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Original article

Historical patterns in naming native Brazilian plant genera

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Abstract: Brazilian botanists have achieved a prime objective of the Global Strategy for Plant Conservation – creation of a detailed species list of the country's flora. This accomplishment was driven by Brazilian scientists and research organisations, through international collaboration and with the benefit of centuries of accumulated exploration, collecting and research. Publication dates, authorship and etymology of 3,294 native Brazilian vascular plant and bryophyte genera were used as surrogates for the process of recording the Brazilian flora between 1753 and 2023. Half of all native Brazilian genera were described by the mid-nineteenth century, with most genera described by non-Brazilian botanists. The pattern of generic naming by Brazilian botanists shows distinct periods of activity from 1753 to 1995. Between 1921 and 1949, 38 genera were described, primarily by Adolpho Ducke (1876-1959) and João Geraldo Kuhlmann (1882-1958). In contrast, between 1995 and 2023, dozens of Brazilian botanists contributed to the authorship of 125 genera. Based on etymology, 89.1% of all native Brazilian generic names fall into four categories: morphonyms (40.5%), eponyms (28.2%), autochthonyms (10.2%) and taxonyms (10.2%). Most (80.1%) of angiosperm generic names are morphonyms, eponyms and autochthonyms, whilst autochthonyms, which are based on vernacular or indigenous names, are infrequent in lycophytes and ferns (6.0%) and bryophytes (0.5%).

Keywords: vascular plants, bryophytes, exploration, authorship.

Resumo: (Padrões históricos na nomeação de gêneros de plantas nativas do Brasil) Os botânicos brasileiros alcançaram um dos principais objetivos da Estratégia Global para a Conservação das Plantas: a criação de uma lista detalhada das espécies da flora do país. Essa conquista foi impulsionada por cientistas e organizações de pesquisa brasileiras, por meio da colaboração internacional e com o benefício de séculos de exploração, coleta e pesquisa acumuladas. As datas de publicação, autoria e etimologia de 3.294 gêneros de plantas vasculares e briófitas nativas do Brasil foram usadas como substitutos para o processo de registro da flora brasileira entre 1753 e 2023. Metade de todos os gêneros nativos brasileiros foram descritos em meados do século XIX, com a maioria dos gêneros descritos por botânicos não brasileiros. O padrão de nomenclatura genérica por botânicos brasileiros mostra períodos distintos de atividade de 1753 a 1995. Entre 1921 e 1949, 38 gêneros foram descritos, principalmente por Adolpho Ducke (1876-1959) e João Geraldo Kuhlmann (1882-1958). Em contraste, entre 1995 e 2023, dezenas de botânicos brasileiros contribuíram para a autoria de 125 gêneros. Com base na etimologia, 89,1% de todos os nomes genéricos nativos brasileiros se enquadram em quatro categorias: morfônimos (40,5%), epônimos (28,2%), autochtônimos (10,2%) e taxônimos (10,2%). A maioria (80,1%) dos nomes genéricos de angiospermas são morfônimos, epônimos e autochtônimos, enquanto os autochtônimos, que se baseiam em nomes vernáculos ou indígenas, são pouco frequentes em licófitas e samambaias (6,0%) e briófitas (0,5%).

Palavras-chave: plantas vasculares, briófitas, exploração, autoria.

Introduction

Scientific names, and their correct application, are central to the scientific cataloguing and the description of life on earth, and to species protection and the regulation of species trade under national and international legislation. In Brazil, home to the highest biological diversity and one of the highest endemism levels on the planet, recognition that understanding plant diversity has strategic importance, and that Brazilians be actively involved in such activities, has deep roots (Kury, 2004).

