga B 2007. Conciliar o útil ao agradável e fazer ciência: Jardim Botânico do Rio de Janeiro – 1808 a 1860. História, Ciências, Saúde-Manguinhos. 14: 1131–1157.

Bediaga B, Drummond RP. 2007. Cronologia: Jardim Botânico do Rio de Janeiro. Rio de Janeiro (RJ): Instituto de Pesquisas Jardim Botânico do Rio de Janeiro.

BFG- Brazilian Flora Group 2015. Growing knowledge: an overview of seed plant diversity in Brazil. Rodriguésia. 66: 1085–1113.

Cerdan MA. 2019. O cultivo do chá: breves considerações a partir do município de Itu - século XIX. Semina: Ciências Sociais e Humanas. 40(1): 121–138.

Cicciza D, Kokotos S. 2007. The invasive potential of tea: naturalization and spread of *Camellia sinensis* in natural and logged forests of the Amani Nature Reserve. [accessed 2021, Sep. 16]. http://www.tropical-biology.org/admin/documents/pdf_files/ Tanz_abstracts/1_Daniele%20&%20Stef_Final.pdf

Dean W. 1989. A Botânica e a Política Imperial: Introdução e Adaptação de Plantas no Brasil Colonial e Imperial. Instituto de Estudos Avançados da Universidade de São Paulo, São Paulo. 20 p. [accessed 2022 Jan. 4]. https://antigo.mdr.gov.br/images/stories/ArquivosSNPU/Biblioteca/ReabilitacaoAreasUrbanas/Historia_Botanica_Politica_Imperial.pdf

Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. [accessed 2022, Jan. 22]. http://floradobrasil.jbrj.gov.br/.

Fidalgo O, Bononi VLR. 1989. Técnicas de coleta, preservação e herborização de material botânico. Reimpressão. Instituto de Botânica, São Paulo. 62p

[FAO] Food and Agriculture Organization 2018. Global tea consumption and production driven by robust demand in China and India. New report also warns of climate change threat to tea production. Rome. 16 p.

Freitas B. 1987. Santa Cruz: fazenda jesuítica, real e imperial: vice-reis e reinado (1760-1821). Rio de Janeiro: Asa Artes Gráficas. 2.

Fundação SOS Mata Atlântica e Instituto Nacional de Pesquisas Espaciais (INPE). 2015. Atlas dos remanescentes florestais da Mata Atlântica: período de 2014–2015. [accessed: 2022, Jan. 20]. http://mapas.sosma.org.br.

Gama JS. 1869. Biografia do botânico brasileiro Fr. Leandro do Sacramento. Memória lida no Instituto Histórico perante S. M. o Imperador. Revista do Instituto Histórico e Geográfico Brasileiro, tomo XXXII – Parte Segunda: p. 181-230. [accessed 2020 Oct 29] <https://www.ihgb.org.br/publicacoes/revista-ihgb/item/107732-revista-ihgb-tomo-xxxii-parte-segunda.html>.

GBIF.org (2022) GBIF Home Page. [accessed 2022 Jan. 10]. https://www.gbif.org

JABOT. JBRJ - Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Jabot - Banco de Dados da Flora Brasileira. [accessed 2022, Jan. 22]. http://jabot.jbrj.gov.br/.

Junqueira MCC. 2018. O primeiro e único Conde da Barca Um iluminado na corte de Dom João [Ph.D thesis]. Rio de Janeiro (RJ). Universidade Federal do Rio de Janeiro.

Keller HA, Delucchi G, Romero HF. 2011. *Camellia sinensis* (Theaceae) en la Argentina: naturalización y usos locales. Boletín de la Sociedad Argentina de Botánica. 46: 145–150.

Lima PA. 1828. Discurso. Annaes do Parlamento Brasileiro, Rio de Janeiro, 3 de junho de 1828. Ed. 00002, p. 17–20 [accessed 2020, Oct 29]. http://memoria.bn.br/DocReader/DocReader.aspx?bib=132489

Loyola R, Machado N, Ribeiro BR, Martins E, Martinelli G. 2018. Áreas prioritárias para conservação da flora endêmica do estado do Rio de Janeiro. Graficci, Rio de Janeiro. 60p

Martinelli G, Martins E, Moraes M, Loyola R, Amaro R. 2018. Livro Vermelho da Flora Endêmica do estado do Rio de Janeiro. Andrea Jakobsson estúdio, Rio de Janeiro. 456p.

Majumdar A, Bera B, Rajan A. 2012. "Tea Statistics: The Chinese Scenario", The International Journal of Tea Science. 8(1): 73–75. [accessed 2021, Sept. 15]. http://teaboard.gov.in/pdf/Tea%20Statistics-The%20Chinese%20Scenario.pdf

Meegahakumbura MK, Wambulwa, MC, Thapa KK, Li MM, Möller M, Xu JC, Yang JB, Liu BY, Ranjitkar S, Liu J, Li DZ, Gao KM. 2016. Indications for Three Independent Domestication Events for the Tea Plant (*Camellia sinensis* (L.) O. Kuntze) and New Insights into the Origin of Tea Germplasm in China and India Revealed by Nuclear Microsatellites. PLOS ONE 11(5): e0155369. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0155369.

Ming TL, Bartholomew B. 2007. Theaceae. In: Wu ZY, Raven PH, Hong DY, editors. Flora of China 12. p. 366– 478. Beijing: Science Press; St. Louis: Missouri Botanical Garden Press.

Namita P, Mukesh R, Vijay KJ. 2012. *Camellia sinensis* (green tea): a review. Global Journal of Pharmacology. 6(2): 52–59.

Reflora - Herbário Virtual 2022. [accessed: 2022, Jan. 22]. http://reflora.jbrj.gov.br/reflora/herbarioVirtual/

Rezaeinodehi A, Khanghol S, Aminidehaghi M, Kazemi H. 2017. Allelopathic potential of tea (*Camellia sinensis* (L.) Kuntze) on germination and growth of *Amaranthus retroflexus* L. and *Setaria glauca* (L.) P.Beauv. Journal of Plant Diseases and Protection, Special Issue 20: 447–454.

Rodrigues JB. 2017. Hortus fluminensis. Revista Do Serviço Público. 40(4): 209–224.

Rugendas JM. 1835. Voyage pittoresque dans le Bresil. Paris, Lith. de G. Engelmann. 190 p.

Sha J, Chen Q, Miao Y, Qu R, Tang X, Fang W, 2020. Journal of Nuclear Agricultural Sciences 6: 1327-1336. [accessed: 2021, Sept. 16] http://www.hnxb.org.cn/EN/abstract/abstract13274.shtml.

Silva RB. 2013. Biologia de *Ceratobasidium* spp. associada à doença queima dos fios no chá (*Camellia sinensis* L.) [dissertation]. Botucatu (SP). Universidade Estadual Paulista, Faculdade de Ciências Agronômicas de Botucatu.

SpeciesLink 2022. [acessed: 2022, Jan. 11]. http://www.splink.org.br.

Thiers B, continuously update. Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. [accessed: 2022, Jan. 2].

Tropicos.org 2022. Missouri Botanical Garden. Available from. [accessed 2021 Sep. 9].

Werneck FPL. 1863. Memória sobre a fundação de uma fazenda na Província do Rio de Janeiro, Rio de Janeiro, Eduardo e Henrique Loemmert, 2 ed., 252 pp. [accessed: 2021 Nov. 30]. https://play.google.com/books/reader?id=4kU7AAAAcAAJ&hl=pt

Zenni RD, Ziller SR. 2011. An overview of invasive plants in Brazil. Brazilian Journal of Botany. 34(3): 431–446.