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RESEARCH ARTICLE
TAXONOMIC CATALOG OF THE BRAZILIAN FAUNA

The Diptera (Insecta) fauna of Brazil: an online system and two centuries of taxonomic progress

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ABSTRACT. Data from the Taxonomic Catalog of the Brazilian Fauna provides an overview of the present knowledge of Diptera diversity in Brazil and an insight into the historical development of the taxonomy of a megadiverse animal order in a large country. Diptera represents 9.3% of the known Brazilian fauna, with 1,986 genera and 12,194 valid species in 102 families. The 15 most species-rich families, with over 300 species each, correspond to 66.5% of all Brazilian known species diversity, of which Phoridae is the richest, followed by Tachinidae, and Chironomidae. The number of species reported grew sharply from the late 19th century. So far, the most productive decade sequence was from 1910 to 1960, when over half of the presently known Brazilian dipterofauna was described. The most productive decade alone was the 2010s, with almost 1,300 species described. Thomas Borgmeier was the most prolific author of species in Brazil (585), followed by Charles Paul Alexander (559), and John Lane (481). Species names based on geographical localities often derive from "Brazil/Brasil" (154), "Amazonia" (57), and "state of São Paulo" (41). The top three honored people with species names are Fritz Plaumann (69), Hugo de Souza Lopes (57), and John Lane (49). In the last 20 years, the number of Brazilian dipterists studying the fauna has increased, with the establishment of several research groups across the country, more authors collaborating in papers describing species, and interconnection between the Brazilian research groups, resulting in more complex studies.

KEY WORDS. Biodiversity, checklist, flies, Hexapoda, Neotropics, true flies.

INTRODUCTION

The Taxonomic Catalog of the Brazilian Fauna ("Catálogo Taxonômico da Fauna do Brasil" – CTFB, see http://fauna.jbrj.gov.br/fauna/listaBrasil) is an online platform of the scientific valid names applied to the known Brazilian fauna. The main goal is to provide a list of all animal species known to occur in Brazil validated by specialists in each respective group. The catalog also provides synonyms, homonyms, distribution data, and pertinent literature for most taxa, which will be further expanded for all taxa in the next steps of the project. The CTFB started in 2015 and now includes about 700 experts in the taxonomy of different groups. Up to now (and counting), approximately 128,000 valid species/subspecies of animals have been reported for Brazil. According to the CTFB, most species are arthropods, with over 104,000 species/subspecies (81.2% of the total of animals), of which the Hexapoda correspond

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to about 92,000 species/subspecies, 71.2% of the total, followed by other invertebrates (almost 13,000, 10.2%), and by chordates (nearly 11,000, 8.6%). Megadiverse insect orders (with over 100,000 species described worldwide) are also the most diverse in Brazil, each with about 10,000 valid species, in the following order of species-richness: Coleoptera, Lepidoptera, Diptera, Hymenoptera, and Hemiptera. These five orders comprise 90% of all hexapod species reported from Brazil alone.

The CTFB index of scientific names of extant Brazilian animal species includes the following data for each taxon: i) taxonomic hierarchy with author and year of publication, ii) name qualification (availability and validity), iii) synonyms, iv) electronic data (species-id, Zoobank), v) typology (primary, secondary, or collective types), vi) life form and substrate, vii) host (vegetal or animal hosts), viii) distribution (by state, region, and biome in Brazil, and occurrences in other countries, when applicable), and ix) additional references about the taxon. The system, accessed by each expert through their login and password, is dynamic and allows additions and corrections in real-time, such as the inclusion of newly discovered species and new records of taxa for Brazil and its states, as well as corrections concerning nomenclatural decisions. The public interface of the system allows everyone to search for a taxon—e.g., a family, a genus, or a species—, a particular author or authors, and a particular state or region of Brazil, and the results of such search can include a list of all genera and species of a family, distributional data and references of a taxon, and the species described by a particular author and species reported from a certain state or region.

The most comprehensive compilation of Neotropical Diptera was the series "The Catalogue of the Diptera of the Americas South of the United States", published in several fascicles by different authors from 1966 to 1984, organized and edited by Nelson Papavero (1966–1984). These catalogs brought together taxonomic information on fly families, culminating in 24,075 species of Diptera for the Neotropical Region (Amorim et al. 2002), although not all families known in the region have been compiled (Amorim 2009, Klassa and Santos 2014). Of the Neotropical list of species, about 8,700 species were known to occur in Brazil (Rafael et al. 2012) (see Fig. 1 for a few representatives of the Brazilian fly fauna).

This study compiles and discusses the data available on the Brazilian fauna of Diptera in the CTFB and provides an overview of the knowledge of the diversity of the group in Brazil.

MATERIAL AND METHODS

Data shown in Tables 2–6 and Figs 4–14 were updated as of January 1, 2023, extracted from the CTFB website (http://fauna.jbrj.gov.br/fauna/listaBrasil), with a focus on Diptera (Rafael et al. 2024). Data summarized in Table 1 and Figs 2–3 were updated as of July 1, 2024.

A complete list of species in alphabetical order, arranged by family, genus, and species within each genus is provided in Supplementary File 1. The data from the CTFB were extracted, compiled, and segmented in Excel spreadsheets (Supplementary Files 2–5) with the following analyses: i) the total of species and genera for the country; ii) total of species and genera of each family and higher rank taxon (ranked by most species-rich families); iii) the total of described and valid species reported to Brazil per decade since the first species described in 1758; iv) most productive authors in terms of described species; v) authors with more eponyms; vi) authors by gender; and vii) total of names of species described after geographical localities. All tables and graphics were made in Microsoft Excel.

Searching for the names of genera and specific epithets referring to localities and Brazilians was made by manipulating the full dataset of the CTFB in spreadsheets. For genera, names were filtered by similarity with proper nouns of people, especially those of outstanding dipterists. Specific epithets were filtered by similarity with proper nouns of people and also by identifying the genitive singular endings commonly used for this purpose (-i for species named after men and -e or -ae for species named after women). In case of doubts, the etymology of the names was consulted in the original description. The total number of epithets of the Brazilian species honoring people includes scientists and non-scientists, however, Tables 6 and 7 only include scientists, highlighting their relevance amongst the peer dipterists.

Particularly, the progress and speed of fly species descriptions in recent decades were carefully analyzed. Data for this analysis was compiled considering only the last 30 years, separated by three periods of 10 years: i) 1993–2002; ii) 2003–2012; and iii) 2013–2022. We aimed to verify the progress on the number of authors describing species, how collaborative these studies were between authors, and how the main groups of authors interacted. To examine these last two questions, a matrix for each decade was modified using unique codes for each author, to distinguish authors with the same last name (i.e., surname or family name) and initials. Each matrix was loaded in VantagePoint v.9.0 to generate the co-authorship matrices. The analysis of co-authorship

Figure 1. Adults of some Brazilian Diptera families, most living specimens, except for Figures H and O. A. Anisopodidae. B. Culicidae. C. Tabanidae. D. Mydidae. E. Stratiomyidae. F. Mesembrinellidae. G. Empididae. H. Phoridae. I. Hippoboscidae. J. Curtonotidae. K. Pyrgotidae. L. Richardiidae. M. Ropalomeridae. N. Tephritidae. O. Celyphidae. P. Neriidae.

was performed in Gephi v.9.0 using a community detection algorithm.

RESULTS

Overall species richness of Diptera in Brazil

A total of 1,986 genera, 12,194 species, and 77 subspecies of Diptera have been recorded for Brazil until July 2024 (Table 1), representing 9.3% of the Brazilian fauna. This gives Diptera the status of the third most species-rich taxon in the country. The overall fly diversity has been compiled by 85 specialists—including researchers, postdocs, and graduate students—, mostly Brazilians, of which 34 are women (about 42%) and 51 are men (about 58%) (Table 2).

Among the 102 families of Diptera, the 15 most species-rich families, with more than 300 valid species (Table 1, Fig. 2), represent 66.5% of the overall Brazilian species diversity of the order: (1) Phoridae (896), (2) Tachinidae (826), (3) Chironomidae (679), (4) Psychodidae (623), (5) Syrphidae (613), (6) Culicidae (552), (7) Ceratopogonidae (531), (8) Tabanidae (494), (9) Limoniidae (486), (10) Asilidae (480), (11) Mycetophilidae (431), (12) Drosophilidae (395), (13) Sarcophagidae (385), (14) Muscidae (378), and (15) Stratiomyidae (344). The 15 most genera-rich families, with more than 40 genera recognized in each family (Table 1, Fig. 3), represent 65.2% of all the Brazilian generic diversity: (1) Tachinidae (320), (2) Stratiomyidae (108), (3) Chironomidae (103), (4) Phoridae (102), (5) Asilidae (100), (6) Cecidomyiidae

Table 1. Number of genera and species per family of Diptera reported from Brazil, with total per suborder (following the classification of Amorim and Yeates 2006), in the alphabetical order by family within each suborder, as displayed in the Taxonomic Catalog of the Brazilian Fauna (Rafael et al. 2024).