In 1824, after seeing work by German botanist Karl Friedrich Philipp von Martius (1794-1868) on Brazilian plants, the founder and first ruler of the Empire of Brazil, Dom Pedro I (1798-1834), is reputed to have stated 'must foreigners come in order to describe our plants; cannot we do this ourselves?' (von Martius, 1837: 10, Hooker, 1842). Consequently, text and drawings by the botanist

José Mariano de Conceição Vellozo (1742-1811; known as Frei Vellozo), who was born in Tiradentes (Minas Gerais) were re-discovered and ordered to be printed and lithographed in Paris as the *Flora Fluminensis* (1825-31; see Bediaga and Lima, 2015 for details of the complex publication history of this work) (Atala, 1961; Carauta, 1973). Over subsequent centuries, knowledge of the Brazilian flora has increased, such that by 2020, Brazilian scientists had achieved Objective I ('Plant diversity is well understood, documented and recognized') of the Global Strategy for Plant Conservation, under the Convention on Biological Diversity (The Brazil Flora Group, 2021). This fundamental pillar to understanding Brazilian plant diversity, and global diversity generally, was driven by hundreds of Brazilian scientists and research organisations, collaborating with international colleagues.

A name, whether vernacular or scientific, is a cipher to facilitate the storage, retrieval and communication of information, but to be useful a name must be consistently applied to the same concept or thing. However, as a cultural activity, scientific practice means names are constrained by the people who create them, and the places and periods in which these people work (Livingstone, 2019). Consequently, names may provide insight into the cultures and traditions of their creators, together with their own beliefs, prejudices and preoccupations. The construction of scientific names, which aim for international stability, unambiguous application and comprehensibility, has been controlled through time by the application of various international Codes, presented in Latin using the Roman alphabet (Ohl, 2018). Tensions between the practical need for name stability and the evolving nature of scientific practice within societies since the mid-eighteenth century have concerned humanities scholars for decades (e.g., Schiebinger, 2007). Recently, similar discussions have emerged within some scientific communities (e.g., Gillman and Wright, 2020, Knapp et al., 2020, Hammer and Thiele, 2021, Smith and Figueiredo, 2021, Mosyakin, 2022, Palma and Heath, 2021, Slabin, 2023, Cheng et al., 2023, Guedes et al., 2023, Pethiyagoda, 2023).

This paper uses the publication dates, authorship and etymology of 3,294 native Brazilian vascular plant (2,889) and bryophyte (405) genera, as surrogates for the historical process of recording the Brazilian flora, to investigate three interrelated questions. What is the pattern of Brazilian genus description between 1753 and 2023? Has the pattern of description by Brazilian and non-Brazilian botanists changed over this period? Has the origin of generic names changed over the same period?

Material and Methods

An Excel workbook of 3,294 genera of bryophytes (Anthocerotophyta, Bryophyta, Marchantiophyta), lycophytes and ferns (Lycopodiophyta, Polypodiophyta), gymnosperms (Cycadophyta, Gnetophyta, Pinophyta) and angiosperms (Magnoliophyta) native to Brazil was assembled. The included fields were: generic name and valid publication date; genus author nationality; and name category. Generic names were derived from the Flora e Funga do Brasil (2024) website, whilst valid publication dates were taken from either The World Flora Online (2024) or Tropicos (2024) websites. Author nationalities were derived from online resources, including the International Plant Names Index (2024) and Harvard Herbaria and Libraries Index of Botanists (2024) websites. Based on their etymological origins, generic names were grouped into eight broad categories (Harris, 2025): (i) agnostonym (uncertain, obscure or unknown origin); (ii) autochthonym (based on vernacular or indigenous name); (iii) bionym (association with a plant's habit, habitat or biological properties); (iv) eponym (commemorates a real person, group of people or fictional/ mythological character); (v) ergonym (association with people's uses or reactions to plants); (vi) morphonym (associated with physical plant features); (vii) taxonym (denote real or imagined similarities/ relationships, including anagrams and generic combinations of previously published names); and (viii) toponym (commemorates places). However, not all generic names were conveniently placed into a single category, for example, authors may have deliberately created names with multiple meanings. Generic names were defined as 'Brazilian-related' when autochthonyms, eponyms or toponyms were associated with Brazilian vernacular names or commemorated Brazilian people or places. Botanists were identified as Brazilian when they were born in Brazil, naturalised, or were educated and trained in Brazil.

Temporal cumulative relative-frequency curves were generated and summarised using the dates by which 50% (T_{50}) and 75% (T_{75}) of native genera were named. Independence of association between Brazilian generic names and Brazilian authorship was investigated using χ^2 tests.

Results and discussion

Half of native Brazilian genera were described by the mid-nineteenth century

Before the arrival of the Portuguese court in South America in 1808, non-Portuguese access to Brazil was highly restricted (Fausto & Fausto, 2014; Disney, 2009). Consequently, European knowledge of Brazilian natural history is strongly associated with the foundation of the Empire of Brazil, and the wealth of material sent to European institutions for formal description during the nineteenth century (L. B. Kury, 2012; L. B. Kury, 2014).

The maximum rate of all genus-naming across the Brazilian flora (excluding algae) occurred between approximately 1800 and 1850 (≈28.9 genera/ year; Fig. 1), then slowed to approximately 7.7 genera/ year (T_{50} = 1839; T_{75} = 1909). As expected, the pattern of angiosperm genus description closely mirrored this (T_{50} = 1837; T_{75} = 1906), since they contribute most (82.6%) generic names to the total. Lycopods and ferns display a similar pattern to angiosperms in terms of the period of maximum rate of genus description, but the curve is broader and distinctly stepped after the mid-1800s (T_{50} = 1841; T_{75} = 1944). By convention, formal scientific

naming of bryophytes starts in 1801, rather than 1753 as with the other taxonomic groups. This difference partially accounts for the right shift in the cumulative distribution (T_{50} = 1869; T_{75} = 1909). Between 1801 and 1906 approximately 2.6 bryophyte genera/ year were described, which after 1907 slowed to approximately 0.9 genera/ year. Overall patterns of genus description probably reflect the peaks and troughs of research interest in tropical bryophyte, lycophyte and fern diversity from the mid-nineteenth century to the present day, together with changing approaches to delimiting genera.