Suborder / Family	Genus	Species	Subspecies
Bibionomorpha	202	1001	
1. Anisopodidae Knab, 1912	3	23	
2. Bibionidae Fleming, 1821	6	49	
3. Cecidomyiidae Newman, 1835	100	298	
4. Diadocidiidae Winnertz, 1863	1	1	
5. Ditomyiidae Keilin, 1919	4	11	
6. Keroplatidae Rondani, 1856	24	90	
7. Lygistorrhinidae Edwards, 1925	1	5	
8. Mycetophilidae Newman, 1834	41	431	
9. Rangomaramidae Jaschhof & Didham, 2002	2	2	
10. Sciaridae Billberg, 1820	20	91	
Culicomorpha	164	1,939	18
11. Ceratopogonidae Newman, 1834	31	531	
12. Chaoboridae Edwards, 1920	1	10	
13. Chironomidae Newman, 1834	103	679	1
14. Corethrellidae Edwards, 1932	1	58	
15. Culicidae Meigen, 1818	23	552	17
16. Dixidae Schiner, 1868	1	9	
17. Simuliidae Newman, 1834	3	99	
18. Thaumaleidae Bezzi, 1913	1	1	
Psychodomorpha	60	660	8
19. Blephariceridae Loew, 1861	1	32	
20. Psychodidae Newman, 1834	55	623	8
21. Scatopsidae Newman, 1834	4	5	
Tipulomorpha	47	650	24
22. Limoniidae Rondani, 1856	38	486	18
23. Tipulidae Latreille, 1802	9	164	6
Brachycera	1,513	7,944	27
24. Acroceridae Leach, 1815	9	31	
25. Agromyzidae Fallén, 1823	15	131	
26. Anthomyiidae Robineau-Desvoidy, 1830	8	33	
27. Asilidae Latreille, 1802	100	480	3
28. Asteiidae Rondani, 1856	3	3	
29. Atelestidae Hennig, 1970	1	1	
30. Athericidae Nowicki, 1873	2	2	
31. Aulacigastridae Duda, 1924	1	8	
32. Austroleptidae Nagatomi, 1982	1	3	
33. Bombyliidae Latreille, 1802	27	114	2
34. Brachystomatidae Melander, 1908	2	3	
35. Braulidae Egger, 1853	1	1	
36. Calliphoridae Brauer & Bergenstamm, 1889	9	33	
37. Canacidae Jones, 1906	5	7	
38. Celyphidae Bigot, 1852	1	1	
39. Chamaemyiidae Hendel, 1910	4	8	
40. Chloropidae Rondani, 1856	47	151	
41. Clusiidae Handlirsch, 1884	7	145	4
42. Conopidae Latreille, 1802	12	100	
43. Ctenostylidae Bigot, 1882	4	6	
44. Curtonotidae Duda, 1934	1	19	
45. Diastatidae Hendel, 1917	1	1	
46. Dolichopodidae Latreille, 1809	31	224	
47. Drosophilidae Rondani, 1856	19	395	
48. Empididae Latreille, 1804	18	158	1
49. Ephydridae Zetterstedt, 1837	41	150	
50. Fanniidae Schnabl & Dziedzicki, 1911	2	49	
51. Heleomyzidae Westwood, 1840	5	15	
52. Helosciomyzidae Steyskal, 1965	1	1	
53. Hippoboscidae Samouelle, 1819	10	30	1
54. Hybotidae Meigen, 1820	18	148	
55. Inbiomyiidae Buck, 2006	1	2	
56. Lauxaniidae Macquart, 1835	43	111	
57. Lonchaeidae Rondani, 1856	4	47	
58. Lonchopteridae Macquart, 1823	1	1	
59. Mesembrinellidae Shannon, 1926	2	16	
60. Micropezidae Blanchard, 1840	15	124	
61. Milichiidae Schiner, 1862	8	33	
62. Muscidae Latreille, 1802	61	378	2
63. Mydidae Latreille, 1809	10	31	
64. Mythicomyiidae Melander, 1902	5	17	
65. Nemestrinidae Macquart, 1834	5	9	
66. Neriidae Westwood, 1840	6	17	
67. Nycteribiidae Samouelle, 1819	2	28	
68. Odiniidae Hendel, 1920	9	25	
69. Oestridae Leach, 1815	4	23	
70. Pantophthalmidae Bigot, 1886	2	12	
71. Periscelididae Oldenberg, 1914	6	33	
72. Phoridae Curtis, 1833	102	896	
73. Piophilidae Macquart, 1835	4	7	
74. Pipunculidae Walker, 1834	14	161	2
75. Platypezidae Latreille, 1829	3	3	
76. Platystomatidae Schiner, 1862	2	5	
77. Pseudopomyzidae McAlpine, 1966	3	5	
78. Psilidae Macquart, 1835	1	3	
79. Pyrgotidae Hendel, 1916	5	34	
80. Rhagionidae Samouelle, 1819	2	20	
81. Rhinophoridae Robineau-Desvoidy, 1863	3	4	
82. Richardiidae Loew, 1868	15	63	
83. Ropalomeridae Schiner, 1868	8	30	
84. Sarcophagidae Macquart, 1834	41	385	
85. Scenopinidae Burmeister, 1835	3	9	
86. Sciomyzidae Macquart, 1846	10	32	
87. Sepsidae Walker, 1833	7	26	
88. Somatiidae Hendel, 1935	1	4	
89. Sphaeroceridae Macquart, 1835	28	83	
90. Stratiomyidae Latreille, 1802	108	344	
91. Streblidae Kolenati, 1863	24	102	2
92. Syringogastridae Prado, 1969	1	9	
93. Syrphidae Latreille, 1802	79	613	
94. Tabanidae Latreille, 1802	44	494	6
95. Tachinidae Robineau-Desvoidy, 1830	320	826	
96. Tanypezidae Rondani, 1856	1	9	
97. Tephritidae Newman, 1834	49	304	4
98. Teratomyzidae Colless & McAlpine, 1970	1	1	
99. Therevidae Newman, 1834	11	36	
100. Ulidiidae Macquart, 1835	29	64	
101. Xylomyidae Verrall, 1901	2	7	
102. Xylophagidae Fallén, 1810	2	7	
Total	1,986	12,194	77

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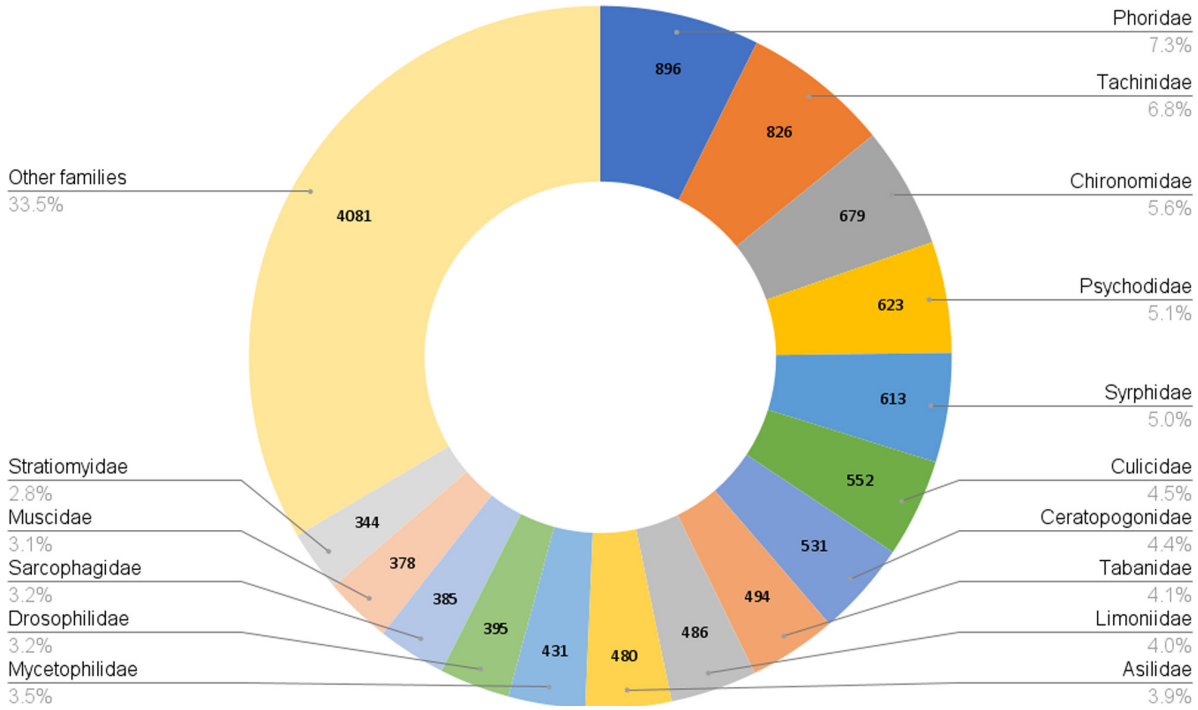


Figure 2. The top 15 species-rich families of Diptera in Brazil.

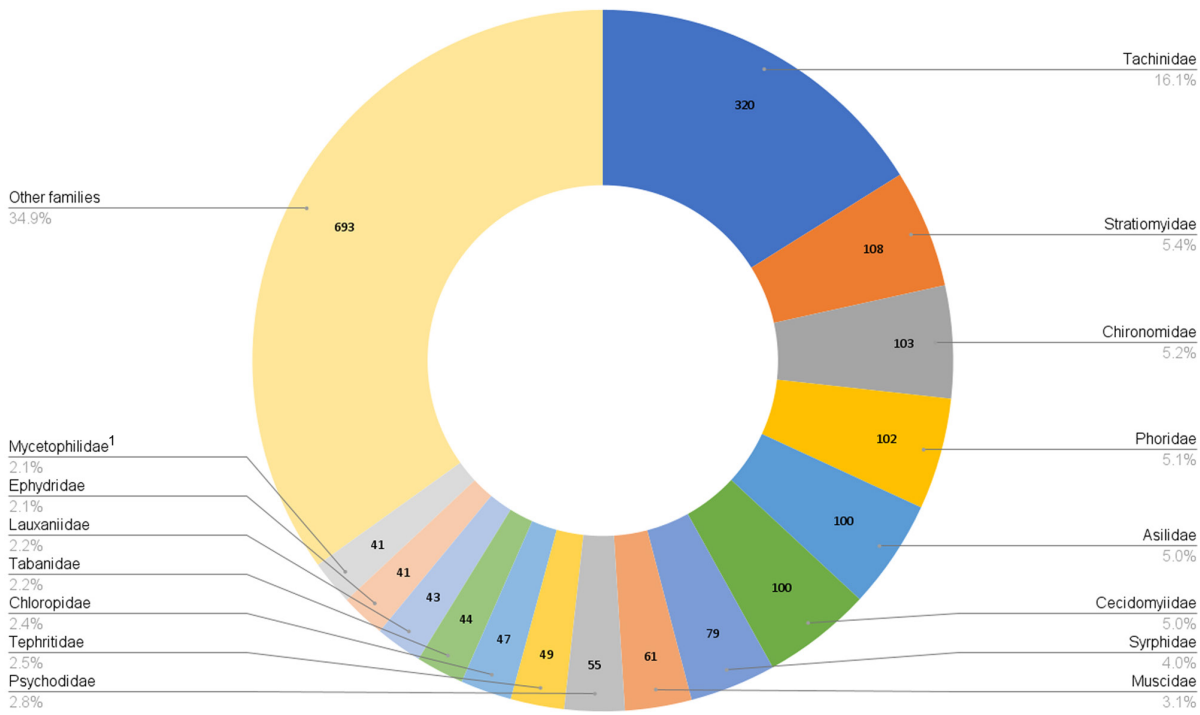


Figure 3. The top 15 genera-rich families of Diptera in Brazil (Mycetophilidae[1] also includes Sarcophagidae in the same position, with 41 genera known).