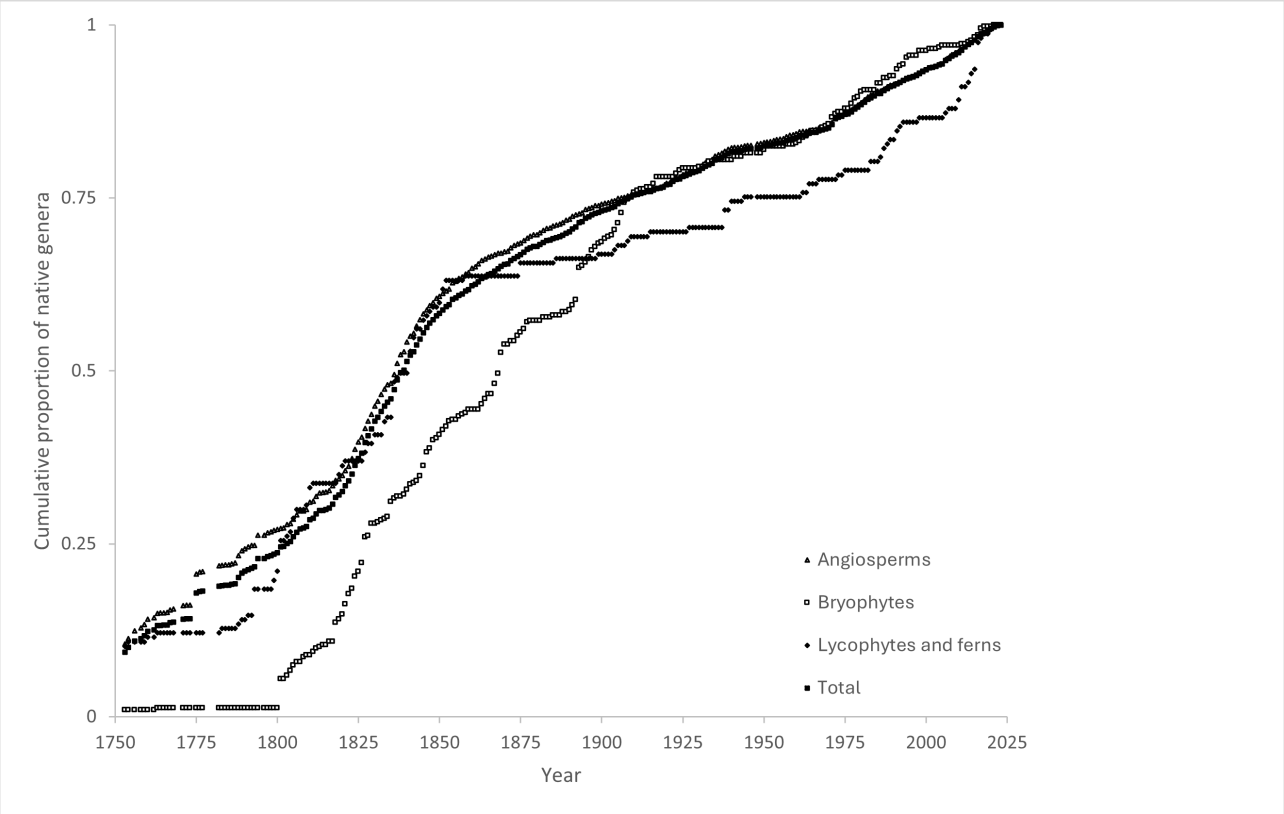

Figure 1: Cumulative proportion of currently recognised native genera, validly published between 1753 and 2023, in the Brazilian flora. Total genera (filled squares; n = 3,294) and genera separated according to higher-level taxonomy: bryophytes (unfilled squares; n = 405); lycophytes and ferns (filled diamonds; n = 157); and angiosperms (unfilled triangles; n = 2,726). Gymnosperms not presented as a separate curve since only six native genera are known in the Brazilian flora.

Brazilian botanists described genera most actively between 1921-1949 and post-1995

Cumulative patterns of native Brazilian genus description show marked differences when non-Brazilian and Brazilian authors were considered (Fig. 2). By 1837, 50% of native Brazilian genera had been described by non-Brazilian authors, whilst this point was not reached until 1999 for those native genera named by Brazilian authors. Dates for the description of 75% of the genera by non-Brazilian and Brazilian botanists were 1893 and 2015, respectively. Moreover, Brazilian botanists used Brazilian-based names less frequently than expected, in contrast to non-Brazilian authors, who used them more frequently than expected (χ^2 = 312.49, df = 1, p = «0.001).

The distinct break in the cumulative distribution of generic names between 1773 and 1775 is primarily because of French apothecary and colonial administrator Jean Baptiste Christophore Fusée Aublet's (1720-78) *Histoire des plantes de la Guiane Françoise* (1775), in which plants from French Guiana are described and illustrated. Aublet's research added 120 names to the list of native Brazilian genera, e.g., *Maprounea* Aubl. (Euphorbiaceae), *Rourea* Aubl. (Connaraceae) and *Tapura* Aubl. (Dichapetalaceae), which, together with others, often show broad distributions across tropical America.

The period of most rapid growth in native Brazilian genus description was between 1818 and 1846 (≈28.9 genera/ year) virtually all of which were described by non-Brazilian botanists, such as the Swiss botanist Augustin Pyramus de Candolle (1778-1841), working in Europe. Many such botanists did not visit Brazil (or South America), but relied on specimens collected by other European collectors. After this period, there was an approximately steady increase in the number of genera described (≈7.7 genera/ year), mostly by non-Brazilian botanists, with no evidence of curve flattening.