Table 2. Families reported from Brazil based on CTFB with respective systematists who have compiled data for each family (Rafael et al. 2024). Families are in partial phyletic sequence.

Family	Collaborator
Anisopodidae	Rafaela Lopes Falaschi, Sarah Siqueira de Oliveira
Bibionidae	Rafaela Lopes Falaschi, Daniel de Castro Schelesky-Prado
Cecidomyiidae	Valéria Cid Maia
Diadocidiidae	Rafaela Lopes Falaschi
Ditomyiidae	Rafaela Lopes Falaschi
Keroplatidae	Rafaela Lopes Falaschi
Lygistorrhinidae	Sarah Siqueira de Oliveira
Mycetophilidae	Sarah Siqueira de Oliveira, Giovana de Pina Siqueira Afiune
Rangomaramidae	Rafaela Lopes Falaschi
Sciaridae	Dalton de Souza Amorim
Ceratopogonidae	Maria Luiza Felippe Bauer, Maria Clara Alvares Santarém
Chaoboridae	Leonardo Henrique Gil-Azevedo, Caio Cezar Dias Corrêa
Chironomidae	Luiz Carlos de Pinho, Lívia Maria Fusari, Humberto Mendes
Corethrellidae	Caio Cezar Dias Corrêa, Leonardo Henrique Gil-Azevedo
Culicidae	Roger William Hutchings, Rosa Sá Gomes Hutchings, Maria Anice Mureb Sallum, Maycon Sebastião Alberto Santos Neves
Dixidae	Caio Cezar Dias Corrêa, Leonardo Henrique Gil-Azevedo
Simuliidae	Leonardo Henrique Gil-Azevedo
Thaumaleidae	Luiz Carlos de Pinho
Blephariceridae	Leonardo Henrique Gil-Azevedo
Psychodidae	Paloma Helena Fernandes Shimabukuro, Andrey José de Andrade, Eunice Aparecida Bianchi Galati, Danilo Pacheco Cordeiro, Freddy Bravo
Scatopsidae	Dalton de Souza Amorim
Limoniidae	Daubian Santos, Guilherme Cunha Ribeiro
Tipulidae	Daubian Santos, Guilherme Cunha Ribeiro
Acroceridae	Jéssica Paula Gillung
Agromyzidae	Viviane Rodrigues de Souza, Márcia Souto Couri
Anthomyiidae	Claúdio José Barros de Carvalho, Márcia Souto Couri
Asilidae	Carlos José Einicker Lamas, Alexssandro Camargo
Asteiidae	Fernando da Silva Carvalho-Filho
Atelestidae	Paula Raile Riccardi
Athericidae	Charles Morphy dos Santos
Aulacigastridae	Alessandra Rung, Santos
Austroleptidae	Diego Aguilar Fachin, Charles Morphy dos Santos
Bombyliidae	Carlos José Einicker Lamas
Brachystomatidae	Josenir Teixeira Câmara, José Albertino Rafael
Braulidae	Gustavo Graciolli
Calliphoridae	Marco Antonio Tonus Marinho, Thaís Madeira Ott
Canacidae	Luciane Marinoni, Fábio Siqueira Pitaluga de Godoy
Celyphidae	José Albertino Rafael
Chamaemyiidae	Cinthia Chagas
Chloropidae	Paula Raile Riccardi
Clusiidae	Vera Cristina Silva
Conopidae	Leonardo Silvestre Gomes Rocha
Ctenostylidae	Ramon José Correa Luciano de Mello
Curtonotidae	Ramon José Correa Luciano de Mello
Diastatidae	Sávio Cunha Costa
Dolichopodidae	Renato Soares Capellari
Drosophilidae	Rosana Tidon, Marco Silva Gottschalk, Hermes José Schmitz, Marlúcia Bonifácio Martins, Sávio Cunha Costa
Empididae	José Albertino Rafael, Josenir Teixeira Câmara
Ephydridae	Luciane Marinoni, Wayne Mathis, Daniel Negoseki Robalo
Fanniidae	Claúdio José Barros de Carvalho, Márcia Souto Couri
Heleomyzidae	Júlia Calhau, Rosaly Ale-Rocha
Helosciomyzidae	Alessandre Pereira-Colavite, Fábio Siqueira Pitaluga de Godoy
Hippoboscidae	Gustavo Graciolli
Hybotidae	Rosaly Ale-Rocha, Rafael Augusto Pinheiro de Freitas-Silva, Luana Machado Barros
Inbiomyiidae	Paula Raile Riccardi
Lauxaniidae	Vera Cristina Silva
Lonchaeidae	Manoel Araécio Uchôa
Lonchopteridae	Gil Felipe Gonçalves Miranda
Mesembrinellidae	Marco Antonio Tonus Marinho
Micropezidae	Gustavo Borges Ferro, Claudio José Barros de Carvalho
Milichiidae	Fernando da Silva Carvalho-Filho
Muscidae	Márcia Souto Couri, Claudio José Barros de Carvalho
Mydidae	Júlia Calhau
Mythicomyiidae	Carlos José Einicker Lamas
Nemestrinidae	Carlos José Einicker Lamas
Neriidae	Tatiana Sepúlveda
Nycteribiidae	Gustavo Graciolli, Gabriela Hrycyna
Odiniidae	Francisco Limeira-de-Oliveira, Ana Alice Tôrres de Souza
Oestridae	José Roberto Pujol-Luz, Socrates Letana
Pantophthalmidae	Diego Aguilar Fachin
Periscelididae	Rosaly Ale-Rocha, Sandra Duque dos Santos
Phoridae	Danilo César Ament, Thalles Platiny Lavinscky Pereira
Piophilidae	João Paulo Vinicios Rodrigues
Pipunculidae	Dayse Willkenia Almeida Marques, José Albertino Rafael
Platypezidae	Thalles Platiny Lavinscky Pereira
Platystomatidae	João Paulo Vinicios Rodrigues
Pseudopomyzidae	Alessandre Pereira-Colavite, Luana Machado Barros
Psilidae	Rosaly Ale-Rocha, Luana Machado Barros
Pyrgotidae	Ramon José Correa Luciano de Mello
Rhagionidae	Charles Morphy dos Santos
Rhinophoridae	Silvio Shigueo Nihei
Richardiidae	Rosaly Ale-Rocha, Luana Machado Barros
Ropalomeridae	Rosaly Ale-Rocha
Sarcophagidae	Cátia Antunes de Mello-Patiu, Josenilson Rodrigues dos Santos, Fernando da Silva Carvalho-Filho, Marina Morim Gomes
Scenopinidae	Carlos José Einicker Lamas
Sciomyzidae	Luciane Marinoni
Sepsidae	Vera Cristina Silva
Somatiidae	Dayse Willkenia Almeida Marques
Sphaeroceridae	Gil Felipe Gonçalves Miranda
Stratiomyidae	Diego Aguilar Fachin
Streblidae	Gustavo Graciolli
Syringogastridae	Josenir Teixeira Câmara, José Albertino Rafael
Syrphidae	Mírian Nunes Morales, Luciane Marinoni
Tabanidae	Tiago Kütter Krolow, Augusto Loreiro Henriques
Tachinidae	Silvio Shigueo Nihei, Deivys Moises Alvarez Garcia, Felipe Macedo Gudin, Marcelo Domingos de Santis, Rodrigo de Vilhena Perez Dios
Tanypezidae	Rodrigo Marques Vieira
Tephritidae	Manoel Araécio Uchôa
Teratomyzidae	Rafael Augusto Pinheiro de Freitas-Silva
Therevidae	Francisco Limeira-de-Oliveira
Ulidiidae	Ramon José Correa Luciano de Mello
Xylomyidae	Diego Aguilar Fachin
Xylophagidae	Diego Aguilar Fachin

Continues

(100), (7) Syrphidae (79), (8) Muscidae (61), (9) Psychodidae (55), (10) Tephritidae (49), (11) Chloropidae (47), (12) Tabanidae (44), (13) Lauxaniidae (43), (14) Ephydridae, and (15) Mycetophilidae (41).

Fly species described by Carolus Linnaeus

The number of species of Diptera known for Brazil has increased since the early taxonomic efforts from Carolus Linnaeus (Linnaeus 1758, 1762). He described 18 species nowadays occurring in Brazil (Table 3). Overall, between the first description of a fly species in 1758, *Oestrus ovis* Linnaeus, 1758 (Oestridae), until now, the average rate of annual records for Diptera has been 44.71 species/year. At the beginning of the 19th century, the number of new records increased, reaching the highest number in the 1830s, with 402 species described at the end of that decade, mainly by efforts by Christian Rudolph Wilhelm Wiedemann (Wiedemann 1828, 1830), with 242 species described, then dropping in the following decades to as much as only 53 species in the 1870s. From the end of the 19th century, the number of newly described species has been moving up (Figs 4–5). In the 20th century, from the 1910s to 1960s, 5,871 species were described, nearly 50% of the known Brazilian dipteran fauna, with an average rate of 97.9 species/year and close to 1,000 species/decade, emphasizing Charles Alexander, Thomas Borgmeier, John Lane, and Charles Townsend, which described together 1,861 species during this time frame. In the 1970s, 1980s, and 1990s, in which there were additional 1,456 species described, the number of species/year decreased to an average rate of 48.53, less than 500 species/decade (Figs 4–5). In the 2000s, the number increased again and reached the level of the 1960s. In the 2010s, the number of species being described and reported for Brazil was higher than the number of the most productive decades of last century, with 1,277 species described, with an average of 127.7 species/year (Figs 4–5).