The pattern of Brazilian botanists describing native Brazilian genera is different to that for non-Brazilian botanists. Between 1753 and 2023, 202 native Brazilian genera were described by Brazilian researchers, whilst 3,092 genera were described by non-Brazilian botanists. The earliest validly published genera associated with a

Brazilian-born botanist are *Paliavana* Vell. ex Vand. (Gesneriaceae) and *Mendoncia* Vell. ex Vand. (Acanthaceae). These were published by the Lisbon-based, Italian-born naturalist Domenico Vandelli (1735-1816) in his *Florae Lusitanicae et Brasiliensis* specimen (1788), who expressly acknowledged the work of Vellozo. Following this initial phase of native genus description, names were published in four discrete, step-like phases until the mid-1990s: (i) 1828-1849; (ii) 1876-1881; (iii) 1921-1949; and (iv) 1968-1987. Each phase was dominated by a small number of Brazilian botanists, for example: (i) António Luiz Patrício da Silva Manso (1788-1848) and Francisco Freire Allemão e Cysneiro (1797-1874); (ii) João Barbosa Rodrigues (1842-1909); (iii) Adolpho Ducke, João Geraldo Kuhlmann and Frederico Carlos Hoehne (1882-1959); and (iv) Graziela Maciel Barroso (1912-2003), João Murça Pires (1917-94), João Rodrigues de Mattos (1926-2020) and William Antônio Rodrigues (b.1928). In contrast, since 1995, the rate of native genus description (≈4 genera/ year) has been approximately continuous, and involved dozens of different Brazilian botanists. Moreover, during the twenty-first century there was no significant difference in the number of Brazilian (102) and non-Brazilian (115) botanists involved in the description of native Brazilian genera (χ^2 = 0.779, df = 1, p = 0.377).