Table 3. Taxa described by Carolus Linnaeus (1758, 1762) reported from Brazil.

Family	Species	Author	Original combination
Culicidae	*Aedes aegypti*	(Linnaeus, 1762)	*Culex*
Anthomyiidae	*Delia radicum*	(Linnaeus, 1758)	*Musca*
Faniidae	*Fanis lateralis*	(Linnaeus, 1758)	*Musca*
Hippoboscidae	*Melophagus ovinus*	(Linnaeus, 1758)	*Hippobosca*
Muscidae	*Stomoxys calcitrans*	(Linnaeus, 1758)	*Conops*
Muscidae	*Haematobia irritans*	(Linnaeus, 1758)	*Conops*
Muscidae	*Musca domestica*	Linnaeus, 1758	*Musca*
Oestridae	*Gasterophilus nasalis*	(Linnaeus, 1758)	*Oestrus*
Oestridae	*Oestrus ovis*	Linnaeus, 1758	*Oestrus*
Piophilidae	*Piophila casei*	(Linnaeus, 1758)	*Musca*
Rhinophoridae	*Melanophora roralis*	(Linnaeus, 1758)	*Musca*
Stratiomyidae	*Hermetia illucens*	(Linnaeus, 1758)	*Musca*
Syrphidae	*Eristalis tenax*	(Linnaeus, 1758)	*Musca*
Tabanidae	*Chlorotabanus mexicanus*	(Linnaeus, 1758)	*Tabanus*
Tabanidae	*Leucotabanus exaestuans*	(Linnaeus, 1758)	*Tabanus*
Tabanidae	*Phaeotabanus fervens*	(Linnaeus, 1758)	*Tabanus*
Tabanidae	*Tabanus antarcticus*	Linnaeus, 1758	*Tabanus*
Tabanidae	*Tabanus occidentalis*	Linnaeus, 1758	*Tabanus*

Authors of Brazilian Diptera species

The 50 most productive authors described 7,938 species, which represents 67% of all valid species known for Brazil (Table 4). The top five authors described over 300 species each and, at least four of them, focused their research on particular families. Thomas Borgmeier contributed significantly to the current number of Phoridae, while Charles P. Alexander was important for the understanding of the Brazilian fauna of Tipulomorpha, John Lane to the knowledge of Bibionomorpha families, and Charles Henry T. Townsend to Tachinidae. Of the 50 most productive authors, 22 are Brazilians (three with dual nationality), followed by 12 Americans (one with dual nationality), seven are German (one with dual nationality), and another 11 are from other nationalities. Together, Brazilian authors on the list have described 3,790 species, nearly 48% of the total by the 50 most prolific authors of the Brazilian fauna. The number of Brazilians has not only increased among the top 50 in recent years but it is likely to surpass foreigners in the number of species described shortly—11 Brazilian taxonomists on the top most productive list are still active.

Species names based on localities

Naming species is but one of many components of species descriptions. One of the several strategies to compose the specific epithet of a species name is associating the name with the collecting sites, such as continents, countries, states, departments, provinces, municipalities, etc. For the Brazilian fauna, there are 493 species among the 15 most common names of places (Table 5). The most common names are associated with "Brasil/Brazil", with 154 species named after it, followed by "Amazonia", with 57, and "São Paulo", with 41. Although most species are not necessarily restricted to a locality, such as the state of São Paulo or the Amazon Forest, these numbers often reflect where the species was first found.

Taxa named after people

Another option for naming species is to honor someone who directly or indirectly helped authors or was parti-

Table 4. Top 50 most prolific authors of valid species reported for Brazil according to CTFB.

	Author	Species	Nationality
1.	Thomas Borgmeier	585	GER/BRA
2.	Charles Paul Alexander	559	USA
3.	John Lane	481	BRA
4.	Christian Rudolph Wilhelm Wiedemann	461	GER
5.	Charles Henry Tyler Townsend	337	USA/BRA
6.	Pierre Justin Jean Marie Macquart	249	FRA
7.	Charles Howard Curran	248	CAN
8.	José Albertino Rafael*	232	BRA
9.	Günther Enderlein	230	GER
10.	Freddy Ruben Bravo*	206	ECU/BRA
11.	Hugo de Souza Lopes	197	BRA
12.	Brian Victor Brown*	163	CAN
13.	Adolpho Lutz	162	BRA
14.	Trond Andersen*	158	NOR
15.	Humberto Fonseca Mendes*	152	BRA
16.	Stephen Archer Marshall*	146	CAN
17.	Frederich Wallace Edwards	139	UK
18.	Rosaly Ale-Rocha*	137	BRA
19.	Johan Christian Fabricius	129	SWE
20.	Dalton de Souza Amorim*	126	BRA
21.	Frank Montgomery Hull	126	USA
22.	Suzana Trivinho-Strixino*	124	BRA
23.	José Henrique Guimarães	123	BRA
24.	Samuel Wendell Williston	123	USA
25.	Valéria Cid Maia*	120	BRA
26.	Willis Wagner Wirth	119	USA
27.	Márcia Souto Couri*	116	BRA
28.	Friedrich Georg Hendel	115	AUS
29.	Dalcy de Oliveira Albuquerque	113	BRA
30.	Ignatz Rudolf Schiner	108	AUS
31.	Erwin Lindner	104	GER
32.	Harrison Grey Dyar Jr.	101	USA
33.	Luiz Carlos de Pinho*	93	BRA
34.	Owen Lonsdale*	92	USA
35.	John William Scott Macfie	90	UK
36.	Ângelo Pires do Prado	89	BRA
37.	Kenneth George Valentine Smith	89	UK
38.	Messias Carrera	88	BRA
39.	Ângelo Moreira da Costa Lima	85	BRA
40.	Otto Kröber	85	GER
41.	Alexander Graham Bell Fairchild	84	USA
42.	Maíra Xavier Araújo*	78	BRA
43.	Pavel Theodor Friedrich Oswald Duda	78	GER
44.	Friedrich Hermann Loew	77	GER
45.	Carlos José Einicker Lamas*	75	BRA
46.	Wayne Neilsen Mathis*	72	USA
47.	Mauro Pereira Barretto	71	BRA
48.	Dilbert Elmo Hardy	69	USA
49	John Merton Aldrich	67	USA
50	John Russell Malloch	67	USA
Total		7,938	

Continues

*Indicates which dipterists are still active. (AUS) Austria, (BRA) Brazil, (CAN) Canada, (ECU) Ecuador, (FRA) France, (GER) Germany, (NOR) Norway, (SWE) Sweden, (UK) United Kingdom, (USA) United States of America.

Table 5. Top 15 localities named after valid species of Diptera reported from Brazil, according to the CTFB.

Locality	Specific epithet	Species
Brasil/Brazil	*brasilae*, *brasileira*, *brasilense*, *brasilensis*, *brasilia*, *brasiliae*, *brasiliana*, *brasilianum*, *brasilianus*, *brasiliensis*, *brazil*, *brazilana*, *brazilensis*, *braziliae*, *braziliana*, *brazilianum*, *brazilianus*, *braziliensis*, *brazuca*	154
Amazonia	*amazon*, *amazona*, *amazonazi*, *amazonica*, *amazonicola*, *amazonicum*, *amazonicus*	57
São Paulo	*paulensis*, *pauliceia*, *paulista*, *paulistae*, *paulistana*, *paulistanensis*, *paulistensis*, *paulistorum*, *sanctipauli*	41
Amazonas	*amazonense*, *amazonensis*	28
Santa Catarina	*catarina*, *catarinae*, *catarinense*, *catarinensis*, *catharinae*, *catharinensis*, *sanctaecatharinae*	26
Neotropics	*neotropica*, *neotropicalis*, *neotropicum*, *neotropicus*	23
Pará	*paraensis*, *neoparaensis*, *pseudoparaensis*, *quasiparaensis*	22
Manaus	*manaoensis*, *manaos*, *manaosensis*, *manauara*, *manauensis*, *manaura*, *manausensis*	21
Paraná	*parana*, *paranaense*, *paranaensis*, *paranensis*	21
Boraceia	*boracea*, *boraceae*, *boraceana*, *boraceia*, *boraceiensis*, *boracensis*	19
Bahia	*bahiana*, *bahianus*, *bahiensis*, *baiana*	18
Rio de Janeiro (the state)	*fluminense*, *fluminensis*	18
Atlantic Forest	*atlantica*, *atlanticum*, *atlanticus*	15
Rio de Janeiro (the city)	*carioca*	15
Mato Grosso	*matogrossense*, *matogrossensis*, *mattogrossae*, *mattogrossensis*	15

cularly important to the knowledge of an area of research. About 2,320 species reported from the Brazilian fauna were named after some relevant scientist, collector of the species, close relative, or even a dear person using 1,213 unique epithets. The 20 most honored people comprise 478 species, most dipterists, other entomologists, or collectors of insects (Table 6) who have made outstanding contributions to the knowledge of biodiversity and taxonomy of Diptera and in-

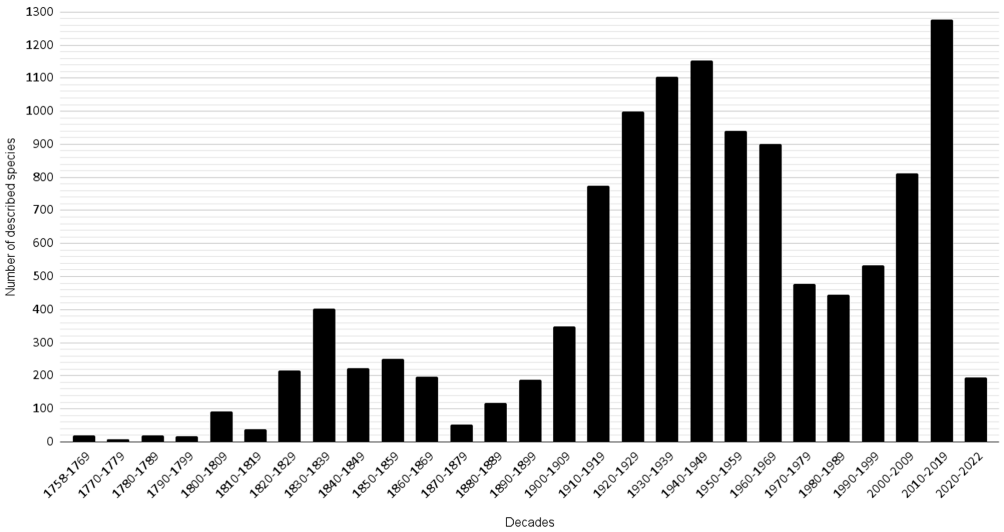


Figure 4. Number of described and valid species of Diptera recorded in Brazil per decade, from 1758 to 2022.

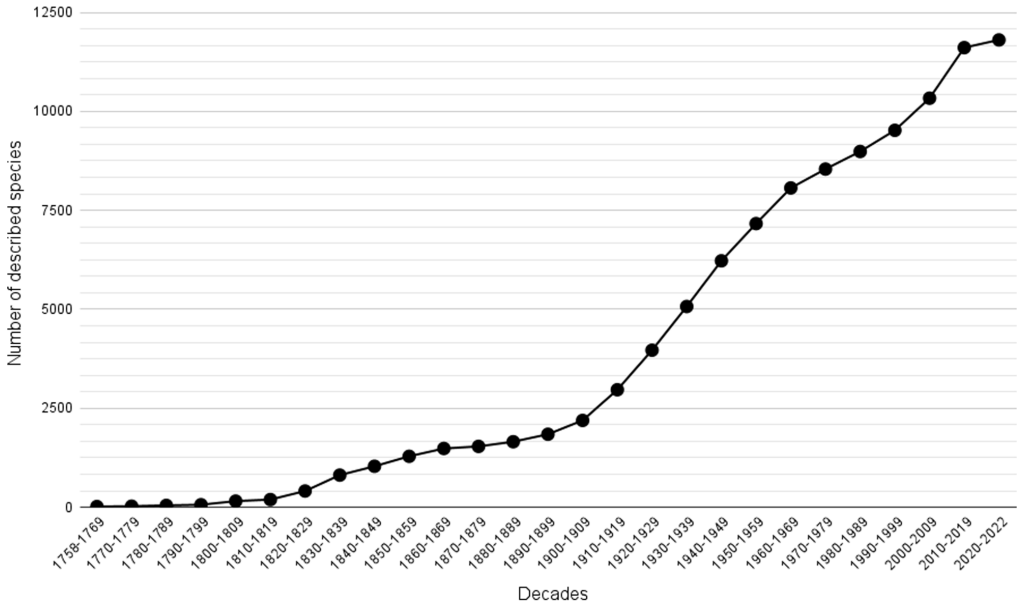


Figure 5. Accumulation curve of Diptera species recorded in Brazil per decade, from 1758 to 2022.

sects, in general, and applied Entomology. Many of the most honored people are Brazilians or lived in Brazil for a long time. The most honored was Fritz Plaumann (1902–1994), with 69 species named after him. He was born in East Europe and moved to Brazil in 1924, where he, in the countryside of the state of Santa Catarina, intensively collected insects from an area with ombrophilous mixed forests (Lubenow 2016, Radin and Corazza 2018). He sent thousands of insects abroad and, as a result, almost all primary types described from his material are deposited outside Brazil. There is an important set of specimens collected by Plaumann in the Museu de Zoologia, Universidade de São Paulo (MZUSP), especially from the late 1960s and early 1970s.

Differently of the species name, it is considerably rarer to loan a person's name for a genus, and in general, this is used to express greater gratitude for contribution in different parts of the scientific process, collecting specimens, describing species, or even science funding and supporting. We have

Table 6. The 20 most honored people with valid species of Diptera from Brazil, according to the CTFB.

Honored	Specific epithet	Species	Nationality
Fritz Plaumann	*plaumanni*, *plaumanniana*, *plaumannina*	69	GER/BRA
Hugo Souza Lopes	*lopesi, lopesae, souzalopesi*	57	BRA
John Lane	*lanei*, *laneanus*, *laneana*	49	BRA
Lauro Pereira Travassos	*lauroi, travassossi*, *travassosanus*	28	BRA
Raymond Corbett Shannon	*shannoni*, *shannoniana*	27	USA
Messias Carrera	*carrerai*, *carreranus*, *carrerella*	26	BRA
Thomas Borgmeier	*borgmeieri*, *borgmeieranus*	24	GER/BRA
Adolpho Lutz	*lutzi*, *lutzii*, *lutziana*, *lutzianum*	19	BRA
Nelson Papavero	*nelsoni, papaveroi*	18	BRA
Charles Curran	*currani*	17	CAN
Ernst Joseph Fittkau	*fittkaui*, *parafittkaui*	17	GER
José Albertino Rafael	*rafaeli*, *zerafael*	17	BRA
Mauro Pereira Barretto	*barretoi*, *barrettoi*	17	BRA
Karol Lenko	*lenkoi*	14	POL/BRA
Samuel Wendell Williston	*willistoni*, *neowillistoni*	14	USA
Frederick Wallace Edwards	*edwardsi*, *edwardsae*, *edwardsiana*	13	UK
Arthur Neiva	*neivai*	13	BRA
Sebastião José de Oliveira	*oliveirai*	13	BRA
Charles Henry Tyler Townsend	*townsendi*, *townsendiana*	13	USA/BRA
Joseph Francisco Zikán	*zikani*, *zikanellus*, *zikaniana*	13	BRA

(BRA) Brazil, (CAN) Canada, (GER) Germany, (POL) Poland, (UK) United Kingdom, (USA) United States of America.

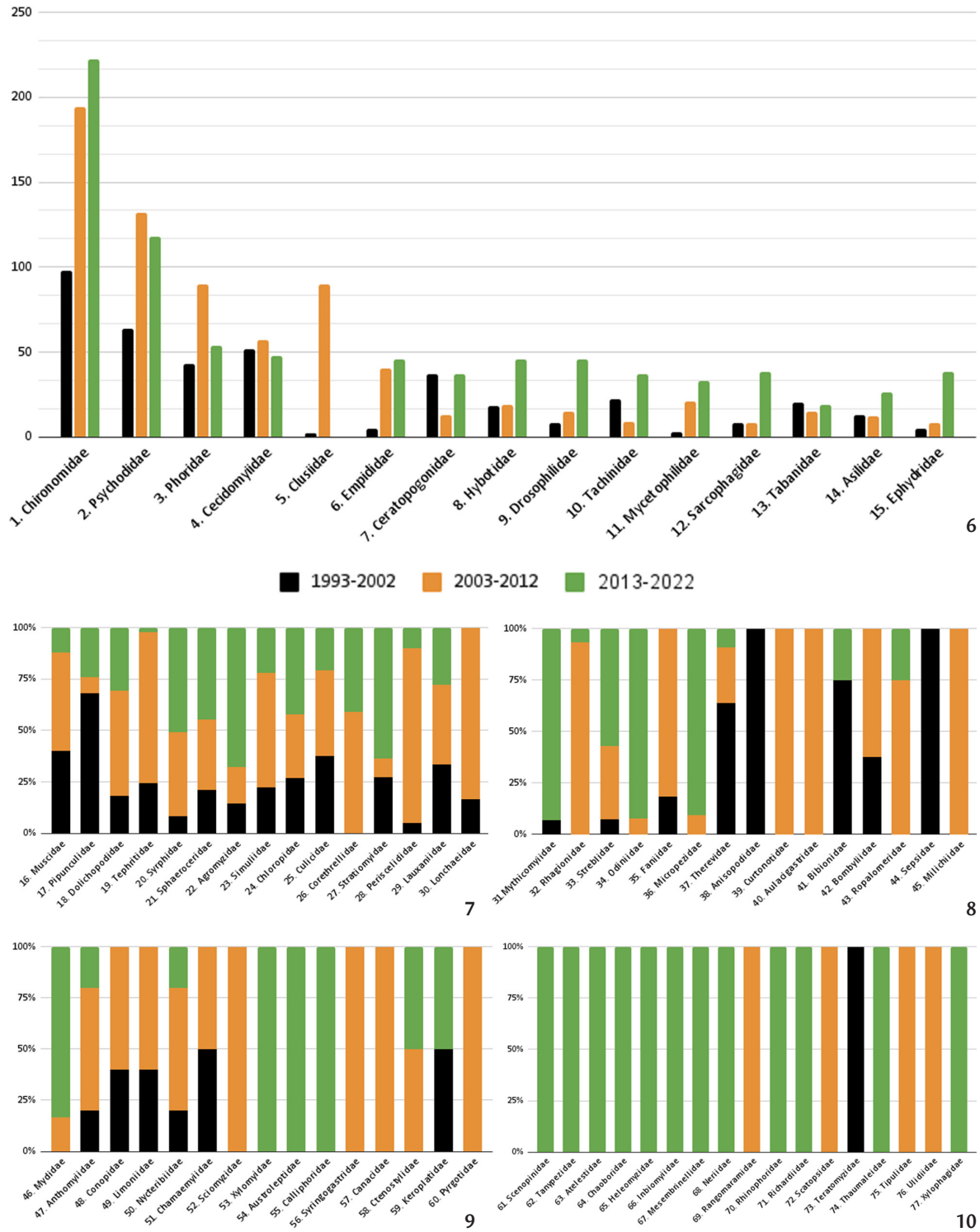
identified over 150 genera occurring in Brazil named after people, 49 of them are Brazilian scientists, mainly dipterists (Table 7). Messias Carrera, who contributed, mainly to the systematics of Asilidae, was honored with names of four genera, followed by Hugo de Souza Lopes, Thomas Borgmeier, and Adolpho Lutz, with three generic eponyms.