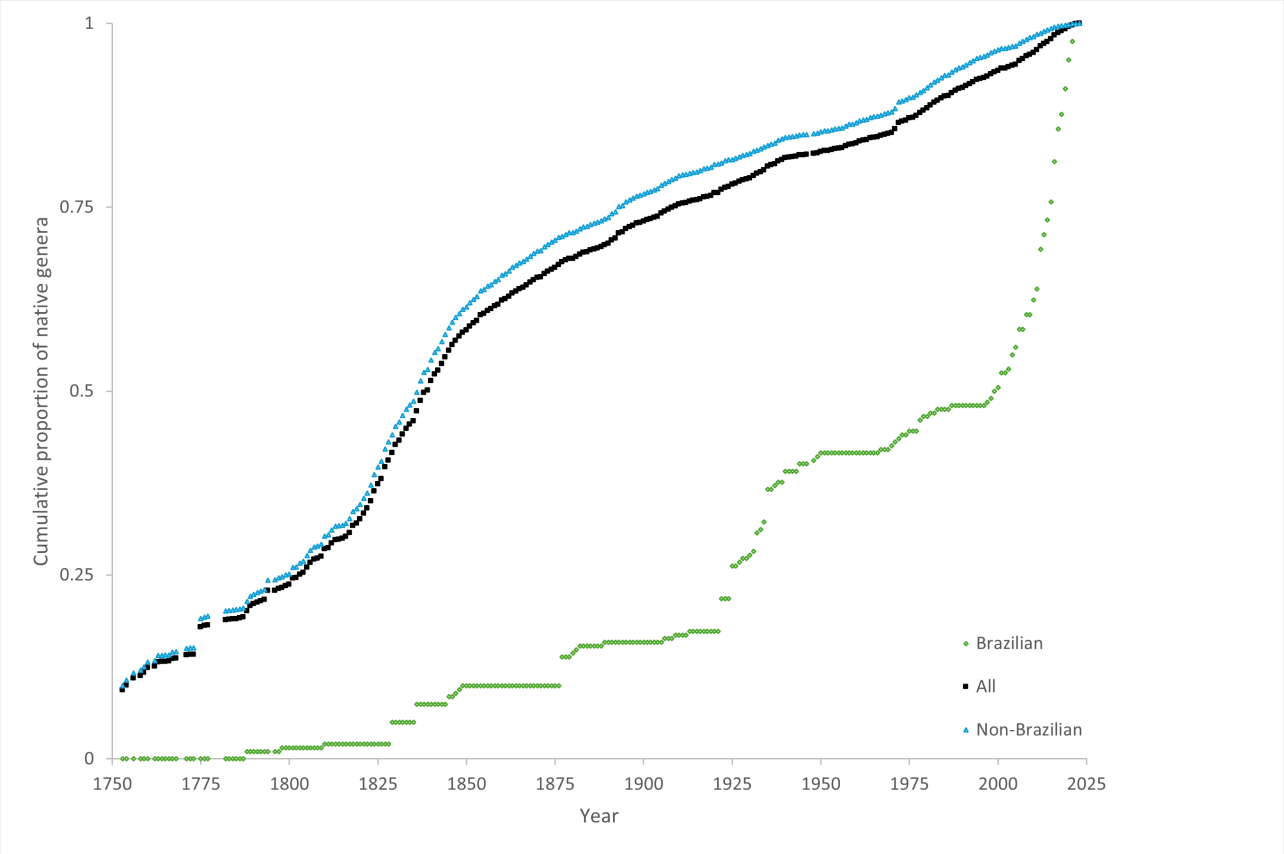

Figure 2: Cumulative proportion of currently recognised native Brazilian genera, validly published between 1753 and 2023, by authors of all nationalities (filled squares; n = 3,294), non-Brazilians (unfilled triangles; n = 3,092) and Brazilians (unfilled diamonds; n = 202).

Morphonyms and eponyms account for almost 70% of Brazilian generic names

Almost 90% (89.1%) of native Brazilian generic names fall into four categories: morphonyms (40.5%; n = 1,313), eponyms (28.2%; n = 920), autochthonyms (10.2%; n = 332) and taxonyms (10.2%; n = 320, Table 1). The remaining approximately 10 per cent are bionyms (4.5%), ergonyms (2.6%), toponyms (1.9%) and agnostonyms (1.9%). There are differences in ranking across taxonomic groups. For example, 80.1% of angiosperm names are morphonyms, eponyms and autochthonyms. However, autochthonyms, which are based on vernacular or indigenous names, are infrequent in lycophytes and ferns (6.0%) and bryophytes (0.5%). This may be because: botanists actively chose not to use such names; plants in these groups are unlikely to have vernacular names; or botanists were ignorant of the indigenous names when creating the generic names. Surprisingly, taxonyms are more frequent in lycophytes and ferns (13.3%) and bryophytes (18.4%) than in angiosperms (8.8%).

Table 1: Number of native Brazilian genera grouped according to name category and higher-level taxonomy. When a generic name was assigned to two categories, the name was scored as '0.5' for each category. Underlining indicates name categories contributing to >10% of each taxonomic group.

Name category	Number of native genera (%)				
	Angiosperms	Gymnosperms	Lycophytes and ferns	Bryophytes	Total
Agnostonym	55 (2.0)		1 (0.6)	6 (1.5)	62 (1.9)
Autochthonym	322 (11.8)	3 (50)	9.5 (6.0)	2 (0.5)	336.5 (10.2)
Bionym	119.5 (4.4)		5 (3.2)	24.5 (6.0)	149 (4.5)
Eponym	826.5 (30.3)	1 (16.7)	27 (17.3)	73.5 (18.2)	928 (28.2)
Ergonym	80.5 (3.0)		1.5 (1.0)	2 (0.5)	84 (2.6)
Morphonym	1,023 (37.5)	2 (33.3)	91 (58)	219.5 (54.2)	1,335.5 (40.5)
Taxonym	240.5 (8.8)		21 (13.3)	74.5 (18.4)	336 (10.2)
Toponym	59 (2.2)		1 (0.6)	3 (0.7)	63 (1.9)
Total	**2,726**	**6**	**157**	**405**	**3,294**