A closer look at the last 30 years

A total of 2,653 species were described in the last 30 years (1993–2022) for Brazil, with 578 between 1993 and 2002, 1,034 between 2003 and 2012, and 1,041 between 2013 and 2022. The increase in the number of species shows similar progress over these decades for 77 fly families, which certainly reflects the distribution of specialists. The top 15 families with more described species in the period comprised 1,929 species, nearly 73% of all described species in the last 30 years. These had at least one species described in each decade. An exception is Clusiidae, which had two species described between 1993 and 2002 and 90 species described from 2003 to 2012—which largely reflects the effort made by Owen Lonsdale and Stephen A. Marshall (Lonsdale and Marshall 2006, 2007, 2012) to deal with the Neotropical fauna of the family.

The increase in the number of species for Brazil in most top 15 fly families in the last decade was as high as the decade before or higher (Fig. 6). The only exceptions were Psychodidae, Phoridae, Cecidomyiidae, and Clusiidae. In the rank of families with more described species in the 30 years, from rank #16 to #30, there is a predominance of species described from 2003 to 2012 (nine). Another five families had more described species from 2013 to 2022 and, only one family (Pipunculidae) had more species described from 1993 to 2002 (Fig. 7). Similarly, from #31 to #45, seven families had more species described from 2003 to 2012, four families with a high number of species described from 2013 to 2022, and another four for which most of their species were described from 1993 to 2002 (Fig. 8). Finally, from #46 to #77 in the rank, families whose species were described in only one of the three periods, 24 out of 32, predominate. Of these, the fauna of 15 families in the last 30 years were all described from 2013 to 2022, while eight families had species described from 2003 to 2012, and only one family from 1993 to 2002 (Figs 9–10).

The number of people who have authored species descriptions over the last 30 years has changed, with more authors collaborating on the descriptions in the most recent decade (Fig. 11). From 1993 to 2002, more than half of the species, 54.4% (315 species), were described by a single author, followed by 37% (213) and 8.6% (50), with two and three or more authors, respectively. From 2003 to 2012, the proportion of species described by a single author dropped to 24% (246 species), while species proposed by two or three



Figures 6–10. Diptera families ranked by the total of species described in the last three decades in Brazil: 1993–2002, 2003–2012, and 2013–2022: (6) family list from 1st to 15th; (7) family list from 16th to 30th; (8) family list from 31st to 45th; (9) family list from 46th to 60th; (10) family list from 61st to 77th.

Table 7. List with honored Brazilians scientists with names of genera of Diptera according to the CTFB.

	Genus	Honored Brazilians	Family
1.	*Albertinella* Couri & Carvalho, 2005	José Albertino Rafael	Muscidae
2.	*Albuquerquea* Melo, 1967*	Dalcy de Oliveira Albuquerque	Membrinellidae
3.	*Alvarenga* Carrera, 1960	Moacyr Alvarenga	Asilidae
4.	*Amorimius* Papavero, 2009	Dalton de Souza Amorim	Asilidae
5.	*Araujoa* Artigas & Papavero, 1991	Renato Lion de Araújo	Asilidae
6.	*Barbiellinia* Bezzi, 1922	Amadeu Amadei Barbiellini	Stratiomyidae
7.	*Borgmeieriphora* Prado, 1976	Thomas Borgmeier	Phoridae
8.	*Borgmeiermyia* Townsend, 1935	Thomas Borgmeier	Tachinidae
9.	*Carreraia* Corrêa, 1947	Messias Carrera	Anisopodidae
10.	*Carreramyia* Doesburg, 1966	Messias Carrera	Syrphidae
11.	*Carrerapyrgota* Aczél, 1956	Messias Carrera	Pyrgotidae
12.	*Chagasia* Cruz, 1906	Carlos Justiniano R. Chagas	Culicidae
13.	*Claudiotendipes* Andersen, Mendes & Pinho, 2017	Claudio Gilberto Froehlich	Chironomidae
14.	*Costadiplosis* Viceconte & Maia, 2009	José Carlos Costa	Cecidomyiidae
15.	*Costalima* Sabrosky, 1953	Ângelo M. da Costa Lima	Milichiidae
16.	*Deanemyia* Galati, 1995	Leônidas de Mello Deane	Psychodidae
17.	*Djalmabatista* Fittkau, 1968	Djalma da Cunha Batista	Chironomidae
18.	*Duckemyia* Kano & Lopes, 1969	Adolpho Ducke	Sarcophagidae
19.	*Evandromyia* Mangabeira, 1941	Evandro Serafim L. Chagas	Psychodidae
20.	*Fernandesia* Rodrigues & Maia	Geraldo Wilson Fernandes	Cecidomyiidae
21.	*Goeldichironomus* Fittkau, 1965	Emílio Augusto Goeldi	Chironomidae
22.	*Henriquella* Bonatto, 2005*	José Henrique Guimarães	Mesembrinellidae
23.	*Laneella* Pinto de Melo, 1967	John Lane	Mesembrinellidae
24.	*Lenkokroeberia* Prado, 1966	Karol Lenko	Ropalomeridae
25.	*Lewinsohnia* Norrbom & Prado, 2006	Thomas Lewinsohn	Tephritidae
26.	*Lopescladius* Oliveira, 1967	Hugo de Souza Lopes	Chironomidae
27.	*Lopesiodinia* Pires do Prado, 1973	Hugo de Souza Lopes	Odiniidae
28.	*Lutzia* Theobald, 1903	Adolpho Lutz	Culicidae
29.	*Lutzomyia* França, 1924	Adolpho Lutz	Psychodidae
30.	*Lutzsimulium* d'Andretta & Vulcano, 1947	Adolpho Lutz	Simuliidae
31.	*Maiamyia* Evenhuis, 2022	Valéria Cid Maia	Cecidomyiidae
32.	*Martinsmyia* Galati,1995	presumably Amicar Vianna Martins	Psychodidae
33.	*Messiasia* d'Andretta, 1951	Messias Carrera	Mydidae
34.	*Neivamyia* Pinto & Fonseca, 1930	presumably Arthur Neiva	Muscidae
35.	*Oliveiriella* Wiedenbrug & Fittkau, 1997*	Sebastião José de Oliveira	Chironomidae
36.	*Papaverellus* Artigas & Vieira, 2014	Nelson Papavero	Asilidae
37.	*Pintomyia* Costa Lima, 1932	Cezar Pinto	Psychodidae
38.	*Plaumannimyia* Hering, 1938	Fritz Plaumann	Tephritidae
39.	*Pradea* Borgmeier, 1927	presumably Alcides Prado	Phoridae
40.	*Pressatia* Mangabeira, 1942	André Pressat	Psychodidae
41.	*Rochadiplosis* Tavares, 1917	Franscisco Dias da Rocha	Cecidomyiidae
42.	*Seabramyia* Carrera, 1960	Carlos Alberto de Campos Seabra	Asilidae
43.	*Souzalopesmyia* Albuquerque, 1951	Hugo de Souza Lopes	Muscidae
44.	*Thomazomyia* Lopes, 1976	Thomas Borgmeier	Sarcophagidae
45.	*Townsendia* Williston, 1895	Charles Henry Tyler Townsend	Asilidae
46.	*Travassomyia* Lopes, 1935*	Lauro Pereira Travassos	Ctenostylidae
47.	*Travassophora* Borgmeier, 1938	Lauro Pereira Travassos	Phoridae
48.	*Viannamyia* Mangabeira, 1941	Gaspar de Oliveira Vianna	Psychodidae
49.	*Zikania* Borgmeier, 1925	Josef Franz Zikán	Phoridae

*Indicates non-valid names of genera.

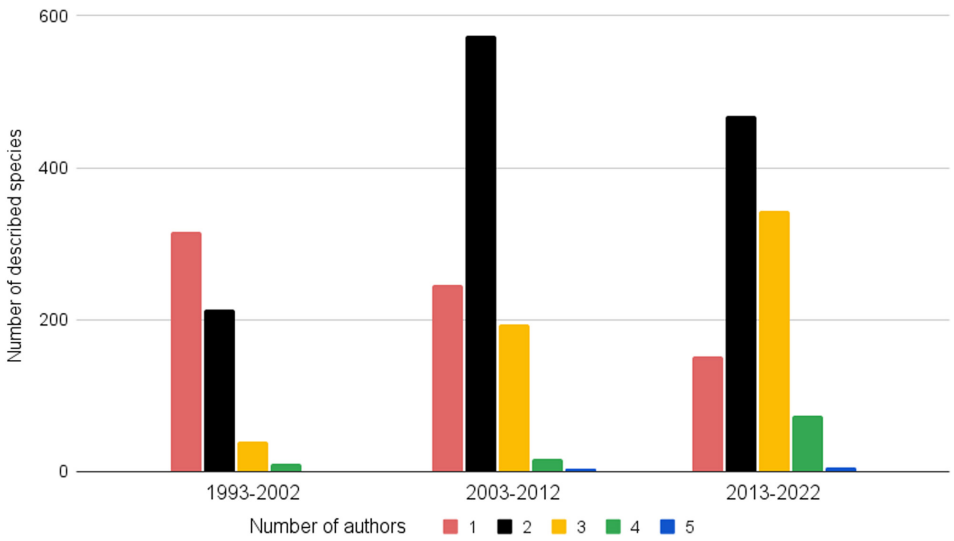


Figure 11. Number of authors of Diptera species in the last three decades in Brazil.

authors increased substantially, representing 55% (574) and 19% (193) of the names of that decade, respectively. Lastly, from 2013 to 2022, the proportion of species described by a single author dropped even more, to 15% (152) of the total, and species described by two authors represented 45% (468) and those described by three authors increased to 33% (343) of all names of this last decade.

The interaction and collaborative work of the Brazilian research groups while describing species between 1993 and 2022 was analyzed. In Figs 12–13, each circle represents an author with at least five species described. The size of the circles is relative to the number of species names proposed by each author and the intensity of colors represents how central that author is to the network concerning the connections with other authors. Connections between authors result from species names described and the width of the connection is related to the number of species names in collaboration. Comparing the connections over the decades, we found that not only did the number of dipterists expand in Brazil and not only the number of co-authors for each species increased, as referred to above, but the network among authors and research groups became more complex, reflecting an increase of collaboration among Brazilians.

DISCUSSION

Currently, there are approximately 160,000 known species of Diptera worldwide (Evenhuis and Pape 2023, Whitmore et al. 2021), the Brazilian fauna with 12,194 thus represents nearly 7.6% of the world fauna. There are 102 families reported in the country, of close to 160 families known worldwide. Of the families with records for Brazil, five were only recently reported—Austroleptidae (Fachin et al. 2018, 2020), Inbiomyiidae (Riccardi and Amorim 2019), Atelestidae (Amorim et al. 2020), Celyphidae (Rafael et al. 2022), and, more recently, Diastatidae (Costa et al. 2023)—what indicates that there is an important fraction of the fly diversity that is still unknown even at higher taxonomical levels in Brazil.

Of the list of 15 most species-rich families in Brazil, 10 are also present in the inventory of flies in a tropical forest in Zurquí, Costa Rica (Brown et al. 2018, Borkent et al. 2018)—Phoridae, Tachinidae, Mycetophilidae, Tipulidae s.l., Drosophilidae, Ceratopogonidae, Psychodidae, Chironomidae, Muscidae, and Syrphidae. The other five in the Zurquí list were Cecidomyiidae, Sciaridae, Agromyzidae, Lauxaniidae, and Dolichopodidae.

Even though the numbers of Brazilian species correspond to the accumulated effort for over two centuries, there is still a taxonomical bias, dark taxa (in the sense of Hartop et al. 2022) introduce biases. The top-15 list of families with larger number of barcode index numbers found in Canada by Hebert et al. (2016), for temperate environments, shares nine families of their list of most species-rich families with Brazil—Chironomidae, Ceratopogonidae, Mycetophilidae, Phoridae, Dolichopodidae, Tachinidae, Muscidae, and Syrphidae—and their list also includes Cecidomyiidae, Sciaridae, Agromyzidae, Empididae, Anthomyiidae, and

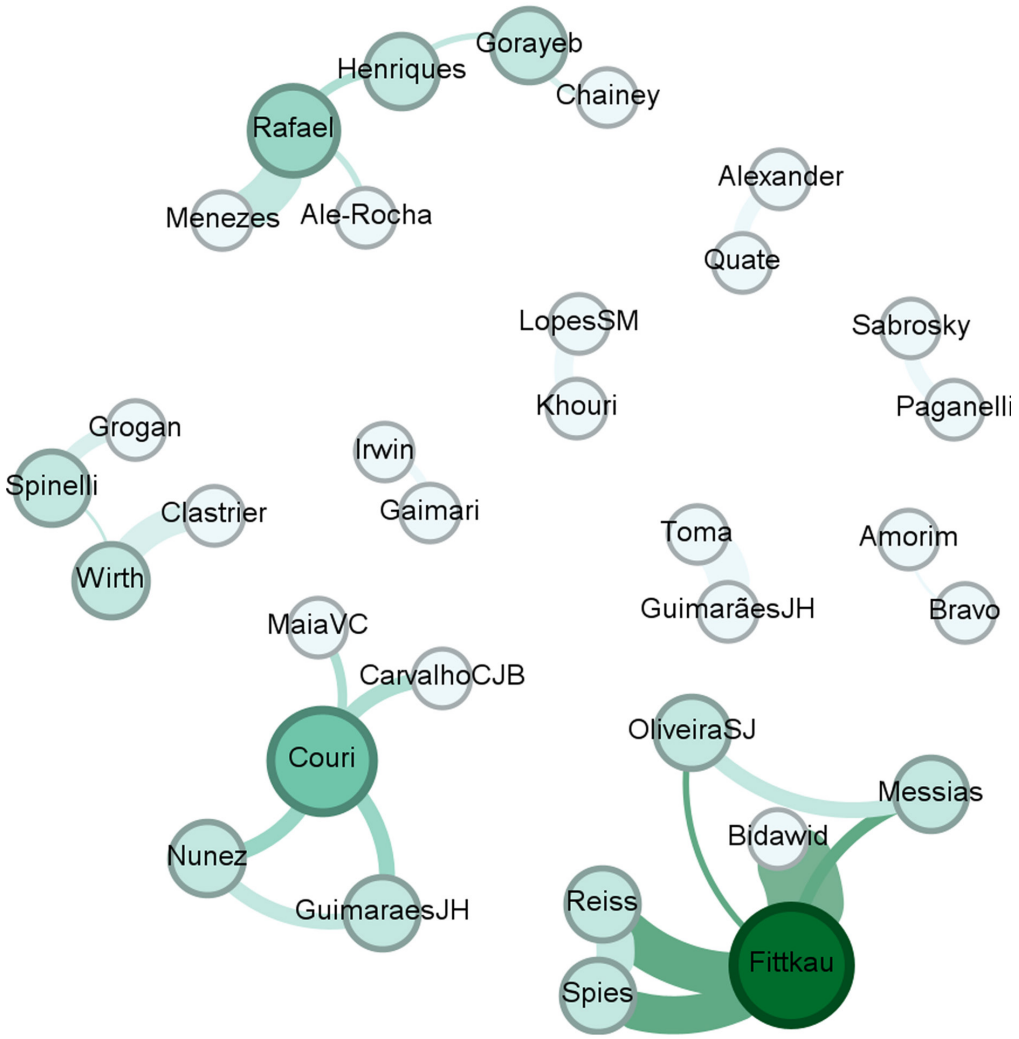


Figure 12. Co-authorship network of Diptera species in Brazil from 1993 to 2002.

Chloropidae. Srivsathsan et al. (2023), dealing with Malaise trap samples from different regions, reported 10 fly families among the 20 most species-rich families of insects: Cecidomyiidae, Ceratopogonidae, Chironomidae, Chloropidae, Dolichopodidae, Muscidae, Phoridae, Psychodidae, Sciaridae, and Sphaeroceridae. These numbers stress the difference between the expected families with more species and those with more described species and highlight to the dipterist community the bias in the distribution of specialists considering the major taxonomical gaps in species diversity.

The data available for other countries or biogeographical areas strongly suggests a deficit of taxonomic investment in some fly families in Brazil and the Neotropical Region. For the sake of comparison, Pape et al. (2009) indicated that, for 152,715 species known in the world, the Palearctic Region had 44,894 species, the Neotropical Region had 31,088, the Oriental Region had 22,543, the Nearctic Region had 21,449, the Afrotropical Region had 20,163, and the Australasian Region had 18,920. Particularly noteworthy are the Cecidomyiidae, which may be the insect family with the largest abundance of species on the planet (Hebert et al. 2016). There is certainly a very high portion of unknown diversity in Brazil in the Sciaridae, Empidoidea, and in some schizophoran families, e.g., Agromyzidae, Chloropidae, Drosophilidae, Lauxaniidae, and Sphaeroceridae. Especially in the last 20 years, the question of lack of investment and continuity of studies in fly families has been addressed in the discussion of long-term faunal surveys, such as the SISBIOTA-Diptera

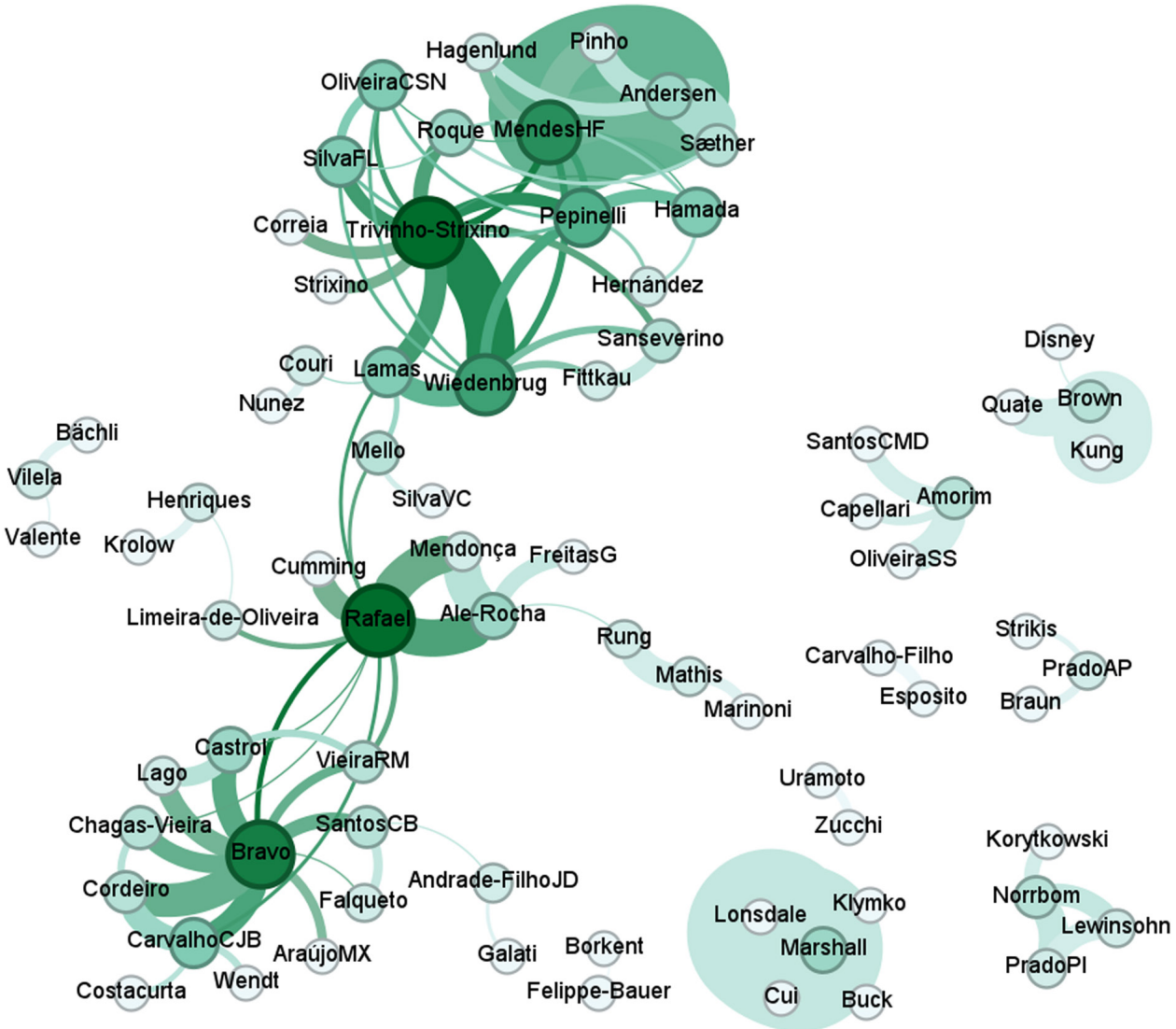


Figure 13. Co-authorship network of Diptera species in Brazil from 2003 to 2012.