Cumulative distributions of name categories across time are also distinctive (Fig. 3). In the cases of morphonyms and eponyms, the cumulative number of genera show broadly similar patterns, although they differ in complexity and detail. Both distributions show rapid increases in the first half of the nineteenth century, associated with European botanical exploration of Brazil and South America, although morphonyms are more tightly distributed than eponyms (T_{50} = 1840, T_{75} = 1883 and T_{50} = 1832, T_{75} = 1920, respectively). The highest rate of morphonym description was between 1794 and 1850 (≈11.1 genera/ year), whilst that for eponyms was greatest between 1818 and 1850 (≈8.1 genera/ year). Following the period of rapid growth in morphonyms the rate slowed between 1879 and 2023 to ≈2.4 genera/ year. In contrast, eponym distribution could be divided into five distinct phases: (i) 1794-1817 (≈3.2 genera/ year); (ii) 1818-50 (≈8.1 genera/ year); (iii) 1855-1970 (≈1.5 genera/ year); (iv) 1972-97 (≈2.7 genera/ year); and (v) post-2006 (≈3.4 genera/ year). Prior to these phases, a distinct step in the distribution of eponyms occurred in 1794. Most of these were widespread genera (31 out of 33), e.g., *Campomanesia* Ruiz & Pavón (Myrtaceae), *Miconia* Ruiz & Pavón (Melastomataceae) and *Neea* Ruiz & Pavón (Nyctaginaceae), described by the Spanish botanists Hipólito Ruiz López (1754-1816) and José Antonio Pavón (1754-1840) based on their collections made during their exploration of the colonial territories of the Viceroyalty of Peru and Chile between 1777 and 1788 (Schultes & von Thenen de Jaramillo-Arango, 1998).

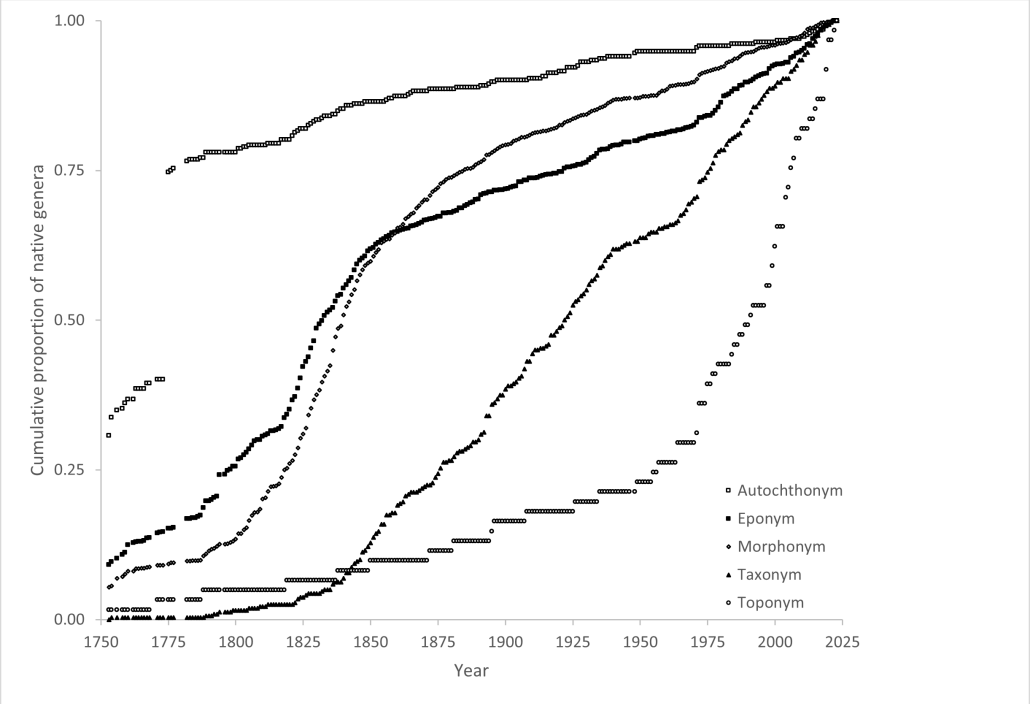

Figure 3: Cumulative proportion of currently recognised native Brazilian genera, validly published between 1753 and 2023, separated by name categories contributing to greater than 10% of the total (morphonym, unfilled diamonds, n = 1335.5; eponym, filled squares, n = 928; autochthonym, unfilled squares, n = 336.5; taxonym, filled triangles, n = 336) and toponym (unfilled circles; n = 63).