(Lamas et al. 2023), and governmental programs that have focused on poorly studied biomes and areas and neglected taxa, forming a new generation of experts (Rafael et al. 2009).

The fact that the last decade was the most productive ever in terms of unearthing the hidden insect diversity is meaningful. Over the last decades, North America, Europe, Japan, and Australia lost hundreds of taxonomists' research positions in universities. This is impressive considering the amount of attention given to biodiversity and conservation in a world impacted by climate change. Indeed, the loss of taxonomist positions is revealed to be a large-scale counterintuitive decision when considering the need for urgent actions for biodiversity conservation and the fulfillment of the Paris Agreement—and it is evidence of the biased current methods for measuring scientific impact. Over the last 40 years, Brazil has expanded its baseline of specialists and improved the quality and productivity of its biodiversity community—the fact that the last decade was the most productive ever in terms of species described did not occur by chance. It is the result of planned investment in training, hiring, funding, and valuing biodiversity research in nationwide research funding agencies and universities, but also at state-level funding agencies and universities (Rafael et al. 2009)—not without a fight, though (Bockmann et al. 2018). Nevertheless,

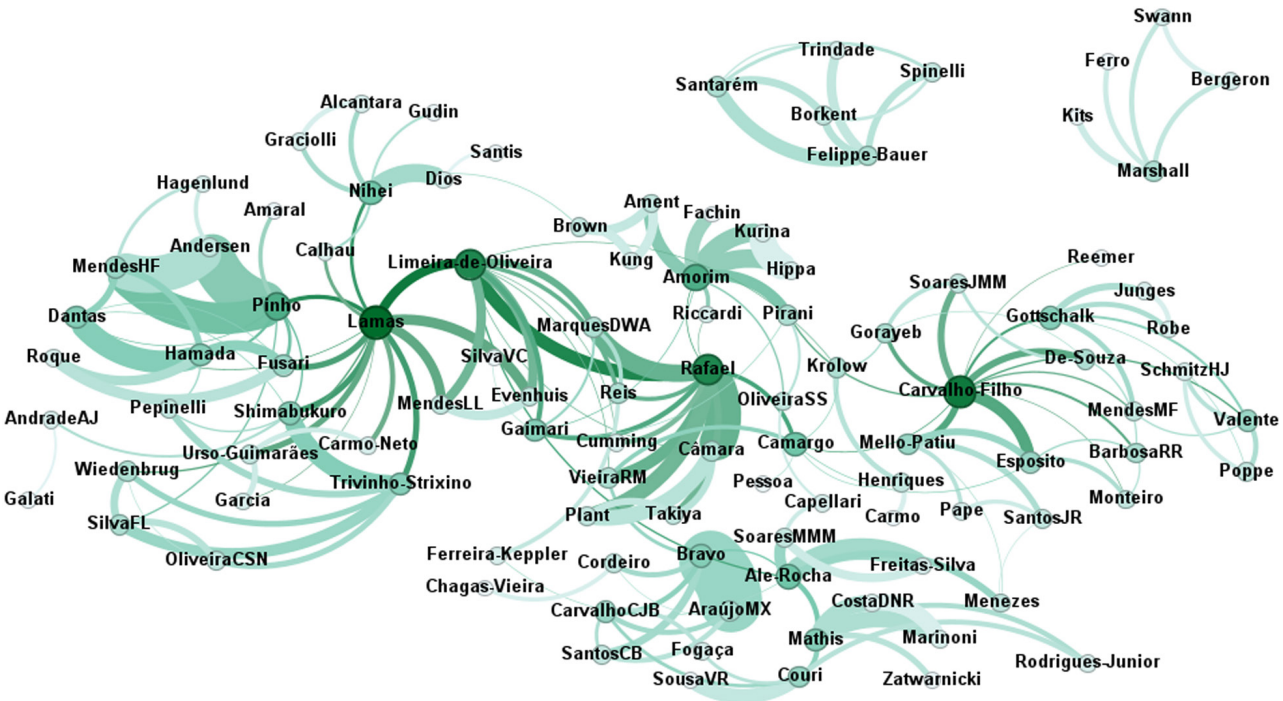


Figure 14. Co-authorship network of Diptera species in Brazil from 2013 to 2022.

improving biodiversity knowledge is not enough to balance the fast loss of natural environments and biodiversity which is considered one of the top five threats to planetary health (World Economic Forum 2023). Biodiversity assessment and monitoring are among the most urgent challenges of modern biology and contemporary society (unpublished data). We hope that we can still expand the size and productivity of the entomologist community in Brazil in terms of describing insect diversity in the country.

Final remarks

The CTFB is a real-time tool to assess and update the knowledge on Brazilian animal diversity and develop new scientific policies for biodiversity. In this sense, more data should be added soon, and inferences that can be built from it should be implemented. Particularly, the information on the geographic distribution of species diversity, for the sake of formal use, gathers elements of the fauna spread across the country, however, most faunal elements overlap in distribution. The improvement of the CTFB system to include distribution by states and biomes will provide much better maps of species distribution and reveal the geographical gaps in our present knowledge. This further step is indispensable to assess local diversity and implement conservation policies.

The CTFB makes public and easily accessible high-quality taxonomic information about the species occurring in Brazil, curated by taxonomic specialists, which may include for each taxon, besides a distributional occurrence map, more complex information, such as the history of nomenclatural changes, classifications, and a reference list. In a manner, it publicly gives information about the Brazilian fauna, which is often found only by the charge of papers that not everyone, Brazilian and non-Brazilian scientists, can afford. Thus, the CTFB may impact positively the quality of the scientific studies covering the Brazilian fauna, as well as the surrounding countries where the fauna overlaps.

The increase in the speed of species descriptions over the last few decades reported here has not happened by chance. This is a reflection of political decisions made on behalf of science by funding agencies in Brazil. This process began with Nelson Papavero's Special Course on Zoological Systematics, which laid the foundations of biological systematic theory and practice for grad students in the 1980s. The creation of the area of Biodiversity by CAPES (Coordination for the Improvement of Higher Education Personnel) as an independent area of research (with a customized system of quality assessment) was key to promoting research and training in taxonomy. In terms of research funding and training

for biodiversity, CNPq (National Council for Scientific and Technological Development) launched the PROTAX program (Program for Capacity Building in Taxonomy) in 2005, which is in its fourth edition, funding biodiversity research nationwide. Other programs, such as the BIOTA program (Biodiversity Characterization, Conservation, Restoration and Sustainable Use), launched in 1999 by the FAPESP (The São Paulo Research Foundation), were also vital for funding research on biological systematics (Noll 2022).

The analysis of the Brazilian Diptera based on the CTFB shows that this insect order presently represents 9.3% of the Brazilian fauna, the third most species-rich taxon in the country. The number of dipterists in Brazil has grown and the number of co-authors for each species has increased in the last decade. The network among authors and research groups became more complex, reflecting an increasing collaboration among Brazilian taxonomists and foreign specialists. We reached a higher number of species described and reported for Brazil in the last decade (2010s), which certainly reflects the distribution of specialists in several families. Soon, the total number of Brazilian species described by Brazilian authors will surpass the number of described species by foreign authors. This shows that the country has reached autonomy in the production of scientific information in this area, and non-Brazilian scientists are welcome to contribute to the knowledge of the Brazilian fauna. Policies should be put in place to address the families with the strongest deficit in the proportion of expected faunal diversity and availability of specialists—e.g., the top 11 species-rich fly families in Malaise trapping, regardless of clade age, continent, climatic region, and habitat type: Cecidomyiidae, Ceratopogonidae, Chironomidae, Psychodidae, Sciaridae, Phoridae, Tipulidae, Dolichopodidae, Muscidae, Chloropidae, and Mycetophilidae (Srivasthan et al. 2023).

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Supplementary material 1

Supplementary 1. List of all valid species of Diptera recorded in Brazil until January 2023.

Authors: Rafael JA, Amorim DS, Carmo DDD, Cordeiro DP, Freitas-Silva RAP, Fachin DA

Data type: Species data

Supplementary material 2

Supplementary 2. Top 15 most genera and species-rich families (until July 2024).

Authors: Rafael JA, Amorim DS, Carmo DDD, Cordeiro DP, Freitas-Silva RAP, Fachin DA

Data type: Species data.

Supplementary material 3

Supplementary 3. Valid species of Diptera recorded to Brazil per decade (until January 2023).

Authors: Rafael JA, Amorim DS, Carmo DDD, Cordeiro DP, Freitas-Silva RAP, Fachin DA

Data type: Species data.

Supplementary material 4

Supplementary 4. All families and the top 15 families in the last 30 years in the Brazilian dipterofauna (until January 2023).

Authors: Rafael JA, Amorim DS, Carmo DDD, Cordeiro DP, Freitas-Silva RAP, Fachin DA

Data type: Species data.

Supplementary material 5

Supplementary 5. List of authors of species names of Diptera described between 1993 and 2022 for Brazil.

Authors: Rafael JA, Amorim DS, Carmo DDD, Cordeiro DP, Freitas-Silva RAP, Fachin DA

Data type: Species data.

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