Eponyms have been especially sensitive in recent discussions of scientific naming practice (e.g., Hammer and Thiele, 2021; Smith and Figueiredo, 2021). Guedes et al. (2023) have argued that all eponyms are not only inappropriate in modern biological nomenclature, but that retrospective action must be taken to replace them. This view has been rigorously opposed by some practicing taxonomists, e.g., Pethiyagoda (2023), who highlighted the negative effects on nomenclatural stability, tying-up limited global taxonomic expertise in making the changings and the impracticality of implementation of such a proposal.

The temporal pattern of autochthonyms is dominated by the generic names published by Aublet in 1775. These names were mostly derived from indigenous names used in late-eighteenth-century French Guiana. However, Aublet's use of indigenous names (together with his opposition to slavery in the French empire) was controversial, which lead some researchers in the early-nineteenth entry to call for them to be replaced (see Zarucchi, 1984). Despite Carolus Linnaeus' assertion that names from 'barbarous … languages not understood by the learned' (i.e., neither Latin nor Greek; Freer, 2005: 172), should not be used to construct generic names, indigenous names have been steadily used to construct native Brazilian generic names. Indeed, there has been discussion about the active restoration of indigenous names into scientific naming practice (Gillman & Wright, 2020; Knapp et al., 2020; Palma & Heath, 2021). Among Brazilian native genera, there were slight rate increases between 1821 and 1840 (≈0.8 genera/ year; compared with 1782-1820, ≈0.3 genera/ year) and post-2010 (≈0.7 genera/ year; compared with 1841-2009, ≈0.2 genera/ year).

The cumulative distributions of morphonyms, eponyms and autochthonyms are broadly S-shaped. In contrast the distribution of taxonyms (which have the same proportion of the total data as autochthonyms) has a broadly J-shaped distribution (T_{50} = 1922; T_{75} = 1975; (Fig. 3)). Moreover, there was a distinctive slowing in the rate of taxonym description between 1940 and 1964 (≈0.6 genera/ year) compared with the 25-year windows on either side of the period (≈2.0 genera/ year and ≈2.9 genera/ year, respectively).

In contrast, toponyms account for only 1.9% (n = 63; Table 1) of native Brazilian generic names. However, the cumulative distribution shows a distinctive J-shaped distribution with half of the generic names added after 1991 (T_{50} = 1991; T_{50} = 2006; (Fig. 3)). Prior to 1970, 18 native Brazilian genera, based on geographic names, had been published in a stepwise manner. After this date, new genera were described in a more continuous manner (≈0.8 genera/ year).

Conclusion

The present analysis is focused on the list of names of native Brazilian genera currently accepted by the Flora e Funga do Brasil. Consequently, the role of Brazilian botanists in the description of native genera is likely to be underestimated, since lists of genera drawn up at different periods will differ. Many generic names will be shared, but new genera may be discovered requiring the assignment of novel names. In other cases, genera will be merged so names disappear into the obscurity of synonymy, whilst splitting a genus may require the erection of a new name (or the resurrection of a synonym). For example, the north-eastern Brazilian genus *Delgadoa* S.Santos, Snak & L.P.Queiroz (Fabaceae) was erected by three Brazilian botanists in 2024, but a nomenclatural oversight meant four non-Brazilian botanists republished the name as *Delgadoana* U.B.Deshmukh, M.B.Shende, E.S.Reddy & Mungole, with *Delgadoa* as a synonym (Deshmukh et al., 2024). Such changes were not part of the current analysis, therefore a complete analysis of Brazilian involvement in generic naming should also include generic synonymies, together with the collectors of types and the teams of people contributing to any decisions that resulted in the formal publication of generic names.

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